APPENDIX 1

A-1. ABRAM CREEK

A-1.1 Watershed Information

Abram Creek is in the central portion of the North Branch/Potomac River watershed and drains approximately 44.2 square miles (28,276 acres) as shown in Figure A-1-1. The dominant land use is forest, which covers 66.2 percent of the watershed. Another important land use type is agriculture (25.1 percent). All other individual land cover types account for less than 8.9 percent of the total watershed area. There are 10 impaired streams in the watershed, including Abram Creek itself. Figure A-1-2 shows the impaired segments and the pollutants for which each is impaired.

Before establishing Total Maximum Daily Loads (TMDLs), WVDEP monitored each of the impaired streams in the North Branch/Potomac River watershed to characterize water quality and refine impairment listings. Monthly samples were taken at 20 stations throughout the Abram Creek watershed from July 1, 2002, through June 30, 2003. Monitoring suites at each site were determined based on the types of impairments observed in each stream. Streams impaired by metals and low pH were sampled monthly and analyzed for a suite of parameters (including total iron, dissolved iron, total aluminum, dissolved aluminum, total suspended solids, selenium, pH, sulfate, and specific conductance). In addition, benthic macroinvertebrate assessments were performed at specific locations on the biologically impaired streams during the pre-TMDL monitoring period. Instantaneous flow measurements were also taken at strategic locations during pre-TMDL monitoring. More information about the location of monitoring stations and other geographic information can be found in the ArcExplorer project compact disk.

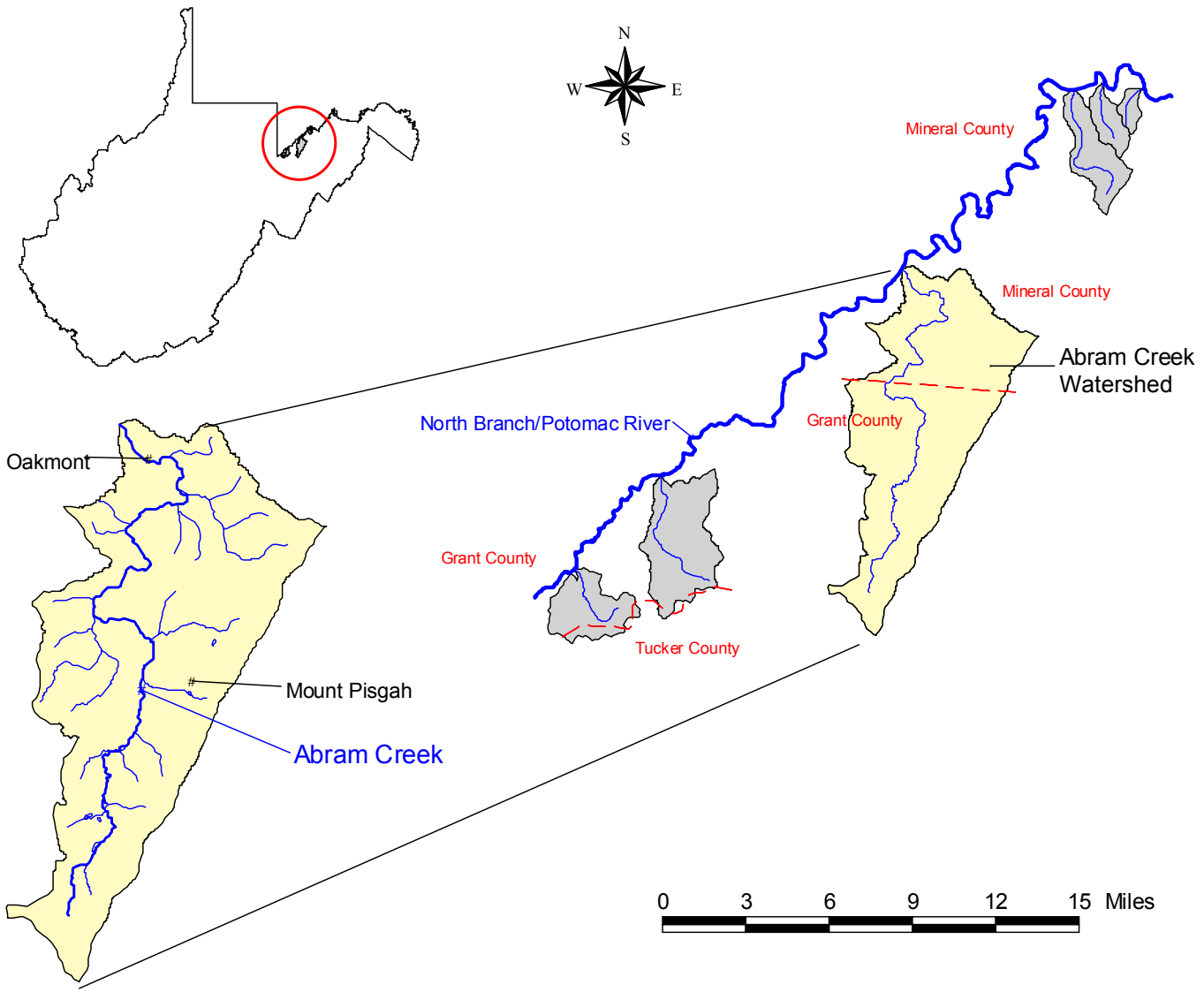
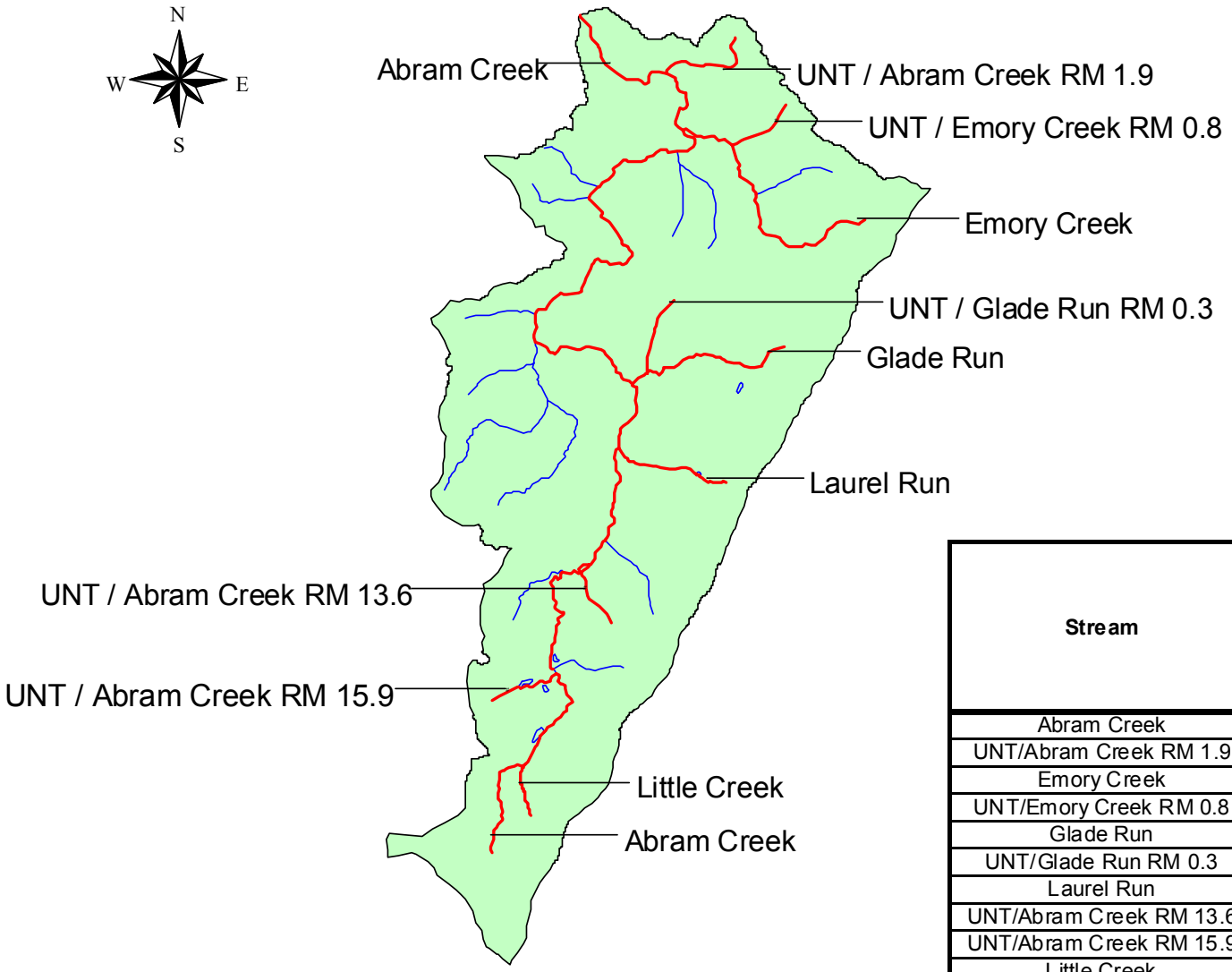


Figure A-1-1. Location of the Abram Creek watershed.



Stream	Aluminum	Iron	pH	Biological
Abram Creek	X	X	X	X
UNT/Abram Creek RM 1.9				X
Emory Creek	X	X	X	X
UNT/Emory Creek RM 0.8	X		X	
Glade Run	X	X	X	
UNT/Glade Run RM 0.3	X	X	X	
Laurel Run	X	X	X	
UNT/Abram Creek RM 13.6	X	X	X	
UNT/Abram Creek RM 15.9	X	X	X	
Little Creek	X	X	X	

Figure A-1-2. Impaired waterbodies in the Abram Creek watershed.

A-1.2 Metals and pH Sources

This section identifies and examines the potential sources of aluminum, iron, and pH impairment in the Abram Creek watershed. Sources can be classified as either point sources (specific sources subject to a permit) or nonpoint sources (diffuse sources). Mining and non-mining related permits are considered metals and pH point sources. Metals and pH nonpoint sources are diffuse, non-permitted sources such as abandoned or forfeited mine sites.

Pollution sources were identified using statewide geographic information system (GIS) coverages of point and nonpoint sources, and through field reconnaissance. As part of the TMDL process, WVDEP documented pollution sources by describing the pollution source in detail, collecting Global Positioning System data, and if necessary, collecting a water quality sample for laboratory analysis. WVDEP personnel recorded physical descriptions of the pollutant sources, such as the number of outfalls, the source of the outfalls, and the general condition of the stream in the vicinity of each outfall. These records were compiled and electronically plotted on maps using GIS software. This information was used in conjunction with other information to characterize pollutant sources. Significant metals sources in the watershed are shown in Figure A-1-3.

Based on scientific knowledge of sediment/metals interaction and knowledge of West Virginia's soils, it is reasonable to conclude that sediments contain high levels of aluminum and iron. Control of sediment-producing sources may be necessary to meet water quality criteria for dissolved aluminum and total iron during critical high flow conditions. Although some of these sediment-producing sources are not displayed in Figure A-1-3 (e.g., harvested forest areas, agriculture and unpaved roads), specific details relative to these sources are discussed in section A-1.2.2.

A-1.2.1 Metals Point Source Inventory

As described in the main report, 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. Metals and pH point sources can be classified into two major categories: permitted non-mining point sources and permitted mining point sources.

In the Abram Creek watershed, all NPDES permits for metals effluents are related to mining. There are 8 mining-related NPDES outlets in the Abram Creek watershed. The WVDEP's *HPU* GIS coverage was used to determine the locations of the mining permits; the detailed permit information came from WVDEP's *ERIS* database system. The permits related to these outlets are listed in the Technical Report, which shows the name of each responsible party and the total number of outlets that discharge to the Abram Creek watershed. The Technical Report also contains detailed information on the specific data for each permitted outlet (including effluent type, drainage areas, and pump capacities) and permit limits for each of the mining-related NPDES outlets.

A-1.2.2 Metals Nonpoint Source Inventory

In addition to point sources, nonpoint sources also contribute to metals-related water quality impairments in the Abram Creek watershed. Nonpoint sources are diffuse, non-permitted sources. Abandoned mine lands and facilities subject to the Surface Mining Control and Reclamation Act of 1977 that forfeited their bonds or abandoned operations can be a significant non-permitted source of metals. Non-mining land disturbance activities can also be a nonpoint source of metals, causing metals to enter waterbodies as a component of sediment. Examples of such land disturbance activities are agriculture, forestry, oil and gas wells, and the construction and use of roads. The applicable land disturbance activities in the Abram Creek watershed are discussed below.

Abandoned Mine Lands and Bond Forfeiture Sites

Based on the identification of a number of abandoned mining activities in the Abram Creek watershed, abandoned mine lands are a significant non-permitted source of metals and pH impairment in the watershed. WVDEP's Office of Abandoned Mine Lands identified the locations of abandoned mine lands in the Abram Creek watershed. In addition, source-tracking efforts by WVDEP's Division of Water and Waste Management identified and characterized 27 abandoned mine sources (discharges, seeps, portals, culverts, refuse piles, diversion ditches, and ponds).

WVDEP's Division of Land Restoration, Office of Special Reclamation, provided bond forfeiture information and data. This information included the status of both land reclamation and water treatment activities. There is one bond forfeiture site that comprises 50 acres of the Abram Creek watershed.

Land Disturbance Activities

Based on the GAP 2000 land use coverage, there are 7,086 acres (25.1 percent) of agriculture in the Abram Creek watershed. There are three active logging operations in the watershed. The disturbed areas associated with these operations are estimated to cover 537 acres (1.9 percent) of the total watershed area. The watershed contains 1 active oil and gas well, which, based on the survey by WVDEP's Office of Oil and Gas, is estimated to comprise 1.38 acres (0.005 percent). The length and area of paved roads were calculated using the Census 2000 TIGER/Line files roads coverage for West Virginia. Information on unpaved roads from TIGER was supplemented by digitizing any unpaved roads on topographic maps that were not included in the TIGER shapefile. There are 90.61 miles of paved roads and 161.67 miles of unpaved roads in the Abram Creek watershed.

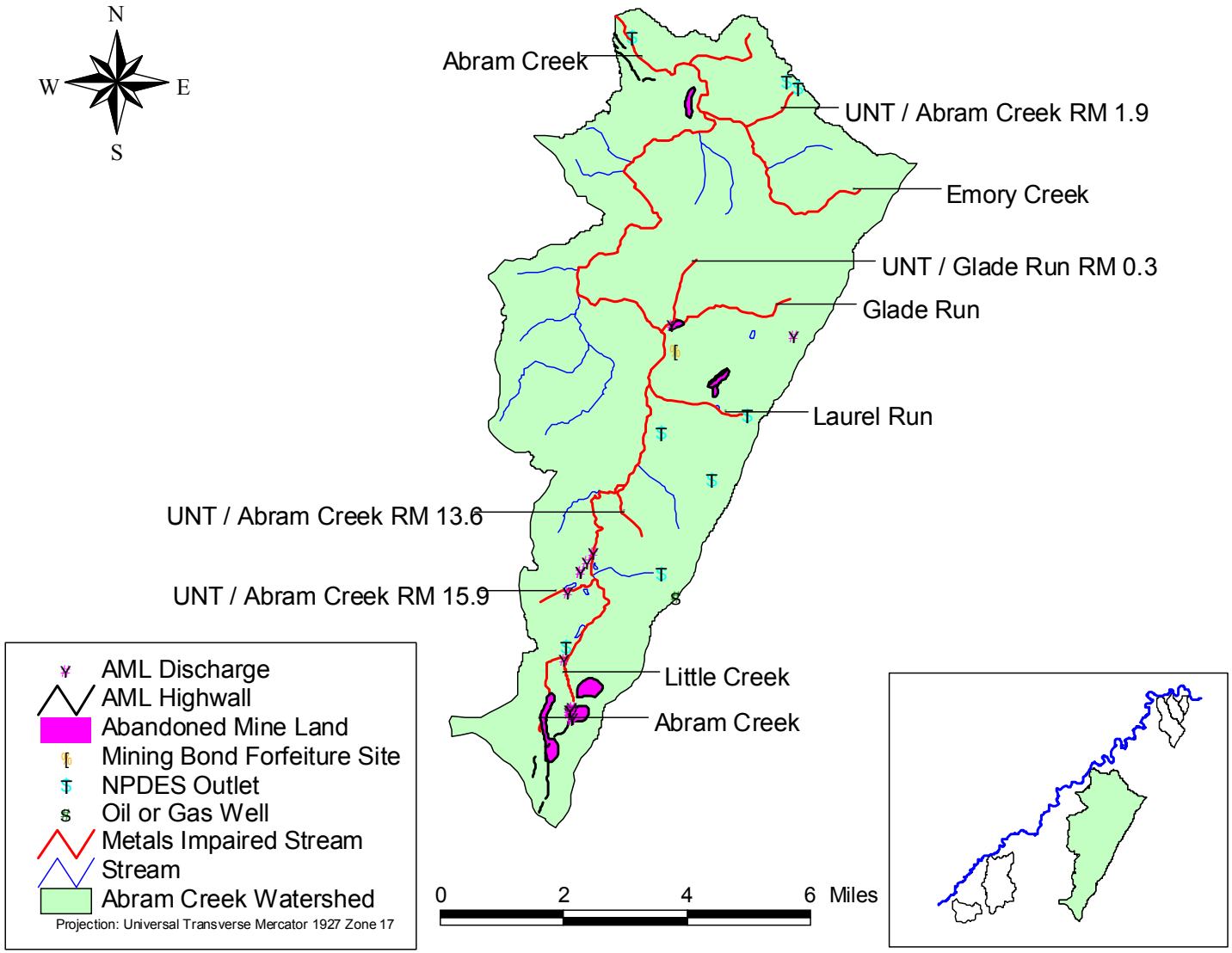


Figure A-1-3. Metals sources in the Abram Creek watershed.

A-1.3 Stressors of Biologically Impaired Streams

The Abram Creek watershed has three biologically impaired streams for which TMDLs have been developed. These streams are identified in Table A-1-1 along with the biological stressors of the streams' benthic communities and the TMDLs required to address these impairments. A stressor identification process was used to evaluate and identify the primary stressors of impaired benthic communities. Refer to the main report for a detailed description of the stressor identification process.

Table A-1-1. Primary stressors of biologically impaired streams in the Abram Creek watershed

Stream	Biological Stressors	TMDLs Required
Abram Creek	Metals toxicity (aluminum, iron) pH toxicity (acidity)	Aluminum Iron pH
UNT/Abram Creek RM 1.9	Sedimentation	Sediment
Emory Creek	Metals toxicity (aluminum, iron) pH toxicity (acidity)	Aluminum Iron pH

UNT = unnamed tributary

TMDLs for each specific biological stressor are shown in Table A-1-5. Sediment TMDLs are required only when the stressor identification process indicates that a sedimentation problem is impairing the biological community. Sediment TMDLs are presented for UNT/Abram Creek RM 1.9. Figure A-1-4 shows the sediment deposition near the mouth of UNT/Abram Creek with Abram Creek. See section A-1.2.2 for additional sediment source information.

Figure A-1-4. Sediment depositional area at the mouth of UNT/Abram Creek.

A-1.4 TMDLs for the Abram Creek Watershed

A-1.4.1 TMDL Development

TMDLs and source allocations were developed for impaired streams in the Abram Creek watershed. A top-down methodology was followed to develop these TMDLs and allocate loads to sources. Headwaters were analyzed first because they have a profound effect on downstream water quality. Loading contributions were reduced from applicable sources for these waterbodies and TMDLs were developed. Refer to Section 6.4 of the main report for a detailed description of allocation methodologies used in the development of the pollutant-specific TMDLs.

The TMDLs for iron, aluminum, pH, and sediment are shown in Tables A-1-2 through A-1-5. The TMDLs for iron and aluminum are presented as annual average loads, in terms of pounds per year. The TMDLs for sediment are presented in tonnes per year. All TMDLs are presented as average annual loads because they were developed to meet TMDL endpoints under a range of conditions observed throughout the year.

As stated in Section 6.3.1, a surrogate approach was used to develop pH TMDLs. It was assumed that reductions in metals concentrations to TMDL endpoints would result in compliance with the pH water quality standard. To verify this assumption, the Dynamic Equilibrium In-stream Chemical Reactions (DESC-R) model was run for an extended period under TMDL conditions — conditions where TMDL endpoints for metals were met. A median equilibrium pH was calculated based on the daily equilibrium pH output from the DESC-R model. The results, shown in Table A-1-4, are the TMDLs for the pH-impaired streams in the watershed. Refer to the Technical Report for a detailed description of the pH modeling approach.

A-1.4.2 TMDL Tables: Metals and pH

Table A-1-2. Iron TMDLs for the Abram Creek watershed

Major Watershed	Stream Code	Stream Name	Metal	Load Allocation (lb/yr)	Wasteload Allocation (lb/yr)	Margin of Safety (lb/yr)	TMDL (lb/yr)
Abram Creek	WVPNB-16	Abram Creek	Iron	21,913	7,913	1,570	31,395
Abram Creek	WVPNB-16-A	Emory Creek	Iron	1,418	1,764	167	3,349
Abram Creek	WVPNB-16-B.5	Glade Run	Iron	4,183	NA	220	4,403
Abram Creek	WVPNB-16-B.5-1	UNT/Glade Run RM 0.3	Iron	700	NA	37	737
Abram Creek	WVPNB-16-C	Laurel Run	Iron	262	1,916	115	2,293
Abram Creek	WVPNB-16-C.4	UNT/Abram Creek RM 13.6	Iron	484	NA	25	509
Abram Creek	WVPNB-16-C.8	UNT/Abram Creek RM 15.9	Iron	184	NA	10	194
Abram Creek	WVPNB-16-D	Little Creek	Iron	1,288	NA	68	1,356

NA = not applicable; UNT = unnamed tributary.

Table A-1-3. Aluminum TMDLs for the Abram Creek watershed

Major Watershed	Stream Code	Stream Name	Metal	Load Allocation (lb/yr)	Wasteload Allocation (lb/yr)	Margin of Safety (lb/yr)	TMDL (lb/yr)
Abram Creek	WVPNB-16	Abram Creek	Aluminum	10,977	3,261	749	14,987
Abram Creek	WVPNB-16-A	Emory Creek	Aluminum	1,037	413	76	1,526
Abram Creek	WVPNB-16-A-1	UNT/Emory Creek RM 0.8	Aluminum	84	413	26	524
Abram Creek	WVPNB-16-B.5	Glade Run	Aluminum	1,200	NA	63	1,263
Abram Creek	WVPNB-16-B.5-1	UNT /Glade Run At RM 0.3	Aluminum	403	NA	21	424
Abram Creek	WVPNB-16-C	Laurel Run	Aluminum	284	449	39	772
Abram Creek	WVPNB-16-C.4	UNT /Abram Creek RM 13.6	Aluminum	138	NA	7	146
Abram Creek	WVPNB-16-C.8	UNT /Abram Creek RM 15.9	Aluminum	128	NA	7	135
Abram Creek	WVPNB-16-D	Little Creek	Aluminum	292	NA	15	307

NA = not applicable; UNT = unnamed tributary.

Table A-1-4. pH TMDLs for the Abram Creek watershed

Major Watershed	Stream Code	Stream Name	Parameter	pH* (Under TMDL conditions)
Abram Creek	PNB-16	Abram Creek	pH	8.45
Abram Creek	PNB-16-A	Emory Creek	pH	8.41
Abram Creek	PNB-16-A-1	UNT/Emory Creek RM 0.8	pH	7.64
Abram Creek	PNB-16-B.5	Glade Run	pH	8.69
Abram Creek	PNB-16-B.5-1	UNT/Glade Run RM 0.3	pH	8.61
Abram Creek	PNB-16-C	Laurel Run	pH	8.52
Abram Creek	PNB-16-C.4	UNT/Abram Creek RM 13.6	pH	8.46
Abram Creek	PNB-16-C.8	UNT/Abram Creek RM 15.9	pH	8.69
Abram Creek	PNB-16-D	Little Creek	pH	8.72

UNT = unnamed tributary.

*Predicted pH assumes that all metals (aluminum and iron) meet TMDL endpoints.

A-1.4.3 TMDL Tables: Biological

Table A-1-5. Biological TMDLs for the Abram Creek watershed

Stream	Biological Stressor	Parameter	Load Allocation	Wasteload Allocation	Margin of Safety	TMDL	Units
Abram Creek PNB-16	Metals Toxicity	Aluminum	10,977	3,261	749	14,987	lb/yr
		Iron	21,913	7,913	1,570	31,395	lb/yr
	pH Toxicity (Acidity)	pH	Not Applicable			8.45	Standard Units
UNT/Abram Creek RM 1.9 PNB-16-0.5A	Sedimentation	Sediment	124	NA	7	130	tonnes/yr
Emory Creek PNB-16-A	Metals Toxicity	Aluminum	1,037	413	76	1,526	lb/yr
		Iron	1,418	1,764	167	3,349	lb/yr
	pH Toxicity (Acidity)	pH	Not Applicable			8.41	Standard Units