THE LITTLE RIVER WATERSHED ASSESSMENT: WATER QUALITY IN A RAPIDLY DEVELOPING SUBURBAN ATLANTA WATERSHED

Mike Morrissey[1] and Anthony Pelliccia[2]

AUTHORS: [1]Laboratory Superintendent, Cherokee County Water & Sewerage Authority, 1957 Authority Drive, Woodstock, GA 30189; and [2]Water Resources Engineer, Welker and Associates Inc., 445 Magnet Street SE, Marietta, GA 30062.
REFERENCE: Proceedings of the 2001 Georgia Water Resources Conference, held March 26-27, 2001, at the University of Georgia. Kathryn J. Hatcher, editor, Institute of Ecology, the University of Georgia, Athens, Georgia.

Abstract. This paper presents the results of the Little River watershed assessment that identified current water quality conditions in the watershed of a major tributary to Allatoona Lake, a heavily used reservoir in northern metropolitan Atlanta.

Water quality impairment was found to be the result of both point and nonpoint sources. Biological monitoring showed fish communities to be in "fair" to "good" condition while· benthic macroinvertebrate communities generally rated "poor". Water quality modeling indicated that standards for phosphorus loads entering the Little River embayment are likely being exceeded, and loads will continue to increase under current land use projections. The watershed protection plan focuses on eliminating point source impairment and on watershed based analyses, planning and zoning by the Cherokee County government for nonpoint source control. Plans are to add substantially to the water quality database before recommending specific measures to reduce nonpoint source impairment so that Cherokee County government can cost-effectively implement best management practices.

INTRODUCTION

The purpose of the assessment was to comply with regulations requiring a watershed assessment for new or expanding National Pollutant Discharge Elimination System permit applicants (DNR, 1999). The Cherokee County Water & Sewerage Authority plans an expansion of the Rose Creek Water Pollution Control Plant (RCWPCP) from the currently permitted 4 million gallons-per-day (MGD) to 5 MGD and eventually to 15 MGD.

The watershed assessment and watershed protection implementation plan were completed for the RCWPCP service area (an area that mostly coincides with the portion of the Little River watershed contained within Cherokee County). Other portions of the watershed lie within the counties of Cobb, Fulton, and Forsyth. The Little River is a major tributary of Allatoona Lake, a heavily used multipurpose reservoir in the northern Atlanta metropolitan area (Fig. 1). The project was conducted in five phases (watershed characterization, water quality modeling, on-going monitoring plan, stakeholder and public participation, and watershed protection implementation plan) and followed Georgia Environmental Protection Division guidelines.

A major element of this study was the projection of annual total phosphorous loads at two distinct points within the watershed. At these "compliance" points, total phosphorous water quality standards have been established in an effort to limit the amount of phosphorous conveyed to an area of Allatoona Lake known as the Little River embayment.

This paper summarizes the watershed assessment project and highlights salient observations, results, and conclusions regarding current and projected water quality within the Little River watershed, and consequently within the Little River embayment.

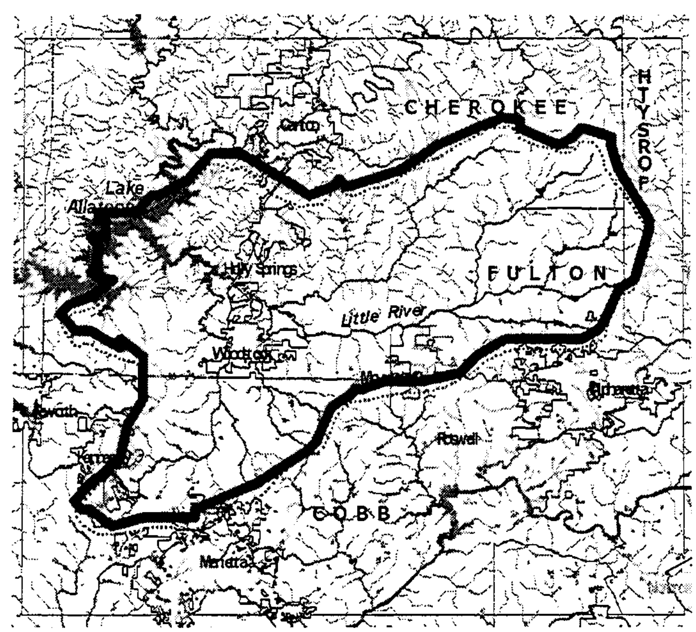

Figure 1. Little River watershed study area.

WATERSHED CHARATERIZATION

Water quality monitoring

Water quality was monitored at 17 stations and at two reference streams. Ten stations were on streams in the southern urban portion of the watershed, five in the northern rural area, and two in a section of new development and urban and industrial land uses.

Grab samples were collected, preserved, and analyzed following EPA (CFR, 1998) or other approved methods. Samples were collected during periods of both dry and wet weather and analyzed for five *in-situ* and 19 laboratory parameters. Dry weather was defined as a period of at least 72 hours since the last rainfall while wet weather means a period following at least 0.1 in. of rainfall (DNR, 1999). Typically, three to five samples were collected during dry and wet weather at each station for each parameter.

***In-situ* parameters.** Measurements of in-stream pH, conductivity, temperature, and dissolved oxygen were made using a Hydrolab Minisonde® 4a. Data showed that all streams met water quality standards for temperature and dissolved oxygen. A few individual pH measurements were outside the water quality standard range. No numeric water quality standard exists for turbidity or conductivity. However, increases in turbidity at the reference stations after rain events were low compared to the much larger increases noted at most of the stations in the southern and rural sections of the watershed. Specific conductance measurements decreased markedly following rain events at stations downstream from known point sources.

Fecal coliform, solids, hardness, and BOD_5. Most stations in the watershed showed significant increases in fecal coliform counts after rain events (Fig. 2). The graph indicates several potential water quality violations in both rural and urban areas of the watershed. Reference station fecal coliform data were well below relevant standards.

Dry weather suspended solids concentrations were low at all stations and increased only slightly after rainfall at the reference stations. Increases in suspended solids concentrations after rain were relatively low at the northwest stations, but increases observed at both the southern and northern stations were generally large.

Dry weather total dissolved solids at stations below known point sources were significantly higher than at other stations in the watershed and decreased markedly after rainfall. Hardness values at all stations were indicative of very soft water with the exception of Blankets Creek (below a point source) where hardness was approximately 10 times that measured at other stations in the watershed. With one exception (Blankets Creek), BOD_5 values were below the detection limit.

Nutrients. Concentrations of all forms of nitrogen and phosphorus measured in this study were low at the reference stations. One station below a point source had elevated levels of ammonia relative to other stations in the watershed. Ammonia decreased significantly at this station after rainfall, an effect opposite that observed at most other stations.

Dry weather dissolved ortho-phosphate and total phosphorus concentrations were significantly higher at stations downstream from point sources relative to other stations in the watershed (Fig. 3). Both dissolved ortho-phosphate and total phosphorus concentrations were much higher at Blankets Creek (below a point source) than at any other station. Many streams in the watershed had average total phosphorus concentrations greater than 0.1 mg/L P with nonpoint source inputs producing significant increases after rainfall.

Metals. With the exception of zinc, all dissolved metals concentrations measured were below the laboratory detection limit. Individual dry weather sample concentrations of dissolved zinc exceeded the water quality standard at three stations in the watershed and at the reference stations.

Habitat assessment and biological monitoring

Biotic integrity monitoring was conducted during late spring at the same locations where water quality samples were collected and included an assessment of fish and benthic macroinvertebrate communities and their habitats using standard protocols (DNR, 1997).

Many of the monitoring stations were obviously impacted by sedimentation and silt deposition, with sedimentation and bank erosion the primary causes of habitat degradation observed in this study.

Habitat. Habitat assessment scores for the reference monitoring stations indicated relative high quality, resembling “least impacted” habitat. With one exception, the smaller monitoring stations scored in the “suboptimal” category. Two large monitoring stations were rated as “suboptimal-marginal”, while one station received the lowest habitat rating of “marginal-poor”. All other large stations were rated as having “marginal” conditions based on their habitat component scores.

Macroinvertebrates. The largest group of macroinvertebrates found at most of the stations was the midgefly larvae (chironomids). In general, a high number of chironomids reflects impact and degradation

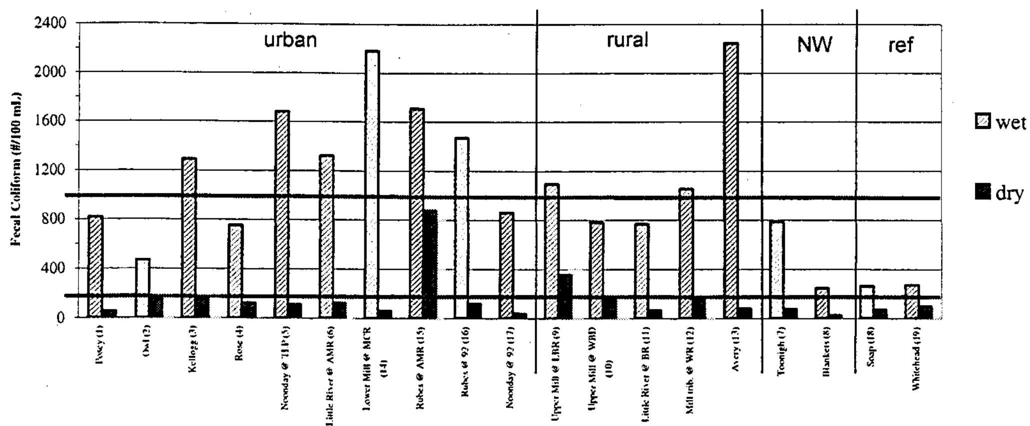

Figure 2. Geometric mean fecal coliform counts at watershed and reference stations. Lower horizontal line indicates the May-October water quality standard. Upper horizontal line is the November-April standard.

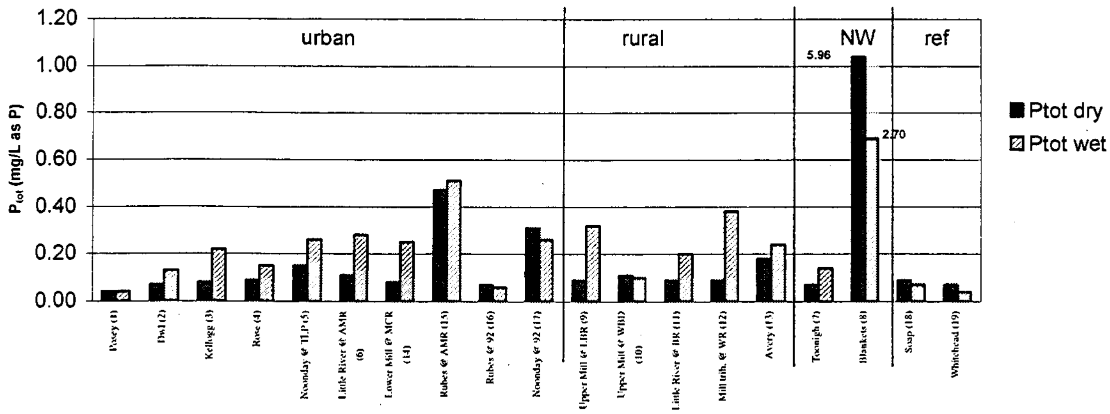

Figure 3. Average dry and wet weather total phosphorus concentrations in the Little River watershed.

to the system (Hilsenhoff, 1991).

No monitoring stations received the best rating of "very good" based on macroinvertebrate scores, indicating reduced biotic integrity compared to reference monitoring stations. Only three stations scored "good" when compared to reference streams, with the rest scoring "poor" or "very poor". The most noticeably impacted stream was Blankets Creek where virtually every hard surface in the stream was covered with blackfly larvae. These organisms are generally widely distributed, even in high quality streams, but such large numbers indicate water quality perturbations (Hilsenhoff, 1991).

Fish. In general, the monitoring stations had a good diversity of fish. Centrachids (sunfish), which prefer lower velocities and more cover and can thrive on soft substrates, dominated in the larger streams. The Cyprinids (minnows) were more common in the smaller, swifter streams. The federally threatened Cherokee darter was found in Kellogg and Rose Creeks, as well as at both reference stations. Overall, Index of Biotic Integrity scores generally indicated "fair" to "good" conditions.

WATER QUALITY MODELING

Two computer models, the Generalized Watershed Loading Function (GWLF) and the Water Quality Analysis Simulation Program (WASP), were customized and linked in order to estimate current and future pollutant loads of total phosphorous, fecal coliform, sediment, cadmium, lead, and zinc within the Little River watershed.

The watershed was divided into 35 sub-watersheds and the GWLF model was calibrated to a nearby USGS flow-monitoring station and validated versus field-collected flow data. Current and year-2020 pollutant loads were modeled for each sub-watershed. This procedure facilitated a comparison between estimated current and future pollutant loads and between the model-estimated and regulatory total phosphorous limits at the two compliance points on the Little River and Noonday Creek.

The model estimates that regulatory annual total phosphorous load limits will be exceeded for both the current and future years. Nonpoint sources, particularly medium density residential areas, are the main reason for exceeding the regulatory load limits. Also, the existing industrial point source on Blankets Creek is identified as a significant source of total phosphorous reaching Allatoona Lake.

Sediment, fecal coliform, and dissolved metal loads also are expected to increase in the future as more development occurs within the watershed.

ON-GOING MONITORING PLAN

Results from the water quality and modeling efforts were used to develop an on-going monitoring plan based on observed and predicted areas of water quality impacts. The number of parameters monitored will be reduced in order to focus on suspended sediment, fecal coliform and phosphorus. Monitoring station locations will be altered in order to concentrate on the Little River itself and its major tributaries. Samples will be collected on a quarterly basis, and we will attempt to sample during periods of both wet and dry weather each quarter. Also, a concerted effort will be made to add to the phosphorus database at the compliance points on the Little River and Noonday Creek.

STAKEHOLDERS AND PUBLIC PARTICIPATION

A group of local stakeholders representing various interests in the watershed met on several occasions to review progress of the watershed assessment and to evaluate the proposals for watershed protection and on-going monitoring. Recommendations from the stakeholders group will be submitted to the Cherokee County government for review and implementation.

WATERSHED PROTECTION IMPLEMENTATION PLAN

Plans are already underway to deal with point source pollution problems in the watershed. Numerous structural and non-structural measures (increased stream buffer widths, improved erosion control, sediment retention basins, constructed wetlands, reduction of impervious areas, etc.) are documented in the literature for controlling nonpoint source water pollution. The colossal costs associated with watershed protection programs are undisputed, typically tens of millions of dollars over a couple of decades.

Because the amount of data acquired over the course of a watershed assessment is typically small, we believe it would be irresponsible to base a multi-million dollar watershed protection program on limited data. For this project, we felt that a more reasonable and responsible approach was to propose a program that emphasizes an intensive field data collection effort for a period of five years. As statistically relevant field data become available, a dynamic watershed protection program beginning with intensive public education can be formulated. Cherokee County government recently adopted policies designed to protect water quality that include watershed based planning & development, zero tolerance levels on erosion/sedimentation from construction sites, and stream buffer widths of 75 ft. The effect of these newly adopted policies on ambient water quality improvement will be assessed by analysis of the stream-monitoring database as it expands.

SUMMARY

This study identified altered water quality in the Little River watershed due to both point and nonpoint sources. Chemical water quality data were evaluated relative to water quality standards and reference streams in conjunction with an assessment of biological integrity to identify current water quality conditions. However, evaluation of water quality was limited by the absence of water quality standards for most of the parameters measured. An on-going monitoring plan will increase data availability so that expensive watershed protection measures can be selected based on a sound database. The watershed protection plan will focus on eliminating point source impairment and on watershed based analyses, planning and zoning by the Cherokee County government for the control of nonpoint source impacts.

REFERENCES

CFR (Code of Federal Regulations), 1998, Section 40, Part 136, U.S. Government Printing Office, Washington, DC.

DNR (Georgia Department of Natural Resources), Environmental Protection Division, 1999, Planning for Domestic Wastewater Systems.

DNR (Georgia Department of Natural Resources), Environmental Protection Division, 1997, Draft Standard Operating Procedures: Freshwater Macroinvertebrate Biological Assessment.

Hilsenhoff, W.L., 1991, Diversity and Classification of Insects and Colembola, in J.H. Thorp and A.P. Covich, eds., Ecology and Classification of North American Freshwater Invertebrates, Academic Press, San Diego, CA.