APPENDIX 6

A-6. FIELDS CREEK

A-6.1 Watershed Description

Fields Creek is located in the western portion of the Upper Kanawha watershed, as shown in Figure A-6-1, and drains approximately 12 square miles (7,763 acres). Figure A-6-2 shows the land use distribution for the watershed. The dominant land use is forest, which covers 94.96 percent of the watershed. Another important land use type is urban/residential (2.96 percent). All other individual land cover types account for less than 2 percent of the total watershed area.

Seven streams in the Fields Creek watershed are impaired. Figure A-6-3 shows the impaired segments and the pollutants for which each is impaired.

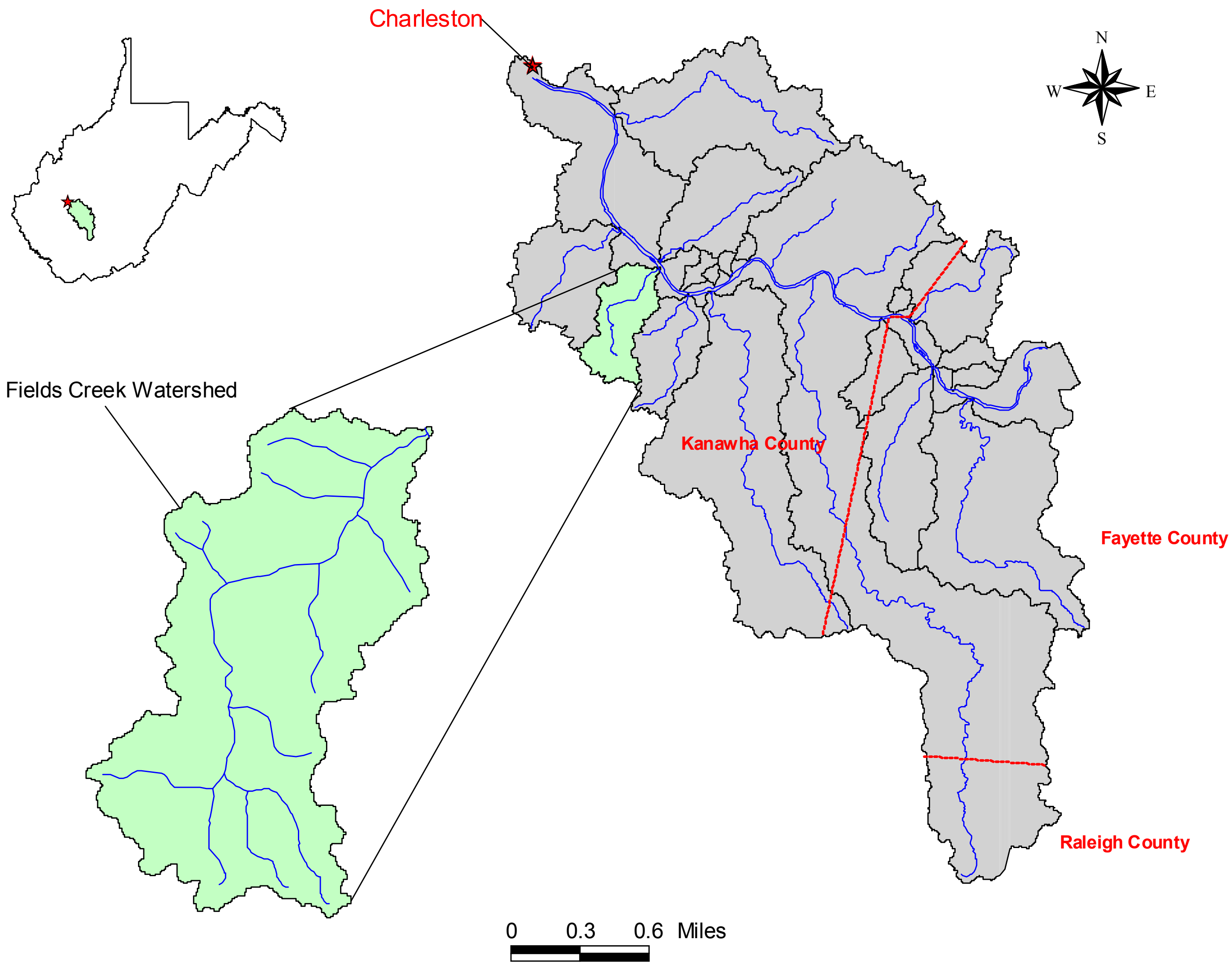


Figure A-6-1. Location of the Fields Creek watershed

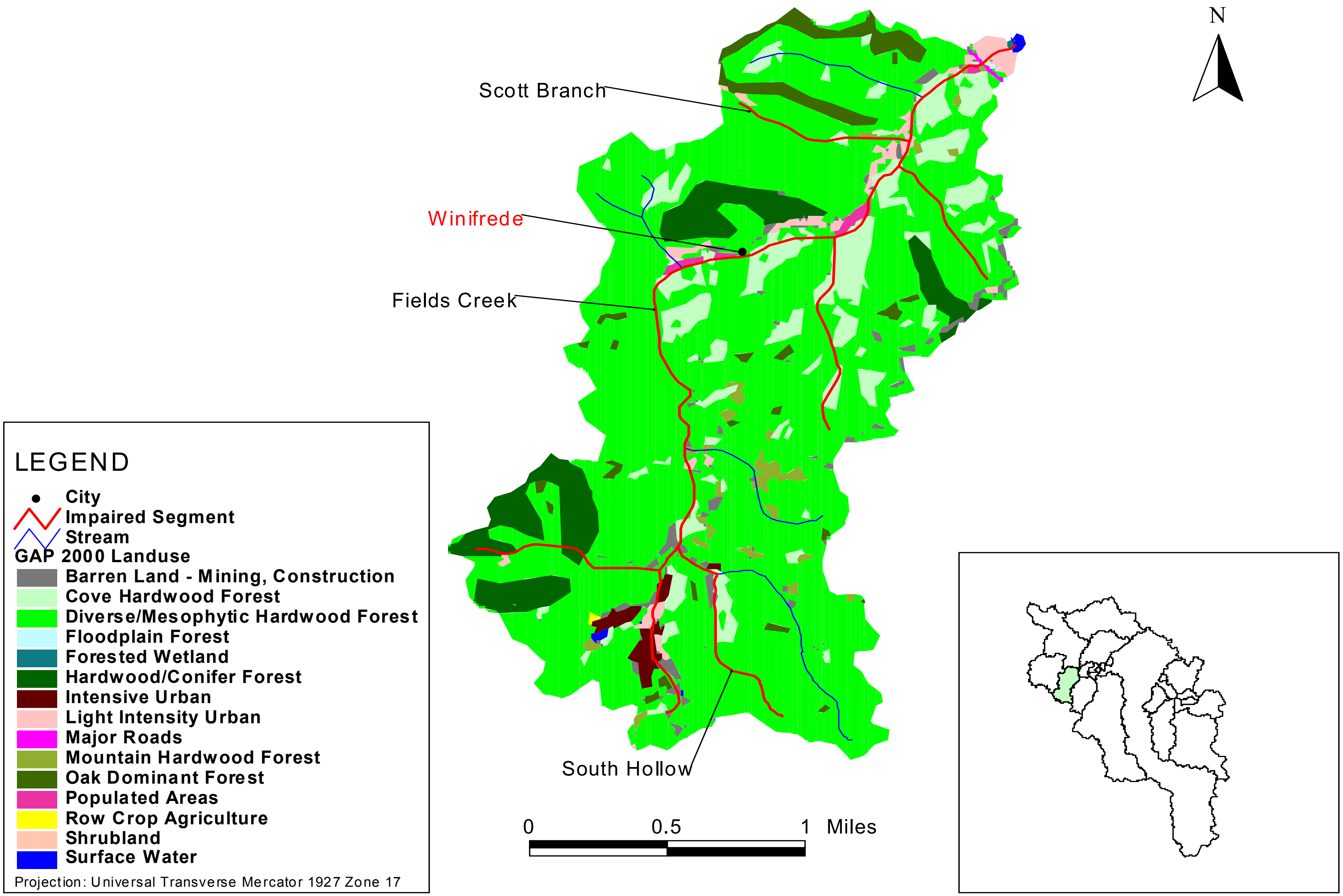
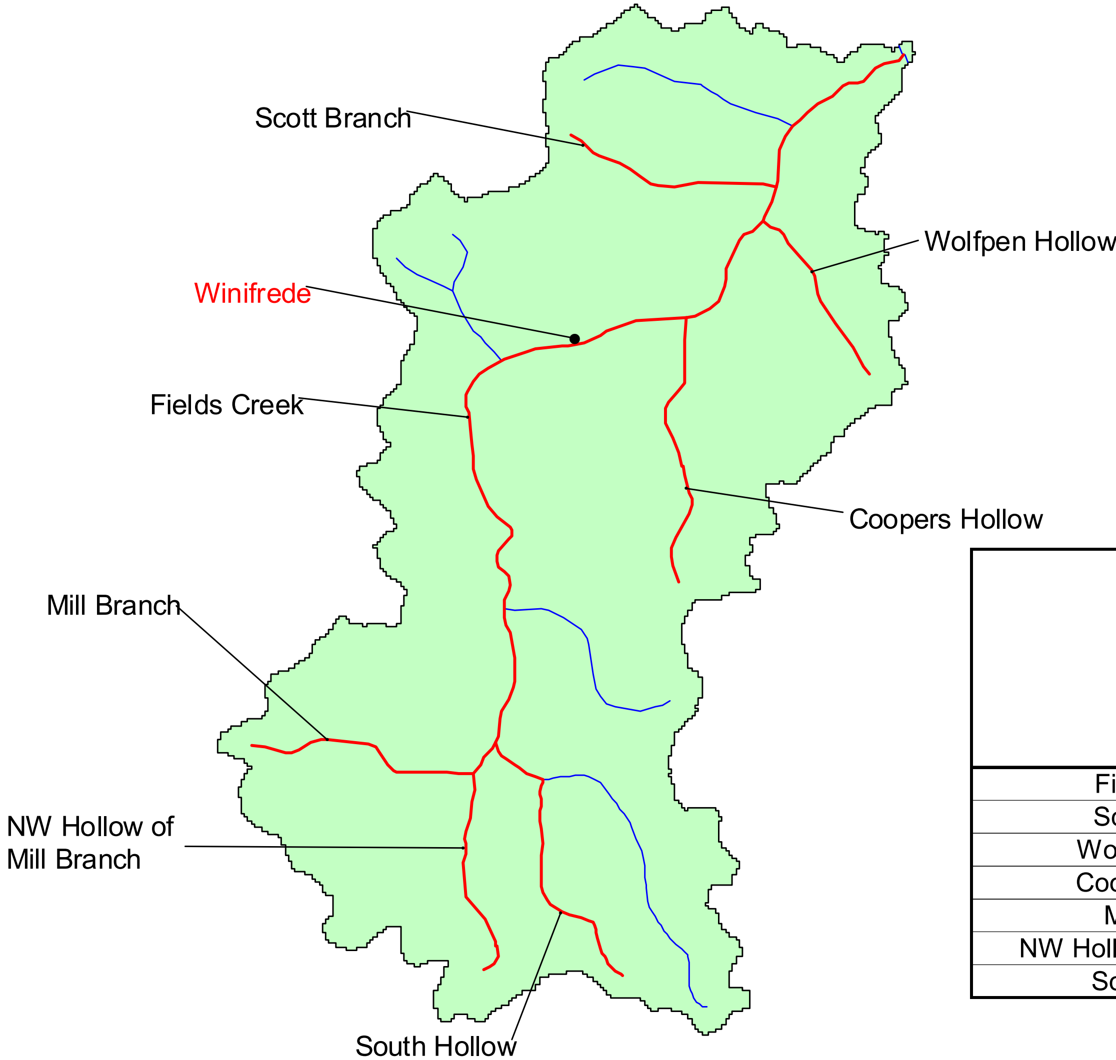


Figure A-6-2. Land use distribution in the Fields Creek watershed



Stream	Aluminum	Iron	Manganese	pH	Biological	Fecal Coliforms
Fields Creek	X				X	X
Scott Branch						X
Wolfpen Hollow	X	X	X	X	X	X
Coopers Hollow						X
Mill Branch	X					
NW Hollow of Mill Branch	X	X	X			
South Hollow					X	

Figure A-6-3. Impaired waterbodies in the Fields Creek watershed

A-6.2 Pre-TMDL Monitoring

Before establishing Total Maximun 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 Fields Creek watershed are shown in Figure A-6-4. 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.

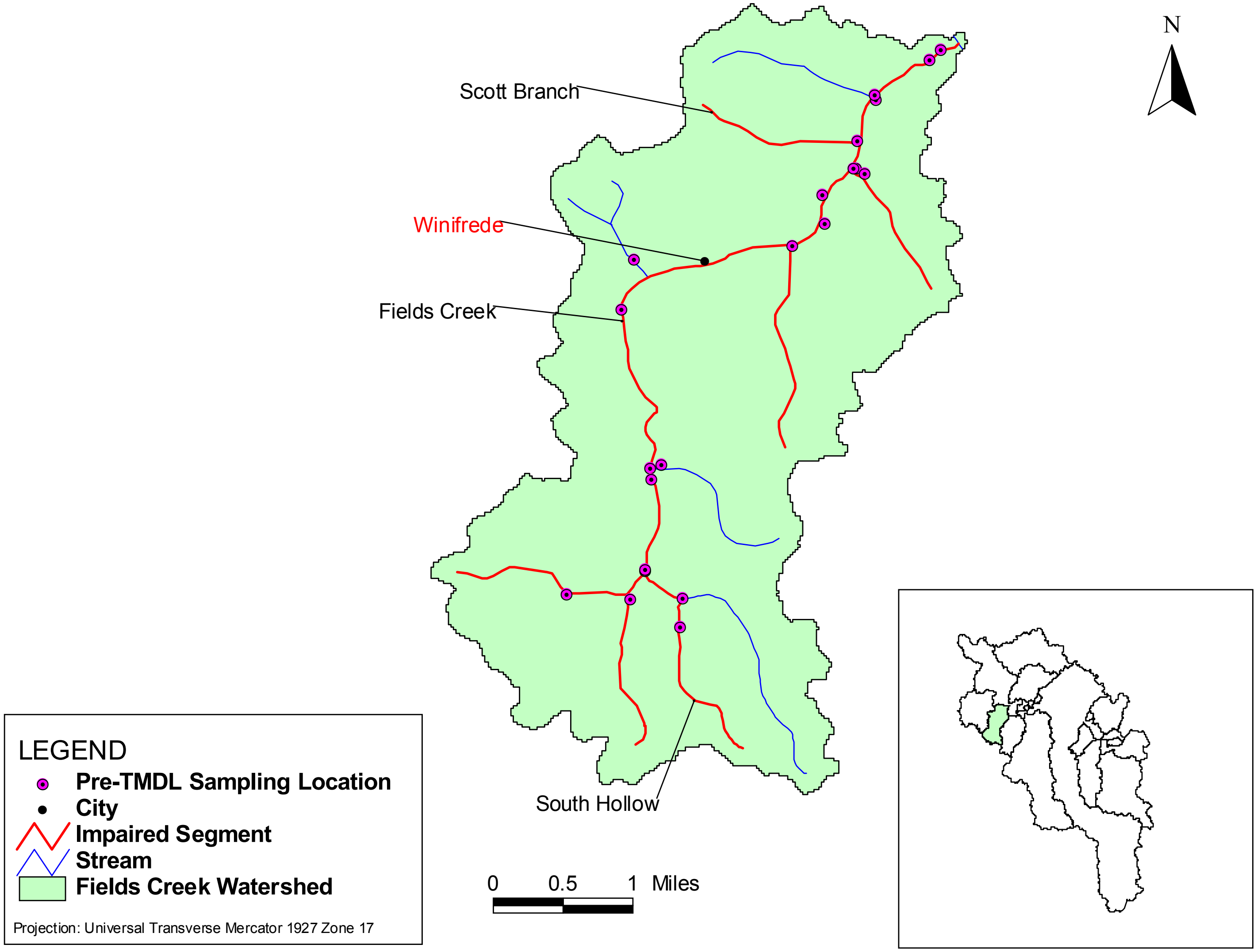


Figure A-6-4. Pre-TMDL monitoring stations in the Fields Creek watershed

A-6.3 Metals and pH Sources

This section identifies and examines the potential sources of aluminum, iron, manganese, and pH impairment in the Fields 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 by describing the pollution source in detail, collecting Global Positioning System data, and if necessary collecting a water quality sample for laboratory analysis. WVDEP staff 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 the outfalls. 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.

Based on scientific knowledge of sediment/metal interactions and knowledge of soils in West Virginia, 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-6.3.1 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 Fields Creek watershed.

Permitted Non-mining Metals Point Sources

Non-mining NPDES permits are not present in the 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. Twelve mining-related NPDES outlets were found in the watershed (Figure A-6-5). 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 Fields 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.

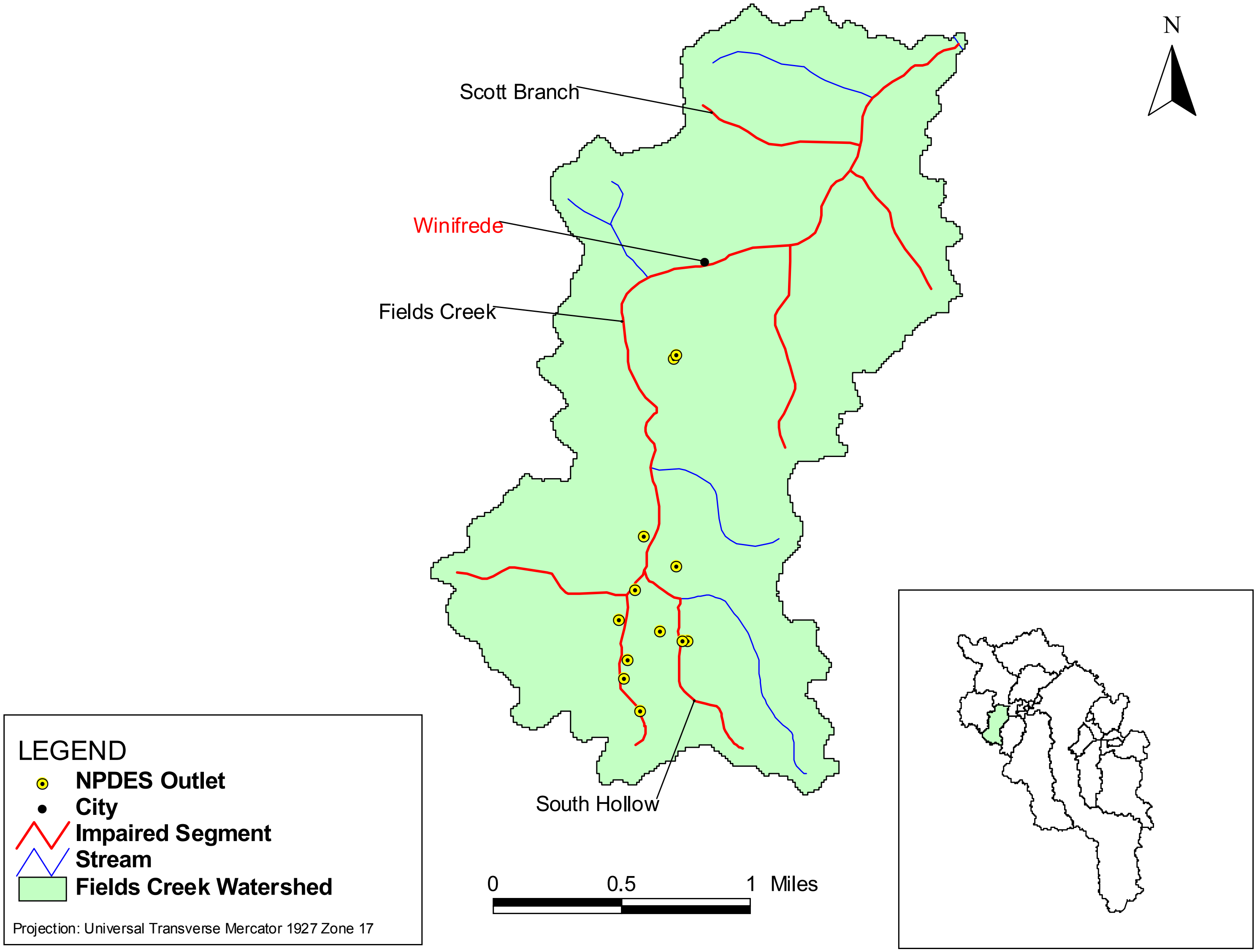


Figure A-6-5. NPDES outlets in the Fields Creek watershed

A-6.3.2 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 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. Various 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 Fields 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 locations of abandoned mine lands in the Fields Creek watershed. In addition, source-tracking efforts by WVDEP's Division of Water and Waste Management identified and characterized four abandoned mine sources (sources can include discharges, seeps, portals, culverts, refuse piles, diversion ditches, and 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 is one bond forfeiture site in the Fields Creek watershed.

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

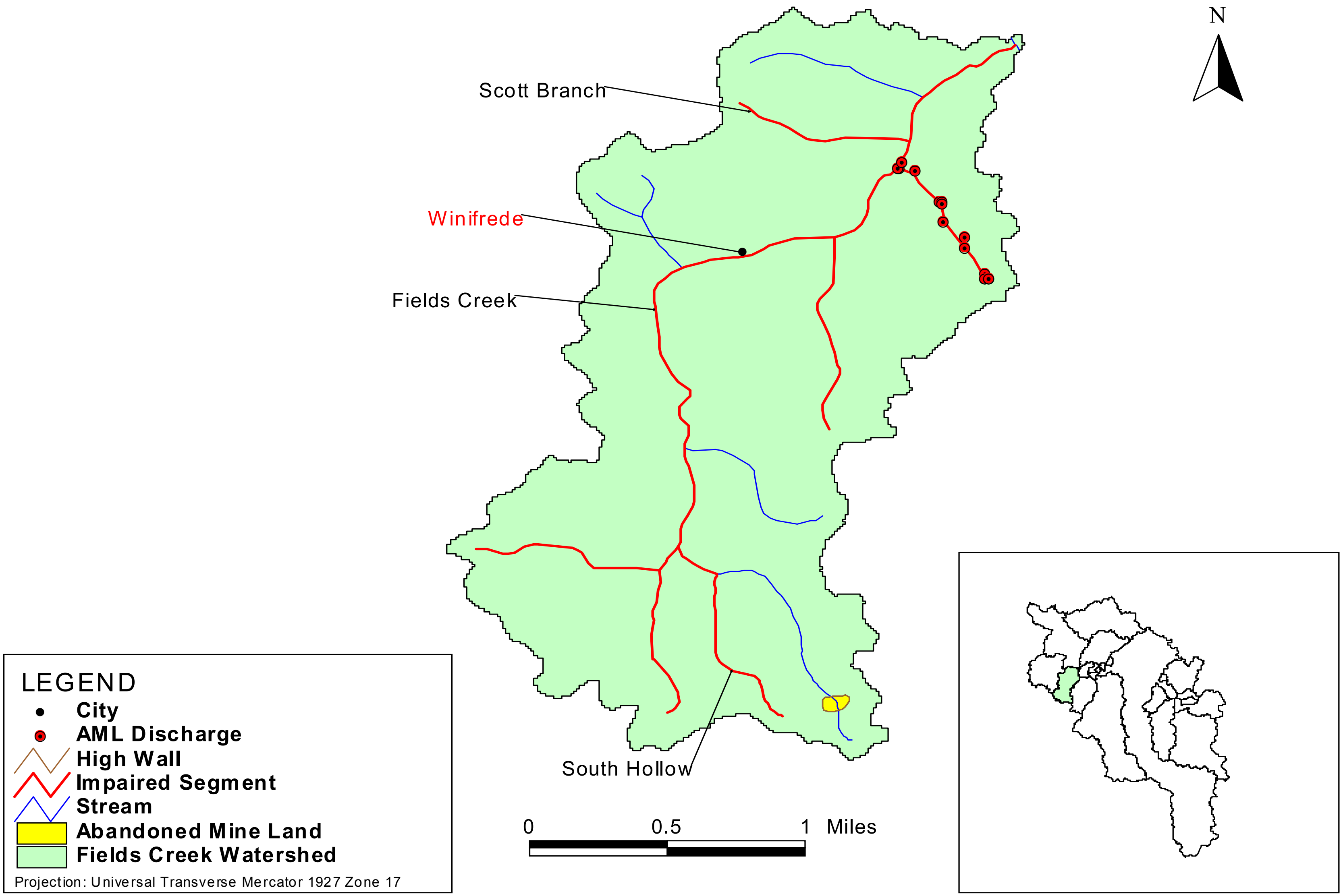


Figure A-6-6. Abandoned mine land and bond forfeiture sites in the Fields Creek watershed

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 Fields Creek watershed are discussed below.

Agriculture
Based on the GAP 2000 land use coverage, agricultural areas cover 2.9 acres (0.04 percent) of the Fields Creek watershed.

Forestry
The active logging operation in the Fields Creek watershed is listed in Table A-6-1. The disturbed area associated with this operation is estimated to cover 225 acres (2.9 percent) of the total watershed area.

Table A-6-1. The logging site in the Fields 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-58: L-1	225	2.9%	13.3	5.9%

Oil and Gas Wells
There are 87 active oil and gas wells in the Fields Creek watershed, the locations of which are indicated in Figure A-6-7. Based on the survey by WVDEP's Office of Oil and Gas, it is estimated that 13.96 acres (0.18 percent) of the Fields Creek watershed are disturbed by the active well sites (including areas associated with access roads).

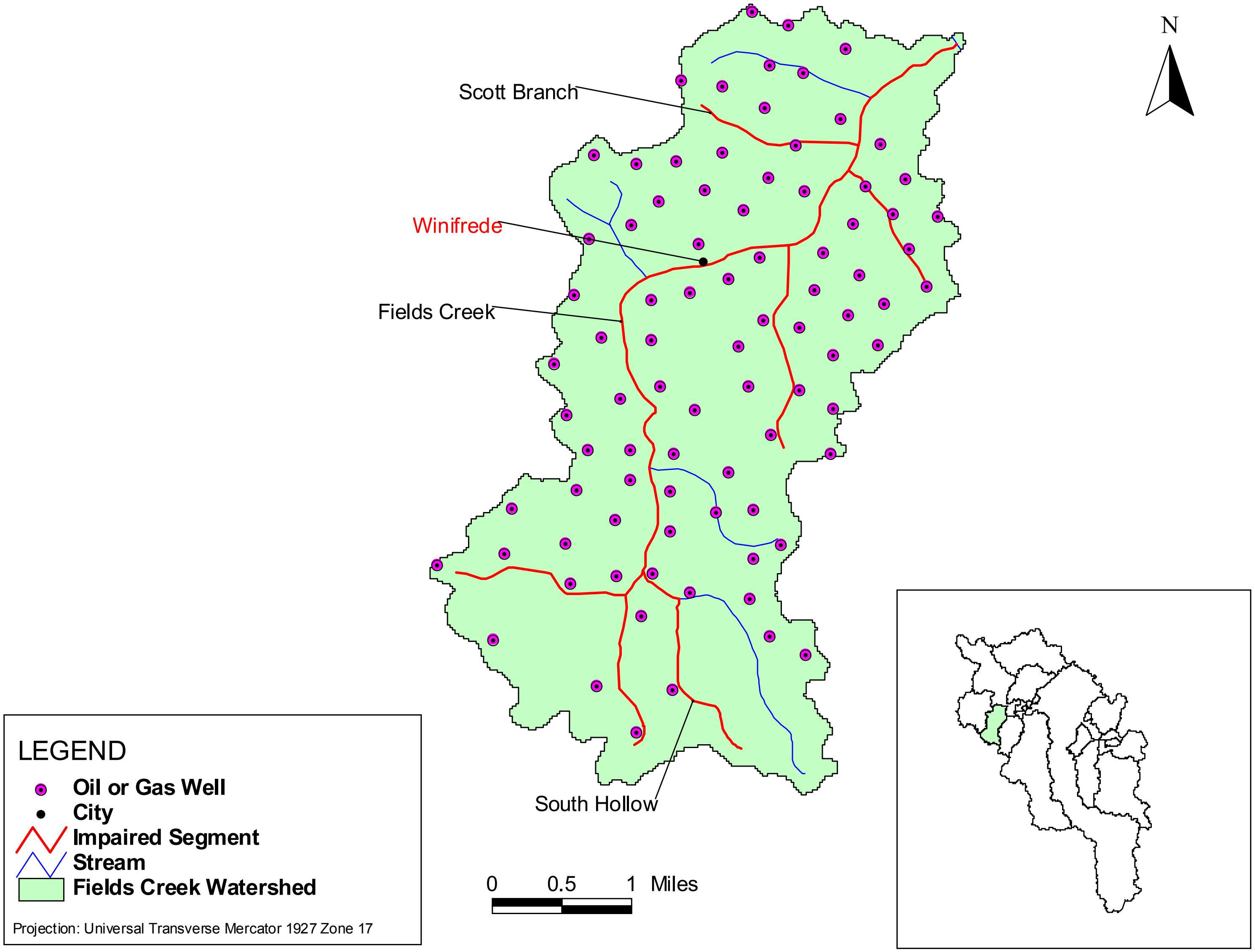


Figure A-6-7. Oil and gas wells in the Fields Creek watershed

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-6-2 summarizes the length, area, and percentage of total watershed area of both paved and unpaved roads in the Fields Creek watershed.

Table A-6-2. Road miles by type in the Fields Creek watershed

Road Type	Road Distance (miles)	Road Area (acres)	Road Area as Percentage of Watershed
Total paved	13.41	26.77	0.34%
Total unpaved	104.50	155.85	2.01%

A-6.4 Fecal Coliform Bacteria Sources

This section identifies and examines the potential sources of fecal coliform bacteria in the Fields 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-6.4.1 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 Fields Creek watershed there are two discharge permits for Home Aeration Units for sewage treatment.

A-6.4.2 Nonpoint (Non-permitted) Fecal Coliform Bacteria Sources

Pollutant source tracking by WVDEP personnel identified areas of high population density without access to public sewers in the watershed. Human sources of fecal coliform 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 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 data from the 1990 Census combined with WVDEP source-tracking information yielded an estimate of 638 people living in unsewered homes in the Fields Creek watershed. Figure A-6-8 shows the estimated distribution of the unsewered population in the watershed.

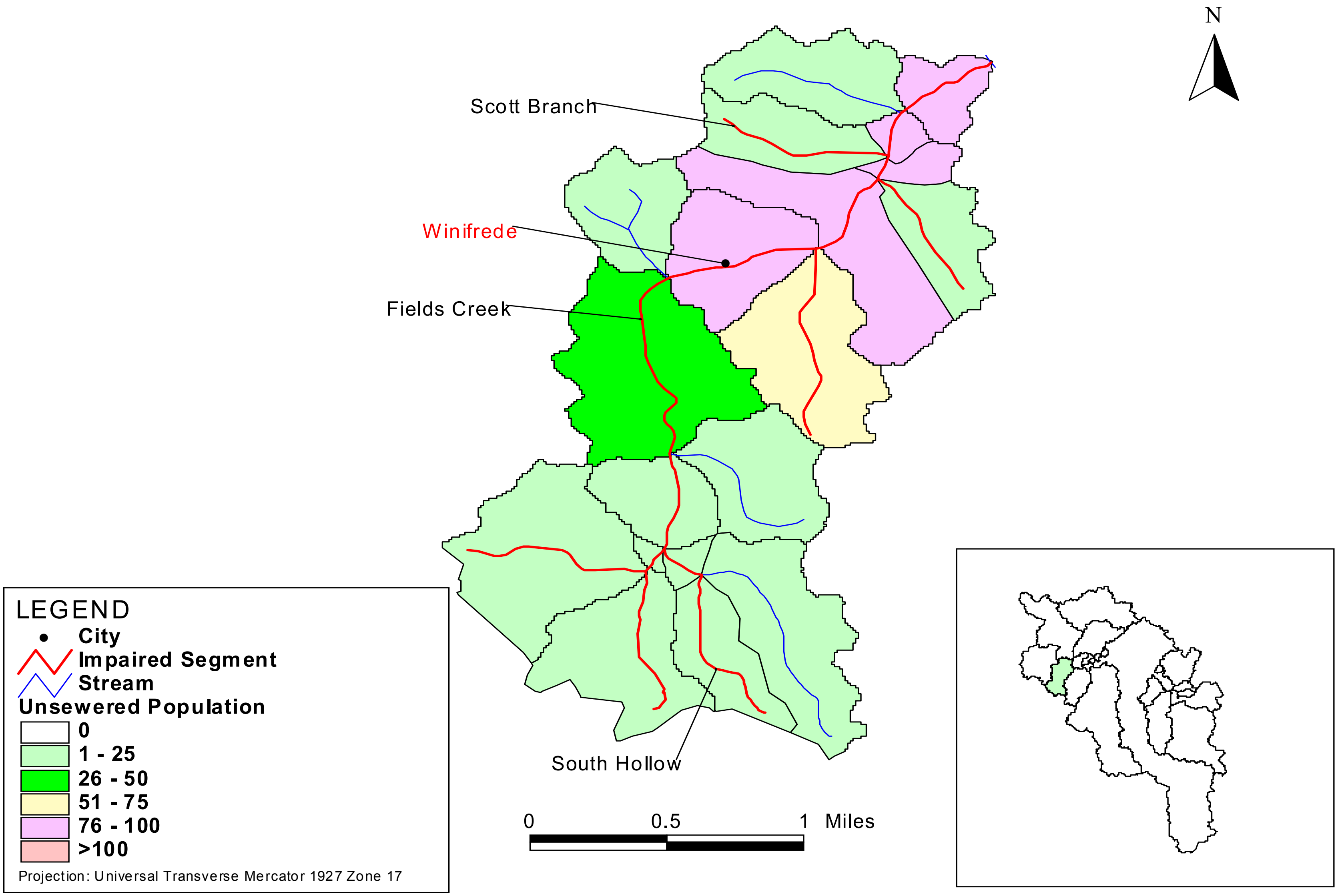


Figure A-6-8. Estimated unsewered population in the Fields Creek watershed

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

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.

Based on the small percentage of residential and agricultural areas in the watershed, and the low fecal accumulation rates for forested areas, stormwater runoff was not considered to be a significant nonpoint source of fecal coliform bacteria.

A-6.5 Stressors of Biologically Impaired Streams

The Fields Creek watershed has three biologically impaired streams for which TMDLs have been developed. These streams are identified in Table A-6-3 along with the primary stressors of the streams' benthic communities and the TMDLs required to address the cause of biological impairment. Refer to the main report for a detailed description of the stressor identification process.

Table A-6-3. Primary stressors of biologically impaired streams in the Fields Creek watershed

Stream	Primary Stressors	TMDLs Required
Fields Creek	Sedimentation Organic enrichment	Sediment Fecal coliform bacteria
Wolfpen Hollow	Aluminum toxicity Acidity (pH) Organic enrichment	Aluminum pH Fecal coliform bacteria
South Hollow	Sedimentation Organic enrichment	Sediment Fecal coliform bacteria

The aluminum TMDLs presented in Table A-6-6 address the aluminum toxicity biological stressor, and the fecal coliform TMDLs presented in Table A-6-8 are surrogates for the organic enrichment biological stressor. Please refer to sections A-6.3 and A-6.4 for source information.

A-6.6 TMDLs for the Fields Creek Watershed

A-6.6.1 TMDL Development

TMDLs and source allocations were developed for impaired streams in the Tomlinson Run 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. These TMDLs represent a successful scenario for which detailed load allocations were developed for specific nonpoint source categories in the West Virginia portion of the watershed. The loadings associated with the individual nonpoint source categories were aggregated and presented in this TMDL report as a gross load allocation for Pennsylvania. This TMDL report does not prescribe specific load or wasteload allocations for the contributing area of Pennsylvania. Instead, it allows Pennsylvania and its stakeholders to determine appropriate and necessary source reductions.

The TMDLs for iron, manganese, aluminum, pH, fecal coliform bacteria, and sediment are shown in Tables A-6-4 through A-6-9. The TMDLs for iron, manganese, and 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, and the TMDLs for sediment are presented in terms of tons 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, 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-6-7, are the TMDLs the pH-impaired streams in the watershed. Refer to the Technical Report for a detailed description of the pH modeling approach

A-6.6.2 TMDL Tables: Metals

Table A-6-4. Iron TMDLs for the Fields 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)
FIELDS CREEK	K-58-B.1	Wolfpen Hollow	Iron	1,618	NA	85	1,704
FIELDS CREEK	K-58-B.8-1	NW Hollow of Mill Branch	Iron	443	1,160	84	1,687

NA = not applicable.

Table A-6-5. Manganese TMDLs for the Fields 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)
FIELDS CREEK	K-58-B.1	Wolfpen Hollow	Manganese	753	NA	40	793
FIELDS CREEK	K-58-B.8-1	NW Hollow of Mill Branch	Manganese	131	713	44	888

NA = not applicable.

Table A-6-6. Aluminum TMDLs for the Fields 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)
FIELDS CREEK	K-58	Fields Creek	Total Aluminum	16,248	2,841	1,005	20,094
FIELDS CREEK	K-58-B.1	Wolfpen Hollow	Total Aluminum	1,243	NA	65	1,308
FIELDS CREEK	K-58-B.8	Mill Branch	Total Aluminum	5,434	1,352	339	7,125
FIELDS CREEK	K-58-B.8-1	NW Hollow of Mill Branch	Total Aluminum	811	1,216	107	2,134

NA = not applicable.

Table A-6-7. pH TMDLs for the Fields Creek watershed

Major Watershed	Stream Code	Stream Name	Parameter	pH* (Under TMDL conditions)
FIELDS CREEK	K-58-B.1	Wolfpen Hollow	pH	7.41

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

A-6.6.3 TMDL Tables: Fecal Coliform Bacteria

Table A-6-8. Fecal coliform bacteria TMDLs for the Fields Creek watershed

Major Watershed	Stream Code	Stream Name	Parameter	Load Allocation (counts/yr)	Wasteload Allocation (counts/yr)	Margin of Safety (counts/yr)	TMDL (counts/yr)
FIELDS CREEK	K-58	Fields Creek	Fecal coliform	2.51E+13	6.08E+09	1.32E+12	2.64E+13
FIELDS CREEK	K-58-B	Scott Branch	Fecal coliform	9.99E+11	NA	5.26E+10	1.05E+12
FIELDS CREEK	K-58-B.1	Wolfpen Hollow	Fecal coliform	6.51E+11	NA	3.42E+10	6.85E+11
FIELDS CREEK	K-58-B.3	Coopers Hollow	Fecal coliform	8.72E+11	NA	4.59E+10	9.18E+11
FIELDS CREEK	K-58-C	South Hollow*	Fecal coliform	8.97E+11	NA	4.49E+10	9.42E+11

NA = not applicable.
* Indicates TMDL developed to address biological impairment.

A-6.6.4 TMDL Tables: Sediment

Table A-6-9. Sediment TMDLs for the Fields Creek watershed

Major Watershed	Stream Code	Stream Name	Parameter	Load Allocation (ton/yr)	Wasteload Allocation (ton/yr)	Margin of Safety (ton/yr)	TMDL (ton/yr)
FIELDS CREEK	K-58	Fields Creek	Sediment	853	69	49	971
FIELDS CREEK	K-58-C	South Hollow	Sediment	74	39	6	119