Metals, pH, and Fecal Coliform TMDLs for the Guyandotte River Watershed, West Virginia

FINAL REPORT

U.S. Environmental Protection Agency
Region 3
1650 Arch Street
Philadelphia, PA

March 2004

Acknowledgments

This study was developed and prepared by Tetra Tech, Inc., in Fairfax, Virginia, under U.S. Environmental Protection Agency (EPA) Contract Number 68-C-02-108, Task Order 2003-12. The EPA Regional Coordinator was Thomas Henry of EPA Region 3. The EPA Work Assignment Manager was Francis Mulhern of EPA Region 3. Additional EPA Region 3 support was provided by Jennifer Sincock and Mary Beck. Completion of this study also depended on the generous support of various groups that provided data and other information. The following people especially are acknowledged:

Mary Beck	United States Environmental Protection Agency, Region 3
Pat Campbell	West Virginia Department of Environmental Protection, Division of Water and Waste Management
Angela Dorsey	West Virginia Department of Environmental Protection, Division of Mining and Reclamation
Debbie Martin	West Virginia Department of Environmental Protection, Division of Mining and Reclamation
Thomas Henry	U.S. Environmental Protection Agency, Region 3
Ken Politan	West Virginia Division of Environmental Protection, Division of Mining and Reclamation
Steve Stutler	West Virginia Department of Environmental Protection, Division of Water and Waste Management
David Vande Linde	West Virginia Division of Environmental Protection, Division of Mining and Reclamation
Dave Montali	West Virginia Department of Environmental Protection, Division of Water and Waste Management
Frank Borsuk	U.S. Environmental Protection Agency, Region 3, Wheeling, West Virginia
Lou Reynolds	U.S. Environmental Protection Agency, Region 3, Wheeling, West Virginia
Jim Green	U.S. Environmental Protection Agency, Region 3, Wheeling, West Virginia
John Wirts	West Virginia Department of Environmental Protection, Division of Water and Waste Management
Maryellen Schultz	U.S. Environmental Protection Agency, Region 3, Fort Meade, Maryland

Contents

Executive Summary
Figures v
Tables v
1. Problem Understanding 1-1
1.1 Watershed Description 1-1
1.2 Economy 1-2
1.2.1 Mining 1-2
1.2.2 Forestry 1-2
1.3 Section 303(d) Listed Waterbodies 1-6
1.4 Effects of Aluminum Criteria Change on TMDL Development 1-12
2. Water Quality Standards 2-1
3. Source Assessment 3-1
3.1 Data Inventory and Review 3-1
3.2 Stream Flow Data 3-2
3.3 Water Quality 3-2
3.4 Sources with NPDES Permits 3-3
3.4.1 Permitted Non-mining Sources 3-3
3.4.2 Permitted Mining Sources 3-4
3.4.3 Permitted Fecal Sources 3-7
3.5 Sources That Do Not Have NPDES Permits 3-9
3.5.1 Abandoned Mine Lands (AML) and Revoked Mines 3-12
3.5.2 Sediment Sources 3-12
3.5.3 Other Metals Sources That Do Not Have NPDES Permits 3-14
3.5.4 Selenium Source Characterization 3-15
3.5.5 Sources of Fecal Coliform Bacteria That Do Not Have NPDES Permits 3-19
4.0 Technical Approach 4-1
4.1 Model Framework Selection 4-1
4.2 Mining Data Analysis System (MDAS) Overview 4-2
4.3 MDAS Model Configuration 4-4
4.3.1 Watershed Subdivision 4-4
4.3.2 Meteorological Data 4-4
4.3.3 Representation of Metals Sources Without NPDES Permits 4-6
4.3.4 Fecal Coliform Bacteria Nonpoint and/or Unpermitted Source Representation 4-10
4.3.5 Permitted Metals Source Representation 4-16
4.3.6 Fecal Coliform Permitted Source Representation 4-19
4.3.7 Stream Representation 4-19
4.3.8 Hydrologic Representation 4-20
4.3.9 Pollutant Representation 4-20
4.4 Dissolved Aluminum TMDL Methodology using Dynamic Equilibrium in-Stream Chemical reactions (DESC) 4-20
4.4.1 DESC Overview 4-21
4.4.2 DESC Calibration 4-21
4.5 pH TMDL Methodology Overview 4-22
4.5.1 Overview 4-22
4.5.2 MINTEQA2 Application 4-23

4.5.3 Assumptions 4-24
4.6 MDAS Model Calibration 4-26
4.6.1 Hydrology Calibration 4-26
4.6.2 Water Quality Calibration 4-28
4.7. Selenium TMDL Methodology Overview 4-28
5.0 Allocation Analysis 5-1
5.1 TMDL Endpoints 5-1
5.1.1 Dissolved Aluminum, Total Iron, and Manganese 5-1
5.1.2 Fecal Coliform Bacteria 5-2
5.1.3 Selenium 5-2
5.1.4 pH 5-2
5.1.5 Margin of Safety 5-2
5.2 Baseline Conditions 5-2
5.3 Source Loading Alternatives 5-4
5.4.1 Dissolved Aluminum, Total Iron and Total Manganese TMDLs 5-5
5.4.2 Fecal Coliform Bacteria TMDLs 5-12
5.4.3 Selenium TMDLs 5-14
5.4.4 pH Modeling Results 5-14
5.4.5 Seasonal Variation 5-15
5.4.6 Critical Conditions 5-15
5.4.7 Future Growth 5-15
5.4.8 Water Quality Trading 5-16
6.0 Reasonable Assurance 6-1
6.1 Permitting Program 6-1
Division of Mining and Reclamation 6-1
6.2 Reclamation 6-1
Office of Abandoned Mine Lands and Reclamation 6-1
Office of Special Reclamation 6-2
6.3 Watershed Management Framework 6-2
Management Framework 6-2
7. Monitoring Plan 7-1
8. Public Participation 8-1

References R-1

Appendix A. Guyandotte River Watershed Data and TMDLs A-1
Appendix A-1. Region 1 . . . . . A-1-1
Appendix A-2. Region 2 . . . . . A-2-1
Appendix A-3. Region 3 . . . . . A-3-1
Appendix A-4. Region 4 . . . . . A-4-1
Appendix A-5. Region 5 . . . . . A-5-1
Appendix A-6. Region 6 . . . . . A-6-1
Appendix A-7. Region 7 . . . . . A-7-1
Appendix A-8. Region 8 . . . . . A-8-1
Appendix A-9. Region 9 . . . . . A-9-1
Appendix A-10. Region 10 . . . . . A-10-1
Appendix A-11. Region 11 . . . . . A-11-1

Appendix A-12. Region 12 . . . . . A-12-1
Appendix A-13. Region 13 . . . . . A-13-1
Appendix A-14. Region 14 . . . . . A-14-1

Appendix B. Mining Permits in the Guyandotte River Watershed B-1
Appendix C. Sewage Permits in the Guyandotte River Watershed C-1
Appendix D. Water Quality Data Analysis D-1
Appendix E. Forest Harvest Operations and Forest Fires E-1
Appendix F. Water Quality Calibration Results F-1
Appendix F-1. Hydrology Calibration F-1-1
Appendix F-2. Water Quality Calibration F-2-1
Appendix G. Stormwater Permits and Their Relationship to TMDLs G-1

Figures

Figure 1-1 Location of the Guyandotte River watershed 1-3
Figure 1-2 Counties in and around the Guyandotte River watershed 1-4
Figure 1-3 Guyandotte River watershed and its 14 regions 1-11
Figure 3-1 Mining Permits in the Guyandotte River watershed 3-6
Figure 3-2 Potential sources contributing to impairments in the Guyandotte River watershed 3-10
Figure 3-3 Landuse coverage in the Guyandotte River watershed 3-11
Figure 3-4 Selenium impaired waterbodies in the Guyandotte River watershed 3-16
Figure 3-5 Selenium sampling locations in the Guyandotte River watershed 3-17
Figure 3-6 Geographic distribution of selenium in WV coals 3-18
Figure 3-7 Surface mining in the Upper Mud River watershed 3-20
Figure 3-8 Digital Orthophoto Quadrangle of Upper Mud watershed 3-21
Figure 4-1 Weather stations used in modeling of the Guyandotte River watershed 4-5
Figure 4-2 Number of unsewered homes in the Upper Guyandotte River watershed 4-14
Figure 4-3 Number of unsewered homes in the Lower Guyandotte River watershed 4-15
Figure 4-4 Comparison of simulated and observed flow for the validation period (USGS 0320400 Guyandotte at Branchland) 4-27
Figure 4-5 Selenium-Flow correlation analysis for stations 6 through 9 4-29
Figure 4-6 Upper Mud watershed where the low 7Q10 flow was calculated to be 0 cfs . . . 4-30
Figure 5-1 Annual Precipitation totals and Percentile Ranks for the Logan weather station 5-3
Figure 5-2 Baseline and TMDL conditions for iron 5-5

Tables

Table 1-1 Population estimates for the Guyandotte River watershed 1-5
Table 1-2 Total coal production in West Virginia for 2002 1-5
Table 1-3 Forested area in and near the Guyandotte River watershed 1-6
Table 1-4 West Virginia 303(d) metals, pH, and fecal coliform listed waterbodies in the Guyandotte River watershed 1-7
Table 1-5 West Virginia 303(d) biological listed waterbodies in the Guyandotte River watershed corresponding to waters listed in Table 1-4 1-9
Table 1-6 Water quality criteria for aluminum 1-12
Table 1-7 Waterbodies in the Guyandotte River watershed for which dissolved aluminum TMDLs are being developed 1-13
Table 2-1 Applicable West Virginia water quality criteria 2-1
Table 3-1 Inventory of data and information used to develop the Guyandotte River watershed TMDLs 3-1
Table 3-2 Flow analysis for the Guyandotte River watershed 3-2
Table 3-3 Non-mining sources in the Guyandotte River watershed 3-4
Table 3-4 Classification of West Virginia mining permit type and status 3-5
Table 3-5 Sediment source characterization 3-13

Table 3-6 GAP 2000 landuse distribution in the Guyandotte River watershed 3-14
Table 3-7a Water quality observations for selenium in the Guyandotte River watershed collected for the Mountaintop Removal Environmental Impact Study 3-15
Table 3-7b Summary of recently collected selenium water quality data from Fall 2003 . . . 3-18
Table 3-8 Mining related NPDES permits discharging in upper Mud River watershed . . . 3-19
Table 4-1 Modules from HSPF[a] converted to HSPC 4-3
Table 4-2 Metals model landuse grouping 4-6
Table 4-3 Assigned perviousness and estimated width for each type of road 4-9
Table 4-4 Average percent perviousness and imperviousness for different landuse types 4-10
Table 4-5 Fecal coliform bacteria model landuse grouping 4-10
Table 4-6 Fecal coliform production rates for beef cattle and deer 4-12
Table 4-7 Model nonpoint source representation of different permitted mines 4-16
Table 4-8a Modeled landuse distribution in acres for Regions 1 through 7 4-17
Table 4-8b Modeled landuse distribution in acres for Regions 8 through 14 4-17
Table 4-9 Input values for MINTEQA2 4-24
Table 4-10 MINTEQA2 results for the pH impaired streams in the Guyandotte River watershed 4-27
Table 4-11 Comparison of simulated and observed flow for water years 1994 and 1995 (USGS 03203600) 4-28
Table 5-1 Metals concentrations used in representing permitted conditions for mines 5-4
Table 5-2 Source Reduction (AML) for SWS 209 5-6
Table 5-3 Load and waste load allocations for dissolved aluminum 5-8
Table 5-4 Load and waste load allocations for iron 5-8
Table 5-5 Load and waste load allocations for manganese 5-10
Table 5-6 Individual fecal coliform MS4 WLAs for the Guyandotte River watershed . . . 5-13
Table 5-7 Load and waste load allocations for fecal coliform bacteria for the Guyandotte River mainstem 5-14
Table 5-8 Selenium TMDLs for the Mud River watershed 5-14
Table 8-1 Newspapers where public notices were published 8-1

1. Problem Understanding

The Clean Water Act at Section 303(d) and its implementing regulations (*Water Quality and Planning and Management Regulations)* at 40 CFR 130 require that a Total Maximum Daily Load (TMDL) be developed for those waterbodies identified by the state as to which technology-based and other required controls are not sufficient to achieve applicable water quality standards. Under the consent decree entered in *Ohio Valley Environmental Coalition, Inc., et al. v. Browner, et al.*, No. 2:95-0329 (S.D.W.Va. July 9, 1997), a TMDL for the Lower Guyandotte River was scheduled for completion by September 30, 2002, and TMDLs for acid mine drainage (AMD) impaired waters (including many tributaries to the Upper and Lower Guyandotte River) were scheduled for completion by March 30, 2008. EPA and the plaintiffs agreed to a modification of the consent decree for the Lower Guyandotte River. That modification effectively extended the date for TMDL development for the Lower Guyandotte watershed by 18 months to March 30, 2004. The modification provided EPA sufficient time to simultaneously develop TMDLs for both the Lower Guyandotte River and the Upper Guyandotte River and tributaries in both watersheds impaired by AMD and/or fecal coliform bacteria. This is consistent with EPA's view that, where possible, it is preferable to develop TMDLs on a watershed basis. The extended time frame, however, did not allow sufficient time for the data collection and analysis necessary to develop TMDLs for waters listed as biologically impaired, but as to which no impairing pollutant has been identified. It is EPA's expectation that WVDEP will establish TMDLs for those waters in accordance with the Watershed Management Framework.

For this TMDL report, the Lower Guyandotte and the Upper Guyandotte watersheds were combined into a single watershed called the Guyandotte River watershed. The objective of this study was to develop TMDLs for waterbodies impaired by AMD and fecal coliform bacteria in the Guyandotte River watershed, West Virginia. As a result, TMDLs are being developed for the mainstem Upper and Lower Guyandotte River and waters in the Guyandotte watershed that have been listed on West Virginia's 1996, 1998 and 2002 Section 303(d) lists as impaired by AMD and/or fecal coliform bacteria.

1.1 Watershed Description

The Guyandotte River is in southwestern West Virginia. Its drainage area is approximately 1,680 square miles (1,075,691 acres) and is represented by the Guyandotte River watershed (Figure 1-1). The Guyandotte River watershed lies entirely in the Appalachian Plateau Physiographic Providence. From its headwaters in Raleigh County, the Guyandotte River flows westerly through Wyoming County; then northwesterly through Logan, Lincoln, and Cabell counties, with tributaries entering from Mingo, Putnam, and Boone counties; to its confluence with the Ohio River northwest of Pea Ridge for a total of approximately 102 miles (Figure 1-2). The largest tributaries of the Guyandotte are Mud River, Clear Fork, and Island Creek, which have drainage areas of 359, 129, and 105 square miles, respectively. Big Ugly Creek, Big Creek, Indian Creek, Pinnacle Creek, Barkers Creek, Slab Fork, Winding Gulf, and Stonecoal Creek are also significant tributaries to the Guyandotte River. The Guyandotte River watershed comprises extremely narrow valley floors that rise quickly to form steep and rugged mountain walls. The elevations of the ridges range from 3,400 feet in the upper portion of the watershed to a

maximum of 1,000 feet in the lower portion of the watershed. As the watershed approaches the Ohio River, it becomes less rugged; the valleys are wider, and the mountains tend to be more rolling. (WVDNR, 1987)

The Guyandotte River watershed lies in Raleigh, Wyoming, Logan, Mingo, Boone, Lincoln, Putnam, and Cabell counties and adjacent to Mercer, McDowell, Wayne, Kanawha, and Lawrence (Ohio) counties, as shown in Figure 1-2. Most of the population resides in the northwest corner of the watershed, in western Cabell County near the cities of Pea Ridge and Barboursville. Two areas of higher population density lie in Logan County to the east and north of the city of Mount Gay. The rest of the watershed is sparsely populated. Population estimates (based on 2000 census data) for Pea Ridge, Barboursville, Culloden, and Mount Gay and the counties in and near the watershed are given in Table 1-1. Note that only portions of some of these counties lie within the Guyandotte River watershed. Since 1990 the entire region has experienced a very slight decline in population (Table 1-1).

1.2 Economy

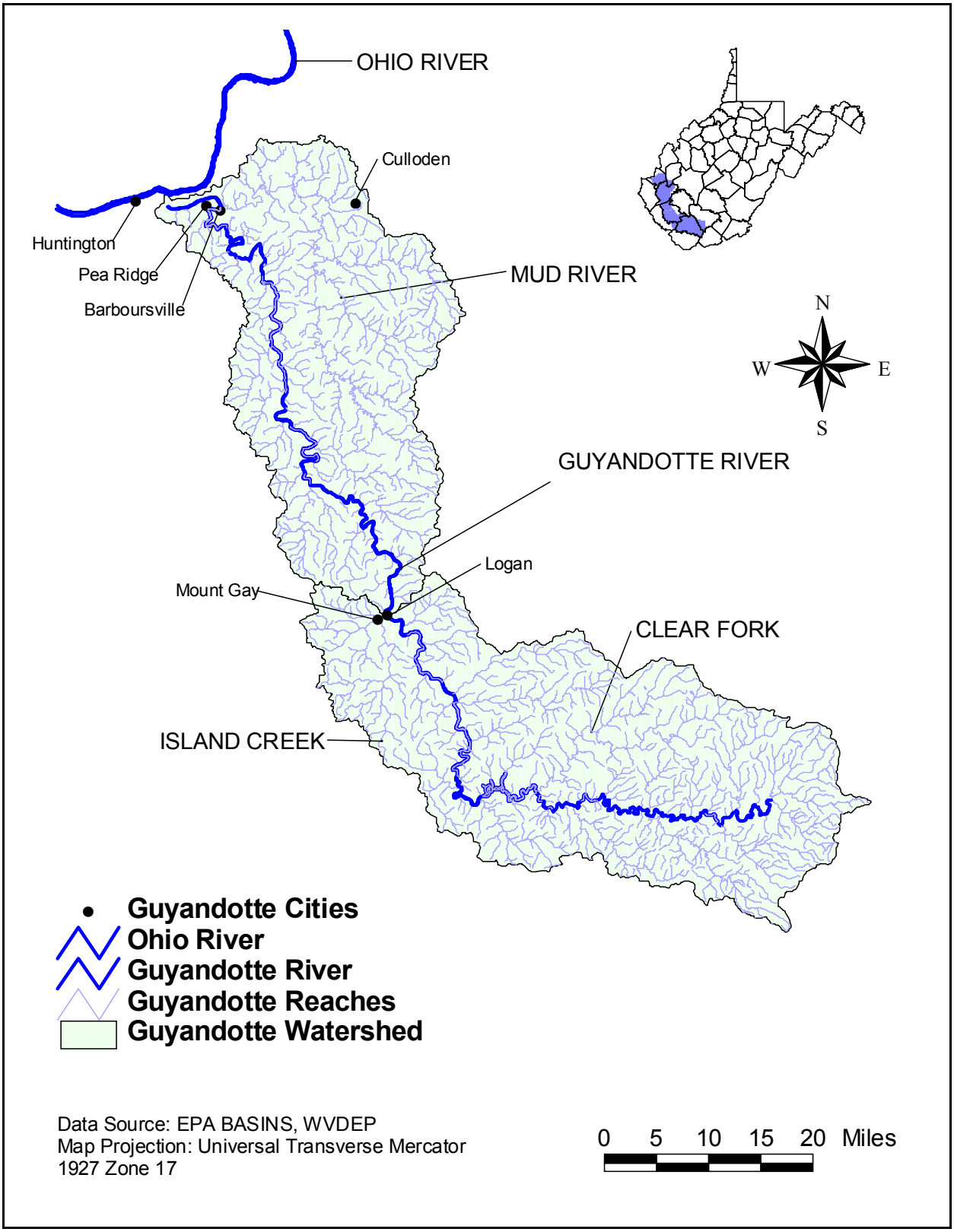
1.2.1 Mining

Historically, coal has been the most economically valuable mineral resource in the Guyandotte River watershed. There are extensive deposits of low-sulfur coal in all three formations of the Pottsville group. These formations (Kanawha, New River, and Pocahontas) include large mineable beds in Logan, Mingo, Wyoming, and Raleigh counties. Smaller coal seams are present in the lower basin in Cabell and Lincoln counties. There has been continuous mining in the basin since the completion of the Norfolk and Western Railroad in the late 1800s. In the 1970s, approximately 90 percent of the coal was produced from underground mines and the remaining 10 percent came from surface mining. Surface mining activities have significantly increased since then (WVGES, 1998). The increase in surface mining is due to the increased demand for production of low-sulfur coal. Table 1-2 presents the total amount of coal produced in 2002.

1.2.2 Forestry

Forestry is another major industry in the Guyandotte River watershed. According to the U.S. Forest Service Forest Inventory and Analysis Database Retrieval System, there are more than 2,900 square miles (approximately 1.9 million acres) of forestland in the eight counties in and around the Guyandotte River watershed. Table 1-3 shows the estimated area of forested land (in square miles) for each of the counties in or adjacent to the Guyandotte River watershed.

Figure 1-1. Location of the Guyandotte River watershed.



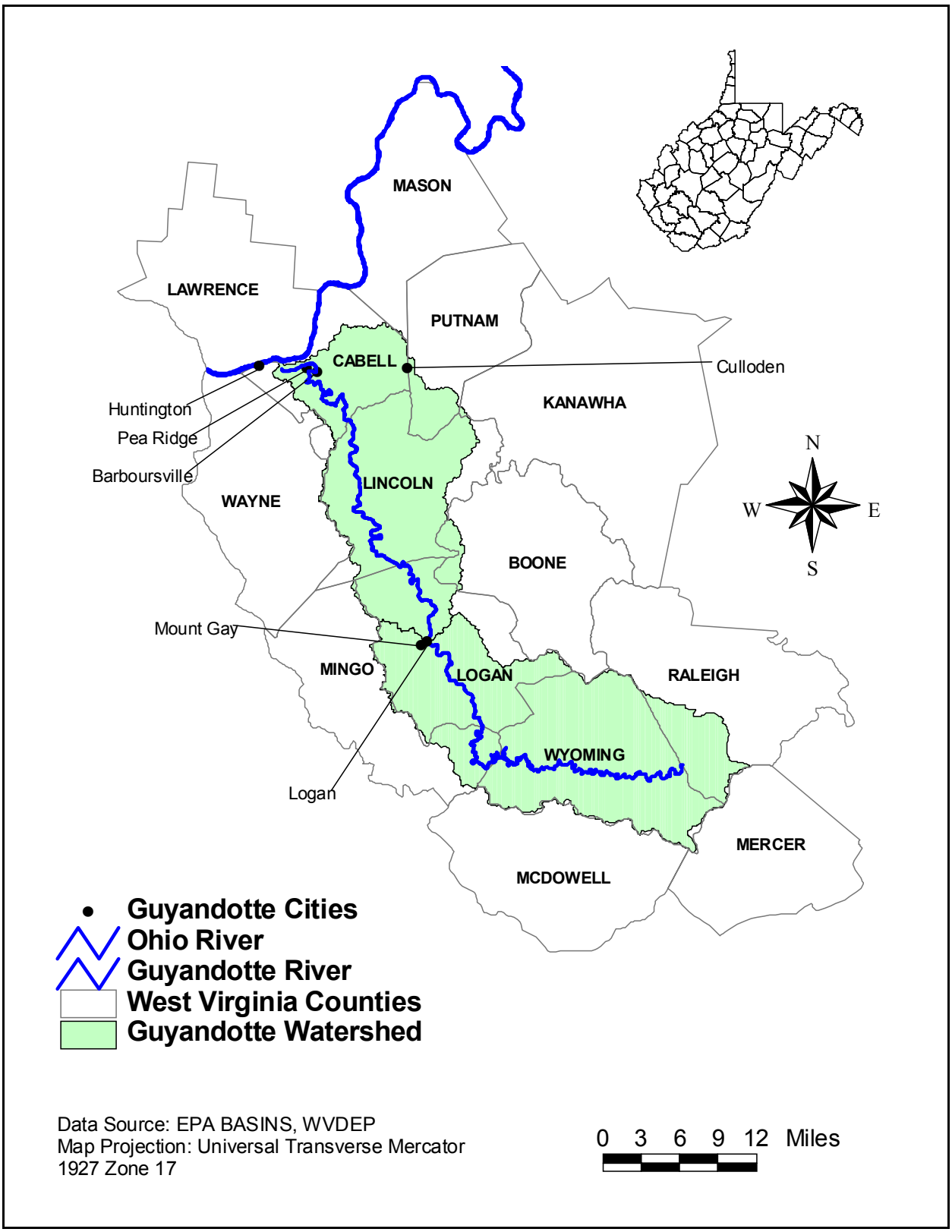

MASON
LAWRENCE
PUTNAM
CABELL
Culloden
KANAWHA
Huntington
Pea Ridge
Barboursville
WAYNE
LINCOLN
BOONE
N
W
E
S
Mount Gay
MINGO
LOGAN
RALEIGH
WYOMING
Logan
MERCER
MCDOWELL
Guyandotte Cities
Ohio River
Guyandotte River
West Virginia Counties
Guyandotte Watershed
Data Source: EPA BASINS, WVDEP
Map Projection: Universal Transverse Mercator
1927 Zone 17
0 3 6 9 12 Miles

Figure 1-2. Counties in and around the Guyandotte River watershed.

Table 1-1. Population estimates for the Guyandotte River watershed

Location	1990 Population Estimate	2000 Population Estimate	1990-2000 Numeric Population Change	1990-2000 Percent Population Change
State of West Virginia	1,793,477	1,808,344	14867	0.8
Boone County	25,870	25,535	-355	-1.4
Cabell County	96,827	96,784	-43	0.0
Lincoln County	21,382	22,108	726	3.4
Mingo County	33,739	28,253	-5486	-16.3
Putnam County	42,835	51,589	8754	20.4
Raleigh County	76,819	79,220	2401	3.1
Wyoming County	28,990	25,708	-3282	-11.3
Total of all Counties	**326,462**	**329,197**	**2715**	**-2.14**
City of Pea Ridge	6,535	6,363	-172	-2.6
City of Barboursville	2,774	3,183	409	14.7
City of Culloden	2,907	2,940	33	1.1
City of Mount Gay	3,377	2,623	-754	-22.3

Source: U.S. Census Bureau, Washington D.C., Population Division, Population Estimates Program.

Table 1-2. Total coal production in West Virginia for 2002

Location	Total Employees	Underground Production (tons)	Surface Production (tons)	Total Production (tons)
State of West Virginia	15,377	100,600,258	63,296,632	163,896,890
Boone County	3,044	15,980,343	15,837,475	31,817,818
Cabell County[a]	N/A	N/A	N/A	N/A
Lincoln County	76	192,036	1,088,388	1,280,424
Logan County	1,296	4,496,716	7,179,543	11,676,259
Mingo County	1,545	10,258,614	9,736,582	19,995,196
Putnam County[a]	N/A	N/A	N/A	N/A
Raleigh County	845	7,962,508	905,883	8,868,391
Wyoming County	1,100	5,226,310	2,970,089	8,196,399
Total of Counties	1,945	13,188,818	3,875,972	17,064,790

[a]No data available for 2002.
Source: West Virginia Geologic and Economic Survey, 2002.

Table 1-3. Forested area in and near the Guyandotte River watershed

County	All Land (mi^2)	Total Forest (mi^2)	Timberland (mi^2)	Nonforest Land (mi^2)
Boone	503	423	423	80
Cabel	282	194	194	87
Lincoln	438	370	370	68
Logan	454	387	387	67
Mingo	423	360	360	63
Putnam	346	263	263	83
Raleigh	607	499	462	108
Wyoming	501	434	434	67
Total	**3,553**	**2,930**	**2,894**	**623**

Source: U.S. Forest Service, 2000.

1.3 Section 303(d) Listed Waterbodies

West Virginia's 1996, 1998, and 2002 Section 303(d) lists include 123 waterbodies in the Guyandotte River watershed (Upper and Lower Guyandotte River watersheds combined) because of fecal coliform bacteria, metals (total aluminum, iron, manganese, and selenium), pH, and/or biological impairments. The impaired waterbodies include the Upper and Lower Guyandotte River which comprise the main stem of the Guyandotte River and 121 additional stream segments in the watershed. Table 1-4 shows the 66 stream segments listed for fecal coliform bacteria, metals, and/or pH. Table 1-5 lists those streams from Table 1-4 that also have biological impairments. The pH and metals impairments, which include iron, aluminum, and manganese, have been attributed to AMD. The cause of the fecal coliform bacteria, selenium, and biological impairments was unknown at the time of listing. The objective of this study is to develop TMDLs for the 66 waters in the Guyandotte River watershed that are impaired relative to total iron, manganese, selenium, dissolved aluminum, pH, and fecal coliform bacteria.

It is assumed that the implementation of these metals TMDLs likely will resolve the biological impairment. The iron, pH and dissolved aluminum TMDLs address aquatic life protection criteria and call for significant reductions of existing loads. It is reasonable to assume that the achievement of these reductions will have a positive biological impact to the Guyandotte River and its tributaries. Additionally, the fecal coliform TMDL calls for elimination of untreated sewage discharges in the watershed. Removal of the myriad of pollutants potentially present in untreated sewage will also benefit the aquatic ecosystem. Future monitoring plans to evaluate overall TMDL implementation effectiveness in the Guyandotte River watershed should include provisions for biological assessments to confirm the assumptions made herein.

Many of the waters that are the subject of the pollutant-specific TMDLs have overlapping biological impairment. After developing the pollutant-specific TMDLs, stream by stream evaluations were made to ascertain if accomplishment of the required pollutant reductions would return the water to an unimpaired biological condition. Consideration was given to the magnitude of specified pollutant reductions and the present biological condition of the stream relative to the WVSCI impairment threshold of 60.6

It is reasonable to assume that the biological condition of waters with low pH and/or metals concentrations in excess of aquatic life protection criteria will improve upon the removal of

metals and return pH to a circumneutral condition. The fecal coliform bacteria TMDL calls for elimination of untreated sewage discharges and the myriad of pollutants associated with sewage.

The consent decree does not require EPA to establish TMDLs for the 57 stream segments listed for biological impairment only without an identified impairing pollutant that were listed based on failure to support the aquatic life use ("biological), and for which the 2002 Section 303(d) list states the pollutant as "unknown." EPA had originally intended to establish TMDLs for all waters in the Guyandotte watershed simultaneously. However, the time constraints imposed by the consent decree deadline precluded EPA from performing the monitoring and analysis necessary to identify the impairing pollutant(s) for these waters. Therefore, this report does not establish TMDLs for those 57 waters. It is EPA's expectation that West Virginia will establish TMDLs for those waters within 8-13 years of their initial listing.

This report presents pH, fecal coliform bacteria, and metals TMDLs for 66 impaired waterbodies in the Guyandotte River watershed. To develop the TMDLs and other watershed and waterbody information, the watershed was divided into 14 regions (Figure 1-3), representing hydrologic units. The 14 watershed regions provide a basis for georeferencing pertinent source information and monitoring data, and for presenting TMDLs. To facilitate hydrologic modeling, the 14 regions were further divided into a total of 369 subwatersheds for the entire Guyandotte River watershed. This information is presented in Appendixes A-1 through A-14 of this report. The numeric designation for each Appendix A section corresponds to the same numerically identified region of the Guyandotte watershed, e.g., A-3 corresponds to Region 3 of the Guyandotte watershed.

Table 1-4. West Virginia 303(d) metals, pH, and fecal coliform listed waterbodies in the Guyandotte River watershed

DNR Name	DNR Code	Miles Affected	Human Health	Aquatic Life	Pollutant	Source	Year Listed[A]
Guyandotte River	O-4-upper and lower	168.00	X	X	Fecal coliform, Iron, Aluminum	Unknown	1998 & 2002
Right Fork/Merritt Creek	OG-10-A	1.50	X	X	Iron	Unknown	2002
Little Cub Creek/Upper Guyandotte River	OG-108	3.60	X	X	Iron	Unknown	2002
Indian Creek	OG-110	18.90	X	X	Metals	Mine drainage	1998 & 2002
Brier Creek/Indian Creek	OG-110-A	4.80	X	X	Metals	Mine drainage	1998 & 2002
Marsh Fork/Brier Creek	OG-110-A-2	2.00	X	X	Metals	Mine drainage	1998 & 2002
Pinnacle Creek	OG-124	26.60	X	X	Metals	Mine drainage	1998 & 2002
Smith Branch/Pinnacle Creek	OG-124-D	2.10	X	X	Metals	Mine drainage	1998 & 2002
Laurel Branch/Pinnacle Creek	OG-124-H	2.10	X	X	Metals	Mine drainage	1998 & 2002
Spider Creek	OG-124-I	3.50	X	X	Metals	Mine drainage	1998 & 2002
Cabin Creek	OG-127	3.60	X	X	Metals	Mine drainage	1998 & 2002
Joe Branch	OG-128	1.60	X	X	Metals	Mine drainage	1998 & 2002
Long Branch	OG-129	2.10	X	X	Metals	Mine drainage	1998 & 2002
Still Run	OG-130	5.30	X	X	Metals	Mine drainage	1998 & 2002
Barkers Creek	OG-131	8.00	X	X	Metals	Mine drainage	1998 & 2002

DNR Name	DNR Code	Miles Affected	Human Health	Aquatic Life	Pollutant	Source	Year Listed[A]
Hickory Branch/Barkers Creek	OG-131-B	2.10	X	X	Metals	Mine drainage	1998 & 2002
Gooney Otter Creek	OG-131-F	6.80	X	X	Metals	Mine drainage	1998 & 2002
Jims Branch/Gooney Otter Creek	OG-131-F-1	1.40	X	X	Metals	Mine drainage	1998 & 2002
Noseman Branch	OG-131-F-2	2.30	X	X	Metals	Mine drainage	1998 & 2002
Slab Fork	OG-134	15.10	X	X	Metals	Mine drainage	1998 & 2002
Measle Fork	OG-134-D	3.30	X	X	pH, metals	Mine drainage	1998 & 2002
Left Fort/Allen Creek	OG-135-A	2.60	X	X	Metals	Mine drainage	1998 & 2002
Devils Fork	OG-137	4.90	X	X	Metals	Mine drainage	1998 & 2002
Winding Gulf	OG-138	15.50	X	X	Metals	Mine drainage	1998 & 2002
Stonecoal Creek	OG-139	10.20	X	X	Metals	Mine drainage	1998 & 2002
Mud River	OGM	79.00	X	X	Selenium	Unknown	2002
Limestone Branch	OG-48	1.80	X	X	pH, metals	Mine drainage	1998 & 2002
Ed Stone Branch/Big Creek	OG-49-A	2.30	X	X	pH, metals	Mine drainage	1998 & 2002
North Branch/ Ed Stone Branch	OG-49-A-1	0.80	X	X	pH, metals	Mine drainage	1998 & 2002
Godby Branch	OG-53	1.50	X	X	pH, metals	Mine drainage	1998 & 2002
Buffalo Creek	OG-61	3.10	X	X	pH, metals	Mine drainage	1998 & 2002
Right Fork/Buffalo Creek	OG-61-A	1.50	X	X	pH	Unknown	2002
Coal Branch/Island Creek	OG-65-A	2.10	X	X	pH, metals	Mine drainage	1998 & 2002
Copperas Mine Fork	OG-65-B	9.30	X	X	pH, metals	Mine drainage	1998 & 2002
Mud Fork	OG-65-B-1	7.50	X	X	pH, metals	Mine drainage	1998 & 2002
Lower Dempsey Branch	OG-65-B-1-A	2.10	X	X	pH, metals	Mine drainage	1998 & 2002
Ellis Branch/Mud Fork	OG-65-B-1-B	1.60	X	X	pH, metals	Mine drainage	1998 & 2002
Upper Dempsey Branch	OG-65-B-1-E	1.30	X	X	pH, metals	Mine drainage	1998 & 2002
Trace Fork/Copperas Mine Fork	OG-65-B-4	3.80	X	X	pH, metals	Mine drainage	1998 & 2002
Hall Fork/Left Fork/Cow Creek	OG-65-J-3-A	1.00	X	X	Selenium	Unknown	2002
Proctor Hollow/Buffalo Creek	OG-75-C.5	1.60	X	X	pH, metals	Mine drainage	1998 & 2002
Huff Creek	OG-76	21.20	X	X	Metals	Mine drainage	1998 & 2002
Toney Fork/Huff Creek	OG-76-L	4.20	X	X	Metals	Mine drainage	1998 & 2002
Oldhouse Branch/Rockhouse Creek	OG-77-A.5	1.10	X	X	pH, metals	Mine drainage	1998 & 2002
Muzzle Creek	OG-92-I	3.30	X	X	Metals	Mine drainage	1998 & 2002
Buffalo Creek/Little Huff Creek	OG-92-K	3.10	X	X	pH, metals	Mine drainage	1998 & 2002
Kezee Fork	OG-92-K-1	0.80	X	X	Metals	Mine drainage	1998 & 2002
Mudlick Fork/Buffalo Creek	OG-92-K-2	0.70	X	X	Metals	Mine drainage	1998 & 2002
Pad Fork	OG-92-Q	4.10	X	X	Metals	Mine drainage	1998 & 2002
Righthand Fork/Pad Fork	OG-92-Q-1	2.10	X	X	Metals	Mine drainage	1998 & 2002
Sturgeon Branch	OG-96-A	1.60	X	X	Metals	Mine drainage	1998 & 2002
Road Branch	OG-96-B	1.60	X	X	Metals	Mine drainage	1998 & 2002

DNR Name	DNR Code	Miles Affected	Human Health	Aquatic Life	Pollutant	Source	Year Listed[A]
Elk Trace Branch/Big Cub Creek	OG-96-C	2.00	X	X	Metals	Mine drainage	1998 & 2002
Toler Hollow	OG-96-F	1.10	X	X	Metals	Mine drainage	1998 & 2002
McDonald Fork	OG-96-H	1.30	X	X	Metals	Mine drainage	1998 & 2002
Reedy Branch	OG-99	2.80	X	X	Metals	Mine drainage	1998 & 2002
Clear Fork	OGC	29.00	X	X	Iron	Unknown	2002
Lower Road Branch	OGC-12	2.50	X	X	Metals	Mine drainage	1998 & 2002
Laurel Fork	OGC-16	23.50	X	X	Metals	Mine drainage	1998 & 2002
Milam Branch	OGC-16-M	4.90	X	X	Metals	Mine drainage	1998 & 2002
Trough Fork	OGC-16-P	3.60	X	X	Metals	Mine drainage	1998 & 2002
Toney Fork/Clear Fork	OGC-19	6.60	X	X	Metals	Mine drainage	1998 & 2002
Crane Fork	OGC-26	4.30	X	X	Metals	Mine drainage	1998 & 2002
Sugartree Branch	OGM-47	1.60	X	X	Selenium	Unknown	2002
Stanley Fork	OGM-48	2.00	X	X	Selenium	Unknown	2002

Note: Impaired streams in this table reflect information provided in West Virginia's 2002 section 303(d) list.
Metals - denotes Aluminum, Iron, and Manganese
A - As designated in Appendix A of 2003 West Virginia Water Quality Standards
B - Trout Waters as designated in 2003 West Virginia Water Quality Standards

Table 1-5. West Virginia 303(d) biological listed waterbodies in the Guyandotte River watershed corresponding to waters listed in Table 1-4

DNR Name	DNR Code	Miles Affected	Human Health	Aquatic Life	Pollutant	Source	Year Listed[a]
Guyandotte River	O-4-upper	50.00		X	Biological	Unknown	2002
Clear Fork	OGC	25.00		X	Biological	Unknown	2002
Smith Branch/Pinnacle Creek	OG-124-D	2.10		X	Biological	Unknown	2002
Joe Branch	OG-128	1.60		X	Biological	Unknown	2002
Long Branch	OG-129	2.10		X	Biological	Unknown	2002
Barkers Creek	OG-131	8.00		X	Biological	Unknown	2002
Slab Fork	OG-134	7.80		X	Biological	Unknown	2002
Left Fort/Allen Creek	OG-135-A	2.60		X	Biological	Unknown	2002
Devils Fork	OG-137	4.90		X	Biological	Unknown	2002
Winding Gulf	OG-138	9.10		X	Biological	Unknown	2002
Stonecoal Creek	OG-139	10.20		X	Biological	Unknown	2002
Mud River	OG-2	79.00		X	Biological	Unknown	2002
Right Fork/Merritt Creek	OG-10-A	2.10		X	Biological	Unknown	2002
Ed Stone Branch/Big Creek	OG-49-A	2.30		X	Biological	Unknown	2002
Godby Branch	OG-53	1.50		X	Biological	Unknown	2002
Coal Branch/Island Creek	OG-65-A	2.10		X	Biological	Unknown	2002
Copperas Mine Fork	OG-65-B	9.30		X	Biological	Unknown	2002
Mud Fork	OG-65-B-1	7.50		X	Biological	Unknown	2002
Lower Dempsey Branch	OG-65-B-1-A	2.10		X	Biological	Unknown	2002
Ellis Branch/Mud Fork	OG-65-B-1-B	1.60		X	Biological	Unknown	2002
Upper Dempsey Branch	OG-65-B-1-E	1.30		X	Biological	Unknown	2002

DNR Name	DNR Code	Miles Affected	Human Health	Aquatic Life	Pollutant	Source	Year Listed[a]
Trace Fork/Copperas Mine Fork	OG-65-B-4	3.80		X	Biological	Unknown	2002
Proctor Hollow/Buffalo Creek	OG-75-C.5	1.60		X	Biological	Unknown	2002
Huff Creek	OG-76	13.90		X	Biological	Unknown	2002
Toney Fork/Huff Creek	OG-76-L	4.20		X	Biological	Unknown	2002
Oldhouse Branch/Rockhouse Creek	OG-77-A.5	1.10		X	Biological	Unknown	2002
Muzzle Creek	OG-92-I	3.30		X	Biological	Unknown	2002
Buffalo Creek/Little Huff Creek	OG-92-K	1.80		X	Biological	Unknown	2002
Toler Hollow	OG-96-F	1.10		X	Biological	Unknown	2002
Laurel Fork	OGC-16	10.90		X	Biological	Unknown	2002
Milam Branch	OGC-16-M	4.90		X	Biological	Unknown	2002
Trough Fork	OGC-16-P	3.60		X	Biological	Unknown	2002
Toney Fork/Clear Fork	OGC-19	6.60		X	Biological	Unknown	2002
Crane Fork	OGC-26	4.30		X	Biological	Unknown	2002
Sugartree Branch	OGM-47	1.60		X	Biological	Unknown	2002
Stanley Fork	OGM-48	2.00		X	Biological	Unknown	2002

Note: Impaired streams in this table reflect information provided in West Virginia's 2002 section 303(d) list.
[a] - As designated in Appendix A of 2003 West Virginia Water Quality Standards

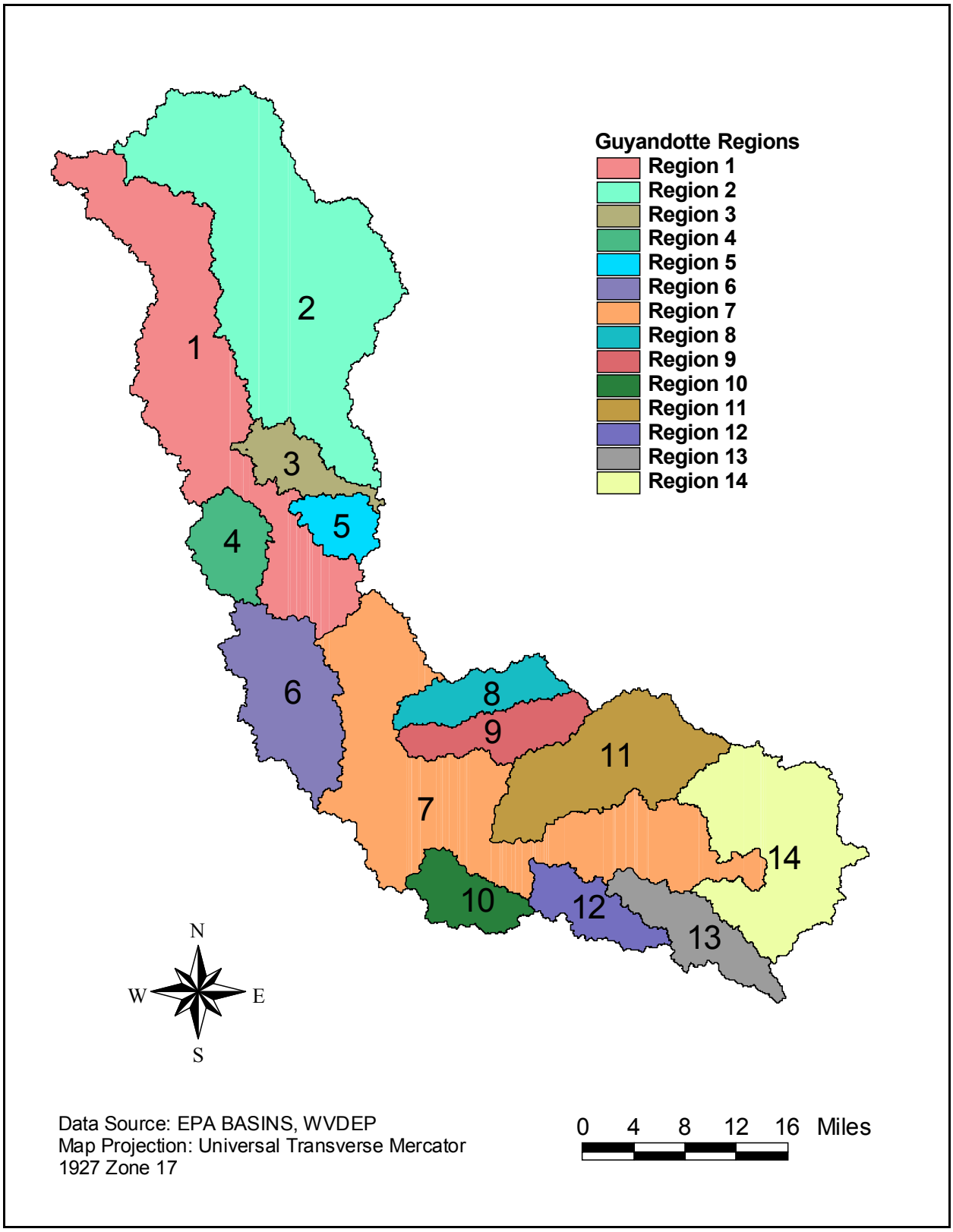


Figure 1-3. Guyandotte River watershed and its 14 regions

1.4 Effects of Aluminum Criteria Change on TMDL Development

On April 17, 2003, EPA approved revisions to certain water quality standards in West Virginia, including an aquatic life protection aluminum criteria change from total recoverable to dissolved. EPA's approval of the change in the aluminum criteria recently was upheld in *West Virginia Rivers Coalition v. Environmental Protection Agency*, Civ. Action No. 03-1022 (E.D. Pa. Jan. 14, 2004). The previous criteria and current criteria are summarized in Table 1-6. This criteria change has made developing aluminum TMDLs problematic because much of the available data in the state is for total aluminum, and there is no accepted translator between total and dissolved aluminum. Available monitoring data shows widely variable ratios between dissolved and total aluminum depending upon sites, soil types and flow conditions.

After careful deliberation, EPA and WVDEP Division of Water and Waste Management (DWWM) determined that the best and most scientifically supported way to evaluate waters under the new aluminum criteria is to obtain additional monitoring data for both total and dissolved aluminum where adequate dissolved aluminum data does not exist. Due to limited funds, all streams in the state will be monitored within the normal Watershed Management Framework monitoring schedule. Additionally, all permittees will be required to monitor both dissolved and total aluminum for three years. This monitoring will determine whether or not the streams are impaired for dissolved aluminum and also provide data necessary to calculate site specific translators, as necessary. Finally, since acid mine drainage is the typical source for aluminum impairments, as well as iron and manganese impairments, TMDL allocations and permit limits set to reduce iron and manganese loads are likely to reduce the aluminum loads as well.

Table 1-6. Water quality criteria for aluminum

Pollutant	Use Designation				
	Aquatic Life				Human Health
	B1, B4		B2		A[c]
	Acute[a]	Chronic[b]	Acute[a]	Chronic[b]	
Previous Water Quality Criteria					
Aluminium, Total (ug/L)	750	-	750	-	-
New Water Quality Criteria					
Aluminium, Dissolved (ug/L)	750	87	750	87	-

Source: WVDEP, 2003; B1=Warm water fishery stream, B2=Trout waters, B4=Wetlands, A=Water supply, public
[a]One hour average concentration not to be exceeded more than once every three years on average
[b]Four-day average concentration not to be exceeded more than once every three years on average

The aluminum criteria change directly impacted TMDL development in the Guyandotte River watershed. Table 1-4 shows waterbodies listed for total aluminum impairment on the 2002 Section 303(d) list. In the Guyandotte River watershed, there was very little dissolved aluminum data available for waters listed for total aluminum. Where adequate dissolved aluminum data does exist, EPA developed TMDLs for dissolved aluminum on waterbodies, including the Guyandotte River mainstem and 10 tributaries listed in Table 1-7. Data supporting the dissolved aluminum TMDLs is located in Table 3 of Appendixes A-1 to A-14. Because of the lack of an accepted translator and variability in the relationship of total aluminum to dissolved aluminum, TMDLs for dissolved aluminum will not be developed for waterbodies previously listed on the 2002 Section 303(d) list for total aluminum where no dissolved aluminum data exists. EPA

expects that West Virginia will address these waterbodies by monitoring for dissolved aluminum and total aluminum within the normal Watershed Management Framework Cycle and by requiring permittees to monitor for three years. This monitoring data will determine dissolved aluminum impairment and provide data for future TMDL development or site-specific translator calculations, as necessary. Additionally, Guyandotte River watershed TMDL allocations and permit limits set to reduce iron and manganese loads are likely to reduce most, if not all, of the aluminum load occurring on these streams. Any necessary dissolved aluminum TMDLs will be developed by West Virginia within 8-13 years of the original listing.

Table 1-7. Waterbodies in the Guyandotte River watershed for which dissolved aluminum TMDLs are being developed

Stream Name	Stream Code	Listed on 2002 303(d) List for Total Aluminum	Sufficient Dissolved Aluminum Data Present	Impaired for Dissolved Aluminum and TMDL Developed
Barkers Creek	OG-131	X	X	
Brier Creek/Indian Creek	OG-110-A	X	X	
Buffalo Creek	OG-61	X	X	X
Buffalo Creek/Little Huff Creek	OG-92-K	X	X	
Cabin Creek	OG-127	X	X	
Coal Branch/Island Creek	OG-65-A	X	X	
Copperas Mine Fork	OG-65-B	X	X	X
Crane Fork	OGC-26	X	X	
Devils Fork	OG-137	X	X	
Ed Stone Branch/Big Creek	OG-49-A	X		
Elk Trace Branch/Big Cub Creek	OG-96-C	X	X	
Ellis Branch/Mud Fork	OG-65-B-1-B	X	X	
Godby Branch	OG-53	X		
Gooney Otter Creek	OG-131-F	X	X	
Guyandotte River	O-4	X	X	X
Hickory Branch/Barkers Creek	OG-131-B	X	X	
Huff Creek	OG-76	X	X	
Indian Creek	OG-110	X	X	
Jims Branch/Gooney Otter Creek	OG-131-F-1	X	X	
Joe Branch	OG-128	X	X	
Kezee Fork	OG-92-K-1	X	X	
Laurel Branch/Pinnacle Creek	OG-124-H	X	X	
Laurel Fork	OGC-16	X	X	
Left Fork/Allen Creek	OG-135-A	X	X	
Limestone Branch	OG-48	X		
Long Branch	OG-129	X	X	
Lower Dempsey Branch	OG-65-B-1-A	X	X	
Lower Road Branch	OGC-12	X	X	
Marsh Fork/Brier Creek	OG-110-A-2	X	X	
McDonald Fork	OG-96-H	X	X	
Measle Fork	OG-134-D	X	X	
Milam Branch	OGC-16-M	X	X	
Mud Fork	OG-65-B-1	X	X	
Mudlick Fork/Buffalo Creek	OG-92-K-2	X	X	
Muzzle Creek	OG-92-I	X	X	

Stream Name	Stream Code	Listed on 2002 303(d) List for Total Aluminum	Sufficient Dissolved Aluminum Data Present	Impaired for Dissolved Aluminum and TMDL Developed
Noseman Branch	OG-131-F-2	X	X	
North Branch/ Ed Stone Branch	OG-49-A-1	X		
Oldhouse Branch/Rockhouse Creek	OG-77-A.5	X	X	
Pad Fork	OG-92-Q	X	X	
Pinnacle Creek	OG-124	X	X	
Proctor Hollow/Buffalo Creek	OG-75-C.5	X	X	
Reedy Branch	OG-99	X		
Righthand Fork/Pad Fork	OG-92-Q-1	X	X	
Road Branch	OG-96-B	X	X	
Slab Fork	OG-134	X	X	X
Smith Branch/Pinnacle Creek	OG-124-D	X		
Spider Creek	OG-124-I	X		
Still Run	OG-130	X	X	
Stonecoal Creek	OG-139	X	X	
Sturgeon Branch	OG-96-A	X	X	
Toler Hollow	OG-96-F	X	X	
Toney Fork/Clear Fork	OGC-19	X		
Toney Fork/Huff Creek	OG-76-L	X	X	
Trace Fork/Copperas Mine Fork	OG-65-B-4	X	X	
Trough Fork	OGC-16-P	X	X	
Upper Dempsey Branch	OG-65-B-1-E	X		
Winding Gulf	OG-138	X	X	X
Big Creek	OG-49			X
Clear Fork	OGC			X
Crawley Creek	OG-51			X
Gilbert Creek	OG-89			X
Big Cub	OG-96			X