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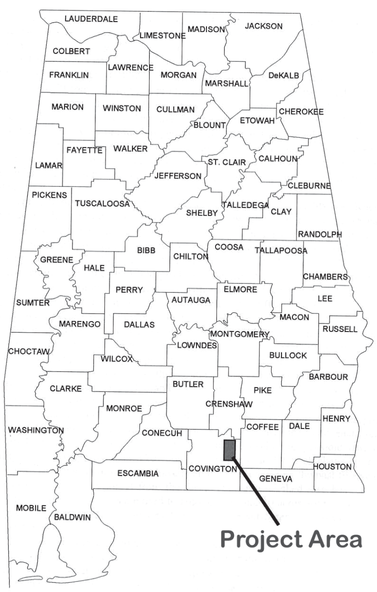

Figure 1. Lightwood Knot Creek National Monitoring Program project location.

IN THIS ISSUE

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PROJECT SPOTLIGHT

Water Quality Improvements Resulting from Implementation of Best Management Practices in the Lightwood Knot Creek Watershed, South Alabama

Marlon Cook, Hydrogeologist
Pat O'Neil, Biologist
Water Investigations Program
Geological Survey of Alabama

Introduction

The Lightwood Knot Creek Project, in Covington County, South-central Alabama (see Figure 1), is a Section 319 Nonpoint Source National Monitoring Program project, initiated in 1996. The purpose of the seven-year project is to assess the effects of poultry production on water quality and to evaluate the effectiveness of best management practices (BMPs) in four watersheds (Cook et al., 2002).

The geology of the area is primarily composed of porous and permeable sand and sandy clay of Tertiary age. The hydrogeology is characterized by flashy surface-water runoff and close seasonal interaction of surface and ground waters. For much of the year, ground water, issuing from seeps and springs along the floodplains, composes most of the stream discharge.

The 43,700-acre Lightwood Knot Creek watershed, located in Covington and Crenshaw Counties, Alabama, is approximately half forested and half in agriculture. Pasture, hayland, cropland, and poultry production are the dominant agricultural land uses. Lightwood Knot Creek is a tributary of the 1,100-acre W. F. Jackson Lake, a recreational impoundment constructed in 1987 (see Figure 2). Lightwood Knot Creek is also used for recreation. Disposal of animal wastes and erosion in the watershed and resulting sedimentation of Jackson Lake and its tributaries are primary water quality concerns. In addition to sediment, elevated levels of nitrogen, phosphorus and fecal bacteria counts have been found in Lightwood Knot Creek tributaries.

The Lightwood Knot Creek project area consists of four subwatersheds (1-C, 2-S, 3-C and 4-S) varying in size from 75 to 240 acres (see Figure 2). Project streams discharge directly into or immediately upstream from Jackson Lake. Project watersheds were divided into groups, utilizing the paired watershed approach. Watersheds with a “C” (control) designation received no treatment while watersheds with the “S” (study) designation received treatment. However, due to drought, flood, and beaver activity and the resulting absence of accurate discharge data for the streams in the 1-C and 2-S watersheds, the data from the 3-C and 4-S watersheds received most of the analytical evaluation related to statistical determinations of water quality change for the pre- and post-treatment periods. Therefore, only information on subwatersheds 3-C and 4-S are presented in this article.

EDITOR’S NOTE

In this issue of *NWQEP NOTES*, we continue our series on National Nonpoint Source Monitoring Program (NMP) projects that have been completed and have documented improvements in water quality due to best management practice (BMP) implementation.

The 43,700-acre Lightwood Knot Creek project in Alabama is located in an agricultural watershed with significant poultry production. Animal waste, erosion and sedimentation are the major water quality concerns. A paired-watershed study was performed over a period of six years, including pre- and post-BMP monitoring. Erosion control and animal waste management practices were implemented in 1999. Data analysis revealed a 92 percent decrease in bedload sedimentation, 71 percent decrease in nitrate concentrations, as well as substantial improvements in habitat quality, mostly due to the reduction of sediment loading. Results of this project, and other successful NMP projects, validate the importance and effectiveness of nonpoint source control practices in protecting and restoring water quality.

As always, please feel free to contact me regarding your ideas, suggestions, and possible contributions to this newsletter.

Laura Lombardo

Laura Lombardo
Editor, *NWQEP NOTES*
Water Quality Extension Associate
NCSU Water Quality Group
Campus Box 7637, NCSU
Raleigh, NC 27695-7637
Tel: 919-515-3723, Fax: 919-515-7448
Email: notes_editor@ncsu.edu

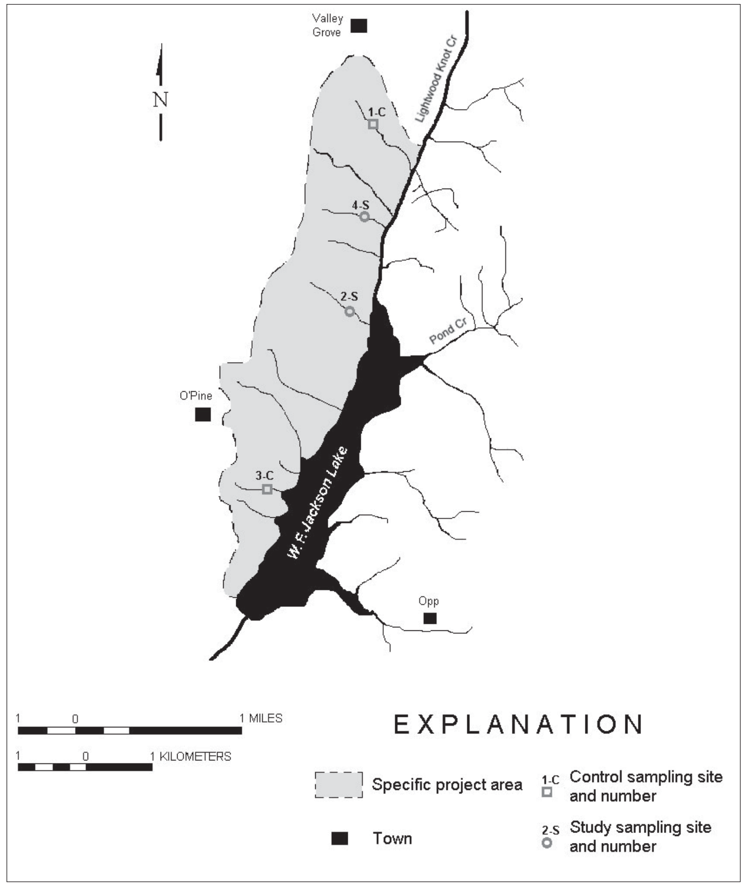

Figure 2. Water Quality Monitoring Stations for Lightwood Knot Creek (Alabama) Watershed.

Pre-BMP water quality monitoring commenced in spring 1996, with BMPs implemented in summer 1999. Erosion control practices included runoff and sediment control structures, floodplain fencing, critical area planting, cover and green manure crops, and pasture and hayland management. Animal waste management practices included poultry litter storage, litter and dead poultry composting, rotational cattle feeding, and prescribed waste utilization. Post-BMP monitoring was completed in fall 2002.

Land Use and Poultry Waste Management

The 3-C subwatershed (control site) is the southernmost subwatershed in the Lightwood Knot Creek project area and is 150 acres in size. Land uses include one poultry production facility with approximately 105,000 chickens produced every 8 to 10 weeks. Approximately 350 tons of litter are produced each year and transported off the farm. Average poultry mortality, excluding periodic catastrophic mortality events, is approximately 20,000 chickens per year. Dead chickens were previously buried for an unspecified period of time, but have been incinerated during the past five years. All incineration waste is transported from the farm. The subwatershed also has 35 head of cattle. Approximately 10 acres are used to produce hay and 20 acres are periodically used to grow cotton or peanuts.

The unnamed stream in the subwatershed flows directly into Jackson Lake.

The 4-S watershed (treatment site) is composed of 178 acres. One poultry facility operates in the subwatershed and produces approximately 150,000 chickens every 8 to 10 weeks and approximately 550 tons of litter are produced each year. Most of the litter is spread in the watershed, twice yearly, at a rate of approximately two tons per acre. Average poultry mortality, excluding periodic catastrophic mortality events, is about three percent or approximately 22,000 chickens per year. For more than ten years, dead chickens were disposed in burial pits but are now composted in a structure built in September 1999 during the BMP installation stage of the project. Composted waste is spread on the farm. Other animals in the subwatershed include 100 head of cattle and a small number of horses and goats. Approximately 35 acres have been used for pine tree production over the past ten years. Most of this area was clear-cut during late 1997 and was planted in permanent pasture during the BMP installation stage of the project in June 1999. Ten acres are used to grow hay.

Water Quality Monitoring

Water Sample and Stream Data Collection

Surface-water quality monitoring was initiated on April 1, 1996. The monitoring program included physical, geochemical, and biological characteristics of the project streams. Water samples were collected weekly along with other pertinent water-quality information. Concurrently, continuous water and sediment sampling equipment were installed at the sample sites. Initially, each site was fitted with an instrument house containing an automated water sampler and digital data logger, a primary in-stream device consisting of an appropriately-sized corrugated steel culvert, a 15-inch Thelmar weir and a modified Birbeck bedload sediment pit sampler.

Stream discharge and water level, specific conductance, and temperature data were recorded at 15-minute intervals. Water samples were collected every 24 hours from April to September and every 8 hours from September to April, with the capability to collect up to three storm event samples per week. Continuous bedload sediment volumes were monitored for all four streams and continuous rainfall data were collected at two sites. Because of the short holding time for samples used for bacteria and biochemical oxygen demand analyses, performed from April to September, these samples were collected as weekly grab samples.

Biological monitoring was performed in the project watersheds quarterly. A modified version of the rapid bioassessment technique outlined in Plafkin et al. (1989), Barbour et al. (1999), and ADEM (1996) was used to collect aquatic macroinvertebrates. Habitat conditions were determined during each monitoring period.

Paired Watershed Calibration

Each watershed pair included an untreated, or control watershed and a treatment, or study, watershed, monitored during three periods of study: pre-treatment or calibration period (1996-1999), treatment (summer 1999), and post-treatment (fall 1999-fall 2002). The calibration period was used to ascertain the degree of similarity between the two watersheds in terms of measured parameters; that is, to determine the relationship for each parameter between the two watersheds (Cook and Puckett, 1998). Data collected during the calibration period were used to determine the magnitude of change that could be detected as a result of BMP installation in the treatment watersheds at the conclusion of the calibration period. The calibration period included two growing seasons. The statistical analyses performed to assess the degree of calibration between the two watershed pairs were performed for 11 parameters that included fecal streptococcus bacteria, fecal coliform bacteria, specific conductance, dissolved oxygen (DO), ammonia (NH_3-N), nitrate (NO_3-N), pH, total phosphorus (P-total), total suspended solids (TSS), total dissolved solids (TDS), and turbidity. The calibration procedure used for the Lightwood Knot Creek project followed the guidance outlined in the U.S. EPA *Paired Watershed Study Design* (publication 841-F-93-009).

All but two of the eleven parameters analyzed indicated that sufficient data had been collected to detect a change in the means of less than 10%. The statistically detectable difference for the other two parameters, nitrate and total phosphorus concentrations, were 12.8% and 13.6%, respectively (Cook and Puckett, 1998).

Best Management Practices Implementation

BMP installation for erosion and animal waste control began in the 4-S watershed on June 1, 1999, after three years of monitoring. Approximately 73 acres of permanent grass were planted. Seed and nutrients were applied according to recommendations based on results of laboratory soil analyses. Tifton bahaia was sown on pasture areas. Bermuda and Pensacola bahaia and brown top millet were sown on all slopes. Five critical eroded areas, identified as primary sources for sediment, received treatment. A sediment retention structure was constructed in late July 1999 in Critical Area 1, in the headwaters of the stream (see Figures 3, 4 and 5). Critical Areas 2, 4, and 5 were filled, smoothed, and seeded during July (Figure 3). Critical Area 3 is a series of steeply sloping, shallow, north-south trending gullies that carry runoff from six chicken houses on the upland area near the northern watershed boundary (Figure 3). A broad, shallow waterway designed to direct and control runoff was constructed in this critical area in mid-July, 1999.

In September 1999, approximately 4,000 feet of barbed wire fencing and approximately 2,000 feet of solar-powered electrified fencing were constructed, to prevent cattle access to the stream floodplain (Figure 3). Cattle and vehicles were

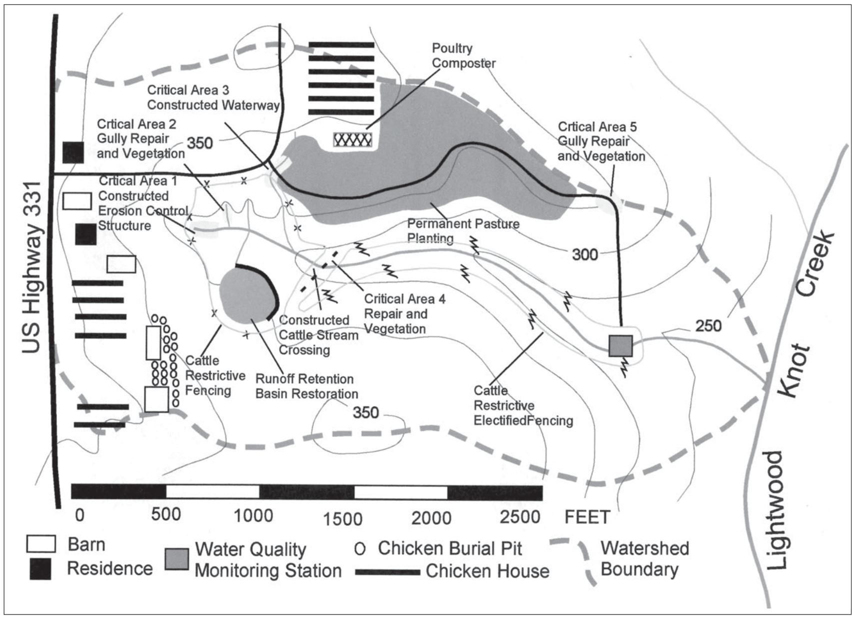

Figure 3. Topographic map of 4-S watershed with completed BMPs.

Figure 5. 4-S watershed critical area one after BMP installation (sediment reduction structure).

allowed to cross the floodplain along a hard surfaced crossing constructed to prevent erosion (see Figures 3 and 6). In addition, the practice of underground disposal of dead poultry was terminated. Dead poultry and litter are being composted and excess litter is stored in a composter/dry stack house constructed in the 4-S watershed (see Figures 3 and 7). Composted material and litter are spread on pasture and hayland in the watershed according to specifications supplied by the NRCS.

Figure 4. 4-S watershed critical area one before BMP installation.

Water Quality Findings

The primary constituents identified during the pre-treatment phase of the project that caused water quality impairments in the project watersheds were excessive sedimentation, large nutrient loads (primarily nitrate), and excessive bacteria.

Stream sediment loads are composed of two components. Material that is suspended in the water column (suspended sediment) and larger material that rolls or saltates along the streambed (bedload sediment). Average annual suspended sediment loads were calculated from the average daily data. The streams at sites 4-S and 3-C discharged approximately 12 tons and 7.2 tons of suspended solids per year (138 lbs/ac/yr and 97 lbs/ac/yr), respectively.

The bedload sedimentation rate for the 3-C (control) watershed for the entire monitoring period was approximately 74 lbs/ac/yr. The rate for the pre-treatment period was approximately 72 lbs/ac/yr, while the rate for the post-treatment period was approximately 77 lbs/ac/yr.

The bedload sedimentation rate for the stream at site 4-S (treated watershed) for the entire monitoring period was approximately 2,577 lbs/ac/yr. The rate for the pre-treatment period was approximately 5,168 lbs/ac/yr, while the rate for the post-treatment period was approximately 1,858 lbs/ac/yr. Although the effects of drought in 1999 and 2000 are clearly portrayed on Figure 8, the bedload rate for the 4-S watershed continued to be very low throughout the post-treatment period.

Figure 6. 4-S watershed constructed cattle crossing.

Figure 7. 4-S watershed poultry waste composter.

Typical nitrate concentrations in streams vary from 0.5 to 3.0 mg/L. Concentrations of nitrate in streams without significant nonpoint sources of pollution vary from 0.1 to 0.5 mg/L. Streams fed by shallow ground water draining agricultural areas may approach 10 mg/L (Maidment, 1993). Water samples collected at sites 3-C and 4-S contained the largest concentrations of nitrate during the sampling period (see Table 1 and Figure 9). Consistently large concentrations of nitrate were observed in surface waters from the 3-C and 4-S subwatersheds even during periods of low flow. This nitrate probably originated from contaminated shallow ground water that enters the streams from seeps and springs in the floodplains.

Table 1. Summary data for nitrate measured in water collected from streams in the project subwatersheds.

Subwatershed	Maximum NO_3 (mg/L)	Minimum NO_3 (mg/L)	Average NO_3 (mg/L)	NO_3 Loads (lbs/ac/yr)
3-C (Pre-Treatment)	3.930	0.055	2.475	4.4
3-C (Post-Treatment)	7.380	0.052	1.680	2.6
4-S (Pre-Treatment)	3.580	0.183	2.296	2.4
4-S (Post-Treatment)	1.800	0.081	0.618	0.5

Ground-water samples were collected in August 1999 and in January and April 2001 from a spring downgradient from poultry production houses and poultry mortality burial pits at site 4-S. Results of chemical analysis indicated that the samples contained 8.83, 20.8, and 18.9 mg/L nitrate (NO_3 as N), respectively. Another ground-water sample collected in April 2001 from a spring downgradient from poultry mortality burial pits at site 3-C contained 23.6 mg/L nitrate (NO_3 as N).

Natural background concentration of total dissolved phosphorus is approximately 0.025 mg/L (Maidment, 1993). Phosphorus concentrations as low as 0.01 to 0.005 mg/L may cause excessive algae growth, but the critical level of phosphorus necessary for excessive algae is around 0.05 mg/L (Maidment, 1993). Site 3-C consistently exhibited the largest concentrations of phosphorus. Concentrations decreased in the 4-S watershed during 1998 and April, May, and June 1999. This decrease occurred at the beginning of a prolonged period of drought so that large, high intensity rainfall and runoff events were minimized.

Fecal streptococci bacteria were more prevalent than fecal coliform bacteria during the sampling period, as expected, due to the land-use characteristics of the project area. The limit for fecal coliform bacteria, established for surface waters classified as Fish and Wildlife, is 2,000 colonies per 100 milliliter sample for a single

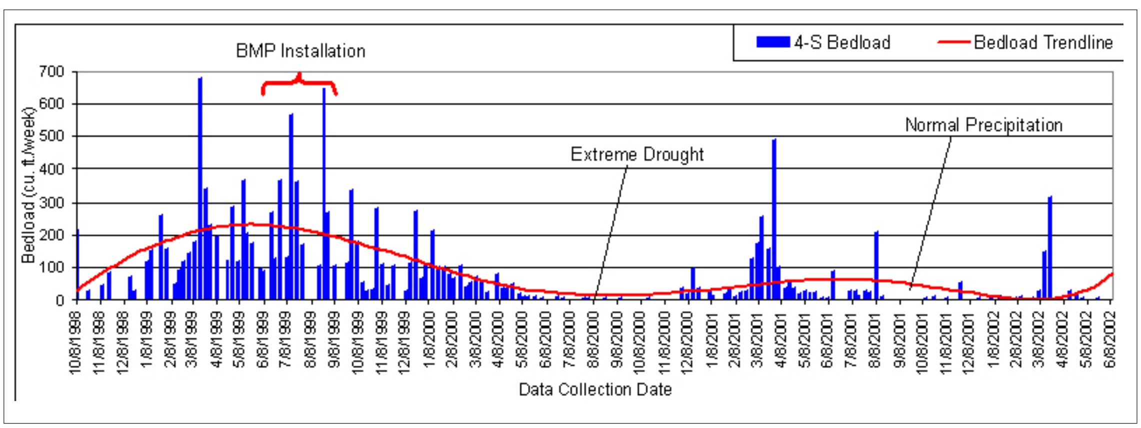

Figure 8. Weekly bedload sedimentation rates for the 4-S watershed.

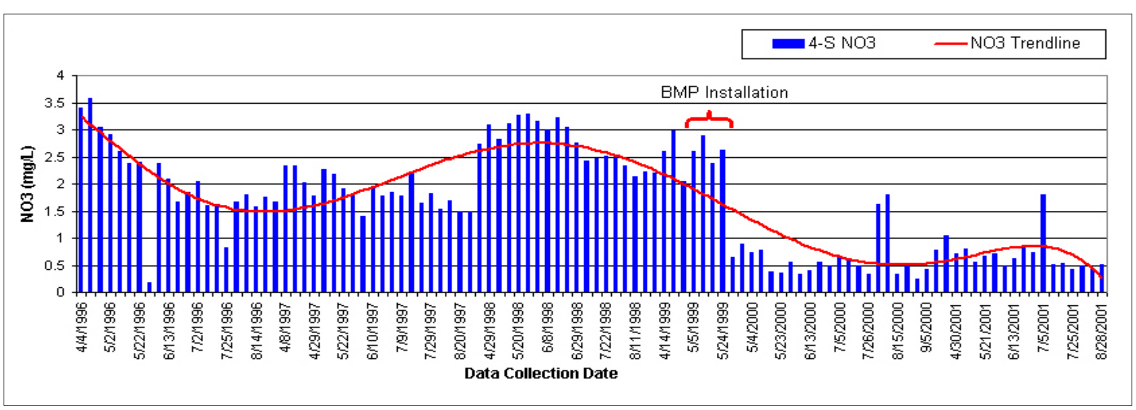

Figure 9. Nitrate concentrations from samples collected in the 4-S watershed.

sample or a geometric mean of 1,000 colonies per 100 milliliter sample based on a monthly average (ADEM, 1992). Sampling results indicated that the single sample limit was exceeded in the Lightwood Knot Creek project area during 20 of 133 weeks of sampling at site 3-C, and 14 of 127 weeks at site 4-S. The limit, based on monthly average of the geometric mean, was exceeded during 6 of 33 months of sampling at site 3-C, and 4 of 32 months at site 4-S.

Biological Condition

Median biological condition at the control site 3-C degraded from good during the pre-BMP period to good-fair during the post-BMP period. Likewise, biological condition at site 4-S degraded from good-fair to fair, pre- versus post-BMP. Also, biological condition at site 4-S was more variable post-BMP compared to pre-BMP (see Figure 10). Significant variation in the EPT (Ephemeroptera, Plecoptera, Trichoptera) index was also observed at site 4-S from a median of 2.0 pre-BMP to a median of 1.0 post-BMP compared to a decline at the control site from 4.0 to 3.0, pre- versus post-BMP. Substantial differences were also observed in catch, both median and total, which increased at the control site and decreased at the experimental site post-BMP. Total EPT genera was similar pre- versus post-BMP at the control site (10 to 11) but declined at the experimental site (11 to 4). One of the more interesting findings was that *Paraleptophlebia* was the most common taxon at the control site both pre- and post-BMP, whereas dominance shifted at the experimental site from *Simulium* pre-BMP to *Bittacomorpha* post-BMP. *Bittacomorpha* was the dominant taxon at site 2-S and is known to thrive in streams with poor water quality and a predominance of fine substrate particles.

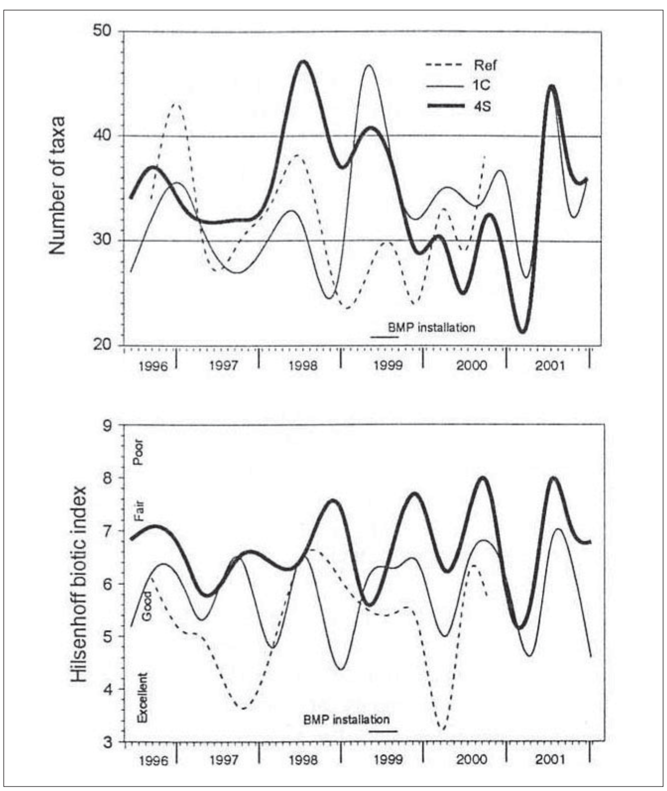

Figure 10. Seasonal variation of macroinvertebrate diversity and the HBI for three watersheds, pre- versus post-BMP installation.

Most of these changes were not statistically significant, but they do signal a fluctuating macroinvertebrate community structure in response to BMP installation at site 4-S. It appears that diversity at site 4-S was higher than reference conditions, a situation sometimes observed in small impacted headwater streams, and that water-quality improvements from BMP installation are shifting the macroinvertebrate community closer to the reference conditions.

Post-treatment Water Quality Change

Detection of change in water quality from pre- to post-treatment stages of the Lightwood Knot Creek Project was essential to determine the effectiveness of BMPs in project watersheds. It was also very important to know if the changes in water quality were caused by the BMP treatment or if factors such as drought, flood, or land use change were the major causes. The paired watershed monitoring design allows comparisons of physical and chemical characteristics between treatment and control watersheds. Comparisons of key constituents were accomplished by the use of statistical tests designed by the NCSU Water Quality Group at North Carolina State University (Grabow et al., 1998). Analysis of Covariance (regression analysis with covariates, or explanatory variables) was applied to the Lightwood Knot Creek water quality data. As previously discussed, drought, flood, and beaver activity prevented the proper use of this statistical test for the data collected in the 1-C and 2-S watersheds. Therefore, the 3-C and 4-S watersheds were paired for the statistical analysis to determine water quality change for the pre- and post-treatment periods.

Compared to a t-test of just the means, regression analysis is usually the most powerful method of detecting and evaluating change, particularly when covariates (the control and treatment water quality parameter of interest in a paired watershed design) exhibit a strong relationship (Grabow et al., 1998).

Regression analysis indicated that suspended sediment increased in the 4-S watershed relative to the 3-C watershed by 18 percent. However, the increase in suspended material was not attributed to a failure of the treatment since regression analysis indicated a 92 percent decrease in bedload sedimentation. Sandbed streams with large bedloads have extremely dynamic streambeds. When the BMPs limited the amount of sand bedload, the stream removed much of the remaining sandbed so that the new exposed streambed was more clayey and resistant to mobilization, thus allowing colonization by iron bacteria. Stabilization of the streambed (by limiting the sedi-

Continued on p. 9

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- Understanding the Role of Agricultural Landscape Feature Function and Position in Achieving Environmental Endpoints: Final Project Report (to the U.S. Environmental Protection Agency) (1996) (118p) (*abstract and instructions for downloading the report available at: ftp://ftp.epa.gov/epa_ceam/wwwhtml/software.htm*

ment entering the stream) in the 4-S watershed during the post-treatment period caused a dramatic increase in iron bacteria and iron hydroxide that contributed to an increase in suspended material that is not related to erosion-induced sedimentation.

Figure 9 (Site 4-S) portrays a dramatic decrease in nitrate concentrations that occurred during the post-BMP monitoring period immediately after the BMP implementation. Regression analysis indicated a 71 percent decrease in nitrate in the 4-S watershed as compared to the 3-C watershed (see Figure 11).

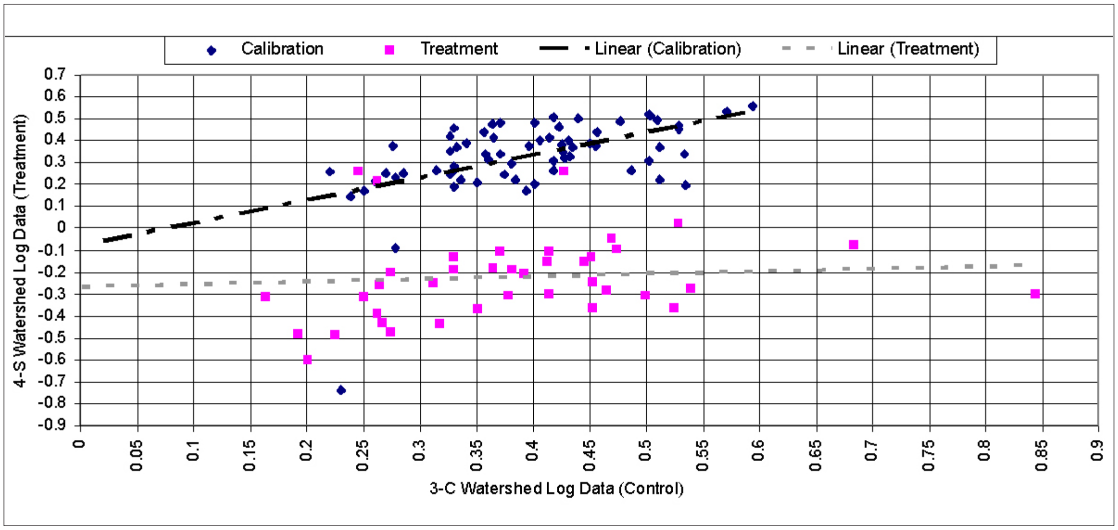

Figure 11. Regression analysis plot of nitrate data, 3-C and 4-S watersheds, calibration and treatment periods.

Phosphorus concentrations in the 4-S watershed were relatively small when compared to the 3-C watershed during the project period. Numerous soil samples collected and analyzed for phosphorus during the project period indicated very small concentrations as well. Therefore, a large magnitude of change in phosphorus concentrations in the 4-S stream was not expected. The change indicated by regression analysis was an increase of seven percent. This is below the detection limit determined by the calibration analysis (13.6 percent). Therefore, it is assumed that no significant change in phosphorus concentrations in the 4-S stream occurred during the post-treatment period.

Regression analysis indicated an 11 percent decrease in fecal coliform bacteria in the 4-S subwatershed. Although land use practices in the subwatershed were altered significantly, the change was near the 10 percent detection limit established during the calibration period. Therefore, this change is not considered to be significant. Regression analysis indicated an increase in fecal streptococcus bacteria counts during the post-treatment period in the 4-S watershed (14 percent). Although this change was relatively small, the increase may be attributed to a design flaw in the constructed cattle crossing that encourages cows to congregate on the crossing during dry periods. This design will be modified for future applications.

Installation of BMPs in watershed 4-S resulted in substantial improvement of habitat quality due principally to a reduction of sediment loading. Average sand coverage in the substrate decreased from around 80 percent pre-BMP to 40 percent post-BMP with an associated increase in detritus coverage. One interesting observation in watershed 4-S was the increased variability of habitat metrics after BMP installation. It appears that the stream is returning to a level of habitat stability after the sediment source was reduced or eliminated. This watershed may continue to experience variable habitat quality for some time until the stream channel is rehabilitated to levels observed at the two reference sites. Biological improvements in watershed 4-S have not been as dramatic as habitat improvements but signs that the biology is changing were observed. Conditions actually degraded or worsened after BMP installation for several of the biological metrics, but this is again interpreted as a response of the biological community to an evolving stream channel and associated changes in habitat quality. The biological characteristics may remain variable until such time that habitat stabilizes.

Conclusions

Results of various aspects of the Lightwood Knot Creek National Monitoring Program Project (public awareness and education, water quality monitoring, BMP implementation, and statistical analysis) have shown that a team approach to water quality improvement can be effective. The project demonstrated water-quality problems that can be attributed to land-use practices in the project area, in particular, commercial poultry operations. The results of the project also showed that BMPs implemented in the 4-S watershed caused significant water-quality improvements through better management of animal wastes and by limiting the amount of sediment transported to the stream. It also showed willingness on the part of stakeholders in the community to participate in learning about these water-quality problems and to take steps to correct them.

For More Information

Marlon Cook
Hydrogeologist
Geological Survey of Alabama
P.O. Box 869999
Tuscaloosa, AL 35486-6999
205-247-3692
mcook@gsa.state.al.us

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Information

Stream Restoration Handbook Available

The NCSU Stream Restoration Institute in partnership with NC Sea Grant just released a guidebook on stream restoration. Funding was provided by US EPA, NC Department of Environment and Natural Resources, and NC Department of Transportation. The guidebook is intended as a reference for natural resource professionals who plan, design, review and implement stream restoration projects. It is available for sale on the SRI website at: http://www.ncsu.edu/sri/stream_rest_guidebook/guidebook.html. It is also downloadable in pdf for free.

EPA Voluntary Guidelines Aid City and County Septic System Management

EPA announced the release of new guidelines that are designed to help local governments strengthen their management of septic systems and other small, privately-owned wastewater treatment systems. Failing and improperly managed septic systems are a significant source of water pollution, potentially causing contamination of drinking water wells or restricting shellfish harvest. Septic systems serve approximately 25 percent of U.S. households, and one in every three new homes built today use these systems – making proper maintenance essential for protecting America's waters.

The Voluntary Guidelines for Management of Onsite and Clustered (Decentralized) Wastewater Treatment Systems complements EPA's efforts to help state and local governments strengthen their oversight of septic systems and other small, privately-owned wastewater treatment systems. EPA worked with stakeholders from the public and private sectors to develop these voluntary management guidelines. The guidelines and an accompanying Management Handbook provide local governments with a risk-based model for evaluating local conditions and then a five-tier system developing an appropriate management program to address local conditions.

The Voluntary Guidelines document (EPA 832-B-03-001) is available for download at www.epa.gov/owm/onsite. Copies are also available by calling 800-490-9198. For more information, please contact Joyce Hudson at 202-564-0657 or Steve Hogye at 202-564-0631.

Federal EQIP Funds Target NPS Reductions

The Department of Agriculture recently approved the Final Rule for the Environmental Quality Incentives Program (EQIP). The rule may be found at: **www.nrcs.usda.gov/programs/farmbill/2002/products.html** (scroll down to 4th row in table).

This site includes a summary of the Final Rule, the text of the Final Rule, and a news release that provides insight on the rule publication. National Priorities will be used to guide which producers will be selected to receive EQIP assistance. They are:

- Reductions of nonpoint source pollution, such as nutrients, sediment, pesticides, or excess salinity in impaired watersheds consistent with TMDLs where available, as well as the reduction of groundwater contamination and the conservation of ground and surface water resources;
- Reduction of emissions, such as particulate matter, nitrogen oxides (NOx), volatile organic compounds, and ozone precursors and depleters that contribute to air

quality impairment violations of National Ambient Air Quality Standards;

- Reduction in soil erosion and sedimentation from unacceptable levels on agricultural land; and
- Promotion of at-risk species habitat conservation.

The Environmental Quality Incentives Program (EQIP) is a USDA program administered by the NRCS. These funds can be used to help restore impaired waters by improving the management of animal feeding operations, implementing BMPs on crop land, and otherwise working toward more environmentally-protective farm and ranch operations.

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Meetings

Call For Papers

Putting the LID on Stormwater Management: September 21-23, 2004, University of Maryland, College Park, Maryland. The Metropolitan Washington Council of Governments is co-hosting a national conference dealing with the environmental practice of Low Impact Development (LID). Session Topics include, but are not limited to:

- Architecture of LID- Making it Look Great!
- Creative Applications of LID Nationally and Internationally
- Community and Neighborhood Involvement and Acceptance of LID
- Impediments to using LID and Examples of Removing Those Barriers, from Public Acceptance to Regulatory Constraints
- LID Education to the Owner, Real Estate and Design Communities
- LID Research, Performance Monitoring, and Modeling
- LID, Second Generation- Lessons Learned and Lessons not to be Repeated
- Maintenance Practices for LID
- Restoring the Urban Watershed: LID and Stream Restoration
- Site Design and Analysis Considerations for a Successful LID Application
- Successful Collaborative Funding Approaches to LID
- The Developer Angle- Why Use LID?

Abstracts due November 30, 2003. To submit an abstract, or to be placed on the distribution list for future conference announcements and final program mailings, contact the conference coordinator: Brian Rustia, MWCOG, 777 North Capitol Street, NE, Suite 300, Washington, DC, 20002; or send by email to: brustia@mwcog.org.Website: **www.mwcog.org/environment/lidconference**.

Meeting Announcements — 2003

September

11th National Nonpoint Source Monitoring Workshop:
Monitoring and Modeling the Urban Environment
September 8-11, 2003, Dearborn, Michigan.
http://ctic.purdue.edu/NPSWorkshop.html

The 11th year of this workshop will once again bring together land managers and water quality specialists to share information on the effectiveness of best management practices in improving water quality, effective monitoring techniques, and statistical analysis of watershed data. The workshop will focus on the successes of Section 319 National Monitoring Program projects as well as other innovative monitoring projects from throughout the U.S. The agenda will include three days of workshop sessions/presentations and a one-day field trip to visit nonpoint source project sites relating to the workshop.

October

The Practice of Restoring Native Ecosystems National Conference: October 20-22, 2003, Nebraska City, NE. Sponsored by the National Arbor Day Foundation in cooperation with Land & Water Magazine. Web site: http://arborday.org/programs/conferences/rne/

Wetlands 2003 Landscape Scale Wetland Assessment and Management: October 20-24, 2003, Nashua, NH. Association of State Wetland Managers web site: http://aswm.org/calendar/2003am/.

Getting It Done: The Role of TMDL Implementation In Watershed Restoration Conference: October 29-30, 2003, Stevenson, WA. Web site: http://www.swwrc.wsu.edu/conference2003/index.html; Email: watercenter@wsu.edu.

November

AWRA 2003 Annual Water Resources Conference: November 3-6, 2003, San Diego, CA. Web site: http://www.awra.org/meetings/California2003/index.html

Meeting Announcements — 2004

March

7th National Mitigation & Conservation Banking Conference, March 3-5, 2004, New Orleans, Louisiana. Tel: 703-548-5473; Web site: http://www.mitigationbanking conference.com

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NCSU Water Quality Group
Department of Biological and Agricultural Engineering
North Carolina Cooperative Extension Service
Campus Box 7637
North Carolina State University
Raleigh, NC 27695-7637

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PAID
RALEIGH, NC
PERMIT No. 2353

NC STATE UNIVERSITY

NCSU Water Quality Group
Campus Box 7637
North Carolina State University
Raleigh, NC 27695-7637
Telephone: (919) 515-3723
Fax: (919) 515-7448
Web Site: http://www.ncsu.edu/waterquality/

Personnel

Jean Spooner
Robert O. Evans
Jon Calabria
Garry L. Grabow
Karen R. Hall
Frank J. Humenik
William F. Hunt
Daniel E. Line
Laura A. Lombardo
Catherine S. Smith
Dani E. Wise