

Watershed Management of the Blackstone River



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Abstract

The Blackstone River watershed is being contaminated by point and nonpoint source pollution. The goal of this project was to provide recommendations that organizations can use to improve upon current efforts to fully sustain a healthy Blackstone River Watershed. Through archival research, interviews, and case studies, we identified challenges in current watershed management. Based on our findings, we recommended policy changes, a redirection of funding, pooled resources for larger scale watershed education, and expanded watershed activities for the public.

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Executive Summary

The Blackstone River watershed is being contaminated by point and nonpoint source pollution from both past and on-going pollution. Although many organizations are actively trying to correct and prevent further pollution of the watershed, efforts up until now have not been enough to fully support the quality of the Blackstone River watershed. Current watershed policies still need improvement, especially to better manage nonpoint pollution. The distribution of funds used for watershed management and protection is unsatisfactory, resulting in insufficient or unavailable funds for the impacted communities. Moreover, although several agencies in Massachusetts and throughout the Blackstone River region promote watershed welfare, there is still an inadequate level of awareness on the importance of watersheds and pollution prevention techniques. Furthermore, much of the public is still unwilling to contribute to restoring the watersheds, whether through money, time, or any other resource.

The purpose of this project was to provide recommendations that interested organizations and agencies can use to improve upon current efforts to manage the Blackstone River Watershed, resulting in an overall healthier watershed. To achieve this goal, we focused on the following objectives: to identify shortcomings in current policies related to sustainable watershed management; to identify watershed funding distribution; to identify current efforts to educate the public about the importance of watersheds and the consequences of polluting; and to identify methods to increase public efforts in collaboratively sustaining our watersheds and to improve long-term participation in watershed management.

These objectives were accomplished using various research methods. Archival research was used to gain a better understanding of current watershed management in the areas of policies and regulations, funding, public education, and collaborative approaches. Staff and volunteer

interviews were conducted with nearby watershed organizations, as well as state and municipal agencies. These interviews provided up-to-date data discussing the importance of watersheds, current efforts to protect watersheds, and the challenges faced by these organizations in regard to protecting and caring for watersheds. Furthermore, case studies were reviewed to provide examples of watershed management in nonlocal regions, such that their successes may be applied to the Blackstone watershed.

Much has been done by the government to control pollution from point sources, with further improvement limited mostly by the availability of affordable technology. Consequently, controlling nonpoint pollution has become the focal point in proper watershed management. Stormwater runoff is the main form of nonpoint pollution, and probably the most problematic to handle. Several policies and regulations have been drafted to limit the amount of runoff allowed from new developing areas, and encourage existing businesses to implement controls to minimize stormwater runoff. However, watersheds do not conform to the political boundaries set by the government, limiting the effectiveness of these policies and regulations. The watershed, therefore, needs to be viewed and managed on a sub-basin level; with the relevant organizations within each basin collaborating amongst themselves and with neighboring basins. The current state of Worcester's sewer system also presents itself as a limitation to controlling nonpoint source pollution. This needs to be addressed by replacing old leaky pipes with new ones and installing a transport system which separates runoff from municipal wastes, allowing for more efficient treatment.

The government's funding for watershed organizations has decreased over the past five years. Because of the economic recession, government and private funding for watershed management has decreased. Watershed management projects and programs have become a low

priority for government, businesses, and individuals during these tough times. As a result, funding for watershed organizations has been limited. After paying their staff, most organizations are left with little money to produce outreach materials and sponsor programs, such as water quality testing and monitoring, which can be used to identify sources of pollution. Government grants are available to support the efforts of these organizations, but the organization are required to submit extensive, time consuming paperwork during and after receiving grant money. This takes away time and effort that could be used more efficiently to promote good watershed stewardship.

One of the most influential methods to increase societal awareness of our watersheds is through public education. Through teaching the public about the condition of our watersheds and the tremendous impact we have on watersheds as a community, the public can be further incorporated into the cleaning, monitoring, and maintenance of our watersheds. Watershed organizations are currently utilizing various means for educating the public, including outdoor activities and field trips, the integration of watershed topics into school curricula, technical and nontechnical presentations, and information/educational brochures and hand-outs. However, watershed organizations face several challenges that hinder their optimistic efforts, with funding being a particular problem. On the other hand, it has been shown that as long as residents receive any form of educational material, they will be able to learn from it. Accordingly, several of the watershed organizations in Massachusetts agree that educating the public about watersheds is of paramount importance, and they are thus trying to broaden their public outreach as much as possible.

In a collaborative approach to watershed management, all stakeholders within the watershed communities work together to address the current problems within the watershed.

Without including all stakeholders, problems may arise when recommendations are to be implemented. Moreover, the willingness of the public to participate in a collaborative approach is critical to a successful partnership among the stakeholders and for the overall management of the watershed. Public participation plays an important role in developing trust among the stakeholders. However, getting the public motivated and committed to managing a watershed has been challenging to many watershed organizations and especially to those in the Blackstone River watershed. The public does not seem ready to make a long-term commitment to maintaining the watershed they live in. Without personal interest, the public will continue to be uncommitted to long-term support. Therefore, it is vital to motivate the public to participate in watershed management through a broader range of educational and participatory activities.

Based on the results collected and respective analyses, a set of recommendations for interested Blackstone River watershed organizations, both governmental and non-governmental, was developed. Implementation of these recommendations would help improve the maintenance of the Blackstone River Watershed according to policies and regulations, funding, public education, and collaborative approach. The government should invest more funds toward the nonpoint source pollution program, with one of these programs being water quality testing and monitoring. The government's grant procedure should be streamlined to reduce grant application and compliance time. For public education, we think creating an educational video documentary that discusses the importance of watersheds and how people, including children, can help prevent pollution, would be beneficial. The video could be shown in school systems as well as on public broadcasting stations to increase its range of influence. More government and business involvement in the Blackstone River is needed to improve watershed health. Without these two taking active roles in watershed management, the public will not have the motivation

and attitude to participate. In addition, more research should be complete on how businesses can collaborate more effectively in Blackstone River watershed management. By doing so, researchers can identify ways to encourage businesses to become more active in maintain the watershed.

1 Introduction

With the ever growing world population, and a limited supply of fresh water, the protection and maintenance of watersheds is crucial for the survival of habitats, animals, and humans alike. Watersheds are areas into which water drains; they provide water to people, plants, and animals, making it essential to keep them clean. According to the World Health Organization (2008), it is estimated that 3.575 million people die each year from water related diseases. As population increases, so does the ever-growing demand for clean water, making clean watersheds imperative.

Ideally, everyone would have clean drinking water, but we live in an imperfect world where 884 million people lack access to safe, potable water supplies (World Health Organization, 2008). In central Massachusetts, the Blackstone River Watershed is polluted and not suitable for drinking, having elevated levels of industrial waste and nutrients, toxic chemicals, and pathogens. The Blackstone watershed empties out into Narragansett Bay in Rhode Island, polluting surrounding water in that Bay. The watershed contributes up to 20% of the dry weather nutrient loading into the bay and up to 50% of nutrients in wet weather (GeoSyntec Consultants, 2004). Although people do not directly take water from the Blackstone River, the watershed partially empties out into surrounding small sources of water, which in turn become polluted, thus killing aquatic life and destroying habitats. By keeping the watersheds as clean as possible, people could reduce the strain on the wastewater management system and reduce the costly and continuous spending to treat the polluted river water. Unfortunately, so far the general public has not been actively engaged in keeping the Blackstone River Watershed clean.

The Blackstone River watershed is being contaminated by point and nonpoint source pollution. The past and on-going pollution of the Blackstone watershed has led to severely reduced water quality, which in turn disrupts the ecological functions of the watershed and diminishes recreational opportunities. As of now, steps have been taken to correct the current condition of the Blackstone River. Treatment plants have been built to purify wastewater before it is discharged into the River, but building and maintaining these facilities have cost the state and federal government, as well as local communities, millions of dollars annually. Local communities have established several watershed organizations to promote education and public involvement in the cleanup and monitoring of local watersheds. The government has also contributed to the health of watersheds by providing funding and protecting watersheds through legislation and regulations.

Unfortunately, efforts heretofore have not been enough to fully sustain a healthy Blackstone River Watershed. The current watershed policies still need improvement, and there is limited policy compliance and enforcement. The distribution of funds used for watershed management and protection is unsatisfactory, resulting in insufficient or unavailable funds for the impacted communities. Moreover, although several agencies in Massachusetts and throughout the Blackstone River region promote watershed welfare, there is still an inadequate level of awareness on the importance of watersheds and pollution prevention techniques. Furthermore, much of the public is still unwilling to contribute to restoring the watersheds, whether through money, time, or any other resource.

The purpose of this project is to determine methods that organizations and agencies can use to improve upon current efforts to manage the Blackstone River Watershed. In order to provide recommendations for a more sustainable and participatory watershed, we have focused

on the following key elements of watershed management: policies and regulations, funding, public education, and collaborative approach. By thoroughly reviewing current federal, state, and local policies, we have identified shortcomings in policies and have suggested improvements that will help protect our watersheds more effectively. Also, there is limited funding for watershed management and protection; therefore, in order for this money to be used most effectively, wasteful spending needs to be minimized. Accordingly, we have evaluated the current distribution of state and federal funding to watersheds to identify unnecessary spending and identify what the money should instead be spent on. By analyzing existing research and speaking with local watershed agencies within and near the Blackstone River Watershed communities, we have identified alternative methods to increase public watershed awareness, pollution prevention techniques, and public participation. Our project report provides a set of recommendations that watershed agencies and organizations working in the Blackstone watershed, whether they are government sponsored or non-profit, can use to improve watershed management and sustainability, resulting in an overall healthier watershed. We believe our recommendations can be useful for other watersheds in Massachusetts as well.

2 Background

Everyone lives in a watershed. John Wesley Powell, a scientist and geographer, defined a watershed as an “area of land, a bounded hydrologic system, within which all living things are inextricably linked by their common water course and where, as humans settled, simple logic demanded that they become part of a community” (U.S. Environmental Protection Agency, 2010k). In other words, a watershed is a land area in which water drains to a common body of water and provides drinking water, habitat for wildlife, recreational space, and much more, making watersheds essential for survival. For such reasons, it is crucial to protect our watersheds by removing existing hazardous pollutants and preventing further contamination by using preventative measures and strict regulation and enforcement.

In this chapter, we will provide a broad overview of watershed concerns and the various types of common water pollutants. We will first describe the current problems with watersheds and how these problems can affect us and the environment we live in. We will then provide information on watershed policies, funding, education, and collaborative approach.

2.1 Watershed Problems

Human behavior and interaction with the environment has the ability to negatively impact our watersheds. Untreated waste from point and nonpoint sources can infiltrate rivers, streams, and other water sources that empty out into watersheds. The pollution can result in insurmountable damage to the ecosystem and drinking water, which would require many years of cleaning and a hefty sum of money to rectify.

2.1.1 Point Source Pollution

Point source pollution defined by the U.S. Environmental Protection Agency (U.S. EPA) (2010c) is “any discernible, confined and discrete conveyance, including but not limited to any

pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged” (para. 14). This pollution directly contributes to the degradation of our watersheds. Point sources, including those from municipal, agricultural, and industrial sources, can emit numerous pollutants (Harvey, 2008). Some examples of point source pollutants are heavy metals, agricultural, and petroleum-based products. The most common types of point source pollution in surface water are high temperature discharge; microorganisms, which consist of bacteria, viruses, and parasites; and in some cases, nutrients such as nitrogen, phosphorus, and other trace contaminants.

2.1.2 Nonpoint Source Pollution

Nonpoint source pollution (NPS) occurs when water runoff moves across land and picks up pollutants on the ground’s surface. Unlike point source, nonpoint source pollution is the result of many dispersed sources coming from different locations around the watershed (U.S. Environmental Protection Agency, 2010c). This runoff ends up in local rivers, lakes, streams, and ponds, which may or may not empty into another part of the watershed. The most common nonpoint source pollution comes from stormwater runoff, which can include sediment, nutrients, microorganisms, and toxins (Harvey, 2008). Sediments are destructive to watersheds because they cause silting, which can destroy spawning grounds for aquatic creatures. In addition, this silt usually contains other contaminants from human activities, such as petroleum-based products like motor oil and gasoline. Also, in Massachusetts, salt and sand from the de-icing of roads can enter watersheds in silt.

2.1.3 Total Maximum Daily Load

The Total Maximum Daily Load (TMDL) defined by the U.S. EPA is “a calculation of the maximum amount of a pollutant that a body of water can receive and still safely meet water quality standards” (U.S. Environmental Protection Agency, 2010g). The TMDL is calculated using the equation:

$$\text{TMDL} = \text{WLA} + \text{LA} + \text{MOS} + \text{SV},$$

WLA = Waste Load Allocation (point sources)

LA= Load Allocation (non-point sources)

MOS= Margin of Safety

SV= Seasonal Variation

TMDL is implemented to control further degradation of water quality and to allow water to meet state water quality standards. The Blackstone River Valley Watershed is divided up into five different sections for analyzing the TMDL. The five sections of the Blackstone are Indian Lake, Lake Quinsigamond and Flint Pond, Leesville Pond, Northern Blackstone Lakes, and Salisbury Pond. The government only has regulations for the TMDL of phosphorus entering the Blackstone Watershed. The TMDL for the watershed is provided by the Massachusetts Department of Environmental Protection measurements and are shown in Table 1 and Table 2.

Table 1: TMDL of Phosphorus for Blackstone River Watershed (Massachusetts Department of Environmental Protection, 2010c)

	Indian Lake (2002a)	Lake Quinsig. & Flint Pond (2002d)	Leesville Pond (2002b)	Salisbury Pond (2002e)
Desired TMDL Phosphorus	<27ppb	<12ppb	<40ppb	<45.5ppb
Most Current Estimated	44ppb	30 – 50ppb	60ppb	70ppb
Difference	+17ppb	+18 to 38ppb	+20ppb	+25.5ppb

Table 2: TMDL of Phosphorus for the Northern Blackstone Lakes (U.S. Environmental Protection Agency, 2010e)

WBID	Lake Name	TP (ppb) range in Griffith ecoregion	TP (ppb) range in Rohm ecoregion	NPSLAKE Predicted TP (ppb)	Surface TP data (ppb)	Selected Target TP (ppb)
MA51004	Auburn Pond	15-19	30-50	34	NA	25
MA51010	Brierly Pond	15-19	30-50	30	NA	25
MA51032	Curtis Ponds	15-19	30-50	26	NA	25
MA51033	Curtis Ponds	15-19	30-50	27	NA	25
MA51039	Dorothy Pond	15-19	30-50	26	33	25
MA51043	Eddy Pond	15-19	10-14	15	NA	15
MA51056	Green Hill Pond	15-19	30-50	44.2	NA	25
MA51071	Howe Reservoirs	15-19	30-50	50.9	NA	25
MA51078	Jordan Pond	15-19	30-50	67.6	NA	25
MA51105	Mill Pond	15-19	30-50	46.5	NA	25
MA51110	Newton Pond	15-19	30-50	31.9	NA	25
MA51120	Pondville Pond	15-19	30-50	28.1	NA	25
MA51156	Smiths Pond	5-9	10-14	30	NA	20
MA51157	Southwick Pond	5-9	10-14	30.4	NA	10
MA51160	Stoneville Pond	15-19	30-50	26.7	NA	25
MA51196	Shirley Street Pond	15-19	30-50	37.7	NA	25

The Northern Blackstone Lakes consist of 15 bodies of water in the upper part of the Blackstone River watershed. These bodies of water are Southwick Pond, Smith Pond, Curtis Pond, Green Hill Pond, Newton Pond, Shirley Pond, Mill Pond, Jordan Pond, Dorothy Pond, Howe Reservoir, Stoneville Pond, Eddy Pond, Pondville Pond, Auburn Pond, and Brierly Pond.

Figure 1 shows the location of these bodies of water.

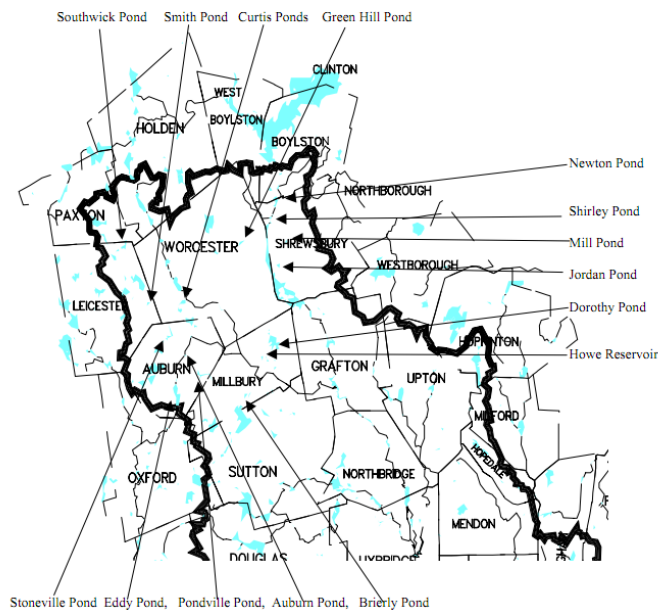


Figure 1: The Northern Blackstone Lakes (U.S. Environmental Protection Agency, 2010e)

The predicted phosphorous TMDL for the segments of the Blackstone Watershed is sufficiently higher than the desired amount. Indian Lake, Lake Quinsigamond and Flint Pond, Leesville Pond, and Salisbury Pond are above the desired TDML by at least 17ppb. The Northern Blackstone Lakes consist of smaller bodies of water but some are at least 19ppb over their desired TMDL, such as Jordon Pond, Mill Pond, and Howe Reservoir. This will impact habitats and further degrade the water quality. Increased efforts are necessary to limit pollutants from entering these bodies of water.

2.1.4 Political Boundaries

One of the paramount challenges in proper watershed management is that watersheds don't conform to political boundaries (Blomquist & Schlager, 2005). Watersheds can extend into different counties, and even different states and countries. This means that activities in one area, whether positive or negative, can affect a part of the watershed in a different township, county, state, or country. Thus, watershed management requires integrated and collaborative support to be successful. However, this is easier said than done, resulting in a gap between prescription and practice.

2.2 Acceptable Water Quality

The identification of "acceptable" water quality is essential to achieve the goal of this project. Water quality is a term that is hard to define because it is not clear what is considered good or bad water (U.S. Geological Survey, 2010). Water that is bad for people to drink may be good for watering plants or supporting animals. For the purpose of this project, watersheds that have "acceptable water quality" are those that are able to support healthy life such as fish, amphibians, plants, and are safe for boating and fishing.

2.2.1 Water Contaminants

With our predefined acceptable watershed water quality standard, we can identify the maximum level of chemicals, nutrients, and pollutants within a watershed that can still support aquatic life and recreational activities. The U.S. EPA (2010a) has a set of recommended water quality criteria for aquatic life, as shown in Table 3. Criteria Maximum Concentration (CMC) is an estimation of the highest allowable concentration of a substance in surface water such that no harm is incurred when aquatic life is briefly exposed to the substance. Criterion Continuous Concentration (CCC) is an estimation of the highest concentration of a substance in surface water that an aquatic life can be exposed to indefinitely without effects.

Table 3: Recommended Water Quality Criteria for Aquatic Life (U.S. Environmental Protection Agency, 2010a)

Priority Pollutant	Freshwater	
	CMC (acute)	CCC (chronic)
Acrolein	< 3.0 µg/L	<3.0 µg/L
Ammonia (at pH 8 and 25°C))	<2.9 mg N/L mussels present 5.0 mg N/L mussels absent	<0.26 mg N/L mussels present 1.8 mg N/L mussels absent
Cadmium	$<e^{(1.0166[\ln(\text{hardness})]-3.924)}$	$<e^{(.7409[\ln(\text{hardness})]-4.719)}$
Copper	BLM model: Need 10 parameters to calculate; temperature, pH, dissolved organic carbon (DOC), calcium, magnesium, sodium, potassium, sulfate, chloride, and alkalinity	
Diazinon	<0.10 µg/L	<0.10 µg/L
Methyl Tertiary-Butyl Ether (MTBE)	<151mg/L	<51mg/L
Nonylphenol	<2.8 µg/L	<6.6 µg/L
Tributyltin	<0.46ug/L	<0.072ug/L

These criteria were set by the U.S. EPA to protect aquatic animal life and have not been updated since 1985. They can serve as basic guidelines for aquatic life, but they may need to be updated and additional criteria must be added. High levels of any of these chemicals will cause aquatic life to die. Many additional contaminants need to be limited in order to meet our predefined acceptable water quality standard, but these contaminants must be limited in order to preserve healthy life for fish, amphibians, and other aquatic life.

2.2.2 *Phosphorus*

The amount of phosphorus in water plays an important role in aquatic life. An increase in phosphorus concentrations results in an increased growth of algae and other aquatic plants (Smollen, 2004). The increase in algae and aquatic plants provides extra available food to aquatic life, but once the algae and plants die, they consume oxygen as a result of decomposition. This can lower the dissolved oxygen levels in the water to a point where the fish suffocate and die; thus, it is important to keep the phosphorous concentration as low as possible. Phosphorus can enter a watershed as a point source from municipal waste treatment plants and industrial discharge. As a nonpoint source, phosphorus can enter watersheds from soil erosion, runoff from lawns and gardens due to fertilizers, and animal waste.

2.2.3 *Lead*

Lead can enter watersheds as a point source from industrial waste discharge or by nonpoint source through runoff of lead-based products such as old paint. The consumption of lead can be dangerous to humans. For infants and children, an excess amount of lead in drinking water can result in a slowing of physical or mental development (U.S. Environmental Protection Agency, 2010e). If adults consume lead-containing water over several years' time, it can result in

kidney complications or high blood pressure. The EPA set 15 µg/L of lead as the action level for public water supplies (Agency for Toxic Substances & Disease Registry, 2010b).

2.2.4 Benzene

Benzene is a clear colorless liquid that can be used to make plastics and resin. It can also be found in solvent form in printing, paint, and dry cleaning products (Agency for Toxic Substances & Disease Registry, 2010a). The most common source of Benzene found in watersheds most likely comes from gasoline. Benzene can enter watersheds as a point source from industrial discharge or as a nonpoint source from runoff. Some examples of benzene containing products are detergents, lubricants, and pesticides (Agency for Toxic Substances & Disease Registry, 2005). People who consume benzene in excess for many years could experience anemia and an increased risk of getting cancer (U.S. Environmental Protection Agency, 2010e). The U.S. EPA set the maximum level of Benzene in drinking water to be 5ppb (parts per billion) (Agency for Toxic Substances & Disease Registry, 2010a).

2.2.5 Asbestos

Asbestos is a fibrous mineral that occurs in natural deposits. Because asbestos is resistant to heat and most chemicals, it is used in a variety of products, including brake pads, roofing materials, and cement pipes. As a point source, asbestos enters watersheds as industrial waste. Nonpoint source asbestos comes from wearing or breaking down of asbestos containing products (Home Water Purifier and Filters, 2010). The maximum acceptable level of asbestos in water is 7 MFL or less (million fibers/ liter). If people drink water with an excess of asbestos for many years, they will have an increased risk of developing intestinal polyps (U.S. Environmental Protection Agency, 2010e) and an increased chance of developing cancer of the mouth, throat, and digestive system (Devine, 2009).

2.2.6 Nitrates

Nitrates are found in fertilizers, animal waste, septic tanks, municipal sewage treatment systems, and decayed-plants. Infants who drink water with high levels of nitrate can develop the condition called methemoglobinemia or alternatively, Blue Baby Syndrome (Wisconsin Department of Natural Resource, 2003). The infants' skin color changes into a blue-gray color because it lacks oxygen in its blood. If Blue Baby Syndrome is not treated immediately, there is a risk of the infant going into a coma or in some cases death. Infants under the age of 6 months are at high risk of nitrate poisoning.

2.3 Evaluation and Management Procedures for a Watershed

There are five phases to evaluating watershed management quality in the Commonwealth of Massachusetts. The first phase reviews the current water resources and water quality issues to establish future plans (Massachusetts Water Pollution Abatement Trust, 2009). Next, the Massachusetts Department of Environmental Protection works with watershed organizations, outside agencies, environmental groups, and the general public to improve the watershed quality.

In the second phase, the water quality is monitored by collecting physical, chemical, and biological water-resource data (Massachusetts Water Pollution Abatement Trust, 2009). These data are gathered every 5 years. The data collected are then analyzed in the third phase. From this analysis, measures are developed to improve the current water quality standards by preventing the causes and sources of problems.

The fourth phase is the actual implementation of developed measures to improve the water quality (Massachusetts Water Pollution Abatement Trust, 2009). The Department of Environmental Protection talks to the dischargers of pollution and teaches them best

management practices. The last phase is the evaluation of watershed quality as a result of the changes and to establish improvements that should be made in the next 5-year cycle.

2.4 Blackstone River Valley Watershed

The Blackstone River is a 48 mile long river that starts in Central Massachusetts in the city of Worcester and extends south and east, emptying out into the Narragansett Bay in Rhode Island (GeoSyntec Consultants, 2004). Blackstone River is the main artery of the watershed, spanning 24 miles in both Massachusetts and Rhode Island. The city of Worcester, Massachusetts, has contributed significantly to the degradation of the Blackstone River Watershed. The Blackstone River Valley is the birthplace of the industrial revolution. Because the Blackstone River runs through Worcester, the water was used as a power source to run machinery, making the city a prime location for factories and industrial buildings. Due to the numerous factories and industrial buildings along the river, there was an enormous amount of pollution deposited into the Blackstone River. These contaminants consisted of untreated sewage, detergents, solvents, heavy metals, and other industrial waste, some of which can still be found today in the sediment of the Blackstone River (GeoSyntec Consultants, 2004). Due to the length of the Blackstone River, the river collects large amounts of nonpoint source pollution that flows into it, including fertilizer and petroleum-based products such as motor oil and gasoline and garbage.

2.5 Policies and Regulations

A policy is defined by the Merriam-Webster dictionary (2010) as “a course or method of action selected from among alternatives and in light of given conditions to guide and determine present and future decisions.” It is a broad and complex concept, making it difficult to define properly in clear, unambiguous terms; but simplified, it is viewed as an intentional course of

action which seeks to achieve some desired goal that is viewed as most beneficial to all involved (C. E. Cochran, Mayer, & Carr, 2008; Torjman, 2005). Public policy consists of political decisions to achieve societal goals and governs most aspects of our lives from the quality of the water we drink to what we are able to eat (C. L. Cochran & Malone, 2005; Torjman, 2005).

2.5.1 Rationale for Environmental Policies

The environment has long been considered a free and seemingly endless resource (Corbitt, 2004). As such, its usage has been ignored, allowing for significant ecological degradation, and this has led to other negative economic and social effects. Thus, environmental laws are required to protect the health and welfare of society.

2.5.2 Concerns with Environmental Policies

The common theme of the environmental movement is that good environmental quality contributes to economic growth in the long run (Corbitt, 2004). However, the short term problems have usually been ignored. Legislation and regulations create ambitious compliance schedules that are accompanied by substantial costs to industries and municipalities.

According to Corbitt (2004), many public administrators, engineers, planners, industrialists, and other decision makers recognize the need for environmental legislation and related regulations to protect the environment. However, they also recognize the importance of economic efficiency and utility, and as such have raised a number of concerns regarding many environmental regulations. These concerns are shared by many who feel that environmental regulations can be structured in a way that minimally affects efficiency and productivity of industry, does not interfere with other essential federal programs, and still achieves reasonable environmental protection goals.

2.5.3 Role of Federal vs. State Agencies

Initially legislation and implemented regulations were primarily designed with a principal federal role in environmental protection. However as time passed, much of the regulatory responsibility has been shifted to the states and local agencies (Corbitt, 2004). This was a result of state and local agencies continually voicing their desire to have more influence in environmental affairs and was fueled by the federal government's desire to reduce expenditures on environmental programs. Reduced federal support, however, was not supported by state and local politicians, with several representatives objecting to taking over the administration and enforcing environmental programs if federal financial support dropped below a certain threshold level.

At the federal level, the U.S. EPA (2007) is primarily responsible for the protection of the environment, and its impact on human health. They are considered a regulatory agency that establishes and enforces regulations based on environmental laws. Watersheds are monitored by the Office of Water within the U.S. EPA, more specifically the Office of Wetlands, Oceans and Watersheds. There are several laws that serve as a foundation from which the EPA creates policies and writes regulations. Several of these regulations directly or indirectly act as protection for watersheds.

Watersheds are protected directly by the Clean Water Act (CWA) (U.S. Environmental Protection Agency, 2010b). The Act establishes the basic structure for regulating discharge or pollution into bodies of water and regulating quality standards for surface water. Originally, the CWA was intended to eliminate the discharge of all water pollutants by 1985, but it only had provisions to control point source pollution. The significant contributions of nonpoint sources were largely overlooked (Heathcote, 2009). The Act was, however, reauthorized in the late

1980's with the aim to improve water quality for the protection of wildlife and for recreation in and around the water, with increased efforts to address nonpoint runoff (Heathcote, 2009; U.S. Environmental Protection Agency, 2010b).

Other federal Acts that may, but not necessarily, involve the protection of watersheds are The Endangered Species Act (ESA) (U.S. Environmental Protection Agency, 2010f) and The Safe Drinking Water Act (SDWA) (U.S. Environmental Protection Agency, 2010j). The ESA provides a program for the conservation of threatened and endangered plants and animals and the habitats in which they are found. Watersheds are a primary residence for a significant number of living creatures. This Act protects those watersheds where its inhabitants are considered to be threatened. The SDWA was created to protect the quality of drinking water in the United States (Heathcote, 2009; U.S. Environmental Protection Agency, 2010j). It “focuses on all water actually or potentially designed for drinking use” (para. 1), and establishes mandatory, nationwide drinking water quality standards. The Act pertains to water that exits a drinking water treatment plant; however, the treatment process can be expensive, making the protection of the sources of water entering the plant a practical alternative, especially for large cities, such as New York (New York City Environmental Protection, 2009).

Within the state of Massachusetts, there are two government agencies with the responsibility to protect and maintain the state's watersheds: the Office of Watershed Management and the Massachusetts Department of Environmental Protection (MassDEP). The Office of Watershed Management is a section of the Department of Conservation and Recreation (DCR) (2010a) that manages and protects the drinking water supply for over two million people in Massachusetts. They focus primarily on the protection of the Quabbin Reservoir, Ware River, and Wachusett Reservoir and their contributing watersheds. MassDEP (2010a) “is responsible

for ensuring clean air and water, the safe management of toxins and hazards, the recycling of solid and hazardous wastes, the timely cleanup of hazardous waste sites and spills, and the preservation of wetlands and coastal resources” (para. 1). Unlike the Office of Watershed Management, MassDEP is not only responsible for watersheds providing water for human consumption, but it is also responsible for the quality of all surface waters within the state.

Similar to federal agencies, state agencies also have legislation that is the basis for their policies and regulations to protect watersheds. Massachusetts’ laws include the Watershed Protection Act (Department of Conservation and Recreation, 2010c), the River Protection Act (Massachusetts Department of Environmental Protection, 2010b), and the Wetlands Protection Act (Commonwealth of Massachusetts, 2010). The Watershed Protection Act (WsPA) regulates land use and activities within critical areas of the watersheds protected by the Office of Watershed Management, for the purpose of protecting the quality of drinking water. The River Protection Act protects a 200-foot area that extends on both sides of rivers and streams, helping keep water clean, preserving wildlife habitat, and controlling floods. The Act does not prevent use of the land; however, applicants must show that their projects have no practical alternative and that they will have no significant undesirable impact on the area (Massachusetts Department of Environmental Protection, 2010b). The Wetland Protection Act prevents any dredging, filling, or altering of any waters or the land that is bordering it. It protects less area around the water than the previous two laws, but it is not limited to select water body types, e.g. rivers, streams, lakes and ponds.

2.6 Funding

Funding for watershed management and protection programs is crucial in maintaining and keeping our water supply clean. Watershed funding provides the necessary capital to

maintain and improve the current watershed infrastructure and allow for removal of contaminants that can be detrimental to animals, habitats, and people. This funding is partially distributed to communities for education on watershed degradation, prevention, and maintenance techniques. An understanding of the financial support for watershed related programs and projects and how the funds are distributed is useful in identifying wasteful spending that could be redirected to more effective watershed programs and projects.

2.6.1 American Recovery and Reinvestment Act

The American Recovery and Reinvestment Act (ARRA) were signed by President Obama on February 17th, 2009 (University of Washington, 2009). The purpose of this act was to stimulate the economy by accomplishing 3 goals: (1) create new jobs and save existing ones, (2) spur economic activity and invest in long-term growth, and (3) foster unprecedented levels of accountability and transparency in government spending (Recovery.gov, 2010). As of June 30, 2010, the Commonwealth of Massachusetts had been awarded \$5.48 billion and has received \$2.08 billion to date. The distribution of the ARRA funding for Massachusetts can be seen in Table 4.

Table 4: ARRA Funding Distribution (Mass.gov, 2011a)

Funding Category	Awarded
Accountability	\$12,900,000
Clean Energy and Environment	\$244,829,482
Education	\$2,012,444,827
Housing	\$225,935,993
Public Safety and Homeland Security	\$42,635,433
Safety Net Program	\$4,000,209,866
Technology and Research	\$90,590,152
Transportation	\$398,277,042
Workforce Program	\$77,348,569
TOTAL	\$7,105,171,364

Of the total \$7.1 billion provided by the ARRA, only \$244 million is spent towards clean energy and environment, which is 3.4% of the funding. Table 5 shows the water related programs in Worcester County sponsored by the ARRA.

Table 5: Worcester County Water Related Programs (Mass.gov, 2011b)

City and Program	Awarded
SHREWSBURY Stimulus - MA Water Quality Management Planning	\$289,996
Massachusetts Water Pollution Abatement Trust Construction of wastewater treatment facilities and associated infrastructure	\$5,322,292
TOTAL	\$5,612,288

This amount of money is sufficiently small compared to the total ARRA funding available. Clean Energy and Environment programs are not a top priority of the Massachusetts government. Out of the \$244 million spent on energy and environment, approximately 2% is spent on the Worcester County Watershed programs and projects. The construction of wastewater treatment facilities cost significantly more than programs. Money used for the treatment facilities can fund tens of watershed programs to educate communities about watersheds.

2.6.2 Clean Water Act State Revolving Fund

The MassDEP regulates the funding from the Clean Water Act State Revolving Fund (CWASRF) from the state and federal government (Massachusetts Government, 2007). The Clean Water Act State Revolving Fund, CWASRF for short, provides funding for point and nonpoint source pollution. From 1987 to the present, the CWASRF has provided 74 billion dollars for over 24,288 low-interest loans to fund projects for wastewater treatment, water quality control, nonpoint source pollution regulation, and watershed management projects (U.S.

Environmental Protection Agency, 2010d). The CWASRF received \$133,057,300 in ARRA funds with \$127,734,792 invested towards clean water projects (Massachusetts Water Pollution Abatement Trust, 2010). The project funds were leveraged into 61 loans totaling \$571,697,200.

Figure 2 from the U.S. EPA (2010h) shows the distribution of grant funds to New England States during the years 1999-2008 and is followed by Table 6 from the U.S. EPA (2010h) that compares the total funding received by each New England state between 2004 and 2010.

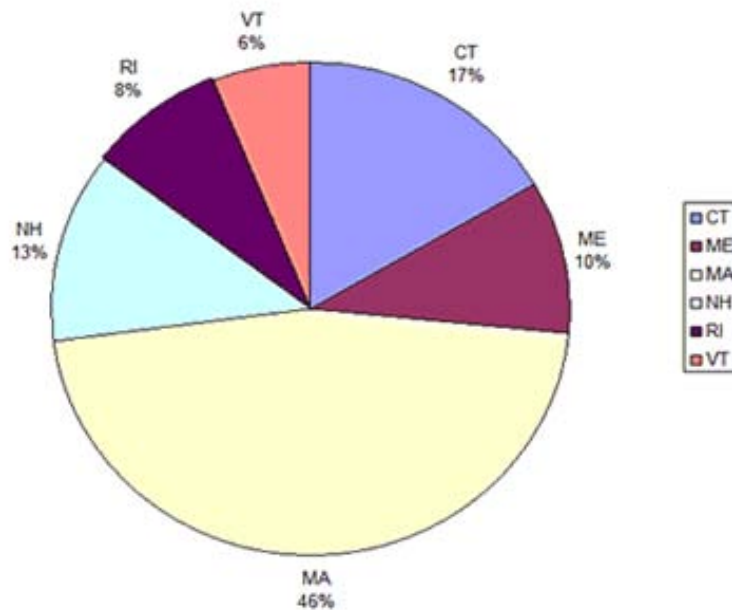


Figure 2: CWASRF Grants by State from 1989-2008 (U.S. Environmental Protection Agency, 2010h)

Table 6: CWASRF Annual Distribution of Grant Funding between 2004-2010 (U.S. Environmental Protection Agency, 2010h)

Year	CT	ME	MA	NH	RI	VT	Annual Total
2004	\$16,235,604	\$10,258,974	\$44,995,896	\$13,244,022	\$8,888,700	\$6,471,800	\$100,094,996
2005	\$13,201,056	\$8,325,800	\$36,585,846	\$10,768,626	\$7,208,600	\$5,243,500	\$81,333,428
2006	\$10,727,838	\$6,747,200	\$29,731,383	\$8,739,500	\$5,839,300	\$4,242,300	\$66,027,521
2007	\$13,111,758	\$8,268,800	\$36,338,643	\$10,695,762	\$7,159,200	\$5,207,300	\$80,781,463
2008	\$8,320,600	\$5,220,800	\$23,103,630	\$6,769,000	\$4,515,300	\$3,274,300	\$51,203,630
2009	\$8,320,600	\$5,220,800	\$23,103,630	\$6,769,000	\$4,515,300	\$3,274,300	\$51,203,630
2010	\$24,961,000	\$15,773,000	\$69,177,000	\$20,361,000	\$13,681,000	\$10,002,000	\$153,955,000

From Figure 2, it is clear that Massachusetts received sufficiently more funds than any other New England state, receiving 46% of grants, with Connecticut in second place with 17% from 1989 -2008. Table 6 shows that the total New England funding through the CWASRF increased significantly for the year 2010, approximately three times more than in 2009. This increase in funding was available on behalf of the Obama administration.

A bill proposed by the Obama administration was approved on June 10, 2010, and this bill increased the overall CWSRF funding from \$689 million to \$2.3 billion. In addition, the U.S. EPA received an increase in funding from \$7.64 billion to approximately \$10 billion, giving the agency more funds to be distributed among its subcommittees (Clean Water Funding Network, 2010). Although Massachusetts is receiving the largest amount of the funds in New England, there are still watershed problems that have not been addressed due to a lack of funding and the increase in funding is a one-time stimulus that will not be maintained through the upcoming years.

2.6.3 Clean Water State Revolving Fund Projects

The State Revolving Fund Program is a government run program that has sponsored numerous projects over the years with the main goal of improving water quality (Massachusetts Water Pollution Abatement Trust, 2010). The majority of the projects have been for combined sewer overflow, wastewater treatment, and wastewater collection projects.

North Attleboro received \$441,123 for rehabilitation of their collection systems for the removal of inflow and infiltration. By doing this, the government is hoping to limit water quality violations. As a result, this will improve the water quality and aquatic life around Ten Mile River near the wastewater treatment plant discharge location.

The Upper Blackstone Water Pollution Abatement District received \$31,950,000 for phase 3 wastewater treatment facility improvements. This money is used to improve the capacity of sludge collection, pumping, storage, and handling systems. With these improvements, it will allow the district to handle high volumes of water flow, limiting overflow, and allowing this water to be treated.

Webster was awarded \$10,322,000 for the Webster-Dudley Wastewater Treatment Facility upgrades. These upgrades consist of installing phosphorous removal system in order to meet new National Pollutant Discharge Elimination System permit requirements set in March of 2006 which limits phosphorous discharge to 0.2mg/L average from April to November and 1mg/L for the other months of the year.

The Greater Lawrence Sanitary District received funding through the program for the purpose of increasing energy efficiency and installing photovoltaic cells. The district receives wastewater from Andover, North Andover, Lawrence, Methuen, and Salem, NH, processing 50 million gallons of waste per day (Massachusetts Water Pollution Abatement Trust, 2010). They

received \$4.9 million in grants to install a 310kW solar photovoltaic system, replace existing motors with variable speed drives, insulate digesters, and perform process maintenance to improve the heat recovery system and become more energy efficient. The project will reduce the annual energy expenditures by 52%, over \$1.5 million in savings, and reduce carbon dioxide emissions by estimated 5,887 tons annually. With the money saved from energy savings, the district can reinvest in their water cleaning facility and further improve water quality.

The Charlton Wastewater Treatment Plant received money through the state revolving fund program to upgrade their treatment plant. The project will cost almost \$2.8 million (Massachusetts Water Pollution Abatement Trust, 2010). The goal of the project is to increase the wastewater capacity for the sewer system to 450,000 gallons per day. By increasing the capacity of the system, the chance of sewerage overflow will be decrease, reducing the chance of untreated waste emptying directly into water sources. The installation of a new, low level phosphorus removal system and the expansion of a UV disinfection system will lower the concentration of ammonia, phosphorus, aluminum and copper in the treated water. In addition, new rotating biological contractors and changes to the existing sludge pipes will be installed.

New Bedford received money to remove PCB contaminated grit in their CSO Main Interceptor. This will improve the main interceptor and side line sewers by removing PCB contaminated grit and refurbish the pipe lines, costing a total of \$19.3 million (Massachusetts Water Pollution Abatement Trust, 2010). By removing the PCB contaminants, the pipes will increase the capacity of the sewer system which will in turn limit street flooding and lower the likelihood of combined sewer overflow from the New Bedford Sewer System. This will decrease the likelihood of untreated waste being emptied out into water sources from the New Bedford Sewage treatment plants.

2.6.4 Drinking Water State Revolving Act

In addition to the CWASRF, the Drinking Water State Revolving Act (DWSRA) is a subcommittee of the U.S. EPA that provides funding to watersheds. Under the DWSRA, funds are used to remove any contaminants, assess water sources and protection activities, monitor and prevent nonpoint source pollution, and restore resource areas (Massachusetts Government, 2007). Some projects that fall under these funding criteria are installation or replacement of distributed water systems, promoting agricultural best management practices, development and implementation of protective laws and regulations, and educational programs that encourage protective practices. This act provided \$3.7 million in grant money to the Upper Blackstone Water Pollution Abatement District in 2009 (Pro Publica, 2010). The Upper Blackstone Water Pollution Abatement District (Massachusetts Water Pollution Abatement Trust, 2010) cleans industrial and municipal waste from surrounding cities, which include Worcester, Millbury, and Auburn.

The DWSRF fund sponsors a large number of drinking water projects. The majority of these projects consist of the construction or refurbishment of drinking water treatment plants, replacement of old water mains, and the construction of drinking water storage facilities (Massachusetts Water Pollution Abatement Trust, 2010).

The Woburn Horn Pond Treatment Facility received a total of \$15.7 million to install a four million gallon a day treatment facility to remove elevated levels of iron and manganese in the water source (Massachusetts Water Pollution Abatement Trust, 2010). The project will require the construction of a 3.9 million gallon storage tank, as well as pump modifications and a new system to control backwashing from the filtration system. This project will be an attachment to the existing water system.

2.6.5 Coastal Nonpoint Source Pollution Grant Program

The Coastal Nonpoint Source Pollution Grant Program is funded by the EPA and the Executive Office of Energy and Environmental Affairs. The main purpose of this program is to provide funding for public and non-profit organizations with funds to implement nonpoint source pollution control (Massachusetts Office of Coastal Zone Management, 2011a). Some of the programs funded by the program are the development of public education and outreach programs, funding for nonpoint source devices used to control nonpoint source pollution, and design and implementation of smart growth and low impact development strategies for nonpoint source pollution control. The program's funding is shown in Figure 3.

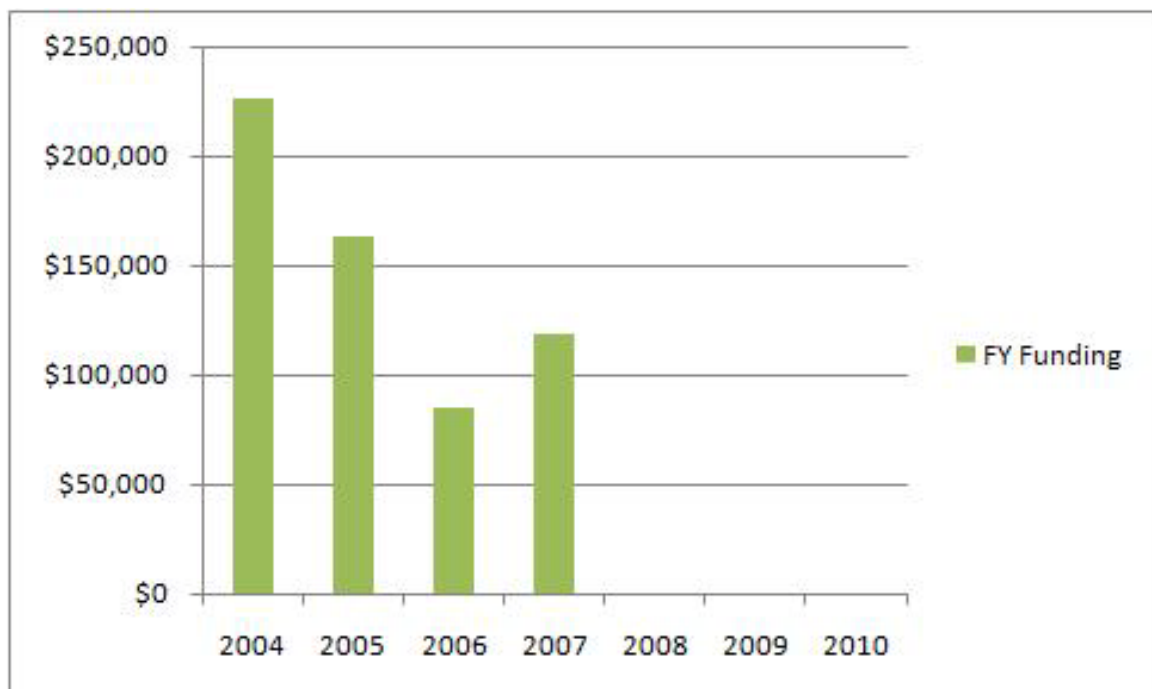


Figure 3: Coastal Nonpoint Source Pollution Grant Program (Massachusetts Office of Coastal Zone Management, 2011a)

From the bar graph, you can see that funding for the program has followed a decreasing trend. In the years of 2008, 2009, and 2010, the program did not provide any funding and does not expect to provide any funding for fiscal year of 2011.

2.6.6 Coastal Pollution Remediation Grant

The coastal pollutant remediation grant is funded by the EPA and the Executive Office of Energy and Environmental Affairs. The purpose of the program is to help Massachusetts communities identify and improve water quality that was degraded by nonpoint source pollution with a focus on transportation –related sources (Massachusetts Office Coastal Zone Management, 2011b). The projects funded by the program are related to urban runoff from municipal roadways, improvement coastal resources, traditional and unique nonpoint source control strategies and education on storm water runoff. The recipients must match 25% of the total project cost. Figure 4 shows the available funding of the program.

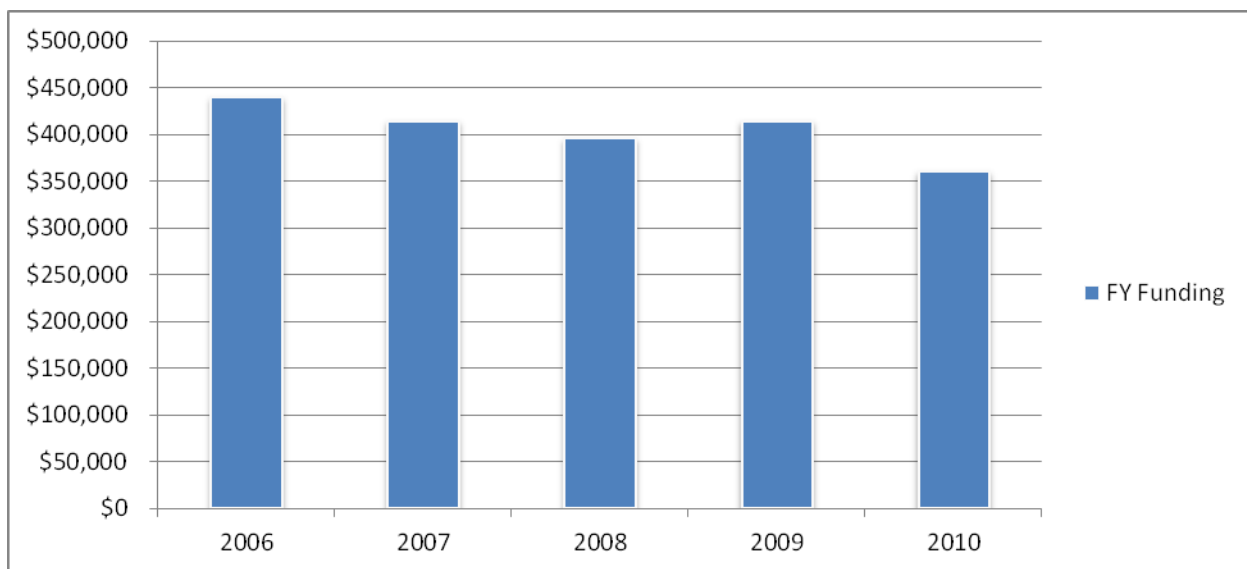


Figure 4: Coastal Pollution Remediation Grant Program (Massachusetts Office Coastal Zone Management, 2011b)

From the graph, you can see the funding for the program follows a decreasing trend. The amount of money for this program is not significant compared to other government based programs.

2.6.7 Federal Section 319 Nonpoint Source Competitive Grant Program

The Federal Section 319 Nonpoint Source Competitive Grant is under the Federal Clean Water Act and focuses on nonpoint source pollution (Peirce, 2010). The program is funded by the DEP. The program funds projects and programs that prevent and control nonpoint source pollution through the implementation of best management practice and is eligible for any public or private organization. The average number of grants available is 11 grants and the size of these grants is approximately \$186,000 (Executive Office of Energy and Environmental Affairs, 2011). In the fiscal year of 2010, \$1,872,339 million dollars was awarded and the program is estimated to award \$2,000,000 in the fiscal year of 2011 for organizations. Awardees are required to match 40% of the total cost. A list of past projects funded by the program can be seen in Appendix A.

2.6.8 Payment in Lieu of Taxes Program

The Payment in Lieu of Taxes Program (PILOT) is a program in which the DCR pays communities that have land or live within the watersheds that make up one of the nation's largest unfiltered water supply systems (Department of Conservation and Recreation, 2010b, PILOT). Payments from the PILOT program have been given to 29 communities in Massachusetts that live around the Quabbin Reservoir, Ware River, Wachusett Reservoir, and Sudbury Reservoir Watershed. Figure 5 from the DCR (2010b) shows the location of the watershed in reference to the state of Massachusetts.

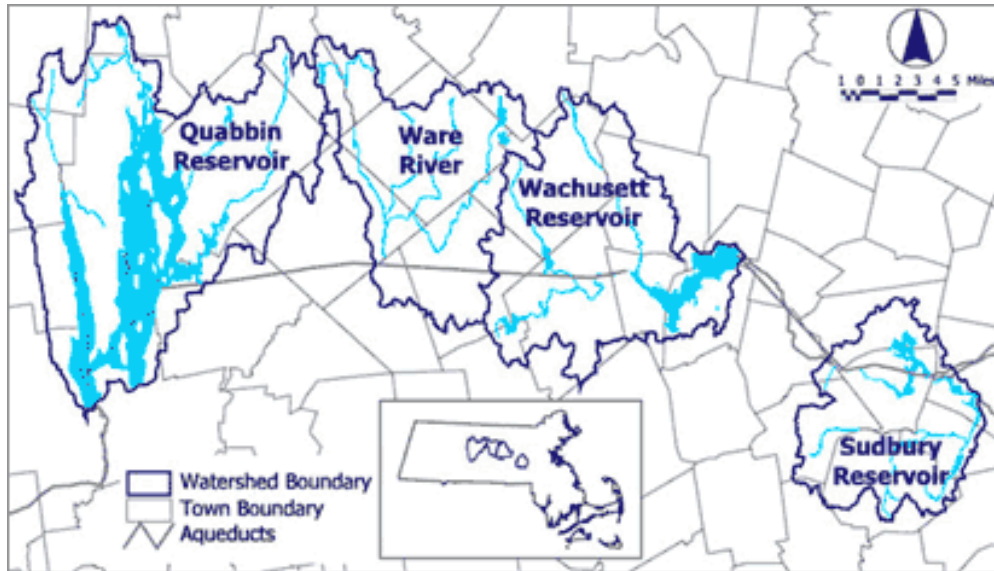


Figure 5: Location of PILOT Reservoir (Department of Conservation and Recreation, 2010b)

The amount of money given to a community is determined by multiplying the Department of Revenue valuation of DCR division water supply protection land by the local commercial tax. This money comes from the Massachusetts Water Resources Authority rate payers who use the reservoir water. Since 1875, 87 million dollars have been distributed from the watershed protection PILOT program (Department of Conservation and Recreation, 2010b). Table 7 shows the yearly payments from the PILOT program from 2000-2010, according to the DCR (2010b).

**Table 7: PILOT Funds by year
(Department of Conservation and Recreation, 2010b, PILOT)**

YEAR	Total Watershed Management PILOT
2010	\$6,741,130
2009	\$6,107,378
2008	\$6,226,338
2007	\$5,969,049
2006	\$5,919,709
2005	\$5,076,573
2004	\$5,029,106
2003	\$4,965,870
2002	\$4,911,470
2001	\$4,876,535
2000	\$3,113,761

2.6.9 State Revolving Funds

The State Revolving Fund provides loans to communities who need funds for watershed management projects and programs (Massachusetts Water Pollution Abatement Trust, 2010). These funds are appealing to communities due to their low interest rates, which otherwise wouldn't be obtainable through any bank. The types of loans the revolving fund provides are series 15 bonds, interim loans, and community septic management program loans.

The Series 15 Bond is used to finance water quality improvement projects. These bonds are funded by federal grants, the state government, and repayments paid by previous borrowers (Massachusetts Water Pollution Abatement Trust, 2010). In July 2010, the Massachusetts Water Pollution Abatement Trust awarded \$317.5 million in 96 clean water loans. The borrowers have two years to spend the projects' funds once the loan is permanently financed. Some

projects funded by the Series 15 bonds are the town of Milbury with \$828,194.00 for sewer construction, the Upper Blackstone Water Pollution Abatement District with \$31,950,000 for phase III of wastewater treatment facility improvement, and Webster with \$10,328,000 for wastewater treatment facility upgrades.

Interim Loans are funds made available to eligible projects through the Interim Loan Program (Massachusetts Water Pollution Abatement Trust, 2009). These loans provide construction funds year round to borrowers for watershed development projects. In June of 2009, \$64.3 million were put into 14 clean water interim loans. The money for the interim loans is financed by the interest from the Series 15 bonds.

The Community Septic Management Program Loan provides zero percent interest funding to Massachusetts' cities and towns for the repair of failed septic systems (Massachusetts Water Pollution Abatement Trust, 2009). In June 2010, 44 Community Septic Loans totaling \$24.9 million were given out. The loans are permanently financed when fully drawn or within three years of closing, whichever comes first.

The interim and series 15 bonds provided through the program are set at 2% interest or lower for short-term loans (Massachusetts Water Pollution Abatement Trust, 2009). Loans that extend over 20 years may have loans subsidized at rates greater than 2%. The repayments of these loans are crucial for continuing the funding of this program. In 2010, borrowers' repayments resulted in 58.8% of the loans, which totaled \$161.2 million.

2.7 Watershed Public Education

One of the most influential methods to increase societal awareness of our watersheds is through public education. Through teaching the public about the condition of our watersheds and the tremendous impact we have on watersheds as a community, the public can be further

incorporated into the cleaning, monitoring, and maintenance of our watersheds. Before we can expect the public to donate resources, time or effort, the public must understand the importance of watersheds to their own well-being.

2.7.1 Importance of Clean Watersheds

Ultimately, we get our drinking water from watersheds; furthermore, we get our *clean* drinking water from watersheds. Watershed soil not only sustains and collects rainfall, but it acts as a filter to purify our water. Moreover, watersheds serve utilitarian functions, such as providing us with water to irrigate our lawns, crops, golf courses, and so on (Center for Watershed Protection, 2000). Watersheds are complex: they provide rich nutrients and habitat to support aquatic life; they are a location where vital ecological functions occur (University of Florida, 2007); and they allow the processing of carbon, sediments, and nutrients (Center for Watershed Protection, 2000).

2.7.2 Consequences of Watershed Pollution

Human activity and behavior directly affect the health of watersheds. Any pollution, whether from point sources, non-point sources, toxins, or just a little trash, damages watersheds. It is crucial that the public realizes that their actions can negatively impact their own watershed. Polluted watersheds can no longer provide clean drinking water, habitat for aquatic plants and animals, a collection center for rainfall, or recreational opportunities for the public (Watershed Action Alliance, 2010). Once a watershed is polluted, the consequences are difficult to fix, and they will diminish the public's quality of life as well as the health of the plant and animal species that rely on the watershed.

2.7.3 Review of Organizations and Agencies in Massachusetts

Various organizations and agencies around the globe have created methods to educate the public about watersheds, whether through volunteering, workshops, or brochures. There are several organizations in Massachusetts that are promoting the well-being of watersheds. They are using different techniques to try to make the public more aware of watershed health and how to properly maintain a watershed.

The Watershed Action Alliance of Southeastern Massachusetts (WAA) (2010) is focused on protecting and restoring the watersheds of Southeastern Massachusetts. They are accomplishing this mission at a grassroots level, through public education and policy advocacy. Their three main goals are to maintain adequate, natural stream flows, restore free-flowing rivers by removing dams, and reducing water pollution. The WAA's primary source of education is through their website. On their site, the WAA provides information about the organization and the problems with watersheds in Massachusetts. Most importantly, however, the site includes a "Can My Family Really Do Anything Anyway to Make a Difference?" section. This section provides details and solutions of simple ways to maintain our drinking water supplies. Also, the site highlights several local organizations working on river restoration that need volunteers, in case the public is interested in contributing to watershed maintenance.

Another group is the Massachusetts Bays Education Alliance (MBEA), which was formed in 1993 as a subgroup of the Mass Bays Program (2010b), for the sole purpose of outreach and education. The Alliance aims to protect Massachusetts bays, shores, and watersheds through a united community of teachers and educators in Massachusetts. Their efforts include encouraging teachers and their respective schools to make use of watersheds as teaching resources and establish working connections among schools and local organizations. The

MBEA's website also provides a "Massachusetts Bays Watershed Stewardship Guide" for teachers to use as a means of incorporating watershed protection into classroom settings (Massachusetts Bays Program, 2010a). The guide gives ideas and suggestions of ways that teachers can use watersheds in the classroom, such as using activities that allow students to survey, investigate, and analyze land use, problem solving, taking part in service projects relating to water resource issues, and so on. It also describes topics that could be addressed regarding watersheds based on the subject being taught, whether it is civics, physics, or even language arts.

A more physically active group is the Massachusetts Watershed Coalition (MWC) (2010b), which was founded on "building a network of watershed partners" (home page). They have a website designed to inform the public about how water impacts our lives and how to keep those waters safe and healthy. In regard to public education, the site has limited technical details about watersheds, but it provides a list of services that MWC provides to the community. Examples of services are volunteer monitoring; community surveys; community outreach and education programs; workshops, public forums, and conference planning; and land owners and home builders assistance (Massachusetts Watershed Coalition, 2010a). All these events and services give the public opportunities to learn about their local watershed and proper behavior for those living within a watershed, which is ultimately all of us.

Two important organizations specific to the Blackstone River watershed are the Blackstone River Watershed Association (2010a) and the Blackstone River Coalition (2010). They both advertise primarily through their websites, which are extremely multi-faceted. The Blackstone River Watershed Association site includes a "Get Involved" section that explains various volunteer opportunities for the public; an "Events" section so that the public is aware when cleanup days and other activities are happening; and most importantly, a "Publications"

section that has survey reports and guides. The Blackstone River Coalition site has the same concepts plus additional information, but with different headings. Both of these sites have one of the most educational pamphlets that our team has encountered—the Homeowner’s Guide to Protecting Water Quality in the Blackstone River Watershed (Blackstone River Watershed Association, 2010b). This guide was developed by Mass Audubon (2010) for the BRC as a part of the “Campaign for a Fishable/Swimmable Blackstone River by 2015.” It is a rather complete yet simple handbook of how communities can individually contribute to restoring and protecting local watersheds. It also educates people on why they should practice certain techniques and why these methods are beneficial to preventing watershed pollution. Furthermore, this brochure is also available for the “Horse Owner” and the “Small Farmer.” All in all, these guides are simple yet powerful ways to educate communities while helping them implement better watershed sustainability behavior.

2.7.4 Public Education Challenges

Although many groups are enthusiastically trying to promote the health of watersheds, there are several challenges that they face when considering watershed education. The most difficult challenge is that there are many minds that must be changed. Watershed pollution is not just a local issue. Everyone needs to take part in sustaining watersheds to make a difference in watershed health, not just a handful of people here and there.

Building upon the previous challenge, most of the minds that the organizations are trying to change are very unaware of what watersheds actually are. They cannot ask community members to practice sustainable watershed behavior if they do not understand what a watershed is. According to a 1999 Roper survey from the Center for Watershed Protection (2000), only 41% of Americans had any idea of what “watershed” meant, and only 22% knew that stormwater

runoff is the most common source of pollution in streams, rivers, lakes, ponds, and oceans. The average American citizen is unaware of watershed concepts and the “hydrologic connection between the yard, the street, the storm sewer, and the stream” (p. 630).

Furthermore, current resources for watershed education are inadequate. Several communities have tried to develop educational programs and implement watershed pollution prevention techniques, but most of these efforts have been under-supported. For example, in 1999, CWP (2000) surveyed 50 local programs that were trying to teach ways the community could reduce their environmental footprint, whether through lawn care and/or pet waste management. The survey exposed programs with inexperienced staff and meager annual budgets (\$2,000 to \$25,000) (p. 630). With such limited resources, it is difficult to implement strategies that properly educate the public on good watershed maintenance.

Because one of the challenges to public education is limited resources, a resultant difficulty is targeting large groups of people. With a small budget, only low cost techniques, such as brochures and demonstration projects, can be afforded. These methods, however, can only be used to reach a select number of residents (Center for Watershed Protection, 2000). Figure 6 clearly indicates that public TV was the most preferred outreach method by residents in 1999, which also happens to be the most expensive method (p. 631). Unfortunately, the techniques most implemented were those which are low cost and included brochures and training workshops, ranked 6th and 12th out of 14, respectively. This gap in outreach due to lack of funds is clearly a difficulty when considering using educational programs to promote better watershed management.

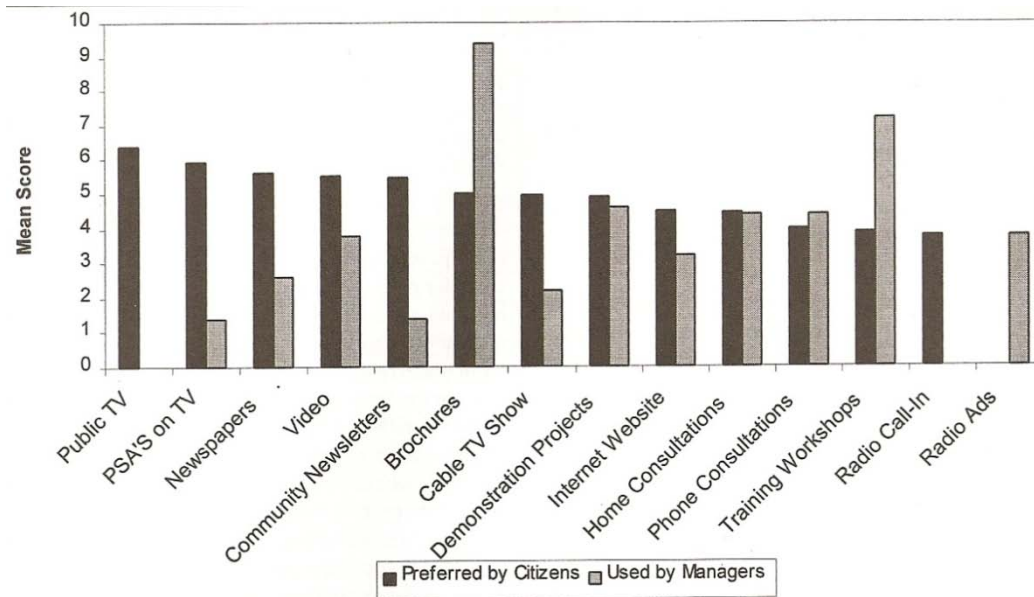


Figure 6: Comparison of Outreach Methods Preferred by Residents to Those Used by Watershed Educators (Center for Watershed Protection, 2000, p. 631)

2.7.5 Public Education Topics

When providing outreach to the public, it is crucial to emphasize not only what watersheds are and why they are important, but also the techniques to prevent watershed pollution. In theory, point source pollution is simple to prevent—don't do it. Don't dump hazardous toxins into a river; don't dump trash into lakes, etc. In reality, much of the point source pollution in rivers is from wastewater discharge from treatment plants. In order for the treatment plants to discharge cleaner water, the plant must receive enough funding and support to actually further purify the wastewater. On the other hand, nonpoint source pollution is even more difficult to prevent because there is no one identifiable polluting agent or source (U.S. Environmental Protection Agency, 2009c). Therefore, educational outreach has also focused on ways for people to prevent nonpoint source watershed pollution at the grassroots level.

In order to practice better watershed management, the public must first understand how watersheds become polluted. As previously stated, nonpoint source (NPS) pollution presents a

challenge because there is no one identifiable source, yet it is the nation’s leading source of water quality degradation, according to the U.S. Environmental Protection Agency (2009c). Although NPS pollution can result from mining, forestry, and agriculture, the most prevalent source of NPS pollution (in Massachusetts) is from urban stormwater runoff (U.S. Environmental Protection Agency, 2010l). Stormwater runoff results when rainfall or snowmelt moves over and through the ground, picking up any substances or debris it encounters along the way. The runoff, which is now polluted, comes to rest in local bodies of water, ultimately polluting this water as well (U.S. Environmental Protection Agency, 2009c). Stormwater runoff can include pet wastes, lawn care substances, household chemicals, car maintenance fluids, and miscellaneous debris from nature and people. Table 8 was compiled by the Center for Watershed Protection (2000) and describes the prevalence of watershed polluters based on 1999 U.S. data (p. 629).

Table 8: Provisional Estimates of Potential Residential Polluters in the United States (Center for Watershed Protection, 2000, p. 629)

Watershed Behavior	Prevalence in Overall Population	Estimates of Potential Residential Polluters
Over-Fertilizers	35%	38 million
Bad Dog Walkers	15 %	16 million
Chronic Car washers	25%	27 million
Septic Slackers	15%	16 million
Bad Mechanics	1 to 5%	3 million
Pesticide Sprayers	40%	43 million
Driveway Hosers	15%	16 million
<i>Note: Estimates are based on 1999 U.S. population of 270 million, 2.5 persons per household, and average behavior prevalence rates based on surveys in Understanding Watershed Behavior.</i>		

Although nonpoint source pollution is very difficult to control, there are some techniques that the public is able to utilize to help lessen NPS pollution. As mentioned earlier, the Blackstone River Coalition has an extremely helpful guide of prevention techniques and

explanations (see Appendix B). Reducing polluted runoff is the major goal of several organizations, and it can be achieved if people slightly alter their lifestyles so that they reduce the level of impact they have on the watershed. This involves using better “care” practices, reducing stormwater volume, and consuming less water. Many organizations are focusing on NPS prevention strategies to avoid further polluting watersheds and have generally grouped these strategies into the following categories: landscaping and gardening, household chemicals, car care, pet care, septic systems, and water conservation.

One method to prevent runoff is to “green” your lawn and gardens by using less fertilizers, toxic pesticides, and herbicides. Although lawns benefit from chemical fertilizers because they provide nutrition for the grass, these chemicals are not suited for adding to water sources. For example, chemical fertilizers, once they reach bodies of water, encourage algae growth, which uses up oxygen essential to other aquatic life, and pesticides kill aquatic insects and aquatic plants, creating watershed degradation. Residents can instead select fertilizers with low or no phosphorous, use organic or slow-release fertilizers, or use no chemical fertilizers at all and naturally strengthen and feed plants by adding compost (Mass Audubon, 2010). Also, residents can preserve existing trees and implement grass swales or porous walkways to increase water infiltration into the soil, which in turn decreases runoff. Mass Audubon (2010) recommends not mowing down to your stream, if applicable, and leave ten feet in native plants as buffers to filter pollutants.

While managing watershed nonpoint source pollution from home, residents can contribute by properly using, storing, and disposing of chemicals, including household cleaners, grease, oil, plastics, food, and paper products. Not only do chemicals pollute any water they come into contact with, but if they are not properly disposed of and instead are poured down

drains, they can corrode septic system pipes and interfere with chemical and biological reactions within septic tanks (U.S. Environmental Protection Agency, 2009b). It is paramount that chemicals are properly disposed of. Any unwanted chemicals should be taken directly to hazardous-waste collection centers. Chemicals, detergents, and other household substances should never be poured down the drain or nonchalantly poured on the ground. Soil cannot purify most chemicals, resulting in contaminated runoff (Goo, 2010) . Residents can also help by using phosphate-free detergents and soaps, whether for washing clothes, dishes, cars, or boats! As with fertilizers, many detergents contain phosphorous which ultimately ends up in waterways after passing from the dishwasher or laundry machine to the septic system. Although phosphorous is crucial in several biological compounds and essential for human and plant life, it is not beneficial for water sources (Phosphorus.2007). When in water, phosphorus promotes algae growth, which negatively impacts water sources, as explained in section 2.7.5.

In addition to household chemicals, fluids from car maintenance should also be properly disposed of. Spilled brake fluid, oil, antifreeze, and other car products should always be cleaned up—never just hosed down into the street where they can eventually enter a water source. According to Mass Audubon (2010), “In the U.S., it is estimated that petroleum washed off the pavement every year, along with dirty oil dumped directly into storm drains, sends 15 times more oil into the ocean than the Exxon Valdez did,” and “One pint of motor oil can contaminate 125,000 gallons of drinking water and make an oil slick about the size of two football fields” (p. 6 of Appendix B).

In regard to pets, it is important that pet wastes are picked up and thrown in the trash, not left on the sidewalk or grass. When it rains, the feces will be swept away into a water source.

Within the feces are bacteria, pathogens, nutrients, and other harmful pollutants that then contaminate the water and possibly cause disease to humans (Goo, 2010).

Pathogens and bacteria also enter waterways through improperly maintained septic systems. To reduce the risk of contamination from septic systems, it is important for residents to annually inspect their system; regularly pump out their system; refrain from using additives, diverting storm drains to the septic system, and flushing excess solids; and reduce the use of their garbage disposal (Goo, 2010). Furthermore, by conserving water, homeowners can prevent their septic system from overloading, which accounts for seventy-five percent of drainfield failures and contaminates both ground and surface water.

The aforementioned activities are straightforward and uncomplicated to implement. The following techniques are excellent methods to reduce nonpoint source pollution, but they require more effort than the previous prevention routines. For instance, there are a couple of techniques homeowners can implement to reduce rooftop runoff. Homeowners can install rain barrels to collect rainfall; redirect gutters and downspouts so they discharge runoff at least six feet away from the driveway so no extra substances are picked up; and create rain gardens, which consist of water-loving plants that help absorb runoff (Mass Audubon, 2010). These methods help to reduce the volume of runoff flowing across yards and into water sources. Moreover, Mass Audubon states, “This [reducing paved surfaces] is one of the most important actions you can take toward helping improve our local streams in the Blackstone watershed” (para. 1). By using pervious surfaces (gravel, wood mulch, or open-design pavers) for driveways and walkways, stormwater is able to infiltrate through the pavement and into the soil instead of flowing along impervious surfaces until reaching a storm drain. Without pervious pavements, thousands of

gallons of water from rain wash across yards and streets, collecting contaminants and polluting other bodies of water (Mass Audubon, 2010).

2.8 Collaborative approaches in Watershed Management

Collaborative approach has been more widely used in the field of watershed management than any other environmental fields. Much research and evaluation on a collaborative approach has been conducted to describe the benefit managing watershed problems. The problems are spanning into governmental jurisdictions, numerous stakeholders, and a wide range of pollutants. These are just a few of the issues that a collaborative approach addresses in watershed management.

2.8.1 Definition of collaborative approach

A collaborative approach can be interpreted in many ways, but a general definition is the involvement of face-to-face information exchange and problem solving among the stakeholders (Sabatier et al., 2005). More specifically, Clark (2005) defines it as “an inherent recognition of ecological interconnectedness, holistic management strategies, promotion of sustainable development, participation and inclusive decision-making structures, legitimate stakeholders involvement, and the forgoing of public-private partnership on a distinctively local basis” (p. 298).

2.8.2 Support for a Collaborative Approach

A collaborative approach is a management strategy to reduce conflict between stakeholders, to improve cooperation between with companies and government, and to pass regulations that are more attuned to public and private interests and thus less contentious. This watershed-based approach to resource management and arrangements represents a shift from the traditional “command-and-control” approach to environmental management (Born & Genskow,

2000). The traditional way of managing watersheds is through the decision making of government legislators, who have little knowledge of local watershed conditions. Although this approach has achieved some success in watershed management, such as the Clean Water Act of 1972, it has been widely criticized for its regulatory inflexibility—“one-size-fits-all” policy—and the high execution cost of the policy (Kenney, 1997). Researchers have argued that the traditional approach is ineffective when handling a variety of problems, such as NPS pollution, water quality planning under the TMDL, protection of aquatic species, and development of watershed areas (Sabatier et al., 2005). These watershed problems require an in-depth knowledge attained from the environmental experiences of the local residents, environmental agencies, and other stakeholders.

Sabatier, Focht, Lubell, Trachtenberg, Vedlitz, and Matlock (2005) produced a comprehensive study of collaborative approaches to watershed management in the United States. After analyzing a variety of recent studies in collaborative watershed management, the authors defined three strategies for watershed management: (1) collaborative engagement process—set-up a third party to resolve conflicts among diverse stakeholders, (2) collaborative watershed partnership—assist government and non-government stakeholders to develop a management plan for the watershed and then carry out the plan, and (3) collaborative superagencies—negotiate management plans and implement actions. These strategies focus on finding win-win solutions to the diverse problems faced by the stakeholders. The stakeholders, which include federal, state, and local governments as well as the public and private sector, must first identify the critical problems in the watershed and then work together to focus on implementing effective strategies to solve these problems.

The collaborative approach has encouraged the development of many nonprofit watershed organizations (NPWO) across the United States. Although, the exact number of nongovernmental organizations (NGOs) is not available, the number is increasing. As of 2010, the database contained more than 2600 NGOs across the United States (U.S. Environmental Protection Agency, 2010i). In addition, many state environmental protection agencies and NGOs are working together to build a mutual relationship to facilitate watershed efforts.

2.8.3 Potential problems with collaborative approach

Many researchers question whether a collaborative approach is effective in developing and implementing solutions to watershed problems. Sabatier et al. (2005) identified the most important concern as the stakeholders' ability to deal with complex issues. Many collaborative efforts create policies that rely on voluntary cooperation from the stakeholders to implement solutions to improve watershed conditions. These stakeholders may not have the necessary knowledge and technical skills that are needed for monitoring and managing a watershed. Therefore, some of the more complex and difficult issues regarding watershed health may not be addressed.

In addition, many researchers are also concerned about whether or not the collaborative approach truly represents the general population. Sabatier et al. (2005) argues that special interest groups, such as business owners, are typically over-represented because they are most concerned with the economic impacts of regulation, while the general public may be less involved in decision-making due to the time commitments these processes require.

On the other hand, Glicken (1999) argues that including a collaborative approach strategy will enhance the decision-making process. The information derived from a collaborative approach process provides the decision makers with more holistic perspectives on the issues at

hand because the public has experience with local watershed situations. The public's first-hand knowledge is vital to the decision-making process. Through the collaborative approach, people can learn about the technical aspects of decisions and can thus better contribute to a more comprehensive solution. The collaborative approach may not guarantee that the stakeholders will make correct decisions in every instance, but the overall benefits from the collaborative approach are transparency, openness to new information, and general acceptance by the public, despite some failures (Anderson, Hilborn, Lackey, & Ludwig, 2003).

2.8.4 Collaborative approach in other watersheds

There are many watershed organizations throughout the United States that are using a collaborative approach to address many watershed problems. The problems stem from a variety of issues and are not limited to implementing watershed's plans or decision-making regarding policy. Using a collaborative approach can build trust among the contributors of watershed management. A case study was conducted on the analysis of a contaminated site in New Jersey, "Building and Breaking a Bridge of Trust in a Superfund Site Remediation," by Danielson et al. (2008). In 1950s to the 1990s, a chemical company disposed of toxic wastes into several watershed basins that leached into groundwater that was at the time used by the local municipal water system and private wells in the community. In this case study, the authors illustrated that proper trust among the public, the companies, and EPA needed to be established in order to succeed in the river's cleanup.

In the case study, there was distrust among the members involved; the public did not believe that the company and the EPA were making any progress in cleaning up the pollution. Danielson et al. (2008) points out that this distrust resulted from public opinion on the company's behavior: the public assumed the company only acted to make a profit. The public

believe no progress was being made due to the EPA's slowness in cleaning up the pollution, as well as the EPA's lack of interaction with the public. However, these distrust tendencies between the public, the company, and the EPA were resolved through moderate links of trust among the intermediaries, who were from the public, the company, and the EPA. Each of these stakeholders severed to bridging the trust among the other two groups. For example, the EPA would bridge the trust between the public and the company, etc. If all the playing members examined one another without strengthening any of these trusting links, the result would be loss of trust with one another. A careful balance in trust among the stakeholders must be formed in order to maintain their relationship.

2.8.5 Collaborative approach in Blackstone River watershed

The Blackstone River in Massachusetts is polluted from centuries of loose industrial discharge and human contributions. Many NGOs in the Blackstone watershed have involved the public in order to implement cleanup plans, improve protection, and strengthen the condition of the Blackstone watershed. For example, the Blackstone River Watershed Association (BRWA) (2010c) has undertaken a three year action plan to achieve three primary goals to protect the Blackstone watershed. The three primary goals are to: (1) educate members, supporters, and watershed residents on watershed protection strategies, (2) engage the public in watershed stewardship activities, and (3) improve the water quality of the Blackstone River watershed. To insure the long-term effectiveness of the BRWA, the public is routinely updated on planned activities and events. The organization sets and tracks the progress towards their goals in order to improve the planning within watershed management.

Public participation is the most important source of man-power in managing a watershed. This resource is critical for a NPWO in implementing an effective watershed plan. In 2003, there

was a failure in the Upper Blackstone Water Pollution Abatement District in Millbury, Massachusetts, that released millions of gallons of untreated water into the upper Blackstone River. Within the water quality samples taken from nearby in the Blackstone River by the Department of Environmental Management (DEM), there were elevated fecal coliform bacteria levels that reached > 1600 fc/100ml, greatly exceeding the normal Blackstone River water quality standards B (< 200 fc/100ml) (Rhode Island Department of Environmental Management, 2003). In response to this catastrophe, the Blackstone River Coalition (BRC) launched a campaign for a fishable and swimmable Blackstone River by 2015. This campaign commenced with a set of goals and objectives that involved all public volunteers working with state environmental agency to develop a watershed action plan. The goals and objectives of the BRC (2008) campaign consist of protecting wetlands, reducing pollution from point and nonpoint sources, and promoting recreational and educational opportunities on the river. Without an adequate level of public participation in this campaign, the BRC will not be able to successfully facilitate the watershed plan.

Many Blackstone watershed organizations have realized that involving the public in watershed management efforts is more effective than the government's "command-and-control" approach. In 2004, the "Blackstone River Watershed Five-Year Action Plan" was introduced by the cooperative work of Massachusetts Executive Office of Environmental Affairs (MEOEA), GeoSyntec Consultants, Blackstone NPWOs, and stakeholders to improve and protect the Blackstone watershed. The GeoSyntec Consultants (2004) came up with a Five-Year Watershed Action plan that consists of three primary goals. These goals are to: (1) promote watershed-wide planning, cooperation and consistency, (2) synthesize and prioritize existing information from the previous assessments of Blackstone watershed, and (3) develop a plan that is relevant and

achievable within a five-year timeframe with the existing resources. The goals are set to improve water quality, restore natural flows to the river, protect and restore biodiversity and habitats, improve public access and balanced resource use, improve local capacity, and promote a shared responsibility for watershed protection and management. Only through the collaboration and efforts of public participants and environmental agencies will these goals be met.

The intense industrial usage of the Blackstone River during the nineteenth century left many pollutants that can still be found in the river's sediments today. These pollutants continue to influence the water quality and overall health of the Blackstone River's ecosystem. In 1971, the Blackstone River was labeled "one of America's most polluted rivers" by an article in *Audubon* magazine (Kerr, 1990). However, with the help of Blackstone NGOs and public efforts in monitoring the Blackstone watershed, today the river can support nineteen aquatic species in the mainstream and thirty-seven aquatic species throughout the Blackstone River. However, despite improvements, most of the water quality in the Blackstone watershed still does not meet the Class B water quality standards. The major causes of this continuing impairment are nonpoint sources of pollution, wastewater treatment plants, and contaminated sediments (Blackstone River Coalition, 2008). However, most researchers have suggested that a collaborative approach in watershed planning is the best solution to improving a watershed's condition (Sabatier et al., 2005).

3 Research Methodology

The purpose of this research project was to provide a set of recommendations that watershed agencies and organizations, whether they are government sponsored or non-governmental, can use to improve watershed management and sustainability, resulting in overall healthier watersheds.

To achieve the project goal, the main objectives were to:

1. Identify shortcomings in current policies related to sustainable watershed management and recommend new standards;
2. Identify a set of recommendations for watershed funding distribution by analyzing the current funding for watershed projects and programs and how it is distributed;
3. Identify current efforts to educate the public about the importance of watersheds and the consequences of polluting watersheds in order to provide suggestions to interested groups and agencies on additional ways to create public awareness and promote pollution prevention;
4. Identify methods to increase public efforts in collaboratively sustaining our watersheds and to improve long-term participation in watershed management.

3.1 Policies, Regulations, and Enforcement

Policies and regulations are designed for the benefit of the society. Environmental policies, such as those for protecting watersheds, are no different. However, it sometimes seems otherwise as demands stipulated by the regulations can make life difficult for the members living in the areas it protects. To achieve our first objective, we needed insights into the concerns that all involved have regarding current regulations and policy directions. We also wanted to identify methods used by towns and cities that have effectively combated these problems.

3.1.1 Staff and Volunteer Interviews

Different sections of society have different problems with the current policies depending on how the policies affect the goals they are trying to achieve. As such, we have identified three groups that are representative of the majority of views regarding the policies and regulations protecting the Blackstone River Watershed. These groups include: state/local government environmental protection agencies; private watershed organizations and coalitions; and industrial and wastewater treatment plants. Representatives from each of these groups were interviewed to determine how they have been affected, if at all, by the current watershed regulations, as well as how they think the situation can be improved. Table 9 contains the list of interviewees and the type of information that we have gathered from each interview. See Appendix D for the questions asked during each interview.

Table 9: Interview Details for Policies and Regulations

Interviewee	Position/Organization	Purpose of Interview
Therese Beaudoin	Watershed Coordinator- Massachusetts Department of Environmental Protection (Central Regional Office)	Challenges faced in implementing watershed management policies, and enforcing the regulations. Opinions on how to improve
Peter Coffin	Coordinator- Blackstone River Coalition	Views on the quality and effectiveness of current watershed policies and regulatory methods. Opinions on how to improve.
Tom Walsh	Engineer, Director/Treasurer- pper Blackstone Water Pollution Abatement District	Challenges faced in complying with regulations. Inconvenience caused by the presence of regulatory limitations. Opinion on how to improve.

3.2 Funding

The government sets aside only a small portion of its budget to maintain watersheds, which are crucial to humans, animals, and plants. Because these funds are so limited, it is important that these funds be given to communities that need them most and could use their funds wisely and effectively. The evaluation for funding must be strict and carefully analyzed. The techniques

used to provide a set of recommendations on how to better distribute watershed funding consisted of the following: (1) archival research on the current distribution of funding and (2) interviews with watershed representatives and officials throughout the state of Massachusetts.

3.2.1 Funding Distribution

In order to develop a set of recommendations to improve watershed funding distribution, we analyzed the current funding distribution. The Commonwealth of Massachusetts provides an annual report on the spending of the state revolving fund. These reports list the intended use of funds, the project cost, and the town or city receiving the funds. To analyze these data, we produced a bar graph of total funding received by towns/cities throughout Massachusetts.

3.2.2 Staff and Volunteer Interviews

Interviews were conducted with Blackstone River Valley Treatment Plant and Massachusetts Department of Environmental Protection Agency representatives, as seen in Table 10. These interviews provided further insights into the reasons behind inadequate funding and a further understanding of the costs versus benefits of the Upper Blackstone Abatement District Treatment plant. In addition, interviews with various Blackstone River associations gave us insights into their total available funding and its distribution. See Appendix D for the questions asked during each interview.

Table 10: Interview Details for Funding

Interviewee	Position	Purpose
Steve McCurdy	Massachusetts Department of Environmental Protection-Director of Municipal Services	Funding and spending of MassDEP
Peter Coffin	Coordinator-Blackstone River Coalition	Funding and spending of the Blackstone River Coalition
John Marsland, Alice Clemente, and Joe Pailthorpe	President, Secretary, and Treasurer-Blackstone River Watershed Council	Funding and spending of the Blackstone River Watershed Council
Nancy Bryant	Executive Director-SuAsCo Watershed Community Council	Funding and spending of SuAsCo Watershed Community Council
Elizabeth Campbell	Executive Director-Nashua River Watershed Association	Funding and spending of Nashua River Watershed Association

3.2.3 Case Study

Case studies were researched to understand watershed problems and solutions in different geological locations around the world. By researching the case study, we hope to find solutions to watershed pollution in previously highly industrial locations and learn from their mistakes and successes. See Appendix C for the case study that was reviewed.

3.3 Watershed Education

Both governmental groups and local organizations are supporting better watershed maintenance and less watershed pollution. One way they are promoting watersheds is through public education and outreach. It is important for communities to understand how their daily activities affect the watershed they live in and the consequences of polluting the surrounding watershed. Some organizations are trying to incorporate watershed education into primary school education, while others only educate the public through their website. Therefore, the techniques we used to better understand public education on watersheds included: (1) archival research on case studies to see which educational programs have been successful or unsuccessful, and (2) interviews with staff and volunteers at local organizations to see which programs they think have been or might be beneficial.

3.3.1 Case Studies

We researched case studies on the implementation of educational programs across the country to see which techniques have been used and how successful they have been. Within the reports we hoped to find techniques that could be applied to Massachusetts to further educate the public on the importance of watersheds and how the public can help prevent watershed degradation. See Appendix C for the case study that was reviewed.

3.3.2 Staff and Volunteer Interviews

We personally interviewed several active groups in Massachusetts including the Blackstone River Coalition in Worcester, the Nashua River Watershed Association in Groton, and the SuAsCo Watershed Community Council in Stow, as well as the Blackstone River Watershed Council in Rhode Island. Also, we electronically interviewed the Neponset River Watershed Association in Canton, MA, the Massachusetts Audubon Society in Lincoln, MA, and the Blackstone River Watershed Association in Uxbridge, MA through email. Furthermore, we conducted a phone interview with Steve McCurdy from the MassDEP in Boston. Table 11 shows the list of interviewees and the purpose of the interview.

Table 11: Interview Details for Public Education

Interviewee	Position	Purpose of Interview
Steve McCurdy	Director of Municipal Services- Massachusetts Department of Environmental Protection	Current outreach programs and pollution prevention applied to the state of Massachusetts
Peter Coffin	Coordinator-Blackstone River Coalition	Current educational outreach programs of organization
John Marsland, Alice Clemente, and Joe Pailthorpe	President, Secretary, and Treasurer- Blackstone River Watershed Council	
Donna Williams	Advocacy Coordinator, Mass Audubon	
Elizabeth Campbell	Executive Director-Nashua River Watershed Association	
Dona Neely	Blackstone River Watershed Association	
Nancy Bryant	Executive Director-SuAsCo Watershed Community Council	
Anonymous	Neponset River Watershed Association	

See Appendix D for the questions asked during each interview. Answers to these questions helped us devise recommendations for additional ways to implement educational watershed programs and increase awareness among watershed communities.

3.4 Collaborative approach

Many states have adopted a collaborative approach as their primary method of managing watersheds. However, the success of a collaborative approach still remains controversial. To determine whether the collaborative approach is a successful strategy in watershed management, we investigated the perspectives of watershed coordinators and public participants. By focusing on the watershed coordinators' and public participants' perspectives, we obtained the common thoughts and ideas regarding this watershed-based approach. We analyzed the perspectives of each watershed coordinator and the public participants to identify their common concerns and conflicts of using a collaborative approach in watershed management.

3.4.1 Staff and Volunteer Interviews

We conducted interviews with Blackstone watershed organizations that included the Blackstone River Watershed Council, Blackstone River Coalition, Nashua River Watershed Association, Neponset River Watershed Association, Blackstone River Watershed Association, and MassDEP. These interviews (see Table 12) examined the effectiveness of a collaborative approach, and it gave us a better understanding of how these watershed organizations approach the public to get them to participate and be involved in watershed management.

Table 12: Interview Details for Collaborative approach

Interviewee	Position	Purpose of Interview
Peter Coffin	Coordinator-Blackstone River Coalition	Campaign for a fishable/swimmable Blackstone River by 2015
Nancy Bryant	Executive Director-SuAsCo Watershed Community Council	Public involvement with the organization
John Marsland, Alice Clemente, and Joe Pailthorpe	President, Secretary, and Treasurer-Blackstone River Watershed Council	Public involvement with the organization/ watershed Planning
Elizabeth Campbell	Executive Director- Nashua River Watershed Association	Public, government, and business involvement with the organization
Anonymous	Neponset River Watershed Association	Public, government, and business involvement with the organization
Dona Neely	Blackstone River Watershed Association	Public and government involvement with the organization

See Appendix D for questions asked during each interview. The answers to these questions helped us devise recommendations for additional ways to increase public, government, and business participation to improve collaborative approaches in watershed management.

3.4.2 Case Studies

We reviewed case studies from across the United States in which collaborative approaches and strategies were used in watershed management. We analyzed the lessons learned from each case study to get a better understanding of the directions taken in collaborative

watershed management and the successes or failures this approach may have encountered. These perspectives provided relevant information and ideas that can be used to improve the watershed planning in the Blackstone River watershed.

4 Results and Analysis

In order to achieve our goal of formulating recommendations for the Blackstone River Watershed, we conducted interviews with nearby watershed organizations and examined case studies from nonlocal watersheds. The analysis of our results is divided into the four major subsections that correspond to the four objectives of this paper: to identify shortcomings in current watershed policies and regulations, to identify how watershed funding is received and distributed and how this can be improved, to identify current efforts for educating the public on watershed topics and how this can be improved, and to identify methods to increase public effort in collaborative watershed management. This section describes the data we collected and provides an analysis of the results we used to attain our goal and objectives. See Appendix E for all collected data.

4.1 Policies and Regulations

During the early years of water pollution prevention policies, point sources – in the form of discharge from industrial and municipal treatment plants – were the major causes of pollution in environmental water systems. As such, the regulatory system was built and developed with the goal to reduce and control these sources of pollution. Point source discharge has significantly improved, limited mainly by the lack of easily affordable technology for further improvements. As a result, more emphasis is now being placed on managing nonpoint source pollution.

4.1.1 Managing Non-point Source Pollution

Non-point sources are widely viewed as the biggest challenge to water quality in the Blackstone River Watershed. Stormwater runoff, the major contributor among nonpoint sources, combines the contaminants left by residences and businesses alike, the majority of which may end up in rivers, lakes and ponds. It is extremely difficult to regulate this as no one person or

entity is 'responsible'. Dona Neely, President of the Blackstone River Watershed Association, believes the government is now doing more to promote smart practices among developers and businesses to implement controls to minimize stormwater runoff. According to Therese Beaudoin, the watershed coordinator at the MassDEP, "bylaws enacted on a town by town basis can be very effective in minimizing development related nonpoint source pollution." However, these bylaws are not regulated by the state, and therefore they rely on the support of people within the individual towns/cities to enforce them.

An important way to manage stormwater runoff would be to improve the current wastewater transport facilities within the city of Worcester, a sentiment shared by a few watershed associations and engineers at municipal wastewater treatment facilities. Normally, an outdated sewer system would only be an urban problem. However, the city of Worcester is located at the beginning of the Blackstone River; therefore its pollution problems affect the majority of the watershed. Thomas Walsh, engineer and director/treasurer of the Upper Blackstone Water Pollution Abatement District, believes the government should put more effort into developing separate transport systems for municipal wastewater (sewage) and runoff. This would improve the quality and effectiveness of the treatment plant, especially during major storms, when maintaining plant stability becomes difficult due to the excess stormwater inflow. It is understood that this solution would be extremely costly and inconvenient, as it would require tearing up many city roads to replace the old sewage pipes with new ones and add separate stormwater runoff pipes. However, it is viewed as a necessary inconvenience if the problem is to be properly addressed.

Most agree that the government has recognized the importance of nonpoint source pollution management. They also agree that significant improvements have been made to the

policies that govern watersheds. Still, stormwater runoff remains a huge problem and may require policies that promote the involvement of residents in the attempt to combat this problem.

4.1.2 Political and Communicational Boundaries

Literature containing policy prescriptions for water resources typically share two major themes: the watershed is an appropriate scale to organize management and political boundaries almost never correspond with watershed boundaries. This problem of political boundaries is believed by many watershed organizations to be a significant obstacle in developing proper watershed governance. Peter Coffin, coordinator of the Blackstone River Coalition, also believes that there is no government or even overall structure to manage watersheds. These watershed organizations suggest that, in order to address this, the watershed should be viewed in terms of sub-basins and not by towns and counties when policies are being drafted. Peter Coffin suggested that each basin be given team leaders, who work full time in bringing all stakeholders within the basin together. This integrated approach would not only improve communicative relations within each basin, but also reduce challenges to cooperation among all watershed basins within the state.

Unfortunately, there is a gap between the theory and practice of integrated watershed management, even if the required watershed-scale decision makers are in place (Blomquist & Schlager, 2005). Since several towns are likely located within the same basin, it is inevitable that problems in decision-making arrangements and issues of accountability will arise in watershed management. Taking into consideration the country's current economic state, finding a participatory balance acceptable to each town would be difficult. However, it is possible to achieve some success with integrated watershed management, as seen with the Massachusetts Watershed Initiative. Most, if not all interviewed watershed organizations, commended the

achievements of the Initiative before its discontinuation. The reinstatement of the watershed initiative by the government, or implementing a similar program, would be a possible recommendation to improve watershed management.

4.2 Funding

Funding for watershed protection has decreasing trend for the last 6 years and the lack of funding for watersheds in Massachusetts has affected the quality of the Blackstone River Watershed. Because the government has prioritize it's spending, watershed funding has been given a less of a priority over other spending. This has resulted in a decrease in the number of watershed grants, reducing the amount of available funding and making these grants extremely competitive. Additional funding sources such as business and individual donations have also decreased, which can as well be attributed to the economic recession.

4.2.1 Government Funding Distribution

The Federal Government has increased funding for the fiscal year 2010 to the Commonwealth of Massachusetts, but the funding has focused on other sectors that will provide more jobs and will benefit the economy overall. Watershed projects that are funded by the Federal Government focus mainly on point source pollution. Sewer system upgrades seem to have been the target for the past three years, and since these upgrades are costly, they consume a huge portion of the watershed funding, (refer to Table 5: Worcester County Water Related Programs) leaving minimal funding for non-point source pollution programs and projects.

From “Sustainable Watershed Management: An International Multi-Watershed Case Study” by Walter Wagner et al. (Wagner et al., 2002), we learn that industrialization has led to an increase in population, agricultural activities, and water use. In all four watershed locations examined, decreased water quantity and quality was the result. The identified solution was to

use energy-intensive and costly technology to improve water quality, but this was not enough to revive previously existing habitats, animals, and plant life. In the Toess Watershed, we learn that there needs to be a balance between management of point source and nonpoint source pollution. Although the watershed has reduced its point source pollution, these efforts have been offset by nonpoint sources. Learning from this, more focus needs to be directed towards nonpoint source pollution in order to see water quality improvements.

4.2.2 Limitation of Funding Resources

Steven McCurdy of the MassDEP, Nancy Bryant of the SuAsCo Watershed Community Council, Dona Neely of the Blackstone River Watershed Association, and John Marsland of the Blackstone River Watershed Council believe that one of the major resources that limits their organizations is funding. Funding has decreased through the years, resulting in many organizations being understaffed. A representative of the Nashua River Watershed Association and Peter Coffin of the Blackstone River Coalition said that the majority of their organization's money is used to pay their staff. Peter Coffin estimated that 90% of the Coalition's budget is spent paying staff.

Due to insufficient funding, outreach programs and projects are limited. Peter Coffin of the Blackstone River Coalition, Nancy Bryant of the SuAsCo Watershed Community Council, and Dona Neely of the Blackstone River Watershed Association believe that educational programs and projects are essential to healthy watershed sustainability. A representative from another watershed organization said that "Today's youth is the steward of tomorrow", so it is essential to teach the younger generation about good watershed practices so that they will make good decisions in the future.

If given additional funding, Steven McCurdy of the MassDEP would invest in additional public education and environmental protection because this will prevent nonpoint source pollution in the first place. He believes this is a more efficient way to deal with watershed pollution. Dona Neely of the Blackstone River Watershed Association stated that if the organization were given additional funding, it would want to further expand its current program, which consists of the publication of outreach materials, strengthen its presence in the surrounding communities, and conduct additional remedial watershed projects.

4.2.3 Water-quality Testing and Monitoring

Frequent testing and monitoring of water quality in watersheds helps identify the locations where water is becoming highly polluted. The Neponset River Watershed Association, Blackstone River Coalition, and Blackstone River Watershed Council have their own water testing programs. The Blackstone River Watershed Council has 2 to 3 paid, trained professionals who train approximately 70 volunteers to collect water samples from tributaries that flow into the Blackstone River. The Neponset River Watershed Association receives support from watershed towns by requesting help on funding their water-quality testing within the town's boundaries. Elizabeth Campbell of the Nashua River Watershed Association (NRWA) stated that small organizations such as the NRWA can do watershed quality monitoring more cost effectively than the State. In addition, if organizations can do this water quality testing to a high standard and provide useful data, it may be beneficial for the government to pay these organizations rather than conducting the tests themselves.

Peter Coffin of the Blackstone River Coalition believes that "there can never be enough testing. The majority of testing and monitoring is done on the Blackstone River itself, leaving more than 70% of tributaries, small rivers, and other water sources that flow into the river not

assessed.” If his organization were given additional funding, Mr. Coffin would do more frequent water testing of the river, tributaries, etc. Testing is expensive, and as a result some organizations only test for basic contaminants such as phosphorus, nitrogen, and fecal coliform on a yearly basis. According to a representative from a watershed organization, the MassDEP does extensive testing of the Blackstone River every five years. They test for dissolved oxygen, turbidity, pH, phosphorus, nitrogen, ammonia nitrogen, nitrate-nitrite nitrogen, alkalinity, chloride, hardness, and bacteria. In addition, they look at aquatic vegetation, algae, habitat, benthic macroinvertebrate communities, and fish community composition. If testing were done annually, sources of pollution could be identified and addressed more quickly, which would limit the impact on the river from any pollution sources that were found. Elizabeth Campbell of the Nashua River Watershed Association hopes to test for pharmaceuticals, but they currently have more to learn before testing can occur. Pharmaceutical drugs can be found in most households and these drugs have side effects that could be dangerous if consumed in unsafe quantities or by the wrong person or animal, making it essential to test for such contaminants.

4.2.4 Government Funding Process

Some government funding provides organizations with money that is needed to further their efforts on watershed wellness. Receiving government funding for projects and programs requires- a significant amount of paper work due to the government desiring “nonprofits to be transparent”. Many organizations believe that less paperwork would be beneficial, and this may be because organizations are currently understaffed. A representative from the Neponset River Watershed Association said that getting government funding is a “challenge” and the applications and project reporting are “time-intensive”. Staff time is not being used effectively when they are sitting at a desk composing numerous reports and completing paper work.

4.2.5 Additional Funding Opportunities

Finding additional resources is important to counteract the effects of decreased government funding. By cleaning the river, organizations can enable recreational activities that were previously deemed unsafe. The Blackstone River Watershed Council has an annual canoe/kayak event for high school seniors on the Blackstone River. Kayak, rowboat, and canoe rentals during the spring and summer can provide an alternative source of funding. With the draw of recreational activities on the water bodies in the watershed, cities could charge a small parking fee that could be reinvested in maintaining the watershed.

If the MassDEP allows qualified watershed organizations could be hired/contracted to conduct water quality testing in their respected watershed. This would be a win-win for both the government by having testing done in a more cost effective way and for watershed organizations by receiving additional funding. In addition, organizations could make water testing an activity that could inspire and educate people, children or adults, about good watershed practices.

4.3 Public Education

Several of the watershed organizations in Massachusetts agree that educating the public about watersheds is of paramount importance. Many residents are unaware of what a watershed is and how a watershed is affected by human activity. Donna Williams of Mass Audubon and the Blackstone River Coalition (BRC) commented, “There aren’t problems with watersheds; there are problems with people’s lack of understanding of how watersheds function and their making inappropriate decisions.” When asked how to improve watershed planning, several of the organizations agreed that making the public understand about the watershed they live in is essential. Dona Neely of the Blackstone River Watershed Association (BRWA) stated,

“education, education, education...when people understand the problems and what they can do about it [they will attempt to sustain a clean watershed].”

4.3.1 Current Means and Methods

The public must first and foremost understand why watersheds are important. The Blackstone River Watershed Council (BRWC) believes that there needs to be “public awareness and pride of ownership” for the promotion of better watershed health. The BRWC finds that the public, especially younger generations, need to be more “connected to nature” in order to better understand the vitality of watersheds and what people can do to improve current watershed efforts, specifically in the Blackstone River watershed. Accordingly, the BRWC provides many opportunities for all age groups to experience nature and in doing so helps them learn about watersheds and the Blackstone River. The BRWC brings high school students to into the watershed through canoeing trips, particularly their annual senior class canoe trip. Moreover, the BRWC has been educating hands-on with water quality testing of the Blackstone for seven years now, as well as cleanups along the River. The Neponset River Watershed Association (NepWRA) also educates through active outreach events including, but not limited to, river cleanups, natural history interpretive walks and canoe trips, and water-testing. Furthermore, the BRWA also provides opportunities for volunteers to test the water quality of the Blackstone on a monthly basis and clean up the river twice a year.

Many organizations also offer the public technical programs and presentations on watershed topics. For several years now, the NepRWA has run town-wide water conservation programs with willing towns. The programs have focused on “public education initiatives, school curricula and presentations, and retro-fitting buildings with water-conserving devices.” Another program run by the NepRWA focused on improving a particular watershed’s health by educating

the residing citizens on proper maintenance of their septic systems. Mass Audubon and the BRC show presentations on watersheds, stormwater impacts, best management practices (BMPs) for low impact development and bylaw changes. The BRWA also contributes through their “Coffee and Conservation” lecture series, which provides discussions on topics such as organic lawn care and composting. The Nashua River Watershed Association (NRWA) has had great success with their presentations on topics such as snakes and bears. Although not directly related to watersheds, the presentations introduce a crowd of people to the NRWA office, which is prepared with informative materials and the activities it sponsors. The NRWA also has a “SMART growth circuit rider” who works with the municipality to help inform residents. The rider aids in designing bylaws, working with towns on low impact development, helping towns to keep water local, and designing systems to more effectively handle wastewater.

Several of the organizations are making an impact by introducing watershed educational materials into school systems. Mass Audubon, the BRC, the BRWA, the BRWC, and the SuAsCo Watershed Community Council all participate in presentations at schools. The EnviroScape model is typically used because it demonstrates how activities on land can pollute local waterways in a manner that young children can understand. Peter Coffin of the BRC believes that if you can engage children in a way that they’ll share the knowledge at home, then parents will become informed as well. He says, “If you want to get politicians, you must get the voter. And if you want to get the voter, you must get the kids.” The students serve as the recruiters and educators that pass on the message of the importance of keeping watersheds clean to their parents to help engage their parents in watershed management. Steve McCurdy agrees that outreach in primary and secondary schools is one of the most influential methods of outreach and that public education is an investment for the future. He believes that investing in

teaching the public proper behavior for maintaining a watershed is better than amending the consequences of poor behavior. The NRWA also spends much of their effort working with students out on the river educating them about the importance of the watershed in their daily life. In doing so, the NRWA hopes to get the students to appreciate the local watershed and take part in watershed management in the future. Furthermore, the NepRWA annually speaks about water issues in watersheds to students in Westwood during the middle school's science day.

The SuAsCo Watershed Community Council, on the other hand, has focused much of their efforts into developing a stormwater education program called the "Stormwater Community Assistance Program." The program was developed to provide towns and cities with the materials necessary to educate their citizens about stormwater. It is a tremendous resource that watershed communities can acquire on an annual basis to help maintain their watershed through an organized, ready-to-go outreach program. Some of the materials included in the package are brochures, posters, school lesson plans, cable TV ads, maps, and storm drain marking kits. The program is designed to target a large audience and is not limited to residents, businesses, municipal staff, and children.

Another significant means used by watershed organizations for educating the public is through brochures, websites, and other media. All of the interviewed organizations use their website as a major means for communicating information such as events, educational material, and other opportunities. Mass Audubon and the BRC distribute several pamphlets, including "A Homeowner's Guide to Protecting Water Quality in the Blackstone River Watershed," as mentioned in section 2.7.3; "Tackling Stormwater in the Blackstone River Watershed"; and other brochures on topics such as rain gardens. The NepRWA tries to staff a NepRWA table at local "green" and environmental fairs/events to speak with the public and distribute educational

brochures. They also maintain profiles on social networks including Twitter, Facebook, and Flickr. The BRWA also runs a booth at various public forums and events, such as River Bend Farm in Uxbridge and farmers' markets, to discuss BRWA activities with visitors and pass out pamphlets. They also send out a monthly electronic newsletter and educate through an easy-to-understand "Do's and Don'ts for the Blackstone River" brochure, which explains why the Blackstone is polluted, the difference between point source and nonpoint source pollution, and how we can help prevent watershed pollution. The SuAsCo Watershed Community Council staff and volunteers also dispense handouts and discuss tabletop displays and community events and public forums. They also electronically provide a monthly calendar of meetings so that the public is made aware of SuAsCo Watershed issues.

4.3.2 *Current Limitations*

Donna Williams of Mass Audubon and the BRC stated, "More and more people are aware of the watershed concept and how it works, but they have a hard time relating their own practices to the degradation of our waterways." The organizations interviewed, as well as others around the country, are trying to increase watershed awareness among watershed residents. Their efforts, however, are unable to be fully extended because of insufficient resources. The endeavors of the SuAsCo Watershed Community Council, BRWC, BRC, NepRWA, BRWA, NRWA, and Mass Audubon are all limited by finances. Some of the successful events sponsored by these organizations were funded by government grants, allowing the programs to receive more resources, time and staff in particular. Unfortunately, some programs and events that the organizations think would be beneficial if implemented are unable to take off because of inadequate resources. On top of funding, lack of volunteers, trained staff, and staff and project

partner time are additional limitations that hinder the progress of local watershed organizations in achieving their goals.

4.3.3 Analysis

From background research and collected data, we can begin to analyze how the public is being educated about watersheds and any resulting discrepancies. A major disadvantage for several watershed organizations is insufficient funding. The organizations interviewed discussed limited finances as a large contributing factor as to why certain desired programs had not been implemented. According to the interviews, insufficient funding leads to fewer staff and less resources, resulting in less time available to carry out successful programs and events.

A noticeable inconsistency in public education was briefly discussed in section 2.7.4. A survey conducted by the Center for Watershed Protection (2000) outlined the outreach methods the public prefers. The top response was outreach through public TV, including public service announcements; however, this technique is very costly, and watershed organizations cannot afford this method. On the other hand, brochures were less preferred by the public, and yet this method of outreach has been highly utilized because of convenience and cost-effectiveness. Accordingly, several of the organizations interviewed indicated the use of brochures and booklets as a common method to educate the public. On the other hand, no conclusions can currently be drawn in regards to the effectiveness of this method, only that it is a popular method of outreach for watershed organizations. Furthermore, there is insufficient data to discuss the preference and effectiveness of TV over other methods, such as brochures.

It is also important to analyze the effectiveness of the educational materials made available to the public. Wagenet et al. (1999) (see case study in Appendix C) produced a study that assessed the effects of an educational program for watershed residents in New York. Upon

completion of the program, residents were issued a survey to evaluate their retained knowledge from the program, as well as their attitudes towards the subject matter. There were three targeted groups: individuals who fully utilized the educational materials (full users); individuals who received the materials but did not fully use them (partial users); and individuals who did not receive the materials (nonrecipients). The educational program consisted of a series of fact sheets on watershed topics, as well as a concluding videotape, and was presented over a course of several weeks. The first fact sheet discussed groundwater and how it can be protected. The second fact sheet examined watersheds on a large scale so that residents would be able to fully understand the corresponding technical terms. The third fact sheet discussed what nonpoint source pollution is and how it can be prevented. This was an essential sheet, especially because approximately 90% of New York's water quality problems had been created by nonpoint source pollution. The final fact sheet incorporated concepts from the previous sheets and related them to managing individual septic systems. The concluding videotape provided a separate means of education and discussed how residents can protect water resources.

The post-program surveys indicated that readership had a positive and a statistically significant, albeit weak, correlation to knowledge-if the participants had access to the material, they were able to learn from it. Furthermore, individuals who took full advantage of the program had much higher knowledge on watershed issues compared to the other two groups. This study thus suggests that simple means for educating the public, such as fact sheets and videotapes, are in fact, effective tools, assuming that residents have access to these materials and actually use them. The survey however, did not indicate any relationship between reading the material and applying the concepts. Getting residents involved in protecting and maintaining watersheds can be difficult and is further discussed in section 4.4.

The examples presented in this section by no means exhaust the efforts or limitations of the watershed organizations. It merely provides some examples by which the public is being educated about watersheds and some challenges presented to watershed organizations.

4.4 Collaborative Approach

The use of a collaborative approach in watershed management is designed to address many issues that current watershed organizations are dealing with. Nancy Bryant of the SuAsCo Watershed Community Council states,

“This balanced representation of interest groups [businesses, municipal officials, environmental organizations, and state and federal government] enables the SuAsCo Council to have a positive impact on watershed policy decisions by improving the understanding of the issues among all involved and promoting consensus so that stakeholders can work together towards the common good of the watershed.”

4.4.1 Level of public participation in watershed organizations

People who take part in a watershed organization’s activities are usually not involved in long-term watershed management. Many of these public participants get involved with watershed programs such as an annual river cleanup event, river canoe event, catch a snake event, or see a bear event, etc. The Blackstone River Annual river cleanup, the number of public participants who attend exceeds 250 volunteers every year. As Peter Coffin stated “...the traditional clean ups, it gives something that they can do and feel good about it. Don’t ask them to go to meetings. Don’t ask them to sign a petition but you break it into some smaller things that make people feel good. We need to make smaller things that people like [to participate in]”. In contrast, the number of participants in decision-making policy events consists of at most 15 people across several towns. The same turnout results for technical watershed programs.

However, public's involvement in watershed cleanups has helped many watershed organizations to achieve their goals. For instance, the BRC's goal for a "Fishable and Swimmable Blackstone River by 2015", even though this watershed plan has not been completed, has evidently been improving the water quality in the Blackstone River.

A case study done by Wyman (2008) evaluated public involvement of the Jordan Lake Watershed (JLW). In the evaluation, Wyman observed that public participants are both involved in not only watershed cleanups, but also decision-making and regulatory meetings. The Jordan Lake Stakeholder Project (JLSP) brought together 222 individuals representing 113 organizations. Public engagement in the JSLP was an indicator of the project's success: twenty-one meetings were conducted to develop a TMDL implementation plan in which all participants could reach an agreement. This can be compared to the Blackstone River watershed, where not many public meetings have been held due to a lack of public participation. However, the success of the project may be attributed to the watershed being categorized as a superfund site by the EPA. The public was mandated to take part in the JLSLP because the pollutants in the watershed were directly affecting people's health. By contrast, the Blackstone River Watershed is not a superfund site and consequently does not generate nearly as much public attention as the JLW.

4.4.2 Problems associated with public participation in watershed management

Many watershed organizations have difficulty getting people involved in maintaining good condition of the watershed. Nancy Bryant of the SuAsCo Watershed Community Council observed that more and more people are becoming less exposed to nature such that they may not develop a sense of responsibility to care for the watershed and thus may take watershed resources for granted. She believes nonpoint source pollution often occurs because of people's

lack of awareness in which they don't understand how their decisions and actions will affect the watershed around them or their local environment.

Peter Coffin of the Blackstone River Coalition thinks that the problem lies with the challenge of who is responsible for the contaminants in the watershed. Much of the pollution problems in watersheds are caused by nonpoint sources from the public and business owners, as well as point sources due to limited government regulation on sewage discharge. Theoretically, the public, the business owners, and the government should be responsible for the contamination and degradation of the River, but none of these parties is willing to act. A representative from Neponset River Watershed Association stated that it is hard to improve the watershed condition when “the people, business, and government agencies [who are not getting together] implement long-term, pro-environment changes to routines, or pursue pro-environmental, future-oriented directions in decision-making.”

4.4.3 Managing Watersheds Locally

In the watershed management planning that was discussed in our interviews with watershed organizations and Massachusetts DEP staff, a key success to watershed management is thought to be to involve local participants who are living near the water body. In an interview with Elizabeth Campbell of Nashua Watershed Association, she suggested that for watershed management to be effective it should be done locally or town by town. She states that “the public does not think in terms of the watershed and thinks in terms of towns. There are many regulations for towns and cities, and there is a political boundary to coordinate [associate with it].” As mentioned previously in the policy section managing a watershed is more successful when the regulation reflects on the community watershed problems.

4.4.4 Government collaboration with the watershed organizations

Many watershed organizations have different points of view on the government's involvement with their watershed planning. For example, in the annual Blackstone River cleanup, the Blackstone watershed organizations are required obtain a permit to remove the trash that lies on the bottom of the river beforehand. The organizations believe that this policy is unnecessary because they are improving the watershed, and obtaining such a permit may in fact discourage participation. The government is not making a sufficient effort to work with the watershed organizations in order to achieve a common goal. Wyman (2008) also mentioned that public participants seemed skeptical that "the regulations would be implemented due to the enormously high costs associated with the plan". For these reasons Wyman disbelieves the process to be "beneficial to improving water quality."

The collected data provided us with in-depth responses concerning current policies and regulations, funding, public education, and a collaborative approach, as well as the challenges presented to watershed agencies and organizations in each of these categories. Watersheds do not conform to political boundaries, making it difficult to assess who is responsible for maintaining the watershed. Watershed protection is not a high priority and the organizations protecting the watersheds do not receive enough funding, resulting in under-supported efforts from the organizations. Many watershed agencies are diligently providing educational opportunities to the public, while also promoting participation and collaboration amongst citizens, businesses, and the government for an overall collective management style.

5 Conclusions and Recommendations

This chapter presents the conclusions and recommendations of our research on watershed management of the Blackstone River Watershed. Conclusions were achieved through the aforementioned results and analyses. Based on our conclusions, we have developed a set of recommendations for Blackstone River watershed organizations that we hope will help them promote the welfare of the watershed more effectively. Our findings may also be relevant for organizations working to maintain and protect other watersheds.

5.1 Policies and Regulations

With nonpoint source pollution becoming the major source of pollution in watersheds, the government has turned its attention towards creating policies and regulations to address the problem. Much has been done to convince businesses and industries to reduce their runoff, but policies are also needed to encourage residents to do the same. Improving the outdated sewer system within the city of Worcester is also important in controlling stormwater runoff. Having separate flow systems for runoff and sewage would allow for better, more appropriate treatment.

Watersheds most often do not conform to political boundaries. This creates quite a problem when policies need to be implemented and regulations enforced. Instead, watershed management needs to be viewed on a sub-basin level, using an integrated management approach to improve collaboration among organizations. This approach is by no means perfect, as there will be differences in opinions and beliefs among involved organizations that may hinder the decision making process. As such, collaboration has the potential to be more detrimental than helpful; but collaboration has also shown that it can be useful and effective if enough effort is exerted by all the stakeholders involved.

5.2 Funding

Funding plays an important role in promoting and maintaining a clean watershed. Because of the economic recession, the government has reduced the grant funding available for watershed protection activities. With limited budgets, most organizations have spent their money on staff, leaving little money for educational and other programs in the community. Water quality monitoring programs are crucial for identifying problem areas in a watershed by locating those areas that are contributing a significant amount of pollution. Water testing done by government scientists is more costly than if the tests were to be completed by watershed organizations. If organizations can do the testing according to the standards set by the State, it would be more cost effective for the government to pay watershed organizations to do the water quality monitoring. Obtaining government grants is time consuming and requires a substantial amount of paper work before, during, and after the completion of a sponsored project. This is not an efficient way to use the limited number of paid staff working for watershed organizations, who could instead be helping promote good watershed management. Thus, streamlining the grant application and compliance process would be very helpful.

5.3 Public Education

Educating the public about what a watershed is and how people's behavior affects the watershed they live in is considered a high priority among watershed organizations. Until the public is aware of the importance of protecting a watershed, it is difficult to expect the public to take an active role in protecting and maintaining the watershed they live in. Several organizations in Massachusetts and nearby states, as well as many others across the nation, are actively educating the public about watersheds and their critical importance. These organizations are currently utilizing various means for educating the public, including outdoor activities and

field trips, the integration of watershed topics into school curricula, technical and nontechnical presentations, and information/educational brochures and hand-outs. Although these organizations are diligently promoting watershed welfare, their efforts in public education are limited by various obstacles, including the limited number of trained staff, limited project partner time, and most importantly, limited funding. Without funding, it is difficult for these agencies to prepare programs and organize events. As mentioned earlier, although TV was and may still possibly be the preferred outreach method for residents, a study by Wagenet et al. (1999) showed that less expensive outreach methods such as hand-outs and fact sheets are, in fact, an effective means for educating the public. As long as residents receive some form of educational material, they will be able to learn from it.

5.4 Collaborative approach

The biggest challenge to a collaborative approach in the Blackstone River watershed is the public's unwillingness to get involved in long-term watershed management. Most of the participants in Blackstone River watershed activities are one-time volunteers, helping out at events like the watershed cleanup. Without having an interest in the watershed as motivation, the public will not focus their efforts on the watershed problems. Much of the public has succumbed to the notion that because the Blackstone River does not impact their daily life, they don't have to worry about it. In addition, because the Blackstone River watershed is not a superfund site, it is perceived by the public and government as nonessential and they have not yet fully taken responsibility for managing the watershed in which they live.

Although the public may not currently be involved in long-term watershed activities, they are essential to the success of preventing NPS in the watershed. Including public participants in

watershed management has helped decrease the level of contaminants in the Blackstone River. Even one-time participants make a difference.

5.5 Recommendations

Based on our conclusions, we would like to make recommendations to interested Blackstone River watershed organizations, both governmental and non-governmental, to help improve the maintenance of the Blackstone River Watershed according to policies and regulations, funding, public education, and collaborative approach.

The state government should develop policies and programs based on the watershed boundaries by separating the watershed into sub-basins. A statewide watershed management organization should be created, similar in function to the former Massachusetts Watershed Initiative. This organization would be comprised of a team of leaders assigned to each sub-basin, who would be required to coordinate the watershed protective activities within their respective basins. Team leaders, although only working within their own sub basin, would need to meet frequently to share ideas and concerns and implement collaborative actions when required. Interested and qualified candidates, preferably those residing in or familiar with the basin they intend to lead, should apply for the basin leadership position. These would most likely be people who have already been actively involved in the protection of watersheds and are acquainted with the respective shareholders involved with watershed management. Prior to the implementation of the program, a list of criteria for choosing team leaders should be developed. Since several of the watersheds in the state cross state boundaries, collaboration with surrounding states would also be required. Ideally, agreements should be made between the states, since making it a federal issue would most likely delay and complicate the process. Funding is likely to be an issue; however, since it is a statewide program, it should be funded primarily by the state, budget

permitting. Also, the Initiative should also try to generate donations, which could be tax deductible. Watershed resources within each basin can be used for scenic and recreational activities that could raise revenue.

The local government in Worcester should replace the outdated sewer system within the city. Not only should old leaky pipes be replaced, but transport systems that separate runoff from sewage should be designed and installed. This will most likely cost a substantial amount of money, limiting the number of funding options available. The city should try to obtain money from state or federal governments, or even willing private sector companies. The improvements would have to be done in phases and could take several years to complete. The size of each phase would depend on the amount of funds available to complete the phase.

The government needs to provide more funding to watershed organization so hired staff can have resources to produce and conduct educational programs to limit watershed pollution. The grant funding request process should be streamlined to require less paper work so that paid watershed employees can use their time more effectively in trying to protect our watersheds. Water quality monitoring should become a top priority so that the major sources of contamination can be identified and corrected. The government should allow and pay qualified watershed organizations to conduct this water testing because they can complete it for less money while still meeting quality standards and it will provide them with additional funding. By cleaning the river, additional funding opportunities will emerge in recreational activities such as canoe and kayak rentals.

In regard to public education, Blackstone River watershed organizations should consider using a well-qualified circuit rider to travel throughout the watershed, educating the towns and cities about watershed technical issues. Also, because TV is the public's preferred outreach

method, all the organizations supporting the Blackstone River watershed should consider pooling their funds to create public service announcements or other televised programs to briefly discuss watershed topics or announce watershed programs and events. Another consideration is to create an educational film documentary that could be shown on a public television station or at schools. Although these types of outreach may cost more money up front, they will reach a larger audience than other, more individualized forms of outreach, expanding its range of influence. Furthermore, we recommend additional research on both the preferred method of outreach and the most effective type of outreach. As mentioned, television has been the preferred outreach method; however, this conclusion was made in 1999 and may no longer be accurate. For example, current social networking sites like Facebook may be the new and more useful medium to reach out to the public. It is also important to establish the most effective means of educating the public, as the most effective method may not necessarily be the method preferred by the public. A correlation between these two crucial aspects of public education could prove beneficial for watershed organizations.

More government agencies and local businesses in the Blackstone River watershed should get involved with the watershed organizations to promote watershed health. Without efforts from the government and the business sector, the public will not have the mindset that preserving the watershed is important. In addition, the local government should increase its investment in building watershed recreational sites. The purpose of this recommendation is to increase the public's activities in the watershed. By doing so, the public will experience the watershed's surroundings and hopefully gain an appreciation for the watershed.

More research needs to be done on businesses' involvement in the Blackstone River Watershed. This paper did not present enough information or analysis on businesses' role in

watershed management. In a case study by Danielson et al. (2008), the authors mentioned that business collaboration within watershed management will help to provide the necessary funding and the technical expertise to maintain watershed health. The authors noted that by having a company directly involved in the cleanup process helped to avoid legal paperwork, as mentioned in regard to cleanups along the Blackstone River.

All in all, the purpose of this project was to provide recommendations that interested organizations and agencies can use to improve upon current efforts to manage the Blackstone River Watershed. For the purpose of this project, watershed management was separated into the following four categories: policies and recommendations, funding, public education, and a collaborative approach. Data was collected by analyzing case studies, performing archival research, and interviewing staff and volunteers of watershed organizations. Conclusions were made according to the results achieved and include inadequate nonpoint source pollution management, insufficient funding and unequal distribution to watershed organizations, insufficient public awareness, and an unwillingness of public and business to participate in watershed maintenance. Several recommendations were suggested and include the use of watershed boundaries, an improved sewer system, redistribution of watershed funding, creating an educational documentary, and increasing recreational sites within the watershed. We feel that the implementation of these recommendations would help improve the maintenance of the Blackstone River Watershed, resulting in an overall healthier watershed.

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Appendices

Appendix A: MassDEP Indicative Project Summaries: Section 319 Nonpoint Source Competitive Grants Program (Peirce, 2010)



INDICATIVE PROJECT SUMMARIES

SECTION 319 NONPOINT SOURCE COMPETITIVE GRANTS PROGRAM

FFY 2006 - 2010

Massachusetts Department of Environmental Protection
Bureau of Resource Protection
Glenn Haas, Acting Assistant Commissioner

2010

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

**SECTION 319 NONPOINT SOURCE PROGRAM
INDICATIVE PROJECT SUMMARIES**

FFY 2006 – 2010

**Prepared by:
Jane Peirce, 319 Nonpoint Source Program Coordinator**

**Massachusetts Executive Office of Energy and Environmental Affairs
Ian A. Bowles, Secretary**

**Department of Environmental Protection
Laurie Burt, Commissioner**

**Bureau of Resource Protection
Glenn Haas, Acting Assistant Commissioner**

**Division of Watershed Management
Glenn Haas, Director**

**Division of Municipal Services
Steven J. McCurdy, Director**

2010

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Massachusetts Department of Environmental Protection
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INTRODUCTION

This report presents indicative summaries of the projects partially financed by the Section 319 Massachusetts Nonpoint Source Competitive Grants Program during federal fiscal years (FFY) 2006 through 2010. Projects funded from the inception of the program in 1990 through 2005 are listed in the Appendix at the end of this report.

Congress annually appropriates funds under Section 319 (319) of the Clean Water Act of 1987 (33 U.S.C.A., Sec. 1251 et. seq.) to assist states in implementing their approved nonpoint source (NPS) programs. Section 319 is administered by the US Environmental Protection Agency (EPA), which oversees the awards to individual states. The Massachusetts Department of Environmental Protection (Department), Bureau of Resource Protection, administers this award as part of the Massachusetts Nonpoint Source Program.

The 319 program focuses on the implementation of activities and projects for the control of nonpoint source pollution. EPA defines NPS pollution as that which is "caused by diffuse sources that are not regulated as point sources and are normally associated with precipitation and runoff from the land or percolation." The awards are intended to provide financial support for the state's programs for controlling the major statewide categories of NPS pollution or for protecting or improving NPS-impaired or threatened targeted water resources.

Each year, a portion of the 319 funds awarded to the state is used for specific watershed implementation projects that improve or protect threatened or impaired priority freshwater and coastal waters. Projects funded under this program must implement measures that address the prevention, control, and abatement of NPS pollution, and must result in restoration of beneficial uses or achieving or maintaining state water quality standards. A Request for Responses for competitive projects is issued by the Massachusetts Department of Environmental Protection in the spring. Proposals may be submitted by any interested Massachusetts public or private organization. The Department encourages all types of eligible, competitive proposals from all watersheds.

Since FFY '01, the Department has particularly encouraged proposals that will begin implementation of Massachusetts's Total Maximum Daily Load (TMDL) analyses, or that implement recommendations made in Diagnostic/Feasibility (D/F) or other studies for waters that do not meet Water Quality Standards. The Department also continues to encourage applicants to propose projects that support the Department's ongoing basin-wide water quality activities. The Massachusetts Nonpoint Source Management Plan (<http://mass.gov/dep/water/resources/nonpoint.htm>), is a primary source of information for identification of comprehensive, 319-eligible projects that will lead to water quality improvement. The Massachusetts Watershed-based Plan, <http://public.dep.state.ma.us/Watershed/Intro.aspx>, was developed in 2007 as an additional tool specifically for the purpose of identifying and developing priority projects to be funded using 319 funds. All projects represented in these Indicative Summaries are consistent with both the Massachusetts Watershed-based Plan and the Massachusetts Nonpoint Source Management Plan.

An intra- and inter-agency screening committee reviews all eligible 319 proposals. Projects selected by the Department for funding are included in the Department's yearly program plan, which is submitted to EPA prior to the start of the federal fiscal year. Once the program plan has been approved, the Department enters into a contractual agreement with the applicant to conduct the project.

A 40% non-federal match is required from the grantee. This match may be in cash or from in-kind services performed as part of the approved project activities. Unless specifically recommended in a TMDL, research, program development, assessment, planning, and water quality monitoring for assessment purposes are not considered implementation activities and are not eligible for 319 funding or match credit. The typical project timeline is for three years.

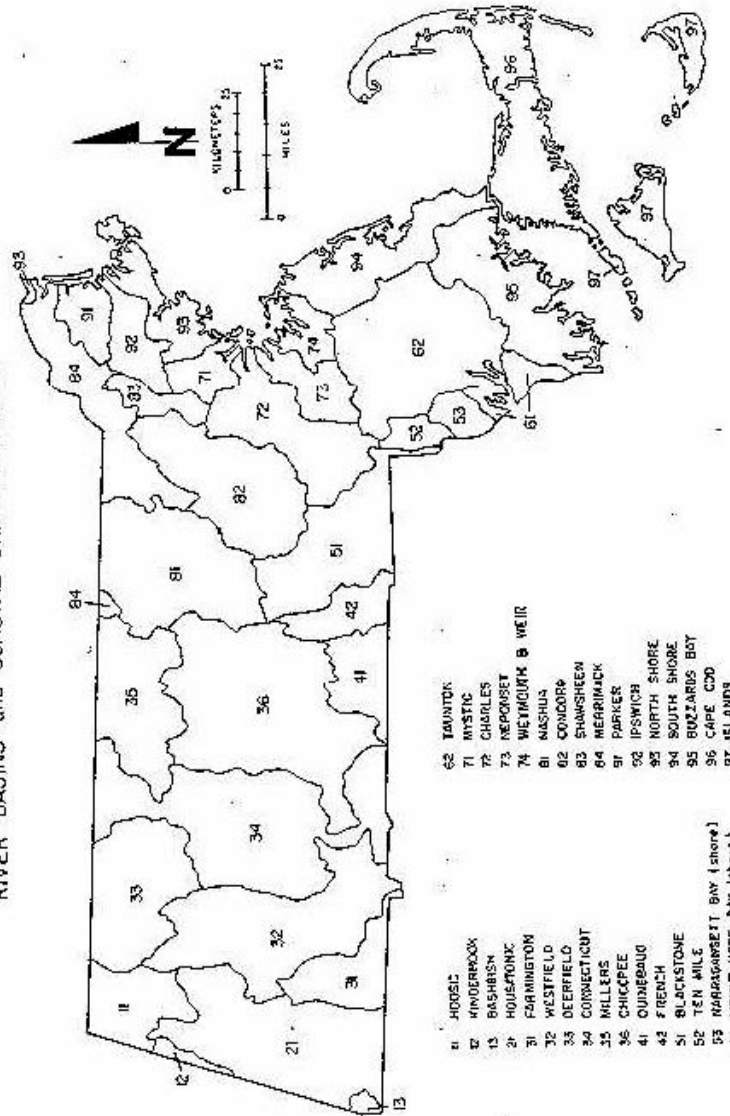
In March of 2006, MassDEP developed and received EPA approval for a Program Quality Assurance Project Plan that covers all projects that do not have a sampling component. The Program QAPP applies to implementation projects beginning in FFY 2006, as well as some projects from previous years. Therefore, most 319 funded projects no longer

require a project-specific Quality Assurance Project Plan. However, an Operation and Maintenance Plan is required for each implementation project.

Final reports for completed projects are available from the Division of Watershed Management, Massachusetts Department of Environmental Protection, 627 Main Street, Worcester, MA 01608, 508-792-7470.

The Massachusetts river basins used in watershed planning are illustrated in Figure 1. Table 1 shows a comparison between the total number of projects funded through the 319 program in each basin, and the total project costs in each basin since the inception of the program in 1990. Indicative summaries are presented in numerical order rather than by the fiscal year in which the project was selected.

COMMONWEALTH of MASSACHUSETTS
RIVER BASINS and COASTAL DRAINAGE AREAS



**MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION
Number of 319 Projects and Allocation of Funds by Basin (1990-2010)**

Table I

<u>Basin Name</u>	<u>Number of Projects</u>	<u>Dollars Allocated (match plus 319 funds)</u>
Hudson	0	\$0
Housatonic	15	\$2,855,817
Deerfield	2	\$62,500
Westfield	4	\$998,170
Farmington	4	\$173,200
Connecticut	13	\$2,972,308
Millers	2	\$704,330
Chicopee	7	\$1,035,190
Quinebaug	2	\$467,080
French	0	\$0
Nashua	11	\$2,835,230
Blackstone	9	\$2,257,010
Merrimack	5	\$620,600
Concord (SuAsCo)	9	\$1,274,450
Shawsheen	1	\$159,650
Parker	1	\$88,300
Ipswich	4	\$1,162,420
N Coastal	4	\$453,600
Boston Harbor	11	\$2,553,730
Charles	11	\$2,587,947
South Coastal	21	\$5,391,890
Cape Cod	17	\$3,152,553
Islands	2	\$218,600
Buzzards Bay	22	\$3,504,493
Taunton	3	\$146,800
Narr Bay & Mt Hope	0	\$0
Ten Mile	1	\$260,800
Statewide	47	\$5,926,472
TOTAL	228	\$41,863,140

Notes:

- Where projects encompass more than one basin, the grant allocation has been divided evenly among basins.
- Dollar amounts shown are total project costs and include 40% non-federal matching funds.
- All dollar amounts are rounded to the nearest \$10.

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 01-27/319

PROJECT TITLE: Beaver Brook Culvert Rehabilitation and Improvements to Beaver Brook Park
NPS CATEGORY: Resource Restoration
INVESTIGATOR: City of Worcester
LOCATION: Blackstone Basin

DESCRIPTION:

This project will offset construction costs related to the stream restoration (daylighting) of approximately 1,175 linear feet of Beaver Brook within Beaver Brook Park. This is part of a larger project that will improve recreational fields within the park. Beaver Brook Park is located within a 100-year flood plain associated with Beaver Brook, which is currently culverted. During storm events, the water surface within a failed portion of the existing culvert overflows through the lower sidewalls adjacent to the playing fields, resulting in flooding. The functional value of the water resource is extremely limited due to its culverted state, and it primarily serves as a conduit for water flow. Beaver Brook is listed as a Category 5 water, impaired by habitat alteration, pathogens, and objectionable deposits.

The goal is to improve water quality by exposing the stream to air and sunlight. The project will result in approximately 1,175 linear feet of open channel and new bank, with significantly improved wildlife habitat values.

Stream daylighting will include excavation and removal of approximately 1,175 linear feet of culvert to create an open channel. The new channel will be 16 feet wide at its base and will be constructed with stone and habitat structures to encourage the development of meanders. The wetland shelf and upland side slope will be vegetated with native plants appropriate to the newly created habitat. The stream daylighting and related reconstruction of the floodplain will result in flood mitigation and improved habitat and water quality as follows:

- The banks and open channel will allow for free groundwater discharge to the brook, thereby reducing the water temperature and allowing more dissolved oxygen in the water
- Dissolved oxygen will also be increased by exposure to wind and turbulence from cascading over instream stones
- The banks will be partially vegetated, thereby improving slope stability and wildlife habitat.
- Vegetation on the banks will shade and cool the water
- Vegetated banks will also improve water quality by providing a buffer to slow and treat NPS pollutants carried by runoff

The project will be evaluated through development and implementation of a MassDEP- and EPA-approved QAPP.

PROJECT COST: \$ 433,334

FUNDING: \$ 260,000 by the U.S. EPA
\$ 173,334 by the City of Worcester

DURATION: 2006 – 2009

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 02-12/319

PROJECT TITLE: Martins Pond Shoreline Restoration and Sediment Reduction Project
NPS CATEGORY: Resource Restoration
INVESTIGATOR: Town of North Reading
LOCATION: Ipswich Basin

DESCRIPTION:

Martins Pond is 303d listed for turbidity and noxious aquatic plants. Water clarity in the pond falls short of the minimum requirement for swimming, and a local beach that once offered swimming has been closed. The Pond is currently undergoing a diagnostic/feasibility study, funded through a 2005 Massachusetts Supplemental Budget award. While there are several factors contributing to the turbidity levels in the Pond, one obvious cause is the suspended sediment contributed by direct discharges and eroding shoreline.

With this project, the Town of North Reading will move forward with addressing several priority sources of suspended sediment. Structural Best Management Practices will be implemented at three priority sites, and several non- structural and outreach activities will also be conducted to mitigate the problem. Boat no-wake zones will be created and enforced, landowner Best Management Practices will be encouraged, and town policies will be reevaluated to maximize protection of the Martins Pond shoreline.

Project tasks include:

1. Structural Best Management Practices for erosion control at Traveled Way and Poplar Terrace;
2. Construction of a rain garden at Clarke Park;
3. Creation of no-wake zones;
4. Noxious aquatic plant harvesting;
5. An operation and maintenance plan for the Best Management Practices; and
6. Outreach and technology transfer to encourage good homeowner practices.

PROJECT COST: \$384,920

FUNDING: \$ 218,600 by the U.S. EPA
\$ 13,600 by shoreline property owners
\$152,720 by the Town of North Reading

DURATION: 2006 – 2009

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 02-13/319

PROJECT TITLE: Mill Creek Estuary Stormwater Mitigation
NPS CATEGORY: Urban Runoff
INVESTIGATOR: Town of Sandwich
LOCATION: Cape Cod Basin

DESCRIPTION:

This project will remediate pathogenic contamination within the Mill Creek Estuary as recommended in the Mill Creek Assessment Report of 2003 funded under the Coastal Pollution Remediation Program (CPR). Specifically, the proposed project will provide for the design and construction of BMPs that mitigate stormwater discharges from six subdrainage basins and eight outfalls into the Mill Creek Estuary. The project is a natural follow-on to prior work completed on five outfalls discharging from the Town Neck area into Mill Creek, funded under CPR between 2000 and 2002.

The proposed project is organized to be completed in two Phases over a six-year period to enable the Town to meet its funding obligations in a manageable way. This proposal is for Phase 1, the first three years of work. A proposal for Phase 2 will be made three years hence.

The overarching objective is to enable the reopening of Sandwich Harbor, an 88-acre shellfishing area impacted by Mill Creek (Marine Fisheries designation CCB:37). The objective for Phase 1-Year 1 is to complete the design and construction necessary to mitigate two sites in Subbasin 7. The balance of Subbasin 7 and all of Subbasin 6 will be completed in Phase 1-Year 2. The objective for Phase 1 -Year 3 is to design and construct mitigation systems serving Subbasin 4. The remaining sites will be mitigated in a similar manner during Phase 2. This project will address activities consistent with the Massachusetts Watershed-Based Plan and the Massachusetts NPS Management Plan. While the project will complement the Town's Phase II program, none of the activities proposed are required by the permit.

PROJECT COST: \$ 425,518
FUNDING: \$ 255,300 by the U.S. EPA
\$ 170,218 by the Town of Sandwich
DURATION: 2007 – 2010

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 04-16/319

PROJECT TITLE: Tree Box Filters as a Tool for Implementing the Neponset Bacteria TMDL
NPS CATEGORY: Urban Runoff
INVESTIGATOR: Neponset River Watershed Association
LOCATION: Boston Harbor Watershed/Neponset

DESCRIPTION:

Despite tremendous improvements in water quality along the Neponset River in the last two decades, much of the Neponset River and many of its tributaries continue to fall short of their designated standards for primary and secondary recreational contact because of bacteria related to pet waste, wildlife and other sources entering the river from stormwater runoff. In response to these continued problems, a TMDL has been developed which cites Nonpoint sources in urban runoff as a major contributor of the bacteria.

This project will partially implement the Neponset River Watershed bacteria TMDL by retrofitting an existing "curb and catch basin" drainage system in the Central Crossing neighborhood of Milton using tree filter boxes. Tree filter boxes are prefabricated bioretention cells that can be readily integrated into existing streetscapes with minimal engineering and permitting costs. Research on bioretention and tree filter boxes has indicated that fecal coliform removal rates will be 80% or higher. The project goal is to reduce bacterial loading to Pine Tree Brook and the lower Neponset River while raising awareness of tree filter boxes as a cost- and value-effective means of addressing the widespread problem of bacteria from untreated stormwater runoff in the Neponset Basin.

The anticipated environmental results include an 80%+ reduction in bacteria, nutrient, and sediment loading from urban runoff in the treated drainage system. A modest reduction in total runoff volumes and corresponding increase in groundwater recharge and stream base flow is also expected. Substantial technology transfer and public education benefits are expected as well.

Project tasks include:

1. Development of a MassDEP and EPA Approved Quality Assurance Project Plan;
2. Implementation of nineteen tree box filters;
3. Development of an Operations and Maintenance Plan; and
4. A public Education and Outreach program.

PROJECT COST: \$ 221,309

FUNDING: \$ 132,433 by the U.S. EPA
\$ 7,755 by NepRWA
\$ 81,121 by the Town of Milton

DURATION: 2006 – 2009

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 04-17/319

PROJECT TITLE: Erosion and Sediment Control and Stormwater Management at Construction Sites using
Soils- and Compost-Based Best Management Practices
NPS CATEGORY: Urban Runoff
INVESTIGATOR: Patriot Resource Conservation and Development Area Council, Inc.
LOCATION: Charles River Basin

DESCRIPTION:

Statistics from the US EPA show that sediment loads from construction activities are among the greatest compared to other land uses and activities. Assessments have documented that a construction site of 4.75 acres where 4.2 percent of the site is disturbed will increase the sediment yield three fold above natural levels. The goal of this project is to demonstrate and help institutionalize the use of compost and amended soil BMPs for erosion and sediment control and stormwater runoff at active construction sites. This will be done by employing these BMPs at a redevelopment project and comparing the methods with more traditional practices.

The Olmsted Green mixed use development project at the former Boston State Hospital in Mattapan will be the site of this project. This property is within a highly urbanized area of the Charles River basin. During the redevelopment project, soil and compost-based erosion controls will be employed side-by-side with standard BMPs such as geosynthetic silt fence and hay bales, to determine and demonstrate the effectiveness of the compost-based BMPs for erosion control. Extensive outreach and education will be conducted concurrently to encourage more widespread use of compost BMPs. Target audiences include construction companies, land developers, stormwater permitting agencies and other stakeholders involved or interested in construction and development. Findings will be disseminated through publications and presentations.

The targeted pollutant is sediment. The project will be evaluated through development and implementation of a MassDEP- and EPA-approved QAPP.

PROJECT COST: \$ 440,492

FUNDING: \$ 229,881 by the U.S. EPA
\$ 210,611 non-federal match from the following sources:

\$ 2,160 WeCare Organics	\$ 2,050 Kuhn-Knight
\$ 9,255 Apple D'Or Tree, Inc.	\$ 2,000 BioCycleMagazine
\$ 101,778 Lena New Boston	\$ 5,180 Patriot RC&D
\$ 9,085 New Ecology Inc.	\$ 5,000 Roto-Mix
\$ 4,600 Vanasse Hangen Brustlin, Inc	\$ 2,050 Pro-Bark, Inc.
\$ 19,930 City Soil and Greenhouse Co.	
\$ 18,000 Boston Public Works Department	
\$ 9,965 Soil and Water Quality Alliance	
\$ 9,703 Massachusetts Audubon	
\$ 8,910 Suffolk Conservation District	
\$ 525 Boston Parks and Recreation Department	
\$ 420 Boston Conservation Commission	

DURATION: 2006 – 2009

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 04-18/319

PROJECT TITLE: Bare Hill Pond III
NPS CATEGORY: Urban Runoff
INVESTIGATOR: Town of Harvard
LOCATION: Nashua Basin

DESCRIPTION:

Bare Hill Pond in Harvard, Massachusetts is a 321-acre, municipally managed pond in the Nashua Watershed. The watershed is moderately developed, although it maintains the rural nature of the community due to largely forested environs. The pond was originally 200 acres surrounded by pasturelands. In 1838, the pond was dammed, bringing it to its present size. The damming of the pond, the prior surrounding agricultural land uses and more recent residential development have brought the pond to its present day condition.

The pond suffers from extensive growths of invasive plants such as variable milfoil, water chestnuts, water lilies, fanwort, smartweed, and pondweed. The pond has elevated phosphorous levels which exacerbate the macrophyte growth, and a TMDL for phosphorus has been developed. Accelerated eutrophication and extensive prevalence of invasive aquatic plants seriously interfere with recreational uses and wildlife habitats. Two previous 319 projects, 03-05/319 and 08-04/319, have begun to implement BMPs to address water quality impairments in Bare Hill Pond.

The goal of this project is to continue implementing the TMDL by: (1) reducing the current levels of NPS phosphorus pollution; and (2) reducing the existing biomass of noxious aquatic plants. Phosphorus reduction will be accomplished through (1a) implementation of six watershed BMPs to provide LID treatment of stormwater inflows and (1b) excavation of phosphorus-enriched sediments. Invasive weed reduction will be accomplished through (2a) monitored winter drawdowns and (2b) harvesting. This project also includes an extensive outreach and education component to engage watershed abutters and encourage adoption of BMPs to reduce nutrient loading from their properties into the Pond.

PROJECT COST: \$ 497,463
FUNDING: \$ 294,000 by the USEPA
\$ 203,463 by the Town of Harvard
DURATION: 2010 – 2013

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 05-04/319

PROJECT TITLE: Operation and Maintenance of the Massachusetts Alternative Septic System Test Center and Investigation into Onsite Treatment of Endocrine-Disrupting Compounds
NPS CATEGORY: Land Disposal
INVESTIGATOR: Barnstable County Dept. of Health and the Environment
LOCATION: Statewide

DESCRIPTION:

The Massachusetts Estuaries Program (Project 01-26/319) is in the final phase of developing Total Maximum Daily Load (TMDL) allocations for nitrogen in some marine estuaries in Barnstable County. As implementation strategies begin to be developed in Barnstable County and elsewhere, the question remains as to whether innovative/alternative septic systems can provide an enhanced level of treatment that will help provide the necessary pollutant load reductions to meet TMDL goals.

The Massachusetts Septic System Test Center serves as a resource for quality third-party performance information regarding advanced onsite septic system technologies. In addition, the existence of the Test Center promotes the trial of new technologies to reduce nitrogen and phosphorus from wastewater. This continuing project endeavors to support the state's TMDL program by providing environmental decision makers with the tools by which the goals of the TMDL program can be achieved, especially where wastewater is a major source of pollutant loading. The project proposes to continue the ongoing work of the MASSTC.

In addition to nitrogen, another emerging concern of onsite wastewater disposal is the treatment of pharmaceuticals and personal care products (PPCPs) and their possible role in the disruption of normal endocrine functions in humans and wildlife. Initial data taken from beneath standard the Title 5 system and the recirculating sand filter systems at the MASSTC suggest that these systems may not adequately treat for PPCPs.

A study will be conducted to develop information vital to decision makers involving the effectiveness of onsite systems for treatment of these potentially endocrine disrupting compounds. The project will be evaluated through development and implementation of a MassDEP- and EPA-approved Quality Assurance Project Plan (QAPP).

Project tasks include:

1. Development of a Quality Assurance Project Plan;
2. Conducting facility operations;
3. Synthesizing data derived from testing new systems;
4. Evaluating PPCP treatment;
5. Reporting on test results; and
6. Outreach and education through published articles and facility tours.

PROJECT COST: \$ 256,361

FUNDING: \$ 153,611 by the U.S. EPA
\$ 102,750 by various onsite system vendors

DURATION: 2006 – 2009

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 05-05/319

PROJECT TITLE: Drumlin Farm Nonpoint Source Stormwater Management Project
NPS CATEGORY: Agricultural Runoff
INVESTIGATOR: Massachusetts Audubon Society, Inc.
LOCATION: Charles River Basin

DESCRIPTION:

Drumlin Farm Wildlife Sanctuary in Lincoln is the Massachusetts Audubon Society's flagship sanctuary. The farm property includes 232 acres of fields, forests, and ponds, highlighted by a working farm complex. Drumlin Farm has as many as 150,000 visitors per year.

A pond on the property serves as an important educational resource for thousands of students, educators and parents who come to the Farm each year to learn about pond organisms and ecology. Runoff from the main farm complex, including pens and pastures for poultry and livestock, drains via overland flow into the pond. Runoff from adjacent Route 117 also carries pollutants into the pond. The overload of sediment, nutrients and bacteria from these combined sources causes increasing sedimentation, elevated coliform levels, and algal blooms, impairing the habitat of the pond and limiting its usefulness as a unique resource and teaching tool.

Best Management Practices designed to treat agricultural runoff will be constructed to retain, treat and disperse the runoff from the farm area concurrently with construction of a new farm building. Educational and interpretive resources will also be created to inform the general public and potential BMP users about the water quality improvement practices being put into place. Pollutants of concern are pathogens, nutrients, and total suspended solids. The project will be evaluated through development and implementation of a MassDEP- and EPA-approved QAPP.

PROJECT COST: \$ 49,990

FUNDING: \$ 29,994 by the U.S. EPA
\$ 19,996 by Massachusetts Audubon Society Inc.

DURATION: 2006 – 2009

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 05-06/319

PROJECT TITLE: Pembroke LID Retrofit Implementation Project
NPS CATEGORY: Urban Runoff
INVESTIGATOR: North and South Rivers Watershed Association
LOCATION: South Coastal Watershed

DESCRIPTION:

The Town of Pembroke is one of many rapidly growing communities in the south coastal area. It currently has 4 waterbodies listed as Category 5 waters on the MA Year 2002 Integrated List of Impaired Waters. Impairments include organic enrichment, low dissolved oxygen, nutrients, pathogens, and metals. Additionally, Pembroke has 3 waterbodies listed as impaired by exotic species. Previous studies have indicated that nonpoint source pollutants are one of the greatest factors impacting water quality in the listed waterbodies.

The goal of this project is to improve water quality and enhance groundwater levels through the implementation of Low Impact Development (LID) Best Management Practices (BMPs). LID is a design strategy that seeks to maintain or replicate the pre-development hydrology on a site.

The project will focus on retrofitting the Town Hall and the Oldham Pond Boat Ramp with Low Impact Development (LID) techniques to help improve water quality. LID BMPs to be utilized include rain gardens, leaching catch basins, permeable pavers, and grassed level spreaders.

Tasks include

1. Development of a MassDEP and EPA Approved Quality Assurance Project Plan;
2. Implementation of LID retrofit BMPs;
3. Development of an Operations and Maintenance Plan;
4. A public Education and Outreach program; and
5. Continuation of the Greenscapes Program.

Anticipated pollutant load removals per year:

- 18,730 lbs. of total suspended solids
- 2 lbs. total phosphorus
- 17 lbs. nitrogen
- 5 lbs. metals
- 100% bacteria removal

PROJECT COST: \$ 271,924

FUNDING: \$ 160,800 by the U.S. EPA
\$ 111,124 by the Town of Pembroke

DURATION: 2006 – 2009

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 05-07/319

PROJECT TITLE: Kingston Elementary School LID Retrofit Implementation Project
NPS CATEGORY: Urban Runoff
INVESTIGATOR: North and South Rivers Watershed Association
LOCATION: South Coastal Watershed

DESCRIPTION:

The Town of Kingston is one of many rapidly growing communities in the south coastal area. It currently has 3 waterbodies listed as Category 5 waters on the MA 2002 Integrated List of Impaired Waters, including the Jones River. Impairments include pathogens, turbidity and noxious aquatic plants. Additionally, Kingston has 3 listed waterbodies as Category 4C for exotic species. Previous studies of these impaired waters have clearly indicated nonpoint source pollutants to be one of the greatest sources of water quality problems in the watershed.

Low Impact Development (LID) is a design strategy with a goal of maintaining or replicating the pre-development hydrologic regime on a site. LID elements incorporate techniques that focus on stormwater storage, infiltration, and groundwater recharge. The proposed project will focus on retrofitting the Kingston Intermediate School with various LID techniques designed under a previous 319 project (04-03/319) to help improve the water quality of the Jones River Watershed and reestablish the site's natural hydrology.

Tasks include

1. Development of a MassDEP and EPA Approved Quality Assurance Project Plan;
2. Implementation of LID retrofit BMPs;
3. Development of an Operations and Maintenance Plan;
4. A public Education and Outreach program; and
5. Continuation of the Greenscapes Program.

Anticipated pollutant load removals per year:

1. 31,501 lbs. of total suspended solids
2. 23 lbs. total phosphorus
3. 180 lbs. nitrogen
4. 55 lbs. metals
5. 100% bacteria removal

PROJECT COST: \$ 254,732

FUNDING: \$ 152,780 by the U.S. EPA
\$ 101,952 by the Town of Kingston

DURATION: 2006 – 2009

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 05-08/319

PROJECT TITLE: Children's Wharf Project: Growing the Next Generation of Environmental Stewards
NPS CATEGORY: Urban Runoff
INVESTIGATOR: Boston Children's Museum
LOCATION: Boston Harbor

DESCRIPTION:

Since 2000, the Fort Point Channel has been the focus of significant attention within the City of Boston. As part of the Municipal Harbor Plan for the South Boston area, the Fort Point Channel was specifically called out as an area with great potential, launching an intensive and inclusive activation planning effort through the Boston Redevelopment Authority. During the planning of the Channel vision, it was quickly acknowledged that water quality is a key to realizing the potential of the Fort Point. Currently, the Fort Point Channel is listed as a Category 5 waterbody, impaired by priority organics and pathogens due to stormwater runoff and combined sewer overflows. With this project, the Boston Children's Museum will mitigate pollutants from stormwater runoff by incorporating Best Management Practices into the design and construction of a facility expansion and renovation project.

Project tasks will include construction of a green roof, stormwater reclamation system, rainwater harvesting, and other low-impact development practices to encourage infiltration and reuse of stormwater. An extensive public outreach and education task will include hands-on interactive displays, interpretive signage, and special programs to educate children, educators, and other adult caregivers about the new onsite stormwater management practices and the importance of individual actions and activities to improve water quality.

Pollutants of concern are total suspended solids, phosphorus, and pathogens. The project will be evaluated through development and implementation of a MassDEP- and EPA-approved QAPP.

PROJECT COST: \$ 833,334

FUNDING: \$ 500,000 by the U.S. EPA
\$ 333,334 by the Boston Children's Museum

DURATION: 2006 – 2009

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 05-09/319

PROJECT TITLE: Old Oaken Bucket Pond Watershed NPS Improvements
NPS CATEGORY: Urban Runoff, Water Supply Protection
INVESTIGATOR: Town of Scituate
LOCATION: South Coastal Basin

DESCRIPTION:

Old Oaken Bucket Pond, located in Scituate, MA is an Outstanding Resource Water and serves as the Town's primary drinking water supply. It is listed on the MA 303d List of Impaired Waters as Category 5 for noxious aquatic plants and turbidity. Old Oaken Bucket Pond serves as a source for the Herring River and ultimately the North River, both listed as impaired on the 303d list for pathogens. The majority of land within the watershed is zoned as residential with several areas zoned for commercial and industrial. Current imperviousness and increasing development pressures have become a threat to water quality, causing excessive sedimentation, nuisance aquatic plants and an increase in nutrient levels.

The goal of the project is to improve the water quality of Old Oaken Bucket Pond through the implementation of LID based BMPs within the watershed. BMPs will be used to improve the water quality flowing directly into Old Oaken Bucket Pond as well as help improve the quality of water feeding the Herring River and ultimately the North River.

Five locations have been selected within the Old Oaken Bucket watershed with LID elements/BMPs, focusing around the installation of multiple raingardens for stormwater control, treatment and infiltration of roadway runoff. Additional elements include an infiltration trench and the installation of several leaching catch basins. The proposed BMPs are expected to reduce nonpoint source pollutants currently entering Old Oaken Bucket Pond, its tributaries and ultimately the Herring River and North River. The proposed BMPs were also selected to showcase how LID elements can be incorporated to help improve a water supply source as well as treat municipal roadway runoff. The project will be evaluated through development and implementation of a MassDEP- and EPA-approved QAPP.

Based on land use factors, typical stormwater concentrations of pollutants, design characteristics and system removal efficiencies, the following estimated quantities of targeted pollutants can be removed:

- 82,128 lbs. of Total Suspended Solids per year
- 15 lbs. of Total Phosphorus per year
- 94 lbs. of Nitrogen per year
- 100% bacterial removal per year

PROJECT COST: \$ 250,128

FUNDING: \$ 148,778 by the U.S. EPA
\$ 101,350 by the Town of Scituate

DURATION: 2006 – 2009

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 05-10/319

PROJECT TITLE: Lake Shirley Low Impact Development Stormwater Improvement Project
NPS CATEGORY: Urban Runoff
INVESTIGATOR: Town of Lunenburg
LOCATION: Nashua Basin

DESCRIPTION:

Lake Shirley is a 354-acre great pond located within the Nashua River watershed in Lunenburg and Shirley, MA. Lake Shirley is an important ecological and recreational resource for the Town of Lunenburg and surrounding communities. The lake is on the Massachusetts Year 2002 Integrated List of Waters for impairments by noxious aquatic plants, turbidity, and exotic species. The Lake Shirley Improvement Corporation (LSIC) and the Town of Lunenburg have led an ongoing effort to assess and provide long-term solutions to the water quality and nuisance plant problems in the Lake.

Each element of this project has been designed to mitigate the identified impairments in Lake Shirley. The four major project goals are as follows:

- Reduce sediment and nutrient loading to Lake Shirley by installing a variety of Low Impact Development stormwater management controls throughout the watershed.
- Conduct a lake-level drawdown for nuisance plant control
- Develop a Lunenburg Best Development Practices Guidebook
- Provide public education outreach to watershed residents.

Tasks include

1. Development of a MassDEP and EPA Approved Quality Assurance Project Plan;
2. Implementation of LID BMPs at twelve sites;
3. Development of an Operations and Maintenance Plan;
4. Development of a Town of Lunenburg Best Development Practices Guidebook;
5. Continuation of a lake-level drawdown program;
6. A public Education and Outreach program; and
7. An aquatic vegetation survey program.

Targeted pollutants include sediments, nutrients, and nuisance aquatic plants. The project will be evaluated through development and implementation of a MassDEP- and EPA-approved QAPP.

PROJECT COST: \$ 148,030

FUNDING: \$ 87,370 by the U.S. EPA
\$ 27,500 by the Lake Shirley Improvement Committee
\$ 23,300 by private contractors
\$ 9,960 by the Town of Lunenburg

DURATION: 2006 – 2009

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 05-11/319

PROJECT TITLE: Congamond Lakes FFY 06
NPS CATEGORY: Urban Runoff
INVESTIGATOR: Pioneer Valley Planning Commission
LOCATION: Westfield Basin

DESCRIPTION:

The Congamond Lakes are comprised of three interconnected ponds: North Pond, Middle Pond, and South Pond. The lakes are located in the Westfield river watershed in Southwick, Massachusetts, with the eastern shores of Middle and South Ponds forming the Connecticut state border. Southwick has evolved from a rural farming community to a bedroom community over the past twenty years, and the shoreline of the Ponds has become densely developed. The Ponds are listed in the Massachusetts Integrated List of Waters under Category 4c, impaired by nuisance aquatic weeds.

With this project, Southwick will continue its ongoing efforts to address the water quality problems in the Lakes. A previous 319 project (02-03/319) implemented recommendations of a 1983 Diagnostic Feasibility Study to reduce phosphorus loading in the Middle Pond. The current project will undertake similar work on four additional subwatersheds on Middle Pond, with a goal of reducing sediment loading and associated pollutants as well as invasive weed populations.

Tasks include

1. Development of a MassDEP and EPA Approved Quality Assurance Project Plan;
2. Implementation of BMPs in four subwatersheds;
3. Development of an Operations and Maintenance Plan;
4. A public Education and Outreach program; and
5. An aquatic weed management program.

PROJECT COST: \$ 354,480

FUNDING: \$ 212,500 by the U.S. EPA
\$ 139,400 by the town of Southwick
\$ 2,580 by the Lake Management Committee

DURATION: 2006 – 2009

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 05-12/319

PROJECT TITLE: Manchaug Pond NPS Improvement Project
NPS CATEGORY: Resource Restoration
INVESTIGATOR: Manchaug Pond Association
LOCATION: Blackstone Basin

DESCRIPTION:

Manchaug Pond is a 344-acre Great Pond located in Sutton and Douglas. The Pond is 303d listed, impaired by organic enrichment, low dissolved oxygen, and noxious aquatic plants and exotic species. Manchaug Pond directly feeds the Mumford River, which leads to the Blackstone River; both rivers are also 303d waterbodies. The Manchaug Pond watershed is dominated by shoreline residential homes and camps, with a large amount of privately owned open space and agricultural land in the upper watershed.

Sediment and erosion are targeted as primary causes of water quality problems in the Pond. The project will implement Best Management Practices to control roadway runoff at five prioritized sites identified in a recent watershed survey. The Manchaug Pond Association will also undertake a substantial outreach and education program to encourage homeowner and agricultural Best Management Practices.

Project tasks include:

1. Design and construction of roadway Best Management Practices;
2. Outreach to homeowners to encourage septic maintenance;
3. Outreach to horse owners within the watershed to encourage good horsekeeping practices; and
4. An educational display about the benefits of Low Impact Development;

PROJECT COST: \$ 219,370

FUNDING: \$ 129,250 by the U.S. EPA
\$ 90,120 by the Towns of Sutton and Douglas

DURATION: 2006 – 2009

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 06-01/319

PROJECT TITLE: Orange Riverfront Park: Using Low Impact Development Techniques to Manage
Stormwater Runoff
NPS CATEGORY: Urban Runoff
INVESTIGATOR: Town of Orange
LOCATION: Millers Basin

DESCRIPTION:

Urban Runoff discharges from stormwater outfalls are the single largest source of pollution responsible for water quality problems in many of the rivers, streams, and lakes in the state. Recent assessment projects conducted for the Millers River watershed have identified stormwater as a major contributor of nonpoint source pollution.

The purpose of this project is to introduce local officials in the Town of Orange to an alternative to the conventional 'pipe and pond' approach to stormwater management – Low Impact Development (LID). LID is an ecologically-based approach to stormwater management that creates a hydrologically functional landscape, which generates less surface runoff and less nonpoint source pollution. This is especially important for development projects that are adjacent to sensitive resource areas. The project will create an outdoor LID classroom, showcasing several different LID techniques including porous pavement, rain barrels, bioretention cells, and rain gardens. Stormwater will infiltrate back into the ground, removing pollutants and recharging groundwater.

The site is a .72-acre former brownfields parcel adjacent to the Millers River that is being developed into a Riverfront Park. Interpretive signs will be installed to inform visitors about the LID features and functions, and will be used as a demonstration site to encourage others to implement similar LID practices in other areas.

Project tasks include

1. Development of a MassDEP and EPA Approved Quality Assurance Project Plan (QAPP);
2. Installation of LID BMPs;
3. Development of an Operation and Maintenance Plan; and
4. A public outreach and education program

PROJECT COST: \$ 376,388

FUNDING: \$ 224,600 by the U.S. EPA
\$ 151,788 by the Town of Orange (anticipated Urban Self-Help funds)

DURATION: 2006 – 2009

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 06-04/319

PROJECT TITLE: Oak Hill Tributary Improvement Project
NPS CATEGORY: Resource Restoration
INVESTIGATOR: City of Pittsfield
LOCATION: Housatonic Basin

DESCRIPTION:

Unkamet Brook is a tributary to the East Branch of the Housatonic River. The stream channel is choked with sediment that impedes the flow of water, resulting in stagnant pools that increase water temperature, facilitate algae blooms, and decrease water clarity and quality. During storm events, the build up sediment impedes flow, causing channel erosion, damage to roads and property, and localized flooding.

Using a watershed-wide approach, the project will install Best Management Practices throughout the Unkamet Brook watershed to mitigate the impacts of stormwater runoff that are causing the serious flooding and erosion problems with accompanying downstream buildup of sediment throughout the adjacent residential neighborhoods. An outreach program will focus on protection and preservation of riparian zones on adjacent properties, to help stabilize the stream channel and address water quality issues.

Project tasks include:

1. Final design, engineering, and implementation of Best Management Practices;
2. Securing legal easements from affected abutters; and
3. Outreach and education to watersheds residents to encourage good homeowner practices, riparian buffers, and Low Impact Development Best Management Practices.

PROJECT COST: \$474,600

FUNDING: \$ 207,000 by the U.S. EPA
\$ 267,600 by the City of Pittsfield

DURATION: 2006 – 2009

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 06-05/319

PROJECT TITLE: First Herring Brook Low Impact Development Stormwater Enhancements
NPS CATEGORY: Resource Restoration
INVESTIGATOR: Town of Scituate
LOCATION: South Coastal Basin

DESCRIPTION:

Old Oaken Bucket, the Town of Scituate's main drinking water supply, lies within the First Herring Brook watershed and is listed on the Final Massachusetts 2002 Integrated List of Waters as a Category 5 waterbody, impaired by noxious aquatic plants, turbidity, and nutrients. Also in the First Herring Brook watershed, the Herring and North Rivers are listed for pathogens, and Tack Factory Pond is Category 3 listed for exotic species. The watershed has been a MassDEP priority since the 1996 South Coastal Watershed Resource Restoration Report. Since that time, several implementation projects, including several funded by MassDEP's Source Water Assessment Program and the 319 program, have been undertaken by the Town to address surface water quality problems in the watershed.

This is one of two recommended FFY 07 projects submitted by the town of Scituate for work that will improve water quality in the First Herring Brook watershed. This project will reduce urban stormwater runoff through the installation of stormwater devices and Low Impact Development Best Management Practices at eight locations around Tack Factory Pond. The work will expand upon previous and ongoing work by supplementing the existing stormwater drainage with Low Impact Development retrofits in the upper reaches of the watershed.

Project tasks include:

1. Design and installation of Low Impact Development Best Management Practices at priority outfalls;
2. Infiltrate stormwater in the upper reaches of the watershed; and
3. Provide education and outreach to residents and stakeholders in the First Herring Brook watershed.

PROJECT COST: \$ 429,700

FUNDING: \$ 256,500 by the U.S. EPA
\$ 173,200 by the Town of Scituate

DURATION: 2006 – 2009

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 06-06/319

PROJECT TITLE: Herring River Coastal Low Impact Development Project
NPS CATEGORY: Resource Restoration
INVESTIGATOR: Town of Scituate
LOCATION: South Coastal Basin

DESCRIPTION:

The Old Oaken Bucket Reservoir is impaired by noxious aquatic plants. Together with the Tack Factory Pond and surrounding watersheds, the Reservoir is a drinking water supply protected under the Town's Water Resources Protection District. This project builds upon two previous 319 projects (98-08/319 and 05-09/319) as part of an overall strategy to improve water quality in the First Herring Brook watershed, and is synergistic with the First Herring Brook Low Impact Development Stormwater Enhancement Project, also funded in FFY 2007.

The goal of the project is to reduce NPS pollution in the Herring and North Rivers. Two Best Management Practices will be installed to aid in the treatment of stormwater, reduce runoff, promote infiltration and enhance groundwater recharge near Driftway Park. Pet waste from the dog park will be targeted through an outreach and education program, and the Greenscapes and Think Blue programs will be presented to watershed stakeholders.

Project tasks include:

1. Design and implementation of Best Management Practices including pervious pavement, outlet stabilization, and rain gardens;
2. A Greenscapes demonstration garden;
3. Installation of Think Blue signage throughout Driftway Park; and
4. Outreach and education to encourage proper pet waste disposal.

PROJECT COST: \$183,274

FUNDING: \$ 108,760 by the U.S. EPA
\$ 74,514 by the Town of Scituate

DURATION: 2006 – 2009

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 06-07/319

PROJECT TITLE: Reducing NPS from Equine Facilities
NPS CATEGORY: Agriculture
INVESTIGATOR: UMass Amherst
LOCATION: Statewide

DESCRIPTION:

Agricultural activities are generally recognized as one major cause of nonpoint source pollution, and horse owners represent an important component of commercial and recreational animal agriculture in Massachusetts.

The goal of this project is to reduce the risk of nonpoint source pollution from equine facilities through education and demonstration of best management practices for nutrient management. The project follows on several previous and ongoing grants to UMass that have developed and facilitated nutrient best management practices for a variety of agricultural activities to address TMDL recommendations and issues. This project targets equine operations, a new area of endeavor for UMass Extension and one that has traditionally fallen outside the scope of agricultural technical providers.

Project tasks include:

- Establishment of an equine advisory committee;
- Implementation of demonstration Best Management Practices at three or more equine facilities;
- Workshops and on-farm demonstrations; and
- Development and distribution of educational materials and tools.

PROJECT COST: \$ 256,480

FUNDING: \$ 149,736 by the U.S. EPA
\$ 106,744 by UMass Amherst

DURATION: 2006 – 2009

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 06-08/319

PROJECT TITLE: Bedford NPS Project
NPS CATEGORY: Urban Runoff
INVESTIGATOR: Town of Bedford
LOCATION: Shawsheen Basin

DESCRIPTION:

The Shawsheen River is an important recreational and natural resource, although most reaches of the River are 303d listed as impaired by a multiplicity of causes including pathogens, nutrients, metals, and toxicity. The Bedford Engineering Department has identified and prioritized 18 subdivision cul-de-sacs that directly contribute untreated stormwater to the Shawsheen River. This project proposes to design and install raingardens at several cul-de-sacs to provide pollutant removal and infiltration at priority sites, and to serve as demonstration projects to facilitate rain garden installation at the remaining sites.

This proposal incorporates recommendations of the Shawsheen Bacteria TMDL. The goal of the project is to improve water quality in the Shawsheen River, and to improve local capacity to implement effective Low Impact Development Best Management Practices throughout a large area by encouraging technology transfer focused on rain gardens.

Project tasks include:

1. Design and implementation of rain gardens in priority cul-de-sacs;
2. Development and distribution of a design document to encourage the use of Low Impact Development Best Management Practices;
3. A storm drain marking program; and
4. Additional outreach and education aimed at good homeowner practices, especially pet waste management.

PROJECT COST: \$159,653

FUNDING: \$ 95,775 by the U.S. EPA
\$ 63,878 by the Town of Bedford

DURATION: 2006 – 2009

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 06-09/319

PROJECT TITLE: River Street Best Management Practice Implementation
NPS CATEGORY: Urban Runoff
INVESTIGATOR: Town of Ludlow
LOCATION: Chicopee Basin

DESCRIPTION:

Ludlow is located on the north side of the Chicopee River, with several areas of dense development adjacent to the River. The Chicopee River is 303d listed for pathogens in several of its segments in Ludlow. The Ludlow DPW has identified priority areas that are contributing untreated stormwater to the River. For this project, the Town of Ludlow will treat discharges originating from the priority River Street area that are impacting the Chicopee River. Structural Best Management Practices will be installed to treat all discharges in the target area near Town Hall and the Library. An infiltration bed and offline leaching structures will infiltrate runoff, and low-impact landscaping will be showcased as an outreach and educational task of the project.

The goal of the project is to improve the water quality of the Chicopee River by treating all stormwater generated from the subwatershed/catchment area.

Project tasks include:

1. Implement source reduction Best Management Practices in the River Street area;
2. Install and educate about Low Impact Development landscaping at the Town Hall; and
3. Present a permanent display at the Town Hall and Library on the topic of stormwater and nonpoint source pollution.

PROJECT COST: \$ 131,792

FUNDING: \$ 77,768 by the U.S. EPA
\$ 54,024 by the Town of Ludlow

DURATION: 2006 – 2009

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 06-10/319

PROJECT TITLE: Operation and Maintenance of the Massachusetts Alternative Septic System Test Center
NPS CATEGORY: Land Disposal
INVESTIGATOR: Barnstable County Dept. of Health and the Environment
LOCATION: Statewide

DESCRIPTION:

The Massachusetts Septic System Test Center serves as a resource for quality third-party performance information regarding advanced onsite septic system technologies. In addition, the existence of the Test Center promotes the trial of new technologies to reduce nitrogen and phosphorus from wastewater.

This continuing project supports the state's TMDL program by providing environmental decision makers with the tools with which the goals of the TMDL and the Massachusetts Estuaries programs can be achieved, especially where wastewater is a major source of pollutant loading. This project will continue the ongoing work of the MASSTC. Tasks include conducting facility operations, synthesizing data derived from testing of new systems, reporting on test results, and providing outreach and education at the test center through published reports and articles, and with the development and maintenance of a web site. The project will also develop a testing protocol for alternative soil absorption technologies (e.g., gravelless chambers, pipe-media matrices) to support MassDEP by providing a rational basis for approving various sizing or vertical setback credits.

PROJECT COST: \$ 210,531

FUNDING: \$ 105,871 by the U.S. EPA
\$ 104,750 by onsite system vendors

DURATION: 2007 – 2010

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 06-11/319

PROJECT TITLE: Operation and Maintenance of the Massachusetts Alternative Septic System Test Center
NPS CATEGORY: Outreach and Education
INVESTIGATOR: Barnstable County Dept. of Health and the Environment
LOCATION: Statewide

DESCRIPTION:

The Massachusetts Septic System Test Center serves as a resource for quality third-party performance information regarding advanced onsite septic system technologies. In addition, the existence of the Test Center promotes the trial of new technologies to reduce nitrogen and phosphorus from wastewater.

This continuing project supports the state's TMDL program by providing environmental decision makers with the tools with which the goals of the TMDL and the Massachusetts Estuaries programs can be achieved, especially where wastewater is a major source of pollutant loading. This project will continue the ongoing work of the MASSTC. Tasks include conducting facility operations, synthesizing data derived from testing of new systems, reporting on test results, and providing outreach and education at the test center through published reports and articles, and with the development and maintenance of a web site.

The project also investigates the claims of selected soil absorption system products to verify that their treatment for pathogens is commensurate with requested reductions in size and vertical separations. A standardized protocol for tests of this type will also be created for future use.

Finally, the project endeavors to add to the knowledge regarding emerging contaminants such as pharmaceuticals and personal care products by testing at least three removal strategies. Outreach components include publications, workshops, and conference presentations for individuals involved in wastewater planning and watershed protection.

PROJECT COST: \$ 210,581

FUNDING: \$ 101,243 by the USEPA
\$ 109,338 by various onsite system vendors

DURATION: 2009 – 2012

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 07-01/319

PROJECT TITLE: Stormwater and Low Impact Development Technology Transfer
NPS CATEGORY: Urban Runoff
INVESTIGATOR: UMass Amherst
LOCATION: Statewide

DESCRIPTION:

MassDEP and other state and local officials need verified information about the performance of stormwater treatment devices and techniques on which to base their permitting, regulatory, and resource protection activities. Information that is independent of manufacturers' literature is necessary in order for stakeholders and regulators to make informed decisions about optimal resource protection strategies.

This project follows on a current project, 04-02/319, which is developing a web-based technology transfer clearinghouse to help municipal officials and others gain access to current, credible information about stormwater technologies. This project will continue that work, and will add information about Low Impact Development Best Management Practices, including decision-making tools and guidance materials. The clearinghouse, which can be seen at www.mastep.com, has proven to be a valuable tool in providing an objective assessment of the capabilities of many of the stormwater devices currently on the market.

Project tasks include:

1. Maintain and enhance the current database and web site;
2. Assess and respond to user needs;
3. Expand the database to include low-impact development Best Management Practices; and
4. Perform outreach to the public through an organized distribution plan.

PROJECT COST: \$375,006

FUNDING: \$ 225,000 by the U.S. EPA
\$ 150,006 by UMass Amherst

DURATION: 2006 – 2009

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 07-02/319

PROJECT TITLE: Operation and Maintenance of the Massachusetts Alternative Septic System Test Center
NPS CATEGORY: Land Disposal
INVESTIGATOR: Barnstable County Dept. of Health and the Environment
LOCATION: Statewide

DESCRIPTION:

The Massachusetts Septic System Test Center serves as a resource for quality third-party performance information regarding advanced onsite septic system technologies. In addition, the existence of the Test Center promotes the trial of new technologies to reduce nitrogen and phosphorus from wastewater.

This continuing project supports the state's TMDL program by providing environmental decision makers with the tools with which the goals of the TMDL and the Massachusetts Estuaries programs can be achieved, especially where wastewater is a major source of pollutant loading. This project will continue the ongoing work of the MASSTC. Tasks include conducting facility operations, synthesizing data derived from testing of new systems, reporting on test results, and providing outreach and education at the test center through published reports and articles, and with the development and maintenance of a web site.

PROJECT COST: \$213,441

FUNDING: \$ 121,611 by the U.S. EPA
\$ 91,830 by onsite system vendors

DURATION: 2006 – 2009

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 07-03/319

PROJECT TITLE: Rockwell Pond Source Reduction Pilot Project
NPS CATEGORY: Urban Runoff
INVESTIGATOR: Massachusetts Watershed Coalition
LOCATION: Nashua Basin

DESCRIPTION:

The goal of this project is to reduce sources of sediment, phosphorus and bacteria which studies have identified as the pollutants that impair Rockwell Pond, Monoosnoc Brook, and the North Nashua River. The watershed remediation strategy will include: (1) installation of bioretention areas and source reduction practices; (2) installation of structural BMPs to treat storm drainage systems; (3) community education to enable source reduction and pollution prevention by homeowners, homebuilders, businesses, and municipal officials; and (4) preparation of an Operations and Maintenance Plan, including agreements by private and municipal owners to ensure the effective operation of all installed BMPs.

Project activities during the first year will install at least 5 demonstration rain gardens in visible locations; at least 8 bioretention areas in road right-of-ways; and at least 7 home rain gardens. Field inspections of first year practices will provide guidance for the siting and design of at least 20 additional bioretention areas, rain gardens, and storm drain system treatment BMPs to be installed in the second year. All proposed structural and non-structural BMPs are recommended by the MassDEP *Clean Water Toolkit* and *Massachusetts Watershed Based Plan*, as well as reports by consultants, community organizations, and the federal Natural Resources Conservation Service

PROJECT COST: \$ 429,250

FUNDING: \$ 205,050 by the U.S. EPA
\$ 220,950 by the City of Leominster
\$ 3,250 by the Massachusetts Watershed Coalition

DURATION: 2007 – 2010

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 07-04/319

PROJECT TITLE: Improving Water Quality in the Hamilton Reservoir Watershed
NPS CATEGORY: Urban runoff
INVESTIGATOR: Pioneer Valley Planning Commission
LOCATION: French & Quinebaug Watershed

DESCRIPTION:

Hamilton Reservoir is a 413-acre recreational impoundment forming the headwaters of the Quinebaug River located in Holland, Massachusetts and Union, Connecticut. Hamilton Reservoir is listed as a Category 4c Waters for exotic species on the Integrated List of Impaired Waters. Sediment infilling and nuisance aquatic plants (*Myriophyllum heterophyllum*) are impeding the ecological function of the reservoir and its recreational value. This situation has worsened dramatically since the problems were first documented in the 1983 Diagnostic Feasibility Study (D/F) performed by Cullinan Engineering Company.

This project will reduce sediment loading and associated pollutants to Hamilton Reservoir in the town of Holland, Massachusetts by implementing four structural BMPs in three subwatersheds documented for contributing excessive amounts of sediment loading; and, engage in extensive public outreach for the implementation of both structural and non-structural BMPs on residential properties. The proposed BMPs are at Steven's Brook, May Brook (#2 and #3), and Brandon Street.

The project goals are: 1) sediment loading and associated pollutants are reduced, 2) invasive aquatic weed populations continue to decrease, 3) sediment loading is reduced from targeted subwatersheds, 4) watershed residents are knowledgeable about residential landscaping techniques and maintenance protocols for a healthy lake and, 5) the Holland Highway Department implements an effective maintenance program for stormwater facilities.

PROJECT COST: \$380,380

FUNDING: \$ 228,450 by the U.S. EPA
\$ 139,050 by the Town of Holland
\$ 12,880 by the Hamilton Reservoir Association

DURATION: 2007 – 2010

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 07-05/319

PROJECT TITLE: Franklin Stormwater Retrofit Improvement Project
NPS CATEGORY: Urban runoff
INVESTIGATOR: Town of Franklin
LOCATION: Charles Basin

DESCRIPTION:

Like many communities throughout the Commonwealth, the Town of Franklin is experiencing development pressures and an increased level of imperviousness in many areas. Contaminated stormwater is a recurring issue. The Town has a number of waterbodies affected by contaminated stormwater, resulting in several of these waterbodies being listed on the 303(d) list of impaired water because they do not meet designated uses. Several of these resources are located within the watershed of the Charles River, which is also on the 303(d) list with draft phosphorous and pathogen TMDLs associated with it.

The goal of this program is to improve the water quality to impaired waters while developing typical or template BMPs for future projects that have been identified with similar needs. Tasks include

- Design and construct retrofits to existing drainage features and BMPs to enhance water quality with lower capital costs than new BMPs;
- Develop a variety of BMP retrofits for use with similar projects in the future; and
- Increase public awareness of non-point source pollution and stormwater management needs through classroom education and informational newsletters by DPW discussing the project and water quality benefits.

PROJECT COST: \$229,762

FUNDING: \$ 131,000 by the U.S. EPA
\$ 98,762 by the Town of Franklin

DURATION: 2007 – 2010

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 07-06/319

PROJECT TITLE: Stormwater BMP Implementation for Little Harbor
NPS CATEGORY: Urban Runoff
INVESTIGATOR: Town of Cohasset
LOCATION: South Coastal Basin

DESCRIPTION:

This Project will improve the water quality and protection of Little Harbor through the design, environmental permitting, and construction of stormwater control and treatment systems within the Little Harbor watershed in the Town of Cohasset. These designs will utilize structural best management practice (BMP) solutions and will incorporate low impact development (LID) strategies to contain and minimize runoff flows and nonpoint source pollution loading into Little Harbor. Structural BMP improvement options to be considered will include hooded catch basins, bioretention facilities, rain gardens, roadside swales with biofilters, and spill containment facilities. This Project includes on-going operation and maintenance and a public outreach and education component that will explain the Project and the effectiveness of stormwater BMPs to residents and encourage participation in reducing nonpoint source pollution.

This Project will also complement an on-going sewer construction project initiated by the Town of Cohasset and supported by the Commonwealth through a loan from the State's Revolving Fund (SRF) for wastewater infrastructure and water quality protection. By coordinating these projects, the reduction of onsite sewage disposal system source pollution and stormwater runoff nonpoint source pollution will result in a more effective "total solution".

The BMP controls will be sited in areas of concentrated stormwater runoff and will be designed to treat runoff prior to discharge into Little Harbor. The BMP controls will include low impact development (LID) techniques such as bioretention rain gardens and vegetated swales to be sited within public rights-of-way. A secondary goal of this Project is to implement a public outreach and education program for Cohasset residents. This program will inform residents of the proposed stormwater BMPs and of project progress. This program will also educate and encourage residents to participate in the reduction of NPS pollution by using innovative LID treatment systems

PROJECT COST: \$ 250,000
FUNDING: \$ 150,000 by the U.S. EPA
\$ 100,000 by the Town of Cohasset
DURATION: 2007 – 2010

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 07-07/319

PROJECT TITLE: Jackson Square LID Program
NPS CATEGORY: Urban Runoff
INVESTIGATOR: Jackson Square Partners LLC
LOCATION: Charles Basin

DESCRIPTION:

The Stony Brook, a Charles River tributary, does not meet water quality standards for organics, metals, nutrients, pathogens and other pollutants. Overflow of the Stony Brook Culvert is also a significant contributor to this water quality degradation in the Muddy River as well as the Lower Charles River Basin. Non-point source pollution from urban runoff is the primary source of pollution to the Stony Brook Culvert.

The Jackson Square Low Impact Development (LID) Program will reduce non-point source pollution from an 11-acre site in Roxbury/Jamaica Plain by using low impact stormwater management techniques in the redevelopment of this area, including green roofs on 75% of roof surfaces, bioswales and rain gardens. This Project is part of a larger effort to convert an underutilized brownfield site in one of Boston's poorest neighborhoods into a model of vibrant, 'super green', mixed-use, transit-oriented development that will include housing, retail and office space, and new community facilities – all adjacent to an MBTA station.

Low impact stormwater management is a key piece of the project's aggressive green development agenda, which also includes on-site renewable energy generation, green buildings, better access to alternative transportation, and extensive outreach and education about the projects green design elements to local residents and the development community.

PROJECT COST: \$350,000
FUNDING: \$ 200,000 by the U.S. EPA
\$ 150,000 by Jackson Square Partners
DURATION: 2007 – 2010

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 07-08/319

PROJECT TITLE: Onota Lake Preservation Project
NPS CATEGORY: Resource Restoration
INVESTIGATOR: City of Pittsfield
LOCATION: Housatonic Basin

DESCRIPTION:

Onota Lake is classified as mesotrophic and suffers from accelerated eutrophication. Onota Lake is listed as impaired by exotic species within the Final Massachusetts 2004 Integrated List of Waters under Category 4c. According to the Diagnostic / Feasibility Study for Onota Lake (IT Corp. 1991), the most pervasive cause of Onota Lake's problems stem from excessive sediment and nutrient loading. Watershed urbanization, agricultural practices and stormwater runoff have contributed to increased nutrient and sediment loading resulting in a decline in water quality, loss of fish habitat, and impaired use of the lake.

The goal of this project is to implement the recommendations of the *Onota Lake Long-Range Management Plan* by addressing the highest priority water quality impairments and the major sources of NPS within a Category 4c water body. Tasks include

- Increase the Capacity of Drawdown through Structural Modifications to the Onota Lake Dam: The Onota Lake dam is owned and operated by the City of Pittsfield. The City of Pittsfield has been authorized to conduct drawdowns up to 6 ft to improve the effectiveness of the weed control. The project will complete the construction of an additional low-level outlet pipe dam to augment existing drawdown capabilities.
- Install Stormwater BMPs at Burbank Park: Priority sites for stormwater management at Burbank Park were identified through prior projects conducted in partnership between the City, LOPA and BRPC. Stormwater best management practices were successfully installed at the top priority sites under the s.319 grant 00-01/319. The project will build on that prior effort by improving the quality of the existing drainage system at Burbank Park and will further reduce pollutants, sedimentation, and erosion at the lake.
- Monitoring & Project Evaluation: LOPA volunteers will continue to conduct water quality monitoring pursuant to the QAPP approved by EPA/MassDEP under 00-01/319.
- Education & Outreach: The City will partner with LOPA and BRPC to conduct a three pronged outreach and education approach aimed at homeowners, visitors and boaters. The project partners will utilize the principles of social marketing through a variety of different media including newsletters, websites, signs and television/radio.

PROJECT COST: \$456,200
FUNDING: \$ 268,700 by the U.S. EPA
\$ 187,500 by the City of Pittsfield
DURATION: 2007 – 2010

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 07-09/319

PROJECT TITLE: James Brook Urban Stormwater Improvements
NPS CATEGORY: Urban runoff
INVESTIGATOR: Town of Groton
LOCATION: Nashua Basin

DESCRIPTION:

The Town of Groton recently undertook a multi-phased effort to comprehensively revitalize and improve a dense mixed-use development area of Town called Station Avenue. Just outside of the center of town and within the James Brook Subwatershed of the Nashua River Basin, this area houses several high impervious industrial businesses. The Town has established a new Low Impact Development (LID) zoning overlay district and is in the process of establishing a LID bylaw specific to this section of town to encourage recharge and innovative stormwater management.

The proposed project will complement the above efforts already implemented by the Town by addressing nonpoint source issues within already developed areas of this priority subwatershed. Individual elements include:

- Addition of off-line leaching/deep sump catch basins along Main Street (Route 119 – maintained by the Town of Groton Highway Department), retaining sediment and significantly reducing storm surges to James Brook.
- Culvert improvement and stream channel restoration to the downtown outlet of James Brook, reducing total suspended solids and nutrient runoff downstream.
- Court Street pervious paver interceptor reducing nutrient, pathogen and sediment laden roadway runoff.
- Develop an updateable stormwater display with a schedule of monthly subtopics to be exhibited at the Groton Town Hall and Library.
- Implementation of various outreach efforts including construction of several residential LID elements along Court Street, installation of pet waste bag dispensers along the rail trail and updating of the rail trail kiosk also visible from Court Street and Station Avenue.

PROJECT COST: \$ 223,910

FUNDING: \$ 134,350 by the U.S. EPA
\$ 89,560 by the Town of Groton

DURATION: 2007 – 2010

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 08-01/319

PROJECT TITLE: Eel River Headwaters Restoration
NPS CATEGORY: Resource Restoration
INVESTIGATOR: Plymouth DPW
LOCATION: South Coastal Basin

DESCRIPTION:

The Eel River Headwaters Restoration project will convert abandoned cranberry bogs to wetland habitat, removing flow structures to restore the river channel thereby creating coldwater stream habitat and reducing nutrients in both freshwater and coastal systems. The restoration site is located within the Eel River Watershed, a sub-basin of the South Coastal Watershed. In 2005, the Town of Plymouth purchased 34 acres of bogs and 40 acres of upland at the headwaters of the Eel River south of Long Pond Road. The Town also owns an additional 100+ acres north of Long Pond Road connecting to Russell Mill Pond.

The abandoned bog system will be restored to a complex of natural wetlands including riparian wetlands, red maple swamp, Atlantic white cedar swamp and scrub-shrub wetlands. Approximately 1.25 miles of river channel will be restored by removing the Sawmill Pond Dam and earthen dams and dikes within the bog system. The removal of the earthen dams and the Sawmill Pond Dam will result in the restoration of fish passage and the restoration of 1,100ft of cobble-boulder stream as well as coldwater habitat restoration. The project will also result in an increased diversity of species (fish, mussels, macroinvertebrates) and will aid in the removal of excess nutrients from the Eel River system and ultimately Plymouth Harbor. This is a large project with several components and partners. 319 funding will implement the portion of the project that will remove of flow alterations (culverts, ditches, small dams) and restore of the river channel.

PROJECT COST: \$ 666,666

FUNDING: \$ 400,000 by the U.S. EPA
\$ 266,666 by the MassDEP Wetland Mitigation Fund

DURATION: 2007 – 2010

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 08-02/319

PROJECT TITLE: Lake Waushakum LID BMP Implementation Project
NPS CATEGORY: Urban runoff
INVESTIGATOR: Town of Ashland
LOCATION: Concord (SuAsCo) Basin

DESCRIPTION:

Waushakum Pond is located on the border of the towns of Ashland and Framingham. The pond is located in the headwaters of the Concord River Watershed (Major Basin SuAsCo – Concord) and is tributary to the Sudbury River. It is also one of Massachusetts' *Great Ponds*. The area around the pond is highly developed and receives stormwater discharge from a roadway collection system that currently provides little or no treatment. Waushakum Pond is currently listed on Massachusetts Department of Environmental Protection (MassDEP) Proposed Year 2006 Integrated Lists of Waters as Category 4c for "Impairment not Caused by a Pollutant." Two pond assessments and MassDEP's *SuAsCo Watershed 2001 Water Quality Assessment Report* have identified non-point source pollutants (TSS and phosphorous) as the major causes of impairment.

This project will utilize the information developed in these previous assessments, and will implement three priority Best Management Practices (BMPs) in the Pond's watershed. The proposed Low Impact Development (LID) BMPs include several tree bioretention facilities (raingardens), and the installation of permeable paving with the major project goals of reducing phosphorous, suspended solids and other non-point source pollutants, promoting recharge through infiltration, and replicating the area's natural hydrology. This project is the first phase of a multi phase project.

A decision matrix was used to evaluate potential BMP locations. Ten (10) locations were evaluated and the three (3) most promising were chosen. Once locations were determined, a second matrix was used to identify the best BMP per site. The selected BMPs are:

1. Site #1 - Installation of permeable paving at the boat launching area in Ashland to prevent significant sedimentation of the pond from ongoing erosion and untreated discharge of stormwater, and promotes stormwater recharge.
2. Site #2 and Site #10 - Installation of bioretention cells to capture, treat and infiltrate storm water. Bioretention has been shown to be extremely effective in reducing nutrient levels and sediment loading associated nonpoint source pollution. The bioretention cells will take the form of tree filters/rain gardens located near catch basins. Street trees will be planted in the tree filter along with perennials. Street trees will also help reduce thermal pollution associated with hot summer weather.

PROJECT COST: \$163,890

FUNDING: \$ 98,500 by the U.S. EPA
\$ 38,990 by the Town of Ashland
\$ 20,000 by the Town of Framingham
\$ 6,400 by volunteers

DURATION: 2007 – 2010

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 08-03/319

PROJECT TITLE: Brewster Stony Brook Road Stormwater Improvements
NPS CATEGORY: Implementation
INVESTIGATOR: Town of Brewster
LOCATION: Cape Cod Basin

DESCRIPTION:

The Stony Brook subwatershed in Brewster extends from headwaters in Walkers Pond and Slough Pond down through Upper Mill Pond, Lower Mill Pond, along Stony Brook, and then into Paines Creek, the tidal estuary of Stony Brook that discharges into Cape Cod Bay. There is a public swimming beach at Paines Creek Beach, and recreational swimming and boating are allowed in the four Great Ponds. The Stony Brook subwatershed and its tidal estuary contain regionally important shellfish and anadromous fish resources as well as rare species habitat. Existing impacts on this watershed include degraded water quality, untreated stormwater runoff, tidal restrictions and invasive plant species. Walkers Pond, Upper Mill Pond and Lower Mill Pond are currently listed on the Massachusetts Year 2006 Integrated List of Waters as Category 5 waters.

The Town's overall goal is to improve water quality in the Stony Brook subwatershed in order to open up closed shellfish areas in Paines Creek; protect open shellfish areas in the Brewster North Coastal shellfish growing area; improve anadromous fish, rare species and salt marsh habitat; improve water quality at public bathing beaches; and improve water quality in the impacted headwaters of Stony Brook. A stormwater mitigation assessment project for Paines Creek and the Stony Brook Watershed was completed during fiscal year 2007 as part of the Massachusetts Office of Coastal Zone Management (CZM) Coastal Nonpoint Source Pollution (NPS) grant program. Four focus areas were identified during this assessment, with the Mill Site being assessed as one of the highest priority areas based on the water quality characteristics evident at the site, specifically elevated levels of fecal coliform during first flush conditions. BMPs will be implemented following recommendations from that study.

The structures being proposed for the lower elevations where groundwater will be shallower are strictly containment and settling structures not designed to leach runoff, but designed to accumulate solids and bacteria that would otherwise be deposited into receiving water bodies. The intent in this area is to capture the majority of the surface runoff incrementally so the runoff generated at the lower elevations is far less in volume than in the existing conditions. The BMPs specifically selected for this project are a series of leaching pits, settling tanks, catch basins and infiltrator units designed within six significant leaching areas.

Project tasks include

1. Estimation of pollutant load reduction accomplished by the project;
2. Final design, permits, and implementation of BMPs at two locations;
3. Outreach and education for watershed stakeholders; and
4. Reporting.

PROJECT COST: \$ 578,000
FUNDING: \$ 346,800 by the USEPA
\$ 231,200 by the Town of Brewster
DURATION: 2009 – 2012

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 08-04/319

PROJECT TITLE: Bare Hill Pond Noxious Aquatic Plant Reduction
NPS CATEGORY: Implementation
INVESTIGATOR: Town of Harvard
LOCATION: Nashua Basin

DESCRIPTION:

Bare Hill Pond in Harvard, Massachusetts is a 321-acre, municipally managed pond in the Nashua Basin. The pond is moderately developed although it maintains the rural nature of the community due to largely forested environs. As described in the TMDL (DEP DWM TMDL Report MA81007-1999-001), the pond was originally 200 acres surrounded by pasturelands. In 1838, the pond was dammed bringing it to its present size. The damming of the pond, the prior surrounding agriculture uses and more recent residential development has brought it to its present day condition.

The water quality of the pond and the data on the invasiveness of the plants has been well documented for over 20 years. The TMDL, as well as the attached 2002 ENSR assessment on the quality of the water and aquatic plant growth in the pond, reported that the pond suffers from extensive growths of invasive plants such as variable milfoil, water chestnuts, water lilies, fanwort, smartweed, and pondweed. The pond has elevated nutrient levels, particularly in terms of phosphorous concentrations and macrophyte growth. The excessive growth of invasive species has been due to shallow water depths, bottom sediment rich in nutrients from macrophyte growth and historical uses, and sustained nutrient enrichment from the pond's watershed. Accelerated eutrophication and extensive prevalence of invasive aquatic plants seriously interfere with recreational uses and wildlife habitats.

Project goals include

- 1 – Reduce the level of phosphorous in the pond from 0.044 mg/l to the TDML-recommended goal of 0.030 mg/l
- 2 – Reduce the level of invasive plant growth in the pond so that total plant coverage is limited to the recommended level of 30% sediment coverage, as measured along existing transect points.

This will be accomplished by constructing an integrated series of LID (Low Impact Design) structures to reduce the sediment, nutrient, and bacterial inflows. A more detailed stormwater assessment of the remainder of the watershed will be developed, and a plan for removing as much accumulated road sediment as possible will be developed and implemented.

Project tasks include

1. Design, permitting, and implementation of BMPs
2. Development and implementation of an Operation and Maintenance Plan,
3. Deep drawdown for aquatic invasive control,
4. Public outreach and education, and
5. Reporting.

PROJECT COST: \$ 493,345
FUNDING: \$ 290,950 by the USEPA
\$ 202,395 by the Town of Harvard
DURATION: 2009 – 2012

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 08-05/319

PROJECT TITLE: Restoration of Lake Wickaboag at Wickaboag Valley Road
NPS CATEGORY: Implementation
INVESTIGATOR: Town of West Brookfield Storm Water Authority
LOCATION: Chicopee Basin

DESCRIPTION:

Lake Wickaboag is impaired by metals, noxious aquatic plants, and turbidity. The goal of this project is to improve water quality in Lake Wickaboag by constructing a Best Management Practice at Wickaboag Valley Road that will reduce the phosphorus and sediment load to the pond from one of the major sources identified in the Wickaboag watershed. The path for achieving this goal has been clearly laid out in the recommendations made by MassDEP in the TMDL for Selected Lakes in the Chicopee Basin and in a 2005 Diagnostic/Feasibility study of the lake and its watershed. The TMDL recommended that phosphorus loads to the lake be reduced as a way to address the impairments. The Town's Storm Water Authority has been working to address stormwater which transports phosphorus into the Lake. The D/F study and subsequent work identified ten locations where mitigation work is required to address phosphorus.

This project will implement an infiltration system and upgraded catch basins at a priority location, and will further address the impairments through outreach and education to help watershed stakeholders understand how they can help mitigate the problem.

Project tasks include

1. Design, permit and construct a comprehensive BMP structural solution
2. Develop and implement an operation and maintenance plan
3. Conduct public outreach and education to stakeholders, and
4. Reporting

PROJECT COST: \$ 104,000

FUNDING: \$ 62,400 by the USEPA
\$ 41,600 by the Town of West Brookfield

DURATION: 2009 – 2012

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 08-06/319

PROJECT TITLE: Stormwater BMPs: Implementation for Straits Pond at Richards Road and Pond Street
NPS CATEGORY: Implementation
INVESTIGATOR: Town of Hull
LOCATION: South Coastal Basin

DESCRIPTION:

Straits Pond covers approximately 92 acres and varies in depth from three to five feet, and is listed as part of the Weir River Area of Critical Environmental Concern (ACEC). Straits Pond has a history of water quality problems resulting in the growth of algae blooms, fish kills, dense swarms of midges and foul odors. The Pond is listed in the Massachusetts Year 2006 Integrated List of Waters as a Category 5 Water "Waters Requiring a TMDL" for Pathogens as part of the Weir River watershed from Rockland Street to the mouth of Straits Pond at Worlds End. As such, the maintenance and protection of Straits Pond is mandated by Massachusetts Law. The water quality within Straits Pond is exacerbated through continued stormwater pollution, sedimentation, and the spread of invasive species. Each spring, water temperatures increase, triggering a drop of Dissolved Oxygen, and then the emergence of nonbiting adult midges. During the summer, the Pond's surface becomes covered in thick blanket of algae and the bottom is covered by widgeongrass (*Ruppia maritima*) and pondweed (*Potamogeton pectinatus*). These rooted plants feed on nutrients in pond sediments, returning these nutrients to the pond bottom as they die and decompose in late summer/early fall.

The primary objective of this Project is to design and construct stormwater Best Management Practice (BMP) controls to address and alleviate problems associated with nonpoint source (NPS) pollution within the Straits Pond watershed. The BMP controls will be sited in areas of concentrated stormwater runoff and will be designed to treat runoff prior to discharge into Straits Pond. The BMP controls will include low impact development (LID) techniques such as bioretention rain gardens and vegetated swales to be sited within public rights-of-way. The project will intercept, treat, and recharge the first 1" of rainfall through a combination of structural and non-structural BMP's in the study area of Richards Road and Pond Street. A secondary goal of this Project is to implement a public outreach and education program for Hull residents. This program will inform residents of the proposed stormwater BMPs and of project progress. This program will also educate and encourage residents to participate in the reduction of NPS pollution by using innovative LID treatment systems.

Project tasks include

1. Design, permitting, and implementation of stormwater management BMPs
2. Development and implementation of an Operation and Maintenance (O & M) Plan
3. Outreach and Education for Stormwater Management BMPs, and
4. Reporting.

PROJECT COST: \$ 86,000
FUNDING: \$ 51,600 by the USEPA
\$ 34,400 by the Town of Hull
DURATION: 2009 – 2012

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 08-07/319

PROJECT TITLE: Boston Architectural College Green Alley & Roof Project
NPS CATEGORY: Implementation
INVESTIGATOR: Boston Architectural College
LOCATION: Charles Basin

DESCRIPTION:

This project addresses stormwater runoff in the Charles River watershed. The site is within the Category 5 listed Cheese Cake Brook to Boston Harbor sub-watershed. The water quality of the river is impaired after a rainstorm because of stormwater discharges carrying pollutants, such as pathogens from untreated combined sewage, waterfowl feces, wildlife feces, and domestic pet waste, that have collected on parking lots, streets, driveways and other impervious surfaces. The Charles River Watershed Association recommends that innovative stormwater management techniques be employed – reducing runoff at the source by decreasing impervious surface areas and promoting infiltration, storage and detention of runoff on site.

The project has three goals: (1) Reduce stormwater runoff into the Charles River Basin in one of its most polluted sections. (2) Demonstrate and evaluate the use of sustainable design in existing structures and densely built urban neighborhoods. (3) Use the green roof and green alley as teaching tools for students, faculty, the design profession and the larger community; encourage the use of sustainable design to reduce stormwater runoff and achieve other environmental goals. Grant funds will be directed toward construction of the green alley, while the green roof construction is offered as match.

Project tasks include

1. Final design, permitting, and construction of the green alley and green roof;
2. Outreach and education using the green roof and green alley as teaching tools;
3. Operation and Maintenance plans for green alley and green roof;
4. Evaluation and reporting of results; and
5. Reporting.

PROJECT COST: \$ 1,420,000

FUNDING: \$ 250,000 by the USEPA
\$ 1,170,000 by the Boston Architectural College

DURATION: 2009 – 2012

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 08-08/319

PROJECT TITLE: PCSWMM Evaluation
NPS CATEGORY: Urban Runoff
INVESTIGATOR: UMass Amherst
LOCATION: Statewide

DESCRIPTION:

The purpose of this project is to evaluate a PC version of EPA's Stormwater Management Model (PCSWMM, Version 1.0, Build 5.0.144) to determine whether it accurately converts the Water Quality Volume MassDEP requires for sizing of stormwater treatment practices to an equivalent flow rate.

The model will be evaluated using default parameters and assumptions to provide information and a recommendation to MassDEP on the relative accuracy of the model to conform to the MassDEP's required Water Quality Volume based standard. Third party studies that were used to calibrate the PCSWMM Model will also be evaluated as to their robustness. Project results will help inform MassDEP about the appropriate use of, and reliance upon, PCSWMM model results.

Project tasks include

1. Development of a Quality Assurance Project Plan;
2. An evaluation report on the adequacy of the PCSWMM model to convert the 1-inch and ½ inch Water Quality Volume to a flow rate;
3. Evaluate the adequacy of three additional methods identified as the Ahlfeld, Bryant, and Claytor methods to convert the 1-inch and ½ inch Water Quality Volume to a flow rate;
4. Comparison of PCSWMM analysis to that from other models; and
5. Reporting

PROJECT COST: \$ 23,450
FUNDING: \$ 15,450 by the USEPA
\$ 7,700 by MassDEP
DURATION: 2009 – 2010

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 08-09/319

PROJECT TITLE: Onsite Septic System Investigations at the Massachusetts Alternative Septic System Test Center in Support of Comprehensive Wastewater Management Planning Efforts
NPS CATEGORY: Groundwater Disposal
INVESTIGATOR: Barnstable County Department of Health and the Environment
LOCATION: Statewide

DESCRIPTION:

The Massachusetts Septic System Test Center serves as a resource for quality third-party performance information regarding advanced onsite septic system technologies. In addition, the existence of the Test Center promotes the trial of new technologies to reduce nitrogen and phosphorus from wastewater.

This continuing project supports the state's TMDL program by providing environmental decision makers with the tools to achieve the goals of the TMDL and the Massachusetts Estuaries programs, especially where wastewater is a major source of pollutant loading. This project will continue the ongoing work of the MASSTC.

This project endeavors to investigate three areas of concern identified by Massachusetts DEP personnel and wastewater planners: pharmaceutical and personal care product (PPCP) treatment in onsite septic systems, the effects of septic system remediation technologies on the overall treatment ability of septic systems, and a continued assessment of nutrient removal technologies and their applicability in comprehensive wastewater/nutrient management plans. The project integrates existing resources of the Massachusetts Alternative Septic System Test Center to advance the understanding of these three issues and provides valuable information to wastewater planning efforts statewide.

PROJECT COST: \$ 157,225
FUNDING: \$ 94,045 by the USEPA
\$ 63,180 by Barnstable County and project participants
DURATION: 2010 – 2013

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 09-01/319

PROJECT TITLE: Congamond Lakes FFY 09
NPS CATEGORY: Implementation
INVESTIGATOR: Pioneer Valley Planning Commission
LOCATION: Westfield Basin

DESCRIPTION:

The Congamond Lakes are comprised of three interconnected ponds: North Pond, Middle Pond, and South Pond. The Town of Southwick has been working diligently to improve the conditions of the Congamond Lakes, a Category 4c Waters on the Massachusetts List of Impaired Waters for nuisance aquatic weeds. The two primary invasive species are Eurasian watermilfoil (*Myriophyllum spicatum*) and curly-leaved pondweed (*Potamogeton crispus*).

Southwick has undertaken great investment in improving the municipal infrastructure that exists within this watershed in an attempt to reduce the phosphorus loading to the Congamond Lakes, which was identified in the 1983 Diagnostic Feasibility Study as the leading source of impairment. To date, the Town of Southwick has: 1) sewered the Middle and South Pond subwatersheds; 2) mapped all outfalls and catchbasins in Southwick with GIS, including the lake watershed, and created a GIS database about the depth of the sumps, construction materials, and maintenance history; 3) installed three Baysavers and replaced numerous shallow basins with deep sump catchbasins in the lake watershed; 4) installed a detention basin and water quality swale at a major outfall on Middle Pond of the Congamond Lakes (FY03 s.319 project) and in-lake dredging at this location; 5) performs annual street sweeping and catchbasin cleanout; and, 6) developed an Illicit Discharge Elimination Bylaw and Erosion and Sedimentation Bylaw (scheduled to be voted on at Town meeting in October). Phase II of the sanitary sewer is underway including design of the interceptor to expand flows to the Westfield Wastewater Treatment Plant.

The project goals are: 1) sediment loading and associated pollutants are reduced, 2) invasive aquatic weed populations continue to decrease, 3) targeted outfalls are free of stormwater debris and erosion, and 4) watershed residents are knowledgeable about residential landscaping techniques and maintenance protocols for a healthy lake.

Project tasks include

1. BMP Design, Permitting, and implementation,
2. Development and implementation of an operation and maintenance plan,
3. Public education and outreach,
4. An aquatic weed management program, and
5. Reporting.

PROJECT COST: \$ 505,100
FUNDING: \$ 257,700 by the USEPA
\$ 247,400 by the Town of Southwick
DURATION: 2009 – 2012

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 09-02/319

PROJECT TITLE: Stockbridge Bowl Management Project Phase I
NPS CATEGORY: Implementation
INVESTIGATOR: Town of Stockbridge
LOCATION: Housatonic Basin

DESCRIPTION:

Stockbridge Bowl is a Great Pond with a surface area of 366 acres. The lake is located in the Hop Brook to Williams River subwatershed, HUC 12 #011000050107. The lake is an important water resource in the region. It is one of the few lakes in the state with a coldwater fisheries habitat during the summer months. It also serves as the backup water supply for the neighboring town of Lenox, and it provides public recreation via the boat ramp located on Lenox Road and the Stockbridge Town Beach via Mahkeenac Road. Stockbridge Bowl is listed as a 4c water body on the 303(d) 2006 Integrated List of Waters, impaired by Exotic Species.

The first objective of this project is to install a diversion pipe under the gas pipelines which currently obstruct the channel and inhibit lake drawdown. The second objective of the s.319 project is to identify sites that are potential sediment-contributors and implement remediation at priority locations. The third goal of this project is to increase local stakeholders' understanding and involvement in exotic aquatic species management and nonpoint source pollution mitigation. The Town of Stockbridge and the Stockbridge Bowl Association (SBA) will build on previous work to continue to implement several recommendations to control macrophyte growth within Stockbridge Bowl. Matching funds for the project will be drawn from a mix of sources, including funds from the Town, SBA, and the Tennessee Gas Pipeline. The Town and SBA are jointly responsible for implementation of this project and will share fiscal and reporting responsibilities.

Project tasks include:

1. Final permits for the diversion pipe;
2. Installation of the diversion pipe to gain an additional 1-1.5' of drawdown;
3. Develop and implement an O&M Plan;
4. Continue the harvesting program;
5. Identify and remediate NPS contributions within the watershed;
6. Evaluate project results; and
7. Quarterly reporting and final report.

PROJECT COST: \$ 706,000
FUNDING: \$ 245,500 by the USEPA
\$ 460,500 by Stockbridge Bowl Association and the Town of Stockbridge
DURATION: 2009 – 2012

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 09-03/319

PROJECT TITLE: Stormwater BMPs in the Provincetown Harbor Watershed
NPS CATEGORY: Implementation
INVESTIGATOR: Town of Provincetown
LOCATION: Cape Cod Basin

DESCRIPTION:

Provincetown Harbor is currently listed on the 2006 Integrated List of Waters as a Category 5 water requiring a TMDL for pathogens. Provincetown harbor is a fragile resource that accommodates a multitude of recreational and commercial activities and uses. The importance of the Harbor to ecological systems, recreational uses, and the local economy demands appropriate planning and assessment of external impacts that may degrade it. Currently, dense development and large amounts of impervious areas immediately adjacent to the Harbor result in significant stormwater runoff reaching the Harbor waters. Beach closures after rain events are a frequent occurrence at the Harbor beaches.

The primary pollutants of concern in stormwater runoff to Provincetown Harbor are bacteria and sediments. The Massachusetts Office of Coastal Zone Management (CZM) provided funding during fiscal year 2003 to perform a stormwater assessment and develop a comprehensive stormwater management plan. Consistent with recommendations made in that plan, the goal of this project is to significantly reduce the quantity of pollutants generated by stormwater runoff through installation of structural BMPs at two locations, Court Street and Bradford Street. It is anticipated that this project will result in fewer beach closures caused by high bacteria counts.

Project tasks include

1. Estimation of pollutant load reduction accomplished by the project;
2. Final design, permits, and implementation of BMPs at two locations;
3. Outreach and education for watershed stakeholders; and
4. Reporting.

PROJECT COST: \$ 512,333

FUNDING: \$ 307,400 by the USEPA
\$ 204,933 by the Town of Provincetown

DURATION: 2009 – 2012

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 09-04/319

PROJECT TITLE: Northern Fairhaven New Bedford Inner Harbor Drainage Area LID Stormwater Enhancements
NPS CATEGORY: Implementation
INVESTIGATOR: Town of Fairhaven
LOCATION: Buzzards Bay Basin

DESCRIPTION:

Water quality impairment in Buzzards Bay, and specifically New Bedford Inner Harbor, has been documented in detail through the Commonwealth's Final Massachusetts Year 2006 Integrated List of Waters list of impaired waters as a Class 5 Water for priority organics, metals, nutrients, organic enrichment/low dissolved oxygen, pathogens, oil and grease, taste, odor, color and objectionable deposits. Numerous other documents produced by EOEAA, MassDEP, Office of Coastal Zone Management, Buzzards Bay National Estuary Program (BBNEP), and USEPA have also documented the impaired water quality of the New Bedford Inner Harbor.

The goal of this project is to improve the water quality in the New Bedford Inner Harbor by improving the treatment of direct nonpoint source pollutants from roadway runoff and fertilizers and allow storm water recharge within the upper watershed. These improvements in treatment and recharge will expand upon previous projects and will help in decreasing the nutrient and bacteria loading to the New Bedford Inner Harbor. This will be accomplished by retrofitting the existing conventional stormwater drainage system through a series of Low Impact Development (LID) BMP upgrades in the upper reaches of the New Bedford Inner Harbor watershed within Northern Fairhaven. BMPs retrofits will be installed within the watershed to the various existing direct discharge points and by installing additional drainage system controls further reducing the loading of sediment, nutrients, bacteria, and other contaminants from entering the water bodies.

Through this grant the Town will implement the following specific tasks to significantly reduce the contaminant loading to the New Bedford Inner Harbor:

1. Design and install Low Impact Development Stormwater Treatment BMPs at the storm water outfalls and/or improve storm water treatment and recharge on Pilgrim Avenue, Livesy Parkway, Main Street, Magnolia Avenue, Harding Road, Elm Avenue, Glenhaven Avenue, Parker Street, Cherry Street, and Hedge Street,
2. Monitor and maintain BMPs for the contract period and for the life of the BMPs,
3. Provide educational outreach to the residents and businesses within the New Bedford Inner Harbor Watershed, and,
4. Reporting.

PROJECT COST: \$ 463,500
FUNDING: \$ 278,100 by the USEPA
\$ 185,400 by the Town of Fairhaven
DURATION: 2009 – 2012

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 09-05/319

PROJECT TITLE: Phosphorus Mitigation Program for Cranberry Bogs on White Island Pond
NPS CATEGORY: Implementation
INVESTIGATOR: Cape Cod Cranberry Growers' Association
LOCATION: Buzzards Bay Basin

DESCRIPTION:

This project is specifically targeted to cranberry growers located on White Island Pond in Plymouth. The Pond is a 294-acre Great Pond and is listed as a Category 5 on the 2006 Integrated List of Waters due to nutrients, organic enrichment/low dissolved oxygen, turbidity, and noxious aquatic plants.

Cranberry production is currently one of the largest components of the Massachusetts agricultural economy. An abundant freshwater supply, mainly surface water from ponds, rivers, and reservoirs, is required for standard cultural practices, and most acreage exists in wetland settings.

Conducting cranberry farming in ways that minimize negative impacts to surface waters is obviously in the interests of the farmer and a benefit to ecosystem sustainability. It is also a community concern, since cranberry farming may contribute to nutrient loading and subsequent water quality degradation in ponds and other surface waters. While implementation of existing BMPs for cranberry production can help to protect water resources, recent research, funded by an EPA/DEP 319 Grant (Project 01-12/319), has shown that some standard practices, in particular flood use and discharge and up-welling groundwater flowing through beds, may be a source of water quality degradation even when nutrient use is limited. Discharge of nutrients in stream-flow from bogs and during flood cycles remains of concern.

The long term goal of this project is to reduce phosphorous to .2 mg/l or less from the bog outflows. During the term of this grant, the goal is to determine the remediation methods that will reduce phosphorous from the bog outflow water (.2 mg P/l or less) while maintaining plant vigor and berry production. This requires phosphorous remediation expertise, knowledge of cranberry production practices, engineering, and scientific analysis.

Project tasks include

1. Collection and analysis of water samples,
2. Determining effective ways to remove or mitigate phosphorus from bog discharge,
3. Produce soil/tissue test results on plant health,
4. Updating of the White Island Pond Conservation Alliance throughout the project,
5. Dedicated location on web site for data reports and ongoing activities, and
6. Reporting

PROJECT COST: \$ 49,576

FUNDING: \$ 29,716 by the USEPA
\$ 19,860 by the Cape Cod Cranberry Growers' Association

DURATION: 2009 – 2012

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 09-06/319

PROJECT TITLE: Massachusetts Regional Stormwater Management Training Seminar Series
NPS CATEGORY: Urban Runoff
INVESTIGATOR: Vanasse Hangen Brustlin Inc. (VHB)
LOCATION: Statewide

DESCRIPTION:

The need for proper stormwater management is well known across the nation. Municipalities, citizens groups, and watershed associations often find it difficult to get the resources to make the leap from understanding the need for better stormwater management to developing realistic, effective strategies to start improving water quality on the ground. In Massachusetts, the organizations called on to implement the Commonwealth's stormwater management and non-point source programs have varying degrees of training, knowledge, and resources, and achieve varying degrees of success. Most of the responsibility for education and outreach—as well as the technical transfer of proper stormwater management techniques—falls on municipalities through the State Stormwater Standards/Regulations, which are implemented under the Wetlands Protection Act at the local level by Conservation Commissions; and via the EPA NPDES MS4 Permit program. While municipal programs enjoy some support from the state and EPA Region 1, the quality and effectiveness of implementation programs can vary.

The goals of this seminar series are:

1. To enhance the training opportunities and increase the awareness and knowledge base among municipal officials, state and regional planning agency personnel, other nonprofit organization members involved water resource protection
2. To help residents of the Commonwealth gain a better understanding of the latest regulatory changes, proposals, and techniques for stormwater management
3. To provide a regional and topic-specific approach geared toward improving water quality

Multiple statewide training sessions will be conducted, tailored to the needs of the specific audience and designed to meet identified deficiencies in stormwater awareness or need for additional training. The ultimate goal of this training series is to provide training and guidance for residents and decision-makers to implement proper stormwater management programs and practices that over time will lead to improved water quality conditions for the water bodies of the Commonwealth. The training will build on existing programs and will fulfill a growing need to address and understand the multiple layers of regulatory control and the latest technologies that have been developed in recent years.

Topics will potentially cover issues such as stormwater funding and specifically how to complete a stormwater utility feasibility study and set up stormwater utilities, prioritizing the stormwater requirement language in new ordinances/bylaws, design concepts for stormwater LID systems, executing proper stormwater management practices, and how to access and use free existing educational and reference materials.

PROJECT COST: \$ 338,431

FUNDING: \$ 203,941 by the USEPA
\$ 134,490 by multiple project partners, including watershed groups and regional planning agencies

DURATION: 2010 – 2013

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 10-01/319

PROJECT TITLE: MaSTEP 2010
NPS CATEGORY: Urban Runoff
INVESTIGATOR: UMass Amherst
LOCATION: Statewide

DESCRIPTION:

MassDEP and other state and local officials need verified information about the performance of stormwater treatment devices and techniques on which to base their permitting, regulatory, and resource protection activities. Information that is independent of manufacturers' literature is necessary in order for stakeholders and regulators to make informed decisions about optimal resource protection strategies.

This project continues the effort to develop and refine a web-based technology transfer clearinghouse to help municipal officials and others gain access to current, credible information about stormwater technologies. The continued operation of the MASTEP web site (www.mastep.net) and database of performance studies is important to inform stormwater management policy and practices in the Commonwealth.

The science of stormwater management is still evolving. Current stormwater provisions in the Massachusetts Wetland regulations, which emphasize control of Total Suspended Solids (TSS), leave ecosystems vulnerable to nutrient enrichment. Systems that are designed to remove suspended particles from the waste stream may or may not be effective at removing TP and other nutrients. A better understanding of the nutrient removal capabilities of different environmentally sensitive site design, low impact development practices, and structural stormwater BMP designs will help conservation commissions and other environmental decision makers select practices that are most effective in those situations where nutrient control is a high priority.

MASTEP will augment the existing database, which was created to assess the scientific veracity of studies examining TSS removal in stormwater BMPs, to examine Total Phosphorus (TP) removal. As MassDEP begins to regulate TP in stormwater runoff, tools will be required to assist conservation commissions in evaluating which environmentally sensitive site design, low impact development, and structural BMPs are best suited to remove TP in addition to TSS.

The goal of this project is to achieve a reduction in non-point source pollution, specifically TSS and TP, through continued creation and refinement of web based materials providing validated performance information on a variety of stormwater treatment practices, with a particular emphasis on TSS and TP control. The web-based tool is targeted primarily to Massachusetts conservation commissions and secondarily toward other municipal officials and professionals who deal with stormwater issues, including regulators at the state and local levels as well as those who design and propose projects requiring stormwater management.

PROJECT COST: \$ 83,333
FUNDING: \$ 50,001 by the USEPA
\$ 33,333 by UMass Amherst
DURATION: 2010 – 2013

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 10-02/319

PROJECT TITLE: Investigation of Blackwater Disposal as a Means of Nutrient Management in Watersheds of Nitrogen Sensitive Marine Embayments
NPS CATEGORY: Groundwater Disposal
INVESTIGATOR: Barnstable County Department of Health and the Environment.
LOCATION: Statewide - Coastal

DESCRIPTION:

The costs of municipal sewer to address nutrient issues in nitrogen sensitive areas often compel communities to investigate alternative means of nutrient management. The option of employing alternative onsite septic systems that treat all of the wastewater from a residence has been investigated and the advantages and limitations of this strategy are well known. Information on technologies that separate blackwater (toilet wastes) and greywater, however, is not available. Since a high percentage of nutrients present in wastewater are derived from toilet wastes, separation of these waste products may offer an economical alternative to municipal sewers in some situations. Therefore, the efficacy of diverting toilet wastes from the wastewater stream in reducing the overall nutrient load calls for investigation. In addition, information on the economics, practicality and acceptance of this strategy will be valuable to communities involved in comprehensive wastewater management planning.

This project will install at least ten blackwater-diverting technologies (composting toilets or urine diverting toilets) at residences to document the efficiency of this technology in addressing the nutrient loading from onsite septic systems. Measurements of the remaining nutrient loads in greywater, as well as a documentation of all attendant issues such as costs of operation maintenance and the disposal of residual byproducts, will enable the first cost-benefit analysis of this strategy for the use in comprehensive wastewater planning. The project will also investigate means by which residuals might be reprocessed for beneficial use such as fertilizer.

PROJECT COST: \$ 236,025
FUNDING: \$ 39,175 by the USEPA
\$ 54,350 by Barnstable County
\$ 150,000 by participating homeowners
DURATION: 2010 – 2013

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 10-03/319

PROJECT TITLE: Lower Monoosnoc Brook Remediation Project
NPS CATEGORY: Urban Runoff
INVESTIGATOR: Massachusetts Watershed Coalition
LOCATION: Nashua Basin

DESCRIPTION:

Monoosnoc Brook and its watershed are well-used for outdoor recreation activities. The Brook flows out of the Monoosnoc Hills on the west side of Leominster, connecting six impoundments, Leominster's busy downtown area, and a variety of industrial facilities. Densely developed areas in the lower watershed are major sources of nonpoint source pollution, and the lower two thirds of the Brook are increasingly impaired for contact recreation and aquatic life uses. The pollutants are transported downstream into the North Nashua River, which is listed as Category 5 on the 2006 Integrated List of Waters for multiple impairments.

This project follows Project 07-03/319, which has begun to implement water quality remediation BMPs in the watershed. This project will install many additional source reduction practices in very densely developed areas of the lower two thirds of Monoosnoc Brook watershed. Improved stream health will also increase riparian property values, foster reuse of abandoned buildings next to the Brook, and provide a stimulus for small business creation in downtown.

Activities include the installation of rain gardens, tree box filters, porous sidewalk, tandem catch basins, a two-chambered underground tank to remove TSS, and other infiltration practices to reduce the amount of pollutants being discharged to the Brook. The project will promote Low Impact Development and will assist businesses, schools, churches and homeowners to utilize source reduction techniques that can supplement the project activities.

PROJECT COST: \$ 394,600

FUNDING: \$ 221,900 by the USEPA
\$ 3,750 by MWC
\$ 4,500 by Leominster Land Trust & Nashua River Watershed Association
\$ 7,000 by Leominster Credit Union (rain garden)
\$ 5,000 by Parker Realty Trust (Engineering Design)
\$ 88,450 by the City of Leominster

DURATION: 2010 – 2013

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 10-04/319

PROJECT TITLE: Stormwater Best Management Practices: Little Harbor, Cohasset Cove, and Cohasset Harbor
NPS CATEGORY: Urban Runoff
INVESTIGATOR: Town of Cohasset
LOCATION: South Coastal Basin

DESCRIPTION:

This project will continue to improve the water quality and protection of Little Harbor, Cohasset Cove and Cohasset Harbor through the design, environmental permitting, and construction of stormwater control and treatment systems within these watersheds. Cohasset Harbor is Category 5 listed for pathogens. The subwatersheds are in the Town of Cohasset, and are part of the South Coastal Watershed. The project complements an on-going sewer construction project initiated by the Town of Cohasset and supported by the Commonwealth through a loan from the State's Revolving Fund (SRF) for wastewater infrastructure and water quality protection in addition to the previous remedial steps. The project will also complement previously completed stormwater projects in the James Brook and Little Harbor watersheds. By coordinating these projects, the reduction of onsite sewage disposal system source pollution and stormwater runoff nonpoint source pollution will result in a more effective "total solution".

The primary objective of this Project is to design and construct stormwater Best Management Practice (BMP) controls to address and alleviate problems associated with nonpoint source (NPS) pollution within the Little Harbor, Cohasset Harbor, Cohasset Cove and James Brook watersheds. The BMP controls will be sited in areas of concentrated stormwater runoff and will be designed to treat runoff prior to discharge into Little Harbor, as well as James Brook, Stuart Brook, Ellms Meadow Wellfield (Zone II), Cohasset Cove, Cohasset Harbor, and Jacobs Meadow salt marsh, which ultimately discharges to Cohasset Cove. The BMP controls will include low impact development (LID) techniques such as bioretention, permeable pavement, vegetated swales, and infiltration (with pre-treatment) to be sited on public lands and/or within public rights-of-way.

The scope of work also includes on-going operation and maintenance and a public outreach and education component that will explain the Project and the effectiveness of stormwater BMPs to residents and encourage participation in reducing nonpoint source pollution.

This Project will target fecal coliform bacteria, nitrogen, phosphorus, suspended solids, and hydrocarbons derived from stormwater runoff. The Project will construct stormwater BMPs designed to capture and treat at least the first one inch of rainfall, which carries the majority of NPS pollutants and is known as the "first flush".

PROJECT COST: \$ 300,000

FUNDING: \$ 180,000 by the US EPA
\$ 120,000 by the Town of Cohasset

DURATION: 2010 – 2013

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 10-05/319

PROJECT TITLE: North Reading Stormwater Infiltration Project: Reaching Out to Address Runoff (ROAR)
NPS CATEGORY: Urban Runoff
INVESTIGATOR: Town of North Reading
LOCATION: Ipswich Basin

DESCRIPTION:

The Town of North Reading is entirely located within the Upper Ipswich Basin. In the past three decades, urbanization and suburbanization, and the subsequent land use changes and stormwater infrastructure associated with them, have strongly impacted the hydrological patterns in the basin. The river chronically suffers from low flows, and multiple Category 5 impairments are found within the subwatershed. The focus of this project is infiltration and source reduction to capture and treat stormwater and to promote the minimum level of flow and groundwater recharge. The project follows Project 02-12/319, implementing LID BMPs at Martins Pond.

The overall goal of this project is to promote infiltration of runoff closer to its source. Implementation tasks will disconnect impervious surfaces, mitigate first flush pollutant loads, allow for natural filtration and groundwater recharge, reduce the amount of runoff reaching the outfall and more closely mimic pre-development hydrology. This project also addresses the immediate need for outreach and education about the linkages between water quality, water quantity, and stormwater issues in the upper basin.

Specific tasks include

1. Infiltration of roadway runoff and sediment reduction on North Street through the installation of deep sump catch basins and infiltration chambers;
2. A bioswale, infiltration enhancement, rain gardens and outfall rehabilitation at J. T. Hood Elementary School to capture roof and parking lot runoff;
3. Rain Garden project, including a Town Common installation and a town-wide participatory program centered on planning and implementing parcel-based rain gardens to promote infiltration; and
4. Outreach and education via an Elementary School education program and contest, newspaper advertising campaign, Town Hall Low Impact Development (LID) kiosk, Town Library display, Town event outreach and signage. In addition, each project will act as a potential demonstration project increasing the visibility and transferability of each individual project.

PROJECT COST: \$ 328,335

FUNDING: \$ 190,500 by the USEPA
\$ 30,000 by Merrimack College
\$ 60,000 by Town of North Reading
\$ 8,800 by J. Turner Elementary School
\$ 39,035 by in-kind services

DURATION: 2010 – 2013

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 10-06/319

PROJECT TITLE: Northern Fairhaven New Bedford Inner Harbor Drainage Area Phase II LID Stormwater Enhancements
NPS CATEGORY: Urban Runoff
INVESTIGATOR: Town of Fairhaven
LOCATION: Buzzards Bay Basin

DESCRIPTION:

The Town of Fairhaven is one of eleven communities that share Buzzards Bay, a highly ecologically significant large estuary connected to Cape Cod Bay via the Cape Cod Canal. Water quality impairment in Buzzards Bay and specifically New Bedford Inner Harbor has been documented in detail through the Commonwealth's Final Massachusetts Year 2006 Integrated List of Waters. These marine embayments are classified as a Class 5 Water for priority organics, metals, nutrients, organic enrichment/low dissolved oxygen, pathogens, oil and grease, taste, odor, color and objectionable deposits. The Town of Fairhaven has established a comprehensive stormwater system capital improvement program within the Northern Fairhaven New Bedford Inner Harbor Drainage Area and is well underway with implementing this plan. Phase I of this capital plan is currently being implemented through a FY09 MassDEP 319 grant (09-04/319) and several other state and federal sources.

The goal of this phase of the project is further improvement of the water quality in the New Bedford Inner Harbor by additional treatment of direct NPS pollutants from roadway runoff and fertilizers and stormwater recharge within the upper watershed. These improvements in treatment and recharge will expand upon previous projects and will decrease the nutrient and bacteria loading to the New Bedford Inner Harbor. This will be accomplished by additional retrofitting of the existing conventional stormwater drainage system through a series of Low Impact Development (LID) BMP upgrades in the upper reaches of the New Bedford Inner Harbor watershed within Northern Fairhaven.

Through this grant the Town will implement the following specific tasks to significantly reduce the contaminant loading to the New Bedford Inner Harbor:

1. Design and install Stormwater Treatment BMPs at the stormwater outfalls and/or improve stormwater treatment and recharge on Harding Road, River Avenue, and Sycamore Street, and will install 20 tree box filters in locations throughout the New Bedford Inner Harbor watershed.
2. Monitor and maintain BMPs for the contract period and for the life of the BMPs
3. Provide educational outreach to the residents and businesses within the New Bedford Inner Harbor watershed

PROJECT COST: \$ 430,000
FUNDING: \$ 258,400 by the USEPA
\$ 171,600 by the Town of Fairhaven
DURATION: 2010 – 2013

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 10-07/319

PROJECT TITLE: Stormwater Management BMPs for Unpaved Roads: Four Mile Brook Road in Northfield, Massachusetts
NPS CATEGORY: Resource Restoration
INVESTIGATOR: Town of Northfield
LOCATION: Connecticut Basin

DESCRIPTION:

Four Mile Brook is a coldwater stream that drains a 4.8 mi² watershed, most of which is located in Northfield, Massachusetts. The brook is one of two major tributaries that comprise the HUC 12 subwatershed *Connecticut River-Dry Brook to Deerfield River*. Total suspended solids (TSS) is listed as a pollutant needing a TMDL (Category 5 Waters) in Segment MA 34-03_2008, which is within this HUC 12 subwatershed. Sediment-laden runoff is flowing into the Four Mile Brook from Four Mile Brook Road, which is a gravel road along all of its 2.75 mile length, except for an approximately 1,000 foot section in the lower part of the watershed. Much of the road lies within the Rivers Protection Act 200-foot riparian buffer of the brook. Significant amounts of sediment are delivered to the brook during storm events, and sediments entering Four Mile Brook are being deposited in the lowest reaches of the brook and into the Connecticut River.

The goal of this project is to implement priority projects identified in a previous 604b funded (05-02/604) Watershed Management and Restoration Plan, which contains recommendations for restoration and mitigation projects in the watershed. Six priority locations were identified in the Plan, and conceptual stormwater Best Management Practices (BMPs) were developed for these priority sites. The assessment also provided a list of locations along the road where minor to moderate erosion and sedimentation is occurring. Accordingly, improvements will be implemented at numerous other sites along Four Mile Brook Road. BMPs will be employed at 16 culvert crossings, 10 plow pull-offs and 2,000 linear feet of windrow removals to improve the management and quality of stormwater runoff.

PROJECT COST: \$ 394,987
FUNDING: \$ 225,613 by the USEPA
\$ 169,374 by the Town of Northfield
DURATION: 2010 – 2013

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 10-08/319

PROJECT TITLE: Sawmill River Implementation Project: An Ecosystem Approach to Restoration
NPS CATEGORY: Resource Restoration
INVESTIGATOR: Franklin Conservation District
LOCATION: Connecticut Basin

DESCRIPTION:

The Sawmill River watershed encompasses 32 square miles in the western Massachusetts towns of Montague, Shutesbury, Leverett and Wendell. The river flows westerly for fourteen miles through mostly forested and steep terrain to its confluence with the Connecticut River in Montague. This segment of the Connecticut is Category 5 listed as impaired by flow and habitat alterations. Watershed land uses include cropland, pasture, forest, and residential and commercial areas. Over the past thirty years, towns in the Sawmill River watershed have been plagued by numerous river-related problems including flooding, sediment accumulation, and damage to property and infrastructure. Water quality, fisheries, and wildlife habitat have been adversely impacted by sediment load transport and bank scouring.

For several decades, watershed communities have attempted to apply "quick fixes" to these problems. Numerous stream bank stabilization and dredging projects have been undertaken to address catastrophic damage to roads, bridges and agricultural areas. Bank erosion along the Sawmill River is accelerating, contributing to more substantial sediment loads, which in turn further impacts ecosystem health and public safety. Each time towns and residents have attempted to fix one problem, other problems have emerged.

The goal of this project is to implement a 2005 restoration plan that was developed through the funding of a 604(b) EPA/DEP project entitled "An Ecosystem Approach to the Restoration of the Sawmill River Watershed". This plan provided a three-phase geomorphic assessment using an innovative ecosystem approach. Findings were used to develop conceptual solutions for flooding, erosion and sedimentation problems using natural stream channel principles.

Engineering plans for the river restoration project, developed pursuant to the Vermont Stream Geomorphic Assessment protocols, will be finalized; related state, federal and local permits will be secured; restoration of 2,500 linear feet of straightened channel, including application of bioengineering techniques, will be accomplished; and outreach and technology transfer regarding the project will be conducted.

PROJECT COST: \$ 513,287

FUNDING: \$ 318,772 by the USEPA
\$ 152,945 by the Town of Shutesbury
\$ 2,050 by the Franklin Conservation District
\$ 18,200 by Northeast Networks
\$ 4,350 by the Sawmill River Steering Committee
\$ 35,000 by the Mass. Division of Fisheries and Wildlife

DURATION: 2010 – 2013

APPENDIX
319 NONPOINT SOURCE PROGRAM PROJECTS 1990-2005

- 90-01/319 **Avon Industrial Park Storm Water Management**
by Old Colony Planning Council
- 90-02/319 **Milkroom Wastewater Treatment Demonstration**
by Northwest Worcester Co. Conservation Dist.
- 90-03/319 **Pesticide Handling Demonstration**
by Franklin, Hampden & Hampshire Co. Conservation Districts
- 90-04/319 **Development of Pesticide Data and Support System for Risk Assessment**
by Worcester County Conservation District
- 90-05/319 **North and South Rivers Storm Water Mitigation**
by North & South Rivers Watershed Assoc.
- 91-01/319 **Soil Morphology as an Indicator for Maximum Groundwater Elevation Levels in MA**
by UMass, Amherst, Department of Plan and Soil Sciences
- 91-02/319 **Rehabilitation and Evaluation of the Sterling Filter Beds at Wachusett Reservoir**
by MDC, Division of Watershed Management
- 91-03/319 **Soil Bioengineering Streambank Protection Measures on the Blackstone and North Rivers**
by Franklin, Hampden & Hampshire Co. Conservation Districts
- 91-04/319 **Investigation of Low-Input Cranberry Production**
by UMass, Amherst, Entomology Dept.
- 91-05/319 **Hydrogeologic Evaluation of the Waquoit Bay Land Margin Ecosystem**
by Cape Cod Commission
- 92-01/319 **Spragues Cove Storm Water Remediation**
by Town of Marion
- 92-02/319 **Control of Urban Runoff in the Connecticut, Merrimack and Sudbury River Basins**
by Metropolitan Area Planning Council
- 92-03/319 **Ipswich River Nonpoint Source Prevention Program**
by MDFWELE, Riverways
- 92-04/319 **Technical Support for Developing and Implementing Urban Runoff Nonpoint Source Control Strategies in the Merrimack River Basin**
by MassDEP, Division of Water Supply
- 93-01/319 **Storm Water Remediation for the Broad Marsh River**
by Town of Wareham
- 93-02/319 **Sediment and Erosion Control in the Taunton River Basin Program**
by MDFWELE, Riverways
- 93-03/319 **Artificial Recharge Evaluation and Guidance to Municipalities**
by Pioneer Valley Planning Commission
- 93-04/319 **H₂Ome Check Pilot Project**
by Nashua River Watershed Association
- 93-05/319 **Commercial Underground Storage Tank Compliance**
by Barnstable County Department of Health and the Environment
- 93-10/319 **Cape Cod Coastal Nonpoint Source Management Plan**
by Cape Cod Commission
- 93-11/319 **Wachusett Septic System Management System**
by UMass Cooperative Extension, Amherst

- 93-12/319 **Nitrogen Loading Model Computer Program Development**
by Horsley & Witten, Inc.
- 93-13/319 **Development and Outreach of an Erosion and Sedimentation Control Guide for Massachusetts**
by Franklin, Hampden & Hampshire County Conservation Districts
- 94-01/319 **Best Management Practices to Control Nonpoint Source Pollution from Forestry Operations**
by Berkshire-Pioneer Resource Conservation and Development Area
- 94-03/319 **Green River Soil Bioengineering Demonstration Project**
by Berkshire Conservation District
- 94-05/319 **Alternative Onsite Septic Systems – Encouraging Their Use in Environmentally Sensitive Areas of Barnstable County**
by Barnstable County Dept. of Health and the Environment
- 94-06/319 **Orleans Storm Water Remediation Project**
by Cape Cod Conservation District
- 94-07/319 **Mill River Nonpoint Source Management Project**
by Mass Audubon Society, North Shore
- 94-08/319 **Lake Tashmoo Storm Water Remediation Project**
by Tisbury Waterways, Inc.
- 94-09/319 **Jones River/Billington Sea Nonpoint Source Pollution Control Project**
by Pilgrim Resource Conservation & Development Area Council, Inc.
- 95-01/319 **Lake Lorraine and Fivemile Pond Nonpoint Source Project**
by Pioneer Valley Planning Commission
- 95-02/319 **A Demonstration Program to Mitigate Storm Drain Pollution Impacting Shellfish Beds**
by MA Coastal Zone Management
- 95-03/319 **Buttermilk Bay Storm Water Remediation Project**
by Town of Bourne
- 95-04/319 **Demonstration of Urban Pollution Control in the Green River Watershed**
by Franklin, Hampden and Hampshire Conservation District
- 95-05/319 **Demonstration of an Alternative Onsite Wastewater Disposal System at Allen’s Pond Wildlife Sanctuary**
by Buzzards Bay Project
- 95-06/319 **Comprehensive Nonpoint Source Management in the Mill River Subwatershed, Hatfield, MA**
by Pioneer Valley Planning Commission
- 95-07/319 **Title 5 Training for Boards of Health in Five Towns in Barnstable County**
by Barnstable County Department of Health and the Environment
- 95-08/319 **Swan Pond River Storm Water Remediation Project**
by Town of Dennis
- 95-09/319 **Buzzards Bay Action Committee-Holmes Brook Restoration**
by Buzzards Bay Action Committee
- 95-10/319 **Developing and Conducting Training Workshops for the Revised Regulations for MGL C 132, Forest Cutting Practices Act**
by Berkshire-Pioneer Resource Conservation and Dev. Area Council
- 95-11/319 **Neponset River Fishway Project**
by MassDEP
- 96-01/319 **Septic System Management 2000 Project**
by Cooperative Extension System, UMass, Amherst
- 96-02/319 **Monitoring Strategies for Innovative Onsite Sewage Disposal Technologies**
by UMass, Amherst and Lowell
- 96-03/319 **Connecticut River Watershed Restoration Project**
by Franklin County Commission
- 96-04/319 **Demonstration of Urban Streambed Stabilization and Wetlands Function and Wildlife Habitat Improvement Using Soil Bioengineering Treatments at Hearthstone Quarry Brook, Chicopee**

- by City of Chicopee
- 96-05/319 Spicket River Watershed Revitalization**
by Merrimack River Watershed Council
- 96-08/319 Statewide Outreach Course and Tool Kit and Central Massachusetts Partnership Pilot**
by Worcester County Conservation Districts
- 96-09/319 Sub-Basin Assistance for the SuAsCo and Charles River Watersheds**
DFWELE, Riverways Program
- 96-10/319 Watershed Display on NPS Information, Basin Team Newsletter and Resident Survey**
by Berkshire Conservation District
- 96-11/319 Watershed Education Teaching (WET) Program**
by UMass Cooperative Extension System, Amherst
- 97-01/319 Development of Stormwater Utilities in Two Demonstration Communities: Chicopee & South Hadley**
by Pioneer Valley Planning Commission
- 97-02/319 Red Lily Pond Rejuvenation**
by Town of Barnstable
- 97-03/319 Technical Outreach to Communities Regarding Alternative Onsite Septic Systems**
by Barnstable County Dept. of Health and the Environment
- 97-04/319 Alternative Septic Systems Technologies Workshop Program**
by Berkshire Regional Planning Commission
- 97-05/319 Leak Prevention for Heating Oil Storage Systems**
by Barnstable County Dept. of Health and the Environment
- 97-07/319 Protecting Nitrogen Sensitive Coastal Embayments Through Land Conservation**
by Buzzards Bay Project
- 97-08/319 Hall's Pond Wetlands Restoration Project**
by Town of Brookline
- 97-09/319 Three Bay Area - Ropes Beach Subwatershed**
by Town of Barnstable
- 98-01/319 Determining the Effectiveness of Onsite Septic Systems for the Removal of Viruses**
by Barnstable County Dept. of Health and the Environment
- 98-03/319 Coastal Embayment/Title 5 Training Video**
by Cape Cod Commission
- 98-05/319 Nashawannuck Pond Watershed Restoration Project, Easthampton, MA**
by Pioneer Valley Planning Commission
- 98-06/319 NPS Pollution Correction in the Farmington River Watershed – Dirt Roads BMP Handbook**
by Berkshire Regional Planning Commission
- 98-08/319 Protection of First Herring Brook**
by Town of Scituate
- 98-09/319 Manual of Innovative/Alternative Onsite Wastewater Treatment Technologies**
by UMass Amherst
- 98-11/319 Development and Demonstration of Protocols for Evaluating Greywater Disposal Systems**
by Massachusetts Department of Environmental Protection
- 98-12/319 Demonstrating the Use of Eelgrass Monitoring to Assess Coastal Nonpoint Source Pollution**
by Massachusetts Department of Environmental Protection
- 98-07/319 Reducing Stormwater in an Ultra-Urban Watershed**
by City of Somerville
- 99-01/319 Alternative Septic System Test Center Project Monitoring**
by Buzzards Bay Project
- 99-03/319 Pontoosuc Lake Watershed Resource Restoration Project**
by Berkshire Regional Planning Commission
- 99-04/319 Winsegansett Salt Marsh Restoration Project**

- by Town of Fairhaven
- 99-05/319 Telecom City: Malden, Medford, Everett**
by Mystic Valley Development Commission
- 99-06/319 Development of Recharging Stormwater Control Structures and Flow and Volume Design Criteria**
by UMass/Amherst
- 99-07/319 Design and Guidance for Shallow Trench Low Pressure Pipe Distribution Systems for the Massachusetts Title 5 Innovative/Alternative Septic System Program**
by UMass/Amherst
- 99-08/319 Mill River Watershed Restoration Project**
by Franklin Regional Council of Governments
- 99-09/319 Demonstration of Best Management Practices to Control Agricultural NPS Pollution**
by Massachusetts Department of Food and Agriculture
- 99-11/319 Coastal Zone Management Stormwater BMP Monitoring Project**
by Massachusetts Department of Environmental Protection and Office of Coastal Zone Management
- 00-01/319 Implementing the Diagnostic/Feasibility Study Recommendations for Onota Lake**
by the Berkshire Regional Planning Commission
- 00-02/319 Alternative Septic System Test Center Project Monitoring**
by the Barnstable County Department of Health and the Environment
- 00-03/319 Development of a Rapid Field Test for the Quality of Stone Aggregate in Onsite Septic Systems**
by the Barnstable County Department of Health and the Environment
- 00-04/319 Connecticut River Watershed Restoration Phase II**
by the Franklin Regional Council of Governments
- 00-05/319 Atlas of Stormwater Discharges**
by the CZM Buzzards Bay Project
- 00-06/319 Management Strategies for MA Dairy Farms to Reduce the Risk of Nonpoint Source Pollution**
by UMass Amherst
- 00-07/319 Town of Acton Nonpoint Source Control Program**
by the Town of Acton
- 00-08/319 Long Pond Restoration Project**
by the Town of Littleton
- 00-09/319 Onset Bay, Wareham, MA, Nonpoint Source Pollution Remediation Project**
by the Town of Wareham
- 00-10/319 Shaw's Plaza Drainage NPS Management**
by the Town of Sharon
- 00-12/319 Salisbury Pond Resource Restoration**
by the City of Worcester
- 00-13/319 Implementation of Nutrient Management Standards on Massachusetts Crop/Livestock Farms to Reduce the Risk of Nonpoint Source Pollution**
by UMass/Amherst
- 00-14/319 Forestry Best Management Practices (BMP) Implementation and Monitoring Protocol Project**
by the Massachusetts Department of Conservation and Recreation
- 00-15/319 Revision of the Massachusetts Nonpoint Source Management Manual**
by GeoSyntec Consultants
- 00-16/319 Lake Wyola TMDL Implementation**
by the Massachusetts Department of Conservation and Recreation
- 00-17/319 Stormwater BMPs on Residential Property**
by EOEEA: DFWELE/Riverways
- 01-01/319 Lake Cochituate, Snake Brook NPS Remediation, Phase I**
by the Department of Environmental Management
- 01-02/319 Boat Waste Oil Recovery Program for New Bedford Harbor**
by the Massachusetts Coastal Zone Management Buzzards Bay Project

- 01-03/319 **Parker Pond Restoration, Gardner**
by the City of Gardner
- 01-04/319 **Massachusetts Buffer Manual and Demonstration Projects**
by the Berkshire Regional Planning Commission
- 01-05/319 **Evaluation of Phosphorus Removal in Onsite Septic Systems**
by the Barnstable County Department of Health and the Environment
- 01-06/319 **Memorial Pond Restoration, Phase I**
by the Town of Walpole
- 01-07/319 **Wareham NPS Remediation Program: East River, Broad Cove, Muddy Cove**
by the Town of Wareham
- 01-08/319 **Gray's Beach Park Restoration, Kingston**
by the Town of Kingston
- 01-09/319 **Nashawannuck Pond Restoration, Phase II**
by the City of Easthampton
- 01-10/319 **Development and Demonstration of a Lake Watershed Survey Program**
by the Massachusetts Department of Fisheries, Wildlife and Environmental Law Enforcement/Riverways Program
- 01-12/319 **Cranberry Bog Phosphorus Dynamics for TMDL Development**
by the University of Massachusetts Cranberry Experiment Station
- 01-13/319 **Lake Buel Implementation and Demonstration Project**
by the Berkshire Regional Planning Commission
- 01-14/319 **Pontoosuc Lake Watershed Resource Restoration Project**
by the Town of Lanesborough
- 01-15/319 **Implementing a Stormwater Remediation Strategy at Ashmere Lake**
by the Town of Hinsdale
- 01-16/319 **Plymouth Road Stormwater Treatment System**
by the Town of Bellingham
- 01-17/319 **North Green Stormwater Management Project**
by the Town of Ipswich
- 01-18/319 **Lagoon Pond Runoff Renovation Project**
by the Town of Oak Bluffs
- 01-19/319 **Oldham and Furnace Pond Stormwater Treatment**
by the Town of Pembroke
- 01-20/319 **Lake Attitash Stormwater Treatment Program**
by the Town of Amesbury
- 01-21/319 **Lake Quinsigamond and Lake Ripple Restoration Project**
by the Town of Brookfield
- 01-22/319 **Stormwater Management Plan at the Millyard Marketplace**
by the Town of Sturbridge
- 01-23/319 **Demonstration of Innovative Stormwater Management Retrofit Systems**
by the Center for Urban Watershed Restoration
- 01-24/319 **Storm Water System Maintenance and Residuals Waste Handling**
by the City of Quincy
- 01-25/319 **Operation and Maintenance of the Massachusetts Alternative Septic System Test Center**
by the Barnstable County Dept. of Health and the Environment
- 01-26/319 **Massachusetts Estuaries Project**
by UMass Dartmouth

- 02-01/319 **Indian Lake Watershed Resource Restoration**
by the City of Worcester
- 02-02/319 **Wall Street Highway Yard Stormwater Improvements Project**
by the City of Attleboro
- 02-03/319 **Stormwater Management on the Middle Pond of the Congamond Lakes**

- 02-04/319 **NPS BMPs at Richmond Pond**
by the Pioneer Valley Planning Commission
- 02-05/319 **Neponset River Watershed Bacteria TMDL Implementation Project**
by the Neponset River Watershed Association
- 02-06/319 **Head of Westport Stormwater Project**
by the Town of Westport
- 02-07/319 **Lake Singletary Storm Drain Retrofit Program**
by the Town of Millbury
- 02-08/319 **Hammond Pond Stormwater Management Plan Implementation Phase I**
by the City of Newton
- 02-09/319 **Stormwater Remediation for Plymouth Harbor and Plymouth Bay**
by the Town of Plymouth
- 02-10/319 **Implementation of TMDL Recommendations at Lake Boon**
by the Town of Stow
- 02-11/319 **Wachusett Mountain NPS**
by Wachusett Mountain Associates (WMA)

- 03-01/319 **Operation of the Massachusetts Alternative Septic System Test Center**
by the Barnstable County Department of Health and the Environment
- 03-02/319 **Comparison Of Virus Removal In Aggregate Free Chamber Leaching Systems vs. Aggregate Laden Trenches**
by the Barnstable County Department of Health and the Environment
- 03-03/319 **South Coastal Inter-Municipal Water Quality Improvement Project**
by the Town of Pembroke
- 03-04/319 **Dorothy Pond Perimeter and Local Watershed Stormwater Management/Remediation**
by the Town of Millbury
- 03-05/319 **Bare Hill Pond Noxious Aquatic Plant Reduction**
by the Town of Harvard
- 03-06/319 **Pittsfield Water Supply Stormwater Remediation Project**
by the City of Pittsfield
- 03-07/319 **Connecticut River Phase III**
by the Franklin Regional Council of Governments
- 03-08/319 **Powow River Stormwater Management**
by the City of Amesbury
- 03-09/319 **Clark and Cobb's Pond Stormwater Management**
by the Town of Walpole
- 03-10/319 **Spy Pond Stormwater Management**
by the Town of Arlington
- 03-11/319 **Billington Sea Stormwater Remediation**
by the town of Plymouth
- 03-12/319 **Stormwater BMPs at Peppermint Brook and Lily Pond**
by the Cohasset Water Department

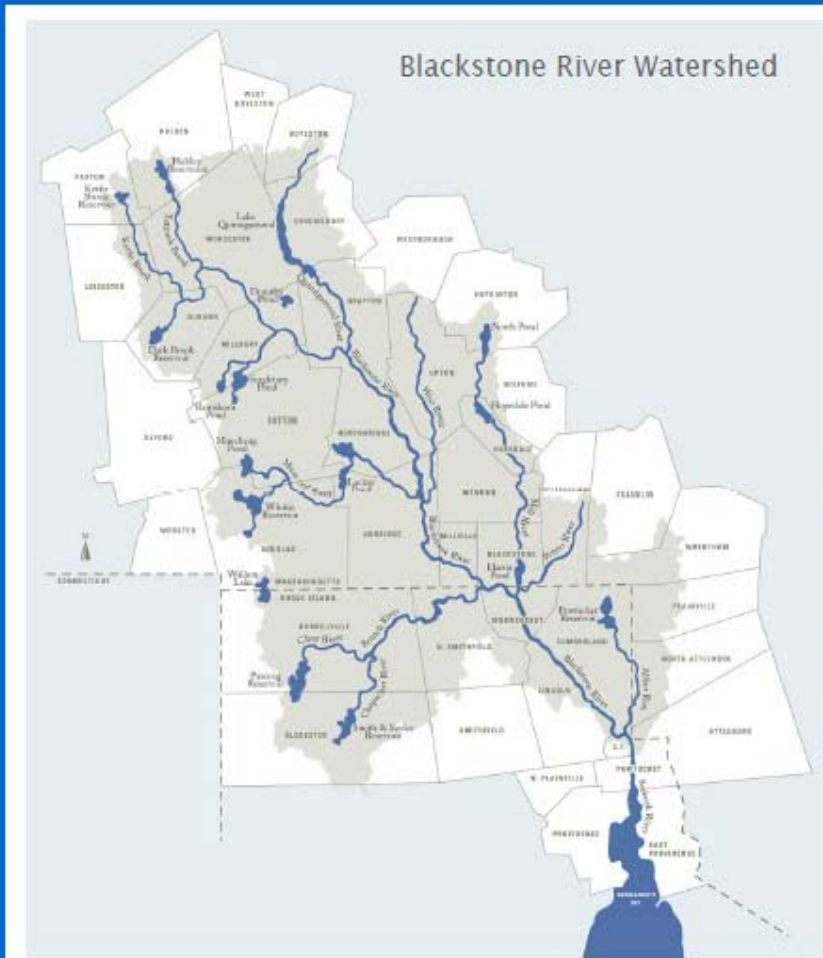
- 04-01/319 **Operation and Maintenance of MASSTC**
by the Barnstable County Dept. of Health and the Environment
- 04-02/319 **UMass/EOEEA Innovative Stormwater Technology Transfer and Evaluation**
by the University of Massachusetts/Amherst
- 04-03/319 **LID Training and Technical Assistance for Local Decision Makers**
by the North and South Rivers Watershed Association
- 04-04/319 **Upper Charles River Watershed Total Maximum Daily Load and Watershed-Based Plan**
by the Charles River Watershed Association
- 04-05/319 **Phosphorus and Sediment Load Reduction at Quaboag and Quacumquasit Ponds**

- by the Town of Brookfield
- 04-06/319 Enhancing Implementation of Nutrient Management on Massachusetts Crop/Livestock Farms to Reduce the Risk of Nonpoint Source Pollution**
by the University of Massachusetts/Amherst
- 04-07/319 Stormwater BMP Implementation for Route 28 to Bass River Subwatershed**
by the Town of Yarmouth
- 04-09/319 Stormwater Management Retrofits for the Samoset Street Outfall to Plymouth Harbor**
by the Town of Plymouth
- 04-10/319 Pontoosuc Lake Watershed Planning Program**
by the Berkshire Regional Planning Association
- 04-11/319 Cold Spring Brook Watershed Remediation**
by the Town of Wellesley
- 04-12/319 Demonstration Boat Bottom Wash Water System**
by the Manchester Marina
- 04-14/319 Development of Watershed-Based Plans**
by BETA Group, Inc.
- 04-15/319 Dudley Pond Comprehensive Water Quality Improvement Project**
by the Town of Wayland
- 05-01/319 Operation and Maintenance of the Massachusetts Alternative Septic System Test Center**
by the Barnstable County Dept. of Health and the Environment
- 05-03/319 Windsor Reservoir Restoration Project**
by the Dalton Fire District

Appendix B: A Homeowner's Guide to Protecting Water Quality in the Blackstone River Watershed (Blackstone River Watershed Association, 2010b)

Campaign for a Fishable/Swimmable Blackstone River by 2015

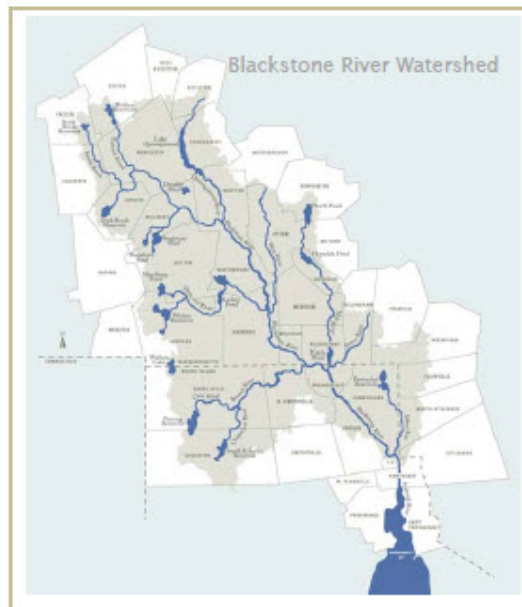
A Homeowner's Guide to Protecting Water Quality in the Blackstone River Watershed



If you live in the shaded area of the map, then you live in the Blackstone River watershed. You can help restore and protect its water quality. Look inside to learn how. A cleaner Blackstone River begins in your own backyard!

Campaign for a Fishable/Swimmable Blackstone River by 2015

A Homeowner's Guide to Protecting Water Quality in the Blackstone Valley



If you live within the shaded area, you live in the Blackstone watershed.

A Cleaner Blackstone River Begins in Your Own Backyard!

Lawns/
Gardens

Car Care

Pet Waste

Clean
Dishes/
Clean
Streams

Rooftop
Runoff

Household
Hazardous
Waste

Pervious
Surfaces

Stream
Buffers

THE BLACKSTONE VALLEY is, in fact, a watershed – a drainage basin that includes all the land over which rain and snowmelt flow to the Blackstone River. Reducing polluted runoff, or nonpoint source pollution, in the watershed is the major goal of the Blackstone River Coalition. We're working with homeowners, business owners, developers and local decision makers to all do their part – it's called the "Tackling Stormwater in the Blackstone River Watershed" initiative. Together, we can all help reach the goal of a fishable and swimmable Blackstone River by 2015.

Introduction:

WE DRINK IT, bathe in it, flush it, swim in it and more. Water is an integral part of our every day lives. The water you use to drink, wash, and cook comes from a watershed near your home. Every community, whether it is hilly or flat, urban or rural, is part of a watershed. Ours is the Blackstone River's watershed, with many sub-watersheds for the tributaries that drain to it. Within each watershed, all water drains to the lowest point, carrying with it soil particles, oil, road salt, organic materials, pesticides, and fertilizers.

THE BLACKSTONE AND ITS TRIBUTARIES define our landscapes, yet their beauty hides the fact that beneath the surface, those streams and rivers are not entirely well. Runoff from roads, parking lots, lawns, and farms can carry oil, metals, bacteria, pesticides, and nutrients into streams, making them unhealthy places for critters like fish and aquatic insects to live. High bacterial levels can make it unsafe for humans to swim.

BUT THERE IS GOOD NEWS...we know the prescription for the Blackstone's health, and it starts with us. By each of us developing simple, water-friendly lifestyle practices right at home we can make a huge difference!

What You Can Do....

This guide is designed to help us reduce our impact on the streams and rivers in the Blackstone River watershed. To achieve this we need to develop new yard- and home-care practices that reduce our pollution, storm water volume, and water consumption. To learn how, turn the page.

Reducing pollutants: Water running off our lawns, roads, and other surfaces picks up nutrients, bacteria, and chemicals, carries them to stormdrains in the roads, and then deposits them directly into streams in the Blackstone watershed. These pollutants can cause a variety of problems for living things — including humans — that live in or interact with our streams. For example, extra nutrients from fertilizer cause too much algae to grow, which robs the water of oxygen and makes it a bad place for fish, snails, and other stream critters to live. If the stream isn't a healthy habitat for these critters, this in turn affects animals that are higher in the food chain, like mammals and birds.

Reducing storm water volume: Another major problem for the streams in the Blackstone River watershed is the sheer volume of storm water that flows into them. As the land becomes more and more developed, impervious surfaces like roads, parking lots, driveways and rooftops generate more and more runoff. Because there are fewer and fewer vegetated areas, there is less and less infiltration of rainwater.

Storm water from all parts of the watershed is concentrated in the storm drain system and carried to our streams at very high speeds. When the water finally reaches the streams, it blasts adjacent stream channels, causing them to become wider and deeper. The soil eroded from stream banks during storms smothers aquatic habitat in the Blackstone River watershed. Over time, this sediment is carried downstream to Narragansett Bay, where it combines with sediment from other urban streams in the Bay. Sediment is one reason that the Bay is unhealthy.

Reducing water consumption: Water that we consume in the Blackstone watershed eventually flows back into the Blackstone watershed, either through septic systems, wastewater treatment plants, or untreated into our storm drains. Using less tap water prevents unnecessary chemical treatment and disposal from the treatment plant, and save you money on your water bill. By not overwatering your yard, you can help prevent too much water — and pollutants — from entering the streams in the watershed.

As you decide which actions to do, remember this: The actions you learn about will reduce both pollutants and the volume of storm water entering the stream from your yard.



The Blackstone River Coalition is a partnership of numerous organizations working to restore the Blackstone River and improve the health of its watershed. For more information contact BRC Coordinator Peter Coffin at 508-753-6087 or peter.coffin@zaptheblackstone.org.

This guide was developed by Mass Audubon for the BRC, with partial funding from Southold Meadow Farm, Auburn, MA. It is adapted from the Watershed Approach to Stream Health (WASH) Project.



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Campaign for a Fishable/Swimmable Blackstone River by 2015

“Greening” Your Lawn and Gardens

Lawns/ Gardens

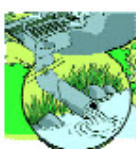
Reducing Your Use of Fertilizer, Toxic Pesticides, and Herbicide on Your Lawn and Gardens

WHY?

Car Care

Whether you are growing grass, beautiful flowers or delicious vegetables, consider doing this without using fertilizers, toxic pesticides, and herbicides.

Pet Waste



Lawn: If you have a lawn, you may be using fertilizers and weed killers to keep it green and weed-free. When it rains, these chemicals are washed into the street. **Storm drains** in the streets collect the runoff and empty it untreated into the nearest waterway. So, when you fertilize or treat your lawn, you could also be fertilizing or harming our lakes and streams. Fertilizer encourages algae growth. This can form large algae blooms and uses up oxygen that fish and other critters need to survive. Pesticides kill aquatic insects and herbicides kill aquatic plants, both of which fish and other species need to survive.

Clean Dishes/ Clean Streams

Gardens: In your gardens, herbicides and pesticides can harm children, pets, and local wildlife and kill helpful insects such as ladybugs and green lacewings that keep real pests in check. Even when used sparingly, these chemicals can end up washing down storm drains, into streams and eventually polluting the local water supply.

Rooftop Runoff

Here’s how to create a natural lawn and help protect the health of your family, wildlife, and our local resources.



<http://www.itsmore.nsw.gov>

Household Hazardous Waste

HOW?

- ◆ Get your soil tested and apply fertilizers only at the appropriate time in the right amounts. UMass Extension and URI Extension can help you test your soil and have information about chemical-free lawn and garden care.

- ◆ To naturally strengthen the resistance of your plants and lawn to pests, build healthy soil by adding organic matter such as compost. Make your own compost or purchase it.

Pervious Surfaces

- ◆ If you fertilize at all, it’s better to use compost instead of chemical fertilizers.

Fertilizers act as pollutants once they enter our waterways.

- ◆ If compost doesn’t work for you, then use an organic or slow-release fertilizer. A slow-release fertilizer has at least half of the nitrogen in water insoluble form. These fertilizers gradually release nitrogen to plant roots. This provides a steady supply of plant nutrients over an extended period of time. Because you need less fertilizer, you will save time and money.

Stream Buffers

- ◆ Select a fertilizer with low or no phosphorus. Most lawns already contain enough phosphorus. Excess phosphorus is the primary culprit of algae blooms in our lakes.

- ◆ Make fertilizer-free zones of at least 20 feet from the edge of lakes, streams or storm drains.

More →

- ◆ Sweep any excess fertilizer back onto the lawn. Do not hose it down to the drain.
- ◆ Cut the grass high to encourage the root system, and let the cut grass stay on the lawn to add moisture and act as a natural fertilizer. Don't dispose of grass or leaves in wetland areas, because they will "fertilize" local waters.
- ◆ Overseed thin areas in the spring and fall to crowd out weeds. Just rake to expose the soil, spread the seed, and cover with 1/4 inch of compost or soil.
- ◆ In your garden choose native plants that are naturally pest-resistant, less water-dependent, and adapted to our climate.
- ◆ If unwelcome pests do appear, pull them off by hand or spray them with a diluted solution of phosphate-free soapy water. You can also pick off the affected part of the plant. Remember that insects are part of your garden's ecosystem. The occasional pest in your garden may also be a food source for beneficial insects, amphibians and birds.

RESOURCES

UMass Extension: <http://www.umassgreeninfo.org/>
<http://www.umass.edu/plsoils/soiltest/>

URI Extension: <http://www.uri.edu/ce/factsheets/indices/0lawnmaintindex.html>
<http://www.uri.edu/ce/publications/soiltest.pdf>

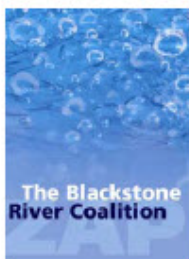
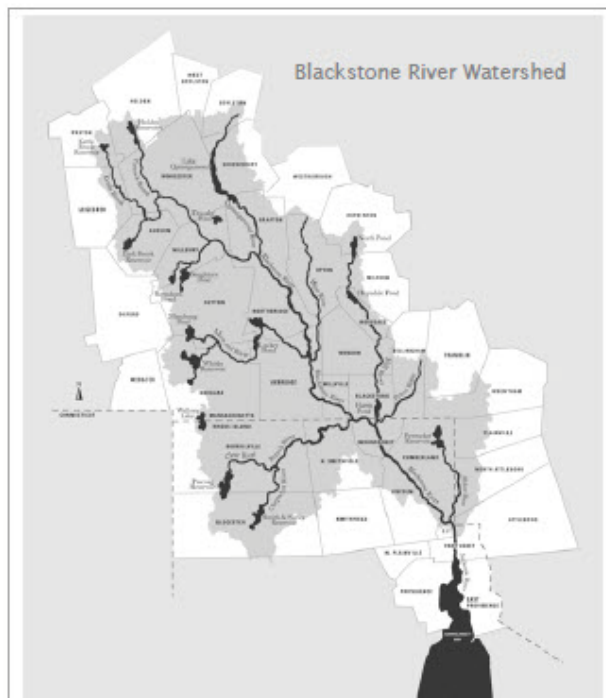
Cornell Cooperative Extension:
<http://www.gardening.cornell.edu/lawn/almanac/almanac.pdf>

EPA: <http://www.epa.gov/req3esd1/garden/what.htm>

BENEFITS

By "greening" your lawn and gardens, you prevent the pollution from fertilizers, herbicides and pesticides from flowing into the stormdrains and streams of the Blackstone watershed while making your yard a natural and safe place for you, your family, your pets, and your neighbors to enjoy.

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Campaign for a Fishable/Swimmable Blackstone River by 2015

Cleaner Car Care

Lawns/ Gardens	Fixing oil and antifreeze leaks, and getting clean on the green
Car Care	<p>WHY?</p>  <p>Leaks: Oil, antifreeze and other fluids that leak from your car are washed from your driveway into the street, and then into storm drains that flow directly into our Blackstone watershed waterways. In the U.S., it is estimated that petroleum washed off the pavement every year, along with dirty oil dumped directly into storm drains, sends 15 times more oil into the ocean than the Exxon Valdez did. One pint of motor oil can contaminate 125,000 gallons of drinking water and make an oil slick about the size of two football fields.</p> 
Pet Waste	
Clean Dishes/ Clean Streams	<p>Washing: How and where you wash your vehicle makes a difference to our local environment! The soap, together with dirt and oil washed from your vehicle, can find its way to local streams, wells and groundwater through storm drains, which are not linked to a water treatment plant. Runoff of excess phosphorous from cleaning products can contribute to the decline in health of our local streams. Phosphorus acts as a nutrient or fertilizer for aquatic plants, causing excessive growth. This pollution harms water quality and aquatic life.</p>  <p><small>http://www.itsmore.nsw.gov</small></p>
Rooftop Runoff	
Household Hazardous Waste	<p>Here's how you can reduce harmful oil and cleaning-product runoff from your vehicle.</p> <p>HOW?</p>
Pervious Surfaces	<p>Leaks:</p> <ul style="list-style-type: none">◆ If you notice vehicle fluids on your driveway, call your local repair shop to fix it, or repair it as soon as possible. If you change your own oil, return the used motor oil to the place where you bought it for recycling – it's the law in Massachusetts. Also you can check with your Department of Public Works to see if they collect it. Never pour it down the storm drain.
Stream Buffers	<ul style="list-style-type: none">◆ Clean up spills immediately. Use a non-toxic biodegradable chemical from your local hardware store that will safely break down oil deposits, or use kitty litter to soak up oil. Place it in your garbage can in a sealed bag. Do not hose fluids into the street where they can eventually reach local streams and lakes.◆ When parked in your driveway, keep a drip pan under the leak until you repair it. Empty the collected fluids into a tightly sealed and labeled container, and recycle it.

more →

Washing:

- ◆ If you wash your vehicle at home, wash it on grass or gravel instead of the street or driveway to help filter the soapy water and grime.
- ◆ Use soap that is biodegradable. To conserve water, make sure your hose has an on-off switch or nozzle.
- ◆ If you use a bucket of soap and water, pour what is left in your bucket down the sink so it can be treated, not down the stormdrain.

RESOURCES

<http://www.semcoq.org/OursToProtect/7SimpleSteps/CarCareTip.htm>

<http://www.mass.gov/dep/water/resources/oilspi01.pdf>

<http://www.dem.ri.gov/programs/bpoladm/stratpp/oilrecy.htm>

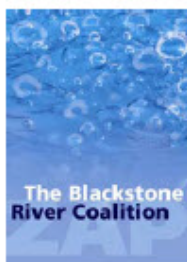
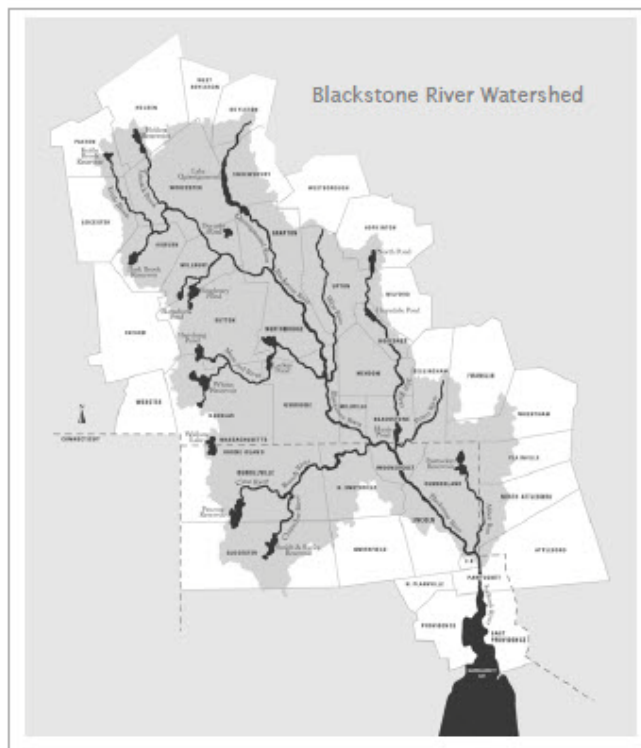
Visit EPA's website to learn about the "You Dump It, You Drink It" Campaign:

<http://www.epa.gov/epaoswer/hazwaste/usedoil/index.htm>

BENEFITS

You reduce the impacts of oil and other petroleum products from harming aquatic life, and avoid adding nutrients that cause excessive aquatic vegetation.

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Campaign for a Fishable/Swimmable Blackstone River by 2015

Poop Pickup

Lawns/
Gardens

Cleaning Up After Your Dog



WHY?

Car Care



Poop pollutes. Thousands of dogs live in the Blackstone watershed and their waste is a health risk when deposited on streets and lawns. It can be washed down **storm drains** and end up in our brooks, streams and rivers, and lakes and ponds. The bacteria, together with other pollutants, can make the water unsafe for swimming and cause health hazards for humans and aquatic life. It may be difficult to

Pet Waste

picture how one dog depositing a small amount of animal waste here and there can result in potential water pollution, but studies have shown that the cumulative impact of waste from all the pets, livestock, and resident waterfowl within a watershed can have a significant impact on water quality. Here's how to take care of your pet's poop without polluting your neighborhood and its water quality.

Clean
Dishes/
Clean
Streams

HOW?

Rooftop
Runoff

- ◆ When walking your dog, bring a small trowel or "pooper-scooper" and a plastic bag.
- ◆ Make sure your pet does not pee directly on the pavement. It is less likely the next rainstorm will wash the waste into the storm drains or local tributaries.
- ◆ After your pet does its business, scoop the poop and place it in the bag. Tie it shut until you get home.
- ◆ Flush the poop down the toilet or place the bag in your garbage can.

Household
Hazardous
Waste

- ◆ It's not just your dog! Feeding ducks and geese may seem harmless but, in fact, can be a nuisance to people and harmful to our water. Feeding waterfowl causes them to become dependent on humans. This, in turn, creates unnaturally high populations and problems in our parks and lakes. Waterfowl waste can pollute our water with harmful bacteria.

Pervious
Surfaces

RESOURCES

<http://www.uri.edu/ce/healthylandscapes/tips/7.html>

Stream
Buffers

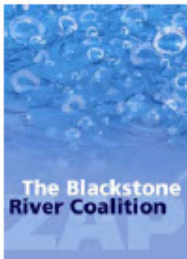
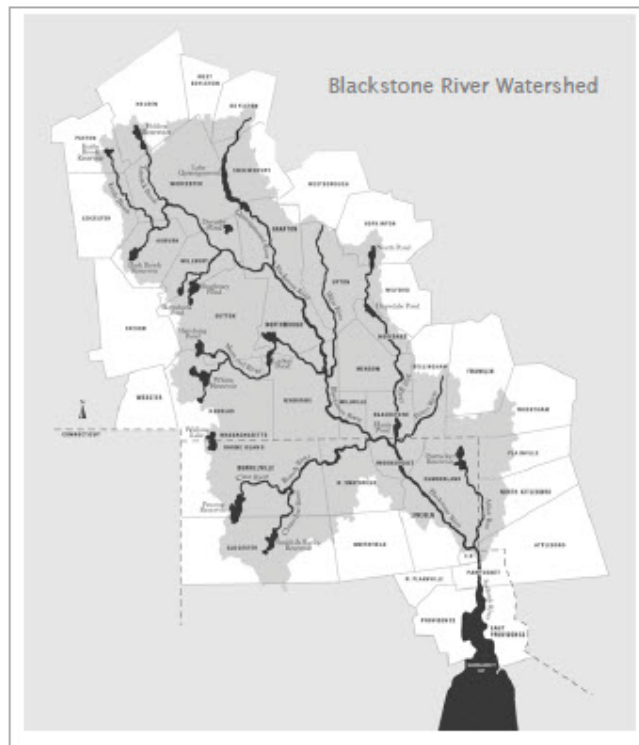
BENEFITS

You help keep the watershed healthy, protecting fish and wildlife habitats. You also make your neighborhood more enjoyable.

more →

Blackstone River Coalition www.zaptheblackstone.org

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Campaign for a Fishable/Swimmable Blackstone River by 2015

Clean Dishes and Clean Streams

Lawns/
Gardens

Using phosphate-free detergent in your dishwasher

WHY?

Car Care

Dirty soapy water from your dishwasher flows into your septic system, and can leach into the nearest waterway, bringing with it lots of phosphorus. Phosphorus is a nutrient and causes excessive aquatic plant growth, maybe in your local swimming area. Even if your home is sewered, treatment plants don't remove all phosphorus, discharging some to waterways.



Pet Waste

HOW?

Clean
Dishes/
Clean
Streams

◆ You can help improve water quality by using no- or low-phosphorus dishwasher detergent. Read labels and make sure phosphorus is not a listed ingredient. Most common brands of dishwasher detergent contain phosphorus, with the amount varying considerably by brand and by type, with the lesser amounts in gels and liquids, and greater amounts in powders and tablets/pacs. The chart shows percentage of phosphate by brand and type.

Rooftop
Runoff

Household
Hazardous
Waste

RESOURCES

This shelf survey was conducted at Big Y, Hannaford, Market Basket, Shaw's, Stop & Shop and Trader Joe's. Information is from the Mass. Department of Environmental Protection and the New Hampshire Department of Environmental Services website <http://www.des.state.nh.us/bb.htm>

Pervious
Surfaces

Stream
Buffers

BENEFITS

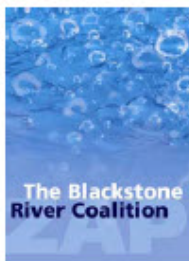
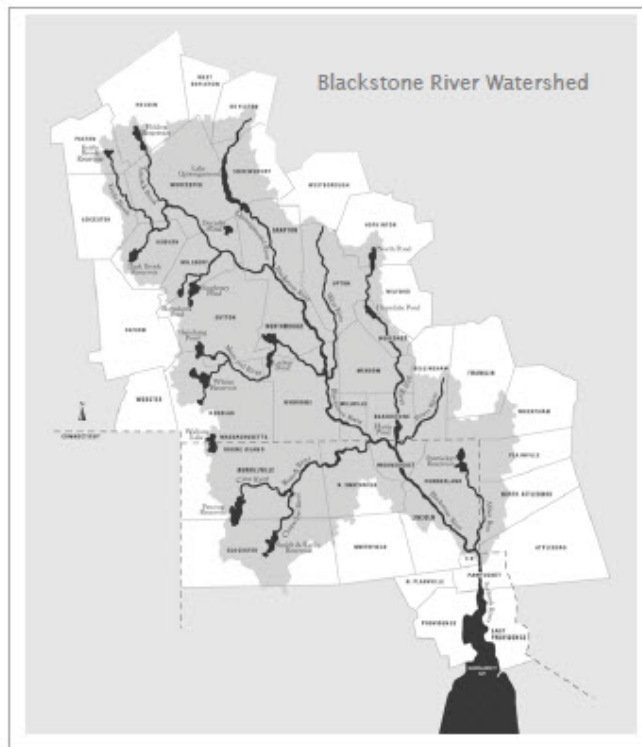
You reduce the amount of phosphorus entering our waterways and the wastewater treatment plants.

Automatic Dishwasher Detergent	% Phosphorus
Gel/Liquid	
Citrus Magic	0
Seventh Generation	0
Palmolive Gel	3.3
Electrasol Gel	3.7
Hannaford Gel	4.0
Best Yet Gel	4.0
Sunlight Gel	4.3
Cascade Liquid	4.5
Cascade Gel	4.5
Cascade Complete	5.0
Powder	
Trader Joe's	0
Electrasol	4.5
Sunlight 2 in 1	4.5
Hannaford	5.3
Cascade	6.4
Cascade Complete	6.9
Tablets/Pacs	
Sun & Earth Concentrated Pacs	0
Market Basket Tabs	8.0
Cascade 2-1 Pacs	8.0
Sunlight 3 in 1 Pacs	8.6
Electrasol Tabs	8.7
Electrasol 3 in 1 Tabs	8.7
Electrasol Gel Pacs	8.7
Dishwashing Liquid	
No phosphates allowed	0
Laundry Detergent	
No phosphates allowed	0

more →

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Campaign for a Fishable/Swimmable Blackstone River by 2015

Rooftop Runoff - Harvesting Rainwater

Lawns/
Gardens

Redirecting downspouts, collecting rainwater in rain barrels, and creating rain gardens can cut down on your water bill as well as protect water quality.

WHY?

Car Care



Water running off your roof during a rainstorm can be part of the problem — or a resource you can put to good use! On many properties in the Blackstone watershed, rooftop runoff from the gutter and downspout drains to the driveway or onto yards with compacted clay soil. In either case, it eventually flows into **storm drains** in the road and directly into our local streams, often causing flooding. Reducing storm water runoff is the first step to reviving life in urban streams.

Pet Waste

Clean
Dishes/
Clean
Streams

What's a rain garden? A rain garden is an attractive native plant garden with a special purpose: to reduce the amount of stormwater that rushes into our streams and other waterways. It is constructed as a place to direct the stormwater that falls on your property and is landscaped with water-loving native plant species. By creating a rain garden in your yard, you can use rain the way nature intended — instead of wasting this valuable resource!



http://news.uconn.edu/toolbox/publications/rain_garden_broch.pdf

Rooftop
Runoff

Here's how to divert rainwater runoff away from hard surfaces and create rain gardens to infiltrate more, so that you can help support aquatic life and reduce stream bank erosion. What's more, rainwater diversion can help you save water for use in your yard, eliminate potential flooding in your basement, and reduce your water bill.

Household
Hazardous
Waste

HOW?

Redirect downspouts:

Pervious
Surfaces

- ◆ Check your gutters and roof drains and remove any leaves or other debris that may block water flow. If leaf accumulation is a recurring problem, consider installing commercial gutter shields.

- ◆ If your roof drain downspouts discharge to your driveway or too close to the house, install extensions that carry the water at least six feet away from the driveway or foundation to a vegetated area of your yard. Use additional pieces of downspout or open gutters for the extensions. Place a splash block at the end of the extension to spread out the water as it runs onto your lawn. This reduces the potential for soil erosion.

Stream
Buffers

- ◆ Or you can collect runoff in a rain barrel to use for irrigation. Cut off your downspout at an appropriate distance from the ground, and place a rain barrel underneath. Place screening over it to protect it from leaf litter and mosquitoes. Attach a hose to the spigot or use a watering can.



more →

Create Rain Gardens:

- ◆ Look for low-lying areas of your yard where water tends to run or collect during a rainstorm.
- ◆ Dig out the soil 2-4 feet down, taking care not to destroy any significant roots of nearby trees.
- ◆ Mix shredded leaf mulch (available from your municipality) with the soil that you have removed. Refill the hole.
- ◆ Place a berm (small mound) along the lower edge of the area you've selected, so you can capture and retain stormwater.
- ◆ Plant the garden with water-loving native plants that can handle alternately very wet and dry conditions.

RESOURCES

Rain Garden How-To: http://nemo.uconn.edu/tools/publications/rain_garden_broch.pdf
<http://clean-water.uwex.edu/pubs/home.htm#yard>
<http://www.uri.edu/ce/healthylandscapes/rainbsources.html>

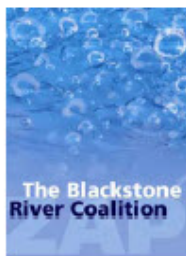
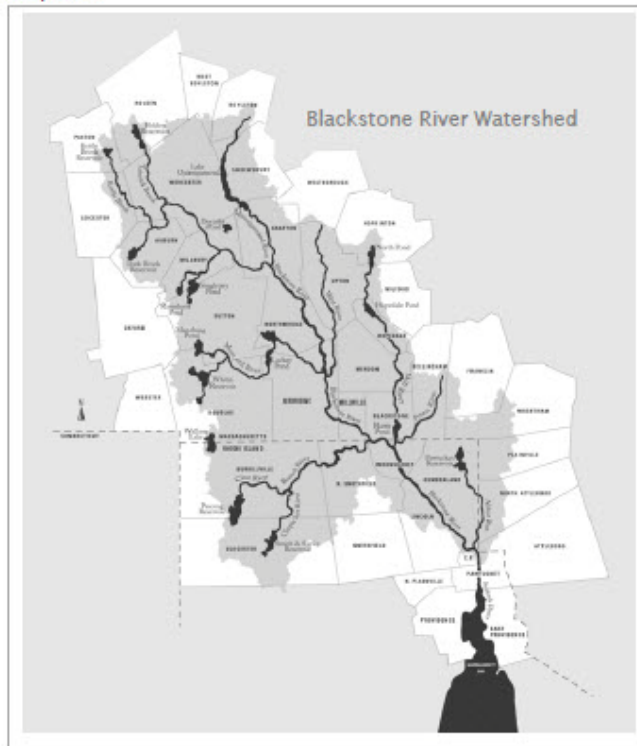
Visit Mass Audubon's demonstration rain garden at Broad Meadow Brook Conservation Center, 414 Massasoit Road, Worcester, MA.

BENEFITS

You reduce the volume of stormwater entering our streams, while creating a source of water for your yard between rainfalls. You also save money on your water and sewer bills.

Your rain garden will help keep water in the ground – where it belongs! It will also add an attractive and interesting new element to your landscaping.

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Campaign for a Fishable/Swimmable Blackstone River by 2015

H2W – Household Hazardous Waste

Lawns/
Gardens

Carefully storing and disposing of household cleaners, chemicals, and oils



Car Care

WHY?



Antifreeze, household cleaners, gasoline, pesticides, oil paints, solvents, and motor oil are just some of the common household products that can enter our **storm drains**. Help keep these out of our lakes and streams. Instead of putting these items in the trash, down the storm drain, or on the ground, take them to a local hazardous waste center or collection day.

Pet Waste

Clean
Dishes/
Clean
Streams

HOW?

Here are some simple steps you can take to carefully dispose of household wastes and help keep our water clean. Give them a try. A few simple changes can make a big difference!

Rooftop
Runoff

- ◆ Identify it. Be aware of household products that can harm children, pets, and the environment. The words "danger," "caution," "warning," or "toxic" indicate that you need to be careful in how you use and dispose of the product.

- ◆ Less is better. Reduce waste and save money by purchasing only the materials you need. When possible, choose less toxic alternatives. For example, try cleaning your windows with vinegar and water.

Household
Hazardous
Waste

- ◆ Store properly. Keep unused products in their original containers with labels intact. Select cool, dry storage areas that are away from children, pets, and wildlife.

Pervious
Surfaces

- ◆ Disposal is key. Never dump motor oil, chemicals, and other toxic materials down storm drains, sinks, or on the ground. Contact your local community for disposal locations, guidelines, and dates.

- ◆ Don't forget the RV. Dispose of recreational vehicle sanitary waste at a nearby drop-off location. Never put it down a storm drain or roadside ditch!

Stream
Buffers

RESOURCES

<http://www.uri.edu/ce/wg/has/PDFs/WQP.Hazardous.pdf>

For more information on RV dump locations and requirements:

MA: <http://www.rvdumps.com/dumpstations/node/46>

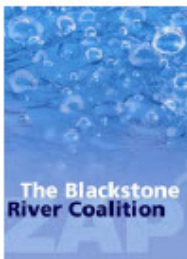
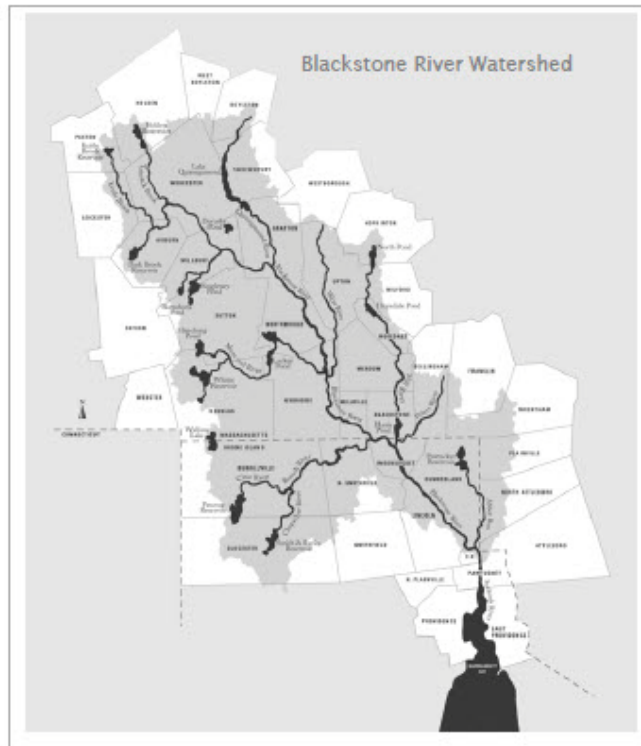
RI: <http://www.rvdumps.com/dumpstations/node/65>

more →

BENEFITS

By keeping these toxic materials out of our waterways, you make living much easier for aquatic critters and plants.

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Campaign for a Fishable/Swimmable Blackstone River by 2015

Homeowners: UNPAVE!



Lawns/
Gardens

Reducing paved surfaces

WHY?

Car Care



This is one of the most important actions you can take toward helping to improve our local streams in the Blackstone watershed. Did you ever consider how much water runs off your property during a rainstorm? Every time there's a heavy rain, hundreds—even thousands—of gallons of water fall on your roof, driveway, patio, and other paved surfaces. These surfaces are called "impervious" because it is impossible for the water to penetrate them.

Pet Waste

Clean
Dishes/
Clean
Streams

Instead of seeping back into the ground, the water rushes from your property into **storm drains**, picking up chemicals, litter, oil and other pollutants along the way. From the storm drains, it flows directly into local streams, untreated. The large volume of water that flows into our streams during a rainstorm flushes life out of our waterways, erodes stream banks, recedes quickly, and leaves excessively low levels of water in the stream after a rain. Storm water running off of impervious surfaces does not infiltrate to ground water, so there is less recharge in our streams. Our streams are "flashier", with higher high water and lower low water.

Rooftop
Runoff

Here's how you can reduce runoff from your property and infiltrate more.

HOW?

Household
Hazardous
Waste

- ◆ Analyze how much of your property is covered with paved surface. Make a list of all of the impervious surfaces, including your roof, driveway, patio, and other paved areas.
- ◆ When it comes time to repave your driveway, front walk, or other pathways, choose gravel, wood mulch, or open-design pavers such as flat stones, bricks, pre-cast concrete lattice pavers, or pervious concrete. Place the new cover on well-drained soil or on a sand or gravel bed, so that rainwater can soak into the ground. (If weeds grow in the spaces between pavers, consider introducing moss as a natural way to crowd out weeds and make the area more attractive.)
- ◆ If you want to take action right away, decide where you could most easily remove impervious surface and replace it with wood mulch, gravel, soil, or alternative pavers.

Stream
Buffers

- Start with one small area or project, and expand from there.
- Remove the paved surface or compacted soil using a pick or hire a contractor to remove the pavement for you.
- Break up the compacted soil underneath, and add shredded leaf mulch to help the soil retain water.
- Cover with the pervious surface of your choice, as indicated above.

more →

- ◆ If you're thinking about building an addition on your house, consider building up – not out.

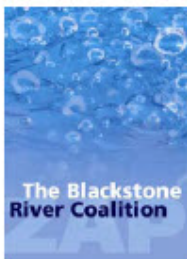
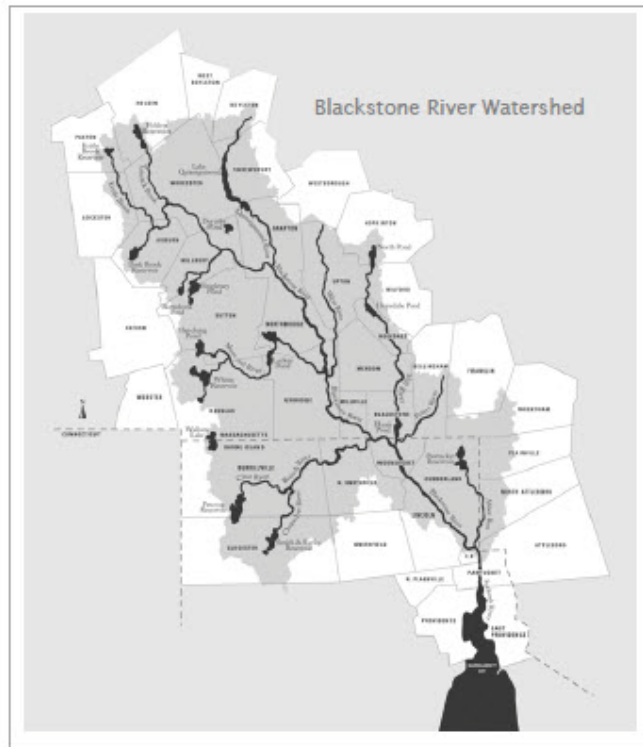
RESOURCES

http://www.recycleworks.org/greenbuilding/sus_impervioussurfaces.html
<http://www.spacreek.org/cn-storm.htm>

BENEFITS

By replacing hard surface with porous surface, you will allow water to be absorbed into the ground. Not only will you save thousands of gallons of rainwater from running into the storm drains and into the streams – you are helping to replenish our groundwater at a time when water is more precious than ever!

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Campaign for a Fishable/Swimmable Blackstone River by 2015

Life on the Edge – of a Waterway



daf.chesoo.org/

Lawns/
Gardens

Maintaining stream buffers and tree canopies

WHY?

Car Care

A key component for improving water quality is the protection of environmentally sensitive areas of vegetation that exist near streams, lakes and ponds, and wetland areas. These buffer areas help protect water quality in local streams and the mainstem of the Blackstone.

Pet Waste

Vegetated buffers and tree canopies along stream banks shade waterways thus keeping temperatures down and dissolved oxygen up, provide detritus in the stream that serves as food and shelter for aquatic species, and stabilize stream banks, stream channels and floodplains from the erosion and scour of high velocity flood flows. These buffers also serve as the link between terrestrial wildlife and their source of water, food and cover. The roots absorb and "take up" nutrients and other pollutants from ground water as it migrates through the root zone. Plant stems and leaves filter pollutants and sediment from overland flow of storm water through passing through the buffer.

Clean
Dishes/
Clean
Streams

Rooftop
Runoff

Buffers prevent lawn chemicals from entering the waterway. Fertilizers washing into aquatic systems can cause algae blooms, which can ruin swimming and boating opportunities, create foul taste and odor in drinking water, and kill fish by removing oxygen from the water. Buffers also prevent sedimentation from erosion. Too much sediment can cloud the water, reducing the amount of sunlight that reaches aquatic plants, and raising water temperature thus reducing oxygen. Sediment can also clog the gills of fish or smother fish larvae.

Household
Hazardous
Waste

It is very important to protect and restore stream buffers and tree canopy to help preserve these environmentally sensitive areas. If you are lucky enough to have a waterway or wetland on your property, you have a unique opportunity to help improve water quality in your neighborhood and the Blackstone River. Here's how to create, protect and maintain buffer areas.

Pervious
Surfaces

HOW?

Stream
Buffers

- ◆ Don't mow down to your stream. Leave at least 10 feet in native plant buffer to filter pollutants.
- ◆ If you fertilize your lawn, stop application at least 20 feet from water's edge to minimize runoff.
- ◆ Reduce surface water runoff and erosion by using permeable paving surfaces, directing runoff to planted areas and increasing groundwater recharge.



[more →](#)

- ◆ If your stream bank has begun to erode, seek expert help to repair it.
- ◆ Compost yard waste such as grass clippings, sticks, leaves, and brush; do not dump on the river's edge or into the water, as it can add nutrients that result in excessive aquatic plant growth just like fertilizer does.

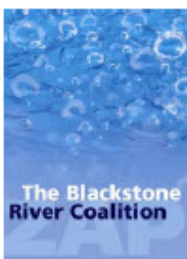
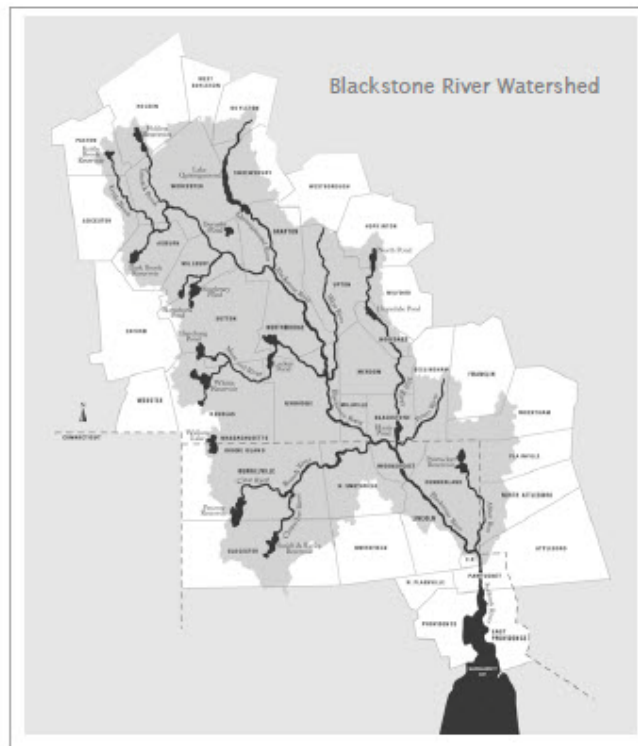
RESOURCES

http://www.uri.edu/ce/healthylandscapes/URI_HomeLandImprovement.pdf

BENEFITS

You help keep the watershed healthy, protecting fish and wildlife habitats. You also make your neighborhood more enjoyable.

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Appendix C: Case Studies

Wagenet, L.P., Pfeffer, M.J., Sutphin, H.D., & Stycos, J.M. (1999). Adult Education and Watershed Knowledge in Upstate New York. *Journal of the American Water Resources Association*, 35(3), 609-621.

Public education is essential for successful integrated watershed management. However, according to Wagenet et al., educational programs that teach the concept of watersheds are often unavailable to residents and stakeholders. As such, this study assessed the effects on an education program, especially in regard to the prevention of nonpoint source pollution, for residents of the New York City watershed. A survey was sent to residents within the watershed and evaluated and compared concerning their retained knowledge and attitudes. There were three targeted groups: individuals who fully utilized the educational materials (full users); individuals who received the materials but did not fully use them (partial users); and individuals who did not receive the materials (nonrecipients). Participants were selected from rural and suburban counties immediately surrounding New York City, an area from which the City receives its drinking water.

The study examined environmental knowledge according to knowledge, which deals with fact recall; application, which represents average cognitive ability; and evaluation, which involves values and judgment to assess issues. The program was evaluated using developed indexes and scales from the survey results, allowing the authors to correlate the responses to measures of interest. Computational procedures were also utilized to allow for the characterization of relationships and interactions compared to the experimental variables.

In Fall of 1995, the authors issued a series of fact sheets and a videotape describing water supply protection concepts to the participants over a course of several weeks. The first fact sheet, "What is groundwater and how can you protect it?" broadly discussed groundwater. The second fact sheet, "What is a watershed," examined watersheds on a scale that allowed the residents to fully comprehend the technical terms. Fact sheet number three, "What is nonpoint source pollution and how can you prevent it?" tied together groundwater and watersheds and how almost 90% of New York State's water quality problems were created by nonpoint source pollution, at the time. The last fact sheet, "What is the best way to maintain a septic system?" related concepts from the previous three sheets to the individual septic system. The final ten-minute videotape presentation, "Water Resource Protection," allowed for self-directed learning using a different strategy. Surveys were then mailed in January 1996.

The results of the surveys showed that readership had a positive and statistically significant, albeit weak, correlation to knowledge—if the participants had access to the material, they were able to learn from it. Individuals who completely utilized the educational program were more significantly knowledgeable in watershed issues than the other two variable groups. This suggests that simple fact sheets and videotapes are effective tools for educating the public about watershed concepts. However, the results did not indicate any relationship between reading the material and applying the concepts. Moreover, the study indicated that residents who were hostile to New York City watershed protection issues did not fully use the program, as expected.

Christine G. Wyman (2008). Stakeholder Participation in Watershed Management: An Evaluation of the Jordan Lake Stakeholder Project (Master's thesis). Available from Nicholas School of the Environment and Earth Sciences database.

The case study "Stakeholder Participation in Watershed Management: An Evaluation of the Jordan Lake Stakeholder Project", by Wyman evaluated the Jordan Lake Stakeholder Project (JLSP) based on the framework of its procedures and outcomes. The JLSP was a public participation project convened by North Carolina Department of Water Quality (DWQ) in respond to high level of nutrient found in the Jordan Lake. The JLSP brought together 222 individuals from 113 organizations to implementing watershed plans along with the government agency to target the containments in the lake. The author analysis the case study on the criteria of process execution, process fairness, and technical support to indicates the successes and failures of the JLSP.

The indicators for execution process in Wyman's framework are to identify the clearness of implementation plan to the participants and the participant's involvement in the decision making. The interviews respondents in Wyman's report "indicated conveners and facilitators should have defined consensus and a clear endpoint to the process." Because the DWQ is required by law to retain the final decision-making authority, it should be make clear to the stakeholders how consensus and non-consensus based decision will be incorporated in the final decision.

The process fairness indicates whether the public participants are treated with respect in the development of management strategy. Through the data Wyman collected from the interviews and survey from the participants in JLSP. She found that not all stakeholders are treated with respect. The reason is due to the non-participant stakeholders in JLSP delaying the implementing plan proposed by the DWQ. The non-participants are inconsiderate of the participants who are involved and committed to maintaining the watershed health. In respond, this lack of respect has contributed to the JPLS's failure to develop a "consensus-based nutrient management strategy."

One challenge to JSPL was concerned with participant's understanding of the technical information. In Wyman's analysis it concluded a successful collaborative process needs to focus more on education at the beginning of the process. Through education, participants are able to understand the technical aspect of implementing a watershed plan. In addition, to improve participants knowledge in technical information JLSP have allow stakeholders to participate in the planning and development of data collection and water quality modeling.

Wyman found that when all stakeholders are not included, problem will arise when the project recommendations are to be implemented. The willingness of public participants who are cooperative and committed to the watershed management is important to the success of partnership. In addition, for a success watershed management, educating the participants is essential in the planning and decision making of watershed recommendations.

S. Danielson, S.L. Santos, T. Webler, and S.P. Tuler (2008). Building and Breaking a Bridge of Trust in a Superfund site remediation. *International Journal of Global Environmental Issues*, 8, 45-60. Retrieved from <http://ideas.repec.org/a/ids/ijgenv/v8y2008i1p45-60.html>

The case study “Building and Breaking a Bridge of Trust in a Superfund site remediation” by Danielson, Santos, Webler, and Tuler was based on the analysis of a contaminate site in New Jersey watershed. In 1950s to the 1990s, a chemical company disposing toxic wastes into several watershed basins that leached into groundwater that was used by the local municipal water system and private wells in the community. In the case study, the authors will present two cases; the distrusting stakeholders were able to achieve cooperation through a moderate links of trust with two intermediaries, and the breaking of the trusting link by the formation of too much trust between the stakeholders.

The authors identified individual actors in the watershed to let the readers have a better understanding of their role in the cleanup process; the general public is the risk bearer, and the company is the risk manager. When the site was listed on the Nation Priority List and proceeds with the cleanup process, there was no trust between the stakeholders. The public thought of the company only acting on profiting their business, while the EPA was postponing on the cleanup process. In addition, the lack of communication with each other also makes the public more distrusting on the company and the EPA.

The distrusting was resolved when a group of citizens aimed at pushing for the cleanup. This group brought together 500 volunteers to advocate the general public, and the public was able to trust in the group due to its leadership and its symbolization as the public’s interest in the site. The non-government organization (NGO) eventually brought together the distrusting actors to push forward the cleanup process. The company has provided the necessary funding and the technical expertise to the cleanup. The authors noted that by having company directly involved in cleanup process it was able to avoid legal paperwork.

The key of not keeping a strong links of trust between the public, the company, and EPA is to allow each individuals actor checking on each other’s work. Danielson et al (2008) demonstrates on the case study the importance of not strengthen trust between one another. In the cleanup process, EPA did parallel check studies to double check the company’s work. The parallel studies allowed EPA to demonstrate that “it was keeping a close eye on the company. The public had extensive access to these studies, including in draft form, and this helped to convince them that EPA and the company were not trying to hide anything.” This allowed the NGO to build trust with the EPA and the company. The NGO received funding from the company and the EPA that was used to hire independent technical expertise. The technical expertise conducted tests to double check EPA and the company’s testing result.

One important mechanism that was mentioned in the case study to build trust between the stakeholders is to allow public participants in the decision making. EPA’s openness toward the NGO by making efforts to listens to public’s concern and doubt with the site cleanup. As the cleanup of the site close to its completion, many public began to fade away from the scene. Without any controversy to motivate them, the public focus on the site was taken away. Danielson et al (2008) quotes from one of his interviewee, “I think what’s happened with the community involvement is that now that the cleanup is happening, and everything is taken care of, the community is no longer interested. It’s not news.” As the public faded from the scene, the NGO become less representation of public’s interests.

The case study point out several important factors of constructing trust between the stakeholders and getting public involve in the cleanup process. There must exist a general interest, it plays an important role of motivating public to participate. As the authors point out, the public has interests to cleanup due to the containments in the site affecting their health, and the company and the EPA must be willing to share information to the public. Openness to the public was critical of trust-building, and the importance of for each actors checking on one another's work. By these factors that allows the decision making and implementation plan in the cleanup site to go forward.

Sustainable Watershed Management: An International Multi-Watershed Case Study. Walter Wagner, James Gawel, Hiroaki Furumai, Marcelo Pereira De Souza, Denilson Teixeira, Leonardo Rios, Shinichiro Ohgaki, Alexander J. B. Zehnder, and Harold F. Hemond

This case study compares watersheds from Massachusetts, Japan, Switzerland, and Brazil. Sustainable water management practice was achieved by a common learning process involving industrialized, newly industrialized, and developing countries following general sustainability guidelines.

The demand for natural resources by growing global population and freshwater will be the first resource to run short. Local human activities such as water consumption, waste production, construction of buildings and traffic systems and engineering of rivers has caused damage to watershed. The author believes that many of these water problems are either “home-made” or are the result of upstream activities.

Aberjona River Watershed is a watershed in Massachusetts that runs 15-22 km northwest of Boston and discharges into Upper Mystic Lake. The watershed is highly urbanized with embedded commercial and industrial areas. The Tama River Watershed in Japan wraps around the southeast through Tokyo and then empties out into Tokyo Bay. This river flows through a mountainous region. Toess River Watershed is located in Switzerland. The watershed starts in Northeast of Zurich and runs through the pre-alpine region to southeast and flows northwest. The Headwaters are forested and the lower part highly influenced by industrial and agricultural activities. Atibaia River Watershed is located in Sao Paulo, Brazil. Its starts in the Eastern part of Sao Paulo State and flows westward starting from Mantiqueria Mounts meets with Jaguari River then goes into Piracicabi River. The upper part of the watershed is mostly forested area and undeveloped while the lower part is highly influenced by agricultural and industrial activities.

Aberjona Watershed is a highly developed suburban area that is mostly residential. It does contain large area of commercial or light industrial development. The area gets most of water outside of watershed because in the early 19th century to mid-20th century, the area was dominated by leather and chemical industry. Woburn, in the middle of the watershed, contains thousands of tons of arsenic, chromium, and other toxic metal during 1890 to 1950. In addition, there are organic solvents in water. The nitrogen concentration exceeds 100ppm. The nutrients in the river of the watershed overshadows the toxic chemicals and as a result little has been done been done then.

In 1970s, a cluster of childhood leukemia cases centered in east Woburn brought the river to the attention of the government and this event was known as the Woburn toxic trials. The contaminated water came from municipal wells adjacent to Aberjona River. Flooding of the rivers caused deposits of sediment into adjacent rivers that contains high levels of arsenic that exceeded Massachusetts regulatory limits. Today, the river is used highly for fishing, swimming, boating, and other recreational activities

In the early 1950s, Japan policies for the Tama River watershed focused mainly on the protection of the population and agriculture from flooding and provide enough water for citizens, industry and agriculture. In 1960s, the industrialization caused massive environmental problems. The population increased and became more dependent on the river as a source of water. This caused the lower part of the watershed to receive little to no flow during the dry season. By 1970s, the water demand was so high that the only choice the community had was to build a purification plant. At the time Japan just developed a water quality standard with the goal of

protecting human health and regulation of biochemical oxygen demand. Today the river's flow is controlled by dams. Aquatic habitats have been reduced. In addition, fish population can only survive by having a large number of fish introduced each year.

The Toess watershed is facing water quality and quantity problems that are caused by the industrialization of European countries, population growth, and increased agricultural activities. This has led to a shortage of water, dangerous chemicals in water as a result of agricultural pesticides and fertilizers, and synthetic chemicals from the discharge of wastewater. Today the amount of pollution entering the watershed has decreased. High concentration of phosphorus and nitrate has decreased since 1970s and are now under the national regulation limits. However, it was determined that the decreases in nutrient in ground water and surface water in point source pollution was largely offset by the increase in non-point source pollution. Habitats have been severely affected and many animals and plants are becoming or are already extinct in the area.

The Atibaia Watershed is polluted from urbanizations along the Atibaia River. Chemical, petrochemical, textile, paper, and food industries moved into the watershed which lead to a huge growth in population. The community is highly dependent on the water. Because the watershed does not have a treatment facility, water in the lower part of the river is no longer suitable for consumption.

The authors conclude that population growth and economic development in these watersheds was accompanied by a decrease in water quality. Water quantity and quality are a result of human activities such as industrial waste, agricultural pesticides and fertilizers, and wastewater. Water quantity is affected by people take water from ground and surface, and the increase in impervious surfaces. The Abjeona, Tama, and Toess are trying to clean the rivers with energy intensive and costly clean techniques.

Appendix D: Interview Questions and Protocols

Interviewees:

- Donna Williams, Advocacy Coordinator of the Massachusetts Audubon Society and President of the Blackstone River Coalition
- A representative from the Neponset River Watershed Association

Protocol: This interview was conducted electronically. After the interview request was accepted, questions were compiled and emailed to the interviewee. The interviewee was asked if anonymity was preferred and if he/she could be contacted with follow up questions.

Questions:

1. Why do you feel watersheds are important?
2. What do you think are the biggest challenges to watershed management?
3. What do you think are the current problems with watersheds?
4. What do you think is the best way to solve these problems?
5. Do you think public education about watersheds is essential to preventing watershed degradation? If so, please explain.
6. A. Does your organization currently have any educational programs or outreach available to the public? If yes, please explain. If not, have you ever had any in the past or plan on implementing any in the future?
B. What has been the turnout on these programs? Would you consider this successful?
C. Do you feel these programs could be beneficial in other watersheds?
7. Have you received any feedback on the programs?
8. What are your means for educating the public?
9. Are these means limited by anything [resources]?
10. Have these means proved successful? Please explain.
11. A. What methods of outreach do you think would be most influential?
B. Why have these methods not been implemented?
12. In your opinion, do you think the government provides enough funding for the watershed organization?
13. Roughly how much of the organization's total funding comes from the government?
14. What does a majority of your spending go into and why?
15. What is your opinion of the government funding request/approval process? How can this be improved?
16. Do you receive your funds in a timely matter?
17. If you were given additional funding, what would you use the funding for?

Interviewee: Blackstone River Watershed Council: John Marsland, President; Alice Clemente, Secretary; and Joe Pailthorpe, Treasurer

Protocol: Upon interview request acceptance, the team met with the interviewees to conduct an interview. The interview began with the team explaining the project and their current understanding of watersheds at that time. The interviewees were asked if anonymity was preferred, if they could be contacted with follow up questions, and if the interview could be recorded.

Questions:

1. Why do you feel watersheds are important?
2. What do you think are the biggest challenges to watershed management?
3. What do you think are the current problems with watersheds?
4. What do you think is the best way to solve these problems?
5. Do you think public education about watersheds is essential to preventing watershed degradation? If so, please explain.
6. A. Does your organization currently have any educational programs or outreach available to the public? If yes, please explain. If not, have you ever had any in the past or plan on implementing any in the future?
B. What has been the turnout on these programs? Would you consider this successful?
C. Do you feel these programs could be beneficial in other watersheds?
7. Have you received any feedback on the programs?
8. What are your means for educating the public?
9. Are these means limited by anything [resources]?
10. Have these means proved successful? Please explain.
11. A. What methods of outreach do you think would be most influential?
B. Why have these methods not been implemented?
12. Do you think that public participation will improve watershed protection?
13. What is the public's role in watershed management?
14. Do you think that public participation in watershed management decision-making is the best way to manage a watershed? Can you give us some examples of past watershed decision-making?
15. What are some strategies the organization has used to recruit the public in watershed protection?
16. What do you think is the biggest challenge when recruiting public participants in watershed management?
17. What are some of the reasons that encourage public participation in watershed management?
18. Is most of the public participation involved in long-term watershed management?
19. How active is the public participation in watershed management?
20. What do you think are some of the reasons why the public does not want to participate in watershed protection?
21. In your opinion, do you think the government provides enough funding for the watershed organization?
22. Roughly how much of the organization's total funding comes from the government?
23. What does a majority of your spending go into and why?

24. What is your opinion of the government funding request/approval process? How can this be improved?
25. Do you receive your funds in a timely matter?
26. If you were given additional funding, what would you use the funding for?

Follow-up Questions:

1. Where does your organization get their funding from? What are the percentages of the total funding comes from these resources?
2. How is your funding used among your organization? What does a majority of your spending go into and why?
3. What is your opinion of the government funding request/approval process? How can this be improved?

Interviewee: Elizabeth Campbell, Executive Director of Nashua River Watershed Association

Protocol: Upon interview request acceptance, the team met with the interviewee to conduct an interview. The interview began with the team explaining the project and their current understanding of watersheds at that time. The interviewee was asked if anonymity was preferred, if he/she could be contacted with follow up questions, and if the interview could be recorded.

Questions:

1. Why do you feel watersheds are important?
2. What do you think are the biggest challenges to watershed management?
3. What do you think are the current problems with watersheds?
4. What do you think is the best way to solve these problems?
5. Do you think public education about watersheds is essential to preventing watershed degradation? If so, please explain.
6. A. Does your organization currently have any educational programs or outreach available to the public? If yes, please explain. If not, have you ever had any in the past or plan on implementing any in the future?
B. What has been the turnout on these programs? Would you consider this successful?
C. Do you feel these programs could be beneficial in other watersheds?
7. Have you received any feedback on the programs?
8. What are your means for educating the public?
9. Are these means limited by anything [resources]?
10. Have these means proved successful? Please explain.
A. What methods of outreach do you think would be most influential?
B. Why have these methods not been implemented?
12. In your opinion, do you think the government provides enough funding for the watershed organization?
13. Roughly how much of the organization's total funding comes from the government?
14. What does a majority of your spending go into and why?
15. What is your opinion of the government funding request/approval process? How can this be improved?
16. Do you receive your funds in a timely matter?
17. If you were given additional funding, what would you use the funding for?

Follow-up Questions:

1. Where does your organization get their funding from? What are the percentages of the total funding comes from these resources?
2. How is your funding used among your organization? What does a majority of your spending go into and why?

Interviewee: Peter Coffin, Coordinator of the Blackstone River Coalition

Protocol: Upon interview request acceptance, the team met with the interviewee to conduct an interview. The interview began with the team explaining the project and their current understanding of watersheds at that time. The interviewee was asked if anonymity was preferred, if he/she could be contacted with follow up questions, and if the interview could be recorded.

Questions:

1. Why do you feel watersheds are important?
2. What do you think are the biggest challenges to watershed management?
3. What do you think are the current problems with watersheds?
4. What do you think is the best way to solve these problems?
5. Do you think public education about watersheds is essential to preventing watershed degradation? If so, please explain.
6. A. Does your organization currently have any educational programs or outreach available to the public? If yes, please explain. If not, have you ever had any in the past or plan on implementing any in the future?
B. What has been the turnout on these programs? Would you consider this successful?
C. Do you feel these programs could be beneficial in other watersheds?
7. Have you received any feedback on the programs?
8. What are your means for educating the public?
9. Are these means limited by anything [resources]?
10. Have these means proved successful? Please explain.
11. A. What methods of outreach do you think would be most influential?
B. Why have these methods been implemented or not implemented?
12. A. Do you think current policies are effective in managing watersheds?
B. If yes, please explain.
C. If no, how can it be improved?
13. How would you describe the quality of the enforcement efforts of government agencies?
14. A. Are these efforts enough to encourage compliance?
B. What improvements are needed?
15. What are some of the challenges when organizations try to promote a watershed plan?
16. Do you see a positive result in watershed planning when involving public participation?
17. What do you think should be done to improve watershed planning?
18. Does the public have the necessary technical skills to monitor a watershed, or can they be properly trained to do this?
19. What has the organization done to help the public have the necessary skills in monitoring?
20. Aside from public participation, what have state and local governments done to help with watershed planning?
21. In your opinion, do you think the government provides enough funding for the watershed organization?
22. Roughly how much of the organization's total funding comes from the government?
23. What does a majority of your spending go into and why?
24. What is your opinion of the government funding request/approval process? How can it be improved?
25. Do you receive your funds in a timely matter?

26. If you were given additional funding, what would you use the funding for?

Interviewee: Thomas Walsh, Engineer, Director/Treasurer of Upper Blackstone Water Pollution Abatement District

Protocol: Upon interview request acceptance, the team conducted the interview via telephone. The interview began with the team explaining the project and their current understanding of watersheds at that time. The interviewee was asked if anonymity was preferred, and if he could be contacted with follow up questions.

Questions:

1. What is the operation size of you treatment plant.
2. What are some of the contaminants in the wastewater?
3. A. What percentage of the initial contaminants is removed during the treatment process?
B. What contaminants are not removed by your treatment process?
4. What additional contaminants are being considered for regulation (for discharge) now, or may in the long term be regulated?
5. A. Is the plant currently operating at the required regulatory standards?
B. If not, what are the factors preventing the plant from operating at those standards?
6. A. What hardship would the District incur if the allowable discharge limits for nutrients are decreased (made more stringent)?
B. Is there enough space (footprint) for additional treatment steps?
C. Any thoughts on impact to taxpayers?
7. How difficult is it to maintain regular operating standards during special situations, such as storms?
8. What can be done to improve this?
9. What limitations do you face in implementing these improvements?
10. How effective are the enforcement policies of regulating watershed pollution?
11. What do you think can be done to improve the enforcement of policies?
12. A. Are there any limitations to implementing these improvements
B. If so, what are they?

Interviewee: Dona Neely, President of the Blackstone River Watershed Association

Protocol: This interview was conducted electronically. After the interview request was accepted, questions were compiled and emailed to the interviewee. The interviewee was asked if anonymity was preferred and if he/she could be contacted with follow up questions.

Questions:

1. Why do you feel watersheds are important?
2. What do you think are the biggest challenges to watershed management?
3. What do you think are the current problems with watersheds?
4. What do you think are the best ways to solve these problems?
5. Do you think public education about watersheds is essential to preventing watershed degradation? If so, please explain.
6. A. Does your organization currently have any educational programs or outreach available to the public? If yes, please explain. If not, have you ever had any in the past or plan on implementing any in the future?
B. What has been the turnout on these programs? Would you consider this successful?
C. Do you feel these programs could be beneficial in other watersheds?
7. Have you received any feedback on the programs?
8. What are your means for educating the public?
9. Are these means limited by anything [resources]?
10. Have these means proved successful? Please explain.
11. A. What methods of outreach do you think would be most influential?
B. Why have these methods been implemented or not implemented?
12. What are some of the challenges when organizations try to promote a watershed plan?
13. Do you see a positive result in watershed planning when involving public participation?
14. What do you think should be done to improve watershed planning?
15. Does the public have the necessary technical skills to monitor a watershed, or can they be trained to do so?
16. What has the organization done to help the public have the necessary skills in monitoring?
17. Aside from public participation, what have state and local governments done to help with watershed planning?
18. In your opinion, do you think the government provides enough funding for the watershed organization?
19. Roughly how much of the organization's total funding comes from the government?
20. What does a majority of your spending go into and why?
21. What is your opinion of the government funding request/approval process? How can this be improved?
22. Do you receive your funds in a timely matter?
23. If you were given additional funding, what would you use the funding for?

Follow-up Questions:

1. Where does your organization get their funding from? What are the percentages of the total funding comes from these resources?
2. How is your funding used among your organization? What does a majority of your spending go into and why?

Interviewee: Steve McCurdy, Director of Municipal Services for MassDEP

Protocol: Upon interview request acceptance, the team conduct an interview via phone. The interview began with the team explaining the project and their current understanding of watersheds at that time. The interviewee was asked if anonymity was preferred, if he/she could be contacted with follow up questions, and if the interview could be recorded.

Questions:

1. Why do you feel watersheds are important?
2. What do you think are the biggest challenges to watershed management?
3. What do you think are the current problems with watersheds?
4. What do you think are the best ways to solve these problems?
5. Does MassDEP currently have any educational programs or outreach available to the public? If yes, please explain. If not, have you ever had any in the past or plan on implementing any in the future?
6. What has been the turnout on these programs? Would you consider this successful?
7. Are these means limited by anything [resources]?
8. What methods of outreach do you think would be most influential?
9. What needs to be done to promote better watershed behavior among communities?
10. Should watershed education be consistent state-wide or vary based on specific watersheds and watershed communities?
11. In your opinion, do you think the government provides enough funding for the watershed organization?
12. How does the varying of funding from year to year affected your organization/ department?
13. What does a majority of your spending go into and why?
14. If you were given additional funding, what would you use the funding for?

Interviewee: Therese Beaudoin, Watershed Coordinator of MassDEP

Protocol: This interview was conducted electronically. After the interview request was accepted, questions were compiled and emailed to the interviewee. The interviewee was asked if anonymity was preferred and if he/she could be contacted with follow up questions.

Questions:

3. What are the biggest challenges to watershed management?
4. What do you think are the current problems with Blackstone River watershed?
5. What are some of the watershed management strategies which have been implemented or have not been implemented do you feel would be most effective in controlling non-point sources and point sources pollution?
6. Are there any limitations to implementing these improvements? Unfortunately, yes. B. If so, what are they?
7. What is the current Total Maximum Daily Load (TMDL) implementation plan for Blackstone River watershed?
8. What is the current Water quality target for Blackstone River?
9. What are the contaminants MassDEP tests to establish the water quality standard?
10. What contaminants do you think are important to test that are currently not tested? .
11. After an assessment of water bodies are completed, how long is the waiting period for the funds are received under section 319 of the clean water act?
12. How effective are the enforcement of policies at regulating watershed pollution?
13. Are there any regulations waiting to be passed which would help improve the watershed management?
14. What do you think can be done to improve the enforcement of policies?

Interviewees: Nancy Bryant, Executive Director of SuAsCo Watershed Community Council

Protocol: This interview was conducted electronically. After the interview request was accepted, questions were compiled and emailed to the interviewee. The interviewee was asked if anonymity was preferred and if he/she could be contacted with follow up questions. A personal communication also occurred.

Questions:

3. Where does your organization get their funding from? What are the percentages of the total funding comes from these resources?
4. How is your funding used among your organization? What does a majority of your spending go into and why?
5. What is your opinion of the government funding request/approval process? How can this be improved?
6. Do you receive your funds in a timely matter?
7. If you were given additional funding, what would you use the funding for and why?

Appendix E: Interview Responses

Interviewee: Donna Williams, Advocacy Coordinator of the Massachusetts Audubon Society and President of the Blackstone River Coalition

[Question] Why do you feel watersheds are important?

[Answer] Watersheds are the natural system of land and water in which land use impacts directly affect water resources. This natural system must be the basis for actions to restore and protect water resources.

[Question] What do you think are the biggest challenges to watershed management?

[Answer] Fostering a widespread understanding of the critical importance of the connection between land use and water quality; Elevating watershed management to the highest level of importance at all levels – local, state and national; Adopting bylaws and regulations that insist on protective practices for water resources.

[Question] What do you think are the current problems with watersheds?

[Answer] There aren't problems with watersheds – there are problems with people's lack of understanding of how watersheds function and their making inappropriate decisions.

[Question] What do you think is the best way to solve these problems?

[Answer] Education and outreach to local decision makers, homeowners, business owners, developers regarding the need to guide growth more carefully by instituting new bylaws and regulations, changing practices and designing more innovative developments.

[Question] Do you think public education about watersheds is essential to preventing watershed degradation? If so, please explain.

[Answer] Yes, this is absolutely necessary if we are going to reduce stormwater impacts from new and existing development.

[Question] A. Does your organization currently have any educational programs or outreach available to the public? If yes, please explain. If not, have you ever had any in the past or plan on implementing any in the future?

B. What has been the turnout on these programs? Would you consider this successful?

C. Do you feel these programs could be beneficial in other watersheds?

[Answer] A. Yes, our Campaign for a Fishable/Swimmable Blackstone River by 2015 is all about education and outreach to the public. Please see the Blackstone River Coalition website at www.zaptheblackstone.org.

B. Turnout varies depending on the approach. Inviting the public to specific programs often leads to low turnout. We often present programs to town boards and commissions and various organizations at their regularly scheduled meetings. Turnout at these programs is usually good. Also we attend big events like festivals, canoe races, farmers' markets and distribute outreach materials. However successful we are, though, we still feel the need to reach more people who are not already in the "choir".

C. Yes. Our outreach programs have been models for other watershed groups.

[Question] Have you received any feedback on the programs?

[Answer] Yes, it's usually good.

[Question] What are your means for educating the public?

[Answer] Formal PowerPoint program presentations on watersheds, stormwater impacts, Low Impact Development best management practices, bylaw changes; Presentations specifically about rain gardens to garden clubs and watershed associations; Wide distribution of "A Homeowner's Guide to Protecting Water Quality in the Blackstone River Watershed", rain garden brochures, "Tackling Stormwater in the Blackstone River Watershed" brochures, progress report on the Blackstone River restoration effort; School classroom presentations; Website

[Question] Are these means limited by anything [resources]?

[Answer] Yes – by limited funding and trained staff

[Question] Have these means proved successful? Please explain.

[Answer] More and more people are aware of the watershed concept and how it works, but they have a hard time relating their own practices to the degradation of our waterways. That said it's even more difficult to reach people who have no interest in the environment. Changing behavior is remarkably difficult!

[Question] A. What methods of outreach do you think would be most influential?

B. Why have these methods not been implemented?

[Answer] A. Hit people in the pocketbook – show them how they can save money by changing their practices whether it be harvesting rainwater at their home, or designing and building a residential development that has homes clustered on small lots, narrower roadways, no curbing, vegetated swales, etc. and extensive protected open space.

B. We're working on it!

[Question] In your opinion, do you think the government provides enough funding for the watershed organization?

[Answer] We have applied for many grants but have been unsuccessful as of late. More and more organizations are in need of limited resources. No – there should be more government funding available. Watershed organizations are helping implement programs that the governments requires, so there should be more financial assistance.

[Question] Roughly how much of the organization's total funding comes from the government?

[Answer] BRC – approximately 40%; Mass Audubon – approximately 5%. Most is from grants from foundations and private donations

[Question] What does a majority of your spending go into and why?

[Answer] Staff, because our major mission is accomplished through education and outreach.

[Question] What is your opinion of the government funding request/approval process? How can this be improved?

[Answer] Larger amounts of funding need to be made available to support the efforts of many groups.

[Question] Do you receive your funds in a timely matter?

[Answer] Yes, when we do have successful grants.

[Question] If you were given additional funding, what would you use the funding for?

[Answer] Build demonstration projects of rain gardens, green roofs, pervious pavement, etc.

Interviewee: A representative from the Neponset River Watershed Association

[Question] Why do you feel watersheds are important?

[Answer] Watersheds affect the “health” of a water system that in turn affects multiple natural systems, and vice versa. A “watershed”, defined well, can be a helpful tool for discussing local impacts of environmental issues and “solutions” with the public.

[Question] What do you think are the biggest challenges to watershed management?

[Answer] Getting people, businesses and government agencies to implement long-term, pro-environment changes to routine actions, and to pursue pro-environment, future-oriented directions in decision-making.

[Question] What do you think are the current problems with watersheds?

[Answer]

- Daunted by the difficulty of implementing, funding or even visualizing change -- people, businesses and government agencies are not implementing long-term, pro-environment changes to routines, or pursuing pro-environment, future-oriented directions in decision-making.
- Many people don’t understand or want to know how their decisions and actions affect the watershed around them / the local environment or the community’s water supply.
- Outdated stormwater treatment structures (and lack thereof).
- Water quality issues due to contaminated stormwater runoff .
- Water flow issues (fast-moving water, flooding, etc.), channel erosion, water quality issues, thermal pollution and decreased aquatic biodiversity due to impervious surface.
- Low water levels throughout landscape due to high water usage, especially in the summer.
- Damaged sewage- and wastewater-carrying pipes contaminating groundwater and local waterways and also receiving (and exporting out of the watershed) clean water from the ground.
- Damaged water pipes leaking clean water into ground.
- The spread of populations of exotic, invasive species – e.g., Purple loosestrife, Garlic mustard, buckthorn, Black swallow-wort, Mile-a-minute, Asian water-chestnut, etc. Folks continuing to plant exotic, invasives – e.g., Burning bush, Japanese barberry, etc.

[Question] What do you think is the best way to solve these problems?

[Answer]

- Use Social Marketing concepts to effectively word informational articles and distribute these to media that the public references and respects. Articles should clearly explain the environmental issues, their significance, and exactly what the public can do to help solve the problems.
- Repeat the message in multiple media – from signage in the neighborhood to on-line articles, to newspaper articles, radio messages, TV hot-spots, Tweets, etc. – to enforce the message.
- Work with local towns to implement on-the-ground solutions (i.e., install progressive stormwater treatment structures, retro-fit buildings with water-conserving appliances, implement water-conservation classroom curricula and town-wide education initiatives, etc.).
- Partner with organizations, governments, towns, businesses and volunteers to pool resources and get work done.

[Question] Do you think public education about watersheds is essential to preventing watershed degradation? If so, please explain.

[Answer] It's one step in a multi-step process of getting people to take watershed-conserving actions.

[Question] A. Does your organization currently have any educational programs or outreach available to the public? If yes, please explain. If not, have you ever had any in the past or plan on implementing any in the future?

B. What has been the turnout on these programs? Would you consider this successful?

C. Do you feel these programs could be beneficial in other watersheds?

[Answer] A. For several years, we have run a grant-funded water conservation program in which we partner with willing watershed towns to implement town-wide water conservation programs. The programs include public education initiatives, school curricula and presentations, and retrofitting buildings with water-conserving devices.

In the past, we ran a grant-funded program that educated citizens of one watershed town on proper septic system maintenance. The goal of the program was to improve septic system maintenance in order to protect local water supplies by lengthening the lives and effectiveness of people's septic systems, thereby delaying the installation of additional sewer lines. Sewer lines export water out of the watershed, while septic systems recharge local water supplies. Through that same grant-funded program, we also educated another watershed town's citizens about the importance of reducing local water pollution through picking up and properly disposing of dog waste and reducing chemical and water use in yard maintenance. In that town, we also installed bioretention cells along a pathway by a brook in order to reduce the negative effects of stormwater in the stream.

In the past we have acquired grant funding to educate local citizens groups or town governments concerning certain environmental issues. For those initiatives, we run a series of presentations at meetings.

We maintain a website (www.neponset.org) and Social Media profiles (Twitter, Facebook, Flickr), and generate mass e-mails to our constituents, to disseminate educational and general outreach information.

In addition, we write reports on various watershed protection-related subjects and make these available through our office and/or website.

Every year we hold an Annual Meeting that is open to the public and at which we present our work over the past year and our plans for the next. We indicate why the various programs are important to the health of the watershed.

We run other events, as well, such as river cleanups, general presentations on our work, or natural history interpretive walks or canoe rides, or we co-sponsor events with other groups.

We also participate in educational programs run by other organizations, from time to time. For instance, each year, we present on water issues in watersheds at a middle school-focused science day in Westwood. We also staff NepRWA tables at local "green" and environment-related fairs and events. When asked, we occasionally give presentations to groups, such as university classes, or workshops at local institutions, etc.

We maintain volunteer opportunities open to the public in our water-testing program, wetland restoration program, and in various other programs, as they become available.

B. I am not sufficiently aware of the long-term results of these programs to know if the programs have been successful over the long-term. Monitoring would help us understand the success (or not) of these programs.

The grant-funded programs receive greater “turn-out” in general because we can devote more time to them – e.g., our stormwater presentation made available to town government employees was highly attended, and certainly we spoke with many households during our neighborhood canvas, likewise, many households received our brochures and bill stuffers. However, the question to answer is what was the actual effect of these programs – what difference did we see in stormwater pollutant levels, water use, or requests for sewer service?

The events that we run receive relatively high turn-out – 25-75 people, or 75-125, depending on the event.

C. Yes.

[Question] Have you received any feedback on the programs?

[Answer] I am not aware of it all; different staff members have led different programs, thus they and potentially our Executive Director would be the ones to hear the feedback. For instance, our Advocacy Director led the workshops on stormwater treatment options for towns. Our Water Conservation Coordinator leads the water conservation programs. As the Outreach Director, I have managed events, Social Media output, and some public education segments of grant-funded programs, such as the septic system maintenance program and the reduce-your-water-and-chemical-use in yard maintenance program.

[Question] What are your means for educating the public?

[Answer] Workshops, brochures, postcards, bill-stuffers, phone calls, Social Media posts, press releases to newspapers, community access cable stations, and other local groups who blast their constituents with mass e-mails or e-newsletters, or who hold events or meetings at which they can convey information, and occasionally canvassing.

[Question] Are these means limited by anything [resources]?

[Answer] Only limited staff time, project partner time, and money can be allotted to each method.

[Question] Have these means proved successful? Please explain.

[Answer] The extent of the success is a good question. Pre-project, during project, and post-project monitoring would help us understand the success (or not) of these activities. Once we knew the long-term effects, we’d know if the programs were useful.

[Question] A. What methods of outreach do you think would be most influential?

B. Why have these methods not been implemented?

[Answer] Send our messages across various popular media, multiple times.

Select people who our constituents trust and respect, and who have personally taken the conservation actions we want - or who have interacted with people who have. Have each person – in-person: 1) Describe to our constituents the action that we want implemented (for instance, conserving water at home by installing faucet-aerators or low-flow toilets, or modifying lawn-watering routines), 2) Describe the significance of taking (or not taking) this action, 3) Describe

the personal experience of taking that action, clearly indicating how to implement the action, 4) Answer any questions, and 5) Ask our constituents to pledge to take that action.

B. We do implement these methods in various ways, and for various environmental issues. NepRWA staff, Board Members, Supporters and Volunteers variously take the role of “expert,” asking watershed residents, towns or businesses, NepRWA supporters, and others, to take certain environmental actions. Board Members have made presentations to groups around the watershed, explaining how to be more watershed-friendly and why. Our Executive Director does this more frequently. We contract a well-known expert in the field at each of our Annual Meetings, who presents on a topic and includes in his/her presentation how audience members can help the cause.

At times, we post our messages on our website and Social Media profiles, via mass e-mails and / or hard-copy letters, in press releases to local and regional newspapers, TV and radio, in TV or radio interviews, on signage along the street and by our project sites, and via presentations to groups.

[Question] In your opinion, do you think the government provides enough funding for the watershed organization?

[Answer] It is a challenge to obtain government funding (or funding from any source). Grant applications and project reporting are time-intensive (as is any donor solicitation and maintenance). In recent years, we have approached watershed towns, requesting that they help to fund our water-quality-testing within their boundaries. Some of the towns have agreed and are now helping to fund our water testing program.

[Question] Roughly how much of the organization’s total funding comes from the government?

[Answer] The Executive Director would have to answer that question.

[Question] What does a majority of your spending go into and why?

[Answer] The Executive Director and Board of Directors would answer this question.

[Question] What is your opinion of the government funding request/approval process? How can this be improved?

[Answer] The Executive Director would answer this question.

[Question] Do you receive your funds in a timely matter?

[Answer] The Executive Director or Bookkeeper would answer this question.

[Question] If you were given additional funding, what would you use the funding for?

[Answer] The Executive Director would answer this question.

Interviewee: Blackstone River Watershed Council: John Marsland, President; Alice Clemente, Secretary; and Joe Pailthorpe, Treasurer

[AC] I would like to ask you some questions before you begin asking us questions, because I think that might give us a better idea of.... Who you are and what you understand by certain things. So we know what kind of answers to give you... okay. The reason I am asking you this, is when I read through your questions, one thing that struck me is that you keep using the expression watershed management and I would like to know what you understand by that. What that means to you? What the premises are behind all of this? Do you think that there is a watershed management plan out there for every watershed and that there is some entities somewhere implementing this plan, or do you have some other way look at this?

[JC] I don't think there is like one organization taking care of all of it which is

[AC] That is what I mean, not for the whole world

[JC] Right!

[AC] Even for each watershed

[JC]I, well from what we've read some watersheds do have certain model they try to follow, but not the same for everyone

[AC] Okay, so what you understand by watershed management, could you enlighten us a bit on that? What it is that you think is going on or you think should be going on?

[JC] Basically, what is taking care of like who is kind of looking after, such as your organization who trying to promote its welfare I guess.

[AC] There might be surprise - there are many organizations and there is no single plan for most of them, unless it is a water supply watershed.

[JP] I have an upfront question to ask, like what is your background as far as what you pursuing as... What is your educational thing that points you in our direction?

[JC] So this is a project for student which is called an IQP, every junior has to take, it is outside of your field to broaden your knowledge. I'm a BME major.

[CF] I'm an ECE major.

[XC] I'm also an ECE major.

[JC] So we don't have a lot watershed experience.

[JM] That is why you try to learn from us.

[JC] And just the brief, our paper basically focuses on four categories these are policy; public education, if the association are actively promoting watershed education among the public to maybe of what they doing;

[AC] That is an easy one for us.

[JC] And then we have funding, if you guys receive funding how you get it, and is it easy to obtain them; and public effort, do you get support from the community.

[JC] So that is what the paper is basically wrapped around.

[AC] When you talk about policy you have to understand that all this function has many different levels. You have the federal government, you have the state, you have the local, and you have all the individual groups too. Can we talk about stormwater; this will illustrate them how this is happening?

[JM] You pre-read all the questions right?

[AC] Yes, right I think I give them an example since this starting so far back you know how this actually works okay. Stormwater is.... also leads to your first question too: "What do you think is the biggest challenge to watershed management?" Right now stormwater is the BIG one, right....these solution to that, or the effort to came up with a solution to that problem go all the way back to Clean water act, which was passed in 1972. When the federal clean water act was passed, they mandated storm water programs to clean the river that is divided into two phases. Phase I was for medium [passed out Phase I information], that was done some time ago, so right now, we are in Phase II. Phase II says that it is intended to further reduce pollution [passed out Phase II information]. This phase II is for smaller communities like ours and smaller projects, but related to, that is mandated education, public education program. Do you know all about this?

[JC] No

[AC] Okay, I will give you all of this, you can just take it home and read it

[Question] Is this say that the federal must collaborate with the public to clean up the pollution?

[AC] Right, so the clean water act does mandate the cleaning of all water way in United State, but back then that impacted each state and the impact was low. First they started with big picture and now in Phase II, are getting close to home. So the Phase II is the public education aspect. You can also get more information from the federal Environmental Protection Agency website. As part of that each state are forces now to come up with some plans to do something about this, like it or not. So this is what we've been helping out with. You want to talk little bit about this John [JM].

[JM] Yes, we started this summer. We went to fifth grade schools, where the fifth graders; actually which is first through fifth grade school. The whole town was invited to the school

before the school opened, and we kind of taught them about stormwater runoff. We used the 'EnviroScape'. It is like a suit case that opens and that lets you show a farmhouse; there is pitch to this thing and you drop a little of color, of water food color in it. You can actually watch how stormwater can run down and pollute the clean water.

[Question] And what is that call?

[AC] EnviroScape, and the purpose behind all of this is to teach little kids about all of this, because our idea is that you have much better chance dealing with little kids, than when you deal with adults. If you start when they are young, and as John have demonstrate because he is very much involved with the school, year after year you get them involved, and when they get to be adult they know what they are doing. So one of things we did, as the one John was talking about, is that we also gave out these things; this is "do and don't" guideline. This is intended for third graders, and we will give you all of these so you can take it home and look at them. When giving out all these things to them, the kids are accompanied by their parents, so we also give one to parents. So we think this is a much better way than trying to put it in the newspaper or whatever they don't pay attention to. You can take those things too. So you can see, the point is, this is a much different level. It is not just one master plan and everybody is, you know. It just works in many different levels, so it is not that simply. There are different kinds of watersheds and different agencies and different approaches to all of this.

[JM] The problem we having are that the Blackstone River is a highly polluted river from the industrial revolution; and that stigma is hard to break with the older people. So that is why, we figured, we target the younger people, that don't really know about that stigma yet. It might be lot easy to get them involved in what we are doing. It is very hard to get older adults involved because they figure out that Blackstone River is a polluted river, "why do I want to get involve with that river", which is tough.

[AC] There is something called Blackstone River Coalition, and I don't know if you are interviewing anybody form there, we are a part of that coalition.

[JC] Yes.

[AC] Okay, what they are doing with stormwater is they put together a very elaborate package.

[JC] I have seen that online I believe.

[AC] Wonderful, so you get them to give them to you.

[JM] There is a stormwater conference this Thursday, did you hear about that, in Blackstone Massachusetts. This Thursday from 1:00 P.M. to 5 P.M., they have a conference with people associated with stormwater runoff, and expert there to talk about it.

[JC] This Thursday?

[JM] This Thursday from 1:00 P.M. to 5 P.M. at the Blackstone Public Library in Blackstone, Mass.

[AC] And the coalition is putting that on. Another thing is to teach businesses along the Blackstone River about good housekeeping. So they don't pollute the river even more. They gave some thoughts as to kind of things they can do: the driveways they put in or parking lots, or plantings or whatever, and how they discard waste things like this [showing a picture]. This is another thing: teaching businesses to do things properly.

[JC] Do you do this through workshop or ...?

[AC] No, one on one contact.

[JC] Oh...Okay so you kind of like go door to door?

[AC] Right, go to the businesses along the river that are most likely to be affecting river.

[JP] Everything we do, with the exception of going to schools and stuff like that, usually one on one contact, networking, and small group education, versus trying to do public meetings. We don't do a lot of public meetings. We go right to the sources, and keep networking, and networking constantly. And that is not saying that we shouldn't or couldn't add anything in the future.

[AC] Some of the questions here seem to talk about events? What he is saying is usually the way we work.

[JC] Okay.

[AC] Our group works not with you know, you don't have an event with a lot of people come or don't come. We have different ways, and it is on who is going.

[JP] See a lot of a things you are talking about here and what AC is talking about, you know, there is a lot of professional in the education realm of health department. There are so many agencies in the state that are doing this, providing materials that we don't have staff to do. We work with them; we let them do the show and tell on educating the real stuff [general public].

[AC] Then again, to complicate life for you, the state agencies are right now in the process of planning; because they don't have all their act together either. So they, in the last month or so I went to a series of three workshops, representative from a lot of state agencies and NGOs, and they put together a Narragansett Bay region integrated plan. So they are trying to do what you are talking about. Like come up with management or a watershed management plan. So this is all happening now, there isn't one in place. There were certain things in place like DEM; if you are building something right on the river or near a water body, you have to go to the Department of Environmental management for a permit. They say you can do this or you can't do this or whatever, but that is only part of it. These people try to do lot more things involving people like us: people who are interested in doing the kind of things we do... and work on. Why don't you

[to John Marsland] talk about some of wonderful things we do. John is great he started this whole thing 20 years ago.

[JM] One thing we got going before that, I don't really play a large part in this water quality testing that has been going on for 7 years. So we have a seven year track record, and they all test the same day, same weekend out of the month. That is the whole river at the same time to get how much nitrogen, oxygen, and other things. And then they find the problem area, which is why they might say there is a problem area, let's find the sources of that problem and then let's go talk to that business owner.

[JP] If we can find them.

[JM] A lot of farms or whatever with the manure runoff stuff is a major problem

[JP] and we have our district; it doesn't include Massachusetts right the water quality testing?

[AC] yes, from Worcester all the way to our town.

[JP] 70 volunteers, and two or three paid people that collect and train them: collect the data and they do all the tributaries. So 70 volunteers with family, you know father take their son out or daughter, and collect water sample and report it.

[AC] and in end of the year they put together a report. It is online, and you can get it online through the coalition actually.

[JM] Tammy Gilpatrick is the coordinator for all of these.

[AC] I think you may be interested in this since you people are living in Worcester at the moment. You might be interested in this because when you look at the statistic and the charts which you are going to see. You know where the waste water treatment in Millbury, Massachusetts is.

[XC] Yes

[AC] Pay attention to those guy because they are not necessary the good guy. When you see the...go look it online for the report, what you are going to see is that all the water quality testing north of there is showing much cleaner river than below there and as soon as it passes Millbury it changes. So those guys; see how these things are all happening, but they all happening kind scattered. There is no major one plan.

[JM] So the way I started like in 1990, I found the friends of Blackstone, which was mainly doing cleanup with tire and trash in the river. And we have being doing that for 20 years now. We are going to construct fish ladders, and other things. We are trying to restore the habitat, because you have to have something to protect for the people to think that this river is worth

protecting. If it is just a polluted river, then it has nothing to protect. So this is why it is important to restore habitat to the river.

[JP] 4 million dollar fisher project underway in spring, affecting 3 or 4 dams, I don't know.

[JM] Four dams.

[JP] One removal right?

[JM] No they are going to have it lowered two feet.

[JM] That took a long time; that took like 20 years to get them going. It wouldn't happen if it wasn't for our group, because the state departments couldn't work together to get this project going until we brought them together in this building[Blackstone Public Library] and started to move this thing along; but for years nothing happen.

[JP] You see we are all volunteers, and we don't have bureaucracy holding us back.

[AC] The thing is that state agencies are a little under staff; they don't have any money. They have to prioritize what they doing, and our little river is not a high priority necessarily. So we have to make it a priority and push on them all the time.

[JP] With all these officials, we have a high degree of integrity in our relationship with them.

[JM] In actuality, they are trying to make this river into an Industrial River again; they want to put some of the Hydroline into some of these dams again. And we kind of want this river retired from that, and we want this river to be a recreational river, since it is clean.

[AC] Another of the biggest challenge to watershed management is that the river, not just talking about watershed, one of the big problems is low flow. If you have hydro on there it can get problematic if you already have low flow in the river in the summer time.

[JM] The major flow in the river is actually waste water.

[JP] and those are today are acceptable discharges right?

[JM] yes.

[JP] unless they have a problem.

[JM] yea, like the power go out, and next things you know, well that will be a big problem.

[AC] In some rivers, in some watersheds you find in Massachusetts, there are not a lot of communities that draw from the river for drinking river.

[JM] The towns in Commonwealth Lincoln have well water.

[AC] Another issue, I'm going to get this to you [hand us some information]. It is something we haven't talked about at all, is climate change. How this is going to impact the river in our watershed. So the state is already working on that, with the integrated plan I told you about. Take that into account, and thinking how are we going to plan for the effect of, because they are already having their effect on Narragansett Bay. You sure know how the weather is changing in the spring, we have mass flood over here in Rhode Island, and then in the summer the river is practically dry. So because of the way the weather is going crazy like this, it is affecting the river and watershed in a way that we can't really anticipate and so this is one area we are planning. I'm going to give you this handout.

[JP] Are you done with your hand out?

[AC] Yes.

[JC] So who does this goes to?

[AC] It goes to all of our members, but anytime I go to these conferences I take a stack.

[JP] We do not have a membership role. We have a membership but very shallow like 30 people, and mostly board members and volunteers. We do not do funding and outreach membership type of things, but some organization do. So we are very grant donation oriented.

[JM] We don't have a paid executive director

[JP] No.

[JM] All we have are volunteers

[AC] And some of the questions involve how you get your community involved: with great difficulty most of them are not participating

[JP] That is one good introduction that I got, I got one handout I only brought one and I have been talking about this and thinking about this. This is very interesting this is a sampling of, and this is, let me explain this

[AC] We were talking about this awhile ago.

[JP] John Marshland is the president, and I am down here the last guy JP, and here is AC. And we share another board, we volunteer works with other groups, we share resources, brain power, and we do a lot of work. And you can see I'm the treasurer of these two boards, so I do the financial things and help with the grants you know.

// some of the audio is lost when recorder is rested because it has reached its maximum memories it can record.

[AC] and so nobody takes care of that, so we have to go in and take care of it

[JP] we are very heavy on the basis in fact the land trust is work with, same group the watershed council works with on the basis of varies area we have, you know, tons of them all over the place.

[AC] So this is one of the things we do with the money we get.

[JP] We just always find a new project to spend money on it.

[Question] Do you have to submit the project to the state government to get approved?

[AC] Depends on the project. In some cases you do have to get permit to do something.

[JP] In our upcoming project, we are going to build a building, all these storage we have, in the past we have brought a lot of canoe and kayak, and we have to store those and right now we use / borrow people's warehouse.

[Question] Is all your equipment is canoes and kayaks?

[JP] well we got equipment for cleaning the river, we have equipment for recreation. Recreation and education, we take the high school student out every year and that is educational experience too. You know taking them to a recreational trip on the river; a lot of them have never experienced this.

[AC] Back to your pervious question, even when we are asked to take the car out of the river, we have to get a permit to do that.
Everyone: laughs

[AC] because you are disturbing maybe who knows what

[JP] how many tons of tiers have we taken out for the last 20 year?

[JM] we know we've filled a fifty-three foot trailer with tiers; this is just in one clean up.

[JP] We still find tires the river. The river was a natural dump before the regulations came along and we came along as volunteers. Agencies don't: towns, states, they don't go down there and monitor the river.

[JM] We have a property owner that was at the beginning of Pawtucket water supply. I guess in the past their relative used to dump tires into the river. So we took twenty dumpster full of tires out of this area. That was like 20,000 tires from that one place.

[JP] We actually charged them for the cleanup.

[JM] I think it cost them \$20,000, but we did and it is a lot cheaper go through us than others.

[JP] You know I don't get question 19: how active is the public participation in watershed management? Well you know if you look at the population of the nine communities that are in watershed. In Northern Rhode Island there is probably, 25% of our state population it is like 200,000+ people. There are only a minor percentage of these people engaging.

[JM] I think most people take the watershed for granted, as they turn the water on and here is my water so why worry about it.

[JP] So it is polluted, what they going to do?

[AC] One thing that has being helping is the bike path; the bike path is big success. It goes right along the river and people are out there all the time. I don't think we even imagined it would be this successful

[JM] How old is the bike path in this area?

[AC] Not very.

[JP] 10 years old; maybe something like that. But I have been on this planet for 70 years and the bike path has been there for 10, and I tell you I have seen more of the river for the last ten years because of the bike path. My knowledge of the river was crossing the bridges looking down, but I never visited the river. The bike path give you, in fact this has economic development related to it because when you have connectivity, you know people can walk from point A to point B in the bike path, it gives people an appreciation to the river.

[AC] You know, so I think they are more conscious if they know there is a lot of trash there, they will get upset. They may take it for granted because we clean it, and I think if we didn't they would notice

[JM] So you guys got twenty-five minutes left, any questions you may want to ask us that we didn't answer? Ask us something.

[Question] What do you think is most important for preventing pollution?

[AC] Stormwater right now?

[Question] So how, I mean educating the public to not pollute the river?

[AC] and what we say before about the companies too, you know if you keep people from throwing stuff in the river to begin with, then that helps a lot.

[Question] Do you think if you could implement other outreach programs that might be beneficial to the organization?

[AC] well, if we could get more newspapers to write about what we do, which is very hard to do. We have local newspaper that is, it is one of these free newspaper, they are called the [5:22] and

they are very good about writing us up what we do. To get the Providence journal to do it is not so easy.

[Question] It is because you have to pay them or they are not interested?

[AC] They are not interested.

[JP] The local newspaper owner here is a volunteer himself and a contributing member of our group. His staff knows how we feel about the community so they are always out there. Sometime they send up people, and sometime we take pictures and bring them in, and we get turned away.

[JM] I think is kind of our fault because we are doers not promoter and none of us having this specialty of being a promoter, trying to get people involved. We just go out and do it, and then it goes “oh gezz we should have taken a before and after.” We never do. I think that is our shortfall, kind of demoting what we do

[JP] My last remark is, in the volunteering community you are going to meet the most passionate, heart-warming people, and make friendships, and another groups in your lifetime is like your work environment, school environment and a lot things can come to pass, but volunteering you meet the nicest people in the world and I guarantee you that. I know I have experience it.

Follow-up Responses:

[Question] Where does your organization get their funding from? What are the percentages of the total funding comes from these resources?

[Answer] We get most of our funding from grants. We also have a few small fundraising activities during the year.

[Question] How is your funding used among your organization? What does a majority of your spending go into and why?

[Answer] With the exception of the fish ladder project, our funds go primarily into stewardship activities (e.g., cleanups of the river and its banks in the RI stretch of the river), water quality monitoring, education, advocacy. Most of our activities are related to the restoration and protection of the river, though there are also occasional recreational activities.

[Question] What is your opinion of the government funding request/approval process? How can this be improved?

[Answer] I believe that up to now we've had good experience with government grant procedures. The problem now, of course, is that because of the economic collapse, future funding prospects are more uncertain than they have been in the past. So far so good.

Interviewee: Elizabeth Campbell, Executive Director of Nashua River Watershed Association

[Question] Why do you feel watersheds are important?

[Answer] Watershed is an important unit. The health of the water is connected. Upstream and downstream and geographic region is connected. “It is a great way to protecting natural resources.”

[Question] Biggest challenge for watershed

[Answer] Maryland Watershed protection is good resource. Government working on watershed and sub basin level. There are two dozen defined subbasin. Can work really important. The public does not think in terms of the watershed and thinks in terms of towns. There are many regulations to town and city and there is political boundary to coordinate. Aspect of watershed has been developed and how areas of planed Management- want to bring people together that can make decision together. TO do effective management we need everyone together and it can be challenge.

[Question] What do you think is the current problem?

[Answer] Storm water is one of the problems that many of the towns in the watershed are facing. You will get really different answer depending on where you are. In agriculture- run off livestock, Charles- city is engineer and infrastructure of waste disposal. In Nashua, storm water and pace develop and want to keep a health part of the watershed protect. The surface water and ground water is very connected. What happens on the land is very important to what happens in a stream and aquifer. Many people in town have a private well. You want a good percentage of land to be forested if possible. One of challenge is working with municipal. Plan where to build or rebuild something so that the most important natural resources are protected. In this economy, developing is not as it was a couple years ago. In the east, there is different answer of water. Water quantity is a problem and stream flow and try to figure out there is enough water for development. A lot of towns have been doing exercise to see if there is maximum build out and to see if there is enough water. It’s problematic. It looks like there is enough water but one of the current problems is that we have to handle the water. Emerging containment is also a problem. So the problem is both quantity and quality. Many of the towns have private wells. Some of the town has a water supply district with town sewers most like from an aquifer. The watershed is connected to the wachuset aquifer and we help protect that reservoir. Most of water from aquifer to wells.

[Question] What is the best way to solve problem?

[Answer] One of the things we do we have a “smart growth circuit rider”. Works with municipality. Works to design bylaws and that kind of things. He will work with towns and talk about low impact development and new ways to approach that. He will engage engineering in these discussions. Engineers, developers there are a lot of portals. There a lot of different ways to work on those problems. Beneficial working with him. Would you suggest using a rider- funding permitting
The towns need to work on keeping water local. There has been a lot of engineering and how to design systems that handle water effectively. Instead of dumping it in the ocean and looking for new source of water. Fitchburg does not have the money to update control sewer overflow. It is so costly to fix. Need to be continued advancement in area.

[Question] Priority level of public education

[Answer] We think it is high. But our association is not unique in this. Our association work on water resources. We have a volunteering monitor program that takes samples every 7 months that DEP is not taken but work closely with DEP and share data with DEP. Do plans to achieve different levels of confidence. A lot of land protection, we don't own land but go to protect priority land maybe land to protect aquifer. Spend a lifetime with another group to protect land. Work as land steward. We have a large education department. Folks are working on taking kids out on the river through river class program by canoes. We also work with kids on land on programs, school programs. Have programs in which someone works with school and helps with curriculum. 10,000 -11,000 people/ adults outreach per year. Have adult program on snakes but people came to see the snakes.

Very technical program- erosion or sediment control for municipal.
Things that are really targeted are not going to bring in local.
Horse farm- 4 people who have house farm.

[Question] Do you think public education is essential?

[Answer] "Today's youth is the steward of tomorrow"
Help them understand so that they will be good decision makers.
Working on all fronts and trying to make people make good decisions whether family, policy maker

[Question] Turn out to program

Every once in the while turn out is small but overall it is good. If we have meeting, at location so 100 people is good but standing room is not good so turn people away.
Form to policy- 15 people within 7 towns
Focus talk about laws- 15 and right 15 that could make use of information- good

[Question] Received any feedback on program

[Answer] We get anecdotal information that is given verbally to staff or friends of the associations. A lot of the adult program, it's all they do. For programs running through education, they are different, they often have an evaluation process and that happens all different ways- survey with teacher or with kids.

Have you had any feedback on educational program

Basically no. It will be like "the room is crowded".

We have fabulous speakers. We have a lot of knowledgeable speakers and people are really happen and feel enriched to have this opportunity. People are pleased.

Have tree and tree falls in river.

People who fish are excited. People who canoe does not like it. Land owner is not happy that people on land. Who has the right to do something about it? What should be done? A lot of people that have happened to them try to find out what should be done. If you get someone who knows what they are talking about and the legal ramifications and the pros and cons of taking out. It is a high quality program and as long as you publicize it properly there will be a good turnout. Guessing that there was 50 or so and that was a good turnout. E-new that talks about programs. Typically do not have to pay for the speakers.

[Question] How often do you have a program?

[Answer] These programs vary. We will circle back to certain programs to some popular programs but at least a year. Some of the other topics, it may at the heart be the same topic but the presenter goes at it at another direction. People are increasingly concerned in topics such as bears. There is a lot of interest on what is out there what they are doing.

[Question] Is there anything you do to educate community?

[Answer] We send out a lot of press releases and we have a lot of electronic bulletins about all these things. Need to be on the mailing list and people. Just working with towns on across boundaries on policies that will benefit towns. Developed a guidance document idea for people new on municipal board. It is aimed at someone that has taken on some responsibility who kind of knows what they are doing. Distribute to town and then put it on websites for documents that are development.

We are doing in Fitchburg with the high school with the touch population to help keep people in school. Design a model on how the city water affects the river. The purpose was kids but designing it so that people can take it and display it. Public education piece designed by school. Money is the limitation.

[Question] Is your staff paid?

[Answer] We are paid staff. 13 part time- 6 full time equivalent.

[Question] If given extra funds what would you do?

[Answer] There are so many projects that can make a difference in one aspect or another. It is a hard question to answer. A lot of stuff cost a lot of money. One thing that is different, fund to provide for diligents for land protection.

There are costs that come out that a land owner is reluctant to pay or can't afford, that have to get done to move the project forward even if the state will pay money. Land appraisal, title cost, and related things of this nature from few thousands to tens of thousands of dollars. On any given parcel, cannot pay and not enough to loan it. One way is protect land from "forest legacy". Like to have money revolving fund or not to do this protection and it has become an increasing issue. Organization point of view it's a small change.

[Question] Where do you get funding?

[Answer] Members, donors, businesses, grants and contracts, private foundation, state local grants. Few events- auctions but trending from fund raising events. Do charge fees for most of the educational program and most of the time a break even thing.

Government provides enough funding?

I would like more. It varies from year to year and what organization can apply to. Amount of money available varies a lot and hard to predict over a multi-year art.

There are a few services that strike me as appropriate and make sense that government pay for. Water quality monitoring- done more cost effectively than the state. Given the small amount of rivers, our being monitored and meeting water quality standards. If we have groups that could do it to standard and get the type of data that is useful, that they will do well to pay for it than opposed to not. We are not a government agency, and we are not in service to people through government program. They do give money to interesting program. Big EPA grant with partners. Often get little grants.

Percentage varies through years do not have right away.
Majoring of spending is spent towards staff.

[Question] Request and approval process?

[Answer] Grants are getting competitive.

I hear a lot of people complain about how hard the process. "Just do it"

Read the forms and do it. Think that they have been changing a lot. A lot of processes that have been streamlined. There are a lot of rules. There are a lot more pressure on nonprofit to be transparent. The government has to do forms and procedures so that you are doing stuff the right way. It makes it complex and make sure you have to track processes. There is a lot of reporting afterwards but as long as you know. Many days to collecting financial information.

Do you get your fund in timely manner?

Department of environmental trust- 50% start; 25% middle% rest at end

Big federal project- paid quiet quickly pay back

EPA must have changed mechanism and has been quicker through the years.

It varies

Usually have to ask people to fund for project and mostly done through cooperative agreement. People have different ways of doing things. Organization has different ways to do stuff. There needs to be a cash reserve to do things and it makes it hard to have things done.

[Question] Additional funding-

[Answer] She would pay staff more

[Question] What are the contaminants measuring?

[Answer] Fecal coliform, temperature, solidity, if you go on website you can collect data. Try to color code to see if river meets the state standard. Volunteers do the measurement and they train the volunteers. Work with waste treatment plants and some to somewhere else to do results.

[Question] Suaco storm water treatment stuff?

[Answer] New storm water regulations. Good match to educate towns with new regulation. Need to ask towns if it was beneficial.

[Discussion] Bob Zimmerman-Charles River- different because they pay for more of a technical staff

Not major focusing on educations- wants to solve problems

Have terrific grasp with policy and what needs to be done to reengineer towns and city to fix problems

Have bold projects to solve the problems. A lot of what Charles done has become a model when successful.

[Question] What contaminant not measuring you want?

[Answer] Nothing about pharmicital- need to learn more about it.

[Question] Difficult to have people come volunteer?

[Answer] Yes and no. I think if we are looking for volunteer for programs, folks in charge of program. You have to keep working on having people are having a good experience and time is wide and doing important work.

There are some office volunteers. Can use volunteers in so many other ways but hard to find match with interest and talents. New and old that has come in and considers them part of the organization. Other people show up for a while and then go.

Bearers to watershed management

Have a lot of players at the table- tried to do this through associate.

We believed that that watershed associate was really effective. Bob Zimmerman does not think it was important.

Public private initiative- breaking it down by watershed like watershed initiative

Follow-up Responses:

[Question] Where does your organization get their funding from? What are the percentages of the total funding comes from these resources?

[Answer] Our types of funding sources and their APPROXIMATE percentages of overall revenue on an annual basis are:

Individuals & Bequests from Individuals: 53%; Corporations: 7%; Grants & Contracts: 27%; Program Fees: 11%; Events 1%; Other 1%

These percentages vary from year to year. Sometimes we have a significantly higher percentage of funding from grants & contracts.

Every other year we do an auction, and on those years the percentage from events is somewhat higher (e.g., up to 11%).

At one point Jennifer asked what percentage of the grants & contract funding is from government sources: approximately 32% in recent years.

That also varies.

[Question] How is your funding used among your organization? What does a majority of your spending go into and why?

[Answer] Funding is used for (percentages are APPROXIMATE):

Salaries, Taxes, Insurance and Benefits 69%; Professional Fees: 12%; Postage, Printing & Office: 3%; Events & Meetings: 3%; Building: 4%; All Other Expenses: 9%

It's not unusual for the majority of a non-profit's funding to go into staff salaries and related expenses.

Interviewee: Peter Coffin, Coordinator of the Blackstone River Coalition

[PC] Conquers the west was made in Worcester, and Worcester really grows in this time period. What I am going with it's unusually to have a big city on a small stream so the city has paved over and converted a lot of those small streams. So what was known as mill brooks it goes into the Salisbury pond and disappears for 5 miles. It's a twin covert now its been buried. It was such a bad health concern that they covered it over because they knew the fumes were not good. So that river the mill brook is still under. Does the state recognize it as a brook? No it is an unnamed tributary. It is at some point it was a pipe that the city responsible for storm water, but then the pipe breaks out and becomes a stream. The city is not responsible for the stream and then it goes and turns back into a pipe the city is responsible. What is the difference between a stream and a converted and an urban environment that is happened more and more? So there is a professor at Holy Cross "urban stream syndrome" this is kind of a new field for some biologist that all the study at work tend to be great cold water fishery in Portland. No all these urban area, Boston and Philadelphia, that urban rivers what are you going to do about them. Its different challenges

[XC] Ya boston harbor is covered

[PC] Ya Boston, well, Boston Harbor, that was a major push and they ok. The fix was take the sewerage and pump it up

[XC] There is an island then they pump it in again

[PC] well, each city has different Issues but eh.

[Question] so what do you think needs to be done?

[PC] what do I think needs to be done?

[JC] I am sure the list keeps going on

[PC] Right, well I was just had a meeting today with Narragansett Bay. What can you do? What are the indicator and research and. Its educations. The problem is that its education and also changing attitudes and changing traditional practices so there are a couple things there. The things we get is infiltration. Ok, rain gardens they water in ground. Ok, basically what this is encouraging. You want puddles on people's lawns. Landscapers have been trained for generations. Achieve positive drainage. Don't let water sit. Don't let it puddle. Get the water away from the basement. Now we are asking the citizens, well depending what type of soil you have. Maybe could have something here, its changing the way engineers are being asked to do. The other issue is for years we trained engineers to get the water off as quick as possible. It's a safety concern. The Roads. Get that stuff off quickly. Now we are saying, no, slow it down. Let the water infiltrates. So go back to country drainage versus know what is easy to maintain. You know everything is gear towards figuring how to handle with an engineer solution. Got more flow build a bigger pipe. Well are there other ways of looking at. Can you reduce the amount of flow you have to handle by not caving it much. Can you rather than one detention pond at the

bottom of the hill which is the only place you can put it without a handler to meet these standards. Does it make sense to decentralize, lots of little spots. Well as an engineering, you can't commit that the homeowner are going to remain that rain garden. You got to come up with a system that's not full proof that can handle the water that you can stand and approve and if its dependent on what someone might or might not do. As an engineer you couldn't, in good faith that that's the way to do it. So it is a challenge on how to design structures for multiple purposes. Like control and now we are asking water quality concerns and sometimes they work against each other. Which is the more important?

[Question] So, next on the list, Do you think public education on watersheds are essential?

[PC] OH yeah. But the problem is that public education; first thing they don't know what a watershed is. So that's one. And then you know could water be the sciences. That gets really complex quickly. And then you want to go to what can people can do about the problem that they don't know understand why they should do anything about. Which comes first? And the other is, so the Mass Audubon has a "monchra", I can't remember but it's something like "awareness leads to action". There is a third step in there. You got to get people to the resource. Then they start to understand it. Then they can be aware what is happening and get inspired or motivated to change or do something. I guess that comes in the rubric of education

[Question] So are you currently doing any educational programs or outreach?

[PC] We do the one um it's a great program. Do you know the EnviroScape? There is watershed model. The EnviroScape is just patented model, 3 dimension.

[JC] Is it a box thing?

[PC] Yes. It's a watershed in a box and you sprinkle different colored eh things on it to pretend different pollutants. So its good for kids of all ages. You know they want to play with and build the houses and neighborhood.

[Question] Do you take those to classes or do they come to you?

[PC] We are not geared. That's not our principle audience, our principle audience is municipal official. So actually, it works for them as well but if we do it to school group in front of the principle office, in front of the adults. They get it cause they see the children. So we will go into schools or after school programs. We also use it at community events. Our strategy is to get that outreach into the hands of adults or homeowners. Well, if their kids are screaming they are not going listen to us talking about watershed, so we engage the children with this so they can play so the parents can read our stuff about water quality associated with. It is kind of cool. Just another remark, if you want to get the politicians you got to get the voters. Voters are adults. You want to get the adults get the kids. Gets the kids get the adults to barter the politicians to get the regulators. Its hard to refuse a boy or girl scout they look so cute. If I was up there. Who is this guy? But if you can have someone in their town that they can show they are doing the right thing in front of.

[XC] Making the children as the promoter

[PC] Yes, ambassador, stewards that's what we need, spreading the words. What is the word? Well that what you do on the land is important. Do you need a green lawn? We can get into social movement what comes and take. Why does everyone need a lush green grass? Cultural thing, someone is going to judge my character by the color of my lawn. But that's sort of education shift that's needed. That's it is not appropriate in all things.

[Question] Are your programs limited by anything on what you guys are trying to do? Any resources?

[PC] Oh yeah, its money. Donna is a full time employee of Mass Audubon. This is not her main job. Kami is a half time person who doing water monitor. I am half time person that does everything else, so I don't have the time to go to the school systems. **One of my bosses** said" Education is a black hole because you don't get results next year. We don't get results 5 years from now and if I am on a grant and I got to show deliverables. Well I talked to 560 kids, ok well so what. Yeah so what kids got the message. Maybe 10% change their well that to prove that is tough. Some people love education knows that's a needed things but you got to get a grant for that. So we try to do a little bit but that's not our principle focus.

[Question] Do you have a membership?

[PC] The Blackstone River Coalition was designed as a coalition of other organizations working on that same always share the river and that goal for a cleaner river. There are 9 organizations that make up the coalition. The coalition only has members of nonprofit organizations. Those 9 organizations will have members so theirs pond associations, there is the Blackstone River Watershed Associations. Further south in Massachusetts.

[Jennifer] Side note about it. Do you know who we can talk to because we have not been able to get a hold of them?

[PC] Ah. Kami is the vice president. The president is the person you should reach out is Dona Neely. D-O-N-A N-E-E-L-Y

[Jennifer] Just one N

[PC] N-E-E-L-Y and I have her email so probably send her those. She can tell you so that's the Blackstone River Watershed Association. Then in Rhode Island there is the Blackstone River Watershed Council /friends of the Blackstone

[JC] We spoke to them

[PC] So those are the threes Bs. The three citizens grass root organizations that one of funder heritage corridors that frustrated that have to deal with multiple people. They want just one person to coordinate the effort so they encourage joining together. Then, in Worcester you might not have picked up on, there is a Blackstone Head Water Coalition which was my job before

hand. That was meant to be a watchdog on the city of Worcester as they did their stormwater. So that again was a coalition that did have some members but meant to be a coalition of pond associations throughout Worcester so like Quinsigamond Watershed Association. There is Leesville Pond Neighborhood Associations. There is Tatnuck Association. There is Indian Lake Watershed Associations. There is like 5 of them. They all have their water body that they are interesting. They also value coming together once in a while and working together on projects.

[Question] So if you had unlimited resources are there anything else that the coalition would like to do?

[PC] Yeah. It hasn't been confirmed yet but sound likes we stepping into 90,000 bucks. It was a settlement from an auto scrap yard that wasn't doing what they should and there is a group called the clean water action they hired a lawyer and they did a citizen suit against this firm and they are going to fix up their site and in addition instead of penalty they are going to pay \$90,000 to fund our effort. So now the question is my board was like "how are we going to use that money," of course many people have different plans. We got a small grant that I hope to take significant chunk of the money to invest in a modeling effort; it is really to support the development of TMDL, frustrated that the states knows how to do it but putting it off and has roll out of the Charles and wait to see how that turn out before they do any more and I say no let's start now; lets begin to bring people together and begin to investigating the tradeoff, so we are focusing on phosphorous that is the fresh water nutrient concern that we kind of doing a mock case study. Bring together the stakeholders, bring together the treatment plants, the fisherman, bring together the people who might have some, they don't have control, but might have some opportunities to work on the nutrient specifically phosphorous. Show them that there might be opportunities in larger scale, well couple of things, there are things people can do to phosphorous such say rain garden but that is so small that the engineer are going to "pupu". No you can't no way you can install enough rain garden to have a significant effect and I hoping the model might say no you know it is not going to solve the problem, but it is going to resolve in assume direction of reducing half pound of phosphorous may about one thousand of rain garden. It is not the answer but it is not significant it is some people can do to kind of create to overcome this behavior of there is nothing we can do about it, it is so bad they will tell to figure out before come and brothering me this kind of thing. So hoping the time to modeling out with a professor in UMass like what could be pass here and what's not, so the engineers to provide that credibility and begin to engage in this kind of like a series of meeting and we try to bring together the stakeholders have them to respond to a white paper what we think the sources of pollution are and here we think the sources of pollutant are, and how can we implement this. It is getting at this process, who is responsible for what and the needs to get education and get people talks to unfortunately when it comes to phosphorous how much is too much, it is going to court because the treatment plant has being force to spend the money they are not happy as engineer they kind of struggling with say no we got this new system and I willing to bring it down what we do, of course, we came with the buzz in order to get that next level down I have give up the system go with adding chemicals and filtering it and putting more sludge and need more energy. So as an engineer, yea but how wells, it is hard for as an advocate to lighten on pushing for higher nutrient loads when I feel stronger there is too much nutrient in the system you got to push as far as you can, and when it goes to court nobody wants to talk to you. So it is hard to work with city of Worcester on outreach on phosphorus and if we are going to be in court suing them on their

sewage treatment plant or there is a fine line between watchdogs versus working with in partnership, so another organization is suing them. Hopefully we can work with city knowledge that disagreement with the treatment plant and hopefully that will get settle sooner or later. But now let's work on non-point sources pollution.

[Question] The SuAsCo has a stormwater program do you know what that is about?

[PC] I do know what this is about; it is great program it was trying to get funding mechanism pay for the public education so they put a package that any towns can use in their education.

[Question] How do you feel about it?

[PC] It is good, it is a good thing. Now do you get me a little jealous say as to "Oh so now their outreaching to the town of Grafton, it seem a little bit, the town of Grafton has spend couple thousand bucks. I don't know but it wasn't cheap.

[JC] So they brought it

[PC] Yes, they brought it, and now this is; what they get is oh here is the new customized; we give you the stuff but you customized for your town and you figured out so they are making money on this because they use skills of volunteers to craft a good product that's available for towns and they try to get pay for it by selling it; it is not free market system that stuff is out there that could other town do it and not spend money it takes somebody's time. I don't fault the town oh we got to do public education here is something we can easily do, lets spend the money and do it.

[Question] Has being effective?

[PC] That I don't know, I question the fact that anything you receive something with a bill does it get you is like, in some way yes, it keep getting it if it is a one-time thing, so there get be marketing. I'm not marketing person, I know the need of.

[Question] so it is not something Blackstone can look at it?

[PC] well no, the town of Oxbridge we let them use our materials and they printed out and submit the flyers themselves that is sort of thing that is better that was customized for their town. However the outreach didn't happen, that is a good program I think they struggling with keeping it fresh each year cause it is constantly yield when you develop that outreach it is good this but it may be good next year.

[Question] what do you think is best kind of outreach and most influential?

[PC] It is face to face, from somebody you know and know all these facts. I talks about it is okay but it doesn't do half good as good if your neighbor said; tell but the tone of the voice they really believed and that so it got to be as local as it can get. And here is a challenge; everybody lived in the watershed so everybody in some degree impacted. There is a different of degree for

someone owns land right there versus someone lived far away. There needs to be, you need to be part of it resources that is the challenge to know why should people care about Blackstone River; they swim in the river, they don't drink from it, is it enough they care about the animals well that maybe ten percent of the population. How you going to get other ninety percent, but you never going to get that ninety, what is the key that we need. So we are very optimistic when it floods we talk about flooding and when is drought. It is all watershed. It is such a complex issues, the good news is there is something you can talk about that ties to it, land use, sub division basins, you can just walk down the street and just find example of, you know, what you look for are runoff but it is trying to make it effective. So is it effective that is a good question.

[Question] Do you have any yearly events that you guys do?

[PC] yes do our water quality monitoring every year we have a water quality summit that we bring all the people together that usually are state agencies.

[Question] How often do you do the water monitoring?

[PC] It is once a month from April to November so eight testing. We test for phosphate, nitrate, dissolve oxygen, turbidity, and we give up on pH, we do temperature and that is it.

[Question] Is any other contaminant that is not being tested?

[PC] there are a lot of them; WPI must have a lot of water report on these contaminants that have being tested and that is something we are not going to do. There is never enough testing, and there is a lot of testing have been on the Blackstone but it is very expensive. Fish tissues sampling that really properly the better, what I think the EPA is going toward macroinvertebrates forget this chemistry test. Then better is whether the bugs can that can survive that is better getting a glass sample testing for chemistry. If you are working more towards biological methods, so I think that is the way they going, but volunteer can be train but it is lot harder, so we are focusing on nutrient that really helps give us that is our backbone cause we actually providing information state legislators. It is approve data, so they can't say it is no good

[Question] which state did you provide the information to?

[PC] There are two states; Massachusetts and Rhode Island, we also shared with EPA. So they accept our data, but I'm not sure how they use maybe to support their or to highlight the watershed area that might have to do further testing. Unfortunately, this truth everywhere there is never enough monitoring and usually the state just monitors the main stream, so the percent of unassisted stream miles it is properly seventy percent are unassisted. The good news a lot of that is in are in the stream that are not going to be impacted. Who knows? So we do the water quality, we do special workshop on stormwater that runs once a year. The water quality is mostly for the monitor themselves, but the community as well and then what we found is that we got to take that information to the communities and we got to give to the conversation committees. And here are our results we have major focus on cold water fisher, so just getting to acknowledge that are cold water fisher in your town and then we found that water sampling from the site of their town. They just pay more attentions. If that shows that our testing have found little nutrients that is

good enough to them, they never care about the heavy details or the size. They need to know their stream is not right.

[Question] These workshops, do you have good turn out for them?

[PC] It's really hard at times. This time we were blessed with good speakers. Robert Roseen from UNH stormwater.

[Question] Do you pay them to come in or do they volunteer?

[PC] Jury is still out on this one. Usually we pay, but he hasn't asked for money yet we might have snuck freebie. Usually we pay for the key note and the other speakers come for free. We try to have local or relatively nearby state agencies to come. We had pulled together with the upper Blackstone where they have supported heavy duty bring in the expert from California and UNC and innovated waste water treatment. That was two years ago so how to treat for both phosphorus and nitrate and having the guy that runs the council of Washington. You know the blue planes down there having someone coming Syracuse. We let them bring in those speakers. I think they spent three to five thousand bucks and we brought in the keynote guy and it was a good program. But that was really technical. Just engage in those discussions.

[Question] Who usually comes to those? Is it the public or officials?

[PC] No that would have been much more of a technical and for design engineers. We just kind of sat in the back and listen.

[Question] So you didn't advertise it?

[PC] Didn't advertise it. The challenge is what your audience is and often we want to get at the local land use officials, planning board, and stockcoms. This isn't their priority. They are not going to go more than 15 minutes. So if you want the regulators, you got to have a workshop between Mondays through Friday from 9 A.M to 5 P.M, because they get paid for it. You have the volunteers from the board, it's got to be got to be after working hours. Well is it on the weekend? Who wants to go to a Saturday workshop? They've got family. So it's a struggle. So usually we fall back on a week day even if we need both and if it is more technical, we will often have it during the week and hope that some volunteers can come. But it is more agencies and regulator or engineers.

[Question] Do you think current policies are affective in managing watersheds? Like policy direction

[PC] When the watershed approach was introduced in Massachusetts, it was highly effective but that did not get funded. That lasted for 5 to 7 years. They reorganized the whole way they approach on watersheds and for whatever reason they said that was not sufficient or wasn't good enough. They hired a basin team leader for each of the 18 basins. So that brought in "Hey we can do this" if there is someone to help coordinate it and the stakeholders are on board. It takes

somebody a full time job. It needs the status of the state. Nonprofits can help push but they can't make things happens so you really need that partnership of public-private.

[Question] Are you just trying to do partnership or do you think anything else can helpful?

[PC] The research has to be there as well. The state does the monitor but they are such sort staff that they can't release the water quality data. So we have the assessment. I think the most recent is 1998 assessment. I think I might be exaggerating. It might be 2003. But that is still 7 years. The data they took last year. "sorry the data has not been released yet" so I get a little frustrated with scientist and releasing the data. I understand that.

[JC] It's like everyone is dying but you don't know yet.

[PC] And the transparency of the data. Its getting better with the web but it still it is not as good as it should be.

[Question] Do you think that there is less public assisting the watershed that it is causing the data to be less transparent?

[PC] Well that's a big part of it. If people are not asking for the data why should they bother? Well they are saying "no one is asking for them then I will get to it later. So yes, the squeaky wheel gets the grease. Well there is not enough people squeaking because they are worried about something else.

[Question] Do you think government agencies do enough enforcement?

[PC] If I can go off on a specific thing erosion control and sediments and who is responsible for inspecting that. To me it should be clear that it's the conservation commission and the case of city of Worcester finally got inspectors assigned to the conservation commission so they are responsible for enforcing the state wetland protection act. So they review all subdivisions and if there is an erosion problems they are the people that are supposed to be looking after that. But the board is made up of volunteers so who is going after the site? You have building inspectors and you have others who inspect for structural stuff, who is inspecting for sediment. Often times they don't get called until a mistake happens. The mistake happened because it rained on the weekend. By the time they get there Monday morning the stream is running clear. What is the problem? The finds are long gone. There needs to be more, I don't want to say more inspections cause construction workers themselves should be inspecting and knows the erosion control. They will get a little bit sloppy until someone tells them to do it right. So that's just the issue with construction. Then you get into maintenance. Where is the maintenance to clean up all these catch basins you have installed with deep sumps? Well deep sumps don't work if you don't clean up the sumps. Who is inspecting the sumps? I think with technology they are beginning to track their work better but they are slow to get into it .

[Question] Do you find that when you do a watershed even and meeting, does the public give you feedback?

[PC] The program is getting to the meeting in the first place. So we had a work shop here and sent out postcards to all the neighborhoods who wanted to focus on Millbrook. I think like 4 people showed up. It's discouraging but how do you get people? Does it have to be fun? Does it have to be educational? What's in it for them? They don't know if there is a problem they shouldn't be. So that's the problem, getting the audience and then once you get them, are they inspired by what you saying or are they learning something? Will they make changes? Its funny cause, all it takes is one then you feel good when you make that connection. People get inspired and enthusiastic. Who knows who they are going to talk to in their neighbors? Someday you feel what you are doing, others not as much. That is the challenge. There is "what are words that work" is a work shop. We environmentalist tend to speak in lingo and that message does not get across to the public so there are 4 simple steps. You are supposed to be clear with your message. What change of action do you want? And then what are you suppose to take a picture of people doing that action? There should be a child in there and a face.

[XC] Like a cute child.

[PC] Animals help too. Then you have to get rid of the lingo. You have to write in clear 7th grade English. You can use the word stormwater. What is the first one? It's the image. Be clear on what you want to change. If we want to change detergents, how we mow our grass, how we build our houses, how we clean our streets? Maybe we are too broad because there are so many different things that are affecting the river. It is not just one issue. Maybe that's our weakness. The success of something like the Charles River is bacteria. Just focus like a laser on that and that enough and because people use the Charles for boating and sometimes swimming. Out west, it is the salmon that is the issue that galvanizes people so each watershed has to find its own purpose or to find its own issue.

[Question] Is it because not much people are using the Blackstone compares to the Charles River?

[PC] Well so it doesn't applies to Worcester but downstream people do you the river for recreation so we are trying to play that up and the bike way along the river. People are now appreciating it as a resource but it takes a while to overcome and that's and I think in general cause around here. If you grew up here the Blackstone had a bad reputation. It is a polluted river why do you want to go there. It smells and its stinky. It still has a distinctive smell to it but it is really kind of pretty in some places. It's overcoming that attitude. That's a generation thing. It is getting better.

[Question] Do you see more people engaging in activities in the Blackstone? Trying to clean up?

[PC] Well yes that um traditional clean ups. That very good. Its gives something that they can do and feel good about it. Don't ask them to go to meetings. Don't ask them to sign a petition but you break it into some smaller things that make people feel good. Clean ups are good. Some of our organizations are going into invasive, sub-management. Pulling weeds. People like to do things and look at a big pile at the end of the day. It's hard finding the right activities for the

volunteer work place, it has to be for family orientated, it has to be for youth, boy scouts. Who is going to come?

[Question] Is it hard to find people with that passion about the watershed?

[PC] How to find people? how to create that passion? Its just a little bit of interest.

[Question] How much funding do you get from the government?

[PC] The Heritage Corridor has been good to us. The Heritage Corridor which was established in the '87 so it is an element of the national park service. They supported us with water quality monitoring and they encourage us for water quality testing but that money has shrunk up a little bit during the years so maybe federal funds 25 a year perhaps from various sources.

[JC] Twenty-five?

[PC] Grand

[Question] Do you know what percentage of that of your total funding?

[PC] That might be about 50% and rest usually comes from grants. Now is that federal grants? We also get some nonprofit recipient of the Greater Worcester Community foundation. Well actually what supports us is the Mass Audubon. They give us free room and board. They pay for electricity and phones so that's quite generous. It's a cost I don't include in my budget because we never have to pay for it. We are not necessary a membership so we that's not how we get our money but we have some success in Supplementary Environmental Projects (SUP) in Lou of penalties. We have been a recipient of some of those. So is it governmental? Well its actually the private sector but they are only giving the money because the government is penalizing them and we are the recipients. It is not government money but government assisted.

[Question] Do you think government provides enough funding for watershed organizations?

[PC] No. Nope I don't. The DEPs are getting cut back so its hard to ask the state to do their jobs because there are less of them there. The money available to nonprofits is really limited. There is the 319 project. Even there you need a 40% match and then you need the land owners. You can work in partnership with towns. There are better successes. We have been able to identify project that town sees the value of and they apply for it and we work with them and do the outreach and do the monitoring. The that partnership has been pretty successful

[Question] What does the majority of your spending go into?

[PC] Staff, so I am half time.

[JC] Is this speaking to the coalition?

[PC] Yes. So basically 90% of our funding goes to pay mine salaries. I am about \$20,000 a year and she is about \$20,000 a year and that's about our budget.

[JC] And you two are the only two staff?

[PC] Correct. Some organizations don't have any paid staff. That's why you can't do things that you want do.

[Question] What is your opinion of the government funding processing? Is it hard to get your money?

[PC] If you have a good idea. You pull together partnership and get all the commitments; its doable. The problem is time and usually you don't have that much time between what is coming out until it's due. So you got to be ready before hand and have your partnership altogether and then agree on who's going to do what work. So that's the good side when you have a good idea. The other problem is it pays for in the ground stuff. It doesn't pay for my salary. It doesn't pay for keeping a web site. So all these things we know we have to do.

[JC] So no overhead cost?

[PC] We are not geared for it. You know what we should do is charge for overhead. The WPI probably has a 40% overhead to pay for salaries. We just have not gotten to that and maybe we should just be smart. At least 10 or 20%. It's up to us to be smart. The problem is we are kind of too cheap. Well this project and all these deliverables. What are the deliverables that the funders want? Well that's new work so unless I can spend what I am already doing as a deliverable, there is no money to pay what I am already doing and what needs to continue to do. So it's kind of how you be a good grant's men.

[Question] And you have to apply for them all right?

[PC] You have to apply for them. You have to put a lot of work into it and you think it is a great project and it doesn't get funded. Well that's life and you're not going to all of them. 50%, 30% might be good track record but we don't have the resources to do that many projects.

[Question] Do you get the money in a timely fashion or do you have to reimburse for it?

[PC] Different ones are different. Often the federal funding they will give you the first little bit. Almost all of them are based on kind of do the works. We have fortunate enough that you know that the money left over from last year are going to roll over because we have a low overhead. So if money is tight then I will just work less hours that week so you know.

[Question] If you were given additional funding what would you use it for?

[PC] Well this is that \$90,000 so we gave three projects. We are going to enhance that modeling effort so with TMDL, Total Maximum Daily Load so that was a \$5,000 grant that may push for a \$30,000 research study. We continue our water quality monitoring and spread that over two

years so that's probably another \$30,000. So another is more focus outreach to homeowners throughout the valley. So we want to be really clear on what that outreach is? We are trying to keep it broad and affect more people.

[Question] Do you have any idea what that outreach would be?

[PC] Its trying to get rain gardens. Its trying to get down spout diverters. There is a display downstairs. The typical house generates in a half inch storm about a 1,000 gallons. So that adds up after a while where desperate enough that we are going to subsidize. We are going to take a little cart and walk around the neighborhood with downspout diverts and this display and offer them at no charge to people if they were willing to install it.

[JC] Down spout diverts?

[PC] Your gutters they come down and down spout and often people will put them down on the driveway and get that water onto the road as quick as possible because they don't want it to get into their basement. So where saying if the sight allows. Rather than diverting onto your pavement, why don't you divert it onto your grass or mulch then at the corner of your house let the water infiltrate and do sheet run off over your grass before it goes into the street. Is it going to get in the way of my lawn mower? Is it going to come back into my basement? Why should I bother? That's the challenge.

[Question] Have you started any of that or is that what you are hoping to do?

[PC] No. We are. That was the workshop where only 4 people came to last week and we even gave away a rain barrel. Just trying to get people. So that's how desperate we are. So I am not sure what it takes but it takes an implementer. Having a few implementers taking pictures and then what they are creating a display. If this person is doing it you can to.

[Question] Do you get any publicity in the newspaper or anything?

Peter: Yeah. Although we are not as good at blowing our horn or we should really being taking more pictures and writing our own articles. You know you send out a press release and no reporters coming out to attend and writing a story. We do not have as good a relationship with paper. Unfortunately there is paper cover the, the Worcester TMG, we trying to establish a relationship there "as I see it columns" but we really need to develop a better relationship.

[Question] Do you think that would be beneficial?

[PC] Oh yeah. It's all about getting the message out there especially local newspapers. They come free; they are more desperate for copy material. So is that how I should be spending my time is writing up articles to papers? Probably should. So it's getting the message out. Suppose the new way would be social messaging. You know I am not going... I suppose but I am always hung up with. There should a purpose on what you want to say and then what are we trying to say. Does it infiltrate? Yes but that's the dumbing down of this complex world we live in. So if you have the time you get into it with people and have a discussion. That's the more effective

outreach. I want small groups where you are able to take people's questions and bring them along through. We don't often have that luxury. But, if you are out there long enough and you run into enough people. People know that you are interested, they will give you a call when you have questions and that leads into "oh I have a project and I know who at the city is responsible for that" and try to connect that network of advocates or opportunistic.

Interviewee: Thomas Walsh, Engineer, Director/Treasurer of Upper Blackstone Water Pollution Abatement District

[KR] What is the operation size of your plant, i.e., daily flow of wastewater processed, number of workers, amount of people serviced?

[TW] The plant has a maximum processing capacity of about 45 million gallons per day; on average processes about 30 million gallons of waste water each day. The plant employs 52 people and provides service to about 250, 000 people.

[KR] What are some of the contaminants in the wastewater?

[TW] Incoming wastewater typically contains organic matter such as BOD, suspended solids, nitrogen, phosphorus, coliform, metals such as copper and aluminum. More detailed information can be found on the website: www.ubwpad.org

[KR] What percentage of the initial contaminants is removed during the treatment process?

[TW] Estimated removals are:

Organic matter and suspended solids – 95%

Nitrogen, phosphorus and coliform – 80%

Metals – 60%

[KR] What contaminants are not removed by your treatment process?

[TW] The wastewater may contain pharmaceuticals, care products, cleaning products, etc; however the plant isn't designed to remove them. There are no regulatory requirements to remove them.

[KR] What additional contaminants are being considered for regulation (for discharge) now, or may in the long term be regulated?

[TW] The contaminants mentioned above [pharmaceuticals, care products, etc] are being considered for regulation. However, current technology is too expensive to test and remove them.

[KR] Is the plant currently operating at the required regulatory standards?

[TW] Yes it is.

[KR] What hardship would the District incur if the allowable discharge limits for nutrients are decreased (made more stringent)?

Any thoughts on the impact to taxpayers?

[TW] That depends on the nature of a permit currently being appealed. The permit requires phosphorus removal that would cost about \$180 million in upgrades. This is in addition \$200 million upgrade for the previous permit in 2008. The 2008 permit increase customer rate cost by about 600%, which could double if the appeal of the current permit fails. The permit requires levels that are below the limits of technology, and would cost about \$5 million a year to maintain.

[KR] How difficult is it to maintain regular operating standards during special situations, such as storms?

[TW] Major storms are extremely difficult to handle. When there are hurricanes and storms, especially during spring, it is very hard to keep the plant stable.

[KR] What can be done to improve this?

[TW] City's sewer system is too old, and needs updating. At the time of design, people were more concerned about getting rid of waste than treating. City should invest more into changing from combined sewers; have separate flows for municipal wastes and stormwater.

[KR] What limitations do you face in implementing these improvements?

[TW] They seem to be effective

[KR] How effective are the enforcement policies of regulating watershed pollution?

[TW] They have many struggles common in most policies, but they are effective.

[KR] What do you think can be done to improve the enforcement of policies?

[TW] Does not see compliance as an issue. Thinks people should want to do the right thing

Interviewee: Dona Neely, President of the Blackstone River Watershed Association

[Question] Why do you feel watersheds are important?

[Answer] Watersheds are a critical source of drinking water, provide valuable habitat, and are a recreational resource.

[Question] What do you think are the biggest challenges to watershed management?

[Answer] Urban growth, encroachment, and pollution

[Question] What do you think are the current problems with watersheds?

[Answer] Impact of contaminated stormwater runoff – the main source of water pollution in MA and increasing water consumption levels (by residents and businesses) which are causing rivers to run dry.

[Question] What do you think are the best ways to solve these problems?

[Answer] Regulations that promote smart growth practices; and a re-evaluation of water flow levels and capacity.

[Question] Do you think public education about watersheds is essential to preventing watershed degradation? If so, please explain.

[Answer] Yes – Only when people understand the problem(s) and what they can do about it, will they act.

[Question] A. Does your organization currently have any educational programs or outreach available to the public? If yes, please explain. If not, have you ever had any in the past or plan on implementing any in the future?

B. What has been the turnout on these programs? Would you consider this successful?

C. Do you feel these programs could be beneficial in other watersheds?

[Answer]

A.

- We host a booth at various public forums and events (activities at River Bend Farm in Uxbridge, farmers markets, etc.). Board members staff the booth and tell visitors about our activities and how they can get involved. They also encourage the review of a range of take away materials available at the table.
- We have a model of a watershed that is used to demonstrate how activities on the land cause pollution in local water ways. We do this training at events (above), to various youth organizations, and in schools and libraries.
- We host four Coffee and Conservation lecture series per year that address topics such as organic lawn care, composting, etc.
- We have more than 40 volunteers that test the quality of the water at sites throughout the watershed on a monthly basis. The results are publicized and used to identify problem areas.
- We host two annual cleanups that attract over 100 volunteers each.
- We host stream team surveys every other year
- We have partnered with the Blackstone River Coalition to do a targeted mailing of 600+ Homeowner Guides that are packed with tips for how to minimize contamination of stormwater runoff around the home.

- We are getting ready to launch a new program that will focus on the identification and management of aquatic invasive plants that will include the dissemination of outreach materials, hands-on identification and management trainings, and a database for tracking.
- B. Participation really varies, depending on the venue and topic. Trainings average 25 attendees. We appreciate all participation but would certainly welcome more.
- C. Of course!

[Question] Have you received any feedback on the programs?

[Answer] Yes – always positive. People feel good when they get empowered to make a difference and they are grateful for our efforts.

[Question] What are your means for educating the public?

[Answer]

- Our website – currently being redesigned and repopulated – to make it easy for stewards
- to learn about current conditions and what they can do
- We have a monthly electronic newsletter that gets sent to approximately 300 people
- Educational materials on how to protect water resources, minimize polluted runoff, manage aquatic invasive plants, etc., made available at public events
- Presentations, workshops described above
- Press releases
- Targeted mailings to river abutters
- Meetings with municipal leaders, conservation commissions

[Question] Are these means limited by anything [resources]?

[Answer] People and financial resources

[Question] Have these means proved successful? Please explain.

[Answer] We can certainly see areas of improvement, but its hard to determine a direct correlation or to confirm what actions people took after meeting with us

[Question] A. What methods of outreach do you think would be most influential?

B. Why have these methods been implemented or not implemented?

[Answer] Multiple interactions are necessary to get the message out, studies say it takes 3-7 “touches.” This is a challenge, given the non-profit constraints of people and funding. Personal interactions are best, because you can confirm that the target audience is gaining an understanding of the problem and desired actions.

[Question] What are some of the challenges when organizations try to promote a watershed plan?

[Answer] It’s a challenge to engage the public; they have to perceive a personal benefit. Unfortunately not everyone is a tree hugger!

[Question] Do you see a positive result in watershed planning when involving public participation?

[Answer] Yes – mass ownership ensures success

[Question] What do you think should be done to improve watershed planning?

[Answer] Education – education – education

[Question] Does the public have the necessary technical skills to monitor a watershed, or can they be trained to do so?

[Answer] Most do not have the technical skills, but they can be easily trained.

[Question] What has the organization done to help the public have the necessary skills in monitoring?

[Answer] We hold trainings that encourage public participation; promote opportunities to learn on our website, in local newspapers and on cable stations. Volunteer monitors participate in the water quality monitoring and stream team survey programs; this will expand to include invasive plants this year.

[Question] Aside from public participation, what have state and local governments done to help with watershed planning?

[Answer] State government is doing more to promote smart growth practices by developers and requiring businesses to implement more controls to minimize stormwater pollution. Local governments are also adopting regulations to minimize stormwater in new developments.

[Question] In your opinion, do you think the government provides enough funding for the watershed organization?

[Answer] We could certainly use more!

[Question] Roughly how much of the organization's total funding comes from the government?

[Answer] Varies year to year, 0-20%

[Question] What does a majority of your spending go into and why?

[Answer] The publication of outreach materials that can be used in trainings, mailings, public venues. Funds also used to hire a project manager to manage aspects of grant-sponsored programs.

[Question] What is your opinion of the government funding request/approval process? How can this be improved?

[Answer] Less paperwork would be helpful

[Question] Do you receive your funds in a timely matter?

[Answer] Yes

[Question] If you were given additional funding, what would you use the funding for?

[Answer] To build on current offerings, hire full time staff to strengthen presence in the communities, and to conduct remediation projects.

Follow-up Responses:

[Question] Where does your organization get their funding from? What are the percentages of the total funding comes from these resources?

[Answer]The majority (avg 75%) of our funding comes from grants awarded, the remaining comes from member donations. Funding entities will vary year to year.

[Question] How is your funding used among your organization? What does a majority of your spending go into and why?

[Answer]Monies collected are invested in program development and delivery - typically outreach materials and educational activities. What type of education (e.g., stormwater, invasive plants) will be influenced by the successful grant proposal.

Interviewee: Steve McCurdy, Director of Municipal Services for MassDEP

[CF] Why do you feel watersheds are important?

[SM] Well they are nature's own planning unit: whatever happens in one part of the watershed effects another. Well, it's a good basis of planning to ensure all that are interconnected systems.

[CF] What do you think are the biggest challenges to watershed management?

[SM] Probably the political subdivision. The fact that you can be in a community that is an important drainage area to a basin, but not really see the economic value the way that you would if you have a lake or water front. You can just have a small trip and you know you need to spend a lot of money to protect that trip and don't gain any economic benefit from doing that. Neighboring communities can gain a lot of benefit from your protective investment, and it makes it difficult to convince watershed communities to invest a lot of their money in protecting resources from which they don't get much benefit.

[CF] What do you think are the current problems with watersheds?

[SM] Well you know it's probably mostly budget. They are certainly suffering from the effects of lots of years in a row of obscure budget, and as a consequence municipalities have cut themselves down to taking of the core functions. DPW have less additional funding to devote to that sort of stuff. In the state level, there has been a reduction in the state's budgets, so it's hard to find well financed watershed associations.

[CF] What do you think are the best ways to solve these problems?

[SM] As the budget situation improves you certainly need an active stewardship community. If they are not actively, you know, pursuing and lobbying for watersheds. You know that the areas of public interests that are lobbying for their causes, will get more money and the watersheds will get less. So that would certainly be the main opportunity for them to get more money.

[CF] Where do you think public education about watersheds falls in regard to priority?

[SM] With any public education program they are difficult. They can be difficult. It depends because there are no evident benefits from them, in terms of immediate water quality improvements. But what it does is that it's an investment in the future, and if you accept the fact that it is an investment in the future then you are willing to make the investment. That you are teaching people to behave properly towards the watershed for a lifetime, rather than just spending the money to put in the best management practice, that might give you pounds of removal of sediments that you can point to as direct benefit and this isn't new. This is a long term problem with any of the public education programs, is that you can't correlate investment with \$100 in public education to \$100 in environmental benefits. You just won't see it. But \$100 investment in the best management practice might get you \$500s worth water quality improvement that shows. There is always that sort of balance that has to happen between the core functions, as a regulatory agency, to make sure the money is well spent, but keep an eye on the future as well.

[CF] Does MassDEP currently have any educational programs or outreach available to the public? If yes, please explain. If not, have you ever had any in the past or plan on implementing any in the future?

[SM] There is a lot of information that can be found on the website. The department also does have some circuit riders and trained conservationists about wetlands. I would say less outreach right now. The department's main function is to write permits conduct inspections to make sure permits and other state laws are being adhered. In times of budget obscurity, those core functions have to be met and there is less focus on public education. The department does fund some small sub-grants, federal sub-grant and nonpoint source pollution grants that will have technical transfer component to public educational component, where part of the project is to explain to the general public what the problem is, how it is being solved and that sort of thing. You know we do some level of public education but not as much as we like to.

[CF] Have you received any feedback on these programs?

[SM] Well you get different feedback from different people. We have had professional budget hawks that have questioned the use of funds for public education. You cannot connect a dollar of public education to a dollar of improvement in water quality. On the other hand, any number of our projects that have some of the grants, that have been built have received EPA awards.

[CF] Are these means limited by anything [resources]?

[SM] Well of course, absolutely. We are on a tight, tight budget. We have a structural deficit budget in 2012 that going to have to be met either by revenue enhancements, that seems unlikely, or constrictions in government services, which seems more likely.

[XC] What methods of outreach do you think would be most influential?

[SM] I would say that educations in the primary and secondary schools, where you know they are open to new things. They are caring about the environment. They've got the time and inclination to listen, and things that you learn as a child will carry with you for a lifetime. The social sciences studies will prove that its more difficult to teach an old dog new tricks. If somebody has a 10 year old that is a recycler then they are going to remain a recycler for their life time. You know when you got somebody that's in their 60s or 70s and has always been an inhibitor that has always been throwing their things away. It's a lot more time intensive and difficult to get them to change behavior. So absolutely doing programs with the schools would be the best investment.

[XC] What needs to be done to promote better watershed behavior among communities?

[SM] I think there is certainly a level of knowledge that already exists. The value of the watershed stewardship. Reinforcing that message that all of these systems are interconnected, and that good behavior benefits us all. You know some of that will have to do with money to provide for the opportunity to continue stewardship programs and building of strong constituencies to lobby for watersheds.

[XC] Should watershed education be consistent state-wide or vary based on specific watersheds and watershed communities?

[SM] Well I think there are large elements that would be useful across the board. The water cycle, the impact in biological cycle, chemical cycles, would generally be the same. But you know you can customize it to the specific historic value. There is scenic value that other watersheds don't have and that can cause people to want to protect them more or less. Urban watersheds affect more people, although very fewer people will use an urban river than a rural

river, but the water goes past many more people so you know explaining to folks, you probably don't have to explain it to folks out in far western Mass that it is not a good idea to dump oil in a storm drain, and that happens in the city all the time. People change their oil in the car and dump it in the storm drain because it is out of site out of mind, and that storm drains wines out in a water body some place. So there would large slots of the public education that can be general to watersheds and then some portions of it specific to individual watersheds.

[XC] In your opinion, do you think the government provides enough funding for the watershed organization?

[SM] Well you know, my way of thinking, watershed should be self-sustaining. They should be able to raise enough money so that they don't need government subsidies. But that said, the government providing grants for projects they can take on that are communal interest is certainly a good role for the government. Is there enough, I don't know. Any of those folks will understand there is enough. They have to do fund raising of various kinds but neither do I think they should be completely supported by government money. I think that you know if you are going to do a good job as a steward, you can't always be holding to the hand that feeds you. If the government is providing you with all the money, you can't be or feel at liberty to question judgments of bureaucrats. You have to get financial independence from them.

[XC] How does the varying of funding from year to year affect your organization/department?

[SM] How does it affect my department? Well as I said earlier, if we got some budget flexibility; we are more likely to engage in public assistance, public education to teach people why protection is good. When we have tighter budgets, we are more likely to be doing the police work, like here is what you are allowed to do. Here is what you are doing and here is fine, and here is your penalty that sort of thing. You are not explaining to people ahead of time why they should do the right thing. You are just punishing them for doing the wrong thing.

[XC] What does a majority of your spending go into and why?

[SM] I would say it probably goes into inspections and into urban writing.

[XC] If you were given additional funding, what would you use the funding for?

[SM] Like what I say before: enhance the public education in the aspect of environmental protection. If you avoid pollution in the first place it a lot more economical than to clean it up after the fact. If you could educate 10 people not to dump their motor oil down the storm drain, that might cost you \$100. Trying to clean up 10 gallons of oil down a storm drain would cost 10s of thousands. It's hard to prove that education will stop them from doing that, but that's the case.

[CF] Do you want to remain anonymous if we put the information in our paper or do you want to look at it for and then decide?

[SM] Why don't you let me know how you have used my information, and I will let you know.

[CF] We will be done in March and will we send you a copy of it before we submit it. Can we contact you for additional information?

[SM] Yes

[CF] Sorry for such a rush. I know you're really busy and we really appreciate it.

[SM] Alright Chuck. Good luck on your project.

[CF] Thank you so much. Bye.

Interviewee: Therese Beaudoin, Watershed Coordinator of MassDEP

[Question] What are the biggest challenges to watershed management?

[Answer] By the early 1970s, the worst sources of pollution to our rivers were the point source discharges from municipal and industrial facilities. Thus, our regulatory system was structured to address these, and we are now at a point where improvements at these discharges are limited by the state of the technology. Thus, nonpoint sources are our biggest challenges to water quality in the Blackstone and other Massachusetts rivers today. And managing nonpoint sources is the biggest challenge to watershed management.

[Question] What do you think are the current problems with Blackstone River watershed?

[Answer] The City of Worcester sits at the headwaters of the Blackstone, and urban runoff from the >65% impervious surface cover here places the Blackstone in a water quality impaired status at its beginning. And just downstream is the Upper Blackstone facility whose discharge constitutes up to 90% of the flow in the Blackstone under prolonged dry weather conditions.

[Question] What are some of the watershed management strategies which have been implemented or have not been implemented do you feel would be most effective in controlling non-point sources and point sources pollution?

[Answer] Bylaws enacted on a town by town basis can be very effective in minimizing development-related NPS, such as stormwater management, LID development elements in larger developments, and active open space protection.

[Question] A. Are there any limitations to implementing these improvements?

Unfortunately, yes.

B. If so, what are they?

[Answer] The examples above are not regulated on a state level, thus support for them relies on local networks of supporters i.e., in each city/town.

[Question] What is the current Total Maximum Daily Load (TMDL) implementation plan for Blackstone River watershed?

[Answer] Contact Elaine Hartman at MassDEP; her email is elaine.hartman@massmail.state.ma.us and phone (508) 767-2857

[Question] What is the current Water quality target for Blackstone River?

[Answer] The target for the Blackstone River is to achieve the qualities of a Class B water – the details of Class B water, as well as the remainder of the surface water quality standards, can be found at: <http://www.mass.gov/dep/service/regulations/314cmr04.pdf>

[Question] What are the contaminants MassDEP tests to establish the water quality standard?

[Answer] The parameters that MassDEP has historically tested include: DO, T, pH, specific conductivity, total phosphorus, total nitrogen (formerly total Kjeldahl nitrogen), ammonia nitrogen, nitrate-nitrite nitrogen, alkalinity, turbidity, chlorides, hardness, and bacteria. We also note the presence/extent of nuisance aquatic vegetation and/or algae, aquatic habitat, benthic

macroinvertebrate communities, and fish community composition. Not all of these were conducted on the 5-year cycle. The most recent Blackstone Water Quality Assessment Report can be found at: <http://www.mass.gov/dep/water/resources/wqassess.htm>

[Question] What contaminants do you think are important to test that are currently not tested?

[Answer] Historically, sediments in the Blackstone River were known to be contaminated with a range of petroleum products, as well as byproducts of industrial processes upstream. The most recent river-wide sediment report of which I am aware was written in 1980. The bottom condition is likely changed, perhaps greatly, in the past 30 years, resulting in sediments in some areas being capped by recently settled materials, and others being scoured and more exposed. We also would benefit from an estimation of the nutrients stored within sediments, particularly within the impoundment “sinks”, which have been identified as a source of nutrient enrichment to the Blackstone ecosystem.

[Question] After an assessment of water bodies are completed, how long is the waiting period for the funds are received under section 319 of the clean water act?

[Answer] Water quality assessments are not linked to the Section 319 program in that way. 319 grants utilize the information in the 303(d) list of Impaired Waters (now the Integrated List – see <http://www.mass.gov/dep/water/resources/tmdls.htm> for further information - to determine the water quality need of individual project proposals.

[Question] How effective are the enforcement of policies at regulating watershed pollution?

[Answer] Enforcement of any regulation is limited by the effectiveness of the underlying regulations, as well as the resources to implement them.

[Question] Are there any regulations waiting to be passed which would help improve the watershed management?

[Answer] Although this is outside of my area of expertise, I am aware that the state has been working on developing a streamflow policy which is still in the design stage. Streamflow issues, in terms of both quantity of flow and manipulation thereof, is problematic across Massachusetts.

[Question] What do you think can be done to improve the enforcement of policies?

[Answer] See No. 10 above.

Interviewee: Nancy Bryant, Executive Director of SuAsCo Watershed Community Council

[Question] Where does your organization get their funding from? What are the percentages of the total funding comes from these resources?

[Answer] FY 10: grants 23%; donations 7%; stormwater community assistance program 70%

[Question] How is your funding used among your organization? What does a majority of your spending go into and why?

[Answer] Majority of funding goes into creating and distributing the annual products from our stormwater community assistance program. Why, because it is an excellent revenue source, it helps municipalities with their stormwater compliance, it educates citizenry on the importance of water quality and the role everyone has in cleaning up stormwater, and this program results in improved water quality.

Substantial funding also goes into holding workshops and conferences and Steering Committee meetings.

Depending on the year, and financing sources, some funding will go into fulfilling specific project work.

Funding also goes into serving as an information resource to the watershed, through my knowledge, our database, and our library.

Funds also have to pay for administrative costs such as rent, utilities (electric, phone, fax, internet), website fees, workman's compensation insurance which is required by law, business owners insurance which is required by law, payroll company, annual audit and tax filing, etc.

[Question] What is your opinion of the government funding request/approval process? How can this be improved?

[Answer] I'm not sure what you mean by the "government funding request/approval process". Many state and federal agencies offer grant programs that are highly competitive and often require extensive applications and if won, require extensive reporting requirements. Grant programs often change with the times, so that grant money is allocated for the new "hot" topic. Presently, there is a paucity of state and federal grant programs in comparison to the wide array of environmental issues that need attention. So improvements would include simplifying the application and reporting process and increasing the amounts of grant money available.

[Question] Do you receive your funds in a timely matter?

[Answer] Again, are you referring to state and federal grants? If so, most state and federal grants reimburse organizations after the grant work is completed, often on a quarterly basis. This is difficult as the organization must fund their staff and bills up front when the work occurs, not after the fact, which means that an organization may need to take out a loan or have other funding available that can fill the gap time between grant work completed and reimbursement from the grant.

[Question] If you were given additional funding, what would you use the funding for and why?

[Answer] I wish that all environmental organizations that meet certain criteria would all receive a base grant to help cover overhead (office expenses as described above). The criteria would have to be determined and the organization would have to prove themselves worthy of such base

support. But this would help immensely in the day to day financial management of environmental non-profits.

A heavy reliance on grants often ends up dictating what an organization does, as they are forced to write for the grant and carve their work around the grant money available. The old case of does the dog wag the tail (i.e., the organization determine what its mission and goals are), or does the tail wag the dog (the grants dictate what the organization does).

Personal Communication:

The SuAsCo Watershed Community Council (SuAsCo Council) has a slogan of “three rivers, one community” helping to instill a sense of place and pride in one’s watershed. The SuAsCo Council has created a stormwater education program called the “Stormwater Community Assistance Program” that goes by the slogan “Stormwater Matters” that annually provides educational materials to municipalities to help them educate their citizenry about stormwater. Educational materials are geared to a wide range of citizens including residents, homeowners, commercial and industrial businesses, town employees, school children, reaching out to virtually everyone in the community. The stormwater educational materials include brochures, postcards, posters, bookmarks, surveys, tabletop displays, school lesson plans, stickers, maps, storm drain marking kits, PowerPoint presentations, cable tv ads, and website materials.

The SuAsCo Council has two websites, one focuses on stormwater while the other focuses on the Watershed. The SuAsCo Council staff and volunteers also attend community events and public forums, sharing tabletop displays and handouts (brochures, postcards, bookmarks, etc.), as well as delivering public presentations using PowerPoint and other media. The SuAsCo Council also sends out an electronic monthly calendar of meetings on SuAsCo Watershed issues.

The SuAsCo Watershed Community Council (SuAsCo Council) has a unique structure where it brings diverse interest groups – businesses, municipal officials, environmental organizations, and state and federal government – together to collaborate on environmental issues in the watershed. This balanced representation of interest groups enables the SuAsCo Council to have a positive impact on watershed policy decisions by improving the understanding of the issues among all involved and promoting consensus so that stakeholders can work together towards the common good of the watershed.