

NC STATE UNIVERSITY

EVALUATION OF THE STREAM RESTORATION AT TOWN BRANCH



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Water Quality Group

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Stream Restoration Evaluation Town Branch

Introduction and project description. In March 2006 the Water Quality Group at NCSU was awarded a monitoring contract with the Clean Water Management Trust Fund (2005A-900). The purpose of the contract is to establish an evaluation protocol to be conducted by the NCSU Water Quality Group on a subset of the CWMTF's stream restoration, stormwater and agricultural best management practices (BMP) projects. The program will include a field evaluation of 31 existing projects to provide a snapshot of project compliance and water quality benefits. Staff of the Water Quality Group was asked to prepare a rapid, yet effective evaluation of these projects. These evaluations were planned for a single project visit and to ultimately determine if these projects met their proposed goals. These projects include 18 stream restorations, 8 stormwater evaluations and 6 ag/BMP evaluations. The NCSU Water Quality Group will also conduct a more comprehensive monitoring program on a smaller subset of recently funded projects. The results will provide the CWMTF with a better understanding of the status and water quality benefits of these types of projects.

Stream Restoration Projects

- *Selection Criteria.* The staff at the Water Quality Group suggested that stream restoration projects be given priority if these projects had natural channel design (channel pattern, profile and dimension were all modified) and were longer than 1000 linear feet. Ultimately 18 stream sites were selected by review of CWMTF files and discussions with project managers.
- *Site Evaluation.* An evaluation protocol for stream restoration projects was developed by the staff at the NCSU Water Quality group (<http://www.ncsu.edu/sri/cwmtf/>). This protocol was field tested and subsequently sent to several agencies and individuals for external review. As part of this evaluation numeric values are given to several parameters with four categories: channel condition including bedform, dominant substrate material and streambank stability; riparian vegetation and floodplain condition; aquatic insect community structure and cover/refuge; and the condition and function of instream structures. Stream size, land cover, ecoregion and the number of years following construction were variable between projects making comparisons difficult. Each evaluation was conducted by a team of 8 trained individuals; a bedform and structure team, a vegetation team, an insect and cover team and a rover team who was responsible for photographs and GPS locations. A photographic log of each project can be seen at the NCSU Water Quality website.

Town Branch

Town Branch is a very small urban feature draining sections of the town of Andrews and is a tributary of the Valley River. The Hiwassee River Watershed Coalition noted that Town Branch was both laterally and vertically unstable due to historic channelization and an increase in stormwater runoff within the last 10-15 years. Channel instability and streambank erosion were common along the reach of Town Branch in the Andrews Recreation Center and was selected for restoration. This small feature was accounting for approximately 96 tons of sediment each year. The as-built evaluation (Buck Engineering) of the feature noted incision, instability due to a lack of riparian buffer and infrastructure concerns. The streambed lacked diversity and was mostly a long run with very few pools and riffles.

Project Name	CWMTF #	County	Ecoregion	Primary Landuse
Town Branch	2004B-401	Cherokee	Broad Basins	Urban
Year Constructed	Drainage Area	Length (ft)	Slope	Width (ft)
2005	0.57	1129	0.0078	13
Primary Goal of the Project		Secondary Goal of the Project		Repairs
Improve water quality and aquatic habitat by reducing sediment		Improve stream stability and improve riparian functionality		None to date.

Field Observations

The following tables summarize the observations of NCSU field team during the evaluation 19 June 2006. The first table lists the scores for the four major categories and the second table lists the index data for each assessment by category. The tables also contain for comparison the average scores for all CWMTF projects.

	Evaluation Categories	Town Branch	CWMTF average	Points possible
Channel Condition	Bedform Condition	15.0	13.5	20
	Dominant Substrate Material	12.0	9.7	12
	Streambank Stability	24.0	19.6	24
Riparian Habitat	Riparian Vegetation	11.0	12.1	20
	Floodplain Condition	17.0	18.3	24
Aquatic Insects	Community Structure	8.0	13.8	24
	Cover and Refuge	10.0	10.2	16
Instream Structures	Structure Function	14.9	14.4	16
	Structure Condition	11.0	10.8	12
	Total Score	122.9	122.4	168

Evaluation Categories	Proj.	Avg.
Community Structure		
Total No. abundant taxa	2	2.4
No. of abundant EPT taxa	1	1.9
EPT abundance	1	2.1
Abundant taxa in common	1	2.9
% shredders and predators	2	2.6
# indicator taxa	1	2.0
Cover and Refuge		
Cover type	4	4.3
Overall cover %	6	6.1
Bedform Condition		
Riffle habitat & location	3.5	2.4
Run or glide habitat & location	3.5	2.9
Pool habitat & location	3.5	3.1
Structure habitat & location	3.5	2.9
Additional CGU habitat & location	1	2.0
Dominant Substrate Material		
D50	4	3.3
D84	4	3.1
%<2 mm	4	3.3
Streambank Stability		
Bank height ratio	4	3.1
Root depth ratio	4	3.0
Root density %	4	3.6
Bank angle (degrees)	4	3.3
Surface protection	4	3.6
Near bank Stress	4	3.1

Index result tables. Possible scores generally ranged from 1 to 4 for each category. Instream structure condition is reported as an average for the three most common structure types. Structure function scores are averaged over all structures.

Evaluation Categories	Proj.	Avg.
Instream Structures		
Rootwad condition (n=11)	4.0	3.5
Riffle condition (n=12)	3.0	3.6
Crossvane condition (n=1)	4.0	3.5
Bank protection	3.3	3.6
Biological habitat	3.6	3.6
Grade control	4.0	3.7
Flow deflection/concentration	4.0	3.6
Floodplain Condition		
Floodplain connection	4	3.4
Vegetated buffer width	2	2.7
Floodplain habitat	1	2.2
Floodplain encroachment	2	2.8
Soil characteristics	4	3.5
Percent exposed or bare ground	4	3.7
Riparian Vegetation		
Structural complexity	1	1.9
Planted tree/shrubs/livestakes	4	3.3
Natural tree & shrub regeneration	2	2.1
Invasive exotic species	3	2.9
Streambank root mass	1	1.8

Discussion of Results

- **Channel condition**

Bedform. The bedform consists of stable riffles and pools as designed in the meandering stream. Riffles are long and steep with large rock placed in the beds. Pools are long and deep around the meander bends. The in-stream structures are stable, providing grade control, scour pools, and streambank protection as designed. There are very few additional CGUs providing habitat diversity.

Dominant Substrate. Substrate consists of a range of gravel sizes typical of this region. There does not appear to be a problem with excess sediment being transported from upstream.

Bank Stability. Bank stability is excellent due to low bank heights and good vegetation providing protection from high flow erosive energy along much of the banks.

- **Bank and Riparian Habitat**

Riparian Vegetation. Trees fare well at Town Branch, other vegetation less well. Some mature trees were successfully preserved through the restoration process,

- and add shade and structure to the buffer. Unusually large trees were planted as part of the restoration process, and survival and growth of these trees appears healthy. Herbaceous vegetation is generally in poor condition, due to frequent close mowing of the buffer. Some natural regeneration of woody plants is present. Streambank root mass has had limited time to develop since completion of restoration.
- *Floodplain Condition.* Stream connection to the floodplain is good. Width of the buffer is variable – in several places, the adjacent corn field and playing fields keep the buffer narrow. Human activity impacts the buffer. In addition to the mowing, a concrete pad had recently been poured in the buffer. Bare soil is evident in patches on the project. If bare soil is still visible next growing season, soil amendments may be required to succeed in revegetating the area. Mowing bollards would also be useful.
 - **Aquatic Insects**
Surveys were conducted at two locations on Town Branch; a reference reach above the project and at a location near the bottom of the restored reach. The restored reach of Town Branch was constructed recently (2005) and because of this effective recovery of the benthic fauna is unlikely. The aquatic insect fauna at the upstream location was depauperate, no EPT taxa were collected and chironomidae and aquatic oligochaetes were dominant. These data suggest the effects of urban stormwater runoff or other sources of perturbation. Tolerant EPT taxa were collected in the restored reach (Baetidae and Hydropsychidae), but the fauna here was dominated by blackflies and pulmonate snails (*Physella*). The lower reach of the restoration project had prolific growths of aquatic macrophytes and green algae coated most of the substrate material. These observations suggest that nutrients are enriching the stream feature at this point and that recovery of the benthic fauna in the restored reach will be limited. The field team did collect *Elimia* in the reference reach, but did not see this snail in the restored reach.
Cover and Refuge. Overall cover within the newly restored reach was given a good score and many of the individual habitat types were present. This habitat types included pools > 2 feet deep, rootwads, and aquatic macrophytes. Undercut banks, boulders and LWD were noticeably absent in the reach.
 - **Instream Structures**
The project included rock cross vanes, root wads, and constructed riffles, all of which were rated as good to excellent for bank protection, habitat, grade control, and flow deflection/concentration. The riffles are long and stable. There were no observed structure failures on this project.

Project Effectiveness

This project is unusual among CWMTF projects for the scope and specificity of its stated goals. Stated goals included addressing erosion problems, stabilizing streambank, restoring buffer areas, protecting 2.06 acres of riparian buffer, improving water quality and aquatic habitat by significantly reducing sedimentation (by approximately 68 tons/year), and improving riparian and floodplain functionality. The restored reach of Town Branch evaluated is a newly constructed reach (2005) and therefore many of the evaluation parameters should be considered tentative. We

expect many parameters to improve as this reach matures. Streambank stability, bedform condition, and instream structures scored well, indicating this project is moving toward accomplishing its goals for stability and reduced erosion. The project is new, so many features of aquatic habitat have not had time to develop. Macroinvertebrate monitoring indicated that upstream communities were poor, and sampling within the reach produced macroinvertebrate taxa associated with poor water quality. Good riffles and bedform hold the potential for higher aquatic productivity, but if water quality entering the reach is poor, the macroinvertebrate and fish communities cannot establish even in good physical habitat. Algae and emergent vegetation within the reach indicate nutrient enrichment. The growth of trees should improve riparian functionality, but mowing and poor soil quality limit the developing biomass. Lower banks have helped floodplain functionality.

Other Observations.

Project effectiveness would be much improved if stormwater quality were addressed both upstream and within the project. Mowing and other activities from the park are limiting development of the riparian buffer. A better barrier is needed around the riparian zone, and soil amendments may be required to revegetate some areas.