1.0 Title and Approval Page

Document Title:	Piscataquog River Riparian Restoration Project Quality Assurance Project Plan
Lead Organization:	St. Anselm College Biology Department, Piscataquog Watershed Association
Preparer's Name:	Dr. Barry Wicklow
Organizational Affiliation: Address:	St. Anselm College Biology Department 100 St. Anselm Drive Manchester, NH 03102
Preparation Date (month/day/year):	2/14/02

Project Manager: _____
Signature / Date
Margaret Watkins, PWA

Project QA Officer: _____
Signature / Date
Dr. Barry Wicklow, St. Anselm College

Program Quality Assurance Coordinator: _____
Signature / Date
Andrea Donlon, NH DES

Quality Assurance Manager _____
Signature / Date
Vincent Perelli, NHDES

USEPA Project Manager: _____
Signature / Date
Warren Howard, US EPA Region I

USEPA QA Officer: _____
Signature / Date
Arthur Clark, US EPA Region I

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2.2 Document Control Format

The document control format is shown in the upper right hand corner of each page of this document.

2.3 Document Control Numbering System

A document control numbering system for all copies of this QAPP was not used because this project is of a small scale. The people who will receive copies of the QAPP are listed in Table 1 in Section 3.0.

2.4 EPA-NE QAPP Worksheet #2

Please see the next page for Worksheet #2.

EPA-NE QAPP Worksheet #2

1. Identify Guidance used to prepare QAPP:

Format and content: Region I, EPA-NE Compendium of QAPP Requirements and Guidance, Final October 1999, and Attachment A, Region I, EPA-NE QAPP Manual. Draft, September, 1998.
Scale of content: EPA Requirements for Quality Assurance Project Plans, EPA QA/R-5. Interim final, November, 1999.

2. Identify EPA Program: Clean Water Act Section 319, NPS Program

3. Identify approval entity: EPA-NE, State, or other: EPA-New England

4. Indicate whether the QAPP is a generic program QAPP or a project specific QAPP. (underline one)

5. List dates of scoping meetings that were held: 1/26/01 and 3/2/01

6. List title of QAPP documents and approval dates written for previous site work, if applicable: Not applicable

7. List organizational partners (stakeholders) and connection with EPA and/or State:
Piscataquog Watershed Association
St. Anselm College Aquatic Ecology and Conservation Biology Students and Faculty
Natural Resource Conservation Service, Milford Office
New Hampshire Department of Transportation
Trout Unlimited, national and NH chapter
Town of New Boston
New Hampshire Department of Environmental Services

8. List data users:
Piscataquog Watershed Association
St. Anselm College Aquatic Ecology and Conservation Biology Students and Faculty
Natural Resource Conservation Service, Milford Office
New Hampshire Department of Environmental Services

9. If any required QAPP Elements (1-20), Worksheets and/or Required Information are not applicable to the project, then circle the omitted QAPP Elements, Worksheets and Required Information on the attached Table. Provide an explanation for their exclusion below:
Several sections and worksheets are not included in this QAPP because the project does not involve any laboratory analysis. Sections and tables related to a fixed laboratory are therefore not applicable. We have numbered the tables contained in this QAPP sequentially. Worksheets not included are shown in parentheses in the table below.

Required EPA QA/R-5 QAPP Elements	Required EPA-NE QAPP Elements and Corresponding EPA-NE QAPP Sections	EPA-NE QAPP Worksheet #	Required Information
Project Management and Objectives			
A1	1.0 Title and Approval Page	1	-Title and Approval Page
A2	2.0 Table of Contents and Document Format 2.1 Table of Contents 2.2 Document Control Format 2.3 Document Control Numbering System 2.4 EPA-NE QAPP Worksheet #2	2	-Table of Contents -EPA-NE QAPP Worksheet
A3	3.0 Distribution List and Project Personnel Sign-off Sheet	3 (4)	-Distribution List -Project Personnel Sign-off Sheet
A4, A8	4.0 Project Organization 4.1 Project Organizational Chart 4.2 Communication Pathways 4.2.1 Modifications to Approved QAPP 4.3 Personnel Responsibilities and Qualifications 4.4 Special Training Requirements/ Certification	5a 5b 6 7	-Organizational Chart -Communication Pathways -Personnel Responsibilities and Qualifications Table -Special Personnel Training Requirements Table
A5	5.0 Project Planning/Project Definition 5.1 Project Planning Meetings 5.2 Problem Definition/Site History and Background	8a 8b	-Project Scoping Meeting Attendance Sheet with Agenda and other Project Planning Meeting Documentation -Problem Definition/Site History and Background -EPA-NE DQO Summary Form -Site Maps (historical and present)
A6	6.0 Project Description and Schedule 6.1 Project Overview 6.2 Project Schedule	9a (9b) (9c) (9d) 10	-Project Description -Contaminants of Concern and Other Target Analytes Table -Field and Quality Control Sample Summary Table -Analytical Services Table -System Designs -Project Schedule Timeline Table
A7	7.0 Project Quality Objectives and Measurement Performance Criteria 7.1 Project Quality Objectives 7.2 Measurement Performance Criteria	11a (11b)	-Project Quality Objectives/Decision Statements -Measurement Performance Criteria Table
Measurement/Data Acquisition			
B1	8.0 Sampling Process Design 8.1 Sampling Design Rationale	(12a) (12b)	-Sampling Design and Rationale -Sampling Locations, Sampling and Analysis Method/SOP Requirements Table -Sample Location Map

Required EPA QA/R-5 QAPP Elements	Required EPA-NE QAPP Elements and Corresponding EPA-NE QAPP Sections	EPA-NE QAPP Worksheet #	Required Information
B2, B6, B7, B8	9.0 Sampling Procedures and Requirements 9.1 Sampling Procedures 9.2 Sampling SOP Modifications 9.3 Cleaning and Decontamination of Equipment/Sample Containers 9.4 Field Equipment Calibration 9.5 Field Equipment Maintenance, Testing and Inspection Requirements 9.6 Inspection and Acceptance Requirements for Supplies/Sample Containers	13 (12b) 14 15	-Sampling SOPs -Project Sampling SOP Reference Table -Sampling Container, Volumes and Preservation Table -Field Sampling Equipment Calibration Table -Cleaning and Decontamination SOPs -Field Equipment Maintenance, Testing and Inspection Table
B3	10.0 Sample Handling, Tracking and Custody Requirements 10.1 Sample Collection Documentation 10.1.1 Field Notes 10.1.2 Field Documentation Management System 10.2 Sample Handling and Tracking System 10.3 Sample Custody	(16)	-Sample Handling, Tracking and Custody SOPs -Sample Handling Flow Diagram -Sample Container Label (Sample Tag) -Chain-of-Custody Form and Seal
B4, B6, B7, B8	11.0 Field Analytical Method Requirements 11.1 Field Analytical Methods and SOPs 11.2 Field Analytical Method/SOP Modifications 11.3 Field Analytical Instrument Calibration 11.4 Field Analytical Instrument/ Equipment Maintenance, Testing and Inspection Requirements 11.5 Field Analytical Inspection and Acceptance Requirements for Supplies	17 18 (19)	-Field Analytical Methods/SOPs -Field Analytical Method/SOP Reference Table -Field Analytical Instrument Calibration Table -Field Analytical Instrument/Equipment Maintenance, Testing and Inspection Table

Required EPA QA/R-5 QAPP Elements	Required EPA-NE QAPP Elements and Corresponding EPA-NE QAPP Sections	EPA-NE QAPP Worksheet #	Required Information
B4, B6, B7, B8	12.0 Fixed Laboratory Analytical Method Requirements 12.1 Fixed Laboratory Analytical Methods and SOPs 12.2 Fixed Laboratory Analytical Method/SOP Modifications 12.3 Fixed Laboratory Instrument Calibration 12.4 Fixed Laboratory Instrument/ Equipment Maintenance, Testing and Inspection Requirements 12.5 Fixed Laboratory Inspection and Acceptance Requirements for Supplies	(20) (21)	-Fixed Laboratory Analytical Methods/SOPs -Fixed Laboratory Analytical Method/SOP Reference Table -Fixed Laboratory Instrument Maintenance and Calibration Table
B5	13.0 Quality Control Requirements 13.1 Sampling Quality Control 13.2 Analytical Quality Control 13.2.1 Field Analytical QC 13.2.2 Fixed Laboratory QC	(22a) (22b) (23a) (23b) (24a) (24b)	**Sampling** - Field Sampling QC Table - Field Sampling QC Table cont. **Analytical** - Field Analytical QC Table - Field Analytical QC Table cont. - Field Screening/Confirmatory Analysis Decision Tree - Fixed Laboratory Analytical QC Sample Table - Fixed Laboratory Analytical QC Sample Table cont.
B9	14.0 Data Acquisition Requirements	25	-Non-Direct Measurements Criteria and Limitations Table
A9, B10	15.0 Documentation, Records and Data Management 15.1 Project Documentation and Records 15.2 Field Analysis Data Package Deliverables 15.3 Fixed Laboratory Data Package Deliverables 15.4 Data Reporting Formats 15.5 Data Handling and Management 15.6 Data Tracking and Control	26	-Project Documentation and Records Table -Data Management SOPs

Required EPA QA/R-5 QAPP Elements	Required EPA-NE QAPP Elements and Corresponding EPA-NE QAPP Sections	EPA-NE QAPP Worksheet #	Required Information
Assessment/Oversight			
C1	16.0 Assessments and Response Actions 16.1 Planned Assessments 16.2 Assessment Findings and Corrective Action Responses 16.3 Additional QAPP Non-Conformances	27a 27b (27c)	-Assessment and Response Actions -Project Assessment Table -Project Assessment Plan -Audit Checklists
C2	17.0 QA Management Reports	(28)	-QA Management Reports Table
Data Validation and Usability			
D1	18.0 Verification and Validation Requirements		-Validation Criteria Documents
D2	19.0 Verification and Validation Procedures	29a (29b) (29c)	-Data Evaluation Process -Data Validation Summary Table -Data Validation Modifications
D3	20.0 Data Usability/Reconciliation with Project Quality Objectives	30	-Data Usability Assessment

3.0 Distribution List and Project Personnel Sign-off Sheet

Table 1 presents a list of people who will receive the approved QAPP, the QAPP revisions, and any amendments. A project personnel sign-off sheet is not included in this draft. It will be generated upon finalization of the QAPP, and all people related to the project will indicate they have read the QAPP before completing any work on this project.

Table 1. QAPP Distribution List

QAPP Recipient Name	Title	Organization	Telephone Number
Dr. Barry Wicklow	Project QA Officer	St. Anselm College	603-641-7163
Margaret Watkins	Project Manager	Piscataquog Watershed Association	603-226-2340
Andrea Donlon	Program QA Coordinator	NH DES Watershed Management Bureau	603-271-8862
Vincent Perelli	NHDES Quality Assurance Manager	NH DES Planning Unit, Office of the Commissioner	603-271-8989
Warren Howard	USEPA Project Manager	USEPA New England	617-918-1587
Arthur Clark	USEPA Quality Assurance Officer	USEPA New England	617-918-8397

Based on EPA-NE Worksheet #3

4.0 Project Organization

This section identifies the organizations and key personnel participating in the project and describes their specific roles, responsibilities and qualifications. This section also explains communication pathways.

4.1 Project Organization Description and Chart

The Piscataquog River Riparian Restoration Project requires the participation of a number of partners. The two primary partners are the Piscataquog Watershed Association (PWA) and St. Anselm College. Margaret Watkins, PWA President (603-226-3240) is the Project Manager and will coordinate the project with St. Anselm College, NH DOT and NH DES. Margaret will also be responsible for coordinating the participation of project stakeholders as well as overseeing generation of the final project report.

Dr. Barry Wicklow of St. Anselm College (603-641-7163) is the Field Manager and Project Quality Assurance Officer. Barry will coordinate sampling teams, sample collection, sample analysis and reporting. Mussel surveys, habitat assessments and morphological measurements will be conducted by Barry and students enrolled in the St. Anselm Aquatic Ecology and Conservation Biology Program. Barry is also the Data Manager and will be responsible for data entry, development of the project database, and generation of data for the final report demonstrating the anticipated environmental results.

Andrea Donlon of NH DES (603-271-8862) is the Program QA Coordinator, and is responsible for coordination with USEPA about QAPP issues.

Helen Castle from the NRCS Milford Office is providing technical assistance and will be involved in oversight of construction activities.

James MacCartney, Trout Unlimited regional river restoration specialist, is providing technical assistance with design and will be involved in oversight of construction and planting activities. Volunteers from Trout Unlimited will assist with project installation.

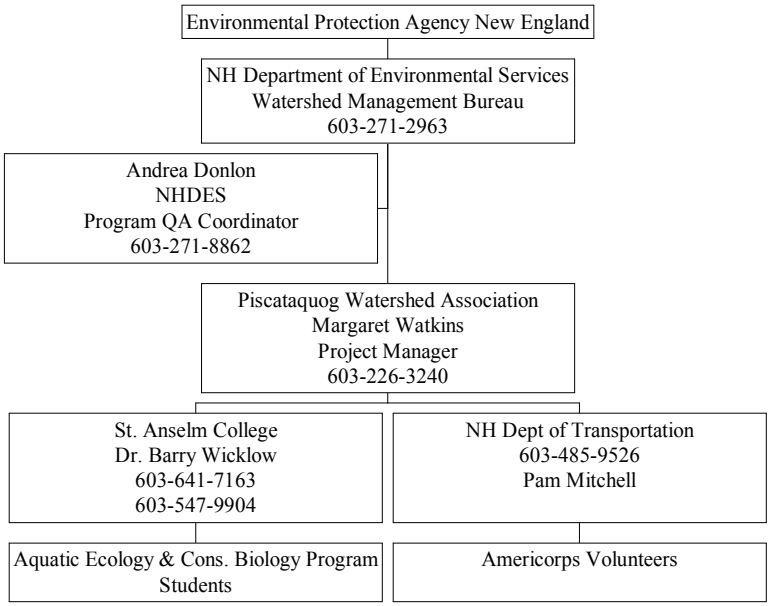
NH DOT Hooksett District Office personnel, under supervision of Pam Mitchell, will install a berm along Rte. 13 to divert water from the site to a vegetated area upstream where runoff can be slowed and treated.

The Town of New Boston will provide equipment, if appropriate, and as owner of the land, has authorized access to the property for this project. Members of the Conservation Commission may participate.

Figure 1 shows an organizational chart for this project.

It is anticipated that data from and results of this project will be used by St. Anselm College students, NH NRCS offices, particularly the Milford office, the Trout Unlimited regional river restoration specialist, NH Wetlands Bureau in considering future bank stabilization projects on similar rivers, NH DES Nonpoint Source Program in evaluating similar projects, and possibly NH DOT.

Figure 1. Organizational chart for Piscataquog River Riparian Restoration Project



4.2 Communication Pathways

As project manager, Margaret Watkins will be the primary contact for all parties involved in the Piscataquog River Riparian Restoration Project. If problems arise in the field or in any phase of the project, Margaret Watkins will be contacted and will determine the best course of action based upon the circumstances and the outcome of consultations with Dr. Barry Wicklow (Project QA Officer/Field Manager) and Andrea Donlon (NH DES Program QA Coordinator).

4.2.1 Modifications to Approved QAPP

EPA New England requires that all modifications to an approved QAPP be documented and submitted for approval in the same manner as the original QAPP. The following paragraphs document the procedures that will be followed when any project activity originally documented in this QAPP requires real-time modification to achieve project goals.

If the sampling design needs to be modified, Margaret Watkins, Project Manager and Dr. Barry Wicklow, Project QA Officer/Field Manager, will work with the Andrea Donlon, NH DES Program QA Coordinator, to effect the appropriate changes. The NH DES Program QA Coordinator will submit the modifications to EPA New England and the NH DES QA Manager.

If the sampling procedures need to be modified, the Project Manager will work with the Program QA Coordinator to effect the modifications, and the Program QA Coordinator will submit the modifications to EPA New England and the NH DES QA Manager.

4.3 Personnel Responsibilities and Qualifications

Table 2 identifies project personnel responsible for project functions.

Table 2. Personnel Responsibilities and Qualifications

Name and Affiliation	Responsibilities	Education and Experience Qualifications
Dr. Barry Wicklow	Supervise all flow and mussel assessments, advise and oversee plantings, assist in treatment design, analyze data, assist with final report	Ph.D. zoology, UNH, numerous publications on ecology, brook floater and other freshwater mussels, professor of biology at St. Anselm since 1986; prior teaching and research experience.
Margaret Watkins	Coordinate site activities, interface with NH DES regulatory and grants staff, write final project report, assist as needed	M. Env. Mgmt., Duke University; many years of experience in planning, water quality, and conservation.
Andrea Donlon NH DES Watershed Management Bureau	Reviews QAPP preparation and other QA/QC activities	M.S. Forestry 1999, University of Vermont; B.S. Mathematics 1990, Haverford College; 10 yrs exp. in environmental science.

Based on EPA-NE Worksheet #6.

4.4 Special Training Requirements/Certification

Table 3 displays the information for project activities that require some level of training.

Table 3. Special Personnel Training Requirements

Project function	Description of Training	Training Provided by	Training Provided to	Location of Training Records
Velocity profiling	Measuring stream flow	Dr. Barry Wicklow	St. Anselm students and PWA volunteers	St. Anselm College
Mussel measurement and tagging	Use of caliper and attachment Floy tags	Dr. Barry Wicklow	St. Anselm students and PWA volunteers	St. Anselm College

Based on EPA-NE Worksheet #7.

5.0 Project Planning/Project Definition

This section documents the project planning, identifies the environmental problem, defines the environmental questions that need to be answered and provides background information.

5.1 Project Planning Meetings

Several project scoping meetings were held during the planning phase of this project. A summary of each meeting follows.

During 1999 and 2000 several meetings were held on site with members of the board of the Piscataquog Watershed Association (PWA), Dr. Barry Wicklow of St. Anselm College, and Helen Castles of Natural Resources Conservation Service. In addition, students of Aquatic Ecology classes at St. Anselm College have conducted flow studies at the site in 2000 and 2001 (see discussion below).

Project principals Dr. Barry Wicklow and Margaret Watkins, PWA President, have met on site with district office personnel from the NH DOT and NH DOT's environmental review coordinator.

On December 15, 2000 a site visit was arranged for Frank Richardson, NH Wetlands Bureau, and Jim MacCartney, then NH Rivers Coordinator for the NH DES and currently Regional Restoration Specialist for Trout Unlimited and advisor to this project. Helen Castles of the NRCS, Dr. Barry Wicklow of St. Anselm College, and Margaret Watkins, representing the PWA attended this meeting as well.

On January 26, 2001, a scoping meeting was held with the intent of defining quantitative sampling elements that would effectively measure environmental success related to the scope of work outlined in the Piscataquog River Riparian Restoration Project proposal. Attendees included Margaret Watkins, PWA; Dr. Barry Wicklow, St. Anselm College Professor; Eric Williams, NH DES Watershed Assistance Section Supervisor; and Steve Landry, NH DES Merrimack Watershed Supervisor.

On March 2, 2001, a QAPP scoping meeting was held in an effort to initiate the QAPP preparation process and to finalize the physical and biological monitoring components associated with the project. Attendees included Margaret Watkins, Piscataquog Watershed Association (PWA) President; Dr. Barry Wicklow, St. Anselm College Professor; Andrea Donlon, NHDES Program QA Coordinator; and Steve Landry, NH DES Merrimack Watershed Supervisor. Meeting attendees decided that a draft QAPP would be prepared and submitted to NH DES and EPA for review as soon as possible with emphasis on the biological monitoring components and physical morphology measurements being considered as quantitative measures of success for the project.

5.2 Problem Definition/Site History and Background

This streambank stabilization and riparian restoration implementation project is situated in New Boston, NH in the vicinity of the Gregg Mill Road bridge (see Site Map in Attachment A). Rte. 13 is the most heavily used road in New Boston. It is a narrow, single-lane road; traffic flows in both directions, the road's shoulders are low, and the road follows the river from Goffstown to New Boston. In past years, the town of New Boston relied on the river for transportation. Today it is a popular fishing and recreation spot for many local residents. The road is a designated state scenic highway. The stretch of river at the project site, the south branch of the Piscataquog River, is a designated "rural river" in the state Rivers Management and Protection Program.

Historically, the Piscataquog River between Goffstown and New Boston was bounded on the north by the B&M Railroad corridor and on the south by Rte. 13. The railroad bed has been converted to a rail/trail and is heavily wooded with an adequate amount of riparian vegetation. The south side of the river, however, is degraded from road runoff and bank erosion. These impacts are particularly severe upstream from the bridge where the road is approximately 2 meters from the bank, excluding the road shoulder. Excessive road runoff occurs because the intersection of Rte. 13 and Gregg Mill Road creates a large area of impervious surface. Rte. 13 at this location slopes towards the river and there is no swale or other treatment to redirect the water. The bank in this area is undermined by the force of spring floods and the scouring of ice floes.

Just downstream of the bridge on the opposite (north) side of the river is a second bank erosion site that appears to be the result of a recent concrete bulkhead installed to stabilize the bank just upstream of the bridge. A population of state-endangered brook floater mussels (*Alasmidonta varicosa*) is located just downstream of this site.

This situation overall creates four interrelated resource issues: water quality impacts caused by silt and road runoff pollutants, stability and expansion of the riparian buffer, habitat enhancement, and species protection.

The existing environmental problems will be addressed by protecting and restoring the bank and riparian vegetation upstream of the bridge using bioengineering techniques and by installing a berm along Rte. 13 to redirect the runoff to an area of extensive riparian vegetation. Measures to minimize impacts of human use below the bridge will also be implemented.

The proposed techniques involve use of log or rock veins, large woody debris, porous weirs, and planting of native vegetation. The Natural Resource Conservation Services (NRCS) has developed bioengineering models on larger rivers and smaller rivers, but as of yet has no model for a river of this size. As a result, this project represents a unique opportunity to create a new model for this class of rivers. Adding to its potential as a model, the project site is highly visible and is located in a part of the state where rivers are increasingly impacted by development.

The questions to be addressed are:

- Can least-harm bioengineering techniques be used successfully to prevent bank erosion while preserving critical wildlife habitat?
- What is the efficacy of these methods in reducing hydraulic forces on a deeply undercut bank as measured by stream velocity changes across five different transects at the site of impact?
    - Was the deepest channel redirected?
    - Was the flow dampened or reduced?

This project proposes to use relatively low-impact techniques to dampen and divert erosive forces away from the bank. We will assess their effectiveness quantitatively by measuring pre and post velocities across the stream, pre and post riparian habitat assessments, and long-term mussel population tracking. Bank stability will be observed over time as well.

Under the direction of Dr. Barry Wicklow, St. Anselm students have, prior to this project: 1) determined discharge and current velocity profiles at five transects within the project area; 2) determined discharge at bank full; 3) calculated entrenchment ratio; 4) calculated width-to-depth ratio; 5) measured the depth of undercutting along 30 m of high flood impact bank; 6) qualitatively surveyed macroinvertebrate and fish communities and riparian vegetation; 7) determined sinuosity; and 8) documented the numbers and location of the brook floater mussels. Activities 1-7 were done in spring 2001; activity 8 was done fall 2000. Students will continue their involvement in the analysis and documentation of effects of treatments. Impacts of ice flow on the bank have also been observed over several years.

The primary project goal is to minimize erosion through this stretch of river in order to maximize the potential for the highly silt-sensitive/pollution intolerant brook floater mussel population to remain viable (no decrease in population density or recruitment). The population will continue to be monitored over time, beyond the scope of this project grant. There is good evidence in the literature that increased riparian habitat along stream reaches improves wildlife habitat, although this anticipated result will not be measured due to the long reproductive and recruitment cycles of the brook floater mussel. Instead, post implementation discharge measurements will determine whether the treatments achieved the desired redirection of flow within the stream reach.

6.0 Project Description and Schedule

This section presents a general overview of the activities that will be performed during this project, and it includes a schedule for implementation.

6.1 Project Overview

This project proposes to stabilize stream banks along a stretch of the Piscataquog River where endangered brook floater mussels, a species highly sensitive to effects of sedimentation and turbidity, have been documented. The questions it will address are:

- Can least-harm bioengineering techniques be used successfully to prevent bank erosion while preserving critical wildlife habitat? and
- What is the efficacy of these methods in reducing hydraulic forces on a deeply undercut bank as measured by stream velocity changes across five different transects at the site of impact?

Sampling tasks: Five streamflow measurement transects have been established in strategic places, as follows:

Transect #1 is upstream from the area where bank erosion is occurring;

Transects #2, #3 and #4 are each downstream of proposed treatments; # 3 and #4 are also at the sites of greatest hydraulic impact to the bank.

Transect #5 is downstream of the greatest impact.

Transects have been established for measuring current velocities pre- and post- treatment implementation. Transect stations have been measured and established upstream from the bridge abutments and will be mapped. Six additional transects have been added downstream of the original five in order to satisfy the EMAP protocol requirements. Sampling will occur once before installation and twice after installation.

For tables based on EPA-NE Worksheets #9b and #9c, please see Sections 7.0 and 8.0, respectively.

Mussels will also be sampled, using line transect sampling in an area beginning at the downstream side of the bridge abutment and extending 30 m downstream and 6 m from the north bank (see transects # 7 – 11 in the schematic map in Attachment A). This is where the mussels occurred in 1993.

Current velocities will be measured using a Global Flow Probe with digital readout (Global Water Instrumentation, Fair Oaks, CA). The mussel population will be evaluated using line transect sampling and mark and recapture for long-term population estimation. Riparian habitat will be assessed using the US EPA's EMAP habitat assessment method (Barbour et al. 1999).

Analysis tasks: Not applicable. See above for sampling and assessment methodologies.

Quality control tasks: Ten percent of the transects (one transect) will be repeated for quality control. A complete description of quality control tasks is included in Section 16.0. All mussel identifications will be verified by Barry J. Wicklow; one mussel out of ten will be measured twice for quality control. All records will be checked prior to leaving the field site.

Secondary data: There will be no secondary data. Data from previous years has been used to better understand the river system and will be used for comparative purposes with future data generated at the site.

Data management tasks: Field data will be recorded on a field data sheet. Data will be entered into Microsoft Excel spread sheet for analysis. Spread sheet data will be cross referenced with field sheet data for verification and validation purposes.

Documentation and records: Field sheets will be used for recording all measured data. Hard copy and computer records will be maintained. A complete description of documentation and records are included in Section 15.0.

Data packages: All data will be generated and held at St. Anselm College.

Assessment/Audit tasks: There will be no assessment or audit tasks for this project.

Data verification and validation tasks: Data verification will include replicate sampling and triplicate averaging. Validation involves assessing the reasonable range of the data based on expected values for that parameter. Data will be compared with previous data from individual transect locations. A complete description of data verification and validation tasks and procedures are included in Sections 18.0 and 19.0.

Data usability tasks: Data usability will be based on data verification and validation. Section 20.0 includes a complete description of data usability assessments.

6.2 Project Schedule

Table 4 presents a schedule of the work to be performed for this project. The schedule is dependent on receipt of a wetlands permit from the NH DES (application has been submitted) and the occurrence of low summer flows for installation of treatments. In the event of project delays, project manager Margaret Watkins will notify NH DES project contacts, Andrea Donlon and Steve Landry. The grant contract expires 12/31/03.

Table 4. Project Schedule Timeline

Activity	Dates (MM/DD/YYYY)		Deliverable	Deliverable Due Date
	Anticipated Date(s) of Initiation	Anticipated Date(s) of Completion		
QAPP Preparation	3/01	2/02	QAPP Document	
Pre-installation sample collection for data not previously collected	Upon approval of QAPP	5/30/02	Current velocity profiles	11/30/02 to NH DES
Construction of physical BMPs Riparian vegetation	8/1–9/30/02 fall 02; spring 03	9/30/2002 fall 02; spring 03	Not applicable	N/A
Year 1 post-installation sample collection	10/1-10/30/02	10/30/02		
Year 2 post-installation sample collection	10/1-10/30/03	10/30/03	Current velocity profiles	11/15/03 to NH DES
Data validation	10/7/02	12/31/02	Raw data	3/1/03 to NH DES
Data assessment report	8/15/03	11/30/03	Written report	11/15/03 to NH DES
Final project report preparation	8/15/03	11/30/03	Written report	

Based on EPA-NE Worksheet #10.

7.0 Project Quality Objectives and Measurement Performance Criteria

This section documents the environmental decisions that need to be made and the level of data quality needed to ensure that the decisions are based on sound data.

7.1 Project Quality Objectives

If successful, this project will serve as a model for similar riparian restoration projects in the State. The Piscataquog Watershed Association will promote educational activities at the site and will use the data collected to document and explain the changes that occurred as a result of the techniques that were implemented. In addition to these uses, St. Anselm College will use the site for long-term scientific research on mussels and habitat creation/restoration. The New Boston conservation commission, which maintains trails along the river, may use the site for educational purposes. The NRCS may use it as a model for riparian restoration and as a reference site. Trout Unlimited likely will use the site as a reference site and model. NH DES will use the information for reporting purposes and for better evaluating use of this approach to bank stabilization in future 319 project requests.

In order to evaluate fully the success of this project, we will need both quantitative and qualitative data for current velocity, flow, riparian habitat assessment, and population monitoring. Project action limits for these parameters need not be established because this is not a regulatory issue. Field methods are detailed in SOPs in appendices. Data collected at each site will be adequate to determine the effectiveness of BMPs in redirecting highest stream velocities from bank closer to stream center. Stream flow data will be collected at six transects and mussel population data will be collected at eleven transects; see Attachment A. One data set will be collected preinstallation of BMPs and two will be collected postinstallation over a period of two years. Data will be collected according to the field sampling protocols outlined in appendices by members of the PWA and St. Anselm College students under the direction of Dr. Barry Wicklow. Data will be analyzed and discussed in the final report to be prepared on this project. The final report will include history of the area, data results, data interpretation, and observed changes in current and habitat. The final section will make recommendations about use of these BMPs on similar class streams.

7.2 Measurement Performance Criteria

Subcategories shown below should be included and described.

Precision: Duplicate precision will be determined for one transect each time transects are measured. Desired precision will be plus or minus 0.25 m/second.

Relative Percent Difference will be calculated using the following equation:

$$RPD = [(x_1-x_2)/[(x_1+x_2)/2]] \times 100\%$$

Accuracy and bias: Target accuracy for stream flow is 5%.

Representativeness: Transect locations were chosen to best represent the anticipated flow changes and mussel population. The mussel sampling location is based on historical data.

Comparability: Comparability between transects will be achieved by maintaining consistency with SOPs, transect locations, and sampling methods. The same techniques for determining mussel population size and viability as used in the past will be used for this project to ensure comparability over time. These data may be used by NRCS, NHDES, and Trout Unlimited as a model for other class C type streams.

Sensitivity: Sampling protocols for velocity determinations, riparian habitat assessment, and mussel population measurements are based on standard methods. Previous data show the methods and instruments are appropriate for these measurements and adequate for the purposes of this study.

Completeness: The guidelines and protocols for the sampling procedures will be adequate for the purposes of this study. Ninety percent of measurements within a transect and measurements of mussels

would indicate data completeness, and critical data (profile produced by a transect) should be at least 80%.

Quantitation Limits: There will be no chemical analyses in this study.

8.0 Sampling Process Design (Experimental Design)

This section describes the sampling rationale and procedures.

8.1 Sampling Design Rationale

A map of the Piscataquog River Riparian Restoration Site depicting transect locations, mussel bed, and proposed treatments is attached as Attachment A.

Velocity determinations:

Velocity will be measured along the same transects before and after steambank restoration and are shown on Attachment A. The transects for measuring velocity profiles are located as follows:

Transect #1 – 65.3 m upstream of bridge abutment

Transect #2 – 39.0 m upstream of bridge abutment

Transect #3 – 33.6 m upstream of bridge abutment

Transect #4 – 26.5 m upstream of bridge abutment

Transect #5 – 21.9 m upstream of bridge abutment

These locations were selected to achieve velocity profiles from just upstream of the project area, within the project area, and immediately downstream of the project area. Velocities will be determined before and after installations, using procedures described in section 6.1 and Appendix 1. See site map (Appendix A) with transects marked on it.

Transects #6-11 include the entire area of the mussel population in order to assess habitat.

Mussel population surveys:

All surface mussels will be surveyed using a complete census method. The survey area will be located from the bridge abutment to 30 m downstream and will extend 6 m from the north bank (this is the location of the 1993 mussel population). A timed search method will be use to check adjacent areas of stream bed. Mussels will be located using a face mask and snorkel. Distance along the bank from the bridge abutment, perpendicular distance from the bank, and mussel length will all be measured and recorded. Each mussel will be labeled using 5 mm x 3 mm numbered Floy tags for use in mark-recapture studies (Rogers et al., Journal of the North American Benthological Society, in press). Mussel locations will be mapped.

Data will be collected for all species of mussels observed.

Habitat Assessment:

Habitat assessments will be performed using the EPA EMAP assessment sheets along all the transects. Habitat assessment will allow us to compare the river reach affected by this project and the mussel bed site before and after the installation of the BMPs to document their influence on stream habitat.

9.0 Sampling Procedures and Requirements

This section describes in detail how samples will be collected. Use of field analytical equipment is discussed in Section 11.0

Flow measurements will be taken with a Global Flow Probe Model FP 101, portable flow meter. (See Appendix 1 for selected sections of the instruction manual.) Current velocity profiles will be measured along each of eleven transects. Stage level will be marked as vertical measurements on the bridge abutment. Mussels will be measured using a Mitutoyo Dial Caliper. See Appendix 1 for SOPs.

9.1 Sampling Procedures

Standardized sampling procedures provide consistency between samplers; facilitate collection of accurate, precise, and representative samples; and help to ensure data comparability.

The stream velocity measurements, pre and post installation, will enable project participants to determine whether anticipated outcomes were achieved. Velocities will be measured along transects, as depicted on the map in Section 8, above. Similarly, mussel population sampling will enable participants to determine stability of/changes to this population. See Appendix 1 for SOPs.

Table 5. Project Sampling SOP Reference Table

SOP title, revision date and/or number	Reference number	Originating organization	Equipment used
Global Flow Probe Owners Manual and Users Guide	Model FP 101	Global Water Instrumentation	Global Flow Probe
Dial Caliper		Mitutoyo	Mitutoyo Dial Caliper
Equipment decon – N/A			
Equipment cleaning – per users manual			

Based on EPA-NE Worksheet #13.

9.2 Sampling SOP Modifications

No SOPs were modified to meet the project quality objectives.

9.3 Cleaning and Decontamination of Equipment/Sample Containers

Cleaning and decontaminating of sampling probe is not generally necessary for this project, although a mild soap and water may be desirable should probe get gritty. Measuring faces and reference surfaces of dial caliper will be kept clean with soft cloth, per instrument care instructions.

9.4 Field Equipment Calibration

All field equipment calibration procedures are summarized below. Equipment was factory set. Calibration will be checked to ensure the probe is set at factory reading. See Appendix 1.

Table 6. Field Sampling Equipment Calibration Table

Equipment name	Procedure and SOP Reference	Frequency of calibration	Acceptance criteria	Corrective action	Person responsible
Mitutoyo Dial Caliper	N/A	Once every field season	Factory number is obtained	Send to factory	Dr. B. Wicklow
Global Flow Probe	Users manual	After battery change	Factory number is obtained	Contact factory	Dr. B. Wicklow

Based on EPA-NE Worksheet #14.

9.5 Field Equipment Maintenance, Testing and Inspection Requirements

Equipment maintenance logs will be kept and equipment will be checked before each use. Table 7 summarizes the equipment maintenance, testing, and inspection procedures.

Table 7. Field Sampling Equipment Maintenance, Testing, and Inspection

Equipment name	Activity	Frequency of activity	Acceptance criteria	Corrective action	Person responsible
Mitutoyo Dial Caliper	Dial check	As necessary	Meets factory setting	Contact factory	Dr. B. Wicklow
Global Flow Probe	Battery change	As necessary	Meets factory setting	Contact factory	Dr. B. Wicklow

Based on EPA-NE Worksheet #15.

9.6 Inspection and Acceptance Requirements for Supplies/Sample Containers

No special procedures are necessary since no chemical analyses will be performed.

10.0 Sample Handling, Tracking and Custody Requirements

10.1 Sample Collection Documentation

This section describes field documentation procedures that will be followed for the project. Proper field sampling documentation help to ensure sample authenticity and data integrity. See Appendix 2 for sample sheet.

10.1.1 Field Notes

Field notes will be taken on write-in-the-rain field notebooks. The following information will be included:

Site name and location

Field sampler name, date, time

Transect number and data

Mussel metrics

Habitat assessment data

Records of photographs taken

Habitat assessment forms will also be completed.

10.1.2 Field Documentation Management System

Data notebooks will be titled, dated, and archived at St. Anselm College.

10.2 Sample Handling and Tracking System

No water quality samples will be collected during this project, so this section is not applicable.

10.3 Sample Custody

No water quality samples will be collected during this project, so this section is not applicable.

11.0 Field Analytical Method Requirements

Not applicable, as all procedures are sampling.

12.0 Fixed Laboratory Analytical Method Requirements

A fixed laboratory will not be used for this project. Therefore, this section is not applicable to the project.

13.0 Quality Control Requirements

13.1 Sampling Quality Control

Flow measurements:

When using the flowmeter, one transect will be duplicated by a second person as a quality control replicate. If the two samples are off by more than 10%, the field personnel will discuss the procedures with the Project Manager until an understanding is reached. The measurement may be discarded or one kept depending on the result of the conversation.

Mussel measurements:

One out of every ten mussels will be measured by a second person as a quality control measure. If the two samples are off by more than 10%, the field personnel will discuss the procedures with the Project

Manager until an understanding is reached. The measurement may be discarded or one kept depending on the result of the conversation.

Habitat assessment:

Each biologist will be trained in the visible-based habitat assessment techniques for a C-4 class stream in New Hampshire. Periodic checks of assessment results will be discussed among the biologists.

13.2 Analytical Quality Control

This section of the QAPP identifies the QC procedures, checks, and samples, and their respective acceptance limits that will be used during the project

13.2.1 Field Analytical QC

Not applicable, as all procedures are sampling.

13.2.2 Fixed Laboratory QC

Not applicable. A fixed laboratory will not be used in this project.

14.0 Data Acquisition Requirements

This section of the QAPP identifies the sources of previously collected data and other information that will be used to make project decisions. None of the data sources referenced in the table below were generated under an approved QAPP. However, methods for collection are the same as those detailed in this QAPP. Data collected from these studies were not validated or generated from models or algorithms.

Under the direction of Dr. Barry Wicklow, St. Anselm students have, prior to this project: 1) determined discharge and current velocity profiles at five transects within the project area; 2) determined discharge at bank full; 3) calculated entrenchment ratio; 4) calculated width-to-depth ratio; 5) measured the depth of undercutting along 30 m of high flood impact bank; 6) qualitatively surveyed macroinvertebrate and fish communities and riparian vegetation; 7) determined sinuosity; and 8) documented the numbers and location of the brook floater mussels. Activities 1-7 were done in spring 2001; activity 8 was done fall 2000. Students will continue their involvement in the analysis and documentation of effects of treatments. Impacts of ice flow on the bank have also been observed over several years.

Table 8. Non-Direct Measurements Criteria and Limitations Table

Non-direct measurement (secondary data)	Data source, report date, data generator, data collection dates	How data will be used	Limitations on data use
Velocity	Aquatic Ecology Program, 2000	Historical Data - velocity	Only five transects measured
Mussels	Aquatic Ecology Program, 2000	Historical Data – mussels	
Mussels	Dr. B. Wicklow, 1993	Historical Data – mussels	

Based on EPA-NE Worksheet #25.

15.0 Documentation, Records and Data Management

This section of the QAPP describes how project data and information will be documented, tracked, and managed from the field to final use and storage in a manner that ensures data integrity and defensibility.

15.1 Project Documentation and Records

The table below summarizes where data will be recorded in the field and how they will be stored for subsequent analysis.

Table 9. Project Documentation and Records Table

Sample Collection Records	Field Analysis Records	Fixed Laboratory Records	Data Assessment Records
Field notebooks	Raw field data in field notebook	None (N/A)	Computer database
Data Sheets	Raw field data	None (N/A)	Computer database/spreadsheet

Based on EPA-NE Worksheet #26.

15.2 Field Analysis Data Package Deliverables

Field analytical data will be used as screening data rather than as definitive data in this project.

Field analytical measurements will be generated instantaneously. Measurements will be recorded in a field notebook, and these data will be transferred to a computer database. Entries into the databases will be compared against the field notebook and habitat assessment sheets by a second person as a quality check.

All raw data will be kept by St. Anselm College. Data will be summarized in the Final Project Report

15.3 Fixed Laboratory Data Package Deliverables

Not applicable as there are no fixed laboratory procedures.

15.4 Data Reporting Formats

No data are being collected in this project for legal proceedings, therefore there are no set procedures for recording data, other than the habitat assessment sheets shown in Appendix 2. Field data will be recorded in a computer database that will be designed for this study. There are no standard procedures for format or content; their content will be appropriate for the project.

15.5 Data Handling and Management

Data Recording.

Data recorded in the field will be stored with the Project Field Manager and transferred to a spreadsheet database (Microsoft Excel), with quality check by a second individual.

Data Transformations/Data Reduction.

Data will be used for graphic representation of velocity profiles and discharge.

Data Transfer/Transmittal.

Data will be transferred from data sheets and field notebooks to a computerized database.

Data Analysis.

Data will likely be analyzed using Microsoft Excel and EPA habitat assessment (EMAP) protocol.

Software.

The following software will be used in data analysis: Microsoft Excel.

Data Assessment.

Data will be cross-referenced with field book entries and computer entries. Calculation of discharge will be verified using manual calculations.

15.6 Data Tracking and Control

Data Tracking

This project is small enough that specific procedures have not been established for tracking data as they are collected, transmitted, and analyzed. All data will be in the custody of the QA Officer/Project Field Manager, and he will make sure that all hard copies and electronic copies are stored in an organized fashion.

Data Storage, Archival, and Retrieval

Hardcopies of the following items will be stored by the QA Officer/ Field Project Manager: maps, photographs, raw data, and final report. A hard copy of the final report will also be on file with the Piscataquog Watershed Association.

Electronic copies of the following items will be stored on the computer of the QA Officer/Field Project Manager: raw data, analytic information, and final report.

Data Security

All data are public information and need not be secured.

16.0 Assessments and Response Actions

This section of the QAPP identifies the number, frequency, and type of planned assessment activities that will be performed for the project.

16.1 Planned Assessments

See Table, below.

In order to determine that field sampling and field analysis are occurring as planned, field staff shall meet, after the first sampling event, to discuss the methods being employed and to review the quality assurance samples. At this time all concerns regarding the sampling protocols and analysis techniques shall be addressed and any changes deemed necessary shall be made to ensure consistency and quality of subsequent sampling.

Table 10. Project Assessment Table

Assessment Type	Frequency	Person(s) responsible for performing assessment, title and organizational affiliation	Person(s) responsible for responding to assessment findings, title and organizational affiliation	Person (s) responsible for identifying and implementing corrective actions (CA), title and organizational affiliation	Person (s) responsible for monitoring effectiveness of CA, title and organizational affiliation
Field Sampling Technical Systems Audit (TSA)	Once at beginning of study	Dr. Barry Wicklow, QA Officer/ Field Project Manager, St. Anselm College	Dr. Barry Wicklow, QA Officer/ Field Project Manager, St. Anselm College	Dr. Barry Wicklow, QA Officer/ Field Project Manager, St. Anselm College	Dr. Barry Wicklow, QA Officer/ Field Project Manager, St. Anselm College

Based on EPA-NE Worksheet #27b.

16.2 Assessment Findings and Corrective Action Responses

Field Sampling Technical Systems Audit - QAPP deviations and project deficiencies determined during the field sampling TSA will be evaluated for source of deviation and corrected with verbal communications in the field. Any necessary written/structural changes will be made through a revision of the SOP for that activity. Field sampling activities will be monitored to determine compliance.

Field Analytical Technical Systems Audit - QAPP deviations and project deficiencies determined during the field analytical TSA will be evaluated for source of deviation and corrected with verbal communications in the field. Any necessary written/structural changes will be made through a revision of the SOP for that activity. Field analytical activities will be monitored to determine compliance.

16.3 Additional QAPP Non-Conformances

Corrective actions will be implemented any time that deviations or errors are noted in field and laboratory work during the project.

17.0 QA Management Reports

No QA Management Reports will be generated for the project. In lieu of frequent QA Management Reports, a QA/QC section will be included in the final project report, and will include the following items:

- Summary of project QA/QC programs and trainings conducted during the project

- Conformance of project activities to QAPP requirements/procedures
- Status of project and schedule delays
- Deviations from the approved QAPP and approved amendments to the QAPP
- Required corrective actions and effectiveness of corrective action implementation
- Data quality assessments in terms of precision, accuracy, representativeness, completeness, comparability, and sensitivity (Refer to Section 20.0)
- Limitations on the use of measurement data generation

Though frequent QA management reports will not be generated, frequent reviews of data (as described in Section 16) will be conducted to determine monitoring efficiency.

The Final Project Report will meet project quality objectives and will include:

- Development of project quality objectives, narrative and timeline of project activities
- Summary of major/critical problems encountered, and their resolution
- Data summary including tables, charts, or graphs with appropriate transect identification and related data
- Reconciliation of project data with project quality objectives
- Conclusions and recommendations

18.0 Verification and Validation Requirements

Tier 3 data validation will be used to evaluate project data. This means that the raw data will be examined in detail to check for calculation, compound identification, and transciption errors.

19.0 Verification and Validation Procedures

This section of the QAPP describes the process that will be followed to verify and validate project data.

Verification.

The table below shows the verification tasks for this project.

Table 11. Data Verification Process

Verification task	Description	Person responsible for verification (name, organization)
Field notes	Field notes will be collected at the end of each day and reviewed internally for completeness, accuracy, and comparability between sample locations and field samplers. Any required corrective actions will be addressed with field samplers prior to further site work. Copies of field notes will be maintained by the QA Officer.	Dr. Barry Wicklow, QA Officer/ Field Project Manager, St. Anselm College

Based on EPA-NE Worksheet #29a.

Validation.

After initial review and evaluation, raw data will be summarized and incorporated in report form. At the completion of the study, a final report will be submitted to NH DES. The report will describe in text, supported by data tables and geographical references, the methods of data collection, results of the field and analytical work, and interpretations.

20.0 Data Usability/Reconciliation with Project Quality Objectives

This section of the QAPP describes how validated project data will be reconciled with the project quality objectives.

This project does not follow the formal DQO process, so Section 20 is not entirely applicable. The following items address some aspects of data review.

Preliminary data review: Data will be reviewed for completeness throughout and at the end of the field study. An evaluation of data completeness will be conducted at this time.

Precision: Results of all field duplicates will be presented separately in tabular format for each analysis.

Accuracy/bias: Data will be compared with cirtical ranges to determine accuracy/bias.

Sensitivity and quantitation limits: See section 7.2.

Completeness: See section 7.2.

Comparability: See section 7.2.

Data limitations and actions: When data do not meet acceptable standards they will be omitted from final analysis. If the data set is limited and questionable but the data must be used, they will be used for reference only and will be footnoted that the data are questionable.