

**V(A). Planned Program (Summary)**

**Program # 6**

**1. Name of the Planned Program**

Sustaining Natural Resources

Reporting on this Program

**V(B). Program Knowledge Area(s)**

**1. Program Knowledge Areas and Percentage**

<b>KA Code</b>	<b>Knowledge Area</b>	<b>%1862 Extension</b>	<b>%1890 Extension</b>	<b>%1862 Research</b>	<b>%1890 Research</b>
102	Soil, Plant, Water, Nutrient Relationships			13%	
112	Watershed Protection and Management			39%	
133	Pollution Prevention and Mitigation			3%	
403	Waste Disposal, Recycling, and Reuse			5%	
511	New and Improved Non-Food Products and Processes			3%	
608	Community Resource Planning and Development			13%	
901	Program and Project Design, and Statistics			10%	
903	Communication, Education, and Information Delivery			14%	
	<b>Total</b>			100%	

**V(C). Planned Program (Inputs)**

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

<b>Year: 2013</b>	<b>Extension</b>		<b>Research</b>	
	<b>1862</b>	<b>1890</b>	<b>1862</b>	<b>1890</b>
Plan	0.0	0.0	0.7	0.0
Actual Paid Professional	0.0	0.0	0.6	0.0
Actual Volunteer	0.0	0.0	0.0	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
0	0	35908	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	0	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	493879	0

**V(D). Planned Program (Activity)**

**1. Brief description of the Activity**

Diverse activities in the planned program included the following activities.

- A sensor network was installed in the headwaters and mainstem of the Lamprey River, and on the Oyster River, to monitor nitrate, phosphorous, and organic nutrients levels. Sensor data will be used to develop a model for nonpoint sources of nutrient flux into NH's Great Bay.
- The river network model will be used to evaluate potential land use priorities or modifications, which could affect the water quality of rivers that are tributaries to the Great Bay Estuary and coastal margins.
- In a pilot study to decrease nutrients in the Great Bay estuary, eelgrass rack was harvested and repurposed as horse bedding.
- Methods to enhance two-way communication among stakeholders, who are interested in potential agricultural and natural resources decisions, were developed and tested.

**2. Brief description of the target audience**

Residents of New Hampshire and New England; private, public and municipal users of water; agricultural and suburban land use planners and managers, individuals and organizations interested in conservation of water and estuarine resources, town managers and relevant committee members, other scientists, undergraduate and graduate students, state and federal agencies, and natural resources professionals.

**3. How was eXtension used?**

eXtension was not used directly in this program. Instead several web based resources were developed that are project specific. Web surveys have been used to collect data for several social science projects and to evaluate the quality of data collected by these survey to improve agricultural and natural resource management policies and programs.

A Facebook site was developed for NH Route1A/1B Corridor Study Adivosry Committee to communicate activities to residents of the NH Seacoast.

**V(E). Planned Program (Outputs)**

**1. Standard output measures**

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	1372	2100	47	0

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

**Patent Applications Submitted**

Year: 2013

Actual: 0

**Patents listed**

**3. Publications (Standard General Output Measure)**

**Number of Peer Reviewed Publications**

2013	Extension	Research	Total
Actual	0	3	0

**V(F). State Defined Outputs**

**Output Target**

**Output #1**

**Output Measure**

- Number of graduate students trained and directly involved in the research.

Year	Actual
2013	7

**Output #2**

**Output Measure**

- Number of undergraduate students trained and directly involved in the research.

Year	Actual
2013	11

**Output #3**

**Output Measure**

- Number of stakeholder venues where results have been presented.

<b>Year</b>	<b>Actual</b>
2013	8

**Output #4**

**Output Measure**

- Publications in peer reviewed journals and in meetings proceedings.

<b>Year</b>	<b>Actual</b>
2013	4

**Output #5**

**Output Measure**

- Development of databases including social science data for collaborative projects with citizens, advisory groups and state agencies.

<b>Year</b>	<b>Actual</b>
2013	24

**V(G). State Defined Outcomes**

**V. State Defined Outcomes Table of Content**

O. No.	OUTCOME NAME
1	Knowledge of the relative contributions of different agricultural land management practices and suburban land uses toward N, P and C exports from the watersheds to the coastal estuary.
2	Improved collection of social science data from end users for public policy makers and regional planners with respect to natural resource management.
3	A spatially distributed river network model for the Great Bay watershed that includes relative land use sources and sinks for N, P and C.

## **Outcome #1**

### **1. Outcome Measures**

Knowledge of the relative contributions of different agricultural land management practices and suburban land uses toward N, P and C exports from the watersheds to the coastal estuary.

### **2. Associated Institution Types**

- 1862 Research

### **3a. Outcome Type:**

Change in Knowledge Outcome Measure

### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

### **3c. Qualitative Outcome or Impact Statement**

#### **Issue (Who cares and Why)**

Among the public, there is poor understanding of how non-point sources of nitrogen and phosphorous contribute to the nutrient levels in the NH Great Bay estuary. These non-point sources include agricultural, forested, and suburban landscapes. Climate extremes that generate storm events have become more common in the last decade, leading to episodic increased fluxes from these various landscapes. The NH Great Bay estuary is highly eutrophied and local municipalities are planning expensive upgrades to sewage treatment plants. Understanding the relative contributions of point and nonpoint sources to eutrophication of the Great Bay is a regional imperative.

#### **What has been done**

Sensors for nitrate, dissolved organics, oxygen, pH and conductivity have been deployed in the Lamprey River headwaters and mainstem and are being continuously monitor. The Lamprey is one of the seven major rivers feeding into the Great Bay estuary. Leveraging other grant sources have expanded monitoring to the Oyster River. The data collected will be used to measure the relative contributions of agricultural, forested suburban landscapes to nutrient run off into the Great Bay. The sensor information allows researchers to detect storm water responses in a variety of land uses and watershed sizes during different seasons.

#### **Results**

Although nitrate concentrations were highest at the agricultural site during summer baseflow, area-weighted nitrate fluxes in the headwaters were similar to those of the suburban site. During storms, dilution of nitrate concentrations occurred at both the suburban and agricultural sites. However, nitrate flux always increased during high flow in both catchments. Nitrate concentration response during storm events exhibited seasonal variability, which may be attributed to seasonal land management practices and legacy pollutant impacts.

#### 4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management

#### Outcome #2

##### 1. Outcome Measures

Improved collection of social science data from end users for public policy makers and regional planners with respect to natural resource management.

##### 2. Associated Institution Types

- 1862 Research

##### 3a. Outcome Type:

Change in Knowledge Outcome Measure

##### 3b. Quantitative Outcome

Year	Actual
2013	0

##### 3c. Qualitative Outcome or Impact Statement

###### **Issue (Who cares and Why)**

Systematic research is needed for evaluating the effectiveness of various survey tools used with natural and agricultural resources. Documenting the value of engaging and communicating with the public and stakeholders will inform managers and policy makers.

###### **What has been done**

Qualitative and quantitative methods have been used to evaluate the effectiveness of web-based tools intended to enhance the two way communication with the public and stakeholders in the decision-making processes associated with the management of natural and agricultural resources. These web-based tools have been applied to diverse policy and resources studies: monitoring wild turkeys in NH, conducting a survey of members of the Atlantic States Marine Fisheries Commission (ASMFC) to document social science needs of the commission, and initiating the engagement of stakeholders in the Corridor Management Plan for Route 1A/B in Rockingham County.

###### **Results**

A survey has been completed to assess public attitudes and interest in monitoring wild turkeys in New Hampshire, which will ultimately enhance the ability of the New Hampshire Fish and Game Department (NHFG) to recruit and retain public participation in wild turkey monitoring programs. These surveys have led to a dramatic increase in documented observations and have successfully engaged a large portion of the public with a strong and growing interest in wild turkeys.

A survey of ASMFC commissioners (50% response) showed no consensus was apparent on the most effective use of either economic or social information in making management and policy decisions. The results from the web survey serve to stress the importance of making a distinction between qualitative and quantitative data since these data are collected for achieving different goals. The commission's level of understanding of these approaches is critical since stakeholders may try to influence their decisions through the misuse of data.

#### 4. Associated Knowledge Areas

KA Code	Knowledge Area
608	Community Resource Planning and Development
901	Program and Project Design, and Statistics
903	Communication, Education, and Information Delivery

#### Outcome #3

##### 1. Outcome Measures

A spatially distributed river network model for the Great Bay watershed that includes relative land use sources and sinks for N, P and C.

##### 2. Associated Institution Types

- 1862 Research

##### 3a. Outcome Type:

Change in Knowledge Outcome Measure

##### 3b. Quantitative Outcome

Year	Actual
2013	0

##### 3c. Qualitative Outcome or Impact Statement

###### **Issue (Who cares and Why)**

Since 1980, there has been a 65% increase in population and associated development in NH's Strafford and Rockingham Counties that surround the Great Bay Estuary. Over this period, the Great Bay has become hyper-eutrophied with respect to nitrogen and phosphorous, with corresponding declines in eelgrass and habitats for juvenile marine organisms. Ameliorating the degraded state of the Great Bay requires a better understanding how the rivers in the watershed are sources and sinks, leading nitrogen, phosphorous, and carbon to the Great Bay.

###### **What has been done**

A distributed sensor network in the Lamprey and Oyster Rivers has provided baseline data for the development of a river model of the Great Bay Watershed.

## Results

The river model has been developed, and scenarios have been run to understand the factors controlling N fluxes to the coastal zone. Modeling results have revealed that the Lamprey River network has a moderate capacity to remove elevated inorganic nitrogen inputs. The moderate capacity occurs in part because much of the developed area of the watershed is skewed to the watershed mouth, or to the larger river mainstem, providing less residence time and contact with benthic sediments where permanent N removal (denitrification) occurs.

## 4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation
903	Communication, Education, and Information Delivery

## V(H). Planned Program (External Factors)

### External factors which affected outcomes

- Appropriations changes
- Competing Programmatic Challenges

### Brief Explanation

A decrease of 23.9% in state matching funds in the previous biennium continues to limit research support dollars.

## V(I). Planned Program (Evaluation Studies)

### Evaluation Results

The success of research projects in this planned program is measured in several ways:

- For new projects, is there evidence of progress toward objectives?
  - o Research projects in this planned program all demonstrated progress towards objectives.
- For more mature projects, have results been published in peer reviewed journals? Do project directors participate in national and international conferences?
  - o Researchers in one project have published several papers, including one in the prestigious journal Nature.
  - o Researchers in two projects have actively participated in regional, national and international conferences.
- Where appropriate, are outcomes disseminated to stakeholders, policy groups and state and regional agencies?

- o Results and outcomes of one project to monitor nitrogen run off from agricultural, forested, and suburban landscapes have been incorporated into the planning activities of communities in the Great Bay estuary and state and federal agencies, all of whom are developing interventions to ameliorate eutrophication of the Great Bay.
- o Improvement of web-based methods and tools for engaging stakeholders has led to better data for local, regional, and national policy makers.

### **Key Items of Evaluation**

Nitrate levels have been monitored in the headwaters of the Lamprey River, one of the major rivers feeding the Great Bay estuary. Although nitrate concentrations were highest at the agricultural site during summer baseflow, area-weighted nitrate fluxes were similar to those of the suburban sites.

This project's monitoring activities have been expanded to several locations in the Oyster River watershed to improve understanding of non-point sources for the town of Durham and University of New Hampshire's effort in creating a single integrated waste water permit.