WATERSHED RESTORATION ACTION STRATEGY

A water quality & watershed restoration project helping citizens improve & protect their water resources.

Funding for this project is provided by a U.S. EPA Section 319(h) Grant from the Non-Point Source Program Environmental Protection Division Georgia Department of Natural Resources

WILLACOOCHEE RIVER 319 PROJECT

Willacoochee River
Watershed Restoration Action Strategy

Willacoochee River

Prepared by:
South Georgia Regional Development Center, Valdosta, GA
John Leonard, Executive Director
Emily Perry, Environmental Planner
Willacoochee 319 Project Coordinator
Robert Lindsey

Assisted by:
Seven Rivers Resource Conservation & Development Council, Baxley, GA
University of Georgia, Department of Biological & Agricultural Engineering
National Wildlife Federation
USDA, Natural Resources Conservation Service
USDA, Agricultural Research Service
Georgia Forestry Commission
Upper Suwannee River Watershed Initiative
Upper Suwannee Conservation Tillage Alliance
Georgia Soil & Water Conservation Commission
Alapaha Soil & Water Conservation District
Middle South Soil & Water Conservation District

January 31, 2004

ASSISTED BY:

U.S. Environmental Protection Agency

Georgia Environmental Protection Department of Natural Resources

Seven Rivers Resource Conservation & Development

South Georgia Regional Development Center

Georgia Soil & Water Conservation Commission

Core4 Conservation Alliance
Better Soil. Cleaner Water. Greater Profits. Brighter Future.

Upper Suwannee Conservation Tillage Alliance

College of AGRICULTURAL & ENVIRONMENTAL SCIENCES
Cooperative Extension Service

Funding for this project is provided by a U.S. EPA Section 319(h) Grant from the Non-Point Source Program Environmental Protection Division Georgia Department of Natural Resources

TABLE OF CONTENTS

PAGE

PAGE

LIST OF FIGURES

PAGE

LIST OF TABLES

PAGE

LIST OF PHOTOS

PAGE

ACRONYMS

AAS: Adopt-A-Stream

ARS: Agriculture Research Service

AS&WCD: Alapaha Soil & Water Conservation District

BMP: Best Management Practice

C.A.S.E: Center of Agricultural Study and Excellence

Cd: Cadmium

CERCLIS: Comprehensive Environmental Response, Contamination and Liability Information System

CPGL: Conservation of Private Grazing Land

CSO: Combined Sewer Overflow

CSP: Conservation Security Program

Cu: Copper

CWA: Clean Water Act

CWSRF: Clean Water State Revolving Fund

DO: Dissolved Oxygen

DNR: Department of Natural Resources

DWSRF: Drinking Water State Revolving Fund

EPA: Environmental Protection Agency

EPD: Environmental Protection Division

EQIP: Environmental Quality Incentives Program

FC: Fecal Coliform

FS: Fecal streptococci

FEMA: Federal Emergency Management Agency

GA: Georgia

GA EPD: Georgia Environmental Protection Division

GEFA: Georgia Environmental Facilities Authority

GEMA: Georgia Emergency Management Agency

GFC: Georgia Forestry Commission

GPS: Global Positioning System

GA S&WCC: Georgia Soil & Water Conservation Commission

Hg: Mercury

HQ: Head quarters

HUC: Hydrologic Cataloging Units

M: Municipal

NAWCA: North American Wetlands Conservation Act

NPDES: National Pollutant Discharge Elimination System

NPS: Non-point source

NRCS: Natural Resource Conservation Service

NS: Not supporting

NWF: National Wildlife Federation

NWI: National Wetland Inventory

P2AD: Pollution Prevention Assistance Division

Pb: Lead

PCS: Permit Compliance System

POTW: Publicly Owned Treatment Works

PS: Partially Supporting

RC&D: Resource Conservation and Development Council

S&WCD: Soil & Water Conservation District

SGRDC: South Georgia Regional Development Center

SPLOST: Special Purpose Local Option Sales Taxes

TMDL: Total Maximum Daily Load

UGA: University of Georgia

USCTA: Upper Suwannee Conservation Tillage Alliance

USDA: United States Department of Agriculture

USGS: United States Geological Survey

U.S. EPA: United States Environmental Protection Agency

USRWI: Upper Suwannee River Watershed Initiative

WHIP: Wildlife Habitat Incentives Program

WPCP: Water Pollution Control Plant

WRAS: Watershed Restoration Action Strategy

WRP: Wetlands Reserve Program

WQLS: Water Quality Limited Segments

Zn: Zinc

GLOSSARY

Algae – any of various chiefly aquatic, eukaryotic, photosynthetic organisms, ranging in size from single-celled forms to the giant kelp. Algae were once considered to be plants but are now classified separately because they lack true roots, stems, leaves, and embryos.

Algal bloom – a heavy growth of algae in and on a body of water as a result of high nitrate and phosphate concentrations from farm fertilizers and detergents.

Basin – the land area drained by a river and its tributaries.

Best management practices (BMPs) – an engineered structure or management activity, or combination of these that eliminates or reduces an adverse environmental effect of pollutants.

Blackwater streams – originate in swampy areas and get their names because the water that flows through them is stained dark brown, like the color of tea, by organic acids. This staining gives the appearance of "black" water.

Buck – the adult male of various mammals, such as goats, deer, or other related animals.

Catch Crop - a cover crop established after harvesting the main crop and is used primarily to reduce nutrient leaching from the soil profile.

Channel – the section of the stream that contains the main flow.

Channelization – the straightening of a stream; this is often a result of human activity.

City/County Comprehensive Plan – a document that establishes a community's future goals and objectives for growth and development. In Georgia, these plans are used as a guide for local governments that incorporate information such as existing infrastructure, housing demands, population projections, economic factors, community facilities, land use, and natural/cultural resources. Comprehensive plans typically are projected for a range of ten years.

Clarity – clearness of water. This is important in aquatic habitats. When water is not clear, it is called turbid (cloudy water).

Clean Water Act (CWA) – the Act established the basic structure for regulating discharges of pollutants into the waters of the United States and gave the U.S. EPA the authority to implement pollution control programs such as setting wastewater standards for industry, set water quality standards for all contaminants in surface waters, etc.

Clean Water Action Plan – an aggressive plan outlining the next generation of clean water protection by setting strong goals and providing states, communities and farmers with the tools and resources to meet them.

Clear cutting – the removal of all trees in a forest area.

Coastal Plain Province – a low, flat region of well-drained, gently rolling hills and poorly drained flatwoods. The Coastal Plain extends east and south of the Fall Line Hills, the old Mesozoic shoreline still marked by a line of sand hills. In Georgia, the Atlantic Ocean forms the eastern border of the Coastal Plain. The southern border of this province is formed by the Gulf of Mexico, in the State of Florida.

Cover Crop - any crop grown to provide soil cover, regardless of whether it is later incorporated.

Dendritic – a dendritic drainage pattern is the most common form and looks like the branching pattern of tree roots. Tributaries joint larger streams at acute angles (less than 90 degrees). This drainage pattern tends to develop in regions underlain by homogeneous material.

Designated classification – all waters in the State of Georgia have been classified based on

the beneficial uses designated for each water body. Some examples of designated classifications are public drinking water supply, recreation, fishing, wild river/scenic, coastal fishing.

Dissolved oxygen (DO) – oxygen dissolved in water and available for living organisms to use for respiration. The concentration of DO in water is highly dependent on temperature (higher temperatures, lower DO) but pollution also tends to lower the DO.

Doe – the female of various mammals such as goats, deer or other related animals.

Ecosystems – an ecological (the relationship between organisms and their environment) community together with its environment, functioning as a unit.

Encroachment – any entry into an area not previously occupied.

Environmental steward – someone who strives to sustain natural resources and our environment for future generations.

Erosion – the wearing away of the earth's surface by running water, wind, ice, or other geological agents; processes, including weathering, dissolution, abrasion corrosion, and transportation, by which material is removed from the earth's surface.

Eutrophication – the artificial or natural enrichment of nutrients to a water body, which may lead to depleted oxygen concentrations. Eutrophication is a natural process that is frequently accelerated and intensified by human activities.

Fall Line – the imaginary line that separates the Piedmont and Coastal Plain Provinces of the State of Georgia.

Fecal coliforms (FC) – are bacteria that live in the digestive tract of warm-blooded animals (humans, pets, farm animals, and wildlife) and are excreted in the feces.

Fish kill – the sudden death of fish due to the introduction of pollutants or the reduction of dissolved oxygen concentration in a water body.

Flow – the direction or movement of a stream or river.

Grab sample – when you literally grab a water sample (scoop some water in a bag) when you are at a site (i.e., no sampling station set up for weekly or flow proportional composite samples).

Groundwater – water beneath the earth's surface, often between saturated soil and rock, that supplies wells and springs.

Homogenous – where the subsurface geology has a similar resistance to weathering so there is no apparent control over the direction the tributaries take.

Hydrologic Unit Code (HUC) – are a way of identifying all of the drainage basins in the United States in a nested arrangement from largest (Regions) to smallest (Cataloging Units).

Hydrology – the scientific study of the properties, distribution, and effects of water on the earth's surface, in the soil and underlying rocks, and in the atmosphere.

Impaired stream – a stream that cannot attain its use designation based on conclusions from the analysis of biological and chemical data, modeling, and/or NPS monitoring results.

Land Application System (LAS) – the State of Georgia's non-NPDES permit requirement for non-point source discharges. All facilities in Georgia that generate sewage sludge from the treatment of domestic (or industrial) sewage must obtain a NPDES permit, a LAS permit, or a local or state pretreatment permit.

Land use – the actual use of a parcel of land, typically grouped into eight general categories (residential, commercial, industrial, public / institutional, transportation / communication /

utilities, parks / recreation / conservations, agriculture / forestry, and undeveloped).

Living document – a document that can be continually updated or added to.

National Pollutant Discharge Elimination System (NPDES) – a permit program that controls water pollution by regulating point sources that discharge pollutants into waters of the United States.

Non-Point Source (NPS) Pollution – pollution that cannot be traced to a specific point, but rather from many individual places (i.e. stormwater and agricultural runoff).

Nutrient – substance which is necessary for growth of all living things (i.e. phosphorous and nitrogen).

Paddocks – a fenced area used for grazing purposes.

Pesticide – a chemical that kills insects and rodents. Pesticides can poison aquatic life when they reach surface waters through runoff.

Phosphorus – a nutrient that is essential for plants and animals.

Point-Source Pollution – a type of pollution that can be tracked down to a specific source such as a factory discharge pipe.

Pollutant – something that makes land, water, or air dirty and unhealthful.

Pollution – any natural or manmade material that contaminates the soil, air, or water.

Riparian – of or pertaining to the banks of a body of water.

Runoff – water, including rain and snow, which is not absorbed into the ground but instead flows across the land and eventually runs into streams and rivers. Runoff can pick up pollutants from the air and land, carrying them into the stream.

Section 319 Non-point Source Management Program – this section of the Clean Water Act allows States, Territories, and Indian Tribes to receive grant money to support a wide variety of activities including technical assistance, financial assistance, education, training, technology transfer, demonstration projects, and monitoring to assess the success of specific non-point source implementation projects.

Sediment – soil, sand, and materials washed from land into waterways. Other pollutants may attach to sediment and be carried into the stream.

Sedimentary – of or relating to rocks formed by the deposition of sediment.

Sedimentation – when soil particles (sediment) settle to the bottom of a waterway.

Silviculture - the care and cultivation of forest trees; forestry.

Sinkhole – a natural depression in a land surface communicating with a subterranean passage, generally occurring in limestone regions and formed by solution or by collapse of a cavern roof.

Soil and Water Conservation District (S&WCD) – there are 40 S&WCD in Georgia and they exist to serve the public and to ensure a healthy and productive environment by safeguarding the land, water and other related resources for the benefit of future generations. The S&WCD is an agency of the State of Georgia organized to exercise public powers conferred under the Provision of the Georgia Soil and Water Conservation Law of 1937.

Soil association –a group of related soil series that generally occur in a characteristic pattern of landscapes that have identifiable topographic features, slopes, and parent materials.

Stakeholder – anyone who has a share or interest.

Streambank Restoration – the process of restoring the banks of a stream to a condition that can recreate the habitat needed to support aquatic life. This can be accomplished through but not limited strictly to the following actions: controlling the velocity of the water flow, restoring a normal bank gradient, removing major stream obstructions, and restoring suitable stream patterns such as meandering, irregular, and braided.

Streambank Stabilization – the process of stabilizing the banks of a stream to minimize or eliminate erosion by either (1) reducing the force of flowing water; (2) increasing the resistance of the bank to erosion; or (3) a combination of both. No single method is appropriate in all situations, but this can be done through but not limited strictly to the following actions: the use of vegetation; soil bioengineering; the use of rock work in conjunction with plants; and conventional bank armoring.

Stormwater Runoff – the water that flows overland during a rain event.

Sub-watersheds – a sub-watershed is a smaller basin of a larger drainage area that all drains to a central point of the larger watershed.

Superfund – the commonly-used name for the Comprehensive Environmental Response, Contamination and Liability Act (the "Superfund" law). The U.S. EPA was empowered to accept reports of toxic spills and pollution, and created the Comprehensive Environmental Response, Contamination and Liability Information System (CERCLIS) database.

Surface Water – precipitation which does not soak into the ground or return to the atmosphere by evaporation or transpiration and is stored in streams, lakes, wetlands, and reservoirs.

Total Maximum Daily Load (TMDL) – a calculation of the maximum amount of a pollutant that a river, stream, or lake can receive and still be safe and healthy. It is also a means for recommending controls needed to meet water quality standards.

Total Maximum Daily Load (TMDL) Implementation Plan – a plan developed after a TMDL is established to examine the probable causes of pollution and recommended strategies for correcting the problem. The process for developing these plans involves reviewing and updating land use data; visiting the affected watersheds; gathering information and input from stakeholders; and consulting with soil and water experts to determine the most effective solutions.

Topographic features – include mountains, drainage patterns, location of rock outcroppings, hills and other natural features

Tributary – a body of water that flows into another, typically larger, body of water.

Turbid – when water is visually cloudy. Cloudy water is a result of turbidity.

Turbidity – the result of sediment or other materials being stirred up in the water.

Washboarding – a groove or ridge on a surface such as a road. This term is used because when driving it feels like you are driving over a giant washboard. The three causes of washboarding are lack of moisture, motorists' driving habits, and poor quality of gravel.

Water – a substance that in its purest form is odorless, colorless and tasteless and is needed for survival by every living object.

Water Discharge Permits – are permits that allow companies to discharge an issued amount of waste water into a waterway.

Water Quality Limited Segments (WQLS) – are segments of waters that do not meet their water quality standard for their designated water classification, even after point sources of pollution have installed the minimum required levels of pollution control technology.

Water Quality Standards – are limits that are established and enforced under state or federal law.

Watershed – the land area from which water drains to a particular water body.

Watershed Restoration Action Strategies (WRAS) – a document that compiles information on a particular watershed and can be used to identify potential projects and funding for implementation.

Wetlands – a lowland area, such as a marsh or swamp that is saturated with moisture, especially when regarded as the natural habitat of wildlife.

Willacoochee River Research Group – personnel from the University of Georgia (UGA) and the National Wildlife Federation (NWF).

ACKNOWLEDGMENTS

I would like to first thank the Seven Rivers Resource Conservation and Development (RC&D) Council and staff for believing in protecting and improving our natural resources and their continued support in the Willacoochee River Watershed 319 Project. Second, I would like to thank Dr. Mary Davis for her vision and guidance in establishing the foundation from which the Willacoochee River Watershed 319 project was created; the University of Georgia's Cooperative Extension Service Agents in Ben Hill, Irwin, Berrien, Atkinson and Coffee counties; the United States Department of Agriculture (USDA) – Natural Resource Conservation Service (NRCS) District Conservationist and Soil Conservation Technicians for their endless help with working with the many landowners in the Willacoochee River Watershed; and the many staff at the University of Georgia's Biological & Agricultural Engineering Department Coastal Plain Experiment Station and the USDA – Agricultural Research Service (ARS) Southeast Watershed Research Lab in Tifton for their time, resources, and expertise.

Additional thanks for their valuable contributions to the Willacoochee River Watershed Restoration Action Strategy go to the Upper Suwannee Conservation Tillage Alliance (USCTA), the Upper Suwannee River Watershed Initiative (USRWI), the Georgia Forestry Commission (GFC), the Georgia Soil & Water Conservation Commission, the Alapaha Soil & Water Conservation District, the Middle South Georgia Soil & Water Conservation District, the South Georgia Regional Development Center (SGRDC), and the Georgia Department of Natural Resources Environmental Protection Division Water Protection Branch Non-Point Source Pollution, in particular Amber Greer.

Sincerely,

Robert Lindsey
Willacoochee 319 Project Coordinator

Willacoochee River

EXECUTIVE SUMMARY

The Watershed Restoration Action Strategy (WRAS) development and implementation in the Willacoochee River Watershed Project was funded through a United States Environmental Protection Agency (U.S. EPA) Section 319 (h) grant. In addition to having a number of endangered species, including the gopher tortoise and indigo snake, several stream segments along the Alapaha and Willacoochee Rivers have been found "partially supporting" or "not supporting" of their designated water use, which is for fishing. This is based on the *Georgia 2000 Lists of Water as required by the Section 303 (d) list associated with the Federal Clean Water Act*.

By addressing the entire Willacoochee River Watershed, the WRAS is meant to educate citizens about water quality and to connect them with resources and programs to help control and abate sources of pollution. The goal of the WRAS is to bring citizens into the watershed restoration planning process so they can understand how watersheds work and how land uses impact water quality and aquatic habitat. Although agriculture and forestry are the largest land uses in the project area, other potential sources of pollution exist, such as urban runoff and industrial waste. By assessing and addressing the water quality in a watershed approach instead of a single stream approach, we will be able to address all sources of pollution and aquatic habitat alterations in the Willacoochee River Watershed.

The primary objective of the Willacoochee River Watershed project was to develop and implement a demonstration Watershed Restoration Action Strategy (WRAS). The WRAS will provide information about the Willacoochee River Watershed's:

~ physical description	~ land use	~ best management practices
~ biological/chemical assessment	~ sources of pollution	~ resources available

Additional elements include a glossary that defines all words in **bold**, an acronym list for convenience, and several appendices that include maps and a table with the contact information for stakeholder groups in the Willacoochee River Watershed. Citizen involvement in the development of the WRAS is the key to obtaining and maintaining good water quality. A major portion of this project was coordinating citizen groups to provide input and evaluation of the WRAS thus ensuring success of the project.

South Georgia Regional Development Center (SGRDC)
327 West Savannah Avenue
Valdosta, GA 31601
Phone: 229.333.5277
Fax: 229.333.5312
www.sgrdc.com

Willacoochee River

CHAPTER 1: INTRODUCTION

Congress amended the **Clean Water Act** (CWA) in 1987 to establish the **Section 319 Non-point Source Management Program** in recognition of the need for greater federal leadership to help focus state and local **non-point source (NPS) pollution** efforts. Under section 319, states, territories, and Indian Tribes are eligible to receive grant monies to support a variety of activities including technical assistance, financial assistance, education, training, technology transfer, demonstration projects, and monitoring to assess the success of specific non-point source implementation projects (U.S. EPA, 2002).

In 1998, President Clinton announced the **Clean Water Action Plan**, which outlined the importance of developing and implementing **Watershed Restoration Action Strategies (WRAS)** to restore and protect America's waters that were not meeting **water quality standards**. Within the Willacoochee River Watershed there are 5 stream segments that do not meet the State of Georgia's water quality standard and are considered "**impaired**" (See Figure 1 and Chapter 3 for more information). The 5 impaired stream segments are:

(1) Little Brushy Creek (Irwin County);
(2) Reedy Creek (Irwin County);
(3) Turkey Creek (Ben Hill County);
(4) Willacoochee River (Berrien/Atkinson/Coffee Counties); and
(5) Willacoochee River (Irwin County)

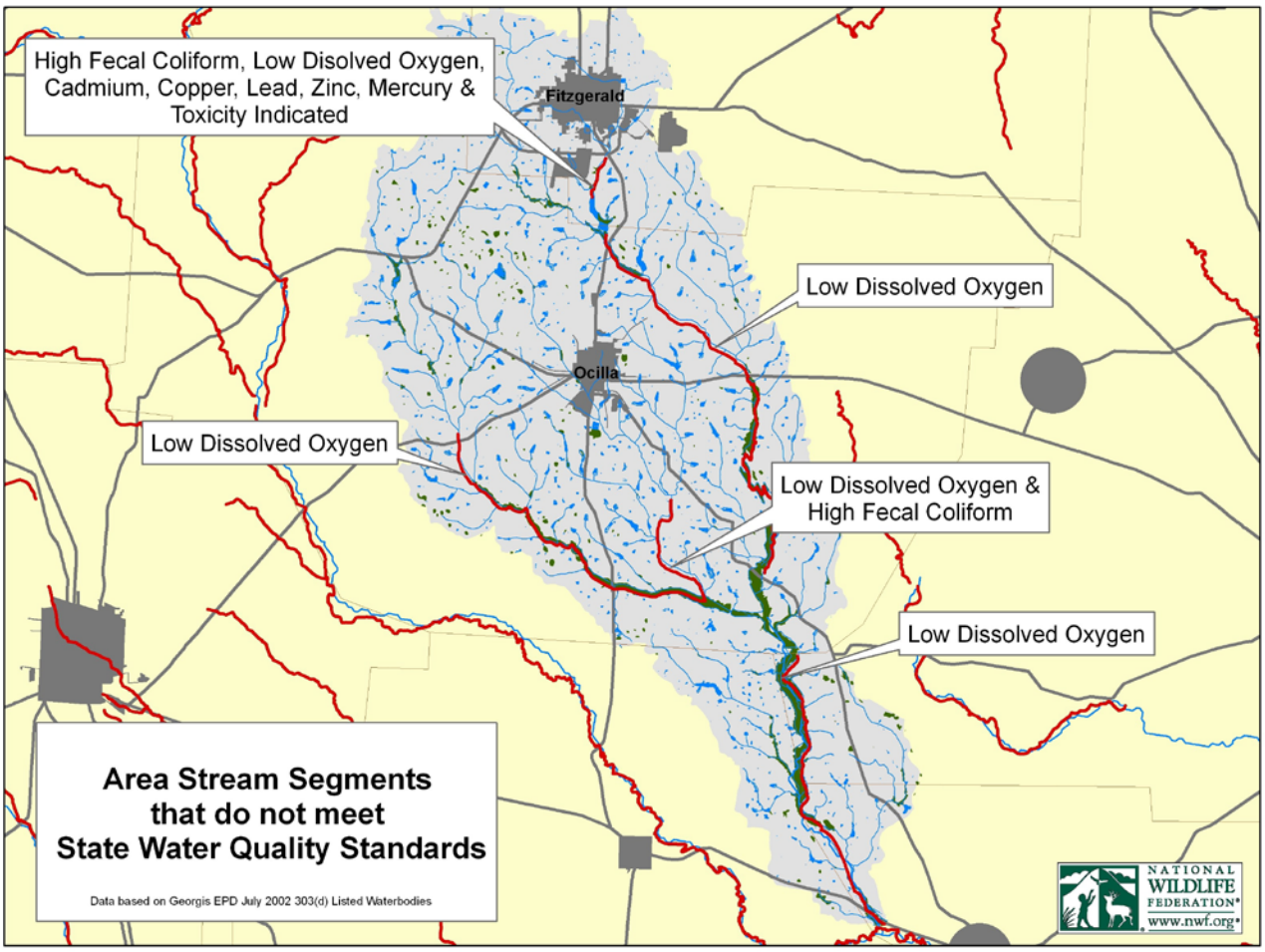


Figure 1. *Impaired stream segments in the Willacoochee River Watershed*

Since the Willacoochee River Watershed has a number of impaired streams, it was a prime candidate for a U.S. Environmental Protection Agency (EPA) Section 319 (h) grant project. In March 2000, Seven Rivers Resource Conservation & Development (RC&D) Council submitted the Willacoochee River Watershed 319 Project proposal with the assistance of the National Wildlife Federation (NWF) to the GA EPD – Water Protection Branch – Non-Point Source Program. The project was approved and initiated in June 2001 and completed in January 2005. This project required a significant amount of citizen (**stakeholder**) outreach and participation, 2 full years of water quality sampling at 11 locations throughout the **watershed**, the implementation and demonstration of a minimum of 6 **best management practices** (BMPs), and the development of this WRAS.

1.1 Willacoochee River Watershed Restoration Action Strategy (WRAS)

The State of Georgia is developing Watershed Restoration Action Strategies (WRAS) for streams and rivers that do not meet **water quality standards** for waters with a **designated classification**. Georgia currently has six designated water classifications and they each have their own water quality standards (Wild and Scenic rivers have been combined in Tables 1 and 2 of this document because they have the same water quality standards). The six water classifications are as follows:

TABLE 1:
WATER CLASSIFICATIONS

CLASSIFICATION	DESCRIPTION
Drinking Water Supply	Waters approved as a source for public drinking water systems permitted by the Georgia EPD. Waters classified for drinking water supplies will also support fishing use and any other use requiring water of a lower quality.
Fishing	Waters that support general recreational activities such as water skiing, boating or swimming.
Wild River and Scenic River	Waters that refer to streams or rivers that are wild or scenic. This is the highest water quality standard.
Recreation	Waters that support the propagation of fish, shellfish, game and other aquatic life.
Coastal Fishing	Waters along the ocean side of Georgia's coast that support recreational and commercial fishing.

Source: University of Georgia, *Georgia's Water Quality Standards*, 2004

TABLE 2:
SPECIFIC WATER QUALITY CRITERIA

	FECAL COLIFORM BACTERIA	DISSOLVED OXYGEN	PH	TEMPERATURE
Drinking Water Supply	May–Oct < 200 colonies/100 mL as geometric mean. Nov–Apr < 4000 colonies/100 mL (instantaneous max).	>5 mg/L daily average Not >4 mg/L at all times	Between 6.0 - 8.5	< 90 F
Fishing	May–Oct <500 colonies/100 mL as geometric mean. Nov-Apr <4000 colonies/100 mL (instantaneous max).	>5 mg/L daily average Not >4mg/L at all times	Between 6.0 - 8.5	< 90 F
Wild River and Scenic River	No Alteration of natural WQ	No Alteration of natural WQ	No Alteration of natural WQ	No Alteration of natural WQ
Recreation	Coastal water: 100 colonies/100mL. Other: 200 colinies/100mL.	>5 mg/L daily average Not >4mg/L at all times	Between 6.0 - 8.5	< 90 F
Coastal Fishing	May–Oct <500 colonies/100 mL as geometric mean. Nov-Apr <4000 colonies/100 mL (instantaneous max).	Site Specific	Between 6.0 - 8.5	< 90 F

Source: University of Georgia, *Georgia's Water Quality Standards*, 2004

The objective of the WRAS is to provide assistance to local governments, interested citizen groups, etc. on ways to achieve and maintain good water quality in their watershed by identifying the resources necessary to control pollution. Key elements of this project's WRAS included, but were limited to:

- Identification of environmental and programmatic goals;
- Identification of sources of water pollution;
- Implementation of pollution control and restoration measures to achieve clean water;
- Schedule and implementation of pollution control measures;
- Monitoring and evaluation of progress;
- Identification of funding sources to implement and maintain restoration measures;
- Coordination across agencies, interested groups, and individuals; and
- Seek and include public input.

The Willacoochee River Watershed 319 Project has two main goals. The first is to provide swimmable and fishable waters that will provide a healthy place for people and wildlife to live and work. By providing an environmentally sound setting, the WRAS will establish an overall plan for the watershed, which is the second goal. With the establishment of an overall plan or schedule for the Willacoochee River Watershed, the water resources can be restored in a cost-effective and timely manner; and potentially avoid regulatory actions.

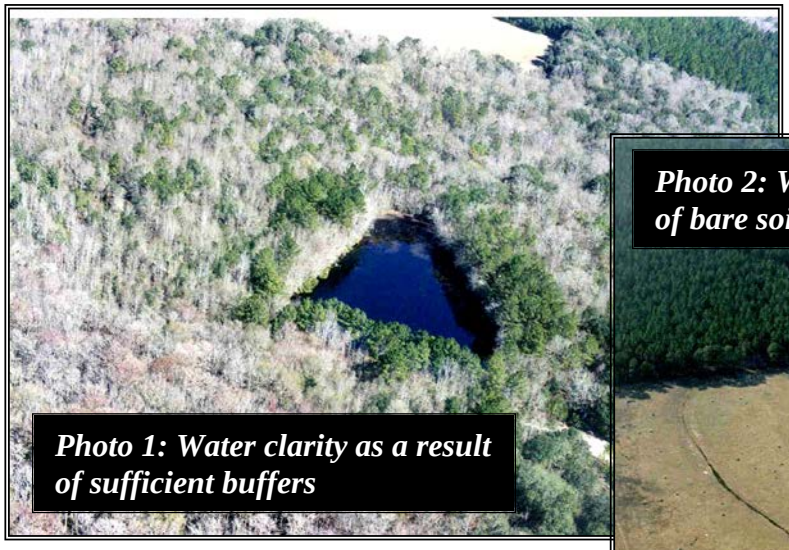


Photo 1: Water clarity as a result of sufficient buffers

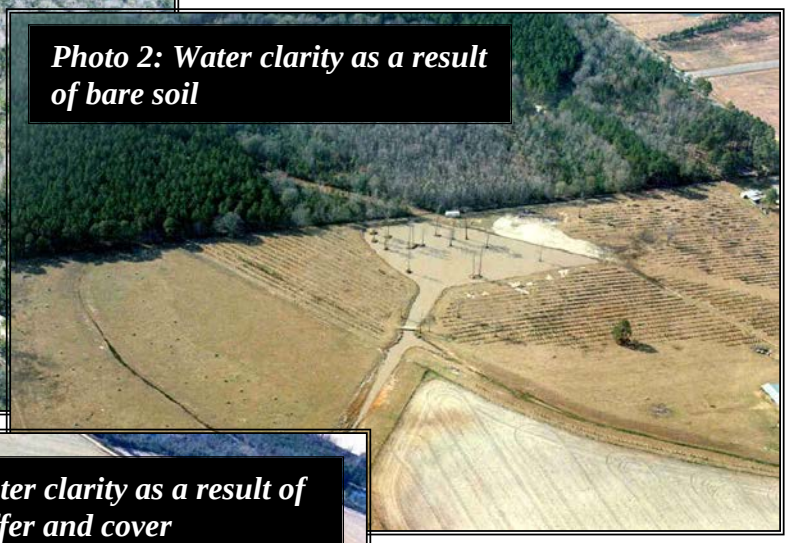


Photo 2: Water clarity as a result of bare soil

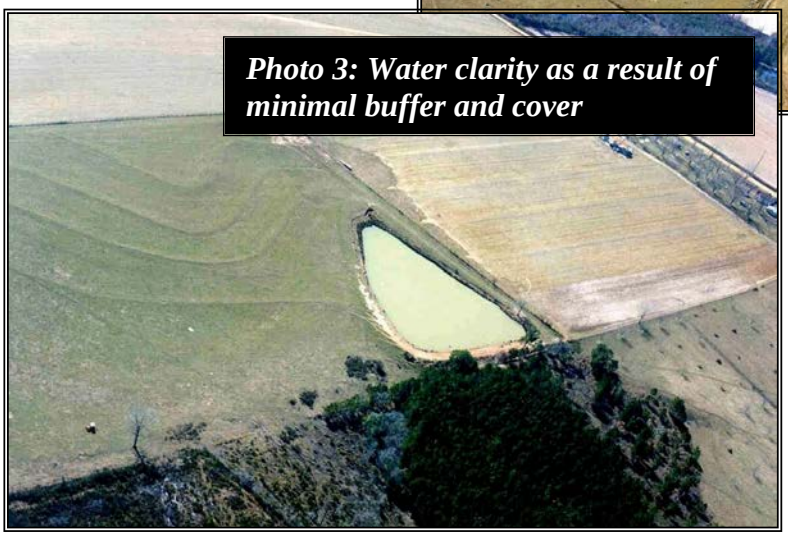


Photo 3: Water clarity as a result of minimal buffer and cover

CHAPTER 2: WILLACOOCHEE RIVER WATERSHED

Understanding the **watershed** itself is one of the first steps in maintaining and planning for its future. The study of the **land uses**, **soil associations**, **topographic features**, and **hydrology** all play very important roles when it comes to the structure and history of the watershed. This chapter will cover several key elements of the Willacoochee River Watershed such as physiographic and geologic information, land uses, and soil associations. A more detailed description of each of these features along with other topics can be found in each of the **City/County Comprehensive Plans** that have been constructed for each of the communities. This information can be accessed via the Georgia Department of Community Affairs- PlanBuilder website, www.georgiaplanning.com/planspub1/ or by contacting your local government.

2.1 Physiographic and Geologic Information

The Willacoochee River Watershed is located in the **Coastal Plain Province** of Georgia (See Appendix A: *Georgia Physiographic Map*). The Coastal Plain Province is located just south of the **Fall Line** and consists of Cretaceous[1] and Cenozoic[2] **sedimentary** rocks and sediments. The sedimentary rocks of the Coastal Plain Province consist of sediment eroded from the Piedmont over the last 100 million years or so, and partly of limestones generated by marine organisms and processes at sea. The most valuable geologic resource in this watershed is the **groundwater**. The Floridian aquifer provides groundwater for domestic consumption, industry, and agricultural irrigation in the Willacoochee River Watershed (UGA). The United States Geological Survey (USGS) actively monitors Ground-Water Conditions in Georgia. Currently, there is one real-time **surface water** site in Berrien County on the Alapaha River near the City of Alapaha; however there are no additional USGS surface water sites or any ground-water sites located in the watershed (USGS, 2002).

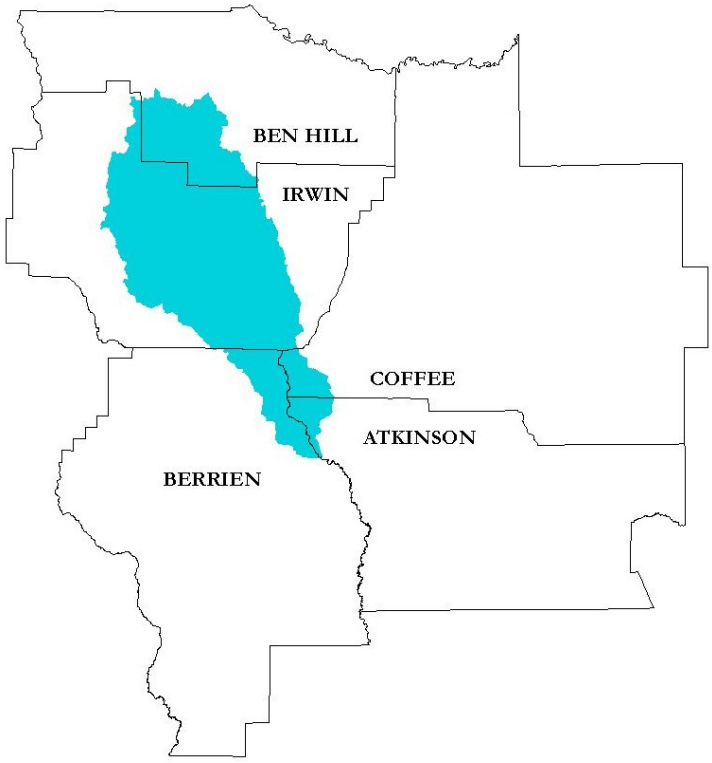
Photo 4: Sink hole in Albany, GA. Courtesy of James Hyatt

A possible geologic hazard in the Coastal Plain Province is **sinkholes** (Photo 4: *Sink hole in Albany, GA*). Sinkholes form in areas of limestone bedrock when subsurface dissolution of rock leads to a collapse of the earth's surface. Examples of this have occurred in the area surrounding Albany, Georgia. Other examples are the sinkhole lakes that have formed south of Valdosta in Lake Park, Georgia. These lakes, Balboa and Ponce de Leon, are better known as Twin Lakes and also include Long Pond and Ocean Pond, all found in Lake Park (Hyatt, 1996).

[1] Cretaceous rock (145 - 65 million years ago) originates from the final period of the Mesozoic era. The name is derived from the Latin word for chalk ("creta") and was first applied to extensive deposits of this age that form white cliffs along the English Channel between Great Britain and France. It is also known as "The Age of Dinosaurs."

[2] Cenozoic rock (65 million years ago – Present) originates from an era of geologic time from the beginning of the Tertiary period to the present. Its name is from Greek and means "new life." It is also known as the "Age of Recent Life."

2.2 Physical Description of the Watershed



The Willacoochee River Watershed flows through five counties: Ben Hill, Irwin, Coffee, Berrien and Atkinson (Figure 2 (left): *Willacoochee River Watershed and Adjoining Counties*). The watershed is located in south-central Georgia and has an approximate land area of 148,286 acres, or about 233 square miles. The project area is within the Alapaha **Soil and Water Conservation District** (S&WCD) and the Middle South Georgia Soil and Water Conservation District[3]. Most of the land is well-drained and the counties are well-suited for agriculture and commercial timber production. The physical landscape is fairly **homogenous** with no outstanding physical features. The predominant land uses of this watershed are agricultural and forestry. The two major urban areas are the cities of Fitzgerald (Ben Hill) and Ocilla (Irwin), which both have negative environmental contributions from municipal, commercial and industrial uses.

2.3 The Land Use of the Watershed

The Willacoochee River Watershed is located in a primarily rural region of south central Georgia. There are two urban areas that impact this **watershed**, which are the cities of Ocilla and Fitzgerald. The City of Ocilla is the county seat for Irwin County with a population of 3,270 (U.S. Census Bureau, 2000) and approximately 1,445 acres of land. Early development in Irwin County included lumber trade and other land clearing activities as a result of the railroad system. With the invention of the automobile, development spread throughout the entire county and resulted in the formation of several small communities. The small unincorporated communities that still exist in the Willacoochee River Watershed are Mystic, Holt, and Lax. Today only Ocilla remains as a functioning city and urban center. The decrease in the supply of lumber, the removal of railroads, and the increasing growth of urban centers outside of Irwin County, such as Fitzgerald and Tifton, have since caused the decline of all these communities.

[3] The Alapaha and Middle South Georgia Soil & Water Conservation Districts fall under the Georgia Soil & Water Conservation Commission's Region V District. The Alapaha Soil & Water Conservation District includes six counties: Berrien, Clinch, Cook, Echols, Lanier, and Lowndes, while the Middle South Georgia Soil & Water Conservation District includes nine counties: Ben Hill, Brooks, Colquitt, Crisp, Irwin, Thomas, Tift, Turner, and Worth. The regional office is in Albany, GA and the contact information is located in Appendix F.

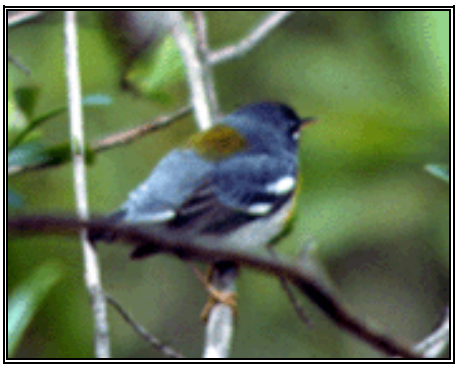
The City of Ocilla's land use is primarily residential (443 acres), with a mixture of transportation / communication / utilities (332 acres), public / institutional (139 acres), industrial (126 acres), agriculture (75 acres), forestry (71 acres), commercial (34 acres), parks / recreation / conservation (19 acres), and undeveloped (204 acres). Irwin County is predominately used for agricultural (90,998 acres) and forestry (130,000 acres) purposes and also includes sparse, sporadic residential development (2,474 acres) throughout the county (SGRDC, 1994).

The City of Fitzgerald is the county seat for Ben Hill County with a population of 8,758 (U.S. Census Bureau, 2000) and approximately 4,637 acres of land. It was originally designed to have a platted grid pattern and intended to be a retirement community for both Union and Confederate Civil War Veterans. In the 1900's, with the introduction of railroads and eventually the state and federal highway system, the physical configuration of the City of Fitzgerald was altered slightly.

Today, the city's land use is very similar to the City of Ocilla's. The primary land uses are for residential (1,652 acres) and transportation / communication / utilities (977 acres). Other land uses in the City of Fitzgerald include industrial (497 acres), public / institutional (329 acres), agricultural / forestry (275 acres), parks / recreation / conservation (225 acres), commercial (151 acres) and undeveloped / unused (829 acres). In the county, the majority of the land use is agriculture / forestry (147,963 acres) and also includes sparse, sporadic residential development (3,376 acres) throughout the entire county (SGRDC, 1991).

2.4 Endangered Plant and Animal Species

The Willacoochee River Watershed is a sensitive, unique **watershed** and has a number of endangered plant and animal species. The U.S. Fish and Wildlife Service – Region IV updated the list of the plants, invertebrates, fish, reptiles, amphibians, birds, and mammals protected under the Endangered Species Act in the State of Georgia in 2004. Table 3 (next page) depicts both plants and animals that are on the "threatened" or "endangered" species lists for the counties of Ben Hill, Irwin, and Berrien. Table 3 also includes if these species are on the Federal list of endangered species. Current local regulations should adequately protect habitats for these plant and animal species.



These pictures are courtesy of the U.S. Fish and Wildlife Service

TABLE 3:
Ben Hill, Irwin, and Berrien Counties Endangered Plant and Animal Species

SPECIES Common Name – (*Species Name*)	GEORGIA Threatened	 Endangered	FEDERAL Status
Plants			
Georgia Plume – (*Elliottia racemosa)*	X		
Pondspice – (*Litsea aestivalis)*	X		
Lax Water-milfoil – (*Myriophyllum laxum)*	X		
Parrot Pitcherplant – (*Sarracenia psittacina)*	X		
Ocmulgee Skullcap – (*Scutellaria ocmulgee)*	X		
SPECIES Common Name – (*Species Name*)	**GEORGIA** Threatened	 Endangered	**FEDERAL** Status
Animals			
Flatwoods Salamander – *(Ambystoma cingulatum)*	X		T
Eastern Indigo Snake – *(Drymarchon couperi)*	X		T
Bald eagle – *(Haliaeetus leucocephalus)*		X	T
Gopher Tortoise – *(Gopherus polyphemus)*	X		
Wood stork – *(Mycteria americana)*		X	E
Red-cockaded Woodpecker – *(Picoides borealis)*		X	E

Source: U.S. Fish and Wildlife Service – Georgia Ecological Services – Athens, Brunswick, and Columbus, 2004.

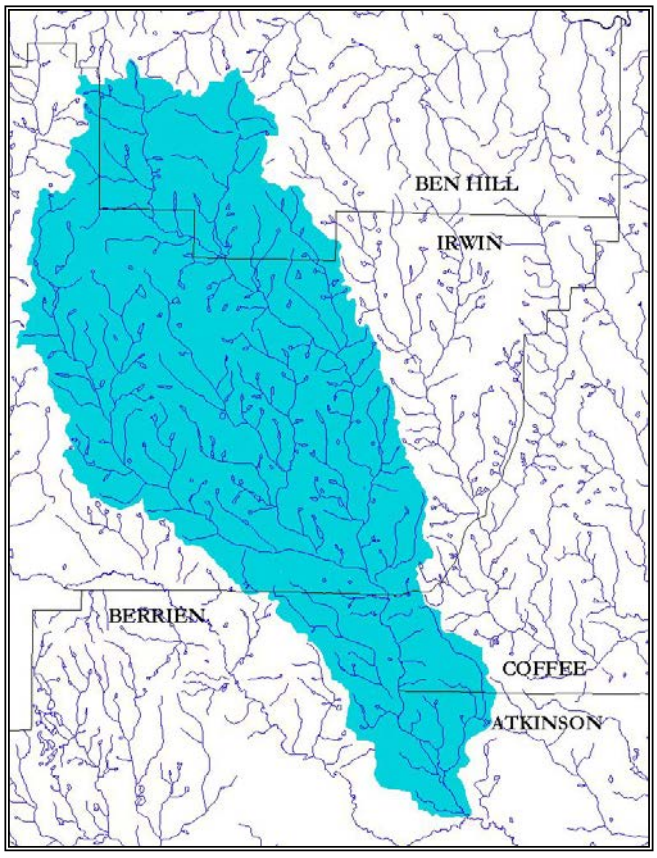


Figure 3. *Willacoochee River Hydrology*

2.5 Hydrology

The Willacoochee River originates in central Ben Hill County, west of Fitzgerald, and flows southeastward through Irwin County and into Berrien County where it later joins the Alapaha River. The Willacoochee River has several **tributaries** that feed into it including Turkey Branch, Brushy Creek, and Reedy Creek. Reedy Creek receives waters from Stump Creek and Little Brushy Creek. There are also several unnamed streams that feed into the Willacoochee River.

The surface drainage is directed, for the most part by, a **dendritic** pattern that flows generally southeastward and eventually empties into the Gulf of Mexico (Figure 3 (left): *Willacoochee River Hydrology*). In the urban areas of Fitzgerald and Ocilla, it is common to find that the stream **channel** has been **channelized**. In many of the urban streams, there is little vegetation or bare vertical stream banks, which can result in streambank **erosion**. The streams located downstream from the urban areas are directly effected by urban pollution such as **stormwater runoff**. In the rural areas of Ben Hill, Irwin, Berrien, Atkinson and Coffee counties, the streams tend to be known as "**blackwater streams**." In addition, the stream flow in the Willacoochee River watershed tends to fluctuate both seasonally and annually.

2.6 Soils

Soils are the foundation for any **watershed** or environment. The soils in the Willacoochee River watershed are mostly level or very gently sloping and occur on uplands that are cut by many small, shallow streams (USDA, 1969). The soil associations vary from well- to poorly-drained throughout the entire watershed. The soil associations found in Ben Hill and Irwin County are listed in Table 4 (below). (See Appendix B: *General Soil Map Ben Hill and Irwin Counties, Georgia* for a detailed map of the soil associations for Ben Hill and Irwin County).

Photo 5 (right): Soil sampling is important and easy to do. Call your local University of Georgia Cooperative Extension Service office or USDA-NRCS office for assistance.

TABLE 4:
BEN HILL AND IRWIN COUNTY SOIL ASSOCIATIONS

SOIL ASSOCIATION	DESCRIPTION
Tifton-Carnegie-Fuquay	Well-drained, gently sloping and sloping soils on dissected upland ridges. Slopes range from 3 to 12 percent. Most of this association is in sloping areas adjacent to and west of the flood plains of the Alapaha, Willacoochee and Satilla Rivers.
Tifton-Alapaha-Carnegie	Well-drained and poorly drained, very gently sloping and gently sloping soils on dissected divides. Slopes range from 3 to 8 percent.
Ocilla-Plummer-Alapaha	Somewhat poorly drained and poorly drained, sandy, nearly level soils on broad flats. This association consists of broad, nearly level areas in which slopes are generally less than 2 percent. The association covers about 10 percent of the two counties and is located on broad flats east of Fitzgerald and northwest of Ocilla.
Tifton-Alapaha-Fuquay	Well-drained and poorly drained, nearly level and very gently sloping soils on broad divides, on flats, and in drainageways. Slopes do not exceed 4 percent.
Carnegie-Cowarts-Alapaha	Well-drained, gently sloping and sloping, eroded soils on choppy ridges, and poorly drained soils in drainageways. Slopes range from 3 to 12 percent. This association is mainly along the sharp breaks adjacent to and east of the flood plains along the Satilla River and Hunters Creek and adjacent to and south of the flood plains along Randall Creek and Reedy Creek. The most prominent is the area of sharp breaks about a mile north of Fitzgerald.
Osier-Bibb-Leaf-Chastain	Very poorly drained to somewhat poorly drained, nearly level soils on flood plains. Nearly level flood plains along rivers and creeks make up this association. Slopes generally do not exceed 1 percent.
Fuquay-Cowarts-Plummer	Well-drained, gently sloping and sloping soils on narrow ridges and knobs, and poorly drained, sandy soils on flats and in drainageways. Slopes range from 3 to 12 percent. For this watershed, this association is only located at the northern tip of the watershed in Ben Hill County.

Source: USDA, *Soil Survey Ben Hill and Irwin Counties, Georgia*, 1969.

The soil associations found in Berrien County are listed in Table 5. (See Appendix C: *General Soil Map Berrien and Lanier Counties, Georgia* for a detailed map of the soil associations for Berrien County).

TABLE 5:
BERRIEN COUNTY SOIL ASSOCIATIONS

SOIL ASSOCIATION	DESCRIPTION
Johnston-Osier Bibb	Very poorly drained and poorly drained, nearly level soils on flood plains. Slopes range from 0 to 2 percent. This association consists of nearly level soils on the flood plains of the Alapaha, Willacoochee, Withlacoochee, and New Rivers, and their tributaries. Each year they are subject to frequent flooding, which leaves a thin deposit of fresh soil material each time.
Tifton-Fuquay-Pelham	Well-drained, nearly level and very gently sloping soils on broad inter-stream divides, and poorly drained soils of intermittently ponded flats and drainageways. Slopes range from 0 to 5 percent.
Leefield-Pelham-Alapaha	Somewhat poorly drained and poorly drained, nearly level soils on broad flats. Slopes range from 0 to 3 percent. Sluggish stream branches that have poorly defined channels make up the drainage system.
Fuquay-Cowarts-Pelham	Chiefly well-drained, gently sloping soils on narrow upland ridges and knolls, and poorly drained, nearly level soils along drainageways. Slopes range from mainly from 0 to 8 percent. Many areas are rough and choppy and contain eroded spots.
Tifton-Carnegie-Pelham	Chiefly well-drained to poorly drained, nearly level to gently sloping soils on upland ridges. Slopes range from about 1 to 8 percent. This association consists of moderately wide ridges dissected by small shallow streams. It has somewhat stronger slopes than the Tifton-Fuquay-Pelham association.
Esto-Cowarts-Plummer	Moderately drained and well drained, very gently sloping to sloping soils on choppy ridges, and poorly drained soils along drainageways. Slopes range from 3 to 12 percent. This association consists of short, narrow, very gently sloping ridge tops, gently sloping and sloping side slopes, and numerous small drainageways and narrow breaks along the drainageways.

Source: USDA, *Soil Survey of Berrien and Lanier Counties, Georgia, 1973.*

2.7 Wetlands

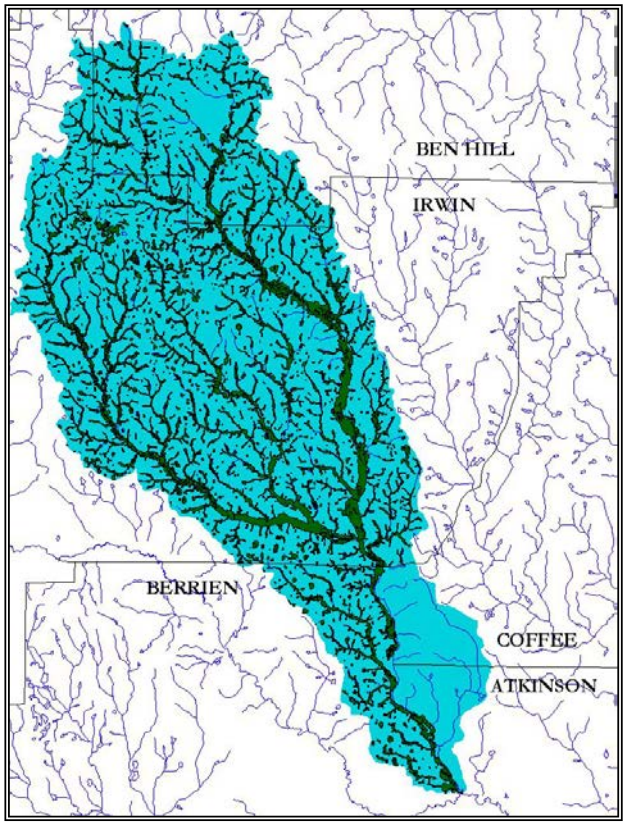


Figure 4. *Willacoochee River Wetlands*

Wetlands are one of our richest natural habitats with some of the most diverse **ecosystems** and tend to be the least appreciated. In the United States there are about 274 million acres of wetlands, which is 12% of the world's total wetlands. Each year, there are approximately 290,000 acres of freshwater and coastal wetlands lost due to activities such as development, salt water intrusion, and dredging **channels**.

The National Wetland Inventory (NWI) data illustrates that potential and existing wetlands can be found throughout the entire Willacoochee River Watershed (Figure 4: *Willacoochee River Wetlands*). Large wetland areas are located in the Osier-Bibb-Leaf-Chastain Association which tends to occur along the large branches and creeks.

It is important that we preserve and protect our wetlands because numerous animals live and use the wetlands as a place to nest, eat, rest during migration, and reproduce. Wetlands are also important because they are able to help control flooding by storing and slowly releasing excess water. They reduce erosion and

sediment deposition downstream by allowing the sediment to settle. In addition, wetland plants are able to remove contaminants and **nutrients** from water, which results in improving the water quality; provides excellent areas for bird-watching, fishing, hunting, and offers endless educational opportunities.

2.8 Breaking Down the Watershed

The State of Georgia has 14 Major River **Basins** (Appendix D: *Georgia's 14 River Basins*), 52 major **watersheds** (Appendix E: *Georgia's 52 Large Watersheds*) and many **sub-watersheds**. The Willacoochee River Watershed project is located within the Suwannee Basin. The Suwannee Basin consists of four **Hydrologic Unit Code** (HUC) 10 watersheds, which include the Alapaha, Little River, Suwannee, and Withlacoochee watersheds. The Willacoochee River Project area is located within the Alapaha Watershed (Figure 5, below) *Suwannee Basin, Alapaha Watershed, and Willacoochee Sub-Watershed*) and accounts for approximately 13.7% of the Alapaha Watershed, which totals 1,082,753 acres. The Willacoochee River Watershed is composed of two 10-digit HUC watersheds, which are the Willacoochee River (HUC 0311020205) and Reedy Creek (HUC 0311020206).

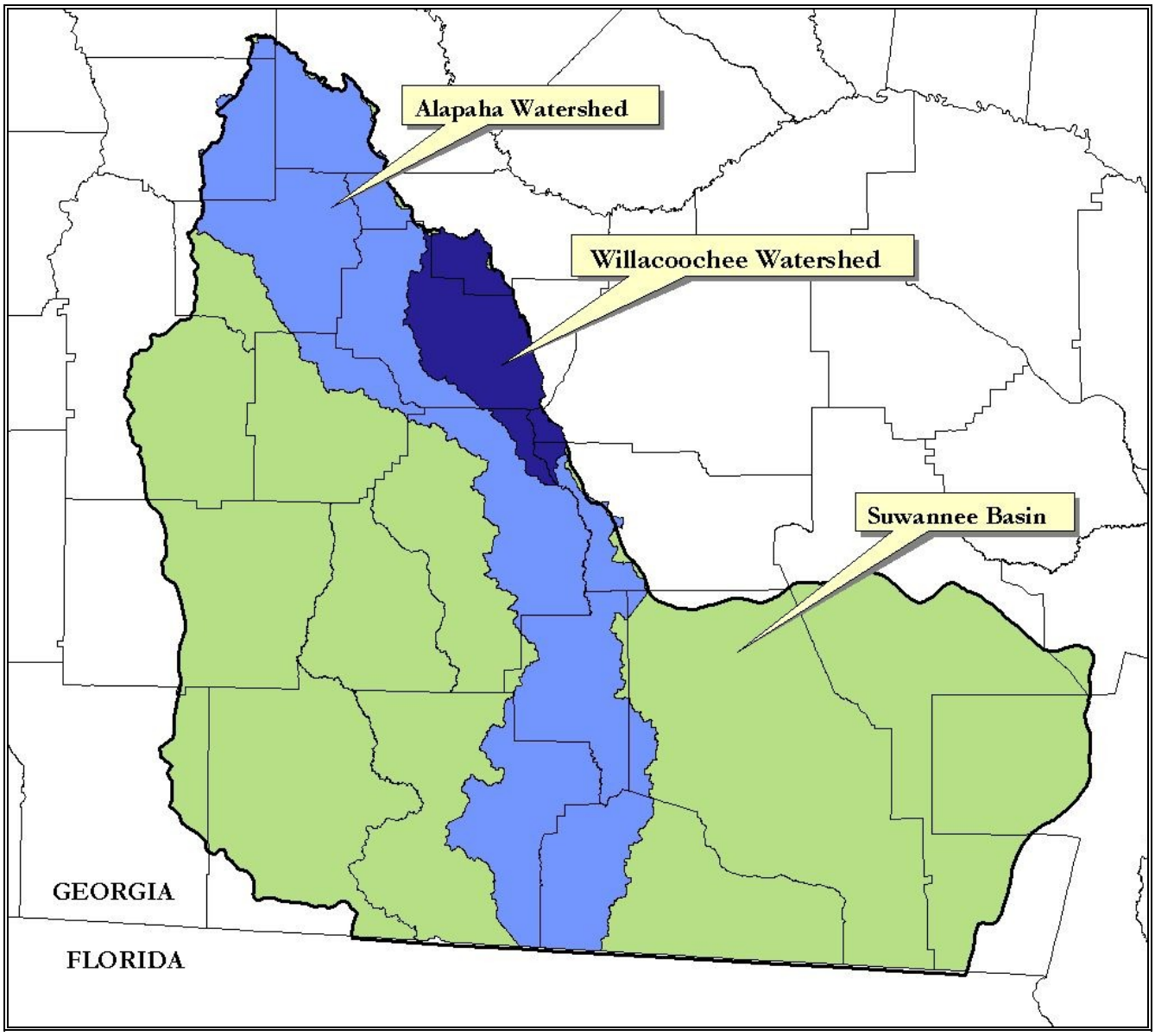


Figure 5. *Suwannee Basin, Alapaha Watershed, and Willacoochee Sub-Watershed*

Since the Willacoochee River Watershed has seven **sub-watersheds**, the **Willacoochee River Research Group** decided to evaluate and compare each of the smaller watersheds to potentially isolate and pinpoint water quality contributors. Below, Figure 6: *Willacoochee Sub-watersheds* illustrates the seven sub-watersheds.

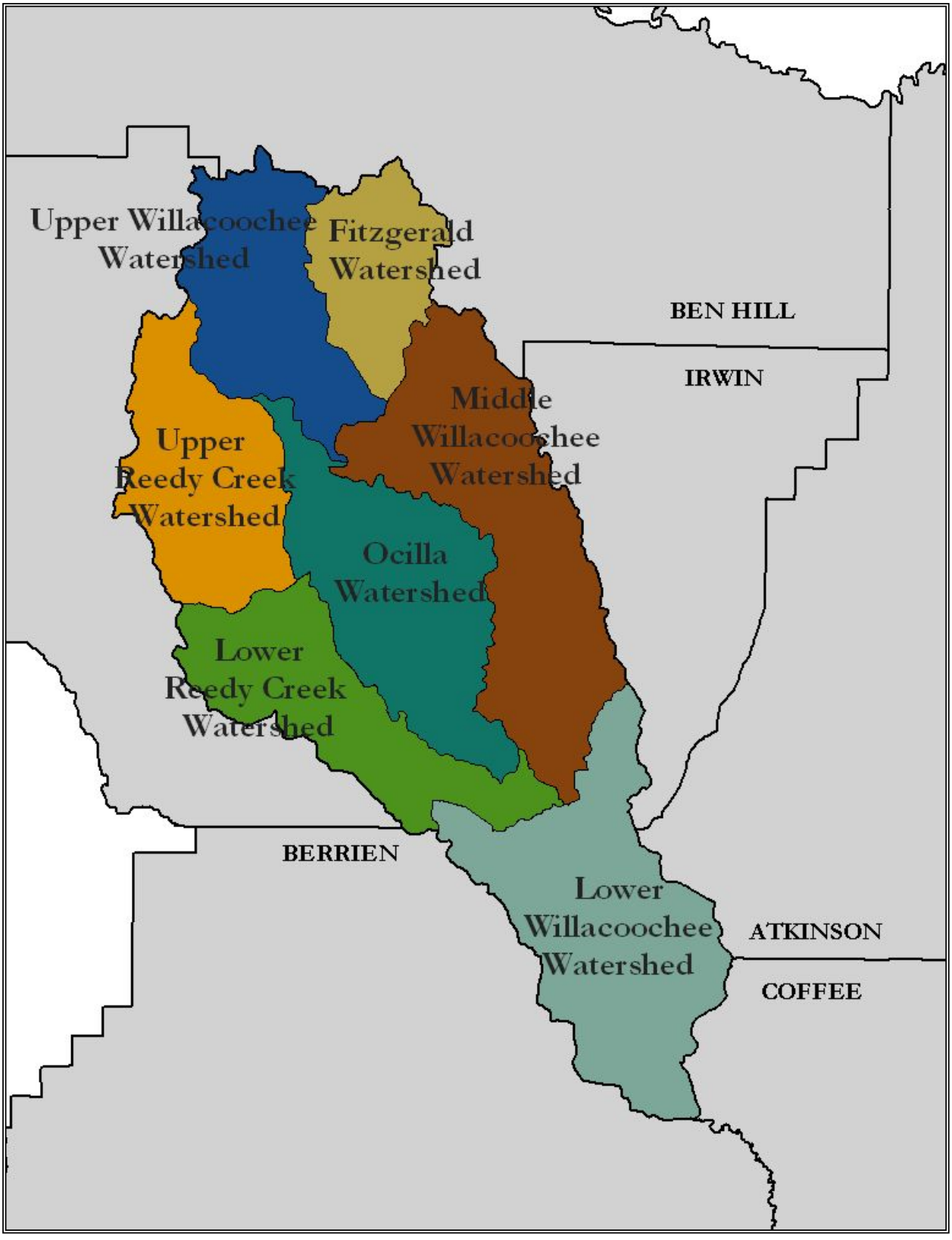


Figure 6. *Willacoochee Subwatersheds*

2.8 (a) Fitzgerald Watershed

The Fitzgerald Watershed is the smallest sub-watershed in the Willacoochee River Watershed area. The majority of the Fitzgerald Watershed is located in Ben Hill County with a small southwestern portion in Irwin County. The watershed consists of approximately 11,214 acres or 17.5 sq. miles. This watershed is where the City of Fitzgerald is located making this watershed the most urban watershed in the Willacoochee River Watershed Project area. The City of Fitzgerald has approximately 3,968 housing units in an area of 7.29 sq. miles and a population of 8,758. The soil associations consist of mainly well-drained soils with the exception of the south-central portion of the watershed were Turkey Branch is located. The soil associations consist of Tifton-Alapaha-Fuquay, Tifton-Alapaha-Carnegie, Osier-Bibb-Leaf-Chastain, Carnegie-Cowarts-Alapaha, and Fuquay-Cowarts-Plummer (See Table 4: *Ben Hill and Irwin County Soil Associations* for more details). The predominant land use is residential with a mixture of commercial and recreational. There are four water permits and one waste permit located in this watershed and they are listed below in Table 6:

TABLE 6:
BEN HILL COUNTY WASTE AND WATER PERMITS

FACILITY NAME	ADDRESS	SIC DESC.	ID	PERMIT ISSUE DATE	PERMIT EXPIRATION DATE	HUC CODE
Tolleson Lumber Company Incorporated	1010 South Thomas St. Fitzgerald, GA 31750	N/A	CERLIS EPA GAD003275450	N/A	N/A	03110202
Camp Brooklyn Road LAS	Fitzgerald, GA 31750	Sewerage Systems	NPDES GAU020240	06/30/2003	06/28/2008	03110202
Custom Profiles, Inc.	256 Industrial Drive E Fitzgerald, GA 31750	Plastic Products, Not elsewhere classified	NPDES GA0037842	06/30/2004	05/31/2009	03110202
East Center Technical Institute	667 Perry House Road Fitzgerald, GA 31750	Vocational Schools, Not elsewhere classified	NPDES GA0022101	03/29/2004	03/28/2009	03110202
Fitzgerald CA Newcomer Water Pollution Control Plant	116 South Johnston St. Fitzgerald, GA 31750	Sewerage Systems	NPDES GA0047236	08/28/2004	06/14/2004	03110202

Source: U.S. EPA, *Envirofacts Data Warehouse*, 2004

The Fitzgerald Water, Light, and Bond Commission (the City of Fitzgerald's municipal water system) is located in this watershed. Upstream of the Fitzgerald Water, Light, and Bond (WL&B), the land use area is a mixture of urban and agricultural. Downstream of the Fitzgerald WL&B discharge point, the stream flows through a **wetland** area and transitions into Lake Beatrice, which drains into the Willacoochee River.

In recent years, Lake Beatrice has seen an increase in **eutrophication.** Eutrophication is water pollution that is caused by excessive plant **nutrients**. Examples of nutrients are **phosphorus**, nitrogen, and carbon and humans add excessive amounts of plant nutrients to our streams and lakes in various ways. Sources of these nutrients can come from **runoff** from agricultural fields, urban lawns, and golf courses.

Phosphates have been proven to be powerful stimulants to **algae** growth and this can result in oxygen depletion, which can cause **fish kills**. Photo 6, below, is an excellent example of eutrophication.

Photo 6: Eutrophication, Ben Hill County

2.8 (b) Upper Willacoochee Watershed

The Upper Willacoochee Watershed is located in the counties of Ben Hill and Irwin, directly west of the Fitzgerald Watershed and spans approximately 17,422 acres or 27.2 sq. miles. This watershed is fairly rural and consists primarily of agricultural and forestry land uses. This rural watershed consist of Tifton-Alapaha-Fuquay (well-drained), Carnegie-Cowarts-Alapaha (well-drained), Esto-Cowarts-Plummer (moderately well drained), Tifton-Alapaha-Carnegie (well-drained), Osier-Bibb-Leaf-Chastain (very poorly drained), Ocilla-Plummer-Alapaha (somewhat poorly drained), and Fuquay-Cowarts-Plummer (well-drained) soil associations. The majority of the watershed is on private well and septic systems and a small portion on the east side of the watershed has water and sewer services made available through the City of Fitzgerald.

2.8 (c) Upper Reedy Creek Watershed

The Upper Reedy Creek Watershed is a rural watershed that is located southwest of the Upper Willacoochee Watershed in Irwin County. The total area is 18,476 acres or 28.8 sq. miles with Tifton-Alapaha-Fuquay (well-drained), Tifton-Alapaha-Carnegie (well-drained), Osier-Bibb-Leaf-Chastain (poorly drained), and Ocilla-Plummer-Alapaha (somewhat poorly drained) soil associations. The watershed is primarily used for agricultural and forestry purposes with scattered development throughout (Photo 7, next page). The entire Upper Reedy Creek Watershed is on private wells and septic systems with the exception of private water services provided in unincorporated Mystic. This watershed is also where Reedy Creek originates.

2.8 (d) Lower Reedy Creek Watershed

Reedy Creek flows downstream from Upper Reedy Creek Watershed into the Lower Reedy Creek Watershed. This rural watershed is located southeast of the Upper Reedy Creek Watershed in Irwin County and has a land area of approximately 18,649 acres or 29.1 sq. miles. The watershed consists of several soil associations including Tifton-Alapaha-Fuquay (well-drained), Tifton-Alapaha-Carnegie (well-drained), Osier-Bibb-Leaf-Chastain (very poorly drained), Ocilla-Plummer-Alapaha (somewhat poorly drained), Carnegie-Cowarts-Alapaha (well-drained), and Tifton-Carnegie-Fuquay (well-drained). There is little development throughout this watershed and no public water and sewer services are available.

2.8 (e) Ocilla Watershed

The Ocilla Watershed is an urban watershed that is located directly south of the Fitzgerald Watershed in Irwin County. This watershed has a land area of approximately 25,597 acres or 36.8 sq. miles with a population of 3,270. The land use in this watershed is primarily agricultural and forestry. The City of Ocilla is the only incorporated city in Irwin County and the Ocilla Watershed. The City of Ocilla has approximately 1,283 housing units and makes up 2.59 sq. miles of the watershed. The watershed soils consist of a mixture of drainage types from poorly to well-drained. These soils include Tifton-Alapaha-Carnegie (well-drained), Ocilla-Plummer-Alapaha (somewhat poorly drained), Tifton-Alapaha-Fuquay (well-drained), Tifton-Carnegie-Fuquay (well-drained), and Osier-Bibb-Leaf-Chastain (very poorly drained). The majority of residents within the watershed depend on well water and septic systems; however, water and sewer services are available in the City of Ocilla. The City of Ocilla handles their waste on a waste water treatment facilities pivot land application site.

2.8 (f) Middle Willacoochee Watershed

The Middle Willacoochee Watershed originates in Ben Hill County, southeast of the City of Fitzgerald, and ends up in Irwin County. This rural watershed is where the Willacoochee River originates and is the largest sub-watershed of the Willacoochee River Watershed in size with approximately 30,286 acres or 47.3 sq. miles. The soil associations include Ocilla-Plummer-Alapaha (somewhat poorly drained), Tifton-Alapaha-Fuquay (well-drained), Osier-Bibb-Leaf-Chastain (very poorly drained), Tifton-Carnegie-Fuquay (well-drained), and Tifton-Alapaha-Carnegie (well-drained). The land use is predominantly agricultural with small developments throughout the county. There is access to the City of Fitzgerald's water and sewer services in the extreme northern portion of the watershed and a small area to the east that has access to the City of Ocilla's water and sewer services; however, the majority of the watershed is on private well and septic systems.

2.8 (g) Lower Willacoochee Watershed

Photo 8: Clear cutting and minimum stream buffer

The Lower Willacoochee Watershed is the most southern sub-watershed of the Willacoochee River Watershed. It is located in the four corners of Irwin, Berrien, Atkinson, and Coffee counties and spans approximately 26,642 acres or 46.3 sq. miles in area. The soil composition is primarily poorly drained soils and includes Tifton-Alapaha-Carnegie (well-drained), Osier-Bibb-Leaf-Chastain (very poorly drained), Carnegie-Cowarts-Alapaha (well-drained), Ocilla-Plummer-Alapaha (somewhat poorly drained), Johnston-Osier-Bibb (very poorly drained), Fuquay-Cowarts-Pelham (chiefly well drained), Tifton-Carnegie-Pelham (chiefly well drained), Leefield-Pelham-Alapaha (somewhat poorly drained), and Tifton-Fuquay-Pelham (well-drained).

This rural watershed has no incorporated cities, public water, or sewer services, which means that residents must rely on private wells and septic systems. Even though it is primarily used for agricultural and forestry land uses, there is an increase in timber harvesting and land clearing for potential development. As seen in Photo 8 (above), this area has been clear cut and left with limited buffer areas.

A stream buffer is important because it can physically protect and separate a waterway from future disturbance or **encroachment**. With the appropriate vegetation width, a stream buffer can improve and protect our waterways by minimizing **erosion** through bank stability and help control water temperatures. In Chapter 6, more detailed information can be found on this particular sub-watershed in regards to the increase in **sedimentation** and the lack of adequate stream buffers that could be contributing to this problem. If your community has out-of-date buffer regulations or currently does not have any, you may contact the SGRDC to assist you or your local NRCS office for more information regarding the appropriate stream buffer widths.

CHAPTER 3: WATER QUALITY

3.1 Impaired Stream Segments

Since the Willacoochee River Watershed had a number of impaired streams segments that were identified by the State of Georgia and had **Total Maximum Daily Load** (TMDL) **Implementation Plans** written on each of them, it is important to understand what exactly is a TMDL. A **Total Maximum Daily Load** or TMDL is important because it determines the maximum amount of a **pollutant** that a river, stream, or lake can receive and still be considered safe and healthy. Once a water body exceeds the maximum amount of a pollutant allowable, it is then considered impaired and actions should be taken to improve the water quality so that the aquatic life can continue to thrive and humans can enjoy the water.

The reason for the concern and actions to address impaired waterbodies is that the Clean Water Act requires: (1) states to identify waters that do not meet **water quality standards**; (2) states must set priorities for the development of TMDL's; (3) states must develop TMDL's for each pollutant in each identified water body; and (4) the U.S. EPA must approve or disapprove each state's submissions of TMDL's. If the U.S. EPA disapproves the TMDL's established by the State, the U.S. EPA will be responsible for developing the TMDL's.

In 1994, the State of Georgia identified all waters that did not meet water quality standards and set the priorities for Total Maximum Daily Load (TMDL) development. The Suwannee Basin was covered under the United States District Court's schedule of June 30, 2000 to develop TMDL's for all **water quality limited segments** (WQLS) also known as "impaired stream segments." The Willacoochee River Watershed is located within the Suwannee Basin and contains five (5) stream segments that have TMDL's. They are as follows:

TABLE 7:
2002 RIVERS/STREAMS PARTIALLY/NOT SUPPORTING DESIGNATED USES

WATER BODY	COUNTY	LOCATION	POLLUTANT	SOURCE	EVALUATION
Little Brushy Creek	Irwin	Stump Creek to Reedy Creek S of Ocilla	Low Dissolved Oxygen (DO) / Fecal Coliform (FC)	Non-point (NPS)	Partially Supporting (PS)
Reedy Creek	Irwin	Little Creek	Low Dissolved Oxygen (DO)	Non-point (NPS)	Partially Supporting (PS)
Turkey Branch	Ben Hill	Headwaters to Withlacoochee River downstream Fitzgerald	Low Dissolved Oxygen (DO) / Fecal Coliform (FC) Cd, Cu, Pb, Zn, Hg, Toxicity	Municipal (M)	Not Supporting (NS)
Willacoochee River	Berrien	SR 158 to Alapaha River	Low Dissolved Oxygen (DO)	Non-point (NPS)	PS Partially Supporting (PS)
Willacoochee River	Irwin	Turkey Branch, upstream SR 90/US Hwy 319 N of Ocilla to SR 90, SE of Ocilla	Low Dissolved Oxygen (DO)	Non-point (NPS)	PS Partially Supporting (PS)

Source: Georgia Department of Natural Resources Environmental Protection Division, 2002.

For each of the identified stream segments listed above, TMDL Implementation Plans were created in 2002. The TMDL Implementation Plan is developed to serve as a form of action to restore the quality of impaired water bodies within a watershed. Within each of these plans, you will find an action plan,

education/outreach activities, list of stakeholders, potential pollutant sources, management measures such as regulatory/voluntary practices, potential funding sources to assist in implementing the plan, and a monitoring plan. These plans are "**living documents**" so as new information is gathered or changes occur that would effect the water quality of the watershed, updates can and will be made as necessary.

In each of the streams listed with TMDL Implementation Plans, you will find reference to both the Willacoochee River Watershed 319 Project, identified as the Willacoochee River Restoration, and the United States Environmental Protection Agency (U.S. EPA) Section 319 Grant Projects, identified as 319 (h) Grants. Local governments, stakeholders, and other interested parties are highly encouraged to initiate projects such as the Willacoochee River Watershed 319 Project because this is an excellent process to have local governments and citizens working towards the common goal of maintaining and improving water quality. To view a complete TMDL Implementation Plan, contact the SGRDC at 229.333.5277.

As of January 9, 2004, the Georgia Department of Natural Resources Environmental Protection Division (GA DNR EPD) released a "Notice of Availability of a Listing of Waterbodies Pursuant Section 303(d) of the Clean Water Act." The public notice was given to inform stakeholders that the State of Georgia had completed a draft list of impaired waters in Georgia for 2004 as required by Section 303(d) of the Federal Clean Water Act (CWA). The proposed list and its impairments for the Willacoochee River Watershed are as follows:

TABLE 8:
2004 RIVERS/STREAMS PARTIALLY/NOT SUPPORTING DESIGNATED USES (DRAFT)

WATER BODY	COUNTY	LOCATION	POLLUTANT	SOURCE	EVALUATION
Little Brushy Creek	Irwin	Stump Creek to Reedy Creek South of Ocilla	Dissolved Oxygen (DO) / Fecal Coliform (FC)	Non-Point (NPS)	Partially Supporting (PS)
Reedy Creek	Irwin	Little Creek to Little Brushy Creek South of Ocilla	Dissolved Oxygen (DO)	Non-Point (NPS)	Partially Supporting (PS)
Willacoochee River	Irwin	Turkey Branch, upstream SR 190/US Hwy 319 North of Ocilla to SR 90, SE of Ocilla	Dissolved Oxygen (DO)	Non-Point (NPS)	Partially Supporting (PS)
Willacoochee River	Berrien	SR 158 to Alapaha River	Dissolved Oxygen (DO)	Non-Point (NPS)	Partially Supporting (PS)
Turkey Branch	Ben Hill	Headwaters to Willacoochee River downstream Fitzgerald	Dissolved Oxygen (DO) / Fecal Coliform (FC)	Municipal (M)	Non-Supporting (NS)

Source: Georgia Department of Natural Resources Environmental Protection Division, 2004.

CHAPTER 4: SOURCES OF WATER POLLUTION

Once the **watershed** was divided up into **sub-watersheds**, the Willacoochee River Watershed Research Group used a number of resources such as aerial photography, **point-source** and **non-point source** pollution, the 303 (d) list of impaired streams, and citizen input to begin locating the potential sources of pollution that could be contributing to the **impaired streams** within the watershed.

The Willacoochee River Watershed Research Group originally thought that the agricultural areas would be the primary source of pollution due to increased **nutrient** loads from herbicides, insecticides, **pesticides**, etc. However, after reviewing all the information, it was determined that the focus should be redirected towards or include the urban areas since there seemed to be a link between urban areas and high concentration of nutrients. Even though the **dissolved oxygen** (DO) levels may be naturally low in this region of the state, the research group focused primarily on nutrients and **fecal coliform** (FC) bacteria levels; however, there were a few areas that had extremely low levels of DO.

4.1 Point Source Pollution

Point source pollution is pollution that may come from industrial, municipal and/or other facilities that discharge directly into any waters of the United States. Point source pollution is regulated through the **National Pollutant Discharge Elimination System** (NPDES) permit program, which is authorized by the Clean Water Act. In the Willacoochee River Watershed Project area, there are approximately 21 **Water Discharge Permits** and 5 **Superfund** sites (U.S. EPA, 2004).

4.2 Non-Point Source Pollution

Non-point source pollution is pollution that comes from unspecified sources such as automobiles, pets, residents, agricultural, construction, businesses and **runoff** from storm drains. Non-point source pollution is more difficult to control than point source pollution simply because it is hard to pinpoint the source. Some examples of non-point source pollution are antifreeze, animal waste, fertilizers, gasoline, litter, metal, motor oil, pesticides, car washes, paint, debris, and sediment (Photo 9 and 10). Any of these pollutants may come from our streets, neighborhoods, parking lots, farmlands, and construction sites. Non-point source pollution is continually affecting our fish, birds, and wildlife living in and around Georgia's waterbodies. Pollution from non-point sources has impacted Georgia's urban streams to such a degree that they have become the most degraded and disturbed aquatic systems in the State. Many feel that non-point source pollution is an inevitable consequence of growth and development. However, with the combination of ongoing

Photo 9: Non-Point Source Pollution, Oil in Parking Lot

education/outreach, voluntary actions and local official support with ordinances, we can significantly reduce the non-point source pollution problems that many of our streams face[4].

Photo 10: Soil erosion in a field

4.3 Solutions to Water Pollution

There are many ways to address water pollution through both regulatory and voluntary actions. Local governments can address water pollution by adopting ordinances that outline certain requirements that must be followed so that the environment is protected. Examples of ordinances that can assist your community are:

TABLE 9:
ORDINANCES TO ADDRESS WATER QUALITY

ORDINANCE	DESCRIPTION
Soil Erosion and Sedimentation Control Ordinance (E&S)	Excessive soil erosion and resulting sedimentation can take place during land disturbing activities. The application of measures and practices shall apply to all features of the site, including street and utility installations, drainage facilities and other temporary and permanent improvements. Measures shall be installed to prevent or control erosion and sedimentation pollution during all stages of any land-disturbing activity.
Water Resource Protection Districts (WRPD)	The intent of this ordinance is to establish minimum development standards and criteria, which will afford reasonable protection of environmentally sensitive natural resources, such as groundwater recharge areas, protected river corridor, or wetlands. Based on the Department of Natural Resources Part V Environmental Planning Standards, the Mountain and River Corridor Protection Act of 1991, it has been determined that the wise management of these resources as defined in this ordinance is essential to maintaining the health, safety, welfare and economic well being of the public, and to provide a guide for future growth and development in the water resource districts as defined.

Voluntary actions that homeowners may consider to improve the water quality include (1) using fertilizers sparingly to minimize nutrient overload in streams; (2) place all yard waste in a trash can or

[4] This information came from the Pollution Prevention Assistance Division's (P2AD) brochure entitled, *You're the Solution to Water Pollution* and the Georgia Environmental Protection Division's (GA EPD) brochure entitled, *Watershed Wisdom Georgia's TMDL Program*.

approved bag so that it is not washed into the gutter/ditch where it can block the water **flow** or be washed directly into the stream; (3) wash the car in the grass versus in the driveway so the soap and dirt is absorbed into the yard instead of being washed into the stream; (4) plant trees because their root systems hold the soil in place as well as shade your home; (5) have your vehicle serviced on a regular basis at a garage that recycles all vehicle fluids properly; and (6) recycle items such as card board, glass, paper, and plastic if your community offers a recycling program.

Another project that a community can participate in is streambank restoration. The Georgia Soil & Water Conservation Commission (GA S&WCC), in cooperation with the Metro Atlanta Association of Conservation Districts, USDA – NRCS, and Georgia EPD, has put together a document entitled, *Guidelines for Streambank Restoration* to help owners of streamside property understand how to prevent and, if necessary, correct simple streambank **erosion** problems. The booklet describes the interactions of stream flows, streambanks, **sediment**, and streamside vegetation. An understanding of this information is intended to help a property owner appreciate the need for streambank protection and assist in selecting the most appropriate natural methods for correcting streambank erosion problems. **Streambank stabilization** techniques utilize live plant materials, structural measures, or a combination of both. The techniques described in this manual are intended for small stream systems with uncomplicated erosion problems (Georgia Soil & Water Conservation Commission, 2000). In Chapter 7, there is additional information in regards to the streambank restoration project in the City of Fitzgerald that was used by the Willacoochee River 319 Project Coordinator as one of the BMPs in the Willacoochee River Watershed.

Photo 11: Stream Cleanup

CHAPTER 5: PUBLIC OUTREACH

One of the key elements of the Willacoochee River WRAS is **stakeholder** involvement. The Willacoochee River Watershed has a number of stakeholder groups and individuals that have their own missions, but share a common goal, which is to maintain and improve the water quality within this watershed. It was vital that this project bring together stakeholders that were knowledgeable about farming, education and other needs associated with **land use** practices so all issues, concerns, and community roles could be established and addressed.

5.1 Stakeholders

The first stakeholders identified were from the agricultural and forestry community since the primary land uses in this watershed are agriculture and forestry. A list of names and contact information was developed with the assistance of the United States Department of Agriculture – Natural Resource Conservation Service (USDA-NRCS), University of Georgia (UGA) Cooperative Extension Services, Georgia Forestry Commission (GFC), Department of Natural Resources Wildlife Resource Division, and the UGA water quality specialists. Local officials were brought in when the research team received the first set of data indicating that the water quality was the poorest in urban areas. At this point, the research team realized it needed to not only focus on agricultural communities, but on urban areas as well. Eventually, other interested parties, such as **environmental steward** groups and the school systems were brought in as partners. The importance of having this wide range of groups and ages was to bring in new and old ideas while achieving the ultimate goal: to improve the water quality. Stakeholders were addressed not only through meetings, but also through surveys, workshops, and field days. See Appendix F- *Stakeholder Contact Information*, for a complete list of all stakeholders, their role, and contact information.

5.2 Outreach Activities

Outreach activities are projects that can be used to protect and improve your watershed. In order to participate, you should first find out what is going on in your watershed. There are several organizations that you can join and participate in activities and projects that are already occurring in the Willacoochee River Watershed, such as the Upper Suwannee River Watershed Initiative (USRWI), the Upper Suwannee Conservation Tillage Alliance (USCTA), local Georgia Adopt-A-Stream groups, etc. You can also come up with ideas that tailor specifically to your community and ask your local government, civic groups, non-profits, home owner associations, and or other volunteers to participate. The key is to get involved and be persistent in your watershed management.

5.2 (a) Watershed Field Days

Field days and workshops are a wonderful resource to bring interested citizens together and provide them with resourceful information on topics of interest. The Willacoochee River Watershed Coordinator collaborated with numerous partners to plan, organize and hold several field days to educate stakeholders on the importance of water quality in the Willacoochee River Watershed. The first workshop was held on November 22, 2002 at the Irwin County Center of Agricultural Study and Excellence (C.A.S.E.) Farm (Photo 12, next page). This workshop covered topics such as the importance of watershed protection, water quality, conservation practices, cost share opportunities, conservation tillage, and the importance of **cover crops**.

Photo 12: Irwin County C.A.S.E. Farm

The second workshop was held on March 30, 2004 at the Irwin County C.A.S.E. Farm and covered topics such as the importance of BMPs on watershed water quality, agricultural water conservation, agricultural water metering, the importance of environmental stewardship, NRCS cost share programs, new technology such as global positioning system (GPS) & light bars as well as field demonstrations.

The third workshop was held on September 8, 2004, again at the Irwin County C.A.S.E. Farm and was entitled, "Cover Crop & Nutrient Management." This workshop was held by the SGRDC and UGA in conjunction with the USCTA. The USCTA is a non-profit farmer alliance whose mission is to promote the adoption of conservation tillage. The workshop began with the Ag Pollution Prevention model (Photo 13 and 14) to demonstrate the importance of cover crops and how different cover crops work. The four cover crops used in the demonstration are (from left to right) grass cover, wheat straw cover, corn stalk cover, and bare soil (See Appendix G for all workshop brochures).

Photo 13 and 14: Ag Pollution Prevention Demo

5.2 (b) Georgia Adopt-A-Stream Program

One education outreach tool that has proven easy to use is the Georgia Adopt-A-Stream (AAS) Program. It is a voluntary program that encourages individuals and communities to adopt sections of streams, wetlands, lakes or rivers. There are four Adopt-A-Stream Regional Training Centers and thirty (30) local community/watershed Adopt-A-Stream organizers that can assist you with manuals, training, and technical support. The Adopt-A-Stream and Wetland Regional Training Centers are located at State Universities in Columbus, Milledgeville, Americus and Savannah. These centers play a key role in providing training, technical support and organizational support to citizens throughout Georgia. The goals of the AAS program are:

(1) Increase public awareness of the state's non-point source pollution and water quality issues;
(2) Provide citizens with the tools and training to evaluate and protect their local waterways;
(3) Encourage partnerships between citizens and their local government; and
(4) Collect quality baseline water quality data.

Photo 15: Monitoring Kit

Once an individual, group or organization is certified to perform biological and/or chemical monitoring analysis, there are monitoring kits (Photo 15) that GA AAS has put together containing all the materials needed to begin sampling. You can purchase these monitoring kits through GA AAS, but first check to see if you qualify for free monitoring equipment. All active monitoring programs can apply for monitoring equipment and replacement reagents through a program sponsored by the Environmental Education Alliance and Georgia Adopt-A-Stream. International Paper is providing funding for the monitoring equipment (Appendix H – *Adopt-A-Stream in the Classroom Application for Stream Monitoring Equipment*).

Over the last two years, the Willacoochee 319 Project Coordinator worked diligently in organizing, participating and holding Georgia Adopt-A-Stream workshops. Today, approximately 275 stakeholders have been certified to monitor biological and/or chemical habitats in the Willacoochee River Watershed.

5.2 (c) Rivers Alive Program

Photo 16: Rivers Alive Cleanup 2002

Rivers Alive is Georgia's annual volunteer waterway cleanup event that targets all waterways in the State including streams, rivers, lakes, beaches, and wetlands. The mission of Rivers Alive is to create awareness of and involvement in the preservation of Georgia's water resources. Rivers Alive is held annually each October and is sponsored by the Georgia Department of Natural Resources' Georgia Adopt-A-Stream Program and the Georgia Department of Community Affairs' Keep Georgia Beautiful Program. Anyone can participate (Photo 16).

5.2 (d) Storm Drain Awareness Program

This project is part of an effort by the SGRDC and the GA EPD to educate communities on water issues and the importance of preventing non-point source pollution of **surface waters** in the state. The SGRDC Region-Wide Storm Drain Awareness Program was developed under the Fiscal Year 2002 TMDL Contract with the GA EPD, Water Protection Branch.

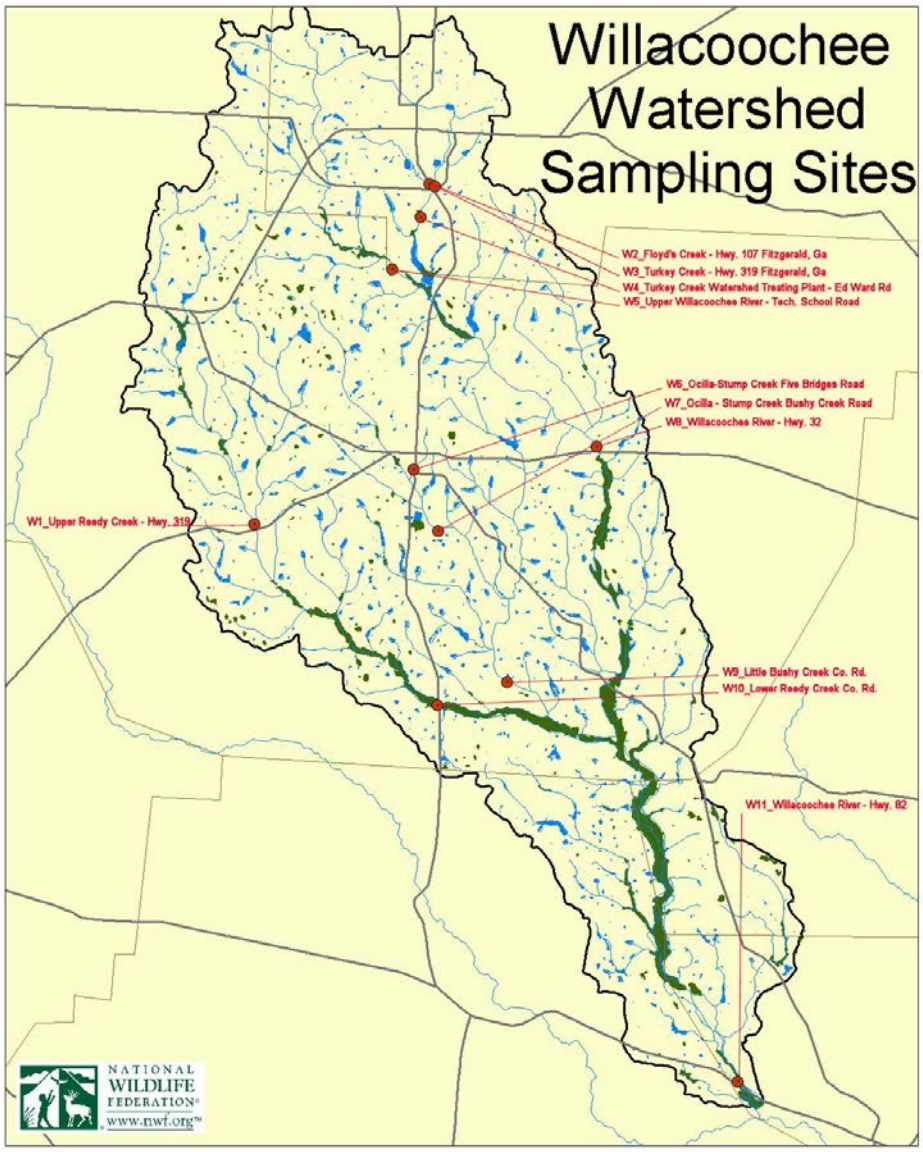
After the SGRDC completed the TMDL Implementation Plans for the Suwannee River Basin, the SGRDC wanted to provide an education outreach program about non-point source pollution that would provide each community the opportunity to take an active role in helping protect their natural resources. This program includes placing DAS Manufacturing, Inc. curb markers that read, “No Dumping, Drains to Stream” on storm drain inlets, sidewalks, and/or curbs to remind people that everything that goes down a storm drain is not connected to the water treatment system and eventually ends up in one of our waterways. Volunteers also pass out door hangers that have a picture of the curb marker on the front and explain on the back the purpose of the curb markers, what you can do to alleviate the problem, and contact information. The SGRDC collaborated with numerous groups and individuals such as city and county officials, Utility Departments, local UGA Cooperative Extension Service, and 4-H Clubs. This is an easy and inexpensive activity for volunteers such as 4-H, Boy & Girl Scouts, schools and other interested citizens.

CHAPTER 6: WATER QUALITY IN THE WILLACOOCHEE RIVER WATERSHED

The Willacoochee River Watershed has been shown to contain a number of endangered species, as compared to other sub-watersheds in the larger Alapaha River Watershed. Unfortunately, the Willacoochee River Watershed also has several of its fishing stream segments listed on Georgia's 303 (d) lists of impaired waters. With these streams listed as impaired, this indicates below standard water quality, which threatens the delicate stream **ecosystems**.

A water quality study was performed to quantify and compare impacts of rural and urban land use areas to water quality in the Willacoochee River Watershed. The study was designed so that local communities and landowners could use the data to identify sources of water pollution and aid in the implementation of pollution control and in achievement of cleaner water.

6.1 Sample Site Locations



The Willacoochee River Watershed Research Group, which was represented by personnel from the University of Georgia (UGA) and National Wildlife Federation (NWF), chose a total of eleven (11) sample site, ranging from urban to rural, on sub-watersheds within the Willacoochee River Watershed (Figure 7 left: *Willacoochee Watershed Sampling Sites*). Site selection was based on information gathered by topographical maps, aerial photos, visual surveys, and a review of impaired streams within the study area that were listed in Georgia's 2000 list of impaired water body's as required by Section 303 (d) of the Federal Clean Water Act. See Appendix I: *Willacoochee Watershed Sampling Sites*, for an 8x10 map of the sample site locations.

The sample site locations were divided into four categories: (1) reference, (2) rural, (3) urban, and (4) total watershed. Table 10, below, breaks down each sample site locations by site name, stream name, location, GPS location, and reason for placement.

TABLE 10:
WILLACOOCHEE RIVER WATERSHED SAMPLE SITE LOCATIONS

SAMPLE SITE	STREAM	LOCATION	GPS LOCATION	REASON
W-1	Upper Reedy Creek	Hwy 319	N 31.56679° W 083.31258°	Reference Site: This site was selected as the reference site because its primary land use was forestry and it did not contain a concentrated population.
W-2	Floyd's Creek	Hwy 107	N 31.69236° W 083.24609°	Urban Site: This site was selected as an urban site because it discharges into Turkey Creek, which is listed on the 303 (d) list. There was no data available for this stream and the group wanted to try isolating any potential target areas of pollution.
W-3	Turkey Creek	Hwy 319	N 31.69092° W 083.24400°	Urban Site: This site was selected as an urban site because it is located directly south of the City of Fitzgerald, is listed on the 303(d) list, and was also identified by a number of stakeholders that the stream had problems.
W-4	Turkey Creek	Airport Road at the City of Fitzgerald's municipal water system	N 31.67959° W 083.25105°	Urban Site: This site was selected as an urban site because it is located on Turkey Creek and is immediately downstream from the City of Fitzgerald's municipal water system, Fitzgerald Water, Light, and Bond Commission (Fitzgerald Utilities).
W-5	Upper Willacoochee River	Technical School Road	N 31.66023° W 083.26255°	Rural Site: This site was selected as a rural site because it is the headwaters of the Willacoochee River and is surrounded by agriculture.
W-6	Ocilla-Stump Creek	Five Bridges Road	N 31.58607° W 083.25600°	Urban Site: This site was selected as an urban site because it is a tributary to Stump Creek that drains through the City of Ocilla and picks up the water just before it enters the City of Ocilla's Waste Water Treatment Facilities' land application system (LAS). This site is one of two that was used to determine the impacts of urban areas on water quality.
W-7	Ocilla-Stump Creek	Bushy Creek Road	N 31.56400° W 083.23991°	Rural Site: This site was selected as a rural site because it is located directly downstream from the City of Ocilla's Waste Water Treatment Facilities' land application system (LAS). This is the second site that the group wanted to look at to see if the treatment plant was having an effect on the water quality by comparing it to site W-6. This site also had the greatest silt problems of all 11 sites.
W-8	Willacoochee River	Hwy 32	N 31.59591° W 083.17276°	Rural Site: This site was selected as a rural site because it was listed by GA EPD on their 303(d) list. The group wanted to review the data from this area before it joined later with Little Brushy/Lower Reedy Creek.
W-9	Little Brushy Creek	Little Brushy Creek Co. Rd	N 31.50769° W 083.20889°	Rural Site: This site was selected to compare the discharge of Little Brushy to that of Sites 6 and 7. The group also wanted to use this site to compare Little Brushy Creek's water quality to that of Lower Reedy Creek before they joined together.
W-10	Lower Reedy Creek	Lower Reedy Creek Co. Rd	N 31.49928° W 083.23865°	Rural Site: This site was selected because it is located downstream from the reference stream (W-1) and this site is more agriculturally influenced.
W-11	Willacoochee River	Hwy 82	N 31.35661° W 083.10088°	Total Watershed: This site was selected because it is located at the base of the Willacoochee River Watershed and to give an overall view of the water quality from the entire Willacoochee River Watershed before it merges with the Alapaha River.

6.2 Water Quality Sampling

Water quality in the Willacoochee River Watershed was assessed by measuring both the chemical and biological water quality parameters of the selected sites. **Grab samples** were collected for both chemical and biological water quality sampling on a biweekly basis at all sites. A pole sampler, an approximately sixteen foot pole with a cage secured to the end, which is capable of holding a 500 mL glass collection bottle, was used to collect water samples. Samples were collected by extending the pole to the center of the stream and submerging the collection bottle approximately one foot below the surface.

6.3 Water Quality Analysis

The chemical analysis samples were collected in two, clean 500 mL glass bottles and were taken to the laboratory within two hours after collection. Once in the laboratory, the two samples were combined and shaken vigorously until thoroughly mixed. Samples were analyzed for concentrations of nitrate-nitrite (NO_3^-+NO_2^-), Ortho-phosphorous (PO_4-P), and ammonium-nitrogen (NH_4-N). Nutrient quantifications were done using U.S. EPA approved colorimetric techniques. Suspended solids were quantified using conventional techniques. All analyses were routinely done within two days of collection. Samples for biological water quality analyses were collected in 530 mL sterile bags. Samples were kept in a cooler on ice until they were taken to the laboratory. Fecal coliform and fecal streptococci were determined by using the EC Medium test and the Multiple Tube Technique respectively.

6.4 Chemical Water Quality Results

Chemical and biological water quality data from the 11 stream segments were compared among each segment. Further comparisons were done by categorizing the streams into rural (W5, W7, W8, W9, W10), urban (W2, W3, W4, W6), reference (W1), and total watershed (W11) and doing comparisons between each category.

NITRATE-NITRITE. The enrichment limit, maximum concentration which does not lead to ecological changes, for nitrates is commonly regarded to be 0.1 mg/L. Concentrations at the reference site W1 averaged 0.12 mg/L over the 21 month record period while site W11, the Willacoochee River watershed outlet site, averaged 0.08 mg/L over the same period. Statistical tests showed that nitrate-nitrite values were not significantly different between categorized sites (i.e., reference, urban, rural, and watershed); however, there were significant differences among all sites (Figures 8 and 9, next two pages). Differences among all sites, but not among categorized sites, was likely due to the fact that stream segment W4, the City of Fitzgerald's municipal water system, consistently maintained the highest concentration levels of nitrate-nitrite of all the sampled sites, averaging 1.35 mg/L during the record period.

Figure 8. *Comparison of mean nitrate-nitrite ($N0_3$- + NO_2-) concentrations among rural sites, the reference site, and the watershed outlet.*

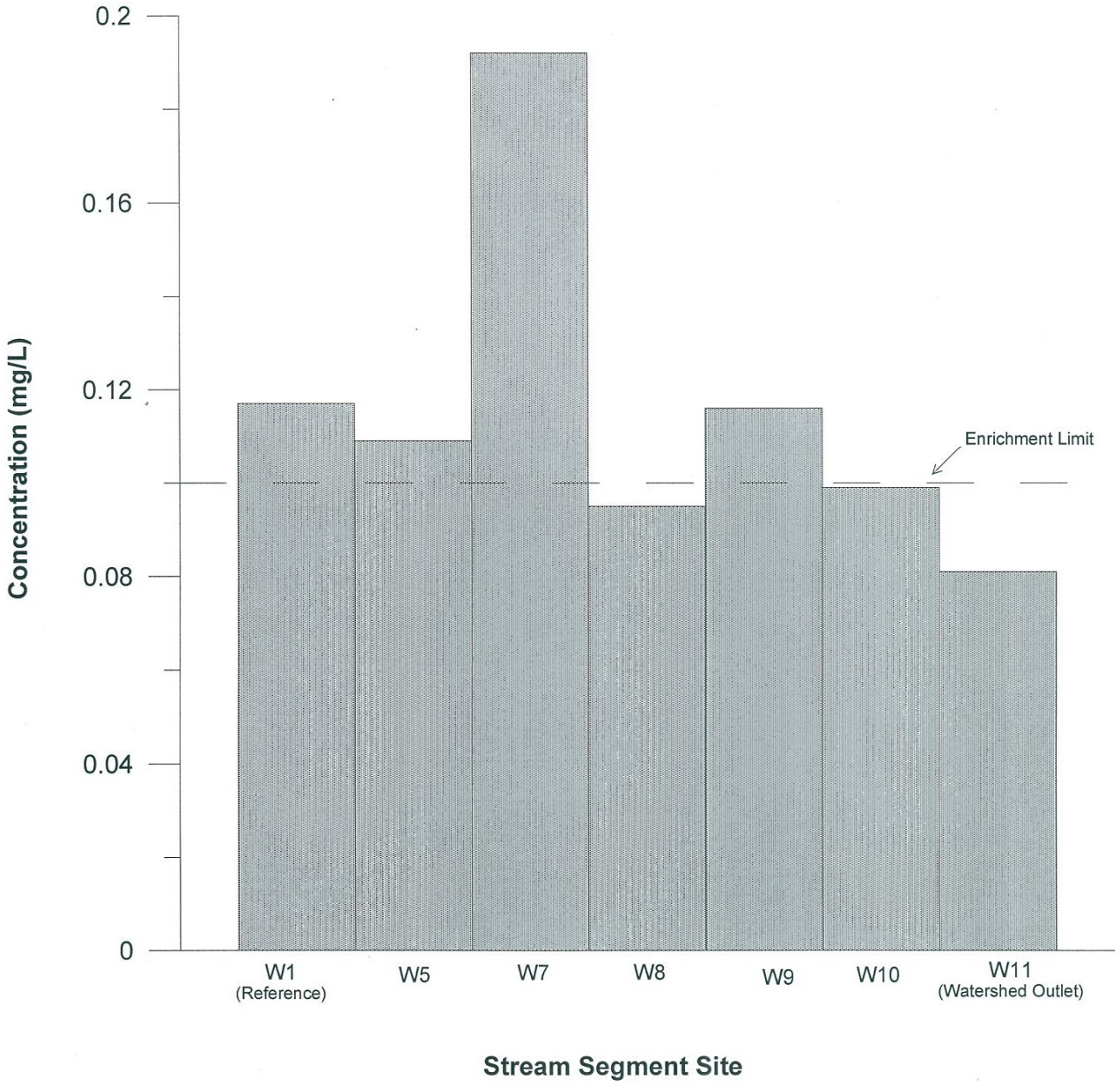
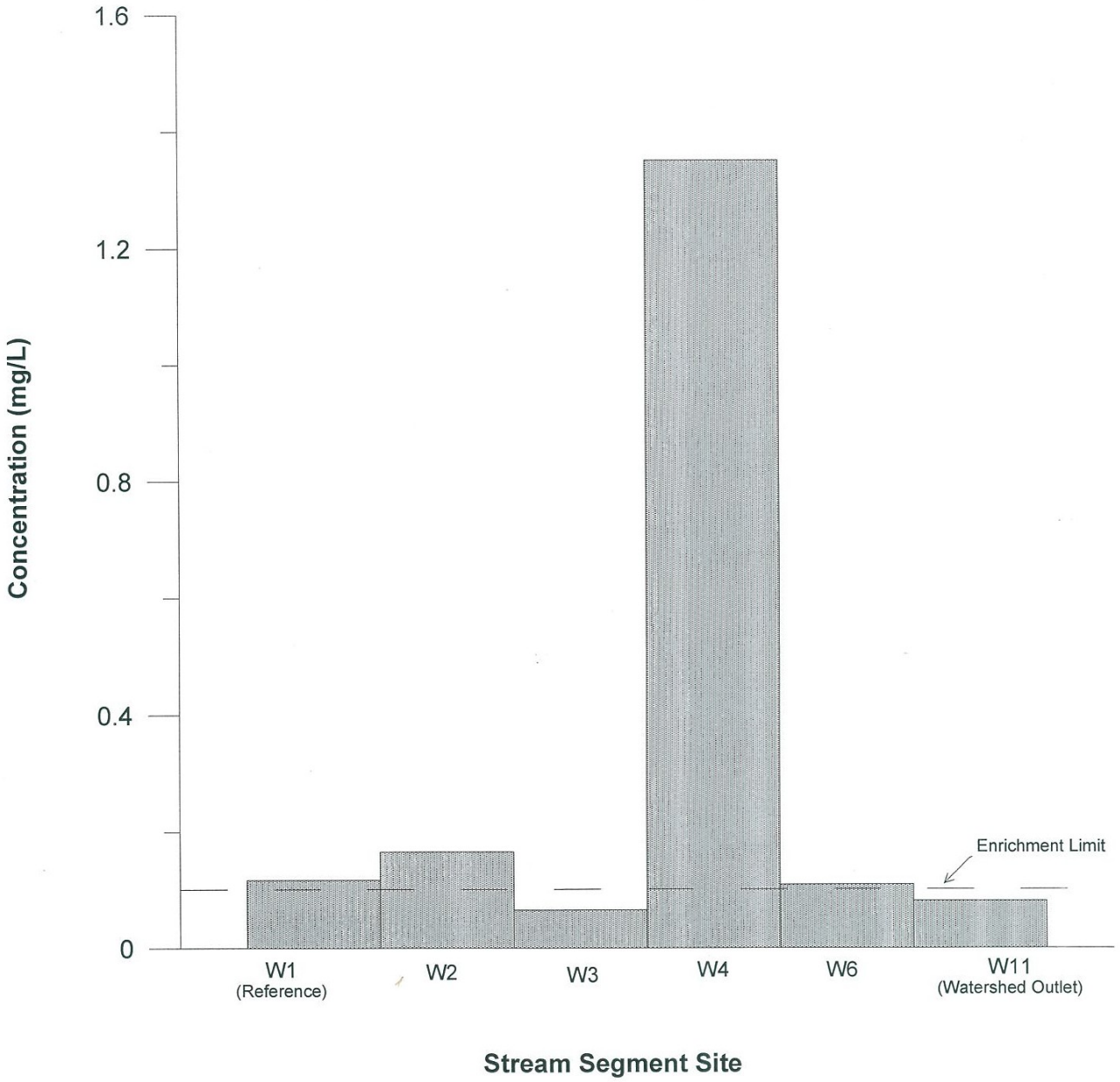


Figure 9. *Comparison of mean nitrate-nitrite ($N0_3$- + NO_2-) concentrations among urban sites, the reference site, and the watershed outlet.*



Among the rural sites, concentrations were highest during the fall and winter months of 2002-03. This seasonal trend is not uncommon around agricultural sites because there are no commercial crops to take up the excess nitrates in the soil and therefore nutrients can be easily leached out during rainfall events. With the exception of site W4, there were no dramatic variations in seasonal concentration levels for the urban sites.

ORTHO-PHOSPHORUS. Ortho-phosphorus concentrations were 0.03 mg/L at reference site W1 and 0.04 mg/L at the watershed outlet, W11. The saturation limit for **phosphorus** is 0.02 mg/L.

Concentration levels were not significantly different between categorized sites but they were significantly different among all sites (Figures 10, below, and 11, next page). Differences may be attributed to higher concentrations in waste water treatment sites W4 and W7. Among the urban sites W4 had the highest concentration values averaging 0.4 mg/L never dropping below the 0.02 mg/L saturation limit. These high concentrations could explain why the downstream site W8 on average exhibited higher concentration value (0.08 mg/L) than most of the other rural sites. Similarly site W7, averaged 0.08 mg/L and is downstream from the City of Ocilla's waste water treatment facilities pivot land application site.

Figure 10. *Comparison of means of ortho-phosphorus (PO_4-P) concentrations among rural sites, the reference site, and the watershed outlet.*

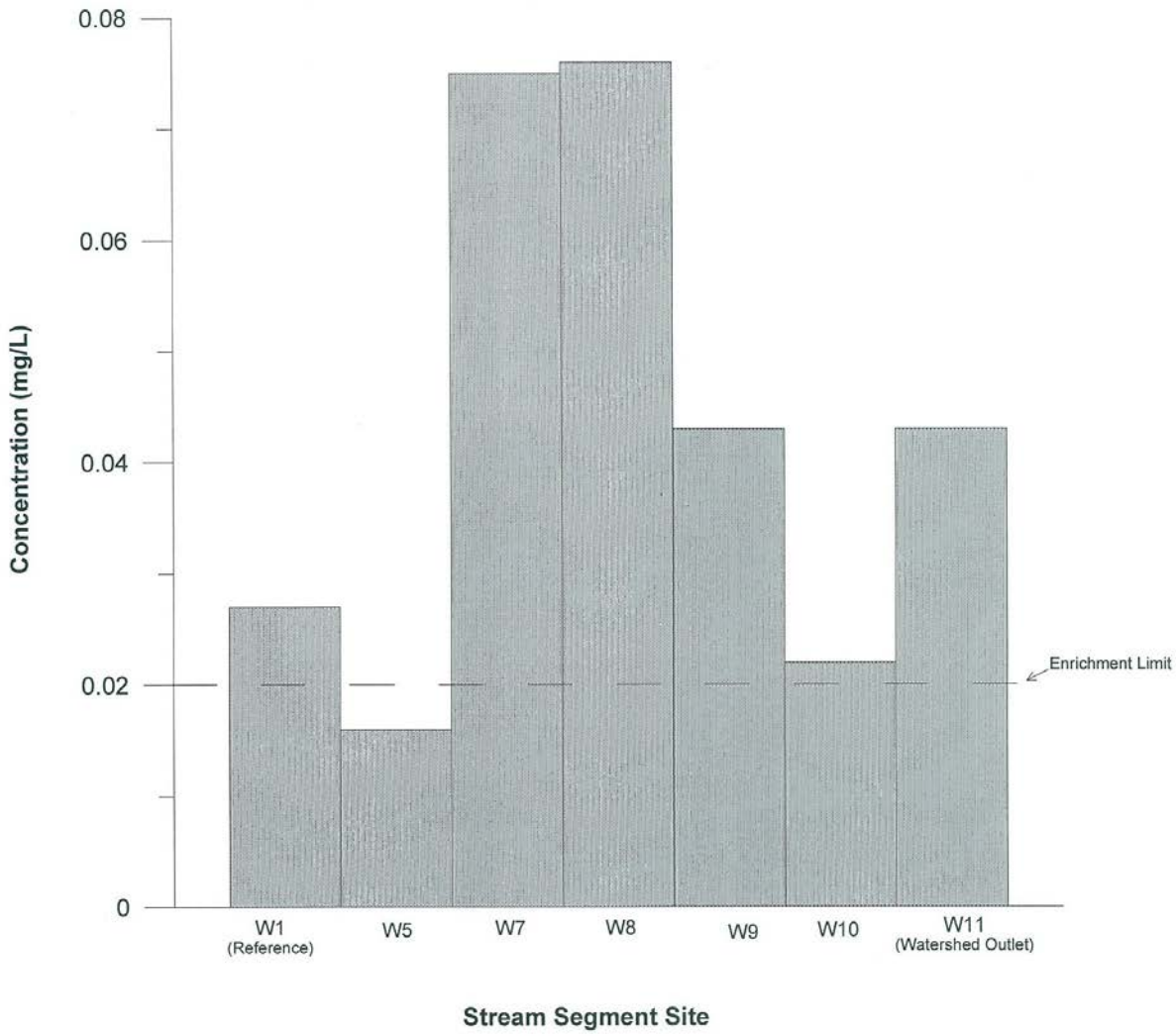
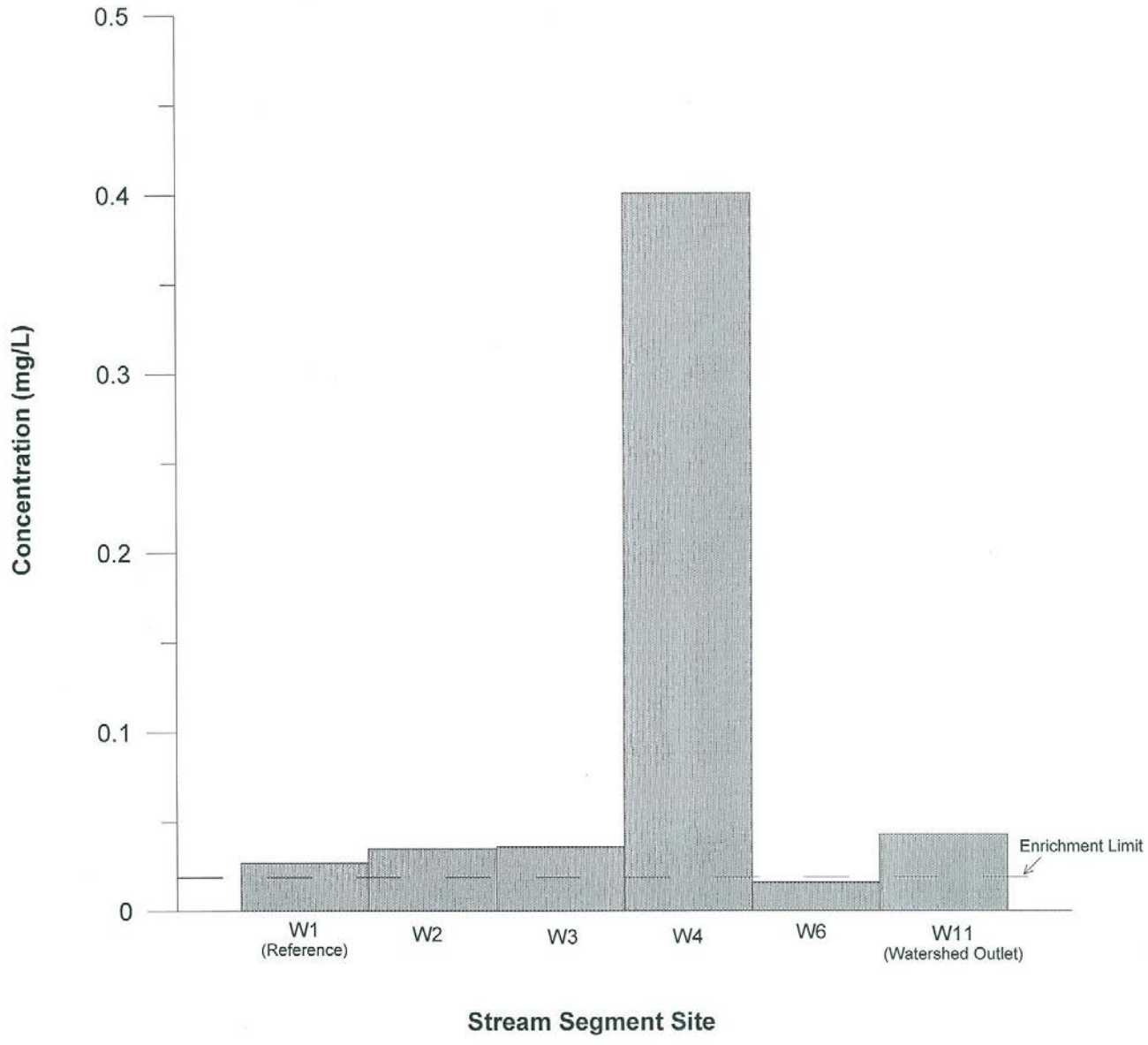


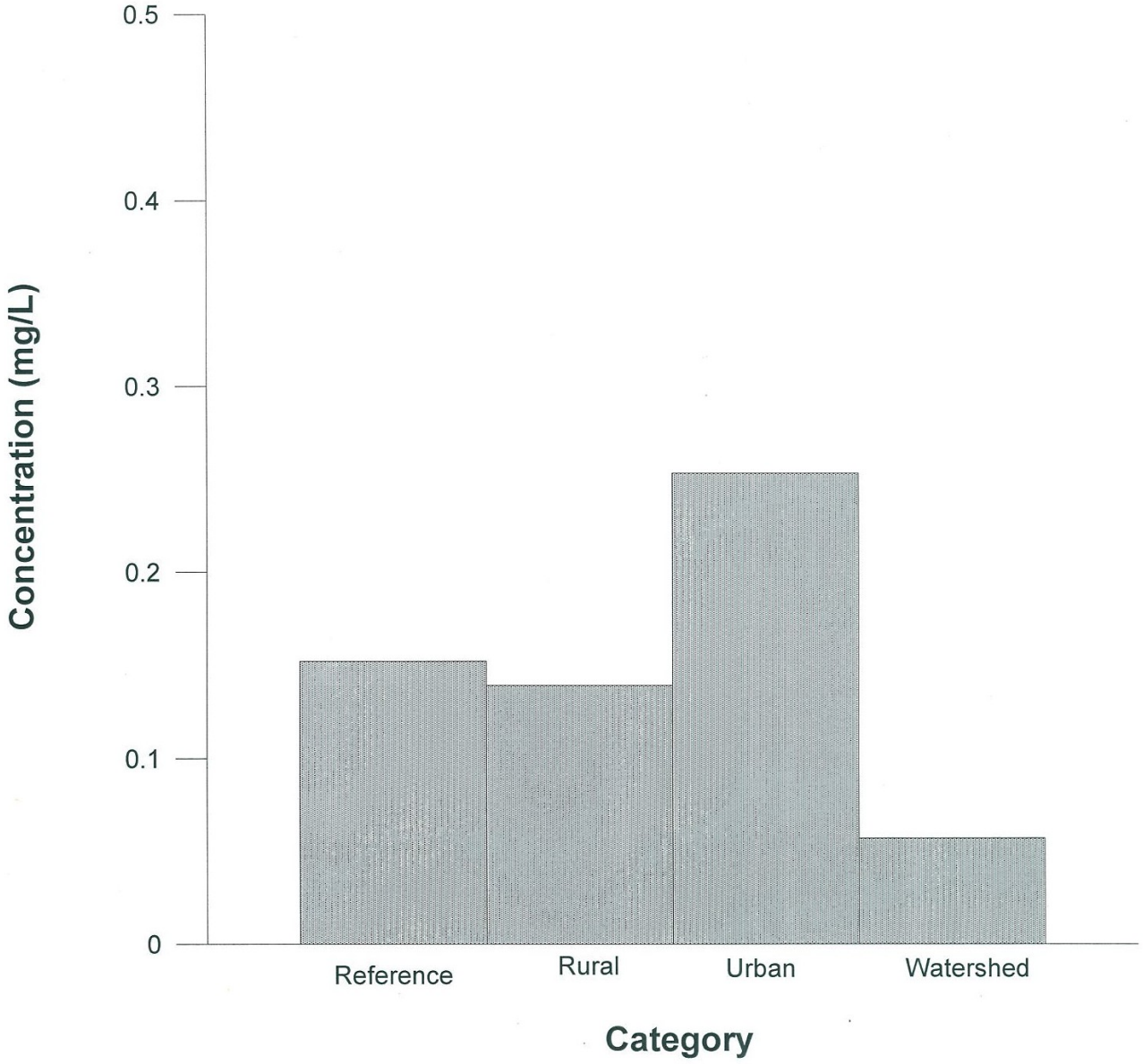
Figure 11. *Comparison of means of ortho-phosphorus (PO_4-P) concentrations among urban sites, the reference site, and the watershed outlet.*



AMMONIUM-NITROGEN. Ammonium concentrations were highest at the sites that were downstream from the waste water treatment facilities, W4 & W7. This is particularly true for site W4, which exhibited the highest concentration levels of all the sites peaking at 7.5 mg/L with an average of 0.68 mg/L. Tests showed there were significant differences both among all sites and between categorized sites (Figure 12, next page). Rural sites averaged 0.14 mg/L of ammonium, while urban sites averaged 0.25 mg/L as compared to the reference site, W1, at 0.15 mg/L and the watershed outlet, W11, at .06 mg/L. Higher levels of ammonium can often be attributed to the natural conversion of nitrates to

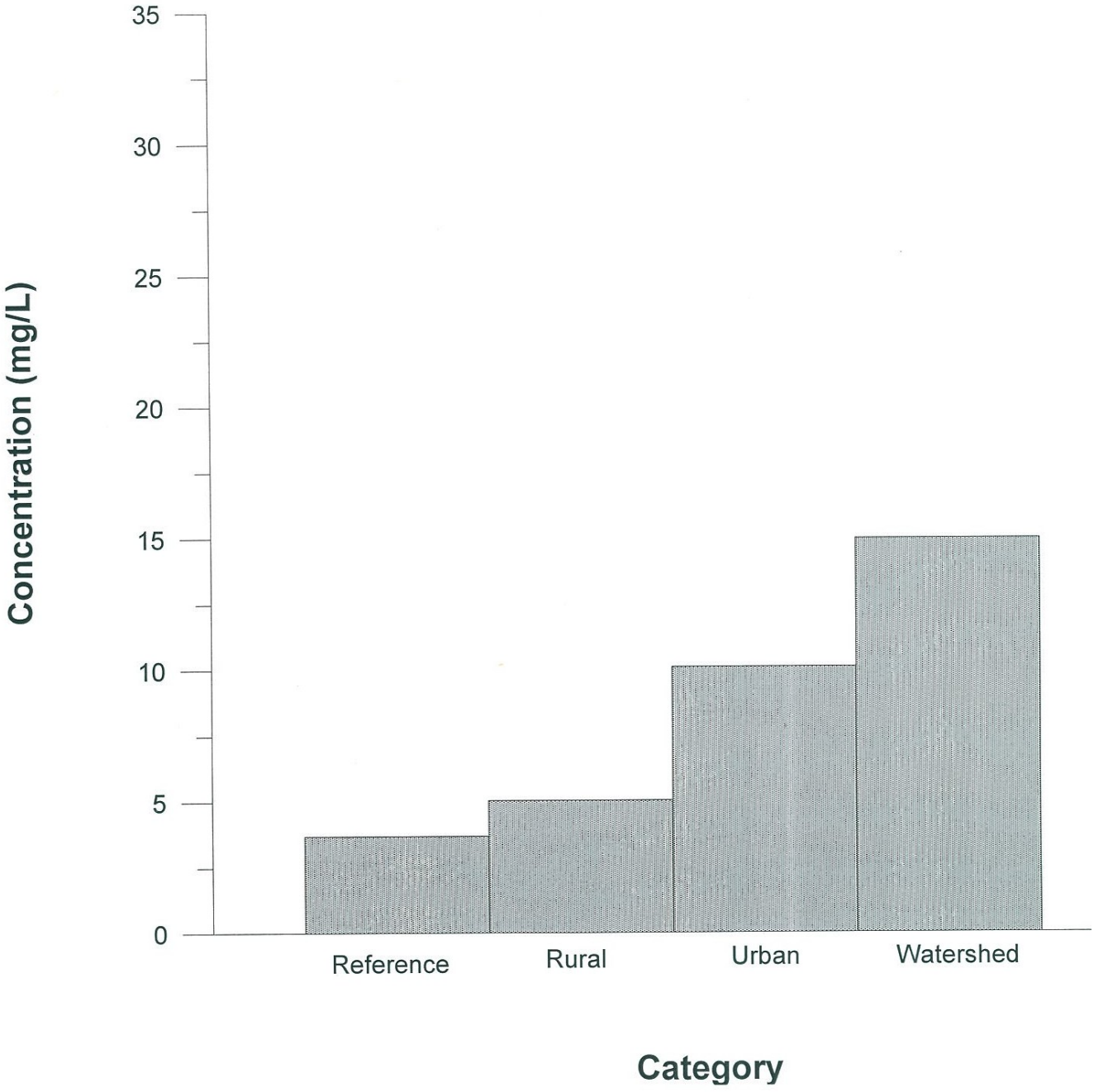
ammonium. Ammonium is also a common ingredient in fertilizers and the higher average concentration may in part be attributed to homeowners' improper use of these products.

Figure 12. *Comparison of mean ammonium-nitrogen (NH_4-N) concentrations between stream categories.*



SUSPENDED SOLIDS. Suspended solids were shown to be significantly higher among stream segments and between categories (Figure 13, next page). Among the urban sites, W2 showed the highest concentrations with an average of 13.66 mg/L. The high concentrations at this site can be attributed to the fact that W2 had no buffer zone between the stream and urbanized area surrounding it. It is worth noting that urban site W6 showed an unexplained spike, 17.41 mg/L, in June 2002. The watershed outlet site, W11, which is on the Willacoochee River, also exhibited an unexplained concentrations spike in July of 2002, 18.1 mg/L. These unexplained spikes are likely due to non-routine occurrences such as construction or a large rainfall event upstream. Over the remainder of the sampling period, the watershed outlet maintained the lowest reading of suspended solids suggesting that the cumulative upstream effects had little impact.

Figure 13. *Comparison of mean suspended solids concentrations between stream categories.*



6.5 Biological Water Quality Results

FECAL COLIFORM. Fecal coliform is often used as a water quality indicator because they are relatively easy to detect and use. The presences of fecal coliform indicates that the water source has been contaminated with fecal material from either man or animal. Contamination of a water source with fecal material may indicate that the source water is also contaminated with disease producing bacteria or viruses and can pose a health risk to both humans and animals.

Long term trends of fecal coliform counts and the ratio between fecal coliform and fecal streptococci are used to more accurately assess the overall health risk of the source water. In this case, geometric means are used to establish the long term trends in data.

The State of Georgia's Environmental Protection Division has set the state standards for fecal coliform concentrations for **surface waters** that are designated for use as fishing, at 1000 colonies/100 mL (GA DNR-EPD, 1996). Table 11 shows that the state standard is met by all of the monitored streams.

TABLE 11:
MEAN FECAL BACTERIA CONCENTRATIONS

Site	Fecal Bacteria		FC: FS
	Coliforms (colonies/ 100 mL)	Streptococci (colonies/ 100 mL)	
W1	154.96	174.12	0.89
W2	215.02	227.88	0.94
W3	165.95	243.97	0.68
W4	358.34	891.30	0.40
W5	72.20	289.90	0.25
W6	163.14	348.82	0.47
W7	327.76	538.48	0.61
W8	119.86	342.64	0.35
W9	380.79	663.23	0.57
W10	136.82	302.18	0.45
W11	80.83	258.77	0.31

The ratio of fecal coliform (FC) to fecal streptococci (FS) has long been recognized as being an indicator to the origins of the fecal material. If the ratio of FC/FS is greater than 4, the source is human waste. A ratio between 0.1 and 4 is an indication of contamination by domesticated animals, while a ratio of 0.2 to 0.4 indicates livestock and a ratio of less than 0.1 is generally accepted as wildlife. The mean fecal ratio for four of the streams were between 0.2 and 0.4 indicating that the likely source of fecal contamination was from livestock animals such as cows and hogs. The remaining seven streams were between 0.4 and 4, a strong indicator that the fecal source was domesticated animals and not humans. Comparing the data as rural and urban sites, most of the rural sites indicated that the fecal contamination was from livestock, while the urban fecal ratio levels indicated that the contamination source was domesticated animals.

DISSOLVED OXYGEN & TEMPERATURE. The State of Georgia's Environmental Protection Division has set the dissolved oxygen (DO) standard for streams, which are designated as fishing, at a minimum of 4.0 mg/L with a daily average of 5.0 mg/L. The temperature standard is set at a maximum temperature of 32.2°C Mean DO and temperatures are reported in Table 12.

TABLE 12:
MEAN DISSOLVED OXYGEN AND TEMPERATURE

	DO (mg/L)		Temp (°C)	
Site	Mean	Min	Mean	Max
W1	4.11	0.05	14.55	25.5
W2	1.80	0.03	17.84	27.0
W3	0.40	0.02	16.83	27.1
W4	2.55	0.05	18.05	26.5
W5	3.74	0.04	15.13	27.1
W6	2.37	0.02	15.60	26.3
W7	3.27	0.04	16.11	26.1
W8	4.68	1.71	15.78	26.1
W9	2.74	0.04	15.94	26.1
W10	3.04	0.03	15.03	25.5
W11	5.67	2.76	15.87	28.4

Mean DO values are low and only reference site W11 met the state standard for daily average. All sites minimum values were well below the state standard of 4.0 mg/L. DO measurements were taken in the morning between 8:00 and 11:00; therefore, it can be assumed that DO levels would drop even further as the water temperature reaches its daily maximum.

Although all sites were within the state's standard for temperature it should be noted that, as with the DO data, readings were taken in the morning well before maximum water temperature was attained.

6.6 Overall Water Quality Results of the Willacoochee River Watershed

The water quality at the outfall of the Willacoochee River (W11) sub-watershed appears to be better than the upstream sub-watersheds. The increase in water quality on the Willacoochee River was probably due to dilution of **nutrients** from upstream sub-watersheds. Among the rural sites, W7 & W8 had the poorest water quality, while W4 had the poorest water quality among the urban sites. Sites W4 and W7 poor water quality is easily explained by their immediate proximity to the waste water treatment facilities. Site W8's higher nutrient levels, as compared to other rural sites, are probably also due to the fact that it is downstream from site W4. These comparisons suggest that the City of Ocilla's Waste Waster Treatment Facilities' pivot application system is more efficient in reducing the amount of nutrients returned to the streams as compared to the City of Fitzgerald's municipal water system. Comparisons between categorized sites showed that urban activities were a larger contributing factor to lower water quality than rural activities. The installation of **riparian** buffers between urban areas and stream segments would reduce the impact of these activities on water quality. These results suggest that there do not seem to be any cumulative effects on the Willacoochee River Sub-watershed's water quality level. A technical summary of the *Water Quality in the Willacoochee River Sub-watershed* can be found in Appendix J.

Photo 17: Willacoochee 319 Project Coordinator / Educational Program Specialist, Robert Lindsey, as he prepares to take water samples.

6.7 Aquatic Macroinvertebrate and Stream Habitat Assessment

The object of the aquatic macroinvertebrate and stream habitat assessment was to assess the habitat quality and biological integrity of the 11 sample sites in the Willacoochee River Watershed. The purpose of the biological monitoring was to quickly assess both water quality and habitat. The abundance and diversity of macroinvertebrates found was an indicator of the overall stream quality.

The Georgia Environmental Protection Division rates habitat quality and biological integrity of streams in four categories: Very Good; Good; Fair; and Poor. There were several factors that contributed to the category classifications of each sample site location, such as the number of organisms and the variety. Of the 11 sample sites, one site (W-11) ranked "Very Good"; two sites (W-9 and W-10) ranked "Good"; six sites (W-1, W-2, W-5, W-6, W-7, and W-8) ranked "Fair"; and two sites (W-3 and W-4) ranked "Poor". See Figure 7 on page 43 or Appendix I for the *Willacoochee Watershed Sampling Sites*. Table 13 (next page) shows the breakdown of each sample site location and its ecological condition. For more information or to receive a copy of the complete assessment contact Seven Rivers RC&D at 912.367.7679.

TABLE 13:
ECOLOGICAL CONDITION CHARACTERIZATION

Metric	W1		W2		W3	
	Value	Score	Value	Score	Value	Score
Taxa Richness	27	3	31	5	28	3
EPT Index	1	1	2	1	0	1
# Chironomidae Taxa	9	5	9	5	4	1
% Contrib. Dom. Taxon	37	3	30	3	18	5
% Diptera	52	1	24	3	18	3
Florida Index (FI)	8	3	5	1	3	1
% Filterers	10	3	4	1	1	1
Total Habitat Score (%ref.)	93	5	48	0	62	1
Total Score		24		19		16
Ecological Conditions		**Fair**		**Fair**		**Poor**

Metric	W4		W5		W6	
	Value	Score	Value	Score	Value	Score
Taxa Richness	25	3	34	5	21	3
EPT Index	0	1	3	1	0	1
# Chironomidae Taxa	5	3	9	5	9	5
% Contrib. Dom. Taxon	71	1	26	3	53	3
% Diptera	15	3	55	1	77	1
Florida Index (FI)	2	1	10	3	6	1
% Filterers	0	1	5	1	11	3
Total Habitat Score (%ref.)	63	1	89	3	98	5
Total Score		14		22		22
Ecological Conditions		**Poor**		**Fair**		**Fair**

Metric	W7		W8		W9	
	Value	Score	Value	Score	Value	Score
Taxa Richness	25	3	34	5	21	3
EPT Index	0	1	3	1	0	1
# Chironomidae Taxa	6	3	9	5	9	5
% Contrib. Dom. Taxon	20	5	26	3	53	3
% Diptera	60	1	55	1	77	1
Florida Index (FI)	9	3	10	3	6	1
% Filterers	28	5	5	1	11	3
Total Habitat Score (%ref.)	67	1	89	3	98	5
Total Score		22		22		22
Ecological Conditions		**Fair**		**Fair**		**Fair**

Metric	W10		W11	
	Value	Score	Value	Score
Taxa Richness	29	3	31	5
EPT Index	1	1	6	3
# Chironomidae Taxa	14	5	10	5
% Contrib. Dom. Taxon	33	3	54	3
% Diptera	57	1	25	3
Florida Index (FI)	19	5	18	5
% Filterers	21	5	11	3
Total Habitat Score (%ref.)	91	5	100	5
Total Score		28		32
Ecological Conditions		**Good**		**Very Good**

Source: Broughton A. Caldwell, 2003.

CHAPTER 7: BEST MANAGEMENT PRACTICES (BMPs)

The future of our water resources depends on how we as citizens protect them and the use of best management practices is one way to do so. **Best Management Practices,** also known as a BMP, is a voluntary practice that preserves or enhances the quality of our soil, water and/or air. There are various types of BMPs that can be tailored towards urban, rural, industrial, or agricultural practices. As defined by the USGS, an agricultural BMP is used to minimize **pollutants** from agricultural activities from entering water resources (I.e. cover crops, fences, nutrient management, residue management, etc.). It is important to note that the implementation of a BMP is the first step and should be continually monitored and/or assessed to ensure that the practice is operating properly.

In the Willacoochee River Watershed, there were several locations that were identified as being potential sources of pollution. Some potential sources of pollution included **erosion**/**sedimentation** from unpaved roads and bare soil; fecal coliform bacteria from cattle wading directly in the stream, leaking sewer lines/or septic systems; and urban **runoff** such as stormwater. By identifying these areas visually and using water quality data to pinpoint sources of pollution, 17 sites were chosen to implement 5 different types of BMPs.

7.1 Best Management Practice (BMP): Conservation Tillage

The first type of BMP implemented in the watershed was conservation tillage at the Irwin County C.A.S.E. Farm. Conservation tillage is when crops are grown using minimal cultivation practices. By reducing the amount of tillage and allowing most, if not all of the plant residue to remain on top of the soil, the new crop is then planted on top of the soil versus being plowed into the soil.

Photo 18: Conservation Tillage, first BMP

It is typically stated that 30 percent of the crop residue should be left on the ground to be considered conservation tillage. Weeds are managed by cover crops or herbicides instead of cultivation. Lime and fertilizer can either be used early during the production cycle or left on top of the soil during planting. Conservation tillage is not recommended in every case; however on highly erodible soils, the soil can be better protected when trying to minimize the use of herbicides and pesticides, and conserving moisture through the use of conservation tillage practices (NCSU, 2001).

7.2 Best Management Practice (BMP): Livestock Exclusion Fencing

Photo 19: Water well, second BMP

The second type of BMP implemented was for livestock exclusion fencing. The purpose of this type of BMP is to prevent animals such as cattle or goats from damaging the **riparian** area of a stream by restricting their access to the stream and providing alternative water sources. By allowing livestock to continually enter into the stream, the animals may cause severe damage to the streambank, increase in erosion, resulting in the loss or destroying of trees and shrubs, and degradation in water quality. In the Willacoochee River Watershed, there were several farms that were in need of this BMP so it was determined to implement four demonstration sites of livestock exclusion fencing: one cattle site in Irwin, two cattle sites in Berrien, and one goat site in Ben Hill County.

Since the livestock were excluded from their original water source, an alternative source was needed. The first step of implementing this BMP was to construct a well that could be used to pump water to the new location. Photo 19 (above) shows the new water well that was put into place so that an alternative water supply could be provided. Photo 20 (below) illustrates the actual alternative water source and the gravel needed around this heavy use area. The gravel eliminates erosion that tends to occur around water and feeding troughs.

Photo 20: Alternative water source and gravel area for second BMP

The goat livestock exclusion BMP project in Ben Hill County was implemented on the G&L Quality Boer farm (photo 21 left). There were several individual BMPs, that when combined, played into the completion of this project. This BMP included grass planting; fencing; installing a well, watering troughs, pipeline, and heavy use pads around the water troughs.

First, the entire track was fenced on the boundaries and a 30 foot buffer was left. There were eight 1 acre **doe paddocks** built for rotational grazing. South of the doe area, there were four 1 acre paddocks installed for the **bucks**. There is a wetland area on the property that was fenced off to prevent access by the goats. Since the goats were excluded from their water source, a well was installed to provide an alternate water source. Next, a 2" PVC pipe was installed from the well to the paddock areas for the water troughs. Before the watering troughs were put into place, 6 heavy use pads, which consisted of 8 inches of crusher run gravel over a layer of geotextile, were installed to prevent the area from becoming saturated and boggy around the watering troughs. Finally, the 6 plastic watering troughs were installed to supply 2 paddocks each. They are easy to clean and all components are protected inside the casing so they will not be damaged by the livestock. This system provides fresh water and keeps the animals out of the natural waterways.

Photo 22: Travel lane between pens at the G&L Quality Boer Farm

7.3 Best Management Practice (BMP): Unpaved Road Options

The third type of BMP was the paving of the unpaved road that led to the Irwin County C.A.S.E. Farm. This BMP was chosen because there are approximately 1,000 miles of county owned or maintained unpaved roads in the Willacoochee River Watershed. Two of the most significant factors affecting the maintenance of unpaved roads are **erosion** and the upkeep of their drainage systems. Erosion tends to occur when soil particles are loosened, carried away from the roadway base, and deposited in the roadway drainage system. Soil particles that deposit in the drainage systems may result in roadway flooding due to the reduction in the carrying capacity of the ditch. One solution to this problem is to grade the unpaved roads and ditches; however, this can result in another problem known as "**washboarding**." Below are two photos, one before the BMP was put into place and one during construction.

As you can see before the implementation of the BMP in photo 23 (left), the Irwin County C.A.S.E. Farm driveway had severe issues with erosion as a result of rain and this driveway being a heavy use area. In some situations, BMP practices such as grass waterways and gravel may stabilize unpaved roads and driveways; however, this is a temporary solution. Asphalt or concrete paving are the most expensive initially, but most feasible over time. As you can see in photo 24 (below), by paving the Irwin County C.A.S.E. Farm driveway, this eliminates erosion and provides a safe and smooth surface. By adding the grass waterways alongside the road, this helps to minimize erosion and filter pollutants before it enters into a nearby waterway.

Photo 24: Previous unpaved road during BMP implementation

The Georgia Department of Transportation (DOT) has funding available to assist with road improvements through programs such as the Local Assistance Road Program (LARP). This resurfacing program initiated in 1978 to help local governments preserve the integrity of their paved roads. For more information, call GA DOT District IV in Tifton, 229.386.3283.

7.4 Best Management Practice (BMP): Stream bank Restoration

The fourth type of BMP was a stream bank restoration on Floyd's Creek in Ben Hill County. Floyd's Creek was chosen because it is located in an urban setting, had several areas that were eroding due to runoff from the surrounding paved areas, and because it feeds into Turkey Branch, which has been identified by the State of Georgia as impaired (see Chapter 3 for more details). There were also areas that sediment buildup was resulting in excessive maintenance to keep the channel flowing. One of the key components of this project was the planting of vegetation to strengthen the streambank, filter **pollutants**, and provide shade for the stream to keep water temperatures cooler, which can help with keeping the DO levels at a normal and healthy level for aquatic life. The local land owners were notified and agreed to participate in the project to install about 1/2 acre of riparian forest buffer type border.

The banks of the stream were cleaned, smoothed and then planted with trees and shrubs. The pattern started at waters edge with a row of Crepe Myrtles 5' apart. Then a row of Popular trees were planted 5' up the bank and offset from the row in front at a 20' interval. Then another 5' up the bank a row of Azaleas was planted, again offset from the previous row and planted 5' apart. The entire area was also heavily mulched. On the eastern bank, an erosion control blanket was placed first and then the trees were planted because of the steeper slope on this side of the bank. By planting trees/shrub, using the erosion control blankets, and mulch, this will prevent the continued erosion of the bank and slow the sediment buildup in the creek. This particular project was a wonderful community activity that provided education to the public on the importance of maintaining our waterways. By identifying and addressing the concerns of the community, the local government and cooperating community groups were able to implement this restoration project.

Photo 25: Floyd's Creek Streambank Restoration Project

7.5 Best Management Practice (BMP): Clover Cover Crops

The fifth type of BMP was planting clovers as a **cover crop**. A cover crop is any crop grown primarily to prevent soil erosion by wind and water. Cover crops can be annual, biennial, or perennial herbaceous plants grown in a pure or mixed stand during all or part of the year. In addition to providing ground cover and, in the case of a legume, fixing nitrogen, they also help suppress weeds and reduce insect pests and diseases. When cover crops are planted to reduce nutrient leaching following a main crop, they are often termed **catch crops**. There were 9 sites throughout the watershed that the clover cover crops were implemented. Photo 26 (below) is of a field in northwest Ben Hill County that was planted with clover as a cover crop using a no-till drill. No-till drills plant rows about 6" apart and disturbs only the soil where the seeds are planted. This allows as much surface area as possible to be undisturbed. Clover is a good cover because many species will regenerate yearly, saving the farmer the cost of replanting. For information about clovers or other cover crops, contact your local UGA Cooperative Extension Office or your local USDA office.

Photo 26: Clover Cover Crop

CHAPTER 8: WATER QUALITY ISSUES, GOALS, AND ACTIONS

Protecting our natural resources is important for the conservation and enrichment of habitats for not only fish and wildlife, but for people as well. If our water supplies are not protected or improved, poor water quality will harm species and habitats. The factors that are known to cause poor water quality including temperature, sedimentation, runoff, erosion, dissolved oxygen, pH, decayed organic materials, pesticides, and an array of other toxic and hazardous substances.

8.1 Stream Channel Related Issues

A. Channelization: is when the natural meanders of a stream are removed in order to straighten a stream so that it is more navigable. In many cases, channelization has a negative impact on its surroundings. Channelization of streams typically results in increased downstream sedimentation and increases downstream flooding.

a. **Short-Term Goal**: To assess the overall health of the streams in the watershed and identify potential contributions of unstable stream banks.

i. **Action 1**: Establish a working committee in the Willacoochee River Watershed to develop guidelines that address channel modifications in urban areas to insure that channel changes are either avoided or done in a manner that does not contribute to streambank erosion or bank failure. Disseminate information to city/county governments to incorporate information into local planning ordinances.

ii. **Action 2**: Conduct an inventory of the stream channels throughout the watershed to identify ditches/creeks/streams/rivers that contribute significantly to the overall water quality of the watershed.

iii. **Action 3**: Utilize the expertise from resources such as NRCS, UGA Cooperative Extension Service, GFC, and the SGRDC to develop plans on priority areas to implement corrective measures.

iv. **Action 4**: Identify funding sources to implement streambank restoration project(s). Provide information to local governments and landowners in the watershed about programs such as U.S. EPA Section 319 grants and NRCS cost share sign up programs to re-vegetate areas previously disturbed areas along riparian corridors and/or in need of streambank restoration.

b. **Long-Term Goal**: To restore/restructure all significant ditches/creeks/streams/rivers in the Willacoochee River Watershed to a stable condition and/or its natural structure. This can be done by vegetating stream banks to provide filtration from adjacent lands and reconfiguring the natural meanders so that the water body is no longer channelized.

B. Obstructions/debris: obstructions/debris are objects that prohibit the flow of water. Obstructions in a stream channel can block the flow of water in the stream channel or ditch and can result in standing water or flooding in the immediate area and/or minimize the downstream flow. Examples of obstructions/debris are scrap concrete, bricks, pipes, garbage, yard waste, tree branches, etc. These items not only alter stream flow but are an eyesore and can be dangerous for aquatic life.

a. **Short-Term Goal**: To assess all ditch/creek/stream/river obstructions and the severity of each obstruction.

   i. **Action 1**: Conduct an inventory of the ditch/creek/stream/river obstructions in Willacoochee River Watershed and maintain a location record with specific information about each location. This can be done through field notes or by using GIS technology.

   ii. **Action 2**: Prioritize the severity of obstructions for removal.

   iii. **Action 3**: Utilize resources of local government, landowners and volunteers in the watershed to schedule removal efforts.

b. **Long-Term Goal**: To remove or open all ditch/creek/stream/river blockages in the Willacoochee River Watershed.

C. Flooding: is an overflowing of water on to land that is normally dry. It is normal for some flooding to occur along streams/rivers during certain times of the year; however, as a result of man's action, we are seeing flooding in areas that would not normally occur or more often then usual. There are a number of agencies that have flood maps that depict the 100 year and 500 year flood hazards (i.e. The Flood Insurance Rate Map (FIRM). For more information contact Federal Emergency Management Agency (FEMA), Georgia Emergency Management Agency (GEMA), city/county engineers, and/or the SGRDC.

a. **Short-Term Goal**: To assess areas and identify landowners within the Willacoochee River Watershed that are prone to flooding problems.

   i. **Action 1**: Conduct an inventory of landowners who have chronic flooding problems. Conduct a site review for assessment of severity of the problem and identify those agencies that can assist with planning to reduce or prevent and future damage from flooding.

   ii. **Action 2**: Identify actual and potential causes of flooding and prioritize each area based off severity and human hazards.

   iii. **Action 3**: Utilize resources and expertise of local governments, state and federal agencies such as GEMA, FEMA, USGS, and EPD to review and address the problem areas so that actions can be taken to minimize or alleviate the problem.

b. **Long-Term Goal**: To reduce flooding problems within the Willacoochee River Watershed through corrective and planning actions.

8.2 Sedimentation

A. Development/Construction: are activities where changes, occurrences, and/or significant changes are being made to the land. Examples of issues surrounding development/construction are the loss of tree and vegetation cover which result in erosion. Erosion is most likely to occur during land clearing activities, preparation for development, and before vegetation is re-established.

a. **Short-Term Goal**: To establish and/or enforce BMPs to control runoff from development/construction sites to reduce erosion and sediment transport.

    i. **Action 1**: Follow and enforce the Soil Erosion and Sedimentation Control Ordinance.

    ii. **Action 2**: Design an informational flyer for developers/contractors that will guide them through the proper required procedures during the development processes.

b. **Long-Term Goal**: To reduce sedimentation problems within the Willacoochee River Watershed through the use of BMPs and regulatory enforcement actions.

B. Unpaved (Dirt) Roads: can contribute significantly to sedimentation if not properly maintained. All unpaved roads should be constructed in a manner to minimize and/or prevent erosion and to decrease maintenance needs. If not properly maintained, these roads can become sources of runoff and pollution to neighboring streams and waterways. This can include re-grading a poor road surface, improving upon the road surface and road drainage thus, minimizing sediment and erosion. Tree and shrub establishment, which acts as a roadside/streamside buffer, can provide while minimizing sediment and runoff. Currently, the State of Georgia does not have a BMP manual specifically for unpaved road maintenance.

a. **Short-Term Goal**: To assess the number of unpaved roads in the watershed.

    i. **Action 1**: Conduct an inventory of how many miles of unpaved roads exist in the Willacoochee River Watershed and prioritize their conditions.

    ii. **Action 2**: Design a maintenance schedule for the upkeep of unpaved roads that will provide recommendations as to how to reduce erosion problems.

b. **Long-Term Goal**: To ensure that existing unpaved roads are constructed and maintained in a manner that increases their stability and reduces erosion.

C. Eroding Farmland: since agriculture and silviculture are two of the most common practices in the Willacoochee River Watershed, it is assumed that these practices contribute to the increase in sedimentation found in many of the streams.

a. **Short-Term Goal**: To assess the watershed's erosion conditions from agricultural land uses.

    i. **Action 1**: Identify priority areas within the watershed that are susceptible or vulnerable to erosion and then rank each area based on its severity.

    ii. **Action 2**: Educate farmers on agricultural practices/conservation planning such as conservation tillage, cover crops, and nutrient management to reduce farmland erosion.

    iii. **Action 3**: Coordinate conservation planning within the Willacoochee River Watershed so landowners can take advantage of USDA-NRCS cost-share programs and other related funding opportunities.

iv. **Action 4**: Identify and/or develop BMP demonstration sites to familiarize farmers/landowners with the conservation practices most effective in reducing soil erosion.

b. **Long-Term Goal**: To reduce farmland erosion through the development of conservation plans and use of best management practices on all farms within the Willacoochee River Watershed.

8.3 Water Quality and Clarity

A. Runoff: runoff from both urban and rural settings may result in serious water quality and clarity problems. Issues related to runoff include stormwater runoff, erosion, and nutrient transport.

a. **Short-Term Goal**: To establish and/or enforce BMPs, ordinances, and regulatory actions to control any and all sources of runoff.

i. **Action 1**: To provide educational material on the importance of water quality to citizens, schools, civic groups, etc.

ii. **Action 2**: To continually monitor streams so that base line data is available for watershed.

b. **Long-Term Goal**: To improve the water quality throughout the Willacoochee River Watershed and have all impaired streams on the 303(d) list removed.

B. Algal Blooms: algal blooms are often associated with eutrophic conditions and tend to be associated with standing bodies of water. When nutrients such as fertilizers from cultivated fields, pastures, and lawns, are introduced to a body of water, algal blooms tend to occur. Algal blooms can also be the result of leaking septic systems or wastewater treatment plants.

a. **Short-Term Goal**: To identify source of pollution that contribute to eutrophic conditions.

i. **Action 1**: Inventory tributaries and land use practices to identify potential sources contributing to eutrophic conditions.

ii. **Action 2**: Distribute educational materials to landowners, landscapers, homeowner associations, etc. in urban areas that provide information on proper fertilizer use for lawn maintance.

iii. **Action 3**: Work in conjunction with the University of Georgia's Cooperative Extension Service and USDA-NRCS to provide information to farmers on how to properly maintain their fertilizer consumption and manage animal waste (I.e. Nutrient management plans, soil testing, etc).

iv. **Action 4**: Establish a maintenance schedule for septic system pumpouts and inspections for communities within the watershed.

v. **Action 5**: Examine point source discharges to insure that water quality standards are being met by wastewater facilities throughout the watershed.

b. **Long-Term Goal**: To continually reduce sources of pollution that are contributing to unnatural algal blooms/eutrophication in the streams of the Willacoochee River Watershed.

8.4 Riparian Issues

A. Lack of Ground Cover/Land clearing: as communities continue to grow, the need for land increases. This is why we are continually seeing the loss of trees and other vegetation. It is important to have some form of vegetation on the ground because without it, the soil can be eroded by wind or water. Vegetated stream buffers play an important role in protecting water quality by acting as a filtering system for erosion. As stormwater runoff flows into the streams, the presence of trees and natural shrubs help to prevent soils in the water from flowing into the stream. The roots of trees and shrubs also help stabilize the stream banks**.** Bare channel banks and lack of buffers between both urban and rural land uses can result in water quality issues such as sedimentation, bank erosion, debris, and flooding.

a. **Short-Term Goal**: To establish, enforce, and improve current ordinances such as landscape and buffer regulations.

i. **Action 1**: Assess current buffer regulations and determine if it should be strengthened.

ii. **Action 2**: Encourage landowners to leave forested buffers on streams that flow through their property and properly train city/county workers on proper stream bank maintenance.

b. **Long-Term Goal**: To reduce soil erosion and improve water quality by maintaining pervious land through sufficient ground covering.

8.5 Other

A. Coordination/partnerships: are key to any successful program. By developing partnerships and coordinating efforts, you provide a means to communicate problems, solutions, and resources. This also reduces the chances of duplication and unneeded costs.

a. **Short-Term Goal**: To strengthen the existing watershed groups.

i. **Action 1**: Keep up-to-date on current activities and organizations in the watershed.

ii. **Action 2**: Prioritize problems to determine which needs immediate attention.

iii. **Action 3**: Evaluate recommended measures in this plan, develop cost estimates for specific projects, identify potential funding sources, and secure funds to implement projects.

b. **Long-Term Goal**: To implement all measures identified in the Willacoochee River WRAS.

CHAPTER 9: FUNDING RESOURCES

As with all programs, funding is an integral component in making a program not only happen, but a success. There are numerous funding opportunities for local governments, non-profits, and individuals from federal, state, and local sources. This chapter will cover funding opportunities from the U.S. Environmental Protection Agency, GA Environmental Protection Division, U.S. Department of Agriculture – Natural Resource Conservation Service, and GA Environmental Facilities Authority. These are only a few of the many funding sources available. It is important to note that funding sources and opportunities change on a yearly basis, so always check for the most up-to-date information.

9.1 U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA) PROGRAMS

In recent years, between 40 and 50 percent of the U.S. EPA's enacted budgets have provided direct support through grants to State environmental programs. The U.S. EPA grants to States, non-profits and educational institutions support high-quality research that will improve the scientific basis for decisions on national environmental issues and help the U.S. EPA to achieve its goals. The U.S. EPA provides research grants and graduate fellowships; supports environmental education projects that enhance the public's awareness, knowledge, and skills to make informed decisions that affect environmental quality; offers information for state and local governments and small businesses on financing environmental services and projects; and provides other financial assistance through programs such as the Drinking Water State Revolving Fund, the Clean Water State Revolving Fund, and the Brownfield's Program. For more information on the U.S. EPA, go to their website, http://www.epa.gov/.

Continuing Program Grants

The Continuing Program Grant is a baseline grant program awarded primarily to states and tribes. These grants are available under specific statutes (such as Clean Air Act Section 105, Clean Water Act Section 106, Resource Conservation and Recovery Act Section 3011) or under a combination of these programs into a Performance Partnership Grant. The purpose of these grants is to help support ongoing state and tribal environmental programs, such as air, water, and waste.

Project Grants

Project Grants are available to a broader range of recipients for a wide spectrum of Agency priorities such as pollution prevention, watershed planning, environmental justice, and environmental education. These project grants change from year to year and some of them are managed by the U.S. EPA HQ in Washington, DC.

Clean Water State Revolving Fund Program

Title VI of the Clean Water Act created the Clean Water State Revolving Fund (CWSRF) program. These state-run programs operate much like environmental banks that are funded with state and federal contributions. The CWSRF provides low interest rates and flexible loan terms for funding wastewater treatment plants, non-point source pollution control and estuary protection. The CWSRF assists a variety of borrowers including municipalities, farmers, homeowners, small businesses and nonprofit organizations. For more information about this program contact Greg Mason at 404.656.3824 or by email: Gmason@gefa.org.

Water Pollution Control Program

The U.S. EPA provides annual grants to state water pollution control agencies and Indian Tribes to assist them in establishing and maintaining programs to prevent and control water pollution. Water Pollution Control grants are authorized by Section 106 of the Clean Water Act. For more information about this program contact Robert Scott at 404.675.6236 or by email: robert_scott@mail.dnr.state.ga.us.

Water Quality Cooperative Agreements Program
The U.S. EPA Region 4 provides funds through a competitive process for Water Quality Agreement Grants that are authorized by Section 104(b)(3) of the Clean Water Act. The funds are available for States, Indian Tribes, interstate agencies, and other public or nonprofit organizations. The grants are used to develop, implement, and demonstrate innovative approaches relating to the causes, effects, extent, prevention, reduction, and elimination of water pollution. Awarded grants will have project periods from one to two years. For more information about this program contact Robert Scott at 404.675.6236 or by email: robert_scott@mail.dnr.state.ga.us.

Water Quality Management Planning Program
Water Quality Management Planning Grants are awarded to States to support unified watershed assessments and watershed restoration priorities. The grants are authorized by Section 604(b) of the Clean Water Act and are generally awarded to state water quality agencies as continuing environmental program agreements. States are obligated to give 40% of the grant money to Regional Public Comprehensive Planning Organizations and Interstate Organizations. For more information about this program contact Robert Scott at 404.675.6236 or by email: robert_scott@mail.dnr.state.ga.us.

Onsite Wastewater Management Planning Program
The U.S. EPA makes grants to States to provide wastewater operator onsite training and assistance. The program focuses on the needs of Publicly Owned Treatment Works (POTW's) under five million gallons per day that are out of compliance and attempts to bring them back into compliance. Onsite assistance is provided by wastewater professionals from either state environmental agencies or their designated state environmental training centers. The program includes small treatment system security issues. Funds for the grants are authorized by Section 104(g)(1) of the Clean Water Act. For more information about this program contact Greg Mason at 404.656.3824 or by email: Gmason@gefa.org.

Drinking Water State Revolving Fund Loan Program
Capitalization grants are available to each State for the purpose of establishing a Drinking Water State Revolving Fund (DWSRF) that the State can use to provide loans and other types of financial assistance to both public and private water systems. The water systems use the loans for construction and other infrastructure improvements that achieve or maintain compliance with the requirements of the Safe Drinking Water Act. A portion of each grant is also available to fund programs such as source water protection, state program administration, well head protection, and technical assistance to small systems. For more information about this program contact Greg Mason at 404.656.3824 or by email: Gmason@gefa.org.

Brownfield's Program
The U.S. EPA's Brownfield's Program provides direct funding for brownfield's assessment, cleanup, revolving loans, and environmental job training. To facilitate the leveraging of public resources, the U.S. EPA's Brownfield's Program collaborates with other EPA programs, other federal partners, and state agencies to identify and make available resources that can be used for brownfield's activities. In addition to direct brownfield's funding, EPA also provides technical information on brownfield's financing matters. For more information about this program, go to http://www.epa.gov/brownfields/pilot.htm.

9.2 GEORGIA DEPARTMENT OF NATURAL RESOURCES (DNR) ENVIRONMENTAL PROTECTION DIVISION (EPD)

The Environmental Protection Division (EPD) is a division of the Georgia Department of Natural Resources (DNR). The mission of EPD is to help provide Georgia's citizens with clean air, clean water, healthy lives and productive land by assuring compliance with environmental laws and by assisting others to do their part for a better environment. As a result of the Clean Water Act, each year the State of Georgia receives funding from the U.S. Environmental Protection Agency to assist the state with addressing environmental issues.

Section 106 Grants

Under Section 106 of the Clean Water Act, the U.S. Environmental Protection Agency (U.S. EPA) awards grants to States and interstate agencies to assist them in administering programs for the prevention, reduction, and elimination of pollution, including enforcement directly or through appropriate State law enforcement officers or agencies.

Section 319 (h) Grants

Under Section 319(h) of the Clean Water Act, the U.S. Environmental Protection Agency (U.S. EPA) awards a *Non-point Source Implementation Grant* to the Georgia Environmental Protection Division (GAEPD) to fund projects in support of the *Georgia Non-point Source Management Program*. In Federal FY03, the State is scheduled to receive approximately $4.6 million to be distributed via a competitive process to select the most appropriate projects for funding. Each year the eligible projects vary, but in previous years projects have included Phase II Stormwater NPDES Programs, TMDL Implementation, Watershed Restoration, Technical Assistance, Education and Outreach, Technology Transfer, Monitoring and Assessment, Best Management Practices Demonstrations, Regulatory Enforcement, and Watershed Restoration Action Strategies (WRAS). For more information about this program contact Amber Greer at 404.675.1642 or by email: Amber_Greer@dnr.state.ga.us.

Section 604 (b) Grants

Under Section 604 (b) of the Clean Water Act, each state shall reserve each fiscal year 1 percent of the sums allotted to such State under this section for such fiscal year, or $100,000, whichever amount is greater, to carry out planning under sections 205(j) and 303(e).

9.3 USDA – NRCS CONSERVATION PROGRAMS

The U.S. Department of Agriculture – Natural Resource Conservation Service (USDA-NRCS) offers a number of funding opportunities as a result of the Farm Security and Rural Investment Act of 2002. This Act is landmark legislation for conservation funding and for focusing on environmental issues. The conservation provisions will assist farmers and ranchers in meeting environmental challenges on their land. This legislation simplifies existing programs and creates new programs to address high priority environmental and production goals. The 2002 Farm Bill enhances the long-term quality of our environment and conservation of our natural resources.

Conservation of Private Grazing Land Program

The Conservation of Private Grazing Land Program (CPGL) is a voluntary program that helps owners and managers of private grazing land address natural resource concerns while enhancing the economic and social stability of grazing land enterprises and the rural communities that depend on them.

Conservation Security Program
The Conservation Security Program (CSP) is a voluntary program that provides financial and technical assistance for the conservation, protection, and improvement of soil, water, and related resources on Tribal and private lands. The program provides payments for producers who historically have practiced good stewardship on their agricultural lands and incentives for those who want to do more.

Environmental Quality Incentives Program
The Environmental Quality Incentives Program (EQIP) is a voluntary conservation program that promotes agricultural production and environmental quality National goals. Through EQIP, farmers and ranchers may receive financial and technical help to install or implement structural and management conservation practices on eligible agricultural land.

Farmland Protection Program
The Farmland Protection Program is a voluntary program that helps farmers and ranchers keep their land in agriculture. The program provides matching funds to State, Tribal, or local governments and non-governmental organizations with existing farmland protection programs to purchase conservation easements or other interests in land.

Resource Conservation and Development Program
The Resource Conservation and Development Program (RC&D) encourages and improves the capability of civic leaders in designated RC&D areas to plan and carry out projects for resource conservation and community development. Program objectives focus on "quality of life" improvements achieved through natural resources conservation and community development. Such activities lead to sustainable communities, prudent land use, and the sound management and conservation of natural resources.

Wetlands Reserve Program
The Wetlands Reserve Program (WRP) is a voluntary program that provides technical and financial assistance to eligible landowners to address wetland, wildlife habitat, soil, water, and related natural resource concerns on private land in an environmentally beneficial and cost-effective manner. The program provides an opportunity for landowners to receive financial incentives to enhance wetlands in exchange for retiring marginal land from agriculture.

Wildlife Habitat Incentives Program
The Wildlife Habitat Incentives Program (WHIP) is a voluntary program that encourages creation of high quality wildlife habitats that support wildlife populations of National, State, Tribal, and local significance. Through WHIP, NRCS provides technical and financial assistance to landowners and others to develop upland, wetland, riparian, and aquatic habitat areas on their property.

For More Information
If you need more information about these and other conservation programs, please contact your local USDA Service Center, listed in the telephone book under U.S. Department of Agriculture, or your local conservation district. Information also is available on the World Wide Web at:
http://www.nrcs.usda.gov/programs/farmbill/2002/

9.4 U.S. Fish and Wildlife Programs

The U.S. Fish and Wildlife Service administers a variety of natural resource assistance grants to governmental, public and private organizations, groups and individuals. Grants are available for projects such as sport fish restoration, recovery land acquisition, conservation, boating infrastructure, and landowner incentives to name just a few. For more information on the many grant opportunities offered by the U.S. Fish and Wildlife, check out their Grants-At-A-Glance website, http://grants.fws.gov/ or contact the Banks Lake Field Office at 912.496.7366.

Sport Fish Restoration
The Sport Fish Restoration Program helps to support restoration and management of sport fish populations to preserve and improve sport fishing.
Wildlife Restoration Program
The Wildlife Restoration Program supports restoration and management of wildlife populations and provides public use opportunities for hunter safety programs.

Boating Infrastructure Grants
The Boating Infrastructure Grants support construction, renovation or maintenance of tie-up facilities for transient, non-trailerable recreational boats.

North American Wetlands Conservation Act
The North American Wetlands Conservation Act (NAWACA) gives preference to projects that have grantee or partners that have never participated in a NAWACA supported program.

Landowner Incentive Program
The Landowner Incentive Program helps establish or supplement existing landowner incentive programs that provide technical or financial assistance, including habitat protection and restoration, to private landowners to species at risk.

9.5 Georgia Environmental Facilities Authority

The Georgia Environmental Facilities Authority's (GEFA) mission is to provide financing and other support services for infrastructure improvements, energy programs and fuel storage systems that result in a cleaner environment for all Georgians. Below are a number of the GEFA loan programs they offer. For more information on GEFA, contact Paul Burks at 404.962.3002 or go to the GEFA website at http://www.gefa.org/.

GEFA's State Funded Water and Sewer Loan Program

Low interest rate loans are available under several loan programs. GEFA and EPD have worked together to finance over $1 billion in improvements since 1984. GEFA loans bridge the gap between local environmental infrastructure needs and the financial resources to pay for them.

Georgia Fund
Loans through this state bond-funded program finance all types of water and sewer projects including water and sewer lines, treatment plants, pumping stations, and water storage tanks. Loans from this program range from $20,000 to $3 million. Over 70% of communities receiving Georgia Fund are in rural areas. For more information on the Georgia Fund, contact Dan Clarke at 404.656.0940 or Beverly McElroy at 404.656.7975.

Environmental Emergency Loans

Environmental emergency loans are available at any time for projects needed to protect community health or safety. The interest rate is only 2.0%. The maximum loan amount is $200,000, but this can be combined with other GEFA loan programs to fully finance projects that cost more than $200,000. For more information on the Environmental Emergency Loans, contact Dan Clarke at 404.656.0940 or Beverly McElroy at 404.656.7975.

Construction Loans

GEFA offers up to $1,000,000 in interim financing for applicants with a known source of permanent financing, such as Special Purpose Local Option Sales Taxes (SPLOST), a United States Department of Agriculture (USDA) loan, etc. The Construction Loan Program interest rate is set at the current GA Fund interest rate not to exceed 4.0%. For more information on the Construction Loans, contact Dan Clarke at 404.656.0940 or Beverly McElroy at 404.656.7975.

Clean Water State Revolving Loan Fund (CWSRF) Program

The Clean Water State Revolving Loan Fund (CWSRF) is a Federal fund administered by the Georgia Environmental Facilities Authority (GEFA) for waste water projects. Eligible projects include a wide variety of water quality and wastewater treatment projects, such as (1) constructing new wastewater treatment plants; (2) expanding wastewater treatment plants; (3) installing sewer lines and sewer rehabilitation projects; (4) correcting infiltration/inflow problems and/or combined sewer overflow (CSO) problems; (5) constructing and rehabilitating municipal storm sewer systems; (6) purchasing street and storm sewer cleaning equipment; (7) acquisition of buffer zones and/or wetlands; and (8) constructing storm water control structures such as detention and retention ponds (particularly on a regional basis), and restoring streambanks. Loans are available at a low interest rate for a maximum of twenty (20) years.

Drinking Water State Revolving Loan Fund (DWSRF)

The Drinking Water State Revolving Loan Fund (DWSRF) is a Federal fund administered by the Georgia Environmental Facilities Authority (GEFA) for drinking water projects. Eligible projects include a wide variety of public health related water supply projects, such as (1) Implementation of security measures such as fencing, surveillance equipment, backflow prevention devices, and enhanced filtration/disinfection treatment; (2) Maintaining compliance with existing or proposed standards and regulations; (3) Rehabilitating or replacing aging infrastructure; (4) Rehabilitating or developing sources to replace contaminated sources of drinking water, including replacing contaminated private wells with public water supply; (5) Installing or upgrading treatment facilities to improve drinking water quality; (6) Installing or upgrading storage facilities to prevent microbiological contaminants from entering the system; and (7) Installing or replacing transmission and distribution pipes to prevent contamination. Loans are available at a low interest rate for a maximum of twenty years.

Solid Waste Facility Financing

GEFA offers low interest loans of up to $1 million for solid waste capital projects that serve local governments. Also, to help minimize their waste streams, cities and counties can purchase facilities and equipment for new recycling or waste reduction programs through GEFA recycling and waste reduction grant funds.

REFERENCES

Caldwell, B. A. *Aquatic Macroinvertebrate and Stream Habitat Assessment*. April 22, 2003.

Georgia Department of Community Affairs. 2004. *Georgia DCA: Plans Online*. Retrieved from the World Wide Web, http://www.georgiaplanning.com/planspub1/.

Georgia Department of Natural Resources. Environmental Protection Division. 2002. *Final Georgia 2002 305(b)/303(d) List*. Retrieved from the World Wide Web, http://www.dnr.state.ga.us/dnr/environ/.

Georgia Department of Natural Resources. Environmental Protection Division. 2002. *Draft Georgia 2004 305(b)/303(d) List*. Retrieved from the World Wide Web, http://www.dnr.state.ga.us/dnr/environ/.

Georgia Department of Natural Resources. Environmental Protection Division Georgia Adopt-A-Stream Program. *What is Georgia Adopt-A-Stream*. Retrieved from the World Wide Web, http://www.riversalive.org/aas.htm.

Georgia Department of Natural Resources Pollution Prevention Assistance Division. *Watershed Wisdom: Georgia's TMDL Program* brochure.

Georgia Department of Natural Resources Pollution Prevention Assistance Division. *You're the Solution to Water Pollution* brochure.

Georgia Museum of Natural History & Georgia Department of Natural Resources. 2000. Retrieved from the World Wide Web, http://museum.nhm.uga.edu/gawildlife/gawwregions.html.

Georgia Soil & Water Conservation Commission. 2000. *Guidelines for Streambank Restoration*. Retrieved from the World Wide Web, http://www.gaswcc.org/PDF/Guidelines%20for%20Streambank%20Restoration.pdf.

Hyatt, J. A., and Jacobs, P. M. 1996. *Geomorphology*, Vol. 17:305-316. Retrieved from the World Wide Web, http://www.easternct.edu/personal/faculty/hyattj/ressknew.htm#new.

Layher, W.G. 2003. *L'Anguille River Watershed Restoration Action Strategy (WRAS).* Pine Bluff, Arkansas.

Milton, A.W., G. Hawkins, G. Vellidis, and R. Lindsey. *Water Quality in the Willacoochee River Subwatershed*. 2004.

National Wildlife Federation. 2003. Maps: *Area Stream Segments that do not meet State Water Quality Standards* and *Willacoochee Watershed Sampling Sites*.

North Carolina State University. 2001. *Conservation Tillage*. Retrieved from the World Wide Web, http://www.cals.ncsu.edu/sustainable/peet/tillage/c03tilla.html.

South Georgia Regional Development Center. 1991. *Greater Ben Hill County Comprehensive Plan*.

South Georgia Regional Development Center. 1994. *Greater Irwin County Comprehensive Plan.*

United States Census Bureau. 2000. *American Fact Finder*. Retrieved from the World Wide Web, http://factfinder.census.gov/servlet/SAFFPeople?_sse=on.

United States Department of Agriculture. 1969. *Soil Survey Ben Hill and Irwin Counties Georgia*.

United States Department of Agriculture. 1973. *Soil Survey Berrien and Lanier Counties, Georgia.*

United States Department of Agriculture. Natural Resources Conservation Service. *Best Management Practices*.

University of Georgia. 2004. *Georgia's Water Quality Standards*. Retrieved from the World Wide Web, http://pubs.caes.uga.edu/caespubs/pubs/PDF/B1242-3.pdf.

University of Georgia – Department of Geology. *The Coastal Plain*. Retrieved from the World Wide Web, http://www.gly.uga.edu/GAGeology.html#CP.

United States Environmental Protection Agency. 2003. *Clean Water Act*. Retrieved from the World Wide Web, http://www.epa.gov/region5/water/cwa.htm.

United States Environmental Protection Agency. 2002. *Clean Water Action Plan*. Retrieved from the World Wide Web, http://www.epa.gov/history/topics/cwa/03.htm.

United States Environmental Protection Agency. 2004. *Clean Water Act Section 319*. Retrieved from the World Wide Web, http://www.epa.gov/owow/nps/cwact.html.

United States Environmental Protection Agency. 2004. *Envirofacts Data Warehouse*. Retrieved from the World Wide Web, http://www.epa.gov/enviro/index_java.html.

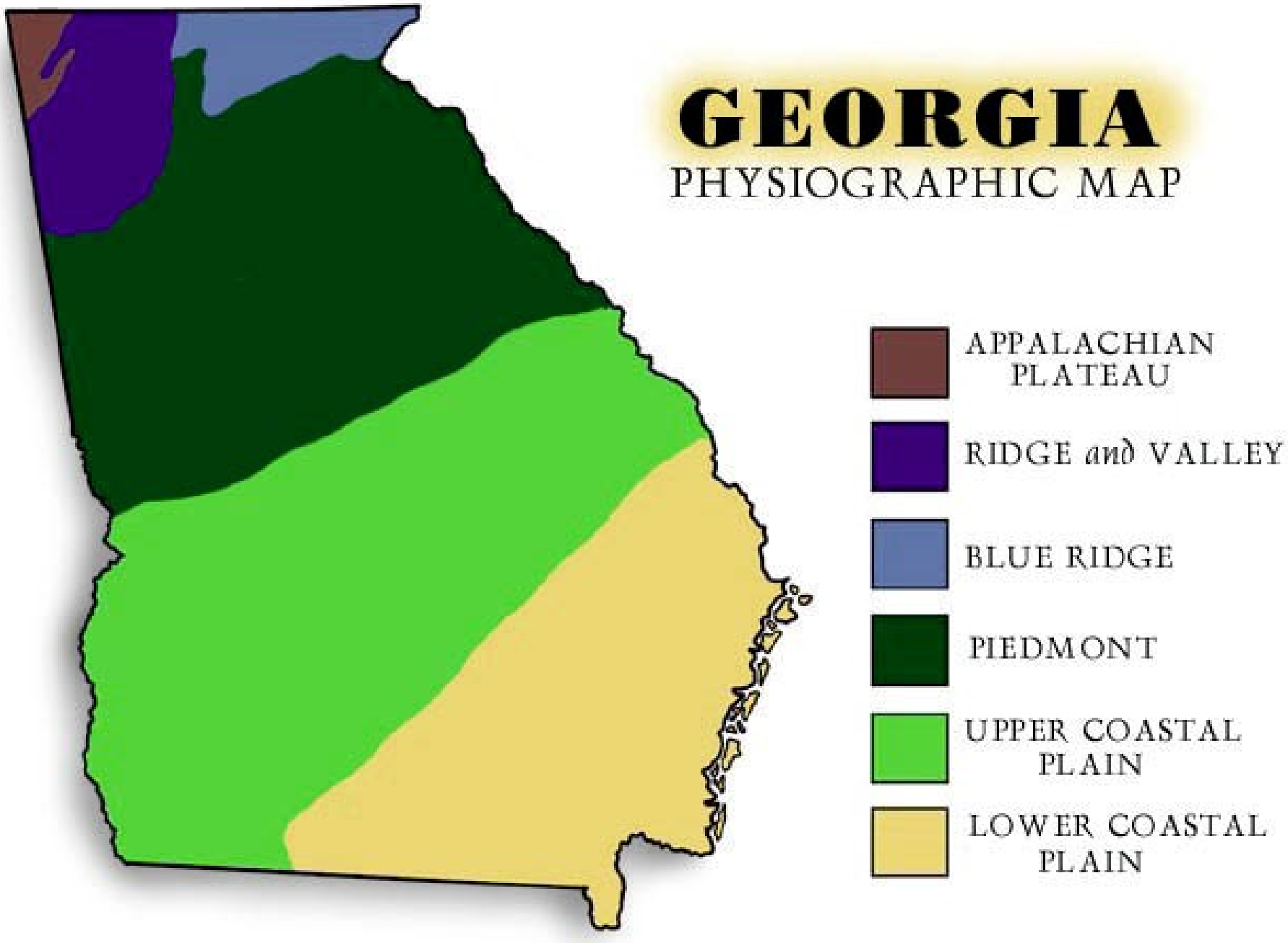
United States Fish and Wildlife. 2004. *Listed Endangered Species in Georgia*. Retrieved from the World Wide Web, http://athens.fws.gov/endangered/counties_endangered.html.

United States Geological Survey. 2002. *Georgia Water Information Network.* Retrieved from the World Wide Web, http://ga2.er.usgs.gov/gawater/countysites.cfm?code=019.

APPENDIX
A – J

APPENDIX A

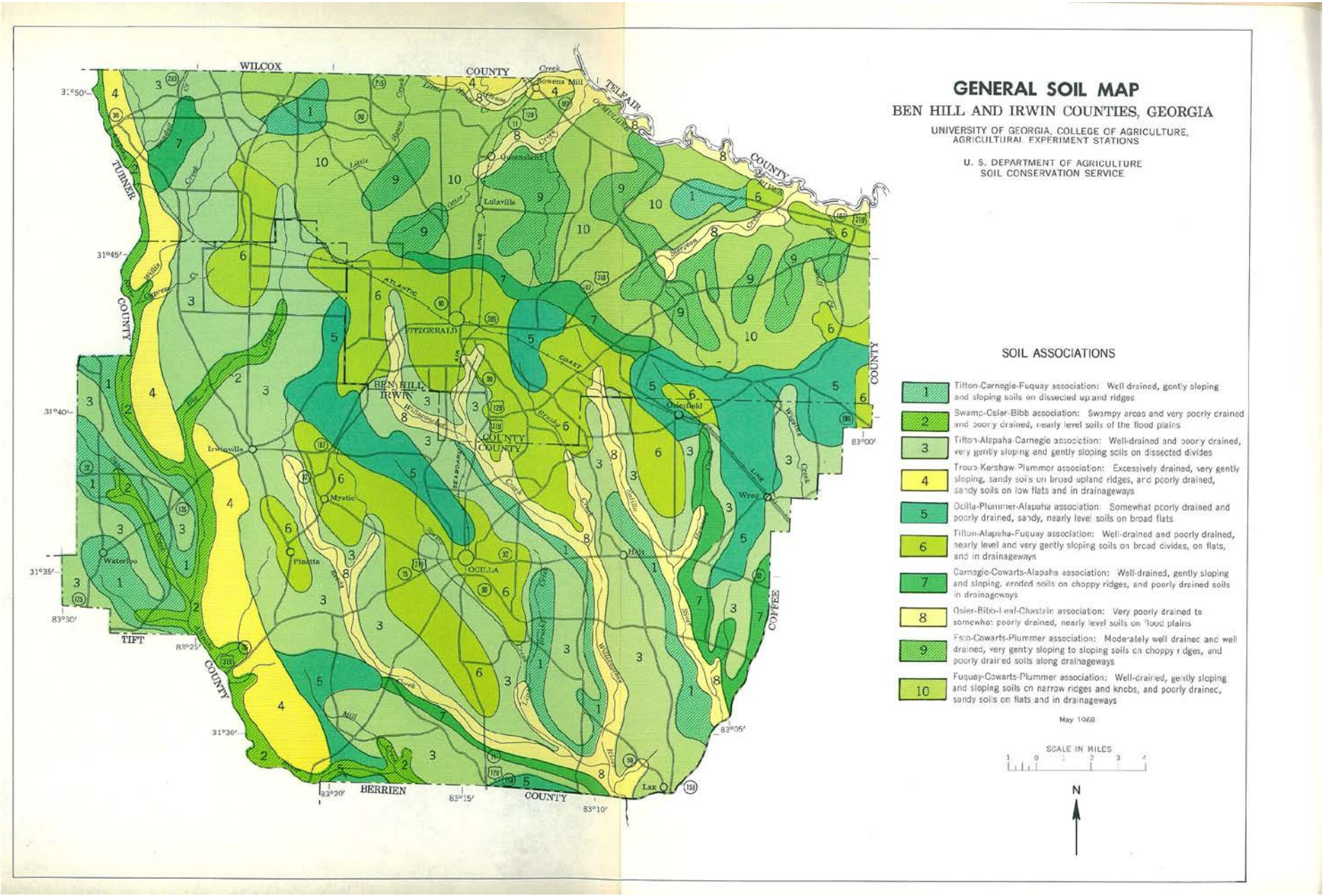
Georgia Physiographic Map



The Georgia Museum of Natural History & Georgia Department of Natural Resources 2 June 2000.

APPENDIX B

General Soil Map Ben Hill and Irwin Counties, Georgia


GENERAL SOIL MAP
BEN HILL AND IRWIN COUNTIES, GEORGIA
UNIVERSITY OF GEORGIA, COLLEGE OF AGRICULTURE, AGRICULTURAL EXPERIMENT STATIONS
U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE
SOIL ASSOCIATIONS
1 Tifton-Carnegie-Fuquay association: Well drained, gently sloping and sloping soils on dissected upland ridges
2 Swamp-Osier-Bibb association: Swampy areas and very poorly drained and poorly drained, nearly level soils of the flood plains
3 Tifton-Alapaha-Carnegie association: Well-drained and poorly drained, very gently sloping and gently sloping soils on dissected divides
4 Troup-Kershaw-Plummer association: Excessively drained, very gently sloping, sandy soils on broad upland ridges, and poorly drained, sandy soils on low flats and in drainageways
5 Ocilla-Plummer-Alapaha association: Somewhat poorly drained and poorly drained, sandy, nearly level soils on broad flats
6 Tifton-Alapaha-Fuquay association: Well-drained and poorly drained, nearly level and very gently sloping soils on broad divides, on flats, and in drainageways
7 Carnegie-Cowarts-Alapaha association: Well-drained, gently sloping and sloping, eroded soils on choppy ridges, and poorly drained soils in drainageways
8 Osier-Bibb-Leaf-Chastain association: Very poorly drained to somewhat poorly drained, nearly level soils on flood plains
9 Fuquay-Cowarts-Plummer association: Moderately well drained and well drained, very gently sloping to sloping soils on choppy ridges, and poorly drained soils along drainageways
10 Fuquay-Cowarts-Plummer association: Well-drained, gently sloping and sloping soils on narrow ridges and knobs, and poorly drained, sandy soils on flats and in drainageways
May 1968
SCALE IN MILES
N
WILCOX COUNTY
TURNER COUNTY
TIFT COUNTY
BERRIEN COUNTY
COFFEE COUNTY
TELFAIR COUNTY
IRWIN COUNTY
BEN HILL COUNTY
FITZGERALD
Ocilla
Irwinville
Mystic
Pinatta
Waterloo
Lulaville
Queensland
Bowens Mill
Osierfield
Wray
Hay
Lax
31°50′
31°45′
31°40′
31°35′
31°30′
83°30′
83°25′
83°20′
83°15′
83°10′
83°05′
83°00′

APPENDIX C

General Soil Map Berrien and Lanier Counties, Georgia

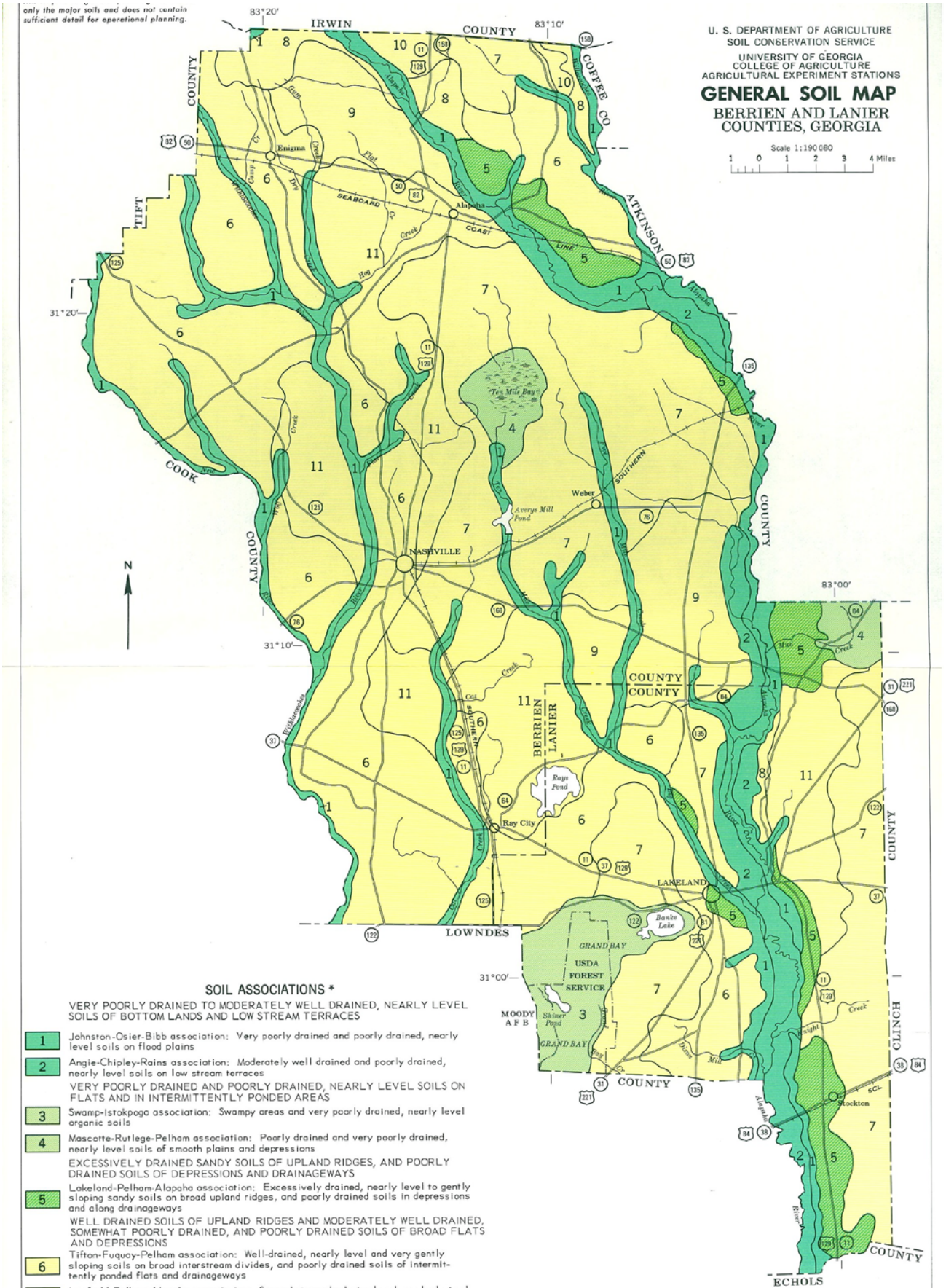
only the major soils and does not contain sufficient detail for operational planning.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
UNIVERSITY OF GEORGIA
COLLEGE OF AGRICULTURE
AGRICULTURAL EXPERIMENT STATIONS

GENERAL SOIL MAP

BERRIEN AND LANIER COUNTIES, GEORGIA

Scale 1:190 080
1 0 1 2 3 4 Miles



SOIL ASSOCIATIONS *

VERY POORLY DRAINED TO MODERATELY WELL DRAINED, NEARLY LEVEL SOILS OF BOTTOM LANDS AND LOW STREAM TERRACES

1 Johnston-Osier-Bibb association: Very poorly drained and poorly drained, nearly level soils on flood plains

2 Angie-Chipley-Rains association: Moderately well drained and poorly drained, nearly level soils on low stream terraces

VERY POORLY DRAINED AND POORLY DRAINED, NEARLY LEVEL SOILS ON FLATS AND IN INTERMITTENTLY PONDED AREAS

3 Swamp-Istokpoga association: Swampy areas and very poorly drained, nearly level organic soils

4 Mascotte-Rutlege-Pelham association: Poorly drained and very poorly drained, nearly level soils of smooth plains and depressions

EXCESSIVELY DRAINED SANDY SOILS OF UPLAND RIDGES, AND POORLY DRAINED SOILS OF DEPRESSIONS AND DRAINAGEWAYS

5 Lakeland-Pelham-Alapaha association: Excessively drained, nearly level to gently sloping sandy soils on broad upland ridges, and poorly drained soils in depressions and along drainageways

WELL DRAINED SOILS OF UPLAND RIDGES AND MODERATELY WELL DRAINED, SOMEWHAT POORLY DRAINED, AND POORLY DRAINED SOILS OF BROAD FLATS AND DEPRESSIONS

6 Tifton-Fuquay-Pelham association: Well-drained, nearly level and very gently sloping soils on broad interstream divides, and poorly drained soils of intermittently ponded flats and drainageways

7 Leefield-Pelham-Alapaha association: Somewhat poorly drained and poorly drained, nearly level soils on broad flats

8 Fuquay-Cowarts-Pelham association: Chiefly well-drained, gently sloping soils on narrow upland ridges and knolls, and poorly drained, nearly level soils along drainageways

9 Fuquay-Leefield-Pelham association: Well-drained to poorly drained, nearly level and very gently sloping soils on broad interstream divides and along drainageways

10 Tifton-Carnegie-Pelham association: Chiefly well-drained to poorly drained, nearly level to gently sloping soils on upland ridges

11 Irvington-Leefield-Pelham association: Moderately well drained to poorly drained, nearly level soils on broad flats, in low areas, and along drainageways

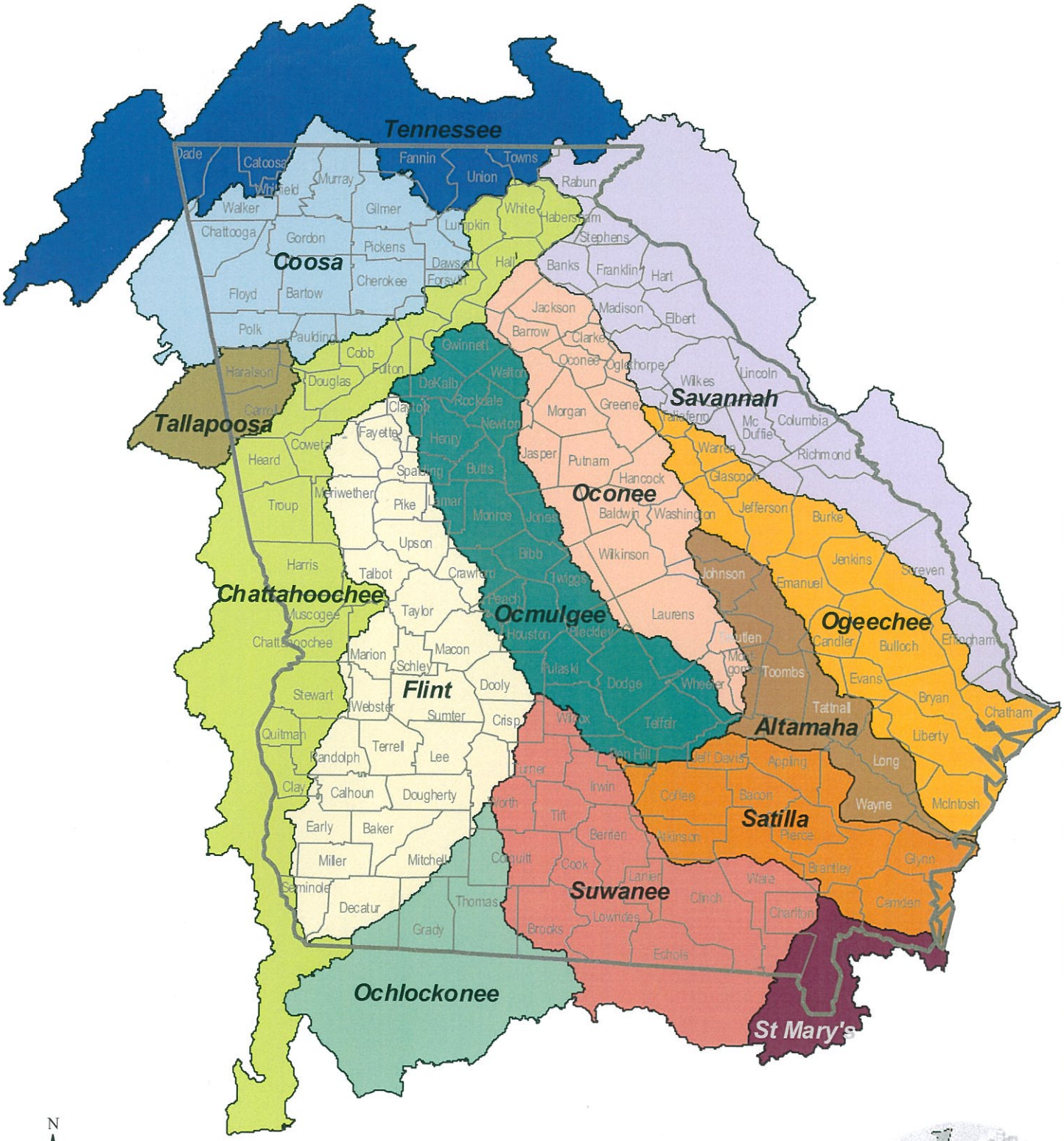
*The texture given is that of the surface layer.

Published 1972

APPENDIX D

Georgia's 14 River Basins

Georgia's 14 River Basins



N

Produced by the Georgia Department of Community Affairs

APPENDIX E

Georgia's 52 Large Watersheds

Georgia's 52 Large Watersheds

Produced by the Georgia Department of Community Affairs

APPENDIX F

Stakeholder Contact Information

ORGANIZATION	ROLE/RESPONSIBILITIES	CONTACT INFORMATION
Alapaha Soil & Water Conservation District (AS&WCD)	Provide technical assistance to the group in regards to protection, conservation and improving the soil and water resources of the State of Georgia and specifically in the Alapaha watershed	Alapaha Soil & Water Conservation District 4344 Albany Highway Dawson, GA 39842
Georgia Department of Natural Resources Adopt-A-Stream (AAS) Program	Citizen education and outreach	GA Adopt-A-Stream Program Dept of Natural Resources Environmental Protection Division 4220 International Parkway, Suite 101 Atlanta, GA 30354 Phone: 404.675.1636
Georgia Department of Natural Resources (DNR) Environmental Protection Division (EPD)	Financial assistance and technical guidance on environmental issues surrounding the land, air, and water.	GA DNR EPD Water Protection Branch Non-point Source Program 4220 International Parkway, Suite 101 Atlanta, GA 30354 Phone: 404.675.1634 Fax: 404.675.6245
Georgia Forestry Commission (GFC)	Forestry/Silviculture information, Best Management Practice (BMP) demonstration site implementation, assessment, and landowner contacts	GFC Macon Office 5645 Riggins Mill Rd Dry Branch, GA 31020 Ph: 1.800.GATREES Fax: 478.751.3465 Ben Hill Co GFC District 8 473 Bowens Mill Hwy Fitzgerald, GA 31750 Ph: 229.426.5259 Fax: 229.426.5261 Irwin Co GFC District 8 703 Douglas Hwy Ocilla, GA 31774 Ph: 229.468.5492 Fax: 229.468.7803 Berrien Co GFC District 8 Rt. 3 Box 267 Nashville, GA 31639 Ph: 229.686.3766 Fax: 229.686.5715
Georgia Soil & Water Conservation Commission (GS&WCC)	Provide technical assistance to the group in regards to protection, conservation and improving the soil and water resources of the State of Georgia.	GA Soil & Water Conservation Commission Region V Office P.O. Box 445 Albany, GA 31702 Phone: 229.430.4408 Fax: 229.878.1998
Joseph W. Jones Ecological Research Center	Aquatic habitat quality monitoring protocol and data management	Joseph W. Jones Ecological Research Center at Ichauway Route 2, Box 2324 Newton, GA 39870 Phone: 229.734.4706 Fax: 229.734.4707

Mid South Georgia Resource Conservation & Development Council (RC&D)	Assist people in caring for and protecting their natural resources while improving the region's economy, and standard of living. Serves the counties of Ben Hill, Brooks, Colquitt, Crisp, Irwin, Thomas, Tift, Turner, and Worth.	Mid-South Georgia Resource Conservation and Development Council, Inc. 1468 Carpenter Road South Tifton, Georgia 31794
National Wildlife Federation (NWF)	Assembly and analysis of information for the development of the WRAS, presentations to citizen groups, education and outreach, BMPs demonstration site coordination and implementation	National Wildlife Federation 1330 West Peachtree St., Suite 475 Atlanta, GA 30309 Phone: 404.867.8733 Fax: 404.892.1744
Seven Rivers Resource Conservation & Development Council (RC&D)	Grant administration and reporting to GA-EPD, ground-truthing, education and outreach materials, BMPs demonstration site coordination and implementation.	Seven Rivers RC&D 400 N. East Park Avenue, Suite 5 Baxley, GA 31513 Phone: 912.367.7679 Fax: 912.367.1184
South Georgia Regional Development Center (SGRDC)	WRAS development and local government coordination	SGRDC 327 W. Savannah Avenue Valdosta, GA 31601 Phone: 229.333.5277 Fax: 229.333.5312
University of Georgia, Department of Biological and Agricultural Engineering	Quality Assurance Program Plan (QAPP) development, water quality and aquatic habitat assessment protocol design and implementation, and assist with agriculture BMP implementation.	UGA Dept. of Bio & Ag Engineering University of Georgia Athens, GA 30602 Phone: 706.542.1652 Fax: 706.542.8806 UGA Dept. of Bio. & Ag Engineering Tom Woody (USDA) CPES 2329 Rainwater Road P.O. Box 748 Tifton, GA 31793 Phone: 229.386.3914 Fax: 229.386.958
University of Georgia, Cooperative Extension Service	Provide landowner contacts and extensive knowledge of the land	UGA SW Dist Ext Head 15 RDC Road P.O. Box 1209 RDC Tifton, GA 31793 Phone: 229.386.3413 Fax: 229.391.3740 Ben Hill County 406 W. Palm St. Fitzgerald, GA 31705 Phone: 229.426.5175 Fax: 229.426.5176 Irwin County 107 W. 4th St. Ocilla, GA 31774 Phone: 229.468.7409 Fax: 229.468.9838 Berrien County 516A Co. Farm Rd Nashville, GA 31639 Ph. 229.686.5431 Atkinson County P.O. Box 638 Pearson, GA 31642 Ph: 912.422.3277 Coffee County 709 E. Ward Street Douglas, GA 3133 Ph: 912.384.14027

University of Georgia, Carl Vinson Institute of Government National Environmentally Sound Production Agriculture Laboratory (NESAPL)	Assist in WRAS development and citizen workshop facilitation	NESAPL 2356 Rainwater Road P.O. Box 748 Tifton, GA Phone: 229.386.7274 Fax: 229.386.7371
United States Department of Agriculture – Agriculture Research Service (USDA-ARS)	Water quality monitoring assessment protocol and data management	USDA-ARS Southeast Watershed Research Laboratory POB 748 Tifton, GA 31793 Phone: (229) 386-3515 Fax: (229) 386-7215 http://www.tifton.uga.edu/sewrl/
United States Department of Agriculture – Natural Resource Conservation Service (USDA-NRCS)	Ground-truthing, agricultural BMP implementation assessment, design, and installation of demonstration sites, land owner contacts, conservation plan development, demonstration BMP design and installation	USDA-NRCS, Office of the Chief 14th and Independence Ave., SW Room 5105-A Washington, DC 20250 Phone: 202.720.7246 Fax: 202.720.7690 USDA-NRCS Office District Conservationist Ben Hill/Irwin Co Tifton Service Center 1468 Carpenter Rd. S Tifton, GA 31794 Phone: 229.382.4776 Fax: 229.388.9513 USDA-NRCS Office District Conservationist Berrien County Nashville Service Center 516-A Co Farm Rd. Ste 2 Nashville, GA 31639 Phone: 229.686.2363 Fax: 229.686.9485
Upper Suwannee River Watershed Initiative (USRWI)	Assist in identifying and solving problems that affect their water, soil, and forests as well as their quality of life.	USRWI Office Bio. & Ag Engineering UGA, CAES Tifton Campus Tifton, GA 31793 Phone: 229.386.3915 Fax: 229.386.3958 E-mail: USRWI@tifton.cpes.peachnet.edu Website: www.uppersuwanee.org
Watershed Citizen Groups	WRAS development and implementation, BMP demonstration site development and implementation, water quality and aquatic habitat monitoring	Willacoochee River Watershed

APPENDIX G

Workshop Brochures

Willacoochee Watershed Field Day

November 22, 2002
10:00 am - 2:00 pm

C.A.S.E. Farm
Irwin County High School
(on Hwy. 90 in Ocilla, Georgia)

WILLACOOCHEE RIVER

Willacoochee Watershed Restoration Project Information

Funding for this project is provided by a
Section 319(h) Grant
from the

NonPoint Source Program
Environmental Protection Division
Georgia Department of Natural Resources

through the

Seven Rivers Resource Conservation and Development Council, Baxley, GA

Collaborating Agencies

University of Georgia, Department of Biological and Agricultural Engineering

National Wildlife Federation

USDA, Natural Resources Conservation Service

USDA, Agriculture Research Service

South Georgia Regional Development Center

Georgia Forestry Commission

Upper Suwannee River Watershed Initiative

Georgia Soil & Water Conservation Commission

Alapaha Soil & Water Conservation District

For More Information
Robert Lindsey, Project Coordinator
(229) 386-3915 or (229) 386-3377
rlindsey@tifton.uga.edu

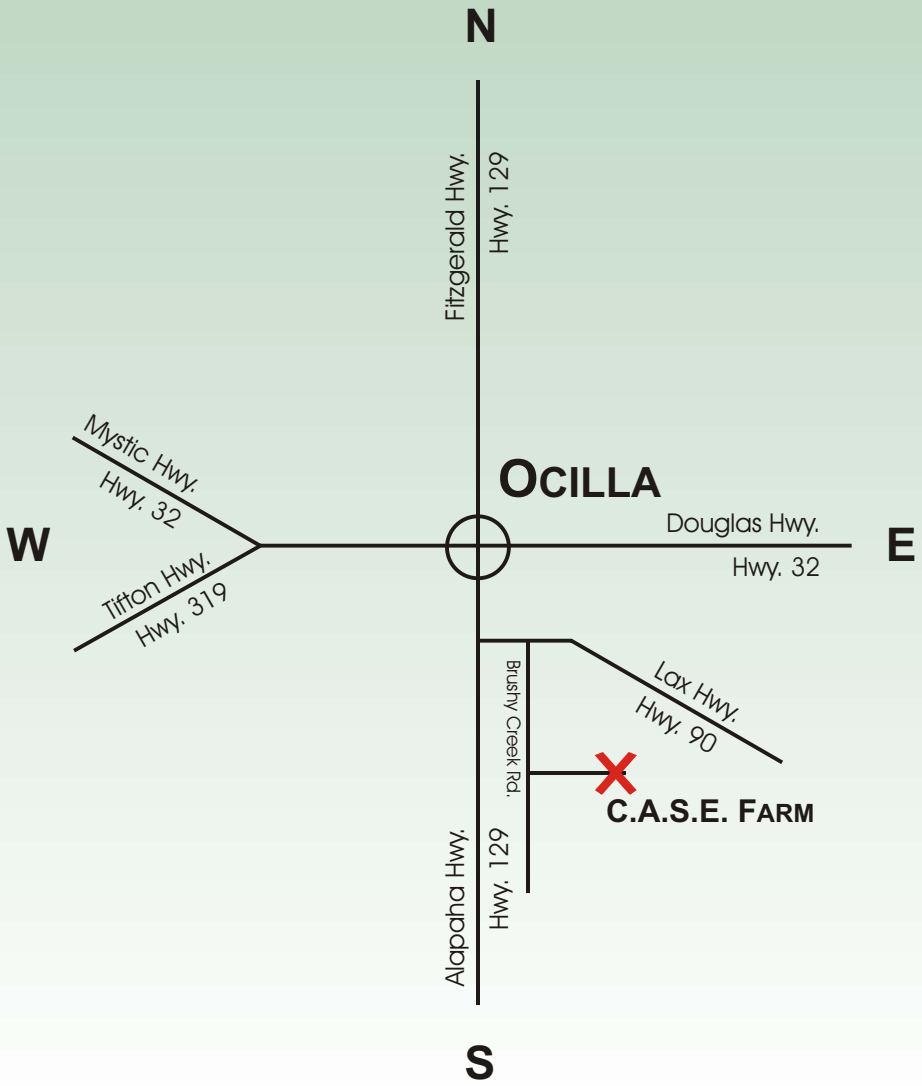
Visit our website for updates & activities
www.uppersuwannee.org

Agenda

10:00	**Welcome**	Troy Davis Assistant School Superintendent Irwin Co.
10:10	**Introduction**	Robert Lindsey Project Coordinator Willacoochee Watershed Restoration Project
10:25	**Watershed**	Facts and Importance of Water Quality Mary Davis National Wildlife Federation
10:50	**Water Quality**	All About Water Quality Gary Hawkins University Of Georgia
11:15	**Break**	View Displays
11:30	**Conservation**	Conservation Practices and Cost Share Mary Liedner USDA Natural Resource Conservation Service
12:00	**Lunch**	Provided
1:00	**Tillage**	Conservation Tillage Jay Williams University Of Georgia
1:30	**Cover Crops**	Importance and Varieties Rick Reed, County Agent Coffee County

Working together to restore our watershed ...

Driving Directions to the C.A.S.E. Farm



Willacoochee Watershed Field Day

March 30, 2004
9:00 am - 2:00 pm

C.A.S.E. Farm
Irwin County High School
(on Hwy. 90 in Ocilla, Georgia)

WILLACOOCHEE RIVER

Willacoochee Watershed Restoration Project Information

Funding for this project is provided by a
Section 319(h) Grant
from the

NonPoint Source Program
Environmental Protection Division
Georgia Department of Natural Resources

through the

Seven Rivers Resource Conservation and Development Council, Baxley, GA

Collaborating Agencies

University of Georgia, Dept. of Biological & Agricultural Engineering

University of Georgia Extension Service

USDA, Natural Resources Conservation Service

USDA, Agriculture Research Service

South Georgia Regional Development Center

Georgia Forestry Commission

Upper Suwannee River Watershed Initiative

Georgia Soil & Water Conservation Commission

Alapaha Soil & Water Conservation District

Middle South GA Soil & Water Conservation District

Upper Suwannee Conservation Tillage Alliance

For More Information
Robert Lindsey, Project Coordinator
(229) 386-3915 or (229) 386-3377
rlindsey@tifton.uga.edu

Visit our website for updates & activities
www.uppersuwannee.org

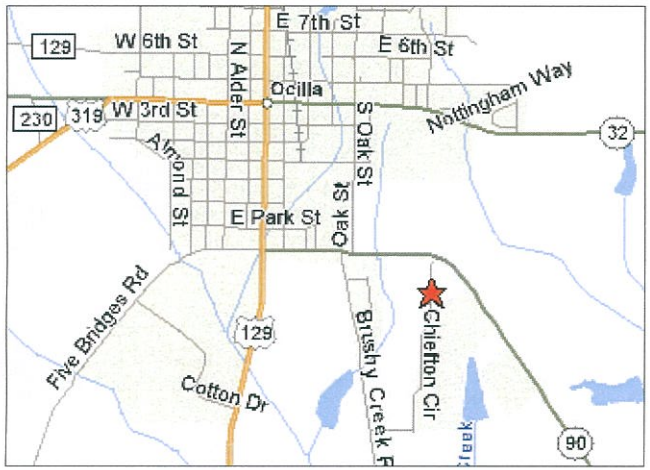
Agenda

9:00	**Welcome**	Wesley Paulk
9:15	**Water Quality Watershed BMPs**	Robert Lindsey
9:45	**Upper Suwannee Tillage Alliance**	Don Register
10:00	**Ag Water Conservation, Ag Water Metering & Environmental Stewardship**	Gary Hawkins
10:30	**NRCS Cost Share Programs**	Mary Leidner
11:00	**Break**	
11:15	**Regional Development Center Cost Share Programs**	Emily Perry
11:40	**New Technology: GPS & Light Bars**	Calvin Perry
12:00	**Lunch**	Provided
1:00	**Field Demonstrations**	GPS, Light Bar, Tillage, plus Yancey Agricultural Products' auto-steer tractor

Working together to restore our watershed …

Irwin County Regional C.A.S.E. Farm
(Center of Agricultural Study and Excellence)
149 Chieftain Circle
Ocilla, GA 31774
Phone Number:
(229) 468-4163 or (229) 468-7485

MAP



Additional Contact Information:

Don Register, USCTA President: 229.382.7523
Emily Perry, SGRDC: 229.333.5277
Robert Lindsey, Willacoochee Coordinator: 229.386.3915
Scott Carlson, Ben Hill County Extension Office: 229.426.5175
Forrest Connelly, Berrien County Extension Office: 229.686.5431
Johnny Whiddon, Brooks County Extension Office: 229.263.4103
Ben Tucker, Cook County Extension Office: 229.896.7456
Mickey Fourakers, Echols County Extension Office: 229.559.5562
Phillip Edwards, Irwin County Extension Office: 229.468.7409
Elvin Andrews, Lanier County Extension Office: 229.482.3895
Mickey Fourakers, Lowndes County Extension Office: 229.333.5185
Brian Tankersley, Tift County Extension Office: 229.391.7980
Scott Utley, Turner County Extension Office: 229.567.3448

South Georgia Regional Development Center
327 West Savannah Avenue
Valdosta, GA 31601
Phone: 229.333.5277
Fax: 229.333.5312

The Upper Suwannee Conservation Tillage Alliance (USCTA) is hosting a fall 2004:

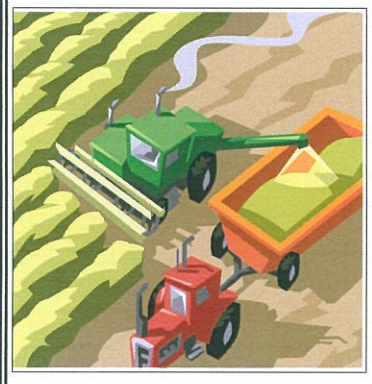
COVER CROP & NUTRIENT MANAGEMENT WORKSHOP

Where: Irwin County C.A.S.E. Farm
When: September 8, 2004
Time: 9:00 AM—12:00 PM

FREE LUNCH

This workshop was made possible through a Georgia Department of Natural Resources—Environmental Protection Division Section 604 (b) FY 2004 Grant

UPPER SUWANNEE CONSERVATION TILLAGE ALLIANCE {USCTA}



Interested in Conservation Tillage for 2005 Crops — Already Strip-tilling or Conservation Tilling – Would like to talk to experienced farmers — Never tried Conservation Tillage — Watching neighbors but afraid to try — Have heard that New Farmer Conservation Programs will require some form of Conservation Tillage to Qualify — Scared of too much cover or even best cover crop to use — When to Plant — How much Organic Matter in my Soil — Why is it Important — Nitrogen prices are going to be Sky High next year — What can I Do?

How can I keep my Cost Expenses Down and Yield up and still make a profit — Want to Stop Erosion — Filling up Ditches, Creeks, Rivers with Sand and Good Soil — Spending too much Time in the Winter Repairing Terraces, Filling up Gullies — Government Payments for Cover Crops — Managing Fertilizer Costs — Tired of General Public NOT Understanding Farm Programs and Benefits Not Only to Farmers but in Best Interest of Everyone — Worried about Water Availability and Supply — How can I cut back on irrigation and fight high fuel prices — Using Less Equipment and Extending Life of what I have.

This and much more is what our Upper Suwannee Conservation Tillage Alliance {USCTA} is all about!

Our next meeting will be at the Irwin County C.A.S.E. Farm in Ocilla on September 8, 2004 from 9 till 12 noon. We will have coffee and snacks from 9:00 - 10:00 and a very informal chance to ask questions, view demonstrations, discuss problems, etc. We will have speakers, experienced farmers, and resource people discussing some of the above problems and you can ask questions about the rest. Lunch will be provided at 12:00 noon by the USCTA.

We know this is at the beginning of the harvest season, but it is also time to make decisions about cover crops and give input about how the USCTA can best serve you.

The South Georgia Regional Development Center in Valdosta is sponsoring this meeting.

Please contact your Extension Office if you plan to attend.

Sincerely,

Don Register
President, USCTA

Emily Perry
South GA Regional
Development Center

Robert Lindsey
Project Coordinator
Willacoochee Restoration Project

TENTATIVE AGENDA

9:00—10:00 AM Coffee & Snacks, Equipment Display, Demonstrations, Questions & Answers, Conservation Security Program

10:00 AM Don Register—Upper Suwannee Conservation Tillage Alliance President
Opening Remarks

10:05—10:15 AM Emily Perry
Cost Share Programs

10:15—10:40 AM Robert Lindsey & Gary Hawkins
Water Quality & Organic Matter

10:40—11:25 AM Jimmy Dean
Improving soil quality and cover crops… Where we are and where we are going

11:25—12:00 PM Glenn Harris
Nutrient Management in Conservation Tillage

12:00 PM LUNCH PROVIDED

The USCTA is a participant of the Purdue University program:

Core4 Conservation Alliance
Better Soil. Cleaner Water. Greater Profits. Brighter Future.

APPENDIX H

Adopt-A-Stream in the Classroom
Application for Stream Monitoring Equipment

APPLICATION FOR STREAM MONITORING EQUIPMENT

Georgia Adopt-A-Stream

Qualified applicants: All programs must be registered with Georgia AAS and include at least one up-to-date QAQC certified volunteer.

Please complete and submit the following application in full:

Primary contact: _____

Name of AAS Group: _____

Group identification number: _____

Monitoring site identification number(s): _____

Address: _____

_____

Phone number: _____ Email address: _____

List all QAQC volunteers: (include date and whether chemical and/or biological) _____

_____

_____

Official stream name & brief directions _____

Narrative: (3 to 4 sentences) Please give a brief description of the benefits your monitoring activities will provide to Georgia streams.

Please list all materials you will need – may not exceed $650.

Example itemized list:

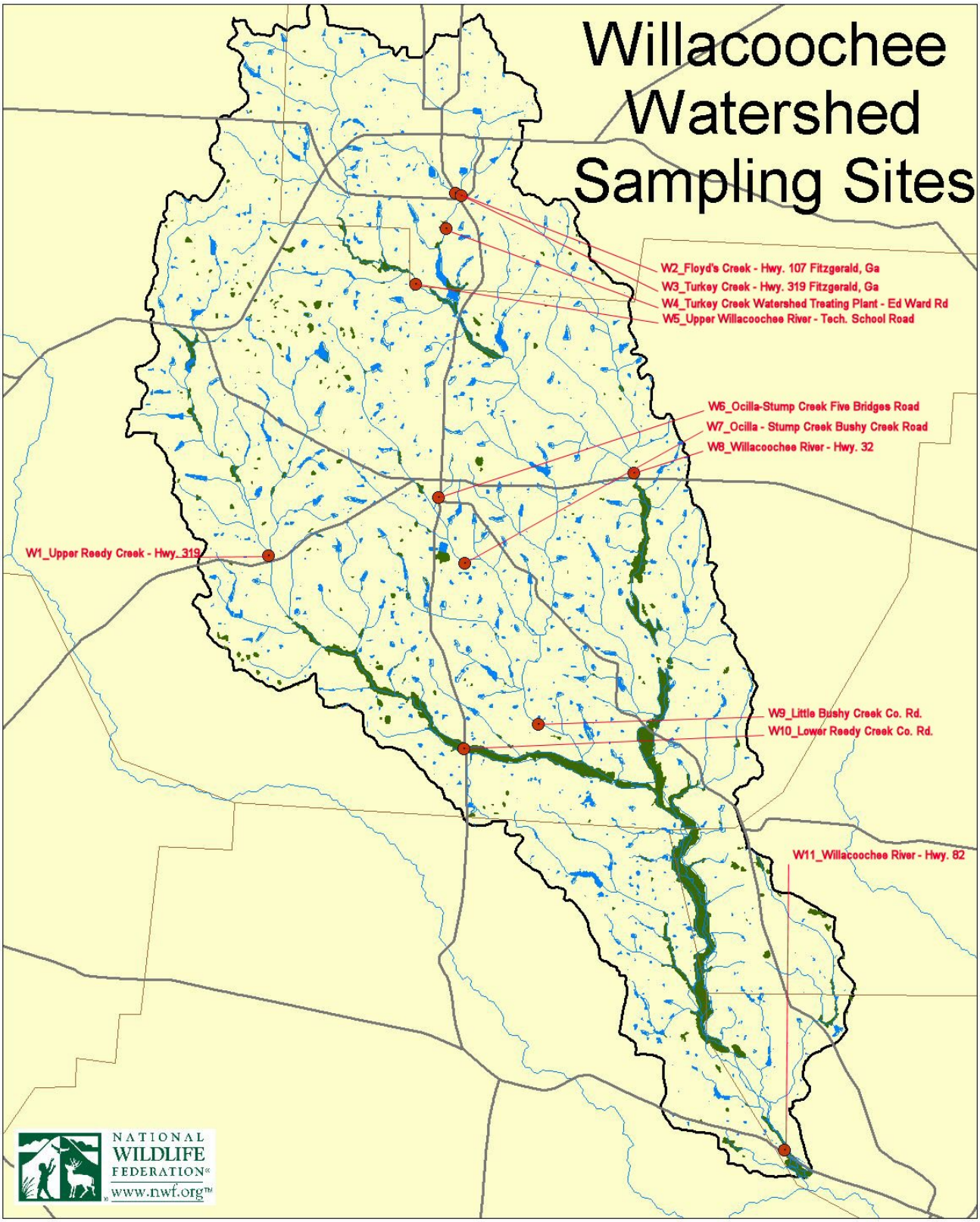
- ☐ Biological Test Kit $100
- ☐ Chemical Test Kit $400
- ☐ Visual Monitoring Equipment $100
- ☐ Replacement reagents $100
- ☐ Volunteer Monitoring Gear $50

Return to: Georgia Adopt-A-Stream, 4220 International Parkway, Suite 101, Atlanta, Georgia 30030

www.riversalive.org/aas.htm webmaster@riversalive.org 404-675-1639 or 1636

APPENDIX I

Willacoochee Watershed Sampling Sites


Willacoochee Watershed Sampling Sites
W2_Floyd's Creek - Hwy. 107 Fitzgerald, Ga
W3_Turkey Creek - Hwy. 319 Fitzgerald, Ga
W4_Turkey Creek Watershed Treating Plant - Ed Ward Rd
W5_Upper Willacoochee River - Tech. School Road
W6_Ocilla-Stump Creek Five Bridges Road
W7_Ocilla - Stump Creek Bushy Creek Road
W8_Willacoochee River - Hwy. 32
W1_Upper Reedy Creek - Hwy. 319
W9_Little Bushy Creek Co. Rd.
W10_Lower Reedy Creek Co. Rd.
W11_Willacoochee River - Hwy. 82
NATIONAL WILDLIFE FEDERATION
www.nwf.org

APPENDIX J

Technical Summary of the Water Quality in the Willacoochee River Subwatershed

Water Quality in the Willacoochee River Subwatershed

Andrea W. Milton, G. Hawkins, G. Vellidis, and R. Lindsey

ABSTRACT: The Willacoochee River watershed is a subwatershed in the Alapaha River watershed that reaches into five counties within the Georgia Costal Plain. The Willacoochee River subwatershed has been shown to contain a relatively large number of endangered species. The concerns within the watershed are that several stream segments have been placed on Georgia's 303 (d) list of impaired waters thus indicating below standard water quality which threatens the delicate stream ecosystem.

The role of this project was to quantify the water quality impacts of rural and urban land uses in the subwatershed. This paper reports on the chemical and biological water quality data collected from eleven sampling stations in the watershed over a span of 21 months. Conclusions are presented on the observed water quality for urban, rural, and reference stream segments and the watershed outlet.

INTRODUCTION

The Willacoochee River subwatershed is located in the Alapaha River watershed and spans through five counties within the Georgia Costal Plain. The Willacoochee subwatershed encompasses mostly rural, agricultural and silviculture land with a few concentrated urban areas. Compared to other subwatersheds in the Alapaha River Watershed, the Willacoochee subwatershed contains a relatively large number of endangered species and, unfortunately, several stream segments in the subwatershed have been found to not fully meet the State's water quality standards for waters designated for fishing (GA DNR-EPD, 2000).

It has been well established that humans' daily activities influence water quality. Rural activities such as agriculture and animal production can increase nutrient loads to receiving waters (Donner, 2003; Vellidis et al., 1999). Increased urbanization has also been linked to an increase in nutrient concentrations and eutrophication of receiving waters due to wastewater disposal (Hranova et al. 2002; Bowen and Valiela, 2001). Over the past decade, numerous studies have illustrated that the presence of riparian buffers can help minimize this degradation of water quality by limiting the amount of pollutants which are transported in shallow groundwater and in storm runoff (Perry et al. 1999; NRCS 1996; Lowrance et al. 1995).

The objective of this study was to quantify and compare impacts of rural and urban land use areas to water quality in the Willacoochee subwatershed. The study was designed so that local communities and landowners could use the data to identify sources of water pollution and aid in the implementation of pollution control and in achievement of cleaner water.

METHODS

SITE SELECTION:

University of Georgia (UGA) and National Wildlife Federation (NWF) personnel chose eleven sampling sites, ranging from urban to rural, on subwatersheds in the Willacoochee River Watershed (Fig. 1). Site selection was based on information gathered by topographical maps, aerial photos, visual surveys, and a review of impaired streams within the study area that were listed in Georgia's 2000 list of water as required by the Section 303(d) of the Federal Clean Water Act .

Reference. Subwatershed and stream segment Upper Reedy Creek, site W1, was selected as the sampling site for the reference subwatershed. The subwatershed was selected as a reference because its primary land use was silviculture and it did not contain a concentrated population.

Rural. Five stream segments were selected for monitoring which were considered to be within rural subwatersheds. These sites were W5, W7, W8, W9, and W10. For this project, rural watersheds were defined as areas that did not have concentrated populations and whose primary land use was agriculture. Intact riparian forest buffers existed between the agricultural activities and all stream sampling sites. Site W7, which is located on a segment of Stump Creek, is located directly downstream from the City of Ocilla's Waste Water Treatment Facilities' land application pivot.

Urban. Four streams segments were classified as urban. These sites were W2, W3, W4, and W6. Urban sites were defined as having a concentrated population. Small to no vegetative buffers existed along the streams in the urban areas. Site W4 is located on Turkey Creek and is immediately downstream from the City of Fitzgerald's municipal water system, Fitzgerald Water, Light and Bond Commission (Fitzgerald Utilities).

Total Watershed. Site W11 is located on the Willacoochee River at the base of the subwatershed. The site was chosen to give an overall view of the water quality from the entire Willacoochee subwatershed before it merges with the Alapaha River.

WATER QUALITY SAMPLING:

Water quality of the Willacoochee River subwatershed was assessed by measuring both the chemical and biological water quality parameters of the selected sites. Grab samples were collected for both chemical and biological water quality sampling on a biweekly basis at all sites. A pole sampler, an approximately sixteen foot pole with a cage secured to the end which is capable of holding a 500 mL glass collection bottle, was used to collect water samples. Samples were collected by extending the pole to the center of the stream and submerging the collection bottle approximately one foot below the surface.

WATER QUALITY ANALYSES:

Chemical and biological water quality analyses were preformed by collecting biweekly grab samples. Samples for chemical analysis were collected in two, clean 500 mL glass bottles and were taken to the laboratory within two hours after collection. Once in the laboratory, the two samples were combined and shaken vigorously until thoroughly mixed. Samples were analyzed for concentrations of NO_3^-+NO_2^-, PO_4-P, and NH_4-N. Nutrient quantifications were done using EPA approved colorimetric techniques.

Suspended solids were quantified using conventional techniques. All analyses were routinely done within two days of collection. Samples for biological water quality analyses were collected in 530 mL sterile bags. Samples were kept on ice until they were taken to the laboratory. Fecal coliform and fecal streptococci were determined by using the EC Medium test and the Multiple Tube Technique respectively.

TEMPERATURE & DISSOLVED OXYGEN:

A YSI probe was used to determine the percent dissolved oxygen and temperature for each stream site. Measurements were taken on a biweekly basis.

RESULTS & DISCUSSION

Chemical and biological water quality data from the eleven stream segments are compared among each segment. Further comparisons are done by categorizing the streams into rural (W5, W7, W8, W9, W10), urban (W2, W3, W4, W6), reference (W1), and total watershed (W11) and doing comparisons between each category. Although the data were distributed normally, equal variance could not be obtained even after transformations were preformed; therefore, the non-parametric Kruskal-Wallis test was used for data analysis.

CHEMICAL WATER QUALITY:

NO_3^-+NO_2^-. The enrichment limit, maximum concentration which does not lead to ecological changes, for NO_3^- is commonly regarded to be 0.1 mg/L. Concentrations at the reference site W1 averaged 0.12 mg/L over the 21 month record period while site W11, the Willacoochee River watershed outlet site, averaged 0.08 mg/L over the same period. Tests for differences in "location" showed that NO_3^-+NO_2^- values were not significantly different between categorized sites (i.e., reference, urban, rural, and watershed); however, there were significant differences among all sites (p-value=26.42, p<.0001, d.f.=3; Fig. 2). SiteW4 consistently maintained the highest concentration levels of NO_3^-+NO_2^- of all the sampled sites, averaging 1.35 mg/L during the record period.

Among the rural sites, concentrations were highest during the fall and winter months of 2002-03. This seasonal trend is not uncommon around agricultural sites because there are no commercial crops to take up the excess nitrates in the soil and therefore nutrients can be easily leached out during rainfall events. With the exception of site W4, there were no dramatic variations in seasonal concentration levels for the urban sites.

PO_4-P. The saturation limit for PO_4-P is 0.02 mg/L. Ortho-phosphorus concentrations were 0.03 mg/L at reference site W1 and 0.04 mg/L at the watershed outlet, W11. Concentration levels were not significantly different between categorized sites but they were significantly different among all sites (p-value = 189.74, $p < 0.001$, d.f = 10; Fig. 3). Among the urban sites, W4 had the highest concentration values averaging 0.4 mg/L never dropping below the 0.02 mg/L saturation limit. The two rural sites, W7 & W8, which are located downstream from the City of Ocilla's Waste Water Treatment

Facilities pivot site and Fitzgerald Utilities respectively, exhibited higher average concentrations (0.08 mg/L) than the other rural sites.

NH_4-N. Ammonium concentrations were highest at the sites that were downstream from the waste water treatment plants, W4 & W7. This is particularly true for site W4 which exhibited the highest concentration levels of all the sties peaking at 7.5 mg/L with an average of 0.68 mg/L. Test showed there were significant differences both among all sites (p-value = 131.97, $p < 0.001$, d.f. = 10) and between categorized sites (p-value = 26.42, $p < 0.0001$, d.f. = 3; Fig. 4). Rural sites averaged 0.14 mg/L of NH_4-N while urban sites averaged 0.25 mg/L as compared to the reference site, W1, at 0.15 mg/L and the watershed outlet, W11, at .06 mg/L. Higher levels of NH_4-N can often be attributed to the natural conversion of NO_3^- to NH_4. Ammonium is also a common ingredient in fertilizers and the higher average concentration may in part be attributed to homeowners' improper use of these products.

SUSPENDED SOLIDS:

Suspended solids were shown to be significantly higher among stream segments (p-value = 128.21, $p < 0.0001$, d.f. = 10) and between categories (p-value = 90.89, $p < 0.001$, d.f. = 3; Fig. 5). Among the urban sites, W2 showed the highest concentrations with an average of 13.66 mg/L. The high concentrations at this site can be attributed to the fact that W2 had no buffer zone between the stream and urbanized area surrounding it. It is worth noting that urban site W6 showed an unexplained spike, 17.41 mg/L, in June 2002. The watershed outlet site, W11, which is on the Willacoochee River, also exhibited an unexplained concentrations spike in July of 2002, 18.1 mg/L. These unexplained spikes are likely due to non-routine occurrences such as construction or a large rainfall event upstream. Over the remainder of the sampling period, the watershed outlet maintained the lowest reading of suspended solids suggesting that the cumulative upstream effects had little impact.

BIOLOGICAL WATER QUALITY:

FECAL COLIFORM. Fecal coliform is often used as a water quality indicator because they are relatively easy to detect and use. The presences of fecal coliform indicate that the water source has been contaminated with fecal material from either man or animal. Contamination of a water source with fecal material may indicate that the source water is also contaminated with disease producing bacteria or viruses and can pose a health risk to both humans and animals.

Long term trends of fecal coliform counts and the ratio between fecal coliform and fecal streptococci are used to more accurately assess the overall health risk of the source water. In this case, geometric means are used to establish the long term trends in data.

The State of Georgia's Environmental Protection Division has set the state standards for fecal coliform concentrations for surface waters that are designated for use as fishing, at 1000 colonies/100 mL (GA DNR-EPD, 1996). Table 1 shows that the state standard is met by all of the monitored streams.

The ratio of fecal coliform (FC) to fecal streptococci (FS) has long been recognized as being an indicator to the origins of the fecal material. If the ratio of FC/FS

is greater than 4, the source is human waste. A ratio between 0.1 and 4 is an indication of contamination by domesticated animals, while a ratio of 0.2 to 0.4 indicates livestock and a ratio of less than 0.1 is generally accepted as wildlife. The mean fecal ratio for four of the streams were between 0.2 and 0.4 indicating that the likely source of fecal contamination was from livestock animals such as cows and hogs. The remaining seven streams were between 0.4 and 4, a strong indicator that the fecal source was domesticated animals and not humans. Comparing the data as rural and urban sites, most of the rural sites indicated that the fecal contamination was from livestock, while the urban fecal ratio levels indicated that the contamination source was domesticated animals.

DISSOLVED OXYGEN & TEMPERATURE:

The State of Georgia's Environmental Protection Division has set the dissolved oxygen (DO) standard for streams which are designated as fishing at a minimum of 4.0 mg/L with a daily average of 5.0 mg/L. The temperature standard is set at a maximum temperature of 32.2°C. Mean DO and temperatures are reported in Table 2.

Mean DO values are low and only reference site W11 met the state standard for daily average. All sites minimum values were well below the state standard of 4.0 mg/L. DO measurements were taken in the morning between 8:00 and 11:00; therefore, it can be assumed that DO levels would drop even further as the water temperature reaches its daily maximum.

Although all sites were within the state's standard for temperature it should be noted that, as with the DO data, readings were taken in the morning well before maximum water temperature was attained.

CONCLUSIONS

The water quality at the outfall of the Willacoochee River (W11) subwatershed appears to be better than the upstream subwatersheds. The increase in water quality on the larger Willacoochee River was probably due to dilution of nutrients from upstream subwatersheds. Among the rural sites, W7 & W8 had the poorest water quality, while W4 had the poorest water quality among the urban sites. Sites W4 and W7 poorer water quality is easily explained by their immediate proximity to waste water treatment facilities. Site W8's higher nutrient levels, as compared to other rural sites, are probably also due to the fact that it is downstream from site W4. These comparisons suggest that the City of Ocilla's Waste Waster Treatment Facilities' pivot application system is more efficient in reducing the amount of nutrients returned to the streams as compared to the City of Fitzgerald's Utilities facilities. Comparisons between categorized sites showed that urban activities were a larger contributing factor to lower water quality than rural activities. The installation of riparian buffers between urban areas and stream segments would reduce the impact of these activities on water quality. These results suggest that there do not seem to be any cumulative effects on the Willacoochee River subwatershed's water quality level.

REFERENCES

Bowen, Jennifer L. and I. Valiela. 2001. The ecological effects of urbanization of coastal watersheds: historical increases in nitrogen loads and eutrophication of Waquoit Bay estuaries. *Can. J. Fish. Aquat. Sci.* 58, 1489-1500.

Donner, S. 2003. The impact of cropland cover on river nutrient levels in the Mississippi River Basin. *Global Ecology & Biogeography*, 12 (4), 341-355.

GA DNR-EPD. 2000. Georgia 2000 list of water as required by the section 303(d) of the federal clean water. Georgia Department of Natural Resources, Atlanta, Georgia.

Hranova, R. et al. 2002. Aspects of the water resources management practice with emphasis on nutrients control in the Chivero Basin, Zimbabwe. *Physics & Chemistry of the Earth*, 27(11-22), 875-885.

Lowrance, R. et al. 1995. Water quality functions of riparian forest buffer systems in the Chesapeake Bay watershed. *EPA Rep. 903-R-95-004*, Environmental Protection Agency, Washington, D.C.

NRCS. 1996. Model national specification for riparian forest buffers. Watershed Science Institute, U.S. Dept. of Agriculture-Natural Resources Conservation Service, Seattle, Wash.

Perry, Calvin D., G. Vellidis, R. Lowrance, D.L. Thomas. 1999. Watershed-scale water quality impacts of riparian forest management. *Journal of Water Resources Planning and Management*, 125(3), 117-125.

Vellidis, G., R. Lowrance, P. Gay, J. Sheridan, D. Bosh. 1999. Water quality of Piscola Creek watershed. Presented at the 1999 ASAE Annual International Meeting, Paper No. 992131. ASAE, 2950 Niles Road, St. Joseph, MI 49085-9659 USA.

Figure 1. Map of stream segment sampling locations in the Willacoochee River subwatershed.

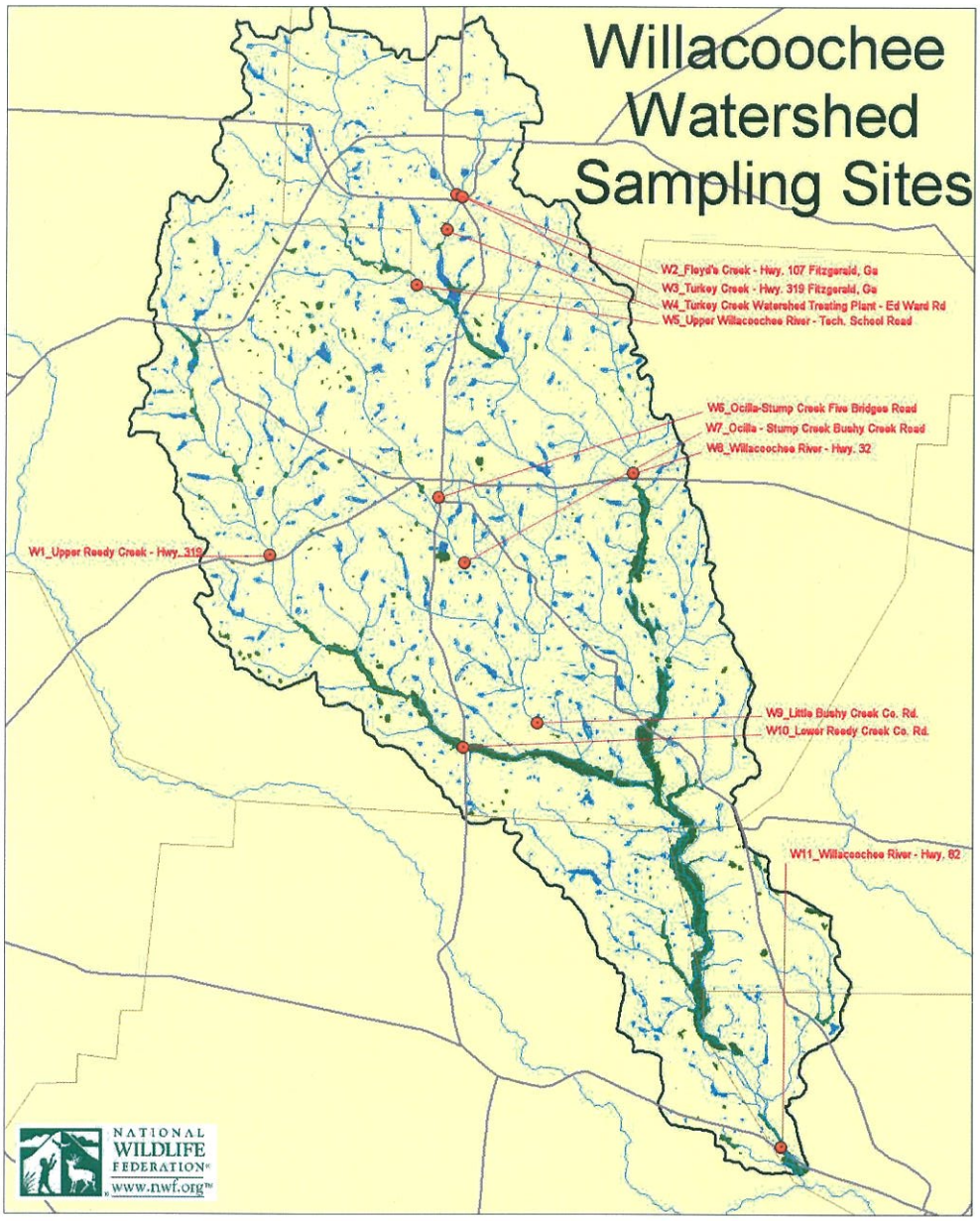


Figure 2. Comparison of nitrate-nitrite concentrations among stream segments (Kruskal-Wallis; Chi-square = 133.49, $P < 0.001$).

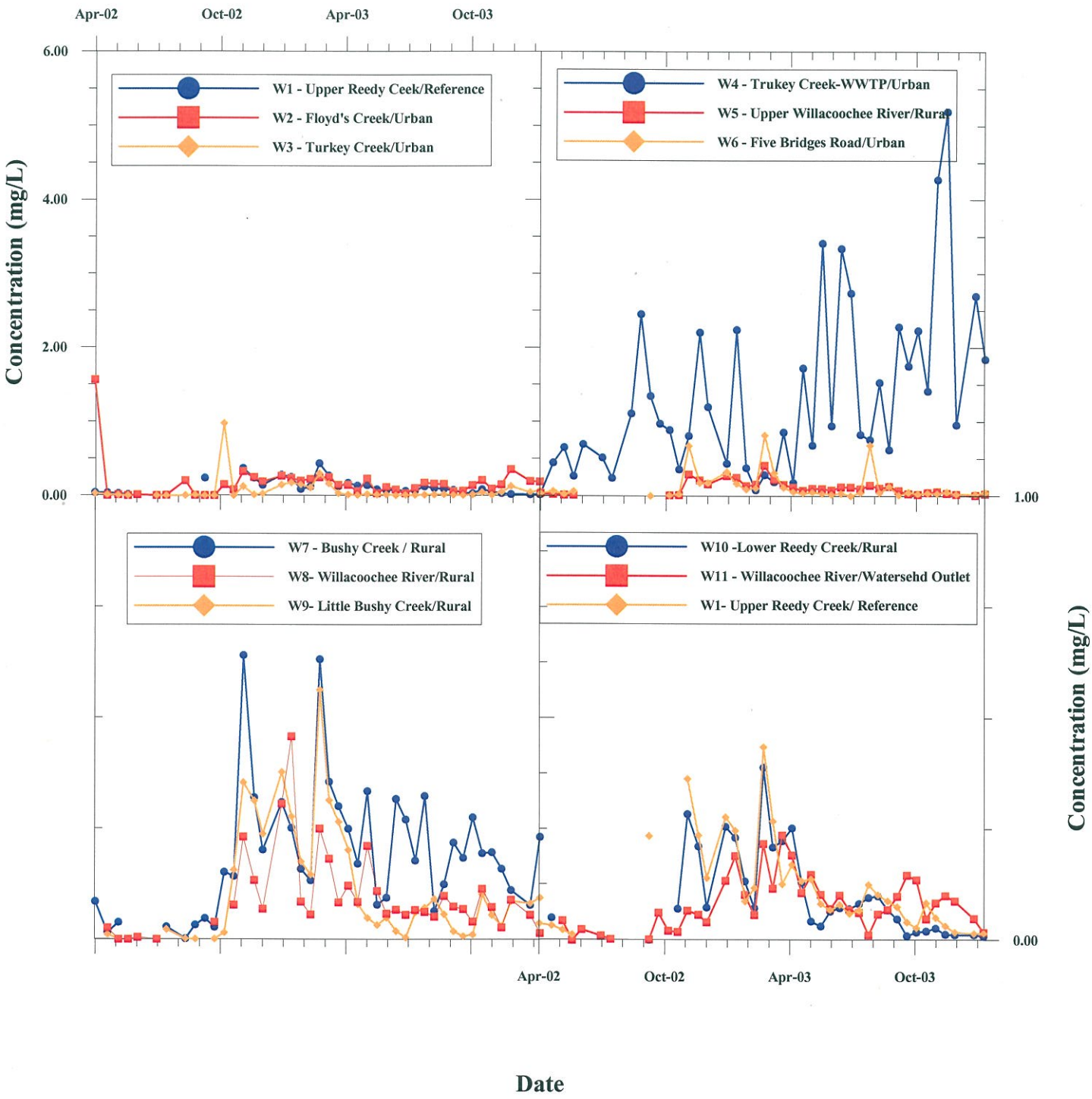


Figure 3. Comparison of Ortho-phosphorus concentrations among stream segments (Kruskal-Wallis; Chi-Square = 189.74, P < 0.001).

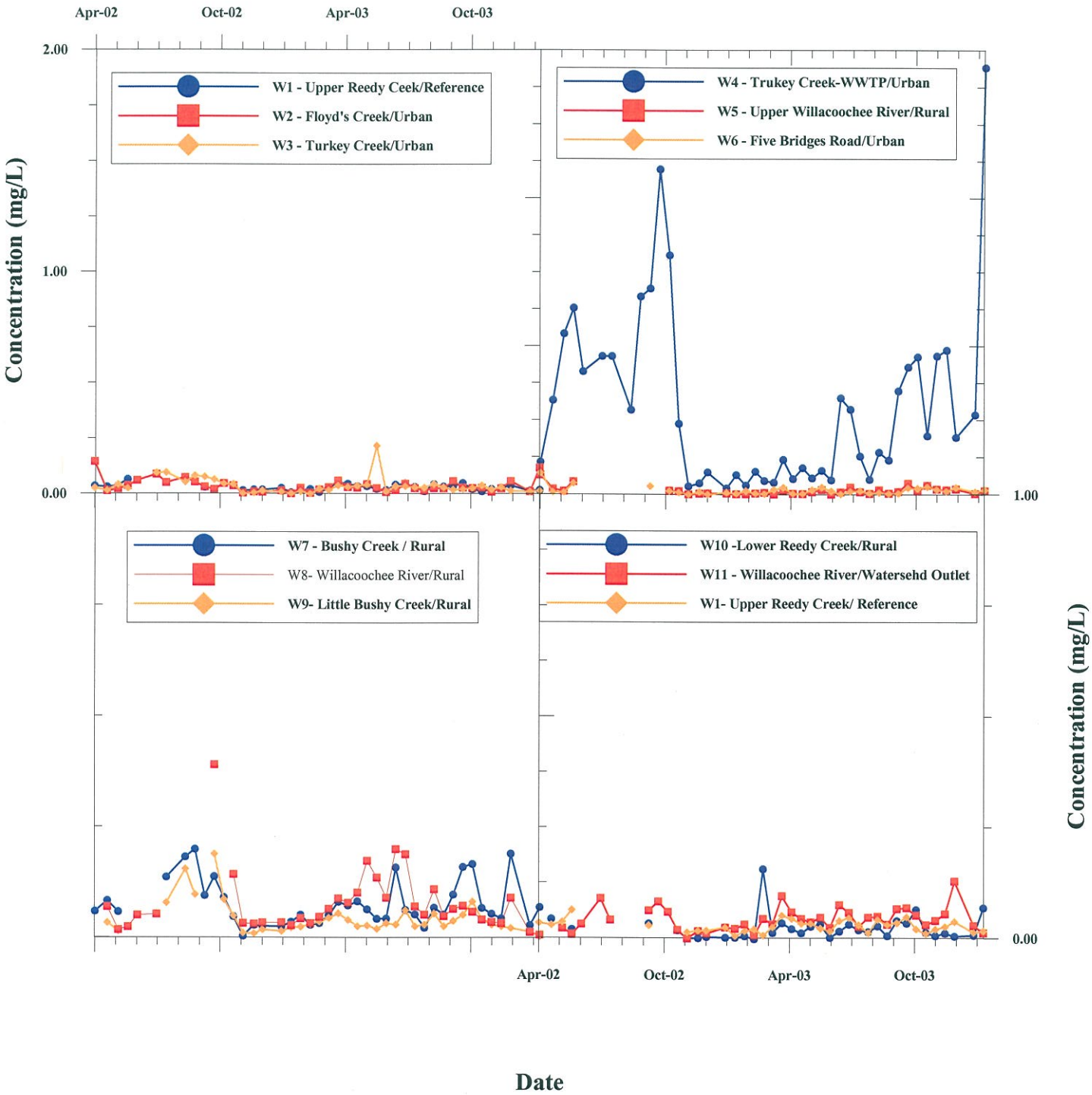


Figure 4. Comparison of ammonium-nitrogen concentration (mean + SE) between stream categories (Kruskal-Wallis; Chi-square=26.42, P < 0.001).

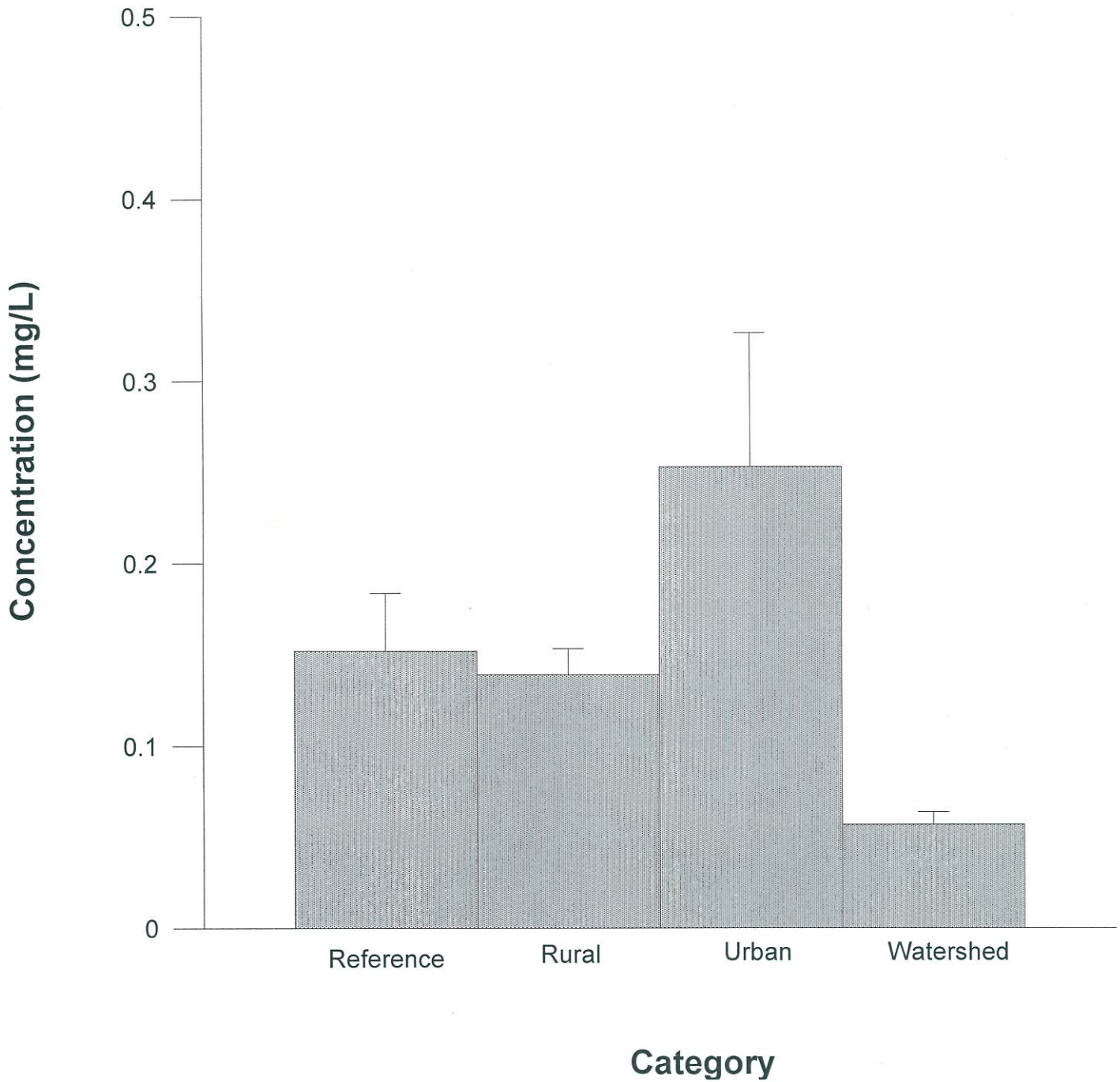


Figure 5. Comparison of suspended solids concentration (mean + SE) between stream categories (Kruskal-Wallis; Chi-square=90.89, P < 0.001).

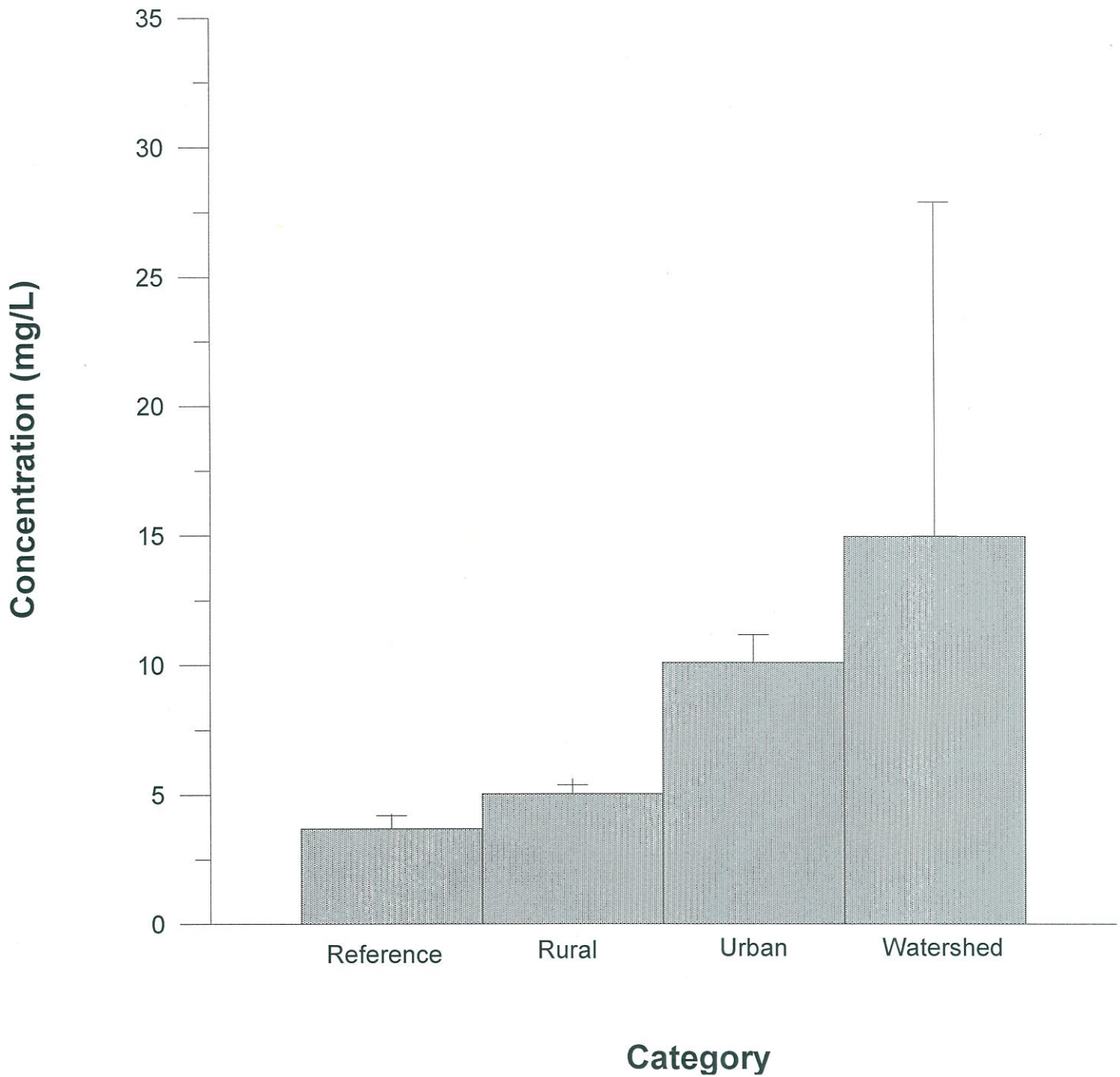


Table 1: Mean fecal bacteria concentrations.

Site	Fecal Bacteria		FC: FS
	Coliforms (colonies/ 100 mL)	Streptococci (colonies/ 100 mL)	
W1	154.96	174.12	0.89
W2	215.02	227.88	0.94
W3	165.95	243.97	0.68
W4	358.34	891.30	0.40
W5	72.20	289.90	0.25
W6	163.14	348.82	0.47
W7	327.76	538.48	0.61
W8	119.86	342.64	0.35
W9	380.79	663.23	0.57
W10	136.82	302.18	0.45
W11	80.83	258.77	0.31

Table 2: Mean dissolved oxygen and temperature.

	DO (mg/L)		Temp (°C)	
Site	Mean	Min	Mean	Max
W1	4.11	0.05	14.55	25.5
W2	1.80	0.03	17.84	27.0
W3	0.40	0.02	16.83	27.1
W4	2.55	0.05	18.05	26.5
W5	3.74	0.04	15.13	27.1
W6	2.37	0.02	15.60	26.3
W7	3.27	0.04	16.11	26.1
W8	4.68	1.71	15.78	26.1
W9	2.74	0.04	15.94	26.1
W10	3.04	0.03	15.03	25.5
W11	5.67	2.76	15.87	28.4

A Special Thanks to all those who participated:

Seven Rivers Resource Conservation & Development Council; Middle South Georgia Resource Conservation & Development Council; Willacoochee 319 Project Coordinator; University of Georgia, Department of Biological & Agricultural Engineering; USDA – Natural Resources Conservation Service; USDA Agricultural Research Service; Georgia Forestry Commission; Upper Suwannee River Watershed Initiative; Upper Suwannee Conservation Tillage Alliance; Georgia Soil & Water Conservation Commission; Alapaha Soil & Water Conservation District; Middle South Soil & Water Conservation District; National Wildlife Federation; South Georgia Regional Development Center; and all the citizens of the Willacoochee River Watershed.