APPENDIX 12

A-12. MORRIS CREEK

A-12.1 Watershed Description

Morris Creek is in the eastern portion of the Upper Kanawha watershed, as shown in Figure A-12-1, and drains approximately 7.54 square miles (4,827 acres). Figure A-12-2 shows the land use distribution in the watershed. The dominant land use in the Morris Creek watershed is forest, which covers 95.35 percent of the watershed. Another important land use type is urban/residential (3.71 percent). All other individual land cover types account for less than 2 percent of the total watershed area.

There are two impaired streams, including Morris Creek, in the watershed. Figure A-12-3 shows the impaired segments and the pollutants for which each is impaired.

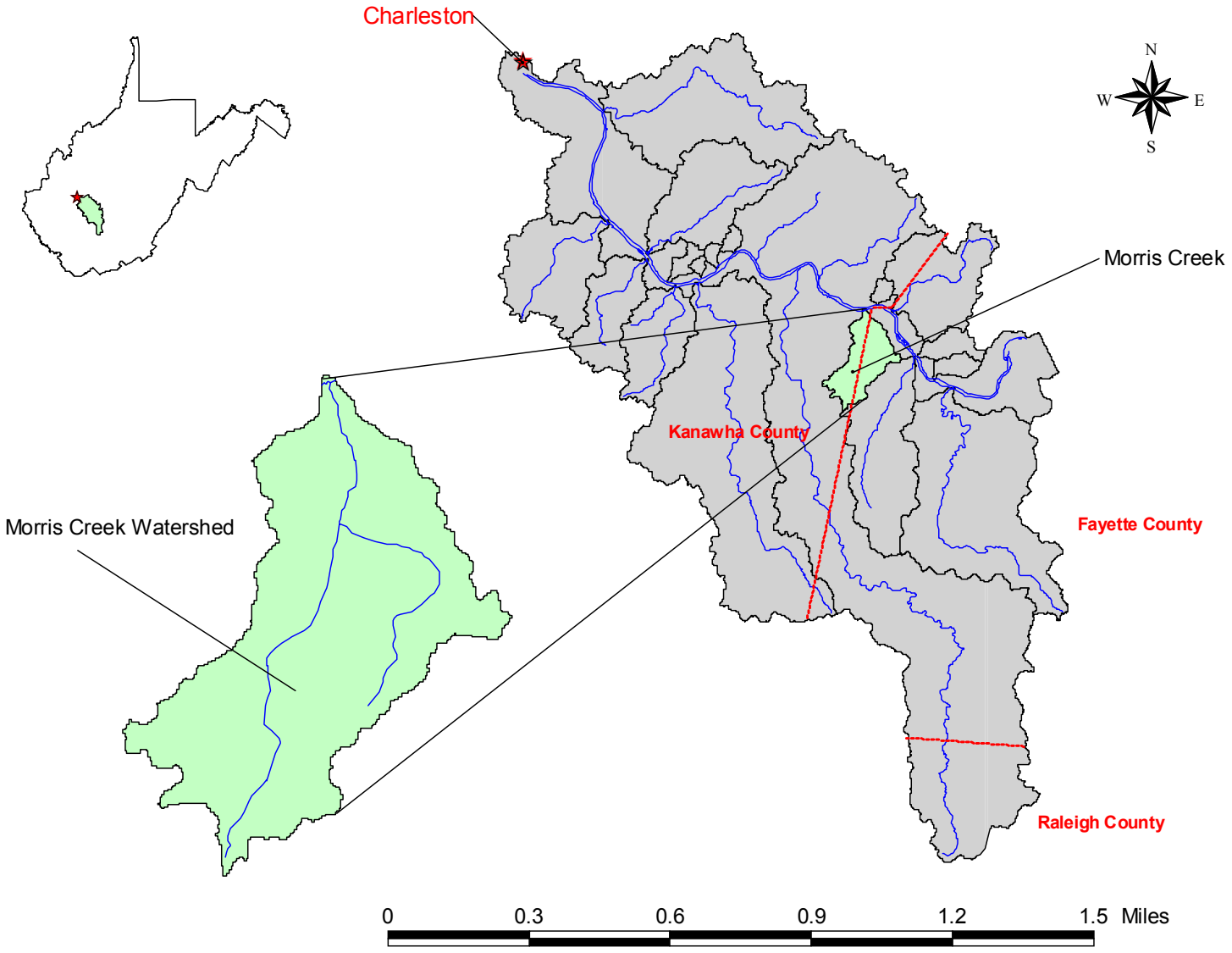

Figure A-12-1. Location of the Morris Creek watershed

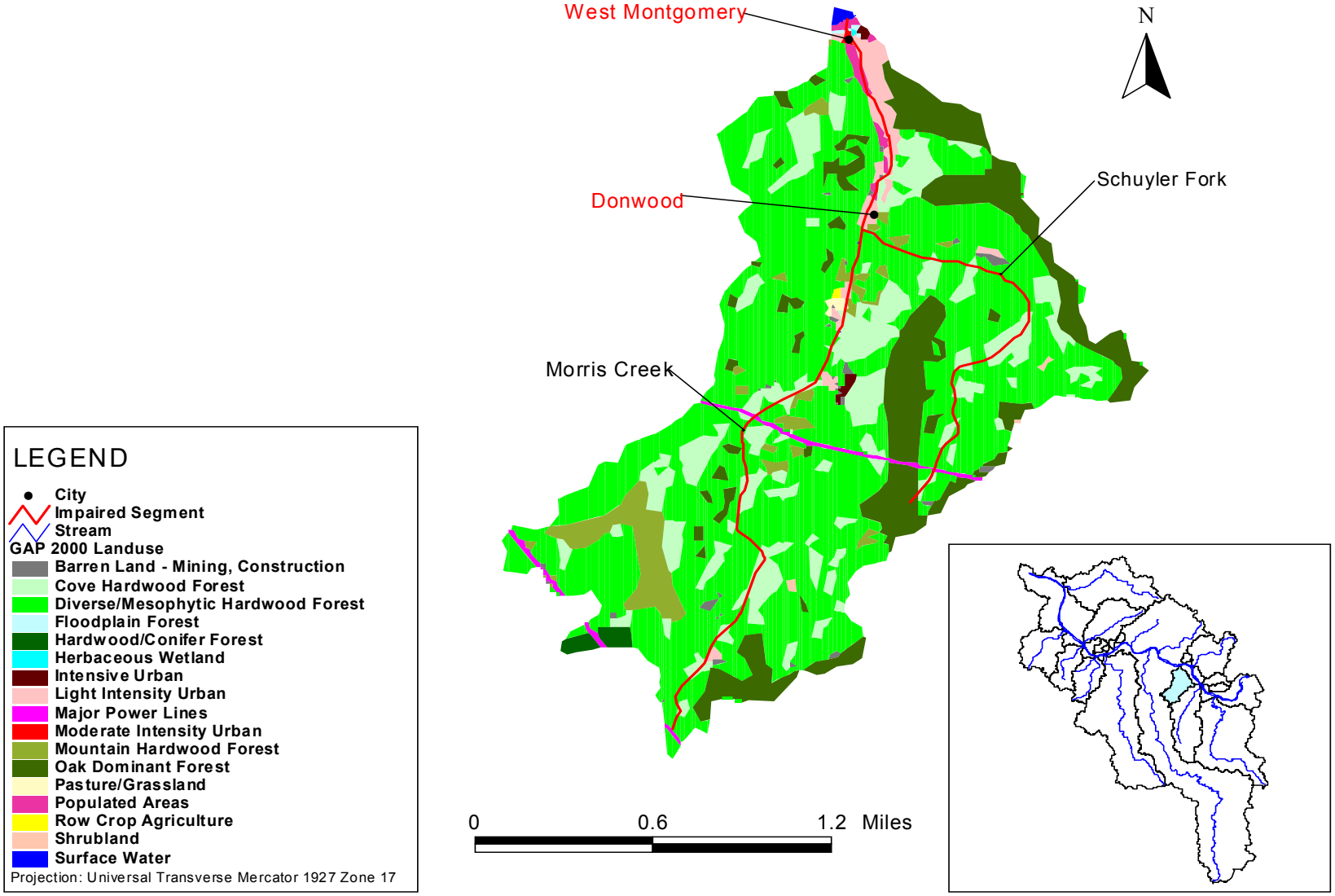

Figure A-12-2. Land use distribution in the Morris Creek watershed

Stream	Aluminum	Iron	Manganese	pH	Biological	Fecal Coliforms
Morris Creek		X	X	X	X	
Schuyler Fork	X		X	X		

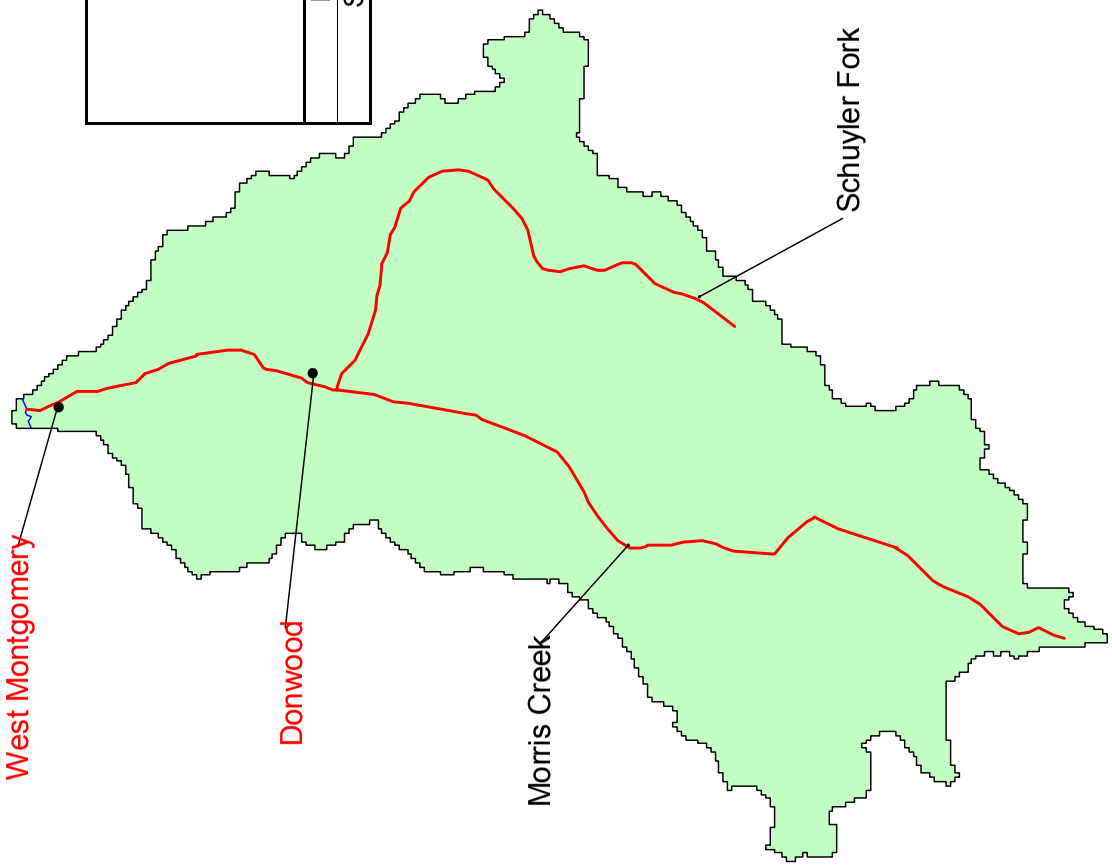

Figure A-12-3. Impaired waterbodies in the Morris Creek watershed

A-12.2 Pre-TMDL Monitoring

Before establishing Total Maximum Daily Loads (TMDLs), WVDEP conducted monitoring in each of the impaired streams in the Upper Kanawha watershed to better characterize water quality and to refine impairment listings. Monthly samples were taken at 339 stations throughout the Upper Kanawha watershed from July 1, 2001, through June 30, 2002. The locations of the pre-TMDL monitoring sites in the Morris Creek watershed are shown in Figure A-12-4. Monitoring suites at each site were 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 (e.g., total iron, dissolved iron, total aluminum, dissolved aluminum, total manganese, total suspended solids, pH, sulfate, and specific conductance). Monthly samples from streams impaired by fecal coliform bacteria were analyzed for this parameter, pH, and specific conductance. Appropriate monitoring suites were also selected for streams with multiple impairments. For example, if a stream was impaired by metals and fecal coliform bacteria, the samples were analyzed for total iron, dissolved iron, total aluminum, dissolved aluminum, total manganese, total suspended solids, pH, sulfate, specific conductance, and fecal coliform bacteria. In addition, benthic macroinvertebrate assessments were performed at specific locations on the biologically impaired streams during the pre-TMDL monitoring period. When conditions allowed, instantaneous flow measurements were also taken at the pre-TMDL sampling locations.

Figure A-12-4. Pre-TMDL monitoring stations in the Morris Creek watershed

A-12.3 Metals and pH Sources

This section identifies and examines the potential sources of aluminum, iron, manganese, and pH impairment in the Morris Creek watershed. Sources can be classified as either point sources (specific sources subject to a permit) or nonpoint sources (diffuse sources). Metals and pH point sources are classified by mining- and non-mining-related permits. 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 in detail by collecting Global Positioning System data and water quality samples for laboratory analysis. WVDEP personnel recorded physical descriptions of the pollutant sources: the number of outfalls, the source of the outfalls, and the general condition of the stream in the vicinity of the outfalls. These records were compiled and electronically plotted on maps using GIS software. This information was used in conjunction with additional data to characterize pollutant sources.

Based on scientific knowledge of sediment/metal interactions 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 may be necessary to meet water quality criteria for dissolved aluminum, total iron, and total manganese during critical high flow conditions.

A-12.3.1 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. Only mining-related point sources exist in the Morris Creek watershed.

Permitted Non-mining Metals Point Sources

Non-mining NPDES permits are not present in the Morris Creek watershed.

Permitted Mining Metals Point Sources

WVDEP's *HPU* GIS coverage was used to determine the locations of the mining permits; subsequent detailed permit information was obtained from WVDEP's *ERIS* database system. Seven mining-related NPDES outlets were found in the watershed (Figure A-12-5). The permits related to these outlets are listed in the Technical Report. The list identifies each responsible party and the total number of outlets that discharge into the Morris Creek watershed. The Technical Report also contains detailed information regarding NPDES/Article 3 permit relationships, specific data for each permitted outlet, and permit limits for each mining-related NPDES outlet.

Figure A-12-5. NPDES outlets in the Morris Creek watershed

A-12.3.2 Metals Nonpoint Source Inventory

In addition to point sources, nonpoint sources contribute to metals-related water quality impairments in the watershed. Nonpoint sources are diffuse, non-permitted sources. Abandoned mines can create acid mine drainage, which contributes low pH and high metals concentrations to surface and subsurface waters; therefore, abandoned mine lands can be a significant non-permitted metals and pH source. 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 mining-related non-permitted source. 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.

Abandoned Mine Lands and Bond Forfeiture Sites

Based on the identification of a number of abandoned mining activities in the Morris Creek watershed, abandoned mine lands are a significant non-permitted source of metals and pH impairment. WVDEP's Office of Abandoned Mine Lands identified locations of abandoned mine lands in the Morris Creek watershed. In addition, source-tracking efforts by WVDEP's Division of Water and Waste Management identified and characterized three abandoned mine sources (sources can include discharges, seeps, portals, culverts, refuse piles, diversion ditches, and ponds). The locations of abandoned mine lands are shown in Figure A-12-6. There are no bond forfeiture sites in the Morris Creek watershed.

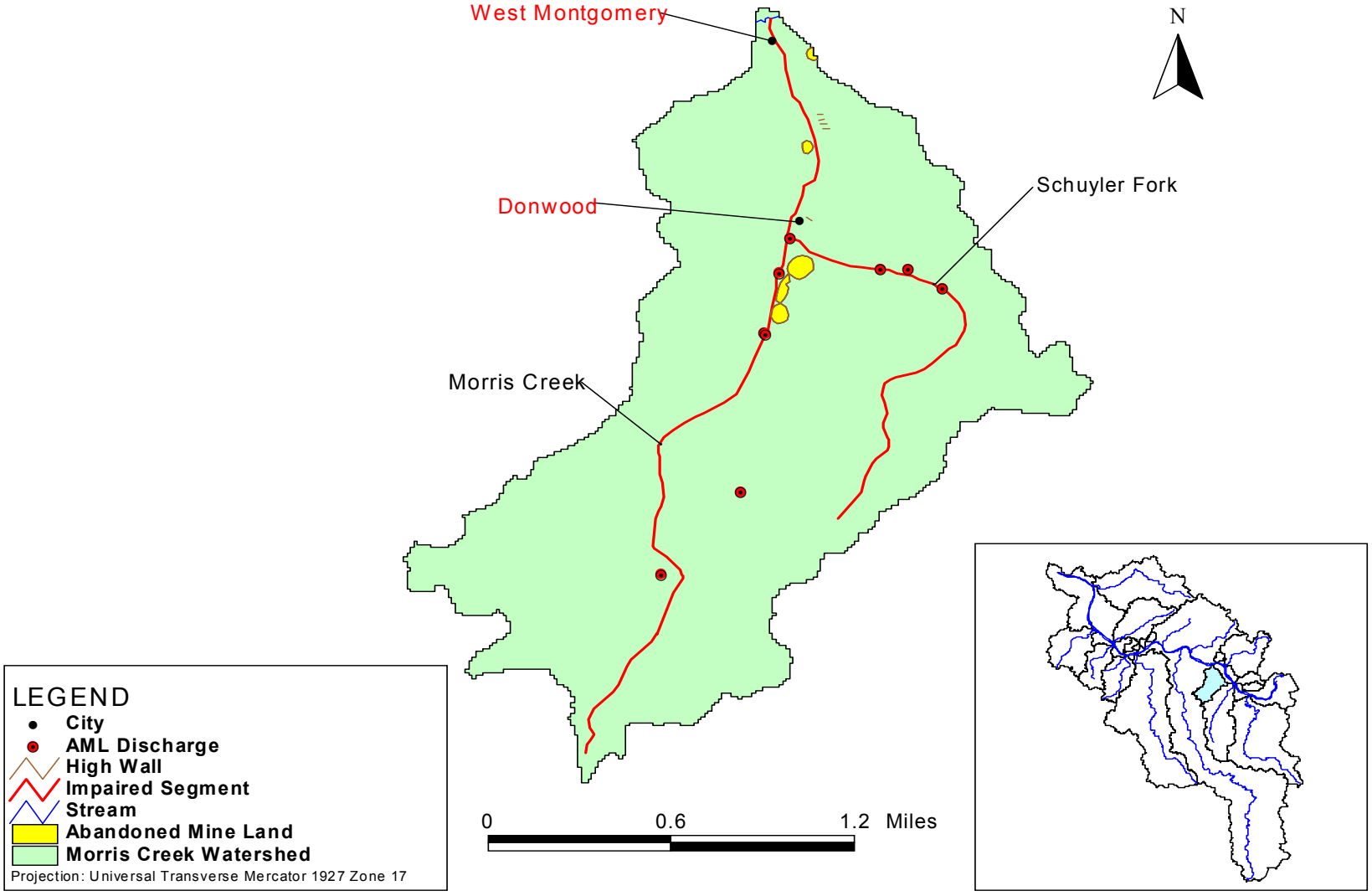

Figure A-12-6. Abandoned mine lands in the Morris Creek watershed

Land Disturbance Activities

Land disturbance resulting from agriculture, forestry, oil and gas operations, and the construction and use of roads can contribute metals to streams. The areas related to these activities and the number of sites in the Morris Creek watershed are discussed below.

Agriculture
Based on the GAP 2000 land use coverage, agricultural areas cover 8.2 acres (0.17 percent) of the Morris Creek watershed.

Forestry
The active logging operation in the Morris Creek watershed is identified in Table A-12-1. The disturbed area associated with this operation is estimated to cover 383 acres (7.9 percent) of the total watershed area.

Table A-12-1. The logging site in the Morris Creek watershed

Logging Site ID	Area of Logging Site (acres)	Percentage of Watershed	Logged Area that Consists of Roads/ Landings (acres)	Percentage of Total Logging Area that Consists of Roads/Landings
K-70: L-1	383	7.9%	22.3	5.8%

Oil and Gas Wells
There are 17 active oil and gas wells in the Morris Creek watershed, the locations of which are shown in Figure A-12-7. Based on the survey by WVDEP's Office of Oil and Gas, it is estimated that 2.73 acres (0.06 percent) of the Morris Creek watershed are disturbed by the active well sites (including areas associated with access roads).

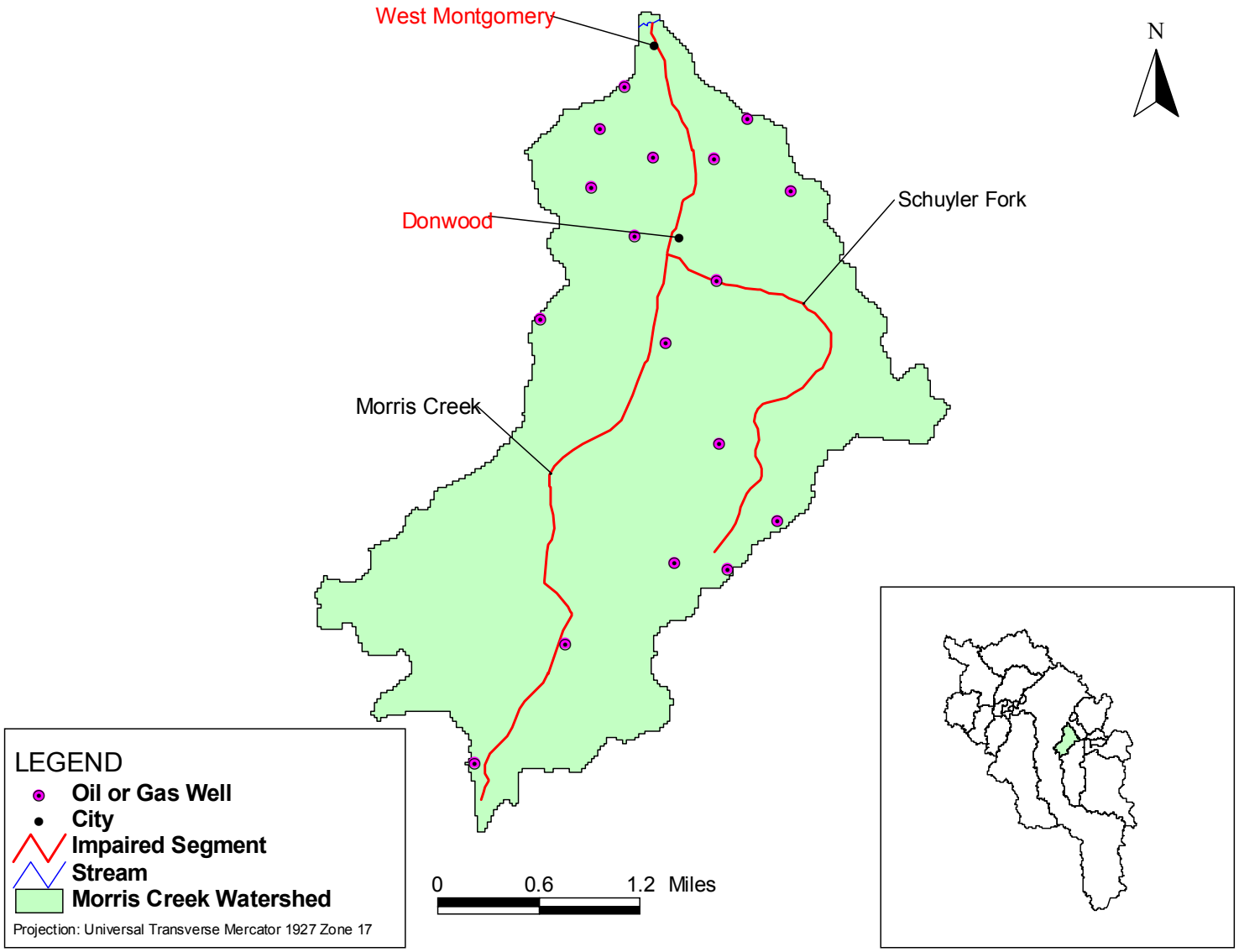

Figure A-12-7. Oil and gas wells in the Morris Creek watershed

Roads
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. Table A-12-2 summarizes the length, area, and percentage of total watershed area for both paved and unpaved roads in the Morris Creek watershed.

Table A-12-2. Road miles by type in the Morris Creek watershed

Road Type	Road Distance (miles)	Road Area (acres)	Road Area as Percentage of Watershed
Total paved	3.53	6.83	0.14%
Total unpaved	37.73	55.80	1.16%

A-12.4 Fecal Coliform Bacteria Sources

There are no fecal coliform bacteria impairments in this watershed.

A-12.5 Stressors of the Biologically Impaired Stream

The Morris Creek watershed has one biologically impaired stream for which TMDLs have been developed. This stream is identified in Table A-12-3 along with the primary stressors of the stream's benthic communities and the TMDLs required to address the cause of biological impairment. A stressor identification process was used to evaluate and identify the primary stressors of impaired benthic communities.

Table A-12-3. Primary stressors of the biologically impaired stream in the Morris Creek watershed

Stream	Primary Stressors	TMDLs Required
Morris Creek	Iron toxicity Acidity (pH)	Iron pH

The iron TMDL presented in Table A-12-4 address the iron toxicity biological stressor. Please refer to section A-12.3 for source information.

A-12.6 TMDLs for the Morris Creek Watershed

A-12.6.1 TMDL Development

TMDLs and source allocations were developed for the impaired streams in the Morris 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 in these waterbodies

and TMDLs were developed. Refer to section 7.4 of the main report for a detailed description of allocation methodologies used in the development of the pollutant-specific TMDLs.

The TMDLs for iron, manganese, aluminum, and pH are shown in Tables A-12-4 through A-12-7. The TMDLs for iron, manganese, and aluminum are presented as annual loads, in terms of pounds per year. They 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 of the main report, 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-12-7, 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-12.6.2 TMDL Tables: Metals

Table A-12-4. Iron TMDLs for the Morris 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)
MORRIS CREEK	K-70	Morris Creek	Iron	13,485	705	747	14,936

Table A-12-5. Manganese TMDLs for the Morris 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)
MORRIS CREEK	K-70	Morris Creek	Manganese	4,301	441	250	4,991
MORRIS CREEK	K-70-A	Schuyler Fork	Manganese	543	NA	29	572

NA = not applicable.

Table A-12-6. Aluminum TMDLs for the Morris Creek watershed

Major Watershed	DNR Stream Code	Stream Name	Metal	Load Allocation (lb/yr)	Wasteload Allocation (lb/yr)	Margin of Safety (lb/yr)	TMDL (lb/yr)
MORRIS CREEK	K-70-A	Schuyler Fork	Total Aluminum	1,993	NA	105	2,098

NA = not applicable.

Table A-12-7. pH TMDLs for the Morris Creek watershed

Major Watershed	Stream Code	Stream Name	Parameter	pH* (Under TMDL conditions)
MORRIS CREEK	K-70	Morris Creek	pH	7.21
MORRIS CREEK	K-70-A	Schuyler Fork	pH	7.24

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

A-12.6.3 TMDL Tables: Fecal Coliform Bacteria

Table A-12-8. Fecal coliform bacteria TMDLs for the Morris Creek watershed

There are no fecal coliform bacteria impairments in this watershed.

A-12.6.4 TMDL Tables: Sediment

Table A-12-9. Sediment TMDLs for the Morris Creek watershed

There are no sediment impairments in this watershed.