



# ***Etowah Habitat Conservation Planning Grant*** **Report on Year Two Activities and** **Completion of Objectives**

Report for the U.S. Fish and Wildlife Service  
Prepared by the Etowah HCP Advisory Committee

June 21, 2004

## **Introduction**

This document reports on the tasks completed in the second year of funding of the Etowah Regional Habitat Conservation Planning process, which covers the period February 2003 to March 2004. The purpose of the process is to develop a multi-jurisdictional HCP covering all of the imperiled aquatic species of the Etowah Basin, in which the permit holders are local governments that commit to managing growth and development in ways that minimize impacts to aquatic organisms. Although this is a four-year project, for each year we have established and completed a defined set of objectives.

The decision-making body for the Etowah HCP is the Steering Committee, the voting members of which consist of representatives of each of the participating jurisdictions. The working staff for the Etowah HCP, called the Advisory Committee, is comprised primarily of faculty and staff at the University of Georgia, Kennesaw State University and the Georgia Conservancy, working with the Georgia Department of Natural Resources and the U.S. Fish and Wildlife Service. Responsibility for completing objectives generally resides with the Advisory Committee, working in close cooperation and consultation with the Steering Committee. The Advisory Committee includes Bud Freeman, Laurie Fowler, Liz Kramer, Seth Wenger, Beth Gavrilles, Erin Dreelin, Bill Bumback, Heidi Millington, Jeffrey Boring, Elizabeth Pate, Libby Ormes, and Garnett Stokes of the University of Georgia; Mary Freeman of the U.S. Geological Survey; Bill Ensign of Kennesaw State University; Mike Harris of the Georgia Department of Natural Resources; Aaron Valenta, Mike Hobbs, Robin Goodloe, and Sandy Tucker of the U.S. Fish and Wildlife Service; Candace Stoughton of the Nature Conservancy; Ron Papaleoni and Ginger Rayburn of the Lake Allatoona Preservation Authority; Susan Kidd and Doug Parsons of the Georgia Conservancy.

In the Fiscal Year 2002 Habitat Conservation Planning Assistance Grant Proposal for the Etowah Regional HCP, we established the following major objectives:

1. Convene regular meetings of the stakeholder steering committee to receive updates from the HCP development team (the Advisory Committee) and provide direction to the project.
2. Organize public meetings with target stakeholder groups to increase awareness and to identify problems and concerns that must be addressed in the HCP development process.
3. Create outreach and educational materials as part of an integrated public education campaign.
4. Develop a regional greenspace protection plan for the Etowah that focuses on permanent protection of land in the most critical watersheds.
5. (a) Characterize the effects of poorly managed stormwater runoff on aquatic species through a correlative examination of multiple variables in 30 watersheds in the basin; (b) identify the relative contributions of construction sites and channel erosion to sedimentation of habitat; (c) review information on the performance of stormwater treatment systems, including the use of regional vs. onsite detention.

We met all of these objectives with the exception of #5b. After beginning that project, we discovered that methods for accurately determining the sources of sediment, and for measuring quantities of sediment produced by various sources, are still in their infancy. It became clear that meeting this objective would require additional expertise than was currently represented on the Advisory Committee, and pursuing the question without such expertise would be an inefficient use of scarce funds. Accordingly, we enlisted the aid of David Leigh, a fluvial geomorphologist, who will take the lead in addressing the question beginning in late 2004. In the meantime, we identified three new objectives and redirected funds toward these:

6. Determine the extent to which road crossings serve as barriers to fish movement and assess feasibility of alternative road crossing design criteria, by (a) conducting mark-recapture studies on fishes above and below different road crossing types; (b) surveying road crossings, assessed the ubiquity of different culvert types, and measuring physical characteristics at different types of road crossings; and (c) collecting cost information on different road crossing types.

7. (a) Develop site design guidelines and stormwater regulations to reduce impervious cover and to minimize impacts of stormwater runoff on aquatic biota; (b) create consensus among local officials on the implementation of riparian buffer ordinances; (c) hold meetings with local officials to develop more effective policies for erosion and sedimentation control.
8. Research adaptive management policies and the use of a regional transferable development rights program as a growth management tool.

We met all of these additional objectives. On the following pages we summarize the activities on each of these topics.

## **1. Steering Committee Meetings**

The Etowah Regional HCP Steering Committee includes 20 voting members, each representing one of the participating counties or municipalities. In addition, Steering Committee meetings are regularly attended by representatives of other HCP partners, including the U.S. Fish and Wildlife Service, U.S. Geological Survey, The Nature Conservancy and Georgia Department of Natural Resources, who participate in discussions and provide information and insight. Meetings are planned and staffed by the Etowah HCP Advisory Committee. The schedule of meetings is intended to provide regular contact with and among Steering Committee members, without burdening them with excessive or unnecessary meetings. Five Steering Committee meetings were held over the course of the project year, and are summarized below.

### **February 20, 2003**

Steering Committee Members present: 10. Total attendance: 26

#### *Agenda:*

- Presentation on public survey results
- Presentation on natural history of Etowah and its fishes
- Presentation on current ordinances in place in Etowah counties
- Presentation on HCPs by FWS

- Discussion of HCP Mission statement
- Discussion of timeline and committees

*Steering Committee Actions:*

- SC adopted mission statement
- SC voted on top priority types of development activities for inclusion in HCP
- SC agreed to include larger municipalities in SC; directed AC to determine viability/necessity of including smaller municipalities on SC. In any case, smaller municipalities to be kept informed.
- SC decided to establish stakeholder committees in each county (vs. one large stakeholder committee.)
- SC agreed that outreach/education materials will be approved by SC before use.
- SC voted to direct AC to focus on erosion and sedimentation control, road crossings, and riparian buffers first.
- SC directed AC to develop an education plan to present at next meeting

**May 1, 2003**

Steering Committee Members present: 10. Total attendance: 20

*Agenda:*

- Presentation on and discussion of Transferable Development Rights (TDR) program for the Etowah
- Presentation of Public Involvement and Education Action Plan
- Discussion of Stakeholder Involvement Committee
- Agenda and process for initial public meetings
- Update on research of priority implementation options

*Steering Committee Actions:*

- SC directed AC to continue work on development of a regional TDR program, without committing to implement such a program
- SC voted not to make public an initial prioritization map of Etowah subwatersheds

## **August 14, 2003**

Steering Committee Members present: 8. Total attendance: 21.

### *Agenda:*

- Discussion of Outreach Coordinator position
- Status of local Stakeholder Committees and public meetings
- Discussion of Message Statement
- Presentation/discussion of Metropolitan North Georgia Water Planning District (MNGWPD) requirements
- Update/Discussion of Management Tools (Riparian Buffers, Erosion and Sedimentation Control, Stream Crossing Guidelines)
- Discussion of Next Management Tools to be Studied

### *Steering Committee Actions:*

- SC members decided on office location(s) for Outreach Coordinator
- SC members directed AC to edit message statement
- SC directed AC to make its recommendations consistent, where possible, with the MNGWPD plan
- SC directed AC to set up meetings with the 3 non-MNGWPD counties to discuss riparian buffer issue, with goal of asking them to adopt MNGWPD ordinance
- SC directed AC to conduct judicial training on E&S control
- SC directed AC to begin work on stormwater control and subdivision regulations
- SC requested that UGA Etowah Practicum students begin process of initial drafting of HCP framework and Incidental Take Permit

## **October 16, 2003**

Steering Committee Members present: 11. Total attendance: 31.

### *Agenda:*

- Presentation on environmental impacts of different development patterns in the Etowah
- Review of site design provisions in county codes (*re* stormwater management)

- Update on riparian buffer regulation discussions
- Update on E&S judicial training
- Introduction of Outreach Coordinator
- Kickoff and stakeholder outreach meetings

*Steering Committee Actions:*

- SC members appointed members for Stormwater/Better Site Design Technical Committee
- SC directed AC to continue to work on “how” and “where” to develop aspects of HCP together, rather than in two separate phases

**February 13, 2004**

Steering Committee Members present: 14. Total attendance: 36

*Agenda:*

- Discussion of Adaptive Resource Management
- Discussion of Water Supply Planning
- Stormwater/Better Site Design Committee report
- Demonstration and discussion of visualization model for growth scenarios
- Enforcement Issues report
- Outreach report

*Steering Committee Actions:*

- SC agreed to provide data for growth scenario modeling

**2. Public Meetings with Stakeholder Groups and Other Outreach Activities**

In addition to a summary of public meetings, this section provides an overview of the entire Etowah HCP Public Outreach and Involvement Program.

We have incorporated a two-pronged outreach approach in the Etowah HCP, involving (a) targeted outreach to members of the watershed community with specific and deep interests in the outcome of the planning process, and (b) broader, more general outreach to the larger watershed community. The HCP outreach efforts were designed to elicit local perspectives and regional cultural contexts so that they could be incorporated into the planning process. This goal was to be accomplished by identifying and involving key stakeholders and community members with the ability to give local, technical feedback and input into the plan, as well as members of the community able to serve as conduits of information to larger local groups and facilitate the building of a local base of support for the HCP. Concepts from the fields of social networks research and community development provided the guiding principles for these outreach efforts.

### *Social Networks*

Social networks are the relationships that connect community members to one another. Network linkages may be based on family relationships, friendship ties or professional acquaintanceships, for example. Using a social networks approach for outreach utilizes the strength and capacity of linkages among community members to spread information and gather input throughout the community and to bring additional community members into the planning process. In order to successfully use a networks approach one must understand the types of networks important in a community as well as the network roles played by specific members. For example, network “stars”—well connected individuals—may play important roles in spreading information to a large group at once, or in arranging introductions with key members of the community. Network “isolates”—individuals with few linkages—may represent disenfranchised members and perspectives of the community and individuals with whom linkages should be fostered. A networks approach may also identify key individuals who can serve as entry points into community groups.

For the purposes of the HCP, entry points into local networks were provided by Steering Committee members, participant observation, and informal interviews with community members. These individuals and experiences have identified community members to involve in the plan, and the personal networks of these individuals have been used to spread information and bring additional community members into the planning process. Utilizing a networks

approach allows outreach to become a local process, based on local relationships, rather than a process driven by outsiders. Additionally, networks based outreach allows the focus and connections individuals have with the HCP to be based on relationships with other community members rather than on intangible or impersonal components of the natural environment.

### *An Attachment Community*

Communities of attachment form among individuals who share common feelings for particular places and interests. Natural resource-dependent communities, such as timber villages, for example, are good examples of attachment communities because members often have strong feelings for locations within the community, such as local forests or sawmills, and common interests in the health of local natural resources. The goal of the Etowah HCP outreach program is to facilitate the development of a watershed-wide attachment community in the Etowah.

Concentrating on forming network linkages among and between members of diverse industry and community groups is designed to allow personal linkages—based on shared interests in the health of the region, local communities, local industries, the local economy and the success of the plan—to form among the participants in the planning process and among members of their networks. The feelings of attachment shared by these individuals will then spread through the broad community outreach campaign and local linkages to the wider community. The process of developing an attachment community will culminate in the formation of an active support base for local elected officials voting to adopt the HCP.

### *Targeted Outreach*

Targeted outreach for the HCP is occurring in four phases: 1) identification of community types and members to include in the planning process; 2) building of network linkages among community members by participating in HCP planning activities; 3) building of network linkages across communities involved in the planning process; and 4) facilitating support for the adoption of the HCP at the local level. It is important to recognize that the four phases are not independent parts of the process with clear beginnings and ends. Different regions of the watershed, and different communities within the watershed's larger geographic community, may be in different phases of the targeted outreach process simultaneously. Phase 1 began in October

2003, when communities and community members were first identified by members of the HCP steering committee, as well as through observations and informal interviews with members of the watershed's geographic community. As individuals were informed about the HCP, and brought into the planning process, they were asked to recommend other community members for inclusion. Once a significant number of individuals, representing broad geographic and interest communities, had been identified, Phase 2 of the outreach process began. Throughout winter 2003 and spring 2004, several events were held to allow targeted stakeholders to participate in the HCP planning process. The goal of these events was to allow members of the watershed community to begin developing linkages, based on participation and support for the HCP, with other community members. For example, several focus groups were held for members of the development industry community. Phases 3 and 4 of the outreach process will take place in Year 3 of the Etowah HCP Planning Process.

*Summary of Targeted Outreach Activities:*

We held over 100 meetings with stakeholders who can be placed in a range of categories, including private landowners, agricultural producers and forestry professionals. Because the Steering Committee voted not to include forestry and agricultural activities under the Etowah HCP, however, we did not make a concerted effort to target these groups in Year 2. Targeted outreach was focused on three groups.

*1. Developers and Homebuilders.* We created stakeholder involvement committees for development-industry professionals in several counties. A total of 12 meetings of these "Developer Focus Groups" were held during Year 2. These meetings provided opportunities to introduce and explain the Etowah HCP and hear the range of ideas and concerns of the development community. We also met individually with professionals in development-related industries and met with the Cherokee County Chamber of Commerce.

*2. Environmental Organizations.* We met with most of the active local environmental organizations in the Etowah, including the Coosa River Basin Initiative, Lake Allatoona Preservation Authority, Mountain Conservation Trust, Forsyth Forest Conservation

Group, Mountain Stewards, Georgia Mountain Land Trust, and the Upper Etowah River Alliance.

*3. Local Government Officials.* Local government officials are intimately involved with the Etowah HCP via the Steering Committee. In addition, we held dozens of meetings with local elected officials and staff to discuss both general and specific aspects of the Etowah HCP.

#### *Broad Community Outreach*

Broad community outreach efforts have focused on community groups and individuals with more general interests in the health of the region and success of the habitat conservation plan. The purpose of this broad outreach campaign has been to educate community members and groups about the HCP through printed materials, presentations, and exposure in the mass media. One component of this is the “diner campaign,” in which restaurants throughout the watershed were provided with placemats that introduce the HCP and make connections with the cultural and historic resources of the region. The diner campaign uses the capacity of local restaurants such as diners, pizzerias, BBQ restaurants and coffee houses to serve as outlets to the broader community, at minimal cost.

#### *Summary of Broad Community Outreach:*

- We placed HCP placemats in restaurants around the Etowah watershed.
- We generated eight newspaper articles about the Etowah HCP in local and regional outlets, including a major feature story in the *Atlanta Journal Constitution*.
- Curt Gervich, Outreach Coordinator for the Etowah HCP, was featured in two radio interviews.
- We made five formal presentations to general civic or community organizations.
- We began creation of an outreach tool to aid in visualization of alternative development scenarios, based on the commercial *Community Viz* software and a Geographic Information System.

### *External Presentations:*

In addition to outreach within the Etowah watershed, we have made several presentations about the Etowah HCP to external audiences:

- Fowler, L.A., B.J. Freeman and S.J. Wenger (presenter). *The Etowah Regional Habitat Conservation Plan*. 2003 Georgia Water Resources Conference, April 24, 2003.
- Ormes, L., E. Dreelin, L. Fowler, and E. Pate. 2003. *Public participation in the development and implementation of the Etowah Habitat Conservation Plan*. Georgia Water Resources Conference, Athens, Georgia, 23-24 April 2003.
- Roy, A.H., M.C. Freeman, B.J. Freeman, S.J. Wenger, W.E. Ensign, and J.L. Meyer. 2003. *Investigating hydrologic alteration as a mechanism for fish species loss in urbanizing streams*. Symposium on Urbanization and Stream Ecology, Melbourne, Australia, 8-10 December 2003.
- Wenger, S.J., B.J. Freeman, M.C. Freeman, A.Roy and W.E. Ensign, 2003. *Assessing Effects of Development on Imperiled Fish Communities for the Etowah Regional Habitat Conservation Plan*. Ecological Society of America 2003 Annual Conference, August 6, 2003.

### **3. Outreach Materials**

The outreach activities described in the previous section required the creation of numerous physical materials. These included:

- A professionally-designed placemat based on the poster designed in Year 1, which has been distributed to restaurants throughout the basin.
- A revised fact sheet which provides background on the HCP.
- A media kit providing general information about the HCP for journalists.
- An HCP display for conferences and meetings.
- Two slide presentations, one providing general information about the endangered species act and HCPs; the other providing information about the imperiled species of the Etowah, and the process for creating, and proposed components of, the Etowah HCP.

## **4. Develop Draft Regional Greenspace Plan**

The Etowah Regional HCP is designed to minimize the impacts of development on aquatic systems, both through site-level regulations such as stormwater ordinances, and through landscape-level controls. The major purpose of the latter approach is to direct development away from highly sensitive areas, and toward locations where the environmental effects are low and the economic benefits are high. One tool for such landscape-level planning is a Greenspace Plan, which has been employed by many jurisdictions in Georgia in recent years. Encouraged by grants from the Georgia Community Greenspace Program, eligible counties and cities have identified 20% or more of their land area as desirable for permanent protection. However, because these greenspace plans follow jurisdictional boundaries, neighboring governments often have plans that are only moderately compatible, and opportunities to provide protection for resources of regional importance may be lost.

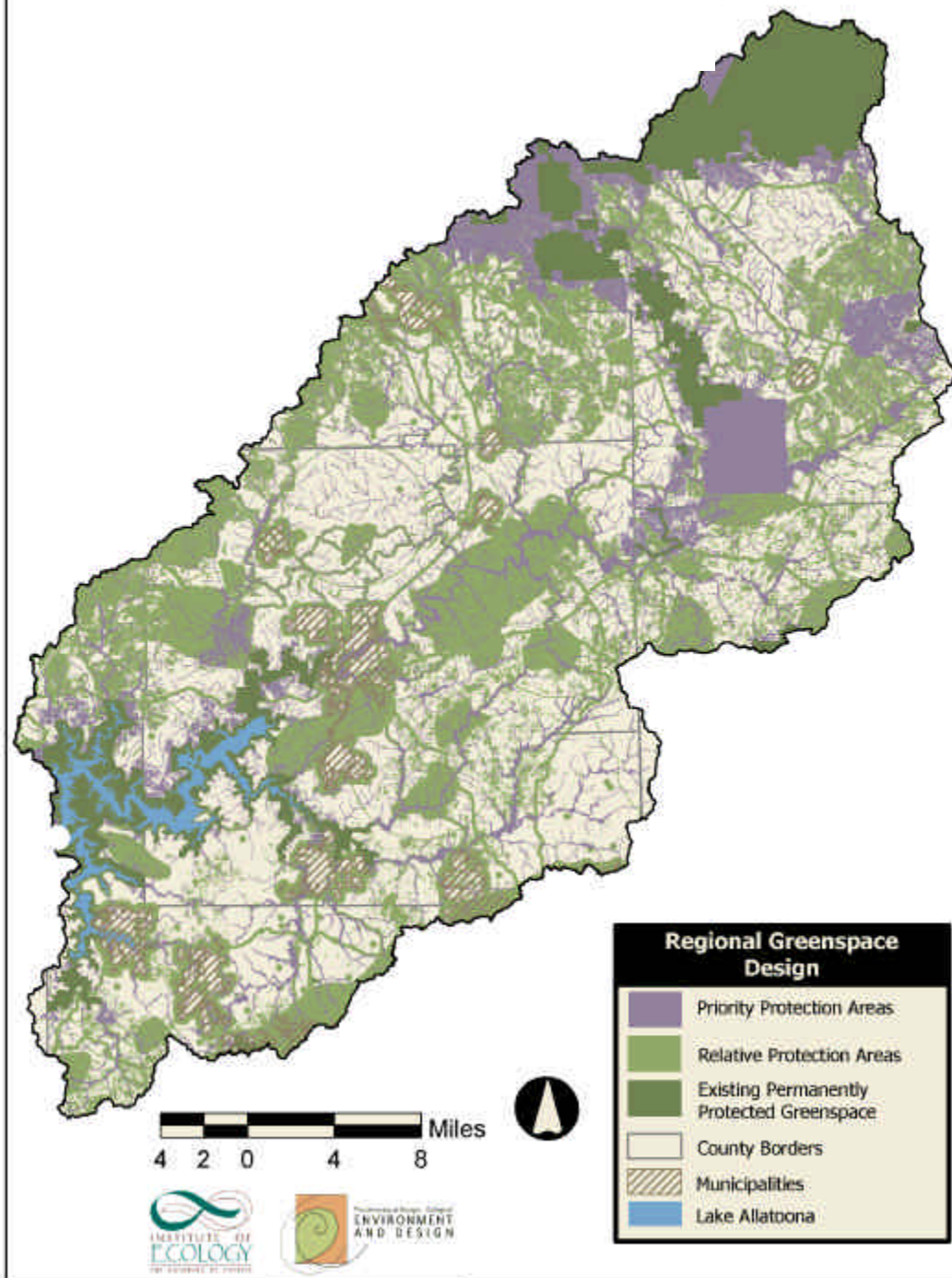
We worked with jurisdictions in the Upper Etowah (the area draining to Lake Allatoona) to combine local greenspace and comprehensive plans into an integrated regional greenspace plan. This was an initial, draft attempt which will serve as a basis for an even more comprehensive approach in the future. The plan took into consideration ecological information, such as the location of certain sensitive types of land features, but distribution of imperiled fish species was not given the weight it will have in the final version. Only Upper Etowah jurisdictions were included to keep the project at a manageable size.

Seven of the eight counties of the Upper Etowah Watershed (Bartow, Cobb, Cherokee, Fulton, Forsyth, Lumpkin, and Pickens) completed individual greenspace plans under the Georgia Greenspace Program. The eighth, Dawson County, did not create a greenspace plan but provided documents that addressed greenspace issues. The Upper Etowah Watershed Regional Greenspace Plan was developed using *CEDAR* methodology, which combines the information from cultural, ecological, developmental, agricultural, and recreational resources into one greenspace design. This methodology was chosen because each of these issues was addressed in each of the Etowah counties' greenspace plans. Throughout the process there was constant

information flow between local governments and University of Georgia staff via workshops and individual conversations.

Greenspace areas were identified as currently protected, Priority Protection Areas (high priority), or Relative Protection Areas (lower priority). The priority protection areas covered 25% of the Upper Etowah Watershed, while the other greenspace areas make up 40% (Figure 1). All eight counties considered water quality a top concern, and therefore riparian areas were identified as priority protection areas in all jurisdictions. Other greenspace areas were based on local conditions and locally identified needs. The Regional Greenspace Plan will be revised to focus more explicitly on aquatic biota and expanded to include all jurisdictions participating in the HCP in 2004.

**Figure 1. Draft Greenspace Areas of the Upper Etowah Basin.**



## **5a. Impacts of Stormwater Runoff**

The policies and ordinances implemented under the Etowah Regional HCP should reflect the best available scientific understanding of how urbanization impacts sensitive aquatic species. Based on previous research, we believed that stormwater runoff from impervious surfaces was likely to be one of the most critical stressors to these organisms. However, advanced stormwater management can be significantly more expensive than conventional stormwater management; further, the causal mechanism by which runoff impacts aquatic species is not well understood, which limits our ability to mandate appropriate controls. Therefore, we conducted a research project to determine whether there was actual evidence of deleterious effects of stormwater runoff on species presence and abundance, and to increase our understanding of the mechanism. Our hypotheses were that (1) flow alteration from increased runoff causes physical alteration to habitat, through erosion and deposition; and (2) lower base flows decrease the availability of certain habitat types in urban streams. Work was begun on this project in Year One of the Etowah Regional HCP with a set of objectives that were completed at that time (see previous year's report). Using the same sites, we set and completed a new set of objectives for Year Two, which we report on here.

### *Data Collection*

We collected continuous stage height data at sampling stations in 30 small (9-21 km<sup>2</sup> drainage area) watersheds using AquaRod® stage recorders. We collected water quality data (specific conductance, pH, dissolved oxygen, turbidity, temperature) on a quarterly basis. We translated the stage height data into nine baseflow and 18 stormflow variables that we expected to respond to impervious cover and that could affect fish assemblages. These included variables such as magnitude and duration of both high and low flow events.

We sampled fishes in August through October 2003 at each of the 30 sites. Block nets were set every 50 m for a 150-m reach in each stream. The three adjacent 50-m reaches were sampled in a single pass, to provide replicates that facilitate estimation of species richness. One randomly selected reach of the three was sampled with two additional passes, to provide species abundance estimates based on depletion. During each pass, all habitats were thoroughly sampled using a

backpack electroshocker (Model 12-B; Smith-Root® Inc): areas with sufficient flow were sampled by kicking with an 8-ft seine held downstream; pool habitats were sampled with dip nets; and sandy, shallow runs were sampled using seine hauls. Fishes were identified, measured, and released in the field or euthanized with buffered MS-222 and preserved in ~8% formalin for identification in the laboratory. The program CAPTURE® was used to calculate abundances and richness estimates, both for the entire assemblage and for subsets: endemic species, cosmopolitan species, fluvial specialists, lentic tolerants, and sensitive species.

We measured habitat variables at the thirty sites between July 2003 and March 2004. A Topcon® AT-F6 level and stadia rod were used to obtain elevations for a channel cross-section at the location of the AquaRod® and for calculating the energy grade line slope between riffle-tops for a 150-m reach. Three liters of bed sediment were collected from three riffles within each stream reach and brought back to the lab to determine % fines in riffle habitats. Sediments were dried, sieved, and weighed to determine mean % fines (< 2 mm) for each stream. Depth, velocity, and modal particle size were measured at 70 locations along the thalweg and modal particle size was also measured for 70 points along the centerline of the stream. Lengths of habitat units (riffle, run, pool) along the 150-m reach were also measured. Streambed rigidity was determined at 10 transects using a heavy chain by measuring the length of the chain along the stream bottom and dividing that by the wetted width.

Steady-flow analysis in HEC-RAS® (Version 2.2, Hydrologic Engineering Center, U.S. Army Corps of Engineers) was used to determine the mean hydraulic depth for the 0.5-year recurrence interval (RI) flood at each site. Manning's n, stream slope, and cross-sectional area at the water level sensor were incorporated into the HEC-RAS® model for each stream. Discharges for the 0.5-yr RI flood were calculated based on basin area at each site using flood-frequency formulas derived for rural streams in the Georgia Piedmont.

Impervious cover for each watershed was calculated based on an impervious cover map produced by the Natural Resources Spatial Analysis Laboratory at the Institute of Ecology. Impoundments in the Etowah River basin were mapped from 1999 digital aerial photography.

## *Results*

Throughout the study period, many of the AquaRods® (24 of the 30) experienced periods of failure or improper function. To deal with this incomplete data set, analyses were divided by seasons based on AquaRod® downloading dates. Increased percent impervious cover was positively correlated with the frequency, magnitude, and duration of storm events above 50%, 75% and 100% mean stage of the 0.5-year RI flood during most seasons. Other measures of flashiness such as the rate of the rising and falling limb of the hydrograph were also positively related to impervious cover, except during high flow spring months when soil saturation likely masked any land cover effects. Increased duration of low flows associated with impervious cover only occurred during the autumn low flow period, and this corresponded to significant increases in richness of lentic tolerant species. Altered stormflows in summer and autumn were related to decreased richness of endemic, cosmopolitan, and sensitive fish species, and decreased abundance of lentic tolerant species. Species that were predicted to be sensitive to urbanization based on life history and other attributes were also related to stormflow variables after accounting for variation associated with % fines in riffles. Overall, hydrologic variables explained 20-66% of the variation in fish assemblage richness and abundance. The linkages between hydrologic alteration and stream fishes were potentially complicated by contrasting effects of elevated flows on sediment delivery and scour, and mediating effects of stream gradient. Further analyses are necessary to determine the relative importance of these habitat variables. We will continue to collect hydrologic data in order to get a more complete dataset and evaluate inter-annual differences in storm and base flows.

### **5b. Sources of Sedimentation**

As noted in the Introduction, this objective has been postponed, and replaced with new objectives (6, 7 and 8).

### **5c. Review of Information on Stormwater Treatment Systems.**

Because stormwater runoff is thought to be a major stressor to the aquatic species covered under the HCP (as discussed above), we reviewed the literature on the performance of various stormwater management practices. Traditionally, stormwater management has focused on flood prevention and conveying runoff away from private property as quickly as possible. This approach to stormwater control has been shown to cause severe changes to stream hydrology, geomorphology, and pollutant loads. Therefore, we wished to examine the range of stormwater best management practices (BMPs) that are used for this type of traditional stormwater control, as well as newer techniques that have been developed to minimize such problems. We focused especially on the use of infiltration BMPs. We also studied the benefits of regional stormwater management versus on-site stormwater management. Our major findings were the following:

- The most commonly used BMPs are traditional detention and retention systems. These are useful for preventing flooding but do little or nothing to manage pollutants or protect the channel from hydrologic and geomorphic change. However, modified BMPs designed to provide extended detention and water quality treatment are becoming more common in many areas.
- Both on-site and regional stormwater treatment systems can be effective at removing pollutants, but on-site systems are better at maintaining pre-development hydrology. Regional systems are not appropriate for new development except under exceptional circumstances, although they may be necessary for retrofitted stormwater management. The EPA has restricted regional detention systems in the Atlanta area because of negative effects.
- Properly installed infiltration BMPs have the highest pollutant removal capacity of all practices, and can be economical to install and maintain. These approaches are especially desirable because they mimic the pre-development hydrology more closely than detention-based BMP systems. However, proper site preparation is necessary for low-infiltration soils. Infiltration may not be feasible in areas of very shallow soils and very steep slopes.
- Filter systems, such as sand filters, are infrequently used because they are expensive to install and maintain. Biofilters, however, are as a rule less expensive and commonly used in combination with other BMPs. These include such practices as grass filter strips and certain types of bioretention.

- Open channel practices, such as grassed swales, can handle relatively small volumes of runoff and are useful when used in combination with other BMPs. They are inexpensive.
- Low Impact Development practices that minimize impervious cover may be the most cost-effective methods of stormwater management, since they prevent problems from occurring.

Based on these findings and the research conducted under Objective 5a, we developed a stormwater ordinance and guidelines for Low Impact Development (see Objective 7).

## **6. Road Crossings as Barriers to Fish Movement**

Many road crossings of streams, especially pipe culverts, appear to limit fish passage in an upstream direction. This has been well documented in the Pacific Northwest, where guidelines have been developed for culverts to ensure upstream movement by salmon. However, this phenomenon has received less attention in the Southeast, although anecdotal evidence indicates that passage through culverts is especially difficult for the small-bodied fish such as those to be covered by the Etowah HCP. Culverts that serve as movement barriers fragment populations and greatly increase the likelihood of local extinctions.

Many small stream fish cannot pass through culverts with high water velocity, or culverts that are perched above the water surface, especially if the culvert is overhanging (Figure 2). Very shallow flow through hard-bottom culverts may also represent an obstacle to upstream movement. Our goals with this portion of the project were to document the extent to which culverts served as barriers to fish movement and to develop draft guidelines for ensuring fish passage. The latter objective will be completed in the next project year.

### *Survey of Road Crossings*

We surveyed 70 road crossings in four size categories, representing a range of crossing types: single and multiple opening pipe culverts, box culverts, and freespan bridges. We measured physical and local hydraulic parameters to determine if culverts were likely to be passable or

impassable. We considered a culvert impassable if velocity was greater than 0.4 m/s or if the drop at the outlet was greater than 0.15 m to the water surface. The study found 16 impassable pipe culverts out of 29 (55% impassable), and 8 impassable box culverts out of 22 (36% impassable). The 18 freespans and arches all were considered passable. Many culverts appeared to be undersized, creating excessive velocities and scouring. Shallow water depths (less than 5 cm) occurred in many culverts.

**Figure 2. A typical pipe culvert with a drop to the tailwater surface (Camp Creek, Lumpkin County).**



### *Movement Study*

This portion of the study assessed movement of fish across three types of road crossings (clear span, box culvert and pipe culvert) in six small streams in the upper Etowah River basin. In each stream, continuous reaches directly upstream and downstream of the crossings were divided into three contiguous cells. Each cell encompassed a single pool and riffle sequence. Fish in each cell were captured, tagged with fluorescent elastomer tags, and released. Unique combinations of tag color and tag position allowed assignment of all marked fish to the cell of original capture. One month later, fish were collected from the same cells and inspected for tags. The recapture data allowed estimation of the average probability of both upstream and downstream movement

between contiguous cells that were not separated by a road crossing, as well as estimation of 95% confidence intervals around the movement probabilities. To determine if road crossings altered fish movement patterns, we compared the point estimates of movement between upstream and downstream reaches separated by a road crossing to the estimated movement between contiguous cells. If the individual point estimates from the reaches separated by road crossings fell outside the 95% confidence intervals of the point estimates for movement between contiguous cells, we inferred that the road crossing affected fish movements.

Across the six streams a total of 1407 fish were tagged and 418 tagged fish were recaptured during the second sampling period. Of the 418 fish recaptured, 132 were found outside their original cell of capture. The probability of upstream movement between contiguous cells was 6.3% (95% CI: +/- 2.8%) and the probability of downstream movement between contiguous cells was 3.5% (95% CI: +/- 1.9%). Movement both upstream and downstream across box and pipe culverts fell below the lower 95% confidence intervals of these estimates, indicating that these culvert types act as impediments to fish movement. In each of the streams with box culverts, a single fish moved upstream across the culvert while a single fish moved upstream through one of the pipe culverts. We observed no evidence that fish moved downstream across either box or pipe culverts. Movement across the clear span crossings did not differ from movement between contiguous cells.

**Table 1. Summary of recaptures and movement patterns.** Total moves indicates fish that were found outside the cell of marking during the recapture period. Crossing upstream indicates the number of fish that moved upstream across the road crossing and crossing downstream indicates the number of fish that moved downstream across the road crossing.

<b>Site</b>	<b>Crossing Type</b>	<b>Total Recaptures</b>	<b>Total Moves</b>	<b>Crossing Downstream</b>	<b>Crossing Upstream</b>
<b>Clark Creek</b>	Clear Span	91	21	5	7
<b>Noonday Creek</b>	Clear Span	85	37	3	6
<b>Scott's Mill Creek</b>	Box Culvert	97	31	0	1
<b>Unnamed Sweat Mountain Tributary</b>	Box Culvert	82	28	0	1
<b>Possum Creek</b>	Tube Culvert	36	8	0	1
<b>Hickory Log Creek</b>	Tube Culvert	28	8	0	0

*Cost Data*

Typical cost data for culverts and bridges proved difficult to obtain, as costs tend to depend greatly on site-specific conditions, as well as local costs for construction materials and labor. As a rule, freespan bridges are approximately 40% more expensive than similarly sized concrete box culverts. Part of the cost of freespan bridges is due to extra design time to meet structural integrity requirements. Pipe culverts are the least expensive option, especially for small streams. Thus, unfortunately, the cost of the different road crossing types appears to be inversely related to their ability to permit fish passage.

## **7. Policy Development for Riparian Buffers, Stormwater Management and Erosion and Sedimentation Control**

The Steering Committee voted to begin steps toward implementation of some ordinances and policy tools as soon as possible, rather than waiting until the end of the HCP development process to attempt to implement a large package of regulations at once. This decision was influenced by state requirements for many jurisdictions within the Metropolitan North Georgia Water Planning District to adopt a set of ordinances in 2004-2005, including stormwater ordinances, riparian buffer regulations, and others. Several of the counties and cities participating in the HCP are subject to this requirement, and many of these regulations overlap closely with those that were being considered for recommendation by the Advisory Committee. Therefore, the Steering Committee agreed that the regulations under the HCP should be based on those of the MNGWPD to the extent possible (acknowledging that additional requirements will be necessary under the HCP). The Advisory Committee also began working specifically with the four HCP jurisdictions that are not part of the MNGWPD to encourage them to be adopt similar ordinances in the same time frame.

### *7a. Riparian Buffer Ordinances*

The Advisory Committee agreed that the Model Riparian Buffer Ordinance that sets a minimum standard for jurisdictions in the MNGWPD was adequate for all the jurisdictions in the Etowah HCP. This ordinance requires protection of 50-ft vegetated buffers on all perennial streams with additional 25-ft setbacks for impervious surfaces. The Advisory Committee recommended that the four jurisdictions not in the MNGWPD also adopt similar ordinances. Officials representing these jurisdictions met in August, 2003, and agreed to this requirement, with the option of removing the requirement for the additional 25-ft setbacks if it proved too difficult politically. These jurisdictions are largely rural and historically have had powerful property rights movements that opposed riparian buffer regulations; therefore, we considered this a realistic compromise that would not unduly sacrifice protection of aquatic organisms, if other protective ordinances were also implemented.

### *7b. Stormwater Management Ordinances*

We developed draft Low Impact Development guidelines (site design guidelines) and a model stormwater management ordinance for jurisdictions participating in the HCP. Unlike most traditional stormwater regulations, the goal of these policies is to reduce impervious surface area and preserve the natural hydrology of a site as much as possible, thereby reducing the negative impacts on aquatic ecosystems. The regulations and guidelines were based on research into the effects of urbanization on aquatic ecosystems, the effectiveness of stormwater BMPs, and low impact development policies from across the nation. The structure of the ordinance was based on the model stormwater management ordinance developed by the MNGWPD, to facilitate adoption by local governments.

We convened a Stormwater and Better Site Design technical committee in March 2004 to develop site design guidelines for residential, commercial and industrial development and to develop a model stormwater management ordinance for the Etowah HCP. The committee was staffed by members of the Advisory Committee and included 32 local government engineers, planners and other staff, as well as builders and developers. The committee provided extensive input into the draft guidelines and ordinance. The resulting guidelines are highly flexible; the goal is to minimize stormwater runoff by whatever means suit the site rather than require specific BMPs. The committee recommended revising existing development and zoning codes to allow for this flexibility. The committee also developed a Site Design Checklist to assist developers and plan review staff in incorporating these techniques.

The committee made several revisions to the MNGWPD stormwater management ordinance, including:

- Clarification of bond and fee requirements
- Strengthening maintenance and inspection requirements
- Encouraging the use of Better Site Design credits

The most significant change was the addition of a new performance standard for stormwater runoff from new developments in “Sensitive Areas.” This standard requires infiltration of the first 1.2 inches of rainfall, unless precluded by site conditions. Sensitive areas have not been

defined and established yet, but will be based on areas essential to the survival of imperiled species.

### *7c. Erosion and Sedimentation Ordinances and Policies*

Members of the Advisory Committee met with local erosion and sedimentation control officials from five jurisdictions in the Etowah in three roundtable discussions initially coordinated by the Georgia Mountains Regional Development Center and the Upper Etowah River Alliance. The purpose of the meetings was to allow local enforcement officials to identify what they perceived as necessary reforms to improve the level and consistency of enforcement. These included:

- Better staffing levels
- Ability to track and punish repeat offenders
- Limitations on mass grading of sites
- Preventing misuse of agricultural and forestry exemptions
- Better training for judges, many of whom do not issue strong penalties for violations.

We conducted legal research to determine the best ways to address these needs. We drafted an ordinance to limit mass grading and investigated ways of tracking and punishing repeat offenders. Finally, we developed a judicial training program for erosion and sedimentation issues, which was presented at the Annual Meeting of Georgia State Superior Court and Administrative Law Judges in Savannah, Georgia on January 29, 2004. All the Superior Court judges for the jurisdictions participating in the Etowah HCP attended the training, as did judges from other watersheds. In the third year of the HCP we will pursue additional objectives related to improving erosion and sedimentation control, including training of magistrate judges, who have been given increased enforcement authority under recent amendments to the erosion and sedimentation laws, and to local government attorneys and district attorneys. The Steering Committee has also appointed an eighteen-member Erosion and Sedimentation Control Technical Committee, made up of engineers, local erosion and sedimentation control officials, and consultants, which has met three times since March 2004,. This committee will make further recommendations for improving erosion and sedimentation control.

## **8a. Preliminary Research into Adaptive Management Program**

### *Designing an Adaptive Management Process for the Etowah HCP*

This year we began the work of designing an adaptive management (AM) plan through communication with the Steering Committee and with research on methods for monitoring fishes in Etowah River tributaries. Our vision for AM is a process through which the participating governments, with the help of technical advisory committee(s), use feedback from monitoring data to adjust the management guidelines and regulatory provisions of the HCP as needed after implementation, to ensure the viability of the covered species. Achieving an adaptive process is challenging in part because it requires the ITP holders to be flexible with respect to future HCP provisions, which in turn mandates that the HCP participants have a clear understanding of why AM is needed and what it entails. We presented an overview of the AM process to the HCP Steering Committee in February 2004, in which we discussed the need for AM in the context of uncertainties implicit in HCP implementation; the steps required to design and apply AM; how modeling should be used in the AM process; and the need for post-implementation monitoring.

Designing an effective monitoring program will require identifying biological variables that are sensitive to changes in ecological integrity and that can be measured with sufficient precision. This year we evaluated the applicability of two model-based estimators of fish species richness and fish abundance as part of our research on hydrologic alteration effects in Etowah River tributary streams. In autumn of 2003, we re-sampled fish assemblages in each of the 30 tributary study sites, using a within-site replicated sampling design to estimate average species probability of detection and, from this, species richness. We used a multi-pass removal sampling procedure to estimate species-specific capture efficiencies and abundances. Results showed that spatial replication could be used to derive estimates of species richness, although the lengths of stream sampled may need to be adjusted, and that removal sampling was effective for the dominant fishes in the assemblages, including the Cherokee darter. Research over the next year will focus on estimating species detection probabilities and capture efficiencies for Etowah mainstem species. Results will guide our design of biological monitoring protocols.

## **8b. Preliminary Research into a Regional Transfer of Development Rights Program**

Protecting the Etowah's imperiled species will involve limiting development in significant portions of the watershed. One of the most equitable and cost effective ways of doing this is through a Transferable Development Rights program, whereby development rights are severed from a property to be protected, and sold for use on a parcel in an area where more dense development is desirable. TDRs are new to the state of Georgia. Members of the Advisory Committee drafted the only TDR program currently in place in Georgia to protect 40,000 acres of farmland in Fulton County. Our task for Fiscal Year 2003 was to determine whether a regional TDR program, involving multiple counties and cities, was feasible in the Etowah basin and to determine the basic structure of any such program. A team of graduate students and faculty researched that issue, incorporating a review of regional natural resource-based TDR programs from other parts of the country and presented their findings to the Steering Committee at its May 7, 2003 meeting. The Steering Committee authorized the Advisory Committee to proceed with a more in-depth analysis which is currently under way.