



# Brier Creek Watershed Management Plan

Thomson, Georgia

Developed by Phinizy Center for Water Sciences in cooperation with  
Georgia EPD and Thomson-McDuffie County Government

2014-2015

## Introduction

### *Purpose of the Watershed Management Plan*

In 2014, the GAEPD contracted with the City of Thomson to build on earlier efforts to restore Brier Creek by developing a Watershed Management Plan (WMP) to more effectively address USEPA's *Nine Elements of Watershed Planning*. USEPA's "Handbook for Developing Watershed Plans to Restore and Protect Our Waters" and GAEPD's "Watershed Planning Guidance" were used as resources in the planning process. According to USEPA and GAEPD guidelines, Watershed Management Plans are intended as platforms for evaluating and tracking water quality protection and restoration. These plans are designed to accommodate continual updates and revisions as new conditions and information warrant. In addition, field verification of watershed characteristics and listing data has been built into the preparation of the plans. The overall goal of the plans is to define a set of actions that will help achieve water quality standards in the State of Georgia.

This management plan for the Brier Creek watershed provides identification of causes and sources of impairments; an estimate of the expected load reductions; assessment of the NPS management measures needed and the critical areas where they need to be implemented; an estimate of the amount of technical and financial assistance needed to implement the plan and the sources of this assistance; a plan for an education and information component; a schedule for implementation; interim measureable milestones for NPS management measure implementation; criteria for evaluating progress toward load reductions; and a long-term monitoring strategy to correlate the previous two items. While the context of this water quality improvement effort encompasses the Brier Creek Watershed, HUC 10 #0306010801, this plan specifically focuses on the nonpoint sources (NPS) of fecal coliform bacteria in the HUC 12 #030601080103 watershed area located upstream of the confluence of Brier Creek and Sweetwater Creek, which is just downstream of the US Hwy 17 crossing.

## *Background*

Three miles of Brier Creek from White's Creek to Sweetwater Creek near Thomson (formerly Big Brier Creek to Sweetwater Creek) have been classified as "impaired" under Section 303(d) of the Federal Clean Water Act for not supporting the designated use of fishing due to excessive fecal coliform levels. Water quality samples collected in 2002 are not meeting the Georgia standards for bacteria:

- Geometric mean of 200 per 100 ml (May-October)
- Geometric mean of 1000 per 100 ml (November-April)
- Single sample of 4000 per 100 ml (Nov-April)

A Total Maximum Daily Load (TMDL) written in 2005 required a reduction of 57% in fecal coliform loadings from nonpoint sources in order for the segment to resume assimilative capacity. A Revised TMDL Implementation Plan and a Watershed Improvement Plan were written in 2007 and 2010, respectively, aimed at restoring Brier Creek to its designated use. The Thomson Water Pollution Control Plant (WPCP) discharges into White's Creek (latitude 33.3824 and longitude -82.5037). White's Creek is a tributary of Brier Creek entering at the upstream end of the impaired reach and extending north while the main stem of Brier Creek extends west.

The Savannah River Basin is located primarily in eastern Georgia and western South Carolina and defines the state boundary between Georgia and South Carolina. The Savannah River flows for more than 300 miles to the Atlantic Ocean, beginning in the Blue Ridge Mountains of North Georgia. Supplying drinking water to cities such as Augusta, Savannah, Hilton Head, and Beaufort, SC, and many smaller municipalities, along with hydropower and a large port, the Savannah River is among the most highly impacted of southeastern rivers. The lower Savannah River watershed encompasses more than 10,577 square miles and supports extremely high species biodiversity, including the greatest number of native fish species of any river draining into the Atlantic. As salt water intrudes into the aquifers near the coast, the Savannah River is ever more important as a source of drinking water. Despite its scenic beauty and natural diversity, the ecological health of the river system from the headwaters to the estuary requires constant management. The construction of dams and reservoir systems just 50 years ago has negatively altered the natural flow patterns that support the wildlife and natural communities of the Savannah River, its floodplain and its estuary. Additionally, large-scale timbering, municipal water needs and harbor dredging and expansion are contributing to the degradation of the entire ecosystem. (Savannah River Basin Management Plan, 2001).

The Savannah River Basin is located within three physiographic provinces: the Blue Ridge, Piedmont, and the Coastal Plain provinces. The Blue Ridge and Piedmont provinces, which constitute approximately 60 percent of the Savannah River Basin, are underlain by crystalline metamorphic and igneous rocks. Coastal Plain sediments constitute approximately 40 percent of the Savannah River basin. Approximately 80 percent of the sediments are sands and clays. The rest include calcareous sediments and Quaternary alluvium. The Coastal Plain sediments overlap the southern edge of the Piedmont Province at the Fall Line and are dominantly marine in origin, consisting of sand, kaolinitic sand, kaolin, and pebbly sand. These

sediments host the major kaolin deposits in Georgia with many of these deposits found within the Savannah River basin.

Much of the southeastern Piedmont is covered by deeply weathered bedrock called saprolite. Average saprolite thickness in the Piedmont rarely exceeds 20 meters, but the thickness can vary widely within a short distance. A considerable amount of ground water flows through the saprolite and recharges streams in the Piedmont. Saprolite is easily eroded when covering vegetation and soil are removed. Extensive erosion of soil and saprolite caused by during the 1800s and early 1900s contributed a vast quantity of sediments into stream valleys, choking the streams and raising the base flow level. As conservation practices stabilized erosion, streams began to reestablish grade and to cut into the thick accumulations of sediments, remobilizing them into the major rivers and eventually into reservoirs (Savannah River Basin Management Plan, 2001).

#### *Watershed Description*

The Savannah River Basin is divided into 7 sub-basins or Hydrologic Unit Codes (HUC). Each sub-basin or HUC 8 is divided further into HUC 10s and HUC 12s. Brier Creek is located in HUC 8 #03060108 as shown in the map (Figure 1) and extends into parts of Glascock County, McDuffie County and Warren County, Georgia. The 3-mile impaired stream segment of Brier Creek (Whites Creek to Sweetwater Creek near Thomson - formerly Big Brier Creek to Sweetwater Creek) is located in HUC 10 #0306010801 and contained entirely within McDuffie County, Georgia (Figure 2).

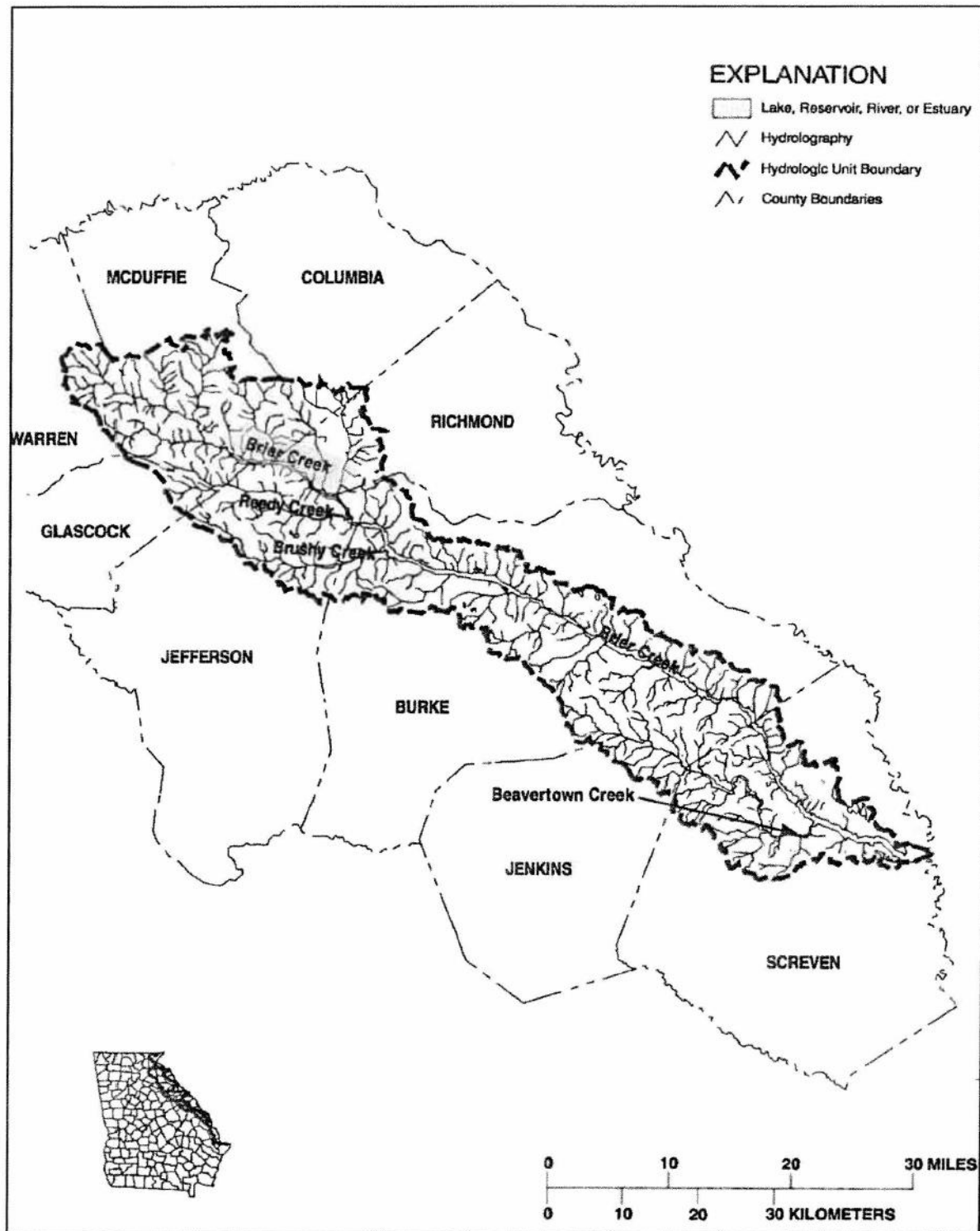
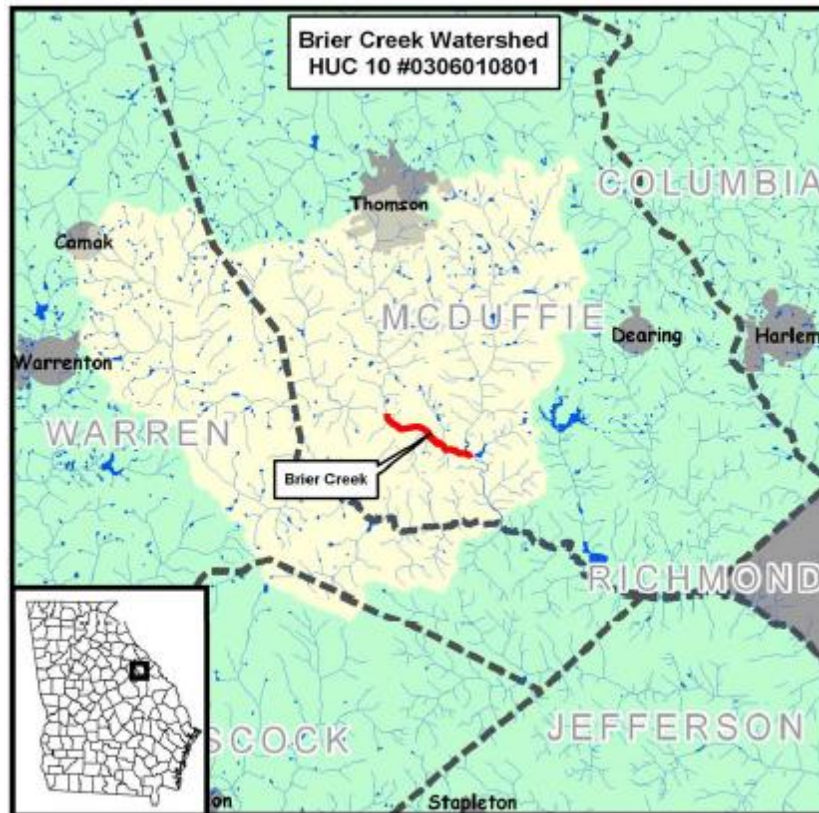


Figure 1. Brier Creek Watershed



**Figure 2. Impaired Reach of Brier Creek in McDuffie County**

Brier Creek itself is a riverine watercourse traversing much of eastern Georgia between the Ogeechee River and the Savannah River. It arises between Warrenton in Warren County and Thomson in McDuffie County in the lower portion of the Piedmont. The upper portion of the creek is surrounded by open pit kaolin mines as it passes through the fall line. This waterway has a length of approximately 80 miles (130 kilometers). In many places along the length of its course it is 30 to 50 feet (9 to 16 meters) in width. Near its mouth it is sometimes as broad as 80 feet (25 meters). In many ways it is more a river than a creek by the time it reaches the Savannah. The joining of Brier Creek with the Savannah River forms a significant geographic constraint upon movement in that area between the forks formed by the creek and river. The land surrounding the creek and river is often swampy, and movement across both waterways is greatly constrained.

The impaired stream segment of Brier Creek (Whites Creek to Sweetwater Creek near Thomson - formerly Big Brier Creek to Sweetwater Creek) is contained in McDuffie County. It is approximately three miles long from Sterling Gibson Road to Georgia Highway 17 south of the City of Thomson. The TMDL segment is listed as not supporting its designated use of fishing due to excess fecal coliform bacteria (Table 1). The data that put the segment on the 303(d) list were collected in 2002.

Table 1. GA EPD INTEGRATED 305(b)/303(d) LIST Streams – Not Supporting Designated Uses								
REACH NAME/ID #/DATA SOURCE	REACH LOCATION/ COUNTY	River Basin/ Use	Criterion Violated	Causes	Extent	Category	Priority	Notes
Brier Creek R030601080101 10	Whites Creek to Sweetwater Creek near Thomson (formerly Big Brier Creek to Sweetwater Creek)  McDuffie County	Savannah Fishing	Fecal Coliform	Non Point Sources	3 miles	4a		TMDL comple ted FC 2005
Source: EPD 2010 305(b)/303(d) List								

Date	Observed Fecal Coliform (counts/100 ml)	Estimated Instantaneous Flow On Sample Day (cfs)	Geometric Mean (counts/100 ml)	Mean Flow (cfs)	Geometric Mean Fecal Coliform Loading (counts/30 days)	Geometric Mean TMDL Fecal Coliform Loading (counts/30 days)
28-Feb-02	230	5.4				
4-Mar-02	1300	81.0				
14-Mar-02	490	26.0				
18-Mar-02	790	20.0	583	33.1	1.42E+13	2.43E+13
20-May-02	1300	20.0				
4-Jun-02	230	4.0				
10-Jun-02	490	2.3				
20-Jun-02	330	8.7	469	8.8	3.01E+12	1.28E+12
12-Aug-02	490	5.5				
19-Aug-02	1300	4.7				
26-Aug-02	70	19.0				
9-Sep-02	70	12.0	236	10.3	1.79E+12	1.51E+12
2-Dec-02	110	6.9				
3-Dec-02	50	11.0				
10-Dec-02	20	12.0				
17-Dec-02	330	31.0	78	15.2	8.67E+11	1.12E+13

The land use characteristics of the HUC 10 and impaired segment drainage areas are provided below in Tables 2 and 3. Information on the livestock (NRCS, 2003) and septic system characteristics of the counties is given in Tables 4 and 5. Livestock populations, particularly cattle, in all McDuffie county are estimated at 27.6 animals per square mile, which can be compared to the estimated deer density of 44 animals per square mile (GADNR, 2005). This is above the optimal 35 deer per square miles for herd management (GADNR, 2005) and the 15-20 deer per square mile that is considered optimal for the ecosystem (USFS, 2012). Therefore, the watershed has a relative high density of both livestock and wildlife, which could be contributing to decreased water quality if not managed carefully.

**Table 2. Land Use Summary for the HUC10 Watershed**

<b>Current Land Use in HUC10 # 0306010801</b>			
	<b>Current Land Use</b>	<b>Area in Feet</b>	<b>Acres</b>
<b>Glasscock County</b>	Unknown	42,038,023	965
<b>McDuffie County (including the City of Thomson)</b>	Agriculture/Forestry	1,658,030,321	38,063
	Commercial	11,888,446	273
	Industrial	12,555,935	288
	IM	5,783,214	133
	Public/Institutional	12,936,650	297
	Parks/Recreation/Conservation	3,509,528	81
	Residential	105,104,990	2,413
	RD	9,684,781	222
	ROAD	25,006	1
	Transportation/Communication/Utilities	1,040,689	24
	Undeveloped	2,921,487	67
	<b>Total:</b>	<b>1,865,519,069</b>	<b>42,826</b>
<b>Warren County</b>	Agriculture	359,892,255	8,262
	Commercial	1,362,984	31
	Forestry	719,494,660	16,517
	Industrial	54,627,678	1,254
	Public/Institutional	9,478,227	218
	Residential	25,395,496	583
	Transportation/Communication/Utilities	28,387,027	652
	<b>Total:</b>	<b>1,198,638,327</b>	<b>27,517</b>
<b>City of Camak</b>	Residential	2,051,597	47
	Commercial	67,993	2
	Industrial	206,086	5
	Public/Institutional	573,739	13
	Transportation/Communication/Utilities	1,671,709	38
	Forestry	7,417,184	170
	<b>Total:</b>	<b>11,988,310</b>	<b>275</b>
<b>Total Land Use for HUC 10 #0306010801:</b>		<b>3,118,183,729</b>	<b>71,584</b>
Source: CSRA Regional Development Center, 1994 and 2005			

**Table 3. Land Use Summary for Brier Creek**

<b>HUC12 Land Use for Brier Creek</b>		
	<b>Acres</b>	<b>Percentage</b>
Open Water	124	.3%
Residential	719	2%
High Intensity Commercial, Industrial, Transportation	350	1%
Bare Rock, Sand Clay	42	.1%
Quarries, Strip Mines, Gravel Pits	152	.4%
Transitional	1,583	4.4%
Forest	24,163	67.5%
Row Crops	7,450	20.8%
Pasture, Hay	632	1.8%
Other Grasses (Urban, recreational; e.g. parks, lawns)	54	.2%
Woody Wetlands	530	1.5%
Emergent Herbaceous Wetlands	3	0%
<b>Total</b>	<b>35,801</b>	<b>100%</b>
Source: TMDL for Fecal Coliform in Savannah River Basin		



**Table 4. Estimated Livestock Densities for the Counties in the Watershed**

Estimated Number of Livestock Animals by County									
County	Beef Cattle	Dairy Cattle	Goats	Horses	Hogs	Sheep	Chickens-Layers	Chickens-Broilers Sold	Chickens-Breeders
Glascock	4,000	-	500	55	150		-	-	-
McDuffie	4,850	650	600	800	100	200	-	-	-
Warren	8,260	1,450	1,950	2,200	1,050		-	-	-

Estimated Density of Livestock Animals by County (per sq mile)							
County	Beef Cattle	Dairy Cattle	Total Cattle	Goats	Horses	Hogs	Sheep
Glascock	28	0	28	3.5	0.4	1.0	0.0
McDuffie	19	3	21	2.3	3.1	0.4	0.8
Warren	29	5	34	6.9	7.7	3.7	0.0

**Table 5. Estimated Septic Systems for the Counties in the Watershed**

Septic Tanks, 1990-2002				
County	Existing Septic Systems (1990)	Existing Septic Systems (2002)	No. of Septic Systems Installed (1990 to 2002)	No. of Septic Systems Repaired (1990 to 2002)
McDuffie	4,664	6,962	2,298	191
Warren	1,395	1,825	430	72
Glascock	708	918	210	6

Estimated Density of Septic Systems (per sq mile)			
County	Existing in 1990	Existing in 2002	Repaired 1990-2002
McDuffie	18	27	0.7
Warren	5	6	0.3
Glascock	5	6	0.0



## Identification of Impairment Causes and Pollutant Sources

In order to meet recommended Georgia Water Quality Standards (Table 6), a 57% reduction in fecal coliform bacteria loadings has been recommended to restore the water body to supporting the beneficial use classification of fishing.

**Table 6: Georgia State Water Quality Standards**

Use Classification	Bacteria (fecal coliform)		Dissolved Oxygen (other than trout streams) <sup>1</sup>		pH	Temperature (other than trout streams) <sup>1</sup>	
	30-Day Geometric Mean <sup>2</sup> (no./100 ml)	Maximum (no./100ml)	Daily Average (mg/l)	Minimum (mg/l)	Std. Units	Maximum Rise (°F)	Maximum (°F)
Drinking Water requiring treatment	1,000 (Nov-April) 200 (May-Oct)	4,000 (Nov-April)	5.0	4.0	6.0-8.5	5	90
Recreation	200 (Freshwater) 100 (Coastal)	--	5.0	4.0	6.0-8.5	5	90
Coastal Fishing <sup>3</sup>							
Fishing	1,000 (Nov-April) 200 (May-Oct)	4,000 (Nov-April)	5.0	4.0	6.0-8.5	5	90
Wild River		No alteration of natural water quality					
Scenic River		No alteration of natural water quality					

<sup>1</sup>Standards for Trout Streams for dissolved oxygen are an average of 6.0 mg/l and a minimum of 5.0 mg/l. No temperature alteration is allowed in Primary Trout Streams and a temperature change of 2°F is allowed in Secondary Trout Streams.

<sup>2</sup>Geometric means should be "based on at least four samples collected from a given sampling site over a 30-day period at intervals not less than 24 hours." The geometric mean of a series of N terms is the Nth root of their product. Example: the geometric mean of 2 and 18 is the square root of 36.

<sup>3</sup>Standards are same as fishing with the exception of dissolved oxygen, which is site specific.

The 2005 Savannah River Basin TMDL determined that this watershed was predominantly rural with agriculture being the primary land use (Table 2). Data from 2008 shows that the watershed is still predominantly agricultural and most residential development is scattered. Average parcel size is greater than 20 acres and many parcels are comprised of hundreds of acres. Agricultural land use consists of livestock (horses and cattle), limited poultry, and pasture; however, the majority of the land is in timber.

The 2005 TMDL established for the stream segment indicates possible sources of fecal coliform contamination in Brier Creek are nonpoint sources due to, but not limited to, wildlife, agriculture, and urban development. Fecal coliform bacteria are an indicator organism used to track the presence of possible pathogens in water instead of analyzing the pathogens themselves. Indicator organisms, or coliforms such as fecal coliform or E. coli, are bacteria that occur along with pathogens in human and animal waste, but are easier to collect and count. The importance of wildlife as a source of fecal coliform bacteria in streams varies considerably, depending on the animal species present in the sub watersheds. Fecal coliform bacteria contributions from deer to water bodies are generally considered less significant than that of waterfowl, raccoons, and beavers. Feces deposited on the land surface can result in the introduction of fecal coliform to streams during rain events. It should be noted that between storm events considerable decomposition of the fecal matter might occur, resulting in a decrease in the associated fecal coliform numbers. This is especially true in the warm, humid environments typical of the southeast.

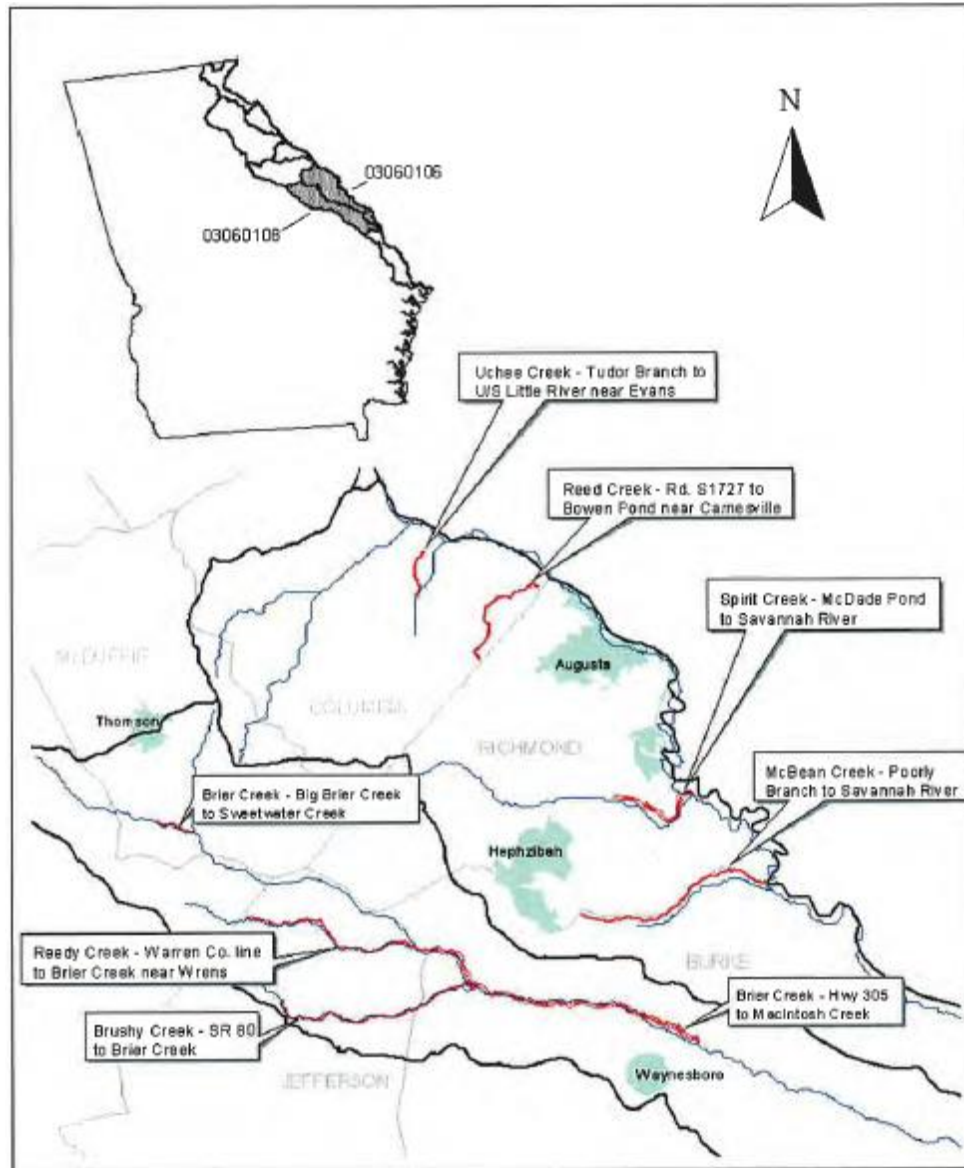
Agricultural livestock are also a potential source of fecal coliform to streams in the Savannah River Basin. The animals grazing on pastureland deposit their feces onto land surfaces, where it can be transported during storm events to nearby streams. Animal access to pastureland varies monthly, resulting in varying fecal coliform loading rates throughout the year. Beef cattle spend all of their time in pastures, while dairy cattle and hogs are periodically confined. In addition, agricultural livestock will often have direct access to streams that pass through their pastures and can impact water quality in a more direct manner (USDA, 2002). Brier Creek is surrounded by pastures where livestock graze and have access to streams.

A portion of the fecal coliform in the Savannah River Basin may also be attributed to failure of septic systems and illicit discharges of raw sewage. Table 5 gives estimates of the number of septic systems in each county of in the Brier Creek Watershed existing in 1990, based on U.S. 1990 Census Data, and the number existing in 2002, based on the Georgia Department of Human Resources, Division of Public Health data. In addition, an estimate of the number of septic systems installed and repaired during the twelve-year period from 1990 to 2002 is given. Since 1990, Georgia has seen a substantial increase in the number of septic systems in most of its counties. This is generally a reflection of population increases outpacing the expansion of sewage collection systems during this period. The table compares the number of septic tanks existing in 1990 to those existing in 2002, as well as the number of repairs between 1990 and 2002.

#### *Pollutant Source Assessment*

##### **Baseline Watershed Assessment**

The hydrology of this watershed is characterized by three data sources. The first is the Brier Creek USGS gage near Waynesboro, GA, near the middle of Burke County (Figure 3, 5). This gage is located downstream of the study region in Brier Creek (Figure 3) and measures a drainage area of 473 square miles. This 473 square miles include the 61 square miles of the study region. While the study area does not have its own USGS gage site, Brushy Creek (Figure 3, 5), another tributary of Brier Creek, does. This gage is the second data source that can be accessed to characterize the hydrology of Brier Creek watershed. Brushy Creek is also included in the Waynesboro gage drainage area, contributing approximately 22 square miles of the drainage area.

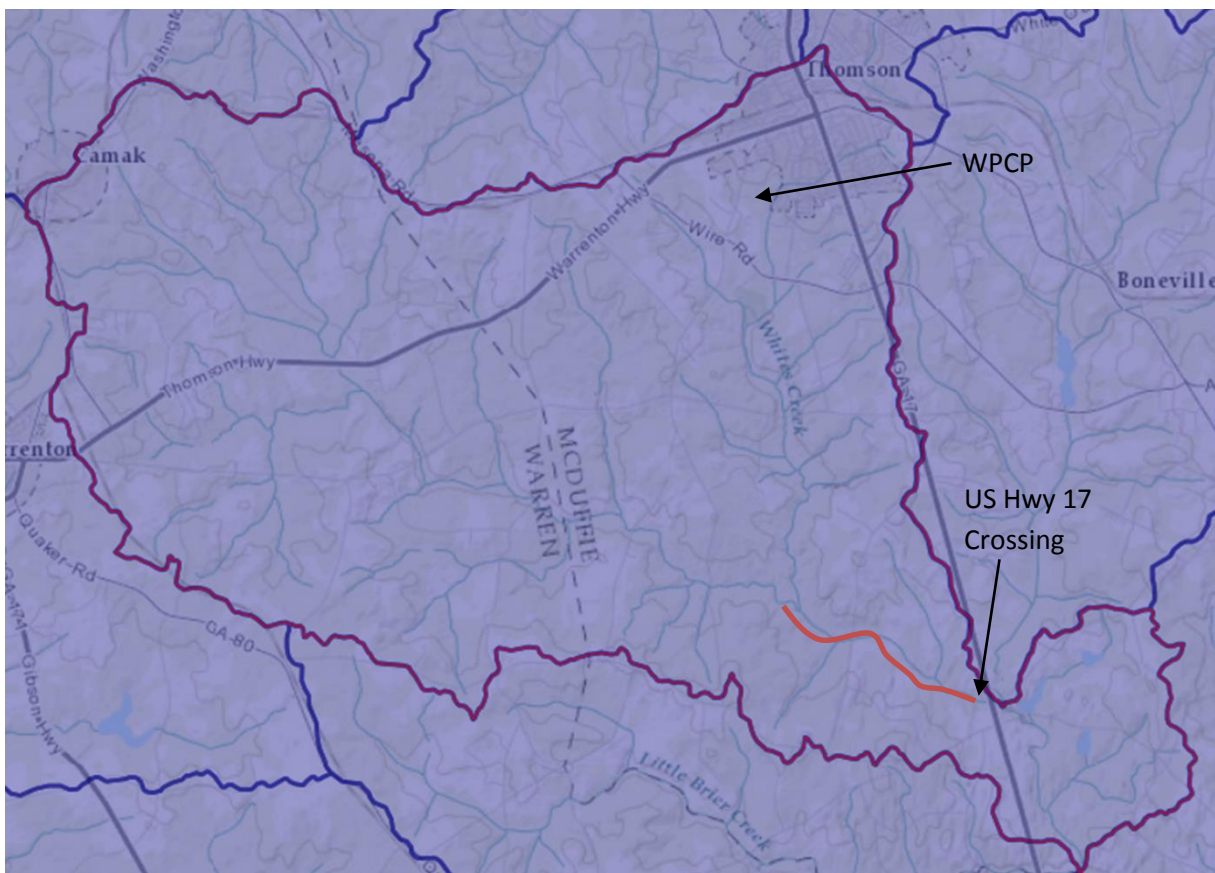


**Figure 3. Brier Creek Watershed**

The third data set to describe the hydrology of the pertinent drainage area is a 2004 study by Chasman and Associates (Chasman, 2004). In this study, the authors identified that the WPCP located in the upstream portions of White's Creek provides a significant portion of the flow in the channel that would otherwise not be present during dry weather conditions. Thus, according to Chasman, the presence of the WPCP likely creates the hydrologic conditions necessary for the designated use of fishing for at least a large portion of White's Creek, if not portions of Brier Creek as well (Figure 4). Observations by the authors confirm this based on tributaries of similar drainage area being dry, while the portion directly below the WPCP had flow. These tributaries are the branches of White's Creek directly east and west of the portion into which the WPCP drains. The Chasman study also indicated that during the time of the study, the

WPCP was responsible for almost 21% of the flow in Brier Creek at US Hwy 17, which is the downstream end of the impaired reach. However, the watershed upstream of the WPCP in White's Creek represents less than 4% of the drainage area to that point at US Hwy 17 on Brier Creek.

This hydrology indicates the disproportionate influence of White's Creek due to the volume of WPCP effluent over the portion of Brier Creek upstream from the confluence of White's Creek and Brier Creek. Therefore, even if the upstream reaches of Brier Creek had similar bacteria concentrations to White's Creek, White's creek would still be the major contributor since it is responsible for a large percentage of the flow but is a small percentage of the watershed.



**Figure 4. Watershed for the Impaired Reach of Brier Creek with impaired reach highlighted in red.**



## USGS 02197830 BRIER CREEK NEAR WAYNESBORO, GA

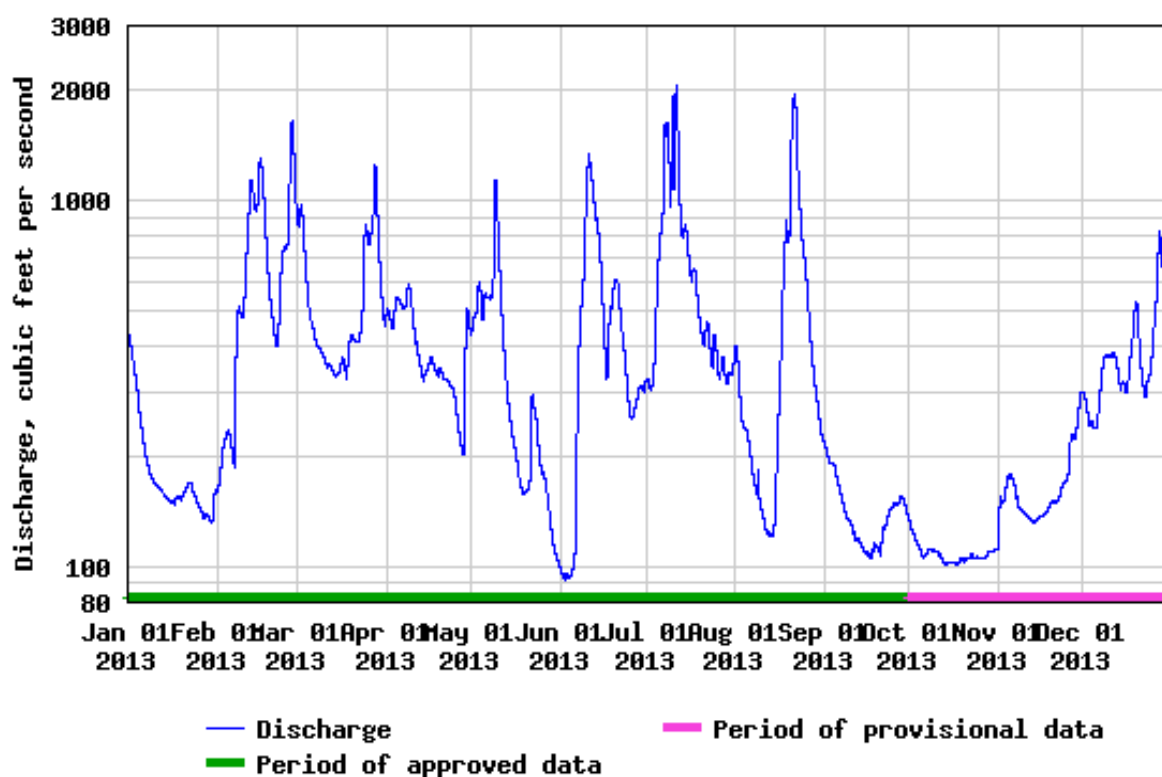


Figure 5. 2013 hydrology data from Brier Creek downstream of the study area

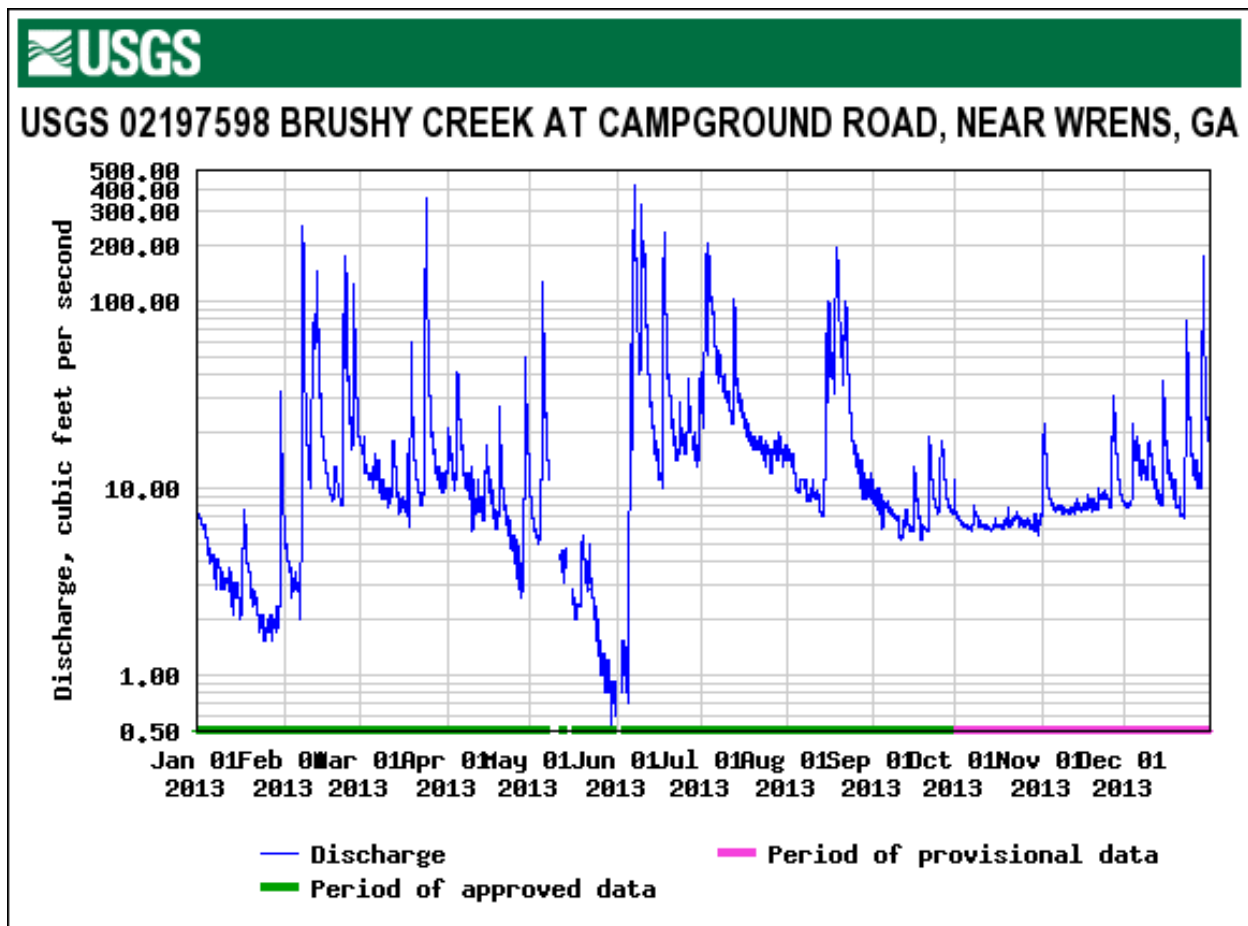


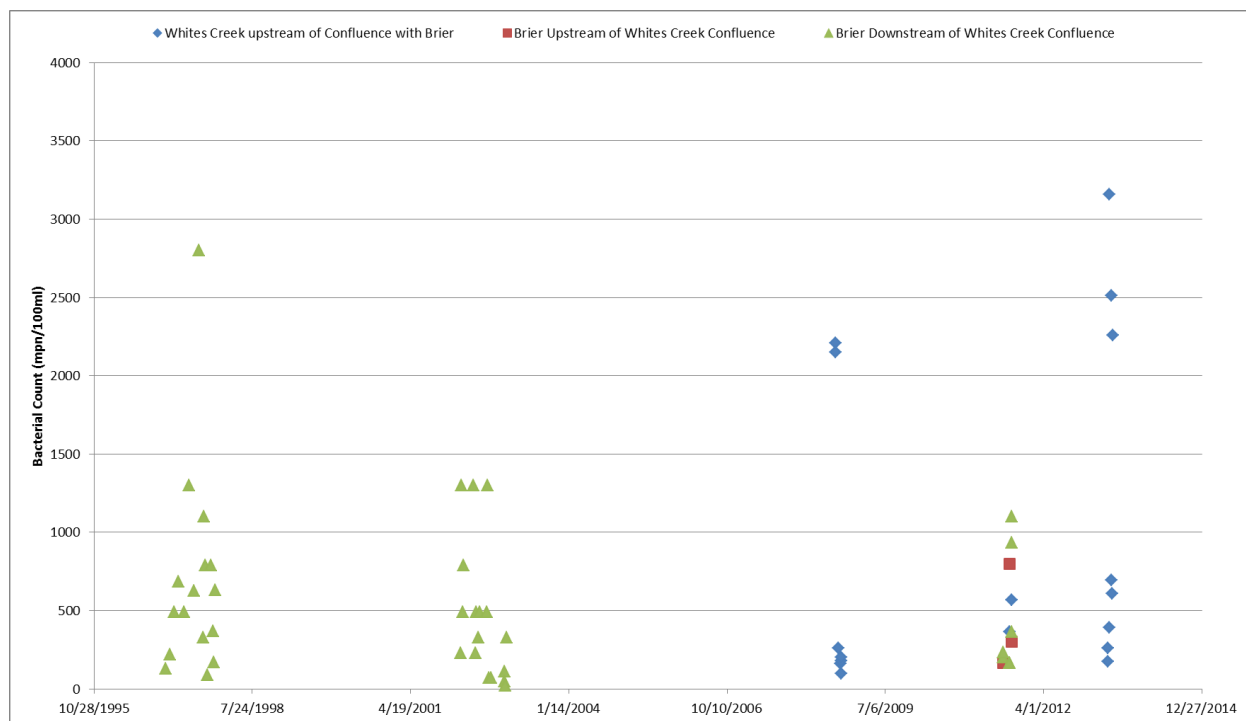
Figure 6. 2013 hydrology data from Brushy Creek, a nearby common tributary to Brier Creek

### Historic Bacteria Data

Hydrology is not the only reason to focus on White's Creek instead of upstream Brier Creek. Bacteria data also indicate its dominant influence. This is likely the reason why the Chasman study focused most of the data collection and analysis on the White's Creek watershed. As discussed below, in addition to the inordinately high flow, the bacteria concentrations in White's Creek are consistently higher than those upstream in Brier Creek.

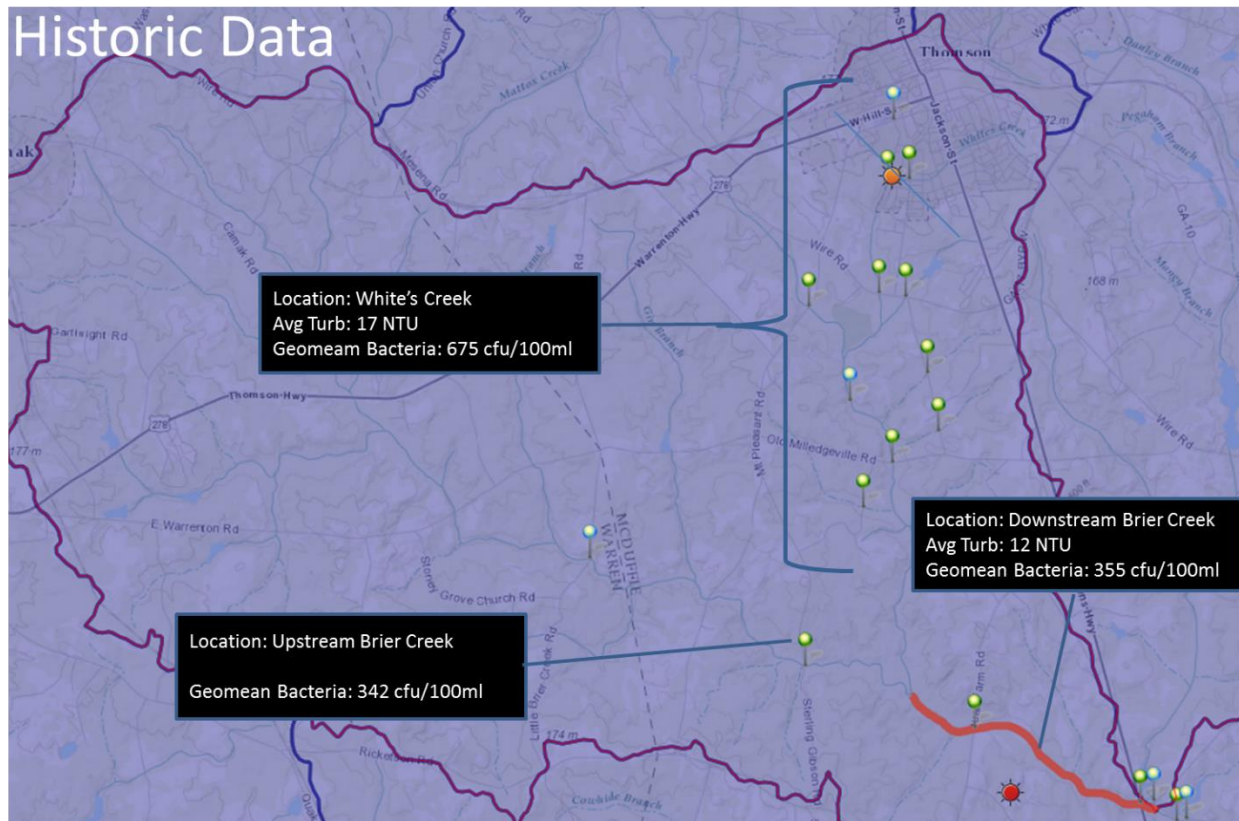
Past data on pathogen indicator bacteria (Fecal Coliform and E. Coli) in Brier Creek also comes from three sources: USGS monitoring (EPA Storet Archive, 2014), Adopt-A-Stream citizen monitoring (GA AAS Database, 2014), and a Nutter and Associates contracted study (Watershed Assessment for City of Thomson, 2010; Figure 7). The data from upstream of the confluence with White's Creek comes from the Adopt-A-Stream monitoring during July to September of 2011. The data from in-stream White's Creek comes from the Nutter and Associates study during August to October of 2008 and May to June of 2013 and the Adopt-A-Stream data during July to September of 2011. The data from below the confluence comes primarily from the USGS throughout the year during 1997 and 2002. All three data sets indicate a

potential to exceed regulatory criteria (Figure 7), while the values from the White's Creek confluence and below are notably higher than those in Brier Creek above the confluence. This further supports the focus of this study on the White's Creek watershed. It is also noteworthy that the data from White's Creek seem to group into higher and lower values (blue diamonds on Figure 7). However, there was no explanatory variable observed for this grouping. The historic data are also summarized graphically in figure 8.



**Figure 7. Prior Data on Fecal Coliform and/or E. coli in Brier Creek**

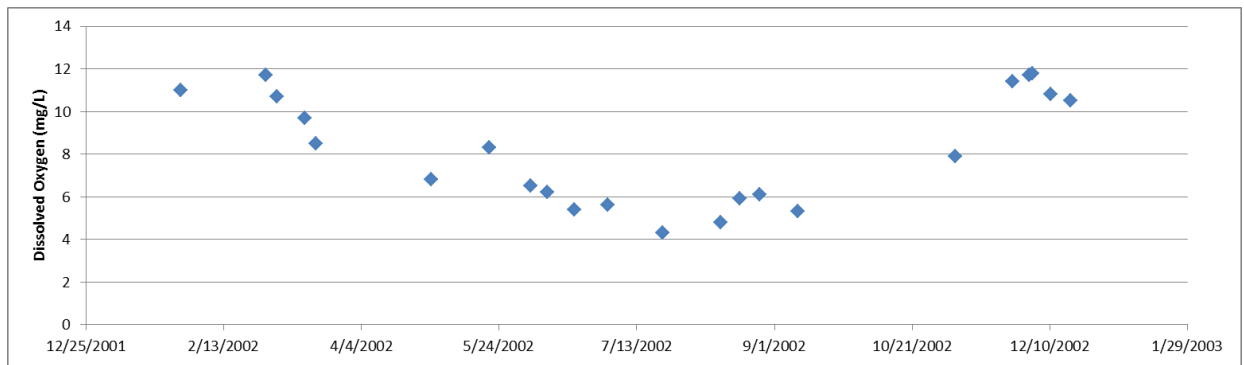




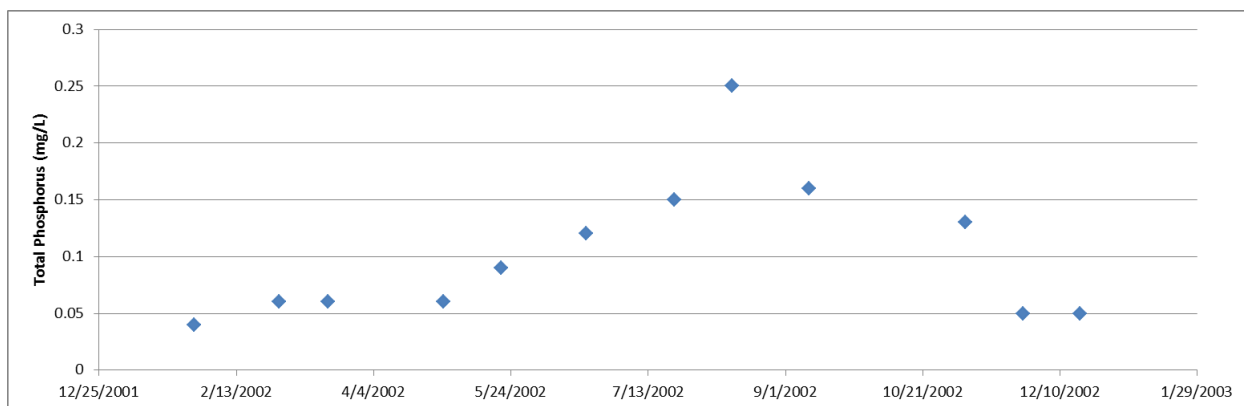
**Figure 8. Summary of Historic Data on Fecal Coliform and/or E. coli in Brier Creek**

## Supporting Water Quality Information

The Chasman study, which looked at stream chemistry, macroinvertebrate populations, and fish populations, seems to indicate that the WPCP is either neutral or of a slightly positive net benefit to the stream ecology. The same study did find periodic instances of toxicity from the WPCP, but the source proved very difficult to identify and no significant effects on stream ecology could be seen to coincide with the periodic instances of high toxicity. GAEPD data (Figures 9 and 10) from 2012, accessed through Storet, indicate dissolved oxygen levels very close to the regulatory limit during July and August. This is supported by relatively high total phosphorus concentrations during summer months, indicating a relationship to season that might be explained by seasonal release from in-stream stores or seasonal land application and runoff. Seasonal algal growth is a possible explanation. These seasonal trends weigh against wastewater as a source of nutrients or low DO. BOD levels are low and not otherwise noteworthy.



**Figure 9. Dissolved oxygen data from 2001-2003**



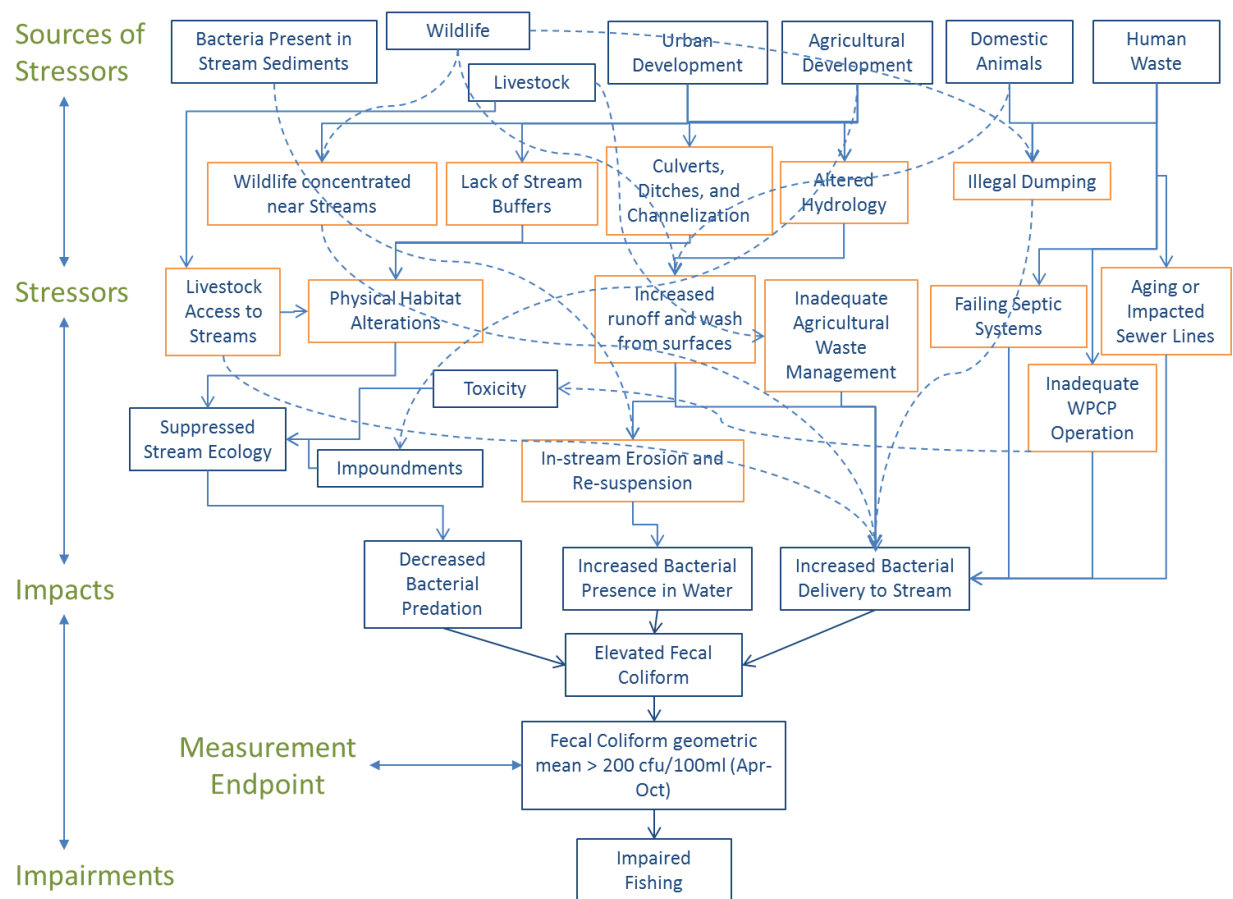
**Figure 10. Total phosphorus data from 2001-2003**

### *Quantify the Present Extent Needing Improvement*

The available historic data indicates that White's Creek supplies much more bacterial load to the impaired reach than the upstream portion of Brier Creek for the following reasons: 1) White's Creek supplies a disproportional amount of the water to the impaired reach; 2) there are higher indicator bacteria concentrations in White's Creek compared to upstream of the confluence in Brier Creek; and 3) there is not a noticeable increase in indicator bacteria concentrations in the impaired portion of Brier Creek above those observed in White's Creek.

Given the observed situation in this watershed, the following tool has been designed to look at possible stressor-impact-impairment scenarios. This watershed impact schematic (Figure 11), used along with the data, will allow stakeholders to evaluate the most likely scenarios that are causing the majority of impact to the water quality of the stream. In this schematic, a yellow outline is used to denote a link in the scenario chain where a BMP might be used to interrupt the chain and prevent pollutant loading. The

additional data collected during this report, presented below and included as Appendix C, will allow refinement of the options and a narrowing down of the most likely impact scenarios.



**Figure 11. Watershed impact schematic for White's Creek indicating possible scenarios for elevated bacterial concentrations in the impaired reach.**

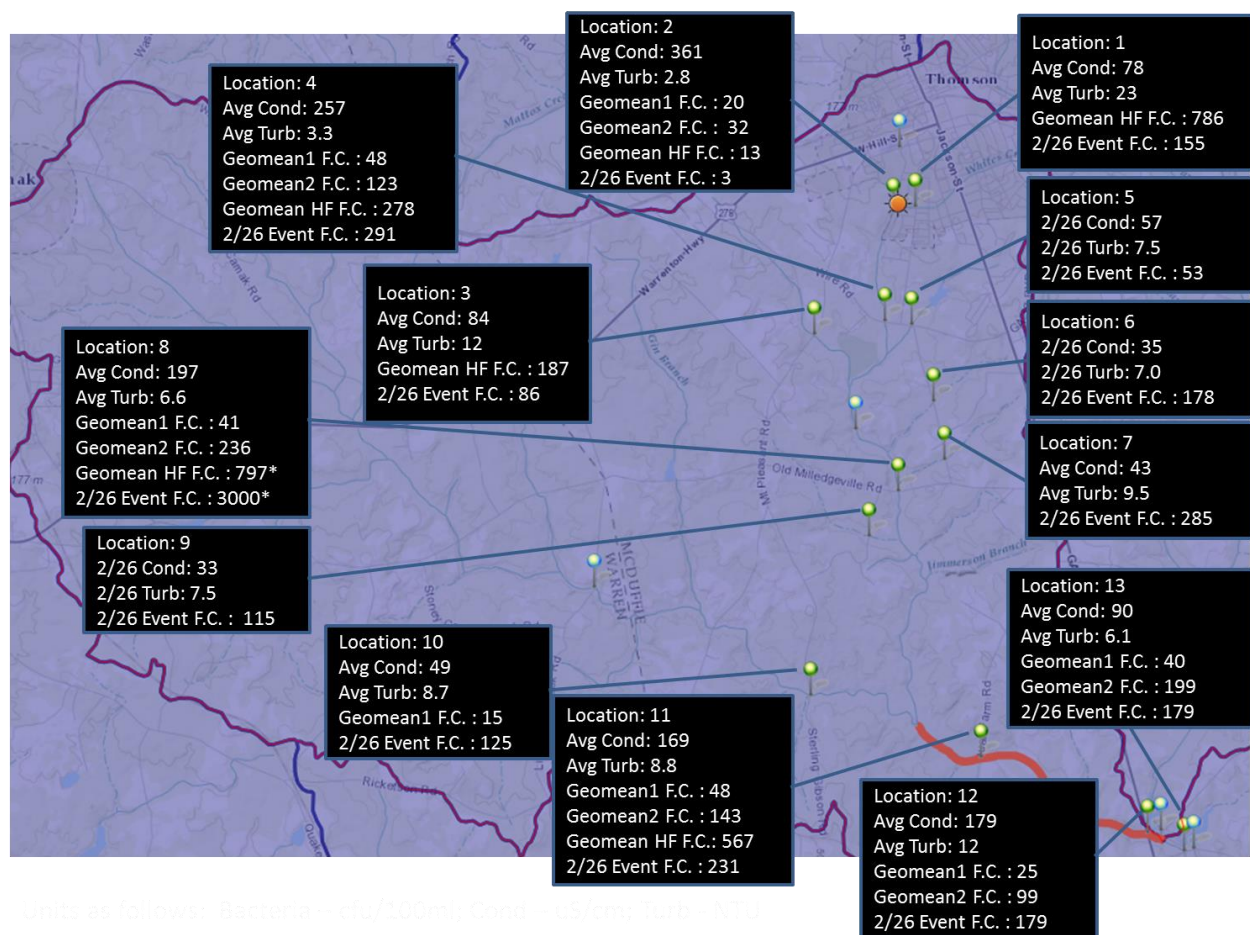
## Estimation of Load Reductions Expected from Management Measures

### *High Spatial Density Sampling (Tributary Level Sampling)*

In order to refine both the most probable sources of bacteria and the specific locations of entry into the water body, Phinizy Center undertook an additional data collection effort of high spatial density sampling to narrow down the locations where bacteria are entering the stream. Phinizy uses a sampling strategy that is data intensive, spatially dense, and sensitive to flow and travel time. This approach to sampling is described more fully in Appendix B. Phinizy Center and City of Thomson collected approximately 100 samples from 16 different sampling sites. Sites locations were chosen to separately identify contributions from the various branches of the streams. Data were collected over four months in a variety of flow conditions. Geomean1 and Geomean2 values represent summer and winter Geomean calculations based on four samples spread out over a 30-d period. Geomean HF (high flow) or Geomean LF (low flow) include at least three samples collected during separate sampling events unless otherwise noted. The Geomean 1 flows were all low flow conditions, while the Geomean 2 conditions included some higher flow conditions. All means given are geometric means, while event concentrations are single sample values. The results (Figures 12-13) provide the following information about the sources of bacteria in this watershed:

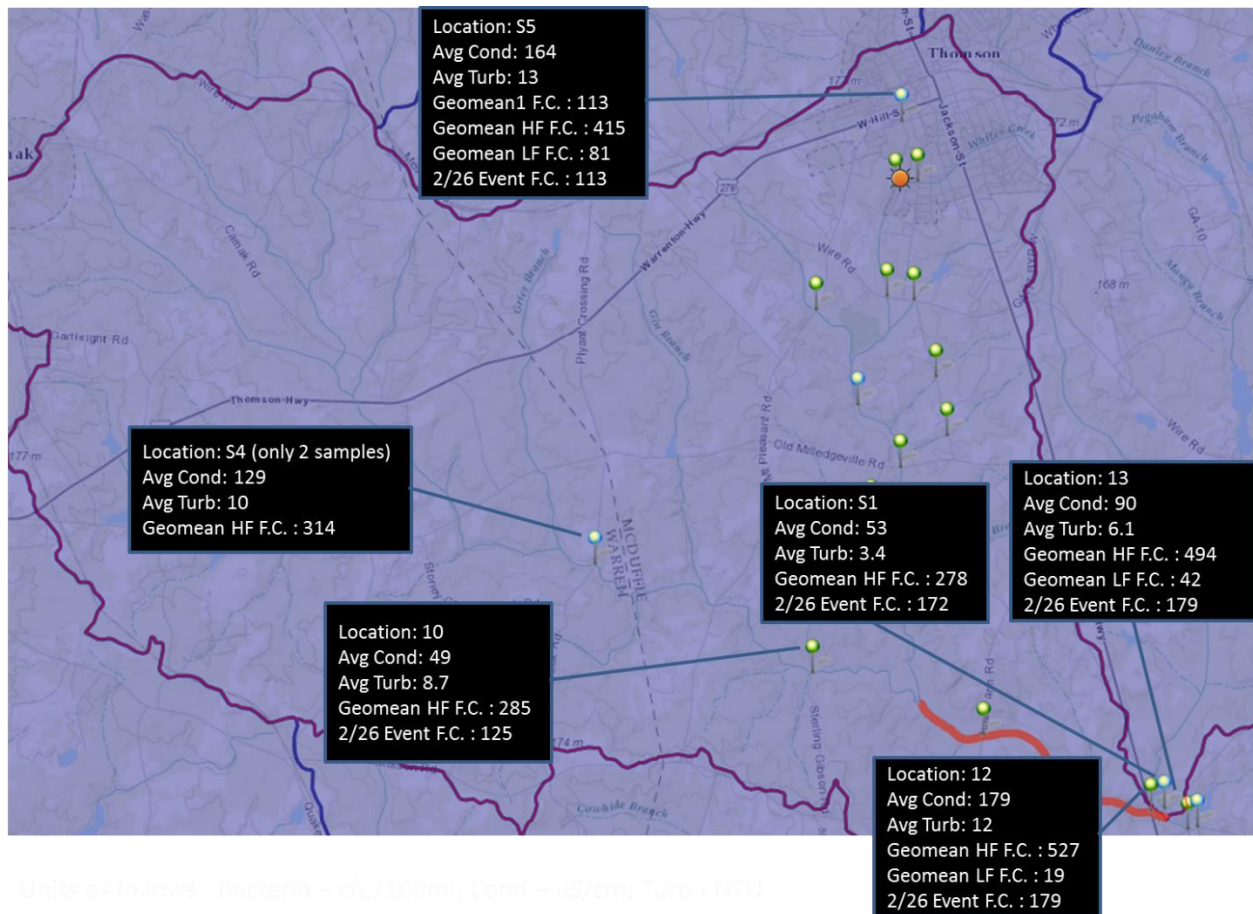
1. Geomean values indicate that for the impaired reach, and for many other locations in the watershed, the stream is likely meeting state standards, at least during lower flow conditions.
2. Due to the enhanced flow and Fecal Indicator Bacteria (FIB) concentrations being consistently higher in White's Creek at site 8 than in upstream Brier Creek at site 10, White's Creek can be considered the dominant source of FIB loading into the impaired reach of Brier Creek. Also, a comparison of the FIB concentrations at site 8 and sites 11 and 12 indicates that most of the loading found in the impaired reach is originating in White's Creek.
3. Data indicate that the tributaries entering the main channel of White's Creek below the City of Thomson are minor contributors of FIB to the stream.
4. Data from sites S5 and 1 indicate that FIB concentrations from the urban area of Thomson are high during high flow periods. However, they are a minor contributor to overall bacterial load due to low flow. There may be some opportunity for BMP implementation in the city to reduce these high flow FIB concentrations from city runoff, but they are a minor impact on the impairment in Brier Creek.
5. WPCP effluent is not a problem and the large quantity of low FIB concentration water coming from the WPCP is likely attenuating the concentrations, even during high flow events.
6. The area where most of the increase in FIB concentrations was observed is between sites 2 and 8 on the mainstem of White's Creek. Below site 8 the concentrations tend to level out or decrease on average. This means that the majority of the source of the impaired portion of Brier Creek appears to be limited to about 3 miles of White's Creek and the adjoining land areas, where sites 2-4 comprise 1 mile and sites 4-8 represent 2 miles. Considering land use within 0.5 miles on both sides of the stream to be most pertinent, there are just 3 square miles of area to consider out of a 60 square-mile contributing area. Furthermore, under most conditions, the majority of this increase is between sites 4 and 8, further reducing the target area.
7. Comparing the high flow FIB concentrations at site 12 (end of the impaired reach) with site S1 (Sweetwater Creek entering Brier Creek below the impaired reach) indicates that the FIB concentrations are similar or slightly lower on average for Sweetwater Creek.

8. Comparison of sites S4 and 10 indicate that at least during higher flows the FIB load that was observed at site 10 is probably coming mostly from Warren County, and not from Gin Branch in McDuffie County.
9. Low turbidity values, even during high flows, indicate that subsurface flow or direct additions instead of surface runoff might be more responsible for high concentrations.
10. Also, during the monitoring activities, Phinzy observed several instances of animal carcass disposal in the stream. These carcasses included a dog and several deer and/or deer gut piles. There was some indication that these disposal areas were elevating FIB concentrations, but the effect was difficult to isolate. Regardless, it is safe to say that dumping the intestines of warm blooded animals directly into the stream is a problem, and steps need to be identified to curtail this practice. The areas where this was observed included site 8, site 10, and site 11. These were all bridge crossings, making it likely the disposal occurred from a vehicle. While the dog could potentially have been injured by a passing car and traveled to the stream, the deer and gut piles were almost certainly disposed of intentionally by hunters. BMP chosen to address this watershed should probably address this issue.



**Figure 12. Main Data from High Density Sampling in Whites and Brier Creek**





**Figure 13. Additional Supplementary Data from High Density Sampling in Whites and Brier Creek**

### *Estimating Load Reductions*

Based on the assessment above, the most likely location of bacteria entry above the impaired reach is between sites 2 and 8 on the main channel of White's Creek. This is below the WPCP down to Old Milledgeville Road. Based on the two geometric means, and a mean of the samples taken during high flow periods, the added load between sites 2 and 4 results in increases in geomean concentrations between 28 and 265 mg/L, with higher flows generally resulting in higher numbers. The added load between sites 4 and 8 results in increases in geomean concentrations between 0 and 519 mg/L. While there are few flow measurements to accompany this data, there are some approximations that could be used to help estimate the bacterial load. For instance, the WPCP released an average of 1.9 cfs during these measurements. Also, the Chasman study included data for the US 17 crossing (site 12) with flows of 5.1 cfs to 11 cfs between December, 1997 and August, 1998 (average of 8 cfs), or 4.0 cfs to 9.9 cfs without the WPCP effluent. Thus, the average flow from the watershed would be 7 cfs. Flow conditions at the various sites can then be estimated by using this average flow, the percentage of the overall watershed for each site, and an assumption of equally

distributed rainfall. These areas and the associated average flows are listed in Table 7. **Note that the load based on the state standard of 200 cfu/100ml at 8 cfs would be 40 billion cfu/d.** If the range of flows is applied to the state standard the values would be 25 billion cfu/d at lower flows and 55 cfu/d at higher flows. The same technique can give estimates for the contributions of White's and upstream Brier Creek to the impaired reach. Table 7 shows that the upstream portion of Brier contributes more flow than White's Creek because these estimates are inclusive of higher flows. At baseflow White's Creek contributes more flow than upstream Brier, and even in this inclusive estimate, White's Creek contributes a disproportionate amount compared to its drainage area.

Table 8 provides the contributions for the critical areas between sites 2 and 8. Notice the combined loading of up to 56 billion cfu/d, a value over the state standard for the entire watershed, in just this three-mile reach. An estimated 77% load reduction from BMP in the critical reach is necessary to enable the 57% reduction across the watershed as specified in the TMDL. With this 77% load reduction, we may expect a range of fecal bacteria concentrations in the impaired reach of 8.4-73 billion cfu/d. Much of this range would fall below the state standard. These data indicated that if it is necessary to reduce stream concentrations of fecal bacteria to below state standards over the entire range of flow conditions, reductions must be above the 57% predicted in the TMDL, and will probably also need to include upstream Brier Creek at some level.

**Table 7. Estimated Flows and Bacterial Loading for Various Portions of the Watershed**

Site	Percent of Watershed	Estimated Average Flow without WPCP	Average Flow from WPCP	Estimated Average Flow with WPCP	Estimated Range of Fecal Coliform Load (in billion cfu/d)
2	4%	0.3 cfs	1.9 cfs	2.2 cfs	1.1-1.7
4	6.5%	0.5 cfs	1.9 cfs	2.4 cfs	2.8-17
8	15.6%	1.1 cfs	1.9 cfs	3.0 cfs	3.0-58
All White's Creek	26%	1.8 cfs	1.9 cfs	3.7 cfs	8.1-84
All Upstream Brier Creek	65.6%	4.7 cfs	0.0 cfs	4.7 cfs	1.7-33

**Table 8. Estimated Load Contributions for Critical Reaches of the Watershed**

Reach Between Sampling Sites	Estimated Load Contribution (in billion cfu/d)	BMP Effectiveness (percent reduction)	Estimated Load Reduction (in billion cfu/d)
2-4	1.7-15	77%	1.3-12
4-8	0.2-41	77%	0.1-32



## Appropriate NPS Management Measures and the Critical Areas where BMPs Need to be Implemented

### *Survey of Critical Area by Remote Imagery*

Survey was conducted of the critical area between sites 2 and 8 as identified by the fecal bacteria data. Remote imagery, municipal land records, and driving survey were used to inform an understanding of the possible best management practices that would have the most benefit to reducing fecal bacteria load to the stream. This identification process was also informed by the watershed impact schematic prepared for this watershed. Potential sources are organized in Table 9 by land use on the creek frontage in the critical area.

**Table 9. Land Use and Creek Frontage Area for the Critical Area**

Land Use Designation	Creek Frontage (ft)	% of Total Frontage
Agriculture-Forestry	13,000	48%
Undeveloped	4,600	17%
Agriculture-Livestock	2,700	10%
Rural Residential	2,200	8%
Golf Course	2,000	7%
High Density Residential	1,400	5%
Agriculture-Row Crop	1,400	5%

**Forested and Undeveloped Land - Wildlife** - Fecal bacteria sources identified for these properties would include wildlife concentrated near streams as there is known to be a high density in this area and also improper animal carcass disposal practices related to hunting. However, the animal carcass disposal issue may be more closely related to stream crossings on roads than the actual hunting areas. Wildlife are not considered to be a major contributor to the elevated concentrations in this critical area since there are similar habitats in the rest of the watershed and wildlife contributions should be relatively homogenous at this scale with similar habitat.

**Agriculture - Livestock Waste Management** - Survey of the critical area by remote imagery identified between 5-7 livestock operations in close proximity to the stream. One of these was between sites 2 and 4, while the remainder were between sites 4 and 8. While it is difficult to determine with much certainty from remote imagery, it is possible that these operations lack stream buffer and/or waste management systems. In at least one instance there appears to be ditches or other channels that could drain directly from feeding areas to the stream. Overall, the survey suggests that there is a good chance that livestock could be a significant source of fecal bacteria loading to the stream.

**Rural Residential & Golf Course - Septic Systems** - Survey of the critical area by land records identified four locations with septic systems representing 4-7 individual systems that could be impacting the stream. One of these systems is between sites 2 and 4, while the remainder are between sites 4 and 8. Predicted failure rates of septic systems vary by the study. An Ohio study predicted an overall average failure rate of 31% (Ohio Department of Health, 2013). A Purdue University publication (2005) reports a 25% failure rate. In either case, these percentages indicate that at least one of the identified systems in the White's Creek watershed is likely failing and could be a source of fecal bacteria to the stream. In

addition to the onsite septic system, the golf course could also be contributing fecal bacteria through wildlife concentrated near water on the property.

**High Density Residential and Row Crops** - These land uses probably have less risk of fecal bacteria sourcing in this case and survey does not reveal any reason to focus on them for BMP.

### Best Management Practice Selection

In Figure 14, portions of the watershed impact schematic have been highlighted to denote the areas identified through survey where BMP are needed to address fecal bacteria loading to streams. Table 9 was also used with the available data to select the best alternatives for this watershed. Tables 10 and 11 provide a catalog of possible BMP choices, along with criteria designed to aid in their selection and measure their effectiveness if chosen.

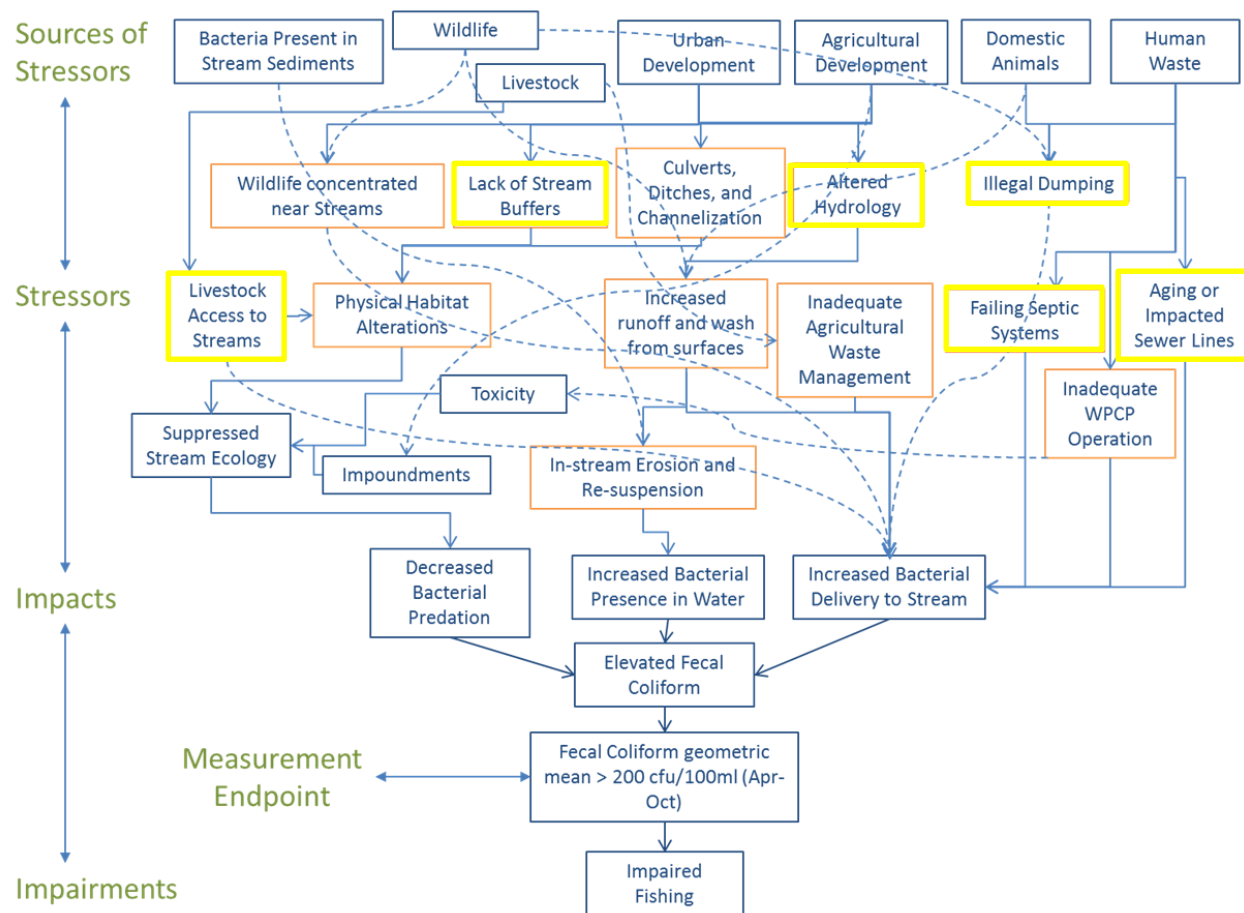


Figure 14. Watershed Impact Schematic with critical pathways highlighted.

**Table 10: Structural BMP options**

		Criteria for Estimating Effectiveness	Metric for Monitoring BMP
Best Management Practice	Measurement		
1. Cattle Exclusion from Streams and/or Ponds			
	a. current bacteria concentrations in ponds with cattle access	x	
	b. current bacteria concentrations in stream below these areas	x	
	c. before and after monitoring of pond bacteria concentrations		x
	d. before and after assessment of riparian zone conditions		x
2. Alternative Water Sources for Cattle			
	a. hotspots identified in high spatial density monitoring	x	
	b. review of current practices	x	
	c. before and after monitoring downstream		x
	d. monitoring of stream above and below BMP		x
3. Livestock Waste Management Systems			
	a. presence of livestock in close proximity to critical stream areas	x	
	b. current bacteria concentrations in stream below these areas	x	
	c. before and after monitoring of pond bacteria concentrations		x
	d. before and after assessment of riparian zone conditions		x
4. Wetlands, Basins, Buffer Strips, etc.			
	a. current conditions in the stream	x	
	b. inability to prevent contamination upstream	x	
	c. documented performance and applicability of the systems	x	
	d. before and after monitoring of stream below BMP		x
	e. monitoring of stream above and below BMP		x
5. Pasture Soil/Vegetation Restoration for Erosion Reduction			
	a. current TSS/turbidity concentrations	x	
	b. documented or measured sediment bacteria concentrations	x	
	c. TSS/Turbidity measurements in stream before and after		x
6. Renovations to WPCP			
	a. current effluent concentrations	x	
	b. documented performance of potential upgrades	x	
	c. effluent monitoring		x
	d. before and after monitoring above and below outfall		x
7. Septic Tank Repair/Replacement			
	a. number of systems in the target area	x	
	b. documentation on likely number failing	x	
	c. proximity of systems to stream and soil classifications	x	
	d. before and after monitoring of stream below repairs		x
8. Sanitary Sewer Line Repair/Replacement			
	a. frequency of currently reported SSOs	x	
	b. visual survey of stream	x	
	c. Locations of any hotspots in high spatial density monitoring	x	
	d. before and after monitoring of stream below repairs		x
	e. receiving volume comparison at WPCP		x
9. Sanitary Sewer Line Extension Projects			
	a. cost/benefit analysis of septic program versus sewer extension	x	
	b. potential magnitude of septic contributions	x	
	c. before and after monitoring of stream below project		x
10. Animal Carcass Disposal Program and Composting Facilities			
	a. Prevalence of improper disposal practices	x	
	b. potential magnitude of load contributions	x	
	c. Monitoring for decrease in improper animal carcass disposal		x

**Table 11: Non-structural BMP options**

		Criteria for Estimating Effectiveness	Metric for Monitoring BMP Performance
Best Management Practice	Measurement		
1. Fat, Oil, and Grease Program			
	a. review of current policies and practices	x	
	b. incidence and location of reported SSOs	x	
	c. reported incidence of SSO events before and after		x
2. Septic System Inventory			
	a. number of systems in the target area	x	
	b. documentation on likely number failing	x	
	c. proximity of systems to stream and soil classifications	x	
	d. before and after monitoring downstream		x
	e. number of systems pumped		x
3. Septic System Educational Program			
	a. number of systems in the target area	x	
	b. documentation on likely number failing	x	
	c. proximity of systems to stream and soil classifications	x	
	d. documentation of effectiveness of educational messaging	x	
	e. before and after monitoring downstream		x
	f. increase in calls for septic system businesses		x
4. Pet Waste Educational Program			
	a. estimate of households with pets	x	
	b. review of current practices	x	
	c. documentation of effectiveness of educational messaging	x	
	d. before and after monitoring downstream		x
5. Livestock Management Educational Program			
	a. estimate of households with livestock	x	
	b. review of current practices	x	
	c. documentation of effectiveness of educational messaging	x	
	d. before and after monitoring downstream		x
6. Local Adopt-A-Stream Chapter (looking for failing systems, monitoring for problem areas, educating others, raising awareness)			
	a. documentation on effectiveness in other communities	x	
	b. local attitudes toward starting a chapter	x	
	c. before and after monitoring downstream		x
	d. number of issues identified		x
	e. amount of monitoring done		x
7. Consider Local Ordinances to Regulate Problem Practices			
	a. estimate of the magnitude of the contribution to impairment for the issue to be regulated	x	
	b. estimate of the inability of other bmp to be effective in handling the issue	x	
	c. documentation of the effectiveness in other communities	x	
	d. before and after monitoring downstream		x
	e. number of citations issued		x
8. Carcass Disposal Education Program			
	a. Prevalence of improper disposal practices	x	
	b. potential magnitude of load contributions	x	
	c. Monitoring for decrease in improper animal carcass disposal		x
9. Overgrazing Prevention for Erosion Reduction			
	a. current TSS/turbidity concentrations	x	
	b. documented or measured sediment bacteria concentrations	x	
	c. TSS/Turbidity measurements in stream before and after		x

## **Selected BMP**

The BMP in Tables 10 and 11 were evaluated and prioritized based on the following:

1. effectiveness criteria listed in Tables 10 and 11 to the extent it was available,
2. results of land records and remote imaging survey,
3. potential impact based on the percent of creek frontage, and
4. cost of BMP and availability of funding.

The process for evaluating each BMP began with looking at the effectiveness criteria and their valuations with the data available. BMP that could be beneficial were included. Next, this list was passed through the survey information to eliminate those BMP with minimal applicability and prioritize those with most applicability. Finally, the BMP priorities were further refined by the frontage to which they would apply, the cost, and the availability of funding.

Based on these criteria the following BMP are recommended for this watershed in order of priority:

1. septic tank inventory, along with repair or replacement if necessary,
2. livestock exclusion from streams and ponds that flow to the stream,
3. adequate vegetated buffer strips between critical source areas (golf course, pasture land, septic drain fields) and the stream (including small tributaries),
4. animal carcass disposal facility and program, including education,
5. pasture restoration and overgrazing prevention educational program, and
6. stormwater constructed wetlands for critical areas.

## **Description of BMP**

Septic tank inventory will start with the County Health Department assessing the age and condition of the systems in question. Homeowners may be contacted regarding this assessment. Once the condition has been determined there will be discussion of whether the problems can be required to be fixed by the homeowner, or whether the city/county will offer some assistance, likely through a grant, to correct any problems, or update systems that are very old or possibly installed improperly.

Livestock exclusion such as that historically implemented in Georgia through the EQIP program has traditionally meant fencing livestock out of perennial streams and providing alternative water sources. This type of BMP has been considered somewhat inaccessible to smaller operations due to the expense of fencing. However, some studies have indicated that simply providing alternative water sources and comfort stations can significantly reduce the use of the stream by cattle (Zeckoski et al., 2012). In addition, ephemeral stream beds or ponds that drain to the stream during rain events may not be included in fence-out programs. The use of livestock exclusion in this watershed management plan is meant to consider these solutions as well. If ponds are found with cattle access that have very high concentrations, fencing or alternative water sources might be considered even if livestock do not currently have access to the stream itself. Also, implementation of alternative water sources and/or comfort stations without fencing may be considered as a more economical option for some landowners.

Vegetated buffer strips are a well-studied and highly-used BMP for managing the quality of surface runoff. Where surface runoff is considered to be a significant source of pollution to streams, placing vegetated buffers between the stream and the source can create a way to prevent pollution from reaching the stream. In this case, we are considering implementing wide, 200-ft buffers adjacent to the stream and any tributaries to reduce the impact of bacteria in surface runoff to the stream. Implementation should

be prioritized in areas within the critical area, where known sources are located, and where current stream bank conditions are not adequately vegetated. In addition to improving the quality of surface runoff, improved soil conditions may also reduce bacteria in subsurface flow by improving the ecology of the soil environment. Riparian improvements may also be a general benefit to stream ecology that may result in reduced bacteria concentrations instream. This is based on the idea that bacteria will be more likely to thrive in an ecologically diminished conditions without natural streambank vegetation where there is less competition for resources. Continuing in this idea, this BMP might also include enhancements to instream ecology directly as a means of increasing competition for resources and decreasing bacteria concentrations. These enhancements might resemble some done in stream restoration activities.

In addition to educating the public of the dangers of disposing of animal carcasses in streams and offering better solutions for private disposal, the animal carcass disposal facility and program would provide a way for hunters or others in possession of an animal carcass to drop off that carcass at an approved location where it can be disposed of properly. This program might be modeled after several successful and related projects such as that described in a Virginia Transportation Research Council Report (2010). Such a program would also serve the community to provide a more cost-effective way to manage animals killed by vehicles on local roads and likely an overall benefit to public health.

Since bacteria will often associate with soil particles, erosion of sediment from fields can often be tied to other pollutants, including pathogens. Healthy pastures in terms of soil and grass along with rotational grazing should reduce the amount of bacteria reaching streams from livestock feces. Where pastures are in poor condition or are being overgrazed, resulting in erosion, the proposal is to discuss measures with landowners to improve the quality of pasture and implement rotational grazing to the extent possible. While there is little literature available to directly support the reduction of fecal coliform from this management scenario, a study by the Minnesota Land Stewardship Project (LSP, 2001) found that using a year-round cover scenario (including rotational grazing) reduced sediment transport to nearby streams by 49% over intensive row-cropping. Since bacteria associate with soil particles, this might be a reasonable estimate of reduction in fecal bacteria.

Constructed wetlands have proved to be a highly effective means of reducing a wide variety of pollutants in water, including pathogens. In a case where an even smaller particular area can be identified within the currently identified critical area as a dominant source, and it is not possible to eliminate the source, constructed wetlands could be a good way to reduce the level of the bacteria before it reaches the stream. This can be a much more expensive option, but a variety of constructed wetland designs are available, and depending on the situation the cost could be reduced below those typically cited.

### **Estimated reductions from selected BMP**

The BMP are meant to address the following three sources of bacteria: livestock waste in runoff, failing septic systems, and improper animal carcass disposal. It is also understood that there are other natural background sources including wildlife that make up a portion of the load added between sites 2 and 8. Based on the data available we estimate that these sources (livestock, septic, animal carcass disposal, and natural background) are responsible for approximately 35%, 35%, 10%, and 20%, respectively, of the bacterial load added in this reach. This estimate is based on the overall number of sites pertinent to each source category, the stream frontage represented by each, and the likelihood of impact from each source. Natural background is assumed to represent 150 cfu/100ml, or 75% of the state standard. Livestock has been reduced in likelihood compared to the frontage it represents based on the

low turbidity values indicating minimal erosion from the land surface. These numbers represent a rough estimate and might be revised in the future as additional data provides more clarity.

Repair and/or replacement of failing septic systems are likely to provide 99% reduction in the bacterial load from these sources. BMP intended to reduce livestock runoff might reduce the bacterial load anywhere from 60% for livestock exclusion, 49% less for pasture restoration and overgrazing education to 75% for buffer strips (Coyne et al., 1998). Constructed wetlands, have also been used for agricultural waste with reported efficiencies of between 70% and 99% (Hathaway and Hunt, 2008; Smith et al., 2005). Of note, cattle exclusion may not necessitate fencing. Studies have shown that providing alternative water sources and comfort areas for livestock can greatly reduce usage of streams for drinking or comfort (Osmond et al., 2007; Zeckoski et al., 2012). Results from implementing several of the BMP for this source should be additive as they address different levels of the pathway to contamination including filtration of bacteria before it enters the stream, reduction in erosion and transport of bacteria associated with soil particles, and reduction in the amount of bacteria deposited to the soil. Full implementation of 2-3 of these BMP would likely result in at least 80-85% reduction in bacterial load.

BMP intended to reduce bacteria from improperly disposed animal carcasses would likely result in 99% reduction to the extent that the facilities are universally utilized for disposal. However, since some of those who dispose improperly will likely continue to do so, reductions in practice will probably not reach that level. A survey of Augusta, GA residents related to pet waste disposal indicated that about a third did not pick up pet waste at all, even though most have heard that it is recommended. Therefore, perhaps half to a third of those involved in inappropriate disposal of carcasses would be convinced to use the disposal facility. In this case we might expect a 40% reduction in this source. In summary, Table 12 provides the expected reduction from the selected BMP.

**Table 12. Selected BMP Reductions in Fecal Sources**

<b>BMP</b>	<b>Percent Reduction from Target Source</b>	<b>Source as Percent of Total Load</b>	<b>Percent Reduction in Stream</b>
Septic Repair and Replace	99%	35%	35%
Animal Carcass Disposal Program and Facility	40%	10%	4%
Pasture Restoration and Overgrazing Reduction	49%	35%	17%
Livestock Exclusion	60%	35%	21%
Vegetated Buffer Strips	75%	35%	45%
Stormwater Constructed Wetlands	85%	35%	26%



## Estimated Amounts of Technical and Financial Assistance, Associated Costs, and Identification of Sources / Authorities Committed to Implement the Plan

### *Responsible Parties*

The responsible parties regarding the implementation of this watershed management plan include the combined McDuffie County-City of Thomson government, GAEPD, the McDuffie County Health Department, and a representative of the Georgia Cooperative Extension and the USDA NRCS program. The entire impacted stream segment of Brier Creek lies within McDuffie County, GA. GAEPD derives authority to require activities associated with the TMDL, NPDES, and MS4 programs to move the stream toward compliance with Georgia water quality standards for fecal coliform bacteria. The McDuffie County Health Department may also play a role of responsibility as it relates to problems determined to originate from failing septic systems. If there are new or existing regulations on watershed activities that require enforcement, these entities would be relevant parties. There are also portions of the upstream watershed that are contained in Warren County. While this portion of the watershed is not the priority for this plan, Warren County government may play a role in addressing any sources of impairment that are determined to originate in that portion of the watershed.

### **Watershed Advisory Council**

This group was directly involved in the development and approval of this watershed management plan.

- |                   |  |
|-------------------|--|
| 1. Lamar Fain     | Wastewater Director, City of Thomson           |
| 2. George Lokey   | Chair, Water-Sewer Commission, City of Thomson |
| 3. Don Powers     | Thomson City Administrator                     |
| 4. Tony Greco     | Nutter and Associates                          |
| 5. Vic VanSant    | Retired GADNR Representative                   |
| 6. Charlie Newton | McDuffie County Commission Chair               |
| 7. Kenneth Usry   | Mayor, City of Thomson                         |
| 8. Teddy Reese    | Watershed Landowner                            |
| 9. Oscar Flite    | CEO, Phinzy Center for Water Sciences          |

### **Zoning and Development Agencies**

In addition to the McDuffie County Planning Commission, the Central Savannah River (CSR) Resource Conservation and Development Council may be available to facilitate planning and development needs.

### **Code and Regulation Evaluation**

The City of Thomson-McDuffie County government will hold the authority to make determinations on implementation of particular codes, regulations, and other recommendations resulting from this plan.

### **Implementation Resources**

The implementation resources for this project consist mainly of those entities or organizations that are represented in the stakeholder group. They include the McDuffie County Board of Commissioners; GAEPD; City of Thomson Administrative Office, Water-Sewer Commission, Wastewater Department, Mayor's Office; local landowners, the kaolin mining industry; the Phinizy Center for Water Science; Nutter and Associates Environmental Consultant Firm; McDuffie County Health Department; Thomson Rotary Club; Augusta-Richmond County Utilities; Columbia County Water Utility; McDuffie County Cooperative Extension Agent; Richmond County Cooperative Extension Agent; and the Central Savannah River Area (CSRA) Land Trust. Based on the particular sources that have been identified, the participation of local landowners will likely be critical to the success of the project in this case. Agricultural agencies will also likely play a key role, as will the health department and transportation and utilities departments. It may also be necessary to involve an Engineering firm for the implementation of certain structural BMP.

### *Funding*

The funding for implementation of the Brier Creek Watershed Management Plan will primarily come through a combination of additional 319(h) Grants and financial resources available through City of Thomson and McDuffie County, as well as watershed landowners. Estimated cost for the various BMP proposed are found in Table 13. These costs may not necessarily include all personnel costs associated with contracted work. The total cost for implementation of all necessary BMP would probably fall within the range of \$200,000-\$600,000, but could be more depending on which BMP are selected.

**Table 13. Cost Estimates for Proposed BMP**

<b>BMP</b>	<b>Range of Implementation Cost</b>	<b>Intended Funding Source Options</b>	<b>Notes</b>
Septic Repair and Replace	\$2,000-\$30,000 one-time	City of Thomson*/319 Grant Program/GEFA Loan	\$1,000-\$15,000 for repair/replace on 4-7 systems with 25% failure rate
Animal Carcass Disposal Program and Facility	\$10,000-\$12,000 annually	City of Thomson*/319 Grant Program/Cost Share with Surrounding Counties	Assuming free compost material, free land use, 1 city employee at 4hrs/d, 100 days per year, \$50/d fuel usage
Pasture Restoration and Overgrazing Reduction	\$4,000-\$7,500	City of Thomson*/Landowners/319 Grant Program	\$15/acre for grazing rotation and \$170/acre for critical area planting from NRCS (2014), 20-40 acres.
Livestock Exclusion	\$50,000-\$90,000 over 1-3 years	City of Thomson*/Landowners/319 Grant Program/EQIP Program	\$12,400/farm average cost from Zeckoski et al. (2012), 5-7 farms
Vegetated Buffer Strips	\$350,000-\$400,000 over 25 years (DNREC) \$50,000-\$100,000 NRCS	City of Thomson*/Landowners/319 Grant Program/Community Development Block Grant	\$2,550/acre from dnrec.delaware.gov, \$270/acre from NRCS (2014), 150 acres, 200-ft buffer, 3 miles of stream
Stormwater Constructed Wetlands	\$600,000-\$1,500,000 one-time	City of Thomson*/319 Grant Program/ Community Development Block Grant	\$26,000-\$55,000 per acre from USEPA (1999), 1% of the livestock watershed area for wetlands, ~20 acres

\* City of Thomson funding might include Community Development Block Grants, reserves from Water and Sewer Enterprise Fund, or Capital Improvements SPLOST funding.

## Education and Information Component

See Appendix A for general guidelines that Phinizy Center uses for education components for watersheds with pathogen impaired streams. Initiatives explained in the guidelines that are key to this watershed include targeting and micro-targeting for the appropriate audience, creating multisensory educational experiences, and measuring success. A narrated PowerPoint presentation has been custom made for this watershed (Appendix D), to be presented at public meetings and/or events. It was presented during the development of this management plan to an audience of stakeholders. A poster on animal carcass disposal has been developed as well (Appendix E) and should be used as a part of the animal carcass disposal educational program. Two public meetings were held on the watershed management plan (April 1, 2015 and June 10, 2015) which included a description of the current conditions and possible BMP to reduce the impairment.

## Schedule for Expeditious Implementation of BMPs

A timeline for implementation of BMP is shown in the following Gantt chart (Table 14). Note that not all BMP will likely be implemented for all source types. For instance, while there is only one option for septic system and animal carcass sources, there are several for livestock runoff. Most likely only one or two would be implemented. More are included as landowner feedback and buy-in throughout the process will be important to achieve results, and project management will require more than one possible path forward to reach the desired outcome.

**Table 14. Timeline for Implementation of BMP and Achievement of Key Milestones**

BMP	Milestones	Q1 2016	Q2 2016	Q3 2016	Q4 2016	Q1 2017	Q2 2017	Q3 2017	Q4 2017	Q1 2018	Q2 2018	Q3 2018	Q4 2018	Q1 2019	Q2 2019	Q3 2019	Q4 2019	2020	2021	2022	2023
<b>Septic Repair and Replace</b>	identify funding source																				
	identify landowners and determine if systems need repair																				
	contract and complete repair work																				
	monitor results																				
<b>Animal Carcass Disposal Facility</b>	identify funding source																				
	secure land and equipment																				
	train personnel																				
	advertise and educate hunting community																				
	monitor deliveries and compliance																				
<b>Pasture Restoration and Overgrazing Reduction</b>	identify landowners and assess the scale of the need																				
	identify funding source																				
	provide educational program to landowners																				
	provide cost-share for any restoration or fencing needed																				
	monitor completion and results																				
<b>Livestock Exclusion</b>	identify landowners and assess the scale of the need																				
	identify funding source																				
	provide landowner workshops																				
	provide cost-share for fencing, alternative water sources, or alternative comfort stations																				
	monitor completion and results																				
<b>Buffer Strips</b>	identify landowners and assess the scale of the need																				
	identify funding source																				
	conduct survey, design, and acquire necessary permits																				
	construction/planting																				
	monitor completion and results																				
<b>Livestock Waste Management System</b>	identify landowners and assess interest in program																				
	identify funding source for planning																				
	provide landowner workshops																				
	decide on optimal components for the system																				
	acquire funding for construction																				
<b>Stormwater Constructed Wetlands</b>	provide cost-sharing system																				
	monitor completion and results																				
	identify landowners and assess interest in program																				
	identify funding source																				
	identify contractor																				
	conduct survey, design, and acquire necessary permits																				
	construction/planting																				
	monitor completion and results																				

## Monitoring Program and Other Criteria to Evaluate BMP Effectiveness and Track Progress toward Attaining Load Reductions

The purpose of the long-term monitoring plan is to track the progress and effectiveness of BMP implementation and assess the water quality of the stream away from an impaired condition. The key parameters for study will be the fecal indicator bacteria used to measure compliance with state standards, flow, and turbidity. Sampling should be conducted in accordance with the 30-d geometric mean technique at least once between May and October annually for 5-10 years. In addition to monitoring stream bacteria concentrations, data can also be collected on the progress of BMP installation. Depending on the BMP selected, metrics could include acres of pasture restoration, feet of vegetative buffer installed, number of septic systems repaired or replaced, feet of livestock exclusion from the stream, or reduction in incidence of animal carcasses dumped in streams. In addition to the desired outcome of lower bacteria concentrations, ancillary benefits to the community from this plan may include improved awareness of septic system maintenance, improved awareness of proper animal carcass disposal and reduced human health risks from exposure, improved stream ecology, and healthier livestock from improved drinking water quality.

## Provisions and Measures for Assessing and Updating the Plan to Assure Continued Commitment to Implementation

In order to ensure that the plan stays on track and is continuously updated to reflect the best available data, an annual meeting of the watershed advisory committee is recommended to review the current status of the watershed and the plan. Changes can be made to the plan based on additional monitoring data and other evaluation criteria mentioned above. Once changes are made to the plan, adjustments can be made to the priorities of BMP implementation. Also, through the annual meetings, attention can be placed on areas where milestones are not being reached in a timely manner.

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## Appendix A – Phinizy Center Guide to Conducting Educational Programming for Pathogen Impaired Streams.

See Attached Document

## Appendix B – Phinizy Center Sampling and Monitoring Procedure Guidance for Communities Conducting Water Quality Assessment

See Attached Document

## Appendix C – Phinizy Center/Thomson Targeted Monitoring Data

See Attached Document

## Appendix D – An Educational Presentation Customized for this Watershed

See Attached Document

## Appendix E – Educational Flyer Regarding Animal Carcass Disposal

See Attached Document