SASCO BROOK WATERSHED-BASED PLAN

Recommendations for Protecting and Improving Water Quality in the Sasco Brook Watershed

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Foreword

This report presents the ''Sasco Brook Watershed-Based Plan'' prepared by the Sasco Brook Pollution Abatement Committee (SBPAC), a voluntary alliance of representatives of governmental agencies and private organizations with authorities, responsibilities, and interests concerning water quality in the watershed. Interested citizens are also participants. The plan, which contains recommendations to protect and improve water quality in the watershed, was prepared in the period 2009-2011 with funds provided by the Connecticut Department of Environmental Protection. The recommendations are non-binding and stress voluntary initiatives to reduce bacterial contamination from animal waste and septic systems that is sometimes carried by stormwater runoff into the brook, its tributaries, and ultimately into Long Island Sound.

The watershed covers a little more than ten square miles in southwestern Connecticut. A significant part of the watershed is in the Town of Westport; most is in the Town of Fairfield, and a relatively small part is in the Town of Easton. The brook and its watershed have important natural values and ecological functions that contribute importantly to the quality of life in the watershed's residential neighborhoods. In addition, there is a fundamental relationship involving the brook, its watershed, and Long Island Sound—an estuary of national significance that depends on the environmental quality, including water quality, of its many tributaries and watersheds.

Included in the Watershed-Based Plan is a review of the significant accomplishments for protecting and improving water quality in the watershed that have been achieved since the SBPAC was established in 1991, along with some of the significant lessons learned by the committee through its experience. The plan sets forth a ''Watershed Vision'' of ten broad goals based on the concept of perpetual stewardship whereby all citizens, governmental officials, agencies, and organizations with an interest or authority pertaining to the watershed will think of themselves as having responsibilities for care of the brook and its watershed. The plan also proposes an implementation strategy focused on cooperative, voluntary actions on the part of all watershed stakeholders to reduce runoff pollution, also called ''nonpoint source'' pollution.

In addition, the Watershed-Based Plan includes a five-year program consisting of specific actions for advancing the Watershed Vision, including: analytical measures to continue to develop understanding of the sources of pollution in the watershed; structural measures to influence the movement of stormwater; outreach and education measures to maintain and increase public interest and support for advancing the Watershed Vision; planning and regulatory measures focused on informed land-use planning, effective application of existing land-use regulations, and ongoing pursuit of available funds to implement best management practices for water quality management. A priority implementation measure is a microbial source tracking analysis, heretofore not conducted in any other watershed-based planning effort in Connecticut, to more precisely assess the most significant bacterial contamination sources affecting the brook.

The Sasco Brook Watershed-Based Plan has been prepared as a guidance document with an emphasis on continued public outreach and education initiatives that will be pursued through already existing programs, including the programs of the SBPAC and the agencies and organizations represented on the committee. A principal goal of the Watershed Vision is to encourage voluntary, personal stewardship actions that will reduce the risk of pollution without creating an additional, undue burden on municipal budgets.

Acknowledgments

Many persons contributed to preparation of the Sasco Brook Watershed-Based Plan. The plan was prepared at the direction of the Sasco Brook Pollution Abatement Committee with input and guidance provided by the Connecticut Department of Environmental Protection's Watershed Management Program in the DEP's Water Protection and Land Reuse Bureau.

While there is not space here to name all of the individuals who contributed their time and knowledge to the watershed-based planning process, the following committee members are among the individuals who provided especially important assistance throughout the project: SBPAC Chairman Alicia Mozian, representing the Town of Westport Conservation Department; Thomas Steinke, Fairfield Conservation Department; Mark Cooper and Lori Romick, Westport-Weston Health District; Carol Donzella, USDA Natural Resources Conservation Service; Kristen Frank, Connecticut Bureau of Aquaculture; Carla Nelson and Stuart Sachs, Fairfield County Hunt Club; and Dick Harris and Pete Fraboni, Earthplace—The Nature Discovery Center. Representatives of the U.S. Environmental Protection Agency and University of Connecticut also provided valuable assistance during the planning process.

From the DEP's Watershed Management Program, Christopher Malik, MaryAnn Nusom Haverstock, and Kelly Streich provided important assistance. Mr. Malik served as the DEP's project manager, participating in the SBPAC's planning meetings and providing vital direction, advice, and information throughout the course of the work.

Special thanks are extended to Lara Donahue and other students from Westport's Staples High School who enthusiastically volunteered to conduct the Town of Westport's Watershed Survey and provided other assistance during the watershed-based planning process.

Thanks also to Peter Ratkiewich, Town of Westport Town Engineer, who provided realistic assessments of stormwater management opportunities, and to Damion Vassel, Town of Westport GIS Coordinator, who provided vital assistance for preparation of the watershed-based plan maps.

Geoffrey Steadman of Westport, Connecticut served as consultant to the SBPAC for preparation of the plan and prepared all final and interim plan documents at the committee's direction. He is the principal author of the Watershed-Based Plan. Associates of Mr. Steadman who contributed to the plan include: Thomas Hart, formerly with the New York State Department of Health, who developed and applied the plan's pollutant loading method, developed the pollutant load reduction goals, and is the co-author of those sections of the plan; and Keith Placko and Frank Stirna III who provided computer-aided mapping assistance.

Appreciation is extended to all study participants and to citizens and property owners who have expressed and demonstrated their commitment to environmental stewardship and continue to support efforts to protect and improve water quality in the watershed and Long Island Sound.

The Sasco Brook Watershed-Based Plan was prepared as part of the State of Connecticut's Watershed Management Program with funding appropriated by Congress and provided by the Connecticut Department of Environmental Protection through a U.S. Environmental Protection Agency Clean Water Act Section 319 Nonpoint Source Grant.

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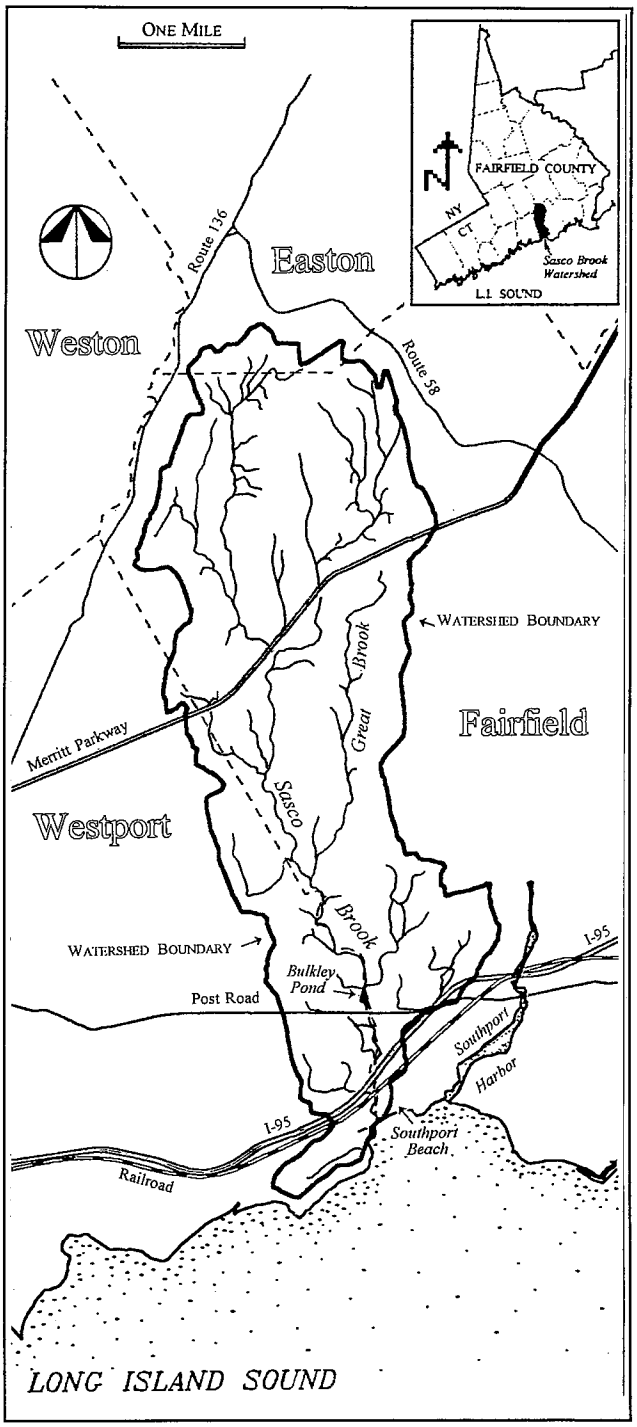
Introduction and Summary

This report—the "Sasco Brook Watershed-Based Plan"—contains recommendations prepared by the Sasco Brook Pollution Abatement Committee (SBPAC) to protect and improve surface water quality in the Sasco Brook Watershed. The watershed is located in southwestern Connecticut.

The recommendations are non-binding and stress voluntary, non-regulatory initiatives to reduce bacterial pollution from animal waste and poorly functioning septic systems. That pollution is sometimes carried by stormwater runoff and ground water into the brook, its tributaries, and Long Island Sound. The recommendations should also serve to reduce other types of runoff pollutants that may affect the watershed, including oil, road sand, trash, debris, pesticides, and excessive nutrients from lawn fertilizer.

The watershed—all of the land area that receives and drains rainwater and melting snow into Sasco Brook and ultimately into Long Island Sound—covers 6,600 acres or a little more than ten square miles. A significant part of the watershed (19%) is in the Town of Westport, although most (78%) is in the Town of Fairfield, and 3% is in the Town of Easton.



Map i: Sasco Brook Watershed and Network of Tributaries.

Sasco Brook's main stem is about six miles long. It begins in northwest Fairfield and forms part of the boundary between Westport and Fairfield before flowing into Long Island Sound. The brook and its watershed have natural values and ecological functions (related, for example, to plant, fish and wildlife habitat) that contribute significantly to the quality of life in the watershed's residential neighborhoods. Downstream of the Bulkley Pond dam, which is just north of the Post Road (Route 1), the brook is tidally influenced and sometimes called Sasco Creek. Here, fresh water from the watershed mixes with salt water from Long Island Sound, forming the Sasco Brook estuary, a coastal environment of high biological productivity that helps support the living marine resources in Long Island Sound.

There is a fundamental relationship involving Sasco Brook, its tributaries and watershed, and Long Island Sound. Historically, that relationship was sometimes not recognized or fully appreciated by all watershed residents and governmental officials. Today, however, there is significant and widespread public recognition of how the ecological health of Long Island Sound greatly depends on the environmental quality, including water quality, of its many tributaries and watersheds.

The Sasco Brook Pollution Abatement Committee

Formed in 1991 by the Town of Westport's Conservation Department acting in coordination with the Town of Fairfield's Conservation Department, the Sasco Brook Pollution Abatement Committee is a voluntary alliance consisting of representatives of a number of governmental agencies and private organizations, all with authorities, responsibilities, and interests concerning water quality in the watershed. Interested citizens have also participated in the committee's functions. In addition to the two towns' conservation departments, active participants include representatives of the Connecticut Department of Environmental Protection (DEP), Connecticut Department of Agriculture's Bureau of Aquaculture, Westport-Weston Health District, U.S. Department of Agriculture's Natural Resources Conservation Service, and private organizations such as Earthplace—The Nature Discovery Center (Earthplace) and the Fairfield County Hunt Club. The alliance was formed after the State of Connecticut prohibited recreational shellfishing near the mouth of the brook due to the detected presence of bacterial contamination in water samples and shellfish. It became the mission of the SBPAC to identify the sources of that contamination and pursue the measures necessary to protect and improve water quality in the brook.

Since its formation, the SBPAC has promoted the concept of environmental stewardship whereby all residents, officials, agencies, and organizations with an interest or authority pertaining to Sasco Brook and its watershed would consider themselves as stewards responsible for care of the brook and watershed. That care would be for the purpose of ensuring that the natural, cultural, and economic values of the watershed are sustained for the benefit of future generations.

Among its activities in pursuit of its mission, the SBPAC has promoted the development and sharing of information, encouraged and supported best management practices (BMPs) to protect and improve water quality, provided a forum for public comments and discussions concerning the watershed, and prepared the Watershed-Based Plan. For the purpose of the plan, SBPAC members are referred to as the ''watershed partners.''

Nonpoint Source Pollution

Soon after its formation, the Sasco Brook Pollution Abatement Committee determined, based on the results of water quality monitoring by Earthplace's Harbor Watch/River Watch Program, that the principal periods of bacterial contamination in Sasco Brook occur during rain storms and are associated with stormwater runoff. This runoff pollution is also called ''nonpoint source'' or NPS pollution. Of concern in all watersheds, NPS pollution occurs when water runs off roads, parking lots, driveways, lawns, hillsides, paddocks, and other surfaces. Many pollutants (including not only bacteria from animal feces but also oil, sand, pesticides, trash, debris, and

excessive nutrients) can be picked up as the water runs over the ground, into storm drains, sometimes through the soil, and eventually to Sasco Brook. Poorly functioning septic systems that leak bacteria and excessive nutrients into the watershed are another potential source of pollution. The risk of NPS pollution being carried by stormwater runoff from impervious surfaces such as roads, sidewalks, and parking areas is much greater than the risk associated with runoff from natural surfaces in the watershed.

Alone, each contributing source of NPS pollution may have only a small impact, but the cumulative impacts, over time, of many sources throughout the watershed can be significant. It is reported by the U.S. Environmental Protection Agency (EPA) that NPS pollution is the principal pollution problem in the nation's coastal waters and has a major impact on Long Island Sound—an estuary of national significance as designated by the U.S. Congress.

Water Quality Standards

Pursuant to federal laws, including the Clean Water Act (CWA), the Environmental Protection Agency is responsible for a number of programs to protect and improve water quality, including programs to reduce polluted discharges, manage stormwater runoff, and provide funding for municipal wastewater treatment facilities. It is a goal of the CWA that all of the Nation's rivers and streams should be ''fishable'' and ''swimmable.'' The CWA and the EPA's programs to implement the act, carried out in coordination with the Connecticut DEP, have provided the basis for the Sasco Brook Pollution Abatement Committee's watershed-based planning to reduce bacterial pollution and otherwise improve water quality in the Sasco Brook Watershed.

The CWA requires that Connecticut, along with all of the other states, must adopt water quality standards and assess rivers, streams and other surface waters to evaluate compliance with those standards. In addition, Section 303(d) of the CWA requires the states to publish a list, known as the ''Section 303(d) Threatened and Impaired Waters List,'' of waters that do not meet the applicable standards.

State Water Quality Standards have been established by the Connecticut DEP and applied to all of the state's water bodies. These standards establish goals (classifications) for the most desirable types of uses (such as recreation, fish and wildlife habitat, and water supply) that can be supported by each water body, along with criteria (numerical standards) that must be met in order to achieve those goals. In other words, if the amount of bacteria or other pollutants detected in a water body exceeds the limit for those pollutants with regard to a specified type of use, the water body does not meet the water quality standards.

Due to the bacteria and other pollutants detected in Sasco Brook from time to time, in amounts exceeding the limits of those pollutants that can be present in order to support recreation and aquatic life, the DEP determined that the brook did not meet the state water quality goals assigned to it. As a result, the brook was included on the state's list of impaired water bodies in 1998.

Total Maximum Daily Load

Section 303(d) of the Clean Water Act also requires that a scientific analysis—called a Total Maximum Daily Load or TMDL—be prepared for each impaired water body identified by a state. The purpose of the TMDL is to set pollution reduction objectives for bringing the impaired water body into compliance with the state's water quality standards, and to specify the maximum amount of a pollutant that the water body can receive without exceeding the standards.

In 1999, the Connecticut Department of Environmental Protection prepared a Sasco Brook TMDL analysis which identified fecal bacteria from wildlife and domestic animals and from poorly functioning septic systems as the likely sources of the bacterial contamination found in the brook in excess of the state's water quality standards.

Subsequent to completion of the 1999 TMDL, the Sasco Brook Pollution Abatement Committee pursued a number of initiatives to protect and improve water quality. Water quality monitoring was continued and information concerning the watershed and NPS pollution was provided to home-owners and others, including the operators of horse farms in the watershed. Also, the towns of Westport and Fairfield both pursued implementation of Connecticut's state requirements for managing the discharge of storm water pursuant to the newly established state program called the Municipal Separate Storm Sewer System (MS4) Program. Through regular street sweeping and cleaning of catch basins, culverts, and stormwater outfalls, the towns worked to reduce the amount of pollutant-laden sediment that otherwise would be washed into Sasco Brook and its tributaries.

In 2005, the DEP updated the Sasco Brook TMDL analysis and found that water quality had improved measurably. Detected amounts of bacteria and nutrients had been reduced to the extent that the brook now met the aquatic life criteria of the state's water quality standards, although it still did not meet the criteria for recreational uses. Sasco Brook, because of its shallowness, does not support swimming, but the recreational criteria of the state's Water Quality Standards are significant because people may wade in the brook or otherwise come into contact with its waters. In addition, despite the water quality improvements, bacteria were still detected near the mouth of the brook and in the nearshore waters of Long Island Sound to the extent that the nearby public shellfishing beds remained closed in order to protect the health of persons who might eat contaminated shellfish.

Watershed-Based Planning

Section 319 of the Clean Water Act establishes a grant program through which the Environmental Protection Agency may provide funds to state programs to prevent, control, and/or abate pollution. Funds are provided to the Connecticut Department of Environmental Protection to support implementation of Connecticut's Nonpoint Source Management Program to manage and reduce NPS pollution. The DEP, in turn, awards funds to towns for the purpose of supporting preparation and implementation of local plans to manage and reduce NPS pollution. Those plans are often called watershed-based plans.

The need to sustain and adapt water quality management initiatives in response to changing circumstances is recognized by the members of the Sasco Brook Pollution Abatement Committee. At the request of the committee, the Town of Westport in 2008 applied for and received a grant (called a Section 319 grant) from the DEP to prepare a watershed-based plan for Sasco Brook. The planning process, completed in 2011, had three principal goals: 1) to increase understanding of the sources and effects of bacterial pollution in the brook; 2) to prepare recommendations to reduce bacterial pollution so that the brook may be removed from the state's list of impaired water bodies; and 3) to provide a basis for requesting additional funds that may be available from the state and other sources to implement the pollution reduction recommendations.

The watershed-based planning process was coordinated by the SBPAC with technical and advisory assistance provided by the DEP's Watershed Management Program and a planning consultant retained by the committee.

Information considered in the watershed-based planning process was obtained from several main sources: 1) relevant reports, studies, maps, photographs, and other documents obtained from agencies and organizations with an interest in the watershed; 2) personal interviews with SBPAC representatives and others, including agencies and organizations participating in watershed-based planning in other jurisdictions; 3) input from SBPAC representatives and interested citizens during 20 regularly scheduled SBPAC meetings held throughout the planning process; 4) land-based visual inspections of the watershed during the four seasons of the year; and 5) a survey, conducted by volunteer high school students, of the interests and attitudes of Town of Westport residents in the watershed.

This ensuing report, ''Sasco Brook Watershed-Based Plan: Recommendations for Protecting and Improving Water Quality in the Sasco Brook Watershed'' is herein presented to summarize the results of the watershed-based planning process. The report is organized in seven chapters. A summary description of the watershed and the existing institutional framework for watershed management is included in Chapter One.

Key issues and planning considerations affecting water quality, achievement of the TMDL goals for pollution reduction, and implementation of the Watershed-Based Plan's recommendations are included in Chapter Two.

Chapter Three includes a discussion of the potential causes and sources of bacterial contamination in the Sasco Brook Watershed and applies a method to estimate the amount of bacterial contamination—the pollutant load—generated by the principal potential sources. Those potential sources, as presumed in the TMDL, are thought to include domestic animal, wildlife, and human (septic system) sources. The method, developed for the purpose of the Watershed-Based Plan, assessed these potential sources of bacterial contamination in the watershed and the relative risks of the sources, and has provided significant information useful for watershed-based planning purposes. The model has increased understanding of the complex variables that must be considered in any useful assessment of pollution causes and sources in the watershed. For example, the model has shown that among domestic animals, the principal sources of bacterial pollution in the watershed are likely dogs and horses, and that the average daily fecal coliform bacteria production of one dog is more than 2.5 times the production of one horse. In addition,

among wildlife, the principal sources of bacterial pollution seem to be geese and ducks, with ducks having the highest average daily fecal coliform production which is more than twice the production of a dog.

In addition, the modeling efforts confirmed that definitive results regarding the specific sources, their relative significance, and the amounts of bacterial contamination generated by each source, can only be obtained through microbial source tracking analyses utilizing DNA ribotyping technologies. Those technologies have not been applied to date for watershed-based planning purposes in the Sasco Brook Watershed or in any other watershed in Connecticut.

Chapter Four includes a summary of the number of positive actions supported by the SBPAC over the past two decades to protect and improve water quality in the watershed. One of the most prominent accomplishments, and a model of the positive changes that can be achieved through cooperative interaction between governmental agencies and private interests, was the action by the Fairfield County Hunt Club to construct a series of stormwater, wastewater, and manure management improvements on its property. Those improvements resulted in significant reductions in the amount of bacteria previously detected in nearby stream courses by the SBPAC.

Also included in Chapter Four is a review of some "stewardship lessons" learned by the SBPAC as a result of the committee's 20-year effort to protect and improve water quality. The lessons should be of interest to persons and organizations thinking about watershed management initiatives in other locations.

Chapters Five, Six, and Seven, summarized below, include the recommendations of the Watershed-Based Plan for protecting and improving water quality, beginning with a Watershed Vision.

The Watershed Vision

Through the watershed-based planning process, a Watershed Vision based on 10 goals has been set forth to provide a guiding framework for the actions of all agencies, organizations, and citizens concerned with protecting and improving water quality in the Sasco Brook Watershed.

The proposed Watershed Vision, summarized below and presented in Chapter 5 of the Watershed-Based Plan, is based on the concept of perpetual stewardship whereby all citizens, governmental officials, agencies, and organizations with an interest or authority pertaining to the watershed will think of themselves as having responsibility for care of the brook and watershed. Consistent with the initiatives developed and pursued by the watershed partners since formation of the SBPAC, the Watershed Vision organizes the basic principles for watershed stewardship developed by the partners over the years but which heretofore were not set forth in any one document and formally adopted or otherwise endorsed.

The Watershed Vision recognizes that stewardship initiatives in the watershed have evolved significantly over the past two decades and must continue to evolve as conditions change and our understanding of the watershed, sources of pollution, and measures to reduce and avoid pollution increases.

WATERSHED VISION:

GOAL 1: SIGNIFICANT REDUCTION OF NONPOINT SOURCE POLLUTION

GOAL 2: REDUCTION AND AVOIDANCE OF POINT SOURCES OF POLLUTION

GOAL 3: PERSONAL ACTIONS FOR WATERSHED STEWARDSHIP

GOAL 4: ACTIVE AND COORDINATED WATERSHED MANAGEMENT BY THE TOWNS

GOAL 5: RECOGNITION OF ECOLOGICAL SYSTEMS

GOAL 6: COORDINATION AND PARTNERSHIPS FOR WATERSHED MANAGEMENT

GOAL 7: FINANCIAL AND TECHNICAL ASSISTANCE FOR WATERSHED MANAGEMENT

GOAL 8: EXPANDED BASE OF WATERSHED KNOWLEDGE AND INFORMATION

GOAL 9: BALANCE OF CONSERVATION AND DEVELOPMENT

GOAL 10: EFFECTIVE RESPONSE TO CHANGING CONDITIONS

Implementing the Watershed-Based Plan

The Watershed Vision will not be useful without an effective implementation strategy. It is recognized by the Sasco Brook Pollution Abatement Committee that such a strategy must be pursued as an ongoing process that will continue to evolve over time. The implementation strategy provided in Chapter Six of the Watershed-Based Plan is intended to provide guidance for that process.

Implementation of the Watershed-Based Plan will proceed with recognition that the plan is not a formal municipal plan prepared with specific authority provided by state statute or local ordinance. The plan does not require adoption or approval by the local legislative bodies of the watershed towns. Instead, the plan is a non-binding guidance document, intended to be implemented through cooperative, voluntary actions by the agencies, organizations, and citizens with interests and authorities in the watershed, including the members of the SBPAC.

As a recommended first step for implementation, the stakeholder agencies and organizations—the watershed partners—should endorse the vision and to the extent possible incorporate its principles into their programs and decisions affecting the Sasco Brook Watershed, including their applicable planning programs.

Among the other elements of the implementation strategy are establishment of bacterial pollution reduction goals and identification of best management practices for water quality management to achieve the goals. Potential sources of funds to support the BMPs are also identified, along with sources of continued technical assistance for plan implementation.

In addition, the implementation strategy calls for a five-year program, included in Chapter Seven of the Watershed-Based Plan, which sets forth specific action items for advancing the Watershed Vision, including: 1) analytical measures and initiatives such as a microbial source tracking analysis to be conducted as a priority implementation project to more precisely identify the most significant contamination sources and the relative bacterial contribution of those sources; 2) structural measures and initiatives including demonstration Low Impact Development (LID) projects and a project to manage and reduce nonpoint source pollution utilizing vegetated swales and other LID measures at the Fairfield County Hunt Club; 3) public outreach and education measures and initiatives to maintain and increase public support and awareness for implementing the Watershed-Based Plan; and 4) planning and regulatory measures and initiatives including preparation of addenda to the watershed towns' plans of conservation and development for the purpose of incorporating appropriate elements of the Watershed-Based Plan.

Benefits of the Watershed-Based Plan

The Watershed-Based Plan will be used by the Sasco Brook Pollution Abatement Committee as the committee continues to pursue its mission to identify the sources of pollution in Sasco Brook and achieve the measures necessary to protect and improve water quality in the brook. A number of benefits are anticipated from the plan, including:

1. *By establishing a measurable list of action items for plan implementation, and a recommended schedule along with responsibilities for implementation, the plan will help sustain the interest and enthusiasm of the watershed partners and the Sasco Brook Pollution Abatement Committee as the committee pursues its mission in the years ahead.*
2. *A microbial source tracking method for the most accurate tracking of the sources of bacterial pollution in the watershed has been designed.*
3. *The plan makes clear to town residents and others that it is the intent of the SBPAC that efforts to protect and improve water quality should be pursued without unduly increasing the burden on municipal budgets and taxpayers.*
4. *The plan also makes clear that it is the intent of the SBPAC to pursue water quality goals without additional governmental regulations that may be viewed unfavorably by watershed residents.*
5. *The plan will be used to encourage personal stewardship actions by residents and business owners in the watershed.*
6. *The plan provides a basis for expanded participation by all three watershed towns to achieve water quality goals.*
7. *The plan provides a basis for requests by the SBPAC and the watershed partners for additional funds that may be available from the state and other sources to implement pollution reduction recommendations.*
8. *Through implementation of the plan, bacterial contamination should be reduced to the extent that Sasco Brook may be removed from the state list of impaired water bodies, and shellfishing grounds in and near the mouth of the brook may once again be opened for public use and enjoyment.*

Cost of Plan Implementation

The Watershed-Based Plan commits no town, agency, or organization to any significant implementation costs. A principal consideration addressed by the Sasco Brook Pollution Abatement Committee in the watershed-based planning process concerns the costs that may be associated with plan implementation. The SBPAC recognizes how budgetary constraints at all levels of government affect the feasibility of implementing some best management practices for pollution abatement, including best management practices that would be implemented through new municipal stormwater infrastructure projects. The SBPAC also recognizes that continued public support for watershed-based planning may be jeopardized if plan implementation required increased tax burdens on watershed residents and business owners.

As a result of these economic issues, the SBPAC prepared the Watershed-Based Plan as a guidance document including continued significant public outreach and education initiatives that will be pursued through already existing programs, including the committee's programs. While some of the plan's implementation recommendations require future expenditure of funds, the SBPAC will seek funding for those initiatives through federal, state, and private grant programs, including programs previously utilized for water quality initiatives in the watershed. The plan does not commit any watershed town to future expenditures, but provides a basis for implementing beneficial projects as funds, including funds from available grant programs and municipal budgets, may be become available.

An Ongoing Process in the Public Interest

Efforts to protect and improve water quality in the Sasco Brook Watershed through the Watershed-Based Plan are an ongoing process that will continue to develop in response to changing conditions and circumstances. As the SBPAC works to advance the Watershed Vision and otherwise implement the plan, it will be recognized that the plan does not identify every issue that is likely to affect water quality in the future, nor does it provide a definitive answer to every possible problem. The plan provides a guideline to be followed by the SBPAC and the watershed partners. The guideline is flexible and will require modification over time as conditions change and responses to sometimes complicated water quality issues continue to evolve.

The status of the Watershed-Based Plan will be reviewed on a regular basis to evaluate its effectiveness and determine the need for any plan amendments. Preparation of an annual plan is recommended to present any new information developed by the SBPAC and to include new recommendations as may be needed to address changing conditions and circumstances. A more comprehensive amendment of the plan should be considered following completion of the plan's microbial source tracking analyses to more precisely identify the most significant contamination sources and the relative bacterial contribution of those sources in the watershed.

1

Background Information for the Watershed-Based Plan

Sasco Brook is about 6 miles long. It begins in northwest Fairfield and forms part of the boundary between Fairfield and Westport before flowing into the Sound. The Brook and watershed have important natural values and ecological functions, and there's a fundamental relationship between the watershed, the Brook, and Long Island Sound.

Sasco Brook Pollution Abatement Committee

Chapter Cover Photo: Sasco Brook estuary and Southport Beach looking east.

Background Information for the Watershed-Based Plan

This chapter provides a summary description of the Sasco Brook Watershed in southwestern Connecticut and a review of the institutional framework for watershed-based planning in the watershed. The description includes information previously complied by the Sasco Brook Pollution Abatement Committee (SBPAC) in 2006 and information from the 1999 and 2005 Sasco Brook Total Maximum Daily Load (TMDL) analyses conducted by the Connecticut Department of Environmental Protection (DEP).

WATERSHED FEATURES

The Sasco Brook Watershed—all of the land area that receives and drains rainwater and melting snow into Sasco Brook and ultimately into Long Island Sound—covers about 6,600 acres or a little more than ten square miles (10.21 square miles). A significant part of the watershed (19%) is in the Town of Westport, although most (78%) is in the Town of Fairfield, and 3% is in the Town of Easton. (See Maps 1-1 and 1-2.)

About 8.5% or 1.9 square miles of Westport's total land area of 22.4 square miles is in the watershed; about 26% or 7.9 square miles of Fairfield's total land area of 30.2 square miles is in the watershed; and about 1% or 0.3 square miles of Easton's total land area of 28.6 square miles is in the watershed. In 2009, the estimated populations of Westport, Fairfield, and Easton were, respectively, 26,799, 57,578, and 7,383. The SBPAC has estimated that approximately 7,500 people live in the watershed.

Photo 1-1: In its upper reaches, Sasco Brook's stream course is relatively undisturbed and provides habitat for plants, fish, and wildlife.

Photo 1-2: Rainwater and melting snow from throughout the Sasco Brook Watershed ultimately drains into Long Island Sound.

Sasco Brook's main stem is about six miles long. It begins in northwest Fairfield and forms part of the boundary between Westport and Fairfield before flowing into Long Island Sound. The town boundary in the brook south of the Post Road (Route 1) has been considered and described by the towns of Westport and Fairfield as the centerline of the water course.

Sasco Brook and its watershed have natural values and ecological functions related, for example, to the habitat it provides for plants, fish, and wildlife. These values and functions contribute significantly to the quality of life in the watershed's residential neighborhoods. Downstream of the Bulkley Pond dam, which is just north of the Post Road (Route 1), the brook is tidally influenced and sometimes called Sasco Creek. Here, fresh water from the watershed mixes with salt water from Long Island Sound, forming the Sasco Brook estuary. Wetlands and intertidal flats in the estuary dilute, stabilize, and partially decompose pollutants. This estuary and the others along the Sound have rich biological productivity; they are the foundation of the food chain upon which the Sound's fish, shellfish, wildlife, and waterfowl depend.

There is a fundamental relationship involving Sasco Brook, its tributaries, watershed, and estuary, and Long Island Sound. Historically, that relationship was sometimes not recognized by all watershed residents and governmental officials. Today, however, there is significant and widespread public awareness of how the ecological health of Long Island Sound greatly depends on the environmental quality, including water quality, of its many tributaries and watersheds.

The Sasco Brook Watershed, shaped many thousands of years ago by the last glacial period, has been influenced in more recent history by human activities. The gently rolling landscape was cleared for agriculture in the 1700s. Today, much of the watershed is a pattern of well-kept

homes, open fields and pastures, mowed lawns, tree-lined roads, and well-forested areas. Significant man-made features include four major transportation routes—the Merritt Parkway, I-95, Post Road, and Metro-North railroad—used by several hundred thousand people who pass through the watershed each day.

Sasco Brook follows a mostly narrow and gently sloping stream course for much of its length; it widens somewhat in its lower reaches and at Bulkley Pond just upstream of the Post Road. The pond's dam marks the upstream extent of tidewater from Long Island Sound. The dam also blocks spawning runs of anadromous fish such as river herring—fish that live most of their lives in salt water but spawn in fresh water and which could once swim upstream as far north in the watershed as Cross Highway. A network of small streams and wetlands feed the brook; the largest of these tributaries is named Great Brook. The total length of the stream courses shown on the U.S. Geological Survey's published topographical map that covers the watershed is about 20.5 miles. In the upper reaches of the watershed, the stream beds are generally scoured and there is a lack of fine-grained riparian sediments. Significant amounts of fine-grained sediments are found only in the watershed's lower reaches, south of Hull's Farm Road.

In the northern part of the watershed the streams and wetlands are largely undisturbed, development is of relatively low density, and forested areas cover much of the landscape. Some of the natural drainage patterns in the middle part of the watershed have been modified more significantly by home construction. Substantial drainage modifications have occurred in the southern and most developed part of the watershed, particularly in the urban corridor along the Post Road. Businesses along the Post Road, and some of the neighborhoods near it, are connected to sanitary sewer systems; the rest of the watershed is served by individual septic systems. (See Map 1-3.)

Photo 1-3: The Merritt Parkway is one of four major transportation corridors that pass through the Sasco Brook Watershed.

Woods, wetlands, and water surfaces cover about 3,600 acres (55% of the watershed); roughly 2,100 acres (32%) are used for low density residential or recreational open space purposes; about 480 acres (7%) are considered ''urban''—covered by impervious roads, parking lots, commercial facilities, and higher density residential development; and about 380 acres (6%) are used for agricultural purposes and include pastures, paddocks, barnyards, and hay fields.

In the entire watershed there are an estimated 2,500 homes and 7,500 residents. Significant open areas include the Fairfield County Hunt Club and Patterson Club properties. There are several town-owned and privately-owned conservation areas, the largest of which is the Town of Fairfield's 186-acre Brett Woods Conservation Area. A number of small-acreage horse farms are maintained in the watershed in addition to the large horse farm operated by the Fairfield County Hunt Club. Including the 85 horses currently maintained at the Hunt Club, it is estimated that at least 150 horses currently reside in the watershed.

Photo 1-4: Large, open areas in the watershed include the Fairfield County Hunt Club's property.

For the purpose of the initial Sasco Brook TMDL prepared by the DEP in 1999, the watershed was divided into four sub-watersheds identified as sub-watersheds A, B, C, and D. (See Map 1-3.) These sub-watersheds are used below to highlight existing conditions in the watershed.

Sub-watershed A, which lies within the northern third of the Town of Fairfield, is north of the Merritt Parkway. The western boundary is Route 136 and the eastern boundary is near Black Rock Turnpike. The sub-watershed encompasses about 2,800 acres, including about 67 acres classified as wetlands and about 473 open space acres. Included are Fairfield's Brett Woods Conservation Area, the privately owned Patterson Club golf course, and the Connecticut Audubon Society's Larsen Wildlife Sanctuary.

Photo 1-5: Significant areas of forested land are found in the northern parts of the watershed.

Sub-watershed A includes water courses known as the western, central, and eastern branches of Sasco Brook. The western branch flows in a southerly direction through large areas of wetlands, ponds, and forested land, and by some open space as it flows near the Patterson Club and pasture land. The central branch runs parallel to Banks Road, cuts through the Patterson Club, and then flows along the Merritt Parkway before connecting with the western branch. Over this one-mile section, the water course drops over 100 feet in elevation. The eastern branch is comprised of three main tributaries, two of which flank Eleven O'clock Road and run nearly parallel to each other through a number of residential properties that may be described as large estates. Both of these water courses drain open space and wetlands on the Connecticut Audubon Society's Larsen Wildlife Sanctuary off Burr Street.

Land cover in sub-watershed A includes small pastures, older estates, open spaces, and a few newer residential developments with large homes on properties of two or more acres. A riparian buffer of natural vegetation, 50 to 150 feet wide, is generally present along the water courses, with a few exceptions where pastures and lawns extend to the water's edge.

Sub-watershed B is bounded on the north by the Merritt Parkway, on the south by Hulls Farm Road, on the east by higher ground to the east of Hillside Road, and on the west by higher ground along Bayberry Lane and Sturges Highway. This sub-watershed has a land area of about 1,922 acres, 60 acres of which are classified as wetlands. Included are the Sasco Brook main stem, Great Brook, and three smaller, un-named tributaries, one of which feeds Banks Pond from the west. Great Brook, which begins in wetlands near the intersection of Congress Street and Cross Highway, drains the eastern part of the sub-watershed and flows southwesterly through pasture land and wetlands until it joins with Sasco Brook just below Banks Pond.

Land in this sub-watershed is characterized by large, older homes built prior to 1975 on properties of two or more acres. In the northern part of the sub-watershed some properties include open fields and pastures. Development is generally set back 50 to 150 feet from the watercourses due to the risk of flooding.

Photo 1-6: A number of small-acreage horse farms and pastures are found throughout the central and northern parts of the watershed.

Sub-watershed C is bounded on the north by Hulls Farm Road, on the south by the Post Road and the Bulkley Pond dam, on the east by Sturbridge Road, and on the west by Bayberry Lane. This sub-watershed has a land area of about 1,298 acres and supports a variety of land uses. Some properties contain open fields and pastures. The western portion, with denser residential development, also includes the Fairfield County Hunt Club property. Some wetlands are found east of Sasco Brook's main stem. In the eastern part of the sub-watershed, an un-named tributary drains wetlands to the north of a large residential development on Flintlock Road, flows by the development, and then southwest through an older residential neighborhood on the east side of Hulls Highway. The tributary then flows through the Town of Fairfield's Sasco Creek Pond Open Space Area before entering the northeast end of Bulkley Pond.

Most of the homes in the Flintlock Road development are served by the Town of Fairfield's sanitary sewer system. These homes are generally close to the stream banks and the natural riparian buffer is reduced. In the southern part of the sub-watershed, development is generally urban in character with many small homes on quarter-acre lots and little if any riparian buffer except for the Sasco Creek Pond Open Space property on the northeast corner of Bulkley Pond. Bulkley Pond is subject to ongoing sedimentation and its natural depths have been significantly reduced.

Sub-watershed D, south of the Bulkley Pond dam, includes the estuarine portion of Sasco Brook and is the smallest of the sub-watersheds, comprising about 580 acres of land and 48 acres of tidal wetlands. The dam, just north of the Post Road, is currently in a state of disrepair. Post Road shopping centers with substantial parking areas have been developed on the south side of the Post Road, to the west of Sasco Brook. Residential properties in this sub-watershed are generally smaller than in the three other sub-watersheds. Continually running storm drain networks under the Post Road commercial areas serve as conduits for small streams to Sasco Brook and also provide drainage for nearby roadways and the large parking areas associate with the commercial development.

Photo 1-7: The Bulkley Pond Dam formed Bulkley Pond and marks the upstream extent of tidewater in Sasco Brook.

In the estuary, modification of the stream banks has been relatively minimal. Tidal exchange, however, has been impaired over the years by the several bridges that cross the brook, including the Pequot Avenue bridge at the mouth of the brook and, moving upstream, the railroad bridge and the I-95, Westway Road, King's Highway West, and Route 1 bridges. Sediment and debris may accumulate at all of the bridge openings and restrict tidal circulation as well as small craft navigation.

Much of the estuary downstream of King's Highway West consists of state-mapped tidal wetlands that provide important fish and wildlife habitat as well as water quality, flood control, and other natural and esthetic values. Approximately 48 acres of tidal wetlands have been mapped by the Connecticut Department of Environmental Protection (DEP) in the estuary, including wetlands on both the Fairfield and Westport sides of the brook.

The estuary portion of Sasco Brook is legally designated as a "natural" shellfish ground for public use. Due to the potential for bacterial contamination, however, the brook is classified as a "prohibited" shellfish area by the State of Connecticut. This classification means that shellfish can not, at the present time, be harvested from the brook for direct consumption. Similarly, shellfish beds in Long Island Sound near the mouth of the brook are also closed due to the detected levels of bacteria.

Southport Beach, a Town of Fairfield facility, is near the mouth of the brook and provides an opportunity for public access to the estuary and Long Island Sound. Canoes and kayaks can be launched near the swimming beach and paddled up the brook or into the Sound.

Photo 1-8: Stream beds in much of the watershed are scoured and rocky with little fine-grained sediment.

INSTITUTIONAL FRAMEWORK FOR WATERSHED-BASED PLANNING

The institutional framework for watershed-based planning in the Sasco Brook Watershed consists of a number of agencies and private organizations as well as many laws, regulations, plans, and programs that affect water quality in the watershed. Governmental agencies at the town, federal, and state levels of government have authorities and responsibilities affecting the watershed. Private organizations, including conservation organizations and educational institutions, also have vital interests. In addition, private landowners and business owners in the watershed have significant rights and interests that are part of the institutional framework. Representatives of interested agencies and organizations participate on the Sasco Brook Pollution Abatement Committee, a voluntary alliance whose mission is to identify and reduce sources of water pollution in the watershed.

Sasco Brook Pollution Abatement Committee

Formed in 1991 by the Town of Westport's Conservation Department acting in coordination with the Town of Fairfield's Conservation Department, the Sasco Brook Pollution Abatement Committee consists of representatives of a number of governmental agencies and private organizations, all with authorities, responsibilities, and interests concerning water quality in the watershed. Interested citizens have also participated in the SBPAC's initiatives. In addition to the Westport and Fairfield conservation departments, active participants include representatives of the Connecticut Department of Environmental Protection (DEP), Connecticut Department of Agriculture's Bureau of Aquaculture, Westport-Weston Health District, U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS), and private organizations such as Earthplace—The Nature Discovery Center (Earthplace) and the Fairfield County Hunt Club. The alliance was formed after the State of Connecticut prohibited recreational shellfishing near the mouth of the brook due to the detected presence of bacterial contamination in water samples and shellfish. It became the mission of the SBPAC to identify the sources of that contamination and pursue the measures necessary to protect and improve water quality in the brook. In pursuit of its mission, the SBPAC prepared the Sasco Brook Watershed-Based Plan and will provide coordination, oversight, and management assistance for plan implementation.

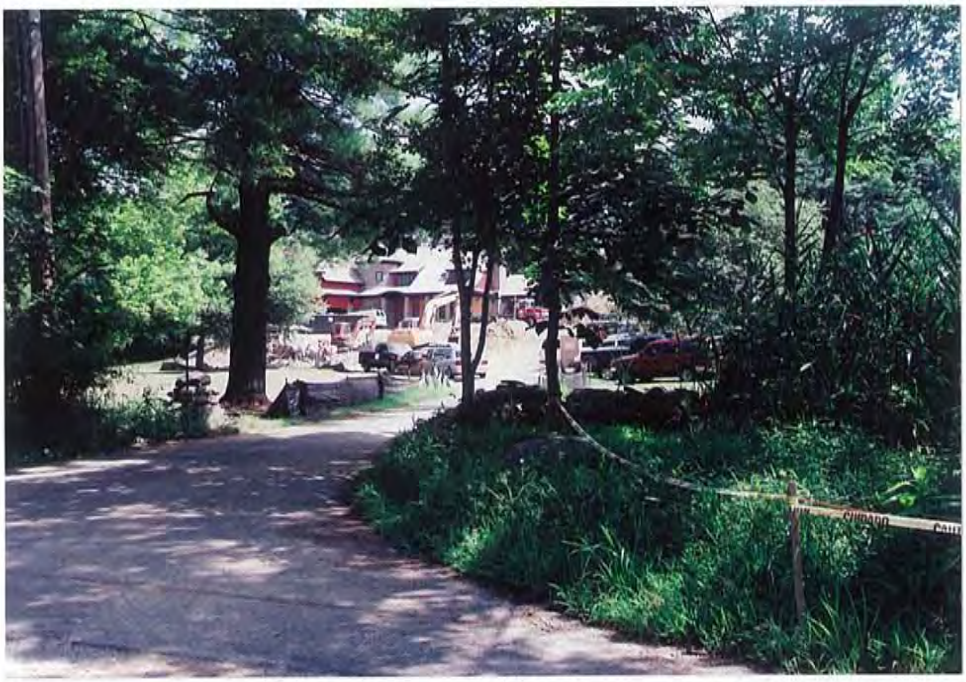


Photo 1-9: Some new home construction on lots of two acres and more is taking place in the central and northern parts of the watershed.

Town Agencies and Authorities

In each of the three towns with jurisdiction in the watershed—Westport, Fairfield, and Easton—the boards of selectmen, planning and zoning agencies, conservation commissions, and public works departments are among the municipal agencies with responsibilities affecting

watershed-based planning. The boards of selectmen have important oversight authority over municipal departments and the First Selectman in each town is the chief executive officer of the town, responsible for administration of all offices of town government. Representative Town Meetings are the legislative bodies of the towns of Westport and Fairfield, responsible for enacting town ordinances and approving appropriations and expenditures of town funds. In Easton, the legislative body is the Town Meeting.

In each town, the planning and zoning commission has the principal authority pertaining to planning and regulation of all land use in the town. These commissions are responsible for preparing, adopting, and amending zoning and subdivision regulations and issuing approvals or denials pursuant to those regulations. Residential zoning districts cover most of the Sasco Brook Watershed, with commercial districts imposed only along the Post Road. In addition, the planning and zoning commissions are responsible for preparing the towns' master plans of land use which are called town plans of conservation and development. The current Westport, Fairfield, and Easton plans were prepared in 2007, 2000, and 2006, respectively, and include town provisions for protecting and improving water quality. In the coastal towns of Westport and Fairfield, the planning and zoning commissions are also responsible for implementing their towns' municipal coastal programs to protect coastal water quality and resources such as tidal wetlands and shellfish resources. The estuary portion of the Sasco Brook Watershed is within the coastal areas of the two towns.

Photo 1-10: The Sasco Brook estuary is downstream of the Bulkley Pond Dam, within the coastal area of the state.

The conservation commission in each town also has significant watershed-based planning interests. Pursuant to state statutes, each commission is charged with the conservation, development, supervision, and regulation of natural resources, including water resources and open space lands in its town. In addition, each conservation commission functions as its town's inland wetlands and water courses agency, carrying out specific provisions of the state's wetland protection statutes and administering town regulations for protecting inland wetlands and watercourses. Several town-owned open space areas managed by the Fairfield Conservation Commission are within Fairfield's jurisdiction in the Sasco Brook Watershed, including the Brett Woods Conservation Area. Representatives of the Westport and Fairfield conservation departments are active participants on the Sasco Brook Pollution Abatement Committee.

Photo 1-11: Tree-lined roads pass through older neighborhoods in the central and northern parts of the watershed.

Also in each town, the public works departments have a number of responsibilities affecting watershed-based planning, including responsibilities for stormwater management and water pollution control. Due to their census classifications as urbanized areas, Westport and Fairfield are both required to implement Connecticut's state requirements for managing the discharge of storm water pursuant to the state program called the Municipal Separate Storm Sewer System (MS4) Program. In this regard, the public works departments conduct regular street sweeping and cleaning of catch basins, culverts, and stormwater outfalls. In addition, through their engineering divisions, the public works departments plan for culverts, drainage facilities, and other flood control and stormwater management structures and provide engineering assistance to other town agencies. The public works departments maintain the towns' geographic information systems with data useful for watershed-based planning.

In Fairfield and Easton, town health departments implement and enforce state health codes pertinent to water quality, and inspect septic systems for compliance with the codes. In Westport, this function is the responsibility of the Westport-Weston Health District (see below) which enforces the *Sanitary Code of the Westport-Weston Health District.*

Photo 1-12: Commercial development in the watershed is essentially limited to the urban corridor along the Post Road (Route 1).

Municipal shellfish commissions in Westport and Fairfield have jurisdiction over the use and management of shellfish resources in the territorial waters of the towns and are concerned with protecting and improving water quality and shellfish resources, including resources found in the estuarine part of Sasco Brook and nearshore Long Island Sound near the mouth of the brook. Another municipal agency concerned with water quality in Sasco Brook is the Fairfield Harbor Management Commission which has jurisdiction in Fairfield's part of the brook upstream to the Post Road. The Fairfield Shellfish Commission and Harbor Management Commission have prepared, respectively, the Fairfield Shellfish Management Plan and Management Plan for Southport Harbor which include provisions for protecting and improving water quality in Sasco Brook.

Federal Agencies and Authorities

The principal federal agency with responsibilities and authorities pertaining to watershed-based planning is the U.S. Environmental Protection Agency (EPA) which implements a number of programs pursuant to the Federal Clean Water Act (CWA), including programs to reduce polluted discharges, manage stormwater runoff, and provide funding for municipal wastewater treatment facilities. It is a goal of the CWA that all of the Nation's rivers and streams should be

''fishable'' and ''swimmable.'' The CWA and the EPA's programs to implement the act are carried out in coordination with the Connecticut Department of Environmental Protection, and have provided the basis for the Sasco Brook Pollution Abatement Committee's watershed-based planning efforts.

For example, the CWA requires that Connecticut, along with all of the other states, must adopt water quality standards and assess rivers, streams and other surface waters to evaluate compliance with those standards. In addition, Section 303(d) of the CWA requires the states to publish a list, known as the ''Section 303(d) Threatened and Impaired Waters List,'' of waters that do not meet the applicable standards. Described below, Sasco Brook was included on Connecticut's list of impaired water bodies in 1998.

Section 303(d) of the CWA also requires that a scientific analysis—called a Total Maximum Daily Load or TMDL—be prepared for each impaired water body identified by a state. The purpose of the TMDL is to set pollution reduction objectives for bringing the impaired water body into compliance with the state's water quality standards, and to specify the maximum amount of a pollutant that the water body can receive without exceeding the standards. Described below, the Connecticut DEP in 1999 prepared a TMDL analysis for Sasco Brook and updated that analysis in 2005.

Photo 1-13: Stormwater runoff from the large parking areas associated with the Post Road shopping centers in the watershed drains to Sasco Brook.

The CWA requirements for stormwater management provide the basis for Connecticut's requirements for managing the discharge of storm water pursuant to the state's Municipal Separate Storm Sewer System (MS4) Program. Pursuant to this program, Westport and Fairfield conduct regular street sweeping and cleaning of catch basins, culverts, and stormwater outfalls. Easton is not required to participate in this program because the Town is not classified as an urban area.

Photo 1-14: Residential development near the Post Road urban corridor is more dense than in the central and northern parts of the watershed.

Section 319 of the CWA establishes a grant program through which the EPA may provide funds to state programs to prevent, control, and/or abate pollution. Section 319 funds historically have been provided to the Connecticut DEP to support implementation of Connecticut's Nonpoint Source Management Program to manage and reduce nonpoint source (NPS) pollution. The DEP, in turn, awards funds to towns for the purpose of supporting preparation and implementation of local plans to manage and reduce NPS pollution, including the Sasco Brook Watershed-Based Plan.

Other federal agencies also have authorities and responsibilities affecting watershed-based planning. The U.S. Department of Agriculture's Natural Resource Conservation Service, for example, has been an active participant on the Sasco Brook Pollution Abatement Committee. The mission of the NRCS includes working cooperatively with landowners and other governmental agencies to address water quality issues and provide assistance for restoration and protection of watershed ecosystems. In this role, NRCS has prepared watershed-based plans for several Connecticut watersheds, and its experience in this regard should be beneficial for implementation of the Sasco Brook Watershed-Based Plan.

State Agencies and Authorities

A number of state laws, regulations, and programs affect watershed-based planning. Among the state legislation of interest is the Connecticut Water Pollution Control Act (Sections 22a-416 through 22a-599 of the General Statutes). Pursuant to this act, state Water Quality Standards have been established by the Connecticut Department of Environmental Protection and applied to all of the state's water bodies. These standards establish goals (classifications) for the most desirable types of water uses (such as recreation, fish and wildlife habitat, and water supply) that can be supported by each water body, along with criteria (published as numerical standards) that must be met in order to achieve those goals.

Sasco Brook and its tributaries, upstream of the zone of tidal influence (upstream of the Bulkley Pond Dam) have been classified by the DEP as Class A waters, a fresh water classification. Pursuant to the state Water Quality Standards, the designated uses of Class A waters are ''habitat for fish and other aquatic life and wildlife; potential drinking water supplies; recreation; navigation; and water supply for industry and agriculture.'' Downstream of the Bulkley Pond Dam, the waters of the brook are considered as coastal and marine waters and are classified by the DEP as Class SA waters. Pursuant to the state Water Quality Standards, the designated uses of Class SA waters are ''habitat for marine fish, other aquatic life and wildlife; shellfish harvesting for direct human consumption; recreation; industrial water supply; and navigation.''

Photo 1-15: Post Road catch basins collect stormwater from the road surface and a system of underground pipes carries the runoff to Sasco Brook.

Photo 1-16: The Connecticut Audubon Society's Larsen Wildlife Sanctuary preserves forest and wetland habitat in the northern part of the watershed.

Due to the bacteria and other pollutants detected in Sasco Brook from time to time, in amounts exceeding the limits (set by the published numerical standards) of those pollutants that can be present in order to support recreation and aquatic life, the DEP determined that the brook did not meet the state water quality goals assigned to it. As a result, the brook was included on the state's list of impaired water bodies in 1998, leading to the current watershed-based planning efforts.

The most prominent state agencies involved with watershed-based planning are various units of the Department of Environmental Protection, including the DEP's Watershed, Lakes and Nonpoint Source Unit within the Planning and Standards Division of the Bureau of Water Protection and Land Reuse. This unit facilitates the state's watershed management program to improve and maintain water quality by assisting with the preparation of watershed-based plans (including the Sasco Brook Watershed-Based Plan), providing public outreach and education, managing funds provided through the federal Clean Water Act to reduce nonpoint source pollution, and other initiatives. The Bureau of Water Protection and Land Reuse is responsible for preparing and adopting the state's water quality standards and for assessing rivers, streams and other surface waters to evaluate compliance with those standards. In addition, the Bureau publishes the state list, known as the "Section 303(d) Threatened and Impaired Waters List," of waters that do not meet the applicable standards.

The Bureau of Water Protection and Land Reuse also conducts the Total Maximum Daily Load analysis for each impaired water body as required by the CWA. In 1999, the Bureau prepared the Sasco Brook TMDL analysis which identified fecal bacteria from wildlife and domestic animals and from poorly functioning septic systems as the likely sources of the bacterial

contamination found in the brook in excess of the state's water quality standards. In 2005, the Bureau updated the Sasco Brook TMDL analysis and found that water quality had improved measurably. Detected amounts of bacteria and nutrients had been reduced to the extent that it was determined that the brook met the aquatic life criteria of the state's water quality standards, although it still did not meet the criteria for recreational uses.

Other units of the DEP involved with watershed-based planning include, but are not limited to: the Wildlife Division, which can assist with the design and implementation of best management practices to address bacterial pollution from excessive wildlife populations; the Office of Long Island Sound Programs, which administers the Connecticut Coastal Management Act and is concerned about nonpoint source pollution affecting the coastal resources of the state; and the Dam Safety Section, which is responsible for implementing Connecticut's dam safety program and which must approve the construction, repair, or alteration of any dam.

Other Connecticut agencies with authorities and responsibilities affecting watershed-based planning include the Department of Agriculture's Bureau of Aquaculture (DA/BA), which is the principal state agency with regard to shellfish management and is responsible for evaluating (testing) and classifying state waters for shellfishing in order to protect public health. The closure of the public shellfishing grounds in and near the mouth of Sasco Brook is by order of the DA/BA due to the presence of bacteria in water samples and shellfish.

Photo 1-17: Well over 100,000 vehicles pass through the southern part of the watershed each day on I-95.

Photo 1-18: The Patterson Club golf course is a large open area from which storm water drains to Sasco Brook.

The Department of Transportation, which is responsible for maintenance of stormwater infrastructure associated with state roads in the watershed, including the Post Road; and the Connecticut Agricultural Experiment Station, which has expertise useful for conducting microbial source tracking (MST) analyses to more accurately identify the most significant sources of bacterial contamination and the relative bacterial contribution of those sources, also have authorities and responsibilities affecting watershed-based planning.

Regional Agencies and Authorities

The principal regional agency with responsibilities affecting watershed-based planning in the Sasco Brook Watershed is the Westport-Weston Health District which is responsible for implementing the Sanitary Code of the ''Westport-Weston Health District,'' including requirements for inspection and maintenance of septic systems. The Health District is an active participant on the Sasco Brook Pollution Abatement Committee and helped design the Watershed-Based Plan's proposed MST analysis to more accurately identify the most significant sources of bacterial contamination in the watershed and the relative bacterial contribution of those sources.

Other regional agencies with interests concerning watershed-based planning include the Southwestern Regional Planning Agency (SWRPA) and the Greater Bridgeport Regional Planning Agency (GBRPA). Westport is within SWRPA's area of service and Fairfield and Easton are in the service area of the GBRPA. Both regional planning agencies are involved with watershed-based planning projects and their experience may be beneficial for implementation of the Sasco Brook Watershed-Based Plan. SWRPA, for example, is participating in the development of watershed-based plans for the Saugatuck, Mianus, and Five Mile rivers in southwestern

Connecticut and the update of the Norwalk River Watershed Action Plan. GBRPA is participating in the development of a watershed management plan for the Pequonnock River that flows through the City of Bridgeport.

Conservation and Education Organizations

In addition to the various governmental agencies with roles and authorities affecting watershed-based planning in the Sasco Brook Watershed, several conservation and educational organizations are also involved. Earthplace—The Nature Discovery Center, located in Westport, has provided water quality sampling and testing services to the Sasco Brook Pollution Abatement Committee since the committee's establishment. These services are provided to advance the organization's mission to educate the community about nature and the environment. Through the Earthplace Harbor Watch/River Watch Program, water quality is monitored at designated sampling locations throughout the watershed by volunteers and then tested in the organization's state and federally approved laboratory. The data, presented in published water quality reports, provides useful information for watershed-based planning decisions and provides educational benefits for the program's participants. Earthplace representatives are active participants on the SBPAC.

Photo 1-19: Small pastures, older homes, and forested land are found in the central and northern parts of the watershed.

The Connecticut Audubon Society (CAS), with a mission to conserve Connecticut's environment through science-based education and advocacy focused on the state's bird populations and their habitats, maintains the Larsen Wildlife Sanctuary off Burr Street in Fairfield, within the Sasco Brook Watershed.

The properties and facilities of Earthplace and CAS may be appropriate for establishment of demonstration projects for application of Low Impact Development techniques for stormwater management.

Another organization with an interest in watershed-based planning is The Nature Conservancy (TNC), a national conservation organization whose mission is to preserve natural diversity by protecting lands and waters supporting the best examples of all types of natural environments. TNC serves as the coordinating partner of the Saugatuck River Watershed Partnership conducting watershed-based planning for the Saugatuck River Watershed. In this regard, TNC's experience may be beneficial for implementation of the Sasco Brook Watershed-Based Plan.

The University of Connecticut has several programs that provide information and assistance for watershed-based planning, including: assistance for stormwater management through the Nonpoint Education for Municipal Officials (NEMO) program; assistance for watershed-based planning using remote sensing and Geographic Information System technologies through the Center of Land Use Education and Research (CLEAR) program; and assistance for horse manure management through the Cooperative Extension System. Other educational institutions are also sources of information and assistance for watershed-based planning, including the University of New Hampshire which has significant experience conducting the microbial source tracking analyses designed as priority projects for implementation of the Sasco Brook Watershed-Based Plan.

In addition, interested students from local public and private schools can also provide information and assistance for watershed-based planning, such as the assistance provided by student volunteers from Westport's Staples High School who, as part of the watershed-based planning process for the Sasco Brook Watershed, helped conduct a survey of the attitudes and concerns of Town of Westport residents in the watershed. It is anticipated that environmentally conscious students from Fairfield Ludlowe and Fairfield Warde high schools also may be interested in providing assistance for watershed-based planning.

Private Landowners and Business Owners

Private landowners and business owners have significant rights and interests to be recognized and addressed in the watershed-based planning process. Many property owners have demonstrated awareness of nonpoint source pollution issues and a willingness to maintain their properties in a manner to improve environmental quality and reduce runoff pollution. At the same time, public support is not expected for additional land-use and other regulations that may be proposed to advance watershed-based planning that are perceived as unduly burdensome on private properties. The owners of large parcels of watershed land including the Fairfield County Hunt Club and the Patterson Club, can have particularly significant roles in the watershed-based planning process by providing information to their members and implementing effective measures to reduce runoff pollution from their properties carrying bacteria from wildlife and domestic animals. Representatives of the Hunt Club have been active participants on the SBPAC and the club has implemented significant initiatives to manage horse manure and reduce runoff pollution from its property.

2

Water Quality Issues and Planning Considerations

Nonpoint source pollution is considered the number one water quality problem in the United States, and stormwater runoff is the primary contributor to nonpoint source pollution. Studies have shown that if 10 to 25% of a watershed is covered with impervious surfaces, water quality becomes adversely impacted. Precipitation either evaporates or runs off through the ground or over land into water bodies or water courses and eventually into Long Island Sound. Pollutants are introduced into stormwater runoff from such sources as failing septic systems, fertilizers, pesticides, animal waste, road and parking lot sands, salts, and hydrocarbons.

from the Long Island Sound Assembly 2010 Report to
the Connecticut General Assembly

Chapter Cover Photo: Bulkley Pond dam.

Water Quality Issues and Planning Considerations

Sasco Brook has been identified by the Connecticut Department of Environmental Protection (DEP) as an impaired water body not meeting State of Connecticut water quality standards for contact recreation1 due to the detected presence, from time to time, of bacterial contamination in water samples. That contamination has contributed to the state-imposed closure of public shellfish beds near the mouth of the brook in Long Island Sound, and may impair other public uses of water resources in the watershed. As a result of concerns about the effects of bacterial contamination in the brook, and to establish goals for reducing that bacteria, the DEP developed the Sasco Brook Total Maximum Daily Load (TMDL) analysis in 1999 and updated that analysis in 2005. (See Appendix F.)

This chapter reviews some of the key issues and planning considerations that affect water quality in the Sasco Brook Watershed, achievement of the TMDL goals for pollution reduction, and implementation of the Sasco Brook Watershed-Based Plan (the Plan). Included are issues and considerations identified and reviewed by the Sasco Brook Pollution Abatement Committee (SBPAC) since the committee was formed in 1991, and other concerns identified more recently in the course of the committee's efforts to prepare the Plan. All of the identified issues are addressed through the Plan's Watershed Vision and implementation strategy set forth in chapters five and six, respectively, of the Plan.

It is recognized by the SBPAC that the Plan can not identify every issue that is likely to affect water quality and watershed-based planning in the Sasco Brook Watershed in the future. Efforts to protect and improve water quality through implementation of the Plan are intended to be part of an ongoing process of watershed stewardship that will continue to evolve as conditions and circumstances change. The Plan can be adjusted as necessary to respond to new issues as they may arise and as the response of municipal agencies, private organizations, and watershed residents to sometimes complicated water quality-related issues continues to evolve.

FUNDAMENTAL QUESTIONS

At the outset of the planning process, the Sasco Brook Pollution Abatement Committee identified some fundamental questions regarding water quality and watershed-based planning in the Sasco Brook Watershed. The questions helped guide the planning process, the pollutant loading methodology, and formulation of the Watershed-Based Plan. As the SBPAC addressed these questions, the committee's understanding of the water quality issues to be addressed through the Plan increased significantly, along with the committee's ability to communicate the issues to watershed residents and other stakeholders. Questions addressed by the SBPAC are listed below, numbered for reference purposes and not to denote priority.

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1 For the purpose of the water quality standards, Sasco Brook is not considered a swimmable stream because of its general shallowness but persons may still wade in the brook or otherwise come into contact with its waters.

Questions for Discussion:

1. *What are the sources and types of water pollution to be concerned about in the Sasco Brook Watershed?*
2. *Why should we be concerned about water pollution in the watershed?*
3. *What does the term "carrying capacity" mean and why is it important for watershed-based planning?*
4. *Why is municipal infrastructure a significant consideration?*
5. *How do different types of land use contribute to water pollution?*
6. *Why is continued data collection necessary?*
7. *How do public attitudes and awareness affect watershed-based planning?*
8. *What are the institutional considerations affecting watershed-based planning?*
9. *Why are economic issues important to consider?*
10. *Why are planning and regulatory considerations significant?*

1. What are the sources and types of water pollution to be concerned about in the Sasco Brook Watershed?

Sources of water pollution to be concerned about can be categorized in general terms as "point" and "nonpoint" sources. Potential "point" sources include the easily identified discharges from storm drainage outfall pipes that empty into Sasco Brook, its tributaries, and the natural and man-made drainage pathways that eventually lead to the watershed's water courses.

Nonpoint source (NPS) pollution, sometimes called runoff pollution, has diverse origins that are not easily identified and, because of its nonspecific nature, is generally more difficult to manage and control than point source pollution. NPS pollution includes pollution carried in storm water that drains from all land surfaces in the watershed, including, but not limited to, roads, parking lots, driveways, lawns, horse paddocks, and open spaces. As precipitation runs off pavement and land to the nearest catch basin or drainage pathway draining to the brook and its tributaries, it can gather bacteria, oil, sediment, debris, and other pollutants that eventually enter the water.

Sometimes the distinction between point and nonpoint sources of pollution is blurred. For example, NPS pollution may be generated over a significant area of the watershed, but when the runoff carrying that pollution is funneled through the municipal stormwater drainage system and then discharged through an outfall pipe it becomes point source pollution for the purpose of watershed-based planning.

Basic types of water pollution are often discussed with regard to: a) the pollution associated with disease-causing bacteria called pathogens that are found in the feces and intestinal tracts of humans and other warm-blooded animals; b) toxic substances such as metals and chemicals generated by automobiles and by commercial and industrial operations;

c) excessive nutrients and phosphorous from fertilizers and other human sources that deplete dissolved oxygen in the water column and thereby cause the condition known as hypoxia; and d) floatable trash and debris. While all of these problems are of interest and potential concern in the Sasco Brook Watershed, priority attention has been given to reducing bacterial pollution which has been detected from time to time in concentrations that have resulted in Sasco Brook being classified as an impaired water body by the State of Connecticut. This bacterial pollution was the focus of the Sasco Brook Total Maximum Daily Load analyses and is addressed in the SBPAC's Watershed-Based Plan.

Based on the results of historical water quality monitoring in the watershed and observations of watershed conditions, it is recognized that bacterial contamination in Sasco Brook is most prominent following precipitation events and is associated with stormwater runoff. The suspected sources of the bacterial contamination include the fecal matter generated by geese, ducks, and other wildlife and by domestic animals such as dogs and horses. Another potential source is human waste in seepage from any poorly functioning septic systems that may exist in the watershed. As in other Connecticut watersheds, the specific sources, their relative significance, and the amounts of potential contamination generated by each source in the Sasco Brook watershed have been inferred over time but are not known with certainty.

2. Why should we be concerned about water pollution in the watershed?

In addition to providing essential habitat for plants, fish, and wildlife, and adding to the beneficial character of the natural landscape and quality of life in the watershed towns (Westport, Fairfield, and Easton), Sasco Brook and its tributaries have a direct effect on Long Island Sound. There is a fundamental relationship among the brook, its watershed and the Sound which greatly depends on the quality of the water in all of its many tributaries and watersheds. Simply stated, if water flowing into the Sound is polluted, the Sound would be polluted too. As a result, the SBPAC believes that all citizens should be concerned about water pollution. Any significant pollution in Sasco Brook and its watershed would diminish the quality of life in residential areas, reduce property values, and adversely affect the Sound. Adverse impacts on plants, fish, wildlife, and aesthetic values occur when hypoxia suffocates fish and other aquatic life, and when metals, plastics, and chemicals accumulate in the water column, bottom sediments, and aquatic animals.

While bacterial contamination may not cause adverse impacts that are as readily apparent as the impacts of other types of pollution, it nevertheless has a potentially significant effect on conditions in the watershed and Long Island Sound. Elevated levels of bacteria detected in the brook from time to time have resulted in closure of the public shellfishing grounds in the Sound near the mouth of the brook and otherwise adversely affect conditions in the Sound—an estuary of national significance as designated by the U.S. Congress.

In the course of the watershed-based planning process, the SBPAC considered the potential adverse economic and public health impacts of pollution in Sasco Brook, along with the potential adverse impacts on town character, quality of life, scenic quality, plant and animal life, and the coastal resources and beneficial uses of Long Island Sound.

Described in Chapter Four, there have been a number of accomplishments with regard to understanding and improving water quality conditions in Sasco Brook since establishment of the SBPAC in 1991. While no one today should think of Sasco Brook as a major pollution problem, the risk of contamination, including fecal contamination from wildlife, domestic animals, and septic systems is an ongoing concern that the SBPAC believes should be recognized and appreciated by all public officials, watershed residents, and business owners.

3. What does the term "carrying capacity" mean and why is it important for watershed-based planning?

"Carrying capacity" usually refers to the amount of use or development that a particular area or resource can accommodate before unacceptable impacts on environmental quality, public safety, beneficial use, or other conditions occur. The concept is relevant to watershed-based planning in several ways. First, the State of Connecticut's water quality standards for Sasco Brook and the Sasco Brook Total Maximum Daily Load analyses are based on the principle that a water body has a limited capacity to dilute or otherwise assimilate pollution. When that capacity is exceeded, unacceptable impacts on environmental quality and/or public health are to be expected.

In addition, the carrying capacity of the Sasco Brook Watershed may be considered with regard to the capability of watershed land to accommodate expanded development without undesirable increases in nonpoint source pollution. The land-use plans and regulations of the watershed municipalities recognize that the environmental carrying capacity of watershed land to accommodate development is not unlimited and that there are a number of potential water quality impacts associated with new and expanded development. Those impacts can be caused by increases in the amount of impervious surfaces that accelerate the runoff of storm water carrying NPS pollution into the municipal stormwater infrastructure and then to the brook and ultimately Long Island Sound. In addition, the capacity of the land to accommodate individual waste disposal systems (septic systems) is limited.

The levels of bacterial contamination observed in the brook would also suggest that existing development and/or animal uses currently exceed the brook's carrying capacity with respect to bacteria. As a result, it would seem that best management practices applied to existing land uses are necessary to reduce the adverse impacts of those uses so that benefits from higher environmental quality can be achieved for both watershed residents and the plant and animal resources that are dependent on the brook.

The Sasco Brook Pollution Abatement Committee recognizes that the difficulty in applying the concept of environmental carrying capacity on a watershed-wide basis and that the level of public understanding concerning the concept can be improved. It is difficult, for example, to precisely determine the amount of future use and development that can occur in the watershed before adverse impacts on water quality may become unacceptable and unmanageable. This does not mean, however, that the watershed's environmental carrying capacity should not be an important consideration in future decisions by

all of the municipal agencies with responsibilities concerning development and land use in the watershed.

When considering the carrying capacity of the watershed to accommodate use and development without increasing NPS pollution, and how the adverse impacts of existing development may be mitigated, the SBPAC recognizes that consideration must be given to the cumulative impacts that can result from individually minor but collectively significant actions that take place over a period of time. Alone, each source of pollution, including bacterial pollution, has only a small impact. The improper disposal of waste from a single pet, for example, is seemingly insignificant, but the cumulative impacts of hundreds of dogs in the watershed, all contributing waste that may be washed into the storm drainage system, can have a significant effect on water quality as demonstrated in the pollutant loading review conducted by the SBPAC for the purpose of the Watershed-Based Plan. (See Chapter Three.)

The SBPAC recognizes that one of the most basic issues affecting watershed-based planning concerns the need to achieve and maintain the most appropriate balance between beneficial use and development of the watershed and protection and improvement of environmental quality, including water quality. The watershed's natural environment provides vital ecological functions and enhances the opportunities for beneficial residential, commercial, and recreational uses that provide significant economic and cultural benefits. Environmental values, however, can be damaged by those same beneficial uses. As a result, the importance of understanding and applying the concept of environmental carrying capacity is particularly significant when making land use and other decisions affecting the watershed and pursuing implementation of the Watershed-Based Plan.

4. Why is municipal infrastructure a significant consideration?

The municipal stormwater and sanitary sewer systems as well as the impervious surfaces associated with road and bridge infrastructure in the watershed have significant existing and potential effects on water quality that must be considered in the watershed-based planning process. The stormwater sewer system provides the most visible impacts of the effects of municipal infrastructure on water quality. That system includes catch-basins, pipes, and other drainage ways that detain, carry, and ultimately discharge stormwater runoff prior to its discharge into Sasco Brook and Long Island Sound. When the storm water that runs off roads, parking lots, and other impervious watershed surfaces exceeds the capacity of the municipal infrastructure to carry and detain it, nonpoint source pollution may flow directly into the brook and its tributaries.

For the purpose of the Watershed-Based Plan, it is recognized that significant costs are associated with improvement and maintenance of stormwater systems. Existing municipal budget constraints are seen to diminish the feasibility of constructing and maintaining new engineered stormwater management controls, as recommended in the 2005 TMDL analysis, to reduce the surge of storm water to Sasco Brook and its tributaries. In addition, the SBPAC recognizes that other types of controls, including catch-basin filters/inserts that require replacement and maintenance, are not considered to be cost effective at this time.

Regarding municipal infrastructure, the most practical approach to watershed-based planning may be to focus on the effective maintenance of the existing infrastructure instead of construction of new structures and facilities. That maintenance is currently pursued by the towns of Westport and Fairfield through implementation of the state requirements for managing the discharge of storm water pursuant to the requirements of the Municipal Separate Storm Sewer System (MS4) General Permit. Through regular street sweeping and cleaning of plunge pools, outfalls, catch basins, and culverts to remove accumulated sediment, the towns can reduce the amount of pollutant-laden sediment that otherwise would be washed into watershed stream courses. Replacement of catch basins with hooded traps can also serve to advance town goals for maintaining and improving water quality by reducing the amount of sediment and debris entering the stream courses.

5. How do different types of land use contribute to water pollution in the watershed?

The different uses of land and types of development in the Sasco Brook Watershed significantly influence the potential sources of pollution that can affect Sasco Brook and its tributaries. A basic consideration for watershed-based planning is the relative extent and location of developed and undeveloped areas in the watershed. More natural, undeveloped areas, including forested and wetland areas, have the potential to absorb and naturally filter stormwater runoff that otherwise might carry bacteria and other nonpoint sources of pollution to the nearest water course. The risk of NPS pollution being carried by stormwater runoff from impervious surfaces such as roads, sidewalks, and parking areas is much greater than the risk associated with natural surfaces, especially if the stormwater runoff from the impervious surfaces surges directly to a water course without some sort of intervening retention or treatment (e.g., filtering). For example, stormwater flowing over impervious surfaces can carry fecal matter from domestic animals and wildlife directly to nearby water courses without the significant reductions in the bacterial load that would occur if that same fecal matter was deposited in more natural, undeveloped areas where contaminants can naturally decompose once retained by vegetation and soil.

The Connecticut Department of Environmental Protection reports in its *2004 Connecticut Stormwater Quality Manual* that if 10 percent to 25 percent of a watershed is covered with impervious surfaces, the risk of NPS pollution is significantly elevated. It is estimated, for the purpose of the Total Maximum Daily Load analysis, that impervious surfaces cover about 7 percent of the Sasco Brook Watershed and are most prevalent in the commercially developed areas along the Post Road/Route 1 corridor that cuts through the watershed. They are also prevalent in the higher density residential areas near the Post Road. The SBPAC recognizes the distinct risk of nonpoint source pollution contribution emanating from the commercial areas along the Post Road.

The Post Road commercial area is served by municipal sanitary sewer systems so the risk of bacterial contamination from poorly functioning septic systems is not a concern for watershed-based planning in the commercial area. However, the potential for pollution resulting from the compacting, handling, and disposal of food wastes generated by the food retail and service establishments in the commercial area is a potential source recog-

nized by the SBPAC. Improper disposal of food wastes can attract wildlife species which then become a source of fecal matter that contributes to bacterial contamination.

Other land use considerations are also relevant for watershed-based planning. A potential source of bacterial contamination is seepage from any poorly functioning septic systems in the residential areas that cover much of the watershed away from the Post Road. In the 6 percent of the watershed considered to include animal paddocks, fields, and pastures, there is the potential for domestic animals such as horses to generate fecal matter that, in the absence of appropriate waste disposal practices, can be carried by stormwater runoff to water courses in the watershed. In addition, populations of migrating and resident geese which contribute to bacterial loads and tend to congregate in the watershed's large open spaces where grazing or mowing has reduced the capability of the land to buffer runoff.

The SBPAC recognizes that any approach to estimating specific pollution sources, their relative significance, and the amounts of bacteria generated by each source in the watershed must take into account a number of considerations regarding watershed land use. Such considerations are incorporated into the pollutant loading review described in Chapter Three.

6. Why is continued data collection necessary?

The Sasco Brook Pollution Abatement Committee recognizes that if the available resources for protecting and improving water quality are to be applied effectively, it will be necessary to continue to advance understanding of the most significant sources of pollution in the watershed, particularly nonpoint sources, and to tailor possible water quality management measures to address these sources. The substantial monitoring efforts that have already taken place have advanced understanding of pollution processes in the watershed, including the effects of natural rainfall variability on pollutant loading, and have illustrated the general extent of bacterial contamination. Continued monitoring is needed to: a) build on the knowledge gained from prior monitoring; b) better address the remaining unanswered questions concerning the pollutant loading processes; c) identify with greater certainty the most significant sources of contamination; and d) document the improvements expected from the application of water quality management measures.

Bacterial contamination in Sasco Brook was detected as a result of a multi-year program of water quality monitoring conducted at the direction of the SBPAC. Continuation of the monitoring program is needed to not only identify the presence of any future contamination that may require immediate attention, but also to evaluate the effectiveness of best management practices and other pollution abatement initiatives carried out in accordance with the Watershed-Based Plan. The SBPAC recognizes that an effective, long-term program for monitoring water quality in the watershed is an essential component of any effort to protect and improve water quality. While funding for the historical and existing monitoring program has been provided by several governmental grant programs and private sources, future funding is uncertain.

The SBPAC recognizes the importance of continued data collection to advance the purpose of watershed-based planning, and to provide the most factual and science-based information on which to base decisions concerning protection and improvement of water quality. Information concerning the experiences of groups and organizations involved with watershed-based planning in other jurisdictions also has significant value.

The current lack of accurate and precise information regarding the sources and relative amounts of bacterial contamination in the Sasco Brook Watershed is a significant planning consideration. Methods used to estimate the amounts of *E. coli* and fecal coliform bacteria generated by potential sources of watershed pollution have been applied in other Connecticut locations in the course of watershed-based planning initiatives. Those methods, reviewed by the SBPAC, are based on a significant number of assumptions, and while the methods facilitate discussion, awareness, and analysis of water pollution issues they may not provide sufficient confidence for justifying municipal expenses for pollution abatement measures.

More detailed analyses of potential contamination sources are possible, including analyses through microbial source tracking (MST) studies utilizing ribotyping analysis of cultures of *E. coli* bacteria. It is the understanding of the SBPAC that while such analyses have been conducted in other states for watershed-based planning purposes, such ribotyping analyses have not been conducted in Connecticut, due in part to the relatively greater expense and level of effort required to do so.

Issues and considerations pertaining to continued data collection in the watershed are of scientific interest for a number of reasons. For example, the watershed provides important opportunities for the study of natural aquatic resources and processes. In addition, research and educational programs not only provide benefits for their participants, they can also help to develop scientific and other information needed to support environmental stewardship initiatives and effective implementation of the Watershed-Based Plan.

Other significant watershed-based planning considerations include how to make sure that beneficial data collection and research continues, and that such research: 1) builds upon and advances the knowledge gained from previous investigations; 2) is coordinated to the extent practical; 3) is shared among interested stakeholders and disseminated to the public as appropriate; 4) is designed to have practical applications for watershed-based planning purposes; and 5) is planned to advance specific water quality goals, including, for example, the pollution reduction goals of the Watershed-Based Plan. In this regard, it is recognized by the SBPAC that no comprehensive analysis of the historically collected water quality data has been conducted to identify trends and other relationships that may increase understanding of Sasco Brook pollutant loading.

7. How do public attitudes and awareness affect watershed-based planning?

The Sasco Brook Pollution Abatement Committee recognizes that implementation of the Watershed-Based Plan will not be successful without continued public support and awareness. In the course of the planning process, the SBPAC conducted a comprehen-

sive survey of Town of Westport residents in the Sasco Brook Watershed to help gauge public attitudes and any concerns regarding watershed-based planning. Results of the survey (see Appendix C) indicate a significant level of public awareness of nonpoint source pollution issues and the effect of runoff pollution on Long Island Sound. Many residents described their willingness to: a) apply cost-effective best management practices for stormwater management on their properties; b) support Town watershed management initiatives that do not create undue burdens for property owners; and c) learn more about watershed management initiatives. Similar surveys have not been conducted of Fairfield and Easton residents in the watershed.

To achieve and maintain the public support and awareness needed to implement the Watershed-Based Plan, it is recognized that continued attention must be given to developing and applying effective educational initiatives and other outreach efforts directed toward the general public. The SBPAC recognizes that these efforts should be designed to increase awareness of, among other things: 1) natural watershed resources and values; 2) existing and potential threats to those resources and values; 3) the applicable laws and regulations affecting watershed-based planning; and 4) the need and opportunities for personal stewardship actions. The pollutant loading review for the Watershed-Based Plan has provided new information regarding the relative significance of sources of bacterial loading in the watershed, including information on the differences in concentration of bacteria in the feces of different animal species. That new information can be used to develop more focused messages for public outreach and education purposes.

Ongoing considerations for watershed-based planning include how to: 1) continue to develop well-prepared materials and programs to inform the general public about a variety of topics concerning the watershed; 2) most effectively distribute those materials and involve the public; and 3) provide all persons and groups that have an interest regarding the watershed with meaningful opportunities to express their ideas and concerns. In this regard, the need for public support to implement the Watershed-Based Plan and other stewardship initiatives will remain constant, along with the need for opportunities for the public to provide input in the development of plan implementation initiatives. When involving the public, the SBPAC anticipates encountering different points of view with regard to some issues, and appreciates the need to recognize and respect different, legitimate viewpoints. In addition, it should be anticipated that no matter how well-designed the educational and outreach efforts may be, some landowners may remain disinterested or unsupportive.

8. What are the institutional considerations affecting watershed-based planning?

There are a number of "institutional" considerations that affect watershed-based planning in the Sasco Brook Watershed and the effective application of land use regulations and nonregulatory measures to protect and improve water quality. The extensive institutional framework for protecting and improving water quality in the watershed, summarized in Chapter One, includes a number of laws, regulations, ordinances, and programs at the local, state, and federal levels of government. Three towns, a number of local, state, and federal agencies, and private organizations all have significant interests and authorities in

the watershed. In addition, watershed residents, property owners, and business owners have important rights and interests regarding water quality and are also part of the institutional framework. As a result, a basic planning issue concerns how to achieve and maintain the most effective coordination and cooperation among all of the different jurisdictions, agencies, organizations, and interests for the purpose of accomplishing shared goals for water quality protection and improvement.

Although a significant part (19 percent) of the watershed's area is within the jurisdiction of the Town of Westport, the majority (78 percent) of the watershed's geographic area is within the Town of Fairfield, and the remainder is in the Town of Easton. As a result, it is recognized that decisions and initiatives by the Town of Fairfield may have a particularly significant influence on water quality in the watershed, and that the most effective measures to ensure long-term protection and enhancement of water quality will involve participation by all three towns with jurisdiction in the watershed.

Other institutional framework considerations that require attention include how to provide adequate funds to support stewardship initiatives; how to provide for the continued effective use of volunteers for assisting with those initiatives; and how to maintain effective organizational structures and capabilities for protecting and improving water quality in response to changing conditions and circumstances.

9. Why are economic issues important to consider?

Economic considerations are inherent in many aspects of watershed-based planning. The principal consideration addressed by the Sasco Brook Pollution Abatement Committee concerns the costs that may be associated with implementing the Watershed-Based Plan and how funds may be obtained to pay for Plan implementation. The SBPAC recognizes how the budgetary constraints at all levels of government affect the feasibility of implementing some best management practices for pollution abatement, including BMPs that would be implemented through new municipal stormwater infrastructure projects. In addition, even if funds should be available through state and federal grant programs to construct certain BMPs, including engineered stormwater controls as recommended in the 2005 Sasco Brook TMDL, the municipal costs of maintaining those controls may be prohibitive. The SBPAC recognizes that continued public support for watershed-based planning may be jeopardized if implementation of the Watershed-Based Plan required increased tax burdens on watershed residents and business owners.

As a result of these economic issues, the SBPAC prepared the Watershed-Based Plan as a guidance document based primarily on continued public outreach and education initiatives that will be pursued through already existing programs, including the programs of the committee and of the agencies and organizations represented on the committee. A principal goal of the SBPAC is to encourage voluntary, personal stewardship actions that will reduce the risk of pollution without requiring significant expenditures of municipal funds. Many of these personal actions will prevent the introduction of contaminants that would require municipal action to address.

While some of the implementation recommendations included in the Plan will require future expenditures of funds, the SBPAC will seek funding for those initiatives through federal, state, and private grant programs, including programs that previously have been utilized for water quality initiatives in the watershed. The Plan does not commit any watershed town to future expenditures, but provides a basis for implementing beneficial projects as funds, including funds available from available grant programs and municipal budgets, may become available.

10. Why are planning and regulatory considerations significant?

Sources of pollution, their relative significance, and the amounts of potential contamination generated by each source in the watershed are influenced by governmental regulations including, but not limited to, municipal building, zoning, and other land use regulations that affect the location, type, and density of land use, and public health regulations concerning the construction, maintenance, and inspection of septic systems. Municipal planning programs also affect the protection and improvement of water quality by establishing policies and recommendations to be considered by decision-makers, including the town policies and recommendations for environmental conservation and beneficial land use established in the Westport, Fairfield, and Easton town plans of conservation and development.

A basic consideration for watershed-based planning concerns how to most effectively blend planning and other nonregulatory initiatives with regulatory programs to protect and improve water quality in the Sasco Brook Watershed, recognizing that there is a general lack of public support for the imposition of new regulations that would affect privately owned properties in the watershed. Many Town of Westport residents surveyed in the watershed-based planning process described their support for watershed management initiatives that do not create undue burdens for property owners, including the burdens that might be imposed by additional regulatory restrictions.

The Sasco Brook Pollution Abatement Committee believes that the most effective Watershed-Based Plan should be based on a combination of regulatory and nonregulatory approaches, with the regulatory approaches focusing on the most effective application of existing regulations affecting watershed use and development. At such time as more precise information regarding the sources of bacterial contamination in the watershed is available, a regulatory review may be conducted for the purpose of identifying any needed changes to town land use regulations. In the mean time, the Watershed-Based Plan, prepared by the SBPAC as a guidance document without the statutory authority of a municipal planning document, will focus on public outreach and other nonregulatory initiatives to encourage environmental stewardship by watershed residents, with proper consideration and respect for private property rights.

3

Sasco Brook Pollutant Loading Review

Pathogens are bacteria, protozoa, and viruses that can cause disease in humans. The presence of bacteria such as fecal coliform or enterococci is used as an indicator of pathogens and of potential risk to human health. Pathogen concentrations in urban runoff routinely exceed public health standards for water contact recreation and shellfishing. Sources of pathogens in stormwater runoff include animal waste from pets, wildlife, and waterfowl; combined sewers; failing septic systems; and illegal sanitary sewer cross-connections. High levels of indicator bacteria in storm water have commonly led to closure of beaches and shellfishing beds along the Connecticut coast.

from the 2004 Connecticut Stormwater Quality Manual

Chapter Cover Photo: Drainage culverts.

Pollutant Loading Review

This chapter includes a discussion of considerations and issues regarding potential causes and sources of bacterial contamination in the Sasco Brook Watershed. Included is a review of some previously collected water quality data and the related pollutant-loading observations considered for development of the Sasco Brook Total Maximum Daily Load (TMDL) by the Connecticut Department of Environmental Protection (DEP). Also included is an estimate of pollution load risks from fecal contaminant sources. This estimate was developed utilizing a simplified method deemed suitable by the Sasco Brook Pollution Abatement Committee (SBPAC) for purposes of the Sasco Brook Watershed Based-Plan. The method is intended to identify potential sources of bacterial contamination in the watershed and the relative risk of those sources, and to increase understanding of the variables that must be considered in an assessment of pollution causes and sources in the watershed. Results from the applied method are shown on Tables 3-1 through 3-4.

REVIEW OF MONITORING DATA AND RELATED POLLUTANT LOADING OBSERVATIONS

The initial Total Maximum Daily Load analysis for Sasco Brook was completed by the Connecticut Department of Environmental Protection in 1999, followed by a year of trend monitoring conducted for the Town of Fairfield. The current TMDL for the watershed is based on a TMDL analysis completed in 2005.

Total Maximum Daily Load Analysis (1999)

A history of water quality sampling for the watershed is available from the 1999 TMDL analysis at which time the watershed was divided into four sub-watersheds (identified as A, B, C, and the the Sasco Brook estuary) based on considerations of hydrology and land use patterns (1). The estuary sub-watershed, where water quality conditions are subject to the ebb and flood of the tide in addition to stormwater runoff, was not included in the TMDL analysis. Sampling to obtain data on concentrations of fecal coliform in each of the three sub-watersheds A, B, and C was conducted at the most downstream location for each sub-watershed in order to develop data most representative of the entire area of each sub-watershed.

Monitoring was conducted over a period of two years to develop a baseline condition which was then compared with both mean and peak endpoint bacterial concentrations that meet State of Connecticut guidelines for general sanitary quality. The TMDL fecal coliform endpoints used in the 1999 analysis were: 1) geometric mean of 200 colonies /100 ml to represent average bacterial loading conditions; and 2) the 90th percentile value of 400 colonies/100 ml to represent peak bacterial loading conditions.

The analysis was quantified and evaluated on an annual basis without adjustment for seasonal variations in indicator bacteria concentrations. It is stated in the TMDL that "Although potential human exposure to pathogenic bacteria during recreational activities is more likely during the summer months, this TMDL employs fecal coliform bacteria density as a broad-based indicator of general quality which should be maintained throughout the year. Consistency with the fecal coliform indicator guideline for frequency of exceedance of a maximum density of 400/100 ml was also evaluated on an annual basis." (1, pg 8)

Overall, fecal coliform concentrations in the upper sub-watershed A were demonstrated to meet the State guidelines. Waters of the middle sub-watershed B met the standard for mean bacterial loading, but peak levels exceeded the standard.

In the lowest sub-watershed C, based on sampling at the outfall of the dam forming Bulkley Pond immediately upstream of Route 1, it was determined that State standards for fecal coliform concentrations were exceeded for both the mean and peak levels of the standards.

The 1999 TMDL analysis established reduction objectives needed to meet standards for each sub-watershed and provided the following general evaluation of potential pollution loading sources. "Existing pollution sources affecting water quality are directly related to land use within the basin. In the northern sections of the watershed, septic systems, poor domestic animal waste management, and natural sources are the predominate source of pollutant. In the lower basin, stormwater runoff, pet waste, and nuisance wildlife are more significant contributors to elevated indicator bacteria levels. In the lower basin, changes to the natural hydrology associated with development and large areas of impervious surface exacerbate the problem." (1, pg 3) This evaluation of potential pollution loading sources was based on observations of watershed conditions and professional judgments. More definitive microbial source tracking analyses utilizing pharmaceutical detection, ribotyoing, or other programs were not conducted.

Town of Fairfield Trend Monitoring (1999-2000)

Subsequent to the 1999 TMDL's Sasco Brook water quality monitoring plan, substantial trend monitoring was undertaken in the Town of Fairfield to track progress in achieving reductions in bacterial loadings needed to meet the TMDL objectives. (1, pg 11)

Trend monitoring included sampling at four stations, three at the same locations previously established in sub-watersheds (A, B, and C) used in the 1999 TMDL analysis, and one additional sampling station at Wakeman Lane in the Town of Fairfield, midway within the lowest sub-watershed C. Two samples were taken each month between June 1999 and October 2000 for a total of 33 observations at the three original monitoring stations. A single monthly sample was taken at the intermediate station at Wakeman Lane providing an additional 18 observations. This trend monitoring program provided over twice as much sampling as obtained for the original 1999 TMDL analysis at each of the three original monitoring locations. In addition to an increase in monitoring observations or samples taken, the effort was also expanded to include three additional bacterial indicators (*Escherichia coli (E. coli),* enterococcus, and total coliform); five nutrient parameters (Total Kjeldahl Nitrogen (TKN), nitrate, nitrite, ammonia, and phosphate); and three physical parameters (total dissolved solids (TDS), total suspended solids (TSS), and turbidity).

Monitoring results in the upper sub-watershed A indicated that the standard for average conditions was met in the overall annual analysis of bacterial loading. In contrast to the 1999 TMDL analysis, the peak bacterial loading objective of 400 colonies/100ml was exceeded with a 95th percentile value of 902 fecal coliform colonies/100ml.

The middle sub-watershed B showed little change from the 1999 TMDL analysis, meeting the average condition standard and exceeding the peak condition standard.

The lowest sub-watershed C including Bulkley Pond demonstrated a 33 percent reduction in fecal coliform loading in comparison to the 1999 TMDL for average conditions. The peak fecal coliform results indicated a 66 percent reduction in peak fecal coliform loading. Both average and peak measures exceed the objective standards, but nearly reached the required TMDL objective of 47 percent and 88 percent reductions respectively.

Data was also used to explore seasonal bacterial loading characteristics in Sasco Brook, and it was found that the annual sanitary guideline values for average and peak standards were exceeded during summer months (considered to be the months when contact recreational activities might take place) in each of the sub-watersheds A, B, and C. Overall, the two upper sub-watersheds A and B showed marked reduction in bacterial load during spring, fall, and winter periods. Summer periods in both 1999 and 2000 showed relatively extreme, 6-fold increases in bacterial loads. The reasons for this seasonal variation are not known with certainty but may be caused by low flow conditions which demonstrate higher concentrations of indicator bacteria, and by higher temperatures facilitating bacterial growth.

Although the lowest sub-watershed C also exceeded the average standard during summer months, the relative increase over spring, fall, and winter periods was small—less than half the increase experienced in the upper sub-watershed A and B. Peak bacterial loading measures showed that each of the three sub-watersheds significantly exceeded endpoint bacterial concentrations in the summer of 2000. Interestingly, although each watershed also exceeded the endpoint in the summer of 1999, only the upper watershed A showed a relatively marked increase.

The data show a significant difference in precipitation and streamflow amounts between 1999 and 2000. Storm events in 2000 appeared to be accompanied by elevated increases in fecal bacteria indicators. Periods of low water flow in 1999 were also accompanied by elevated bacterial results, especially in the upper sub-watershed A. This seems to suggest that sub-watershed A has a relatively lower capacity to receive bacterial loading without exceeding endpoint concentrations. In addition, the data suggested that two means of pollutant loading were present: 1) non-point sources at high flow events, including, but not limited to, stormwater runoff carrying domestic animal waste; and 2) point sources at low flow, including seepage from poorly functioning septic systems and direct deposit of waterfowl fecal matter in the stream. (6)

Observations offered in the press release summary from the Town of Fairfield suggested that the data "indicates that the average indicator organisms are in compliance with DEP's target goals for two of the three sub watersheds. However the 90th percentile goal was not met in all three sub watersheds. The test site at the Post Road is actually a pond with an abundance of waterfowl and it is very likely that target goals will never be achievable at this location." Further, it was suggested that "storm water runoff is likely the primary contributor" and that results from 2000 were abnormal based on the amount of precipitation in that year. (3)

Total Maximum Daily Load Analysis (2005)

In response to the identification of Sasco Brook on the Department of Environmental Protection's *2004 List of Connecticut Waterbodies Not Meeting Water Quality Standards* as a water body which exceeded the water quality standards for contact recreation based on bacterial indicators, the DEP conducted a new TMDL analysis for the brook. Since completion of the 1999

TMDL, the U.S. Environmental Protection Agency (EPA) had recommended *E. coli* rather than fecal coliform as the best indicator of the health risk from water contact in recreational waters (5), and the DEP changed Connecticut's water quality standards and monitoring protocol accordingly (4). In the Sasco Brook Watershed, the change in indicator bacteria is not seen to have a significant effect on watershed-based planning because the collected data shows that *E. coli* and fecal coliform are equivalent in water samples suggesting that *E. coli* comprised most of the fecal coliform measured. In addition, for the purpose of watershed-based planning in the Sasco Brook Watershed, it should be recognized that the brook and its tributaries upstream of the estuary are generally not used for swimming or other contact recreation.

In addition to focusing on a single bacterial indicator—*E. coli*—the 2005 TMDL draws a nexus between the contact recreation limitation, the summer recreational period, and elevated concentrations of fecal indicators during that period. As a result, the 2005 TMDL, unlike the 1999 TMDL, is not based on an annual analysis but on a seasonal analysis focusing on the period of time when the contaminant is an issue. Finally, the 2005 TMDL analysis considers stormwater outfalls as point sources, separate from nonpoint sources.

For the purpose of developing the 2005 TMDL, water sampling and testing was conducted at two sites on Sasco Brook between 1999 and 2004 during the ostensible recreational season from May 1st to September 30th. Monitoring was conducted at the Bulkley Pond dam station to represent the lower watershed and at the single supplemental station at Wakemen Lane previously added to the monitoring program to represent the upper watershed. The prior upstream sampling stations were not used in the 2005 TMDL analysis. Analytical methods were updated to use a cummulative relative frequency based on both dry and wet period samples. (7) The EPA's method for TMDL analyses assumes, for the purpose of watershed-based planning, that elevated levels of indicator bacteria during dry periods generally represent contributions from point source loading while elevated levels during wet periods represent nonpoint sources during periods of overland runoff. Research from other locations indicates that direct contribution of wildlife excrement may also contribute significantly to elevated bacterial indicator concentrations during low flow periods in small waterways leading to higher levels during dry periods when point sources may normally be suspected. (9)

Consistent with the previous analyses, monitoring at the Bulkley Pond dam for the 2005 TMDL analysis indicated higher bacterial loading in the stream segment comprised of the pond, the section of brook leading to Wakeman Lane, and the tributary leading east into the nearby residential area in Fairfield. For the lower sub-watershed, the wet period and dry period percent reduction values are 66 and 53, respectively. The 2005 TMDL analysis concludes, "both point stormwater and nonpoint sources are contributing to the bacteria load. It is likely that nonpoint sources include improperly functioning septic systems, agriculture/farm activities and/or wildlife." The 2005 TMDL analysis also indicates that the "increased bacteria load from Bulkley Pond may originate from waterflowl that use the pond" (2) and that Bulkley Pond does not appear to significantly reduce bacterial loading as does Lake Mohegan on the Mill River to the east of the Sasco Brook Watershed. It is not known if any efforts were made, as part of the TMDL analysis to observe waterfowl presence in Bulkley Pond when the monitoring was conducted.

In the upper sub-watershed above the second sampling station, calculated reduction values are lower at 44 percent for wet weather and 26 percent for dry weather. The 2005 TMDL states

"that water quality...is more strongly influenced by point source stormwater than non-point sources" and that the point source "reduction can be achieved through the installation of engineered controls to improve water quality and reduce the surge of stormwater to the brook" without defining the specific types of controls that may be feasible in the watershed. (For the purpose of watershed-based planning in the Sasco Brook Watershed, the Sasco Brook Pollution Abatement Committee recognizes that municipal public works departments with jurisdiction in the watershed are generally reluctant to pursue additional engineered controls because of concerns regarding the costs of maintaining those controls.) The dry period "reduction of 20 percent indicates that the bacteria load may be caused by improperly functioning septic systems or agriculture/farm activities."

As with the 1995 TMDL analysis, the 2005 evaluation of potential pollution loading sources noted above was based on observations of watershed conditions and professional judgments. More definitive microbial source tracking analyses utilizing pharmaceutical detection, ribotyping, or other programs were not conducted.

Review of the 2005 TMDL for the watershed-based planning purposes suggests additional attention should be given to the following considerations affecting water quality in the Sasco Brook Watershed.

1. **Resuspension of Sediments**: A consideration common in TMDL analyses in other locations but not discussed in the Sasco Brook TMDL analyses is the possibility of resuspension of floodplain, riparian, pond, and drainage system sediment containing indicator bacteria. *E coli* survival in freshwater sediments can be significant (8) and sediments can act as bacterial reservoirs. In addition, *E. coli* has been shown to exist in much higher concentrations in sediment than in the overlying water column with common concentrations being 250 times higher in sediment. (9) As noted in another TMDL analysis reviewed during the watershed-based planning process, part of the bacterial load in a stream course remains suspended in the water column and is transported during low flow periods, while the sediment-bound portion of the bacterial load is likely to be re-suspended and transported during high flow conditions. (28) When considering possible resuspension of riparian sediments in the watershed, it should be recognized that in the upper reaches of the watershed the stream beds are generally scoured and there is a lack of fine-grained riparian sediments. Significant amounts of fine-grained sediments are found only in the lower reaches of the watershed, south of Hull's Farm Road. In addition, significant accumulations of sediment are found in Bulkley Pond, and have reduced the Pond's historical water depths. (1)

2. **Direct Deposit of Fecal Matter**: TMDL analyses in other locations has shown that in addition to re-suspension of bacterial laden sediment, direct deposit of wildlife and domestic animal excrement in water has a significant effect on bacterial concentrations, and this effect is disproportionately larger than many upland nonpoint sources which may be mitigated by intervening upland buffers which have the opportunity to reduce bacterial loads that would reach the brook. The effect of directly deposited excrement would likely be largest in periods of low flow condition in areas with the least volume of water available for dilution.

3. **Floodplain Considerations**: Review of the Town of Fairfield's 2008 Flood Insurance Rate Maps shows that Sasco Brook's upper reaches have relatively wider floodplains in comparison to the size of the waterway than do the lower reaches of the brook and in comparison to other waterways considered in the 2005 TMDL analysis. The larger floodplains offer the opportunity for increased loading of fecal matter, and provide a larger bacterial reservoir available for suspension during flood conditions during very high flow periods.

(1) A Total Maximum Daily Load Analysis for Sasco Brook, Fairfield and Westport, Connecticut. 1999. State Of Connecticut Department Of Environmental Protection.

(2) A Total Maximum Daily Load Analysis for the Mill River, Rooster River, and Sasco Brook. 2005. State Of Connecticut Department Of Environmental Protection.

(3) Year One Water Quality Results of Sasco Brook Analyzed (Press Release). Town of Fairfield Connecticut. (http://www.fairfieldct.org/water_quality_press_release.htm).

(4) Connecticut Department of Environmental Protection, 2004. *List of Connecticut Water Bodies Not Meeting Water Quality Standards*. Bureau of Water Management, 79 Elm Street, Hartford, CT 06106-5127.

(5) Monitoring and Assessment 5.11 Fecal Bacteria. USEPA http://water.epa.gov/type/rsl/monitoring/vms511.cfm

(6) An Approach for Using Load Duration Curves in the Development of TMDLs. August 2007. USEPA http://www.epa.gov/owow/tmdl/duration_curve_guide_aug2007.pdf pg 35

(7) Connecticut Department of Environmental Protection, 2004. *Guidelines for Development of TMDLs for Indicator Bacteria Using the Cumulative Distribution Function Method*. Bureau of Water Management, 79 Elm Street, Hartford, CT 06106-5127.

(8) Burton G. Allen, Jr., Douglas Gunnison and Guy R. Lanza. Survival of Pathogenic Bacteria in Various Freshwater Sediments. Applied and Environmental Microbiology, Apr. 1987, p; 633-638.

(9) Fecal Coliform TMDL Mountain Run Watershed, Culpeper County Virginia. 2001. Virginia Departments of Environmental Quality And Conservation and Recreation.

(10) FEMA FIRM maps. 2008. (Fairfield Town website)

(28) Bacteria TMDLs for Abrams Creek and Upper and Lower Opequon Creek Located in Frederick and Clarke County, Virginia. January, 2004. Virginia Departments of Environmental Quality And Conservation and Recreation.

ESTIMATING POLLUTION LOAD RISKS FROM FECAL CONTAMINANT SOURCES

Based on the prior TMDL monitoring results and more recent ground surveys and observations of conditions in the Sasco Brook Watershed, the Sasco Brook Pollution Abatement Committee recognizes that the principal period of bacterial contamination in Sasco Brook occurs during rain storms and is associated with stormwater runoff. As noted in the commentary that accompanied the 2005 TMDL monitoring efforts, the suspected sources of bacterial contamination in the brook include wildlife and domestic animal waste as well as seepage from any poorly functioning septic systems that may exist in the watershed. The specific sources, their relative significance, and the amounts of potential contamination generated by each source have not been accurately assessed. Available models for estimating watershed waste loads include complex computer-run models and simpler assessments. It is recognized by the SBPAC that modeling for watershed-based planning purposes may not provide definitive results and sufficient confidence to support the allocation of municipal funds for targeted Best Management Practices (BMPs) for pollution reduction. While recognizing the uncertainty and limitations of modeling, the SBPAC decided that exploration of the relative potential of the suspected pollution sources without expending significant resources would be beneficial, and reviewed potentially available numerical and qualitative methods for doing so.

Numerical Modeling

Modeling is often used to aid in the development of an understanding of contaminant loading and in deriving TMDLs (11). The choice of model to use is based on availability of monitoring data, cost of modeling, and availability of input values for a large number of inputs including accurate land cover, slopes, soils, climate, and daily flow. Overall, larger, costlier models are only justified where simpler approaches are unable to achieve the desired outcome. Monitoring data collected for Sasco Brook were sufficient to support development of TMDLs using analysis methods selected, but whether these data are sufficient to be re-tasked to support numerical modeling has not been determined. The SBPAC recognizes that modeling can be a valuable tool to explore development of different contaminant loading scenarios and to estimate the relative contribution of different sources. Every model is limited by assumptions used to estimate the characteristics of the sources being modeled. For example, an estimate of the number of failing septic systems is needed, as is an estimate of the number of domestic animals in the watershed being evaluated, and the number and distribution of the most prevalent wildlife species. The modeling employed will be only as good as the estimates and assumptions placed into the model.

Qualitative Assessment

Based on the water quality monitoring data available and on the general identification of possible sources of bacterial contaminant loading that accompanied each TMDL cycle of monitoring, the SBPAC determined that it may be useful to conduct a simple assessment of the identified sources that are most likely to be contributors to the water quality standard exceedances in Sasco Brook. This assessment can be accomplished by estimating the load from each of the main sources identified using inventory information and calculating the potential amount of fecal contamination that can be associated with that source (19, 20). If any sources are likely to be significantly greater contributors based on this assessment, then the objective of identifying the most important sources to address via BMPs may be achieved. It also may be possible to develop working

hypotheses that can be used to validate the results or determine if revisions to the assessment procedure should be considered.

Methodology for Potential Source Load Assessment

The selected method for assessing potential pollution sources for the purpose of the Sasco Brook Watershed-Based Plan is a simplified approach to estimate bacterial source loads similar to the approach that was used to estimate watershed pollutant loading rates for the Broad Brook watershed in the north-central portion of Connecticut (12). The selected method is used to identify whether particular potential sources are substantially more likely to be significant sources of contamination based on the prevalence of the source and its potential contribution of bacterial loads. If all sources are generally equal, then the assessment will not add new information to the decision-making process to identify sources to receive priority attention. If, however, a particular source appears to be a significantly larger contributor of bacterial load, then additional direction will have been provided.

To apply the selected method, the first step is to identify conditions and populations that may contribute bacterial loading to the waterway. As stated, the main source categories for Sasco Brook are considered to be human, domestic animal, and wildlife categories. (There are no combined stormwater and sanitary sewer outfalls and the threat of leaks from the sanitary sewer system is considered insignificant.) The next step is to identify the most likely contributors within these categories and devise appropriate inventory methods for each.

1. **Human-based bacterial load potential:** Bacterial source loads associated with humans are likely to be based on poorly performing septic systems (See Table 3-1). It is not possible to precisely determine how many septic systems may be failing or under-performing in the watershed without conducting a comprehensive testing of all systems. Lacking that information, for the purpose of this exercise it was inferred that septic systems near waterways and floodplains are more likely to be potential sources of contamination due to elevated water tables. One measure of proximity to waterways is the estimated number of properties with septic systems within 200 feet of an identified water course identified on the U.S. Geological Survey topographical maps of the watershed. The total stream miles identified in the watershed for the purpose of the Watershed-Based Plan is 20.5 miles. For the purpose of this exercise, the total land area of the watershed within 200 feet of an identified stream course was then calculated. That area is a specific percentage of the total land area of the watershed, and that percentage was then applied to the total number of properties served by septic systems in the watershed to arrive at an estimate of the inventory value—the number of properties served by septic systems within 200 feet of an identified stream course.

   An assumed rate of system failure is then applied to the inventory value to estimate the potential number of involved septic systems. Other studies reviewed by the SBPAC have used an assumed failure rate of 5 percent (12). In this analysis, an assumed poor performance criterion of 2.5 percent is applied based on field observations and system inspections performed by the Westport-Weston Health District in the period 2008 through 2010 and personal communications with the Westport-Weston Health District and Town of Fairfield health directors. (21)

Household population estimates are used to calculate the waste water volume handled by each septic system, and *E. coli* concentrations associated with raw sewage are then applied to estimate the total potential bacterial load contribution (14). Raw sewage values are used under the assumption that the septic system is in failure and therefore has not reduced septic waste effluent bacteria concentrations. If this assumption is not accepted, and a reduction in bacterial load can be attributed to normal septic function, then the *E. coli* concentrations would be approximately one order of magnitude less. (14)

Once the septic system effluent concentration is estimated, a final assumption is needed to determine how much of the effluent reaches the brook. For Sasco Brook, elevated bacterial load levels occur during high flow periods following precipitation. This suggests that a wash-off during heavy rains may result in relatively unimpeded effluent entry into waterways, with effective buffering reduction of not more than 50 percent of the pollutant load based on applicable runoff coefficients. (22) Historically, Town of Fairfield personnel have discovered that some failed systems avoided detection by circumventing overland flow with direct discharge to waterways (23) with 0 percent reduction. The assumed reduction of 25 percent used for the purpose of this exercise lies between these estimates. It should be recognized that these estimates are made without consideration of topographical, soil, and other conditions that would affect the amount of bacteria reaching the watercourse. Analysis of those conditions was considered to be impractical for watershed-based planning purposes.

(12) USDA Natural Resources Conservation Service. May 2010. Broad Brook Watershed Report.

(13) Water Environment Research Foundation. 2009. Influent Constituent Characteristics of the Modern Waste Stream from Single Sources. IWA Publishing, 206 p. (range of E. coli concentrations in OWS raw sewage).

(14) USEPA Onsite Wastewater Treatment Systems Manual EPA/625/R-00/008 February 2002 (per capita indoor water usage).

2. **Domestic animal bacterial load potential:** For watershed-based planning purposes, dogs and horses are identified as the significant domestic animals contributing to bacterial loading in the Sasco Brook Watershed. Dog license information was used to estimate town-wide populations and a simple area allocation of watershed area relative to town area is used to estimate dog populations within the watershed. Using this approach, the inventory value of the number of dogs in the watershed is estimated to be 1,123. A second, essentially equal estimate was derived using the number of households within the watershed and applying a national rate of ownership of 0.63 dogs per household. (24)

Land cover based on data from the University of Connecticut's CLEAR program was used to partition the fate of dog waste in the watershed. Impervious surfaces and residential areas are the two most likely cover areas to receive dog wastes. Appropriate percentages of the total number of dogs were assigned to impervious and residential areas based on the percentages of those land cover types within the watershed, resulting in 20 percent of the dog wastes attributed to impervious surfaces and 80 percent attributed to residential areas. For the purpose of this exercise, 90 percent of dog waste on impervious sur-

faces is assumed to reach water. From residential areas, a reduction factor of 50 percent is used based on runoff coefficients.

The inventory value of the horse population in the watershed was estimated based on: 1) the estimated number of small-acreage horse farms in the watershed based on a previous survey conducted for the SBPAC and the assumption of the surveyors, based on their observations, that the average number of horses at each small-acreage farm is two (25); and 2) the 85 horses currently maintained at the Fairfield County Hunt Club, the single largest population of horses in the watershed (26). For both dogs and horses, literature estimates of daily manure production per animal and associated *E. coli* contamination concentrations are used to derive raw bacterial loads (See Table 3-2).

In order to partition how different management practices may control horse-generated bacterial loading to the watercourses for the purpose of this exercise, it was assumed that horses spend 10 hours per day in pasture and 14 hours per day in stalls. Forty percent of the total manure daily production therefore was allocated to pastures. Runoff coefficients for pasture were evaluated to establish a pollution reduction rate of 40 percent. (22) The remaining 60 percent of manure production was allocated to stables. The Fairfield County Hunt Club is equipped to contain stable-generated waste and it is assumed, for the purpose of this exercise, that 95 percent of the possible pollutant load is prevented from reaching waterways. The status of manure containment at the small-acreage horse farms is assumed to follow standard open-pile storage practices which may allow 50 percent of waste entry to streams over time. A value of 75 percent is used to represent a possible intermediate value for all horse farms combined.

The SBPAC recognizes that this assessment does not consider the potential bacterial contribution from horses participating in special events on the Hunt Club property which take place several times each year. Manure generated during those events is actively managed by the club according to a specific plan for doing so, and is collected and hauled off site continuously throughout the events.

(15) ASAE. 2003. American Society of Agricultural Engineers. ASAE D384.1 Feb03, Manure Production and Characteristics. St. Joseph, MI. 4 p

(16) Development of the Total Maximum Daily Load (TMDL) for Fecal Coliform Bacteria in Moore's Creek, Albemarle County, Virginia. May 2002. Virginia Departments of Environmental Quality And Conservation and Recreation. 114 p

3. **Wildlife bacterial load potential:** Estimates of wildlife population densities are used in combination with considerations of appropriate habitat to estimate the inventory value of wildlife populations, giving particular attention to waterfowl because of the potential for direct deposition of waterfowl fecal matter in water courses and the high concentration of bacteria found in waterfowl excrement. Literature estimates of *E. coli* bacteria associated with the excrement of each species are used to develop load estimates per animal and total bacterial load within the Sasco Brook Watershed. Based on discussions with DEP Wildlife Division personnel, wildlife species with potential to provide bacterial source load in the watershed include waterfowl (ducks and geese), small mammals (mice, voles, chipmunks, grey squirrel, skunk, raccoon, fox), and large mammals (coyote, deer). With

the exception of deer population density, population density estimates for these species have not been determined by the Wildlife Division. In addition, bacterial loads attributed to each species have not been determined. Wildlife Division personnel recommended that the SBPAC conduct a literature review to develop information on bacterial loads from identified species. Each of the identified species can be assessed for their potential to directly deposit excrement in water. For the purpose of the Sasco Brook Watershed-Based Plan, contributions from ducks, geese, deer, and raccoons were estimated. Although population estimates could be derived from the literature for some of the smaller species, little information was found regarding the concentration of *E. coli* bacteria associated with the waste of smaller species. (See Table 3-3.)

Deer and raccoon bacterial loads were allocated to woodland and open water land covers. For the purpose of this exercise, it was assumed that five percent of feces is directly deposited in or near waterways with no opportunity for intervening reductions to take place. Ninety-five percent of the estimated waste load was allocated to woodlands where it is assumed that a 75 percent reduction in load may be achieved.

Waterfowl were similarly assessed, with both ducks and geese assumed to have 50 percent direct deposit of feces in or near waterways, and 50 percent in upland areas. Upland areas were assumed to provide a potential reduction of 40 percent, similar to the reduction percentage attributed to pastures and residential areas.

4. **Comparison of Potential Bacterial Load by Category and Specific Sources:** Based on allocation of the total estimated human, domestic animal, and wildlife daily bacterial loads to appropriate areas in the watershed, followed by application of reduction factors applicable to the characteristics of those areas, estimates of total potential daily load available to reach the watershed water courses were calculated. Bacterial loads are provided as fecal coliform since *E. coli* estimates were not available for animal sources. In Sasco Brook, *E. coli* and fecal coliform were equivalent in the water samples collected and analyzed for the Town of Fairfield suggesting that *E. coli* comprised most of the fecal coliform measured and that fecal coliform estimates would be valid for animal sources. (27)

All bacterial load sources are then individually listed, summed by category, and then compared to determine the relative significance of each potential source (see Table 3-4). Relative percent of the total potential bacterial load indicates that waterfowl have the highest potential contribution at 49 percent, followed by domestic animals at thirty seven percent, human sources at eight percent and other wildlife at six percent (Table 3-1). Bacterial contributions from wildlife are underestimated as other species not considered for the purpose of this exercise may contribute to bacterial load estimates. However, the two most prevalent large species are included, and the underestimate may not be significant. The most significant potential bacterial load contributors by specific source type are dogs (38 percent), geese (33 percent), and ducks (13 percent).

These estimates should not be used as definitive measurements, but instead should be used as illustrative comparisons with full knowledge of the assumptions applied. If the lowest percentage is assigned a value of one (as a least common denominator) then the

risk associated with other sources can be expressed as multiples of the lowest percentage. Relative risk values illustrate that the potential contributions of horses and raccoons present the least risk and that geese and dogs may be 25 to 28 times more important than horses while septic system failures may be 6 times more important.

5. **Additional processes potentially affecting bacterial loading:** All calculations presented here for watershed-based planning purposes are based on the estimated daily potential loads and do not necessarily reflect some of the dynamic processes that may affect how those potential loads may ultimately reach watershed water courses. Two potentially significant dynamics deserving additional consideration are associated with the accumulation of bacteria during depositional periods and the role of sediments as bacterial reservoirs.

Depositional periods occur during periods of low precipitation at which time the daily potential bacterial load from domestic animal and wildlife feces may accumulate over time. Periods of high precipitation may then wash off the accumulated bacterial load, producing significantly elevated bacterial counts in non-point runoff.

In addition, riparian sediment may act as a bacterial load reservoir containing significantly higher levels of bacteria than found in the overlying water column. Periods of high water flow can re-suspend sediments in floodplains, stream beds, and ponds to potentially produce significantly elevated bacterial counts. Higher bacterial counts from this process would be accompanied by high turbidity, suspended solids, and dissolved solids.

The effects of high flow and suspension of bacteria have been documented for Sasco Brook in the Fairfield sampling data where a single 2.8-inch rainfall event resulted in bacterial levels of 16 times higher (6200/cfu) than the 90th percentile baseline, suggesting that depositional processes, rain event wash-offs, and sediment re-suspension may play active roles in the transport of bacterial contaminants in Sasco Brook that would not be reflected in daily potential bacterial load analyses. (27)

11) Donigian, A.S.,Jr., B.R. Bicknell, and J.C. Imhof. 1994. Hydrological Simulation Program – FORTRAN (HSPF). In Computer Models of Watershed Hydrology, ed. V.P. Singh, Ch. 12, 395-442. Highland Ranch, Colo.: Water Resources Publications.

(12) Broad Brook Watershed-Based Plan

(17) Allen, A.W. 1987. Habitat suitability index models: gray squirrel, revised. U.S. Fish Wildl. Serv. Biol. Rep. 82(10 .135). 16 pp. [First printed as: FWS/OBS-82/10 .1 9. July 1982.]

(18) Hoffmann, C.O. and J.L. Gottschang. Numbers, Distribution, and Movements of a Raccoon Population in a Suburban Residential Community *Journal of Mammalogy* Vol. 58, No. 4 (Nov., 1977), pp. 623-636

(19) Bacterial Indicator Tool: User's Guide. EPA-823-B-01-003. Washington, DC. Office of Water.

(20) Bacteria Source Load Calculator Users Manual. 2007. Center for TMDL and Watershed Studies. Virginia Tech. 82 pp

(21) Mark Cooper, Director, Westport-Weston Health District. Review of inspection logs from January 1, 2010 to December 31, 2010. Personal Communication.

(22) Urban Hydrology for Small Watersheds, Technical Release 55. June,1986. USDA Natural Resource Conservation Service, Washington, D.C. 164 pp.

(23) Tom Steinke, Fairfield Conservation Director, Personal Communication

(24) American Veterinary Medical Association. 2007. Market research statistics-U.S. pet ownership (http://www.avma.org/reference/marketstats/ownership.asp)

(25) Dick Harris, Earthplace, Personal Communication

(26) Bellucci, C. Water Quality Summary Sasco Brook, Mill River, and Rooster River, Fairfield County Connecticut, June 1999 – October 2000. May 21, 2001.

(27) Town of Fairfield, 2002. Sasco Brook Water Quality Results, Bacterial Indicators (http://www.fairfieldct.org/BacterialwaterFigures.pdf)

Table 3-1:

Estimate of Potential Bacterial Loading
Septic System Assessment

Table 3-1: Estimate of Potential Bacterial Loading - Septic System Assessment

(Expected Load = P*S*F*C*Cv)

Term	Description	Value	Reference
P	Average Number of People / Septic System	2.7	(14)
S	Number of Septic Systems Inventoried	252	
F	Expected Failure Rate (2.5 percent)	0.025	
C	*E. coli* concentration in raw waste (10^6 cfu/100 ml)	3.3	(13)
Q	Daily discharge of wastewater (gal) / person	70	(14)
Cv	Unit conversion factor (3785.6 ml/gal)/100ml	37.856	
	Total Bacterial Load (10^6 cfu/day)	148,761	
	Reduction Factor	0.25	
	Bacterial Load Less Reduction Factor (10^6 cfu/day)	**111,570**	

Intermediate Calculations to Estimate Number of Households with Septic Systems

miles of tmdl stream	6.1	entire watershed - hshlds count	2500		
addtl mapped stream	14.4				
	20.5	those on septic	1639		
buffer width feet	200				
x2	400				
div 5280	0.075758				
area (sq mi)	1.55303	buffered area only (septic systems)	252	0	2.5 percent failure rate

Septic by Town	
Easton	30
Westport	532
Fairfield	1077
	1639

Table 3-2:

Estimate of Potential Bacterial Loading
Domestic Animal Assessment

Table 3-2: Estimate of Potential Bacterial Loading - Domestic Animal Assessment

Source	Estimated Number in Watershed	Daily Fecal Coliform Production (10^6 cfu/animal/day)	Reference	Waste Subject to Reduction Factor (percent)	Fecal Coliform Initial Load (10^6 cfu/day)	Runoff Reduction Factors (pecent)	Factor Description	Load stimate (10^6 cfu/day)
Horses	150	420	(15)	60	37800	75	Confined waste	9,450
				40	25200	40	Pasture	15,120
Dogs	1123	1070	(16)	20	240322	10	Impervious surfaces	216,290
				80	961288	50	Residential development	480,644

Dog estimate (16)	households	2100	
	ownership rate	0.6324	AVMA, 2007
		1328	
	ownership rate	0.372	
	number owned	1.7	

Land cover from brochure	woods wetland water	0.55
	low density res	0.32
	impervious	0.07
	agriculture	0.06

	Dog Licenses	Percent Area	Dogs in Watershed
Easton	2576	8.48	218
Westport	3583	25	896
Fairfield	912	1	9
Total			1123

Horse reduction based on 10 hr/day in pasture, 14 in stall

dog reduction based on ratio impervious to low density assuming most dog live in one of these

tables based on Fecal Coliform, not E. Coli

Table 3-3:

Estimate of Potential Bacterial Loading
Wildlife Assessment

Table 3-3: Estimate of Potential Bacterial Loading - Wildlife Assessment

Source	Density	Units	Area	Description of Habitat	Estimated Number in Watershed	Daily Fecal Coliform Production (10^6 cfu/animal/day)	Reference	Waste Subject to Reduction Factor (percent)	Fecal Coliform Initial Load (10^6 cfu/day)	Runoff Reduction Factors (pecent)	Factor Description	Load estimate (10^6 cfu/day)
Deer	60	sq mi	9.393	Entire watershed - less impervious	564	500	(12)	95	267701	75	wooded	66,925
								5	14090	0	In water	14,090
Raccoon	1	1.5 ha	8.787	Res/Wood	937	125	(18),(19)	95	111302	75	wooded	27,826
								5	5858	0	In water	5,858
Grey squirre	1	acre	8.08	residential and wooded - less water and fields	5171	unknown	(17)					
Chipmunks	2	acre	3.232	residential	4137	unknown						
Mice	10	2.4 ha	8.383	Residential and	8942	unknown						
	80	2.4 ha	8.383	wooded less water	71535	unknown						
Voles						unknown						
Ducks	25	sq mi	5.555	wooded/water	139	2430	(15)	30	101240	0	in or adj wat	101,240
								70	236226	40	upland	141,736
Geese	56	sq mi	8.787	residential/wooded and water	492	1710	(16)	30	252433	0	in or adj wat	252,433
								70	589010	40	upland	353,406

Total area = 10.1 sq mi

Table 3-4:

Potential Bacterial Loading Relative Assessment

Table 3-4: Potential Bacterial Loading - Relative Assessment			
Potential Source	Potential Bacterial Load (10^6 cfu/day)[1]	Relative Percent[2]	Relative Risk[2]
Human	111,570	6	5
Septic Systems[1]	111,570	6	5
Domestic Animals	721,504	40	29
Horses	24,570	1	1
Dogs	696,934	39	28
Terrestrial Wildlife	114,698	6	5
Deer	81,015	5	3
Raccoon	33,684	2	1
Waterfowl	848,815	47	35
Ducks	242,976	14	10
Geese	605,839	34	25
TOTAL	1,796,587		

[1] Septic Load for *E. Coli*; Fecal Coliform for all others.
[2] Category totals listed at left side, individual at right side

4

Stewardship Accomplishments, Initiatives, and Lessons

Rivers and streams are like the veins and arteries of our land. They nourish us, cleanse us, and carry away our wastes. Like the arteries in our bodies, our rivers must be kept clean and healthy in order for us to live healthy lives in a clean environment.

from ''The Importance of Streamside Buffers'' by the Rivers Alliance of Connecticut

Chapter Cover Photo: Horse washing station (Fairfield County Hunt Club).

Stewardship Accomplishments, Initiatives, and Lessons

This section reviews stewardship accomplishments for protecting and improving water quality in the Sasco Brook Watershed since establishment of the Sasco Brook Pollution Abatement Committee (SBPAC) in 1991. Also included is a summary of some of the SBPAC's ongoing initiatives. Both site-specific and watershed-wide accomplishments and initiatives are summarized, including site-specific initiatives by the Town of Westport (the Town). In addition, the section reviews some of the principal lessons learned by the SBPAC's members in the course of pursuing the SBPAC's mission to achieve the highest, reasonably attainable quality of water in Sasco Brook and its tributaries, estuary, and watershed.

As a result of the stewardship accomplishments and initiatives, public awareness of water quality issues and opportunities for reducing nonpoint source pollution have been increased, coordination among agencies and groups for watershed management has been improved, and measurable improvements to water quality have been achieved. Notably, when the first Total Maximum Daily Load (TMDL) analysis for Sasco Brook was completed in 1999, the brook did not meet State of Connecticut water quality standards for aquatic life and contact recreation due to the detected presence of bacterial contamination in water samples. Subsequent initiatives encouraged and supported by the SBPAC resulted in reduction of bacteria and nutrients to the extent that the brook met the aquatic life criteria by 2005 when the current TMDL analysis was completed.

AREA-SPECIFIC ACCOMPLISHMENTS AND INITIATIVES

Some watershed accomplishments and initiatives have been designed and applied to address water quality issues at specific locations within the watershed (see map 4-1), and include successful initiatives to: reduce runoff pollution from horse farms; extend sanitary sewers into targeted areas; achieve Town infrastructure improvements; eliminate several identified point sources of pollution; and address issues concerning the Bulkley Pond Dam.

Horse Farm Improvements: These improvements have resulted in substantial reduction of runoff pollution from the Fairfield County Hunt Club property on Long Lots Road, the largest horse farm in the watershed, as well as reduced runoff from several small horse farms elsewhere in the watershed.

In response to high levels of bacterial contamination detected by the SBPAC in Sasco Brook and its tributary in the vicinity of the Hunt Club, the club voluntarily planned and completed a series of stormwater and wastewater management improvements on its property. Those improvements, undertaken in the period 2003 to 2011 at a total cost of over $500,000, are part of a multi-phased comprehensive landscape plan and resulted in significant reductions in the amount of bacteria previously detected in the nearby stream courses by the SBPAC. Improvements included creation of a buffer area between equestrian activity areas and the nearest tributary; construction of improved stormwater collection and discharge infrastructure, including roof drains, catch basins, and subsurface piping; planting of new trees; installation of septic systems to serve horse wash-stalls; preparation and implementation of an event management plan including measures to reduce

runoff pollution during the annual horse show and other periods when the property receives its most intensive use; implementation of new procedures to handle, store, and dispose of manure; installation of horse washing areas with surface and subsurface treatments to absorb and filter surface runoff; and other improvements described in the report "Fairfield County Hunt Club Facility Improvements 2003-2011." As a result of the successful implementation of these initiatives, the club was designated as a Connecticut Horse Farm of Environmental Distinction by the Connecticut Horse Environmental Awareness Program.

Through improved pasture management and other initiatives encouraged by the SBPAC, runoff pollution has been reduced from properties supporting small-acreage horse farms in the watershed with as few as one or two horses. The property just north of Congress Street nearby Merwins Lane provides a prominent example of the water quality benefits achieved when horses are directed to grazing areas away from the watershed's stream courses. Nonpoint source pollution issues associated with grazing and manure management at other small farms have been brought to the attention of the property owners by the SBPAC.

Sanitary Sewer Connections: Additional connections and improvements to the Town's sanitary sewer system have also provided water quality benefits in areas of the Town considered to be at particular risk for seepage from septic systems. Sanitary sewer connections in the residential area just north of the Post Road in the vicinity of Woodhill Road in 2004 and separation of stormwater and sanitary sewers in the Hidden Brook area also just north of the Post Road in 2000 have reduced potential threats to water quality in those watershed locations.

Town Infrastructure Maintenance and Improvements: Ongoing efforts by the Town's Public Works Department to implement the Town's stormwater management plan established in 2004 have achieved significant water quality benefits. In this regard the Town pursues implementation of the state requirements for managing the discharge of storm water pursuant to the Municipal Separate Storm Sewer System (MS4) General Permit issued to the Town by the Connecticut Department of Environmental Protection. Through regular street sweeping and cleaning of plunge pools, outfalls, catch basins, and culverts to remove accumulated sediment, the Town reduces the amount of pollutant-laden sediment that otherwise would be washed into watershed stream courses. Replacement of catch basins with hooded traps has also served to advance the Town's goals for maintaining and improving water quality by reducing the amount of sediment and debris entering the stream courses. In 2008, the Town began to implement a policy to reduce the amount of sand placed on Town roadways during the winter months and, accordingly, the amount of sand that must be removed in the spring. The most recent Town infrastructure project involves the 2011 planned replacement of the existing culvert at Sasco Creek Road. The Town's stormwater infrastructure initiatives are summarized in annual reports prepared by the Engineering Department pursuant to the MS4 General Permit.

Elimination of Point Source Pollution: Point sources of pollution identified by the SBPAC affecting Sasco Brook and its tributaries have been eliminated by the Town, including illegal connections of wastewater and washwater discharges to the Town's stormwater drainage system. In 1995, the SBPAC identified the adverse impacts being caused by a washwater drain in the shopping center at 1790 Post Road East that was connected to the stormwater drainage system leading to Sasco Brook. Correction of this problem served to stimulate and highlight the positive

changes that can be achieved by the SBPAC's collaborative efforts. Subsequently, improvements to procedures for compacting, handling, and removal of retail food wastes were accomplished at the same address. Those improvements involved use of sealed containers for compacting and storing food waste in order to prevent leachate that had previously drained into the Town's stormwater drainage system.

In 1998, the Town decommissioned and sealed a remnant pipe that had previously drained storm water from the former landfill on the site of the existing multiple family residential community at 1630 Post Road East.

Bulkley Pond Dam: The significant influence of the Bulkley Pond Dam on water quality conditions continues to be investigated by the SBPAC. The need for repairs to the privately owned dam which marks the upstream extent of tidal influence on Sasco Brook and impounds Bulkley Pond has been identified by the Town and the Department of Environmental Protection's Dam Safety Section. Using funds obtained by the Town through a grant from the Federal Emergency Management Agency, the Town in 2003 retained the services of a consulting engineer to prepare plans to repair the dam and install a fish ladder. The Town also prepared the necessary application documents to obtain the DEP approvals that are needed to undertake the repairs to be accomplished by the dam owner.

WATERSHED-WIDE ACCOMPLISHMENTS AND INITIATIVES

Some initiatives encouraged and supported by the SBPAC are not tied to specific geographic areas but are relevant throughout the watershed, including, but not limited to: the Sasco Brook Total Maximum Daily Load analyses; public outreach and education initiatives; projects to develop information for decision-making; and land-use planning and regulatory initiatives.

Total Maximum Daily Load Analyses: The 1999 and 2005 Sasco Brook TMDL analyses established an important foundation for watershed-based planning by identifying likely sources of bacterial pollution and setting pollution reduction objectives needed to meet state water quality standards (see Chapters One and Three). The TMDL analyses helped to encourage ongoing and future initiatives to protect and improve water quality, including preparation of the Watershed-Based Plan, and they established a baseline of water quality data to help evaluate the success of those initiatives. As a result of the TMDL analyses, there is greater awareness and understanding by town and state agencies and private organizations of the sources and effects of water pollution in the watershed than previously existed, and of the need for effective water quality management measures.

Public Outreach and Education: Programs to develop and provide educational materials to the public are a cornerstone of stewardship initiatives in the Sasco Brook Watershed. There is now more public awareness and understanding of the ecological values of the watershed, the threats posed by nonpoint source pollution, and of the opportunities to reduce those threats than existed prior to formation of the SBPAC. Although the education and outreach programs require continued attention and enhancement, the heightened public awareness and understanding of watershed resources, threats, and values is a major accomplishment resulting from SBPAC's stewardship initiatives.

Successful public outreach has been achieved and continues through a variety of means, including: publications; signs and displays; special events; public meetings; school programs; use of the media; and the Town's septic system maintenance campaign.

A variety of publications concerning Sasco Brook and watershed-related topics have been prepared and widely distributed, including, but not limited to, the pamphlets ''Sasco Brook Watershed: A Connecticut Watershed Project to Reduce Nonpoint Source Pollution,'' ''Sasco Brook Watershed: A Cooperative Project to Reduce Pollution and Protect the Environment,'' and ''Sasco Brook Watershed Awareness and Education for Commercial Establishments'' along with the fact sheet ''Protect Sasco Brook,'' all prepared by the SBPAC. In addition, the SBPAC has distributed educational materials prepared by other agencies and organizations including information concerning: septic system maintenance such as the pamphlet ''Septic Care and Maintenance for the Homeowner;'' the effect of runoff pollution on Long Island Sound; horse farm management to reduce runoff pollution; and other environmental topics pertinent to watershed management. A number of these publications were distributed to all homes in the Town's watershed jurisdiction in the course of the April 2010 Sasco Brook Watershed Survey (see below).

Signs and displays have also been used to provide educational information on watershed resources, threats, and values, including displays at the special events noted below. During the period 2000-2002, volunteers used stencils to mark stormwater catch basins in selected watershed neighborhoods with the message ''Don't Dump - Drains to Long Island Sound.''

Special events are also used to increase awareness of watershed resources, threats, and values; develop support for stewardship initiatives; and encourage public participation in those initiatives. Events during which the SBPAC regularly displays and provides information include annual Earth Day events in Fairfield and Westport, the Town-sponsored Eco-Fest event, and the Fairfield County Hunt Club's annual horse show.

Information is also distributed through public meetings and workshops. Public participation is encouraged, for example, at the regular quarterly and special meetings of the SBPAC. Those meetings have provided an opportunity for the exchange of information and ideas. Workshops on specific topics with invited participants are also sponsored by the SBPAC, including, for example, the 2006 workshop entitled ''Good Horse Keeping'' at the Fairfield County Hunt Club to provide information on manure management and other relevant topics to horse farm owners.

Other means of communication that reach watershed residents and the general public, including newspapers and television, are also used to: distribute information concerning the Sasco Brook and watershed; publicize the success of stewardship initiatives; inform residents who may not have been involved with those initiatives; and provide information on special events, public meetings, and educational programs.

A repository of information concerning the Sasco Brook and watershed has been established in the Town's Conservation Department and on the Town's web site (www.westportct.gov).

The Town's septic system maintenance campaign was initiated in 2008 following recommendations contained in the 2007 Town Plan of Conservation and Development (POCD) that additional attention should be given to reducing the potential for seepage from improperly maintained septic systems. A wastewater management committee was established by the Town's First Selectman in 2008 to pursue this matter and a public relations subcommittee was then created to conduct an educational campaign directed toward homeowners throughout the Town. Using funds provided by a grant from the Long Island Sound Futures Fund Grant Program, a door-to-door survey of a targeted group of homeowners was conducted in 2010 to provide information and assess awareness and attitudes concerning wastewater management and septic system maintenance. Also part of the septic system maintenance campaign, the student film club at the Town's Staples High School in 2010 produced a short film that provides information on wastewater management issues and septic system maintenance in a humorous and creative manner. In addition, a "septic model" was created as an educational tool for classroom use in teaching water quality-related topics.

Information for Decision-Making: Another notable accomplishment of stewardship initiatives in the Sasco Brook Watershed is the significant expansion of the base of scientific and other information concerning the watershed. In 1994, a multi-year program of water quality monitoring was initiated. That program, which has evolved to utilize 12 established in-stream sampling locations, has been conducted by the Harbor Watch-River Watch Program of Earthplace-The Nature Discovery Center with local, state, and federal funding assistance, including assistance obtained through the U.S. Environmental Protection Agency's Clean Water Act Sec. 319 nonpoint source grant program and other sources. The monitoring program has increased the base of knowledge available to support science-based management decisions, identified acute and chronic water quality problem areas, and aided in the development of short and long-term water quality management strategies. (See the water quality quarterly reports for the Sasco Brook Watershed by the Harbor Watch-River Watch Program.)

Information relevant to watershed-based planning and decision-making, including the location of Town catch basins and storm drains in the watershed, has been identified and included in the Town's Geographic Information System (GIS) data base. The Town of Fairfield has also included the location of catch basins and storm drains in its GIS data base.

In addition to the development of information on natural and developed conditions in the watershed, information concerning public interests and attitudes has also been assembled, utilizing surveys, questionnaires, and personal interviews. A comprehensive survey of all Town of Westport residents in the watershed was conducted by the SBPAC in April of 2010 to help gauge public attitudes and any concerns regarding the Town's watershed management initiatives. The survey involved 797 watershed residences of which 613 were personally visited by student volunteers from the Town's Staples High School. A response rate of 36% was achieved and results of the survey (see Appendix C of the Watershed-Based Plan) indicate a significant level of public awareness of runoff pollution issues and the effect of runoff pollution on Long Island Sound. In addition, virtually all homeowners surveyed expressed willingness to apply cost-effective best management practices for stormwater management on their properties. They also expressed support for Town watershed management initiatives that do not create undue burdens for property owners, and an interest in learning more about watershed management initiatives. Survey questions and results are included in Appendix C of the Watershed-Based Plan.

The base of information for decision-making has also been expanded through efforts to learn from the experience of other groups and jurisdictions concerned with watershed-based planning in Connecticut. Resource managers from other jurisdictions and educational institutions, including representatives of the U.S. Environmental Protection Agency and University of Connecticut, have participated in meetings of the SBPAC and otherwise contributed to expanding the base of information, thereby enhancing stewardship initiatives in the Sasco Brook Watershed.

Town Planning and Regulatory Initiatives: In 2007, the Town amended its Plan of Conservation and Development and included a number of provisions supportive of watershed-based planning. The POCD specifies that protection and improvement of water quality is the Town's most important natural resource protection priority, and identifies threats to water quality from stormwater runoff and problematic septic systems. Among its provisions, the POCD gives high priority to efforts that: educate the public about the effects of nonpoint source pollution, including the effects on Long Island Sound; manage Canada geese to reduce pollution; and address pollution in the Sasco Brook estuary.

Amendment of the Sanitary Code of the Westport-Weston Health District in 2008 to require inspections of septic systems when additions to existing buildings are being proposed is a significant regulatory initiative that helps to protect and improve water quality in Sasco Brook and its tributaries.

The Town implements a construction site monitoring program whereby throughout the construction phase of all projects a Town Sediment and Erosion Control Inspector visits the site to determine compliance with the sediment and erosion control requirements of the projects' zoning or conservation permits. In addition, the Town requires that water quality be considered in the design of the storm drainage systems of all development or redevelopment projects which must retain on site a minimum of one inch of runoff.

STEWARDSHIP LESSONS

The concept of watershed stewardship described in this plan envisions that all agencies, organizations, and citizens with an interest or authority pertaining to Sasco Brook and the Sasco Brook Watershed will consider that they have certain responsibilities for care of the brook and watershed. That care would be for the purpose of ensuring that the natural, cultural, and economic values associated with the brook and watershed are sustained for the benefit of future generations.

Considerable experience concerning watershed management has been gained over the past two decades by the Town of Westport and Sasco Brook Pollution Abatement Committee in pursuing the SBPAC's mission to protect and improve water quality. Some of the significant lessons learned through that experience are summarized below and on the following pages. (See also the attached box.)

These lessons are of interest to not only the public officials, town planners, environmental managers, property owners, and others concerned with the brook and watershed, but also to those who may be thinking about watershed management initiatives in other locations. The following "stewardship lessons" are numbered for reference and not to denote priority.

STEWARDSHIP LESSONS FROM THE SASCO BROOK WATERSHED

1. VOLUNTARY PUBLIC-PRIVATE PARTNERSHIPS CAN HAVE A SIGNIFICANT ROLE FOR ADVANCING EFFECTIVE WATERSHED MANAGEMENT.
2. WATERSHED STEWARDSHIP IS AN ONGOING PROCESS THAT DOES NOT END WITH THE SUCCESS OF ANY ONE INITIATIVE.
3. ECONOMIC CONSIDERATIONS ARE INHERENT IN MANY OF THE ISSUES CONCERNING WATERSHED MANAGEMENT.
4. "CARRYING CAPACITY" CONSIDERATIONS ARE ALSO INHERENT IN MANY OF THE ISSUES CONCERNING PROTECTION AND IMPROVEMENT OF WATER QUALITY.
5. CONSIDERATION OF CUMULATIVE IMPACTS IS AN ESSENTIAL PART OF DECISION-MAKING PROCESSES AFFECTING NATURAL SYSTEMS AND RESOURCES.
6. EFFECTIVE MANAGEMENT OF WATERSHED RESOURCES INVOLVES AN APPROPRIATE AND SUSTAINABLE BALANCE BETWEEN CONSERVATION OF THOSE RESOURCES AND BENEFICIAL USE.
7. EFFECTIVE MANAGEMENT OF COASTAL RESOURCES REQUIRES LONG-RANGE PLANNING AND OTHER NONREGULATORY INITIATIVES, IN ADDITION TO REGULATORY MEASURES.
8. EXPANDING THE BASE OF KNOWLEDGE AND INFORMATION IS NECESSARY TO MAINTAIN EFFECTIVE WATERSHED MANAGEMENT.
9. RESEARCH WITH A PRACTICAL APPLICATION, SHARED AND COORDINATED, IS MOST BENEFICIAL.
10. PUBLIC SUPPORT AND PARTNERSHIPS PROVIDE AN ESSENTIAL FOUNDATION FOR EFFECTIVE STEWARDSHIP.
11. VOLUNTEERS ARE ESSENTIAL PARTNERS IN THE WATERSHED MANAGEMENT PROCESS.
12. SOME STEWARDSHIP GOALS CAN BE ACHIEVED WITH LITTLE OR NO COST TO TAXPAYERS; MONEY IS NEEDED FOR OTHER INITIATIVES, AND FUNDING MAY BE AVAILABLE THROUGH GOVERNMENT AND PRIVATE GRANT PROGRAMS.
13. THE ABILITY OF WATERSHED DECISION-MAKERS TO WORK WITH PEOPLE IS JUST AS IMPORTANT TO THE SUCCESS OF STEWARDSHIP INITIATIVES AS FUNDING AND TECHNICAL ABILITIES.
14. FLEXIBLE MANAGEMENT STRATEGIES ARE NEEDED TO RESPOND TO CHANGING CONDITIONS AND CIRCUMSTANCES.
15. INVOLVED AGENCIES AND ORGANIZATIONS NEED TO RESPOND TO CHANGING CONDITIONS AND CIRCUMSTANCES TO REMAIN EFFECTIVE.
16. DOCUMENTING AND PUBLICIZING STEWARDSHIP ACTIVITIES CAN BUILD PUBLIC SUPPORT.
17. COORDINATION AMONG MUNICIPALITIES SHARING WATERSHED JURISDICTION IS AN ESSENTIAL BUT SOMETIMES DIFFICULT TO ACHIEVE ELEMENT OF EFFECTIVE WATERSHED MANAGEMENT.
18. DECISIONS BY APPOINTED BOARDS AND COMMISSIONS HAVE A SIGNIFICANT ROLE FOR IMPLEMENTING WATERSHED MANAGEMENT INITIATIVES.

1. Voluntary public-private partnerships can have a significant role for advancing effective watershed management. Experience of the SBPAC over the past two decades as one of the first community-based watershed committees in Connecticut is of value to other organizations involved with managing natural areas and resources and to those considering the establishment of such an organization. The SBPAC's successes demonstrate how a voluntary alliance of interested agencies, organizations, and citizens without any specially authorized regulatory power or other authorities can effectively advance stewardship goals through the development and sharing of information and by encouraging and supporting programs and initiatives that serve to advance a commonly held vision.

2. Watershed stewardship is an ongoing process that does not end with the success of any one initiative. Experience in the Sasco Brook Watershed has shown that effective stewardship of natural resources, including aquatic resources, must be recognized as an ongoing, perpetual process to be maintained as conditions and circumstances change; as specific initiatives may be successfully completed; and as new and significant issues arise. Experience has also shown that some stewardship projects may require significant periods of time to achieve. Such projects require a long-term commitment that may have to be sustained through periods of frustration, controversy, and other obstacles.

3. Economic considerations are inherent in many of the issues concerning watershed management. As water quality initiatives in the Sasco Brook Watershed have evolved over time, it has become apparent that effective stewardship requires understanding of economic issues. The SBPAC has recognized the economic values of watershed resources as well as the economic constraints that affect the feasibility of implementing pollution abatement measures, including best management practices for stormwater management. For example, while engineered controls to improve water quality and reduce surges of storm water to Sasco Brook may be desirable to reduce levels of bacterial contamination, opportunities for construction and maintenance of municipal stormwater infrastructure are significantly limited by Town budgetary constraints.

In addition, it should be recognized that watershed natural resources and environmental quality have economic values that are more difficult to quantify. For example, residential property values in the Sasco Brook Watershed depend in significant part on natural environmental quality. Further, watershed resources provide ecological functions related, for example, to fish and wildlife habitat and water quality functions. These ecological functions also have an economic value that some economists refer to as ''natural capital'' or ''ecosystem services.''

4. ''Carrying capacity'' considerations are inherent in many of the issues concerning protection and improvement of water quality. Issues concerning the capacity of aquatic and other natural resources to accommodate use and development in a safe, enjoyable, and environmentally sound manner are also inherent in watershed management initiatives. A lesson learned is that it is difficult, if not impractical, on a watershed-wide basis to attempt to precisely determine the limits of resource carrying capacity to accommodate watershed use and development. As a result, a more ''indirect'' approach for applying the carrying capacity concept is more appropriate. That approach begins with basic recognition and understanding of the

concept by planning and zoning officials and others who make decisions concerning watershed land uses. That recognition and understanding can then be reflected in the: a) *planning and review of individual projects* to better identify potential water quality impacts as well as measures to mitigate those impacts; b) *formulation of carrying capacity-related policies* for guiding uses of the watershed and decisions affecting the watershed, including policies for inclusion in municipal plans of conservation and development; c) *development of new planning programs such as watershed-based plans* to establish carrying capacity policies; and d) *implementation of regulatory programs and establishment of nonregulatory programs* to implement the policies.

5. Consideration of cumulative impacts is an essential part of decision-making processes affecting watersheds and other natural systems and resources. When considering the carrying capacity of Sasco Brook and the Sasco Brook Watershed for beneficial use and development, through indirect or other means, attention should be given to the cumulative water quality impacts that can result from individually minor but collectively significant actions that take place over time. To address those impacts, their significance should be recognized and emphasized in planning and decision-making processes and in individual stewardship initiatives. In addition, efforts should be directed toward increasing public awareness of the cumulative impacts that everyday activities can have on water quality and other natural conditions. In doing so, the significance of positive cumulative impacts resulting from increased awareness of the effects of personal actions in the watershed should be effectively emphasized.

6. Effective management of watershed resources involves an appropriate and sustainable balance between conservation of those resources and beneficial use. ''Balance'' and ''sustainability'' are vital concepts that should continue to guide resource management decisions affecting the Sasco Brook Watershed. Extreme points of view that would preclude any new development on the one hand, or that would give priority to development of the entire watershed on the other, are not constructive. Experience has shown the wisdom of continuing to strive for balance between dual goals of watershed conservation and beneficial use, while recognizing that some wetland resources, including wetland and riparian resources, should be preserved because of their natural values and sensitivity, while other areas are suitable for residential and commercial development.

7. Effective management of watershed resources requires long-range planning and other nonregulatory initiatives in addition to regulatory measures. A watershed management program based only on regulatory compliance may be expected to principally react to proposals or issues rather than pursue initiatives that would head off problems before they arise or otherwise effectively advance stewardship goals. In addition, a management program perceived to be based primarily on regulation or enforcement should be expected to cause disaffection on the part of some residents and discourage voluntary stewardship initiatives. Experience in the Sasco Brook Watershed has shown that the most effective program to protect and improve water quality requires thoughtful, long-range planning and voluntary stewardship initiatives in addition to effective application, where necessary, of land use regulations and other municipal requirements.

8. Expanding the base of knowledge and information is necessary to maintain effective watershed management. The success of watershed stewardship initiatives depends in large part on knowledge and information, including but not limited to, knowledge and information concerning water quality conditions and values, sources of contamination, watershed use and development, and the institutional framework for resource management (the applicable laws, regulations, and agencies, for example). Experience in the Sasco Brook Watershed has resulted in appreciation of the complexity of natural watershed processes and the uncertainties regarding sources of contamination, and the lesson that no matter how experienced or "expert" one may be, it is not possible to predict their long-term effects with any great certainty.

Part of the ongoing, perpetual process of stewardship is the process of expanding the base of information on which to base management decisions and initiatives, especially as conditions and circumstances change. That base of information may be expanded through scientific research, personal learning initiatives, water quality sampling and testing, and other means, and the information developed should be shared or otherwise disseminated. Information concerning the experiences of groups and organizations involved with watershed management in other locations is particularly valuable.

9. Research with a practical application, shared and coordinated, is most beneficial. Scientific research and other investigations and studies have educational benefits. They can, for example, help increase the awareness and understanding of residents and groups concerning watershed functions and values, water quality issues, and ecologically-based management efforts. Research should also be designed to have practical applications with regard to expanding the base of knowledge and information useful for science-based management decisions, including decisions concerning the application of best management practices, and for other resource management purposes.

10. Public support and partnerships provide an essential foundation for effective stewardship. One of the prominent lessons learned through experience in the Sasco Brook Watershed concerns the value of partnerships—of agencies, organizations, and individuals working together toward a common goal or vision. In this regard, interested and affected individuals and groups should have the opportunity to participate in those partnerships along with the professional agencies and organizations. Experience has also shown that it takes hard work and dedication to develop and maintain an effective partnership. The leadership needed to guide the partnership and direct specific projects and initiatives must ensure that all partners feel they are part of the team and not being overshadowed by others.

While it is recognized that consensus on every issue is not possible, the different interests and points of view of different stakeholders can be recognized and respected. Participants in the process can avoid "preaching" to other participants and affected parties and otherwise not attempt to impose personal goals and values. Experience has shown that to address water quality issues affecting the Sasco Brook Watershed, the watershed partners, including governmental agencies, environmental organizations, and property owners need to recognize and respect each others' legitimate objectives and strive to work together as partners to address issues in an objective, balanced, and practical manner.

11. Volunteers are essential partners in the watershed management process. Experience in the Sasco Brook Watershed shows how volunteers can make vital contributions to the success of specific stewardship initiatives, including, but not limited to, water quality monitoring programs conducted by not-for-profit environmental organizations, as well as to the development and maintenance of public support for those initiatives. These contributions should be respected and encouraged.

12. Some stewardship goals can be achieved with little or no cost to taxpayers; money is needed for other initiatives and funding may be available through government and private grant programs. Experience in the Sasco Brook Watershed has shown that many stewardship goals can be achieved through personal actions and the informed decisions of agencies and organizations, including, but not limited to, municipal land use agencies, not-for-profit environmental organizations, in the normal course of their business, with little or no added cost to taxpayers. Other initiatives, however, require the expenditure of funds for studies, engineering, plan formulation, construction, and maintenance, for example. Experience shows that the need for funds should not discourage the pursuit of watershed stewardship goals. Funds for stewardship initiatives in the watershed have been obtained from state and federal grant programs and private organizations, with matching funds in the form of in-kind services provided locally.

An important lesson for pursuing sources of funds concerns the importance of building on previous efforts. For example, early initiatives of the SBPAC provided the basis for subsequent projects resulting in water quality improvements. Reports and planning documents such as watershed-based plans can be used to establish priority lists of projects and initiatives to achieve stewardship goals. Those lists can reflect careful review of needs and conditions and help to demonstrate the commitment needed to achieve the listed projects. As a result, opportunities for receipt of governmental and private grants to implement the projects can be enhanced.

13. The ability of watershed decision-makers to work with people is just as important to the success of stewardship initiatives as funding and technical abilities. Building public support, maintaining partnerships and the interest and enthusiasm of volunteers, and pursuing projects that may require significant periods of time require more than funds and technical information. Such elements of watershed stewardship require the ability of decision-makers to work effectively with people, including local residents, business owners, volunteers, and representatives of not-for-profit organizations. In fact, experience has shown that this ability is the most important requirement for the success of many stewardship initiatives.

14. Flexible management strategies are needed to respond to changing conditions and circumstances. This lesson is especially applicable to planning initiatives intended to protect and improve water quality and otherwise guide watershed conservation and beneficial use. Experience in the Sasco Brook Watershed has shown that planning documents and guidelines can not anticipate every concern or issue that may arise, nor can they provide a definitive answer to every problem. The need for case by case decision-making will remain but the plans and guidelines can provide a framework to guide that decision-making. The framework, however,

must be flexible because it will require modification over time as conditions change and responses to complex issues continue to evolve.

15. Involved agencies and organizations need to respond to changing conditions and circumstances to remain effective. Regular evaluation of organizational effectiveness is needed to respond to changing conditions and circumstances. Experience in the Sasco Brook Watershed has shown that as conditions and circumstances change, including natural and institutional conditions, the organizations and agencies with relevant roles and authorities in the watershed need to adapt to those changes. Nongovernmental organizations in particular, such as the SBPAC, need to evolve appropriately and accept change as necessary to maintain their effectiveness. The lesson is that all organizations must change in order to maintain effectiveness and that the most opportune time to affect change is before that effectiveness may diminish.

16. Documenting and publicizing stewardship activities can build public support. Watershed management initiatives and the success of those initiatives should be effectively documented and publicized to aid in building and maintaining public support, maintaining the interest and enthusiasm of all stewardship partners, including volunteers, and otherwise helping to instill the concept of stewardship in all stakeholders. Experience in the watershed has shown the value of public outreach programs to highlight initiatives and successes in the media, during special events, and through public exhibits.

17. Coordination among municipalities sharing watershed jurisdiction is an essential but sometimes difficult to achieve element of effective watershed management. Watershed management initiatives planned and implemented on a watershed-wide basis through the coordinated actions of all municipalities with jurisdictions in the watershed are clearly most desirable. Such coordination, however, is not always easily obtainable for a variety of understandable reasons, including, but not limited to, political differences and economic constraints. As a result, watershed partners should recognize that a long-term commitment may be needed to achieve the desired coordination, and that commitment may have to be sustained through periods of obstacles.

18. Decisions by appointed boards and commissions have a significant role for implementing watershed management initiatives. A number of watershed stewardship initiatives are implemented through the decisions of municipal land use boards and commissions, including planning, zoning, and inland wetlands and water courses agencies. The members of these boards are typically lay persons and as a result it is important that they have continued access to watershed-based information useful for decision purposes.

5

A Watershed Vision for Protecting and Improving Water Quality

Protection and improvement of water quality is the most important natural resource protection priority for Westport. Rivers, streams, lakes, ponds, wetlands, marshes, vernal pools and aquifers contribute to the overall health and quality of life in Westport and the region.

Westport 2007 Plan of Conservation and Development

Chapter Cover Photo: Sasco Brook water course.

A Watershed Vision for Protecting and Improving Water Quality

This chapter presents a proposed vision for the future environmental quality of Sasco Brook and the Sasco Brook Watershed in the towns of Westport, Fairfield, and Easton. The Watershed Vision is based on the concept of perpetual stewardship whereby all citizens, governmental officials, agencies, and organizations with an interest or authority pertaining to the watershed will think of themselves as having responsibilities for care of the brook and its watershed. That care would be for the purpose of ensuring that the highest, reasonably attainable quality of surface water is achieved and maintained for the future.

The Watershed Vision is consistent with the provisions concerning protection of water resources and water quality set forth in the Town of Westport's 2007 *Plan of Conservation and Development*. The vision is also consistent with the stewardship initiatives developed and pursued by Town agencies and the Sasco Brook Pollution Abatement Committee (SBPAC) since establishment of the SBPAC in 1991. Goals for water quality stewardship developed by the SBPAC over the years, but heretofore not set forth in any one document and formally adopted or otherwise endorsed, are organized in the vision statement.

The basis for the Watershed Vision is provided by ten broad goals intended to advance the purpose of the Sasco Brook Watershed-Based Plan to protect and improve surface water quality in the Sasco Brook Watershed by reducing nonpoint source (NPS) pollution. The proposed goals are applicable to water quality management in the entire watershed. It is the intent of the plan that the towns of Fairfield and Easton will join with Westport to embrace the vision and, to the extent possible, incorporate its watershed goals, modified as necessary to fit their needs, into their own town agency programs and decisions affecting the brook and watershed.

The Watershed Vision provides a guiding framework for future planning efforts and other decisions and actions by the different municipal, state, and federal agencies with programs or authorities that directly or indirectly affect the Sasco Brook and watershed. The vision is also intended to help guide the actions of the environmental organizations, volunteers, and private landowners and business owners participating in stewardship of the watershed.

A strategy for implementing the Watershed Vision is included in Chapter Five of the Watershed-Based Plan. It is recognized by the SBPAC that an effective implementation strategy must be pursued as an ongoing process that will continue to evolve over time. The recommendations provided in Chapter Five are intended to advance that process.

Goals of the Watershed Vision

SUMMARY OF WATERSHED GOALS:

GOAL 1: SIGNIFICANT REDUCTION OF NONPOINT SOURCE POLLUTION

GOAL 2: REDUCTION AND AVOIDANCE OF POINT SOURCES OF POLLUTION

GOAL 3: PERSONAL ACTIONS FOR WATERSHED STEWARDSHIP

GOAL 4: ACTIVE AND COORDINATED WATERSHED MANAGEMENT BY THE TOWNS

GOAL 5: RECOGNITION OF ECOLOGICAL SYSTEMS

GOAL 6: COORDINATION AND PARTNERSHIPS FOR WATERSHED MANAGEMENT

GOAL 7: FINANCIAL AND TECHNICAL ASSISTANCE FOR WATERSHED MANAGEMENT

GOAL 8: EXPANDED BASE OF WATERSHED KNOWLEDGE AND INFORMATION

GOAL 9: WATERSHED BALANCE

GOAL 10: EFFECTIVE RESPONSE TO CHANGING CONDITIONS

GOAL 1: SIGNIFICANT REDUCTION OF NONPOINT SOURCE POLLUTION.

In the Watershed Vision, the highest, most feasibly attainable quality of surface water in Sasco Brook, its tributaries and estuary, and the Sasco Brook Watershed will be achieved and maintained through significant reduction of nonpoint source pollution, including pollution carried in: a) stormwater runoff from roads, parking areas, lawns, horse paddocks, and all other watershed surfaces: and b) seepage from any poorly functioning septic systems in the watershed. Reduction of NPS pollution will be sufficient to achieve the bacteria reduction goals of the established Total Maximum Daily Load (TMDL) for Sasco Brook, and otherwise meet State of Connecticut water quality standards for Sasco Brook, including the standards that allow contact recreation. In addition, reduction of NPS pollution will be sufficient to enable existing state-established ''prohibited'' shellfish growing area classifications for Sasco Creek and nearshore Long Island Sound to be upgraded to classifications that allow recreational shellfishing for direct consumption.

All feasible measures to reduce NPS pollution and otherwise maintain and improve water quality in the watershed will be considered for application, including measures implemented by municipal agencies and measures pursued by watershed residents and business owners. The towns will continue to reduce NPS pollution through implementation of municipal stormwater management plans and application of Best Management Practices (BMPs) for stormwater management.

- **Effective Implementation of Municipal Stormwater Management Plans:** Continued effective implementation of the municipal stormwater management plans pursuant to the State of Connecticut-required Small Municipal Separate Storm Sewer System (MS4) Stormwater Program will achieve substantial reduction of NPS pollution in the watershed. Municipal stormwater infrastructure in the watershed, including, but not limited to, collection and discharge pipes, catch basins, culverts, and open, roadside drainage ways, will be maintained and improved as necessary in accordance with best available technology, state and federal stormwater management requirements, the stormwater management plans, and municipal budgetary constraints.

- **Successful Application of Best Management Practices:** Effective best management practices (BMPs) including, but not limited to, low impact development strategies, stormwater infiltration and filtration measures, and public outreach and education initiatives, will be applied successfully to manage, reduce where feasible, and otherwise control: a) stormwater runoff into Sasco Brook and its tributaries and estuary; and b) the amount of pollution generated by potential sources of bacterial contamination in the watershed, including, but not limited to, wildlife and domestic animals and seepage from any poorly functioning septic systems.

  BMPs will be designed and implemented with consideration of reliable analyses of the human, wildlife, and domestic animal sources of bacterial contamination and the relative significance of each source. BMPs will be designed and implemented to reduce NPS pollution generated by stormwater runoff from land surfaces throughout the watershed, recognizing the distinct risk of runoff pollution from impervious surfaces, including impervious surfaces in commercially developed areas of the watershed.

GOAL 2: REDUCTION AND AVOIDANCE OF POINT SOURCES OF POLLUTION.

Point sources of pollution affecting the Sasco Brook Watershed, including, but not limited to, direct discharges into Sasco Brook from the municipal stormwater drainage system, will be reduced or eliminated through application of appropriate best management practices and effective operation, maintenance, and improvement, as necessary, of municipal infrastructure. Municipal stormwater infrastructure in the watershed will be maintained and improved as necessary in accordance with municipal stormwater management plans, municipal budgetary constraints, and State of Connecticut stormwater management requirements. Any improper connections of storm water or waste water to the stormwater drainage system will be identified and promptly corrected.

Municipal wastewater collection, conveyance, and treatment facilities, including facilities serving commercial and residential areas in the watershed, will be operated, maintained, and improved as necessary in accordance with best available technology and municipal budgetary constraints. Any acute and cumulative adverse impacts on water quality in the watershed caused by point source pollution, including, but not limited to, any failures of wastewater collection and conveyance facilities, will be corrected promptly. Additional connections to municipal sanitary sewer systems, consistent with system capacity, will be accomplished where necessary to address any significant and chronic adverse impacts on water quality caused by inadequate wastewater treatment systems.

GOAL 3: PERSONAL ACTIONS FOR WATERSHED STEWARDSHIP.

Residents, business owners, and visitors will be aware of the impacts that their everyday activities can have on water quality and other natural conditions in the Sasco Brook Watershed and will demonstrate a strong personal commitment to watershed stewardship. That commitment will be reflected in personal actions to avoid or reduce nonpoint source pollution and otherwise contribute to enhancement, protection, and restoration of environmental quality in the watershed.

Residential property owners in the watershed will maintain their properties utilizing informed and cost-effective landscaping practices and other measures to reduce and avoid runoff pollution. Property owners caring for dogs, horses, and other domestic animals and livestock on their properties will properly dispose of animal waste and otherwise manage that waste to avoid any significant bacterial contamination of Sasco Brook, its tributaries, and estuary.

All citizens, officials, agencies, and organizations with an interest or authority pertaining to the watershed will consider themselves responsible in some manner for care of the watershed; that care will be for the purpose of ensuring that the natural, cultural, and economic values of the watershed are sustained for the benefit of future generations. Public participation for implementation of the Watershed-Based Plan and public awareness of watershed resources, threats, and values will be substantial.

- **Public Participation:** Public interest, support, and participation for municipal initiatives to maintain and improve water quality and otherwise implement the Watershed-Based Plan will be substantial. Municipal officials, agencies, and committees will encourage residents, business owners, and others to express their interests with regard to conditions, issues, and stewardship initiatives in the watershed, and provide appropriate opportunities for that expression. In addition, residents, business owners, and others will develop and demonstrate an awareness of how their personal actions can affect water quality and other watershed resources, and act in a manner that contributes to effective watershed stewardship.

  New and effective outreach programs to inform and educate the public concerning watershed values and opportunities for personal stewardship initiatives will be designed and conducted, including a substantial program utilizing municipal websites to provide watershed-based information. Publications, special events, and environmental interpretation programs will be effectively presented and otherwise utilized to provide interesting, useful, and easily understandable information to the public.

  Volunteers will contribute to the success of watershed stewardship initiatives, including, but not limited to, water quality monitoring programs.

- **Public Awareness of Watershed Resources, Threats, and Values:** Public awareness of the significant natural, cultural, and economic values provided by Sasco Brook, its tributaries and estuary, and the Sasco Brook Watershed will be widespread, along with recognition of the importance of those values to the quality of life in the watershed towns. Also widespread will be public awareness of existing and potential

threats and impairments to watershed resources and values, including, but not limited to, bacterial contamination caused by NPS pollution. Town officials, governmental agencies, private organizations, residents, and business owners will recognize the importance of effectively managing storm water and pursuing other environmental initiatives to protect and improve water quality in the watershed. The extent of public appreciation of the watershed's natural resources and values, including its aquatic resources and values, will be equal to the public appreciation of the opportunities for beneficial use and development in the watershed.

GOAL 4: ACTIVE AND COORDINATED WATERSHED MANAGEMENT BY THE TOWNS.

The towns of Westport, Fairfield, and Easton will actively manage the use and conservation of the land and water resources within their jurisdictions in the Sasco Brook Watershed for the purpose of protecting and improving water quality in the watershed and Long Island Sound. Such management will be accomplished through: a) thoughtful, long-range *planning* to guide beneficial land-use and development in balance with conservation of the natural environment; b) effective *regulation* of that use and conservation through application of appropriate local regulations, including land-use regulations to manage storm water and otherwise reduce or avoid nonpoint source pollution; and c) *nonregulatory measures* for watershed management. Municipal initiatives for watershed management will be planned and implemented with all due consideration of the property rights and interests of watershed residents and business owners.

In accordance with applicable sections of the Connecticut General Statutes and town codes, zoning regulations, and plans of conservation and development, the principal responsibility for planning and managing land use and other activities and conditions affecting water quality in the Sasco Brook Watershed will rest with the watershed towns. When exercising this responsibility, the towns will act in coordination with the Connecticut Department of Environmental Protection, other governmental agencies, not-for-profit organizations, and others as necessary to achieve the most effective implementation of local, state, and federal goals and requirements for protecting and improving water quality.

- **Informed Land-Use Planning:** Municipal land-use plans and policies will be effectively applied to guide beneficial use and development within the Sasco Brook Watershed in a manner to protect and improve water quality and otherwise advance the Watershed Vision, with recognition of the positive and negative impacts that watershed land use and development may have on water quality in the watershed and Long Island Sound. Future amendments of the town plans of conservation and development will encourage and support implementation of the Watershed-Based Plan. Municipal planning initiatives to advance the Watershed Vision will be pursued with recognition that Sasco Brook has a limited capacity to assimilate NPS pollution without the occurrence of unacceptable impacts on water quality.

- **Effective Application of Land-Use Regulations:** Municipal land-use regulations and ordinances, including zoning, building, and inland wetlands and water courses regulations, and regional and local public health regulations concerning inspection and maintenance of

septic systems, will be effectively and reasonably applied to guide beneficial watershed use and development, recognizing the impact that such use and development may have on water quality. New and amended municipal regulations and ordinances to advance the Watershed Vision will only be considered based on demonstrated need, determination that regulatory benefits outweigh regulatory costs, and with input from potentially affected parties.

- **Accentuation of Nonregulatory Initiatives:** Watershed management initiatives will emphasize nonregulatory measures including, but not limited to, personal stewardship actions; continued education and information initiatives involving landowners, visitors, agencies, officials, private organizations, and others; and initiatives involving the participation of volunteers.

GOAL 5: RECOGNITION OF ECOLOGICAL SYSTEMS.

Watershed management initiatives to protect and improve water quality will be based on recognition that the Sasco Brook Watershed functions as an ecological system of water courses, ponds, freshwater and tidal wetlands, and other natural resources influenced by human activities. Recognition and understanding of the ecological relationship among Sasco Brook, the Sasco Brook Watershed, and Long Island Sound will be incorporated into public and private decisions affecting the brook and watershed, along with recognition and understanding that: a) Sasco Brook, its tributaries and estuary, and the Sasco Brook Watershed are part of the larger watershed and ecological system of Long Island Sound; and b) decisions and actions within that larger ecological system can have significant impacts on other parts of the system, or on the system as a whole. Public and private decisions affecting the brook and watershed will reflect understanding of natural resource carrying capacity and the potential adverse effects on water quality caused by cumulative impacts.

- **Understanding Resource Capacity:** Officials, agencies, organizations, and citizens with responsibilities and authorities pertaining to water quality in the Sasco Brook Watershed will have considerable understanding of the "carrying capacity" of the brook to assimilate nonpoint source pollution without the occurrence of unacceptable impacts on water quality. Watershed stakeholders, including residents and business owners, will appreciate the concept of resource carrying capacity when conducting their activities in the watershed or making decisions affecting the watershed. Land-use decisions affecting the watershed will take into consideration the capacity of watershed land and water resources to support new development without impairment of water quality and other significant disruptions of the natural environment.

- **Consideration of Cumulative Impacts:** Decisions and actions affecting the watershed will take into consideration potential cumulative impacts, including, but not limited to, cumulative impacts of NPS pollution that may adversely affect water quality and other watershed resources. It will be recognized and appreciated that significant adverse impacts on water quality can result from individually minor but collectively significant actions taking place over an extended period of time. Watershed residents will recognize the potential adverse impacts on water quality that may be caused by the cumulative impacts

of everyday activities. Increased awareness of the effects of personal stewardship actions in the watershed will lead to significant positive cumulative impacts on water quality.

GOAL 6: COORDINATION AND PARTNERSHIPS FOR WATERSHED MANAGEMENT.

Coordination, communication, and cooperation among all agencies, private organizations, landowners, and business owners with responsibilities, interests, and authorities concerning the Sasco Brook Watershed will be ongoing and effective. The towns of Westport, Fairfield, and Easton with jurisdiction in the watershed will apply their own agency programs and authorities to protect and improve water quality and participate cooperatively in initiatives to advance the Watershed Vision. The towns, agencies, organizations, and citizens will cooperate as ''watershed partners'' to advance the vision and otherwise advance the provisions of the Watershed-Based Plan to the extent feasible. Through cooperation and coordination among the towns of Westport, Fairfield, and Easton, watershed management initiatives based on ecological principles and applied on a watershed-wide basis will be achieved.

Goals and recommendations concerning protection and improvement of water quality as set forth in all municipal plans affecting the watershed will be consistent and complementary. The actions of municipal agencies with responsibilities and authorities affecting the watershed will be conducted in a coordinated manner for the purpose of achieving the towns' water quality-related goals.

GOAL 7: FINANCIAL AND TECHNICAL ASSISTANCE FOR WATERSHED MANAGEMENT.

Implementation of the Watershed-Based Plan will proceed in a manner consistent with municipal budget constraints and in a manner that does not impose an increased burden on municipal taxpayers. Adequate implementation funds will continue to be obtained from governmental and private grant programs and through the towns' normal capital and operating budget process for public works, conservation, and other programs. Technical assistance needed to implement Best Management Practices and other projects for reducing nonpoint source pollution and otherwise maintaining and improving water quality will be provided by the local, state, and federal agencies and nongovernmental organizations represented on the Sasco Brook Pollution Abatement Committee, as those agencies and organizations participate in implementation of the Watershed-Based Plan. The participating agencies and organizations will also provide in-kind services to meet the matching requirements of state, federal, and private grant programs.

GOAL 8: EXPANDED BASE OF WATERSHED KNOWLEDGE AND INFORMATION.

The base of knowledge and information to support science-based watershed management decisions will continue to be expanded, including knowledge and information concerning water quality conditions and values, sources of contamination, watershed use and development, and the institutional framework for resource management (the applicable laws, regulations, and agencies, for example). The base of information will be expanded through scientific research, personal learning initiatives, water quality sampling and testing, and other means, and the information developed will be shared or otherwise disseminated.

- **Effective Monitoring of Watershed Conditions:** Water quality and the conditions affecting water quality in the Sasco Brook Watershed will be monitored on a regular basis to provide valuable information to support science-based watershed management decisions. An ongoing, long-term monitoring program designed and conducted with guidance from the Sasco Brook Pollution Abatement Committee will identify: a) the presence of bacterial contamination and other contaminants; b) relevant trends concerning water quality; and c) the effectiveness of applied Best Management Practices and other measures for reducing and avoiding nonpoint source pollution and otherwise implementing the Watershed-Based Plan. The monitoring program will be designed and implemented to provide valuable information to support science-based watershed management decisions. Assistance from qualified volunteers to implement the monitoring program will be encouraged and supported.

- **Educational and Scientific Use:** Watershed-based educational and scientific activities in the Sasco Brook Watershed will be encouraged and expanded. The awareness and understanding of participating individuals and groups concerning water quality and watershed functions will be increased through educational and scientific activities; those activities will also provide valuable information for science-based watershed management decisions, including, but not limited to, reliable information regarding the sources of bacterial contamination in Sasco Brook and its tributaries.

  Scientific investigations and research initiatives concerning water quality, including initiatives by educational organizations and institutions, will have practical applications for watershed management purposes and be planned and coordinated to the greatest extent possible to increase their utility. Research priorities will be established by the Town and results of scientific investigations and research initiatives will be published or otherwise effectively shared and disseminated to help ensure their value for watershed management purposes.

  The Sasco Brook Watershed will be considered a model Connecticut watershed for investigation and reduction of NPS pollution affecting shellfish beds in Long Island Sound, and for the development and application of microbial source tracking analyses to reliably determine human, wildlife, and domestic animal sources of bacterial contamination and the relative significance of these sources in the state's coastal watersheds.

GOAL 9. BALANCE OF CONSERVATION AND DEVELOPMENT.

Municipal planning and regulatory initiatives to guide beneficial use and conservation of the Sasco Brook Watershed will maintain an appropriate balance between development and conservation in the watershed and among several broad goals of equal importance, including goals to: a) maintain the public health, safety, and welfare; b) protect and improve environmental quality, including water quality; and c) encourage and support sustainable watershed use and development.

The concept of management balance will be reflected in the goals and policies of all municipal plans affecting the watershed and in the decisions by municipal agencies and nongovernmental groups with interests and responsibilities concerning the watershed.

- **Public Health, Safety, and Welfare:** Watershed land use and development will be planned and regulated as necessary to assure the most orderly and beneficial use of watershed land and to provide for the continued health, safety, and welfare of those who use, enjoy, and live in the watershed. Any bacterial contamination posing a risk to human health, including contamination affecting shellfish beds in Long Island Sound, will be eliminated, and the potential impacts of flooding will be reduced, avoided, or otherwise mitigated.

- **Environmental Conservation and Enhancement:** The environmental quality, natural resources, and ecological functions associated with Sasco Brook, its tributaries and estuary and the watershed will be conserved and enhanced, in balance with other public purposes and beneficial uses. In addition to achieving and maintaining the highest reasonably attainable quality of surface water in the watershed, the natural and significant habitat for native fish, wildlife, and plant species in the watershed will be maintained and enhanced.

- **Sustainable Watershed Use and Development:** Watershed management decisions will recognize the substantial property values and economic benefits associated with residential and commercial development in the watershed. Management decisions, including decisions concerning design and implementation of appropriate best management practices for reducing and avoiding nonpoint source pollution, will not cause any significant diminishment of watershed property values and economic benefit opportunities that are consistent with town character and quality of life. Watershed development will be in balance with other public purposes and beneficial uses of the watershed and in harmony with conservation and enhancement of the natural environment. Watershed management decisions will emphasize the importance of attaining environmentally sustainable economic benefits that rely on but do not degrade the natural environment.

GOAL 10: EFFECTIVE RESPONSE TO CHANGING CONDITIONS.

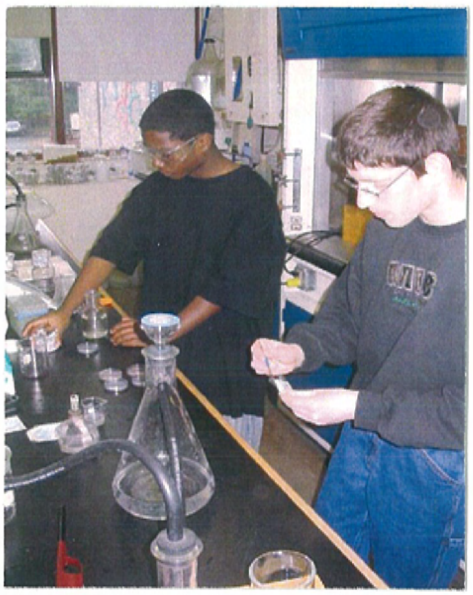
The status of the Watershed-Based Plan will be reviewed on a regular basis to evaluate the effectiveness of the plan and determine the need for any plan amendments needed to respond to changing conditions and circumstances, including conditions and circumstances regarding the physical features of the watershed and the institutional framework for watershed management. Any future amendments to the plan will be prepared through a collaborative process with input from affected stakeholders. Organizational structures and missions of stakeholder organizations will be evaluated over time to ensure the most effective implementation of the plan.

6

A Strategy for Achieving the Watershed Vision

What we apply or throw on the land can have consequences for Long Island Sound and it tributaries. For example, applying too much fertilizer on a lawn may result in nutrients washing into a storm drain, which can lead to algal blooms in nearby streams and ponds, or downstream in the Sound. Even one pint of oil released into the water from a storm drain can spread and cover one acre of water surface area and seriously damage aquatic habitat.

from the Long Island Sound Study by the U.S. Environmental Protection Agency



Chapter Cover Photo: Harbor Watch/River Watch lab at Earthplace.

A Strategy for Achieving the Watershed Vision

This chapter presents a strategy for implementing the Watershed Vision, set forth in Chapter Five, for protecting and improving water quality in the Sasco Brook Watershed.

The implementation strategy is focused on cooperative, voluntary actions by the agencies, organizations, and citizens with interests and authorities in the watershed, including the members of the Sasco Brook Pollution Abatement Committee (SBPAC). These agencies, organizations, and citizens, sometimes called stakeholders, are herein referred to as the watershed partners. The SBPAC itself also will pursue actions to advance the Watershed Vision and function as the coordinating entity for implementation of the vision.

When considering an implementation strategy in 2011 for achieving the Watershed Vision, it should be recognized that an effective strategy must be pursued as an ongoing process that will continue to evolve over time, as conditions and circumstances change. The following priority and supporting elements of the implementation strategy are intended to begin and advance this vital process over the next five years. The implementation strategy includes establishment of a five-year program consisting of several major and measurable initiatives to advance the Watershed Vision. That five-year program is described in more detail in Chapter Seven of the Watershed-Based Plan.

PRIORITY ELEMENTS:

1. Distribute the Watershed Vision
2. Endorse the Watershed Vision
3. Apply Pollutant Load Reduction Goals to Pollutant Sources
4. Identify Water Quality Management Measures
5. Establish and Implement a Five-Year Program for Advancing the Watershed Vision

SUPPORTING ELEMENTS:

1. Emphasize Personal Stewardship Initiatives
2. Maintain and Expand the Involvement of Volunteers
3. Maintain and Expand the Involvement of All Watershed Municipalities
4. Identify and Pursue Implementation Funds
5. Identify and Pursue Technical Assistance for Implementation
6. Adapt to Changing Conditions and Circumstances
7. Continue to Advance the Development, Maintenance and Sharing of Information

Figure 6-1: Priority and Supporting Elements of the Implementation Strategy.

PRIORITY ELEMENTS OF THE IMPLEMENTATION STRATEGY

The strategy for implementing the Watershed Vision consists of five priority elements, beginning with distribution and endorsement of the vision statement and including establishment of the five-year program involving several major and measurable action items for water quality management in the Sasco Brook Watershed.

1. **Distribute the Watershed Vision:** Dissemination of the Watershed Vision presented in Chapter Five to the widest possible audience of stakeholders and interested parties should be the first priority for implementing the Watershed-Based Plan. Through meetings, presentations, and other means, the Watershed Vision should be provided to persons with decision-making responsibilities in the Sasco Brook Watershed, including town and state elected officials and the directors of agencies and organizations with resource management programs and authorities. The vision statement should also be made available to the general public, including watershed residents and business owners. In addition to making the vision statement available to review on the Westport, Fairfield, and Easton town web sites and providing copies in the town halls and other public locations, the Sasco Brook Pollution Abatement Committee should utilize other means for presenting and distributing the vision to the public. The vision statement should be distilled into concise messages suitable for publication and public discovery on town web sites as well as within a summary brochure and/or other documents suitable for mass distribution, including distribution at special events and meetings of community groups. Newspaper and other media should also be used to distribute information concerning the vision statement and Watershed-Based Plan.

2. **Endorse the Watershed Vision:** The watershed partners, including the agencies and organizations with representatives participating on the Sasco Brook Pollution Abatement Committee, and citizens and businesses with interests in the Sasco Brook Watershed, should review and consider the Watershed Vision set forth in Chapter Five of the Watershed-Based Plan. Acting either individually or in concert, the partners should adopt or otherwise endorse the vision as a nonbinding guidance document to give it a measure of formal standing as the policy of the endorsing agency or organization. To the extent possible, the partners should incorporate the principles of the vision into their programs and decisions affecting the watershed, including their applicable planning and/or regulatory programs. The partners should also consider the implementation strategy herein presented and, to the extent possible, incorporate its elements into their programs and decisions.

   As a first step in the endorsement process, the SBPAC should present the Watershed Vision to the Boards of Selectmen of the three watershed towns, along with a suggested Memorandum of Agreement (MOA) as an instrument for endorsement. (A draft MOA for consideration is included herein as Figure 6-2.) Following any modification of the vision statement and MOA based on comments from the boards, the SBPAC should request that the boards formally endorse the vision statement during an appropriate event organized for that purpose.

Draft
Memorandum of Agreement
to Advance a Watershed Vision
for Protecting and Improving Water Quality
in the Sasco Brook Watershed

WHEREAS, the natural environment associated with Sasco Brook and its tributaries, estuary and watershed provides important community benefits relative to the quality of life and property values in the towns of Westport, Fairfield and Easton, as well as important natural values relative to plant, fish and wildlife habitat; and

WHEREAS, the quality of the surface waters flowing in Sasco Brook and its tributaries is a principal determinant of the natural, cultural and economic benefits and values provided by the brook and watershed; and

WHEREAS, Sasco Brook and its watershed are part of the much larger watershed of Long Island Sound—an estuary of national significance—and there is a fundamental ecological relationship among Sasco Brook, its watershed and Long Island Sound; and

WHEREAS, Sasco Brook is subject to pollution carried by stormwater runoff that impairs water quality from time to time; and;

WHEREAS, The Sasco Brook Pollution Abatement Committee, comprised of representatives of town, state and federal agencies, non-governmental organizations and private citizens, has, and continues to carry out, a significant role for promoting the protection and improvement of water quality in the Sasco Brook Watershed; and

WHEREAS, to assure long-term conservation of water resources in the Sasco Brook Watershed, it is desirable to continue the collaborative efforts exemplified by the Sasco Brook Pollution Abatement Committee, including efforts to advance the Watershed Vision set forth in the document *Sasco Brook Watershed-Based Plan*; and

WHEREAS, that Watershed Vision consists of 10 watershed goals reflecting the concept of perpetual stewardship whereby citizens, governmental officials and agencies and organizations with an interest or authority pertaining to the Sasco Brook Watershed may act as collaborating partners to help sustain the natural, cultural and economic values of the brook and watershed for the benefit of future generations;

NOW, THEREFORE, BE IT RESOLVED: that the following agencies and organizations pledge to work voluntarily and collaboratively, to the extent enabled by their individual authorities, duties and budgets, to advance the Watershed Vision for Protecting and Improving Water Quality in the Sasco Brook Watershed.

Figure 6-2: Draft Memorandum of Agreement to Advance the Watershed Vision.

It should be made clear by the SBPAC that endorsement of the vision statement will not commit the endorsing agencies and boards to providing implementation funds nor to any other actions that would not be consistent with the agencies' and boards' existing authorities, duties, and budgets. Assistance provided by the endorsing entities should be provided voluntarily through existing programs as time and budget may permit.

Once the agencies and organizations have endorsed the Watershed Vision, each agency and organization should include the vision in public outreach materials for the purpose of demonstrating the breadth and diversity of community support for protection and improvement of water quality in the Sasco Brook Watershed.

3. **Apply Pollutant Load Reduction Goals to Pollutant Sources:** Utilizing the findings of the Pollutant Loading Review described in Chapter Three, pollutant load reduction goals have been established by the Sasco Brook Pollution Abatement Committee for the purpose of the Watershed-Based Plan. The Plan's implementation strategy should be pursued for the purpose of achieving these goals, set forth below, which may be adjusted over time to reflect additional data developed during the implementation process.

When considering the pollutant reduction goals, it should be recognized that the current Total Maximum Daily Load for Sasco Brook established in 2005 is provided in two sub-sets corresponding to two watershed sub-basins incorporating the three watershed sub-basins A, B, and C identified in the 1999 TMDL. One of the current sub-basins includes Bulkley Pond along with the immediate area of higher density development near the pond and corresponds to most of the 1999 sub-watershed C; the other includes the upper watershed and its lower density development and corresponds to 1999 sub-watersheds A and B and the upper part of C.

For watershed-based planning purposes, best management practices were evaluated by the SBPAC for the entire watershed rather than for each of the two separate sub-basins. This approach was taken in order to reduce the uncertainties that would be introduced by compounding the assumptions used in developing the exploratory model to evaluate the relative significance of source loads. Each individual bacterial source and source category addressed in the Watershed-Based Plan's Pollutant Loading Review was evaluated for potential reduction using applicable BMPs, and pollutant reduction goals were then established for the purpose of the Watershed-Based Plan. (See tables 6-1 and 6-2.) Although the Watershed-Based Plan uses a single set of reduction goals in order to simplify modeling, the goals established in the 2005 TMDL documents should be used to measure progress as the two TMDLs provide valuable means of separately tracking pollutant loading and reduction processes in the upper and lower watershed sub-basins.

Pursuit of the following pollutant load reduction goals of the Watershed-Based Plan should presume that BMPs and other initiatives for Plan implementation will be pursued with equal success and commitment by the three towns sharing jurisdiction in the watershed.

3(a) Human Load and Dry Flow Reduction Goals

The dry flow reduction goal for the entire watershed (based on an arithmetic mean of the two TMDL goals) is 55 percent. Septic systems are the only direct human pollutant load identified. Failing or under-performing septic systems are also the only bacterial source identified in the TMDL affiliated with dry flow periods. For the purpose of the Watershed-Based Plan, a BMP reduction efficiency goal of seventy five percent should be pursued to reflect: a) a continued aggressive program of septic system inspection and maintenance in the watershed in accordance with existing health code regulations; and b) new and continued public outreach and education programs.

In addition to the current septic system inspection program associated with the building approval process, it is expected that bacterial DNA ribotyping will add further specificity to the identification of any additional locations contributing human-originating *E. coli* that will be addressed with targeted septic system testing by the public health authorities. For the purpose of the Watershed-Based Plan, it is assumed that failed or under-performing septic systems, and possible direct pipe discharges from failed systems, will be brought into compliance to achieve the anticipated reduction. Even without bacterial ribotyping to identify bacterial sources, it is anticipated that health department field investigations will continue to evaluate and detect septic system flows to the watershed to achieve the BMP reduction efficiency goal of 75 percent reduction. The ribotying information, however, will facilitate this process by clearly identifying if a human health hazard exists that warrants intervention, without the need to rely only on field investigations.

Summary: Enhanced inspection of septic systems close to Sasco Brook and new and continued public outreach and education initiatives are anticipated to result in reductions that will meet the dry flow reduction goal of 55 percent for the entire watershed with an assumed increase in BMP reduction efficiency of 75 percent (see Table 6-1). Monitoring should be conducted at both sub-watersheds identified in the 2005 TMDL to track the outcomes.

3(b) Animal Load and Wet Load Reduction Goals

The wet flow reduction goal for the entire watershed (based on an arithmetic mean of the two TMDL goals) is 39 percent. For the purpose of the Watershed-Based Plan, this goal is projected to be more difficult to meet as a result of the current uncertainties and lack of understanding regarding: a) high flow resuspension of bacteria from riparian, floodplain, pond, and drainage system sediments; and b) wash-off processes affecting upland fecal deposition. Adding to the difficulty, direct fecal deposition to the waterway is classified in the 2005 TMDL as a non-point source that is artificially accounted for within the wet flow category even though direct fecal deposition also occurs during periods of low flow. Regardless of how the bacterial load is classified for the TMDL analysis, opportunities to achieve significant reduction of bacterial loads for canine, equine, and waterfowl sources are identified and should be pursued.

Canine Sources: Initiatives to reduce canine sources should be focused in the lower watershed in areas of higher residential density. These areas are assumed to have higher dog population densities along with higher percentages of impervious surfaces that facilitate runoff transport of canine fecal bacteria. Initiatives to reduce dog waste sources often involve establishment of dog parks supporting best management practices for proper pet waste disposal. Dog parks have not been established in the watershed and are not anticipated in the foreseeable future. Pursuit of additional public outreach and educational initiatives to promote bagging and proper disposal of dog waste should be considered as a more immediate and practical opportunity, especially if more people are educated about the relatively large impact that dog waste can have on water quality as a result of the higher bacterial production per animal when compared to horse and deer waste. In addition to educational initiatives to instill responsibility in dog owners, storm sewer maintenance including catch basin cleaning scheduled during summer months to coincide with observed seasonally high levels of bacteria has the potential to significantly reduce these depositional sources of bacteria. Intercepting bacterial-laden sediment on impervious roadways through street sweeping also has the potential to reduce bacteria prior to entering storm sewers and watershed water courses. Scheduling these maintenance activities to precede storm events holds the greatest promise to achieve bacterial reduction goals.

A pollutant reduction goal of the Watershed-Based Plan should be to achieve a reduction in canine bacterial loading from the current 10 percent reduction assumed in the Pollutant Loading Review to 60 percent reduction in areas of impervious roadways and other paved areas, and from 50 percent to seventy percent in the denser residential areas through which Sasco Brook and its tributaries flow.

Equine Sources: Bacterial loading due to equine sources has received significant attention historically in the watershed through a number of BMPs, most significantly involving stormwater and manure management at the Fairfield County Hunt Club. It should be anticipated that similar measures, scaled to size, at small-acreage horse farms can achieve similar benefits, thereby supporting a change in the overall equine bacterial contribution to Sasco Brook by increasing reduction efficiency from 75 to 95 percent for stable and confined paddock areas. Pasture areas would benefit from establishment or restoration of stream bank vegetative buffers and grassed swales to intercept and convey overland runoff. It should be anticipated, for the purpose of the Watershed-Based Plan, that the introduction of vegetated buffers and swales on small-acreage horse farms can support an increase in BMP reduction efficiency from 10 to 70 percent in pasture areas (see Table 6-1).

In this analysis, improving vegetative buffers in pasture areas does not appear to lead to a relatively large reduction in the daily bacterial load from horses, in part because the bacterial concentration associated with horse manure is relatively low in comparison to the other animal sources addressed in the Watershed-Based Plan. Nevertheless, the opportunity for contamination is still significant based on the volume of manure produced and the potential for bacteria in accumulated manure deposited during low flow periods to be released by wash-offs during high rainfall periods.

Terrestrial Wildlife Sources: For the purpose of the Watershed-Based Plan, no best management practices for reducing bacterial loading from terrestrial wildlife such as deer and raccoons have been considered. Benefits of vegetated buffers and other BMPs have not been attributed to terrestrial wildlife that are assumed to inhabit primarily upland and wooded areas in the watershed.

Waterfowl Sources: Improvement of vegetative buffers around pastures and other open grassy areas, including the Patterson Club golf course, should be expected to have significant pollution reduction benefits with respect to waterfowl bacterial loads. Pasture improvements to reduce horse manure runoff should also have the effect of reducing waterfowl fecal contamination. Given that geese and, to a lesser extent, ducks congregate in open grassy areas and adjacent to waterways, improved vegetative buffers should have a significant effect in reducing the relatively high bacterial concentration associated with waterfowl in comparison to dogs and horses. For the purpose of the Watershed-Based Plan, it should be assumed that vegetative buffers will be established over time to affect one-half of the habitat used by waterfowl and to increase the BMP reduction efficiency of upland areas from 40 percent to 70 percent (see Table 6-2). The resulting benefit should be comparable to proposed implementation measures to reduce canine bacterial loads (see Table 6-1).

Summary: Overall, the Watershed-Based Plan's identified BMPs for wet flow conditions do not completely account for pollutant load reductions that would be able to meet the wet flow reduction goal of 39 percent for the entire watershed. A 34 percent reduction goal is established for the purpose of the Watershed-Based Plan, with waterfowl direct deposition of fecal matter in waterways being the largest source not addressed. Another possible wet flow source not addressed may be attributable to resuspension of sediments containing bacteria deposited by animal sources during dry flow periods. It is anticipated that monitoring at both sub-watersheds should demonstrate that the goals for the upper sub-watershed's TMDLs will be achieved while the goals for the lower sub-watershed, where the effect of waterfowl deposition and sediment re-suspension may be significant, should be more difficult to achieve.

4. Identify Water Quality Management Measures: To achieve the desired pollution reduction goals, a sustainable program consisting of specific water quality measures should be pursued. The measures will, in effect, establish a blueprint for achieving the reduction goals established for each source of bacterial pollution. Specific actions and schedules are presented in the five-year program set forth in Chapter Seven of the Watershed-Based Plan.

4(a) Analytical Measures and Initiatives

Understanding of the complex processes affecting pollution in the watershed should be improved. Although a substantial set of monitoring data exists, analytical measures should be continued on several fronts to ensure that ongoing efforts to protect and improve water quality have the best chance to succeed. Additional analysis of available historical data provides the first opportunity to further advance understanding of pollutant loading processes and address questions raised during the watershed-based planning process.

Table 6-1:

Potential Bacterial Reduction Assessment

Table 6-1: Potential Bacterial Reduction Assessment

Potential Source	Potential Bacterial Load (10^6 cfu/day)[1]	BMP reduction efficiency percentage	BMP reduction (wet)	BMP reduction (dry)
Human	111,570			
Septic Systems[1]	111,570	75		83,678
Domestic Animals	721,504			
Horses	24,570	62	15,120	0
Dogs	696,934	45	312,419	0
Terrestrial Wildlife	114,698			
Deer	81,015	0	0	0
Raccoon	33,684	0	0	0
Waterfowl	848,815			
Ducks	242,976	29	70,868	0
Geese	605,839	29	176,703	0
TOTAL	1,796,587		575,110	83,678
		Percentages	34	75
		Goal	39	55

[1] Septic Load for *E. Coli*; Fecal Coliform for all others.

Goals are based on a straight average of S1 and S2 station TMDL goal

2005 TMDL lists 'source unknown' as one of the non-point sources - reinforces possible role of dry period deposition since a 'source' remains to be found.

See tables 3-1, 3-2, and 3-3 to review estimates of potential bacterial loads.

Table 6-2:
Reduction Calculations

Table 6-2: Reduction Calculations		
Domestic		
	Horses	
	7560	Increase in reduction from 75 to 95 for confined horse waste
	7560	Increase in reduction from 10 to 70 percent from pasture management and buffers
	62	Percent reduction = increases / potential load
	Dogs	
	120161	Increase in reduction from 10 to 60 percent for impervious runoff
	192258	Increase in reduction from 50 to 70 percent for residential runoff
	45	Percent reduction = increases / potential load
Wildlife		
	Ducks	
	70868	Increase in reduction from 40 to 70 percent for surface runoff from buffers
	Geese	
	176703	Increase in reduction from 40 to 70 percent for surface runoff from buffers
	29	Percent reduction = increases / potential load

Reduction calculations are based on applying the change or increase in reduction efficiency to the percentage of the total load based on the land area applicable to the best management practice. For example, if the efficeincy increased from the current base of 50% to 70% after the best management practice is implemented, then that increase of 20% is applied to the portion of the potential load that the best management practice is intended to address, such as residential runoff. The increase in amount of bacterial load reduction is compared to the total potential load to calculate a percent reduction.

Current and future water quality monitoring is essential to confirm or adjust the relative significance of each pollution source identified during the watershed-based planning process. Ribotyping of fecal coliform will provide greater specificity concerning the proportion of bacterial pollution that can be attributed to each identified source within different parts of the watershed. Sediment analysis also will add valuable information to achieve better understand of the effect that re-suspension of sediments may have with respect to elevated bacterial counts.

The complete suite of biological, chemical, and physical parameters associated with water quality in the watershed should continue to be measured in order to: 1) document pollutant levels; and 2) track changes and improvements in response to application of the selected best management practices and other water quality measures. Consistency in the application of the identified analytical measures will be important to facilitate analysis and interpretation, and to document achievements.

4(b) Structural Measures and Initiatives

Opportunities to improve the management of stormwater runoff in the watershed can be realized through measures that result in physical changes to the environment. These changes can be pursued through improvements to public infrastructure and septic systems and by incorporating runoff control measures in landscape design.

Public infrastructure is in place that, with maintenance practices designed to maximize control of bacterial loading to Sasco Brook, may be able to achieve further pollutant reduction. For the purpose of the Watershed-Based Plan, septic system maintenance is considered a structural approach to protecting and improving water quality in the brook. The impacts of landscape design may be less apparent, but provide significant benefits by ensuring, for example, that vegetative buffers, grassed swales, rain gardens, and other best management practices are provided on privately owned properties throughout the watershed.

4(c) Public Outreach and Education Materials and Initiatives

Initiatives to increase the involvement of residents as stewards of the natural environment and as beneficiaries of improved water quality are essential elements of the strategy to advance the Watershed Vision. It is recognized that some citizens are not aware of the current impairment of water quality in Sasco Brook, the potential sources of contaminants, and what can be done to mitigate those sources. Increasing the attention of residents to these issues within their own watershed utilizing new and compelling information is an achievable goal. Success will depend on the content of the messages and their delivery.

4(d) Planning and Regulatory Measures and Initiatives

Institutionalizing measures to protect and improve water quality is a final piece of the strategy for advancing the Watershed Vision. Planning, including municipal land use planning, can be adjusted to include specific considerations, based on the increased

understanding of contamination risks developed in the watershed-based planning process, for protecting and improving Sasco Brook's water quality. Relative risks, both in terms of the potential human and animal sources of bacterial pollution and the type of land cover conveying that pollution can be used to support and improve decision-making for individual regulated activities. The Sasco Brook Pollution Abatement Committee recognizes the general lack of public support for additional regulatory restrictions that would affect watershed property owners. The SBPAC recognizes, however, that continued effective application of existing regulations affecting watershed use and development will provide significant benefits with regard to protecting and improving water quality.

5. **Establish and Implement a Five-Year Program for Advancing the Watershed Vision:** A five-year program for advancing the Watershed Vision can set a time frame for achieving the pollutant load reduction goals anticipated through application and completion of the identified water quality management measures. The five-year program should be established by the watershed partners involving several major and measurable action items for water quality management, and including a schedule for implementation, implementation milestones and performance criteria, responsibilities for implementation, and estimated project costs. For watershed-based planning purposes, the action items for implementation should be categorized according to: 1) Endorsement of the Watershed Vision as described in no. 2 above; 2) Analytical Measures and Initiatives, including a microbial source tracking (MST) analysis conducted as a priority implementation project to more precisely identify the most significant contamination sources and the relative contribution of those sources; 3) Structural Measures and Initiatives, including demonstration Low Impact Development (LID) projects and a project to manage and reduce nonpoint source pollution utilizing vegetated swales and other LID measures at the Fairfield County Hunt Club; 4) Public Outreach and Education Measures and Initiatives, to maintain and increase public support and awareness for implementing the Watershed-Based Plan; and 5) Planning and Regulatory Measures and Initiatives, including review of land-use and public health regulations and updating of the Plan as needed.

The recommended five-year program for advancing the Watershed Vision is presented in the following Chapter Seven of the Watershed-Based Plan.

SUPPORTING ELEMENTS OF THE IMPLEMENTATION STRATEGY

The strategy for implementing the Watershed Vision, including the five-year program, consists of seven supporting elements to be recognized and emphasized by the Sasco Brook Pollution Abatement Committee and the watershed partners.

1. Emphasize Personal Stewardship Initiatives

The watershed partners should not lose focus on the importance of continuing to advance basic stewardship activities including, for example, public outreach and education efforts, water quality monitoring programs, and personal initiatives by homeowners and business owners in the watershed. It should be recognized and emphasized that stewardship does not end with

the success of any one project or initiative but is an inherently ongoing process to be carried out in perpetuity. Attention should be given to maintaining the organization, interest, information, and long-term commitment needed for effective, ongoing stewardship. In addition, it should be recognized that an important key to achieving the Watershed Vision is an increased level of awareness and support on the part of private landowners in the watershed.

Public outreach and education efforts should emphasize that personal stewardship initiatives begin with recognition of the impacts that everyday activities, including property maintenance and development activities as well as recreational pursuits, can have on water quality in Sasco Brook and its tributaries.

The watershed partners should stress the point that seemingly minor actions can, when added over time to other, similar actions, have significantly adverse cumulative impacts on water quality and natural resources in the watershed. Public outreach and education efforts should provide information on how property owners can act in ways that contribute to nonpoint source pollution reduction. Outreach and education efforts should also describe specific opportunities for actively advancing stewardship initiatives through, for example, volunteering for environmental enhancement projects and attending public meetings to express ideas and concerns.

2. Maintain and Expand the Involvement of Volunteers

Continued volunteer support from groups and individuals, including watershed residents and students, should be a key element of the strategy for implementing the Watershed Vision, including the water quality monitoring and public outreach elements. Governmental agencies and private organizations should encourage and support volunteer efforts to advance the vision. Those agencies and organizations should continue to demonstrate the appropriate management skills and expertise needed to maintain the enthusiasm and effectiveness of the volunteers they may work with and to provide volunteers with appropriate guidance and training.

3. Maintain and Expand the Involvement of All Watershed Towns

The watershed partners should seek to increase participation in the watershed-based planning process by the Town of Fairfield and Town of Easton, recognizing that decisions and initiatives by the Town of Fairfield have a particularly significant influence on water quality in the watershed due to the substantial portion of the watershed within Fairfield's jurisdiction. The five-year program for advancing the Watershed Vision should include initiatives specifically intended to involve Fairfield agencies, including the Conservation, Town Plan and Zoning, and Public Works departments.

4. Identify and Pursue Implementation Funds

The watershed partners should continue to pursue all appropriate sources of funds to support stewardship initiatives, including but not limited to the analytical, structural, public outreach, and planning and regulatory measures and initiatives set forth in the five-year program. Funds for these purposes should be pursued through existing state and federal grant programs

and private sources, including the programs and sources historically utilized for watershed projects encouraged and supported by the Sasco Brook Pollution Abatement Committee. While funds also may be available through the municipal budgeting process, the SBPAC recognizes that current budgetary constraints limit the extent to which the watershed towns may be able to contribute to capital projects for stormwater management best management practices. Implementation funds should be pursued with the understanding that while the Watershed-Based Plan does not commit any municipality to future expenditures, it provides a basis for implementing beneficial water quality measures as funds, including funds from federal, state, and private grant programs and municipal budgets, may become available.

The following funding sources are identified as potential funding sources to be pursued by the watershed partners for implementation of the Watershed Vision. The partners should continue to donate in-kind services where needed (see no.5 below) to help provide the local "match" required for available grants. Web sites providing information regarding these funding sources are included in Appendix B of the Watershed-Based Plan.

4(a) **National Fish and Wildlife Foundation (NFWF) Long Island Sound Futures Fund (LISFF)**, through which funds are available in small and large grant formats to support projects focused on protecting and restoring Long Island Sound, particularly projects that restore and protect important fish and wildlife habitats; and implement community-based projects that improve water quality and protect water resources.

4(b) **Connecticut Department of Environmental Protection (DEP) Landowner Incentive Program (LIP)**,that provides technical advice and cost assistance to private landowners for habitat management, including riparian zone restoration/management that will result in the protection, restoration, reclamation, enhancement, and maintenance of habitats that support fish, wildlife, and plant species considered at-risk.

4(c) **Northeast Utilities Environmental Community Grant Program**,which provides grants for environmental education programs, organized environmental clean-up projects, and habitat restoration.

4(d) **U.S. Environmental Protection Agency (EPA) funding sources**, including sources of funding for watershed protection projects to achieve the goals of the federal Clean Water Act.

4(e) **DEP Clean Water Act – Section 319 Nonpoint Source Pollution Program**, through which funds were provided for development of the Sasco Brook Watershed-Based Plan and through which funds may be available for addressing water quality impairments in the course of Plan implementation.

4(f) **DEP Section 6217 Coastal Nonpoint Source Pollution Program**, through which funds may be available for projects to maintain the ability of wetlands and riparian areas to filter nonpoint source contaminants.

4(g) **DEP Supplemental Environmental Project (SEP) Program**, through which civil penalties assessed by the DEP for violations of state regulatory programs may be used to fund projects for environmental enhancement.

4(h) **American Rivers – National Oceanic and Atmospheric Administration Community-Based Restoration Program Partnership**, through which funds may be available for projects to restore riparian resources and habitat.

4(i) **U.S. Department of Agriculture Natural Resources Conservation Service programs**, including the Environmental Quality Incentives Program (EQIP) and the Wildlife Habitat Incentive Program (WHIP) through which funds may be available to implement conservation practices on eligible agricultural land and restore natural ecosystems in streams and riparian areas.

4(j) **Fairfield County Community Foundation and other private funding sources**, which can provide grants to nonprofit organizations to help meet community needs, including environmental conservation needs.

4(k) **DEP Long Island Sound License Plate Program**, which has provided funds for habitat restoration and public outreach and education projects in the State; is currently not conducting a competitive funding cycle due to budgetary constraints; but may become viable again in the future.

5. **Identify and Pursue Technical Assistance for Plan Implementation:** The agencies and organizations represented on the Sasco Brook Pollution Abatement Committee possess the considerable expertise needed to implement the Watershed-Based Plan and otherwise advance the Watershed Vision. Additional assistance, most notably assistance needed to conduct microbial source tracking (MST) analyses to more precisely identify the most significant contamination sources and the relative contribution of those sources in the watershed, will be obtained by the SBPAC as necessary. Plan implementation should proceed with the understanding that provision of technical assistance by the implementing agencies and organizations listed below will be provided voluntarily, in accordance with time and budgetary constraints, and include, but not be limited to, the types of technical assistance summarized below.

5(a) **Sasco Brook Pollution Abatement Committee**, which will continue to be chaired by the Town of Westport Conservation Director and provide coordinating, oversight, and management assistance for all aspects of implementation of the Watershed-Based Plan, and, on an ongoing basis, consider and review the assistance required from and provided by the committee's members.

5(b) **Town of Westport Agencies**, including: the Conservation Department and Commission, which will provide expertise concerning the natural functions and values of wetlands, watercourses, and shellfish resources in and near the watershed, and assessments of Town ordinances concerning those resources; the Department of Public Works which will continue to implement the Town's stormwater management plan, maintain local compliance with the MS4 General Permit, provide mapping assistance through the Town's Geographic Information System, and otherwise provide expertise concerning maintenance and enhancement of the Town's stormwater and wastewater infrastructure; the Planning and Zoning Department and Commission which will provide land use planning and regulatory assistance, including assistance for any future amendments of the Town's Plan of Conservation and Development and Zoning Regulations to advance the Watershed-Based Plan; and the Shellfish Commission, which will provide expertise regarding shellfish resources that may be affected by bacterial pollution.

5(c) **Town of Fairfield Agencies**, including: the Conservation Department and Commission, which will provide expertise concerning the natural functions and values of wetlands, watercourses, and shellfish resources in and near the watershed, and assessments of Town ordinances concerning those resources; the Department of Public Works which will continue to implement the Town's stormwater management plan, maintain local compliance with the MS4 General Permit, provide mapping assistance through the Town's GIS, and otherwise provide expertise concerning maintenance and enhancement of the Town's stormwater and wastewater infrastructure; the Town Plan and Zoning Department and Commission which will provide land use planning and regulatory assistance, including assistance for any future amendments of the Town's Plan of Conservation and Development and Zoning Regulations to advance the Watershed-Based Plan; the Health Department, which will provide assistance on matters concerning the installation, inspection, repair, and maintenance of septic systems, and application and assessment of the Town's health code as it applies to residential and commercial development in the watershed; the Harbor Management Commission, which will provide assistance for any future amendments of the Town's Harbor Management Plan affecting Sasco Brook to advance the Watershed-Based Plan; and Shellfish Commission, which will provide expertise regarding shellfish resources that may be affected by bacterial pollution.

5(d) **Town of Easton Agencies**, including: the Conservation Department, Public Works Department, Planning Department, and Health Department, which, as necessary, will provide assistance similar to the assistance described above with respect to Westport and Fairfield town agencies, except that assistance from the Town of Easton will not need to address issues concerning shellfish resources, compliance with the MS4 General Permit, and harbor management.

5(e) **Regional Agencies**, including: the Westport-Weston Health District, which will provide assistance on matters concerning the installation, inspection, repair, and maintenance of septic systems, application and assessment of the regional health code

as it applies to residential and commercial development in the watershed, and microbial source tracking analyses to more precisely identify the sources and relative significance of bacterial pollution in the watershed; Greater Bridgeport Regional Planning Agency, which may provide planning assistance based on the agency's experience with preparation of watershed-based plans, including the Pequonnock River Watershed-Based Plan; and South Western Regional Planning Agency, which may provide planning assistance based on the agency's experience with preparation of watershed-based plans, including the Norwalk River Watershed-Based Plan.

5(f) **State of Connecticut Agencies**, including: the Connecticut Agricultural Experiment Station, which will provide assistance for the microbial source tracking analyses to more precisely identify the sources and relative significance of bacterial pollution in the watershed, including establishment and maintenance of a DNA "source library" for watershed-based planning; the Department of Agriculture Bureau of Aquaculture, which will also provide assistance for the MST analyses, continue to collect and test water quality samples for shellfish management purposes, and otherwise assess impacts of bacterial pollution on shellfish beds; the Department of Transportation, which will provide expertise concerning maintenance and enhancement of the stormwater infrastructure associated with State roads in the watershed; and various divisions of the Department of Environmental Protection, including: the Watershed, Lakes, and Nonpoint Source Unit, which will remain a potential source of funding assistance for Plan implementation, continue to provide advice and other information for design, implementation, and monitoring of best management practices, and assist with adjustments and modifications of the Plan and Sasco Brook TMDL over time in response to additional information, including more detailed information concerning the sources and relative significance of bacterial pollution in the watershed; the Wildlife Division, which will provide assistance for design and implementation of BMPs for addressing bacterial pollution from excessive wildlife populations; Office of Long Island Sound Programs, which will provide expertise concerning the natural functions and values of tidal wetlands, intertidal flats, and other coastal resources in the estuary part of the watershed and provide assistance for amendment of the TMDL analysis to include the estuary; the Planning and Standards Division of the Bureau of Water Protection and Land Reuse, which will provide assistance for conducting water quality assessments, including a rapid bioassessment using volunteers; and the Dam Safety Section, which will provide expertise regarding any initiatives concerning repair or removal of dams in the watershed.

5(g) **Federal Agencies**, including: the U.S. Environmental Protection Agency, which will remain a potential source of funding assistance for Plan implementation, provide water quality sampling and testing assistance to aid in the design of MST analyses, provide information for Plan information, including design, implementation, and monitoring of BMPs, and otherwise assist with watershed-based planning; and the U.S. Department of Agriculture Natural Resources Conservation Service, which will continue to provide information for the design, implementation, and monitoring of BMPs, including BMPs for horse manure management.

5(h) **Educational Institutions**, including: local middle and high schools, which will continue to provide volunteer students who will assist with Plan implementation projects, including water sampling and monitoring projects and public attitudinal surveys; and colleges and universities, including the University of Connecticut which will continue to provide information and assistance for stormwater management through the Nonpoint Education for Municipal Officials (NEMO) program, assistance for watershed-based planning using remote sensing and GIS technologies through the Center for Land Use Education and Research (CLEAR) program, and assistance for horse manure management through the Cooperative Extension System, and the University of New Hampshire which will provide assistance for MST analyses through the Jackson Estuarine Laboratory.

5(i) **Private Organizations**, including: Earthplace – The Nature Discovery Center; which will continue to provide water quality sampling, testing, and monitoring assistance through its Harbor Watch-River Watch program, continue to educate its members and visitors concerning watershed management principles and initiatives, and consider development of Low Impact Development demonstration projects for stormwater management on its property; the Connecticut Audubon Society, which will continue to educate its members and visitors concerning watershed management principles and initiatives, and consider development of Low Impact Development demonstration projects for stormwater management on the Audubon Society Center property; The Nature Conservancy, which will provide advisory assistance based on the organization's experience with watershed-based planning for the Saugatuck River watershed; the Fairfield County Hunt Club, which will continue to provide information for the design, implementation, and monitoring of BMPs for horse manure management, host public workshops on horse manure management and geese management topics, construct and monitor BMPs for stormwater management on its property, consider development of a demonstration project for small-acreage horse farm manure management on its property, and continue to educate its members and visitors concerning watershed management principles and initiatives; and the Patterson Club, which may consider hosting a workshop concerning geese management topics, and provide educational materials concerning watershed management principles and initiatives to its members and visitors.

5(j) **Private Citizens and the General Public**, including: watershed residents, who will increase their awareness and understanding of nonpoint source pollution issues and of opportunities through personal stewardship initiatives to contribute to reduction of NPS pollution in the watershed, provide information concerning watershed conditions, review and provide comments concerning any future amendments to town plans and regulations that may affect privately owned properties in the watershed, and who may provide volunteer assistance for conducting water quality assessments; and business owners, who will also increase their awareness and understanding of nonpoint source pollution issues and of opportunities through personal stewardship initiatives to contribute to reduction of NPS pollution in the watershed, and who may provide educational materials concerning watershed management principles and initiatives to their patrons.

6. **Adapt to Changing Conditions and Circumstances:** Agencies and organizations with interests and authorities concerning the Sasco Brook Watershed, including the Sasco Brook Polution Abatement Committee and the individual agencies and organizations represented on the SBPAC, should pursue "adaptive management" strategies in the course of implementing the Watershed-Based Plan. It should be recognized that implementation of the Plan will be an ongoing process that must continue to develop in response to changing conditions and circumstances, and that the Plan will require modification over time as conditions change, including knowledge of the sources and relative significance of bacterial pollution in the watershed. In addition, the watershed partners should regularly evaluate the effectiveness of their own plans, programs, and organizational structures with respect to watershed-based planning and consider any changes that may be needed to maintain and enhance effectiveness. The watershed partners should evaluate their strengths, weaknesses, and opportunities and consider appropriate changes that may be needed to most effectively endorse and implement the Watershed Vision and respond to changing conditions and circumstances in the watershed. As a priority consideration, the SBPAC should pursue opportunities for increasing the participation of watershed landowners and business owners and the towns of Fairfield and Easton in the committee's activities.

7. **Continue to Advance the Development, Maintenance, and Sharing of Information Concerning the Sasco Brook Watershed:** As a basic element of ongoing stewardship, the watershed partners should continue to encourage and support the development, maintenance, synthesis, and sharing of information concerning water resources and other relevant conditions in the Sasco Brook Watershed. Lessons learned through the experience of the Sasco Brook Pollution Abatement Committee and described in Chapter Four of the Watershed-Based Plan, should be shared with those planning similar pollution reduction initiatives in other jurisdictions.

   Information should be shared with agencies and organizations involved with watershed-based planning in other Connecticut municipalities. Continued fundamental research regarding water quality conditions in the Sasco Brook Watershed should be encouraged for the purpose of providing information useful for science-based management decisions and educational purposes. Information should be shared through publications for general distribution and other appropriate means.

7

Five-Year Program for Advancing the Watershed Vision

There are many easy, no-cost ways that citizens and homeowners can help protect and improve the environment. Reduced water consumption, watershed-friendly lawn care, stormwater management, septic system maintenance, and proper disposal of pet and animal waste are some examples. Everyone can contribute to cleaning up and preventing pollution.

Sasco Brook Pollution Abatement Committee

Chapter Cover Photo: Sasco Brook from Bulkley Pond to Long Island Sound.

Five-Year Program for Advancing the Watershed Vision

This chapter outlines a recommended five-year program for advancing the Watershed Vision (set forth in Chapter Five of the Watershed-Based Plan) for protecting and improving water quality in the Sasco Brook Watershed. The five-year program begins with distribution and endorsement of the Watershed Vision in accordance with the procedure set forth in Chapter Six (see page 6-2). That endorsement should be considered as the first major milestone for implementation of the Watershed-Based Plan.

The other recommended implementation actions, summarized below and on the following pages, are categorized according to 1) analytical measures and initiatives; 2) structural measures and initiatives; 3) public outreach and education measures and initiatives; and 4) planning and regulatory measures and initiatives. A proposed schedule for implementation, contingent on funding availability, is presented as Table 7-1; some area-specific actions are shown on Map 7-1. The Sasco Brook Pollution Abatement Committee (SBPAC) will serve as the coordinating entity for implementation of the five-year program and as the lead agency for specific implementation actions. Estimated costs have been assigned to certain analytical and structural implementation actions and the first public outreach and education project.

The five-year program should be considered a flexible guideline that may be modified over time in response to changing conditions and circumstances, especially as knowledge and understanding of the sources and amounts of bacterial pollution in the watershed improves.

ANALYTICAL MEASURES AND INITIATIVES

The analytical measures and initiatives are intended to continue to develop the data and information needed to: a) improve understanding of the sources and impacts of bacterial pollution in the watershed; and b) provide additional information to support science-based decisions for protecting and improving water quality. Among the recommended analytical measures and initiatives, highest priority is assigned to completion of microbial source tracking (MST) analyses to more precisely identify the most significant bacterial contamination sources and the relative contribution of each source.

1. **Microbial Source Tracking (MST) Analyses:** The Sasco Brook Watershed should be considered as a model watershed for developing and testing MST methods suitable for application in southwestern Connecticut watersheds. MST analyses should be conducted to identify dominant sources of fecal contamination in Sasco Brook, its tributaries, and estuary with consideration of human sources (sewage disposal), domestic animal sources (including, but not limited to, dogs and horses), and wildlife sources (including, but not limited to, ducks, geese, and deer). Data developed through MST analyses should be utilized to validate or modify the current assumptions regarding pollution sources and loads developed for the purpose of the Watershed-Based Plan (see Chapter Three). Completion of the recommended pharmaceutical detection and *E. coli* ribotyping projects described below should be considered a major milestone for implementation of the Watershed-Based Plan.

1(a) Pharmaceutical Detection Project

A project to identify the presence of metabolites of selected human-ingested pharmaceuticals in Sasco Brook, as designed in the course of the watershed-based planning process, should be conducted for the purpose of obtaining useful evidence concerning possible human impacts on water quality through sewage disposal systems, and otherwise providing information to aid in the design of *E. coli* ribotyping studies and fecal pollution monitoring. (Water sampling for the pharmaceutical detection project in accordance with this recommendation was completed in April 2011 prior to approval of the Sasco Brook Watershed-Based Plan.)

Estimated Cost: Costs and services to conduct this project are donated by the U.S. Environmental Protection Agency.

Responsibilities for Implementation: U.S. Environmental Protection Agency Region 1 with sampling assistance from the Earthplace Harbor Watch/River Watch Program.

1(b) *E. coli* Ribotyping Project (Fecal Bacteria Pollution Reduction Project)

A project applying ribotyping analysis of cultures of fecal indicator bacteria (*E. coli* bacteria) isolates from both impacted waters and suspected bacterial pollution sources should be conducted to more precisely identify the most significant pollution sources and the relative contributions of those sources in the watershed. The project should be implemented in coordination with the Connecticut Department of Agriculture's Bureau of Aquaculture as a pilot project to address sources of fecal contamination in the watershed affecting closure of shellfish beds in Long Island Sound near the mouth of Sasco Brook. A proposed scope of work for this project, developed in the course of the watershed-based planning process and including a request for funding, is included in Appendix D of the Watershed-Based Plan. The sampling location should be positioned in the estuary, upstream of the Pequot Avenue bridge, and samples should be taken on an outgoing tide to reduce the possibility of detecting bacteria that may be brought into Sasco Brook by the incoming tide from sources in Long Island Sound.

Estimated Cost: $150,000.

Responsibilities for Implementation: Westport-Weston Health District; Connecticut Agricultural Experiment Station; University of New Hampshire Jackson Estuarine Laboratory.

2. Fecal Contamination Assessment: In coordination with the *E. Coli* Ribotyping Project, and utilizing *E. coli* as the fecal bacteria indicator, a five-year seasonal- and event-based water quality sampling and testing program should be conducted to identify: a) the presence of fecal contamination in the Sasco Brook water column and sediments, including riparian, floodplain, pond, and storm drainage sediments; b) relevant trends concerning that contamination; and c) the effectiveness of applied Best Management Practices for achieving Watershed-Based Plan goals for bacteria reduction. The monitoring program should be conducted

utilizing the 12 historically established in-stream sampling locations in the watershed and the three identified storm drain outfalls in the vicinity of the Route 1/Post Road urban corridor. Fecal contamination monitoring should be coordinated with nutrient monitoring (see no. 4 below) and with any Town of Fairfield and/or Town of Westport sanitary surveys undertaken for shellfish management purposes in accordance with Connecticut Bureau of Aquaculture requirements. Sampling should be conducted on a bi-monthly basis from May through September of each year.

Estimated Cost: $5,000/year excluding costs associated with nutrient monitoring.

Responsibilities for Implementation: Earthplace Harbor Watch/River Watch Program.

3. **Nutrient Monitoring:** In coordination with the fecal contamination monitoring program, a water quality sampling and testing program as designed in the course of the watershed-based planning process should be conducted to identify the presence of any significant nutrient contamination in Sasco Brook and pertinent trends concerning that contamination. This program, based on assessment of total nitrogen and total phosphorous conditions, should also be conducted for the purpose of obtaining useful evidence of septic system, fertilization, and domestic animal and wildlife issues affecting water quality in the watershed. Nutrient monitoring should be conducted in the spring, summer, and fall of years one, three, and five of the five-year implementation period.

Estimated Cost: $2,250/year.

Responsibilities for Implementation: Earthplace Harbor Watch/River Watch Program.

4. **Rapid Bioassessment:** An annual program to assess the macro-invertebrate community in Sasco Brook should be conducted to assemble baseline and trend-establishing data that will aid in the evaluation of riparian ecosystem health over time. That evaluation will be based on biological community data that reflect the degree to which the brook supports a wide variety of indigenous organisms sensitive to environmental disturbance, including, but not limited to, the presence of any fecal contamination. The invertebrate community structure of the brook, compared to an ideal reference community, will be used as an indicator of water quality impairment. The program should be conducted as an element of the Connecticut Department of Environmental Protection's Rapid Bioassessment in Wadeable Stream and Rivers by Volunteer Monitors (RBV) program. Volunteers should be trained through a collaborative effort involving the Connecticut DEP and Sasco Brook Pollution Abatement Committee. An RBV assessment should be conducted in the fall of each year of the five-year implementation period.

Estimated Cost: Costs and services for this project are to be donated by the watershed partners and provided through volunteer assistance.

Responsibilities for Implementation: Connecticut DEP and SBPAC.

5. **Water Quality Data Assessment:** Historical water quality and stream flow data collected and/or maintained by the Connecticut Department of Environmental Protection, Earthplace Harbor Watch/River Watch Program, and U.S. Geological Survey, including data from 12 historically established in-stream sampling locations in the watershed and the three identified storm drain outfalls in the vicinity of the Route 1/Post Road urban corridor, should be assembled, consolidated, and analyzed. The purpose of the data assessment should be to identify trends in water quality conditions and provide other information useful for science-based decisions affecting protection and improvement of water quality. Existing historical data should be analyzed using well-documented methods that will enable subsequent data to be added to the assessment. Findings and conclusions should be published and distributed, including a summary of practical applications of the data for watershed management purposes. Water quality data assessment should be conducted twice in the course of the five-year plan. Completion of each water quality data assessment should be considered a major milestone for implementation of the Watershed-Based Plan.

   Estimated Cost: $5,000 for first assessment; less than that amount for second assessment.

   Responsibilities for Implementation: Sasco Brook Pollution Abatement Committee; Harbor Watch/River Watch.

6. **Fecal Contamination "Track-down" Program:** In accordance with findings of the MST and fecal pollution monitoring studies, investigations utilizing best available technology and methods should be pursued to trace and identify any significant sources of fecal contamination that may be found in the municipal storm drainage infrastructure draining to the three stormwater outfalls that discharge directly into Sasco Brook in the vicinity of the Route 1/Post Road corridor. Appropriate measures should then be developed and pursued to reduce, eliminate, or otherwise mitigate significant sources of fecal contamination entering the storm drainage infrastructure.

   Estimated Cost: $10,000.

   Responsibilities for Implementation: Town of Westport Department of Public Works.

STRUCTURAL MEASURES AND INITIATIVES

The structural measures and initiatives are intended to result in placement and or construction of projects that will physically influence the movement of stormwater and/or fecal contamination in the watershed. Among the recommended structural projects, highest priority is assigned to the Fairfield County Hunt Club's pollution reduction project.

1. **Fairfield County Hunt Club Pollution Reduction Project:** A project to replace the existing surface and underground stormwater drainage network in the vicinity of the club's horse barns, paddocks, and exercise ring by constructing a 320-foot grassed swale and other Best Management Practices should be conducted to filter bacteria that would otherwise flow more directly into a Sasco Brook tributary. The project should include monitoring and public education components to evaluate project impacts and increase awareness of opportu-

nities for reducing nonpoint source pollution utilizing Best Management Practices, including, but not limited to, grassed swales. A proposed scope of work for this project, including a request for funding assistance to supplement project funds provided by the Fairfield County Hunt Club, was developed in the course of the watershed-based planning process and is included in Appendix E of the Watershed-Based Plan. Completion of this project should be considered a major milestone for implementation of the Watershed-Based Plan.

Estimated Cost: $228,000.

Responsibilities for Implementation: Fairfield County Hunt Club; Earthplace Harbor Watch/River Watch Program.

2. **Domestic Animal Initiatives:** Demonstration projects for reducing, avoiding, and otherwise mitigating fecal contamination from pets and livestock, including, but not limited to, projects for horse manure management, should be designed, implemented, and publicized. Priority attention should be given to identifying an appropriate small-acreage horse farm in the watershed for establishing, with permission of the property owner, a manure management demonstration project applicable for small-acreage horse farms. That project should demonstrate the construction and use of suitable facilities and Best Management Practices for storage, disposal, and beneficial utilization on or off-site of horse manure, recognizing that the average 1,000-pound horse each day will produce approximately 50 pounds of manure—about nine tons per year, and that a desirable facility should be an enclosed structure of engineered design with a sealed base to prevent seepage. The demonstration project should also include monitoring and public education components to evaluate project impacts and increase awareness of opportunities for reducing nonpoint source pollution emanating from small-acreage horse farms. If a suitable location for the manure management demonstration project is not identified, permission should be sought from the Fairfield County Hunt Club to locate the project on the club's property where the project can be observed by small-acreage horse farm owners, or utilize the club's existing facilities to demonstrate effective manure management measures applicable for use on small-acreage horse farms.

Estimated Cost: To be determined by Sasco Brook Pollution Abatement Committee based on selected site.

Responsibilities for Implementation: U.S. Department of Agriculture Natural Resources Conservation Service; Fairfield County Hunt Club; University of Connecticut Cooperative Extension System.

3. **Low Impact Development (LID) Projects:** Projects to apply cost-effective and sustainable LID technologies, strategies, and Best Management Practices suitable for application in the Sasco Brook Watershed should be designed, implemented, and publicized, with priority attention given to: a) rain gardens (also called bio-retention areas or bio-filters); b) grassed swales (also called vegetated open channels); c) permeable pavements; and d) vegetated riparian areas (also called riparian buffer areas). The purpose of these projects should be to evaluate and demonstrate how well-designed, small-scale projects and landscape treatments integrated throughout a development site can provide water quality benefits by manag-

ing runoff close to its source, and provide aesthetic benefits as well. Demonstration project costs are to be determined pending selection of project sites.

3(a) Rain gardens

A rain garden demonstration project should be designed and constructed on a publicly accessible site in or near the watershed. The project should include a depressed garden bed planted with a variety of native perennial plants and shrubs that are both water and drought-resistant. The size of the garden should be designed in accordance with the size of the area that drains to it (such as a roof or driveway) with consideration of a design guideline whereby the area covered by the garden would be 5 to 10% of the area draining to it, and be sufficient to retain and infiltrate the first one inch of runoff from that drainage area. The purpose of the project should be to demonstrate a cost-effective method for: decreasing the volume of stormwater runoff from impervious surfaces into the stormwater drainage system; recharging ground water; and improving water quality by filtering out pollutants by slowly releasing runoff into the ground. In addition, the project should demonstrate how the rain garden can serve as an attractive landscape feature and provide habitat for birds, butterflies, and other wildlife throughout the year. Consideration should be given to construction of a rain garden demonstration project on the Earthplace – The Nature Discovery Center property in Westport (nearby but outside of the Sasco Brook Watershed) and the Connecticut Audubon Society Fairfield Nature Center property in Fairfield (within the watershed).

Estimated Cost: To be determined by the Sasco Brook Pollution Abatement Committee based on selected sites.

Responsibilities for Implementation: SBPAC; University of Connecticut Nonpoint Education for Municipal Officials program.

3(b) Grassed swales

In addition to the grassed swale to be constructed as an element of the Fairfield County Hunt Club Pollution Reduction Project (see no. 1 above), construction of an engineered grassed swale for stormwater management purposes on a publicly accessible site in the watershed should be pursued. The purpose of the project should be to evaluate and demonstrate how a "dry" swale (designed primarily to provide a stormwater infiltration function rather than a conveyance function) can be applied effectively in low to moderate density residential and commercial areas to treat and attenuate stormwater runoff and provide water quality benefits. Those benefits would be provided by removal of stormwater pollutants through infiltration, sedimentation, adsorption, and nutrient uptake in the swale. The swale, designed to hold stormwater for no longer than 24 hours, should include a soil bed of native soils or highly permeable fill material, and may include a drainage system installed beneath the soil layer to avoid long periods of standing water. Planted with appropriate grasses, the swale should have a trapezoidal or parabolic cross-section and side slopes of 3:1 or flatter to facilitate maintenance. Monitoring of the function of the grassed swale and its

maintenance costs should be conducted to evaluate the feasibility of utilizing this treatment practice in other watershed locations in place of curbs, gutters, and storm drains to reduce nonpoint source pollution. Consideration may be given to encouraging the construction of grassed swales to receive drainage from commercial parking areas as part of future redevelopment projects in the Post Road/Route 1 urban corridor subject to review and approval by Town of Westport and Town of Fairfield land use authorities.

Estimated Cost: To be determined based on selected sites.

Responsibilities for Implementation: Sasco Brook Pollution Abatement Committee; University of Connecticut Nonpoint Education for Municipal Officials program; town land use authorities; town public works departments; Connecticut Department of Transportation.

3(c) Permeable Pavements

Application of permeable paving materials, as alternatives to conventional pavement surfaces, should be pursued in appropriate watershed locations to evaluate and demonstrate how such materials can increase infiltration and reduce stormwater runoff and pollutant loads. Consideration should be given to the application of: modular concrete paving blocks consisting of interlocking units with the open spaces filled with planted grass or gravel; modular plastic lattice that can be rolled, cut to size, and filled with planted grass or gravel; cast-in-place concrete grids that incorporate gaps filled with soil and grass and providing additional structural capacity; soil enhancement technologies in which a soil amendment such as synthetic mesh is blended with a permeable soil medium to create an engineered load-bearing surface; and other, traditional materials with infiltration capacity, such as gravel, cobbles, wood, mulch, brick, and natural stone. Consideration should be given to the application of these materials on low-traffic surfaces such as driveways, low-use parking areas, sidewalks, pool decks, patios, and other suitable locations. Among the design considerations for application of permeable pavements, it should be recognized that such pavements should only be used with soils having suitable infiltration capacity confirmed through field testing; should not be used in areas that require sand and salt application for winter de-icing; should not be used in steep-sloped areas; and must be carefully installed in accordance with the manufacturers' guidelines. It should also be recognized that permeable pavements require regular and careful inspection and maintenance, including careful snow removal. Consideration should be given to applications of permeable paving materials for demonstration purposes on the Earthplace – The Nature Discovery Center property in Westport and the Connecticut Audubon Society Fairfield Nature Center property in Fairfield.

Estimated Cost: To be determined based on selected sites.

Responsibilities for Implementation: Sasco Brook Pollution Abatement Committee; University of Connecticut Nonpoint Education for Municipal Officials program; town public works departments; town land use authorities.

(d) Vegetated Riparian Areas

Well-designed projects to create or enhance a vegetated riparian area adjacent to Sasco Brook or a tributary to the brook should be pursued. The purpose of these projects should be to evaluate and demonstrate how the vegetated area can protect the water course from nonpoint source pollution by preventing bacteria, sediment, nutrients, pesticides, and fertilizers from entering the water course, while providing other environmental benefits as well. Priority attention should be given to identifying riparian property owners willing to consider development of a vegetated riparian area on their properties which would then serve as a model for other property owners. Depending on conditions at the selected site, consideration should be given to establishing a vegetated area at least 20 feet wide. It should be recognized that depending on an assessment of the existing vegetation, it may be possible to establish an effective vegetated riparian area by simply not mowing or cutting the vegetation along the stream, allowing it to fill in and grow naturally. Consideration should also be given to enhancing existing vegetation by planting a variety of native perennial and annual plants , shrubs, and trees best suited for the site conditions, and removing any invasive plants. Selection of plants should follow an evaluation of relevant site and soil conditions, including slope, sun exposure, soil type, texture, and pH, and flooding frequency and duration. Consideration should also be given to utilizing volunteers to assist the participating property owners with planting of the selected vegetation. The projects should be designed to provide multiple benefits, including water quality, stream bank stabilization, geese management, wildlife habitat, aquatic life, and aesthetic benefits.

Estimated Cost: To be determined by the Sasco Brook Pollution Abatement Committee based on selected sites.

Responsibilities for Implementation: SBPAC; University of Connecticut Nonpoint Education for Municipal Officials program; participating property owners.

4. **Stormwater Drainage System Enhancement:** Stormwater drainage system improvements should continue to be pursued through town stormwater management programs, including programs to implement the State of Connecticut requirements for managing stormwater discharges pursuant to the Municipal Storm Sewer System (MS4) General Permits issued by the Department of Environmental Protection to the Town of Westport and Town of Fairfield. The towns should continue to conduct regular street-sweeping and cleaning of plunge pools, outfalls, catch basins, and culverts to remove accumulated sediment. These activities during the summer months are expected to be of particular benefit with regard to removing sediment that may be laden with bacteria from domestic animal and wildlife sources. Following completion of the Microbial Source Tracking Analyses of the Watershed-Based

Plan, the need for additional stormwater drainage system improvements and the cost of such improvements should be evaluated.

Estimated Cost: To be determined; it is anticipated that these activities will be conducted in accordance with existing municipal public works budgets without the need for additional implementation funds.

Responsibilities for Implementation: Town Public Works Departments.

PUBLIC OUTREACH AND EDUCATION MEASURES AND INITIATIVES

The public outreach and education measures and initiatives are intended to maintain and increase public interest, support, and participation for advancement of the Watershed Vision. Through the projects and programs described below, the watershed partners will continue to provide information to watershed residents and business owners and to elected officials concerning a variety of water quality-related topics, including, but not limited to, information on personal stewardship actions to help protect and improve water quality in the watershed. The Sasco Brook Pollution Abatement Committee will be the principal entity for advancing each of the following initiatives. With the exception of the interpretive panel, it is anticipated that each of the following measures and initiatives will be conducted with technical assistance from the watershed partners without the need for additional implementation funds.

1. **Interpretive Panels:** Low-profile, 24-inch by 36-inch wayside exhibit panels presenting images and text concerning the Sasco Brook Watershed and Watershed-Based Plan should be prepared and installed at locations in the watershed where public visibility of the panels will be high. Design of the panels should include design of a unique Sasco Brook Watershed symbol that will be displayed on the panels and used consistently in other public outreach and education initiatives to advance the Watershed Vision. Priority attention should be given to preparation and installation of interpretive panels to be displayed at: 1) the Town of Fairfield's Southport Beach near the mouth of Sasco Brook; and 2) the Fairfield County Hunt Club's property. Panels for permanent display at each of these locations should be designed to present information relevant to each location, including, but not limited to, the relationship of the watershed to Long Island Sound and the potential impacts of horses and other domestic animals on water quality in the watershed. Installation of these two interpretive panels should be considered a major milestone for implementation of the Watershed-Based Plan. The 2011 estimated cost for design, fabrication, and hardware for two panels is $6,400.

2. **Web-based Information Program:** Watershed-related information for presentation on the websites of the watershed towns should be developed, maintained, and updated, including, but not limited to, information concerning the Watershed-Based Plan, the Watershed Vision, nonpoint source pollution, the relationship among Sasco Brook, the watershed, and Long Island Sound, and opportunities for watershed homeowners and business owners to undertake and participate in voluntary initiatives that contribute to achievement of the Watershed Vision. The web-based information program will be continuous and ongoing throughout the five-year implementation period.

3. **Special Events and Programs for Targeted Groups:** Special events and programs to provide information to targeted groups should be designed and conducted, including, but not limited to: a) information concerning effective manure management to horse and horse farm owners; b) pet waste management information to pet owners; c) geese management information to property owners who maintain large grassy areas; and d) septic system maintenance information to homeowners; including new home-buyers and town residents. Information needs and targeted groups should be identified in accordance with findings from the analytical measures and initiatives. Established events, including annual Earth Day programs, should also be utilized to provide information on water quality-related topics to the public. Priority should be given to continuing the "good horse keeping" and "geese management" workshops previously conducted by the SBPAC.

4. **Newspaper, Television, and Other Media Initiatives:** Newspapers with substantial circulation in the watershed towns, government access television, and other available media should be utilized to provide information to the general public and targeted groups concerning the watershed and Watershed Vision. These media initiatives will be continuous and ongoing throughout the five-year implementation period. In addition, consideration should be given to using "social media" techniques (web-based and mobile technologies for social interaction) to provide information to the general public and targeted groups.

5. **Public Opinion Surveys of Watershed Residents:** Additional information concerning public attitudes and awareness of water quality-related topics should be assembled utilizing surveys, questionnaires, and personal interviews. Priority attention should be given to conducting a comprehensive survey of Town of Fairfield and Town of Easton residents in the watershed, in effect replicating the survey of Town of Westport residents previously conducted by volunteers for the SBPAC in the course of the watershed-based planning process. (The Town of Westport survey and survey results are included in Appendix C of the Watershed-Based Plan.)

6. **Sasco Brook Pollution Abatement Committee Meetings:** The SBPAC will continue to meet on a quarterly basis throughout the five-year implementation period to review the status of the Watershed Vision and the five-year program for advancing the vision, and to consider new and/or modified initiatives for advancing the vision. At all regularly scheduled meetings of the SBPAC, watershed residents, business owners, and others who may have water quality-related questions, concerns, or suggestions will be provided an opportunity to express their views.

PLANNING AND REGULATORY MEASURES AND INITIATIVES

The planning and regulatory measures and initiatives are intended to focus on informed land-use planning, effective application of land-use regulations, modification of the Sasco Brook Total Maximum Daily Load, and ongoing pursuit of available funds to implement the five-year plan for advancing the Watershed Vision.

1. **Plans of Conservation and Development Amendments:** Documents containing recommended amendments to the *Town of Westport Plan of Conservation and Development* and *Town of Fairfield Plan of Conservation and Development* should be prepared for the purpose of incorporating appropriate elements of the Watershed-Based Plan, including the Watershed Vision, into those town plans. The completed documents should be prepared by the Sasco Brook Pollution Abatement Committee following consultation with the land use planning agencies of the towns of Westport and Fairfield, recognizing that the Fairfield plan, adopted in 2000, is due to be updated in the near future. Completion of the documents should be considered a major milestone for implementation of the Watershed-Based Plan.

2. **Watershed-Based Plan Review and Amendments:** Recognizing that the Watershed-Based Plan can not identify all matters and issues affecting protection and improvement of water quality, an annual addendum to the Watershed-Based Plan should be prepared to: a) summarize the status of plan implementation; b) modify the plan's provisions to address changing conditions and circumstances; and c) present new information, including information developed through the analytical measures and initiatives of the five-year implementation program. A more comprehensive amendment of the Watershed-Based Plan should be considered twice in the course of the five-year plan, following completion of the microbial source tracking analyses to more precisely identify sources of bacterial pollution, and following amendment of the Sasco Brook TMDL to include the estuary in the TMDL analysis. Completion of each comprehensive amendment of the Watershed-Based Plan should be considered a major milestone for plan implementation.

3. **Sanitary Code Review and Amendments:** Any appropriate amendments to the sanitary codes of the Westport Weston Health District, Town of Fairfield, and Town of Easton should be prepared as necessary to address findings and recommendations developed through the plan's analytical measures and initiatives, including, but not limited to, any amendments regarding inspection and maintenance of septic systems.

4. **Other Regulatory Review and Amendments:** Any appropriate amendments to town zoning and other land-use regulations should be prepared as necessary to address findings and recommendations developed through the plan's analytical measures and initiatives, and especially as needed to achieve the most effective implementation of the state requirements for managing the discharge of storm water pursuant to the Municipal Separate Storm Sewer System (MS4) General Permit issued to the towns of Westport and Fairfield.

5. **Animal Management Initiatives:** Based on findings from the Microbial Source Tracking analyses and fecal contamination monitoring, recommendations for managing excessive wildlife populations (including, but not limited to, geese and deer populations) and domestic animal waste to reduce undue levels of fecal contamination in Sasco Brook should be developed. In consultation with the Connecticut Department of Environmental Protection's Wildlife Division, areas of significant geese congregation in the watershed should be identified and monitored.

6. **Total Maximum Daily Load Estuary Component:** The Sasco Brook TMDL should be amended to include the estuary in the TMDL analysis. The TMDL bacterial reduction objectives should be recalculated as appropriate and attention should be given to assessing the extent to which Long Island Sound acts to dilute bacterial contamination originating in the watershed.

7 **Municipal Land Use Evaluation:** Municipal land use evaluations similar to evaluations conducted by Farmington River watershed towns with funding assistance from the Connecticut Department of Environmental Protection should be conducted in each of the three watershed towns. The purpose of the evaluations should be to identify opportunities for modifications of current land use regulations to better encourage application of Low Impact Development (LID) techniques, including, but not limited to, techniques that reduce impervious surfaces, preserve green space, and generally increase infiltration of storm water into the ground.

8. **Pursuit of Implementation Funding:** Local, state, federal, and private sources of funds available for Watershed-Based Plan implementation should be pursued throughout the five-year implementation period. Applications for grants of funds to support implementation projects and initiatives should be prepared and submitted by the watershed partners, with priority attention given to the one-year *E. coli* ribotyping pilot study and completion of the Fairfield County Hunt Club pollution reduction project. (See appendices D and E of the Watershed-Based Plan.)

Table 7-1:

Five-Year Implementation Schedule

WATERSHED-BASED PLAN IMPLEMENTATION ACTIONS	2011		2012				2013				2014				2015				2016	
	3rd QTR	4th QTR	1st QTR	2nd QTR	3rd QTR	4th QTR	1st QTR	2nd QTR	3rd QTR	4th QTR	1st QTR	2nd QTR	3rd QTR	4th QTR	1st QTR	2nd QTR	3rd QTR	4th QTR	1st QTR	2nd QTR
Endorsement of Watershed Vision																				
Presentation and Distribution																				
Memorandum of Agreement			*																	
Analytical Projects and Initiatives																				
Microbial Source Tracking (MST) Analyses:																				
Pharmaceutical Detection Project																				
Fecal Bacteria Pollution Reduction Project						*														
Fecal Contamination Assessment																				
Nutrient Monitoring																				
Rapid Bioassessment																				
Water Quality Data Assessment			*																*	
Fecal Contamination “Track-down” Program																				
Structural Projects and Initiatives																				
Fairfield County Hunt Club Pollution Reduction Project						*														
Stormwater Drainage System Enhancement:																				
Road Sweeping																				
Sediment Removal																				
Domestic Animal Projects:																				
Manure Mgmt. for Small-Acreage Horse Farms																				
Low Impact Development (LID) Demonstration Projects:																				
Rain Gardens and Bio-retention Areas																				
Vegetated Swales																				
Permeable Pavement Areas																				
Vegetated Riparian Areas																				

* Major milestone for implementation of the Watershed-Based Plan

Table 7-1:

Five-Year Implementation Schedule (Cont.)

WATERSHED-BASED PLAN IMPLEMENTATION ACTIONS	2011		2012				2013				2014				2015				2016	
	3rd QTR	4th QTR	1st QTR	2nd QTR	3rd QTR	4th QTR	1st QTR	2nd QTR	3rd QTR	4th QTR	1st QTR	2nd QTR	3rd QTR	4th QTR	1st QTR	2nd QTR	3rd QTR	4th QTR	1st QTR	2nd QTR
Public Outreach and Education Projects and Initiatives																				
Interpretive Panels					*															
Web-based Information Program																				
Special Events and Programs for Targeted Groups:																				
Town Earth Day Programs																				
Good "Horse Keeping" Workshops																				
Geese Management Workshops																				
Newspaper, TV, and Other Media Initiatives																				
Public Opinion Surveys of Watershed Residents																				
SBPAC Meetings	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Planning and Regulatory Projects and Initiatives																				
Conservation and Development Plan Addenda			*																	
Watershed-Based Plan Review								*									*			
Sanitary Code Review and Any Needed Amendments																				
Other Regulatory Review and Any Needed Amendments																				
Animal Management Initiatives																				
TMDL Estuary Component																	*			
Municipal Land Use Evaluation																				
Pursuit of Implementation Funding																				

* Major milestone for implementation of the Watershed-Based Plan

Appendices

- **APPENDIX A:**
GLOSSARY OF TERMS

- **APPENDIX B:**
SELECTED REFERENCES

- **APPENDIX C:**
TOWN OF WESTPORT WATERSHED SURVEY

- **APPENDIX D:**
PROPOSED *E. COLI* RIBOTYPING PROJECT

- **APPENDIX E:**
FAIRFIELD COUNTY HUNT CLUB POLLUTION REDUCTION PROJECT

- **APPENDIX F:**
TOTAL MAXIMUM DAILY LOAD

Appendices Cover Photo: Stone bridge over Sasco Brook.

APPENDIX A:

GLOSSARY OF TERMS*

* The definitions of terms contained in this Glossary are for the purpose of the Sasco Brook Watershed-Based Plan. In some instances, the meaning and use of the terms included herein may differ in local, state, and federal laws, ordinances, and regulations. Sources of definitions include, but are not limited to, the U.S. Environmental Protection Agency's ''Terms of Environment'' and Total Maximum Daily Loads Glossary; Sec. 22a-113 of the Connecticut General Statutes; 2004 Connecticut Stormwater Quality Manual; and publications of the U.S. EPA and Connecticut Department of Environmental Protection.

Glossary of Terms

Aquatic Environment: Waters of the United States, including wetlands, that serve as habitat for inter-related, interacting communities and populations of plants and animals.

Best Management Practices (BMPs): Methods, including regulatory, structural, or nonstructural methods, that have been determined to be the most effective, practical means of preventing or reducing pollution from non-point sources. Some examples of BMPs are buffers of streamside vegetation to keep pollutants from entering a watercourse; construction of wetlands to act as natural filters; and environmentally sound maintenance of lawns and septic systems.

Bio-retention: A practice to manage and treat stormwater runoff by using a specially designed planting soil bed and planting materials to filter runoff stored in a shallow depression.

Carrying Capacity: A term that may be used generally to refer to the level of use or extent of modification that environmental or man-made resources may bear before unacceptable resource deterioration or degradation occurs.

Catch Basin: A structure placed below grade to conduct water from a street or other paved surface to the storm sewer.

Catch Basin Insert: A structure, such as a tray, basket, or bag, suspended inside of a catch basin that typically contains a pollutant removal medium (i.e., filter media) that filters or otherwise treats stormwater as it flows through the catch basin.

Center for Land Use Education and Research (CLEAR): A University of Connecticut program that provides information, education, and assistance to land use decision-makers in support of efforts to balance growth and natural resource protection, including assistance using remote sensing and geographic information system technologies.

Cistern: Small tank or storage facility used to collect and/or store water, including rain water, for a home or other land use.

Clean Water Act (CWA): The series of legislative acts that form the foundation for protection of U.S. water resources, including the Water Quality Act of 1965, Federal Water Pollution Control Act of 1972, Clean Water Act of 1977, and Water Quality Act of 1987. CWA Secs. 305(b) and 303(d) deal specifically with water quality assessment and Total Maximum Daily Load (TMDL) development.

Coastal Area: The coastal area of Connecticut adjoining Long Island Sound and defined according to criteria established in the Connecticut Coastal Management Act (CCMA). The inland boundary of the coastal area is known as the coastal boundary and essentially encompasses all land within 1,000 feet of the high tide line or the inland edge of tidal wetlands. In the Sasco Brook watershed, the coastal area is subject to the special review and regulatory authorities of the municipal coastal programs of the towns of Westport and Fairfield.

Coastal Area Management Programs: The planning programs (municipal coastal programs) of the towns of Westport and Fairfield that focus on coastal area land use and protection of coastal resources. The coastal area management programs, authorized by the Connecticut Coastal Management Act (CCMA), were adopted by the towns' planning and zoning agencies and are implemented as elements of the towns' plans of conservation and development.

Coastal Resources: Resources including coastal waters, estuarine embayments, beaches, wetlands, intertidal flats, islands, coastal hazard areas, developed shoreline, and other resources as defined in the Connecticut Coastal Management Act.

Coastal Site Plan Review: The CCMA-required municipal review of all major projects or activities proposed within the coastal boundary to determine the consistency of those projects and activities with the CCMA's coastal management policies. Applications for planning and zoning approvals are among the activities subject to coastal site plan review by, as applicable, municipal planning and zoning commissions and the zoning boards of appeals.

Coliform Organism: Microorganisms found in the intestinal tracts of humans and other warm-blooded animals and used as indicators of the sanitary quality of water; their presence in water indicates fecal pollution and potentially adverse contamination by pathogens.

Coliform Index: A rating of the purity of water based on a count of fecal bacteria.

Collector Sewers: Pipes used to collect and carry wastewater from individual sources to an interceptor sewer that will carry it to a treatment facility.

Combined Sewers: A sewer system (not found in the Sasco Brook Watershed) that carries both sewage and stormwater runoff. Normally, the system's entire flow goes to a wastewater treatment plant but during a heavy storm the volume of water may exceed the capacity of the system and cause an overflow (known as a combined sewer overflow or CSO) of untreated mixtures of stormwater and sewage.

Connecticut Coastal Management Act (CCMA): The legislation contained within the State of Connecticut General Statutes, Sections 22a-90 through 22a-112, as may be amended from time to time, and which requires, in part, that municipalities review all major activities within their coastal boundaries for consistency with the policies established by the CCMA, and also provides for the voluntary development of local Municipal Coastal Programs.

Connecticut Department of Agriculture/Bureau of Aquaculture (DA/BA): The principal state agency responsible for shellfish and aquaculture in Connecticut in accordance with powers and duties set forth in Section 26-192a of the Connecticut General Statutes.

Connecticut Department of Environmental Protection (DEP): The principal state agency responsible for management of the State's natural resources. Among the DEP's different divisions and units, the Watershed, Lakes, and Nonpoint Source Unit provides watershed-based planning assistance; the Wildlife Division has a variety of responsibilities concerning wildlife management; and the Office of Long Island Sound Programs (OLISP) is responsible for ensuring that activities within the State's coastal area conform with the policies of the Connecticut Coastal Management Act and also reviews and issues or denies permits for activities that take place waterward of the high tide line.

Connecticut Water Pollution Control Act: The legislation contained within the State of Connecticut General Statutes, Sections 22a-416 through 22a-484, as may be amended from time to time, and which establishes the State's policies and requirements for protection of the State's surface and ground waters.

Contaminant: As defined in the U.S. EPA's "Terms of Environment," any physical, chemical, biological, or radiological substance or matter that has an adverse effect on water, air, or soil. (See Pollutant.)

Contamination: As defined in the U.S. EPA's "Terms of Environment," introduction into water, air, or soil of microorganisms, chemicals, toxic substances, wastes, or wastewater in a concentration that makes the medium unfit for its next intended use.

Cultural Resources: Natural and man-made resources related to open space, natural beauty, scientific study, outdoor education, archaeological and historic sites, and recreation.

Cumulative Impacts: The impacts on environmental or man-made resources that result from the incremental impact of an action when added to other past, present, and reasonably foreseeable actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

Deep Sump Catch Basin: Storm drain inlets that typically include a grate or curb inlet and a sump to capture trash, debris, and some sediment, oil, and grease.

Designated Uses: Those uses specified in water quality standards for each waterbody or segment. Recreational uses, the propagation and growth of a balanced, indigenous population of aquatic life, wildlife, and the production of edible and marketable natural resources are generally stated as "fishable and swimmable" uses. Other uses may be industrial water supply, irrigation, and navigation.

Direct Runoff: Water that flows over the ground surface or through the ground directly into streams, rivers, and lakes.

Discharge: As defined in the Clean Water Act Sec. 502(19), a discharge of a pollutant or pollutants. As defined in the Connecticut Water Pollution Control Act, the emission of any water substance or material into the waters of the state, whether or not such substance causes pollution.

Dissolved Oxygen (DO): The oxygen, vital to fish and other aquatic life, freely available in water. Traditionally, the level of dissolved oxygen has been accepted as the single most important indicator of a waterbody's ability to support beneficial aquatic life.

Dissolved Solids: Disintegrated organic and inorganic material in water. Excessive amounts make water unfit to drink or use in industrial processes.

Drainage Basin: Another term sometimes used to describe a watershed and often a larger watershed; a region or area within which precipitation drains into a watercourse. (See Watershed.)

E. Coli Bacteria: *Escheria coli* bacteria, which is a type of fecal coliform bacteria commonly found in the intestines of animals and humans, used as an indicator bacteria for determining the sanitary quality of a waterbody. The presence of *E. coli* in a waterbody is a strong indication of recent sewage or animal waste pollution.

Ecology: The relationship of living things to one another and their environment, or the study of such relationships.

Ecosystem: The interacting system consisting of a biologic community and its nonliving environment, each influencing the properties of the other and both necessary for the maintenance of life.

Effluent: Treated or untreated wastewater that flows out of a wastewater treatment plant, sewer, industrial outfall, marine sanitation device, or other source; generally refers to wastes discharged into surface waters.

Erosion: The wearing away of land surface by flowing water, wind, ice, or other geological processes.

Estuary: A confined coastal waterbody with an open connection to the sea and a measurable quantity of salt in its waters. Estuaries are of particular ecological value and significance because they provide important natural values concerning, for example, fish and wildlife habitat, flood protection, and the maintenance of water quality. The estuary of Sasco Brook and other Connecticut estuaries contribute to the ecological health of Long Island Sound.

Fecal Coliform Bacteria: Specific coliform bacteria associated with the digestive tract of warm-blooded animals. Their presence in water is an indicator of pollution and possible contamination by pathogens.

Filter Strip: Strip or area of vegetation used for removing sediment, organic matter, and other pollutants from runoff and wastewater.

Filtration: A treatment process, under the control of qualified operators, for removing solid (particulate) matter from water by means of porous media such as sand or a man-made filter; often used to remove particles that contain pathogens. Also, the natural process whereby wetlands and other landscapes elements may filter pathogens and other pollutants from stormwater runoff.

Floatable Debris: Trash floating in waterbodies or washed upon the shore and which may reduce beneficial use and enjoyment of a waterbody, present a nuisance or hazard for boaters, and harm wildlife.

Flood/Flooding: A general and temporary condition of: 1) partial or complete inundation of normally dry land resulting from the overflow of inland and/or coastal waters; and 2) the unusual accumulation of waters from any source.

Flood Insurance Rate Map (FIRM): An official map of a community prepared by the Federal Emergency Management Agency identifying the elevation of the "100-year" flood and the areas that would be inundated by that level of flooding, and used to determine flood insurance rates.

Floodplain: Low lands adjoining the channel of a river, stream, watercourse, or other body of water, which have been or may be inundated by flood water, and those other areas subject to flooding.

Floodway: The channel of a river or other watercourse plus any adjacent floodplain areas that must be kept free of encroachment so that the "100-year" flood discharge can be conveyed without increasing the water surface elevation more than a designated amount. The floodway is intended to carry the deep and fast-moving water.

Geographic Information System (GIS): A computerized data base of land use and other types of information referenced to a location, and which enables statistical analysis, comparison, and display of large quantities of data for planning purposes.

Grassed Swale: A vegetated open channel designed to treat and attenuate stormwater runoff and convey excess runoff, including "dry" and "wet" swales, with dry swales designed primarily to receive drainage from small impervious areas and wet swales designed to receive drainage from larger areas.

Habitat: The place where a human, animal, plant, or microorganism population lives, and the living and nonliving characteristics, conditions, and surroundings of that place.

Hydrologic Cycle: The distribution and movement of water between the earth's atmosphere, land, and water bodies.

Hypoxia: A condition of degraded water quality characterized by a deficiency of oxygen.

Impaired Waterbody: A waterbody (i.e., stream reaches, lakes, waterbody segments) with chronic or recurring monitored violations of the applicable numeric and/or narrative water quality criteria, and included on a list of impaired waters prepared by the State of Connecticut referred to as the "303(d) List" pursuant to Section 303(d) of the Federal Clean Water Act.

Impermeable: A landscape element or surface not easily penetrated. The property of a material or soil that does not allow, or allows only with great difficulty, the movement or passage of water.

Impervious Surface: Also called impervious land cover; including any land alteration or constructed feature that causes precipitation to flow over a surface instead of soaking into the ground, including, but not limited to, paved areas and building roofs.

Indicator Bacteria: A species or group of microbes which are used to conduct microbial examination of water in order to determine its sanitary quality and provide evidence of recent fecal contamination from humans or other warm blooded animals.

Intertidal Flats: Coastal resources consisting of very gently sloping or flat areas located between high and low tides and composed of muddy, silty and fine sandy sediments and generally devoid of vegetation.

Land Use: The character and condition of the use of land and which may be described in terms of general categories, such as residential, commercial, industrial, and open space, or with reference to the specific use or development of a specific site.

Load or Loading: The total amount of pollutants entering a waterbody from one or multiple sources, measured as a rate, as in weight per unit time or per unit area.

Load Allocation (LA): The portion of the pollutant loading capacity that assessed in a TMDL and that may be attributed to (a) the existing or future nonpoint sources of pollution and (b) natural background sources.

Loading Capacity: The greatest amount of a pollutant that a waterbody can assimilate and still meet water quality standards.

Low Impact Development (LID): A site design strategy intended to maintain or replicate pre-development hydrological conditions through use of small-scale controls integrated throughout the site to manage runoff as close to its source as possible, and including such measures and landscape treatments as rain gardens, grassed swales, pervious pavements, and riparian vegetated areas.

Margin of Safety (MOS): A required component of a TMDL that accounts for the uncertainty in the response of the waterbody to pollutant loading reductions.

Monitoring: Periodic or continuous surveillance or testing to determine the level of compliance with statutory requirements and/or pollutant levels in various media or in humans, plants, and animals.

Mitigation: An action to lessen the severity of impact of another action, either natural or human. Mitigation may refer to an action taken to reduce or eliminate the risk to human life and property and the negative impacts that can be caused by flooding and other natural and technological hazards. Mitigation may also refer to actions designed to lessen the adverse impacts of proposed development activities on natural and cultural resources, including wetlands and water resources.

Municipal Coastal Program: The program authorized by the Connecticut Coastal Management Act that provides for the voluntary development and adoption of local plans to guide coastal area development balanced with coastal resource protection.

Municipal Separate Storm Sewer System (MS4): Conveyances for stormwater, including, but not limited to, roads with drainage systems, municipal streets, catch basins, gutters, ditches, man-made channels or storm drains owned or operated by any municipality, State agency or Federal agency and discharging directly to surface waters of the State. (See MS4 General Permit and Small MS4 Stormwater Program.)

MS4 General Permit: An authorization issued by the DEP which authorizes in municipalities the discharge of stormwater from or associated with a regulated Small MS4 provided certain State-established requirements are met, including preparation and implementation of a municipal Stormwater Management Plan specifying Best Management Practices for reducing nonpoint source pollution.

Narrative Criteria: Non-numeric, qualitative guidelines that describe a desired water quality goal.

National Pollutant Discharge Elimination System (NPDES): The national program for issuing, modifying, revoking and reissuing, terminating, monitoring, and enforcing permits, and imposing and enforcing pretreatment requirements, under sections 307, 402, 318, and 405 of the Clean Water Act. Facilities subjected to NPDES permitting regulations include operations such as municipal wastewater treatment plants and industrial waste treatment facilities.

Native Plants: Plants that are adapted to the local soil and rainfall conditions and that require minimal watering, fertilizer, and pesticide application.

Natural Background Levels: Chemical, physical, and biological levels representing water quality conditions that would result from natural processes in a watershed, such as weathering and dissolution.

Natural Resource Values: The qualities of or functions served by natural resources (such as wetlands, floodplains, and water resources) which include but are not limited to: a) water resource values (including natural moderation of floods and water quality maintenance); b) living resource values (fish, wildlife and plant habitats); and c) cultural resource values (open space, natural beauty, scientific study, outdoor education, archaeological and historic sites, and recreation).

Navigable: Capable of being navigated or passed over by ships or vessels.

Navigable Waters of the United States: Those waters that are subject to the ebb and flow of the tide and/or are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce.

Nitrate: A compound containing nitrogen that can exist in the atmosphere or as a dissolved gas in water and which can have harmful effects on humans and animals. Nitrates in water can cause severe illness in infants and domestic animals. A plant nutrient and inorganic fertilizer, nitrate is found in septic systems, animal feed lots, agricultural fertilizers, manure, industrial waste waters, sanitary landfills, and garbage dumps.

No Discharge Zone: An area designated by the U.S. Environmental Protection Agency within which no sewage, untreated or treated, may be discharged from any vessel. The entire area of Long Island Sound has been designated by the EPA as a non discharge zone.

Nonpoint Education for Municipal Officials (NEMO) Program: A University of Connecticut Program that provides information and technical assistance to local land use officials on topics concerning the relationship of land use to natural resources protection, including, but not limited to, stormwater management, low impact development opportunities, and watershed-based planning.

Nonpoint Source (NPS) Pollution: Pollution that does not originate from a specific identifiable source such as a sewage discharge pipe. Also, any unconfined and diffuse source of pollution such as stormwater or snowmelt runoff, atmospheric deposition, or groundwater not conveyed to a surface water discharge point within a discrete conveyance. Sources of NPS pollution include stormwater runoff from roads, parking lots and backyards, as well as wet and dry atmospheric deposition. Precipitation can carry pollutants from the air to the ground and then gather more pollutants as the water runs off pavement and land to the nearest waterway.

Nonstructural Controls: Pollution control techniques, such as management actions and behavior modifications that do not involve the construction or installation of devices.

Numeric Criterion: A measurable value determined for the pollutant of concern that, if achieved, is expected to result in the attainment of water quality standards in the listed waterbody.

Nutrient: Any substance assimilated by living things that promotes growth. The term is generally applied to nitrogen and phosphorous in wastewater, but is also applied to other essential and trace elements.

Nutrient Pollution: Pollution of water resources by excessive inputs of nutrients. In surface waters, excess algal production is a major concern.

Outfall: A structure (e.g., pipe) extending into a body of water or drainage way for the purpose of discharging wastewater, stormwater runoff, or cooling water.

Passive Recreational Use: Recreational activities, such as hiking, walking, picnicking, canoeing, and fishing, generally not requiring facilities and organization for participation and/or having little significant impact on the natural environment.

Pathogen: Microorganisms that can cause disease in other organisms or in humans, animals, and plants. Pathogens may be bacteria, viruses, or parasites transported in sewage and runoff from agricultural and other areas.

Permeable Paving Materials: Materials that are alternatives to conventional pavement surfaces and that are designed to increase infiltration and reduce stormwater runoff and pollutant loads.

Phase II Stormwater: The second phase of the NPDES program which specifically addresses certain regulated small MS4s and construction activity disturbing between one and five acres of land.

Plan of Conservation and Development: In Connecticut, the municipal plan of land use which includes the municipality's goals and policies to guide the future growth and development of the town and conservation of the town's environmental quality and natural resources.

Point Source Pollution: As defined in the Clean Water Act Sec. 502(14), any discernable, confined, and discreet 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.

Pollutant: As defined in the Clean Water Act Sec. 502(6), a pollutant means dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive material, heat, wrecked or discarded equipment, rock, sand, cellar dirt, and industrial, municipal, and agricultural waste discharged into water. As defined by the U.S. EPA's "Terms of Environment," generally, any substance introduced into the environment that adversely affects the usefulness of a resource or the health of humans, animals, or ecosystems. (See Contaminant.)

Pollution: As defined in the Clean Water Act Sec. 502(19), pollution is the man-made or man-induced alteration of the physical, biological, chemical, and radiological integrity of water. The U.S. EPA's "Terms of Environment" add that pollution, generally, is the presence of a substance in the environment that because of its chemical composition or quantity prevents the functioning of natural processes and produces undesirable environmental and health effects. As defined in the Connecticut Water Pollution Control Act, harmful thermal effect or the contamination or rendering unclean or impure or prejudicial to public health of any waters of the state by reason of any wastes or other material discharged or deposited therein by any public or private sewer or otherwise so as directly or indirectly to come in contact with any waters. (See Contamination.)

Private Shellfish Grounds: Shellfish grounds, including town-designated grounds and state franchise or leased grounds, which individuals or companies have exclusive rights to work and harvest.

Rain Barrel: A barrel designed to retain small volumes of runoff for reuse for gardening and landscaping and suitable for application on residential and commercial properties and which can be incorporated into a site's landscaping plan.

Rain Garden: A landscape feature that may be planted with native plants, designed to reduce nonpoint source pollution by absorbing and filtering rainwater running off impervious surfaces, including roofs, driveways and parking lots.

Receiving Water: Creeks, streams, rivers, lakes, estuaries, groundwater formations, or other bodies of water into which surface water, treated waste, or untreated waste are discharged.

Riparian: Of or relating to or living or located on the bank of a watercourse.

Riparian Habitat: Areas adjacent to rivers and streams with a differing density, diversity, and productivity of plant and animal species relative to nearby uplands.

Riparian/Littoral Rights: The rights of an owner of land contiguous to a navigable body of water. If the water in question is flowing (e.g., river or stream) the rights are said to be riparian. If the property is subject to the ebb and flow of the tide, the rights are said to be littoral rights. The terms "riparian" and "littoral" are commonly used interchangeably. Riparian rights may be defined as principally the right of access to the water, the right of accretions and relictions, and the right to other improvements. Littoral rights are usually concerned with the use and enjoyment of the shore.

Riparian Vegetated Area: An area or strip of land characterized by permanent undisturbed vegetation adjacent to a water body that serves to protect the water body from adverse impacts generated by nearby land uses by filtering pollutants carried by stormwater runoff and providing other environmental benefits, including wildlife habitat and aesthetic benefits. (Also called a Vegetated Buffer.)

Risk: A measure of the probability that damage to life, health, property, and/or the environment will occur as a result of a given hazard.

Runoff: That part of precipitation, snow melt, or irrigation water that runs off the land into streams or other surface water and can carry pollutants from the air and land into the receiving body of water.

Sanitary Sewer: A system of pipes, usually underground, that carry only waste water, not storm water.

Section 303(d) CWA: Section of the Clean Water Act that requires states periodically to identify waters that do not or are not expected to meet applicable water quality standards. These waters are identified on the Sec. 303(d) Impaired Waters List. A TMDL must be developed for each waterbody on the Sec. 303(d) list. If a listed waterbody has multiple impairments, a TMDL must be developed for each impairment.

Section 303(d) CWA Threatened and Impaired Waters List: Under Sec. 303(d) of the Clean Water Act, states, territories, and authorized Indian tribes are required to develop lists (Section 303(d) lists) of impaired waters every two years. The states identify all waters where required pollution controls are not sufficient to attain or maintain applicable water quality standards. States are required to establish priorities for development of TMDLs for waters on the 303(d) List.

Section 305(b) CWA: Section of the Clean Water Act that requires states to submit a biennial report in even-numbered years to the U.S. EPA describing the quality of the state's waters. The Sec. 305(b) report describes the overall water quality conditions and trends in the state.

Section 319 (CWA): Section of the Clean Water Act that establishes a grant program through which the U.S. Environmental Protection Agency may provide funds to state programs to prevent, control, and/or abate pollution. In Connecticut, funds are provided to the Department of Environmental Protection to support implementation of Connecticut's Nonpoint Source Management Program and those funds may be awarded to municipalities to prepare and implement watershed-based plans.

Sediment: Particulate material, both mineral and organic, that is in suspension, being transported, or has been moved from its site of origin by the forces of air, water, gravity, or ice, including material deposited in a loose, unconsolidated form on the bottom of a waterbody.

Sedimentation: The process of transportation and deposition of particles onto the bottom of a body of water.

Septic System: An on-site system designed to treat and dispose of domestic sewage. A typical septic system consists of a tank that receives waste from a residence or business and a system of tile lines or a pit for disposal of the liquid effluent (sludge) that remains after decomposition of the solids by bacteria in the tank and must be pumped out periodically.

Septic Tank: An underground storage tank for wastes from homes not connected to a sewer line. Waste goes directly from the home to the tank.

Sewage: The combination of human and household waste with water which is discharged to the home plumbing system including the waste from a flush toilet, bath, sink, lavatory, dishwashing, or laundry machine, or the water-carried waste from any other fixture, equipment, or machine, together with such groundwater infiltration and surface water as may be present.

Sewer: A system of pipes, usually underground, that carries wastewater and/or stormwater runoff from the source to a treatment plant or receiving body of water. Sanitary sewers carry household, industrial, and commercial waste; storm sewers carry runoff from rain and melting snow; combined sewers are used for both purposes.

Sewerage: The entire system of sewage collection, treatment, and disposal.

Shellfish: An invertebrate having a rigid outer covering, such as a shell or exoskeleton; includes oysters, escallops, hard clams, soft clams, razor clams, crabs, shrimp, all kinds of mussels, skimmer or surf clams, periwinkles, and conch.

Shellfish Growing Area Classifications: Classifications for the taking of shellfish established by the DA/BA under Section 26-192e of the Connecticut General Statutes. These classifications are applied to coastal waters, shores, and tidal flats and are based on examinations and surveys, including tests of water quality to determine if coastal waters are suitable for shellfishing. The basic classifications are "Approved," "Conditionally Approved," "Restricted," "Conditionally Restricted," and "Prohibited."

Shellfish Grounds: An area where shellfish grow naturally or with cultivation. The terms "shellfish grounds" and "shellfish beds" are often used interchangeably and there is no distinction in law between the terms "grounds" and "beds."

Small MS4 Stormwater Program: A national stormwater management program developed by the U.S. EPA and delegated to the states for implementation. In Connecticut, this program, which contains standards related to how cities and towns, including Westport and Fairfield, manage their stormwater infrastructure, is overseen by the DEP.

Source Controls: Practices to limit the generation of stormwater pollutants at their source.

Stakeholder: Any person or organization with vested interests in TMDL development and implementation.

Storm Sewer: A system of pipes, generally underground, carrying only stormwater runoff from building and land surfaces; as distinguished from a sanitary sewer.

Stormwater: Water consisting of precipitation runoff or snowmelt.

Stormwater Management Plan: A municipal plan to reduce nonpoint source pollution which must be prepared and implemented in accordance with the MS4 General Permit issued by the Department of Environmental Protection, and which must include a series of best management practices concerning: 1) public education and outreach; 2) public participation; 3) illicit discharge detection and elimination; 4) construction stormwater management; 5) post-construction stormwater management; and 6) pollution prevention and good housekeeping.

Stormwater Retrofits: Modifications to existing development to incorporate source controls and structural stormwater treatment practices to remedy problems associated with, and to improve the water quality functions of, older, inadequately designed, or poorly maintained stormwater management systems.

Stormwater Runoff: The rainwater, melting snow, and associated material draining into storm drains and waterbodies.

Stormwater Treatment Practices: Devices constructed for primary treatment, pretreatment, or supplemental treatment of stormwater.

Street Sweeping: Removal of particulate debris from paved roadways and parking areas utilizing such mechanical equipment as mechanical broom sweepers, vacuum sweepers, regenerative air sweepers, and dry vacuum sweepers.

Stressor: Any substance or condition that adversely impacts the aquatic ecosystem.

Structural Flood Protection Measures: "Engineered" measures such as dams, dikes, levees, seawalls, and channel alterations designed to modify the volume and location of flooding and extent of erosion.

Subwatershed: The catchment area of a stream tributary within the larger watershed.

Threatened Waterbody: Any waterbody of the United States that currently attains water quality standards, but for which existing and readily available data and information on adverse declining trends indicate that water quality standards will likely be exceeded by the time the next list of impaired or threatened waterbodies is required to be submitted to the U.S. EPA.

Tidal Cycle: Elapsed time between successive high and low waters.

Tidal Wetlands: Wetlands subject to the ebb and flow of the tide, defined by State statute, and subject to the regulatory authorities of the Connecticut Department of Environmental Protection in accordance with Sections 22a-359 through 22a-363f (the "Structures and Dredging" statute) of the Connecticut General Statutes.

Tide: Periodic rise and fall of the ocean surface and connecting bodies of water resulting from the gravitational attraction of the moon and sun acting upon the rotating earth.

Total Maximum Daily Load: The sum of the individual waste load allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources and natural background, and a margin of safety (MOS). TMDLs can be expressed in terms of mass per time, toxicity, or other appropriate measures that relate to a state's water quality standard.

Total Maximum Daily Load Analysis: An analysis of the sum of the individual waste load allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources and natural background, and a margin of safety (MOS) for a specific waterbody and included in a TMDL adopted by the Connecticut DEP and approved by the U.S. EPA.

Toxic Substances: Substances, both naturally occurring and derived from human sources, that cause adverse biological effects or health risks when their concentrations exceed a certain level in the environment. Toxic substances include heavy metals and organic chemicals such as chlorine, polychlorinated biphenyls (PCBs), polyaromatic hydrocarbons (PAHs), and pesticides.

Urban Stormwater Runoff: Stormwater runoff from developed areas.

Vulnerability: Characterization of the nature and extent of damage to life, health, property, and/or the environment will occur as a result of a given hazard.

Waste Load Allocation (WLA): The portion of a receiving water's loading capacity that is allocated to one of its existing or future point sources of pollution.

Waste Water: Water that carries treated or untreated wastes, including dissolved or suspended solids, from homes, businesses, and industries.

Waterbody: A geographically defined portion of navigable waters including segments of rivers, streams, lakes, wetlands, and coastal waters.

Water Column: The water located vertically over a specific location on the floor of a waterbody.

Water Quality: The biological, chemical, and physical conditions of a waterbody which measure the waterbody's ability to support beneficial uses.

Water Quality Classification: The designation of the proposed uses of surface and ground waters with alphabetic characters. Classification does not signify water quality.

Water Quality Criteria: Elements of state water quality standards expressed as constituent concentrations, levels, or narrative statement, representing a quality of water that supports a particular use. When criteria are met, water quality will generally protect the designated use.

Water Quality Modeling: A system of mathematical expressions that describe both hydrologic and water quality processes. When used for the development of TMDLs, models can estimate the load of a specific pollutant to a waterbody and make predictions about how the load would change as corrective actions are implemented.

Water Quality Standards (WQS): Standards established by the Connecticut Department of Environmental Protection for all of the state's waters to provide clear and objective statements for existing and projected water quality and the state's general program to improve Connecticut's water resources.

Water Resources Values: Natural values including those related to natural storage and conveyance of flood water, maintenance of water quality, and recharge of groundwater.

Waters of the United States: Currently defined by regulation to include all navigable and interstate waters, their tributaries and adjacent wetlands, as well as isolated wetlands and lakes, and intermittent streams.

Watershed: A region or area contributing ultimately to the water supply of a particular water course or waterbody. The Sasco Brook watershed, for example, is the area within which precipitation drains into the brook, its tributaries, and ultimately into Long Island Sound. A number of smaller watersheds called sub-watersheds may be identified within a larger watershed.

Watershed Management: The process of implementing land use practices and water management practices to protect and improve the quality of the water and other natural resources within a watershed by managing the use of those land and water resources in a comprehensive manner.

Watershed Management Planning: The process that results in a plan of how to best protect and improve the water quality and other natural resources in a watershed.

Watershed-Based Plan: A plan prepared to advance the restoration of a polluted or otherwise impaired waterbody by addressing a specific nonpoint source impairment identified on the DEP's list of impaired waterbodies, and with the ultimate goal of reducing or removing the impairment so the waterbody can meet water quality standards and be removed from the list.

APPENDIX B:

SELECTED REFERENCES

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Connecticut Department of Environmental Protection
http://www.ct.gov/dep/site/default.asp

From DEP Home Page, Search:

1. Air, Land, Water

2. Water

3. Watershed Management

3(a) Overview of Watershed Management Principles

3(b) Connecticut's Watershed Management Program

3(c) Watershed Management Plans and Documents

3(d) Guidance for Developing Watershed-Based Plans

3(e) Municipal Outreach and Low Impact Development for Watersheds

3(f) Funding Sources and Guidance for Watershed Management Plans and Projects

3(g) Nonpoint Source (NPS) Water Pollution Management

3(h) Proposed Stream Flow Standards and Regulations

And

From DEP Home Page, Search:

1. Air, Land, Water

2. Water

3. Water Quality

4. Surface Water

4(a) Overview of Watershed Management Principles

4(b) 40 Years of the Clean Water Act

4(c) Beach Monitoring

4(d) Impervious Cover Studies

4(e) Long Island Sound Water Quality Program and Information

4(f) Nonpoint Source (NPS) Management

4(g) Stormwater

4(h) Total Maximum Daily Load (TMDL)

4(i) Watershed Management

4(j) Water Quality Monitoring Program

4(k) Water Quality Standards and Classifications

Earthplace—The Nature Discovery Center
http://www.earthplace.org/

Fairfield County Community Foundation
http://www.fccfoundation.org/

National Fish and Wildlife Foundation Long Island Sound Futures Fund
http://www.nfwf.org/

Northeast Utilities Community Grant Program
http://www.nu.com/environmental/grant.asp

South Western Regional Planning Agency
http://www.swrpa.org/

Town of Easton
http://eastonct.gov/

Town of Fairfield
http://www.fairfieldct.org/

Town of Westport
http://www.westportct.gov/

U.S. Department of Agriculture Natural Resources Conservation Service (Connecticut)
http://www.ct.nrcs.usda.gov/

U.S. Environmental Protection Agency
http://www.epa.gov/

From EPA Home Page, Search:

1. Learn the Issues

2. Water

3. Stormwater

3(a) Basic Information

3(b) Municipal MS4s

3(c) Menu of BMPs

3(d) Green Infrastructure

3(e) Urban BMP Tool

And

From EPA Home Page, Search:

1. Learn the Issues

2. Water

3. Watersheds

3(a) Handbook for Developing Watershed Plans
to Restore and Protect our Waters

3(b) Water Quality Assessment and Total Maximum Daily Loads Information

3(c) Catalogue of Federal Funding Sources for Watershed Protection

University of Connecticut Center for Land Use and Education (CLEAR)
http://clear.uconn.edu/

University of Connecticut Map and Geographic Information Center (MAGIC)
http://magic.lib.uconn.edu/

University of Connecticut Nonpoint Education for Municipal Officials (NEMO)
http://nemo.uconn.edu/

University of New Hampshire Stormwater Center
http://www.unh.edu/unhsc/

APPENDIX C:

TOWN OF WESTPORT WATERSHED SURVEY*

Letter to Town Residents in the Sasco Brook Watershed

Map of Survey Zones

Description of Survey Zones

Survey Questionnaire

Summary of Survey Results

* On April 10, 2010, a door-to-door survey was conducted in the Sasco Brook watershed in the Town of Westport. This survey, an integral part of the Sasco Brook watershed-based planning process, was conducted by students from the Town's Staples High School who volunteered to assist the Sasco Brook Pollution Abatement Committee in the planning process. The survey provided data on the residents' views and concerns about the Sasco Brook Watershed. Those views and concerns were important considerations in the development of the Watershed-Based Plan.

WESTPORT, CONNECTICUT
CONSERVATION DEPARTMENT
TOWN HALL - 110 MYRTLE AVENUE
WESTPORT, CONNECTICUT 06880
(203) 341-1170 • FAX (203) 341-1088

April 10, 2010

Dear Town Resident in the Sasco Brook Watershed:

The Town of Westport and volunteer Sasco Brook Pollution Abatement Committee are conducting an environmental study of the Sasco Brook watershed. The watershed is the geographic area from which rainfall and other precipitation run off the land, into the brook, and ultimately into Long Island Sound.

The purpose of the study is to identify any environmental problems and develop reasonable solutions to them.

Members of the committee include Westport town agencies, the Connecticut Department of Environmental Protection, the Westport-Weston Health District, and the U.S. Department of Agriculture's Natural Resources Conservation Service. Private organizations in town such as Earthplace-The Nature Discovery Center and the Fairfield County Hunt Club are also committee members, along with interested citizens. In addition, the Town of Fairfield is participating because part of the watershed is in Fairfield.

The committee would like to know what you think about the watershed and about any concerns you may have. Students from Staples High School are assisting with this project and learning about the environment. They are visiting homeowners to provide information about the watershed and to conduct a brief survey of citizens' interests and opinions. Your answers will have a direct influence on the development of town goals and recommendations to help avoid pollution and otherwise protect and enhance the environment. If you are not home when the students call on you, please take a few minutes to complete the survey and return it according to the instructions on the survey form. You can also view and complete the survey on-line at:

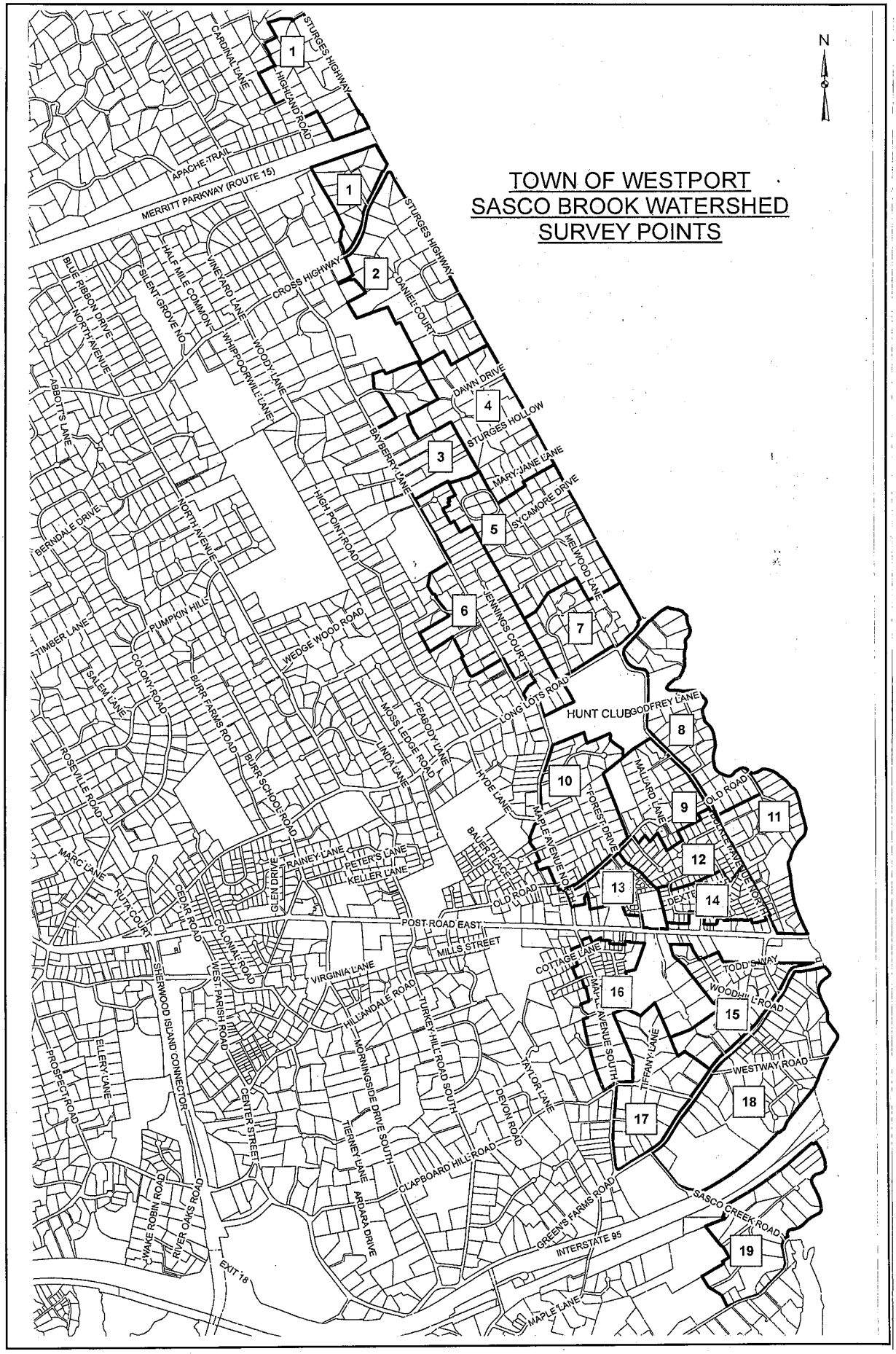
www.westportct.gov/agencies/landuse/conservation/.

We will keep you informed of our efforts and post the survey results on the Town's website. If you have any questions, please call the Westport Conservation Department at (203) 341-1170.

Sincerely,

Alicia Mozian

Alicia Mozian
Conservation Director, Town of Westport
Chair, Sasco Brook Pollution Abatement Committee


TOWN OF WESTPORT
SASCO BROOK WATERSHED
SURVEY POINTS
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STURGES HIGHWAY
CARDINAL LANE
HIGHLAND ROAD
APACHE TRAIL
MERRITT PARKWAY (ROUTE 15)
CROSS HIGHWAY
BLUE RIBBON DRIVE
NORTH AVENUE
SILENT GROVE NO
HALF MILE COMMON
VINEYARD LANE
WHIPPOORWILL LANE
WOODY LANE
DANIELS COURT
DAWN DRIVE
STURGES HOLLOW
BAYBERRY LANE
MARY JANE LANE
SYCAMORE DRIVE
MELWOOD LANE
ABBOTTS LANE
BERNDALE DRIVE
TIMBER LANE
PUMPKIN HILL
HIGH POINT ROAD
WEDGE WOOD ROAD
JENNINGS COURT
LONG LOTS ROAD
HUNT CLUB
GODFREY LANE
MALLARD LANE
OLD ROAD
FOREST DRIVE
MAPLE AVENUE NO
HYDE LANE
LINDA LANE
MOSS LEDGE ROAD
PEABODY LANE
BURR FARMS ROAD
BURR SCHOOL ROAD
COLONY ROAD
SALEM LANE
ROSEVILLE ROAD
MARC LANE
RUTA COURT
CEDAR ROAD
GLEN DRIVE
RAINEY LANE
PETERS LANE
KELLER LANE
BAUER PLACE
POST ROAD EAST
MILLS STREET
COTTAGE LANE
TODDS WAY
WOODHILL ROAD
MAPLE AVENUE SOUTH
TIFFANY LANE
WESTWAY ROAD
COLONIAL ROAD
WEST PARISH ROAD
SHERWOOD ISLAND CONNECTOR
VIRGINIA LANE
HILLANDALE ROAD
TURKEY HILL ROAD SOUTH
MORNINGSIDE DRIVE SOUTH
TAYLOR LANE
DEVON ROAD
ELLERY LANE
PROSPECT ROAD
CENTER STREET
TIERNEY LANE
CLAPBOARD HILL ROAD
ARDARA DRIVE
WAKE ROBIN ROAD
RIVER OAKS ROAD
EXIT 18
GREENS FARMS ROAD
INTERSTATE 95
SASCO CREEK ROAD
MAPLE LANE

April 5, 2010

TOWN OF WESTPORT
SASCO BROOK WATERSHED SURVEY

SURVEY ZONES

ZONE 1: North of Cross Highway and west of Sturges Highway; bounded on the north by Pilgrim Trail which is off Sturges Highway. Homes to be surveyed are along Sturges Highway, Pilgrim Trail, Cross Highway (on the north side), Primrose Lane (which is off Cross Highway), and Highland Road (which is off Bayberry Lane). The Merritt Parkway cuts through this zone.

ZONE 2: West of Sturges Highway and south of Cross Highway. Homes to be surveyed are along Sturges Highway, Cross Highway (on the south side), Boxwood Lane, and Daniel Court. Boxwood Land and Daniel Court are both off Sturges Highway.

ZONE 3: East of Bayberry Lane, bounded on the north by Baldwin Place and on the south by Bayberry Common. Homes to be surveyed are located along Bayberry Lane and at the end of Baldwin Place.

ZONE 4: West of Sturges Highway, bounded by Dawn Drive on the north and Mary Jane Lane on the south. homes to be surveyed are off Sturges Highway, Dawn Drive, Sturges Hollow, and Mary Jane Lane.

ZONE 5: West of Sturges Highway, bounded on the north by Sycamore Drive and on the south by the homes off Melwood Lane. Homes to be surveyed are off Sturges Highway, Sycamore Drive, Sturges Commons, Greenwood Lane, and Melwood Lane.

ZONE 6: Includes homes along Bayberry Lane, bounded by Bayberry Common on the north and Long Lots Road on the south. Homes to be surveyed are off Bayberry Lane, Bayberry Common, Jenning Court, and Long Lots Road.

ZONE 7: North of Long Lots Road and the Hunt Club; bounded on west by Sprucewood Lane and on east by Sturges Highway. Homes to be surveyed are off Long Lots Road (on north side), Sprucewood Lane, Paddock Lane, and Debra Lane.

ZONE 8: South of Long Lots Road and east of Bulkley Avenue North and the Hunt Club; bounded on the south by Old Road. Homes to be surveyed are along Long Lots Road (on the south side), Bulkley Avenue North (on the east side), Godfrey Lane, Ulbrick Lane, and Old Road.

ZONE 9: West of Bulkley Avenue North; bounded on west by Elizabeth Drive. Homes to be surveyed are along the west side of Bulkley Avenue North, Alpine Lane, Mallard Lane, Evans Court, and on both sides of Old Road.

ZONE 10: East of Maple Avenue North, bounded on the north by the Hunt Club and on the south by Old Road. Homes to be surveyed are along Maple Avenue North, Hunt Club Lane, Old Orchard Road, Forest Drive, and the north side of Old Road.

ZONE 11: East of Bulkley Avenue North, bounded on the north by Old Road and on the south by the Post Road. The properties along the Post Road are not part of the survey. Homes to be surveyed are along the east side of Bulkley Avenue North, Grist Mill Lane, North Sasco Common, and Palmieri Road.

ZONE 12: West of Bulkley Avenue North, south of Old Road, and north of the Post Road. Homes to be surveyed are along Westfair Drive, Elizabeth Drive, Brook Lane, Hunting Lane, and the west side of Bulkley Avenue South.

ZONE 13: South of Old Road, east of Maple Avenue North, and north of the Post Road. The properties along the Post Road are not part of the survey. Homes to be surveyed are along the south side of Old Road, Davis Lane, Oak View Circle, and the east side of Maple Avenue South.

ZONE 14: North of the Post Road, bounded by Bulkley Avenue North on the east. The properties along the Post Road are not part of the survey. Homes to be surveyed are along Dexter Road, Westfair Drive, and Fairport Road.

ZONE 15: South of the Post Road, east of the Landsdowne Condos, and north of Greens Farms Road. The Landsdowne Condos and the properties along the Post Road are not part of the survey. Homes to be surveyed are along the north side of Greens Farms Road, Woodhill Road, Bulkley Avenue South, Todd's Way, and Roshab Lane.

ZONE 16: South of the Post Road, bounded on the west by Maple Avenue South and on the east by the Landsdowne Condos. The Landsdowne Condos and the properties along the Post Road are not part of the survey. Homes to be surveyed are along Maple Avenue South (south to Clapboard Hill Road), George Street, and High Gate Road.

ZONE 17: East of Maple Avenue South and north of Greens Farms Road. Homes to be surveyed are along the north side of Greens Farms Road, Whitehead Terrace, Clapboard Hill Road, Tiffany Lane, and the east side of Maple Avenue South.

ZONE 18: Between Greens Farms Road and the Thruway and railroad, bounded on the west by Sasco Creek Road. The homes to be surveyed are along the south side of Greens Farms Road, Westway Road, Robin Hill Road, Tomahawk Lane, and Parsell Lane.

ZONE 19: South of the Thruway and railroad, between the Thruway and Beachside Avenue. Homes to be surveyed are along Sasco Creek Road, Gray Lane, Hedley Farms Road, and the north side of Beachside Avenue.

TOWN OF WESTPORT
SASCO BROOK WATERSHED SURVEY

1. **Do you know what a watershed is?** Yes ☐ No ☐

2. **Did you know that you live in the Sasco Brook Watershed?** Yes ☐ No ☐

3. **Does Sasco Brook or any of its tributaries have a <u>positive</u> impact on your property?**

   Yes ☐ No ☐ **If yes, why? Is it because:**

   ☐ The streams have scenic qualities?

   ☐ The streams support fish and wildlife?

   ☐ The plants and trees near the streams are important?

   ☐ You have other reasons? Please explain.

4. **Does Sasco Brook or any of its tributaries have a <u>negative</u> impact on your property?**

   Yes ☐ No ☐ **If yes, why is there a negative impact?**

5. **Are you aware of the impacts that a watershed can have on Long Island Sound?**

   Yes ☐ No ☐

6. **Do you participate in boating, beach-going or other recreational activities on Long Island Sound?**

   Yes ☐ No ☐

7. **Are you aware of the pollution problems that can be caused when rainfall runs off the land?**

   Yes ☐ No ☐

8. **Are you concerned about any environmental problems in Sasco Brook or any of its tributaries?**

   Yes ☐ No ☐ **If yes, are you concerned about:**

   ☐ Water pollution? ☐ Flooding? ☐ Other problems? Please explain.

9. **Do you make any special efforts to maintain your lawn and property in a way that will improve environmental quality and avoid pollution?**

   Yes ☐ No ☐

   If yes, what special lawn and property maintenance practices do you apply?

10. **Would you be willing to consider some new landscaping and other property maintenance practices if you knew those practices could avoid pollution and protect the environment?**

    Yes ☐ No ☐

11. **Would you be willing to participate in an organized volunteer project to improve the environmental quality of Sasco Brook and the watershed, such as a stream clean-up project or an educational activity?**

    Yes ☐ No ☐

12. **Would you be supportive of a Town of Westport watershed plan with goals and recommendations to protect and improve Sasco Brook and its watershed?**

    Yes ☐ No ☐

13. **Do wild geese congregate on your property?** Yes ☐ No ☐

14. **Does your home have a septic system?** Yes ☐ No ☐ Don't Know ☐

    If yes, do you know the recommended guidelines for maintaining your system?

    Yes ☐ No ☐

(Continued on back panel)

15. **Would you like to receive more information about specific homeowner initiatives that can help protect and improve the natural environment and avoid pollution?**

    Yes ☐ No ☐

    If yes, would you like to see that information provided on the Town of Westport web-site?

    Yes ☐ No ☐

16. **Please provide any additional comments or questions that you may have regarding Sasco Brook and the Sasco Brook watershed.**

THANK YOU FOR YOUR TIME AND INTEREST.

Summary of Survey Results

The one-day survey involved 797 properties in the watershed of which 613 were contacted by the student volunteers. The watershed was divided into 19 residential zones for the purpose of the survey. Volunteers were organized into two- and three-person survey teams and each team was assigned to a different survey zone. On the day of the survey, volunteers interviewed 183 residents and completed 183 forms; 45 forms were given to residents to mail in; 379 forms were left at a residence, 6 residents refused the survey, and 184 homes were not contacted. To date, 223 surveys have been completed, (183 verbal, 36 mailed in, and 4 from the "Monkey Survey" internet site), with a return rate of 36%.

The following breakdown of the responses to the 16 survey questions was prepared by the U.S. Department of Agriculture Natural Resources Conservation Service, an active member of the Sasco Brook Pollution Abatement Committee.

Question 1: Do you know what a watershed is?

65% – yes 34% – no 1%- other

Question 2: Do you know that you live in the Sasco Brook Watershed?

46%– yes 54% – no 0% - other

Question 3: Does Sasco Brook or any of its tributaries have a <u>positive</u> impact on your property?

37% – yes 59% – no 4% - other

If yes, why? Is it because:

- The streams have scenic qualities
- The streams support fish and wildlife
- The plants and trees near the streams are important
- You have other reasons
- Pond in backyard – ducks
- Drains property
- Assume
- We can't build on wet land
- In general has positive impact
- Recreation
- Interesting birds
- Access
- Recreational, aesthetics, wildlife
- Not directly – have respect and enjoy the variety of nature nearby including the birds.
- Lots of birds like osprey to watch

- Trees along the watershed greatly temper temperature during the warm season.
- It changes with the season, when it is high its exciting, watching the ducks, geese, herons use it is endlessly fascinating.
- Shields our property from other homes, gives privacy, beautiful trees, green all around.

Question 4: Does Sasco Brook or any of its tributaries have a <u>negative</u> impact on your property?

28% – yes 68% – no 4% - other

If yes, why is there a negative impact?

- Wetter conditions
- Animals
- Mosquitoes
- Flooding miserable
- Flooding
- Can't build on 1st floor
- Basement floods
- Flooding – high groundwater
- So much water and mud
- Swampy
- Very wet
- Building has increased flooding
- Devalues properties
- Killing ponds
- Devalues land – flooding
- Muddy backyards
- Water in basement
- Trees falling into river – positive impact can be maintained even if dead trees were trimmed
- Potential flooding
- Pollution
- Reduced people's property values
- If there is garbage – like shopping carts
- Runs under property
- I don't know
- PCBs
- Wetlands – can't build on it
- Water table too high
- Wet land hard to garden
- Bad weather

- Maintain it a lot of hard work
- Geese
- Could flood
- Flooding on property and inside house
- Not negative – just a choir with septic
- Source of woodchucks
- undecided
- Swampy appearance
- Just the flooding , water in house from flooding four times in past seventeen years
- If high tide and high rainfall prevent speedy drainage
- Flow impeded by dams – flooding uprooting trees
- Flood runoff from creek to property
- Sometimes floods property
- Lots of geese

Question 5: Are you aware of the impacts that a watershed can have on Long Island Sound?

65% – yes 35% – no 0%- other

Questions 6: Do you participate in boating, beach-going or other recreational activities on Long Island Sound?

82%– yes 18% – no 0% – other

Question 7: Are you aware of the pollution problems that can be caused when rainfall runs off the land?

88%– yes 12% – no 0%- other

Question 8: Are you concerned about any environmental problems in Sasco Brook or any of its tributaries?

68% – yes 30% – no 2% - other

If yes, are you concerned about?

- Water Pollution
- Flooding

Other problems? Please explain.

- Flooding , long island sound
- Conservation doesn't participate in pesticide issues
- Too much development negatively affecting the watershed
- Too much silt
- Drainage getting worse on Buttonwood Lane

- Wetlands being filled
- Runoff
- Chemicals on lawns
- Deforestation, global climate change, keeping intelligent design out of schools
- Pharmaceuticals
- Doesn't want to ruin earth
- Algae growth kills fish
- Don't know what they are
- Future of water supply, muddy brook, sewage contamination
- High coli form counts, water turned Windex color, water pollution
- Dumping
- Greens Farm Station rust run off
- Nitrogen problem
- Pesticides
- Fertilizer
- Unaware of any problems
- Want to maintain the environment for animals and plants, they have so little left along the shoreline

Question 9: Do you make any special efforts to maintain your lawn and property in a way that will improve environmental quality and avoid pollution?

71%– yes 28%– no 1%- other

If yes, what special lawn and property maintenance practices do you apply?

- No chemicals
- No pesticides and some spraying
- No fertilizers
- Green Enviro Company and green lawn
- No toxic fertilizers or weed killer
- Organic
- Fertilizer used rarely
- All organic and home admin
- Use natural fertilizer, use organic fertilizer
- Drains – dry wells, lowering water use
- Organic pesticides
- No dumping
- Use green contractor
- Trees, cleans drains, no pesticides, remove debris, plants to draw water
- Not sure
- Chemicals
- No lawn care
- Organic lawn chemicals

- Natural fertilizers
- No leaf blowing
- Landscaping service
- Gravel under deck and plants surrounding to prevent erosion
- Septic tank maintenance
- Environmentally safe fertilizers
- Bio degradable pesticides
- Natural grass
- Winter rye on fields for erosion
- Recycling
- Emptying septic tank every 2 years
- Take of it naturally, avoid fertilizers, clean lawn
- You can't do anything possible attract rodents
- Sprayed with environmentally friendly materials
- No herbicides
- Organic mulch
- Minimal weed killing
- Organic pest control methods
- Compost and no chemical fertilizers
- No fertilizer, regular cleaning of septic system, cuts left on lawn, no toxic waste
- No chemicals on the lawn
- Built a small berm to prevent further land erosion
- Minimal chemical application, organic where possible
- No chemicals, fertilizers, or other harmful substances used
- Asked landscaper to use less polluting treatments for grass and shrubs, Leave clipping on lawn when mowed
- No poisons or weed killers or many chemicals on lawn
- Use Save-A-Lawn as a lawn service, they apply mostly organic treatments and they help us preserve our trees as much as possible
- No sprinkler system, conservation zone, planting to control runoff
- Septic, cog waste pickup
- Absolutely no chemicals of any sort
- Avoid using pesticides, do not use lawn service
- Don't use fertilizers, pesticides or herbicides
- Purposely use no chemicals on lawns and plants, maintain septic regularly
- No chemicals on grass
- No fertilizers used, clippings remain on lawn
- No fertilizer, divert cleansers
- Minimal pesticides
- Minimal use of pesticides, less concern about appearance, let natural weed growth continue.

- Green products
- Don't fertilize lawns
- I do not apply any pesticides or fertilizers
- No dog waste, fertilizer is environmentally friendly
- Don't use harmful chemicals on lawn and plants.

Question 10: Would you be willing to consider some new landscaping and other property maintenance practices if you knew those practices could avoid pollution and protect the environment?

86% –yes 13% – no 1% - other

Comments:

- Uses a green lawn care service
- Depends on price
- Costs should be low
- Costs
- Plantings – need more plants
- Erosion

Question 11: Would you be willing to participate in an organized volunteer project to improve the environmental quality of Sasco Brook and the watershed, such as a stream clean-up project or an educational activity?

51%–yes 43% – no 6%- other

Comments:

- Time permitting
- Maybe
- Maybe
- Maybe
- Undecided
- Tax dependent
- Depends on timing/work may interfere
- Possibly
- Already cleans out own stream
- Over committed right now – might have time in the summer
- Have done this on our own/a stream cleanup
- Depends
- Possible
- But from my eyes, the brook always seems clean and clear.

Question 12: Would you be supportive of a Town of Westport watershed plan with goals and recommendations to protect and improve Sasco Brook and its watershed?

85%– yes 9% – no 6%- other

Comments:

- Depends on impact
- Depends on the plan
- If they don't affect land/taxes/not impact property values
- Tax dependent
- State of CT
- Basement!
- Depends on costs
- But not at substantial financial cost
- People should volunteer – it shouldn't be mandatory
- Depends on plan
- Depends on the specific requirements of the plan
- Depending on the content of such plan
- Depends

Question 13: Do wild geese congregate on your property?

9%– yes 91%- no 0% -other

Comments:

- Have turkeys and deer
- Ducks – when wetland overflows
- Ducks in wetland
- They congregate across the street/hundreds on Hunt Club polo field
- Sometimes wild turkeys, but no geese – thank goodness!
- Occasionally they walk up the bank on my property
- Not often, but occasionally
- Sometimes, not often

Questions 14: Does your home have a septic system?

83%– yes 16%– no 1% - other

If yes, do you know the recommended guidelines for maintaining your system?

71% – yes 11%– no 18% - other

Comments:

- Kind of knows
- I had it crushed and filled – connected to sewer in 1999

Questions 15: Would you like to receive more information about specific homeowner initiatives that can help protect and improve the natural environment and avoid pollution?

75% – yes 24% – no 1%- other

Comments: Email

If yes, would you like to see that information provided on the Town of Westport website?

73% – yes 18% – no 9%- other

Comments:

- By mail
- Regular mail
- Save the paper

Question 16: Please provide any additional comments or questions that you may have regarding Sasco Brook and the Sasco Brook watershed.

Comments:

- Do the tributaries affect my properties? Example: Brook
- Like to see more information in *Minuteman* and *Westport News.*
- Is it part of the Saugatuck? Impact our drinking water? Has it been deteriorating? Does it wash onto beaches? Education for new home owners. Try to keep cost down on the more enviro-friendly alternatives.
- No
- No
- Great idea – plans set forth
- More public seminars/blowing leaves into Creek
- Realtors need to be upfront about properties, wetlands and rules/regulations
- Large homes – overuse of land – water has to go someplace
- Do something to curve deer population/oversupply of animals not good for environment in general/maintain streams/sewer system – need to enforced it
- Home Goods/Mall pollutes. During storms it floods and gets trash everywhere, blocks up stream – need to clean up their act.
- Positive effort, good idea
- Don't know too much
- Don't think people have an idea, need a website, status of the water, happy to take samples. Assessment of quality of fish, or lots of blue crabs. Hope to get people to appreciate the Sasco Brook. Keep an eye on it.
- I grew up catching frogs, turtles, and fish in Sasco Creek. I use to catch trout (they use to stock it in 1950s). 35 years ago I was concerned about over development. I feel the town has no foresight into these problems. It is about time they reacted.
- Thank you for doing this!
- I would love to eventually have some of the rank smelling mud flushed from the pond and dam repair.
- If there are special rules, regulations for this watershed that we should be following, perhaps a mailing or other easy way to find out what those rules are would be helpful.

- I think it is great that you are working together with the Staples students – win/win- and I was very receptive to them because they are students. Thanks!
- Fish (minnows), ducks, frogs, etc., no longer are in the stream alongside and running through 76 Bulkey Ave N.

APPENDIX D:

PROPOSED *E. COLI* RIBOTYPING PROJECT (FECAL BACTERIA REDUCTION PROJECT)*

* This proposed project is identified in the Watershed-Based Plan as a priority analytical measure for implementation. The proposed scope of work included in this appendix was developed in the course of the watershed-based planning process and submitted for funding in 2011 through the National Fish and Wildlife Federation Long Island Sound Futures Fund.

Long Island Sound Futures Fund 2011
Full-proposal Project Narrative
Application for: Stormwater and Nonpoint Source Pollution Control Implementation Projects

Instructions: This is the application for Long Island Sound Futures Fund (LISFF) Large Grant, Stormwater and Nonpoint Source Pollution Control projects that involve activities aimed at directly reducing pollutant loads and hydrologic impacts resulting from modification of waterways. If you are requesting funding for habitat restoration, invasives species control, species conservation, stewardship, acquisition, education, planning of any type (including planning to implement a water quality project aimed at directly reducing pollutant loads) projects or a small grant you are not using the correct application.

If a document, figure or photo is requested in the narrative, please provide it or provide a reason why the document is not available. Answer all questions and complete all sections. If you feel a section is not relevant to your application, insert the phrase "not applicable" and explain why you believe the question is not relevant.

The final narrative should not exceed twenty-five (25) pages. Save this document on your computer and complete the narrative in the format provided. Please do not: 1) delete any of the narrative text below, 2) alter the format, 3) change the numbering, or 4) remove the questions from this application template and place on your own template, letterhead or paper. **Under no circumstances can you create your own format or application. If you do so the proposal will be immediately rejected**. Please do not upload scanned versions of this project narrative (pdf, Microsoft Word etc. acceptable). Upload the completed narrative into the on-line application as instructed into the "Uploads" section of that application.

Proposals due by 5pm Eastern Standard time, 03/18/11. The online application will close at that time. **Problems using online system – contact john.wright@nfwf.org. Content questions – contact lynn.dwyer@nfwf.org. We are happy to assist you.**

1. **Innovation proposal: Grants ranging from $20,000 to $125,000 will be awarded to test new and innovative ecosystem-based management approaches that will expand the collective knowledge about the most cost effective and sustainable approaches to water and habitat quality improvement. Funding may be for any type of activity addressed in this RFP as long as the activity may fairly be characterized as "innovative' such as a new idea, method, or device associated with the RFP activities. Are you applying for a grant in this category? Yes (X) No ( ).**

2. **Why Innovative? If you answered yes to describing this as an "innovation grant request" describe why you believe your project should be considered an innovation grant?**

   This is an innovative implementation grant request because it uses Microbial source tracking (MST) technologies and methodologies to identify bacterial pollution source species from waters subject to a variety of pollution sources. Microbial source tracking can be a cost effective tool for identifying microbial pollution sources allowing watershed managers to focus remediation efforts on the most significant sources rather than guess work and trial by error. Focused remediation efforts should result in less pollution over time negatively impacting recreational and/or shellfishing areas. This will be the first time microbial source tracking technologies have been applied to environmental water quality sanitation efforts in Connecticut in this manner.

The Sasco Brook watershed has been identified as being suitable as a model watershed for development of a Southwest Connecticut shoreline microbial source tracking (MST) program utilizing DNA ribotyping and T-RFLP analysis. In addition to more accurately and quantifying the most significant sources of microbial pollution in Sasco Brook, this project will establish the Connecticut Agricultural Experiment Station as Connecticut's repository for molecular source reference data, expanding our collective knowledge and ability to identify pollution sources. This source species molecular database/library will be the first of its kind in Connecticut and will be available to other shoreline communities and/or Connecticut agencies seeking to identify sources of microbial contamination.

3. **Problem. Describe the water quality problem the project will address and the source of the problem?**

Sasco Brook and the ten-square mile Sasco Brook watershed are within the Long Island Sound Stewardship area and part of the much larger watershed of Long Island Sound - an estuary of national significance as designated by the U.S. Congress. The water quality of the Sound is greatly dependant on the water quality of its many tributaries and watersheds.

Sasco Brook has been identified by the Connecticut Department of Environmental Protection (DEP) as an impaired water body not meeting state water quality standards for contact recreation due to the detected presence of bacterial contamination which, among other impacts that are less apparent, has resulted in the state-imposed closure of public shellfish beds near the mouth of the brook in Long Island Sound.

Since 1991 the Town of Westport has been proactively working to identify the sources of bacterial contamination found from time to time in Sasco Brook. It has pursued several successful initiatives to improve water quality that have resulted in measurable reductions in the detected amounts of bacterial contamination. These initiatives included, but were not limited to, establishment of a water quality monitoring program, implementation of best management practices to reduce bacterial contamination generated by horse farms, extension of sanitary sewers in targeted areas, and public outreach and education directed towards watershed residents and business owners. However, unacceptable levels of bacterial contaminations continues to be present intermittently.

Waste load methodologies used in other Connecticut studies for estimating the amounts of fecal bacteria generated by potential sources of watershed contamination have been calculated. Such methodologies include computer driven models that require substantial data sets, significant number of assumptions and input variables. Application of these methodologies to the Sasco Brook Watershed have indicated that the most significant sources of fecal bacterial contamination may be geese and dogs. However, because of the multitude of calculations and assumptions these methodologies use, they do not provide sufficient confidence for municipal leaders to be able to justifying additional expenses for more aggressive pollution abatement measures.

4. **Solution. Describe how your project will reduce or eliminate the problem?**

The Sasco Brook Fecal Bacteria Pollution Reduction Project is one of several implementation strategies identified in the pending town of Westport's Sasco Brook Watershed Based Plan to reduce bacterial pollutants below the established TMDL. This project seeks to validate the computer modeling findings outlined in Westport's Sasco Brook Watershed Based Plan by more accurately identifying and quantifying the most significant sources of fecal contamination within the Sasco Brook watershed. Environmental sanitation efforts can then target the identified source(s) and municipal leaders will have science based evidence in which to build public support to pursue additional remedial actions beyond that which have already been implemented. It should be noted that it is likely pollution source species may be identified for which there may not be management strategies or best management practices

available. In this case the Westport Weston Health District will facilitate the establishment of an interagency and regional task force to address fecal contamination identified as originating in non-human and unregulated sources and determine options and best management practices to reduce it.

5. **Project Goals. Describe the water quality goals of the project?**

This project has the following four (4) primary goals:

1. Validate the computer modeling findings outlined in Westport's Sasco Brook Watershed Based Plan using microbial source tracking technologies.
2. More accurately identify and quantify the most significant non-human sources of fecal bacterial contamination within the Sasco Brook watershed so that efforts can be targets to reduce them.
3. Development of a Southwest Connecticut shoreline molecular source reference database/library for use by other shoreline communities and/or agencies in their efforts to improve recreational and shellfish bed waters in Long Island Sound.
4. Establishment of an interagency and regional task force to address sources of fecal contamination identified as originating from non-human and unregulated sources, to determine options and best management practices to reduce this pollution.

6. **Amount of Area Retrofit or Restored. Estimate extent of area to be retrofit or restored (linear feet, acres etc.)?**

Sasco Brook and the ten-square mile Sasco Brook watershed are within the Long Island Sound Stewardship area and part of the much larger watershed of Long Island Sound - an estuary of national significance as designated by the U.S. Congress. The water quality of the Sound is greatly dependant on the water quality of its many tributaries and watersheds. This project will address microbial pollution from the Sasco Brook Watershed. By reducing fecal bacteria loading of Sasco Brook, this project seeks to protect the public from potentially harmful pathogens resulting in a reduction in bathing beach closures and re-opening state mandated shellfish bed closures in the area where Sasco Brook discharges into Long Island Sound.

7. **Amount of Treatment or Reduction. Estimate the gallons of water to be treated or infiltrated per year?**

Not Applicable – this project does not propose to treat or filter water.

8. **Site Information. Describe in written form and upload an aerial photo or map with the project site location and boundaries marked on the photo or map.** The map and written description should provide the location of the site in terms of its relationship to the Long Island Sound. Provide the latitude and longitude of the project location in degrees, minutes, seconds format. Google maps are an acceptable format. The maps or photos will be uploaded into the "Uploads" section of the online application. (Map and/or photo(s) are counted towards 25-page limit). Please note, it is helpful to reviewers if you caption photos or a map describing what is represented in the document.

Sasco Brook and the ten-square mile Sasco Brook watershed are located within the municipalities of Westport and Fairfield Connecticut. The watershed boundaries are delineated on the map supplied. Pathogens found in Sasco Brook water for DNA ribotyping and T-RFLP analysis will obtained near where the Sasco Brook discharges into Long Island Sound to capture pathogens from throughout the watershed. The sample point will be just upstream of the Pequot Avenue bridge. The latitude and longitude of Pequot Avenue bridge is: Lat 41° 07' 29.76N, Long 75° 17' 55.98W

Bacteria in scat samples for DNA ribotyping and T-RFLP analysis will be obtained from throughout the

Sasco Brook Watershed proper and along the Southwest Connecticut shoreline from Fairfield to Darien Connecticut.

9. **Fit to the LISFF RFP. Describe how this project specifically relates to the eligible activities described in the LISFF Request for Proposals?**

This project fits within the LISFF RFP General Categories of Grants and Levels of Funding in the category of Implementation Grants because this project will lead to measurable improvement in the health of Long Island Sound and its watershed by more accurately identifying and quantifying the sources of fecal contamination impacting the Sasco Brook Watershed. With more accurate identification, targeted efforts can be undertaken to reduce pathogens from these sources. The reduction of pathogens from the Sasco Brook Watershed will improve the water quality in the area where it discharges into Long Island Sound so that near by Southport and Westport bathing beaches are better protected and impaired shellfish beds maybe re-opened. Additionally, as a pilot program to establish a Connecticut source species molecular database/library, Connecticut shoreline communities and/or Connecticut agencies will be better able to develop and participate in cost effective coastal nonpoint pollution control programs to control pathogen discharges in Long Island Sound. This project may also identify potential sources of pathogens which have not traditionally been considered in the past, but could be identified using DNA ribotyping and T-RFLP analysis.

10. **Local or Regional Context of the Project. Reference specific local or regional watershed initiative or plan (e.g., *Comprehensive Conservation and Management Plan for the Long Island Sound, Long Island Sound Total Maximum Daily Load for Dissolved Oxygen* etc.) to which the project relates?**

Sasco Brook and the ten-square mile Sasco Brook watershed are within the Long Island Sound Stewardship area and part of the much larger watershed of Long Island Sound - an estuary of national significance as designated by the U.S. Congress. The water quality of the Sound is greatly dependant on the water quality of its many tributaries and watersheds.

The plan addresses the Long Island Sound Study Comprehensive Conservation and Management Plan in terms of Pathogen Contamination reduction as it relates to public bathing beach and shellfish bed closures.

Sasco Brook has been identified by the Connecticut Department of Environmental Protection (DEP) as an impaired water body not meeting state water quality standards for contact recreation (swimming) due to the detected presence of bacterial contamination which has resulted in the state-imposed closure of public shellfish beds near the mouth of the brook in Long Island Sound.
The Sasco Brook Fecal Bacteria Pollution Reduction Project is one of several implementation strategies identified in the pending town of Westport's Sasco Brook Watershed Based Plan to reduce the bacterial pollutants below the established TMDL.

11. **Current Uses. Identify current uses of the proposed retrofit or restoration area?** A photo showing current site conditions is particularly helpful to reviewers. The photos will be uploaded into the "Uploads" section of the online application. (Photo(s) are counted towards 25-page limit). Please note it is helpful to reviewers if you caption photo describing what is represented in the document.

The ten square mile Sasco Brook Watershed is located in the towns of Fairfield and Westport Connecticut. The watershed is characterized predominately by single family homes on larger lots of more than one (1) to two (2) acres with on-site subsurface sewage waste disposal systems in the headwaters, mixed uses and smaller lots in the mid section and greater housing density and businesses between the Post Road (U.S. Rt. 1) and interstate 95 corridor. Along the shore, there are homes and public beaches. The submitted watershed map is part aerial photograph and shows these uses.

12. **Adverse Project Impacts. Describe the adverse impacts (if any) at the site of the proposed retrofit or restoration?** (This is particularly important in the case of where you may be working in areas of sensitive natural resources).

    There will be no adverse project impacts.

13. **Methods. Describe in detail the methods to complete the retrofit or restoration project?** You **must** also upload either a conceptual or an engineered plan which illustrates the retrofit or restoration approach into the "Uploads" section of the online application. Plans are counted towards 25-page limit. Please note, if you do not upload a plan, it is highly likely your proposal will not be funded.

    There are no conceptual or engineered plans as part of this project. However, the methodologies to be employed with the DNA ribotyping and T-RFLP analysis are fully described in the required QAPP submittal.

14. **Measuring Impact. Describe in detail how you will measure the specific water quality benefits of the project (i.e., targeted water quality data sampling at designated locations, metering of flows, tracking of waste intercepted or removed and etc.)?**

    New data and testing results will be integrated with previously collected surface water quality monitoring data from the Town's files. A benchmark of comparison for future ongoing monitoring to measure the effectiveness of water quality improvement efforts will be established. Once pathogen source species have been identified and appropriate and/or applicable management strategies considered, town water quality monitoring efforts will used to determine whether bacterial pollutants are below the established TMDL. A final report will be produced outlining the results of the DNA ribotyping and T-RFLP analysis. All DNA ribotyping and T-RFLP data will be made available to the Connecticut Agricultural Experiment Station for future microbial source tracking efforts.

15. **Maintenance and Management. Describe the long term maintenance/management that you will implement associated with the project?**

    There is no long term site or facility maintenance associated with this project. However, the Connecticut Agricultural Experiment Station has agreed to be the repository for the DNA ribotyping and T-RFLP analysis data generated by this project, to be built upon over time and used for future microbial source tracking efforts by Connecticut shoreline communities and/or agencies.

16. **Workplan: Provide a breakdown of key project activities and projected timeline to complete that work? Project should be completed in 1 year to 15 months.** Project should begin within 3 months of award (e.g., Fall 2011).

Activity	Timeline
Grant Submittal	March 18, 2011
Grant Award	September 30, 2011
Water fecal collection and analysis begins	December 15, 2011
Scat fecal collection and analysis begins	December 15, 2011
Need for task force evaluated	May 15, 2012
Completion of fecal collections and analysis	December 15, 2012
Need for task force evaluated and/or task	

for initiated	January 1, 2013
Final Report	March 15, 2013

17. **Assessments/Feasibility Studies/Lists. List any feasibility studies or assessments prepared to address the site retrofit or restoration?** If you have any of this type of documentation associated with the project design e.g. plant lists, flow analysis etc., we highly recommend you provide them as they are very important to our review. These documents go into the "Uploads" section of the online application.

Name of Study/Assessment	Purpose
Sasco Brook Watershed Based Plan (pending)	The Sasco Brook Fecal Bacteria Pollution Reduction Project is one of several implementation strategies identified in the plan. The Plan addresses town's strategy to reduce the bacterial pollutants in Sasco Brook below the established TMDL.
Sasco Brook Summary, Westport Weston Health District, 2001 Interim Report	Sanitary survey results for homes in Westport within the Sasco Brook Watershed. Documentation of fecal contamination and previous efforts to reduce levels.
A Total Maximum Daily Load Analysis for Southport Harbor Shellfishing Areas, Fairfield, Ct., Sept. 12, 2007, Ct. DEP.	Analysis of fecal pollution load in Sasco Brook and impact on local shellfishing beds.
Water Quality Data Year End Report for Sasco Brook Watershed, Feb. 1999 to March 2000, CTDEP commissioned study with EPA 319 funding	Water quality monitoring report establishing pathogen problem.
Report for the Town of Westport, Sasco Creek Water Quality Reports, prepared by Nature Center for Environmental Activities/Earth Place, Westport Ct. Various reports, multiple years.	Water quality monitoring reports establishing pathogen problem.

18. **Special Status Species. Have reviews been conducted to determine if special status species are present at the project site and are such species currently occupying the site? If so, list the species.**

Not Applicable – this project has no impact on any species or project site.

Special Status Species	Status (federal or state)

19. **Quality Assurance Project Plans. Please note projects involving Data Collection may require a United States Environmental Protection Agency, Quality Assurance Project Plan (QAPP).** The general rule of thumb is a QAPP is required when the data or the results of the data would be used by an external entity to guide their management or projects. Data collected by students for use in the classroom does not require a QAPP. Any questions about when a QAPP is required please contact Lynn.Dwyer@nfwf.org. Check one: ( ) Our project has an EPA approved QAPP (X) We are developing an EPA approved QAPP ( ) We need to seek an EPA approved QAPP ( ) We are not collecting data associated with our project.

    A project QAPP has been developed and submitted to the EPA for approval. A copy the Sasco Brook Fecal Pollution Reduction Project Quality Assurance Project Plan, dated March 18, 2011, has been uploaded as part of this submittal.

20. **Project Match. Break out the match relative to LISFF 2011 budget request?**

Budget Category	Total $s project budget by Budget Category	Nonfederal cash or inkind matching contributions Applied to Budget Category	LISFF $s Requested towards Budget Category
Salaries & Benefits	33,600	12,000	21,600
Equipment			
Contractual Services	90,022.80	18,300	71,722.80
Supplies/Materials	22,269		22,269
Printing			
Travel	2,550		2,550
Other	750		750
Totals	149,191.80	30,300	118,891.80

21. **Experience. Describe staff and organization's experience in conducting similar types of projects?** Please do not insert or attach resumes or CVs. Provide no more than a single paragraph description of individual staff expertise.

    Project Manager Mark A.R. Cooper, Director of Health, Westport Weston Health District. B.S. - Natural Resource and Conservation Management., M.P.H. –Administration. Former ten year chairman of a local Water Pollution Control Authority and separate Inland-wetland Commission. Over 32 years of experience in program and project management. Was responsible for community improvement projects valued over $10,000,000 during tenure as the First Selectman for the Town of Southbury. Have served on the board of directors, advisory boards and board of trustees of various quasi public and public agencies.

    John Cimarosa, Director of Finance, Westport Weston Health District. Will be assisting in financial management of project. Mr. Cimarosa has been the Health District's Director of Finance and Special

Projects for two years, and before that was an independent consultant. His firm provided financial management, administrative and information technology services to the District for over 15 years.

The Westport Weston Health District is the local health department for the towns of Westport and Weston, Connecticut. It was the first such regional health district recognized by the State of Connecticut (founded in 1966), and has managed a number of important environmental projects. The most recently managed "Target Lyme Disease", a nine year program supported by the Centers for Disease Control and Prevention (CDC) with a budget of over $1.5 million over that period.

22. Continuing Projects. Indicate whether this project is a continuation or expansion of an existing project and provide information on the status and results/outcome of the previous work.

Not Applicable. This is the first application for consideration of funding.

23. Prior Grant. If you have received a prior grant under the Long Island Sound Futures Fund, please provide no more than two paragraph summary of your progress associated with that grant relative to promised deliverables?

Not Applicable. This is the first application for consideration of funding

24. Dissemination. Describe how the results of the project will be communicated to appropriate audiences (e.g., websites, signs, public outreach etc.)?

Final Reports to all interested and appropriate party's including but not limited to local, state and federal governmental officials and/or agencies, local media outlets. Professional peer review journal submittal to be considered.

25. Partner Justification. Describe the strength, qualifications and nature of the specific contribution of other collaborating organizations?

Stephen Jones, Ph.D. University of New Hampshire Jackson Estuarine Laboratory. Research Professor of Marine Science/Natural Resources, Ph.D. in Bacteriology; 26 years experience in microbiology. Recognized expertise in field.

Douglas Dingman, Ph.D.,Department of Biochemistry and Genetics, The Connecticut Agricultural Experiment Station. Associate Scientist at CAES, Ph.D. in Microbiology; 31 years experience in microbiology/molecular biology. Recognized expertise in field.

26. Community Involvement. Describe how the project will involve the local community(ies)?

In 1991 the Town of Westport Conservation Department organized the Sasco Brook Pollution Abatement Committee (SBPAC), a voluntary alliance consisting of representatives of local, state, and federal agencies, private organizations, and interested citizens. Several SBPAC initiatives resulted in the successful reduction of the detected amounts of bacterial contamination in Sasco Brook from potential sources of contamination from human and/or human related activities such as failing septic systems, domestic animals and agricultural activities. These initiatives included, but were not limited to, establishment of a water quality monitoring program, implementation of best management practices to reduce bacterial contamination generated by horse farms, extension of sanitary sewers in targeted areas, and public outreach and education directed towards watershed residents and business owners. The Based Plan, and support it implementation.

27. **Site Ownership. Identify current site ownership (i.e., Ms. I love Nature Smith, 12 Estuarine Row, Windsor, CT)?** Please upload a letter of permission to work on the site into the "Uploads" section of the online application. If you own the site, prepare a paragraph on letterhead stating "Name of group" owns the restoration site" and upload that document into the "Uploads" section of the online application."

    The property is owned by the town of Fairfield and is overseen by the Town of Fairfield Conservation Department as a Conservation Open Space property. As Director of the Conservation Department, he provided approval to access the collection site in a letter dated March 17, 2011. It has been submitted as part of this application.

28. **Project Certification. I certify that this project is not a legally mandated action under local, state or federal law, under an administrative permit condition, or under the terms of a settlement agreement. If your project is a legally mandated action it is not eligible for funding under the LISFF. Check: (X) Agree.**

29. **UPLOADS! List of Required and Recommended Uploads.** In the LISFF online application you will note there is a section called "Uploads." Please look at the table below which provides a list of those uploads and when you should be prepared to upload a document. Please note all the following documents must be uploaded as part of the application process for water quality proposals. It is important to upload photos, maps, letters, plans, lists, assessments in a high resolution format. Low resolution or scanned photos, maps and schematics may not be legible to reviewers after upload. Set the resolution on the image to 640 x 480 pixels. Some cameras may have resolution settings such as "small," "medium," etc. instead of actual pixel dimensions. High resolution documents may take longer to upload.
30.

Document	Status	What to upload
Map	Required	Upload an aerial photo or map with the project site location and boundaries marked on the photo or map. The map and written description should provide the location of the site in terms of its relationship to the Long Island Sound. Google maps are an acceptable format. Please note, it is helpful to reviewers if you caption photos or a map describing what is represented in the document.
Letters of Support	Optional	You may provide a maximum of 5 letters. We suggest you put letters in a single file rather than uploading multiple individual letters. Letters will not be accepted after the close of the application period. Address letters of support: LISFF Review Team, c/o NFWF, 40 West 4th Street, #151, Patchogue, NY, 11772.
Landowner Permission Letter	Required	Letters documenting permission to work on private, federal or state land not owned or managed by the applicant are required. If you own the site, prepare a paragraph on letterhead stating "Name of group" owns the restoration site" and upload that document into the "Uploads" section of the online application. Please note, it is helpful to reviewers if you caption photos or a map describing what is represented in the

		document.
Conceptual or engineered plans	Required	Provide either a conceptual or an engineered design for your projects. If you do not provide one or the other type of design you will not be funded.
Photos	Highly Recommended	Photo illustrating site conditions are very helpful to reviewers. Please note, it is helpful to reviewers if you caption photos or a map describing what is represented in the document.
Assessments/Lists	Optional, but recommended	Assessments confirming need for project or value of project and plant lists especially associated with ecological restorations. Do not upload big generic plan(s) or assessment(s). Prepare a document for upload of the sections of the assessment or plan most relevant to the LISFF application.

APPENDIX E:

PROPOSED FAIRFIELD COUNTY HUNT CLUB POLLUTION REDUCTION PROJECT*

* This proposed project is identified in the Watershed-Based Plan as a priority structural measure for implementation. The proposed scope of work included in this appendix was developed in the course of the watershed-based planning process and submitted for funding in 2011 through the National Fish and Wildlife Federation Long Island Sound Futures Fund.

Long Island Sound Futures Fund 2011
Full-proposal Project Narrative
Application for: Stormwater and Nonpoint Source Pollution Control Implementation Projects

Instructions: This is the application for Long Island Sound Futures Fund (LISFF) Large Grant, Stormwater and Nonpoint Source Pollution Control projects that involve activities aimed at directly reducing pollutant loads and hydrologic impacts resulting from modification of waterways. If you are requesting funding for habitat restoration, invasive species control, species conservation, stewardship, acquisition, education, planning of any type (including planning to implement a water quality project aimed at directly reducing pollutant loads) projects or a small grant you are not using the correct application.

If a document, figure or photo is requested in the narrative, please provide it or provide a reason why the document is not available. Answer all questions and complete all sections. If you feel a section is not relevant to your application, insert the phrase "not applicable" and explain why you believe the question is not relevant.

The final narrative should not exceed twenty-five (25) pages. Save this document on your computer and complete the narrative in the format provided. Please do not: 1) delete any of the narrative text below, 2) alter the format, 3) change the numbering, or 4) remove the questions from this application template and place on your own template, letterhead or paper. **Under no circumstances can you create your own format or application. If you do so the proposal will be immediately rejected**. Please do not upload scanned versions of this project narrative (pdf, Microsoft Word etc. acceptable). Upload the completed narrative into the on-line application as instructed into the "Uploads" section of that application.

Proposals due by 5pm Eastern Standard time, 03/18/11. The online application will close at that time. **Problems using online system – contact john.wright@nfwf.org. Content questions – contact lynn.dwyer@nfwf.org. We are happy to assist you.**

1. **Innovation proposal: Grants ranging from $20,000 to $125,000 will be awarded to test new and innovative ecosystem-based management approaches that will expand the collective knowledge about the most cost effective and sustainable approaches to water and habitat quality improvement. Funding may be for any type of activity addressed in this RFP as long as the activity may fairly be characterized as "innovative' such as a new idea, method, or device associated with the RFP activities. Are you applying for a grant in this category? Yes ( ) No (X).**

2. **Why Innovative? If you answered yes to describing this as an "innovation grant request" describe why you believe your project should be considered an innovation grant?**

3. **<u>Problem</u>. Describe the water quality problem the project will address and the source of the problem?**

The Fairfield County Hunt Club (FCHC) is a 39 acre horse farm with a club house, pool, paddle court and tennis courts that has been in existence since the late 1920s. The facility has stalls in seven barns to board a total of 140 horses and presently has 85 animals in residence which are owned by a limited number of club members. FCHC features two large horse shows each year, the largest in June where up to 500 additional horses are boarded on the property for a week and a slightly smaller show held in August. Up to 10,000 owners, riders and spectators attend these events each year. FCHC has an additional 5,000 people who are club members, guests and visitors to the club during the year. An annual classic car show is held at the club in September.

Storm water runoff impaired by *E. coli* (indicator bacteria) and nutrients (nitrogen and phosphorus) have been a major problem at FCHC for many years particularly during the large horse shows when the waste from visiting horses (up to 500 for week long periods) and horses permanently boarded at the club greatly exacerbate the pollution loading in storm water runoff.

Over the last 15 years FCHC has taken many steps and considerable expense to reduce the runoff associated with daily activities and the large shows (Photo section uploads). Much time, funding, and effort has been expended by FCHC to 1) collect, cover and remove manure from the property on a daily basis, 2) add horse septic systems to all seven barns and put a new septic system in for the clubhouse, 3) enhance and protect (silt fencing) riparian buffer along the tributary that extends from the FCHC property 1000ft east to Sasco Brook (Figure 1). Improved horse wash stands have been installed that promote infiltration and permanent drainage. Four feet wide by three feet deep open top trenches filled with coarse rock have been installed around all temporary boarding tents arranged for the horse shows.

With all these improvements water quality impairment to the FCHC drainage tributary and to Sasco Brook is still a problem. The existing storm drain network, which drains surface water from around the seven horse barns and related structures (8.1 acres), still pollutes the tributary which flows 1000ft east to Sasco Brook (Table 1). The input of bacteria and nutrients is observed in a recent 2010 water quality study by HW/RW of the FCHC drainage tributary and Sasco Brook (Highlights of this survey are shown in Figure 1, Table 1, Table 2).

The geometric mean for *E. coli* bacteria for all 16 samples taken at Site HC0.1 is 415 CFU/100mLs (Table 1) against a CT DEP standard of <126 CFU/100mLs for a Class B River. The observed CT DEP single sample maximum (SSM) of 576 CFU/100mLs is exceeded 53.33%[1] of the time (Table 1). The impact of the storm water discharge on Sasco Brook downstream from its confluence with the FCHC Tributary is shown at Sasco Brook Site SB5.5c (Figure 3, Table 1, Table 2, Figure 4).

[1] The SSM is a secondary *E. coli* criteria which means that <10% of all samples taken for a single geomean can not exceed the SSM of 576CFU/100mLs for a Class B river rating.

Table 1 *E. coli* concentrations, geometric means and % frequency exceeding 576 colonies/100 mLs at nine sampling sites in the Sasco Brook Watershed for the period of 11/10/09 through 8/23/10

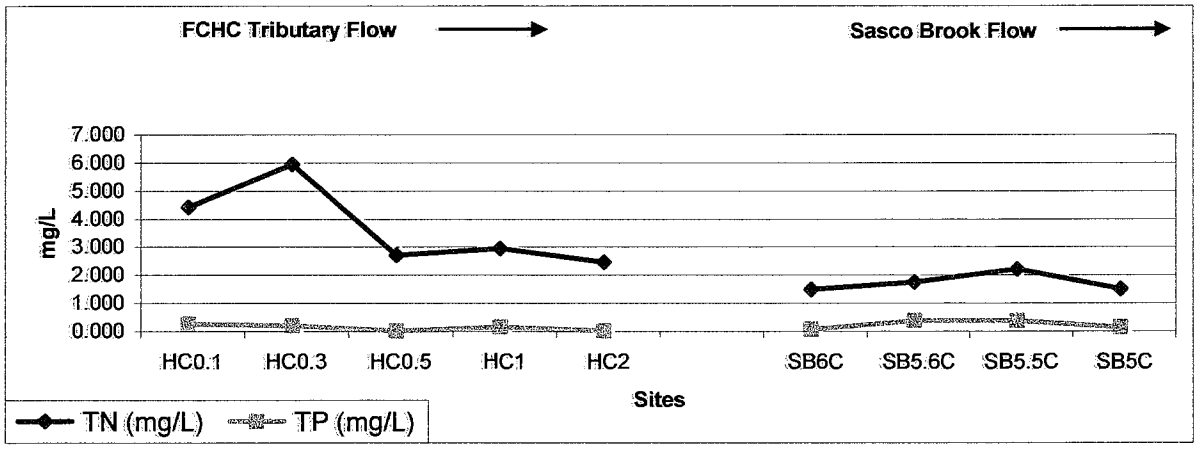
	11/10/2009	11/24/2009	12/8/2009	12/22/2009	1/5/2010	1/19/2010	2/2/2010	2/16/2010	3/2/1010	3/23/2010	3/30/2010	4/6/2010	4/13/2010
SB6C		46	32	40	14	76	24	42	6		1000	20	12
HC0.1			34	36	1	720	580	3000	126	4800	3200	8	148
HC0.3			22	2	1	n/a	20	300	8	60	800	4	32
HC0.5			4	2	6	166	n/a	92	2	350	500	8	60
HC1	280	34	30	4	84	88	16	56	16	1200	1000	44	36
HC2	24	160	26	4	26	94	12	130	10		500	n/a	8
SB5.6C	12	46	30	42	112	86	24	32	10		1000	28	48
SB5.5C	48	70	30	14	28	56	40	88	30		600	32	16
SB5C						64	24	26	10		200	44	40
Rainfall inches	0.00	0.73	0.58	0.79	0.02	0.35	0.12	0.43	2.60	2.32	4.19	4.19	0.19
Days Prior	7	4	3	3	4	2	5	6	4	1	0	7	4

5/18/2010	5/25/2010	6/9/2010	6/11/2010	6/21/2010	6/22/2010	6/23/2010	6/25/2010	6/29/2010	7/1/2010	8/18/2010	8/21/2010	8/23/2010	Geomeam	%frequency over 576 colonies/100 mLs
92	144	216			360					168	136		61	6.25%
n/a		420				2500	25000	20000		Dry	Dry	Dry	415	53.33%
100		56		540		1500				Dry	Dry	Dry	42	14.29%
80		220							90		Dry		36	0.00%
260		160		220		4400	770	11000	900		12300		192	33.33%
64	208		600		32		340	81000	400	200	144	37000	128	14.29%
430	168		248		76	1560	210	230		640		4800	116	19.05%
80	156		380		68		60	11000		680		5700	109	20.00%
	200		248			1820				40			76	9.09%
0.06	0.08	0.30	0.52	0.12	0.12	0.91	1.04	0.45	0.49	0.70	0.07	1.88		
0	1	3	2	3	4	0	2	1	2	3	6	1		

Table 2 TN and TP averages for the FCHC Tributary (Site HC0.1 through Site HC2) and Sasco Brook (Site SB6C through Site SB5C)

	FCHC Tributary					Sasco Brook			
Site	**HC0.1**	**HC0.3**	**HC0.5**	**HC1**	**HC2**	**SB6C**	**SB5.6C**	**SB5.5C**	**SB5C**
TN (mg/L)	4.454	5.980	2.740	2.980	2.488	1.513	1.772	2.238	1.540
TP (mg/L)	0.289	0.223	0.043	0.182	0.043	0.095	0.394	0.395	0.166
	Direction of Flow -->					Direction of Flow -->			

Figure 2 TN and TP average values for the FCHC Tributary (Site HC0.1 through Site HC2) and Sasco Brook (Site SB6C through Site SB5C)



4. **Solution. Describe how your project will reduce or eliminate the problem?**
The "daylighting" of the storm drain network (engineer drawing) serving the 8.1 acres surrounding the horse barns, paddocks, and exercise ring into a 320' grass swale will serve to filter out bacteria and reduce some TN and TP concentrations though biological uptake by plants (Figure 5).

5. **Project Goals. Describe the water quality goals of the project?**
Once the swale is completed it is anticipated that observed bacteria levels at the Site HC0.1 discharge will meet CT DEP criteria for *E. coli* bacteria and will reduce TN and TP concentrations to levels shown in Table 3. Although the exact reduction of bacteria and nutrient levels cannot be predicted at Site SB5.5c in Sasco Brook (Table 1) due to input from two other tributary sources (Site HC0.3 and HC0.5, from other residential properties) the goal for bacteria counts at Site HC0.1 is <126CFU/100mLs, the SSM <576 CFU/100mLs to meet the CT DEP *E. coli* criteria for a Class B River. The goal for TN and TP concentrations is shown in Table 3.

Table 3 Existing TN and TP concentrations and volume, goals and percent improvement after FCHC swale is complete

	Observed		Goal		% Reduction
	mg/L	lbs/yr	mg/L	lbs/yr	mg/L lbs/yr
TN	4.454	394.3	2.272	197.2	50%
TP	.289	25.1	.1445	12.6	50%

6. **Amount of Area Retrofit or Restored. Estimate extent of area to be retrofit or restored (linear feet, acres etc.)?**
Area of FCHC where storm drain water is to be remediated is the 8.1 acres served by drainage piping (Figure 5 engineer drawing, upload) around barns and out buildings.

7. **Amount of Treatment or Reduction. Estimate the gallons of water to be treated or infiltrated per year?**
The storm drain network serves 8.1 acres x 43,560 sq ft/acre = 352,836 sq ft x 4ft annual rainfall = 1,411,344 cu ft x 7.48 gal/cu ft = 10,556,853 gal/year x .775 drainage coefficient = 8,181,561 gal/year or 22,415 gal/day infiltration to swale.

8. **Site Information. Describe in written form and upload an aerial photo or map with the project site location and boundaries marked on the photo or map.** The map and written description should provide the location of the site in terms of its relationship to the Long Island Sound. Provide the latitude and longitude of the project location in degrees, minutes, seconds format. Google maps are an acceptable format. The maps or photos will be uploaded into the "Uploads" section of the online application. (Map and/or photo(s) are counted towards 25-page limit). Please note, it is helpful to reviewers if you caption photos or a map describing what is represented in the document. Maps of the study site are located in the "upload section" of the grant request.
The FCHC is located at in the Sasco Brook Sub-watershed C section at GPS coordinates N41° 08" 56.0", W073° 18' 35.7" and is 2 miles from L.I Sound (Figure 3, Figure 4 uploads).
FCHC is 39 acres in size, fronting 1400' on Long Lots Road (North side) and extending 1300' along Bulkley Avenue North (East side). Land to the south is all residential housing with some wetlands. The FCHC Tributary (Figure 1) partly cuts across the southern end of the property and the headwaters are composed of two small creeks (HC0.3, HC0.5) and the outlet of the FCHC stormwater discharge pipe (HC0.1). Flow is to the east, 1000' to Sasco Brook. The west side of the property is bounded by Maple Ave North (Figure 2). Buildings on the premises include seven horse barns with stalls for 140 horses,

covered wash stalls and covered riding rings on the west side of the property. A main club house, swimming pool, paddle and tennis courts are located to the north side of the property with an entry road coming in from Long Lots Road. The site has an upper sand ring, a lower exercise ring, and paddocks all located on the southwest corner of the property. The balance of the FCHC consists of a large playing field (eastern half of the property) with areas for three temporary tents at the southern end which are erected to board up to 500 visiting horses for the shows.

9. **Fit to the LISFF RFP. Describe how this project specifically relates to the eligible activities described in the LISFF Request for Proposals?**
This project fits within the LISFF RFP *General Categories of Grants and Levels of Funding in the category of Implementation Grants* because this project will lead to measurable improvements in the health of Long Island Sound and Sasco Brook; and includes on-the-ground restoration activities that help attain water quality standards by controlling nutrients and other pollutants identified at the Fairfield County Hunt Club. It is a LISFF RFP Eligible Activity in the category of Nonpoint Source Pollution Control and Stormwater Management because the project uses a 320' swale to promote infiltration of stormwater and implements on-site systems for retention and treatment of stormwater including pervious surfaces. The education component of the project mirrors the priorities of the LISFF RFP because it is a project that will "inform horse people and the public to increase awareness, appreciation, and stewardship of Long Island Sound, "including: goals defined in the LISS CCMP specially related to "water quality, and polluted runoff". The FCHC property management has steadily improved over the years resulting in reduced pollutant entering the FCHC stream (see item 3 and photo section).

   Shellfish beds located at the mouth of the Saco Brook at Southport Beach have remained closed since 1993 and remediation of the FCHC main surface water discharge is one of the many positive steps toward the eventual re-opening of these recreational beds. The reduction of nutrients (especially TP, the limiting nutrient in freshwater systems) will also help clean up the algae mats choking Bulkley Pond every summer (Table 2, Figure 2).

10. **Local or Regional Context of the Project. Reference specific local or regional watershed initiative or plan (e.g., *Comprehensive Conservation and Management Plan for the Long Island Sound, Long Island Sound Total Maximum Daily Load for Dissolved Oxygen* etc.) to which the project relates?**
The Sasco Brook Pollution Abatement Committee (SBPAC), a group of stakeholders sponsored by the Westport Town Conservation Dept., has been in existence for 15 years and has made steady progress in improving the water quality of the Sasco Brook. A major goal of SBPAC has always been improving environmental conditions at the FCHC. FCHC has fully cooperated in this effort. The task is more urgent, because the objective of the Town of Westport and SBPAC is to finalize and attain approval of a pending CT DEP Water Management Plan, and to meet the conditions stated in an existing TMDL for Sasco Brook (CT DEP issued on November 2002).

11. **Current Uses. Identify current uses of the proposed retrofit or restoration area?** A photo showing current site conditions is particularly helpful to reviewers. The photos will be uploaded into the "Uploads" section of the online application. (Photo(s) are counted towards 25-page limit). Please note it is helpful to reviewers if you caption photo describing what is represented in the document.

   The site is a 39 acre horse farm with fields for horse exercising, exhibiting and competition (photo) located at the intersection of Long Lots Road and Bulkley Avenue North. The property also includes a clubhouse, swimming pool and tennis courts. Photo uploads shows aerial views (photo and engineer drawing) and map shows the relationship of the site to Sasco Brook and Long Island Sound.

12. **Adverse Project Impacts. Describe the adverse impacts (if any) at the site of the proposed retrofit or restoration?** (This is particularly important in the case of where you may be working in areas of sensitive natural resources).

None. The proposed swale lies within the FCHC property, which has been consistently used as a horse farm. There are no adverse impacts to sensitive natural resources anticipated with this project.

13. **Methods. Describe in detail the methods to complete the retrofit or restoration project?** You **must** also upload either a conceptual or an engineered plan which illustrates the retrofit or restoration approach into the "Uploads" section of the online application. Plans are counted towards 25-page limit. Please note, if you do not upload a plan, it is highly likely your proposal will not be funded.

    1) Volume and shape of swale defines by engineering study for safety and flow rate; limited available area because of proximity to water table and likelihood of stagnant water breeding mosquitoes. This is a danger because of Eastern Equine Encephalitis. 2) References 2002 CT Guidelines for Soil Erosion and Sediment Control and 2004 CT Stormwater Quality Manual. 3) Contractor selection criteria includes a minimum of five practiced and experiences project completions.
    Summary of Design Criteria – Pervious Pavement
    Grass ring turf reinforcement detail, Section 7 3/4/11(Enclosed)
    Grading and Drainage Plan 3/4/11 (Enclosed)
    Peak Runoff Analysis (Section 1) Stormwater Management Report 8/9/04 (Enclosed)
    Summary of Design Criteria
    Swale and Centerline Marker/Under Drain, Section 5 (Enclosed)
    Side Slopes: Swale and Centerline Marker/Under Drain, Section 5
    Longitudinal Slopes: Swale and Centerline Marker/Under Drain, Section 5
    Flow Depths; Outflow Control Structure, Section 8 (Enclosed)
    Peak Runoff Analysis Page 3 (Enclosed)
    Flow Velocity: Peak Runoff Analysis Page 3
    Length 320' long

    1. Sizing: Swale and Centerline Marker/Under Drain, Section 5
       Construction: Grading and Drainage Plan
       Vegetation: Section 4, Count is 904 trees, shrubs, and perennials. Swale contains 860 perennials, 25 shrubs plus an over seeding with a Wetland Restoration Wildflower Seed mix.
       Soil: Grading and Drainage Plan and Swale and Centerline Marker/Under Drain

14. **Measuring Impact. Describe in detail how you will measure the specific water quality benefits of the project (i.e., targeted water quality data sampling at designated locations, metering of flows, tracking of waste intercepted or removed and etc.)?**
    The Earthplace HW/RW Program will perform repetitive water quality monitoring at nine previously identified sites. (See Figure 1 above for previous work on bacteria and nutrients). Indicator bacteria monitoring frequency will be monthly during the winter months November 2011 through March 2012. Bacteria monitoring will continue twice monthly from April 2012 until October 2012, then on a monthly basis until the project ends on 4/30/2013. Nutrient monitoring frequency will be monthly. Nutrient analysis will be performed by York Laboratories (Stratford, CT).

15. **Maintenance and Management. Describe the long term maintenance/management that you will implement associated with the project?**
    Instructions to facility management and staff for periodic observation, record keeping and scheduled site work at benchmark triggers for manual or mechanical tasks, cleanout of catch basins, cleanout of sediment chambers and landscape architects judgment on condition of grass in swale (schedule to be determined).

16. Workplan: Provide a breakdown of key project activities and projected timeline to complete that work? Project should be completed in 1 year to 15 months. Project should begin within 3 months of award (e.g., Fall 2011).

Activity	**Timeline**
Installation of temporary erosion control measures	NTP + 14 days
Site preparation, tree transplants and equipment removals	NTP + 30 days
Strip site of soils and exercise ring footing	NTP + 35 days
Begin rough grading of paddock, sand ring, and access drive	NTP +60 days
Slope and roadway area turf stabilization/turf blanket installation	NTP + 75 days
Install paddock curbs and project gravel and asphalt pavements	NTP +85 days
Fine grading and landscape and swale plantings; install signs	1 Apr, 2013 – 30 Apr, 2013
Provide planting and erosion control maintenance	NTP - Continuous
Perform final site inspection after planting establishment and remove temporary erosion control measures	Planting Apr 1-Apr 30, 2013

NTP = Notice to proceed

17. **Assessments/Feasibility Studies/Lists. List any feasibility studies or assessments prepared to address the site retrofit or restoration?** If you have any of this type of documentation associated with the project design e.g. plant lists, flow analysis etc., we highly recommend you provide them as they are very important to our review. These documents go into the "Uploads" section of the online application. Vegetation, See item 13, plan, section 4 (enclosed)

Name of Study/Assessment	**Purpose**
Water Quality Monitoring of Fairfield County Hunt Club Storm Water Discharge 2011, available on request, HW/RW	Water Quality Survey by HW/RW of FCHC storm water discharge and impact on Sasco Brook

18. **Special Status Species. Have reviews been conducted to determine if special status species are present at the project site and are such species currently occupying the site? If so, list the species.**

Special Status Species	**Status (federal or state)**
Horse farm exercise rings, paddock and playing fields	No special status found

19. **Quality Assurance Project Plans. Please note projects involving Data Collection may require a United States Environmental Protection Agency, Quality Assurance Project Plan (QAPP).** The general rule of thumb is a QAPP is required when the data or the results of the data would be used by an external entity to guide their management or projects. Data collected by students for use in the classroom does not require a QAPP. Any questions about when a QAPP is required please contact Lynn.Dwyer@nfwf.org. Check one: (X) Our project has an EPA approved QAPP ( ) We are developing an EPA approved QAPP ( ) We need to seek an EPA approved QAPP ( ) We are not collecting data associated with our project.

Nutrient samples done by York Analytical Laboratories Inc., TN methods Nitrogen Calc MDL 0.00700mg/L, TP methods, SM4500-PB4E, MDL 0.020mg/L, % precision ±15%, % accuracy 10 %.

20. Project Match. Break out the match relative to LISFF 2011 budget request?

Budget Category	Total $s project budget by Budget Category	Nonfederal cash or inkind matching contributions Applied to Budget Category	LISFF $s Requested towards Budget Category
Salaries & Benefits	**$20,600**	**$8,600**	**$12,000**
Equipment	-	-	-
Contractual Services	**York: $5,000 FCHC: $198,154**	**- $128,154**	**$5,000 $70,000**
Supplies/Materials	**$3,870**		**$3,870**
Printing	**$90**		**$90**
Travel	**$399**		**$399**
Other	**$88**		**$88**
Totals	**$228,201**	**$136,754**	**$91,447**

21. Experience. Describe staff and organization's experience in conducting similar types of projects?
Please do not insert or attach resumes or CVs. Provide no more than a single paragraph description of individual staff expertise.
HW/RW has been in the water quality monitoring business for 25 years. The organization under the direction of Richard Harris with Peter Fraboni as Quality Control Officer operates under six EPA approved QAPPs. HW/RW has two water quality laboratories; one CT DPH approved facility at Earthplace (PH 0262), and a new facility in Norwalk. HW/RW has had numerous contracts from CT DEP on Pequonnock, Norwalk, Aspetuck, Silvermine, and Five Mile Rivers as well as Sasco Brook. A new contract for HW/RW is being reviews by CT DEP for Five Mile River for 2011.
Mr. Harris has a MS in Marine Science (1978) from Stony Brook and Mr. Fraboni has MS in Biology (1979) from U. Bridgeport. The volunteer group is 60 long term members. HW/RW trains over 60 high school and college students/year in water quality monitoring

22. Continuing Projects. Indicate whether this project is a continuation or expansion of an existing project and provide information on the status and results/outcome of the previous work.
This project is a continuing project for FCHC (Stage 4 and 5). The proposed is a new project for HW/RW and is not a contamination of an LISFF project.

23. Prior Grant. If you have received a prior grant under the Long Island Sound Futures Fund, please provide no more than two paragraph summary of your progress associated with that grant relative to promised deliverables?
Grant 2009-0061-023 Indicator Bacteria and Nutrient Levels in the Norwalk River. Final report submitted to LISFF in February 2011. Primary goals were to monitor 14 sites in Norwalk River (three of which were WTP discharges) for indicator bacteria and Total Nitrogen and Total Phosphorus. Bacteria monitoring was done 21 times, all sites except WTP and Site NR9.5 failed CT DEP *E. coli* criteria. Nutrient/bacteria studies were done on Comstock, Cooper, Bennett's and Steep Brook and three WWTPs discharge. High levels of TN and TP observed in brooks and at Rte 25 WTP (Ridgefield), an obsolete 50 gpd unit in need of modernization. Full report is available upon request. Report submitted to

all agencies including towns and CT DEP.

24. **Dissemination. Describe how the results of the project will be communicated to appropriate audiences (e.g., websites, signs, public outreach etc.)?**
Two permanent signs will be installed on FCHC property informing users about steps taken to remediate storm water runoff and actions they can take on other horse farms to protect nearby waterways. The swale will be officially highlighted by a public official at the planned open house upon completion of construction. Newspaper activities, Minuteman, Westport News – Website, Westport Patch.

25. **Partner Justification. Describe the strength, qualifications and nature of the specific contribution of other collaborating organizations?**
Fairfield County Hunt Club for improving water quality at FCHC for over 20 years.
Town of Westport, Conservation District partner in Sasco Brook Pollution Abatement Committee (SBPAC) (see enclosed letter from A. Mozian).
CT DEP has expressed an ongoing interest in this project.

26. **Community Involvement. Describe how the project will involve the local community(ies)?**
Local area high school students will participate in phases of indicator bacteria monitoring. Local area high school students will help put curb markers on all nearby storm drain catch basins. FCHC draws many horse people and people interested in other club uses.

27. **Site Ownership. Identify current site ownership (i.e., Ms. I love Nature Smith, 12 Estuarine Row, Windsor, CT)?** Please upload a letter of permission to work on the site into the "Uploads" section of the online application. If you own the site, prepare a paragraph on letterhead stating "Name of group" owns the restoration site" and upload that document into the "Uploads" section of the online application."
Fairfield County Hunt Club, Inc., 174 Long Lots Road, Westport, CT
Permission letter from Carla Nelson, FCHC Manager enclosed.

28. **Project Certification. I certify that this project is not a legally mandated action under local, state or federal law, under an administrative permit condition, or under the terms of a settlement agreement. If your project is a legally mandated action it is not eligible for funding under the LISFF. Check: (X) Agree,**

Appendix F:

Total Maximum Daily Load (TMDL)

A Total Daily Maximum Load Analysis for Sasco Brook

Fairfield and Westport, Connecticut

1999

A Total Daily Maximum Load Analysis for the Mill River, Rooster River and Sasco Brook

2005

Photo Credits

Cover: G. Steadman

Chapter 1 cover: G. Steadman
Chapter 1 photos 1-1 through 1-19: G. Steadman

Chapter 2 cover: Earthplace—The Nature Discovery Center

Chapter 3 cover: Earthplace—The Nature Discovery Center

Chapter 4 cover: Earthplace—The Nature Discovery Center

Chapter 5 cover: L. Donahue

Chapter 6 cover: Earthplace—The Nature Discovery Center

Chapter 7 cover: T. Steinke

Appendices cover: L. Donahue


CONNECTICUT DEPARTMENT
ENVIRONMENTAL PROTECTION


UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY