V(A). Planned Program (Summary)

Program # 4

1. Name of the Planned Program

Natural Resources and Environment

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
101	Appraisal of Soil Resources	10%		7%	
102	Soil, Plant, Water, Nutrient Relationships	15%		18%	
104	Protect Soil from Harmful Effects of Natural Elements	8%		1%	
112	Watershed Protection and Management	10%		17%	
121	Management of Range Resources	5%		0%	
122	Management and Control of Forest and Range Fires	8%		2%	
123	Management and Sustainability of Forest Resources	15%		17%	
124	Urban Forestry	10%		3%	
135	Aquatic and Terrestrial Wildlife	3%		10%	
136	Conservation of Biological Diversity	4%		9%	
141	Air Resource Protection and Management	5%		2%	
403	Waste Disposal, Recycling, and Reuse	5%		6%	
511	New and Improved Non-Food Products and Processes	2%		8%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	20.8	0.0	59.9	0.0
Actual	28.1	0.0	30.5	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
930134	0	496584	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
2678766	0	3648421	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
1256020	0	2968160	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Collectively, research and extension seeks to restore, improve, and sustain the health and well-being of water, land, air, flora, and fauna for the essential use by and enjoyment of present and future generations. CES natural resource programs integrate research with innovations in outreach to address the state's major pollution generating or natural resource threatening activities including agricultural and industrial production, energy exploration and production, and urbanization. Growing pressures from land conversion activities within the Marcellus shale region of the state exacerbate the need for meeting the needs of rural audiences who are positioned to make the land use decisions and trade-offs within this natural gas production region along with balancing demands with the needs to protect the layers of natural resources lying above the Marcellus shale including ground- and surface water, and forests supporting vast, and biologically diverse wildlife. CES natural resources programs focus on addressing critical knowledge gaps. With a focus on pollution prevention and adaptive management by communicating research informed management choices, participants in natural resource programs collectively move the State towards it's desired outcome of healthy waters, lands, forests, and wildlife In many cases, natural resource extension targets the individual for whom choices relative to protecting one's private water supply, forest lands, residential on-lot wastewater system, household level storm water runoff, water and energy demands, intrinsic ecosystems such as vulnerable headwater streams, riparian buffers, and privately held green infrastructure, is made at the household, farm, or forest landowner level. Educating and supporting the decision maker at the level for which the decision maker holds a unique sphere of influence is essential to ensuring sound and scientifically guided stewardship of natural resources. Penn State Forest Resources researchers have identified that nearly 70% of Pennsylvania's forests are privately owned, managed by independent decision makers and their trusted agents. Likewise, individual landowners manage the lands from which the state's majority of headwater streams emanate, critical sources of the state's water for drinking water supplies, sustaining critical baseline flows for aquatic habitat, as well as serving as the source of water that provides outstanding recreation and aesthetic value for Pennsylvanians.

2. Brief description of the target audience

Decision makers at multiple levels and scales comprise the target audiences for natural resource extension programs, ranging from individuals who manage farms, private forestlands, and households to organizations and institutions that manage natural resources or influence their management such as businesses and industry, municipalities, commercial agriculture and forestry, county, regional, state and federal agencies, non-governmental organizations including woodlot and watershed associations, civic groups, and the professionals who serve each of these scales in support of individual and institutional decision making related to natural resources. Geographically, critical audiences exist in all reaches of the

state. In rural Pennsylvania, citizens and municipalities within the Marcellus shale region seek clarity on water and land protection in light of the rapid change to the landscape that natural gas exploration has imposed. Other rural areas of the state are confronted with heightened scrutiny and enforcement related to the management of nonpoint source from various landscapes (agricultural and non-agricultural). Likewise, suburban and urban audiences seek improved mechanisms for defining, protecting, and adopting essential green infrastructure for the purposes of stormwater management. These audiences have unique and varied, but meaningful spheres of influence in respect to managing and stewarding natural resources that can benefit their property, family, community, and region.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	33100	89100	0	0
Actual	20199	569189	5864	200

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2010
Plan: 1
Actual: 2

Patents listed

Serial No.: 61/250,989; Filed: 10/13/09; Title: Composites Containing Polypeptides Attached to Polysaccharides and Molecules

Serial No.: 61/349,506; Filed: 5/28/10; Title: Composites Containing Polypeptides Attached to Polysaccharides and Molecules

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Plan	0	0	
Actual	0	0	290

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of invention disclosures

Year	Target	Actual
2010	1	1

Output #2

Output Measure

- Number of people enrolled or registered in programs related to natural resources and environment

Year	Target	Actual
2010	23700	30135

Output #3

Output Measure

- Number of research projects completed

Year	Target	Actual
2010	{No Data Entered}	9

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of participants who were evaluated and demonstrated increased knowledge and skills related to natural resources and environment
2	Number of participants who were evaluated in a follow up and who implement/adopt practices related to natural resources and environment
3	Number of volunteers that helped with program leadership and program delivery

Outcome #1

1. Outcome Measures

Number of participants who were evaluated and demonstrated increased knowledge and skills related to natural resources and environment

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	3100	6821

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Nonpoint source runoff from industrial operations (mining, impervious surfaces), ag- and forestlands, homes and yards, roads, and commercial and municipal properties has impaired local surface- and ground water quality, exacerbated stormwater volume and energy, and collectively diminished the quality of significant ecosystems (e.g. Chesapeake Bay and lower Mississippi River-Gulf of Mexico). Human health (drinking water quality) and environmental health (aquatic life, biodiversity) are compromised by nonpoint source pollution with significant social, economic, and environmental costs to Pennsylvanians and their communities.

What has been done
Targeting the household, farm and forest owner level and the practitioners that serve these levels, workshops, e-classrooms, conferences, field-trainings, seminars, webinars, face-to-face consultations, and peer-to-peer exchanges made possible through train-the-trainer programs have provided these decision makers working at local and regional scales with suites of science informed actions and tools to protect their drinking water source, reduce pollutant runoff from their properties, improve (and retain) forests, and improve retention of stormwater for improved filtration and aquifer recharge. Trainings for on-lot septic system management, safe drinking water, forest stewardship, agricultural and stormwater best management practices (BMPs), and pond and lake management have been provided to critical audiences who simultaneously have the greatest opportunity for managing risks while being the most vulnerable to these risks.

Results
Ninety-three percent of participants in on-lot septic system management training demonstrated an increase in knowledge or skill. Of that, 88% indicated that they would be taking a specific course of action to improve their system operation. Ninety-three percent of those participating in the best management practice training for agricultural lands indicated an improved understanding of

innovative and applied approaches for decreasing nutrients emitted from ag operations. Another 94% of participants in groundwater protection education indicated that they would be willing to take at least one action to protect groundwater. The pond and lake management participants indicated they would take a recommended action to improve the quality of the system they manage. Nearly 2,100 private water supply owners received direct services advising them on how to ensure their drinking water supply was safe. Ninety-five percent of private water supply owners indicated they gained knowledge and 84% planned to take action to better manage their supply. One hundred percent of responders to the survey of training related to water and energy conservation indicated gained knowledge and 62% planned action to install water conservation devices, water meters, or reduce overall water use. In forest landowner conferences, 81% indicated moderate to considerable new knowledge from the training, 73% indicated considerable skill improvement and 70% identified a desire to implement a sustainable forestry practice. Eighty-nine percent agreed that they intended to sustainably manage their woodland and 80% indicated a willingness to share with their peers the information they learned. An additional 35 people have obtained the necessary credentials to write forest stewardship plans in Pennsylvania. Of influence in respect to managing and stewarding natural resources that can benefit their property, family, community, and region.

4. Associated Knowledge Areas

KA Code	Knowledge Area
101	Appraisal of Soil Resources
102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
123	Management and Sustainability of Forest Resources
135	Aquatic and Terrestrial Wildlife
403	Waste Disposal, Recycling, and Reuse
511	New and Improved Non-Food Products and Processes

Outcome #2

1. Outcome Measures

Number of participants who were evaluated in a follow up and who implement/adopt practices related to natural resources and environment

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual

2010	2660	3858

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The implementation of the knowledge gained from natural resources training and education results in the actual environmental outcomes sought - reduction of pollution emissions that cause deleterious impacts to local water quality and quantity sources with the potential to harm human health, aquatic health, biodiversity, or downstream resources. All actions undertaken by natural resource program participants result in direct pollution prevention, reduce the potential risk for harm to human health and the environment with value to property and the well-being of the local community as well as those living downstream.

What has been done
Delivery mechanisms delineated in previous section.

Results
Eighty-two percent of pond and lake program participants took specific action to improve their system including managing a nuisance plant or algae, testing the water quality, installing buffer strips, or reducing use of fertilizer near the water. All of these actions address water quality and have a direct influence on emissions of nutrients and other pollutants to waters of the Commonwealth. It is particularly important to note that Pennsylvania's ponds and lakes represent significant nutrient sinks on across the landscape and serve as essential traps to diminish the transport of nutrients and sediments to downstream ecosystems where hypoxia has catastrophic consequences - environmentally and economically. Pond owners also indicated that they had tested their water quality (89%), measured their pond size (67%), checked for lead (67%) and managed their ponds wildlife (33%). Private water supply owners indicated that they would take a specific action to manage and protect their drinking water (81%) including test the water quality (36%), shock chlorinate their water supply (21%), install water treatment (11%), reduce land-based polluting activities in the wellhead vicinity (8%), or improve construction of their well (10%). A pilot pharmaceutical return program resulted in 25 pounds of unwanted medications being turned in at a McKean County site, and growth of this pilot to at least five other areas of the state has begun based on these results. Water conservation measures implemented in response to participation include 63% of participants indicated that they checked for water leaks, 56% installed water saving appliances, 75% installed rain gardens or rain barrels, and 69% reduced the volume of water they used.

4. Associated Knowledge Areas

KA Code	Knowledge Area
101	Appraisal of Soil Resources
102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
123	Management and Sustainability of Forest Resources
135	Aquatic and Terrestrial Wildlife
403	Waste Disposal, Recycling, and Reuse
511	New and Improved Non-Food Products and Processes

Outcome #3

1. Outcome Measures

Number of volunteers that helped with program leadership and program delivery

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	1342	893

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Social scientists have identified that the peer-to-peer exchange of information is the single most effective delivery mechanism for modifying behaviors and improving management of natural resources at the landowner level. To improve environmental outcomes at the landowner level (farm, forest, household) both water and renewable natural resource programs have developed extensive, efficient, and high performing peer-to-peer networks in the form of volunteer programs like the Master Well Owner Network (MWON), the Pennsylvania Forest Stewards (PFS) program, the NatureStart youth education program, and even the "dairy discussion groups" utilized within the Pennsylvania Discovery Watershed program in coordination with the Dairy Alliance, within which precision feeding is encouraged on a farmer-to-farmer basis and through enhanced dialogue and sharing networks. By nature, Pennsylvanians are influenced by their neighbors, social networks, and community members. Peer-to-peer and volunteer networks are gaining in their value and prominence in effecting land management changes that have enormous environmental consequences.

What has been done
Networks of volunteers have been developed, fostered, trained, and empowered to deliver science based information in their communities and across their social networks resulting in significantly enhancing the number, frequency, and follow-up of contacts statewide and improving dissemination of research, practices, and approaches for improved natural resource management with the goal of increasing and improving natural resource sustainability across Pennsylvania. The MWON, albeit faced with flat external funding, has continued to train volunteers who agree to extend extension's outreach efforts.

Results
MWON volunteers reached 4,687 private water supply owners who indicated that they had increased their knowledge level about how to protect their private water supply (92%). Eighty-two

percent of these took some action to protect their drinking water supply from potential contamination. The MWON program also continued to garner external support from the PA Department of Environmental Protection and the Pennsylvania Groundwater Association. PFS volunteers, of which 522 have been trained since the program inception, with 27 new volunteers joining their ranks in this reporting cycle. Seventy-two PFS participated in the statewide training for best practices in Woodland Owners Associations and collectively, PFSs reached over 16,500 people and provided the equivalent of 23 FTEs in outreach time.

4. Associated Knowledge Areas

KA Code	Knowledge Area
101	Appraisal of Soil Resources
102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
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V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Populations changes (immigration, new cultural groupings, etc.)
- Other (Extramural Funding)

Brief Explanation

There is extensive policy and regulatory shifts underway that influence natural resource protection and management options related to Marcellus shale exploration and development (water quantity, withdrawals, wastewater disposal options, and local ordinances). Likewise, the Total Maximum Daily Load (TMDL) imposed for the waters of the Chesapeake Bay, and the State's Watershed Implementation Plan (WIP) that guides how Pennsylvania will allocate the TMDL across key sectors including agriculture, urban storm water, and the waste water discharges from municipal and industrial sources provide new policy and regulatory landscapes for citizens and the source sectors. For some sectors, these shifts have resulted in a "wait and see what will be enforced" philosophy that is counter to improving adoption of practices that are essential for reducing nonpoint source pollution and diminishing deleterious water quality impacts. The WIP has been backstopped by the USEPA for the storm water loads, and there is much confusion and concern about how local municipalities will meet their anticipated loads, what the actual expectations are, and the questions of "who pays" for meeting these loads. Extension programs have focused on providing the practices and approaches that are known, innovative, or emerging. It is anticipated that the regulatory climate related to agricultural

and storm water based loads will only become more stringent. Extension programs have focused historically on supporting the voluntary aspects of practice implementation, with an understanding that decision makers can better protect their own families health (as is the case with the safe drinking water program focus) and make improve economic and environmental outcomes through practice adoption. Extreme weather events - ranging from drought to flood conditions - also influence willingness to adopt, or even interest in, conservation-based programs based on the audience perception of water availability.

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- After Only (post program)
- Retrospective (post program)
- Before-After (before and after program)
- During (during program)
- Case Study

Evaluation Results

The evaluation results indicate that natural resource-based Extension has influenced behavioral changes in respect to either adaptive management, implementation of a specific practice, or a reduction in resource use that improves environmental outcomes. While individual adoption and implementation of these practices may not appear to have wide impact, it is clear that the aggregate impact of multiple small changes at the local landscape level -- to protect drinking water, improve buffers of aquatic systems, increase forest stewardship practices, reduce volume of water use, removal of potential emerging contaminants (i.e. pharmaceuticals) from waste streams, and engaged citizenry on information exchange (from peer-to-peer, neighbor-to-neighbor) -- have enormous impact on the net quality of water, land, forests, and consequent health and biodiversity of plants and animals.

Key Items of Evaluation

The consistently high percentage (80 to 100%) of participants who indicated a specific practice, approach, or management choice they made to improve protection of water quality, quantity, forestlands, and flora and fauna on lands or water bodies that they personally steward is a powerful indication of incremental change in behaviors that will collectively aggregate for measurable environmental improvements.