CITY OF GRIFFIN STREAM BANK RESTORATION PROGRAM

Lee Phillips[1], J. Erik Alford[2] and M. Brad McLeod[3]

AUTHORS: [1]Project Engineer, Integrated Science & Engineering, 118 North Expressway, Griffin, GA 30223; [2]President and [3]Vice President, Ecological Solutions Inc., 1936 Wellona Place NE, Atlanta, GA 30345.
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. Urban growth and development has adversely affected the water quality, stability, and biotic integrity of the streams within the City of Griffin, Georgia. The implementation of corrective measures for addressing stormwater runoff is an integral part of the City's Stormwater Management Program. The program objective is to improve water quality and biological function of the watershed by incorporating structural and non-structural Best Management Practices (BMP's). Stream Bank Restoration is a structural BMP that requires physical restoration and enhancement of features within the watershed to complete the water quality improvement process.

PROGRAM OVERVIEW

City of Griffin's Stromwater Management Program

In 1997, the City established a formal Stormwater Management Program (SWMP). As a result of this program, the City promptly created the Stormwater Department. To fund this new separate department, a Stormwater Utility was implemented, the first in the State of Georgia. The purpose of the Stormwater Management Program is to manage City watersheds and to create an example for other cities to consider when evaluating possible management models to achieve compliance with the upcoming National Pollution Discharge Elimination System (NPDES) Phase II permitting process and to address Total Maximum Daily Loads (TMDL's) for impaired or threatened waterbodies within the City. The Utility provides the City of Griffin with a financial mechanism from which to address both water quality and water quantity control issues that will be required as part of the Phase II permitting process. It will allow the City of Griffin to develop BMP's (stormwater management practices) to address nonpoint source pollution and flood control management (via infrastructure improvements) that, when implemented together, will ensure protection of the regions' water resources. The foundation of the City's SWMP was laid out as a roadmap to guide the Stormwater Utility and to track its progress of developing BMPs. Currently the City is focused on addressing existing water quantity and quality issues on a watershed or basin approach. Specific elements of this focus include hydraulic and hydrologic modeling and subsequent watershed assessments within each basin. In addition, the City is developing a Comprehensive Land Use Plan to prepare for future growth.

Stream Bank Restoration Program

In addition to the City's focus on addressing the water quality regulations, the SWMPs ultimate goal is to restore and protect the streams and associated stream banks, wetlands, and associated buffers that have been degraded over the years from inadequate stormwater management. The definition of Stream Bank Restoration is the act of restoring natural conditions of a degraded stream channel, including stabilizing the stream and stream bank, planting native trees, shrubs and grasses. Measurable results of this project would include reduced erosion and flooding, re-established buffers, improved water quality/habitat and enhanced stream aesthetics.

While the focus of these and similar programs have examined source control of non-point source pollution, the thrust of all of these programs has been to eliminate pollution prior to entering the receiving waters. Unfortunately, no measure will ever completely eliminate all pollution to the streams. In addition, many of the streams that receive this "polished" stormwater runoff are already in a state of extreme degradation. The City believes that healthy streams can finish the job that source controls begin and provide for even healthier waters downstream. By restoring streams to a pristine nature, the natural riparian vegetation within the stream corridor could effectively mitigate minor inputs of pollution that escape upland controls. The steps outlined above would complete the goals of the NPDES and TMDL

Programs by providing an end product of healthy streams and rivers in areas of extreme development.

Public/Private Partenrship

Stream mitigation can be especially expensive because of the required ecological and engineering studies and designs, and because of construction costs. The Department of the Army Corps of Engineers (ACOE) and other natural resource agencies recently estimated that construction costs alone for stream mitigation would average approximately $125 per linear foot; this cost estimate does not include design, coordination, or property acquisition. To address the important issue of project cost, the City has explored a joint venture relationship outlined below to assist with the project.

Alternative Funding

As stated above, the City believes that the use of stream restoration could be an effective tool in a municipality's arsenal of watershed management tools; however, the cost of this restoration can be an expensive endeavor. In order to provide for the financial resources for such a project the City has partnered with a private sector company to conduct the restoration project. The vehicle for this joint relationship is the ACOEs Stream Bank Mitigation Program. This program allows private organizations to restore degraded streams back to more natural conditions in return for the right to sell mitigation credits to other developers who need to impact streams to construct certain aspects of projects (e.g., road crossings and piping projects). Therefore, the City is able to restore its streams at no cost and the private sector company is able to fund the restoration work and even realize a financial profit through the sale of stream mitigation credits from its work on the streams.

PHASE I STREAM INVESTIGATION AND CHARACTEIZATION

The Stream Mitigation Bank Program was structured utilizing a phased approach. Phase I included stream investigations and characterizations to develop the stream mitigation prospectus. During the Phase I stream investigation all streams within the City were assessed for inclusion in the mitigation bank. Primary stretches for consideration includes systems on city-owned property; secondary stretches consist of systems located on private property. An emphasis was placed on locating degraded stream segment in the upper reaches of the watershed. During the initial investigation all streams within the City were generally classified based on the following:

- **Restoration** – Highly degraded, acceptable for full streambed and stream bank restoration.
- **Restoration or Enhancement** – Moderately degraded, acceptable for restoration of stream bank or streambed.
- **Enhancement** – Slightly degraded, acceptable for enhancement of aquatic habitat.
- **Preservation** – Intact streambed or riparian corridor acceptable for permanent preservation.

The existing condition of streams and associated riparian corridors within the City were classified as highly degraded resulting from streams having been channelized and severely entrenched by high velocity runoff. Stream bank undercutting and collapses are common through many of the reaches reviewed.

A total of 84,514 linear feet (16 miles) of streams within the city limits have been visually assessed and preliminarily categorized for enhancement, restoration and preservation and are incorporated into the City's GIS database according to restoration potential. The goal of restoring streams and riparian corridors is most effective if the full reach of a stream is the focus of restoration, rather than discontinued by sections of degraded reaches. Because of this, public coordination will likely be required since not all of the streams in need of restoration are located on City property.

The initial stream segments selected for inclusion into the stream bank project are identified on a Project Location Map for presentation in the stream mitigation prospectus. These segments were selected based on basin location, degree of degradation and accessibility.

PHASE II PHYSICAL RESTORATION

While Phase I is essential in determining the current condition of the stream, Phase II of the process involves the physical restoration of natural features with the watershed and its timely return to a more pristine condition of water quality and a restored biological function. Restoration could occur through natural processes; however, the return of many biological functions would require an extended period of time. By physically implementing efforts to restore the watershed ecosystems, and by protecting vegetated buffers, the efforts would serve as a catalyst to return water quality and biological functions to approaching pre-impact levels. Specific restoration measures are detailed in the following sections.

Rosgen Stream Classification

The Rosgen stream classification method provides a way to categorize streams based on general morphology, slope, and channel bed materials for comparison with other similar streams. The methodology produces 41 major stream types for which stream channel stability and stream bank erosion potential can be assessed. From the assessment, structures for in-stream and stream bank restoration can be selected based on the stream type category.

The following methods will be utilized for stream classification to acquire stream reference reach data. Reference reaches are established for each general stream type by locating representative transects between pools and riffles with no obstructions to flow. The locations of transects will be at the narrow width of the transition reach as it extends from a riffle into the head of a pool.

The cross-section of the channel reach is mapped identifying specific stream characteristics such as the elevations of the deepest point in the stream channel, the bankfull stage and flood prone stage. Additionally, channel and valley slope is determined utilizing surveyed maps with 2-foot contours along with recent aerial photography.

To accurately determine the composition of the streambed material, the Wolman method (streambed pebble counts) is conducted at transect locations based on the ratio of riffles/runs to pools. The intermediate axis of each particle is measured using calipers and classified into the Wentworth size classes. The cumulative percent composition is graphed and the d50 (diameter at which 50 percent of the particles collected were less than) is utilized for the mean bed material.

Channel stability is evaluated using the Pfankuch stream classification. The method utilizes 15 categories that are evaluated for one of four levels of stability (excellent, good, fair, and poor). Each level corresponds to a numeric index value that are summed and given a Pfankuch rating of excellent, good, fair, or poor.

Bank erosion potential is evaluated using Rosgen's bank erode-ability hazard rating guide. The guide incorporates an index value for ratio of bank height to bankfull height, ratio of root depth to bank height, root density, bank angle, surface protection, bank materials, and stratification. Index values are summarized and an erosion potential rating is assessed.

Utilizing the data from the above-mentioned methods, a stream type is determined. In-stream and stream bank structures that are best suited for inclusion in restoration of our determined stream type were chosen based on Rosgen's recommendations and limitations.

The same research methodology utilized on the impaired stream will be implemented within a reference stream to be identified nearby. This reference reach will represent the "goal" restoration for each impaired stream.

Utilizing the stream classification system, stream design will allow for suitable structures to be installed while maintaining the goal of the project. The goal of the restoration effort is to improve in-stream habitat conditions for aquatic biota and prevent further erosion of the stream channel.

STREAM RESTORATION MONITORING

The purpose of the stream restoration monitoring plan is to evaluate the following: 1) the construction/installation of restoration components, 2) the stability of the measures after installation, 3) the richness and diversity of the aquatic wildlife, 4) the water chemistry and 5) the survival of planted herbaceous and woody vegetation. This monitoring plan, based on the Rosgen method, utilizes qualitative measures to evaluate the structural, wildlife, and herbaceous components, in addition to quantitative measurements for evaluation of aquatic biota and woody vegetation survival.

The projects must be monitored for success twice annually to evaluate the effectiveness of the restoration effort in re-establishing natural/estimated water quality and biological conditions for a period of up to seven years.

Routine inspections of the restoration site will be conducted during construction to evaluate stream bank stabilization, planting methods, condition of planted material, erosion control measures, compliance with design plans, and progress. These inspections would be qualitative in nature, commenting on the condition and progress of the restoration.

Additionally, comprehensive inspections will be conducted on a quarterly basis for the first year and twice annually for the next four years following construction to accurately evaluate the effectiveness of the stream restoration projects. The purpose of the inspections is to project stabilization practices, evaluate evidence of erosion, bank failure, bare areas, bank sloughing, undermining, rill formation, settling, percent vegetation establishment, material integrity, sediment deposition and maintenance needs. The stability and effectiveness of stream bank restoration would be evaluated under low and high flow conditions. A minimum of one inspection during and after high flow conditions would be conducted. Overall structural conditions will be evaluated and noted for inclusion in the monitoring report.

Stream bank vegetative protection monitoring would measure the amount of vegetative protection provided to the stream bank and the near-stream portion of the riparian zone. This parameter provides information as to the banks ability to resist erosion as well as control stream scouring and shading within the stream.

Aquatic Biota Monitoring

The reference reach stations will be monitored for benthic macroinvertebrates as well as fish species. To assess the effectiveness of habitat structures, richness, diversity, and trophic assemblage, composition will be evaluated for both fish and benthic invertebrates annually for 5 years. Baseline samples of these indicators were collected as a component of the City's watershed assessments. These parameters provide a description of the aquatic community based on the number of species present (richness) the abundance of individuals within each species (diversity) and their relationship in the stream continuum concept (trophic assemblage), while also providing insight into the ecological stability and health of the stream ecosystem. These parameters are also common in several biotic indices to include the U.S. Environmental Protection Agencies 1999 Second edition of *Rapid Bioassessment Protocol for Use in Wadeable Streams and Rivers.* To acquire a representative sample of the aquatic population the standard methodology will include the use of electrofishing, kick seining, and dip net samples. If a reference stream can be located within the watershed, equivalent samples would be collected for restoration success comparison.

Water Quality/Chemistry Monitoring

As part of the stream restoration project, standard water quality/chemistry parameters will be monitored during wet and dry periods twice annually for five years to evaluate the effectiveness of the restoration effort in re-establishing natural/estimated pre-disturbance water quality conditions. Dry samples will be collected only after extended dry periods (72 hour having no more than 0.1inch of precipitation). In addition, wet samples will be collected within 24 hours of a precipitation event greater than 0.1 inch within a 24-hour period. Parameters to be evaluated include temperature, dissolved oxygen, pH, turbidity, conductivity, nitrates, nitrites, total phosphorus, total dissolved solids, total suspended solids, chemical oxygen demand, biological oxygen demand, fecal coliform, total copper, total lead, and total zinc. These parameters evaluate the components of the water column that support aquatic fauna and flora, limiting factor nutrients, and represent the pollutants and indicators of pollution commonly recorded in Metropolitan Atlanta streams. Baseline water quality samples have been acquired to determine the background concentration of pollutants in the stream and will be used to measure the success of the restoration efforts. Additionally, a reference stream will be located within the watershed and representative samples would be collected for restoration success comparison.

SUCCESS CRITERIA

Project success or failure for the mitigation sites would be determined following the fifth year of monitoring. A successful project should consist of the following components:

- Pollutant removal as the restored stream return to a natural state.
- A final survival rate of 70 percent of all planted vegetation. Final plantings per acre would be determined in pre-mitigation field studies that calculate average densities of the forested wetland systems within the project area.
- Proven periods of extended surface and subsurface hydrology measured monthly in shallow water wells for wetland restoration areas.
- Hydrophytic ground cover and recruited woody community development due to increased hydrology for wetland restoration areas. Determination that the herbaceous community is hydrophytic would be based on the prevalence index rating. The herbaceous community should have an index below three to be successful.
- Increase in wildlife utilization of the mitigation areas.

Annual reports would be generated for a period of 5 years. These reports would include information such as condition of streams, surface and groundwater levels, survival rate of planted species, natural recruitment of species, and natural development of a ground cover stratum in respect to hydrological periods.

SUMMARY

The City would benefit from potentially removing streams that are currently on the State's 303(d) list, and would be developing a model approach for other local jurisdictions as water quality continues to move to the forefront of growth and development issues. Additionally, the City could benefit from a reduction in water quantity as the vegetation matures and protects the stream bank and riparian habitat thus providing enhanced storage capacity in the floodplain. The Stream Bank Restoration Program would also prove to be a vital component of other regulatory programs such as the NPDES Phase II Stormwater Program, the TMDL Program and the Source Water Protection Plan. The City would also be a step ahead of potential required improvements and protections associated with expansion of facilities (for example, water reclamation discharge permits and associated watershed assessment studies) that require the approval of the EPD.

Furthermore, mitigation has long been a desperate need for many development projects. The need will become even greater with the recent changes in the ACOE's Nationwide Permits for working within wetlands and streams. To summarize, most impacts to open waters (streams, rivers, etc.) as well as impacts to wetlands that exceed 0.1 acre now require compensatory mitigation in an effort to achieve a no net loss of functions or acreage of streams and wetlands. Though historically mitigation banks were a desirable option for compensating for impacts, the above regulatory changes will make the option of purchasing credits from a bank even more desirable.

The assemblage of the MBRT would provide a platform for the City to initiate a partnership with the natural resource regulatory agencies to gain their understanding and support of initiatives to improve water quality. This opportunity would develop the contacts and support for the City of Griffin to continue to establish a model for other urban areas to follow.

ACKNOWLEDGEMENTS

We appreciate the assistance of Brant D. Keller and the City of Griffin Stormwater Department.