A Year in Review:
Conservation Reserve Enhancement Program
Pennsylvania Highlights 2014-2015

Native Joe-Pye Weed (Eupatorium fistulosum) attracts pollinators as part of a riparian buffer planting. Photo courtesy of PACD.

Oct. 1, 2014 – Sept. 30, 2015

Executive Summary

The Pennsylvania Conservation Reserve Enhancement Program (CREP) continues to lead the nation in the number of acres enrolled in the national Conservation Reserve Program (CRP). A voluntary initiative, CREP assists agricultural producers in land preservation by minimizing erosion, restoring wildlife habitat and protecting both ground and surface water. The original CREP agreement was signed in 1999 with the first practices implemented in 2000.

Cool season grasses. Photo courtesy of PACD.

Program Highlights

Currently, 8,784 contracts are in place for a total of 144,538 acres under contract.

Since the program's inception, in Pennsylvania**:**

- 13,313 landowners have received cost-share payments from FSA and the Commonwealth of Pennsylvania
- FSA has provided $45,123,189 in cost-share payments

In the 2014-15 CREP program year, in Pennsylvania:

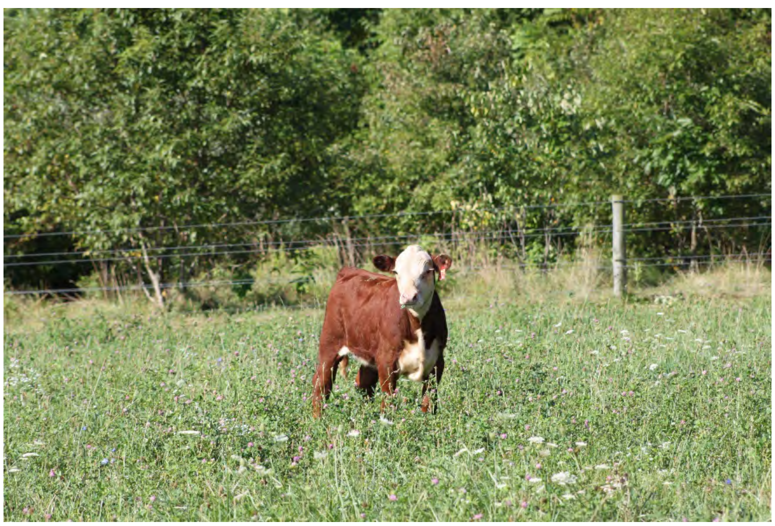
- 330 contracts were approved on 4,770 acres.
- 388 acres of forested riparian buffers were installed.
- 4,215 acres of native grasses were planted.
- $1,249,422 in direct cost-share payments were obligated by the FSA:
  - $1,205,995 in the Chesapeake Bay
  - $43,427 in the Ohio Basin
- $263,157 in direct cost-share payments were obligated by DEP:
  - $248,760 in the Chesapeake Bay
  - $14,397 in the Ohio Basin

CREP Program Overview

The CREP program is an offshoot of the Conservation Reserve Program (CRP), the country's largest private-lands environmental improvement program. Administered by the U.S. Department of Agriculture’s Farm Service Agency (FSA), the program is a partnership between farmers, state and federal government, and private groups. By combining CRP resources with state and private programs, CREP provides farmers and other landowners with a sound financial package for conserving and enhancing natural resources.

The CREP project began in Pennsylvania when the state government and several local nongovernmental groups identified an agriculture-related environmental issue of state and national significance. These parties worked with the state’s FSA office to develop a project proposal to address specific environmental issues and goals, such as the reduction of nonpoint source pollution in the state’s water bodies, and enhancement of wildlife habitat.

Pennsylvania’s CREP program supports increased conservation practices that help protect streams, lakes, and rivers from sedimentation and agricultural runoff. By helping to restore the state’s water systems, the program helps protect national treasures, such as Pennsylvania’s portion of the Chesapeake Bay and the Ohio River Basin.



Streambank fencing and riparian buffer. Photo courtesy of PACD.

Like CRP, CREP contracts require a 10- to 15-year commitment to keep lands out of agricultural production. CREP provides payments to participants who offer eligible land. A federal annual rental rate is offered, plus cost-share of up to 100 percent of the eligible costs to install the practice: 50 percent from FSA and 50 percent from the PA Department of Environmental Protection (DEP). Further, the program generally offers a sign-up incentive for participants to install specific practices. FSA uses CRP funding to pay a percentage of the program's cost, and Pennsylvania provides the balance through Environmental Stewardship Act funds (Growing Greener I and II). State government and nonprofit groups involved in the effort provide technical support and other in-kind services.

In order to be eligible, lands must have been planted with an agricultural commodity during four out of the six years between 2002 and 2007, and must have been held by the landowner for the last 12 months. Highly erodable lands (HEL) eligible for enrollment meet the following criteria: all pasture, hayland, and cropland within 180 feet of a stream regardless of Erodibility Index (EI) value; all cropland within 1,000 feet of a stream with EI > 8 and < 12; all cropland further than 1,000 feet from a stream with an EI of greater than 12. The EI is determined by dividing potential erosion (from all sources except gully erosion) by the T value, which is the rate of soil erosion above which long term productivity may be adversely affected.

For the landowner, CREP is not only a cost-effective way to address environmental problems and meet regulatory requirements; it can provide a viable option to supplement farm income as well. CREP is convenient for farmers and other landowners because it is based on the familiar CRP model. Enrollment is on a continuous and voluntary basis, permitting farmers and other landowners to join the program at any time rather than waiting for specific sign-up periods.

The PA CREP program is currently active in the Chesapeake Bay and Ohio River Watersheds. In 2012, the PA CREP partners finalized a draft proposal to expand the program into the seven counties in the PA portion of the Delaware River Basin including (from north to south): Bucks, Delaware, Lehigh, Monroe, Montgomery, Northampton and Pike. The Delaware River Basin CREP will coordinate federal, state and local efforts to address various natural resource issues throughout the project area by seeking to retire 20,000 acres of marginal cropland, pastureland and/or environmentally sensitive land to include: 16,000 acres of HEL practices, 2,000 acres of riparian forest buffers, 1,500 acres of other buffer practices, and 500 acres of wetland restoration.

PA DEP and the state FSA office worked with a contractor to complete an environmental assessment in compliance with the National Environmental Policy Act for the enactment of the Delaware River Basin CREP. Pending approval at the national level, training and signups for the Delaware River Basin CREP will be announced in 2016.

Pennsylvania CREP Summary 2014-2015

Pennsylvania CREP projects are designed to target environmental concerns of the Chesapeake Bay and Ohio River drainages, and the neighboring upland habitat. The program is voluntary and offers financial incentives to entice agricultural landowners and operators to enroll targeted environmentally sensitive and potentially wildlife-friendly acres of pastureland and cropland. This includes the establishment of native grass stands, riparian buffers, wetlands, wildlife habitat, grass filter strips and other land improvement practices. Pennsylvania CREP has a maximum authorized enrollment of 259,746 acres across 59 counties and currently has 155,475.7 acres under contract for the benefit of soil, water and wildlife. CREP is a model for success in finding cooperative solutions to environmental challenges of today and has been met with overwhelming interest and support by the agricultural community.

CREP contracts expire September 30th every year. Re-enrollment remains low for a variety of reasons. The primary reason for low re-enrollment, across the nation and in Pennsylvania, continues to be high commodity crop prices. FSA and partner agencies offer resources and assistance to landowners to determine what maintenance may be needed to keep acreage in compliance with their current contract, as well as opportunities to meet the established thresholds for re-enrollment in the future, and the state continues efforts to reach out to landowners prior to their contract expiration dates.

Before and after photos of a stream project incorporating riparian buffer planting.
Courtesy of the Bradford County Conservation District

In 2015 the Pennsylvania Association if Conservation Districts (PACD) was awarded a Growing Greener Watershed Protection Grant from the PA DEP to create the CREP Outreach Program Office. The Outreach Office has four primary goals:

- Increase the total acreage in CREP through new enrollees.
- Retain acres currently in CREP by increasing re-enrollment.
- Provide support to partners to provide maintenance to insure that installed BMP's are functioning properly
- Promote CREP in the Delaware River Basin when it becomes approved for CREP.

To meet these goals PACD is increasing the public relations strategies used to promote CREP. PACD has directed an overhaul of the CREP PA website to make sure it is up to date and user friendly. A promotional video featuring two CREP participants sharing program benefits and experiences was produced and is available online. A resource library has been established allowing easy access to CREP related materials, including a new CREP brochure and banner stand. The office is also using other modern technologies and social media outlets to ensure that partners and CREP participants are aware of program issues.

Scheduled for the spring of 2016, PACD will host two "Open House" meetings. PACD, conservation districts, FSA and NRCS staff, Pheasants Forever, and other partners will present information and workshops for both existing and potential CREP participants. In addition, the program has awarded twenty mini-grants to conservation districts for CREP-focused training and outreach. Mini-grants have been approved for workshops, walk-abouts, one-on-one training on maintenance techniques, and other CREP topics.

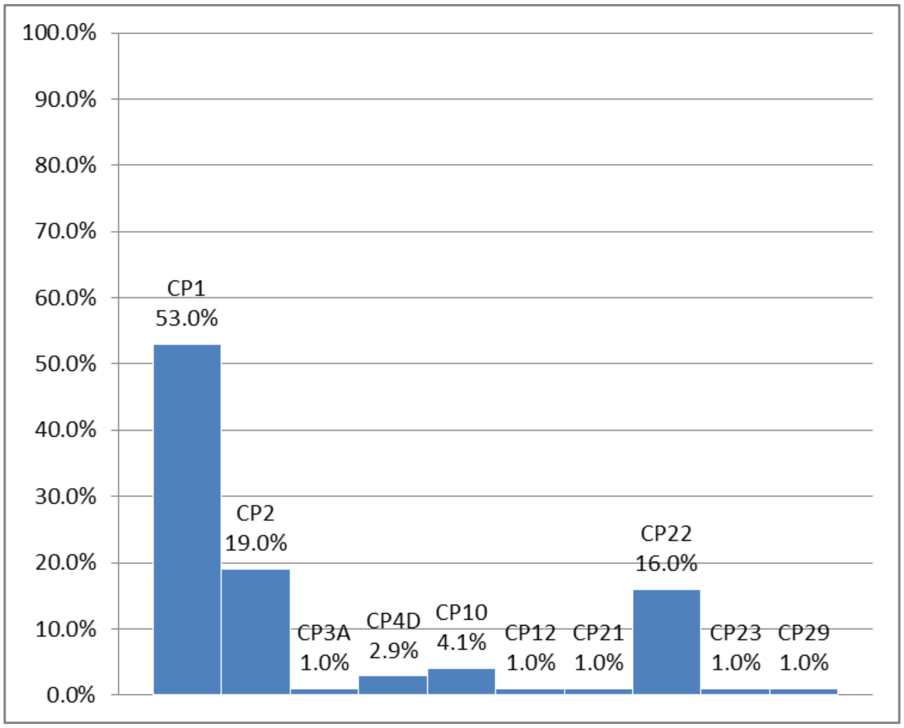
Summary of PA CREP Contracts by Practice, Acres, and Occurrences

As of the end of September 2015			
Practice	**Description**	**Acres**	**Practice Occurrences**
CP1	Introduced grasses and legume planting	76,682.4	4,583
CP2	Native grass planting	27,817.3	2,093
CP3	Tree planting	4.8	1
CP3A	Hardwood tree planting	843.4	15
CP4B	Wildlife habitat corridor	No Data	No Data
CP4D	Permanent wildlife habitat	4,214.8	355
CP8A	Grassed waterways	219.5	245
CP9	Shallow water areas for wildlife	33.2	15
CP10	Vegetative cover already established (grass)	6,466	281
C12	Wildlife food plots	1,055.5	475
CP15A	Contour grass buffer strips	47.8	25
CP21	Filter strips	1,018.9	361
CP22	Riparian forest buffers	23,555.7	4,313
CP23	Wetland restoration	943.8	95
CP29	Marginal pastureland wildlife habitat buffer	1,162.8	244
CP30	Marginal pastureland wetland buffer	434.7	71
CP31	Bottomland hardwood on wetlands	No Data	No Data
TOTALS		**144,500.6**	**13,172**

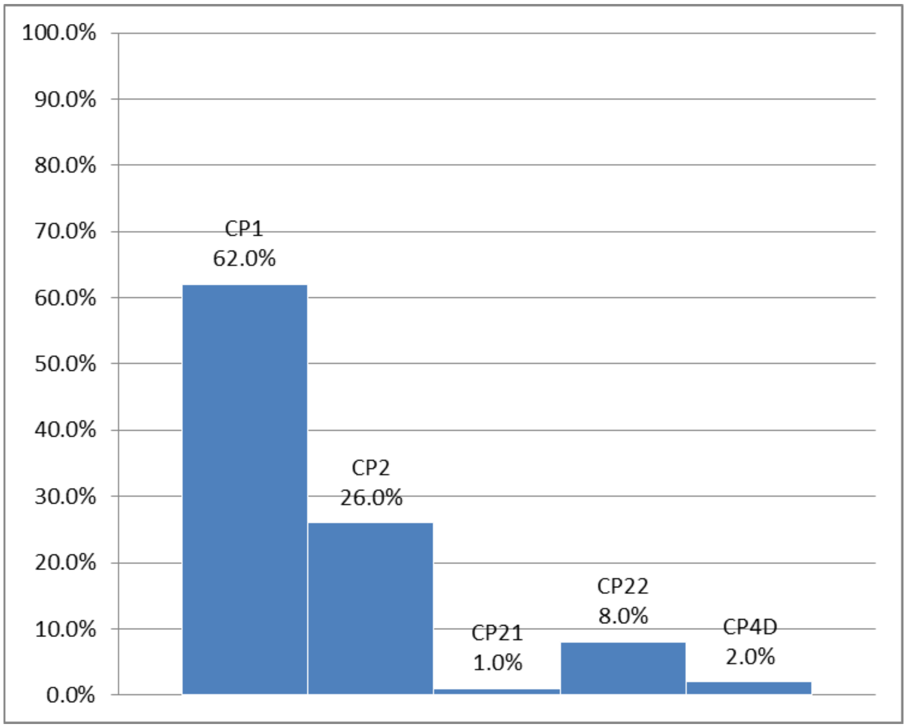
Chart modified from the USDA's FSA Summary of Active CREP Contracts by Program Year: CRP-Monthly Contracts Report. Oct. 30, 2015.

Practices as Percentage of Total Acres

1999-2015 *(CP3, CP4B, CP8A, CP9, CP15A, CP30, CP31 are less than 1% and not reportable.)*



2014-2015 *(CP3A, CP8A, CP12, CP30 are less than 1% and not reportable.)*



CP1:	Introduced grasses and legume planting
CP2:	Native grass planting
CP3:	Tree planting
CP3A	Hardwood tree planting
CP4B	Wildlife habitat corridor
CP4D	Permanent wildlife habitat
CP8A	Grassed waterways
CP9:	Shallow water areas for wildlife
CP10:	Vegetative cover already established (grass)
CP11:	Established trees
CP12:	Wildlife food plots
CP15A:	Contour grass buffer strips
CP21:	Filter strips
CP22:	Riparian forest buffers
CP23:	Wetland restoration
CP29:	Marginal pastureland wildlife habitat buffer
CP30	Marginal pastureland wetland buffer

Practices by Federal and State Maximum Cost Share Per Acre

CREP PRACTICE	SRR INCENTIVE	COST SHARE		INCENTIVES		
		FSA	PA	SIP	PIP	MISC
CP1 – Establishment of Cool Season Grass	(1)	50%	50% up to $40/acre (5)			
CP2 – Establishment of Native Grasses (Mixed Varieties)	(1)	50%	50% up to $120/acre (5)			PA Game Commission (3)
CP4D – Permanent Wildlife Habitat	(1)	50%	50% up to $160/acre (5)			
CP8A – Grassed Waterways	150%	50%	50% up to $1000/acre (5)	$100/acre	40% of Eligible Costs	
CP9 – Shallow Water Area for Wildlife	(1)	50%	N/A	N/A	40% of Eligible Costs	
CP12 – Wildlife Food Plot	(1)	N/A	N/A			
CP15A – Establishment of Permanent Vegetative Cover: Contour Strips	150%	50%	50% up to $65/acre (5)	N/A	40% of Eligible Costs	
CP21 – Filter Strips	150%	50%	50% up to $70/acre	$100/acre	40% of Eligible Costs	
CP22 – Riparian Buffer (Without Fencing)	150%	50%	50% up to $850/acre (2)	$100/acre	40% of Eligible Costs	
CP22 – Riparian Buffer (With Fencing)	150%	50%	50% up to $1250/acre (2)	$100/acre	40% of Eligible Costs	
CP23 – Wetland Restoration	150%	50%	50% up to $740/acre	$150/acre	40% of Eligible Costs	
CP29 – Wildlife Habitat Buffer (without fencing) (4)	150%	50%	None	$100/acre	40% of Eligible Costs	
CP29 – Wildlife Habitat Buffer (with fencing) (4)	150%	50%	50% up to $400/acre (2)	$100/acre	40% of Eligible Costs	
CP30 – Wetland Buffer (4)	150%	50%	None	$100/acre	40% of Eligible Costs	
CP33 – Habitat Buffer For Upland Birds	150%	50%	50% up to $65/acre (5)	$100/acre	40% of eligible costs	

Disclaimer: Practices outlined by federal and state maximum cost share per acre.

NOTES:

(1) SRR Incentive varies with the weighted EI for the eligible acres offered according to the following chart:

- $8 \leq EI \leq 12$ 75% Incentive
- $12 < EI \leq 20$ 150% Incentive
- $20 < EI \leq 25$ 175% Incentive
- $25 < EI \leq 30$ 200% Incentive
- $EI > 30$ 225% Incentive

(2) The State of Pennsylvania cost share reimbursement is only available on Riparian Buffers that are 50 feet or more in width. In the case of CP 29, no mowing will be done in the first 50’ from top of bank. The cost share will not be paid until the participant completes a PA Stream Buffer Tracking Form and submits it to the State FSA office.

(3) Incentive only available if land enrolled in CREP is also enrolled in the Pennsylvania Game Commission Farm Game or Safety Zone Program. Maximum payment to any one CREP participant is $2,999.99.

(4) Eligible only on Marginal Pastureland.

(5) Pennsylvania cost share will be provided to the limits indicated for this practice if any of the following apply:

a. The participant agrees to enroll all areas eligible along the riparian corridor on the enrolled tract in practice CP22 and/or CP29 at a minimum of 50 feet from bank.

b. The participant signs a maintenance agreement for post planting establishment on practice CP22 and/or

c. The participant has no water bodies on the offered tract but has water bodies on adjacent tract(s) and agrees to sign an agreement to maintain all existing and functioning forested buffers or enroll all eligible areas in CP 22 and/or 29 at a minimum width of 50 feet from bank on all tracts adjacent to the offered tract.

d. The participant has no water bodies on the offered tract or on adjacent tracts(s).

CREP Partner Resources and Activities

Cost-Share Arrangements

Pennsylvania Department of Environmental Protection (DEP): Since 2000, Pennsylvania has obligated $36,922,765 for direct cost share payments and administration of the payments through Growing Greener Grants to PACD.

For the current reporting period, Pennsylvania DEP has obligated $263,157 for direct cost share payments to farmers through a Growing Greener grant to the Pennsylvania Association of Conservation Districts, Inc. (PACD). Of this funding, $248,760 is dedicated to the Chesapeake Bay Basin and $14,397 to the Ohio River Basin.

Pennsylvania Game Commission (PGC): The PGC provided incentive payments to landowners to re-enroll in CREP totaling $233,935 in the federal fiscal year. These are in-kind costs, not non-federal match.

Easement Payments

Pennsylvania's CREP agreement does not require Pennsylvania to make easement payments. However, in 2006, DEP refocused state participation in CREP to encourage installation of edge of stream practices such as Riparian Forest Buffers (buffers). As part of this refocusing effort, the department requires landowners to install buffers through CP22 and protect any existing buffers through a Riparian Forest Buffer Protection Land Owner Assurance on their properties for the duration of the CREP contract (which is 15 years for the majority of participants). If landowners install and/or protect buffers on their streams or have no streams on their tract or adjoining tracts, they are eligible for state cost share on other conservation practices that are more than 180 feet from the stream. To date, 621 landowners have signed agreements with DEP to protect existing buffers. DEP's Watershed Support Staff (WSS) continue to inspect existing buffers and have completed inspections on 4527 acres of existing buffers to date.

Riparian Buffer (CP22) with fencing. Photo from PACD.

The purpose of the inspection is to ensure the buffers are being protected, determine their size and composition, and identify candidate buffers for permanent protection under conservation easement. With the exception of a very small percentage (less than 5% of the properties inspected), all were cooperating within the terms of the Riparian Buffer Protection Agreement. Those that were operating outside the agreement terms were referred to local field personnel who helped the property owners to address any outstanding issues.

In addition, the CREP Riparian Forest Buffer Protection Land Owner Assurance has helped DEP to expand permanent riparian easement opportunities by working with other state agencies and non-governmental organizations to target limited resources to high priority interests within the partnership. Partners in this effort include the PA Fish and Boat Commission, PA Department of Conservation and Natural Resources, Western PA Conservancy, Juniata Clean Water Partnership, and the Blair and Huntingdon County Conservation Districts. The partnership began with a pilot on the Frankstown Branch of the little Juniata which was very successful and is expanding into other areas, primarily looking at WIP and/or TMDL related planning. The Little Juniata River Pilot project anticipates 500 acres of forested buffers protected by the end of 2015.

In addition to the Little Juniata River Project, DEP has recently begun a new project in collaboration with the Western Pennsylvania Conservancy, which has yielded more than 1400 acres of riparian easements in just over a year. The main focus of this program is to work with landowners that have buffers installed with CREP funding who are at the end of their contracts and do not plan to re-enroll.

Technical Assistance

The Natural Resources Conservation Service (NRCS): Through an agreement with Pheasants Forever and with matching support from the Game Commission, NRCS funds seven Pheasants Forever biologists working on CREP in the Chesapeake Bay Watershed. There are also two Pennsylvania Game Commission biologists working on CREP, one in the Chesapeake Bay Watershed and one in the Ohio River Watershed. These biologists focus on all habitats, providing service to multi-county areas. These wildlife biologists, along with NRCS field staff and state office staff, assisted landowners with existing CREP contracts or with new conservation plans for new contracts. The Chesapeake Bay Foundation, with funding support from NRCS, continues to assist NRCS with riparian buffer CREP applications and contracts.

Re-enrollment options were available in the lower Chesapeake beginning in 2011. Technical assistance was provided in 2015 for farmfield eligibility and field visits to assess the existing wildlife habitat and/or the conversion of cropland to wildlife habitat. Practices included warm season grasses and wildflowers, cool season grasses and legumes, tree and shrub habitat, and riparian buffer habitat, just to name a few. NRCS staff, biologists, and partners also assisted new contract holders with implementation of conservation practices. Throughout 2015, NRCS staff conducted outreach to encourage landowners to sign up for wildlife practices and stream buffers while conserving the natural resources on their farm.

The Pennsylvania Game Commission (PGC): The PGC private lands section chief spent about 15 percent of his time on CREP administration, for a value of $13,500. In addition, regional PGC staff assisted with coordination and administration.

The Chesapeake Bay Foundation (CBF): CBF receives public and private grant funding, which is used to advance CREP riparian forest buffer establishment and maintenance in the Pennsylvania portion of the Chesapeake Bay Watershed. CBF employs six field staff who provide technical assistance to Pennsylvania landowners for forested buffer planning, establishment, and maintenance in 19 watershed counties. Each staff person is positioned in one of PA's CREP counties and also provides service to neighboring counties. The bulk of their work activities are related to riparian forested buffers, the majority of which are contracted through CREP. During FY15, CBF worked with over 300 watershed landowners. Staff also conducted public outreach on CREP forested buffers at several large agriculture focused trade and community events.


Before and after pictures of a stream crossing incorporating CP22 with fencing.
Photos courtesy of the Chesapeake Bay Foundation.

In recent years, CBF has worked to link the establishment of riparian forested buffers to the adoption of other important agricultural BMPs, testing the hypothesis that farmers are willing to forgo production on streamside land and plant forested buffers in exchange for additional financial assistance to pay for practices that improve production and efficiency elsewhere on the farm. Through its Buffer Bonus Program, CBF issues vouchers to producers who install riparian forested buffers, the value of which is based on buffer acreage. The vouchers can be used to pay out-of-pocket expenses associated with the installation of other farm BMPs such as barnyard improvement, waste management facilities, alternative water sources, nutrient management planning, cover cropping, reduced tillage, or fencing. To participate in the program, farmers must have or obtain a current conservation plan as required by state law, and must pledge to address all identified runoff concerns from animal concentration areas and any identified milkhouse waste issues. CBF currently offers the program in 13 Pennsylvania counties. In FY15, CBF obligated just over $200,000 in vouchers to 18 producers for whole-farm projects.

Other Technical Assistance: Several existing programs in Pennsylvania support the same program goals and objectives as PA CREP. These activities include the funding of 43 Chesapeake Bay Program technicians and six engineers in CREP counties; providing Growing Greener funds to hire watershed specialists in the 59 CREP counties to assist in the development of watershed plans; and Pennsylvania Department of Agriculture (PDA) and State Conservation Commission (SCC) funding for agriculture conservation technicians in 45 CREP counties. These technicians develop and assist in the implementation of resource management plans that can include nutrient management plans and conservation plans.

In-kind Services

Financial contributions for in-kind services took place throughout the reporting period. Examples include meeting with state representatives to discuss CREP, meetings throughout the CREP counties, advertisements in numerous local newspapers and newsletters, the distribution of brochures/literature at various events, the display of the CREP exhibit, and one-on-one interaction with farmers to promote the CREP Program.

In addition to PA CREP staff assignments made by the DEP, PACD, CBF and PGC, each of the CREP partners has provided additional in-kind support for the program. All of the PGC services for this reporting period are considered in-kind services, not non-federal match. PGC expended $375,603 on nine positions providing technical assistance to the CREP program in the federal fiscal year.

Monitoring and Evaluation

A subcommittee of the Statewide CREP committee was formed in 2004 to discuss monitoring and evaluation of CREP practices in PA. To complement DEP's ongoing evaluation of waterbodies, the CREP subcommittee decided to initiate a special long-term project for site specific water quality monitoring where water quality, stream habitat, and aquatic life (macroinvertebrates and fish) could be assessed for impact by CREP practices.

The subcommittee decided to look for areas that are expected to show significant (or at least easily detectable) positive change in response to riparian forest buffer establishment, streambank fending or other streamside improvement practices resulting from CREP. Other criterion for the site includes landowners who would welcome sampling efforts on their property for at least five years. DEP's Watershed Support Section (WSS) continues the project begun by the CREP subcommittee. See Appendix B for a detailed report on this project.

With regard to agency responsibilities for monitoring wildlife habitat benefits of CREP practices, the PA Game Commission (PGC), in cooperation with Penn State University, established "bird" routes to monitor all bird species and mammals (rabbits only) in the original 20 CREP counties in the lower Susquehanna.

Based on this study, PGC observed that CREP has resulted in an increase in the population of four species of wintering raptors, including the Northern Harrier. In addition, CREP has made the reintroduction of wild pheasants feasible in several locations in Pennsylvania. Populations in most areas have been steadily increasing. If CREP acres can be retained over time, they will become successful wild pheasant areas. The final report for this study, *Evaluating the Effects of CREP on Ring-necked Pheasants and Grassland Birds and Farmland Birds*, and the related article, *Association of Wintering Raptors with Conservation Reserve Enhancement Program Grasslands in Pennsylvania*," published in the 2010 Journal of Field Ornithology, can be obtained by contacting Mike Pruss of the PGC at mpruss@pa.gov.


Native warm season grass planting (CP2)

This report is a collaborative effort between the Pennsylvania Association of Conservation Districts, Inc. (PACD), the Pennsylvania Department of Environmental Protection, the USDA Farm Services Agency, the PA Fish and Boat Commission, the Pennsylvania Game Commission, the USDA Natural Resources Conservation Service, and the Chesapeake Bay Foundation. Questions may be submitted to PACD, who will direct inquiries to the appropriate agency.

The Pennsylvania Association of Conservation Districts, Inc. (PACD)
www.pacd.org – 717.238.7223 – pacd@pacd.org

Appendix A: PA CREP Partners and Resources

Partners

- Chesapeake Bay Foundation: www.cbf.org
- PA Association of Conservation Districts: wwwpacd.org
- PA Department of Environmental Protection: www.dep.pa.gov
- PA Game Commission: www.pgc.state.pa.us
- Pheasants Forever: www.pheasantsforever.org/
- USDA Farm Service Agency: www.fsa.usda.gov
- USDA Natural Resources Conservation Service (USDA NRCS): http://www.nrcs.usda.gov/wps/portal/nrcs/site/national/home/

Resources

- Pennsylvania's CREP website: www.creppa.org
- PA Department of Agriculture: www.agriculture.state.pa.us
- PA Department of Conservation and Natural Resources: www.dcnr.state.pa.us
- PA Ducks Unlimited: http://www.ducks.org/Pennsylvania/
- PA Farm Bureau: http://www.pfb.com
- PA Fish and Boat Commission: http://www.fish.state.pa.us
- PA State Conservation Commission: http://www.agriculture.pa.gov/Protect/StateConservationCommission
- Penn State Cooperative Extension: http://extension.psu.edu/
- Stroud Water Research Center: www.stroudcenter.org
- USDA NRCS Resource Conservation & Development (RC&D) Councils: http://parcd.org
- Western Pennsylvania Conservancy: http://www.paconserve.org/
- Wild Turkey Federation: http://www.nwtf.org/about/state/pennsylvania

Appendix B: Site-specific Water Quality Monitoring to Assess the Impact of Conservation Practice 22 and Other Best Management Practices

Pennsylvania has a wealth of surface water resources, with more than 86,000 miles of streams and rivers and 161,455 acres of lakes, ponds and reservoirs. These abundant water resources are protected by a variety of laws, regulations, policies, and on-the-ground best management practices (BMPs). A subset of these water resources is afforded "Special Protection" through regulatory programs because they are of the highest quality in terms of their chemical, physical, and biological health. There have also been enormous efforts and resources invested by the public and government at all levels across the commonwealth to restore and protect water resources.

According to the 2014 *Pennsylvania Integrated Water Quality Monitoring and Assessment Report (Integrated Report*), 16,882 miles of Pennsylvania streams are impaired. The two largest sources of pollutants are agriculture and abandoned mine drainage. The most frequently named pollutants are siltation and metals. Urban runoff and storm sewers are also a major source of pollutants in metropolitan areas (PA DEP 2014).

The DEP Watershed Support Section (WSS) has written a PA CREP Monitoring Study Design (Monitoring Design) and Quality Assurance Project Plan (QAPP) that provides guidance for site specific water quality monitoring to assess the impact of BMPs, including Conservation Practice 22 (CP 22) – Riparian Forest Buffers - on water quality in impaired streams.

The Monitoring Design and QAPP cover a suite of chemical, physical, and biological indicators including air temperature, water temperature, pH, conductivity, dissolved oxygen, nutrients, total suspended solids, benthic macroinvertebrates, and bacteria. A habitat assessment is performed on all sites and, on one site, 100 meters of stream reach were electro fished. Photo documentation is included in the protocol. The monitoring plan includes background monitoring prior to practice installation and annual follow-up monitoring after installation of the practices for as long as possible. The purpose of this Monitoring Design is to document and report measurable improvements in water quality in streams, rivers and lakes.

The table below provides summary information on the sites monitored to date by the WSS as part of the CREP impact project. Individual monitoring reports follow.

County	Landowner	Stream /Watershed Name	Start	End	Notes
Adams	King	Unnamed Tributary to Latimore Creek	2004	2017	Stream is showing improvement.
Bradford	Various	Milk Creek Watershed & Stephen Foster Lake	2006	2017	Streams and lake are showing improvement.
Centre	Walizer	Unnamed Tributary to Little Fishing Creek (known locally as Rock Run)	2006	2011	Stream chemistry improved.
Northumberland	Kaufman	Schwaben Creek (tributary to Shamokin Creek)	2012	2017	Stream is showing improvement.
York	McClelland	Pierceville Run	2006	2012	Stream restored and removed from List of Impaired Waters.

Unnamed Tributary to Latimore Creek

Introduction
A riparian forest buffer, along with other BMPs, have been installed on a dairy farm, owned and operated by Jeffrey King in Adams County. An unnamed tributary (UNT) to Latimore Creek runs through the King farm. The stream on the King Farm was accessible to cattle in the pasture area until stream bank fencing, and cattle crossings were put in place along the stream as part of the CREP project. Twelve acres of riparian forest buffer (CP 22) were planted in December 2005 on marginal pastureland on both sides of the stream. The average width of the buffer is approximately 130 feet and the length of the buffer, including both sides of the stream, is approximately 2,120 feet. By limiting cattle access to the stream, a natural herbaceous buffer also developed along the stream, further enhancing the riparian forest buffer area.

Additional BMPs were installed in the barnyard as a result of a comprehensive manure management plan in late 2012, which should result in additional water quality improvements in the UNT to Latimore Creek. The UNT to Latimore Creek is being evaluated for improvements in chemical and physical water quality indicators, biological indicators, habitat for aquatic organisms, and overall stream health that result from the establishment of CP22 and the other BMPs.

This report is based on field surveys and laboratory analyses conducted by the DEP's WSS and the PFBC with assistance from the SRBC. From 2004 through 2014 (with the exception of 2011 when no sampling occurred), assessments were completed on both a midstream monitoring site and a downstream site on King Farm. Assessments were also conducted for a reference tributary site on another unnamed tributary to Latimore Creek. Monitoring site locations were adjusted in 2009 and are described in detail within the stream and monitoring plan description in the next section of this report.

General Stream and Watershed Description
This 3.7 mile-long UNT to Latimore Creek is part of the Conewago River watershed, which drains into West Conewago Creek in the Susquehanna River Basin. The Latimore sub-watershed drains approximately 21 square miles, while the Conewago watershed covers an area of 515 square miles. The UNT enters Latimore Creek at stream mile 3.7. Its headwaters are located in Latimore Township, York County. Land use in this drainage is mostly agricultural with scattered, wooded slopes and riparian areas. The unnamed tributary ranges in elevation from 640 feet near its headwaters to 600 feet at its confluence with Latimore Creek. Latimore Creek's respective elevation ranges from 755 to 472 feet. The tributary is described as a shallow, low gradient (<2%), freestone pasture stream. The designated use of Latimore Creek listed in Chapter 93 of the Pennsylvania Code is Cold Water Fishes (CWF).

Three monitoring sites were originally used for this study. The midstream monitoring site is located on the UNT to Latimore Creek within both the King Farm property and the upper part of the CREP practice. The downstream monitoring site is also within the King Farm property, below a cattle crossing, within the lower part of the CREP area. The original reference site is on another UNT to Latimore Creek, which is located in an adjacent watershed with an existing riparian forest buffer.

Monitoring sites were chosen before the installation of CP22 in order to capture stream conditions without the stream bank fencing, cattle crossings, and riparian buffer. However, after reviewing three years of stream data, seeing impacts from cattle accessibility to the stream on cattle crossings, and discussing property boundaries with Mr. King, it was decided in 2009 to change the locations of the monitoring sites. The original downstream site, which was below the lower cattle crossing was moved further downstream to a location adjacent to Route 94 and upstream of the bridge. This location is at the lower end of the King property where the stream exits the CREP practice and King Farm and should give a better indication of overall impacts from the CREP practice without the influence of the cattle using the cattle crossing.

A new monitoring site was designated after looking at the area covered by the CREP practice and the property boundary discussion with Mr. King. The site is located further upstream along White Oak Road at the upper limit of the King property just above the start of the CREP practice. This upstream site will give data on stream conditions before entering the CREP practice. The new upstream location will also be used as the reference site because it characterizes stream conditions prior to impacts from the cattle and the pasture area as well as CREP practice impacts. The original reference site in the adjacent watershed has become unstable with areas of erosion and bank failure within the original monitoring site reach. A mid project monitoring project site was moved to an area just above the upper cattle crossing. This site characterizes stream conditions within the CREP practice including potential impacts from cattle, pastureland and the CREP practice.

It was decided in 2013 to concentrate on the upstream and downstream sites to get a better understanding of the stream condition entering (upstream site) the CREP practice and changes to the stream condition after passage through the CREP practice (downstream site).

Monitoring includes: habitat assessment (EPA Rapid Bioassessment Protocol method), macroinvertebrate screening (presence/absence/abundance screening to order/some family level), flow measurements (flow meter or float method), pictures, bacteria sampling (lab analyses for *E. coli, fecal coliforms* and *Enterococc*i) and water chemistry (field and lab analysis). After collecting data for an additional three years, a final report will be compiled in 2017.

Physical/Chemical Indicators

Methods: The protocols outlined in Monitoring Design and QAPP were used to monitor a core set of parameters including water temperature, pH, dissolved oxygen, conductivity and stream flow in the field. Water samples were collected for analysis at DEP's laboratory for a suite of parameters including: alkalinity, total nitrogen, total phosphorous and total suspended solids.

Results: Data are averaged over the 2004-2005 and 2006- 2013 sampling seasons as the practice was installed at the end of 2005. The first set of data represents conditions prior to application of the CREP practice and the second set of data represents post application conditions. See Tables 1-3 for results. Data for the mid project site show improving trends or stability at acceptable levels for alkalinity, nitrate, pH, and total Phosphorus. Data for the downstream site demonstrate improving trends or stability at acceptable levels for Alkalinity, Conductivity, Nitrate, and Total Phosphorus, pH and dissolved oxygen.

Table 1 – UNT to Latimore Creek-Averaged/Median Data Reference – Upstream Site

King Farm – Adams County	2004-2005	2006-2013	% Change	2014	2015	Goal	Interpretation/ Recommendation
Indicator	Average/ Median	Average/ Median					
*Alkalinity	57.6	57.5	-1%	76.3	78.4	> 20	Acceptable/ Maintain or Increase
Conductivity (µS/cm)	215.5	207.2	-4%	189	216	200	Acceptable/Maintain or Decrease
*Dissolved Oxygen	9.5	9.8	+3 %	8.39	11.13	9.0	Acceptable/Maintain
pH (pH units)	7.6 #	7.82 #	-	7.45	7.84	7.0	Acceptable/Maintain
*Total Nitrogen	0.7	0.85	+21%	0.9	0.83	<1.0	Acceptable/Maintain or Decrease
*Total Phosphorus	0.03	0.03	0	0.029	0.013	<0.03	Acceptable/Maintain or Decrease

** Units are mg/L*

Table 2 –UNT to Latimore Creek–Averaged/Median Data – Mid Project Site

King Farm –Adams County	2004-2005	2006-2012	% Change
Indicator	Average/ Median	Average/ Median	
*Alkalinity	86.2	91.3	+5%
Conductivity(µS/cm)	178	217	+21%
*Dissolved Oxygen	10.0	7.8	-23%
*Total Nitrogen	<0.01	<0.01	0
pH (pH units)	8.14 #	7.98 #	-
*Total Phosphorus	0.027	0.040	+48%

**Units are mg/L*

Table 3 –UNT to Latimore Creek–Averaged/Median Data – Downstream Site

King Farm –Adams County	2004-2005	2006-2013	% Change	2014	2015	Goal	Interpretation/ Recommendation
Indicator	Average/ Median	Average/ Median					
*Alkalinity	98.2	97.5	<1%	86.8	93.2	>20	Acceptable/ Maintain or Increase
Conductivity(µS/cm)	201.5	228.0	+13%	212	240	200	Acceptable/Maintain or Decrease
*Dissolved Oxygen	10.0	10.7	+6%	8.45	12.12	9.0	Acceptable/Maintain
*Total Nitrogen		0.92	-	0.98	0.94	<1.0	Acceptable/Maintain or Decrease
pH (pH units)	7.82#	7.7 #	-	6.83	8.28	7.0	Acceptable/Maintain
*Total Phosphorus	0.029	0.025	+13%	0.036	0.017	<0.03	Acceptable/Maintain or Decrease

**Units are mg/L*

Biological Indicators

A. Macroinvertebrates

Methods: Because the instantaneous nature of grab samples precludes more than a general comparison to applicable water quality criteria, the indigenous aquatic community can often serve as a better indicator of long-term conditions and is used as a measure of ecological significance. Macroinvertebrates were collected and assessed annually from 2004 through 2010, biennially in 2013 and annually in 2014 and 2105, using presence/absence/abundance observations from a streamside bioassessment protocol based on the Isaac Walton League's Save Our Streams survey. The protocol generates a water quality rating score based upon diversity and sensitivity to pollution with organisms identified to taxonomic order in most cases and taxonomic family in some cases. The water quality rating follows: Good = Total score > 40; Fair = Total score between 20 and 40; Poor = Total score <20. Sampling locations and changes to those locations are consistent with those for other parameters as described previously in this report.

Results: Water quality scores began a trend upward at the mid project and downstream sites in 2009 and 2010 possibly indicating that treatment from the growing riparian buffer was having a positive impact on the aquatic biological community. However, in 2013 sampling at these same sites resulted in very low water quality scores. The cause for this is unknown at this time. 2014 results showed improvement. Results in 2015 showed a decrease in water quality again. Sampling will be conducted in both spring and fall in 2106 to observe seasonal differences. See Table 4 for the individual scores.

Table 4: Water Quality Rating Scores Based on Macroinvertebrate Sampling

King Farm – Adams County	Water Quality Rating Scores										
Site	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**Spring 2013**	**Fall 2013**	**2014**	**2015**
Reference/Upstream	41.9	18.1	20.8	28.0	21.7	39.7	28.0	18.4	8.6	21.0	14.2
Mid Project	31.8	20.0	28.3	40.9	37.7	48.2	44.0	-	-	-	-
Downstream	22.3	35.9	28.0	15.6	21.0	27.1	41.6	14.0	16.7	32.6	16.7

B. Fish

Methods: Fish populations were assessed annually in September at both the CREP monitoring site within the King Farm and the reference tributary site 2004-08. A portable backpack electrofishing unit was used to conduct the fish assessments within approximately 100 meters of stream reach at each of the sampling sites. All fish were collected from three electrofishing passes at each site and held in separate live bags. Fish were subsequently identified to species, counted, and released back into the waterway. Fish population estimates were calculated by using the removal method between electrofishing passes.

Results: The results of our sampling effort can be found on Tables 4 and 5. At the reference site, a total of 13 different fish species were observed during the five year study period (Table 5). The fish species composition was dominated by blacknose dace, longnose dace, creek chub, white sucker and central stoneroller. Fish population estimates (N) ranged from 588 in 2005 to 1028 in 2007 (Table 4). Overall, it was judged that the fish populations at the reference site fluctuated but were similar during the 2004-08 sampling period.

At the CREP application site within the King Farm, a total of 18 different fish species were observed during the five-year study period (Table 5). The fish species composition was dominated by blacknose dace, longnose dace, creek chub, white sucker, central stoneroller, tessellated darter, banded killifish and bluntnose minnow. There were six additional fish species observed during the 2006-08 sampling period, which is indicative of improved habitat conditions as a result of the riparian corridor treatment associated with the CREP project. Fish population estimates ranged from 1,288 in 2006 to 2,556 in 2005 (Table 6).

Both the stream width and fish population estimates generally declined subsequent to the riparian corridor improvement project at the King Farm. The narrowing of the stream channel is a common result once livestock are precluded from entering the waterway and the stream banks are given the time to re-vegetate and adjust themselves to address the natural morphology of the respective affected stream system.

There are several explanations for the decline in fish numbers. First, the open and shallow habitat conditions prior to the stream bank fencing project supported large numbers of juvenile fish representing approximately eight different fish species. As the steam channel narrowed, deepened, and the fish habitat improved with the addition of overhead cover, it was observed that the percentage of adult fish representing these eight species increased while the percentage of the juvenile fish decreased. It should also be noted that the six additional fish species that were observed post-treatment (Table 6) probably replaced habitat space previously dominated by the common fish species at this sampling site.

If similar fish studies are planned to assess riparian corridor improvement projects, it is recommended to collectively weigh the fish captured from each of the electrofishing passes in order to calculate biomass estimates. Fish biomass estimates would be an additional data result that may help explain any biological changes between pre and post project conditions.

Table 5 – Fish population estimates from one sampling station on an unnamed tributary stream (Reference Site) to Latimore Run, Adams County, September 2004-2008

	Sampling Date				
Species	**2004**	**2005**	**2006**	**2007**	**2008**
Blacknose dace	520	311	517	594	620
Longnose dace	39	50	45	29	36
Creek chub	174	180	162	104	201
White sucker	59	24	82	139	17
Central stoneroller	7	17	140	127	103
Blue spotted sunfish	1	-	-	-	1
Bluegill	-	1	21	20	19
Northern hogsucker	-	2	1	-	-
Cutlips minnow	-	1	-	-	-
Common shiner	-	1	-	-	-
Tessellated darter	1	1	2	14	6
Brown trout	-	-	-	1	-
Bluntnose minnow	-	-	-	-	4
Total Fish Pop. Estimate (N)	801	588	970	1028	1007

Sampling Site Length (m)	113	105	100	100	100
Sampling Site Width (m)	4.29	3.36	4.03	2.69	2.87
Sampling Site Area (ha)	0.049	0.035	0.040	0.027	0.029

Table 6 – Fish population estimates from one sampling station on an unnamed tributary stream (CREP Site/King Farm) to Latimore Run, Adams County, September 2004-08

	Sampling Date				
Species	**2004**	**2005**	**2006**	**2007**	**2008**
Blacknose dace	1430	1544	690	784	311
Longnose dace	27	124	35	8	1
Creek chub	255	263	170	242	170
White sucker	103	48	50	42	31
Central stoneroller	160	238	137	251	171
Tessellated darter	127	81	33	41	16
Bluegill	5	-	8	-	31
Northern hogsucker	1	14	-	-	4
Cutlips minnow	-	5	6	7	9
Banded killifish	149	126	103	327	216
Margined madtom	1	-	-	-	-
Bluntnose minnow	116	113	49	141	255
Pumpkinseed sunfish	-	-	6	-	-
Greenside darter	-	-	1	-	2
Brown bullhead	-	-	-	1	-
Green sunfish	-	-	-	5	7
Spotfin shiner	-	-	-	-	33
Common shiner	-	-	-	-	76
Total Fish Pop. Estimate (N)	2374	2556	1288	1849	1333

Sampling Site Length (m)	100	107	100	100	100
Sampling Site Width (m)	2.92	2.27	2.27	1.73	1.83
Sampling Site Area (ha)	0.029	0.024	0.023	0.017	0.018

C. Bacteria

Methods: Water samples were collected for analysis at DEP's laboratory for a suite of indicators including: *Fecal coliforms, Enterococci,* and *E. coli*.

Results: See Tables 7-9 for results. *Fecal coliform, E. coli,* and *enterococci* bacteria are used as indicators of a stream contamination because they are commonly found in the feces of humans and other animals. They can be good indicators of the effectiveness of livestock exclusion and riparian enhancement efforts, as livestock (and their feces) are restricted in their ability to gain direct access to the stream. Although *fecal coliforms* are generally not particularly harmful to the health of most organisms themselves, they indicate the possible presence of pathogenic bacteria, viruses and protozoa that could also live in human and animal digestive systems. Therefore, the presence of fecal-related bacteria in a stream suggests that pathogenic microorganisms are potentially present as well, and that water contact recreation such as swimming, or use for livestock watering could pose a health risk. In other words, fecal bacteria are useful for indicating that there is a corresponding potential for disease causing agents to be in the water.

DEP has used *fecal coliform* bacteria as its indicator for many years, while the United States Environmental Protection Agency (EPA) EPA recommends using *E. coli* as an indicator of health risk from water contact. *E. coli* is a species of *fecal coliform* bacteria that occurs in the gastro-intestinal tract of warm-blooded animals. It occurs in high densities in warm-blooded animal (and human) feces and has been used as an indicator of fecal contamination for many years. It does not grow in natural environments under ordinary circumstances. There is a close correlation between high *E. coli* counts and the incidence of gastroenteritis (digestive tract illness) at swimming areas. Most strains of *E. coli* are not disease causing bacteria, but their presence signals the possible presence of viruses and other pathogens. Lastly, some entities see *enterococci* as another useful form of indicator bacteria.

For contact such as swimming, the standards are such that these numbers should not be exceeded: *Fecal coliform* Standards for human recreational contact are set that a single sample is not to exceed 400CFU (Colony Forming Units) per 100ml. *E. coli* Standards are set that a single sample is not to exceed 406CFU per 100ml. There is no official set DEP or US EPA standard for *Enterococci***.** An accepted target of <35 is sometimes employed by some other states and private entities, and academic interests for *enterococci* as an indicator of disease and stream health continues. In laymen's terms, it is the case that for all three indicator bacterial forms, the lower the number the better.

The first set of data represents conditions prior to the application of the CREP practice and the other sets represent post application conditions. The bacterial numbers for the reference/upstream site indicate that there is a bacterial problem even before the stream reaches the King Farm. The mid project and downstream sites indicate that there is additional contamination entering the stream from the cattle on the King farm. The manure management plan that is being implemented currently on the King Farm should address this problem and affect future monitoring results.

Table 7 – Reference / Upstream Site

Indicators	2006- 2010 Average	2012-2013 Average	2014	2015	Goal	Interpretation/ Recommendation
Fecal coliforms*	2768	1603	770	490	400	Unacceptable/Decrease
Enterococci*	160	587	600	-	<35	Unacceptable/Decrease
E. coli*	2876	2772	320	540	406	Unacceptable/Decrease

** Colony forming units per 100 ml*

Table 8 –Mid Project Site

Indicators	2004-2005 Average	2006-2010 Average	2012
Fecal coliforms*	650	2132	690
Enterococci*	340	674	610
E. coli*	650	2148	1700

** Colony forming units per 100 ml*

Table 9 - Downstream Site

Indicators	2004-2005 Average	2006-2010 Average	2012 – 2013 Average	2014	2015	Goal	Interpretation/ Recommendation
Fecal coliforms*	1800	5939	5330	3000	530	400	Unacceptable/Decrease
Enterococci*	520	2282	2015	420	-	<35	Unacceptable/Decrease
E. coli*	1700	4672	7050	3000	650	406	Unacceptable/Decrease

** Colony forming units per 100 ml*

Habitat Assessment

Method: Habitat assessments, like biological samplings, were conducted at all three sites using the EPA's "Rapid Bioassessment Protocol for Use in Streams and Wadeable Rivers – Second Edition." The evaluator scores the stream, streambanks and riparian vegetative zone for a variety of 10 parameters that are integral to the protection and enhancement of habitat for aquatic species of macroinvertebrates and fish. Each parameter receives between 0 and 20 for a total possible score of 200. Table 9 below shows the total scores for each site. The mid project and downstream sites show improvement in habitat due to the impact of the growing riparian forest buffer.

Table 10: Habitat Assessment Scores

King Farm – Adams County	Total Habitat Assessment Scores											
Site	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2012**	**Spring 2013**	**Fall 2013**	**2014**	**2015**
Reference/Upstream	125	125	133	132	140	154	147	142	144	130	145	159
Mid Project	112	112	154	160	161	152	149	160	-	-	-	
Downstream	92	92	151	144	120	135	134	151	155	144	144	156

Summary and Recommendations

Over the course of 11 years of monitoring the UNT to Latimore, data for the downstream site show improving trends or stability at acceptable levels for alkalinity, conductivity, nitrate and total phosphorus. These are all indications that the riparian forest buffer is positively impacting the receiving stream.

Water quality scores based on the macroinvertebrate community began a trend upward at the mid project and downstream sites in 2009 and 2010, indicating that treatment from the growing riparian buffer may be having a positive impact on the aquatic biological community. However the results in 2013 through 2015 indicate a problem that is affecting the biological community. The aquatic biological community will be surveyed in both spring and fall in 2016 to address seasonal variation.

The bacterial numbers for the reference/upstream site indicate that there is a bacterial problem even before the stream reaches the King Farm. The mid project and downstream sites indicate that there is additional bacterial contamination entering the stream on the King farm. The manure management plan that is being implemented currently on the King Farm should address this problem and affect future monitoring results.

The mid project and downstream sites show improvement in habitat due to the impact of the growing riparian forest buffer.

Fish population estimates generally declined subsequent to the riparian corridor improvement project at the King Farm through 2008. No additional fish sampling was conducted after 2008. The narrowing of the stream channel is a common result once livestock are precluded from entering the waterway and the stream banks are given the time to re-vegetate and adjust themselves to address the natural morphology of the respective affected stream system.

There are several explanations for the decline in fish numbers. First, the open and shallow habitat conditions prior to the stream bank fencing project supported large numbers of juvenile fish representing approximately eight different fish species. As the steam channel narrowed, deepened, and the fish habitat improved with the addition of overhead cover, it was observed that the percentage of adult fish representing these eight species increased while the percentage of the juvenile fish decreased. It should also be noted that the six additional fish species that were observed post-treatment (Table 6) probably replaced habitat space previously dominated by the common fish species at this sampling site.

If similar fish studies are planned to assess riparian corridor improvement projects, it is recommended to collectively weigh the fish captured from each of the electrofishing passes in order to calculate biomass estimates. Fish biomass estimates would be an additional data result that may help explain any biological changes between pre and post project conditions.

Overall, water quality is showing improvement that is attributed to the exclusion of cattle from the stream and the establishment of a riparian forest buffer on both sides of the stream. Due to recent improvements within the study area (a comprehensive manure management plan on the King Farm) further positive impacts to the stream are expected. This study will continue for two more years.

Upstream monitoring site in existing riparian forest area above CREP practice on King Farm. Photo courtesy of DEP.

Downstream monitoring site at lower end of CREP practice on King Farm. Photo courtesy of DEP.

Unnamed Tributary to Little Fishing Creek (Locally Known as Rock Run)

Rock Run is the local name for an officially unnamed tributary to Little Fishing Creek. The entire tributary is in Walker Township, Centre County and it is listed in Chapter 93 of the Pennsylvania Code with a designated use of High Quality Cold Water Fishes (HQ-CWF). As a result of the 2005 CREP project put in place at the Walizer Tree Farm, the stream has been evaluated yearly for improvements in water quality, habitat for macroinvertebrate organisms, bacteria load and overall stream health. The Vonada Farm, just upstream of the Walizer Farm, also entered into a similar stream protection effort in 2007. This updated report is based on data collected by field surveys conducted by DEP from 2006 through 2011.

This CREP project encompasses an area of about 2.41 acres, wherein a riparian buffer zone consisting of grass and mostly natural woody shrub vegetation has been established. Grass in the riparian area near the Walizer barn, and later on the Vonada Farm, was re-established mostly naturally, by excluding cattle from the zone. The newly established riparian zone is minimally 35 feet in width on both sides of the stream and is estimated to be 1,500 feet in length. The segment of stream within the project totals approximately 1,700 feet in length, and is typically about 3 to 12 feet in width. The 200-foot reach near the mouth remains wooded with mature trees on the right side of the stream, facing upstream. A sampling site in the wooded area upstream of all agriculture is not part of the CREP project but is monitored as a reference to the project. This area was virtually undisturbed until late in 2009 when many of the hemlock trees nearby were cut down and sold for lumber. The owner was concerned about damage from the woolly adelgid and feared a substantial financial loss if the trees were to die from the infestation.

The photos above show the extent of the lumbering activity in the headwaters area of Rock Run. Both photos courtesy of DEP's WSS.

Since 2009, the Vonada barnyard area has been improved by establishing a limited access stream crossing site and grass plantings. The Vonada riparian area has been improved by establishing tree plantings in the riparian area and cattle exclusion from it. Each farm has installed an improved access to the water and stream crossing areas for the herds.

In-Stream Habitat

In-stream habitat was assessed from 2006 through 2011 using the EPA Habitat Assessment parameters. As hoped, and despite logging activity, there was no significant change in total score for habitat at the headwaters site which served as a reference site. There was a 9% improvement in the final overall habitat score at the Vonada Farm site (going from 149/200 to 163/200) and a 5% improvement in the final overall habitat score at the Walizer Farm site (going from 132/200 to 138/200). Increased (worsening) embeddedness and sediment deposits near the mouth were observed near the end of the study in 2011. This actually lowered the final habitat score at the mouth by about 10% in 2011 when compared to earlier scores. The reason for the additional sediment is uncertain but it is possible that logging in the headwaters or project work that occurred upstream disturbed loose soil which was deposited near the mouth of the stream.

Macroinvertebrate Collections

Macroinvertebrate collections were analyzed using five metrics: Taxa Richness, Modified EPT Index, Modified Hilsenhoff Biotic Index, Percent Dominant Taxa, and Percent Modified Mayflies. Over time, some improvement in the number of sensitive taxa at the site on the Vonada farm and the site behind the barn on the Walizer Farm occurred. Near the mouth of Rock Run the effects of sediment remain, and macroinvertebrate scores have not improved. Even with some improvements, when compared to the headwaters reference site, no downstream site is close to the 80% comparability that would indicate an unimpaired condition. The table below shows the macroinvertebrate scores and comparability of the monitored sites.

Table: Macroinvertebrate Metrics and Scores

	Stations			
Metric	**1-Mouth**	**2-Walizer**	**3- Vonada**	**4-Head/Ref**
1. Taxa Richness	24	20	12	19
Biol. Cond. Score	8	8	2	8
2. Modified EPT Index	10	9	3	13
Biol. Cond. Score	7	5	0	8
3. Modified HBI	4.46	4.74	5.16	1.95
Biol. Cond. Score	0	0	0	8
4. % Dominant Taxa	23	44	69	56
Biol. Cond. Score	8	8	6	8
5. % Modified Mayflies	21	18	10	72
Biol. Cond. Score	0	0	0	8
Total Biological Condition Score	23	21	8	40
% Comparability to Reference	58	53	20	

Water Chemistry Improvements

Over the course of five years of monitoring Rock Run, data shows significant improvements in ammonia, nitrate and phosphorus. Overall, the bacteria counts have dropped significantly as have suspended solids. In the final analysis of this CREP project, water quality is showing improvement that is attributed to the exclusion of cattle from the stream and the establishment of riparian grasses on both the Walizer and Vonada Farms. Due to two recent changes within the study area (logging and septage application) some effects on the stream could occur. Any future studies on Rock Run should find the data acquired in this study very useful for comparative purposes.

Mill Creek Watershed & Stephen Foster Lake

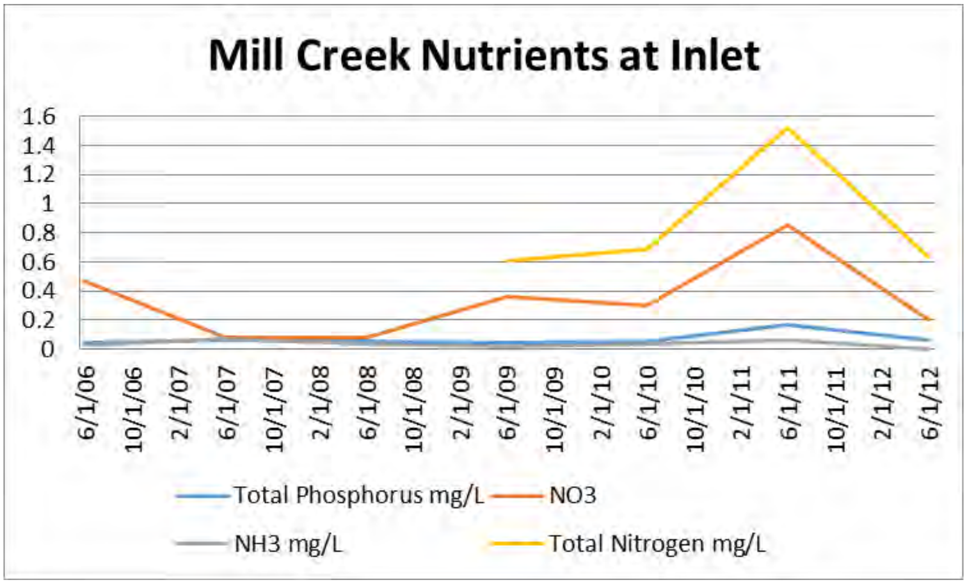
Stephen Foster is located in Mount Pisgah State Park in Bradford County west of Towanda. Mill Creek was dammed in 1977 to form the 78-acre lake. The watershed covers about 11 square miles of mostly agricultural lands (58%.) The park hosts approximately 150,000 annual visitors for the lake's recreational opportunities, including boating and an exceptional bass and panfish fishery.

Stephen Foster Lake was plagued with algal blooms and sedimentation just a few years after its impoundment in 1977. After a Clean Lakes Phase 1 Study was completed in 1995, identifying the source and extent of the pollution problems, the lake was placed on the State's List of Impaired Waters, and a TMDL document was completed in 2001. The watershed assessment indicated agricultural and streambank Best Management Practices (BMPs) were needed to improve water quality and to reduce pollutant loads.

During the next 10 to 12 years of watershed improvements, stakeholders in the Mill Creek Watershed had installed a wide variety of agricultural Best Management Practices (BMPs) as well as 6,290 feet of stream channel restoration projects. Agricultural BMPs included animal waste control, barnyard runoff management systems and exclusion fencing. More recently, since 2003, riparian buffer plantings under CREP were implemented on 20 sites (892 acres) amounting to 6.8 miles of stream buffered. As a result of these projects, sediment reductions are estimated at 1,325 tons annually, which corresponds to annual Nitrogen and Phosphorus reductions of 3,315 lbs and 1,325 lbs, respectively. Overall, more than $1.5 million restoration funds were garnered from both state and federal sources including Growing Greener, EPA's 319 Program, Environmental Quality Incentive Program (EQIP), CREP, PA Act 6 and the Chesapeake Bay Program along with matching funds from landowners.

Planted riparian buffer (CP22)on a farm in Mill Creek Watershed. Photo courtesy of DEP's WSS.

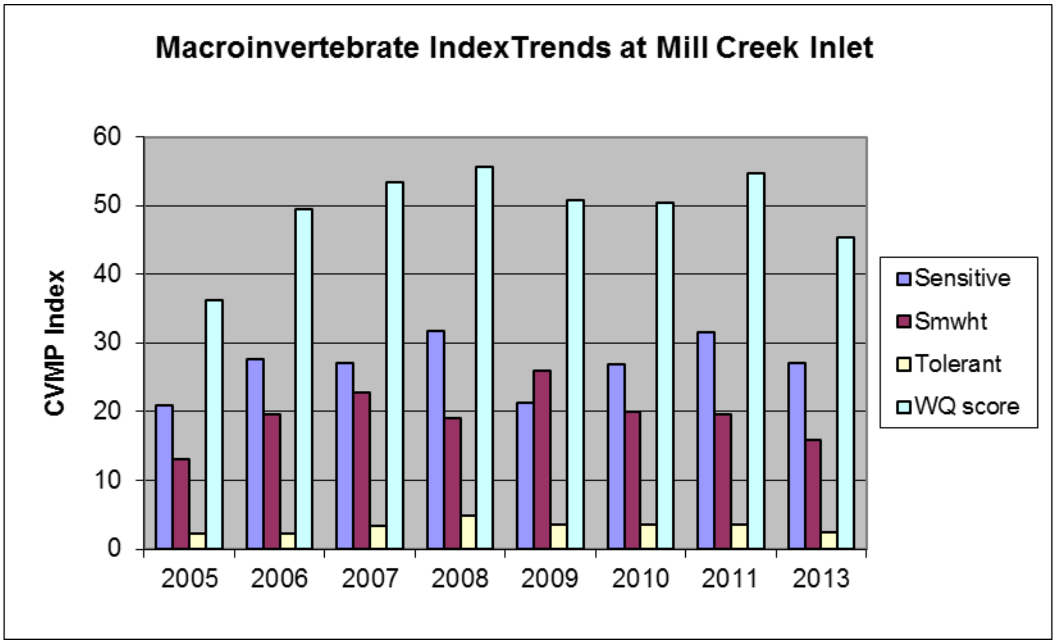
Efforts of the stakeholders have resulted in improved water quality conditions in Stephen Foster Lake as well as in Mill Creek. A significant reduction of phosphorus loading to the lake was detected by ongoing sampling of the watershed. A 2010 report completed by Princeton Hydro indicates that the total growing season phosphorus load has been reduced from a 1994-95 average of approximately 3,750 lbs. to a 2005-09 average of approximately 450 lbs.



Biological improvements are also notable at most of the monitored stations. Sensitive types of macroinvertebrates have increased at the lower end of Mill Creek where it flows into the lake (see bar chart below). The water quality rating follows: Good = Total score > 40; Fair = Total score between 20 and 40; Poor = Total score <20.

Monitoring during the past five years have indicated that the indices have fluctuated but there has been improvement in the total water quality score which was below 40 in 2005 and reached 50 and above in subsequent years.

(Left) *Launching the artificial wetland island in forebay of Stephen Forest Lake.* ***(Right)*** *Replanted artificial wetland island in forebay of Stephen Forest Lake. Both photos courtesy of DEP's WSS.*



Since the successful implementation and observed water quality improvements in Mill Creek, in-lake BMPs were targeted to address the in-lake conditions. In 2011, two 15 ft. x 12 ft. artificial wetland islands were placed in the forebay to establish more wetland area for nutrient uptake in the area. The islands are a relatively new and innovative technology, and only a few have been installed statewide. Initial plantings were impacted by waterfowl but were replanted before winter set in. The consultant, Princeton Hydro, is monitoring nutrient uptake by established islands in another lake so that reductions may be applied to these islands in the future.

Also implemented in the spring of 2011 was an extensive buffered alum treatment in an effort to control internal nutrient loads from the lake sediments. Poly-aluminum chloride was used to combine with and lock up phosphorus in the water column and in the upper layers of lake sediments, with the net result of reducing available in-lake phosphorus, limiting algae blooms.

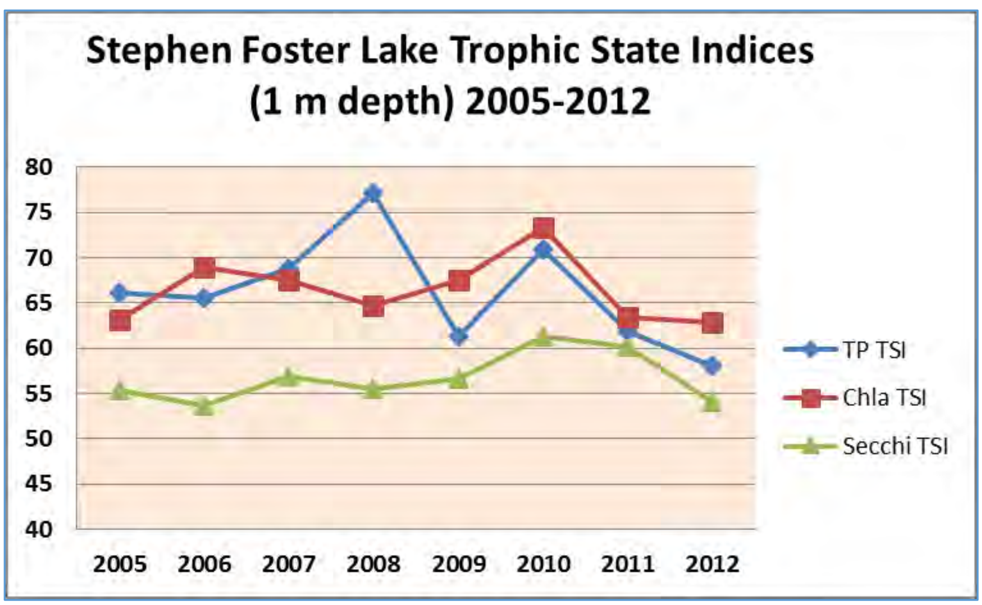
Applying alum treatment on Stephen Forest Lake.
Photo courtesy of DEP's WSS.

Lake water quality samples were collected over the 2011 and 2012 growing season to determine efficacy of the alum treatment. Unfortunately the second half of May 2011 was extremely wet in northcentral PA. Rainfall was recorded every day from the 15th to the 31st of May 2011, and some storms were strong. Much sediment in the form of total suspended solids came into the lake from the watershed. Lake monitoring in June and August showed that high pHs in surface waters and low dissolved oxygen below 3m depth were pervasive in the lower lake. However four parameters showed improvements over pre-alum conditions (previous years): surface and bottom water total phosphorus (TP), Secchi depth, and chlorophyll-a levels.

Post alum in-lake surface TP concentrations were from 33% to 46% lower than previous TP concentrations. Summer bottom water TP concentrations were from 14% to 64% lower than pre-treatment. Secchi depth values generally improved (i.e. showed greater clarity) in 2011 and 2012 data compared to earlier years (see chart). Chlorophyll-a concentrations were 42% lower during the first half of the season, and were lower than nuisance conditions observed in the past, particularly in 2010.

Inter-annual Trophic State Index (TSI) data were compared with historical data, to elucidate biological activity of the lake on a relative basis. The index was calculated on TP, Secchi, and chlorophyll-a values. TSI's greater than 50 indicate high productivity (eutrophic conditions) while values greater than 65 represent hypereutrophic conditions, typically associated with nuisance conditions such as algal scums and impaired aesthetics.

The 2012 TSIs were the lowest on each parameter since 2005. Based on TP TSI values, the lake shifted from hypereutrophic in the mid-1990's to eutrophic conditions since 2005. After alum treatment, the seasonal average TP TSI was trending downward at 62 (2011) and 58 (2012). Secchi TSIs were lowest in 2012 at 53. Chlorophyll-a results also recorded the lowest TSI since 2005. The lake will continue to be sampled through 2017to document efficacy and improvements.



Pierceville Run

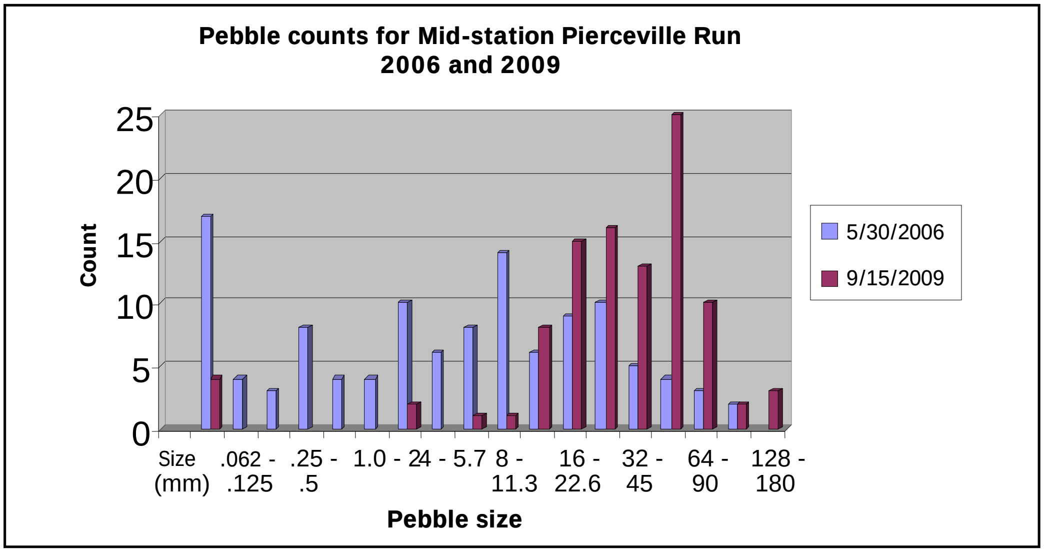
Pierceville Run flows 2.67 miles through hilly farmland in southern York County in State Water Plan Subbasin 7H (Lower Susquehanna River). It joins Centerville Run, which then flows into the South Branch Codorus Creek just north of Centerville, PA. Land use in this 6.7-square-mile-area of York County is a mix of crop fields and pasture along with forested patches. There are no urban areas in this subwatershed. The stream was assessed as "high priority" for restoration during a full South Branch watershed assessment project sponsored by the Izaak Walton League's Chapter 67 (IWLA) under a 319 Non-Point Source grant in 1999. Streambank erosion in Pierceville Run was significant with 3 to 4 foot vertical banks eroding up to 1.5 feet/year.

Heavily vegetated stream bank as result of CREP practice in Mill Creek Watershed. Photo courtesy of DEP's WSS.

Two stations on the reach were also assessed for habitat and macroinvertebrate conditions by DEP in 1999, resulting in the 2002 Impaired Aquatic Life Use listing on the Integrated Report due to agriculture, leading to "siltation and flow alterations" (i.e. unstable stream banks resulting in extensive stream migration). A TMDL for the entire South Branch watershed was approved by EPA in 2003. The TMDL addressed excessive nutrients, siltation, and suspended solids as impairments to the stream. Pierceville Run impacts were singled out as 'Allocation 4' for targeted reductions as follows: Phosphorus reductions needed for farmland and streambanks, 2,387 lbs./year (or 73% reduction); sediment reductions for farmland and streambanks, 1.54M lbs./year (42%).

The Izaak Walton League of America (IWLA) secured a 319/Growing Greener Grant in 2003 to design and restore 2,271 linear feet of Pierceville Run using natural stream channel design. Implemented in 2006, the project improved flow regimes and aquatic habitat by grading and stabilizing streambanks using numerous in-stream rock structures, and by installing an extensive riparian buffer including grasses, forbs and 600 trees under the PA CREP managed by the York County Conservation District. After project completion, the estimated sediment savings for this reach was reported at 700 tons/year (2272 ft. x .308T/linear ft. average erosion rate in project area) in the final report (July 2006). This amounts to 9% of the TMDL sediment load reduction needed for the entire South Branch Codorus Creek watershed.

DEP's WSS staff has been monitoring this project for macroinvertebrates, habitat and pebble counts since the spring of 2006. Water chemistry was added in 2007. Staff developed and used stream restoration protocols that track trends of change over time. The riparian area is no longer used for grazing and has become more stable. Besides visual observations and photo documentation that indicate greatly improved habitat, data is documenting improvements in pebble counts: the trend is towards larger gravel and cobbles, which provides increased living space for macroinvertebrates. Just before construction (May 2006), the mid-station substrates were 34% sand-silt, 62% pebbles and 4% cobbles. By September 2009, the percentages were 4%, 81% and 15% respectively.



In 2011, the two stations on the reach were reassessed for habitat and macroinvertebrate conditions. The results show improvements sufficient to remove the stream from the impaired list of waters. This stream was delisted in the 2012 Integrated Waters Report. This indicates a major success for CREP and the other grant programs that facilitated this stream and habitat improvement. An American Bittern was observed in the CREP buffer on Pierceville Run during the stream re-assessment (see photo below).

American Bittern in CREP buffer on Pierceville Run. Photo courtesy of DEP's WSS.

Schwaben Creek (North Branch) Kauffman Farm CREP

The North Branch Schwaben Creek is a small tributary to Schwaben Creek, which in turn flows into Mahanoy Creek, and it flows to the Susquehanna River. Most of the length of Schwaben Creek parallels State Route 3010, running from east to west through the agricultural valley near the village of Rebuck in Northumberland County. The North Branch Schwaben Creek joins Schwaben Creek and is approximately one mile southeast of the Kauffman Farm CREP project. The entire Schwaben Creek basin is listed in Chapter 93 of the Pennsylvania Code with a designated use of Trout Stocking (fishery) and Migratory Fishes (TSF-MF). Schwaben Creek is also listed by the DEP as impaired due to sediment.

The Kauffman Farm is a small family operated farm that works the land for crops and maintains a slight flock of assorted fowl, but it is primarily oriented toward raising a small herd of pastured beef cattle. Prior to 2004 the cattle had unrestricted access to North Branch Schwaben Creek. In response to the need for better stream protection, a CREP stream riparian buffer project was put in place in 2004 on the property. The original Kauffman Farm riparian buffer project totaled a length of about 1,600 feet of buffer on North Branch Schwaben Creek, but in addition to this, there are two small unnamed tributaries on the farm which are also part of the managed stream buffer, adding an additional 2,000 feet of length, bringing the farms buffered stream length to approximately 3,600 feet. The newly established riparian zone is minimally 35 feet in width on both sides of the creek. While not part of this project, the next farm upstream (The Jim Fesner Farm, an operation similar to the Kauffman Farm) is also maintaining a stream riparian buffer of approximately 1,700 feet to the upstream point where Kulp Road (T391) crosses the North Branch Schwaben Creek. Upstream of this point, the stream enters a small woodlot, becomes very small, low flow (possibly intermittent) headwaters.

For our present CREP monitoring effort, the stream is being evaluated yearly at several points on the Kauffman Farm for improvements in water chemistry, stream temperature, bacteria load, and instream habitat for macroinvertebrate organisms, as well as riparian quality, and overall stream health. A headwater site in the previously mentioned woodlot will be monitored as a reference or control site. The first data for the present CREP monitoring effort was collected in July 2012 and evaluation of that data is now completed and reported here. Monitoring (and yearly updates) will continue for a total of 5 years and a final report will be offered in 2017.

Over the summer of 2012 the Kauffman Farm was visited multiple times for three primary reasons: 1) To collect water samples for testing for bacteria and water chemistry; 2) To measure stream flow; and 3) To deploy long-term water temperature data loggers. A fourth reason of much internal interest was to assess the riparian conditions by utilizing a new method called the Systematic Riparian Assessment method as drafted by DEP's WSS. We are determining the utility of the method.

Bacteria

Fecal coliform, E. coli, and *enterococci* bacteria are used as indicators of a stream contamination because they are commonly found in human and animal's feces. They can be good indicators of the effectiveness of livestock exclusion and riparian enhancement efforts, as livestock (and their feces) are restricted in their ability to gain direct access to the stream. Although *fecal coliforms* are generally not particularly harmful to the health of most organisms themselves, they indicate the possible presence of pathogenic bacteria, viruses and protozoa that could also live in human and animal digestive systems. Therefore, the presence of fecal-related bacteria in a stream suggests that pathogenic microorganisms are potentially present as well, and that water contact recreation such as swimming, or use for livestock watering could pose a health risk. In other words, fecal bacteria are useful for indicating that there is a corresponding potential for disease causing agents to be in the water.

DEP has used *fecal coliform* bacteria as its indicator for many years, while the EPA and the Health Department recommends using *E. coli* as an indicator of health risk from water contact. *E. coli* is a species of *fecal coliform* bacteria that occurs in the gastro-intestinal tract of warm-blooded animals. It occurs in high densities in warm-blooded animal (and human) feces and has been used as an indicator of fecal contamination for many years. It does not grow in natural environments under ordinary circumstances. There is a close correlation between high *E. coli* counts and the incidence of gastroenteritis (digestive tract illness) at swimming areas. Most strains of *E. coli* are not disease causing bacteria, but their presence signals the possible presence of viruses and other pathogens. Lastly, some entities see *enterococci* as another useful form of indicator bacteria.

For contact such as swimming, the standards are such that these numbers should not be exceeded: *Fecal coliform* Standards for human recreational contact are set that a single sample is not to exceed 400CFU (Colony Forming Units) per 100ml, or have a 5-sample geometric mean exceeding 200CFU per 100ml, where the samples are collected at least a day apart within a 15-30-day period. *E. coli* Standards are set that a single sample is not to exceed 406CFU per 100ml, or have a 5-sample geometric mean exceeding 126CFU per 100ml, where the samples are collected at least a day apart within a 15-30-day period. There is no official set PA or EPA standard for *Enterococci.* An accepted target of <35 is sometimes employed by some other states and private entities, and academic interests for *enterococci* as an indicator of disease and stream health continues. In laymen’s terms, it is the case that for all three indicator bacterial forms, the lower the number, the better.

Sampling for *fecal coliform* bacteria and *E. coli* was done five times at each site. For a more thorough evaluation each site was also sampled twice for *enterococci*. Sampling for *fecal coliform* and *E. coli* was done on a schedule that would meet the frequency requirements for determining a geometric mean. Geometric means were calculated for all sites. This is useful in determining if there are sites with chronically high levels of bacteria. All of the results are depicted in Table 1. Sites Kk1 and Kk2 are not meeting any of the bacteria count goals. Bacteria counts show that the small tributary (Kk2) is conveying the highest concentration of fecal bacteria. This small run is in close proximity to a barnyard which has potential to be a leading source of the feces. Initially, in order to indicate an improvement, the goal for bacteria on the farm is to have a lower geometric mean at sites Kk1 and Kk2, and to maintain the already good numbers present at site Kk5. The next step after achieving site specific improvements will be for the water leaving the property at site Kk1 to be carrying no more bacteria than the water entering the farm at site Kk3. The ultimate goal, of course is to meet Water Quality Standards criteria, wherever standards exist. The same is true for all other water chemistry factors and indicators of stream and watershed health.

TABLE 1. BACTERIA ANALYSIS RESULTS and flow measurement
F.Col = Fecal Coliforms, e.coli = Escherichia coli, Ent = Enterococci
All samples collected July & August 2012

Site >	Kk1 F.Col.	Kk1 e.coli	Kk1 Ent	Kk2 F.Col.	Kk2 e.coli	Kk2 Ent	Kk3 F.Col.	Kk3 e.coli	Kk3 Ent	Kk4 F.Col.	Kk4 e.coli	Kk4 Ent	Kk5 F.Col.	Kk5 e.coli	Kk5 Ent
	540	630		800	840		60	60		10	55				
	1000	920		890	1200		60	100					40	20	
	430	620	2400	4100	2300	2400	70	80	2400	80	20	390	10	60	100
	6000	6000	2400	6000	6000	2400	230	330	1600	280	410	2000	170	230	1100
	360	450		630	490		340	200		660	710		30	90	
										360	340		10	10	
GEO. MEAN >	871	994	2400	1616	1468	2400	115	126	1960	140	161	883	29	48	332

Kk1= the downstream site where the stream exits the Kauffman Property @ N 40.72492, W -076.69593
Kk2= trib1 near pond on Kauffman Farm @ N 40.72579, W -076.69569
Kk3=upstream of Kauffman boundary (at Jim Fesner Farm lane, where stream enters the Kauffman Farm property @ N 40.72909, W -076.68646
Kk4=(control site) upstream of project in woodlot upstream of Kulp Road (T391) crossing.@ N 40.72579, W -076.69217
Kk5=trib2 @ upper Kauffman Farm @ N 40.72777, W -076.69321

Site > Date >	Kk1 26 July 2012	Kk2 26 July 2012	Kk3 26 July 2012	Kk4 27 July 2012	Kk5 27 July 2012
FLOW>	101 Gallons Per Minute	6 GPM	75 GPM	13 GPM	20 GPM

Flows

In general the North Branch Schwaben Creek is a low-flow stream, especially in the summer months. Anecdotally, it is not known to dry up and become intermittent at the Kauffman Farm (Kk1), but has been known to become intermittent at site Kk4 in times of drought. Flows are measured primarily for the purpose of quantifying any pollutants for which calculating loading would be of interest. Flow is also of importance to maintaining aquatic life. To the farmers, it is critical for livestock watering.

Water Chemistry

The parameters of most interest in this project are those that are associated with agricultural practices or directly related to or indicative of the problems associated with the North Branch Schwaben Creek. They are all listed in Table 2, along with the results of the analysis, the interpretation of each result, and the goal and aim for each over the next several years. The parameters that are of greatest concern are highlighted in Table 2. Many other parameters (mostly metals) were tested at site Kk1. All of the metals tested for are within normal range and meeting standards in the cases where standards exist. Therefore the metals will not be reported on other than to say that metals are not problematic and are meeting standards. Periodic monitoring for them will continue and any anomalies that might occur would then be reported upon.

TABLE 2. WATER CHEMISTRY ANALYSIS RESULTS, INTERPRETATION, AND GOALS			
Site -> Kk1 Date -> 07/26/2012			
Description	**Results**	**Interpretation**	**GOAL (Aim)**
CHLORIDE	3.8 MG/L	acceptable	Maintain (<1500 MG/L)
T ORG CARBON	1.54 MG/L	acceptable	Maintain/monitor
Hardness T	35 MG/L	Naturally low; acceptable	Maintain or increase
BOD5 INHIB	0.80 MG/L	acceptable	Maintain/monitor
SETT SOLIDS	<0.2 ML/L	acceptable	Maintain/monitor
ALKALINITY	23.6 MG/L	Naturally low; marginally acceptable	Maintain or increase (>20 MG/L)
NITROGEN TOT	2.11 MG/L	Prefer lower	Decrease (0.9 MG/L)
T SUSP SOLID	<5 MG/L	acceptable	Maintain (<10 MG/L)
RESIDUE TOT	82 MG/L	acceptable	Maintain (<1000 MG/L)
TURBIDITY	2.62 NTU	acceptable	Maintain or decrease
PHOSPHORUS T	0.039 MG/L	Prefer lower	Decrease(<0.02 MG/L)
NITRITE-N	<.01 MG/L	acceptable	Maintain
Nitrate-N	1.92 MG/L	Prefer lower	Decrease (0.60mg/L)
AMMONIA-N T	0.02 MG/L	Prefer lower	Decrease (<0.2 MG/L)
MAGNESIUM T	3.295 MG/L	acceptable	Maintain (<5.0 MG/L)
MANGANESE T	29.0 UG/L	acceptable	Maintain (<1000 ug/L)
CALCIUM T	8.583 MG/L	Naturally low; Prefer higher	Maintain or increase

Note: In the above table, the highlighted sections are those parameters of greatest concern as outlined in the paragraph above.

Due to the local geologic materials, hardness is naturally low. Associated in the same way, alkalinity, and calcium are also naturally low, but at marginally acceptable levels. It would be desirable to maintain or increase these amounts; however, apart from introducing limestone to the stream or surrounding watershed there is no practical way to do that. At the present levels of alkalinity, the stream does have some buffering capacity against acids and the present levels are not compromising the health of the stream.

The other group of parameters of high interest is the nutrients, which are depicted in Table 2 as Nitrogen Total, Nitrite-N, Nitrate-N, Ammonia-N T and Phosphorus Total. None of these parameters are alarmingly high; however, both the Nitrogen Total and Phosphorus Total are elevated above average or natural levels that are typically observed across the state and we would prefer to see lower levels. The goal in all cases regarding the nutrient parameters is to keep them as low as possible, and especially not to have them elevated by application of animal manure in or near the stream, and to avoid using excess chemical fertilizers. As the riparian zones become more mature and more time passes with cattle having limited access to the stream we should see the hoped for decrease in nutrients. Future monitoring and reporting in subsequent years will update conditions in bacteria and water chemistry, flow, long-term water temperature data, and include an assessment of the riparian conditions as determined by utilizing the Systematic Riparian Assessment method now being refined by DEP’s WSS.

2014 Update

The riparian plantings on both the Kauffman Farm and the Jim Fesner Farm, which is the next property upstream, are maturing nicely (see Photo 1). The red line in Photo 1 shows the approximate boundary between the two cooperative farms. The blue lines represent the location of the water. The blue line on the Kauffman Farm is a very small but permanently flowing unnamed tributary to Schwaben Creek. The blue line extending onto the Fesner Farm is the mainstem of Schwaben Creek. At this point the creek is approaching its origin and is very narrow (averaging <2' wide) with low, but permanent flows (approx. 75 GPM). A HOBO water temperature datalogger is in place in the stream near the point depicted as the intersection of the red and blue line.

Photo 1—*Schwaben Creek; Kauffman Farm/Fesner Farm boundary.*
Photo courtesy of DEP.

The HOBO temperature datalogger has been continually recording stream temperature since August 2, 2012, taking and recording the water temperature every 51 minutes. The datalogger is deployed at the upstream boundary of the Kauffman Farm property. The site is shown in Photo 2 below. Photo 3, also below, captures the datalogger as it's about to be connected to the HOBO Base Station coupler. The data is then downloaded and stored on the weatherproof computer as shown. Data was last downloaded from the datalogger on Oct. 29, 2014.

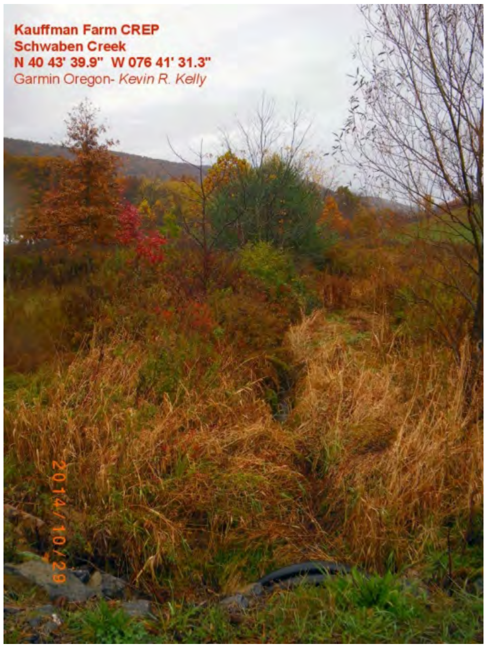


Photo 2: Upstream Kauffman Farm (Site KK3). Photo courtesy of DEP

Photo 3: Temperature Datalogger (Site KK3). Photo courtesy of DEP.

One purpose for stream temperature monitoring is to determine if uses (for example, cold-water fishery) are supported. For this study another principal purpose for long-term continual monitoring of water temperatures is to determine spatiotemporal temperature effects. The premise is that cooler stream temperatures might be attributable to the growth of an enhanced riparian zone throughout the reach. Long-term (5-year) comparisons between upstream and downstream temperatures should provide support to this premise as should comparisons to air temperature and other weather-related records.

Maximum temperatures (in °F) regulated under Chapters 92a, 96 and other sources where temperature limits are necessary to protect designated and existing uses are shown in *Table 3 - Maximum Temperature Targets*. Ideally, to support a cold-water-fishery (CWF) the temperature should not exceed the temperatures depicted in the first temperature column in Table 3. Likewise, the second and third temperature columns depict maximum temperatures for warm-water-fisheries (WWF) and trout-stocked-fisheries (TSF) respectively.

TABLE 3 – Maximum Temperature Targets			
PERIOD	**TEMP CWF**	**TEMP WWF**	**TEMP TSF**
July 1-31	66	87	74
August 1-15	66	87	80
August 16-30	66	87	87
September 1-15	64	84	84
September 16-30	60	78	78

Temperatures at the site monitored on Schwaben Creek (Photo 2) always met the WWF and TSF temperature targets shown in (Table 3.) Throughout the entire monitoring period to date, there were only three days in July and August where temperatures exceeded the 66°F CWF criterion. However, there were 21 times in the past three years (2012, 2013, 2014) that the CWF temperature criteria for September were not met by as much as 3°F. It is yet to be determined whether improved riparian areas will be enough to affect a 3°F lowering of the streams temperature that would be required to meet the September CWF targets. Speculation suggests that this might not be achievable due to the very low flows and diminutive width of the stream in this headwater area, and the fact that fair quality buffers are already in place. But data shows fewer exceedances are occurring as the vegetation matures, so it is possible that some addition cooling affect from maturing trees might occur.

The 40 highest temperatures recorded are shown in *Table 4 - Top 40 Temperatures*. The warmest temperature recorded between Aug. 1, 2012 and Oct. 29, 2014 occurred on Sept. 11, 2013, when the stream reached 67.97°F. Only five of the top 40 warmest daily high temperatures occurred in 2014, while 15 occurred in 2013, and even though temperature data collections didn't begin until well into the summer of 2012, 20 of the top 40 temperatures occurred in 2012. The trend shows progressively fewer exceedances with each successive year of monitoring so far. While much more analysis of the temperature data needs to be done, this could indicate that the growth of trees and other vegetation in the riparian area is helping to moderate peak temperatures, possibly through increased shading allowing for less direct sunlight hitting the water. A complete 5-year set of temperature data will be available in 2017.

Table 4 – Top 40 Temperatures Between Aug. 1, 2012 and Oct. 29, 2014
Shaded temperatures exceed the CWF criterion for the date

Rank	Date	Temperature F	Rank	Date	Temperature F
1	September 11, 2013	67.971	**21**	August 11, 2012	64.888
2	July 14, 2014	66.258	**22**	July 8, 2014	64.888
3	July 19, 2013	66.087	**23**	August 2, 2012	64.845
4	August 28, 2012	65.959	**24**	August 27, 2012	64.845
5	September 6, 2014	65.959	**25**	July 22, 2013	64.803
6	August 9, 2012	65.788	**26**	July 23, 2013	64.717
7	July 18, 2013	65.745	**27**	October 6, 2013	64.503
8	June 10, 2013	65.701	**28**	August 1, 2012	64.459
9	August 6, 2012	65.658	**29**	August 7, 2012	64.459
10	July 20, 2013	65.615	**30**	July 6, 2013	64.332
11	September 7, 2012	65.53	**31**	July 14, 2013	64.288
12	August 5, 2012	65.444	**32**	August 26, 2012	64.247
13	August 4, 2012	65.359	**33**	August 31, 2012	64.247
14	July 16, 2013	65.316	**34**	August 3, 2012	64.204
15	September 5, 2012	65.273	**35**	August 16, 2012	64.204
16	August 8, 2012	65.188	**36**	September 12, 2013	64.204
17	July 17, 2013	65.145	**37**	September 1, 2012	64.161
18	July 13, 2014	65.145	**38**	July 7, 2013	64.117
19	July 15, 2013	65.059	**39**	August 12, 2012	63.99
20	September 6, 2012	64.931	**40**	September 2, 2014	63.946

Systematic Riparian Assessment

The Systematic Riparian Assessment method was drafted by PADEP Bureau of Conservation and Restoration. A greatly improved method of assessing riparian zones over the simple width measurement and limited visual assessments that are traditionally conducted, the assessment is more intensive and qualitative. In this method, there is the option to measure up to 17 different factors according to their applicability. Conditions evaluated by this group of factors are assessed for each stream reach being investigated. For project-specific reasons the number of factors and the length of the reach assessed can be adjusted to meet the needs of the specific undertaking. The Systematic Riparian Assessment was first done at the Kauffman Farm in July 2012, after the riparian zone had already been established for approximately two years. At the Kauffman Farm, we examined 10 different parameters as listed in *Table 5- Systematic Riparian Assessment.* Each factor [or parameter] is assessed independently and scored on a 0-20 point scale. The total score can be addressed as an OVERALL Rating (Total Score divided by possible score). The ratings are: EXCELLENT = >79% GOOD = 79 - 59% FAIR = 58 – 35%, and POOR = <35%. These overall ratings are useful for general discussion, but as is always the case, individual scores are more important as they show where the strongest and weakest aspects of the riparian conditions are occurring; therefore, where the improvements and need for improvements are greatest.

Table 5 – Systematic Riparian Assessment (Assessment date - 31 July 2012)

PARAMETER	**SCORE**
1. Slope And Average Width Of Established Buffer Zone In Reach	15
2. Livestock And/or Manure Within The Riparian Zone	18
3. Bare Earth Within The Width Of Buffer Zone	17
4. Number And Size Of Trees	4
5. Diversity Of Ground Cover Living And Dead Inside Of A Riparian 'Plot'	8
6. Wild Animal / Insect Damage To Plants	13
7. Perc Rate 20' Inland From The Bankful Mark	8
8. Earthworm Abundance	0
9. Nearest Distance To Where Permanent And Regular Human Activities Occur Affecting Natural Permeability Of The Surface Area	18
10. Riparian Habitat Senses Quality	14
Total Score	115
Possible Score	200
% Overall Rating (Total Score divided by possible score):	58%
Rating : (E / G / F / P)	FAIR+

EXCELLENT	>79%
GOOD	59 – 79%
FAIR	35 – 58%
POOR	<35%

The Systematic Riparian Assessment will be conducted again in 2015 in order to make comparisons and contrasts to the conditions measured in 2012 as shown in Table 5. A determination will then be made as to whether the zone has continued to improve, and if so, by how much. Casual observations made in October 2014 suggest that improvements to the riparian zone are continuing to progress nicely. The vegetation is growing well and is dense up to the streams edge. Additionally, cattle crossing areas have been improved and are working as designed and helping to reduce the impact of steers crossing the stream to use the adjacent pasture land.

The next scheduled visit to collect data will occur during the summer of 2015 when additional riparian assessments will be made, and new water chemistry and bacteria data will be collected for comparisons to the 2012 data. Conclusions from all collected data will be made available in the final report scheduled for 2017. Presently it appears as though the Kauffman Farm CREP project is proceeding well and should be considered a success as far as having improved vegetation in the riparian area as well as livestock restrictions. It is likely that these improvements are contributing to improved water chemistry and biological integrity and, if so, these improvements should be detectable in the 2015 study.

2015 Update

A temperature datalogger was put in place at the downstream border of the Kauffman Farm. The temperature datalogger at the upstream border of the Kauffman Farm continues to collect data as intended, and now with the addition of the information gathered with new continuous datalogger we will be able to compare upstream and downstream data and hopefully be able to better determine the influences of runoff, base flow, riparian shading, and weather on the streams water temperature. Two cattle crossings, one on the Kauffman Farm and in the other in the headwaters have both been concreted across the streambed and these improvements will reduce the bank erosion in both areas. The improved culvert (new larger pipes installed in 2014) carrying water under the Feeser Farm lane has noticeably improved the erosion problem that was occurring there due to the smaller, old pipes having created a plunge pool.

Due to limitations on travel and expenditures lab analysis of water sample was not done this year. The next scheduled visit to collect data will occur during the summer of 2016 when additional riparian assessments will be made, and new water chemistry and bacteria data will be collected for comparisons to the previous data. Conclusions from all collected data will be made available in the final report scheduled for 2017. Presently it appears as though the Kauffman Farm CREP project is proceeding well and should be considered a success as far as having improved vegetation in the riparian area as well as livestock restrictions, improvements to the cattle crossing areas, and improvements to the culvert at the upstream border of the Kauffman Farm. It is likely that these improvements are contributing to improved water chemistry and biological integrity and, if so, these improvements should be detectable in the 2016 study.