Spavinaw Creek
Watershed Implementation Project
2012 Report

FY 2008 319(h) Project 15 and FY 2009 319(h) Project 5

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Introduction

Lakes Eucha and Spavinaw are the result of impoundment of Spavinaw Creek and provide water for a combined population of nearly one million people in northeastern Oklahoma. Lake Eucha is one of three "Category I" watersheds in Oklahoma that were recognized in 1997 as significantly impaired and in need of immediate federal and state funding to target restoration activities. The excessive nutrient loading in the watershed, particularly phosphorus, and the resulting eutrophication of the lakes has impacted 10 municipalities, including Tulsa, and 11 Rural Water Districts which depend on the lakes to supply their populations with drinking water and recreation. Significant taste and odor problems have been linked to eutrophication in the lakes, and complaints from water users have led to increased treatment costs and increased water quality monitoring. Low dissolved oxygen has resulted in both lakes, and some streams in the watershed are impaired by pathogens.

Pollutant-reducing efforts were initiated in the 1990s in the Beaty Creek subwatershed, and several iterations of funding in recent years have allowed expansion of best management practice (BMP) implementation into the entire Spavinaw Creek watershed area. The latest 319 project, initiated in FY 2008, focused implementation dollars towards nonpoint source pollution problems in the Spavinaw Creek Watershed; however, the original amount of funds dedicated towards the program was reduced due to shortfalls in other parts of the Oklahoma nonpoint source program, so additional implementation was achieved with FY 2009 project funding.

The ultimate goal of these efforts is to improve the water quality of the lakes and streams so that impairment of water quality standards is no longer an issue. This particular project involved the collaboration of numerous agencies as well as Oklahoma State University and local landowners, with nearly three million dollars spent in BMP implementation overall. Data was collected at several stream monitoring sites using a paired watershed design to determine the effects of the implementation project on water quality. Several distinct components were included in the earlier Spavinaw Creek watershed implementation projects which helped guide efforts in this project, including targeting areas of highest NPS pollution, watershed education, and soil sampling and analysis. These items can be reviewed in the FY 2003 Spavinaw Project Report (OCC 2008).

Based on the knowledge gained through previous work, this project allowed the continuance of the watershed scale effort to reduce NPS loading in the Spavinaw Creek Watershed. This report will summarize the BMP implementation and water quality monitoring results over the period 2008-2012 funded by the FY 2008 and 2009 319 projects.

Project Background

The Spavinaw Creek watershed is located in Mayes and Delaware Counties in northeastern Oklahoma and in Benton County in northwestern Arkansas (Figure 1). The watershed includes Hydrologic Unit Codes 11070209050, 11070209040, and 11070209060. The principal stream in the Lake Eucha Watershed is Spavinaw Creek, which drains approximately 230,000 acres in Arkansas and Oklahoma (60% in Oklahoma). Spavinaw Creek is a tributary to the Neosho River, which is a tributary to the Arkansas River. Spavinaw Creek drains Lake Eucha and is impounded downstream to form Lake Spavinaw located approximately four stream miles downstream of the Eucha dam. Other major tributaries to Lake Eucha include Beaty Creek, Brush Creek, and Dry Creek.

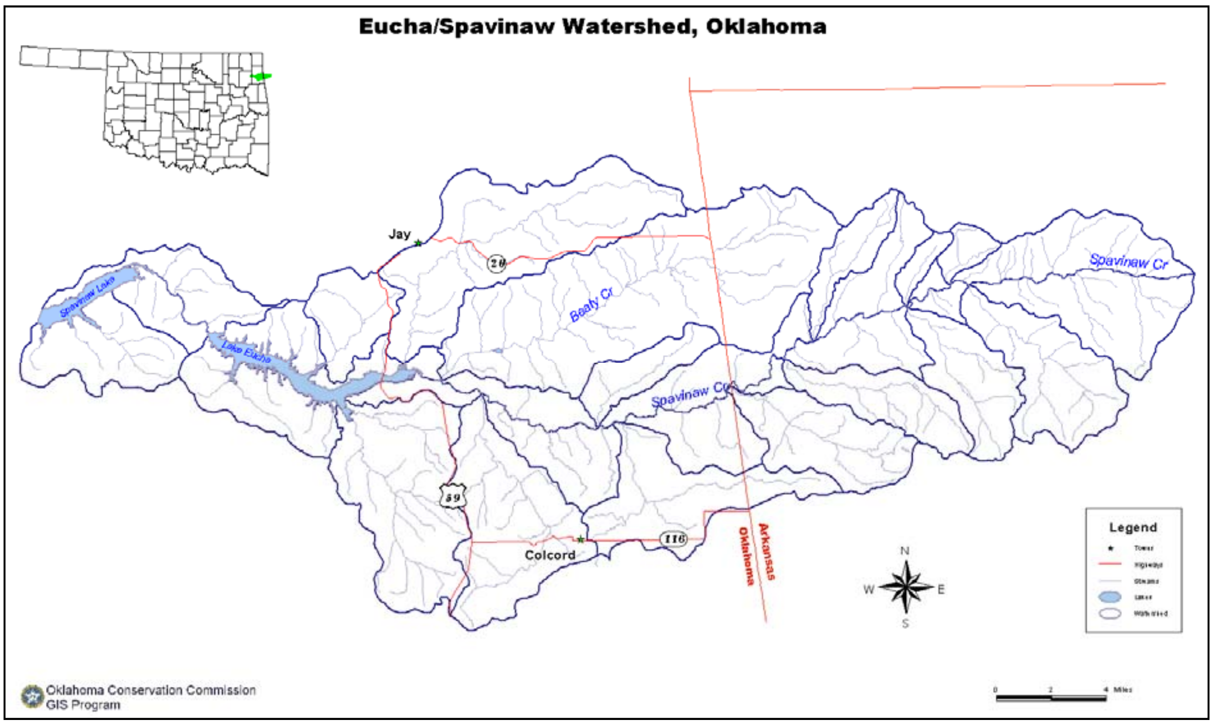


Figure 1. Location of Spavinaw Creek Watershed.

The designated beneficial uses for Lake Eucha, Lake Spavinaw, and Beaty Creek include public and private water supply (PPWS), fish and wildlife propagation--cool water aquatic community (CWAC), agriculture, primary body contact recreation (PBCR), and aesthetics. Both lakes have also been designated “sensitive public and private water supply” (SWS) and “nutrient limited watershed” (NLW). In addition, Beaty Creek has a “high quality water” (HQW) designation, which indicates water quality that exceeds that necessary to support the propagation of fish and other aquatic life. This designation prohibits any new point source discharge or increased load or concentration from an existing point source which would lower water quality.

Both Lakes Eucha and Spavinaw have been on the state's 303(d) list of impaired waters for nutrients (phosphorus) and low dissolved oxygen values since 2006 and for chlorophyll-*a* since 2008. Beaty Creek has been listed for "pathogens" (*E. coli* and *Enterococcus*) impairment since 2000. Beaty Creek was **delisted** for *E. coli* bacteria in 2006 but remains impaired for *Enterococcus* bacteria, as does Spavinaw Creek. The Spavinaw Creek Watershed is located in the poultry and cattle producing area of northeastern Oklahoma. Agricultural activities appear to be the major NPS source of impact. Riparian areas in this region are frequently compromised, either through removal of protective vegetation or through uncontrolled livestock access. The result is streambank erosion, habitat loss, and increased sediment and nutrient transport into streams.

It is estimated that the Spavinaw Creek watershed supplies approximately 85% of the phosphorus entering Lake Eucha. The phosphorus in Beaty Creek, one of the major tributaries to Spavinaw Creek, likely originates from nonpoint source pollution due to agricultural practices associated with the poultry industry, while the phosphorus in Spavinaw Creek likely originates from a combination of both point source pollution (from the Decatur, AR WWTP) and nonpoint source pollution (from agricultural practices associated with the poultry industry). Another indication of nonpoint source contamination and likely impacts from animal waste is suggested by the elevated levels of bacteria found in the tributaries to Lake Eucha.

The major agricultural industry in the Oklahoma portion of the watershed includes cattle and poultry. Tens of millions of birds are produced annually, resulting in more than 73,000 tons of litter containing over 1,300 tons of waste phosphorus (based on estimates by Everett 2004). There are also a number of dairy and hog operations in the watershed.

The OCC first began work in the area in 1998 in the Beaty Creek subwatershed, a watershed of nearly 38,000 acres. This initial project was designed to demonstrate BMP implementation as well as the ability of a paired watershed monitoring design to assess the effects of BMPs. A paired watershed monitoring design was instituted, with Little Saline Creek being the control watershed where no BMPs were implemented. A significant reduction in the expected loading of phosphorus (relative to the control) was observed after implementation in the Beaty Creek subwatershed, indicating that BMP implementation was improving water quality.

The FY 2003 Spavinaw Creek Watershed project expanded BMP implementation, education programs, and monitoring from the Beaty Creek watershed into the larger Spavinaw Creek watershed. Sources of phosphorus were assessed with a Soil and Water Assessment Tool (SWAT) model, and areas were targeted for BMP implementation to maximize the potential for improvement of water quality. Over two million dollars was spent on implementation, which allowed BMPs to be installed in more than 26% of the watershed.

Paired watershed monitoring was continued in the Beaty and Little Saline watersheds, and monitoring of Spavinaw (treatment) and Saline (control) Creeks was initiated. When the data was analyzed in 2008, significant decreasing trends in nutrients, especially phosphorus, were evident in the Beaty Creek watershed relative to Little Saline (control). Total phosphorus loading improved from the 14% reduction reported after one year of implementation to a 66% reduction over what was expected based on pre-implementation conditions. Average phosphorus loading was significantly decreased in the post-implementation period relative to the calibration. In addition, TKN loading was reduced by 80% in the Beaty watershed, ortho-phosphorus loading by 53%, and ammonia loading in Beaty Creek was reduced by 87% over what was expected without BMP implementation. Bacteria levels were significantly decreased in the Beaty watershed, while there was no significant change in Little Saline. The fish community remained "excellent" in Beaty Creek while decreasing in Little Saline Creek, and the in-stream habitat improved in Beaty Creek. There was not enough data from Spavinaw-Saline to see significant changes in the last report, so this report will include the first analyses of that data using the paired watershed method.

Demonstration of Best Management Practices

Past studies in the Spavinaw watershed identified sources of pollution in the watershed, and the SWAT (Soil and Water Assessment Tool) model was used to predict areas contributing a disproportionate amount of phosphorus per unit area (Figure 2; Storm et al. 2005). These areas were targeted to implement BMPs to impact these areas of greatest phosphorus loss. Storm's targeting study indicated that the most significant limiting factor to load reduction was current soil phosphorus concentrations in the watershed. Many soils in the watershed are supersaturated with phosphorus and will require many years (perhaps even decades) of depletion through leaching, crop harvest/export, and runoff to reach levels that do not contribute significantly to water quality problems. Possible management measures are listed in Table 1, along with the expected total NPS load reduction

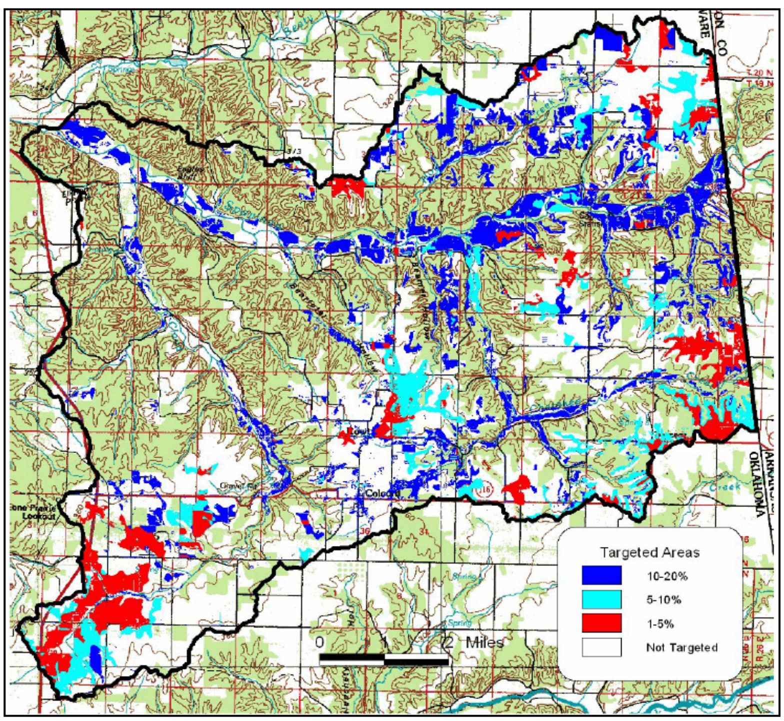


Figure 2. Targeted areas in the Spavinaw Creek Basin as predicted by SWAT (Storm et al. 2005).

associated with that practice, based on simulations in the SWAT model. Riparian fencing, converting row crops to pasture, ceasing litter/fertilizer application, and improving pastureland are suggested to provide the greatest potential for load reduction.

Table 1. Suggested NPS Best Management Practices and expected load reductions (from Storm et al. 2005).

Practice	Expected NPS Load Reduction (from SWAT)
Cease poultry litter application	20%
Row crop BMPs	6%
Convert row crops to pasture and cease fertilizer use	50%
Fencing of riparian areas	60-78%
Strip cropping / contour farming	up to 40%
Nutrient management plan / decreased litter application	10-15%
Pastureland BMPs (no litter, rotational grazing, pasture planting, terrace installation)	44%
Vegetated strips around urban streams	0.5%
Conservation easements around Lake Eucha (erosion control)	0.5-0.7%
Streambank stabilization	15%

To facilitate the demonstration of BMPs throughout the watershed, the OCC partnered with the Delaware County Conservation District and local NRCS. The OCC employed a local project coordinator who was responsible for working with the individual landowners to develop conservation plans and agreements and verify practice implementation and maintenance. A Watershed Advisory Group (WAG) was convened as part of the FY 2003 Spavinaw Creek 319 Project to decide on BMPs and cost-share rates to be offered through the project. The BMPs selected focused on reduction of nutrient, sediment, and bacteria loading. The BMPs offered in subsequent projects have followed these original recommendations, with slight alterations in cost-share rates to reflect changing prices of equipment and supplies. These practices include: 1) the establishment of riparian areas through fencing, vegetative establishment, and off-site watering; 2) buffer zone establishment through fencing and vegetative establishment; 3) streambank stabilization through fencing and vegetative establishment; 4) animal waste management through storage facility and composter installation and cleanouts; 5) pasture establishment and management including vegetative plantings, alternative water supplies, and fencing; 6) litter transport for poultry producers; 7) establishment of heavy use areas; and 8) rural waste system improvements.

All residents of the Spavinaw Creek Watershed were eligible for cost-share assistance regardless of size of land ownership. Applicants were assigned a priority rank based on the proximity of their property to streams, whether the property was in the targeted area, and the practice suite recommended for implementation. The maximum cost-share assistance to any one participant in Spavinaw Creek was $20,000, and cost share rates were generally set at 60-80%, requiring a 20-40% match from the landowner (see below). Detailed breakdowns of each component can be found in the *Spavinaw Implementation Plan* (**Appendix A**).

Cost Share Practices			***Cost Share Rate***
Riparian Area Establishment/Management			
	Components:	(1) Use Exclusion	100%
		(2) Off-Site Watering	80%
		(3) Fencing	80%
Buffer Zone / Filter Strip Establishment			
	Components:	(1) Use Exclusion	100%
		(2) Vegetative Establishment	80%
		(3) Fencing	80%
Animal Waste Storage			
	Components:	(1) Composter	60%
		(2) Cake-out house	60%
		(3) Full clean out house	60%
		(4) Cattle feeding / waste storage	60%
Pasture Establishment / Management			
	Components:	(1) Vegetation Plantings	60%
		(2) Fencing	60%
		(3) Off-Site Watering	60%
Waste Utilization for Poultry			
	8¢-15¢ per lb. of phosphorus produced and properly utilized		
Heavy Use Areas			60%
Rural Waste Systems			
	Components:	(1) Septic System	80%
		(2) Percolation test	80%

Since the start of the implementation project in April of 2008, the OCC has made significant progress in implementing these practices with the help of local landowners. As of September 2012, 137 landowners have installed best management practices on their property. To date, a total of $2,921,692 has been spent on implementation, of which $1,205,406 has been contributed by landowners. OCC continues to work to recruit new participants and create new opportunities for existing participants to implement additional practices through FY 2011 and 2012 319 "special projects" grants.

Planning efforts were coordinated with the NRCS and the Delaware Conservation District to allow leveraging of funds for mutual benefit. For example, EQIP provides funding for some practices that 319 does not. If a landowner could not participate in the 319 program, they were informed about EQIP possibilities so that both agencies benefited from the relationship and worked towards mutual goals.

Figure 3, below, shows where BMPs have been installed through both the 2003 and 2008 319 projects. Participation in the 2003 project resulted in about 26% of the land in the Oklahoma portion of the watershed having some sort of BMP effort. Participation in the 2008 project has added another 15% of the watershed area under plan, for a total of approximately 40% of the Oklahoma watershed involved in BMP implementation through the 319 program.

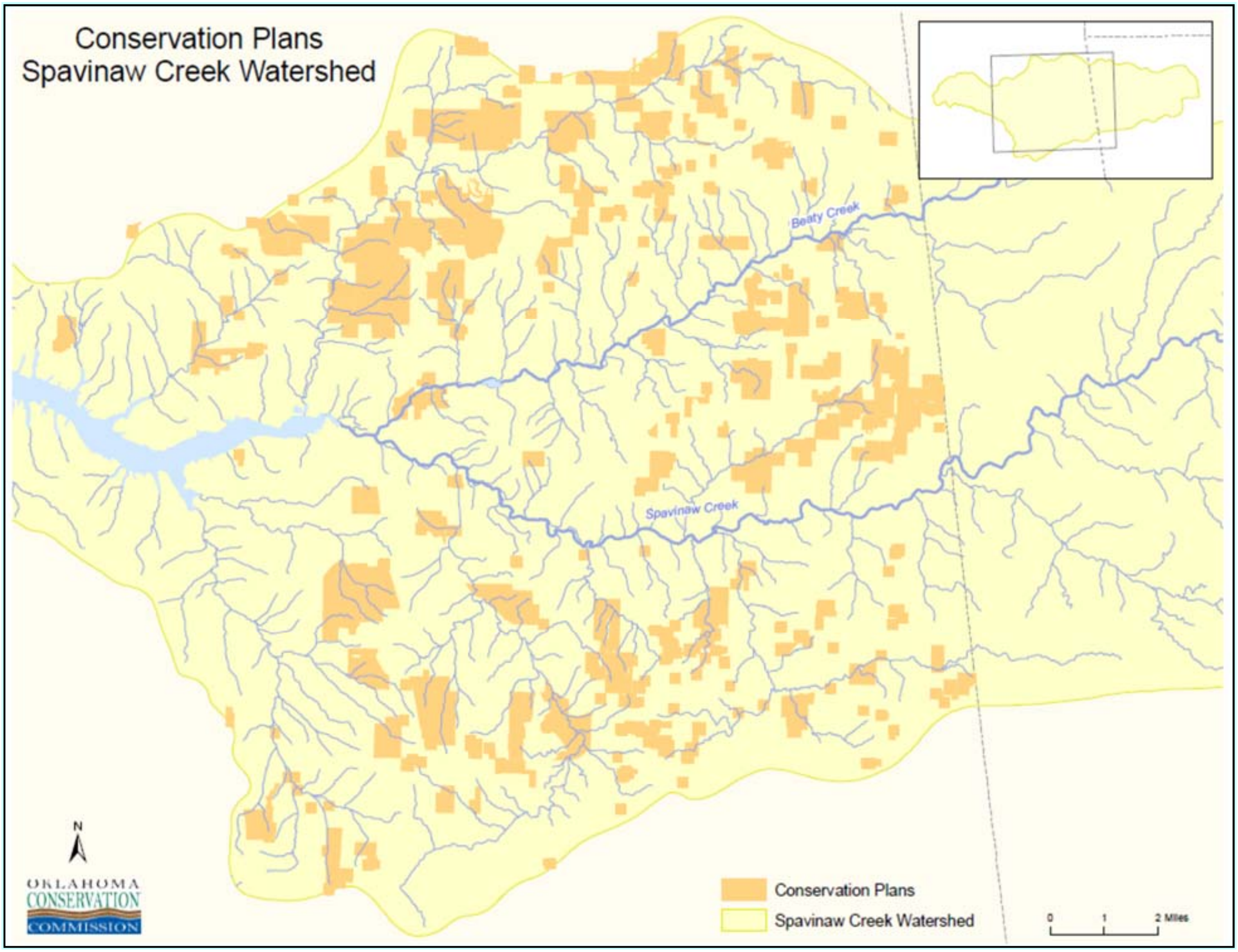


Figure 3. Spavinaw Creek Project Cooperators.

Riparian Establishment and Management and Buffer Zone / Filter Strip Establishment

Cultivated fields, pastures, and / or farmsteads have the potential to contribute large amounts of nutrients and sediment that pollute the waters of Lake Eucha during runoff events. The establishment of vegetated riparian zones and buffer zones / filter strips around these areas helps to reduce the nonpoint source pollution from these sources. The demonstration of the cumulative benefit of comprehensive buffer and riparian management incentives was a top priority. The following practices were implemented in order to reduce the nutrient and sediment load (shown in Figure 4):

1) Fencing for Riparian Management
Landowners look upon the riparian areas as critically needed, highly productive pasture. However, heavily grazed riparian areas function poorly as nutrient traps, and cattle trails become channels for direct transport of nutrients to the stream. Fencing to exclude cattle from a certain area along a stream was recommended to control these problems. Incentives were offered to establish a buffer of 150 feet, maximum, on each side of the stream (average width). In order to take advantage of existing fences, the buffer widths occasionally varied slightly. Fences were built above the flood prone area elevation to lower maintenance costs.

All riparian exclusion incentives were for no more than four years. Landowners were given the following options: a) riparian protection with total livestock exclusion for a $50/acre/year incentive payment, b) riparian protection with limited hay production (with haying allowed only in vegetative zone of the buffer and only during a time of the year to allow sufficient regrowth prior to the end of the growing season) for a $45/acre/year incentive payment, or c) riparian protection with limited grazing for a $40/acre/year incentive payment. Limited grazing or flash grazing would allow landowners to grant livestock access to the riparian zone for a brief period in summer when streambanks were most stable (due to lack of rain) and with sufficient time for regrowth before the end of the growing season. As part of the plan, landowners agreed to pull livestock out of the area prior to the point where it became overgrazed.


The acreage that was converted to riparian buffer zones or filter strips is given in Table 2, below, along with the other riparian protection BMPs. Three landowners (total of 25 acres) used the limited grazing option, while the rest of the riparian area was total exclusion. As shown in the photos on the previous page, the riparian area (side of the fence with trees) can be quite wide, and vegetation will quickly grow to the height of the fence or more once cattle are excluded.

Table 2. Riparian buffer and filter strip establishment/management BMPs implemented.

Best Management Practice	Number of Landowners	Amount	Unit
Riparian area/filter strip total exclusion/limited grazing	16	421	acres
Riparian fence	10	43,537	feet
Pond	1	1	pond
Water tank	2	2	tanks
Well	1	1	well

2) Off Stream Watering

Pastures where the stream is the primary or sole source of water for livestock were provided with an alternate water source to allow riparian management. Studies have shown that off-stream water sources can substantially reduce the impact of cattle even without fencing the stream. Off-stream watering was budgeted only for the perennial sections of the stream because the landowners already had provided water supplies for livestock where the stream does not supply permanent water. Watering options included pond excavation and freeze-proof water tanks. Wells are sometimes drilled to supply the alternative water. Some ponds are fenced off to prevent cattle from loafing in them. Table 2, above, indicates the number of alternative water supplies installed as part of riparian buffer establishment. Most of the water sources installed in this project were as part of pasture management, discussed in a later section.

3) Permanent Vegetative Establishment

The planting of grasses and/or trees within the riparian zone or in a filter strip/waterway was encouraged by providing cost share funds for seed, seedbed preparation, lime, and fertilizer (if necessary). Permanent vegetation in these areas should help to reduce runoff of both sediment and nutrients from cropland and pasture adjacent to a stream. One landowner installed two grassed waterways, and one landowner planted Bermuda grass as part of this BMP category.

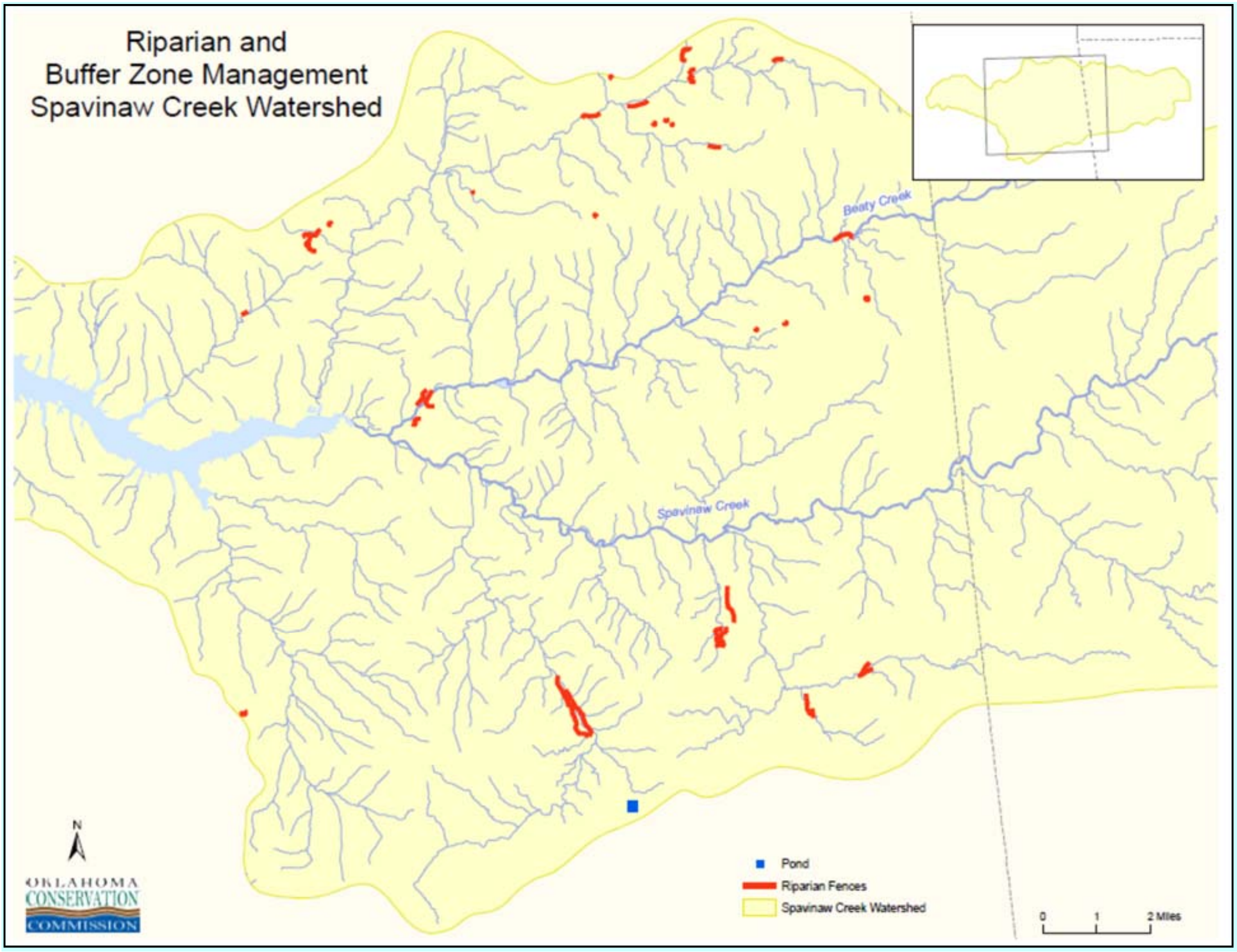


Figure 4. Location of riparian management practices implemented 2008-2012.

Animal Waste Storage

1) Poultry Composters / Cake-out Houses

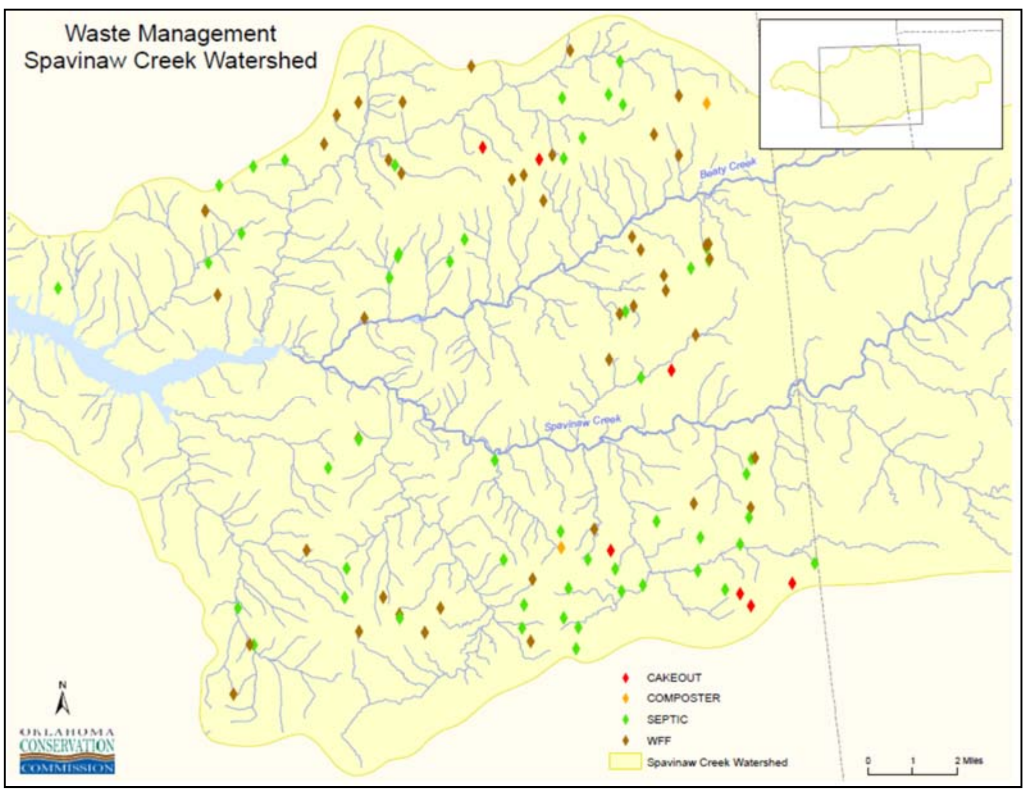
There are many poultry operations in the Spavinaw Creek watershed. Many producers did not have a means of properly disposing of dead birds, resulting in disposal on their fields. Producers are also often forced to clean out their poultry houses when weather and soil conditions are not acceptable for application of animal waste as fertilizer. Cost-sharing was used to provide composting and waste storage facilities to producers. This enabled the producers to clean out their houses regardless of weather and time of year and store the waste out of the elements until it could be transported off of the farm or applied properly. Table 3, below, indicates the number of participants in this BMP, and Figure 5 shows the locations of these facilities.

Table 3. Animal Waste Storage Facilities installed.

Best Management Practice	Number of Landowners	Amount	Unit
Cakeout house/Composter and full cleanout	2	2	houses
Waste storage/Animal feeding facility	23	24	facilities

2) Cattle Feeding / Waste Storage Facilities

Cattle feeding / waste storage facilities (photo below) are elaborate structures which are designed to reduce runoff of nutrients, bacteria, and sediment from cattle supplemental feeding areas. Landowners typically overwinter and often feed cattle in the same areas of a pasture, areas that are chosen because they are easy to get to and provide a reliable source of shelter and water for overwintering stock. This often means they are close to the creek or a ravine or dry channel where shelter from the wind is available, and the running water in the creek generally insures that it does not freeze often. Unfortunately, these areas become trampled, overgrazed, and laden with waste, and, hence, are susceptible to runoff. By providing a sheltered feeding area away from the stream, feeding facilities reduce this problem. The structure has a concrete floor with a lip all around to contain waste. In addition, the back 1/3 of the structure is devoted to dry manure storage, sized sufficiently to store up to 3 months worth of manure until such a time it can be properly land applied. This was a very popular BMP, with 24 facilities constructed during the project period.



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igure 5. Location of poultry cakeouts and composters, winter feeding facilities, and septic systems installed 2008-2012.

Pasture Establishment / Management

1) Vegetative Plantings

Over-grazed and poorly grassed fields and pastures can be significant sources of erosion in the watershed. Since the phosphorus levels in the soil in this watershed are very high, soil entering streams can contribute high phosphorus loads from the watershed. Proper fertilization of 288.5 acres of poor pastureland and cropland in the watershed allowed for the establishment of better quality and quantity of vegetative cover. As indicated in Table 4, 455.5 acres of grass was planted to create healthy pastures which will reduce the amounts of nutrients and sediment which enter streams due to runoff. Figure 6 shows the locations of pasture BMPs in the watershed.

Table 4. Pasture establishment/management BMPs implemented.

Best Management Practice	Number of Landowners	Amount	Unit
Cross-fence	60	245,890	feet
Pasture planting (bermuda, fescue)	12	455.5	acres
Watering facilities and pipeline	50	93	tanks
Ponds	26	33	ponds
Wells	29	29	wells
Lime	2	57	acres
Fertilizer	8	288.5	acres

2) Cross-Fencing

To keep pastures in optimal condition, producers must avoid overgrazing. Cross-fencing techniques are used to rotate cattle to various pastures and prevent overgrazing. Rotating herds lessens the potential for development of bare, erodible areas associated with loafing in certain spots of a pasture. 245,890 linear feet of fence was erected to allow rotation of livestock across pastures.

3) Water Facilities

Cross-fencing livestock often necessitates addition of water facilities. As part of the pasture management BMPs, 93 water tanks and 33 ponds were installed during the project period. The water source for some of these tanks was supplied by new wells.

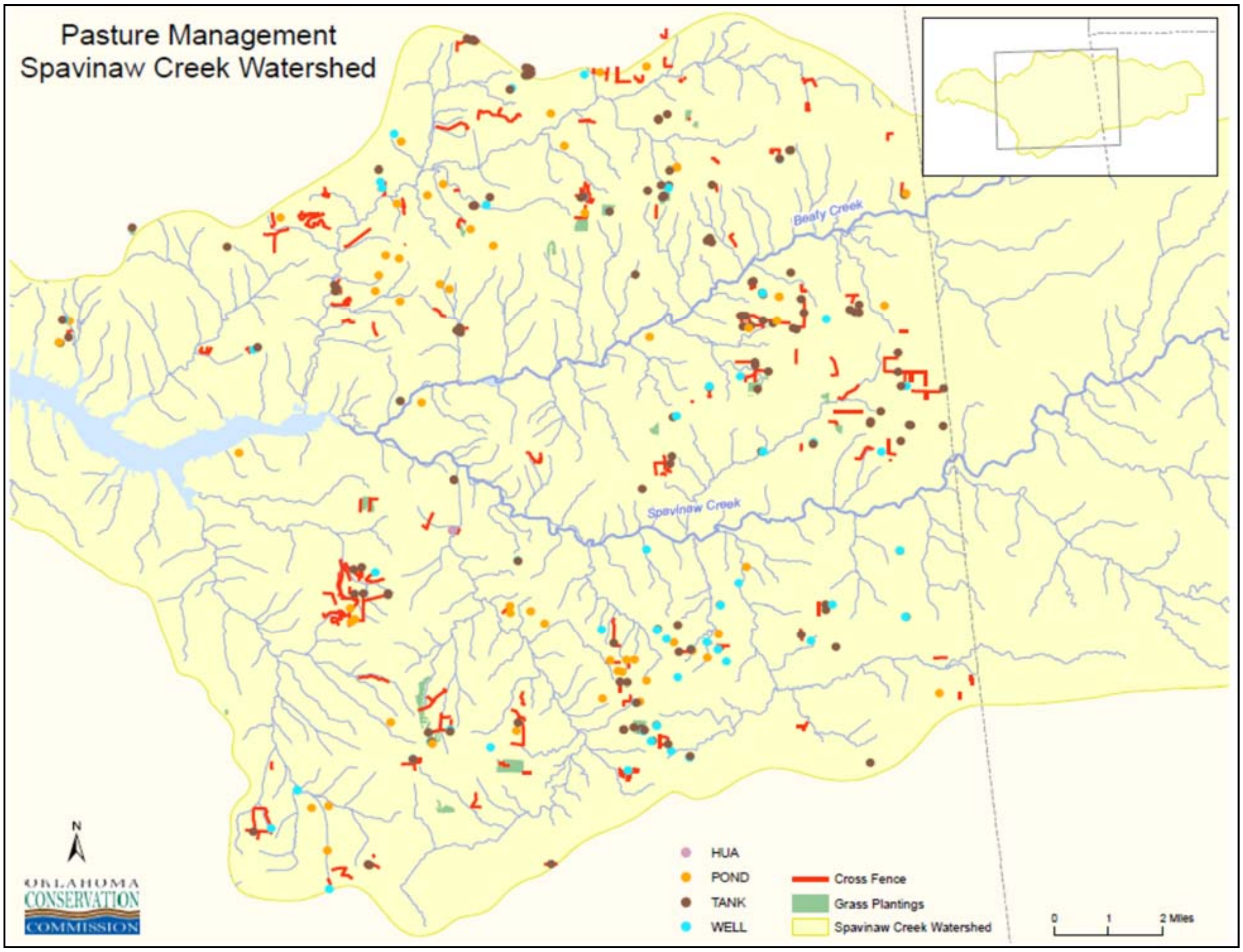

Figure 6. Location of pasture establishment/management BMPs implemented 2008-2012.

Waste Utilization for Poultry

Poultry litter is a mixture of manure and bedding material which is cleaned out of poultry houses. Because of its nutrient content, it is typically used to fertilize local pastures to promote grass growth. The timing of litter application as well as the amount applied can have a large impact on water quality in the area. In the Spavinaw Creek watershed, soils are very high in nutrients, particularly phosphorus, due to years of litter application.

To target producers who have excess litter or who are prevented from spreading litter due to soil test phosphorus levels, litter transfer was incentivized to promote movement to areas outside the Spavinaw Watershed. For this project period, 1,727 tons of litter was moved out of the watershed to a non-nutrient limited area.

Heavy Use Areas

As large animals, cattle can severely impact areas around feeding or watering facilities where heavy traffic compacts soil and destroys stabilizing vegetative cover, increasing soil erosion from the area. Heavy traffic is usually accompanied by increased waste deposition, which can lead to increased nutrients and bacteria in runoff from these areas. Installation of concrete feeding pads for round hay bale feeding or gravel and grading in loafing areas are modifications that can reduce runoff of soil, nutrients, and bacteria from these heavy use areas. In some instances, only geotextile and gravel are necessary to prevent degradation around feeding/watering areas. Sixty-three landowners installed heavy use areas as part of this project. Most areas consisted of a combination of concrete surrounded by geotextile and gravel, but a few opted for the geotextile/gravel area only. The photos below show the improvement in the area around a water tank after installation of geotextile and gravel. Similar improvement is observed in other heavy use areas such as travel paths and feeding areas.

Cattle travel path before and after geote

Rural Waste Systems

Rural residents within the Spavinaw Creek watershed often do not have proper onsite sanitation, or systems may be in bad repair. To decrease the amount of residential sewage pollution entering the streams and lakes in the watershed, septic tanks and lateral lines were installed after a percolation test was performed. Twenty-six septic systems were installed, as shown in Figure 5, above.

In addition to BMPs implemented through the OCC's 319 program, the NRCS has provided cost-share funding for landowners through the Environmental Quality Incentives Program (EQIP). From 2008 to 2012, NRCS spent approximately $140,494 on implementation in the watershed through the EQIP program. Locations cannot be disclosed, but the following is a summary of BMPs installed by NRCS during this period:

Fence	48,812 Feet	Nutrient Management	29 Acres
Pest Management	5,207 Acres	Composters	2
Brush Management	13 Acres	Watering Facility	1
Pasture Planting	29 Acres	Heavy Use Area	0.2 Acres

The water quality improvements discussed in the next section are the result of the cumulative efforts of OCC and NRCS watershed programs which have been active in the watershed since 2003.

Water Quality Assessment

Water quality monitoring was initiated in the watershed as part of the 1998 Beaty Creek Project. That monitoring effort was expanded with the 2003 Spavinaw Creek Project to measure the impact of implementation in the larger watershed, and monitoring has continued under the 2007-2008 project. This monitoring uses a paired/nested design as recommended by the National Monitoring Program to document changes in water quality over time due to implementation while accounting for environmental factors such as weather patterns. Monitoring is accomplished using a series of automated samplers to collect continuous, flow-weighted measurements of water quality over time, paired with weekly and monthly grab samples for additional parameters of concern.

Water quality monitoring is critical to the project for purposes of determining the causes and sources of NPS derived pollution in the watershed and ascertaining whether or not project efforts have had an effect on water quality. A considerable amount of water quality monitoring has occurred since 1999 in the Beaty Creek watershed and since September 2005 in the larger Spavinaw Creek Watershed as part of this project. All monitoring followed the protocols detailed in the project QAPP, with data collected at the locations indicated in Table 5 and Figure 7.

Table 5. OCC monitoring sites.

SiteName	WBID		Lat	Long	County
Beaty Creek	OK121600-05-0160F	Treatment	36.3704	-94.7191	Delaware
Little Saline Creek	OK121600-02-0070F	Control	36.2796	-95.0710	Mayes
Spavinaw Creek	OK121600-05-0150G	Treatment	36.3418	-94.7550	Delaware
Saline Creek	OK121600-02-0030D	Control	36.2820	-95.0929	Mayes

Monitoring in the Spavinaw Creek Watershed Project was implemented using a paired watershed design, developed in accordance with requirements outlined in Clausen and Spooner (1993). The basic method requires a minimum of two watersheds, a control and a treatment, and two definable periods of study, calibration and treatment. The control watershed is chosen to account for environmental variability, which may otherwise mask the overall effect of BMPs on NPS pollutant loads in the treatment watershed over the periods of study. The control watershed must be located near the treatment watershed in order to experience the same weather and seasonally induced changes. The difference in quality of runoff between the control and treatment watersheds is not the concern; rather, it is that the relationship between paired observations between the two remains the same through time, except for the effects of the BMPs (Clausen and Spooner 1993). Differences in water quality between the two watersheds are expected, but it is the predictable response of the two watersheds together that is the foundation of the paired watershed method.

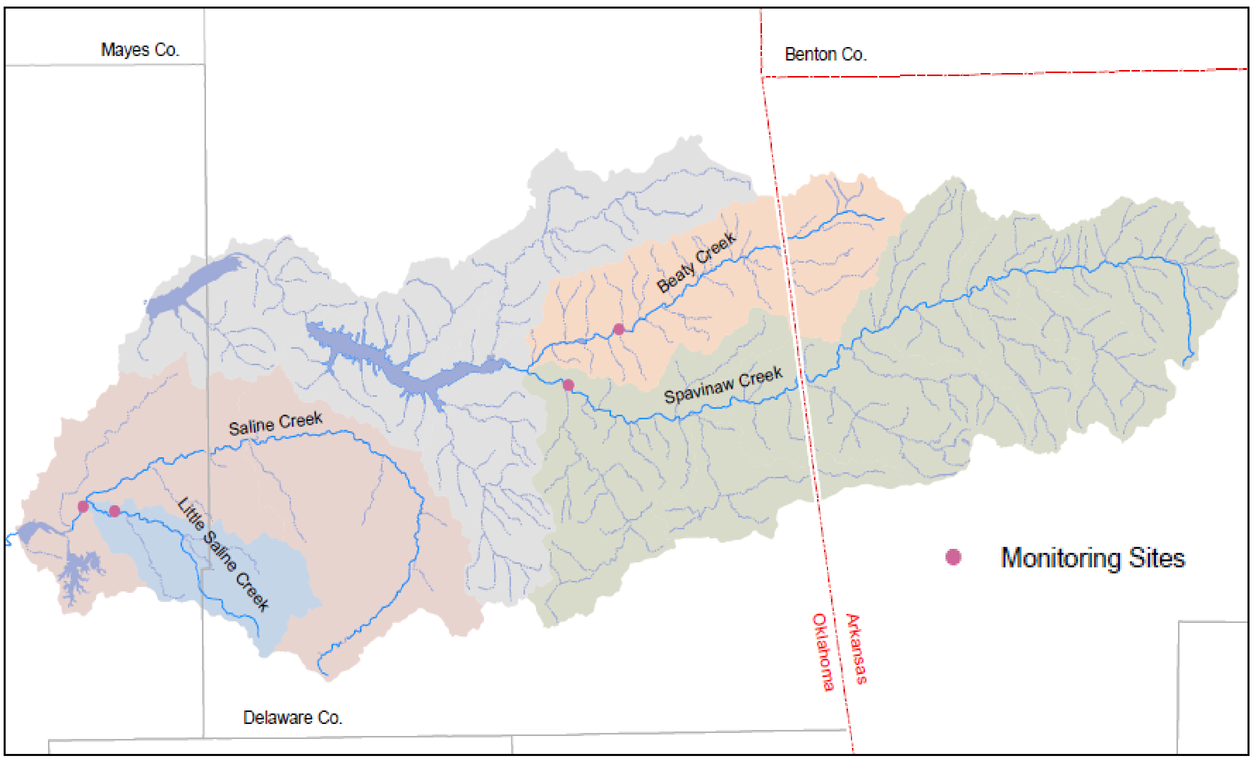

Figure 7. Map of the project watersheds with monitoring sites indicated by the purple dots.

This project allowed analysis of two sets of paired watersheds: Beaty / Little Saline and Spavinaw / Saline. Monitoring was conducted at each watershed outlet in an identical fashion for both the treated (Beaty and Spavinaw) and the control (Little Saline and Saline) watersheds, and through the calibration and treatment periods, as required in the paired watershed design. Automated samplers were established (Figure 7) to obtain continuous, flow-weighted samples from the different streams. These samples were collected at least weekly, depending on flow conditions. If the autosampler had malfunctioned, a grab sample was obtained and submitted to the lab.

Water quality samples were analyzed for ortho-phosphorus, total phosphorus, nitrate-nitrogen, ammonium nitrogen, and total Kjeldahl nitrogen (TKN). *Escherichia coli* and *Enterococcus* bacteria were assessed weekly during the recreation season only (May 1-September 30). The OCC also conducted routine physico-chemical monitoring at each site on a weekly basis throughout the length of the project. This included the following field parameters: dissolved oxygen, pH, temperature, turbidity, conductivity, instantaneous discharge, and alkalinity. Monthly grab samples were analyzed for total suspended solids (TSS), chloride, and sulfate. Additionally, benthic macroinvertebrates were collected twice a year throughout the project, and fish and habitat data was collected every other year for each site.

Beaty / Little Saline Watershed Analysis

Little Saline Creek was used as the control watershed for Beaty Creek. For the Beaty Creek subwatershed, calibration monitoring began in August 1999 and continued until August 2001, when BMP implementation began in Beaty. This data provided a baseline relationship between Beaty Creek (the treatment watershed) and Little Saline Creek (the control watershed) and allowed calibration of the paired watershed model used to assess implementation effectiveness. Post-implementation monitoring began in September 2003 and is ongoing.

Nutrient Load Reduction Analyses

Data analysis was conducted according to procedures outlined in Clausen and Spooner (1993). The relationship between water quality variables from the two watersheds during the calibration phase was described by simple linear regression. For purposes of calibration, the baseline relationship between Beaty and Little Saline Creeks was evaluated using autosampler data collected between August 1999 and August 2001. The calibration regression is then used to compute the expected effects of BMPs after two years of implementation, as described in detail in the "Lake Eucha Watershed Implementation Project: Beaty Creek Watershed" Final Report (OCC 2006). Four years of post-implementation data were presented and discussed in the "Spavinaw Creek Watershed Implementation Project Final Report" (OCC 2008). Now, an additional four years of post-implementation data (total of eight years of post-implementation data) will be presented here to continue tracking the effects of BMPs installed from 2001 to present.

All load reduction analyses were conducted on log-transformed data to satisfy assumptions of parametric statistical analyses. The significance of the regression between paired observations was tested using analysis of variance (ANOVA). The probability (p) value associated with the resulting F statistic indicates whether the regression explained a significant amount of the variation in the paired data ($p \leq 0.05$). The coefficient of determination (r^2) indicates the quality of the regression (i.e., its utility in predicting y from x).

At the end of the treatment period, the significance of the effect of the BMPs was determined using analysis of covariance (ANCOVA). Specifically, the analysis determines:

1. the significance of the treatment regression equation,
2. the significance of the overall regression which combines the calibration and treatment period data,
3. the difference between the slopes of the calibration and treatment regressions, and
4. the difference between the intercepts of the calibration and treatment regressions.

Item 1 was determined through an ANCOVA for the treatment period regression. Items 2 – 4 were determined through an ANCOVA comparing the treatment and calibration period regressions.

A preliminary comparison of total phosphorus loading by Lyon (2006) compared total phosphorus loading in Beaty Creek and Little Saline Creek between the calibration period (1999-2001) and the post-implementation period (2003-2005). This analysis indicated a 31% reduction in total phosphorus load as compared to expected results based on the relationship between the paired watersheds (Lyon 2006).

Two years later, OCC repeated this analysis using data from 2003-2007 for the post-calibration period, and a 66% reduction in modeled total phosphorus load was observed (OCC 2008). As described in the 2006 and 2008 reports, weekly total phosphorus (T-P) loads were determined by multiplying T-P concentrations from weekly, integrated samples by the total flow for the sampling period. The first step in the analysis was to determine the relationship, if any, between the watersheds for both the calibration and treatment phases. To meet assumptions necessary to utilize certain statistical methods, weekly T-P loads were converted to log base ten values before analysis. These log T-P load values were paired between the watersheds by date of collection and analyzed by linear regression to determine relationship. Figure 8 indicates strong, statistically significant ($p<0.000$) linear relationships for total phosphorus loads between the two watersheds for both the calibration and post-implementation periods.

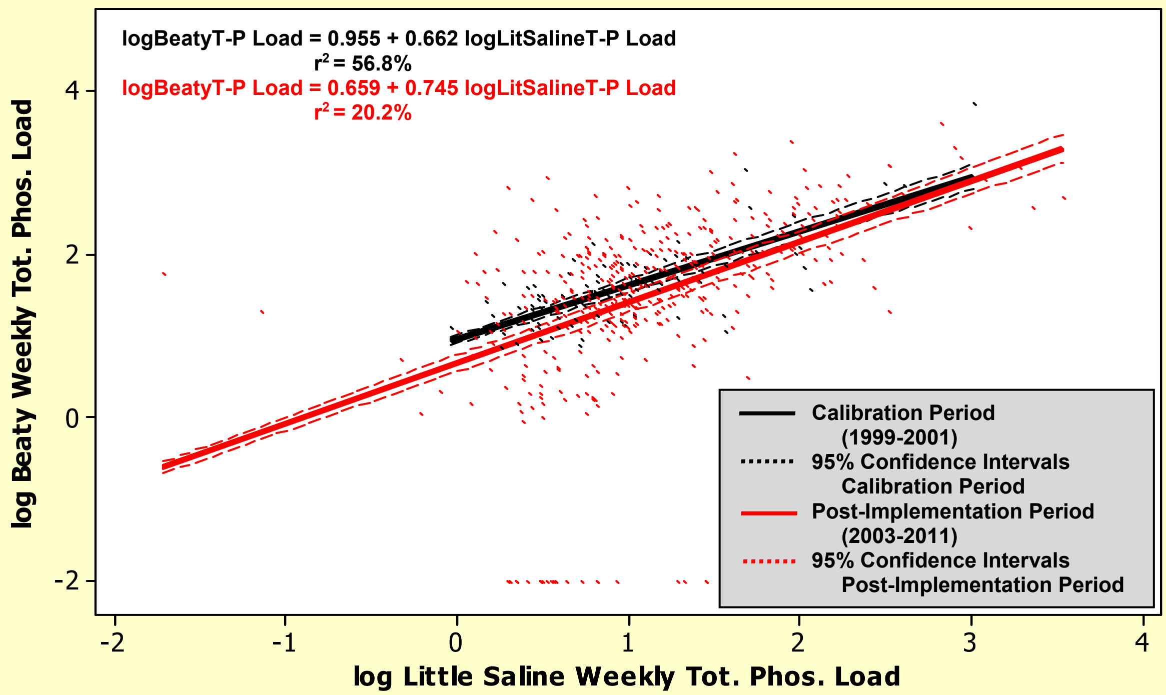

Figure 8. Regressions of log-transformed total phosphorus data. Regression of the 95% confidence intervals for each regression line are indicated by dashed lines. The equations for the regression lines are given at the top of the graph, with black lines and font representing the calibration period and red lines and font depicting post-implementation.

An analysis of covariance (ANCOVA) was performed to determine the effect of the BMP implementation on weekly T-P load in Beaty Creek relative to the control. This type of analysis allows the determination of difference between the calibration and treatment periods despite whatever difference might have occurred because of environmental variability (e.g., wet year vs. dry year). The statistical software package Minitab, V. 14 was employed to conduct the analysis. The results of the ANCOVA analysis are shown in Table 6 (below). The p value of 0.028 indicates that there is a significant effect of time period between the two streams.

Table 6. Minitab results of the ANCOVA for the combined calibration and post-implementation T-P data (log transformed) for Beaty and Little Saline Creeks.

Factor:	**Type:**	**Levels:**	**Values:**
Period	Fixed	2	Calibration, Post-implementation

Analysis of Variance for logBeatyT-P Load, using Adjusted SS for Tests:

Source	**DF**	**Seq SS**	**Adj SS**	**Adj MS**	**F**	**P**
logLSalineT-P Load	1	103.341	106.429	106.429	141.74	0.000
period	1	3.661	3.661	3.661	4.88	0.028
Error	512	384.442	384.442	0.751		
Total	514	491.444				

To quantify the reduction in total phosphorus load, expected loads are calculated for Beaty Creek using the calibration and post-implementation regression equations and the observed post-implementation loads in Little Saline. The percent reduction is calculated in terms of the average of the difference between the calibration and post-implementation weekly loads relative to the calibration load:

*% reduction = (calibration – postimplementation) / calibration * 100*

Using this method, a **37% reduction in the modeled or "expected" total phosphorus loading** has been achieved in Beaty Creek during the post-implementation period of 2003-2011. Observed average TP load was slightly higher (not statistically significant) in the implementation period relative to the average calibration period load, possibly reflecting the significant influence of a couple of historic storm events (500 year events) in 2010 and 2011 that overwhelmed the installed BMPs and led to streambank sloughing and significant nutrient and sediment loads into the waterbodies.

Statistically significant reductions in average ammonia and TKN concentrations were observed for Beaty Creek (Table 7, below) and in average ammonia concentration in Little Saline. Average nitrate concentration and load increased significantly in Beaty Creek during the implementation phase relative to the calibration period.

Table 7. Average nutrient concentrations and loads for the calibration period (1999-2001) and the post-implementation period (2003-2011). Statistically significant differences between periods, as determined by ANOVA, are indicated by the p value under arrows in the "change" columns.

	Parameter	Beaty Calib	Beaty Post-Impl	Beaty Change	Lit. Saline Calib	Lit. Saline Post-Impl	Lit. Saline Change
Concentration (mg/L)	TotPhosphorus	0.1035	0.1023	⇓	0.0352	0.0404	⇑
	O-Phosphorus	0.0447	0.0449	Approx same	0.0114	0.0137	⇑
	Nitrate	2.235	2.783	⇑ $p<0.000$	0.5956	0.5991	⇑
	Ammonia	0.0638	0.0465	⇓ $p=0.074$	0.0345	0.0218	⇓ $p<0.000$
	TKN	0.5863	0.3748	⇓ $p=0.008$	0.1705	0.1791	⇑
Load (lbs)	TotPhosphorus	139	144	Approx same	31	59	⇑
	O-Phosphorus	76	78	Approx same	12	23	⇑
	Nitrate	1786	3657	⇑ $p=0.003$	467	774	⇑
	Ammonia	82	45	⇓	23	21	Approx same
	TKN	815	405	⇓	142	207	⇑

All other nutrient parameters were analyzed in this same way. There was no significant difference between the control and treatment sites in the calibration versus post-implementation period in ortho-phosphorus, as indicated by the p value of >0.05 in Table 8 and shown in Figure 9 below.

Table 8. Minitab results of the ANCOVA for the combined calibration and post-implementation orthoPhosphorus data (log transformed) for Beaty and Little Saline Creeks.

Factor:	Type:	Levels:	Values:
Period	Fixed	2	Calibration, Post-implementation

Analysis of Variance for logBeaty orthoPhos Load, using Adjusted SS for Tests:

Source	DF	Seq SS	Adj SS	Adj MS	F	P
logLSaline orthoPhos Load	1	115.940	113.996	113.996	156.18	0.000
period	1	0.043	0.043	0.043	0.06	0.808
Error	512	373.714	373.714	0.730		
Total	514	489.697				

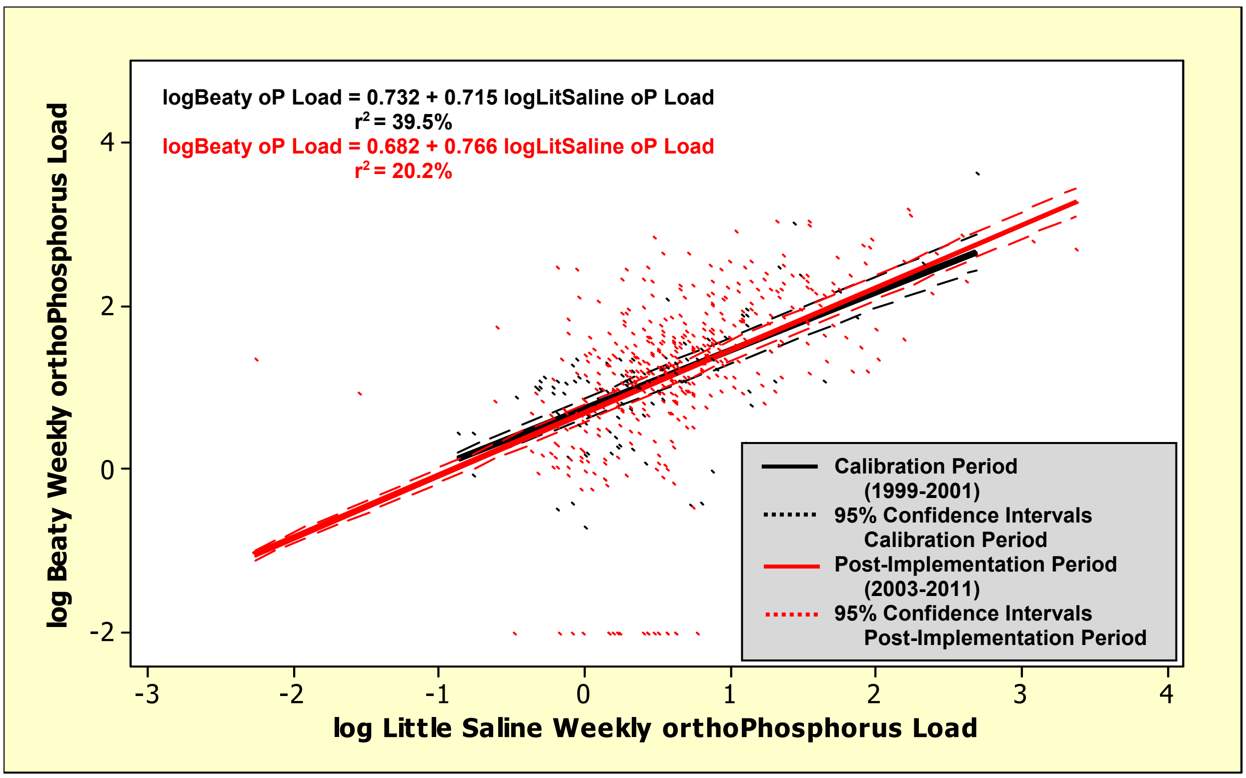

Figure 9. Regressions of log-transformed ortho-phosphorus data. 95% confidence intervals for each regression line are indicated by dashed lines. The equations for the regression lines are given at the top of the graph, with black lines and font representing the calibration period and red lines and font depicting post-implementation.

Figure 10 shows the shift in expected TKN loads between the calibration and implementation periods. There was a significant reduction in expected TKN load between the calibration and post-implementation period for Beaty relative to Little Saline, as indicated by the p value of 0.000 for period in Table 9 below. **The modeled (expected) TKN load reduction was 81%** as calculated using the average percent reduction method. The observed mean TKN load was reduced, although the reduction was not statistically significant using an ANOVA, and the observed mean TKN concentration was significantly lower (p=0.008) in the post-implementation period than the calibration period (Table 7, above).

Table 9. Minitab results of the ANCOVA for the combined calibration and post-implementation TKN data (log transformed) for Beaty and Little Saline Creeks.

Factor:	**Type:**	**Levels:**	**Values:**
Period	Fixed	2	Calibration, Post-implementation

Analysis of Variance for logBeatyTKN Load, using Adjusted SS for Tests:

Source	**DF**	**Seq SS**	**Adj SS**	**Adj MS**	**F**	**P**
logLSalineTKN Load	1	246.05	172.87	172.87	270.46	0.000
period	1	25.06	25.06	25.06	39.30	0.000
Error	500	319.59	319.59	0.64		
Total	502	590.71				

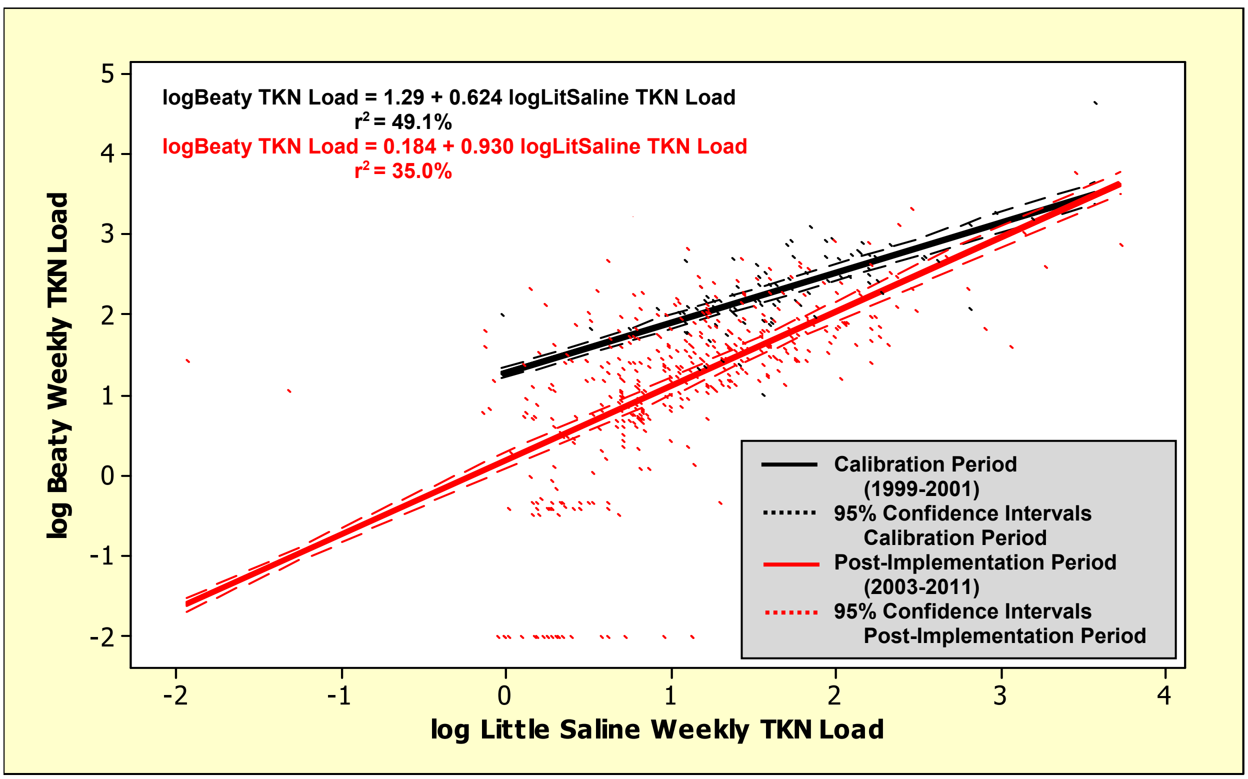

Figure 10. Regressions of log-transformed total Kjeldahl nitrogen (TKN) data. 95% confidence intervals for each regression line are indicated by dashed lines. The equations for the regression lines are given at the top of the graph, with black lines and font representing the calibration period and red lines and font depicting post-implementation.

There was a slight increase in ammonia loading in the post-implementation period relative to the calibration period, although, as shown below, it was not a significant difference between the periods (p=0.834, Table 10). The shift in the regression lines (Figure 11) was not statistically significant.

Table 10. Minitab results of the ANCOVA for the combined calibration and post-implementation ammonia data (log transformed) for Beaty and Little Saline Creeks.

Factor:	Type:	Levels:	Values:
Period	Fixed	2	Calibration, Post-implementation

Analysis of Variance for logBeaty Ammonia Load, using Adjusted SS for Tests:

Source	DF	Seq SS	Adj SS	Adj MS	F	P
logLS Ammon Load	1	482.03	370.69	370.69	322.38	0.000
period	1	0.05	0.05	0.05	0.04	0.834
Error	512	588.72	588.72	1.15		
Total	514	1070.80				

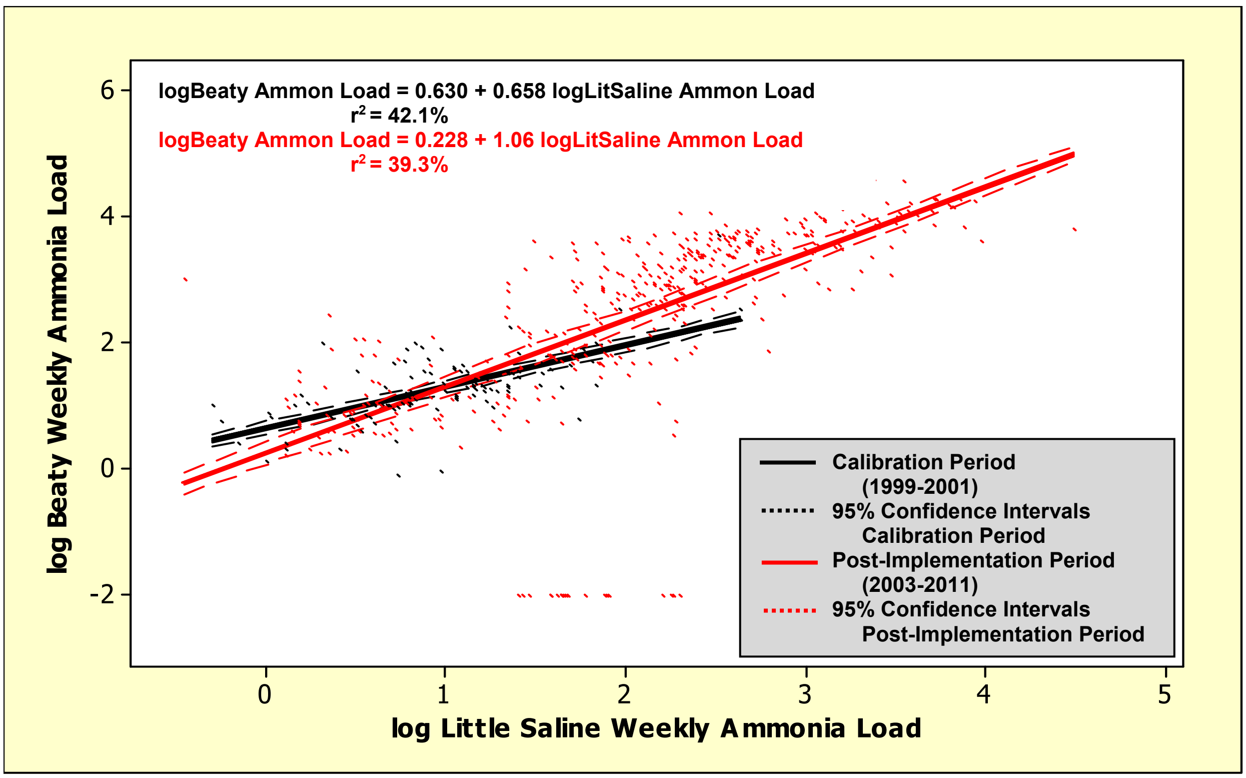

Figure 11. Regressions of log-transformed ammonia data. 95% confidence intervals for each regression line are indicated by dashed lines. The equations for the regression lines are given at the top of the graph, with black lines and font representing the calibration period and red lines and font depicting post-implementation.

There was a 55% reduction in expected nitrate loading in Beaty Creek relative to Little Saline between the calibration and implementation periods. Figure 12 shows the lower overall regression line, and Table 11 indicates that this difference between periods is statistically significant (p=0.006). The observed nitrate loads increased at both sites, possibly due to the influence of two extreme storm events discussed previously.

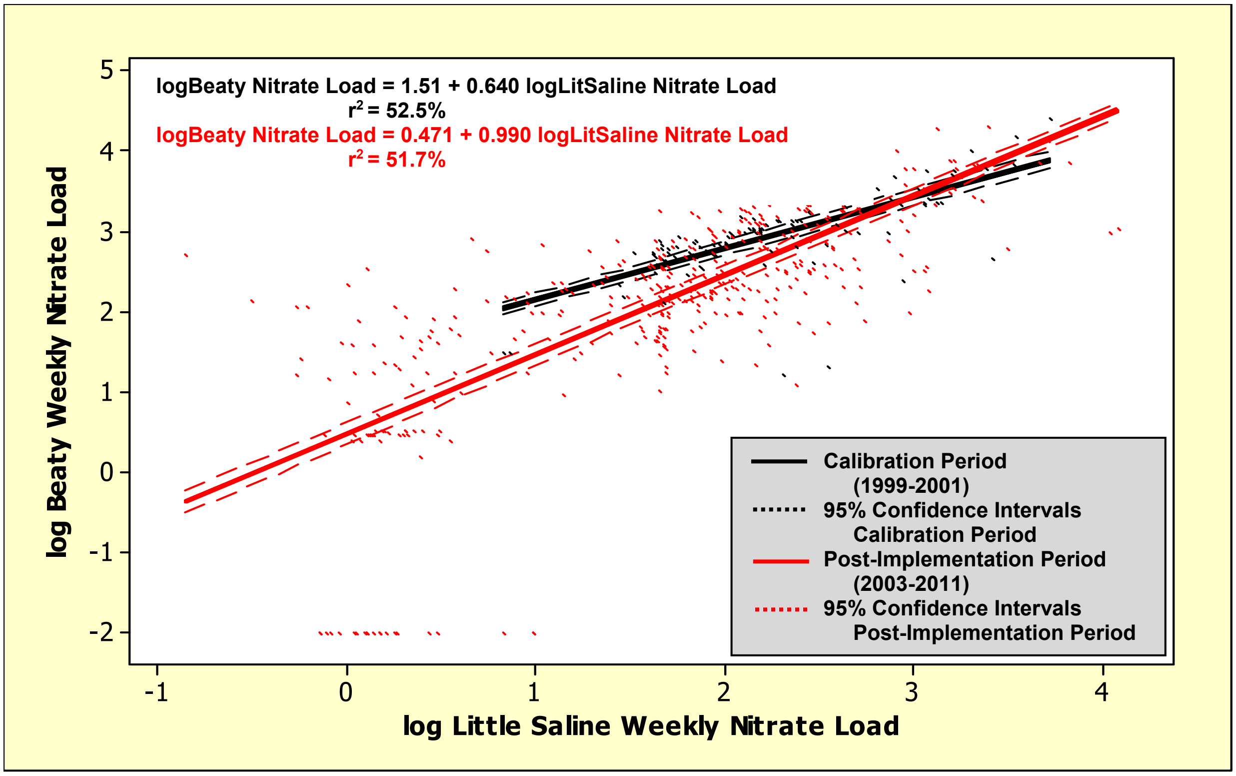

Figure 12. Regressions of log-transformed nitrate data. 95% confidence intervals for each regression line are indicated by dashed lines. The equations for the regression lines are given at the top of the graph, with black lines and font representing the calibration period and red lines and font depicting post-implementation.

Table 11. Minitab results of the ANCOVA for the combined calibration and post-implementation nitrate data (log transformed) for Beaty and Little Saline Creeks.

Factor:	Type:	Levels:	Values:
Period	Fixed	2	Calibration, Post-implementation

Analysis of Variance for logBeaty Nitrate Load, using Adjusted SS for Tests:

Source	DF	Seq SS	Adj SS	Adj MS	F	P
logLS Nitrate Load	1	413.42	360.64	360.64	525.11	0.000
period	1	5.27	5.27	5.27	7.67	0.006
Error	503	345.46	345.46	0.69		
Total	505	764.14				

Spavinaw / Saline Watershed Analysis

Saline Creek is the control watershed for the Spavinaw Creek watershed where implementation occurred. Monitoring began in Saline Creek in 2007. All data was analyzed as described above for the Beaty-Little Saline analysis. The first step was to establish the relationship between the watersheds for both the calibration and treatment phases. To meet assumptions necessary to utilize certain statistical methods, weekly TP loads were converted to log base ten values before analysis. These log TP load values were paired between the watersheds by date of collection and analyzed by linear regression to determine relationship. Figure 10 indicates strong, statistically significant ($P<0.000$) linear relationships between the two watersheds for both the one-year calibration period (2007-2008) and the post-implementation period (2008-2011).

As shown in Table 12, below, both Spavinaw Creek and Saline Creek had statistically significant ($p<0.05$) decreases in ortho-phosphorus and nitrate concentrations between the calibration and implementation periods. Spavinaw had no change in total phosphorus concentration, while Saline had an increase, although it was not significant. Total phosphorus loading, ortho-phosphorus loading, and nitrate loading decreased in Spavinaw Creek, although only the ortho-phosphorus decrease is statistically significant. All loads increased in Saline Creek except for ortho-phosphorus, which stayed the same.

Table 12. Average nutrient concentrations and loads for the calibration period (2007-2008) and the post-implementation period (2008-2011). Statistically significant differences between periods, as determined by ANOVA, are indicated by the p value under arrows in the "change" columns.

	Parameter	Spavinaw Calib	Spavinaw Post-Impl	Spavinaw Change	Saline Calib	Saline Post-Impl	Saline Change
Concentration (mg/L)	TotPhosphorus	0.095	0.098	Approx same	0.034	0.042	⇑
	Ortho-Phosphorus	0.047	0.019	⇓ (p<0.000)	0.011	0.009	⇓ (p=0.078)
	Nitrate	3.417	2.36	⇓ (p<0.000)	0.726	0.553	⇓ (p=0.031)
	Ammonia	0.046	0.056	⇑	0.016	0.026	⇑ (p<0.000)
	TKN	0.175	0.900	⇑ (p<0.000)	0.117	0.520	⇑ (p<0.000)
Load (lbs)	TotPhosphorus	974	809	⇓	146	160	⇑
	Ortho-Phosphorus	463	157	⇓ (p=0.001)	45	45	Approx same
	Nitrate	26,866	15,864	⇓	3104	3127	⇑
	Ammonia	294	350	⇑	58	96	⇑
	TKN	1912	6380	⇑	436	1428	⇑ (p=0.024)

An analysis of covariance (ANCOVA) was performed to determine the effect of the BMP implementation on weekly TP load in Spavinaw Creek relative to the control despite whatever difference might have occurred because of environmental variability (e.g., wet year vs. dry year). The results of the ANCOVA analysis are shown in Table 13 (below), and Figure 13 shows the linear regressions between the two sites during the calibration and implementation periods. The p value of 0.006 indicates that there is a significant effect of time period between the two streams.

To quantify the reduction in total phosphorus load, expected loads were calculated for Spavinaw Creek as described in the previous section, using the calibration and post-implementation regression equations and the observed post-implementation loads in Saline Creek. The percent reduction was calculated in terms of the average of the difference between the calibration and post-implementation weekly loads relative to the calibration load, as described in the previous section:

*% reduction = (calibration – implementation) / calibration * 100*

Using this method, it was calculated that a **37% reduction in modeled (expected) total phosphorus loading** has been achieved in Spavinaw Creek during the implementation period of 2008-2011. Observed average TP load was slightly lower (not statistically significant) in the implementation period relative to the average calibration period load.

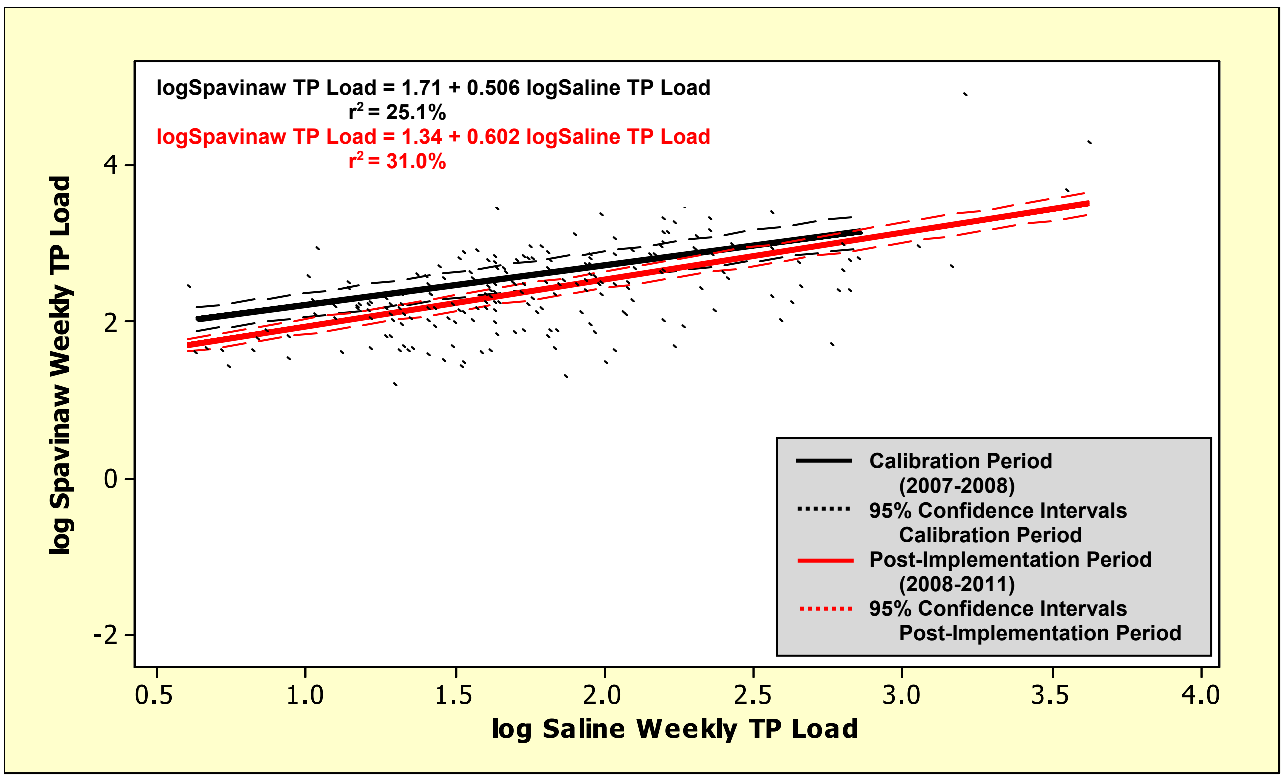

Figure 13. Regressions of log-transformed total phosphorus data. 95% confidence intervals for each regression line are indicated by dashed lines. The equations for the regression lines are given at the top of the graph, with black lines and font representing the calibration period and red lines and font depicting post-implementation.

Table 13. Minitab results of the ANCOVA for the combined calibration and post-implementation total phosphorus data (log transformed) for Spavinaw and Saline Creeks.

Factor:	Type:	Levels:	Values:
Period	Fixed	2	Calibration, Post-implementation

Analysis of Variance for logSpavinaw TP Load, using Adjusted SS for Tests:

Source	DF	Seq SS	Adj SS	Adj MS	F	P
logSaline TP Load	1	20.842	19.662	19.662	82.72	0.000
period	1	1.869	1.869	1.869	7.86	0.006
Error	179	42.546	42.546	0.238		
Total	181	65.258				

Similar analyses were conducted for all other parameters. The ANCOVA for ortho-phosphorus loads indicated a statistically significant difference between the sites across the two periods (p=0.000, Table 14). A **64% reduction in modeled (expected) ortho-phosphorus loading** was calculated for Spavinaw relative to Saline, with a **21% reduction in observed load**. Figure 14 shows this reduction clearly.

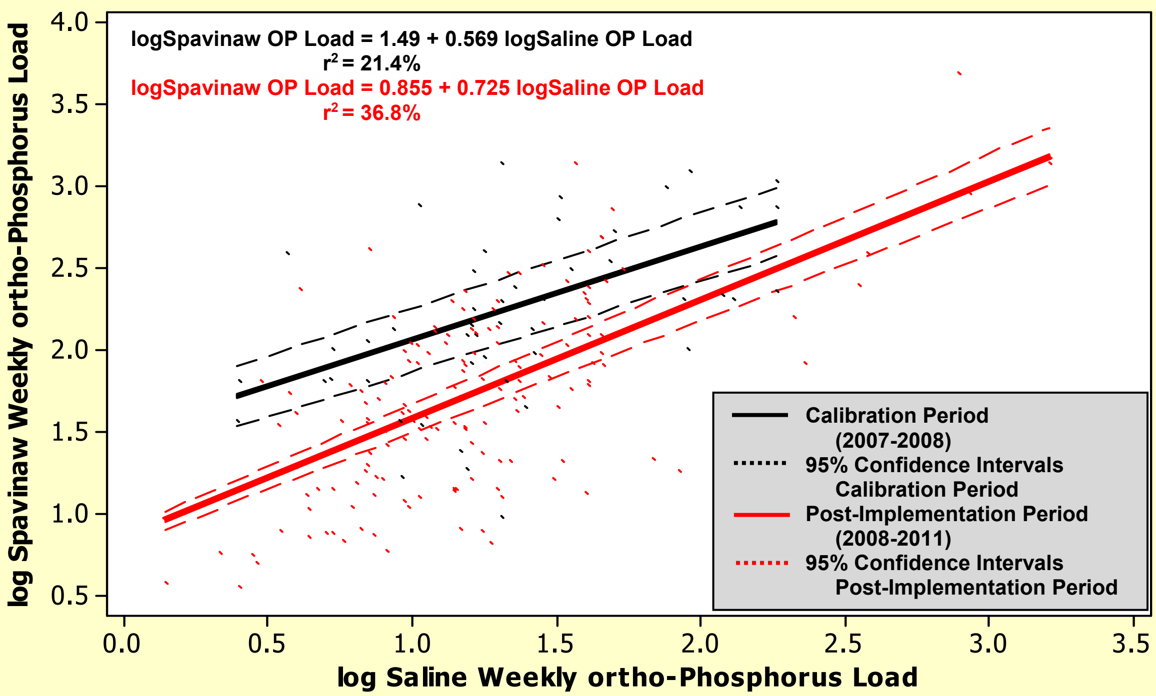

Figure 14. Regressions of log-transformed ortho-phosphorus data. 95% confidence intervals for each regression line are indicated by dashed lines. The equations for the regression lines are given at the top of the graph, with black lines and font representing the calibration period and red lines and font depicting post-implementation.

Table 14. Minitab results of the ANCOVA for the combined calibration and post-implementation ortho-phosphorus data (log transformed) for Spavinaw and Saline Creeks.

Factor:	Type:	Levels:	Values:
Period	Fixed	2	Calibration, Post-implementation

Analysis of Variance for logSpavinaw OP Load, using Adjusted SS for Tests:

Source	DF	Seq SS	Adj SS	Adj MS	F	P
logSaline OP Load	1	26.891	21.207	21.207	95.07	0.000
period	1	8.065	8.065	8.065	36.16	0.000
Error	179	39.929	39.929	0.223		
Total	181	74.885				

The ANCOVA for ammonia loads also indicated a statistically significant difference between the sites across the two periods (p=0.005, Table 15). A **19% reduction in modeled (expected) ammonia loading** was calculated for Spavinaw relative to Saline, as evident in Figure 15, although the average observed load in Spavinaw was higher than expected, though not significantly so.

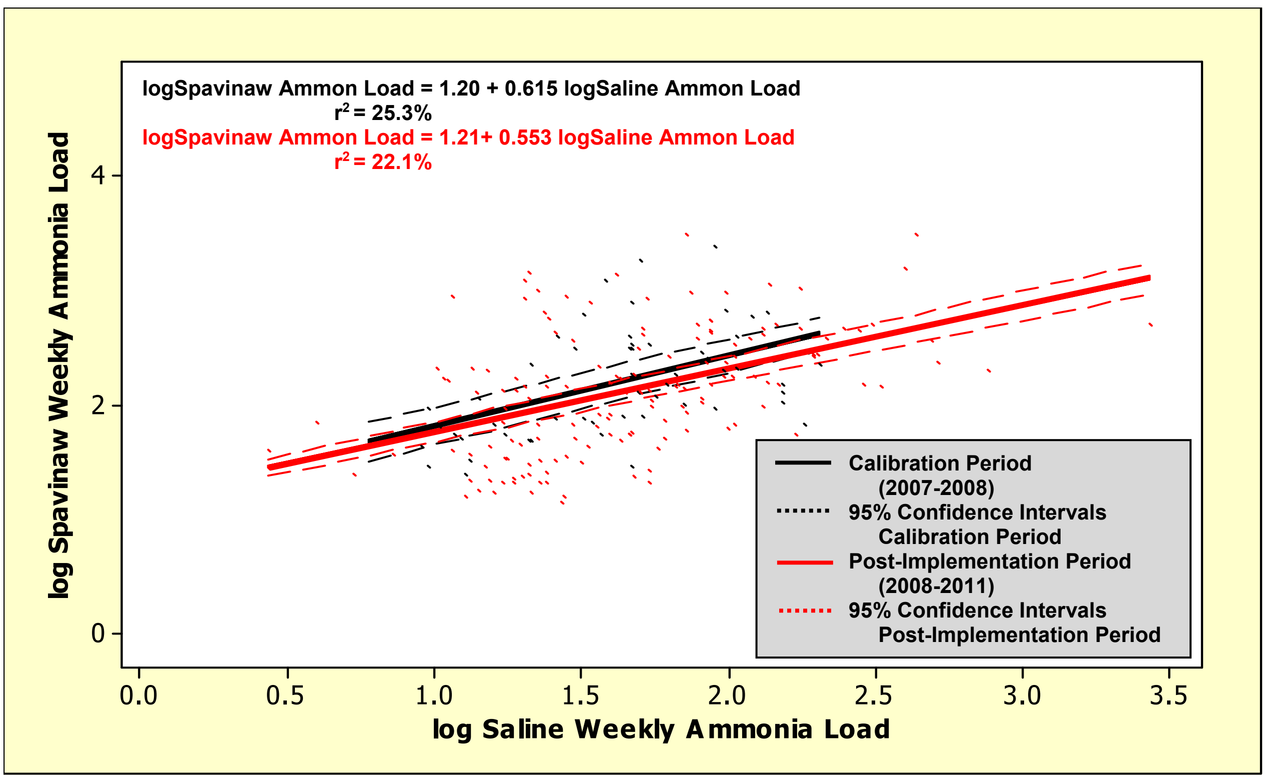

Figure 15. Regressions of log-transformed ammonia data. 95% confidence intervals for each regression line are indicated by dashed lines. The equations for the regression lines are given at the top of the graph, with black lines and font representing the calibration period and red lines and font depicting post-implementation.

Table 15. Minitab results of the ANCOVA for the combined calibration and post-implementation ammonia data (log transformed) for Spavinaw and Saline Creeks.

Factor:	Type:	Levels:	Values:
Period	Fixed	2	Calibration, Post-implementation

Analysis of Variance for logSpavinaw Ammonia Load, using Adjusted SS for Tests:

Source	DF	Seq SS	Adj SS	Adj MS	F	P
logSaline Ammon Load	1	14.869	15.347	15.347	88.15	0.000
period	1	1.390	1.390	1.390	7.99	0.005
Error	179	31.163	31.163	0.174		
Total	181	47.423				

The ANCOVA for TKN loads indicated no statistically significant difference between the sites across the two periods (p=0.233, Table 16). Figure 16 shows the **37% *increase* in expected TKN loading** that was calculated for Spavinaw relative to Saline. The observed load increase was not significant, although the concentration increase was significant.

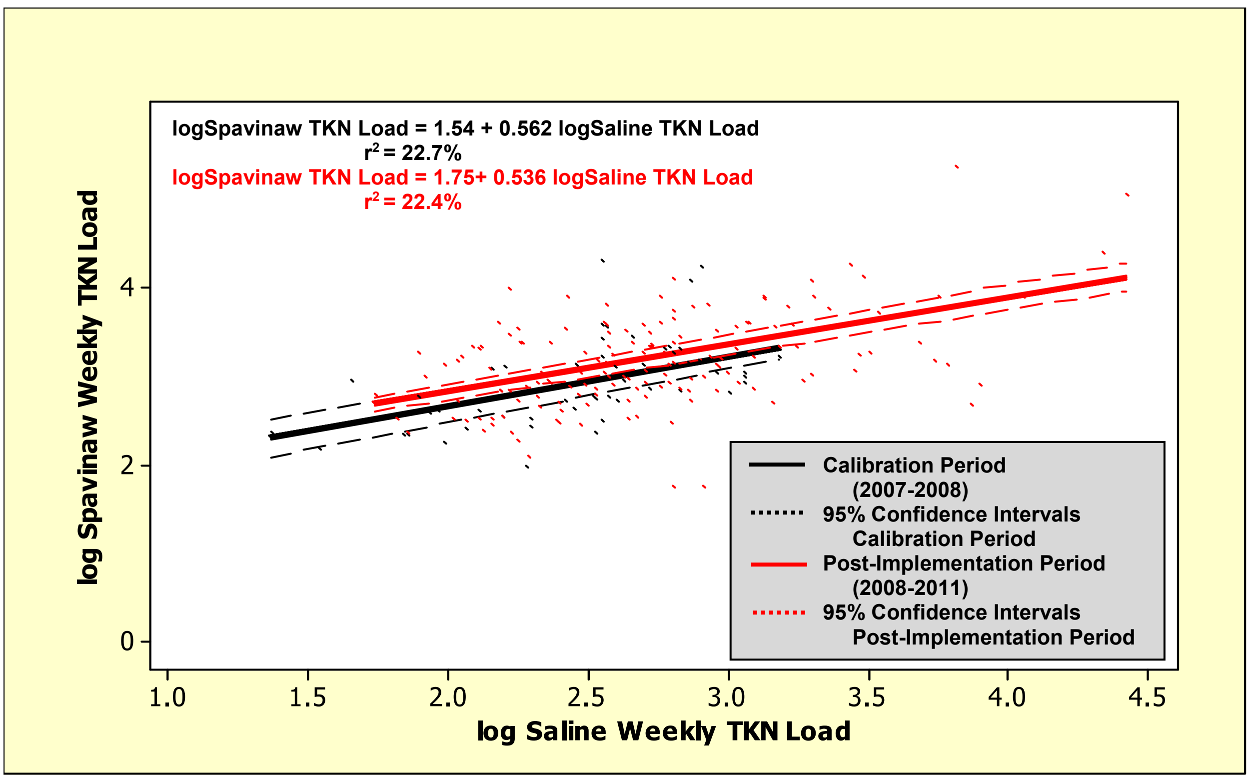

Figure 16. Regressions of log-transformed TKN data. 95% confidence intervals for each regression line are indicated by dashed lines. The equations for the regression lines are given at the top of the graph, with black lines and font representing the calibration period and red lines and font depicting post-implementation.

Table 16. Minitab results of the ANCOVA for the combined calibration and post-implementation TKN data (log transformed) for Spavinaw and Saline Creeks.

Factor:	Type:	Levels:	Values:
Period	Fixed	2	Calibration, Post-implementation

Analysis of Variance for logSpavinaw TKN Load, using Adjusted SS for Tests:

Source	DF	Seq SS	Adj SS	Adj MS	F	P
logSaline TKN Load	1	17.707	15.113	15.113	60.28	0.000
period	1	0.359	0.359	0.359	1.43	0.233
Error	179	44.879	44.879	0.251		
Total	181	62.946				

The ANCOVA for nitrate loads indicated a statistically significant difference between the sites across the two periods (p<0.000, Table 17). A **46% decrease in expected nitrate loading** was calculated for Spavinaw relative to Saline. The regression lines for the ANCOVA are shown in Figure 17. The observed load decrease was not significant, although the concentration decrease was significant (Table 12, above).

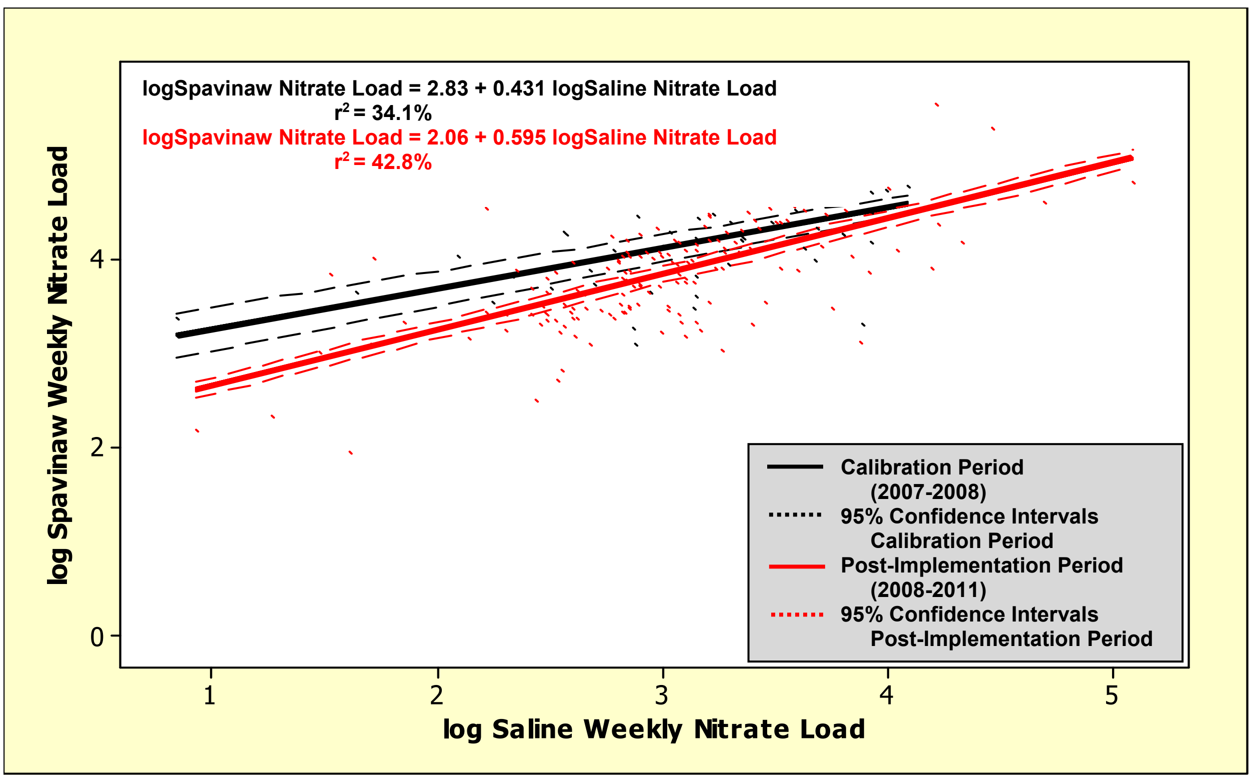

Figure 17. Regressions of log-transformed nitrate data. 95% confidence intervals for each regression line are indicated by dashed lines. The equations for the regression lines are given at the top of the graph, with black lines and font representing the calibration period and red lines and font depicting post-implementation.

Table 17. Minitab results of the ANCOVA for the combined calibration and post-implementation nitrate data (log transformed) for Spavinaw and Saline Creeks.

Factor:	Type:	Levels:	Values:
Period	Fixed	2	Calibration, Post-implementation

Analysis of Variance for logSpavinaw Nitrate Load, using Adjusted SS for Tests:

Source	DF	Seq SS	Adj SS	Adj MS	F	P
logSaline Nitrate Load	1	21.617	18.499	18.499	103.86	0.000
period	1	2.712	2.712	2.712	15.23	0.000
Error	179	31.881	31.881	0.178		
Total	181	56.210				

Load Reduction Estimates from STEPL Model

Load reductions expected due to implementation of practices through the 319 project were estimated using the Spreadsheet Tool for Estimating Pollutant Load (STEPL) model and have been reported in the EPA's Grants Reporting and Tracking System (GRTS) annually. One of the goals of this project was to reach a significant reduction (at least 20%) in estimated phosphorus load, based on STEPL water quality modeling. For the project period of 2008 through 2011, installed BMPs were estimated to reduce phosphorus loading by 116,175 lbs, nitrogen loading by 163,952 lbs, and sediment loading by 1,321 tons. For phosphorus, this equates to an annual reduction of approximately 27% from the initial estimate of 48,000 kg/yr loading into Lake Eucha, so this interim goal was attained.

Biological Data Analysis

Fish

Fish collections were obtained in 1999, 2001, 2003, 2007, 2009, and 2011 for both Beaty Creek and Little Saline Creek. Fish data was assessed in 2005, 2007, and 2011 for Spavinaw Creek and in 2006, 2009, and 2011 for Saline Creek. Data was analyzed in accordance with EPA Rapid Bioassessment Protocols (Plafkin et al. 1989) and an "Index of Biological Integrity" (IBI) score was calculated relative to high quality sites in the ecoregion. Table 18, below, shows the metrics used to calculate the scores. Details on data evaluation methods used may be accessed in the latest OCC Rotating Basin report (OCC 2011).

All streams in this watershed are designated as "Cool Water Aquatic Communities." Analysis of fish collection data resulted in "excellent" fish community scores for most collections relative to cool water aquatic community (CWAC) high quality sites in the ecoregion. As seen in Table 18, below, both the Beaty and Little Saline sites had improvement in the fish community in 2001 relative to 1999; however, the 2007 and 2011 Little Saline collections indicated a slightly lower IBI score again. The 2007 Spavinaw collection gave a lower score but then rebounded in 2011.

Table 18. Fish metric values, overall IBI score, percent of reference, and final biological condition for study sites.

Site	Date	Total Species	# Darter Spp	# Sunfish Spp	# Intolerant Spp	% Tolerant Spp	% Insectivorous Cyprinids	% Lithophilic Spawners	OCC IBI	OCC %ref	OCC condition
Beaty Creek	8/26/1999	20	4	6	12	1.92	13.46	98.08	31	0.89	good
	8/16/2001	22	3	6	14	3.22	61.37	96.78	35	1.00	excellent
	7/29/2003	19	3	5	13	0.35	64.71	99.65	35	1.00	excellent
	8/16/2007	18	3	4	12	0.38	40.15	99.62	33	0.94	excellent
	6/18/2009	17	3	3	12	1.36	67.48	94.99	35	1.00	excellent
	7/6/2011	15	3	5	10	1.50	24.06	98.49	33	0.94	excellent
Little Saline Creek	9/15/1999	11	2	2	7	0.65	38.06	99.35	29	0.83	good
	8/28/2001	14	3	1	8	8.78	57.98	71.28	33	0.94	excellent
	7/24/2003	12	3	1	8	0.53	47.47	99.47	33	0.94	excellent
	7/30/2007	12	3	1	8	1.28	28.26	98.72	29	0.83	good
	6/17/2009	12	3	2	8	1.10	50.95	98.90	33	0.94	excellent
	6/7/2011	11	3	1	6	0.66	58.21	99.34	29	0.83	good
Spavinaw Creek	9/20/2005	20	5	3	14	0.23	37.63	98.63	33	0.94	excellent
	8/10/2007	23	4	5	12	1.63	15.63	97.14	31	0.89	good
	7/7/2011	20	4	5	10	5.07	31.14	93.62	33	0.94	excellent
Saline Creek	7/13/2006	19	5	5	12	2.22	23.33	96.11	33	0.94	excellent
	8/3/2009	22	4	6	12	1.90	26.00	95.92	33	0.94	excellent
	6/30/2011	19	4	5	10	2.29	34.79	97.08	33	0.94	excellent

Instream and riparian habitat assessments were conducted at sites concurrent with fish collections. All assessments were conducted in accordance with procedures outlined in the OCC Habitat Assessment Standard Operating Procedures (SOP) (OCC 2009). The OCC's habitat assessment adheres to a modified version of the EPA Rapid Bioassessment Protocols (RBP) (as described in the SOP) and is designed to assess habitat quality in relation to its ability to support biological communities in the stream. Table 19, below, shows the results of the habitat assessments.

The Beaty and Little Saline habitat scores remained relatively stable, but both Spavinaw and Saline showed decreased scores in 2011. The loss of deep pools due to drought conditions and the resulting impact on the "pool variability" value is the most significant influence contributing to these lower scores.

Table 19. Habitat metric scores, total habitat score, and percent score relative to reference.

SiteName	Date	Instream Cover	Pool Bottom Substrate	Pool Variability	Canopy Cover Shading	Presence of Rocky Runs or Riffles	Flow	Channel Alteration	Channel Sinuosity	Bank Stability	Bank Vegetation Stability	Streamside Cover	Total Habitat Score	% of Reference
Beaty Creek	8/16/2001	14.8	14.4	19.4	11.5	0.0	20.0	2.3	1.1	8.7	5.5	9.2	106.9	0.94
	7/29/2003	14.4	18.8	20.2	14.5	0.0	20.0	1.4	1.0	8.8	4.5	10.0	113.6	1.00
	8/16/2007	18.7	18.8	19.3	18.0	7.5	20.0	1.8	1.1	9.6	6.5	10.0	131.3	1.16
	6/18/2009	17.5	16.3	15.6	15.7	16.1	15.9	0.5	1.6	9.1	5.2	10.0	123.6	1.09
	7/6/2011	19.4	19.4	13.5	16.6	16.1	15.9	0.5	1.6	9.1	4.7	8.0	125.0	1.10
Little Saline Creek	8/28/2001	18.2	15.7	14.0	20.0	16.2	7.6	5.0	0.8	9.0	5.8	9.7	122.0	1.07
	7/24/2003	18.8	16.7	15.0	20.0	15.6	12.1	5.8	0.4	8.9	3.9	9.6	126.8	1.12
	7/30/2007	19.3	17.9	19.4	19.7	16.1	14.3	4.2	0.5	8.5	3.8	10.0	133.7	1.18
	6/17/2009	18.5	16.8	6.1	19.8	16.3	15.9	0.5	1.6	8.3	5.1	9.5	118.5	1.04
	6/7/2011	19.6	18.6	13.0	19.9	16.1	15.9	0.4	1.6	4.9	1.4	10.0	121.4	1.07
Spavinaw Creek	9/20/2005	19.4	16.4	13.3	1.4	15.2	20.0	0.4	0.9	7.4	4.5	9.7	108.6	0.96
	8/10/2007	19.6	17.5	13.5	0.6	15.6	18.8	7.7	1.1	7.9	4.5	3.2	110.0	0.97
	7/7/2011	19.6	18.6	0.0	0.0	16.2	15.9	1.0	1.6	6.3	1.4	10.0	90.8	0.80
Saline Creek	8/2/2001	18.0	16.2	17.2	7.7	15.2	15.0	0.4	0.1	5.1	1.6	8.4	104.7	0.92
	7/13/2006	13.0	17.2	0.0	2.7	16.3	17.0	1.4	0.1	3.1	1.8	8.9	81.3	0.72
	8/3/2009	14.6	14.8	17.2	3.0	16.1	15.9	0.4	1.6	4.4	1.0	8.9	97.8	0.86
	6/30/2011	9.2	7.9	0.0	2.2	9.0	15.9	1.4	1.6	6.1	3.3	10.0	66.6	0.59

Macroinvertebrates

Macroinvertebrate collections were attempted at all sites twice a year, once in the winter period (January 1 to March 15) and once in the summer period (July 1 to September 15). Macroinvertebrates were only collected if there was flowing water, so no samples were obtained in dry periods. All samples were obtained from rocky riffle habitat. Table 20 summarizes results for collections since the start of BMP implementation in the area in 2001.

Macroinvertebrate community condition for each site was determined using methods outlined in the EPA Rapid Bioassessment Protocols (Plafkin et al. 1989). The biological data was compared relative to data from high quality cool water aquatic community (CWAC) sites in the Ozark Highland ecoregion following the method described in the latest Rotating Basin report (OCC 2011). Beaty Creek was slightly impaired relative to reference for winter 2003 and 2004 collections, severely impaired in 2006, and moderately impaired in 2007. The winter 2009 and 2010 collections were improved and showed better than reference IBI scores. None of the summer collections were impaired at either Beaty or Little Saline. Little Saline showed slight impairment in the winter 2006 and 2007 collections. None of the Spavinaw collections have been less than “non-impaired”.

Table 20. Average macroinvertebrate metrics used to calculate an IBI score, score percent of reference, and general biological condition of sites. For condition, "NI" represents nonimpaired relative to high quality sites in the ecoregion, "SI" indicates slightly impaired, "MI" is moderately impaired, and "SVI" is severely impaired relative to reference sites.

Site name	Season	Date	Total Species	EPT Taxa	Percent EPT	Shannon Diversity	HBI	Percent dominant 2 taxa	IBI Score	%of Ref IBI Score	Condition
Beaty Creek	summer	7/30/2001	16	7	0.72	2.13	4.33	0.54	30	1.10	NI
		7/16/2002	20	10	0.66	2.64	4.51	0.29	34	1.24	NI
		7/1/2003	25	13	0.62	2.39	4.29	0.47	32	1.17	NI
		7/19/2004	21	13	0.84	2.51	4.20	0.36	34	1.24	NI
		9/8/2005	14	6	0.35	1.62	4.08	0.71	22	0.80	NI
		6/19/2006	17	6	0.77	1.69	4.36	0.66	26	0.95	NI
		8/14/2007	20	9	0.73	2.11	4.27	0.54	32	1.17	NI
		8/5/2008	21	11	0.54	2.22	4.66	0.52	32	1.17	NI
		7/16/2009	33	12	0.36	2.93	4.63	0.29	34	1.24	NI
Beaty Creek	winter	1/13/2000	19	11	0.30	2.21	5.50	0.55	26	0.85	NI
		3/22/2001	21	12	0.45	2.12	4.73	0.57	30	0.98	NI
		1/28/2002	16	11	0.45	1.83	4.35	0.66	26	0.85	NI
		2/4/2003	16	8	0.64	1.70	2.97	0.69	22	0.72	SI
		1/14/2004	16	8	0.49	2.31	4.46	0.41	24	0.78	SI
		2/14/2005	27	17	0.32	2.08	5.29	0.64	28	0.91	NI
		1/27/2006	11	3	0.05	0.78	5.78	0.87	4	0.13	SVI
		2/7/2007	12	6	0.15	1.60	5.89	0.69	12	0.39	MI
		3/5/2009	22	12	0.23	2.13	4.56	0.56	30	1.10	NI
		3/3/2010	22	13	0.54	2.36	4.53	0.50	32	1.17	NI
Little Saline Creek	summer	7/30/2001	22	12	0.65	2.60	4.27	0.32	34	1.24	NI
		7/16/2002	20	8	0.33	2.72	4.65	0.29	34	1.24	NI
		7/1/2003	17	9	0.54	2.38	5.05	0.40	32	1.17	NI
		7/19/2004	21	9	0.26	2.59	3.98	0.38	32	1.17	NI
		9/8/2005	20	11	0.31	1.59	4.14	0.76	28	1.02	NI
		6/19/2006	22	12	0.32	2.44	3.91	0.43	32	1.17	NI
		7/30/2007	20	9	0.64	2.37	3.83	0.40	32	1.17	NI
		8/5/2008	19	10	0.64	2.26	4.65	0.42	32	1.17	NI
		7/16/2009	23	11	0.40	2.50	5.02	0.38	34	1.24	NI
Little Saline Creek	winter	1/13/2000	16	10	0.46	2.25	4.32	0.43	26	0.85	NI
		3/22/2001	21	15	0.59	2.30	4.61	0.51	32	1.04	NI
		1/28/2002	20	9	0.36	2.46	4.39	0.39	26	0.85	NI
		2/4/2003	20	9	0.52	2.47	4.20	0.31	26	0.85	NI
		2/2/2004	23	11	0.65	2.73	5.83	0.41	28	0.91	NI
		2/14/2005	20	12	0.58	2.49	4.19	0.43	30	0.98	NI
		1/27/2006	15	4	0.13	1.70	4.90	0.66	16	0.52	SI
		2/12/2007	16	6	0.20	2.08	5.44	0.52	18	0.59	SI

Site name	Season	Date	Total Species	EPT Taxa	Percent EPT	Shannon Diversity	HBI	Percent dominant 2 taxa	IBI Score	%of Ref IBI Score	Condition
		3/17/2009	26	10	0.26	2.38	4.11	0.52	30	1.10	NI
		3/3/2010	26	14	0.42	2.73	4.81	0.28	34	1.24	NI
Saline Creek	summer	6/26/2006	14	4	0.35	2.04	5.48	0.54	22	0.80	NI
		7/10/2007	19	8	0.37	2.13	5.93	0.51	30	1.10	NI
		8/2/2007	16	6	0.05	1.40	7.03	0.76	12	0.44	MI
		8/5/2008	22	9	0.21	2.20	6.15	0.50	28	1.02	NI
		7/16/2009	17	4	0.10	1.72	6.37	0.69	16	0.59	SI
		8/11/2009	24	9	0.61	2.57	3.55	0.42	34	1.24	NI
Saline Creek	winter	2/6/2007	20	9	0.16	1.58	5.74	0.71	16	0.52	SI
		3/17/2009	18	11	0.17	1.66	6.20	0.77	22	0.80	NI
		3/3/2010	15	9	0.47	2.13	4.81	0.55	32	1.17	NI
Spavinaw Creek	summer	6/20/2006	23	10	0.59	2.60	4.41	0.38	34	1.24	NI
		8/1/2007	17	9	0.59	2.44	4.41	0.34	32	1.17	NI
		8/1/2008	25	10	0.61	1.99	5.12	0.64	28	1.02	NI
		8/5/2009	18	7	0.28	2.27	4.07	0.45	28	1.02	NI
Spavinaw Creek	winter	2/7/2007	20	9	0.58	2.59	4.93	0.32	26	0.85	NI
		3/5/2009	18	8	0.19	2.13	4.99	0.56	28	1.02	NI
		3/3/2010	21	11	0.37	2.32	5.49	0.48	30	1.10	NI

The more impaired macroinvertebrate samples in 2006 are likely the result of two years of drought (2005-2006) and are not representative of normal conditions. The reference samples to which all collections were compared were taken during more normal climatic conditions, which would accentuate the stress of the communities that resulted from lack of normal water conditions. Due to the design of the paired watershed method, the data is valuable for comparison between treatment watersheds and the control watershed, regardless of environmental stresses, since all watersheds in the area experienced the same climatic conditions. There is not a significant difference in macroinvertebrate IBI score between the treatment and control watersheds.

Bacteria

Bacteria concentrations are only assessed during the formal recreational period, defined as May 1 through September 30. All of the sites sampled for this project are listed on the state's 2010 303(d) list as not attaining the designated Primary Body Contact Recreation (PBCR) use due to impairment by *Enterococcus* bacteria. Beaty Creek was removed from the 303(d) list for *E. coli* bacteria in 2006 and has remained off the list for this impairment. The criteria for 303(d) listing of impaired waters are detailed in the Oklahoma State Standards (OWRB 2011).

To examine the effects of BMP implementation while accounting for climatological effects, the paired watershed analysis method was used to calculate changes in bacteria levels. Instantaneous loads were calculated for both *E. coli* and *Enterococcus* for each sampling event using grab samples and instantaneous discharge data. The instantaneous load (expressed as colony forming units per second; "cfu/sec") was calculated by multiplying the bacteria concentration (colony forming units per 100 mL; "cfu/100 mL") from each grab sample by the instantaneous discharge (cubic feet per second; "cfs") measured at the time of sample collection and then adjusting the units to be expressed in cfu/sec.

An analysis of covariance (ANCOVA) was performed on the instantaneous loads to determine the effect of the BMP implementation in the treatment streams relative to the controls. The results of the ANCOVA analyses for Beaty Creek are shown in Tables 21 and 22 (below), and Figure 18 shows the linear regressions between the two sites during the calibration and implementation periods. The p values of 0.007 for *E. coli* and 0.099 for *Enterococcus* indicate that there is a significant effect of time period between the two streams. **Load reductions of 72% and 52% were observed for *E. coli* and *Enterococcus* loads, respectively, in the treatment period relative to the calibration period in Beaty Creek.**

Table 21. Minitab results of the ANCOVA for the combined calibration and post-implementation *E. coli* data (log transformed) for Beaty and Little Saline Creeks.

Factor:	**Type:**	**Levels:**	**Values:**
Period	Fixed	2	Calibration, Post-implementation

Analysis of Variance for logBeaty E. coli Load, using Adjusted SS for Tests:

Source	**DF**	**Seq SS**	**Adj SS**	**Adj MS**	**F**	**P**
logLSaline E. coli Load	1	78.333	77.976	77.976	70.77	0.000
period	1	8.200	8.200	8.200	7.44	0.007
Error	228	251.211	251.211	1.102		
Total	230	337.743				

Table 22. Minitab results of the ANCOVA for the combined calibration and post-implementation *Enterococcus* data (log transformed) for Beaty and Little Saline Creeks.

Factor:	**Type:**	**Levels:**	**Values:**
Period	Fixed	2	Calibration, Post-implementation

Analysis of Variance for logBeaty Enterococcus Load, using Adjusted SS for Tests:

Source	**DF**	**Seq SS**	**Adj SS**	**Adj MS**	**F**	**P**
logLSaline Entero Load	1	51.666	50.465	50.465	50.76	0.000
period	1	2.724	2.724	2.724	2.74	0.099
Error	228	226.674	226.674	0.994		
Total	230	281.064				

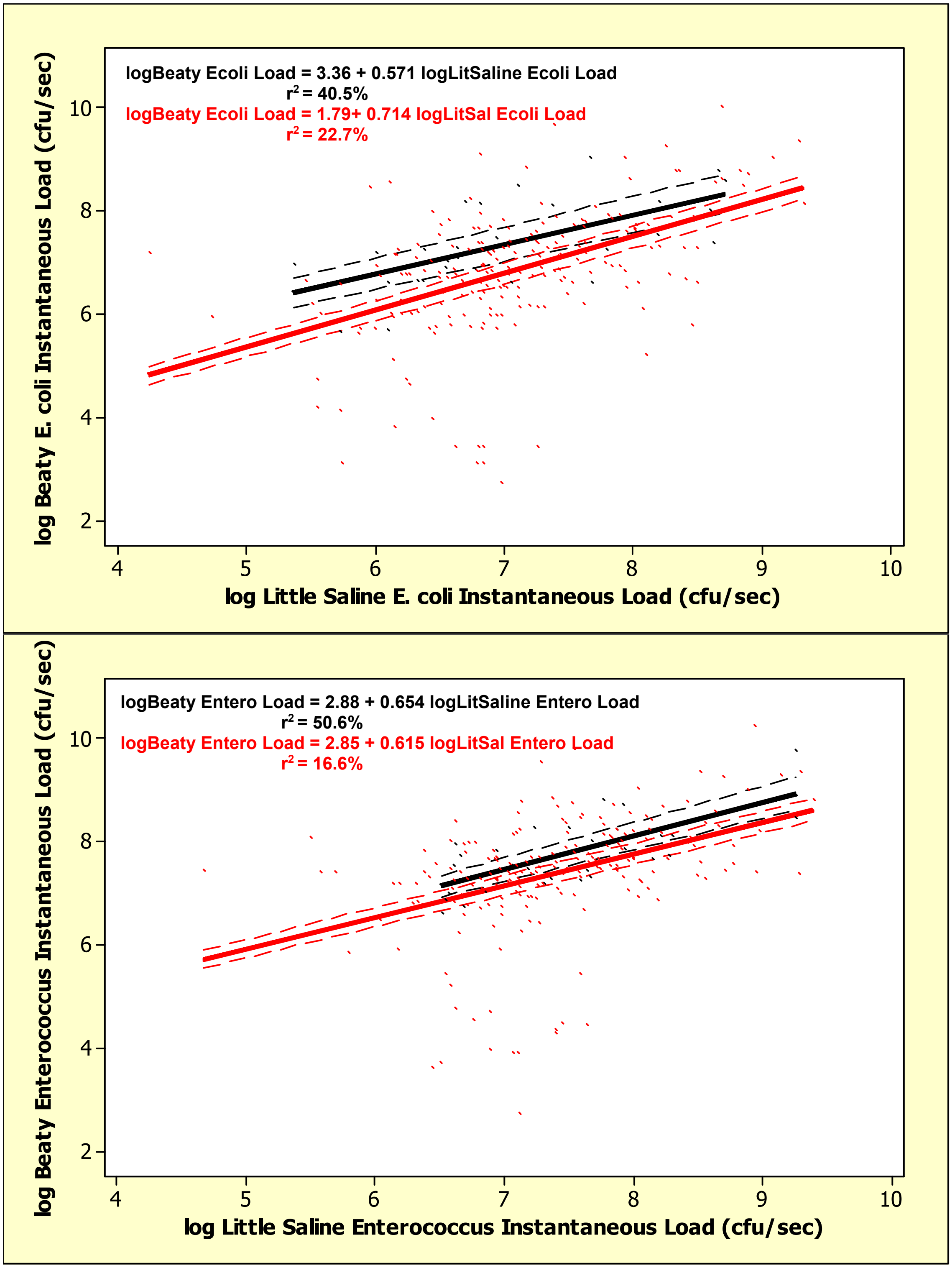

Figure 18. Regressions of log-transformed *E. coli* and *Entercoccus* bacteria instantaneous load. 95% confidence intervals for each regression line are indicated by dashed lines. The equations for the regression lines are given at the top of the graph, with black lines and font representing the calibration period and red lines and font depicting one year of implementation.

As shown in Tables 23 and 24 and Figure 19 below, ANCOVAs of the instantaneous bacteria loads for Spavinaw and Saline indicated no significant difference in either parameter between the calibration and post-implementation periods (p=0.324 *E. coli* and 0.627 *Enterococcus*).

Table 23. Minitab results of the ANCOVA for the combined calibration and post-implementation *E. coli* data (log transformed) for Spavinaw and Saline Creeks.

Factor:	**Type:**	**Levels:**	**Values:**
Period	Fixed	2	Calibration, Post-implementation

Analysis of Variance for logSpavinaw E. coli Load, using Adjusted SS for Tests:

Source	**DF**	**Seq SS**	**Adj SS**	**Adj MS**	**F**	**P**
logSaline E. coli Load	1	34.397	34.317	34.317	130.29	0.000
period	1	0.258	0.258	0.258	0.98	0.324
Error	112	29.499	29.499	0.263		
Total	114	64.154				

Table 24. Minitab results of the ANCOVA for the combined calibration and post-implementation *Enterococcus* data (log transformed) for Spavinaw and Saline Creeks.

Factor:	**Type:**	**Levels:**	**Values:**
Period	Fixed	2	Calibration, Post-implementation

Analysis of Variance for logSpavinaw Enterococcus Load, using Adjusted SS for Tests:

Source	**DF**	**Seq SS**	**Adj SS**	**Adj MS**	**F**	**P**
logSaline Entero Load	1	27.727	27.799	27.799	81.01	0.000
period	1	0.081	0.081	0.081	0.24	0.627
Error	111	38.088	38.088	0.343		
Total	113	65.896				

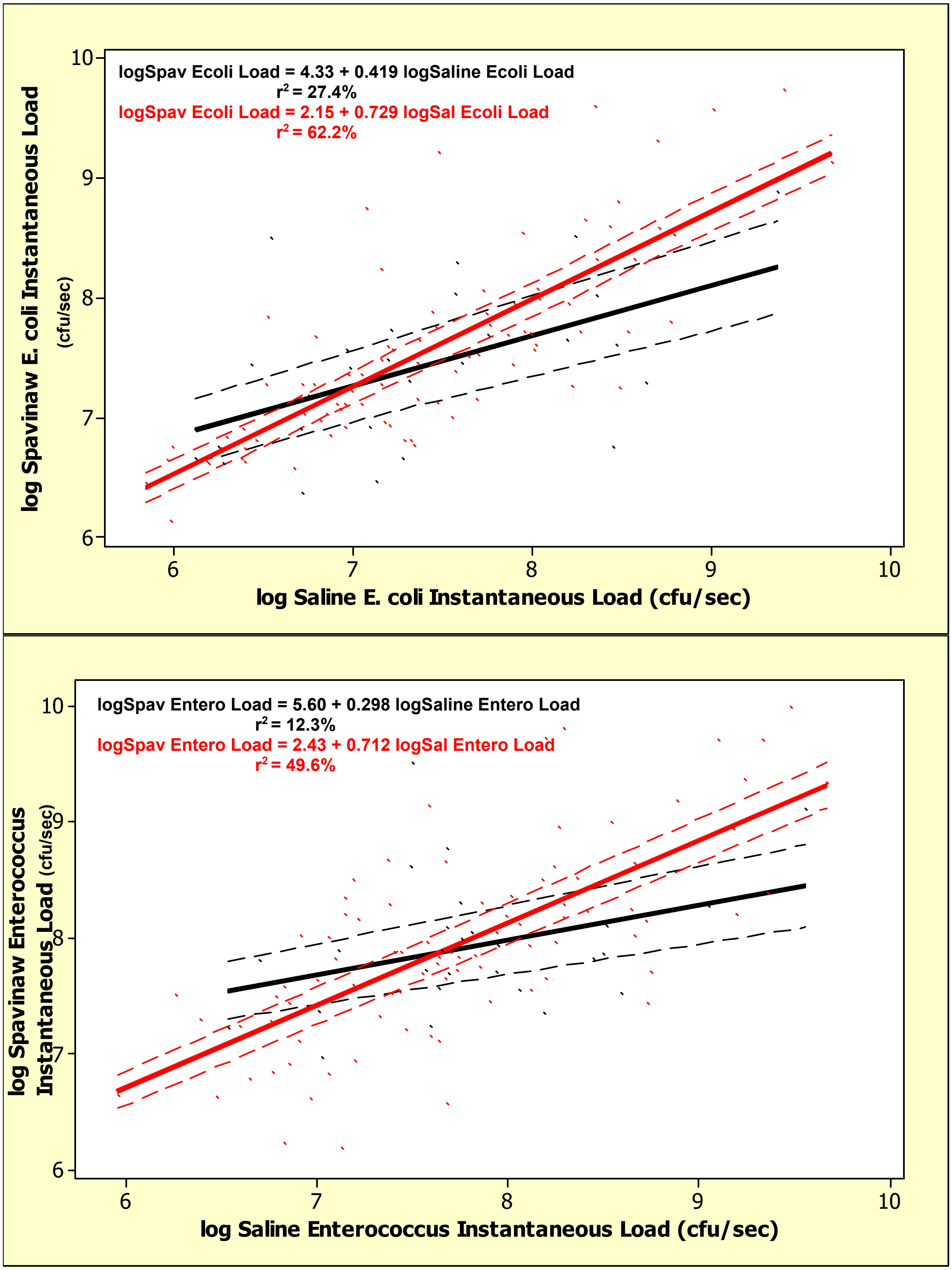

Figure 19. Regressions of log-transformed *E. coli* and *Entercoccus* bacteria instantaneous load. 95% confidence intervals for each regression line are indicated by dashed lines. The equations for the regression lines are given at the top of the graph, with black lines and font representing the calibration period and red lines and font depicting one year of implementation.

All sites generally exhibited lower bacteria levels and variability in the post-implementation period than in the calibration period (Figures 20 and 21, below), although none of the differences were statistically significant.

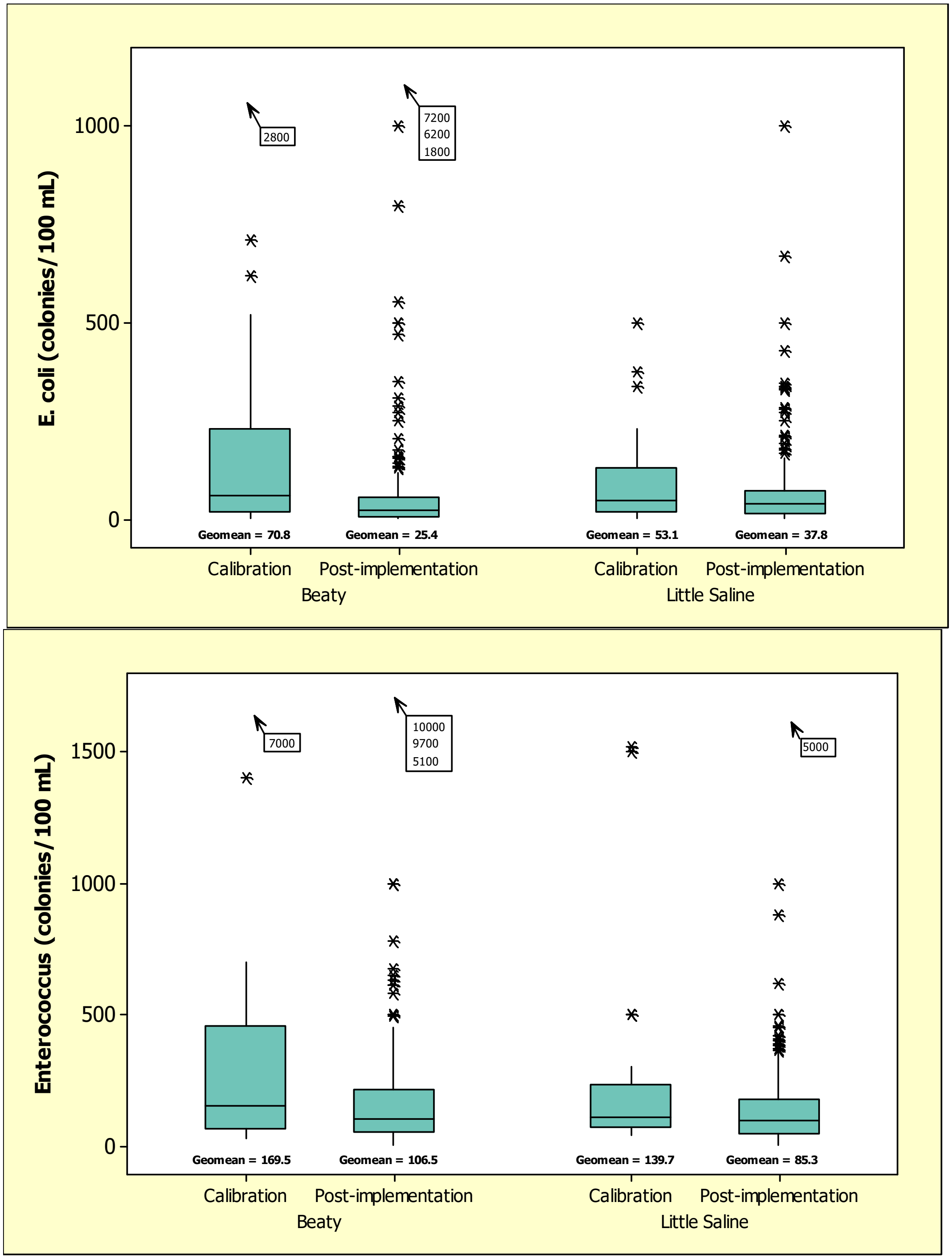

Figure 20. Boxplots of the bacteria data for Beaty Creek and Little Saline Creek. The solid line within each box is the median value, and the box represents the interquartile range (25th-75th quartile) of the data. Asterisks indicate outliers, with values in boxes showing extreme outliers whose values exceed the scale shown on the y axis.

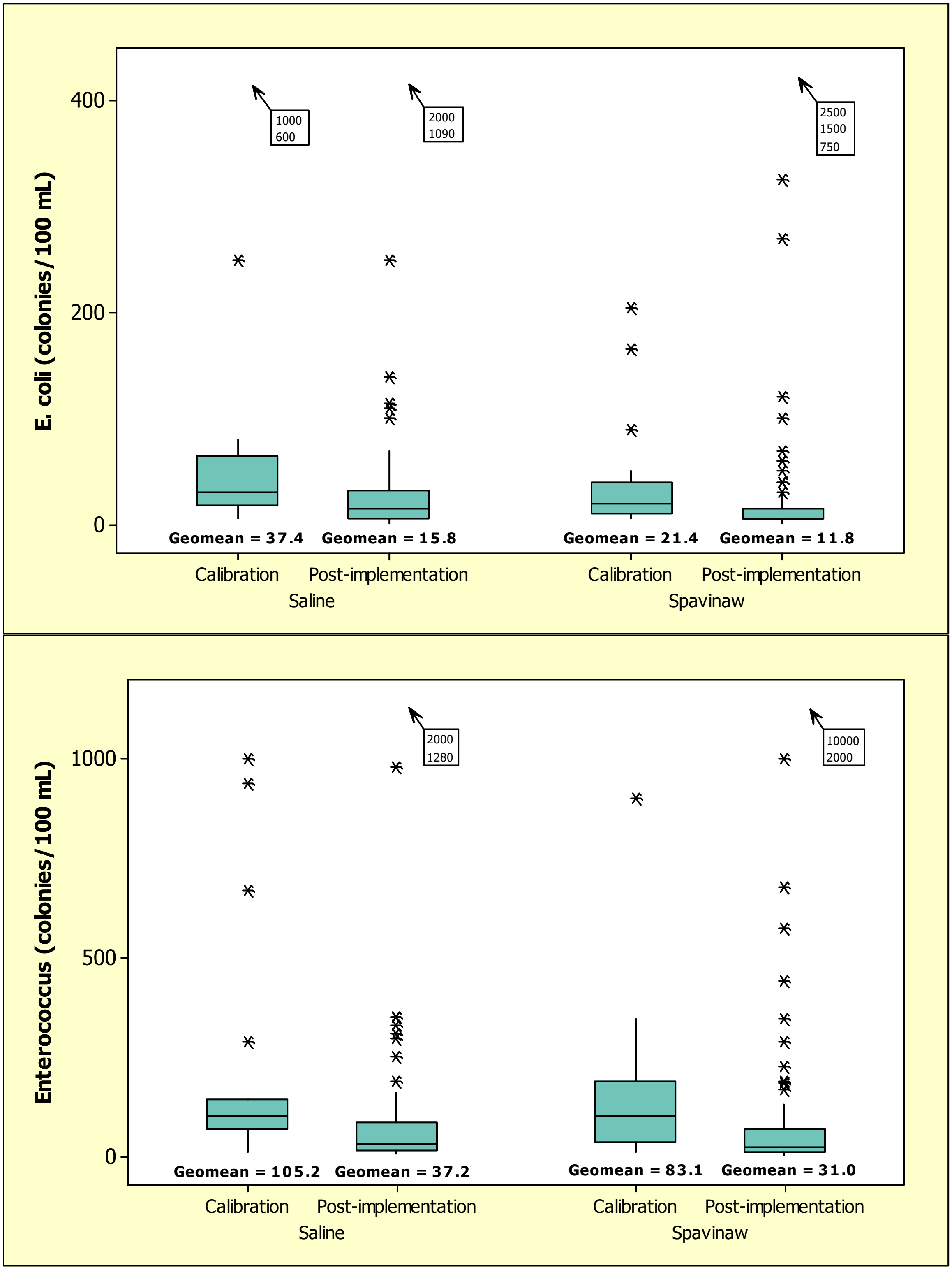

Figure 21. Boxplots of the bacteria data for Spavinaw Creek and Saline Creek. The solid line within each box is the median value, and the box represents the interquartile range (25th-75th quartile) of the data. Asterisks indicate outliers, with values in boxes showing extreme outliers whose values exceed the scale shown on the y axis.

Summary

The Spavinaw Creek Watershed Implementation Project expanded the successful efforts that have been ongoing in the Beaty Creek watershed over the past decade. This latest iteration of work in the watershed, from 2008 through 2012, reflects nearly three million dollars of additional BMP implementation and expansion of BMPs to an additional 15% of the watershed.

Significant decreasing trends in nutrients have continued in the **Beaty Creek** watershed relative to the Little Saline control watershed, including:

- 37% reduction in expected total phosphorus loading over what was expected based on pre-implementation conditions.
- 81% reduction in expected TKN loading, and significantly lower average TKN concentration in implementation period relative to calibration period.
- 55% reduction in expected nitrate loading over what was expected based on pre-implementation conditions.
- Significant reduction in ammonia concentrations in implementation period relative to calibration period.
- 72% reduction in expected instantaneous *E. coli* loading and 52% reduction in expected *Enterococcus* loading over what was predicted based on pre-implementation data.
- Maintained excellent biological community and instream habitat conditions.

Similar results were observed for **Spavinaw Creek** relative to the Saline Creek control watershed, including:

- 37% reduction in expected total phosphorus loading over what was expected based on pre-implementation conditions.
- 64% reduction in expected orthophosphorus loading, and significantly lower average oP concentrations and loads in the implementation period relative to calibration period.
- 46% reduction in expected nitrate loading over what was expected based on pre-implementation conditions, and significantly lower nitrate concentrations.
- 19% decrease in expected ammonia loading over what was predicted based on pre-implementation data.
- Reduced bacteria levels.
- Excellent, nonimpaired fish and macroinvertebrate communities.

Efforts are continuing in the Spavinaw Creek watershed. The OCC has an ongoing project in the watershed which will enable continued BMP implementation through 2014, the NRCS continues to focus available EQIP funding in the watershed, and additional riparian buffer areas are expected to be established in the watershed through the Conservation Reserve Enhancement Program (CREP). The cooperative, cumulative efforts of all of these programs are expected to further the progress toward attainment of the ultimate goal of the work in this watershed: the full attainment of all beneficial uses in the waterbodies of the Spavinaw Creek watershed.

References

Clausen, J.C. and J. Spooner. 1993. *Paired Watershed Study Design*. EPA Publication 841-F-93-009, USEPA Office of Water, Washington, D.C.

Everett, J. 2004. Eucha/Spavinaw Watershed Management Team. Presented at the Secretary of Agriculture's Poultry Waste Task Force Meeting April 29, 2004 in Jay, Oklahoma.

Lyon, A.S. 2006. *Paired watershed analysis to evaluate phosphorus in Spavinaw and Beaty Creeks, Oklahoma.* Masters Thesis, Oklahoma State University.

OCC. 2011. *Small Watershed Rotating Basin Monitoring Program Basin Group 3: Lower North Canadian, Lower Canadian, and Lower Arkansas Basins, Second Cycle, Final Report*. Oklahoma Conservation Commission.

OCC. 2009. *Oklahoma Conservation Commission Standard Operating Procedures*. Oklahoma Conservation Commission.

OCC. 2008. *Spavinaw Creek Watershed Implementation Project Final Report*. Oklahoma Conservation Commission Task 4, FY 2003 319(h).

OCC. 2006. *Final Report: Lake Eucha Watershed Implementation Project: Beaty Creek Watershed*. Oklahoma Conservation Commission Task 1200, FY 2000 319(h).

OWRB. 2011. *Implementation of Oklahoma's Water Quality Standards, Chapter 46, Subchapter 15: Use Support Assessment Protocols (USAP).* OAC 785:46-15.

Plafkin, J. L., M. T. Barbour, K. D. Porter, S. K. Gross, R. M. Hughes. 1989. *Rapid Bioassessment Protocols for Use in Streams and Rivers*. USEPA/444/4-89-001. U. S. E.P.A, Assessment and Watershed Protection Division, Washington, D. C.

Storm, D., M. White, and P. Busteed. 2005. *Targeting High Phosphorus Loss Areas in the Spavinaw Creek Basin*. Oklahoma State University, Biosystems and Agricultural Engineering Department, Stillwater, OK.

Appendix A:
Spavinaw Implementation Plan

OKLAHOMA CONSERVATION COMMISSION

STATE GUIDELINES
FOR THE
LAKE EUCHA STATE PRIORITY PROGRAM
AND 319 NON POINT COST SHARE PROGRAM
PROJECT 4 SPAVINAW CREEK WATERSHED

APPROVED PRACTICES

I. GENERAL

The Oklahoma Conservation Commission hereby declares that the following problems are having a detrimental affect on the state's water resources in the Lake Eucha Watershed:

Oklahoma's water resource is an important foundation of the state's economic infrastructure. Natural climatic events as well as human activity are impacting the state's water resources. As long as farmers and ranchers produce food from the land to feed the world and rain falls, we will continue to see impacts on the state's water. Our task, as stewards of the natural resources, is to minimize these impacts. Protecting these vital natural resources is paramount in preserving the state's economic future. In order to accomplish this goal, the Commission hereby establishes the following goals and objectives to address these problems affecting our renewable natural resources:

Make cost-share funds available to conservation districts so that they can implement cost-share practices which will protect our natural resource of water.

The Conservation Commission herein establishes the complete list and description of the Conservation Cost-Share Program policies and conservation practices approved by the Delaware County Conservation District for use during this program. (See Section II for the approved list of conservation practices.) Any variances in the Best Management Practices or cost-share percentage rates must be approved by the Delaware County Conservation District, the Oklahoma Conservation Commission Water Quality Director, and the Oklahoma Conservation Commission. These variances must be approved prior to implementation.

BMP unit cost will be implemented using the Oklahoma Natural Resources Conservation Service (NRCS) state average unit cost, which are updated annually. Unit cost rates will be adjusted when current actual price/unit is at least 20% greater than the unit cost in force. Upon approval by the Delaware County Conservation District with concurrence of the Water Quality Division Director and approval by the Oklahoma Conservation Commission new unit costs may be approved. . Unit costs for rural waste septic systems (which are not included in the NRCS state average unit cost) will be revised and set as needed by the Delaware County Conservation District with the concurrence of the Water Quality Division Director and the approval of the Oklahoma Conservation Commission. When a project agreement (contract) has been developed with an applicant, unit cost to be used will be the unit cost in effect at the time the practice is completed.

ALLOCATION OF FUNDS

The Commission, on the recommendation of the Delaware County Conservation District and the Commission's Water Quality staff, has designated Spavinaw Creek in the Lake Eucha Watershed as the demonstration area to allocate the following funds for the purpose of providing cost-share payments to eligible applicants for implementing approved cost-share water quality conservation practices.

NOTE:	State funds and land user contribution:	$249,541
	EPA 319 funds	$801,662
		$1,051,203

The allocation period for current funds is approximately 2 years. The allocation period will start October 1, 2008 and end September 30, 2010. Funds not allocated by the ending date will divert back to the Commission.

All residents of the Spavinaw Creek Watershed are eligible for cost-share assistance regardless of size of land ownership. There will be no minimum cost-share payment to any applicant. The maximum cost-share assistance to any one participant in Spavinaw Creek will be $20,000.00 for the first sign-up period. If this is deemed too small to meet the water quality needs for the watershed, the Delaware County Conservation District will review and revise the cap.

POLICIES

- The Lake Eucha Watershed Advisory Group, the Delaware County Conservation District and the Oklahoma Conservation Commission have approved eight (8) best management practices (see Section II) that will be offered to the residents of Spavinaw Creek for cost-share assistance.

- Cost-share practices shall be implemented according to NRCS standards and specifications. Best Management Practice No. 8 – Rural Waste Systems will be implemented by Department of Environmental Quality standards and specifications Bulletin 641 and subsequent revisions.

- Conservation Commissioners, Conservation Commission staff, conservation district employees or the spouses of any of these people shall not be eligible to participate in the Conservation Cost-Share Program.

Conservation district directors are eligible and encouraged to participate in the Spavinaw Creek Watershed Cost-Share Program. If district directors choose to participate, the following OCC policy will apply: In order to provide for an impartial legal majority, no more than two district directors shall participate in the cost-share program for the Spavinaw Creek Priority Watershed and 319 Non Point Source Pollution Program. In addition, the directors who desire to apply for the cost-share program shall refrain from discussing or voting on any items or issues pertaining to the cost-share program. This includes: rates, practices, maximum payment, and applicants for the program.

The Oklahoma Conservation Commission Water Quality staff, with the concurrence of the Delaware County Conservation District and the Oklahoma Conservation Commission, have developed special forms for the following: (1) CC Project Cost-Share Assistance Application Form; (2) CC Project Priority Ranking System; (3) CC Project Performance Agreement (see attached forms).

SIGN UP

A three week sign-up period will be established by OCC, with concurrence of the participating conservation district, for taking applications for cost-share assistance. Applications will be taken at the Delaware County Conservation District and the Lake Eucha Water Quality Project offices, using the CC Cost-Share Application Form. After the prospective cooperator signs up, the conservation planners will contact each applicant and: (1) determine eligibility; (2) develop a conservation plan to determine needs; (3) set priority ranking (using the priority ranking form); (4) with applicants' concurrence, a project agreement will be developed in accordance with the Oklahoma Conservation Commission Cost-Share Program (refer to OCC State Guidelines for Program Year 7); (5) the completed conservation plan and project agreement will be presented for approval to the Delaware County Conservation District; (6) the final approval will be authorized by the designated OCC representative.

NOTE: Absolutely no work will begin on any project until the OCC staff and representative have approved the plan and project agreement.

As funds become available after the initial sign-up period and planning have been completed, a second sign-up period can be conducted as determined by the conservation district and the OCC staff representative. At regular intervals a review/audit of the program will be made by the OCC water quality representative. This will be used to determine compliance with the program objectives and to determine if modifications are necessary.

ELIGIBILITY CRITERIA

The following criteria must be satisfied for an applicant to participate in the Cost-share program: (1) must own or operate land in the Spavinaw Creek Watershed in Delaware County, Oklahoma; (2) must have a need for one of the Priority Best Management Practices; (3) if it is determined that the applicant requires a priority practice, he/she must be willing – with cost-share assistance – to install the needed BMPs; (4) the applicant will be required to maintain the BMP for the life of the practice.

CONTRACT COMPLIANCE

The cooperator will be required to sign a project agreement with the Delaware County Conservation District and follow a specified schedule of operations. The schedule of operations form details a year by year plan of the Best Management Practices (BMPs) to be installed and a time frame within which to install them. Each Fall, the project coordinator will conduct annual status reviews. If a cooperator is found to be out of compliance with the schedule of operations due to circumstances beyond his/her control, a revision schedule can be discussed and completed. These revisions will require conservation district board approval. In the event a cooperator is not in compliance due to lack of interest, the district board has the discretion to terminate the contract. The idle funds can then be utilized by another cooperator. The importance of the cooperators keeping on schedule must be stressed by the planner. The lifespan of the project dictates the need for schedule compliance. All funds for BMP installation must be expended by September 30, 2010.

II. LIST OF APPROVED CONSERVATION PRACTICES FOR THE SPAVINAW CREEK PRIORITY WATERSHED AND 319 NON-POINT PROGRAM

Contained in this section is a master list of Best Management Practices (BMPs) and cost-share levels that were approved for implementation in the Beaty Creek Demonstration Area. The Lake Eucha Watershed Advisory Group approved the majority of these BMPs at their regularly scheduled meeting on Thursday, December 17, 1998 (BMP 4d was added late in the program). The Delaware County Conservation District approved the BMP list at their regularly scheduled board meeting on January 14, 1999 and the Oklahoma Conservation Commission gave their approval at their meeting on February 8, 1999. Those BMPs are incorporated into the Spavinaw Creek Demonstration Area, using the USDA/NRCS Environmental Quality Incentive Program cost list effective April 19, 2004, and any supplemental cost lists as they become effective.

High potential phosphorus loss on targeted riparian area and grazing lands, based on OSU targeting results, will be used on a ranking sheet as follows:

- Poor condition pastures – 20 points
- High potential phosphorus loss (red on targeting maps) – 20 points
- High potential phosphorus loss (blue on targeting maps) – 15 points
- High potential phosphorus loss (purple on targeting maps) - 10 points
- Filter strip development next to riparian areas - 15 points

Funds will be expended based on a ranking sheet using the above system, plus rural waste concerns and plant condition. The fields receiving the highest score on the ranking sheet will be given first priority for available funds.

PRACTICES
Riparian Area Management/Establishment
Buffer/Filter Strip Establishment
Stream Bank Stabilization
Animal Waste Storage Facilities
Pasture Establishment/Management
Proper Waste Utilization
Heavy Use Area
Rural Waste Systems

APPROVED BEST MANAGEMENT PRACTICES

To include the following conservation practices, components, units, cost-share rates and costs.

Best Management Practices (BMPs)
Spavinaw Creek 319 Project

			Incentive Percentage
1.	Riparian Area Management Establishment		100%
	Components:		
1a.	Incentive Payments:		
	1a-1. Total exclusion	$50.00/ac/year for up to 4 years	
	1a-2. Total exclusion with hay production of riparian area in Zone 3 only	$45.00/ac/year for up to 4 years	
	1a-3. Limited grazing	$40.00/ac/year for up to 4 years	

These incentive payments will be limited to no more than an average of 150 feet on each side of the stream bank. To qualify for these incentive payments, one or more practices to improve water quality must be completed and certified by the Project Coordinator.

1b. Off-site Watering Facilities — 80%

- 1b-1. Pond
- 1b-2. Trickle pipe
- 1b-3. Well Drilling
- 1b-4. Watering facilities
- 1b-5. PVC Pipeline
- 1b-6-9. Watering lane to creek

1c. Vegetative Establishment — 80%

- 1c-1- 1c-5. Pasture (grass planting)
- 1c-6. Lime
- 1c-7. Fertilizer
- 1c-8. Seedbed preparation
- 1c-9. Drill & Tractor
- 1c-10 – 1c-11. Forestry plantings

1d. Fencing — 80%

- 1d-1. 4-wire fence
- 1d-2. Woven wire fence

1. <u>PURPOSE</u>
To establish riparian areas along Spavinaw Creek and all tributaries draining into Lake Eucha. To control and filter runoff water from pastures and fields and to stabilize the creek banks to stop erosion.

2. <u>APPLICABILITY</u>
To target areas where the stream banks are eroded, over grazed and over used by cattle having access to the water. These targeted areas have deteriorated because of the lack of vegetation or the proper vegetation to hold them in place.

3. POLICIES

A. Cost-sharing is authorized for:

(1) Incentive payment for

(a) Total exclusion

(b) Total exclusion with hay production

(c) Limited grazing

(2) Off-site watering

(3) Vegetative establishment

(4) Fencing

(5) To receive cost-share assistance, the following criteria must be met:

(a) The livestock producer must be willing to fence the riparian area as established by the Natural Resources Conservation Service/Oklahoma Conservation Commission Water Quality staff technicians.

(b) The livestock producer will be required to maintain the riparian area and all component parts for the life of the practice.

(c) To receive Incentive Payments, the cooperator must enter into an agreement with the Delaware County Conservation District.

B. Cost-share is not authorized for:

(1) Individuals receiving cost-share funds from any other state or federal agencies on the same Best Management Practices.

(2) Producers who do not enter into a total farm or water quality plan with the Delaware County Conservation District.

C. Design, layout and inspection:

(1) Technical assistance will be accomplished by the Conservation Commission Water Quality staff representatives or Natural Resources Conservation Service personnel.

(2) Natural Resources Conservation Service standards and specifications will be used in all designs.

D. Best Management Practice approval:

(1) The Oklahoma Conservation Commission Water Quality staff representatives will be responsible for the initial approval of this Best Management Plan.

(2) The Delaware County Conservation District will be the official approving authority.

Best Management Practices (BMPs)
Spavinaw Creek 319 Project

			Incentive Percentage
2.	Buffer-Filter Strip Establishment		80%

Components:

- 2a. Incentive Payments: $45.00/ac
- 2b. Vegetative Establishment (same as 1c)
- 2c. Fencing
  - 2c-1. 4-wire fence
  - 2c-2. Woven wire

1. PURPOSE

   To establish buffer/filter strip around cultivated fields and/or farmsteads where the runoff water has the potential to contain large amounts of nutrients that pollute the waters of Lake Eucha.

2. APPLICABILITY

   To target areas where the stream banks are eroded, over grazed and over used by cattle having access to the water. These targeted areas have deteriorated because of the lack of vegetation or the proper vegetation to hold them in place.

3. POLICIES

   A. Cost-sharing is authorized for:
      - (1) Incentive payments
      - (2) Vegetative establishment
      - (3) Fencing, if necessary
      - (4) To receive cost-share assistance, the following criteria must be met:
        - (a) Have a whole farm conservation plan to include Animal Waste Plan, if applicable.
        - (b) Must agree to maintain all component parts of the Best Management Practices for the entire life of the practices.

   B. Cost-share is not authorized for:
      - (1) Individuals receiving cost-share funds from any other state or federal agencies on the same Best Management Practices.
      - (2) Producers who do not enter into a total farm or water quality plan with the Delaware County Conservation District.

   C. Design, layout and inspection:
      - (1) Technical assistance will be accomplished by the Conservation Commission Water Quality staff representatives or Natural Resources Conservation Service personnel.
      - (2) Natural Resources Conservation Service standards and specifications will be used when available.

D. Best Management Practice approval:

(1) The Oklahoma Conservation Commission Water Quality staff representatives will be responsible for the initial approval of this Best Management Plan.

(2) The Delaware County Conservation District will be the official approving authority.

3. Streambank Stabilization 80%

Components:

3a. Fencing

3a-1. 4-wire fence

3a-2. Woven wire

3b. Vegetative Plantings

3b-1 – 3b-9: Grass establishment

3b-10 – 3b-11: Forestry plantings

3c. Special Best Management Practices

Note: this will only be used when a BMP is needed that is not covered under the list of approved BMPs.

1. <u>PURPOSE</u>

This BMP is designed to correct/protect stream banks in the Spavinaw watershed. Stopping erosion will stop sediment build up in the waters of Lake Eucha.

2. <u>APPLICABILITY</u>

To target high use areas where the riparian area is depleted.

3. <u>POLICIES</u>

A. Cost-sharing is authorized for:

(1) Areas determined in need of erosion control.

(2) Areas where vegetative cover is lacking.

(4) To receive cost-share assistance, the following criteria must be met:

(a) Have a whole farm conservation plan to include Animal Waste Plan, if applicable.

(b) Must agree to maintain all component parts of the Best Management Practices for the entire life of the practices.

B. Cost-share is not authorized for:

(1) Individuals receiving cost-share funds from any other state or federal agencies on the same Best Management Practices.

(2) Projects that will require large amounts of work, materials and labor to complete. (The objective for this BMP is to correct small on-the-farm stream bank erosion.)

C. Design, layout and inspection:

(1) Technical assistance will be accomplished by the Conservation Commission Water Quality staff representatives or Natural Resources Conservation Service personnel.

(2) Natural Resources Conservation Service standards and specifications will be used when available.

D. Best Management Practice approval:

(1) The Oklahoma Conservation Commission Water Quality staff representatives will be responsible for the initial approval of this Best Management Plan.

(2) The Delaware County Conservation District will be the official approving authority.

4. Composters (dead bird) Animal Waste Storage Facilities 75%

Components:

4a: Composter

4b. Cake out house

4c. Full clean out house

4d. Cattle feeding/waste storage facility

1. PURPOSE

This BMP has been developed to address the proper disposal of dead animals and proper storage of animal waste.

2. APPLICABILITY

To target producers who do not have available proper disposal of dead birds and those producers who are required to dispose of animal waste when weather and soil conditions are not acceptable.

3. POLICIES

A. Cost-sharing is authorized for:

(1) Producers who have no other way to dispose of their dead birds.

(2) Producers who need to clean animal waste out of their poultry houses and need a place to store the waste until such time as it can be transported off the farm.

(3) Producers who need an animal waste storage and feeding facility to store animal waste until weather permits proper application.

B. Cost-share is not authorized for:

(1) Individuals receiving cost-share funds from any other state or federal agencies on the same Best Management Practices.

(2) Producers who have adequate means for proper disposal of dead birds.

C. Design, layout and inspection:

(1) Technical assistance will be accomplished by the Conservation Commission Water Quality staff representatives or Natural Resources Conservation Service personnel.

(2) Natural Resources Conservation Service standards and specifications will be used when available.

D. Best Management Practice approval:

(1) The Oklahoma Conservation Commission Water Quality staff representatives will be responsible for the initial approval of this Best Management Plan.

(2) The Delaware County Conservation District will be the official approving authority.

5. Pasture Establishment/Management Components:

5a. Pasture Establishment 75%

Components

- 5a-1. Sprigging
- 5a-2 – 5a-5. Seeding
- 5a-6. Lime (Soil Test)
- 5a-7. Fertilizer (Soil Test)
- 5a-8. Seedbed Preparation
- 5a-9. Drill & Tractor

5b. Pasture Management 75%

Components:

- 5b-1. Fencing (for rotational grazing systems)
  Off-site Watering
- 5b-2. Pond
- 5b-3. Watering facilities
- 5b-4. Pipeline (PVC)
- 5b-5. Well drilling

1. <u>PURPOSE</u>

This BMP is to be used to correct erosion problems that contribute to the movement of nutrients from pastures into the waters of Lake Eucha.

2. <u>APPLICABILITY</u>

To encourage producers to manage pastures so as not to overgraze, causing erosion problems. Also, to establish vegetative cover on areas where inadequate cover is causing nutrients to move from pastures into the waterways of Lake Eucha.

3. POLICIES

A. Cost-sharing is authorized for:

(1) Pasture establishment

(2) Pasture management with components:

(a) Fencing

(b) Watering facilities

Cost-share is not authorized for:

(1) Pasture establishment where an adequate cover is present

(2) Where a producer wants to change species of vegetation. Example: from fescue to Bermuda

(3) Producers who do not want to develop a total pasture rotational system

(4) Individuals receiving cost-share funds from any other state or federal agencies on the same Best Management Practices.

.

C. Design, layout and inspection:

(1) Technical assistance will be accomplished by the Conservation Commission Water Quality staff representatives or Natural Resources Conservation Service personnel.

(2) Natural Resources Conservation Service standards and specifications will be used when available.

D. Best Management Practice approval:

(1) The Oklahoma Conservation Commission Water Quality staff representatives will be responsible for the initial approval of this Best Management Plan.

(2) The Delaware County Conservation District will be the official approving authority.

6. Proper Waste Utilization (For Poultry Waste Producers)
(This BMP will require a waste management plan)

6a. **8¢ per lb. of phosphorus produced and properly utilized on producer's farm according to Oklahoma State guidelines and USDA-NRCS waste utilization standard 633. Must have soil/litter tests and application plan developed by Eucha/Spavinaw Watershed Management Team.*

6b. **10¢ per lb. of phosphorus moved from producer's farm and applied in Lake Eucha Watershed according to Oklahoma State guidelines and USDA-NRCS waste utilization standard 633. Must have soil/litter tests and application plan developed by Eucha/Spavinaw Watershed Management Team.*

6c. **15¢ per lb. of phosphorus moved from producer's farm to an alternative use waste project or moved out of Spavinaw Creek watershed into a non-phosphorus threatened watershed and applied according to*

Oklahoma State guidelines and USDA-NRCS waste utilization standard 633. Cannot be moved into Grand Lake, Illinois, Wister or Illinois watersheds. Must have soil/litter tests.

*Must show movement location.

1. PURPOSE
To insure proper application of animal waste and not to exceed the phosphorus level as established by the Natural Resources Conservation Service and application plan developed by the Eucha/Spavinaw Watershed Management Team.

2. APPLICABILITY
To target producers who have excess litter or cannot spread and give an incentive for movement to areas within the Eucha Watershed that can utilize it and also to encourage movement of litter out of the Eucha/Spavinaw Creek watershed or to an alternative use waste project.

3. POLICIES
A. Cost-share is authorized for:
(1) Proper use of litter
(2) Movement of litter

B. Cost-share assistance is not authorized for:
(1) When like funds are being received from any other state or federal agency. (Note: NRCS funds being paid to a purchaser of producer's litter does not constitute funds being received.)
(2) Where producer cannot or will not show proof of movement and provide a soil test at receiving location.

C. Best Management Practice Structure:
(1) Producer/Cooperator **must have** an Animal Waste Management Plan and Conservation Plan.
(2) The structure of movement will be by the producer and concurred by the Oklahoma Conservation Commission Water Quality Staff representatives.

D. Best Management Practice approval
(1) The Oklahoma Conservation Commission Water Quality staff representatives will be responsible for the initial approval of this Best Management Plan.
(2) The Delaware County Conservation District will be the official approving authority.

7. Heavy Use Areas 75%

7a. Establish permanent feeding areas away from water sources (creeks, drainageways, etc.)
Components:
7a-1. Concrete pads for round bale feeding.

7a-2. Gravel for heavy traffic areas (cattle).
7a-3: Geotextile fabric and terracells for use under gravel
7a-4. Concrete or gravel pads around watering facilities.
7a-5. 6" Terracell – erosive areas.

1. <u>PURPOSE</u>
To reduce pollution entering the stream from pasture feeding of hay to livestock.

2. APPLICABILITY
To target livestock producers who feed hay in areas too close to streams.

3. <u>POLICIES</u>
A. Cost-sharing is authorized for:
(1) Construction of feeding areas away from creeks.
(2) Diversion of winter runoff feeding areas to proper disposal areas.

B. Cost-share is not authorized for:
(1) Producers who do not have a full farm conservation plan to include an Animal Waste Management Plan.
(2) Producers who are not involved with Best Management Practice #5 (Pasture Management).

C. Design, layout and inspection:
(1) Technical assistance will be accomplished by the Conservation Commission Water Quality staff representatives or Natural Resources Conservation Service personnel.
(2) Natural Resources Conservation Service standards and specifications will be used when available.

D. Best Management Practice approval:
(1) This Best Management Plan will be written into the whole farm plan developed and approved by the he Oklahoma Conservation Commission Water Quality staff representatives and the Delaware County Conservation District.

8. Rural Waste Systems 75%
Install residential septic system in the rural areas of the Spavinaw Creek watershed
Components:
8a-1. Septic Tank – 1000 gallon
8a-2. Installation of tank.
8a-3. Percolation test and certification (one allowed)
8b. Installation of lateral lines
Includes materials, machinery, cost and labor

1. <u>PURPOSE</u>
To reduce residential sewer pollution entering the waters of Lake Eucha.

2. APPLICABILITY

To target problems within the watershed where septic tanks are not in place, or systems which are not adequate to function as needed to prevent water pollution in Lake Eucha.

3. <u>POLICIES</u>

A. Cost-sharing is authorized for:

(1) Installation of septic systems to include:

(a) Septic tank

(b) Lateral lines

(c) Labor for installation

(d) Percolation test and certification.

(2) To receive cost-share assistance, the following criteria must be met:

(a) If the applicant is an agriculture livestock producer (dairy, poultry, swine or beef), a water quality conservation plan must be developed with the Delaware County Conservation District.

(b) If the Water Quality Conservation Plan addresses other Best Management Practice needs, the applicant will be required to correct them along with the septic system. These other BMP needs may also receive cost share assistance, if they are in the system.

(c) If the applicant is a non-agriculture producer and lives within 1000 feet of a tributary of the Lake Eucha reservoir, cost-share assistance is available. They must meet all criteria of the program and have no other water quality problems on the property.

B. Cost-share assistance is not authorized for:

(1) Trailer type homes not permanently attached to the ground.

(2) Recreational trailer

(3) Seasonal homes

(4) New home construction

C. Design, layout and inspection:

(1) A local representative of the Department of Environmental Quality for the State of Oklahoma or a certified percolation tester and septic system installer will design and make final approval of the installation.

(2) The septic system will be designed within the guidelines of Oklahoma Departmental Quality Bulletin No. 641.

D. Best Management Practice approval:

(1) The Oklahoma Conservation Commission Water Quality staff representatives will be responsible for the initial approval of this Best Management Plan.

(2) The Delaware County Conservation District will be the official approving authority.

SPAVINAW CREEK WATERSHED
CONSERVATION COST-SHARE PROGRAM
PRE-APPLICATION

Delaware County Conservation

Name			
Address	City	State	Zip
Phone Number			
I heard about this program □ from a friend/neighbor □ from a newspaper or newsletter article or radio broadcast □ from NRCS or Conservation District personnel			
Legal description where the conservation practice(s) is to be constructed. Sec. ____ T ____ R ____ Number of Acres____________			
Do you own, lease, or rent this land? Own Lease Rent If not the landowner, provide a properly executed consent form from the owner(s) of the land and file it with the application.			
For which conservation practice(s) are you applying?			

I understand this application does not obligate the applicant or the Conservation District to enter into a contract. I am not an Oklahoma Conservation Commission commissioner or employee, conservation district employee or the spouse of any of these people mentioned above.

____

Applicant Signature Date

Failure to provide correct, complete information will result in the withholding or withdrawal of financial assistance.

STATE OF OKLAHOMA
CONSERVATION COST-SHARE PROGRAM
PERFORMANCE AGREEMENT

This agreement, made and entered into by and between the Delaware County Conservation District, hereinafter referred to as District, and ____ hereinafter referred to as participant.

Part I - Conservation Practice(s) To Be Completed
See attached Schedule for the conservation practice(s) to be implemented as set forth in the participant's Conservation Plan.

Part II - Stipulations

1. The participant agrees:
   1. To perform or have performed all work described in Part I in accordance with conservation practice standards and specifications furnished by the District or the Natural Resources Conservation Service (NRCS).
   2. To submit to the District a detailed, itemized statement of costs and copies of contractor's invoices when conservation practice(s) are constructed by a contractor.
   3. To submit to the District detailed invoices for participant in-kind contributions.
   4. To complete or have completed all work described in Part I on or before ____________________
   5. To obtain required permits and approvals prior to the construction of the conservation practice(s).
   6. To permit free access to the participant's land for District and NRCS representatives to inspect the conservation practice(s) upon completion.
   7. To maintain the conservation practice(s) as outlined in the cost-share Maintenance Agreement for the specified life of the conservation practice(s) at no cost to the District.
   8. To accept the District's method of calculating the cost-share payment(s) for completed work.

2. The District agrees:
   1. To provide assistance to the participant to develop a new or revised Conservation Plan that reflects the conservation practice(s) outlined in Part I.
   2. To provide conservation practice standards and specifications and technical assistance for work described in Part I.
   3. To provide and pay a cost-share level, as shown on the attached Schedule, of the lesser of the established District average cost or actual cost to construct the conservation practice(s). Cost share reimbursement will not exceed the amount on the attached Schedule.
   4. To accept in-kind contributions from the participant for work performed by the participant on approved cost-share conservation practice(s) constructed.

Part III B Signatures
This agreement shall be effective from the <u>last date</u> of signature below. Work cannot begin until an effective agreement is signed <u>and</u> dated by the participant <u>and</u> the conservation district.

PARTICIPANT:

________________________________ __________
Participant Signature Date

________________________________ __________
Project Coordinator Date
Lake Eucha Water Quality Project

____
Social Security Number or
Federal Employee Identification Number

________________________________ __________
District Representative Date
Delaware County Conservation District

____
Participant Signature

____
Social Security Number

	SPAVINAW CREEK 319 NON-POINT PRIORITY WATERSHED		
	PRIORITY RANKING SYSTEM 2004		
Producer:		Total Acres:	
Telephone		Farm No(s):	
Legal Description:	Section ___ Township ___ Range ___	Total Points:	
	Conservation Priorities:	**Evaluation Score**	
	Water Quality- High Potential Phosphorus Loss		
	Plant Condition- Productivity, Health and Vigor - and Inadequate Stock Water		
		Total Evaluation Points:	

Water Quality- High Potential Phosphorus Loss on Targeted Riparian Area and Grazing Lands (Total: 100 pts)		
Poor Condition Pastures as identified on Target Maps (20 pts)		
High Potential Phosphorus Loss areas identified in **red** on Target Maps (20 pts)		
High Potential Phosphorus Loss areas identified in **blue** on Target Maps (15 pts)		
High Potential Phosphorus Loss areas identified in purple on Target Maps (10 pts)		
Land offered will apply a Comprehensive Nutrient Management Plan if applying poultry litter according to a plan prepared by the Eucha/Spavinaw Management Team. (20 pts)		
Distance from confined livestock facility to USGS Blue Line Stream or other water body. Adjacent (15 pts) <1/4 mile (10pts) 1/4-1/2 mile (5pts) >1/2 mile (0pts)		-
General topography between confined livestock facility and USGS Blue line or Water Body. >8% slope (10pts) 3% - 8% slope (5pts) 0% - 3% slope (0pts)		
319 Project application will develop filter strips for the entire length of land that is adjacent to streams and lakes in offered land units (15pts)		
Plant Condition- Productivity, Health and Vigor - and Inadequate Stock Water (Total: 43 pts)		
Offer includes implementation of Prescribed Grazing (528A) system that balances forage production with livestock numbers for the period of the contract.		-
% of the grazing lands in the operating unit planned for implementation of Prescribed Grazing according to the (528A) standard during the contract period. 100% (25pts) 50%-99% (15pts) 49%-25% (5pts) <25% (0pts)		
Practice(s) will facilitate improved grazing distribution. (382, 614, 642, 378)(10pts)		-
Grazing system rotates through 3 or more pastures per grazing season. 3-5 (6pts); 6/7 (7pts); 8 or more (8pts)		

319 Project Evaluation Worksheet Page 2

*********TO BE USED ONLY IN THE CASE OF A TIE FOR FUNDING*********

Cost: Benefit ratio based on $/acre score	-
Lowest $/acre wins the tie-break	-

Designated Conservation Planner

______________________________________ ________ *(Signature)*
Date

Applicant

______________________________________ ________ *(Signature)*
Date

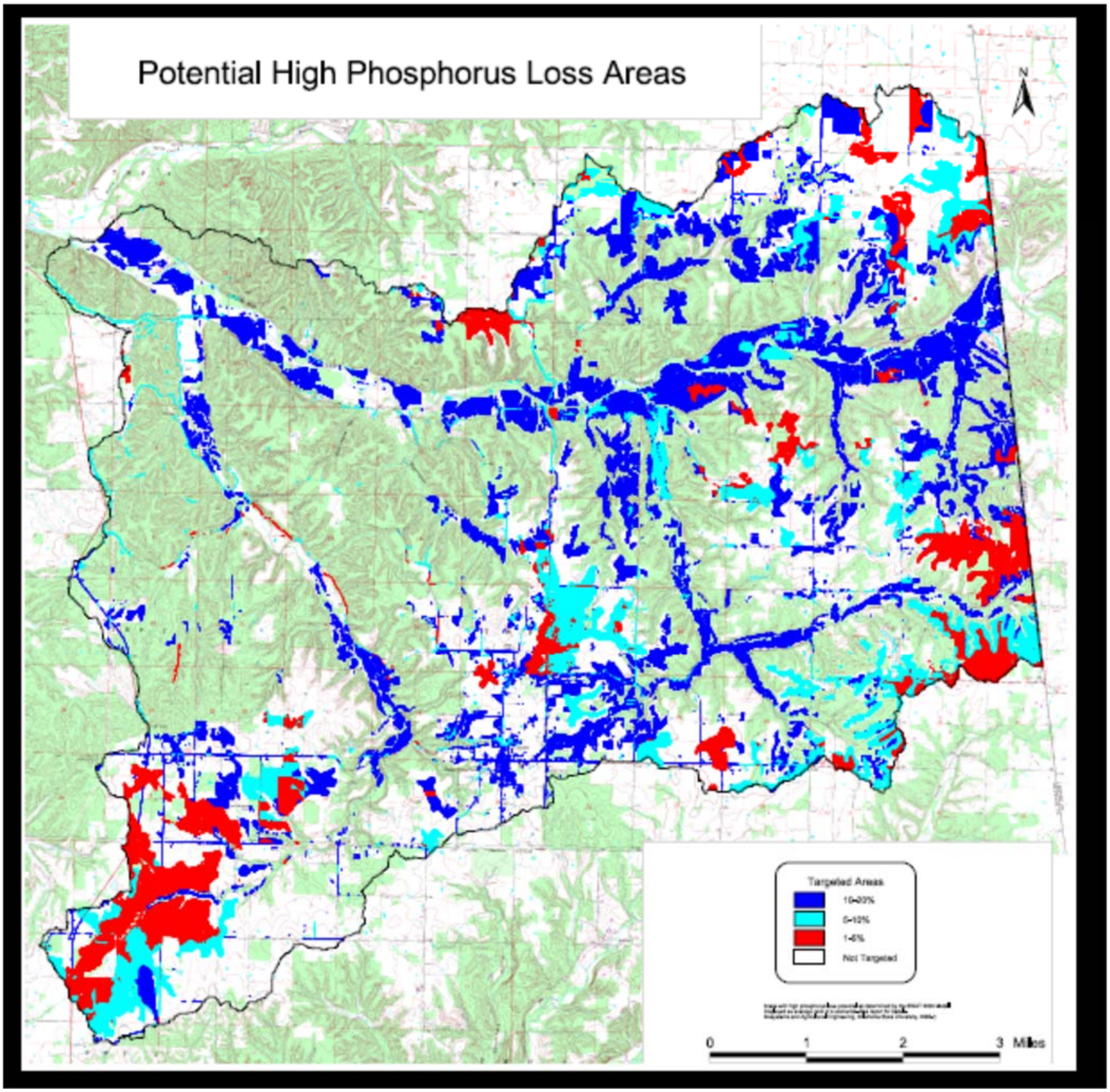

Figure 1. Watershed Areas with Greatest Potential Phosphorus Loss.

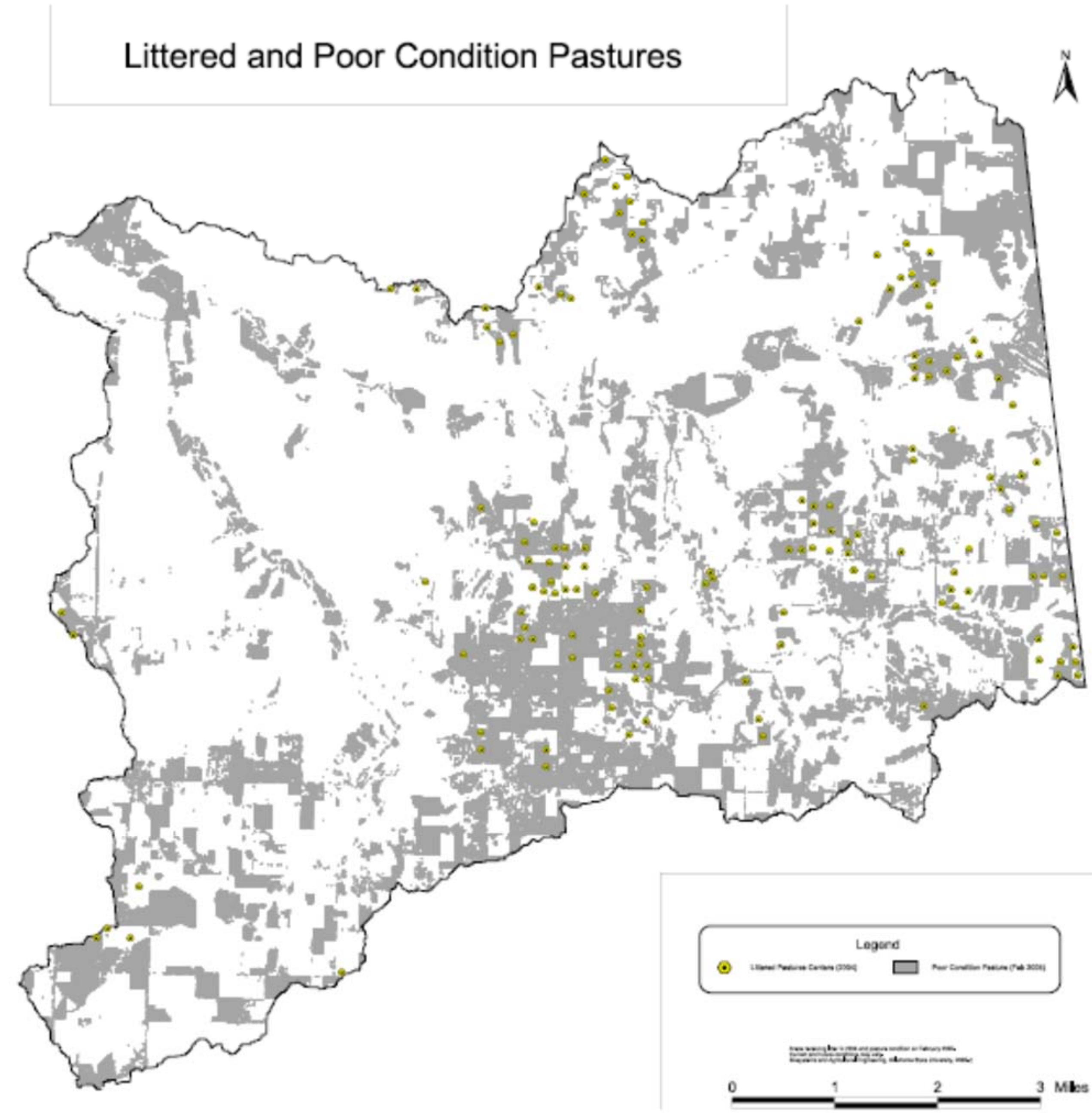

Figure 2. Pastures in Poor Condition and Poultry Litter Application Points.