Oklahoma

Peacheater Creek
Section 319
National Monitoring Program Project

Figure 34: Peacheater Creek (Oklahoma) Project Location

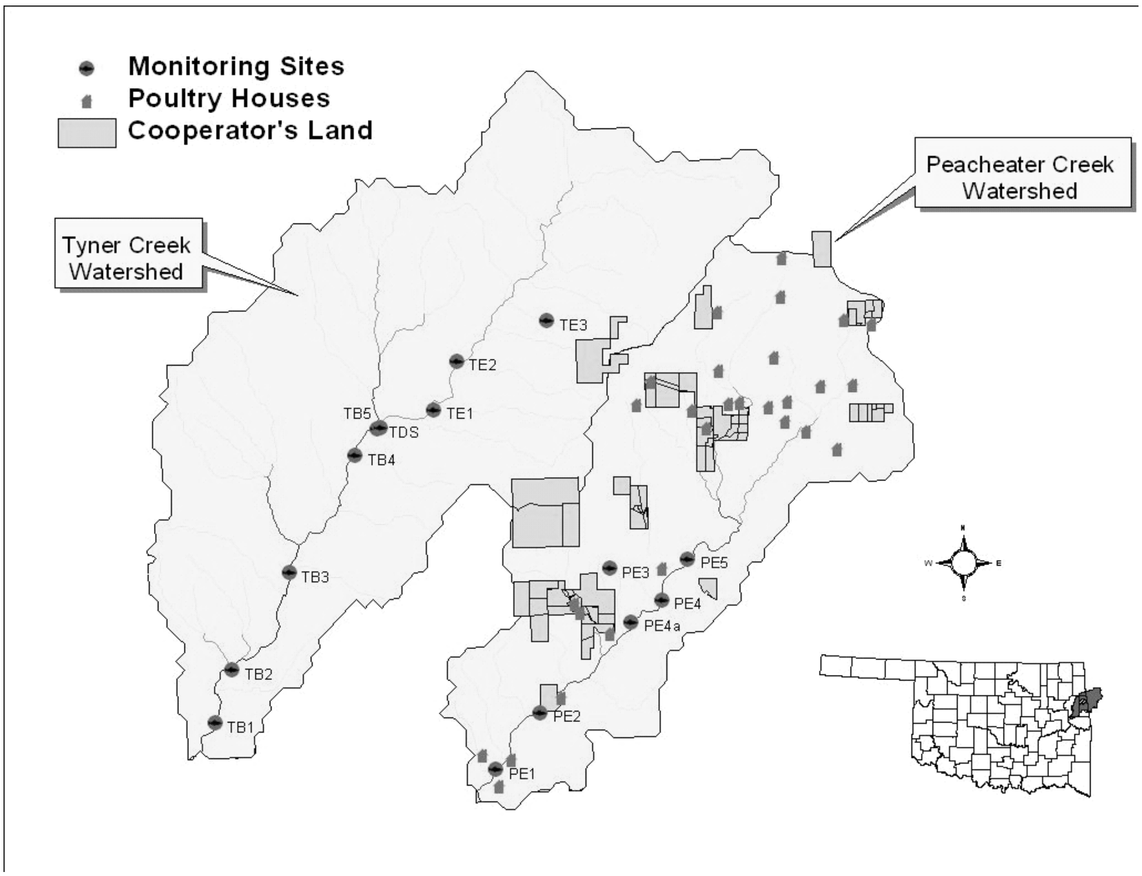


Figure 35: Water Quality Monitoring Stations for Peacheater Creek (Oklahoma) Watershed

PROJECT OVERVIEW

Peacheater Creek is located in eastern Oklahoma (Figure 34). The watershed is primarily pastureland and forestland with little cropland or rangeland. There are 65 poultry houses (locations of complexes or single houses shown in Figure 35), four dairies, and numerous beef cattle producers in the watershed. Cattle traffic and forestry activities are known to be major contributors to streambank erosion. Streambank erosion was quantified to estimate loads of sediment, total nitrogen, and total phosphorus contributed to each stream. Large gravel bars generated from streambank erosion impair fish and macroinvertebrate habitat quality. Baseflow monitoring shows intermittent high nutrient levels contribute to creek eutrophication. Impacts downstream of Peacheater Creek include streambank erosion, habitat degradation, 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 were digitized and mapped in a geographic information system. A distributed parameter watershed model was used to determine critical areas for treatment. Critical areas included pasturelands, riparian areas, and dairies. Nutrient management planning was completed to improve poultry and dairy waste utilization on cropland and pastureland.

Chemical, biological and habitat monitoring was completed for tributaries and the main stem stream. The project was designed as a paired watershed study comparing Peacheater Creek to Tyner Creek watershed, the control watershed. The program compared water quality data collected in the two streams before (preimplementation) and after (post-implementation) the implementation of best management practices. Sufficient data were collected to develop statistically significant relationships between the two watersheds using water quality variables. This pre-implementation calibration enabled a post-implementation comparison that linked improvements in water quality to implementation of best management practices as opposed to differences in weather patterns between the two periods.

Following calibration, implementation of best management practices began in 2000 to address the animal waste and erosion issues in the watershed. Implementation was challenged by several factors including drought, poor economic returns, and in some cases, resistance to the program. Despite these challenges, installation of practices was completed in the winter of 2002.

Post-BMP implementation monitoring, which began in January 2003, was completed in August 2005. Results indicated significant improvements in water quality due to the implementation of the project. The final project report is expected to be finalized in September 2007. Upon approval, the final report will be available from the Oklahoma Conservation Commission Website at: www.ok.gov/okcc/Agency_Divisions/Water_Quality_Division/WQ_Reports/WQ_Project_Reports/WQ_Reports:_Watershed_Specific.html.

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 baseflow 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. Geology in the basin is karstic.

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 65 poultry houses, four dairies and 176 private residences. Upper Tyner Creek has 19 poultry houses, three dairies, and 150 private residences. The 65 poultry houses in the Peacheater Creek watershed have a total capacity of approximately 1,290,000 birds. Five broods a year are produced for a total annual population of approximately 6,450,000 birds. Types of poultry grown in the watershed include broilers, layers, pullets, and breeder hens. In addition, at least 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

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 baseflow 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 which threatens the fishery, water supply, and recreational resource. Peacheater has been recommended for listing for impaired primary body contact recreation use based on Enterococcus concentrations in Oklahoma's 2006 Integrated Report.

Pollutant Sources

Primary sources of pollution are suspected to 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 which degrades in-stream habitat is also a pollutant. Its primary source is believed to be streambank erosion. This streambank erosion is largely due to riparian degradation or removal. Forestry activities and other clearing on steep slopes are an important secondary source of gravel.

Pre-Project Water Quality

Baseflow 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. 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 baseflow 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 baseflow concentrations.

Both Peacheater and Tyner Creeks have sections of 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 cattle traffic and forestry activities. The streambank erosion is believed to be further accelerated by the destabilization of the stream channel by the growing bed load.

Evaluation of the chemical, habitat, and biological data suggests that streambank erosion and bedload may be more problematic for Peacheater and Tyner Creeks than nutrient loading. It appears that although nutrient loading translates to water quality problems downstream, the most significant problems in Peacheater and Tyner are related to sedimentation. In other words, although nutrient concentrations are significantly above background levels, lack of available habitat due to bedloads which sometimes result in entirely subsurface flow is a more significant problem than periphyton growth and dissolved oxygen concentrations.

Water Quality Objectives

Restore recreational and aquatic life beneficial uses in Peacheater Creek and minimize eutrophication impacts on the Illinois River and Lake Tenkiller.

Project Time Frame

1995 to 2005. The Section 319 NMP project approval date was October, 1995.

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.

Eleven landowners participated in the project. Two were dairy producers, three combined dairy and poultry, two had poultry houses and beef cattle, and four had beef cattle. Acreage included in the program totaled 3,643 of the total 16,209 or twenty-two percent of the watershed.

All the operating dairies have animal waste management plans. A total of four waste management systems, including waste storage structures, were completed. Eight planned grazing systems were implemented. Three heavy use areas were installed to reduce sediment and nutrient runoff from feeding and loafing areas. Travel and or feeding lanes were installed at two dairies.

One hundred percent of the poultry producers have current Conservation Plans that include animal waste plans. Fifteen mortality composters were recommended and five were installed through the program. One litter storage building was installed. The conservation plans recommend 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 made recommendations on the amount of animal waste that could be applied to the soil according to the soil and litter test. Poultry producers in the watershed established one new buffer, four riparian buffer zones, four new pastures and installed 20 cross-fences for pasture management, and completed litter transport to farms where soil tests indicate litter spreading is allowable.

Twelve alternative water sources were installed, either ponds or freeze-proof tanks. The purpose of these alternative sources was to replace fenced off original water sources, or in the absence of fences, to encourage livestock to stay out of the creek, thereby protecting riparian areas. In addition, three ponds were fenced to restrict livestock access and prevent fouling.

One septic tank was installed to reduce NPS pollution from onsite wastewater. Although the exact percentage of watershed residents with inadequate onsite wastewaters systems is unknown, previous projects in similar watersheds suggest that as many as 70% of watershed residents have inadequate, or nonexistent onsite wastewater systems.

The land treatment and monitoring plan is summarized:

Project Schedule

Site	Pre-BMP	BMP Installation	Post-BMP	BMPs
Peacheater Creek[T]	12/95 – 8/98	3/99 – 12/02	1/03-9/05	Nutrient management (w/ respect to poultry litter), streambank stabilization
Tyner Creek[C]	12/95 – 8/98		1/03-9/05	

[T]Treatment watershed
[C]Control watershed

Water Quality Monitoring

The monitoring design for the Peacheater Creek 319 National Monitoring Program project was a paired watershed design. Peacheater Creek watershed treatment was paired with Tyner Creek watershed (control) (Figure 33). Water quality monitoring occurred at each watershed outlet. Habitat and biological monitoring occurred in both streams at appropriate locations.

Variables Measured

Biological

Periphyton productivity
Fisheries survey
Macroinvertebrate survey
Intensive and extensive habitat assessment
Bank erosion and bank soil sampling

Chemical
Dissolved oxygen (DO)
Specific conductance (SC)
pH
Alkalinity
Turbidity
Total Kjeldahl nitrogen (TKN)
Nitrate + nitrite nitrogen (NO2 and N03)
Total phosphorus (TP) and ortho-phosphorus (oP)
Total suspended solids (TSS)
Sulfate
Chloride
Hardness

Covariates (Explanatory Variables)
Stream discharge
Precipitation

Sampling Scheme

Pre-implementation monitoring consisted of chemical, biological, and habitat monitoring begun in December 1995 on Peacheater and Tyner Creeks. Chemical variables were monitored monthly from July through January, weekly during February through June, and during storm events for a duration of 20 weeks. Storm event monitoring was stage-activated and samples were taken continuously over the hydrograph. Concentration samples were flow-weighted composites.

Biological monitoring varied considerably with assemblage being sampled. Periphyton productivity was measured in the summer and the winter. Macroinvertebrates were monitored twice per year: once in the summer and once in the winter. Fish were intensively monitored every other year. Pool dwelling fish were inventoried quarterly. Future frequency will be determined by variance of parameters. Extensive habitat, based on transects every 100 meters over the stream length was monitored on alternate years. Bank erosion and bank soil sampling were monitored on alternate years. Permanent transects have been established to monitor channel morphology and streambank erosion.

Post-implementation monitoring to document effects of BMP installation on water quality was conducted from January 2003 through August 2005. The post-implementation monitoring program was identical to pre-implementation monitoring with regard to site location, parameters measured, and frequency of monitoring events. Post-implementation monitoring continued for a minimum of two years or until such time sufficient data was collected to verify whether a change in water quality had occurred.

Land Treatment Monitoring

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

Modifications Since Project Start

Since commencing the project, interactions with landowners in the Peacheater Creek watershed revealed considerable resistance and even hostility towards interaction by any outside source, especially governmental. Landowners in a majority of the critical areas of the watershed (mainly riparian areas) were particularly resistant. Consideration was given to switching implementation activities to the Tyner Creek watershed, leaving Peacheater as the control. Though the original intent was to focus implementation in the most impaired of the two watersheds and thus bring about the most dramatic improvement, local opposition threatened this design. Initial contacts with landowners in the Tyner Creek watershed revealed much lower resistance to outside aid.

A public meeting was held January 26, 1996 in the Peacheater Creek Watershed to inform watershed landowners about the results of the monitoring and the problems the results suggested. Every landowner residing in the watershed attended (over 60 people). The project team then spoke about planned implementation practices and cost-share rates offered to correct some of the problems. Landowners were encouraged to respond with what they felt were the problems in the watershed and whether they approved of the actions the project team was proposing. Based on the outcome of this meeting, it was decided the Peacheater Creek would remain as the Implementation Watershed.

Monitoring Scheme for the Peacheater Creek Section 319 National Monitoring Program Project

Design	Sites or Activities	Primary Parameters	Covariates	Frequency of WQ Sampling	Frequency of Habitat/Biological Assessment	Duration
Paired	Tyner Creek[C]	Periphyton productivity	Stream discharge		Summer / winter	2 yrs. pre-BMP
	Peacheater Creek[T]	Fisheries survey	Precipitation		Alternate years	2 yrs. post-BMP
		Macroinvertebrate survey			Summer / winter	
		Stream habitat quality			As needed	
		Bank erosion			Alternate years	
		Turbidity		Monthly		
		DO		Storm event		
		TKN				
		$NO_3 + NO_2$				
		TP and OP				
		TSS				

[C]Control watershed
[T]Treatment watershed

Land Treatment Progress to Date

The implementation of BMPs was completed in 2002, although contracts to maintain practices extended through 2004. Eleven landowners participated in the program. The following is a breakdown of the practices planned and implemented.

PRACTICE	PLANNED	COMPLETED
Cross Fencing for Pasture Management	27,170 ft.	13,598 ft.
Pond Excavation	5 ponds totaling 7,250 yd^3	2 ponds totaling 1,496 yd^3
Fence Pond	2,900 ft.	400 ft.
Fencing Around Pond	2,900 ft.	400 ft.
Buffer Strip	27.52 acres	7 acres
Buffer Strip/Filter Strip Fencing	4,400 ft	1,800 ft.
Freeze Proof Tanks- Alternate Water Source	14	14
Lagoon Excavation	3 totaling 3,548 yd^3	3 totaling 2,953 yd^3
Fence Lagoon	1,000 ft.	0 ft.
Pasture Management Incentives	902 ac -	433 ac
Heavy Use Protection	4 -	3
Lane Fencing	4,000 ft.	2,560 ft.
Poultry Litter Storage Facility	2 -	2
Septic Systems	2 -	1
Nutrient Management	405 acres	94 acres
Proper Waste Utilization	418 acres	259* acres
Riparian Areas	61 ac -	49 ac
Riparian Fencing	5,900 ft.	4,000 ft.

*****management of these 259 acres resulted in removal of at least 22,921 pounds of phosphorus from the watershed.

Implementation was completed in December 2002, although incentive payments continued through December 2004. Eleven producers participated in the program, and over seventy practices were put in place. Although approximately 35% of the watershed landowners participated in the program, only 66% of practices originally planned were implemented. Landowners cited economics as the primary factor leading to the failure to install planned practices.

Figure 34.

Failure to install originally planned practices led to unobligated monies but a lack of willing landowners. Therefore, landowner needs were evaluated to come up with practices that would solve landowner problems and protect water quality. The solution was winter feeding areas (Figure 34). Through installation of these feeding areas, landowners had a facility to feed livestock in a healthier, less wasteful, more convenient area. At the same time, cattle were encouraged to concentrate in an area farther away from the stream where waste products could be collected and disposed of more appropriately.

DATA MANAGEMENT AND ANALYSIS

Data Management and Storage

Chemical variables will be entered into the U.S. Environmental Protection Agency (USEPA) STORET system, the Oklahoma Conservation Commission (OCC) Water Quality Data Base and OCC office library. Biological variables will be entered into the OCC Water Quality Data Base, the collections stored at the OCC, and archived in the BIOS data base.

The OCC will prepare data and summary statistics for entry into the USEPA Nonpoint Management System Software (NPSMS).

Final Results

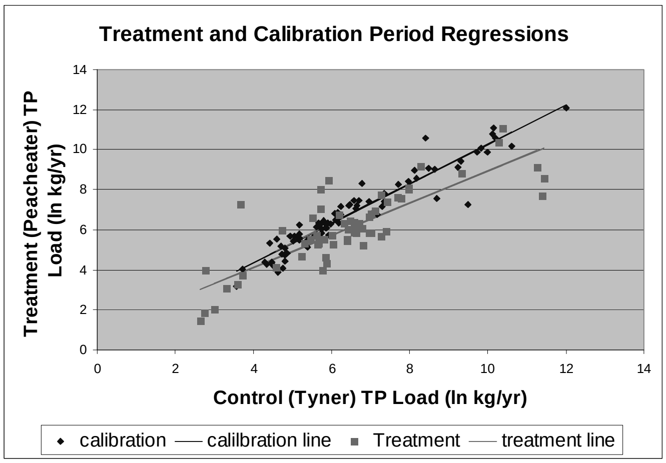
The pre-implementation monitoring verified that Peacheater and Tyner Creeks have similar habitat, water quality, and biological communities. A statistically significant relationship has been defined between water quality analysis for Tyner and Peacheater Creeks. This relationship is based on USEPA requirements for paired watershed studies and 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 problems with riparian destruction which are resulting in bank erosion and increased 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 contributes significantly to the total nutrient load of the creeks. Although anthropogenic influences are more intensive in the Peacheater Creek watershed, overall landuse is still very similar between watersheds.

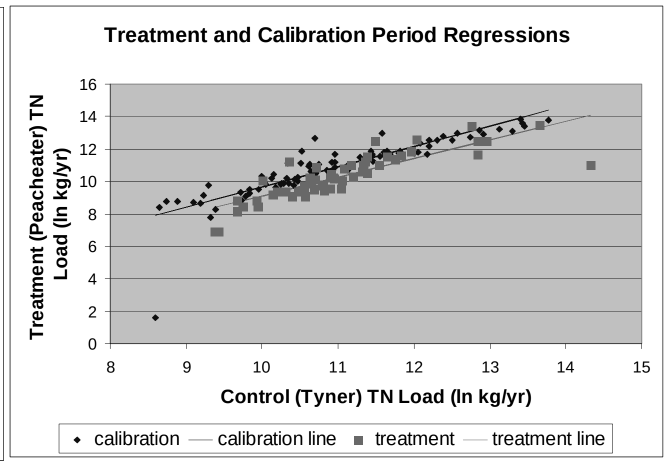
During the course of the project and often as a result of the problems encountered, several lessons have been learned that can be incorporated into future projects. These include:

- The most significant water quality problems may be different from those initially suspected.

- Insure that a reasonable number of landowners, particularly those in critical areas or with large holdings, are receptive to the program before you begin.
- Prevent partial implementation of recommended practices. Consider an "all or nothing" clause for contracts.
- Select practices that protect water quality, but that also meet the specific needs of landowners- be flexible.
- Develop a means of effective communication among all the people involved in the project.

Two years of post-implementation monitoring began in 2003 in order to document water quality changes due to installation of best management practices. Analysis of results indicated statistically significant reductions in total phosphorus loading (66%) (Figure 35), total phosphorus concentration (10%), nitrate concentrations (23%), nitrite concentration (54%), and total nitrogen loading (57%) (Figure 36), due to the implementation of practices. Analysis also suggested a significant increase in dissolved oxygen concentrations (3%). Impacts of these water quality changes were more significant during baseflow conditions than highflow conditions.

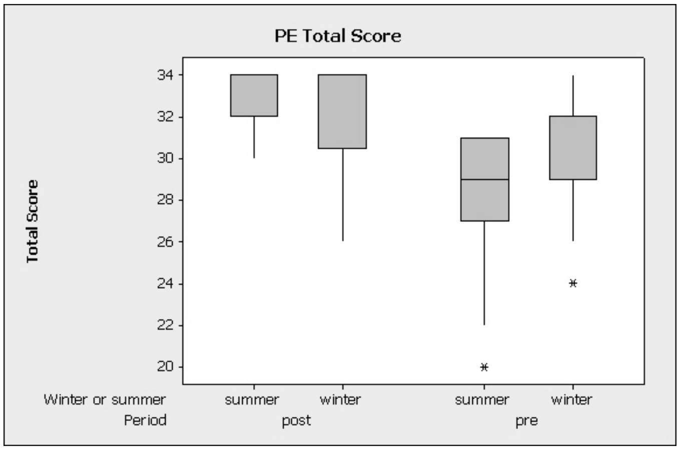


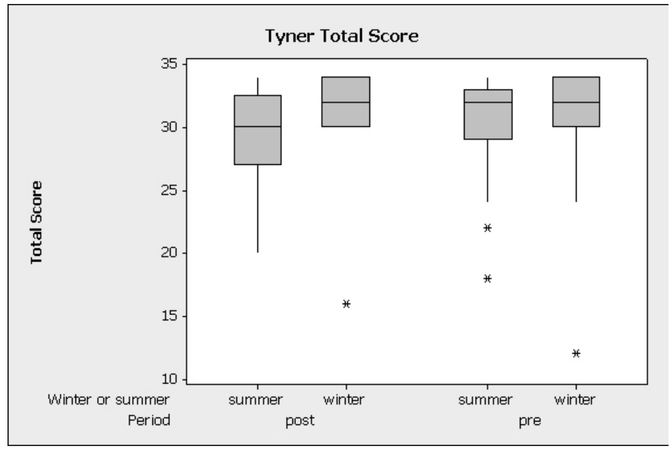


Comparison of habitat and fish community metrics and scores did not indicate any significant differences between pre- and post-implementation overall scores; however, comparison of individual metrics suggested that bank stability and bank vegetation may have been increased in Peacheater following implementation. However, canopy cover in Peacheater may have decreased following implementation. The cause of this decrease is not immediately evident based on examination of aerial photographs from the two periods of record.

The increased bank stability and bank vegetation evident in habitat scores is further supported by bank erosion studies which document significantly less bank erosion and mutrient loading due to bank erosion during the post-implementation period.

The effects of these improvements were also evident upon analysis of the benthic macroinvertebrate community. Although overall health of the community was well in line with reference streams for the area, post-implementation summer benthic community total score improved significantly in Peacheater Creek, but did not change in Tyner Creek. The summer community is often the poorer of the two indexing periods; therefore it is important that the summer community was improved, but also significant that it was improved to a level equal to that of the winter community.





INFORMATION, EDUCATION, AND PUBLICITY

Several methods were used to educate the general public and agricultural community about pollution control and water quality management. A primary concern in the watershed was animal waste and nutrient management. Producer meetings were used to provide updates on regulations for concentrated animal feeding operations, which include egg laying poultry operations and various types of poultry for flesh production. Records on waste clean-out operations and litter applications were recommended. Cooperative Extension Service and the US Department of Agriculture Natural Resources Conservation Service worked together to promote the proper use of waste holding ponds for dairies in the watershed. Soil nutrient sampling was provided free-of-charge to identify fields with excessive phosphorus levels. Litter testing was also available for broiler and laying operations. Litter application demonstrations are used to illustrate nutrient management principles on bermuda grass and fescue.

Rainfall simulator studies and demonstrations have been held to show effects of animal waste best management practices (BMPs) on water quality. The effect of nutrient application rate and filter strips was demonstrated during a summer field day. Future rainfall simulator study demonstrations are planned.

A 4-H Day camp for three days has been completed annually to provide water quality education. An inner tubing excursion was used to show the extent and effect of stream bank erosion on stream habitat quality. Youth camp participants also tested the chemical quality of Peacheater Creek using portable kits. Resource Fairs for students were held in 2000 and another scheduled for 2001.

TOTAL PROJECT BUDGET

The estimated budget for the Peacheater Creek National Monitoring Program project for the life of the project is:

Project Element	**Funding Source ($)**			
	Federal	**State**	**Local**	**Sum**
WQ Monitoring	250,000	166,667	NA	416,667
Flow Monitoring	100,000	66,670	NA	166,670
Implementation	108,000	72,000	NA	180,000
Post Implementation Monitoring	19,000	12,667	NA	31,667
TOTALS	477,000	318,004	NA	795,004

Source: Phillip Moershel (Personal Communication), 1996

IMPACT OF OTHER FEDERAL AND STATE PROGRAMS

This project compliments a larger program to improve the water quality of the Illinois River and Lake Tenkiller. An effort to establish a Total Maximum Daily Load (TMDL) for the system is nearing completion, which may build upon the results in Peacheater Creek. The TMDL will recommend significant nonpoint source reductions for the watershed. Successes and failures in the Peacheater watershed will guide the larger watershed implementation efforts.

The USDA Natural Resources Conservation Service (NRCS) is an important partner in State Programs to reduce Nonpoint Source Pollution. The NRCS implemented additional practices in the watershed through the EQIP program. Also through this program, 96 producers with poultry, dairy cattle, or beef cattle operations have developed waste management plans for their operations. As a result, it was estimated that over 63% of producers in the watershed reduced their waste application rates and/or quit applying waste to unsuitable areas.

OTHER PERTINENT INFORMATION

None.

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