Lower Coal River Watershed Based Plan

October 2014

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Watershed Based Plan

Submitted by:
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Acknowledgements:

The following agencies and organizations contributed to this watershed based plan:

- The Coal River Watershed Group (CRG)
- The Appalachian Coal Country Watershed Team (ACCT)
- West Virginia Department of Environmental Protection (WVDEP)
- West Virginia Conservation Agency (WVCA) Capitol Conservation District
- U.S. Office of Surface Mining Reclamation and Enforcement (OSM)
- Dunn Engineers
- Kanawha-Charleston Health Department (KCHD)
- Marshall University

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Cover: Lower Coal River downstream of Tornado, photo by Sara Cottingham

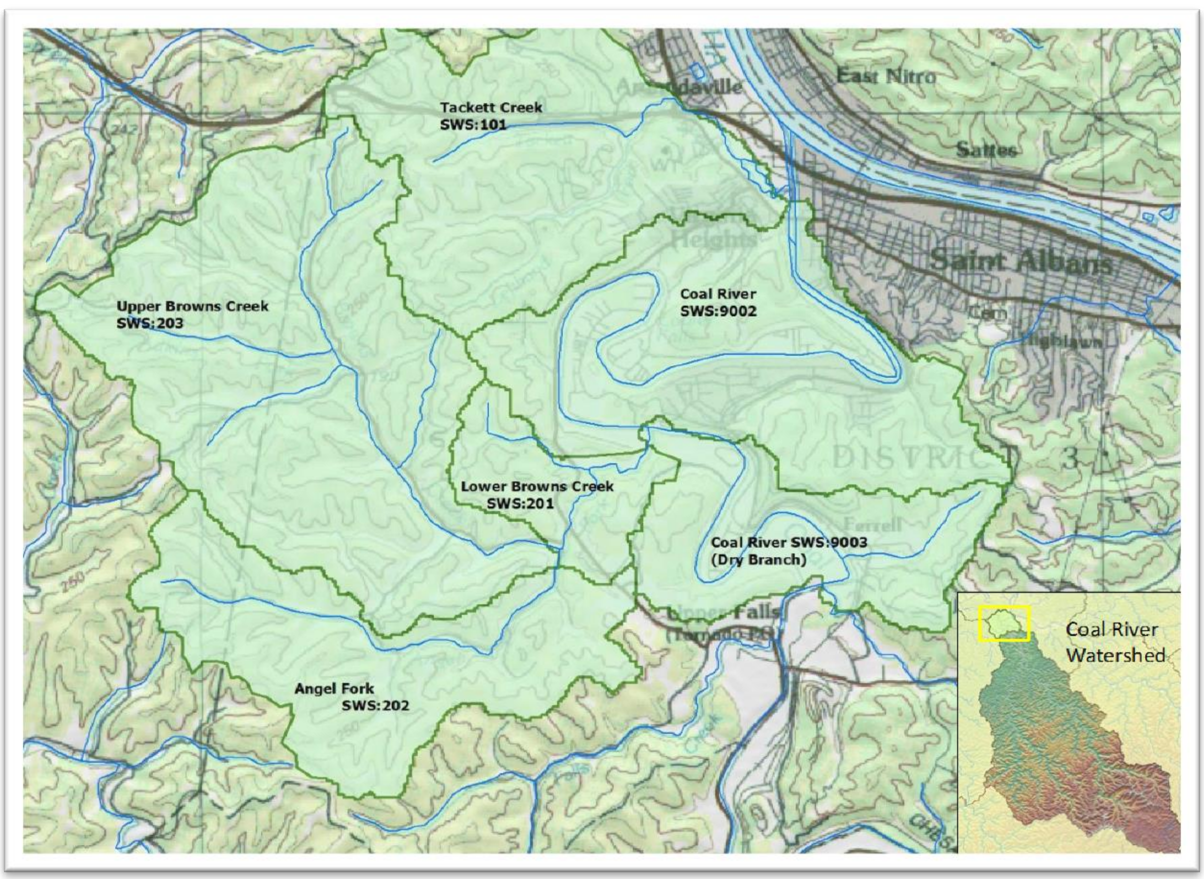
1 Introduction

The purpose of this watershed based plan is to define the nonpoint problems, resources, costs, and management measures necessary to restore the impaired streams of the Lower Coal River watershed (WVKC-2), based on the Total Maximum Daily Load (TMDL) set for these streams by the WV Department of Environmental Project (WVDEP).

The Browns Creek-Coal River watershed is defined by the U.S. Geological Survey (USGS) as 12-digit hydrologic unit code (50500090608), and is included in the Coal River TMDL. The Browns Creek-Coal River watershed is referred to in this plan as the "Lower Coal River watershed."

The area is part of the larger Coal River watershed, 8-digit hydrologic unit code (05050009), an 891-sq mi watershed draining the Big Coal, Little Coal, and main stem Coal Rivers. The watershed forms in the highlands of Boone and Raleigh counties and flows north to the Coal's confluence with the Kanawha River. The HUC-12 Lower Coal River area addressed in this plan makes up the northern-most reach of the Coal River watershed and includes the mouth of the Coal River at St. Albans, WV.

Figure 1: Lower Coal River Watershed (Map created by John Wirt, WVDEP 2013)



The Lower Coal River area drains 14,371 acres (22.5 sq. mi) in Kanawha and Putnam counties. The watershed consists of the Coal River, from below Upper Falls in Tornado, WV, to the confluence with the Kanawha River in St. Albans, WV. Major tributaries within the area consist of Browns Creek, Angel Fork of Browns Creek, and Tackett Creek.

The HUC-12 Lower Coal area is divided into six sub-watersheds:

- Tackett Creek (SWS 101)
- Lower Browns Creek (SWS 201)
- Angel Fork (SWS 202)
- Upper Browns Creek (SWS 203)
- Coal River (SWS 9002)
- Coal River-Dry Branch (SWS 9003)

The Coal River follows a meandering course through the Lower Coal River watershed and forms a narrow river valley. This area of mostly rolling hills and some flat land is now a suburban residential area extending from the City of St. Albans to the unincorporated town of Tornado. Beyond this floodplain lies steep, rugged terrain that remains heavily forested.

According to the 2010 Census, the entire Lower Coal watershed is home to approximately 11,700 residents. Typical of southern West Virginia, development in the Lower Coal watershed is concentrated in the flatter areas along the Coal River and its tributaries. The watershed includes parts of the City of St. Albans (estimated population of 12,000) and the community of Tornado (estimated population of 1,000), and several subdivisions along Coal River Road and U.S. Route 60.

Just beyond the boundary of St. Albans, the area transitions rapidly from urban to rural. With the majority of residents primarily in the urban and suburban areas of the Tackett Creek (101) and Coal River (9002) sub-watersheds, the surrounding hills are sparsely populated and rural in nature. Small-scale agriculture is prominent in all six sub-watersheds, and several horse and cattle farms are located in the area.

Figure 2: Land Use of the Lower Coal River watershed *(STEPL Model Input Data Server)*

Land Use	Acres
Forest	8984.013
Urban	2524.564
Pasture	189.115
Cropland	91.434

The dominant hydrologic soil group is type “C,” indicating a slow infiltration rate.
The combination of poor soil percolation with a high water table makes proper sewage treatment a widespread difficulty for the Lower Coal River area.

2 Nonpoint Source Pollution Sources and Causes

Per the federal Clean Water Act, states are required to identify rivers and streams that do not meet water quality standards and place them on a statewide 303(d) list. A Total Maximum Daily Load (TMDL) is then prepared for these impaired streams to set the maximum allowable pollutant load to achieve water quality standards.

In 2006 the U.S. Environmental Protection Agency (USEPA) approved a TMDL for the Coal River watershed developed by the West Virginia Department of Environmental Protection (WVDEP). The WVDEP conducted extensive monitoring throughout the watershed from 2002 to 2003 in order to confirm stream impairments identified on 303(d) lists from previous years and to identify other impaired streams that were not listed previously.

A TMDL is composed of a sum of individual wasteload allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources and natural background levels. In addition, the TMDL must include a margin of safety (MOS) that accounts for uncertainty in the relationship between pollutant loads and the quality of the receiving stream. TMDLs can be expressed in terms of mass per time or other appropriate units. TMDLs are calculated by the following equation:

$$\text{TMDL} = \text{sum of WLAs} + \text{sum of LAs} + \text{MOS}$$

The determination of impaired waters involves comparing in-stream conditions to applicable water quality standards. West Virginia's water quality standards are codified at Title 47 of the Code of State Rules (CSR), Series 2, titled *Legislative Rules, Department of Environmental Protection: Requirements Governing Water Quality Standards.* Water quality standards consist of three components: designated uses; narrative and/or numeric water quality criteria necessary to support those uses; and an antidegradation policy.

Figure 3: Selected West Virginia water quality standards *(*Coal River TMDL)

		Aquatic Life		Human Health	
Parameter	**Section**	**Category B1 (Warm water fishery streams)**	**Category B2 (Trout waters)**	**Category A (Public water supply)**	**Category C (Water contact recreation)**
Biological impairment	3.2.i	[N]o significant adverse impact to the...biological [component] of aquatic ecosystems shall be allowed.			
Fecal coliform	8.13	None	None	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 ten percent of all samples taken during the month.	

Based on monitoring conducted by the WVDEP in 2002 and 2003, the TMDL found 127 impaired streams within the entire Coal River watershed. The DEP's studies of the Lower Coal River watershed identified Browns Creek as impaired for fecal coliform and biological impairment in West Virginia's 303(d) lists of 1996, 1998, 2002, and 2004. As a result, TMDLs were developed for fecal coliform, sediment, and biological impairment on Browns Creek.

2.1 Fecal Coliform Bacteria

Fecal coliform bacteria pose a major issue throughout the entire Coal River watershed. The Lower Coal River area faces some of the most serious fecal coliform problems due to its high population density. Stream monitoring conducted by Marshall University in 2008 and 2013 confirmed that high levels of fecal coliform still persist (See Appendix A: Fecal Coliform Sampling Results from Browns Creek).

The Coal River TMDL gives the Lower Coal watershed (labeled "Browns Creek- Coal River") the second highest reductions in the entire Coal River watershed, shown in Figures 4 and 5.

Figure 4: Fecal Coliform reductions from TMDL *(WVDEP)*

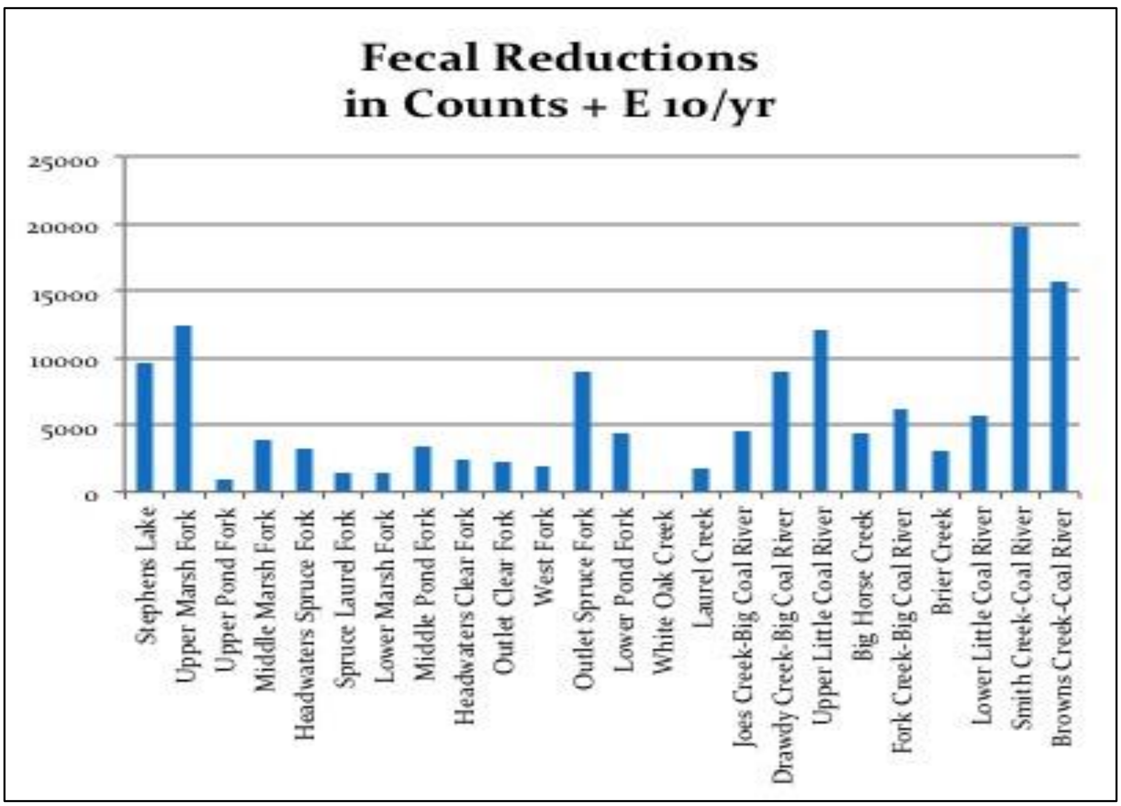
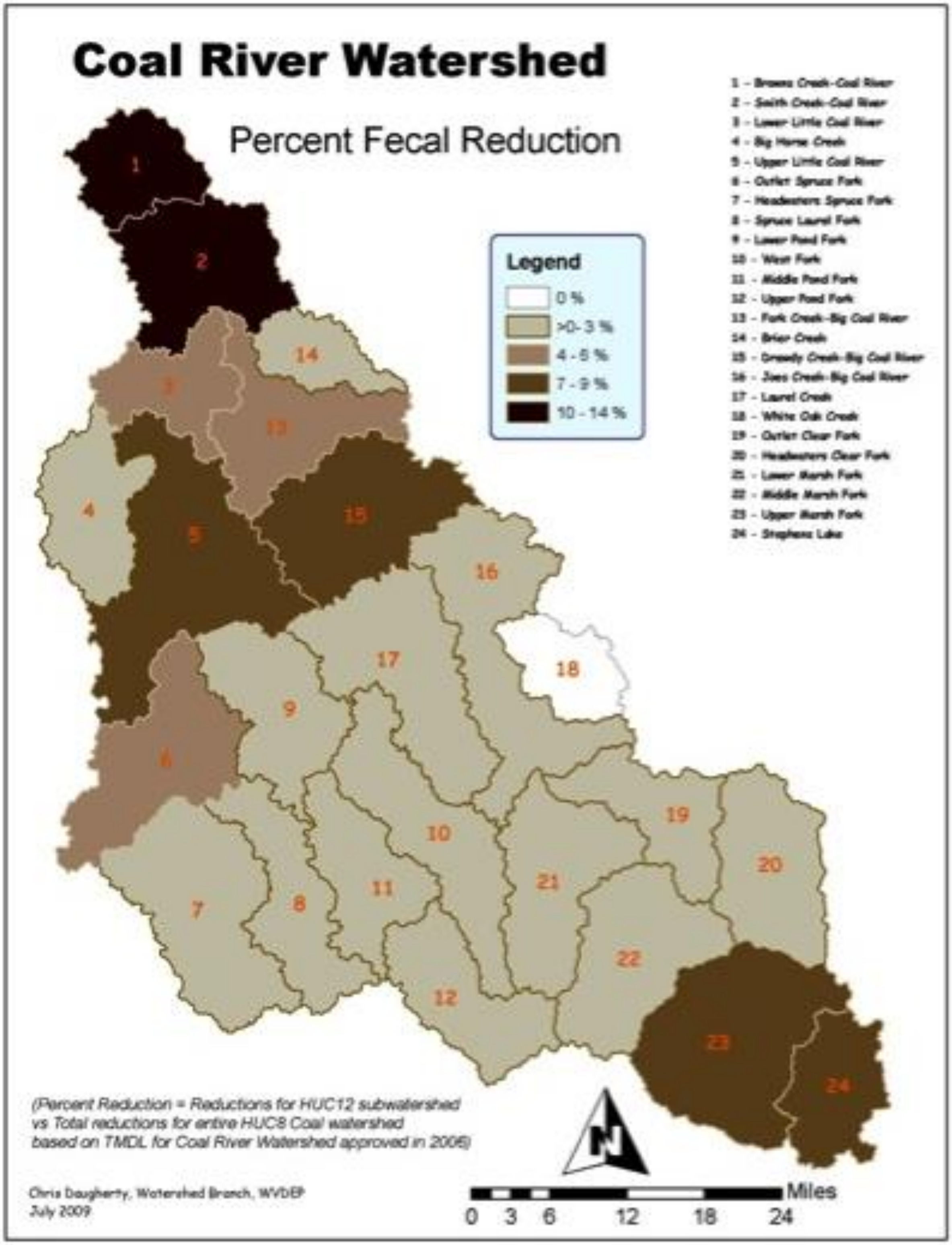


Figure 5: Fecal Coliform sources in the Coal River watershed *(*WVDEP, TMDL A2-9. *Map created by Chris Daugherty, WVDEP WAB 2009)*



The water quality standard for human health from 47 CSR, Series 2, *Legislative Rules, Department of Environmental Protection: Requirements Governing Water Quality Standards* is:

Human Health Criteria Maximum allowable level of fecal coliform content for Primary Contact Recreation (either MPN [most probable number] or MF [membrane filter counts/test]) 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.

Fecal coliform contamination of the Lower Coal River is caused by both point and nonpoint sources. Point sources are pollution sources regulated by permit. Point sources for fecal coliform within the Lower Coal watershed include stormwater discharges from the City of St. Albans municipal separate storm sewer systems (MS4), eight private sewage treatment plants, and 86 Home Aeration Units (HAUs). These point sources are all regulated by National Pollutant Discharge Elimination System (NPDES) permits and are not included in this watershed based plan.

Significant nonpoint sources of fecal coliform pollution include onsite treatment systems and residential stormwater runoff.

2.1.1 Failing Sewage Treatment Systems

Failing onsite treatment systems pose the most significant nonpoint source of fecal coliform bacteria in the Lower Coal River watershed.

Pollutant source tracking by WVDEP personnel identified scattered areas of high population density without access to public sewers in the Coal River watershed. Human sources of fecal coliform bacteria from these areas include sewage discharges from failing septic systems and possible direct discharges of sewage from residences in the form of straight pipes.

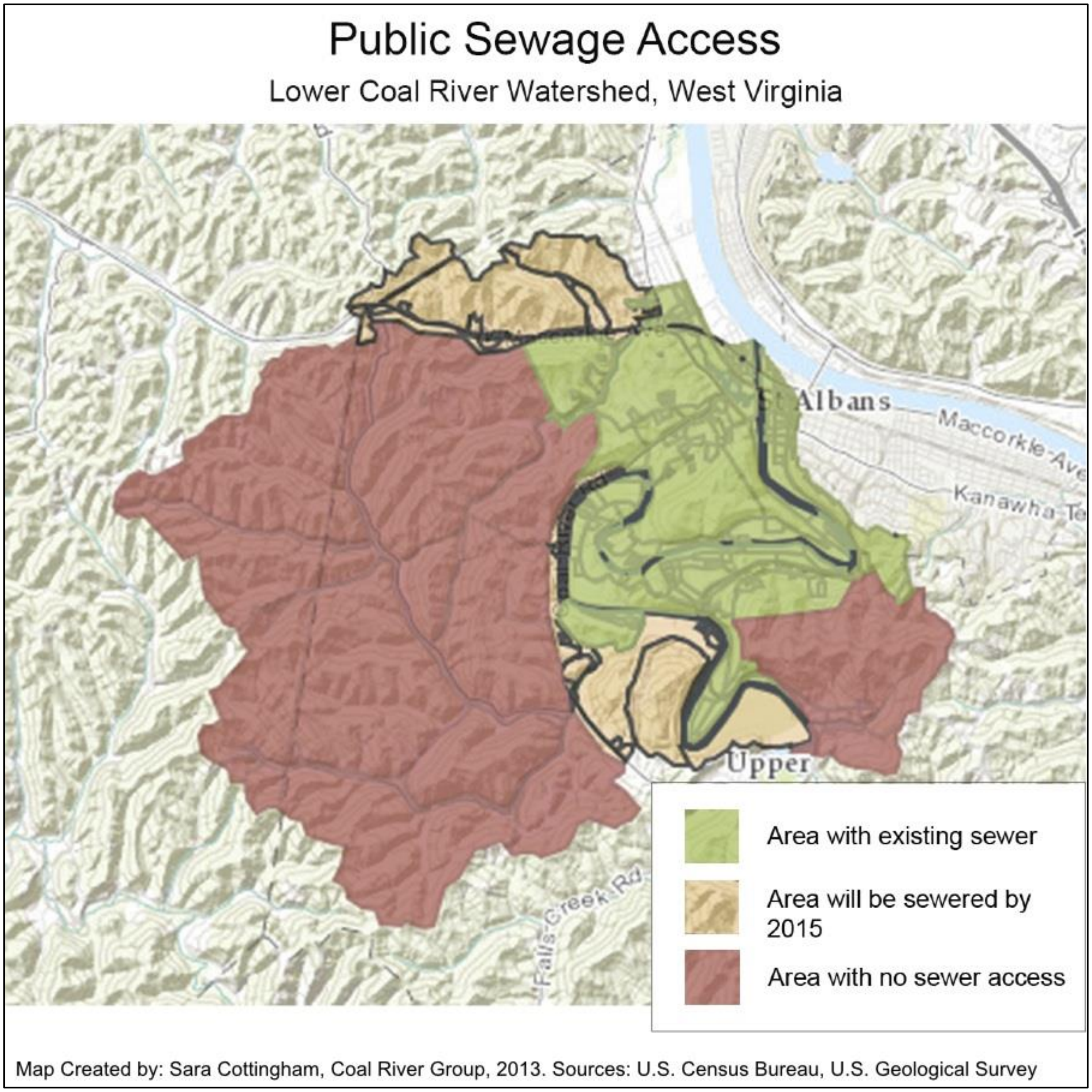
Until recently, sewer coverage by the City of St. Albans Municipal Utility Commission (MUC) and the Greater St. Albans Public Sewer District (PSD) extended only to a small portion of the Lower Coal watershed around St. Albans. The remainder of homes in the watershed relied on HAUs or onsite septic systems.

In 2006, however, the Greater St. Albans PSD approved a $25 million sewer extension for the communities in the Lower Coal River watershed. This sewer extension, which enters its final construction phase in summer 2014, will take six failing package plants offline and convert a total of 1,250 homes from onsite septic systems to public sewer. Once this public sewer expansion project is completed in 2015, 88% of residents in the Lower Coal River watershed will be connected to public sewer.

As shown in Figure 6, however, the three sub-watersheds of Upper and Lower Browns Creek, Angel Fork (collectively referred to as the Browns Creek/Angel Fork area), and the Coal River-Dry Branch sub-watershed will remain without access to public sewer. In the

Browns Creek/Angel Fork area, most homes are located right beside the creek. In the Coal River-Dry Branch area, development is mostly concentrated around Ferrell Road and Dry Ridge Road. While some of these are located along the Coal River, most of the homes are located on higher land.

Figure 6: Public Sewage Access Map *(Sources: 2010 U.S. Census, U.S. Geological Survey)*



To calculate the number of homes remaining on septic systems, the Coal River Group used Geographic Information Systems (GIS) and aerial imagery to spatially relay data from the 2010 U.S. Census. The Census block data was clipped to the watershed boundary in order to determine the total population and number of homes within the Lower Coal River watershed boundary. Data from Dunn Engineers, the engineering company leading the sewer expansion project for the Greater St. Albans PSD, was then applied to determine the extent of areas with existing sewer coverage, areas without public sewer, and areas that will be added to public sewer by 2015. The results are shown in the table below.

Figure 7: Public Sewage Access - Lower Coal River *(*2010 U.S. Census, U.S. Geological Survey)

	Homes	Population
Covered by existing sewer	4,084	8,844
Will be connected to sewer by 2015	786	1,762
No access to public sewer	523	1,117
TOTAL	**5,390**	**11,723**

As a result, 523 homes will remain unsewered. These homes are concentrated in the Browns Creek/Angel Fork subwatersheds and the Coal River-Dry Branch subwatershed located along Ferrell Road and Dry Ridge Road. An additional 32 homes in other areas were not connected to sewer due to homeowner refusal. As a result, this watershed based plan focuses on the remaining 491 unsewered homes in the watershed.

Of these 491 homes, a total of 82 have HAUs, which are regulated by NPDES permits. The remaining 409 homes are assumed to be on septic tanks.

Figure 8: Breakdown of Unsewered Homes (*2010 U.S. Census, U.S. Geological Survey*)

	Unsewered Homes	HAUs	Septic Tanks
Browns Cr/Angel Fork	381	37	344
Ferrell Rd & Dry Ridge	110	45	65
TOTAL	**491**	**82**	**409**

Given the geography of the area, many of these homes are built on hillsides with little flat land suitable for septic leach fields. The West Virginia Bureau for Public Health (BPH) estimates a 70% failure rate for septic tanks in this area during the first 10 years after installation (WV BPH 2003).

2.1.2 Residential Stormwater Runoff

Stormwater runoff is another nonpoint source of fecal coliform bacteria in Browns Creek. According to the TMDL:

> *Runoff from residential areas can deliver the animal waste of pets and wildlife to the waterbody. In addition, rural stormwater runoff can transport significant loads of bacteria from livestock pastures, livestock and poultry feeding facilities, and manure storage and application.*

Although the Browns Creek area is rural and has some small-scale agriculture in the watershed, residential runoff from the lack of adequate sewage treatment infrastructure constitutes the predominant source of stormwater runoff in the watershed.

2.1.3 Other Sources:

Agriculture can play a role in fecal coliform bacteria in rural areas. Within the Browns Creek sub-watershed there are several small-scale farming operations; however, the WVDEP's studies of the watershed using GAP 2000 land use data found that agriculture is not prevalent in the impaired sections of the area. As a result, fecal coliform inputs from pasture and grassland in Browns Creek are considered minimal. Wildlife estimates were similarly determined to be of little impact to fecal coliform levels in the area.

2.2 Biological Impairment

The Coal River TMDL assesses biological integrity through stream surveys of benthic macroinvertebrate communities. Such assessments are useful in detecting impairments but do not always clearly identify causes of impairment. As a result, the USEPA developed guidelines for resource managers to identify stressors and stressor combinations that cause biological impairment.

The WVDEP generated primary data from water quality monitoring, benthic sampling, and habitat assessment to identify stressors of biological impairment in addition to other agency data sources on mining activities, land use information, soil data, and literature sources.

The stressor identification process determined sedimentation and organic enrichment to be the primary causes of biological impairment on Browns Creek. Organic enrichment in Browns Creek is caused by the elevated levels of fecal coliform bacteria due to inadequately treated sewage. As a result the WVDEP determined that implementing the TMDLs for fecal coliform and sediment will alleviate biological impairment in Browns Creek.

Figure 9: Primary stressors of biologically impaired streams *(*Coal River *TMDL Appendix A2-10)*

Stream	Biological Stressors	TMDLs Required
Browns Creek	Organic enrichment	Fecal Coliform
	Sedimentation	Sediment

2.2.1 Sediment

The TMDL identified roads, barren lands, and grassland/pastureland as the major sources of sediment in Browns Creek. After conducting site visits and analyzing aerial photography, officials from the West Virginia Conservation Agency (WVCA) and the Coal River Group (CRG) found that pastureland is the most pressing cause of sedimentation in the three

Browns Creek/Angel Fork sub-watersheds. At several isolated sites, animal grazing has left the ground totally denuded of vegetation and thus qualifying as a barren land.

Browns Creek Road and Angel Fork Road follow the entire length of both streams. These paved roads contribute to sedimentation through stormwater runoff and increase stream bank erosion. In addition, many unpaved roads and barren land in the area contribute to sediment through stormwater runoff.

Logging and oil and gas extraction also contribute to sediment erosion. Runoff from cleared well sites and unpaved access roads deposits sediment in adjacent streams. Residential construction similarly contributes to sedimentation through disturbed land and unpaved driveways. After verifying conditions on the ground through field visits and aerial imagery, these sources do not seem to be significant sources of sedimentation. The TMDL also identifies an Abandoned Mine Land (AML) site in the watershed. According to the WVDEP, there are two mine pads in the Upper Browns Creek sub-watershed, neither of which is planned for reclamation at this time. These sites are not known to be significant sources of sediment, although further investigation may be needed in the future.

The WVCA identified 27 areas within the Browns Creek and Angel Fork sub-watersheds as Potential Management Areas (PMA's). These PMA's were identified as sources of excessive sedimentation on field visits coupled with analysis of aerial photography. The WVCA has spatially delineated these PMA's on Google Earth (See Appendix C: Sediment Calculations and Appendix D: Calculating Agriculture-Related Fecal Coliform for further details).

3 Expected Load Reductions

This watershed based plan uses load reductions provided by the TMDL for the Coal River watershed. The TMDL sets goals for pollutant reductions from point and nonpoint sources. If implemented, these reductions are designed to improve water quality so that impaired streams can be removed from the 303(d) list.

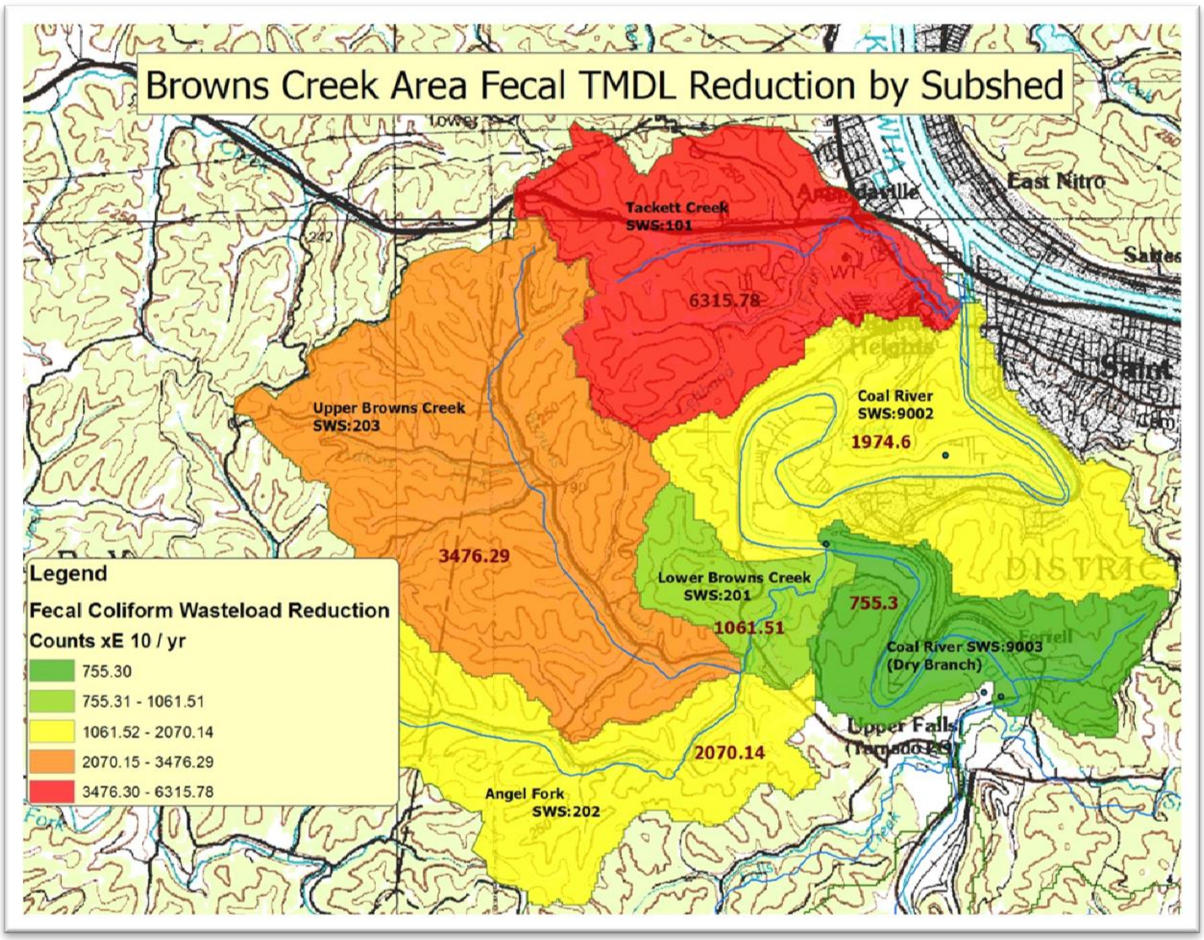
3.1 Fecal Coliform

The TMDL set all point sources at the permit limit (200 counts/100mL monthly average) for the waste load allocation. The load allocation were based on eliminating all discharges of human waste through inadequate treatment methods, as West Virginia BPH regulations prohibit the discharge of raw sewage into surface waters within the state.

Figure 10: TMDL for Browns Creek (tons/yr) *(*Coal River TMDL)

Stream Name	Baseline LA (tons/yr)	Fecal LA (tons/yr)	Baseline WLA (tons/yr)	WLA (tons/yr)	Margin Of Safety (tons/yr)	TMDL (tons/yr)	Percent Reduction
Browns Creek	7.94E+13	1.33E+13	2.51E+11	2.51E+11	7.15E+11	1.43E+13	83%

Figure 11: Fecal coliform load reductions from TMDL *(Map created by John Wirt, WVDEP. 2013)*



3.1.1 Failing Septic Load Reductions

Failing onsite septic systems require a 100% reduction because the discharge of untreated sewage to surface waters is illegal in West Virginia. All six sub-watersheds in the Lower Coal area require reductions to failing septic systems.

Figure 12: Septic System Fecal Coliform Load Reductions *(Coal River TMDL)*

Subwatershed	Stream Name	Stream Code	Onsite Sewer Systems Baseline Load (counts/yr)	Onsite Sewer Systems Allocated Load (counts/yr)	Onsite Sewer Systems Percent Reduction
101	Tackett Creek	WVKC-1	3.72E+13	0.00E+00	100.0
201	Lower Browns Creek	WVKC-2	7.01E+12	0.00E+00	100.0
202	Angel Fork	WVKC-2-A	1.85E+13	0.00E+00	100.0
203	Upper Browns Creek	WVKC-2	2.90E+13	0.00E+00	100.0
9002	Coal River	WVKC	1.97E+13	0.00E+00	100.0
9003	Coal River – Dry Branch	WVKC	7.55E+12	0.00E+00	100.0

3.1.2 Residential Fecal Coliform Load Reductions

The residential fecal coliform load reductions presented in Figure 13 originate from pet and livestock waste in residential areas and could potentially signify leaking public wastewater lines in heavily populated areas with public sewage.

Figure 13: Residential Fecal Coliform Load Reductions *(Coal River TMDL)*

Subwatershed	Stream Name	Stream Code	Residential Baseline Load (counts/yr)	Residential Allocated Load (counts/yr)	Residential Percent Reduction
101	Tackett Creek	WVKC-1	3.46E+13	8.66E+12	75%
201	Lower Browns Creek	WVKC-2	5.15E+12	1.54E+12	70%
202	Angel Fork	WVKC-2-A	3.11E+12	9.32E+11	70%
203	Upper Browns Creek	WVKC-2	8.24E+12	2.47E+12	70%

3.1.3 MS4 Residential Fecal Coliform Load Reductions

The Coal River TMDL allocated MS4 residential fecal coliform load reductions for the Tackett Creek sub-watershed for the City of St. Albans. Records from the City of St. Albans MS4 Program, however, show that the St. Albans MS4 boundary stops at Coal River and does not include any portion of Tackett Creek (See Appendix C: St. Albans MS4 Map).

MS4 residential fecal coliform load represents runoff from impervious surfaces and pet waste. In some areas with public sewer lines, some of the fecal coliform load may be caused by leaking wastewater infrastructure and/or residential laterals.

Figure 14: MS4 Residential Fecal Coliform Load Reductions *(Coal River TMDL)*

Sub-watershed	Stream Name	Stream Code	Municipality	Baseline Load (counts/yr)	Allocated Load (counts/yr)	Percent Reduction
101	Tackett Creek	WVKC-1	Saint Albans	3.67E+11	9.17E+10	75%

3.2 Sediment

The TMDL sediment load reductions are represented below.

Figure 15: Browns Creek Sediment Reductions (tons/yr) *(Coal River TMDL)*

Sediment Reductions	Baseline Load (tons/year)	Allocated Load (tons/year)	Total (tons/year)	Percent Reduction
Lower Browns Creek (201)				
Barren Land	0.8	0.2	1	75%
Roads	49.1	12.4	61.5	74.70%
Oil & Gas	11	5	16	50%
Pasture/Grassland	206.7	55.8	262.5	73%
Residential	161.8	82.2	244	49.20%
		TOTAL:	**585**	
Upper Browns Creek (203)				
Barren Land	16.4	4.9	21.3	70%
Roads	416.9	125.6	542.5	69.90%
Oil & Gas	79	64	143	20%
Pasture/Grassland	1066.5	384.9	1451.4	63.90%
Abandoned Mine	3.6	1.2	4.8	67%
		TOTAL:	**2163**	
Angel Fork (202)				
Barren Land	3.4	1.9	5.3	45%
Roads	107.3	59.2	166.5	44.80%
Forest Harvest	90.9	67.1	158	26.10%
Oil & Gas	21	17	38	20%
Pasture/Grassland	449.5	226.2	675.7	49.70%
		TOTAL:	**1043.5**	

The TMDL calls for the largest reductions from pasture/grassland, particularly within the Upper Browns Creek sub-watershed. Analysis by the WVCA found animal grazing to be the dominant impact. Several of the barren land sites visible from aerial imagery have been overgrazed and are considered in conjunction with pasture/grassland in this report. Field visits to the area showed little erosion from paved roads in the three Browns Creek/Angel Fork sub-watersheds. Trails visible from aerial photography were determined to be horse or ATV trails on mostly private land.

4 Proposed Management Measures

4.1 Wastewater Treatment Measures

Sewage treatment is notoriously difficult in southern West Virginia, and the Lower Coal River watershed is no exception.

Public sewer service, provided by either the St. Albans MUC or the Greater St. Albans PSD, is the best option for safe and effective treatment of wastewater in the Lower Coal watershed. The recent sewer extension project will connect most of the higher population areas to the Greater St. Albans PSD system.

Only two areas—the Browns Creek and Angel Fork sub-watersheds and the Ferrell Road area of the Coal River-Dry Branch sub-watershed—will not be connected to public sewer through the sewer expansion project. Engineering studies show that extending sewer service to the 500 homes in these two areas is not cost effective at this time due to the steep terrain and low population density. There are long-range plans to extend sewer to Browns Creek; however, the project is estimated to cost $10 million and would likely take over 30 years to accomplish.

After working with a team of officials from Dunn Engineers, the Kanawha-Charleston Health Department, and local stakeholders, the following management measures were determined to be the most feasible for the Lower Coal watershed.[1]

- *Replace Failing Onsite Septic Tanks*

Failing septic tanks in the Lower Coal watershed generally require the installation of a new or upgraded system. The average cost, based on local estimates, is about $8,000 but can range widely due to site-specific circumstances.

- *Initiate Septic Pump-Out Programs*

Periodically failing septic systems can often be improved by pumping the septic tank. Septic tanks should be pumped every three years as part of proper routine maintenance, but lack of education leads many homeowners, particularly in rural areas, to neglect septic maintenance until a problem arises. Following the example of some successful Potomac watersheds, partial payment coupons for septic pumping services and outreach programs

[1] It is possible that some homes within the watershed do not have septic systems or any other method of onsite sewage treatment. In these cases, soil percolation tests will be needed to determine the proper sewage treatment method.

to educate homeowners would be an ideal strategy for the rural Browns Creek/Angel Fork and Ferrell Road communities. Costs are generally less than $500 per home.

- *Install Alternative Effluent Collection Systems*

Septic tank effluent collection systems can be installed as a small-diameter sewer alternative. The system works in conjunction with onsite septic systems, which continue to collect waste solids. Wastewater effluent is then collected by the collection system, using gravity (STEG systems) or pressure (STEP systems).

While septic tank replacement and pump-out programs are the favored management measures within the local context, in certain situations these STEP and STEG systems could be necessary. STEP or other cluster systems would be considered in areas of the watershed where soil percolation tests indicated septic systems to be inappropriate for local sewage treatment. Further soil percolation data is needed before determining if these alternative systems will be necessary. Due to cost and increased operation and maintenance requirements, these systems will be considered as a last option for the Lower Coal watershed.

Figure 16: Treatment Technology Cost Assumptions *(figures based on local estimates)*

BMP	Cost per home	Annual O&M	Included With Installation:
Replace onsite septic system	$8,000	$50	Tank and leach field
Septic tank pump-out program	$500		
STEP (Septic Tank Effluent Pump) system	$9,000	$180	New septic tank with street-side hookup
STEG (Septic Tank Effluent Gravity) discharge system	$6,000	$50	New septic tank with street-side hookup

Figure 17: Estimated Cost of Management Measures *(figures based on local estimates)*

BMP	Cost	Homes*	Total Cost
Septic Tank Replacement	$8,000	286	$2,288,000
Pump-Out Program	$500	123	$61,500
			$2,349,500**
*Based on total number of 409 homes on septic, 70% of which are failing			
**Does not include Annual O&M Costs			

Based on the West Virginia BPH's estimated 70% failure rate for septic tanks within the Coal River watershed, the following table estimates treatment costs, assuming the 70% of homes will require a septic system replacement (for complete failure) and 30% of homes will participate in a tank pumping program.

4.1.1 Anticipated Load Reductions for Fecal Coliform

To estimate the reductions from remediating failing septic tanks, the project team used a methodology approved by the WVDEP based on a spreadsheet used in the Upper Guyandotte watershed. The spreadsheet calculates the total load per sub-watershed by estimating the fecal contribution per home in the watershed (See tables in Section 7.3 Load Reduction Criteria).

Using the GIS application developed for this watershed based plan, the project team was able to determine extremely accurate figures for the number of septic tanks in each sub-watershed and the average number of residents per home. As a result, the estimated load reductions for failing septic tanks provide the most accurate counts available to date.

The tables shown in Section 7.3 revise loads based on sewage infrastructure improvements that have been made in the years following the TMDL's publication. Significant strides have been made to reduce fecal coliform bacteria in the Lower Coal watershed since the Coal River TMDL was released in 2006. The Greater St. Albans PSD's $25 million sewer expansion project, slated for completion in summer 2015, will connect 1,250 homes to public sewer and take six failing package sewer plants off-line.

The first phase of the sewer expansion has already added 665 homes (with 1,488 total residents) to public sewer. Sewer has been extended to the areas of Strawberry Road and Lower Falls, and a failing package plant in the Indian Head subdivision has been taken off-line. The final phase of the sewer expansion project will connect an additional 783 homes with 1,762 residents to public sewer by the end of 2015.

4.2 Sediment

After numerous site visits and examination of aerial imagery, the WVCA determined that the biggest sediment sources within the Browns Creek/Angel Fork sub-watersheds are related to livestock.

In order to quantify potential sediment reductions for the Browns Creek/Angel Fork sub-watersheds, the WVCA used a combination of field visits and satellite imagery to identify potential sites that may contribute excessive quantities of sediment to the Coal River. If an area exhibited bare or overgrazed ground, animal trails, and or livestock fencing, it was designated as a Potential Management Area (PMA).

Each PMA was measured for area and slope calculations, and then referenced on the USDA Web Soil Survey to gather important information regarding soils properties. This information was used to calculate erosion rates using the Revised Universal Soil Loss Equation (RUSLE) spreadsheet. The RUSLE calculation takes into account several factors that are exclusive to each site, including vegetative cover, slope, and dominant type of soil.

The following table shows estimated reductions available by managing each PMA drainage basin. For more information on the sediment calculations and criteria, prepared by the WVCA, see Appendix D: Sediment Calculations.

Figure 18: Summary of Management Measures and Sediment Reduction *(WVCA)*

Proposed Practices Total	
Total number of Potential Management Areas (PMA's)	27 PMA's
Total acreage for PMA's	295 acres
Fence total estimated footage	85,612 ft
Pipeline total estimated footage	15,736 ft
Water facilities estimated total	35 facilities
Riparian Development (total acres)	4 acres
Pasture Renovation (total acres)	295 acres
Total cost of cost of practices	**$537,971.00**
Total potential for reduction of sediment	**2,280 tons**

Figure 19: Land Management Costs *(WVCA)*

Costs Associated with Implementation			
BMP	**Planned Units**	**Cost/Unit**	**Total**
Fencing Systems	85,612ft	$2.00	$171,224.00
Water System (including pipe)	35 facilities	$7,000.00	$245,000.00
Riparian Development	4 acres	$7,953.24	$31,813.00
Pasture Renovation	295 acres	$304.86	$89,933.70
Total Cost of BMP's			**$537,971.00**

Figures 18 and 19 show the WVCA's estimates for potential sediment reduction and cost for potential projects. Land management projects require a high level of landowner cooperation. As a result, landowners will need to be contacted well in advance and must agree to participate before projects can begin. Once landowners agree to participate, the WVCA will revise project proposals to include actual field measurements for fencing/water system requirements and management measures. The WVCA will work with landowners to design a project with the most fitting management measures for their site.

The underlying goal of the WVCA's proposed practices is to decrease sediment and fecal loading associated with agricultural activity. The WVCA proposes a range of conservation management and structural practices geared toward increasing vegetative coverage in the watershed. These include:

- *Physical practices*: various fencing projects, water systems, and buffers.
- *Management practices*: improvements to pasture management including pasture division and rotational grazing, and pasture renovation.

These practices will increase ground cover to reduce soil erodibility and motility of nutrients and fecal born bacteria utilizing two spreadsheets: BMP Efficiency Calculator and Region 5 Model, and the USDA NRCS Field Office Technical Guide Section 3. These management measures will be planned to assure they meet the overall load reduction required by the TMDL.

The following best management practices (BMP's) may be applied to the Lower Coal Watershed, per the NRCS Conservation Practice Standard:

- *Fencing and alternative water sourcing*

To reduce occurrences of livestock coming into direct contact with a stream or other waterway, a narrow strip of land along the stream bank can be fenced off. Alternative watering sources, such as spring development and wells with pipelines and troughs, must then be provided for the livestock. This will prevent livestock form defecating in or close to the stream, and reduce stream bank erosion. NRCS conservation practices that can accomplish this are: 378 Pond, 382 Fence, 516 Pipeline, 533 Pumping Plant for Water Control, 574 Spring Development, 587 Structure for Water Control, 614 Watering Facility, 636 Water Harvesting Catchment, 642 Well, 472 Access Control.

- *Erosion and sediment control*

Practices that protect water resources from sediment pollution and increases in runoff associated with land development activities. By retaining soil onsite, sediment and attached nutrients are prevented from leaving disturbed areas and polluting streams. *Examples:* Silt fence, slope drain, permanent vegetation. NRCS conservation practices that can accomplish this are: 342 Critical Area Planting, 362 Diversion, and 561 Heavy Use Area Protection. Other practices are available and located in the WV Erosion and Sediment Control Handbook.

- *Riparian buffers*

Areas of vegetation; herbaceous or woody, that are tolerant of intermittent flooding or saturated soils and that are established or managed in the transitional zone between terrestrial and aquatic habitats. NRCS conservation practices that can accomplish this are: 314 Brush Management, 390 Riparian Herbaceous Cover, 412 Waterways, 468 Lined Waterways, 490 Tree/Shrub Site Prep, 612 Tree/Shrub Establishment, 391 Riparian Forest Buffer.

- *Filter strip*

A strip or area of herbaceous vegetation situated between cropland, grazing land or disturbed land (including forestland) and environmentally sensitive areas. NRCS conservation practices that can accomplish this are: 393 Filter Strip.

- *Heavy use area protection*

Practices that restore or put into proper use, areas that are or have been used by large numbers of areas for feeding, walking, loafing. NRCS conservation practices that can accomplish this are: 313 Waste Storage Facility, 342 Critical Area Planting, 484 Mulching, 512 Pasture & Hayland Planting, 528 Prescribed Grazing, Access Road, 561 Heavy Use Area Protection, 575 Animal Trails and Walkways, 561 Heavy Use Area Protection.

- *Nutrient management plans*

Farm operators develop a comprehensive plan that describes the optimum use of nutrients to minimize nutrient loss while maintaining yield and appropriate ground cover. NRCS conservation practices that can accomplish this are: 100 CNMP Development, 313 Waste Storage Facility, 316 Animal Mortality Composter, 328 Conservation Crop Rotation, 329 Residue Management, 340 Cover Crop, 590 Nutrient Management, 634 Manure Transfer.

- *Animal Waste Management Systems*

Livestock operators design practices for proper storage, handling, and use of wastes generated from confined animal operations. This includes a means of collecting, scraping, or washing wastes and contaminated runoff from confinement areas into appropriate waste storage structures. Livestock feedlots commonly utilize waste lagoons or move animal feeding areas away from the streamside. NRCS conservation practices that can accomplish this are: 313 Waste Storage Facility, 359 Waste Treatment Lagoon.

- *Storm Water Management*

These practices prevent stormwater from coming into contact with fecal material and washing it into streams. NRCS conservation practices that can accomplish this are: 362 Diversions, 412 Waterway, 468 Lined Waterway, 558 Roof Runoff Management, 606 subsurface Drain, and 620 Underground Outlet.

- *Sediment Ponds & Wetlands*

These structures intercept surface runoff and treat it through settling, then discharge it at a controlled rate to minimize the environmental and physical impacts on receiving waters. Less expensive runoff filtration practices such as vegetated swales may also be used. NRCS conservation practices that can accomplish this are: 350 Sediment Basin, 658 Wetland Creation, and 657 Wetland Restoration.

Figure 20: Sediment BMP Efficiencies *(WVCA)*

Best Management Practice	Reduction Efficiency
Filter Strip	70%
Single Stage Waste Stabilization Lagoon	85%
Sediment Pond/Swale in Combination with Filter Strip	85%
Fencing (complete removal of livestock from waterway)	90%
Buffer	80%
Off Watering System Without fencing	50%
Off Site Watering System With Flash Rotational Grazing in the Riparian Zone	90%

5 Technical & Financial Resources

5.1 Technical Resources

- *West Virginia Conservation Agency (WVCA)*

The WVCA will provide assistance needed for the implementation of Section 319 grants, particularly as pertains to sediment management measures. The WVCA coordinates statewide conservation efforts to conserve natural resources, control floods, prevent impairment of dams and reservoirs, assist in the maintaining the navigability of rivers and harbors, conserve wildlife, and assist farmers with conservation practices. The WVCA's Capitol Conservation District will be coordinate with other agencies and work directly with landowners to implement the practices called for in this watershed based plan. The WCVA will conduct monitoring of land management practices.

- *The Natural Resources Conservation Service (NRCS)*

The NRCS is the federal agency that works directly with farmers and WVCA for installing Best Management Practices (BMPs). The NRCS implements the Conservation Reserve Enhancement Program (CREP).

- *The West Virginia Department of Environmental Protection (WVDEP)*

The WVDEP is the agency with primary responsibility for protecting the water quality in West Virginia. The WVDEP's Nonpoint Source Program (NPS) administers Section 319 grants, and Basin Coordinators work closely with project managers to accomplish the approved watershed based plans. The Watershed Assessment Branch (WAB) develops the TMDL and the integrated watershed report with the 303(d) list of impaired streams. After best management practices have been installed, the WAB is responsible for determining if the TMDL has been fully implemented.

- *The Kanawha-Charleston Health Department (KCHD)*

The KCHD is responsible for inspecting and approving all onsite wastewater systems in Kanawha County. Since the KCHD is currently running the Putnam County Health Department, the agency covers the entire Lower Coal watershed.

- *Dunn Engineers*

Dunn Engineers are responsible for designing and overseeing the Greater St. Albans PSD's public sewer expansion project. The company has vast experience in remediating wastewater measures within the Lower Coal watershed.

- *The Coal River Group (CRG)*

The CRG is a nonprofit watershed organization dedicated to "bringing life back to the Coal Rivers." The CRG was instrumental in advocating for the Greater St. Albans PSD sewer expansion project within the community. The CRG has a strong base of support in the watershed and has experience with education and outreach programs. The CRG will conduct monitoring for fecal coliform results.

- *St. Albans Municipal Utility Commission (MUC) & Greater St. Albans Public Sewer District (PSD)*

Two entities provide public sewer in the Lower Coal watershed—the St. Albans MUC and the Greater St. Albans PSD. The MUC and PSD will provide technical assistance for wastewater treatment issues.

5.2 Financial Resources

- *Clean Water Act Section 319 Grants*

The U.S. EPA provides Section 319 funds to the states. In West Virginia, the WVDEP distributes these funds to agencies or organizations completing projects related to nonpoint source pollution.

- *WVCA*

The WVCA will provide cost share and staff technical assistance for agricultural practices associated with an approved Section 319 grant proposal.

- *Conservation Reserve Enhancement Program (CREP)*

CREP is a federal-state land retirement conservation program targeted to address state and nationally significant agriculture-related environmental problems. CREP addresses high-priority conservation issues as designated by the NRCS State Conservationist.

- *Environmental Quality Incentive Program (EQIP)*

EQIP is a federal farm bill program, advised by a local work group, which provides cost-share funds to landowners with conservation plans to develop practices that address resource concerns on their farm.

- *WV Onsite Loan Program (OSLP)*

The OSLP is a program administered by the WVDEP to provide loan funding for individual onsite systems. The program also provides loans for homeowner-owned components of decentralized systems. OSLP can be used to help homeowners fund the portion of costs for septic remediation projects not covered by Section 319 grants.

- *Landowners*

Landowners will provide a 25% match for practices developed on their property. Much of this match will be in-kind for labor, equipment use, and materials. Homeowners who participate in a septic program will provide at most 40% of the funding through a low interest loan program. Additional matching funds may lessen the burden on homeowners.

6 Information & Education

The CRG will be coordinating the education and public outreach efforts for the Lower Coal watershed.

The CRG is a nonprofit watershed organization dedicated to bringing life back to the Coal Rivers. The organization was formed in 2004 by local paddlers and fishermen to protect the rivers' ecology, promote recreational opportunities on the rivers, and preserve the area's unique history. For the last nine years, the volunteer-run organization has tended 88 miles of the Big, Little, and main stem Coal Rivers.

The CRG plays an important role in southern West Virginia where the mining industry has traditionally held sway. While dedicated first and foremost to restoring the environmental quality of the watershed, the CRG serves the region by educating the community on the watershed and its history, and providing recreational opportunities to raise awareness, appreciation, and enjoyment of the rivers.

By working closely with community members and building partnerships throughout the region, the CRG has achieved a long track record of success.

- Working with local news media, the CRG raised public awareness of the failing package sewer plants within the Lower Coal watershed that for years fed raw sewage directly into the Coal River. The CRG then spearheaded the effort to expand public sewer coverage in the Lower Coal watershed, and served as a key advocate and community liaison for the $25 million Greater St. Albans PSD project.

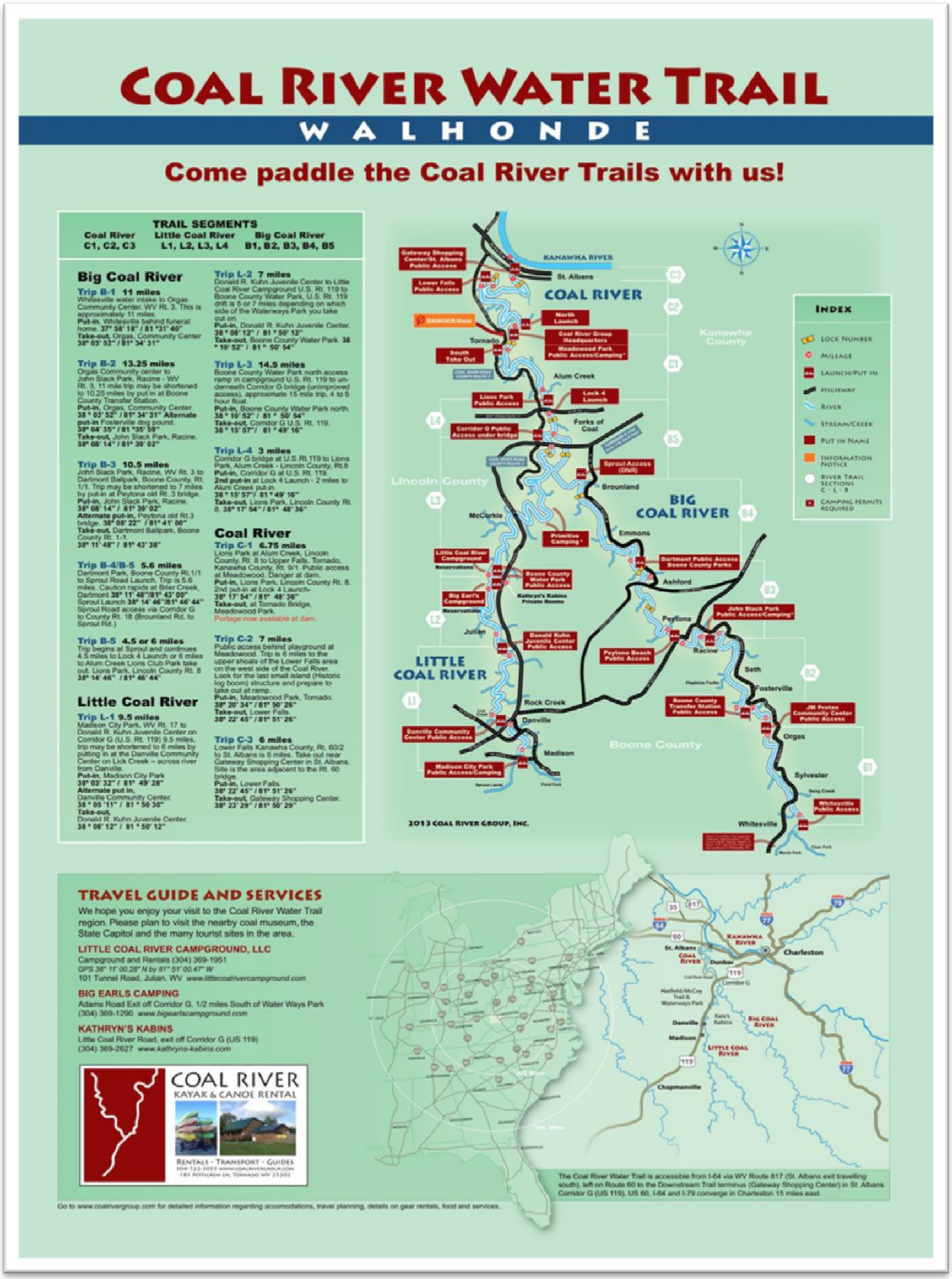
- The CRG worked with the WVDEP and the WV Division of Natural Resources (DNR) to launch a $9 million river restoration project on the Little Coal River in Boone County, West Virginia. The project used state coal mine mitigation funds to restore 30 miles of river from decades of sedimentation and is scheduled for completion in 2015.

- The CRG partnered with the US EPA, WVDEP, and DNR to designate the Coal River as the first water trail located entirely within West Virginia. The 88-mile Coal River Water Trail brings thousands of visitors to the Coal Rivers every year, including over 600 paddlers who float the CRG's annual Tour de Coal event every June. The water trail has become an economic engine, providing quality river recreation opportunities for locals and tourists alike, and now serves as a regional model for asset based development.

- In 2012 the CRG acquired a small business, Coal River Kayak and Canoe Rental, which is operated from the CRG's headquarters in Tornado, WV. In its first season of operation, the boat rental enterprise got nearly 400 customers on the lower Coal River, many for the first time. Coal River Kayak and Canoe Rental is raising awareness of the CRG's mission both within the state and across the country. All proceeds from boat rentals go directly towards the CRG's river restoration efforts. In addition, the CRG currently runs an internship program in entrepreneurial development, bringing top local college students to gain business experience with Coal River Kayak. Interns also contribute with the CRG's cleanups and education and outreach programs and learn the basics of nonprofit management.

- *The state of West Virginia recognized the CRG's diverse programs and achievements by naming the Coal River Group the West Virginia Watershed of the Year in both 2009 and 2011.*

Figure 21: Coal River Water Trail Map *(Coal River Group)*



The CRG has a long legacy of building community support for projects relating to the three Coal Rivers. The following table quantifies the CRG's local impact in the last two years.

Figure 22: CRG Impact *(Coal River Group)*

CRG Community Impact (2012-13)	Amount
Pounds of litter collected from stream & river cleanups	88,000 lbs
Number of tires removed	1,053 tires
Hours worked by community volunteers	4,700 hours
Number of active volunteers	487 volunteers
Number of children participating in education events	547 children
Number of school groups participating in education events	22 groups
Number of active water quality monitoring sites	20 sites
Acres of park land maintained	320 acres

6.1 Existing Educational Programming

Water Festivals

Each spring, the CRG holds an event titled the "Coal River Water Festival" at the CRG's River Center in Tornado, WV.

Figure 23: 2013 Water Festival Participants *(Coal River Group)*

Station topics include the water cycle, surface water, ground water, water quality, watersheds, fly-fishing, and aquatic life. Past festivals have featured presenters from Trout Unlimited, the WVDEP, the Kanawha-Charleston Health Department, the City of St. Albans, Toyota Motor Manufacturing West Virginia, the St. Albans Historical Society, and the Coal River Group. In 2012, the CRG hosted 110 children from the Boys and Girls Clubs of Charleston and St. Albans. The 2013 festival was attended by 150 fifth graders from four local elementary schools.

Samsung "Solve for Tomorrow" Project

In the spring of 2013, the CRG coordinated a six-week long project for the 8^{th} graders at Madison Middle School to explore the 34-mile river restoration taking place just downstream from the school.

Throughout March and April, students learned about watersheds, the scientific method, GPS and GIS technology, stream restoration theory, and water quality monitoring. A team of experts from the WVDEP, the WV Conservation Agency, Marshall University, WVU, Stantec Engineering, CEC, and Appalachian Stream Restoration led in-class presentations and field trips to sites along the Little Coal River.

Figure 24: Project with Madison Middle School *(Coal River Group)*

Over 200 students at Madison Middle School took part in this CRG-led project. The CRG sponsored the project through the Samsung "Solve for Tomorrow" contest and won $40,000 in new electronics for the school.

Kids Kayaking Workshops

The CRG launched a "Kids Kayaking Initiative" in the summer of 2013. The purpose of this project was to introduce kids to kayaking in a fun, safe environment and to provide the knowledge, skills, and equipment needed for these children to enjoy a lifetime of recreational boating.

Through a grant funded by the Outdoor Nation, the CRG hosted four events in which volunteer instructors taught basic paddling skills to 110 youth participants—95% of whom were first-time paddlers. We partnered the youth participants with millennial-aged volunteers from local universities, who served as mentors and instructors. In total, we had 10 volunteers help with the event and around 30 parents and other adult supervisors attend the events.

Figure 25: Kids Kayaking Days 2013 *(Coal River Group)*

6.2 Programs for the Lower Coal Watershed

The CRG has a proven track record for initiating sewer programs in the Lower Coal River watershed. As a crowning accomplishment, The CRG was instrumental in getting the $25 million Greater St. Albans PSD Sewer Expansion Project off the ground. Beginning in 2007, the organization began promoting the program as a way to clean up the Coal River and worked tirelessly to gain public support for the project. The CRG's leadership helped formulate the project plans with the Greater St. Albans PSD and engineering teams. This wealth of experience initiating a major sewage treatment project has fully prepared the CRG for leading the implementation of the Lower Coal Watershed Based Plan.

Education and outreach are essential for any watershed planning effort. In rural communities found in the Browns Creek/Angel Fork and Coal River-Dry Branch sub-watersheds, sensitivity is needed when approaching homeowners about onsite wastewater treatment issues. The WVCA and WVDEP will assist the KCHD in passing out information packets on septic remediation programs to homes in the watershed. The CRG will prepare handouts on proper septic maintenance to be disseminated throughout the watershed and will give presentations to local civic groups on septic remediation programs.

For sediment measures, the WVCA officials from the Capitol Conservation District will go door-to-door to communicate with landowners about participating in land management programs. The WVCA will be responsible for working with these landowners to design a conservation plans to meet the landowner's needs while also meeting the reductions called for in the TMDL.

The CRG will handle the remainder of general education and outreach. The CRG will continue its education and outreach programming, including annual Project WET water festivals, specialized events for school groups at the CRG River Center in Tornado, and attendance at public events in the watershed and throughout the region. The CRG will also help identify home and landowners who would be willing to participate in Section 319 funded activities.

7 Implementation

7.1.1 Schedule

Figure 26: Schedule for Implementation

2014				2015				2016			
Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
Apply for Funds				Baseline monitoring		Recruit participant homeowners		Start Phase I septic projects			
								Apply for Funds			

2017				2018				2019			
Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
Continue Phase I septic projects				Complete Phase I septic projects		Post-project monitoring					
Baseline monitoring		Recruit participant homeowners		Start Phase II septic projects				Continue Phase II septic projects			
				Apply for Funds				Baseline monitoring		Recruit participant homeowners	

2020				2021				2022			
Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
Apply for Funds				Baseline monitoring		Recruit participant homeowners		Start Phase II septic projects			Continue Phase II
Post-project monitoring				Apply for Funds - Ag. Project 1				Baseline monitoring		Recruit participant landowners	
Start Phase III septic projects				Complete Phase III septic projects				Post-project monitoring			
								Apply for Funds			

2023				2024				2025			
Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
Phase II Septic Projects Cont'd				Post-project monitoring							
Baseline monitoring		Recruit participant homeowners		Start Phase I septic projects				Complete Phase I septic projects		Post-project monitoring	
Complete Phase I BMP installation				Post-project monitoring		Apply for Funds - Ag. Project 2		Baseline monitoring		Recruit participant landowners	

2026				2027			
Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
Complete Phase II BMP installation				Post-project monitoring			

LEGEND
319 Project 1 - Angel Fork (67 homes)
319 Project 2 -Upper Browns A (90 homes)
319 Project 3 -Upper Browns B (90 homes)
319 Project 4 -Upper Browns C (90 homes)
319 Project 5 - Coal River Dry Branch (65 homes)
319 Projects - Ag. (2)

7.2 Milestones

7.2.1 Septic Milestones

Remediating failing septic systems is the first priority of this watershed based plan. The goal of the septic remediation projects is to reduce the fecal coliform load for the sub-watersheds that will remain without public sewage: Angel Fork (202), Upper Browns Creek (203), and Coal River Dry Branch (9003).

The project to remediate failing onsite septic systems in these three sub-watersheds will be divided into three phases.

-Phase I will address 67 septic tanks on Angel Fork.

- Goal: achieve 39% fecal reduction (7.13E+12 counts/yr) by end of Phase I (2018)

-Phase II will address the first 90 septic tanks within the Upper Browns Creek sub-watershed.[2]

- Goal: achieve 34% fecal reduction (9.83E+12 counts/yr) by end of Phase II (2020)

-Phase III will address the middle 90 septic tanks within the Upper Browns Creek sub-watershed.

- Goal: achieve 34% fecal reduction (9.83E+12 counts/yr) by end of Phase II (2022)

-Phase IV will address the last 90 septic tanks within the Upper Browns Creek sub-watershed.

- Goal: achieve 34% fecal reduction (9.83E+12 counts/yr) by end of Phase II (2024)

-Phase III will address the 65 septic tanks in the Coal River Dry Branch sub-watershed located primarily along Ferrell Road and Dry Ridge Road.

- Goal: achieve 38% fecal reduction (5.98E+12 counts/yr) by end of Phase III (2025)

***Interim Milestones:** The septic remediation projects are contingent upon voluntary homeowner participation. As a result, outreach to prospective homeowners is a crucial component of the project. If participation is lower than anticipated, target numbers for milestones will be revisited and outreach efforts increased. Interim milestones to educate homeowners and increase project participation will include:

- Volunteers going door-to-door
- Flyers delivered to each residence and local businesses
- Coordinated outreach with the Kanawha-Charleston Health Department
- Radio and newspaper adds

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[2] Phases II, III, and IV are all equal-sized projects taking place within the Upper Browns Creek sub-watershed. As a result, their individual reductions (34% each) represent one third of the total reductions for that sub-watershed (102%), as shown in Figure 28.

7.2.2 Sediment Milestones

Based on a timeline proposed by the WVCA, the project team plans to complete the land management work within a five-year timeframe beginning in 2022. This will enable the project team to focus its capacity first on the septic remediation projects before expanding the project scope to cover land management areas.

The goal of the land management project is to reduce the sediment load going into Browns Creek by meeting the following goals:

-Year I will renovate 60 acres of pasture, install one riparian buffer, and install fencing and water system BMP's.

- Goal: achieve 14% reduction (459.5 tons) in the Upper Browns Creek sub-watershed by the end of Year I (2022)

-Year II will renovate 60 acres of pasture, install one riparian buffer, and install fencing and water system BMP's.

- Goal: achieve 14% reduction (459.5 tons) in the Upper Browns Creek sub-watershed by the end of Year II (2023)

-Year III will renovate 60 acres of pasture, install one riparian buffer, and install fencing and water system BMP's.

- Goal: achieve 14% reduction (459.5 tons) in the Upper Browns Creek sub-watershed by the end of Year III (2024)

-Year IV will renovate 60 acres of pasture, install one riparian buffer, and install fencing and water system BMP's.

- Goal: achieve 14% reduction (459.5 tons) in the Angel Fork sub-watershed by the end of Year IV (2025)

-Year V will renovate 60 acres of pasture.

- Goal: achieve 7% reduction (228 tons) in the Angel Fork sub-watershed by the end of Year V (2026)

***Interim Milestones:** The land management projects will rely on the voluntary participation of landowners. The WVCA aims to recruit five landowners per year to participate. Should recruitment numbers lag initially during the first few years of the project, the project team will redouble efforts at landowner outreach. Once the first year's practices are installed in 2022, the WVCA will promote the project's successes within the community to attract other interested landowners to participate. The WVCA plans to go door-to-door to educate landowners and increase participation in the project.

Milestones for achieving load reductions are outlined in Figure 27 below.

Figure 27: Best Management Practice Schedule for Land Management *(WVCA)*

Year	Best Management Practice	Sediment Reductions (tons)	Fecal Reductions
2022	Contract with landowners to renovate 60 pasture acres	228	5.90E+11
	Contract with 5 landowners to install NPS BMP's including 5 fencing/water systems	215	6.10E+11
	Contract with landowners to install 1 acre of riparian buffer	16.5	6.95E+11
2023	Contract with landowners to renovate 60 pasture acres	228	5.90E+11
	Contract with 5 landowners to install NPS BMP's including 5 fencing/water systems	215	6.10E+11
	Contract with landowners to install 1 acre of riparian buffer	16.5	6.95E+11
2024	Contract with landowners to renovate 60 pasture acres	228	5.90E+11
	Contract with 5 landowners to install NPS BMP's including 5 fencing/water systems	215	6.10E+11
	Contract with landowners to install 1 acre of riparian buffer	16.5	6.95E+11
2025	Contract with landowners to renovate 60 pasture acres	228	5.90E+11
	Contract with 5 landowners to install NPS BMP's including 5 fencing/water systems	215	6.10E+11
	Contract with landowners to install 1 acre of riparian buffer	16.5	6.95E+11
2026	Contract with landowners to renovate 60 pasture acres	228	5.90E+11

7.3 Education Milestones

The goal of the education and outreach component is to raise awareness of proper sewage treatment and land management in the Lower Coal River watershed.

- Reach 500 households through direct mailing and brochures.
- Hold two public meetings to educate the public about the project.
- Hold one water festival a year for 200 kids from local schools.
- Participate in local and regional outreach events to educate the public at large.

The project team will coordinate and monitor the success of implementation. The WVDEP Basin Coordinator and the NPS Coordinator will also monitor the implementation schedule. The CRG will meet quarterly with the WVDEP Basin Coordinator to review progress.

***Interim Milestones:** Education and outreach are pivotal for achieving the landowner and homeowner participation needed to carry out the management measures proposed in this plan. The project team will meet quarterly throughout implementation to discuss whether project participation goals are being met. If not, the team will increase outreach measures accordingly to ensure the project stays on track.

7.4 Load Reduction Criteria

Fecal from Septic Tanks

Substantial fecal reductions have been implemented since the Coal River TMDL was published in 2006. Figure 28 below provides a summary of fecal reductions already implemented through the Greater St. Albans PSD Sewer Expansion Project and those anticipated through septic remediation projects outlined in this watershed based plan.

Figure 28: Fecal Load Reductions from Septic Measures

Implemented Reductions from Sewer Expansion (as of 2013)										
Sub-watershed	Location	# Units	Gal/person/day	Conversion (gal to ml)	Persons/ household	mL/ household/ day	cfu/100mL	Days of year	Efficiency	cfu Load Reduction
9002	Indian Head	216	35	3.79E+03	2.32	3.08E+05	1.00E+03	365	100%	2.42E+13
9002	Strawberry Rd	217	35	3.79E+03	1.88	2.49E+05	1.00E+03	365	100%	1.97E+13
9002	Lower Falls	232	35	3.79E+03	2.42	3.21E+05	1.00E+03	365	100%	2.72E+13
	Total # Houses:	**665**								

Expected Reductions from Sewer Expansion by 2015										
Sub-watershed	Location	# Units	Gal/person/day	Conversion (gal to ml)	Persons/ household	mL/ household/ day	cfu/100mL	Days of year	Efficiency	cfu Load Reduction
101	Tackett Creek	434	35	3.79E+03	2.12	2.81E+05	1.00E+03	365	100%	4.45E+13
9002	Coal River Rd	106	35	3.79E+03	2.2	2.92E+05	1.00E+03	365	100%	1.13E+13
9003	Tornado area	178	35	3.79E+03	2.7	3.58E+05	1.00E+03	365	100%	2.33E+13
201	Lower Browns Creek	65	35	3.79E+03	1.98	2.63E+05	1.00E+03	365	100%	6.23E+12
	Total # Houses:	**783**								

Lower Coal River Estimated Reductions from Failing Septic Tanks										
Sub-watershed	Location	# Units	Gal/person/day	Conversion (gal to ml)	Persons/ household	mL/ household/ day	cfu/100mL	Days of year	Efficiency	cfu Load Reduction
203	Upper Browns Creek	277	35	3.79E+03	2.2	2.92E+05	1.00E+03	365	100%	2.95E+13
202	Angel Fork	67	35	3.79E+03	2.2	2.92E+05	1.00E+03	365	100%	7.13E+12
9003	Ferrell Rd	65	35	3.79E+03	1.9	2.52E+05	1.00E+03	365	100%	5.98E+12
	Total # Houses:	**409**								

Revised Load - Post Sewer Expansion									
Sub-watershed	**Stream Name**	**Stream Code**	**TMDL Onsite Septic Load (counts/yr)**	**Load Reductions from Sewer Extension Project**	**Revised Onsite Sewer Baseline Load (by 2015)**	**Expected Reductions from Management Measures**	**Final Estimated Load**	**Percent Reduction**
101	Tackett Creek	WVKC-1	3.72E+13	4.45E+13	-7.32E+12			120%
201	Lower Browns Creek	WVKC-2	7.01E+12	6.23E+12	7.82E+11			89%
202	Angel Fork	WVKC-2-A	1.85E+13		1.85E+13	7.13E+12	1.14E+13	39%
203	Upper Browns Creek	WVKC-2	2.90E+13		2.90E+13	2.95E+13	-4.89E+11	102%
9002	Coal River	WVKC	1.97E+13	8.24E+13	-6.27E+13			418%
9003	Coal River-Dry Branch	WVKC	7.55E+12	2.33E+13	-1.57E+13	5.98E+12	-2.17E+13	38%

Reductions from Agricultural Practices

The land management practices outlined in this plan are focused on addressing sedimentation. As shown below in Figure 29, the proposed management measures will meet and exceed the sediment reductions called for in the TMDL.

Figure 29: Load Reductions from Agriculture *(WVCA)*

Summary of Conservation Practices and Associated Reductions			
BMP	**Planned Units**	**Fecal Coliform Reduction (counts/yr)**	**Sediment Reduction (tons)**
Fencing with alternative water systems (calculated as filter strip)	20 systems	2.44E+12	1,074
Buffer (Riparian area Development)	4 acres	2.78E+12	66
Pasture renovation/seeding	295 acres	2.96E+12	1140
	Totals	**8.18E+12**	**2,530**

Sediment Reduction from Land Management Practices				
Reductions call for in TMDL	**Baseline LA (tons/yr)**	**Percent Reduction Needed**	**Reductions from Management (tons/yr)**	**Percent Achieved**
Sediment	3,314	47.50%	2,530	**76%**

Fecal coliform reductions from agricultural practices will have a relatively small impact on the overall fecal coliform levels in the watershed. The total fecal coliform reduction from land management measures (8.18E+12 counts/year) is spread across the Angel Fork, Upper Browns, and Lower Browns sub-watersheds. The WVCA determined that some fecal matter is transported through small ephemeral streams, resulting in a small fecal coliform load from land management in the watershed. Since there are no required fecal coliform reductions outlined in the TMDL for agriculture-related fecal sources, the fecal contribution calculated from land management is considered negligible and is not a focus area of this plan.

To calculate the fecal contribution, the WVCA took livestock density estimates and applied them to the PMA's in the Brown's Creek and Angel Fork watersheds in order to estimate the fecal coliform load reduction from implementation of BMP's. Utilizing the efficiency rate provided by the Chesapeake Bay model for the various BMP's and their efficiencies, the WVCA inferred the reduction per head of livestock through the listed practices to determine an estimated load reduction for the entire project. These figures are listed in Table 29. To see the full calculations behind the Fecal Coliform Reductions and Sediment Reductions, go to Appendix D: Sediment Calculations and Appendix E: Calculating Agriculture-Related Fecal Coliform.

7.5 Monitoring

Water monitoring will continue before and after the septic projects to judge the impact of the projects on reducing fecal loads. The CRG and the WVDEP Nonpoint Source Program Basin Coordinator will be primarily responsible for monitoring of water quality, which will be sampled according to the WVDEP's quality assurance project plan (QAPP). The goals of monitoring are to assure that septic remediation measures are functioning properly and to provide measurable reductions in fecal contamination as pertains to the streams 303(d) listing.

The CRG will work with the WVDEP to develop a QA PP for the Lower Coal River watershed. The WVCA will be responsible for all monitoring on land management projects. The WVDEP's Watershed Assessment Branch (WAB) will conduct its regular 5-year cycle sampling in the Coal River watershed in 2017. At that time, sites from the pre-TMDL sampling in watershed will likely be re-tested. WAB will also coordinate with the NPS Program and the CRG to monitoring the sites identified below prior to and following project implementation. The monitoring will be completed on a quarterly basis, but will also incorporate weather related events, when possible.

The focus of this effort will be fecal coliform along with visual inspections to evaluate qualitative changes that may indicate a reduction in sediment and organic enrichment due to fecal coliform. The CRG will coordinate quarterly sampling conducted by volunteer stream monitors. The CRG will work with students and faculty from Marshall University and the WVDEP's Save Our Streams (SOS) Program to conduct trainings and collect samples.

8 References & Sources

Lower Coal River Watershed Based Plan GIS Platform. Created by Sara Cottingham, Coal River Group OSM/VISTA. 2013. Interactive map may be viewed at: http://bit.ly/1bwwW6R

U.S. Environmental Protection Agency (EPA), Region 3. 2006. *Total Maximum Daily Loads for Selected Streams in the Coal River Watershed, West Virginia.*

U.S. Department of Agriculture, Natural Resources Conservation Service. 2013. *Conservation Practice Standard.*

Appendix A: Fecal Coliform Sampling Results from Browns Creek

Sampling within the Lower Coal watershed has consistently shown high levels of fecal coliform. The WVDEP's sampling for the Coal River TMDL in 2002 and 2003 found the mainstem Coal River and its major tributary Browns Creek to be exceeding federal water quality standards and resulted in placing Browns Creek on the statewide 303(d) impaired list. In October 2008 researchers from Marshall University collected bacteria samples from 98 sites throughout the entire Coal River watershed, including two samples from the Lower Coal River. The two Lower Coal sites were taken in the mainstem of the river below Browns Creek and Tackett Creek, and both had E. coli levels above the 200 colonies/100ml sample.

Figure 1: Marshall University Bacteria Samples from 2008

Site	Total Coliform	E. Coli
Coal River below Tackett Creek	3000	410.6
Coal River below Browns Creek	3000	686.7

Source: Marshall University, 2008

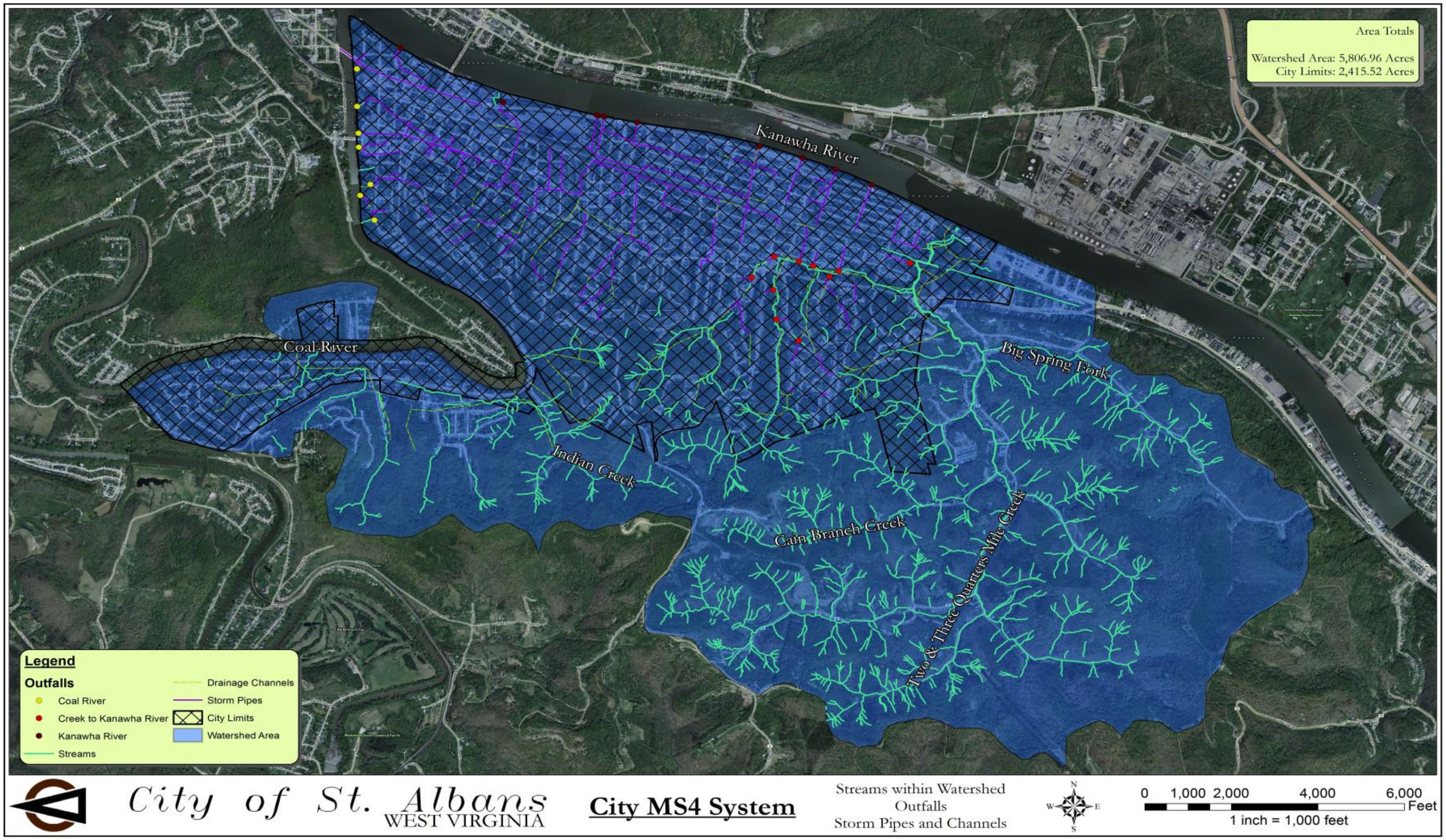
In September 2013 a group from Marshall University students and Coal River Group volunteers collected fecal coliform samples on Browns Creek and Angel Fork. The samples were collected after a period of intense rain.

Figure 2: Marshall University Bacteria Samples from 2013

Site Name	pH	Conductance	TDS	Temp °C	Fecal Coliform
Mountain Drive	7.35	0.48	0.19	19.1	1636
Upstream Adkins Branch	7.55	0.26	0.13	20.1	45
Downstream Adkins Branch	7.65	0.27	0.14	20.6	153
Upstream Bryan Branch	7.38	0.27	0.13	21.1	260
Downstream Bryan Branch	7.48	0.27	0.13	21	280
Downstream Angel Fork	7.57	0.27	0.14	22.1	240
Coal River Mouth at Indian Head	7.52	0.29	0.13	21.9	230
Random Angel Fork	7.71	0.27	0.13	21.9	450

Source: Marshall University, 2013

Appendix B: City of St. Albans MS4 Map



Appendix C: Sediment Calculations

Browns Creek Watershed Sediment Assessment for Agriculture related Impacts
Submitted to Coal River Group Watershed Association
Mark Buchanan Conservation Specialist WVCA

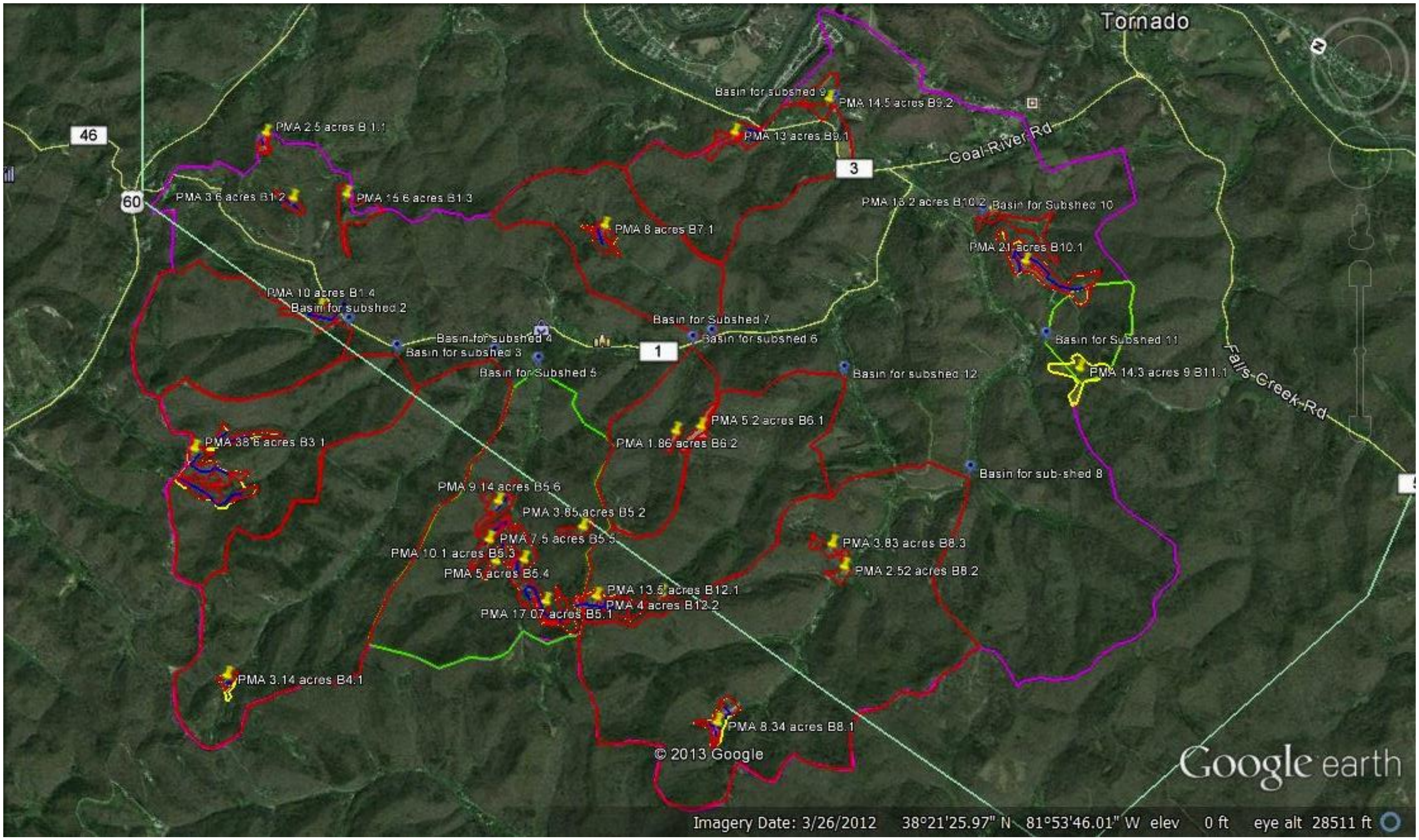
Erosion and Sedimentation (Ag Related Sources)

Erosion is a natural part of the dynamic landscape. Many factors play a role in impacting the severity of erosional forces including topography, soil type, rain intensity, and vegetative cover. Land use in the form of roads and roofs for settlement or land clearing for agricultural uses like grazing alter the natural ebb and flow of water across the land. These alterations can lead to an increase in sedimentation within a watershed. Consequently, sediment supplied to a stream is usually increased. The increased volume of sediment can lead to a variety of water quality impairments including loss of aquatic habitat, increased water temperatures, and an increased risk of flooding.

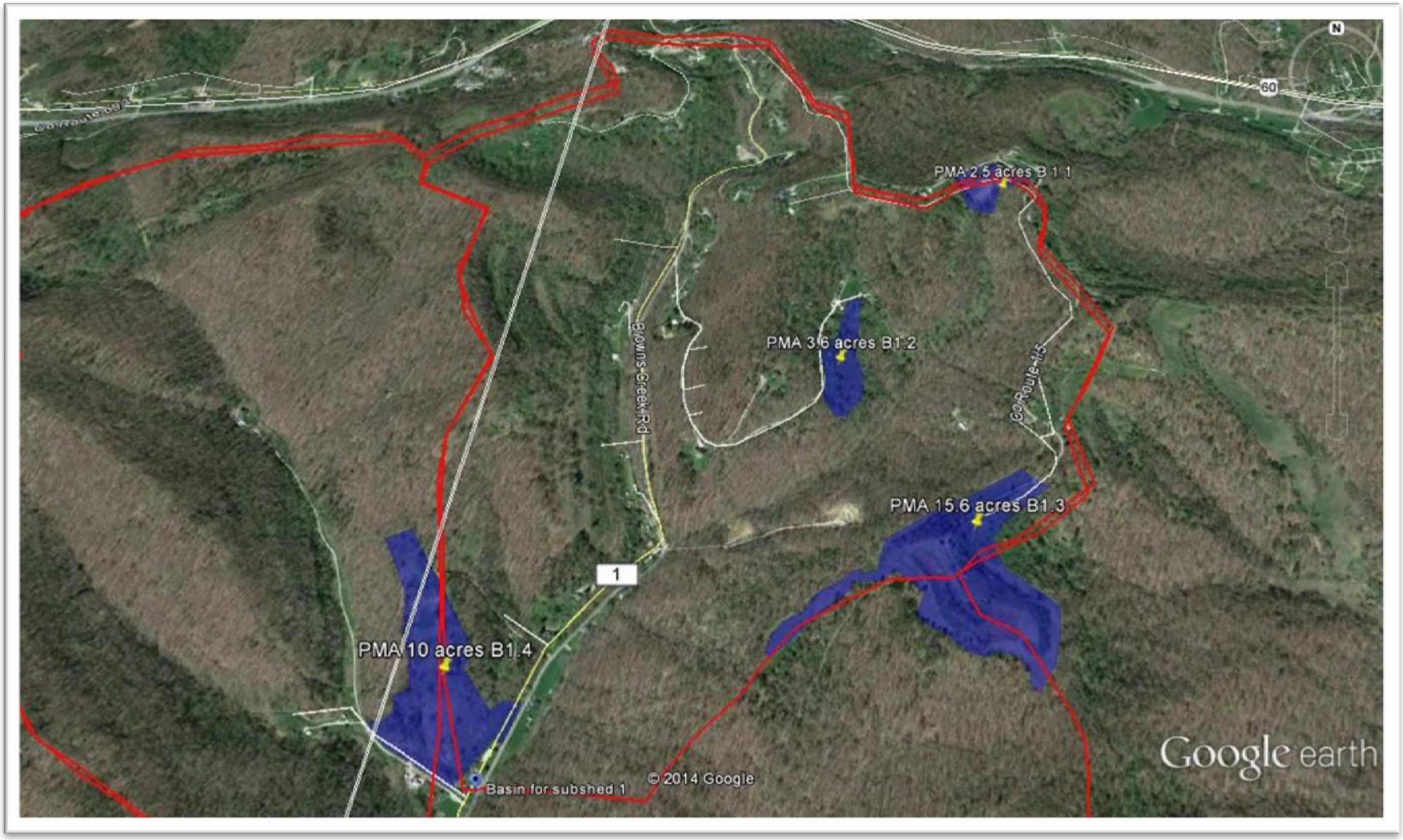
In order to quantify potential sediment reductions for the Brown's Creek Watershed a combination of field visits and satellite imagery were used to identify potential sites that may contribute excessive quantities of sediment to the Coal River. Generally speaking, if an area exhibited bare or overgrazed ground, animal trails, and or livestock fencing it was designated as a Potential Management Area (PMA). The area that illustrated a similar type "management schemes" was measured and the average slope calculated. Each PMA was then referenced on the USDA Web Soil Survey to gather important information regarding soils properties. This information was used to calculate erosion rates using the Revised Universal Soil Loss Equation (RUSLE) spreadsheet. The RUSLE calculation takes into account several factors that are exclusive to each site including vegetative cover, slope, and dominant type of soil. The watershed was divided into "sub-sheds" and corresponding basins. Each basin was numbered 1 through 12. Only basins with "perceived" sedimentation issues were noted therefore not every sub watershed is taken into account in this report. Each site within a particular basin is numbered based on the basin number it is located within. For example, site 5.6 indicates that the site is located in Basin 5 and is identified as the 6th site within the basin. No farm names, tracts or numbers will be included in this report.

RUSLE Spreadsheet

"Before" and "After" denotes the site conditions prior to implementation of best management practices and post implementation. Specific practices will accompany project proposals. For the purpose of this report, it is assumed that employed practices will constitute a 95% vegetative coverage rate of the ground surface. Most sites were calculated using 80% coverage prior to management except in extreme situations where the ground was denuded of most/all vegetation. Following are the 27 Potential Management Areas identified including RUSLE Calculations.



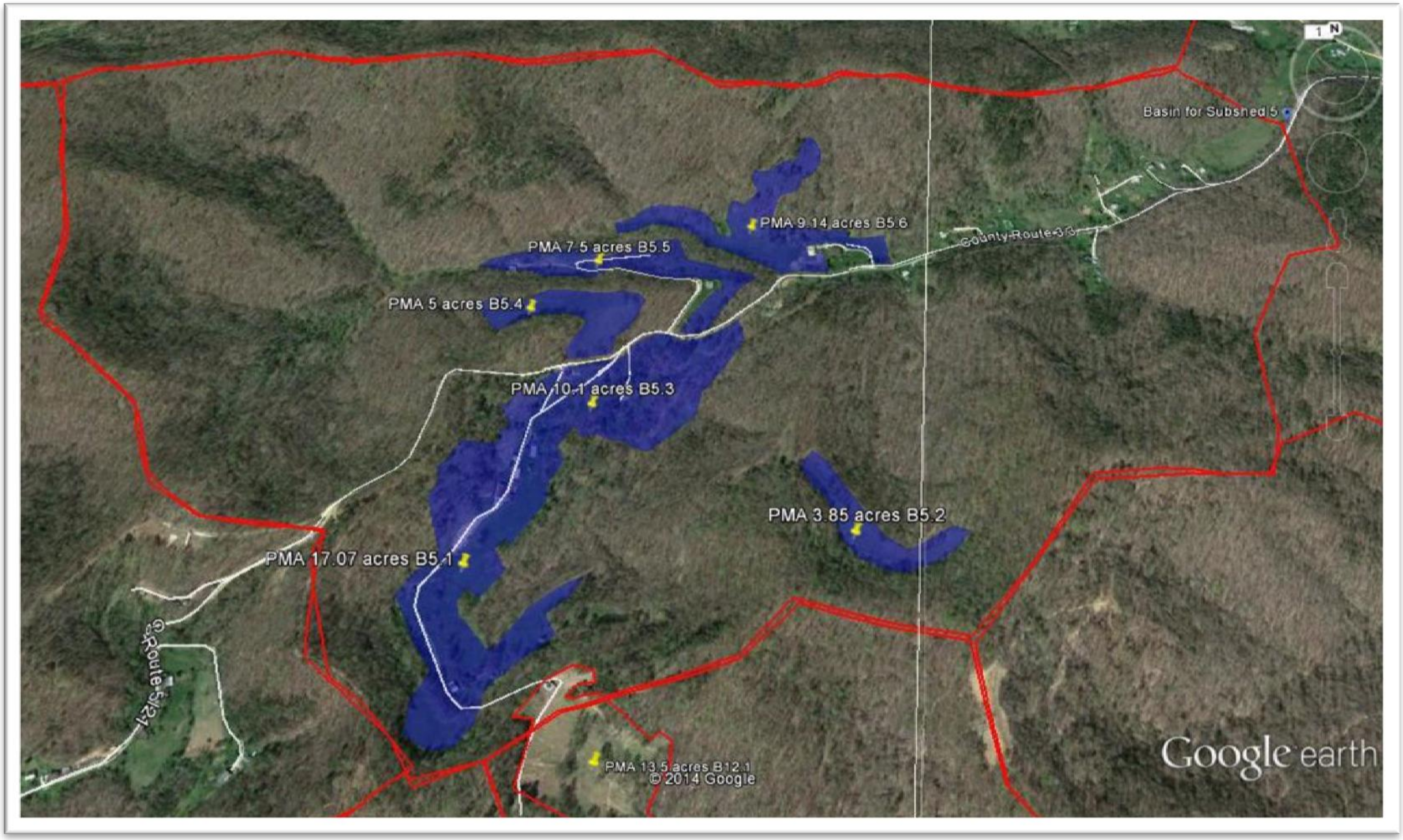
PMA's in Sub-shed 1



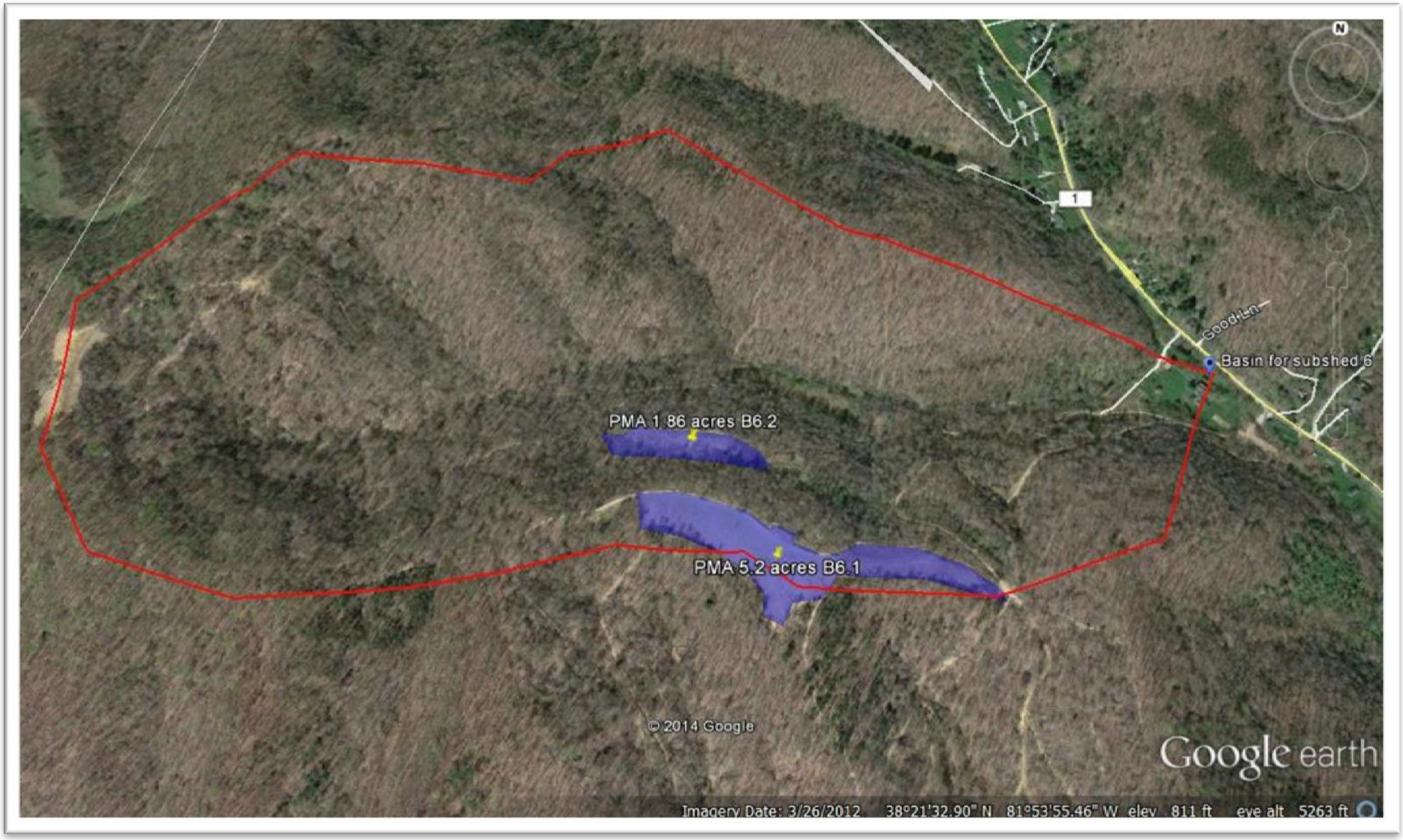
PMA's in Sub-sheds 2 and 3

PMA's in Sub-shed 4

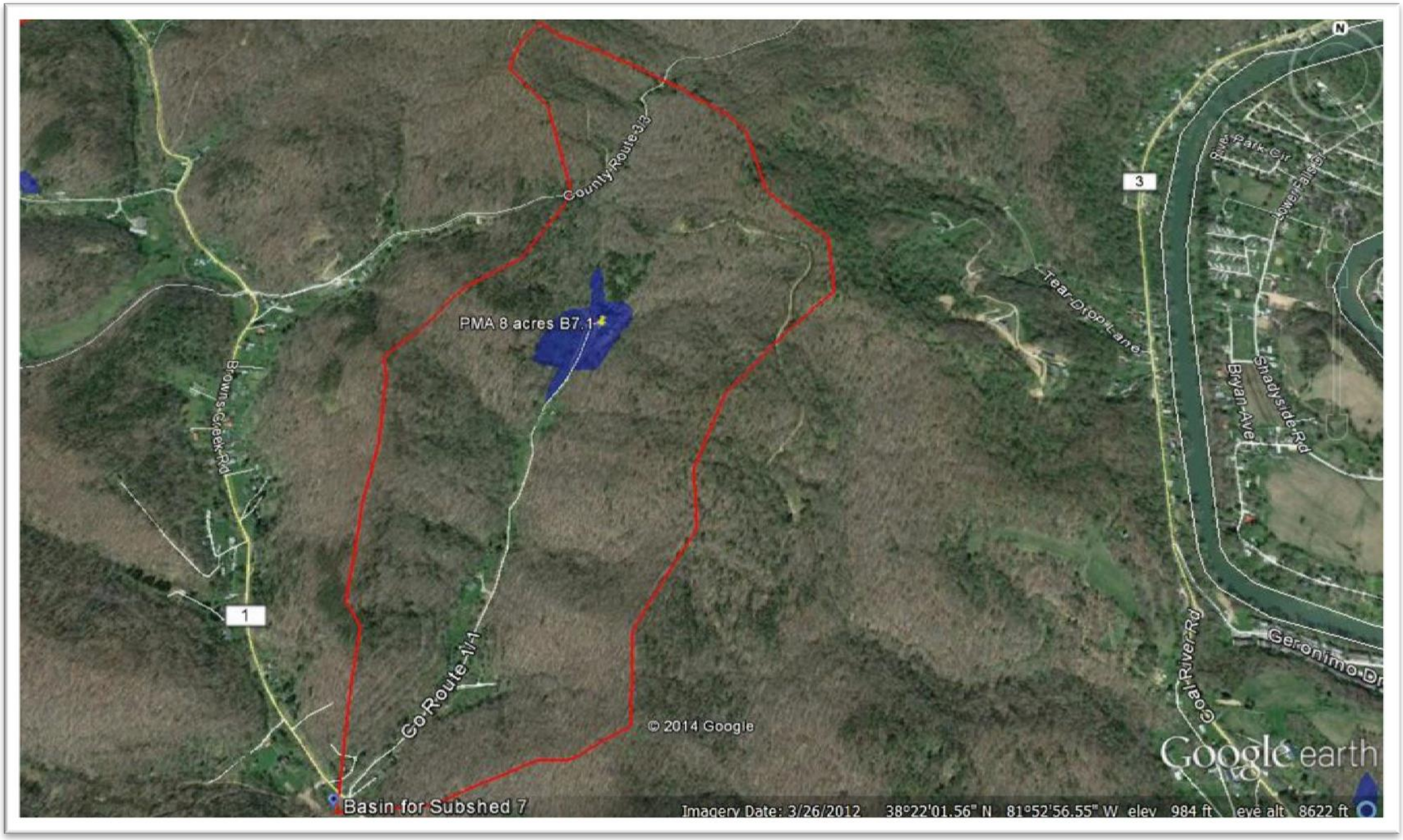
PMA's in Sub-shed 5



PMA's in Sub-shed 6

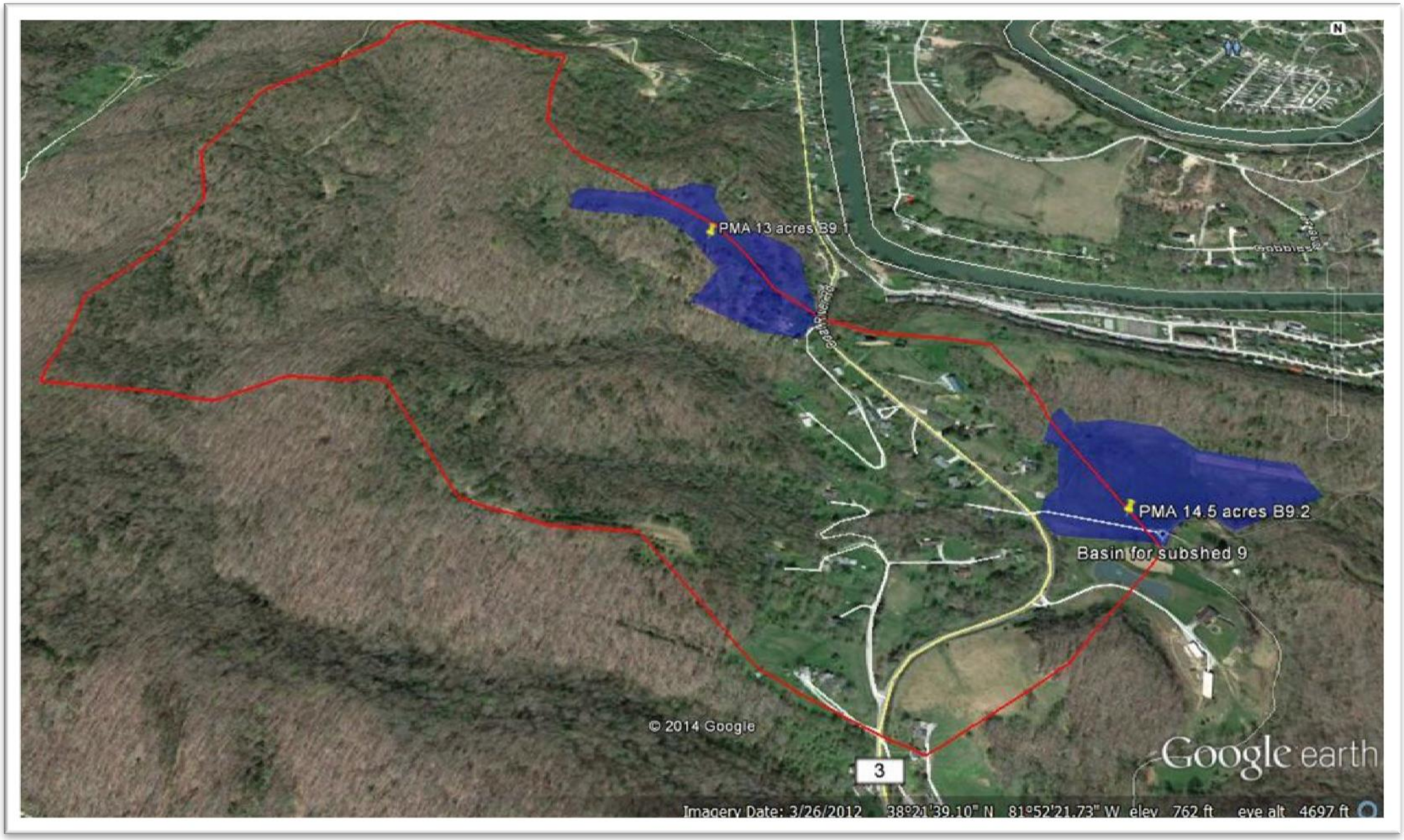


PMA's in Sub-shed 7



PMA's in Sub-shed 8

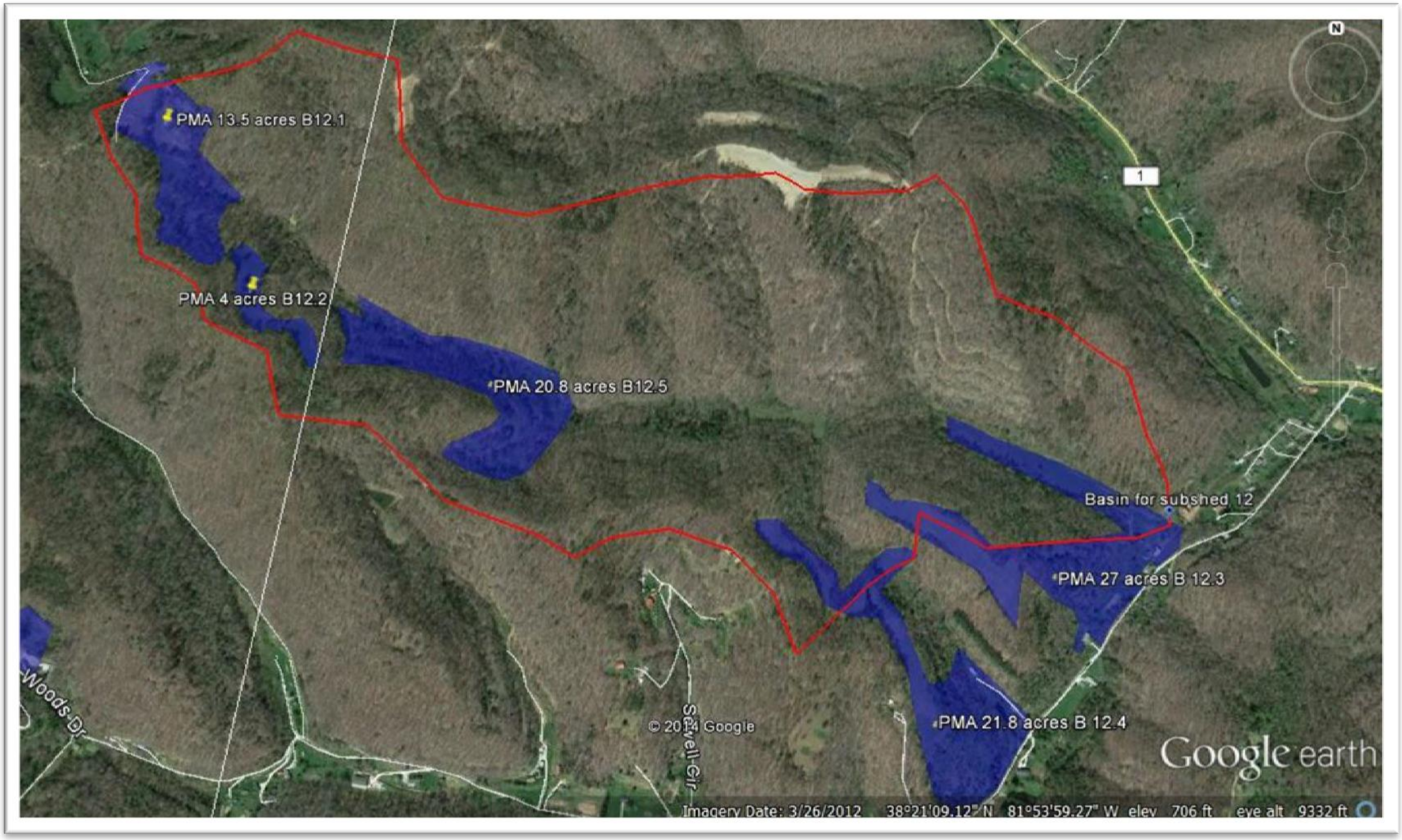
PMA's in Sub-shed 9



PMA's in Sub-shed 10

PMA's in Sub-shed 11

PMA's in Sub-shed 12



Revised Universal Soil-Loss Equation (RUSLE)

Soil Loss = RK(LS)CP

Field Identification Practices	Dominant Soil Type	B=before Treatment A=after Treatment	Date	Ac.	% Cover	C*	L	S	LS*	K*	T*	P	Soil Loss Tn/Ac/Yr	Tolerable Soil Loss Tn/Ac/Yr	Soil Saved After Treatment Tn/Ac/Yr	Total Soil Saved
					(R) Rainfall Factor		150									
PMA B1.1	Clymer Dekalb Complex	B	10/1/2013	2.5	50	0.053			5.95	0.24	3	1	11.35	-8.35		
		A		2.5	95	0.003			5.95	0.24	3	1	0.64	2.36	6.00	14.988
PMA B1.2	Gilpin Upshur Complex	B	10/1/2013	3.6	80	0.012			11.99	0.32	3	1	6.91	-3.91		
		A		3.6	95	0.003			11.99	0.32	3	1	1.73	1.27	2.63	9.47808
PMA B1.3	Gilpin Upshur Complex	B	10/1/2013	15.6	80	0.012			13.92	0.32	3	1	8.02	-5.02		
		A		15.6	95	0.003			13.92	0.32	3	1	2.00	1.00	4.02	62.74944
PMA B1.4	Gilpin Upshur Silt Loam	B	10/1/2013	10	80	0.012			9.99	0.32	3	1	5.75	-2.75		
		A		10	95	0.003			9.99	0.32	3	1	1.44	1.56	1.19	11.928
PMA B3.1	Gilpin Upshur Complex	B	10/1/2013	38.6	80	0.012			11.99	0.32	3	1	6.91	-3.91		
		A		38.6	95	0.003			11.99	0.32	3	1	1.73	1.27	2.63	101.62608
PMA B4.1	Vandalia Silt Clay Loam	B	10/1/2013	3.14	80	0.012			8.68	0.37	4	1	5.78	-1.78		
		A		3.14	95	0.003			8.68	0.37	4	1	1.45	2.55	0.77	2.430046
PMA B5.2	Gilpin Upshur Complex	B	10/1/2013	3.85	80	0.008			9.71	0.32	3	1	3.73	-0.73		
		A		3.85	95	0.003			9.71	0.32	3	1	1.40	1.60	0.87	3.361512
PMA B5.3	Gilpin Upshur Complex	B	10/1/2013	10.1	70	0.027			9.99	0.32	3	1	12.95	-9.95		
		A		10.1	95	0.003			9.99	0.32	3	1	1.44	1.56	8.39	84.69456
PMA B5.4	Gilpin Upshur Complex	B	10/1/2013	5	60	0.042			8.68	0.32	3	1	17.50	-14.50		
		A		5	95	0.003			8.68	0.32	3	1	1.25	1.75	12.75	63.744
				92.39												354.999718

Browns Creek Angel Fork Watershed

Revised Universal Soil-Loss Equation (RUSLE)

Soil Loss = RK(LS)CP

Field Identification Practices	Dominant Soil Type	B=before Treatment A=after Treatment	Date	Ac.	% Cover	C*	L	S	LS*	K*	T*	P	Soil Loss Tn/Ac/Yr	Tolerable Soil Loss Tn/Ac/Yr	Soil Saved After Treatment Tn/Ac/Yr	Total Sediment Saved
					(R) Rainfall Factor		150									
PMA B5.5	Gilpin Upshur Complex	B	10/1/2013	7.5	80	0.012			9.71	0.32	3	1	5.59	-2.59		
		A		7.5	95	0.003			9.71	0.32	3	1	1.40	1.60	0.99	7.434
PMA B5.6	Sensabaugh Silt Loam	B	10/1/2013	9.14	80	0.012			3.22	0.24	5	1	1.39	3.61		
		A		9.14	95	0.003			3.22	0.24	5	1	0.35	4.65	8.26	75.507368
PMA B6.1	Gilpin Upshur Complex	B	10/1/2013	5.2	0	0.45			7.11	0.32	3	1	153.58	-150.58		
		A		5.2	95	0.003			7.11	0.32	3	1	1.02	1.98	148.60	772.719168
PMA B6.2	Gilpin Upshur Complex	B	10/1/2013	1.86	0	0.45			9.71	0.32	3	1	209.74	-206.74		
		A		1.86	95	0.003			9.71	0.32	3	1	1.40	1.60	205.13	381.5496864
PMA B7.1	Vandalia Silty Clay Loam	B	10/1/2013	8	80	0.012			9.71	0.37	4	1	6.47	-2.47		
		A		8	95	0.003			9.71	0.37	4	1	1.62	2.38	0.06	0.6686
PMA B8.1	Vandalia Silty Clay Loam	B	10/1/2013	8.34	50	0.062			7.94	0.37	4	1	27.32	-23.32		
		A		8.37	95	0.003			7.94	0.37	4	1	1.32	2.68	20.64	172.7865135
PMA B9.1	Gilpin Upshur Complex	B	10/1/2013	13	80	0.012			7.11	0.37	3	1	4.74	-1.74		
		A		13	95	0.003			7.11	0.37	3	1	1.18	1.82	0.08	1.052025
PMA B9.2	Senecaville Silt Loam	B	10/1/2013	14.5	80	0.012			0.09	0.37	5	1	0.06	4.94		
		A		14.5	95	0.003			0.09	0.37	5	1	0.01	4.99	9.93	143.9135875
PMA 10.1	Vandalia Silt Loam	B	10/1/2013	21	70	0.05			9.99	0.37	4	1	27.72	-23.72		
		A		21	95	0.003			9.99	0.37	4	1	1.66	2.34	21.39	449.097285
				88.56	acres											2004.728233

Browns Creek Angel Fork Watershed

Revised Universal Soil-Loss Equation (RUSLE)

Soil Loss = RK(LS)CP

(R) Rainfall Factor 150

Field Identification Practices	Dominant Soil Type	B=before Treatment A=after Treatment	Date	Ac.	% Cover	C*	L	S	LS*	K*	T*	P	Soil Loss Tn/Ac/Yr	Tolerable Soil Loss Tn/Ac/Yr	Soil Saved After Treatment Tn/Ac/Yr	tons soil saved
PMA B10.2	Vandalia Silt Loam	B	10/1/2013	13.2	80	0.012			4.38	0.37	4	1	2.92	1.08		
		A		13.2	95	0.003			4.38	0.37	4	1	0.73	3.27	4.35	57.46818
PMA B11.1	Gilpin Upshur Complex	B	10/1/2013	14.3	80	0.012			8.68	0.32	3	1	5.00	-2.00		
		A		14.3	95	0.003			8.68	0.32	3	1	1.25	1.75	0.25	3.56928
PMA B12.1	Gilpin Upshur Complex	B	10/1/2013	13.5	80	0.012			7.11	0.32	3	1	4.10	-1.10		
		A		13.5	95	0.003			7.11	0.32	3	1	1.02	1.98	0.88	11.88
PMA B12.2	Gilpin Upshur Complex	B	10/1/2013	4	80	0.012			9.99	0.32	3	1	5.75	-2.75		
		A		4	95	0.003			9.99	0.32	3	1	1.44	1.56	1.19	4.7712
PMA B8.2	Sensenbaugh Silt Loam	B	10/1/2013	2.52	80	0.012			1.51	0.24	5	1	0.65	4.35		
		A		2.52	95	0.003			1.51	0.24	5	1	0.16	4.84	9.18	23.145192
PMA B8.3	Gilpin Upshur Complex	B	10/1/2013	3.83	80	0.012			8.29	0.32	3	1	4.78	-1.78		
		A		3.83	95	0.003			8.29	0.32	3	1	1.19	1.81	0.03	0.119496
PMA B12.3	Gilpin Upsur Complex	B	10/1/2013	19.5	80	0.012			6.78	0.32	3	1	3.91	-0.91		
		A		19.5	95	0.003			6.78	0.32	3	1	0.98	2.02	1.12	21.8088
PMA B12.4	Gilpin Upsur Complex	B	10/1/2013	21.8	80	0.012			6.78	0.32	3	1	3.91	-0.91		
		A		21.8	95	0.003			6.78	0.32	3	1	0.98	2.02	1.12	24.38112
PMA B12.5	Gilpin Upsur Complex	B	10/1/2013	20.8	80	0.012			6.78	0.32	3	1	3.91	-0.91		
		A		20.8	95	0.003			6.78	0.32	3	1	0.98	2.02	1.12	23.26272
				113.5												170.405988

Total Sediment Load and Potential Management Areas

Total number of PMA's	27 PMA's
Total Acreage for Potential Management	295 acres
Total Potential Reduction of sediment (tons)	2530 tons

Appendix D: Calculating Agriculture-Related Fecal Coliform

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 coliform 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. Agriculture operations exist within the Browns Creek and Angel Fork drainage.

The following charts denote how numbers of livestock were calculated followed by loading estimates.

Estimated Livestock Numbers (based on Ag statistics) within Brown's Creek and Angel Fork Watersheds*

Livestock	Head	Animal Unit (AU) per Head	Number of AU's
Beef Cattle	18	1	18
Equine	9	1.25	11.25
Chickens	6	0.033	1
Goats	3	0.3	1
Total	36		31.25
Total estimated Animal Units in watershed			31.25
Total farm acres in watershed (sum of PMA's)			295
Average Animal Units Per Acre			0.11

After calculating the estimated livestock concentrations, using 2007 Census of Agriculture, the technical team decided the numbers were not representative of actual conditions witnessed on field visits and reconnaissance. Livestock concentrations were adjusted by adding values of known livestock numbers. The following chart illustrates the adjusted numbers.

Adjusted Livestock numbers (combination of statistical and field visits)

Livestock	Head	Animal Unit (AU) per Head	Number of Animal Units
Beef Cattle	75	1	75
Equine	38	1.25	47.5
Chickens	50	0.033	1.65
Goats	15	0.3	4.5
Total	178		128.65
Total estimated Animal Units in watershed			128.65
Total farm acres in watershed (sum of PMA's)			295
Average Animal Units Per Acre			0.44

The above chart demonstrates that livestock within the watershed generally have ample area for grazing and feeding based on West Virginia University guidelines of 1 animal unit per acre. It can be inferred that the fecal coliform contamination of the watershed from livestock is a result of livestock concentrating themselves in or near streams or conveyances in addition to poor land management practices.

How numbers were calculated:

Livestock density was calculated using data derived from the 2007 Agriculture Census. USDA National Agriculture Statistics Service "Quick Stats 2.0" Website: http://www.nass.usda.gov/Data_and_Statistics/Quick_Stats/index.asp

Total number of a specific species is divided by the farmland acres in the county. This number is the density for that particular species.

Livestock density = Total **number of animals of a given species in Kanawha County**
Total farmland acres in Kanawha County (derived from Ag Statistics)

Total farmland acres for Kanawha county = 23,755 acres (2007 Ag Census of Agriculture)
To calculate livestock numbers in Browns Creek the Livestock density was multiplied by the total PMA acreage in subject drainages (295)

Livestock density values and total livestock numbers for Brown's Creek and Angel Fork
1362 cow and calves in Kanawha County/23755 farm acres in Kanawha County = .06 animals/farm acre in Kanawha County
.06 x 295 acres (Farmland acreage in the Browns Creek and Angel Fork drainage) = 18 cow calf pairs

576 chickens/23755 = .02 animals/acre .02 x 302 = 6 chickens	816 Equine/23755 = .03 animals/acre .03 x 302 acres = 9 horses	246 goats/23755 = .01 animals/acre .01 x 302 = 3 goats

Explanation of estimated load reductions for agriculture

If we take the livestock density estimates and apply it to the Potential Management Areas in the Brown's Creek and Angel Fork Watershed we can begin to estimate the fecal coliform load reduction from implementation of BMPs. For each management area considered under this proposal, not all livestock have direct access to streams. However, given the general steep topography of the rugged landscape, small ephemeral streams present in all of the potential management areas act as direct conveyances during precipitation events moving sediment, nutrients and fecal material to perennial bodies within the watershed. Utilizing the efficiency rate provided by the Chesapeake Bay model for the various BMP's and their efficiencies, we can infer the reduction per head of livestock through the listed practices and come up with an estimated load reduction for the entire project. These figures are listed in the table below.

Ag Related loading estimates in the watershed

Total Baseline	4.49E+14
Total Animal Units	129
Baseline Per Animal Unit	3.48E+12
Total Pasture Acres	295
Total Animal Units On Grazing Unit	129
Total Load Per Acre	1.52E+12

TABLE 1 Reduction Estimates

% Load Reductions by Conservation Practice	
Filter Strip and fencing	70%
Sediment Pond/Swale in Combination with Filter Strip	85%
Buffer	80%
The Following Practices Alone Will Reduce Loads By:	
Filter Strip and fencing	2.44E+12
Sediment Pond/Swale in Combination with Filter Strip	2.96E+12
Buffer (Riparian area development)	2.78E+12
Total	8.18E+12