APPENDIX 10

A-10. LOOP CREEK

A-10.1 Watershed Description

Loop Creek is in the eastern portion of the Upper Kanawha watershed, as shown in Figure A-10-1, and drains approximately 49.60 square miles (31,746 acres). Figure A-10-2 shows the land use distribution in the Loop Creek watershed. The dominant land use is forest, which covers 96.58 percent of the watershed. Another important land use type is urban/residential (2.14 percent). All other individual land cover types account for less than 2 percent of the total watershed area.

There are four impaired streams, including Loop Creek, in the watershed. Figure A-10-3 shows the impaired segments and the pollutants for which each is impaired.

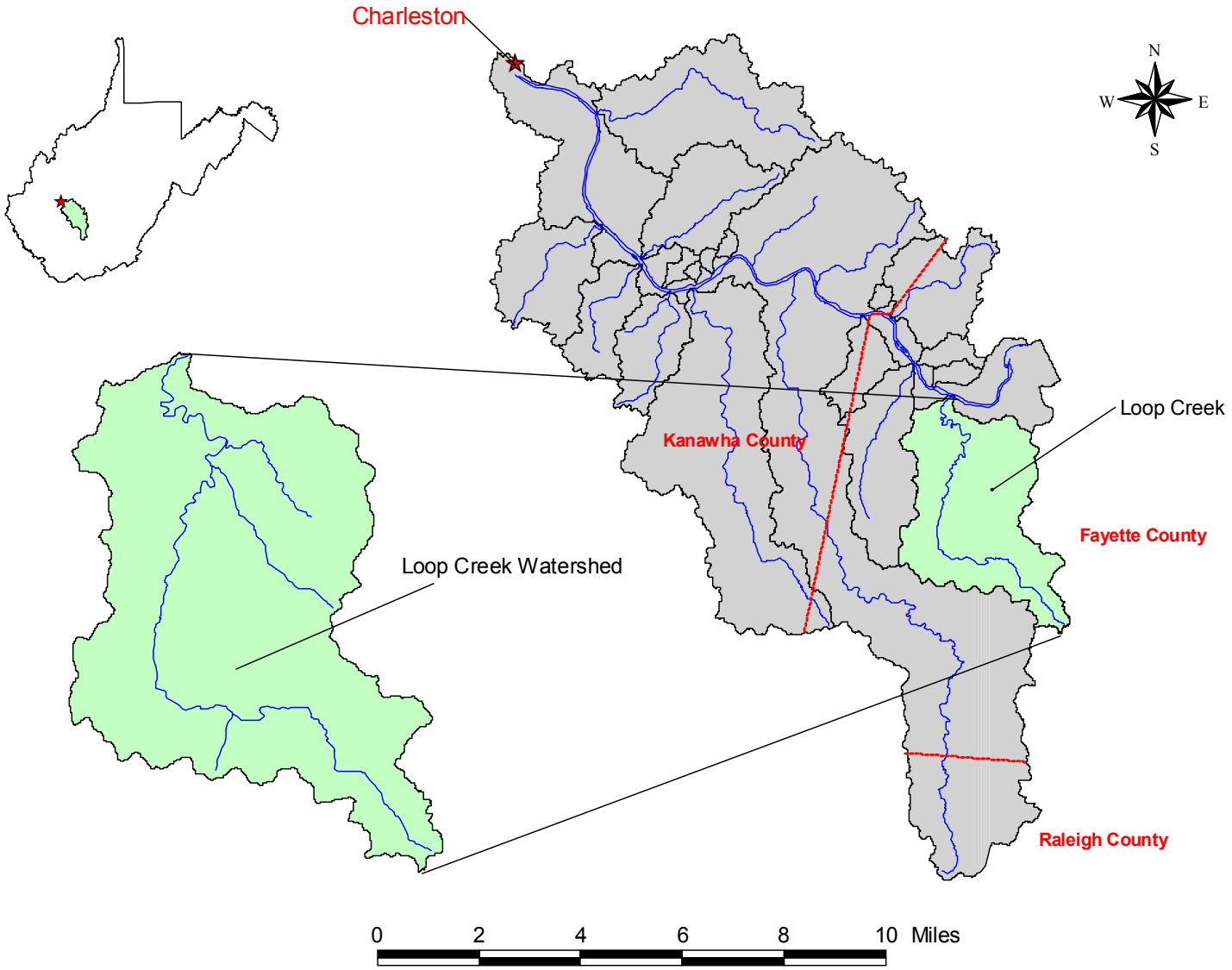


Figure A-10-1. Location of the Loop Creek watershed

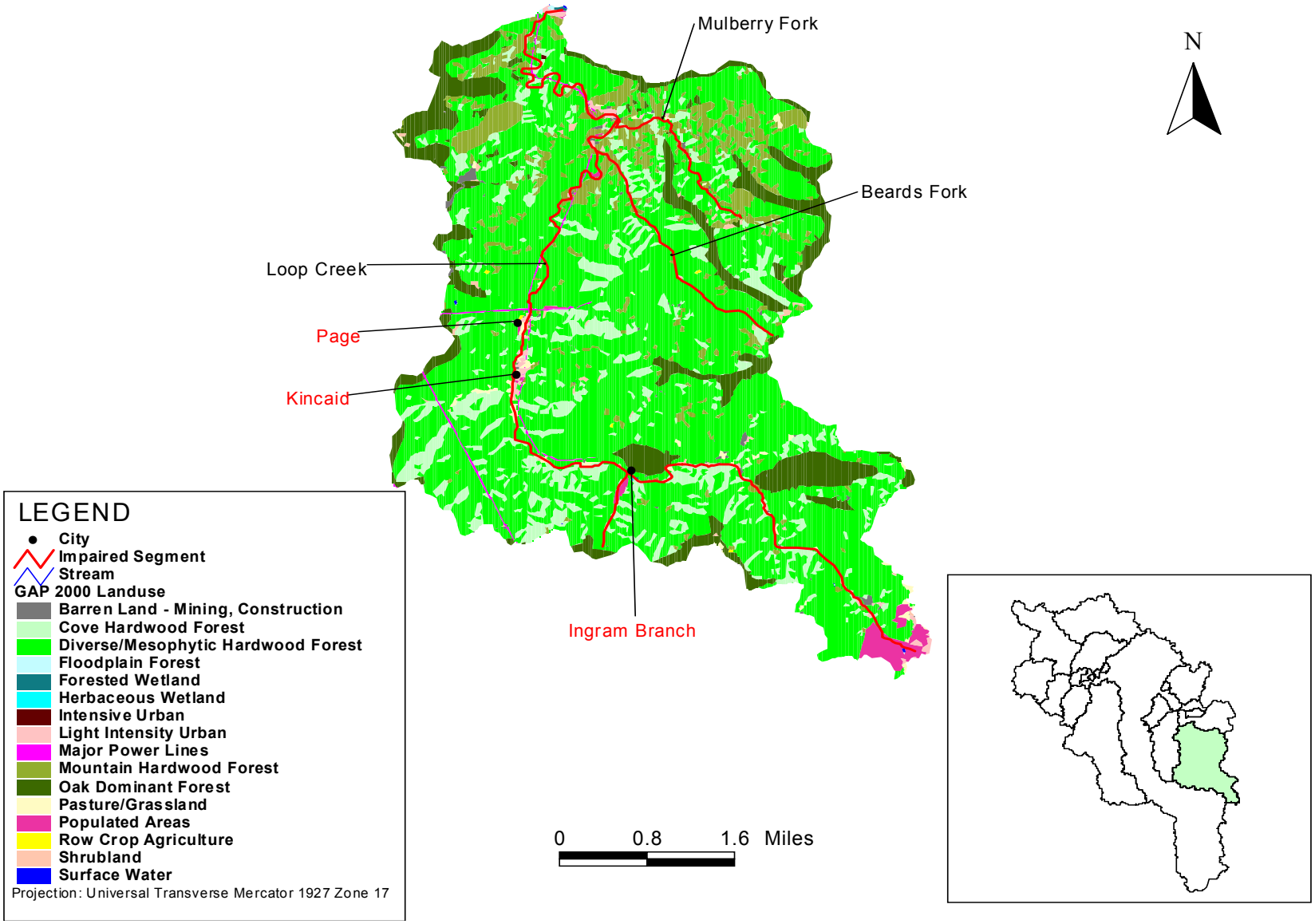
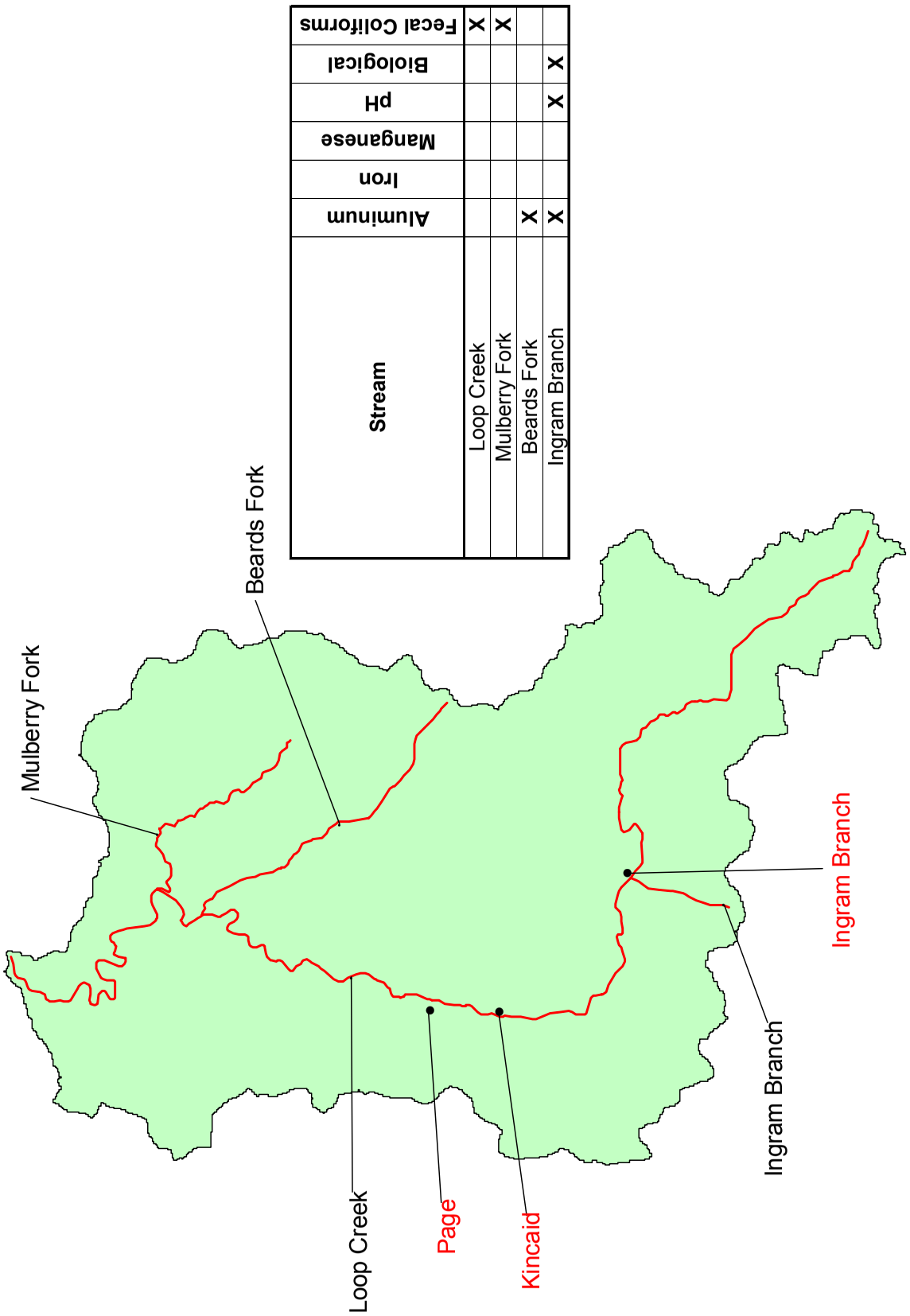


Figure A-10-2. Land use distribution in the Loop Creek watershed



Stream	Aluminum	Iron	Manganese	pH	Biological	Fecal Coliforms
Loop Creek						X
Mulberry Fork						X
Beards Fork	X					
Ingram Branch	X			X	X	

Figure A-10-3. Impaired waterbodies in the Loop Creek watershed

A-10.2 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 Loop Creek watershed are shown in Figure A-10-4. 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.

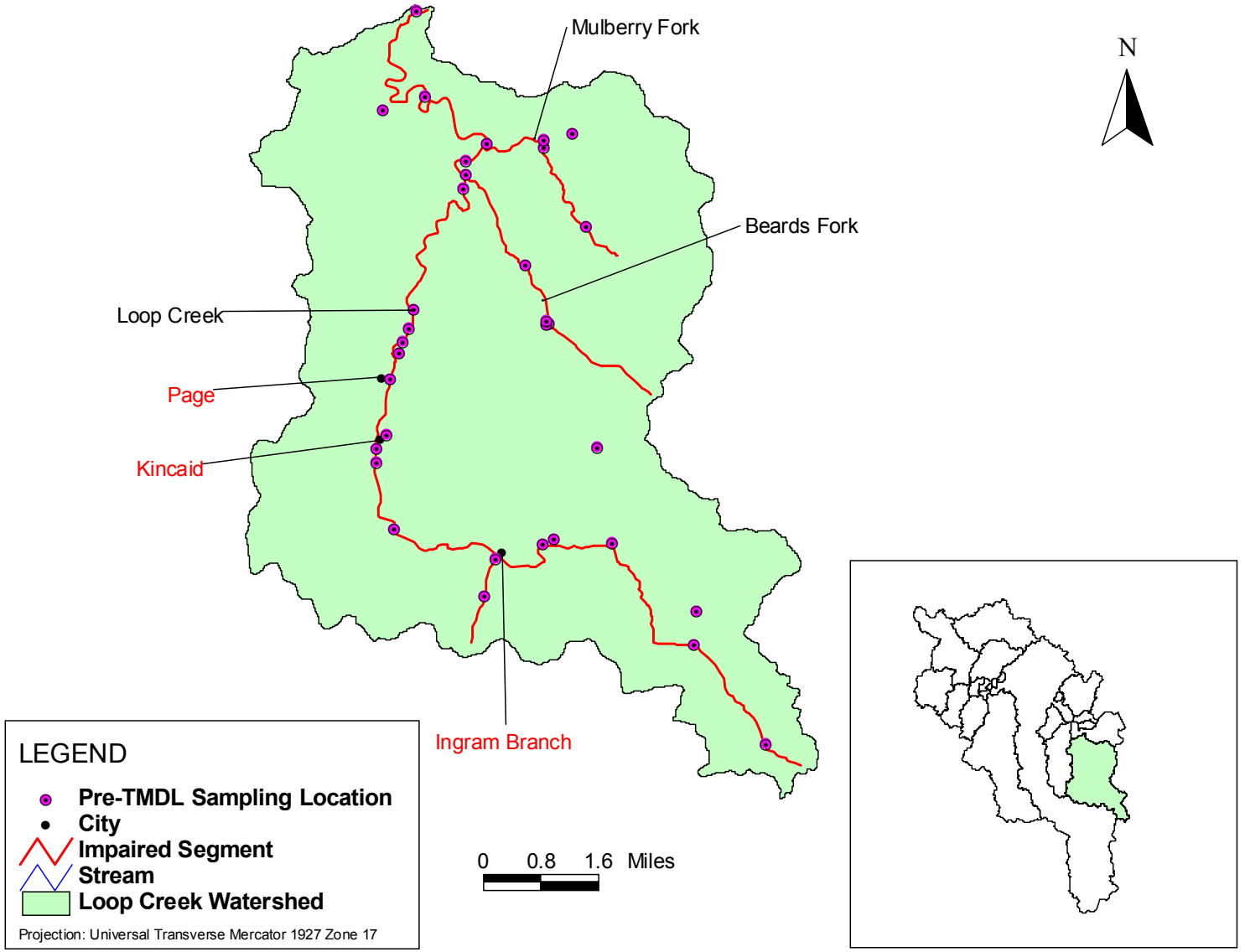


Figure A-10-4. Pre-TMDL monitoring stations in the Loop Creek watershed

A-10.3 Metals and pH Sources

This section identifies and examines the potential sources of metals and pH impairment in the Loop 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-10.3.1 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 Loop Creek watershed.

Permitted Non-mining Metals Point Sources

Non-mining NPDES permits are not present in the Loop 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. Thirty-two mining-related NPDES outlets were found in the watershed (Figure A-10-5). 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 Cabin 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.

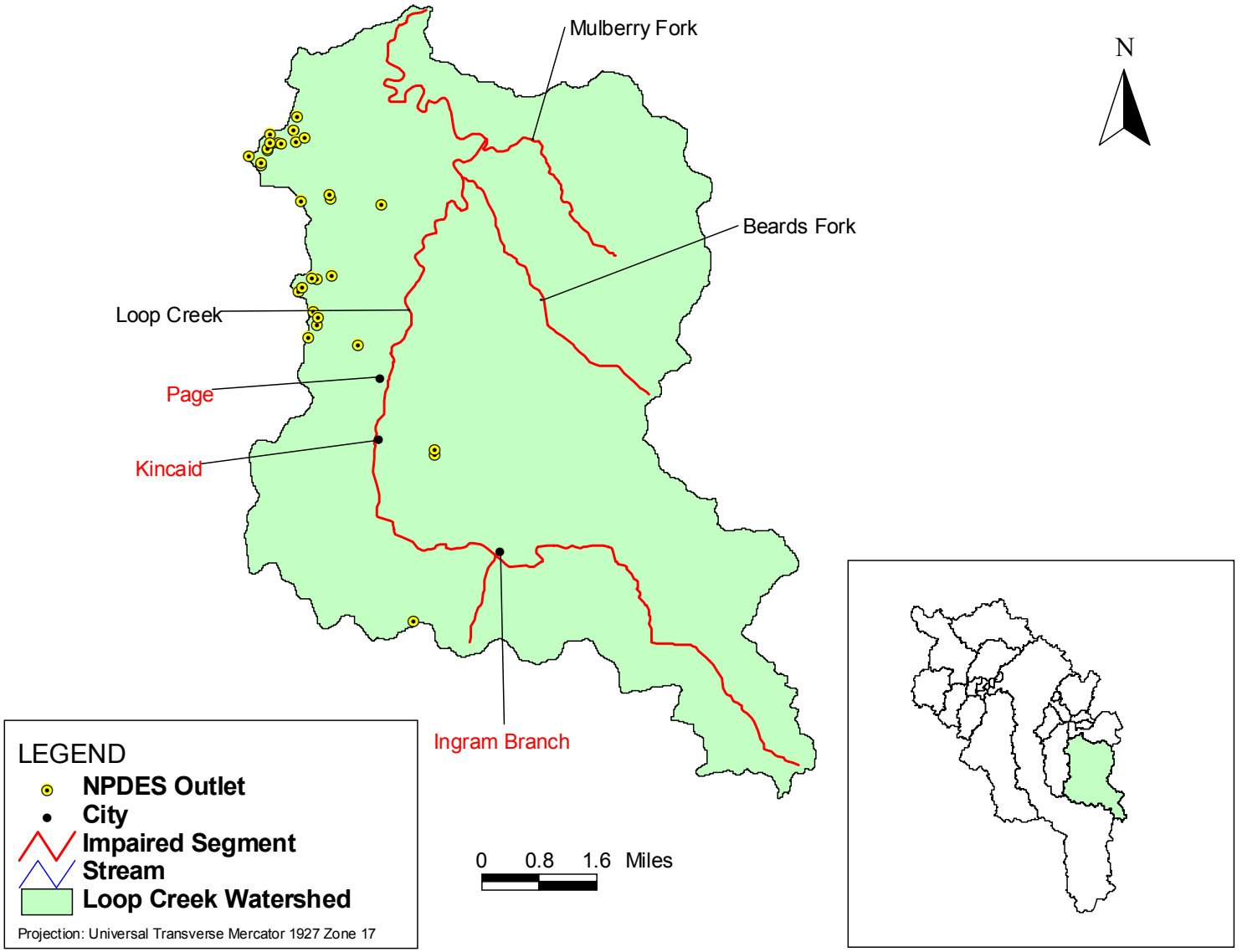


Figure A-10-5. NPDES outlets in the Loop Creek watershed

A-10.3.2 Metals Nonpoint Source Inventory

In addition to point sources, nonpoint sources also 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 source of metals and pH impairment. 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 Loop 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 Loop 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, or ponds).

WVDEP's Division of Land Restoration, Office of Special Reclamation, made bond forfeiture data available. The information provided included the status of both land reclamation and water treatment activities. There are eight bond forfeiture sites in the Loop Creek watershed.

The locations of abandoned mine lands and bond forfeiture sites are shown in Figure A-10-6.

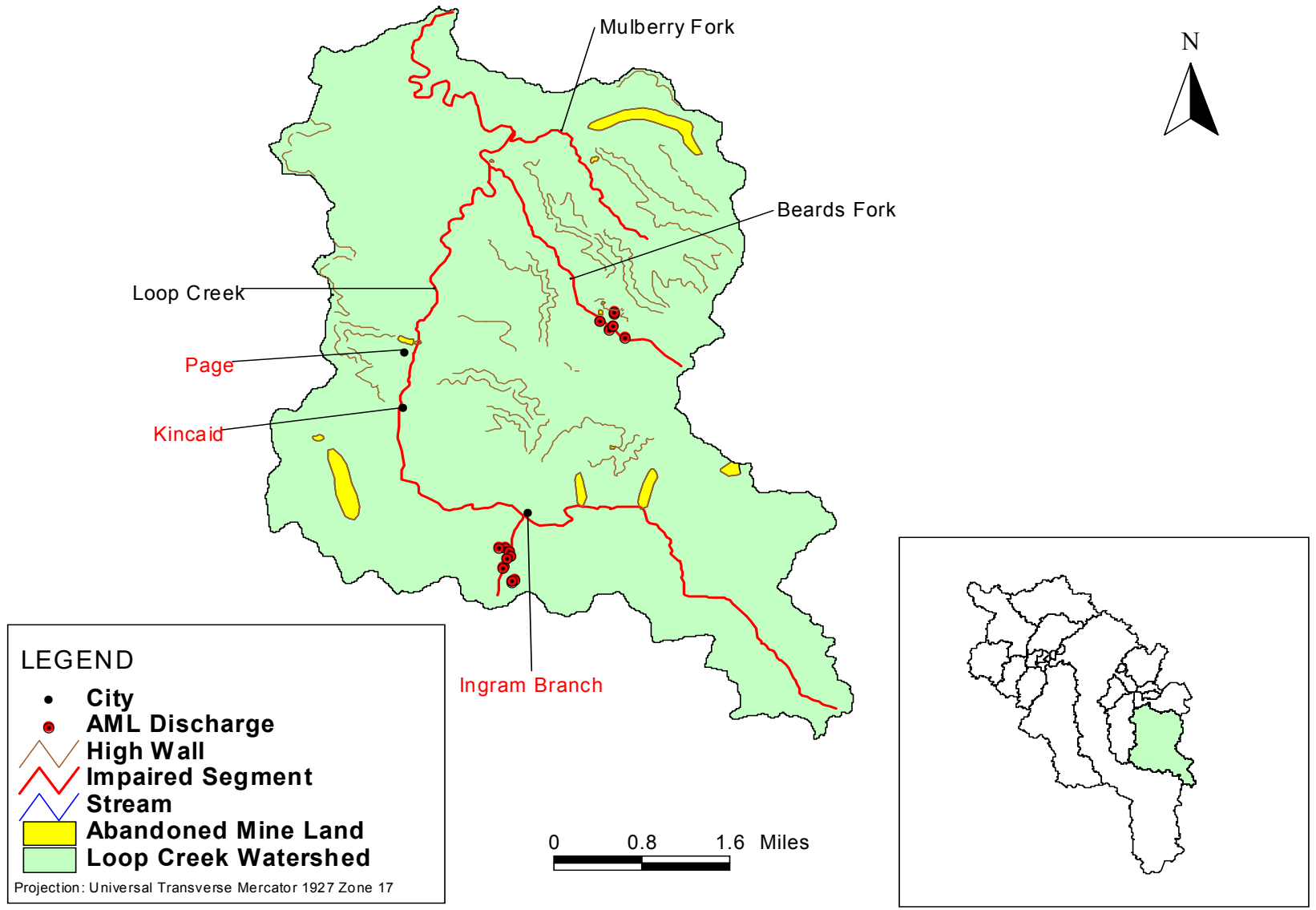


Figure A-10-6. Abandoned mine lands and bond forfeiture sites in the Loop Creek watershed

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 Loop Creek watershed are discussed below.

Agriculture
Based on the GAP 2000 land use coverage, agricultural areas cover 217.4 acres (0.68 percent) of the Loop Creek watershed.

Forestry
The active logging operations in the Loop Creek watershed are listed in Table A-10-1. The disturbed areas associated with these operations are estimated to cover 3,929 acres (12.4 percent) of the total watershed area.

Table A-10-1. Logging sites in the Loop Creek watershed

Logging Site ID	Area of Logging Sites (acres)	Percentage of Watershed	Logged Area that Consists of Roads/ Landings (acres)	Percentage of Total Logging Area that Consists of Roads/Landings
K-76: L-1	30	0.1%	2.0	6.7%
K-76: L-2	35	0.1%	2.6	7.4%
K-76: L-3	60	0.2%	4.4	7.3%
K-76: L-4	74	0.2%	4.7	6.4%
K-76: L-5	100	0.3%	6.5	6.5%
K-76: L-6	110	0.3%	7.1	6.5%
K-76: L-7	140	0.4%	9.1	6.5%
K-76: L-8	150	0.5%	9.8	6.5%
K-76: L-9	150	0.5%	9.5	6.3%
K-76: L-10	150	0.5%	9.5	6.3%
K-76: L-11	175	0.6%	11.2	6.4%
K-76: L-12	200	0.6%	12.7	6.4%
K-76: L-13	200	0.6%	12.5	6.3%
K-76: L-14	210	0.7%	13.6	6.5%
K-76: L-15	250	0.8%	15.5	6.2%
K-76: L-16	275	0.9%	17.0	6.2%
K-76: L-17	300	0.9%	19.2	6.4%
K-76: L-18	400	1.3%	26.4	6.6%
K-76: L-19	420	1.3%	26.7	6.4%
K-76: L-20	500	1.6%	32.1	6.4%
Total	**3,929**	**12.4%**	**252.1**	**6.4%**

Oil and Gas Wells

There are 26 active oil and gas wells in the Loop Creek watershed, the locations of which are shown in Figure A-10-7. Based on the survey by WVDEP's Office of Oil and Gas, it is estimated that 4.17 acres (0.01 percent) of the Loop Creek watershed are disturbed by the active well sites (including areas associated with access roads).

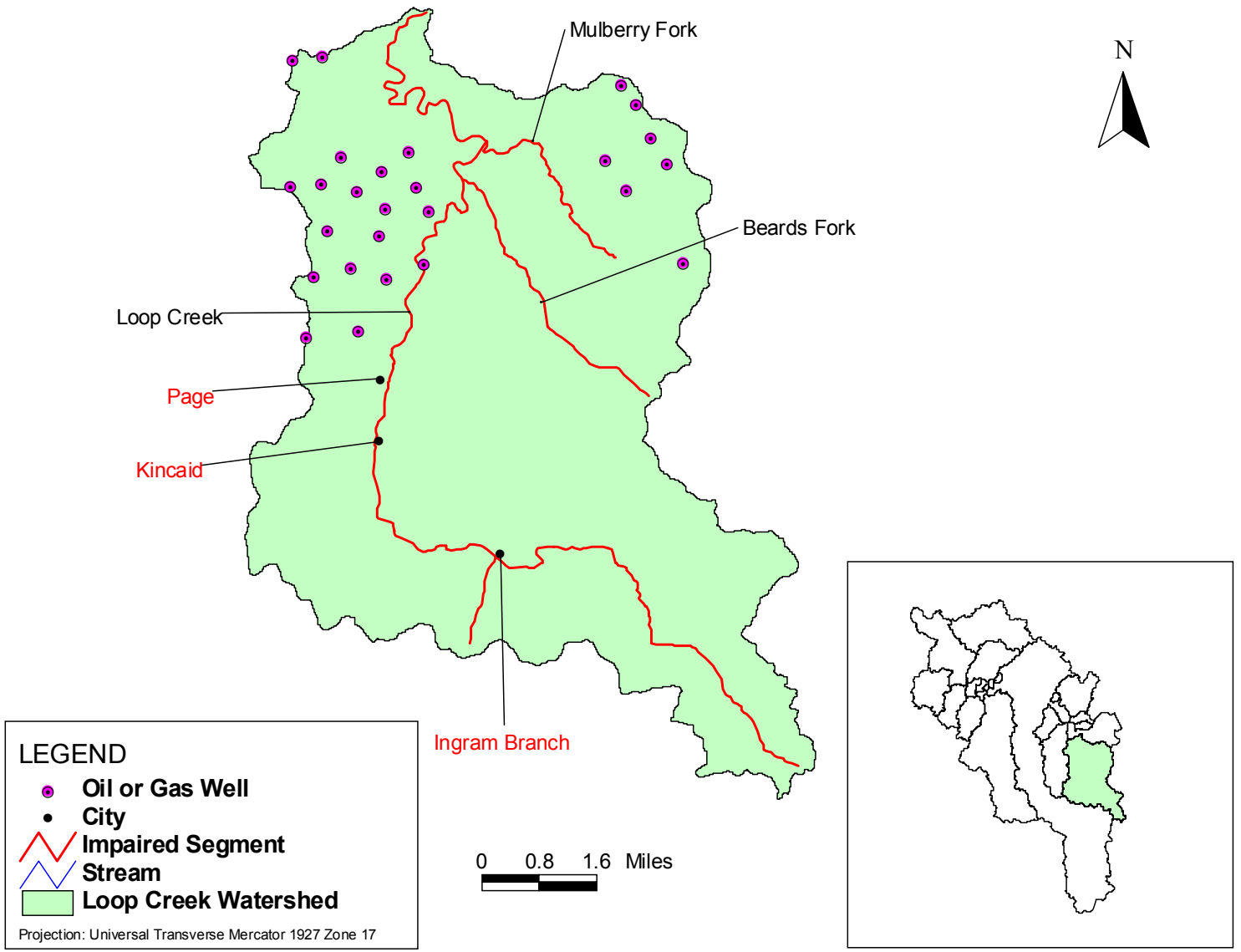


Figure A-10-7. Oil and gas wells in the Loop Creek watershed

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-10-2 summarizes the length, area, and percentage of total watershed area of both paved and unpaved roads in the Loop Creek watershed.

Table A-10-2. Road miles by type in the Loop Creek watershed

Road Type	Road Distance (miles)	Road Area (acres)	Road Area as Percentage of Watershed
Total paved	61.97	137.84	0.43%
Total unpaved	179.10	272.48	0.86%

A-10.4 Fecal Coliform Bacteria Sources

This section identifies and examines the potential sources of fecal coliform bacteria in the Loop Creek watershed. Sources can be classified as either point (permitted) or nonpoint (non-permitted) sources. Point sources of fecal coliform bacteria are classified by several different types of sewage permits and the point source discharges regulated therein. Nonpoint sources are diffuse, non-permitted sources.

A-10.4.1 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 Loop Creek watershed there are two discharge permits for individual publicly owned treatment works for sewage treatment.

A-10.4.2 Nonpoint (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 Loop Creek watershed. Human sources of fecal coliform bacteria from these areas include undisinfected sewage discharges from failing septic systems, and possible direct discharges of undisinfected sewage from residences (straight pipes). The West Virginia Bureau for Public Health estimates septic tank failure rates in this area to be 70 percent in the first 10 years (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 1,076 people living in unsewered homes in the Loop Creek watershed. Figure A-10-8 shows the estimated distribution of the unsewered population in the watershed.

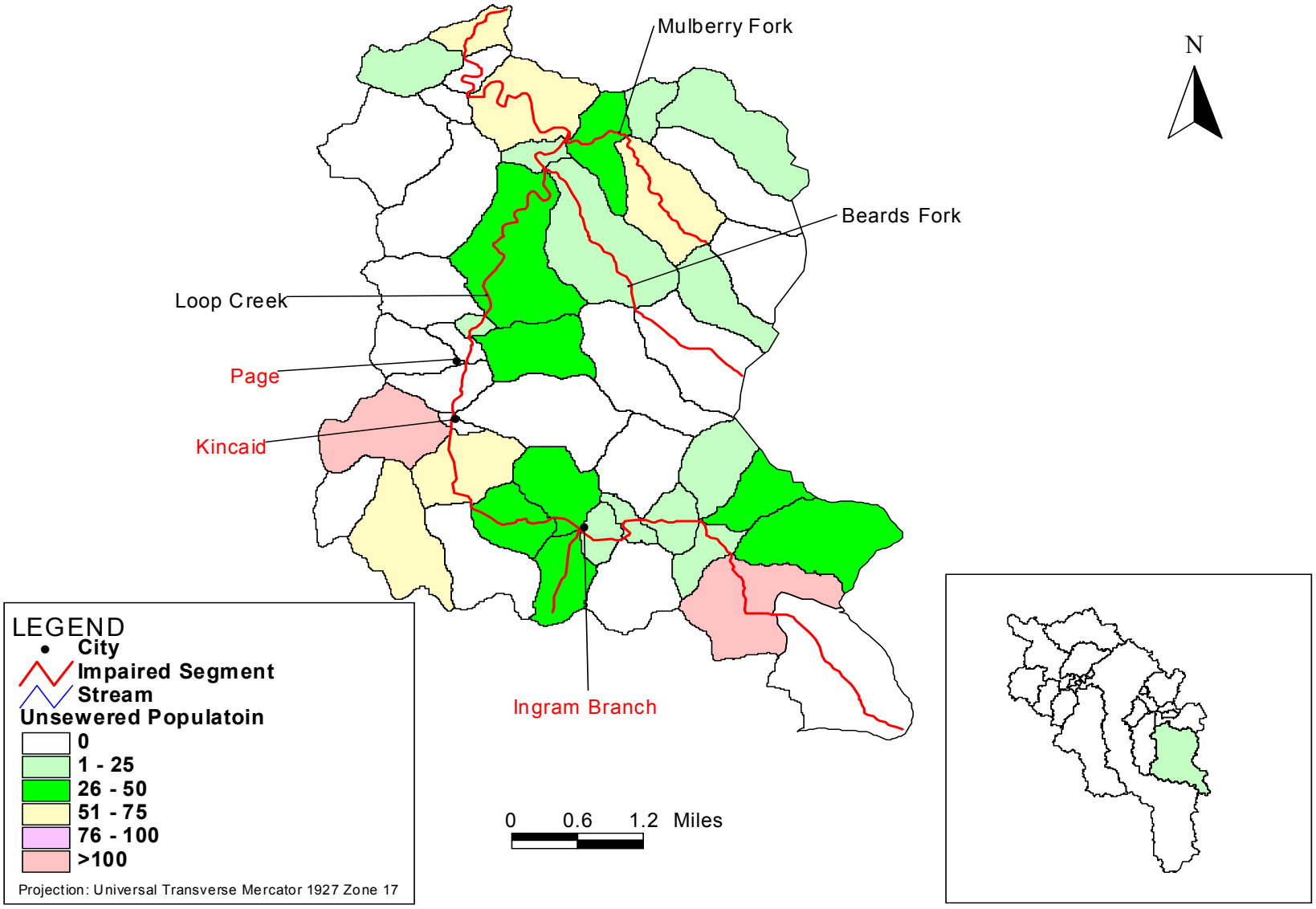


Figure A-10-8. Estimated unsewered population in the Loop Creek watershed

Stormwater runoff is another potential nonpoint source of fecal coliform bacteria in both residential/urban and rural areas. Runoff from residential areas can be a significant source, delivering bacteria present in litter and in the waste of pets and wildlife to the waterbody. Rural stormwater runoff can transport significant loads of bacteria from livestock pastures, livestock and poultry feeding facilities, and manure storage and application. In the Loop Creek watershed, there were isolated instances of dogs confined near a stream. Cattle, horses, and other agricultural livestock were not found in the area.

Given the small portion of total land area in the Upper Kanawha watershed that consists of residential and agricultural areas, and the low fecal accumulation rates for forested areas, stormwater runoff from these areas is not considered to be a significant nonpoint source of fecal coliform bacteria, except in localized areas.

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

A-10.5 Stressors of the Biologically Impaired Stream

The Loop Creek watershed has one biologically impaired stream for which TMDLs have been developed. This stream is identified in Table A-10-3 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-10-3. Primary stressors of biologically impaired streams in the Loop Creek watershed

Stream	Primary Stressors	TMDLs Required
Ingram Branch	Aluminum toxicity Acidity (pH)	Aluminum pH

The aluminum TMDLs presented in Table A-10-6 address the aluminum toxicity biological stressor. Please refer to section A-10.3 for source information.

A-10.6 TMDLs for the Loop Creek Watershed

A-10.6.1 TMDL Development

TMDLs and source allocations were developed for impaired streams in the Loop 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 the waterbody 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 aluminum, pH, and fecal coliform bacteria are shown in Tables A-10-6 through A-10-8. The TMDLs for aluminum are presented as annual loads, in terms of pounds per year; the TMDLs for fecal coliform bacteria are presented in terms of the number of colonies per year. All the 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 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 time 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 result, shown in Table A-10-7, is the TMDL for the pH-impaired stream in the watershed. Refer to the Technical Report for a detailed description of the pH modeling approach.

A-10.6.2 TMDL Tables: Metals

Table A-10-4. Iron TMDLs for the Loop Creek watershed

Iron impairments are not present in Loop Creek watershed.

Table A-10-5. Manganese TMDLs for the Loop Creek watershed

Manganese impairments do not exist in Loop Creek watershed.

Table A-10-6. Aluminum TMDLs for the Loop 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)
LOOP CREEK	K-76-D	Beards Fork	Total Aluminum	5,151	NA	258	5,409
LOOP CREEK	K-76-K	Ingram Branch	Total Aluminum	1,272	NA	67	1,339

NA = not applicable.

Table A-10-7. pH TMDL for the Loop Creek watershed

Major Watershed	Stream Code	Stream Name	Parameter	pH* (Under TMDL conditions)
LOOP CREEK	K-76- K	Ingram Branch	pH	7.51

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

A-10.6.3 TMDL Tables: Fecal Coliform Bacteria

Table A-10-8. Fecal coliform bacteria TMDLs for the Loop Creek watershed

Major Watershed	Stream Code	Stream Name	Parameter	Load Allocation (count/yr)	Wasteload Allocation (count/yr)	Margin of Safety (count/yr)	TMDL (count/yr)
LOOP CREEK	K-76	Loop Creek	Fecal coliform	1.12E+14	1.77E+11	5.92E+12	1.18E+14
LOOP CREEK	K-76-C	Mulberry Fork	Fecal coliform	1.02E+13	NA	5.38E+11	1.08E+13

NA = not applicable.

A-10.6.4 TMDL Tables: Sediment

Table A-10-9. Sediment TMDLs for the Loop Creek watershed

There are no sediment impairments in this watershed.