A local stakeholder and Georgia EPD approved plan that outlines the framework for improving water quality in Holly Creek and its tributaries

Holly Creek Watershed Management Plan

Limestone Valley RC&D Council

Acknowledgements

Limestone Valley Resource Conservation and Development Council, Inc., would like to express its appreciation to the many organizations and individuals that assisted with the research and compilation of information presented in this plan. First and foremost, Limestone Valley wishes to thank the Environmental Protection Agency and the Georgia Environmental Protection Division for funding the preparation of this document. Additionally, the council would like to thank the individuals associated with Dalton Utilities, the Natural Resources Conservation Service, and U.S. Fish and Wildlife Service that contributed many hours by providing resource information, guidance, and donated services. Other organizations that contributed to this plan include the City of Chatsworth, the Conasauga River Alliance, Dalton State College, Georgia Department of Natural Resources, Georgia Soil and Water Conservation Commission, Murray County Commission, Murray County Environmental Health Department, The Nature Conservancy, U.S. Forest Service, and University of Georgia Cooperative Extension. It is the hope of Limestone Valley RC & D that the information presented here, as well as the cooperative partnerships formed during this process, will work to improve the water quality in the Holly Creek Watershed in Georgia.

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Contents

Executive Summary

Several stream segments within the Holly Creek Watershed fail to meet criteria set by the State of Georgia for pathogens and biotic integrity, which respectively tend to be impairments that stem from excessive fecal contamination and sediment loading. Due to these impairments, load reductions of these nonpoint source pollutants are necessary in many areas within the watershed. The need for a further effort to identify consistent sources of these pollutants and work towards addressing the load reductions led to the creation of this Watershed Management Plan. The plan includes the Nine Elements as recommended by the Environmental Protection Agency, and outlines a process for implementing the load reductions necessary for watershed restoration. In addition, the plan seeks to include methods to reduce nutrients as mandated within the Upper Coosa Basin. Development of the plan also featured a stakeholder-driven process to build momentum and partnerships with the local community that could assist in its implementation. The plan has been written by Limestone Valley Resource Conservation and Development Council as a deliverable associated with a Environmental Protection Agency Clean Water Act (§319) grant administered by the State of Georgia.

This Watershed Management Plan recommends a multi-faceted Holly Creek Watershed Restoration Program in order to focus on load reductions of fecal coliform bacteria and sediment as well as assist in the reduction of nutrients from agricultural, residential, and urban sources. The program was conceptualized in an effort to play on the strengths of the various project partners, and could complement existing conservation programs. Smaller projects, however, could be devised that address individual components of the recommended program should a qualified organization seek funding. As part of the recommended program, agricultural lands were identified for targeting load reductions through cost-shares with landowners and/or potentially the Coosa Basin Nutrient Trading Program for the installation of Best Management Practices. The agricultural practices implemented will vary according to the interests of the farmers, but will likely include stream access control, alternative watering systems, heavy use area protection, and stream crossings for livestock producers, as well as streambank biostabilization and stream buffer enhancement. Incentives for proper nutrient management will also be considered. Natural Resources Conservation Service will be a significant contributor to the success of these program components. Residential lands could also be targeted to reduce the contributions of fecal coliform bacteria from human sources by addressing septic system issues. This should include cost-shares on septic system repairs focused near streams and intermittent conveyances, and elsewhere in the watershed to build further momentum. For this program component, it is anticipated that North Georgia Health District will play a key role. Additional "on-the-ground" conservation will potentially be achieved

through the implementation of stormwater practices such as streambank biostabilization and green infrastructure projects in the more urbanized areas like Chatsworth. Depending on location, these practices may be implemented in collaboration with the City of Chatsworth or Dalton Utilities.

In addition to actual “on-the-ground” projects, this document outlines outreach activities for volunteers that were identified by the stakeholder group as having the potential to contribute toward the reduction of pollutant loads and/or further educate the community about watersheds and the importance of water quality and biotic integrity, as well as soil and water conservation.

As part of the development process for this watershed management plan, estimates were prepared to consider the time and funding from 319 sources likely needed to accomplish restoration goals. These estimates were based on the assumption that the recommended multi-faceted watershed restoration effort would be pursued, as opposed to a piecemeal approach. Other sources of funding (mainly anticipated in the form of in-kind donations from stakeholders, agencies, and non-governmental organizations) were not estimated, but were assumed to contribute significantly to the program. In order to come up with a financial estimate, the extent of work within the watershed needed for complete watershed treatment was first conceptualized using Geographic Information Systems analysis and inspection of aerial photography. Next, the extent of the total watershed treatment that would likely be necessary to result in the de-listing of the majority of impaired stream segments was estimated. Finally, the stakeholder recommended projects that these funds would finance were arranged in an implementation schedule that spans several years (including grant proposal submission periods). The proposed implementation schedule includes all grant activities including water quality monitoring, education and outreach activities, and conservation activities (e.g., agricultural Best Management Practices, septic system repairs, streambank biostabilization, etc). Each of these activities was assumed to continue through each grant implementation period. It is believed that funding should be pursued for four consecutive grant implementation periods, with the belief that program implementation over this time frame may allow for significant improvements within the watershed. Afterward, it is expected that some impaired stream reaches will have been de-listed and others will at least be improved and approaching compliance with state criteria. Success in this endeavor would depend on a number of variables, and priorities will be evaluated and altered throughout the multiple year periods to maximize results.

1. Plan Preparation and Implementation

The purpose of the Watershed Management Plan is described below, as well as the objectives it aims to accomplish, some of the details of the plan development and stakeholder process, and ultimately how the plan will be implemented.

The presence of several impaired segments in the Holly Creek Watershed led to the development of this Watershed Management Plan (WMP) in an effort to outline a feasible prescription and timeline to implement their restoration. Plan development was also intended to unite watershed stakeholders in recognizing the sources of impairing pollutants and allow them to provide feedback on how to reduce them. Stakeholders were encouraged throughout the development of the plan to commit to making some type of contribution in the eventual restoration process. The plan is not a regulatory document, but is meant to guide restoration efforts likely to take place in the watershed. The ultimate goals of the planning effort and the restoration process are for impaired segments to eventually be and remain de-listed and for the integrity of other segments to be maintained so that they continue to meet the criteria for each designated use. Ultimately, a broader goal is to make stakeholders and landowners in the watershed more knowledgeable of watershed issues and how to manage the landscape to minimize water and soil resource concerns.

Figure 1.1.a. Holly Creek of Murray County, Georgia, within the Coosa River Basin.

The development of this WMP by Limestone Valley Resource Conservation and Development (RC&D) Council was completed as part of an EPA Clean Water Act (§319) grant. The plan is meant to be a more extensive update of previous TMDL Implementation Plans for the Holly Creek Watershed.

EPA Clean Water Act (§319) grants have already been implemented by Limestone Valley RC&D in the Conasauga Watershed in Georgia, which includes the entirety of the Holly Creek Watershed. Success had been achieved with regard to participation in programs, development of excellent partnerships, and approximately 25 repairs of failing septic systems were completed in the Holly Creek Watershed as part of Conasauga Watershed Section 319 projects from 2006 to 2012. Other groups have achieved a great deal in the watershed. NRCS has indicated that ongoing participation in their Environmental Quality Incentives Program (EQIP) and Continuous Conservation Reserve Program (CCRP) has occurred in the watershed throughout the years, estimating that between 30-40 contracts (potentially more) have been completed between 1997 and 2014. In 2005, The Nature Conservancy purchased lands along Holly and Dill Creeks to start what is now the 250 acre Holly Creek Preserve. The U.S. Fish and Wildlife Service and other partners also purchased a bridge to replace a culvert crossing on Dill Creek at the confluence of Holly Creek that was previously a barrier to upstream movement of aquatic species. In addition, the U.S. Fish and Wildlife Service, Partners for Fish and Wildlife Program, has conducted several projects along Holly Creek over the years, including working with landowners on restoring a native, woody vegetated buffer along approximately two miles of Holly Creek upstream of Chatsworth.

Despite all of these efforts, improvements in water quality have not yet been realized to the extent necessary for the de-listing of impaired streams. Along with the continued effort of other programs, a more finite focus on the smaller Holly Creek Watershed using EPA Clean Water Act (§319) grants (as opposed to the entire Conasauga River Watershed as in the past) should allow for more expedient improvements in water quality. Developing the WMP on the front end of such an effort will allow us to evaluate previous efforts in the watershed and consider changes in strategies to improve further restoration efforts.

In comparison to previous TMDL Implementation Plans, this WMP is intended to focus more effort on specific watershed details. Further focus on these details should lead to a greater understanding of the local physical and social environment and help ensure greater success. Compiling more extensive data should help us better define priorities in the watershed for targeting Best Management Practice (BMP) installations, allow for better long-term land use and riparian comparisons, and assist in the development of more discreet objectives and milestones.

Extensive research on the watershed, including water quality monitoring and GIS analysis, was used to construct this WMP. Data regarding water quality, fish assemblages, geology, soils, and land use were considered when conducting watershed research. Only data sets and summaries of the parameters most relevant to the purpose of the WMP were included. The GIS component focused on analyzing riparian buffers, land use percentages, and housing densities as factors that exert an influence on non-point source (NPS) pollutant loads. GIS and water quality monitoring are also tools to identify broad areas of likely NPS pollution sources and priority areas for installation of BMPs.

The development of this WMP also coincided with a state-wide effort by Georgia Environmental Protection Division (EPD) to update all Total Maximum Daily Load (TMDL) Implementation Plans to include the Nine Elements of watershed planning (described below) as recommended by the U.S. Environmental Protection Agency (EPA). The nine elements are a recommended addition to these documents to help ensure stakeholder involvement and approval lead to an explicit prescription to eventually meet watershed restoration objectives. Specifically, the nine elements are as follows:

1. An identification of the sources or groups of similar sources contributing to nonpoint source (NPS) pollution to be controlled to implement load allocations or achieve water quality standards.

2. An estimate of the load reductions needed to de-list impaired stream segments;

3. A description of the NPS management measures that will need to be implemented to achieve the load reductions established in the TMDL or to achieve water quality standards;

4. An estimate of the sources of funding needed, and/or authorities that will be relied upon, to implement the plan;

5. An information/education component that will be used to enhance public understanding of and participation in implementing the plan;

6. A schedule for implementing the management measures that is reasonably expeditious;

7. A description of interim, measurable milestones (e.g., amount of load reductions, improvement in biological or habitat parameters) for determining whether management measures or other control actions are being implemented;

8. A set of criteria that can be used to determine whether substantial progress is being made towards attaining water quality standards and, if not, the criteria for determining whether the plan needs to be revised; and;

9. A monitoring component to evaluate the effectiveness of the implementation efforts, measured against the criteria established under item (8) above.

Another part of the development of this plan was to include and engage watershed stakeholders in the process and eventually receive their input on the WMP document. The stakeholder group (Table 1.1.a.) consisted of members of local, state, and Federal government, local utilities and universities, nonprofit groups, and the private sector. Several members were invited to take part in the process due to their professional expertise and interest in relevant disciplines and familiarity with previous stakeholder efforts regarding water quality concerns and restoration efforts. Other stakeholders (e.g., farmers, landowners) were involved in the process to seek their opinions on how best to go about implementing BMPs in the watershed. Local governments were also made aware of the stakeholder process and given the opportunity to participate in the stakeholder group. Overall, we wanted a diverse community represented in the stakeholder group.

Table 1.1.a. Stakeholder committee members that participated in the Holly Creek Watershed Management Plan development process.

WATERSHED ADVISORY COMMITTEE MEMBERS	
Name	**Main Affiliation**
Heath Harrison	Chatsworth Water Works
Dan Penland	City of Chatsworth
Mack Belue	Conasauga River Alliance
Amos Tuck	Coosa River Basin Initiative
John Lugthart	Dalton State College
Robert Ledford	Dalton Utilities
Keith Coffey	Dalton Utilities
Jimmy Petty	Farmer, Landowner, Limestone Valley SWCD Supervisor
John Loughridge	Farmer, Landowner, and Georgia Soil and Water Conservation Commission
Linda Loughridge	Farmer, Landowner, Limestone Valley SWCD Supervisor
Catherine Fox	Fox Environmental, LLC.
Dickie Barnes	Murray County
Brittany Pittman	Murray County Commission
Jason Osgatharp	Murray County Environmental Health Department
Cindy Askew	Natural Resource Conservation Service
Katie Owens	The Nature Conservancy
Gretchen Lugthart	Northwest Georgia Regional Commission
Robin Goodloe	U.S. Fish and Wildlife Service

Anita Goetz	U.S. Fish and Wildlife Service: Partners for Fish and Wildlife Program
Ruth Stokes	U.S. Forest Service
Brenda Jackson	University of Georgia Cooperative Extension

In an effort to engage stakeholders in the process of providing input for an implementation plan, a series of public meetings (conducted in late 2014 and early 2015) were held with the group. Stakeholders were informed of what was expected of them throughout the plan development process, which was in general a positive attitude and constructive presence. Members were also asked if they had resources that they could contribute to the WMP development and/or restoration process. Due to their expertise and willingness to provide additional support, a few stakeholders were consulted more regularly in the process of developing the plan. It was also anticipated that some stakeholders may be become project partners and contribute significantly in the restoration process. In this case, we tried to document their likely roles within the WMP. Meetings focused on informing the stakeholders of the process, gathering input about potential problems and solutions, discussing sampling data, developing priorities, evaluating what BMPs may be received locally with the best public reception, and obtaining insight on the WMP document itself. Finally, approval was sought for the document to serve as the plan on which implementation efforts follow to restore and maintain the watershed.

The watershed restoration effort to follow the approval of this plan likely depends on EPA Clean Water Act (§319) funding to ensure its success. Stakeholder assistance in some aspects of the restoration effort will also be a key factor in success. The restoration effort will focus to improve the watershed through several specific project components. These include reducing NPS pollution from agricultural lands and septic systems in the watershed, as well as educating the public about NPS pollution and watershed processes. More agricultural focus may be necessary in comparison to past efforts in the watershed. Plan implementation will occur with respect to private property rights and rely on voluntary conservation, which involves participation from landowners in cost-shares to put in BMP practices that reduce NPS pollution on/from their properties. Most practices are mutually beneficial to the landowner and water quality, which helps incentivize participation further. A potential incentive program for farmers that conduct proper nutrient management will also be considered. There is also the potential that the Coosa Basin Nutrient Trading Program can assist in providing a portion of the cost-shares for agricultural projects that reduce nutrients. If this proves to be the case, the combined sources of funding would take more of the burden off of landowners and perhaps create more substantial interest in agricultural projects. Although management of individual parcels is key to watershed restoration, a discussion regarding individual parcels has been avoided so as not to discourage participation, which could occur if directed criticisms over the management of specific private lands were included. Instead, the general NPS issues associated with specific land uses which predominate within the watershed are discussed, and the proposed project components are meant to address a number of NPS pollutant sources that occur on the landscape.

Successful implementation of this plan that includes accomplishing all the objectives through the voluntary conservation approach will be a difficult endeavor, but by building momentum through a phased approach, and further developing relationships in the community, the process should cumulatively achieve significant NPS pollution reduction. To increase the chance of successful watershed restoration, a reassessment of the plan is scheduled every five years. This iterative process will allow for adaptive management where citizens and stakeholders can analyze project successes and failures, and provide opportunities for changes in restoration priorities.

Figure 1.1.b. A common rural landscape within the Holly Creek Watershed.

2. Holly Creek Watershed Description

Extensive knowledge about a watershed is necessary in order to make effective watershed planning decisions. This section will focus on providing the watershed background as it relates to the development of a WMP for the Holly Creek Watershed in Northwest Georgia. The section is organized into three parts. The first part is a description of landscape features and includes the local watershed geography and geology. The second part focuses on the local forests, wildlife, and fishes. The last describes anthropogenic features in the watershed (e.g., resource uses, political boundaries, etc.). Much of the following information regarding the Holly Creek Watershed was written with the assistance of the historical TMDL Implementation Plans and the Soil Survey of Murray and Whitfield Counties, Georgia. Additional sources are referenced within the text.

2.1 Landscape Features

Watershed Geography

The Holly Creek Watershed in Northwest Georgia is classified by drainage area as a "HUC 10" watershed (specifically Hydrologic Unit Code #0315010104; Figure 2.1. a) in the Coosa River Basin. The vast majority of the watershed lies within Murray County, Georgia, where it drains more than 74,000 acres. Altogether National Forest accounts for 28% of the watershed area, and vacant lands are prevalent in the watershed as well at 27% of land use. Residential and agricultural lands account for 14% and 11% of the land in the watershed, respectively. Much of the residential lands are concentrated around the portion of the watershed lying within and around the City of Chatsworth in the central part of the watershed.

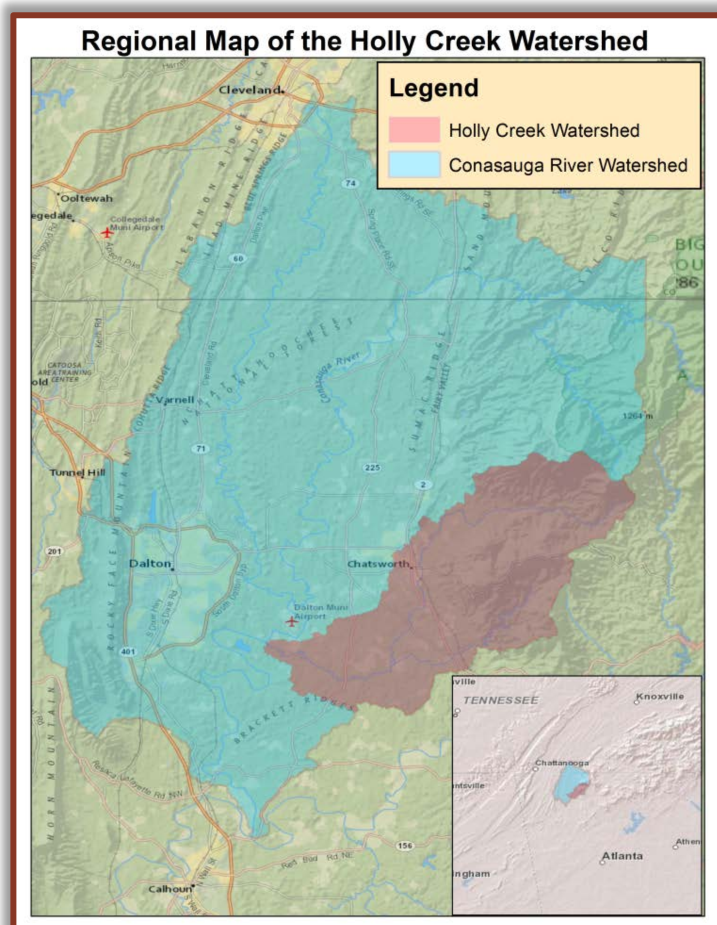


Figure 2.1.a. The Holly Creek Watershed is a part of the larger Conasauga River Watershed.

Holly Creek originates in the mountains of the Chattahoochee National Forest in the Northeast portion of the watershed where it drains a significant area and flows more-less in the direction of Southwest. Eventually, it enters the valley to the West and the flatter terrain leads to a more sinuous creek with a more significant floodplain. From this point in the watershed, a few tributaries continue to come from the forested ridges to the East (e.g., Rock Creek) and eventually from the South, but only a few small tributaries exist to the north and west, as the Conasauga River Watershed boundary is just a few miles away. Holly Creek (and the watershed) trends Southwest through the area around Chatsworth.

Downstream of the Chatsworth area, lower Holly Creek (and the watershed) continues to meander Southwest and then slowly Northwest before entering the Conasauga River at the border of Whitfield County. The largest tributary in the watershed is Rock Creek, not to be confused with the smaller tributary Goldmine Branch/Rock Creek that drains into Holly Creek farther upstream. Rock Creek originates south of Holly Creek in Chattahoochee National Forest, drains several miles of forest and then a few miles of private lands, and confluences with Holly Creek eight miles prior to Holly Creek joining the Conasauga River.

Tributaries that contribute to Holly Creek within Chattahoochee National Forest include Moreland Branch, Boatwright Branch, Shanty Creek, Emery Creek, Milma Branch, and Rigley Branch. After Holly Creek enters private lands, Mill Creek, Dry Prong, Rock Creek/Goldmine Branch, Chicken Creek, and Rock Creek (mentioned above) enter Holly Creek from the South and then East. Each of these tributaries originate within the National Forest. Muskrat Creek also originates in the forest, but enters Holly from the north. The only other tributaries to enter Holly Creek from the North and West prior to its confluence with the Conasauga River are Lick Branch, Stewart Branch, and eventually Bullpen Branch. Buck Creek, Rock Branch, Casey Springs Branch, and Pettiet Branch also contribute to Holly Creek from the South and East as Holly Creek turns in a more west and then northwest direction.

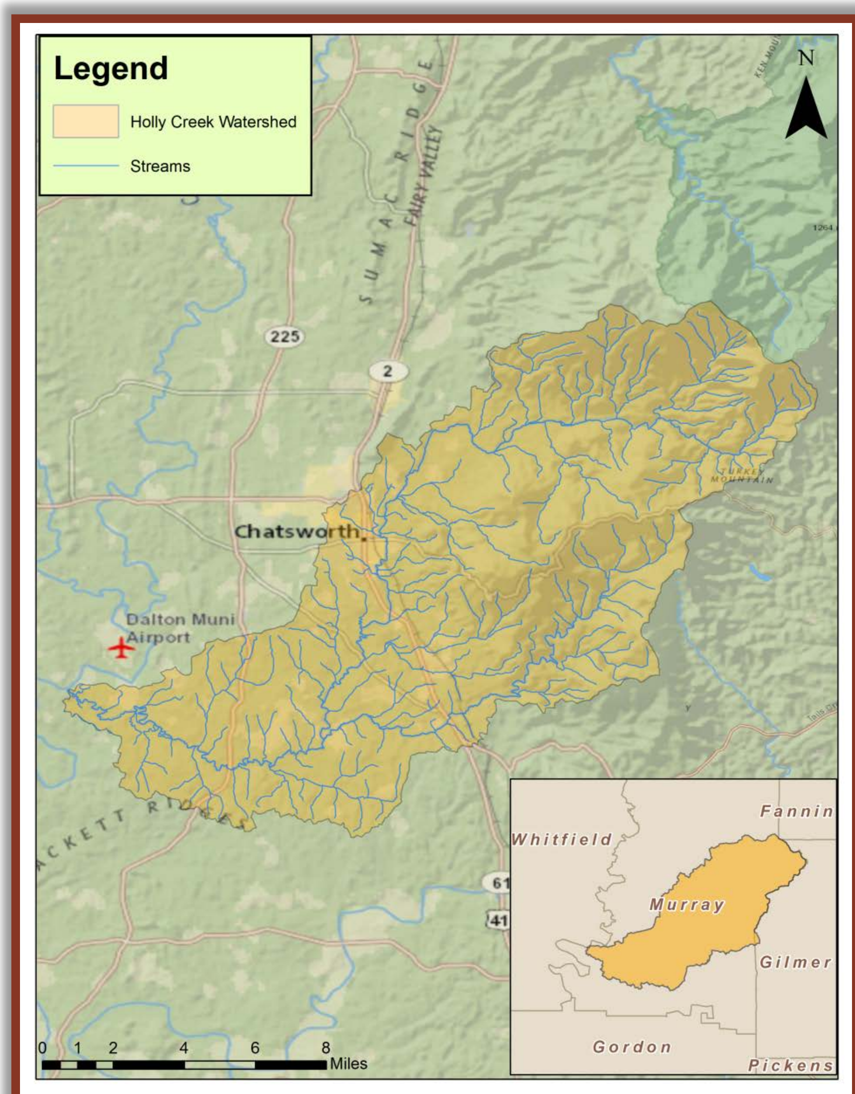


Figure 2.1.b. The Holly Creek Watershed .

<u>Watershed Geology and Soils</u>

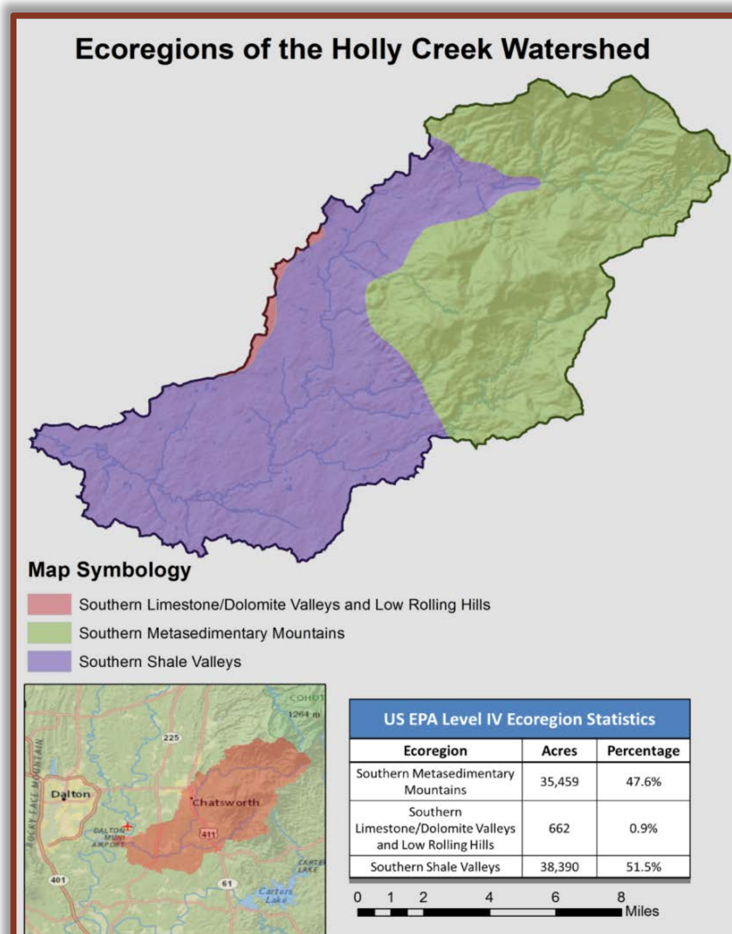
Much of the following information was compiled from USEPA's online resources (USEPA, 2014), as well as the Soil Survey of Whitfield and Murray Counties, Georgia.

In the Holly Creek Watershed, the Blue Ridge Mountains are the most significant landform. A few peaks in this area rise more than 3,000 feet above sea level, while most of the valley areas have elevations ranging from 640 to 800 feet. The tallest mountain in the watershed is Bald Mountain, rising to 4,005 feet. These higher formations tend to be a part of the drainage divide in the area.

The Holly Creek Watershed is located within two separate Level III physiographic regions. The Ridge and Valley physiographic region makes up 52.4% of the watershed, and includes two Level IV ecoregions (see figure 2.1.c. below; purple and red sections). Rocks in the Ridge and Valley physiographic region range from early Cambrian to Mississippian age. Northward-trending valleys separated by low, rounded ridges and high, steep-sided ridges dominate the landscape. The ridges tend to be composed of chert and capped sandstone, while the valleys are most often limestone or shale. The Blue Ridge physiographic region makes up 47.6% of the watershed, and only one Level IV ecoregion occurs in the watershed (green section of map above). This ecoregion contains mostly forested slopes, high-gradient, cool, clear streams, and rugged terrain that occurs on a mix of igneous, metamorphic, and sedimentary geology. Rocks of the Blue Ridge province belong to the Great Smoky group. Types of rock in this group include slate, phyllite, quartzite, graywacke, schist, and gneiss.

Soils within the Holly Creek Watershed are described in detail in the Soil Survey of Whitfield and Murray Counties, Georgia. In summary, typical soils found in the Blue Ridge area of the watershed include Cataska, Cheoah, Edneytown, Junaluska, Pigeonroost, and Tsali. Most of these soils are located in steep areas and are shallow to moderately deep and well drained. Additional soils on the more moderate to gentle slopes include Craigsville, Shelocta, and Suches.

Thicker, more fertile soils typically form in the valleys from the weathering of parent material and erosion of soil at higher elevations as well as alluvial deposition processes. Along the Holly Creek corridor towards the confluence with the Conasauga River, the prevalence of loamy soils that have been deposited over time has resulted in characterization of much of the area in close proximity to the floodplain as prime farmland or farmland of statewide agricultural importance. Prime farmland is land with soils that produce the highest



US EPA Level IV Ecoregion Statistics		
Ecoregion	Acres	Percentage
Southern Metasedimentary Mountains	35,459	47.6%
Southern Limestone/Dolomite Valleys and Low Rolling Hills	662	0.9%
Southern Shale Valleys	38,390	51.5%

Figure 2.1.c. There are three different Level IV ecoregions within the watershed.

crop yields with minimal energy expenditure, economic resources, and environmental damage. Additional farmland of statewide importance is important for agriculture in the county, yet is less productive, more difficult to cultivate, seasonally wet, and more erodible. Attempts to drain these wetter soils, such as tile drains and ditching, can be vectors for excess fecal coliform bacteria, nutrients, and pesticides to enter Holly Creek.

2.2 Important Flora and Fauna

Forest Ecosystems

Forested lands make up over 70% of the land use within the Holly Creek drainage. The headwaters are located in the Chattahoochee National Forest, and make up the majority of this land use category. In addition to these upland slopes, floodplains and depressions are also where forests are commonly located. Most forest is characterized as mixed oak-hickory-pine and loblolly-shortleaf pine forest. Since the majority of forestland in the watershed is managed by the US Forest Service, consistent efforts are made to manage this land in a sustainable manner.

Wildlife and Habitat

The southern portion of the Blue Ridge Mountains (covering portions of Virginia, Tennessee, South Carolina and Georgia) is one of the richest centers of biodiversity in the eastern U.S. The headwaters of the Holly Creek watershed in the national forest are no exception, and provide excellent habitat for wildlife. The rest of the watershed (with the exception of Chatsworth) is primarily a rural environment with an abundance of pasture and forest that also provides decent habitat for wildlife. Wildlife in woodland habitats in the watershed can include wild turkey (*Meleagris gallopavo*), American woodcock (*Scolopax minor*), thrushes *(Turdidae* family*)*, woodpecker (*Picidae* family), and American black bear (*Ursus americanus)*. Pine and hardwood forests surrounding pasture make good habitat for white-tailed deer (*Odocoileus virginianus*), mourning dove (*Zenaida macroura*), raccoon (*Procyon lotor*), gray squirrel (*Sciurus carolinensis*), opossum (*Didelphis virginiana*), and fox (*Vulpes sp.*). Cropland, pasture, meadows, and other open areas with suitable food and cover are inhabited by Eastern cottontail rabbit (*Sylvilagus floridanus*), bobwhite quail (*Colinus virginianus*), meadowlark (*Sturnella magna*), field sparrow (*Spizella pusilla*), and red fox (*Vulpes vulpes*). Deer, rabbit, fox, quail, and other wildlife gain food and cover in the abundant native woody and herbaceous plants that occur in unmanaged pasture, old fields, young pine plantations, and thin woodland tracts. Waterfowl, otter (*Lontra canadensis*), beaver (*Castor canadensis*), bobcat (*Lynx rufus*), and raccoon inhabit forested wetlands, which occur mostly along streams. More open wetlands attract ducks and geese (*Anatidae* family), herons (*Ardeidae* family), shorebirds, and beaver. Beaver are abundant and a particular problem along upper Holly Creek (upstream of Chatsworth). Not only do they contribute some fecal coliform directly into the stream, their dams can lead to avulsions, where a new channel is carved, as well as streambank erosion and instability.

Listed and Sensitive Species

According to the Georgia Department of Natural Resources, the Holly Creek Watershed is home to several federally listed species, some of which may be influenced by changes in the watershed. Known occurrences of Federally listed aquatic species include the following mussels: Alabama moccasinshell (*Medionidus acutissimus*), finelined pocketbook (*Hamiota altilis*), Southern clubshell (*Pleurobema decisum*), rayed kidneyshell (*Ptychobranchus foremanianus*), Coosa moccasinshell (*Medionidus* *parvulus*), and Southern pigtoe (*Pleurobema georgianum*); and the fish species blue shiner (*Cyprinella caerulea*). The U.S. Fish and Wildlife Service continues to monitor the status of these federally listed species within Holly Creek.

Non-federally listed aquatic species that are protected by the State of Georgia known to occur in the Holly Creek Watershed include the following fishes: rock darter (*Etheostoma rupestre*), trispot darter (*Etheostoma trisella*), lined chub (*Hybopsis lineapunctata*), river redhorse (*Moxostoma carinatum*), burrhead shiner (*Notropis asperifrons*), and bridled darter (*Percina kusha*); the mussel species Alabama creekmussel (*Strophitus connasaugaensis*); and the crayfish species Conasauga blue burrower (*Cambarus cymatilis*).

Figure 2.2.a. The trispot darter is a protected species found in the Holly Creek Watershed.

<u>Fisheries</u>

The most upstream portion of the Holly Creek Watershed (upstream from Dill Creek) in Georgia has been designated as trout fishing waters. In addition, Mill Creek and Rock Creek (the most northern Rock Creek in the watershed) are year-round trout streams. Year-round trout streams are stocked several times per year and open to trout fishing all year. The most southern Rock Creek in the watershed has been designated as a seasonal trout stream. Trout-designated streams in Georgia are often stocked, and can include brown (*Salmo trutta*), rainbow (*Oncorhynchus mykiss*), and/or brook trout (*Salvelinus fontinalis*). Such designations result in more strict regulations intended to minimize sedimentation and maintain forest buffers for temperature control. Current state regulations require the maintenance of a 50 foot vegetated buffer on either side of a trout stream with permits required for modifications within the buffer areas. People can also be regularly seen fishing in the downstream areas of the watershed, especially at road crossings. They likely fish for and catch various sunfish (*Lepomis* sp.) and basses (*Micropterus* sp.).

2.3 Anthropogenic Features

Political Boundaries

Aside from an insignificant sliver, all of the Holly Creek Watershed lies within Murray County (Figure 2.3.a.). However, the vast majority of the upper watershed (upstream of Chatsworth) is managed as part of Chattahoochee National Forest by the U.S. Forest Service. Approximately half of the city limits of Chatsworth are located within the watershed. Some medium and high density development can be found in this area. During the 2010 census, Chatsworth had a population of over 4,200 individuals. Wastewater services exist in this portion of the watershed. Low density development is consistent across the rest of the lower and middle portions of the watershed. These areas lack a sewer system, and residents rely on septic systems for waste management.

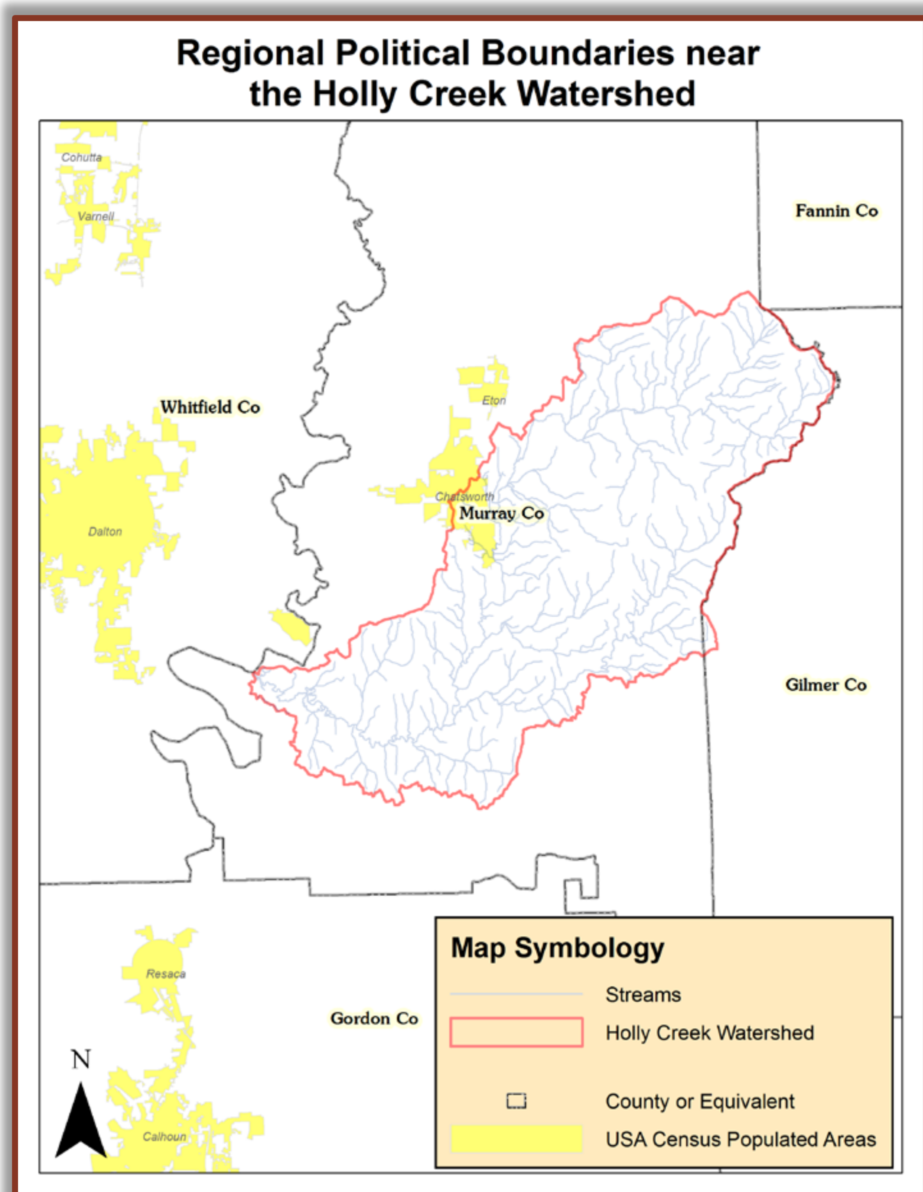


Figure 2.3.a. A map displaying the political boundaries in the Holly Creek Watershed.

Community Water Supply

According to Chatsworth Water Works, the majority of drinking water for the City of Chatsworth is captured outside of the Holly Creek Watershed. A portion of this water supply is purchased from Dalton Utilities, which obtains much of its water from the Conasauga River upstream of the Holly Creek/Conasauga River confluence. Holly Creek and its tributaries have a designated use for fishing, although the water is eventually processed for drinking water in downstream areas of North Georgia.

People in some areas in the watershed rely on wells as a water source, which are used for both domestic and livestock purposes. Livestock water sources also include streams and ponds, which is a topic of discussion found later in this document.

Active Groups Within the Watershed

Several groups with a local presence are relevant to the conservation of the Holly Creek Watershed and/or the larger Conasauga River Watershed. Federal entities relevant to the WMP development process and/or conservation efforts in the area include the EPA, the Farm Services Agency (FSA), the Natural Resource Conservation Service (NRCS), the United States Fish and Wildlife Service (USFWS), and the United States Forest Service (USFS). State entities relevant to the conservation efforts in the area include the Georgia Association of Regional Commissions, Georgia Department of Natural Resources (DNR), Georgia Department of Public Health, the Georgia Environmental Protection Division (EPD), and the Georgia Soil and Water Conservation Commission (GSWCC). In addition, non-governmental organizations that contribute to local watershed conservation include the Conasauga River Alliance, Dalton Utilities, Limestone Valley RC&D Council, Limestone Valley Soil and Water Conservation District, The Nature Conservancy (TNC), and the Tennessee Aquarium Conservation Institute (TNACI). Most of these groups have already conducted actions relevant to conservation within the Conasauga River Watershed, and others have improved local education regarding watershed science and water pollution. Groups conducting long-term programs, conducting monitoring, installing "on-the-ground" projects, implementing nonstructural practices, or those predicted to play a significant role in the implementation of this WMP are discussed further within the document.

3. Watershed Conditions

The section that follows will focus on introducing the state water quality standards and their importance, as well as impairments in the Holly Creek Watershed, and sampling data from past and current monitoring endeavors. Assessments representative of current watershed conditions are also included.

3.1 Water Quality Standards and Impairments within the Holly Creek Watershed

Georgia Water Quality Criteria

Georgia's water quality standards are made up of two different groups of criteria. The general criteria apply to all waters, and certain specific criteria exist for each of six designated uses. The general criteria are more qualitative in nature, and include:

- Waters shall be free of materials, oils, and scum associated with municipal or domestic sewage, industrial waste or any other waste which will settle to form sludge deposits, produce turbidity, color, or odor, or that may otherwise interfere with legitimate water uses.

- Waters shall be free from toxic, corrosive, acidic, and caustic substances in amounts which are harmful to humans, animals, or aquatic life.

The six designated uses in Georgia, which can vary in strictness of standards, are:

- Drinking Water Supply
- Fishing
- Wild River
- Recreation
- Coastal Fishing
- Scenic River

The waters of the Holly Creek Watershed are all designated for "Fishing". The numeric criteria associated with this designated use are found in Table 3.1.a. The water quality parameters associated with the numeric criteria are important for several reasons including minimization of human health risk and protection of aquatic fauna. When streams fail to meet water quality criteria for a given designated use, they are listed as impaired on the Georgia Integrated 303(d)/305(b) List.

Table 3.1.a. A description of the quantitative water quality criteria for waters designated for the uses of drinking water supply and fishing.

Fecal Coliform Bacteria	Dissolved Oxygen	pH	Temperature
May – Oct < 200 colonies/100 ml as geometric mean* Nov – April < 1000 colonies/100 ml as geometric mean* Nov – April < 4,000 as instantaneous max	< 5 mg/l daily average Not < 4 mg/l at all times	Between 6.0 and 8.5	< 90° F

**** The geometric mean is calculated from at least four samples within a 30 day period.***

Impairments in the Holly Creek Watershed

Sampling of water quality and biota, specifically fecal coliform counts and fish assemblages in this case, in the Holly Creek Watershed has resulted in the placement of four stream segments on the Georgia Integrated 303(d)/305(b) List for failure to meet state criteria. These impaired stream segments account for approximately 21 miles of streams in the watershed. On Holly Creek, the impaired segments are due to fecal coliform violations and occur in the lower watershed (Figure 3.1.a.; Table 3.1.b.). On Mill Creek and Goldmine Branch/Rock Creek, impacted biota impairments stem from poor Index of Biotic Integrity scores, which were revealed during fish sampling endeavors.

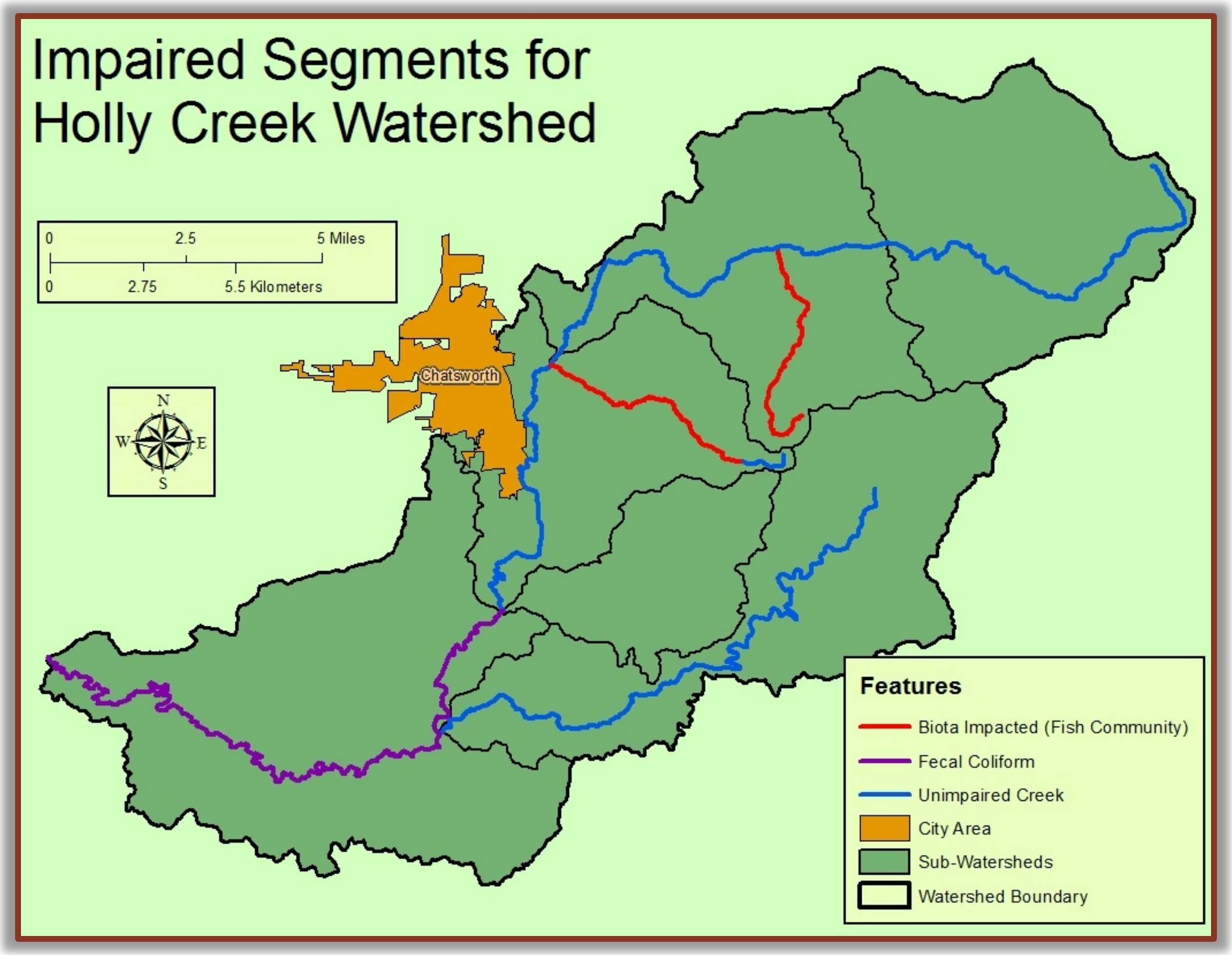


Figure 3.1.a. A map displaying all impaired segments found within the Holly Creek Watershed.

Table 3.1.b. A table displaying the location and criterion violated for each impaired segment found within the Holly Creek Watershed.

HOLLY CREEK WATERSHED IMPAIRED SEGMENTS		
Waterbody (Impaired Miles)	**County**	**Criterion Violated***
Holly Creek (4 miles) – Downstream Chatsworth to Rock Creek	Murray	Fecal Coliform
Holly Creek (8 miles) – Rock Creek to Conasauga	Murray	Fecal Coliform
Mill Creek (5 miles) – Headwaters to Holly	Murray	Bio (F)
Goldmine Branch/Rock Creek (4 miles) – Fort Mountain Lake to Holly	Murray	Bio (F)

Bio (F) = Impacted biota characterization resulting from fish sampling.

Fecal Coliform Impairments

Two impaired segments on Holly Creek failed to meet state criteria due to having high concentrations of fecal coliform bacteria. Downstream of the watershed the same issues persist, as the mainstem Conasauga River is also impaired for high fecal coliform counts. Although generally present in the environment and not alarming at low levels, high fecal coliform bacteria (and *Escherichia coli*) concentrations in streams are used as an indicator for significant fecal contamination and more importantly the human health risks and pathogens that often coincide with fecal contamination. For this reason, impairments are often described as pathogen impairments even though they result from high fecal coliform bacteria counts.

Although high fecal coliform bacteria concentrations can indicate a human health hazard, they are unlikely to exert direct negative effects on aquatic species. However, the nutrient enrichment that coincides with fecal contamination may result in indirect effects leading toward eutrophication of waterbodies. Nutrient enrichment can result in heavy algal growth that can alter aquatic habitats and cause harmful dissolved oxygen fluctuations.

Figure 3.1.b. Cattle with direct access to streams can contribute to a high fecal coliform load, such as the loads found in Holly Creek.

In addition, fecal contamination within the upper Conasauga River Watershed has been found during ongoing research conducted by University of Georgia scientists (Peter Lasier, etc) and The Nature Conservancy to coincide with high concentrations of hormones, particularly estrogens, that have led to an abundance of ovary development within male fish and ultimately negative impacts on populations of sensitive fishes.

Sources of fecal coliform bacteria in streams include fecal contamination from humans, pets, livestock including poultry, and wildlife. More specifically, common causes of elevated fecal coliform counts in impaired watersheds include failing septic systems, livestock (especially with direct stream access), applied manure, tile drains, and natural areas with abundant wildlife. Relative proportions of contributors are watershed specific and difficult (as well as expensive) to determine.

Impacted Biota Impairments

Within the Holly Creek Watershed, two segments, totaling nine miles, are designated as impaired due to impacted biota. These segments are located on Mill Creek, from the headwaters to Holly Creek, and along Goldmine Branch/Rock Creek, from Fort Mountain Lake to Holly Creek. A stream is considered impaired for impacted biota when sampling of fish or macroinvertebrates reveals negatively impacted assemblages as indicated by poor or very poor Index of Biotic Integrity or modified Index of Well Being scores.

In general, low biotic integrity is caused by a lack of quality fish habitat that results from stream sedimentation. According to Georgia EPD, it is generally assumed that if the sediment loads are reduced to and maintained at acceptable levels, the streams will repair themselves over time. Other parameters (e.g., heavy metals, high temperatures, low dissolved oxygen levels) can adversely affect the aquatic communities, but the TMDLs generally identify the probable impairing pollutant as sediment. Although there are qualitative descriptions in Georgia's water quality criteria that address restrictions on turbidity (a measurement of water clarity), there is no numeric criterion to identify discrete thresholds beyond which violations can be determined for sediment loading. Instead, indices of biotic integrity are used to represent stream health or various levels of degradation.

Sediment pollution can originate from many sources including, but not limited to: eroding streambanks, timber harvesting sites, construction sites, agricultural heavy use areas, and cropland. In urban areas, the prevalence of impervious surfaces can lead to increased stormwater runoff, which often results in increased erosion of streambanks, channel incision (down-cutting), and eventually habitat homogeneity. Negative implications for aquatic fauna that often result from these types of erosion can include the deposition of fine sediment, which contributes to a loss of habitat diversity, as well as other issues. The deposition of fine sediment on the stream-bottom can result in a change in interstitial spaces (areas between substrate particles), which can have a negative effect on aquatic insect communities and the fish species which feed upon them. Fine sediments also tend to reduce habitat complexity and cover up gravels which are critical areas for fish to spawn. Altogether, significant increases in sediment loads adversely impact the biotic community.

Figure 3.1.c. The greenbreast darter is one of many native species in the Holly Creek Watershed that are sensitive to sediment pollution.

3.2 Available Monitoring/Resource Data from Recent Years

During the formation of this WMP, a significant effort was undertaken to acquire any recent data collected in the watershed. In the past, Georgia EPD and Georgia Department of Natural Resources (DNR) Wildlife Resources Division (WRD) have conducted relevant monitoring within the Holly Creek Watershed. A portion of monitoring data from these groups was made available for the purposes of this document, and a relevant subset is presented in this section.

Georgia Environmental Protection Division Water Quality Monitoring Efforts

Water quality data collected using the listing/de-listing protocol by Georgia EPD in 2001 resulted in the listing of both Holly Creek stream segments on the 303(d)/305(b) list of impaired waters for fecal coliform violations. These data that resulted in impairments are displayed below in Table 3.2.b. In both cases, sampling results from multiple 30 day time periods confirmed the impairments. The geometric means for each quarter are included below in Tables 3.2.a.

Table 3.2.a. A display of geometric means of fecal coliform counts (in colony forming units/100 mL) calculated from samples collected by Georgia EPD in 2001 from Holly Creek at HW 411 and 225.

FECAL COLIFORM GEOMETRIC MEANS				
Location	Feb./March	May/June	Aug./Sept.	October
Holly Creek @ Highway 411 - 2001	505*	150	757*	635*
Holly Creek @ Highway 225 - 2001	602*	190	564*	284*

**** These time periods had violations that resulted in impairment.***

Georgia Wildlife Resources Division Monitoring Efforts

In addition to Georgia EPD's water quality monitoring efforts, Georgia WRD periodically monitors fish populations and lotic habitats (along with basic water quality parameters) to determine whether statewide criteria are being met. Data collected by WRD in 2004 in Mill Creek and Goldmine Branch/Rock Creek resulted in poor and very poor IBI scores, respectively, which led to the characterization of these sites as impaired due to impacted biota. A portion of the data from these sampling endeavors are included in Table 3.2.b. Impacted biota impairments, more often than not, are said to be caused by excessive sedimentation and habitat alterations within TMDLs; however, a TMDL has not yet been completed for these impaired reaches. Currently, the TMDL document is scheduled as a priority for 2018.

Table 3.2.b. A portion of the data obtained by Georgia DNR on July 15, 2004 during fish sampling efforts that led to impacted biota impairments in the Holly Creek Watershed.

FISH AND HABITAT DATA						
Location	# of Riffles	# of Pools	# of Native Species	Habitat Score	IBI Score	IBI Cat
Mill Creek	1	11	9	148.7	28	Poor
Goldmine Branch/Rock Creek	1	0	6	131.2	24	Very Poor

IBIs, according to Georgia EPD, assess the biotic integrity of aquatic communities based on the functional and compositional attributes of fish communities. They consist of twelve metrics, which assess species richness and composition, trophic composition and dynamics, and fish abundance and condition. Each metric is scored by comparing its value to that particular scoring criterion of the regional reference site. Collectively, the metric scores are combined to reach an IBI score that can be classified as Excellent, Good, Fair, Poor, or Very Poor. Although the IBI scores for the impacted biota impairments have been provided in Table 3.2.b., the metrics that contributed most to the low IBI scores for the Mill Creek and Goldmine Branch/Rock Creek impairments are not readily available.

Habitat assessments were also conducted at each sampling site to supplement and help clarify the results of the biotic indices. The habitat assessment utilized by WRD is broken into three levels that describe: in-stream characteristics, channel morphology, and the riparian zone surrounding the stream. The total habitat scores indicate optimal conditions from 166 to 200, suboptimal conditions from 113 to 153, marginal conditions from 60 to 100, and poor conditions from 0 to 44. Both stream reaches sampled were revealed to have suboptimal habitat conditions (although high scores for that characterization) based on their scores, but displayed generally good water quality conditions during the sampling effort.

Not available within the data received was information on the embeddedness of rocky substrates or the prevalence of fine sediments; however, the lack of riffles (only one at each site) stands out as a potential indicator of habitat homogeneity. The dominance of pools in Mill Creek and lack of pools altogether within Goldmine Branch/Rock Creek add weight to the argument. This information suggests a dominance of deep run and pool habitat at the Mill Creek site, and a dominance of likely shallow, run habitat within the site along Goldmine Branch/Rock Creek.

Another potential issue that may be negatively affecting biotic integrity at these sites was brought up at the stakeholder meeting and within stakeholder surveys. Specifically, undersized and perched culverts are a widespread problem throughout the country and may be impeding fish passage and negatively affecting stream habitats along these streams. Not only are improperly sized culverts prone to failure, but they also tend to constrict flow and augment velocities, often resulting in scour pools and a lowering of the stream bed, which creates a perched culvert. Perched culverts exhibiting vertical drops, debris blockages, and/or increased current velocities and turbulence can impede fish passage at culverts, which can limit fish movements between necessary habitats, recovery/recolonization after disturbance (such as drought), and dispersal from source populations. In addition, undersized culverts can lead to aggradation zones at culvert inlets and scour pools, and often channel incision, when accelerated culvert outflows erode banks and substrates at a greater rate than deposition can occur. As a result of potential culvert issues affecting biotic integrity along these streams, a preliminary investigation was conducted on their culverts. Further detail is provided in Section 3.3.

Figure 3.2.a. The Alabama hogsucker, a fish common to the Holly Creek Watershed, was one of nine native fishes sampled during monitoring efforts at the Mill Creek site.

The Nature Conservancy and U.S. Fish and Wildlife Service Monitoring Efforts

The Holly Creek Watershed has been and remains a high priority watershed for both The Nature Conservancy and U.S. Fish and Wildlife Service due to its unique aquatic assemblage which includes several listed species. In 2005, these groups worked together to conduct a rapid stream corridor assessment for eight miles of upper Holly Creek from the Chattahoochee National Forest boundary moving downstream to the City of Chatsworth. The assessment consisted of walking the entire length of stream channel along this segment of Holly Creek and documenting all relevant issues and stressors according to the Maryland Department of Natural Resources guidelines (available at http://www.dnr.state.md.us/irc/docs/00005291.pdf). Locations within the stream corridor with barriers to aquatic organism passage, beaver dams, channel alterations, ditches, ford crossings, inadequate riparian vegetation, livestock access, row crops, streambank erosion, tile drains, and other issues were all to be documented with this effort along with their severity, the relative ease of ameliorating the particular issue, the accessibility of the location, and the potential for wetland construction.

A website (http://hollycreekga.blogspot.com/) was put together in 2008 to document the rapid corridor assessment online, and to this date for the most part the site remains in working order. An interactive map was also constructed using Google Earth to show the locations of various issues and stressors that were encountered and allow pictures and corresponding datasheets to be viewed from each pinpointed location. This information remains available, and is helpful to assess the potential impacts that may be found in the future on properties of landowners interested in cost-shares on best management practices.

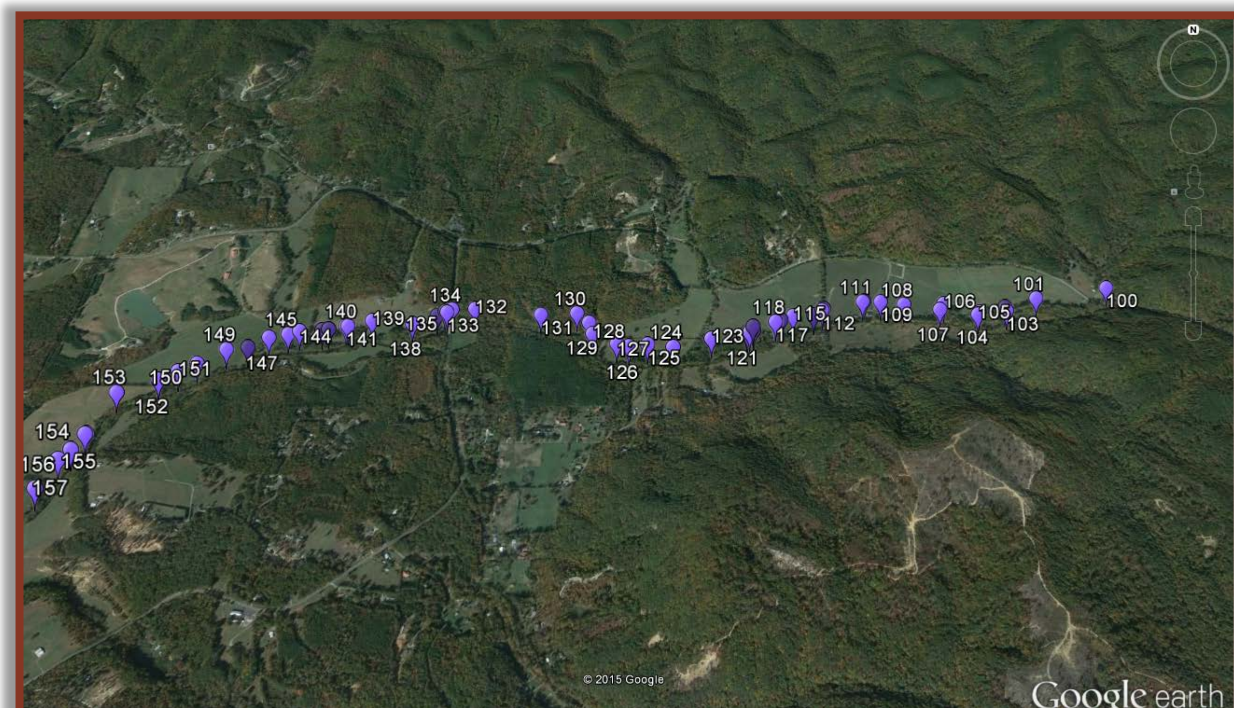


Figure 3.2.b. This screenshot of the Google Earth interactive map shows the relative number of issues along Holly Creek pinpointed in the 2005 stream corridor assessment. This information can be accessed at http://hollycreekga.blogspot.com/

Figure 3.2.c. The above photo is a picture from the Google Earth interactive map documenting a lack of riparian buffer and a vertical, continuously eroding streambank along Holly Creek. Vertical, earthen streambanks tend to slough off massive amounts of sediment into streams making life difficult for sensitive aquatic organisms downstream.

In addition to allowing access to the maps and corresponding photos and data, the website discusses the ecological significance of Holly Creek. It also points out that a decline of mussels was occurring in 2008 starting from the Rock Creek-Holly Creek confluence. Evidence at the time suggested that a head cut, or overly steep drop-off of the channel, had originated at a farm near this confluence and was working its way upstream along Holly Creek and Rock Creek, lowering the elevation of the channels through erosive channel adjustments. The migration of a head cut tends to continue upstream until a grade control structure such as a bedrock outcrop (or artificial structure) stops the channel downgrading from moving upstream. This channel downgrading tends to lead to increased bankfull capacity during storm events and reduced connection with floodplains (where flows are neutralized). As a result, more streambank erosion often occurs, and subsequently, further sedimentation and alteration of substrate composition.

Despite this evidence of a head cut in 2008, further updates on Holly Creek were not been made available on the site. However, the effort to investigate and document issues within Holly Creek is quite valuable as a starting point for additional restoration efforts. A similar rapid stream corridor assessment could be implemented in the future to allow comparisons with upper Holly Creek from this time period.

3.3 Monitoring/Resource Data Collected for the WMP

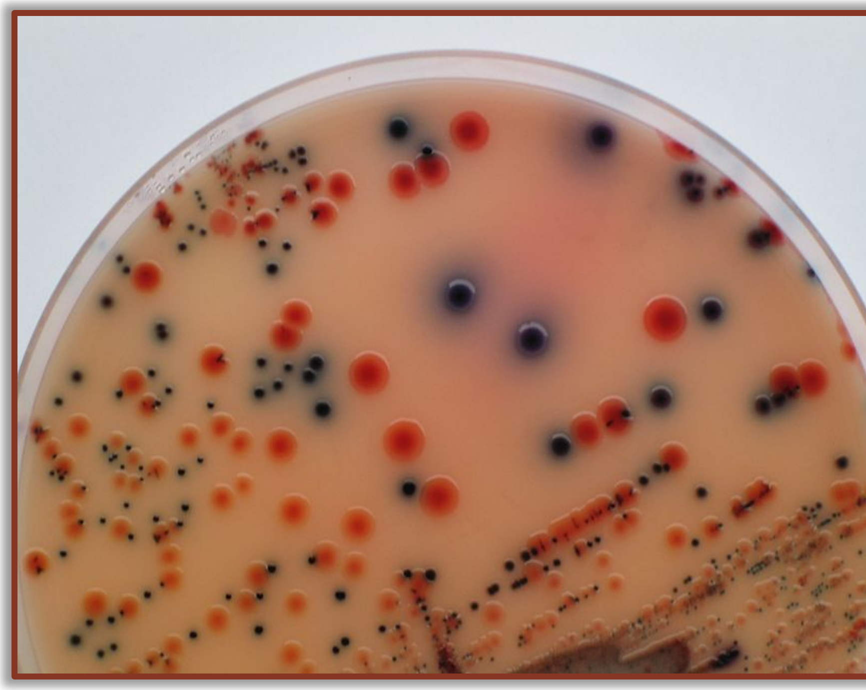


Figure 3.3.a. Bacterial growth on a petri dish.

Additional efforts were made to determine current watershed conditions and provide stakeholders with current water quality data and assist with the decision-making process (e.g., determining priority areas) during the development of this plan. This sampling effort, detailed in a *Targeted Water Quality Monitoring Plan,* focused on collection of fecal coliform count and total suspended solids (TSS) data. Fecal coliform counts were determined to represent amounts of fecal contamination upstream of each site, and TSS was used to represent potential erosion issues upstream of each site. Samples were taken from eight sample sites (Figure 3.3.b.) to allow comparisons within the watershed. Samples were collected from these sites during both wet and dry periods of the summer and winter. This was orchestrated because wet weather samples better represent the NPS pollution flushed from the landscape during runoff events (and potentially when floodplains are inundated); whereas samples collected during dry events better reveal instream sources of NPS pollutants. Summer and winter samples were collected because state criteria change seasonally.

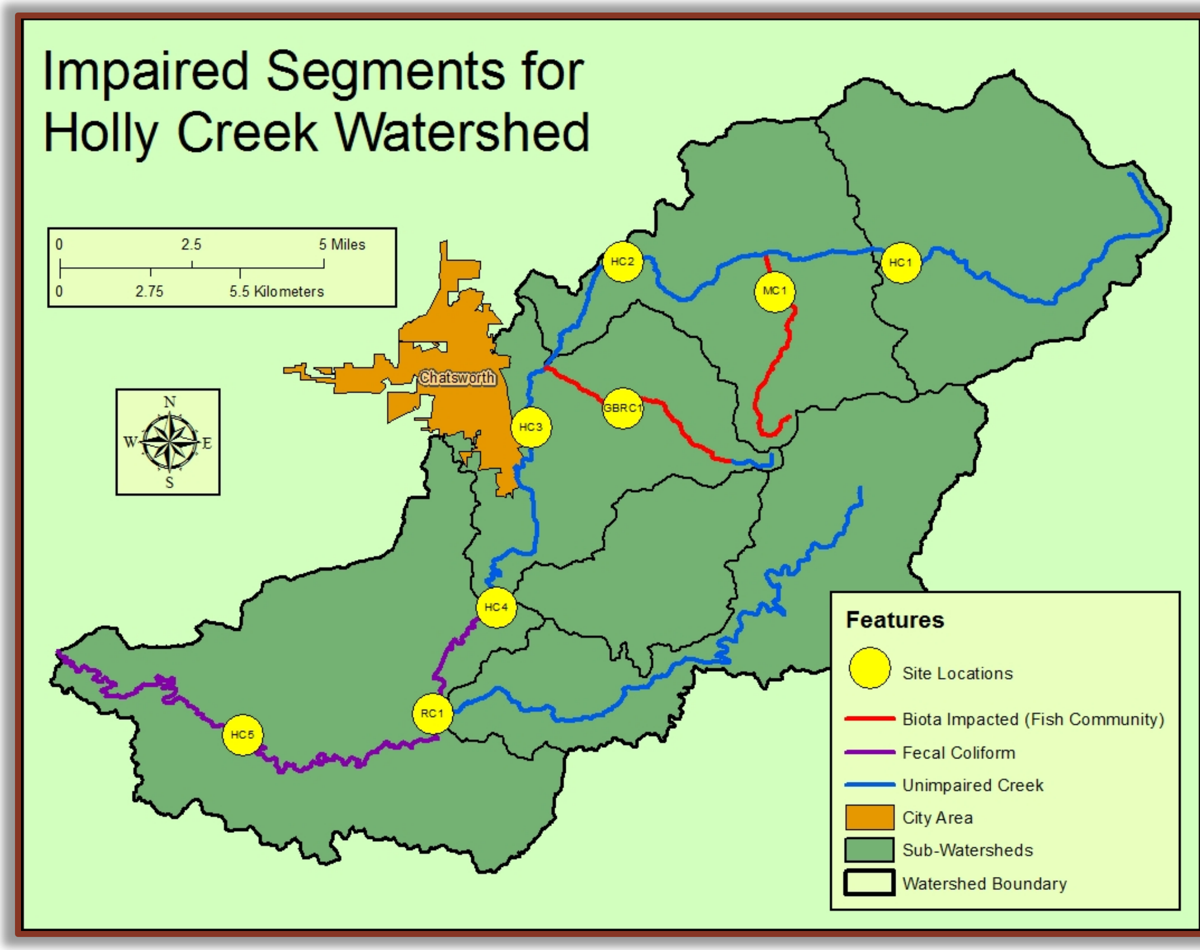


Figure 3.3.b. A display of the locations of the eight sample sites used during targeted monitoring in the Hollv Creek Watershed.

<u>Fecal Coliform Sampling</u>

Sampling the eight sites revealed additional information regarding fecal coliform bacteria and sediment sources in the watershed. The fecal coliform sampling data (Table 3.3.a.) revealed a few potential trends. In general, greater fecal coliform counts were found in the lower segments of Holly Creek (where the fecal coliform impairments are located) and to a lesser extent within middle Holly Creek (HC3) and Rock Creek (RC1). All of the maximum counts per site occurred after precipitation events. Counts above 4,000 cfu/100 mL occurred at the three lowest sites on Holly Creek (HC3, HC4, and HC5) after a precipitation event in February of 2014 and are considered instantaneous maximum violations. The lowest fecal coliform counts on average were recorded at the most upstream Holly Creek site (HC1) within the Chattahoochee National Forest and at the Mill Creek site.

Table 3.3.a. A display of geometric means and maximums (n = 12) of fecal coliform counts (in colony forming units) calculated from samples collected in 2013 and 2014 in the Holly Creek Watershed.

GEOMETRIC MEANS OF FECAL COLIFORM COUNTS (2012-2013)		
Site (code)	**Geometric Mean (CFU)**	**Maximum Count (CFU)**
Holly Creek Site 1 (HC-1)	11	80
Holly Creek Site 2 (HC-2)	61	500
Holly Creek Site 3 (HC-3)	91	5,000
Holly Creek Site 4 (HC-4)	131	12,000
Holly Creek Site 5 (HC-5)	163	8,500
Goldmine Branch/Rock Creek Site 1 (GBRC-1)	74	300
Mill Creek Site 1 (MC-1)	20	500
Rock Creek Site 1 (RC-1)	82	2,400

Sampling was conducted during wet weather events on four of twelve sampling dates as sampling during wet weather tends to indicate where runoff issues lie on the landscape. Wet weather was characterized by more than 0.25 inches of precipitation within the last 48 hours. These wet-weather events often resulted in higher bacteria counts than when sampling was conducted during dry periods. The geometric means from these sampling events per site are documented in Table 3.3.b. below. Again, all of the maximum counts per site (shown above) occurred after precipitation events.

Table 3.3.b. A display of geometric means (n = 4) of fecal coliform measurements calculated from samples collected during wet weather events in 2013 and 2014 in the Holly Creek Watershed.

GEOMETRIC MEANS OF FECAL COLIFORM COLONY FORMING UNITS (2013-2014) FROM WET WEATHER SAMPLING EVENTS	
Site (code)	**Geometric Means (CFU)**
Holly Creek Site 1 (HC-1)	31
Holly Creek Site 2 (HC-2)	137
Holly Creek Site 3 (HC-3)	477
Holly Creek Site 4 (HC-4)	857
Holly Creek Site 5 (HC-5)	958
Goldmine Branch/Rock Creek Site 1 (GBRC-1)	134
Mill Creek Site 1 (MC-1)	21
Rock Creek Site 1 (RC-1)	324

On eight of twelve sampling dates, sampling was conducted during dry weather events, which is likely a better indicator of direct introduction of fecal contamination upstream. The data gathered from these events show relatively low levels of fecal coliform bacteria. The geometric means from these sampling events per site are documented in Table 3.3.c. below, along with the maximum fecal coliform counts from dry weather sampling per site.

Table 3.3.c. A display of geometric means (n = 8) of fecal coliform measurements calculated from samples collected during dry weather events in 2013 and 2014 in the Holly Creek Watershed.

GEOMETRIC MEANS AND MAXIMUMS OF FECAL COLIFORM COLONY FORMING UNITS (2013-2014) FROM DRY WEATHER SAMPLING EVENTS		
Site (code)	**Geometric Mean (CFU)**	**Maximum Count (CFU)**
Holly Creek Site 1 (HC-1)	7	63
Holly Creek Site 2 (HC-2)	41	230
Holly Creek Site 3 (HC-3)	40	220
Holly Creek Site 4 (HC-4)	51	131
Holly Creek Site 5 (HC-5)	67	171
Goldmine Branch/Rock Creek Site 1 (GBRC-1)	56	280
Mill Creek Site 1 (MC-1)	19	200
Rock Creek Site 1 (RC-1)	41	160

Due to the unpredictable nature of fecal coliform bacteria in streams, the recent fecal coliform count data are difficult to compare with the historic EPD data due to a lack of congruency in terms of sampling sites and schedules, as well as a lack of data on precipitation, flows, and rainfall antecedent. However, the 2001 data collected by Georgia EPD show three of four 30 day periods at both sites along lower Holly Creek failing to meet state criteria for fecal coliform counts, which indicated clearly evident, if not obvious impairments at the time. Overall geometric means of counts from these historical data were as high as 437 cfu/100 mL (n=16) at the Highway 411 site and 331 cfu/100 mL (n=24) at the Highway 225 site. These sites are located between HC3 and HC4 and between HC4 and HC5, respectively. In comparison, the data collected within 2013 and 2014 reveal overall geometric means of counts as low as 91, 131, and 163 cfu/100 mL respectively for HC3, HC4, and HC5, which were each sampled on 12 occasions. This evidence suggests that extensive water quality improvements have occurred over the years in lower Holly Creek. Despite these perceived improvements, however, lower Holly Creek still appears to deserve its characterization as impaired as evidenced by the recent instantaneous maximum violations. Additional water quality improvements appear necessary before a de-listing effort can be successfully conducted.

Sampling for Total Suspended Solids

The total suspended solids data (Table 3.3.d.) revealed TSS as generally higher in the downstream segments of Holly Creek than its upstream segments and tributaries. All but one of the maximum counts per site occurred after precipitation events. Segments impaired for impacted biota had relatively low TSS levels compared within mainstem Holly Creek sites, suggesting a lack of mobilized fine sediment during most hydrological conditions.

Table 3.3.d. A display of TSS geometric means (n = 12) from samples collected by Limestone Valley in 2013 and 2014 in the Holly Creek Watershed.

TOTAL SUSPENDED SOLIDS GEOMETRIC MEANS (2013-2014)		
Site (code)	**TSS Geometric Mean**	**Maximum TSS Observation**
Holly Creek Site 1 (HC-1)	2.8	22
Holly Creek Site 2 (HC-2)	3.5	61.6
Holly Creek Site 3 (HC-3)	6.5	124.8
Holly Creek Site 4 (HC-4)	11.2	182
Holly Creek Site 5 (HC-5)	14.4	166
Goldmine Branch/Rock Creek Site 1 (GBRC-1)	4.6	23.4
Mill Creek Site 1 (MC-1)	1.5	16
Rock Creek Site 1 (RC-1)	2.2	38.3

A Preliminary Assessment of Culverts along Mill Creek and Goldmine Branch/Rock Creek

Culverts and other stream crossings along Mill Creek and Goldmine Branch/Rock were preliminarily investigated and photographed to assess whether barriers to fish passage could be impacting biotic integrity within these stream reaches. While road crossings can pose a myriad of other issues, only the likelihood of fish passage was evaluated for this preliminary effort due to the time and expertise required to consider more comprehensive inspections of the structures and their effects on streambanks and instream habitats.

Mill Creek has four road crossings, and the three most-downstream were able to be viewed without entering private property. The stream reach sampled by Georgia DNR was upstream of at least the first two road crossings. The fourth and most-upstream road crossing in a private neighborhood above the stream reach sampled by Georgia DNR was not assessed. The most downstream crossing is a four cell box culvert beneath Holly Creek-Cool Springs Road, and is shown in Figure 3.3.c. No vertical barriers were present, although some debris was present on the upstream end and an island was present on the lower end in the middle of the four chambers. Natural substrates appeared dominant within the structure, and riffles of moderate gradient upstream and downstream of the structure and likely within the cell with the lowest elevation appeared navigable to fishes. The second most downstream crossing was a free span bridge, depicted in Figure 3.3.d. No vertical barriers to fish passage were present, and current velocity appeared similar to the rest of the stream. Large cobbles dominate the substrate beneath the structure. Fish passage appears feasible at this location in the vast majority of conditions. The most upstream crossing was a free-span bridge leading onto a private property. While the stream appears steeper in this reach and the bridge does reduce flood plain connectivity, fish passage issues are unlikely to result from the bridge.

Figure 3.3.c. A photograph of the box culvert that spans Mill Creek on Holly Creek-Cool Springs Road. The structure is the least ideal along Mill Creek, but does appear likely to allow fish passage during most hydrological conditions.

Figure 3.3.d. The free span bridge that spans Mill Creek on Hassler's Mill Road.

Figure 3.3.e. The free span bridge that spans Mill Creek on a private drive off of Clinton Lunsford Road.

Goldmine Branch/Rock Creek has three road crossings, all of which were assessed for the development of this WMP. The stream reach sampled by Georgia DNR was upstream of at least the first two road crossings, and probably the third as well. The most downstream crossing is a concrete box culvert with three circular holes to convey water beneath Hensley Road, and is shown in Figure 3.3.f. A vertical drop is present on the downstream edge that is at the very least likely impeding movements of small fishes during the dryer periods of the year. Water depth within the structure during dry periods may be quite shallow as well. Debris was present on the upstream end in each of the three holes, with aggradation of cobbles upstream of the structure apparent as well due to the inability of the structure to properly convey bedload material. The second most downstream crossing was a concrete box culvert with three cells along Holly Creek-Cool Springs Road, depicted in Figure 3.3.g. A significant vertical barrier (greater than 10 cm) was present across the culvert outlet, and is likely a barrier to the movement of small fishes during most hydrological conditions (according to Coffman 2005). The most upstream crossing along Goldmine Branch/Rock Creek was a free-span bridge leading in the direction of a private property, and is shown in Figure 3.3.h. Although the stream appears steeper in this reach and a rock outcrop beneath the bridge creates a steep, turbulent riffle, the bridge does not appear the cause of any significant issues.

Figure 3.3.f. The concrete culvert that spans Goldmine Branch/Rock Creek on Hensley Road.

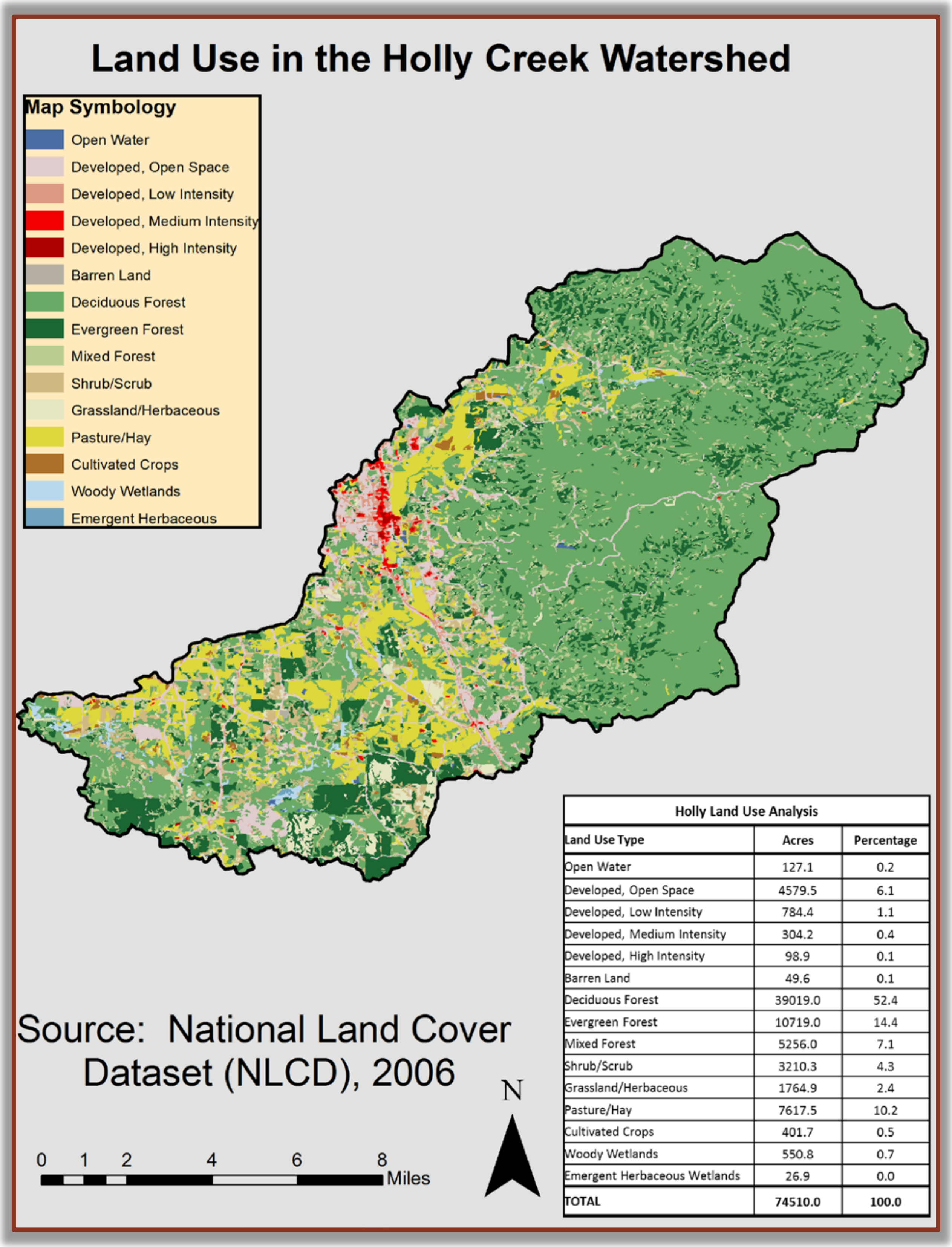
Figure 3.3.g. The concrete box culvert on Holly Creek-Cool Springs Road above Goldmine Branch/Rock Creek.

Figure 3.3.h. The bridge that crosses Goldmine Branch/Rock Creek upstream.

In summary, despite several road crossings along Mill Creek, the crossings visited appeared likely to allow fish passage during most conditions. As for Goldmine Branch/Rock Creek, the more downstream road crossings appear to be fairly concerning in terms of fish passage. With the more upstream reaches more likely to dry during drought, connectivity with downstream segments is important for post-disturbance recovery of fish assemblages.

3.4 Land Use Analysis

Land uses within the Holly Creek Watershed are somewhat variable (and revealed in Figure 2.3.a.), yet primarily reflect its rural nature with the exception of the area around Chatsworth, the largest city in Murray County. Forested lands predominate the watershed (73.9%), especially in the headwaters (The Blue Ridge Mountains within Chattahoochee National Forest) and along floodplains, although a sizeable percentage of land and its resources are also devoted to agricultural production in the lower and middle portions of the watershed (10.7%). Most agricultural lands are used for cattle and horse grazing, however, poultry and crop production (mostly corn and soybeans) also occurs within the drainage. Urban lands account for just over 7% of the land use. While small in comparison to other land uses, urban land uses mostly occur in the areas in and surrounding Chatsworth. All of the land use types outlined likely exert some contribution to the current water quality conditions in the watershed, although significant variation in NPS contributions per land use exists from parcel to parcel depending on management.



Holly Land Use Analysis

Land Use Type	Acres	Percentage
Open Water	127.1	0.2
Developed, Open Space	4579.5	6.1
Developed, Low Intensity	784.4	1.1
Developed, Medium Intensity	304.2	0.4
Developed, High Intensity	98.9	0.1
Barren Land	49.6	0.1
Deciduous Forest	39019.0	52.4
Evergreen Forest	10719.0	14.4
Mixed Forest	5256.0	7.1
Shrub/Scrub	3210.3	4.3
Grassland/Herbaceous	1764.9	2.4
Pasture/Hay	7617.5	10.2
Cultivated Crops	401.7	0.5
Woody Wetlands	550.8	0.7
Emergent Herbaceous Wetlands	26.9	0.0
TOTAL	74510.0	100.0

Figure 3.4.a. A map displaying the Holly Creek Watershed's more prominent land uses and their percentages within the watershed.

3.5 Riparian Buffer Analysis

A stream buffer analysis was also completed for the Holly Creek Watershed as part of the development of the WMP due to the importance of woody vegetative buffer zones (i.e., riparian zones) on stream and water quality conditions. As the name indicates, these zones literally serve as a buffer between activities that occur on the landscape and the contents of the water in the stream by physically catching pollutants (e.g., sediment, nutrients, bacteria) from runoff during rain events.

In addition, woody buffers serve many other functions that are important to the health of the stream. One of the functions of sufficiently intact buffers is the mitigation of stream bank erosion, which is a common contributor of sediment to streams. The roots of the vegetation help to hold the sediment in place during high flows, making the banks more stable. Woody vegetation also provides shade for the stream, which aids in keeping the temperatures low (and dissolved oxygen high). Dense vegetation in the riparian zone also contributes falling dead and dying vegetation into the stream channel, providing diverse habitat for aquatic life.

Conducting an analysis of woody buffers within an impaired watershed has become an acceptable way to assess areas in need of restoration. Insufficient riparian buffers often indicate sources of NPS pollution. These areas could simply be a place where pollutants enter the stream through runoff, or even a place where livestock enters the stream (heavy use inhibits vegetative growth) thereby allowing direct introduction of NPS pollutants.

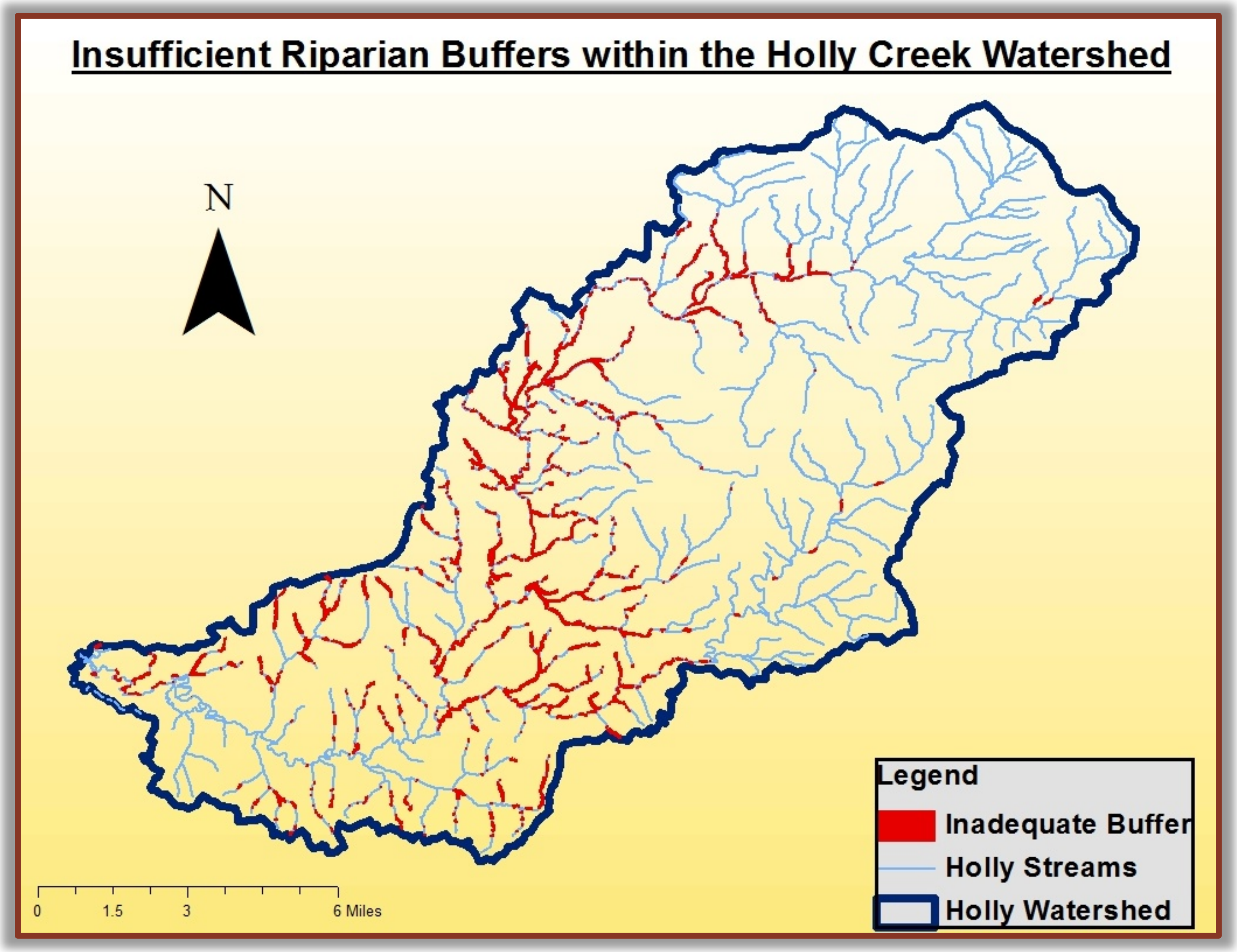
The stream buffer analysis was conducted using GIS software and recent aerial imagery. The purpose of this analysis was to identify areas of inadequate woody vegetation within a 100 foot buffer on each side of all streams. Every tributary was analyzed with the software and aerial imagery (viewed with the naked eye), to confirm insufficient buffers. The areas having insufficient riparian zones are depicted in pink in Figure 3.6.a. A percentage of inadequate buffer was also calculated and is displayed in Table 3.6.a. This information was used for estimating the technical and financial assistance needed to de-list the impaired segments (discussed later).

Table 3.5.a. A display of inadequate buffer statistics for the Holly Creek Watershed.

INADEQUATE BUFFER STATISTICS BY LAND USE	
Land Use	**Inadequate Acreage (%)**
Urban Lands	74.3 (10.9%)
Agricultural Lands	388.5 (56.9%)
Other Lands	219.5 (32.2%)
Total Inadequate Acreage	**682.3 acres**
Percent Inadequate Buffer	**10.5%**

The buffer analysis map reveals that many of the insufficient woody buffers in the watershed are along tributaries towards the more developed middle portion of the Holly Creek watershed. The majority of the inadequate buffer acreage lies on grazing lands where lack of riparian buffers when combined with cattle access can increase bank erosion, and thus sediment introduction, into the Holly Creek system. Urban areas around Chatsworth appear to have a significant portion of their buffers classified as inadequate. One can assume that the more intense development and impervious surface cover in the Chatsworth area has a great need for an intact riparian buffer zone to better protect the stream banks and instream habitats from the more potent storm-flows that coincide with more intense development.

Figure 3.5.a. An image depicting insufficient buffers (in red) within the 100 foot buffer of streams in the Holly Creek Watershed.



3.6 Structure Density Analysis

Additional GIS analysis was conducted to investigate the number of structures that occur within a 500 foot buffer of streams within the watershed. This analysis generated the map in Figure 3.6.a., and the information in Table 3.6.a. Specific types of dwellings were quantified, and residences can be used to represent the likelihood of septic system presence and ultimately fecal coliform contributions from failed septic systems. The figure and the data in the associated table were utilized to evaluate where sources of fecal coliform contributions from septic systems are likely significant. These data indicate that septic systems may be significant issues on the outskirts of the City of Chatsworth and the surrounding agricultural/residential lands.

Table 3.6.a. A display of the number of structures found within a 500 foot buffer within the Holly Creek Watershed.

STRUCTURES WITHIN HOLLY CREEK BUFFERS		
Agricultural	Commercial	Residential
648	552	4,786

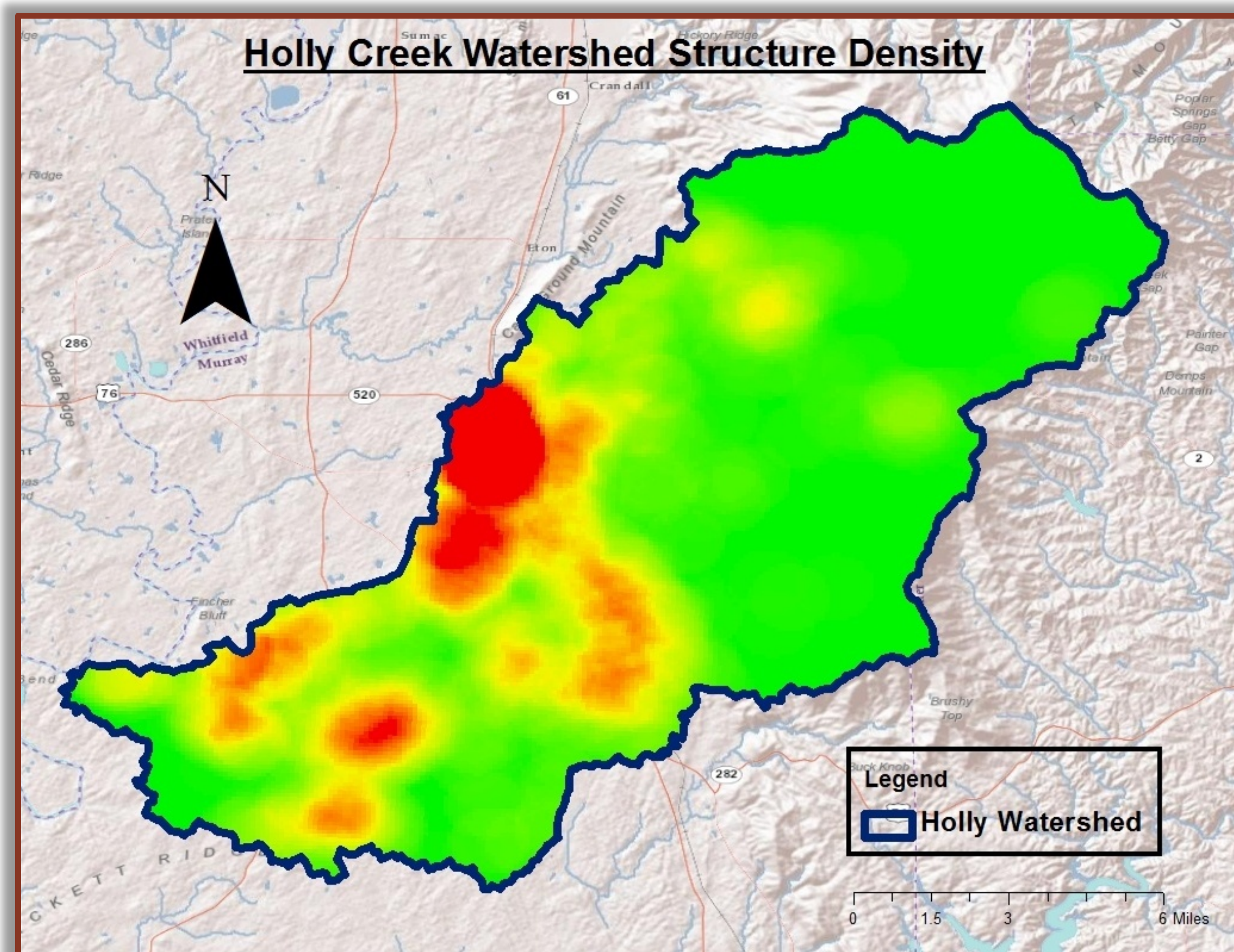


Figure 3.6.a. An image depicting the distribution of structures found in the Holly Creek Watershed. Red depicts a high density area, whereas green reflects low density areas.

4. Pollutant Source Assessment

This section of the WMP outlines the most likely significant sources of impairing pollutants within the watershed. The most significant issues in the watershed stem from excessive fecal coliform loads, and presumably sediment and habitat homogeneity, which more than likely led to impaired biota. The two major categories of pollutants addressed in this section are point and nonpoint sources. The following information was gathered through both research and stakeholder input during WMP formation.

4.1 Nonpoint Sources

Nonpoint source pollution encompasses a wide range of pollutants distributed across the landscape and washed into streams during rain events, as well as those NPS pollutants deposited directly into streams from unregulated sources. These pollutant sources are difficult to identify and regulate since they are typically ubiquitous and originate from numerous land parcels with various owners. NPS pollution can also be quite variable over time due to variable land uses, management practices, grazing rotations, runoff events, and other factors. It is generally assumed that NPS pollution makes up a significant portion of the pollutant load in this watershed leading to impairments since there are few point sources permitted under the NPDES program.

Although the management of particular parcels will not be discussed within this plan, it is apparent that the most prevalent nonpoint source pollution issues in the watershed relate to insufficient riparian buffers along streams, livestock access to streams, failing septic systems, streambank erosion, stormwater runoff, undersized culverts, the application of poultry manure, drainage ditches and tile drains from agricultural fields, and potentially others.

<u>Agriculture</u>

Within the Holly Creek Watershed, agriculture makes up 10.7% of the land use. Activities range from livestock grazing and hay production (pasture = 10.2%) to cultivation of crops (0.5 %). Many poultry operations are also located in the watershed. Agriculture, with the exception of forest, is the most dominant land use type and over half of the inadequate buffer detected through GIS analysis was found to be in agricultural lands. Thus it likely plays a role in impairment issues. Stakeholders postulated that installing agricultural best management practices would likely help reduce fecal coliform bacteria and sediment loads within the watershed. These agricultural programs will not only lead to nonpoint source pollution reduction, but will do so in a way that is already accepted in the local community, while also assisting farmers in their management operations.

Figure 4.1.a. Cropland is a common contributor of nonpoint source pollution in the U.S.; however, it only accounts for a small percentage of land use within the watershed.

With pastures representing approximately 10% of the land use in the watershed, livestock has the potential to be a significant contributor to both fecal coliform and sediment loads in the form of NPS pollution. Although dairy cattle, hogs, and poultry spend a large portion of their time confined (see CAFOs in 5.2), beef cattle spend the vast majority of their time in pastureland. In the pasture, cattle tend to deposit their feces upon the land, as well as create erosion issues and destroy vegetative cover when overgrazed. When significant feces builds up and erosion becomes more prevalent on the landscape, fecal coliform bacteria and eroded soil become more frequently captured by rainwater runoff and delivered into nearby waterways.

In addition to nonpoint sources of pollution derived from the landscape, beef cattle often have access to streams that run through pastureland, giving them the opportunity to deposit feces directly into the waterways. This stream access also generally contributes to the sediment load through streambank erosion, which is often significant. When cattle destroy much the vegetation in the riparian zone, the streambank may collapse into the waterway, increasing the sediment load further.

Poultry operations are also fairly common throughout the watershed. Depending on the number of animals present, these operations can be classified as potential nonpoint sources (< 125,000 animals) or potential point sources (> 125,000 animals; see Permitted CAFOs in 5.2) which require an NPDES permit to operate. There are many poultry operations in the Holly Creek Watershed, although none exceed the threshold above which NPDES permits are required. Despite this fact, these operations are still potential NPS contributors due to their production of large quantities of animal waste that is often applied to agricultural lands. According to Wang et. al. (2004), fecal coliform can survive for several months after animal waste excretion. This suggests that even aged manure could be a significant contributor to the fecal coliform bacteria load when applied to the landscape.

Only a small percentage of the watershed is characterized as cropland. Despite this fact, croplands could still contribute significant amounts of pollutants (e.g., fecal coliform after manure application) into nearby waterways. Croplands can also factor into sediment loading. According to the National Research Council (1989), sediment deposition into surface waters is significantly related to cropland erosion within basins.

Various ways to ameliorate nonpoint source issues from agricultural operations in the watershed are depicted in Figures 4.1.b. through 4.1.e. and include establishing and maintaining sufficient riparian buffers along streams, reducing livestock access to streams, offering alternative watering practices (e.g., livestock ball waterers, troughs, stream crossings, and watering ramps) to reduce livestock utilization of streams and other water bodies, promoting rotational grazing practices (e.g., cross-fencing, etc.) to improve grazing efficiency and reduce livestock impacts, ensuring agricultural ditches and tile drains have a vegetative buffer to reduce direct inputs of nutrient-rich drainage into streams, reducing tillage where possible, promoting best management practices for poultry litter application, restoring eroding streambanks with biostabilization practices, and assisting farmers in installing properly sized culverts where undersized culverts are a problem.

Some of these practices are already implemented with assistance from various programs in the watershed (see Section 6-1). Many of these practices will be part of the newly proposed conservation program to improve water quality in the Holly Creek Watershed. These practices are detailed within Section 6.1 and Section 7.

Figure 4.1.b. The establishment of a riparian buffer along a stream impacted by livestock grazing.

Figure 4.1.c. The establishment of fencing along a stream impacted by heavy livestock use can immediately reduce direct inputs of nutrient-rich feces, fecal coliform bacteria, sedimentation from constant bank erosion, and allow healthy vegetation to thrive along the stream providing shade.

Figure 4.1.d. Installation of automatic watering systems along fencing establishes a source of clean water in multiple grazing units, and reduces the need for livestock to be in the vicinity of streams. The layer of graded aggregate base around the waterer reduces erosion issues in the immediate area.

Figure 4.1.e. Installation of stream crossings on farms allows the movement of livestock across streams while potentially maintaining livestock access to water. However, these crossings significantly reduce the impacts of livestock on the streambanks and in the channel. Combined with fencing along the stream, the impacts of livestock are drastically reduced, while water is still accessible.

Wildife

Depending on the animals present within the watershed (see 3.2), wildlife contributions of fecal coliform and sediment to streams vary considerably. Based on the TMDL written for this section of Georgia and information provided by the Wildlife Resources Division of Georgia DNR, the animals that spend the majority of their time in and around aquatic habitats are the most important wildlife sources of fecal coliform bacteria. Waterfowl are considered to be significant contributors since they spend a large portion of their time on surface waters and deposit feces directly into the waterway. Other contributors include aquatic mammals such as beaver, muskrat, and river otters. Beaver are a particular problem along upper Holly Creek (upstream of Chatsworth) as their dams can lead to the formation of new channels, streambank erosion, and instability, in addition to their contributions to the fecal coliform load. Feral pig populations (*Sus scrofa*), known to exist along the floodplains of every major river in Georgia, could also contribute as they have been sighted locally. According to

Figure 4.1.f. Wildlife can also contribute to a stream's fecal coliform load.

Kaller et. al. (2007), these animals can contribute both fecal coliform and sediment to waterways due to their numbers and behavior. The large proportion of forested lands in this watershed suggests that wildlife may be contributing to the fecal coliform load, however our data from the forested lands indicate minimal impacts. Regardless, minimization of fecal coliform contributions from wildlife will not be a major focus of the plan. Instead the plan will emphasize the reduction of anthropogenic sources of fecal coliform bacteria.

Urban/Suburban Runoff

Sediment pollution can originate from many sources in an urban or suburban area, such as Chatsworth. Land-disturbing activities are a consistent contributor of sediment to streams nationwide. These activities include clearing, grading, excavating, or filling of land. Disturbance of land typically removes the vegetation, which exposes the surface sediment to rain events resulting in erosion and sediment delivery into streams. For example, conversion of forests to developed land (clearing) is often associated with water quality degradation.

In more urbanized areas, stormwater runoff can also contribute to erosion issues in streams. This type of runoff originates from developed land that contains higher proportions of impervious surface cover (rooftops, parking lots, roads, etc.). These surfaces concentrate large quantities of water into the stream quickly, resulting in stream bank erosion and incision. Eventually, as banks collapse, streams tend to widen and collect additional sediment, which can lead to losses in habitat variation. Assisting the community of Chatsworth with the installation of various, additional stormwater practices and other green infrastructure may be able to reduce these issues in the Holly Creek Watershed.

Figure 4.1.g. A failing septic system can introduce pathogens into nearby streams. This system has effluent surfacing in the yard, and drains into a nearby tributary.

In addition to introduction of sediment into waterways, fecal coliform contributions can also occur as a result of stormwater runoff. Domestic pets and urban wildlife populations contribute fecal coliform to the landscape, which is often washed directly into streams during rain events. Similar contributions in urban environments often originate from leaks and overflows from sanitary sewer systems, illicit discharges, and leaking septic systems in areas not serviced by sewer.

Stakeholders identified failing septic systems as a significant contributor to the fecal coliform load in the watershed. Past efforts to reduce this widespread issue were dispersed throughout the greater Conasauga Watershed area. Targeting these issues in the smaller Holly Creek Watershed should lead to more effective water quality improvement efforts during the implementation of this plan.

When considering failing septic systems as contributors of fecal coliform bacteria in our streams, it is important to look at current systems on the ground, as well as anticipate those that come along with new development. Currently, there are over four thousand households in the watershed that are serviced by septic systems. The Murray County Environmental Health Department has stated that failing septic systems in the area are frequent due to the poor percolating soils in the area, and homeowners are often unable to fix these systems in a timely manner due to the local financial conditions of many residents.

Due to population growth rates and the frequent use of septic systems (over 4,000 households in the watershed), stakeholders considered failing septic systems to be another significant source of fecal coliform bacteria loads. It was decided by the stakeholder group that landowners experiencing septic failures would likely be motivated to fix them, especially if cost-share assistance is available.

4.2 Point Sources

Point sources of pollution are those which are delivered to a waterbody via “discrete conveyances”. These sources are regulated through the NPDES permitting system. Point sources typically include industrial sites, municipal separate storm sewer systems, and confined animal feeding operations (CAFOs). There are few permitted point sources in the watershed, and it is assumed that the majority of impairing pollutants result from NPS pollution.

Industrial Sites

Many industries are required to apply for an NPDES permit when discharging industrial storm water to a nearby waterbody. There are only two permits of this type located within the watershed. Since all are in compliance with their NPDES permits, it is likely that industrial stormwater’s contribution to stream impairment is minimal. Table 4.2.a. lists the industrial NPDES permits found within the watershed.

Table 4.2.a. A display of the locations of facilities that hold NPDES permits within the Holly Creek Watershed.

INDUSTRIAL NPDES PERMITEES WITHIN THE HOLLY CREEK WATERSHED	
FACILITY	ADDRESS (CHATSWORTH, GA)
O-N Minerals Chemstone	103 Holly Street
Murray County Landfill	6585 Hwy. 411 South

According to the EPA (2011), Stormwater Phase I regulations (1990) require *medium* and *large* cities or certain counties with populations of 100,000 or more to obtain NPDES permit coverage for their stormwater discharges. Phase II (1999) requires regulated small MS4s in urbanized areas, as well as small MS4s outside the urbanized areas that are designated by the permitting authority, to obtain NPDES permit coverage for their stormwater discharges. There are no areas within the Holly Creek Watershed that fall under phase I or Phase II regulations, and thus any stormwater issues found within the watershed must be considered non-point source pollution.

CAFO Permits

Confined animal feeding operations (CAFOs) are considered a point source of pollution by Georgia EPD and require an NPDES permit as they reach certain capacity thresholds. Although there are many poultry operations with the Holly Creek Watershed, none are large enough (>125,000 birds) to require an NPDES permit and therefore be characterized as point source pollution. No dairy or swine operations are present within the watershed either. Thus, no CAFOS are present in the watershed that are large enough to require an NPDES permit. Permitted CAFOs are therefore not considered to be a source of impairment in the Holly Creek Watershed.

Figure 4.2.a. There are many poultry operations within the Holly Creek Watershed. None, however, exceed the capacity threshold that requires NPDES permits.

5. Watershed Improvement Goals

This section of the WMP outlines the overall goals for the watershed improvement process in the Holly Creek Watershed. In addition, the minimum NPS load reduction objectives for each segment (as written in TMDLs) are included and describe the estimated necessary load reductions for streams to meet water quality criteria.

5.1 Overall Objectives

Restoration

Figure 5.1.a. Excluding cattle from streams can reduce the fecal coliform load in the watershed.

The primary objective of this WMP is to outline a framework that will lead to the restoration of the Holly Creek Watershed to achieve and maintain compliance with state standards. Four segments have been placed on Georgia's 303 (d)/305 (b) list, totaling over eighteen miles of impairments. A major component of restoration efforts will include implementing cost-share programs that incentivize landowners to address pollution sources on their privately-owned lands. Reductions in relevant pollutants will be tracked through water quality monitoring and potentially by sampling fish assemblages. State-designated water quality collection and analysis protocols will be followed during periodic sampling events in an effort to de-list stream segments impaired for high fecal coliform bacteria counts. In addition, sampling rotations by monitoring groups (from Georgia EPD) should help indicate improvements in biotic integrity as they occur within the streams of the watershed. Should these groups not revisit these streams, a local effort may be made to sample them again to see if biotic assemblages have improved.

The restoration objectives outlined in this WMP were derived from the desires of Georgia EPD, the Watershed Advisory Committee, and local stakeholders. The underlying concerns for these water quality issues within the group were variable; however, a general consensus was identified. The main concern of the stakeholder group appears to be the health hazard that fecal coliform contamination poses. In addition, the stakeholders expressed the need for sedimentation and other issues that negatively affect aquatic organisms to be reduced to preserve the tremendous biodiversity present within the watershed.

Anti-degradation

Through water quality sampling data obtained during the formation of this WMP, the stakeholder group recognized that the entire watershed contained sources of fecal coliform and sediment, and that in addition to the current impairments, other stream segments had at least some potential to be listed at some point as well. Due to this recognition, anti-degradation efforts were emphasized as a primary objective of restoration efforts. For this reason, any cost-share program should be implemented on a watershed-wide basis. In addition, outreach efforts will be focused on the whole watershed to raise awareness of existing programs that make best management practices more affordable to private landowners and prevent further degradation of stream segments within the watershed. Given the current growth trends in the area (e.g., conversion of farmland to suburban uses), one of the biggest threats to anti-degradation objectives in the future may be stormwater pollution that negatively affects water quantity and water quality.

Education

The third and final objective identified in this plan is to educate local citizens on the uniqueness of their watershed and its diverse fauna, the NPS threats present in the area, and what can be done to mitigate these issues. Education and outreach efforts are paramount if watershed goals and objectives are to be reached. Involving local communities in the watershed improvement process is a key to success, and providing an opportunity for locals to gain an understanding of the importance of watershed restoration needs to be a priority program component to supplement BMP installation efforts.

Presentations at local events will be used as a means to reach a broad audience in the community. Creation of events with the sole purpose of gaining support was also suggested. Specific examples include stream cleanups, rainbarrel workshops, and canoe cleanup floats down local waterways. Although the majority of Holly Creek may not be large enough for canoe cleanup floats, the objectives would still be accomplished by floating the larger Conasauga River, which Holly Creek enters not far from Chatsworth and Dalton.

5.2 Load Reduction Targets

Two impaired segments within the watershed are the result of past fecal coliform concentrations exceeding state standards. These segments have had TMDLs created in 2003 and 2009. Based on these TMDLs, percent reductions of fecal coliform loadings were calculated. These load reductions attempt to calculate how much the pollutant load must be reduced from the watershed for a stream to meet state criteria for a particular pollutant. The results from these calculations are listed for each segment in Table 5.2.a.

The other two listed segments resulted from impacted biota. It is generally assumed that sediment load is the main contributor to impairment due to impacted biotic assemblages in the State of Georgia, and that should load reductions for sediment be reduced and maintained, biotic assemblages will recover in time. However, for the impairments due to impacted biotic assemblages in the Holly Creek Watershed, TMDLs have not been completed to assess sediment loads and suggest appropriate reductions.

Table 5.2.a. Required load reductions for impaired segments in the Holly Creek Watershed.

Impaired Stream Segment	Impairing Pollutant	Percent Reduction
Holly Creek (4 miles) – Downstream Chatsworth to Rock Creek	Fecal Coliform Bacteria	74%
Holly Creek (8 miles) – Rock Creek to Conasauga	Fecal Coliform Bacteria	65%
Mill Creek (5 miles) – Headwaters to Holly Creek	Impacted Biota (Fish)	NA
Goldmine Branch/Rock Creek (4 miles) – Fort Mountain Lake to Holly Creek	Impacted Biota (Fish)	NA

6. Pollution Reduction

This section explores management programs and strategies (structural and non-structural) that currently exist within the Holly Creek Watershed that impact fecal coliform and/or sediment pollution. Structural practices are those that are engineered and result in a physical structure that is designed to reduce a specific type(s) of pollution. Non-structural practices are those that typically work to change the attitude or behavior of individuals. It also explores a proposed program needed in the Holly Creek Watershed in order for the previously identified restoration goals and objectives to be accomplished.

6.1 Existing Conservation Programs

Table 6.1.a. A display of existing structural programs and practices in the Holly Creek Watershed.

Structural Measure	Responsibility	Description	Impairment Source Addressed
Clean Water Act Section 319 Nonpoint Source Grants	US EPA, GA EPD	Makes Federal funding available for impaired watersheds to address nonpoint source pollution concerns and ultimately seek to move toward de-listing impairments.	Agriculture/ Residential/ Urban
Conservation Reserve Program	FSA, NRCS	Addresses problem areas on farmland through conversion of sensitive acreage to vegetative cover such as establishing vegetative buffers along waterways. Conversion costs are shared with FSA, and the landowner receives an annual payment for maintaining the conversion.	Agriculture
Conservation Tillage Program	Limestone Valley RC&D, Limestone Valley SWCD	Makes conservation tillage equipment available for rent within the watershed, helping producers plant their crops with minimal disturbance to the soil. This reduces erosion from cropland, and increases water retention and nutrients.	Agriculture
Environmental Quality Incentives Program (EQIP)	NRCS	Works to address resource concerns on agricultural lands. EQIP is a cost-share program (75% typically) for landowners seeking to implement BMPs on their property.	Agriculture
National Fish Passage Program	USFWS, National Fish Passage Program	Works to address barriers to the movements of aquatic organisms as well as improve aquatic habitats.	Biotic Communities
Septic System Permitting and Inspection Program	North Georgia Health District	Septic system repairs and installations are permitted and inspected by North Georgia Health District Staff. This not only ensures that systems are functioning, but also that they are installed by a licensed individual according to state regulations	Urban/Residential
Stream, Riparian Buffer, and Streambank Improvement Efforts	USFWS, Partners for Fish and Wildlife Program	Works to address stream habitat, riparian buffer, and streambank issues on private lands through a cost-share program aimed at areas key to fish and wildlife habitat improvement.	Agriculture/ Biotic Communities/ Residential

There are several existing structural conservation programs implemented within the Holly Creek Watershed (See Table 6.1.a.); however, none are unique to the area. Most programs that encourage water quality improvements are ubiquitous across Georgia, if not the nation. Only those that specifically relate to sediment and/or fecal coliform pollution reduction are displayed here.

Many programs also provide non-structural practices in the Holly Creek Watershed (See Table 6.1.b.), and most are not unique to the area. These practices, although not physically reducing pollution, can arguably improve water quality as much or more than structural practices themselves. Changing behaviors and/or attitudes can be contagious, making a real difference in both the cultural and natural landscape over time.

Table 6.1.b. A display of existing non-structural programs and practices in the Holly Creek Watershed.

Non-Structural Measure	Responsibility	Description	Impairment Source Addressed
Army Corps of Engineers Regulatory Program	USACE	Conducts permitting for Section 404 of the Clean Water Act, which regulates the discharge of dredged or fill materials into US waters of the US, including wetlands.	All inclusive
Conservation Technical Assistance Program	NRCS	Assists landowners with creating management plans for their lands, including but not limited to Farm and Forest Conservation Plans and Comprehensive Nutrient Management Plans (CNMPs).	Agriculture
Endangered Species Act	USFWS	Among other things, this act ensures projects with a Federal nexus avoid deleterious impacts on listed aquatic organisms and their habitat.	Impacted Biota/ Sedimentation
Georgia Erosion and Sedimentation Act	Georgia EPD	Among other things, it prevents buffers on state waters from being mechanically altered without a permit.	All inclusive
Georgia Water Quality Control Act (OCGA 12-5-20)	Georgia EPD	Makes it unlawful to discharge excessive pollutants into waters of the state in amounts harmful to public health, safety, or welfare, or to animals, birds, aquatic life, or the physical destruction of stream habitats.	All inclusive
Land Conservation and Preservation	US Forest Service, TNC	Conservation and preservation of lands within the upper Holly Creek Watershed generally lead to appropriate management measures for water quality, aquatic organisms, and habitat.	All inclusive

Limestone RC&D Council	LVRCD	Has the ability to apply for CWA Section 319 grants to implement water quality improvement in impaired watersheds of Northwest Georgia.	All inclusive
Rules and Regulations for On-site Wastewater Management	Murray County Environmental Health Office	Stringent enforcement and application of the regulations through permitting and inspection of new and repaired systems.	Suburban, Residential
UGA Cooperative Extension Program	Murray Co. Extension Office	Assists with general agricultural assistance, which includes providing suggestions for soil and water conservation.	Agriculture

6.2 Proposed Conservation Program for the Holly Creek Watershed

Although this WMP allows for individual organizations to piecemeal restoration efforts by submitting proposals that request funds for only one or more project activity, a more comprehensive approach is recommended to ensure solid progress is achieved toward meeting the watershed goals. The following proposed program, the *Holly Creek Watershed Restoration Program* (HCWRP), would be an endeavor partially funded by Clean Water Act (§319) grants (and assisted by in-kind donations of certain stakeholders, agencies, and non-governmental organizations) that would provide cost-shares on practices that have been deemed by the stakeholder group as a means to address the water quality issues specifically related to the local watershed. In addition, this program would attempt to raise awareness of the issues in the area, as well as educate citizens about potential solutions to these local problems.

<u>Proposed Structural Practices of the Holly Creek Watershed Restoration Program</u>

Based on water quality analysis results and stakeholder surveys, it was evident that fecal coliform bacteria was present in excess at times throughout much of the lower watershed. These data, when combined with the anti-degradation objective as well as stakeholder survey results, indicate the need to implement BMP installations to address this issue throughout the watershed instead of only those locations in close proximity to the impaired segments themselves. The stakeholders decided that at least some emphasis should be placed on each of the three major sources of pollutants which include agriculture, failing septic systems, and stormwater.

Figure 6.2.a. Constructing heavy use area pads for cattle feeding or watering areas can reduce erosion and sediment loads in the watershed.

Since agricultural activity encompasses a large proportion of land use within the watershed, the HCWRP could include a cost-share program that will help local farmers afford conservation practices that reduce fecal coliform and/or sediment contributions to receiving waters. Many of these practices are also beneficial to landowners which will serve as additional motivation for participation in the program. Most of the agricultural lands within the watershed are used for grazing, so funds need to be available to assist farmers with an interest in voluntary conservation to restrict livestock stream access and provide alternative watering sources. These practices would reduce the fecal coliform load from direct sources and agricultural runoff in the watershed. Projects that address erosion issues will likely include streambank and heavy use area stabilization. In addition, funds are needed to help establish riparian buffers where they are absent. GIS analysis indicated that approximately 11% of the watershed has inadequate riparian buffers. Projects to improve riparian buffers would help reduce both fecal coliform and sediment pollution by acting as a physical barrier to runoff during rain events.

Altogether, many types of agricultural BMPs should be installed as a part of the HCWRP. In general, however, projects that only marginally address the resource concerns should be avoided. A suite of agricultural BMPs may be installed as part of the restoration process assuming they collectively assist in sediment and/or fecal coliform load reductions.

Since failing septic systems were determined by the stakeholder group to be a significant contributor to the fecal coliform bacteria load in the watershed, the HCWRP should include a cost-share program to address this issue. High failure rates are said to occur for several reasons, including poorly percolating soils, outdated systems, and the low-income financial condition of a portion of the local population. A cost-share program in the area would help to incentivize more of the population to get their systems repaired. Cost-share rates are likely to vary according to the likely contributions of the failed systems to pollutant loads, and in the cases of impoverished families, financial conditions. In addition, greater public demand for septic system repairs will likely result in lower cost-shares offered in order to assist more homeowners, as well as result in greater water quality benefit per dollar. Although higher rates will generally be offered on projects that more significantly reduce pollutant loads, inclusion of other property owners to be eligible for lower cost-share rates will maximize program participation while building important momentum within communities.

Figure 6.2.b. A septic system repair can reduce the fecal coliform load in streams. A cost-share program can help incentivize costly repairs.

Water quality data and the likelihood of further future development in the area led the stakeholders to desire an emphasis on stormwater BMPs, as well as streambank biostabilization efforts within Chatsworth. Stormwater practices should be considered on city property with the assistance of Chatsworth that seek to mitigate stormwater quantity (e.g., retention ponds, rain gardens, etc.). Streambank biostabilization projects should also be explored in upstream stream reaches, especially the impacted biota impairments. A cost-share program would incentivize private landowners to implement streambank biostabilization techniques, as well as riparian restoration.

Proposed Non-Structural Practices of the Holly Creek Watershed Restoration Program

Efforts to educate and inform the public should also accompany the cost-share programs funded through the HCWRP. The idea is to invest in conservation practices while demonstrating their effectiveness to other landowners, with hopes that voluntary conservation and modern land management practices that address resource concerns become contagious in the community. At the least, the concepts and practices will slowly become more accepted over a period of time as they become more commonplace. Local newspaper articles derived from the press releases, farm days, and workshops are all acceptable ways to spotlight the benefits of agricultural BMPs. Other efforts will offer educational opportunities during volunteer work days (riparian plantings, stream cleanups, etc.).

As a part of the HCWRP, an outreach plan should be developed for any and every grant that is received from the 319 program. This plan should identify annual or semi-annual events that will be held that encourage public participation in the watershed improvement process. These events could include canoe floats, stream cleanups, and the establishment of viable Adopt-A-Stream groups. Although many of the streams within this watershed may be too small for floats or effective cleanups, the Conasauga River offers ample opportunity to make significant connections between citizens and their waterways.

In addition, the new program should include promotion of the watershed improvement process to local stakeholders to further develop and maintain program momentum. Press releases should be periodically issued to local newspapers highlighting program details, and the watershed issues it attempts to resolve. Promotions should also include local presentations to stakeholder groups. These promotions would serve to maintain community interest in the restoration effort by reminding local groups of the benefits the implementation effort is seeking to provide (e.g., reduced human health risk and water treatment costs as well as increased financial assistance within the community). These stakeholders should be also updated as significant progress is made toward water quality goals in order to show them that the goals of the restoration efforts are attainable.

Figure 6.2.c. Volunteer events, such as stream cleanups, can keep stakeholders engaged while benefitting stream quality.

7. Implementation Program Design

The objective of this WMP is to outline implementation efforts needed to result in the long-term goal of de-listing the four impaired stream segments, while ensuring additional segments are not listed. This section of the WMP outlines specific restoration activities, how they relate to implementation milestones, and estimated dates of completion. In addition, costs associated with the measures needed for watershed restoration are estimated.

7.1 Management Strategies

The recommended strategy for implementation of this WMP is to create and manage a program that features both structural and non-structural controls within the watershed to address the fecal coliform and sediment issues. It is the intent of the proposed restoration program (HCWRP) to restore the watershed to the extent that impaired segments are eventually de-listed, while ensuring that additional segments are not listed. This should be accomplished by increasing the available agricultural BMP cost-share opportunities, creating a septic system repair cost-share program, assisting in the biostabilization of problematic streambanks, improving local stormwater management, making available educational opportunities to encourage public participation in the watershed improvement process, and monitoring water quality to track improvements and potentially de-list impaired segments. Septic system failures will be identified and addressed with the technical assistance provided by the North Georgia Health District. The NRCS will assist with technical advisement with respect to agricultural projects and streambank projects. Other agencies and non-governmental organizations will make key contributions to outreach efforts, as well as other facets of the program. All participation in grant programs will be voluntary in nature, and great care should be taken to respect private property rights.

In order to de-list several stream segments through implementation of a number of small projects, it is likely that the investment of significant time and funding will be necessary. Assuming the behaviors and land management practices improve over time, the benefits of clean water can last generations. The program, as outlined here, would cumulatively fund approximately $860,000 worth of projects and at this point has been designed to be implemented over the course of thirteen years (including grant proposal submission periods). This proposed allocation of funds is similar to other restoration efforts that have been funded in the state, yet is to be focused on a smaller geographic scale, which should lead to more pronounced improvements. It is believed that certain stream segments listed could be de-listed as a result of this effort, although there is also a small possibility that more funding could be necessary to accomplish that goal.

7.2 Management Priorities

<u>Project Fund Allocation</u>

Cost-share programs are to be developed for agricultural BMP installations (including cattle access control, streambank biostabilization, riparian enhancement, etc.), septic repairs and pumpouts, and stormwater improvement projects. Stakeholders were solicited as to how to allocate the funds between these projects within the watershed. Stakeholder opinions were variable, but analysis of responses resulted in approximately 50% of the potential funds being allocated to septic system repairs and pumpouts, 25% to agricultural BMPs, and 25% for stormwater projects. The demand for stormwater, streambank biostabilization, and riparian planting projects is not entirely known, but these projects should be marketed to gauge interest and sought after when feasible project opportunities present themselves. Using adaptive management strategies, adjustments can be made when necessary to capitalize on successful efforts and ensure we learn from less desirable outcomes.

Cost-Share Rates and Priority Areas

Agricultural BMPs addressing water quality concerns should generally be cost-shared upon at a rate of 60%. This rate is such that these projects adequately assist in providing matching fund contributions that count toward grant requirements, while remaining reasonably competitive with the NRCS EQIP program, which cost-shares at 75% on estimated project costs for projects that receive funding.

Stormwater projects should also be cost-shared upon at a rate of 60%. This rate again allows completed projects to adequately assist in providing matching fund contributions that count toward grant requirements. When the high costs of these practices are prohibitive, perhaps a portion of the cost-shares could be offset by donated advisement, planning, and expertise. In addition, the utilization of donated labor to assist with or complete stormwater, streambank biostabilization, and riparian planting projects may contribute to cost-share obligations. Trustees and/or citizens can contribute to such projects in this way especially in Chatsworth. On private lands, the cost-shares should incentivize landowners with considerable streambank concerns to act to improve their properties while assistance is available.

For septic system repair projects and pumpouts, cost-share rates should depend on the demand. If demand for repair assistance is high, cost-shares should be set at lower rates in order to accommodate as many projects as possible and achieve the greatest water quality improvement. The most ideal projects for water quality improvement will be those significantly addressing the pollutants in close proximity to streams within or just upstream of impaired reaches. However, inclusion of landowners from the entire Holly Creek Watershed to be eligible for program cost-shares on projects that address water quality concerns is necessary to maximize program participation by building important momentum within the local community. In addition, since the problem areas are often in the downstream reaches, all areas of the Holly Creek Watershed likely contribute to the impaired status of local stream segments, albeit to varying degrees.

Since certain septic system repair projects may address resource concerns more than others, variable cost-share rates should be considered to reflect the anticipated water quality improvement. For example, a septic system within 100 feet of an impaired stream would generally receive a higher cost-share rate than one located much farther away. This method of incentivizing participation will bring about the greatest load reductions while maximizing the overall number of participants. Similarly, impoverished members of the community may be further incentivized with higher cost-share rates in order to ensure they get failing systems repaired.

In addition to a 100-foot buffer along streams getting priority, the portions of the watershed upstream of Chatsworth are considered priority areas with respect to BMP implementation. Local stakeholders agreed that these areas should be marketed to first concerning any available BMP funds for several reasons. Most of the important aquatic fauna are located in this section. Also, these areas are upstream of the impairments, so any improvements would have a positive effect over a greater portion of the impaired segments. In addition to taking priority with marketing strategies, projects in these areas would be more competitive for funding should demand for cost-share assistance be high.

7.3 Interim Milestones

To allow momentum to build in the community and ensure success, this WMP should be implemented for multiple years over several grants, each of which may have its own updated objectives and milestones according to changes in watershed conditions and/or management strategies. This section, however, seeks to outline objectives and milestones that could be used by any group (in any combination) seeking funds for restoration efforts in the watershed.

OBJECTIVE #1: Create a septic system repair and pumpout cost-share program in the watershed.

MILESTONES:

- Identify local certified septic system contractors interested in participating in the program.
- Hold meetings with NGAHD representatives to design program.
- Establish initial cost-share criteria based on proximity of system to state waters.
- Maintain the septic repair and pumpout program throughout the implementation process.

The repair process should involve the submission of bids from locally-owned businesses with an interest in participating on grant projects. Bids should be requested from three or more contractors for each repair, and the homeowner should be allowed to choose which bid to accept. The rate of cost-share should be considered when possible on a sliding scale that will result in offering more assistance to projects that will likely result in the greatest load reductions.

OBJECTIVE #2: Create an agricultural BMP cost-share program in the watershed.

MILESTONES:

- Hold meetings with the NRCS to determine appropriate BMPs and cost-share rates.
- Advertise the available grant money through local media.
- Issue press releases for successful BMP installations.
- Maintain the agricultural BMP program throughout the implementation process.

Agricultural BMPs should focus on restricting cattle access to streams, enhancing riparian zones, biostabilizing streambanks, and installing heavy use areas. Restricting access must involve replacing the water source that is removed through fencing, which often includes cost-sharing on pipelines and troughs. Agricultural BMP installation should be on a strictly voluntary basis, and landowner confidence and satisfaction should be a primary focus. This will allow any program to develop a positive reputation in the area, which is hoped to eventually garner more conservation interest in the watershed.

OBJECTIVE #3: Create a stormwater project cost-share program in the watershed.

MILESTONES:

- Hold meetings with the City of Chatsworth and stormwater experts to determine appropriate projects.
- Seek to incorporate trustee labor to cover cost-share contributions for projects in Chatsworth.
- Advertise the available grant money for projects on private lands through local media.
- Issue press releases for successful stormwater and streambank biostabilization projects.
- Maintain the program throughout the implementation process.

Stormwater improvement efforts may include any project designed to reduce the effects of impervious surfaces in the watershed. Stormwater retention and streambank biostabilization projects should be a primary focus. Stormwater improvement projects should be on a strictly voluntary basis, and community and landowner confidence and satisfaction should be a priority. This will allow any program to develop a positive reputation in the area, which is hoped to eventually garner more conservation interest in the watershed.

OBJECTIVE #4: Conduct a culvert and barrier assessment effort for impacted biota impairments in the watershed.

MILESTONES:

- Coordinate with USFWS and GA DNR to assess culverts and other barriers in the watershed, particularly those located in close proximity to reaches impaired due to impacted biota.
- Conduct a cost-benefit analysis on the replacement of any inadequate culverts and/or removal of barriers.
- Depending on cost-benefit analysis, potentially seek to acquire support and funding sources (grants, city, county, etc.) to achieve culvert replacement and/or barrier removal.

Stakeholders identified inadequate culverts (and possibly other barriers) as a potential cause of the impacted biota segments. When culverts are perched, they can prevent fish passage to repopulate areas that have experienced a decline in biotic integrity. In addition, undersized culverts are prone to failure and can be a financial burden. Undersized culverts can cause accelerated flows at the culvert outlet during heavy rains. This high velocity water can scour habitats, causing erosion and sedimentation issues downstream. This program should allow for the assessment of culverts and other potential barriers in critical areas of the watershed, and potentially the replacement of inadequate culverts and/or barrier removal should community support and funding be gained.

OBJECTIVE #5: Implement BMPs to achieve load reductions specified in the TMDL.

MILESTONES:

- Identify farmers willing to cost-share on agricultural BMP projects such as: access control, riparian enhancement, heavy use area stabilization, and streambank biostabilization.
- Identify areas in Chatsworth where stormwater projects could be completed.
- Identify homeowners within targeted subwatersheds with failing or without proper septic systems.
- Implement septic repairs and pumpouts in the watershed.
- Implement agricultural BMPs in the watershed.
- Implement stormwater BMPs in the watershed.
- Estimate load reductions from projects when possible.

BMPs that specifically address fecal coliform should be emphasized on agricultural lands. These include activities that restrict cattle access to the stream while providing alternative water sources, stabilize eroding areas, and enhancement of riparian zones that may prevent animal waste and sediment from entering the stream during runoff events. Failing septic systems and “straight-pipes” should be identified and repaired to reduce the contribution of fecal coliform originating from residential areas. Streambank biostabilization projects should be sought on agricultural land, as well as in urban areas that experience heavy flows from increased impervious surface cover. Stormwater projects should be implemented in urban areas as well.

OBJECTIVE #6: Reduce pollution inputs from suburban and rural areas through education and outreach.

MILESTONES:

- Provide opportunities for the public to assist with stream restoration and cleanup efforts.
- Provide opportunities for the public to participate in Georgia's Adopt-A-Stream Program.
- Conduct presentations discussing watershed restoration efforts at local events.
- Submit press releases to inform the public of the restoration process and NPS pollution issues and solutions.

A key component of the education and outreach portion of implementation should be designed to raise the awareness of citizens in the area through local media and "hands-on" events. Stream cleanups, creek walks/floats, and rainbarrel workshops should be planned to be offered to interested citizens in the area throughout any implementation effort. This ensures that the general public is provided the opportunity to not only learn about the watershed, but also participate in restoration events. These events should have the ability to not only educate and empower local citizens about water quality, but also effectively provide program outreach that can lead to agricultural BMP and streambank biostabilization projects, as well as septic system repairs and proper maintenance in the form of pumpouts.

OBJECTIVE #7: Document changes in water quality throughout WMP implementation.

MILESTONES:

- Submit a targeted water quality monitoring plan for each grant received.
- Monitor several sites regularly, including at locations previously sampled by Georgia EPD.
- Conduct Pre- and Post-BMP monitoring for large agricultural BMP projects near significant streams.
- Sample to potentially de-list streams impaired for fecal coliform violations.
- Initiate WMP revisions.

Baseline data should be collected to determine the average concentrations of pollutants found at various locations within the watershed. This would allow for future comparisons when data is gathered to determine if improvements are measurable and if so, their significance. Targeted monitoring (accompanied by a Targeted Water Quality Monitoring Plan) should occur at least once for each grant that is received.

When large agricultural BMP projects are implemented near significant streams, an effort should be made to sample for the pollutants of concern before and after project completion. This may allow inferences to be made about what projects are most beneficial, as well as build local confidence on finding solutions to water quality issues.

A SQAP should be also written for each grant that is received. This will guide efforts to sample fecal coliform according the procedure necessary to "de-list" stream segments should standards be found to have been met.

Biological monitoring will also be conducted as part of regular Georgia DNR/EPD rotations and will provide insight on whether the local biotic integrity in the impaired segments is improving as water quality improvement activities take place in the Holly Creek watershed.

Additional biotic monitoring (e.g., fish IBIs) could be conducted in conjunction with a university, or other qualified entity, to investigate whether the biotic community has improved in the impacted biota segments should funding be approved. Such an effort to again sample fishes in these impaired streams could also include sampling upstream and downstream of the culverts suspected to be impassable much of the year to fishes. If the fish assemblages differ upstream and downstream of these structures, there is a chance that the potential barrier plays a role. Since both stream reaches sampled were upstream of multiple culverts, some of which appeared likely impassable to fish, culverts acting as barriers may be contributing to the low IBI scores.

OBJECTIVE #8: Provide local community leaders with the knowledge to consider the effects management decisions may have on stream health in the watershed.

MILESTONES:

- Establish connections with local community leaders.
- Conduct presentations to community leaders discussing water quality issues and the solutions that BMPs can provide.
- Share water quality data and interpret the results with local community leaders for discussion purposes.

City and county personnel should be updated regularly through presentations at local meetings to keep up involvement and/or awareness during the restoration process.

7.4 Schedule of Activities

The following schedule provides the anticipated years for various objectives and milestones to be addressed in the WMP implementation process, assuming that a long-term comprehensive approach is pursued by the proposing organization and that funding needs are met.

Table 7.4.a. A display of milestone activities and a timeline in which they will each be addressed throughout the implementation of the WMP.

IMPLEMENTATION SCHEDULE													
MILESTONE ACTIVITY	2015	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Submit §319 Proposal to GA EPD	X		X			X			X				
Create septic cost-share program		X											
Create an agricultural BMP cost-share program		X											
Create a stormwater improvement cost-share program		X	X	X	X	X	X	X	X	X	X	X	X
Create a culvert and barrier assessment program		X											
Install septic system agricultural, stormwater, and streambank BMPs		X	X	X	X	X	X	X	X	X	X	X	X
Assess culverts/barriers for potential replacement and/or removal		X	X	X									
Establish AAS Monitoring Group			X		X		X		X		X		X
Update County Commission/press releases			X		X		X		X		X		X
Conduct education/outreach Events		X	X	X	X	X	X	X	X	X	X	X	X
Conduct WQ monitoring (targeted)				X			X			X			
Conduct WQ monitoring (de-listing)				X			X			X			X
Reevaluate milestones				X			X				X		
Initiate reassessment of WMP						X					X		

7.5 Indicators to Measure Progress

The number of completed projects (e.g. septic system, agricultural, stormwater, streambank biostabilization, etc.), as well as outreach event attendance should reveal progress that the implementation program is gaining momentum. Landowner participation rates can be another useful tool in determining the success of grant implementation. It is hoped that the rate will increase through subsequent years of watershed restoration due to education and outreach efforts, as well as the gradual acceptance of BMPs within the watershed. Education and outreach participation rates can be analyzed to help measure progress. It is anticipated that these rates will also increase through subsequent years as the events gain notoriety within the watershed.

Of more importance in the long run will be to measure how these projects have translated toward the goals of accomplishing the necessary load reductions and eventually de-listing the impaired segments within the watershed. For the stream segments impaired for high fecal coliform bacteria counts, tracking water quality improvements will best indicate progress toward reducing fecal contamination and eventually de-listing streams. Water quality improvements should be revealed using two water quality sampling regimes intermittently throughout the implementation process. Both types of water quality monitoring (targeted sampling and "de-listing" sampling) should be used to measure progress towards de-listing of segments impaired for exceeding fecal coliform standards.

For stream segments impaired for poor biotic diversity, progress may be more difficult to indicate. Targeted water quality monitoring may potentially reveal changes in TSS (total suspended solids) within the water column over time, but Georgia DNR/EPD will be relied upon to sample fish according to their scheduled rotations in order to determine whether biotic integrity has improved and to potentially de-list streams.

In addition, discussions have been had with consultants (that conduct fish sampling endeavors) to potentially work with them to assess the biotic integrity of the impacted biota segments should funding be provided. These groups have the expertise and equipment to provide the assessments according to the same protocols, and working with them may allow a more immediate assessment (and potentially more frequent assessments focusing on temporal changes) of the impacted reaches than Georgia DNR/EPD can provide. It is not yet known, however, whether such an endeavor would result in de-listing should it reveal improved fish assemblages. Other than Georgia DNR/EPD, no one to our knowledge is known to have sampled biota locally that has resulted in impairments. It is unknown whether deference is given to practiced and permitted fish ecologists as well.

7.6 Technical Assistance and Roles of Contributing Organizations

This section will focus on the roles of various groups anticipated to make new or additional contributions to make the watershed restoration effort a success. An organization seeking to implement this WMP should rely on technical expertise from the NRCS with respect to agricultural BMP implementation, and the North Georgia Public Health District with respect to septic system BMPs. The program also relies on in-kind assistance with logistics and education/outreach activities from other groups listed below (Table 7.6.a.).

Table 7.6.a. The following groups are anticipated to contribute directly to implementation by taking on the roles described below. While working towards accomplishing conservation goals, many of these activities could count towards non-federal match contributions associated with any funded 319 projects.

Organization Roles and Responsibilities		
Organization Name	**Organization Type**	**Description of Role in Holly Creek WMP Implementation**
Dalton Utilities	Utility	Provide donated services in order to aid the restoration efforts. Analyze water samples for fecal coliform and TSS concentrations, which will be collected by project partners throughout implementation of this plan.
Environmental Protection Agency	Federal Agency	Provide EPA Clean Water Act Section 319 funds to Georgia EPD to administer through the state 319 grant program.
Georgia Department of Natural Resources	State Agency	Conduct biotic monitoring at sites in the watershed that can reveal improvements or de-list impairments.
Georgia Environmental Protection Division	State Agency	Administer Clean Water Act Section 319 Grants to provide funding for this restoration program. Conduct monitoring rotations at sites in the watershed for fecal coliform bacteria that can reveal improvements or aid in de-listing efforts.
Limestone Valley Soil and Water Conservation District	State Agency	Assist with marketing for agricultural BMPs in the watershed. Potentially help identify willing landowners in the watershed that are interested in the program.
Limestone Valley RC&D Council	Quasi-Governmental Organization	Lead implementation efforts including submitting grant applications, serving as grantee fulfilling reporting obligations, marketing program components, spearheading outreach efforts, managing finances, conducting monitoring, and managing projects.
Murray County Commission	County Org.	Provide in-kind assistance to any grantee through donated office space, meeting space, and potentially equipment/labor for certain types of projects.
Natural Resources Conservation Service	Federal Agency	Provide technical expertise for agricultural BMPs. This process will include multiple farm visits, the development of a conservation plan for the landowner, project supervision and project inspection. All projects will be installed according to NRCS specifications and standards.
North Georgia Public Health District	State Agency	Provide technical expertise for septic system repairs. This process will include assessing, planning, permitting, and inspection of installed or repaired septic system components. Help may also be provided through identification of potential septic system repair projects. Assistance may also be provided during workshop preparation if applicable.
Northwest Georgia Regional Commission	State Agency	Provide technical assistance for implementation efforts in the watershed. Serve as a vehicle to promote the Holly Creek Restoration Project and assist in marketing its outreach efforts.
US Fish and Wildlife Service	Federal Agency	Provide recommendations for culvert and barrier assessment and replacement activities. Provide guidance related to stream restoration projects that utilize natural channel design methods. Consult on any project that may potentially impact instream aquatic habitat.
University of Georgia Cooperative Extension	State Agency	Assist in marketing efforts for program components and outreach events.

7.7 Estimates of Funding

As discussed in Section 6, many programs are already offered within the Holly Creek Watershed that aim to reduce NPS pollution. Despite the existence of these successful endeavors, impairments persist in the area. The estimates in this section for implementing the recommended comprehensive restoration program (HCWRP) are reliant on the 319 program as the main source of funding (in addition to key contributions from various groups as discussed above), and assume continuous consistent effort from the other programs previously mentioned in order for water quality improvements to occur.

In order to estimate the cost associated with the de-listing of impaired segments within the watershed, several approaches were taken. The septic system BMP needs were estimated based on information obtained from Murray County and failure statistics provided by the U.S. EPA. Agricultural BMP quantities were largely estimated through Geographic Information Systems analysis. Each tributary in the watershed was studied to determine the location of grazing lands and cropland. This information was coupled with an insufficient riparian buffer analysis to determine likely areas in need of BMPs. NRCS cost estimates were then used to determine the funding needed to accomplish watershed improvement goals. Although the primary concern when estimating costs is ensuring that amounts are sufficient to de-list streams, it is also important to consider the demand for the practices locally and consider funding limits from the 319 program. This iterative process was led by Limestone Valley RC&D Council, and considered stakeholder input. Ultimately, recommendations are to pursue funding in the amount of approximately $860,000 over four grant cycles, which is both practical and likely sufficient for meeting watershed goals.

Efforts to begin working towards the de-listing of impaired stream segments are recommended to begin immediately with the approval of this WMP. **A goal of implementing four 319(h) grants has been set to be accomplished by 2028, which is believed to likely be sufficient to de-list impaired segments.** In order to lay the framework to accomplish this, Table 7.7.a. was created to outline the recommended approach for fund requests, and collectively represents BMP installation costs excluding landowner contributions. These values are displayed at 60% of the total cost in order to better describe federal funding needs.

Table 7.7.a. A display of recommended financial requests for each of four 319 grants sought by an organization attempting comprehensive watershed restoration. The proportions are derived by stakeholder recommendations, and the amounts were estimated using local knowledge, EPA statistics, and GIS analysis.

	Septic System Funds	Agricultural BMP and Streambank Project Funds	Stormwater and Urban Streambank Project Funds	TOTAL
Proposal 1 - 2016	**$80,000**	**$60,000**	**$40,000**	**$180,000**
Proposal 2 - 2019	**$100,000**	**$70,000**	**$50,000**	**$220,000**
Proposal 3 - 2022	**$100,000**	**$70,000**	**$50,000**	**$220,000**
Proposal 4 - 2025	**$110,000**	**$75,000**	**$55,000**	**$240,000**

7.8 Getting Started

A goal of implementing four 319(h) grants has been set to be accomplished by 2028 through the recommended comprehensive approach (assuming funding needs are met). This treatment prescription is believed to be enough to de-list the fecal coliform impairments on the Holly Creek segments, although the status of impaired biota segments may be more difficult to improve by 2028 due to the time needed for fish communities to rebound following habitat improvement. Efforts to begin working towards the de-listing of impaired stream segments are recommended to begin immediately with the approval of this document by Georgia EPD and the US EPA.

8. Education and Outreach Strategy

Outreach associated with watershed restoration efforts should seek to put volunteers to work in ways that assist with cleaning up Holly Creek, enhancing the riparian buffer, reducing non-point source pollution, and sampling water quality parameters. These events have been recommended, since they aid in raising awareness of local nonpoint source issues and lay the groundwork for implementation through the establishment of partnerships and identification of potential BMP projects. This idea is based on stakeholder opinions and Limestone Valley's past experience with implementing 319 grant projects, which revealed that the general public is one of the most valuable sources of information with respect to identifying both general and specific sources of pollutants. With each commitment from a citizen to volunteer their time, the likelihood of successful watershed restoration increases. The following descriptions are recommended events that could be held in and adjacent to the watershed. A value could be placed on many of these events through calculating volunteer labor, supplies, or other in-kind donations. This value, with all supporting documentation, could then be reported as match to the federal funds distributed through any applicable 319 grant.

Riparian Tree Plantings

Press releases could educate the public on the need for a riparian zone and stream shading and advertise the availability of trees and live stakes to be planted along streams in the Holly Creek Watershed. It is anticipated that trees and the tools with which to plant them would be obtained through the use of grant funds or donations from non-federal sources. Riparian tree planting events with volunteers could also be held on the banks of streams and creeks in the watershed. The volunteers to plant the trees could be acquired through these newspaper articles and word-of-mouth. The primary purpose would be to utilize volunteer labor to plant trees in an effort to increase the riparian buffer within the watershed. Another purpose of this event is to identify potential BMP projects through personal interaction with volunteers that encourage them to assist in "spreading the word" about grant funds and opportunities. These events should include a presentation about the non-point source pollution issues that face Holly Creek. Other educational materials on septic system repairs and maintenance, and stormwater practices (rainbarrels, raingardens) should be made available.

Rainbarrel Workshops

During past 319(h) grant implementation projects in Northwest Georgia, rainbarrel workshops have proven to be one of the more useful tools to garner public support for watershed restoration efforts. Through these past projects, the workshops not only develop a relationship with the local Coca-Cola plant that provides the barrels, but also assess the level of interest from the public. In the past, these events have generated overwhelming interest from local communities, and have attracted the most enthusiastic volunteers. Furthermore, rainbarrels are desired by a diverse array of citizens including both farmers and homeowners, which is the exact demographic that is needed to implement BMPs that address resource concerns on residential and agricultural lands.

For the purposes of conducting outreach thorugh a 319(h) grant project, this outreach activity would have the primary objective of incentivizing rainbarrel construction and installation to reduce NPS pollution, but would also serve as the sounding board from which to advertise available BMP funds. At these events, citizens should receive specific information about cost-share funds for projects that benefit both landowners and our natural resources, information about Holly Creek's water quality issues (with watershed map visual aids), and the opportunity to work to construct and take home a free rainbarrel to affix to the guttering system of their home. Volunteers from these events should be encouraged to participate further in identifying potential BMP sites and assisting with other outreach events. Follow-up communications should be initiated to keep these interested citizens engaged throughout the implementation process. The barrels donated from Coca Cola, the parts used to retrofit them, and the homeowners' labor and time spent constructing rainbarrels are all values that could be calculated and compiled for matching purposes for any applicable 319 grant.

Adopt-A-Stream Workshops

These events are designed to train volunteers on how to use Adopt-A-Stream (AAS) monitoring equipment to sample water quality parameters and inform them of non-point source pollution issues. At these workshops, volunteers should be informed of the basics of water quality sampling and watershed science, as well as how to use the AAS website to enter all collected data from the stream that they choose to adopt. The hours that volunteers spend in the training workshop, along with subsequent hours of actual sampling, could be used to calculate a match value that could be reported with supporting documentation to Georgia EPD. In addition, volunteers should be given information advertising potential available cost-share funds for both agricultural projects and septic system repairs that reduce non-point source pollution. Some workshop components may be featured in events that fall under a different category (e.g., Water Quality Monitoring Canoe Float).

River's Alive Cleanup

As part of previous 319 grants, this Rivers Alive event was established across the Conasauga Watershed in order to provide outreach activities for volunteers in the local communities. Seven stream cleanup sites have been established, and the event has consistently surpassed 200 volunteers. Although only one site is in the Holly Creek watershed itself, three additional sites are nearby on the mainstem of the Conasauga River, which receives Holly Creek and is also impaired due to fecal coliform concentrations. These four sites are all frequently attended by residents from in and around the Holly Creek watershed.

At each site throughout the cleanup event, a recruiting effort will be made with volunteers to garner stakeholder involvement for the planning process, disseminate information about the Holly Creek project, and provide general education on the NPS issues that threaten the local water quality. Interested volunteers will be solicited for feedback regarding potential programs that may assist in watershed improvement for the development of the Watershed Management Plan. Encouragement will also be given to volunteers to support projects for other impaired segments within the Conasauga Watershed that are not currently receiving as much attention as Holly Creek.

Water Quality Monitoring and Stream Cleanup Canoe Floats

These events should be designed to attract members of the local community to volunteer to clean up our local waterways from a canoe and/or sample water quality during a training session on how to use Adopt-A-Stream equipment for water quality sampling. These volunteers could paddle while picking up all accessible trash within the stream and on the banks, and/or sample water quality at several sites, while learning about the importance of varying water quality parameters, agricultural and residential runoff issues and how they pertain to Holly Creek. Maps and handouts should be distributed at stops along the way to discuss pollution sources, BMPs, and steps they can take on their own property to reduce pollution. In addition, local aquatic fauna should be a topic of discussion in order to convey what could be at stake should pollution problems continue. Volunteer labor and donated material values will be recorded and reported as matching funds for any applicable 319 grant.

Summary of Nine Elements

The following is a summary of the Nine Elements addressed in the Holly Creek Watershed as identified in the Watershed Management Plan (WMP).

1. An identification of the sources or groups of similar sources contributing to nonpoint source pollution to be controlled to implement load reductions or achieve water quality standards.

The Holly Creek Watershed has streams that fail to meet the criteria within the State of Georgia for pathogens and impacted biota, which respectively tend to result from fecal contamination and excessive sediment loads. Load reductions of these pollutants are necessary in two stream segments, so the WMP focuses on fecal coliform bacteria and sediment as the nonpoint source (NPS) pollutants of concern and identifies several consistent sources for these pollutants (discussed in detail in Section 4), each of which relates to land use. This WMP identifies agricultural lands for targeting load reductions of both fecal coliform bacteria and sediment pollution through the installation of Best Management Practices (BMPs; e.g., controlling livestock access to water sources, installing alternative watering sources, protecting heavy use areas, etc.). In addition, residences will be targeted for septic system repairs to reduce the contributions of fecal coliform bacteria from failing septic systems. Streambank biostabilization and stormwater projects will be completed on agricultural and/or urban land when feasible.

2. An estimate of the load reductions expected for the management measures described under number 3 (below);

The load reductions recommended in Total Maximum Daily Load (TMDL) documents are featured in Section 5. Management measures that will be implemented to achieve load reductions include agricultural projects, stormwater and streambank biostabilization projects, and septic system repairs. Agricultural BMPs will vary according to the interests of the farmers, and it is difficult to predict the frequency that each practice will be used during implementation, as well as where projects will be located, the current onsite conditions, and the significance of the NPS pollution at each site to be ameliorated. Septic system repairs will also be conducted as part of the WMP implementation process, especially in close proximity to blueline streams. However, the type of repairs, the proximity to streams, and the contributions to instream fecal coliform counts may vary for each septic repair project. Complicating matters further, conditions within the watershed will change over time. Due to the complexity involved in predicting the load reductions from the broad management measures provided below, the WMP instead seeks to focus on the completion of multiple projects and intermittently evaluating where the watershed is within the restoration process. Eventually, the management measures implemented should result in restoration to the extent that the necessary load reductions will be met and the impaired segments will be able to remain delisted.

3. A description of the NPS management measures that will need to be implemented to achieve the load reductions established in the TMDL or to achieve water quality standards;

A number of management measures including both structural and non-structural practices have already accomplished and will continue to accomplish various objectives. These practices are highlighted within Section 6. WMP implementation will also aim to execute additional structural controls to include some combination of the agricultural practices, streambank biostabilization efforts, and a number of septic system repairs directed toward NPS load reductions (discussed in Chapters 6 and 7). The management measures should be implemented across several grants with each involving monitoring to gain updates on current watershed conditions and completing projects potentially according to changing priorities. In conjunction with these efforts, we recommend implementing non-structural controls geared towards promoting watershed improvements with educational involvement within the community (also described in Chapters 6 and 7).

4. An estimate of the amounts of technical and financial assistance needed, and/or the authorities that will be relied upon to implement the plan;

The groups responsible for each existing and new management measure are described within Section 7 of the WMP. Estimates of funding needs are indicated only for activities conducted exclusively for WMP implementation. The process used to estimate the financial resources utilized is described in greater detailed in Section 7, and was chosen due to the complexities of implementing load reductions "on the ground" through voluntary conservation practices. The anticipated sources of funding to achieve restoration goals are several Environmental Protection Agency (EPA) Section 319 grants administered by the Georgia Environmental Protection Division (EPD), in conjunction with in-kind services from Murray County, North Georgia Health District, and volunteers from across the region.

5. An informational/educational component that will be used to enhance public understanding of and participation in implementing the plan;

Public education and outreach recommendations are identified in Section 8. The more successful programs should remain standard practices for the duration of the implementation process. The recommended educational programs focus on water quality monitoring, septic system maintenance, and stream cleanups, among others. Additional programs should be designed and implemented as necessary for successful implementation.

6. A schedule for implementing the management measures that is reasonably expeditious;

The proposed implementation schedule is found in Section 7 and initially estimates implementation activities to occur through 2026. This includes water quality monitoring and implementation activities (e.g., agricultural BMPs, and septic system repairs), in addition to education and outreach. Each of these activities will continue through each grant implementation period, although priorities may be reevaluated and subsequently altered with each grant period. Currently, we anticipate that four grant implementation periods may allow for the goals of the WMP to be accomplished.

7. A description of interim, measurable milestones (e.g., e.g., amount of load reductions, improvement in biological or habitat parameters) for determining whether management measures or other control actions are being implemented;

A number of goals and objectives are recommended as interim milestones proposed to implement the management measures of this watershed improvement plan. These are included in Section 7. The initial goals of the WMP include developing a septic system cost-share program, building momentum toward implementation of agricultural management practices, completing septic, stormwater, streambank biostabilization, and agricultural projects that reduce pollutant loads, carrying out educational activities, and monitoring to observe where extra focus is necessary and maintain that load reductions are occurring as a result of implementation. Over the course of implementation, each grant will include interim milestones with more finite objectives for each of the overall goals (i.e., number of agricultural and septic projects, number of newspaper articles, number of Adopt-A-Stream (AAS) programs initiated, multiple years of water quality monitoring data, etc.).

8. A set of criteria that can be used to determine whether substantial progress is being made towards attaining water quality standards and, if not, the criteria for determining whether the plan needs to be revised; and;

Several sources of the pollutants of concern will be addressed by WMP implementation. Water quality data collection is ongoing to determine priorities and current conditions and will continue intermittently to indicate how projects on the landscape are translating into water quality changes. Yet, it may be a few years before enough projects are completed in each subwatershed to significantly affect water quality. Therefore, throughout the implementation process, project types and locations will be documented to get an idea of the extent of water quality improvements as projects become more prevalent within each subwatershed and the Holly Creek Watershed. This will allow management measures to be adapted to effectively address concerns that may arise with improvements in the implementation strategy. In the interim, continued monitoring of water quality and determination of the success of completed projects is necessary to determine if revisions are needed. At the least, revisions should be submitted in an addendum to this document in 2019 to evaluate successes and adaptations to the initial management measures recommended in this WMP. Section 7 includes how progress will be indicated and considers documenting the details of each project, load reductions per project when applicable, increased public interest, and changes in water quality that indicate progress toward the overall goal of de-listing impaired segments within the watershed.

9. A monitoring component to evaluate the effectiveness of the implementation efforts, measured against the criteria established under item (8).

In Section 7, the WMP recommends that two different monitoring protocols continue to be conducted within the watershed as the new management measures (and the ongoing programs discussed in Section 6) are implemented. One type of monitoring is identified as “Targeted Monitoring”, and involves sampling at specific sites in both wet and dry periods to help establish baseline conditions and monitor for improvements. The second type of monitoring is for “de-listing” purposes, and follows a strict procedure (regardless of weather) in an attempt to show that restoration has been achieved.

Glossary of Acronyms

AAS - Adopt-A-Streams

BMP - Best Management Practice

CNMP - Comprehensive Nutrient Management Plan

DNR - Department of Natural Resources

EPA - Environmental Protection Agency

EPD - Environmental Protection Division

FWS - Fish and Wildlife Service

GIS - Geographic Information Systems

HCWRP - Holly Creek Watershed Restoration Program

IBI - Index of Biotic Integrity

NPS - Nonpoint Source

NRCS - Natural Resource Conservation Service

RC&D - Resource Conservation and Development Council

SQAP - Sampling and Quality Assurance Plan

TMDL - Total Maximum Daily Loads

TNC - The Nature Conservancy

WMP - Watershed Management Plan

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