APPENDIX 4

A-4. MARSH FORK

A-4.1 Watershed Information

Marsh Fork is in the southeastern portion of the Coal River watershed and drains approximately 163.2 square miles (104,461 acres), as shown in Figure A-4-1. The dominant landuse in the watershed is forest, which covers 74.2 percent of the watershed. Other important landuse types include active mining land (12.5 percent), pasture (7.1 percent), and urban/residential (1.6 percent). All other individual land cover types account for less than 5 percent of the total watershed area. There are 36 impaired streams in the watershed, including Marsh Fork, that are addressed in this TMDL development effort. Figure A-4-2 shows the impaired segments and the pollutants for which each is listed as impaired.

Before establishing Total Maximum Daily Loads (TMDLs), WVDEP performed monitoring in each of the impaired streams in the Coal River watershed to better characterize water quality and refine impairment listings. Monthly samples were taken at 88 stations (station locations can be viewed using the ArcExplorer project) throughout the Marsh Fork 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 acidity, alkalinity, total iron, dissolved iron, total aluminum, dissolved aluminum, total suspended solids, pH, sulfate, total selenium, total manganese, and specific conductance. Monthly samples from streams impaired by fecal coliform bacteria were analyzed for fecal coliform bacteria, pH, 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.

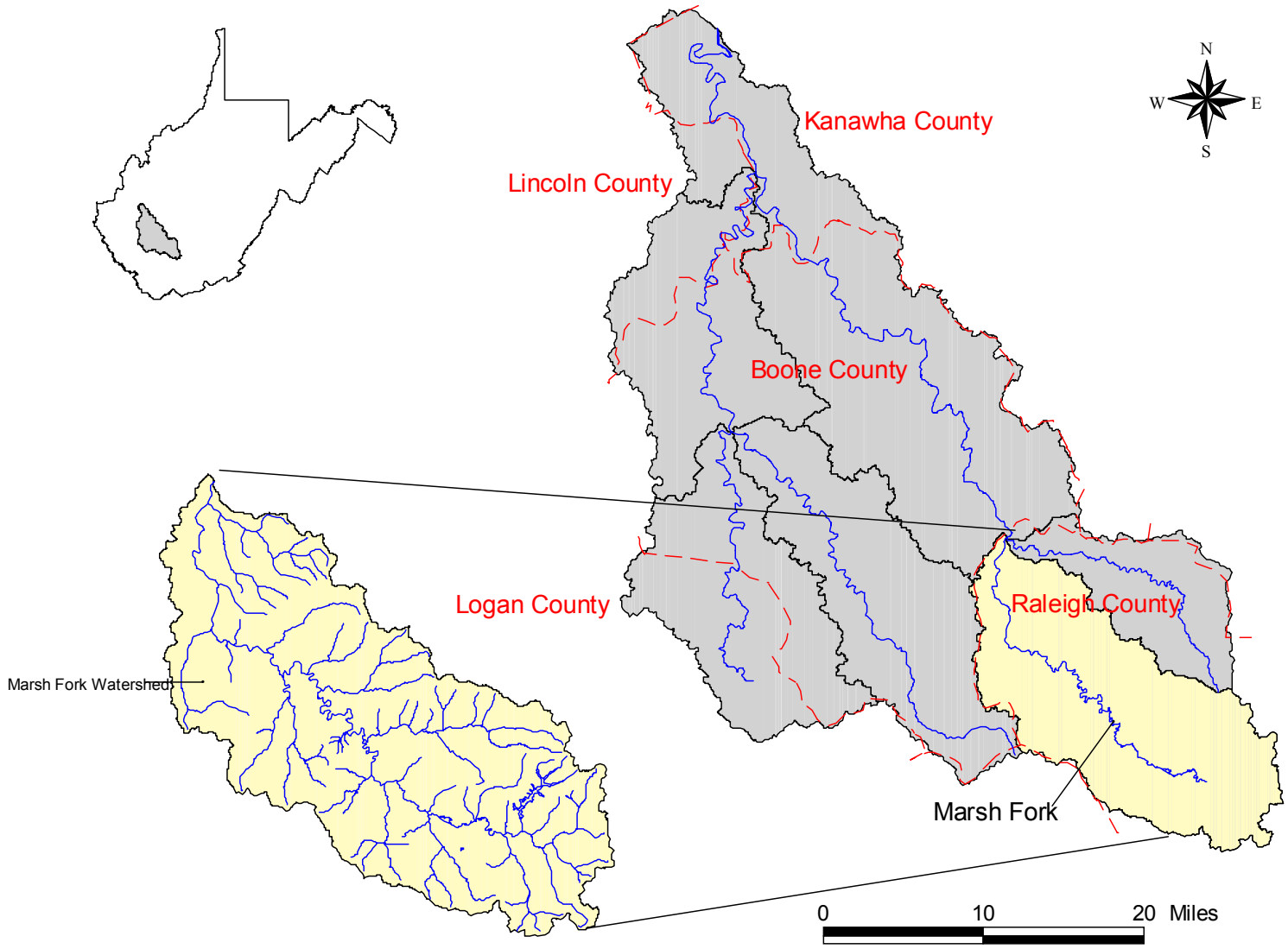


Figure A-4-1. Location of the Marsh Fork watershed.

Stream	Aluminum	Iron	Manganese	pH	Biological	Fecal Coliforms	Sediment
Marsh Fork		X				X	
Little Marsh Fork	X	X	X				
Brushy Fork	X	X	X				
Ellis Creek		X					
Hazy Creek		X					
Stink Run		X				X	
Horse Creek		X					
Peachtree Creek		X					
Drews Creek		X					
Martin Fork	X	X		X			
Millers Fork		X					
Dry Creek						X	
Rock Creek		X				X	
Flat Branch						X	
Righthand Fork						X	
Sandlick Creek		X			X	X	X
Bee Branch	X			X			
Right Fork/Sandlick Creek					X	X	X
Wingrove Branch		X				X	
Harper Branch		X					
Cove Creek		X				X	
UNT/Cove Creek RM 1.2						X	
Breckenridge Creek						X	
UNT/Breckenridge Creek RM 2.7						X	
Spanker Branch						X	
Maple Meadow Creek		X			X	X	
Claypool Hollow						X	
Rockhouse Fork		X				X	
Dingess Branch		X				X	
Surveyor Creek		X			X	X	X
Millers Camp Branch	X	X			X	X	X
Clay Branch						X	
Stephens Branch		X					
Shockley Branch		X					
Laurel Branch		X					
Jehu Branch		X					

Figure A-4-2. Waterbodies and impairments under TMDL development in the Marsh Fork watershed.

A-4.2 Metals and pH Sources

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

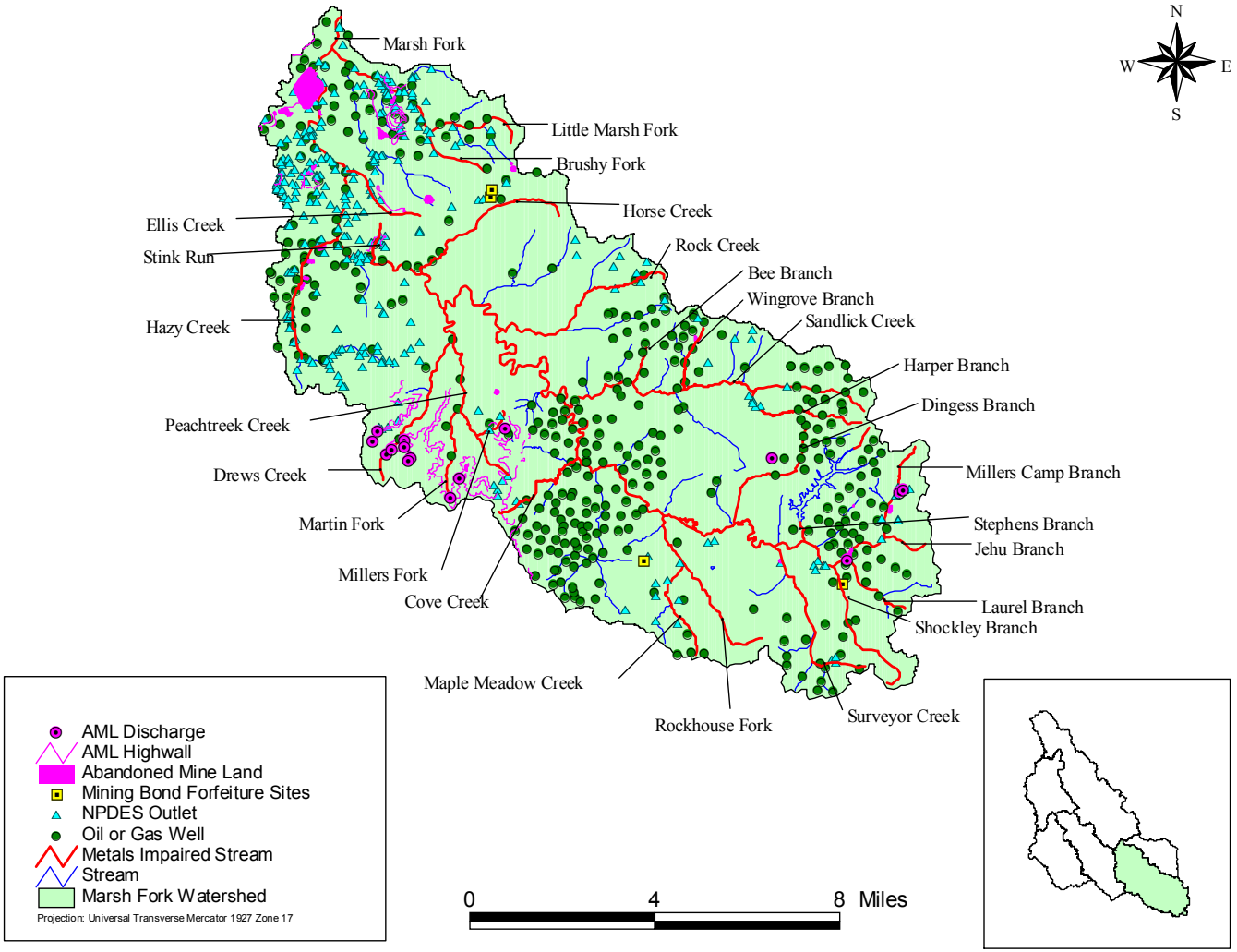
Pollutant sources were identified using statewide geographic information system (GIS) coverages of point and non-point sources, and through field reconnaissance. As part of the TMDL process, WVDEP documented pollution sources by describing the pollutant source in detail, collecting Global Positioning 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-4-3.

On the basis of 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, and, to a lesser extent, manganese. Control of sediment-producing sources might be necessary to meet water quality criteria for dissolved aluminum, total iron, and total manganese during critical high-flow conditions. Although some of these sediment-producing sources are not shown in Figure A-4-3 (e.g., agricultural areas and unpaved roads), specific details relative to these sources are discussed in section A-4.2.2.

A-4.2.1 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 Marsh Fork watershed, non-mining NPDES-permits are not present. 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. There are 321 mining-related NPDES outlets in the Marsh Fork watershed. 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 Marsh Fork watershed. The Technical Report also contains 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.



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

Figure A-4-3. Metals sources in the Marsh Fork watershed.

A-6.2.2 Metals Non-point Source Inventory

In addition to point sources, non-point sources also contribute to metals-related water quality impairments in the Marsh Fork watershed. Non-point sources are diffuse, non-permitted sources. Abandoned mine lands and facilities that were subject to the Surface Mining Control and Reclamation Act of 1977, and forfeited their bonds or abandoned operations can be a significant non-permitted source of metals. Non-mining land disturbance activities can also be a non-point 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-disturbing activities in the Marsh Fork watershed are discussed below.

Abandoned Mine Lands and Bond Forfeiture Sites

Based on the identification of a number of abandoned mining activities in the Marsh Fork 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 Marsh Fork watershed. In addition, source-tracking efforts by WVDEP's Division of Water and Waste Management identified and characterized 15 abandoned mine sources (i.e. discharges, seeps, portals, culverts, fractured highwall, artesian flow, 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 are four bond forfeiture sites that comprise approximately 395 acres in the Marsh Fork watershed.

Land-Disturbing Activities

Based on the GAP 2000 landuse coverage, there are only 66 acres of row crop agriculture in the Marsh Fork watershed, representing 0.06 percent of the total area. There are no active logging operations in the watershed. The watershed contains 244 active oil and gas wells, which, based on the survey by WVDEP's Office of Oil and Gas, are estimated to comprise 337 acres (0.3 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 shown on topographic maps that were not included in the TIGER shapefile. There are 233.3 miles of paved roads and 931.3 miles of unpaved roads in the Marsh Fork watershed.

A-4.3 Fecal Coliform Bacteria Sources

This section identifies and examines the potential sources of fecal coliform bacteria in the Marsh Fork watershed. Sources can be classified as either point sources (specific sources subject to a permit) or non-point sources (diffuse sources). Point sources of fecal coliform bacteria are classified by several different types of sewage permits and the point source discharges regulated in them. Non-point sources are diffuse, non-permitted sources.

A-4.3.1 Fecal Coliform Bacteria Point Sources

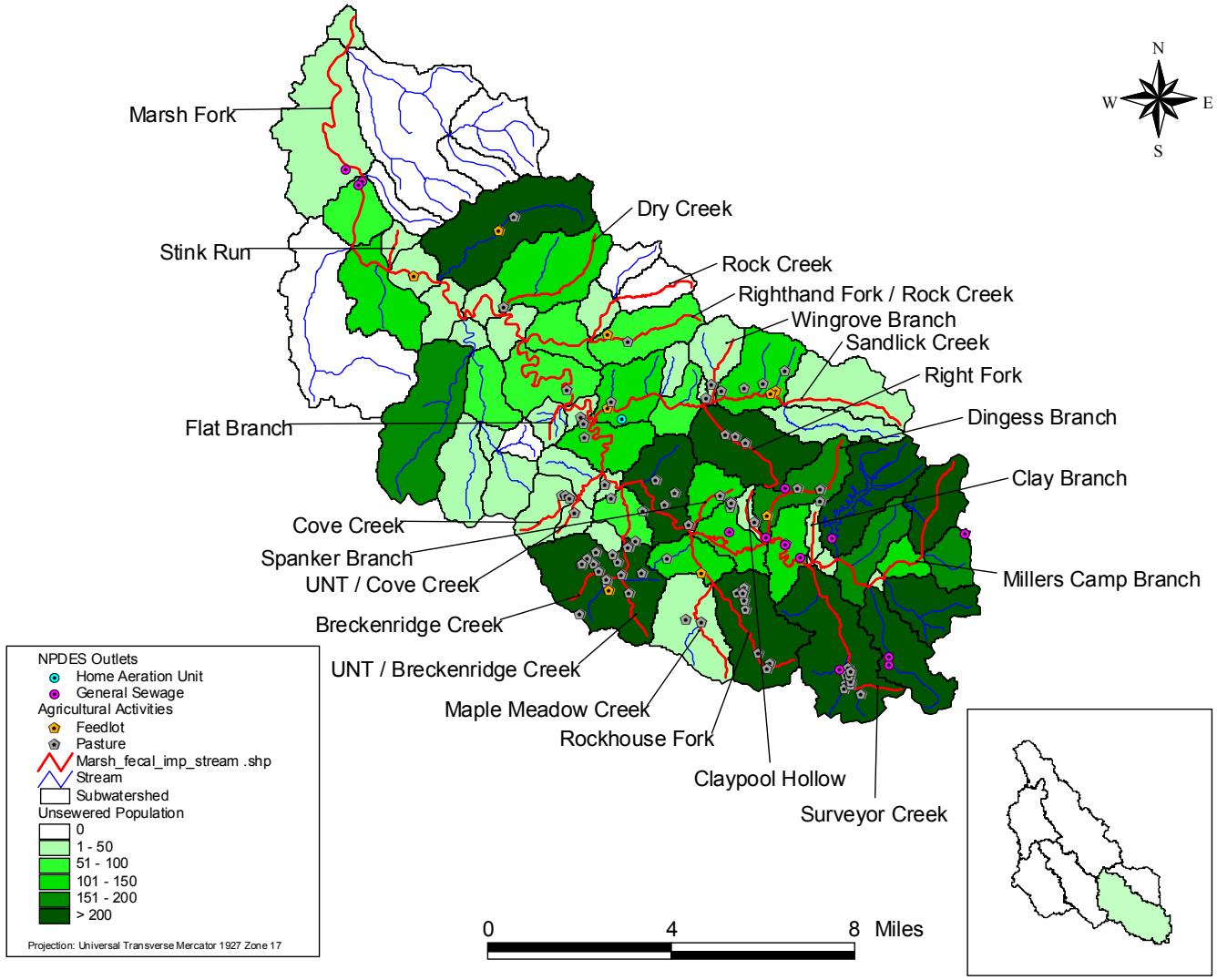
Permitted sources of fecal coliform bacteria that experience effluent overflows or that do not comply with permit limits can cause occasional high loadings of fecal coliform bacteria in receiving streams. In the Marsh Fork watershed there are 14 discharge permits. One permit is a general sewage permit for a home aeration unit serving a private residence. The other 13 permits are general sewage permits for schools, businesses, community buildings, and a private residence.

A-4.3.2 Non-point (Non-permitted) Fecal Coliform Bacteria Sources

Pollutant source-tracking by WVDEP personnel identified scattered areas of high population density without access to public sewers in the Marsh Fork watershed. Human sources of fecal coliform bacteria from these areas include sewage discharges from failing septic systems, and possible direct discharges of sewage from residences (straight pipes). The West Virginia Bureau for Public Health estimates the septic tank failure rate in this area to be 70 percent in the first 10 years after installation (WV Bureau for Public Health 2003). An analysis of census data from the 1990 Census combined with WVDEP source-tracking information yielded an estimate of 6,477 people living in the unsewered homes in the Marsh Fork watershed. Figure A-4-4 shows the estimated distribution of the unsewered population in the watershed.

Stormwater runoff is another potential non-point source of fecal coliform bacteria in both residential/urban and rural areas. Runoff from residential areas can deliver the waste of pets and wildlife to the waterbody. In addition, rural stormwater runoff can transport significant loads of bacteria from livestock pastures, livestock and poultry feeding facilities, and manure storage and application. Given the small portion of total land area in the Marsh Fork watershed that consists of agricultural areas, stormwater runoff from these areas is not considered a significant non-point source of fecal coliform bacteria, except in localized areas. Therefore, fecal coliform bacteria reductions from agricultural landuses are required in only 9 of the 70 subwatersheds in the Marsh Fork drainage. Stormwater runoff from residential areas is a source of fecal coliform bacteria in the Marsh Fork watershed. Twenty-one of the 70 subwatersheds that compose the Marsh Fork drainage area require residential reductions.

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 the Division of Natural Resources. Although wildlife contributions of fecal coliform bacteria were considered in modeling, they were not found to be a significant source.



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

Figure A-4-4. Fecal coliform sources in the Marsh Fork watershed.

A-4.4 Stressors of Biologically Impaired Streams

The Marsh Fork watershed has five biologically impaired streams for which TMDLs have been developed. These streams are identified in Table A-4-1 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. WVDEP is deferring biological TMDL development for Ellis Creek. The information available on the causative pollutants and associated impairment thresholds is insufficient to support TMDL development at this time.

Table A-4-1. Primary stressors of biologically impaired streams in the Marsh Fork watershed

Stream	Biological Stressors	TMDLs Required
Sandlick Creek	Metal toxicity (iron) Sedimentation	Iron Sediment
Right Fork/Sandlick Creek	Sedimentation Organic enrichment	Sediment Fecal coliform
Maple Meadow Creek	Metal toxicity (iron) Organic enrichment	Iron Fecal coliform
Surveyor Creek	Organic enrichment Sedimentation	Fecal coliform Sediment
Millers Camp Branch	Sedimentation	Sediment

TMDLs for each specific biological stressor are shown in Table A-4-7. 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 Sandlick Creek, Right Fork/Sandlick Creek, Surveyor Creek, and Millers Camp Branch. Refer to section A-4.2.2 for additional sediment source information.

A-4.5 TMDLs for the Marsh Fork Watershed

A-4.5.1 TMDL Development

TMDLs and source allocations were developed for impaired streams in the Marsh Fork 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 7.5 of the main report for a detailed description of the allocation methodologies used in developing the pollutant-specific TMDLs.

The TMDLs for iron, manganese, aluminum, pH, fecal coliform bacteria, and sediment are shown in Tables A-4-2 through A-4-7. The TMDLs for iron, manganese, and aluminum are presented as annual average loads, in pounds per year. The TMDLs for sediment are presented in tonnes per year. The TMDLs for fecal coliform bacteria are presented in number of colonies 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 7.4.1, 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 model (DESC-R) 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 DESC-R. The results, shown in Table A-4-5, 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-4.6 TMDL Tables: Metals and pH

Table A-4-2. Iron TMDLs for the Marsh Fork watershed

Major Watershed	Stream Code	Stream Name	Metal	Load Allocation (lbs/yr)	Wasteload Allocation (lbs/yr)	Margin of Safety (lbs/yr)	TMDL (lbs/yr)
Marsh Fork	WVKC-46-E	Stink Run	Iron	528	411	49	988
Marsh Fork	WVKC-46-F	Horse Creek	Iron	5,957	144	321	6,422
Marsh Fork	WVKC-46-G	Peachtree Creek	Iron	15,338	887	854	17,080
Marsh Fork	WVKC-46	Marsh Fork	Iron	141,198	98,179	12,599	251,977
Marsh Fork	WVKC-46-A	Little Marsh Fork	Iron	4,121	48,691	2,780	55,592
Marsh Fork	WVKC-46-A-4	Brushy Fork	Iron	321	4,954	278	5,552
Marsh Fork	WVKC-46-B	Ellis Creek	Iron	93	5,673	303	6,070
Marsh Fork	WVKC-46-C	Hazy Creek	Iron	7,534	7,542	793	15,870
Marsh Fork	WVKC-46-G-1	Drews Creek	Iron	7,848	296	429	8,573
Marsh Fork	WVKC-46-G-2	Martin Fork	Iron	2,327	234	135	2,695
Marsh Fork	WVKC-46-G-3	Millers Fork	Iron	802	70	46	918
Marsh Fork	WVKC-46-I	Rock Creek	Iron	7,581	115	405	8,101
Marsh Fork	WVKC-46-J	Sandlick Creek	Iron	19,309	689	1,053	21,051
Marsh Fork	WVKC-46-J-4	Wingrove Branch	Iron	1,584	71	87	1,742
Marsh Fork	WVKC-46-J-7	Harper Branch	Iron	1,945	275	117	2,337
Marsh Fork	WVKC-46-K	Cove Creek	Iron	3,562	210	199	3,971
Marsh Fork	WVKC-46-N	Maple Meadow Creek	Iron	10,574	162	565	11,301
Marsh Fork	WVKC-46-N-1	Rockhouse Fork	Iron	5,194	NA	273	5,467
Marsh Fork	WVKC-46-O	Dingess Branch	Iron	3,137	NA	165	3,302
Marsh Fork	WVKC-46-P	Surveyor Creek	Iron	6,668	648	385	7,701
Marsh Fork	WVKC-46-Q	Millers Camp Branch	Iron	10,515	2,442	682	13,639
Marsh Fork	WVKC-46-Q-1	Stephens Branch	Iron	2,235	NA	118	2,352
Marsh Fork	WVKC-46-Q-3	Shockley Branch	Iron	1,993	NA	105	2,097
Marsh Fork	WVKC-46-Q-4	Laurel Branch	Iron	1,720	NA	91	1,811
Marsh Fork	WVKC-46-Q-5	Jehu Branch	Iron	929	NA	49	977

NA = not applicable.

Table A-4-3. Manganese TMDLs for the Marsh Fork watershed

Major Watershed	Stream Code	Stream Name	Metal	Load Allocation (lbs/yr)	Wasteload Allocation (lbs/yr)	Margin of Safety (lbs/yr)	TMDL (lbs/yr)
Marsh Fork	WVKC-46-A	Little Marsh Fork	Manganese	648	32,391	1,739	34,777
Marsh Fork	WVKC-46-A-4	Brushy Fork	Manganese	54	3,358	180	3,591

Table A-4-4. Aluminum TMDLs for the Marsh Fork watershed

Major Watershed	Stream Code	Stream Name	Metal	Load Allocation (lbs/yr)	Wasteload Allocation (lbs/yr)	Margin of Safety (lbs/yr)	TMDL (lbs/yr)
Marsh Fork	WVKC-46-A	Little Marsh Fork	Aluminum	755	6,032	357	7,144
Marsh Fork	WVKC-46-A-4	Brushy Fork	Aluminum	53	287	18	358
Marsh Fork	WVKC-46-G-2	Martin Fork	Aluminum	479	307	41	828
Marsh Fork	WVKC-46-J-2	Bee Branch	Aluminum	170	NA	9	179
Marsh Fork	WVKC-46-Q	Millers Camp Branch	Aluminum	2,936	3,671	348	6,954

Table A-4-5. pH TMDLs for the Marsh Fork watershed

Major Watershed	Stream Code	Stream Name	Parameter	pH* (Under TMDL conditions)
Marsh Fork	WVKC-46-G-2	Martin Fork	pH	8.50
Marsh Fork	WVKC-46-J-2	Bee Branch	pH	8.64

UNT = unnamed tributary.
*Predicted pH assumes that all metals (aluminum, iron, manganese) meet TMDL endpoints.

A-4.7 TMDL Tables: Fecal Coliform Bacteria

Table A-4-6. Fecal coliform bacteria TMDLs for the Marsh Fork watershed

Major Watershed	Stream Code	Stream Name	Parameter	Load Allocation (counts/yr)	Wasteload Allocation (counts/yr)	Margin of Safety (counts/yr)	TMDL (counts/yr)
Marsh Fork	WVKC-46	Marsh Fork	Fecal coliform	1.34E+14	2.68E+11	7.06E+12	1.41E+14
Marsh Fork	WVKC-46-E	Stink Run	Fecal coliform	2.97E+11	NA	1.56E+10	3.13E+11
Marsh Fork	WVKC-46-H	Dry Creek	Fecal coliform	3.93E+12	NA	2.07E+11	4.14E+12
Marsh Fork	WVKC-46-I	Rock Creek	Fecal coliform	5.92E+12	NA	3.12E+11	6.23E+12
Marsh Fork	WVKC-46-I.7	Flat Branch	Fecal coliform	4.10E+11	NA	2.16E+10	4.31E+11
Marsh Fork	WVKC-46-I-1	Righthand Fork	Fecal coliform	1.84E+12	NA	9.70E+10	1.94E+12
Marsh Fork	WVKC-46-J	Sandlick Creek	Fecal coliform	1.33E+13	1.38E+09	7.01E+11	1.40E+13
Marsh Fork	WVKC-46-J-3	Right Fork/Sandlick Creek	Fecal coliform	2.76E+12	NA	1.46E+11	2.91E+12
Marsh Fork	WVKC-46-J-4	Wingrove Branch	Fecal coliform	1.41E+12	NA	7.44E+10	1.49E+12
Marsh Fork	WVKC-46-K	Cove Creek	Fecal coliform	3.19E+12	NA	1.68E+11	3.36E+12
Marsh Fork	WVKC-46-K-2	UNT/Cove Creek RM 1.2	Fecal coliform	7.91E+11	NA	4.16E+10	8.32E+11
Marsh Fork	WVKC-46-L	Breckenridge Creek	Fecal coliform	1.63E+13	NA	8.58E+11	1.72E+13
Marsh Fork	WVKC-46-L-1	UNT/Breckenridge Creek RM 2.7	Fecal coliform	1.22E+13	NA	6.40E+11	1.28E+13
Marsh Fork	WVKC-46-M	Spanker Branch	Fecal coliform	1.22E+12	NA	6.41E+10	1.28E+12
Marsh Fork	WVKC-46-N	Maple Meadow Creek	Fecal coliform	7.83E+12	NA	4.12E+11	8.25E+12
Marsh Fork	WVKC-46-N.9	Claypool Hollow	Fecal coliform	9.91E+11	NA	5.21E+10	1.04E+12
Marsh Fork	WVKC-46-N-1	Rockhouse Fork	Fecal coliform	3.19E+12	NA	1.68E+11	3.36E+12
Marsh Fork	WVKC-46-O	Dingess Branch	Fecal coliform	3.68E+12	3.65E+10	1.95E+11	3.91E+12
Marsh Fork	WVKC-46-P	Surveyor Creek	Fecal coliform	5.19E+12	2.77E+10	2.75E+11	5.49E+12
Marsh Fork	WVKC-46-Q	Millers Camp Branch	Fecal coliform	1.21E+13	1.25E+11	6.44E+11	1.29E+13
Marsh Fork	WVKC-46-Q-0.1	Clay Branch	Fecal coliform	6.62E+11	NA	3.48E+10	6.97E+11

NA = not applicable; UNT = unnamed tributary.

A-4.8 TMDL Tables: Biological

Table A-4-7. Biological TMDLs for the Marsh Fork watershed

Stream	Biological Stressor	Parameter	Load Allocation	Wasteload Allocation	Margin of Safety	TMDL	Units
Sandlick Creek WVKC-46-J	Metals toxicity	Iron	19,309	689	1,053	21,051	lbs/yr
	Sedimentation	Sediment	2940.7	361.0	173.8	3475.4	tonnes/yr
Right Fork/Sandlick Creek WVKC-46-J-3	Sedimentation	Sediment	700.4	NA	36.9	737.4	tonnes/yr
	Organic enrichment	Fecal coliform	2.76E+12	NA	1.46E+11	2.91E+12	counts/yr
Maple Meadow Creek WVKC-46-N	Metals toxicity	Iron	10,574	162	565	11,301	lbs/yr
	Organic enrichment	Fecal coliform	7.83E+12	NA	4.12E+11	8.25E+12	counts/yr
Surveyor Creek WVKC-46-P	Organic enrichment	Fecal coliform	5.19E+12	2.77E+10	2.75E+11	5.49E+12	counts/yr
	Sedimentation	Sediment	827.4	210.3	54.6	1092.4	tonnes/yr
Millers Camp Branch WVKC-46-Q	Sedimentation	Sediment	2376.2	464.4	149.5	2990.1	tonnes/yr