

# WATERSHED-BASED STORMWATER MASTER PLANNING – WATERSHED ASSESSMENTS, CITY OF GRIFFIN STORMWATER UTILITY DEPT., GA

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**Abstract.** The City of Griffin Stormwater Department has completed Watershed Assessments on the City's three major watersheds as part of its comprehensive watershed masterplanning efforts. The three major watersheds are Shoal Creek and Potato Creek in the Upper Flint River Watershed (HUC 03130005), and Cabin Creek in the Upper Ocmulgee Watershed (HUC 03070103). The City is situated at the headwaters of the three major watersheds, and this unique location affords the City an opportunity to mitigate the effects of stormwater runoff originating from the urbanized areas of Griffin. The Assessments have quantified the pollutant loadings for the three watersheds as well as additional data regarding the impacts downstream. The objective of the Assessments was to develop comprehensive Watershed Management Plans that will address water quality within the City and downstream of the City's boundaries. The City's ability to implement an effective watershed management strategy will require that the City utilize the information from the masterplanning work to develop cost-effective structural and non-structural Best Management Practices (BMPs) to improve water quality. These improvements will assist the City in accomplishing the following goals: 1) achieve regulatory compliance with the NPDES Phase II Stormwater General Permit requirements; 2) address Total Maximum Daily Loads (TMDLs); 3) provide data for use in securing future NPDES wastewater discharge permits; and 4) assist the City in regulating future development by mitigating some of the anticipated impacts.

## INTRODUCTION

As an integral part of their on-going Stormwater Management Program, and in an effort to prepare for future growth and redevelopment, the City of Griffin initiated a comprehensive evaluation of all watersheds within its jurisdiction to determine the overall health of their streams, and to identify needed improvements

to ensure the preservation of this vital resource for future generations. The comprehensive evaluation took place through a series of watershed assessments beginning with the Potato Creek watershed, followed by the Shoal and then the Cabin Creek Watersheds. Each Assessment is documented in two volumes. Volume I presents the rationale, sampling methodology, results, and characterization of the watershed. Volume II contains a Watershed Management Plan that presents the City's overall strategy for protecting and enhancing the watershed.

The primary data development components of the Watershed Assessments included water quality and sediment analysis at 33 sample sites throughout the City. This data was utilized and supplemented to establish the following: 1) existing levels of fecal coliform, nutrients, organic contaminants and metals; 2) land-use characterization to identify potential stressors to the watersheds; and 3) a detailed habitat, macro-invertebrate and fish community assessment.

The Watershed Management Plan documents also addressed the stream segments within the City that are listed on the Georgia's Environmental Protection Division (EPD) 303(d) list of impaired waters as well as issues pertaining to TMDLs within the City's jurisdictional watersheds.

## AREAS & CONSTITUENTS OF CONCERN

The primary constituents and areas of concern identified by the watershed characterization are:

- Watershed-Wide Biological / Habitat Impairments
- Elevated Fecal Coliform Bacteria

Secondary constituents and areas of concern were found in selected locations:

- Low Dissolved Oxygen
- Elevated Metals
- Elevated Turbidity
- Elevated Nutrients

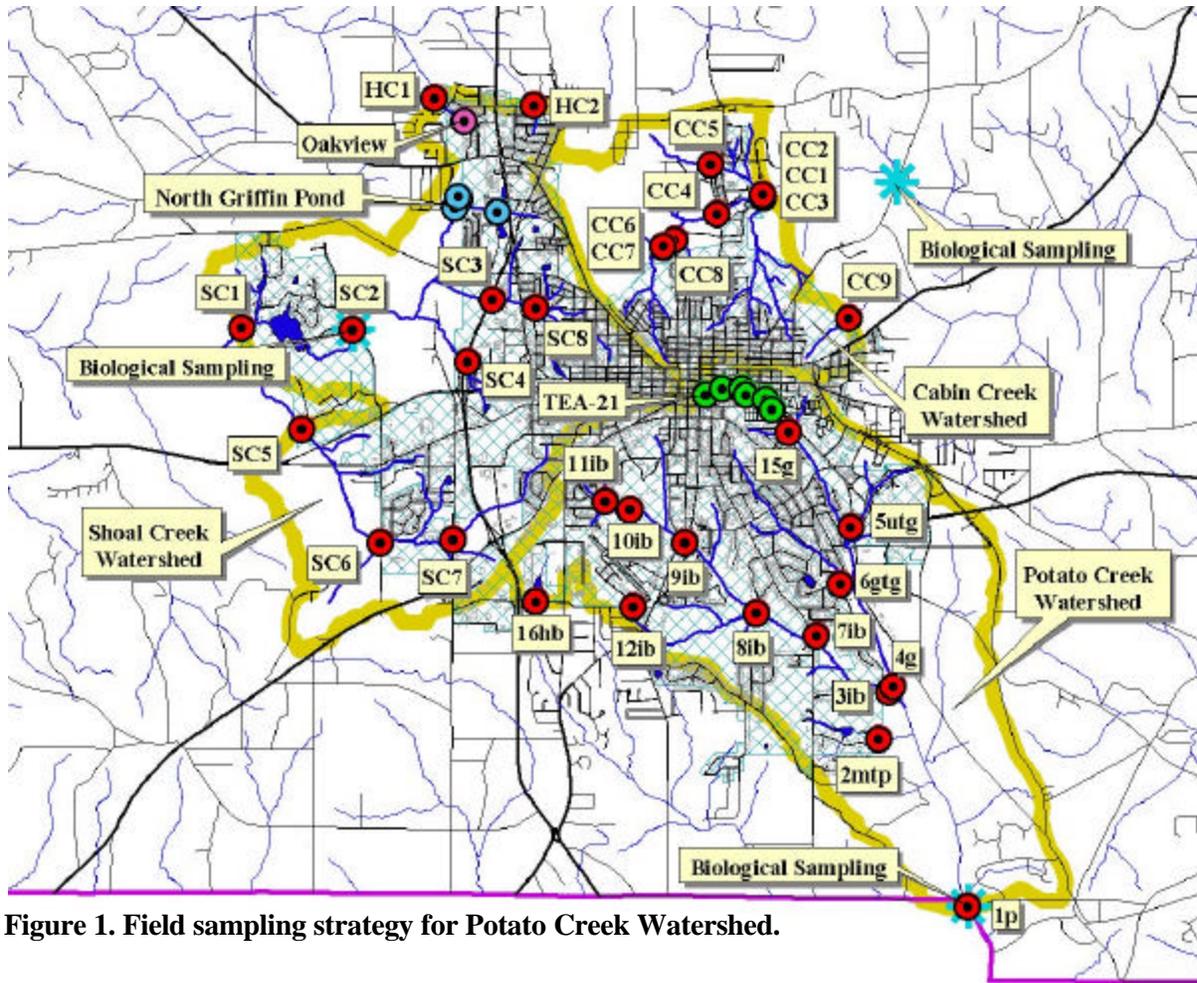


Figure 1. Field sampling strategy for Potato Creek Watershed.

### WATERSHED MODELING

Throughout the masterplanning effort, the focus was on providing a watershed constituent run-off model that will accomplish three objectives. The first objective was to provide the City of Griffin a tool for use in future development and land-use planning efforts. The second objective was to assess constituent run-off and quantify pollutant loadings. The third objective was to provide a model within a GIS environment to complement the City's development of a comprehensive GIS database for all the City's watershed and asset management databases.

The City opted to utilize the USEPA's BASINS model to perform the watershed modeling work effort. One of the advantages of utilizing the BASINS model was that it has been developed to facilitate TMDL formulation, and the City is having to address several TMDL issues within its watersheds. There are four models provided within the BASINS environment. Three of these can be used to develop a constituent run-off model for a specific watershed. The three are SWAT, HSPF, and PLOAD.

### SWAT (Soil and Water Assessment Tool)

SWAT is an evolutionary model derived from several previous models developed by the USDA Agricultural Research Service. The primary historical pre-cursor for SWAT is the SWRRB (Simulator for Water Resources in Rural Basins). For the most part, the components of SWAT are taken from agricultural land management models developed by the USDA. The SWAT focus is predicting "the impact of land management practices on water, sediment and agricultural chemical yields in large complex watersheds with varying soils, land use and management conditions over long periods of time." SWAT appears to have a specific use in large rural watersheds with substantial agricultural impacts. The BASINS model documentation describes SWAT as best suited for "TMDL development in large agricultural watersheds." After the initial model review, it was decided that the urban land uses in the City of Griffin could not be appropriately defined in sufficient detail within the SWAT model to provide the City with a viable watershed planning tool. That and the atypical nature of the agricultural activity

outside the City of Griffin was sufficient cause to decline the selection of the SWAT model.

### **HSPF (Hydrologic Simulation Program Fortran)**

It was initially felt that this model would be the most likely to provide the City with a viable watershed-planning tool. In the initial watershed assessment effort in Potato Creek, an effort was made to produce a Potato Creek model through the BASINS interface to HSPF using as a foundation much of the BASINS database augmented with the results of the Potato Creek data collection effort. It was very quickly discovered that the small size of the Potato Creek sub-basins hindered the development of an HSPF model through the BASINS interface. Seamless transfer of data from the BASINS core to the HSPF model could only be facilitated by combining the sub-basins into two major watersheds, the Grape Creek and Isons Branch watersheds. This effectively produced an average model for both basins that did not account for some of the data collection findings in upstream sub-basins. It also meant ignoring two smaller watersheds, Honey Bee Creek and the Maplewood Tributary to Potato Creek, thus depriving the City of a planning tool in two of its most desirable development areas. Cabin Creek has very similar characteristics to Potato Creek and would produce similar model development problems. The HSPF model also requires a substantial amount of hydrologic/hydraulic calibration data. The City does not yet have enough flow data suitable for developing long-term hydrologic simulations. Most of the data the City has collected to date is from an extended drought period and would have an extremely limited application to long-term run-off simulations.

Intuitively, calibrating to a small drought flow database would under report long-term storm run-off, and therefore would either underestimate constituent loads or overestimate pollutant concentrations. There is also no USGS gage sufficiently near in location or representative basin drainage area, or of sufficient period of record, to effectively produce a synthetic stream trace for calibration within the City's watershed's. Thus, the effort was made to investigate the use of the third model available within the BASINS environment, PLOAD.

### **PLOAD**

PLOAD is a simplified, GIS-based model for calculating pollutant loadings in a watershed. There are two methods for performing the calculations, one is based on a constituent loading rate per acre of a specific land use (export coefficient method) and the

other is based on an Event Mean Concentration (EMC) produced from a specific land use. The EMC method is based on the EPA's Simple Method approach. This approach is applicable to watersheds of less than one square mile and assumes that impervious area is the greatest contributor to pollutant loads due to generation of the greater amount of storm run-off, when compared to land uses with less impervious area. PLOAD can also calculate potential reduction in loadings due to BMP implementation.

The primary disadvantage to PLOAD is the assumption, using the Simple Method approach, that the greater the impervious area, the greater the contribution to pollutant loading. This might not necessarily be the case in reality, particularly with regard to some nutrients, such as phosphorus and nitrogen, where less impervious area might translate to a greater propensity for producing nutrient loading through residential landscape maintenance and other similar activities.

However, the extensive database from the Assessments could be used to develop export coefficients specific to a land use within a sub-basin, under the assumption that each land use within a sub-basin contributes equally to the EMC. As a planning tool, this would be invaluable to the City to assess impacts to pollutant loadings from changes in land use (i.e., adjustments to amounts of impervious area).

The capability to quantify loading reductions through BMP implementation would also be an invaluable planning tool for the City. Through an on-going monitoring program and development of BMP implementation projects, this model could be used to quantify the relative contribution to loading reduction from specific BMP implementation. The City has already begun a database on BMP loading reduction with the projects implemented through the USEPA Clean Water Act Section 319(h) program and this would expand on that database.

Given the pros and cons of the PLOAD model, it appeared to offer the best opportunity for a viable planning tool for the City within the BASINS, and therefore, a GIS environment.

### **LAND USE**

Development of a comprehensive watershed management plan is dependent on the anticipated changes in land use. Existing land use and the estimated pollutant loading from this land use affect the recommendations for watershed management. In addition, projected future land use will impact

watershed management decisions. Therefore, existing land use was used to develop current estimated pollutant loadings and the City's 2020 future land use projection was used in comparison to existing land use to assess the potential impact of future development.

### CURRENT WATERSHED MANAGEMENT STRATEGY

In addition to the Watershed Assessments the City has completed, there are a variety of structural and non-structural BMPs the City has implemented to address stormwater issues within its jurisdiction.

### RECOMMENDED WATERSHED MANAGEMENT STRATEGY

The findings from the Watershed Assessments and information provided in the Watershed Management Plans have yielded additional BMP options that are recommended for implementation by the City. The recommended BMPs are based on enhancing existing conditions conducive to good stream quality, and implementing both structural and non-structural development controls to address stormwater runoff. The focus of the recommended BMPs is to address documented and potential environmental impairments within the watershed in an effort to enhance water quality within the City's streams.

### NEW POLICIES & REGULATIONS

In order to improve water quality and restore habitat in the City's major watersheds, it was recommended that changes be made to existing City policies and ordinances. Specifically, it was recommended that new ordinances be developed and existing ordinances be enhanced to improve regulation of stormwater runoff and expand existing stream buffers. Once these ordinances are created and/or updated, they must also be enforced through comprehensive plan review, performance of regular field inspections and through enforcement action, if necessary.

### LONG-TERM WATERSHED MONITORING

The purposes of a long-term monitoring program are multifaceted and involve documenting water quality impairments as well as documenting emerging water quality trends that hopefully indicate improvement. In the end, the City's long term monitoring program will evaluate and document the

effectiveness of Watershed Management Plan implementation and the recommended BMPs. The long-term chemical, biological, and hydrological data will provide valuable information on the increasing or decreasing health of City's watersheds. Based on the monitoring data collected and experience gained in implementing the Watershed Management Plans, refinements will be made with respect to future implementation of the Watershed Management Plans.

### SUMMARY & CLOSING

The City of Griffin has developed watershed-based masterplans for the three major watersheds within the City. The watershed masterplanning work evaluated water quality through the watershed assessments and water quantity through hydrologic and hydraulic (H&H) modeling efforts. The City intends to address the water quality issues and concerns through the implementation of the Watershed Management Plans developed for each watershed. This information has been combined with the findings from the H&H studies to develop a comprehensive watershed management strategy. The information and data provided by the watershed masterplanning efforts will assist the City with the following: 1) land use planning efforts; 2) regulate development impacts through non-structural and structural BMPs; 3) achieve compliance with NPDES Phase II Stormwater Permit requirements; 4) securing future NPDES discharge permits; 5) address TMDL issues; 6) evaluate the success of the City's watershed management strategy through long-term monitoring; and 7) provide the City an opportunity to practice the concept of "adaptive implementation" as part of its future Watershed Management Plan implementation efforts.

The City voluntarily undertook the masterplanning work in an effort to develop a comprehensive and coordinated watershed management strategy. This approach is somewhat unique in Georgia since most communities implement Watershed Assessments and develop Watershed Management Plans in response to a regulatory mandate tied to NPDES discharge permit renewal, or a capacity increase. By voluntarily undertaking this masterplanning effort, the City has developed a watershed management strategy that has not been influenced by the need to secure a NPDES discharge permit or some other predetermined objective. The proposed strategy is based solely on the watershed management goals and needs as established by the elected officials, City staff, citizens and community stakeholders.