Total Aluminum and Fecal Coliform Bacteria TMDLs for the Fourpole Creek, West Virginia

FINAL TMDL

U.S. Environmental Protection Agency
Region 3
1650 Arch Street
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1.0 Problem Understanding

The Clean Water Act at Section 303(d) and its implementing regulations (Water Quality and Planning and Management Regulations at 40 CFR 130) require a Total Maximum Daily Load (TMDL) to be developed for those waterbodies identified as impaired by the state where technology-based and other required controls do not provide for the attainment of water quality standards. To fulfill the consent decree requirements relating to *Ohio Valley Environmental Coalition, Inc., et al.* v. *Carol Browner, et al., No. 2:95-0529 (S.D.W.VA.)* entered on July 9, 1997, TMDLs will be completed by U.S. EPA for the waters included on West Virginia's operative Section 303(d) list of impaired waterbodies to the extent such TMDLs are not established by the State consistent with the schedule in the consent decree. Fourpole Creek was listed on the 1996 and 1998 Section 303(d) list as impaired by aluminum. Therefore, a TMDL for aluminum on Fourpole Creek is being developed. More generally, the objective of this work effort on Fourpole Creek was to:

- Confirm the aluminum impairment in Fourpole Creek,
- Identify sources of impairment,
- Develop a technical approach for developing TMDLs on impaired waterbodies,
- Perform modeling to support TMDL development, and
- Develop TMDL and document the analysis and recommendations.

At the time of the initial data review, there was very little water quality data available. West Virginia Department of Environmental Protection (WVDEP) completed data collection activities during the period October 2001 to March 2002. The data collected were used to develop the TMDL for aluminum. In addition, the data indicated violations of water quality standards for fecal coliform. WVDEP believes it is appropriate to simultaneously develop a TMDL for fecal coliform to take advantage of the ongoing modeling and analysis efforts being used for the development of the TMDL for aluminum.

1.1 Background Information

Fourpole Creek is located Cabell and Wayne counties in the southern portion of the Raccoon-Symmes watershed (HUC 05090101) in southwestern West Virginia near the State's borders with Ohio and Kentucky (Figure 1-1). The entire length of the stream was placed on West Virginia's 1996 and 1998 Section 303(d) lists for aluminum impairments. Table 1-1 presents the information found on the 1996 and 1998 Section 303(d) lists and the potential listing information of fecal coliform bacteria on the draft 2002 Section 303(d) list.

Table 1-1. 1996, 1998 and Potential 2002 Section 303(d) List Information for Fourpole Creek

<table>
<tr><th>Stream Name</th><th>Stream Code</th><th>Designated Use</th><th>Pollutants</th><th>Year Listed</th><th>Primary Source of Impairment</th><th>Stream Length</th></tr>
<tr><td rowspan="2">Fourpole Creek</td><td rowspan="2">O-3</td><td rowspan="2">Aquatic Life
Human Health</td><td>Aluminum</td><td>1996, 1998</td><td>Undetermined</td><td rowspan="2">11.74 miles</td></tr>
<tr><td>Fecal coliform</td><td>Possible listing in 2002</td><td>Undetermined</td></tr>
</table>

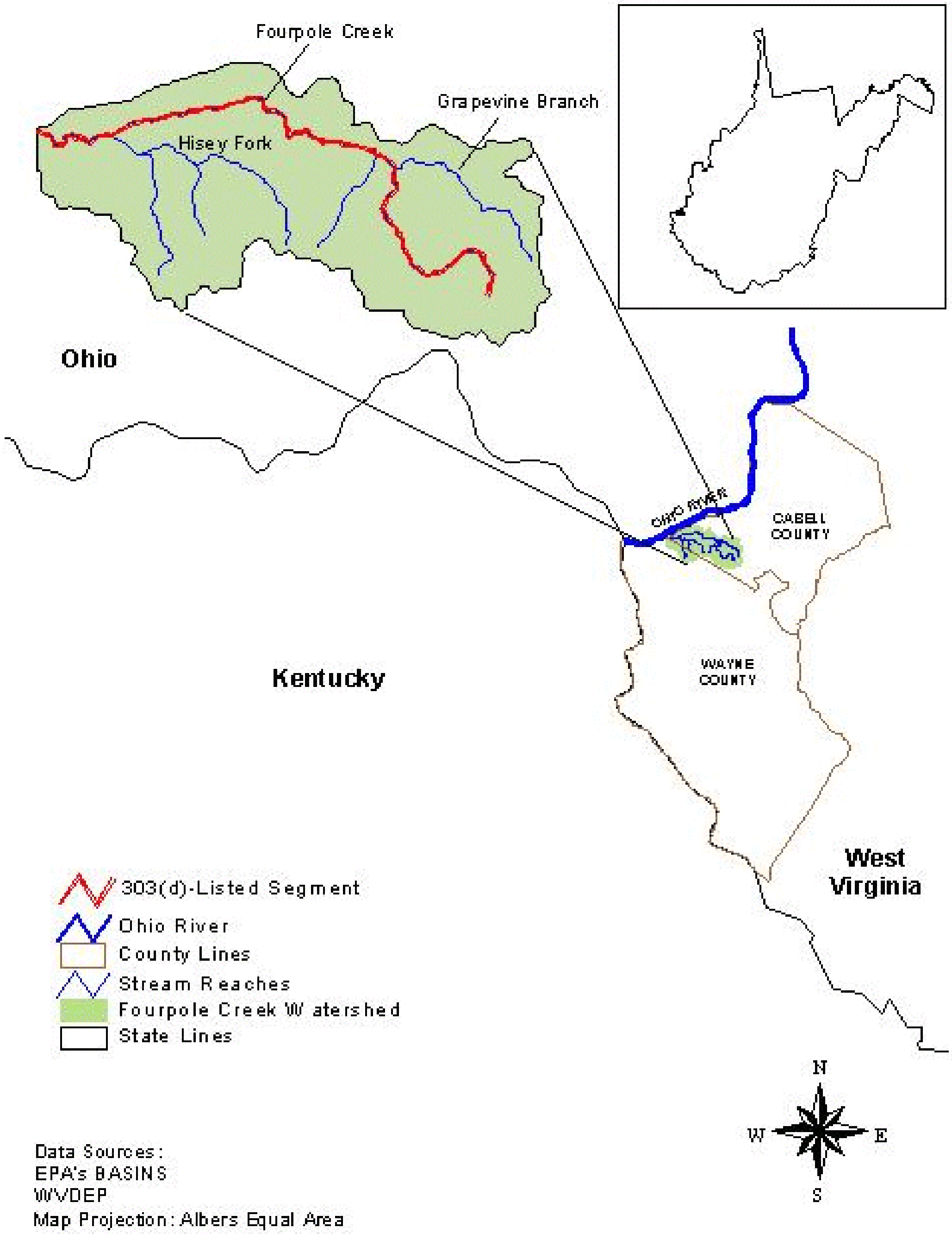

Figure 1-1 Location of the fourpole Creek Watershed

Fourpole Creek is a tributary to the Ohio River and flows through the city of Huntington, West Virginia. Major tributaries to Fourpole Creek itself include Grapevine Branch, an Unnamed Tributary along Woodville Lane, and Hisey Fork. Figure 1-2 presents the City of Huntington's boundaries within the Fourpole Creek watershed as well as the locations of the major tributaries. The watershed is approximately 23.4 square miles (14,967 acres) in size. Approximately 49 percent of the watershed consists of forested lands, while urban and agricultural land uses encompass about 32 percent and 19 percent, respectively. Forested lands are primarily in the upper portion of the watershed, while urban land uses make up the majority of the lower portion.

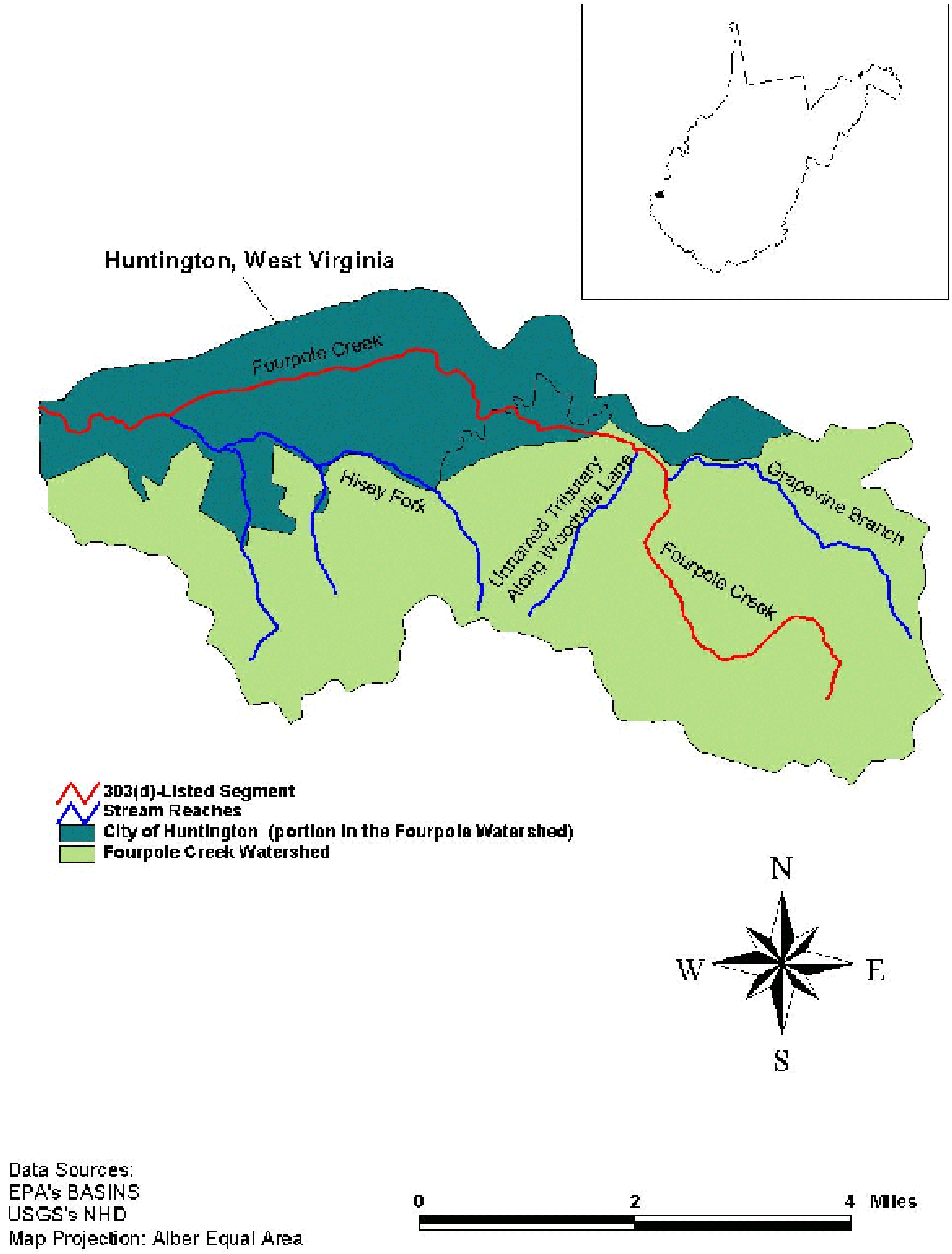

Figure 1-2. The City of Huntington within the Fourpole Creek Watershed

2.0 Water Quality Standards

Water Quality Standards consist of three components: designated and existing uses; narrative and/or numerical water quality criteria necessary to support those uses; and an anti-degradation statement. Furthermore, Water Quality Standards serve two purposes. The first is establishing the water quality goals for a specific waterbody. The second is establishing the regulatory basis for water quality-based treatment controls and strategies beyond the technology-based levels of treatment required by Sections 301(b) and 306 of the Act (USEPA, 1991). In *Title 46, Legislative Rule, Environmental Quality Board, Series 1, Requirements Governing Water Quality Standards*, West Virginia sets forth designated and existing uses as well as numeric and narrative water quality criteria for waters in the state. Appendix E of the *Requirements Governing Water Quality Standards* contains the numeric water quality criteria, while narrative water quality criteria are in Section §46-1-3 of the same document. Total aluminum and fecal coliform levels have numeric criteria under the Aquatic Life use and Human Health use designation categories, respectively (WVSOS 1999). There are no human health water quality criterion for aluminum and no aquatic life criterion for fecal coliform bacteria. Fourpole Creek watershed streams are all warm-water fishery streams. Table 2-1 presents the Aquatic Life and Human Health criteria applicable to the impairments in the Fourpole Creek watershed.

Table 2-1. Applicable West Virginia Water Quality Criteria

POLLUTANT	USE DESIGNATION				
	Human Health	Aquatic Life			
	C, A	B1, B4		B2	
		Acute[a]	Chronic[b]	Acute[a]	Chronic[b]
Aluminum, Total (µg/L); not to exceed:		750		750	
Fecal coliform	Maximum allowable level of fecal coliform content for Primary Contact Recreation (either MPN or MF) shall not exceed 200/100 ml as a monthly geometric mean based on not less than 5 samples per month; nor to exceed 400/100 ml in more than 10 percent of all samples taken during the month.				

Source: WVSOS, 1999; B1 = Warm-water fishery streams, B4 = Wetlands, B2 = Trout waters, C = Water contact recreation, A = Public water supply

[a] One-hour average not to be exceeded more than once every three years

[b] Four-day average concentration not to be exceeded more than once every three years on average

3.0 Source Assessment

This section examines and identifies the potential sources of aluminum and fecal coliforms in the Fourpole Creek watershed. A variety of data types were used to identify potential sources and to characterize the relationship between point and nonpoint source discharges and in-stream response at monitoring stations.

3.1 Data Inventory and Review

The categories of data used in developing these TMDLs include physiographic data that describe the physical conditions of the watershed and environmental monitoring data that identify potential pollutant sources and their contribution. Table 3-1 presents the various data types and data sources used in the development of these TMDLs.

Table 3-1. Inventory of Data and Information Used for the Source Assessment of the Watershed

Data Category	Description	Data Source(s)
Watershed Physiographic Data	Land use (WV GAP 2000)	Natural Resource Analysis Center, West Virginia University
	Stream reach coverage	WVDNR; Reach File, Version3
	Weather information	National Climatic Data Center
Environmental Monitoring Data	303(d) listed water	WVDEP
	Water quality monitoring data	WVDEP
	Permitted mining data	WVDEP
	NPDES data	WVDEP
	Stream flow data	USGS, WVDEP

3.2 Stream Flow Data

Flow data is used to help determine critical conditions in the watershed and to characterize contributions from various sources. There is one U.S. Geological Survey (USGS) flow gauge in the Fourpole Creek watershed (station 03206500, Fourpole Creek at Huntington, West Virginia). Data was collected at this station from March 1940 through September 1948, however, since it is very likely that the hydrology of the watershed has changed over the past 50 years, the flow data at the Fourpole Creek station is considered inadequate for use in the present-day TMDL development for the watershed. For example, some portions of the watershed are highly urbanized and it is likely that the impervious area of the watershed has increased since the 1940s. Limited amounts of flow data were collected by WVDEP from October 2001 through March 2002 to characterize the flow conditions in the Fourpole Creek watershed. Table A-1 in Appendix A presents all of the recent flow data available in the watershed.

Due to the lack of recent available time-series flow data for the Fourpole Creek watershed, a watershed with similar properties to Fourpole Creek, with time-series flow data, was chosen as a reference for the hydrology characterization of the Fourpole Creek watershed. The reference watershed of Hurricane Creek, located approximately 17 miles east of the Fourpole Creek watershed in Hurricane, West Virginia, Figure 3-1, was chosen based on its proximity and similarities to the Fourpole Creek watershed. The Hurricane Creek watershed has similar geology, soils, size, and land use attributes in comparison to the Fourpole Creek watershed, Table 3-2. The Hurricane Creek watershed is an appropriate-sized watershed, partially urban, with available flow data. The USGS flow station in the Hurricane Creek watershed is USGS 03201405, Hurricane Creek at Hurricane, West Virginia. The gauge's period of record is for the two-year time period of October 1, 1998 through September 30, 2000.

Table 3-2. Comparison of the Reference watershed Hurricane Creek to the Fourpole Creek watershed

Parameter	Impaired Waterbody	Reference Watershed
	Fourpole Creek	Hurricane Creek
Watershed Size (Acres)	14,718	17,970
Geology	Shale, Sandstone, Alluvium	Shale, Sandstone, Alluvium
Soil Hydrologic Groups	C-83%, D-17%, B-1%	C-100%
Land Uses	**Percent Distribution %**	**Percent Distribution %**
Forest	47.2%	63.2%
Urban (pervious and Impervious)	31.4%	18.1%
Row Crops	0.3%	0.3%
Pasture	18.5%	16.4%
Barren	0.8%	1.0%
Wetlands	0.4%	0.5%

3.3 Water Quality Data

Water quality data for the Fourpole Creek watershed were obtained from WVDEP. Observations used to configure, calibrate, and test the model were taken throughout the watershed. There were a total of 22 water quality stations in the watershed (Figure 3-2) with anywhere from one to 13 observations at each one. Monthly water quality data were available at station 551074 for the year 1994. All other data were collected by WVDEP from October 2001 through March 2002. Appendix A presents the water quality information used during this modeling and TMDL development effort, including stations, corresponding periods of record, and basic parameter summaries.

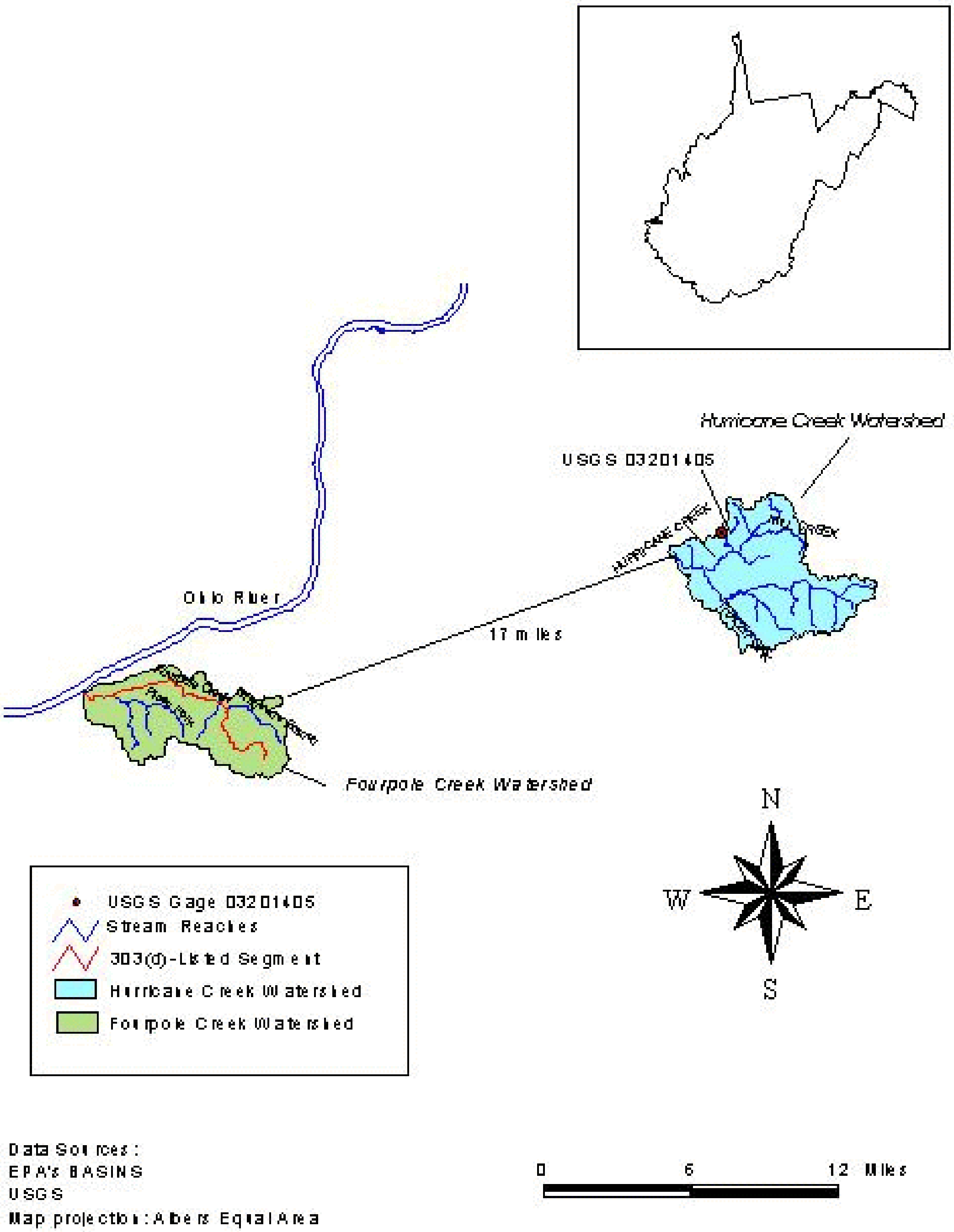

Figure 3-1. Location of the Hurricane Creek Reference Watershed

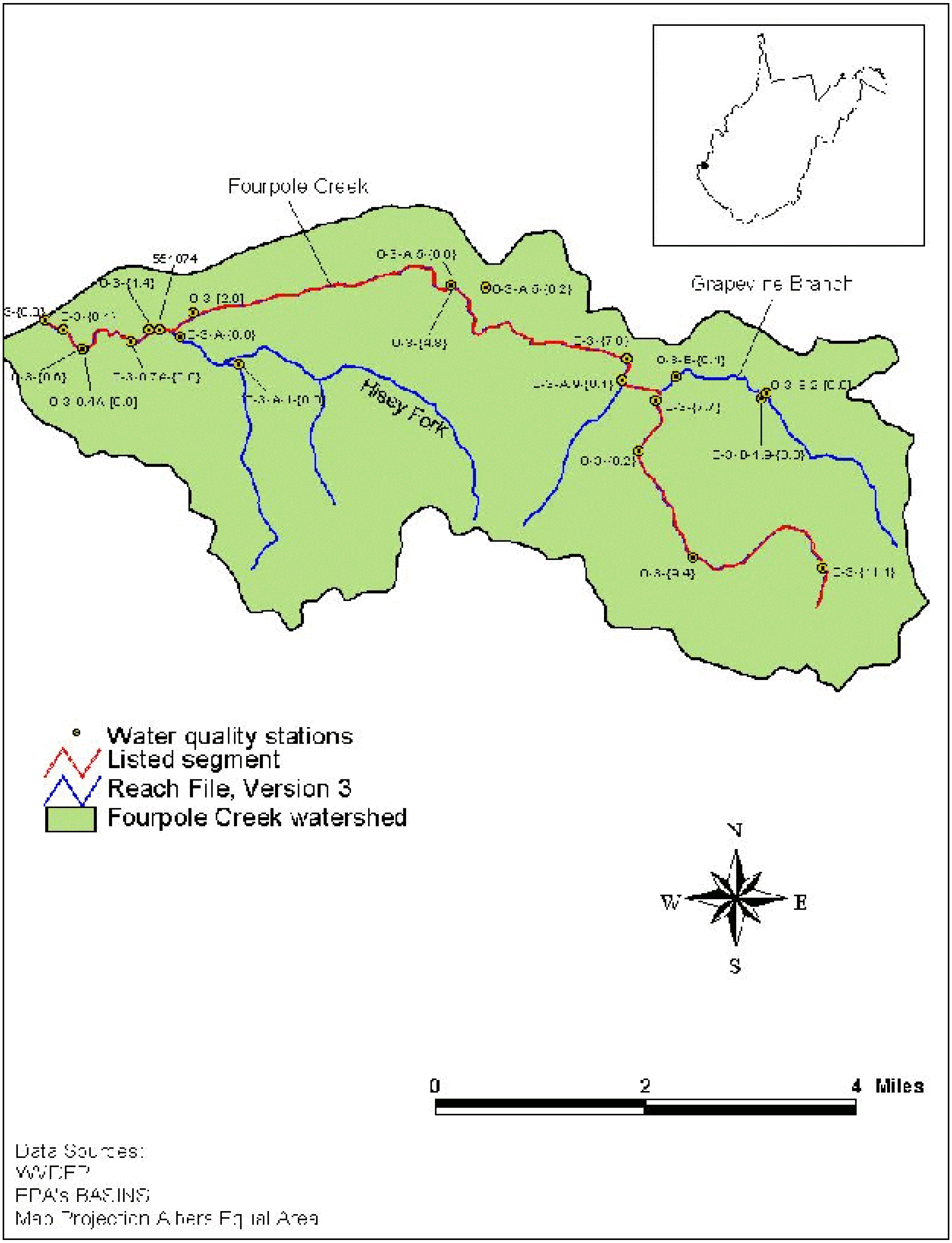

Figure 3-2. Water Quality Stations in the Fourpole Creek Watershed

3.4 Land Use

The predominant land uses in the Fourpole Creek watershed were identified based on West Virginia GAP 2000 land use data (WVU, 2000). According to the GAP 2000 data, the major land uses in the Fourpole Creek watershed are forest and urban, which constitute approximately 47 percent and 31 percent of the watershed, respectively. The land uses represented in the GAP 2000 land use coverage were grouped into 10 consolidated land uses for the purposes of this TMDL project. Table 3-3 presents the various land uses in the Fourpole Creek watershed and their associated areas. Figure 3-3 presents the land use coverage for the watershed.

Table 3-3. Land Use Areas in the Fourpole Creek Watershed

Regrouping	GAP 2000 Land Use	Acres	% Composition
Forest	Shrubland Floodplain forest Cove hardwood forest Diverse mesophytic hardwood Hardwood conifer forest Oak dominant forest	6,953.95	47.25
Surface water	Surface water	21.14	0.14
Urban Pervious	Roads Power lines Intensive urban Populated urban Light-intensity urban Moderate-intensity urban	2,810.74	19.10
Urban Impervious	Power lines Intensive urban Populated urban Light-intensity urban Moderate-intensity urban	1,811.14	12.30
Cropland	Row crops	46.73	0.32
Pasture	Pasture	2,728.52	18.54
Barren	Barren	124.60	0.85
Wetlands	Forested wetlands Shrub wetlands Herbaceous wetlands	59.85	0.41
Active Surface Mine	Active Surface Mine	10.40	0.07
Construction	Construction	151.20	1.03
Total Watershed Area		**14718.16**	**100**

The land uses in the Fourpole Creek watershed have the potential to contribute nonpoint source loads of aluminum and fecal coliform bacteria to receiving waterbodies. The land uses in the watershed, along with the water quality data provided by WVDEP, were used to determine significant sources of aluminum and fecal coliform to the watershed. Sections 3.5.1 and 3.5.2 discuss possible nonpoint sources of aluminum and fecal coliform bacteria to the Fourpole Creek watershed in more detail.

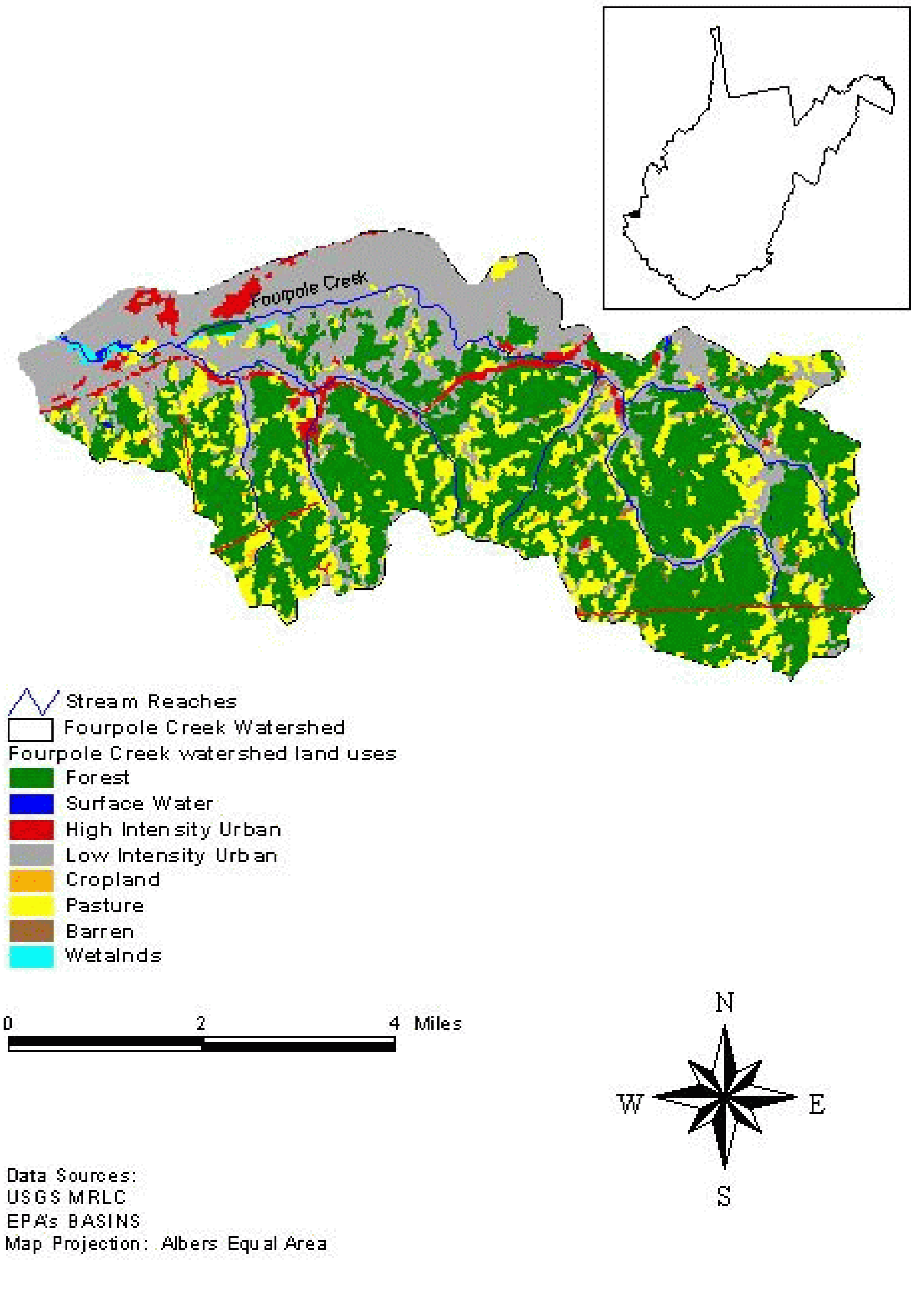

Figure 3-3. Landuse Coverage in the Fourple Creek Watershed

3.5 Geology

West Virginia is composed of two basic geologic areas: the western two-thirds has relatively flat-lying rocks, and the eastern one-third has folded and faulted rocks. The Appalachian Plateau Province is in the west and the Valley and Ridge Province in the east, separated by the Allegheny Front. The oldest formation, the Catoctin Formation (late Precambrian), is in the eastern part of the state, with younger formations (Paleozoic) in the west. Quaternary alluvium is distributed throughout the state. The Appalachian Plateau is composed mostly of Pennsylvanian and Permian strata (Watts et al., 1994).

Fourpole Creek, which is part of the Ohio River basin, lies in the Appalachian Plateau Physiographic Province (WVDNR, 1988). The Province is characterized by narrow flood plains and deeply indented stream valleys, however, the floodplain areas of the Ohio river are not as steep. The exposed rocks in the basin are more than 225 million years old and consist primarily of Permian and Pennsylvanian ages. The majority of the rock in the strata is comprised of shale, sandstone, siltstone, limestone, and coal.

The specific geology of the Fourpole Creek watershed is primarily made up of shale from the Pennsylvanian period and is part of the Conemaugh group. There is also a large section of Quaternary period alluvium in the area of the watershed where the City of Huntington is located. There are smaller portions of Pennsylvanian period sandstone in the Monongahela group at the higher elevations at the edge of the watershed.

The Lower Pocahontas Basin in the southern part of West Virginia is the older of two sedimentary basins in West Virginia (Watts et al., 1994). The Dunkard basin (the northern sedimentary basin) overlaps the Pocahontas Basin in central West Virginia. Sediments of the Dunkard Basin consist of sandstone and shale from the Conemaugh Formation, with small amounts of coal from the Monongahela and Dunkard Groups. The sediments of the Dunkard basin are representative of sediments in the Fourpole Creek watershed.

Watts et al. (1994) identified clays derived from shale units within the Lower Pocahontas and Dunkard sedimentary basins as the primary source of high aluminum concentrations in stream sediments.

3.6 Nonpoint Sources

3.6.1 Aluminum Sources

Water quality analysis showed that sediment represents a substantial nonpoint source of aluminum to the watershed, primarily associated with erosion and surface runoff during high flow periods. Nineteen percent of the 52 available aluminum observations in the watershed exceed the total aluminum water quality criterion of 750 ug/L (see Appendix A, Table A-5). The associated total suspended solids (TSS) observations were usually high when aluminum concentrations were high. High aluminum concentrations tended to be associated with high flow events and appeared to be correlated with high runoff and erosion from disturbed land. All water quality stations in the watershed with three or more observations were analyzed for TSS and aluminum correlations. Table 3-4 presents the R^2 values for the TSS and total aluminum correlations at seven water quality stations in the Fourpole Creek watershed. Note that the R^2 values are based on very limited amounts of water quality data. Tables B-1 through B-7 in Appendix B present plots of the available TSS and total aluminum observations at each of the seven water quality stations.

Table 3-4. R^2 Values from Total Aluminun and TSS Correlations at All Water Quality Stations in the Fourpole Creek Watershed with More than Two Observations

Water Quality Station	R2	Number of Observations
551074	0.595	11
O-3-{1.4}	1	4
O-3-{4.8}	0.991	6
O-3-{7.0}	0.997	4
O-3-{7.7}	1	4
O-3-A-1-{0.0}	0.994	3
O-3-B-{0.1}	1	4

Construction, urban land, and barren land are identified as the most likely contributors of sediment to the Fourpole Creek watershed based on water quality data analysis and a site visit to the watershed in April 2002. Higher metals loadings are contributed by barren land, construction sites, surface-mined, or agricultural land than by forest because runoff and erosion potential is greater for land without adequate vegetative cover. The urbanization and paving of large areas of the watershed can also result in dramatic increases in stormwater runoff, which leads to periodic high flows that erode stream banks and contribute increased amounts of silt and associated metals to the creek bottom. These nonpoint sources are extremely difficult to pinpoint, measure, and control, but they are a probable cause of degradation of water quality in the Fourpole Creek watershed.

Where West Virginia soils are naturally high in aluminum, an increase in sediment to the stream results in an increase in total aluminum in the water.

Agricultural Land

Agricultural runoff from cropland and pasture often contribute pollutant loads to a water body when poor farm management practices allow soils to be washed into the stream, increasing in-stream sediment levels. Based on GAP 2000 land use coverage, the cropland percentage in the impaired watersheds ranges from 0 to 1 percent. When hay/pasture and cropland are combined, the percentage of agricultural land ranges from 3 to 32 percent.

Silviculture

Silviculture, especially forest harvesting, can be an important nonpoint source of sediment and, therefore, aluminum, to water bodies. The USDA's Forest Service FIA Database Retrieval System provided information on silvicultural practices in Cabell and Wayne counties. Forest land in the basin includes all land with at least 10 percent stock forest trees of any size, or formerly having such tree cover, and not currently developed for non-forest use. Timberland represents the portion of forest land that is producing, or is capable of producing, crops of industrial wood and has not been withdrawn from utilization. Ninety-nine percent of the forested acres in the Fourpole Creek watershed are considered to be timberland. The average annual removal rate is the average volume of growing-stock removed in one year by harvesting, cultural operations, land clearing, or changes in land use for the time period between two successive forest inventories. Table 3-5 presents the timberland area and annual harvested growing stock in Cabell and Wayne counties, West Virginia.

Table 3-5. Timberland Area and Annual Harvested Growing Stock for Cabell and Wayne Counties

Area	Timberland (acres)	Growing Stock (acres)
Cabell County	131,000	1,815
Wayne County	275,000	939

Based on timberland area and growing stock removal rates in Cabell and Wayne counties, only about 0.7 percent of the timberland in the watershed is harvested. It is assumed that the barren land use coverage accounts for any forest harvesting operations in the watershed.

Urban/Residential Areas

Sediment from nonpoint sources may be carried into streams through surface runoff and through erosion from unpaved areas and disturbed sites. The impervious land area associated with paved roads in urban areas increases the stormwater runoff, which leads to periodic high flows that erode land surface and stream banks and contribute increased amounts of sediment and associated metals to the creek. The area of paved roads in the watershed is included in the urban land use coverage of GAP 2000. See Table 3-3.

3.6.2 Fecal Coliform Bacteria Sources

Comparison of fecal coliform bacteria to observed flow at several water quality stations throughout the watershed to shows that fecal coliform bacteria concentrations are present in relatively high concentrations at both high- and low- flow conditions, indicating that there may be a number of fecal coliform bacteria sources. Figures C-1 through C-11 in Appendix C present fecal coliform bacteria versus flow for all water quality stations with both fecal and flow data on the same date.

Important sources of fecal coliform bacteria loads in urban areas are storm runoff from impervious and pervious areas, failing septic tanks, illicit discharges, and leaking sanitary sewer systems. In rural settings, the amount of impervious area is usually much lower, resulting in greater infiltration of precipitation and less runoff. However, sources of fecal coliforms in rural areas include runoff from fields receiving land application of animal wastes, runoff from concentrated animal operations and grazing land, wildlife, cattle in the stream, and failing septic tanks may be a significant source of impairment.

Potential sources of fecal coliform bacteria in the Fourpole Creek watershed were evaluated to identify and quantify sources of bacteria. The identified nonpoint sources of fecal coliform bacteria include:

- Leaking sanitary sewers
- Failing septic systems
- Runoff from pastureland with grazing livestock
- Runoff from cropland
- Wildlife contributions

Leaking Sanitary Sewers

Often in older sanitary sewer systems it is possible for the system to have fractured sewer lines that discharge raw sewage to streams and/or groundwater instead of taking it to the sewage treatment plant. A fractured sewer line was reported in the Fourpole Creek watershed during the sampling period. Huntington Sanitary Board personnel notified the property owners and the line was immediately repaired. The fractured sewer line may have been responsible for some of the very high fecal coliform bacteria observations at low-flow periods in that area of the watershed. The sewer system in the Fourpole Creek watershed is aging and it is possible that additional fractured sewer lines exist in the watershed, but have not been identified and, thus, will not be specifically represented in the modeling process.

Failing Septic Systems

Failing septic systems are also a common source of fecal coliforms to a watershed. The number of septic systems per county is provided in the 1990 census (U.S. Bureau of the Census, 1990). The percent increase in population in Cabell and Wayne counties since 1990 is so small (U.S. Bureau of the Census, 2000) that it is assumed the number of septic systems has not changed significantly. Table 3-6 presents the number of septic systems in Cabell and Wayne counties.

Table 3-6. Number of Septic Systems in Cabell and Wayne Counties

County	Number of Septic Systems
Cabell	8,485
Wayne	9,039

Onsite septic systems have the potential to deliver fecal coliform bacteria loads to surface waters due to system failure and malfunction. Many of the citizens in the Fourpole Creek watershed rely on septic systems for wastewater treatment (Cabell County Health Department, 2002). To evaluate this loading, it is necessary to determine where septic tanks are located and what proportion of these are malfunctioning. The Huntington Sanitary Board provided a geographic information system (GIS) coverage of the sewer system. It was assumed that areas within the sewered area of the watershed did not contain any homes with septic systems. A septic system density was determined for each county and septic systems were distributed evenly throughout the non-urban land use areas in the unsewered portion of the watershed. A septic system failure rate of 10 percent was used based on the assumption that because of a high water table and clay soils in the Fourpole Creek watershed, there is a high septic failure rate (Cabell County Health Department, 2002). The Cabell County Health Department was contacted to provide a specific failure rate for the area, but this information has not been provided to date.

Grazing Livestock

Grazing cattle and other agricultural animals deposit manure and, therefore, fecal coliforms on the land surface, where it is available for wash-off and delivery to receiving water bodies. The livestock information used to characterize the Fourpole Creek watershed is based on the 1997 Agricultural Census (USDA, 1997). The Agricultural Census provided counts of livestock in both Cabell and Wayne counties. The livestock count in the watershed is not large; Table 3-7 presents total livestock numbers in Cabell and Wayne counties based on the 1997 Agricultural Census (USDA, 1997).

Table 3-7. Livestock Numbers in Cabell and Wayne Counties

County	Cattle and Calves	Hogs	Chickens
Cabell	2,243	62	310
Wayne	2,569	79	N/A

Total pastureland within the watershed was provided by the GAP 2000 land use coverage. The livestock counts and pasture areas were used to determine livestock densities (i.e., number of cows per acres of pastureland) for the watershed, assuming even distribution of livestock over pasture area. Livestock densities were determined for each county based on the area of pasture land in each county. For example, dividing the total number of cattle in Cabell County by the area of pasture land in Cabell County provides a livestock density of 0.066 cattle per acre. Multiplying the cattle density by the area of pasture land within each subwatershed in Cabell County provides an estimate of the number of cattle in that subwatershed. The estimated livestock numbers in the Fourpole Creek watershed based on the above calculations are 188, 5, and 19 for cattle, hogs, and chickens, respectively.

Wildlife

Wildlife is another potential source of fecal coliform bacteria loading to receiving water bodies. For modeling purposes, the deer population is assumed to represent the wildlife contribution, since specific population data for other wildlife species in the watershed was not available. It is also assumed that deer habitat within the watershed includes cropland, pasture, wetland, and forest land uses. The deer population in West Virginia counties is estimated by the number of harvested bucks during the hunting season in each of the counties (WVDNR, 2001). It is estimated that the harvested bucks represent 10 to 15 percent of the entire deer population within a county. There are approximately 12,310 deer in Cabell County and 15,340 in Wayne County.

3.7 Point Sources

Thirty-seven point sources have been identified as potential sources of either fecal coliforms or aluminum in the watershed. Point sources are pollutant loads that are discharged at a specific location from pipes, outfalls, and conveyance channels and are subject to National Pollutant Discharge Elimination System (NPDES) permitting. Table 3-8 presents the permitted facilities located in the Fourpole Creek watershed, and Figure 3-5 presents the locations of the point sources in the watershed.

Table 3-8. Point Sources Located in the Fourpole Creek Watershed

Permit ID	Facility Name	Description	Permit Type	Area Disturbed (Acres)	Design Flow (cubic feet per second (cfs))
WVG550228	Plant at Huntington	General Sewage	Sewage	0.00	0.0015
WVG550211	Green Valley Hghts.	General Sewage	Sewage	0.00	0.0180
WVG550302	Woodhaven Subdivision	General Sewage	Sewage	0.00	0.0120
WVG550511	Marathon, 3901	General Sewage	Sewage	0.00	0.0010
WVG550811	Brentwood Village Homeowners	General Sewage	Sewage	0.00	0.0110
WVG071513	Christ Temple Church	Storm Water Construction (General Permit)	Industrial	14.10	0.0000
WVG071831	RT. 10/16th Street Development	Storm Water Construction (General Permit)	Industrial	9.10	0.0000
WVG551037	Hite-Saunders Elementary	General Sewage	Sewage	0.00	0.0100
WVG410116	Private Home	Home Aeration Unit General	Sewage	0.00	0.0005
WVG410195	Private Home	Home Aeration Unit General	Sewage	0.00	0.0006
WVG410209	Private Home	Home Aeration Unit General	Sewage	0.00	0.0005
WVG410052	Private Home	Home Aeration Unit General	Sewage	0.00	0.0006
WVG410087	Private Home	Home Aeration Unit General	Sewage	0.00	0.0005
WVG071940	Cabell County Contract #1	Storm Water Construction (General Permit)	Industrial	5.40	0.0000
WVG071937	Rt. 10/16th Street Development	Storm Water Construction (General Permit)	Industrial	24.60	0.0000

Permit ID	Facility Name	Description	Permit Type	Area Disturbed (Acres)	Design Flow (cubic feet per second (cfs))
WVG410384	Private Home	Home Aeration Unit General	Sewage	0.00	0.0006
WVG410496	Private Home	Home Aeration Unit General	Sewage	0.00	0.0005
WVG072060	The Huntington Business and Technology Park	Storm Water Construction (General Permit)	Industrial	88.00	0.0000
WVG410600	Private Home	Home Aeration Unit General	Sewage	0.00	0.0005
WVG072104	Columbia Gas Transmission Corporation	Storm Water Construction (General Permit)	Industrial	10.00	0.0000
WVG410617	Private Home	Home Aeration Unit General	Sewage	0.00	0.0005
WVG410656	Private Home	Home Aeration Unit General	Sewage	0.00	0.0005
WVG410580	Private Home	Home Aeration Unit General	Sewage	0.00	0.0005
WVG410785	Private Home	Home Aeration Unit General	Sewage	0.00	0.0006
WVG410792	Private Home	Home Aeration Unit General	Sewage	0.00	0.0006
WV0023159	Huntington Sewage Treatment Plant	Combined Sewer Overflow (CSO) (022)	Sewage	unknown	N/A
O-3-{2.6}*	At gas compression station near Memorial Blvd., in Huntington	Stormwater Discharge	MS4	unknown	N/A
O-3-{2.67}*	Along Memorial Blvd., in front of condos, in Huntington	Stormwater Discharge	MS4	unknown	N/A
O-3-{3.0}*	6th Street, Huntington	Stormwater Discharge	MS4	unknown	N/A
O-3-{3.2}*	2nd Street, Huntington	Stormwater Discharge	MS4	unknown	N/A
O-3-{3.4}*	4th Street, Huntington	Stormwater Discharge	MS4	unknown	N/A
O-3-{3.7}*	3rd Street, Huntington	Stormwater Discharge	MS4	unknown	N/A
O-3-{3.9}*	8th Street, Huntington	Stormwater Discharge	MS4	unknown	N/A
O-3-{4.4}*	Enslow Blvd. and Morris Street, Huntington	Stormwater Discharge	MS4	unknown	N/A
O-3-{4.47}*	1322 Enslow Blvd., Huntington	Stormwater Discharge	MS4	unknown	N/A
O-3-{4.78}*	Hal Greer Blvd., Huntington	Stormwater Discharge	MS4	unknown	N/A

* Note that this is not an NPDES permit number, but an ID number given to the discharge by WVDEP for sampling purposes. The stormwater discharges do not have NPDES permit numbers at the current time.

Source: WVDEP, 2002

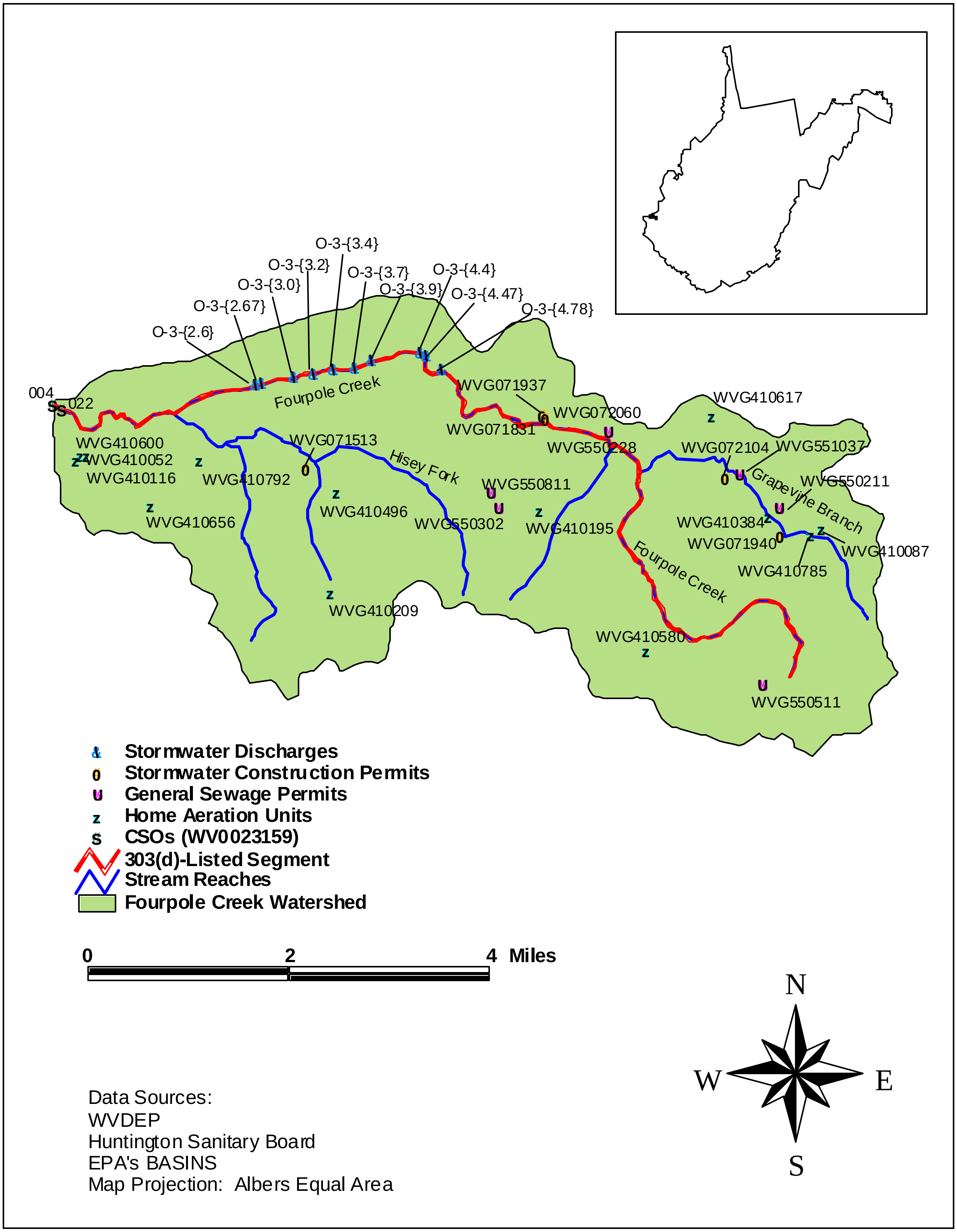

Figure 3-4. Fecal Coliform Bacteria and Aluminum Point Sources in the Fourpole Creek Watershed

3.7.1 Aluminum Point Sources

There are six potential point sources of aluminum in the Fourpole Creek watershed. The point sources are stormwater construction permits. While none of these facilities is specifically regulated to discharge aluminum, construction sites often contribute sediment to the watershed, which can result in an increase in total aluminum.

The current excavation for, and construction of, the new Huntington Business and Technology park, as well as other construction sites in the watershed, are potential point sources of aluminum. Construction on the park site began in 2001 and has a NPDES permit (ID WVG072060). The U.S. Army Corps of Engineers also issued a permit to allow the city of Huntington to relocate part of Fourpole Creek to make way for the office park (*Huntington Herald Dispatch*, 2001).

Two ponds are located on the construction site. One is upstream of the technology park and one is downstream. The ponds are used to control storm runoff based on expectations of a 50-year storm. The ponds are used to reduce sediment runoff from the construction site. Soils in the Fourpole Creek watershed are shown to be naturally high in aluminum concentrations, so any soil disturbance can result in an increase of sediment as well as aluminum to Fourpole Creek.

3.7.2 Fecal Coliform Point Sources

General Sewage Permits

There are six general sewage permits in the watershed that allow direct discharge of treated sewage into waters of the State (see Table 3-8). All of these facilities are permitted to discharge fecal coliform bacteria. The water quality data collected over the past few months, as well as inspection reports for some of the fecal coliform bacteria point sources in the watershed, show that some permitted facilities in the watershed do not always function properly. The malfunctioning of these facilities seems to be sporadic (WVDEP inspector), indicating that the facilities do function when properly cared for. However, it is likely that the malfunctioning permitted facilities account for the often high fecal coliform bacteria observations in the stream during low flow periods.

Stormwater Discharges

The water quality data collected from the stormwater drains along the mainstem of Fourpole Creek in the city of Huntington, as well as the data collected in-stream below the stormwater drains, suggest that the largely urban area of the city of Huntington is a significant source of fecal coliform bacteria to the stream. The locations of the stormwater drains within the city of Huntington are presented in Figure 3-5. The water quality data from the stormwater drains show that the stormwater drains often discharge high concentrations of fecal coliform bacteria after both small and large rain events. Based on the available data from those stormwater drains, it does not appear that fecal coliform bacteria are being discharged during very dry periods. The available flow and fecal coliform bacteria data collected at the stromwater drains are presented in Tables A-2 and A-3, respectively, in Appendix A.

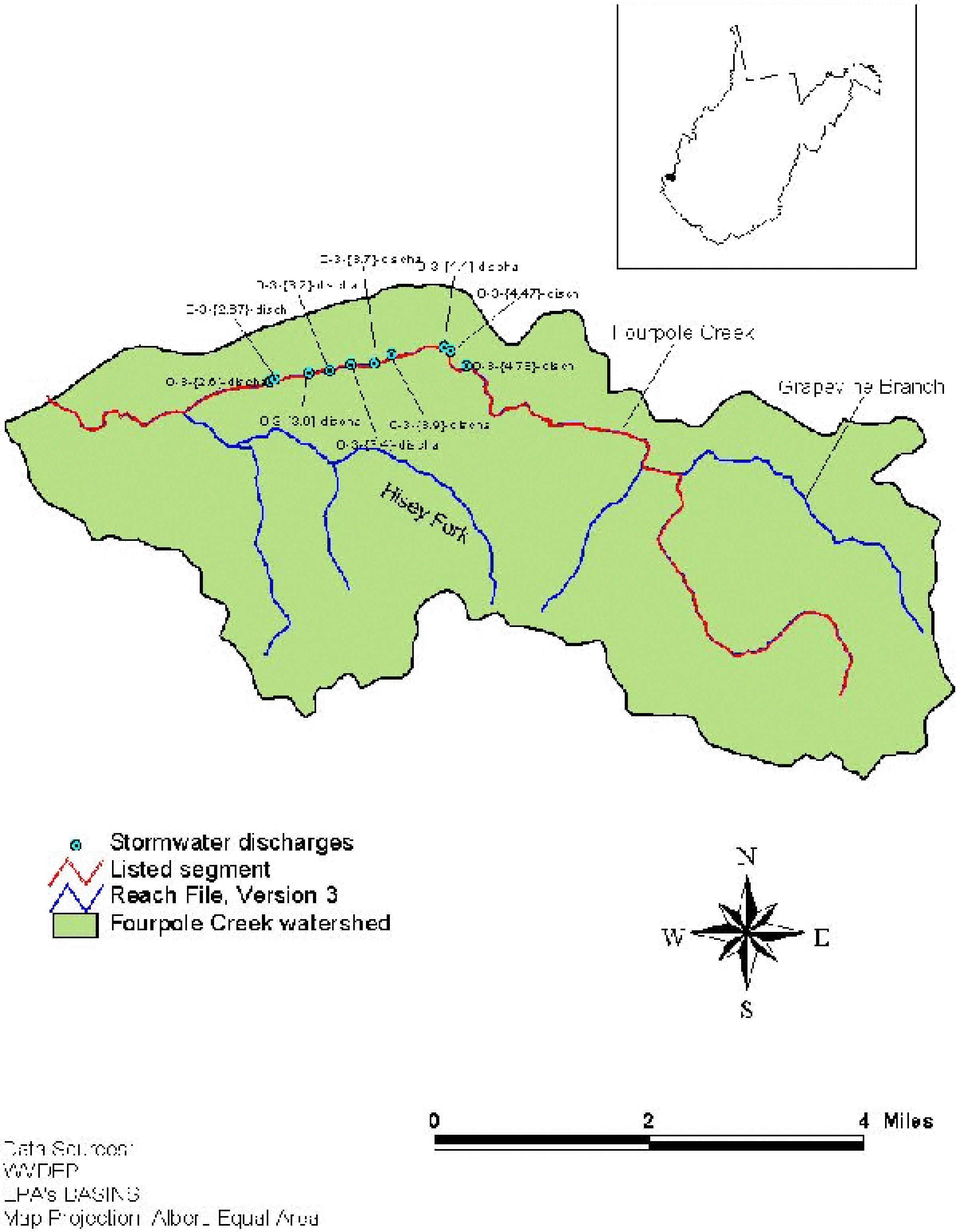

Figure 3-2. Location of Storm Sewers in Huntington

It is assumed that some homes in the watershed may be illicitly connected to the stormwater drains instead of the sanitary sewer lines and are contributing fecal coliform bacteria loads to the stormwater drains that are washed out during rain events.

Huntington's storm sewer system is subject to NPDES permitting, however, the storm sewers do not have NPDES permits or permit limits at this time. WVDEP will be issuing a general permit for Municipal Separate Storm Sewer Systems (MS4) by December 2002. The City of Huntington's storm sewer system is a MS4 facility and will be required to obtain coverage by March of 2003. One of the provisions of the coverage will be identification and elimination of illicit discharges into the storm sewer system.

Home Aeration Units

Approximately 13 homes in the Fourpole Creek watershed are not connected to the sewer system and do not have septic systems to treat their waste. These homes use home aeration units (HAUs) instead. HAUs are most often used when there is limited land area for a leach field, shallow water tables, or slowly permeable soils (WVU, 1995-1997). A two-year maintenance contract from the HAU distributor is required directly after installation, but after two years, the homeowner is responsible for maintaining the system.

A survey of HAUs was conducted through a cooperative effort between the Division of Plant and Soil Sciences and the Environmental Services and Training Division of the National Research Center for Coal and Energy, six county health departments, and the West Virginia Bureau of Public Health (WVU, 1995-1997). The purpose of the study was to determine if HAUs were discharging water that met health and environmental standards. The HAUs included in the study were selected for intensive examination by analyzing water samples for biological oxygen demand (BOD_5), total suspended solids (TSS), and fecal coliform bacteria. In addition, approximately 150 units were tested for levels of residual chlorine and turbidity. The results of the study indicated that many HAUs are not functioning as originally intended.

Based on permit criteria for BOD_5, TSS, and fecal coliforms, more than 90 percent of the inspected HAUs failed to meet state effluent criteria for at least one of the pollutants (WVU, 1995-1997). High levels of fecal coliform bacteria were likely due to inadequate chlorination of the effluent discharge. Only seven of the 150 units examined had chlorine residuals that were greater than 0.5 mg/L, which is the minimum standard for disinfection. In addition, 65 percent of the HAUs had one or more obvious maintenance deficiencies, including septic solids in the aeration chamber, aerator malfunctions, floating solids in the settling chamber, and failure to stock chlorine tablets for disinfection.

The county sanitarian for Cabell County provided an estimated failure rate of 50 percent for the HAUs in the Fourpole Creek watershed (Stan Mills personal communication, 2002).

Combined Sewer Overflows (CSOs)

There are also four combined sewer overflows (CSOs) that have been identified in the watershed (Huntington Sanitary Board, Personal Communication, 2002). The CSOs outfalls are part of the sewer system associated with the City of Huntington's sewage treatment plant (STP) (WV0023159). Two of the CSOs no longer discharge (023 - Park Avenue Regulator and 024 - James River Road Regulator), and the other two CSOs are located near the mouth of Fourpole Creek (004 - Fourpole Creek Pump Station and 023 - B&O Regulator). The Huntington Sanitary Board was contacted to provide flow information for the active CSOs. Information provided included the locations of the CSO outfalls, a GIS coverage of the CSO drainage area, the storm-event size that causes the CSOs to overflow (0.25 inches/hour), and monitored CSO and sewer-line flow data for two of the outfalls (outfalls 022 and 023). CSO 004, Fourpole Pump station, actually discharges to the Ohio River Baskwater and not Fourpole Creek and, therefore, was not included in this TMDL study. CSO 022, B & O Regulator is the only CSO discharging to Fourpole Creek. In Figure 3-6 the combined sewer and the CSO outfall currently discharging to the Fourpole Creek are shown just upstream from the mouth of the Fourpole Creek. The storm sewer system is shown further upstream (above the stream name).

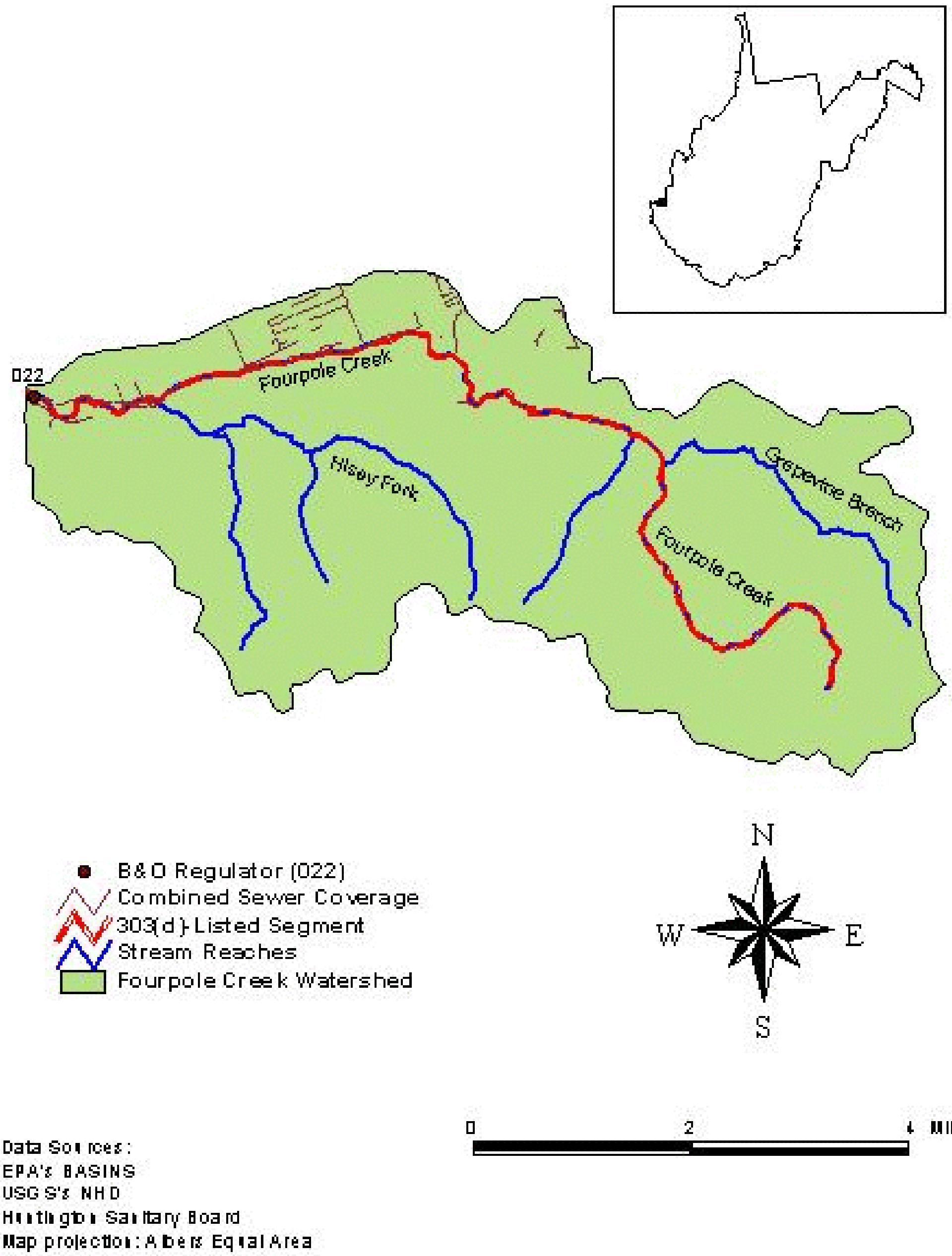

Figure 3-6. CSO System, Outfall, and Storm Sewer System Included in thr Fourpole Creek TMDL Study

4.0 Technical Approach

Establishing the relationship between the in-stream water quality targets and source loadings is a critical component of TMDL development. It allows for the evaluation of management options that will achieve the desired source load reductions. The link can be established through a number of techniques, ranging from qualitative assumptions based on sound scientific principles to sophisticated modeling techniques. Ideally, the linkage will be supported by monitoring data that allow the TMDL developer to associate certain waterbody responses to flow and loading conditions. The objective of this section is to present the approach taken to develop the linkage between sources and in-stream response for TMDL development in the Fourpole Creek watershed. Furthermore, according to 40 CFR Part 130, TMDLs must be designed to achieve and maintain the applicable water quality criteria. The applied water quality criteria for aluminum and fecal coliform bacteria in West Virginia are presented in Section 2.

In Section 3.7 point sources are pollutant loads that are discharged at a specific location from pipes, outfalls, and conveyance channels and are subject to National Pollutant Discharge Elimination System (NPDES) permitting. In this Section, the use of the terms "point source" and "nonpoint source" to describe the sources of pollutants representation does not represent a determination by EPA that certain types of discharges do or do not fit the definition of "point source" in Section 502(14) of the Clean Water Act, 33 U.S.C. § 1362(14), nor does the use of those terms in this Section represent any determination by EPA as to whether certain types of discharges do or do not require a permit pursuant to the National Pollutant Discharge Elimination System. In the context of this Section, the term "nonpoint source" is used simply to describe discharges that behave in a certain manner, specifically, discharges that are primarily precipitation-driven.

4.1 Model Framework Selection

Selecting the appropriate approach or modeling technique required considering the following:

- Expression of water quality criteria
- Dominant processes
- Scale of analysis

The relevant criteria for aluminum and fecal coliform bacteria were presented in Section 2. Numeric criteria, such as those applicable here, require evaluation of magnitude, frequency, and duration. Magnitude refers to the criterion maximum concentration (CMC) to protect against short-term (acute) effects or the criterion continuous concentration (CCC) to protect against long-term (chronic) effects. Frequency indicates the number of water quality criteria violations over a specified time period. In this case, for aquatic life criterion, WV WQS allows one excursion every three years. Duration measures the time period of exposure to increased pollutant concentrations. For CMC criteria, excursions are measured over a one-hour period while excursions for CCC criteria are measured over a four-day period. In addition to these considerations, any technical approach must consider how numeric aquatic life criteria are expressed. For aluminum, the West Virginia criteria are expressed as total aluminum. This dictates that the methodology predict the total metals concentration in the water column of the receiving water. Thresholds of a numeric measure are evaluated for frequency of exceedance (i.e., not to exceed more than once every three years on average). Acute standards typically require evaluation over short time periods, and violations may occur under variable flow conditions. Chronic criteria require the evaluation of the response over a four-day averaging period. The fecal coliform bacteria criteria are presented as either a geometric mean, using a minimum of five consecutive samples over a 30-day period, or a maximum standard not to be exceeded in more than 10 percent of all samples taken in a month. The approach or modeling technique must permit representation of in-stream concentrations under a variety of flow conditions in order to evaluate critical flow periods for comparison to chronic and acute criteria.

The approach must also consider the dominant processes regarding pollutant loadings and in-stream fate. For the Fourpole Creek watershed, primary sources contributing to aluminum and fecal coliform impairments include an array of nonpoint sources, as well as permitted point sources. Loading processes for nonpoint sources or land-based activities are typically rainfall-driven and thus relate to surface runoff and subsurface discharge to a stream. Permitted discharges may or may not be dependent on rainfall; however, they are controlled by permit limits.

Key in-stream factors that must be considered include routing of flow, dilution, and transport of total aluminum and fecal coliforms. In the Fourpole Creek watershed, the primary physical driving process is the transport of aluminum by diffusion and advection in streams. Significant chemical processes are the speciation and precipitation of aluminum followed by sediment adsorption/desorption and redox reactions related to the precipitation reactions. Significant in-stream processes affecting the transport of fecal coliforms and sediment include fecal coliform die-off, and deposition and resuspension of sediments.

Scale of analysis and waterbody type must also be considered in the selection of the overall approach. The approach should have the capability to evaluate watersheds at multiple scales, particularly those of a few hundred acres in size. Selection of scale should be sensitive to locations of key features, such as disturbed areas and point source discharges. At the larger watershed scale, land areas are lumped into subwatersheds for practical representation of the system, commensurate with the available data. Occasionally, there are site-specific and localized acute problems that may require more detailed segmentation or definition of detailed modeling grids.

Based on the considerations described previously, analysis of the monitoring data, review of the literature, and past aluminum and fecal coliform modeling experience, the Mining Data Analysis System (MDAS) was applied to represent the source-response linkage in the Fourpole Creek watershed. The MDAS is a comprehensive data management and modeling system that is capable of representing loading from both mining and non-mining nonpoint and point sources in the Fourpole Creek watershed and simulating in-stream processes.

4.2 Mining Data Analysis System Overview

MDAS is a system designed to support TMDL development for areas impacted by nonpoint and point sources. MDAS is capable of supporting TMDL development for pollutants other than metals, including fecal coliforms and sediment. The system integrates the following:

- Graphical interface
- Data storage and management system
- Dynamic watershed model
- Data analysis/postprocessing system

The graphical interface supports basic geographic information system (GIS) functions, including electronic geographic data importation and manipulation. Key data sets include stream networks, land use, flow and water quality monitoring station locations, weather station locations, and permitted facility locations. The data storage and management system functions as a database and supports storage of all data pertinent to TMDL development, including water quality observations, flow observations, and permitted facility discharge monitoring reports (DMRs), as well as stream and watershed characteristics used for modeling. The system also includes functions for inventorying the data sets. The Dynamic Watershed Model, also referred to as the Hydrological Simulation Program C++ (HSPC), simulates nonpoint source flow and pollutant loading as well as in-stream flow and pollutant transport, and it is capable of representing time-variable point source contributions. The data analysis/postprocessing system conducts correlation and statistical analyses and enables the user to plot model results and observation data.

The most critical component of the MDAS to TMDL development is the HSPC model, because it provides the linkage between source contributions and in-stream response. The HSPC is a comprehensive watershed model used to simulate watershed hydrology and pollutant transport as well as stream hydraulics and in-stream water quality. It can simulate flow, sediment, metals, nutrients, pesticides, and other conventional pollutants, as well as temperature and pH for pervious and impervious lands and waterbodies. The HSPC is essentially a re-coded C++ version of selected Hydrologic Simulation Program FORTRAN (HSPF) modules. HSPC's algorithms are identical to those in HSPF. Table 4-1 presents the modules from HSPF used in HSPC. Refer to the *Hydrologic Simulation Program FORTRAN User's Manual for Release 11* (Bicknell et al., 1996) for a more detailed discussion of simulated processes and model parameters.

Table 4-1. Modules from HSPF[a] Converted to HSPC

RCHRES Modules	HYDR	Simulates hydraulic behavior
	CONS	Simulates conservative constituents
	HTRCH	Simulates heat exchange and water
	SEDTRN	Simulates behavior of inorganic sediment
	GQUAL	Simulates behavior of a generalized quality constituent

	PHCARB	Simulates pH, carbon dioxide, total inorganic carbon, and alkalinity
PQUAL and IQUAL Modules	PWATER	Simulates water budget for a pervious land segment
	SEDMNT	Simulates production and removal of sediment
	PWTGAS	Estimates water temperature and dissolved gas concentrations
	IQUAL	Uses simple relationships with solids and water yield
	PQUAL	Simple relationships with sediment and water yield
	IWATER	Simulates water budget for impervious land segments

[a] Source: Bicknell et al., 1996.

4.3 Model Configuration

The MDAS was configured for the Fourpole Creek watershed, and the HSPC model was used to simulate the watershed as a series of hydrologically connected subwatersheds. Configuration of the model involved subdivision of the Fourpole Creek watershed into modeling units, followed by continuous simulation of flow and water quality for these units using meteorological, land use, point source loading, and stream data. The specific pollutants that were simulated were total aluminum, sediment, and fecal coliforms. This section describes the configuration process and key components of the model in greater detail. As mentioned previously, the hydrologic response of the Fourpole Creek watershed was developed by applying hydrologic parameters established by the hydrologic calibration of the Hurricane Creek watershed. The following descriptions referring to hydrologic calibration, e.g., land use, meteorological data, etc., but not water quality data, were required for Hurricane Creek watershed also.

4.3.1 Watershed Subdivision

To represent watershed loadings and resulting concentrations of aluminum and fecal coliforms in Fourpole Creek, the watershed was divided into 12 subwastersheds. These subwatersheds represent hydrologic boundaries and are presented in Figure 4-1. The division was based on elevation data (7.5-minute Digital Elevation Model [DEM] from USGS), stream connectivity (from USGS's National Hydrography Dataset [NHD] stream coverage), and locations of monitoring stations. Hurricane Creek was not divided into subwatersheds, but was represented as one watershed (Figure 4-2).

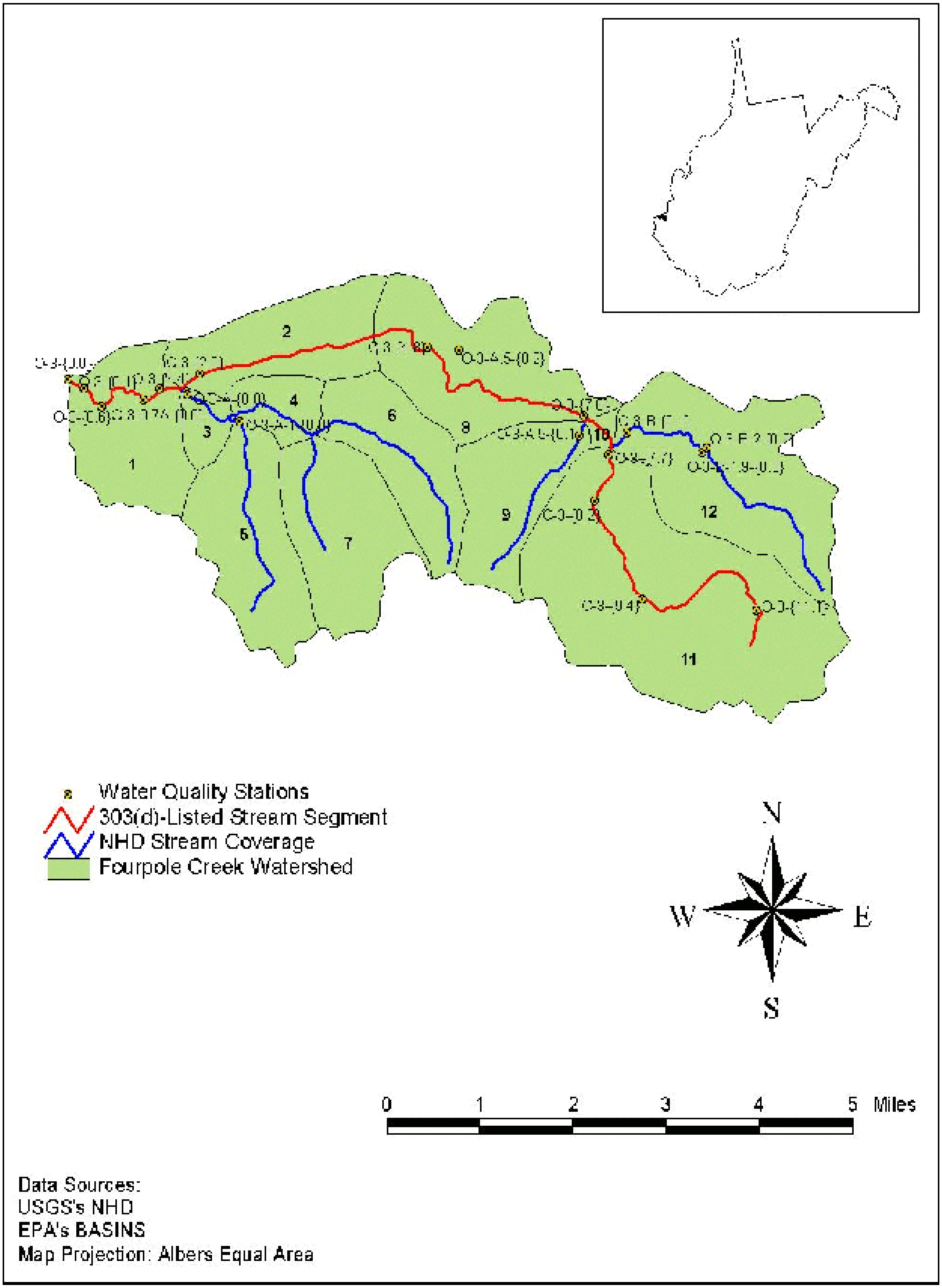

Figure 4-1. Subwatersheds of the Fourpole Creek Watershed

4.3.2 Meteorological Data

Meteorological data are a critical component of the watershed model. Appropriate representation of precipitation, wind speed, potential evapotranspiration, cloud cover, temperature, and dewpoint are required to develop a valid model. Meteorological data from a number of sources were accessed in an effort to develop the most representative dataset for the Fourpole Creek watershed.

In general, hourly precipitation data are recommended for nonpoint source modeling. Therefore, only weather stations with hourly recorded data were considered in developing a representative dataset. Long-term hourly precipitation data (through 2000) available from four National Climatic Data Center (NCDC) weather stations located near the watersheds were considered. The stations were: Huntington WSO Airport, Portsmouth Sciotoville, Louisa 2S, and Charleston WSO Airport. Figure 4-2 presents the locations of the four nearby NCDC weather stations. The Huntington WSO Airport station was chosen for the Fourpole Creek and reference watershed modeling effort due to its proximity to the watershed.

Since nearly all of the water quality observation data were collected during late 2001 and early 2002, it was necessary to obtain recent weather data. Recent weather data (to current date) were obtained through the Automated Flood Warning System (AFWS) website. The website is a cooperative effort between the National Weather Service and NOAA, and is managed by the IFLOWS Network Program of the National Weather Service. These IFLOWS stations were used to supplement the NCDC data for the year 2001 and 2002. The three IFLOWS weather stations used to patch the missing 2001 and 2002 weather data included Salt Rock, Tick Ridge, and Mill Creek.

Meteorological data for the remaining required parameters were available from the Huntington WSO Airport and Charleston WSO Airport stations. These data were applied based on watershed location relative to the weather stations.

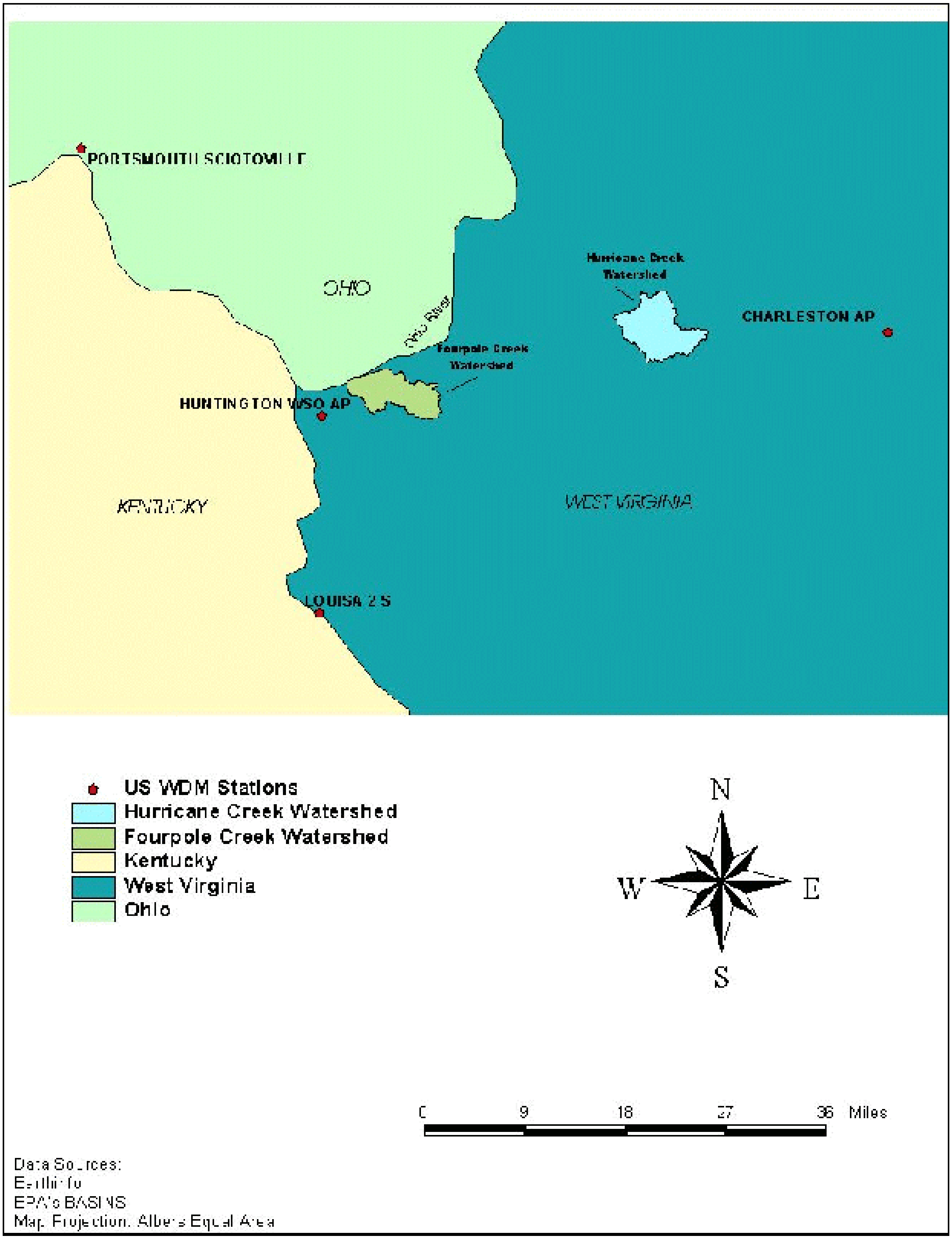

Figure 4-2. NCDC Weather Stations Near the Fourpole Creek Watershed

4.3.3 Nonpoint Source Representation

The nonpoint sources in the Fourpole Creek watershed are presented differently in the model depending on their type and behavior. The GAP 2000 land use categories were regrouped into ten categories that best describe the watershed conditions and dominant source categories (as shown in Section 3.4). The ten land use categories represent nonpoint sources, including forest, barren land, cropland, pasture, surface mining, construction areas, urban, and wetlands. Table 4-2 presents the area of each reclassified land use by subwatershed.

Table 4-2. Land Use Areas (in acres) by Subwatershed for Fourpole Creek

Sub-watershed	1	2	3	4	5	6	7	8	9	10	11	12	Total
Surface Water	15.35	0.00	0.00	0.00	0.00	0.00	0.45	0.22	0.00	0.00	1.11	4.01	21.14
Barren	10.24	3.56	0.00	0.00	2.89	3.78	6.01	2.23	7.79	2.67	52.96	32.49	124.60
ASM	0.00	0.00	0.00	0.00	10.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.40
Construction	0.00	0.00	0.00	0.00	0.00	0.00	14.10	121.70	0.00	0.00	0.00	15.40	151.20
Cropland	0.00	0.00	0.00	3.34	12.68	2.00	0.00	0.00	3.12	0.00	25.59	0.00	46.73
Pasture	190.46	36.49	71.42	34.27	335.98	178.89	282.80	105.91	263.44	12.68	759.39	456.79	2728.52
Forest	269.23	87.44	41.83	105.02	821.31	526.88	748.85	220.28	644.58	16.02	2407.23	1065.28	6953.95
Wetlands	44.95	13.35	0.00	0.45	0.00	0.00	0.00	0.00	0.00	0.00	1.11	0.00	59.85
Urban Pervious	396.67	615.26	66.71	128.67	75.56	168.45	96.12	733.05	54.89	9.59	176.51	289.25	2810.74
Urban Impervious	225.22	345.27	44.76	82.03	45.92	155.51	126.38	405.04	33.22	22.90	157.91	166.88	1811.04
TOTAL	1152.11	1101.38	224.73	353.78	1304.74	1035.52	1274.70	1588.43	1007.04	63.86	3581.81	2030.09	14718.16

The land uses of construction and active surface mining (ASM) were not included in the original GAP 2000 land use coverage, however, NPDES permits and Article 3 permits for those facilities provided the disturbed area associated with each construction or mining facility in the watershed. The disturbed area was subtracted from the dominant land use, which was forest, in each appropriate subwatershed. The land use coverage was used as the basis for estimating aluminum and fecal coliform loadings. The assumed pervious and impervious percentage for each land use, which affects the hydrology and water quality of the Fourpole Creek and Hurricane Creek watersheds, is listed in Table 4-3. These percentages are based on the average percent impervious area of different land use types found in the Soil Conservation Services *Urban Hydrology for Small Watersheds* manual (USDA-SCS, 1986).

Table 4-3. Average Percent Perviousness and Imperviousness for Different Land Use Types

Land Use	Pervious (%)	Impervious (%)
Pasture	100	0
Cropland	100	0
Forest	100	0
Barren	100	0
Active Surface Mine (ASM)	100	0
High-density commercial/industrial/transportation (urban impervious)	10	90
Lower-density residential (urban pervious)	81	19
Unpaved roads	100	0
Wetlands	100	0

Fecal Coliform Sources

The nonpoint fecal coliform sources within the Fourpole Creek watershed are represented differently in the model depending on their type and behavior. The following nonpoint fecal coliform sources have been identified within the listed watersheds:

- Urban and residential runoff
- Leaking sanitary sewers
- Failing septic systems
- Grazing livestock
- Runoff from cropland
- Wildlife

Frequently, nonpoint sources are characterized by build-up and wash-off processes. Bacteria accumulates on land surfaces where it is subject to die-off and wash-off with surface water runoff. These nonpoint sources are represented in the model as land-based runoff from the land use categories. Fecal coliform accumulation rates (number per acre per day) can be calculated for each land use based on all sources contributing fecal coliforms to the land surface. For example, grazing livestock and wildlife are specific sources contributing to land uses within the watershed. The land uses that experience bacteria accumulation due to livestock and wildlife include:

- Cropland (wildlife)
- Forest (wildlife)
- Pasture (livestock and wildlife)
- Wetlands (wildlife)

Accumulation rates can be derived using the distribution of animals by land use and using typical fecal coliform production rates for different animal types (Table 4-4). For example, the fecal coliform bacteria’s accumulation rate for pasture lands is the sum of the individual fecal coliform accumulation rates due to contributions from grazing livestock (cattle) and wildlife.

Table 4-4. Fecal Coliform Production Rates for Beef Cattle and Deer

Animal	Fecal Coliform Production Rate	Reference
Beef cow	1.0×10^{11} counts/day	ASAE, 1998
Deer	5×10^{8} counts/day	Linear interpolation; Metcalf & Eddy, 1991

Direct contributions to the waterbodies from in-stream cattle were not included in this TMDL modeling effort because of the relatively small number of cattle estimated to be in the watershed (see Section 3.5.3). A site visit to the watershed in April of 2000 found the watershed to be very urban and residential and there were no cattle seen in the stream.

Literature values for typical fecal coliform bacteria accumulation rates were used for the urban/residential land uses. The literature value used for residential land uses is 1.66 E+07 fecal coliform counts/ac/day, the maximum average of the default values for high-density single family residential/urban areas (Horner, 1992). This conservative assumption was selected to account for the illicit connections to storm sewers discussed in Section 3.5.2 as well as any failing septic systems and/or straight pipes in the urban areas along the stream in the unsewered subwatersheds.

Failing septic systems represent a nonpoint source that can contribute fecal coliforms to receiving waterbodies through surface or subsurface flow. The number of septic systems per subwatershed were determined using U.S. Census data. The 1990 Census provided the number of homes with septic systems in both Cabell and Wayne counties. The number was then divided by the total county area to obtain a septic density. That septic density was applied to the unsewered non-urban land use areas in each subwatershed. The estimation of the number of septic systems that are failing is discussed in Section 3.5.2. To provide for a margin of safety accounting for the uncertainty of the number, location, and behavior (e.g., surface vs. subsurface breakouts; proximity to stream) of the failing systems, failing septic systems are represented in the model as direct sources of fecal coliforms to the stream reaches. Fecal coliform contributions from failing septic system discharges are included in the model with a representative flow and concentration, which were quantified based on the following information:

- Number of failing septic systems in each subwatershed (failure rate discussed in Section 3.3.2).
- Estimated population served by the septic systems (average of county averages of people per household, obtained from 1990 Bureau of the Census data).
- An average daily discharge of 70 gallons/person/day (Horsley & Witten, 1996).
- Septic effluent concentration of 1.0 E+06 fecal coliform counts/100 mL (Horsley & Witten, 1996).

Aluminum Sources

As with fecal coliforms, sediment nonpoint sources are typically characterized by erosion and wash-off processes. Based on analysis of the water quality data in Fourpole Creek watershed, possible nonpoint sources of sediment include surface mining, barren land, harvested forest, forest, roads, and agriculture. The contributions of sediment to the watershed from these sources is discussed in Section 3.3.1. Soil detachment by rainfall on the contributing land uses is represented in the sediment module of HSPC.

The detached sediment is removed by surface flow and is washed off into the stream reach where it eventually settles or is resuspended in the water column.

Erosion is linked to the aluminum loading to the streams because of the naturally high aluminum concentrations in the soils of the watershed. Non-mining sources may produce high aluminum concentrations due to the naturally high concentrations of aluminum in the soils and bedrock in the watershed and their association with sediment. As configured, HSPC does not directly link reductions in sediment to reductions in metals, but based on the assumption that high metals loadings are associated with increased sediment delivery to the watershed, it is assumed that reduction in sediment would in turn result in a reduction of metals to the watershed.

4.3.4 Point Sources Representation

Permitted Fecal Coliform Point Sources

A total of 19 point sources have NPDES permits regulating fecal coliform bacteria discharge to Fourpole Creek and its tributaries (see Section 3.6). Six of the permits for fecal coliforms are general sewage permits. These general sewage point sources are represented in MDAS with a constant flow and fecal coliform count. The representative constant flow is the design flow provided in the NPDES permit for each facility. The fecal coliform discharges from each of the facilities are represented in the MDAS model by a the monthly average discharge limitation of 200 fecal coliform counts/100 mL provided in the NPDES permits.

The remaining 13 point sources with NPDES permits regulating fecal coliform bacteria discharge are the HAUs discussed in Section 3.6.2. It was assumed that 50 percent of the HAUs were failing, so the functioning HAUs were represented in the model by their design flow and the average monthly permitted fecal coliform discharge of 200 counts /100mL. For model calibration purposes the failing HAUs were represented in the model by their design flows and a fecal coliform discharge of 1.0 E+06 counts/100mL. It was assumed that a failing HAU acts much like a failing septic system and therefore, the fecal coliform concentration used for failing septic systems was also used for failing HAUs during the water quality calibration period. However, for the allocation scenario (discussed in Section 5) the average monthly permitted fecal coliform discharge of 200 counts/100 mL was used to represent the HAUs, assuming that at the time of implementation of this TMDL all point sources in the watershed will be meeting their allowable pollutant loads as regulated in their NPDES permits.

There is also one CSO discharge associated with the City of Huntington's STP (WV0023519) discharging within the watershed. The CSO was included as point sources in the watershed. The CSO outfall discharges at a discrete point, however, it behaves more like a nonpoint source of fecal coliform bacteria because the discharge is driven by rainfall. To account for the CSO discharge to the watershed, the area of the watershed contributing to both the B&O Regulator (022) and the Fourpole Pump Station (004) CSO discharges was determined based on GIS maps of the combined sewer system (Huntington Sanitary Board, 2002). The drainage areas of the CSOs encompassed portions of subwatresheds 1, 2, and 8. According to the Huntington Sanitary Board, a rainfall event of 0.25 inches per hour causes the CSOs to discharge. Based on that information, it was assumed that any time it rains 0.25 inches per hour or more, the runoff from the CSO drainage area goes into the combined sewer system and is discharged in subwatershed 1 at the CSO outfalls. Fecal coliform bacteria loadings from the CSO drainage area were calulated by MDAS using the weather data at the Huntington weather station discussed in Section 4.3.2 and a second time only for the rainfall events under 0.25 inches per hour. The difference between the fecal coliform bacteria loads at regular rainfall conditions and the reduced rainfall conditions was subtracted from the urban land use areas in subwatersheds 1, 2, and 8 and included as the fecal coliform bacteria load from CSOs to subwatershed 1. Information provided on the CSO discharges in the watershed indicated that the Fourpole Pump Station (004), that actually discharges to the Ohio River backwater, makes up approximately 99 percent of the flow and fecal coliform bacteria load from the Fourpole watershed as compared to one percent from the B&O Regulator (022). One percent of the total modeled CSO load was assumed to be coming from the B& O regulator and was included as the existing load of fecal coliform bacteria to the watershed. The 99 percent of the load from the Fourpole Pump Station was not included as part of the fecal coliform bacteria load since it is discharged to the Ohio River backwater.

Permitted Aluminum Point Sources

The six point sources in the watershed are stormwater permits for construction sites. The permits require that the effluent from the sites meet West Virginia's water quality standards, however, monitoring of the effluent is not required. The permits also require that the construction sites employ best management practices such as silt fences, sediment traps, seeding and mulching, and rip-rap to prevent or reduce erosion and off-site migration of sediment. The stormwater construction NPDES permits do not specifically regulate the discharge of aluminum, however, construction sites in the Fourpole Creek watershed are considered to be significant sources of sediment and therefore, of aluminum (see Section 3.5.1).

Construction sites do not behave as traditional point sources and are more accurately depicted as being rainfall-driven discharges. The disturbed area for each of the point sources was provided in its corresponding NPDES permit. The disturbed area associated with each permit was subtracted from the dominant land use in each of the respective subwatersheds, which was forest in all cases. The sediment and aluminum loads from each of the point sources were determined through water quality calibration using the sediment module of MDAS.

4.3.5 Stream Representation

Modeling subwatersheds and calibrating hydrologic and water quality model components required the routing of flow and pollutants through streams. Each subwatershed was represented with a single stream. Stream segments were identified using USGS's NHD stream coverage.

In order to route flow and pollutants, development of rating curves was required. Rating curves were developed for each stream using Manning's equation and representative stream data. Required stream data include slope, Manning's roughness coefficient, and stream dimensions including mean channel widths and depths. Manning's roughness coefficient was assumed to be 0.05 for all streams (representative of natural streams). Slopes were calculated based on digital elevation model (DEM) data and stream lengths measured from the RF3 and NHD stream coverages. Stream dimensions were estimated using regression curves that relate upstream drainage area to stream dimensions (Rosgen, 1996).

4.3.6 Hydrologic Representation

Hydrologic processes were represented in MDAS using algorithms from the PWATER (water budget simulation for pervious land segments) and IWATER (water budget simulation for impervious land segments) modules of HSPF (Bicknell et al., 1996). Parameters associated with infiltration, groundwater flow, and overland flow were designated during hydrologic model calibration for Hurricane Creek and then applied to the Fourpole Creek watershed.

4.3.7 Pollutant Representation

In addition to flow, total aluminum and fecal coliform bacteria were modeled with the HSPC. The loading contributions of these pollutants from different nonpoint sources were represented in MDAS using the PQUAL (simulation of quality constituents for pervious land segments) and IQUAL (simulation of quality constituents for impervious land segments) modules from HSPF (Bicknell et al., 1996). Pollutant transport was represented in the streams using the GQUAL (simulation of behavior of a generalized quality constituent) and SEDMNT (simulation of sediment and its associated quality constituents) modules. Values for the pollutant representation will be refined through the water quality calibration process for the Fourpole Creek watershed only.

4.4 Model Calibration

After the model was configured, calibration was performed at multiple locations throughout the Fourpole Creek watershed. Calibration refers to the adjustment or fine-tuning of modeling parameters to reproduce observations. Model calibration focused on two main areas: hydrology for the Hurricane Creek watershed and water quality for the Fourpole Creek watershed. Upon completion of the calibration at selected locations, a calibrated dataset containing parameter values for modeled sources and pollutants was developed. This dataset was applied to areas where calibration data were not available.

A significant amount of time-varying monitoring data were necessary to calibrate the model. Available monitoring data in the watershed were identified and assessed for application to calibration. Because of the very limited data available for calibration in the Fourpole Creek watershed, stations with the largest amount of available data were used for calibration throughout the watershed. The locations selected for water quality calibration are presented in Figure 4-3.

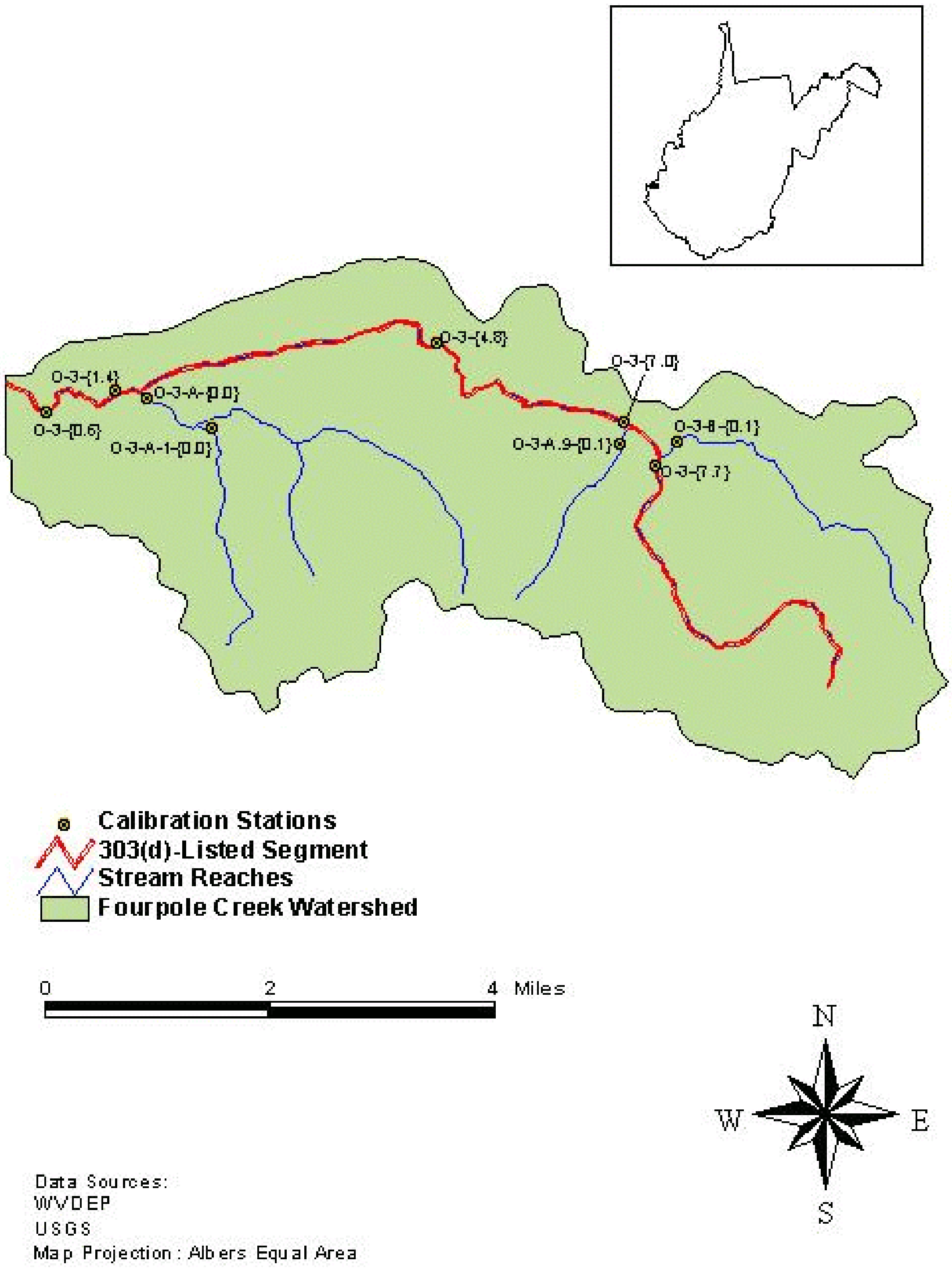

Figure 4-3. Water Quality Stations used for Calibration

4.4.1 Hydrology Calibration

Hydrology was the first model component calibrated. The hydrology calibration involved a comparison of model results to in-stream flow observations at selected locations and the subsequent adjustment of hydrologic parameters. Key considerations included the overall water balance, the high-flow/low-flow distribution, storm flows, and seasonal variation.

As mentioned in Section 3.2, there are no recent time series flow data available for the Fourpole Creek watershed. In order to calibrate the MDAS model for hydrology, a reference watershed approach was used. A watershed with similar properties to Fourpole Creek as well as available time series flow data was chosen as a reference for the Fourpole Creek watershed. The reference watershed Hurricane Creek was chosen based on its proximity and similarities to the Fourpole Creek watershed. The USGS flow station used for hydrology calibration in the Hurricane Creek watershed was USGS 03201405 (Hurricane Creek at Hurricane, West Virginia). The gauge only had flow data for the two-year time period of October 10, 1998 through September 30, 2000. The model was calibrated for the Hurricane Creek watershed, and the resulting hydrology parameters were applied to the model for use in the Fourpole Creek watershed. Temporal comparisons and comparisons of high flows and low flows were developed to support calibration. The calibration involved adjustment of infiltration, subsurface storage, evapotranspiration, surface runoff, and interception storage parameters.

There were no available weather data directly at the Hurricane Creek watershed. The Charleston weather station is located approximately 22 miles to the east, and the Huntington weather station is located about approximately 30 miles to the west, near the Fourpole Creek watershed. Both weather stations were used during calibration, but Huntington was chosen for the final hydrology calibration because it seemed to work best overall. Due to the mountainous nature of West Virginia, it is common for localized summer thunderstorms to vary greatly over very short distances. The Charleston and Huntington weather data often showed localized spring and summer rain events that may not have occurred in the Hurricane Creek watershed. These localized rain events during the spring and summer seasons made it very difficult to calibrate the model within reasonable percent errors for these time periods. The model was primarily calibrated during the fall and winter seasons, which are more representative of both watersheds because they have fewer thunderstorms than the spring and summer seasons.

Table 4-5 presents the simulated flow to the observed flow at USGS gauge 03201405 for the time period October 1, 1999 through September 30, 2000. The hydrology was calibrated based on water year 2000 because 1999 was a drought year without much flow variation.

Table 4-5. Hydrology Calibration: Comparison of Simulated and Observed Flow in the Hurricane Creek Watershed for Water Year 2000

Simulated Versus Observed Flow	Percent Error	Recommended Criterion
Error in total volume	-13.47	+/- 10%
Error in 50% lowest flows	-55.23	+/- 10%
Error in 10% highest flows	-2.15	+/- 15%

Simulated Versus Observed Flow	Percent Error	Recommended Criterion
Seasonal volume error - Summer	-65.89	+/- 30%
Seasonal volume error - Fall	11.51	+/- 30%
Seasonal volume error - Winter	13.25	+/- 30%
Seasonal volume error - Spring	-28.31	+/- 30%
Error in storm volumes	-15.32	+/- 20%
Error in summer storm volumes	-71.58	+/- 50%

After adjusting the appropriate parameters within acceptable ranges, good correlations were found between model results and observed data for the comparisons made during the fall and winter seasons. Temporal analyses are presented in Appendix D.

The calibrated parameter values were validated for an independent time period after calibrating hydrology parameters at the station in Hurricane Creek. The flow observations used for validation were the very limited data obtained for Fourpole Creek between November 2001 and March 2002. Validation involved comparison of model results and flow observations without further adjustment of parameters. The validation comparisons also showed a good correlation between modeled and observed data. Refer to Appendix D for the validation results.

4.4.2 Water Quality Calibration

Following hydrology calibration, the water quality constituents were calibrated for Fourpole Creek only. Modeled versus observed in-stream concentrations were directly compared during model calibration. The water quality calibration consisted of executing the watershed model, comparing water quality time series output to available water quality observation data, and adjusting water quality parameters within a reasonable range.

The approach taken to calibrate water quality focused on matching trends identified during the water quality analysis. Daily average in-stream concentrations from the model were compared directly to observed data. Observed data were obtained from data collected by WVDEP from November 2001 through March 2002. The objective was to best simulate low flow, mean flow, and storm peaks at representative water quality monitoring stations. The model was calibrated for all water quality stations having a significant amount of observation data during the chosen calibration period.

The time period of the model simulation was from January 2001 through March 2002. This time period was selected based on the availability and relevance of the observed data to the current conditions in the watershed. For each pollutant, model results were plotted against available data at eight water quality stations to assess the model's response to spatial variation of loading sources. The results of the water quality calibrations for fecal coliform and aluminum are presented in Appendices E and F, respectively.

5.0 Allocation Analysis

TMDLs are comprised of the sum of individual wasteload allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources, and natural background levels. In addition, the TMDL must include a margin of safety (MOS), either implicitly or explicitly, that accounts for the uncertainty in the relationship between pollutant loads and the quality of the receiving water body. TMDLs can be expressed in terms of mass per time or by other appropriate measures. Conceptually, this definition is denoted by the equation:

$$TMDL = \sum WLAs + \sum LAs + MOS$$

To develop aluminum and fecal coliform bacteria TMDLs for each of the waterbodies in the Fourpole Creek watershed listed on the West Virginia 303(d) list, the following approach was taken:

- Define TMDL endpoints.
- Simulate baseline conditions.
- Assess source loading alternatives.
- Determine the TMDL and source allocations.

5.1 TMDL Endpoints

TMDL endpoints represent the in-stream water quality targets used in quantifying TMDLs and their individual components. Different TMDL endpoints are necessary for each impairment type (aluminum and fecal coliforms). West Virginia's numeric water quality criteria for aluminum and fecal coliform bacteria, identified in Section 2, including an explicit and implicit margin of safety (MOS) were used to identify endpoints for TMDL development.

5.1.1 Aluminum

The TMDL endpoint for aluminum was selected as 712.5 ug/L based on the 750 ug/L criterion for aquatic life minus an approximate five percent MOS. Components of the TMDLs for aluminum are presented in terms of mass per time in this report.

5.1.2 Fecal Coliform Bacteria

The endpoint for fecal coliform bacteria was selected as the instantaneous endpoint of 380 counts/100mL based on the 400 counts/100mL criterion for human health minus an approximate five percent MOS and the geometric mean endpoint of 190 counts/100mL based on the 200 counts/100mL geometric mean criterion minus an approximate five percent MOS. The instantaneous criterion is more stringent and more difficult to obtain, however, both criteria are satisfied in this TMDL.

5.1.3 Margin of Safety

An implicit MOS was included in TMDL development through application of a dynamic model for simulating daily loading over a wide range of hydrologic and environmental conditions, and through the use of conservative assumptions in model calibration and scenario development. In addition to this implicit margin of safety, an explicit MOS of approximately five percent was used to account for the uncertainties in the modeling.

5.2 Baseline Conditions

The calibrated model provided the basis for performing the allocation analysis. The first step in this analysis involved simulation of baseline conditions. Baseline conditions represent existing nonpoint source loading conditions and permitted point sources' maximum allowed loads, whether or not the point source is discharging at its permitted loads. The baseline conditions allow for an evaluation of in-stream water quality under the "worst currently allowable" scenario.

The model was run for baseline conditions for the period January 1, 1996, through December 31, 2000. Predicted in-stream concentrations of aluminum and fecal coliforms for the impaired waterbodies in the Fourpole Creek watershed were compared directly to the TMDL endpoints. This comparison allowed evaluation of the expected magnitude and frequency of exceedances under a range of hydrologic and environmental conditions, including dry periods, wet periods, and average periods. Figure 5-1 presents the total rainfall sum for the years 1991 through 2001 at the Huntington weather station. The years from 1996 through 2000 are marked to show that a wide range of precipitation conditions was used forTMDL development in the Fourpole Creek watershed.

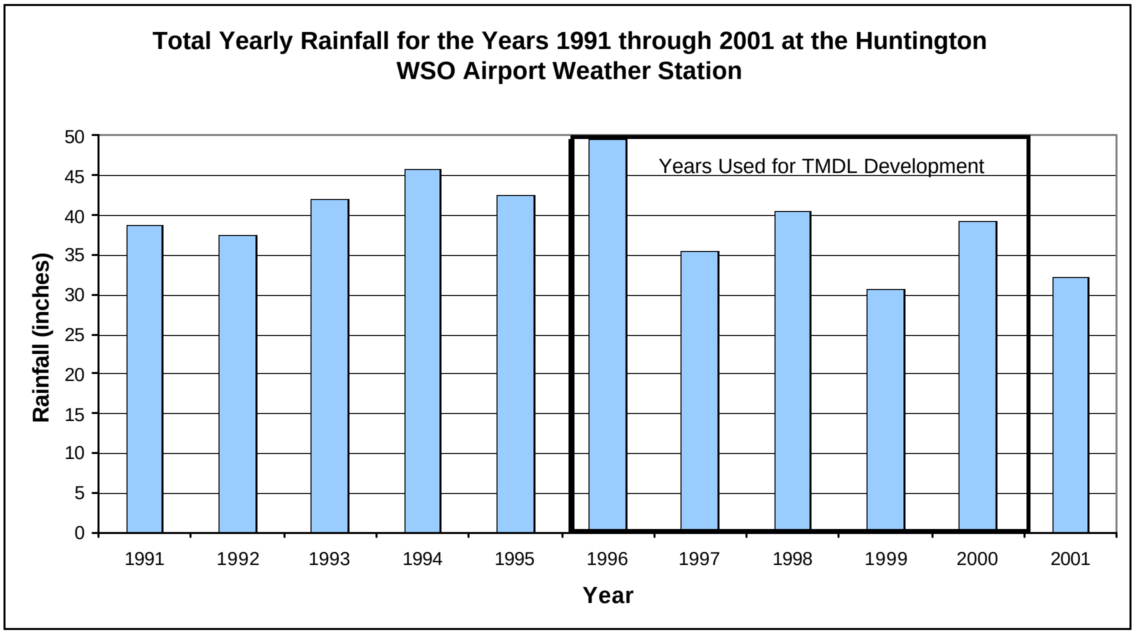

Figure 5-1. Total Annual Precipitation Sums at the Huntington WSO Airport (1991-2001)

Permitted conditions for fecal coliform bacteria point sources were represented using the design flow for each facility and the monthly average discharge of 200 counts/100mL.

There are six stormwater construction permits (WVG071513, WVG071831, WVG071940, WVG071937, WVG072060, and WVG072104) in the watershed. These permitted facilities were grouped by subwatershed in the modeling process and are represented by the land use Construction Sites. All of these permitted sources were represented in the watershed by including their disturbed areas, as given in their permits.

5.3 Source Loading Alternatives

Simulation of baseline conditions provided the basis for evaluating each stream's response to variations in source contributions under virtually all conditions. This sensitivity analysis gave insight into the dominant sources and how potential decreases in loads would affect in-stream pollutant concentrations. For example, loading contributions from permitted facilities and nonpoint sources were individually adjusted and in-stream concentrations were observed.

Multiple scenarios were run for the impaired waterbodies. Successful scenarios were those that achieved the TMDL endpoints under all conditions for aluminum and fecal coliforms for the 1996 through 2000 modeling period. Exceedances for aluminum were allowed once every three years. Figure 5-2 presents an example of a total aluminum TMDL at the mouth of the Fourpole Creek watershed. In general, aluminum loads contributed by construction and urban land uses were reduced first because they generally had the greatest impact on in-stream concentrations. If additional load reductions were required to meet the TMDL endpoints, reductions were made to barren land, then cropland and pasture.

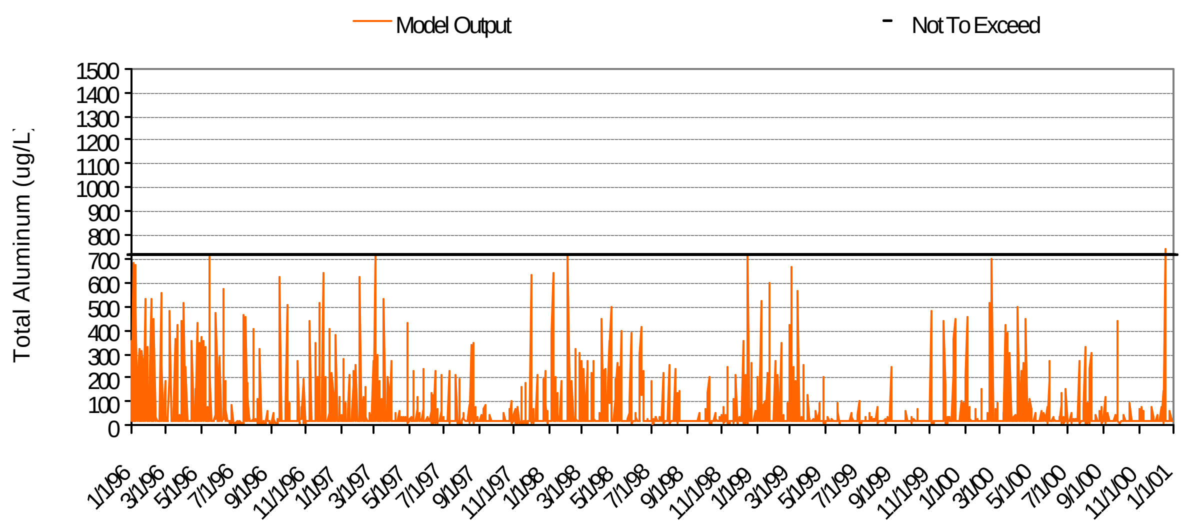

Figure 5-2. Total aluminum TMDL at the mouth of Fourpole Creek (subwatershed 1)

The fecal coliform loading from each subwatershed was reduced until the geometric mean criterion of 200 counts/100mL (minus the MOS) was met. Once the geometric mean standard was met, fecal coliform bacteria loads were further reduced until the instantaneous criterion of 400 counts/100mL was met. Exceedances of the instantaneous fecal coliform criterion were allowed in no more than 10 percent of the modeled days per month as required by West Virginia's water quality standards. Figure 5-3 presents an example of a fecal coliform bacteria TMDL based on the 30-day geometric mean at the mouth of Fourpole Creek. Figure 5-4 presents an example of a fecal coliform TMDL based on the instantaneous criterion at the mouth of Fourpole Creek. In general, fecal coliform bacteria loads contributed by urban land uses were reduced first because they generally had the greatest impact on in-stream concentrations. If additional load reductions were required to meet the TMDL endpoints, reductions were made to pasture. Reductions were not made to any remaining point sources. Point sources were included in the model at their monthly average permit limits for fecal coliforms. Exceedances of permit limits have been observed in the watershed, however, for TMDL purposes it is assumed that these point sources will be compliant prior to implementation of the TMDL.

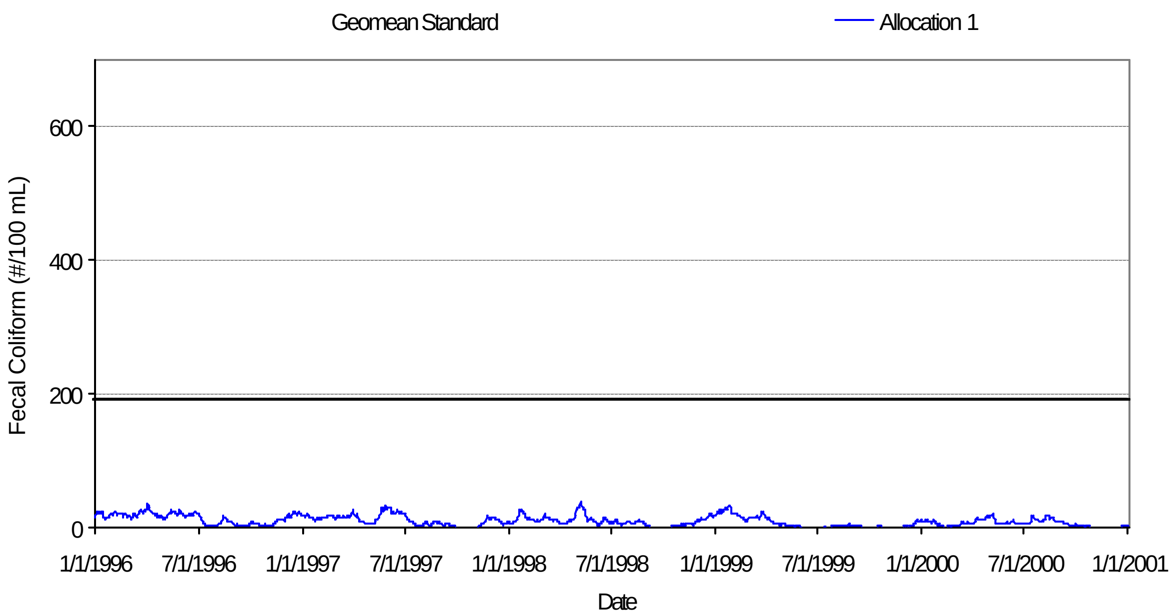

Figure 5-3. Fecal coliform bacteria TMDL based on the 30-day geometric mean criterion at the mouth of Fourpole Creek (subwatershed 1)

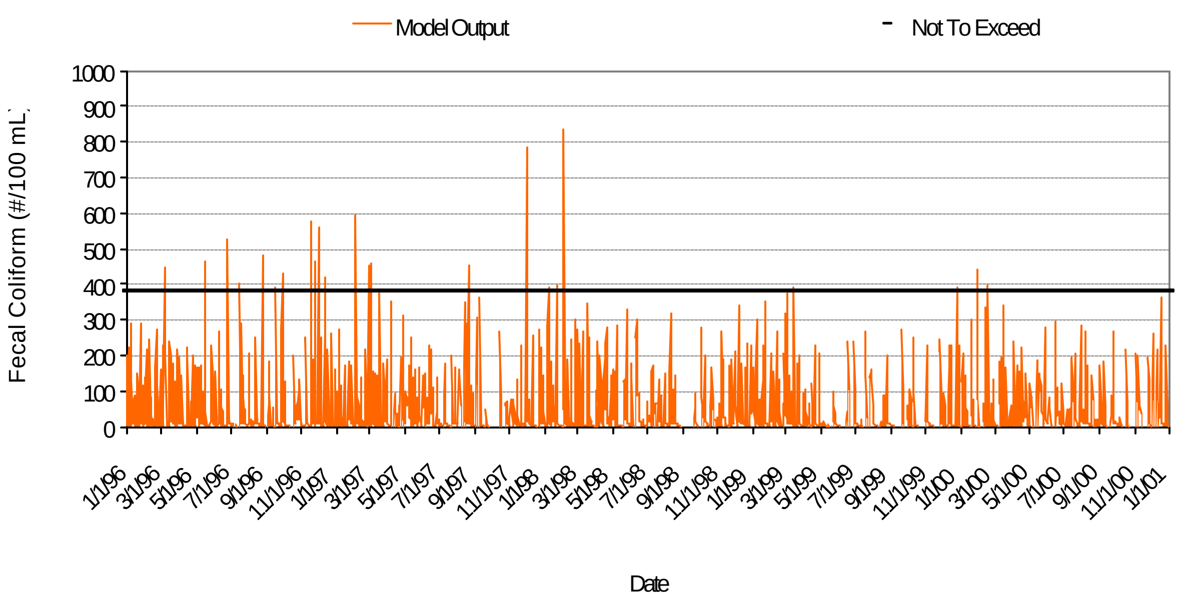

Figure 5-4. Fecal coliform bacteria TMDL based on the instantaneous criterion at the mouth of Fourpole Creek (subwatershed 1)

5.4 TMDLs and Source Allocations

A top-down methodology was followed to develop the TMDLs and allocate loads to sources. Impaired headwaters were analyzed first because their impact frequently had a profound effect on downstream water quality. Loading contributions were reduced from applicable sources for these waterbodies, and TMDLs were developed. Model results from the selected successful scenarios were then routed through downstream waterbodies. Therefore, when TMDLs were developed for downstream impaired waterbodies, upstream contributions were representing conditions meeting water quality criteria. Using this method, contributions from all sources were weighted equitably.

The TMDLs for the Fourpole Creek watershed were determined on a subwatershed basis and the following general methodology was used when allocating to sources for the Fourpole Creek TMDL:

- For watersheds with significant sediment sources (i.e., barren land, construction sites, cropland, and pasture), the aluminum from the sediment-producing land uses was reduced until in-stream water quality criteria were met. The point source contributors of sediment and aluminum were grouped under the land use "Construction Sites" (see Section 5.2), therefore, reductions made to permitted sources in the watershed are included in the allocations to construction land uses.

- For watersheds with nonpoint and point fecal coliform bacteria sources, point sources were set at permit limits (200 counts/100mL) and nonpoint sources were subsequently reduced until in-stream water quality criteria were met. One percent of the total load from CSOs was included as the fecal coliform bacteria load from the B&O Regulator. No reduction is required due to the small percentage of the entire CSO load from the CSO drainage area and the fact that the B&O Regulator will most likely be eliminated in the near future.

5.4.1 Wasteload Allocations (WLAs)

Waste load allocations (WLAs) were made for all facilities permitted to discharge fecal coliform.[1] Water quality data indicated some high fecal coliform observations during low flow periods, suggesting point source problems in the watershed. This TMDL analysis assumed that all permittees exceeding their permit limits will be notified and the exceedances will be stopped before implementation of this TMDL. Therefore, all permitted fecal coliform sources are represented by the monthly average fecal coliform limit of 200 counts/100mL and no reductions were applied.

Water quality data in the watershed showed that there is a sediment problem associated with the high levels of total aluminum. Construction sites are often a source of sediment to waterbodies due to the associated disturbed land area. The WLAs for the six construction sites in the watershed are represented by the sediment loads from the disturbed areas indicated by their respective NPDES permits.

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[1]As far as EPA knows, the use of the term "point source" in this Section is accurate with respect to the definition of point source in Section 502(14) of the Clean Water Act, 33 U.S.C. § 1362(14), however, the use of "point source" or "nonpoint source" does not represent any determination by EPA as to whether certain types of discharges do or do not require a permit pursuant to the National Pollutant Discharge Elimination System.

The fecal coliform bacteria WLAs are presented as annual loads, in terms of counts per year and the aluminum WLA is presented as an annual load, in terms of pounds per year. They are presented on an annual basis (as an average annual load), because they were developed to meet TMDL endpoints under a range of conditions observed throughout the year. Tables G-1 through G-12 and Table H-10 present the WLAs in the Fourpole Creek watershed for fecal coliform and aluminum, respectively.

5.4.2 Load Allocations (LAs)

Load allocations (LAs) were made for the dominant source categories, as follows:

Aluminum:

- Urban land uses
- Other nonpoint sources (agricultural land contributions)

Fecal

- Urban land uses
- Agricultural land uses (pasture)

The LAs for aluminum and fecal coliform bacteria are presented in Appendix G and Appendix H, respectively. The LAs are presented as annual loads, in terms of pounds per year for aluminum and counts per year for fecal coliform bacteria for each subwatershed. They are presented on an annual basis (as an average annual load) because they were developed to meet TMDL endpoints under a range of conditions observed throughout the year.

5.4.3 TMDL Summary

Table 5-1 presents a summary of the TMDL loads for aluminum and fecal coliform bacteria by subwatershed.

Table 5-1. TMDL Loads by Subwatershed for Total Aluminum and Fecal Coliform Bacteria

Subwatershed	Pollutants	LA	WLA	MOS	TMDL	Overall % Reduction
1	Total Aluminum (lbs/yr)	4,322	0	217	4,539	98%
	Fecal Coliform Bacteria(counts/yr)	1.240E+13	1.647E+10	1.240E+12	1.370E+13	56%
2	Total Aluminum (lbs/yr)	6,118	0	306	6,424	98%
	Fecal Coliform Bacteria(counts/yr)	2.863E+12	2.169E+11	1.540E+11	3.334E+12	88%
3	Total Aluminum (lbs/yr)	987	0	49	1,036	97%
	Fecal Coliform Bacteria(counts/yr)	4.854E+12	3.386E+03	2.427E+11	5.097E+12	37%

Subwatershed	Pollutants	LA	WLA	MOS	TMDL	Overall % Reduction
4	Total Aluminum (lbs/yr)	2,360	0	118	2,478	96%
	Fecal Coliform Bacteria(counts/yr)	2.430E+12	0.000E+00	1.215E+11	2.552E+12	71%
5	Total Aluminum (lbs/yr)	4,286	0	214	4,500	89%
	Fecal Coliform Bacteria(counts/yr)	1.217E+13	0.000E+00	6.085E+11	1.278E+13	50%
6	Total Aluminum (lbs/yr)	4,043	0	202	4,245	95%
	Fecal Coliform Bacteria(counts/yr)	1.185E+13	0.000E+00	5.925E+11	1.244E+13	43%
7	Total Aluminum (lbs/yr)	4,490	108	230	4,828	93%
	Fecal Coliform Bacteria(counts/yr)	1.526E+13	6.694E+03	7.631E+11	1.602E+13	37%
8	Total Aluminum (lbs/yr)	4,900	933	292	6,125	99%
	Fecal Coliform Bacteria(counts/yr)	7.081E+12	4.567E+11	3.769E+11	7.915E+12	81%
9	Total Aluminum (lbs/yr)	3,161	0	158	3,319	91%
	Fecal Coliform Bacteria(counts/yr)	8.773E+12	1.435E+05	4.387E+11	9.212E+12	54%
10	Total Aluminum (lbs/yr)	348	0	17	365	95%
	Fecal Coliform Bacteria(counts/yr)	8.641E+11	0.000E+00	4.321E+10	9.074E+11	52%
11	Total Aluminum (lbs/yr)	11,419	0	571	11,990	91%
	Fecal Coliform Bacteria(counts/yr)	2.801E+13	9.489E+03	1.400E+12	2.941E+13	51%
12	Total Aluminum (lbs/yr)	7,588	118	385	8,091	95%
	Fecal Coliform Bacteria(counts/yr)	2.157E+13	1.840E+05	1.080E+12	2.265E+13	48%

Appendices G and H present a more detailed version of the LAs and WLAs by land use for each subwatershed for fecal coliform bacteria and aluminum, respectively.

5.4.4 Seasonal Variation

A TMDL must consider seasonal variation in the derivation of the allocation. By using continuous simulation over several years, seasonal hydrologic and source loading variability was inherently considered. The aluminum and fecal coliform bacteria concentrations simulated on a daily time step by the model were compared to TMDL endpoints. An allocation that would meet these endpoints throughout the year was developed.

5.4.5 Critical Conditions

TMDL developers must select the environmental conditions that will be used for defining allowable loads. Many TMDLs are designed around the concept of a “critical condition.” The critical condition is the set of environmental conditions which, if controls are designed to protect, will ensure attainment of objectives for all other conditions.

Nonpoint source loading is typically precipitation-driven. In-stream impacts tend to occur during wet weather and storm events that cause surface runoff to carry pollutants to waterbodies. During dry periods, little or no land-based runoff occurs, and elevated in-stream bacteria levels may be due to point sources (Novotny and Olem, 1994). Water quality data analysis in the Fourpole Creek watershed shows high fecal coliform concentrations during both high and low flow, indicating that there is both a point and nonpoint source fecal coliform bacteria issue. The aluminum and sediment observations in the watershed were consistently high during high-flow periods and low during low-flow periods, indicating a strong relationship with surface runoff. Although there does appear to be a fecal coliform bacteria point source problem in the watershed, it is assumed that the point sources will all be compliant with the West Virginia fecal coliform criteria prior to implementation of this TMDL, therefore the critical conditions for the development of the Fourpole Creek TMDLs were high-flow. Both high-flow and low-flow periods were taken into account during TMDL development by using a long period of weather data that represented wet, dry and average flow periods (see Section 5.2).

6.0 Reasonable Assurance

6.1 Best Management Practices

Aluminum reductions associated with sediment reductions in the TMDLs are allocated mainly to urban, barren, and agricultural sources in each subwatershed. Implementation of best management practices (BMPs) in the affected areas should achieve the loading reduction goals established in the TMDLs. Substantial reductions in the amount of sediment reaching the streams can be made through the planning of riparian buffer zones, planting vegetation ground-cover on exposed soils, and the proper installation of silt fences and other erosion control mechanisms. The implementation of BMPs aimed at sediment reduction will in turn assist in the reduction of total aluminum. Other possibilities for attaining the desired reductions in sediment and aluminum include stabilization of stream banks and stream fencing.

6.2 MS4 Permits

West Virginia is currently drafting a general MS4 permit system based on the national guidance for Discharges from Small Municipal Separate Storm Sewer Systems. The general permit will include the six minimum controls from the national guidance and will be adopted in December 2002. Any areas or cities with stormwater discharges must apply for an MS4 permit by March of 2003. The six minimum controls from the national guidance for MS4s include the following:

- Public education and outreach on stormwater impacts
- Public involvement/participation
- Illicit discharge detection and elimination
- Construction site stormwater runoff control
- Post-construction stormwater management in new development and re-development
- Pollution prevention/good houskeeping for municipal operations

These six minimum controls will help to reduce both the fecal coliform bacteria and aluminum/sediment loading to the Fourpole Creek watershed though actions required through the MS4 permits such as developing, implementing, and enforcing a plan to eliminate all illicit discharges into small MS4s. The permit will require procedures for locating priority areas, which include areas with higher likelihood of illicit connections, such as communities with older sanitary sewer lines. There must also be a plan for removing the sources of any illicit discharges. The MS4 permit will also require that a program be developed, implemented, and enforced to reduce pollutants in any stormwater runoff to the small MS4 from construction activities that result in a land disturbance of greater than or equal to one acre. Reduction of stormwater discharges from construction activities disturbing less than one acre must also be included in the program if that construction activity is part of a larger common plan of development or sale that would disturb one acre or more.

6.3 Combined Sewer Overflows

The CSO discharge along Fourpole Creek is part of the City of Huntington's publicly owned treatment works (POTW) system. The POTW system has 25 CSOs and provides wastewater flow to the largest wastewater treatment plant in the state of West Virginia. Parts of the collection system are close to 100 years old and there are plans for future improvement. A Nine Minimum Control plan has been implemented for the POTW system and as a result three sensitive areas of the system have been identified to be investigated in the near future. One of the sensitive areas is Fourpole Creek. The three smaller CSOs in the watershed (022, 023, and 024) are regulator chambers, not pumping stations. The remaining CSO (004) that discharges to the Ohio River backwater is a major lift station of the POTW and there is an overhaul planned for it as soon as funding is available. The Huntington Sanitary Board has requested federal grant money to overhaul this station and is in the process of completing paperwork to receive this grant from EPA. No construction or completion dates have been set for the overhaul project at this time. Upon completion of this station overhaul, the Board will evaluate and engineer the feasibility of eliminating the other three CSOs.

7.0 Monitoring Plan

Follow-up monitoring of the Fourpole Creek watershed is recommended. Future monitoring can be used to evaluate water quality conditions, changes or trends in water quality conditions, and contribute to an improved understanding of the source loading behavior. The following monitoring activities are recommended for this TMDL.

West Virginia DEP should continue monitoring the impaired segments of Fourpole Creek and its tributaries via its established Watershed Management monitoring approach in 2005, 2009, and beyond.

West Virginia DEP should consider additional stations and more frequent sampling of water quality in the impaired reaches, and continue to encourage participation by active watershed organizations.

West Virginia DEP should emphasize the use of proper Quality Assurance Quality Control (QA/QC) protocols to avoid potential sample contamination during water sample collection and transfer.

8.0 Public Participation

EPA policy is that there must be full and meaningful public participation in the TMDL development process. Each state must, therefore, provide for public participation consistent with its own continuing planning process and public participation requirements. As a result, it is the intent of the West Virginia DEP to solicit public input by providing opportunities for public comment and review of the draft TMDLs. The Fourpole Creek TMDL went to public notice on July 22, 2002 and the public comment period lasted until August 26, 2002. A public notice was published in *The Herald Dispatch* in Huntington, West Virginia. A public meeting was held and the Huntington Public Library in Huntington, West Virginia on August 12, 2002.

References

American Society of Agricultural Engineers (ASAE). 1998. *ASAE Standards, 45th edition*. Standards, Engineering Practices, Data.

Bicknell, B.R., J.C. Imhoff, J. Kittle, A.S. Donigian, and R.C. Johansen. 1996. Hydrological Simulation Program - FORTRAN, Users Manual for Release H. U.S. Environmental Protection Agency, Environmental Research Laboratory, Athens, Ga.

Cabell County Health Department. 2002. Personal Communication with Stan Mills, County Sanitarian. May 2002.

Horner. 1992. *Water Quality Criteria/Pollutant Loading Estimation/Treatment Effectiveness Estimation*. In R.W. Beck and Associates. Covington Master Drainage Plan. King County Surface Water Management Division. Seattle, WA.

Horsley and Witten, Inc. 1996. *Identification and evaluation of nutrient and bacterial loadings to Maquoit Bay, New Brunswick and Freeport, Maine*. Final Report.

Huntington Herald Dispatch. 2001. Article on the Huntington Business and Technology Park (no title).

Huntington Sanitary Board. 2002. Personal Communication with Luke Richmond. May 2002.

Metcalf and Eddy. 1991. Wastewater Engineering: Treatment, Disposal, Reuse. 3rd edition. McGraw-Hill, Inc., New York.

Rosgen, D. 1996. *Applied River Morphology*. Wildland Hydrology. Pagosa Springs, Co.

U.S. Bureau of the Census. 1990. 1990 Census. http://factfinder.census.gov

U.S. Bureau of the Census. 2000. 2000 Census. http://quickfacts.census.gov/qfd/ststes/54/54011.html

USDA-SCS. 1986. *Urban Hydrology for Small Watersheds* manual. United States Department of Agriculture, Soil Conservation Service.

United States Department of Agriculture (USDA). 1997. 1997 Agricultural Census. www.nass.usda.gov/census97/highlights/wv/wvc006.txt

USEPA. 1991. Guidance for Water quality-based Decisions: The TMDL Process. Assessment and Watershed Protection Division. Office of Water. U.S. Environmental Protection Agency. EPA440/4-91-001. April 1991.

USEPA. 2001. Metals and pH TMDLs for the Elk River Watershed, West Virginia.

USEPA. 2001. Metals and pH TMDLs for the Tygart Valley River Watershed, West Virginia.

Watts, K.C. Jr., M.E. Hinkle and W.R. Griffitts. 1994. *Isopleth Maps of Titanium, Aluminum and Associated Elements in Stream Sediments of West Virginia*. United States Department of the Interior, United States Geological Survey.

WVDEP. 1998. 1998 Section 303(d) List. West Virginia Department of Environmental Protection.

West Virginia Department of Natural Resources (WVDNR), Division of Water Resources. 1988. Ohio River Basin Plan. Charleston, WV.

West Virginia Department of Natural Resources (WVDNR). 2001. Deer Hunting Harvests 2001. www.dnr.state.wv.us/wvhunting/deerh.html

WVSOS. 1999. *Code of State Rules, Title 46: Legislative Rule Environmental Quality Board, Series 1, Requirements Governing Water Quality Standards.* West Virginia Secretary of State, Charleston, WV.

West Virginia University. 1995-1997. Rural Wastewater Treatment by Septic Systems. http://www.caf.wvu.edu/wvafes/water.htm

West Virginia University. 2000. GAP 200 Land Use Coverage. Natural Resource Analysis Center.

Appendix A
Available Flow and Water Quality Data

Table A-1. Flow Observations at Water Quality Stations in the Fourpole Creek Watershed

AN-Code	Site Description	Date	Time	Flow (cfs)
551074	Fourpole Creek in Huntingdon	11/7/01	12:30	0.01
551074	Fourpole Creek in Huntingdon	10/9/01	16:15	0.06
O-3-{1.4}	Fourpole Ck. - behind St. Cloud Commons	12/12/2001	9:50	1.39
O-3-{1.4}	Fourpole Ck. - behind St. Cloud Commons	1/10/2002	7:45	5.15
O-3-{1.4}	Fourpole Ck. - behind St. Cloud Commons	2/20/2002	9:00	1.37
O-3-{1.4}	Fourpole Ck. - behind St. Cloud Commons	2/1/2002	12:35	10.61
O-3-{1.4}	Fourpole Ck. - behind St. Cloud Commons	3/1/2002	9:00	1.3
O-3-{1.4}	Fourpole Ck. - behind St. Cloud Commons	3/15/2002	9:25	1.44
O-3-{1.4}	Fourpole Ck. - behind St. Cloud Commons	1/15/2002	17:00	2.3
O-3-{4.8}	Fourpole Ck.- above UNT (at Hal Greer Blvd	2/20/2002	13:45	1.49
O-3-{4.8}	Fourpole Ck.- above UNT (at Hal Greer Blvd	3/1/2002	11:10	0.86
O-3-{4.8}	Fourpole Ck.- above UNT (at Hal Greer Blvd	3/15/2002	11:10	0.94
O-3-{4.8}	Fourpole Ck.- above UNT (at Hal Greer Blvd)	12/12/2001	14:15	0.932
O-3-{7.0}	Fourpole Ck.- behind WVDHHR building	2/20/2002	14:15	1.09
O-3-{7.0}	Fourpole Ck.- behind WVDHHR building	1/20/2002	13:40	7.25
O-3-{7.0}	Fourpole Ck.- behind WVDHHR building	12/12/2001	17:00	0.5455
O-3-{7.0}	Fourpole Ck.- behind WVDHHR building	1/10/2002	8:25	2.9
O-3-{7.0}	Fourpole Ck.- behind WVDHHR building	1/15/2002	17:30	1.77
O-3-{7.7}	Fourpole Ck.- above Grapevine Br.	2/20/2002	15:30	0.37
O-3-{7.7}	Fourpole Ck.- above Grapevine Br.	3/1/2002	13:10	0.36
O-3-{7.7}	Fourpole Ck.- above Grapevine Br.	3/15/2002	14:30	0.39
O-3-{7.7}	Fourpole Ck.- above Grapevine Br.	12/12/2001	16:00	0.2779
O-3-{7.7}	Fourpole Ck.- above Grapevine Br.	1/24/2002	8:50	41.43
O-3-{9.4}	Fourpole Ck.- below Plybon Br.	12/13/2001	9:30	0.16
O-3-{11.1}	Fourpole Ck.- below Price's Ck.	12/13/2001	9:00	0.0463

AN-Code	Site Description	Date	Time	Flow (cfs)
O-3-0.4A-{0.0}	UNT / Fourpole Creek - @ mouth	12/12/2001	9:10	0.0392
O-3-0.4A-{0.0}	UNT / Fourpole Creek - @ mouth	2/20/2002	8:00	0.05
O-3-0.4A-{0.0}	UNT / Fourpole Creek - @ mouth	3/1/2002	8:15	0.02
O-3-0.4A-{0.0}	UNT / Fourpole Creek - @ mouth	3/15/2002	8:35	0.02
O-3-0.7A-{0.0}	Gimlet Hollow - mouth	2/20/2002	8:45	0.06
O-3-0.7A-{0.0}	Gimlet Hollow - mouth	3/1/2002	8:45	0.04
O-3-0.7A-{0.0}	Gimlet Hollow - mouth	3/15/2002	9:10	0.05
O-3-0.7A-{0.0}	Gimlet Hollow - mouth	12/12/2001	10:10	0.0188
O-3-A-{0.0}	Hisey Fork - mouth	2/20/2002	9:30	0.23
O-3-A-{0.0}	Hisey Fork - mouth	3/1/2002	9:25	0.14
O-3-A-{0.0}	Hisey Fork - mouth	3/15/2002	10:00	0.34
O-3-A-{0.0}	Hisey Fork - mouth	12/12/2001	10:45	0.1543
O-3-A-1-{0.0}	Medley Fork at mouth	2/20/2002	9:55	0.02
O-3-A-1-{0.0}	Medley Fork at mouth	3/1/2002	9:45	0.001
O-3-A.5-{0.0}	UNT / Fourpole Creek - @ mouth	1/24/2002	11:50	1.11
O-3-A.5-{0.2}	UNT / Fourpole Creek - above Elem. School	2/20/2002	13:15	0.11
O-3-A.5-{0.2}	UNT / Fourpole Creek - above Elem. School	3/1/2002	11:45	0.02
O-3-A.5-{0.2}	UNT / Fourpole Creek - above Elem. School	3/15/2002	13:10	0.01
O-3-A.5-{0.2}	UNT / Fourpole Creek - above Elem. School	1/24/2002	16:45	0.51
O-3-A.9-{0.1}	UNT/Fourpole Ck.- along Woodville Lane	2/20/2002	14:45	0.22
O-3-A.9-{0.1}	UNT/Fourpole Ck.- along Woodville Lane	3/1/2002	10:45	0.09
O-3-A.9-{0.1}	UNT/Fourpole Ck.- along Woodville Lane	3/15/2002	11:40	0.1
O-3-A.9-{0.1}	UNT/Fourpole Ck.- along Woodville Lane	12/12/2001	15:10	0.075
O-3-A.9-{0.1}	UNT/Fourpole Ck.- along Woodville Lane	1/24/2002	8:30	21.94
O-3-B-{0.1}	Grapevine Br.- near mouth	2/20/2002	15:55	0.51

AN-Code	Site Description	Date	Time	Flow (cfs)
O-3-B-{0.1}	Grapevine Br.- near mouth	3/1/2002	13:30	0.29
O-3-B-{0.1}	Grapevine Br.- near mouth	3/15/2002	14:10	0.27
O-3-B-{0.1}	Grapevine Br.- near mouth	11/7/2001		0.07
O-3-B-{0.1}	Grapevine Br.- near mouth	12/12/2001	16:30	0.2357
O-3-B-{0.1}	Grapevine Br.- near mouth	1/24/2002	8:00	25.15
O-3-B-1.9-{0.0}	UNT/ Grapevine Br. Below elem school plant	2/20/2002	16:30	0.01
O-3-B-1.9-{0.0}	UNT/ Grapevine Br. Below elem school plant	3/1/2002	14:10	0.02
O-3-B-1.9-{0.0}	UNT/ Grapevine Br. Below elem school plant	3/15/2002	14:00	0.02
O-3-B-1.9-{0.0}	UNT/ Grapevine Br. Below elem school plant	1/24/2002	17:10	0.58
O-3-B-2-{0.0}	UNT/ Grapevine Br. - @ mouth	12/13/2001	11:00	0.0655

Table A-2. Flow Observations at the Stormwater Drains in the Fourpole Creek Watershed

Station ID	Site Description	Date	Time	Flow (cfs)
O-3-{2.67}-discharge	Stormwater Eff. - @Huntington, in front of condos	2/20/2002	10:55	0.02
O-3-{3.2}-discharge	Stormwater Eff.- @ 2nd St.	1/24/2002	15:45	0.2
O-3-{3.2}-discharge	Stormwater Eff.- @ 2nd St.	2/20/2002	11:10	0.05
O-3-{3.4}-discharge	Stormwater Eff.- @ 4th St.	1/24/2002	15:55	0.02
O-3-{3.4}-discharge	Stormwater Eff.- @ 4th St.	2/20/2002	11:20	0.01
O-3-{3.7}-discharge	Stormwater Eff.- @ 6th St.	12/12/2001	N/A	0.000008
O-3-{3.9}-discharge	Stormater Eff. - @ 8th St.	2/20/2002	11:35	0.02
O-3-{4.47}-discharge	Stormwater Eff. - @ 1322 Enslow Blvd.	12/12/2001	13:45	0.0001
O-3-{4.47}-discharge	Stormwater Eff. - @ 1322 Enslow Blvd.	1/24/2002	16:20	0.006
O-3-{4.47}-discharge	Stormwater Eff. - @ 1322 Enslow Blvd.	2/20/2002	12:10	0.04
O-3-{4.78}-discharge	SW Eff.- @ Hal Gr. Blvd and Wash. St.	2/20/2002	12:20	0.02
O-3-{4.78}-discharge	SW Eff.- @ Hal Gr. Blvd and Wash. St.	12/12/2001	14:00	0.0002

Station ID	Site Description	Date	Time	Flow (cfs)
O-3-{4.78}-discharge	SW Eff.- @ Hal Gr. Blvd and Wash. St.	1/24/2002	16:30	0.01

Table A-3. Fecal Coliform Bacteria Observations at Water Quality Stations in the Fourpole Creek Watershed

Station ID	Site Description	Date	Time	Fecal coliform #/100ml
O-3-{0.0}	Fourpole Ck. - at mouth	12/12/2001	8:30	14000
O-3-{0.6}	Fourpole Ck. - below UNT (near WSAZ towers)	12/12/2001	9:00	300
O-3-{0.6}	Fourpole Ck. - below UNT (near WSAZ towers)	1/24/2002	13:40	5000
O-3-{0.6}	Fourpole Ck. - below UNT (near WSAZ towers)	2/20/2002	8:15	5600
O-3-{0.6}	Fourpole Ck. - below UNT (near WSAZ towers)	3/1/2002	8:25	800
O-3-{0.6}	Fourpole Ck. - below UNT (near WSAZ towers)	3/15/2002	8:45	3700
O-3-{1.4}	Fourpole Ck. - behind St. Cloud Commons	12/12/2001	9:50	150
O-3-{1.4}	Fourpole Ck. - behind St. Cloud Commons	1/15/2002	17:00	20
O-3-{1.4}	Fourpole Ck. - behind St. Cloud Commons	1/24/2002	14:15	5000
O-3-{1.4}	Fourpole Ck. - behind St. Cloud Commons	2/1/2002	9:00	720
O-3-{1.4}	Fourpole Ck. - behind St. Cloud Commons	2/20/2002	12:35	52
O-3-{1.4}	Fourpole Ck. - behind St. Cloud Commons	3/1/2002	9:00	10
O-3-{1.4}	Fourpole Ck. - behind St. Cloud Commons	3/15/2002	9:25	208
O-3-{1.4}	Fourpole Ck. - behind St. Cloud Commons	1/10/2002	7:45	210
O-3-{2.0}	Fourpole Ck. - above Hinsey Fork	12/12/01	11:15	100
O-3-{4.8}	Fourpole Ck.- above UNT (at Hal Greer Blvd)	12/12/2001	14:15	400
O-3-{4.8}	Fourpole Ck.- above UNT (at Hal Greer Blvd)	2/20/2002	13:45	30
O-3-{4.8}	Fourpole Ck.- above UNT (at Hal Greer Blvd)	3/1/2002	11:10	8
O-3-{4.8}	Fourpole Ck.- above UNT (at Hal Greer Blvd)	3/15/2002	11:10	2100
O-3-{4.8}	Fourpole Ck.- above UNT (at Hal Greer Blvd)	1/24/2002	12:00	5700
O-3-{7.0}	Fourpole Ck.- behind WVDHHR building	12/12/2001	17:00	84

Station ID	Site Description	Date	Time	Fecal coliform #/100ml
O-3-{7.0}	Fourpole Ck.- behind WVDHHR building	1/10/2002	8:25	1060
O-3-{7.0}	Fourpole Ck.- behind WVDHHR building	1/15/2002	17:30	140
O-3-{7.0}	Fourpole Ck.- behind WVDHHR building	1/24/2002	11:30	5500
O-3-{7.0}	Fourpole Ck.- behind WVDHHR building	2/20/2002	14:15	60000
O-3-{7.0}	Fourpole Ck.- behind WVDHHR building	2/1/2002	13:40	455
O-3-{7.0}	Fourpole Ck.- behind WVDHHR building	3/1/2002	10:30	18
O-3-{7.0}	Fourpole Ck.- behind WVDHHR building	3/15/2002	13:40	452
O-3-{7.7}	Fourpole Ck.- above Grapevine Br.	12/12/2001	16:00	76
O-3-{7.7}	Fourpole Ck.- above Grapevine Br.	1/24/2002	8:50	1200
O-3-{7.7}	Fourpole Ck.- above Grapevine Br.	2/20/2002	15:30	60
O-3-{7.7}	Fourpole Ck.- above Grapevine Br.	3/1/2002	13:10	380
O-3-{7.7}	Fourpole Ck.- above Grapevine Br.	3/15/2002	14:30	2230
O-3-{8.2}	Fourpole Ck.- below UNT (Mt. Union Rd)	12/13/2001	11:15	150
O-3-{9.4}	Fourpole Ck.- below Plybon Br.	12/13/2001	9:30	200
O-3-{11.1}	Fourpole Ck.- below Price's Ck.	12/13/2001	9:00	170
O-3-0.4A-{0.0}	UNT / Fourpole Creek - @ mouth	1/24/2002	13:30	35000
O-3-0.4A-{0.0}	UNT / Fourpole Creek - @ mouth	2/20/2002	8:00	200
O-3-0.4A-{0.0}	UNT / Fourpole Creek - @ mouth	3/1/2002	8:15	380
O-3-0.4A-{0.0}	UNT / Fourpole Creek - @ mouth	3/15/2002	8:35	340
O-3-0.4A-{0.0}	UNT / Fourpole Creek - @ mouth	12/12/2001	9:10	12000
O-3-0.7A-{0.0}	Gimlet Hollow - mouth	12/12/2001	10:10	430
O-3-0.7A-{0.0}	Gimlet Hollow - mouth	2/20/2002	8:45	52
O-3-0.7A-{0.0}	Gimlet Hollow - mouth	3/1/2002	8:45	22
O-3-0.7A-{0.0}	Gimlet Hollow - mouth	3/15/2002	9:10	56
O-3-A-{0.0}	Hisey Fork - mouth	12/12/2001	10:45	760

Station ID	Site Description	Date	Time	Fecal coliform #/100ml
O-3-A-{0.0}	Hisey Fork - mouth	1/24/2002	15:00	5000
O-3-A-{0.0}	Hisey Fork - mouth	2/20/2002	9:30	60
O-3-A-{0.0}	Hisey Fork - mouth	3/1/2002	9:25	26
O-3-A-{0.0}	Hisey Fork - mouth	3/15/2002	10:00	370
O-3-A-1-{0.0}	Medley Fork - mouth	12/12/2001	11:00	110
O-3-A-1-{0.0}	Medley Fork - mouth	2/20/2002	9:55	10
O-3-A-1-{0.0}	Medley Fork - mouth	3/1/2002	9:45	6
O-3-A-1-{0.0}	Medley Fork - mouth	3/15/2002	10:15	13
O-3-A.5-{0.0}	UNT / Fourpole Creek - @ mouth	1/24/2002	11:50	12750
O-3-A.5-{0.0}	UNT / Fourpole Creek - @ mouth	2/20/2002	13:35	14000
O-3-A.5-{0.0}	UNT / Fourpole Creek - @ mouth	3/1/2002	11:20	2
O-3-A.5-{0.0}	UNT / Fourpole Creek - @ mouth	3/15/2002	11:20	11000
O-3-A.5-{0.0}	UNT / Fourpole Creek - @ mouth	12/12/2001	14:10	29000
O-3-A.5-{0.2}	UNT / Fourpole Creek - above Meadows Elem.	1/24/2002	16:45	7000
O-3-A.5-{0.2}	UNT / Fourpole Creek - above Meadows Elem.	2/20/2002	13:15	10000
O-3-A.5-{0.2}	UNT / Fourpole Creek - above Meadows Elem.	3/1/2002	11:45	120
O-3-A.5-{0.2}	UNT / Fourpole Creek - above Meadows Elem.	3/15/2002	13:10	116
O-3-A.9-{0.1}	UNT/Fourpole Ck.- along Woodville Lane	12/12/2001	15:10	> 60000
O-3-A.9-{0.1}	UNT/Fourpole Ck.- along Woodville Lane	1/24/2002	8:30	2000
O-3-A.9-{0.1}	UNT/Fourpole Ck.- along Woodville Lane	2/20/2002	14:45	2
O-3-A.9-{0.1}	UNT/Fourpole Ck.- along Woodville Lane	3/1/2002	10:45	110
O-3-A.9-{0.1}	UNT/Fourpole Ck.- along Woodville Lane	3/15/2002	11:40	520
O-3-B-{0.1}	Grapevine Br.- near mouth	12/12/2001	16:30	5500
O-3-B-{0.1}	Grapevine Br.- near mouth	1/24/2002	8:00	5500
O-3-B-{0.1}	Grapevine Br.- near mouth	2/20/2002	15:55	96

Station ID	Site Description	Date	Time	Fecal coliform #/100ml
O-3-B-{0.1}	Grapevine Br.- near mouth	3/1/2002	13:30	24
O-3-B-{0.1}	Grapevine Br.- near mouth	3/15/2002	14:10	412
O-3-B-1.9-{0.0}	UNT/Grapevine Branch	1/24/2002	17:10	110
O-3-B-1.9-{0.0}	UNT/Grapevine Branch	2/20/2002	16:30	220
O-3-B-1.9-{0.0}	UNT/Grapevine Branch	3/1/2002	14:10	55000
O-3-B-1.9-{0.0}	UNT/Grapevine Branch	3/15/2002	14:00	108

Table A-4. Fecal Coliform Bacteria Observations at Stormwater Drains in the Fourpole Creek Watershed

Station ID	Site Description	Date	Time	Fecal coliform #/100ml
O-3-{2.67}-discharge	Stormwater Eff. - @Huntington, in front of condos	2/20/2002	10:55	22000
O-3-{3.0}-discharge	Stormwater Eff. - @ 6th St.	12/12/2001	12:10	60000
O-3-{3.2}-discharge	Stormwater Eff.- @ 2nd St.	1/24/2002	15:45	2000
O-3-{3.2}-discharge	Stormwater Eff.- @ 2nd St.	2/20/2002	11:10	5900
O-3-{3.4}-discharge	Stormwater Eff.- @ 4th St.	1/24/2002	15:55	4000
O-3-{3.4}-discharge	Stormwater Eff.- @ 4th St.	2/20/2002	11:20	5800
O-3-{3.7}-discharge	Stormwater Eff.- @ 6th St.	1/24/2002	15:30	460
O-3-{3.9}-discharge	Stormater Eff. - @ 8th St.	2/20/2002	11:35	4800
O-3-{4.47}-discharge	Stormwater Eff. - @ 1322 Enslow Blvd.	1/24/2002	16:20	200
O-3-{4.47}-discharge	Stormwater Eff. - @ 1322 Enslow Blvd.	12/12/2001	13:45	740
O-3-{4.47}-discharge	Stormwater Eff. - @ 1322 Enslow Blvd.	2/20/2002	12:10	3000
O-3-{4.78}-discharge	SW Eff. - @Hal Gr. Blvd and Wash St.	1/24/2002	16:30	4000
O-3-{4.78}-discharge	SW Eff. - @Hal Gr. Blvd and Wash St.	2/20/2002	12:20	14000
O-3-{4.78}-discharge	SW Eff.- @ Hal Gr. Blvd and Wash. St.	12/12/2001	14:00	4000

Table A-5. Total Aluminum Observations at Water Quality Stations in the Fourpole Creek Watershed

Station ID	Site Description	Date	Time	Total Al. (mg/L)
551074	Fourpole Creek at Huntington, WV	1/25/94	11:20	3.3
		2/8/94	9:20	.155
		3/1/94	9:30	.175
		4/19/94	9:30	.745
		5/18/94	10:00	.055
		6/22/94	9:30	.945
		7/6/94	9:15	.220
		8/4/94	9:20	1.3
		9/13/94	9:20	.160
		10/19/94	9:15	.095
		2/26/2001	14:40	.095
		10/9/2001	16:15	0.25
		11/7/2001	12:30	0.26
O-3-{0.6}	Fourpole Ck. - below UNT (near WSAZ towers)	12/12/2001	9:00	0.264
O-3-{1.4}	Fourpole Ck. - behind St. Cloud Commons	1/24/2002	14:15	14.1
O-3-{1.4}	Fourpole Ck. - behind St. Cloud Commons	2/20/2002	9:00	0.09
O-3-{1.4}	Fourpole Ck. - behind St. Cloud Commons	3/1/2002	9:00	0.09
O-3-{1.4}	Fourpole Ck. - behind St. Cloud Commons	3/15/2002	9:25	0.08
O-3-{4.8}	Fourpole Ck.- above UNT (at Hal Greer Blvd)	12/12/2001	14:15	0.755
O-3-{4.8}	Fourpole Ck.- above UNT (at Hal Greer Blvd)	1/24/2002	12:00	16.8
O-3-{4.8}	Fourpole Ck.- above UNT (at Hal Greer Blvd)	2/20/2002	13:45	0.49
O-3-{4.8}	Fourpole Ck.- above UNT (at Hal Greer Blvd)	2/1/2002	13:20	1.73
O-3-{4.8}	Fourpole Ck.- above UNT (at Hal Greer Blvd)	3/1/2002	11:10	0.26
O-3-{4.8}	Fourpole Ck.- above UNT (at Hal Greer Blvd)	3/15/2002	11:10	0.33
O-3-{7.0}	Fourpole Ck.- behind WVDHHR building	12/12/2001	17:00	0.137
O-3-{7.0}	Fourpole Ck.- behind WVDHHR building	1/24/2002	11:30	6.26
O-3-{7.0}	Fourpole Ck.- behind WVDHHR building	2/20/2002	14:15	0.11
O-3-{7.0}	Fourpole Ck.- behind WVDHHR building	3/1/2002	10:30	0.14
O-3-{7.0}	Fourpole Ck.- behind WVDHHR building	3/15/2002	13:40	0.19
O-3-{7.7}	Fourpole Ck.- above Grapevine Br.	12/12/2001	16:00	<0.05
O-3-{7.7}	Fourpole Ck.- above Grapevine Br.	1/24/2002	8:50	10.4

Station ID	Site Description	Date	Time	Total Al. (mg/L)
O-3-{7.7}	Fourpole Ck.- above Grapevine Br.	2/20/2002	15:30	0.05
O-3-{7.7}	Fourpole Ck.- above Grapevine Br.	3/1/2002	13:10	<0.05
O-3-{7.7}	Fourpole Ck.- above Grapevine Br.	3/15/2002	14:30	0.05
O-3-{8.2}	Fourpole Ck.- below UNT (Mt. Union Rd)	12/13/2001	11:15	<0.05
O-3-{9.4}	Fourpole Ck.- below Plybon Br.	12/13/2001	9:30	<0.05
O-3-{11.1}	Fourpole Ck.- below Price's Ck.	12/13/2001	9:00	<0.05
O-3-A-{0.0}	Hisey Fork	2/20/2002	9:30	<0.05
O-3-A-{0.0}	Hisey Fork	3/1/2002	9:25	<0.05
O-3-A-{0.0}	Hisey Fork	3/15/2002	10:00	<0.05
O-3-A-1-{0.0}	Medley Fork	2/20/2002	9:55	0.06
O-3-A-1-{0.0}	Medley Fork	3/1/2002	9:45	0.34
O-3-A-1-{0.0}	Medley Fork	3/15/2002	10:15	0.06
O-3-0.4A-{0.0}	UNT / Fourpole Creek - @ mouth	12/12/2001	9:10	0.058
O-3-0.7A-{0.0}	Gimlet Hollow - mouth	12/12/2001	10:10	<0.05
O-3-B-{0.1}	Grapevine Br.- near mouth	1/24/2002	8:00	14.3
O-3-B-{0.1}	Grapevine Br.- near mouth	2/20/2002	15:55	0.05
O-3-B-{0.1}	Grapevine Br.- near mouth	3/1/2002	13:30	<0.05
O-3-B-{0.1}	Grapevine Br.- near mouth	3/15/2002	14:10	<0.05
O-3-B-{0.1}	Grapevine Br.- near mouth	11/7/2001		0.29
O-3-B-{0.1}	Grapevine Br.- near mouth	12/12/2001	16:30	<0.05
O-3-B-2-{0.0}	UNT/ Grapevine Br. - @ mouth	12/13/2001	11:00	<0.05

Table A-6. TSS Observations at Water Quality Stations in Fourpole Creek Watershed

AN-Code	Site Description	Date	Time	TSS (mg/L)
551074	Fourpole Creek at Huntington, WV	1/25/94	11:20	77
		2/8/94	9:20	6
		3/1/94	9:30	56
		4/19/94	9:30	25
		5/18/94	10:00	1
		6/22/94	9:30	18
		7/6/94	9:15	5
		8/4/94	9:20	22
		9/13/94	9:20	6
		10/19/94	9:15	4
		2/26/2001	14:40	5
O-3-{1.4}	Fourpole Ck. - behind St. Cloud Commons	1/24/2002	14:15	636
O-3-{1.4}	Fourpole Ck. - behind St. Cloud Commons	2/20/2002	9:00	<3
O-3-{1.4}	Fourpole Ck. - behind St. Cloud Commons	3/1/2002	9:00	4.8
O-3-{1.4}	Fourpole Ck. - behind St. Cloud Commons	3/15/2002	9:25	<3
O-3-{4.8}	Fourpole Ck.- above UNT (at Hal Greer Blvd)	12/12/2001	14:15	7
O-3-{4.8}	Fourpole Ck.- above UNT (at Hal Greer Blvd)	1/24/2002	12:00	896
O-3-{4.8}	Fourpole Ck.- above UNT (at Hal Greer Blvd)	2/20/2002	13:45	22.8
O-3-{4.8}	Fourpole Ck.- above UNT (at Hal Greer Blvd)	2/1/2002	13:20	160
O-3-{4.8}	Fourpole Ck.- above UNT (at Hal Greer Blvd)	3/1/2002	11:10	18
O-3-{4.8}	Fourpole Ck.- above UNT (at Hal Greer Blvd)	3/15/2002	11:10	16.8
O-3-{7.0}	Fourpole Ck.- behind WVDHHR building	1/24/2002	11:30	254
O-3-{7.0}	Fourpole Ck.- behind WVDHHR building	2/20/2002	14:15	3.2
O-3-{7.0}	Fourpole Ck.- behind WVDHHR building	3/1/2002	10:30	18.8
O-3-{7.0}	Fourpole Ck.- behind WVDHHR building	3/15/2002	13:40	7.2
O-3-{7.7}	Fourpole Ck.- above Grapevine Br.	1/24/2002	8:50	532
O-3-{7.7}	Fourpole Ck.- above Grapevine Br.	2/20/2002	15:30	<3
O-3-{7.7}	Fourpole Ck.- above Grapevine Br.	3/1/2002	13:10	<3
O-3-{7.7}	Fourpole Ck.- above Grapevine Br.	3/15/2002	14:30	3.2
O-3-A-{0.0}	Hisey Fork - mouth	2/20/2002	9:30	<3

AN-Code	Site Description	Date	Time	TSS (mg/L)
O-3-A-{0.0}	Hisey Fork - mouth	3/1/2002	9:25	<3
O-3-A-{0.0}	Hisey Fork - mouth	3/15/2002	10:00	<3
O-3-A-1-{0.0}	Medley Fork - mouth	2/20/2002	9:55	<3
O-3-A-1-{0.0}	Medley Fork - mouth	3/1/2002	9:45	45.6
O-3-A-1-{0.0}	Medley Fork - mouth	3/15/2002	10:15	5.2
O-3-B-{0.1}	Grapevine Br.- near mouth	1/24/2002	8:00	876
O-3-B-{0.1}	Grapevine Br.- near mouth	2/20/2002	15:55	4.4
O-3-B-{0.1}	Grapevine Br.- near mouth	3/1/2002	13:30	<3
O-3-B-{0.1}	Grapevine Br.- near mouth	3/15/2002	14:10	<3
O-3-0.4A-{0.0}	UNT / Fourpole Creek - @ mouth	12/12/2001	9:10	<5
O-3-0.7A-{0.0}	Gimlet Hollow - mouth	12/12/2001	10:10	<5

Appendix B

Total Aluminum and TSS Relationship

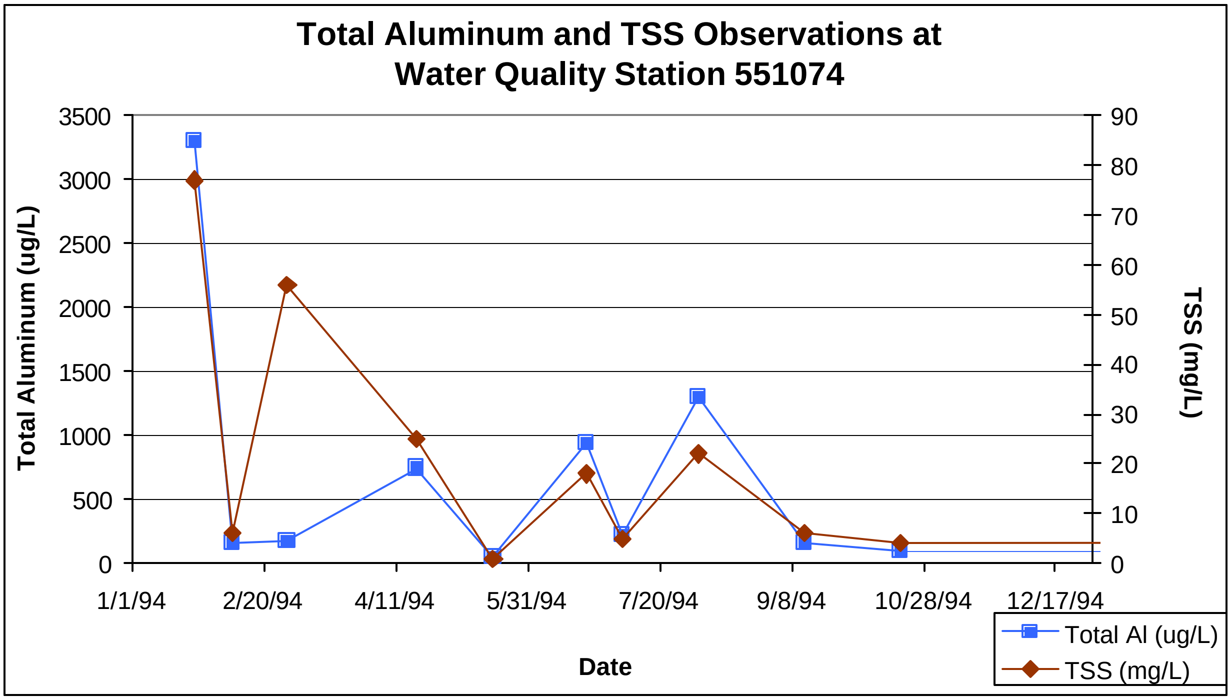

Figure B-1. Total Aluminum and TSS Observations at Water Quality Station 551074

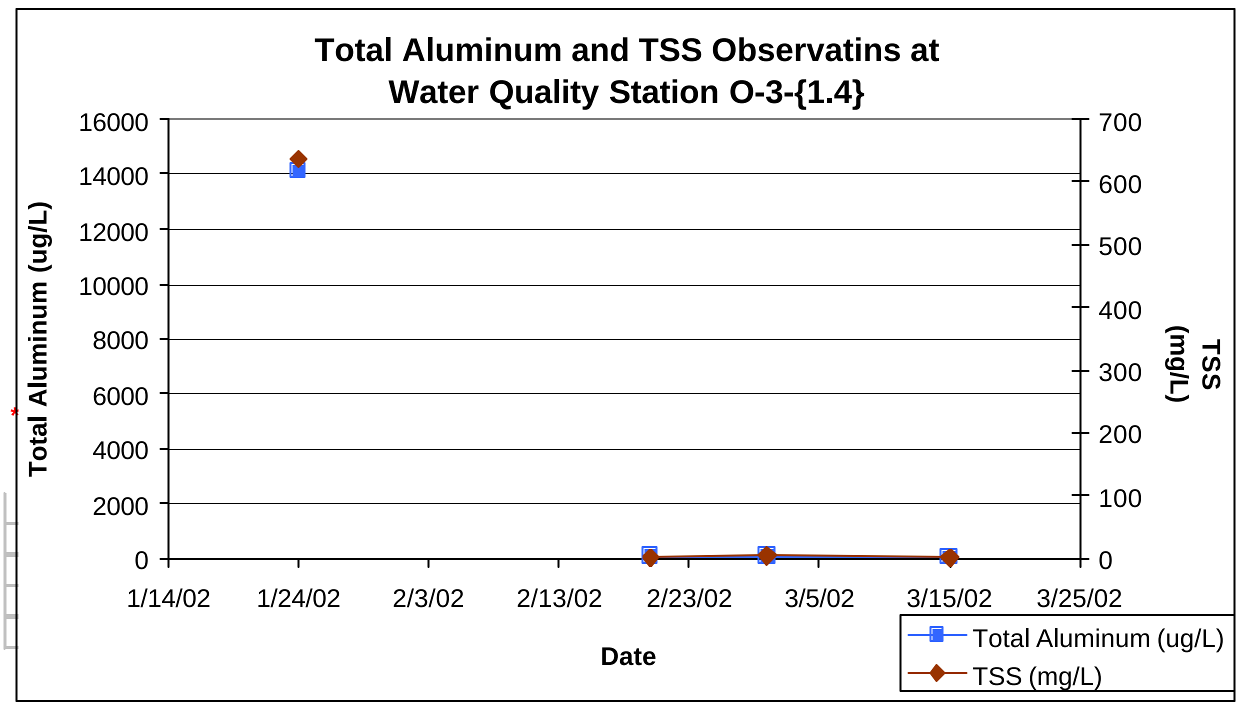

Figure B-2. Total Aluminum and TSS Observations at Water Quality Station O-3-{1.4}

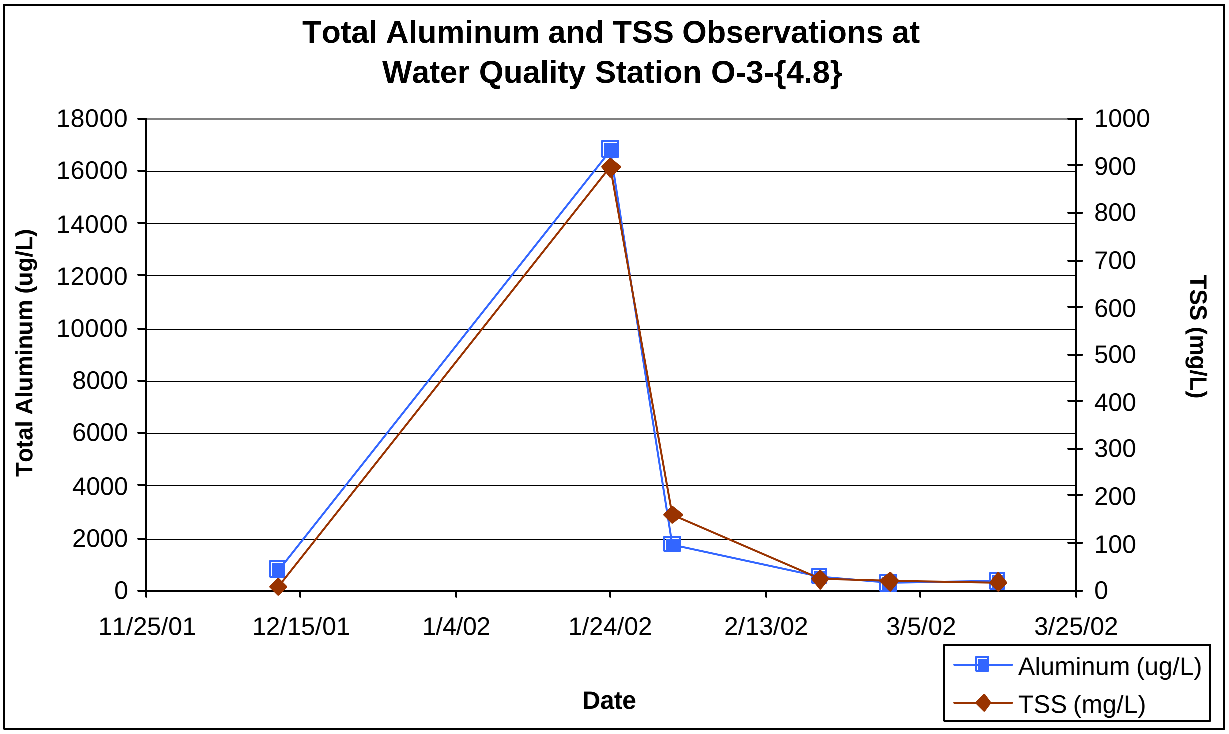

Figure B-3. Total Aluminum and TSS Observations at Water Quality Station O-3-{4.8}

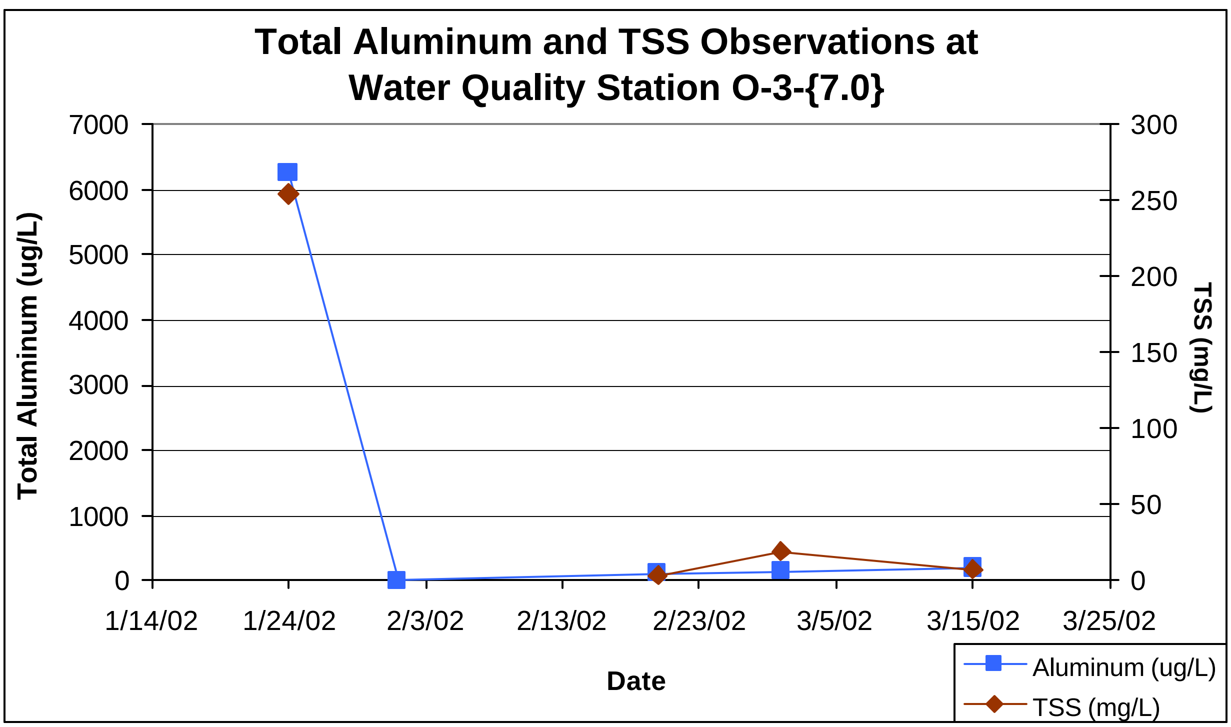

Figure B-4. Total Aluminum and TSS Observations at Water Quality Station O-3-{7.0}

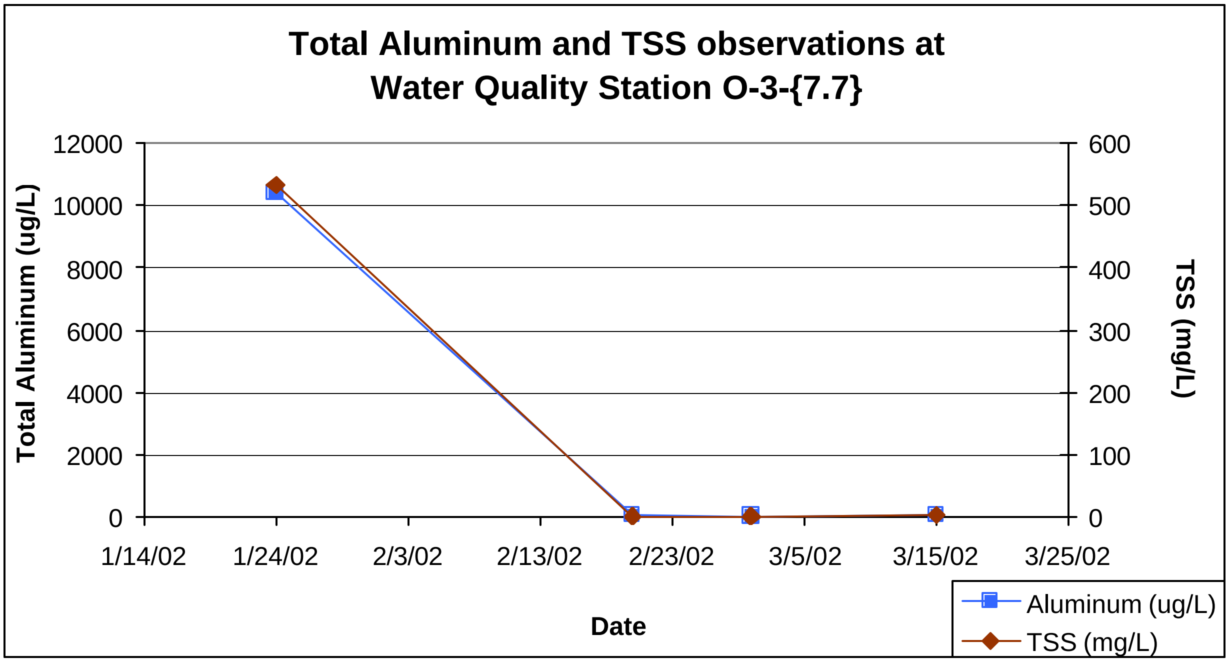

Figure B-5. Total Aluminum and TSS Observations at Water Quality Station O-3-{7.7}

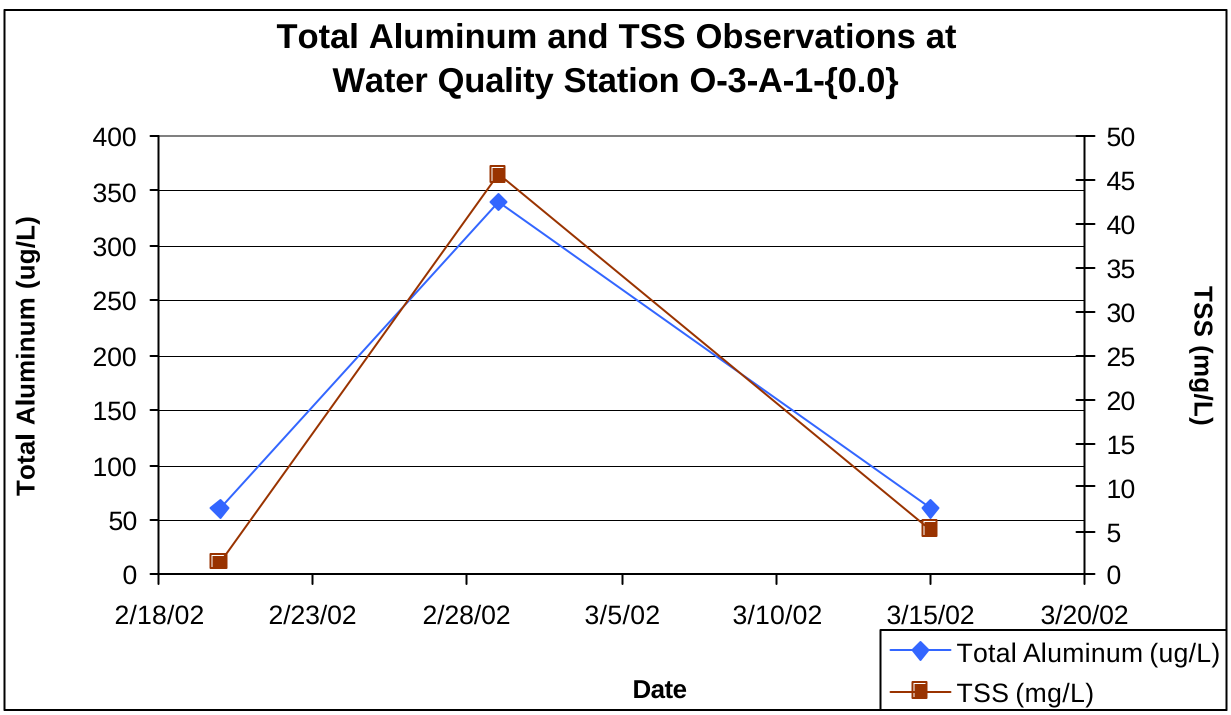

Figure B-6. Total Aluminum and TSS Observations at Water Quality Station O-3-A-1-{0.0}

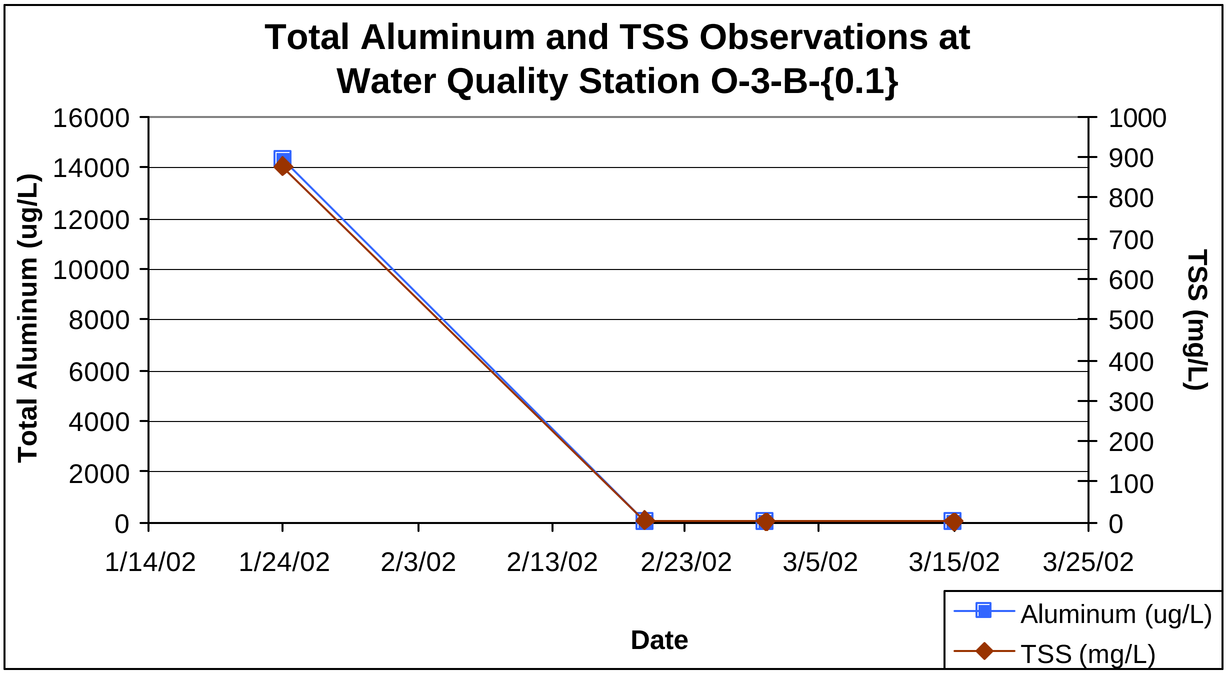

Figure B-7. Total Aluminum and TSS Observations at Water Quality Station O-3-B-{0.1}

Appendix C

Fecal Coliform Bacteria Water Quality Data Analysis

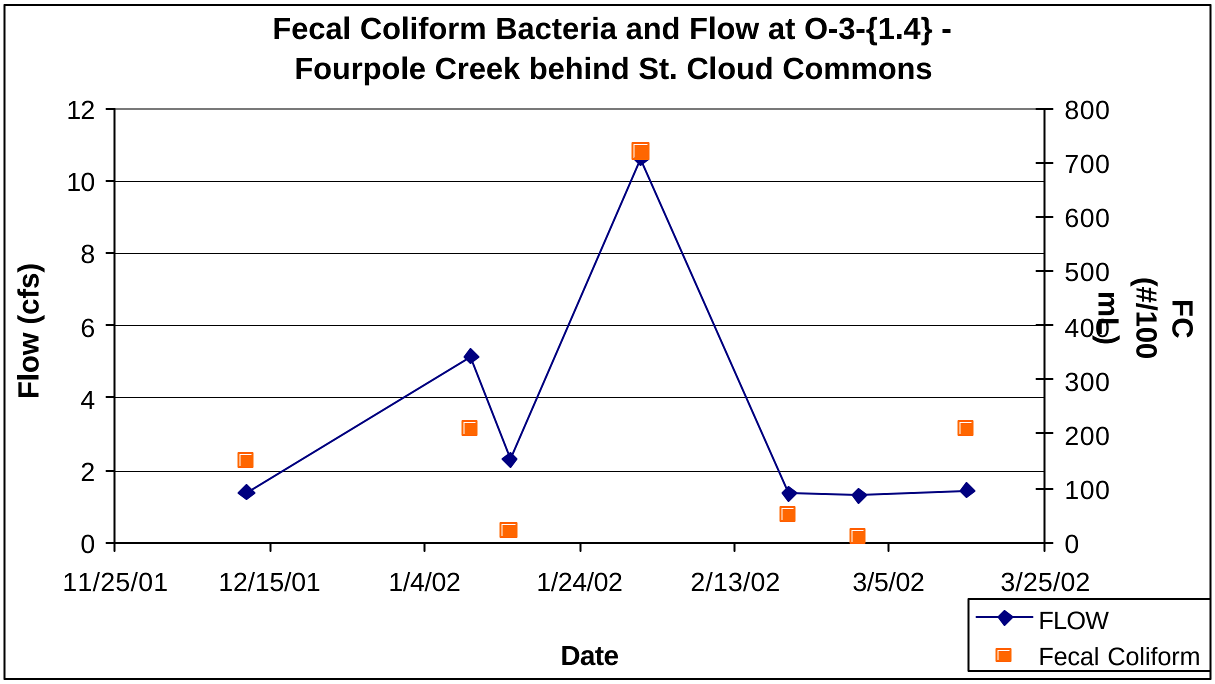

Figure C-1. Fecal Coliform Bacteria and Flow Observations at Water Quality Station O-3-{1.4} in Subwatershed 1

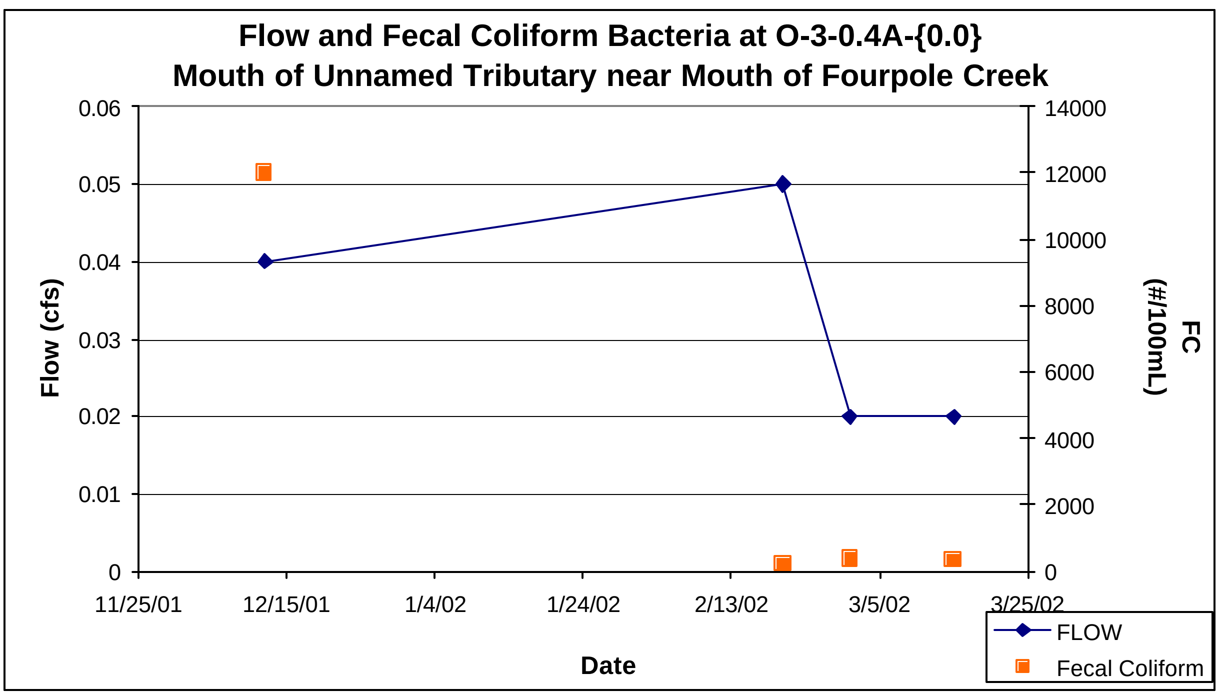

Figure C-2. Fecal Coliform Bacteria and Flow Observations at Water Quality Station O-3-{1.4} in Subwatershed 1

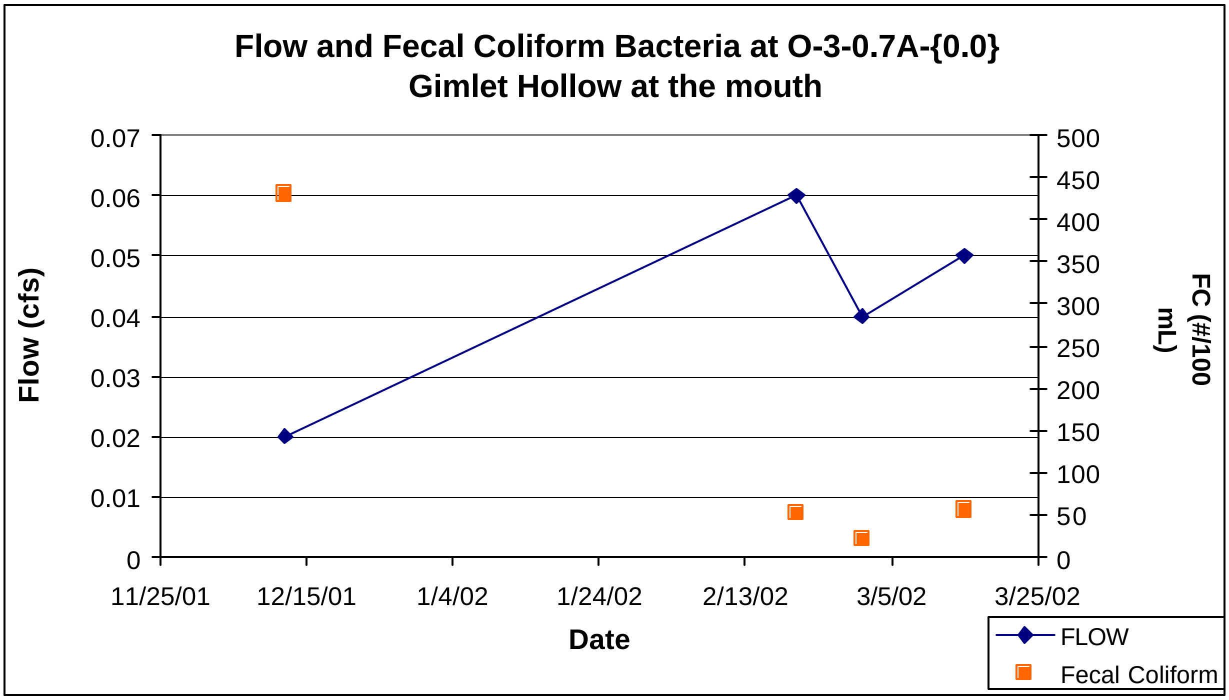

Figure C-3. Fecal Coliform Bacteria and Flow Observations at Water Quality Station O-3-0.7A-{0.0} in Subwatershed 1

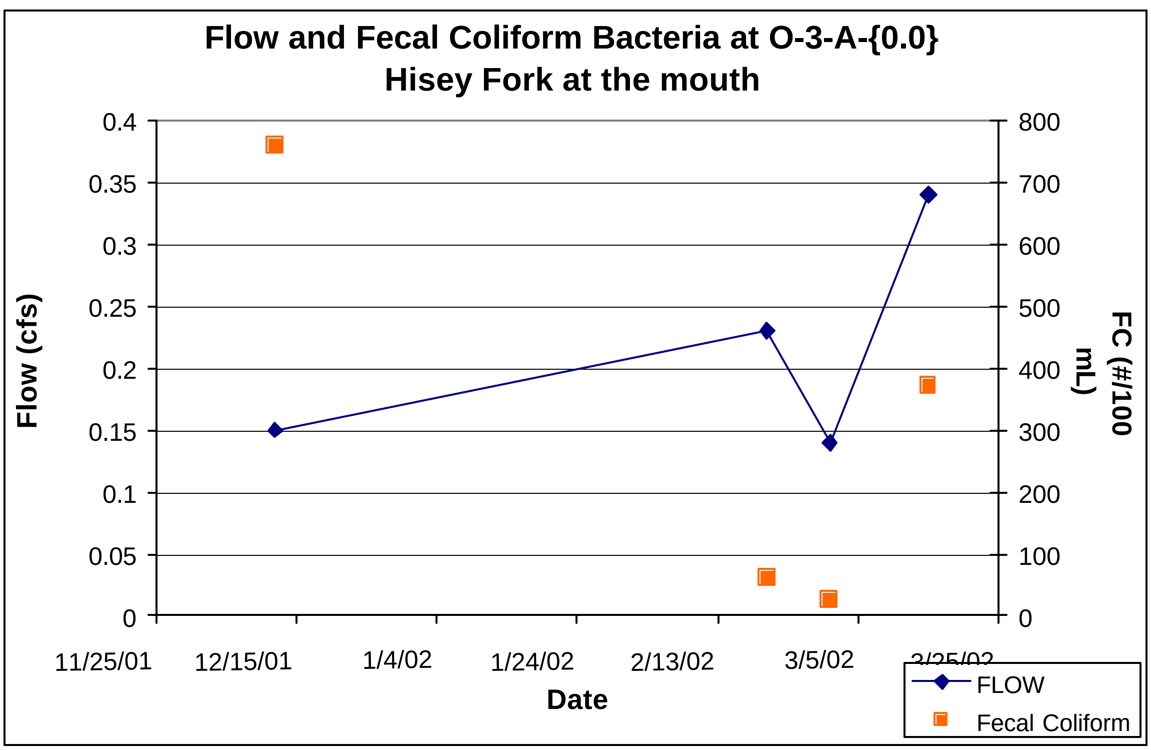

Figure C-4. Fecal Coliform Bacteria and Flow Observations at Water Quality Station O-3-A-{0.0} in Subwatershed 3

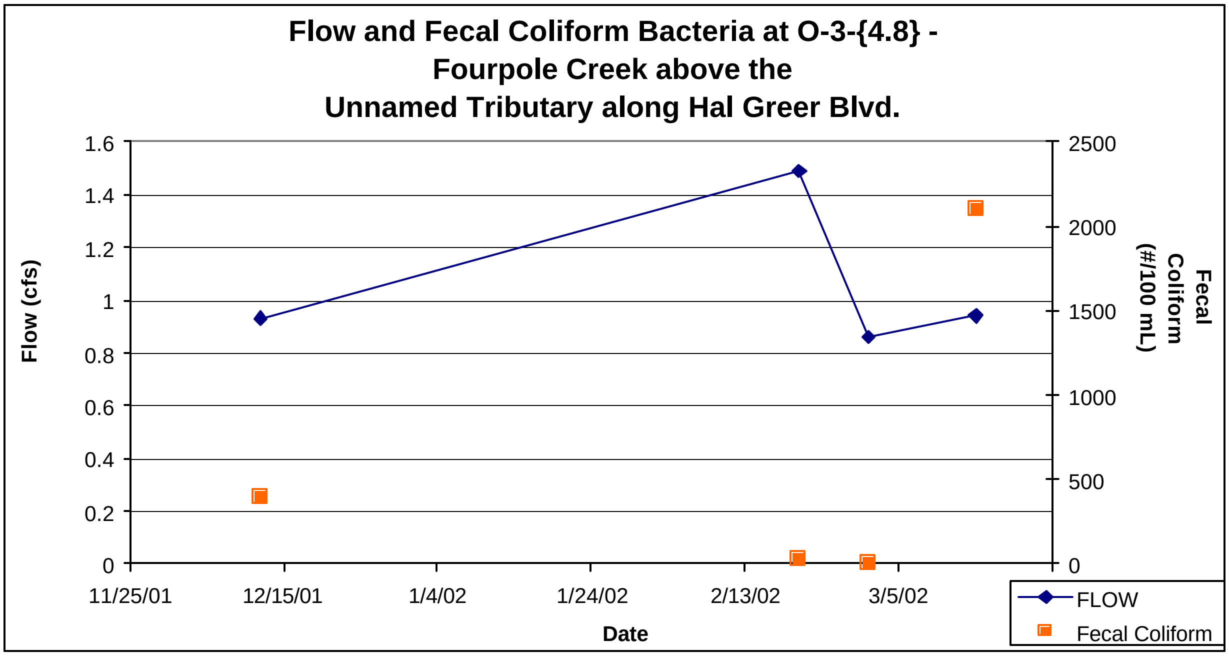

Figure C-5. Fecal Coliform Bacteria and Flow Observations at Water Quality Station O-3-{4.8} in Subwatershed 8

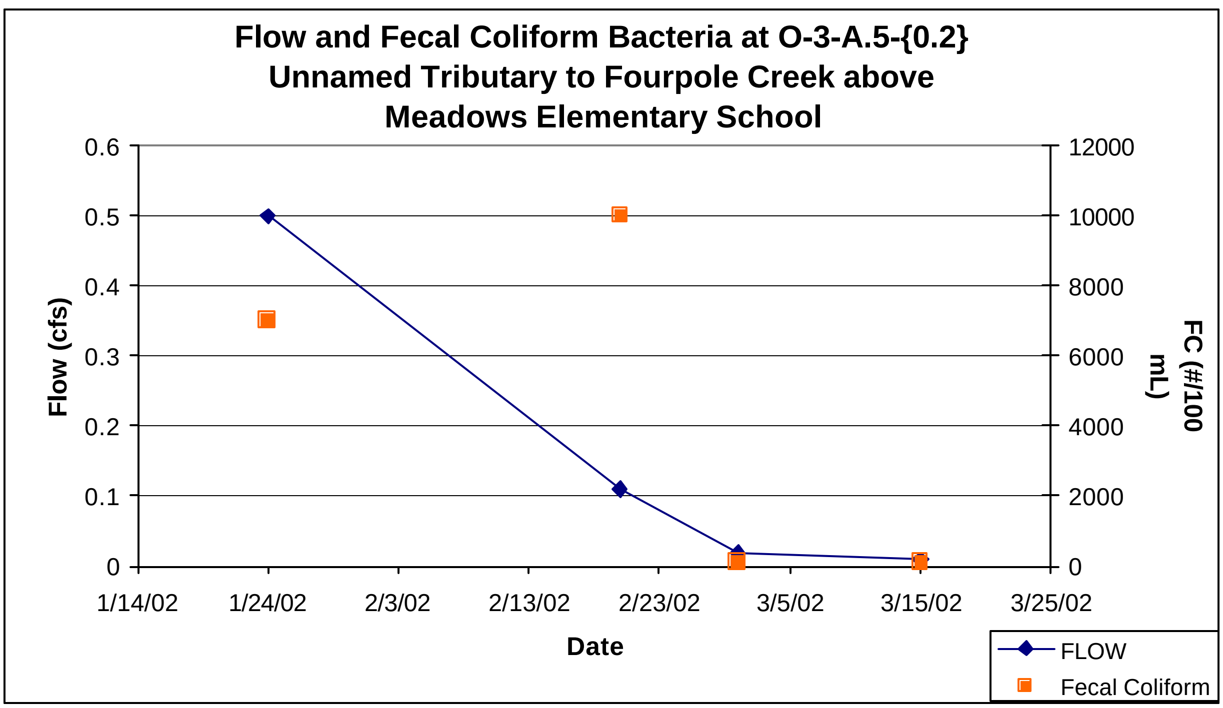

Figure C-6. Fecal Coliform Bacteria and Flow Observations at Water Quality Station O-3-A.5-{0.2} in Subwatershed 8

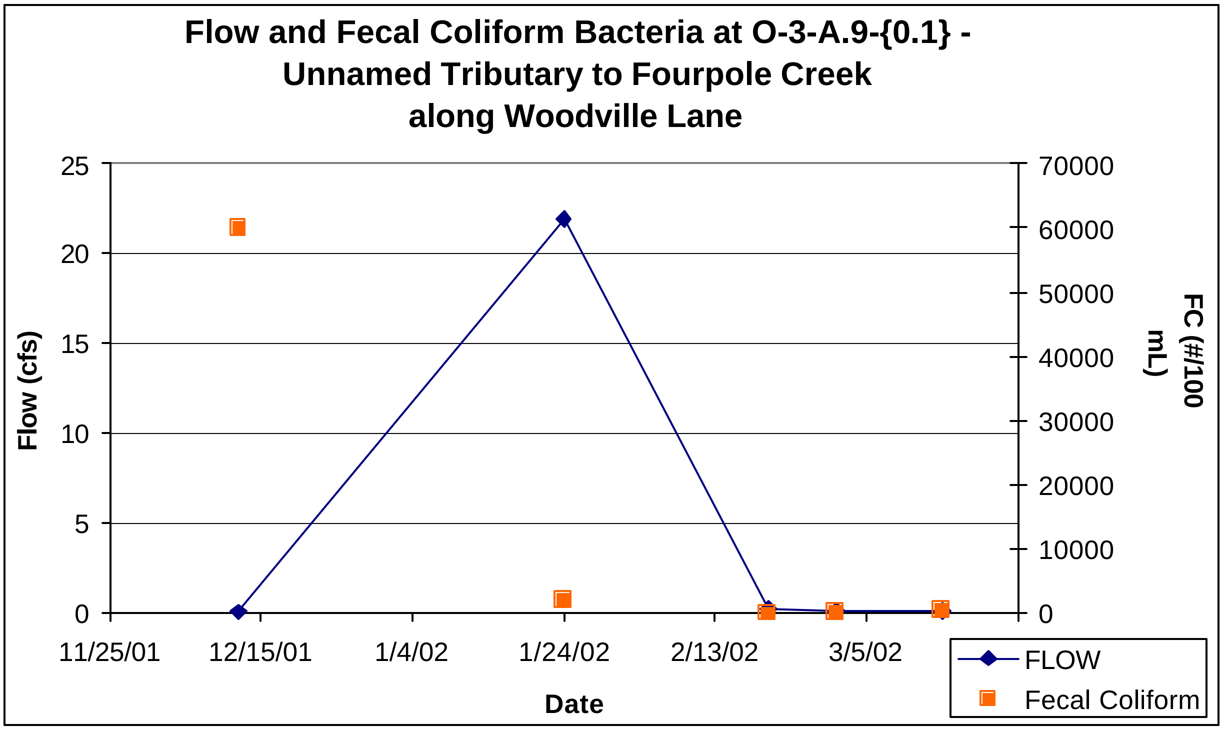

Figure C-7. Fecal Coliform Bacteria and Flow Observations at Water Quality Station O-3-A.9-{0.1} in Subwatershed 9

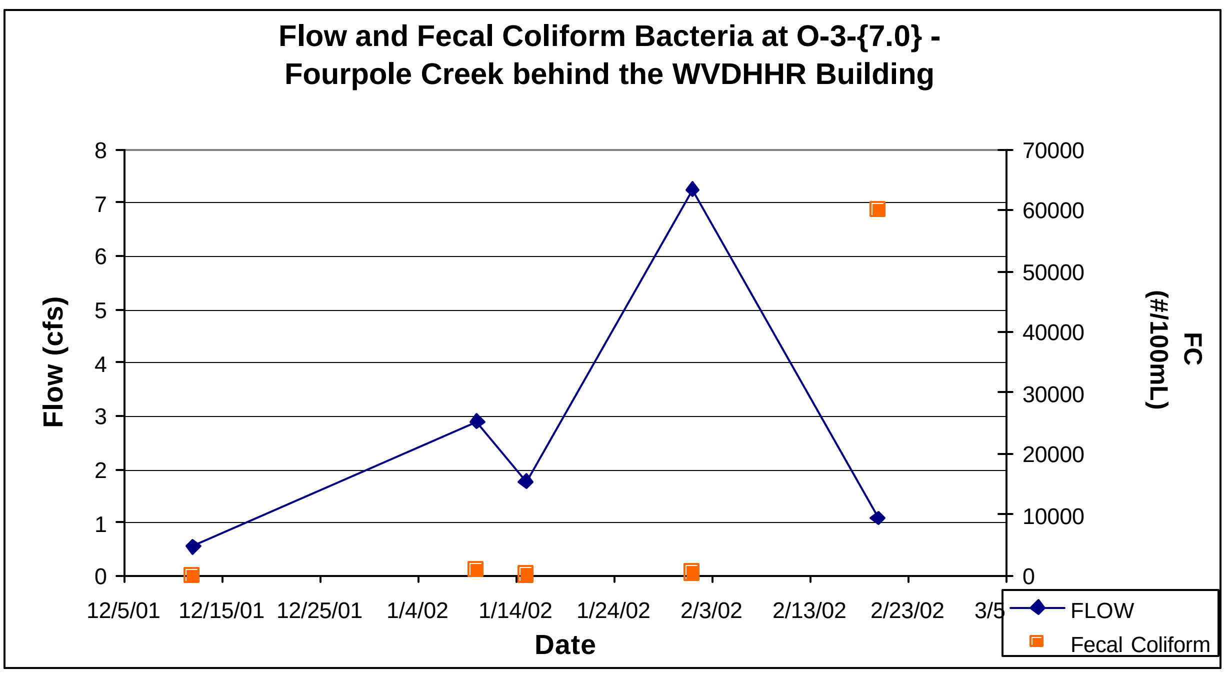

Figure C-8. Fecal Coliform Bacteria and Flow Observations at Water Quality Station O-3-{7.0} in Subwatershed 10

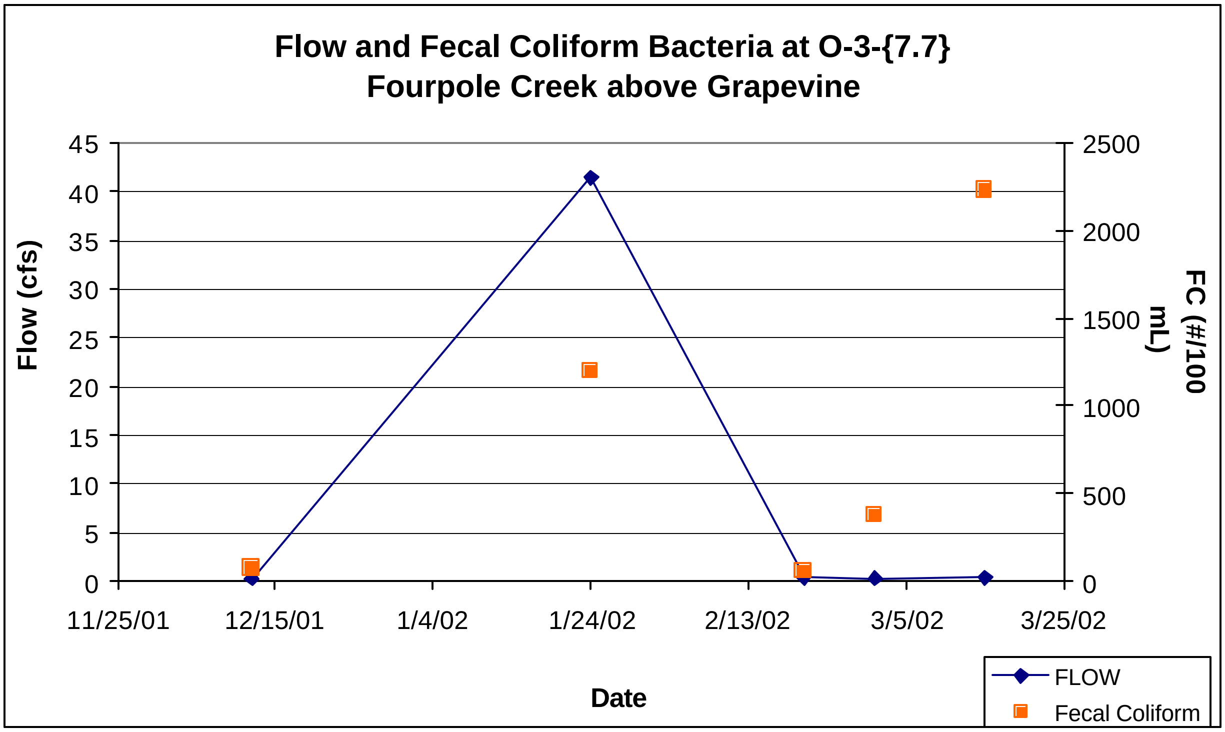

Figure C-9. Fecal Coliform Bacteria and Flow Observations at Water Quality Station O-3-{7.7} in Subwatershed 11

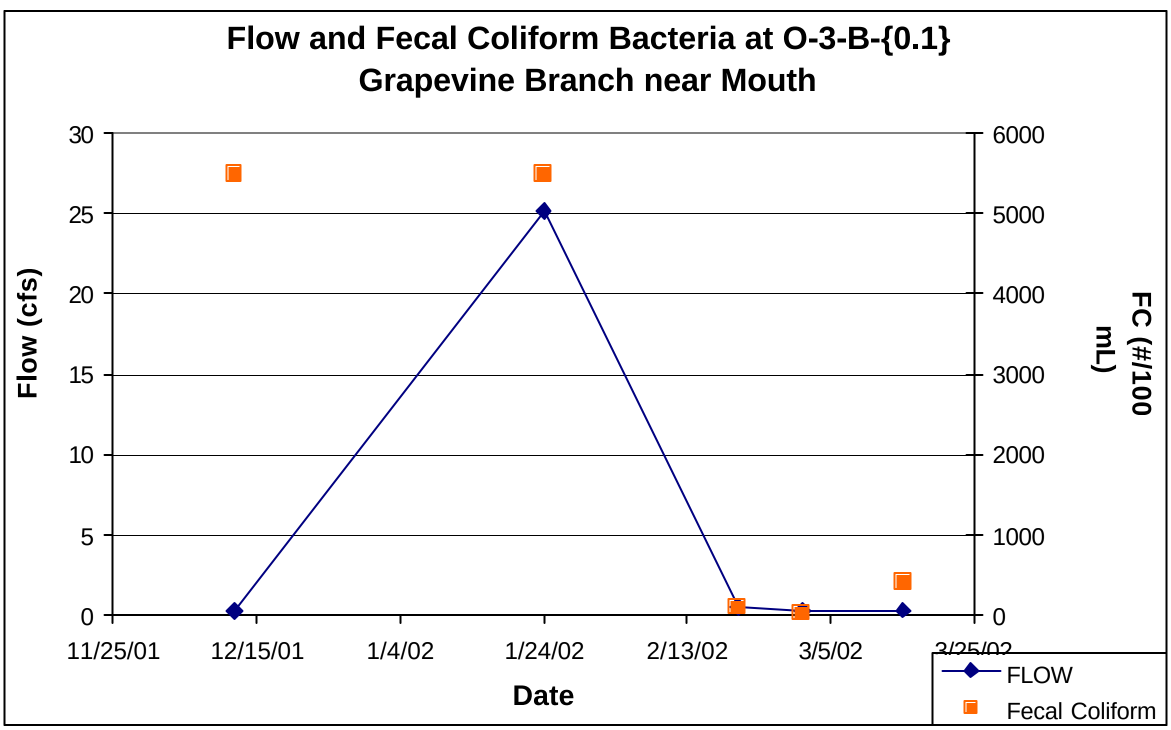

Figure C-10. Fecal Coliform Bacteria and Flow Observations at Water Quality Station O-3-B-{0.1} in Subwatershed 12

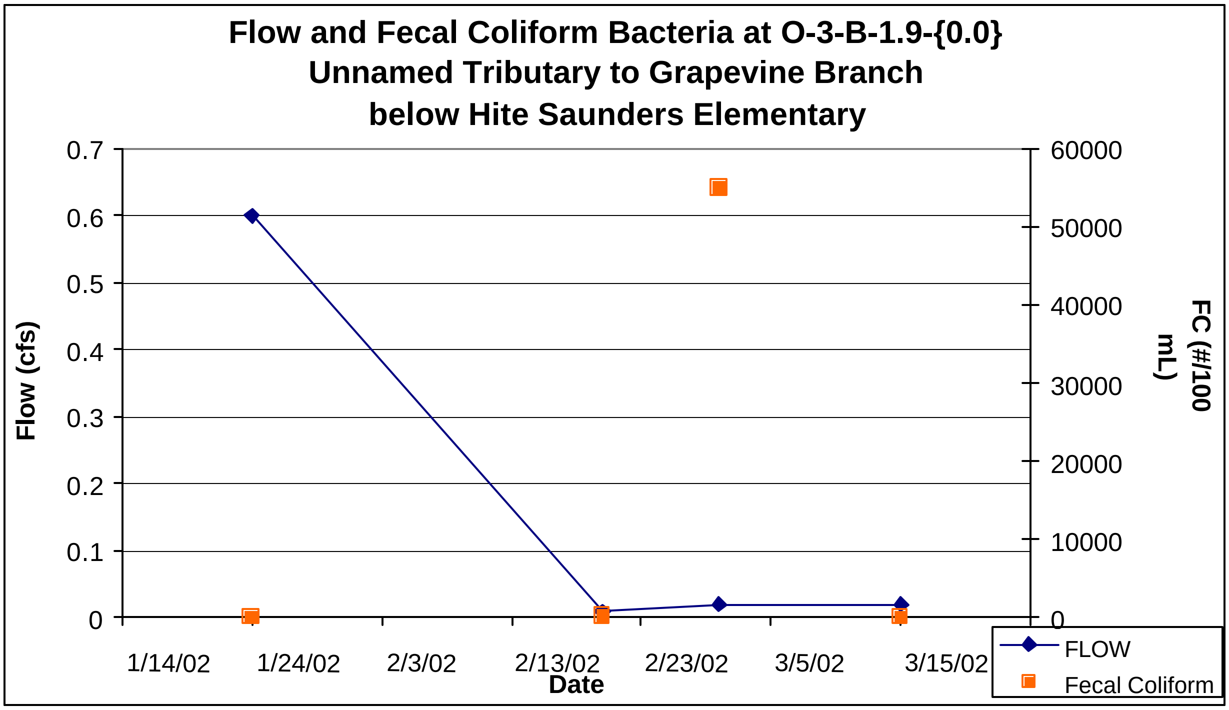

Figure C-11. Fecal Coliform Bacteria and Flow Observations at Water Quality Station O-3-B-1.9-{0.0} in Subwatershed 12

Appendix D
Hydrology Calibration and Validation

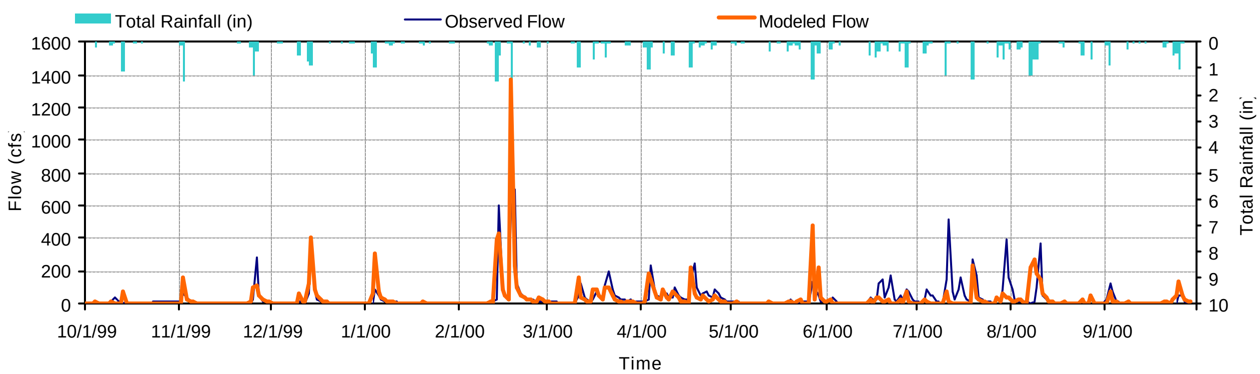

Figure D-1. Hydrology Calibration at USGS Gage 03201405 (Hurricane Creek at Hurricane, WV)

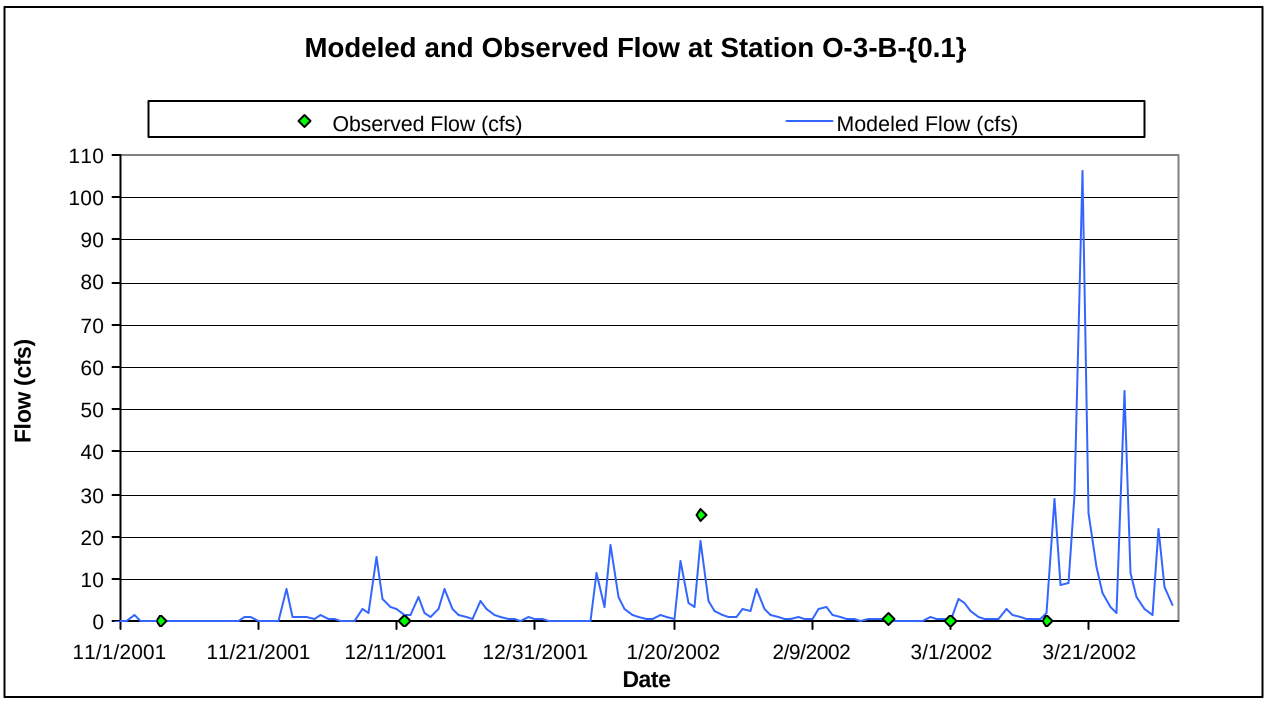

Figure D-2. Hydrology Validation at Station O-3-B-{0.1} in Subwatershed 12

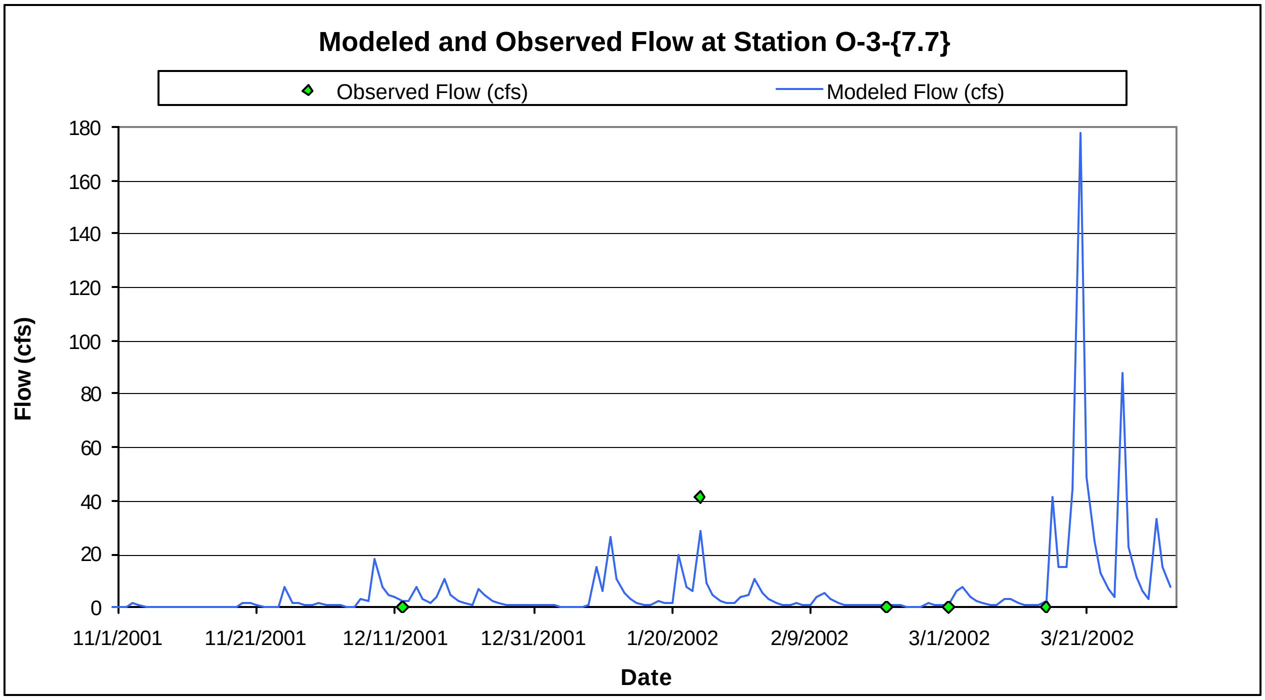

Figure D-3. Hydrology Validation at Station O-3-{7.7} in Subwatershed 11

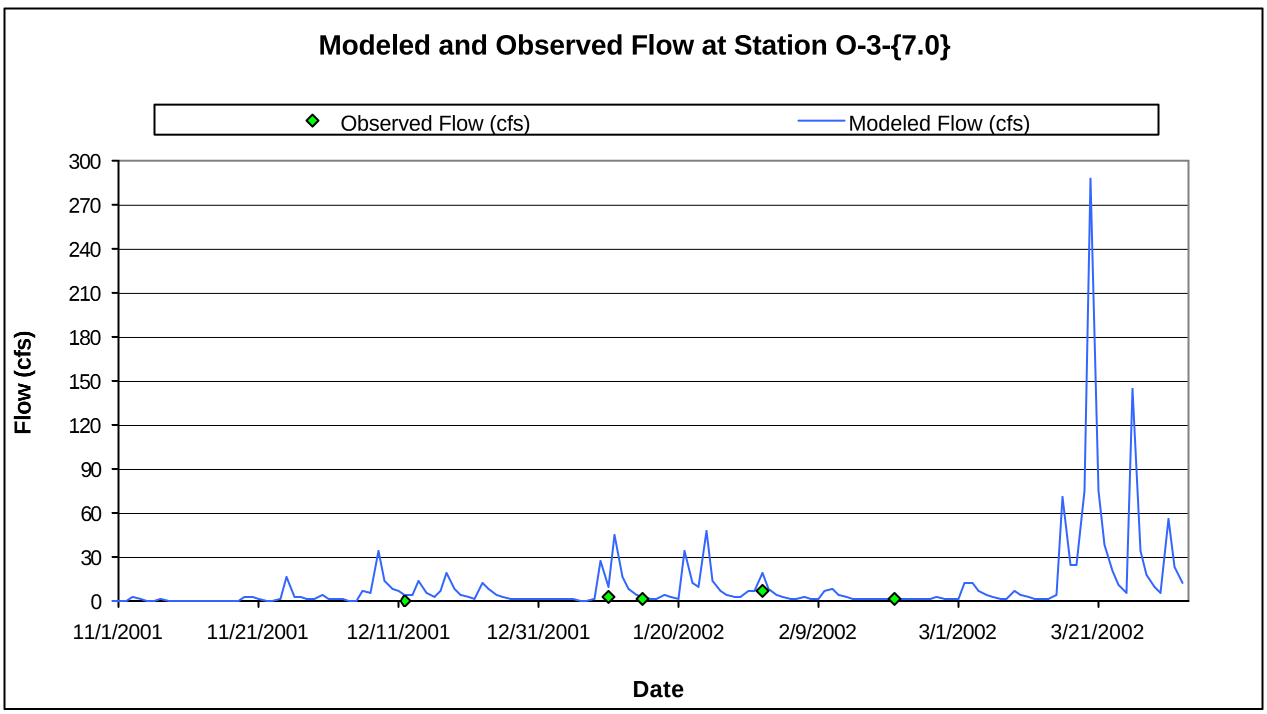

Figure D-4. Hydrology Validation at Station O-3-{7.7} in Subwatershed 10

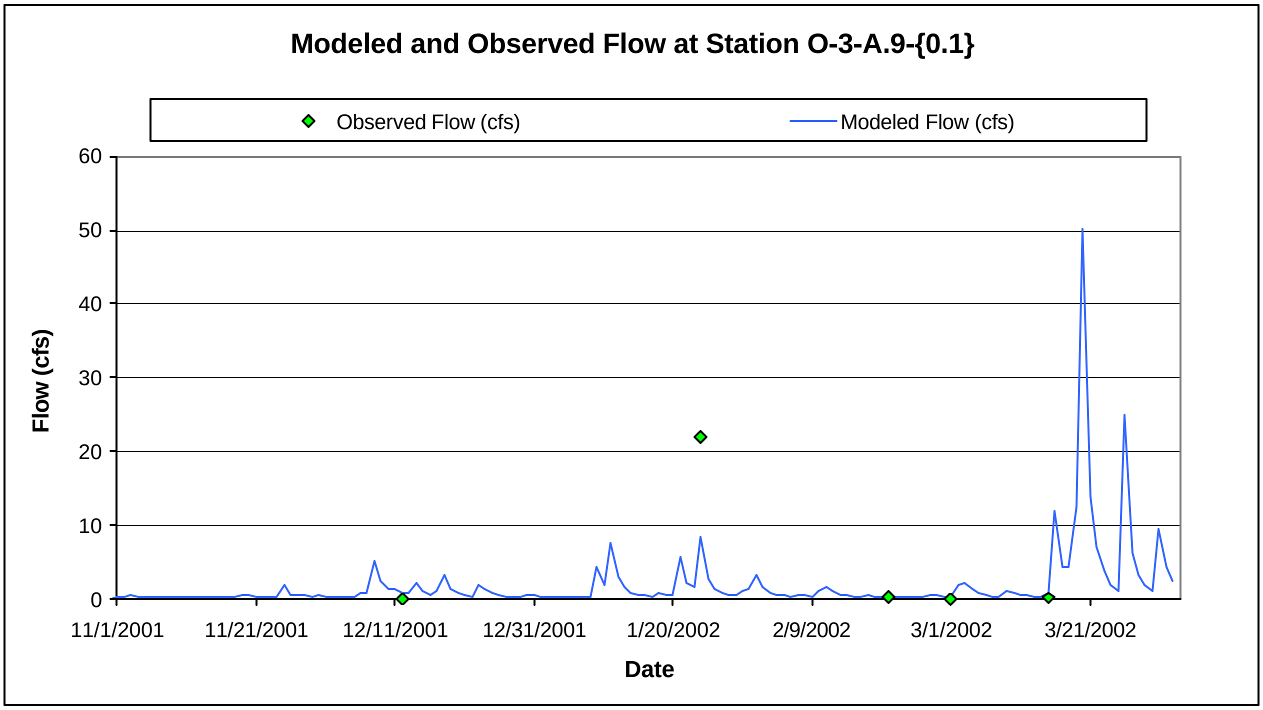

Figure D-5. Hydrology Validation at Station O-3-A.9-{0.1} in Subwatershed 9

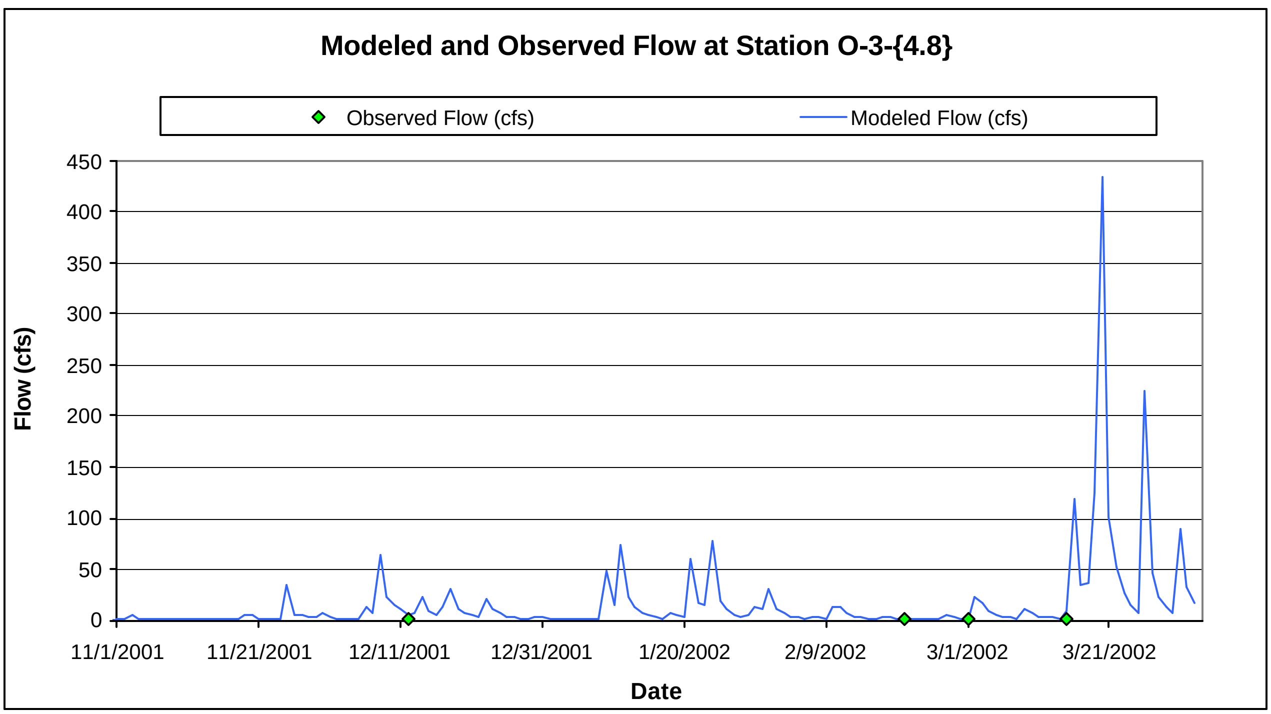

Figure D-6. Hydrology Validation at Station O-3-{4.8} in Subwatershed 8

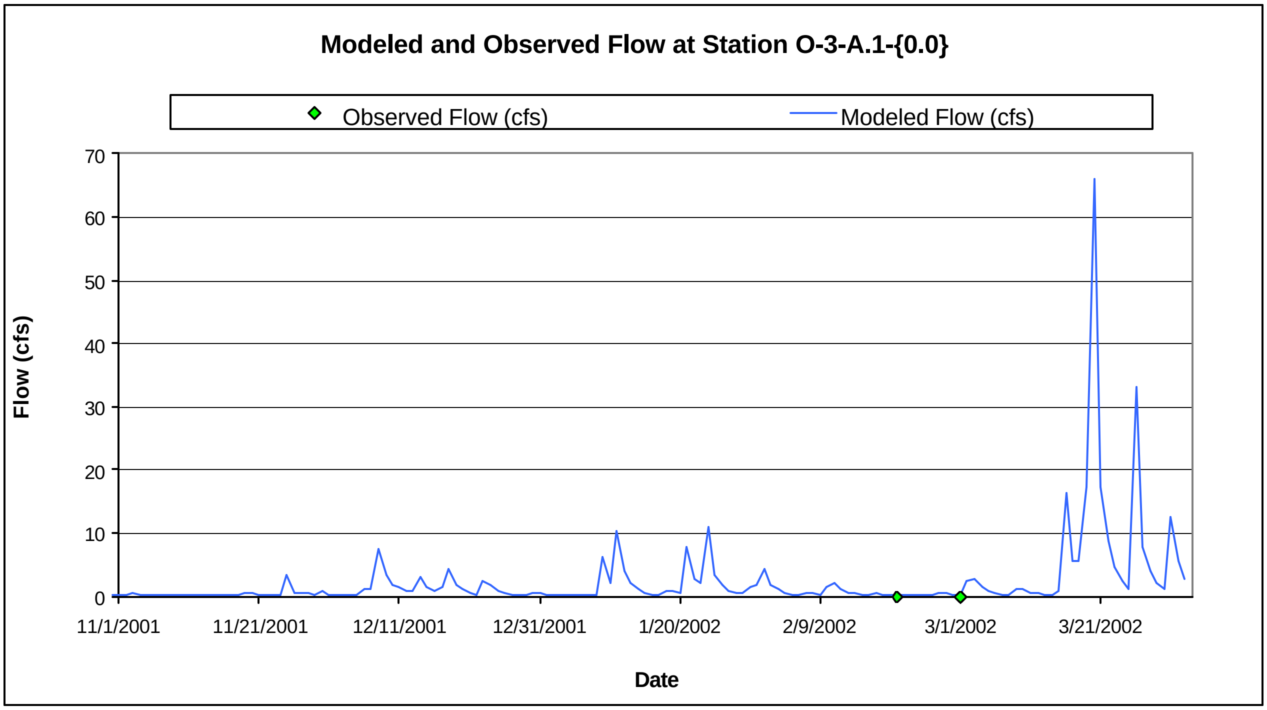

Figure D-7. Hydrology Validation at Station O-3-A.1-{0.0} in Subwatershed 5

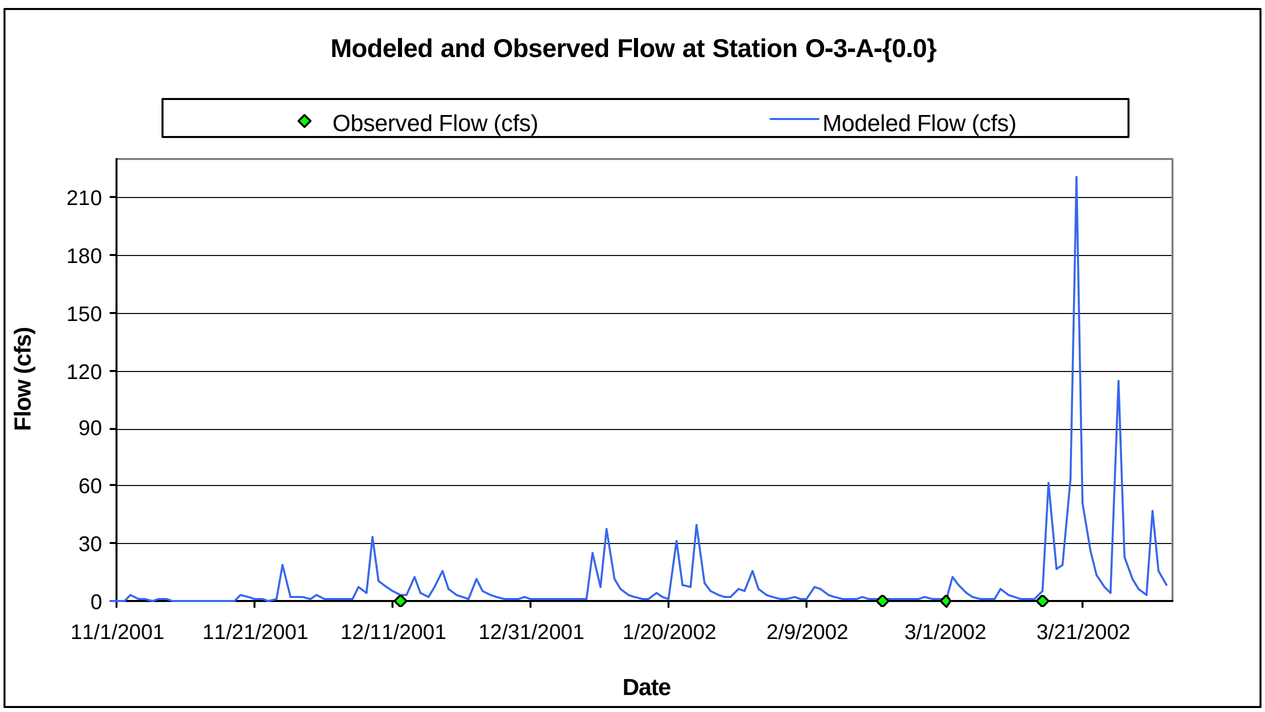

Figure D-8. Hydrology Validation at Station O-3-A-{0.0} in Subwatershed 3

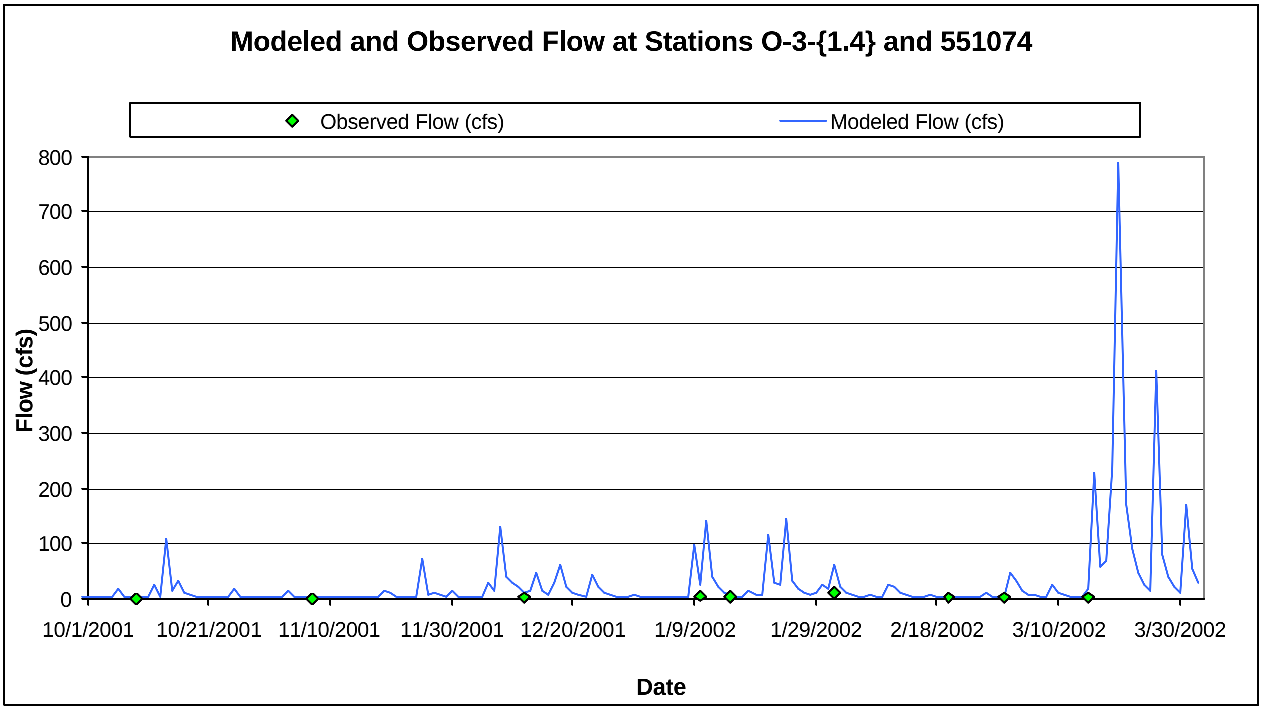

Figure D-9. Hydrology Validation at Stations O-3-{1.4} and 551074 in Subwatershed 1

Appendix E
Water Quality Calibration: Fecal Coliform

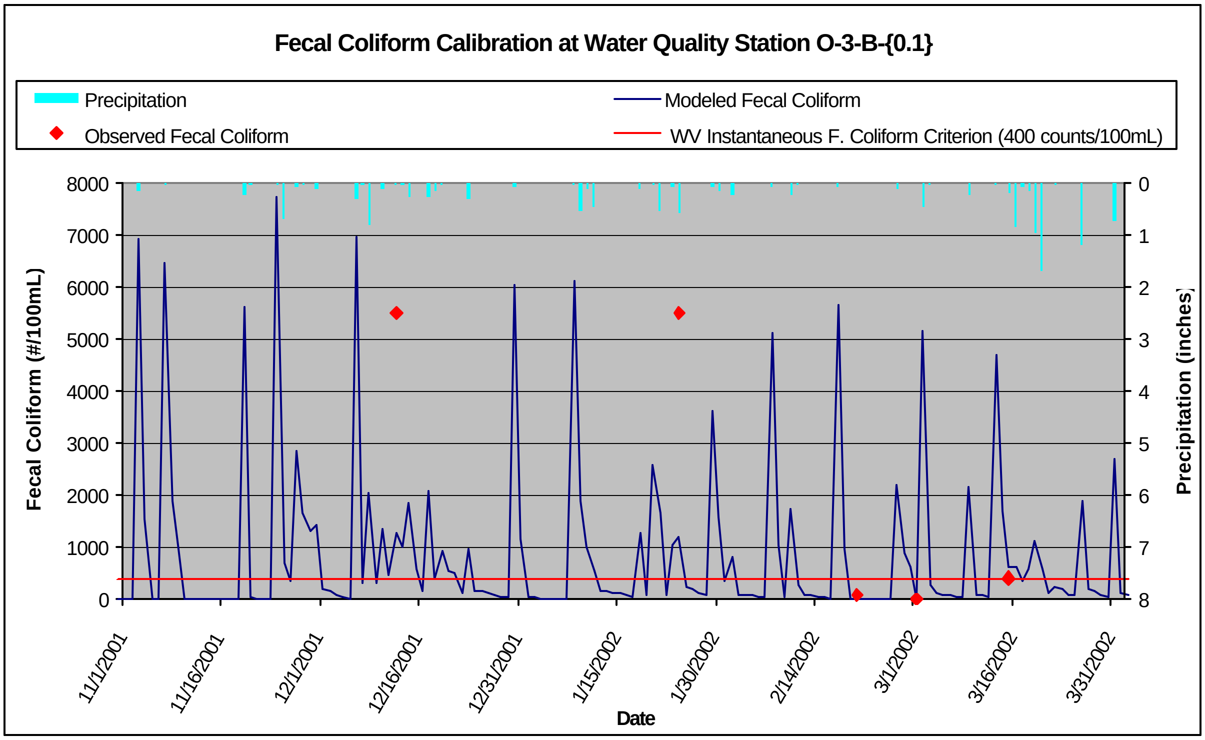

Figure E-1. Fecal Coliform Calibration at Water Quality Station O-3-B-{0.1} in Subwatershed 12

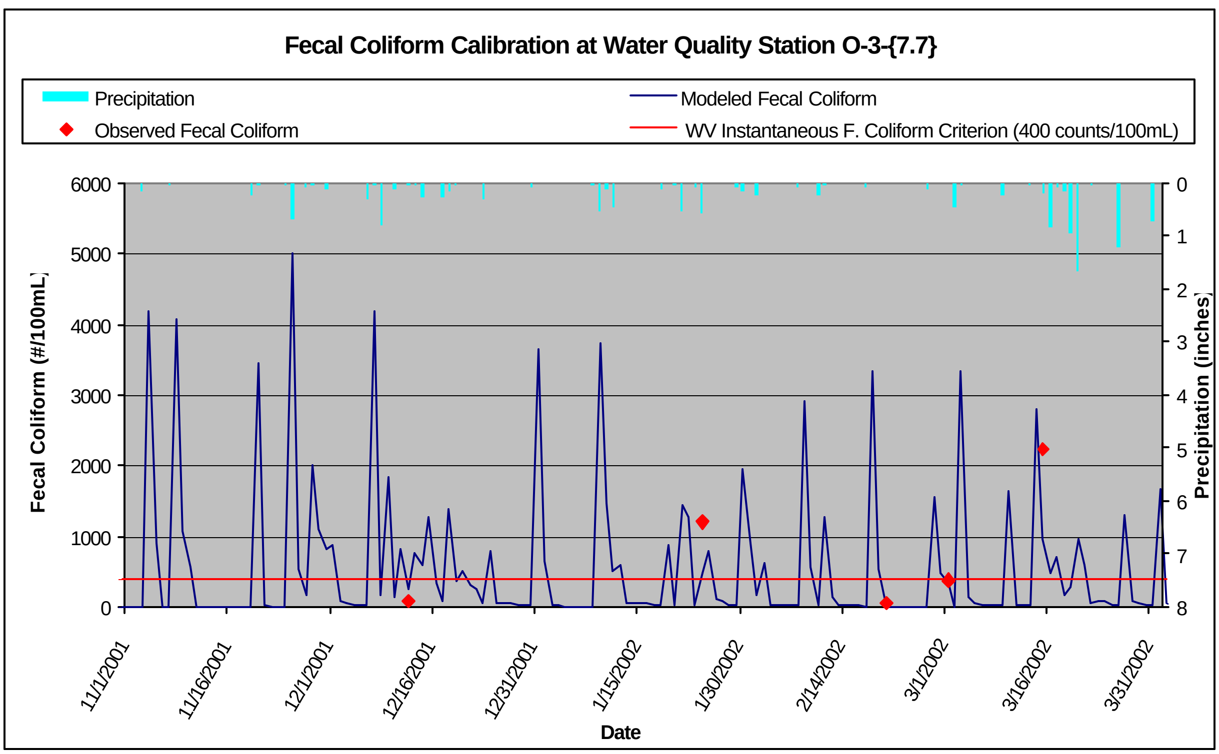

Figure E-2. Fecal Coliform Calibration at Water Quality Station O-3-{7.7} in Subwatershed 11

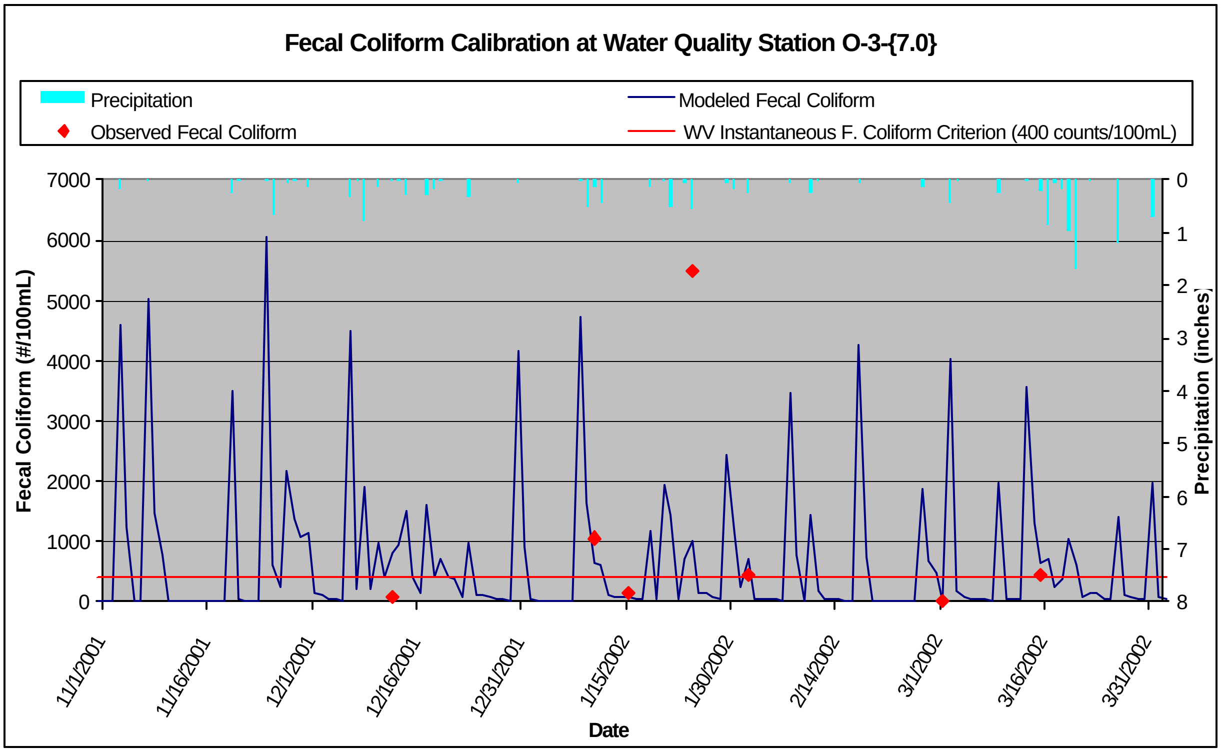

Figure E-3. Fecal Coliform Calibration at Water Quality Station O-3-{7.0} in Subwatershed 10

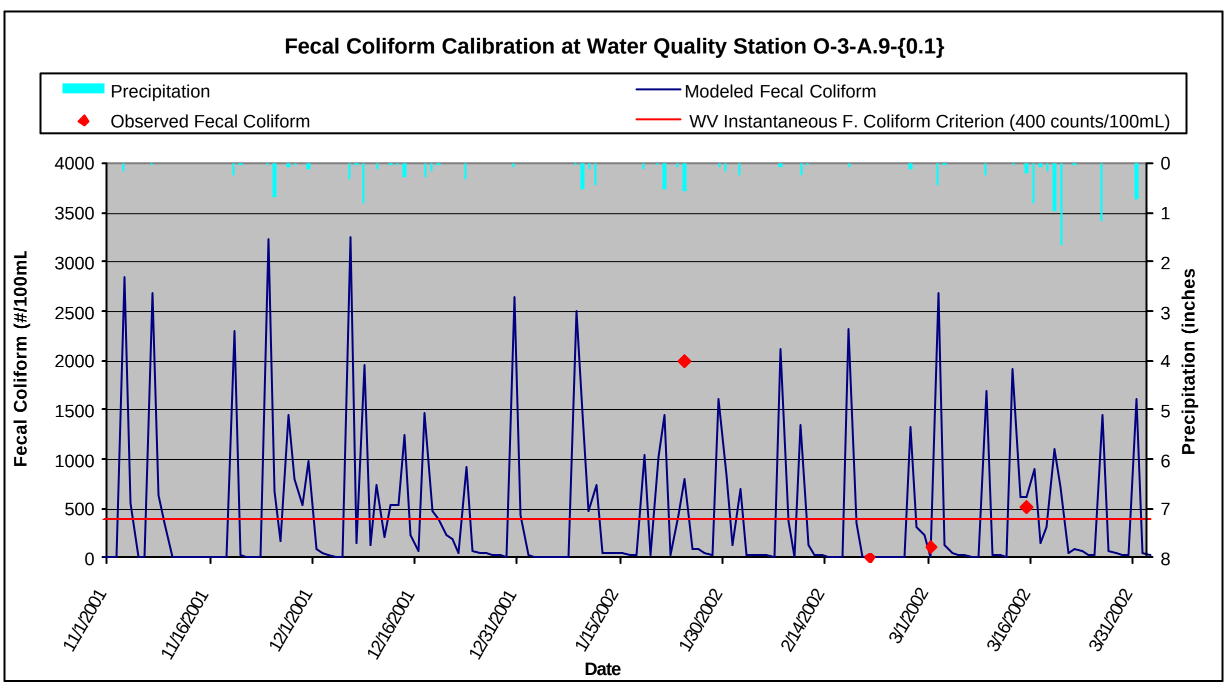

Figure E-4. Fecal Coliform Calibration at Water Quality Station O-3-A.9-{0.1}

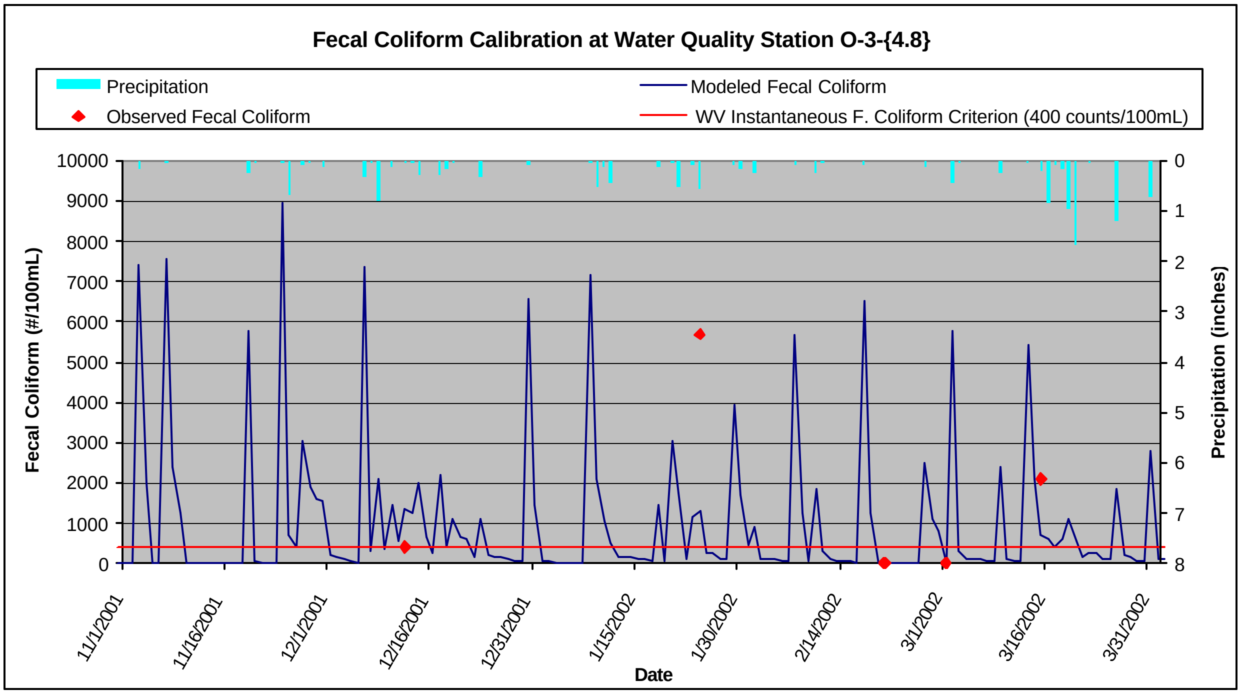

Figure E-5. Fecal Coliform Calibration at Water Quality Station O-3-{4.8} in Subwatershed 8

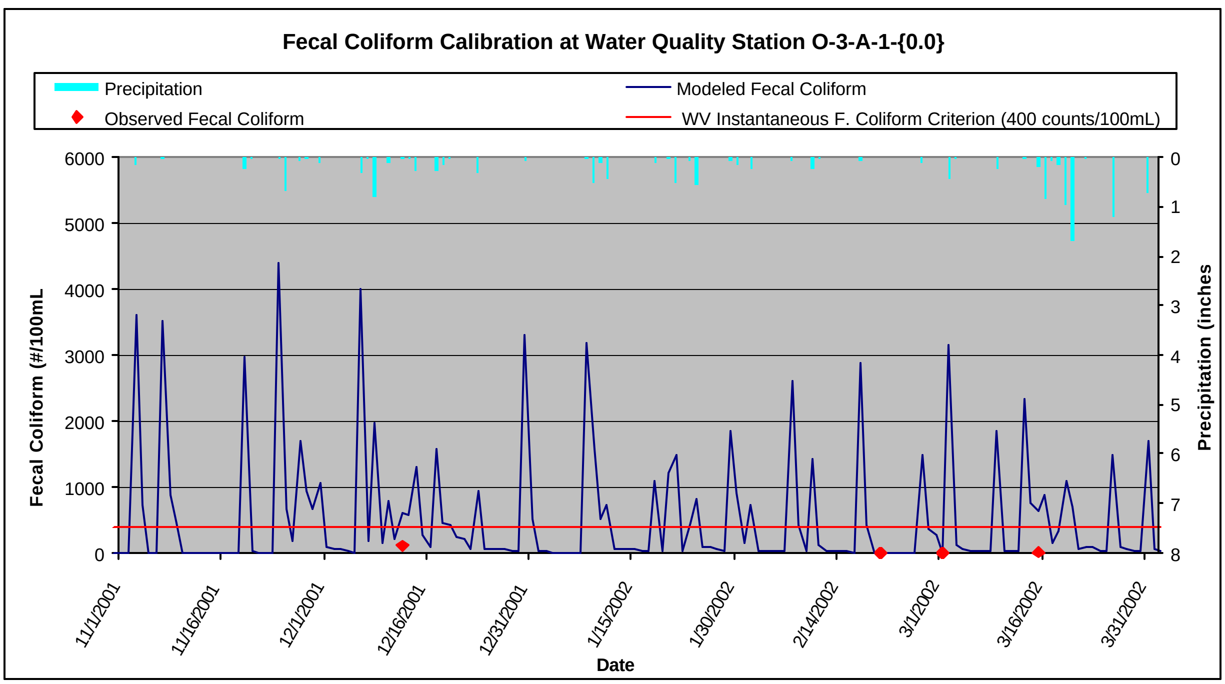

Figure E-6. Fecal Coliform Calibration at Water Quality Station O-3-A-1-{0.0} in subwatershed 5

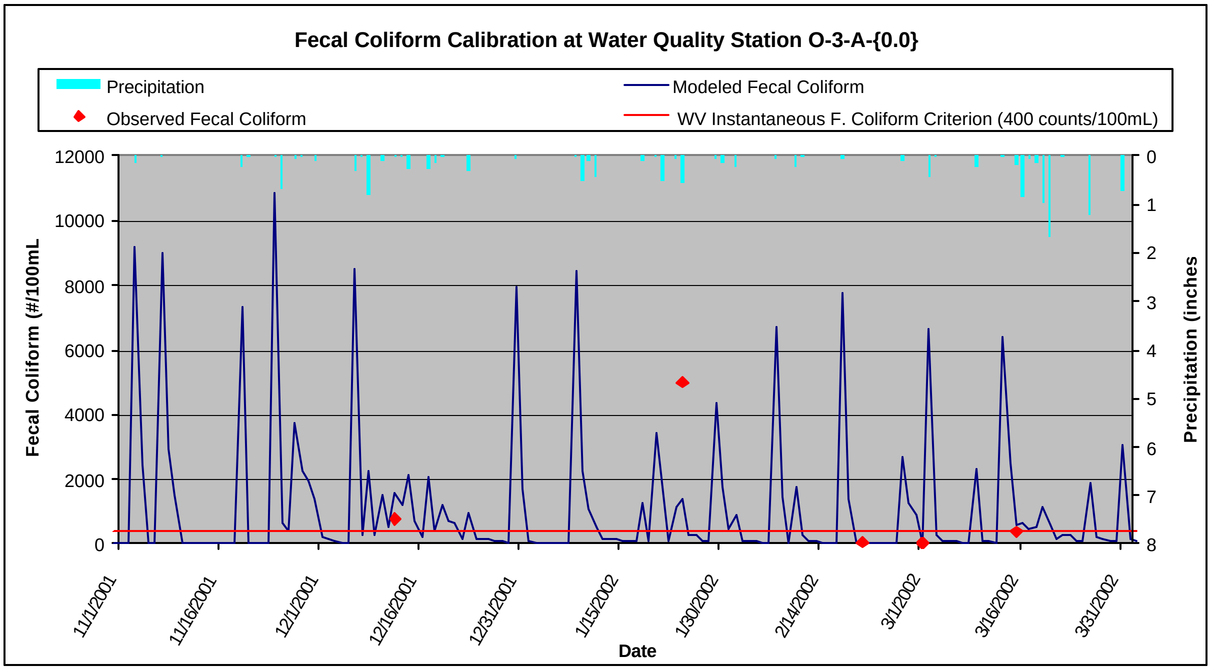

Figure E-7. Fecal Coliform Bacteri aCalibration at Water Quality Station O-3-A-{0.0} in Subwatershed 3

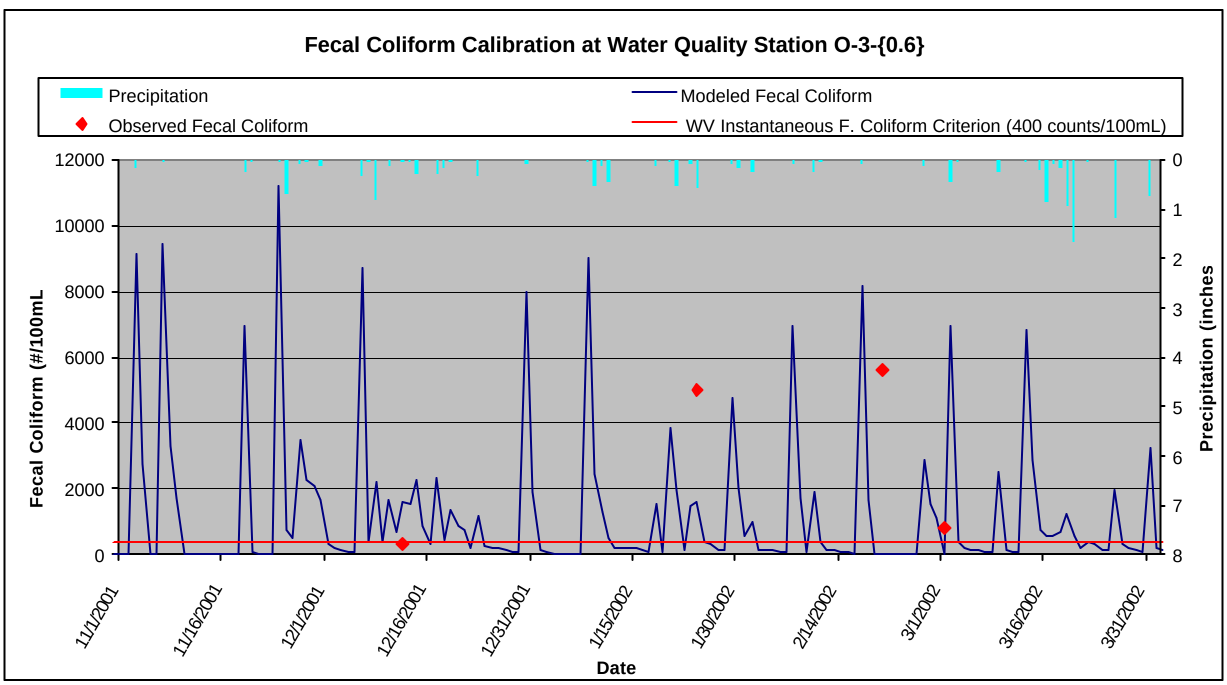

Figure E-8. Fecal Coliform Bacteria Calibration at Water Quality Station O-3-{0.6} in Subwatershed 1

Appendix F
Water Quality Calibration: Aluminum

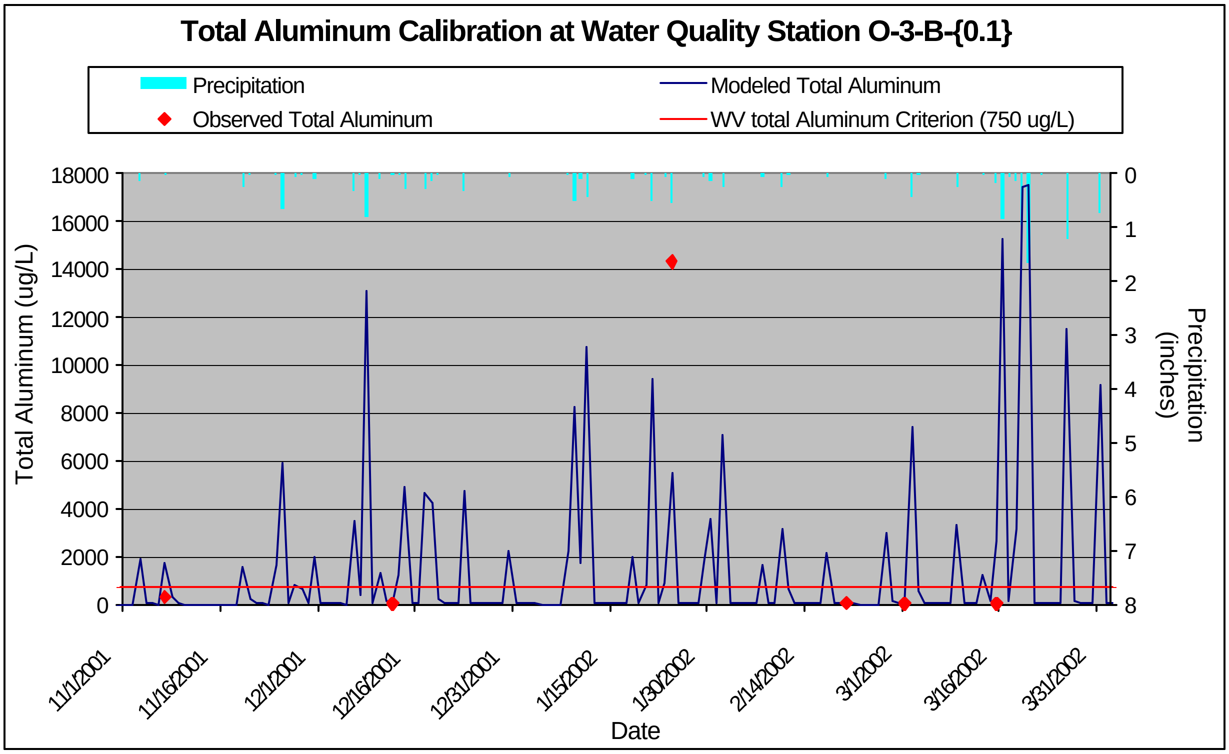

Figure F-1. Total Aluminum Calibration at Water Quality Station O-3-B-{0.1} in Subwatershed 12

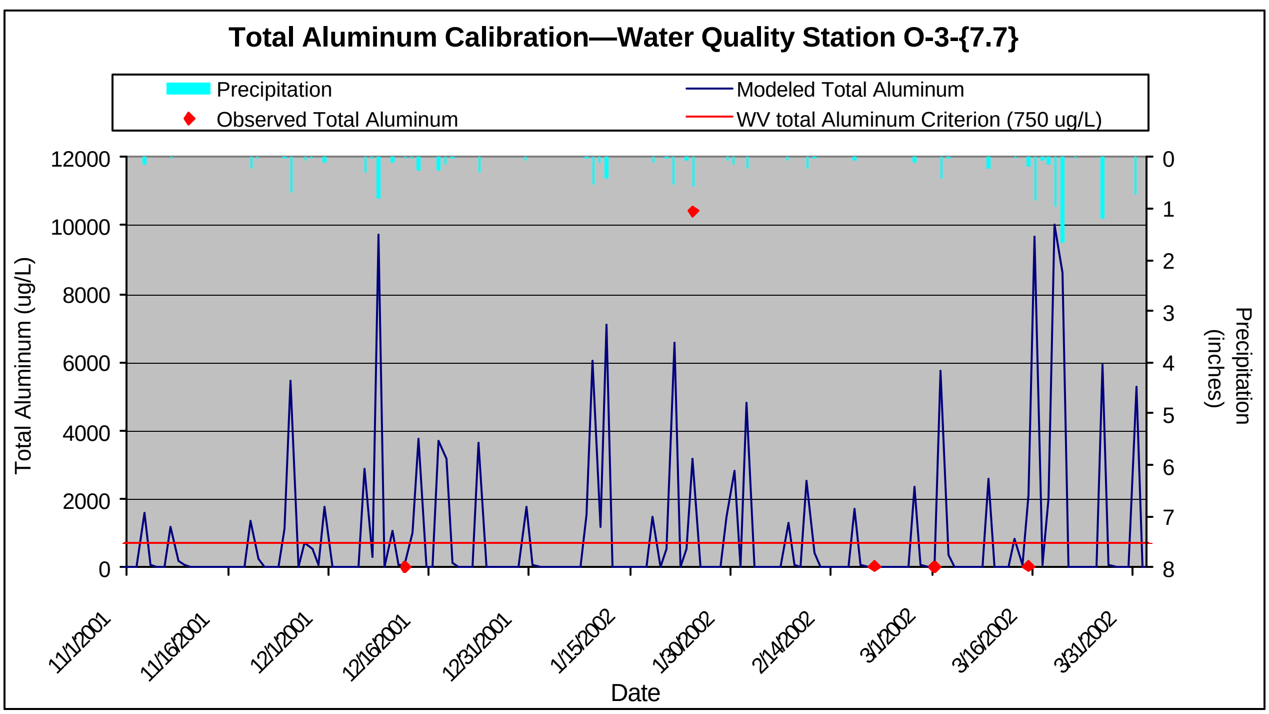

Figure F-2. Total Aluminum Calibration at Water Quality Station O-3-{7.7} in Subwatershed 11

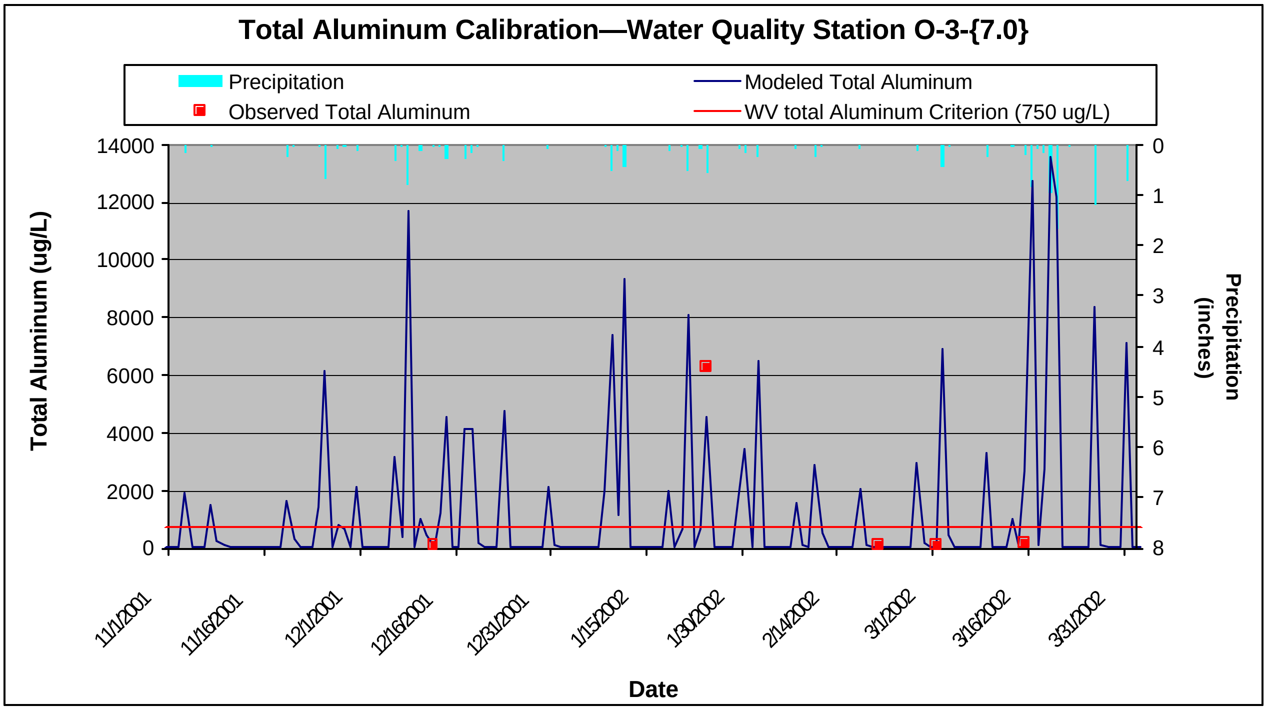

Figure F-3. Total Aluminum Calibration at Water Quality Station O-3-{7.0} in Subwatershed 10

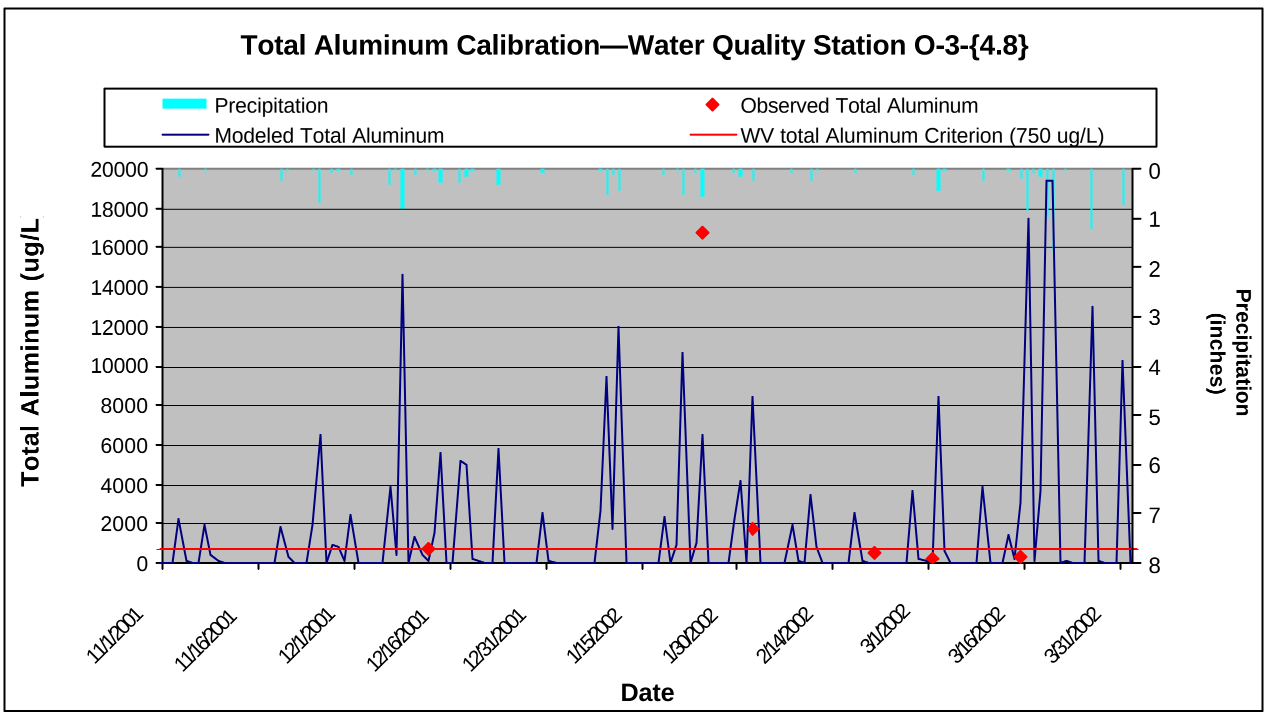

Figure F-4. Total Aluminum Calibration at Water Quality Station O-3-{4.8} in Subwatershed 8

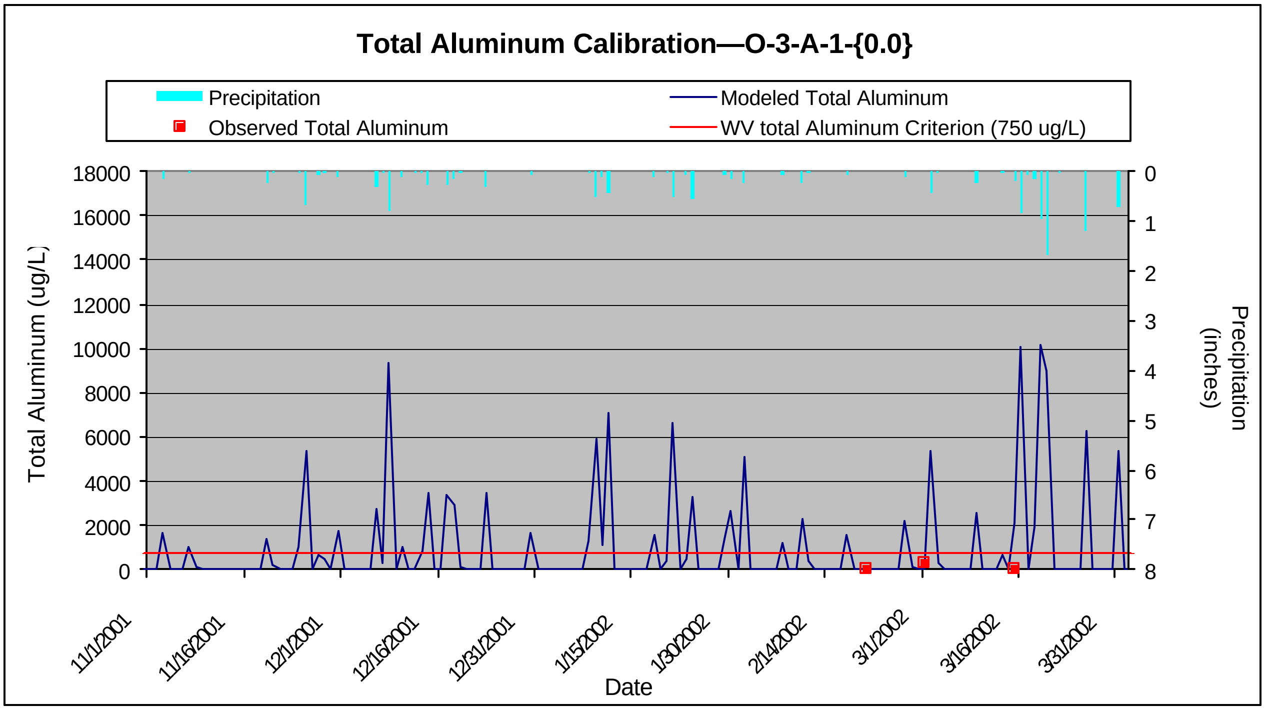

Figure F-5. Total Aluminum Calibration at Water Quality Station O-3-A-1-{0.0} in Subwatershed 5

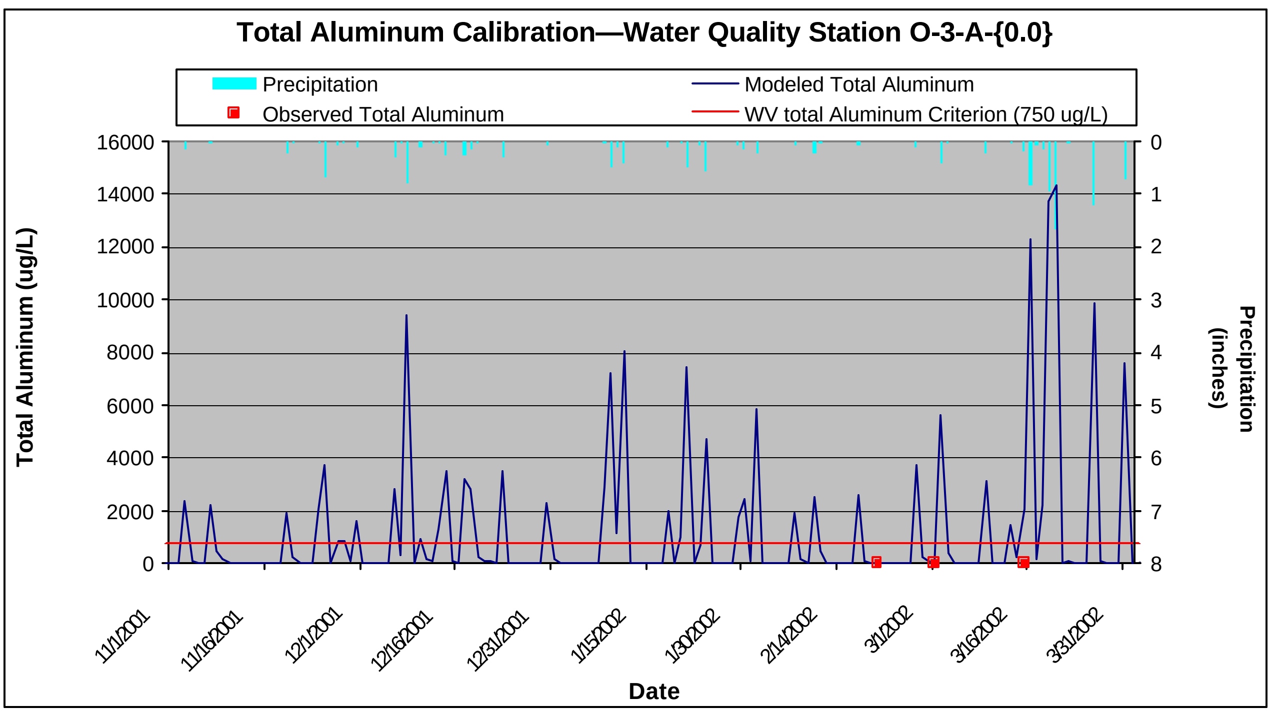

Figure F-6. Total Aluminum Calibration at Water Quality Station O-3-A-{0.0} in Subwatershed 3

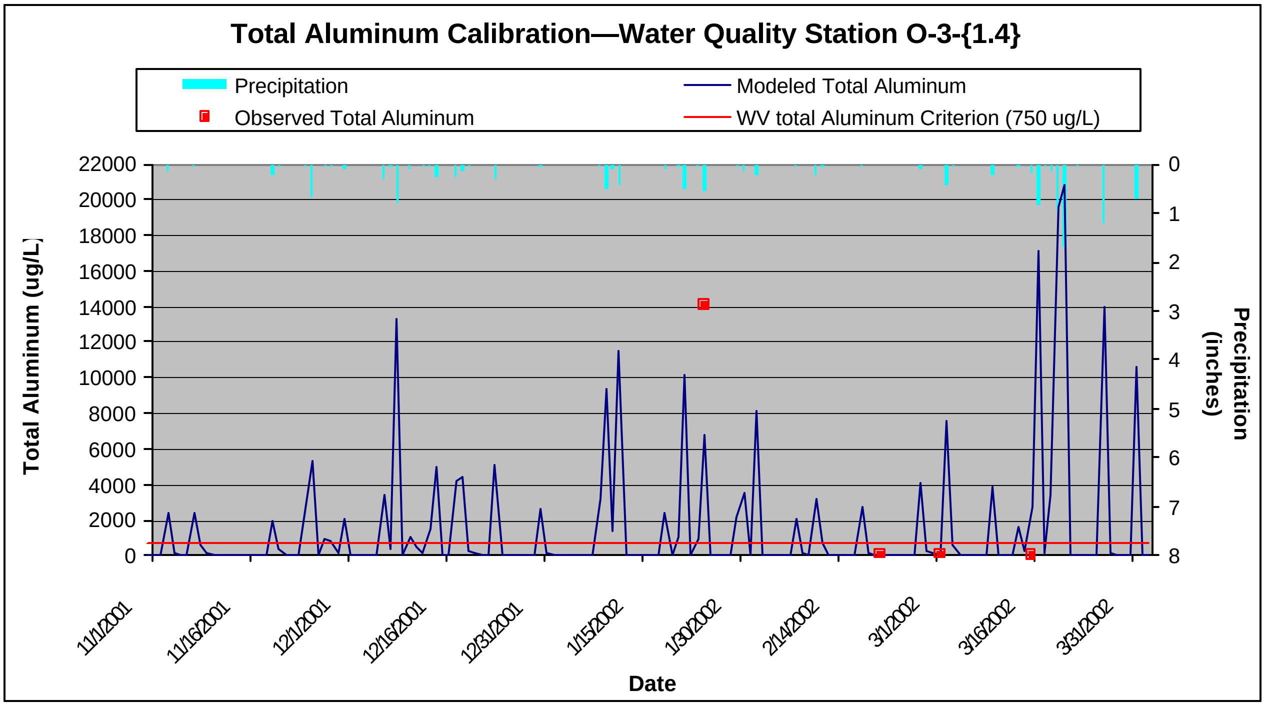

Figure F-7. Total Aluminum Calibration at Water Quality Station O-3-{1.4} in Subwatershed 1

Appendix G
Fecal Coliform Bacteria Baseline and Allocations

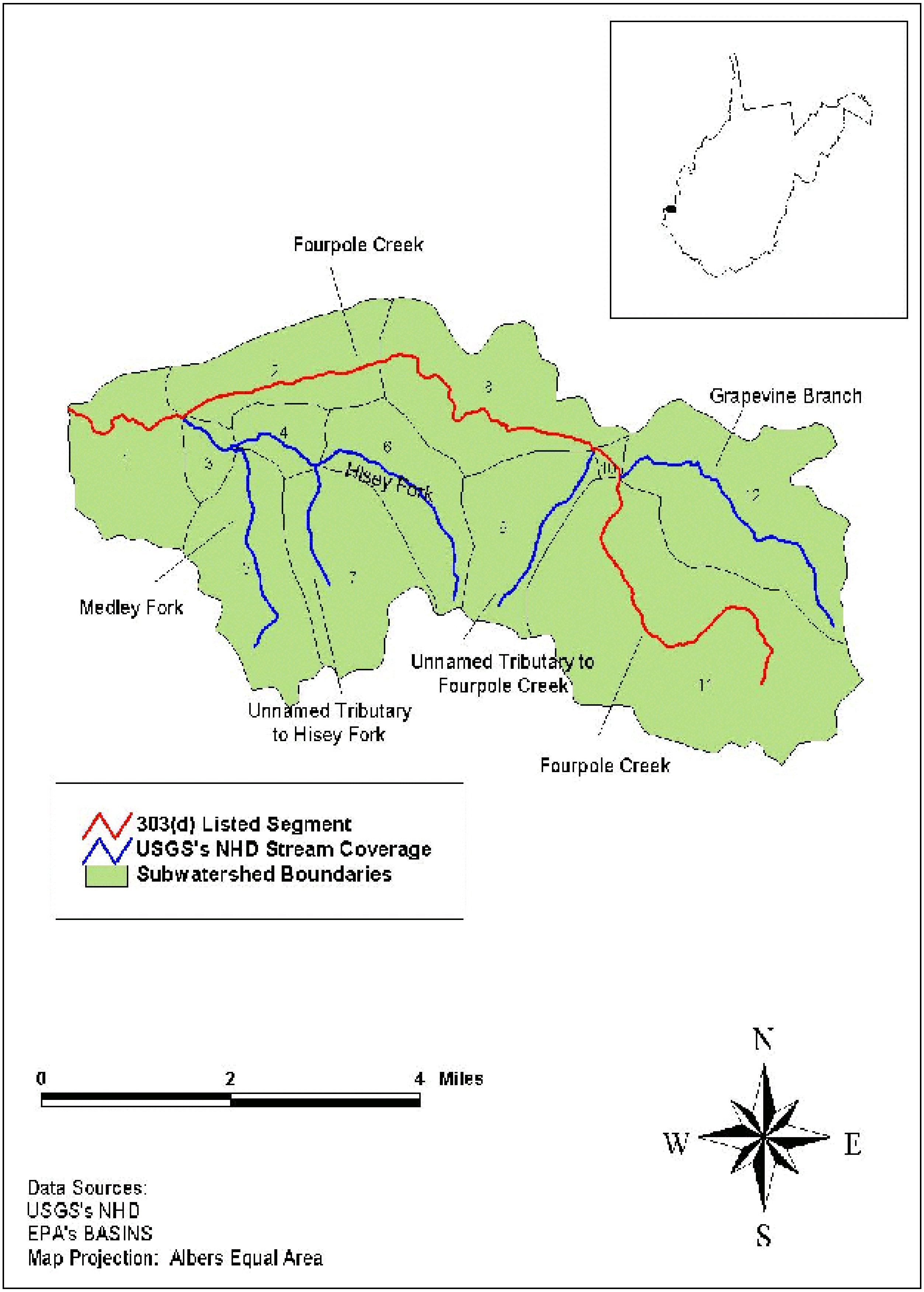

Figure G-1. Fourpole Creek Watershed

Table G-1. Fecal Coliform Baseline Conditions and Allocations (LA and WLAs) for Subwatershed 12; Grapevine Branch

Source	Baseline Fecal Coliform Load (counts/yr)	Allocated Fecal Coliform Load (counts/yr)	Percent Reduction (%)
Nonpoint Sources			
Barren	8.133E+09	8.133E+09	0
Construction Sites	3.855E+09	3.855E+09	0
Cropland	0	0	0
Pasture	2.942E+13	2.060E+13	30
Forest	2.459E+11	2.459E+11	0
Wetlands	0	0	0
Urban	1.421E+13	7.105E+11	95
Failing Septic Systems	3.386E+05	0	100
Point Sources			
WVG550211	1.099E+05	1.099E+05	0
WVG551037	6.103E+04	6.103E+04	0
Home Aeration Units[1]	1.339E+04	1.339E+04	0

Total Existing Load	**4.388E+13**	**Total Load Allocation**	**2.157E+13**
		Wasteload Allocation	**1.84E+05**
		Margin of Safety[2]	**1.08E+12**
		TMDL = Loading Capacity =	**2.265E+13**

[1] Home aeration units (HAUs) were modeled as a group in each subwatershed, therefore the HAU load is presented as a sum of the loads from all HAUs in the subwatershed. The HAUs in subwatershed 12 include WVG410087, WVG410384, WVG410617, and WVG410785.

[2] The MOS was included implicitly in the analysis with conservative assumptions and explicitly with a target/endpoint of 380 counts/100 mL as the instantaneous endpoint and 190 counts/100mL as a monthly geometric mean. See Section 5.1.2.

Table G-2. Fecal Coliform Baseline Conditions and Allocations (LA and WLAs) for Subwatershed 11; Fourpole Creek

Source	Baseline Fecal Coliform Load (counts/yr)	Allocated Fecal Coliform Load (counts/yr)	Percent Reduction (%)
Nonpoint Sources			
Barren	1.326E+10	1.326E+10	0
Construction Sites	0	0	0
Cropland	7.035E+09	7.035E+09	0
Pasture	4.891E+13	2.690E+13	45
Forest	5.558E+11	5.558E+11	0
Wetlands	2.850E+08	2.850E+08	0
Urban	1.063E+13	5.314E+11	95
Failing Septic Systems	7.683E+05	0	100
Point Sources			
WVG550511	6.103E+03	6.103E+03	0
Home Aeration Units[1]	3.386E+03	3.386E+03	0
Total Existing Load	**6.012E+13**	**Total Load Allocation**	**2.801E+13**
		Wasteload Allocation	**9.489E+03**
		Margin of Safety[2]	**1.400E+12**
		TMDL = Loading Capacity =	**2.941E+13**

[1]Home aeration units (HAUs) were modeled as a group in each subwatershed, therefore the HAU load is presented as a sum of the loads from all HAUs in the subwatershed. The home aeration units represented in subwatershed 11 include WVG410580.

[2] The MOS was included implicitly in the analysis with conservative assumptions and explicitly with a target/endpoint of 380 counts/100 mL as the instantaneous endpoint and 190 counts/100mL as a monthly geometric mean. See Section 5.1.2.

Table G-3. Fecal Coliform Baseline Conditions and Allocations (LA and WLAs) for Subwatershed 10; Fourpole Creek

Source	Baseline Fecal Coliform Load (counts/yr)	Allocated Fecal Coliform Load (counts/yr)	Percent Reduction (%)
Nonpoint Sources			
Barren	6.684E+08	6.684E+08	0
Construction Sites	0	0	0
Cropland	0	0	0
Pasture	8.167E+11	8.167E+11	0
Forest	3.699E+09	3.699E+09	0
Wetlands	0	0	0
Urban	1.077E+12	4.308E+10	96
Failing Septic Systems	3.052E+03	0	100
Point Sources			
NONE	0	0	0

Total Existing Load	**1.898E+12**	**Total Load Allocation**	**8.641E+11**
		Wasteload Allocation	**0.000E+00**
		Margin of Safety[1]	**4.321E+10**
		TMDL = Loading Capacity =	**9.074E+11**

[1] The MOS was included implicitly in the analysis with conservative assumptions and explicitly with a target/endpoint of 380 counts/100 mL as the instantaneous endpoint and 190 counts/100mL as a monthly geometric mean. See Section 5.1.2.

Table G-4. Fecal Coliform Baseline Conditions and Allocations (LA and WLAs) for Subwatershed 9; Unnamed Tributary to Fourpole Creek

Source	Baseline Fecal Coliform Load (counts/yr)	Allocated Fecal Coliform Load (counts/yr)	Percent Reduction (%)
Nonpoint Sources			
Barren	1.950E+09	1.950E+09	0
Construction Sites	0	0	0
Cropland	8.577E+08	8.577E+08	0
Pasture	1.697E+13	8.484E+12	50
Forest	1.488E+11	1.488E+11	0
Wetlands	0	0	0
Urban	2.751E+12	1.375E+11	95
Failing Septic Systems	2.193E+05	0	100
Point Sources			
WVG550302	7.311E+04	7.311E+04	0
WVG550811	6.702E+04	6.702E+04	0
Home Aeration Units[1]	3.386E+03	3.386E+03	0

Total Existing Load	**1.987E+13**	**Total Load Allocation**	**8.773E+12**
		Wasteload Allocation	**1.435E+05**
		Margin of Safety[2]	**4.387E+11**
		TMDL = Loading Capacity =	**9.212E+12**

[1] Home aeration units (HAUs) were modeled as a group in each subwatershed, therefore the HAU load is presented as a sum of the loads from all HAUs in the subwatershed. The home aeration units represented in subwatershed 9 include WVG410195.

[2] The MOS was included implicitly in the analysis with conservative assumptions and explicitly with a target/endpoint of 380 counts/100 mL as the instantaneous endpoint and 190 counts/100mL as a monthly geometric mean. See Section 5.1.2.

Table G-5. Fecal Coliform Baseline Conditions and Allocations (LA and WLAs) for Subwatershed 8; Fourpole Creek

Source	Baseline Fecal Coliform Load (counts/yr)	Allocated Fecal Coliform Load (counts/yr)	Percent Reduction (%)
Nonpoint Sources			
Barren	5.582E+08	5.582E+08	0
Construction Sites	3.047E+10	3.047E+10	0
Cropland	0	0	0
Pasture	6.394E+12	6.394E+12	0
Forest	5.077E+10	5.077E+10	0
Wetlands	0	0	0
Urban	1.986E+13	6.053E+11	97
Failing Septic Systems	5.784E+04	0	100
Point Sources			
WVG550228	9.155E+03	9.155E+03	0
Stormwater Discharges	1.499E+13	4.567E+11	97

Total Existing Load	**4.133E+13**	**Total Load Allocation**	**7.081E+12**
		Wasteload Allocation	**4.567E+11**
		Margin of Safety[1]	**3.769E+11**
		TMDL = Loading Capacity =	**7.915E+12**

[1] The MOS was included implicitly in the analysis with conservative assumptions and explicitly with a target/endpoint of 380 counts/100 mL as the instantaneous endpoint and 190 counts/100mL as a monthly geometric mean. See Section 5.1.2.

Table G-6. Fecal Coliform Baseline Conditions and Allocations (LA and WLAs) for Subwatershed 2; Fourpole Creek

Source	Baseline Fecal Coliform Load (counts/yr)	Allocated Fecal Coliform Load (counts/yr)	Percent Reduction
Nonpoint Sources			
Barren	8.806E+08	8.806E+08	0
Construction Sites	0	0	0
Cropland	0	0	0
Pasture	2.311E+12	2.311E+12	0
Forest	1.885E+10	1.885E+10	0
Wetlands	3.427E+09	3.427E+09	0
Urban	1.750E+13	5.290E+11	97
Failing Septic Systems	0	0	0
Point Sources			
Stormwater Discharges	7.175E+12	2.169E+11	97
Total Existing Load	**2.701E+13**	**Total Load Allocation**	**2.863E+12**
		Wasteload Allocation	**2.169E+11**
		Margin of Safety[1]	**1.540E+11**
		TMDL = Loading Capacity =	**3.334E+12**

[1] The MOS was included implicitly in the analysis with conservative assumptions and explicitly with a target/endpoint of 380 counts/100 mL as the instantaneous endpoint and 190 counts/100mL as a monthly geometric mean. See Section 5.1.2.

Table G-7. Fecal Coliform Baseline Conditions and Allocations (LA and WLAs) for Subwatershed 6; Hisey Fork

Source	Baseline Fecal Coliform Load (counts/yr)		Allocated Fecal Coliform Load (counts/yr)	Percent Reduction (%)
Nonpoint Sources				
Barren	9.463E+08		9.463E+08	0
Construction Sites	0		0	0
Cropland	5.498E+08		5.498E+08	0
Pasture	1.152E+13		1.152E+13	0
Forest	1.216E+11		1.216E+11	0
Wetlands	0		0	0
Urban	1.031E+13		2.062E+11	98
Failing Septic Systems	1.230E+05		1.230E+05	100
Point Sources				
NONE	0		0	0
Total Existing Load	**2.195E+13**	**Total Load Allocation**		**1.185E+13**
		Wasteload Allocation		**0**
		Margin of Safety[1]		**5.925E+11**
		TMDL = Loading Capacity =		**1.244E+13**

[1] The MOS was included implicitly in the analysis with conservative assumptions and explicitly with a target/endpoint of 380 counts/100 mL as the instantaneous endpoint and 190 counts/100mL as a monthly geometric mean. See Section 5.1.2.

Table G-8. Fecal Coliform Baseline Conditions and Allocations (LA and WLAs) for Subwatershed 7; Unnamed Tributary to Hisey Fork

Source	Baseline Fecal Coliform Load (counts/yr)	Allocated Fecal Coliform Load (counts/yr)	Percent Reduction (%)
Nonpoint Sources			
Barren	1.504E+09	1.504E+09	0
Construction Sites	3.530E+09	3.530E+09	0
Cropland	0	0	0
Pasture	1.822E+13	1.494E+13	18
Forest	1.729E+11	1.729E+11	0
Wetlands	0	0	0
Urban	7.196E+12	1.439E+11	98
Failing Septic Systems	1.994E+05	1.994E+05	0
Point Sources			
Home Aeration Units[1]	6.694E+03	6.694E+03	0
Total Existing Load	**2.559E+13**	**Total Load Allocation**	**1.526E+13**
		Wasteload Allocation	**6.694E+03**
		Margin of Safety[2]	**7.631E+11**
		TMDL = Loading Capacity =	**1.602E+13**

[1] Home aeration units (HAUs) were modeled as a group in each subwatershed, therefore the HAU load is presented as a sum of the loads from all HAUs in the subwatershed. The home aeration units represented in subwatershed 7 include WVG410209 and WVG410496.
[2] The MOS was included implicitly in the analysis with conservative assumptions and explicitly with a target/endpoint of 380 counts/100 mL as the instantaneous endpoint and 190 counts/100mL as a monthly geometric mean. See Section 5.1.2.

Table G-9. Fecal Coliform Baseline Conditions and Allocations (LA and WLAs) for Subwatershed 4; Hisey Fork

Source	Baseline Fecal Coliform Load (counts/yr)	Allocated Fecal Coliform Load (counts/yr)	Percent Reduction (%)
Nonpoint Sources			
Barren	0	0	0
Construction Sites	0	0	0
Cropland	9.182E+08	9.182E+08	0
Pasture	2.207E+12	2.207E+12	0
Forest	2.425E+10	2.425E+10	0
Wetlands	1.155E+08	1.155E+08	0
Urban	6.593E+12	1.978E+11	97
Failing Septic Systems	6.587E+03	0	100
Point Sources			
NONE	0	0	0
Total Existing Load	**8.825E+12**	**Total Load Allocation**	**2.430E+12**
		Wasteload Allocation	**0**
		Margin of Safety[1]	**1.215E+11**
		TMDL = Loading Capacity =	**2.552E+12**

[1] The MOS was included implicitly in the analysis with conservative assumptions and explicitly with a target/endpoint of 380 counts/100 mL as the instantaneous endpoint and 190 counts/100mL as a monthly geometric mean. See Section 5.1.2.

Table G-10. Fecal Coliform Baseline Conditions and Allocations (LA and WLAs) for Subwatershed 5; Medley Fork

Source	Baseline Fecal Coliform Load (counts/yr)	Allocated Fecal Coliform Load (counts/yr)	Percent Reduction (%)
Nonpoint Sources			
Active Surface Mine	2.60E+09	2.60E+09	0
Barren	7.235E+08	7.235E+08	0
Construction Sites	0	0	0
Cropland	3.486E+09	3.486E+09	0
Pasture	2.164E+13	1.190E+13	45
Forest	1.896E+11	1.896E+11	0
Wetlands	0	0	0
Urban	3.793E+12	7.586E+10	98
Failing Septic Systems	1.319E+05	0	100
Point Sources			
NONE	0	0	0
Total Existing Load	**2.563E+13**	**Total Load Allocation**	**1.217E+13**
		Wasteload Allocation	**0**
		Margin of Safety	**6.085E+11**
		TMDL = Loading Capacity =	**1.278E+13**

[1] The MOS was included implicitly in the analysis with conservative assumptions and explicitly with a target/endpoint of 380 counts/100 mL as the instantaneous endpoint and 190 counts/100mL as a monthly geometric mean. See Section 5.1.2.

Table G-11. Fecal Coliform Baseline Conditions and Allocations (LA and WLAs) for Subwatershed 3; Hisey Fork

Source	Baseline Fecal Coliform Load (counts/yr)	Allocated Fecal Coliform Load (counts/yr)	Percent Reduction (%)
Nonpoint Sources			
Barren	0	0	0
Construction Sites	0	0	0
Cropland	0	0	0
Pasture	4.600E+12	4.600E+12	0
Forest	9.657E+09	9.657E+09	0
Wetlands	0	0	0
Urban	3.496E+12	2.447E+11	97
Failing Septic Systems	1.844E+04	0	100
Point Sources			
Home Aeration Units[1]	3.386E+03	3.386E+03	0
Total Existing Load	**8.106E+12**	**Total Load Allocation**	**4.854E+12**
		Wasteload Allocation	**3.386E+03**
		Margin of Safety[2]	**2.427E+11**
		TMDL = Loading Capacity =	**5.097E+12**

[1] Home aeration units (HAUs) were modeled as a group in each subwatershed, therefore the HAU load is presented as a sum of the loads from all HAUs in the subwatershed. The home aeration units represented in subwatershed 3 include WVG410792.

[2] The MOS was included implicitly in the analysis with conservative assumptions and explicitly with a target/endpoint of 380 counts/100 mL as the instantaneous endpoint and 190 counts/100mL as a monthly geometric mean. See Section 5.1.2.

Table G-12. Fecal Coliform Baseline Conditions and Allocations (LA and WLAs) for Subwatershed 1; Fourpole Creek

Source	Baseline Fecal Coliform Load (counts/yr)	Allocated Fecal Coliform Load (counts/yr)	Percent Reduction (%)
Nonpoint Sources			
Barren	2.553E+09	2.553E+09	0
Construction Sites	0	0	0
Cropland	0	0	0
Pasture	1.194E+13	1.194E+13	0
Forest	6.202E+10	6.202E+10	0
Wetlands	7.773E+09	7.773E+09	0
Urban	1.928E+13	3.872E+11	98
Failing Septic Systems	5.217E+04	0	100
Point Sources			
Combined Sewer Overflow (022 - B&O Regulator)	1.647E+10	1.647E+10	0
Home Aeration Units[1]	1.339E+04	1.339E+04	0

Total Existing Load	**3.13E+13**	**Total Load Allocation**	**1.240E+13**
		Wasteload Allocation	**1.647E+10**
		Margin of Safety[2]	**1.24E+12**
		TMDL = Loading Capacity =	**1.37E+13**

[1]Home aeration units (HAUs) were modeled as a group in each subwatershed, therefore the HAU load is presented as a sum of the loads from all HAUs in the subwatershed. The home aeration units represented in subwatershed 1 include WVG410116, WVG410052, WVG410600, and WVG410656.

[2] The MOS was included implicitly in the analysis with conservative assumptions and explicitly with a target/endpoint of 380 counts/100 mL as the instantaneous endpoint and 190 counts/100mL as a monthly geometric mean. See Section 5.1.2.

Appendix H
Aluminum Baseline and Allocations

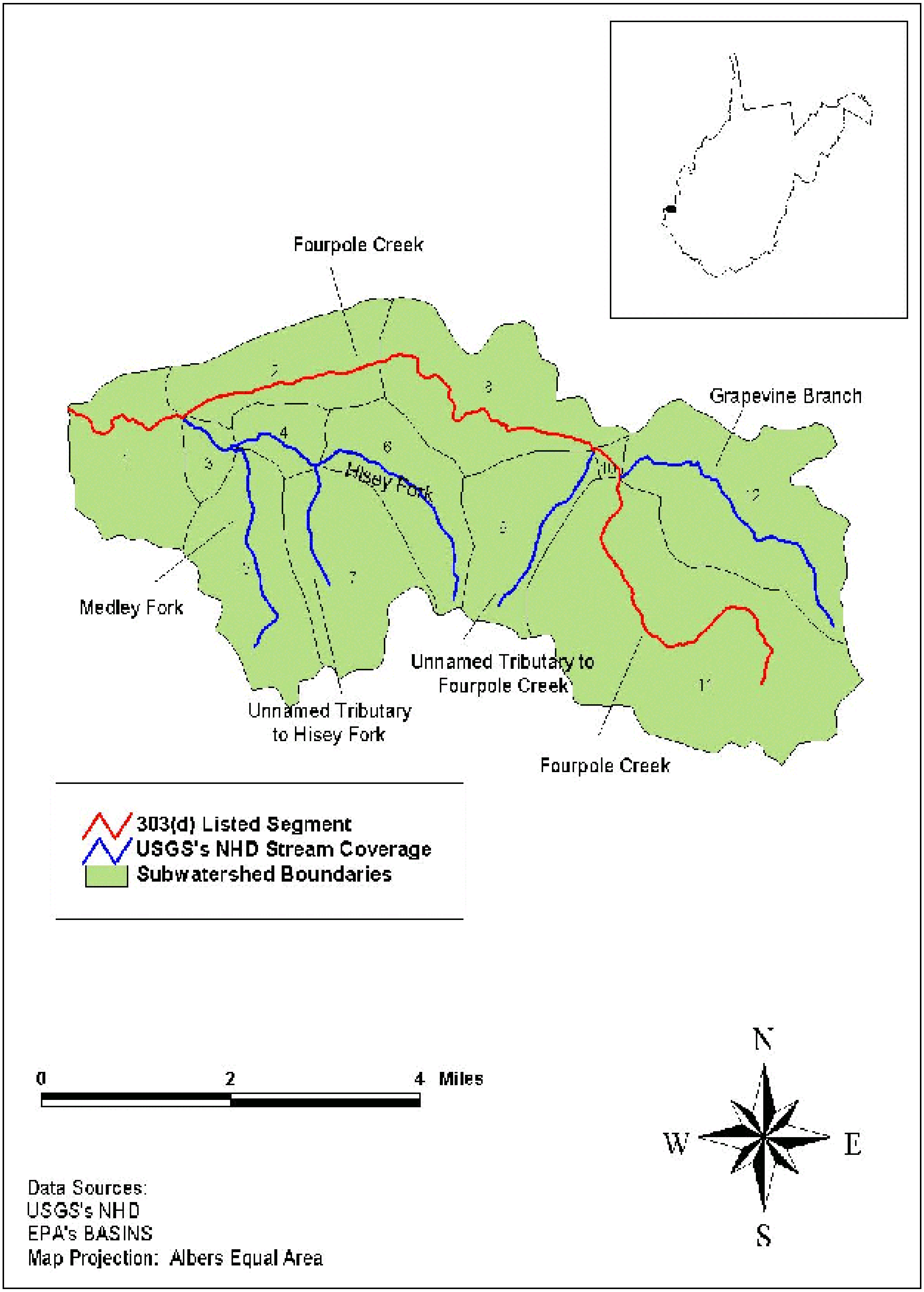

Figure H-1. Fourpole Creek Watershed

Table H-1. Aluminum Baseline Conditions and Allocations (LA and WLAs) for Subwatershed 12; Grapevine Branch

Source	Baseline Aluminum Load (lbs/yr)	Allocated Aluminum Load (lbs/yr)	Percent Reduction (%)
Nonpoint Sources			
Barren	24,915	249	99
Cropland	0	0	0
Pasture	3,566	2,853	20
Forest	3,170	3,170	0
Wetlands	0	0	0
Urban	131,602	1,316	99
Point Sources			
Construction Sites[1]	11,810	118	99
Total Existing Load	**175,063**	**Total Load Allocation**	**7,588**
		Wasteload Allocation	**118**
		Margin of Safety[1]	**385**
		TMDL = Loading Capacity =	**8,091**

[1] Construction sites include NPDES stormwater permits WVG071940 and WVG072104

[2] The MOS was included implicitly in the analysis with conservative assumptions and explicitly with a target/endpoint of 712.5 ug/L. See Section 5.1.1.

Table H-2. Aluminum Baseline Conditions and Allocations (LA and WLAs) for Subwatershed 11; Fourpole Creek

Source	Baseline Aluminum Load (lbs/yr)	Allocated Aluminum Load (lbs/yr)	Percent Reduction (%)
Nonpoint Sources			
Barren	40,613	406	99
Cropland	136	68	50
Pasture	5,929	2,965	50
Forest	7,163	7,163	0
Wetlands	4	4	0
Urban	81,293	813	99
Point Sources			
NONE	0	0	0
Total Existing Load	**135,138**	**Total Load Allocation**	**11,419**
		Wasteload Allocation	**0**
		Margin of Safety[1]	**571**
		TMDL = Loading Capacity =	**11,990**

[1] The MOS was included implicitly in the analysis with conservative assumptions and explicitly with a target/endpoint of 712.5 ug/L. See Section 5.1.1.

Table H-3. Aluminum Baseline Conditions and Allocations (LA and WLAs) for Subwatershed 10; Fourpole Creek

Source	Baseline Aluminum Load (lbs/yr)	Allocated Aluminum Load (lbs/yr)	Percent Reduction (%)
Nonpoint Sources			
Barren	2,048	61	97
Cropland	0	0	0
Pasture	99	99	0
Forest	48	48	0
Wetlands	0	0	0
Urban	4,668	140	97
Point Sources			
NONE	0	0	0

Total Existing Load	**6,863**	**Total Load Allocation**	**348**
		Wasteload Allocation	**0**
		Margin of Safety[1]	**17**
		TMDL = Loading Capacity =	**365**

[1] The MOS was included implicitly in the analysis with conservative assumptions and explicitly with a target/endpoint of 712.5 ug/L. See Section 5.1.1.

Table H-4. Aluminum Baseline Conditions and Allocations (LA and WLAs) for Subwatershed 9; Unnamed Tributary to Fourpole Creek

Source	Baseline Aluminum Load (lbs/yr)	Allocated Aluminum Load (lbs/yr)	Percent Reduction (%)
Nonpoint Sources			
Barren	5,974	60	99
Cropland	17	7	55
Pasture	2,057	926	55
Forest	1,918	1,918	0
Wetlands	0	0	0
Urban	25,001	250	99
Point Sources			
NONE	0	0	0
Total Existing Load	**34,967**	**Total Load Allocation**	**3,161**
		Wasteload Allocation	**0**
		Margin of Safety[1]	**158**
		TMDL = Loading Capacity =	**3,319**

[1] The MOS was included implicitly in the analysis with conservative assumptions and explicitly with a target/endpoint of 712.5 ug/L. See Section 5.1.1.

Table H-5. Aluminum Baseline Conditions and Allocations (LA and WLAs) for Subwatershed 8; Fourpole Creek

Source	Baseline Aluminum Load (lbs/yr)		Allocated Aluminum Load (lbs/yr)	Percent Reduction (%)
Nonpoint Sources				
Barren	1,710		86	95
Cropland	0		0	0
Pasture	827		827	0
Forest	655		655	0
Wetlands	0		0	0
Urban	333,205		3,332	99
Point Sources				
Construction Sites[1]	93,327		933	99
Total Existing Load	**429,724**	**Total Load Allocation**		**4,900**
		Wasteload Allocation		**933**
		Margin of Safety[2]		**292**
		TMDL = Loading Capacity =		**6,125**

[1] Construction sites includes the NPDES stormwater permits WVG071831, WVG01937, and WVG02060

[2] The MOS was included implicitly in the analysis with conservative assumptions and explicitly with a target/endpoint of 712.5 ug/L. See Section 5.1.1.

Table H-6. Aluminum Baseline Conditions and Allocations (LA and WLAs) for Subwatershed 2; Fourpole Creek

Source	Baseline Aluminum Load (lbs/yr)	Allocated Aluminum Load (lbs/yr)	Percent Reduction (%)
Nonpoint Sources			
Barren	2,730	2,730	0
Cropland	0	0	0
Pasture	285	285	0
Forest	260	260	0
Wetlands	45	45	0
Urban	279,757	2,798	99
Point Sources			
NONE	0	0	0
Total Existing Load	**283,077**	**Total Load Allocation**	**6,118**
		Wasteload Allocation	**0**
		Margin of Safety[1]	**306**
		TMDL = Loading Capacity =	**6,424**

[1] The MOS was included implicitly in the analysis with conservative assumptions and explicitly with a target/endpoint of 712.5 ug/L. See Section 5.1.1.

Table H-7. Aluminum Baseline Conditions and Allocations (LA and WLAs) for Subwatershed 6; Hisey Fork

Source	Baseline Aluminum Load (lbs/yr)		Allocated Aluminum Load (lbs/yr)	Percent Reduction (%)
Nonpoint Sources				
Barren	2,899		290	90
Cropland	11		11	0
Pasture	1,397		1,397	0
Forest	1,568		1,568	0
Wetlands	0		0	0
Urban	77,665		777	99
Point Sources				
NONE	0		0	0
Total Existing Load	**83,540**	**Total Load Allocation**		**4,043**
		Wasteload Allocation		**0**
		Margin of Safety[1]		**202**
		TMDL = Loading Capacity =		**4,245**

[1] The MOS was included implicitly in the analysis with conservative assumptions and explicitly with a target/endpoint of 712.5 ug/L. See Section 5.1.1.

Table H-8. Aluminum Baseline Conditions and Allocations (LA and WLAs) for Subwatershed 7; Unnamed Tributary to Hisey Fork

Source	Baseline Aluminum Load (lbs/yr)		Allocated Aluminum Load (lbs/yr)	Percent Reduction (%)
Nonpoint Sources				
Barren	4,609		46	99
Cropland	0		0	0
Pasture	2,208		1,766	20
Forest	2,228		2,228	0
Wetlands	0		0	0
Urban	44,978		450	99
Point Sources				
Construction Sites[1]	10,813		108	99
Total Existing Load	**64,836**	**Total Load Allocation**		**4,490**
		Wasteload Allocation		**108**
		Margin of Safety[2]		**230**
		TMDL = Loading Capacity =		**4,828**

[1] Construction sites includes the NPDES stormwater permit WVG071513
[2] The MOS was included implicitly in the analysis with conservative assumptions and explicitly with a target/endpoint of 712.5 ug/L. See Section 5.1.1.

Table H-9. Aluminum Baseline Conditions and Allocations (LA and WLAs) for Subwatershed 4; Hisey Fork

Source	Baseline Aluminum Load (lbs/yr)	Allocated Aluminum Load (lbs/yr)	Percent Reduction (%)
Nonpoint Sources			
Barren	0	0	0
Cropland	18	18	0
Pasture	268	268	0
Forest	312	312	0
Wetlands	2	2	0
Urban	58,678	1,760	97
Point Sources			
NONE	0	0	0
Total Existing Load	**59,278**	**Total Load Allocation**	**2,360**
		Wasteload Allocation	**0**
		Margin of Safety[1]	**118**
		TMDL = Loading Capacity =	**2,478**

[1] The MOS was included implicitly in the analysis with conservative assumptions and explicitly with a target/endpoint of 712.5 ug/L. See Section 5.1.1.

Table H-10. Aluminum Baseline Conditions and Allocations (LA and WLAs) for Subwatershed 5; Medley Fork

Source	Baseline Aluminum Load (lbs/yr)	Allocated Aluminum Load (lbs/yr)	Percent Reduction (%)
Nonpoint Sources			
Barren	2,216	22	99
Cropland	67	67	60
Pasture	2,624	1,196	60
Forest	2,657	2,657	0
Wetlands	0	0	0
Urban	34,421	344	99
Point Sources			
None	0	0	0

Total Existing Load	**41,985**	**Total Load Allocation**	**4,286**
		Wasteload Allocation	**0**
		Margin of Safety[1]	**214**
		TMDL = Loading Capacity =	**4,500**

[1] The MOS was included implicitly in the analysis with conservative assumptions and explicitly with a target/endpoint of 712.5 ug/L. See Section 5.1.1.

Table H-11. Aluminum Baseline Conditions and Allocations (LA and WLAs) for Subwatershed 3; Hisey Fork

Source	Baseline Aluminum Load (lbs/yr)	Allocated Aluminum Load (lbs/yr)	Percent Reduction (%)
Nonpoint Sources			
Barren	0	0	0
Cropland	0	0	0
Pasture	558	558	0
Forest	124	124	0
Wetlands	0	0	0
Urban	30,464	305	99
Point Sources			
NONE	0	0	0
Total Existing Load	**31,146**	**Total Load Allocation**	**987**
		Wasteload Allocation	**0**
		Margin of Safety[1]	**49**
		TMDL = Loading Capacity =	**1,036**

[1] The MOS was included implicitly in the analysis with conservative assumptions and explicitly with a target/endpoint of 712.5 ug/L. See Section 5.1.1.

Table H-12. Aluminum Baseline Conditions and Allocations (LA and WLAs) for Subwatershed 1; Fourpole Creek

Source	Baseline Aluminum Load (lbs/yr)	Allocated Aluminum Load (lbs/yr)	Percent Reduction (%)
Nonpoint Sources			
Barren	7,853	79	99
Cropland	0	0	0
Pasture	1,487	1,487	0
Forest	801	801	0
Wetlands	151	151	0
Urban	180,425	1,804	99
Point Sources			
NONE	0	0	0

Total Existing Load	**190,717**	**Total Load Allocation**	**4,322**
		Wasteload Allocation	**0**
		Margin of Safety[1]	**217**
		TMDL = Loading Capacity =	**4,539**

[1] The MOS was included implicitly in the analysis with conservative assumptions and explicitly with a target/endpoint of 712.5 ug/L. See Section 5.1.1.