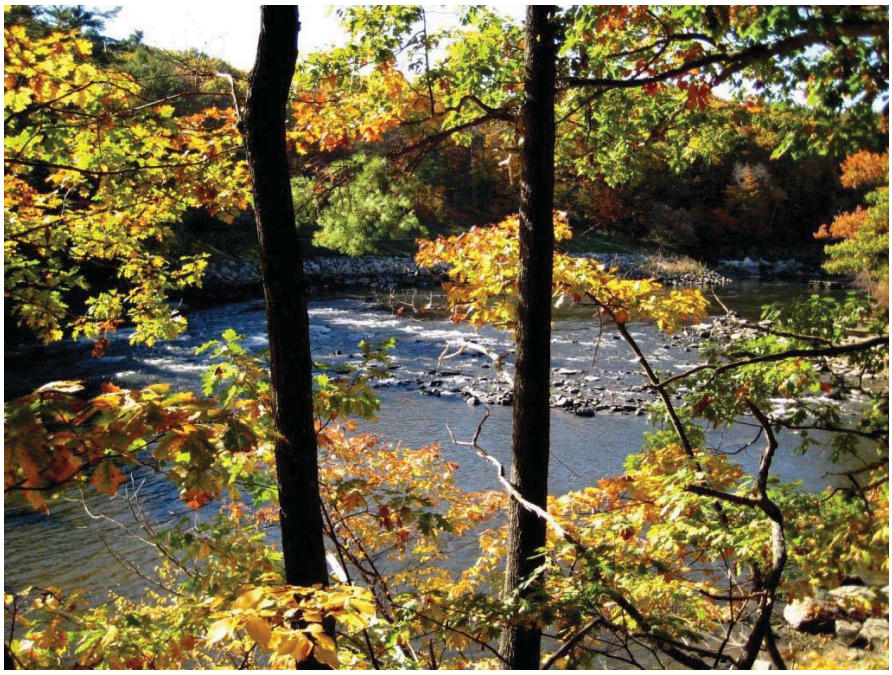
Presumpscot Watershed Initiative

Implementing Water Quality Improvements To Support Vital Fisheries



Final Report

February 2010

Submitted By:

Casco Bay Estuary Partnership
Presumpscot River Watershed Coalition

ACKNOWLEDGEMENTS

The Casco Bay Estuary Partnership and the Presumpscot River Watershed Coalition wish to recognize the following organizations and individuals for their significant contributions toward implementation of the Presumpscot Watershed Initiative:

Casco Bay Estuary Partnership: Beverly Bayley-Smith, Curtis Bohlen, Matt Craig, Karen Young
Cumberland County Soil and Water Conservation District: Chris Baldwin, Jami Fitch, Betty McInnes, Tamara Lee Pinard, Sarah Plummer, Heather True, Betty Williams
Friends of Casco Bay: Mary Cerullo, Mike Doan, Peter Milholland, Joe Payne, Cathy Ramsdell
Maine Dept. of Environmental Protection: Joe Anderson, Malcom Burson, Margaret Chabot, Melissa Evers, Wendy Garland, Don Kale, Norm Marcotte, Jeff Varricchione
ORBIS Mapping Solutions: Kirsten Boettcher, Rosemary Mosher
Presumpscot River Watch: Forrest Bell, Tim Bennett, Casey Dalton, Fred Dillon
Presumpscot River Watershed Coalition: Lee Carlton, Andy Colvin, Erin Crowley, Will Plumley
Presumpscot River Youth Conservation Corps: Chad Brown, Michael Coty, Myles Crawford, Jessica Curlew, Andrew Darkenwald, Emma Deans, Christopher Dunn, Joe Ferrian, Ben Goodness, Joe Kirkbride, Evelyn Lane, Becky McKinnon, Julien Morton, Emily Myshall, Jeremy Lowell, Chelsea Smith, Warren Taylor, Nora Theodore, Sam Tureff, Lisa Vickers
University of Southern Maine: Rob Sanford
U.S. Environmental Protection Agency, Region 1: Diane Gould

As well as key partners on-the-ground:

Audubon International
Breezy Knoll Farm
Interlocal Stormwater Working Group
City of Portland
City of Westbrook
Clark Farm
Ethos Marketing and Design
Falmouth Country Club
Falmouth Land Trust
FB Environmental
Friends of the Presumpscot River
Hartwell Farm
Maine Audubon
Maine Board of Pesticide Control
Maine Conservation Corps
Maine Dept. Inland Fisheries and Wildlife
Maine Landscapers and Nurseries Association
Maine Conservation Corps
Maine Department of Transportation
Natural Resource Conservation Service
New England Chiropractic
Portland Trails
Portland Water District
Presumpscot Regional Land Trust
River Meadow Golf Course
Riverside Golf Course
SAPPI Fine Paper
Shaw Brothers
Sunset Ridge Golf Course
Town of Cumberland
Town of Falmouth
Town of Gorham
Town of Gray
Town of Standish
Town of Windham
University of Maine Cooperative Extension
U.S. Fish and Wildlife Service
Val Halla Golf Course
Vienna Farm
Walnut Crest Farm

Table of Contents

LIST OF TABLES

LIST OF ABBREVIATIONS AND TERMS

AI – Audubon International
BMP – Best Management Practice
BPC – Maine Board of Pesticide Control
CBEP – Casco Bay Estuary Partnership
CCSWCD – Cumberland County Soil and Water Conservation District
DEP – Maine Department of Environmental Protection
DMR – Maine Department of Marine Resources
DO – Dissolved oxygen
DOT – Maine Department of Transportation
DMR – Maine Department of Marine Resources
EPA – U.S. Environmental Protection Agency
FOCB – Friends of Casco Bay
FOPR – Friends of the Presumpscot River
GIS – Geographic Information Systems
GPS – Global Positioning System
HUC – Hydrologic Unit Code
IFW – Maine Department of Inland Fisheries and Wildlife
ISWG – Casco Bay Interlocal Stormwater Working Group
MeLNA - Maine Landscapers and Nurseries Association
MS4 – Municipal Separate Stormwater Sewer Systems
NMP – Nutrient Management Plan
NPDES – National Pollutant Discharge Elimination System
NPS – Nonpoint Source
NRCS – Natural Resource Conservation Service
PRW – Presumpscot River Watch
PRWC – Presumpscot River Watershed Coalition
PRYCC – Presumpscot River Youth Conservation Corps
PWI – Presumpscot Watershed Initiative
STORET – U.S. EPA Storage and Retrieval Data Warehouse
TWG – Targeted Watershed Initiative Grant
UMCE – University of Maine Cooperative Extension
USFWS – United States Fish and Wildlife Service
USM – University of Southern Maine
WEPP – Water Erosion Prediction Project
WQX – U.S. EPA Water Quality Exchange Database

EXECUTIVE SUMMARY

Presumpscot Watershed Initiative

Executive Summary

Casco Bay Estuary Partnership

Historical Background

The Presumpscot River flows 27 miles from Sebago Lake into Casco Bay and the Gulf of Maine. The river's watershed encompasses 205 square miles of primarily forested and agricultural land. The river itself has a history of extensive industrial use since the early 1700s. By the 1950s, the river had nine dams and was so polluted that fumes from the river peeled paint off nearby homes. Prior to industrialization, there were abundant salmon, alewife, shad, smelt, and eel fisheries, which have since been greatly diminished.

In recent years the water and habitat quality of the river have improved with the cessation of pulp mill discharges in the 1990s and the removal of Smelt Hill Dam in 2002. Anadromous fish are returning to the river's main stem and tributaries.

Environmental Challenges

While the river has recovered from some past problems, increased watershed and shoreline development are leading to impacts to the environment:

- Toxic chemicals and excess nutrients flow into the river system with stormwater from impervious surfaces.
- Excess sedimentation from roadways and livestock activities is causing deterioration of fish spawning areas.
- The loss of riparian vegetation is causing thermal impacts, which impair the water quality for cold water fisheries.

Targeted Watershed Grant

In order to build on the recent improvements in the river, the Presumpscot River Watershed Coalition and the Casco Bay Estuary Partnership (CBEP) applied to the highly competitive US Environmental Protection Agency's *Targeted Watershed Grant Program*. In 2006, they were awarded nearly $740,000 to implement the *Presumpscot Watershed Initiative* (PWI): a successful three year collaborative project focused on enhancing riparian habitat, reducing contaminant loading, and fostering increased stewardship among watershed inhabitants through a series of innovative partnerships.

Interactive Online Maps and Final Report

To highlight work accomplished during the Presumpscot Watershed Initiative and share project outcomes, Presumpscot River Watch joined with Orbis Mapping to create a series of interactive watershed maps with links to site-specific project summaries, graphs, and photos. The interactive maps and final report can be accessed from the PWI project web site at http://www.presumpscotcoalition.org/geo.html.

PROJECT FACTSHEET

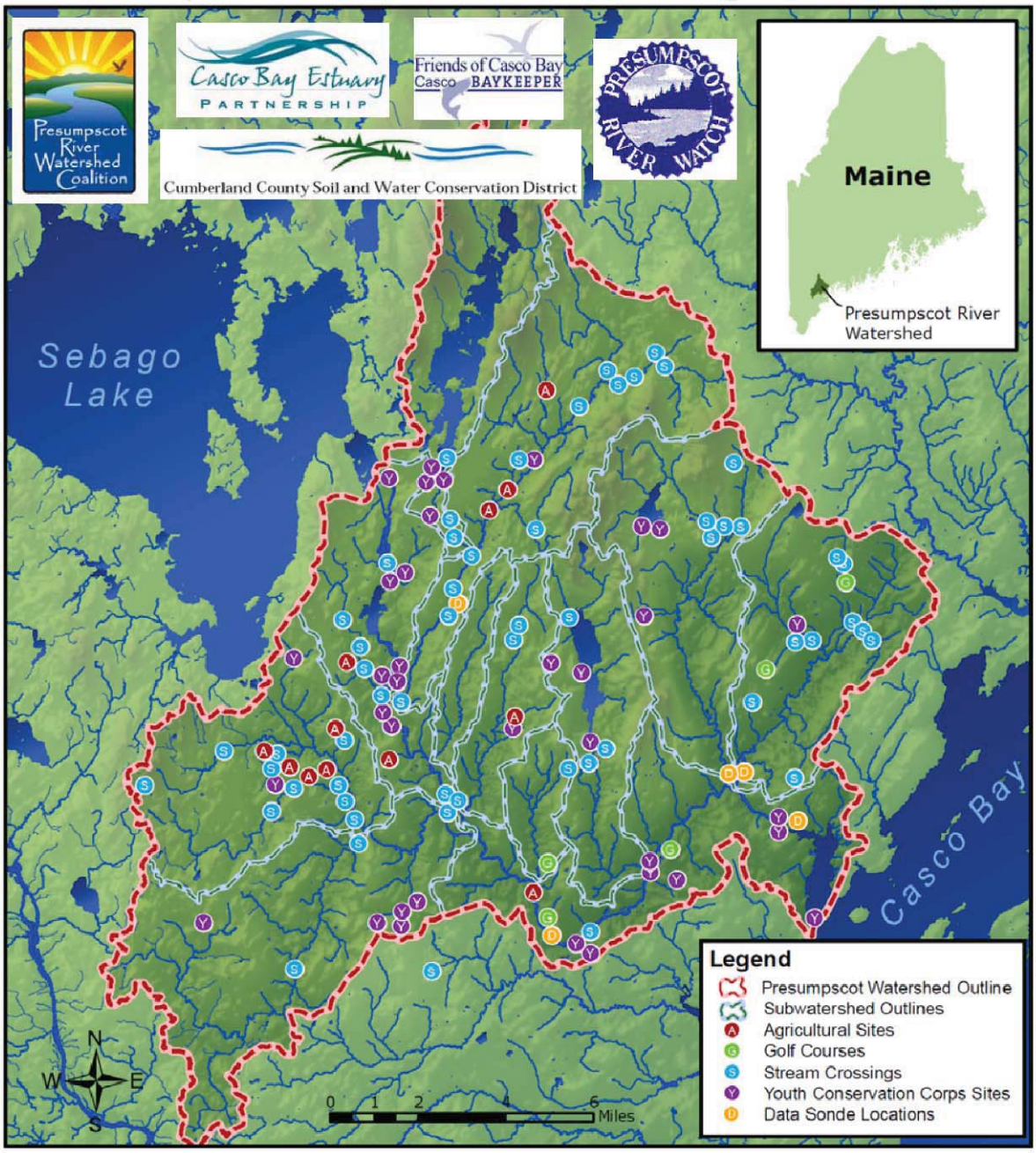
The success of the Presumpscot Watershed Initiative was the result of many partners working together throughout the watershed to improve habitat and water quality and to foster stewardship. In addition to the Casco Bay Estuary Partnership, partners included:

- Cumberland County Soil and Water Conservation District
- Friends of Casco Bay
- Presumpscot River Watch
- Presumpscot River Watershed Coalition
- Maine Department of Environmental Protection
- Municipal road crews, state agencies, golf courses, citizen volunteers, landowners, schools, and many others!

Presumpscot River Youth Conservation Corps members rebuild the canoe launch Gorham's Shaw Park to prevent further erosion.

Walnut Crest Farm owner Dale Rines machine plants white and red pines on four acres of pasture along river. Livestock were fenced from the area to promote revegetation.

Presumpscot River Watershed - Project Locations



Map by R. Mosher, Orbis Mapping

Completed Tasks

"Yardscaping" to Reduce Nonpoint Source Pollution

The "Yardscaping" task, led by Cumberland County Soil and Water Conservation District (CCSWCD) and Friends of Casco Bay, provided education on the impact of lawn chemicals on the environment, children, and pets. It also promoted healthy lawn care practices (including the best ways to mow, seed, aerate, and use compost). Community education classes and workshops reached 135 homeowners, 17 municipal maintenance workers from five watershed communities, and over 130 landscapers. Outreach efforts included point-of-sale promotions in 16 stores and nurseries in 10 communities. Follow-up studies and surveys among participants suggest that this ongoing program has a real impact on homeowner lawn care choices. Details of safe "Yardscaping" practices are provided at www.cumberlandswcd.org/yardscape.htm.

The new watering system for livestock on Walnut Crest Farm.

Agricultural Management

This task, led by CCSWCD staff, provided technical assistance and cost-share funds for landowners at five farms to address stream pollution and bank erosion. Landowners prevented 417 livestock from accessing and polluting streams, and planted 1,625 linear feet of riparian buffer with trees and shrubs. *Highlight:* Walnut Crest Farm in Gorham lies on the Presumpscot River. As part of the PWI project, the landowner installed 630 feet of fencing to exclude cattle from the river and a perennial stream. A new watering system was installed several hundred feet from the river. In 2006, the landowner planted 4,000 pine, hardwood and shrub seedlings in a four acre field that included 300 feet of frontage along the riverbank and 1,200 feet of frontage along the sides of the perennial stream. This successful project was highlighted in a front page article in the *American Journal* in October, 2007.

Totten Road crossing of Thayer Brook in Gray. Installation of a bottomless culvert pre- (above), and post- (below) installation.

Stream Crossing Erosion Control and Culvert Replacement

CCSWCD staff provided municipal road crews with technical assistance and PWI-funded cost-sharing to address erosion and runoff problems at 46 stream crossing sites (plus one private road) in seven watershed communities. A total of 13 culverts were installed to replace existing failed or undersized culverts and approximately 670 tons of potential sediment pollutant were controlled. The participation of the road crews, Maine Department of Transportation, and volunteers from road associations contributed to the success of this effort. *Highlight:* The installation of a fish-friendly bottomless culvert in Gray resulted from a remarkable opportunity to partner with the Town, the CBEP Habitat Restoration Committee, and the Maine Department of Inland Fish and Wildlife. The project replaced existing inadequate twin culverts with a 14-foot span open bottom culvert that provided full fish passage, addressed stream-bank erosion, and prevented flooding of nearby fields. The installation serves as a demonstration site for local contractors and public works departments.

PRYCC crew members install infiltration steps on an eroding swimming hole access trail adjacent to a local road.

Presumpscot River Youth Conservation Corps

The pilot PRYCC, made up of trained high school students, focused on riparian buffer enhancement, prevention of soil erosion, and improved water quality. The PRYCC also provided youth with hands-on opportunities to be stewards of the river. The PRYCC was managed by CCSWCD and guided by the Casco Bay YCC Collaborative. During the summers of 2006 through 2008, crews planted six riparian areas with a total of 1,381 trees and shrubs. Riparian planting occurred at the former Smelt Hill Dam in Falmouth, Bicentennial Park in Westbrook, Riverton Trolley Park in Portland, Route 35/Presumpscot River crossing in Standish and Windham, and Shaw Park and Vienna Farm in Gorham. Best Management Practices were installed at 50 sites, including stabilization of six miles of trail. The crews also removed 400 pounds of invasive plants. To educate the general public about water quality impacts, the crews stenciled 442 storm drains with a "Don't Dump" message.

Golf Course Environmental Certification and Equipment Wash Pads

Working with Audubon International guidelines, Presumpscot River Watch and five shorefront golf courses improved water quality management and reduced chemical use. A total of 70,000 square feet of riparian area were designated

as no-mow zones, and 4,500 square feet of eroding streambank, culvert inlets/outlets, and equipment fueling and wash areas were stabilized.
Highlight: Falmouth Country Club began brewing compost tea, which adds beneficial microorganisms to the soil, for greens application. Fungicide applications were reduced by nearly 50%, more than paying for the program. The course also constructed an equipment wash area to filter grey water through a silt pond rather than directing it to the Piscataqua River.

The new compost tea brewer at Falmouth Country Club.

Maps for Schools Program

CCSWCD staff taught watershed and mapping concepts to a total of 1,085 middle-school students from seven local communities to foster their sense of place and stewardship. Activities included field water quality sampling and building model landscapes. Participating schools were given a CD Resource Guide for teachers, incorporating interactive GIS maps with a series of corresponding lesson plans. Workshops trained 28 educators on using the maps, ensuring that the program will continue to reach new students.
Highlight: Falmouth Middle School sixth graders presented research on watershed stakeholders and nonpoint source pollutants to peers, parents, and local conservation commissioners.

Students work with laminated maps as part of the Maps for Schools Program.

Water Quality Monitoring

Presumpscot River Watch and Friends of Casco Bay deployed unattended data sondes at five locations in the watershed to record water quality data between 2006-2008, creating an extensive baseline data set on temperature, dissolved oxygen, pH, conductivity, and turbidity levels in the Presumpscot River and its tributaries.

The Future

The partnerships developed and strengthened through the PWI are having a lasting impact on water quality, habitat protection, and educational activities. For example, CBEP and partners are assessing road/stream crossings for barriers to fish passage; working to ensure that anadromous fish can pass Cumberland Mills Dam; and addressing sedimentation in the Pleasant River. Monitoring equipment is available on-loan from CBEP. Overall, the PWI has built local capacity to address environmental impacts, raised the public visibility of watershed issues, and helped to ensure that the Presumpscot River will continue to recover.

Presumpscot River Watch staff prepare to deploy a data sonde to monitor water quality in the Pleasant River.

Protecting & restoring the ecological integrity of the Casco Bay watershed

Casco Bay Estuary Partnership

The Casco Bay Estuary Partnership works to preserve the ecological integrity of Casco Bay and to ensure compatible human uses of the Bay's resources, through public stewardship and effective management.

Casco Bay Estuary Partnership · Muskie School of Public Service · University of Southern Maine
PO Box 9300 · Portland, ME 04104-9300 · 207.780.4820 (phone) · 207.228.8460 (fax) · www.cascobayestuary.org

INTRODUCTION

Summary from 2005 Targeted Watershed Initiative Grant Proposal

Presumpscot River Watershed Hydrologic Unit Code (HUC): 01060001

The Presumpscot River, the largest freshwater source to Casco Bay, flows for 27 miles from Sebago Lake to the Presumpscot Estuary, draining a 205 mile^2 watershed that includes parts of 12 municipalities in Cumberland and York Counties (Figure A). The watershed, which encompasses much of the greater Portland metropolitan area, is among the most developed and fastest-growing watersheds in Maine. Impervious surfaces cover 7% of the entire watershed, and within subwatersheds, impervious surface coverage ranges between 4% (Inkhorn Brook) and 12% along the Presumpscot main stem (Table A).

Historically, the 'Pes-ompsk-ut", or "river of many rough places," was primarily a riffle and pool system that supported abundant salmon, shad, and alewife stocks. Since the early 1700s, dams have blocked fish passage and severely altered the physical characteristics of the River. In 2000, the Presumpscot was identified as the 13th most endangered river in the United States, primarily due to nine dams (now eight) that impound the river without fish passage (American Rivers 2000).

The Presumpscot River is a river in recovery. In 1999, pulp mill discharges to the Presumpscot ceased and water quality has dramatically improved on the river, prompting a movement to upgrade the State water body classification. In 2002, the Smelt Hill Dam, the lowest of the nine dams on the river, was removed so that the lower seven miles of the Presumpscot and 100 miles of tributaries now flow freely to the estuary allowing unrestricted access for anadromous fish. Seven of the other dams have undergone re-licensing that will lead to opportunities to restore anadromous fish passage further upstream.

Despite recent improvements, water quality within some sections of the watershed remains degraded. The lower Presumpscot River and nine tributaries were on Maine's 2002 list for impaired water bodies (DEP 2002) at the time the Targeted Watershed Initiative Grant proposal was written. Presumpscot River Watch (PRW) monitoring data suggested that several other monitored tributaries did not meet class B standards for dissolved oxygen and bacteria during the summer months. Sedimentation via runoff and erosion altered stream channels and degraded fisheries habitat. Cumulative impacts from nonpoint source pollution were identified as a primary source of degradation.

Figure A. Presumpscot River watershed (R. Mosher).

In 2000, in response to the aforementioned significant changes on the River and with strong local stakeholder support, the Casco Bay Estuary Partnership (CBEP) convened a broad-based stakeholder group to develop a management plan for the Presumpscot River. The foundation of *A Plan for the Future of the Presumpscot River*, (the *Presumpscot Plan*) was a series of three detailed white papers containing a wealth of credible scientific analyses. The prioritized goals of the *Presumpscot Plan* are to mitigate cumulative impacts, restore native anadromous fish, and protect and restore high value riparian habitats.

The Presumpscot River Watershed Coalition grew out of the stakeholder process that developed the *Plan* and is firmly committed to its implementation. CBEP facilitates and provides support to this diverse group which represents a variety of interests in the watershed including municipalities, non-profit organizations, regional government entities, state and federal agencies, and businesses.

PRWC partners collaboratively developed the Targeted Watershed Initiative Grant proposal with the aim of implementing recommendations in the *Presumpscot Plan* to address cumulative impacts. Several tasks in the PWI Workplan addressed a high priority action from the *Presumpscot Plan* to: "Identify and remediate nonpoint sources of pollution." Assessment and monitoring work initiated by PRWC partners found that roadways and livestock were impacting stream crossings, resulting in streams with excess sedimentation and subsequent deterioration of important fish spawning areas. Additionally, inputs from nutrients and toxics from residential areas and golf courses and the thermal impacts of lost riparian vegetation were identified as further impairments to water quality for the sensitive cold water fisheries targeted for restoration. Water quality improvements were identified as necessary to promoting the return of native and anadromous fish species.

In 2005, CBEP and PRWC jointly submitted the successful Targeted Watershed Initiative Grant (TWG), with assistance from the primary PWI partners, Cumberland County Soil and Water Conservation District (CCSWCD), Friends of Casco Bay (FOCB), and Presumpscot River Watch (PRW). The Presumpscot Watershed Initiative (PWI) Workplan was designed to lower the overall sediment, bacteria, nutrient, and pesticide loads to the watershed. The suite of Workplan tasks addressed identified sources of water quality degradation and demonstrated better land stewardship to multiple stakeholder groups through partnerships with homeowners, students, and municipalities, as well as farms and golf courses. The monitoring components of the project built on prior baseline data for the river. The project's educational outreach element transferred information and knowledge gained to watershed stakeholders and provides a model for other watersheds facing similar challenges. The PWI was implemented between February 2006 and December 2009.

Table A. Presumpscot River subwatershed statistics (R. Mosher).

Sub Watershed	Acres	Sq Miles	%Area	Population[1]	%Pop	Density (Pop per Acre)	Avg Density	Imperv (sq m)[2]	Imperv (sq Mi)[2]	Imperv Acres[2]	% Imperv
Black Brook	2500	3.9	2%	1,045	2%	0.4	1.1	897,008	0.3	221.7	9%
Colley Wright Brook	4898	7.7	4%	2,040	3%	0.4	1.9	1,590,929	0.6	393.1	8%
E. Branch Piscataqua R.	1264	19.8	10%	6,346	10%	5.0	5.2	3,842,124	1.5	949.4	8%
Highland Lk/Mill Bk	8724	13.6	7%	4,489	7%	0.5	2.9	1,629,664	0.6	402.7	5%
Inkhorn Brook	2504	3.9	2%	529	1%	0.2	1.3	391,905	0.2	96.8	4%
Little R./Tannery Br.	1834	28.7	14%	7,086	11%	3.9	1.8	4,657,151	1.8	1,150.8	6%
Little Sebago/Ditch Br.	1294	20.2	10%	3,448	5%	2.7	1.7	2,311,270	0.9	571.1	4%
N. Branch Little/Douglas	1319	20.6	10%	4,062	6%	3.1	1.1	3,081,062	1.2	761.3	6%
Piscataqua River	1357	21.2	10%	4,013	6%	3.0	1.3	4,151,091	1.6	1,025.8	8%
Pleasant R./Baker Br.	1835	28.7	14%	6,285	9%	3.4	2.1	4,818,384	1.9	1,190.6	6%
Presumpscot Main Stem	2379	37.2	18%	26,921	41%	11.3	10.2	11,855,277	4.6	2,929.5	12%
Entire Watershed	29908	205.4	100%	66,263	100%	2.2	5.1	39,225,867	15.1	9,692.9	7%

Notes:

1 - Populations are estimated by pro-rating the population of census units that fall both inside and outside of a watershed.

2 - Impervious calculations based on 2005 GIS data obtained from the Maine Office of GIS.

Final Expenditures

The initial overall budget for the Presumpscot Watershed Initiative was $986,576, including $739,942 in US EPA Targeted Watershed Initiative Grant monies, and an estimated $246,634 in match. The final PWI budget was $1,076,143.24, including $739,942 in TWG funding and $336,201.24 in match. Non-federal match amounted to 31.2% of overall PWI costs.

Tally of Implementation Activities

Overall, one hundred and sixteen sites were addressed through Presumpscot Watershed Initiative (Table B), not including education and outreach activities (Task 6), or water quality monitoring activities (Task 7).

Table B. Summary of PWI project site distribution by subwatershed.

Project Sites					
Watershed	Agricultural	Stream Crossing	Golf Course	Youth Conservation Corps	Total
Black Brook		1			1
Colley Wright Brook	1	2		1	4
E. Branch Piscataqua R.		10	2	1	13
Highland Lake/Mill Brook		3		4	7
Inkhorn Brook		1	1		2
Little R./Tannery Br.		2		5	7
Little Sebago/Ditch Br.		3		4	7
N. Branch Little/Douglas	7	10		2	19
Piscataqua River		5		3	8
Pleasant R./Baker Br.	3	12		1	16
Presumpscot Main Stem	3	9	2	18	32
	14	58	5	39	116

Continuing Activities

Following the completion of the PWI, several activities launched through the grant are continuing. Examples include:

- The Casco Bay Estuary Partnership and the Presumpscot River Watershed Coalition are collaborating to deploy PWI-purchased sondes to monitor water quality in the lower main stem of the Presumpscot in 2010 and 2011, with the PRWC goal of requesting reclassification of the lower main stem from Class C to Class B waters. Friends of Casco Bay is embarking on parallel efforts in the Presumpscot Estuary.
- The Cumberland County Soil and Water Conservation District is utilizing the materials and resources developed from the Maps For Schools program to carry on educational activities in Presumpscot watershed schools.
- The Casco Bay Interlocal Stormwater Working Group is building upon the existing YardScaping program to further education efforts and expand low impact yard and landscaping practices.

- The Presumpscot River Watershed Coalition is using lessons learned from the agricultural improvement program to focus on agricultural non-point sources of pollution in the Pleasant River watershed, a major tributary to the Presumpscot.

The tools, capacity, knowledge, and new relationships gained during implementation of the Presumpscot Watershed Initiative continue to protect and improve water quality in the Presumpscot River watershed.

About This Report

This report is a compilation of information provided by the primary PWI implementation partners. Each task had an organizational 'lead implementer' identified in the Workplan. The lead implementer was responsible for providing report information for their given task throughout the project period, including for this final report.

The Workplan was broken into nine separate tasks. The order of these tasks, as well as their numbering within the Workplan, was maintained in this report, so that Task 1 within the Workplan (YardScaping) is now Chapter 1 in the final report. A brief summary of goals and objectives for each Workplan Task is provided at the start of each chapter. Although water quality monitoring was written into the Workplan in association with multiple PWI tasks, all monitoring is reported on in Chapter 7.

Innumerable documents, datasets, images, presentations, data sheets, maps, and other project materials were developed or prepared during the PWI. Rather than include all of these as appendices to this report, selected materials were printed and included to highlight success stories. Additional materials, included databases referred to in the report, as well as an electronic version of this report, are available in electronic format from Matt Craig of the Casco Bay Estuary Partnership.

1 "YARDSCAPING" TO REDUCE NONPOINT SOURCE POLLUTION

Lead Implementer: Cumberland County Soil and Water Conservation District

1.1 OVERVIEW

Workplan Summary: *CCSWCD will work with FOCB and others to pilot the YardScaping program that incorporates outreach, research, demonstration, and incentives to educate the public about the transport of pesticides and fertilizers into the Presumpscot River.*

The goals of the YardScaping task were as follows:

- Educate homeowners and raise awareness in order to decrease loads of lawn chemicals to the Presumpscot River.
- Demonstrate an increase in knowledge of the impact of lawn chemicals on the environment, children and pets.
- Establish recognition that individual actions affect water quality.
- Demonstrate that natural lawn care practices can result in a nice lawn.
- Quantify changes in YardScaping behavior based on increased awareness and pledges of commitment.

This Chapter was written by CCSWCD.

The intent was to accomplish these goals by carrying out YardScaping socials that would be modeled after the successful Washington Sea Grant Septic Social Program that helped to familiarize homeowners with their septic systems and resulted in 100% of the social participants changing their septic system practices based on the information exchanged during the social.

CCSWCD worked with FOCB, the Maine Department of Environmental Protection (DEP), and the Maine Board of Pesticide Control (BPC) to pilot YardScaping socials that incorporated education, research, demonstration, and incentives to educate the public about the potential transport of pesticides and fertilizers to the receiving waters of the Presumpscot River. The aim was to reduce pollution stemming from the application of lawn and garden chemicals by homeowners, developers, businesses, and municipalities by providing clear and effective recommendations for lawn and garden care that delivers aesthetic and recreational benefits while safeguarding water quality.

Performance Measures were outlined as:

- Participation in the YardScaping socials.
- Demonstration of increase in understanding of the impact of lawn chemicals on children and pets.
- Recognition that individual actions affect water quality.

This chapter describes implementation activities between February 2006 and December 2008.

1.2 TASK IMPLEMENTATION

Section 1.2 provides detailed descriptions of the methodology and strategies behind the YardScaping program and its formation. Since there is considerable information within each subsection about adaptations to improve and modify the program during implementation, there is not a separate 'lessons learned' section for this chapter.

1.2.1 ACTIVITIES

1.2.1.1 HOST IDENTIFICATION

The PWI Workplan identified conservation commissions as key local partners to help identify and secure hosts for YardScaping socials. Project staff later determined through the phone survey and lawn care focus groups, discussed below, that the best people to serve as hosts are those who are not viewed by the general public as "environmentalist," and changed their approach accordingly. CCSWCD worked in communities throughout the Presumpscot River watershed to secure hosts for YardScaping socials. The entire host identification process was focused not only on finding key neighborhoods, but also on finding key people within those neighborhoods.

CCSWCD determined that individuals have strong personal feelings about lawn care. While people are interested in learning more about what they can and should do to manage their lawn in a low impact manner, they are less inclined to want to have someone at their house to share that information. CCSWCD subsequently changed our approach from the original septic system social model in order to take advantage of other opportunities to disseminate YardScaping information.

1.2.1.2 INFORMAL SURVEY

Upon researching the process of developing and carrying out an informal survey, CCSWCD decided that a more formal, statistically significant phone survey for the target population would better serve the long term vision of this effort, which included expanding the effort to include communities outside of the Presumpscot River watershed area. The survey was designed to guide educational efforts in regards to lawn care in 14 urbanized communities in the Greater Portland/Presumpscot/Casco Bay region, working collectively as the Interlocal Stormwater Working Group (ISWG). The survey was tested and finalized. Survey packets were compiled that included instructions, phone numbers, and copies of survey and refusal surveys. Phone-a-thons were coordinated to provide an inexpensive mechanism for gathering data. Preliminary results were compiled into a presentation for the December 2006 CBEP Board meeting.

The phone survey provided the following notable results: Of the 388 phone survey participants, 14% did not have a lawn; 18% hired a lawn care company; and 68% were lawn care do-it-yourselfers. When asked, "What would most encourage you to use more natural weed and bug control methods?" 52% - protect the health of kids and pets; 42% - protect

water quality; 31% alternatives that are as effective; 28% knowing the alternatives.

When asked, "On a scale of 1 to 6 where 1 = not important and 6 = very important, how important is it to you to have a perfect lawn?" For those who hired a lawn care company, 4-6 = 52.3% of the answers where do-it-yourselfers answered 4-6 = 34.5%. Not important (1) was 25.6% of the do-it-yourselfers but only 6.2% of those who hire a lawn care company. When asked, "Why do you like a maintained and manicured lawn" Looks nice and enhances property values were the most popular answers with the breakdown as follows between do-it-yourselfers and those who hire a lawn care company: Looks nice 47.8%/64.8%; enhances property values 11.8%/24.6%.

When asked to give their best estimate of how many times a year the following are used, this was the results for do-it-yourselfers vs. those who hire a lawn care company (Table 1-1).

Table 1-1. Number of times per year that lawn care chemicals were applied.

Lawn Care Company	Once	Twice	Three +	Never
Weed & Feed	19%	15%	19%	31%
Lawn fertilizer	22%	27%	33%	13%
Do-it-yourselfers				
Weed & Feed	21%	3%	4%	67%
Lawn fertilizer	24%	10%	5%	55%

This information helped to further refine our approach. An opportunity existed to get information to those hiring lawn care companies that they are paying for product that they do not need in order to have a nice lawn (i.e., research supports that in Maine fertilization one time per year is generally more than adequate, depending on the soil test). This information would need to be conveyed on a one-on-one basis through homeowner association meetings or neighborhood socials.

Lastly, the survey covered outreach methods. When asked, "Where have you gotten information about local water quality issues?" multiple answers were accepted and no list of options was read. Newspapers were the overwhelming lead with 44.5% response followed by TV (28.2%), brochures (9.9%), Newsletter (7.2%), Word of mouth (6.7%), billing insert (6.2%), radio (5.9%), meetings (5.1%) and public events (4.7%).

The demographics of the 388 respondents were as follows: 87.5% own their home; 58.9% of the respondents were female; Age ranges were 18-24 (4%), 25-34 (5.8%), 35-44 (15.4%), 45-54 (27.3%), 55 – 64 (21%), over 64 (25.2%); and education levels were some high school (4.3%), high school graduate (23.7%), some college/trade (24%), 4-yr college (26.9%), graduate + (21.6%). Demographic information has been utilized in analysis of particular target audiences.

Results from the fall 2006 phone survey were first used to guide the development of questions

for a lawn care focus group that was undertaken by DEP. Focus groups involve bringing together small groups of people to explore issues through open-ended questions. The lawn care focus group helped bring about a deeper understanding of what natural lawn care practices were the most palatable in addition to how to communicate this information.

Figure 1-1. 'Ducky', star of the *Think Blue Maine* campaign.

The combination of information generated from the phone survey and focus groups helped CCSWCD tailor the YardScaping programs and materials to effectively communicate to the target audience. The focus groups highlighted that the "ducky" TV ad campaign (www.thinkbluemaine.org) that ran throughout Maine in 2004 and 2005 had resonated with people. The marketing specialist who convened the focus groups highlighted the ducky (Figure 1-1) as a brand that should be used to promote all stormwater education efforts, including lawn care. Research also showed that many homeowners who maintain their own lawns believe in the importance of environmentally-friendly practices. However, in many cases, the same homeowners don't understand which lawn care products are less harmful to water quality, how to use them properly, or what practices they could change to decrease polluted runoff from their property while still achieving desired lawns.

This research also identified that Maine citizens look for information about what they should put on their lawns at the point of purchase/sale and that the timing of messages is important, since lawn care is not a topic that is frequently considered outside of the moments when lawn care decisions are being made or activities undertaken.

A lawn care consumer/point of sale program was developed to address this need to reach homeowners. In addition, CCSWCD recognized that in order for lawn care education to truly be successful, the message needed to be made available in a number of different formats at a variety of venues. Therefore, a multi-dimensional program was developed that had the following components:

- YardScaping materials that utilized the ducky, which was identified by focus groups as a symbol of water quality efforts in Maine.
- Press releases, feature articles and newsletter articles.
- Static and interactive displays for municipal offices and community events.
- Website.
- Community Education - for homeowners, municipal officials and landscapers.

The accomplishments and lessons learned are documented for each of these components.

1.2.1.3 YARDSCAPING MATERIALS

Many of the YardScaping materials listed below went through a number of permutations before we were satisfied that we had the best format with descriptive graphics and text that was succinct yet still conveyed the sometimes complex information of natural lawn care.

Figure 1-2. YardScaping door hanger (front).

- "Do You Want a Lush Green Lawn Safe for Kids and Pets" brochure
- Fact sheets: Mow Better, Topdressing, Aerate, Overseed, Fertilizing, Compost Tea, Lawn Care Calendar, Soil Test, Brewing & Applying Compost Tea, Water Wisely, Grubs, Ants and Why YardScape?
- Reproduction permission was attained for the article "Organic Doesn't Always Mean it's Safe" (Paul Tukey – April 2006) and the fact sheet, "Pesticides & Your Health" (Healthy Communities Project)
- YardScaping website was launched in April 2007 under the CCSWCD website (www.cumberlandswcd.org/yardscape.htm)
- Website survey to ascertain the effectiveness of various YardScaping outreach efforts
- Agenda, presentation and supporting visuals for two hour Adult/Community Education YardScaping class
- Tri-fold YardScaping display
- Three "Turf tidbits" fact sheets for use in church bulletins/programs
- Bookmark with lawn care tips
- Two door hangers – one targeted at homeowners who do their own lawn care and one for homeowners who hire a lawn care service (Figure 1-2)
- Seven shelf talkers to provide more information about YardScaping practices and direct customers to other YardScaping products
- Promotional poster for Point of Sale program
- Store front poster

Additional selections from this list of YardScaping materials are included in Appendix A.

1.2.1.4 YARDSCAPING MEDIA COVERAGE

Project staff were successful in raising the YardScaping program's visibility through media outlets (some articles discussing YardScaping principles without directly referencing the YardScaping program). The following articles were published during the project period:

- Spring/Summer 2006 – Cumberland County Soil and Water Conservation District Newsletter, "Spring YardScaping Tips – Lush Lawns for Less" Volume 3, Issue 1.
- 8/3/06 - "Is Your Lawn Chemical Free? Maybe it should be," Forecaster – all four editions (Northern, Southern, Portland and Mid Coast).
- 3/4/07 – "Writer lays out how to keep lawns and their users healthy" Tom Atwell, Maine Sunday Telegram, pg G3 (overview of Paul Tukey's, *Organic Lawn Care Manual*).
- 3/8/07 – "Do green lawns make green water?" John Richardson, Portland Press Herald, pg B1 (new phosphorus fertilizer bill).
- 3/9/07 – "Restricting phosphorus is clearly good for lakes." Portland Press Herald, pg A8 (new phosphorus fertilizer bill).
- 3/10/07 – "The grass of home gets greener" John Richardson, Portland Press Herald, pg B1 (Portland Flower show article highlighting environmentally friendly lawn care as a hot topic).
- Spring/Summer 2007 - Cumberland County Soil and Water Conservation District Newsletter
- 11/1/07 - "Autumn is no time to start abandoning your lawn." Windham Independent with a color photo of 10 month old Windham resident playing on her safe, healthy lawn.
- Winter 2007/2008 - Maine Department of Environmental Protection, Nonpoint Source Times Article, "YardScaping in 13 Southern Maine Communities," Volume 17, Issue 1.
- Winter 2008 – "YardScape: Healthy Lawn Care Made Simple" Classes Now Available, Cumberland County Soil and Water Conservation District 2007 Annual Report.
- July 2008 - Provided input for EPA News Notes article on the YardScaping program. The article was printed in EPA's Nonpoint Source News-Notes, Issue #84.
- 7/24/08 - "Looking at lawns from the ground up: Q&A with Courtney O'Neil," American Journal feature article.

Selections from this list of YardScaping media coverage are included with other PWI media coverage in Appendix H.

1.2.1.5 COMMUNITY DISPLAYS

CCSWCD staff developed mobile YardScaping displays for use at conferences, workshops, community events and other venues, including:

- A booth at the 2007 and 2008 Portland Flower Shows, in cooperation with the Maine YardScaping Partnership. The location of the YardScaping booths allowed for one-on-one conversations with approximately 1,000 people both years. In 2008, approximately 1,200 bookmarks were distributed.
- Eight interactive educational display booths (2007: five events and contact with ~ 800 people; 2008: three events and contact with ~160 people) at local events. Contact consisted of answering lawn care questions and conversations regarding approaches to yard care. Almost everyone we talked with walked away with the YardScaping brochure and other handouts.
- Tabletop displays were set up in the spring of 2007 and 2008 at six municipal offices (Westbrook, Portland, Falmouth, Gorham, Windham and Cumberland). The 2007 displays consisted of tri-fold "Why YardScape?" posters and "Mow High, Aerate and Overseed" fact

sheets. The 2008 displays consisted of revised Mow High, Aerate and Overseed fact sheets in addition to "six steps" lawn care bookmarks.

- Tabletop displays in the fall of 2007 at seven City of Portland District meetings where Public Works employees took a couple minutes at the meeting to highlight the YardScaping program.

Event booths and static displays were deemed worthwhile for message dissemination in our introductory stage of getting the word out. The YardScaping website denoted visitors who found the website due to information they picked up in their municipal offices. The events with staffed booths focused on specific questions relating to our recommendations, which served to increase the amount of information people have to make their lawn care decisions. This venue also allowed for interaction at an individual level, which provided us qualitative evidence of increased understanding of lawn care issues.

1.2.1.6 YARDSCAPING WEBSITE

Figure 1-3. Banner across the YardScape web site.

The CCSWCD YardScaping website (http://www.cumberlandswcd.org/yardscape) was launched in mid-April 2007 (Figure 1-3). A website survey was developed in Survey Monkey for tracking website traffic. Thirty-two surveys were completed between April and December 2007. The key survey questions were:

- *How did you find out about this website?*
- *What, if anything, do you plan to do differently regarding your lawn care practices?*
- *What has prompted you to do so?*

Of the completed surveys, most respondents identified specific actions they planned to change regarding their lawn care and indicated that a variety of influences prompted them to make a specific change (including five that mentioned the CCSWCD YardScaping website, materials and/or classes). People found the website through promotional YardScaping materials (54%), classes (17%), links from municipal websites (13%), newspaper articles (8%) and other websites (8%). Additional responses to the website have included requests for soil test kits and requests for more information.

Since most people who visit the website do not fill out the survey, a website counter was added in January 2008 to track website hits and provide descriptive statistics regarding: first time

visitors (based on the assumption that people do not clean out their "cookies"); total website visits; page downloads; and, the source of the website hit (i.e., came from a link on another site, a Google search, typed in directly, etc.). Notable findings included:

- From January through June 2008, there were 413 first time visitors to the website and 482 total website visits.
- Although we did not explore all sources of website hits, a cursory scan showed that hits were coming from municipal sites (Portland and Cumberland, specifically) and the State of Maine YardScaping site.
- There was a noticeable spike in website hits after the Portland Flower Show where over 1,000 bookmarks were distributed to show attendees. This is particularly notable because the bookmark highlighted the State's YardScaping website, so two hits were required to reach our site (the ducky was provided on the State YardScaping website to highlight the link to our YardScaping site).
- Website hits peaked in May 2008 and remained strong, averaging around 80 visitors monthly from July – October, 2008.

The small sampling provided by those website visitors who filled out the survey (32) indicated that most intended to change a specific behavior regarding their lawn care. This is not surprising given that many of the website visits were generated by personal contact at classes and events, indicating that people visiting the website were intending to change their behavior and were simply seeking more information.

The YardScaping website will continue to be maintained and updated by CCSWCD beyond the PWI project period. Additional avenues are also being explored to increase the visibility and use of the website.

1.2.1.7 COMMUNITY EDUCATION: MUNICIPAL OFFICIALS

In recognition of the fact that ISWG/Maine Municipal Separate Stormwater Sewer Systems (MS4; or NPDES Phase II) municipalities are required under their Phase II permits to educate residents about stormwater issues in order to affect behavior change (DEP 2008a), the municipalities identified the need for municipal maintenance, facilities and recreation staff to be trained in landscaping best management practices (BMPs). Paul Tukey, editor of *People, Places and Plants* and author of *The Organic Lawn Care Manual,* was enlisted to provide a July 2007 "Safe Lawns" workshop for municipal officials. Thirty participants, 17 from the Presumpscot River watershed communities of Cumberland, Falmouth, Portland, Westbrook and Windham, attended the workshop.

After attending the workshop, the City of Westbrook committed to piloting YardScaping practices on one recreational field and their municipal offices. The Town of Cumberland began work to reduce, with the goal of ultimately eliminating, the use of pesticides and herbicides on the properties they maintain. The Town of Falmouth had already been utilizing a lot of the YardScaping principles, and they attended the workshop to determine if there were additional measures they should be utilizing. The City of Portland Recreation Director and one of their

facilities managers attended the training, but they did not respond to the follow up survey. School facilities managers from Windham, Cumberland and Westbrook have been identified as a target audience for additional training.

1.2.1.8 COMMUNITY EDUCATION: LANDSCAPERS

Over 130 landscapers in the Greater Portland Area attended the "Go Green to Get Green" training in February, 2008. Attendee feedback conveyed that the training was well received (a survey was sent out 2 weeks after the training, resulting in 38 total responses). Highlights of survey questions and answers are as follows:

Q: *The one big "take home" message from the "Go Green" conference for me was*:
A: (a sampling):

- That being good to the environment doesn't mean losing out on business.
- There are better ways to grow a lawn without the use of pesticides.
- You do not need a lot of NPK to have healthy turf.
- It's not hard to implement these "eco-friendly" practices at our homes and for our clients.
- Almost never a need for pesticides, and surprisingly, many soils may not need fertilizers.

Q: *Do you think your company or agency will add a low input or natural lawn or yard care service to its operation within the next three years?* A: 65% said yes.

Q: *Based on what you now know about fertilizers/herbicides/insecticides/fungicides as potential pollutants, do you intend to change the amount, frequency or timing of fertilizer applications performed or offered by your organization?*
A: 68%, 44%, 44% and 39% said yes, respectively

Q: *Are you interested in learning more about low input or natural lawn or yard care practices?*
A: 90% said yes.

Q: *Do you think more emphasis should be given to homeowner and consumer education regarding low input and natural lawn or yard care?*
A: 95% said yes.

In addition, a tangible result was seen in the advertising material of the largest lawn care companies in Maine. The YardScaping program has tracked lawn care company advertising since the spring of 2006. The promotions in the spring of 2008 put more emphasis on healthy lawn care options and services. The companies that changed their advertising tactics were present at the "Go Green to Get Green" training.

Two meetings have been held to start the process of developing a YardScape certification program for landscape professionals. The first meeting included representatives from Maine Landscapers and Nurseries Association (MeLNA), University of Maine Cooperative Extension (UMCE), FOCB, BPC and CCSWCD. The meeting focused on the framework for the certification and the organization responsible for certifying landscapers. Those in attendance preferred a

certification program based on education and assessment. It was agreed that MeLNA would be the entity to host the certification program.

The second meeting held as part of the development of a YardScape certification program aimed to gather information from landscape professionals. In December 2008, a meeting was held with representatives from UMCE, BPC, CCSWCD and a group of landscape professionals. Similar to the outcome of the first meeting, the group favored a program based on education and assessment. The group also agreed that MeLNA should administer the program but preferred that the UMCE provide the training portion of the program.

All partners involved in developing the YardScape certification program are committed to continuing their participation in this process. The next steps for the program include developing an educational manual, classroom training, and exam in order to certify landscape professionals. Additional "Go Green" conferences will be held to encourage landscape professionals to incorporate the YardScaping principles into their operations.

1.2.1.9 COMMUNITY EDUCATION: HOMEOWNERS

The community education for homeowners had three components – presentations, classes and Point of Sale.

Homeowner Presentations

Presentations were shorter in duration than the two-hour YardScaping classes and generally did not allow time to get attendees to fill out evaluations, but information was still gathered from one-on-one interactions with participants.

In March of 2007, a presentation was set up as part of a Wellness series at New England Chiropractic in Westbrook. Of the twelve people who participated, three indicated that they used both pesticides and fertilizers. Of these, one expressed concern regarding the fact that their backyard drains right down to a stream feeding the Presumpscot, and she asked a lot of questions, then took home all of our YardScaping materials in order to make her case with her husband who did the lawn care. Another individual seemed committed to his lawn and unwillingly to make changes; a third was hard to read.

What was most telling about this presentation experience was that while everyone we spoke with was into healthy living and making better choices regarding their health, they were largely uninformed about the impacts of lawn chemicals. This information confirmed the need to get a simplified message out to a broader audience.

In May of 2008, a presentation was given to the Sebago Lake Rotary Club (20 attendees). Attendees consisted of real estate brokers, developers, doctors and local business men and women from the Windham region. A number of attendees stayed after the presentation to get more information and all 35 packets of comprehensive lawn care information were taken.

Both presentations were well received and provided an opportunity to get the YardScaping message in front of a new audience. Since this format reaches a small audience and only

provides for an introduction to YardScaping practices, it was not the focus of our implementation efforts. However, as opportunities present themselves, the presentations are now ready to go and CCSWCD can continue to respond to requests.

Homeowner Classes

The classes were set up with the Adult/Community Education programs, which helped us to reach our target audience through a previously established mechanism. The two hour class allowed for participants to get a deeper understanding of both why and how to YardScape, including an open format that provided an opportunity for people to get their particular lawn care questions answered. The classes were very well received with many participants providing recommendations directly to the Adult/Community Education programs that this was a worthwhile class that should continue.

A total of eleven classes were offered to 135 students through the three Adult/Community Education sessions between the fall of 2007 and the fall of 2008 (fall 2007 - 4 classes / 41 students; winter/spring 2008 - 5 classes / 60 students; fall 2008 - 4 classes / 34 students).

A total of 39 class participants used weed and feed prior to taking the class and 37 (95%) indicated that they would not use it anymore after the class. Of the 24 class participants who hired a lawn care professional, 22 (92%) indicated that they would now request healthy lawn care practices (Table 1-2).

In terms of implementing healthy lawn care practices, the class evaluations were filled out as follows:

Table 1-2. Summary of healthy lawn care findings from Adult/Community education class evaluations.

	Already Do	Plan To	Don't Plan To	No Answer	Response Count
Set mower height to 3"	49% (66)	47% (64)	1% (1)	3 % (4)	135
Leave grass clippings	65% (88)	27% (36	3 % (4)	6 % (8)	135
Sharpen blades	57% (77)	36% (48)	1 % (1)	7 % (10)	135
Aerate	16 % (21)	75% (100)	5 % (7)	4 % (6)	134
Topdress with ½" compost	4 % (6)	81 % (107)	8.3 % (11)	6 % (8)	132
Spread more grass seed to renew lawn	18 % (24)	78 % (106)	2 % (2)	2 % (3)	135
Use low maintenance grass seed mix	10 % (13)	84% (113)	2 % (3)	4 % (6)	134
Get a soil test to determine needs	8 % (10)	84 % (111)	4 % (5)	6 % (8)	133
Use compost tea	2 % (2)	75 % (95)	11 % (14)	13 % (16)	127
Use nitrogen only fertilizer (10-0-0)[1]	3 % (2)	83 % (50)	5 % (3)	8 % (5)	60

Of note are the very low numbers in the "don't plan to" column and the substantial numbers in the "plan to" column. This denotes that class participants were provided with new information that changed their intended approach to lawn care.

Phone calls were made to class participants in order to determine the level of follow through on the YardScaping practices class participants intended to use. As expected, it was difficult to reach people. But the information we gleaned from those we did reach provided a likely rate of compliance for the YardScaping practices that other class participants intended to implement (Table 1-3).

[1] This practice was included on the evaluation beginning in fall 2008.

Table 1-3. Level of follow through on YardScaping practices following Adult/Community Edcucation class.

Lawn Care Practice	Number of people planning to implement.	Number of people who actually implemented
Set mower to a height of 3"	16	16 (100%)
Never remove more than 1/3 of leaf blade at a	19	18 (95%)
Leave grass clippings on the lawn.	10	9 (90%)
Sharpen mower blades	12	12 (100%)
Aerate	25	15 (60%)
Topdress with ½ inch of compost	23	12 (52%)
Spread more grass seed to renew lawn	20	17 (85%)
Use low-maintenance grass seed mix	22	17 (77%)
Get a soil test	23	3 (13%)
Use compost tea	25	9 (36%)

As expected, the easiest practices to implement (mowing practices (90- 100%) and overseeding (77 – 85%)) had the highest rate of compliance. Aerate (60%) and topdress (52%) had a better than expected rate of compliance given the fact that they are quite labor intensive. Soil test (13%) and compost tea (36%) are the most complex practices and subsequently had the lowest compliance. Given the low response (13%) of people who actually implemented the practice of taking a soil test and using compost tea (36%), the next round of phone calls (spring 2009) will include additional questions to delve further into what would help people to implement these practices.

Survey results showed that a two hour class full of information on how to implement YardScaping practices resulted in behavior change. The goal now moving forward will be to ensure we can continue to branch out and reach more people in our target audience. CCSWCD hopes to build on the community contacts we have now established. Now that all educational and support materials are developed and refined, staff time can be focused on finding more venues to provide the depth of education that results in successful behavior change.

Homeowner Point of Sale

CCSWCD developed the lawn care consumer education program (Point of Sale) and successfully piloted it in four local hardware and garden stores in South Portland in 2007. The program involved getting stores to participate in the program by allowing their staff to be trained on YardScaping principles; tagging products in the store with ducky tags; making pledge cards and ducky flags available for their customers; and making a store representative available for regular check-ins with CCSWCD staff.

Recognizing the value of the Point of Sale program, this project took the successfully piloted program and incorporated the following lessons learned. This time around, we:

- Required an end cap display (one central location to highlight YardScaping information and products) for participating stores.
- Provided more opportunities at the store to educate shoppers on the various aspects of YardScaping. This resulted in the development of seven shelf talkers (fertilizer, soil test, lawn mower tune up, overseed, etc.).
- Developed outdoor store signage to better highlight the store as a YardScaping program participant.
- Developed a standardized packet of information and support materials for each store.
- Worked with the BPC to further develop and refine a product list.
- Developed door hangers to distribute in target neighborhoods within pilot communities.

The program was then expanded to twelve stores in nine communities including three major nurseries in six locations, for a total of sixteen stores/nurseries in ten communities (with five stores in four Presumpscot watershed communities).

The following events were included in the 2008 Point of Sale in-store promotional efforts:

- April 2008 – O'Donal's Nursery Organic Gardening Day; audience – drew people from surrounding communities (Scarborough, Gorham, Westbrook, and Windham); total contact ~50 people; provided information table with a poster board, lawn care handouts, bookmarks and duckies. The location was great, but April proved to be too early for the cold spring we were having. Paul Tukey was a draw and that proved to be the peak of people for the day. It was determined that it was worthwhile to set up for a high profile talk, but otherwise we should aim for Mother's Day weekend or closer to that timeframe to ensure more contact time with target audience. It was good to have a staffed booth at nurseries to provide another avenue for increasing the visibility of YardScaping. It will be important to work with nurseries to determine their busiest weekends to ensure the highest traffic.

- May 2008 – location Windham Blue Seal; audience – Windham, Westbrook and Gorham residents (total contact 16 people); taught a one hour lawn care class at the store. Location was very successful. Blue Seal promoted the class both on their sign with, "Organic Lawn Care Class May 17th" as well as an advertisement in the local paper. The information was well received by the class participants and the store was pleased with the turn out. This was determined to be a good use of staff time and more store classes will be explored for incorporation into the point of sale effort.

Over the two year pilot, CCSWCD staff worked with four stores in one community in the first year, and a total of sixteen stores/nurseries in ten communities in the second year. Since the program was new, project staff did not want to ask too much from these stores, which have a history of selling large volumes of chemical fertilizers and pesticides for lawn care. This proved to be the correct approach and provided anecdotal information, as well as limited quantitative data, which demonstrated program success. Stores that fully embraced the YardScaping

program, and had the most YardScaping endorsed products, generated the most interest among their customers. Stores that sold the end cap and provided YardScaping information sheets, but didn't have a lot to offer in terms of endorsed products, found that the information helped them build relationships with shoppers through the questions that were generated. Homeowner point of sale information generated phone inquiries and website hits from people who had heard about YardScaping from their local hardware store.

Feedback from stores after the second year of the pilot highlighted the need to do more program promotion. Store representatives noticed that the ducky ads did not air during the spring/summer of 2008, and suggested that running the ads would have helped the program. To provide additional promotion, a coupon was developed to serve the dual purpose of providing a quantitative tracking tool and promoting the program and store. Every store agreed to provide 10-15% off to customers who brought in a YardScaping coupon. Almost every store representative still felt that more detailed product lists were needed so that they could order more of the products that are being recommended. Product tracking still needs to be fleshed out with stores and product tracking is targeted for further exploration during winter/spring 2009.

It was also felt that developing a YardScaping 'four step' program would help to attract people used to following a standard chemical four step program. A YardScaping lawn care calendar provided the basis for building a YardScaping four step program, which is currently being reviewed by lawn care experts around the State to ensure we promote a program that will be successful. The YardScaping 'four step' will then be promoted in the spring of 2009 with a flashy sign to make the end cap display stand out even more. Another thought to further highlight the program is to create a triangular sign that will hang over the YardScaping end cap.

The ISWG YardScaping program goal is to institute recommended changes to this program in the existing sixteen stores/nurseries in ten communities before expanding the program out to additional communities. This is a great program and it is important to put additional quality control and promotional and tracking efforts into place to ensure the continued success of this program as it expands to other communities.

1.2.1.10 NEXT STEPS

The YardScaping program was highlighted at two statewide events, the November 2007 Watershed Manager's Roundtable and the March 2008 Maine Water Conference. The presentations were attended by 25 and 20 participants, respectively, who are carrying out watershed educational efforts within the State of Maine.

UMCE undertook a collaborative New England wide research project, "Changing Homeowner's Lawn Care Behavior to Reduce Nutrient Runoff in New England's Urbanizing Watersheds." This project included a social science research component that identified the primary drivers of homeowners' fertilizer choices and application behaviors by examining the relative strength of various influences including environmental values, attitudes and norms, the level of trust in and influence of opinion leaders (e.g. Master Gardeners, local garden centers, and mass media), and

the relative influence of different types of informational messages. The results of this research underscored our findings regarding the need to get lawn care educational materials into the stores that sell lawn care products.

We anticipate that our YardScaping Point of Sale program will be expanded to nine new stores bringing the total to 25 stores serving 28 communities statewide with the expectation that the program will grow significantly from there as municipalities continue to seek effective, easily transferable ways to meet NPDES Phase II behavior change requirements. This will be achieved through working with the ISWG.

CCSWCD staff are building volunteer networks to disseminate YardScaping information, finding collaborative opportunities to identify -effective avenues for promotion, and establishing relationships with news organizations – print, radio and television - to better utilize donated space and time. Specific YardScaping goals moving forward are to:

- Website – Maintain the website so that it is current. Develop tracking systems and monitor follow up surveys.
- Events – Participation at conferences and other events will be evaluated on a case by case basis. Work to date has created great visuals, handouts and good methods for working with the target audience in many different settings.
- Adult/Community Education – This continues to be a great avenue for getting detailed information out about the program in a way that builds local support. Our goal is to continue to build on this effort in order to increase class participation. In addition, we will continue to recruit local stewards to promote the program in their neighborhoods.
- Point of sale – This successful program can be refined to provide additional documentation to demonstrate success. Our goal is to put additional quality control and promotional and tracking efforts into place to ensure the continued success of the program as it expands to other communities.

1.2.2 EXPENDITURES

The initial budget for this task was $43,138, including $16,951 in estimated match. The final tally of expenditures totaled $84,208.16, including $40,391.66 in match. Match sources include in-kind contributions from the Casco Bay Interlocal Stormwater Working Group.

Task 1: YardScaping

	Workplan Budget	Actual Expenditures
CCSWCD TWG	$ 22,539.00	$ 39,741.84
CCSWCD Match	$ 16,951.00	$ 36,909.00
FOCB TWG	$ 3,648.00	$ 4,074.66
FOCB Match	$ -	$ 3,482.66
Total	$ 43,138.00	$ 84,208.16

1.3 OUTPUTS & OUTCOMES

Table 1-4 summarizes the outputs and outcomes from Task 1, YardScaping, in a logic model format.

Table 1-4. YardScaping program logic model.

<table>
<tr><th colspan="3">YardScaping</th></tr>
<tr><td>What we do & whom we reach</td><td>What the short & long term results are</td><td>What the ultimate impacts are</td></tr>
<tr><th>Outputs</th><th colspan="2">Outcomes</th></tr>
<tr><th>Short-term</th><th>Short-Term</th><th>Long-Term</th></tr>
<tr><td>Survey of 388 households</td><td>Determined communication tools and methods to reach target audience</td><td>Target audience changes their lawn care methods.</td></tr>
<tr><td>YardScaping educational and promotional materials</td><td rowspan="3">Increased access to healthy lawn care methods</td><td rowspan="4">Changes in lawn care practices that reduces the use of fertilizers, herbicides and pesticides</td></tr>
<tr><td>YardScaping website</td></tr>
<tr><td>Static and interactive displays for municipal offices and community events</td></tr>
<tr><td>Identification of target neighborhoods for natural lawn care education and distribution of door hangers</td><td rowspan="4">Increased knowledge of the impact of lawn chemicals on the environment, children and pets</td></tr>
<tr><td>Recruitment of lawn care stores</td><td rowspan="5">Water quality in the Presumpscot River watershed improves</td></tr>
<tr><td>Workshops for store employees</td></tr>
<tr><td>Adult education classes</td></tr>
<tr><td>Community presentations</td><td rowspan="3">Increased motivation to switch to healthy lawn care methods</td></tr>
<tr><td>Workshop for 17 municipal maintenance, facilities and recreation staff from five watershed communities</td></tr>
<tr><td>Workshop for 130+ landscapers</td></tr>
</table>

2 AGRICULTURAL MANAGEMENT IMPROVEMENTS

Lead Implementer: Cumberland County Soil and Water Conservation District

2.1 OVERVIEW

Workplan Summary: *CCSWCD staff will provide agricultural landowners with technical assistance and cost sharing to address stream bank erosion problems associated with livestock use of tributaries as a water source.*

CCSWCD staff Betty Williams and Engineer Chris Baldwin provided agricultural landowners with technical assistance and cost sharing to address stream bank erosion problems. These issues are associated with livestock use of tributaries as a water source, which contributes high amounts of water-borne bacteria, sediments, and nutrients to the watershed. Volunteers assisted with fieldwork through watershed service learning projects on two separate occasions.

Initial Workplan goals were to:

- Reduce non-point source pollution from livestock usage of streams/tributaries as a water resource.
- Demonstrate the use of agricultural BMPs to reduce site runoff, eliminate stream bank erosion, and eliminate non-point source pollution.

Figure 2-1. Walnut Crest Farm owner Dale Rines machine plants pine seedlings from his tractor.

Initial Workplan performance measures were:

- Installation of approximately 4,470 feet of fencing and 8 livestock watering systems.
- Numbers of pre and post BMP installation *E. coli* bacteria colonies per 100 ml measured by monitoring equipment (reported on as part of Task 7)

This program was implemented between February 2006 and the fall of 2008.

2.2 TASK IMPLEMENTATION

2.2.1 ACTIVITIES

Below are individual project summaries for the five farms. Individual site reports for this task are included on the PRWC web site's geo-spatial database at http://www.presumpscotcoalition.org/geo.html.

Cost-share projects were implemented at five farms: Walnut Crest Farm, Hartwell Farm, Vienna Farm, Breezy Knoll Farm, and Clark Farm. Of those, four took advantage of the alternative watering system cost share program. All five farms were interested in the fence cost share program while two also wanted to install or enhance their shoreline buffers. Additional farms we contacted already had alternate watering systems in place and did not need assistance with additional systems.

In addition to the information provided below, additional photographs of the PWI work conducted at individual farms are provided in Appendix B. Water quality monitoring activities associated with this task are reported on in Chapter 7.

2.2.1.1 WALNUT CREST FARM

The Walnut Crest Farm, located in the Town of Gorham on the Presumpscot River, has been in the Rines Family for almost 100 years. Typical land use includes hay field management and cattle grazing on approximately 300 to 400 acres of woods and hay land. On average, the farm is home to approximately 50 head of cattle but as many as 300 head can comb the fields. All the livestock would access the river for watering and as a result degraded and eroded an estimated 300 feet of the river bank.

Additional information about the PWI activities at Walnut Crest Farm is provided in Section 2.2.2.

The landowner worked with CCSWCD to achieve the following:

- 626 feet of fencing installed
- Up to 300 livestock excluded
- 1 watering system
- 1,500 feet of river bank stabilized
- 4,000 trees installed over a 4 acre parcel along the shoreline

PWI Expenditures on Walnut Crest Farm:	$10,554.64
Walnut Crest Farm match:	$9,007.50
Total project cost:	$19,562.14

Figure 2-2. Volunteers restore riparian buffer at Walnut Crest Farm (l); the site one year later (r).

2.2.1.2 HARTWELL FARM

The Hartwell Farm (Figure 2-3) is located in Gorham on an unnamed tributary to Nason Brook, which is listed in the State 305b list as impaired by bacteria contamination. Hartwell Farm has also been in the same family for multiple generations. Typical land use includes hay management and cattle grazing on approximately 100 acres. On average, the farm has approximately 45-50 head of cattle that graze the fields on a rotational basis. The tributary had been used as a watering hole and the landowner agreed to install fencing and a watering system (Figure 2-4).

Figure 2-3. Hartwell Farm.

The landowner worked with CCSWCD to achieve the following:

- 1,400 feet of fencing installed
- 47 livestock excluded
- 1 watering system

PWI Expenditures on Hartwell Farm:	$3,500.00
Hartwell Farm match:	$3,532.04
Total project cost:	$7,032.04

Figure 2-4. Newly installed livestock exclusion fencing adjacent to a small drainage.

2.2.1.3 VIENNA FARM

The Vienna Farm is located in Gorham on Douglass Brook, a tributary to the Presumpscot River. Vienna Farm is home to a multi-purpose facility for horse training, as well as programs for riders in the art of dressage. Vienna Farm's typical land use includes hay management for 50 horses, which feed on approximately 150 acres. The landowner contacted CCSWCD with interest in enhancing the riparian buffer along Douglass Brook and fencing the area off from horses (Figure 2-5, Figure 2-6).

Figure 2-5. Livestock exclusion fencing at Vienna Farm.

The landowner worked with CCSWCD to achieve the following:

- 700 feet of fencing installed
- 35 livestock excluded
- 125 feet of stream bank stabilized
- 90 trees planted

PWI Expenditures on Vienna Farm:	$1,383.25
Vienna Farm match:	$1,250.25
Total project cost:	$2,633.50

Figure 2-6. Over 90 trees were planted at Vienna farm to revegetate former grazing area. Douglas Brook can be seen in the background.

2.2.1.4 BREEZY KNOLL FARM

Breezy Knoll Farm is located in Gorham on a tributary to Douglass Brook. Breezy Knoll Farm is home to a dozen cattle, and approximately 30-40 sheep. Typical land use on the farm is for hay field management as well as rotational grazing. In the past, livestock had used the stream as a water source, and landowners worked with NRCS to develop a Nutrient Management Plan (NMP). This plan was referred to as a guide for implementing specific BMP's on the farm. The purpose of a NMP is to properly utilize manure or organic by-products as a plant nutrient source, in order to minimize agricultural nonpoint source pollution of surface and ground water resources and to maintain or improve the physical, chemical and biological condition of soil. A concrete pad was installed for a heavy use area for ease in manure management (Figures 2-7 and 2-8).

Figure 2-7. A concrete feeding and watering pad was installed at Breezy Knoll Farm to address erosion.

The landowner worked with CCSWCD to achieve the following:

- Fence gates installed
- 23 livestock excluded
- 1 watering system
- NMP Implementation – concrete pad for heavy use area

PWI Expenditures on Breezy Knoll Farm:	$4,500.00
Breezy Knoll Farm match:	$7,049.59
Total project cost:	$11,549.59

Figure 2-8. An alternate watering system was purchased and installed at Breezy Knoll Farm.

2.2.1.5 CLARK FARM

The Clark Farm is a neighbor to the Breezy Knoll Farm and is also located in Gorham on Douglas Brook. Typical land use is hay field management as well as rotational grazing. Livestock did have access to the brook but landowners agreed to install fencing and a watering system (Figure 2-9 and Figure 2-10). NRCS also worked with the Clark Farm on specific Farm Bill programs and referred the Clarks for additional assistance as a result of this project.

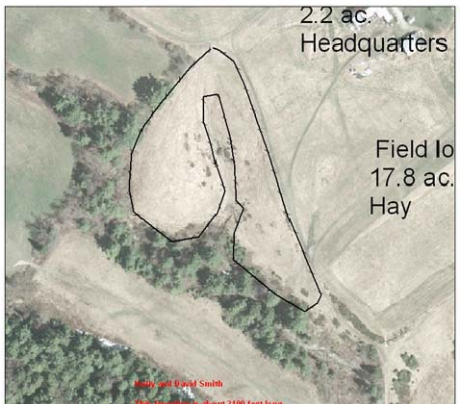


Figure 2-9. Area fenced off for use by livestock at Clark Farm.

Figure 2-10. Livestock exclusion fencing at Clark Farm.

The landowner worked with CCSWCD to achieve the following:

- 520 feet of fencing installed
- 12 livestock excluded
- 1 alternate watering system

PWI Expenditures on Clark Farm:	$3,032.35
Clark Farm match:	$ 4,064.85
Total project cost:	$7,097.20

2.2.2 SUCCESSES AND HIGHLIGHTS

Walnut Crest Farm. The Walnut Crest Farm has been in the same family for over 100 years and when the land was first acquired it was completely forested. Over subsequent years, much of the land was cleared and used for hay fields and raising cattle. Today, the number of cattle on the farm ranges from 35 to 300 depending on the time of year. Upon learning about this program, the landowner became concerned about the potential problems stemming from cattle accessing the river for drinking water.

CCSWCD staff completed a cost share project with Walnut Crest Farm between 2006 and 2007. The landowner installed approximately 630 feet of fencing to eliminate livestock access to the Presumpscot River and a perennial stream which drained out of existing grazing fields (Figure

2-11). Much of this area is within the Presumpscot River's floodplain, and floods on a seasonal basis. An alternate watering system was installed several hundred feet from the river (Figure 2-12). Three separate plantings took place throughout the course of this project resulting in a four acre area planted with 4,000 seedlings. The first planting completed by the landowner in September of 2006 included the machine planting of 3,500 red and white pine trees over four acres (Figure 2-1). The second planting conducted in April of 2007 consisted of 250 hardwood tree species and shrubs along 300 feet shoreline with 15 local volunteers participating. In September of 2008 an additional 250 white pine trees were planted along the river bank with 5 volunteers participating. This open field included 300 feet of frontage directly on the Presumpscot River, where severe erosion was occurring along the river bank, as well as an additional 1,200 feet of frontage along two sides of the perennial stream which runs through the field. The historically significant Cumberland-Oxford Canal also runs through this field.

Figure 2-11. Newly installed livestock exclusion fencing at Walnut Crest Farm.

In sum, this project eliminated a major source of pollution to the river, and restored a 300 feet section of river bank while protecting over 1,200 feet along a perennial stream as well as a section of the historically significant Cumberland and Oxford Canal. The project resulted in a front page article in the *American Journal* in October of 2007 and in June of 2008 this site was showcased on the Casco Bay Estuary Partnership's 2008 EPA Program Implementation Review tour of implementation project sites.

Lessons Learned

Staff found the agricultural landowners to be a unique group of people to work with. CCSWCD staff developed a postcard announcement of the program which was mailed to over 400 farms in the Presumpscot River watershed, but this generated just one response from an interested agricultural landowner. Project staff determined as time went on that the program was better advertised by

Figure 2-12. The new watering system for livestock on Walnut Crest Farm.

word of mouth and through working with secondary referrals from NRCS.

After numerous efforts to entice the Presumpscot watershed agricultural community to partner with CCSWCD on this program, the program fell short of the goal of working with eight farms. We attribute this to several factors:

- Most agricultural landowners have been farming for generations and are used to do doing things a certain way.
- Considerable time was needed to establish trust and build relationships with the local farming community.
- Farmers were generally unaware of the potential negative impacts their management practices could have on water quality, and slow to come around to this realization.
- The 50/50 cost share program was not as enticing as we anticipated. Existing Farm Bill programs are able to offer a 75/25 cost share, leaving our program at a disadvantage due to the requirement to obtain additional match.

CCSWCD was able to engage in cost -share projects with five farms within the Presumpscot River watershed. Remaining funds that were not used for this task were shifted to provide an additional Presumpscot River Youth Conservation Corps (PRYCC) work season in 2008. The PRYCC crew completed work on an additional 20 sites in the watershed during 2008. Additional information about PRYCC activities is provided in Chapter 4.

Key Partnerships

Key partnerships were formed with agricultural landowners including the Walnut Crest Farm, Vienna Farm, Hartwell Farm, Clark Farm and Breezy Knoll Farm, as well as the Natural Resource Conservation Service (NRCS) and volunteers: Joe Anderson, Don Kale, Heather True, Eileen Burke, Caitlin Kirsten, Melissa Libby, Margaret Chabot, Chad Brown, Becky McKinnon, Jeff Varricchione, Judy & Richard Curtis, Molly Just, Dale Rines, Jim Yaeger, Ben Hartwell, Dave Smith and Joanne Clark's (Figure 2-4).

2.2.3 EXPENDITURES

The initial Workplan budget for this task totaled $104,411, with $37,500 of that in the form of match. The final budget for this task totaled $69,576.20. Match sources include volunteer labor, landowner labor and machinery used to install fencing, equipment to install watering systems and volunteers for riparian plantings. Five farms participated in the program and generated $26,188.22 of in-kind match.

Task 2: Agricultural Improvements

	Workplan Budget	Actual Expenditures
CCSWCD TWG	$ 66,911.00	$ 43,387.98
CCSWCD Match	$ 37,500.00	$ 26,188.22
Total	$ 104,411.00	$ 69,576.20

2.3 OUTPUTS AND OUTCOMES

Table 2-1. Agricultural management improvements logic model.

Outputs		Outcomes	
Activities	**Participants**	**Short Term**	**Long Term**
Outreach to 400 farms in the Presumpscot River watershed; 5 Presumpscot-area demonstration sites for agricultural BMPs	CCSWCD, farmers	Expanded engagement and networking capabilities with area farms	Increased collaboration with area farms to protect and restore water resources
Technical assistance and cost sharing to design and install 3 alternate watering systems	CCSWCD, farmers, NRCS	Reduced non-point source pollution from livestock usage of streams/tributaries	Improved water quality from soil stabilization and reduced sediment, nutrient, and fecal coliform inputs to local water bodies
Cost sharing to purchase and install 3,016 feet of livestock exclusion fencing		Exclusion of 417 livestock from riparian habitat and floodplains	
Cost sharing and design assistance to install one concrete manure management pad		Improved manure management and reduced non point source runoff associated with manure	Water quality improvements from reduced fecal bacteria and nutrient loading to the watershed
Cost sharing, planting plan assistance, and volunteer coordination to plant 4,000 trees and shrubs on farmland	CCSWCD, Farmers, PRWC volunteers	1,625 linear feet of shoreline revegetation initiated; stabilization of 4 acres of floodplains	Riparian buffer and floodplain habitat enhancement; improved water quality

Summary of total installments and outcomes*:*

- 2,486 feet of fencing installed
- 4 watering systems installed
- 417 total # livestock excluded
- 1,625 linear feet of riparian buffer plus a 4 acre parcel re-vegetated (4,000 trees)
- One concrete pad for heavy use area management – Nutrient Management Plan component

3 STREAM CROSSING EROSION CONTROL AND CULVERT REPLACEMENT AT 46 SITES

Lead Implementer: Cumberland County Soil and Water Conservation District

3.1 OVERVIEW

Workplan Summary: *CCSWCD staff and the District Engineer will provide municipal road crews with technical assistance and cost sharing to address erosion and runoff problems at 46 identified roadside erosion sites.*

Initial Workplan goals were to:

(Primary)

- Reduce nonpoint source pollution to tributary streams

(Secondary)

- Demonstrate the use of Best Management Practices (BMPs) to reduce site runoff and non-point source pollution (and improve longevity of culverts and road crossings).
- Sites will be used to demonstrate a variety of BMPs that can be used at stream crossings that protect the resource and in turn will train Public Works crews on implementation practices.

Initial Workplan performance measures were:

- 515 feet of shoulder, driveway and road surface erosion will be stabilized
- 3 plunge pools will be installed and stabilized
- 1290 feet of stream bank stabilization
- 20 culvert stabilizations
- 4 turnouts installed and stabilized
- 915 feet of ditching installed and stabilized
- 5 culvert replacements
- Measure of levels of dissolved oxygen, pH, turbidity, flow, conductivity, and temperature

This activity was implemented between February 2006 and the fall of 2008.

3.2 TASK IMPLEMENTATION

3.2.1 ACTIVITIES

CCSWCD staff and Engineer provided municipal road crews with technical assistance and cost sharing to address erosion and runoff problems at 46 identified roadside erosion sites. A technical field assessment was conducted in 2002 that identified 62 eroded road/stream crossing sites. In 2005, the original 2002 field assessment was verified and results identified 46 eroded stream crossing sites continue to exist and exhibit erosion problems. Six municipalities

provided match through cash, material, and labor contributions under cost share agreements. Global Positioning System (GPS) coordinates for each site location were documented and data was entered into the Project Database.

CCSWCD staff documented the estimated nonpoint source (NPS) pollutant load reduction (sediment) that was achieved due to the implementation of the conservation practices at NPS sites in the watershed. The pollutant load reduction estimate method used was created by the United States Forest Service (Elliot and Hall 1997). Estimates were prepared for all sites unless it was not feasible to apply the method on the site. CCSWCD prepared this chapter for the PWI final report that summarizes the implementation of this task. This chapter includes a "Pollutants Controlled Report" which summarizes estimated load reductions, as well as supporting calculations.

Additional photos of PWI work completed under this task, are provided in Appendix C. Individual site reports for this task are included on the PRWC web site's geo-spatial database at http://www.presumpscotcoalition.org/geo.html. Water quality monitoring activities associated with this task are reported on in Chapter 7.

3.2.2 SUCCESSES AND HIGHLIGHTS

Highlights

A remarkable amount of time and energy from municipal public works departments and road association volunteers, who logged many hours assisting CCSWCD staff with project implementation, make implementation of this task a success.

Maine DOT stabilized and or provided materials to address thirteen sites in the watershed.

In total, nine sites were completed in the Town of Cumberland, two in Falmouth, seven in Gorham, seven in Gray, four in Standish, two in Westbrook and sixteen in Windham with one being a private road. In total, thirteen culverts were installed to replace existing failed or undersized culverts.

The final stream crossing stabilization project was supposed to be on Haskell Road/Baker Brook. Due to one difficult landowner the project had to be cancelled. Over 400 announcements had been mailed to local public works departments and contractors advertising the project as a training workshop on the installation of open bottom arch culverts.

Totten Road/Thayer Brook

The Totten Road/Thayer Brook bottomless culvert installation project (Figures 3-1 and 3-2) was a remarkable opportunity to partner with the Town of Gray, the Casco Bay Habitat Restoration Committee, and the Maine Department of Inland Fish & Wildlife (IFW). Totten Road is a publicly maintained two-rod width secondary road that has 3 stream crossings over its 1.5 mile length, the outermost two of which drain to the third, the Pleasant River. The road crosses Thayer Brook approximately ½ mile upstream from its confluence with the Pleasant River. Twin undersized culverts provided flow under Totten Road, which experienced moderate to severe surface erosion from chronic overtopping and flooding caused by inadequately sized and poorly installed culverts. In recent years, the Town had to retrieve culverts after blow-outs and reinstall them with scrap metal anchors to keep them in place. Significant bank erosion was

Figure 3-1. Totten Road crossing of Thayer Brook. Installation of a bottomless culvert: pre (L) and post (r) installation.

evident at the outlets. The adjacent New Boston Farm fields often flood following rain events of 2" or more. These factors have impacted the water quality of the tributary and present a barrier to fish passage at the site. A native brook trout population exists on this section of the Pleasant River and its tributaries. Improving flow at this site opened approximately ½ mile of stream upstream.

This project replaced the existing twin culverts with a Contech MultiPlate Arch open bottom culvert, addressing the erosion from the stream crossing, flooding, and the need for full fish passage. The new crossing has a 14-foot span and a 7-foot, 3-inch rise. It has a natural bottom, providing unhindered passage for fish and other aquatic life.

The installation itself served as a demonstration workshop for local contractors and public works departments in order to demonstrate the versatility of open bottom culverts for addressing chronic erosion, flooding, and fish passage issues on road-stream crossings.

This project was coordinated in a matter of just a few short weeks. The Gray Town Council approved the project and the cash match needed, the necessary permits were submitted, the culvert was re-designed and a new order placed and rushed. CBEP habitat restoration funding provided leveraged federal funds, and the training workshop details were adjusted and everyone notified.

The project was postponed for a week due to high flows and the training workshop postponed until the spring of 2009. A break in the weather allowed for the project to begin and the Gunderboom Company arrived on site to install the sediment barrier curtains. Two barriers were custom made with a fine mesh fabric that allows flow passage but fine particulates are caught in the curtain. The booms remained in place throughout the entire project and were removed only after the brook was breached with the new culvert in place. The massive culvert was assembled; the brook was pumped up and over the road to the other side and excavation began. Six days later, a new 14' x 4' x 32 open bottom arch culvert had been installed with the inlet and outlet stabilized. The Town of Gray also completed the final paving of the road/stream crossing the following week.

Figure 3-2. Gray Public Works and CCSWCD staff builds the bottomless arc culvert on site.

Additional photos of the Totten Road/Thayer Brook bottomless culvert installation project, as well as other PWI work completed under this task, are provided in Appendix C.

Key Partnerships

Through this grant, partnerships were formed and strengthened with public works departments in the following towns: Windham, Westbrook, Gray, Cumberland, Standish, and Falmouth. CCSWCD formed a new working relationship with Maine Department of Transportation (DOT), Gunderboom, R.E. Perry Excavating, the Casco Bay Habitat Restoration Committee, the Presumpscot River Youth Conservation Corps (PRYCC) and the Laskey Road Association. All the partners were essential in accomplishing a total of 47 sites.

Overall, this was a highly successful task but not without the assistance of the Towns and agencies that participated. All of the public works departments, the Maine DOT and the PRYCC went above and beyond in order to address the stream crossings issues identified.

- The Laskey Road/Pleasant River tributary crossing involved a private road association in the Town of Windham. The existing culvert had been installed several years ago using four 275 gallon heating oil tanks butted up together and the road had begun to cave in. The Road Association worked with CCSWCD staff and together replaced the failing culvert with a new

54” x 46’ aluminized culvert. The bottom of the culvert was buried in the stream bed to simulate a natural stream bottom and made it a safe and habitat friendly crossing.

- The Mill Brook/Duck Pond Road crossing located in Westbrook utilized an innovative technique in stream bank protection while enhancing habitat. Woody debris was anchored to the base of the stream bank and log deflectors and rock vanes were angled upstream, helping to turn water away from the bank during high flows. This is the most effective means for stabilizing the bank while simultaneously enhancing aquatic habitat and improving water quality. This project was one of two in the state to utilize this technique and may very well be used as a model for other similar projects. A full Natural Resource Protection Permit was secured through Maine DEP. In addition the U.S. Army Corps of Engineers, U.S. Fish & Wildlife, Maine Department of Marine Resources and IFW all approved this project.
- Maine DOT stabilized thirteen stream crossing sites in the Towns of Gorham, Falmouth, Standish and Windham. The Route 35/Presumpscot River crossing stands out. MDOT partnered with the PRYCC to improve this highly popular recreational area. This area is known for its superb fly fishing for landlocked salmon and trout, and as a great place to stop for a quick swim. In total, the PRYCC planted over 75 trees along both river banks, stabilized several hundred feet of trails with mulch and wood chips. DOT installed an earthen berm at the edge of a parking lot and the PRYCC planted 20+ shrubs to help secure the berm. Four infiltration steps were also installed to eliminate foot traffic erosion and encourage infiltration as well as a defined foot path.

Problems/challenges

Of the seven municipalities where sites had been identified only one was unable to participate in the project to address stream crossing sites. Lack of extra public works staff and time was cited as the most obvious reasons.

3.2.3 POLLUTANTS CONTROLLED

This section describes sediment pollutants controlled by remedial actions, mostly at stream crossings in the towns of Cumberland, Falmouth, Gorham, Gray, Standish, and Windham, in Cumberland County, Maine, as part of the PWI. Initial field reconnaissance to identify publicly owned sites (such as roads), where erosion/sediment transport was taking place in streams and on stream sides, was conducted in 2002. These sites were revisited for technical field assessments in 2005, when some sites were dropped from the list. This report summarizes assessments done in April, May, and June 2006 to estimate the tons of sediment pollutant to be controlled by installation of BMPs appropriate for each respective site, such as placement of stone riprap to stop soil erosion due to the force of stormwater flow at culvert inlets and outlets. One site in Falmouth was added to the assessed list (Site #A). Assessment visits consisted of making measurements of the extent of the soil erosion taking place, taking of digital photographs, and observation of Global Positioning Satellite (GPS) coordinates of latitude and longitude. At some of the sites, public works or contractor crews had already put stone riprap in place, and estimating what was the extent of the erosion that the riprap now controls is a matter of guess as to the original dimensions of the gullies, eroded ground, etc.,

now buried. In such cases, estimated average depth of original erosion under the riprap was given as two inches. At some of the sites, erosion problems were not evident, often because of natural growth of vegetation now holding the soil.

Method of Estimating Tons of Pollutant Controlled

For spots where the erosion was definitely gully wash and channeled scour, average length, width, and depth of the extent of the erosion were measured. With measurements in hand, a spreadsheet was employed using the Gully Erosion Equation developed by Michigan with its conversion factor of 0.055 tons of sediment per cubic foot (Michigan DEQ, 1999). For spots where the problem was sheet erosion, such as exposed road shoulders, with some rills present, the internet calculator[2] WEPP:Road was used, integrating data from the Portland, Maine climate station.

Results

The amount of sediment pollutant controlled by this grant for stream crossings in the six towns is 670 tons. Table 3-1 shows the break-down by town and site. Assistance was provided by Keith Williams, Ph.D., P.E.

[2] Online at http://forest.moscowfsl.wsu.edu/cgi-bin/fswepp/wr/wepproad.pl

Table 3-1. Pollutants controlled (sediments) through implementation of the stream crossing Task.

Town / site	Location	Controlled (Tons)	Completed
Cumberland			
Site #44	Winn Road over Mill Brook	6.9	yes
Site #45	Range Road over Tributary to Mill Brook	22.4	yes
Site #46	Tuttle Road over trib. to East Branch Piscataqua River	5	no
Site #48	Harris Road over trib. to East Branch Piscataqua River	4.1	yes
Site #49	Greely Road over trib. to East Branch Piscataqua River	20.9	yes
Site #50	Hillside Ave. over trib. to E. Branch of Piscataqua River	NA	NA
Site #52	Blanchard Road over Piscataqua River	7.9	yes
Site #53	Mill Road over tributary to Piscataqua River	19.8	yes
Site #54	Mill Road over tributary to Piscataqua River	21	yes
Site #55	Skillings Road over tributary to Piscataqua River	26.4	yes
Site #56	Orchard Road over Tributary to Piscataqua River	NA	NA
Total Cumberland		**134.4**	**129.4**
Falmouth			
Site #43	Winn Road storm drain and roadside ditch	1.3	yes
Site #59	Blackstrap Road over tributary to Piscataqua River	0.4	yes
Site #60	Blackstrap Road over tributary to Piscataqua River	0.5	yes
Site #A	Babbidge Road over tributary to Highland Lake	5.3	yes
Total Falmouth		**7.5**	**7.5**
Gorham			
Site #8	Route114 over Skunk Knoll Brook	14.9	yes
Site #9	Mighty Street over Douglas Brook	NA	NA
Site #12	State Route114 over Douglas Brook	5.3	yes
Site #16	Dunlap Road over Westcott Brook	30.9	no
Site #18	Huston Road over North Branch Little River	76.8	no
Site #67	Canal Road at Presumpscot River, water control gates	NA	NA
Site #68	Canal Road beside Presumpscot Canal	NA	NA
Site #69	North Gorham Road over Nason Brook	18.6	no
Site #72	Flaggy Meadow Road over Little River	66	no
Total Gorham		**212.5**	**20.2**
Gray			
Site #38	Lawrence Road over Pleasant River	4	yes
Site #39	Center Road over Pleasant River	2	yes
Site #40	Totten Road over tributary to Pleasant River	NA	yes
Site #41	Totten Road over Pleasant River	5.3	yes
Site #42	Totten Road over tributary to Pleasant River	1.5	yes
Total Gray		**12.8**	**12.8**
Standish			
Site #21	Shaw's Mill Road over North Branch Little River	5.9	yes
Site #22	Blake Road over tributary to North Branch Little River	5.6	yes
Site #23	State Route 35 over Branch Brook	12	yes
Site #66	State Highway 35 over Presumpscot River	36.9	yes
Total Standish		**60.4**	**60.4**
Windham			
Site #1	Mallison Falls Road over Presumpscot River	10.6	yes
Site #5	Covered Bridge Road over Presumpscot River	117.2	yes
Site #6	Boat launch at Dundee Park	59.4	yes
Site #25	Brand Road over tributary to Pleasant River	4.8	yes
Site #26	US Highway 202 over Pleasant River	3	yes
Site #27	Falmouth Road over Baker Brook	1.7	yes
Site #30	US Highway 302 over Pleasant River	20.2	yes
Site #33	Windham Center Road over Pleasant River	NA	yes
Site #34	Pope Road over Pleasant River	13.2	no
Site #35	Windham Center Road over Colley Wright Brook	4.4	no
Site #64	Webb Road over Black Brook	5	yes
Site #65	Highland Cliff Rd. over trib. to Colley Wright Brook	3	yes
New	Laskey Road trib to Pleasant River	0.5	yes
Total Windham		**243**	**225.4**
Grand Sum All Towns		**670.6**	**455.7**

Not included in the above Pollutants Controlled Report are several stream crossing sites completed by DOT. Construction was underway at the start of the project and measurements could not be taken. The sites include:

Gorham
Route 114 & Johnson Brook
Route 114 & Douglas Brook
Route 114 & No. Branch of the Little River
Route 114 & Skunk Knoll Brook

Gray
Route 100 & Thayer Brook (2 sites)

Windham
Route 202 & Presumpscot River
Route 302 & Pleasant River

3.2.4 EXPENDITURES

The initial Workplan budget for this task was $195,222, of which $61,004 was budgeted for match. The final budget for this task was $230,280.25, of which $100,832.47 was in kind match. Match sources include town public works departments, private road associations and landowners.

Task 3: Stream Crossings

	Workplan Budget	Actual Expenditures
CCSWCD TWG	$ 134,218.00	$ 129,447.78
CCSWCD Match	$ 61,004.00	$ 100,832.47
Total	$ 195,222.00	$ 230,280.25

3.3 OUTPUTS AND OUTCOMES

A total of 46 stream crossing sites in seven towns were identified to be addressed through this task. A total of 47 sites were completed.

Table 3-2. Logic model: Stream Crossing BMPs.

Outputs			Outcomes	
Activities	**Participants**		**Short Term**	**Long Term**
Outreach to 7 public works departments and Maine DOT about PWI program in order to increase awareness of issues at 47 stream/road crossings and coordinate BMP projects	CCSWCD, municipal public works, DOT		Awareness of issues identified by PRW at 47 stream crossings among public works and DOT personnel	Strengthened municipal policies and planning for addressing road/stream crossings; improved collaboration between CCSWCD, municipalities, and DOT
Technical assistance for designing site plans to address problems at stream/road crossings	CCSWCD. Municipal public works, DOT		Design plans completed to guide public works and DOT implementation of BMP installation activities on site	Increased capacity among municipal public works departments and CCSWCD for developing site plans that address water quality impacts at road/stream crossings
Construction activities resulting in replacement of 13 culverts, stabilization of 14 culvert inlets/outlets, installation of 1,645 feet of ditching, creation of 4 turnouts, and installation of 3 plunge pools	Municipal public works, DOT, CCSWCD		795 feet of stream bank stabilized, 1,485 feet of shoulder, driveway, and road surface erosion stabilized	Water quality improvements and aquatic habitat enhancement resulting from an estimated 455.7 tons of sediment stabilized and prevented from entering streams
Coordination of collaborative road/stream crossing demonstration sites resulting in establishment of one bottomless culvert demonstration at Totten Road	CCSWCD, Gray Public Works, CBEP Habitat Restoration Committee, Gunderboom		Improved fish passage to a 1/2 mile of Thayer Brook, reduced flooding upstream, soil stabilization at inlet & outlet	Water quality improvements from reduced road shoulder erosion and reduced nonpoint source runoff from adjacent farm; improved habitat connectivity for aquatic species; successful introduction of emerging BMP technologies to Presumpscot watershed for future education purposes

4 PRESUMPSCOT RIVER YOUTH CONSERVATION CORPS

Lead Implementer: Cumberland County Soil and Water Conservation District

4.1 OVERVIEW

Workplan Summary: *CBEP and CCSWCD will collaborate to establish a Presumpscot River Youth Conservation Corps modeled after other watershed-based YCCs in Maine. The primary mission of the PRYCC will be to implement riparian buffer enhancement and erosion control projects within the Presumpscot River watershed.*

The initial Workplan goals for this task were:

(Primary)

- Enhance degraded riparian buffers within the Presumpscot River watershed
- Demonstrate natural riparian buffers to reduce site runoff, eliminate stream bank erosion and non-point source pollution.

(Secondary)

- Identify and implement additional water quality improvement projects within the Presumpscot River watershed as resources permit.
- Pilot the YCC model in the Presumpscot River watershed and assess the need for a long-term YCC dedicated to the Presumpscot.

The initial Workplan performance measures for this task were:

- 2,000 plants installed.
- Five riparian areas planted.
- Establishment of a pilot Presumpscot River Youth Conservation Corps.

The implementation period for this task was February 2006 to August 2008.

4.2 TASK IMPLEMENTATION

This task was implemented successfully by CBEP and PRWC, with project management by CCSWCD. This collaboration established a youth conservation corps modeled after other successful watershed-based YCCs in Maine. The primary mission of the PRYCC was to implement riparian buffer enhancement projects within the Presumpscot River watershed. Utilizing an extensive riparian area habitat restoration needs survey conducted by CBEP in 2004, the PRYCC installed forested buffers on at least five sites located throughout the watershed. These restoration sites will be utilized as demonstration sites located in high visibility areas possibly including residential, agricultural, recreational, utility, and institutional land uses. A tour at the close of each season of installed buffers and conservation practices was conducted targeting landowners, agency personnel and municipal representatives.

This chapter summarizes the creation of the PRYCC. Additional information about the PRYCC, including final reports for the PRYCC seasons funded by the PWI (2006-2008), are available from the PRWC web site at http://www.presumpscotcoalition.org/ycc.html. Appendix D includes hardcopies of these three final reports. Individual site reports for this task are included on the PRWC web site's geo-spatial database at http://www.presumpscotcoalition.org/geo.html.

4.2.1 ACTIVITIES

The 2006 inaugural Youth Conservation Corps season proved to be a successful program with the completion of 16 conservation projects. The 2007 season yielded 14 completed projects and for the bonus 2008 field season, the crew completed 20 conservation projects.

Due to the relatively low interest from the agricultural community funds were shifted from the Agricultural Management Improvement Task (Task 2) to the riparian buffer/YCC task (Task 4) in order to provide an additional crew season. In total, the PRYCC installed the following conservation practices:

- Planted 1,381 trees, shrubs and groundcovers
- Planted 6 riparian areas
- Spread 98.5 yards of mulch
- Hand placed 120.5 yards of stone
- Installed 12 water diverters
- Installed 82 infiltration steps
- Stenciled 442 storm drains
- Stabilized 6 miles of trails
- Removed 400 pounds of invasive purple loosestrife.

At the conclusion of each season, the Technical Director prepared final reports summarizing the work accomplished that season and highlighting noteworthy projects.

4.2.2 SUCCESSES AND HIGHLIGHTS

Key Partnerships

Numerous partnerships were formed and include the Town of Westbrook Public Works Department, the City of Portland Parks and Recreation Department, Gorham Land & Conservation Commission, Portland Trails, the Town of Windham, DEP, Falmouth Land Trust, Shaw Brothers, DOT, PRW, FOPR, CCSWCD, CBEP and EPA.

Figure 4-1. The Crew prepares a site for planting and seeding.

For each of the three YCC seasons, CBEP and CCSWCD collaborated in identifying additional sites for the crews to address as well as in the hiring of technical directors, crew leaders and crew members. Final YCC model assessment by CCSWCD and CBEP determined that the need does exist in the Presumpscot River watershed for a long term YCC crew. The challenge will be to find dedicated funding to support a crew in the future. As part of the municipal outreach efforts by the PRWC, funding requests will be made to municipalities within the watershed. It may be difficult for towns to commit to supporting a YCC crew during these economic times.

Six riparian areas were planted and include the Smelt Hill Dam removal site in Falmouth, Bicentennial Park in Westbrook, Riverton Trolley Park in Portland, Route 35/Presumpscot River in Standish & Windham, Shaw Park and Vienna Farm in Gorham.

The 2008 YCC bonus season was made possible from construction funds that were unused from the Agricultural Management Improvements task (Task 2). Due to the lack of participation from the agricultural community, five farms participated in the program when funding was available for eight farms. The funding shift for an additional YCC crew season was approved by the CBEP Project Manager and the EPA Grant Administrator.

Lessons Learned

The most challenging aspect of the annual YCC calendar is hiring and training of new technical directors and crew leaders. It is very advantageous for crew leaders and technical directors to return each year, especially technical directors. Ideally, the returning technical directors and crew leaders can “hit the ground running” building on existing work. Minimal training and technical support would need to be provided and this would also offer program continuity.

The PRYCC was one of five YCCs operating in the Casco Bay watershed at the time. To achieve economies of scale, the PRYCC committee realized that it made sense to unite the various YCC steering committees into the Casco Bay YCC Collaborative. This also provided the benefit of numerous YCC's collaborating on individual large projects if needed.

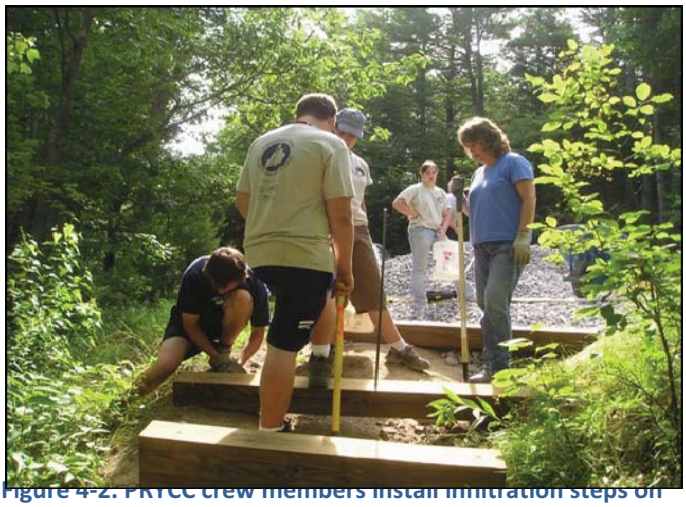


Figure 4-2. PRYCC crew members install infiltration steps on an eroding swimming hole access trail adjacent to a local road.

During the first two seasons, the grant provided a 50/50 plant cost sharing program to landowners in order to stretch the grant dollars. This proved to be very popular and beneficial since there would be a third crew season in 2008. The remaining grant funds were then available to the YCC tree/riparian planting program during the course of the final crew season.

4.2.3 EXPENDITURES

The initial Workplan budget for this task was $80,660, with $20,000 estimated as match. The final budget was $97,734.73, with $25,311.91 in non-federal match. Match sources include town public works departments, private road associations and landowners.

Task 4: PRYCC

	Workplan Budget	Actual Expenditures
CCSWCD TWG	$ 60,660.00	$ 72,422.82
CCSWCD Match	$ 20,000.00	$ 25,311.91
Total	$ 80,660.00	$ 97,734.73

4.3 OUTPUTS AND OUTCOMES

Table 4-1. Logic Model: Presumpscot River Youth Conservation Corps.

Outputs		Outcomes	
Activities	**Participants**	**Short & Medium Term**	**Long Term**
Creation of a pilot Youth Conservation Corps for the Presumpscot River watershed, including formation of PRYCC steering committee in 2006 & three full PRYCC seasons from 2006-2008. coalition	CCSWCD, CBEP, PRWC	Establishment of YCCs as a local resource to address water resource conservation needs; formation of the ongoing Casco Bay YCC	Expanded stewardship among area youth; increased awareness of the need to protect and restore water quality in local communities
Outreach to media, 7 municipalities, conservation organizations, and private landowners to advertise the PRYCC and solicit projects, resulting in identification of 50 improvement projects and approximately 20 newspaper articles	CCSWCD, CBEP, PRYCC, partners	Expanded PRWC knowledge of water quality degradation sites and needs for improvement projects	Improved water resources stewardship among communities and PRYCC partners; ongoing inventory/evaluation by PRYCC partners of water quality impacts
Technical assistance to identify water quality impacts, recommend options to landowners, and design BMPs to address impacts resulting in development of PRYCC project plans	CCSWCD, PRYCC Technical Director, partners	Increased capacity among partners and crew members to design BMPs for a broad range of circumstances; refinements to existing BMP designs	Improved water quality resulting from increased local capacity/knowledge and improvements to BMP designs
On site installation of BMPs at 50 sites using 98.5 cubic yards of mulch, 120 cubic yards of stone, 12 water diverters, 82 infiltration steps	PRYCC crew, PRYCC partners	Reduced soil erosion from stabilization, reduced stormwater runoff from infiltration, stabilization of approximate 6 miles of trail	Water quality improvements from reduced non point source pollution
Education to reduce water quality impacts from dumping in storm drains through stenciling of 442 storm drains	PRYCC crew, public works	Increased awareness among general public about stormwater infrastructure, infrastructure connectivity to water resources, and impacts of dumping on water resources	Water quality improvements through improved community stewardship of water resources
Coordination, purchase, and planting of 1,381 trees and shrubs; post-planting site maintenance, including removal of 400 lbs. of invasive plants	PRYCC crew, partners, volunteers	Riparian buffer enhancement, soil stabilization	Water quality improvements from improved riparian buffers; riparian buffer habitat enhancement

5 GOLF COURSE ENVIRONMENTAL CERTIFICATION AND EQUIPMENT WASH PADS

Lead Implementer: Presumpscot River Watch

5.1 OVERVIEW

Workplan Summary: *PRW will work with course owners, superintendents, and members on the measurable environmental improvements necessary to become certified as an Audubon International Cooperative Sanctuary. Six golf courses on the shoreline of the Presumpscot River or its tributaries will be targeted.*

Initial Workplan goals for this task included:

- Reduce nonpoint source pollution from fertilizer and pesticide runoff from golf courses.
- Assist BMP installation for nutrient and pesticide reduction at three Presumpscot River watershed golf courses.
- Audubon International Cooperative Sanctuary certification for six watershed golf courses (long-term).

Initial Workplan performance measures for this task included:

- Number of square feet no-spray and limited-spray zones of pesticides and nutrients applied in sensitive riparian areas
- Number of square feet of increased vegetated riparian buffer widths due to plantings and no-mow zones
- Number of square feet of stabilization for areas where chronic soil erosion occurs
- Number of BMPs incorporated for proper storing, handling, and disposing of chemicals
- Measures of instream pesticides and total phosphorus levels pre and post project implementation.

The implementation period for this task was February 2006 to fall 2009.

5.2 TASK IMPLEMENTATION

5.2.1 ACTIVITIES

PRW built upon a successful pilot program to target six golf courses located directly on the shoreline of the Presumpscot River or its tributaries. Working with the internationally recognized six-point Audubon International (AI) guidelines for golf courses, PRW staff actively worked with course owners, superintendents, and members on the measurable environmental improvements necessary to become certified as an *Audubon International Cooperative Sanctuary*. The initial outreach to golf courses focused on market-based approaches including providing documentation of substantial course maintenance cost-savings for other regional courses that have become certified sanctuaries through the Audubon International program. In

addition, the project provided matching funds for eleven BMPs, including two equipment wash pads and one innovative compost tea program. These were identified as critical needs to contain concentrated pollutant runoff and reduce in-stream levels of pesticides and herbicides.

Quality-assured data on instream pesticide and total phosphorus levels pre and post project implementation was not competed due to the high cost and low usability of data. Chapter 7 summarizes findings from a macroinvertebrate sample taken at a golf course in place of pesticide and nutrient monitoring.

Implementation activities in this chapter are reported on as they were structured in the Workplan: Golf Course Environmental Planning and Course Management (Task 5A), and Golf Course BMP Assistance (Task 5B).

Note: additional information about this task is provided on the PRWC web site at http://www.presumpscotcoalition.org/golf.html.

5.2.2 GOLF COURSE ENVIRONMENTAL PLANNING AND COURSE MANAGEMENT

PRW and partners worked successfully with five golf courses in the Presumpscot River watershed to enroll in the AI Certified Sanctuary Program for Golf Courses. One course (Woodlands Country Club) did not participate. In addition to the information provided below, individual site reports are included on the PRWC web site's geo-spatial database at http://www.presumpscotcoalition.org/geo.html.

Participating Courses:

- Falmouth Country Club, Falmouth (course is located in the Piscataqua River watershed).
- Riverside Golf Course, Portland (part of course located on the Presumpscot River).
- Rivermeadow Golf Course, Westbrook (course is sited within 300' of Presumpscot).
- Sunset Ridge Golf Course, Westbrook (course borders Inkhorn Brook, a 303(d) listed impaired tributary of the Presumpscot River)
- Val Halla Golf Course, Cumberland (course is located in the East Branch Piscataqua River watershed).

After conducting considerable outreach efforts to collaborate with Presumpscot River golf courses, PRW began efforts to assist the five aforementioned courses with environmental management measures through the guidelines of the AI Sanctuary Golf Course Certification Program. The Audubon program outlines six specific environmental components for which golf courses can apply for certification:

- Environmental Planning
- Wildlife and Habitat Management
- Chemical Use Reduction and Safety
- Water Conservation
- Water Quality Management
- Outreach and Education

Due to the nature of this project – the main areas of focus were 1) Water Quality Management and 2) Chemical Use Reduction and Safety. The five courses that enrolled in the program began intensive environmental planning efforts which included setting obtainable goals. Certification generally takes 3-5 years and none of the courses obtained certification during the tenure of this project.

Lessons Learned

The most effective portion of this task involved the site evaluations undertaken in cooperation with AI during the fall of 2007. As part of these visits – AI and PRW viewed all potential pollution source areas with the golf course owner and/or superintendent. Site visits included review of chemical storage and mixing areas, wash areas, fueling areas, riparian areas, and sensitive habitat areas. This one-on-one technical assistance from experts in the field provided a unique learning experience for all those involved.

The site visit from AI staff should have taken place one year earlier – in the fall of 2006. This would likely have encouraged more courses to participate more actively in the program. An issue with the AI program is the lack of resources for follow-up with courses. If it were not for TWIG funds, these site visits would not have been possible.

Future Needs

It is the opinion of the PRW project manager that even the most motivated superintendents will not be able to participate actively in the AI certification program without frequent and consistent assistance from environmental professionals. Superintendents have extremely demanding work schedules that often require long hours on the course in the spring, summer, and fall. PRW recommends that additional funding be provided to assist with continuation of the AI certification process, or else efforts will likely cease.

Outreach

Due to the outreach efforts of this PWI grant task Project Manager Forrest Bell was invited to present a two hour workshop to the Maine Golf Course Superintendents at the Maine Turf Conference in January of 2008. This session was attended by 60 golf course superintendents and included an overview of Presumpscot River golf course projects, the importance of riparian buffers, and the implementation of environmental management measures for golf courses. The presentation was very well received and an informal written survey was given at the conclusion of the presentation. This survey revealed that considerable knowledge was gained (regarding incorporating environmental measures into golf course management) as a result of the workshop.

A press release of this PWI task was circulated in 2007 with the help of CBEP. Results of this press release included a feature article by the Portland Press Herald (circulation 68,000 homes) and a feature news story on Maine Public Radio.

5.2.3 GOLF COURSE BMP ASSISTANCE

PRW provided financial and technical assistance for installation of BMPs for nutrient and pesticide reduction at three Presumpscot River watershed golf courses including the installation of equipment wash pads, stabilization of eroded areas, and planting of vegetated buffers where applicable.

Key partners in this effort included:

- EPA and CBEP (funding assistance and oversight)
- PRW (project management)
- CCSWCD (engineering design and oversight)
- Golf Course Superintendents and Owners (participation and matching funds)

Lessons Learned

PRW and CCSWCD were successful in implementing these BMP projects. Significant matching funds were contributed by the golf courses. The environmental improvements for these areas are substantial and the BMP projects will act as decent demonstration projects for transfer of technologies to other courses. The unique compost tea program implemented at Falmouth Country Club could have worldwide environmental benefits if the technology continues to show promising results including cost-savings for golf courses.

Planning for BMP installations was often challenging based on a number of factors. For instance, it was difficult to determine which projects should receive cost-sharing assistance. There were numerous opportunities to partner with individual golf courses, but limited funds available through the grant for these projects.

Golf courses in this watershed need assistance. There are considerable opportunities to install numerous BMPs on these properties which comprise several hundred acres of intensively managed turf land.

5.2.3.1 FALMOUTH COUNTRY CLUB

Compost Tea. In 2008 Falmouth Country Club (FCC) began a new program to brew compost tea for application on their greens. The program was launched to reduce the amount of fungicide sprays necessary to maintain the greens throughout the year. Since the greens are sand based, compost tea applications are intended to add beneficial microorganisms to the soil to reduce the overall pressure from turf disease pathogens. The program attempts to overwhelm the microclimate with beneficial organisms that will latch on to plant sites otherwise inhabited by disease organisms.

Figure 5-1. Falmouth Country Club's new compost tea brewer.

Although there is not a great deal of research available, a small number of golf courses in the United States has substantially

reduced fungicide applications from this type of program. FCC typically had 15-16 fungicide sprays on greens per season.

The goals were to: 1) implement a regular compost tea application program, 2) increase the amount of microorganisms and beneficial microbes in the greens soil profile, and 3) reduce fungicide applications by 20% the first year and more in subsequent years.

FCC purchased a compost tea brewer kit (Figure 5-1) from East Coast Organics in March 2008, and a supplier provided FCC with the necessary brewing ingredients. FCC followed the guidelines outlined in *The Compost Tea Brewing Manual* by Dr. Elaine Ingham, which notes that compost tea is most effective when applied on a regular, scheduled interval without tank mixing additional chemicals or fertilizers. The compost tea ingredients must be conditioned in advance, and then the tea is brewed for 24 hrs by aerating the water. The tea is then applied fresh to the greens. Application began in June 2008. There were two regularly scheduled preventative fungicide applications that were skipped during this period and no incidence of turf disease was noted.

FCC and PRW consider the results for the compost tea program successful. With only 5 applications made, goal #1 of making regularly scheduled applications was not met. However, total fungicide applications were cut by nearly 50%, to a total of 9 applications to greens in 2008. This fact alone more than paid for the program. Some disease on the greens was noticed through the late summer and into the fall. Diseases included Waitea patch, dollar spot, and Fusarium. The disease damage was mostly superficial, and can be viewed as helpful in terms of transitioning to less chemical input if it can be tolerated by golfers, which it was.

Wash Pad. In the fall of 2008 FCC undertook a project intended to reduce the environmental contamination from the existing equipment wash area (Figure 5-2). The equipment wash area is located to the golfer's left of #11 ladies tee. The old wash area consisted simply of an asphalt

Figure 5-2. Falmouth Country Club equipment wash area BMP project: before (L), and after (r).

pad that was sloped for runoff. The grass clippings and grease/oil from the mowers had been running downhill toward the Piscataqua River for some time. The new wash area was constructed with a small silt pond lined with absorbent materials and geo-textile fabric. A mix

of wood chips and loam was constructed as the major filter component of the silt pond. Seeding was completed just in time to germinate a turf cover capable of surviving the winter. The equipment wash water now filters down through the bottom of a pond.

5.2.3.2 RIVERSIDE GOLF COURSE

Riparian Buffer and No-Mow Zone BMP

PRW led a riparian planting effort at Riverside Golf Course in 2006. As part of the planting the golf course agreed to develop "no-mow zones" for approximately 70,000 square feet of the riparian areas of the Presumpscot River and an unnamed tributary that flows through the 17th hole of the course (Figure 5-3). A detailed site plan was developed for six separate areas of the course that bordered these water bodies. Plantings were completed in several of these areas. A mixture of native trees (white pine, maple, oak) and shrubs (winterberry, vibernum, and dogwood) were planted by Riverside staff. Riparian areas around these plants were to be left to revert with the exception of 2-3 mowings per year to keep tall grasses lower and help the growth of the plantings. It is notable that all but two of the 120 trees and shrubs survived a major Presumpscot River flood event in 2007 that inundated most of the course.

Figure 5-3. Riverside Golf Course 17th hole stream corridor BMP: before (L), after (R).

5.2.3.3 RIVER MEADOW GOLF COURSE

River Meadow Golf Course, PRW and CCSWCD worked with the course owner and superintendent at River Meadow Golf Course to install six BMPs. These included: An equipment wash pad, three culvert inlet/outlet protection areas, streambank stabilization, and containment of a vehicle fueling area (Figure 5-4). River Meadow provided matching funds by undertaking the work using course staff and heavy equipment. In total – 3,800 square feet of chronically eroding areas were stabilized. This will help reduce sediment loading in the Presumpscot. Several site visits were made to the course to assist with planning and design.

Figure 5-4. River Meadow Golf Course fuel tank containment BMP installation (F. Bell).

5.2.4 EXPENDITURES

The initial Workplan budget for this task was $56,800, with $26,400 in estimated match. The final budget was $53,755.79, with $21,350 in match. Match sources included in-kind and cash contributions to project implementation from individual golf courses, including staff time and cost-sharing for BMP implementation.

Task 5: Golf Improvements

	Workplan Budget	Actual Expenditures
PRW TWG	$ 30,400.00	$ 32,405.79
PRW Match	$ 26,400.00	$ 21,350.00
Total	$ 56,800.00	$ 53,755.79

5.3 OUTPUTS AND OUTCOMES

Summary of Completed Goals

- There was a reduction in fertilizer and pesticide runoff gained from the installation of BMPs at three watershed golf courses. There was also a reduction due to a change in management measures at five watershed golf courses.
- PRW, with some assistance from CCSWCD successfully assisted three watershed golf courses: Riverside, River Meadow, and Falmouth Country Club with BMP implementation for nutrient and pesticide reduction.
- Audubon International Cooperative Sanctuary enrollment was initiated at five of the six watershed golf courses: Riverside, River Meadow, Val Halla, Sunset Ridge, and Falmouth Country Club. Woodlands Country Club did not participate.

Performance Measure Completion Summary

- Through the project approximately 70,000 square feet of riparian land was taken out of "play" by the golf courses. These areas will no longer be fertilized and pesticides will no longer be applied in these areas.
- As indicated in #1 – approximately 70,000 square feet of riparian land was placed into no-mow zones. This land was currently managed as golf course turf.
- Approximately 4,500 square feet of chronically eroding streambank, culvert inlet/outlet and equipment wash areas were stabilized.
- Three BMPs were installed for the proper disposal of chemicals. Additionally, five courses were given hands-on training on the proper storage, handling, and disposal of chemicals by Joellen Zeh of Audubon International.
- Measures of instream pesticides and total phosphorus levels pre and post project were not undertaken due to the high expense and limited usefulness of the data.

Table 5-1. Logic Model: Golf Course improvements.

Outputs		Outcomes	
Activities	**Participants**	**Short & Medium Term**	**Long Term**
Course management improvements to mowing practices: approximately 70,000 square feet of riparian land and floodplain removed from 'play' through no-mow zones	Presumpscot area golf courses, PRW, FBE, Audubon International	Reduced fertilizer application, improved soil stabilization and filtering capacity in riparian areas and floodplain	Water quality improvements from reduced sediment inputs, reduced pesticide and fertilizer runoff, reduced toxics runoff and improved riparian corridors
Course management improvements to fertilizer and pesticide applications: modified schedule for applications, reduced volume of applications, compost tea as a fertilizer at Falmouth CC		Reduced pesticide and fertilizer applied; improved timing to minimize runoff from flooding and rain events	
Course management improvements: pilot use of compost tea as a fertilizer	Falmouth CC, PRW, FBE	Successful pilot demonstration of compost tea as a low impact fertilizer option	
Outreach/assistance to area golf courses for enrolling in *Audubon International Cooperative Sanctuary* certification program, resulting in five of six courses enrolled	PRW, FBE, Audubon International, Presumpscot course superintendents	Establishment of marketing niche for 'green' courses; competition among courses to attract customers seeking 'green' courses; opportunity for certification	
Design assistance and installation of recommended BMPs on site to address identified water quality impacts One fuel tank containment area installed, one equipment wash pad installed, one equipment wash area improved, purchase of one compost tea brewer, approximately 4,500 sq. feet of eroding streambank, culvert inlets/outlets, and equipment wash areas stabilized	PRW, FBE, CCSWCD, Riverside, River Meadow, Falmouth Country Club	Improved soil stability, fuel containment; reduced pesticide and fertilizer runoff at wash areas	Reduced pesticide and fertilizer runoff from wash areas other hotspots; models for course managers to replicate at other courses
Presentation at Maine Turf Conference workshop to 60 Maine golf course superintendents about optimum course management activities, Audubon International program, and PWI activities	PRW, FBE	Increased awareness among superintendents of AI certification program, best management practices for golf courses; increased knowledge of golf course water quality impacts	Regional water quality improvements stemming from improved golf course management practices

6 EDUCATION AND OUTREACH

Lead Implementers: Cumberland County Soil and Water Conservation District, Presumpscot River Watershed Coalition, Casco Bay Estuary Partnership

6.1 OVERVIEW

No overall summary was provided for Task 6 in the Workplan. Workplan summaries were provided for each sub-task, but not for Task 6 as a whole.

The following goals and performance measures were identified in the Workplan for the education and outreach activities described in Task 6:

Initial Workplan goals for this task were:

(Primary)

- Foster stewardship of the Presumpscot River and its tributaries among targeted stakeholder groups.
- Educate watershed youth about water quality, geography, natural history, and evolution of human use within the Presumpscot River watershed.

(Secondary)

- Engage municipal officials in the project.
- Demonstrate specific BMPs for improving water quality to targeted audiences.
- Disseminate project information to targeted audiences and project partners.

Initial performance measures for this task were:

- Launching of project website on the Internet.
- Launching of Internet mapping component.
- Number of visits to project website.
- Number of presentations to municipal officials.
- Number of presentations to broader watershed management community.
- Number of students participating in 'Maps for Schools' program.
- Number of schools participating in 'Maps for Schools' program.
- Number of CDs distributed.
- Number of participants in Best Management Practices demonstration tours.

The implementation period for this task was February 2006 to fall 2009.

6.2 TASK IMPLEMENTATION

The following education and outreach tasks were separated from other tasks in the original project Workplan. Although there were additional education and outreach activities implemented during the PWI (YardScaping, for example), the following sub-tasks are reported so as to maintain consistency with the structure of the Workplan. Education and outreach

components reported on in this chapter include: development of a PRWC website; intern recruitment; internet mapping; the Maps for Schools program; Presumpscot tours; presentations to municipalities; presentations to the watershed management community; and, administration. An additional education and outreach activity was added during PWI implementation, the 2008 Presumpscot RiverFest.

Two summary PWI fact sheets were developed, one by CBEP at the onset of the project, and one by EPA. These are provided in Appendix I.

6.2.1 PRESUMPSCOT RIVER WATERSHED COALITION WEBSITE

Lead Implementers: Casco Bay Estuary Partnership & Presumpscot River Watershed Coalition

Workplan Summary: *PRWC will collaborate with CBEP and project partners to develop a comprehensive project website.*

In December 2006, CBEP hired Erin Crowley as a part-time temporary staff to develop a PRWC website during the first six months of 2007. The intent was to build a site which would host PWI project content. The CBEP PWI Project Manager and Will Plumley, PRWC Chair, who works in a professional capacity as a marketing consultant, worked with Erin to guide the creation of the web site. As part of this project, Ethos Marketing and Design provided in-kind match in developing a new logo for PRWC (Figure 6-1).

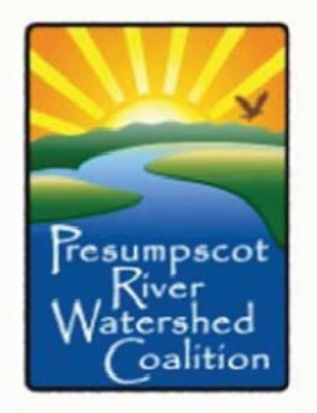


Figure 6-1. New PRWC logo.

PRWC's website is now up and running at http://www.presumpscotcoalition.org. The site is periodically updated and maintained by CBEP staff. Ongoing hosting services are paid by CBEP Section 320 funding.

Each major Task within the PWI Workplan has a separate page on the PRWC web site, and the PWI itself is a sidebar option on PRWC's web site. From here, site visitors can obtain information about YardScaping, the PRYCC, water quality, and other project work. Summary data from each BMP installation project site, as well as water quality data, is available through an interactive geo-spatial web page (Section 6.3).

6.2.2 INTERN RECRUITMENT

Workplan Summary: *PRWC and CBEP will work with USM faculty to recruit undergraduate interns for design, expansion, and maintenance of project website.*

Initially, the PWI partners had hoped to work with a USM intern to develop the PRWC website. After discussing this option in more detail with USM faculty who oversee the intern program, this option was deemed to be a poor fit for USM's Department of Environmental Sciences (DES)

students. However, this initial conversation did open doors to the USM DES intern program that paid off later in the PWI. In 2008, PRWC worked closely with USM intern Nikkilee Carleton to coordinate and implement the inaugural Presumpscot RiverFest. Nikki prepared an extensive report of her work and findings about the successes, lessons learned, and other aspects of the 2008 RiverFest. This report will guide future RiverFest preparation, and has been provided to other watershed organizations seeking to hold a similar event in their communities. Section 6.5 of this report provides additional information about the 2008 RiverFest.

6.2.3 INTERNET MAPPING

Lead Implementer: Presumpscot River Watch/Orbis

Workplan Summary: *PRW will work with project partners to develop an Internet mapping component for the project website which will evolve over the duration of the project. Maps showing monitoring data, as well as GIS layers locating sites from various tasks will be included, and will link, based on location, to associated data or photos.*

Purpose

This task met the following education and outreach goals outlined in the Workplan:

- Educate watershed youth about water quality, geography, natural history, and evolution of human use within the Presumpscot River watershed.
- Demonstrate specific BMPs for improving water quality to targeted audiences.
- Disseminate project information to targeted audiences and project partners.

To accomplish these goals through development of an online mapping tool, PRW worked with Rosemary Mosher of Orbis, as well as Sarah Plummer, the Maps for Schools program manager at CCSWCD, and the PWI Project Manager. As an instructor in USM's GIS laboratory, Rosemary had been closely involved in the development of this component of the TWIG proposal.

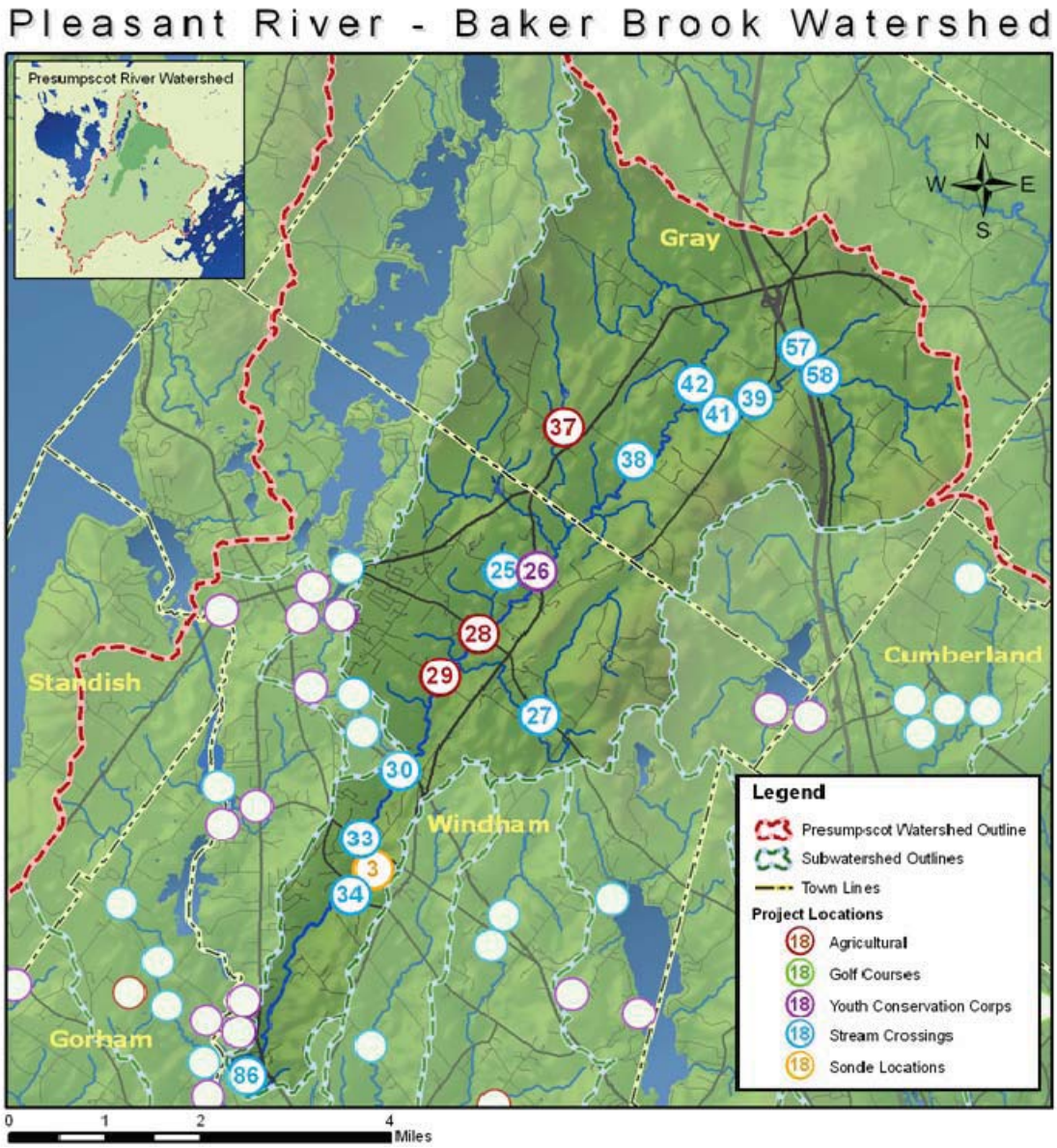


Figure 6-2. An example map of the online PWI mapping database of BMP and water quality monitoring sites, for the Pleasant River subwatershed. A viewer can click on one of the highlighted icons and pull up a site summary report.

Creation of the online geo-spatial interactive mapping system was tied to PRW's responsibility to create and populate a comprehensive relational database that would house all data collected during the PWI. Additional information about the database is provided in Chapter 9, Data Management.

Outcomes

Due to the fact that individual PWI BMP projects were still occurring during 2009, the PWI project database was not finalized until the summer of 2009 at the conclusion of all project

activities. Since the online mapping tool used the PWI project database for content, the online mapping tool was necessarily one of the last aspects of the PWI to be finished.

The most recent draft of the online mapping tool is currently hosted on the PRWC web site at http://www.presumpscotcoalition.org/geo.html. From here, a web visitor is greeted with a map of the lower Presumpscot River watershed. By using a mouse, the visitor can highlight subwatersheds of the Presumpscot and click to pull up a more detailed subwatershed map. The subwatershed maps include georeferenced alphanumeric icons (Figure 6-2). The visitor can click on a highlighted icon and pull up a report of BMP implementation activities at that site, as well as photos or designs if available. For water quality monitoring sites, a visitor can click on an icon and pull up summary water quality statistics for the site, as well as photos and graphs as available. Agricultural Improvement BMPs, Stream Crossing BMPs, PRYCC projects, Golf Course BMPs, and water quality station data are all provided in this online mapping tool.

Lessons Learned

Although the vision for creating a comprehensive database that combined data from each PWI task was shared by all the PWI project partners at the onset of the project, actual creation of database sections for each task proved to be difficult. The early plan was to develop the online mapping tool at the beginning of the PWI project period, in 2006. However, it soon emerged that most PWI partners already had data collection and storage procedures in place that would need to be altered and expanded in order to fit within the new database. Not surprisingly, given the intense workload many were experiencing during the initial phases of PWI project implementation, some individuals were slow to embrace the new reporting format, which had been developed and tailored for the individual needs of each project task. For this reason, population of the new database experienced repeated delays, which affected subsequent creation and population of the online mapping tool. The key take away lesson was to hold off on creation of geo-referenced mapping tools and deliverables until later in the project period, once real on-the-ground project data were available to populate the geospatial database and online mapping tool.

New technology, including Google Earth and other geo-spatial tools, grew popular during the PWI project period and became attractive new opportunities to represent our growing dataset and sharing the PWI work via the internet. Not surprisingly, since the online mapping tool was relatively new to the Maine watershed community, there were also numerous requests to partner with other entities not tied directly to the Workplan. At different points, exploring these opportunities to develop new dimensions, or to collaborate with other entities, created bottlenecks with staff time and funding that ultimately required us to scale back to the specific deliverables outlined in the Workplan. This was a wise decision and sped completion of the project.

Match

The primary source of match for this task came from Rosemary Mosher and Orbis, which offered reduced rates for their professional services, and on some aspects of their PWI work, provided outright in-kind/pro-bono work to ensure completion of deliverables.

6.2.4 "MAPS FOR SCHOOLS" PROGRAM

Lead Implementer: Cumberland County Soil and Water Conservation District

Workplan Summary: *CCSWCD will develop and implement a place-based education program in middle and high schools in the Presumpscot River watershed by utilizing existing partnerships with schools within the watershed to foster interest and expand its network to additional schools*. *PRW will develop maps and Digital Atlas CDs to accompany curriculum materials developed by CCSWCD. Evaluation of educational programs considering both the products distributed and created as well as skills learned and behaviors changed as a result of what is taught.*

Purpose

The overarching goal of the Maps for Schools education program was to educate watershed youth about water quality, geography, natural history, and evolution of human use within the Presumpscot River watershed. Education would encourage long-term stewardship of the Presumpscot River and its tributaries and watershed.

To accomplish this goal, CCSWCD would develop and implement a place-based education program in middle and high schools in the Presumpscot River watershed by utilizing existing partnerships within the watershed to foster interest and expand its network to existing schools. CCSWCD would work closely with teachers and administrators to develop program components so that they are fully complementary with Maine Learning Results requirements. Students would be presented with educational lessons which would raise awareness and appreciation of the Presumpscot River and its resources, and enable students to understand their power in shaping the future of these.

Various subject areas, including environmental science, social studies, history, and geography, would be covered by different lessons. Maps and data, tailored to the CCSWCD educator's needs, would be provided by consultants in order to present students with an understanding of how their town, school, and home relates to the Presumpscot River and its tributaries and watershed. Further, maps would be used in lessons for many of the subjects below.

Specifically, the Program would cover the following topics:

- Environmental Science: Hydrologic cycle, watersheds, nonpoint source pollution, water quality, and BMPs.
- History and Social Studies: Natural history, evolution of human uses and settlement, and planning issues of the River.
- Geography: Geography of the Presumpscot River watershed, students' towns, schools, and homes in relation to the River, its tributaries, and the watershed.

To compliment the school based program, a Presumpscot River watershed maps CD would be developed to accompany curriculum materials developed by CCSWCD. The goal was to create maps that are school-centered. CDs would contain free GIS software and GIS data layers. Initial materials would include base data and high-resolution aerial photographs from the Maine

Office of GIS. As the overall PWI project progressed, data collected from other project tasks will be integrated, including:

- Tree Planting Areas
- Location of Stream Crossing Erosion Control sites
- Location of farm BMPs
- Location of monitoring sites
- Location of YardScaping neighborhoods
- Water quality monitoring sites and data

The Maps for Schools program would be evaluated through consideration of both the products distributed as well as skills learned and behaviors changed as a result of what is taught. CCSWCD would conduct an evaluation for this project which includes:

- Student self-reporting (reports, displays, stories, pictures, etc.) which demonstrate what was learned and/or how behaviors may change.
- The use of a standardized tracking system by the educator to document site visits, including the following components: presentation topic, teacher contacts, number of students, school name, and resources used.
- Evaluation of educational outcomes through teacher/educator observation and assessments.

6.2.4.1 PROGRAM IMPLEMENTATION

The Maps for Schools program began in the spring of 2006 and continued throughout the life of the Presumpscot Watershed Initiative, with final activities occurring in January 2009. Education activities included field trips, indoor and outdoor classroom lessons, water quality monitoring, research projects culminating in public presentations, and a teacher workshop on the *Presumpscot River Watershed CD Resource Guide for Teachers 2009*.

A total of 1,085 students received Maps for Schools education in seven schools in the Presumpscot River watershed communities of Falmouth, Gorham, Portland, Westbrook, Windham, and Yarmouth. Students from grades one through eight received lessons, although the predominant audience included students in sixth grade. These students received a total of 3,135 contact hours of education. [Contact hours are a more accurate way to reflect education delivered than counting students each time they receive education. It breaks apart the number of student served versus hours educated. For example, if a class of the same 20 students received three forty five minute lessons, the total contact hours would be 20 students x 3 lessons x 0.75 hour = 45 contact hours. It would not be accurate to say that 60 students received lessons, since they are the same people, but they received three lessons of forty five minutes each, reflected in the contact hour calculation.]

Figure 6-3. Students analyze water quality samples during a field trip to Gambo Dam.

Lessons and activities were tailored to the Presumpscot River, its resources, and its watershed. Many lessons were adapted to be Presumpscot-specific from existing reputable environmental education curricula, such as *Healthy Water Healthy People*, and *The Wonders of Wetlands* by Project WET. Others were created because after searching, existing resources did not meet the curriculum needs.

2005-2006 School Year

In May of 2006, 100 Windham Middle School sixth grade students participated in a field trip along the Presumpscot River at the Gambo Dam site in Gorham (Figure 6-3). Groups of students visited different stations, including an activity on hydropower, a watershed/vernal pool hike, water quality monitoring, and a historical tour of the Gambo gunpowder mills. Students received a total of 400 contact hours. In addition to students and teachers, parent chaperones attended this event. Education and other CCSWCD staff were joined by AmeriCorps members from Maine DEP to serve as station educators. Another round of this field trip was scheduled but cancelled due to rain.

2006-2007 School Year

During the 2006-2007 school year, the Maps for Schools program was implemented by the CCSWCD educator and an AmeriCorps Educator from the Serve Maine Environmental Education/Volunteer Leader Program. CCSWCD staff met with Orbis and CBEP staff in the early fall to discuss mapping ideas and production. The laminated watershed maps (Figure 6-4) created as a result were used in the 2006-7 school year, as well as through 2009. Lessons began in October and continued every month until May, and were delivered to 259 total students for a total of 1,504 contact hours. Sixth graders at Windham and Gorham middle schools and first graders at St. Patrick's School in Portland received lessons about the following topics:

- A mystery lesson involving nonpoint source pollution and bioaccumulation in an aquatic food chain. Students drew maps based on the fictional story, which included actual geographic features of the Presumpscot River and surrounding towns.
- A watershed, topography, and contour line lesson. Students used Playdough to create a watershed and map their landforms.
- A local mapping lesson of the Presumpscot River subwatersheds and exploration of how water and nonpoint source pollution travels. Students

Figure 6-4. Watershed maps were created then laminated for in-school educational activities.

used their homes and other familiar locations as points of reference.

- A hands-on lesson involving building a model landscape and determining which type of surface is best for keeping non-point source pollution out of the water. Students learned what a buffer is, and what types of vegetation work best as a buffer.
- A local mapping lesson, using maps to explore land use and how this affects the water quality. Students designed their own town, using the land features to decide where would be the best place for town services and businesses.
- A skit performance, acting out an aspect of the history of the Presumpscot River. Students marked on a map of the Presumpscot where the events happened.
- A game about the water cycle which illustrates how water moves around our planet and does not cycle through in a predicable fashion.
- A lesson that modeled a town meeting about the construction of a new hypothetical dam on the Presumpscot River. Each student role played a stakeholder position and the "townspeople" debated whether the new dam should be built.

2007-2008 School Year

Due to the PWI one year extension, most educational activities during the 2007-2008 school year were carried out in watershed towns through another water quality education program, and reflected as match for this grant. Lessons continued to be place-based, in-depth explorations of the Presumpscot River watershed and water quality issues. Additionally, in the fall, CCSWCD staff met with five sixth grade science teachers at Windham Middle School to train them on a water adaptations game lesson and a mystery bioaccumulation lesson. The teachers had seen these lessons in their classrooms previously and found they fit in well with their science curricula. These teachers implemented the lessons with ten classes of sixth graders during the 2007-8 school year.

The 2007-8 school year lessons began in January and continued through June, and were delivered to 421 total students for a total of 451 contact hours. Sixth graders at Windham, Gorham, and King (Portland) middle schools, seventh graders at Wescott Junior High School (Westbrook), and fourth graders at Yarmouth Elementary School received lessons about the following topics:

- A lesson about using macroinvertebrates to assess water quality. Students learned how macroinvertebrates are collected to indicate water quality of local freshwater bodies and then participated in a mock assessment in the classroom using ordinary supplies to represent different species.
- A lesson about the life cycle of the Atlantic salmon, including its sensitivity to pollutants and relation to the Presumpscot River and surrounding watershed. Students partook in part of the life cycle by using their memory of a particular scent to find their way back to their "breeding grounds."
- A lesson about buffers and native plants and their relation to water quality.
- A water quality sampling event on the Presumpscot River at Riverbank Park in Westbrook.
- A hands-on lesson involving building a model landscape and determining which type of surface is best for keeping non-point source pollution out of the water. Students learned

what a buffer is, and what types of vegetation work best as a buffer and discussed land use planning considerations.

- A school yard scavenger hunt, where students walked their school grounds to identify sources of pollution. Students also acted as runoff, traveling downhill and identifying sources of pollutants picked up on their way.

CCSWCD staff also communicated with teachers in Falmouth, Cumberland, and Windham to explain the program, provide resources, and schedule lessons for the 2008-9 school year.

Additionally, CCSWCD staff continued to meet with Orbis staff and other project partners about historic data and maps to be used in the 2008-9 school year, and about components of the final map CD.

2008-2009 School Year

CCSWCD staff began intensive work with Falmouth Middle School during the fall of 2008. Teacher meetings were held to discuss the grant, program offerings, curriculum, and follow-up work. In particular, CCSWCD staff met with Christine Olsen, sixth grade science teacher at FMS, about an intensive unit of study on water quality and the Presumpscot River watershed. Meetings about the grant, program offerings, and future plans were also held at Gorham Middle School. A total of 305 students received 780 contact hours. Both eight graders and sixth graders at Falmouth Middle School and sixth grades at Gorham Middle School participated in the following activities:

- A lesson about topographic maps, contour lines, and local watersheds, with a focus on the Presumpscot River watershed and its subwatersheds. The lesson was repeated to additional classes by teachers.
- A PowerPoint presentation about watersheds, nonpoint source pollutants, and water quality parameters. The presentation was repeated to additional classes by teachers.

Figure 6-5. Students make observations during a field trip to the Piscataqua River.

- A game about the water cycle which illustrates how water moves around our planet and does not cycle through in a predicable fashion.
- A lesson about how water moves. Students listen to and answer questions about the book “Where the River Begins” by Thomas Locker and then discuss personal experiences with investigating sources of local water bodies. Students view river branching patters and compare to other similar patterns.
- A lesson about watersheds. Students build models with tin foil and predict where the water will gather and how it will travel, and discuss the definition of a watershed by looking at models and also at relief maps.
- A local mapping lesson of the Presumpscot River subwatersheds and exploration of how water and nonpoint source pollution travels. Students used their homes and other familiar locations as points of reference.

- A stream walk on the Falmouth Middle School grounds. In addition to exploring the local stream, students participated in an activity about runoff on various surfaces.
- A storm water lessons, where students actively participate in a story by adding pollutants to "rivers."
- A lesson about the adaptation strategies of various plant invasive species, and their effects on water quality and the environment.

The two classes of sixth graders also went on a watershed field trip designed and coordinated by CCSWCD staff. The first stop was at the Eel Weir Dam, the head dam on the Presumpscot River. Dam owners and operators, SAPPI Fine Paper, allowed access to this private site, gave students a tour, and provided background information on the historical features and uses of the River, workings of the dam, and recent changes for the sake of recreational pursuits. The second stop was at Shaw Park in Gorham. Due to time constraints, we were unable to get off the bus at the third and fourth planned stops, but still drove by the sites and discussed their significance. The third site was Riverbank Park in Westbrook and the fourth was at Presumpscot Falls Park in Falmouth, the outlet of the Presumpscot River into Casco Bay. At each site, students participated in a self-directed study of river and riverbank characteristics, features and pollutants coming from the surrounding land, observation of human impacts and activities, and other site-specific features and observations.

6.2.4.2 MAPS FOR SCHOOLS PROGRAM HIGHLIGHTS

Falmouth Middle School Research Projects

As part of course of study during the fall of 2008, Falmouth Middle School sixth graders participated in a month long research project which culminated in two public presentations. CCSWCD staff and Mrs. Olsen designed the research projects. One class was responsible for researching various stakeholders in the Presumpscot River watershed, while the other researched nonpoint source pollutants in the watershed. Both classes participated in a brainstorming session where they derived a list of stakeholders and pollutants, and then pairs of students chose one to research. Watershed stakeholders included lobstermen, golf course owners, ordinary citizens, oil refinery operators, recreational boaters, farmers, business and store owners, and the forest industry. Nonpoint source pollutants included road sand, salt and phosphates, fertilizer and soil, litter including cigarettes and fishing line, acid rain and industrial hazardous

Figure 6-6. Falmouth Middle School students give a PowerPoint presentation to classmates and parents.

waste, pesticides, manure, human wastes and failing septic systems, dog wastes, and chlorine.

Research projects are a main focus of Falmouth Middle School's sixth grade curriculum. Although guidance was provided by CCSWCD staff, Mrs. Olsen, and other school staff, for the most part students worked independently in pairs to address their topics and design a visual and scripts for public presentations in mid-December.

The stakeholder class researched the following questions:

- Describe yourself: Who are you, and what do you do in the Presumpscot River watershed?
- What are the main environmental problems in the Presumpscot River and Casco Bay, as they relate to you?
- How do you contribute to these problems?
- What can you do to help solve environmental problems in the Presumpscot River and Casco Bay? Think of as many solutions as you can.
- Think about what you get from the Presumpscot River and Casco Bay. Some of the solutions might require your group to give up something. But other groups and the River and Bay might benefit. This is a trade-off. For each solution your group proposes, include the trade-offs.

The nonpoint source pollutants class researched the following questions:

- Where and who does the pollutant come from?
- How does the pollutant pollute the water? (For example, does it make the water cloudy or reduce the amount of oxygen in the water?)
- What does it do to species living in the water?
- What can citizens do to prevent this type of pollution?

By design, each class had a different research topic so each would learn from the other during the public presentations. The presentations occurred on December 17 and 18, and were attended by the other science class as well as two addition sixth grade classes, approximately twenty parents, members of the Falmouth Conservation Commission, the CCSWCD educator and other CCSWCD staff, and other project partners.

The visuals, information presented, and students conduct were highly impressive. Visuals included computer-generated presentations, homemade movies, skits, posters, and landscape and science demonstrations. It was clear the students had learned a tremendous deal about their local watershed, threats to water quality, and strategies for improving and lessening impacts to our local water quality. Many students were able to clearly articulate the process of eutrophication due to increased phosphorus from various pollutants.

One student, Gabrielle Cyr and her partner researched fertilizers. At the close of their presentation, Gabrielle stated, "If you love your family and the earth more than your lawn, you may not even use fertilizer!" A pair of students, Cole and John, researched the effects of animal wastes on our water bodies and created a humorous homemade movie featuring a dog and snake having a conversation about the effects of dog waste once the dog relieved himself by a

river. These are just two of many examples of student learning and enthusiasm about the Presumpscot River watershed and the students' power for changing it for the better.

Maps CD & Workshops

In addition to the in-class work conducted during the fall of 2008, CCSWCD staff collaborated with project partners to create maps and a resource guide to be included on a resource CD for teachers. The CD and resource guide were highlighted at a teacher workshop in January.

At the invitation of CCSWCD, Orbis, and CBEP, Dr. Robert Sanford, a professor in USM's Department of Environmental Science, became involved with the CD task. Rob assisted with the development of a resource guide for the map CD, and providing information for the creation of a historical map of the Presumpscot River watershed.

Maps included on the *Presumpscot River Watershed CD Resource Guide for Teachers* CD are watershed-based and in a clickable Adobe .pdf format, allowing for ease of use for teachers and impossible probability that anything can be destroyed or modified by students. The CD includes maps on the following topics:

- Census data
- Impervious surfaces
- Dams
- Westbrook aerials (1940 & 2001)
- Land uses
- Population density (1957 & 2000)
- Stream classifications
- Local sites of historical significance (using Beers' 1871 *Atlas of Cumberland County*)

In addition to the maps, the CD contains the accompanying document "Presumpscot River Watershed CD Resource Guide for Teachers." This guide includes background information on each map, two to three detailed lesson ideas to accompany each map, a list of resources, as well as appendices on how to use Adobe and mapping data sources.

A teacher workshop showcasing the maps and Guide was scheduled on December 11, 2008 but postponed due to a winter storm yielding dangerous driving conditions. Twenty participants registered for the first date. The workshop was rescheduled to January 8, 2008 with ten educators able to attend. Evaluations indicate the workshop was well received and the materials will be used during this and school years to come. The audience included mainly science teachers, and many thought this material would be useful for social studies teachers as well.

Several other teachers who were unable to attend the workshop expressed interest in receiving the materials or attending a workshop at a later date, so another workshop was given on August 21, 2009 at the University of Southern Maine. The workshop featured a revised "Maps for Schools" CD and Resource Guide and was facilitated by Sarah Plummer, Robert Sanford, and Rosemary Mosher. Preparations for the workshop included creating two new watershed maps and writing an overview and lesson topics in the Guide for these maps. Facilitators made

revisions to the existing maps and Guide based on review and feedback from a first educator workshop in January 2009.

Eighteen participants attended this workshop. Evaluations indicated that:

- The workshop was successful at providing information about the usability and content of the maps and the Guide.
- Many teachers were interested in further, more focused trainings about various water and watershed based topics and related lesson plans.
- Most teachers planned to incorporate the CD and Guide into this year's curriculum.
- The only suggestion for improvements to the workshop was to have it in an air-conditioned space.

After the workshop, facilitators recognized a need to add reference information to the Guide for the new watershed maps, make other small edits to the Guide, and to make changes to the CD cover. Sarah and Rob communicated with workshop participants about continuing education credits. Sarah emailed the updated Guide to all participants and reviewed evaluations. In addition, Rosemary burned the remainder of the 100 CDs for later distribution and the CD cover was reprinted due to errors and omissions.

6.2.4.3 PROGRAM EVALUATION

The Maps for Schools program was evaluated throughout the life of the PWI grant. Products created, skills learned, and behaviors changed as a result of what was taught were all part of the program's evaluation.

Many products were created through the Maps for Schools program for use in the classroom, on field trips, and for the teacher workshop. Worksheets, data collection sheets, maps, the Presumpscot River Watershed CD and accompanying Resource Guide, and assessment materials were created (provided in Appendix E).

A standardized tracking system was used to document site visits, and included the activity topic, teacher, grade, school, number of students, contact hours, educator delivering the activity, and additional comments. This tracking system was useful in terms of keeping track of lessons delivered, schools and towns served, students reached, contact hours obtained, etc.

Student self-reporting was another evaluation tool used in the Maps for Schools program. The presentations, maps, worksheets, and thank you notes completed by students reflected what students learned and how their behaviors changed in terms of increasing environmental stewardship.

Written assessments and evaluations were also used in the fall of 2008, both in the classroom and at the teacher workshop. These were extremely effective means of assessing both the amount of student learning and experience with the program, and teacher use of the CD and resource guide and overall feedback on the workshop.

Written assessments were used with both eight graders and sixth graders during the fall of 2008 at Falmouth Middle School. Eighth graders had two lessons and follow up activities, and were given the following assessment before the start of the first class and after the second presentation.

- List the names of all the water bodies (rivers, streams, bays, etc.) that you know of in and around Falmouth.
- What do you think pollutes our water?
- What is a watershed? If you don't know, just take a guess!

Another written assessment was completed by the two classes of sixth graders at Falmouth Middle School. Similarly, they completed the assessment at the first class in October before any material was presented and at our last class in December after two months of lessons, research projects, and public presentations. They were asked the following questions:

- List the names of all the water bodies (rivers, streams, bays, etc.) that you know of in and around Falmouth.
- What is a watershed?
- In what watershed do you live?
- What do you think pollutes our water?
- Who do you think pollutes our water?
- What can we do to prevent pollution?

Results from both assessments indicate that students learned a significant amount about the names of their local water bodies, water pollutants and polluters, what a watershed is, in what watershed they live, and what can be done to prevent pollution. The assessments were an accurate way of indentifying what exactly the students had and had not learned.

All ten attendants completed a survey at the close of the teacher workshop. Teachers ranged from teaching fourth grade to post-secondary students, and the majority taught science. All teachers said the content of the workshop was appropriate for the level and subject they taught, and all said the workshop provided them with strategies and resources to integrate the Presumpscot River watershed maps and Resource Guide into their curriculum. Many teachers said they would be not only integrating the maps and Resource Guide into their curriculum, but also sharing the resources with their colleagues. Most teachers said the best part of the program was being able to explore and share ideas about the resources informally. As for ideas for improvement, three attendants suggested restructuring the workshop to spend more time reviewing the specific activities and specific parts of the maps with the group.

Key Partnerships

CCSWCD staff collaborated with many partners on the Maps for Schools task. Partnerships with teachers were key to delivering and developing lessons and activities. CCSWCD staff also collaborated with Matt Craig, grant administrator, throughout the life of the grant to report on progress, discuss challenges, and share successes. Rosemary Mosher of Orbis was a key partner in terms of working together to create, define, and change maps. Robert Sanford and CCSWCD staff worked closely together on the Presumpscot River Watershed CD and Resource Guide.

Lastly, all CCSWCD staff worked together to ensure the success of the Maps for Schools program.

Comparison of Final Performance Measures vs. Goals

The final performance measures include 1,085 students (3,135 contact hours) received education at seven watershed schools.

Overall, the goals for the Maps for Schools task were met or exceeded. Watershed youth were educated about water quality, geography, natural history, and evolution of human use within the Presumpscot River watershed. Evaluation results indicate this education will encourage long-term stewardship of the Presumpscot River and its tributaries and watershed.

Over the life of the grant, students received education in all the subject areas identified in the "Project Purpose" section of this report.

The components of the Presumpscot River Watershed CD Resource Guide CD were different than those in the original work plan (also identified in the "Project Purpose" section). CCSWCD and Orbis staff worked closely to identify and create maps that would be of most use to teachers and students, and that had accessible data available and workable. As indicated in the workshop evaluations, the maps that were actually created are valuable and practicable, and fit in with existing curricula and the Maine State Learning Results.

The Maps for School task went above and beyond the original goals by including a unique, in-depth and place-based research project on nonpoint source pollutants and stakeholders in the Presumpscot River watershed. These research projects culminated in two public presentations which were well attended and received.

Additionally, a CD Resource Guide was created through a partnership with CCSWCD, Orbis, and USM. Although not part of the original work plan, the Resource Guide is a necessary accompaniment to the Presumpscot River Watershed CD. Without it, teachers would have less information about and no lesson ideas to use with each map contained on the CD. Both the CD and Resource Guide were showcased at a teacher workshop, also not part of the original work plan. Both the workshop and the Resource Guide are products that were well-received, useful, and will have future applications.

6.2.4.4 LESSONS LEARNED: PROGRAM SUCCESSES AND CHALLENGES

School Visitation

A variety of formats were used to deliver the Maps for Schools program, from one time classroom visits to intensive, approximately once weekly visits over a period of three months. Exploring various formats allowed for a comparison of which method was most effective.

Students reached on a regular, consistent and frequent basis seemed to learn, retain, and be most excited about the information and students' ability to make a personal impact. The two Falmouth Middle School sixth grade classes were visited from early October through December,

on the average of once per week and sometimes more. They developed a working relationship with CCSWCD staff, allowing CCSWCD staff to build a rapport with the students as well as to access prior knowledge and build upon concepts. This method was the most effective as students demonstrated the greatest amount of overall learning and increased capacity as stewards.

This method trumps even monthly visits for a sustained period of time, such as the visits made with Windham Middle School sixth graders during the 2006-7 school year. Although these students retained information, the effectiveness seemed to be lessened by the gap in time and other information introduced into their curriculum between visits. Effectiveness, too, is affected by teacher commitment. A teacher committed to making this part of her unit for a semester will be carrying on the lessons even when the CCSWCD educator is not there. This increases student knowledge, commitment, retention, and enthusiasm.

Any education about local watersheds and water quality is important and can be effective. In general, students are interested in the subject matter and engaged by the place-based and hands-on nature of the activities. Even one-time visits make an impact, but to truly increase knowledge and related stewardship, engaging students on a regular and consistent basis, such as once or every other week, is most effective.

Accurate Record Keeping: Contact Hours versus Number of Students

At the beginning of this grant, CCSWCD staff documented the number of students involved in each activity as separate students, but found that this was not an accurate way to reflect performance measures. Using contact hours to express how many hours of education students have received is a much more accurate way to record performance measures, especially considering that many of the same students were visited multiple times, which, as discussed above, is a more effective way of educating.

Assessments

Using written assessments before and after a course of study was an effective way to capture students' progress. Completing a written assessment before one class would even be an effective way to measure students' learning; however, the amount of time it takes to complete such an assessment is significant, so it is a more practical idea if a long-term program with the same students is planned.

Maps CD

The Presumpscot River Watershed CD and Resource Guide were created towards the tail end of the grant. Although CCSWCD staff met with Orbis staff and other project partners throughout the grant, the bulk of work completed on the CD task occurred during the last six months. More progress earlier would have been helpful because then CCSWCD educators and teachers

would have been able to use the CD and Resource Guide throughout some of the life of the grant. Since none of the project partners had completed this type of product for this audience before, it was a little like the blind leading the blind at the outset. Once we got going on the task it went smoothly and efficiently and two great products were created.

Maps are Exciting!

Students' responses to the maps of their local watershed and subwatersheds were really positive. Students enjoyed looking at the maps and exploring their towns in the context of topography, water movement, and watersheds. Having detailed points of reference was very important, as students could be frustrated if they couldn't find their roads, landmarks, etc. because of inaccurate or absent data. Overall, however, the maps complimented other hands-on, place-based lessons and the students learned a great deal about their local landscapes, water bodies, and watersheds through guided exploration of the maps. Laminating the maps so that students could draw on them with dry or wet erase markers was a useful method as well.

Match Sources

The total match budgeted for the Maps for Schools program was $5,500, and the final tally was $9,677.47. Match sources included teachers' time at lessons, meetings, and preparing materials. Educators, presenters, and chaperones at field trips, and parents and members of the Falmouth Conservation Commission that attended the public presentations on December 2008 were also included as sources of match. CCSWCD staff time contributed to match during the 2007-8 school year when educational activities were delivered through a different, non-federal water quality education program.

6.2.4.5 MAPS FOR SCHOOLS FUTURE APPLICATIONS

The lessons and activities created through the Maps for Schools program will continue to be used in the future. The place-based nature of the materials is appealing and extremely effective. An EPA Environmental Education grant was submitted to expand, improve, and continue this program in 2009-2010. The Presumpscot River Watershed CD and Resource Guide will also be used by CCSWCD staff and teachers. The teacher workshop was successful and popular, and we anticipate conducting more workshops in the near future as more teachers and different methods of outreach were brought to light and will be used to recruit additional participants.

6.2.5 PRESUMPSCOT RIVERFEST

Lead Implementer: Presumpscot River Watershed Coalition

The inaugural Presumpscot RiverFest was organized to celebrate the Presumpscot River and increase public awareness about the efforts of PRWC and its partners. 2008 RiverFest was held on July 19th at Riverbank Park in Westbrook. Margaret Chabot, a DEP Americorps volunteer,

and NikkiLee Carleton, a USM student-intern with PRWC, organized the event with assistance and support from CBEP.

The RiverFest schedule was packed with Presumpscot-knowledgeable speakers, activity leaders, musicians, and storytellers. PRWC partners arranged a block of booths near the stage and lead hands on demonstrations and discussed current issues related to the river. A separate educational booth provided a range of environmental education activities to children of various ages, as well as for adults, in activities such as tree planting and fly fishing.

A full report of 2008 RiverFest was prepared by NikkiLee Carleton as part of her USM internship with PRWC. This report is included in Appendix F.

Figure 6-7. RiverFest activities ranged from a fly fishing demonstration to worm composting, shown above.

Other Local Events

In lieu of a full blown 2009 RiverFest, PRWC elected to dedicate resources toward setting up booths at ongoing local events within the watershed. In 2009, this included *Westbrook Together Days* and *Windham Summerfest*. Both events expanded PRWC's base of interested community members while PRWC's visibility in these communities.

CBEP also represented PRWC at the Falmouth Green Expo in the fall of 2008 and shared information about PWI projects and data.

6.2.6 PRESUMPSCOT TOURS

Between 2006 and 2009, PRWC partners led several tours which highlighted the river and projects conducted as part of the PWI. These included:

PRYCC-Led Tours

At the conclusion of the 2006, 2007, and 2008 field seasons, Presumpscot River Youth Conservation Corps crew members led tours of their BMP installations throughout the watershed. The tours aimed to attract local decision makers, municipal planners, project partners, funders, and crew members and peers on other YCCs.

Leading the end of season tours provided Crew Members with an opportunity to highlight showcase their achievements and speak directly to high-impact local partners about their values for stewarding natural resources. As a result, the end of season YCC tours have proven critical to fostering long-term support for YCCs throughout the Casco Bay watershed.

Tours for Natural Resource Professionals

In May 2008, the biannual River Management Society Annual Conference, "Branching out from the Mainstream," was held in Portland. Building on the success of previous Presumpscot tours, CBEP was asked to organize a field trip to noteworthy sites along the Presumpscot River (Figure

6-8). Representatives from PRWC, USFWS, CBEP and other partners spoke to the approximate twenty participants and led a variety of activities including discussion about how to advance restoration goals and priorities, as well as a paddle along a section of the river. Researchers from the University of New Hampshire conducted an introductory-level Water Recreation Opportunities Analysis with participants.

Figure 6-8. Will Plumley, PRWC Chair, speaks to participants on the Branching Out From The Mainstream Presumpscot field trip.

In May 2009, CBEP was asked to organize field trip stops on the Presumpscot River as part of the Switzer Foundation's annual retreat and workshop for Switzer Fellows. The tour provided CBEP with opportunities to engage a dynamic pool of approximately twenty emerging environmental leaders from within academic and natural resource management circles across the country.

Field Trips

In July 2009, CBEP and CCSWCD staff were invited to lead field trip activities for Maine Audubon's Youth Summer Camp. CBEP staff led the group to the Smelt Hill dam removal restoration site, and CCSWCD led activities at Gambo Dam.

Additional field trips were conducted as part of the Maps for Schools program described earlier in this chapter.

6.2.7 PRESENTATIONS TO TARGETTED AUDIENCES

Workplan Summary: *PRWC, CBEP and project partners will make overview presentations to municipal officials in five watershed communities to inform decision makers about project components and highlight opportunities for collaboration and assistance. CBEP, PRWC, and project partners will collaborate to provide a minimum of three project presentations to conference and/or forum audiences locally, statewide, and nationally.*

Municipalities

At the onset of the PWI, project partners identified that municipal decision makers were a key audience to reach to implement the activities outlined in the Workplan. The trio of Betty Williams (CCSWCD), Will Plumley (PRWC), and Matt Craig (CBEP) jointly made a series of presentations to municipal governing bodies throughout the Presumpscot watershed. The objectives of these presentations were to 1) provide an overview of the Targeted Watershed Grant; 2) build support for municipal engagement of PWI projects by working with PWI partners; and 3) elevate the visibility of PRWC throughout the watershed.

Presentations were given to Cumberland, Gorham, Falmouth, Westbrook, and Windham governing bodies. Separate, smaller meetings and presentations occurred more frequently with groups such as the Falmouth Conservation Commission and Gorham Conservation Commission.

Watershed Management Community

Presentations to the broader watershed management community in Maine and beyond were identified as effective means of 'tech transfer', and for sharing lessons learned with groups who would benefit from hearing about the new activities launched under the PWI. PWI partners made several presentations to these audiences, including but not limited to:

- U.S. EPA Targeted Watershed Grants Conference - February 2006
- CBEP Board meeting - December 2006
- Maine Forest Service Protecting and Enhancing Watersheds Workshop – June 2007
- Maine Watershed Manager's Roundtable – November 2007
- Maine Turf Conference – January 2008
- Maine Water Conference – March 2008
- River Management Society *Branching Out From the Mainstream* 9th Biennial River Management Society Symposium – May 2008
- Maine Kindle Conference – October 2008
- EPA 5th National Conference for Nonpoint Source and Stormwater Outreach – May 2009

6.2.8 EXPENDITURES

The initial overall budget for Task 6 in the Workplan was $90,160, including $20,230 in estimated match. The final combined budget for Task 6 was $97,906.82, including $24,340.52 in match. Match sources varied by subtask.

Note: PRW's TWG budget of $42,193.25 includes data management activities conducted by Orbis which are reported on in Chapter 9.

Task 6: Education & Outreach

	Workplan Budget	Actual Expenditures
CCSWCD TWG	$ 13,000.00	$ 23,373.05
CCSWCD Match	$ 5,500.00	$ 9,558.77
PRW TWG	$ 48,930.00	$ 42,193.25
PRW Match	$ 14,730.00	$ 14,781.75
CBEP TWG	$ 8,000.00	$ 8,000.00
CBEP Match	$ -	$ -
Total	$ 90,160.00	$ 97,906.82

6.3 OUTPUTS AND OUTCOMES

Table 6-1. Logic Model: Task 6 Education and Outreach activities.

Outputs		Outcomes	
Activities	**Participants**	**Short & Medium Term**	**Long Term**
Creation of PRWC web page	PRWC, CBEP	Information delivery and exchange system for PRWC, partners, stakeholders, and general public about PRWC, PWI, and Presumpscot - related issues and events	Increased visibility for PRWC, increased community awareness of Presumpscot issues and activities. Expansion of PRWC name recognition outside Presumpscot watershed.
Creation of interactive online mapping tool	PRW/Orbis, CBEP	Online, geo-spatially linked summary reports of PWI project activities	Readily accessible information about Presumpscot work to guide and inform future watershed management activities; accessible information on demonstration areas and water quality data
Presentations to municipal officials	PRWC, CCSWCD, CBEP	Development of municipal awareness and support for opportunities to partner on PWI programmatic activities and cost-sharing programs	Increased visibility for PRWC, increased community awareness of Presumpscot issues and activities. Cultivation of relationships with key stakeholders for future collaborations
Presentations to watershed management community	CCSWCD, PRW, PRWC, CBEP	Tech. transfer to share innovative PWI programs and activities with watershed managers outside the Presumpscot region	Opportunities to build on new programs, learn from mistakes; resource for others considering similar activities.
2008 Presumpscot RiverFest	PRWC, DEP, CBEP, PRWC partners	Celebration of the Presumpscot as a community resource; information sharing; cultivation of new members	Increased visibility of PRWC and Presumpscot generally; revitalized energy among PRWC, communities, and partners to protect Presumpscot
Presumpscot watershed and BMP tours	PRWC, CBEP, PRWC partners	On site information sharing to highlight demonstrations and PWI on-the-ground activities; feedback from experts about how to improve on PWI efforts	Increased visibility for PRWC locally, regionally, and nationally; relationship building with key stakeholder
Organized and conducted student field trips to significant sites in the Presumpscot River Watershed	CCSWCD, area schools	Students experience and learn about historical sites, best management practices, riverine characteristics, and human influences in the Presumpscot River Watershed	Students value and steward water resources, and share information with families; long-term water resource protection
Organized and facilitated student-led research projects that culminated in community presentations		Students learned about the Presumpscot River Watershed, pollutants, stakeholders, and ways to improve water quality	Students become literate about water quality issues and are able to talk knowledgeably about issues with the pubic; water quality of the Presumpscot River is improved through understanding of threats and stewardship roles
Prepared and conducted classroom and outdoor lessons about pollution, watershed features, history, etc.		Students became aware of water quality issues, such as hydropower, nonpoint source pollutants, storm water runoff, and are familiar with the geography and local context of their local watershed	Water quality of the Presumpscot River is improved by citizen actions, such as picking up dog waste, and the watershed and local water bodies are valued and protected through understanding of local features
Instruction to 1,085 students in seven schools, for a total of 3,135 contact hours of education		Students learn about water quality, geography, natural history, and evolution of human use within the watershed	Cultivation of stewardship and sense of place among area youth; fostering future environmental leaders
Created a supplemental Resource Guide to accompany Presumpscot River maps CD	CCSWCD, USM, PRW/Orbis, CBEP	Educators became aware of lessons and maps created as part of the *Maps for Schools* program	Students and teachers understand more about factors which affect water quality and value local features, which leads to increased watershed protection
Organized and conducted two teacher workshops for 28 teachers on the Presumpscot River Watershed CD Resource Guide for Teachers	CCSWCD, USM, PRW/Orbis	Lessons taught throughout watershed, facilitating student learning about Presumpscot watershed, natural and cultural history, and current events issues Educators learned about the products and were motivated to share resources and lessons with their students and colleagues	Teachers have locally-based lessons and resources to teach Maine learning results requirements for science, geography, and local history

7 WATER QUALITY MONITORING

Lead Implementers: Presumpscot River Watch & Friends of Casco Bay

7.1 OVERVIEW

Workplan Summary: *PRW and FOCB will conduct water quality monitoring to supplement existing monitoring programs with the use of data sondes. Site specific monitoring pre and post PWI implementation work will also be conducted by PRW at selected sites. An EPA approved QAPP will be utilized and all data will be entered into STORET.*

The initial Workplan goals for this task were to:

- Monitor instream turbidity, conductivity, temperature, dissolved oxygen, and pH levels pre and post project implementation.
- Monitor bacteria, nutrient, and toxic contaminant loads to selected tributaries pre and post project implementation.
- Provide summary data for pre and post project implementation comparison of water quality parameters.
- Develop baseline data for expanded long-term water quality monitoring efforts.

The initial Workplan performance measures for this task were:

- Measures of instream turbidity, conductivity, temperature, dissolved oxygen, and pH levels pre and post project implementation.
- Six months of data per year for three sites.

Monitoring activities under this task took place between February 2006 and fall 2008. Summary and analysis activities continued into January 2009.

7.2 TASK IMPLEMENTATION

The responsibility for conducting PWI water quality monitoring and related activities was shared between Presumpscot River Watch, which has for years been conducting seasonal, volunteer-based monitoring in the freshwater areas of the Presumpscot and its tributaries, and Friends of Casco Bay, which has a well established estuarine and marine based monitoring program throughout Casco Bay. Through the PWI, a collaboration between these two organizations formed which proved generally beneficial to each party and allowed for the exchange of skills which built overall organizational capacity and knowledge within the Presumpscot River watershed.

This chapter is structured to represent the full breadth of work PRW and FOCB conducted in preparation of this final report. Although monitoring was a collaborative and coordinated effort through the PWI project period, including data analysis, certain subsections within this chapter discuss the work of FOCB and PRW separately for sake of

simplicity, and to reflect the separate analyses these organizations were able to conduct with limited resources at the PWI's conclusion.

7.2.1 QUALITY ASSURANCE PROJECT PLANS

In order to ensure data quality, water quality monitoring conducted under the PWI was required to be conducted under the guidance of approved Quality Assurance Project Plans (QAPPs). Since water quality monitoring is fundamental to the missions of both FOCB and PRW, both organizations already had monitoring protocols in place. Up to the start of the PWI, FOCB had been operating under an existing QAPP to guide their ongoing marine and estuarine monitoring program.

At the onset of the PWI in February 2006, both FOCB and PRW worked diligently to have approved QAPPs in place to immediately launch PWI monitoring activities during the 2006 field season. FOCB's existing QAPP was amended in the summer of 2006 to guide FOCB's PWI monitoring work. PRW developed a new and separate QAPP which utilized portions of FOCB's QAPP while building additional content relative to PRW's specific monitoring requirements within the PWI. PRW's QAPP was finalized in May 2006 and directed their PWI monitoring protocols within the freshwater portion of the watershed. Both QAPPs were approved by Maine DEP and US EPA, who retain final signed versions of the QAPPs.

Due to the length of these documents, neither QAPP was included as an appendix to this report. Copies of each PWI QAPP are available from CBEP.

7.2.2 EQUIPMENT

Figure 7-1. A YSI model 6600 data sonde being prepared for deployment using the 'tombstone' anchoring system devised by PRW.

PRW and FOCB purchased automated, unattended water quality monitoring equipment (data sondes) as well as hand held instantaneous monitoring equipment to perform PWI monitoring tasks (Figure 7-1). Additional costs related to monitoring included maintenance and calibration of equipment, replacement probes, insurance, anchoring systems, and other related costs as described throughout this chapter.

PRW purchased four Yellow Springs Instrument (YSI) model 6600 data sondes for use during the PWI, and FOCB purchased two. Each organization thus had a spare sonde with which to rotate their equipment, allowing for regular maintenance and consistent sonde tending. Each sonde was outfitted with probes allowing for the collection of date/time, temperature, specific conductivity, pH, depth, dissolved oxygen percent saturation, dissolved oxygen concentration, dissolved oxygen charge, and turbidity.

PRW also submitted a successful equipment loan request to US EPA for a flow meter, which was used during the PWI to develop flow curves within the Presumpscot River tributaries as described below. The flow meter was also professionally calibrated during the project period.

Detailed equipment specifications, including maintenance schedule and calibration techniques, are provided in each organization's PWI QAPP.

7.2.3 CONTINUOUS INSTREAM MONITORING

7.2.3.1 PRESUMPSCOT RIVER WATCH

Introduction

PRW deployed data sondes to monitor water quality at four sites in the Presumpscot River watershed between 2006 and 2008. This monitoring project was part of a larger effort to measure potential improvements in the water quality of the river, through the PWI grant. Measured water quality parameters included Temperature, Conductivity, Salinity, DO, pH, and Turbidity.

Methods

Three sondes were deployed in 2006, and in 2007, CBEP loaned PRW a fourth YSI 6600 data sonde to collect data on the Presumpscot main stem, upstream from Saccarappa dam. PRW's data sonde monitoring sites were located as follows:

- On the Pleasant River, upstream from the Pope Road crossing in Windham along a narrow trail that leads to the northeast (43.788, -70.420).
- On the East Branch of the Piscataqua River, just upstream its confluence with the West Brach in Falmouth. This site is located southeast of Leighton Road and just west of Falmouth Road (43.736, -70.286).
- On the West Branch of the Piscataqua River, just upstream its confluence with the East Brach in Falmouth. This site is located south of Leighton Road, between Falmouth Road and Gray Road, and several hundred meters upstream from a railroad crossing (43.735, -70.291).
- On the Presumpscot main stem, just upstream from Saccarappa Dam in Westbrook, near 46 Lincoln Street. This site is west of a large brick mill building at a private home with a dock on the river (43.681, -70.371).

Water quality measurements were collected with a multi-parameter instrument deployed unattended using vertical and horizontal anchoring systems. Two of the sondes (East Branch and West Branch) were deployed vertically in segments of Poly-Vinyl Chloride (PVC) pipe attached to sign posts that were fixed in the substrate of the watercourse. A third sonde (Pleasant River) was deployed horizontally, attached to a 50-pound concrete block, due to rock substrate which prevented installation of a sign post. Holes were cut in the PVC pipes to allow for constant water flow over the sonde sensors. The sondes were secured to the PVC pipe using a padlock, and the sign post and attached PVC pipe were secured to a tree using a wire

cable and padlock. This deployment method allowed the sonde to be deployed without concerns about it becoming covered in sediment, tampered with, or removed without the padlock key. A fourth sonde, at the Presumpscot River (Saccarappa) site, was hung off a dock at a private home using a chain and padlock. At deployment and retrieval, a hand-held meter was used to record water temperature, pH, dissolved oxygen and conductivity for comparison with sonde data.

The instruments, YSI 6600 series data sondes, were programmed to collect data every fifteen minutes. Other than the Saccarappa sonde, which was only deployed in 2007 and 2008, PRW's data sondes were deployed between May and November in 2006 and 2007. In 2008, PRW's sondes were deployed from May 15 – August 21.

In order to ensure continuous data measurements and data accuracy, a spare sonde was kept by PRW to use on a rotating basis. While four sondes were deployed in the river, the spare sonde was subjected to a calibration in a lab. In this way, data collection was not interrupted by sonde calibration needs or maintenance, and high quality data collection was achieved.

Sondes were deployed for approximately 2 weeks at a time. Between deployments data was downloaded from each sonde, and post-calibrated by recording readings in the lab under standardized conditions (and using standard solutions for conductivity, pH, and turbidity). The sondes were also cleaned, maintained, and recalibrated before redeployment. Both calibration and post-calibration records are on file with FB Environmental. The site names within the Presumpscot River watershed are East Branch, West Branch, Pleasant River, and Upper Presumpscot.

7.2.3.2 FRIENDS OF CASCO BAY

Introduction

FOCB monitored water quality at the mouth of the Presumpscot River for a three-year period between 2006 and 2008. This monitoring project was part of a larger effort to measure potential improvements in the water quality of the river, through the PWI grant. This grant was administered by CBEP. Measured water quality parameters included Temperature, Conductivity, Salinity, DO, pH, and Turbidity. Turbidity in particular was considered an important parameter to study since many of the upstream improvements were focused on reducing runoff and improving water clarity.

Methods

The FOCB monitoring site was located just south of Presumpscot Falls, considered the "head of tide" for the Presumpscot River. Below the falls, on the north side of the river, the Town of Falmouth maintains a float at Walton Park, which provides seasonal access to the river. Water quality measurements were collected at this float: latitude 43.716933, longitude -70.263867.

Water quality measurements were collected with a multi-parameter instrument deployed unattended at 0.5 meters below the surface. The instrument, a YSI 6600 series data sonde, collected data every fifteen minutes. The sonde was chained to an eyebolt on the rear of the

float (facing the shore) with 3/8 inch galvanized steel chain and bronze all-weather padlocks. In addition, a rubber gasket and stainless steel collar were secured around the sonde and chained to the float for safety assurances.

The FOCB data sonde was deployed from June 7 to November 7 in 2006, May 11 to October 11 in 2007, and May 20 to September 27 in 2008.

In order to ensure continuous data measurements, two sondes were used by FOCB on a rotating basis. While one sonde was deployed in the river, the other sonde was subjected to a rigorous post deployment procedure in a lab. In this way, data collection was not interrupted by sonde calibration needs or maintenance, and high quality data collection was achieved.

Prior to deployment a sonde was calibrated with NIST-Certified standards. Conductivity was calibrated as specific conductance to 1.413 ms/cm at 25 degrees Celsius. Dissolved oxygen was calibrated as 100 percent saturation based on ambient barometric pressure. Turbidity was calibrated to 0.0 and 100 NTU's, and pH was calibrated at 7.0 and 10.0. In addition, the dissolved oxygen charge and the pH millivolt readings were recorded and tracked as diagnostic values. The temperature was checked against a NIST-Certified lab thermometer. Just prior to deployment, a unique file name was assigned and the sonde was set to record data every fifteen minutes, following a one minute "warm-up" period. Finally, the body of the sonde was covered in a multipurpose sealing wrap for ease of post-deployment cleaning.

Each sonde was deployed for a two-week period, during which the sonde was checked at least once to ensure data collection and sonde performance. The retrieval of one sonde and simultaneous deployment of a cleaned and calibrated second sonde was coordinated to occur within the 15 minute window between scheduled data collection intervals. After a sonde had been retrieved from the site, it was returned to the lab where the collected data was uploaded and a post-deployment calibration check of all parameters was conducted. After data upload and calibration check, the sonde was cleaned with a brush and soapy water, o-rings were greased and replaced, batteries were replaced, and the turbidity sensor wiper was replaced, as needed.

Results

Note: PRW and FOCB staff focused the bulk of limited resources at the conclusion of the PWI grant on building a series of graphs with which to summarize continuous instream data for future analysis. These graphs are provided in Appendix G. Due to funding constraints at the end of the project period (2008 for Task 7), FOCB staff Mike Doan was able to conduct the limited data review (below). PRW was unable to analyze the data beyond their work to develop the series of summary graphs provided in Appendix G.

All of the data from the five sondes were pooled into one database at the conclusion of the project. Additional information about the database is provided in Chapter 9. Due to the size of this database, hourly means were generated for each parameter for each site and used in a final statistical analysis.

Temporal Trends

For each site, the annual means for turbidity (NTU) were compared. There were no significant differences in the annual means for turbidity in the Pleasant River, with means of 10.78 in 2006, 6.24 in 2007, and 11.59 in 2008. The FOCB sonde in the Lower Presumpscot had annual means of 7.53 in 2006, 5.72 in 2007, and 7.68 in 2008, with no statistically significant differences between years. Similarly, the West Branch site had no significant differences, with means of 10.25 in 2006, 8.13 in 2007, and 8.49 in 2008.

However, the East Branch showed a significant difference - the annual turbidity mean was statistically lower in 2008 (11.10) than it was in 2006 (17.95) and 2007 (15.54). This was also the only site that had decreasing turbidity means for each of the three years of the study. The other three sites all had higher means in 2006, lower means in 2007 and then high again in 2008. This trend followed the annual mean for precipitation, which had similar values for 2006 and 2008, but was significantly lower in 2007. The generally lower turbidity in 2007 was most likely the result of the dryer conditions during that year, producing less runoff.

When looking at all of the data, 2006 had a significantly higher annual mean for turbidity than 2007 and 2008, with the lowest annual mean found in 2007.

These are obviously very broad comparisons. A closer look at the data is required to see the daily or weekly changes in turbidity following a storm event. For example, following the remnants of Hurricane Hanna in the fall of 2008, data from the FOCB sonde at the Lower Presumpscot site showed how the heavy rains resulted in a spike in turbidity, which gradually returned to normal levels days later (Figure 7-2). The storm resulted in more than five and a half inches of rain between September 6 and 7. Also of interest are the salinity values over the same time period. Prior to the storm, salinity is regulated by the tidal cycles. During the storm, salinity dropped to almost zero as the high volume of stormwater eliminated the influence of the tidal signal.

The annual means for dissolved oxygen (mg/l) for each site were also compared.

The East Branch had no significant differences in mean dissolved oxygen (mg/l) between years, with values of 8.82 in 2006, 8.72 in 2007, and 8.90 in 2008. The Pleasant had higher annual mean values, 9.48 in 2006, 9.45 in 2007, and 9.61 in 2008, but no significant differences between years. The Lower Presumpscot site had significantly higher mean dissolved oxygen in 2006 (9.72), with mean values falling to 9.28 in 2007 and then 9.17 in 2008. Although these are still relatively high values, well above the state criteria, the downward trend is notable. In the West Branch, annual mean values were consistent in 2006 (9.81) and 2007 (9.91), and then significantly lower in 2008 (9.37).

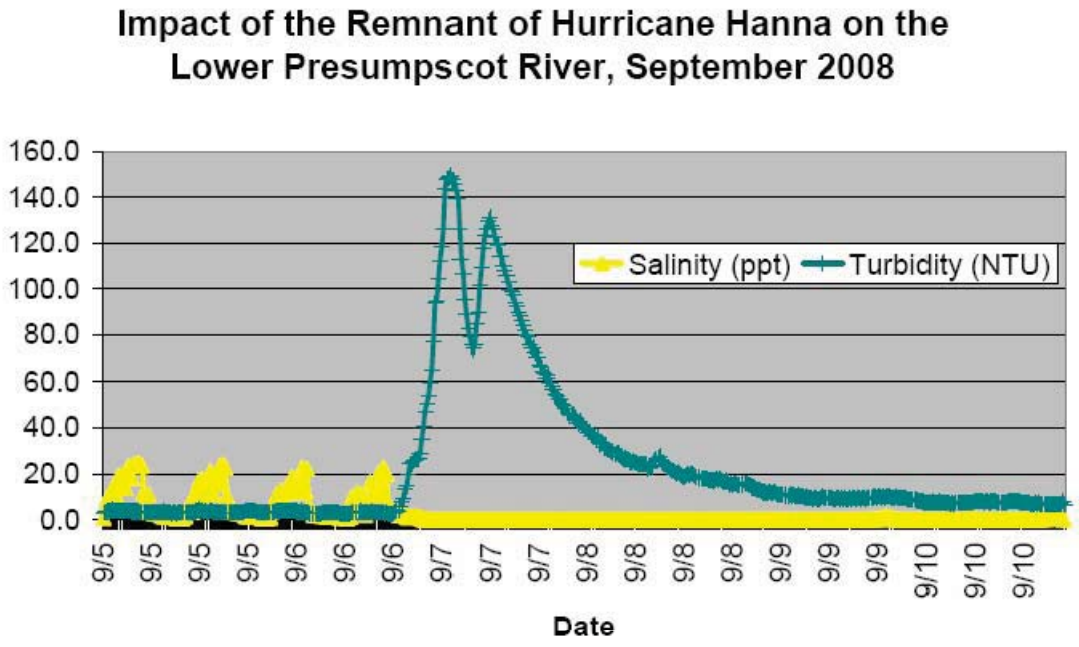


Figure 7-2. Impact of the Remnant of Hurricane Hanna on the Lower Presumpscot River.

Spatial Trends

The 2006 – 2008 mean values for each site were compared for Turbidity, DO and pH. The Upper Presumpscot site was not included in these analyses, since the site was sampled for only the final two years of the study, in 2007 and 2008.

The highest mean Turbidity (NTU) value, significantly different from the other sites, was found at the East Branch site (15.15). The next highest mean value was found in the West Branch (8.96), followed by the Pleasant (9.16) and the Lower Presumpscot (6.75).

The highest mean Dissolved Oxygen (mg/l) value was found in the West Branch (9.74). This was significantly higher than the mean values at the Pleasant (9.49) and Lower Presumpscot (9.37) sites. The East Branch mean (8.80) was significantly lower than the other means, although this value is still indicative of good water quality.

The highest mean pH values were found at the Pleasant River and West Branch sites, 7.25 and 7.24 respectively. These values were significantly higher than the mean for the Lower Presumpscot site (7.19). The East Branch mean value was significantly lower at 7.15.

The East Branch site consistently had the poorest water quality of the sites monitored, with the highest mean turbidity, the lowest mean dissolved oxygen, and the lowest mean pH. However, it is important to note that the mean dissolved oxygen and pH values were certainly at acceptable levels, just lower than other sites. The East Branch was also the only site that displayed an improving annual mean turbidity, although it would be very difficult to determine if this was a result of improvements upstream. Otherwise, there was no clear connection

between upstream improvements and downstream water quality. Future efforts might focus on smaller sections of the river; targeting specific improvement sites and monitoring upstream and downstream of that site, before and after the improvements have been made.

Overall, this monitoring effort was very successful in amassing a great quantity of data on the water quality of the Presumpscot River. In addition to other accomplishments, the PWI has allowed for a baseline of existing conditions to be established. This data may be important in an appeal to DEP to upgrade the water quality classification of the lower portion of the river.

A Note on Water Quality Data Appendices

Considerable work went into developing data summary graphs of the continuous instream data generated by the data sondes at the five sonde deployment locations. A collection of these graphs is provided in Appendix G. Examples of the types of graphs found in Appendix G, with explanations about the information they can provide, are given below.

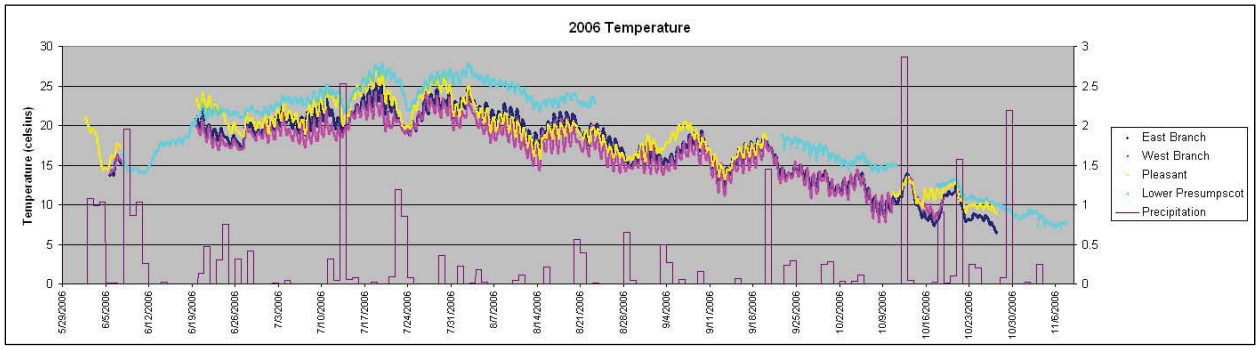


Figure 7-3. Example graph of annual readings of a single parameter (Appendix G).

The '2006 Temperature' graph above (Figure 7-3) is an example of a series of graphs that show all readings for a single parameter (temperature, DO, turbidity, each collected at 15-minute intervals) collected over a full sampling season for all sampling sites (colored "lines", which consist of closely-spaced points) as well as daily precipitation totals (hollow bar graph with a purple outline). The left vertical axis has the parameter value, while the right vertical axis displays daily precipitation. This graph is intended to compare sites to each other across an entire season, with a secondary purpose of showing the full variability in the readings on an intra-day period and against precipitation.

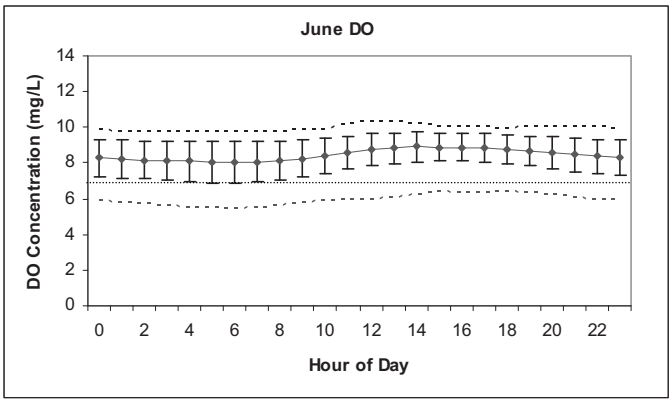


Figure 7-4. Example graph of intra-day variability in DO concentrations (Appendix G).

The 'June DO' graph type (Figure 7-4) is intended to show intra-day variability in dissolved oxygen concentrations during typical day in a given month, with a comparison to the DO water quality standard of 7 mg/L. The DO water quality standard is shown as a straight dotted line. Data have been grouped by hour for a given month, using all three years of available data. The average hourly DO is indicated by a solid dot, the whiskers bracketing that dot indicate ± 1 standard deviation, as an indication of variability. The top and bottom dashed lines indicate the maximum and minimum recorded at that hour.

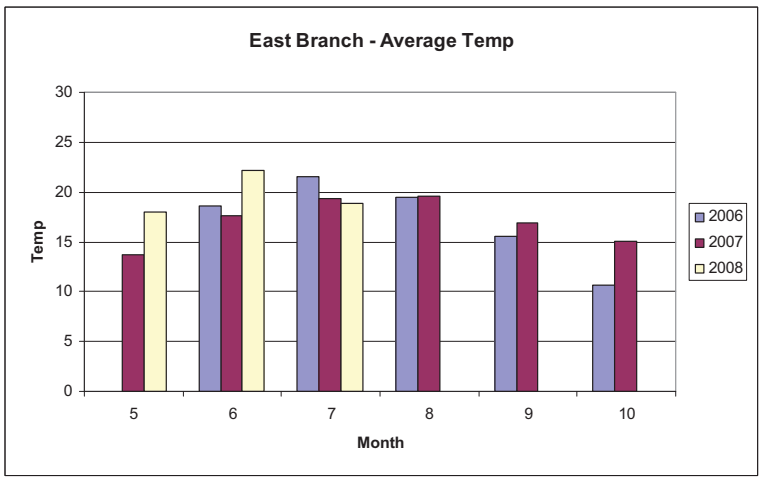


Figure 7-5. Example graph of parameter monthly averages by location (Appendix G).

The 'East Branch – Average Temp' graph (Figure 7-5) is an example of a graph series that shows the monthly averages for each parameter (temperature, DO, or turbidity) during the sampling months, color coded by year. The vertical axis displays the parameter values, and the horizontal axis displays the month by number. This graph shows the change in the value of the parameter over the sampling season, and it allows for easy comparison of the monthly averages for different years.

Data Sondes - Lessons Learned

A 15-minute sampling interval was chosen for this project, and appears to have functioned well. This is the same frequency used by the National Estuarine Research Reserve's System Wide Monitoring Program.[3]

Sonde Tending

Data volume: If deployments are made year-round, this frequency might generate enough data to make analysis with popular spreadsheet software difficult, however, because it may produce more rows of data than will fit on a single sheet. Spreadsheet performance might also be slow. In some cases, spreadsheets with high volumes of data, like those generated by high-frequency monitoring data, have become corrupted because the data can be entered and apparently saved, but not re-opened. Care should be taken to adopt a proven data management strategy, if possible, before sondes are deployed.

Qualified Personnel: If possible, sonde tending personnel should receive hands-on training through several deployments from an experienced technician. The National Estuarine Research Reserve system and the National Estuary Program have generously provided sources of orientation and support throughout this project.

Furthermore, it appears that having access to the sonde manufacturer for help in resolving technical issues would have been helpful in cases of probe or sonde malfunction. We did not have direct access because our equipment was purchased through a second-party vendor. Project managers should carefully consider the quality and speed of technical support when making purchasing decisions.

Having detailed, step-by-step checklist of calibration, deployment, retrieval, and post-deployment procedures that is customized to the project is extremely helpful both for training new staff and for maintaining consistency of effort with minimal human-error.

Quality Assurance and Quality Control: We adopted two primary QA / QC procedures (beyond simply re-calibrating before every deployment). First, we used a hand-held temperature, pH, DO, and conductivity meter to take a reading at each deployment and retrieval. Secondly, we recorded readings with the sonde upon retrieval using calibration standards in the lab, in order to assess sensor failure or drift, before the sonde was washed and re-calibrated. Project managers should carefully budget for the added time required for careful and consistent quality assurance and control.

Record Keeping: Ideally, records should be kept of all pre- and post-calibration readings, and post-deployment readings using calibration standards. The National Estuarine Research Reserve's System Wide Monitoring Program had developed excellent forms and procedures for record-keeping, and these were used as a model for this project.

---

[3] http://nerrs.noaa.gov/RCDefault.aspx?ID=53 (viewed 2/16/2010).

Keeping electronic back-up copies of data files is absolutely essential. Original files should always be kept, and any edits to data saved separately. Sonde technicians should develop a redundant, secure data back-up strategy before the monitoring program begins.

Sonde Deployment and Retrieval Considerations

Public Tampering / Vandalism (Camouflage Considerations): We experienced very few problems with vandalism or tampering, perhaps due to locating sites well away from public areas, either deep in the woods away from trails or at a private home's dock. We used steel anchoring cables attached to a fixed object on shore, and we made an effort to camouflage these cables with brush and leaves. Siting the sondes in remote locations achieved security at the cost of additional travel time and effort. The only site which experienced problems was next to a trail alongside the river. On a few occasions, sonde and anchoring block were dragged from the middle of the stream to the side. After one such event, we discretely attached a small tag to the anchoring cable which stated the cable was attached to a water quality monitoring device, please do not disturb, and giving contact information, in order to satisfy the merely curious without drawing too much attention to the deployment.

Property Access / Landowner Participation: We found that our location at a private dock to be entirely functional. The sonde was conveniently accessible from our parking location, and seemed secure. One must evaluate whether such a site provides representative water quality data, however, because a nearby dock or home may water quality, especially if a boat frequently docks there. This dock appeared to be very lightly used, and the location seemed appropriate.

Length of Deployment Period: We discovered that a two to three week deployment period generally worked well, striking a reasonable balance between time demands and protection against long periods of missing data in the event of a probe failure during deployment.

Cost Considerations

Instrument Replacement / Upgrade: It would have been helpful to have at least one extra pH probe on hand at all times. Having an extra sonde or two available, while expensive, would cut in half the travel time associated with deployments since only one trip per retrieval/re-deployment would be necessary. Additional benefits include no missing data due to removal of the sonde for calibration, and having a ready back-up in case of sonde malfunction. Although in our situation, we determined that extra sondes were not feasible, each project should consider this option. In general, project managers should budget for probe replacement as part of any monitoring program.

7.2.4 REVIEW OF BACTERIA DATA AND AGRICULTURAL BMPS

Workplan Summary: *In conjunction with implementation of Task 2, PRW will determine E. coli bacteria levels by sampling above and below eight agricultural management improvement projects that incorporate livestock exclusion measures from Presumpscot River tributaries.*

As part of Task 2 in the Workplan, PRW used bacteria results from the seasonal volunteer-based monitoring program to examine water quality related to the installation of agricultural management BMPs at several farms throughout the watershed (Figure 7-6). This approach was used instead of establishing new sampling locations closer to the participating farms since doing so might have created the impression among farm operators that they were being targeted for investigation. CCSWCD coordinated the completion of agricultural management improvements over a 2 year period from 2006-2008 (Table 7-1).

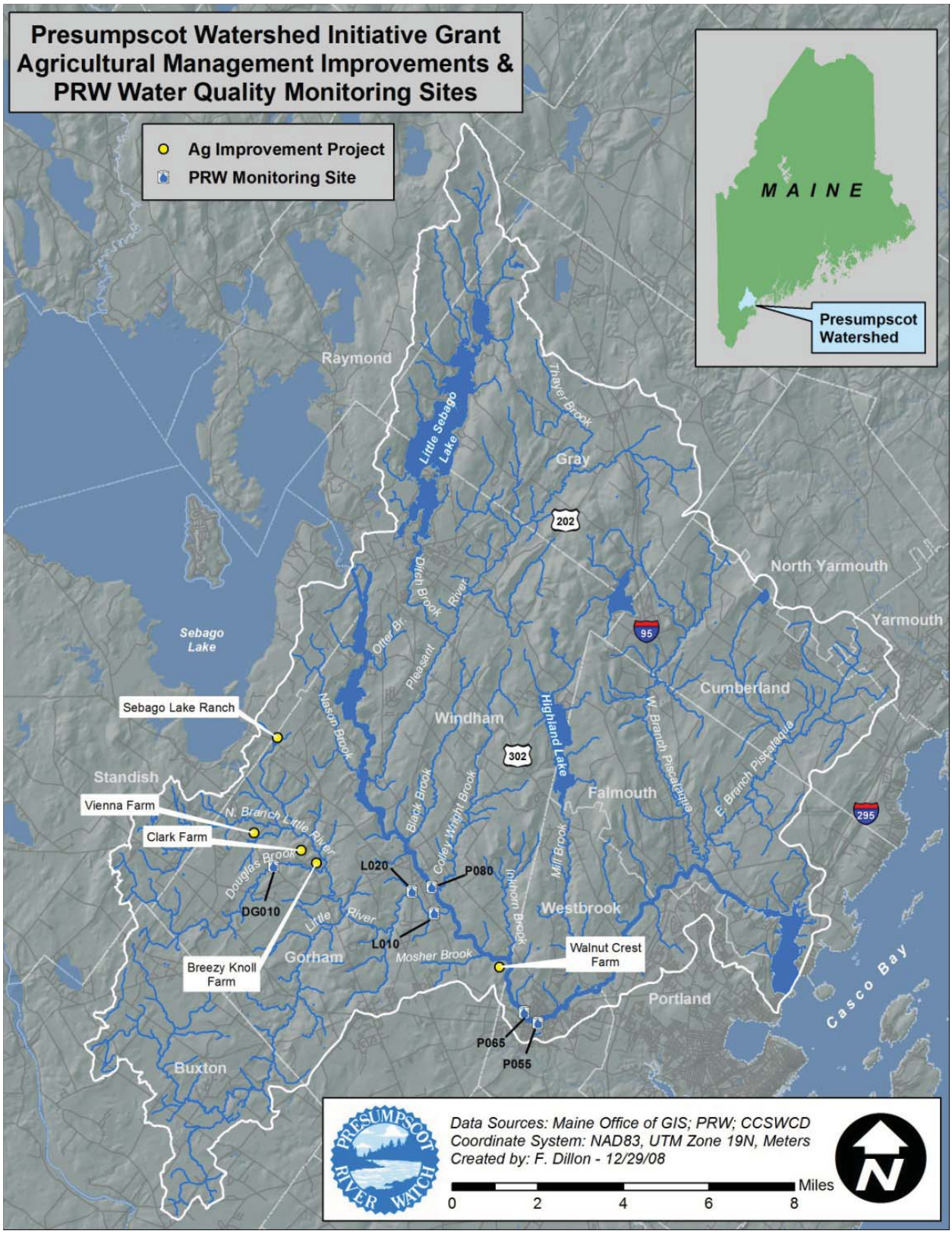


Figure 7-6. Agricultural improvement projects and nearest PRW monitoring sites.

Table 7-1. Agricultural Management BMPs for PWI Project.

Site	Improvements	Installation Dates
Hartwell Farm – Sebago Lake Ranch	❖ Fencing and watering system	❖ Oct-Nov 2008
Vienna Farm	❖ 100 trees ❖ Fencing	❖ Summer 2007 ❖ November 2008
Clark Farm	❖ Watering system ❖ Fencing	❖ May 2008 ❖ October 2008
Breezy Knoll Farm	❖ Watering system ❖ Fencing and concrete pad	❖ January 2008 ❖ May 2008
Rines – Walnut Crest Farm	❖ 3500 trees ❖ Fencing ❖ Riverbank buffer ❖ Watering system ❖ Additional trees	❖ September 2006 ❖ December 2006 ❖ April 2007 ❖ September 2007 ❖ September 2008

To provide a "before and after" basis of comparison for agricultural BMP effectiveness as indicated by water quality improvements, the nearest upstream and downstream PRW sampling sites were identified (Figure 7-6). Distances between farm improvement sites and PRW sampling locations were then measured to determine whether a particular farm should be assessed using PRW's bacteria monitoring results. The basic premise for this determination was that greater distances between farm sites and PRW monitoring locations allow for more bacteria inputs from other sources thereby resulting in a less meaningful assessment. Distances to downstream sample sites were so great from the Hartwell and Vienna Farms that bacteria monitoring assessments were considered unwarranted (Table 7-2). A threshold distance of ~ 5 miles was used somewhat arbitrarily to determine which farms to assess. Given the complexity of the watershed and its numerous and varied land uses, it is very likely that even minimal distances between farm improvement sites and PRW sampling locations allow ample opportunities for additional bacteria inputs beyond those potentially originating from the farm sites. As such, the following assessment has limited utility though it may still provide a baseline for determining BMP effectiveness as more PRW bacteria monitoring data is generated in the future.

Table 7-2. Distances between farm improvement projects and nearest PRW sampling locations.

Farm Name	Upstream PRW Site	Approx. Distance	Downstream PRW Sites	Approx. Distance	Comments
Hartwell Farm - Sebago Lake Ranch	NA	NA	L020, L010	8 miles	Comparison w/ PRW data not warranted given distance to nearest downstream sampling site.
Vienna Farm	NA	NA	L020, L010	7 miles	Comparison w/ PRW data not warranted given distance to nearest downstream sampling site.
Clark Farm	DG010	.85 miles	L020, L010	5 miles	Comparison w/ PRW questionable given distance to nearest downstream sampling site.
Breezy Knoll Farm	DG010	.85 miles	L020, L010	5 miles	Comparison w/ PRW questionable given distance to nearest downstream sampling site.
Rines - Walnut Crest Farm	P080	2.8 miles	P065, P055	1.25 miles	-

The pre- and post-BMP assessment relied on PRW's *E. coli* monitoring data for the 10 year period from 1999 to 2008. For Clark and Breezy Knoll Farms, geometric mean concentrations from the 9 years preceding BMP installation (1999-2007) were compared against 2008's geometric mean concentrations – the period after which most BMPs had been completed. (Pre-BMP sampling results for the entire 9 year period were aggregated for each site to determine geometric means). This assessment does not indicate any measureable improvement in bacteria concentrations. Instead, PRW data indicate that both downstream sites experienced considerable increases in geometric mean values for 2008 (as did the upstream site) relative to the preceding 9 years (Table 7-3, Figure 7-7). Geometric mean concentrations for L020 increased from 72 MPN/100 mL for the period from 1999-2007 to 172 MPN/100mL in 2008 – an overall increase of 139%. For L010, geometric mean concentrations increased from 42 MPN/100 mL for the 1999-2007 period to 220 MPN/100 mL in 2008 – an overall increase of 429%.

In addition to the high likelihood of bacteria inputs from other potential sources between the farm improvement sites and downstream PRW sampling locations, these increases are also partly due to a significant storm event on June 28, 2008 that resulted in bacteria concentrations of >2,419 MPN/100 mL for both L010 and L020. Another factor for the increase in bacteria concentrations at both downstream sites is the number of sampling events used to determine the geometric means for the pre- and post-BMP time periods. For L020, there were 74 sample results used to determine geometric means before BMPs were implemented and only 7 sample results used after BMPs were implemented; for L010, these values were 76 and 7, respectively. As more post-BMP sample results are generated for L010 and L020, it is likely that overall geometric mean values for both sites will be moderated somewhat by the inclusion of additional data points.

Table 7-3. Change in geometric mean concentrations above and below Clark and Breezy Knoll Farms before and after BMP installation.

Table 3: Change in geometric mean concentrations above and below Clark and Breezy Knoll Farms before and after BMP installation

PRW Sample Site	1999-2007 Geomean (Pre-BMP)	2008 Geomean (Post-BMP)	% Change from 1999-2007 to 20008
DG010 (Upstream)	62	154	148%
L020 (Downstream)	72	172	139%
L010 (Downstream)	41	220	429%

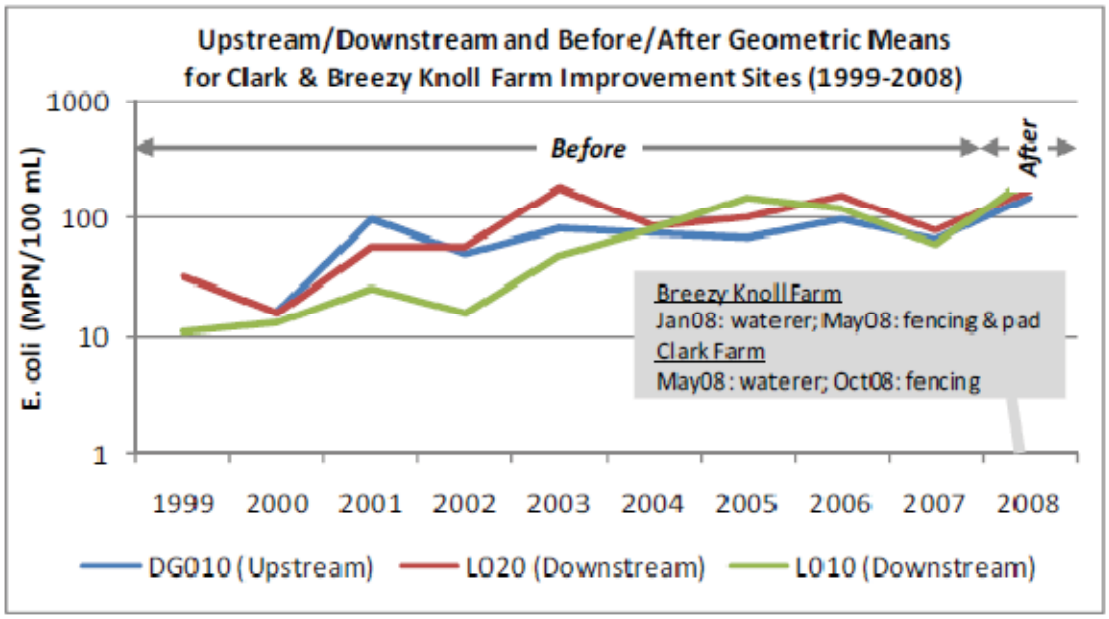


Figure 7-7. Geometric mean comparisons of PRW sampling sites above and below Clark & Breezy Knoll Farms.

Geometric mean results below Walnut Crest Farm showed some improvements in water quality after agricultural BMPs were implemented (Table 7-4, Figure 7-8); though there are other factors that may account for the modest decrease in bacteria concentrations at site P055 (P065 experienced a very slight increase, as did the upstream site P080). Geometric mean concentrations for P055 decreased from 82 MPN/100 mL for the period from 1999-2006 to 60 MPN/100mL for the period from 2007-2008 – an overall decrease of 27%. For P065, geometric mean concentrations increased from 36 MPN/100 mL for the 1999-2006 period to 38 MPN/100 mL for the period from 2007-2008 – an overall increase of 7%.

Part of the reason *E. coli* concentrations at P055 decreased after BMPs were implemented may be due to the fact that the agricultural management improvements were quite extensive at Walnut Crest Farm. Additionally, in contrast to the considerable distance between the

downstream sample sites and the Clark and Breezy Knoll projects, P055 is much closer to the Walnut Crest Farm. Finally, more sample results were used to determine post-BMP bacteria concentrations at both downstream sites – 14 for P055 and 11 for P065. (The numbers of pre-BMP sample results for P055 and P065 were 52 and 19, respectively).

Table 7-4. Change in geometric mean concentrations above and below Walnut Crest Farm before and after BMP installation.

PRW Sample Site	1999-2006 Geomean (Pre-BMP)	2007-2008 Geomean (Post-BMP)	% Change from 1999-2006 to 2007-20008
P080 (Upstream)	37	50	36%
P065 (Downstream)	36	38	7%
P055 (Downstream)	82	60	-27%

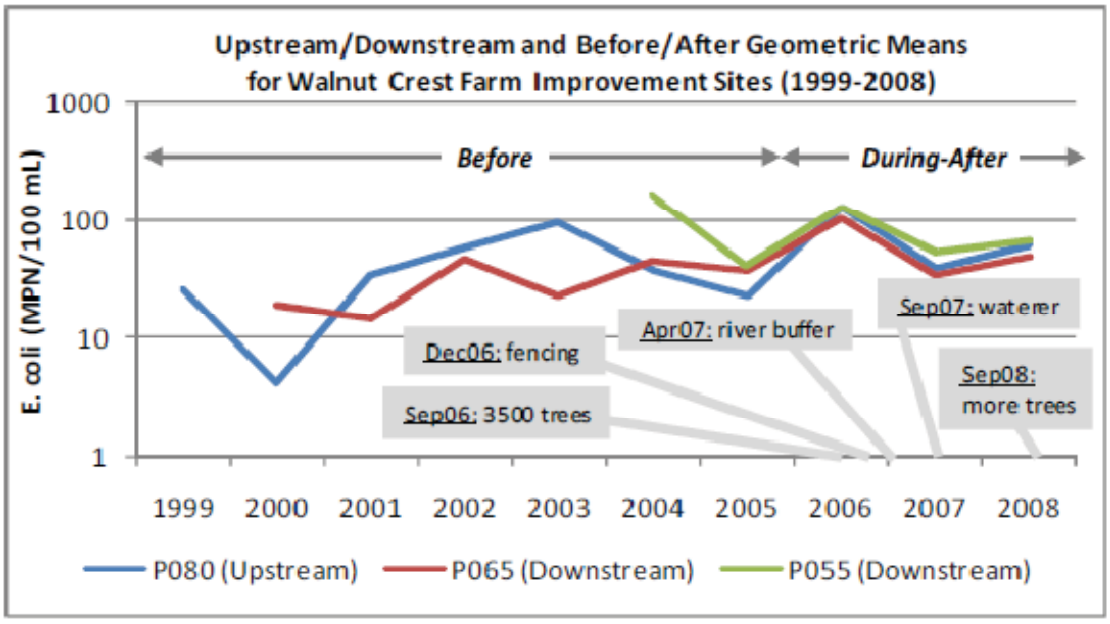


Figure 7-8. Geometric mean comparisons of PRW sampling sites above and below Walnut Crest Farm.

In conclusion, while agricultural management improvements at each of the five farms that participated in the PWI project may have resulted or will result in appreciable improvements to water quality, it is also difficult to measure these improvements with PRW bacteria data given the considerable distances to downstream sample sites. A more definitive determination of water quality improvements resulting from the implementation of these specific agricultural management BMPs will likely require a more targeted monitoring program.

7.2.5 STREAM CROSSING MONITORING

Presumpscot Watershed Initiative Task 7E – Stream Crossing Monitoring

In conjunction with Task 3 (Stream Crossing Erosion Control) of the PWI Workplan, PRW collected water quality samples and measured stream discharge at several sites throughout the Presumpscot River watershed (Figure 7-9). These sites were selected in consultation with the CCSWCD and CBEP.

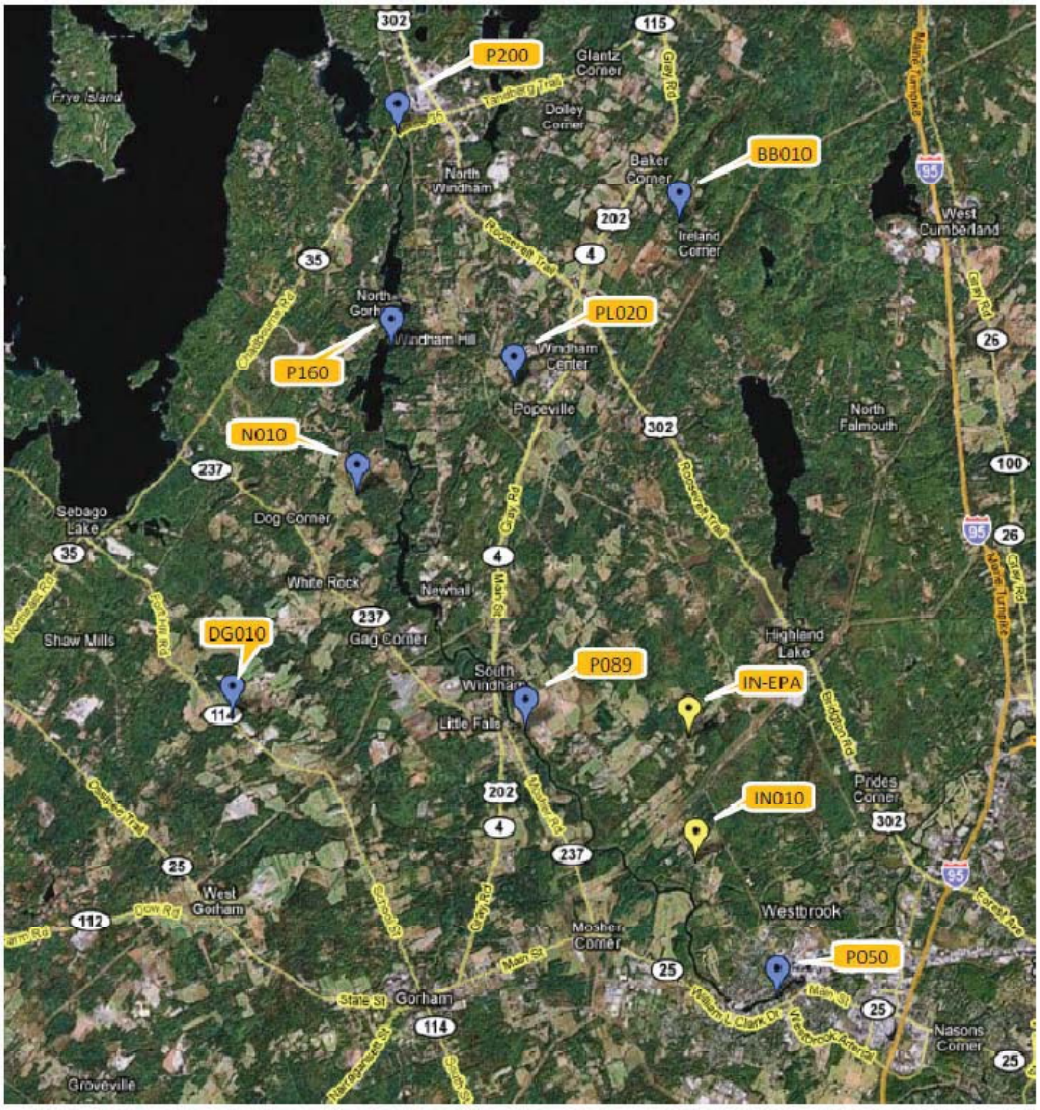


Figure 7-9. Stream crossing sample locations for PWI water quality monitoring and flow measurement.

Water Quality Monitoring

PRW staff measured water quality at eight established PRW sites indicated with blue symbols in Figure 7-9 (P200, BB010, P160, PL020, N010, DG010, P089 and P050) on September 18, 2006 and July 26, 2007. Monitoring parameters included temperature, dissolved oxygen (concentration and percent saturation), turbidity, specific conductance and pH. The results

from these measurements were fairly consistent from 2006 to 2007. Water temperatures for both years were between 20 - 25°C – the range generally considered as potentially detrimental to cold water fish species – at three of the eight stream crossing sites (P200, P160 and P089). Three other sites had water temperatures in this range for 2007: P050, N010 and PL020 (Table 7-5 and Figure 7-10). Dissolved oxygen levels failed to comply with Maine DEP Class B Water Quality Classification standards on only one occasion over the course of the monitoring period. In July 2007, site N010 had a D.O. concentration of 6.4 parts per million and a saturation level of 73.1% (Table 7-5 and Figure 7-11). The minimum standard for each of these parameters is 7 PPM and 75%, respectively. Highlighted DO readings indicate where DO fell below minimum standards. Highlighted temperature readings show high water temperature readings.

Table 7-5. Eight primary stream crossing locations sampled for PWI Project in 2006 and 2007.

Samplers: T. Bennett & F. Dillon		Meters: DO: YSI DO200; Turb: LaMotte 2020; pH/Cond: YSI pH100						Samplers: T. Bennett & F. Dillon		Meters: DO, pH, cond: YSI 85; Turb: LaMotte 2020					
Sept. 18, 2006 Sample Field Measurement		Temp	Dissolved Oxygen		Turbidity	Spec. Conduc-tance		**July 26, 2007 Sample Field Measurement**		Temp	Dissolved Oxygen		Turbidity	Spec. Conduc-tance	
Site Number / Location	Sample Collection Time	(°C)	PPM	% Sat	(NTUs)	(µS)	pH	Site Number / Location	Sample Collection Time	(°C)	PPM	% Sat	(NTUs)	(µS)	pH
P050	10:15	20	9	99.6	1.42	64	6.9	P050	15:26	24.99	9.3	114.8	2.77	69	6.9
DG010	11:30	15.8	7.5	75.4	1.95	134.5	7	DG010	9:20	19.2	7.2	78.5	1.34	130	6.9
N010	11:55	15.4	9.2	90.6	8.49	98.1	7.2	N010	10:44	20.5	6.4	73.1	4.99	99	7
P200	12:30	21.7	8.6	98.4	0.4	48.1	7.5	P200	13:10	25.63	9.67	121	0.14	53	7.05
P160	12:55	22.2	8.6	98.3	0.48	47.7	7.1	P160	15:20	25.5	7.4	92.9	1.15	54	7.3
P089	14:10	24.2	7.8	93.9	0.6	59.1	7.61	P089	15:51	25.01	7.8	99.1	0.65	55	7.8
PL020	14:45	18.6	9.9	106.2	1.62	185.5	7.97	PL020	16:13	26.2	7.8	98.4	3.17	193	6.9
BB010	15:15	17	8.4	87.1	2.4	50.6	6.78	BB010	12:05	19.01	8.9	97.6	1.32	46	6.4

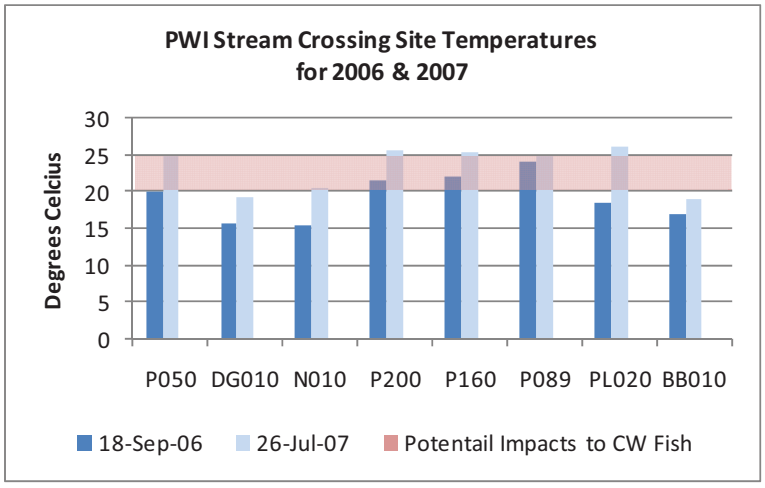


Figure 7-10. Water temperature monitoring results for eight primary stream crossing locations for PWI Project.

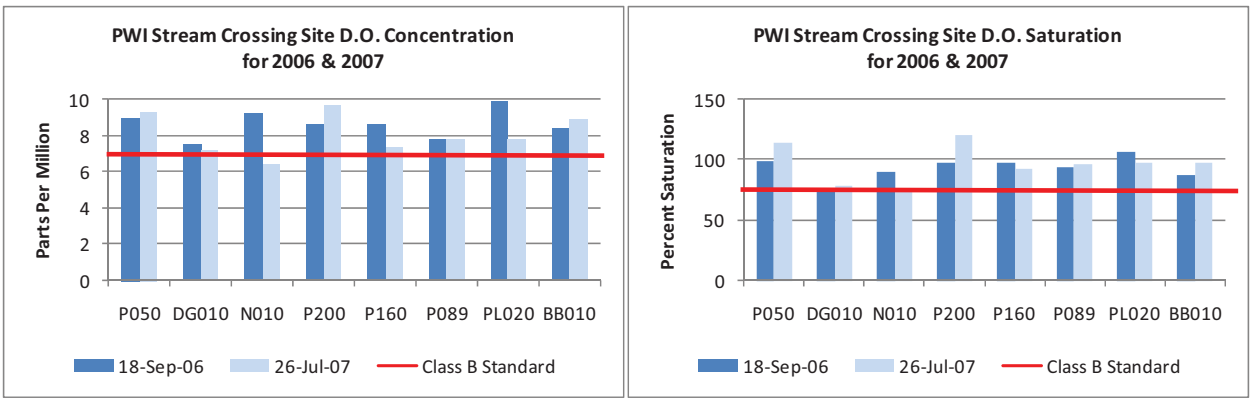


Figure 7-11. Dissolved oxygen monitoring results for eight primary stream crossing locations for PWI Project.

Turbidity results for nearly all of the eight primary stream crossing sites were below 3 NTUs. The only exception was site N010, which had readings of 8.49 and 4.99 NTUs in 2006 and 2007, respectively (Table 7-5 and Figure 7-12). Conductivity and pH results were fairly consistent at each site from year to year (with a couple of notable exceptions) but varied considerably between particular sites (Table 7-5 and Figure 7-13).

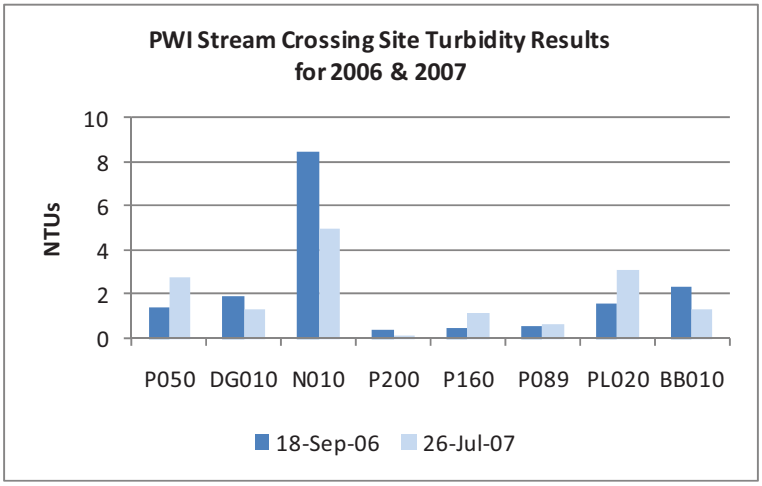


Figure 7-12. Turbidity monitoring results for eight primary stream crossing locations for PWI Project.

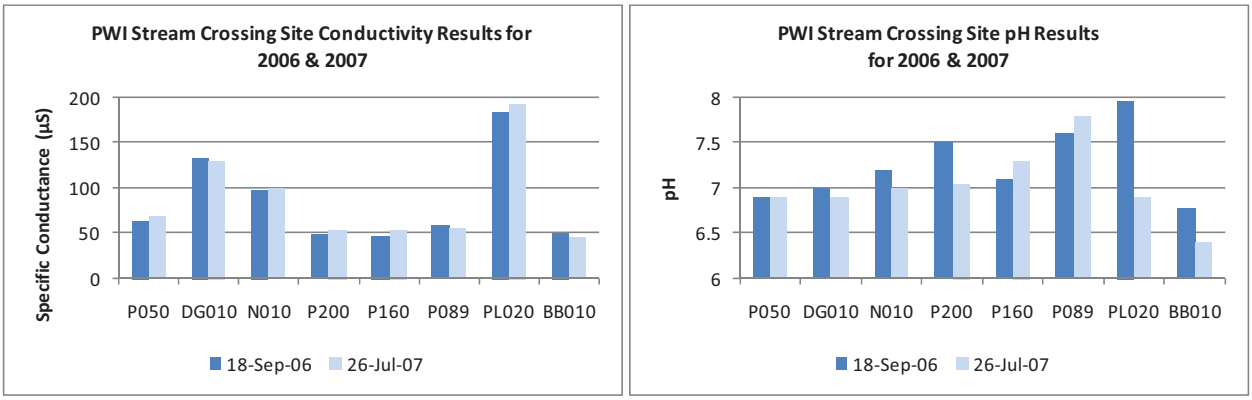


Figure 7-13. Conductivity and pH monitoring results for eighty primary stream crossing locations for PWI Project.

Water quality was also measured and samples were collected on September 26, 2007 from two additional sites (indicated with yellow symbols in Figure 7-9). One of these, IN010, is an established PRW site whereas site "IN-EPA" further upstream on Inkhorn Brook was sampled as part of a separate EPA study. Sampling parameters for these two sites included total phosphorus, Chlorophyll-a, nitrite-nitrate nitrogen, total suspended solids, temperature, dissolved oxygen (concentration and percent saturation), turbidity and specific conductance. Results for all sampling sites are summarized in Table 7-5 and Table 7-6. Field data sheets and laboratory results for all monitoring activities are on file at PRW's office.

Table 7-6. Two additional stream crossing locations sampled for PWI project in 2007.

Sampler: F. Dillon		Meters: DO, pH, cond: YSI 85											
		Sample Collection for Analysis Later							Sample Field Measurement				
Sept. 26, 2007 Sample Collection & Measurement		Sample Container Type			Parameter				Temp	Dissolved Oxygen		Turbidity	Spec. Conduc-tance
Site Number / Location	Sample Collection Time	Plastic	Glass	Whirl Pak	TP (ppm)	Chl-a (ppm)	NO_2-NO_3 (ppm)	TSS (ppm)	(°C)	PPM	% Sat	(NTUs)	(µS)
IN010	11:35	x	-	-	0.030	0.0032	-	-	17.7	3.8	37.7	12	174.5
IN-EPA	12:10	x	-	-	0.052	0.016	0.06	12	18.2	8.22	87.3	20	85.3

Stream Discharge Measurements

Stream discharges were measured in 2007 and 2008 using USGS Type AA and mini ("Pygmy") current meters and methodology. This equipment was obtained through EPA's Equipment Loan Program for volunteer monitoring groups. PRW and CBEP staff measured stream discharges at five of the eight primary stream crossing sites that were monitored for water quality in 2006 and 2007 (P200, BB010, PL020, N010, and DG010). Stream discharges for sites P089 and P050 could not be measured using the EPA's equipment because they are located on the main stem of the Presumpscot (this equipment can only be used on wadeable streams). As such, additional sites were established for stream discharge measurements at PI010 and PI020 – the locations for datasonde deployments under Task 7C (Continuous Instream Monitoring) of the PWI Workplan.

Stream discharges were measured during drier weather conditions in 2007 and wetter weather conditions in 2008 (which was one of the wettest years on record according to the National Weather Service). Consequently, there was considerable variation from year to year at each site. Stream discharges could not be measured at PI010 and PI020 in 2008 due to back flow from the main stem of the Presumpscot. (At the time that PRW and CBEP staff were measuring stream discharges, water was being released from Sebago Lake in preparation for a Maine DEP dye study that required lower flow conditions). Stream discharge results are indicated in Table 7-7 and Figure 7-14. All field data sheets for these activities are on file at PRW's office.

Table 7-7. Stream discharge measurements for PWI Project.

Stream Site	2007 Flow (cfs)	2008 Flow (cfs)	2007 Avg Vel (fps)	2008 Avg Vel (fps)	2007 Area (ft2)	2008 Area (ft2)	Comments
Baker	0.045	0.087	0.006	0.007	6.985	11.638	
Douglas	0.101	1.304	0.013	0.058	7.758	22.291	
Nasons	0.054	0.222	0.004	0.019	12.788	11.568	Avg. of 2 measurements for July & Sept. 2007
EB Piscataqua	2.346	-	0.067	-	34.925	-	Sep08: SAPPI dam release to increase main stem flow for DEP study created back flow to EBP so unable to measure discharge.
WB Piscataqua	3.264	-	0.085	-	38.300	-	Sep08: SAPPI dam release to increase main stem flow for DEP study created "back flow" to WBP so unable to measure discharge.
Pleasant	5.733	19.687	0.139	0.251	41.205	78.326	
Presumpscot	23.099	40.559	0.213	0.286	107.815	142.013	Avg. of 2 measurements for July & Sept. 2007

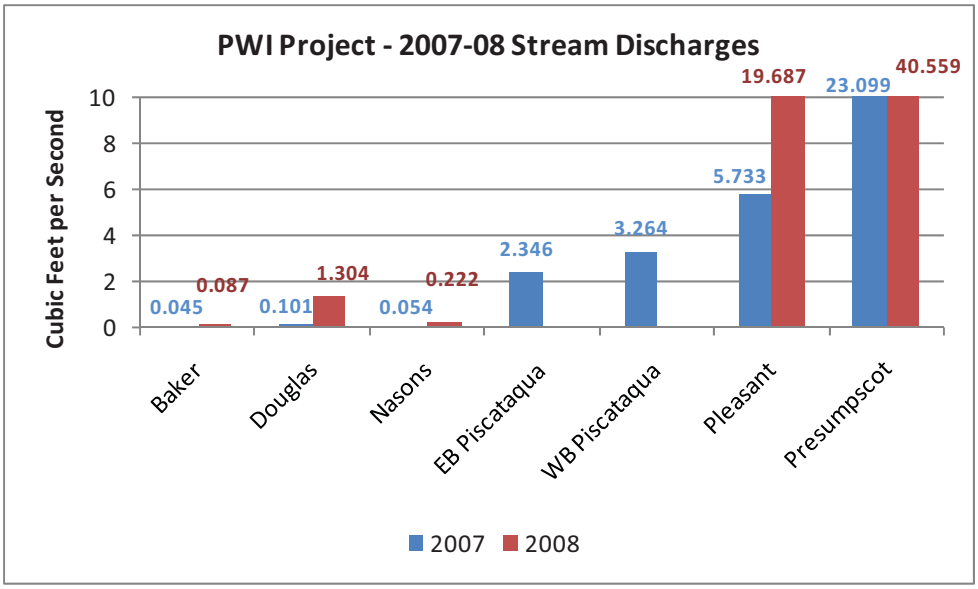


Figure 7-14. Stream discharge measurements for PWI Project.

7.2.6 SAMPLING FOR MACROINVERTEBRATES

Workplan Summary: *In conjunction with the implementation of Task 5, PRW will conduct limited sampling to determine total phosphorus and pesticide levels by sampling above and below three BMP projects at area golf courses.*

The Workplan called for PRW to conduct limited phosphorous and pesticide monitoring in association with the implement of Task 5. However, midway through the project period, this was deemed too expensive for PRW to conduct given the limited budget slated for monitoring activities and the extensive monitoring responsibilities owned by PRW under Task 7. Following discussions between PRW, CBEP, and EPA about how to revise monitoring activities to provide meaningful information about PWI work within Presumpscot watershed golf courses, it was decided that PRWC, using Section 320 funds through CBEP, would provide funding for DEP to take an aquatic life sample at a stream running through the Riverside Golf Course in Portland. This aquatic life (macroinvertebrates) sample was deployed on July 27, 2007 and retrieved on

August 27, 2007, and followed DEP's standard rock bag methodology for monitoring macroinvertebrates.

The results of this single sample (two bags) were delivered at the end of the PWI project period, and PRW staff were unable to conduct analysis for this report. DEP reported that the stream's statutory water quality classification is class B, but the model predicts it as "NA" or nonattainment of any class (AA, A, B, or C), which DEP interprets that the stream is impaired. DEP's cursory review of the sample report showed that the sample produced zero (0) stoneflies (*Plecoptera*), zero (0) mayflies (*Ephemeroptera*), and only a small number of caddis flies (*Trichoptera*) in the samples, which often is a signal of a problem in streams. DEP staff believed that all caddis flies were from the family Chironomidae ("midges") of the order Diptera. Lots of filamentous algae were reported at the site.

Additional aquatic life samples will be taken in this stream in the future as DEP monitors attainment of Class B water quality standards.

7.2.7 EXPENDITURES

The initial Workplan budgeted $226,750 for implementation of this task, including $58,425 in match. The final budget for this task was $262,327.65, including $85,698.47 in match. Match sources included volunteer water samplers and equipment mark-downs by vendors.

Task 7: WQ Monitoring

	Workplan Budget	Actual Expenditures
PRW TWG	$ 98,450.00	$ 107,180.96
PRW Match	$ 33,920.00	$ 61,115.45
FOCB TWG	$ 69,875.00	$ 69,448.22
FOCB Match	$ 24,505.00	$ 24,583.02
Total	$ 226,750.00	$ 262,327.65

7.3 OUTCOMES AND OUTPUTS

Table 7-8. Logic Model: Water Quality Monitoring.

Outputs		Outcomes	
Activities	**Participants**	**Short Term**	**Long Term**
Purchase and deployment of 6 data sondes, 1 hand held instantaneous monitoring tool, replacement probes, calibration standards, and other monitoring equipment and supplies	PRW, FOCB, CBEP	Increased equipment and technical capacity among PRWC partners for monitoring water quality within the Presumpscot River, its tributaries, and Casco Bay	Continued increase in knowledge and understanding about aquatic systems to promote optimum management practices
Develop QAPPs	PRW, FOCB, DEP	EPA and DEP-approved QAPPs for PRW for all PWI monitoring activities; expanded QAPP for FOCB for PWI monitoring activities; improved local understanding of QA issues; improved data quality review.	Documentation of protocols for deploying monitoring equipment and conducting intensive monitoring; increased local capacity for devising sampling plans
Conduct continuous instream monitoring at five locations	PRW, FOCB	Expansion of Presumpscot baseline water quality baseline data set; improved knowledge of water quality in the river	Data availability for future comparisons; information for use in evaluating and demonstrating water body Class designations and status
Sample water quality in proximity to agricultural and stream crossing BMP installations	PRW	Instantaneous grab sample data for sites throughout the Presumpscot watershed; improved knowledge of water quality in the river	Data availability for future comparisons; information for use in evaluating and demonstrating water body Class designations and status
Macroinvertebrate sampling at Riverside Golf Course	DEP, PRWC, CBEP	Rock bag data from an impaired stream running through Riverside Golf Course; improved knowledge of status of invertebrate community	Data availability for future comparisons; information for use in evaluating and demonstrating water body Class designations and status

8 PROJECT MANAGEMENT AND ADMINISTRATION

Lead Implementer: Casco Bay Estuary Partnership

8.1 OVERVIEW

Workplan Summary: *CBEP is the lead organization for oversight, implementation, and fiscal management of all PWI projects.*

There were no goal or performance measures given for this task in the Workplan. Consequently, there was no logic model prepared for this Chapter.

Implementation activities for this task occurred from February 2006 to February 2010.

8.2 TASK IMPLEMENTATION

CBEP Staff

CBEP was the lead organization responsible for oversight, implementation, and fiscal management of all projects within the Workplan. Within CBEP, Karen Young, CBEP Executive Director, provided general fiscal and project management oversight. Matt Craig, CBEP Technical Program Coordinator, served as PWI Project Manager and EPA liaison, overseeing budgeting and scheduling of all projects, completing administrative responsibilities and reports, and coordinating partner project implementation and decision making among project partners. The TWG funded some of the PWI Project Manager's salary for approximately two years of the PWI project period.

Contractual

CBEP was responsible for ensuring that water quality data collected during the PWI were uploaded into the EPA STORET database. During the project period, this requirement was modified to ensure the data were uploaded into the next generation of STORET, WQX. The Workplan set aside $5,000 to hire a contractor to assist with the integration of PWI-generated water quality data into STORET. During project implementation, project staff determined that hiring a contractor to facilitate this process would not be necessary. These funds were reprogrammed with EPA Project Officer approval and primarily used to cover expenses related to the 2008 Presumpscot RiverFest.

Travel

As the legal grant recipient, CBEP was required to attend two national conferences for past and present Targeted Watershed Initiative Grant recipients. Travel funds to and from these conferences were built into the budget for the PWI Project Manager and PRWC Chair to attend TWG conferences in Albuquerque in 2006, and Corpus Christi in 2008. An additional expenditure for out-of-state travel was made to pay for CCSWCD staff Jami Fitch to attend the 2009 National Conference for Nonpoint Source and Stormwater Outreach in Portland, Oregon and present on the successful YardScaping program.

This budget line was also used to cover the expense of in-state CBEP PWI-related travel during the project period.

Equipment

The primary expenditures in this budget line were two laptops and related expenses. One laptop was used by the CBEP Project Manager, and the second was used by the PRYCC Technical Directors on a seasonal basis, as well as by PRWC interns. Additional expenditures in December 2009 provided for data sonde replacement probes, which will enable ongoing PRWC baseline water quality monitoring in 2010 and beyond.

Supplies, Printing

This budget line covered miscellaneous supplies and printing costs, including PRYCC reports for 2006 – 2008.

8.2.1 EXPENDITURES

The initial Workplan budget for this task was $189,435, including an estimated $6,124 in match and $79,266 in USM indirect expenses. The final budget for this task was $183,653.53, including $61,025.09 in USM indirect and $12,087.99 in match. The source of match listed for this task was primarily comprised of PRWC in-kind volunteer participation.

Note: FOCB administrative costs were added to this budget line because they were reported separately from FOCB expenditures in Task 1, YardScaping, and Task 7, Water Quality Monitoring.

Task 8: Project Management

	Workplan Budget	Actual Expenditures
CBEP TWG	$ 104,045.00	$ 107,703.38
CBEP Match	$ 6,124.00	$ 12,087.99
FOCB Administrative		$ 2,837.07
USM Indirect	$ 79,266.00	$ 61,025.09
Total	$ 189,435.00	$ 183,653.53

9 DATA MANAGEMENT

Lead Implementer: Presumpscot River Watch/Orbis

9.1 OVERVIEW

Workplan Summary: *PRW will work with FOCB, PRWC, CCSWCD, and other project members to design and develop a comprehensive project database. This database will store and integrate all monitoring data with photographs and data gathered for each project task.*

The initial Workplan goals for this task were:

- Efficiently manage, organize, and store all project data.
- Construct a digital infrastructure that enables long-term continuation of project goals and facilitates utilization of the project as a model in other watersheds.

The initial Workplan performance measures for this task were:

- Completion of project database skeleton.
- Continuous database population over project duration.

The implementation period for this task was between February 2006 and summer 2009.

9.2 TASK IMPLEMENTATION

Task 9 in the Workplan outlined data management for all PWI project implementation activities. PRW was responsible for data management and subcontracted with Orbis to design a set of comprehensive geo-spatial Access databases to capture PWI work and data, as well as to develop interactive web-based maps. These tasks were budgeted as part of Task 6 in the Workplan.

9.2.1 DATABASE DESIGN

Orbis, working closely with CBEP and PRW, began designing a relational ArcGIS geospatial project database soon after the PWI project began in 2006 using Microsoft Access. The database's conceptual design was structured so that field data collected prior to and during implementation of PWI programmatic (task) activities would relate to data collected about other PWI activities through the project geodatabase (Figure 9-1). Orbis worked closely with PWI project partners from the onset to ensure that essential data were collected for all PWI work right from the start, particularly Global Positioning System (GPS) site coordinates.

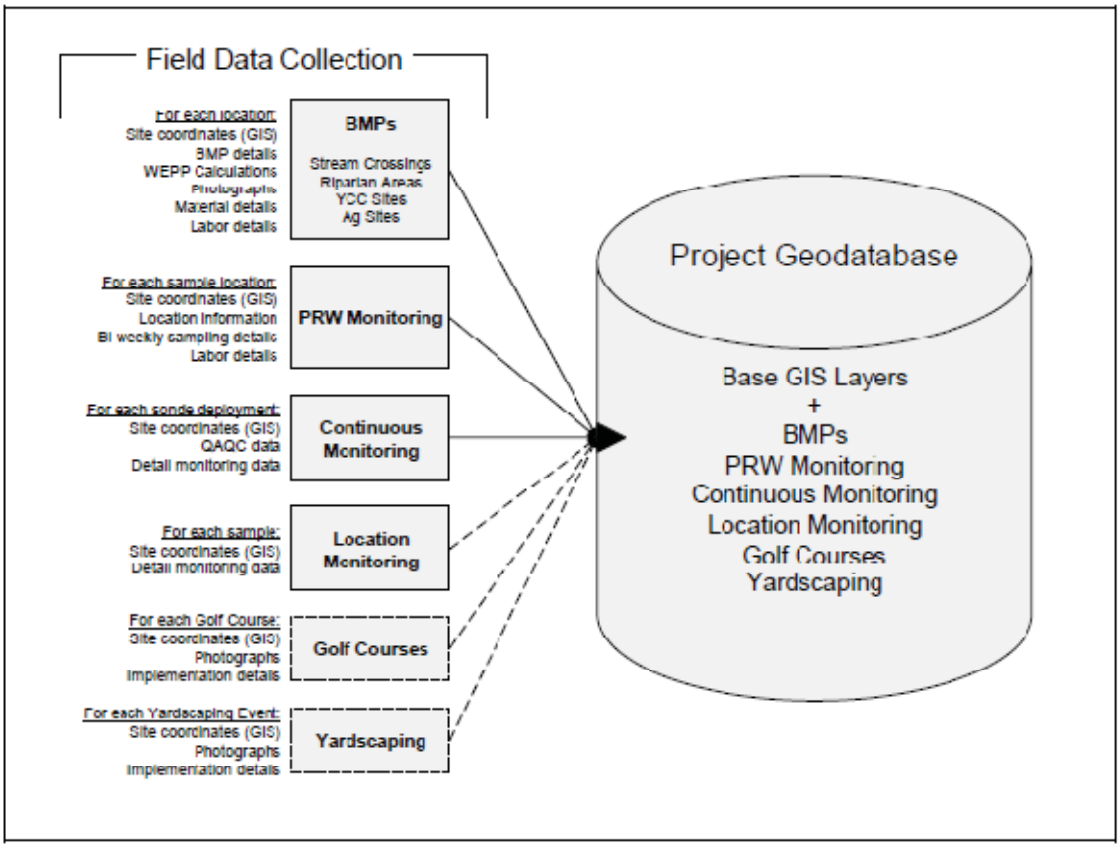


Figure 9-1. Conceptual design of the PWI geodatabase. Dotted lines were used to indicate progress in database development during the project period.

9.2.2 DATABASE DEVELOPMENT

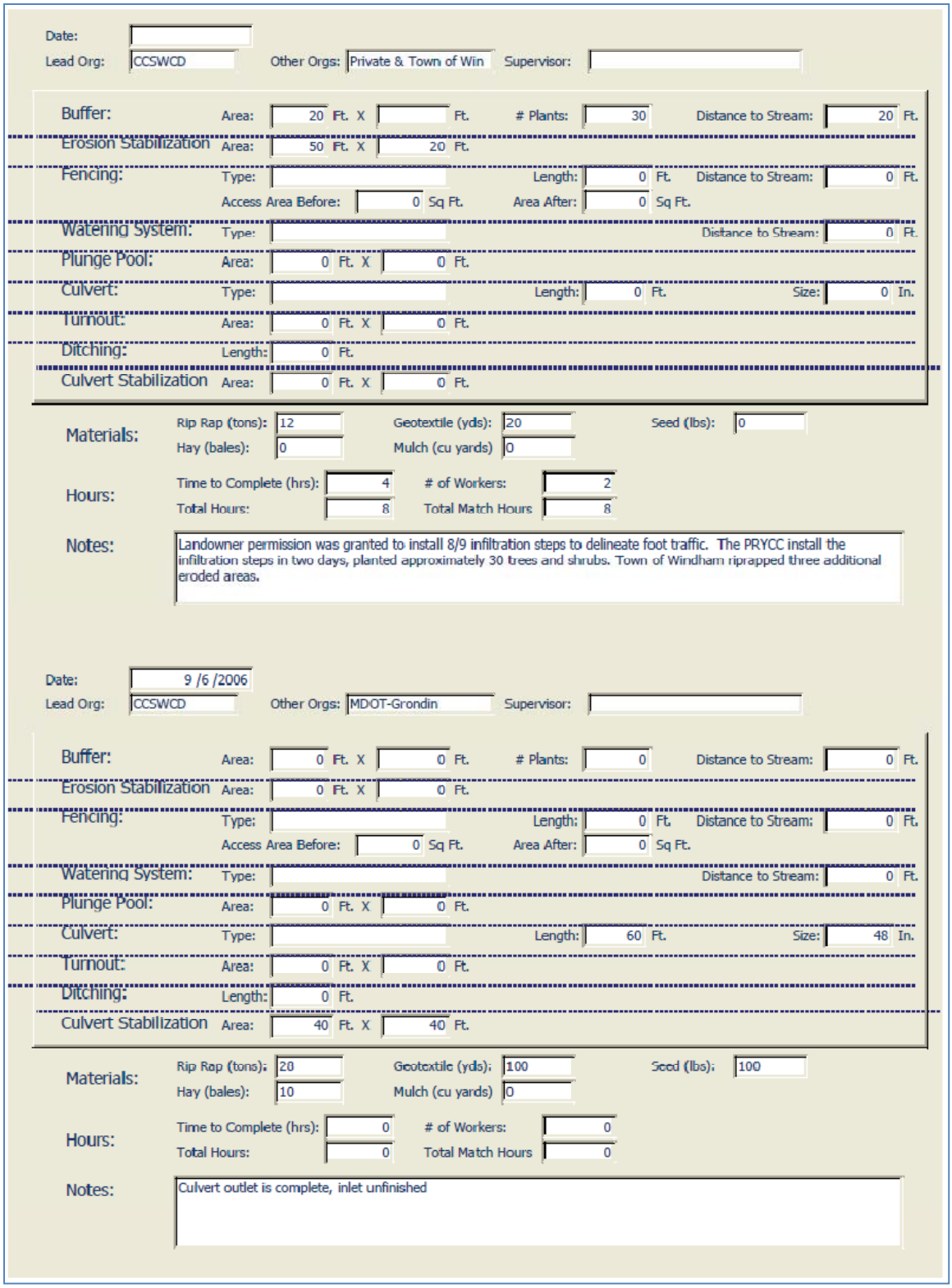
Orbis developed the project database in sections by working closely with the lead implementers for each task over a series of several meetings. This approach was taken for several reasons: 1) to ensure the database would serve the data storage needs for each unique PWI task; 2) to ensure the database interface and data input/output features were functional and readily understandable for task managers and PWI implementers; and, 3) data storage abilities could accommodate individual partner work prior to and following the PWI, ensuring long-term function and usability of the database. In some cases, Orbis developed a series of draft database structures through an iterative process during which PWI partners provided feedback about draft features to provide optimum capabilities.

Construction of the PWI project database was completed in phased sections according to urgency of need. Due to the immediate need for data storage capabilities for water quality monitoring data and BMP projects, these sections were constructed first with other sections following later in the project period. Final construction of the PWI project geospatial database was completed in the spring of 2008, although new features of the database (such as water quality monitoring summaries and reports) were added and/or modified right up to the end of the project period as various reporting needs were identified.

9.2.3 INTEGRATE PROJECT DATA INTO DATABASE

PWI project data integration occurred throughout the project period based on the data storage needs of each PWI task, as well as data availability. Integration of data into the database took different forms depending on the type of data being captured. For instance, since automated water quality monitoring equipment (sondes) output data into tab-delineated datasets automatically, these data sets were suited to importation into the database through Microsoft Excel spreadsheets. Integration of sonde data through this process occurred periodically during the monitoring field season when possible, and otherwise imported to the database on a yearly basis. 'Dry runs' of analysis to summarize and review water quality data were made possible because of the regular data integration.

BMP data collected prior to/during other tasks, including road/stream crossing improvements, agricultural management improvements, PRYCC projects, and golf course management improvements, were incorporated into the database at various points on a logical basis using a data input/database interface window designed specifically for PWI BMP implementation activities (Figure 9.2). WEPP sediment stabilization modeling estimates were completed in the spring of 2006, prior to implementation of stream/road crossing implementation activities, so this data set was completed and ready for integration prior to other data on the actual BMP's installed at these sites, which were entered into the database later in the project period.



Date:
Lead Org: CCSWCD Other Orgs: Private & Town of Win Supervisor:

Buffer: Area: 20 Ft. X Ft. # Plants: 30 Distance to Stream: 20 Ft.
Erosion Stabilization Area: 50 Ft. X 20 Ft.
Fencing: Type: Length: 0 Ft. Distance to Stream: 0 Ft.
Access Area Before: 0 Sq Ft. Area After: 0 Sq Ft.
Watering System: Type: Distance to Stream: 0 Ft.
Plunge Pool: Area: 0 Ft. X 0 Ft.
Culvert: Type: Length: 0 Ft. Size: 0 In.
Turnout: Area: 0 Ft. X 0 Ft.
Ditching: Length: 0 Ft.
Culvert Stabilization Area: 0 Ft. X 0 Ft.

Materials: Rip Rap (tons): 12 Geotextile (yds): 20 Seed (lbs): 0
Hay (bales): 0 Mulch (cu yards) 0

Hours: Time to Complete (hrs): 4 # of Workers: 2
Total Hours: 8 Total Match Hours 8

Notes: Landowner permission was granted to install 8/9 infiltration steps to delineate foot traffic. The PRYCC install the infiltration steps in two days, planted approximately 30 trees and shrubs. Town of Windham riprapped three additional eroded areas.

Date: 9 /6 /2006
Lead Org: CCSWCD Other Orgs: MDOT-Grondin Supervisor:

Buffer: Area: 0 Ft. X 0 Ft. # Plants: 0 Distance to Stream: 0 Ft.
Erosion Stabilization Area: 0 Ft. X 0 Ft.
Fencing: Type: Length: 0 Ft. Distance to Stream: 0 Ft.
Access Area Before: 0 Sq Ft. Area After: 0 Sq Ft.
Watering System: Type: Distance to Stream: 0 Ft.
Plunge Pool: Area: 0 Ft. X 0 Ft.
Culvert: Type: Length: 60 Ft. Size: 48 In.
Turnout: Area: 0 Ft. X 0 Ft.
Ditching: Length: 0 Ft.
Culvert Stabilization Area: 40 Ft. X 40 Ft.

Materials: Rip Rap (tons): 20 Geotextile (yds): 100 Seed (lbs): 100
Hay (bales): 10 Mulch (cu yards) 0

Hours: Time to Complete (hrs): 0 # of Workers: 0
Total Hours: 0 Total Match Hours 0

Notes: Culvert outlet is complete, inlet unfinished

Figure 9-2. Sample completed data entry form used to input PWI BMP project data into the geospatial database.

9.2.4 INTEGRATION OF WATER QUALITY DATA WITH STORET

CBEP and PRW were responsible for ensuring that water quality data collected during the PWI were uploaded into EPA's nationwide STORET (Storage and Retrieval Data Warehouse) database. During the project period, EPA revised the STORET system, and the new generation of the database was subsequently referred to as WQX (Water Quality Exchange Database).

The PWI geospatial project database capabilities for storage of water quality monitoring data and related monitoring metadata were partially designed with the WQX requirement in mind. Early in the PWI project period, EPA data management staff provided Excel templates to guide creation of the database so that assimilation with WQX was simplified. At the conclusion of the PWI project period, Orbis exported the full water quality monitoring dataset and provided it to EPA, which integrated the PWI data with WQX.

9.2.5 EXPENDITURES

The initial Workplan budget for this task was included in Task 6, for PRW. The Workplan budgeted $48,930 in TWG monies for this task, and estimated $14,730 in match. The final budget was $42,193.25 in TWG monies, and $14,781.75 in match. Match sources were in-kind services by Orbis.

9.3 OUTPUTS AND OUTCOMES

Table 9-1. Logic Model: PWI Task 9, Data Management.

Outputs		Outcomes	
Activities	**Participants**	**Short term**	**Long Term**
Database designed and formatted for use by PWI partners, tailored to individual tasks and information needs, resulting in a data storage and delivery system for PWI activities	PRW, CCSWCD, FOCB, CBEP, Orbis, FBE	Increased organizational capacity among PWI partners to track future implementation activities and degradation sites	Increased work efficiency, with resulting water quality and habitat benefits
Integration of project data into database, resulting in a fully populated geo-spatial database for future use of PWI project data		Long term data storage and archiving system	Greater understanding of Presumpscot River watershed water quality and ability to investigate research questions
PWI water quality monitoring data uploaded into national WQX database by EPA, making monitoring data available to EPA for regulatory purposes, as well as to the general public	EPA, Orbis, CBEP	Data readily available for use by regulators and the general public in future management of the Presumpscot River and its tributaries	

REFERENCES

American Rivers, 2000. *America's Most Endangered Rivers of 2000.* http://www.americanrivers.org/assets/pdfs/mer-past-reports/mer_2000.pdf (viewed on 2/16/2010).

Carleton, N. (2008). Presumpscot River Watershed Coalition – 2008 Internship Final Report (CD).

Casco Bay Estuary Partnership, 2004. *A Plan for the Future of the Presumpscot River.* http://www.presumpscotcoalition.org/plan.html (viewed on 2/16/2010).

Elliot, W. and D. Hall, 1997. *Water Erosion Prediction Project (WEPP) Forest Applications*. United States Forest Service. http://forest.moscowfsl.wsu.edu/engr/forestap/forestap.pdf (viewed 2/16/2010).

Friends of Casco Bay, 2006. *Quality Assurance Project Plan for Friends of Casco Bay Citizen Stewards Water Quality Monitoring Program*. Available from CBEP.

Ingham, E., 2003. *The Compost Tea Brewing Manual.* Unknown publisher.

Maine Department of Environmental Protection. *Guidance for Understanding a Biomonitoring River and Stream Macroinvertebrate Aquatic Life Classification Attainment Report.* http://www.maine.gov/dep/blwq/docmonitoring/biomonitoring/keyreport_guidance.pdf (viewed 2/16/2010).

Maine Department of Environmental Protection, 2002. *2002 Integrated Water Quality Monitoring and Assessment Report.* http://www.maine.gov/dep/blwq/docmonitoring/305b/2002report.pdf (viewed on 2/22/2010).

Maine Department of Environmental Protection, 2008. *2008 Integrated Water Quality Monitoring and Assessment Report. Appendices: Acronyms, HUC Maps, Definitions and Integrated Lists of Surface Waters.* http//www.maine.gov/dep/blwg/docmonitoring/305b/2008/appendices.pdf (viewed on 2/16/2010).

Maine Department of Environmental Protection, 2008a. *General Permit for the Discharge of Stormwater from Small Municipal Separate Storm Sewer Systems*. http://www.maine.gov/dep/blwq/docstand/stormwater/ms4/final_2008_ms4_gp.pdf (viewed on 2/16/2010).

Michigan Department of Environmental Quality, 2003. *Pollutants Controlled Calculation and Documentation for Section 319 Watersheds Training Manual.* http://www.srnr.arizona.edu/nemo/BMPdocs/deq-swq-nps-POLCNTRL.pdf (viewed 2/16/2010).

Presumpscot River Watch, 2006. *Quality Assurance Project Plan*. Available from CBEP.

Project WET. *Healthy Water Healthy People Water Quality Educators Guide*. http://projectwet.org/

Project WET. *Wow! The Wonders of Wetlands.* http://projectwet.org/

Sanford, R., S. Plummer, R. Mosher, and M. Craig, 2009. *Presumpscot River Watershed CD Resource Guide for Teachers.* Casco Bay Estuary Partnership and Cumberland County Soil and Water Conservation District, Windham, Maine.