St. Marys Watershed Management Plan

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Georgia Department of Natural Resources, Environmental Protection Division

Coastal Regional Commission of Georgia

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City of St. Marys
City of Kingsland
Camden County
Satilla River Keepers
St. Marys River Management Committee

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LIST OF ACRONYMS

BMPs	best management practices
BOD	biological oxygen demand
CCHD	Camden County Health Department
CMPA	Coastal Marshlands Protection Act
CRC	Coastal Regional Commission
CRD	Coastal Resources Division
CSS	Coastal Stormwater Supplement
DCA	Department of Community Affairs
DNR	Department of Natural Resources
DO	dissolved oxygen
DPH	Department of Public Health
DRI	Development of Regional Impact
EPD	Environmental Protection Division
E&S	Erosion & Sedimentation
GFC	Georgia Forestry Commission
GIS	Geographic Information System
HUC	hydrologic unit code
LAs	load allocations
LAS	land application system
LID	low impact development
MAREX	Marine Extension Service
mg/l	milligrams per liter
MS4s	municipal separate storm sewer systems
NPDES	National Pollutant Discharge Elimination System
NPS	nonpoint source
PAC	Partnership Advisory Council
SGRC	South Georgia Regional Commission
SMRMC	St. Marys River Management Committee
SOD	sediment oxygen demand
TMDL	total maximum daily load
UGA	University of Georgia
UOD	ultimate oxygen demand
USEPA	U.S. Environmental Protection Agency
WAC	Watershed Advisory Committee
WIP	Watershed Improvement Plan
WLAs	waste load allocations
WLAsw	waste load allocations for storm water discharges
WMP	Watershed Management Plan
WPCP	Water Pollution Control Plant
WPP	Watershed Protection Plan
WSA	Watershed Assessment

1. INTRODUCTION

Ecological Planning Group (EPG), LLC, has prepared a Watershed Management Plan (WMP) on behalf of the Coastal Regional Commission of Georgia (CRC), for a six-mile impaired segment of the St. Marys River between Catfish Creek and Millers Branch in Camden County, Georgia. For ease of reference, the plan will hereafter refer to this segment of the River as the St. Marys River.

The primary purpose of the WMP and associated monitoring and planning efforts is to address and improve dissolved oxygen (DO) levels within the impaired segment of the St. Marys River to meet State water quality standards. Because achieving this goal is a complex process, this plan creates and puts into effect a collaborative and holistic approach to water quality management. It provides a voluntary mechanism for stakeholders and landowners in the watershed to become more knowledgeable about watershed issues, provide feedback on how best to address these issues, and become actively involved in restoration efforts. Representatives from local government, academic institutions, and regional and state agencies with relevant areas of expertise and professional interests have also been included in the planning process.

Guidelines set forth by the U. S. Environmental Protection Agency (USEPA) and the Georgia Department of Natural Resources (DNR), Environmental Protection Division (EPD) have been followed in the development of this WMP. The WMP addresses the USEPA's Nine Elements for Watershed Planning and Georgia EPD's Guide to Developing a Watershed Management Plan. It includes detailed information about the scope of the project, historical and current assessments, and other monitoring programs that have targeted the St. Marys River. It also includes specific monitoring protocols, best management practices (BMPs) and milestones to restore and maintain water quality.

Funding for the preparation of this WMP was financed in part through a grant from the USEPA under the Provisions of Section 319(h) of the Federal Water Pollution Control Act, as amended.

2. STREAM SELECTION

Every waterbody in the State of Georgia has one or more designated uses. Examples of designated uses are "fishing", "recreation" and "drinking water". The State has also adopted water quality criteria to protect these uses. For instance, the State has determined that for a waterbody to support its use of fishing, it must have a daily average DO concentration of at least 5.0 milligrams per liter (mg/l) and a minimum of 4.0 mg/l at all times. (DO concentration refers to the amount of oxygen that is dissolved or carried in water.) DO is an important measure of the quality of aquatic habitat and overall health of the ecosystem. Oxygen depletion can indicate a number of undesirable physical, chemical, and biological activities in a watershed.

The Georgia EPD determines whether a waterbody is supporting its designated uses by collecting water quality data and comparing this data against the water quality criteria. It is the goal of the State of Georgia that all of its waters support their designated uses. If it is determined that a water body is not supporting its designated use, then the Georgia EPD will develop a total maximum daily load (TMDL) to begin the process of restoring the waterbody. A TMDL determines how much of a particular pollutant a waterbody can assimilate and still support its designated use. The TMDL will establish the required reduction in pollutant load needed for the water to support its designated use.

Section 305(b) of the federal Clean Water Act requires States to assess and describe the quality of its waters every two years in a report called the 305(b) report. Section 303(d) of the Clean Water Act requires States to submit a list of all of the waters that are not meeting their designated uses and that need to have a TMDL(s) established. The 303(d) list must also be submitted every two years. Georgia submits a combined 305(b)/303(d) report. Both Georgia's 305(b) and 303(d) lists are available on the Georgia EPD's website.

Every two years GA EPD gathers data that has been collected across the State. This data comes from a number of sources including Georgia EPD, other State agencies (such as the Coastal Resources Division [CRD]), federal agencies, and local governments and environmental groups. The water quality data are compared to the State's water quality criteria using Georgia EPD's listing assessment methodology. Based on the comparison of the data to the water quality criteria, Georgia EPD places each water into one of three broad groups. Waters are assessed as 1) supporting their designated use; 2) not supporting their designated use; or 3) assessment pending.

The use classification water quality standards for DO, as stated in Georgia's Rules and Regulations for Water Quality Control, Chapter 391-3-6-.03(6)(c)(i) are:

A daily average of 5.0 mg/L and no less than 4.0 mg/L at all times for waters supporting warm water species of fish.

Certain waters of the State may have conditions where DO is naturally lower than the numeric criteria specified above and therefore cannot meet these standards unless naturally occurring loads are reduced or streams are artificially or mechanically aerated. This is addressed in Georgia's Rules and Regulations for Water Quality Control, Chapter 391-3-6-.03(7):

Natural Water Quality. It is recognized that certain natural waters of the State may have a quality that will not be within the general or specific requirements contained herein. These circumstances do not constitute violations of water quality standards. This is especially the case for the criteria for dissolved oxygen, temperature, pH and fecal coliform. NPDES permits and Best Management Practices will be the primary mechanisms for ensuring that the discharges will not create a harmful situation.

USEPA DO criteria are used to address these situations. Alternative USEPA limits are defined as 90 percent of the naturally occurring DO concentration at critical conditions. Where natural conditions alone create DO concentrations less than 110 percent of the applicable criteria means or minima or both, the minimum acceptable concentration is 90 percent of the natural concentration. Accordingly, if the naturally occurring DO exceeds Georgia EPD numeric limits at critical conditions, then the Georgia EPD numeric limits apply. If naturally occurring DO is lower than the Georgia EPD numeric limits, then 90% of the natural DO will become the minimum allowable.

Table 1 below illustrates the alternate standards.

Table 1: Coastal DO Criteria for Fishing Use Classification

If the natural DO is greater than or equal to (mg/l)	But less than (mg/l)	The Maximum Allowable DO Deficit (mg/l)
2.0	3.0	0.1
3.0	3.3	Never less than 3.0 mg/L
3.3	4.0	0.3
4.0	5.0	0.4
5.0	5.5	0.5
5.5	---	Never less than 5.0 mg/L

Georgia EPD has not yet established a natural occurring DO level for the St. Marys River and other blackwater streams in Georgia. Blackwater streams often have naturally low DO levels, especially during the summer months when temperatures are high and water flows are low. These streams receive significant natural contributions of oxygen-demanding organic materials

from wetlands, swamps, and marshes. As the organic materials decay, tannins leach into the water, resulting in water that is darkly stained. Once the Georgia EPD has established a natural occurring DO level for blackwater streams, the USEPA's alternate criteria for DO may be used to assess DO levels for the St. Marys River.

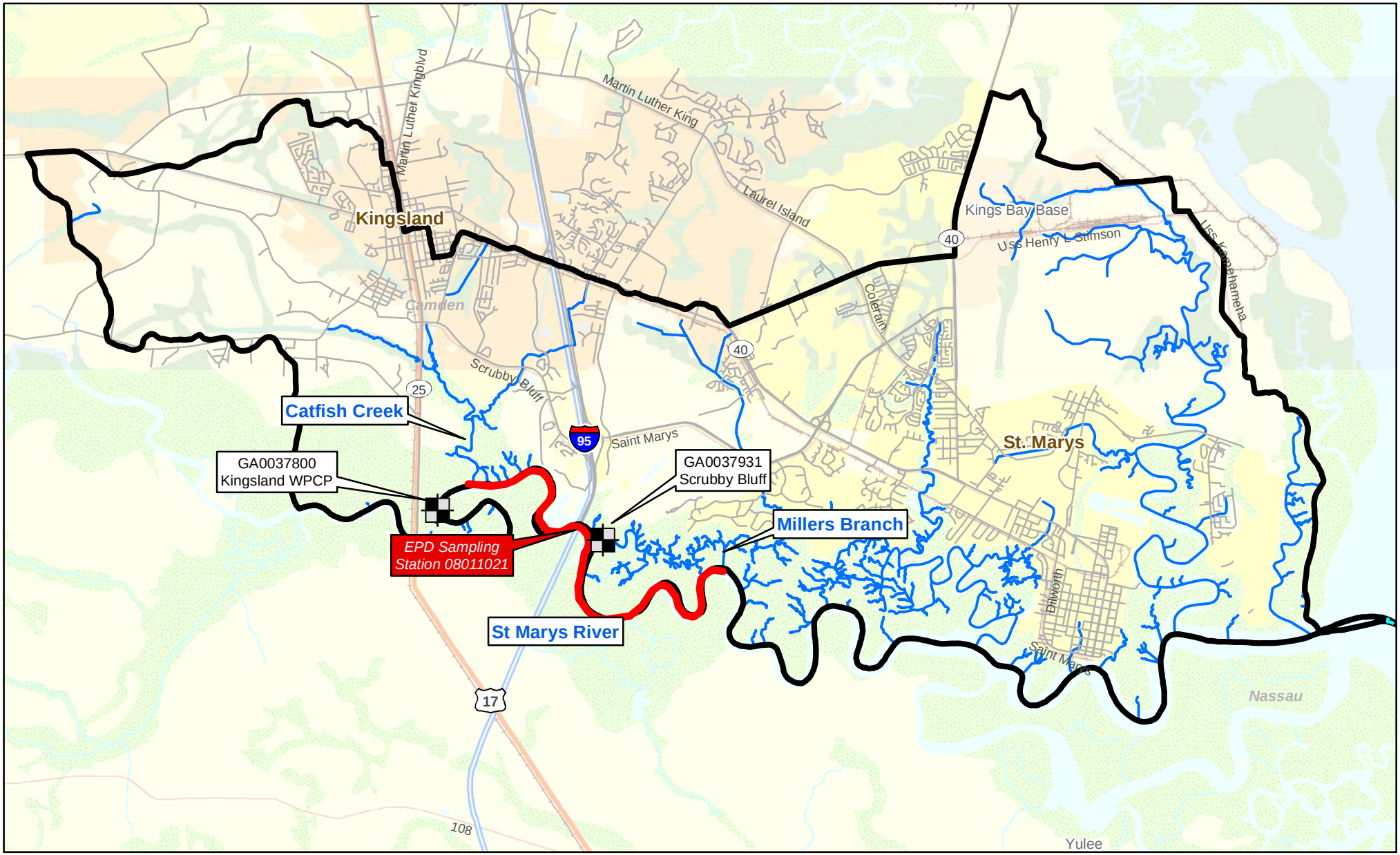
In 2003, the Georgia EPD collected samples from the St. Marys River at Interstate 95 (EPD Station 08011021) to assess water quality. Figure 1 shows the location of this sampling station. The assessment identified a six-mile stream segment of the St. Marys River, from Catfish Creek to Millers Branch in Camden County (hydrologic unit code [HUC] 8# 03070204), as water quality limited due to low DO levels. (A hydrologic unit is part of a watershed mapping classification system showing various areas of land that can contribute surface water runoff to designated outlet points, such as lakes or stream segments). Additional information about the 2003 water quality data collected by the Georgia EPD is included in this report under "State Water Quality Monitoring Data" located in Section 5. This segment of the St. Marys River was placed on the State's draft 2004 303(d) list and the Georgia EPD conducted a TMDL evaluation for DO in 2006 (Appendix A). This segment of the St. Marys River remains on the State's most recent 2012 303(d) list. The TMDL evaluation identified the six-mile segment of the St. Marys River as not supporting its designated use of fishing because DO levels were below established water quality standards (Table 2).

Table 2: Georgia EPD's Waterbody Listing

Stream	Impaired Segment Location	County	Extent	Use	Criterion Violated	Listing
St. Marys River	Catfish Creek to Millers Branch	Camden	6 miles	Fishing	DO	Not supporting designated use

This six-mile stream segment represents a relatively small portion of the St. Marys River Basin, which occupies approximately 1,500 square miles, of which approximately 765 square miles is located in the state of Georgia. Figure 1 shows the location of the impaired stream segment in the St. Marys River Basin. The basin lies within the Coastal Plain physiographic province, which extends throughout the southeastern United States. The St. Marys River drains into the Atlantic Ocean.

Figure 1 - Impaired Stream Segment



Impaired Stream Segment

St Marys River - Impaired Segment
TMDL Evaluation - Dissolved Oxygen

WPCP

N

Watershed Management Plan

St. Marys River
from Catfish Creek to Millers Branch

Legend

Huc12 Watershed
Roads
Streams & Waterways

3. FORMATION OF WATERSHED ADVISORY COMMITTEE

The development of this plan has relied upon the participation of many community members and stakeholders, as well as other professionals with relevant areas of expertise. These stakeholders have been able to provide critical input into the planning process by identifying areas of concern, developing goals and monitoring protocols, and proposing current and future management strategies to improve the water quality of the St. Marys River.

In 2010, the Partnership Advisory Council (PAC) was formed by the CRC. The Council was composed of a diverse array of over 50 members, including landowners, elected officials of cities and counties, representatives from academic institutions and employees of various local, regional, institutional, and state agencies. Two PAC meetings were held in December 2010 and January 2011 with the purpose of identifying impaired watersheds in coastal Georgia and selecting two for development of a plan to address the impairment. The PAC selected the St. Mary River for development of a Watershed Improvement Plan (WIP) and then established a sub-committee of local stakeholders to lead this effort. The local stakeholders group met monthly from February 2011 to June 2011 to discuss the DO impairment within the St. Marys River and identify potential sources for the impairment. Members of the local stakeholders group conducted a visual stream survey of the St. Marys River, including water quality sampling, in April 2011. A listing of the Council members, notes from the PAC and local stakeholders meetings, and the results of the visual stream surveys are included in the 2011 WIP, prepared by the CRC. A copy of the 2011 WIP is included in Appendix B.

In 2013, the former PAC/local stakeholders committee reconvened as the St. Marys Watershed Advisory Committee (WAC). Several new representatives were invited to join the committee based on their areas of expertise and professional interests. A list of current WAC members and their contribution(s) is found in Appendix C. Meetings were held with WAC members on March 27, 2013, February 11, 2014, and March 25, 2014 to summarize and review past planning activities and water quality data. Committee members also discussed and evaluated present and future water quality monitoring protocols, best management practices and outstanding information needed to develop and implement an effective WMP. All members were informed of what was expected of them at the meeting and throughout the plan's development. A few Committee members were consulted more regularly throughout the development of this plan because of their expertise and willingness to provide additional support.

4. SOURCE ASSESSMENT

Pollutants can be delivered to water bodies from various point sources. The discharge of pollutants from point sources, such as pipes, outfalls, and conveyance channels is generally regulated through National Pollutant Discharge Elimination System (NPDES) permits. Existing facilities that discharge into water bodies from specific point sources, including water pollution control/wastewater treatment plants and industrial facilities, are typically required to have NPDES permits. These facilities' discharges may contribute oxygen-demanding substances to the receiving waters, which can reduce DO levels.

Some storm water runoff is covered under the NPDES Permit Program. However, it is considered a diffuse source of pollution. Currently, regulated storm water discharges that may contain oxygen-demanding substances consist of those associated with industrial activities and municipal separate storm sewer systems (MS4s).

Nonpoint source pollution typically comes from many diffuse sources, not specific pipes or conveyances. Nonpoint source pollution is caused by rainfall moving over and through the ground, carrying natural and man-made pollutants and finally depositing them into surface waters. According to the Georgia EPD's 2006 TMDL evaluation, nonpoint sources generally, but not always, involve accumulation of oxygen-demanding substances on land surfaces that wash off as a result of storm events. Constituents may wash off of land surfaces and either: 1) are flushed out of the system along with the water column flow; or 2) settle out and become part of the stream channel bottom. In this manner, historic wash off of settleable materials from land disturbances accumulates and exerts sediment oxygen demand (SOD), which in turn may reduce DO levels. In addition, most of the streams in the St. Marys River Basin receive significant natural contributions of oxygen-demanding organic materials from local wetlands, swamps, and marshes. The organic materials are decomposed by microorganisms that use oxygen in the process, thereby lowering DO levels. The amount of oxygen consumed by these organisms in breaking down the organic matter is known as biological oxygen demand (BOD).

Leaf litterfall is a major contributor to the amount of dissolved organic matter in the stream water column and the amount of SOD being exerted. The oxygen demanding effects of leaf litterfall are reflected in two ways: 1) lowering the DO saturation of water entering the channel from adjacent swampy areas caused by decaying vegetation; and 2) by increasing SOD associated with vegetation decaying on stream channel bottoms.

Many smaller communities use land application systems (LAS) in the treatment of their sanitary wastewater. These facilities are required through LAS permits to apply all their wastewater

"sludge" onto land, and, if properly operated, function as part of a non-discharging treatment system that contribute no runoff to nearby surface waters. However, runoff during storm events may carry surface residual containing oxygen-demanding substances to nearby surface waters. Some of these facilities may also exceed the ground percolation rate when applying their wastewater, resulting in surface runoff. If not properly bermed, this runoff, which contains oxygen-demanding substances, may enter into nearby surface waters.

Pollutant Sources

The Georgia EPD's 2006 TMDL evaluation and 2008 TMDL Implementation Plan (Appendices A and D) included an evaluation of potential sources categories that are broadly classified as either point or nonpoint sources. These sources include:

Point Sources

- Two NPDES-permitted discharges with effluent limits for oxygen-demanding substances identified in the St. Marys River Basin watershed upstream from or within the listed segment. These included the City of Kingsland- St. Marys Water Pollution Control Plant (WPCP) and the City of St. Marys – Scrubby Bluff WPCP. The locations of these WPCPs are identified on Figures 8 and 9, which are included in latter sections of this report.

Nonpoint Sources

Potential sources of oxygen-demanding substances may be either natural or of human origin. Sources of naturally occurring oxygen-demanding organic materials are:

- Adjacent wetlands, swamps and marshes with organically rich bottom sediments
- Direct leaf litterfall onto water surfaces and adjacent floodplains from overhanging trees and vegetation
- storm runoff of leaf litter detritus and wildlife wastes

Potential human-induced nonpoint sources of oxygen-demanding substances include:

- Downstream land application system (spray and buried/septic)
- Erosion and stormwater runoff of sediments from areas of land disturbance
- Loading of fertilizers, herbicides, pesticides, septic effluent & dead vegetation from farming (minor) and silvicultural (major) operations, and from increasing residential and retail commercial area

Additionally, according to the Georgia 2008 TMDL Implementation Plan for the St. Mary's River, base flow in the St. Marys River segment has been potentially lowered due to land alternations including:

- Channelization projects for silvicultural and suburban development,
- Hardening of the landscape (impervious surfaces), and by the
- Filling of wetlands, which has likely decreased the water segment's ability to process sediment loss

An assessment of the watershed by the WAC members has identified the following natural occurrences within the St. Mary's River system that could affect DO levels:

- Metabolism of organic substances in the water and mud
- Inorganic oxidation-reduction (redox) reactions with anaerobic mud upon mechanical disturbance of the sediment
- Physical mixing with runoff of surface water with different DO levels (typically lower) than river water
- Physical mixing with seepage of groundwater with a different level of DO into the overlying river water
- Decrease in ability of water to retain oxygen in high temperatures and high salinity
- Cessation of photosynthesis at night or reduced photosynthesis because of increased turbidity or color
- Drainage from fringing tidal marshes that supplies oxygen-demanding substances
- Setting of suspended organic matter in the mixing zone of an estuary

The WAC also identified the following potential anthropomorphic sources of oxygen- demanding substances within the St. Mary's watershed:

- Drainage from silviculture lands, especially those grid-ditched for better land drainage
- Residual organic matter in sewage effluent
- Drainage from septic tanks
- Drainage of hydrocarbons from large areas of pavement
- Excess plant production due to fertilizers on lawns, gardens, crops, and golf courses
- Five industrial facilities with stormwater NPDES permits located within the St. Marys watershed (Figure 8. Note the locations of all facilities could not be shown due to map scale). None of these facilities were listed in the Georgia EPD's 2006 TMDL and 2008 Implementation Plan evaluation as point sources.

Waste Load and Load Allocations

The Georgia EPD's 2006 TMDL document includes an evaluation of waste load allocations (WLAs) and load allocations (LAs) for the St. Marys River (Appendix A). The WLA is the portion of the receiving water's loading capacity that is allocated to existing or future point sources. WLAs are

provided to the point sources from municipal and industrial wastewater treatment systems, as well as permitted storm water discharges. There are two NPDES permitted facilities in the St. Marys River watershed that may potentially affect in stream DO. WLAs are provided to the point sources from these municipal wastewater treatment systems. Table 3 below lists the WLAs required to meet the target DO standard. The TMDL for the St. Marys River requires no reductions in the wasteload allocations.

State and Federal Rules define storm water discharges covered by NPDES permits as point sources. However, storm water discharges are from diffuse sources and there are multiple storm water outfalls. Storm water sources (point and nonpoint) are different than traditional NPDES permitted sources in four respects: 1) they do not produce a continuous (pollutant loading) discharge; 2) their pollutant loading depends on the intensity, duration, and frequency of rainfall events, over which the permittee has no control; 3) the activities contributing to the pollutant loading may include the various allowable activities of others, and control of these activities is not solely within the discretion of the permittee; and 4) they do not incorporate WLAs that control specific pollutants to meet numeric limits.

The intent of storm water NPDES permits is not to treat the water after collection, but to reduce the exposure of storm water to pollutants by implementing various controls. It would be infeasible and prohibitively expensive to control pollutant discharges from each storm water outfall. Therefore, storm water NPDES permits require the establishment of controls or BMPs to reduce pollutants entering the environment.

The Georgia ESTUARY model used to compute WLAs was run under critical conditions, assuming mid-tide dry weather conditions. Because the critical conditions occur when there are no storm events, no numeric allocation is given to the waste load allocations from storm water discharges (WLAsw) associated with MS4s. Furthermore, there are currently no permitted NPDES MS4s within the St. Mary's River Basin.

The LAs for nonpoint source loads for the TMDL were computed from the model boundary conditions, which include the stream, tributary, and headwater model boundaries under critical conditions. The partitioning of allocations between point and nonpoint sources, shown in Table 3, is based on modeling results and professional judgment.

Table 3: TMDL Loads for the St. Mary's River Basin under Critical Conditions

Stream Segment	WLA (lbs/day)	WLAsw (lbs/day)	LA (lbs/day)	TMDL (lbs/day)
St. Marys River – Catfish Creek to Millers Branch	2,917	N/A	2,686	5,603

Note: TMDL expressed as Ultimate Oxygen Demand (UOD)

5. ASSESSMENT AND CHARACTERIZATION OF CURRENT CONDITIONS

This section of the Plan characterizes the St. Marys watershed to identify possible causes and sources of DO impairment and quantify pollutant loads when possible. Characterizing the watershed, its problems, and pollutant sources provides the basis for developing effective management strategies to meet watershed goals.

Physical and Natural Features

Watershed boundaries

The St. Marys River basin is located in Northeastern Florida and Southeastern Georgia, and is bordered by the Satilla River basin to the north, the Nassau & St. Johns River basins to the south, and the Suwannee River basin to the west. The basin occupies an approximate total area of 1,500 square miles within the Coastal Plain physiographic province, with approximately 765 square miles of the basin located in the Southeastern part of Georgia. The headwaters are located in Charlton County, Georgia, within the Okefenokee Swamp. The river flows first south, and then north and east through Camden County. The Catfish Creek to Millers Branch segment of the St. Marys River is located within Camden County, and is the border between Camden County, Georgia and Nassau County, Florida. The St. Marys River is comprised of one U.S. Geological Survey HUC, 03070204.

The water use classification for the St. Marys River, including the Catfish Creek to Millers Branch segment, is predominately fishing.

Drainage basins do not follow jurisdictional boundaries, which creates a unique situation when a basin intersects multiple states. In an effort to better analyze the “not supporting” segment of the St Marys River from Catfish Creek to Millers Branch, the HUC 12 watershed was used as the basis. Given the availability of data, the basin was farther broken down to the portion that falls within the State of Georgia.

Hydrology

The HUC 12 watershed (030702040402) has been named “St Marys East” and totals roughly 120 square miles. Approximately 63 square miles of this basin falls within Camden County. The portion of the watershed within Camden County contains 117 linear miles of streams and waterways. The major waterways within the basin are St Marys River, North River, and Catfish

Creek. The minor waterways are Burrells Creek, Catfish Creek, Casey Creek, Dark Entry Creek, Little Catfish Creek, May Branch, Millers Branch, Point Peter Creek, and Sweetwater Branch.

Topography

There is little change in elevation within the basin, a trend that is consistent with many counties in coastal Georgia. The elevation ranges from 0 feet to 40 feet with an average of 17.5. By way of comparison, the elevation in Camden County ranges from 0 feet to 80 feet with an average elevation of 20 feet. Figure 2 illustrates the topographic trends within the St Marys East Basin.

Soils

The soil type found directly adjacent to the listed segment of the St Marys River is classified as Capers-Bohicket. This type accounts for slightly over a quarter of soils found within the basin. These soils are very poorly drained and have a high sulfur and salt content. They are generally located in tidal marshes and extend inland several mile along creeks and rivers.

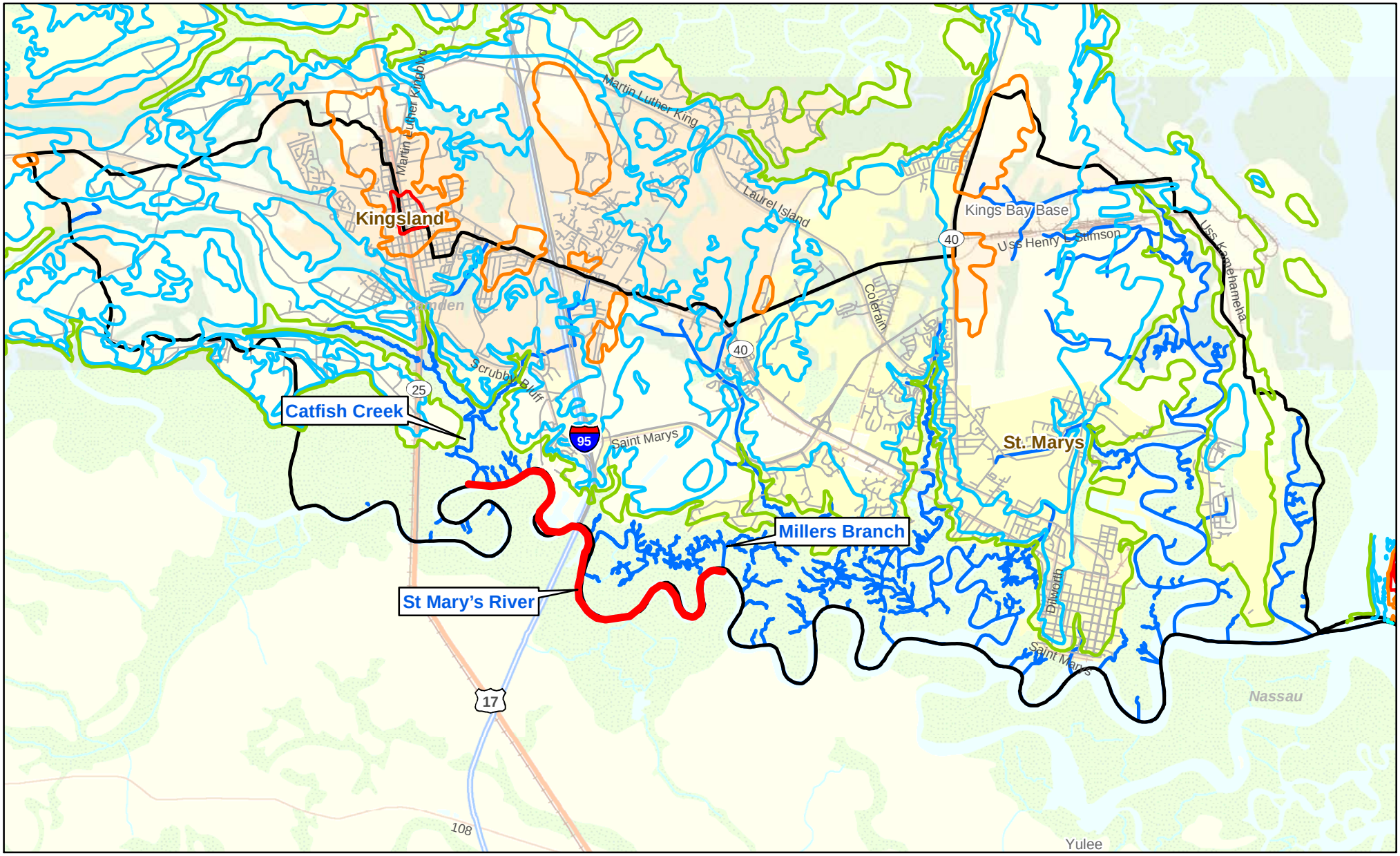
Over 50% of the drainage basin is classified as Rutlege-Mandarin. These soils are nearly level and sandy throughout. They can be classified as somewhat poorly drained when located on slight ridges and broad flats and very poorly drained soils when found in poorly defined drainageways and shallow depressions.

Table 4 summarizes soil types within the St Marys River East drainage basin. Figure 3 also illustrates the distribution of soils within the basin.

Table 4: Soil Types-St. Marys East Drainage Basin

Soil Type	Description	Acres	Percent of Basin
Capers-Bohicket	Level soils that are clayey throughout, in tidal marshes. Very poorly drained	10,707	27%
Maurepas-Kingsland	Level soils that are organic throughout, on floodplains. Very poorly drained.	1,508	4%
Pooler-Brookman-Bladen	Nearly level soils that have a loamy surface layer and a clayey subsoil, on flats and terraces and in depressions. Very poorly drained.	4,890	12%
Rutlege-Mandarin	Nearly level soils that are sandy throughout, on ridges and flats and in depressions and drainage ways. Somewhat poorly drained – very poorly drained.	21,190	53%

Figure 2 - Topographic Trends Within the St. Marys East Basin



Elevation (Feet)

- < 5
- 6 - 10
- 11 - 20
- 21 - 30
- > 30

N

EPG

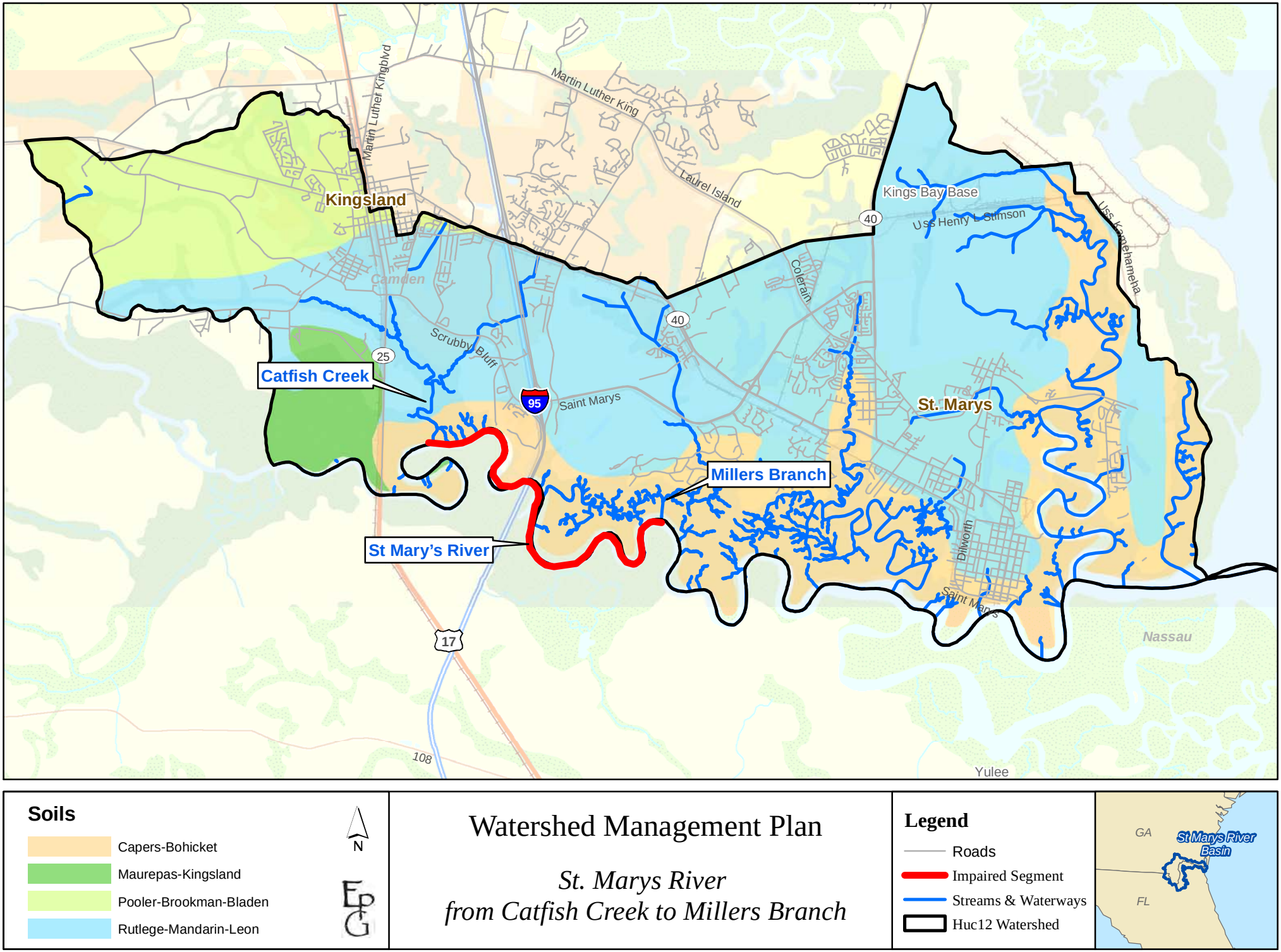
Watershed Management Plan

St. Marys River
from Catfish Creek to Millers Branch

Legend

- Impaired Segment
- Huc12 Watershed
- Roads
- Streams & Waterways

Figure 3 - Soil Classifications



Climate

The St. Mary's River basin is characterized by mild winters and hot summers. Mean annual precipitation ranges from 40 to 52 inches per year. Precipitation occurs as rainfall. Average annual rainfall in the basin is about 50 inches. Fall is the driest season receiving only twenty percent of the total annual precipitation. Summer is the wettest season of the year, receiving about one-third to one-half of the total annual precipitation. The mean annual temperature is about 69 degrees Fahrenheit.

Habitat

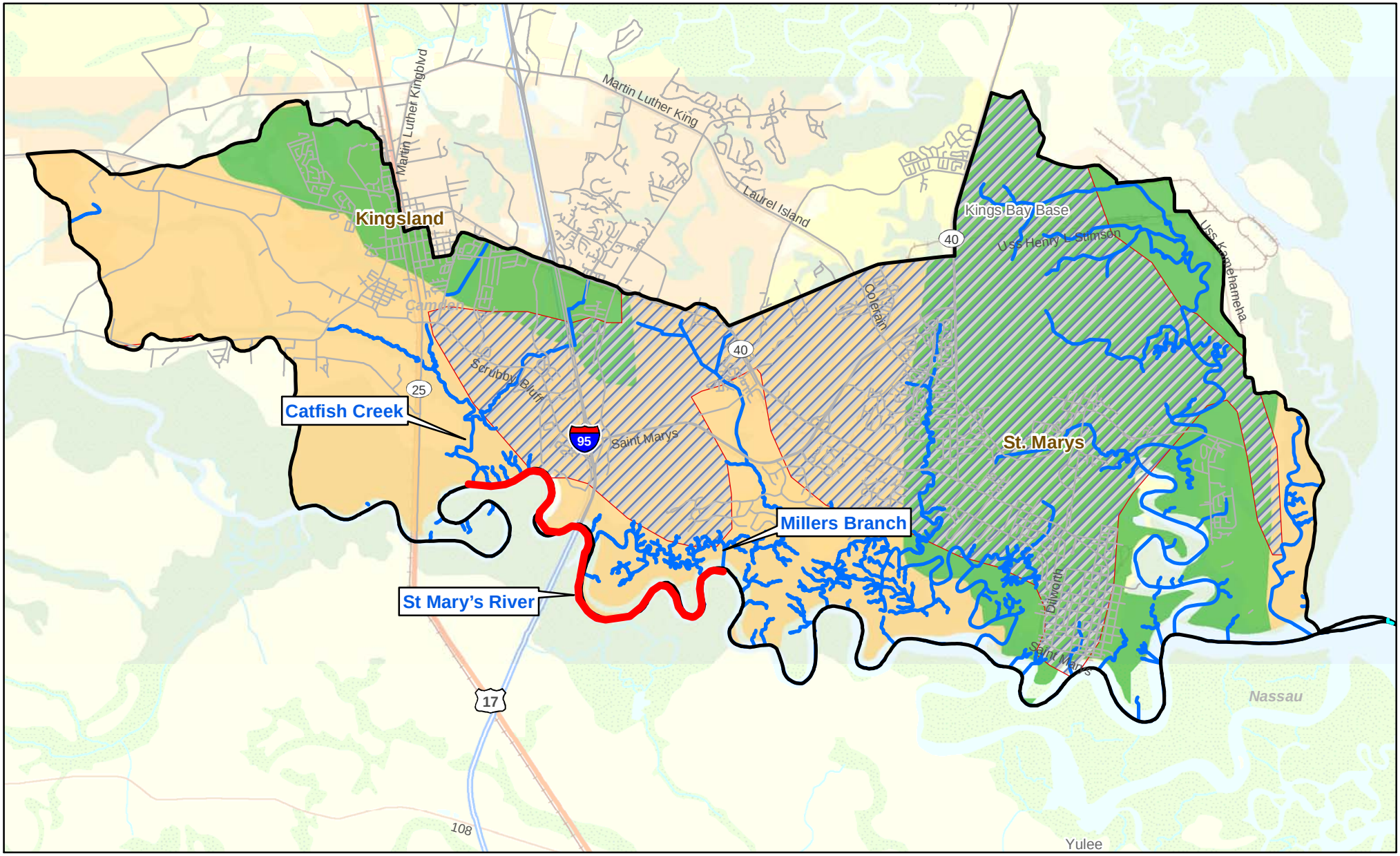
Camden County and the St Marys basin are home to a wide variety of natural habitats, ranging from hardwood forests to coastal salt marshes. This diversity of habitats supports rich wildlife, including a large number of recreationally and commercially valuable species. The County's inland aquatic habitats include ponds, rivers, and marshes. These areas harbor many species of fish and waterfowl, including a number of migratory bird species. The forested habitats present throughout the basin are home to popular game species such as the eastern cottontail rabbit, gray squirrel, white-tailed deer, wild turkey, and feral hog.

Groundwater Recharge Areas

The Georgia DNR mapped areas of high, medium (average), and low susceptibility of groundwater to pollution in Georgia. Over 90% of the Georgia portion of the St Marys East watershed is considered to be high or average based on this assessment. The listed segment of the St Marys River is classified as medium susceptibility with the high susceptibility areas being associated with the more developed areas around the cities of St Marys and Kingsland.

The basin is also intersected by one large groundwater recharge area that covers 46% of the basin and intersects the Northwest portion of the listed segment of the St Marys River, as shown in Figure 4.

Figure 4 - Groundwater Recharge Areas



Groundwater Recharge

Groundwater Recharge Area

Pollution Susceptibility

Medium (Average)

High

N

EPG

Watershed Management Plan

St. Marys River
from Catfish Creek to Millers Branch

Legend

Roads

Impaired Segment

Streams & Waterways

Huc12 Watershed

Flood Zones

The majority of the basin falls within the boundaries of a designated flood zone. The following table (Table 5) summarizes the total acreage within each zone as well as the total percent of the watershed:

Table 5: Flood Zones

Flood Zones	Acres	Percent of Basin
500 Yr	5,420	13.5%
A	785	2.0%
AE	10,220	25.4%
VE	4,890	12.2%

The listed segment of the St Marys River from Catfish Creek to Millers Branch is entirely within the AE zone. It is in close proximity to the VE zone on the eastern part of the listed segment. Figure 5 illustrates the location of flood zones within the basin.

Wetlands

The areas directly adjacent to the listed segment consist of coastal marshland. Coastal marshlands account for roughly 9,200 acres or 23% of area in the basin. The watershed also contains 6,700 acres, or 17% of forested wetlands as categorized by the Georgia DNR. Figure 6 shows the distribution of wetlands within the basin.

Figure 5 - Flood Zones

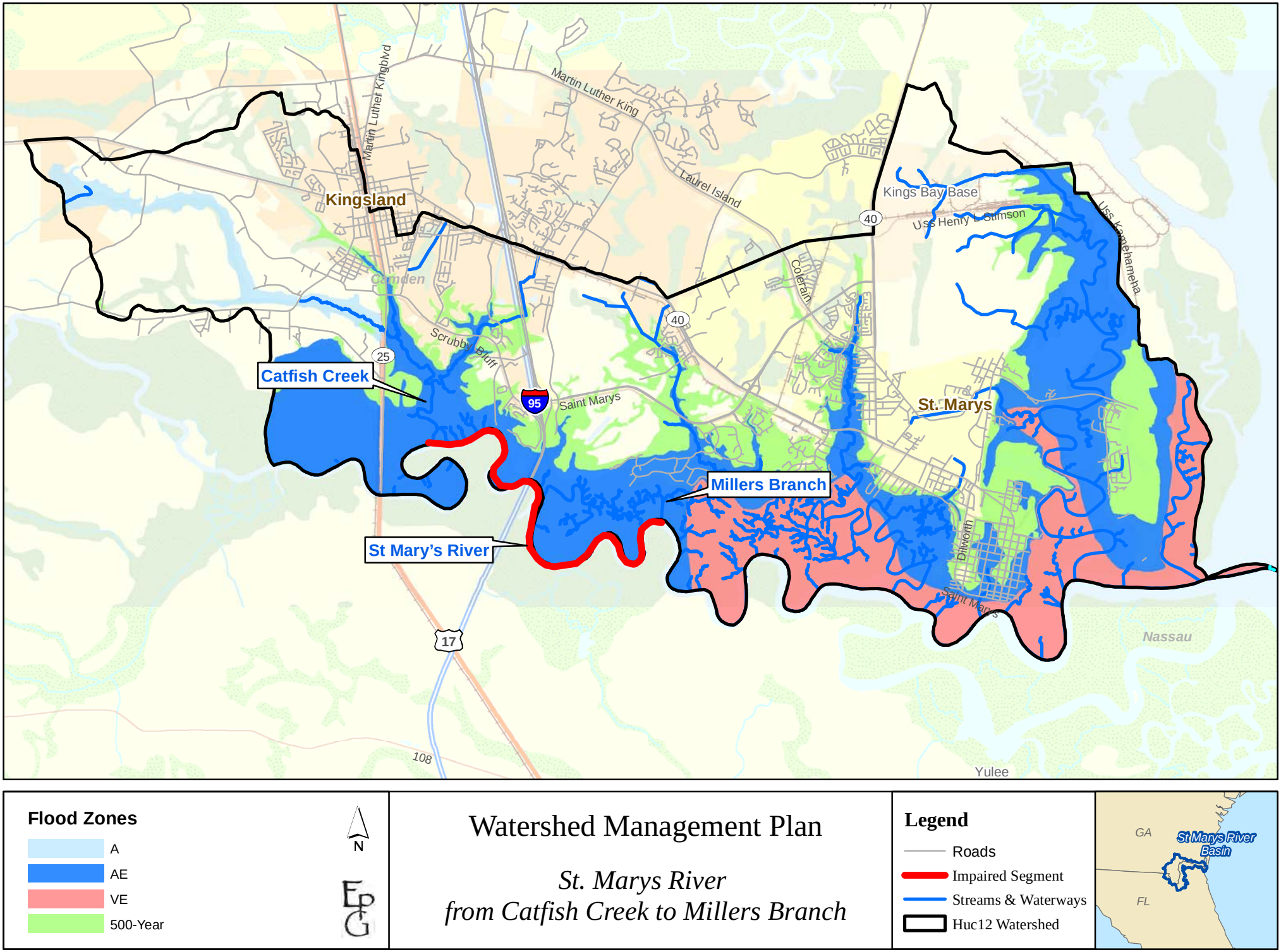
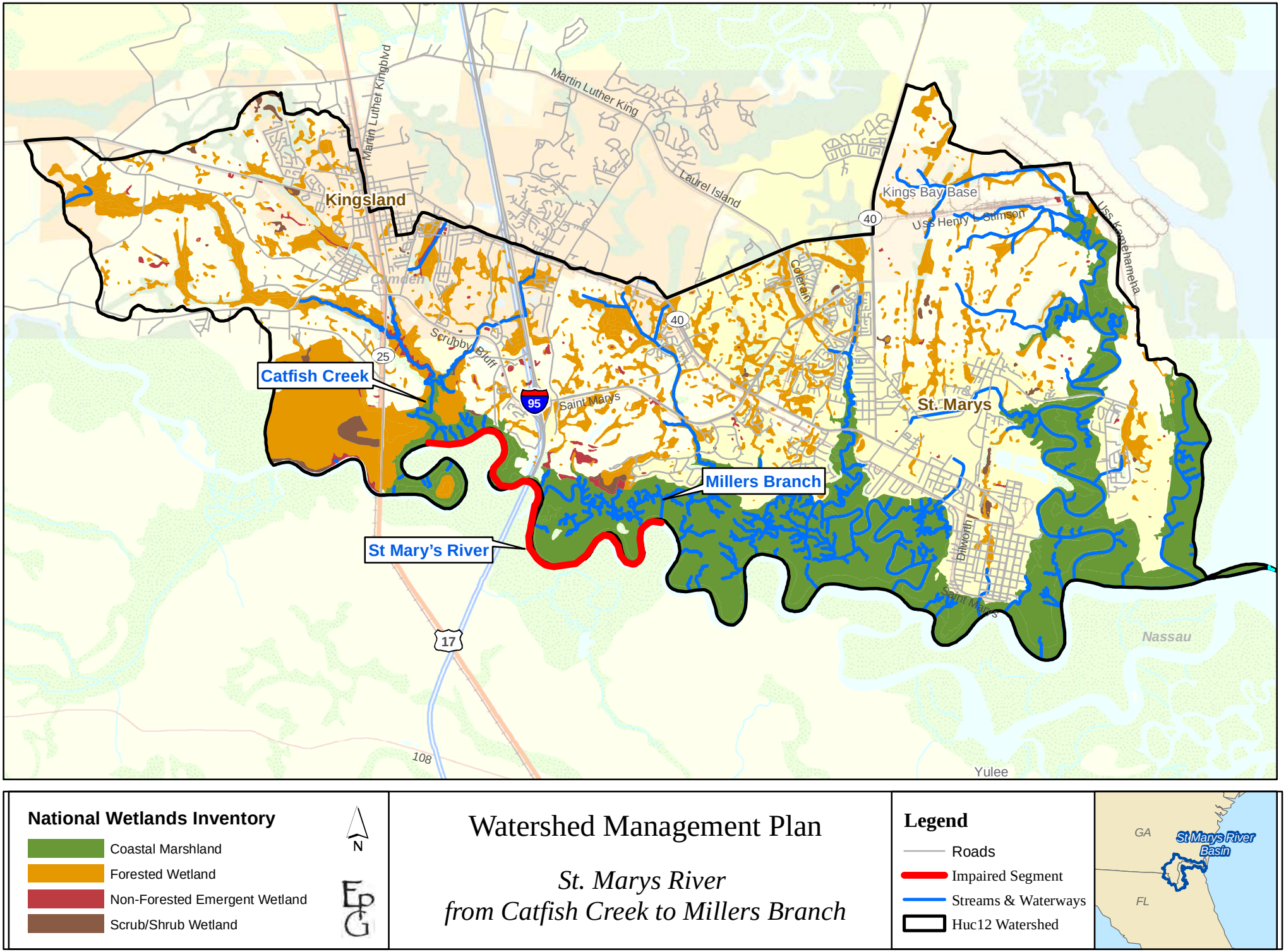


Figure 6 - National Wetlands Inventory



Land use and population characteristics

Land Use and Land Cover

The Land Use analysis completed in this section was partly based on the National Land Cover Dataset (NLCD) for Georgia. Table 6 below shows the land use characteristics for the St Marys River watershed based on this assessment:

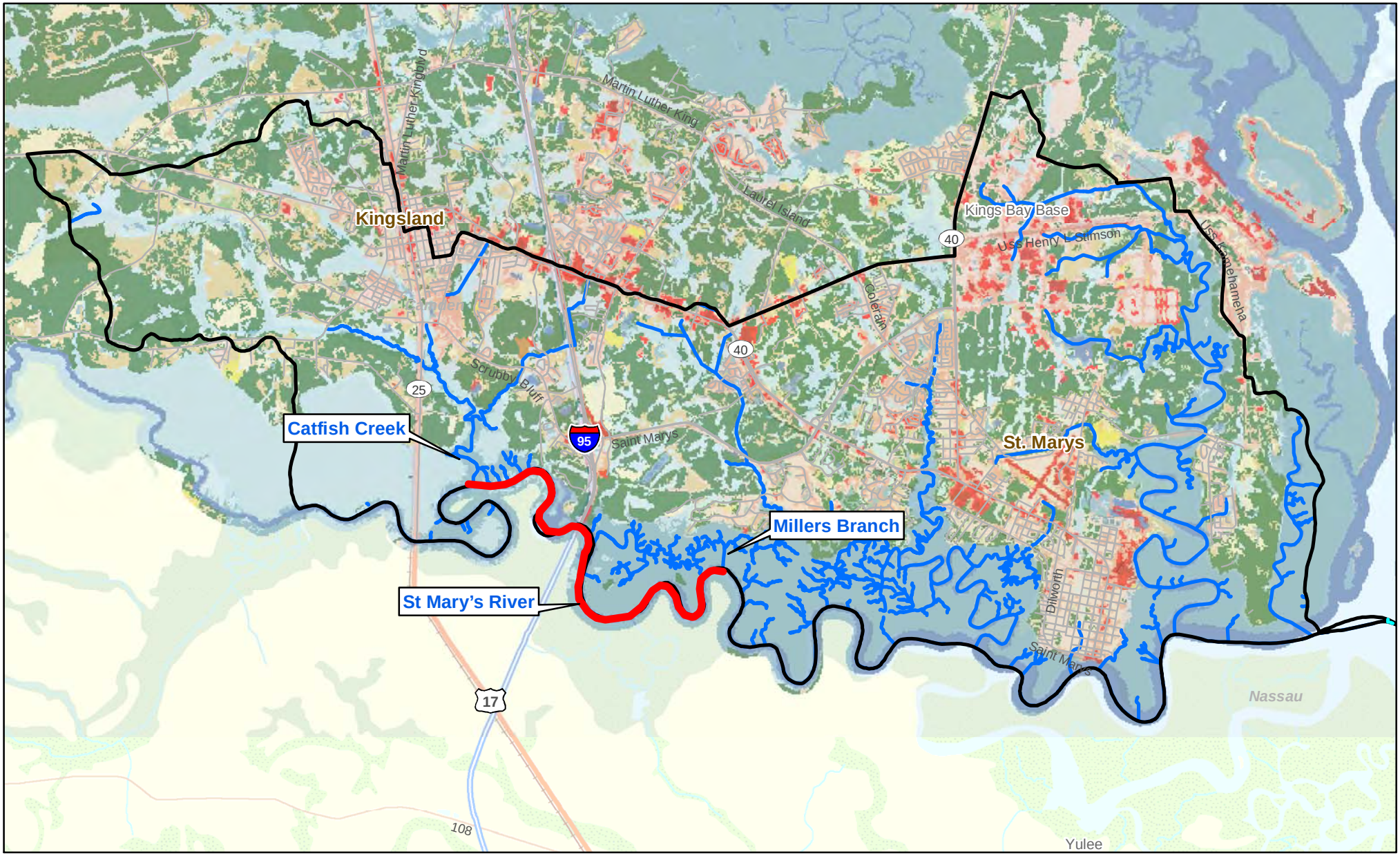
Table 6: Land Use Characteristics

Land Use Categories	Percent of Basin
Open Water	0.8%
Residential	1.0%
High Intensity Commercial Industrial, Transportation	2.0%
Bare Rock, Sand, Clay	0.0%
Quarries, Strip Mines, Gravel Pits	0.0%
Transitional	9.4%
Forest	48.5%
Row Crops	0.8%
Pasture, Hay	0.1%
Other Grasses (Urban, recreational, etc.)	0.0%
Woody Wetlands	35.0%
Emergent Wetlands	4.0%

The joint Comprehensive Plan for Camden County, St Marys, Kingsland, and Woodbine was also referenced to get an accurate understanding of the existing development patterns along the listed segment of the St Marys River. The assessment of these sources shows similar trends in land uses and development patterns within the vicinity of the St Marys River corridor. Based on the Comprehensive Plan, the land use characteristics of the St Marys River Basin are primarily agriculture/forested and parks/recreation/conservation. Collectively, these two land use categories account for roughly 90% of the total land area in the basin. The developed areas within the basin are associated with the cities of Kingsland and St. Marys, much of which is in the form of residential. The residential development is served by sanitary sewer within the city limits. The majority of residential development within the County is served by septic systems. There is little commercial and industrial development within this watershed.

The future land use strategy, coupled with projected population growth in the area indicate that residential development will occur within the basin. The Future Development Map shows a mix of suburban residential growth and conservation land in the area immediately bordering the listed segment of the St Marys River. The current land use trends based on the NLCD are illustrated in Figure 7.

Figure 7 - Land Cover



Open Water	Vegetated
Developed, Open Space	Shrub/Scrub
Developed, Low Intensity	Grassland
Developed, Medium Intensity	Pasture/Hay
Developed, High Intensity	Cultivated/Crops
Barren Land	/Wetlands/Wooded
Deciduous Forest	Emergent Wetlands
Evergreen Forest	

N

Watershed Management Plan

St. Marys River
from Catfish Creek to Millers Branch

Legend

- Impaired Segment
- Huc12 Watershed
- Roads
- Streams & Waterways

Waterbody and Watershed Conditions

Visual Stream Survey

The purpose of a visual survey is to determine if there are observable problems in or on the stream and to characterize land uses and the environment through which the river flows. The visual survey helps pinpoint areas that may be the source of water quality impairments and determine the overall condition of the stream.

Visual stream surveys of the six-mile impaired segment of the St. Marys River were conducted in March and April 2011 by a team of committee members, including representatives from the Georgia EPD. The visual surveys and on-ground assessments focused primarily on the developed areas of the watershed. While some commercial and industrial facilities were identified as discussed below, the majority of the watershed is undeveloped or developed for residential use. Photographs were taken during the visual stream surveys to document stream conditions and adjacent land uses. Sampling was also conducting during the visual surveys to document water conditions. Photographs, summaries of the visual surveys, and sampling results were included in the 2011 WIP prepared by the CRC for the St. Marys River. A copy of this plan is included in Appendix B. Sampling results are also discussed in this report in the section titled "Local Water Quality Data."

An initial visual stream survey was conducted on March 28, 2011. Committee members reviewed maps of the watershed and discussed existing infrastructure and development activities that should be assessed during this portion of the visual stream survey, which was conducted by automobile. The watershed west of I-95 was observed to be primarily residential within Kingsland city limits with commercial developments concentrated along Georgia Highway 40 and U.S. Highway 17. The City of Kingsland provides sanitary sewer services to residents within its city limits; wastewaters from the City's WPCP are discharged to a marsh and not directly to the St. Marys River and therefore a point source discharge could not be surveyed. There were several rural developments outside of the Kingsland city limits that were not provided with sanitary sewer services, including developments west of U.S. Highway 17 and a few developments located between the City of Kingsland and the St. Marys River. These included a trailer park and the riverbank development in the Scrubby Bluff area immediately west of Interstate 95.

On April 8, 2011, Committee members conducted a visual stream assessment by boat and by automobile. The boat assessment identified three houses adjacent to the riverbank upstream of U.S. Highway 17, two of which were located in Florida and one of which was located in Georgia. The Florida riverbank was marshy with little rural residential development in the upland drainage. On the Georgia riverbank, most of the segment reach was marsh with residential development

in the Scrubby Bluff area, immediately west of Interstate 95. The oldest part of the City of St. Marys and a marina were located further downstream.

The on-ground assessment on April 8, 2011 focused on the watershed east of Interstate 95. Existing and future commercial developments were observed along Georgia Highway 40 east of Interstate 95, including strip shopping centers, hotels, retail stores, and a cement plant. Scattered residential development and several large, undeveloped tracts of land were present between GA Highway 40 and the St. Marys River.

Potential sources that may contribute oxygen-demanding pollutants (thereby reducing levels of DO) were identified during the visual surveys. These included several residential subdivisions, industrial and commercial facilities, and two WPCPs (the City of Kingsland- St. Marys WPCP and City of St. Marys – Scrubby Bluff WPCP).

State Water Quality Monitoring Data

The GA EPD collected samples from the St. Marys River at Interstate 95 (EPD Station 08011021) in 2003 that resulted in the St. Marys River's placement on the State's 303(d) list (Figure 1). Thirteen samples, collected between January and July 2003, were analyzed to determine DO levels. Water temperatures were also recorded. DO levels ranged between 2.87 to 9.33 mg/l. DO levels were highest (approximately 9 mg/l) when water temperatures were the lowest (approximately 11 degrees Celsius) in January and February 2003. Four of the thirteen samples, collected in late March and June 2003, had DO levels below the established water quality standard of 4.0 mg/l; water temperatures for these four samples ranged between 20 to 28 degrees Celsius (Appendix A).

Various analyses were performed to correlate the measured low DO concentrations to basic causes such as point and nonpoint contributions, flow conditions, stream and watershed characteristics, seasonal temperature effects, and other parameters. From these analyses, the Georgia EPD determined that low DO values were found to coincide with higher water temperatures during summer months. Figure A-1, included in Appendix A, shows the inverse relationship between DO and water temperature.

The CRD also monitors water quality at various locations throughout the State, including the St. Marys River. The CRD currently monitors five sampling stations (Stations 302 through 306) by boat along the St. Marys River, three of which (Stations 303, 304, and 305) are located within the listed segment of the St. Marys River. (The CRD's Station 304 is the same sampling site as the original EPD Sampling Station 08011021). Table 7 below and Figure 9 identifies the locations of the CRD sampling sites and the parameters monitored. The CRD submits the data collected every two years to the EPD for 305(b)/303(d) listing assessments. At the time of this Plan, CRD

monitoring efforts are ongoing and expected to continue as long as funding is available to support these monitoring efforts.

Table 7: CRD Sampling Sites – St. Marys River

Site	Site Description	Latitude	Longitude	Parameters Monitored[a]
302	Upstream of Highway 17/25 crossing of St. Marys River	30.747	81.700	DO, pH, temperature, salinity, conductivity, nutrients, fecal coliform
303	At Giffen Bluff Road	30.755	81.665	DO, pH, temperature, salinity, conductivity, nutrients, fecal coliform
304[b]	Interstate 95 intersection with St. Marys River	30.472	81.653	DO, pH, temperature, salinity, conductivity, nutrients, fecal coliform
305	Downstream of Interstate 95, near Lower Sister Creek	30.728	81.643	DO, pH, temperature, salinity, conductivity, nutrients, fecal coliform
306	At Crandall Road	30.724	81.619	DO, pH, temperature, salinity, conductivity, nutrients, fecal coliform

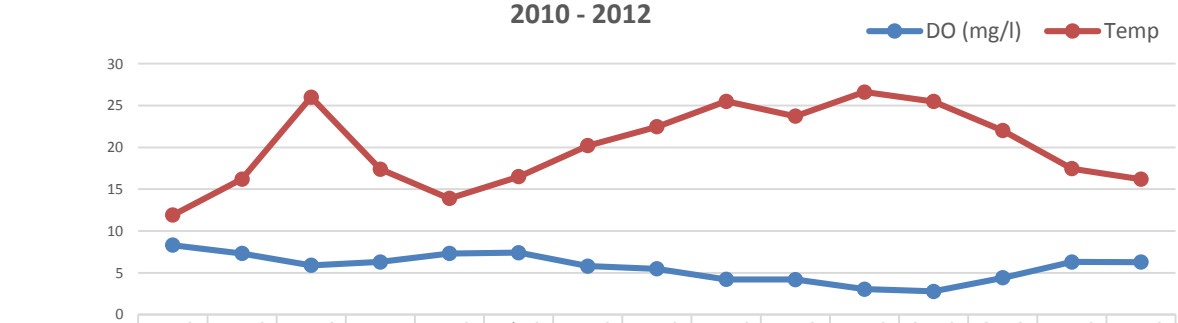
[a/] Parameters listed for 2010-2012 data. Data collected prior to 2010 was analyzed for pH, DO, temperature and salinity only for Stations 303, 304, and 305.

[b]CRD's Station 304 is the same sampling site as the original EPD Sampling Station 08011021 that was initially sampled in 2003 and resulted in the St. Marys River's placement on the State's Section 303(d) list.

Water quality data collected at these five stations in 2010, 2011, and 2012 is included in Appendix E. Approximately fifteen samples at each of these five stations were collected between 2010 through 2012. For each of the five stations, the only DO levels below the state water quality standard of 4.0 mg/l were recorded in July, August, and September 2012, when water temperatures were the highest (between 25 to 30 degrees Celsius). In general, the observed trend was that DO levels decreased as water temperature increased, with higher DO levels occurring during colder months of the year. Figures 8 through 12 depict the inverse relationship between DO levels and temperature and identifies the DO levels for each sampling event.

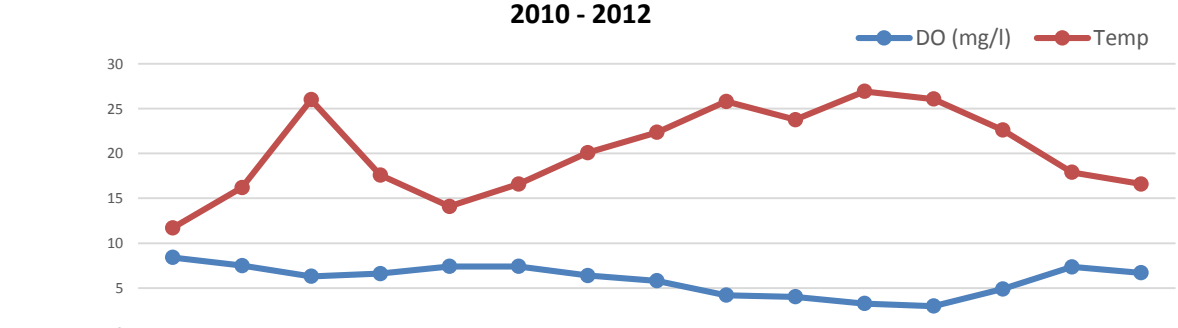
Figure 8 - CRD Sampling Data
Station 302
2010 - 2012

Lat. and Long.
30.747, 81.700



	Jan-10	Mar-10	May-10	Dec-11	Jan-12	Feb-12	Mar-12	Apr-12	May-12	Jun-12	Aug-12	Sep-12	Oct-12	Nov-12	Dec-12
DO (mg/l)	8.3	7.3	5.9	6.3	7.3	7.4	5.8	5.48	4.2	4.18	3.05	2.78	4.4	6.3	6.28
Temp	11.9	16.2	26	17.4	13.9	16.5	20.2	22.46	25.5	23.72	26.62	25.49	22	17.46	16.18

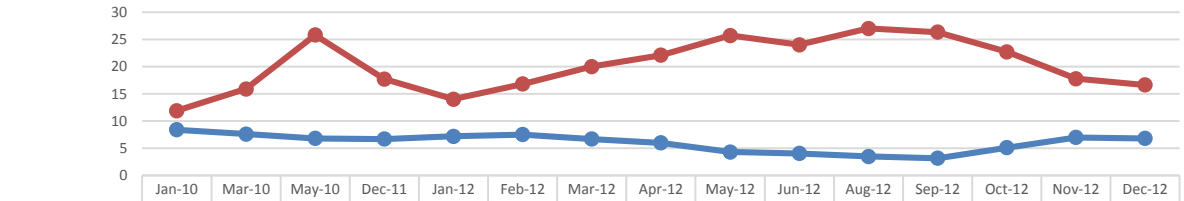
Figure 9 - CRD Sampling Data
Station 303
2010 - 2012



	Jan-10	Mar-10	May-10	Dec-11	Jan-12	Feb-12	Mar-12	Apr-12	May-12	Jun-12	Aug-12	Sep-12	Oct-12	Nov-12	Dec-12
DO (mg/l)	8.4	7.5	6.3	6.6	7.4	7.4	6.4	5.81	4.2	4.02	3.27	2.98	4.9	7.35	6.7
Temp	11.7	16.2	26	17.6	14.1	16.6	20.1	22.36	25.8	23.76	26.92	26.06	22.6	17.89	16.59

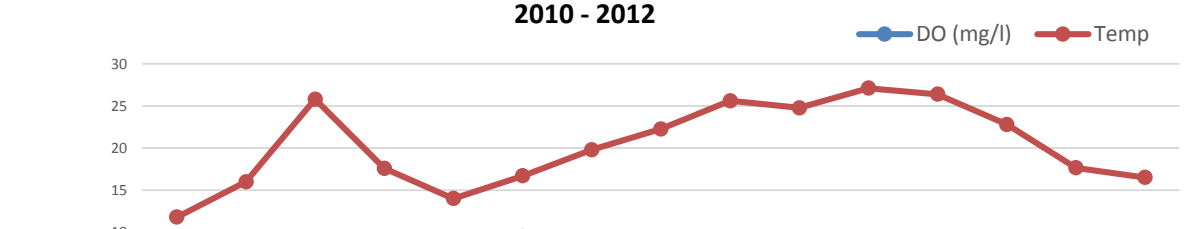
Figure 10 - CRD Sampling Data
Station 304
(EPD Station 08011021)
2010 - 2012

Lat. and Long.
30.742, 81.653



	Jan-10	Mar-10	May-10	Dec-11	Jan-12	Feb-12	Mar-12	Apr-12	May-12	Jun-12	Aug-12	Sep-12	Oct-12	Nov-12	Dec-12
DO (mg/l)	8.4	7.6	6.8	6.7	7.2	7.5	6.7	5.98	4.3	4.03	3.48	3.15	5.1	6.97	6.82
Temp	11.9	15.9	25.8	17.7	14	16.8	20	22.1	25.7	24	27	26.32	22.7	17.76	16.62

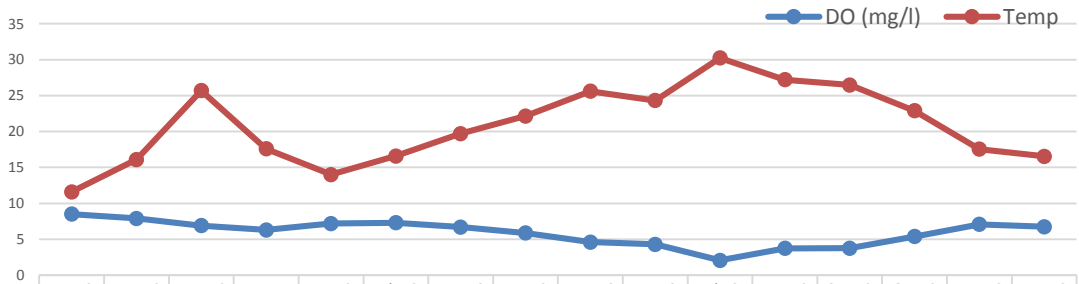
Figure 11 - CRD Sampling Data
Station 305
2010 - 2012



	Jan-10	Mar-10	May-10	Dec-11	Jan-12	Feb-12	Mar-12	Apr-12	May-12	Jun-12	Aug-12	Sep-12	Oct-12	Nov-12	Dec-12
DO (mg/l)	8.6	7.6	6.3	6.7	7.2	9.5	6.8	6.41	4.2	4.08	3.86	3.44	5.21	6.99	6.8
Temp	11.8	16	25.8	17.6	14	16.7	19.8	22.26	25.6	24.77	27.1	26.39	22.8	17.65	16.52

Figure 12 - CRD Sampling Data
Station 306
2010 - 2012

Lat. and Long.
30.724, 81.619



	Jan-10	Mar-10	May-10	Dec-11	Jan-12	Feb-12	Mar-12	Apr-12	May-12	Jun-12	Jul-12	Aug-12	Sep-12	Oct-12	Nov-12	Dec-12
DO (mg/l)	8.5	7.9	6.9	6.3	7.2	7.3	6.7	5.87	4.6	4.31	2.08	3.75	3.77	5.4	7.09	6.75
Temp	11.6	16.1	25.7	17.6	14	16.6	19.7	22.15	25.6	24.32	30.25	27.22	26.48	22.9	17.55	16.55

The CRD also collected water quality data at Stations 303, 304, and 305 between 2002 and 2009. This data is included in Appendix F. In general, DO levels below the state water quality standard of 4.0 mg/l were recorded most often in June through September, when water temperatures were the highest (between 25 to 30 degrees Celsius). DO levels were highest when water temperatures were the lowest during colder months of the year.

Local Water Quality Data

Local water quality data was collected as part of a visual stream survey conducted in April 2011. The visual stream survey was conducted by a group of local community members and stakeholders and is discussed in further detail in the section of this report titled "Waterbody and Watershed Conditions." Results for the data collected during the visual stream survey are included in the 2011 WIP prepared by the CRD for the St. Marys River (Appendix B).

During the April 8, 2011 visual survey, 16 site locations along the St. Marys River were monitored for various parameters, including DO, salinity, and water temperature using two water meters. DO levels ranged from 5.50 to 7.40 mg/l; water temperatures were between 20 and 21 degrees Celsius. All of these levels were in compliance with Georgia EPD's water quality standards for DO.

The CRC and its consultant EPG, in partnership with the CRD and Watershed Protection Branch of the GA EPD, also conducted water quality monitoring within the St. Marys watershed to help identify any potential causes of DO impairment in the St. Marys River. Water quality monitoring was conducted in accordance with the 2013 Target Watershed Monitoring Plan for St. Marys River, Catfish Creek to Millers Branch included in Appendix G.

Water quality data was collected at five sites within the St. Marys watershed, including the St. Marys River, Catfish Creek and Millers Branch between May through September 2013. This data is included in Appendix H. Table 8 below and Figure 9 show the locations of the sampling sites. (Four of the five sampling sites were also monitored by the City of Kingsland and the City of St. Marys as part of their Watershed Assessments, which is discussed in the next section of this Plan.) In addition to DO, water temperature, salinity, pH, conductivity, total dissolved solids, and turbidity were recorded for the eight sampling events. The direction of the tide (ebb or flood) and the weather (cloudy, windy, rainy, sunny, etc.) were also noted.

Table 8: EPG Sampling Sites – St. Marys River Basin

Site	**Site Description**	**Latitude**	**Longitude**	Parameters Monitored
CC01[(a)]	Catfish Creek at Clarks Bluff Road	30.779136	81.706787	DO, temperature, salinity, pH, conductivity, total dissolved solids, and turbidity
LCC01[(a)]	Little Catfish Creek at Scrubby Bluff Road	30.780419	81.685383	DO, temperature, salinity, pH, conductivity, total dissolved solids, and turbidity
MC01[(a)]	May Creek at Scrubby Bluff Road	30.772518	81.665996	DO, temperature, salinity, pH, conductivity, total dissolved solids, and turbidity
2D[(b)]	Millers Branch at the Osprey Drive Crossing	30.749557	81.616424	DO, temperature, salinity, pH, conductivity, total dissolved solids, and turbidity
SM-1	HWY 17 crossing of the St. Marys River	30.742064	81.687812	DO, temperature, salinity, pH, conductivity, total dissolved solids, and turbidity

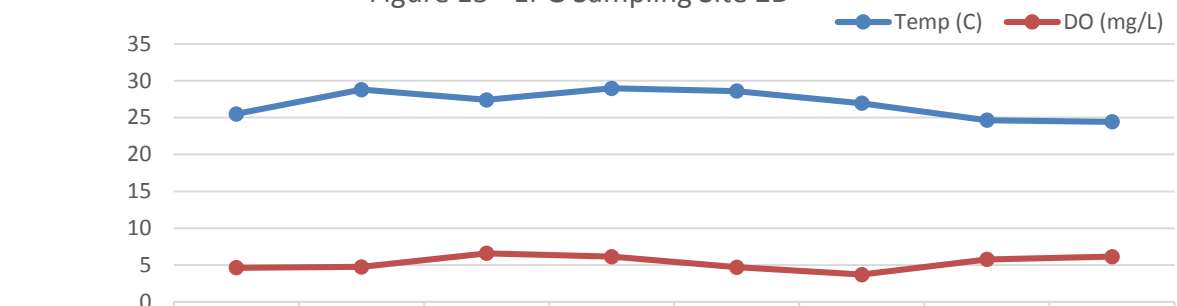
[a] Sampling sites correspond to sampling sites also monitored during the City of Kingsland's Watershed Assessment.

[b] Sampling site corresponds to sampling site also monitored during the City of St. Mary's Watershed Assessment.

Twenty-seven of the forty samples collected as part of this monitoring program had DO levels below the state water quality standard of 4 mg/l; this data is shown and graphically depicted in Figures 13 through 17. Sites 2D and MCO1 had higher levels of DO than the rest of the sampling sites, with only 3 of 24 samples below the water quality standard. The remaining three sites, CCO1, LLCO1, and SM1, had DO levels below 4 mg/l for all sampling events. DO levels in general

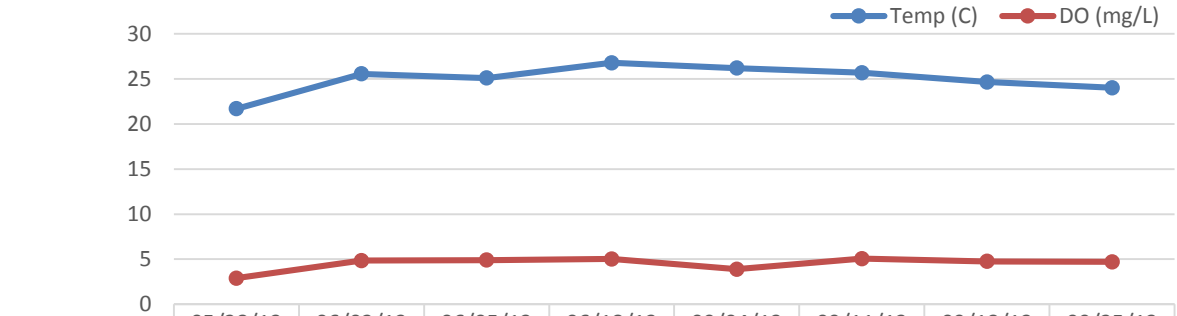
ranged between 3 to 6 mg/l while water temperatures ranged between 21 and 29 degrees Celsius.

Figure 13 - EPG Sampling Site 2D



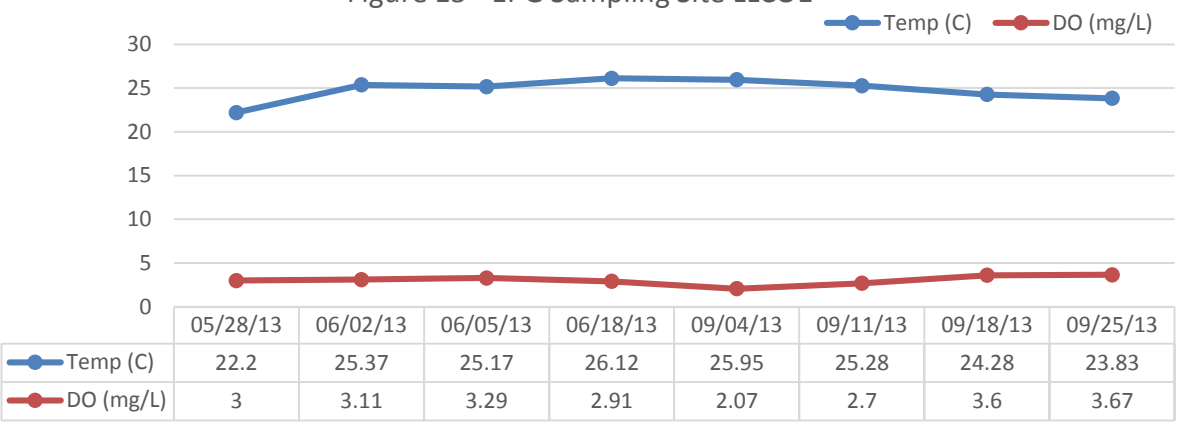
	05/28/13	06/02/13	06/05/13	06/18/13	09/04/13	09/11/13	09/18/13	09/25/13
Temp (C)	25.5	28.8	27.4	28.97	28.6	26.96	24.66	24.44
DO (mg/L)	4.65	4.76	6.59	6.15	4.7	3.72	5.78	6.13

Figure 14 - EPG Sampling Site MCO1



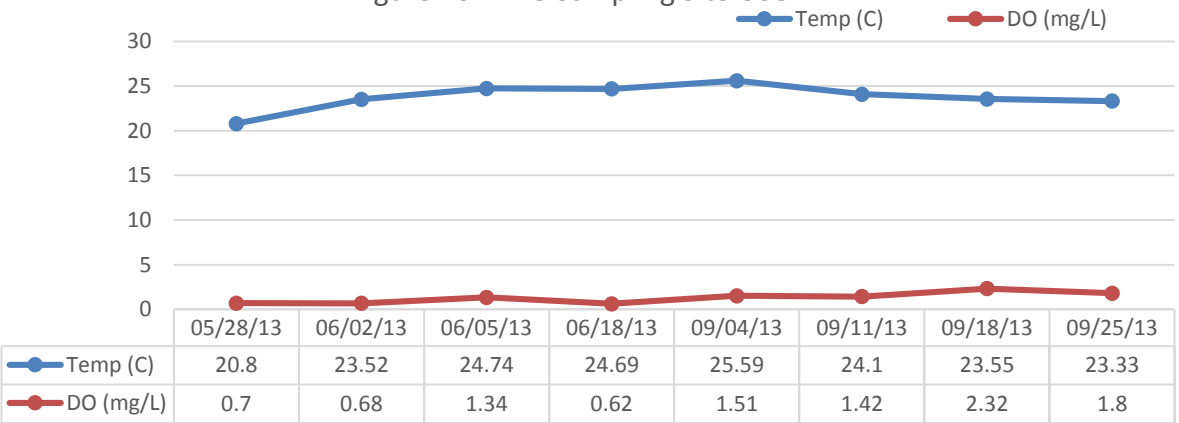
	05/28/13	06/02/13	06/05/13	06/18/13	09/04/13	09/11/13	09/18/13	09/25/13
Temp (C)	21.7	25.56	25.11	26.8	26.2	25.69	24.66	24.02
DO (mg/L)	2.89	4.84	4.89	5.03	3.88	5.05	4.76	4.7

Figure 15 - EPG Sampling Site LLCO1



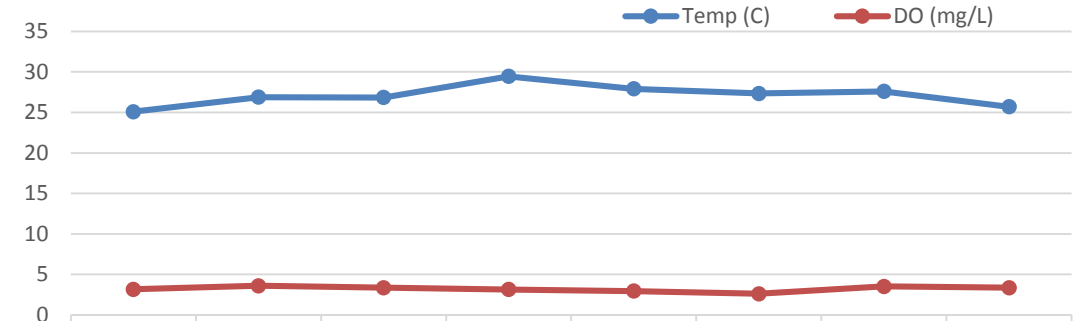
	05/28/13	06/02/13	06/05/13	06/18/13	09/04/13	09/11/13	09/18/13	09/25/13
Temp (C)	22.2	25.37	25.17	26.12	25.95	25.28	24.28	23.83
DO (mg/L)	3	3.11	3.29	2.91	2.07	2.7	3.6	3.67

Figure 16 - EPG Sampling Site CCO1



	05/28/13	06/02/13	06/05/13	06/18/13	09/04/13	09/11/13	09/18/13	09/25/13
Temp (C)	20.8	23.52	24.74	24.69	25.59	24.1	23.55	23.33
DO (mg/L)	0.7	0.68	1.34	0.62	1.51	1.42	2.32	1.8

Figure 17 - EPG Sampling Site SM1



	05/28/13	06/02/13	06/05/13	06/18/13	09/04/13	09/11/13	09/18/13	09/25/13
Temp (C)	25.08	26.88	26.85	29.46	27.92	27.34	27.59	25.71
DO (mg/L)	3.17	3.6	3.38	3.16	2.96	2.63	3.52	3.37

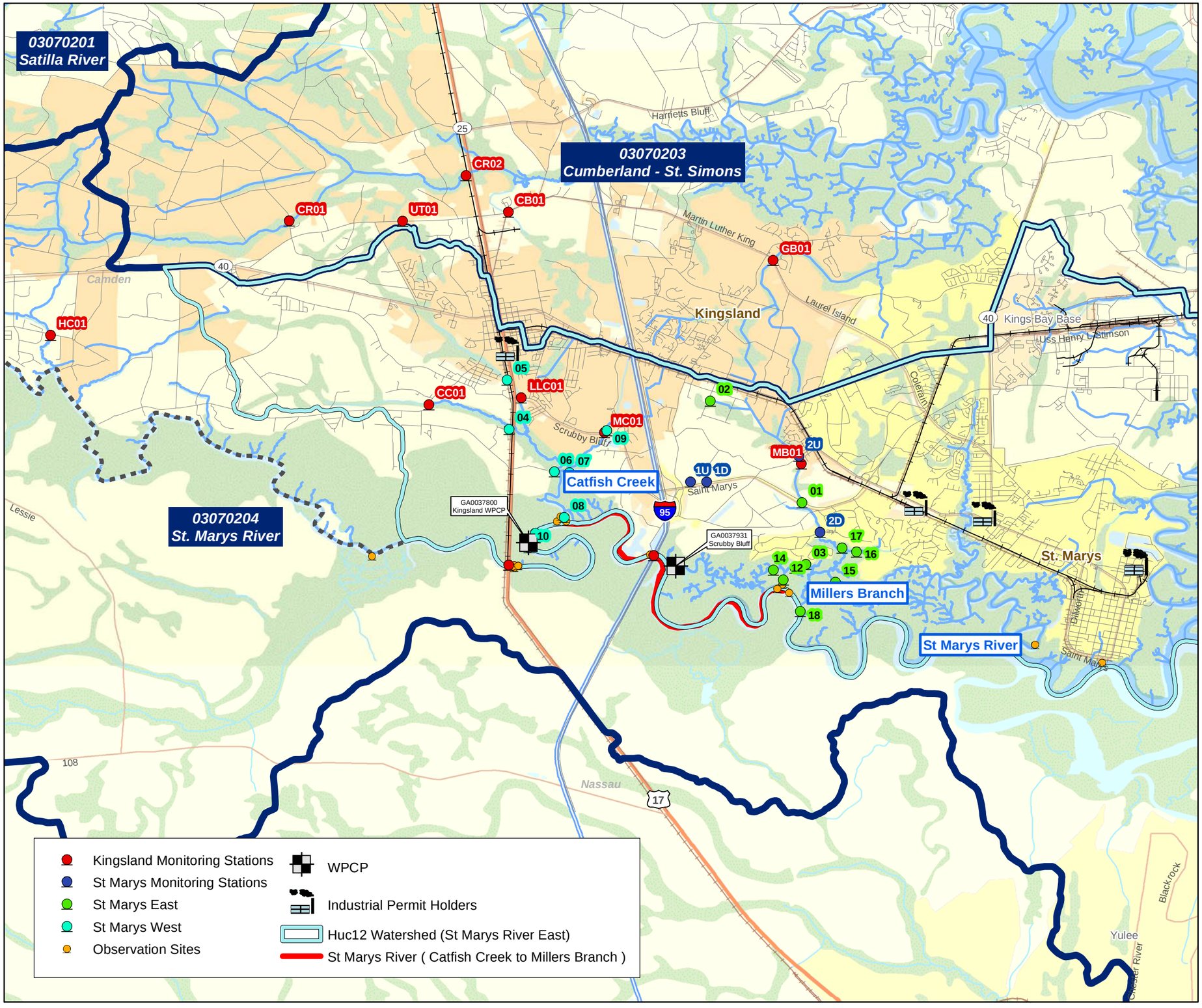
City of Kingsland Watershed Protection Plan and Watershed Assessment

The City of Kingsland is located north of the St. Marys River in Camden County, Georgia. The jurisdictional boundaries of the City of Kingsland fall within several watersheds, including the St. Marys River watershed. In 2007-2008, the City of Kingsland conducted a Watershed Assessment (WSA). The WSA was required for renewal of the City's NPDES permit associated with the expansion of its WPCP. Results of the WSA were used to develop the City's Watershed Protection Plan (WPP) which identified watershed management activities that could address potential water quality issues.

As part of the City's WSA, water quality monitoring, including measurements of DO levels, was conducted at ten stations by the City of Kingsland in February through July 2007. Four of the stations were located within the St. Marys River Basin. These sampling locations are identified on Figure 8. Three of these sampling stations, Stations CC01, LLCO1, and MCO1, were also monitored by EPG in 2013 as discussed above.

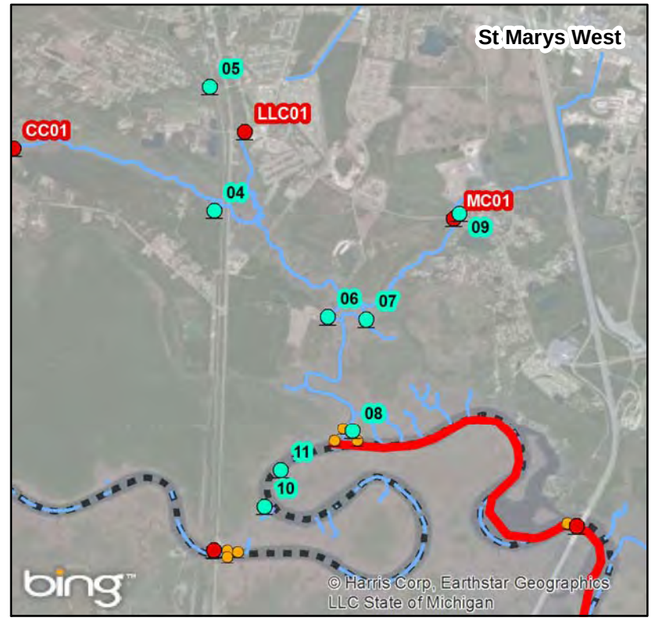
Two of the stations (Stations CC01 and LLCO1) showed significant DO impairment; 14 out of 15 samples taken at these two stations had DO levels below 4.0 mg/l. Three of seven samples and one of five samples collected at Stations MBO1 and MC01, respectively, fell below the state standard. Based upon the watershed monitoring results, the Assessment concluded that the most significant source of pollution within and surrounding the Kingsland service area appeared to be tied to nonpoint source pollution from land use and land cover change.

Figure 18 - Sampling Locations for City of Kingsland and City of St. Marys



Watershed Management Plan

St. Marys River from Catfish Creek to Miller's Branch



Legend

- Railroads
- Roads
- Rivers & Streams
- Kingsland
- St. Marys
- HUC 8 Watersheds

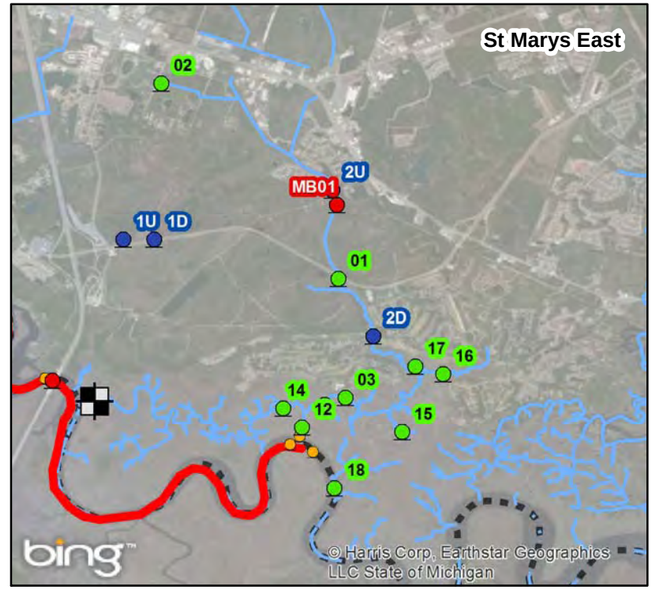
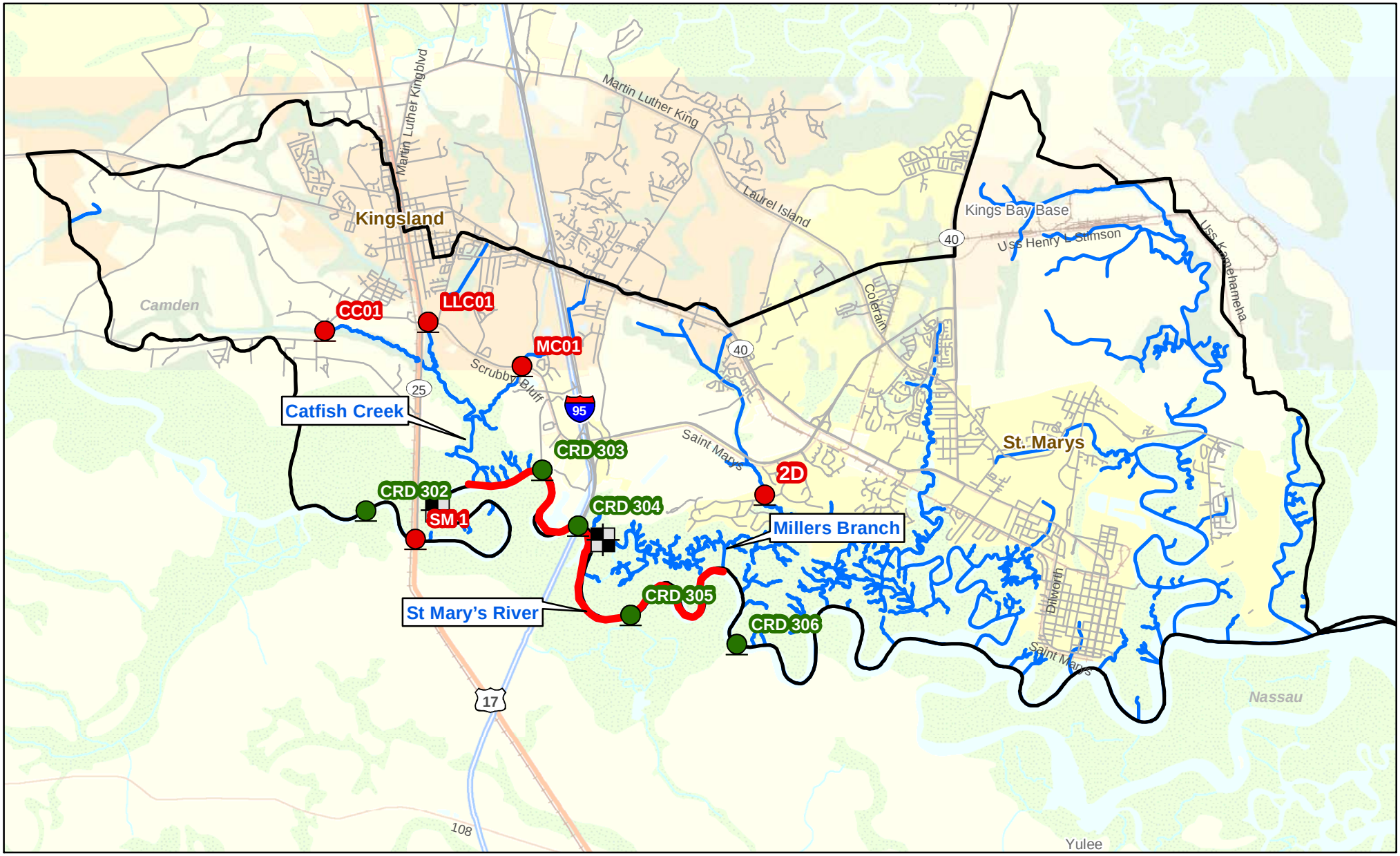


Figure 19 - Sampling Locations for CRD and EPG



CRD Sampling Locations
EPG Sampling Locations
WPCP

N

Watershed Management Plan

St. Marys River
from Catfish Creek to Millers Branch

Legend
- Roads
- Impaired Segment
- Streams & Waterways
- Huc12 Watershed

City of St. Marys Watershed Protection Plan and Watershed Assessment

The City of St. Marys is located north-northeast of the St. Marys River in Camden County, Georgia, part of which is located within the St. Marys River watershed. The City of St. Marys conducted a WSA in 2008. The Assessment was required for renewal of the City's NPDES Wastewater Discharge permit. Results of the WSA were used to develop the City's WPP which identified watershed management activities that could address potential water quality issues

The City of St. Marys began monitoring 4 stations, Stations 1U, 1D, 2U, and 2D, in 2007; these stations are identified on Figure 8. (It should be noted that Station 2D was also monitored by EPG in 2013 as discussed above.) Monitoring was discontinued in 2008 for Station 1U, and in 2010 for 2U. Monitoring continued from 2007 through 2012 for Stations 1D and 2D.

Over 50% of the samples collected for Stations 2U and 2D had DO levels below the state water quality standard of 4 mg/l. Every sample but one for Stations 1U and 1D had DO levels below the state standard. In general, DO levels increased (even though many still remained below 4 mg/l) as water temperatures decreased, again suggesting an inverse relationship between DO and water temperature.

Water Quality Data Gaps

As discussed above, the water quality data collected by the Georgia EPD and CRD for the St. Marys River indicates that DO levels may naturally fluctuate on a seasonal basis. The general trend observed was that DO levels decreased in warmer months as water temperatures increased. However, informational, temporal, and spatial data gaps have been identified that require further analysis to adequately identify and characterize causes and sources of pollutants in the St. Marys Watershed.

It has been well established within the scientific community that warmer water holds less DO than equivalent volumes of cooler water (particularly warm, salty water), and that blackwater streams often have low DO levels during warm summer months when water flows are lower. Given these facts, valuable information about natural DO fluctuations can be gained by monitoring DO levels at different times of the year (i.e., seasonally during both cold and warm months) when water temperatures show a marked change between sampling events.

Water quality data for sites CC01, LCC01, MC01, 2D, and SM-1 was collected by EPG on behalf of the CRC in May through September 2013 when water temperatures were relatively warm for all of the sampling events. Water flows were often low or nonexistent when samples were collected. Therefore, seasonal variations in DO levels were not able to be evaluated and it is not clear whether DO levels were naturally low because of warmer water temperatures and low flow conditions (which is suspected) and/or if DO levels were impaired because of other factors.

Additional water quality data is needed to more accurately assess the water quality, including seasonal DO variations, of the tributaries of the St. Marys River, including Catfish Creek, Little Catfish Creek, May Creek, and Millers Branch.

DO levels also naturally fluctuate over a 24-hour period. DO is lower at night when photosynthesis ceases and can vary up to 1 to 3 mg/l from dawn to dusk. None of the data collected thus far included an hourly time profile to assess natural fluctuations of DO in a 24-hour period.

It is also important to consider that DO levels may also fluctuate because of other natural occurrences. During meetings with the WAC, members identified the following factors that may affect DO levels in the St. Marys River. A comprehensive evaluation of DO would need to address these factors:

- Decrease in DO from metabolism of organic substances in the water and mud;
- Decrease in DO from inorganic-oxidation reduction (redox) reactions with anaerobic mud upon mechanical disturbance of the sediment;
- Decrease in DO (or rarely increase) from physical mixing with runoff of surface water with a different level of DO than the river water;
- Decrease in DO or sometimes increase from physical mixing with seepage of groundwater with a different level of DO into the overlying river water.

Tidal marsh creeks are widely thought to contribute large amounts of organic matter, which are decomposed by microorganisms that use oxygen in the process. The amount of oxygen consumed by these organisms in breaking down the organic matter is known as BOD. Therefore, measuring BOD levels as well as DO levels can provide important information potential causes of DO impairment.

Land Management Ordinances and Activities

A suite of land management ordinances are used by the local governments in the watershed, including Camden County, the City of St. Marys and the City of Kingsland. A number of ordinances are model ordinances developed by the State of Georgia and require property owners to meet state standards regarding stream buffers (25 feet), require protection of wetlands, require larger lot sizes in groundwater recharge areas where there is no public sewer, regulate land-disturbing activities, and regulate post-construction stormwater management, etc. Zoning ordinances typically have the greatest variation among jurisdictions, but all zoning is intended to regulate land uses and their location relative to other uses in order to reduce the potential for conflict. A list of land management ordinances designed to directly or indirectly

protect water quality, as well as the jurisdiction which has adopted these ordinances, is in Table 9 below.

Table 9: Land Management Ordinances

Ordinance	Camden County	City of St. Marys	City of Kingsland
Erosion and Sedimentation Control	X	X	X
Flood Damage Prevention	X	X	X
Post Construction Stormwater Control (Coastal Stormwater Supplement)			X
Wetland Protection	X	X	X
Groundwater Recharge	X	X	X

Several voluntary programs and land development guidelines have been developed specific to the coastal region of Georgia. The manuals/programs are designed to provide standards for new development and redevelopment that reduce the negative impact of land development on water quality. A brief summary of these manuals/programs is listed below:

1. **Coastal Stormwater Supplement (CSS) to the Georgia Stormwater Management Manual:** This manual represents the state's efforts to provide for the implementation of the federally established "management measures" related to new development, watershed protection and site development (USEPA, 1993). Specifically, it provides guidance on using environmentally sensitive better site planning and design techniques, small-scale, low impact development practices and traditional stormwater management techniques (e.g., detention) to:

    a. Reduce the total suspended solid loads contained in post-construction stormwater runoff by 80 percent, as measured on an average annual basis
    b. Maintain pre-development site hydrology
    c. Preserve areas that are particularly susceptible to erosion and sediment loss
    d. Preserve areas that provide important stormwater management benefits and/or provide valuable habitat for aquatic and terrestrial organisms
    e. Protect the integrity of streams, wetlands and other natural drainage features
    f. Limit land disturbing activities, such as clearing and grading and cutting and filling, to protect existing vegetation and reduce erosion and sediment loss
    g. Limit increases in site imperviousness

    In providing for the implementation of these "management measures," this CSS lays the foundation for an integrated, green infrastructure-based approach to natural resource protection, stormwater management and site design that can be used to protect coastal

Georgia's unique and vital natural resources from the negative impacts of the land development process. The CSS also provides a model ordinance to be adopted by local governments that will establish a development review and site plan approval that is consistent with the recommendations of this manual. This ordinance and/or the standards set forth in the CSS have not yet been adopted by all local governments in the St. Mary's watershed; however, it is recommended that they do so.

2. **Green Growth Guidelines:** This manual was developed by the CRD to demonstrate how low impact development (LID) strategies can result in significant positive impacts on the environment while providing superior outcomes both socially and economically. Green Growth Guidelines outlines the environmental, social, and economic benefits from use of LID strategies when compared to today's conventional development approach.

3. **Watershed Assessments and Watershed Protection Plans:** As previously mentioned, the Cities of St. Marys and Kingsland have both completed WSAs and developed WPPs in compliance with their NPDES Wastewater Discharge Permits. WPPs include a description of the legal authority, funding, pollutant sources, and BMPs necessary to address any identified sources of impairment within the Sanitary Sewer Service Area. In addition, a long-term water quality monitoring program is also established.

   In order to ensure consistency between various watershed management activities conducted within the St. Marys River Basin, both the Kingsland and St. Marys WSAs and WPPs were reviewed during the development of this Plan. The monitoring data, applicable BMPs, and long term monitoring programs were incorporated as appropriate.

4. **Septic System GIS Inventory and Visual Inspection:** Initiated by Georgia's Coastal Nonpoint Source Advisory Committee, a multi-phase 319 Clean Water Act project was designed to identify, inspect and map priority septic systems in 11 coastal Georgia counties, including Camden. Priority systems were those systems which were in close proximity to environmentally sensitive areas where conditions would make failure more likely or where failure would have a more detrimental environmental impact. This project was implemented by a partnership that included the University of Georgia (UGA) Marine Extension Service (MAREX), the Coastal Health District, the local County Health Departments, the South Georgia Regional Commission (SGRC) and the Georgia EPD Coastal Non-Point Source Program. All data collected was placed in SGRC's web-accessible geo-referenced WelSTROM database. The project also assisted Camden and McIntosh Counties in transferring historical septic system data into the WelSTROM Geographic Information System (GIS) database. The database provides a standardized

method of recording all existing and future septic system installations and inspections within the eleven coastal counties.

In addition to geo-locating priority septic system, an inspection of each septic system was conducted to identify potential signs of failure. Since local County Health Department staff were conducting the inspections, immediate enforcement action was initiated to ensure that identified failing systems were repaired or replaced according to Georgia statute. In Camden County, 2,817 total septic system records were entered into the GIS database which included 512 inspections and field geo-locations. Through this GIS analysis, a GIS database was created for the coastal nonpoint source area that includes the following layers:

a. Floodplain Data (Federal Emergency Management Agency)
b. National Wetlands Inventory Data (U.S. Fish & Wildlife Service)
c. State Soil Geographic Data (United States Department of Agriculture-Natural Resource Conservation Service)
d. Pollution Susceptibility (Georgia Geologic Survey)
e. Geology (Georgia Department of Natural Resource)
f. Ground Water Recharge Zones (Georgia Department of Natural Resource)
g. Licensed Shellfish Bed (Georgia Department of Natural Resources)
h. Parcel density

This GIS database is a tool that is now available to all County Health Departments to provide more comprehensive information for staff to make decisions regarding septic tank locations, design, and any need for advanced treatment.

5. **University of Georgia River Basin Center Septic System Retrofit Program:** Four miles of Horsepen Creek are included in Georgia's 2012 305(b)/303(d) Listing Documents. The TMDL identified nonpoint pollution sources as the source of this contamination, specifically failing septic systems. The TMDL also considered the impacts of other nonpoint sources such as wildlife, since the St. Marys River basin has a significant deer population, and agricultural livestock as the area does contain some pasture land. This project sought to assess and remediate the septic contributions to these elevated bacteria levels.

   The overarching purpose of this project was to assess the extent to which failing septic systems are contributing to fecal coliform levels in Horsepen Creek and to devise a strategy to reduce septic system failure in this area. To that end, this project had four

objectives: 1) Investigate the extent that failing septic systems contribute to the fecal coliform levels in Horsepen Creek; 2) Install one new septic system as a demonstration project in the challenging conditions found in much of Camden County; 3) Develop a comprehensive septic maintenance strategy for the local community, and 4) Conduct a public outreach campaign to support the septic management strategy.

As part of this project, the UGA River Basin Center held two public outreach events and made two public presentations to the Camden County Board of Commissioners. The septic system investigation consisted of review of county septic records, interviews with local residents, and inspections of 16 septic systems in the Horsepen Creek watershed. A demonstration project was installed at the Temple Landing Park on the St. Marys River near Horsepen Creek using an Eljen Geotextile Sand Filter System, a mounded drainfield, and a dosing pump. The comprehensive septic management strategy consists of five action items:

- Recommendation #1: Build upon past mapping efforts and the development of the Welstrom database to develop a full inventory of septic systems in Camden County.
- Recommendation #2: Leverage State and Federal Funding to Conduct a Broad Septic Assessment, Repair, and Upgrade Program.
- Recommendation #3: Develop a Local Water Quality Monitoring Program to Improve Understanding of the Sources of Contamination and Local Hydrology.
- Recommendation #4: Consider Land Use and Green Infrastructure Policies to Reduce the Impacts of Failing Septic Systems.
- Recommendation #5: Create an Advisory Committee to Consider a Long-Term Septic Management Policy.

Finally, the UGA River Basin Center recommended that the County make a financial investment in developing its own septage disposal capacity. The most effective means of developing this capacity is most likely partnering with the existing disposal facilities in Woodbine or St. Marys. They could also promote the development of private disposal facilities by private septic haulers or develop a county owned facility.

6. RECOMMENDED BEST MANAGEMENT PRACTICES

There are many management measures currently identified within existing planning documents/programs for Coastal Georgia that may be used to help reduce and/or maintain UOD loads. These include: compliance with the requirements of the NPDES permit program and application of BMPs appropriate to nonpoint sources. The amount of oxygen-demanding substances delivered to a stream is often difficult to determine. Furthermore, the Georgia EPD needs to determine the "natural DO" for the area before it can be determined whether the DO criteria is truly being met through BMP implementation. However, by requiring and monitoring the implementation of these practices, such efforts will improve stream water quality and represent a beneficial measure of TMDL implementation.

While the scope of this Plan is specific to the 6 mile segment of the St. Mary's River from Millers Branch to Catfish Creek, BMPs and other controls often require a more watershed-based approach. Furthermore, the implementation of many of the recommended BMPs would be regional in nature based on the local, regional and State agencies for which they are intended.

Coastal, slow-moving streams, like the St. Marys River, often have natural DO levels below the EPA standard due to their tannic nature and the large amount of organic material that is naturally occurring within these types of river systems. This natural cause of low DO is further compounded by the high water and air temperatures that occur naturally in Coastal Georgia in summer months. A range of potential BMPs are available to address low dissolved oxygen through control of oxygen-demanding substances from potential sources within the St. Mary's watershed.

Potential BMPs

Several planning documents were consulted to identify BMPs to address the various sources identified above, including the Georgia EPD's 2008 TMDL Implementation Plan, the Coastal Regional Water Plan, and CZARA Section 6217 Management Measures, as outlined in the "Guide to Developing a Watershed Management Plan, Georgia Environmental Protection Division Non-Point Source Program," dated June 2012. The 2008 TMDL Implementation Plan evaluated BMPs as they related to the major sources of DO impairment identified within that document. These BMPs have been re-evaluated and updated based on new information that has been gathered since the development of that document. In addition, programs that have been implemented or planned for implementation in the St. Marys watershed since 2008 are also included.

The St. Mary's Watershed is primarily located within the planning area addressed by the Coastal Regional Water Plan, adopted in 2011. The Management Practices identified within the Coastal Regional Water Plan that address DO and/or potential sources of UOD are included in the following Table 10. Wherever feasible, these recommended practices have been addressed through the selected BMPs in Table 11.

Table 10: Applicable Management Practices from Coastal Regional Water Plan

Management Practice Number	Description/Definition of Action
DCAR-10 Restoration Impact on Low Flow Conditions Analysis	Conduct research and identify incentives to restore wetlands and other areas to determine if this practice can improve river flows during shortages to 7Q10 low flows
PSDO-1 Collect Water Quality Data	Data collection to confirm loading and/or receiving stream chemistry
PSDO-2 Point Discharge Relocation	Modification of wastewater discharge location. In areas without shortages to 7Q10 low flow conditions, identify feasibility to move discharge location to higher flow streams with greater assimilative capacity.
PSDO-3 Enhance Point Source Treatment	Upgrade/improve treatment to address low dissolved oxygen conditions in receiving streams
PSAN-1 Ammonia Limits	Implementation of ammonia limits, where applicable
PSAN-2 Enhance Nutrient Treatment	Improve/upgrade treatment for nutrients (phosphorus and/or nitrogen)
PSAN-3 Eliminate Illicit Discharges	Identify and eliminate illicit discharges to surface waters
NPS-1 Study Human Impacts on Water Quality	Data collection/analysis to confirm if dissolved oxygen and/or fecal coliform is human induced
NPS-2 Monitor and Address NPS Nutrient Loading	Support efforts to monitor and determine sources of nutrient loading and other Coastal nonpoint source (NPS) impairments to waters of the State, and upon confirmation of source, develop specific management programs to address these needs
NPSU-1 Control Erosion	Use soil erosion and sediment control measures
NPSU-2 Manage Stormwater Runoff	Stormwater retention ponds, wetlands, swales, filter strips, and bank stabilization to manage runoff and help support river flows (as found in City of Pooler, City of Richmond Hill, and City of Savannah Watershed Protection Plans)
NPSU-3 Increase Stormwater Infiltration	Consider measures to promote increased infiltration of stormwater to reduce nutrient and other pollutant runoff
NPSU-4 Riparian Buffers	Protect and maintain riparian buffers along urban streams
NPSF-1 Support Forestry Commission Water Quality Program	Support Georgia Forestry Commission's (GFC) water quality program consisting of BMP development, education/outreach, implementation/compliance monitoring, and complaint resolution process

Management Practice Number	Description/Definition of Action
NPSF-2 Improve BMP Compliance	Improve BMP compliance through State-wide biennial BMP surveys and BMP assurance exams, Master Timber Harvester workshops, and continuing logger education
NPSF-3 Wetland and Forest Restoration Incentives and Support	Incentives to restore wetlands and historically drained hardwood and other areas. Where applicable, support United States Department of Agriculture incentive programs through the Farm Service Agency and National Resources Conservation Service to restore converted wetlands back to forested conditions.
NPSA-2 Utilize Buffers	Field buffers, riparian forested buffers, and strip cropping to control run-off and reduce erosion
NPSA-5 Wetland and Forest Restoration Incentives	Incentives to restore wetlands and historically drained hardwood and other areas
TMDL-1 Evaluate Impairment Sources	Data collection and confirmation of sources to remove streams listed due to “natural sources”
TMDL-2 Analyze Impaired Segments and Sources	Data collection to refine river/stream reach length for impaired waters; focus on longest reaches to refine location and potential sources of impairments
TMDL-3 Stormwater Management BMPs	Agricultural, Forestry, Rural, and Urban/Suburban BMPs
OCP-1 Engage Local Governments in Stormwater Issues	Encourage local government to develop ordinances and standards to implement and/or update stormwater regulations. Possible resource documents include: Georgia Stormwater Management Manual, Coastal Stormwater Supplement, and Metro North Georgia Water Planning District Model Ordinance.
OCP-2 Green Space Opportunities and Incentives	Identify opportunities for green space on incentive and voluntary basis
OCP-3 Promote Integrated Planning	Encourage coordinated environmental planning (land use, water supply, stormwater, wastewater and compliance with the Environmental Planning Criteria developed pursuant to Part V of the Georgia Planning Act and in the Mountain and River Corridors Protection Act
OCP-4 Local Government Erosion Control Measures	Encourage local governments to implement, inspect, and enforce Erosion and Sedimentation Control Measures

The Coastal Regional Water Plan, and CZARA Section 6217 Management Measures, as outlined in the “Guide to Developing a Watershed Management Plan, Georgia Environmental Protection Division Non-Point Source Program,” dated June 2012, outlines specific management measures that must be implemented within the Coastal NPS area, which includes Camden County. All watershed planning activities carried out in the 11-County Coastal NPS area and funded through Georgia EPD grant funds must take these management measures into account where applicable. Plans developed in other areas or funded through other sources should still consider these management measures when developing watershed based plans. Some management

measures are covered through compliance with applicable NPDES permits but all best practices listed should still be considered, where appropriate.

The management measures are organized into six (6) main categories:

1. Agriculture
2. Forestry (Silviculture)
3. Urban Areas
4. Marinas and Recreational Boating
5. Hydromodification Activities
6. Wetlands, Riparian Areas and Vegetated Treatment Systems

The management measures which are applicable to the St. Mary's River Basin, and could potentially address the sources of BOD, have been considered during the development of the recommended BMPs.

BMP Recommendations

The Advisory Committee, using values of 1 through 5 with 5 being the best or most desirable, ranked the potential management practices listed above. The ranking used the criteria listed below. Per USEPA's "Nine Minimum Elements to Be Included in a Watershed Plan for Impaired Waters Funded Using Incremental Section 319 Funds", the tables include a description of the nonpoint source management measures that will need to be implemented to achieve load reductions as well as a description of the critical areas to which the selected BMPs should be applied. Furthermore, the criteria below include an estimate of the load reductions expected from management measures as well as estimates of the cost/needed financial assistance to implement each BMP. The specific criteria utilized to rank the selected BMPs are as follows:

- BMP Extent – Percentage of sources to which BMP is applicable. (Widespread, scattered, or negligible)?
- BMP Effectiveness – How effective will the management measure be in reducing contamination? What is the load reduction potential (high, medium or low)?
- Cost – Is the practice cost-effective when compared to the impact the measure will have on contamination?
- Public Support – Will the measure have public support?
- Added Benefits – Are there water quality benefits in addition to reduction of BOD?
- CZARA Section 6217 Management Measures – Is the measure consistent with the recommendations and requirements of this program?

The Advisory Committee determined ranking values based on their knowledge of the watershed potential for load reduction, applicability to various sources of BOD, likelihood of stakeholder

support of the individual practice, implementation, and its relative expense to the responsible party. Practices were also evaluated for their benefits relative to cost due to the limited funding available for practice installation. The following table includes the final recommended BMPs as well as their ranking by the WAC. BMPs that were not highly ranked, or were no longer applicable, were eliminated from consideration.

Table 11: St. Mary's 2008 TMDL Implementation Plan BMP Assessment

Applicable BMPs	***BMP Extent***	***BMP Effectiveness***	***Cost***	***Public Support***	***Added Benefits***	***CZARA Section 6217***	***Total Score***
Forestry Management							
Implementation of structural BMPs from "Georgia's Best Management Practices for Forestry – January 1999" (Forestry Manual) Implementation of BMPs from the Forestry Manual will restore natural hydrology and reduce BOD inputs from silvicuture, which is identified as a significant source of BOD in this watershed.	3	5	1	5	5	5	24
Professional Forestry Standards of Practice (OCGA 43-1-19) Failure to practice professional forestry in accordance with generally accepted standards of practice in the Forestry Manual shall constitute unprofessional conduct and be grounds for disciplinary action.	3	5	3	5	5	5	26
Georgia Forestry Commission BMP Assurance Program This program is funded by the Georgia DNR and includes inspections performed by the GFC of active silviculture operations. These surveys are designed to measure the degree to which local forestry sites are complying with BMPs in the Forestry Manual. The goal is to improve Forestry Manual BMP compliance through State-wide biennial BMP surveys and BMP assurance exams, Master Timber Harvester workshops, and continuing logger education.	3	5	3	5	5	5	26
Development Regulation							
Part V Environmental Protection Ordinances for Protected River Corridor, Wetland Protection, and Groundwater Recharge These criteria, as required by the Georgia DNR, will reduce the impacts of new development in the St. Marys watershed through more stringent siting requirements for septic drain fields, protection of wetlands, and limitations of various land use practices within the 100 ft buffer of the St. Marys River. The criteria have been adopted by and	3	3	5	3	5	1	20

Applicable BMPs	*BMP Extent*	*BMP Effectiveness*	*Cost*	*Public Support*	*Added Benefits*	*CZARA Section 6217*	*Total Score*
are enforced by Camden County, St. Marys and Kingsland. In addition the Camden County Health Department (CCHD) implements the requirements of the groundwater recharge ordinance through its septic tank permitting program. These regulations limit the input of nutrients, sediment and other sources of BOD.							
Camden Co, Kingsland, and St. Marys Soil Erosion & Sedimentation (E&S) Control Programs. Camden County, Kingsland and St. Marys are all Issuing Authorities for the Georgia Erosion and Sedimentation Control Program which includes adoption of an ordinance that requires BMPs for erosion and sedimentation control during development. It also requires the protection of a 25 foot naturally vegetated buffer along the St. Marys which will further limit BOD inputs.	3	5	5	5	5	3	26
Implementation of the CSS to the Georgia Stormwater Management Manual Camden County, Kingsland and St. Marys have all adopted ordinances requiring the use of the CSS for design of post construction stormwater management systems and stormwater BMPs. Implementation of the standards in the CSS reduces pollutants in stormwater runoff, including nutrients and sediment, from developed sites.	3	5	5	5	5	5	28
Local Government Land Development Review and Regulation Process Camden County, St Marys, and Kingsland review site plans, issue permits, and inspect sites active construction for compliance with the E&S and Stormwater ordinances. This BMP limits the amount of sediment, and associated BOD, entering local waterways.	3	5	3	3	5	5	24
Watershed/Land Use Planning							
Implementation of Kingsland and St Marys Watershed Assessment & Protection Plans The Cities of Kingsland and St Marys both have completed WSAs and developed WPPs as required by their NPDES Wastewater Discharge Permit. The WPP requires the implementation of structural and non-structural best management practices to control nonpoint source pollution within their sanitary sewer service areas. These plans also include requirements for long-term water quality monitoring of various parameters including DO and BOD.	5	5	1	5	5	1	22

Applicable BMPs	*BMP Extent*	*BMP Effectiveness*	*Cost*	*Public Support*	*Added Benefits*	*CZARA Section 6217*	*Total Score*
Consideration of Camden County Green Print Plan Recommendations The Trust for Public Land developed a Green Print Plan in 2008 for Camden County. The Greenprint is a strategic planning, communication and decision making tool. It applies GIS modeling to help local governments make informed decisions about how they want to grow smartly while promoting land conservation, restoration and resource protection. The BMP recommends that local governments utilize this tool and consider the recommendations contained within when making land use decisions.	3	3	1	5	5	1	18
Implementation and Update of Local Comprehensive Plans and Associated Ordinance Amendments Camden County and the Cities of St Marys and Kingsland adopted a joint Comprehensive Plan in 2008. This plan includes recommendations for natural resources protection, greenspace preservation, and land use regulations that would be protective of local water quality. These local governments are required to update this plan in 2018, and should consider the recommendations of this WMP in the updated Comprehensive Plan.	5	1	3	5	5	1	20
Consideration of Coastal Comprehensive Plan The Coastal Comprehensive Plan was developed in 2008 by the CRC through a comprehensive coastal stakeholder process that included Camden County, St. Marys and Kingsland. The plan has recommendations for implementation of local stormwater management programs and preservation of natural areas which would reduce the nonpoint source inputs of BOD. Furthermore, this plan is utilized in the review of Development of Regional Impact (DRI) by the CRC.	5	1	3	5	5	1	20
Promotion of Green Growth Guidelines The Georgia CRD has developed green growth guidelines to encourage developers to implement smart growth techniques when designing new development. Implementation of these standards in the St. Marys watershed would limit the input of water quality pollutants. Promotion of this tool will result in new developments that have less impact on the St. Marys River.	3	3	5	3	5	5	21
Implement the St. Marys River Management Plan The Vision of this plan is to protect the scenic beauty and ecological health of the St. Marys River watershed for the benefit of present and future generations. This can be	5	3	3	5	5	1	22

Applicable BMPs	*BMP Extent*	*BMP Effectiveness*	*Cost*	*Public Support*	*Added Benefits*	*CZARA Section 6217*	*Total Score*
accomplished through coordinated local action that involves the full spectrum of the basin's citizens and through increased public education efforts that foster greater awareness, appreciation and stewardship of the basin's resources. This plan includes recommended programs to accomplish this goal. Protection of the ecological health of the St. Marys River includes reduction of man-made sources of BOD.							
Support the St. Marys River Management Committee (SMRMC) The SMRMC is an intergovernmental entity of elected and appointed members from four counties along the St. Marys River including Charlton, Camden, Nassau and Baker counties. The committee meets monthly to discuss, develop and implement plans and programs in regard to the St. Marys River. The SMRMC is made up of individuals who are involved because of a personal commitment to the St. Marys River. This Committee provides a means of implementation for the St. Marys River Management Plan.	5	***3***	***3***	5	5	1	22
Septic System Operations & Maintenance							
Apply septic tank installation, design, inspection, and maintenance standards The CCHD permits new construction and repairs of septic system. This work must be complete in accordance with standards established by the Department of Public Health (DPH) that are designed to reduce the risk of failure, thereby limiting the input of nutrients and other BOD substances from septic tank influent.	3	5	3	5	5	5	26
Septic System GIS Inventory and Visual Inspection Initiated by Georgia's Coastal Nonpoint Source Advisory Committee in 2009, a multi-phase 319 Clean Water Act project was designed to identify, inspect and map priority septic systems in the 11 Coastal Counties, including Camden, with the use of GIS. This project was implemented by a partnership, led by UGA MAREX, the Coastal Health District, the local County Health Departments, the SGRC and Coastal NPS Program. This information will be maintained and updated by the CCHD and project partners.	3	5	3	5	5	5	26
University of Georgia River Basin Center Septic System Retrofit Program The purpose of this project is to assess the extent to which failing septic systems are contributing to fecal coliform	3	5	3	5	5	5	26

Applicable BMPs	*BMP Extent*	*BMP Effectiveness*	*Cost*	*Public Support*	*Added Benefits*	*CZARA Section 6217*	*Total Score*
levels in Horsepen Creek and to devise a strategy to reduce septic system failure in this area. To that end, this project had four objectives: 1) Investigate the extent that failing septic systems contribute to the fecal coliform levels in Horsepen Creek; 2) Install one new septic system as a demonstration project in the challenging conditions found in much of Camden County; and 3) Conduct a public outreach campaign to support the septic management strategy. Implementation of this project will reduce BOD loadings in an upstream tributary of this segment of the St. Marys River.							
Educate Property Owners about Septic System Maintenance The CCHD provides a DVD entitled, "A Homeowner's Guide to On-Site Sewage Management Systems" to each applicant for a permit for new or expanded on-site septic systems. The Health Department maintains a website with information on educational materials and programs for owners of septic systems. The Georgia Department of Community Affairs (DCA) produced a door hanger brochure about fixing water leaks to protect your septic system for distribution by the CCHD.	3	3	3	5	5	5	24
Implement the Recommendations of the On-Site Sewage Disposal System Strategic Plan 2013 The DCA, in partnership with the Georgia EPD and DPH, developed this Plan to reduce nitrogen discharges from septic system and to encourage inspections and maintenance of septic systems. Implementation of the recommendations in this plan should reduce failure rates and discharges of pollutants from septic system.	3	5	3	3	5	5	24
Hydrologic Restoration/Protection							
Prioritize/Target St. Marys Watershed for Mitigation Bank Development The practice of developing mitigation banks to provide credits for development projects that must purchase mitigation credits to satisfy their 404 Permit requirements results in the restoration of hydrologic function of impacted wetlands.	3	3	1	3	5	1	16
Encourage the Use of Hydromodification Best Management Practices Manual (Coastal Supplement) The purpose of this project is to provide guidance on the design, construction, operation, and maintenance of hydromodification projects in an effort to minimize their impacts on coastal ecosystems. The Hydromodification	3	3	3	5	5	5	24

Applicable BMPs	*BMP Extent*	*BMP Effectiveness*	*Cost*	*Public Support*	*Added Benefits*	*CZARA Section 6217*	*Total Score*
BMP Manual (the Manual), Coastal Supplement has been developed to control nonpoint sources of pollution resulting from certain types of hydromodification activities. The content of the Manual was developed utilizing feedback garnered from a survey of key stakeholders as well as technical advice from experts in the field. The Manual will serve as an addendum to the USEPA's Hydromodification Manual that includes information, design criteria, maintenance programs, etc. specific to the Coastal Georgia environmental characteristics.							
Water Quality Standards and Monitoring							
Florida TMDL Consideration Research TMDL listing and TMDL implementation Plans affecting the Florida side of the St. Marys Watershed. Evaluate impairment and mitigation data to determine the impairment originating on/from Florida. Review TMDL implementation plans and adopt any successful BMPs currently being implemented there. This BMOPS includes consideration of any nutrient standards and associated BMPs Florida develops for this segment of the St. Marys River.	5	3	3	3	5	1	20
Support development of appropriate standards for "Black water" or coastal, slow moving, tannic waterways in coastal Georgia. The Georgia EPD is currently working on developing standards for DO in coastal, slow moving tannic waterways. Once developed, these standards should be applied to the St. Marys River and historic and future monitoring data should be compared with these new standards to determine the level of impairment, if any.	5	5	5	5	5	1	26
NPDES Discharge Permit for St. Marys and Kingsland WPCPs. The Cities of St. Marys and Kingsland have NPDES Discharge permits for their WPCPs that discharge to this segment of the St. Marys River. The discharge standards associated with these permits should be consistent with the recommendations of the St. Marys DO TMDL and any future EPD standards. Kingsland and St. Marys will continue to operate their WPCPs to remain compliant with these permits.	3	5	5	5	5	1	24
Future WPCP Outfall Locations The outfall locations and any future NPDES Wastewater Discharge Permits should be sited to limit the impact to the St. Marys River.	3	3	1	5	5	1	18

Applicable BMPs	*BMP Extent*	*BMP Effectiveness*	*Cost*	*Public Support*	*Added Benefits*	*CZARA Section 6217*	*Total Score*
Implement Long Term Monitoring Recommendations Long term monitoring recommendations have been included in this WMP. They include recommendations to monitor DO and BOD levels in the St. Marys River and tributaries to the St. Marys River. This data will be used to identify trends in DO and BOD levels that could indicate the success or lack thereof of recommended BMPS. Additional recommendations have been made for monitoring that could help provide more information on the sources of the DO impairment and if they are natural or man-made.	5	5	3	5	5	5	28

7. WORKING WITH THE PUBLIC

Education is important for increasing public awareness of water quality problems and offering feasible solutions for restoration and prevention of water quality degradation. Utilizing effective educational outreach strategies is also important for the long-term success of a WMP because implementation of many of the recommended BMPs is voluntary and often requires cooperation between community members and various local and state agencies.

The primary goals of the educational outreach program for the St. Marys River are to 1.) Enlist cooperation and support for the implementation of the BMPs identified in the WMP and 2.) Educate local officials and the general public about strategies to reduce nonpoint source pollution that may negatively impact the St. Marys River. In order to reach these goals, multiple educational outreach strategies and target audiences have been identified, which are discussed below in Table 12. Some of these educational outreach strategies have already been implemented and/or are ongoing, and some are suggested for future implementation.

Several of these educational outreach efforts are being undertaken by the SMRMC, a group of citizen volunteers. This committee, formed in 1991, consists of representatives of each of the four counties (Charlton and Camden counties in Georgia, and Nassau and Baker counties in Florida) that border the river and predominately comprise the basin. The committee meets monthly to discuss, develop, and implement plans and programs in regard to the St. Marys River. Additional information about the SMRMC may be found on their website at http://saintmarysriver.org/index.html.

Table 12: Educational Outreach Strategies

Strategy	Target Audience	Description	Responsible Party and Estimated Date of Completion
Public Presentations	St. Marys and Kingsland City Council Members	PowerPoint presentation will be developed and presented to the City Council members for both St. Marys and Kingsland. Presentation will summarize WMP and related planning process to solicit support for implementation of BMPs identified in WMP, specifically those related to local ordinances of relevance.	EPG (Spring 2014)
Community Meetings	General Public	SMRMC meets monthly to discuss issues of concern and ongoing management strategies related to the St. Marys River. Meetings are open to the public, and meeting agendas and minutes are posted online.	SMRMC (ongoing)
Septic Public Outreach Campaign	Septic System Owners	UGA River Basin Center received a grant to begin implementation of a comprehensive septic system strategy that included a public outreach campaign.	UGA (Future goal)

Strategy	Target Audience	Description	Responsible Party and Estimated Date of Completion
		This strategy should be expanded within the St.Marys Basin when funding permits.	
St. Marys River Clean-up	General Public	SMRMC hosts annual River Clean-Up in March.	SMRMC (annually)
Educational Materials and Electronic Resources	General Public	SMRMC has developed a River Guide brochure that discusses local water quality issues and recommended actions for restoration, including set-back rules for septic tank leakage and flood and shoreline protection. Brochure and additional information about the St. Marys River available online.	SMRMC (ongoing)
	Septic System Permittees	DVD and information folder (including maintenance recommendations) are provided for new or expanded on-site septic tank system permittees.	Camden County Health Department (ongoing)
	General Public	St. Marys WMP is available to the public on the CRC and SMRMC websites.	CRC and SMRMC (suggested future strategy)

8. LONG-TERM MONITORING PLAN

In order to adequately identify and characterize causes and sources of pollutants in the St. Marys watershed, additional, long-term water quality monitoring should be conducted to evaluate natural causes of DO fluctuations and to determine if the St. Marys watershed is trending over time towards lower and lower DO levels. While many coastal scientists think that low DO is a normal characteristic of blackwater streams such as the St. Marys River, a downward trend, over decades, toward lower and lower DO could indicate anthropomorphic causes of impairment. Recommendations for additional water quality monitoring are identified below that address the data gaps identified in section 5 of this WMP.

Specific long-term monitoring suggestions include the following:

- Continue sampling the sites monitored by EPG in 2013 for the St. Marys River and its tributaries (CC01, LLCO1, MCO1, SM1, and 2D) to assess seasonal DO fluctuations and to determine if levels continue to trend downwards over the years. Monitoring should include DO, water temperature, conductivity, salinity and turbidity, in accordance with the procedures outlined in the Revised Target Watershed Monitoring Plan for St. Marys River, Catfish Creek to Millers Branch Sampling and Quality Assurance Plan. Monitoring should also include an analysis of BOD for each sampling site to identify tributaries of the St. Marys River that supply the most BOD or naturally have lower levels of DO because they are stagnant or slow moving. In addition, sampling events should also be spread out over the course of year in order to collect data during colder months of the year and during times of normal water flow. This monitoring should be conducted by the Cities of Kingsland and St. Mary's in coordination with the Long-Term Monitoring requirements of their respective Watershed Protection Plans and NDPES Wastewater Discharge Permits.
- The Georgia CRD should continue to collect water quality data at sampling stations 302 through 306. Monitoring should be expanded to include an analysis of BOD for these sampling stations and conducted over the course of a year to assess seasonal DO fluctuations.
- Select key sites that should be monitored for DO levels over a 24-hour period to assess natural variation of DO levels during the night and day. An hourly time profile of DO levels at a sampling site is a valuable set of data because it shows the change in DO levels from the low point just before sunrise to the high point sometime in the midday.
- Any water quality data that will be used to analyze DO conditions should include the following information if at all possible: time of sampling, weather conditions (cloudy or sunny), wind speed, water currents, salinity, and whether sampling occurred during

drought conditions (when salinity is high). If feasible, an analysis of BOD should also be conducted.

The WAC also made the following suggestions for data collection and analysis that may be more appropriate for implementation by universities, State and Federal agencies, or other organizations with sufficient resources and expertise:

- Identify the length of the tidal excursion of river water upstream on flood tides to indicate the amount of the downstream watershed that could influence the impaired area.
- Follow the DO of water within the same water mass as it moves up and down stream with the tides.
- Determine the mixing zone of the St. Mary's River by evaluating the grain size of bottom sediment at various locations in the river. The mixing zone will be characterized by mud while rapidly flowing sections will have a sandier bottom. Relatively low DO can be a characteristic of the mixing zone of an estuary because suspended organic matter tends to settle in such zones.
- Consider a dome study of the river bottom to determine groundwater seepage rates and the DO of the seepage. A dome study of SOD will likely prove that the sediment is a large user of DO, especially in mud (as opposed to sand).

9. IMPLEMENTATION, EVALUATION, AND REVISION

The basic strategy for implementation of this watershed management plan is to create and manage a program that features both structural and non-structural controls within the watershed to reduce anthropomorphic sources of BOD to the St. Mary's River. The goal of this program is to restore the watershed to the extent that the impaired segment as well as all streams in the watershed meet the future State water quality standards for DO in coastal, slow-moving, tannic waterways. The management strategies that will be utilized to accomplish the goals are listed in Table 13, on the following page, and address potential sources including, but not limited to land development activities and silviculture.

Implementation Plan and Interim Milestones

The Implementation Plan below includes a listing and short description of the recommended BMP management. For each BMP, the Implementation Plan identifies the responsible agency, estimated cost of implementation, potential funding sources, and the evaluation measures by which the success or failure of the BMP will be assessed. The Implementation Plan anticipates an implementation period of 5 -10 years. However, specific projects may be implemented over shorter periods. The schedule includes a schedule for measurable milestones that includes short-term (0-2 years), mid-range (2-5 years), and long-term (5 – 10 years) goals that should reveal significant progress.

Table 13: St. Marys Watershed Management Implementation Plan

Best Management Practice	*Responsible Agency*	*Cost*	*Funding Source*	*Evaluation Measure*	*Milestone*		
					Short (<2 yr)	*Mid (2 – 5 yr)*	*Long (5 – 10 yr)*
Forestry Management							
BMP 1: Implementation of structural BMPs from "Georgia's Best Management Practices for Forestry – January 1999" (Forestry Manual) Implementation of BMPs from the Forestry Manual will restore natural hydrology and reduce BOD inputs from silvicuture, which is identified as a significant source of BOD in this watershed.	Individual Land Owners	Varies	Revenue from Silviculture Operations, Grants	Percent of Operations in Compliance with recommended BMPs	95%	95%	95%
BMP 2: Professional Forestry Standards of Practice (OCGA 43-1-19) Failure to practice professional forestry in accordance with generally accepted standards of practice in the Forestry Manual shall constitute unprofessional conduct and be grounds for disciplinary action.	State of Georgia	N/A	N/A	Increasing or Stable Percent Compliance	95%	95%	95%
BMP 3: Georgia Forestry Commission Water Quality Program In an effort to minimize erosion and stream sedimentation from forestry practices, the GFC has an agreement with the Georgia EPD to educate the forest community and promote the use of Georgia's BMPS for Forestry. Under the same agreement with the Georgia EPD and through an understanding with the USEPA and the Army Corps of	GFC, EPD	EPD grant	319 Grant Funding	Percentage of Sites in Georgia Inspected	20%	50%	100%

Best Management Practice	*Responsible Agency*	*Cost*	*Funding Source*	*Evaluation Measure*	*Milestone*		
					Short (<2 yr)	*Mid (2 – 5 yr)*	*Long (5 – 10 yr)*
Engineers, the GFC also investigates and mediates forestry water quality and wetland complaints. The agreement also requires the GFC to implement the BMPs from the Forestry Manual. The goals are to improve Forestry Manual BMP compliance through State-wide biennial BMP surveys and BMP assurance exams, Master Timber Harvester workshops, and continuing logger education.							
Development Regulation							
BMP 4: Part V Environmental Protection Ordinances for Protected River Corridor, Wetland Protection, and Groundwater Recharge These criteria, as required by the Georgia DNR, will reduce the impacts of new development in the St. Marys watershed through more stringent siting requirements for septic drain fields, protection of wetlands, and limitations of various land use practices within the 100 ft buffer of the St. Marys River. The criteria have been adopted by and are enforced by Camden County, St. Marys and Kingsland. In addition the Camden County Health Department implements the requirements of the groundwater recharge ordinance through its septic tank permitting program. These regulations limit the input of nutrients, sediment and other sources of BOD.	Camden County, Camden County Health Department, St Marys, Kingsland	Staff Time	General Fund, Development Fees	Percent of applicable site plans and Septic permits reviewed for compliance with criteria	100%	100%	100%

Best Management Practice	*Responsible Agency*	*Cost*	*Funding Source*	*Evaluation Measure*	*Milestone*		
					Short (<2 yr)	*Mid (2 – 5 yr)*	*Long (5 – 10 yr)*
BMP 5: Camden Co, Kingsland, and St. Marys Soil Erosion & Sedimentation Control Programs. Camden County, Kingsland and St. Marys are all Issuing Authorities for the Georgia Erosion and Sedimentation Control Program which includes adoption of an ordinance that requires BMPs for erosion and sedimentation control during development. It also requires the protection of a 25 foot naturally vegetated buffer along the St. Marys which will further limit BOD inputs.	Camden County, St Marys, Kingsland	Staff Time	General Fund, Development Fees	Percent of applicable site plans reviewed and active construction sites inspected for compliance with E&S requirements	100%	100%	100%
BMP 6: Implementation of the CSS to the Georgia Stormwater Management Manual Kingsland has adopted an ordinances requiring the use of the CSS for design of post construction stormwater management systems and stormwater BMPs. Camden County has adopted the CSS as a technical reference. St. Marys has not adopted the ordinances as of the date of this document due to a lack of resources. Implementation of the standards in the CSS reduces pollutants in stormwater runoff, including nutrients and sediment, from developed sites.	Camden County, St Marys, Kingsland	Staff Time	General Fund, Development Fees	Percent of applicable site plans reviewed inspected for compliance with CSS	50%	75%	100%
BMP 7: Local Government Land Development Review and Regulation Process Camden County, St Marys, and Kingsland review site plans, issue permits, and inspect sites active construction for compliance with the E&S and Stormwater ordinances. This	Camden County, St Marys, Kingsland	Staff Time	General Fund, Development Fees	Percent of applicable site plans reviewed inspected and construction site inspected for compliance	100%	100%	100%

Best Management Practice	*Responsible Agency*	*Cost*	*Funding Source*	*Evaluation Measure*	*Milestone*		
					Short (<2 yr)	*Mid (2 – 5 yr)*	*Long (5 – 10 yr)*
BMP limits the amount of sediment, and associated BOD, entering local waterways.							
BMP 8: Development of Regional Impact Review DRIs are large-scale developments that are likely to have regional effects beyond the local government jurisdiction in which they are located. This review program is designed to improve communication between affected governments and to provide a means of revealing and assessing potential impacts of large-scale developments before conflicts relating to them arise. At the same time, local government autonomy is preserved since the host government maintains the authority to make the final decision on whether a proposed development will or will not go forward.	CRC, DCA, Camden County, St. Marys, Kingsland	Staff Time	State Funding	Number of qualifying projects receiving DRI review	100%	100%	100%
BMP 9: Coastal Marshland Protection Permitting Process In 1970, the State of Georgia established the Coastal Marshlands Protection Act (CMPA) to protect marsh and estuarine areas, and to regulate the activities within these public trust lands that are held for the citizens of Georgia. As public trustees of the coastal marshlands for succeeding generations, the Georgia CRD allows for the sustainable use of the estuarine area through permits and other methods of authorization that will preserve the condition of the marsh while still allowing for its enjoyment. The CMPA permit application process is intended for structures that will impact jurisdictional marsh and tidal water bodies.	CRD, Coastal Marshland Protection Committee	Staff Time	State Funding	Number of qualifying projects going through the CMPA Permit process.	100%	100%	100%

Best Management Practice	*Responsible Agency*	*Cost*	*Funding Source*	*Evaluation Measure*	*Milestone*		
					Short (<2 yr)	*Mid (2 – 5 yr)*	*Long (5 – 10 yr)*
Structures covered under the Act include marinas, community docks, bridges, dredging, bank stabilizations longer than 500', modification to any such structure, and any construction not exempted from the Act.							
Watershed/Land Use Planning							
BMP 10: Implementation of Kingsland and St Marys Watershed Assessment & Protection Plans The Cities of Kingsland and St Marys both have completed WSAs and developed WPPs as required by their NPDES Wastewater Discharge Permit. The WPP requires the implementation of structural and non-structural best management practices to control nonpoint source pollution within their sanitary sewer service areas. These plans also include requirements for long-term water quality monitoring of various parameters include DO and BOD.	Kingsland and St. Marys	≈ $20,000 annually per WPP	Water & Sewer Enterprise Funds	Annual Report and Certification to EPD	Submit certification annually		
BMP 11: Consideration of Camden County Green Print Plan Recommendations The Trust for Public Land developed a Green Print Plan in 2008 for the Camden County. The Greenprint is a strategic, planning, communication and decision making tool. It applies GIS modeling to help local governments make informed decision about how they want to grow smartly while promoting land conservation, restoration and resource protection. The BMP recommends that local governments utilize this tool and consider the	Camden County, St Marys, Kingsland	Staff Time but cost of actual land preservation varies.	General Fund, SPLOST, Grants, Foundations, Private Development	Number of projects implemented in accordance with goals of plan	N/A	1	2

Best Management Practice	*Responsible Agency*	*Cost*	*Funding Source*	*Evaluation Measure*	*Milestone*		
					Short (<2 yr)	*Mid (2 – 5 yr)*	*Long (5 – 10 yr)*
recommendations contained within when making land use decisions.							
BMP 12: Implementation and Update of Local Comprehensive Plans and Associated Ordinance Amendments Camden County and the Cities of St Marys and Kingsland adopted a joint Comprehensive Plan in 2008. This plan includes recommendations for natural resources protection, greenspace preservation, and land use regulations that would be protective of local water quality. These local governments are required to update this plan in 2018, and should consider the recommendations of this WMP in the updated Comprehensive Plan.	Camden County, St Marys, Kingsland	Staff time annually Plan update ≈ $60,000	General Fund, Grants	Complete Plan update in 2018. Consider recommendations of current plan during all applicable re-zoning decisions.	On-going	Update of plan	On-going
BMP 13: Consideration of Coastal Comprehensive Plan The Coastal Comprehensive Plan was developed in 2008 by the CRC through a comprehensive coastal stakeholder process that included Camden County, St. Marys and Kingsland. The plan has recommendations for implementation of local stormwater management programs and preservation of natural areas which would reduce the nonpoint source inputs of BOD. Furthermore, this plan is utilized in the DRI review by the CRC.	Camden County, St Marys, Kingsland CRC	Staff time annually	General Fund, Grants	Meet or exceed standards during Plan Implementation Assessment	Meet Standards	Meet Standards	Exceed standards

Best Management Practice	*Responsible Agency*	*Cost*	*Funding Source*	*Evaluation Measure*	*Milestone*		
					Short (<2 yr)	*Mid (2 – 5 yr)*	*Long (5 – 10 yr)*
BMP 14: Promotion of Green Growth Guidelines The Georgia CRD has developed green growth guidelines to encourage developers to implement smart growth techniques when designing new development. Implementation of these standards in the St. Marys watershed would limit the input of water quality pollutants. Promotion of this tool will result in new developments that have less impact on the St. Marys River.	CRD, EPD, DCA	Staff Time	Grants	Maintain information on website: www. http://www.coastalgadnr.org/cm/green/guide Complete revision of GGG.	Complete revision	Maintain website	Maintain website
BMP 15: Implement the St. Marys River Management Plan The Vision of this plan is to protect the scenic beauty and ecological health of the St. Marys River watershed for the benefit of present and future generations. This can be accomplished through coordinated local action that involves the full spectrum of the basin's citizens and through increased public education efforts that foster greater awareness, appreciation and stewardship of the basin's resources. This plan includes recommended programs to accomplish this goal. Protection of the ecological health of the St. Marys River includes reduction of man-made sources of BOD.	SMRMC Charleton, Camden, Nassau and Baker Counties EPD, St. Johns River Management District	$2,000 - $4,300 per year	Local government dues, grants	Hold Annual Cleanup Meet Monthly Achieve goals set in plan	Achieve short term goals	Achieve short term goals	Achieve long term goals
BMP 16: Support the SMRMC The SMRMC is an intergovernmental entity of elected and appointed members from four counties along the St. Marys River including Charlton, Camden, Nassau and Baker	Charleton, Camden, Nassau and Baker Counties	$500 per year	General Fund	Provide annual funding	$500 per year per County	$500 per year per County	$500 per year per County

Best Management Practice	*Responsible Agency*	*Cost*	*Funding Source*	*Evaluation Measure*	*Milestone*		
					Short (<2 yr)	*Mid (2 – 5 yr)*	*Long (5 – 10 yr)*
counties. The committee meets monthly to discuss, develop and implement plans and programs in regard to the St. Marys River. The SMRMC is made up of individuals who are involved because of a personal commitment to the St. Marys River. This Committee provides a means of implementation for the St. Marys River Management Plan.							
Septic System Operations & Maintenance							
BMP 17: Apply septic tank installation, design, inspection, and maintenance standards The Camden County Health Department permits new construction and repairs of septic system. This work must be completed in accordance with standards established by the DPH that are designed to reduce the risk of failure, thereby limiting the input of nutrients and other BOD substances from septic tank influent.	Camden County Health Department	Staff Time	Permit and Inspection fees	Number of septic systems installed and repair permits issued	100% of all septic tank installations and repairs permitted by CCHD.		
BMP 18: Septic System GIS Inventory and Visual Inspection Initiated by Georgia's Coastal Nonpoint Source Advisory Committee in 2009, a multi-phase 319 Clean Water Act project was designed to identify, inspect and map priority septic systems in the 11 Coastal Counties, including Camden, with the use of GIS. This project was implemented by a partnership, led by UGA MAREX, the Coastal Health District, the local County Health	Camden County Health Department, Coastal Health District, EPD, UGA MAREX, SGRC	$25,000	319 grant	Number of septic systems in environmentally sensitive areas inspected & GIS	100%	n/a	n/a

Best Management Practice	*Responsible Agency*	*Cost*	*Funding Source*	*Evaluation Measure*	*Milestone*		
					Short (<2 yr)	*Mid (2 – 5 yr)*	*Long (5 – 10 yr)*
Departments, the SGRC and Coastal NPS Program. This information will be maintained and updated by the Camden County Health Department and project partners.							
BMP 19: University of Georgia River Basin Center Septic System Retrofit Program The purpose of this project is to assess the extent to which failing septic systems are contributing to fecal coliform levels in Horsepen Creek and to devise a strategy to reduce septic system failure in this area. To that end, this project had four objectives: 1) Investigate the extent that failing septic systems contribute to the fecal coliform levels in Horsepen Creek; 2) Install one new septic system as a demonstration project in the challenging conditions found in much of Camden County, and 3) Conduct a public outreach campaign to support the septic management strategy. Implementation of this project will reduce BOD loadings in an upstream tributary to this segment of the St. Marys River.	University of Georgia River Basin Center	$166,667	319 Grant Funding UGA Grant Match	Number of septic systems inspected/retrofitted/ repaired/pumped Number of public outreach events	14 systems 2 events	n/a	n/a
BMP 20: Educate Property Owners about Septic System Maintenance The CCHD provides a DVD entitled, "A Homeowner's Guide to On-Site Sewage Management Systems" to each applicant for a permit for new or expanded on-site septic systems. The DPH maintains a website with information on educational materials and programs for owners of septic systems. The DCA produced a door hanger	DPH, EPD, DCA, and CCHD	$1,000	State Funding, Coastal Incentive Grant	Owners of all new Septic Systems installed in Camden County will receive an educational DVD. Number of brochures on water leaks distributed.	100% of owners get DVD 50	100% of owners get DVD 100	100% of owners get DVD 150

Best Management Practice	*Responsible Agency*	*Cost*	*Funding Source*	*Evaluation Measure*	*Milestone*		
					Short (<2 yr)	*Mid (2 – 5 yr)*	*Long (5 – 10 yr)*
brochure about fixing water leaks to protect septic system function for distribution by the CCHD.							
BMP 21: Implement the Recommendations of the On-Site Sewage Disposal System Strategic Plan 2013 The DCA, in partnership with the EPD and DPH, developed this Plan to reduce nitrogen discharges from septic system and to encourage inspections and maintenance of septic systems. Implementation of the recommendations in this plan should reduce failure rates and discharges of pollutants from septic system.	DCA, EPD, CHD, CCHD	Varies	Varies	75% of Septic Systems inspected over a 15 year period. 100% of new and repaired septic systems sited according to recommended standards	10% 100%	25% 100%	50% 100%
Hydrologic Restoration/Protection							
BMP 22: Prioritize/Target St. Marys Watershed for Mitigation Bank Development The practice of developing mitigation banks to provide credits for development projects that must purchase mitigation credits to satisfy their 404 Permit requirements results in the restoration of hydrologic function of impacted freshwater wetlands.	Private Mitigation Bankers ACOE Local Governments	Varies based on property	Sale of Mitigation credits	Number of acres of wetlands/streams mitigated in the St. Marys watershed	ACOE to prioritize St. Marys	Identification and planning of mitigation site	Development of Mitigation Bank

Best Management Practice	*Responsible Agency*	*Cost*	*Funding Source*	*Evaluation Measure*	*Milestone*		
					Short (<2 yr)	*Mid (2 – 5 yr)*	*Long (5 – 10 yr)*
BMP 23: Encourage the Use of Hydromodification Best Management Practices Manual (Coastal Supplement) The purpose of this project is to provide guidance on the design, construction, operation, and maintenance of hydromodification projects in an effort to minimize their impacts on coastal ecosystems. The Hydromodification BMP Manual (the Manual), Coastal Supplement, developed in 2009, has been developed to control nonpoint sources of pollution resulting from certain types of hydromodification activities. The content of the Manual was developed utilizing feedback garnered from a survey of key stakeholders as well as technical advice from experts in the field. The Manual serves as an addendum to the USEPA's Hydromodification Manual that includes information, design criteria, maintenance programs, etc. specific to the Coastal Georgia environmental characteristics.	EPD, UGA MAREX, Local Governments	Staff Time	CIG UGA Funding 319 Grants	Manual available on website: www.marex.uga.edu/uploads/documents/Hydromod_Manual_Sept_2009.pdf	Manual Available on Website	Manual Available on Website	Manual Available on Website
Water Quality Standards and Monitoring							

Best Management Practice	*Responsible Agency*	*Cost*	*Funding Source*	*Evaluation Measure*	*Milestone*		
					Short (<2 yr)	*Mid (2 – 5 yr)*	*Long (5 – 10 yr)*
BMP 24: Florida TMDL Consideration Research TMDL listing and TMDL implementation Plans affecting the Florida side of the St. Marys Watershed. Evaluate impairment and mitigation data to determine the impairment originating on/from Florida. This BMP includes consideration of any nutrient standards and associated BMPs Florida develops for this segment of the St. Marys River. The goal of this BMP is to encourage coordination and partnership between States boarding the St Marys River.	EPD, St. Johns River Management District	Staff Time	State Funding 319 Grants	Review of TMDL for nutrients Review monitoring data collected by Florida	Review Standards, Assess WQ data	Review Standards, Assess WQ data	Review Standards, Assess WQ data
BMP 25: Support development of appropriate standards for "Black water" or coastal, slow moving, tannic waterways in coastal Georgia. The EPD is currently working on revising natural standards for DO in coastal, slow moving tannic waterways. Once developed, these standards should be applied to the St. Marys River and historic and future monitoring data should be compared with these new standards to determine the level of impairment, if any.	EPD	Staff Time	State Funding	New Standard is Developed	Perform necessary analysis	Set New Standard	Review TMDL and WMP

Best Management Practice	*Responsible Agency*	*Cost*	*Funding Source*	*Evaluation Measure*	*Milestone*		
					Short (<2 yr)	*Mid (2 – 5 yr)*	*Long (5 – 10 yr)*
BMP 26: NPDES Wastewater Discharge Permit for St. Marys and Kingsland WPCPs. The Cities of St. Marys and Kingsland have NPDES Wastewater Discharge permits for their WPCPs that discharge to this segment of the St. Marys River. The discharge standards associated with these permits should be consistent with the recommendations of the St. Marys DO TMDL and any future EPD standards. Kingsland and St. Marys will continue to operate their WPCPs to remain compliant with these permits.	EPD	Staff Time	State Funding	NPDES Permit Compliance	Monthly Certification	New permit issued	Monthly Certification
BMP 27: Future WPCP Outfall Locations The outfall locations and any future NPDES Wastewater Discharge Permits should be sited to limit the impact to the St. Marys River.	EPD, Kingsland, St. Marys, SMRMC	N/A	State Funding, Water & Sewer Enterprise Funds	Evaluation of Outfalls associated with Issuance of New NPDES Permits for expanded WWTF	n/a	n/a	Evaluate outfall locations

Best Management Practice	*Responsible Agency*	*Cost*	*Funding Source*	*Evaluation Measure*	*Milestone*		
					Short (<2 yr)	*Mid (2 – 5 yr)*	*Long (5 – 10 yr)*
BMP 27: Implement Long Term Monitoring Recommendations Long term monitoring recommendations have been included in this WMP. They include recommendations to monitor DO and BOD levels in the St. Marys River and tributaries to the St. Marys River. This data will be used to identify trends in DO and BOD levels that could indicate the success or lack thereof of recommended BMPS. Additional recommendations have been made for monitoring that could help provide more information on the sources of the DO impairment and if they are natural or man-made.	CRD, Kingsland, St. Marys Project Partners	Cost of existing monitoring programs is set. Cost associated with monitoring for data gaps will vary.	State Funding, CZM Funding, Water & Sewer Enterprise Funds, 319 Grants, CIG grants	Monitoring Data collected	Annual monitoring	Fund data gap study	Fund data gap study

Indicators to Measure Progress

The Evaluation Measures associated with each task in the Implementation Plan will reveal any progress that the responsible parties are making with regard to implementation of the BMPs. Referencing these measures should provide an indication of specific BMPs that require additional work and/or resources. Periodic assessment of the implementation schedule and review of evaluation measures will be necessary to determine whether task milestones are being met.

In addition, a long-term water quality monitoring plan will be implemented as part of this WMP. The results of this monitoring should indicate trends in DO and BOD levels within the St. Marys River and the tributaries to the listed segment of the St. Marys. This data will help illustrate any changes (positive or negative) in water quality within these waterways and will indicate the successful implementation of the BMPs. Lack of improvement in water quality over time may indicate that the selected BMPs are ineffective, and should be revised. Alternatively, lack of improvement in water quality may be a result of the natural functions of this coastal slow-moving stream. Additional monitoring, as recommended by the Data Gaps section, will provide more information on the potential natural causes of DO impairment.

Indicators identified by the Advisory Committee to measure the status of the watershed management process and educational outreach outlined in this Plan are as follows in Table 14 below:

Table 14: Indicators for Measuring Progress

Type of Indicator	Specific Indicator
Environmental	DO – Direct Water Quality Measurement
Environmental	BOD – General Measure of Stream Water Quality - Significant levels of BOD can indicate the cause of DO impairment.
Environmental	Water Temperature – Physical Measurement – There is a significant correlation between low DO and high water temperature.
Programmatic	Number of BMPs implemented.
Programmatic	Number of educational outreach programs implemented.
Social	Participation in education and outreach programs.

Long-term Plan Implementation

The responsible parties will continue to implement BMPs through their respective agency programs, although implementation may be limited by available funding. It is recommended that this plan be reviewed and/or revised every five years to determine effectiveness of recommended BMPs and to make revisions as necessary. However, review of plan accomplishments and continued plan implementation will also be dependent on available funding.

10. REFERENCES

City of Kingsland. February – July 2007. Watershed Assessment Monitoring Results.

City of St. Marys. 2007 – 2012. Watershed Assessment Monitoring Results.

Coastal Regional Commission of Georgia. January 19, 2011; February 28, 2011; April 20, 2011; May 18, 2011; and June 15, 2011. Watershed Improvement Plan Partnership Advisory/Stakeholder Committee Meeting Minutes.

Coastal Regional Commission of Georgia. 2011. *St. Marys River Catfish Creek to Miller's Branch Segment Watershed Improvement Plan First Year Final Report*.

Ecological Planning Group on behalf of Coastal Resources Commission of Georgia. March 27, 2013. Watershed Management Plan Watershed Advisory Committee Meeting Minutes.

Ecological Planning Group on behalf of Coastal Resources Commission of Georgia. September 24, 2013. Revised Target Watershed Monitoring Plan for St. Marys River, Catfish Creek to Millers Branch Sampling and Quality Assurance Plan.

Ecological Planning Group on behalf of Coastal Resources Commission of Georgia. May-June 2013. Monitoring Data Results.

Georgia Department of Natural Resources, Environmental Protection Division. January 2006. *Total Maximum Daily Load Evaluation for the St. Marys River in the St. Marys River Basin for Dissolved Oxygen*.

Georgia Department of Natural Resources, Environmental Protection Division. November 13, 2008. *Total Maximum Daily Load Implementation Plan for the St. Marys River, Catfish Creek to Millers Branch*.

Georgia Department of Natural Resources, Coastal Resources Division. 2002-2012. Sampling Data for Stations 302 through 306.

Nutter & Associates, Inc. February 2012. *Watershed Protection Plan for the City of Kingsland*, Georgia.

Resource Management Strategies. August 2013. *Little River Watershed Management Plan*, Prepared for the Savannah Resource, Conservation and Development Council, Inc.

APPENDIX A

Total Maximum Daily Load

Evaluation

for the

St. Marys River

in the

St. Marys River Basin

for

Dissolved Oxygen

Submitted to:
The U.S. Environmental Protection Agency
Region 4
Atlanta, Georgia

Submitted by:
The Georgia Department of Natural Resources
Environmental Protection Division
Atlanta, Georgia

January 2006

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EXECUTIVE SUMMARY

The State of Georgia assesses its water bodies for compliance with water quality standards criteria established for their designated uses as required by the Federal Clean Water Act (CWA). Assessed water bodies are placed into one of three categories with respect to designated uses: 1) supporting, 2) partially supporting, or 3) not supporting. These water bodies are found on Georgia's 305(b) list as required by that section of the CWA that defines the assessment process, and are published in *Water Quality in Georgia* every two years. This document is available on the Georgia Environmental Protection Division (GA EPD) website.

Some of the 305(b) partially and not supporting water bodies are also assigned to Georgia's 303(d) list, also named after that section of the CWA. Water bodies on the 303(d) list are required to have a Total Maximum Daily Load (TMDL) evaluation for the water quality constituent(s) in violation of the water quality standard. The TMDL in this document is based on the draft 2004 303(d) listing, which is also available on the GAEPD website. The TMDL process establishes the allowable pollutant loadings or other quantifiable parameters for a water body based on the relationship between pollutant sources and in-stream water quality conditions. This allows water quality-based controls to be developed to reduce pollution and to restore and maintain water quality.

The State of Georgia has identified one stream segment, located in the St. Marys River Basin, as water quality limited due to dissolved oxygen (DO). The St. Marys River from Catfish Creek to Millers Branch in Camden County was included in the State's draft 2004 303(d) list. This report presents the dissolved oxygen TMDL for this segment.

Part of the TMDL analysis is the identification of potential source categories. Sources are broadly classified as either point or nonpoint sources. A point source is defined as a discernable, confined, and discrete conveyance from which pollutants are or may be discharged to surface waters. Nonpoint sources are diffuse, and generally, but not always, involve accumulation of oxygen demanding substances on land surfaces that wash off as a result of storm events.

The process of developing the dissolved oxygen TMDL for the St. Marys River Basin included developing computer models for the listed segment. Georgia Estuary, a steady-state tidally averaged water quality model developed by the GA EPD, was used for the estuary segments that are influenced by tidal actions. These models were calibrated to data collected in the St. Marys River Basin in the summer of 2003.

Management practices may be used to help reduce and/or maintain the Ultimate Oxygen Demand (UOD) loads. These include:

- Compliance with the requirements of the NPDES permit program; and
- Application of Best Management Practices (BMPs) appropriate to nonpoint sources.

The amount of oxygen demanding substances delivered to a stream is difficult to determine. However, by requiring and monitoring the implementation of these practices, such efforts will improve stream water quality and represent a beneficial measure of TMDL implementation.

1.0 INTRODUCTION

1.1 Background

The State of Georgia assesses its water bodies for compliance with water quality standards criteria established for their designated uses as required by the Federal Clean Water Act (CWA). Assessed water bodies are placed into one of three categories with respect to designated uses: 1) supporting, 2) partially supporting, or 3) not supporting. These water bodies are found on Georgia's 305(b) list as required by that section of the CWA that defines the assessment process, and are published in *Water Quality in Georgia* every two years. This document is available on the GA EPD website

Some of the 305(b) partially and not supporting water bodies are also assigned to Georgia's 303(d) list, also named after that section of the CWA. Water bodies on the 303(d) list are required to have a Total Maximum Daily Load (TMDL) evaluation for the constituent(s) in violation of the water quality standard. The TMDL in this document is based on the draft 2004 303(d) listing, which is also available on the GA EPD website. The TMDL process establishes the allowable pollutant loadings or other quantifiable parameters for a water body based on the relationship between pollutant sources and in-stream water quality conditions. This allows water quality-based controls to be developed to reduce pollution and to restore and maintain water quality.

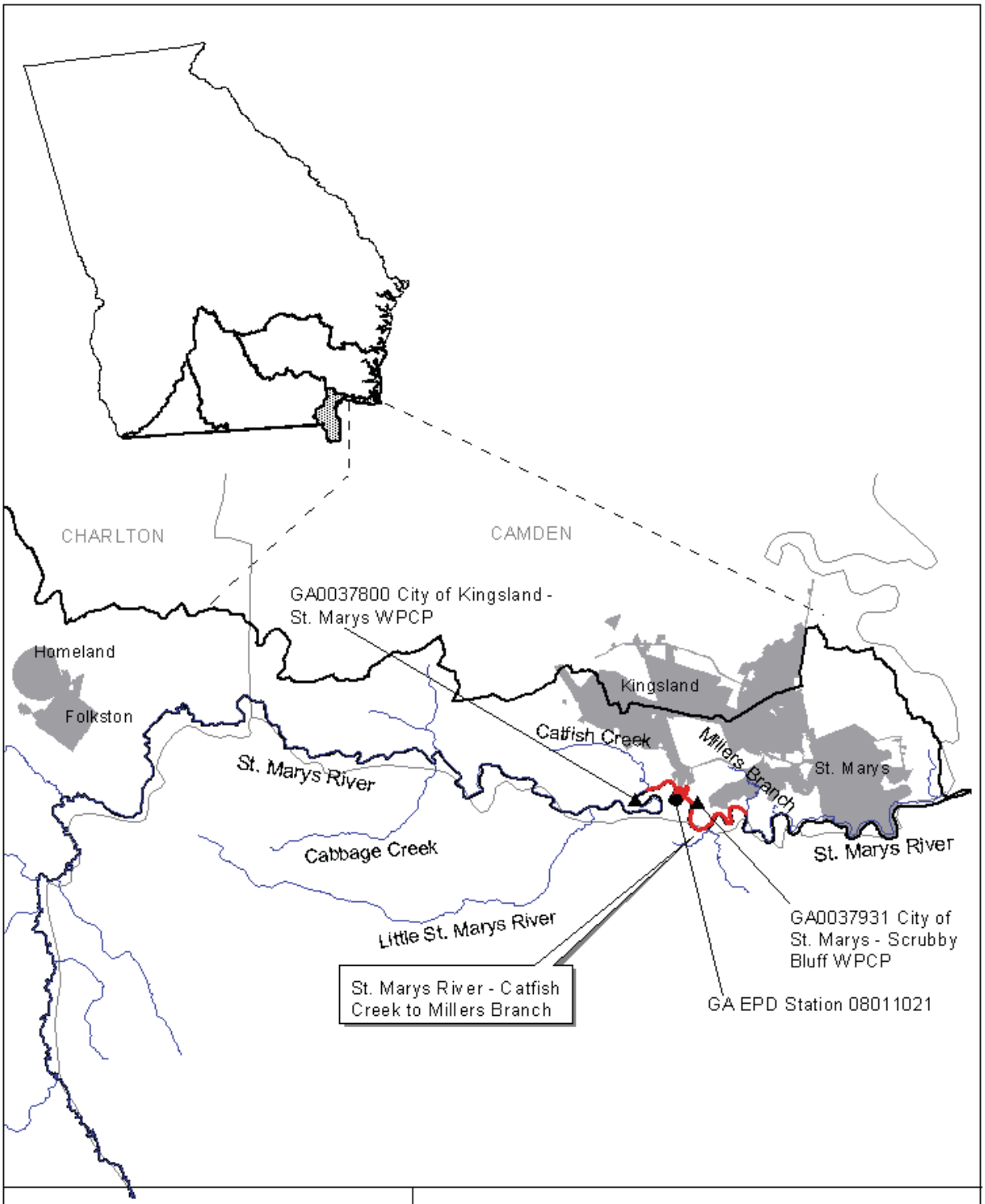
The State of Georgia has identified one stream segment located in the St. Marys River Basin as water quality limited due to dissolved oxygen (DO). This waterbody was included in the State's draft 2004 303(d) list. This report presents the DO TMDL for the listed segment in the St. Marys River Basin identified in Table 1.

1.2 Watershed Description

The St. Marys River basin is located in the southeastern part of Georgia, occupying an area of approximately 1,500 square miles with approximately 765 square miles of the basin in Georgia. The basin lies within the Coastal Plain physiographic province, which extends throughout the southeastern United States. The St. Marys River drains into the Atlantic Ocean.

The St. Marys River Basin is comprised of one USGS Hydrologic Unit Code (HUC), 03070204. Figure 1 shows the location of the listed dissolved oxygen segment in the St. Marys River Basin.

The land use characteristics of the St. Marys River Basin watersheds were determined using data from the National Land Cover Dataset (NLCD) for Georgia. This coverage is based on Landsat Thematic Mapper digital images developed in 1995. The classification is based on a modified Anderson level one and two system. Table 2 lists the land cover distribution and associated percent land cover.



TMDL Evaluation - Dissolved Oxygen St. Marys River Basin	Figure 1. Impaired Stream Segment in HUC 03070204

Table 1. Waterbody Listed For Dissolved Oxygen in the St. Marys River Basin

Stream Segment	Location	Segment Length (miles)	Designated Use	Listing
St. Marys River	Catfish Creek to Millers Branch (Camden Co.)	6	Fishing	NS

Note:
NS = Not Supporting designated use

1.3 Water Quality Standard

The water use classification for the listed stream segment in the St. Marys River Basin is Fishing. The criterion violated is listed as dissolved oxygen, and the potential cause listed is urban runoff. The use classification water quality standards for dissolved oxygen, as stated in Georgia's *Rules and Regulations for Water Quality Control* (GA EPD, 2004), Chapter 391-3-6-.03(6)(c)(i) are:

> A daily average of 5.0 mg/L and no less than 4.0 mg/L at all times for waters supporting warm water species of fish.

Certain waters of the State may have conditions where dissolved oxygen is naturally lower than the numeric criteria specified above and therefore cannot meet these standards unless naturally occurring loads are reduced or streams are artificially or mechanically aerated. This is addressed in Georgia's *Rules and Regulations for Water Quality Control*, Chapter 391-3-6-.03(7) (GA EPD, 2004):

> *Natural Water Quality*. It is recognized that certain natural waters of the State may have a quality that will not be within the general or specific requirements contained herein. These circumstances do not constitute violations of water quality standards. This is especially the case for the criteria for dissolved oxygen, temperature, pH and fecal coliform. NPDES permits and Best Management Practices will be the primary mechanisms for ensuring that the discharges will not create a harmful situation.

EPA dissolved oxygen criteria are used to address these situations. Alternative EPA limits are defined as 90 percent of the naturally occurring dissolved oxygen concentration at critical conditions (USEPA, 1986).

> Where natural conditions alone create dissolved oxygen concentrations less than 110 percent of the applicable criteria means or minima or both, the minimum acceptable concentration is 90 percent of the natural concentration.

Accordingly, if the naturally occurring DO exceeds GA EPD numeric limits at critical conditions, then the GA EPD numeric limits apply. If naturally occurring DO is lower than the GA EPD numeric limits, then 90% of the natural DO will become the minimum allowable.

Table 2. St. Marys River Basin Land Coverage

Stream/Segment	Land use Categories - Acres (Percent)													
	Open Water	Residential	High Intensity Commercial, Industrial, Transportation	Bare Rock, Sand, Clay	Quarries, Strip Mines, Gravel Pits	Transitional	Forest	Row Crops	Pasture, Hay	Other Grasses (Urban, recreational; e.g. parks, lawns)	Woody Wetlands	Emergent Herbaceous Wetlands	Total	Land use Source
St. Marys River – Catfish Creek to Millers Branch	4,680	6,070	1,386	167	60	56,354	290,958	4,716	807	160	210,389	24,158	599,905	NLCD
	(0.8)	(1.0)	(0.2)	(0.0)	(0.0)	(9.4)	(48.5)	(0.8)	(0.1)	(0.0)	(35.1)	(4.0)		

2.0 WATER QUALITY ASSESSMENT

Stream segments are placed on the 303(d) list as partially supporting or not supporting their water use classification based on water quality sampling data. A stream is placed on the partial support list if more than 10% of the samples exceed the dissolved oxygen criteria and on the not support list if more than 25% of the samples exceed the standard.

During 2003, the Georgia EPD collected water quality data at EPD Station 08011021 on the St. Marys River at Interstate 95 (Figure 1). Appendix A provides the water quality data for this station, and includes DO and temperature data. In general, these data show that low dissolved oxygen values usually occurred during the summer months.

All field data relevant to the St. Marys River Basin were compiled by GA EPD and included in electronic database files. The data are managed using either the Water Resources Database (WRDB), a software database that was developed by GA EPD, or the EXCEL database management software.

3.0 SOURCE ASSESSMENT

An important part of the TMDL analysis is the identification of potential source categories. Sources are broadly classified as either point or nonpoint sources. A point source is defined as a discernable, confined, and discrete conveyance from which pollutants are or may be discharged to surface waters. Nonpoint sources are diffuse, and generally, but not always, involve accumulation of oxygen demanding substances on land surfaces that wash off as a result of storm events.

3.1 Point Source Assessment

Title IV of the Clean Water Act establishes the National Pollutant Discharge Elimination System (NPDES) permit program. Basically, there are two categories of NPDES permits: 1) municipal and industrial wastewater treatment facilities, and 2) regulated storm water discharges.

3.1.1 Wastewater Treatment Facilities

In general, industrial and municipal wastewater treatment facilities have NPDES permits with effluent limits. These permit limits are either based on federal and state effluent guidelines (technology-based limits) or water quality standards (water quality-based limits).

EPA has developed technology-based limits, which establish a minimum standard of pollution control for municipal and industrial discharges without regard for the quality of the receiving waters. These are based on Best Practical Control Technology Currently Available (BPT), Best Conventional Control Technology (BCT), and Best Available Technology Economically Achievable (BAT). The level of control required by each facility depends on the type of discharge and the pollutant.

EPA and the States have also developed numeric and narrative water quality standards. Typically, these standards are based on the results of aquatic toxicity tests and/or human health criteria and include a margin of safety. Water quality-based effluent limits are set to protect the receiving stream. These limits are based on water quality standards that have been established for a stream based on its intended use and the prescribed biological and chemical conditions that must be met to sustain that use.

Municipal and industrial wastewater treatment facilities' discharges may contribute oxygen-demanding substances to the receiving waters. There are two (2) NPDES permitted discharges with effluent limits for oxygen consuming substances identified in the St. Marys River Basin watershed upstream from or within the listed segment. One of these discharges is classified as major, with a discharge of 1.0 million gallons per day (MGD) or more. Figure 1 provides the locations of NPDES discharges and Table 3 provides the permitted flows, as well as the 5-day Biochemical Oxygen Demand (BOD_5), ammonia (NH_3), and DO concentrations for the municipal treatment facilities.

Combined sewer systems convey a mixture of raw sewage and storm water in the same conveyance structure to the wastewater treatment plant. These are considered a component of municipal wastewater treatment facilities. When the combined sewage and storm water exceed the capacity of the wastewater treatment plant, the excess is diverted to a combined sewage overflow (CSO) discharge point. There are no permitted CSO outfalls in the St. Marys River Basin.

Table 3. NPDES Facilities in the St. Marys River Basin

Facility Name	NPDES Permit No.	Receiving Stream	NPDES Permit Limits			
			Average Monthly Flow (MGD)	Average Monthly BOD_5 (mg/L)	Average Monthly NH_3 (mg/L)	Minimum DO (mg/L)
St. Marys River Basin						
City of Kingsland – St. Marys WPCP	GA0037800	St. Marys River	2.2	30	17.4	2
City of St. Marys – Scrubby Bluff WPCP	GA0037931	Casey Creek, tributary to St. Marys River	0.5	20[1]	5.0[1]	5

Note:
1 Permit values for the months of May through October.

3.1.2 Regulated Storm Water Discharges

Some storm water runoff is covered under the NPDES Permit Program. It is considered a diffuse source of pollution. Unlike other NPDES permits that establish end-of-pipe limits, storm water NPDES permits establish controls "to the maximum extent practicable" (MEP). Currently, regulated storm water discharges that may contain oxygen demanding substances consist of those associated with industrial activities, including construction sites one acre or greater, and large, medium, and small municipal separate storm sewer systems (MS4s) that serve populations of 50,000 or more.

Storm water discharges associated with industrial activities are currently covered under a General Storm Water NPDES Permit. This permit requires visual monitoring of storm water discharges, site inspections, implementation of BMPs, and record keeping.

Storm water discharges from MS4s are very diverse in pollutant loadings and frequency of discharge. At present, all cities and counties within the state of Georgia that had a population of greater than 100,000 at the time of the 1990 Census are permitted for their storm water discharge under Phase I. This includes 60 permittees, with about 45 located in the greater Atlanta metro area. Phase I MS4 permits require the prohibition of non-storm water discharges (i.e., illicit discharges) into the storm sewer systems and controls to reduce the discharge of pollutants to the maximum extent practicable, including the use of management practices, control techniques and systems, as well as design and engineering methods (Federal Register, 1990). A site-specific Storm Water Management Plan (SWMP) outlining appropriate controls is required by and referenced in the permit. There are no Phase I MS4s in the St. Marys River Basin.

As of March 10, 2003, small MS4s serving urbanized areas are required to obtain a storm water permit under the Phase II storm water regulations. An urbanized area is defined as an entity with a residential population of at least 50,000 people and an overall population density of at least 1,000 people per square mile. Thirty counties and 56 communities within the state of Georgia are permitted under the Phase II regulations. There are no counties or communities located in the St. Marys River Basin that are covered by the Phase II General Storm Water Permit.

3.1.3 Confined Animal Feeding Operations

Confined livestock and confined animal feeding operations (CAFOs) are characterized by high animal densities. This results in large quantities of fecal material being contained in a limited area. Processed agricultural manure from confined hog, dairy cattle, and select poultry operations is generally collected in lagoons. It is then applied to pastureland and cropland as a fertilizer during the growing season, at rates that often vary monthly. Runoff during storm events may carry surface residual containing oxygen demanding substances to nearby surface waters.

In 1990, the State of Georgia began registering CAFOs. Many of the CAFOs were issued land application or NPDES permits for treatment of wastewaters generated from their operations. The type of permit issued depends on the operation size (i.e., number of animal units). There are no CAFOs located in the St. Marys River Basin that are registered or have land application permits.

3.2 Nonpoint Source Assessment

In general, nonpoint sources cannot be identified as entering a waterbody through a discrete conveyance at a single location. Typical nonpoint sources of oxygen demanding substances come from materials being washed into the rivers and streams during storm events. Constituents may wash off of land surfaces and either: 1) are flushed out of the system along with the water column flow; or 2) are settled out and become part of the stream channel bottom.

In this manner, historic wash off of settleable materials accumulates and exerts sediment oxygen demand (SOD). Constituents of concern from surface washoff include the fractions of ammonia and BOD_5 that become an integral part of channel bottom sediments, thus becoming a potential source of SOD. Table 2 provides the land cover distributions for the listed St. Marys River watershed. These data show that the watershed is predominately forested, with 48.5 percent forest land use. Woody wetlands is the next predominate land use, accounting for 35.1 percent of the watershed.

In addition to nonpoint sources of SOD associated with land disturbing activities, most of the streams in the St. Marys River Basin receive significant natural contributions of oxygen demanding organic materials from local wetlands and forested stream corridors. The following sources of naturally occurring organic materials have been identified:

- Adjacent wetlands, swamps, and marshes with organically rich bottom sediments; and
- Direct leaf litterfall onto water surfaces and adjacent floodplains from overhanging trees and vegetation.

Leaf litterfall is a major contributor to the amount of dissolved organic matter in the stream water column and the amount of SOD being exerted. Many streams in southern Georgia are also referred to as “blackwater” streams because of highly colored humic substances leached from surrounding marshes and swamps. In addition, low dissolved oxygen in blackwater streams is very common in the summer months when the temperatures are high and the flows are low (Meyer, 1992). The oxygen demanding effects of leaf litterfall are reflected in two ways: 1) by lowering the DO saturation of water entering the channel from adjacent swampy areas caused by decaying vegetation; and 2) by increasing SOD associated with vegetation decaying on stream channel bottoms.

3.2.1 Land Application Systems

Many smaller communities use land application systems (LAS) for treatment of their sanitary wastewater. These facilities are required through LAS permits to treat all their wastewater by land application and are to be properly operated as non-discharging systems that contribute no runoff to nearby surface waters. However, runoff during storm events may carry surface residual containing oxygen demanding substances to nearby surface waters. Some of these facilities may also exceed the ground percolation rate when applying their wastewater, resulting in surface runoff. If not properly bermed, this runoff, which contains oxygen demanding substances, may discharge to nearby surface waters. There is one permitted LAS system located in the St. Marys River Basin at the U.S. Navy Base at Kings Bay in Camden County. This facility has a permitted flow of 1.5 MGD.

4.0 TECHNICAL APPROACH

The first step of the technical approach for this TMDL is to select the model that can be effectively used to analyze the St. Marys River DO resources. After the appropriate model is selected, data is gathered to develop and calibrate the model. The calibrated model is then used to establish the TMDL during critical conditions. The modeling approach is described in the following sections.

4.1 Model Selection and Structure

Various analyses were performed to correlate the measured low DO concentrations to basic causes such as point and nonpoint contributions, flow conditions, stream and watershed characteristics, seasonal temperature effects, and others. From these analyses, the low DO values were found to coincide with high temperatures. Inflows of very low DO waters from adjacent marshes compounded the situation. Based on the geographic, hydrologic, and water quality characteristics of the St. Marys River, and considering that it is tidally influenced, Georgia Estuary was selected as the appropriate model for the listed stream segment.

USGS quadrangle maps and navigational maps, along with Arcview and MapInfo spatial graphics files, were used to develop drainage areas, stream lengths, bed slopes, segment geometry, and other physical input data for each model. Appendix B provides a summary of the model structure.

4.1.1 Georgia Estuary

Georgia Estuary is a one-dimensional water quality model developed by GA EPD. This model may be used for saline estuaries, as well as non-saline tidal rivers where both freshwater flow and tidal mixing are significant mechanisms in the transport of wastes in the water. Georgia Estuary is a steady state tidally averaged water quality model. The concentrations in the estuary vary spatially, but are assumed to be constant in time. Because an estuary has cyclical tidal variations that effect depth, cross-sectional area, and volume, an average mean water model is developed that is the average of the high water and low water slack tides.

In Georgia estuaries, the natural DO can drop below the freshwater standard of 5.0 mg/L. The Coastal DO Criteria for fishing use classification is given in Table 4.

Table 4. Coastal DO Criteria for Fishing Use Classification

If the natural DO is		The Maximum Allowable DO Deficit (mg/L)
Greater than or equal to (mg/L)	But less than (mg/L)	
2.0	3.0	0.1
3.0	3.3	Never less than 3.0 mg/L
3.3	4.0	0.3
4.0	5.0	0.4
5.0	5.5	0.5
5.5	---	Never less than 5.0 mg/L

Georgia Estuary models are tidally averaged and cannot accept model segments lateral to the main channel. One Estuary model was developed to represent the tidally influenced listed segment of the St. Marys River from Catfish Creek to Millers Branch.

4.2 Model Calibration

The model calibration period was determined from an examination of the GA EPD 2003 water quality data for the listed segment. The data examined included streamflow, DO and water temperature. The combination of the lowest DO and highest water temperature defined the critical modeling period.

For the listed segment, June 2003 was found to be the critical period. The calibration models were run to simulate an average DO from this period. The average summer DO was 3.2 mg/L (ranging from 2.9 mg/L to 3.7 mg/L) at an average summer temperature of 28 ^{o}C (ranging from 27.3 ^{o}C to 28.5 ^{o}C). Headwater and tributary water quality boundaries were developed from these instream field data, expected low DO saturation values (Meyer, 1992), and GA EPD standard modeling practices (GA EPD, 1978).

Average monthly discharge flows, BOD_5, NH_3, and DO concentrations for the discharges were obtained from June 2003 Discharge Monitoring Reports (DMRs). These data were input into the calibration model. BOD_5 was converted to $CBOD_U$ by multiplying by an f-ratio of 2 if the BOD_5 is greater than 20 mg/L and an f-ratio of 3 if the BOD_5 is 20 mg/L or less (GA EPD, 1978). Ammonia was converted to $NBOD_U$ by multiplying by 4.57. Table 5 provides a summary of the actual discharges from these facilities for June 2003.

Table 5. Summary of NPDES Discharges during 2003

Facility Name	NPDES Permit No.	Actual Discharge for June 2003			
		Flow (MGD)	BOD_5 (mg/L)	NH_3 (mg/L)	DO (mg/L)
City of Kingsland - St. Marys WPCP	GA0037800	1.75	10	16.9	5.44
City of St. Marys - Scrubby Bluff WPCP*	GA0037931	0	N/A	N/A	N/A

* The City of St. Marys - Scrubby Bluff WPCP facility, although permitted to discharge to Casey Creek, has not yet gone online.

In shallow streams, SOD is an important part of the oxygen budget. However, there are no field SOD measurements in the St. Marys River Basin. In the South 4 Basins, there are several SOD measurements that ranged from 0.9 to 1.9 g/m^2/day. An examination of South 4 SOD results was performed in order to develop realistic SOD values that could be applied to the St. Marys Estuary model. An SOD value of 0.95 g/m^2/day was adopted for the St. Marys River model.

The kinetic rates and input parameters developed during model calibration are provided in Table 6. These parameters include the carbonaceous BOD (CBOD) decay rate, nitrogenous BOD (NBOD) decay rate, SOD rate, and the Tsivoglou reaeration coefficient used to determine stream reaeration. In addition, GA Estuary requires a dispersion coefficient.

Table 6. Modeling Parameters

Parameter	GA Estuary Values

CBOD Decay Rate (1/day)	0.08
NBOD Decay Rate (1/day)	0.1
SOD (g/m^2/day)	0.95
Reaeration Coefficient	0.16-0.19
Dispersion Coefficient (mi^2/day)	18

The St. Marys River Estuary model was calibrated at Interstate 95, where the GA EPD collected discrete water quality data during 2003. Appendix C provides the DO calibration curves plotted with the data from monitoring stations in the listed segments.

4.3 Critical Conditions Model

The critical conditions model was used to assess the dissolved oxygen standard and to determine if problems exist requiring regulatory intervention. Model critical conditions were developed in accordance with GA EPD standard practices (GA EPD, 1978).

Critical water temperatures were determined by examining historic water quality data. The highest summer-time temperature was used to represent each of the listed segments.

Point sources were incorporated into the critical conditions model at their current NPDES permit limits. Although the City of St. Marys – Scrubby Bluff WPCP facility has not begun discharging to Casey Creek under their existing NPDES permit, their permitted limits were used in the critical conditions model. Water quality boundaries, the SOD rate, and all other modeling rates and constants were the same as those in the calibrated model.

4.4 Natural Conditions Model

For the natural conditions models, all point source discharges were completely removed from the critical conditions model. All other model parameters remained the same. This model was used to determine the natural dissolved oxygen concentrations during critical conditions. This model predicted the natural dissolved oxygen concentrations, during the critical summer months, to be less than 5.0 mg/L. Results of the natural condition runs are plotted in the graphs in Appendix C along with the calibration, critical conditions and TMDL results for comparison.

5.0 TOTAL MAXIMUM DAILY LOAD

A Total Maximum Daily Load (TMDL) is the amount of a pollutant that can be assimilated by the receiving waterbody without exceeding the applicable water quality standard. A TMDL is the sum of the individual waste load allocations (WLAs) from point sources and load allocations (LAs) from nonpoint sources, as well as the natural background (40 CFR 130.2) for a given waterbody. The TMDL must also include a margin of safety (MOS), either implicitly or explicitly, that accounts for the uncertainty in the relationship between pollutant loads and the water quality response of the receiving water body (USEPA, 1991). TMDLs can be expressed in terms of either mass per time, toxicity, or other appropriate measures. For oxygen demanding substances, the TMDL is expressed in lbs/day.

Conceptually, a TMDL can be expressed as follows:

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

This TMDL determines the allowable oxygen demanding load to the listed segment of the St. Marys River. The following sections describe the various oxygen demanding sources which may contribute loads to the TMDL components.

5.1 Waste Load and Load Allocations

The waste load allocation (WLA) is the portion of the receiving water's loading capacity that is allocated to existing or future point sources. WLAs are provided to the point sources from municipal and industrial wastewater treatment systems, as well as permitted storm water discharges. There are two NPDES permitted facilities in the St. Marys River watershed that effect instream dissolved oxygen. Waste load allocations are provided to the point sources from these municipal wastewater treatment systems.

The Georgia ESTUARY critical conditions model was used to determine the WLAs for the discharges upstream from or within the listed segments in order to meet the DO standards. Allocations are based on EPA Dissolved Oxygen Criteria, which states that if the natural dissolved oxygen is less than the standard, then only a 10 percent reduction in the natural condition is allowed. The target limits are defined as 90 percent of the naturally occurring dissolved oxygen concentration at critical conditions and is also the TMDL target.

Table 7 lists the WLAs required to meet the target DO standard. This TMDL requires no reductions in the wasteload allocations. In addition, the ESTUARY model indicates that there is additional assimilative capacity in the St. Marys River segment. However, it should be noted that the SOD rates used in the TMDL allocation models were based on model predictions and may need to be verified before WLAs are implemented.

State and Federal Rules define storm water discharges covered by NPDES permits as point sources. However, storm water discharges are from diffuse sources and there are multiple storm water outfalls. Storm water sources (point and nonpoint) are different than traditional NPDES permitted sources in four respects: 1) they do not produce a continuous (pollutant loading) discharge; 2) their pollutant loading depends on the intensity, duration, and frequency of rainfall events, over which the permittee has no control; 3) the activities contributing to the pollutant loading may include the various allowable activities of others, and control of these activities is not solely within the discretion of the permittee; and 4) they do not incorporate wastewater treatment plants that control specific pollutants to meet numeric limits.

Table 7. St. Marys River Basin WLAs

Facility Name	NPDES Permit No.	Receiving Stream	NPDES Permit Limits			
			Average Monthly Flow (MGD)	Average Monthly BOD_5 (mg/L)	Average Monthly NH_3 (mg/L)	Minimum DO (mg/L)
Canoochee River Basin						
City of Kingland - St. Marys WPCP	GA0037800	St. Marys River	2.2	30	17.4	2
City of St. Marys - Scrubby Bluff WPCP*	GA0037931	Casey Creek	0.5	20[1]	5.0[1]	5

Note:
1 Permit values for the months of May through October.

The intent of storm water NPDES permits is not to treat the water after collection, but to reduce the exposure of storm water to pollutants by implementing various controls. It would be infeasible and prohibitively expensive to control pollutant discharges from each storm water outfall. Therefore, storm water NPDES permits require the establishment of controls or BMPs to reduce pollutants entering the environment.

The Georgia ESTUARY model was run under critical conditions, assuming mid-tide dry weather conditions. Because the critical conditions occur when there are no storm events, no numeric allocation is given to the waste load allocations from storm water discharges associated with MS4s (WLAsw).

The nonpoint source loads for the existing LA and TMDL were computed from the model boundary conditions, which include the stream, tributary, and headwater model boundaries under critical conditions. The partitioning of allocations between point (WLA) and nonpoint (LA) sources shown in Table 8 is based on modeling results and professional judgment.

5.2 Seasonal Variation

The mid-tide, high temperature critical conditions incorporated in this TMDL are assumed to represent the most critical design conditions and to provide year-round protection of water quality. This TMDL is expressed as a total load during the critical low flow period.

5.3 Margin of Safety

The MOS is a required component of TMDL development. As specified by section 303(d) of the CWA, the margin of safety must account for any lack of knowledge concerning the relationship between effluent limitations and water quality. There are two basic methods for incorporating the MOS: 1) implicitly incorporate the MOS using conservative model assumptions to develop allocations, or 2) explicitly specify a portion of the TMDL as the MOS and use the remainder for allocations.

For this TMDL, the MOS was implicitly incorporated in the use of the following conservative modeling assumptions:

- Mid-tide conditions;
- High summer temperatures;
- Conservative reaction rates; and
- The assumption that all point sources continuously discharge at their NPDES permit limits for the same critical period.

Table 8. TMDL Loads for the St. Marys River Basin under Critical Conditions

Stream Segment	WLA (lbs/day)	WLAsw (lbs/day)	LA (lbs/day)	TMDL (lbs/day)
St. Marys River – Catfish Creek to Millers Branch	2,917	NA	2,686	5,603

Note: TMDL expressed as Ultimate Oxygen Demand (UOD), which includes the Carbonaceous Biochemical Oxygen Demand (CBOD) and the Nitrogenous Biochemical Oxygen Demand (NBOD).
NA = no storm water discharges associated with MS4s contributing to the listed segment during critical conditions

6.0 RECOMMENDATIONS

6.1 Monitoring

Water quality monitoring is conducted at a number of locations across the State each year. The GA EPD has adopted a basin approach to water quality management that divides Georgia's major river basins into five groups. This approach provides for additional sampling work to be focused on one of the five basin groups each year, and offers a five-year planning and assessment cycle (GA EPD, 1996). The Ochlockonee, Satilla, St. Marys and Suwannee River Basins were the basins of focused monitoring in 2003 and will again receive focused monitoring in 2008.

The revised TMDL Implementation Plan for the listed segment of the St. Marys River will include monitoring plans which describe pertinent current or impending water quality monitoring activities, recommended future monitoring activities, and suggest procedures for coordinating those activities.

6.2 Reasonable Assurance

The GA EPD is responsible for administering and enforcing laws to protect the waters of the State. The TMDL implementation will be conducted using a phased approach. Permitted discharges will be regulated through the NPDES permitting process described in this report. The permittee may be required to perform temperature and dissolved oxygen monitoring upstream and downstream of the point source. If it is determined that the model assumptions need to be modified, the TMDL will be re-evaluated based on the new data collected during critical conditions, and the TMDL will be reallocated.

The GA EPD is the lead agency for implementing the State's Nonpoint Source Management Program. Regulatory responsibilities that have a bearing on nonpoint source pollution include establishing water quality standards and use classifications, assessing and reporting water quality conditions, and regulating land use activities that may affect water quality. Georgia is working with local governments, agricultural, and forestry agencies such as the Natural Resources Conservation Service, the Georgia Soil and Water Conservation Commission, and the Georgia Forestry Commission, to foster the implementation of BMPs that address nonpoint source pollution. In addition, public education efforts are being targeted to individual stakeholders to provide information regarding the use of BMPs to protect water quality.

6.3 Public Participation

A thirty-day public notice period was provided for this TMDL. During that time, the availability of the TMDL was publicly noticed, a copy of the TMDL was provided upon request, and the public was invited to provide comments on the TMDL. This TMDL was modified to address the comments received.

7.0 INITIAL TMDL IMPLEMENTATION PLAN

GA EPD has coordinated with EPA to prepare this Initial TMDL Implementation Plan for this TMDL. GA EPD has also established a plan and schedule for development of a more comprehensive implementation plan after this TMDL is established. GA EPD and EPA have executed a Memorandum of Understanding that documents the schedule for developing the more comprehensive plans. This Initial TMDL Implementation Plan includes a list of BMPs and provides for an initial implementation demonstration project to address one of the major sources of pollutants identified in this TMDL, while State and/or local agencies work with local stakeholders to develop a revised TMDL Implementation Plan. It also includes a process whereby GA EPD and/or Regional Development Centers (RDCs), or other GA EPD contractors (hereinafter, "GA EPD Contractors"), will develop expanded plans (hereinafter, "Revised TMDL Implementation Plans").

This Initial TMDL Implementation Plan, written by GA EPD and for which GA EPD and/or the GA EPD Contractor are responsible, contains the following elements.

1. NPDES permit discharges are a primary source of excessive pollutant loading, where they are a factor. Any wasteload allocations in this TMDL will be implemented in the form of water-quality based effluent limitations in NPDES permits issued under CWA Section 402. [See 40 C.F.R. § 122.44(d)(1)(vii)(B)]. Nonpoint sources are the secondary cause of excessive pollutant loading in most cases. EPA has identified a number of management strategies for the control of nonpoint sources of pollutants, representing some BMPs. The "Management Measure Selector Table" shown below identifies these management strategies by source category and pollutant.

2. GA EPD and the GA EPD Contractor will select and implement one or more BMP demonstration projects for each River Basin. The purpose of the demonstration projects will be to evaluate by River Basin and pollutant parameter the site-specific effectiveness of one or more of the BMPs chosen. GA EPD intends that the BMP demonstration project be completed before the Revised TMDL Implementation Plan is issued. The BMP demonstration project will address the major pollutant categories of concern for the respective River Basin as identified in the TMDLs. The demonstration project need not be of a large scale, and may consist of one or more measures from the Table or equivalent BMP measures proposed by the GA EPD Contractor and approved by GA EPD. Other such measures may include those found in EPA's "*Best Management Practices Handbook*," the *"NRCS National Handbook of Conservation Practices*," or any similar reference, or measures that the volunteers, etc., devise that GA EPD approves. If for any reason the GA EPD Contractor does not complete the BMP demonstration project, GA EPD will take responsibility for doing so.

3. As part of the Initial TMDL Implementation Plan, the GA EPD brochure entitled *"Watershed Wisdom -- Georgia's TMDL Program*" will be distributed by GA EPD to the GA EPD Contractor for use with appropriate stakeholders for this TMDL. Also, a copy of the video of that same title will be provided to the GA EPD Contractor for its use in making presentations to appropriate stakeholders on TMDL Implementation Plan development.

4. If for any reason the GA EPD Contractor does not complete one or more elements of a Revised TMDL Implementation Plan, GA EPD will be responsible

for getting that (those) element(s) completed, either directly or through another contractor.

5. The deadline for development of a Revised TMDL Implementation Plan is the end of December 2006.

6. The GA EPD Contractor helping to develop the Revised TMDL Implementation Plan, in coordination with GA EPD, will work on the following tasks involved in converting the Initial TMDL Implementation Plan to a Revised TMDL Implementation Plan:

   A. Generally characterize the watershed;
   B. Identify stakeholders;
   C. Verify the present problem to the extent feasible and appropriate (e.g., local monitoring);
   D. Identify probable sources of pollutant(s);
   E. For the purpose of assisting in the implementation of the load allocations of this TMDL, identify potential regulatory or voluntary actions to control pollutant(s) from the relevant nonpoint sources;
   F. Determine measurable milestones of progress;
   G. Develop a monitoring plan, taking into account available resources, to measure effectiveness; and
   H. Complete and submit to GA EPD the Revised TMDL Implementation Plan.

7. The public will be provided an opportunity to participate in the development of the Revised TMDL Implementation Plan and to comment on it before it is finalized.

8. The Revised TMDL Implementation Plan will supersede this Initial TMDL Implementation Plan once GA EPD approves the Revised TMDL Implementation Plan.

Management Measure Selector Table

Land Use	Management Measures	*Fecal Coliform*	*Dissolved Oxygen*	*pH*	*Oxygen demanding substances*	*Temperature*	*Toxicity*	*Mercury*	*Metals (copper, lead, zinc, cadmium)*	*PCBs, toxaphene*
Agriculture	1. Oxygen demanding substances & Erosion Control	–	–		–	–				
	2. Confined Animal Facilities	–	–							
	3. Nutrient Management	–	–							
	4. Pesticide Management		–							
	5. Livestock Grazing	–	–		–	–				
	6. Irrigation		–		–	–				
Forestry	1. Preharvest Planning				–	–				
	2. Streamside Management Areas	–	–		–	–				
	3. Road Construction & Reconstruction		–		–	–				
	4. Road Management		–		–	–				
	5. Timber Harvesting		–		–	–				
	6. Site Preparation & Forest Regeneration		–		–	–				
	7. Fire Management	–	–	–	–	–				
	8. Revegetation of Disturbed Areas	–	–	–	–	–				
	9. Forest Chemical Management		–			–				
	10. Wetlands Forest Management	–	–	–		–		–		

Land Use	Management Measures	*Fecal Coliform*	*Dissolved Oxygen*	*pH*	*Oxygen demanding substances*	*Temperature*	*Toxicity*	*Mercury*	*Metals (copper, lead, zinc, cadmium)*	*PCBs, toxaphene*
Urban	1. New Development	–	–		–	–			–	
	2. Watershed Protection & Site Development	–	–		–	–		–	–	
	3. Construction Site Erosion and Oxygen demanding substances Control		–		–	–				
	4. Construction Site Chemical Control		–							
	5. Existing Developments	–	–		–	–			–	
	6. Residential and Commercial Pollution Prevention	–	–							
Onsite Wastewater	1. New Onsite Wastewater Disposal Systems	–	–							
	2. Operating Existing Onsite Wastewater Disposal Systems	–	–							
Roads, Highways and Bridges	1. Siting New Roads, Highways & Bridges	–	–		–	–			–	
	2. Construction Projects for Roads, Highways and Bridges		–		–	–				
	3. Construction Site Chemical Control for Roads, Highways and Bridges		–							
	4. Operation and Maintenance-Roads, Highways and Bridges	–	–			–			–	

REFERENCES

Carter, R.F. and J.D. Fanning, 1982. *Monthly Low-Flow Characteristics of Georgia Streams*, U.S. Geological Survey, prepared in cooperation with the Georgia Department of Natural Resources, Environmental Protection Division, Open-File Report 82-560.

Dyar, T.R. and S.J. Alhadeff, 1997. *Stream-Temperature Characteristics in Georgia*, U.S. Geological Survey, prepared in cooperation with the Georgia Department of Natural Resources, Environmental Protection Division, Water Resources Investigations Report 96-4203.

Federal Register, 1990. *Federal Register, Part II: Environmental Protection Agency*, Vol. 55, No. 222, November 16, 1990.

GA EPD, 1978. *Modeling Procedures Manual*, prepared for the Georgia Department of Natural Resources, Environmental Protection Division, L. A. Roesner and R. P. Shubinski.

GA EPD, 1996. *Georgia's Watershed Protection Approach: River Basin Management Planning*, Draft Program Description**,** Georgia Department of Natural Resources, Environmental Protection Division, Atlanta, Georgia, February 1996.

GA EPD, 2004. *Rules and Regulations for Water Quality Control, Chapter 391-3-6*, Revised – November 2004, Georgia Department of Natural Resources, Environmental Protection Division, Atlanta, Georgia.

Meyer, J.L., 1992. "Seasonal patterns of water quality in blackwater rivers of the Coastal Plain, Southeastern United States." *Water Quality in North American River Systems,* Battelle Press, Columbus, Ohio, pages 249-276.

Thomann, R.V. and J.A. Mueller, 1987. *Principles of Surface Water Quality Modeling and Control*, Harper Collins Publishers Inc., New York.

Tsivoglou, C. and L.A. Neal, 1976. "Tracer measurement of reaeration: III. Predicting the reaeration capacity of inland streams," *Journal of Water Pollution Control Facilities,* December 1976, pages 2669-2689.

USEPA, 1986. *Ambient Aquatic Life Water Quality Criteria for Dissolved Oxygen (Freshwater)*, U.S. Environmental Protection Agency, Office of Water Regulations and Standards, Criteria and Standards Division, EPA 440/5-86-003.

USEPA, 1991. *Guidance for Water Quality Based Decisions: The TMDL Process*, EPA 440/4-91-001, U.S. Environmental Protection Agency, Assessment and Watershed Protection Division, Washington, D.C.

APPENDIX A

Water Quality Data

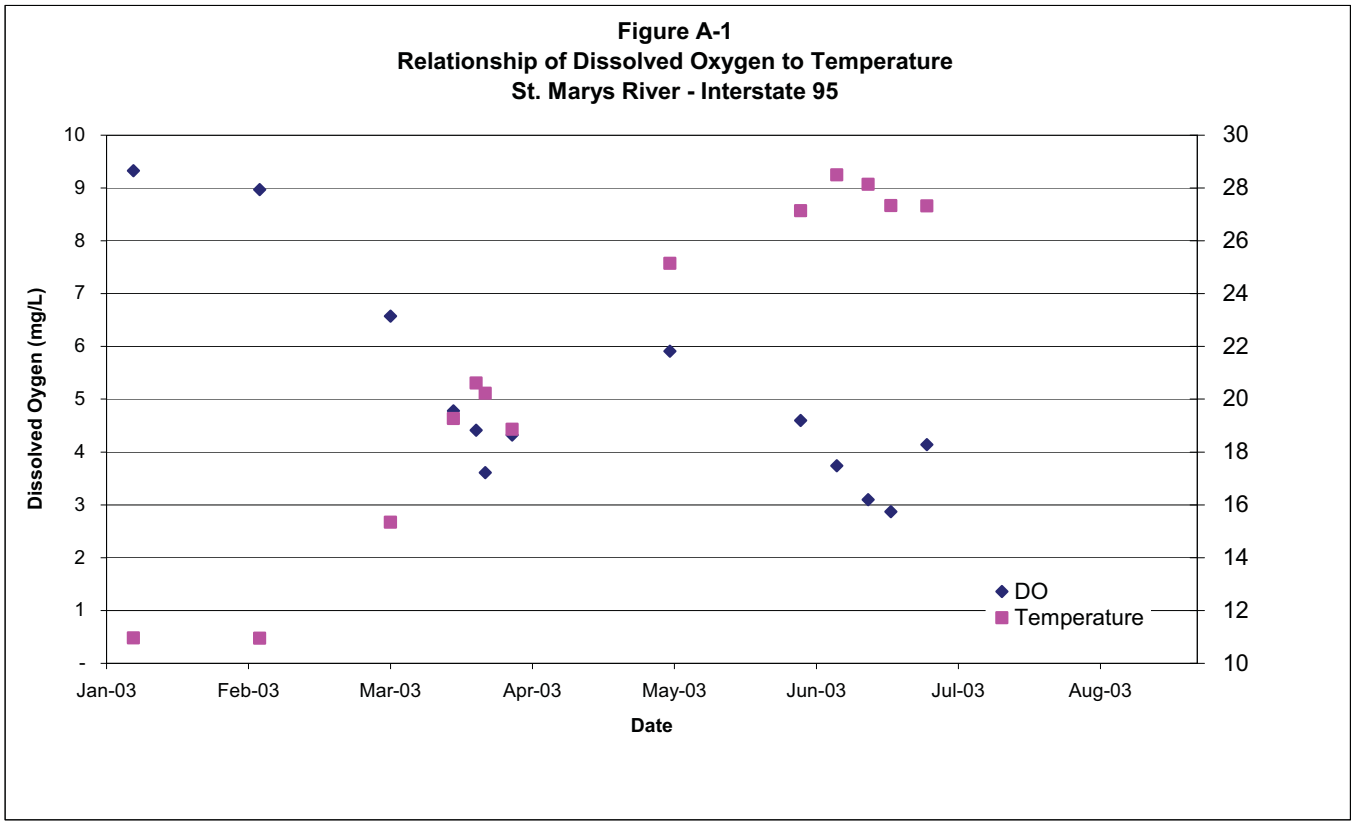


Table A-1. Data for Figure A-1

Date	Dissolved Oxygen (mg/L)	Water Temperature (deg C)
07-Jan-03	9.33	10.96
04-Feb-03	8.97	10.95
05-Mar-03	6.57	15.34
19-Mar-03	4.78	19.27
24-Mar-03	4.41	20.61
26-Mar-03	3.61	20.23
01-Apr-03	4.32	18.86
06-May-03	5.91	25.14
04-Jun-03	4.60	27.14
12-Jun-03	3.74	28.50
19-Jun-03	3.10	28.14
24-Jun-03	2.87	27.33
02-Jul-03	4.14	27.32

APPENDIX B

Model Structure

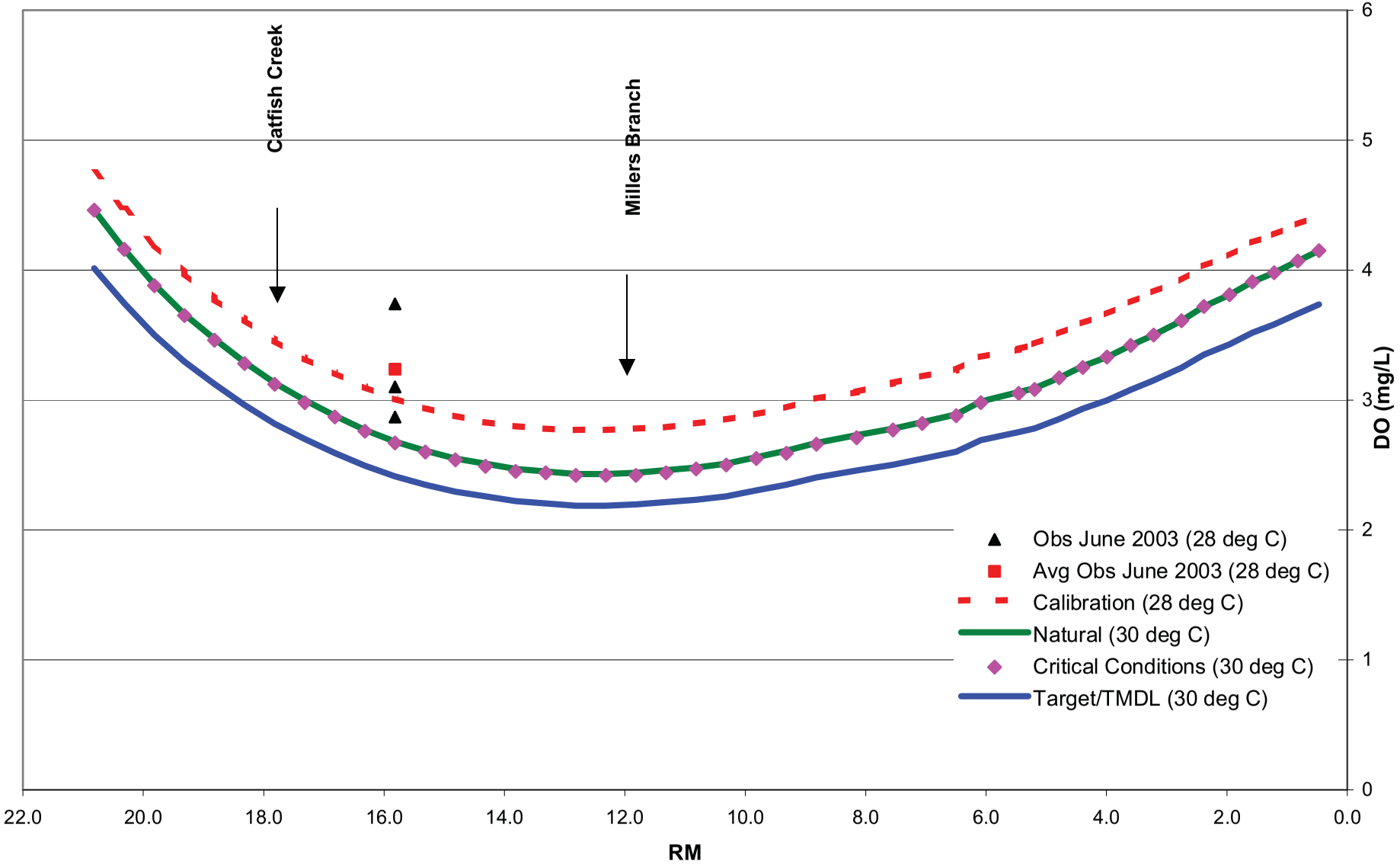
Table B-1. St. Marys River Estuary Model Structure

Segment	Segment Name	Reach Length (feet)	Volume (million gallons)	Depth (ft)
1	USGS 02231253 at RM 21.1	2640	177.8	15.0
2	St. Marys at RM 20.5	2640	177.8	15.0
3	St. Marys at RM 20.0	2640	177.8	15.0
4	St. Marys at RM 19.5	2640	192.6	15.0
5	St. Marys at RM 19.0	2640	207.4	15.0
6	St. Marys at Kingsland WPCP outfall	2640	213.3	16.0
7	St. Marys above Catfish Creek RM 18	2640	205.4	16.0
8	St. Marys at RM 17.5	2640	213.3	16.0
9	St. Marys at RM 17.0	2640	221.2	16.0
10	St. Marys at RM 16.5	2640	213.3	16.0
11	St. Marys at I-95 RM 16.0	2640	218.2	17.0
12	St. Marys above Casey Creek RM 15.5	2640	226.6	17.0
13	St. Marys at RM 15.0	2640	235.0	17.0
14	St. Marys above Sister Cks RM 14.5	2640	235.0	17.0
15	St. Marys at RM 14.0	2640	235.0	17.0
16	St. Marys at RM 13.5	2640	311.1	17.5
17	St. Marys at RM 13.0	2640	380.2	17.5
18	St. Marys above Millers Brch RM 12.5	2640	345.6	17.5
19	St. Marys at RM 12.0	2640	311.1	17.5
20	St. Marys at RM 11.5	2640	293.8	17.5
21	St. Marys at RM 11.0	2640	276.5	17.5
22	St. Marys at RM 10.5	2640	276.5	17.5
23	St. Marys at RM 10.0	2640	276.5	17.5
24	St. Marys at RM 9.5	2640	320.0	18.0
25	St. Marys below Sta. M7 at RM 8.82	3510	492.7	17.8
26	St. Marys at RM 8.15	3200	487.2	19.2
27	St. Marys below Sta. M6 at RM 7.55	2560	399.8	18.6
28	St. Marys at RM 7.06	2970	520.4	16.7
29	St. Marys above Burrell's Ck RM 6.5	2180	344.1	19.2
30	Between Bell/Burrell below Sta. M5	3310	580.5	18.7
31	Below Bells River at RM 5.46	1390	309.6	22.2
32	St. Marys at RM 5.2	2170	453.1	29.8
33	St. Marys at RM 4.78	2050	361.0	18.0
34	Above St. Marys Dock RM 4.4	2130	420.1	21.0
35	Below St. Marys Dock above Sta. M4	2090	422.0	16.2
36	St. Marys at RM 3.6	1990	408.2	19.2
37	St. Marys at RM 3.22	2470	504.6	17.5
38	St. Marys at RM 2.75	1950	358.2	17.9
39	Above St. Marys WTF RM 2.33	2260	495.0	21.2
40	Above North Riv. & Sta. M3	1990	492.0	23.7
41	Below North Riv. at RM 1.56	1920	435.6	15.7
42	St. Mary at RM 1.21	2060	419.2	16.3
43	Below Sta. M2 & Pt. Peter Pier	1870	442.7	20.0
44	St. Marys at RM 0.47	2480	583.5	15.2
45	St. Marys at Sta. M1 & Cumbl. Sound	-	-	-

APPENDIX C

Calibration, Critical Conditions, Natural Conditions, and TMDL Model Curves

Figure C-1
DOSAG Model Results
St. Marys River



APPENDIX D

Daily Oxygen Demanding Substances Load Summary Memorandum

SUMMARY MEMORANDUM
Average Annual Oxygen Demanding Substances Load
St. Marys River

1. 303(d) Listed Waterbody Information

State: Georgia
County: Camden

Major River Basin: St. Marys
8-Digit Hydrologic Unit Code(s): 03070204

Waterbody Name: St. Marys River
Location: Catfish Creek to Millers Branch
Stream Length: 6 miles
Watershed Area: 1,360 square miles
Flows into: Atlantic Ocean
Ecoregion: Atlantic Coast Flatwoods

Constituent(s) of Concern: Dissolved Oxygen

Designated Use: Fishing (not supporting designated use)

Applicable Water Quality Standards:

A daily average of 5.0 mg/L and no less than 4.0 mg/L at all times for waters supporting warm water species of fish.

***Natural Water Quality*. It is recognized that certain natural waters of the State may have a quality that will not be within the general or specific requirements contained herein. These circumstances do not constitute violations of water quality standards. This is especially the case for the criteria for dissolved oxygen, temperature, pH and fecal coliform. NPDES permits and Best Management Practices will be the primary mechanisms for ensuring that the discharges will not create a harmful situation.**

2. TMDL Development

Analysis/Modeling: Georgia Estuary – Steady state tidally averaged water quality model developed by Georgia Environmental Protection Division.

Calibration Data: Georgia EPD field data from summer 2003.

Critical Conditions:
(1) Mid-tide conditions;
(2) High summer temperatures, based on historic water quality data;
(3) Conservative reaction rates; and
(4) Incorporation of point sources discharging at their NPDES permit limits.

3. Allocation Watershed/Stream Reach:

Wasteload Allocations (WLA):	**2,917 lbs/day**
Wasteload Allocations (WLAsw):	**NA**
Load Allocation (LA):	**2,686 lbs/day**
TMDL	**5,603 lbs/day**

*** TMDL expressed as Ultimate Oxygen Demand (UOD), which includes Carbonaceous Biochemical Oxygen Demand (CBOD) and Nitrogenous Biochemical Oxygen Demand (NBOD).**

Margin of Safety (MOS): **Implicit, based on the following conservative assumptions:**
(1) Mid-tide conditions;
(2) High summer temperatures, based on the historical record, persist for the same critical period;
(3) Conservative reaction rates; and
(4) All point sources discharge continuously at their NPDES permit limits for the same critical period.

APPENDIX B

St. Marys River Catfish Creek to Miller's Branch Segment Watershed Improvement Plan First Year Final Report

Watershed Improvement Plan
Contract Number 751-110059

St. Marys River Catfish Creek to Miller's Branch Segment Watershed Improvement Plan First Year Final Report

Project Summary:
This project initiated Phase I in the development of a Watershed Improvement Plan (WIP) for a selected impaired water body defined as "not supporting" on the 303(d) list of the Water Quality in Georgia Report.

A Partnership Advisory Committee (PAC) was convened to select an impaired watershed, St. Marys River Catfish Creek to Miller's Branch, and provide guidance in identifying the source of impairment and development of a targeted monitoring plan. Previous studies identified urban runoff, natural sources and hydrologic modifications as sources for the Dissolved Oxygen Impairment. Local stakeholders and the PAC are concerned with determining the significance of urban runoff to natural sources and conditions as the primary source for the low dissolved oxygen levels in this segment of the St. Marys River. The PAC will continue to provide guidance for Phase II the development of the WIP.

Outreach to Stakeholders and Form Partnership Advisory Council (PAC):
Initial PAC meeting was held November 2010 at the CRC in Brunswick. The CSS TAC and other interested parties were invited to participate. The meeting provided an overview of the WIP project. Participants requested more detail information about candidate watersheds to make the selection.

Thomas and Hutton Engineering made meeting space available for PAC meetings including conference call capability.

The CRC reviewed and summarized candidate streams. The list of candidates was discussed with EPD and was narrowed based on previous studies and planning efforts.

The December 2010 PAC meeting was held at the Thomas and Hutton offices in Savannah. This meeting discussed candidate streams, goals near and long term. The decision made by the PAC was to select streams based on environments to serve as models for the future, which included one rural inland, Jackson Branch and one developed, coastal/tidal - St. Marys.

A local stakeholders meeting was conducted on February 28, 2011. A presentation was made on the WIP project with the focus on how it is building on TMDL and past monitoring projects. The discussion with local stakeholders focused on potential contributing sources and possible monitoring locations.

Visual Survey:
The visual stream survey was scheduled with assistance from Alice Vick, EPD Coastal Nonpoint, for March 28, 2011. The river survey by boat on March 28, 2011 was cancelled due to weather. The survey was rescheduled for April 8, 2011. The survey team included Ken Kessler - Kingsland Planning Director, Clay Montegue - University of Florida, Bill Miller - Satilla Riverkeeper, Phil Jones - St. Marys River Management Committee Member, Conn Cole – Camden County Code Enforcement, Alice Vick and Shannon (boat driver) - EPD and Chris Emmer - CRC. The survey team members divided into two groups, one boat team and one driving team.

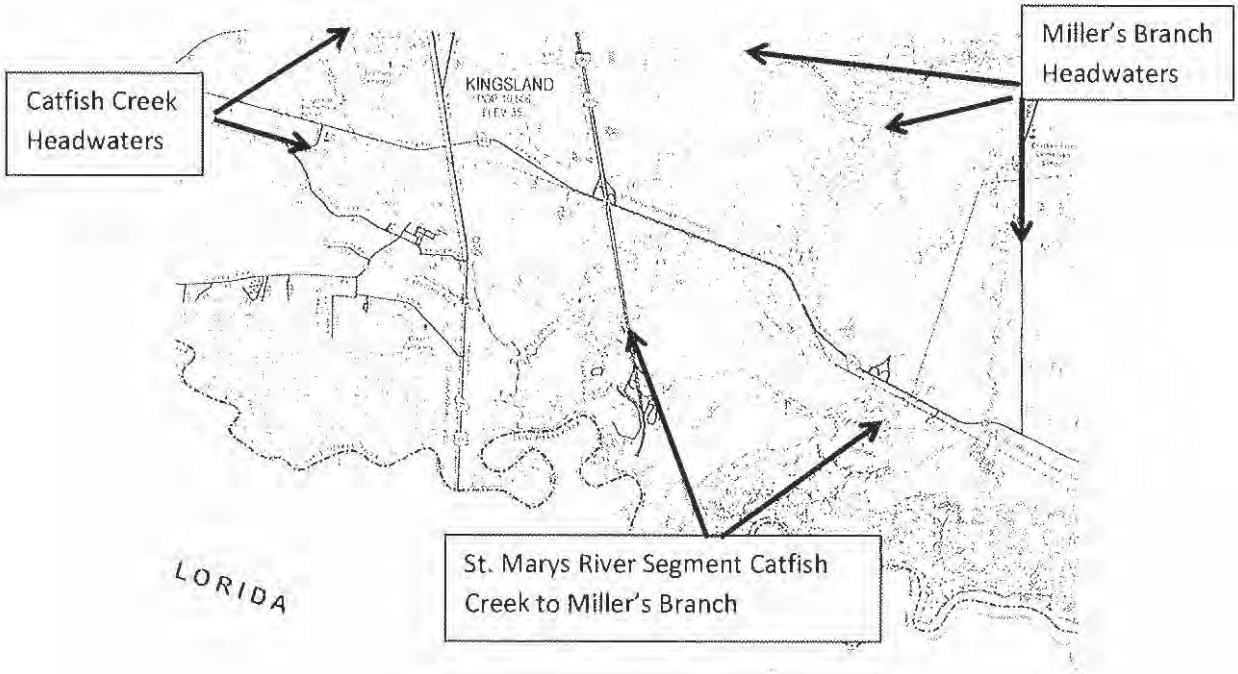
On March 28, following the decision to cancel the boat survey, Ken Kessler, Conn Cole, Clay Montegue and Chris Emmer reviewed maps of the watershed and discussed existing infrastructure and development activities. Then Ken Kessler, Clay Montegue and Chris Emmer drove the watershed west of I-9S. Development west of I-95 is primarily residential within Kingsland City limits, with commercial concentrated along GA 40 and US 17. The City of Kingsland provides sewer service within its city limits.

The Kingsland WWTP discharge point is diffused and located in marsh. It does not discharge directly into the St. Marys River. Outside of Kingsland City limits there is rural development west of US 17 and a few developments between the City and the River that are not sewered. These include a trailer park and the riverbank development in the Scrubby Bluff area just west of I-95.

On April 8, 2011 Alice Vick, Clay Montegue, Paul Jones, and EPD Boat Drive conducted a survey of the St. Marys River segment by boat. Upstream of US 17 the boat survey identified three houses on the bank, two in Florida and one in Georgia. The Florida riverbank in the segment is marsh with little rural residential development in the upland drainage. On the Georgia Riverbank most of the segment reach is marsh with residential development in the Scrubby Bluff area, just west of I-95. The oldest part of the City of St. Marys and a marina are found along the bank and in the river, downstream of the segment. Within the segment Bill Miller and Chris Emmer drove the Watershed east of I-95. GA 40 east of I-95 is commercially developed and developing. The commercial development is a mix of strip shopping centers, hotels, big box retail and a cement plant. There is scattered residential development between GA 40 and the St. Marys River along with some large undeveloped tracts of land.

Survey FINDINGS

St. Marys Watershed Map*



*Base Map is the GDOT Camden Co Road Map

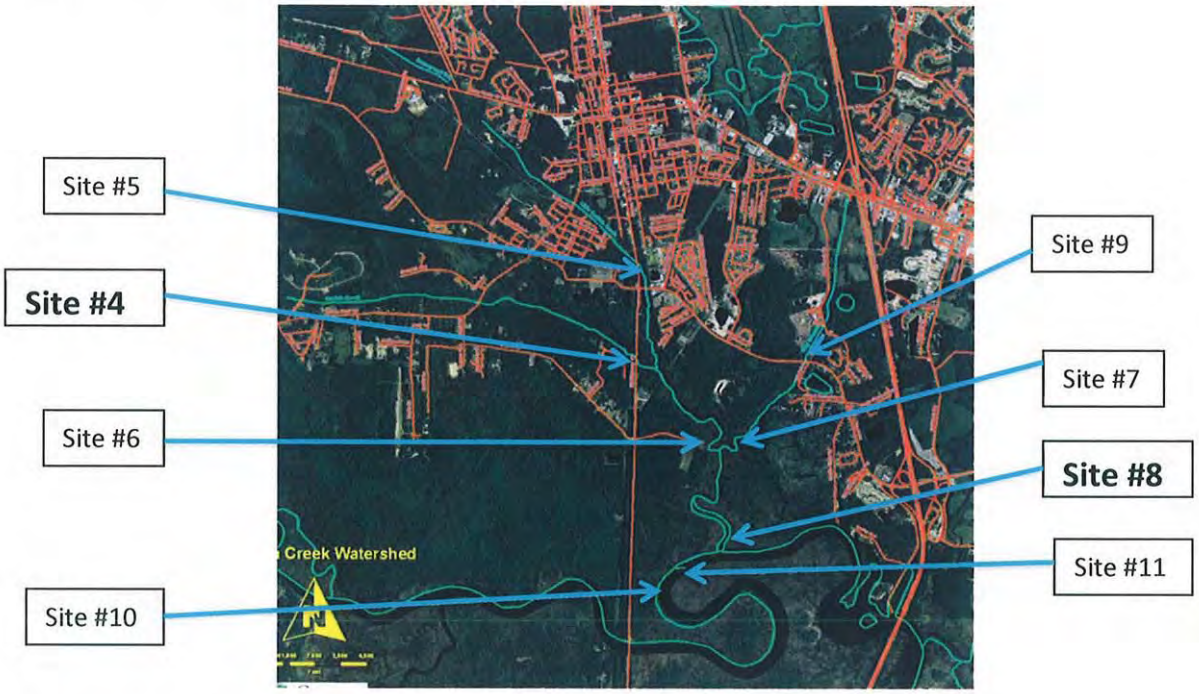
Develop Protocols for Targeted Watershed Monitoring:

Based on the survey, the PAC identified 18 locations it would like to see monitoring occur. Based on the likely budget for monitoring, the PAC decided to sample six sites.

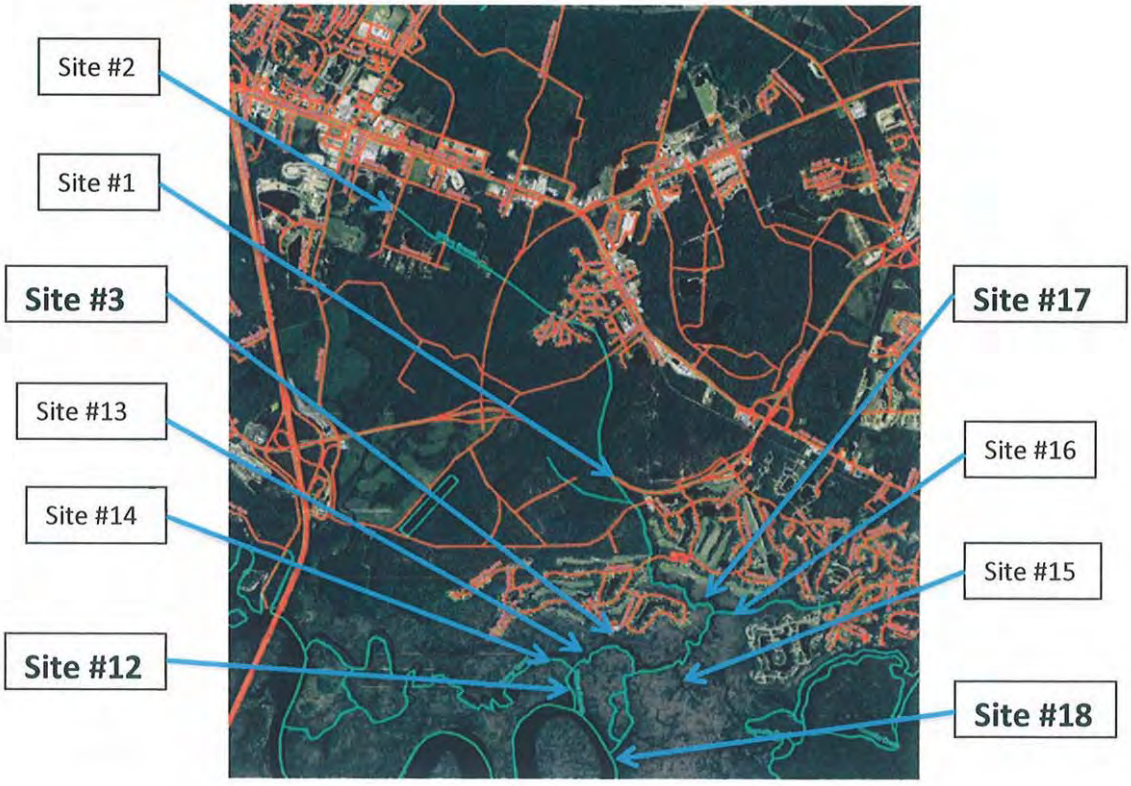
To determine the source of the DO impairment and acquire accurate DO reading, the following parameters will be monitored: BOD, DO, Salinity, Temperature (water and air), channel cross-sections, weather conditions, tidal conditions, and current. Monitoring frequency will be once per month and will be scheduled for spring tide conditions (new or full moon). Monitoring will occur as close to the outgoing ebb tide to normalize monitoring results.

The Satilla Riverkeeper will conduct the monitoring. The Kingsland Wastewater Treatment Plant Lab will conduct the BOD analysis. Satilla Riverkeeper has two DO monitors available for use.

St Marys West Sampling Sites



St Marys East Sampling Sites



PAC and Stakeholders includes Governing Bodies Contacted

CRC Watershed Improvement Plan 2010-2011 Partnership Advisory Committee			
First Name	Last Name	Organization	Email Address
Barry	Allen	City of Kingsland WPCP Manager	ballen@kingslandgeorgia.com
Jill	Andrews	DNR	Jill.Andrews@dnr.state.ga.us
Rita	Barrow	USDA NRCS	rita.barrow@ga.usda.gov
Bryce	Baumgartner	Altamaha Riverkeeper	stewards@altamahariverkeeper.org
Tony	Bonitatibus	Savannah Riverkeeper	
Scott	Brazell	Camden County	sbrazell@co.camden.ga.us
Dave	Briglio, PE	MacTec	DJBRIGLIO@mactec.com
Curtis	Burkett	Zev Cohen	cburkett@zevcohen.com
Robert	Cheshire, PE	City of Statesboro City Engineer	Robert.cheshire@statesboroga.net
Conn	Cole	Code Enforcement Camden County	ccole@co.camden.ga.us
Sonja	Cox	Altamaha Riverkeeper	sonja@altamahariverkeeper.org
Kirk	Croasmun, PE	Bryan County Engineer	kcroasmun@bryan-county.org
Vernon	Edenfield	Screven County Public Works	sclandfill@planters.net
Chris	Emmer	Environmental Planner	cemmer@crc.ga.gov
Sonny	Emmert	DNR	sonny.emmert@dnr.state.ga.us
Denise	Grabowski, LEED, AP	Principle, Symbioscity	dgrabowski@symbioscity.com
David	Hainley	Glynn County Community Development Director	dhainley@glynncounty-ga.gov
Bill	Hodgins	City of Savannah, PE	whodgins@Savannahga.gov
Rick	Jordan	Screven County Manager	comgr@planters.net
Ken	Kessler	City of Kingsland Planning Director	kkessler@kingslandgeorgia.com
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Meeting Minutes related to St. Marys River Catfish Creek to Miller's Branch Segment

Partnership Advisory Committee December 15, 2011 Meeting
Reviewed candidate stream segments to select two watersheds:

- St. Marys River – tidal area, more of an urban area but has some rural. Kingsland WWTP contributing, recent improvements completed. EPA will be performing study to determine the appropriate DO background. There is a hole in St. Marys River near I-95 similar to Satilla. Satilla Riverkeeper assisted in conducting water sampling for TMDL. St. Marys River Management Committee interested in being involved but has limited resources, not able to assist with ground work.

Jackson Branch and St. Marys River were selected as the watersheds for the improvement plans. General Discussion – if show through sampling water quality has improved, then suggest removing from list thus meeting grant objectives. BMPs framework will be used to help/assist in other areas of the state. The WIPs need to be transferable to other communities/areas in the state. Nevills watershed was selected as an alternative.

Partnership Advisory Committee January 19, 2011 Meeting
Review study watersheds:

St. Marys River – River Management Committee 4 counties represented both GA and Fl. Studies, past data acquire from Committee. Alice to provide data on DO SAG

Visual Survey – Russell Moncrief provide US FWS bio assessment standards example for survey, build protocol septic, and adopt a stream. Look at ordinances – buffers. Dianna will pull suspect basic Part V Environmental Criteria Buffers.

Bill Miller St. Marys monitoring wet weather visual observation runoff.

Coastal Non-point has measures to be met. Bio sampling, monitoring check list – adopt a stream, FWS – circulate before next meeting.

Stakeholder February 28, 2011 Meeting
The CRC held the 1st local stakeholder meeting of the St. Marys River WIP.

Chris Emmer presented a power point overview of the WIP project scope. The WIP projects are to occur over a two year period. Year one will involve:

- The formation of a Partner Advisory Committee (PAC);
- Selection of St Marys River Segment with TMDL summary to develop a plan;
- Survey of the watershed,
- Development of a monitoring program and initial monitoring;

Year Two will involve:

- Implementation or continuation of targeted monitoring;
- Development of implementation strategies; and
- Final report of results.

The free flowing segment of the river is tidal; making the water quality problem of Dissolved Oxygen a candidate, natural conditions, the segment may be an estuarine trap. The tidal change on the river is sudden. The St. Marys River has rock bottom and hole in bottom near I-95 DO shifts, river flow is variable

The City of St Marys has 2 buoys. Could it be possible to temporarily move buoy to Millers Branch to serve as monitoring station?

Effect of silviculture activities has resulted in higher rates of runoff. Forestry BMPs recommend should not maintain ditches.

Pollutant load allocation is based on whole basin impacts assign load.

Need to consider the Coastal Regional Water Council proposals/activities.

There are 2 paper mills in Fernandina, producing a groundwater cone of depression that goes north under St. Marys river.

This year FWS study has caught sturgeon in Cumberland Sound and in St. Marys River.

What is the effect of upland runoff on the marsh? At low tide runoff from marsh has a high load.

There are 2 NPDES discharges Kingsland WWTP and St Marys WWTP. Kingsland discharges into marsh, not directly into river.

In Kingsland 1 new subdivision since TMDLs that followed erosion and sedimentation control requirements, St. Marys has older subdivisions along Miller's Branch. Most of the basin forested.

I-95 monitoring station 24 hour?

For monitoring in the river there was a recommendation to have flow 2 meters close enough to measure same water mass

Current is fast through segment. West of I-95 what affect is the ponding having on water quality?

Merrill Varn has DO data from 1995 through 1998. River level is 2 inches higher than 1995 – 98 periods.

What is the Do Standard – 4 mg/l? Is there any protocol from monitoring DO? There is no blackwater standard.

Purpose EPA study at same time - Wednesday 3/2 DO meeting with EPA.

EPA proposing standards lower than if there were no human occupancy – numeric nutrient criteria nitrogen and phosphorous. Already established for Florida rivers, working on estuaries

What to measure? BOD, this should provide what is absorbing the dissolved oxygen.

Salinity is a factor on DO levels; Kingsland does not monitor measure salinity affect on DO. Sampling should occur at depth in the center of the channel. Kingsland provided data sample depth 1 ft. below surface.

Alice method to determine if naturally occurring

St. Marys samples center the flow, tidal influence.

The EPD permanent station is located at the US 17 bridge.

Monitoring at 17, 95 and Millers Branch

Need to have Florida involved, what happening, not paying a lot of attention. The border is center of navigable channel. Pat O'Conner River Management Committee in Florida could assist.

Assets possibly available for the survey:

Kingsland has boat, Camden County Sheriff Office. Ramp at US 17 (city), Alice can get an EPD boat.

St Marys check if stormwater retention failing

Kingsland area check trailer park on septic don't think problems reaching surface.

Partnership Advisory Committee April 20, 2011 Meeting
Review watersheds surveys:

St. Marys. Shannon (EPD boat driver) monitoring – meters available from lower reach for 2-3 days, EPD has equipment. Nutrient loads for algae from Developed area (monitor). St. Marys River Management Committee support CSS adoption, local control.

Reviewed existing and planned monitoring: Jackson Branch – Ogeechee Riverkeeper – quarterly. St. Marys – states of GA and FL conduct monitoring, EPA planned study, USFWS monitoring (underway?), City of Kingsland as part of NPDES permit, City of St. Marys?

Possible Monitoring sites, protocols: Resources available?

St. Marys – identified 18 sites would like to monitor (located to see what is happening) modeling not required. BOD source, design to show where coming from. Determine natural contribution. Measure demand for DO start at lower reach and work up. Look at different uses, contributors (?) - BOD and nutrients? Upstream/downstream problem. Time and tide cycle incoming and outgoing first flush. Goal what available funding dependent

Outreach – design provide guidance take to region/state. BOD monitoring sewer plant onsite monitoring? Depth BOD? Water mass structure, stratification, where concern, exchange vertically? Based on salinity. Assumption BOD well mixed.

Partnership Advisory Committee May 18, 2011 Meeting

Discussion moved to the St. Marys River. The Satilla Riverkeeper needs certification for sampling. Reviewed information provided by Clay Montague concerning what to monitor - BOD measure, DO, salinity, water temperature, stream cross section, different do to loading, current and water level, All of these are important for monitoring, factors contributing to DO level. Possible impact from old paper mill. Should measure incoming tide downstream and outgoing tide upstream.

In the river stormwater runoff will be thin layer. Stratification in river concentrate upper layer, can mix quickly. Consider sampling during rain. Should sample at high water and low water times.

Standards when to sample allow normalize. Need large number of samples to show random pattern.

Budget is approximately $5000 / stream for monitoring from EPD.

BOD and low DO monitoring should focus downstream (#18) and upstream (#10) to see how compare. #17, #12, #8, #4 creek, pick #3 drain marsh, total # from creek to calculate marsh contribution.

WWTP contributing BOD; large natural sources TMDL identified silviculture related historic ditching.

Shannon (EPD boat driver) impaired structures, shade removal higher temperature streams more algae die off with lower sunlight.

Cross section is important, simple stick measure, simple check – recheck 4 times – need to know depth.

Normalize tide - mid ebb; period's high tide / low tide / mid flow for sampling. Require boat. DO measure by instruments at sample time – 2 monitors. BOD to lab. Recommend regular calibration, training DO importance taking salinity; need to be able to adjust for salinity, instrument that measures salinity, temperature and adjust do. 2 mode 85's used simultaneously cost ~$1200 (available monitors). DO refraction adopt a stream; equipment costs.

Need sample lower in water column. EPD see if can use state discount for equipment?

Use in stream; know salinity

Who does analysis – local labs?

Partner opportunities: UNFL – new marine program coastal Biology program. Jacksonville coastal Biology program in marine science; Marine institute UGA at Sapelo. Research done collaborative if funding available/located.

When to sample? First flush 1" rain, Timing important.

Discuss what to sample; where most revealing – specify

Check on lab to use.

Sample certifications

Partnership Advisory Committee June 15, 2011 Meeting
St. Marys River
Kingsland has offered their wastewater lab to conduct BOD analysis and possibly conduct some of the sampling. Based on the level of analysis required Kingsland may donate some portion of their services. At a minimum the use of their lab will eliminate transportation costs. The city's lab is not certified and don't know if their lab technician is certified.
The Kingsland wastewater treatment plant monitors weekly DO in the River. They do not record salinity, river flow or time.
Make sure Kingsland lab knows when analyzing for natural BOD levels do not dilute samples.

USGS has real time gage at I-95, gage height, stream velocity and precipitation

Clay Montague raised the issue of bottom water verse surface water DO monitoring. Low DO is classic condition in an estuarine environment where salinity near. Did the TMDL involved bottom water? Mixing is dependent on weather conditions. Need to know where salinity changes. Forward salinity break in river column each time. Above break DO same/below low DO – constant change

Add time
Importance monitor bottom and top, salinity break is key factor
Mixing of water layers is dependent on weather, salinity of 3 -4 ppt is enough density to make it hard to mix.

New Estuarine water quality criteria are being worked on. Proving difference – few profiles show typical
Normally "surface" sample is taken at approximately 1 meter depth.
Precedent to get few samples from bottom DO/segment
Where standard measured? DO depth Kingsland
Bottom

Need DO surface layer/bottom layer?
Salinity profile important – id break, density (salinity driven) above meter Depth?
Tributaries may see stratification.

BOD loading – volume discharge cross section and current speed (stick gage – 4 to 5 points min)
Depth adjust
Data generated original listing depth? Track early TMDL determine depth.

Natural for estuary to have 4 mg/l DO, common dissolved oxygen concentration.

Gordon Rogers formally with the Satilla Riverkeeper would be a good source of information on the St. Marys River low fish production.

Tidal frequency standardize outgoing monthly, random minimize when in
Normalize sampling outgoing spring tide around full moon/new moon provide consistency first flush on/or outgoing tide

Outreach should include training by Clay to City of Kingsland and Satilla Riverkeeper for St. Marys monitoring sample collection.

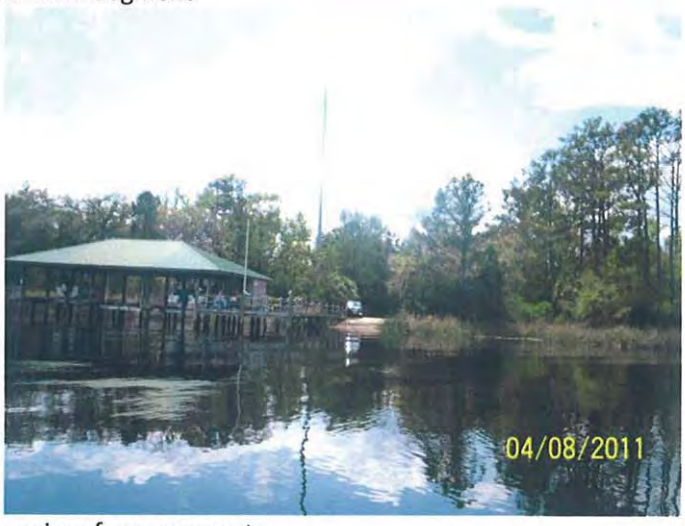
Survey Map

Survey Photos

St. Marys River Boat Survey Crew

St. Marys River

House and Dock up river from Segment

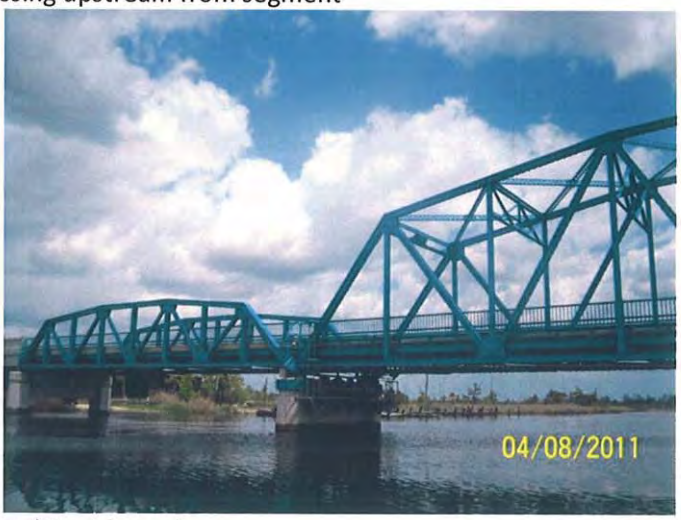


Boat launch and Dock up river from segment

Dock up river from segment

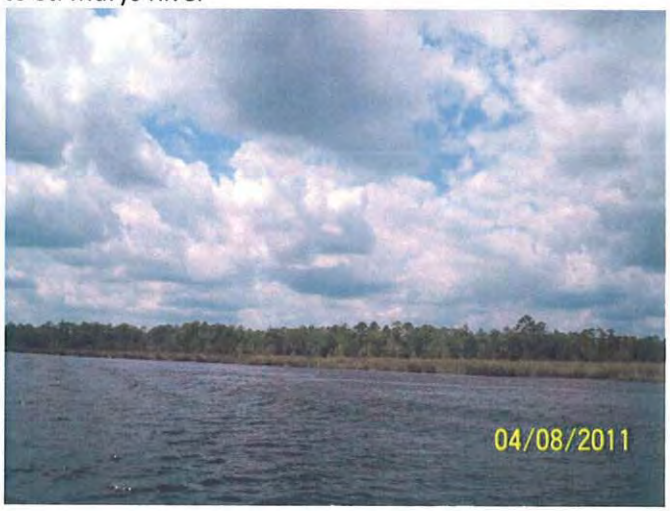
Highway 17 and Rail Road Bridge up river from segment

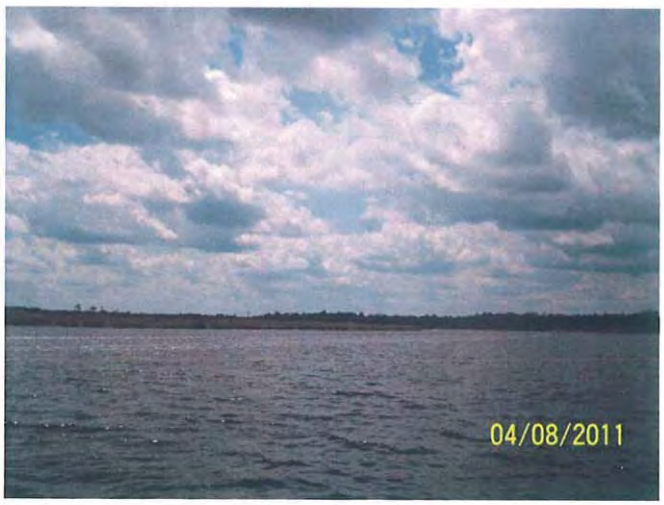
Transmission Lines crossing upstream from segment



US Highway 17 Bridge and Boat Launch

Catfish Creek entrance to St. Marys River





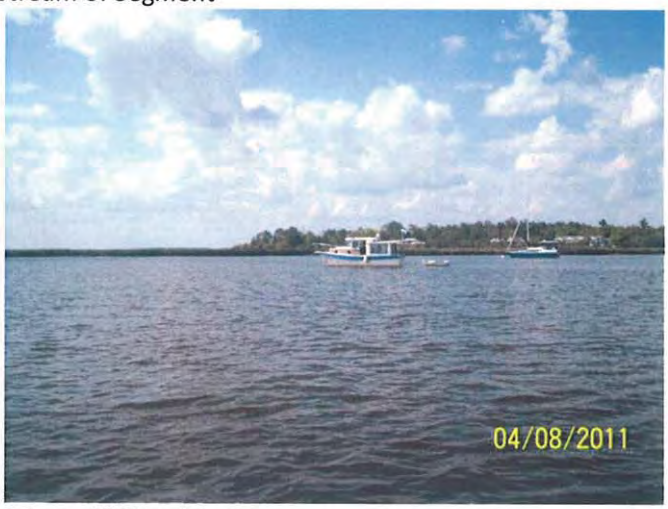
Houses and Docks in Scrubby Bluff Area just west of I-95

I-95 Crossing St. Marys River

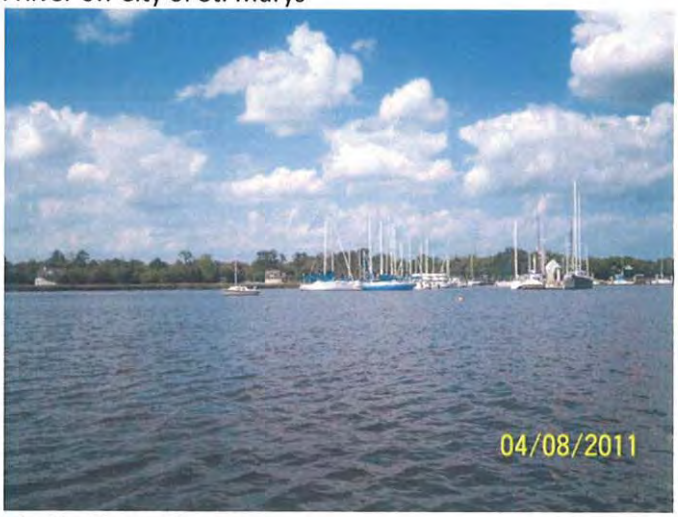
Millers Branch at St. Marys River

Millers Branch at St. Marys River

City of St. Marys Downstream of Segment



Watercraft anchored in River off City of St. Marys



City of St. Marys Marina in St. Marys River

Downtown City of St. Marys

City of St. Marys Riverfront Boat Launch

City of St. Marys Riverfront

City of Kingsland Sewage Plant Discharge Location

Looking South from City of Kingsland Sewage Plant Discharge Location

Catfish Creek East from US 17

Catfish Creek West from US 17

Catfish Creek Water Color at US 17 Crossing

Little Catfish Creek West side of US 17

Little Catfish Creek East from US 17

Catfish Creek near entrance into St. Marys River

St. Marys River looking Upstream from I-95

St. Marys River looking Downstream from I-95

Drainage in the Meadows Subdivision – Headwaters of Little Catfish Creek

Drainage in the Meadows Subdivision – Headwaters of Little Catfish Creek

Stormwater Pond in the Meadows Subdivision – Headwaters of Little Catfish Creek

Stormwater Pond in the Meadows Subdivision – Headwaters of Little Catfish Creek

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Drainage in the Meadows Subdivision – Headwaters of Little Catfish Creek

Drainage in the Meadows Subdivision – Headwaters of Little Catfish Creek

Little Catfish Creek looing North from GA 40

Ponding by Beaver Dam Southside of St. Marys Scrubby Bluff Sewage Plant Access Road

Ponded area north side of St. Marys' Scrubby Bluff Sewage Treatment Plant Access Road

Upper Miller's Branch – Lowes Store Drainage

Looking East Cement Plant in St. Marys – Miller's Branch Drainage

Looking West Cement Plant in St. Marys – Miller's Branch Drainage

Looking South of GA 40 Drainage from Wal-Mart

Drainage Southside GA 40 Across from Wal-Mart

Drainage under GA 40 from Wal-Mart

West along Miller's Branch from Mariner's Landing Subdivision

Pond in Mariners Landing Subdivision

Miller's Branch entering Pond in Mariners Landing Subdivision

Looking West along Miller's Branch from Mariners Subdivision

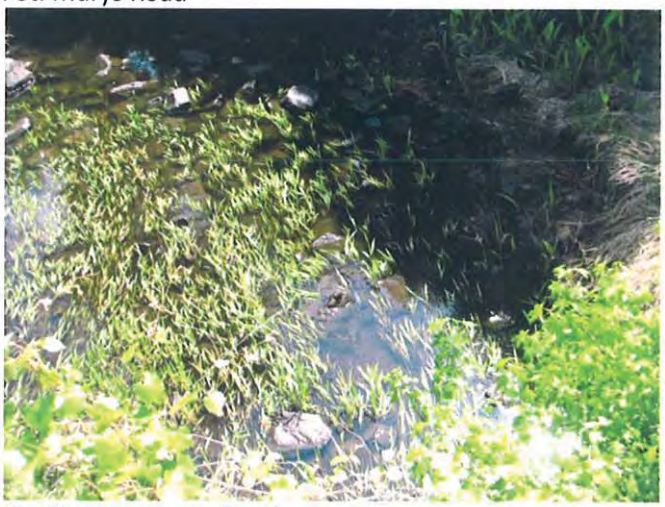
Miller's Branch looking north from St. Marys Road

Drainage joining Miller's Branch North side of St. Marys Road

Miller's Branch looking north from St. Marys Road

Miller's Branch North side of St. Marys Road

Miller's Branch South of St. Marys Road



Miller's Branch Bottom South of St. Marys Road

Drainage into Miller's Branch Southside of St. Marys Road

Miller's Branch Looking South from St. Marys Road

Dissolved Oxygen (DO) measurements

Location:	**St Marys River**
Collection Team on 08-APR-2011	Team 001 (Alice Vick, Phil Jones, Shannon, Clay Montague)

Instruments used

Dissolved Oxygen (DO) (Meter #2)	YSI Model 57 (EES3000L#2) (Air calibrated for each measurement) (Ser No. 95J37982)
Dissolved Oxygen (DO) (Meter #1)*	YSI Model 57 (EES3000L#1) (Air calibrated for each measurement) (Ser No. 95G35564)
Salinity and Water Temperature	YSI Model 30 (Calibration checked in NaCl water on 27 MAR 2011) (Ser No. 95M43793)
Barometer	Air guide Anaeroid Barometer (calibrated before each field trip against a PRINCO mercury barometer)
Wet bulb/dry bulb temperature	Taylor sling psychomotor
Wind speed	Dwyer wind meter (indicator ball rising in a tube)
Wind direction	Davis Instruments hand held fluid filled magnetic compass)

*Meter #1 was simultaneously used, but the salinity correction was not working properly. DO values from Meter #2 are more accurate. Meter #1 was repaired and was fully functional on 09-APR-2011.

** DO saturation level was computed based on water temperature and salinity; to reduce the error in the % saturation calculation, the saturation level was not corrected for barometric pressure because the air calibration was also not corrected for barometric pressure.

Obs. No.	General Location on St Marys River, Georgia/Florida	Latitude (N30 deg + ___min)	Longitude (W081 deg + ___min)	DATE	TIME (24hr)	Time zone	Tide direction at location	Water depth (ft)	Depth of measure (m)	Salinity (‰)	Water Temp (°C)	DO Meter #1 (mg/L)*
1	Boat ramp at US Hwy 17 bridge	45.365	41.270	28-Mar-2011	7:30	EDT	Incoming					
2	Boat ramp at US Hwy 17 bridge	45.365	41.270	28-Mar-2011	7:45	EDT	Incoming		0.1	7.40	20.7	
3	Boat ramp at US Hwy 17 bridge	45.525	42.266	08-Apr-2011	12:15	EDT	Incoming					
4	Boat ramp at US Hwy 17 bridge	44.525	41.266	08-Apr-2011	12:35	EDT	Incoming		0.2	0.80	20.6	6.10
5	Rice fields upstream of Hwy 17 bridge	43.079	44.234	08-Apr-2011	13:15	EDT	Incoming		1.0	0.60	20.6	6.00
6	West of mouth of Catfish Creek	45.117	40.623	08-Apr-2011	13:46	EDT	Incoming		1.0	5.00	20.7	6.41
7	100m into mouth of Catfish Creek	45.185	40.575	08-Apr-2011	13:55	EDT	Incoming		1.0	4.40	20.7	6.40
8	East of mouth of Catfish Creek	45.117	40.497	08-Apr-2011	14:08	EDT	Incoming		1.0	5.40	21.0	6.50
9	West of I95 bridge	44.658	39.333	08-Apr-2011	14:38	EDT	Outgoing		1.0	8.70	20.7	6.45
10	Mouth of Millers Branch	44.240	37.495	08-Apr-2011	14:50	EDT	Outgoing	12	1.0	12.60	20.8	6.70
11	West of mouth of Millers Branch	44.179	37.563	08-Apr-2011	14:58	EDT	Outgoing		1.0	15.85	20.7	6.70
12	East of Millers Branch	44.125	37.400	08-Apr-2011	15:00	EDT	Outgoing		1.0	14.10	20.9	6.70
13	Mouth of Borrells Creek	43.403	33.981	08-Apr-2011	15:22	EDT	Outgoing	23	1.0	22.00	21.0	7.05
14	St Marys City Dock	43.152	33.048	08-Apr-2011	15:40	EDT	Outgoing	27	1.0	28.00	20.9	7.40
15	US Hwy 17 Bridge	44.497	41.299	08-Apr-2011	16:52	EDT	Outgoing	32	1.0	0.90	20.8	6.00
16	Boat ramp at US Hwy 17 bridge	45.365	41.270	08-Apr-2011	17:06	EDT	Outgoing					

Obs. No.	DO Meter #2 (mg/L)	Saturation DO (mg/L)**	% of DO Saturation (Meter #1)	% of DO Saturation (Meter #2)	Color tint	Turbidity (0 clear, 10 opaque)	Distance across jar for turbidity evaluation (cm)	Barometric Pressure (mm-Hg)	Dry bulb temp (F)	Wet bulb temp (F)	Wind speed (mph)	Wind from (compass direction)	Cloud cover (%)	Raining?	Collector
1								765	65		0-5	NE	100	Light drizzle	Clay Montague
2	6.30	8.59		73%	lt. brown	0	7.5				0-5	NE	100	Light drizzle	Clay Montague
3								779	84	73	0-5	S (var)	5	No	Clay Montague
4	5.90	8.94	68%	66%							0-5	S (var)	5	No	Clay Montague
5	5.50	8.95	67%	61%							0-5	S (var)	30	No	Team 001
6	6.40	8.71	74%	73%							0-5	S (var)	50	No	Team 001
7	6.00	8.74	73%	69%							0-5	S (var)	50	No	Team 001
8	6.18	8.64	75%	72%							0-5	S (var)	50	No	Team 001
9	6.30	8.52	76%	74%							0-5	S (var)	50	No	Team 001
10	6.00	8.31	81%	72%							0-5	S (var)	50	No	Team 001
11	6.10	8.17	82%	75%							0-5	S (var)	30	No	Team 001
12	6.00	8.22	81%	73%							0-5	S (var)	30	No	Team 001
13	6.05	7.84	90%	77%							0-5	S (var)	30	No	Team

															001
14	6.10	7.58	98%	80%							0-5	S (var)	30	No	Team 001
15	5.75	8.90	67%	65%							0-5	S (var)	30	No	Team 001
16								776	89	75	0-5	S (var)	30	No	Clay Montague

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Georgia EPD Contract Number:
751-110059

PHASE 1 WATERSHED IMPROVEMENT PLAN
For

St. Marys River
Catfish Creek to Miller's Branch Segment

FINAL REPORT

Submitted by:
Coastal Regional Commission of Georgia

Date:

11/29/2011

EXECUTIVE SUMMARY
PHASE 1 WATERSHED IMPROVEMENT PLAN
for

St. Marys River
Catfish Creek to Miller's Branch Segment

EXECUTIVE SUMMARY
The Coastal Regional Commission (CRC) began work on the Watershed Improvement Plan following notice to proceed on August 2010 with research on the impaired water bodies in the Region. A Partnership Advisory Council (PAC) was formed from the CRC's Stormwater Technical Advisory Committee and other interested agencies, local governments and local residents of the watershed. PAC meetings were conducted November 2010, December 2010, January 2011, April 2011, May 2011 and June 2011, selecting the watershed, reviewing previous studies, information gathered from local residents and visual survey.

Previous studies identified urban runoff, natural sources and hydrologic modifications as sources for the Dissolved Oxygen Impairment. A visual survey was conducted by boat and car over March 28, 2011 and April 8, 2011. The PAC reviewed the survey results and selected monitoring points and provided guidance on the development of the targeted monitoring protocol.

Documentation included with this report is the list of PAC members, PAC and local meeting presentations and meeting minutes, visual survey notes, analysis from samples taken on the survey, and the first three sections of the St. Marys River Catfish Creek to Miller's Branch Segment Watershed Improvement Plan. Attached is the project budget and final invoice.

CHOOSE AN IMPAIRED WATERSHED
Background information, impaired segment location (watershed, HUC, etc.), water quality issues (designations, pollutants of concern, TMDLs, etc.), rationale for selection, and any other relevant watershed information.

The St. Marys River Catfish Creek to Miller's Branch Segment, HUC 10 # 0307020404 is a tidally influenced estuarine segment of the St. Marys River approximately 6 river miles in length. The segment is identified as not meeting dissolved oxygen criteria and is designated partially supporting/not supporting.

Information from the previous TMDLs, assessments and conversations with EPD were presented to the PAC for consideration leading to the selection of St. Marys River Catfish Creek to Miller's Branch segment for the development of the Watershed Improvement Plan. Factors important to the selection included developed watershed, coastal/tidal environment, and local support. An important factor in the decision was to select streams based on environments to serve as models for future watershed improvement plans, one developed coastal/tidal, the St. Marys River and one rural and inland Jackson Branch.

The CRC researched additional historic information and prepared summaries that were presented to PAC members and discussed at the January PAC meeting. The next steps

identified at the January meeting were to identify and contact local stakeholders and schedule a local meeting February 28, 2011, in Kingsland Georgia.

A local stakeholders meeting was conducted February 28, 2011. A presentation was made on the WIP project with the focus on how it is building on TMDL and past monitoring projects. The discussion with local stakeholders focused on potential contributing sources and possible monitoring locations.

DETERMINE SIGNIFICANT SOURCES OF POLLUTANTS CAUSING DEGRADATION (FECAL COLIFORM BACTERIA, LOW DO, PH)

The St. Marys River Catfish Creek to Miller's Branch segment is impaired by Dissolved Oxygen. The urban runoff, naturally occurring sources and historic hydrologic modifications are identified as sources of impairment in the TMDL and other studies. There are two NDPES discharges in the area of the segment, the City of Kingsland wastewater treatment plan, just upstream of the segment and the City of St. Marys Scrubby Bluff Wastewater treatment plant.

IDENTIFY EFFECTIVE MANAGEMENT PRACTICES OR CONTROLS BEST SUITED TO REDUCE POLLUTANT LOADINGS FROM SOURCES
To be addressed in Phase 2.

DEVISE MEASURES OF BMP SUCCESS
To be addressed in Phase 2.

LOCATE FUNDING AND OTHER RESOURCES NEEDED TO INSTALL BMPS
To be addressed in Phase 2.

INITIATE PROPOSALS TO APPLY FOR FUNDING AND SECURE OTHER RESOURCES
To be addressed in Phase 2.

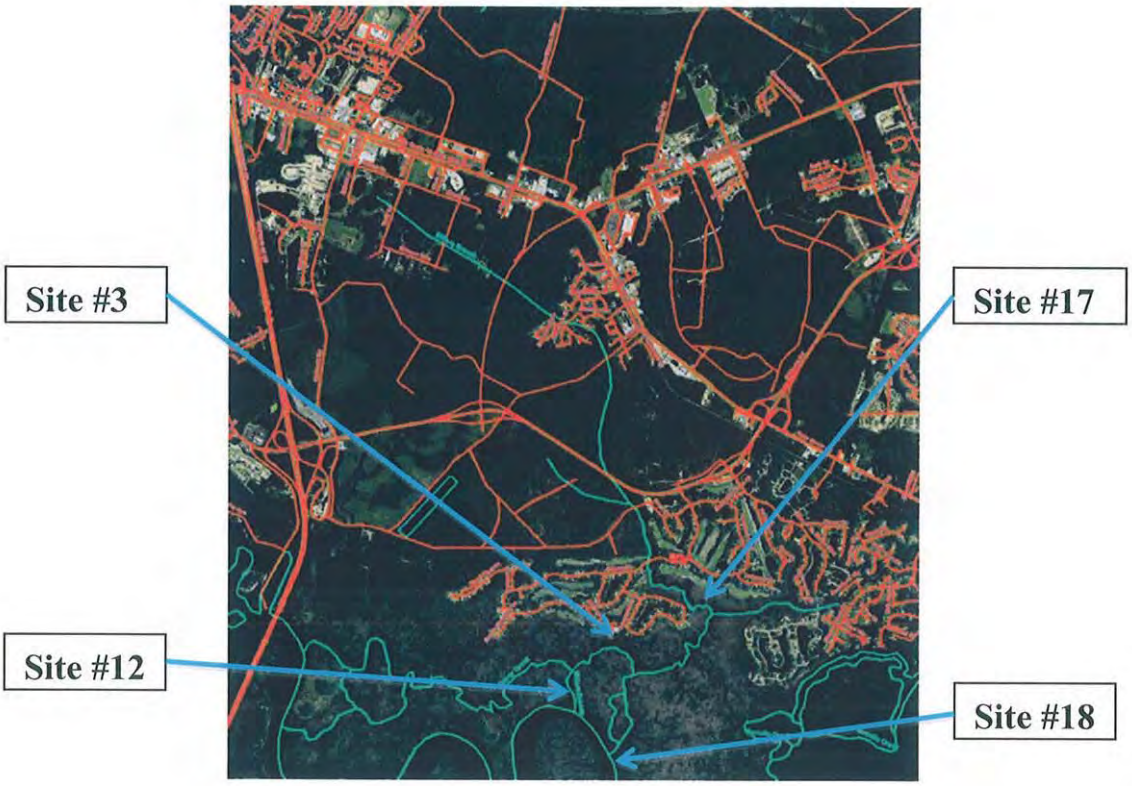
DEVELOP CONTEXT AND SCHEDULE FOR FUTURE MONITORING
Develop Protocols for Targeted Watershed Monitoring:
Based on the survey, the PAC identified 18 locations it would like to see monitoring occur. Based on the likely budget for monitoring, the PAC decided to sample six sites.

To determine the source of the DO impairment and acquire accurate DO reading, the following parameters will be monitored: BOD, DO, Salinity, Temperature (water and air), channel cross-sections, weather conditions, tidal conditions, and current. Monitoring frequency will be once per month and will be scheduled for spring tide conditions (new or full moon). Monitoring will occur as close to the outgoing ebb tide to normalize monitoring results.

The Satilla Riverkeeper will conduct the monitoring. The Kingsland Wastewater Treatment Plant Lab will conduct the BOD analysis. Satilla Riverkeeper has two DO monitors available for use.

St Mary's West Sampling Sites

St Mary's East Sampling Sites



PLANNED AND ACTUAL MILESTONES, PRODUCTS, AND COMPLETION DATES

Milestones	Starting Dates	Completion Dates
Milestone 1 Review & execution of contract	06/2010	10/2010
Milestone 2 Conduction initial outreach to stakeholders	08/2010	11/2010
Milestone 3 Form Partnership Advisory Council (PAC)_ and select impaired water body	10/2010	11/2010
Milestone 4 Prepare & submit DRAFT Outline and Phase 1 Budget	09/2010	11/2011
Milestone 5 Division review & comment on DRAFT Outline	0/92010	11/2011
Milestone 5 Complete and submit FINAL Outline Verify land activities, conduct and report on visual surveys, update PAC and stakeholders	01/2011	04/2011
Milestone 6 Prepare & submit interim Progress Report	04/2011	04/2011
Milestone 7 Develop protocols for Targeted Watershed Monitoring	04/2011	06/2011
Milestone 8 Prepare and submit summaries of three DRAFT sections of Watershed Improvement Plan	05/2011	11/2011
Milestone 9 Complete additional outreach activities	03/2011	06/2011 (Resume in Phase 2)
Milestone 10 Submit Phase 1 Project Completion Report	11/2011	11//2011

SUPPLEMENT INFORMATION

Any additional information relating to achieving project goals, including BMP list, pictures, graphs, maps, reports written, tables, diagrams, etc.

Visual Survey:

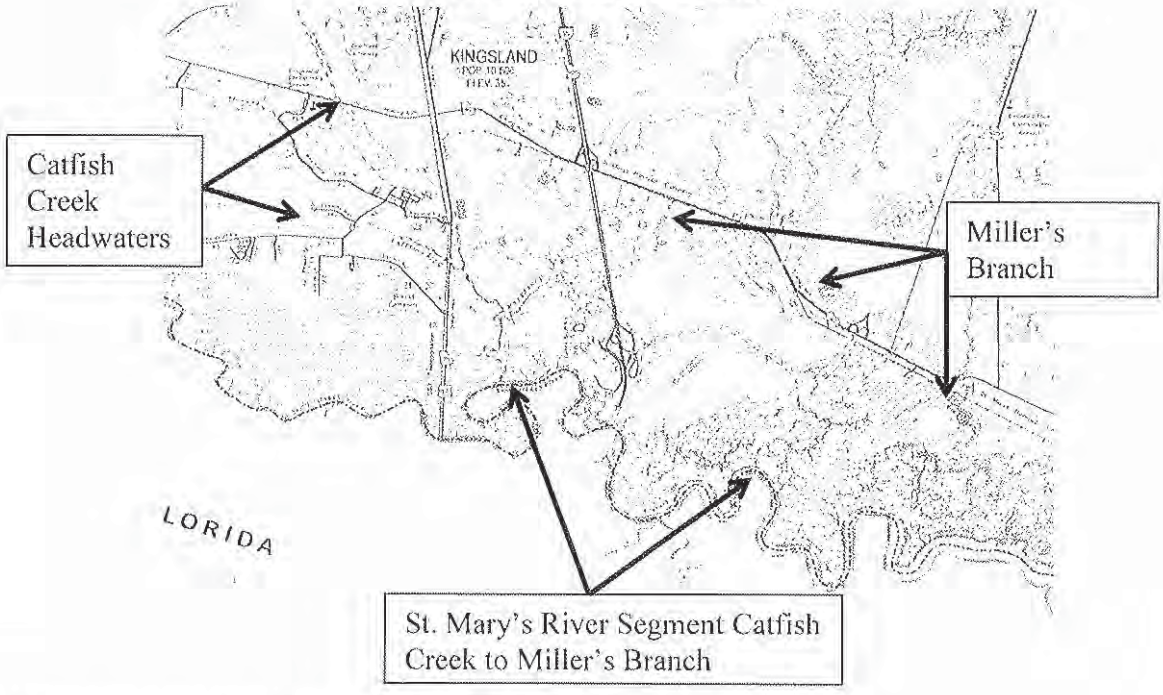
The visual stream survey was scheduled with assistance from Alice Vick, EPD Coastal Nonpoint, for March 28, 2011. The river survey by boat on March 28, 2011 was cancelled due to inclement weather. The survey was rescheduled for April 8, 2011. The survey team included Ken Kessler - Kingsland Planning Director, Clay Montegue - University of Florida, Bill Miller - Satilla Riverkeeper, Phil Jones - St. Marys River Management Committee Member, Conn Cole – Camden County Code Enforcement, Alice Vick and Shannon (boat driver) - EPD and Chris

Emmer - CRC. The survey team members divided into two groups, one boat team and one driving team.

On March 28, following the decision to cancel the boat survey, Ken Kessler, Conn Cole, Clay Montegue and Chris Emmer reviewed maps of the watershed and discussed existing infrastructure and development activities. Then Ken Kessler, Clay Montegue and Chris Emmer drove the watershed west of I-95. Development west of I-95 is primarily residential within Kingsland City limits, with commercial concentrated along GA 40 and US 17. The City of Kingsland provides sewer service within its city limits. The Kingsland WWTP discharge point is diffused and located in marsh. It does not discharge directly into the St. Marys River. Outside of Kingsland City limits there is rural development west of US 17 and a few developments between the City and the River that are not sewered. These include a trailer park and the riverbank development in the Scrubby Bluff area just west of I-95.

On April 8, 2011 Alice Vick, Clay Montegue, Paul Jones, and EPD Boat Drive conducted a survey of the St. Marys River segment by boat. Upstream of US 17 the boat survey identified three houses on the bank, two in Florida and one in Georgia. The Florida riverbank in the segment is marsh with little rural residential development in the upland drainage. On the Georgia Riverbank most of the segment reach is marsh with residential development in the Scrubby Bluff area, just west of I-95. The oldest part of the City of St. Marys and a marina are found along the bank and in the river, downstream of the segment. Within the segment Bill Miller and Chris Emmer drove the Watershed east of I-95. GA 40 east of I-95 is commercially developed and developing. The commercial development is a mix of strip shopping centers, hotels, big box retail and a cement plant. There is scattered residential development between GA 40 and the St. Marys River along with some large undeveloped tracts of land.

St. Marys Watershed Map*



*Base Map is the GDOT Camden Co Road Map

PAC and local meeting presentations and minutes, survey notes, photos, sample results, and maps are attached.

MONITORING RESULTS (IF APPLICABLE)
Include BMP effectiveness evaluations, sampling analysis, trends toward improvement or further degradation, measurable load reductions, estimated load reductions, or any other monitoring results.

To be addressed in Phase 2.

PUBLIC INVOLVEMENT AND COORDINATION
PAC meeting were conducted November 2010, December 2010, January 2011, April 2011, May 2011 and June 2011. Local resident/stakeholder meeting was held March 1, 2011.

STATE AGENCIES
List participating state agencies

CRC Watershed Improvement Plan 2010-2011 Partnership Advisory Committee			
First Name	Last Name	Organization	Email Address
Jill	Andrews	DNR	Jill.Andrews@dnr.state.ga.us
Sonny	Emmert	DNR	sonny.emmert@dnr.state.ga.us
Kelly	O'Rourke	DNR	Kelly.O'Rourke@dnr.state.ga.us
Barbara	Stitt	Outreach and GIS Coordinator DNR	Barbara.Stitt@dnr.state.ga.us
Alice	Vick	DNR	alice.vick@dnr.state.ga.us
Daniel	Westcot	Georgia Forestry Commission	dwestcot@gfc.state.ga.us
Ray	Hicks	Jackson Branch Stakeholder /Extension Agent	rhicks@uga.edu

FEDERAL AGENCIES
List participating federal agencies

CRC Watershed Improvement Plan 2010-2011 Partnership Advisory Committee			
First Name	Last Name	Organization	Email Address
Rita	Barrow	USDA NRCS	rita.barrow@ga.usda.gov
Russell	Moncrief	U.S. Army	Russell.moncrief@us.army.mil

LOCAL GOVERNMENTS, INDUSTRY, ENVIRONMENTAL, AND OTHER GROUPS, PUBLIC AT LARGE
List others

CRC Watershed Improvement Plan 2010-2011 Partnership Advisory Committee			
First Name	Last Name	Organization	Email Address
Barry	Allen	City of Kingsland WPCP Manager	ballen@kingslandgeorgia.com

Bryce	Baumgartner	Altamaha Riverkeeper	stewards@altamahariverkeeper.org
Tony	Bonitatibus	Savannah Riverkeeper	
Scott	Brazell	Camden County	sbrazell@co.camden.ga.us
Dave	Briglio, PE	MacTec	DJBRIGLIO@mactec.com
Curtis	Burkett	Zev Cohen	cburkett@zevcohen.com
Robert	Cheshire, PE	City of Statesboro City Engineer	Robert.cheshire@statesboroga.net
Conn	Cole	Code Enforcement Camden County	ccole@co.camden.ga.us
Sonja	Cox	Altamaha Riverkeeper	sonja@altamahariverkeeper.org
Kirk	Croasmun, PE	Bryan County Engineer	kcroasmun@bryan-county.org
Vernon	Edenfield	Screven County Public Works	sclandfill@planters.net
Chris	Emmer	Environmental Planner	cemmer@crc.ga.gov
Denise	Grabowski, LEED, AP	Principle, Symbioscity	dgrabowski@symbioscity.com
David	Hainley	Glynn County Community Development Director	dhainley@glynncounty-ga.gov
Bill	Hodgins	City of Savannah, PE	whodgins@Savannahga.gov
Rick	Jordan	Screven County Manager	comgr@planters.net
Ken	Kessler	City of Kingsland Planning Director	kkessler@kingslandgeorgia.com
Steve	Liotta, PE	Effingham County Engineer	sliotta@effinghamcounty.org
Lupita	McClenning	Planning Division Manager	lmcclenning@crc.ga.gov
Bill	Miller	Satilla Riverkeeper	bill@satillariverkeeper.org
Ray	Pittman, PE	Thomas & Hutton	Pittman.r@thomas-hutton.com
J. Adam	Ragsdale, RLA, ASLA		adam.ragsdale@wolverton-assoc.com
Courtney	Reich, AICP	Ecological Planning	courtneyreich@ecologicalplanning.net
Bill	Sapp	Southern Environmental Law	bsapp@selcga.org
George	Shaw	Effingham County Zoning Manager	gshaw@effinghamcounty.org
Katie	Sheehan	Staff Attorney UGA River Center	katiesheehan80@gmail.com
Deborah	Sheppard	Altamaha Riverkeeper	debshep@darientel.net
Jackie	Teel, LEED, AP	Natural Resources Administrator	jacksonj@thempc.org
Merrill	Varn	St. Marys River Management Committee	orts7@hotmail.com
Alice	Vick	DNR	alice.vick@dnr.state.ga.us
Roger	Weaver	Planning Director	roger.weaver@ci.st-marys.ga.us

Diana	Wedincamp	Ogeechee -Cannoochee Riverkeeper	dwedincamp@ogeecheeriverkeeper.org
		St. Marys River Management Committee	stmarysriverinfo@gmail.com
Benny	Jeffers	Jackson Branch Stakeholder /Manager Wynant Family	
Sandra	Jeffers	Jackson Branch Stakeholder /Owner Wyant FLP II	swjeffers@planters.net
Alfred "Al"	Alexander	Jackson Branch Stakeholder/ property owner	
Gail	Pollack	Jackson Branch Stakeholder/ property owner	
Jimmy	Pollack	Jackson Branch Stakeholder/ property owner	jpollack@planters.net
Terri	Parker	Ogeechee Riverkeeper Volunteer	tr_parker22@yahoo.com
Terri	Luckie	Ogeechee Riverkeeper Volunteer	t_luckie@yahoo.com
Emelyn	Hunter	Ogeechee Riverkeeper Volunteer	emelynhunter@hotmail.com
Qian	Qang	Ogeechee Riverkeeper Volunteer	tangqian.applicant@gmail.com
Jack	Gross Sr.	St. Marys Stakeholder/ Property Owner	jackg22352@tds.net
Jim Ed	Gross	St. Marys Stakeholder/ Property Owner	jtgross@tds.net
Clay	Montague	St. Marys Stakeholder/ Assoc. Professor UF	montague@ufl.edu
Paula	Staples	St. Marys Stakeholder/ City of Kingsland	paulawav@comcast.net
Todd A.	Driver	St. Marys Stakeholder / Coastal Health District	tadriver@dnr.state.ga.us

OTHER SOURCES OF FUNDS
If the project received funding through other sources (such as non-federal match of state and local funds, volunteer labor, or other federal funds), provide a description of those sources.

To be addressed in Phase 2.

ASPECTS OF THE PROJECT THAT DID NOT WORK WELL
Provide an explanation of elements of the project that did not work out as planned, while the milestones may have been difficult to meet, problems with organizational dynamics, etc.

To be addressed in Phase 2.

FUTURE ACTIVITY RECOMMENDATIONS
Describe any programs, activities, or assessments that are or may be planned based upon the results of this project.

To be addressed in Phase 2.

OUTREACH AND EDUCATION OUTPUTS
Describe any outputs (reference if attached). This includes reports, manuals, pamphlets, videos, guidelines, etc.

The outreach efforts during Phase 1 and planned for the beginning of Phase 2 are to provide the local government and local population with invitations to participate in the PAC meetings and providing PAC meeting presentations and minutes. Work for an ongoing outreach and education program will be part of Phase 2.

FINAL BUDGET IF LINE ITEM ADJUSTMENTS OR INCREASE/DECREASE IN TOTAL AMOUNT EXCEEDS 10%

FINAL INVOICE

Georgia EPD Contract Number:
751-110059

PHASE 1 WATERSHED IMPROVEMENT PLAN OUTLINE
For
St. Mary's River
Catfish Creek to Miller's Branch Segment

Submitted by:
Coastal Regional Commission of Georgia

Watershed Improvement Project Outline

Identify partial supporting and non-supporting water segments in the Coastal Region

Identify initial stakeholders and invite them to participate in the Partnership Advisory Committee (PAC)

Schedule Kick-off meeting and present project and list of partially supporting and not-supporting water segments to select for the Watershed Improvement Plan

Review candidate water segments with EPD prior to final selection

PAC to make final selection of water segment to prepare watershed improvement plan

Contact local stakeholders, local government(s), environmental/conservation organizations, landowners about watershed improvement plan and invite to local stakeholders meeting.

Conduct local stakeholders meeting to introduce project and receive input about watershed.

Conduct visual survey of watershed.

Prepare and submit survey report to PAC and EPD

Develop targeted monitoring protocol with PAC

Prepare draft of first three Sections of the Watershed Improvement Plan:

Initiate targeted Monitoring

Submit first year report and remaining deliverables to EPD.

EPD Contract 751-110059

Estimated budget - Not Final

Item	Objective Class Category	Federal Funds	Non-Federal Funds	Total
A	**Personnel:**			
	Environmental Planner 1 Year	$5,626.00		$5,626.00
				$0.00
				$0.00
B	**Fringe Benefits:**			
	Environmental Planner 1Year	$2,438.00		$2,438.00
				$0.00
				$0.00
C	**Travel:**			
	Mileage	$700.00		
D	**Equipment:**			
E	**Supplies:**			
	Printing, CD's, Admin Supplies			$0.00
	Lecture Hall(s)			$0.00
	Marketing & Advertising			$0.00
F	**Contractual**			
	Monitoring Services	$3,125.00		$3,125.00
G		N/A	N/A	N/A
H	**Other:**			
I	**Total Direct Charges: (Sum of A-H)**	$11,889	$0.00	$11,889
J	**Indirect Charges:**	$3,736.00		$3,736.00
K	**Total: (Sum of I and J)**	$15,625	0.00	$15,625

APPENDIX C

First Name	Last Name	Position / Organization	Contribution				
			Plan Implement-ation	Affected by Plan Implementation	Provide information for Plan	Provide Info on Existing Programs and Plan	Provide Technical and/or Financial Assistance
Alice	Vick	GA EPD, Watershed Protection Branch, Stormwater Team, Program Manager 1	X	X	X	X	X
Mary	Gazaway	GA EPD, Watershed Protection Branch, NonPoint Source Program – Grants Unit	X	X	X	X	X
Kelly	Hill	GA Coastal Resources Division, Coastal Resources Specialist	X	X	X	X	X
Scott	Brazell	Camden County, Director of Public Works	X	X	X	X	
Steven	Hooks	Georgia Survey Practice Leader at KCI Technologies, Inc. (Former Public Works Coordinator at Camden County Board of Commissioners)	X	X			
Terry	Ferrell	Camden County Health Department, Environmental Health Manager	X	X			
Scott Pippin, UGA	Pippin	University of Georgia Odum School of Ecology River Basin Center	X		X	X	

Clay	Montague	University of Florida, Associate Professor of Environmental Engineering Sciences		X	X	X	X
Paula	Staples	St. Marys River Management Committee	X	X	X	X	
Ken Kessler, Kingsland		City of Kingsland, Director of Planning and Zoning	X	X	X	X	X
Roger	Weaver	City of St. Marys, Director of Planning	X	X	X	X	X
Ebony	Simpson	Department of Community Affairs	X	X	X	X	
Barbara	Stitt-Allen	GA EPD, Watershed Protection Branch, NonPoint Source Program – Grants Unit	X	X	X	X	X
Dean	Woehrle	St. Marys River Management Committee	X	X	X	X	
Courtney	Reich	Ecological Planning Group		X	X	X	X
Christina	Dolan	Ecological Planning Group		X	X	X	X
Michael	Baggett	Ecological Planning Group			X		X

Watershed Management Plan Watershed Advisory Committee

March 27, 2013
EPD, Coastal Office, Brunswick
1:30 PM – 3:30 PM

MEETING SUMMARY

Attendees:
Alice Vick, GA EPD
Scott Brazell, Camden County
Steven Hooks, Camden County
Scott Pippin, UGA
Paula Staples, SMRMC
Ken Kessler, Kingsland
Roger Weaver, St. Marys
Terry Ferrell, Camden Health Department
Clay Montague, University of Florida/Satilla River Keeper
Kelly O'Rourke, GA DNR, CRD
Barbara Stitt-Allen, GA EPD
Mary Gazaway, GA EPD

I. Presentation by Courtney Reich of Ecological Planning Group (CRC's new Project Manager for the St.Mary's WMP)

Courtney gave a presentation to the group that addressed the following agenda items (the presentation is attached to this agenda):

- Review of Phase 1: St. Mary's River Watershed Improvement Plan.
- Review findings of Field Survey conducted by the PAC during Phase 1 of this project.
- Review existing water quality data, including data from the City of St. Mary's Long Term Monitoring for their WPP, the City of Kingsland's Watershed Assessment, and the Field Survey
- Watershed Management Plan Deliverables for Phase 2 of this project including:
    - Regroup PAC as new Watershed Advisory Committee (WAC)
    - Watershed Assessment/Review
    - Water Quality Monitoring
    - Develop BMPs
    - Develop Long Term Monitoring Plan, Milestones, Schedule, and Outreach Plan
    - Develop Watershed Management Plan document

- Potential sources of DO Impairment, both natural and man-made

II. WAC Group Discussion

Discussion was had by the WAC throughout the presentation, and is summarized here:

- The group would like to see existing water quality data from the Florida side. Suggestions were made to contact the Department of Environmental Protection and to check Water.com as there is FL water quality data posted there.
- The may be an Adopt-A-Stream group with data from the St. Mary's River going back years. Check with Harold Harbert on this.
- Land use data for Camden County is currently being generated through their Joint Land Use Plan. This data should be available shortly.
- Land cover data is also available from Liz Cramer at UGA. It was recommended that we use the 2008 data set.
- Septic tank GIS information, and parcel based data set regarding inspections, is available through the UGA/SGRC/EPD/HD project.
- Silviculture (primarily on the Florida side) is likely to be a big contributor of BOD, there were comments that ditching associated with silviculture increase the "flashiness"of the river as well as the direct input of organic material.
- There may be sediment data available from the Sturgen Project. Check with Florida and Georgia Fish & Wildlife. Chip Cambell may have this data.
- Groundwater seepage may also be a contributor of low DO to the river. A dome study would be appropriate for this. Withdrawals from paper plants would have an effect on the rate of this seepage.
- The City of Hilliard, Fl has a "racetrack" LAS system upstream with a wetland treatment system. They apparently support a big bird population that may be a contributor of BOD.
- White Oak Park in Florida was discussed but the group felt that they are not likely to be a big source. The owners may be good additions to the WAC.
- EPD performed some monitoring of the St. Mary's in 2012, and that data can be made available to the WAC.

III. Water Quality Monitoring Plan

The group discussed the future monitoring plan and the following is a summary.

- Both the City of St. Marys and Kingsland are willing to contribute to the monitoring effort.
- Kingsland can process BOD samples.
- Satilla Riverkeepers are not currently able to provide assistance.
- Monitoring locations should address the tributaries to this segment of the St. Mary's as well as the Hwy 17 and I-95 crossing.
- Monitoring program should be considerate of available resources, i.e. no boat sampling.

- EPD commented that any monitoring performed as match for this grant cannot be monitoring performed specifically for NPDES permit compliance. Our monitoring will have to go above and beyond what is already required.

IV. Septic System Discussion

The discussion ended with the WAC discussing various other related projects in the St. Mary's Watershed.

- UGA received a $100,000 grant from the Coastal Regional Water Planning Committee to do a study of septics in the Horse Pen Creek watershed. Horse Pen Creek has a TMDL and is an upstream tributary to the St. Mary's River. This project has included some water quality monitoring, public education, free septic inspections and pumpouts, and a demonstration project to replace the septic system at Temple Landing Park.
- There is a new effort to remove the State requirement that all failing septic systems within 200 ft of sanitary sewer must tie in. Something to keep our eye on.
- There is no local facility for septic tank haulers to bring their septage to in Camden County. The closest place accepting septage is Glynn County. This is resulting in higher than average rates for septic tank pumping, and illegal dumping in the County. St. Mary's is willing to consider alterations to their plant to be able to accept septage. The St. Mary's WWTP was recently upgraded and is in need of funds to pay the debt service and additional load to run the plant efficiently. St. Mary's discussed the possibility of seeking grant funds to look at the feasibility of this.
- EPD recommended that we document the septic issues in the St. Mary's watershed and include recommended BMPS related to it in the WMP. We should not limit ourselves based on cost or our perception of feasibility. We should include all recommended steps.

V. Next Steps

1. WQ Monitoring

- Courtney, EPG has asked for copies of the WPPs for both St. Mary's and Kingsland. EPD and the City's will provide documentation.
- Courtney, EPG will work with Kingsland and St. Mary's to work out a monitoring plan.
- Monitoring plan will be approved by EPD and provided to the WAC.
- Monitoring will be conducted over the spring/summer and the WAC will meet after its completion to review results.

2. Quarterly Report

- CRC will submit quarterly report to EPD. EPG will assist CRC.

3. WMP Document

- EPG will begin work on this Watershed Assessment component of this document.
- EPD will provide 2012 data on the St. Mary's to EPG for inclusion
- EPG will work with St. Mary's and the CRD to get land use data for the watershed.
- EPG will contact Liz Cramer with UGA to get their land cover data for the watershed.
- EPG will contact FL DEP to try to get whatever WQ data they are willing to provide.

Watershed Management Plan

Watershed Advisory Committee

February 11, 2014
EPD, Coastal Office, Brunswick
9:30 AM – 11:45 AM

MEETING SUMMARY

Attendees:

Mary Gazaway, GA EPD (phone conference)
Alice Vick, GA EPD
Ken Kessler, Kingsland
Kelly Hill, GA DNR, CRD
Ebony Simpson, DCA
Dean Woehrle, SMRMC
Courtney Reich, EPG
Christina Dolan, EPG

I. Outstanding action items discussed during meeting include the following:

A. Mary Gazaway will talk to Liz Booth of GA EPD to determine status of alternate DO standards for blackwater systems.

B. Kelly O'Rourke will provide EPG with a copy of the Green Print Plan.

C. Alice Vick will provide EPG with a copy of the St. Marys River Management Plan.

D. Ken Kessler to check and see if EPG may give presentation at Kingsland City Council meeting. This meeting has been scheduled for February 24, 2014

E. EPG to do the following:

- Send copy of Kingsland WPP to Alice Vick.
- Request copy of St. Marys WPP. If copy cannot be located Mary Gazaway may help locate document.
- Schedule presentations for St. Marys and Kingland councils and also for SMRMC.

II. **Presentation by Courtney Reich to review Watershed Management Plan (WMP):**

A. Reviewed Elements of the WMP.

- Nine elements according to GA EPD guidelines are to be followed for plan format.

B. *Reviewed existing water quality data.*

- Stream should be flowing to sample for DO.
- EPG's sampling results are not that low for a blackwater stream considering sampling occurred during warmer months.
- EPG initially wanted to monitor BOD over time but there was not enough volunteer participation.
- Members felt entire listed stream segment is tidally influenced and that tidal influences reaches to Trader's Hill/301.
- Deadheading (pulling sunken logs out of river) is being conducted just west of Highway 17 bridge in Florida segment that may contribute to mechanical disturbances of stream.

III. Recommended Best Management Practices

A. Reviewed Identified Best Management Practices (BMPs) with Committee members, including those from 2008 TMDL Implementation Plan and Coastal Regional Water Plan.

- A few BMPs will be modified or removed, including ones pertaining to Georgia Water Quality Control Act; local government collaboration; and regional commission coordination as these are redundant or N/A.
- Green Print Plan was written for Camden County by Trust for Public Land.
- BMPs should note if meets CSS and/or CZARA requirements.
- Mitigation banking applicable based on potential to mitigate previously ditched forest lands.
- EPD is working on nutrient standards and this should be acknowledged in report.

B. Rankings will be assigned based on input provided at meeting and any input received by email from stakeholders.

IV. Future Monitoring Program Recommendations

A. WPP Monitoring (Kingsland and St. Marys)

- Recommended long-term monitoring will focus on these sites that will continue to be monitored as part of their WPP. Both should include BOD in monitoring efforts.

B. CRD Monitoring

- Recommended long-term monitoring will also focus on sites currently

monitored by CRD along St. Marys River.

V. Public Education Plan

A. Presentations to local governments & CRC

- EPG will give a presentation to SMRMC, St. Marys City Council, and Kingsland City Council.

B. *Other public education programs*

- SMRMC has prepared River Guide and meets monthly to discuss issues and conservation activities. Also maintains website.
- Dept. of Health provides DVD and information folder to new septic tank system permittees.

VI. Project Status

A. WMP Review and Comments

- Comments provided by Mary Gazaway will be addressed and remaining draft sections to be completed by end of February 2014.
- Final report due March 31, 2014.

B. Public Presentations

- Presentations to be scheduled before end of March 2014.

C. Next WAC Meeting

- Next meeting should be scheduled for March 2014.

Watershed Management Plan

Watershed Advisory Committee

March 25, 2014
EPD, Coastal Office, Brunswick
10:00 AM – 12:00 PM

MEETING SUMMARY

Attendees:

Mary Gazaway, GA EPD (phone conference)
Alice Vick, GA EPD
Kelly Hill, GA DNR, CRD
Ebony Simpson, DCA
Courtney Reich, EPG
Christina Dolan, EPG

I. Outstanding action items discussed during meeting include the following:

A. Pg. 36 of Draft WMP, Table 9: Alice Vick and Kelly Hill will check to see if Post Construction Stormwater Control ordinance from CSS has been passed for Camden County and City of St. Marys.

B. Ebony Simpson to provide fund source estimate (for what has been spent) for BMP #18 (Septic System Retrofit Program).

C. Alice Vick will check with Liz Booth to determine status of revised DO standards for coastal tannic streams.

D. EPG to schedule presentation for SMRMC

II. Reviewed the Draft Watershed Management Plan including the following:

A. Committee members reviewed each BMP and also discussed the Implementation Schedule, Cost, Fund Source, Evaluation Measure and Milestones. Suggestions included the following:

- *Mary Gazaway suggested that the cost category for certain BMPs should focus on money that has been spent thus far. Dates, where feasible, should be included for ordinance and plan references, etc.*

- *Alice Vick mentioned that for BMP #13, each county provides $500 per year and the SMRMC does not actively seek grant fund sources. Add Johns River Management as responsible agency.*
- *Remove BMP #15.*
- *Mary suggested that for BMP #18 and #22 we consider putting some of the objectives as milestone goals and move selected information to the section that discusses educational goals. Local governments should be added as responsible agencies.*
- *Alice Vick suggested we add the SMRMC to BMP #18 as a responsible agency.*
- *Kelly Hill suggested we clarify BMP # 21 to exclude saltwater because mitigation banking is more difficult for saltwater bodies.*
- *Mary Gazaway suggested rewording BMP #23 to focus more on partnership building with Florida entities and to mention the monitoring described by Alice Vick.*
- *BMP #65 is really BMP #26 and SMRMC should be added as a responsible agency.*

B. *Discussed future monitoring program. No modifications recommended.*

C. *Discussed public education plan and the need to move some of the info from the BMP sections as noted above to this section of the Plan.*

III. Discussed Project Status.

A. *Project deadline is March 31, 2014. Final draft will be submitted to the EPD and WAC members. No additional meetings with the WAC will be scheduled at this time.*

APPENDIX D

STATE OF GEORGIA
TIER 2 TMDL Implementation Plan (Revision # __)
Segment Name: St. Marys River, Catfish Creek to Millers Branch
Date: 11/13/08
River Basin: St. Marys River
Local Watershed Governments:
Camden County
City of St. Marys
City of Kingsland

I. INTRODUCTION

Total Maximum Daily Load (TMDL) Implementation Plans are platforms for evaluating and tracking water quality protection and restoration. These plans have been designed to accommodate continual updates and revisions as new conditions and information warrant. In addition, field verification of watershed characteristics and listing data has been built into the preparation of the plans. The overall goal of the plans is to define a set of actions that will help achieve water quality standards in the state of Georgia.

This implementation plan addresses the general characteristics of the watershed, the sources of pollution, stakeholders and public involvement, and education/outreach activities. In addition, the plan describes regulatory and voluntary practices/control actions (Best Management Practices, or BMPs) to reduce pollutants, milestone schedules to show development of the BMPs (*measurable milestones*), and a monitoring plan to determine BMP effectiveness.

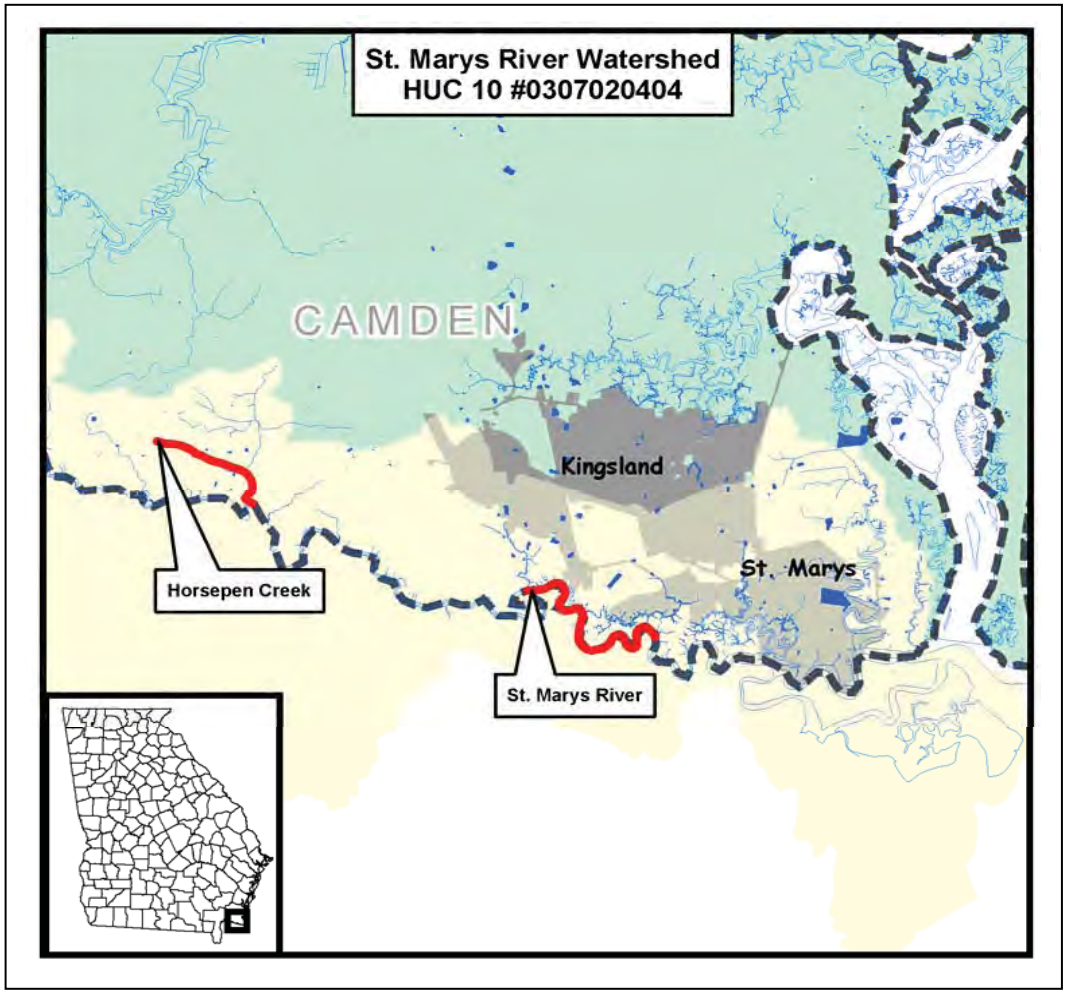


Table 1. IMPAIRED SEGMENTS IN THE HUC 10 WATERSHED

IMPAIRED SEGMENT	IMPAIRED SEGMENT LOCATION	EXTENT (mi/ac)	CRITERIA VIOLATED	EVALUATION
St. Marys River	Catfish Creek to Millers Branch (Camden County)	6	Dissolved Oxygen (DO)	Not supporting

* Plan to be done by EPD

II. GENERAL INFORMATION ABOUT THE HUC 10 AND THE SPECIFIC SEGMENT WATERSHED

Following is a review of watershed characteristics including its size and location, political jurisdictions, physical features, land uses, and identified potential sources of pollutants that could cause or contribute to violations of water quality standards addressed in this TMDL Implementation Plan. New conditions or changes in information contained in the previous TMDL Implementation Plan should be in **bold** and underlined.

The St. Marys River basin is located in Northeastern Florida and Southeastern Georgia, and is bordered by the Satilla River basin to the north, the Nassau & St. Johns River basins to the south, and the Suwannee River basin to the west. The basin occupies an approximate total area of 1,500 square miles within the Coastal Plain physiographic province, with approximately 765 square miles of the basin located in the Southeastern part of Georgia. The headwaters are located in Charlton County, Georgia, within the Okefenokee Swamp. The river flows first south, and then north and east through Camden County. The Catfish Creek to Millers Branch segment of the St. Marys River is located within Camden County, and is the border between Camden County, Georgia and Nassau County, Florida. The St. Marys River is comprised of one USGS Hydrologic Unit Code (HUC), 03070204. The water use classification for the St. Marys River, including the, Catfish Creek to Millers Branch segment, is predominately used for fishing purposes. The criterion violated is listed by the State of Georgia as Dissolved Oxygen (DO), and the potential causes listed in the January 2006 TMDL, are sediment runoff associated with land disturbing activities, and naturally occurring organic materials.

According to the 2006 TMDL Evaluation for the St. Marys River basin, the land use characteristics of the St. Marys River basin are in order of dominance:

- Upland (mostly pine plantation),
- Forest (48%),
- Forested wetland (35%),
- Transitional (9%),
- Emergent wetland (4%), and
- Residential (1%).

Point source contributors of pollutants are limited to two municipal wastewater treatment facilities located upstream from or within the listed segment. The City of Kingsland – St. Marys Water Pollution Control Plant (WPCP) holds a NPDES permit for discharge classified as major, with a discharge greater than 1.0 million gallons per day (MGD). The City of St. Marys – Scrubby Bluff WPCP is NPDES-permitted as well, and discharges an average monthly flow of 0.5 MGD.

Potential non-point sources of oxygen demanding substances are both natural and of human origin. Sources of naturally occurring organic materials are:

- Adjacent wetlands with organically rich bottom sediments;
- Direct leaf litter-fall onto water surfaces and adjacent floodplains; and
- Storm runoff of leaf litter détritus and wildlife wastes.

Potential human-induced non-point sources include:

- Land application systems (spray and buried/septic);
- Erosion and storm runoff of sediments from areas of land disturbance ;
- Organic loading of fertilizers, herbicides, pesticides, and dead vegetation from (minor) farming and (major) silvicultural operations ; and
- Loading of fertilizers, herbicides, pesticides, and dead vegetation from (increasing) residential and commercial (retail) acreages.

Additionally, base flow in the St. Marys River segment was potentially lowered due to land alterations including:

- Channelization projects for silviculture and suburban development,
- Hardening of the landscape (impervious surfaces), and by the
- Filling of wetlands, which likely has decreased the water segments ability to process sediment loads.

The retention throughout the aforementioned relationships has likely increased the relative importance of maintaining current natural processes.

III. CAUSES AND SOURCES OF SEGMENT IMPAIRMENT(S) LISTED IN TMDLs

Table 2 provides information contained in the current TMDL for the impaired water body. This includes the name and location of the impaired segment, the water quality criteria violated, and the wasteload and load allocations determined in the TMDL process. Potential sources described in the TMDL may include

- Domestic treatment facilities (M),
- Industrial treatment facilities (I),
- Urban runoff and sources (UR), and
- Other nonpoint or unknown (NP) sources.

By definition, "Wasteload Allocations" (WLA) are established for municipal and industrial treatment facilities and stormwater discharge in permitted areas (WLAsw), while "Load Allocations" (LA) are established for nonpoint sources. **Wasteload allocations are assigned by EPD during the NPDES permitting process. They are not part of EPD's TMDL implementation planning process, which deals solely with non-point sources of pollutants.**

Table 2. WASTE LOAD AND LOAD ALLOCATIONS AND TMDLS FOR THE IMPAIRED SEGMENT

STREAM SEGMENT NAME	LOCATION	CRITERIA VIOLATED	WLA	WLAsw	LA	TMDL
St. Marys River – Catfish Creek to Millers Branch	Catfish Creek to Millers Branch, Camden County	DO	2,917 lbs/day	NA*	2,686 lbs/day	5,603 lbs/day

*According to the 2006 TMDL, storm water discharges associated with storm sewer systems do not occur during critical conditions (when there are no storm events), per the Georgia ESTUARY critical conditions model used to determine the WLA.

Table 3 also contains information presented in the TMDLs that this plan is designed to address. This includes the criteria responsible for the impairment(s), the specific water quality standard(s) violated, potential sources/causes of impairment, and the needed reduction in source loads estimated in the TMDL.

Table 3. SOURCES OF IMPAIRMENT INDICATED IN THE TMDLs

CRITERIA VIOLATED : DO	WQ STANDARD	SOURCES OF IMPAIRMENT	NEEDED % REDUCTION (FROM THE TMDL)
Not supporting designated use of fishing	5.0 mg/L daily average; no less than 4.0 mg/L at all times for waters supporting warm water fish species	Two municipal wastewater treatment facilities	*Not found in the TMDL (note: investigations should be conducted to determine the base flow ; loading relationships in order to recalculate reductions, or increase base flow)*
		land application systems (spray and buried/septic)	
		erosion and storm runoff of sediments from areas of land disturbance	
		adjacent wetlands with organically rich bottom sediments; direct leaf litterfall onto water surfaces and adjacent floodplains; and storm runoff of leaf litter détritus and wildlife wastes; organic loading of fertilizers, herbicides, pesticides, and dead vegetation from (minor) farming and (major) silvicultural operations ; and loading of fertilizers, herbicides, pesticides, and dead vegetations from (increasing) residential and commercial (retail) acreages. Additionally, base flows in the segment lowered by land alterations including channelization projects for silviculture and suburban development, hardening of the landscape (impervious surfaces), and filling of wetlands, likely have decreased the ability of the segment to process loadings.	

IV. IDENTIFICATION AND RANKING OF POTENTIAL SOURCES OF IMPAIRMENT

This section identifies and describes, in order of importance, the extent and relative contributions from sources of pollutants listed in Table 3 and identified through this TMDL implementation planning process. This description includes information presented in the current TMDL or TMDL implementation plan and/or collected during the TMDL implementation planning process that either verifies or alters estimates of contributions from the sources listed in the TMDL and repeated in Table 3.

The Georgia side of the St. Marys River planning area was ground surveyed on June 2, 2008. The notes from this survey are provided in Appendix C. The Technical Review Committee (TAC), organized to participate in implementation plan development, met on August 26, 2008, and provided a set of findings and recommendations. These are found in Appendix D. The TAC generally found that the Georgia side of the river is heavily suburbanized, and development is expected to continue. The TAC further determined that local sources of impairment are expected to be mostly development-related, and increasing, rather than that of a natural origin. Additionally, base flow and loading relationships should be investigated to determine whether the increases in baseflow might improve or eliminate the impairments.

Table 4 ranks potential sources of water quality impairments in order of importance as determined through this TMDL implementation planning process. A “rating scale” of 0.5 to 5 has been developed for this activity. “Rating A” is an estimate of the geographic extent of each potential nonpoint source as a percentage of the contributing watershed area, percent of stream miles affected, or number of acres. “Rating B” is an estimate of the relative contribution from each major source of the pollutant causing the impairment. The overall relative “Impact Ratings” for each source is calculated by multiplying Rating A by Rating B. The following table provides guidance for rating the estimated extent (Rating A) and portion of the contribution (Rating B) from each potential source and cause:

Rating A: Estimated Geographic Extent of the Source or Cause in the Contributing Watershed	**Rating B:** Estimated Portion of Contribution from the Source to the Pollutant Load Causing the Impairment	**Rating**
None or negligible (approximately 0-5%)	None or negligible (approximately 0-5%)	0.5
Scattered or low (approximately 5-20%)	Scattered or low (approximately 5-20%)	1
Medium (approximately 20-50%)	Medium (approximately 20-50%)	3
Widespread or high (approximately 50% or more)	Widespread or high (approximately 50% or more)	5
Unknown	Unknown	UNK

Comments on the source of information used to determine the extent or contribution are entered in the applicable columns in Table 4. Appropriate management actions (i.e. watershed assessments, increased water quality monitoring, etc.) are suggested where available information is deemed inadequate to estimate the extent and relative contribution of significant potential sources.

Table 4. EVALUATION OF POTENTIAL SOURCES OF STREAM SEGMENT IMPAIRMENT

CRITERION : Dissolved Oxygen (DO)

POTENTIAL SOURCES	ESTIMATED EXTENT OF CONTRIBUTION		ESTIMATED PORTION OF CONTRIBUTION		*IMPACT RATING (A X B)*
	Comments	*Rating (A)*	Comments	*Rating (B)*	
erosion and storm runoff of sediments from areas of land disturbance	2006 TMDL/field observation	5	2006 TMDL/field observation	5	25
adjacent wetlands with organically rich bottom sediments; direct leaf litterfall onto water surfaces and adjacent floodplains; and storm runoff of leaf litter détritus and wildlife wastes	2006 TMDL/field observation	3	2006 TMDL/field observation	3	9
organic loading of fertilizers, herbicides, pesticides, and dead vegetation from (minor) farming and (major) silvicultural operations, and from increasing residential and retail commercial area.	2006 TMDL/field observation/GIS research	5	2006 TMDL/field observation	5	25
decreased capacity for natural processing of organic loading, resulting from decreased base flow caused by silvicultural activity, suburban development, filling of wetlands and overall hardening of the landscape (impervious surface).	2006 TMDL/field observation/GIS research Note: The relationships between loadings and changes in base flow should be investigated, to determine potential effectiveness of measures altering base flow to natural flows as part of the solution to impairment.	UNK (see note)	2006 TMDL/field observation	UNK (see note)	UNK (see note)

Two municipal wastewater treatment facilities	2006 TMDL Note: The relationships between loadings and changes in base flow should be investigated, to determine potential effectiveness of measures altering base flow to natural flows as part of the solution to impairment. WLAs may need to be recalculated and re-permitted pending the outcome of such investigations.	UNK (see note)	2006 TMDL	UNK (see note)	UNK (see note)
land application systems	2006 TMDL	1	2006 TMDL	1	1

V. STAKEHOLDERS

Public involvement through the stakeholder process is a vital component of TMDL implementation planning. Stakeholders with local knowledge can provide valuable information regarding their communities, impaired waters, potential sources of impairments, and BMPs that might be employed to improve water quality. This section describes outreach activities engaging local stakeholders in the TMDL implementation plan preparation process, including the number of attendees, meeting dates, and major findings, and recommendations.

A stakeholder meeting was held on May 1, 2008, at Woodbine City Hall, within the local vicinity of the general study area. The meeting was advertised through several newspapers, and was attended by 21 people. The TMDLs and the TMDL implementation plan preparation process were explained with the aid of a power-point presentation; stakeholder participation was solicited; technical advisory committee participation was solicited; and the role of citizens and technical advisors in the process was explained.

A technical advisory committee (TAC) was assembled, composed of twelve individuals representing a broad spectrum of expertise associated with surface water quality, and interested in management of the St. Marys River Basin. Research on the part of Satilla Riverkeeper, contracted partner to Coastal Georgia RDC, and CGRDC, resulted in a significant volume of technical literature being transmitted to the TAC, to update the TAC on the latest relevant information on the TMDL process and on the dynamics of blackwater streams in Southeast Georgia. The TAC met for a full day on August 26, 2008, resulting in findings and recommendations for improving the water quality within the St. Marys River Basin.

Following is a list of advisory committee or watershed group members who participated in this TMDL implementation planning process.

Table 5. STAKEHOLDER ADVISORY GROUP MEMBERS

NAME/ORG	ADDRESS	CITY	STATE	ZIP	PHONE	E-MAIL
Dr. Clay Montague / U. of Florida	2615 NW 38th Drive	Gainesville	FL	32605	352-375-7223 cell: 352-538-5861	montague@ufl.edu
Mr. Joel Fleming / GA Dept. of Natural Resources	One Conservatiion Way	Brunswick	GA	31520	912-264-7218	jfleming@dnr.state.ga.us
Dr. Liz Kramer / U. of Georgia	UGA, 312 Connor Hall	Athens	GA	30602	706-542-3577	lkramer@uga.edu
Dr. Rob McDowell / GA Dept. of Natural Resources, EPD	4220 Int. Pkwy., Suite 101	Atlanta	GA	30354	404-675-1650	rob_mcdowell@dnr.state.ga.us
Mr. John Day / Jekyll Island Authority	1 Jessup Lane	Jekyll Island	GA	31527	912-635-4021	jday@jekyllisland.com
Mr. Bert Deener, GA Dept. of Natural Resources	PO Box 2089	Waycross	GA	31501	912-285-6094	bert.deener@dnr.state.ga.us
Mr. Robert Boland / UGA Coop. Ext. Service	PO Box 275	Nahunta	GA		912-462-5724	bboland@uga.edu
Mr. John Feldt / National Weather Service	4 Falcon Road	Peachtree City	GA	30269	770-486-0028 x 322	john.feldt@noaa.gov
Mr. Bill Alexander / Soil and Water Conservation District	PO Box 416	Woodbine	GA	31569	912-729-2458	wra@tds.net
Mr. Bill Sapp / Southern Environmental Law Center	127 Peachtree St., Ste. 605	Atlanta	GA	30303-1840	404-521-9900	bsapp@selcga.org
Ms. Jeannie Rhodes / Georgia EPD	One Conservation Way	Brunswick	GA	31520	912-264-7284	jeannie.butler@dnr.state.ga.us
Mr. David Ferrell / NRCS	Federal Building	Waycross	GA	31501	912-283-5598	david.ferrell@ga.usda.gov

Major stakeholders in the watershed are listed in Appendix A.

VI. MANAGEMENT MEASURES AND ACTIVITIES

Table 6A identifies significant BMPs that either have been or may be implemented in the future to address sources of impairment. The BMPs are in Column 1, organization responsible for implementation in Column 2, description of the measure(s) in Column 3, and sources of funding or other resources in Column 4. Column 5 contains one of the following status codes: (A) installed and active; (AE) active and will be enhanced or expanded; (R) required by law, regulation or permit conditions; (P) currently proposed, but not required; (NR) new recommendation; or (NE) enhanced existing recommendation. Column 6 shows the approximate date when the measure has or will be implemented. Column 7 contains an "extent" rating for the BMP or the percentage of individual sources to which the BMP has or will be applied (see the following table). Column 8 is an estimated BMP "effectiveness" rating that may be either provided by local experts or derived from technical guidance information. The following table provides guidance for rating the estimated management measure "extent" and "effectiveness" of each significant potential source:

BMP Extent (Percentage of Sources to Which the BMP Has or Will Be Applied)	**BMP Effectiveness** (Percent Removal of Pollutant by the BMP)	**Rating**
None or negligible (approximately 0-5%)	None or negligible (approximately 0-5%)	.5
Scattered or low (approximately 5-20%)	Low to medium (approximately 5-25%)	1
Medium (approximately 20-50%)	Medium to High (approximately 25-75%)	3
Widespread or high (approximately 50% or more)	High (approximately 75% or more)	5
Unknown	Unknown	UNK

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Table 6A. MANAGEMENT MEASURES AND ACTIVITIES

GENERAL AND SPECIFIC MEASURES APPLICABLE TO CRITERION: DO

BEST MANAGEMENT PRACTICE (1)	RESPONSIBILITY (2)	DESCRIPTION (3)	SOURCES OF FUNDING & RESOURCES (4)	STATUS CODE (5)	TARGET DATE (6)	EXTENT RATING (7)	EFFECT. RATING (8)
Kingsland, Camden County and State monitoring and enforcement review	EPD	Review monitoring and enforcement by Camden County, Kingsland and the State, in association with NPDES sediment and erosion control for construction-related disturbance, and propose recommendations.	Developers through permit conditions	NR	10/2010	5	5
Camden County Comp. Plan – Camden County Ordinance - Coastal Georgia Comp. Plan review	DNR/EPD	Review the Camden County Comprehensive Plan and Ordinances against the Coastal Georgia Comprehensive Plan to determine potential amendments guiding regulations and development in favor of effective controls on adverse impacts to water quality and quantity.	Coastal Georgia Comprehensive Plan Implementation Funds, 319 and Coastal Incentive Grants	NR	10/2009	5	5
Kingsland ordinance review	DNR/EPD	Review Kingsland's ordinances for amendment opportunities to promote techniques and measures associated with Limited Impact Development, emphasizing progressive storm water management to retain/restore natural hydrology and enhance water quality.	319 grant, Coastal Incentive Grants	NR	10/2009	5	5
Shorter sampling intervals	DNR/EPD	Decrease the standard 5-year sampling interval to account for year by year rainfall change, and require shorter intervals for TMDL implementation monitoring.	EPD funds	NR	10/2009	5	5

Apply St. Marys River Management Plan and collaborate with the St. Marys River Mngmt. Committee on measures, activities and proposals for local ordinance amendments.	Georgia DNR and Local Governments	Provides: information and management strategies associated with surrounding natural and economic resources; intergovernmental coordination strategies; model legislation for protection and promotion of environmental and economic resources; basis of best science and planning practices to protect water quality and quantity. Among top priorities of committee: Establish consistent and adequate septic system setbacks and monitor TMDL programs in both states.	Donations	NR	2002; outreach and monitoring activities ongoing	5	5
Florida TMDL research	DNR/EPD	Research the existence of any TMDL listings, and TMDL implementation plans affecting the Florida side. Evaluate impairment and mitigation data within any Florida TMDLs and implementation plans, to determine the relative impairment originating from Florida, and to adapt any potentially effective or successful measures being used there.	DNR/EPD funds	NR	10/2009	5	5
Kingsland water treatment plant outfall locations	DNR/EPD	Research the current and any future location(s) of water treatment plant outfalls serving Kingsland, as well as current and projected standards, effluent constituents and volumes associated with such outfalls.	DNR/EPD funds	NR	10/2009	5	5
Local government collaboration	DNR/EPD	Collaborate with all watershed local governments on the development of measures and activities to decrease impairment.	DNR/EPD funds	NR	10/2009	5	5
RDC to RDC	DNR/EPD	Recommend coordination between	DNR/EPD funds	NR	10/2009	5	5

coordination		RDCs where respective RDC jurisdictions share watersheds.					
Mitigation banking	DNR/EPD	Explore, evaluate, and market the value of mitigation banking upstream of impairment sources, as an alternative to conventional timber plantations, targeting baseflow offsets and restoration credits.	DNR/EPD funds	NR	10/2009	5	5
Nutrient trading	DNR/EPD	Explore and evaluate the value of nutrient trading as an offset in proposed increases in the base flow of water treatment plants.	DNR/EPD funds	NR	10/2009	5	5
State-authorized local Comp. Plan and Ordinance Amendment, Adoption and Enforcement	Georgia DNR and Local Governments	Propose local comprehensive plan and ordinance amendments to achieve effective controls on adverse impacts to water quality and quantity, including techniques and measures associated with Limited Impact Development, emphasizing progressive storm water management to retain/restore natural hydrology and enhance water quality. Local governments can adopt and enforce ordinances consistent with the minimum planning standards and procedures established by Georgia Department of Community Affairs.	Georgia DNR and EPD; Local Governments	NR	10/2010	5	5
Enforce Clean Water Act, Section 404 permits and associated mandated BMPs; EPA/Corps 1995 MOU	EPA/ Army Corps of Engineers, and Property Owners	For wet hardwood forests at least ten acres in area, and swamp forests at least five acres in area, with seasonally flooding or saturation by high water tables: 404 permit required for conversion to pine plantation; Federally mandated BMPs include maintenance of natural contour and ensuring that	EPA, Army Corps of Engineers, Georgia EPD	R	06/1988 (Clean Water Act); 11/1995 (MOU)	5	5

		activities do not immediately or gradually convert the wetland to non-wetland; provisions for forest road construction and maintenance in and across waters of the U.S., in order to qualify for the silvicultural exemption from the permitting process.					
Apply 1985 Farm Bill, Sect. 1221	USDA	Denies eligibility for commodity program payments and other USDA programs to those agricultural operators who convert wetlands for agriculture.	USDA	R	1985	5	5
Apply 1996 Farm Bill, Sections 321 to 326	USDA	Prohibits USDA delegation of compliance decisions to a private entity.	USDA	R	1996	5	5
Apply Professional Forestry Standards of Practice (OCGA 43-1-19)	Georgia State Board of Registration of Foresters, Foresters	Failure to practice professional forestry in accordance with generally accepted standards of practice (including BMPs) shall constitute unprofessional conduct and shall be grounds for disciplinary action.	Georgia State Board of Registration of Foresters	R	1993	5	5
Enforce Georgia Water Quality Control Act (OCGA 12-5-20)	Georgia DNR and EPD	Prohibits discharge of excessive pollutants, including sediments, nutrients, pesticides and animal waste, etc., into waters of the State in amounts harmful to public health, safety or welfare, or to animals, birds, or aquatic life or the physical destruction of stream habitats.	Georgia DNR and EPD	R	1964	5	5
Land Development Review Process	Camden County Planning and Development	Ensures compliance with land use, engineering, and environmental policies and regulations; and guides development toward preferred land use.	County Government	R	NA	5	5

Enforce Camden County Soil Erosion and Sedimentation Control Ordinance, those of counties upstream	Camden County Planning and Development, and similar departments of upstream counties	County code requiring permits and enforcement for land disturbing activities; Sediment and erosion control measures are required, including BMPs consistent with the Manual for Erosion and Sedimentation Control in Georgia; A 25-foot buffer from the banks of any state waters is required.	County Governments	R	NA	5	5
Greenprint Plan	Camden County / Trust for Public Land	Promotes water quality protection	County Government	NR	10/2009	5	5
Apply and Enforce Part V Environmental Protection Ordinances	Camden County Planning and Development	Groundwater, watershed, river corridor, wetlands protection	County Governments	R	NA	5	5
Apply and Enforce Septic Tank Installation and Design Standards	Camden County Environmental Health; Kingsland Environmental Health	Rules and Regulations promulgated by On-site Sewage Management Systems, Chapter 290-5-26, Georgia DHR, Division of Public Health, Environmental Health and Injury Control	Camden County, City of Kingsland, and Georgia DHR	R	NA	5	5
Apply Camden County Water Well and Septic Survey	Camden County Environmental Health, Coastal RC&D Council	Provides locations where high numbers of potentially failing on-site septic systems occur. Among the findings, approximately six percent of the systems surveyed experienced some level of maintenance-related problems. Public outreach and education is focused to address maintenance and repair; A training session was held on August 20, 2004 to discuss findings with stakeholders.	Camden County and Georgia DHR	NR	2005: Outreach continues.	5	5
Enforce City of Kingsland Soil	Kingsland Department of	City code requiring permits and enforcement for land disturbing	City Government	R	NA	5	5

Erosion and Sedimentation Control Ordinance	Community Planning and Development	activities; Sediment and erosion control measures are required, including BMPs consistent with the Manual for Erosion and Sedimentation Control in Georgia; A 25-foot buffer from the banks of any state waters is required.					

The below Work Sheet and Table 6B are designed to evaluate the capacity of existing, proposed, or pending BMPs to achieve nonpoint source load reductions specified in the TMDL as well as other BMPs that might be implemented to further reduce pollutant loading from significant sources; and to identify new enhancements to existing measures (NE) or new recommended measures (NR) that could improve or supplement current or proposed management measures, where current and required measures have been judged inadequate for achieving the load reductions from significant sources identified in the TMDL and in Table 3 above.

A previous TMDL implementation plan recommending or proposing BMPs or other measures does not exist, and this is a New Plan. Regulations currently affecting the water quality of the St. Marys River are listed above in Table 6A. Based on the 2006 TMDL for the Catfish Creek to Millers Branch segment, the water quality within the segment does not meet federal or state standards. Therefore, the current regulatory activity affecting the segment is not fully adequate.

Table 6A above provides new recommended measures that could improve upon the current regulatory activity affecting the segment.

Therefore, the relevance of Table 6B to this implementation plan is limited. However, the worksheet and table are provided below for future reference to evaluate the newly recommended measures once implemented.

Work Sheet for Table 6B. EVALUATION OF GENERAL AND SPECIFIC MANAGEMENT MEASURES AND ACTIVITIES APPLICABLE TO EACH CRITERION

APPLICABLE TO CRITERION 1: DO.

SIGNIFICANT POTENTIAL SOURCES (1) (From Table 3)	**IMPACT RATING (2)** (From Table 3)	**APPLICABLE BMPs (3)** (From Table 6A)	**EVALUATION SUMMARY (4)**	**ADDITIONAL INFORMATION / MEASURES NEEDED (5)**

Table 6B identifies new enhancements to existing measures (NE) or new recommended measures (NR) that could improve or supplement current or proposed management measures listed in Table 6A, where current and required measures have been judged inadequate for achieving the load reductions from significant sources identified in the TMDL. After further evaluation generated in the Work Sheet for Table 6B, the additional management measures proposed in Table 6B have been determined more effective in reducing pollutant loads from the most likely sources of impairment. The BMPs are listed in Column 1, organization responsible for implementation in Column 2, description of the measure(s) in Column 3, and sources of funding or other resources in Column 4. Column 5 contains one of the following status codes: (NE) enhanced existing measure or (NR) new recommended measure. Column 6 shows the approximate date when the measure has or will be implemented. Column 7 contains an "extent" rating for the BMP or the percentage of individual sources to which the BMP could be applied (see the following table). Column 8 is an estimated BMP "effectiveness" rating that may be either provided by local experts or derived from technical guidance information. The following table provides guidance for rating the estimated management measure "extent" and "effectiveness" applied to each significant potential source:

BMP Extent (Percentage of Sources to Which the BMP Has or Will Be Applied)	**BMP Effectiveness** (Percent Removal of Pollutant by the BMP)	**Rating**
None or negligible (approximately 0-5%)	None or negligible (approximately 0-5%)	.5
Scattered or low (approximately 5-20%)	Low to medium (approximately 5-25%)	1
Medium (approximately 20-50%)	Medium to High (approximately 25-75%)	3
Widespread or high (approximately 50% or more)	High (approximately 75% or more)	5
Unknown	Unknown	UNK

Table 6B. RECOMMENDED ADDITIONAL MANAGEMENT MEASURES AND ACTIVITIES TO ACHIEVE LOAD REDUCTIONS (COMPILED FROM TABLE 6A AND COLUMN 5 IN WORK SHEET FOR TABLE 6B)

APPLICABLE TO CRITERION 1: DO.

BEST MANAGEMENT PRACTICE (1)	RESPONSIBILITY (2)	DESCRIPTION (3)	SOURCES OF FUNDING & RESOURCES (4)	STATUS CODE (5)	TARGET DATE (6)	EXTENT RATING (7)	EFFECT. RATING (8)

VII. MONITORING PLAN

Water quality monitoring serves several purposes, some of which include obtaining data to determine sources of pollution, supporting management decisions, describing baseline conditions, and evaluating the effects of management measures on water quality. This section describes parameters to be monitored, status, whether monitoring is required for watershed assessments or stormwater permits, and the intended purpose. Submittal of a Sampling and Quality Assurance Plan (SQAP) for EPD approval is mandatory if monitoring data is to be used in support of listing decisions.

Water quality data used to evaluate the criteria violated are less than five years old? Yes [x] No [ ].

Table 7. MONITORING PLAN

PARAMETER (S) TO BE MONITORED	RESPONSIBLE ENTITY	STATUS (CURRENT, PROPOSED, OR RECOMMENDED)	TIME FRAME		PURPOSE (If for listing assessment, date of SQAP submission)
			START	END	
DO	EPD	Current monitoring cycle. See above listing for recommendation: Impairment Sourcing Study	2010	2010	St. Marys River Basin Management Planning
Recommendation from Table 6A: Conduct a current assessment of DO conditions in the segment; research DO dynamics in the system, including using Biological Oxygen Demand (BOD) work to explore the details of dynamics beyond mere measurement. Gain a complete understanding of the hydrologic	DNR/EPD	Recommended	2009	2009	Improve determination of water quality impairment; monitor success of BMPs, regulations and other activities.

changes in the watershed, including opportunities for restoration of lost functions/flows; understand the sourcing of nonpoint pollutants, the nutrient budgets, BOD dynamics, and the relationship of hydrology to all.					

VIII. PLANNED OUTREACH FOR IMPLEMENTATION

Table 8 lists and describes outreach activities that will be conducted to support this implementation plan, or help to improve water quality in the segment watershed. Identify either the projected start date or completion date. At a minimum, this is to include all education/outreach activities defined in the contractual Scope of Work for TMDL Implementation Plan development or revisions.

Table 8. PLANNED OUTREACH FOR IMPLEMENTATION

RESPONSIBILTY	DESCRIPTION	AUDIENCE	START OR COMOPLETION DATE
Coastal Georgia RDC	A publicly advertised stakeholder meeting was held to kickoff the TMDL Implementation Plan development process, and to invite stakeholder participation.	Interested citizens residing within the planning area.	May 1, 2008
Coastal Georgia RDC	A technical advisory committee (TAC) was assembled, composed of twelve individuals representing a broad spectrum of expertise associated with surface water quality, and	Twelve individuals representing a broad spectrum of expertise associated with surface water quality, and interested in management of the St. Marys River Basin.	May 2008 through October 2008

	interested in management of the St. Marys River Basin. Research on the part of Satilla Riverkeeper, contracted partner to Coastal Georgia RDC, and CGRDC, resulted in a significant volume of technical literature being transmitted to the TAC, to update the TAC on the latest relevant information on the TMDL process and on the dynamics of blackwater streams in Southeast Georgia. The TAC met for a full day on August 26, 2008, resulting in findings and recommendations for improving the water quality of Horsepen Creek.		

IX. MILESTONES AND MEASURES OF PROGESS FOR BEST MANAGEMENT PRACTICES (BMPs) AND OUTREACH

Table 9 tracks and reports progress of significant management measures identified in Tables 6A, 6B, and other sections of this plan, including outreach, additional monitoring and assessments, and enhancement or installation of BMPs. Significant activities and the target dates of accomplishment are listed under STATUS, and comments are provided on the effectiveness of the management measure, the degree of community support, what was learned, how the measure might be improved in the future, and other pertinent observations.

Table 9. MILESTONES AND MEASURES OF PROGRESS

BEST MANAGEMENT PRACTICE	RESPONSIBLE ORGANIZATION	STATUS		COMMENT
		PROPOSED	INSTALLED	
Kingsland, Camden County and State monitoring and enforcement review	EPD	10/2010		
Camden County Comp. Plan - Coastal Georgia Comp. Plan review	DNR/EPD	10/2009		
Kingsland ordinance review	DNR/EPD	10/2009		
Shorter sampling intervals	DNR/EPD	10/2009		
Apply St. Marys River Management Plan	Georgia DNR and Local Governments	2002		outreach and monitoring activities ongoing
Florida TMDL research	DNR/EPD	10/2009		

Kingsland water treatment plant outfall locations	DNR/EPD	10/2009		
Local government collaboration	DNR/EPD	10/2009		
RDC to RDC coordination	DNR/EPD	10/2009		
Mitigation banking	DNR/EPD	10/2009		
Nutrient trading	DNR/EPD	10/2009		
State-authorized local Comp. Plan and Ordinance Amendment, Adoption and Enforcement	Georgia DNR and Local Governments	10/2010		
Greenprint Plan	Camden County / Trust for Public Land	10/2009		
Apply Camden County Water Well and Septic Survey	Camden County Environmental Health, Coastal RC&D Council	2005 – outreach continues		

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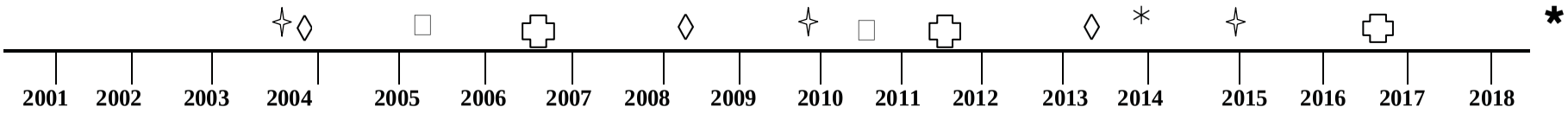
PROJECTED ATTAINMENT DATE

The projected date to attain and maintain water quality standards in this watershed is 10 years from receipt of this TMDL Implementation Plan by Georgia EPD.



✧ Projected EPD Basin Group Monitoring

□ New TMDLs Completed

◊ TMDL Implementation Plan Received by EPD

✚ Evaluation of Implementation Plan/water Quality Improvement

✳ Project Attainment for Plans Prepared in 2002

✱ Project Attainment for Plans Prepared in 2007

Prepared By:	Kevin D. Vienneau, Senior Planner				
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Date Submitted to EPD:				Revision:	

Preparation of this report was financed in part through a grant from the U.S. Environmental Protection Agency under the provisions of Section 106 of the Federal Water Pollution Control Act, as amended.

APPENDIX A.

STAKEHOLDERS

List the names, addresses, telephone numbers, and e-mail addresses for local governments, agricultural or commercial forestry organizations, significant landholders, businesses and industries, and local organizations, including environmental groups and individuals, with a major interest in this watershed.

NAME/ORGANIZATION	ADDRESS	CITY	STATE	ZIP	PHONE	E-MAIL
Ken Kessler / Kingsland Community Planning Director	PO Box 250	Kingsland	GA	31548	912-729-8279	kkessler@kingslandgeorgia.com
Loretta Riggins-Hylton / Camden County Planning Director	107 Gross Road, Suite 3	Kingsland	GA	31548	912-729-5603	lrhylton@co.camden.ga.us
Steve Howard / Camden County Manager	PO Box 99	Woodbine	GA	31659	912-576-5601	
Bob Noble / Camden County Joint Development Authority	PO Box 867	Kingsland	GA	31548	912-729-7201	ccjda@co.camden.ga.us
Roger Weaver / City of St. Marys Planning Director	418 Osborne Street	St. Marys	GA	31558		roger.weaver@ci.st-marys.ga.us
Mr. Bill Alexander / Soil and Water Conservation District	PO Box 416	Woodbine	GA	31569	912-729-2458	wra@tds.net
Chip Campbell / St. Marys River Management Committee	Rt. 1, Box 2924	Folkston	GA	31537	912-276-4779	chip@okefenokeeadventures.com
Anne Blakely / BHT, land owner	PO Box 253	Woodbine	GA	31564	912-576-8838	ablakely@tds.net
Rita Barrow / USDA-NRCS	3661 Altama Ave.	Brunswick	GA	31520	912-265-8043	rita.barrow@ga.usda.gov
Emily Goodson / Tribune & Georgian	206 Osborne St.	St. Marys	GA	31558	912-882-4927	Emily@tribune-georgian.com
Bob Morgan / Anglers	292 Cox Rd.	Woodbine	GA	31569	912-576-9173	Harley_rider@tds.net

Edge Bait and Tackle						
Mr. Robert Boland / UGA Coop. Ext. Service	PO Box 275	Nahunta	GA		912-462-5724	bboland@uga.edu
Rob Hicks / Georgia Pacific	903 Monck St.	Brunswick	GA	31520	912-269-5981	
Jill Huntington / DNR-Coastal Mngmt. Prog.	One Conservation Way	Brunswick	GA	31520	912-262-3053	
George Aikers / property owner	112 Riverwood Drive	Kingsland	GA	31548	912-576-6943	
Rose Vansleet / property owner	112 Riverwood Drive	Kingsland	GA	31548	912-576-6943	
Gordon Rogers / Satilla Riverkeeper®	P.O. Box 159	Waynesville	GA	31566	912-778-3126	riverkeeper@satillariverkeeper.org

APPENDIX B.

UPDATES TO THIS PLAN

If this is a major or minor revision of an existing plan, this section will describe the date, section or table updated, and a summary of what was changed and why. Georgia EPD has developed guidelines for revising existing TMDL implementation plans.

This is a new plan, and not a revision of an existing plan.

APPENDIX C.

FIELD SURVEYS, NOTES, PHOTOGRAPHS, AND MAPS.
REPORT FROM PRELIMINARY GROUND SURVEY

I. HORSEPEN CREEK SUBWATERSHED

II. ST. MARYS RIVER, IMPAIRED TIDAL SEGMENT, CATFISH CREEK TO MILLERS BRANCH

CAMDEN COUNTY
ST. MARYS RIVER WATERSHED
GEORGIA

Bulleted Format; Annotation of Original Field Notes from June 2, 2008

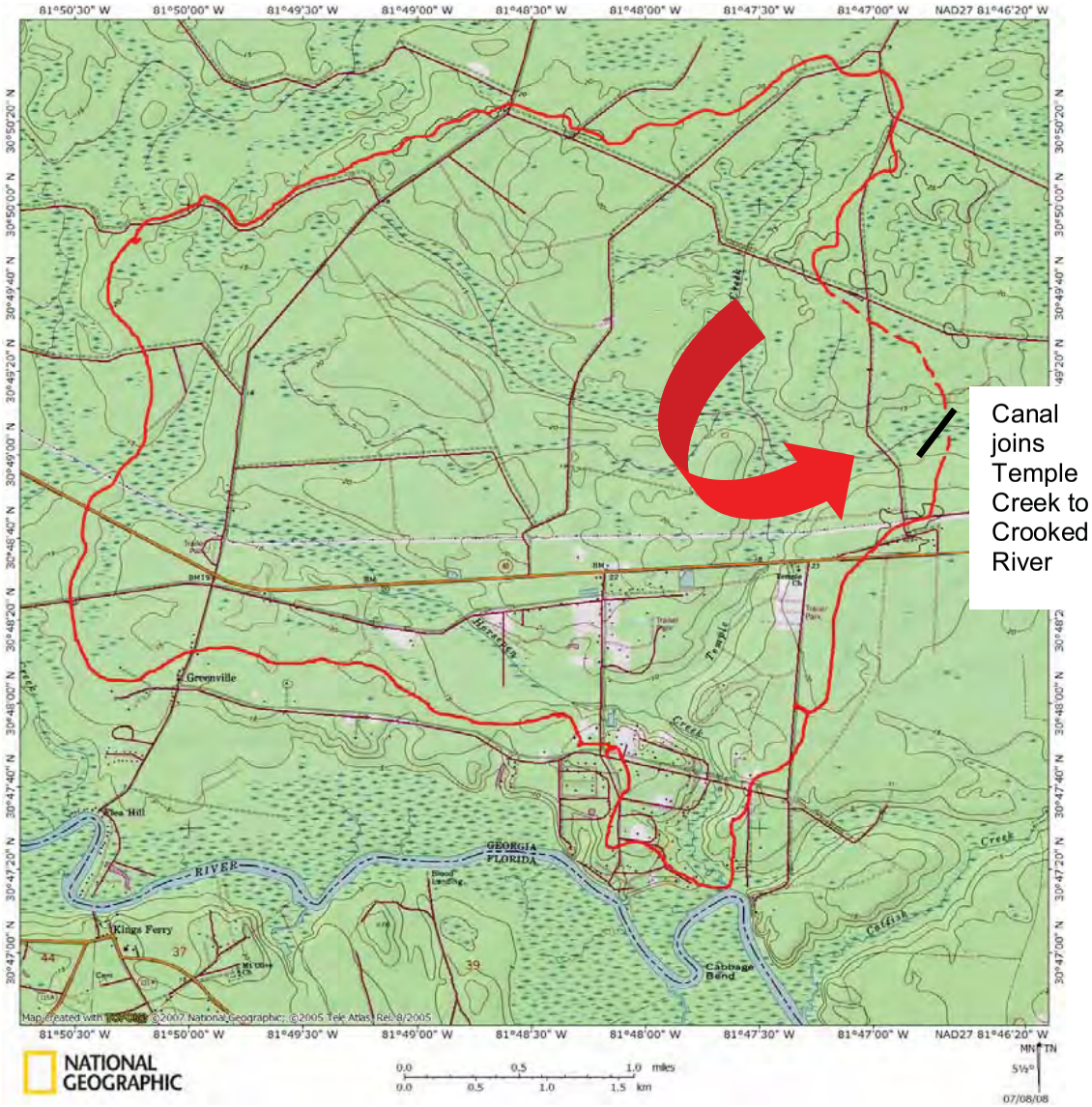
Submitted By (in alphabetical order):
John Carswell, Watershed Specialist, Satilla Riverkeeper®
Gordon Rogers, Riverkeeper® & Executive Director, Satilla Riverkeeper®
Kevin Vienneau, Senior Planner, Coastal Georgia Regional Development Center

Filed: July 15, 2008

I. Horsepen Creek Subwatershed

- Vienneau, Carswell, & Rogers entered the survey area from Exit 29, I-95 for Camden County circa 6:30 a.m.
- Initiated survey where county/woods road intersected State Route 40 on eastern edge of the Horsepen Creek Watershed, in the Browntown area of Camden County, west of Kingsland proper, in the area recently annexed by Kingsland at the request of Crescent Resources, and adjacent to the Northshore development
- Toured the watershed north of SR-40 in a counter-clockwise loop using forestry roads that ran very near the perimeter of the actual watershed. Also, traversed the interior of the watershed at to avoid erroneous impressions based upon perimeter conditions.
- Noted extensive artificial channelization throughout the upper watershed (see examples in Figures 1 & 2).
    - Channelization extends to cypress "heads" (headwaters "domes") in many, many cases; typical of silvicultural activities from the 1960s, 1970s, and 1980s.
    - Larger, canal-like ditches were noted in several instances.
    - Temple Creek headwaters, a nominal tributary to Horsepen Creek, appears to have had a significant portion of its flow redirected into the Crooked River watershed (see map, see also Figure 2).
- In the upper watershed (north of SR 40) there are ½ dozen or so mobile homes & ½ dozen wood frame homes (no more than 20 in aggregate) housing a roughly equal number of families; several are unoccupied; all are (apparently) on septic (see Figures 3 & 4 for exemplary homesites in this area).
- North of SR 40, standing water was very limited, noted only where unnamed forestry road intersected Temple branch (indicated by red "X" in watershed map, Figure X) and in heavily channelized part of canal feeding to Crooked River (revisit Figure 2). Otherwise, the natural drainage system was primarily dry (e.g. Figure 5) with the exception of limited puddling south of SR 40 (e.g. Figure 6).
    - This watershed, in general, has been engineered in much the same fashion as several million acres of poorly drained pine flatwoods, pine flatwoods wetlands, and flatwoods wetland on Southeast Georgia's Lower Coastal Plain: rainfall does not hold in this type of landscape; it is engineered to drain rapidly.
    - And, the case of this watershed, substantial portions of the annual flow appear to have been diverted to the adjacent Crooked River watershed.
    - We immediately note that adjacent tidal and riverine areas could immediately benefit from restored hydrology (volume and timing) without regard to whether such restorations would alter (improve) water quality; however, it should also be noted that intense flushing can elevate fecal counts, and can also lower D. O. due to low flow between rainfall events.
    - This brings to mind, rather immediately, the framework for a possible set of solutions in the Horsepen Creek Watershed: restore the hydrology of the system. Possible features: 1) adjustable weir (at Main road running from Route 40 due north and south of Duck Pond Road) purpose to restore hydrology of Temple Creek wetlands, pushing water back into the

Horsepen system which currently flushes into Crooked River; 2) shallow-ditch plugs throughout the system to restore individual “head/dome” hydrologies.



Note: Dashed line on east indicates Horsepen Creek watershed joined with Crooked River watershed by man-made drainage structure. Total area of watershed affected by flow through the canal to Crooked River, is unknown.

- Useful exercise/work product related to above: ***GIS*** *overlay John's (Carswell's) watershed map with boundary coordinates of the new PUD/Kingsland annexation.*
- Second useful exercise/work product related to above: research with former landowners, UGA personnel (River Basin Center) and other appropriate sources the age of the drainage structures on this large tract of property.
  - This opens the door for the developer(s), Camden County, and the City of Kingsland to explore hydrologic restoration opportunities.
    - PUD process is a potential opportunity for restoration
    - opportunity for developer to be "the good guy"
      - re-flood dewatered wetlands
      - system of adjustable weirs
      - avoidance of mass grading, and other further, unwarranted disturbance (in favor of cost savings, immense infrastructure/environmental benefits)
      - avoidance of a big system of lagoons, which would work contrary to the TMDL issue at hand – further adverse effects on the water table (lowering of)
- South of 40: exemplary photos of suburban/rural development attached (Figures 7 & 8).
  - This area is fairly densely developed in estate and half-estate style tracts
  - Every dwelling appears to be on septic system, mostly mounded, all within a few dozen yards of drainage ditches (see figures 8 & 9), if not immediately adjacent to same
  - A few dwellings directly abut main-run wetlands (see Figure 10); a few are actually in former wetland (see Figure 11).
  - Useful exercise/work product related to above: ***GIS-based*** *count of rooftops, N. & S. of SR 40; we estimate currently 200 dwellings*

- General observations, and recap:
  - There is a lot of sediment moving in the Horsepen system – culverts are silted in; ditches are flattened; margins of wetlands are feathered - this is a general result of road/ditch system, flashy drainage (silvicultural and residential ditching), associated bedding – disturbance without adequate sediment control.
  - Restoration of hydrology and control of sediment movement (bacteria adhere readily to sediment; turbidity and high fecal counts are highly correlated) would each go a long way toward healing any bacterial overload problem, and yield additional D. O. benefits downstream/downgradient.

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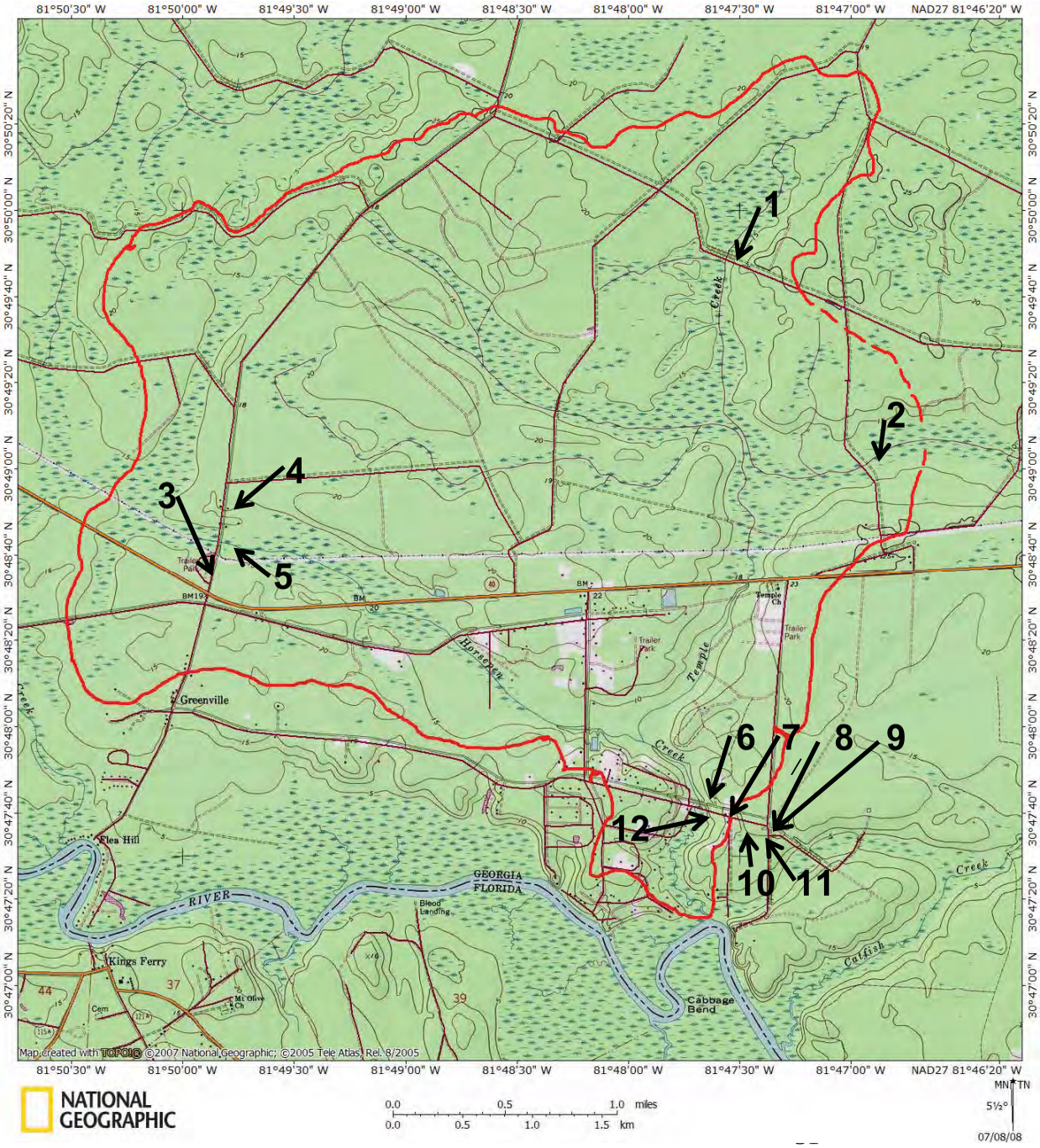

Figure 1: Interior ditch, typical. Tree growth indicates 25 – 40-year-old establishment.

Figure 2: “Temple” Canal. Lack of mainrun tree growth indicates either maintenance activity or heavy stormflows, or both.

Figure 3: Typical manufactured homesite, north of SR40.

Figure 4: Typical stick-built homesite, north of SR 40.

Figure 5: Mainrun flowage, several miles from tidewater, completely dry.

Figure 6: Mainrun flowage, very near tidewater, slightly puddled. In the photograph, Carswell is drawing a sample for E. coli count, to be conducted at UGA MAREX, Brunswick Station. Results: 1,553.1 (Most Probable Number) colonies of E. coli per 100 ml.

Figure 7: Typical manufactured homesite south of SR 40. This site was in area where there was noticeable flow (left to right, westward) down the roadside ditch (foreground) from which Carswell drew a sample (see Figure 11).

Figure 8: Typical stick-built homesite south of SR 40. Note mounded septic system midway between camera and main residence.

Figure 9: Perspective on mounded system in previous Figure (8): note adjacency to drainage infrastructure (borrow pit, center of photo; roadside drainage ditch, foreground)

Figure 10: Residential property immediately adjacent to mainrun of Horsepen Creek wetland system. Hydrologically, this is a drained-wetland homesite, complete with substantial fill, bulwarking/shoring, & interior ditches.

Figure 11: Residential property on a more upland former flatwoods wetland site. Note drainage ditch (line of vegetation) replete with ty-ty, willow, wax myrtle, and monocot wetland species, in addition to loblolly (former plantation pine).

Figure 12: Carswell sampling flowing ditchwater downstream of residences (plus other, not pictured) featured in Figures 7, 10, & 11, flowing to mainrun featured in Figure 6 (entering downstream/downgradient of puddle shown in Figure 6). This is a "live stream", with observed crayfish, water snake, and Gambusia (mosquito fish), springing near the top of a rise in this residential area, flowing down the edge of the road, with the last house prior to entering the mainrun being the one shown in Figure 10. Results: 191.8 (Most Probable Number) colonies of E. coli per 100ml.

II. St. Marys River Impaired Main-Stem Segment, Catfish Creek to Millers Branch

- We took the opportunity, while in the area, to reconnoiter to a small degree the St. Marys River Mainstem Segment under investigation
- Launched Satilla Riverkeeper® boat at the Kings Ferry (U. S. 17) ramp for abortive trip (thunderstorm encroached); made it as far upstream as mouth of Little St. Marys River Took physio-chemical readings in St Marys near confluence of Little St. Marys river (see Figure 13) – Salinity = 3.5 ppt; Dissolved Oxygen = 4.26 ppt (54.7% saturation); conductivity = 6.50 mS/cm.
- Also recorded measurements from "Lower" (easternmost) Catfish Creek at intersection with US-17 (see Figure 14) – Salinity = 4.5 ppt; Dissolved Oxygen = 3.26 ppt (43.2% saturation); conductivity = 6.50 mS/cm.
- Generally, Georgia side has heavy suburbanization
    - Storm water tributary (heavily incised; flowing out of Kingsland) of lower Catfish Creek formerly received Kingsland WWTP effluent (now routed to main river near I-95 per Conn Cole)
    - Very large ditch on east edge North Shore Development – trib of "Upper" Catfish Creek
    - Satilla Riverkeeper®'s YSI meters appeared to be calibrating properly (2 meters were consistent)

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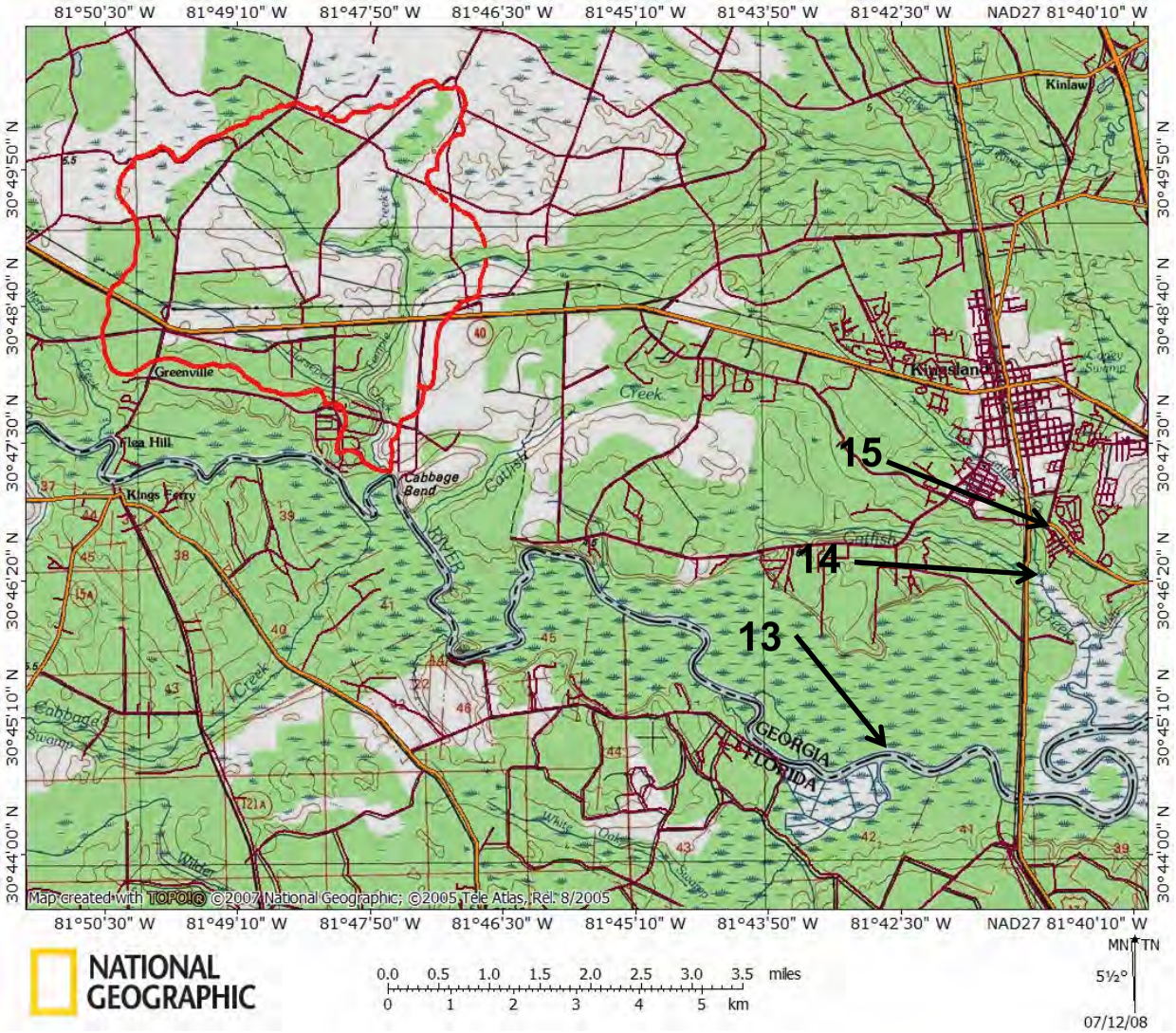


Figure 13: St. Marys River in vicinity of intersection with Little St. Marys River.

Figure 14: “Lower” Catfish Creek at U. S. 17. This is a tidal stretch, and tidal stage is near low.

Figure 15: Heavily incised but wooded non-tidal tributary of “Lower” Catfish Creek, draining stormwater from the south side of Kingsland.

APPENDIX D.

Notes from the August 26, 2008, Meeting of the TMDL Technical Advisory Committee

I. HORSEPEN CREEK SUBWATERSHED

II. ST. MARYS RIVER, IMPAIRED TIDAL SEGMENT, CATFISH CREEK TO MILLERS BRANCH

III. SATILLA RIVER, IMPAIRED TIDAL SEGMENT, ROSE CREEK TO WHITE OAK CREEK

CAMDEN COUNTY
ST. MARYS RIVER AND SATILLA RIVER WATERSHEDS
GEORGIA

Submitted By (in alphabetical order):
John Carswell, Watershed Specialist, Satilla Riverkeeper®
Gordon Rogers, Riverkeeper® & Executive Director, Satilla Riverkeeper®
J. Paul Sansing, Planner I, Coastal Georgia Regional Development Center
Kevin Vienneau, Senior Planner, Coastal Georgia Regional Development Center

Prepared September 11, 2008

I. Horsepen Creek Watershed

Findings:

- The north part of Horsepen Creek watershed is mostly pine-plantation upland and forested but hydrologicaly-altered wetland. Impairment-related issues sources are therefore predominantly flow-volume and –rate related. Natural bacteriology may be being concentrated in altered stormwater flow, and highly pulsed flows may be starving downstream areas for flow during low-flow, or inter-storm, periods. Additionally, ground reconnaissance indicates that some of the watershed's flow may have been redirected to the Crooked River.
- The south part of Horsepen Creek watershed contains rural residential and suburban development. Hydrologic alterations are further exacerbated in this area by the addition of impervious surfaces. Impairment-related issues include those in the undeveloped upper watershed, plus the addition of mainly residential on-site septic systems. Hobby and/or artisnal (subsistence) crop culture is also in evidence. Some livestock were seen, but less than 50 head.
- There are no NPDES permits in the watershed.
- The capacity of the watershed to retain water, support base flows, absorb nutrients, and process bacteria is greatly reduced by alteration of hydrology associated with ditches excavated for silvicultural practices.
- Adverse effects to hydrology in the watershed are exacerbated by the apparent ditched diversion of water from the Temple Creek headwaters to the adjacent Crooked River watershed.
- Approximately the north three-quarters of the Horsepen Creek watershed has been annexed into the City of Kingsland (The Bertha Tract), and is planned by the City as a future Planned Unit Development. This PUD will be serviced by a centralized community sewer system, thereby bypassing the addition of new on-site septic systems, and perhaps offering the opportunity to retrofit existing systems, tapping to the new or extended City of Kingsland system.
- Sediment within natural and constructed water courses is significantly evident, based on professional field observation.
- Limited bacteriological sampling, unbudgeted in the 'new plan' development but performed by Satilla Riverkeeper and UGA, showed that significant amounts of E. coli are being transported down the roadside ditch of CR 53 at into Horsepen Creek. Two observations, inter-storm (near drought) and post-storm, yielded counts of 1553 and 1733 colonies per 100 ml, MPN.

Recommendations:

- Develop options for Best Management Practices for mitigation of fecal coliform and nutrients flowing via groundwater gradient and ditches from residential septic systems. Bio-retention at strategic locations would be one option, a potential mitigation measure to help resolve issues associated with both water quality and water quantity. Retro-fit of existing onsite systems (rebuild) is another option, but would be expected to fail, again. Retro-fits with more advanced technologies should be considered, as should future tap-ins to new sewage-treatment systems.

- Install preferred Best Management Practices for mitigation of fecal coliform and nutrients flowing via groundwater gradient and ditches from residential septic systems.
- Additional data is needed regarding impairment sourcing:
  - The hydrology of the Temple Creek portion of the watershed should be fully explored. If water flow is indeed confirmed to be diverted by ditches from the Horsepen Creek watershed to the Crooked River watershed, redirecting this flow could improve conditions in lower Horsepen.
  - Also, residents and local well-drillers report a shallow, 'coquina' aquifer used for drinking water in the area. It is unknown the existence, extent, and hydrology of this system, including interconnectedness with lower aquifers. A full understanding and recon of possible contamination is warranted.
  - Bacteriological work should be conducted in a 'sweep, sympatric' fashion at all key points in both sub-watersheds of Horsepen Creek (Temple, and Horsepen proper). Such work should be conducted during low- and high-flow periods.
  - By definition, the five-year interval of EPD monitoring should be increased to better understand the hydrology, to account for year to year variation in rainfall.
  - Produce a property-owner overlay to compare to sourcing data.
  - Such (above) additional data satisfaction should be funded by 319 monies, and will not constitute a huge expenditure.
- Review monitoring and enforcement by Camden County, Kingsland and the State, in association with NPDES sediment and erosion control for construction-related disturbance, and propose recommendation accordingly. Permit conditioning for new construction in the watershed should include requirements to fund recon and monitoring work.
- Review Kingsland's ordinances for amendment opportunities to promote techniques and measures associated with Limited Impact Development, with emphasis on progressive storm water management designed to retain or restore natural hydrology, and to enhance water quality.
- Review the Coastal Georgia Comprehensive Plan against the Camden County Joint Comprehensive Plan, to determine potential amendments guiding regulations and development toward more effective control of adverse impacts to water quantity and quality.
- Propose comprehensive plan and ordinance amendments to achieve effective control of adverse impacts to water quantity and quality, including techniques and measures associated with Limited Impact Development, with emphasis on progressive storm water management designed to retain or restore natural hydrology, and to enhance water quality.
- Determine the projected timeframe for development of the PUD.
- For areas of the watershed projected for a greater than ten-year build out, study feasibility of potential hydrologic restoration, by installation of shallow-ditch plugs throughout the system (to restore individual "head/dome" hydrology) of silvicultural drainage ditches in the Horsepen Creek watershed; and by installation of an adjustable weir at Main Road running from Rte. 40 due north and south of Duck Pond Road, to restore hydrology of Temple Creek wetlands.
- Include property owners EARLY in this process through TMDL public input process. Insure that Water Council reps are fully aware of TMDL activities.

II. St. Marys River Main Stem Segment

Findings:

- The Georgia side of the river is heavily suburbanized, and suburbanization is expected to continue. Therefore, local sources of impairment are expected to be more development-related than of natural origin.
- The hydrology of the St. Marys River watershed has been massively altered, and the impairments in fresh tidewater and the oligohaline portion of the estuary may be flow-related (i.e. decreased baseflow-related) as well as due to non-point pollution sourcing. Concomitantly, assimilative capacity in tidewater may have been reduced over time.
- Historical oxygen data in from the impaired segment indicated that the condition developed after the mid-1980s; however, no data are available from the segment (from what the TMDL team can garner) since the late 1990s (1998).
- Additional data on D. O. dynamics are needed.
- Based on the complexity of the estuarine system of the main stem, as well as impacting variables such as tide, wind and flow, data on Biological Oxygen Demand (BOD) is needed to better understand the nature of D. O. deficits on an areal and seasonal basis., and to better determine water quality impairment relative to the designated use of fish habitat.
- Five-year sampling intervals are not reliable. Sampling should be done at shorter intervals.
- An understanding of hydrology for the entire watershed of the segment is lacking.
- A St. Marys River Management Plan is available on the internet at http://www.saintmarysriver.org , prepared by the St. Marys River Management Committee, “an intergovernmental entity of elected and appointed members from … Charlton, Camden, Nassau and Baker Counties”.
- Research is needed regarding any TMDL listings affecting the Florida side.
- Research is needed on the current and any future location, standards, effluent constituent, and volume of water treatment plant outfalls serving Kingsland.
- All watershed local governments need to be involved in the TMDL implementation process.
- Coordination between RDCs should occur where respective RDC jurisdictions share watersheds.
- Mitigation banks or hydrologic offsets (e.g. hydrologic volume and/or nutrient loading) may be an economically viable alternative for developers of large properties downstream, with “banks” located upstream of the listed segment(s) closer to or at the headwaters to achieve maximum benefit.
- Nutrient trading may be effective to offset proposed increases in the base flow of water treatment plants. An example of an offset is installation of retainment structures to impede flow within drainage ditches.

Recommendations:

- Conduct a current assessment of D. O. conditions in the segment; research D. O. dynamics in the system, including using BOD work to explore the details of dynamics beyond mere measurement.
- Gain a complete understanding of the hydrologic changes in the watershed, including opportunities for restoration of lost functions; understand the sourcing of nonpoint pollutants, the nutrient budgets, BOD dynamics, and the relationship of hydrology to all.
- Review monitoring and enforcement by Camden County, Kingsland and the State, in association with NPDES permits, and for sediment and erosion control for construction-related disturbance, and propose recommendation accordingly. Extend this analysis across RDC boundaries.
- Review Kingsland's ordinances for amendment opportunities to promote techniques and measures associated with Limited Impact Development, with emphasis on progressive storm water management designed to retain or restore natural hydrology, and to enhance water quality. Extend this analysis across RDC boundaries.
- Review the Coastal Georgia Comprehensive Plan against the Camden County Joint Comprehensive Plan, to determine potential amendments guiding regulations and development toward more effective control of adverse impacts to water quantity and quality.
- Propose comprehensive plan and ordinance amendments to achieve effective control of adverse impacts to water quantity and quality, including techniques and measures associated with Limited Impact Development, with emphasis on progressive storm water management designed to retain or restore natural hydrology, and to enhance water quality.
- Acquire data on Biological Oxygen Demand (BOD) to improve determination of water quality impairment, and to monitor success of BMPs, regulations and other activities.
- Recommend to EPD, sampling intervals shorter than the standard five days, and use shorter intervals for TMDL implementation monitoring.
- Consult the St. Marys River Management Plan and collaborate with the St. Marys River Management Committee on measures, activities and proposals for local ordinance amendments.
- Research the existence of any TMDL listings, and TMDL implementation plans, affecting the Florida side. Evaluate impairment and mitigation data within any Florida TMDLs and implementation plans, to determine the relative impairment originating from Florida, and to adapt any potentially effective or successful measures being used there.
- Research the current and any future location(s) of water treatment plant outfalls serving Kingsland, as well as current and projected standards, effluent constituents and volumes associated with such outfalls.
- Collaborate with all watershed local governments on the development of measures and activities to decrease impairment.
- Recommend coordination between RDCs where respective RDC jurisdictions share watersheds.
- Explore, evaluate, and market the value of mitigation banking upstream of impairment sources, as an alternative to conventional timber plantations, targeting baseflow offsets and restoration credits.
- Explore and evaluate the value of nutrient trading as an offset in proposed increases in the base flow of water treatment plants.

III. Satilla River Main Stem Segment

Findings:

- Land use within the Satilla River watershed is mostly timber plantation and other forms of agriculture, and water quality impairments resulting from suburban development are comparatively insignificant.
- The hydrology of the Satilla River watershed has been massively altered, and the impairments in fresh tidewater and the oligohaline portion of the estuary may be flow-related (i.e. decreased baseflow-related) as well as due to non-point pollution sourcing. Concomitantly, assimilative capacity in tidewater may have been reduced over time.
- Historical oxygen data in from the impaired segment indicate that the condition was already in place by the late 1980s. Earlier data have not been located. No data are available from the segment (from what the TMDL team can garner) since the late 1990s (1998), with the exception that limited data are being collected under the current contract (4 cruises).
- Additional data on D. O. dynamics are needed.
- Based on the complexity of the estuarine system of the main stem, as well as impacting variables such as tide, wind and flow, data on Biological Oxygen Demand (BOD) is needed to better understand the nature of D. O. deficits on an areal and seasonal basis., and to better determine water quality impairment relative to the designated use of fish habitat.
- Five-year sampling intervals are not reliable. Sampling should be done at shorter intervals.
- An understanding of hydrology for the entire watershed of the segment is lacking.
- Research is needed on the current and any future location, standards, effluent constituent, and volume of water treatment plant outfalls serving Woodbine.
- All watershed local governments need to be involved in the TMDL implementation process.
- Coordination between RDCs should occur where respective RDC jurisdictions share watersheds.
- Mitigation banks or hydrologic offsets (e.g. hydrologic volume and/or nutrient loading) may be an economically viable alternative for owners and developers of large properties, with “banks” located upstream of the impaired segment(s) at or near headwaters to achieve maximum benefit.
- Nutrient trading may be effective to offset proposed increases in the base flow of water treatment plants. An example of an offset is installation of retainment structures to impede flow within drainage ditches.

Recommendations:

- Continue the current assessment of D. O. conditions in the segment; research D. O. dynamics in the system, including using BOD work to explore the details of dynamics beyond mere measurement.
- Gain a complete understanding of the hydrologic changes in the watershed, including opportunities for restoration of lost functions; understand the sourcing of nonpoint pollutants, the nutrient budgets, BOD dynamics, and the relationship of hydrology to all.
- Review Camden County's and Woodbine's ordinances for amendment opportunities to promote techniques and measures associated with Limited Impact Development, with emphasis on progressive storm water management designed to retain or restore natural hydrology, and to enhance water quality. Extend this analysis across RDC boundaries.
- Review the Coastal Georgia Comprehensive Plan against the Camden County Joint Comprehensive Plan, to determine potential amendments guiding regulations and development toward more effective control of adverse impacts to water quantity and quality.
- Propose comprehensive plan and ordinance amendments to achieve effective control of adverse impacts to water quantity and quality, including techniques and measures associated with Limited Impact Development, with emphasis on progressive storm water management designed to retain or restore natural hydrology, and to enhance water quality.
- Acquire data on Biological Oxygen Demand (BOD) to improve determination of water quality impairment, and to monitor success of BMPs, regulations and other activities.
- Recommend to EPD, sampling intervals shorter than the standard five days, and use shorter intervals for TMDL implementation monitoring.
- Collaborate with all watershed local governments on the development of measures and activities to decrease impairment.
- Recommend coordination between RDCs where respective RDC jurisdictions share watersheds.
- Explore, evaluate, and market the value of mitigation banking upstream of impairment sources, as an alternative to conventional timber plantations, targeting baseflow offsets and restoration credits.
- Explore and evaluate nutrient trading as an offset in proposed increases in the base flow of water treatment plants.

APPENDIX E

Table XXX
CRD Monitoring Data
Stations 302 - 306
2010-2012

DateCollected	StationID	Latitude	Longitude	O (mg/	Temp	Salinity
Jan-10	302	30.747	81.700	8.3	11.9	0.08
Mar-10	302	30.747	81.700	7.3	16.2	0.06
May-10	302	30.747	81.700	5.9	26	2.92
Dec-11	302	30.747	81.700	6.3	17.4	7.8
Jan-12	302	30.747	81.700	7.3	13.9	5.4
Feb-12	302	30.747	81.700	7.4	16.5	8
Mar-12	302	30.747	81.700	5.8	20.2	2.5
Apr-12	302	30.747	81.700	5.48	22.46	6.84
May-12	302	30.747	81.700	4.2	25.5	8.5
Jun-12	302	30.747	81.700	4.18	23.72	0.05
Aug-12	302	30.747	81.700	3.05	26.62	0.05
Sep-12	302	30.747	81.700	2.78	25.49	0.06
Oct-12	302	30.747	81.700	4.4	22	0.1
Nov-12	302	30.747	81.700	6.3	17.46	0.62
Dec-12	302	30.747	81.700	6.28	16.18	4.03
DateCollected	StationID	Latitude	Longitude	O (mg/	Temp	Salinity
Jan-10	303	30.755	81.665	8.4	11.7	0.25
Mar-10	303	30.755	81.665	7.5	16.2	0.17
May-10	303	30.755	81.665	6.3	26	9.8
Dec-11	303	30.755	81.665	6.6	17.6	15.1
Jan-12	303	30.755	81.665	7.4	14.1	11.8
Feb-12	303	30.755	81.665	7.4	16.6	15
Mar-12	303	30.755	81.665	6.4	20.1	6.1
Apr-12	303	30.755	81.665	5.81	22.36	10.72
May-12	303	30.755	81.665	4.2	25.8	13
Jun-12	303	30.755	81.665	4.02	23.76	0.07
Aug-12	303	30.755	81.665	3.27	26.92	0.08
Sep-12	303	30.755	81.665	2.98	26.06	0.11
Oct-12	303	30.755	81.665	4.9	22.6	0.69
Nov-12	303	30.755	81.665	7.35	17.89	3.64
Dec-12	303	30.755	81.665	6.7	16.59	7.74

Table XXX
CRD Monitoring Data
Stations 302 - 306
2010-2012

DateCollected	StationID	Latitude	Longitude	O (mg/	Temp	Salinity
Jan-10	304	30.742	81.653	8.4	11.9	0.57
Mar-10	304	30.742	81.653	7.6	15.9	0.63
May-10	304	30.742	81.653	6.8	25.8	13.3
Dec-11	304	30.742	81.653	6.7	17.7	18.2
Jan-12	304	30.742	81.653	7.2	14	15.5
Feb-12	304	30.742	81.653	7.5	16.8	19.5
Mar-12	304	30.742	81.653	6.7	20	10.1
Apr-12	304	30.742	81.653	5.98	22.1	14.55
May-12	304	30.742	81.653	4.3	25.7	15.1
Jun-12	304	30.742	81.653	4.03	24	0.1
Aug-12	304	30.742	81.653	3.48	27	0.12
Sep-12	304	30.742	81.653	3.15	26.32	0.7
Oct-12	304	30.742	81.653	5.1	22.7	1.4
Nov-12	304	30.742	81.653	6.97	17.76	6.4
Dec-12	304	30.742	81.653	6.82	16.62	11.79
DateCollected	StationID	Latitude	Longitude	O (mg/	Temp	Salinity
Jan-10	305	30.728	81.643	8.6	11.8	1.73
Mar-10	305	30.728	81.643	7.6	16	0.074
May-10	305	30.728	81.643	6.3	25.8	14.2
Dec-11	305	30.728	81.643	6.7	17.6	20
Jan-12	305	30.728	81.643	7.2	14	17.4
Feb-12	305	30.728	81.643	9.5	16.7	21.3
Mar-12	305	30.728	81.643	6.8	19.8	13.3
Apr-12	305	30.728	81.643	6.41	22.26	16.88
May-12	305	30.728	81.643	4.2	25.6	16.8
Jun-12	305	30.728	81.643	4.08	24.77	0.41
Aug-12	305	30.728	81.643	3.86	27.1	0.17
Sep-12	305	30.728	81.643	3.44	26.39	0.37
Oct-12	305	30.728	81.643	5.21	22.8	2.06
Nov-12	305	30.728	81.643	6.99	17.65	7.19
Dec-12	305	30.728	81.643	6.8	16.52	14.31
DateCollected	StationID	Latitude	Longitude	O (mg/	Temp	Salinity
Jan-10	306	30.724	81.619	8.5	11.6	5.8
Mar-10	306	30.724	81.619	7.9	16.1	2.4
May-10	306	30.724	81.619	6.9	25.7	18.9
Dec-11	306	30.724	81.619	6.3	17.6	23.8
Jan-12	306	30.724	81.619	7.2	14	22
Feb-12	306	30.724	81.619	7.3	16.6	25.6
Mar-12	306	30.724	81.619	6.7	19.7	18.2
Apr-12	306	30.724	81.619	5.87	22.15	20.95
May-12	306	30.724	81.619	4.6	25.6	20.6
Jun-12	306	30.724	81.619	4.31	24.32	0.11
Jul-12	306	30.724	81.619	2.08	30.25	2.06
Aug-12	306	30.724	81.619	3.75	27.22	0.43
Sep-12	306	30.724	81.619	3.77	26.48	1.17
Oct-12	306	30.724	81.619	5.4	22.9	5.2
Nov-12	306	30.724	81.619	7.09	17.55	12.45

APPENDIX F

2010 305(b)/303(d) List of Waters

Reach Name	Evaluation	Violations	Cause	Basin
St. Marys River	Not Supporting	DO	UR	St Marys

Reach Location	Extent	Category	Reach ID	Data Source
Catfish Creek to Millers Branch	6	4a	R030702040405	55

2010 no change.
Changed water type to Coastal Stream in 2008.
#08011021 2003 T 0/10, DO 2/10; pH 7/10; FC 0/2 gm (limited data Jan - June). CRD data 303, 304, 305 (River).
CRD 303 (04-09) DO 11/63 = 17%
2004: pH 6/12; DO 5/12; T 0/12
2005: pH 9/11; DO 3/11; T 0/11
2006: pH 4/12; DO, T 0/12
2007: pH 3/12; DO 2/12; T 0/12
2008: pH 1/11; DO 1/12; T 0/12
2009: pH, DO, T 0/4
CRD 304 (04-09): DO 9/63 = 14%
2004: pH, DO 4/12; T 0/12
2005: pH 7/11; DO 2/11; T 0/11
2006: pH 3/12; DO, T 0/12
2007: pH, DO 2/12; T 0/12
2008: pH, DO 1/12; T 0/12
2009: pH, DO, T 0/4
CRD 305 (04-09) DO 8/62 = 13%
2004: pH, DO 4/12; T 0/12
2005: pH 7/11; DO 2/11; T 0/11
2006: pH 4/12; DO, T 0/12
2007: pH 2/12; DO 1/12; T 0/12
2008: pH 1/10; DO 1/11; T 0/11
2009: pH, DO, T 0/4
DO TMDL 2005
Blackwater stream (cross hatch State Map 75-j (mix)).

St Marys River (Catfish Creek - Millers Branch)

StationID	DateCollected	Time	Latitude	Longitude	Sound	County	pH	pH < 6	pH > 8.5	DO	DO <4	Temp	T > 32.2	Salinity
303	2/11/2009	12:35	30.76	81.67	Cumberland	Camden	7.8			8.9		12.6		12.2
303	3/12/2009	12:01	30.76	81.67	Cumberland	Camden	7.1			7.7		17.6		9.9
303	4/23/2009	10:38	30.76	81.67	Cumberland	Camden	6.3			6.1		20.4		0.14
303	5/7/2009	10:55	30.76	81.67	Cumberland	Camden	6.45			5.3		25.31		3.46
303	6/10/2009	11:44	30.76	81.67	Cumberland	Camden	5.6	5.6		3.5	3.5	25.6		0.04
303	7/17/2009	11:28	30.76	81.67	Cumberland	Camden	6.3			3.6	3.6	28.5		0.08
303	9/4/2009	10:42	30.76	81.67	Cumberland	Camden	5.6	5.6		4.9		25.7		0.09
303	11/18/2009	13:25	30.76	81.67	Cumberland	Camden	7.3			6.8		19.33		20.8
303	1/22/2010	11:17	30.76	81.67	Cumberland	Camden	6.9			8.4		11.7		0.25
303	3/25/2010	14:04	30.76	81.67	Cumberland	Camden	6.5			7.5		16.2		0.17
303	5/12/2010	12:38	30.76	81.67	Cumberland	Camden	7			6.3		26		9.8

St Marys River (Catfish Creek-Millers Branch)

StationID	DateCollected	Time	Latitude	Longitude	Sound	County	pH	pH < 6	pH > 8.5	DO	DO <4	Temp	T > 32.2	Salinity
304	2/11/2009	12:42	30.74	81.65	Cumberland	Camden	8			8.8		12.8		15.4
304	3/12/2009	12:06	30.74	81.65	Cumberland	Camden	7.3			7.7		17.9		13.6
304	4/23/2009	10:43	30.74	81.65	Cumberland	Camden	6.4			6.3		20.4		0.21
304	5/7/2009	11:00	30.74	81.65	Cumberland	Camden	6.42			5.5		25.17		6.28
304	6/10/2009	11:50	30.74	81.65	Cumberland	Camden	5.7	5.7		3.5	3.5	25.9		0.06
304	7/17/2009	11:33	30.74	81.65	Cumberland	Camden	6.4			4.1		28.7		0.16
304	9/4/2009	10:49	30.74	81.65	Cumberland	Camden	5.8	5.8		5		25.7		0.18
304	11/18/2009	13:33	30.74	81.65	Cumberland	Camden	7.2			6.4		19.29		22.8
304	1/22/2010	11:24	30.74	81.65	Cumberland	Camden	6.7			8.4		11.9		0.57
304	3/25/2010	14:08	30.74	81.65	Cumberland	Camden	6.3			7.6		15.9		0.63
304	5/12/2010	12:43	30.74	81.65	Cumberland	Camden	7.2			6.8		25.8		13.3

St. Marys River (Catfish Creek - Miles Branch)

StationID	DateCollected	Time	Latitude	Longitude	Sound	County	pH	pH < 6	pH > 8.5	DO	DO <4	Temp	T > 32.2	Salinity
305	2/11/2009	12:48	30.73	81.64	Cumberland	Camden	8			8.7		12.6		17.5
305	3/12/2009	12:11	30.73	81.64	Cumberland	Camden	7.4			7.5		17.6		16
305	4/23/2009	10:50	30.73	81.64	Cumberland	Camden	6.4			6.3		20.5		0.23
305	5/7/2009	11:07	30.73	81.64	Cumberland	Camden	6.55			5.2		25.4		6.13
305	6/10/2009	11:55	30.73	81.64	Cumberland	Camden	5.7	5.7		3.9	3.9	26		0.06
305	7/17/2009	11:37	30.73	81.64	Cumberland	Camden	6.4			4		28.8		0.47
305	9/4/2009	10:54	30.73	81.64	Cumberland	Camden	5.8	5.8		5		25.8		0.26
305	11/18/2009	13:37	30.73	81.64	Cumberland	Camden	7.2			6.4		19.43		23.9
305	1/22/2010	11:28	30.73	81.64	Cumberland	Camden	6.6			8.6		11.8		1.73
305	3/25/2010	14:13	30.73	81.64	Cumberland	Camden	6.4			7.6		16		0.074
305	5/12/2010	12:48	30.73	81.64	Cumberland	Camden	7.2			6.3		25.8		14.2

St. Marys River (Catfish Creek-Millers Branch)

DateCollected	StationID	Time	TideCode	Latitude	Longitude	Sound	County	pH	pH<6	pH>8.5	DO	DO<4	Temp	T>32.2
5/7/2009	303	10:55	1	30.76	81.67	Cumberland	Camden	6.45			5.31		25.31	
4/23/2009	303	10:38	3	30.76	81.67	Cumberland	Camden	6.3			6.1		20.4	
3/12/2009	303	12:01	2	30.76	81.67	Cumberland	Camden	7.1			7.7		17.6	
2/11/2009	303	12:35	2	30.76	81.67	Cumberland	Camden	7.8			8.9		12.6	
12/14/2008	303	2:02	2	30.76	81.67	Cumberland	Camden	7.2			8.7		15.1	
11/10/2008	303	12:00	7	30.76	81.67	Cumberland	Camden	6.7			7.2		17.67	
10/27/2008	303	11:45	1	30.76	81.67	Cumberland	Camden	7.3			6.2		20.6	
9/10/2008	303	12:19		30.76	81.67	Cumberland	Camden	5.13	5.13		0.75	0.75	27.5	
8/7/2008	303	12:07	6	30.76	81.67	Cumberland	Camden	6.2			4.4		30	
7/8/2008	303	11:54	6	30.76	81.67	Cumberland	Camden				5.6		28.6	
6/4/2008	303	12:34	1	30.76	81.67	Cumberland	Camden	6.5			4.5		28.2	
5/21/2008	303	12:34	3	30.76	81.67	Cumberland	Camden	7.3			5.5		25.2	
4/9/2008	303	12:36	2	30.76	81.67	Cumberland	Camden	6.9			5.8		20.5	
3/5/2008	303	12:01	8	30.76	81.67	Cumberland	Camden	6			6.8		16.3	
2/8/2008	303	12:57	3	30.76	81.67	Cumberland	Camden	6.7			7.6		15.6	
1/11/2008	303	10:51	2	30.76	81.67	Cumberland	Camden	6.5			7.5		14.7	
12/12/2007	303	11:37	2	30.76	81.67	Cumberland	Camden	7			8.1		18	
11/20/2007	303	10:24	8	30.76	81.67	Cumberland	Camden	5.9	5.9		5.95		16.42	
10/31/2007	303	11:43		30.76	81.67	Cumberland	Camden	5.3	5.3		4.1		20.7	
9/7/2007	303	12:22	3	30.76	81.67	Cumberland	Camden	6			3.3	3.3	28.3	
8/15/2007	303	12:12	2	30.76	81.67	Cumberland	Camden	5.7	5.7		2.4	2.4	30.4	
7/2/2007	303	12:12		30.76	81.67	Cumberland	Camden	7			5		29.4	
6/8/2007	303	12:02	8	30.76	81.67	Cumberland	Camden	7.1			6.2		26.5	
5/4/2007	303	12:05	4	30.76	81.67	Cumberland	Camden	7.2			5.2		24	
4/20/2007	303	12:14	2	30.76	81.67	Cumberland	Camden	7.2			5.2		19.7	
3/7/2007	303	12:30	1	30.76	81.67	Cumberland	Camden	7.2			7.5		16.2	
2/7/2007	303	11:27	5	30.76	81.67	Cumberland	Camden	7			8.8		12.8	
1/12/2007	303	12:10	7	30.76	81.67	Cumberland	Camden	7.1			7		17.5	

St Marys River (Catfish Creek - Miller's Branch)

DateCollected	StationID	Time	TideCode	Latitude	Longitude	Sound	County	pH	pH<6	pH>8.5	DO	DO<4	Temp	T>32.2
5/7/2009	304	11:00	1	30.74	81.65	Cumberland	Camden	6.42			5.52		25.17	
4/23/2009	304	10:43	3	30.74	81.65	Cumberland	Camden	6.4			6.3		20.4	
3/12/2009	304	12:06	2	30.74	81.65	Cumberland	Camden	7.3			7.7		17.9	
2/11/2009	304	12:42	1	30.74	81.65	Cumberland	Camden	8			8.8		12.8	
12/14/2008	304	2:06	2	30.74	81.65	Cumberland	Camden	7.3			8.6		15.1	
11/10/2008	304	12:04	7	30.74	81.65	Cumberland	Camden	6.9			7.2		17.62	
10/27/2008	304	11:53	1	30.74	81.65	Cumberland	Camden	7			6		20.7	
9/10/2008	304	12:28		30.74	81.65	Cumberland	Camden	5.17	5.17		1.5	1.5	27.9	
8/7/2008	304	12:12	6	30.74	81.65	Cumberland	Camden	6.3			4.1		30.1	
7/8/2008	304	11:59	4	30.74	81.65	Cumberland	Camden				5.3		28.9	
6/4/2008	304	12:40	1	30.74	81.65	Cumberland	Camden	6.7			4.5		27.7	
5/21/2008	304	12:44	3	30.74	81.65	Cumberland	Camden							
4/9/2008	304	12:43	2	30.74	81.65	Cumberland	Camden	7.1			5.8		20.7	
3/5/2008	304	12:07	8	30.74	81.65	Cumberland	Camden	6.2			6.6		16.6	
2/8/2008	304	13:06	3	30.74	81.65	Cumberland	Camden	6.8			7.8		15.5	
1/11/2008	304	11:00	2	30.74	81.65	Cumberland	Camden	6.6			7.5		14.9	
12/12/2007	304	11:41	2	30.74	81.65	Cumberland	Camden	7.1			7.6		18.3	
11/20/2007	304	10:31	8	30.74	81.65	Cumberland	Camden	6.1			6.36		16.43	
10/31/2007	304	11:48		30.74	81.65	Cumberland	Camden	5.5	5.5		5.3		20.9	
9/7/2007	304	12:27	5	30.74	81.65	Cumberland	Camden	6.2			3.5	3.5	28.3	
8/15/2007	304	12:22	2	30.74	81.65	Cumberland	Camden	5.9	5.9		2.8	2.8	30.7	
7/2/2007	304	12:17		30.74	81.65	Cumberland	Camden	7			4.4		29.5	
6/8/2007	304	12:06	7	30.74	81.65	Cumberland	Camden	7.1			6		26.6	
5/4/2007	304	12:11	4	30.74	81.65	Cumberland	Camden	7.3			5.3		24.7	
4/20/2007	304	12:19	2	30.74	81.65	Cumberland	Camden	7.3			5.1		19.6	
3/7/2007	304	12:36	1	30.74	81.65	Cumberland	Camden	7.3			7.6		16.6	
2/7/2007	304	11:35	5	30.74	81.65	Cumberland	Camden	7			7.8		13	
1/12/2007	304	12:17	7	30.74	81.65	Cumberland	Camden	7.2			6.8		17.1	

St. Marys River (Catfish Creek- Miles Branch)

DateCollected	StationID	Time	TideCode	Latitude	Longitude	Sound	County	pH	pH<6	pH>8.5	DO	DO<4	Temp	T>32.2
5/7/2009	305	11:07	3	30.73	81.64	Cumberland	Camden	6.55			5.18		25.4	
4/23/2009	305	10:50	3	30.73	81.64	Cumberland	Camden	6.4			6.3		20.5	
3/12/2009	305	12:11	2	30.73	81.64	Cumberland	Camden	7.4			7.5		17.6	
2/11/2009	305	12:48	1	30.73	81.64	Cumberland	Camden	8			8.7		12.6	
12/14/2008	305	2:12	2	30.73	81.64	Cumberland	Camden	7.4			8.7		15.1	
11/10/2008	305	12:08	7	30.73	81.64	Cumberland	Camden	7.1			7.2		16.8	
10/27/2008	305	11:59	1	30.73	81.64	Cumberland	Camden	7.2			6.4		20.6	
9/10/2008	305	12:37		30.73	81.64	Cumberland	Camden	5.4	5.4		1.35	1.35	27.4	
8/7/2008	305	12:17	6	30.73	81.64	Cumberland	Camden	6.4			4.5		30.1	
7/8/2008	305	12:07	4	30.73	81.64	Cumberland	Camden				5.3		28.7	
6/4/2008	305	12:45	1	30.73	81.64	Cumberland	Camden	6.8			4.5		28	
5/21/2008	305	12:51	3	30.73	81.64	Cumberland	Camden							
4/9/2008	305	12:47	2	30.73	81.64	Cumberland	Camden	7.1			5.9		20.5	
3/5/2008	305	12:15	8	30.73	81.64	Cumberland	Camden	6.3			6.6		16.8	
2/8/2008	305	13:11	3	30.73	81.64	Cumberland	Camden	7			7.5		15.8	
1/11/2008	305	11:05	2	30.73	81.64	Cumberland	Camden	6.7			7.6		14.8	
12/12/2007	305	11:48	1	30.73	81.64	Cumberland	Camden	7.3			7.8		18	
11/20/2007	305	10:36	8	30.73	81.64	Cumberland	Camden	5.9	5.9		6.32		15.3	
10/31/2007	305	11:53		30.73	81.64	Cumberland	Camden	5.7	5.7		4.7		21.1	
9/7/2007	305	12:31	5	30.73	81.64	Cumberland	Camden	6.4			4.1		28.1	
8/15/2007	305	12:27	2	30.73	81.64	Cumberland	Camden	6			3.3	3.3	30.5	
7/2/2007	305	12:21		30.73	81.64	Cumberland	Camden	7			4.6		29.4	
6/8/2007	305	12:10	7	30.73	81.64	Cumberland	Camden	7.1			6		26.6	
5/4/2007	305	12:17	2	30.73	81.64	Cumberland	Camden	7.3			5.1		24	
4/20/2007	305	12:25	2	30.73	81.64	Cumberland	Camden	7.4			5.2		19.6	
3/7/2007	305	12:41	1	30.73	81.64	Cumberland	Camden	7.3			7.2		16.1	
2/7/2007	305	11:40	5	30.73	81.64	Cumberland	Camden	7.2			8.4		12.9	
1/12/2007	305	12:22	6	30.73	81.64	Cumberland	Camden	7.3			6.7		17.2	

303-305

St Marys R. or (Catfish Creek - Miller Br)

DateCollected	StationID	Latitude	Longitude	Sound	County	pH	pH 6	pH 8.5	DO(mg/l)	DO 4	Temp©	T 32.2	Time
4/22/2002	302	30.74700	81.70000	Cumberland	Camden				4.22		25.2		9:55 AM
4/16/2002	302	30.74700	81.70000	Cumberland	Camden				4.79		23.2		1:58 PM
3/31/2002	302	30.74700	81.70000	Cumberland	Camden				4.21		22.9		4:45 PM
3/16/2002	302	30.74700	81.70000	Cumberland	Camden				5.2		21.1		1:45 PM
3/4/2002	302	30.74700	81.70000	Cumberland	Camden				6.25		14.8		3:30 PM
2/13/2002	302	30.74700	81.70000	Cumberland	Camden				7.24		15.3		2:33 PM
1/31/2002	302	30.74700	81.70000	Cumberland	Camden				7.68		17.2		3:05 PM
12/11/2006	303	30.75500	81.66500	Cumberland	Camden	7.7			7.2		14.4		11:15 AM
11/3/2006	303	30.75500	81.66500	Cumberland	Camden	7			6.1		20.5		11:33 AM
10/19/2006	303	30.75500	81.66500	Cumberland	Camden	7.3			4.9		23.2		12:47 PM
9/18/2006	303	30.75500	81.66500	Cumberland	Camden	7			4.6		27.3		11:44 AM
8/4/2006	303	30.75500	81.66500	Cumberland	Camden	7			5		31.4		12:12 PM
7/19/2006	303	30.75500	81.66500	Cumberland	Camden	6.7			4.4		30.1		12:07 PM
6/15/2006	303	30.75500	81.66500	Cumberland	Camden	4.1	4.1		7.1		27.8		11:20 AM
5/3/2006	303	30.75500	81.66500	Cumberland	Camden	7.2			7.5		23.5		12:48 PM
4/7/2006	303	30.75500	81.66500	Cumberland	Camden	6.7			7.3		21.5		12:00 PM
3/10/2006	303	30.75500	81.66500	Cumberland	Camden	5.8	5.8		8.1		16.9		12:01 PM
2/17/2006	303	30.75500	81.66500	Cumberland	Camden	4.4	4.4		7.8		11.4		11:25 AM
1/6/2006	303	30.75500	81.66500	Cumberland	Camden	5.2	5.2		7.6		14.7		11:13 AM
12/12/2005	303	30.75500	81.66500	Cumberland	Camden	7.2			8.4		14.1		11:02 AM
11/4/2005	303	30.75500	81.66500	Cumberland	Camden	5.9	5.9		6.8		19.8		11:14 AM
10/28/2005	303	30.75500	81.66500	Cumberland	Camden	5.5	5.5		5.4		20.1		12:09 PM
9/23/2005	303	30.75500	81.66500	Cumberland	Camden	5.8	5.8		3.8	3.8	28		11:29 AM
8/26/2005	303	30.75500	81.66500	Cumberland	Camden	4.7	4.7		3.5	3.5	29.3		10:55 AM
7/15/2005	303	30.75500	81.66500	Cumberland	Camden	4.7	4.7		2.9	2.9	28.3		12:15 PM
6/23/2005	303	30.75500	81.66500	Cumberland	Camden	6.2			4.8		28.9		2:23 PM
5/9/2005	303	30.75500	81.66500	Cumberland	Camden	5.3	5.3		5.5		22		1:11 PM
4/4/2005	303	30.75500	81.66500	Cumberland	Camden	5.2	5.2		5.3		18.6		1:51 PM
3/3/2005	303	30.75500	81.66500	Cumberland	Camden	5.2	5.2		7.9		13.6		11:21 AM
1/7/2005	303	30.75500	81.66500	Cumberland	Camden	5.7	5.7		7.4		13.1		12:00 PM
12/6/2004	303	30.75500	81.66500	Cumberland	Camden	5.8	5.8		6.4		10.4		12:56 PM
11/6/2004	303	30.75500	81.66500	Cumberland	Camden	4.6	4.6		3.5	3.5	23		10:10 AM
10/19/2004	303	30.75500	81.66500	Cumberland	Camden	4.45	4.45		2.57	2.57	22.47		1:11 PM
9/22/2004	303	30.75500	81.66500	Cumberland	Camden	4.42	4.42		3.23	3.23	23.97		1:39 PM

✓ 303 summary

	pH	DO	T
2006	4/12	9/12	0/12
2005	9/11	3/11	0/11
2004	6/12	5/12	0/12
2003	0/0	7/12	0/12
2002	0/0	2/17	0/17

(02-06) pH 19/35 = 54%
DO 17/64 = 27%
T 0/64 = 0%

DateCollected	StationID	Latitude	Longitude	Sound	County	pH	pH 6	pH 8.5	DO(mg/l)	DO 4	Temp©	T 32.2	Time
8/4/2004	303	30.75500	81.66500	Cumberland	Camden	5.7	5.7		3.9	3.9	29.7		12:08 PM
7/9/2004	303	30.75500	81.66500	Cumberland	Camden	5.9	5.9		3.3	3.3	29		10:54 AM
6/3/2004	303	30.75500	81.66500	Cumberland	Camden	7.1			4.8		28.8		1:20 PM
5/6/2004	303	30.75500	81.66500	Cumberland	Camden	6.95			5.8		23.3		11:08 AM
4/7/2004	303	30.75500	81.66500	Cumberland	Camden	6.9			6.45		18.37		11:23 AM
3/3/2004	303	30.75500	81.66500	Cumberland	Camden	6.2			7.6		13.19		1:05 PM
2/6/2004	303	30.75500	81.66500	Cumberland	Camden	7.3			7.77		13.1		11:19 AM
1/21/2004	303	30.75500	81.66500	Cumberland	Camden	7.1			7.84		11.86		12:37 PM
12/8/2003	303	30.75500	81.66500	Cumberland	Camden				5.9		14.6		1:50 PM
11/12/2003	303	30.75500	81.66500	Cumberland	Camden				5.08		21.5		11:30 AM
10/17/2003	303	30.75500	81.66500	Cumberland	Camden				4.33		23.19		1:56 PM
9/5/2003	303	30.75500	81.66500	Cumberland	Camden				2.32	2.32	28.54		10:50 AM
8/8/2003	303	30.75500	81.66500	Cumberland	Camden				3.19	3.19	26.38		11:48 AM
7/31/2003	303	30.75500	81.66500	Cumberland	Camden				2.03	2.03	28.13		2:06 PM
6/19/2003	303	30.75500	81.66500	Cumberland	Camden				2.35	2.35	27.25		10:47 AM
5/20/2003	303	30.75500	81.66500	Cumberland	Camden				3.54	3.54	26.91		9:53 AM
4/23/2003	303	30.75500	81.66500	Cumberland	Camden				3.71	3.71	23.22		12:35 PM
3/26/2003	303	30.75500	81.66500	Cumberland	Camden				3.5	3.5	20.04		10:33 AM
2/12/2003	303	30.75500	81.66500	Cumberland	Camden				6.55		11.4		11:01 AM
1/23/2003	303	30.75500	81.66500	Cumberland	Camden				7.84		9.9		11:56 AM
12/6/2002	303	30.75500	81.66500	Cumberland	Camden				7.37		13.17		11:02 AM
11/22/2002	303	30.75500	81.66500	Cumberland	Camden				7.14		17.06		11:01 AM
10/25/2002	303	30.75500	81.66500	Cumberland	Camden				4.74		22.96		10:05 AM
9/24/2002	303	30.75500	81.66500	Cumberland	Camden				4.4		28.28		3:15 PM
8/15/2002	303	30.75500	81.66500	Cumberland	Camden				5.02		27.56		10:40 AM
7/26/2002	303	30.75500	81.66500	Cumberland	Camden				4.08		29.6		10:31 AM
6/25/2002	303	30.75500	81.66500	Cumberland	Camden				3.84	3.84	26.8		11:29 AM
6/13/2002	303	30.75500	81.66500	Cumberland	Camden				3.68	3.68	28		1:00 PM
5/27/2002	303	30.75500	81.66500	Cumberland	Camden				4.94		24.1		12:47 PM
5/14/2002	303	30.75500	81.66500	Cumberland	Camden				5.07		27.5		2:57 PM
4/22/2002	303	30.75500	81.66500	Cumberland	Camden				4.8		25.6		10:07 AM
4/16/2002	303	30.75500	81.66500	Cumberland	Camden				5.17		23.6		2:41 PM
3/31/2002	303	30.75500	81.66500	Cumberland	Camden				4.8		22.7		4:57 PM
3/16/2002	303	30.75500	81.66500	Cumberland	Camden				5.58		20.9		2:20 PM

DateCollected	StationID	Latitude	Longitude	Sound	County	pH	pH 6	pH 8.5	DO(mg/l)	DO 4	Temp©	T 32.2	Time
3/4/2002	303	30.75500	81.66500	Cumberland	Camden				6.59		14.8		3:41 PM
2/13/2002	303	30.75500	81.66500	Cumberland	Camden				7.52		15.1		2:45 PM
1/31/2002	303	30.75500	81.66500	Cumberland	Camden				7.35		17.8		3:18 PM
12/11/2006	304	30.74200	81.65300	Cumberland	Camden	7.6			6.8		14.4		11:24 AM
11/3/2006	304	30.74200	81.65300	Cumberland	Camden	7.3			6.2		20.7		11:40 AM
10/19/2006	304	30.74200	81.65300	Cumberland	Camden	7.3			4.6		23.2		12:55 PM
9/18/2006	304	30.74200	81.65300	Cumberland	Camden	7.1			5.3		27.4		11:48 AM
8/4/2006	304	30.74200	81.65300	Cumberland	Camden	7.1			5.8		31.5		12:19 PM
7/19/2006	304	30.74200	81.65300	Cumberland	Camden	6.8			4.3		30.4		12:15 PM
6/15/2006	304	30.74200	81.65300	Cumberland	Camden	4.3	4.3		7		27.8		11:21 AM
5/3/2006	304	30.74200	81.65300	Cumberland	Camden	6.4			7		23.6		12:53 PM
4/7/2006	304	30.74200	81.65300	Cumberland	Camden	6.9			7		21.6		12:07 PM
3/10/2006	304	30.74200	81.65300	Cumberland	Camden	6			8.2		16.9		12:09 PM
2/17/2006	304	30.74200	81.65300	Cumberland	Camden	4.5	4.5		7.7		11.6		11:39 AM
1/6/2006	304	30.74200	81.65300	Cumberland	Camden	5.1	5.1		6.8		14.7		11:21 AM
12/12/2005	304	30.74200	81.65300	Cumberland	Camden	6.6			8.4		14.4		11:16 AM
11/4/2005	304	30.74200	81.65300	Cumberland	Camden	6			6.9		20.4		11:22 AM
10/28/2005	304	30.74200	81.65300	Cumberland	Camden	5.5	5.5		5.4		20		12:19 PM
9/23/2005	304	30.74200	81.65300	Cumberland	Camden	6			4.4		28.1		11:23 AM
8/26/2005	304	30.74200	81.65300	Cumberland	Camden	5	5		3.9	3.9	29.3		11:02 AM
7/15/2005	304	30.74200	81.65300	Cumberland	Camden	4.8	4.8		2.9	2.9	28.6		12:20 PM
6/23/2005	304	30.74200	81.65300	Cumberland	Camden	6.4			4.8		28.8		2:29 PM
5/9/2005	304	30.74200	81.65300	Cumberland	Camden	5.6	5.6		5.7		22.7		1:17 PM
4/4/2005	304	30.74200	81.65300	Cumberland	Camden	5.1	5.1		4.9		18.9		2:04 PM
3/3/2005	304	30.74200	81.65300	Cumberland	Camden	5.2	5.2		7.1		13.8		11:35 AM
1/7/2005	304	30.74200	81.65300	Cumberland	Camden	5.7	5.7		7.1		13.2		12:10 PM
12/6/2004	304	30.74200	81.65300	Cumberland	Camden	5.7	5.7		6.1		16.8		1:03 PM
11/6/2004	304	30.74200	81.65300	Cumberland	Camden	4.8	4.8		3.8	3.8	23.1		10:23 AM
10/19/2004	304	30.74200	81.65300	Cumberland	Camden	3.94	3.94		2.9	2.9	22.63		1:24 PM
9/22/2004	304	30.74200	81.65300	Cumberland	Camden	4.54	4.54		3.29	3.29	24.68		1:52 PM
8/4/2004	304	30.74200	81.65300	Cumberland	Camden	6.1			4.4		29.7		12:40 PM
7/9/2004	304	30.74200	81.65300	Cumberland	Camden	6.1			3.5	3.5	29.4		11:04 AM
6/3/2004	304	30.74200	81.65300	Cumberland	Camden	7.1			4.5		28.4		1:30 PM
5/6/2004	304	30.74200	81.65300	Cumberland	Camden	7.1			5.7		23.07		11:13 AM

✓ 304 summary

	pH	DO	T
2006	3/12	0/12	0/12
2005	7/11	2/11	0/11
2004	4/12	4/12	0/12
2003	0/0	4/12	0/12
2002	0/0	2/17	0/17

(02-06) pH 14/35 = 40%
DO 14/64 = 22%
T 0/64 = 0%

DateCollected	StationID	Latitude	Longitude	Sound	County	pH	pH 6	pH 8.5	DO(mg/l)	DO 4	Temp©	T 32.2	Time
4/7/2004	304	30.74200	81.65300	Cumberland	Camden	7.1			6.32		18.27		11:34 AM
3/3/2004	304	30.74200	81.65300	Cumberland	Camden	6.4			7.6		13.53		1:12 PM
2/6/2004	304	30.74200	81.65300	Cumberland	Camden	7.4			7.77		13.4		11:27 AM
1/21/2004	304	30.74200	81.65300	Cumberland	Camden	7.3			7.3		12.12		12:46 PM
12/8/2003	304	30.74200	81.65300	Cumberland	Camden				5.8		14.6		1:58 PM
11/12/2003	304	30.74200	81.65300	Cumberland	Camden				5.05		21.5		11:41 AM
10/17/2003	304	30.74200	81.65300	Cumberland	Camden				4.52		23.25		2:03 PM
9/5/2003	304	30.74200	81.65300	Cumberland	Camden				2.45	2.45	28.66		11:00 AM
8/8/2003	304	30.74200	81.65300	Cumberland	Camden				3.26	3.26	26.7		12:15 PM
7/31/2003	304	30.74200	81.65300	Cumberland	Camden				1.91	1.91	28.17		2:16 PM
6/19/2003	304	30.74200	81.65300	Cumberland	Camden				2.31	2.31	27.53		10:45 AM
5/20/2003	304	30.74200	81.65300	Cumberland	Camden				3.95		26.74		10:01 AM
4/23/2003	304	30.74200	81.65300	Cumberland	Camden				3.51	3.51	22.82		12:40 PM
3/26/2003	304	30.74200	81.65300	Cumberland	Camden				3.53	3.53	20.14		10:44 AM
2/12/2003	304	30.74200	81.65300	Cumberland	Camden				6.77		11.5		11:10 AM
1/23/2003	304	30.74200	81.65300	Cumberland	Camden				7.05		9.92		11:09 AM
12/6/2002	304	30.74200	81.65300	Cumberland	Camden				6.62		13.24		11:20 AM
11/22/2002	304	30.74200	81.65300	Cumberland	Camden				6.18		17.32		11:13 AM
10/25/2002	304	30.74200	81.65300	Cumberland	Camden				4.64		22.98		10:17 AM
9/24/2002	304	30.74200	81.65300	Cumberland	Camden				5.72		28.55		2:20 PM
8/15/2002	304	30.74200	81.65300	Cumberland	Camden				5.18		27.86		10:49 AM
7/26/2002	304	30.74200	81.65300	Cumberland	Camden				3.77	3.77	29.7		10:24 AM
6/25/2002	304	30.74200	81.65300	Cumberland	Camden				3.74	3.74	26.8		11:34 AM
6/13/2002	304	30.74200	81.65300	Cumberland	Camden				3.97		28.3		1:05 PM
5/27/2002	304	30.74200	81.65300	Cumberland	Camden				5.4		24.1		12:52 PM
5/14/2002	304	30.74200	81.65300	Cumberland	Camden				4.79		27		3:02 PM
4/22/2002	304	30.74200	81.65300	Cumberland	Camden				5.11		25.7		10:12 AM
4/16/2002	304	30.74200	81.65300	Cumberland	Camden				5.3		23		2:48 PM
3/31/2002	304	30.74200	81.65300	Cumberland	Camden				4.96		22.7		5:04 PM
3/16/2002	304	30.74200	81.65300	Cumberland	Camden				5.42		20.7		2:26 PM
3/4/2002	304	30.74200	81.65300	Cumberland	Camden				6.8		14.9		3:46 PM
2/13/2002	304	30.74200	81.65300	Cumberland	Camden				6.9		15.1		2:50 PM
1/31/2002	304	30.74200	81.65300	Cumberland	Camden				7.16		17.8		3:24 PM
12/11/2006	305	30.72800	81.64300	Cumberland	Camden	7.6			6.9		14.3		11:29 AM

305 summary

	pH	DO	T
2006	4/12	0/12	0/12
2005	7/11	7/11	0/11
2004	4/12	4/12	0/12
2003	0/0	7/12	0/12
2002	0/6	2/17	0/17

(02-06) pH 15/35 = 43%
DO 15/64 = 23%
T 0/64 = 0%

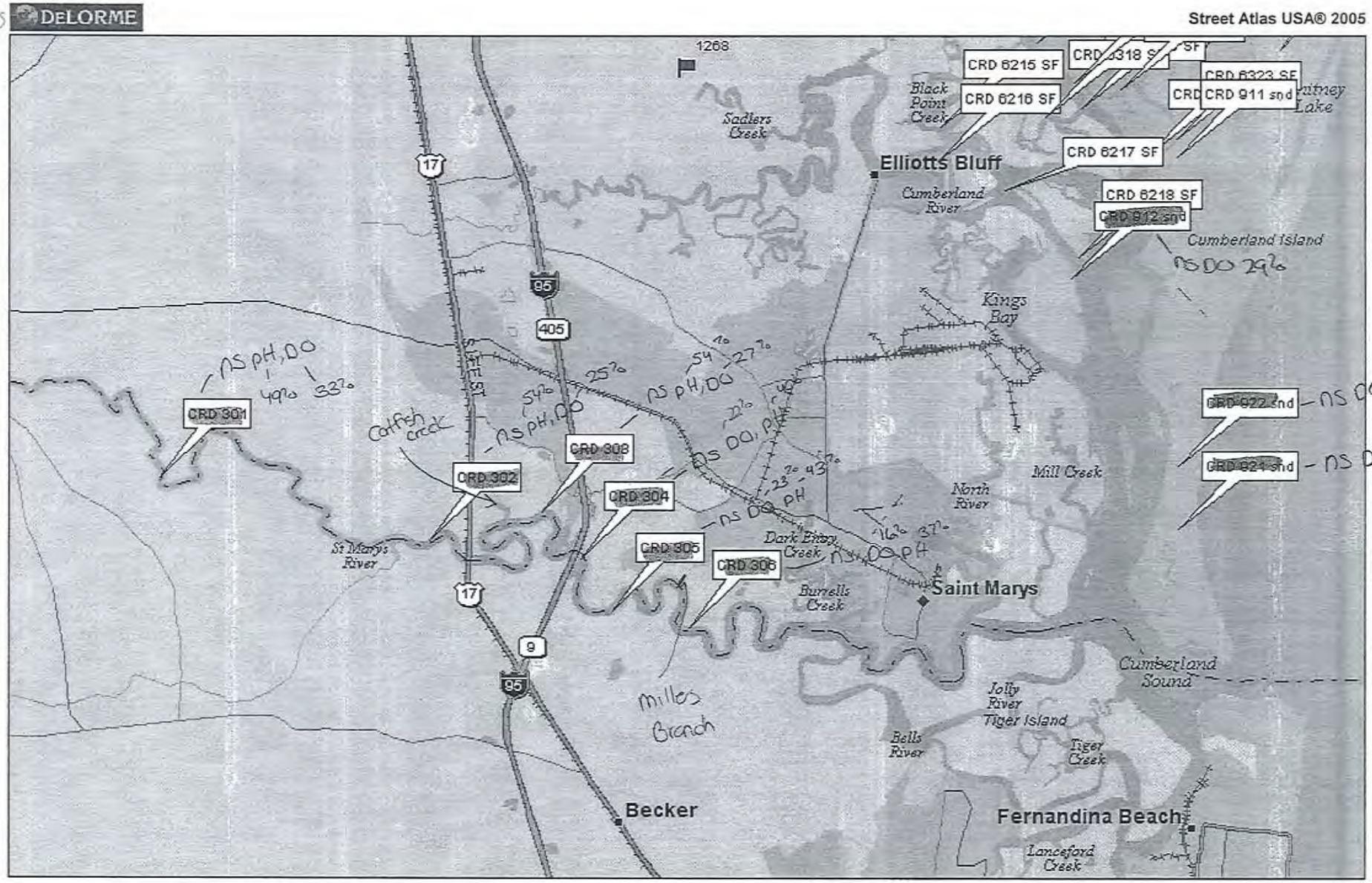
DateCollected	StationID	Latitude	Longitude	Sound	County	pH	pH 6	pH 8.5	DO (mg/l)	DO 4	Temp©	T 32.2	Time
11/3/2006	305	30.72800	81.64300	Cumberland	Camden	7.3			6.4		20.3		11:45 AM
10/19/2006	305	30.72800	81.64300	Cumberland	Camden	7.2			4.5		23.4		1:00 PM
9/18/2006	305	30.72800	81.64300	Cumberland	Camden	7.1			5.1		27.1		11:53 AM
8/4/2006	305	30.72800	81.64300	Cumberland	Camden	7.1			5		31.3		12:24 PM
7/19/2006	305	30.72800	81.64300	Cumberland	Camden	6.9			4.4		30.3		12:20 PM
6/15/2006	305	30.72800	81.64300	Cumberland	Camden	4.3	4.3		7		27.5		11:24 AM
5/3/2006	305	30.72800	81.64300	Cumberland	Camden	6.8			6.9		23.4		12:58 PM
4/7/2006	305	30.72800	81.64300	Cumberland	Camden	7			7.1		21.5		12:14 PM
3/10/2006	305	30.72800	81.64300	Cumberland	Camden	5.9	5.9		8.3		16.9		12:17 PM
2/17/2006	305	30.72800	81.64300	Cumberland	Camden	4.5	4.5		7.8		117	117	~~11:47 AM~~ — 11.7 typo
1/6/2006	305	30.72800	81.64300	Cumberland	Camden	5.1	5.1		6.8		14.7		11:29 AM
12/12/2005	305	30.72800	81.64300	Cumberland	Camden	6.4			8.2		14.4		11:26 AM
11/4/2005	305	30.72800	81.64300	Cumberland	Camden	6.5			6.8		19.6		11:30 AM
10/28/2005	305	30.72800	81.64300	Cumberland	Camden	5.7	5.7		5.9		19.8		12:27 PM
9/23/2005	305	30.72800	81.64300	Cumberland	Camden	6.1			4.3		27.8		11:18 AM
8/26/2005	305	30.72800	81.64300	Cumberland	Camden	5.1	5.1		3.8	3.8	29.5		11:10 AM
7/15/2005	305	30.72800	81.64300	Cumberland	Camden	4.7	4.7		2.9	2.9	28.7		12:21 PM
6/23/2005	305	30.72800	81.64300	Cumberland	Camden	6.5			4.8		28.6		2:35 PM
5/9/2005	305	30.72800	81.64300	Cumberland	Camden	5.7	5.7		5.7		22		1:25 PM
4/4/2005	305	30.72800	81.64300	Cumberland	Camden	5.1	5.1		5.4		19.1		2:10 PM
3/3/2005	305	30.72800	81.64300	Cumberland	Camden	5.3	5.3		7.2		13.8		11:46 AM
1/7/2005	305	30.72800	81.64300	Cumberland	Camden	5.8	5.8		7.3		13.6		12:18 PM
12/6/2004	305	30.72800	81.64300	Cumberland	Camden	5.7	5.7		5.4		16.5		1:10 PM
11/6/2004	305	30.72800	81.64300	Cumberland	Camden	4.9	4.9		3.9	3.9	23.2		10:35 AM
10/19/2004	305	30.72800	81.64300	Cumberland	Camden	3.79	3.79		3	3	22.7		1:33 PM
9/22/2004	305	30.72800	81.64300	Cumberland	Camden	4.43	4.43		3.24	3.24	24.13		2:00 PM
8/4/2004	305	30.72800	81.64300	Cumberland	Camden	6.3			4.2		29.7		12:45 PM
7/9/2004	305	30.72800	81.64300	Cumberland	Camden	6.4			3.7	3.7	29.4		11:12 AM
6/3/2004	305	30.72800	81.64300	Cumberland	Camden	7.1			4.8		28.8		1:36 PM
5/6/2004	305	30.72800	81.64300	Cumberland	Camden	7.1			5.7		23.1		11:25 AM
4/7/2004	305	30.72800	81.64300	Cumberland	Camden	7.2			6.22		18.18		11:43 AM
3/3/2004	305	30.72800	81.64300	Cumberland	Camden	6.3			7.4		13.45		1:21 PM
2/6/2004	305	30.72800	81.64300	Cumberland	Camden	7.4			7.64		13.2		11:35 AM
1/21/2004	305	30.72800	81.64300	Cumberland	Camden	7.3			7.79		11.83		12:56 PM

DateCollected	StationID	Latitude	Longitude	Sound	County	pH	pH 6	pH 8.5	DO(mg/l)	DO 4	Temp©	T 32.2	Time
12/8/2003	305	30.72800	81.64300	Cumberland	Camden				6.1		13.7		2:10 PM
11/12/2003	305	30.72800	81.64300	Cumberland	Camden				5.02		21.4		11:48 AM
10/17/2003	305	30.72800	81.64300	Cumberland	Camden				4.38		22.35		2:11 PM
9/5/2003	305	30.72800	81.64300	Cumberland	Camden				2.48	2.48	28.75		11:10 AM
8/8/2003	305	30.72800	81.64300	Cumberland	Camden				3.17	3.17	26.74		12:25 PM
7/31/2003	305	30.72800	81.64300	Cumberland	Camden				2.04	2.04	28.05		2:22 PM
6/19/2003	305	30.72800	81.64300	Cumberland	Camden				2.36	2.36	27.65		11:02 AM
5/20/2003	305	30.72800	81.64300	Cumberland	Camden				3.53	3.53	24.27		10:07 AM
4/23/2003	305	30.72800	81.64300	Cumberland	Camden				3.53	3.53	22.79		12:50 PM
3/26/2003	305	30.72800	81.64300	Cumberland	Camden				3.7	3.7	19.47		10:55 AM
2/12/2003	305	30.72800	81.64300	Cumberland	Camden				6.73		11.49		11:17 AM
1/23/2003	305	30.72800	81.64300	Cumberland	Camden				7.02		9.96		11:22 AM
12/6/2002	305	30.72800	81.64300	Cumberland	Camden				7.07		13.52		11:29 AM
11/22/2002	305	30.72800	81.64300	Cumberland	Camden				6.46		17.22		11:20 AM
10/25/2002	305	30.72800	81.64300	Cumberland	Camden				4.79		23.03		10:26 AM
9/24/2002	305	30.72800	81.64300	Cumberland	Camden				4.65		28.59		2:30 PM
8/15/2002	305	30.72800	81.64300	Cumberland	Camden				4.71		27.89		10:59 AM
7/26/2002	305	30.72800	81.64300	Cumberland	Camden				4.33		29.5		10:18 AM
6/25/2002	305	30.72800	81.64300	Cumberland	Camden				3.77	3.77	26.8		11:38 AM
6/13/2002	305	30.72800	81.64300	Cumberland	Camden				3.83	3.83	28.2		1:11 PM
5/27/2002	305	30.72800	81.64300	Cumberland	Camden				5.38		24.2		12:56 PM
5/14/2002	305	30.72800	81.64300	Cumberland	Camden				5.08		27.4		3:08 PM
4/22/2002	305	30.72800	81.64300	Cumberland	Camden				4.98		25.8		10:17 AM
4/16/2002	305	30.72800	81.64300	Cumberland	Camden				5.3		23.5		2:53 PM
3/31/2002	305	30.72800	81.64300	Cumberland	Camden				5.09		23.8		5:09 PM
3/16/2002	305	30.72800	81.64300	Cumberland	Camden				5.36		20.8		2:31 PM
3/4/2002	305	30.72800	81.64300	Cumberland	Camden				6.74		14.9		3:52 PM
2/13/2002	305	30.72800	81.64300	Cumberland	Camden				7.64		14.6		2:56 PM
1/31/2002	305	30.72800	81.64300	Cumberland	Camden				7.19		18.2		3:30 PM
12/11/2006	306	30.72400	81.61900	Cumberland	Camden	7.7			6.7		14.3		11:35 AM
11/3/2006	306	30.72400	81.61900	Cumberland	Camden	7.5			5.9		20.8		11:56 AM
10/19/2006	306	30.72400	81.61900	Cumberland	Camden	7.4			4.6		23.2		1:06 PM
9/18/2006	306	30.72400	81.61900	Cumberland	Camden	7.2			5.4		27.5		12:00 PM
8/4/2006	306	30.72400	81.61900	Cumberland	Camden	7.3			4.4		31.4		12:31 PM

306 Summary

	pH	DO	T
2006	3/12	0/12	0/12
2005	6/11	1/11	0/11
2004	4/12	2/12	0/12
2003	0/0	6/12	0/12
2002	0/0	1/17	0/17

(02-06) pH 13/35 = 37%
DO 10/64 = 16%
T 0/64 = 0%



NS St Marys

NS pH, DO 49% 33%

54% NS pH, DO 25%

NS pH, DO 54% 27%

NS DO, pH 21%

NS DO pH 23° 43°

NS DO pH 16° 37°

NS DO 16%

NS DO 21%

NS DO 29%

R2088116 Cumberland Sound
NS DO based on 921+922+912
not sure exact location.

301+302 in Reach U/S cabbage bend to Catfish Creek already listed DO

R2088161 * 306 new reach
maybe Miles Branch to Burrells Creek 6mi NS DO

St Marys River NS DO
pH ok- blackwater

303, 304 + 305 in reach
Catfish Creek- Miles Branch
already listed DO

Camden

Brunswick Region Field Data January 2003 - June 2003

Station ID

08011021 St. Marys Hwy I-95

Date	Time	Cond	pH	DO	Temp
1/7/03	948	108	5.01	9.33	10.96
2/4/03	1100	5320	6.40	8.97	10.95
3/5/03	1000	65	4.56	6.57	15.34
3/19/03	1113	50	4.23	4.78	19.27
3/24/03	1014	44	4.21	4.41	20.61
3/26/03	0930	53	4.14	3.61	20.23
4/1/03	1454	70	4.12	4.32	18.86
5/6/03	1643	5380	6.16	5.91	25.14
6/4/03	1442	751	6.50	4.60	27.14
6/12/03	1327	582	5.60	3.74	28.50
6/19/03	1550	494	5.92	3.10	28.14
6/24/03	1444	66	4.36	2.87	27.33
7/2/03	1530	46	5.59	4.14	27.32

3.24

28.

cy03 Station# 08011021 **Saint Marys River at I-95 near Gross, Florida**

Collection Date/Time	DO	pH	Temp °F	Fecal
01/07/2003 9:48:00 AM	9.33	5.01	51.7	
02/04/2003 11:00:00 AM	8.97	6.4	51.7	
03/05/2003 10:00:00 AM	6.57	4.56	59.6	80
03/19/2003 11:13:00 AM	4.78	4.23	66.7	
03/19/2003 11:33:00 AM				130
03/24/2003 10:14:00 AM	4.41	4.21	69.1	50
03/26/2003 9:30:00 AM	3.61	4.14	68.4	20
03/26/2003 6:50:00 PM	3.75	3.58	68.8	
04/01/2003 2:54:00 PM	4.32	4.12	65.9	
05/06/2003 3:43:00 PM	5.91	6.16	77.3	
→ 05/08/2003 5:00:00 PM	4.48	6.13	79.9	
06/05/2003 1:42:00 PM				<20
06/12/2003 12:27:00 PM				130
06/19/2003 2:50:00 PM				20
06/24/2003 1:44:00 PM				20

gm=57

gm=32

Return to SBS

2/10 7/10 0/10

FC ½ gm

APPENDIX G

September 24, 2013

Targeted Watershed Monitoring Plan for St. Marys River, Catfish Creek to Millers Branch

Sampling and Quality Assurance Plan (Revised)

Submitted to:

The Georgia Environmental Protection Division, Watershed Protection Branch

Prepared by
Ecological Planning Group, LLC
on behalf of the
Coastal Resources Commission

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Appendix 9

INTRODUCTION

A Total Maximum Daily Load (TMDL) is the amount of a particular pollutant that a water body (stream or river segment, lake or estuary) can receive and still meet State water quality standards for that pollutant. TMDLs must be developed for all water bodies identified as not meeting water quality standards and for which there are no ongoing actions to resolve the impairment. After a TMDL is finalized, an implementation plan must be developed for initiating local, regional and state actions that will reduce pollutant loads to levels established by the TMDL.

The St. Mary's River, from Catfish Creek to Miller's branch, (HUC8# 03070204), in Camden County is currently listed on the 2012 303(d) list as impaired due to low levels of Dissolved Oxygen (DO).

Reach Name	Reach Location	County	Use	Criterion Violated	Potential Causes	Extent
St. Marys River	Catfish Creek to Millers Branch	Camden	Fishing	DO	Urban Runoff	6 miles

Coastal waters that do not meet the following standard are to be considered to impaired - a daily average of 5.0 mg/L and no less than 4.0 mg/L at all times for waters supporting warm water species of fish. During 2003, the GA EPD collected water quality data at GA EPD Station 08011021 on the St. Marys River at Interstate 95. In general, these data show that low dissolved oxygen values usually occurred during the summer months. This monitoring data resulted in the St. Marys River from Catfish Creek to Millers Branch being included on the 303 (d) list as impaired for DO.

Coastal, slow-moving streams, like the St. Marys River, often have natural DO levels below the EPA standard due to their tanic nature and the large amount of organic material that is naturally occurring within these types of river systems. The TMDL for the St. Marys River, completed in 2006, even states as such,

"*Natural Water Quality. It is recognized that certain natural waters of the State may have a quality that will not be within the general or specific requirements contained herein. These circumstances do not constitute violations of water quality standards. This is especially the case for the criteria for dissolved oxygen, temperature, pH and fecal coliform. NPDES permits and Best Management Practices will be the primary mechanisms for ensuring that the discharges will not create a harmful situation.*"

The Coastal Resources Division (CRD) of the Department of Natural Resources assumed monitoring responsibilities for this waterway after 2003. Monitoring is now performed by boat at five sampling points within this segment. The map on page six identifies the locations of the CRD sampling sites and the original EPD listing site. The CRD submits the data collected every two years to the EPD for listing assessments. The CRD intends to continue monitor as long as funding is available.

OBJECTIVES

The purpose of this targeted monitoring plan will be to attempt to provide additional data that will help to identify any potential causes of the DO impairment, including natural tanic conditions, urban runoff (as stated in the TMDL), or other causes.

Monitoring will involve the collection of water quality data to evaluate compliance with water quality standards. Sampling sites will include 5 **targeted monitoring sites** for DO.

The monitoring data will be used to develop a Watershed Management Plan in accordance with EPA's guidelines and provide the information needed to support local Section 319 (h) Nonpoint Source Implementation Grants and other water conservation grant programs.

MONITORING PARTNERS

The Coastal Regional Commission (CRC) and its consultant Ecological Planning Group, in partnership with the Coastal Resources Division and Watershed Protection Branch of the Environmental Protection Division (GAEPD) of the Georgia Department of Natural Resources (GADNR) through the Clean Water Act 319 Grant will conduct water quality testing in the St. Marys watershed.

The CRC, with an office at 1181 Coastal Drive SW, Darien, GA 31305 covers a 11-county area. The contact person for the CRC is:

Lupita McClenning
Director of Planning & Government Services
Coastal Regional Commission
1181 Coastal Drive SW, Darien, GA 31305
Phone: 912.262.2870
Cell: 912.577.9902
email: lmcclenning@crc.ga.gov

The CRC has contracted with Ecological Planning Group to manage this project. EPG will also be performing water quality monitoring for this grant. Their contact person is:

Courtney Reich
Ecological Planning Group
7 East Congress St. Suite 801
Savannah, GA 31401
Cell: 912.656.1316
Email: courtney@ecologicalplanning.net

ST. MARYS WATERSHED DESCRIPTION

The St. Marys River basin is located in the southeastern part of Georgia, occupying an area of approximately 1,500 square miles with approximately 765 square miles of the basin in Georgia. The basin lies within the Coastal Plain physiographic province, which extends throughout the southeastern United States. The St. Marys River drains into the Atlantic Ocean. The St. Marys River Basin is comprised of one USGS Hydrologic Unit Code (HUC), 03070204. The map on page 6 shows the location of the listed dissolved oxygen segment in the St. Marys River Basin.

The land use characteristics of the St. Marys River Basin watersheds are primarily forested, some of which is currently in active silviculture. There are also some urban areas associated with the cities of Kingsland and St. Mary's, and much of that area is residential. The residential development is served by sanitary sewer within the city limits, but within the County, most residential development is served by septic systems. There is relatively little commercial and industrial development within this watershed.

The two major Georgia tributaries along this reach of the St. Marys River are Catfish Creek and Miller's Branch. Florida tributaries feeding this reach of the St. Marys River are Upper Sister Creek and Lower Sister Creek. The Florida tributaries drain relatively undeveloped parts of the watershed and will not be monitored as part of this plan.

Monitoring for this project will take place on St. Marys River, Catfish Creek and Millers Branch. Collection of water quality data is for the purpose of establishing water quality conditions and identifying possible oxygen demanding sources in the watershed.

SAMPLING PLAN

SAMPLING LOCATIONS

The map on the next page shows the locations of the following sampling sites for targeted monitoring. The parameters to be monitored are also listed in the table below.

Please note that the GA EPD Monitoring Station 08011021 will not be monitored by the Coastal Resources Division or its Consultant as part of this plan. As stated above, the CRD currently monitors several sites within this listed water body, one of which (304) is in the same location at GA EPD Monitoring Station 08011021. Therefore, data collected by the CRD will be gathered by the project partners and evaluated with the data collected by CRC's consultant as part of this monitoring effort. Together, these data sets will allow project partners to make an assessment of the DO impairment of the St. Marys River for the purposes of developing the Watershed Management Plan.

Site ID	Site Description	Parameter to be Monitored
CC01	Catfish Creek at Clarks Bluff Road	DO
LCC01	Little Catfish Creek at Scrubby Bluff Road	DO
MC01	May Creek at Scrubby Bluff Road	DO
2D	Millers Branch at the Osprey Drive Crossing	DO
SM-1	HWY 17 crossing of the St. Marys River	DO

In addition to DO, each site will be monitored for water temperature, salinity, pH, conductivity, total dissolved solids, and turbidity during every sampling event. The direction of the tide (ebb or flood) will be noted, as will the weather (cloudy, windy, rainy, sunny, etc.).

General Location Map

SAMPLING PROCEDURES

All (1) sample collection, (2) field parameters, and (3) lab analysis will be conducted in accordance with GAEPD's Quality Assurance Manual (June 1999), as referenced in the Georgia DNR Rules and Regulations for Water Quality Control, Chapter 391-3-6 (November 2005), Title 40 CFR Part 136, and USEPA guidelines. These guidelines and references have been set forth in the Quality Assurance Project Plan (QAPP) and Quality Monitoring Plan (QMP) developed per previous USEPA/GAEPD agreement and maintained by GAEPD. Copies of the QAPP and QMP are available from the GAEPD and will be kept on site to be used as reference and provide future guidance on water quality monitoring procedures. Any additional agencies, organizations, or subcontractors that participate in the aforementioned water quality monitoring activities shall also adhere to GAEPD's "Guidance On Submitting Water Quality Data for Use By the Georgia Environmental Protection Division in 305(b)/303(d) Listing Assessments."

Dissolved Oxygen: DO samples will be taken in stream, using a Horiba U-53 multi-parameter probe. DO will be recorded as mg/l. Probes will be manually calibrated once prior start of this sampling program and automatically calibrated prior to each sampling event.

SAMPLING SCHEDULE

Dissolved Oxygen: A total of 8 DO measurements will be taken at the six sampling locations. DO measurements will be taken weekly for four consecutive weeks in the Spring Quarter (Apr – Jun) and four consecutive weeks during summer quarter (July – Sep).

Sample Schedule:

May 2013				**August 2013**			
Week 1	Week 2	Week 3	Week 4	Week 1	Week 2	Week 3	Week 4
1	1	1	1	1	1	1	1

Record Keeping: The CRC will maintain records for at least three years following studies.

EQUIPMENT

The Project Partners have several vehicles available for use by staff, any of which are suitable for the purpose of sample collection.

DO field tests will be conducted using a Horiba U-53 multi-parameter probe.

Additional supplies available include:

- Latex Gloves
- Calibration fluid

QUALITY ASSURANCE PLAN

DISSOLVED OXYGEN SAMPLING

Field tests will be conducted using a Horiba U-53 Multi-Paramter Probe. The probe will be calibrated using standard solution prior to each sampling event, and manual calibrated once prior to the start of the monitoring program. The probe will be rinsed with distilled water prior to the measurement be taken at each sampling site.

Michael Baggett attended the Georgia Adopt-A-Stream training for the field collection of temperature, pH, DO, Turbidity, and conductivity and is Quality Assurance/Quality Control (QA/QC) certified. Training was conducted by Georgia Adopt-Stream Trainer Tara Menz on September 13, 2010 at the Tybee Island 4-H center.

DATA RECORDING AND SUBMISSION

Record dissolved oxygen data and field data on an electronic spreadsheet (Excel). Records will be maintained by the Coastal Regional Commission for a period of three years from the conclusion of the project.

APPENDIX

1. Field Record Data Form

St. Marys Watershed Improvement Plan

Sample Date:

Site	Time	Temp	pH	Conductance (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	DO (%)	Total Dissolved Solids (g/L)	Salinity (ppt)	Notes
2D										
MC01										
LLC01										
CC01										
SM1										
SM2										

APPENDIX H

St. Marys Watershed Improvement Plan					*Sample Date:*	5/28/2013				
Site	Time	Temperature	pH	Conductance (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	DO (%)	Total Dissolved Solids (g/L)	Salinity (ppt)	Notes
2D	12:50	25.5	6.02	5.59	0	4.65	58.9	3.51	3	Inside gated community, sunny windy 81degrees tanic water incoming flow
MC01	13:01	21.7	6.68	0.35	6.21	2.89	33.8	0.228	0.2	sunny windy 81degrees tanic water no observed flow
LLC01	13:10	22.2	6.63	0.201	7.36	3	35.3	1.31	0.1	sunny windy 81degrees tanic water no observed flow
CC01	13:20	20.8	6.25	0.189	15	0.7	8	0.123	0.1	sunny windy 81degrees tanic water no observed flow
SM1	13:30	25.08	5.96	0.203	0	3.17	39.2	0.132	0.1	sunny windy 81degrees tanic water incoming flow
SM2										No Access - Private Property
					Sample Date:	6/2/2013				
Site	Time	Temperature	pH	Conductance (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	DO (%)	Total Dissolved Solids (g/L)	Salinity (ppt)	Notes
2D	14:29	28.8	6.26	6.08	0	4.76	63.2	3.83	3.3	86 degrees tannic windy cloudy in coming flow.
MC01	14:40	25.56	6.57	0.389	17	4.84	60.3	0.253	0.2	86 degrees tannic windy sunny no observed flow.
LLC01	14:50	25.37	6.48	0.266	0	3.11	38.5	0.173	0.1	86 degrees tannic windy sunny no observed flow.
CC01	15:00	23.52	6.12	0.237	0	0.68	8.2	0.154	0.1	86 degrees tannic partly sunny no observed flow.
SM1	15:15	26.88	5.7	0.226	0	3.6	45.7	0.147	0.1	86 degrees tannic windy partly cloudy in coming flow.
										No Access - Private Property
					Sample Date:	6/5/2013				
Site	Time	Temperature	pH	Conductance (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	DO (%)	Total Dissolved Solids (g/L)	Salinity (ppt)	Notes
2D	13:46	27.4	6.68	0.395	0	6.59	84.3	0.256	0.2	78degrees mild breeze rained hard last 24hrs off and on, tide very low and still flowing out.
MC01	13:55	25.11	6.73	0.18	0	4.89	60.4	0.117	0.1	78degrees flowing out.
LLC01	14:00	25.17	6.43	0.275	16.2	3.29	40.6	0.179	0.1	no flow It rain
CC01	14:15	24.74	6.72	0.246	0	1.34	16.4	0.16	0.1	no flow Heavy rain
SM1	14:30	26.85	6.14	0.275	0	3.38	43	0.179	0.1	Heavy rain, outward flowing, very low tide.
					Sample Date:	6/18/2013				
Site	Time	Temperature	pH	Conductance (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	DO (%)	Total Dissolved Solids (g/L)		
2D	13:23	28.97	6.64	0.256	0	6.15	80.5	0.166	0.1	91 degrees Sunny Breezy, dead low tide,no flow
MC01	13:40	26.8	6.31	0.137	0	5.03	63.8	0.089	0.1	91 degrees Sunny Heavy breeze, flowing out to river
LLC01	13:55	26.12	6.3	0.26	21	2.91	36.5	0.169	0.1	91 degrees Sunny No Wind, No Flow
CC01	14:10	24.69	5.59	0.122	0	0.62	7.6	0.079	0.1	91 degrees Sunny Breezy, No Flow
SM1	14:23	29.46	5.34	0.138	0.99	3.16	41.7	0.09	0.1	91 degrees Sunny Breezy, low tide, no obvious flow

St. Marys Watershed Improvement Plan					*Sample Date:*	9/4/2013				
Site	Time	Temperature	pH	Conductance (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	DO (%)	Total Dissolved Solids (g/L)	Salinity (ppt)	Notes
2D	11:16	28.6	6.54	2.12	0	4.7	61.5	1.36	1.1	Tide up flowing outfast black clear water
MC01	11:33	26.2	6.56	0.162	0	3.88	48.7	0.105	0.1	Slow slight flow out black clear water
LLC01	11:42	25.95	6.3	0.217	22	2.07	25.9	0.141	0.1	No observed flow blackwater, fish
CC01	11:50	25.59	6.09	0.113	0	1.51	18.8	0.074	0.1	Very slight outward flow black clear water, fish and turtles
SM1	12:00	27.92	5.51	0.097	0	2.96	38.1	0.063	0	high tide, flowing out black clear water, fish present
SM2										No Access - Private Property
					Sample Date:	9/11/2013				
Site	Time	Temperature	pH	Conductance (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	DO (%)	Total Dissolved Solids (g/L)	Salinity (ppt)	Notes
2D	12:05	26.96	5.55	2.07	0	3.72	47.5	1.32	1.1	overcast windy humid, high tide appears to be flowing in, should have started flowing out past high tide
MC01	12:15	25.69	6.21	0.203	0	5.05	62.9	0.132	0.1	overcast windy humid, high tide flowing out
LLC01	12:34	25.28	6.31	0.233	63.8	2.7	33.4	0.151	0.1	overcast windy humid, flowing out
CC01	12:45	24.1	5.77	0.112	0	1.42	17.3	0.073	0.1	overcast windy humid, flowing out
SM1	13:00	27.34	5.29	0.088	0	2.63	33.6	0.057	0	overcast windy humid, high tide flowing out
SM2										No Access - Private Property
					Sample Date:	9/18/2013				
Site	Time	Temperature	pH	Conductance (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	DO (%)	Total Dissolved Solids (g/L)	Salinity (ppt)	Notes
2D	11:45	24.66	5.85	5.05	0	5.78	73.8	3.18	2.7	High tide, Very windy, over two inches of rain over night heavy flow
MC01	11:56	24.66	6.17	0.119	0	4.76	58.4	0.077	0.1	High tide, Very windy, over two inches of rain over night heavy flow
LLC01	12:03	24.28	6.07	0.136	0	3.6	43.8	0.088	0.1	High tide, Very windy, over two inches of rain over night heavy flow
CC01	12:10	23.55	5.58	0.108	0	2.32	27.9	0.07	0	High tide, Very windy, over two inches of rain over night heavy flow
SM1	12:30	27.59	5.68	3.28	0	3.52	45.6	2.1	1.7	Flooded Road and house, can not determine flow should be flowing out, but extreme winds make water appear to be flowing in.
SM2										No Access - Private Property
					Sample Date:	9/25/2013				
Site	Time	Temperature	pH	Conductance (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	DO (%)	Total Dissolved Solids (g/L)	Salinity (ppt)	Notes
2D	9:10	24.44	5.97	0.533	0	6.13	74.9	0.341	0.3	75 Overcast intermittent drizzle, low tide with slight outward flow
MC01	9:20	24.02	6.16	0.153	0	4.7	57	0.099	0.1	75 Overcast intermittent drizzle, low tide outward flow
LLC01	9:30	23.83	6.08	0.168	0	3.67	44.4	0.109	0.1	75 Overcast intermittent drizzle, low tide
CC01	9:40	23.33	5.94	0.102	0	1.8	21.6	0.066	0	75 Overcast intermittent drizzle, no flow lots of water little bit of duck weed
SM1	9:55	25.71	5.7	0.237	0	3.37	42	0.154	0.1	75 Overcast intermittent drizzle, low tide
SM2										No Access - Private Property