Illinois River Watershed Implementation Program

FY 1996 319(h) Task 240
C9-996100-04

Best Management Practices Implemented on Peacheater Creek

Oklahoma Conservation Commission
Water Quality Division

PROJECT OVERVIEW

Peacheater Creek is located in eastern Oklahoma. The watershed is primarily pastureland and forestland with little cropland and rangeland. There are 59 poultry houses, 8 dairies (800 dairy cattle), and 1200 beef cattle in the watershed. Cattle traffic and poorly managed riparian land clearing activities are known to be major contributors to streambank erosion. Streambank erosion is being quantified to estimate loads of gravel, sand, silt, clay, total nitrogen, and total phosphorus contributed to each stream. Large gravel bars generated from streambank erosion impair fish and macroinvertebrate habitat quality. Base flow monitoring shows intermittent high nutrient levels contribute to creek eutrophication. Impacts downstream of Peacheater Creek include streambank erosion, habitat degradation, and nuisance periphyton growth in Baron Fork and the Illinois River and phytoplankton blooms and summer hypolimnetic anoxia in Lake Tenkiller.

The project team has completed an extensive natural resource and stream corridor inventory. Data from the inventory have been digitized and mapped in a geographic information system. A distributed parameter watershed model has been used for determining critical areas for treatment. Critical areas are pasturelands, riparian areas, and dairies. Nutrient management planning is underway to improve poultry and dairy waste utilization on cropland and pastureland.

Chemical, biological and habitat monitoring was completed prior to implementation for tributaries and the main stem stream, and commenced again, once implementation was completed. A paired watershed study comparing Peacheater Creek and Tyner Creek watershed is ongoing using chemical, habitat, and biological variables. Sufficient data have been collected to develop statistically significant relationships between the two watersheds using water quality variables. Review of calibration data was completed by Dr. Jean Spooner of the North Carolina State University Water Quality Group who agreed that the calibrations looked good and that implementation should begin. Data from the pre-implementation or calibration period was reported on in a 1999 Illinois River Watershed Monitoring Program- National Monitoring Project FY 1996 319(h): TASK 250: Calibration Report.

Post-implementation monitoring data is currently being collected under 2000 and 2001 319 projects to assess impacts to water quality relative to the practices installed. These results will be reported on in a future report. This report will summarize the practices that were installed as part of the project.

PROJECT BACKGROUND

Project Area

The Peacheater Creek watershed area is 16,209 acres. The creek is a tributary of Baron Fork, a tributary of the Illinois River, which is impounded to form Lake Tenkiller.

Relevant Hydrological, Geological, and Meteorological Factors

Average base flow for Upper Tyner and Peacheater Creeks is 2-13 cubic feet per second. Rocks in the project area are chert rubble. Surface rocks are from the Boone Formation, the Osage Series, and of the Mississippian Age. Karstic geology characterizes the basin.

Project area soils are generally gravelly silt loams with high infiltration rates. Typical slopes in the floodplains range from 2-5%. A large portion of the watershed is steeply sloped land (15-40% slopes).

Land Use

Peacheater Creek has 59 poultry houses, 8 dairies with a total of 800 cows, and 176 private residences. Upper Tyner Creek has 65 poultry houses, 7 dairies, and 150 private residences. The 59 poultry houses in the Peacheater Creek watershed have a total capacity of approximately 1,300,000 birds. Five broods a year are produced for a total annual population of approximately 6.5 X 106 birds. Types of poultry grown in the watershed include broilers, layers, pullets, and breeder hens. In addition, approximately 1,200 beef cattle graze in the watershed.

The percentage of land use by major categories in Peacheater Creek is:

Land Use	%
Forest land	36
Grassed pastureland	14
Brushy pastureland	40
Cropland	3
Rangeland	7
TOTAL	100

Timber harvest data from the Timber Product Output Report of the U.S. Forest Service (Howell and Johnson 2003) estimates that 1999 harvest in Adair County was 649,000 cubic feet of hardwoods. Most of the production was for lumber, crossties, pallets, and specialty products.

Water Resource Type and Size

Water resources of concern are the Illinois River and Lake Tenkiller, a downstream impoundment of the river. The project water resource is Peacheater Creek, a fourth order stream, with base flow ranging from 5 to 10 cubic feet per second. Peacheater Creek flows into Baron Fork, a tributary of the Illinois River upstream of Lake Tenkiller. The Illinois River is classified as a State Scenic River in Oklahoma.

Water Uses and Impairments

Beneficial uses for Peacheater Creek include recreation and aquatic life support. Such use of Peacheater Creek is threatened by nutrient enrichment and loss of in-stream habitat. The Illinois River has been degraded by stream bank erosion, loss of habitat, reduced water clarity, and nuisance periphyton growth. Lake Tenkiller experiences phytoplankton blooms and summer hypolimnetic anoxia that threatens the fishery, water supply, and recreational resource.

Pollutant Sources

Primary sources of pollution include poultry houses, the distribution of poultry litter, dairies, and other livestock activities in the treatment and control watersheds (Peacheater Creek and Tyner Creek Watersheds). Other sources of nutrients could include septic systems of private residents.

The gravel that degrades in-stream habitat is also a pollutant. Its primary source is believed to be streambank erosion. Riparian activities such as grazing and clearing, poorly managed silivicultural activities, and other vegetative clearing on steep slopes without proper erosion controls are important secondary sources of gravel.

Pre-Project Water Quality

Base flow monitoring for both Peacheater Creek and Tyner Creek for 1990-1992 indicated high dissolved oxygen levels (generally well above 6 mg/1), suggesting little concern about oxygen demanding pollutants. Turbidity was very low, with all samples collected less than 8 NTU. Specific conductivities ranged from 120 to 183mS/cm. Nitrate-nitrogen concentrations for Peacheater Creek ranged from 0.82 mg/l to 3.4 mg/l. Nitrate-nitrogen levels near 3 mg/l may be considered elevated if significantly above background for the area (Sawyer, 1947). Total Kjeldahl nitrogen (TKN) levels ranged from the detection limit of 0.2 mg/l to 1.5 mg/l. Eleven of the thirty TKN observations were equal to or greater than 0.3 mg/l, which is sufficient organic nitrogen to promote eutrophication. Generally, TKN concentrations for Tyner Creek were lower than Peacheater Creek. Three of the thirty base flow samples showed total phosphorus (TP) levels above 0.05 mg/l, which may be considered a minimum level for eutrophication. Storm sample TP concentrations are elevated. Storm sample TN concentrations are similar to base flow concentrations.

Both Peacheater and Tyner Creeks have poor in-stream habitat. Large chert gravel bars cover expansive portions of the streambed in Peacheater Creek. These gravel bars continue to grow and shift following major runoff events. The gravel covers natural geologic and vegetative substrates reducing habitat quality for macroinvertebrates and fish. Peacheater Creek has extensive streambank erosion due to uncontrolled livestock access and poorly managed land clearing activities. The destabilization of the stream channel by the growing bed load may also be accelerating streambank erosion.

As previously stated, pre-implementation water quality data has been summarized and presented in a calibration report. This report established a relationship in water quality between Peacheater and Tyner Creeks that was of sufficient significance to warrant comparison as a Matched Pair.

Water Quality Objectives

The water quality objectives are to restore recreational and aquatic life beneficial uses in Peacheater Creek and minimize eutrophication impacts on the Illinois River and Lake Tenkiller.

PROJECT DESIGN

Nonpoint Source Control Strategy

Land treatment implemented through the project was designed to 1) reduce nutrient loading to the Illinois River system and Tenkiller Lake and 2) restore streambanks with the objective of improving pool depth and reducing gravel loading in the system. Implementation of land treatment was delayed by design until the calibration phase was finalized.

As a result of the implementation efforts, all the operating dairies have animal waste management plans. Three waste management systems, including waste storage structures have been completed. Eight planned grazing systems have been completed.

One hundred percent of the poultry producers have current Conservation Plans that include animal waste plans. Fifteen composters (for litter and dead birds) have been recommended and five have been installed. The conservation plan recommends planned grazing systems, buffer zones adjacent to streams, watering facilities, critical area vegetation, and riparian area establishment that exclude livestock access to the streams. The animal waste plans make recommendations on the amount of animal waste that can be applied to the soil according to the soil and litter test.

Twelve critical riparian areas have been identified. Activities in riparian areas such as poorly managed timber harvesting, uncontrolled cattle traffic, and livestock grazing have caused stream bank erosion. Best management practices recommended include riparian protection, fencing, no land application of litter in riparian areas, off-site watering systems, and vegetative establishment.

The current land treatment and monitoring plan is summarized:

Project Schedule

Site	Pre-BMP Monitoring	BMP Installation	Post-BMP Monitoring	BMPs
Peacheater Creek [T]	12/95 – 8/98	3/99 – 1/02	1/02-1/04	Nutrient management (w/ respect to poultry litter), streambank stabilization
Tyner Creek [C]	12/95 – 8/98		1/01-3/04	

[T]Treatment watershed
[C]Control watershed

Water Quality Monitoring

The water quality design for the Peacheater Creek 319 National Monitoring Program project is a paired watershed design. Peacheater Creek watershed treatment is paired with Tyner Creek watershed (control). Water quality monitoring occurs at each watershed outlet. Habitat and biological monitoring occurs in both streams at appropriate locations.

Sampling Scheme

Initially, chemical variables were monitored monthly from July through January, weekly during February through June, and during storm events for 20 weeks. Storm event monitoring is stage-activated and samples are taken continuously over the hydrograph. Concentration samples are flow-weighted composites.

Biological monitoring varies considerably with assemblage being sampled. Periphyton productivity is measured in the summer and the winter. Macroinvertebrates are monitored twice per year: once in the summer and once in the winter. Fish are intensively monitored every other year. Pool dwelling fish are inventoried quarterly. Intensive habitat was monitored intensively the first year. Future frequency will be determined by variance of parameters. Extensive habitat will be monitored on alternate years. Bank erosion and bank soil sampling are monitored on alternate years.

Sampling ceased during implementation, but resumed almost immediately following installation of the practices. Sampling will continue for a period of at least two years post-implementation to assess impacts of the implementation. These results will be reported on in a future report as part of FY 2000 and FY 2001 319 post-implementation monitoring projects.

Land Treatment Monitoring

BMP implementation will be tracked by measurement and record of structural controls put in place to control nutrient and sediment in the watershed and by measurement and record of the pounds of manure managed or removed and these effects on nutrient budgets in the watershed.

Land Treatments

There are ten (10) current land users in the program. The following is a breakdown of the practices employed.

Table 1. Planned versus Implemented Practices in the Peacheater Creek Watershed.

Practice	Workplan[1] Planned	Number & Units planned in Conservation Plans	Number and Units of Completed Practices
Buffer- Fence- Use Exclusion	500 ft	2 landowners, 4400 feet	1 landowner, 1800 ft.
Buffer Incentive	25.52 acres	2 landowners, 25.52 acres	1 landowner, 7 acres
Riparian Fence	16,600 feet	2 landowners, 5900 feet	1 landowner, 4000 feet,

[1] Planned in the August 2000 workplan revision. Represents summary of some practices already implemented, as well as others that were planned at the time.

Riparian Area - Exclusion W/Hay	29 acres	2 landowners, 29 acres	0 acres
Riparian Incentive Haying And Limited Grazing	38 acres	1 landowner, 38 acres	1 landowner, 58 acres
Freeze- Proof Tank	14 tanks	5 landowners, 14 tanks	4 landowners, 11 tanks
Streambank stabilization	0.5 acres	1 landowner, 0.5 acres	0 acres
Heavy Use Area Protection	175 cy concrete 510 tons gravel	3 landowners, 175 cy concrete, 648 ton gravel	3 landowners, 175 cy concrete, 648 ton gravel
Lagoon- fencing, concrete, PVC pipe	1000 ft fence, 15 cy concrete, 75 feet lateral lines	3 landowners, 1 cleanout, 2 clay liners (1020 cy), 1 concrete ramp and liner (20 cy), 75' PVC, 3006 cy excavation, 1000 ft fencing,	3 landowners, 1 cleanout, 1 clay liner (500 cy), 1 concrete ramp and liner (20 cy), 2 excavations (3006 cy).
Septic Tanks & Installation, lateral lines	2 tanks, 3 sets lateral lines (900 ft)	3 landowners, 2 tanks and installations, 3 lateral lines (900 ft)	2 landowners, 2 tanks, lateral lines, & installation
Nutrient- proper waste utilization- move litter out of watershed	36,282 lbs phosphorus moved out of watershed	2 landowners- 32,282 lbs phosphorus moved out of watershed	2 landowners- 22,921 lbs phosphorus moved out of watershed
Pasture Management Incentive	1039 acres	8 landowners, 1039 acres	4 landowners, 375 acres
Cross Fencing/Travel Lane Fencing	3000 linear feet	6 landowners, 27,170 ft cross fencing, 3400 foot travel lane fencing	4 landowners, 12,770 feet cross fencing, 3200 ft travel lane fencing
Pond Excavations	6000 cubic yards	12 ponds, 1,500 yd^3 each or 18,000 cy	2 ponds, 1,496 yd^3
Pasture Establishment, seeding, seedbed prep., liming, fertilizer	3404 acres, 399 lbs fescue, 60 lbs clover, 121 tons lime, 33 acres fertilizer, 28 acres bermuda	3 landowners, 33 acres, 14 acres Bermuda sprigging, 33 acres fertilizer, 399 lbs fescue seed, 19 acres seedbed preparation, 60 lbs clover seed, 4 acres lime application, 75 tons lime	0 acres
PVC pipe, trenching, and cover- (associated	5700 feet	5 landowners, 9,900 feet	5 landowners, 7,200 feet

with ponds, and/or freeze-proof tanks)			
Pond Fence	2000 feet	2 landowners, 2900 feet	400 feet
Pressure Tank, Pump, and Acessories	1	1 landowner, 1 tank, pump, and accessories	0
Poultry Litter Storage/cakeout house		1 landowner, 1 house	1 landowner, 1 house
Cattle Winter Feeding / Waste Management Facility		2 landowners, 2 facilities	2 landowners, 2 facilities

Riparian areas contribute much to the environment including stabilizing the stream bank, preventing erosion, reducing the impact of floods, and utilizing nutrients from runoff events. These areas also provide habitat for wildlife (NRCS, 2001). Creating riparian habitat ultimately improves the health and value of the land.

Buffer strips are areas of relatively dense vegetation that reduce erosion and nutrient runoff from entering the water body. These filter strips protect the streambanks and reduce delivery of livestock waste to a stream (WDATCP, 1989). These function by trapping coarser sediment and increasing nutrient uptake through the dense understory vegetation thus reducing the amount reaching the stream. Buffer strips and fencing can also hinder livestock access to the stream, decreasing the amount of bacteria added directly to the stream.

Waste storage facilities are built to contain agricultural waste (including manure, wastewater, and contaminated runoff) temporarily (NRCS, 2002a). Paving areas allows for easier cleaning of the waste. Manure is stored as a liquid in ponds or lagoons, as a semi-solid in an open container that drains into a lagoon, or in its solid form in a roofed dry stacking structure. Dry stacking waste allows for composting (Figures 1 and 2). In addition to use as fertilizer, the dry waste is utilized in combination with other materials as livestock bedding (NRCS, 1992). Feeding and watering areas receive much use by livestock causing increased deposition of waste materials and erosion (Figure 3). By confining livestock to specified feeding and watering areas, the impact of the waste is more easily controlled, allowing less waste to reach water bodies (Figures 4 through 9). By excluding livestock from areas and by containing livestock waste, sources for nutrient enrichment and pathogen exposure to a stream are decreased (Novotny and Olem, 1993).

Figure 1: Feeding facility with dry stack.

Figure 2. Inside of feeding facility showing dry stack on the end.

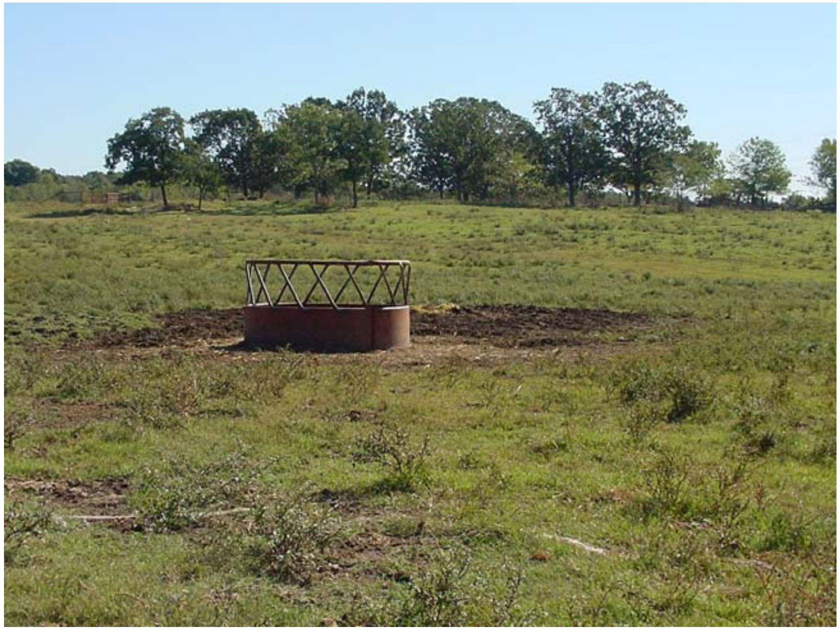

Figure 3. Area exposed to excess waste and erosion. This problem is corrected by building the feeding facilities.

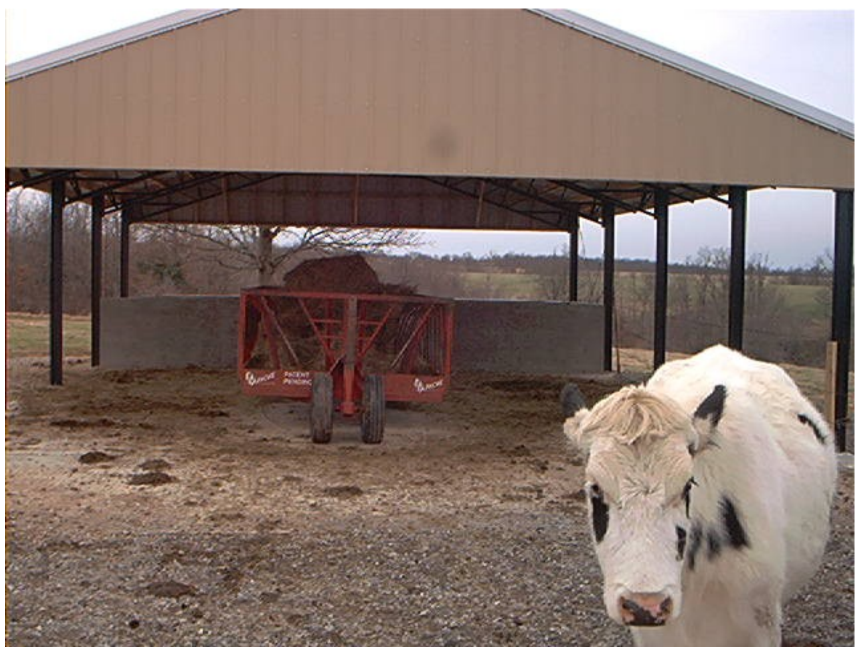

Figure 4. Beef cattle feeding shed.

Figure 5. Another view of the beef cattle feeding shed.

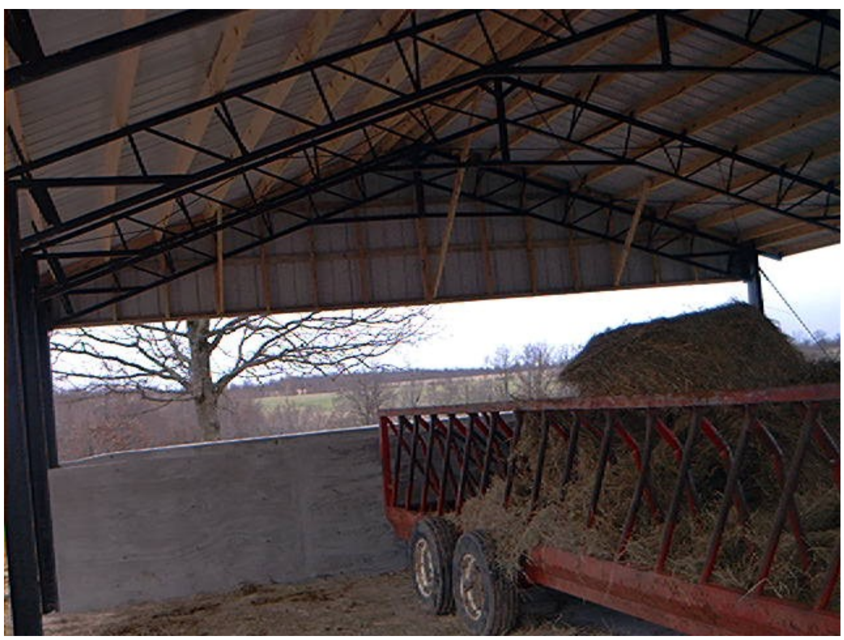

Figure 6. Beef cattle feeding shed.

Figure 7. Dairy feeding floor.

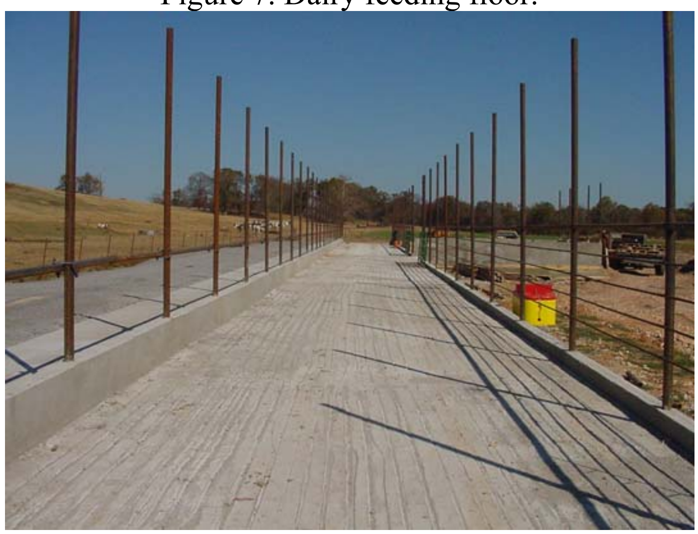

Figure 8. Dairy feeding floor.

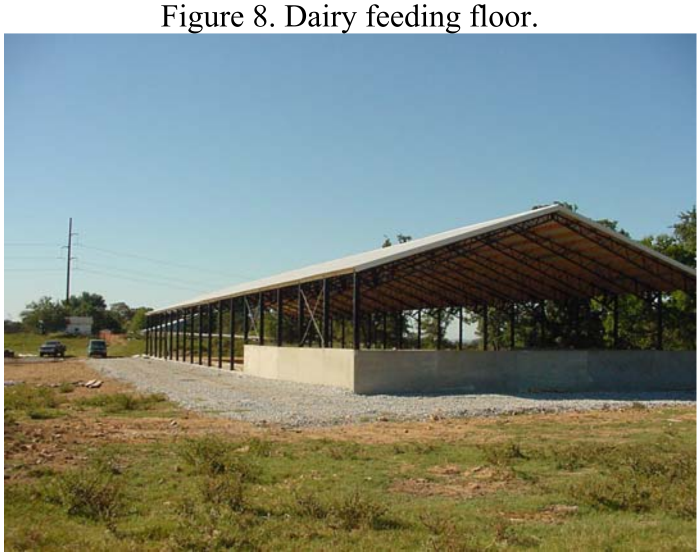

Figure 9. Large dairy feeding facility.

When exposed, poultry litter will lose nitrogen to the air as ammonium. Exposed litter is also vulnerable to runoff events after rainfall. This subjects both groundwater and surface water to pollution. Proper storage ensures that the fertilizer applied to land has improved nutrient retention, as the litter will not have been as exposed to the elements. Leaching of nutrients into ground water can be hindered by use of a ground liner; however, a permanent structure built to contain dry litter is often a better storage choice. These buildings usually have roofs and concrete floors to protect the litter from the elements in addition to protecting groundwater from nutrient leaching (Figure 10). The height of the roof is important, as it should offer enough space for litter to be piled and the equipment to be used. Partial walls may enclose the structure to prevent wind and rain from having an impact on the litter. Interior posts should be avoided as they impede activity in storing and removing the litter (Cunningham et al., 2003).

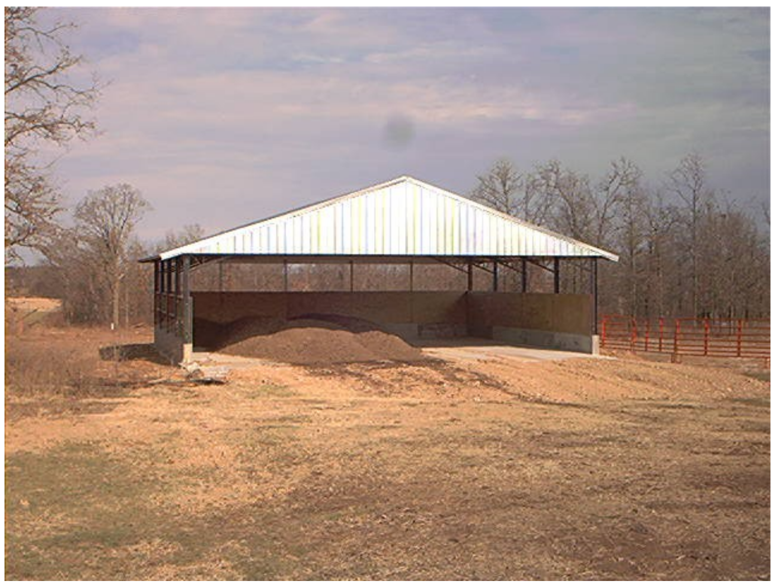

Figure 10: Poultry waste dry stack.

Travel ways allow controlled animal movement to specified foraging areas, watering sites and shelters, protecting areas from erosion and pollution (Figure 11) (NRCS and NHCP, 2002). Watering and feeding facilities protect livestock from disease, offer animals safer areas for eating and drinking while protecting areas from erosion and streams and ponds from sediment and bacterial pollution (NRCS and NHCP, 2000). Use of watering tanks improves water quality both for the animals as well as for streams; the animals are no longer contaminating their water supply and the stream experiences reduced pollution and stream bank erosion allowing for an improved riparian area (Burns, 2003). In a similar way, excavating ponds provides an alternative source of water from streams. The pond can also be fenced off with the pond water being piped to tanks, thus protecting the pond from contamination and erosion. Both insulated tanks and electric heaters can be used to freeze-proof the water supply (Figure 12).

Figure 11. Dairy feeding facility with auto waterer and travelways from pasture to milking parlor.

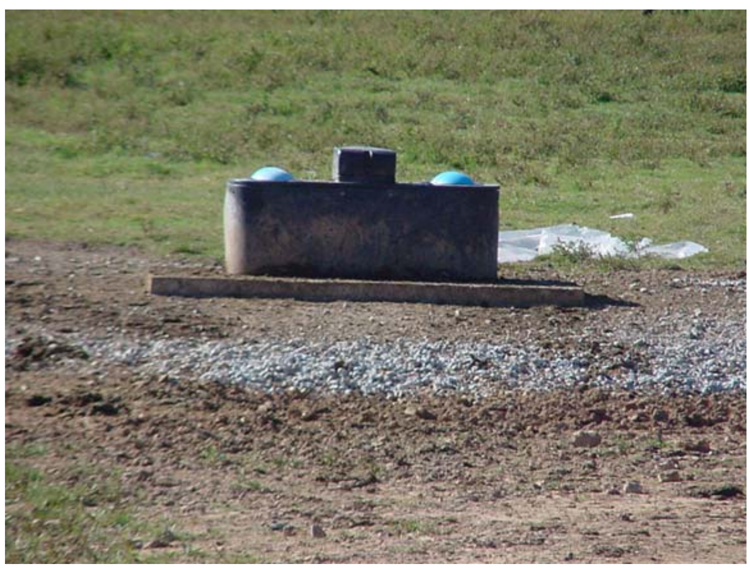

Figure 12. Automatic waterer for large feeding facility.

Cross fencing allows pastures to be grazed on a rotational basis. The pasture is separated into different sections, grazed and then given time to recover before being grazed again. Often, single stranded electric power fences are capable of subdividing pastures. Decreasing section size and increasing the number of grazers yields a more efficient use of pastures. Livestock become less selective in foraging and consume less desirable plants. Overgrazing is prevented by decreasing the time livestock spend in the section. The number of pasture sections depends on the time it takes for the pasture to recover from grazing (Manitoba Agriculture and Food, 2003). Rotating pastures also prevents the build-up of manure in any one area.

Heavy use area protection uses vegetation, surfacing materials, and structures if necessary to stabilize areas that are intensively used by livestock and humans. The goal is to lessen the impacts of heavy use. Soil erosion, degraded water quality, and compromised livestock health are likely results from not implementing these practices. Heavy use areas should be kept as small as possible (NRCS, 2002b).

Pasture management incentives allow ranchers and farmers to receive income for allowing land ordinarily used for farming and ranching purposes to be used for riparian areas, buffer strips, and in other ways that preclude the use of the land for agricultural purposes.

Table 1 summarizes planned versus implemented practices and suggests that many practices are planned, or written into conservation plans as recommended than are actually implemented. The initial planning stages, as summarized in an August 2000 revision of the workplan for this project, suggested a suite of practices that were scheduled to be implemented throughout the next three years of the project. Contracts were written with these landowners, and a given amount of funds were obligated to them as partial reimbursement or incentive payments for implementation of agreed upon practices. During those ensuing years, it became apparent that not all of those practices would be installed, and it became necessary to rescind some of those obligated funds and to reobligate them, perhaps for types of practices that had previously not been offered. Two such practices were winter feeding/waste management facilities and poultry litter storage houses. These practices were being funded through similar programs in other portions of the watershed and landowners who were installing other practices through this program indicated that they would be willing to install these practices.

Landowners cite many reasons for being unable or unwilling to implement practices they had previously agreed upon. The most frequently cited reason is lack of available funds or equivalent resources to provide the required landowner portion of the cost-share for installation. This reason was certainly the most frequently cited excuse in this project, and due to the implementation period's concurrence with drought years, it is understandable that many landowners would not have spare resources to dedicate towards these practices that may be viewed as "extras". In other cases, a death or some other change in the identity of the owner or manager of the land may lead to practices not being installed. More rarely, an excuse as simple as "I changed my mind", or "I don't want to" is given.

The result of these obligated dollars not resulting in implemented practices, was of course, the necessity to find new ways to obligate these dollars, either through new landowners who were willing to install practices already planned, or, in some cases, finding new practices to offer. One lesson that we continue to learn from programs such as this one is the necessity to remain flexible in your implementation plan, but also to listen to the concerns and needs of local landowners. Simply offering a predetermined fixed set of practices may or may not be successful in relatively small watersheds because there may be a greater chance that people won't want to employ those practices (with a larger watershed, you have a larger pool of potential cooperators to choose from and are more likely to be able to find a landowner who agrees that these practices are a good idea **and** has the available resources to implement them).

In a smaller watershed, you need to convince a larger percentage of the landowners to cooperate in your program.

Particularly when you work through voluntary programs such as this and expect landowners to contribute a portion of the cost of implementation, landowners must be receptive to the practices you are offering. Acceptance frequently changes with changing commodities prices and profit margins based on weather patterns, and the like, such that what seemed like a good idea one year, may not seem worth the investment the next. By listening to the landowners and considering practices that they were interested in (as long as those new or alternative practices would work to address the same issues in the watershed as the previously established practices), we were able to adapt the program to meet landowners needs and still install BMPs to protect the environment. Otherwise, fewer BMPs would have been installed, with a lower potential to reduce NPS loading to Peacheater Creek.

DATA MANAGEMENT AND ANALYSIS

Findings to Date

The monitoring has verified that Peacheater and Tyner Creeks have similar habitat, water quality, and biological communities. A statistically significant relationship has been defined between water quality analysis for Tyner and Peacheater Creeks. This relationship, based on USEPA requirements for paired watershed studies, signifies completion of the calibration phase of the project. The creeks respond similarly to disturbances such as high flow events. Both creeks have elevated nutrient concentrations and phosphorus is the primary nutrient of concern. Both creeks also have also suffered from the destruction of riparian areas, which is resulting in bank erosion and considerable bedload. The creeks are literally filling in with gravel from the cherty soils. This bedload is highly mobile during storm events, which further exacerbates the bank erosion problem, causing more bank erosion and making it difficult for stabilizing vegetation to develop. Streambank erosion also contributes significantly to the total nutrient load of the creeks. Although anthropogenic influences are more intensive in the Peacheater Creek watershed, overall land use is still very similar between watersheds.

Specifically, the sampling program was initiated in December 1995. An extensive habitat assessment, based on transects every 100 meters over the stream length, has been completed for both streams. Permanent transects have been established to monitor channel morphology and streambank erosion.

Intensive habitat assessments, consisting of transects every 20 meters at biological sites, have been completed and replicated for quality assurance. A fishery survey of both streams has been completed, involving one intensive survey and four catch and release surveys of large pools requiring sampling by electroshocking. The winter sets of periphytometer samples have been collected.

Measurements of high flow events resumed in 2002 on both Peacheater and Tyner Creeks in order to update the discharge curve. A depth/discharge curve for programming the auto-sampler in both Peacheater and Tyner Creeks has been completed and the samplers are operational.

Sampling will continue for a period of two years following implementation. Data will be collected and analyzed in an identical format to the method used to summarize preimplementation data. These results will be summarized in a later report, in an effort to demonstrate the impacts of these implementation efforts.

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