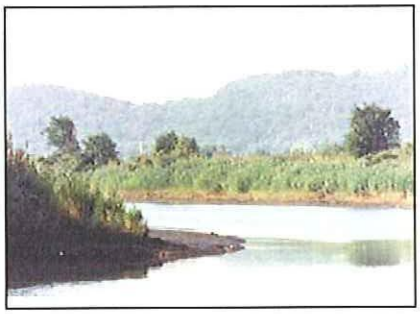
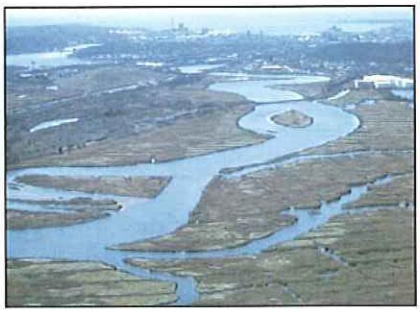
Quinnipiac
Watershed
Partnership


QUINNIPIAC WATERSHED



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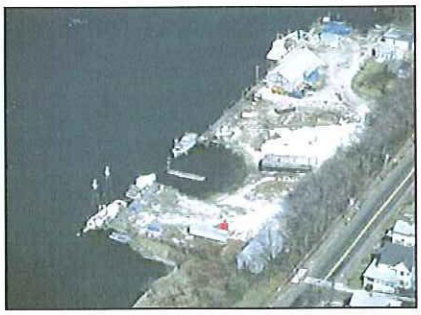

2004

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EPA

Vision Statement

We envision a healthy Quinnipiac Watershed: one that will stay healthy for generations to come; one with clean water and functioning wetlands; one in which a diversity of wildlife can flourish; one in which the river system is a place of beauty and vitality that enhances quality of life, education, tourism and recreation; and one in which growth respects this vision and all sectors of our communities participate in caring for the watershed.

Quinnipiac Watershed Partnership

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Foreword

The Quinnipiac Watershed is at an important crossroad. Despite progress in controlling point sources of water pollution like municipal sewage and industrial wastewater, many watershed problems remain. Present water quality impairments are primarily the result of pollution from widely spread sources. These sources include runoff from roads, parking lots, rooftops, lawns, farms, and failing septic systems. In addition, there are other significant issues related to water supply. A number of streams have already been harmed by low stream flow due to water diversions. Bold steps will be needed to accomplish the vision of a healthy Quinnipiac Watershed - for ourselves, for future generations, and for the wildlife with which we share the land. The key to long-term watershed health is a careful reevaluation of the way we use the land, and the way we go about our daily lives. We are all part of the problem and part of the solution.

This Quinnipiac Watershed Action Plan view is that looking at the watershed as a whole is the best way to understand a wide range of environmental issues and improve environmental quality. With a watershed approach we see the interaction between different sources of pollution and their combined effects.

The successful use of state and federal regulations for reducing point sources of pollution will not work for many other watershed issues that now need to be addressed. These other issues are largely in the hands of municipal governments and people going about their daily lives. This means that improving the watershed system will require changes in local land use practices and people's lifestyles. Changing local land use practices needs close collaboration with municipal governments, and influencing lifestyle requires much public education and outreach.

Executive Summary

Those who live and work in the Quinnipiac Watershed are most likely to understand its problems, have the greatest stake in its health, and have the greatest incentive to make the changes necessary to protect it. This Action Plan provides a framework for voluntary, community-based action in a complex, highly developed, and environmentally stressed watershed.

This plan represents the efforts of many people working with the Quinnipiac Watershed Partnership (Partnership) to promote local watershed protection and improvement. The Partnership, organized in 1998, is a voluntary, locally-based effort to achieve a sustainable, healthy watershed system by fostering collaboration between federal and state agencies, local authorities, businesses, local groups, and individuals. To assist in this effort, Partnership members have developed a watershed Action Plan.

A watershed or basin is the land that water flows through on its way to a river, stream, or lake. The Quinnipiac Watershed includes parts of eighteen Connecticut municipalities. The municipalities having more than 1 percent of the watershed within their boundaries are: New Britain, Plainville, Southington, Cheshire, Hamden, Meriden, New Haven, North Haven, Prospect, Wallingford, and Wolcott. The watershed is approximately 106,000 acres, or 166 square miles, and has nine subwatersheds. The four largest subwatersheds in the Quinnipiac Watershed are the Quinnipiac River, Eightmile River, Tenmile River, and Muddy River. The watershed's population is about 226,000 people (2000 Census). For the purposes of this plan, the southern extent of the watershed boundary ends at the Pearl Harbor Memorial Bridge (Quinnipiac Bridge) in New Haven.

The goals of the Partnership are:

- To educate citizens, businesses, and municipalities about the need for, and benefits of, protection and improvement of the Quinnipiac Watershed system.
- To protect and improve water quality.
- To improve public access and recreational opportunities.
- To minimize pollution through improved municipal land use policies.
- To balance stream flow needs for aquatic life with drinking water supply and other water use needs.
- To preserve, protect, and restore wildlife habitat.

The Partnership has six work groups that focus on watershed issues: Habitat, Land Use, Water Quality, Water Allocation/Low Flow, Tidal Marsh, and Education and Outreach. Each work group has developed goals and objectives that are presented in the work group section of this plan.

This plan notes a number of areas of concern and suggests ways to address them:

Concern 1 - Water quality: Pollution coming from wide spread areas, like parking lots and roads, is having a serious impact on water quality in many areas.

Suggestions:

- Improve stormwater management through local regulations and policy.
- Build end-of-pipe treatment systems to remove pollutants.

Concern 2 - Water quantity: The Quinnipiac River now has much higher flow rates during storms because of increased stormwater runoff. This causes erosion of the river banks and increases the danger of floods. Other streams in the watershed have much lower flows in the summer and some actually go dry, killing stream life. The low flow is a result of not enough water seeping into the ground to supply the streams.

Suggestions:

- Strengthen policies to decrease the amount of surface area that blocks water from seeping into the ground (like parking lots and roads).
- Find out how much stream flow is needed for healthy stream life.
- Find out how much water is diverted away from streams in the watershed.
- Develop a water allocation policy.

Concern 3 - Public access: The potential for public enjoyment of the Quinnipiac River is not fully realized. People are not connected to the river. Lack of good access prevents people from using the river.

Suggestions:

- Increase and improve canoe launch sites.
- Extend the Quinnipiac linear trail system.

Concern 4 - Environmental protection: Present regulations are not doing enough to protect environmental quality.

Suggestions:

- Improve municipal regulations to be more sensitive to protecting environmental quality.
- Make maps that show the natural resources to be protected.
- Give priority to protecting natural resources when planning and changing regulations that affect environmental quality.
- Improve ways to enforce existing regulations.

The Quinnipiac Watershed Partnership looks forward to building collaborative efforts, particularly with its municipal partners, to protect and improve the Quinnipiac Watershed system for ourselves and for future generations.

Abbreviations

ACOE - US Army Corps of Engineers

CCWS - Center for Coastal and Watershed Systems, Yale School of Forestry and Environmental Studies

CNVCOG - Council of Governments of the Central Naugatuck Valley

CTDEP - Connecticut Department of Environmental Protection

CTDOA-AQ - Connecticut Department of Agriculture/Bureau of Aquaculture

CTDOT - Connecticut Department of Transportation

DPH - Connecticut Department of Public Health

DPUC - Connecticut Department of Public Utility Control

EOWG - Education & Outreach Work Group, Partnership

EPA - US Environmental Protection Agency

FEMA - Federal Emergency Management Agency

GIS - Geographic Information System

HWG - Habitat Work Group, Partnership

LFWG - Water Allocation/Low Flow Work Group, Partnership

LUWG - Land Use Work Group, Partnership

MAGIC - Map and Geographic Information Center, UConn web site

NHCSWCD - New Haven County Soil and Water Conservation District

NRCS - Natural Resources Conservation Service, US Department of Agriculture

NEMO - Nonpoint Education for Municipal Officials, UConn Cooperative Extension System

OPM - Connecticut Office of Policy and Management

QRLTAC - Quinnipiac River Linear Trail Advisory Committee

QRWA - Quinnipiac Watershed Association

Partnership - Quinnipiac Watershed Partnership

RGP - South Central Connecticut Regional Growth Partnership

SCCRWA - South Central Connecticut Regional Water Authority

SCRCOG - South Central Regional Council of Governments

TMDL - Total maximum daily load

TMWG - Tidal Marsh Work Group, Partnership

TU - Trout Unlimited

UNH - University of New Haven

WQWG - Water Quality Work Group, Partnership

UConn/CES - University of Connecticut, Cooperative Extension System

USGS - US Geological Survey

YFES - Yale University School of Forestry and Environmental Studies

Chapter 1

Overview

Chapter 1

Overview

Watershed Characteristics

A watershed or basin is the land that water flows through on its way to a stream, river, or lake. Large watersheds like the Quinnipiac Watershed can contain smaller watersheds like the Eightmile River watershed. Water quality, quantity and the biological integrity of streams and rivers depend on what happens in and to the watershed. The term "Quinnipiac Watershed" or "watershed" **(Figure 1)** means the regional basin that contains nine subwatersheds **(Figure 2)**, including the watershed of the Quinnipiac River itself. The Quinnipiac Watershed is located in central coastal Connecticut and drains via the Quinnipiac River and its tributaries to New Haven Harbor and Long Island Sound. The total area of the watershed is about 166 square miles (106,200 acres), about three percent of the state's land area.

The total length of watercourses within the watershed is 522 miles. With 3.1 miles of watercourse per square mile of watershed, the watershed is a very well drained system with a dense network of brooks, streams, and rivers. The Quinnipiac River is the fourth largest river in Connecticut. It starts as a small stream from a 300-acre wetland called Deadwood Swamp on the border of Farmington and Plainville, and flows southward towards its outlet at New Haven Harbor into Long Island Sound.

Table 1 lists each municipality in order of the percent of watershed within their boundary. Eighteen Connecticut municipalities contain some portion of the watershed. However, in the following tables, only municipalities with more than 1 percent of watershed area are shown. Five municipalities, Cheshire, Meriden, North Haven, Southington, and Wallingford, taken together have a total of over 80 percent of the watershed within their political boundaries **(Figure 1).** The remaining municipalities listed in **Table 1** have a total of 15.9 percent of the watershed witin their boundaries. The municipalities with less than 1 percent of the watershed within their political boundaries are Farmington, New Britain, Berlin, Middletown, Middlefield, North Branford, East Haven, and Waterbury, and are not listed in the table.

The Quinnipiac Watershed is made up of nine subwatersheds **(Figure 2). Table 2** shows the area of the subwatersheds in descending order.

Geologic Perspective

Evidence of many geologic processes can be observed throughout the Quinnipiac Watershed. The watershed is located in Connecticut's central valley which was formed as a result of the breakup and separation of large continental land masses millions of years ago. The familiar "trap rock" ridges of Connecticut were formed by volcanic lava intrusions forced up through large fractures in the sedimentary deposits of the watershed. As river channels were eventually carved from the surrounding sedimentary rock, erosion exposed these harder and more resistant basalt ridges.

Table 1
Land Areas of Municipalities in the Quinnipiac Watershed

Source: Town and watershed boundary data from the MAGIC Internet site, UConn.

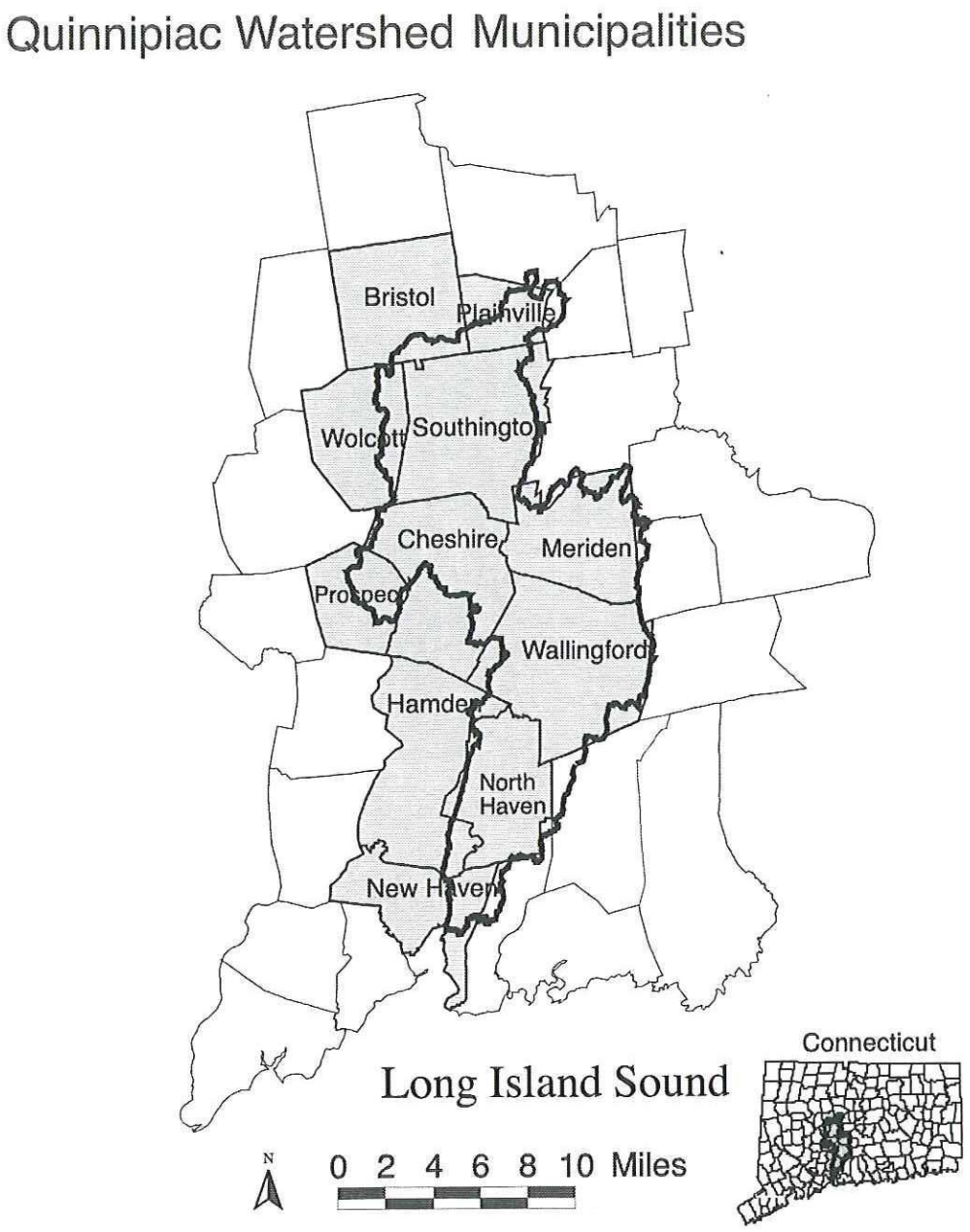
Town	% of Basin in Town	% of Town in Basin	Town Area (Square Miles)	Area in Basin (Square Miles)
Wallingford	22.6	90.8	39.8	36.2
Southington	21.2	92.3	36.6	33.8
Meriden	13.8	90.9	24.2	22.0
Cheshire	13.4	64.1	33.4	21.4
North Haven	12.3	93.5	21.1	19.7
Plainville	3.5	56.8	9.8	5.6
Wolcott	3.1	23.3	21.1	4.9
Prospect	3.0	32.5	14.5	4.7
New Haven	2.4	20.2	19.4	3.9
Hamden	2.2	10.4	33.3	3.4
Bristol	1.7	10.2	26.8	2.7
Totals	95.5	54.4	280.0	158.0

The Quinnipiac River originates in Deadwood Swamp at the base of basalt ridges in Farmington and Plainville and passes numerous prominent traprock formations between Southington and Meriden, including Meriden Mountain, Short Mountain, Ragged Mountain, and Castle Craig in Hubbard Park in Meriden. Red sandstones and mudstones are especially apparent in the Quinnipiac River Gorge, in South Meriden. Further south in North Haven and New Haven, cliffs of red sandstone, called "arkose," can be observed on the river's east side. Erosion of the arkose, the principal sedimentary rock of the watershed, gives many of the soils their signature red-brown color.

Glaciers played a very significant role in shaping the New England region, scraping and scouring the landscape from north to south, and depositing unconsolidated materials in the form of glacial till. Glacial melt waters deposited well-sorted gravel, sand, silt, and clay in the path of the retreating glaciers. The surficial geology of the Quinnipiac Watershed reflects this history, and is largely differentiated by elevation and topography. Upland areas are generally characterized by glacial till and exposed bedrock, whereas lowland areas are various combinations of sand, gravel, and fines deposited by glacial meltwater.

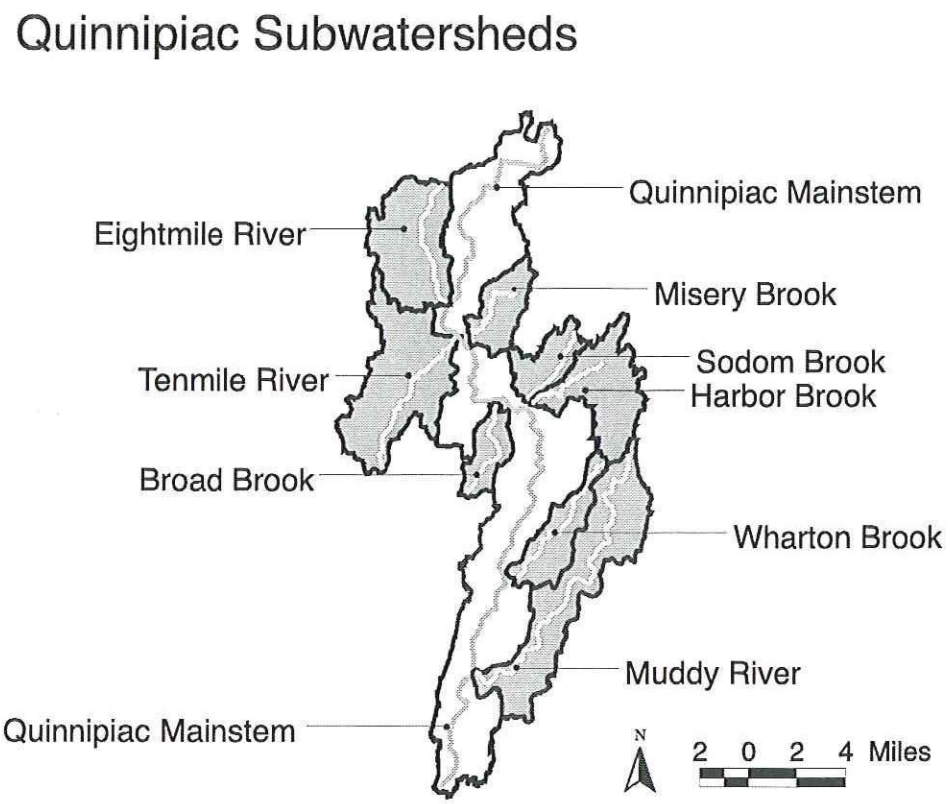
Most of the Quinnipiac River valley's soils developed on layers of glacial lake deposits since the last glacier retreated 15,000 years ago. Soils were formed from parent materials of arkose, shale, and basalt. These soils are well drained, deep, very supportive of vegetation, and are well suited for agriculture. In the uppermost reaches of the watershed, soils with parent materials of gneiss, schist, and granite serve as a transition between the soils of the Central Lowlands and those of the Western Uplands.

Figure 1



The eleven municipalities with more than 1 percent of the watershed within their boundaries are shown in gray

Figure 2



Sociological Profile

The sociological profile of an area can provide insight to the ways land has been used in the past, and will be used in the future. Just as dependence on particular resources, such as an adequate water supply, can substantially direct the way the land is used, social background can indicate where the priorities of a community lie and where opportunities for positive environmental changes may exist.

Table 3 shows the population of the eleven municipalities with more than 1 percent of the watershed within their political boundary. The percent of population within the municipalities' portion of the watershed is also shown. Those municipalities with the largest percentage of land in the watershed also have a comparable percentage of their population in the watershed.

Table 2
Subwatershed Areas of the Quinnipiac Watershed

Source: Watershed data from the MAGIC Internet site, UConn.

Subwatershed	Area (Square Miles)
Quinnipiac Mainstem	72.7
Muddy River	21.8
Tenmile River	20.3
Eightmile River	14.8
Harbor Brook	12.1
Wharton Brook	7.6
Sodom Brook	5.3
Misery Brook	6.2
Broad Brook	4.8

An analysis of the year 2000 census block data shows a population of approximately 226,000 in the watershed. The average population density within the watershed is 1,410 people per square mile. This is more than double the average population density in Connecticut of 678 people per square mile.

Table 3
Municipal Populations in the Quinnipiac Watershed

Source: Town boundary, census 2000 and watershed data from the MAGIC Internet site, UConn.

Town	Population in Basin	% of Pop. in Basin	Town Population
Meriden	56,052	96	58,548
Wallingford	39,512	91	43,469
Southington	38,448	96	39,864
New Haven	25,487	20	126,861
North Haven	20,440	86	23,859
Cheshire	16,140	53	30,708
Plainville	11,976	69	17,448
Hamden	4,448	8	57,195
Bristol	3,856	6	61,173
Prospect	3,022	25	11,872
Wolcott	1,258	5	24,738
Totals	226,321	40	568,695

Table 4 shows the population densities in the watershed for the eleven listed municipalities. There is quite a bit of variation from one town to another, with a low of 256 people per square mile in Wolcott, to 6,518 people per square mile in New Haven. This is reflected in the variation in land use in the watershed. As the population density increases, so does the amount of impervious surface and the resulting potential deleterious effects on the watercourses.

Table 4
Population Densities in the Quinnipiac Watershed

Source: Town boundary, census 2000 and watershed data from the MAGIC Internet site, UConn.

Town	Basin Population/sq mi	Town Population/sq mi
New Haven	6,518	6,539
Meriden	2,548	2,419
Plainville	2,153	1,784
Bristol	1,412	2,283
Hamden	1,289	1,180
Southington	1,138	1,089
North Haven	1,038	1,131
Wallingford	1,091	1,092
Cheshire	754	919
Prospect	640	819
Wolcott	256	1,172

Table 5 shows data on income and educational levels within the eleven listed watershed municipalities. These data indicate some potentially important variations.

In Cheshire, 43 percent of the adult population have graduated college, while in Meriden, this figure is 16 percent. Twenty-seven percent of adults in Meriden have less than a high school education, while in Cheshire this figure is 11 percent. The poverty rate in Meriden is 7.31 percent and in New Haven it is 21.3 percent.

These differences may mean that different ways are needed to inform the people in these municipalities about the state of the watershed and what can be done to restore it. Most people want to live in a healthy, safe, and beautiful environment; however, the priority of their particular concerns may differ based on their income and education.

Table 5
Income and Education in Watershed Municipalities

Source: US Census 1990, Connecticut Economic and Community Development, Connecticut Office of Policy and Management

Town	Median Family Income	Per Capita Income	Poverty Rate %	% Less Than High School	% College or More
Cheshire	63,400	30,800	2.23	10.7	42.9
North Haven	53,500	27,600	2.45	17.1	26.5
Southington	52,800	25,700	2.80	20.6	21.9
Prospect	52,600	23,200	1.83	23.1	20.1
Wolcott	52,200	24,300	1.81	21.0	15.6
Hamden	50,200	25,200	4.36	14.7	32.6
Bristol	45,600	21,200	4.35	24.6	15.5
Plainville	45,000	21,400	4.00	23.5	16.8
Wallingford	42,300	23,700	3.10	19.5	22.6
Meriden	41,900	19,900	7.31	27.2	15.9
New Haven	31,200	16,800	21.30	27.9	27.1

Chapter 2

State of the Watershed

Chapter 2

State of the Watershed

"Anyone who travels the length of a river learns something about themselves."
Verlin Kruger

Introduction

This chapter examines the state of the Quinnipiac Watershed in terms of three basic environmental elements: water resources, land use, and habitat. The water resources are discussed in terms of water quality and water quantity. Ongoing and possible future efforts that improve water quality and address water quantity issues are summarized. Land use is discussed in terms of impervious surface, land use types, land use trends, and the present and potential future impact of these factors on the watershed. The discussion of habitat focuses on the plants and animals of the watershed as resources and as indicators of environmental health. Human habitats and their effect on wildlife ecology are also discussed. In these discussions we must bear in mind that water resources, land use, and habitat are so interdependent that it is virtually impossible to speak of one in isolation from the others.

Water Resources

Water Quality

Water Quality Measurements

A variety of indicators have been used to assess the water quality of the Quinnipiac River and its tributaries. These indicators include: dissolved oxygen, total suspended solids, dissolved organic carbon, nitrate, total nitrogen, phosphate, conductivity, total coliform bacteria, *E. coli*, enterococci, and aquatic biodiversity.

Water Quality Studies

There have been extensive studies of water quality in the Quinnipiac Watershed. A review of ten years of data about pollution from metals and carbon-based chemical compounds was conducted by Mary Tyrell for CCWS.[1] The most recent and comprehensive study of water quality, completed in March 2000, was conducted by CCWS and the UNH, Department of Biological and Environmental Science.[2] CTDEP also conducted water quality studies that were published in its 2000 Water Quality Report to Congress.[3]

Since 1974, USGS and CTDEP have cooperatively maintained three water monitoring stations on the Quinnipiac River mainstem that measure chemical and physical properties. They are located at: the bridge on Cheshire Street, Cheshire (ID# 01196222); Wallingford gage, on Wilbur Cross Highway 0.8 miles downstream from the bridge on Quinnipiac Street, Wallingford (ID# 01196500); and the bridge on U.S. Highway 5 at North Haven (ID# 01196530). Only the Wallingford station has continuous flow information, and so it is the only site at which loads (concentration times flow rate) can be calculated. Sampling is performed eight times per year[4] at the Wallingford station, where monitored parameters include physical properties, common chemical constituents, nutrients, metals, and bacteria.

In addition to the fixed network sites, CTDEP has conducted periodic intensive water quality surveys since 1977. These surveys typically monitor physical and chemical parameters over a twenty-four hour time period. The most recent survey of this type in the Quinnipiac Watershed was in 1997-1998.[5]

CTDEP also maintains twelve biological monitoring sites within the Quinnipiac Watershed, located from Southington to North Haven. At these sites, small creatures like insects and worms that live in the water under rocks and in the mud (benthic macroinvertebrates) are used as indicators of water quality. CCWS also conducted benthic invertebrate studies at twenty-nine sites in the watershed from Southington to North Haven.[6]

Water quality monitoring for biological, physical, and chemical parameters was conducted by a local organization, QRWA, at selected locations along the Quinnipiac River and several major tributaries, beginning in 1997. Sites included nineteen benthic macroinvertebrate stations.[7] Chemical and physical data was collected at the time of macroinvertebrate sampling, and one synchronous August 1998 low flow data set included twenty-six sites.[8] From 1997 to 1999, turbidity was monitored during and after seventeen rain events. Thirteen stations were regularly monitored with additional stations added as needed to identify sediment sources. QRWA also measured bacteria levels in the mid Quinnipiac River in August 1997.

Many of these studies were summarized in a report prepared by the Partnership's WQWG,[9] which also included data on industrial pollutants, contamination from landfills, pesticide contamination and sediment contamination.

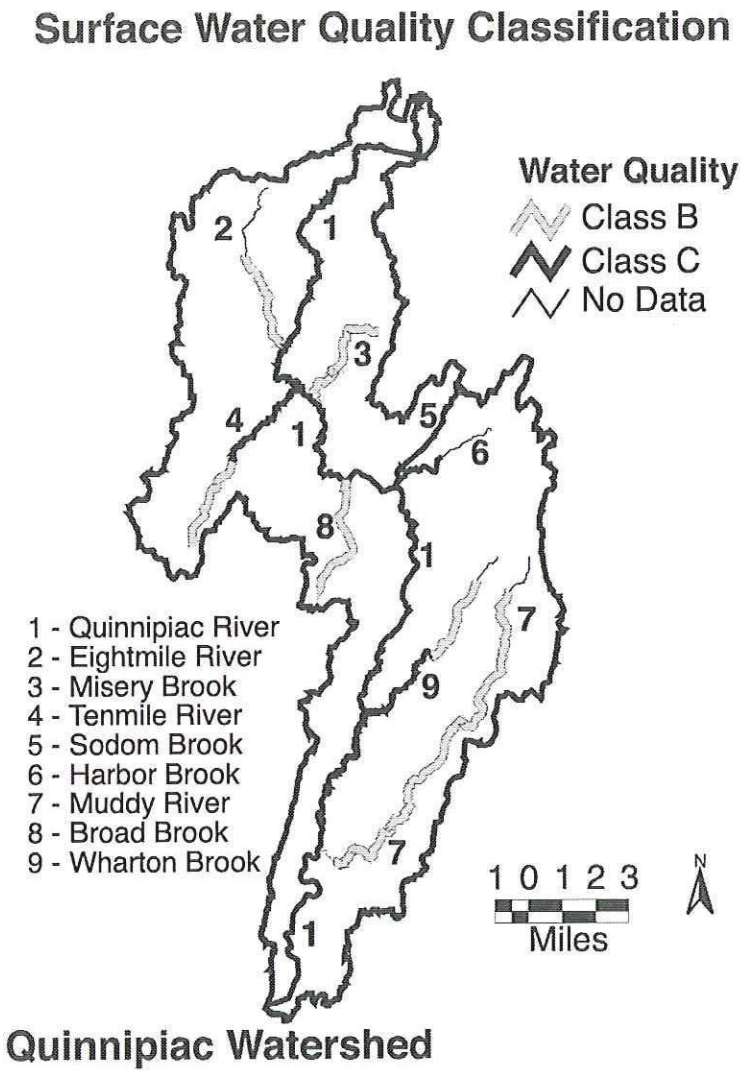
Results

The many water quality studies in the Quinnipiac Watershed are reviewed here in the light of CTDEP's water quality goals. CTDEP water quality goals in the Quinnipiac Watershed are suitability for contact recreation and support of aquatic life. Water quality for contact recreation is defined in terms of the concentration of a gut dwelling bacteria called enterococci. Suitability for use by aquatic life is determined by benthic macroinvertebrates, fish community, and chemical and biological assays of water and sediment.

The Connecticut Water Quality Standards categorize the quality of surface waters into classes (see Appendix 1). Class AA and Class A are for existing or potential drinking water; Class B is suitable for recreation and wildlife habitat; Class C means not supporting one or more designated uses due to pollution. **Figure 3** shows surface water quality classifications for the Quinnipiac River and its tributaries. From its head waters in Dead Wood Swamp in Plainville throughout its entire length, the Quinnipiac River's water quality is designated Class C/B. New Haven's inner harbor itself is designated as unsuitable for contact recreation. Two of the major tributaries, Harbor Brook and Sodom Brook, are considered to have pollution problems that prevent them from consistently meeting Class B standards. A 3.6-mile segment of the lower Tenmile River also does not meet Class B standards. The Eightmile River meets Class B standards, however, there is a fish consumption advisory for the Eightmile and Quinnipiac Rivers due to a PCB spill that occurred in the Plantsville section of the Quinnipiac River in 1996 and 1997, which has since been remediated but affected fish in the Quinnipiac River that migrated to the Eightmile River.

Figure 4 shows the same watercourses but separates the suitability for contact recreation from that of aquatic life.[10] Diverse aquatic life is associated with several tributaries that drain off the forested slopes of trap rock ridges (e.g. upper Tenmile River) and Southington Mountain (e.g. Dayton Brook). Lower Eightmile River and lower Honeypot Brook are examples of tributaries that regain non-impaired status after passing through broad, lowland wetland systems, with dilution from groundwater discharge and non-polluted runoff. Broad Brook has excellent water quality because its watershed is largely protected as a drinking water supply.

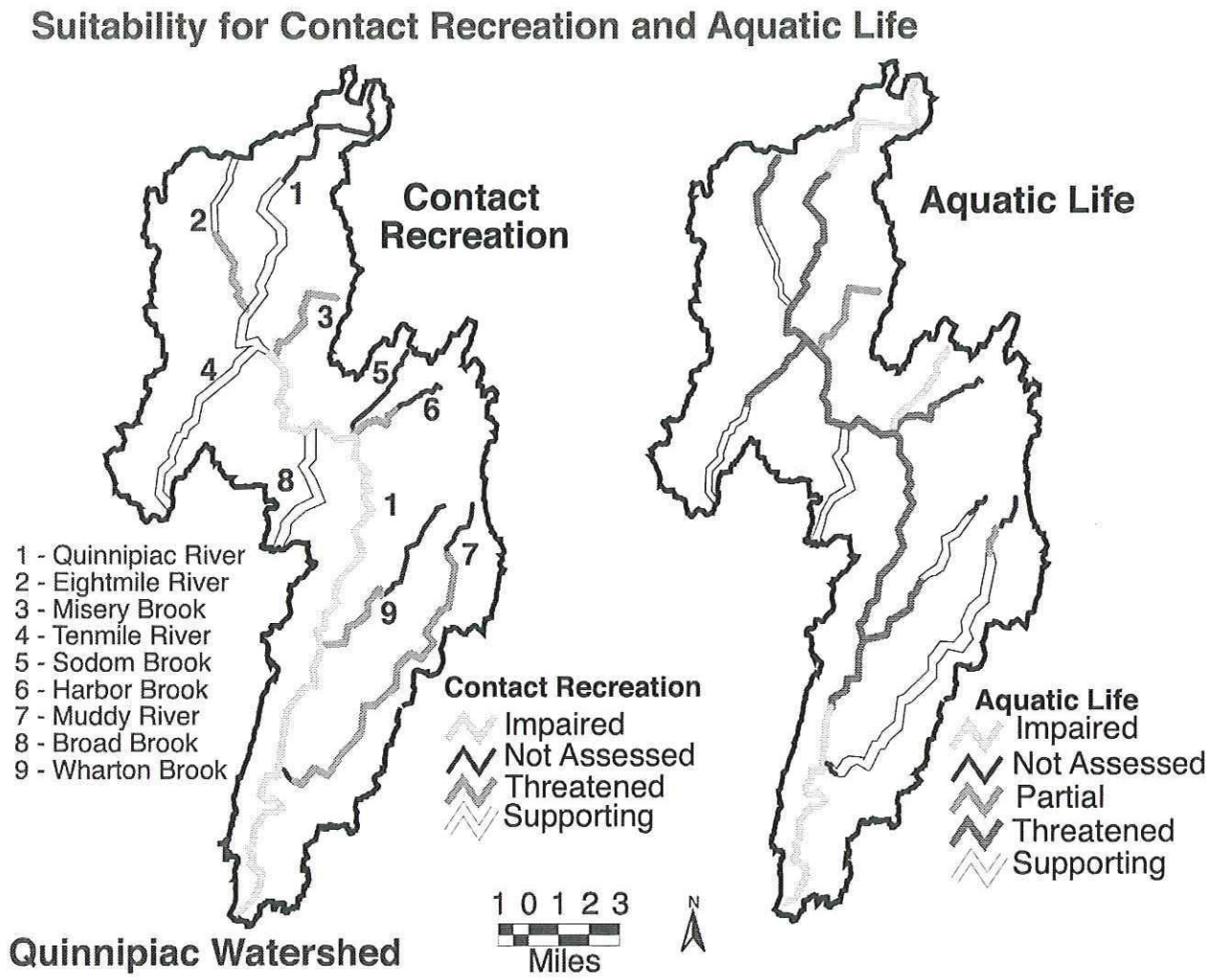
Figure 3



Source: CTDEP 2000 Water Quality Report and the Quinnipiac Watershed Partnership Report on Water Quality

Section 303(d) of the Federal Clean Water Act requires each state to develop a prioritized list of water bodies where existing controls on point and nonpoint sources of pollutants are inadequate to meet water quality standards and support designated uses. In April 1998, CTDEP submitted its list to EPA in the form of a report titled *Connecticut Water Bodies Not Meeting Water Quality Standards.* In August 1998, EPA formally approved this report.

Figure 4



"Supporting" means the water supports contact recreation or aquatic life. "Threatened" means the water supports contact recreation or aquatic life but water quality is threatened for that use. "Partial" means the water does not support aquatic life all the time. "Impaired" means the water does not support contact recreation or aquatic life.

Source: CTDEP 2000 Water Quality Report

Table 6A identifies water bodies found within the Quinnipiac Watershed that do not meet Connecticut Water Quality Standards. The table provides information on the probable reasons why the water body is not currently meeting criteria and supporting designated uses. **Table 6B** shows the location of the impaired river segments.

Table 6A
Impaired River Segments in the Quinnipiac Watershed

Water Body (River segment ID)	Suspected Cause*	Source of Impairment
Quinnipiac River-5.3 mi. (5200_00_01)	Bacteria, nutrients, organic enrichment, low oxygen, siltation	Construction, industrial point sources, land development, municipal point sources, nonpoint sources
Quinnipiac River-8.3 mi (5200_00_02)	Stormwater discharges, metals, toxic organics, low oxygen	Industrial point sources, waste storage tank leaks
Quinnipiac River-1.5 mi. (5200_00_03)	Flow alteration, pathogens, toxic organics	Hydromodification, upstream impoundment, storage tank leaks
Quinnipiac River-4.8 mi. (5200_00_04)	Pathogens, PCBs	Source unknown, storage tank leaks
Quinnipiac River-7.7 mi. (5200_00_05)	PCBs	Storage tank leaks
Quinnipiac River-2.8 mi. (5200_00_06)	PCBs	Storage tank leaks
Quinnipiac River-3.5 mi. (5200_00_07)	PCBs	Storage tank leaks
Eightmile River-3.3 mi. (5201_00_01)	PCBs, Pathogens	Source unknown, storage tank leaks
Eightmile River-2.4 mi (5201_00_02)	PCBs	Storage tank leaks
Tenmile River-3.6 mi. (5202_00_01)	Cause unknown	Unspecified nonpoint source
Sodom Brook-3.8 mi. (5205_00_01)	Flow Alteration	Groundwater withdrawal
Harbor Brook-2.1 mi. (5206_00_01)	Habitat alteration, metals	Channelization, industrial point sources
Harbor Brook-1.5 mi (5206_00_03)	Habitat alteration, metals	Channelization, industrial point sources
Wharton Brook-3.8 mi. (5207_00_01)	Pathogens, siltation, cause unknown	Source unknown
Hanover Pond-73 acres (5200-00-4-L2-00)	Fishway needed, metals, PCBs, excess nutrients, low oxygen, siltation	Road runoff, municipal point sources, nonpoint sources, urban runoff, dam blocks fish passage

The name of the water body and the length of the segment in miles is shown. The CTDEP code for the stream or river segment is in parentheses.

Source: CTDEP 2000 Water Quality Report

*Note that mercury from atmospheric deposition is considered a contaminant of all Connecticut's fresh waters. It does not affect overall use of these waters, except for certain fish consumption restrictions.

Table 6B
Location of Impaired River Segments

Water Body (River segment ID)	Location
Quinnipiac River-5.3 mi. (5200_00_01)	From Rt-5, North Haven, upstream to head of tide at Toelles Road, Wallingford
Quinnipiac River-8.3 mi (5200_00_02)	From Toelles Road, Wallingford, upstream to Hanover Pond, Meriden
Quinnipiac River-1.5 mi. (5200_00_03)	From Hanover Pond, Meriden, upstream through gorge to waterworks (breached dam) at Cheshire-Meriden line
Quinnipiac River-4.8 mi. (5200_00_04)	From breached dam at Cheshire-Meriden borderline, upstream to confluence with Ten Mile River
Quinnipiac River-7.7 mi. (5200_00_05)	From confluence with Ten Mile River, upstream to Rt-10 crossing, north of I-84, Southington
Quinnipiac River-2.8 mi. (5200_00_06)	From Rt-10 crossing, north of I-84, Southington, upstream to Hamlin Pond, Plainville
Quinnipiac River-3.5 mi. (5200_00_07)	From Hamlin Pond, Plainville, upstream to headwaters in Plainville
Eightmile River-3.3 mi. (5201_00_01)	From mouth at the Quinnipiac River, upstream to Grannis Pond, Southington
Eightmile River-2.4 mi (5201_00_02)	From Grannis Pond, Southington, upstream to headwaters, Bristol
Tenmile River-3.6 mi. (5202_00_01)	From mouth at the Quinnipiac River, Southington, upstream to Moss Farms Pond (just upstream of Jarvis Street)
Sodom Brook-3.8 mi. (5205_00_01)	From mouth at the Quinnipiac River, Meriden, upstream to headwaters
Harbor Brook-2.1 mi. (5206_00_01)	From mouth at the Quinnipiac River, Meriden, upstream to box culvert near railroad and Main Street
Harbor Brook-1.5 mi (5206_00_03)	From box culvert crossing I-691 upstream from Camp Street, upstream to Baldwin's Pond, Meriden
Wharton Brook-3.8 mi. (5207_00_01)	From mouth at confluence with the Quinnipiac River at Wallingford-North Haven borderline, upstream to Simpson Pond, Wallingford
Hanover Pond-73 acres (200-00-4-L2-00)	Southwest corner of Meriden, impoundment along Quinnipiac River below Meriden gorge

The name of the water body, and the length of the segment in miles or area in acres is shown. The CTDEP code for the stream or river segment is in parentheses.

Source: CTDEP 2000 Water Quality Report

Bacterial contamination is a severe problem in the Quinnipiac River and its tributaries, and is a major reason why the river is not attaining Class B water quality standards. Data collected by Yale during a two-year study of pollution from nonpoint sources show that during storm flow all twenty-nine sampling sites (including those in reaches of the river that are presently designated Class B) exceeded Class B water quality standards for fecal coliform, a possible indicator of disease bearing bacteria from the feces of humans or other warm-blooded animals.

Several sites exceeded fecal coliform standards at base flow. Although fecal coliform has not been used as a criterion since the 1980's, it continues to be used as a general guidleline for sanitary quality. Watershed-wide sampling results indicated that twelve out of fifty samples (24 percent) at base flow exceeded the standard of 400 bacterial colonies per 100 ml, and all sites exceeded it at storm flow. No more than ten percent of the samples should exceed the standard. Similarly, USGS data for 1995 through 1998 show that most samples are above the standards, seemingly independent of flow.

The dominant source of bacterial contamination is unknown. However, runoff from nonpoint sources through the urbanized areas and the unsewered rural areas of the watershed could be a major source of fecal coliform loading in the river. These excessive levels of bacteria probably result from numerous stormwater pipes that empty into the river and extend for many miles collecting pollutants from streets, parking areas, household pets, failing septic systems, broken sewer lines, sump pumps, illegal drain connections, and illegal hookup of sewage to storm sewers. Other possible sources include wildlife (especially geese and other waterfowl), and sewage treatment plants.

The most serious threat to human health is from human fecal waste. However, fecal coliform is not necessarily the best indicator of bacterial contamination from human waste. In 1986, EPA published new guidelines for bacterial monitoring based on studies which show a strong correlation between human gastrointestinal illness and both enterococci and *Escherichia coli* (*E. coli*) bacteria. There was no correlation between gastrointestinal illness and fecal coliform. Data on *E. coli* in the Quinnipiac River are extremely limited, but there is a long record of enterococci data from the USGS Wallingford station. These data indicate a significant problem with enterococci levels exceeding Connecticut standards for full body contact recreation from May through September. Winter months were excluded from this study since sewage treatment plants are not required to disinfect in the winter. The numbers in the winter are high, but not necessarily higher than those from the spring or summer.

Sewage Waste Water Treatment

Fifty-four percent of the population in the Quinnipiac atershed dispose of their wastes at sewage treatment plants (STPs). The remaining population dispose of their sewage through on-site septic systems.[22] There are six municipal waste water treatment plants in the watershed, servicing Cheshire, Meriden, New Haven, North Haven, Southington, and Wallingford. Figure 5 shows the location of each STP.

USGS recently completed a trend assessment at their Wallingford station[11]. It showed that between 1980 and 1992, ammonia-nitrogen had decreased while nitrate-nitrogen had increased, with total nitrogen staying the same. All six STPs have secondary treatment of the waste water to convert ammonia to nitrate. When they upgraded their waste water treatment to a system that converted ammonia to nitrate, ammonia levels went down and nitrate levels went up.

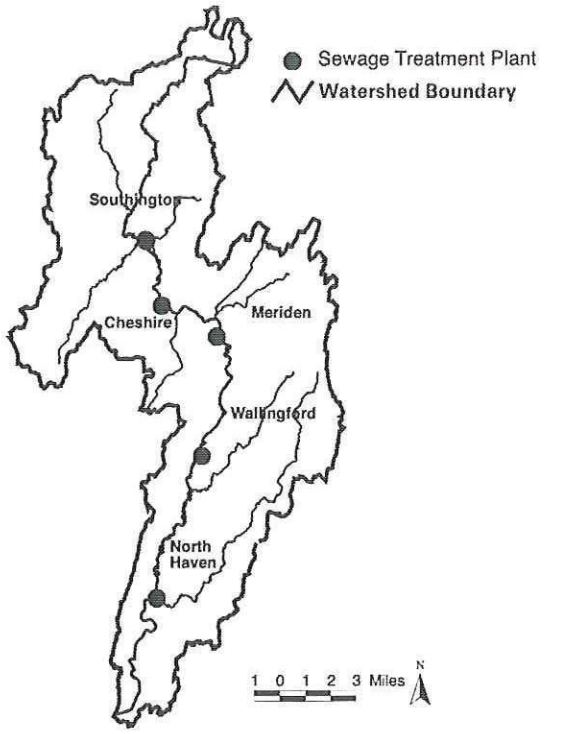
Ammonia is quite toxic to many forms of stream life. Nitrate is not toxic but causes algae overgrowth. When the algae die, their decay results in low oxygen levels that are harmful to life in Long Island Sound. STPs have again been directed to upgrade, this time to reduce the nitrate they discharge by using bacteria that convert the nitrate to nitrogen gas. All these facilities are in the planning stages for denitrification to reduce nitrate levels consistent with Long Island Sound Study recommendations. Implementation of the upgrades should occur within the next five years. According to the CTDEP, all plants are operating well and producing high quality effluents.[23] However, New Haven has a combined storm drain sewer outflow system that discharges untreated sewage into New Haven Harbor during times of heavy rain.

Other Waste Water Discharges

Waste water discharges are regulated by permits issued by the Permitting, Enforcement and Remediation Division of CTDEP Water Management Bureau. All point source discharges to surface water are referred to as direct discharges and are required to obtain a permit which limits their quantity and quality. Through this process, progressively more stringent discharge requirements have been imposed over the last thirty years of permitting, resulting in higher quality and lower volume effluents.

Figure 5

Sewage Treatment Plants



In the Quinnipiac Watershed, there are forty individual permits for surface water discharges, the majority of which are for discharges to the Quinnipiac River itself. Only six of the forty include process water effluents, and eight are publicly owned treatment works. The remainder are mostly large cooling water discharges, waste waters from potable water treatment plants, and groundwater remediation discharges.

In addition to many other requirements, all surface water discharges are required to be of such a high quality that they do not cause immediate or long-term toxicity to sensitive aquatic organisms. All the treated process water discharges in the watershed are directed to the Quinnipiac River. They include Cytec Industries and Allegheny Ludlum Corporation in Wallingford; and Circuit-Wise Inc. and Pratt & Whitney Aircraft Company in North Haven.

All indirect discharges to an STP are controlled through permits which limit their quality and quantity to levels which will protect the collection system and the STP from adverse effects. There are numerous individual permits and general permit registrations for these discharges.

Stormwater Discharges

With reasonably good control over point source discharges of industrial and sewage waste waters, water pollution control has turned more toward control of stormwater runoff. In 1992, CTDEP issued general permits for certain categories of nonpoint source stormwater discharges. These included stormwaters from construction

sites where five or more acres are disturbed, and specific industrial sites according to Standard Industrial Classification or other type of land use. These general permits presently cover many more discharges than the individual permits described above. A third general permit category was established in 1995 for stormwater runoff from commercial activities with impervious surfaces of more than five acres. The majority of stormwater controls are related to pollution prevention, proper maintenance, and proper operation of activities rather than treatment of the stormwater itself.

All sites in the Quinnipiac Watershed covered under the industrial stormwater general permit have been inspected at least once by CTDEP. Regulated construction sites are inspected as complaints are received or as time allows during the application process. CTDEP staff work with permittees to assist them in reducing the introduction of pollutants to stormwater. Enforcement actions are taken when compliance is delayed or ignored.

Significant levels of toxic pollutants continue to be measured in many samples of stormwater runoff from industrial sites (including some municipal activities covered by these permits), and significant erosion and siltation problems continue to occur as land is developed for housing or commercial purposes. Soils in much of the Quinnipiac Watershed are fine textured and easily eroded. As residential development increasingly extends onto the steeply sloping ridges on the watershed periphery, significant soil losses are unavoidable even when proper controls are in place. CTDEP expects to significantly expand its efforts on control of pollutants associated with stormwater in the near future.

Coastal Nonpoint Source Pollution

Section 6217 of the Coastal Zone Reauthorization Amendments of 1990 require that states with federally approved Coastal Zone Management Programs develop Coastal Nonpoint Source Pollution Control Programs to protect their coastal waters. The development of the Section 6217 program closely coordinates with the objectives of this plan to address the problem of coastal nonpoint source pollution in the Quinnipiac Watershed. Nonpoint source pollution, or "polluted runoff," is one of the most critical problems facing the nation's coastal areas and watersheds. All municipalities in the Quinnipiac Watershed except Southington and Plainville will be affected by Section 6217 and will be required to implement specific management measures, where not already in effect, to control nonpoint source pollution affecting coastal waters. Currently, Connecticut has obtained conditional approval for their Section 6217 program and is working towards final approval. The Quinnipiac Watershed Action Plan is an important tool for assisting authorities in identifying issues that will help control coastal nonpoint source pollution as required in the Section 6217 program.

Water Quality Summary and Conclusions

- Improved waste water treatment has reduced toxic ammonia levels and improved levels of dissolved oxygen in the Quinnipiac River.
- Available ambient water quality monitoring data still indicate compromised water quality for the entire length of the Quinnipiac River and for many of its tributaries.
- There are high levels of bacteria indicating contamination of the Quinnipiac River and many of its tributaries. This is why much of the water is considered unsuitable for contact recreation. The dominant source of this contamination is unknown.
- Nonpoint sources, such as stormwater runoff from commercial and industrial areas, degrade habitat for aquatic life because they contain high concentrations of sediments, hydrocarbons, and metals. Runoff from construction sites is a major source of sediment and nutrients. Runoff from residential and agricultural uses

may contain increased concentrations of nitrogen and other agricultural chemicals. Atmospheric deposition of nitrogen is also a source of nonpoint pollution.

- Additional sources of contaminants may come from landfills and historically contaminated sites which leach pollutants into surface and groundwater, as well as from permitted discharges of treated industrial and municipal waste.

The Quinnipiac River and its watershed provide many valuable and essential functions. The surface and groundwater provides an important source of water to many residents of the watershed. To care responsibly for our lands and waters, we must restore the Quinnipiac River so that it can sustain its traditional role of assimilating treated wastewater, while we protect its aquatic life, and provide aesthetic and recreational opportunities for the public.

Water Quantity

Public Water Supply

Connecticut is a water rich state. Its average annual precipitation is 44.8 inches.[12] About half of this precipitation finds its way into ground and surface water.[13] For the 167 square mile Quinnipiac Watershed, this amounts to 65 billion gallons of water a year, or about 732 gallons every day for each person in the watershed. The estimated production of public water supply is 134 gallons per person per day.[14] Though this is much less than the theoretically available water, only a portion of land is actually devoted to collecting and storing potable water. Further, the amount of available water varies with the seasons and human water use is the highest during the driest months of July and August.[15]

Public water supplies include twenty-one Class AA reservoirs and forty-one community water supply well fields.[17] About 80 percent of the population in the watershed obtain their water from a public water supply system.[16] The South Central Connecticut Regional Water Authority (SCCRWA) and utilities in Wallingford, Meriden and Southington, are the major suppliers of potable water in the Quinnipiac Watershed.

Almost 55 percent of public water serving the watershed population comes from well fields in stratified drift aquifers (sand and gravel aquifers) within the Quinnipiac Watershed.[18] Ninety three percent of Southington's water supply comes from public wells. Because of the high dependence on wells, aquifer protection is of particular importance. Contamination of high yielding public wells can have serious health consequences and be very expensive to correct. It is important to note that many aquifer recharge areas for public wells underlie areas that are highly developed. It is to be hoped that these will be afforded additional protection by the State Aquifer Protection Program. Approved municipal land use ordinances that are still pending could offer further protection if they were enacted.

About 25 percent of public water serving the watershed population comes from reservoirs within the watershed, and 20 percent is imported from reservoirs in other watersheds. The four largest reservoirs serving the Quinnipiac Watershed are: Lake Gaillard, Lake Saltonstall, the Hammonasset Reservoir, and the Broad Brook Reservoir (all owned by the SCCRWA). Of the four, only the Broad Brook Reservoir is inside the Quinnipiac Watershed.

Most reservoir watersheds have large tracts of land owned by the water utilities, with the remaining reservoir watershed being forested or lightly developed. Reservoir watersheds constitute about 10 percent of the Quinnipiac Watershed's landscape, a significant portion of the remaining open space in the area.[19] Most reservoirs have excellent water quality protection programs in place, due in large part to the considerable open space under the ownership of the water supply utilities. Most of the watershed land in private ownership is zoned for low intensity

land use. The Federal Safe Drinking Water Act "Source Water Area Protection Program" is a new initiative to strengthen protection mechanisms for all reservoirs and public water supply wells, regardless of size or location.

The "South Central Connecticut Water Utility Management Area, Final Water Supply Assessment Part 1"[20] expressed concern that, "(t)he long term adequacy of area wide supplies is insufficient to meet either average or peak demand levels." The July 2000 report of the Partnership's LFWG[21] raised additional concerns that many of the Quinnipiac River's tributaries may be seriously over allocated in terms of registered and permitted water diversions. For example, Broad Brook and Misery Brook in Southington, and Sodom Brook in Meriden are seasonally impaired by insufficient flows to sustain a healthy aquatic community. These combined concerns point to the need for careful study and planning for water allocation. Issues such as water supply system efficiency and water demand management need to be considered. The availability and use of water resources to serve future potable water supply demands which are compatible with environmental objectives are primary concerns for CTDEP, DPH, water supply utilities, watershed residents and environmental groups.

Recent state legislation mandated that registered and permitted water users start reporting the volume and timing of their withdrawals (Public Act 01-202) and established a Water Planning Council to study statewide water allocation issues (Public Act 01-177). It is hoped that these legislative acts will help with planning water allocation in the Quinnipiac Watershed.

Dams

According to a dam inventory in 1983,[25] one hundred and nine dams have been constructed on the Quinnipiac River and its tributaries. Only five of these dams are on the mainstem of the Quinnipiac. Eleven dams are associated with public water supplies. The rest are "run-of-river," which means that the inflow into the impoundment is equal to the outflow and the dam holds back very little water. Run-of-river dams generally provide little in the way of flood water storage or attenuation of flood peaks. Most of the dams in the watershed are privately owned by homeowners and businesses. Many were constructed as impoundments for recreational or aesthetic purposes.

The first major impediment to fish migration on the Quinnipiac River mainstem is Wallace Dam about twelve miles from the mouth of the river. The second impediment is the Hanover Pond dam about four and a half miles further north. There are plans proposed to have fish ladders built on each of these dams which will reopen many miles of river and streams to migratory fish.

Four dams have breached since 1938. Plants Pond and Community Lake dams are completely breached while two dams are partially breached – one behind the Britannia Spoon building in Wallingford, and the other at the upper end of Meriden Gorge. CTDEP has required major repairs for several dams to prevent breaches. Unauthorized dam work has resulted in several incidents of significant releases of sediment into streams due to inadequate sedimentation and erosion controls.

Flood Management

The Quinnipiac Watershed has a long flood history. Seven major floods have occurred in the past seven decades: September 1938, March 1953, August 1955, October 1955, January 1979, June 1982, and April 1996. The largest was the flood of June 1982. There are no dams constructed specifically for flood control in the watershed.

The response of the river system to large rain events has changed significantly since 1970. In the three decades from 1931 to 1960 there were three years when rain events caused the flow at the USGS Wallingford stream gage to exceed 3000 cubic feet of water per second (cfs). In the three decades from 1970 to 1999, there were fourteen years

where flows exceeded 3000 cfs. A ten-year rain event (the largest rain storm with a statistical recurrence of once every ten years) now produces a much higher discharge than before 1970 because of the effect of urbanization on flow. Urbanization usually results in large amounts of land covered by surfaces impervious to water. Stormwater from these surfaces is usually piped directly to the river (instead of naturally seeping into the ground) and results in abnormally high flows.

CTDEP administers a program that establishes Stream Channel Encroachment Lines (SCEL). This program emerged after the 1955 flood as a nonstructural element in the state's ongoing efforts to lessen the hazards to life and property due to flooding. The SCEL program uses permits to regulate the placement of encroachments and obstructions within a river's floodplain. In making a decision on a SCEL permit application, CTDEP must consider the impact of proposed activities on the floodplain environment, including wildlife and fisheries habitats; flooding; and flood hazards posed to people and property.

SCEL were originally established for the Quinnipiac River based on the 1955 flood, and generally follow the one hundred-year floodplain boundary for seven miles from Sackett Point Road in North Haven to the Meriden-Wallingford line just south of Hanover Avenue. After repeated severe flooding, several neighborhoods along the Quinnipiac River have been purchased by the state – notably the Bantam Street neighborhood in North Haven, which was added to Quinnipiac River State Park.

Land Use

The Quinnipiac Watershed is characterized by a wide variety of land uses, with urban and more commercialized and industrialized sectors and a high degree of residential settlement near Long Island Sound and generally following the river corridor, although a four mile long forested, floodplain wildlife corridor remains in North Haven and Wallingford. A substantial portion of the Quinnipiac River in Cheshire is also relatively undeveloped. Sodom Brook and Harbor Brook run through a heavily urbanized area in Meriden. Other land uses include mixtures of suburban residential, suburban commercial, agricultural land, forest, and open space areas. Substantial tracts of open space (including much water company-owned land) are associated with the traprock ridges and Southington Mountain. Several broad floodplain wetlands also form open space corridors.

Each of these land uses affects the quality of the water that flows into the Quinnipiac River and its tributaries. Forested land, meadows, and wetlands are generally beneficial. Residential development and impervious surfaces may be detrimental. Farmland can be either beneficial or detrimental depending on agricultural practices. **Table 7** identifies the various land cover types, and lists the percent and area of the watershed associated with each of them.

Table 7
Land Cover in the Quinnipiac Watershed

Data derived from Land Use GIS overlay from the MAGIC Internet site, UConn.

Land cover type	Percent of Watershed	Square Miles
Forested land	43.3	71.3
Farm and field	21.7	35.7
Wetland and marsh	0.8	1.2
Open water	2.4	3.9
Residential development - high density	4.3	7.1
Residential development - other	20.7	34.1
Impervious surfaces	6.4	10.6
Total	99.6	163.9

Note: Wetlands and impervious surfaces are under-reported due to technical difficulties with GIS classification methods.

Table 8 shows acreage and percent of impervious surface in the Quinnipiac subwatersheds. Approximately 17 percent of the Quinnipiac Watershed is characterized by impervious surfaces. An impervious surface can be defined as any material (such as pavement and buildings) that prevents water from seeping into the soil. Studies indicate that water quality gets worse as the amount of impervious surface within a watershed or subwatershed increases.

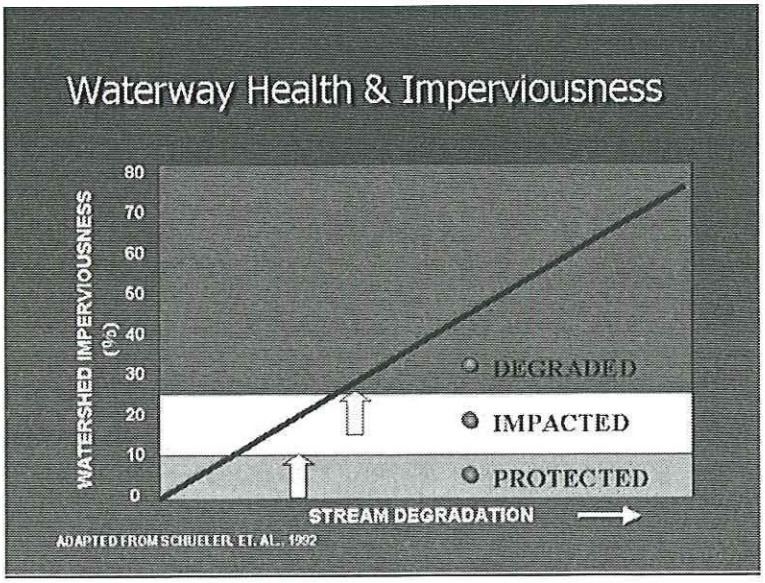
There are two key impervious surface thresholds for water quality: one at 10 percent and the other at 25 percent of land covered by impervious surfaces. **(Figure 6)**. In watersheds with less than 10 percent imperviousness, the water quality remains high. At levels above 10 percent, degradation of water quality can be detected and water quality would be considered as "impacted." When levels exceed 25 percent imperviousness, then degradation becomes so severe that it is unavoidable. The lower portion of the Quinnipiac River exhibits 26 percent impervious conditions; only Broad Brook and Muddy River subwatersheds are less than 10 percent impervious.

Table 8
Impervious Surface in the Quinnipiac Watershed

Subwatershed	Total Area (Acres)	Impervious (Acres)	Impervious (Percent)
Broad Brook	3,080	119	4
Muddy River	13,947	1,273	9
Eightmile River	9,441	1,124	11
Misery Brook	3,993	428	11
Tenmile River	12,967	1,407	11
Wharton Brook	4,895	690	14
Sodom Brook	3,377	595	18
Upper Quinnipiac Mainstem	20,261	3,883	19
Harbor Brook	7,751	1,657	21
Lower Quinnipiac Mainstem	26,238	6,888	26
Total for watershed	105,950	18,064	17

Note: The boundary between the upper and lower mainstem watershed is on a subwatershed boundary that generally follows Route 322 on the Cheshire-Southington border.

Figure 6



The Quinnipiac River corridor is highly urbanized and industrialized. While some areas in the watershed exhibit generally good water quality, in many areas the waters are degraded. The watershed has an astounding number of known or suspected "toxic" or "leachate" sites, over 5,000 according to various sources. These are locations where releases of pollutants have occurred; government enforcement actions have been carried out; or there exists the potential for pollution to reach the rivers or streams. Fifty-five percent of these sites are located within one-quarter mile of a stream or river.

The recreation potential of the Quinnipiac River and its tributaries is considerable yet under utilized. The *Canoe and Natural Resource Guide to the Quinnipiac River*[26] published by QRWA lists twenty-six sites for canoe access. However, many of these sites are unimproved and not frequently used. Recreational boating takes place primarily in Cheshire and in the lower river, while fishing occurs along the entire length of the river. More than five established public access sites are available along the river corridor but direct and convenient public access to the Quinnipiac River is confined to relatively few sites. Well-maintained hiking trails along the river are located in North Haven, Wallingford, Meriden, and Cheshire, but do not yet form a continuous network. It is hoped that the trails will be extended to create a Quinnipiac River corridor greenway.

Open Space

Open space is a category of land use that covers a wide of variety uses and functions. It can provide opportunities for active or passive outdoor recreation; enhance the aesthetic appeal and character of an area; or support natural resources, including plant and animal habitat. CTDEP classification of open space includes golf courses, cemeteries, ball fields, playgrounds, and schools. Committed open space is protected from further alteration. Uncommitted open space may be subject to alteration that degrades its natural functions.

One large block of open space is found along Broad Brook Reservoir in the center of the watershed. Other open space areas are associated with ridges on the watershed periphery. Large forested areas along the upper Muddy River, the Tenmile River, and Humiston Brook are protected for water supply.[27]

Overall, CTDEP data show 12,650 acres, or 12 percent of the watershed, as open space. However, a closer examination shows 9,606 acres (9.0 percent) as protected open space, with the remainder vulnerable to development. **Table 9** indicates the quantity of committed and uncommitted open space within the watershed by ownership and municipality,[28] and **figure 7** shows the distribution of private and public open space in the watershed. In terms of water quality and the health of rivers and streams, the more open space that is kept in, or close to, its natural state, the better. Maintaining forested areas is one of the best ways to provide sources of clean water. The rugged, steep topography of the forested traprock ridge formations has historically constrained development of much of the uncommitted open space. However, advances in engineering and septic system design, and a shortage of land suitable for development elsewhere, is resulting in increasing numbers of proposals for development projects on challenging terrain. There is now a need for formal protection if these areas are to remain as open space.

In 1998, the Connecticut General Assembly enacted into law Public Act No. 98-157, *An Act Concerning Open Space and Watershed Land Acquisition.* This act establishes the state's Protected Open Space and Watershed Land Acquisition Program to provide matching grants to municipalities, nonprofit land conservation organizations, and water companies for use in purchasing land to be preserved as open space. This new land acquisition program is intended to supplement the state's existing acquisition program. There are over 2,400 acres of uncommitted privately held open space land in the Quinnipiac Watershed. Converting a large portion of this to protected forest, meadow, and fields would greatly benefit the environment and the quality of life in the watershed.

Table 9

Open Space in the Quinnipiac Watershed

Source: Data from the MAGIC Internet site, UConn.
and the Quinnipiac River Watershed Internet site, UNH

	Committed Open Space (Acres)		Uncommitted Open Space (Acres)	
Municipality	**Public**	**Private**	**Public**	**Private**
Wallingford	2,599	566	283	591
Southington	2,131	47	53	903
Meriden	1,248	28	111	211
Cheshire	240	72	61	38
North Haven	1,236	88	0	402
Plainville	162	1	55	45
Wolcott	66	1	6	200
Prospect	2	1	0	9
New Haven	231	8	36	1
Hamden	824	0	14	0
Bristol	0	55	0	25
Totals	8,739	867	619	2,425
% of Basin	8.2	0.8	0.6	2.3

Committed open space includes cemeteries, golf courses, playgrounds, town greens and parks.
Uncommitted open space includes parcels designated as "unclassified."

Habitat

Inland Wetlands

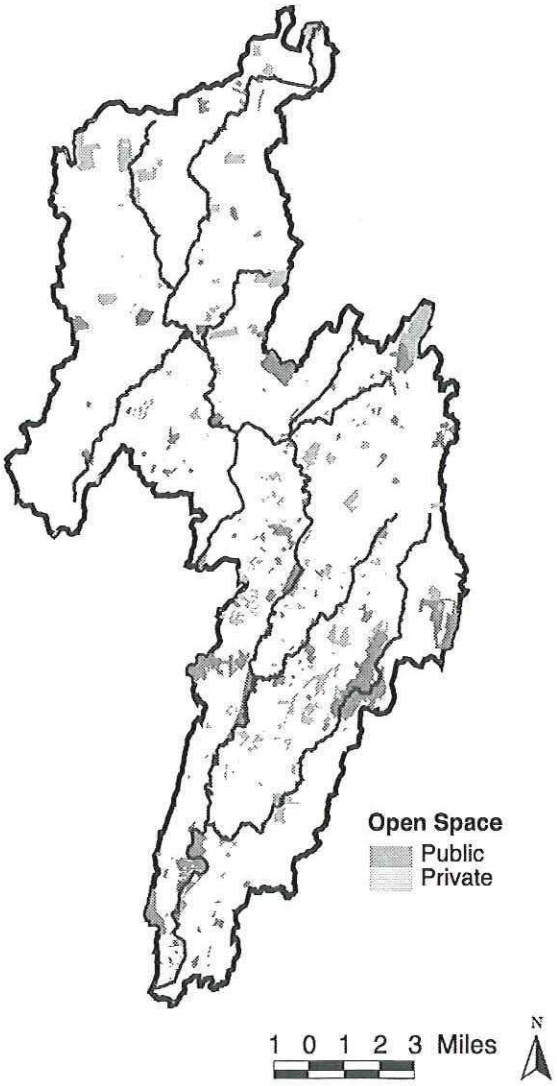
Inland wetlands and watercourses are essential for an adequate supply of surface water and to increase ground water recharge. Wetlands promote hydrological stability, help to control flooding and erosion, purify ground and surface waters, and provide habitat and food for many species of plants and animals. Wetlands help remove sediment and pollutants, especially excess nutrients. Nutrient removal is an important function that protects surface water quality and Long Island Sound.

There are many different types of inland wetland, each with its own special variety of plant and animal life. Of particular note are kettle wetlands and vernal pools. Kettle wetlands formed when blocks of ice from the glaciers that once covered New England melted, and left behind depressions in the sandy soil. Kettle wetlands often have deep peat deposits, sphagnum moss, and more northern bog-type vegetation. They are common in Southington. Vernal pools are fish-free wetlands that are not permanently flooded and provide breeding habitat for a variety of amphibians, including the Jefferson salamander, a Connecticut threatened species. Several productive clusters of vernal pools are associated with traprock ridges and river floodplains in the Quinnipiac Watershed. Floodplain wetlands are especially important as wildlife habitat where they form broad, undeveloped corridors along the mainstem Quinnipiac and the major tributaries. They are travel corridors in the suburban landscape, even for uncommon wildlife such as the bobcat. Lush tangles of vegetation support many species, including a few remaining wood turtles (a Connecticut Species of Special Concern), and migrating song birds. Water quality data from upstream and downstream of several of these wetland corridors indicate that they also improve water quality.

In Connecticut, inland wetlands are defined by soil drainage type. **Figure 8** shows the distribution of wetland soils in the watershed. A quantitative map analysis shows that approximately 12.7 percent of the watershed is composed of inland wetland soils. **Table 10** shows the distribution of inland wetlands in the watershed by municipality.

Figure 7
Source: GIS data from CTDEP

Open Space



Quinnipiac Watershed

Table 10
Inland Wetlands by Municipality in the Quinnipiac Watershed

Source: Data from the MAGIC Internet site, UConn.
and the Quinnipiac River Watershed Internet site, UNH

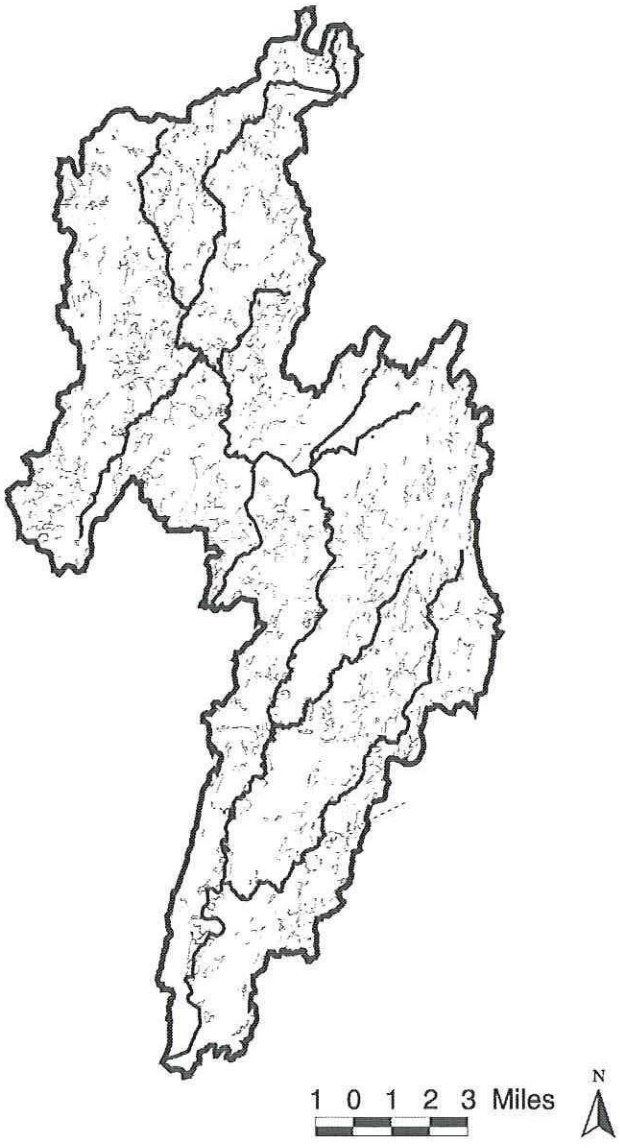
Town	Watershed Inland Wetlands (Acres)	Watershed Inland Wetlands (Percent of Total)
Wallingford	3896	28.0
Southington	2971	22.0
Cheshire	2230	16.2
North Haven	1244	9.1
Meriden	1004	7.3
Wolcott	550	4.0
Prospect	532	3.9
Plainville	436	3.2
New Haven	222	1.6
Bristol	71	0.5
Hamden	44	0.3
Other Towns	540	4.0
Total	13,740	

Many inland wetlands and watercourses have been destroyed because of unregulated use. The deposition or removal of material, the diversion or obstruction of water flow, erection of structures, and other uses have despoiled and polluted wetlands and watercourses throughout the Quinnipiac Watershed. Such unregulated activity has had a significant adverse impact on the environment and ecology of this watershed.

In 1972, Connecticut enacted the Inland Wetlands and Watercourses Act. This act is currently being implemented through municipal inland wetlands and watercourses agencies statewide. It enables CTDEP and municipalities to regulate construction and other activities adversely affecting inland wetlands and watercourses. Local commissions have adopted regulations governing construction activities in inland wetlands and watercourses and also on land adjacent to the inland wetlands and watercourses. This adjacent land is known as an upland review area. The extent of the upland review area and the type of activities requiring a permit vary from town to town. Within the Quinnipiac Watershed, the upland review areas range from no specified distance to 500 feet **(Table 11)**. A defined upland review area is helpful in determining whether a wetland permit may be required for a proposed activity.

Figure 8

Inland Wetlands



Quinnipiac Watershed

Regardless of the size of the upland review area for a particular town, inland wetlands and watercourses commissions have the power to regulate (not prohibit) any activities within their municipality that may harm an inland wetland or watercourse no matter how far away it may be from the regulated area. The extent of upland review should be based on scientific data on the effect of proposed activities on the inland wetland or watercourse.

Table 11
Inland Wetlands and Watercourses Upland Review Areas by Municipality

Source: Akiko Kawaguchi, YFES
Jerry Silbert, personal communication.

Municipality	Upland Review Area (feet)
Cheshire	50
Hamden	200
Meriden	50
New Haven	50
North Haven	50
Plainville	50
Prospect	75-100
Southington	30-80
Wallingford	50-100
Wolcott	50-500

Tidal Marsh

Tidal marshes are generally flat, vegetated areas occurring at the interface of the land and ocean where daily tidal action moves water in and out of the system. Tidal wetlands are one of the richest and most biologically productive resources in the world. They serve as nursery grounds for many coastal fishes; and waterfowl and many aquatic animals use them for homes, food, and resting areas. Tidal marshes also play a role in cleansing water and in protecting shore areas from flooding. The Quinnipiac tidal marsh is the most familiar form of tidal marsh - a coastal salt marsh characterized by such plants as salt marsh cordgrass, salt meadow cordgrass, and phragmites or common reed.

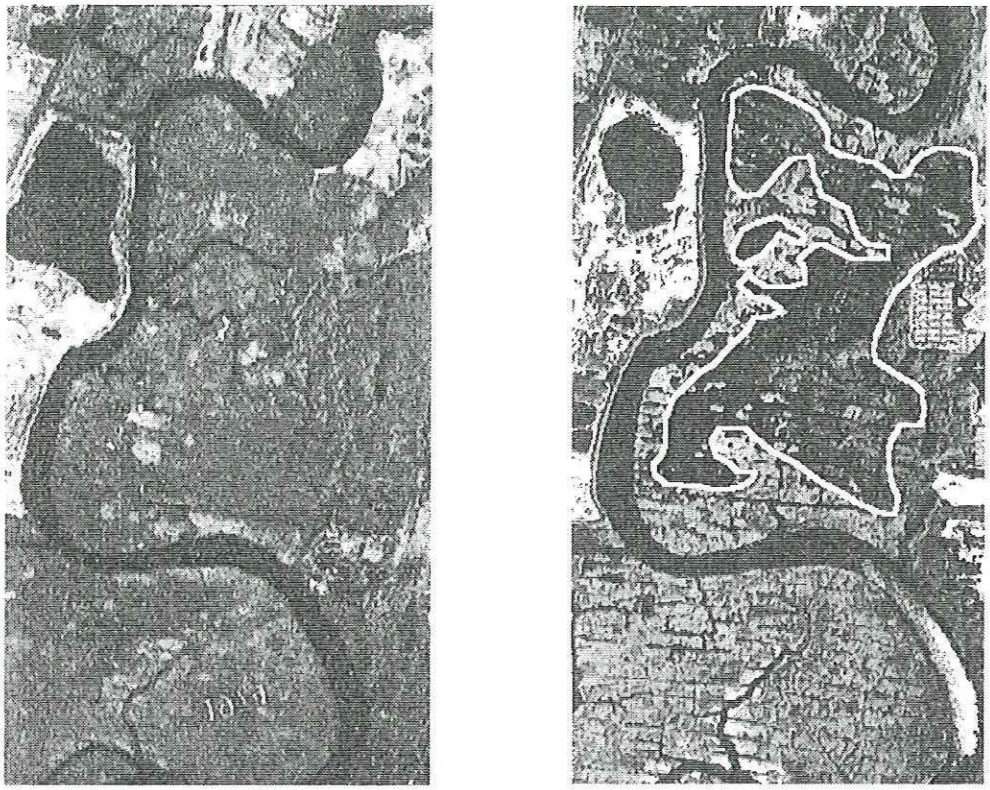
The Quinnipiac tidal marsh covers 834 acres. CTDEP owns 564 acres as a natural preserve.[29] The marsh extends from the Route 40 connector in North Haven, south to the Grand Avenue bridge in New Haven. A dramatic change in the plant composition of the lower Quinnipiac tidal marsh has been taking place over the past twenty years. Aerial photographs, GIS analysis, and field verification have shown that plant species are disappearing and being replaced by mud flats **(Figure 9)**. The cause of this change is not clear and is undergoing further study. Possibilities include changes in the flow regimen of the Quinnipiac River, changes in nutrients, the marsh sinking, or the ocean level rising.

State permits are required for work in tidal wetlands or below the high tide line in coastal, tidal, or navigable waters. CTDEP issues these permits under authority of the Connecticut Tidal Wetlands Act (Connecticut General Statutes Section 22a-28 through 22a-35) and the Structures, Dredging and Fill Permit Prgram (Connecticut General Statutes Section 22a-359 through 22a-363f), and in accordance with the policies of the Coastal Management Act of 1980 (Connecticut General Statutues Section 22a-98).

Figure 9

Source: Yale Center for Coastal and Watershed Systems

Quinnipiac Tidal Marsh: Changes in Plant Composition



The dark ribbon running from top to bottom is the Quinnipiac River. The 1974 aerial photo (left) shows marsh plant life as a gray color. The area outlined in white in the 2000 photo (right) shows where the plants have disappeared and been replaced by mud flats

Stream Corridor Conditions

Stream corridor conditions generally affect the health of fish species and the ability of their populations to survive. Habitat conditions in the stream corridors of the Quinnipiac Watershed vary from extremely good to severely disturbed. Disturbed sites are usually found where the land next to the stream or river has been developed, such as Harbor Brook in Meriden. Water flow is restricted in certain stream segments, and changes in the natural form of the stream bank are common in commercial and residential settings. Stream channel degradation has resulted from sediment deposition and increased volumes of runoff associated with a developed watershed. Streams such as lower Meetinghouse Brook and Wharton Brook in Wallingford have shifting sediment bars, severe bank erosion, and ever-broadening, shallow braided channels. Where excess nutrients enter streams, stringy algae and algal scum may cover the rocks and gravel which are the nesting and feeding habitat for many fish. Good conditions prevail where a substantial amount of land surrounding the stream is forested or wetland. Streams from heavily forested areas can dilute polluted water from a developed area and improve water quality.

Critical Habitat Types

The most distinctive habitat types are those associated with the traprock ridges, the sand plains in Wallingford and North Haven, and the kettle wetlands in Southington.

Substantial portions of the Quinnipiac Watershed are located along the north-trending basalt ridges found in Central Connecticut and designated as a critical habitat by CTDEP. These ridges are rich in uncommon, characteristic plant species like Dutchman's Breeches and bladdernut, as well as state-listed species like wall rue and narrow-leaved spleenwort found in the Hanging Hills. Growing conditions differ from those prevalent in the rest of the state as the soils are more fertile and less acidic. The ridges also include uncommon microhabitats, such as exposed, dry, south-facing ridge crests, cliff faces, and cool fields of broken rock at the base of the cliffs, all of which support unusual flora.

Traprock ridges also support uncommon or rare fauna, such as copperhead snakes and ravens. Bird data collected by QRWA and Quinnipiac Valley Audubon Society show that healthy populations of disturbance-sensitive, forest interior songbirds, such as scarlet tanagers, are still found in the large forested tracts on traprock ridges, though not in most of the rest of the watershed.

Topographic constraints have limited development of these areas in the past, though less so in recent years. Several ridges, like Tyler Mill in Wallingford, have been purchased as open space. The Metacomet Compact, signed by most of the Connecticut towns with traprock geologic formations in the watershed, is an initiative to protect these unique geologic formations for their biodiversity as well as their scenic and recreational value.

Only a few remnant parcels remain of the second critical habitat type, the sand plain. These are found east of the Quinnipiac River in Wallingford and North Haven. Sand plain vegetation is characterized by pitch pines and a variety of drought-tolerant grasses and wildflowers, including the sand dropseed, a Connecticut Species of Special Concern. Characteristic fauna in this habitat include tiger beetles and wolf spiders. This habitat type is now very uncommon in Connecticut, in large part because level, sandy, well-drained soils are readily developed and are often mined for sand. Searches for state-listed species are important in this area because remnant populations may persist even in small parcels, or they may colonize former earth excavation pits. Also, there is the potential for seeds of rare plants to be used for restoration efforts.

The third critical habitat type, the black spruce bog, is found in a kettle wetlands on Route 120 in eastern Southington. Other kettle wetlands, such as the Abetz Kettle, are borderline bogs with some bog plants such as leatherleaf and sphagnum moss. Sediment-laden runoff and nutrient inputs from lawn fertilizers threaten these low nutrient (oligotrophic) wetlands.

Vegetation

Most of Connecticut's natural vegetation communities are represented in the Quinnipiac Watershed, including silver maple floodplain forests along the lower river; red maple-spicebush wooded swamps; mixed hardwood forests with oaks and hickories; sugar maple forests on moist, fertile bottomland; forests dominated by tulip trees; white pine woodlands on sandy outwash plains; chestnut oak dominated forests on dry ridge summits; and old field plant communities dominated by sumac, red cedar and gray birch.

Unfortunately, the Quinnipiac Watershed suffers from an invasion of "nuisance plant species." These are mostly non-native plant species that successfully out-compete native plants. The invasive species of most concern are listed in **Table 12** with both their common and scientific names. While the majority of invasive species are non-native, a few are native, such as the common reed.

The majority of these nuisance invaders originated in Asia and Europe. They were brought to the watershed in the 1800's as ornamental plantings. However, over time, these species escaped their intended landscapes and colonized the surrounding environment. They have succeeded because there are few, if any, animals that eat them

or their seeds. These species compete with less invasive and generally more beneficial plants and eventually win out.

Table 12
Invasive Plants Common to the Quinnipiac Watershed

Common Name	Scientific Name
Norway maple	Acer platanoides
Garlic mustard	Alliaria petiolata
Japanese barberry	Berberis thunbergii
Asiatic bittersweet	Celastrus orbiculatus
Autumn olive	Eleagnus umbellifera
Winged euonymous	Euonymous alatus
Japanese honeysuckle	Lonicera japonica Thunbergii
Purple loosestrife	Lythrum salicaria
Japanese stilt-grass	Microstegium vimineum
Common reed	Phragmites australis
Japanese knotweed	Polygonum cuspidatum
Glossy and common buckthorn	Rhamnus frangula and R. catharticus
Multiflora rose	Rosa multiflora

As native plants have been lost in the Quinnipiac Watershed, the historic plant community of the watershed has been lost as well. When the aggressive growth of invasive species continues, there are areas where one kind of plant chokes out all, or most of, the others. This results in a lack of variety of different plants and, in turn, results in a lack of variety of animal species. Non-native plant species have arrived in this country without the insects that eat them and keep them in check in their country of origin. They gain an an unfair advantage when competing with native species that are eaten by native insects. The value of non-native species is reduced in terms of invertebrate biodiversity, and food sources for insect-eating wildlife. Other impacts from invasive species include changes in soil conditions (i.e. chemistry, moisture, and nutrient composition), and threats to rare or endangered species (both plant and animal).

Often invasive species can first take advantage of disturbed areas before spreading to well-established plant communities. Wetlands disturbed by filling, digging, or draining offer an excellent opportunity for the common reed and purple loosestrife to become established. As a result, these species are becoming quite common along the sides of highways, on lake shores and in tidal marshes bordering New Haven Harbor. These two species have the greatest tendency to become dense, homogenous stands which offer little wildlife support. Another prime area for non-natives to invade is the zone between developed areas and naturally vegetated areas, known as "edges." Bittersweet, multiflora rose, and knotweed are typically found at "edges." Winged euonymous, garlic mustard, and barberry are commonly found dominating the understory of woodlands where the forest's perimeter has been disturbed.

One strategy for controling purple loosestrife is the release of the leaf-eating Galerucella beetles that help control the loosestrife in Europe where it originates. Several watershed land trusts are working to control invasive species in their preserves. Three biological control release sites have been established in Meriden and Southington. Another useful tool is to require invasive species removal projects as a permit condition for new development projects. Seeding or planting newly created forest edges (e.g. along roadways or new subdivisions) with native shrubs and meadow species can also significantly reduce colonization by invasive species.

Fisheries

In 1990, CTDEP conducted a comprehensive stream survey on the western and central coastal watersheds.[30] As part of this survey, the Quinnipiac River and its seven major tributaries were examined for insects, fish, and habitat. Data were analyzed for physical, chemical, and biological parameters (i.e. air and water temperatures, water velocity and discharge, dissolved oxygen, pH, conductivity, and fish species composition). Each of the studied sites had pools and riffles that support cold water fish. The study also noted the presence or absence of trout and trout reproduction.

For the stream segments sampled in the Quinnipiac Watershed, approximately 57 percent had evidence of trout reproduction. In their natural state, over 80 percent of these streams would support trout. Brown Trout had a lower incidence of reproduction (21 percent) than Brook Trout (50 percent). The number of Brown Trout per acre of stream habitat was significantly less than for other streams in the South Central Coastal Major Basin. This means that the streams in the Quinnipiac Watershed provide poor habitat for Brown Trout. The number of Brook Trout per acre was higher than for the rest of the South Central Coastal Major Basin, indicating a more favorable habitat for this species. This is due, in part, to better habitat in small streams that are preferred by Brook Trout and poor habitat in the larger streams that are preferred by Brown Trout. In addition to cold water fish species, the survey revealed the presence of many warm water species. These species are likely to be permanent residents in lakes and ponds behind dams, and occasional visitors through free-flowing river reaches.

One sampling site was located directly on the Quinnipiac River in the Meriden Gorge area and indicated the presence of both cold and warm water fish. The species found within this site included Brook Trout, Brown Trout, White Sucker, Tesselated Darter, Pumpkinseed Sunfish, Bluegill, Largemouth Bass, Fallfish, Yellow Perch, Common Carp, Rock Bass, Longnose Dace, and American Eel. Despite the variety of species, the number of fish per acre was among the lowest for all streams sampled in the watershed. The reason for low total fish is unclear. It may have to do with water temperature variations or the sewage treatment plant outflows upstream of this area.

The 1990 survey indicated that moderate fishing pressure was found on the Quinnipiac River. To satisfy angler demand, CTDEP releases approximately 6,130 hatchery-reared adult Brook, Brown and Rainbow Trout into Quinnipiac Watershed ponds and rivers twice in the fishing season.[31] CTDEP currently manages the resources to maximize the harvest of stocked trout. However, they recognize a high potential for an improved carrying capacity of both hatchery-reared and wild trout if current habitat conditions were improved in the Muddy River in North Haven and Wallingford, and the Tenmile River in Cheshire and Southington. Several smaller tributaries also support diverse and abundant cold water fish (and benthic macroinvertebrate) populations. They are Dayton Brook in Southington, Spruce Brook in Wallingford, and lower Honeypot Brook in Cheshire.

In addition to cold water and warm water fisheries, the Quinnipiac Watershed was once an important habitat for anadromous fish species. Anadromous fish begin life in freshwater, migrate to the sea to reach maturity, and return to freshwater to spawn. Anadromous species native to the Quinnipiac River include American Shad, Alewife, Blueback Herring, Sea Lamprey, White Perch, and Rainbow Smelt. Surveys conducted by CTDEP in the watershed have determined that good habitat is present for Alewife, Blueback Herring, Gizzard Shad, and Sea Lamprey; and moderately good habitat is present for sea-run Brown Trout. Striped Bass have been seen in the lower Quinnipiac River but are not thought to spawn there. CTDEP has identified the Quinnipiac River as a high priority for anadromous fish restoration, particularly for the Alewife, American Shad, and Blueback Herring.

In the spring and early summer of 1997, CCWS conducted a comprehensive survey of anadromous and freshwater fish on the Quinnipiac River.[32] This survey investigated four sites within the Quinnipiac Watershed: 200 meters below Wallace Dam, directly below Wallace Dam, Quinnipiac State Park, and the mouth of the Muddy River.

Table13 lists the fish species collected during the CTDEP and CCWS surveys.

Table 13
Fish Found in the Quinnipiac Watershed

Common Name	Scientific *Name*	Common Name	*Scientific Name*
Unknown Sunfish	*centrarchid*	Alewife*	*Alosa pseudoharengus*
Blueback Herring*	*Alosa aestivalis*	Rock Bass	*Ambloplites rupestris*
American Shad*	*Alosa sapidissima*	White Sucker	*Catastomus commersoni*
American Eel	*Anguilla rostrata*	Tesselated Darter	*Etheostoma olmstedi*
Common Carp	*Cyprinus carpio*	Brown Bullhead	*Ictalurus nebulosus*
Redfin Pickerel	*Esox americanus*	Pumpkinseed	*Sunfish Lepomis gibbosus*
Redbreasted Sunfish	*Lepomis auritus*	Largemouth Bass	*Micropterus salmoides*
Bluegill	*Lepomis macrochirus*	Bridle Shiner	*Notropis bifrenatus*
Golden Shiner	*Notemigonus crysoleucas*	Yellow Perch	*Perca flavescens*
Common Shiner	*Notropis cornutus*	Longnose Dace	*Rhinichthys cataractae*
Blacknose Dace	*Rhinichthys atratulus*	Brook Trout	*Salvelinus fontinalis*
Brown Trout*	*Salmo trutta*	Fallfish	*Semotilus corporalis*
Creek Chub	*Semotilus atromaculatus*		

* Anadromous species

A number of problems affecting fisheries exist on many streams in the Quinnipiac Watershed. Brook Trout and Brown Trout like cold water. Lack of shade along the stream banks results in increased stream temperature. In the summer, stormwater runoff from black-topped roads and parking lots can cause a rapid increase in temperature (thermal shock) harmful to cold water fish. Mud and silt from stream bank erosion are harmful to many fish and can smother the eggs of fish and invertebrate larvae. The Quinnipiac River has considerable siltation problems. A high percent of impervious surface in a watershed results in high flows and increased erosion during storms as water is shunted directly from storm drains into streams. Impervious surfaces also cause abnormally low flows in droughts by preventing water from seeping into the ground. Groundwater naturally contributes to stream flow. Dams prevent migratory fish from reaching spawning grounds. In particular, Wallace Dam and Hanover Pond dam impede fish migration in the upstream tributaries of the Quinnipiac River.

Endnotes

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[3] State of Connecticut, Department of Environmental Protection Planning and Standards Division, Bureau of Water Management, *2000 Water Quality Report to Congress,* September 29, 2000.

[4] US Geological Survey.

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[6] Pupedis, Raymond, J., *A Survey of Benthic Macroinvertebrate Communities in the Quinnipiac River Watershed;* Prepared as part of the Quinnipiac River Nonpoint Source Pollution Assessment §319 Project 98-04. Yale University, Center for Coastal and Watershed Systems and Peabody Museum of Natural History, 2000.

[7] Monitoring for fourteen QRWA stations monitored between 1997 and 1999 followed the EPA family level bioassessment protocol; monitoring in 2000 and 2001 included five additional stations and followed the new, simpler Connecticut Department of Environmental Protection protocol for volunteers.

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[9] Tyrell, Mary, et al., *Report on the Water Quality of the Quinnipiac River,* October 2000, Water Quality Work Group of the Quinnipiac River Watershed Partnership.

[10] State of Connecticut, Department of Environmental Protection, Planning and Standards Division, Bureau of Water Management, *2000 Water Quality Report to Congress,* September 29, 2000.

[11] Zimmerman, Marc, J., *Trends in nitrogen and phosphorus concentrations in southern New England streams*, 1974-92: U.S. Geological Survey Fact Sheet FS-001-97, 1997.

[12] The News Times, July 28, 1997 (see also report June 1997 from Dr. David Miller and Connecticut Department of Environmental Protection).

[13] Personal Communication, Dr. David Miller, Professor of Natural Resources Management and Engineering, UConn.

[14] Calculated from year 2000 water company reports to the DPUC and Table 3 of this plan.

[15] Data from USGS Wallingford gage and Annual Reports of the SCCRWA 1994-2000.

[16] Calculated from SCCRWA service areas for the Quinnipiac Watershed combined with Census 2000 block data.

[17] Data from review of DPH data base and water company annual reports.

[18] Data calculated from year 2000 water company reports to the DPUC, water company maps and GIS analysis.

[19] Derived from year 2000 water company reports to DPUC.

[20] South Central Connecticut Water Supply Management Area, Final Water Supply Assessment Part 1, Connecticut Department of Public Health, Water Supply Division, October 1988.

[21] Water Allocation/Low Flow Work Group of the Quinnipiac Watershed Partnership, *Preliminary Assessment of Water Withdrawals and Stream Flows in the Quinnipiac River Watershed*, July 2000.

[22] Calculated from GIS overlays of year 2000 block census data obtained from the MAGIC Internet site, UConn and sewage treatment plant service areas obtained from the Connecticut Department of Environmental Protection.

[23] *The Cost of Clean Water - A Sewer User Charge Rate Survey and Guidance Manual*, State of Connecticut, Connecticut Department of Environmental Protection, March 1999.

[25] *Connecticut Dams - A Preliminary Map Inventory*, State of Connecticut, Natural Resources Center, Connecticut Department of Environmental Protection, 1983.

[26] *Canoe and Natural Resource Guide to the Quinnipiac River*, published by the Quinnipiac River Watershed Association, 2000.

[27] Humiston Brook is a south-flowing tributary of the Tenmile River located in Southington at the south end of Southington Mountain. Its watershed includes over 1,100 acres of open space for the Southington water supply system.

[28] Data derived from GIS overlays from the State of Connecticut, GIS Mapping Division, Connecticut Department of Environmental Protection and from the MAGIC Internet site, UConn.

[29] Areas derived from GIS overlays from the State of Connecticut, GIS Mapping Division, Connecticut Department of Environmental Protection and from the MAGIC Internet site, UConn.

[30] Hagstrom, N., Humphreys, M., and Hyatt, W., *A Survey of Connecticut Streams and Rivers - Central Coastal and Western Coastal Drainages, F-66-R-3 Progress Report*, April 1, 1990 - March 31, 1991, State of Connecticut, Department of Environmental Protection, Inland Fisheries Division.

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Chapter 3

The Quinnipiac Watershed Partnership: Purpose and History

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The Quinnipiac Watershed Partnership: Purpose and History

The Quinnipiac Watershed Partnership (Partnership) was formed in 1998 to foster local, community-based watershed protection and improvement. The founders of the Partnership felt that those who live and work in the watershed were most likely to understand its problems, have the greatest stake in its health, and have the greatest incentive to make the changes necessary to protect its environmental quality.

In the early 1990's the output of sewage treatment plants was causing low levels of oxygen in the Quinnipiac River. This was making the river unhealthy for people and harming river life. The Connecticut Department of Environmental Protection (CTDEP) directed all the watershed's sewage treatment plants to upgrade to improve oxygen levels in the river. After these upgrades were completed, dissolved oxygen met CTDEPs standards, but unfortunately, many forms of river life still did not recover. This lack of recovery is most likely due to pollution coming from wide-spread sources like roads, parking lots, and lawns, over which CTDEP has little control.

In the hopes of further improving the river, CTDEP made the Quinnipiac River and Quinnipiac Watershed a high priority. At the request of Meriden and Wallingford, CTDEP has set aside funds to look at the feasibility of restoring the former Community Lake, dredging Hanover Pond, and building a fish ladder around Wallace Dam in Wallingford. CTDEP also funded a study by the University of Connecticut to decrease pesticide and fertilizer pollution from farms, and asked researchers to focus attention on the Quinnipiac Watershed.

In 1994, working with the U.S. Environmental Protection Agency (EPA), CTDEP assigned a full-time inspector to the Quinnipiac Watershed. The inspector's job was to find and correct sources of pollution. He worked with municipalities and public interest groups in the watershed on a number of issues, and was able to fix problems that might otherwise never have come to CTDEP's attention. The watershed inspector's report identifies stormwater runoff, erosion, and sedimentation as major problems in the watershed. His recommendations show ways of improving the river beyond the control of federal and state regulations. Unfortunately, in June 2000, staffing shortages forced CTDEP to discontinue the inspector assignment.

Because much of the watershed's continued improvement is in the hands of land owners and municipalities, interest grew in CTDEP for building a local watershed initiative involving citizens, towns, businesses and organizations to address a full range of watershed issues. EPA also wanted to integrate its many programs in specific problem areas. EPA met with CTDEP to discuss their mutual interests, and shortly thereafter designated the Quinnipiac Watershed as one of its "special places" in Connecticut.

The Center for Coastal and Watershed Systems at Yale University (CCWS) responded to CTDEP's interest in a Quinnipiac Watershed initiative by calling a meeting of people and organizations interested in the environmental quality of the river and watershed (stakeholders). About fifty people attended a number of meetings and discussed ways to improve the watershed and its rivers. The participants agreed that an integrated watershed study was needed. A proposal was made for a three-year project in which CCWS would team up with other researchers and the Quinnipiac River Watershed Association (QRWA)to monitor water quality in the Quinnipiac River and tributaries. As the main watershed group in the basin, QRWA would do public outreach and develop the community support for a community-based watershed

initiative. The Partnership would use the data from the studies to develop and help carry out a watershed Action Plan. CTDEP funded the proposal.

Simultaneously, CTDEP expanded their Rivers Program to focus on watersheds and made the Quinnipiac Watershed a pilot project. CTDEP assigned one of its watershed staff as liaison to the Quinnipiac Watershed initiative. This CTDEP liason did much of the organization and administrative work of the initiative.

Beginning in September 1996, staff from CTDEP, the directors of QRWA, and representatives from CCWS visited towns in the watershed (Bristol, Cheshire, Hamden, Meriden, New Britain, New Haven, North Haven, Plainville, Prospect, Southington, Wallingford, and Wolcott) and met with either the chief elected official or with staff from the Engineering, Planning, and Parks departments. They discussed water-related problems that the towns were concerned with, potential solutions, and issues they felt needed to be addressed. The towns noted as problems such issues as lack of public access, lack of funds for needed improvements, attracting industry, stormwater control, trash and illegal dumping, acquiring open space, complying with CTDEP regulations, and lack of education for municipal officials, landowners, and developers. Also discussed was the proposed watershed initiative, and the towns' interest and participation which was generally positive.

The initiative partners had similar discussions with other agencies with an interest in the Quinnipiac Watershed. These included the South Central Regional Water Authority, the New Haven and Hartford County Soil and Water Conservation Districts, the South Central Connecticut Regional Planning Agency, the Central Connecticut Regional Planning Agency, and the Council of Governments of the Central Naugatuck Valley. These groups mentioned lack of public access, economic development, and controlling stormwater among the issues they wanted addressed.

In early 1997, as part of a "special place" geographic initiative, EPA assigned one of their staff as EPA liaison to the initiative. Together, CTDEP, EPA, QRWA and CCWS began planning the formation of the Quinnipiac Watershed Partnership. In Fall of 1997, four public meetings were held around the Quinnipiac Watershed to hear the interests of people and groups concerned about the watershed, and seek the participation of interested stakeholders. A survey was done of interested people to find out their priorities for watershed issues. Survey respondents most frequently mentioned public access to the river as an important issue; water quality and habitat were also frequently mentioned.

The result of these outreach efforts was a general commitment to work together on watershed issues and to explore mechanisms for doing this and sharing resources between agencies, towns, and other stakeholders. Beginning in early 1998, a group of interested citizens and partners met for several months as an ad hoc group to design the organization for the watershed initiative, and held several larger meetings to get input from others interested in the initiative. Based on the areas of interest and how other watershed initiatives had organized themselves, the participants agreed on a structure which included a Steering Committee and technical work groups devoted to a specified topic. These topics included: water quality, low flow, habitat, land use, and education and outreach. The full Partnership group met only a few times in the early days of the initiative. Attention then centered around the work groups. The work groups began meeting in July 1998, and started to identify the issues they wanted to address. Most work groups met regularly. The Partnership later added a work group devoted to the Quinnipiac tidal marsh.

The Steering Committee began to meet in September 1998 and set up operating rules and procedures for the Partnership. They invited towns to assign municipal representatives to the committee, and invited citizens and other organizations to nominate themselves as committee members. The Steering Committee numbered around thirty people, with an official representative and a citizen member from each town along the Quinnipiac River; representatives of governmental and other organizations with an interest in the watershed; and the chairperson of each workgroup.

In the first three years of its existence, the Steering Committee served as a place for decisions about strategy, funding, and public relations. Steering Committee members and their organizations received much information through presentations to the committee on CTDEP activities and reports, work group activities, and reports about municipal, state and federal government activities and projects.

In the Spring of 1999, the Steering Committee officially named the watershed initiative the Quinnipiac River Watershed Partnership, later changed to the Quinnipiac Watershed Partnership in recognition of the full extent of the physical watershed. About this time, CTDEP reorganized its watershed program into five major basins and the South Central Coastal Basin Coordinator became the liaison to the Partnership. The individual work groups wrote mission statements to guide their activities and work plans to define their activities. The Partnership began to write a watershed Action Plan that considered the actions necessary to improve the watershed, and ranked them in order of importance so they could be done as funds become available. The Action Plan could also be used to attract support and funding, and serve as a guide to the towns in regard to proposed development projects. The Partnership intends to have each of the watershed towns sign a pledge to support the general principles of the Action Plan.

In 1999, CTDEP dedicated funds from the Clean Water Act Section 319 program to the Partnership, to fund group projects. The Partnership's Steering Committee recommended to CTDEP which work group projects should be funded. The Partnership secured funding for projects in fiscal years 1999, 2000, and 2001, which included funding for educating municipalities on nonpoint source pollution; two years of a river cleanup; a canoe guide to the river; scientific studies; a storm drain stenciling project; stream walks of various river tributaries; and several habitat restoration projects in the watershed. Funding amounted to approximately $390,000 over the three years, with the allocation of funds dedicated to the Partnership ending with the application for the fiscal year 2002 program. Subsequent funding has been approved on a competitive basis.

Additional support for the Partnership came from a $25,000 grant from the Geoffrey C. Hughes Foundation administered by CCWS. The grant was used for a small stipend for a Partnership secretary. Each work group received $1,000 for their projects. The remainder of the grant was used for administrative purposes, and an educational display at the Peabody Museum in New Haven depicting the natural history of the Quinnipiac River tidal marsh, developed by the Tidal Marsh Work Group.

By the end of 1999, three members had served as volunteer chairpersons of the Steering Committee for a year or more each, but it became clear that the Partnership required more coordination and leadership on a day-to-day basis to complete and carry out an Action Plan for the watershed. The Steering Committee decided to apply some of its Section 319 funds to hiring a coordinator. In the fall of 2000, the Partnership hired its first paid coordinator. The coordinator was based in the offices of the South Central Connecticut Regional Water Authority (SCCRWA). The SCCRWA was chosen by the Steering Committee to provide administrative support and manage the funds for this position.

Quinnipiac Watershed Partnership Accomplishments (as of Dec. 22, 2003)

The following is a list of activities accomplished by the Partnership and its members. These accomplishments support the Partnership's mission to improve, restore and maintain the Quinnipiac River and its tributaries for ourselves and future generations through cooperative stewardship of its watershed.

Steering Committee

- Hughes Grant awarded to Yale for Partnership administration and small projects including the Tidal Marsh Work Group Educational Display.
- Steering Committee established and unites representatives from each municipality in the watershed.
- Steering Committee influenced the designation of $390,000 of Clean Water Action Section 319 funds made available by CTDEP specifically for Quinnipiac Watershed projects.
- Members and work groups generated proposals specific to the Quinnipiac Watershed for Section 319 funds, many of which were funded.
- Steering Committee hired a Coordinator dedicated to helping the Partnership achieve its mission.
- Watershed Action Plan completed.
- Partnership web site for communication within the Partnership established.
- QRWA obtained a new computer system with Partnership help.
- Coordinated activities with the RGP and Development Corridor initiative.
- Improved collaboration between partners.

Land Use Work Group

- Land use regulations reviewed for many municipalities.
- Section 319 Project: River Access Guide updated and reprinted by QRWA.
- Preliminary study of model river protection ordinances completed by QRWA.
- Review and update of the1981 Quinnipiac River Corridor Preservation and Recreation Plan completed by QRWA.
- YFES offered a course in land use law and regulation in the spring of 2001 that included as student projects the preparation of reports on land use regulation in nine municipalities in the watershed.
- The Partnership and QRWA worked with the Connecticut Greenways Council and Quinnipiac Watershed municipalities to obtain greenway status for the Quinnipiac River valley in the summer of 2003.
- The Partnership and QRWA worked with NRCS and Americorps to identify and clear log jams from the Quinnipiac River.

Water Allocation/Low Flow Work Group

- The Quinnipiac Watershed was used as a case study for a low flow and water allocation scenario as part of the CTDEP Diversion 2000 report to the Connecticut legislature, *Report to the General Assembly on State Water Allocation Policies Pursuant to Public Act 98-224, January 2000, Appendix D: Quinnipiac Watershed Case Study.* The LFWG developed this case study and made recommendations for legislative changes to the current water diversion laws.
- Section 319 Project: Analyzed flow statistics.
- Produced Report to the Quinnipiac River Watershed Partnership, *Preliminary Assessment of Water Withdrawals and Stream Flows in the Quinnipiac River Watershed.*
- Presented at the New England Association of Environmental Biologists Conference, April 2001.
- Presented at the Connecticut In-Stream Flow Conference, May 2001.
- USGS flow study of Quinnipiac River.

- The Executive Director of the Partnership served as co-chairman of Connecticut's Water Planning Council Water Allocation Subcommittee.
- The Executive Director of the Partnership continues to represent rivers on the Water Planning Council Advisory Group.

Impoundment Restoration Work Group

- Section 319 Project: Impoundment (Community Lake, Hanover Pond and Wallace Dam) Restoration Study.

Water Quality Work Group

- Reviewed landfills and water quality data with CTDEP.
- Performed a storm water inspection of Harbor Brook.
- Conducted a water quality study: *Report on the Water Quality of the Quinnipiac River.*
- YFES is writing an integrated study of the data it gathered for the Quinnipiac Watershed.

Education and Outreach Work Group

- Section 319 Project: 1999 watershed-wide trash cleanup by QRWA.
- Section 319 Project: 2000 watershed-wide trash cleanup and trash prevention follow up by QRWA.
- Section 319 Project: NEMO presentations tailored to each watershed town by UConn/CES.
- Developed mailing labels and email lists for the Partnership and each work group.
- Brochure developed for the Partnership by NHCSWCD.
- Developed a display for the Partnership and showed it at several local conservation events.
- Worked with NEMO to develop presentations to the towns linking water quality with land use.
- Produced and distributed one issue of the newsletter "Quinnipiac Communicator" to inform Partnership members and the public of Partnership activities.

Habitat Work Group Work Group

- NRCS and other Habitat Work Group participants inspected and characterized impaired watercourses & ponds, resulting in the selection of three sites for Section 319 projects.
- Provided CTDOT with inspection and characterization data for impaired sites near the interstate in Cheshire in response to a request for information on mitigation opportunities.
- Supported the UConn purple loosestrife biological control program: identified infestations, established two new beetle release sites in Southington and Meriden, raised beetles, and continued monitoring at a third site, all with QRWA help.
- Conducted public outreach related to purple loosestrife with support from QRWA volunteers: two volunteer workshops, presentations to town boards, raising beetles, e-mail outreach, two newspaper articles, display table and school presentations at 2000 Panthorn Park festival.
- Developed an educational pamphlet, *Muddy Waters,* on the impact of sediment on aquatic habitats, and best management practices for sedimentation and erosion control. Distributed to inland wetlands and watercourses commissions, and stream walk participants with assistance from QRWA.
- Developed an educational pamphlet on wildlife protection called *Habitats of the Quinnipiac Watershed.*
- Compiled data and articles on buffers, storm water, and Quinnipiac Watershed habitats (fisheries, macroinvertebrates, sand plains, vernal pools, breeding and migratory birds, turtles), for use in the habitat-mapping project. Habitat files may be borrowed and copied.
- Viewing window for a fish ladder funded by the City of Meriden based on efforts by Partnership members resulting from work group discussions.

Tidal Marsh Work Group

- Compiled an inventory of public access points in the Quinnipiac marsh.
- Reviewed contamination sites in the marsh and compiled an inventory.
- Conducted fieldwork for wildlife and contamination inventory.
- Provided research, tabulation, and communication to secure a listing for the marsh as a National Audubon Important Bird Area.
- Held meetings with the CT Attorney General and CTDEP Commissioner that garnered public support for enforcement of wetland protections.
- Conducted a marsh tour for the EPA Regional Administrator, the CTDEP Deputy Commissioner, local officials, Partnership members, the public and the press.
- Researched land use and zoning regulations with respect to public access to the marsh.
- Developed a display of the Quinnipiac tidal marsh and the impact caused by humans at the Peabody Museum of Natural History.

General Partnership

- Teamed up with activities of a dedicated CTDEP Quinnipiac Watershed Inspector for five years. The Inspector worked closely with QRWA and followed up on complaints reported by work groups, Partnership members, and the public.
- EPA funded the distribution of a brochure for the NHCSWCD's Conservation Fair where the Partnership staffed a booth with its display. EPA also sent and staffed a display on recycling.
- Increased the participation of citizens and towns in activities related to Quinnipiac Watershed protection.
- Brought the EPA Regional Administrator and the CTDEP Deputy Commissioner to the watershed for events that included a public visit to the Upjohn and Pharmacia facility in North Haven.
- The QRLTAC hosted a ceremony celebrating the ground breaking for the Quinnipiac Linear Trail at which Section 319 funds for the watershed were announced. The ceremony was attended by local officials, with the EPA Regional Administrator and the CTDEP Deputy Commissioner as guests.
- The City of Meriden hosted a visit by the EPA Regional Administrator and the CTDEP Deputy Commissioner on the Harbor Brook Flood Control Plan.
- The towns of Southington and Plainville hosted a meeting with the EPA Regional Administrator and the CTDEP Deputy Commissioner to discuss local environmental issues.
- Generated publicity about the watershed through press releases, media contacts, and articles and radio reports about media worthy events.
- Assigned a full-time EPA Watershed Coordinator.
- Assigned a CTDEP Basin Coordinator.
- Seminars on Point Source and Nonpoint Source Pollution in the Quinnipiac Watershed conducted by Yale University.
- Section 319 Project: UConn Integrated Pest Management/Integrated Crop Management Program in the Quinnipiac Watershed.
- Section 319 Project: Yale University Nonpoint Source Pollution study.
- QRWA received a Clean Water Act Section 604 (b) grant to conduct the Quinnipiac River Corridor Preservation-Recreation Action Plan review
- Watershed wide trash cleanup, 1998.

Chapter 4

Watershed Action Plans

Chapter 4

Watershed Action Plans

When the Quinnipiac Watershed Partnership (Partnership) was founded, a number of work groups were formed to achieve the mission of the Partnership. Each work group had its own area of interest. The work groups were: Education and Outreach, Habitat, Land Use, Tidal Marsh, Water Allocation/Low Flow, and Water Quality.

This chapter describes the mission, objectives, and specific tasks each work group has chosen. Timetables for task completion are omitted because the members of these groups are volunteers and the tasks will be accomplished as time and resources allow.

The work group tasks are not listed in order of priority. At its annual meeting in January 2002, the Partnership partners recommended that the work groups and the Partnership Coordinator focus on four areas of highest priority. These were to:

- Involve and educate the business community on the connection between environmental quality and economic benefit.
- Participate in the Water Planning Council established by the Connecticut General Assembly.
- Develop model ordinances for watershed improvement and protection.
- Work on creating a Quinnipiac Valley Greenway and promote public access to the Quinnipiac River for recreation and education.

The work group tasks are the heart of the Partnership's Action Plan. We all recognize that protecting our local environment is vital to our quality of life and critical to the long-term sustainability and welfare of our communities. Without the dedication and efforts of each work group, this plan will remain words on paper. Working together we can realize a better future for ourselves and for generations to come.

Education and Outreach Work Group Action Plan

Mission Statement:
The mission of the Education and Outreach Work Group (EOWG) is to support the educational activities of the Quinnipiac Watershed Partnership and assist other Partnership work groups in their educational tasks.

Background:
All the Partnership work groups have an educational component related to their mission. There are also many organizations that have educational materials relevant to the overall mission of the Partnership and to the specific missions of the various work groups. The role of EOWG is to collaborate with Partnership work groups and other organizations to assist the work groups in reaching their targeted audiences. Potential audiences for EOWG are:

- The general public within the watershed.
- Businesses whose activities impact the watershed.
- People living next to the Quinnipiac River and its tributaries.
- Students.
- Municipal officials whose decisions and policies affect the watershed.

Objective 1: Expand the capacity of EOWG to assist other work groups.

Task 1: Augment financial and human resources. EOWG will assist the other work groups to the extent that available resources allow. At present resources are limited and need to be expanded.

Implementation: A plan for funding and organization of education and outreach activities is being developed with the QRWA Board and Executive Director. The goal is to have sufficient resources in place to hire a full time person to engage in capacity building and education and outreach planning. This person would be a member of EOWG and play an active role in the work group. QRWA and the Partnership will work together to see that this position is funded, and that another full time staff position is funded within the following twelve months.
Measure of Success: Securing salary and material resources, and hiring a person who can devote full time to capacity building for education and outreach. Establishing and filling a second full time staff position within twelve months of hiring the first person.

Task 2: Compile and categorize existing sources of educational material. Many other organizations have educational materials that could be helpful to the Partnership. At present, however, these sources and the materials they offer are not organized in a way that would be useful to the Partnership work groups.

Implementation: Develop a consolidated list of available sources and material. Distribute the list through the QWP web site, and mail it to interested parties. Updating this list will be an ongoing effort. QRWA will play a vital role in helping to compile and organize a library of these materials.
Measure of Success: Consolidated list of available materials for distribution via the web site, email, and regular mail. An organized library of materials created with the help of QRWA.

Objective 2: Assist Partnership work groups in their education and outreach tasks.

Implementation: Assist in the following tasks selected by Partnership work groups:

Habitat Work Group

- Provide information on areas and habitat types of unique value. Make this information available as needed for habitat protection initiatives by other entities in the watershed.
- Sponsor and/or publicize workshops and presentations on habitat issues.
- Promote the use of the most effective methods of protection of key areas by means of informational material.
- Organize files of information resources relating to the restoration of impaired sites; provide them upon request and publicize availability.
- Prepare restoration guidance packets for interested entities.

Land Use Work Group

- Increase public knowledge of actual and potential recreational opportunities related to the river, such as promoting a Quinnipiac River Greenway.
- Inform municipalities about model regulations and open space acquisition.
- Publish the public access pamphlet on the Internet.

Tidal Marsh Work Group

- Distribute materials developed in-house to the selected target audiences.

Water Quality Work Group

- Design and complete a "water quality report card" and distribute it to municipal officials and the public.
- Inform municipalities about Storm Water Phase 2 regulations.

Measure of Success: Successful results will be reflected in the restoration and protection of watershed resources through physical projects, regulatory change, and increased public interest in watershed stewardship.

Habitat Work Group Action Plan

Mission Statement:
The mission of the Habitat Work Group (HWG) is to preserve, protect and restore the habitats of the Quinnipiac Watershed by gathering and disseminating information, by promoting environmentally sound land use and habitat management practices, and by facilitating habitat protection and restoration projects.

Background:
With an average population density of over 1,400 people per square mile, humans are the major factor impacting wildlife habitats in the watershed. A substantial portion of the watershed is devoted to human uses that radically alter and diminish the biodiversity of land and waters. The challenge is to restore and preserve the remaining habitats capable of sustaining a rich diversity of plants and animals.

Objective 1: Identify and publicize key habitat areas to be protected. Even though valued habitat is dwindling, there still remain significant habitat areas and unique natural habitats that have not been impaired and are in need of protection.

Task 1: Identify key habitat areas in need of protection. These include headwater trap rock ridges, riparian corridors, stream habitats, vernal ponds, freshwater marshes, and saltwater marshes.

Implementation: HWG will continue to identify key habitat areas by reviewing Plans of Conservation and Development for the watershed towns, and consulting with people familiar with natural habitats in the area. The findings will be incorporated into base USGS maps to produce preliminary annotated maps. Maps will be provided to participating partners with a cover letter asking them to review and supplement the information. HWG will make the revisions and produce a first edition of the maps.

Measure of Success: First edition annotated maps identifying key habitat areas in need of protection.

Task 2: Facilitate habitat protection initiatives in the watershed by disseminating information on key habitat areas and habitat types of unique value.

Implementation: A Watershed Habitat Protection Report will be produced using the supplementary information gathered from partners who reviewed the preliminary maps of key habitat areas. This report, together with the annotated maps, will be provided on an on-going basis to organizations that are active in the watershed. Existing informational pamphlets and study results will also be assembled and shared.

Measure of Success: Publication and dissemination of a Watershed Habitat Protection Report together with first edition annotated maps identifying key habitat areas and their unique values.

Objective 2: Identify and evaluate impaired sites for restoration. Habitats of the Quinnipiac Watershed have suffered past stresses from changes in land use, and from point and nonpoint source pollution. There are many opportunities to restore habitat.

Task 1: Compile existing information on degraded sites that would benefit from habitat restoration.

Implementation: Using existing monitoring data and inspection reports, HWG and selected partners will compile information about degraded sites on to baseline USGS maps of towns and subwatersheds.

Measure of Success: Preliminary annotated maps showing degraded sites.

Task 2: Review the preliminary annotated maps and fill in any information gaps.

Implementation: The preliminary maps will be provided to participating partners (particularly land trusts, municipal officials, and CTDEP officials) with a cover letter asking them to review the information and fill in any gaps.
Measure of Success: First edition annotated maps showing degraded sites.

Task 3: Keep the annotated maps showing degraded sites current.
Implementation: HWG will conduct and encourage additional field inspections and monitoring (such as Streamwalk and Adopt-the-River), and student field research projects. The findings will be evaluated and incorporated into the annotated maps showing restoration opportunities.
Measure of Success: Up to date editions of annotated maps showing degraded sites.

Task 4: Evaluate impaired sites for the feasibility and benefits of restoration, and produce a report on habitat restoration opportunities in the watershed.
Implementation: Concurrent with the review of the preliminary maps showing degraded habitats, participating partners will be asked to make an evaluation of the feasibility and benefits of restoration for those sites that they are familiar with. Any remaining unevaluated sites will be reviewed as time and resources allow. The evaluations will be incorporated into a Watershed Habitat Restoration Report which will be published and disseminated.
Measure of Success: Publication and dissemination of the Watershed Habitat Restoration Report.

Objective 3: Expand the capacity for implementing habitat protection and restoration projects. A key measure of success is the extent of actual habitat protection and restoration projects undertaken in the watershed. Many habitats will continue to be degraded and lost unless an ongoing implementation process is established.

Task 1: Recruit additional members for implementing the Habitat Action Plan.
Implementation: Starting with the dissemination of the Watershed Habitat Protection Report and continuing through the dissemination of the Watershed Habitat Restoration Report, HWG and other interested watershed partners will recruit additional members. By the time the reports are available, HWG will formulate an implementation plan and concentrate its efforts on facilitating habitat related projects.
Measure of Success: Additional members actively working on habitat protection and restoration projects.

Task 2: Support implementation of habitat related projects through local capacity building, coordination, and technical assistance.
Implementation: HWG will determine the most effective ways to accomplish its mission by considering methods such as the following:

- Sponsor and publicize workshops and presentations on habitat issues.
- Help establish stewardship programs for protected habitats.
- Help raise funds for protection and restoration activities.
- Facilitate demonstration projects at several priority sites which offer visibility and the likelihood of success.
- Coordinate and assist with protection and restoration activities.
- Actively encourage people and organizations to apply for restoration grants, donate services, and undertake restoration projects. Candidates include municipalities, Soil and Water Conservation Districts, QRWA, land trusts, and riverside property owners.
- Promote the use of the most effective methods for protecting key habitats. Promotion will include sharing reports and informational material; consulting with municipal, state and

federal officials; presentations to community organizations, land trusts, and foundations; and contacts with private industry.

- Organize files of information and technical support resources relating to the restoration of impaired sites. Publicize their availability and provide them on request to interested parties, especially the Education & Outreach Work Group, others doing outreach, and those planning restoration projects.
- Prepare restoration guidance packets for use by interested entities.

Measure of Success: An increase in habitat restoration and protection projects in the watershed. (HWG will keep a record of accomplishments.)

Land Use Work Group Action Plan

Mission Statement:
The mission of the Land Use Work Group (LUWG) is to encourage land use practices and policies that minimize adverse impacts on the Quinnipiac Watershed and to increase public access to the Quinnipiac River and its tributaries for recreational and educational opportunities.

Background:
The Quinnipiac Watershed has an average population density of over 1,400 people per square mile. With this concentration of people in the watershed, the way land is used can and does have an adverse impact on rivers and streams. Today, the Quinnipiac River fails to attain fishable and swimmable status because of high bacterial counts and chemical contaminants. Both problems are attributable in part to runoff from certain developed land uses. In the past, and to a significant degree at present, land use is largely dictated by economic and social considerations, with little regard for environmental impacts. Only in the last few decades have we come to realize that the need for healthy natural systems cannot be separated from economic and social objectives. Although there is growing interest in using the river as an "urban refuge," a recreation corridor to enhance the quality of life, public enjoyment of the river is still hindered by restricted access and a tradition of using the Quinnipiac as a dumping ground. We must deal with the legacy of past abuse and help people to see the connection between a healthy environment and the economic and social health of our communities.

Objective 1: Establish the Quinnipiac River Greenway. The Quinnipiac River Greenway is intended to protect water quality in the river, preserve wildlife habitat, enhance flood control, and provide the public with greater access to recreational opportunities associated with the Quinnipiac River.

Task 1: Determine and prioritize follow-up actions based on the Quinnipiac River Corridor Preservation - Recreation Action Plan.

Implementation: LUWG will review the Quinnipiac River Corridor Preservation – Recreation Action Plan that prepared in 1981 by the Regional Planning Agency of South Central Connecticut and updated in 1999 by QRWA. LUWG will list and prioritize those recommendations from the plan that are relevant to land use today.

Measure of Success: A prioritized list of follow-up actions.

Task 2: Identify and secure additional access points and land acquisition opportunities along the river.

Implementation: Work has begun on several potential access points in North Haven, Hamden, New Haven, Cheshire, Southington, and Wallingford. Participating partners will help secure these access points, as well as identify and facilitate acquisition of other land along the river.

Measure of Success: Access to the river improved and additional land secured in the river corridor.

Task 3: Coordinate efforts to promote the Quinnipiac River Greenway with the QRLTAC, CNVCOG, and the Trails Committee of SCRCOG .

Implementation: LUWG will meet with the QRLTAC, CNVCOG and SCRCOG Trails Committee to discuss strategy and available resources. QRLTAC will be invited to make a presentation to LUWG and the Partnership Steering Committee on the current status of the greenway and linear trail system. Watershed municipalities will be invited to this meeting.

Measure of Success: Presentation by QRLTAC on the Quinnipiac River Greenway, well attended by key municipalities on the mainstem of the river.

Task 4: Secure designation of the Quinnipiac River as a recreation corridor by the Connecticut Greenways Council.

Implementation: LUWG will draft a Quinnipiac River Watershed Compact to be approved by the Partnership Steering Committee and signed by the municipalities along the Quinnipiac River. The compact will demonstrate the willingness of municipalities to cooperate in the development of the Quinnipiac River Greenway.

Measure of Success: An agreed upon strategy endorsed by the Partnership Steering Committee. Municipalities signed on to the Quinnipiac River Watershed Compact. The Quinnipiac River designated as a greenway by the Connecticut Greenways Council.

Objective 2: Prevent and Decrease Nonpoint Source Pollution. Fortunately, concentrated point sources of water pollution have been brought under greater control. Unfortunately, it is now apparent that this control is not sufficient to restore and protect water quality. Significant amounts of pollution are coming from more diffuse nonpoint sources like roads, buildings, parking lots, lawns, septic systems, construction sites, and agricultural fields. Water quality monitoring shows that the cleanest tributaries are found in heavily forested areas of the watershed. Land use regulations and practices can have a beneficial or adverse effect on the quality and quantity of water in the watershed because they determine how nonpoint sources are located, designed, built, managed, and maintained. For example, regulations can provide for a wide buffer of natural vegetation to protect and improve water quality.

Task 1: Prevent further degradation from stormwater runoff by acquiring and/or requiring wide stream buffers of natural vegetation to remove pollutants and sediment before they reach the stream.

Implementation: LUWG will help to coordinate the efforts of the participating partners to acquire land or conservation easements along the river and streams. Land acquisition and conservation easements are best secured in coordination with land trusts and municipalities by identifying prospective buffer areas and contacting the landowners to learn of their interest in protecting the river or stream. LUWG will also work with municipalities to adopt regulations that will establish natural riparian buffers (see Objective 3).

Measure of Success: Increased buffer areas around streams and rivers in the watershed.

Task 2: Develop and facilitate land use strategies to prevent and decrease nonpoint source pollution. WQWG is taking the lead in identifying the areas, magnitude, and priority of nonpoint source pollution in the watershed. LUWG will focus on how changes in land use practices could remediate or prevent the pollution.

Implementation: The precise strategy will depend on the area and magnitude of the nonpoint source pollution, and the water quality parameters affected. The expertise within the Partnership will be employed to determine feasible remediation or prevention measures on a case-by-case basis. Contact will be made with the parties capable of doing the remediation to see how LUWG and the Partnership can help facilitate action. The strategy will include public outreach to landowners through the QRWA/NRCS streamwalk program.

Measure of Success: The number of case-by-case remediation measures developed in response to the data supplied by WQWG, and the success in facilitating their implementation.

Objective 3: Develop and facilitate the adoption of improved municipal regulations and ordinances for watershed protection. Areas to be regulated include: riparian vegetative buffers, stormwater, sedimentation and erosion controls, flooding, nonpoint source pollution, wildlife habitat, vernal pools, urban sprawl, and impervious surfaces.

Task 1: Evaluate the regulatory tools for watershed protection in each municipality.

Implementation:. Together with CCWS, LUWG will compile and evaluate the regulations currently used by the municipalities in the watershed. LUWG will present the findings to the Partnership Steering Committee.

Measure of Success: Completed evaluation of municipal regulations, and presentation of findings to the Partnership.

Task 2: Analyze how municipal regulations can be improved to better protect the watershed, and facilitate these revisions in watershed municipalities.

Implementation: LUWG will review model ordinances and BMPs for watershed protection and determine how existing ordinances, regulations, and policies might be improved. The report of the QRWA/NRCS stream-walks will help to add town-specific examples for targeted remediation and inform LUWG on how to better structure model ordinances. It is important that watershed municipal officials participate in this process. LUWG will collaborate with RGP to facilitate revisions for those municipalities interested in amending their regulations and policies.

Measure of Success: Municipalities revise local land use regulations and policies to protect the watershed and improve water quality.

Objective 4: Increase public access for recreational and educational use of the river. Providing access to the river for a diversity of recreational and educational uses will not only enhance the quality of life for many people, but will also create a constituency that will help maintain and improve the river.

Task 1: Determine and prioritize follow-up actions based on the Quinnipiac River Corridor Preservation - Recreation Action Plan.

Implementation: LUWG will review the Quinnipiac River Corridor Preservation - Recreation Plan prepared in 1981 by the Regional Planning Agency of South Central Connecticut and updated in 1999 by QRWA. LUWG will list those recommendations from the plan that are relevant to public access today, and prioritize them based on the following:

a) Benefit to public access for recreation or education
b) Feasibility (cost & legal considerations)
c) Number of potential users.

Measure of Success: A prioritized list of follow-up actions.

Task 2: Develop additional access points to and along the river.

Implementation: Work has begun on several potential access points in North Haven, Hamden, New Haven, Cheshire, Southington, and Wallingford. A site for camping is also being sought. In conjunction with the Quinnipiac River Greenway initiatives, participating partners will help secure these access points.

Measure of Success: Access initiatives completed and new access projects developed.

Additional Objectives:

LUWG agreed on the following additional objectives to be considered in the future as time and resources allow:

- Develop strategies to increase the acquisition of open space, particularly to safeguard water quality and recreational uses with an emphasis on supporting greenway and public space goals.
- Develop strategies to help municipalities with the enforcement of their regulations including publicity about how to report potential violations to municipal or state authorities.
- Encourage sustainable redevelopment of "brownfields" and remediation of polluted sites in the watershed.

- Inform municipalities of the benefits of open space by showing the environmental impact and economic consequences of residential development, cataloging properties, identifying property owners, and identifying funding sources for open space acquisition.
- Clear log jams from the river to allow recreational access for small watercraft.

Tidal Marsh Work Group Action Plan

Mission Statement:
The mission of the Quinnipiac Tidal Marsh Work Group (TMWG) is to promote the monitoring, protection, restoration, and improvement of the water quality and habitat of the Quinnipiac tidal marsh and estuary, by working for environmentally sound land use, wildlife management, and restoration projects, and to promote improvement of public access to the marsh for education and recreation.

Background:
The health and productivity of Long Island Sound depends on clean rivers and healthy tidal marshes. Surrounded by railroad yards, housing developments, shopping centers, industrial sites, junkyards, tire dumps, and landfills, the Quinnipiac tidal marsh is an island of biodiversity in a highly urbanized area. The marsh is a nursery for fish, invertebrates, and the Northern Diamondback Terrapin. Over 150 species of birds, and numerous mammals and plants have been recorded in the marsh, many of them Endangered or Species of Special Concern. This is Connecticut's fourth largest tidal salt marsh, with 900 acres owned by CTDEP. Yet there is no direct public access to the areas that are in public ownership. TMWG was established in January 1999 to concentrate solely on this tidal marsh.

Objective 1: Preserve and improve wildlife habitat. Even though the marsh is contaminated with heavy metals and organic chemicals, it is home to many rare and endangered plants and animals. For example, over 150 species of birds, including nesting Osprey, have been documented. The marsh supports a large population of rare Diamondback Terrapin, and muskrat have been trapped there. The marshes were extensively ditched for mosquito control in the 1930's. More recently, there has been a proposal to fill the ditches and make small pannes and ponds to encourage small fish, such as *Fundulus*, to remain in the ponds between extremely high tides and eat mosquito larvae. Shorebirds would also be attracted to these shallow pools. It is not known what, if any, negative effects would result from moving the contaminated soil to make these ponds.

Task 1: Monitor proposed development adjacent to the Quinnipiac tidal marsh in an effort to prevent adverse impacts to wildlife habitat.

Implementation: Maintain contacts with zoning commissions, zoning boards of appeal, and planning offices of New Haven, Hamden and North Haven to review proposed development adjacent to or affecting the tidal marsh, and to obtain access/easements on development projects adjacent to the marsh. TMWG will also contact CTDEP Office of Long Island Sound Programs (OLISP) for information about proposed development adjacent to or affecting the tidal marsh.
Measure of Success: Development projects reviewed with the purpose of protecting the marsh environment.

Task 2: Produce annotated maps and supporting documentation for the Quinnipiac tidal marsh. The maps will include parcel boundaries and ownership, zoning, contaminated areas, potential recreation sites, and areas of special interest in the marsh.

Implementation: Produce a zoning map of the marsh boundaries. Seek further funding for GIS production and publication.
Measure of Success: Maps produced and distributed to towns and citizens, and made available on the Partnership website.

Task 3: Provide the data necessary to secure listing of the Quinnipiac marsh in the Important Bird Area (IBA) Program of the National Audubon Society. IBA recognition will ensure National Audubon Society support for restoring, improving and maintaining the wildlife habitat in the marsh.

Implementation: Follow up on the IBA submission to the National Audubon Society.

Measure of Success: Listing as an Important Bird Area by the National Audubon Society.

Task 4: Promote habitat restoration and remediation projects. Many areas of the marsh and adjacent land require remediation and restoration because they have been subjected to intense degradation from accumulated pollutants (both near the marsh and further upstream), public and private landfills, mosquito ditching, and the filling of more than half the marsh. The water in the tidal marsh is classified as class SC/SB meaning that it is presently not meeting water quality criteria or not supporting one or more designated uses due to pollution.

Implementation: TMWG will use various means to promote marsh restoration and remediation. For example, habitat restoration and provision of public access is planned in conjunction with RGP which has targeted several brownfield sites in New Haven, Hamden and North Haven for remediation. Post-closure use of landfills will also be investigated.

Measure of Success: Habitat restored and remediated, and public access provided. Landfills used for public access and recreation.

Task 5: Work with LUWG to formulate model ordinances, regulations, and practices for tidal marsh protection in New Haven, Hamden and North Haven.

Implementation: CCWS is conducting a review of the regulations and ordinances of the Quinnipiac Watershed municipalities relevant to watershed protection. TMWG will review the regulations to see how they affect the tidal marsh and, in cooperation with CTDEP and CCWS, will help develop a set of model regulations and ordinances to protect the tidal marsh. TMWG will promote the adoption and use of these model ordinances and regulations by the surrounding towns.

Measure of Success: Model regulations and ordinances adopted by New Haven, Hamden and North Haven.

Objective 2: Remove threats to the marsh from contamination and toxic materials. This task involves the remediation of contaminated sites, and preventing the release of harmful materials into the marsh, including untreated sewage/combined sewer overflow, landfill leachates, pesticides, fertilizers, and runoff from impervious surfaces.

Task 1: Work with CTDEP and the mayors, selectman, town planners and agencies in New Haven, Hamden and North Haven to promote the enforcement and monitoring of remediation practices. Compile data on areas of concern to marsh habitat, and on public health risks from contamination and hazardous materials associated with the marsh.

Implementation: TMWG will work with the watershed towns and CTDEP to monitor remediation as needed. TMWG will work with community and environmental groups to publicize areas at risk, and to garner support for remediation.

Measure of success: Monitoring and remediation of target sites completed (a goal of five sites by 2005).

Task 2: Meet with the management and staff of the Attorney General, CTDEP, and EPA, and brief them on marsh issues.

Implementation: TMWG will maintain contact with these agencies and meet with them on an as-needed basis.
Measure of Success: Agency contacts established and maintained.

Objective 3: Improve public access to the marsh for recreation and education. At present there is no direct public access to the portions of the marsh owned by CTDEP. Any access is through private property, or at the New Haven Land Trust site. Areas are needed for observing nature, fishing and hunting, public boat launching, and field trip sites for nature study.

Task 1: Work with governmental, not-for-profit and private agencies, and local businesses to promote the construction of walkways, boardwalks, and observation platforms which are accessible to the public; to create access to areas adjacent to the marsh for use as public parks; and to create small craft launching areas for public use.
Implementation: TMWG will continue its work on marsh access with town and state officials and local business people. Additional contacts will be established, information gathered, and potential sites listed.
Measure of Success: At least three public access sites will be established.

Objective 4: Inform the public and municipal officials about the marsh and its value to our communities.

Task 1: Develop public information materials showing the current marsh and its uses over time.
Implementation: TMWG will continue to develop materials for public information including a slide show, video, and marsh brochure. Slide shows and video screenings will be scheduled for school science classes, and meetings of environmental and community organizations.
Measure of Success: Production and sharing of materials. At least five slide shows will be given annually.

Task 2: Conduct combination driving and walking tours of the Quinnipiac tidal marsh. Most people are unaware of the portions of the marsh owned by CTDEP because of the lack of public access. Government officials and the public will be invited to tour the marsh to emphasize its importance to ecosystem diversity in the area.
Implementation: TMWG will continue to give the type of tours which have proven successful in the past.
Measure of Success: Increased public awareness of the marshes, and use of existing public access points for education and recreation.

Task 3: Maintain contacts and hold meetings with marsh stakeholders.
Implementation: Pursue additional means of contact with stakeholders.
Measure of Success: Increased stakeholder involvement in the protection and remediation of the marsh.

Water Allocation/Low Flow Work Group Action Plan

Mission Statement:
The mission of the Water Allocation/Low Flow Work Group (LFWG) is to evaluate and recommend approaches to balancing instream flow needs, including aquatic life habitat needs, with drinking water supply and other consumptive water uses.

Background:
An adequate supply of clean water is essential for a healthy population, environment and economy. Government, industry, and environmental groups are becoming increasingly aware of the importance of this issue and the need for action. Two well-attended conferences on instream flow organized by CCWS and Rivers Alliance of Connecticut were held in March 2001 and May 2001.

LFWG has already undertaken a study of diversions and stream flow in the Quinnipiac Watershed. The results of this study were published in a July 2000 report to the Partnership entitled "*Preliminary Assessment Of Water Withdrawals And Stream Flows in the Quinnipiac River Watershed.*" The report includes the following conclusions:

- The 1982 Water Diversion Policy Act has several deficiencies that thwart efforts to develop and implement water allocation plans.
- The existing information about water diversions, river flows and fish communities suggests that several tributary streams in the watershed [Misery Brook, Sodom Brook, Muddy River, Patton Brook, and Roaring Brook] may not maintain the designated use for fish and wildlife habitat, and that this failure may be due to periods of low flow caused in part by water diversions, primarily registered diversions.
- There is need for a scientific methodology applicable to Connecticut for the computation of dry season thresholds of minimum stream flow, and the duration of such minimum flows, as they relate to potential degradation of fish and wildlife habitat.

The report includes the following recommendations:

- The Connecticut General Assembly should provide the legislative initiative to ensure the development of a water allocation policy that provides for the prioritization of competing uses, and provides for allocation for instream uses while maintaining public health and the economic well being of the state.
- LFWG should focus its next efforts on supporting the development of a state water allocation policy by providing Quinnipiac Watershed case study information and data to the General Assembly and regulatory agencies.
- A water use budget for each of the nine subwatersheds in the Quinnipiac Watershed should be developed based on completed inventories of withdrawals and discharges.
- Water quantity management systems should be developed for each of the nine subwatersheds in the Quinnipiac Watershed to balance competing needs of all users, particularly fish and wildlife habitat and water supply.

  (Note: The legislature has recently enacted legislation addressing water allocation policy. Public Act 01-202 is intended to provide better data on the amount of water diverted from surface and ground water. Public Act 01-177 establishes a Water Planning Council of key state departments to work on the issue of water allocation. LFWG believes it has an important and helpful role to play in this evolving situation.)

Objective 1: Assist CTDEP and other state agencies with the content and design of a water diversion report form. The Connecticut General Assembly has recently enacted legislation (Public Act 01-202) intended to provide better data on the diversion amounts from surface and ground water. Because of the broad representation of its stakeholders, the Partnership is in an excellent position to assist with developing a form for gathering water diversion information.

Task 1: Provide a forum for CTDEP to obtain input from stakeholders on the development of a reporting form.

Implementation: Allocate time in LFWG meeting agendas for stakeholders to provide input on the diversion report form. CTDEP staff responsible for the report format will be invited to discuss the resulting suggestions.

Measure of Success: LFWG meetings held, and suggestions discussed with responsible CTDEP staff.

Objective 2: Offer, and provide, assistance to the Water Planning Council to help them accomplish their mission mandated by the legislature. Public Act 01-177 established a Water Planning Council chaired by DPUC. LFWG has several years experience working on the issues that this newly established Council is charged with studying. As a result, LFWG and the Partnership are in an excellent position to assist the Water Planning Council while benefiting the Quinnipiac Watershed in the process.

Task 1: Make LFWG information available to DPUC to assist in the endeavors of the Water Planning Council.

Implementation: If our offer of assistance is accepted, LFWG will formulate a plan for obtaining and allocating resources to best assist the Water Planning Council.

Measure of Success: Collaboration between the Water Planning Council and LFWG.

Objective 3: Complete the initial planning for a water budget pilot study in one or more subwatersheds in the Quinnipiac Watershed. This is in accord with the recommendations of LFWG in their July 2000 report. A water budget is designed to quantify the sources of water, and the various uses and distribution of water, in a given watershed.

Task 1: Establish the scope of the pilot study, and determine whether sufficient data are available to produce a first approximation of a water budget.

Implementation: Allocate time in LFWG meeting agendas for discussing the scope of determining a water budget for the Quinnipiac Watershed. Experts will be invited to help with the work group's deliberations as necessary.

Measure of Success: LFWG understands the scope of a water budget pilot study, and produces a report to the Steering Committee.

Task 2: Determine the availability of data necessary to conduct a water budget pilot study in a limited number of subwatersheds.

Implementation: Allocate time in LFWG meeting agendas for the group to discuss what information is available or can be derived from existing data in order to determine a water budget.

Measure of Success: LFWG understands the availability of data and makes the decision whether to undertake a water budget study.

Water Quality Work Group Action Plan

Mission Statement:
The mission of the Water Quality Work Group (WQWG) is to provide data on water quality and trends in the Quinnipiac River and its tributaries to other partners and work groups and collaborate with them in taking action to improve water quality. This working group will also establish a clearinghouse for water quality information for the Partnership and the public in the watershed.

Background:
Since the early 19th century, the Quinnipiac River has had a history of severe water quality degradation. Many of the parameters of water quality have improved since the implementation of the Clean Water Act in 1972. However, there is much to be done to improve water quality in the river so it is safe for contact recreation and can support aquatic life. At present, most of the river and many of its tributaries are unsuitable for one or both these uses. The primary problems are: bacterial contamination and sediment loading from stormwater; discharges from sewage treatment plants and industrial sources; and leaching from historical contamination sites and landfills. A number of recent studies have been conducted on the Quinnipiac River and its tributaries. An overview of historical and current data has been compiled by the Water Quality Work Group in a recent publication ***"A Report on the Water Quality of the Quinnipiac River."*** The following Action Plan is intended to follow up on the work done thus far.

Objective 1: Evaluate water quality data and trends and make this information available for action in terms of public education and changes to municipal regulations, policies, and procedures. WQWG will focus on a specific segment of the river to document where water quality problems are occurring to see if they are improving or getting worse. The effort will serve as a pilot project intended to encourage the public and local government to take action to improve water quality.

Task 1: Review of existing data. Extensive studies have been conducted on the watershed's watercourses by CTDEP, CCWS, UNH, USGS, and QRWA. WQWG will find out when and where the data was obtained and in what format.

Implementation: For a chosen segment of the river, WQWG will identify and quantify the water quality parameters that are relevant to stormwater runoff and nonpoint source pollution. Missing data will be identified. Trends in water quality will be identified to the extent possible.
Measure of Success: Completion of a water quality analysis by sampling site and type of impairment. Missing data identified. Trends in water quality noted where possible.

Task 2: Bring together and organize a GIS database format for the available data.

Implementation: WQWG will design and construct the database. Automated procedures for data entry will be explored.
Measure of Success: Database constructed, data entered, and protocols for automated and manual data entry established.

Task 3: Make this data and analysis available to other work groups and partners who are taking action with respect to water quality.

Implementation: Using the available data, we will write a brief report on water quality and trends. WQWG will provide this report to LUWG, EOWG, and other partners thereby establishing a rationale for changes to local policies, regulations, and procedures that will improve water quality.
Measure of Success: Report written and provided to work groups and partners. Report used to introduce changes to local policies, regulations, and procedures.

Objective 2: Establish a clearinghouse for water quality information for the Partnership and the public in the watershed. WQWG will expand the database created in the pilot project to include an increasing number of river segments and water quality parameters.

Implementation: Based on the experience gained in completing the pilot project (Objective 1), the database will be modified and expanded to include river segments in other municipalities and additional measures of water quality. These data will be made available to interested partners thereby providing a rationale for changes to local policies, regulations, and procedures that will improve water quality.

Measure of Success: Database modified and expanded to include other municipalities, and used to introduce changes to local policies, regulations, and procedures.

Glossary/Appendices

Appendix 1: Excerpts from the Connecticut Water Quality Standards

Appendix 2: Contacts and Resource Information

Appendix 3: Partnership Participants and Affiliations

Glossary

Algae are mostly single cell plants found in both fresh and marine waters. In fresh water they can color the water green, and they can grow in colonies which can form either long filamentous bodies or form a mat on the stream's substrate. Algae are usually green and slimy and do not have any visible structural characteristics. Algae growth may be indicative of excess nutrient problems in the stream. Marine macroscopic green, brown, and red algae are structurally different from aquatic vascular plants.

Alluvial Soils are floodplain soils sediment deposited by flowing water.

Alkalinity is a measure of the capacity of water to neutralize acids. Alkalinity must be more than 20 mg/L to effectively neutralize acids.

Anadromous Fish begin life in fresh water, migrate to the sea to reach maturity, and return to freshwater to spawn.

Benthic Invertebrates refers to organisms like insects and worms that live in or on the bottom of water.

Best Management Practice means a practice, procedure, activity, structure or facility designed to prevent or minimize pollution or other environmental damage or to maintain or enhance existing environmental quality. Such management practices include, but are not limited to: erosion and sedimentation controls; restrictions on land use or development; construction setbacks from wetlands or watercourses; proper disposal of waste materials; procedures for equipment maintenance to prevent fuel spillage; construction methods to prevent flooding or disturbance of wet lands and watercourses; procedures for maintaining continuous stream flows; and confining construction that must take place in watercourses to times when water flows are low and fish and wildlife will not be adversely affected.

Biodiversity refers to the diversity of species in a particular habitat or area.

Bioassay is a test using live organisms. For a water quality bioassay, small fish or water fleas called daphnia are usually used.

Buffer Zones are naturally vegetated borders that help to reduce runoff and nonpoint source pollution to a water body by providing zones of infiltration and bank stabilization adjacent to the stream, river, pond or water body, as well as providing habitat for wildlife.

Culvert is a drain or channel constructed for the purpose of directing surface water flow.

Combined Sewer Systems are designed to allow sewage and stormwater to flow together through sewer pipes. Overflows occur when stormwater exceeds the capacity of the sewer system. The overflow discharges into local waterways instead of being treated in a sewage treatment plant. The discharges cause periodic water quality violations, particularly from fecal coliform bacteria levels.

Degradation is the act of lowering the quality of water or other natural resources to a less useable state.

Discharge Rate is the volume of water flowing through a watercourse or pumped from an aquifer over a specified unit of time; usually measured in cubic feet per second (cfs) or million gallons per day (MGD).

Drainage Basin is the land area from which all water drains into a common outlet. Same as a watershed.

Enterococci are a subgroup of the fecal streptococci group of bacteria that is fecal specific and can be found in warm-blooded mammals as well as humans. CTDEP and the Department of Health Services have adopted Enterococci as the preferred indicator for evaluating the sanitary quality of bathing waters.

Erosion/Sedimentation Erosion is the scouring/removal of upland substrate and washing of soil into the waterway. Sedimentation occurs when soils wash into waterways and increase the turbidity of the water. Turbidity (suspended soil particles) reduces both the clarity of the water and the amount of sunlight reaching the aquatic plants. It also impairs the respiration of the fish and organisms that live in the waterbody. Sedimentation can result in an increase in surface water temperatures, which decreases dissolved oxygen concentrations in water and lessens the number of spawning habitats as more pools and nest sites are filled.

Eutrophication is the process of enrichment of surface waters with plant nutrients which may cause nuisance algae blooms and excessive growth of aquatic weeds.

Evapo-Transpiration is the evaporation of water directly from the ground or water and the evaporation of water from the inside of leaves. Transpiration from leaves is the process that drives the transport of water from the roots to leaves through capillary action.

Fecal Coliform is a broad based indicator of possible fecal contamination from a variety of sources such as untreated wastewater and/or the presence of animal feces which may contain disease-causing bacteria.

Habitat Degradation refers to reduction of riparian and tidal and non-tidal wetland vegetation, restriction of tidal exchange and natural salinity concentrations, streambank or channel erosion, gully erosion, barriers to fish passage, litter, and impoundments.

Hazardous Waste is any material, source material, or special nuclear material which may pose a present or potential hazard to human health or the environment when improperly disposed of, treated, stored, or transported.

Headwater is the natural waterbody, including wetlands, located at the highest elevation within the watershed.

Hydric Soil is a soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in the upper part. The soil is a good indicator for "wetlands."

Hypoxia is a condition of low dissolved oxygen in the western section of Long Island Sound. Nitrogen fuels excessive growth of marine algae, which eventually die and decay, consuming oxygen in the process. Areas affected by hypoxia are toxic to marine species that inhabit the Sound.

Impaired Sites are sections of a stream where physical characteristics indicate conditions adverse to fish life and human uses.

Impervious Surface means a surface that does not allow infiltration of water into the ground, e.g. paved roads, parking lots, and roofs.

Infiltration means percolation of water into soil or other porous material beneath the land surface.

Mitigation actions that make conditions less severe or intense.

Nonpoint Source Pollution (NPS) is any water contamination that does not originate from a point source (see definition for point source pollution). Contamination of water that occurs when rainwater or snowmelt washes over agricultural fields, streets, or lawns, picking up soil particles and pollutants (e.g. fertilizers, pesticides, auto residues), and eventually flowing to groundwater or surface waterbody.

Nutrient Enrichment is the addition of nutrients, such as nitrogen and phosphorous (usually through runoff) to a waterbody that can increase algal and plant growth. This addition of nutrients often results from leaking septic systems and fertilizers.

Point Source Pollution is water pollution originating from a clearly identified discharge source.

Polluted Runoff is caused when rain or snowmelt flows over and through ground that has been disturbed or impacted by land use activities. Runoff carries contaminants from upland areas and deposits them in downstream or downgradient surface and groundwater resources affecting water quality.

pH	is a measure of the acidity in a waterbody. It is measured on a scale of 0 (most acidic) to 14 (most alkaline) with 7 considered to be neutral.
Remediation	is any action taken to improve, restore, or protect the natural ecological condition within the watershed.
Riffle	is a shallow part of a stream where water runs rippling over rocks.
Riparian Zones	are areas of, on, or relating to the bank of a natural watercourse.
Septic System	is an on-site system that provides for the treatment and disposal of waste water. Usually consists of a septic tank, where organic solids settle out and are partially broken down, and a drainage bed or leaching field, where the remaining liquid waste water is dispersed and treated by filtering through the soil.
Substrate	is the material that makes up the bottom of a stream. There is usually a direct relationship between the stream's substrate and the rate of water flow. The composition of the substrate is indicative of the quality of fish habitat.
Waste	means sewage or any substance, liquid, gaseous, solid or radioactive, which may pollute or tend to pollute wetlands or watercourses or any waters.
Water Pollution	means the harmful thermal effect or contamination or rendering unclean or impure of any waters by reason of any waste or other materials discharged or deposited therein by any public or private sewer or otherwise so as to directly or indirectly come in contact with any waters.
Watercourses	**Connecticut General Statutes section 22a-38(16):** "Watercourses" means rivers, streams, brooks, waterways, lakes, ponds, marshes, swamps, bogs and all other bodies of water, natural or artificial, vernal or intermittent, public or private, which are contained within, flow through or border upon this state or any portion thereof, not regulated pursuant to sections 22a-28 to 22a-35, inclusive. Intermittent watercourses shall be delineated by a defined permanent channel and bank and the occurrence of two or more of the following characteristics: (A) Evidence of scour or deposits of recent alluvium or detritus, (B) the presence of standing or flowing water for a duration longer than a particular storm incident, and (C) the presence of hydrophytic vegetation.
Watershed	all of the land area from which precipitation runs off and drains into a particular watercourse or waterbody.
Wetlands	**Connecticut General Statutes Section 22a-38 (15) (Inland):** "Wetlands" means land not regulated pursuant to sections 22a-28 to 22a-35 inclusive, which consists of any of the soil types designated as poorly drained, very poorly drained, alluvial, and floodplain by the National Cooperative Soils Survey as may be amended from time to time.

Connecticut General Statutes 22a-2a (Tidal):
"Tidal wetlands" means those areas which border on or lie beneath tidal waters, such as, but not limited to, banks, bogs, salt marsh, swamps, meadows, flats, or other low lands subject to tidal action, including those areas now or formerly connected to tidal waters, and whose surface is at or below an elevation of one foot above local extreme high water; and upon which may grow or be capable of growing some, but not necessarily all, of the following species...

Appendix 1

Excerpts from the Connecticut Water Quality Standards

The Standards set an overall policy for management of water quality in accordance with the directive of Section 22a-426 of the Connecticut General Statutes. In simple terms the policies can be summarized by saying that the Department of Environmental Protection shall:

- Protect surface and ground waters from degradation.
- Segregate waters used for drinking from those that play a role in waste assimilation.
- Restore surface waters that have been used for waste assimilation to conditions suitable for fishing and swimming.
- Restore degraded ground water to protect existing and designated uses.
- Provide a framework for establishing priorities for pollution abatement and State funding for clean up.
- Adopt standards that promote the State's economy in harmony with the environment.

There are three elements that make up the Water Quality Standards. The first of these are the Standards themselves. This is the text of the policy statements that discuss issues such as classification of different water resources according to the desirable use, anti-degradation, allowable types of discharges, the fundamental principles of waste assimilation, and a variety of other subjects. The second element, also contained in this document, are the Criteria. These are descriptive and numerical standards that describe the allowable parameters and goals for the various water quality classifications. The final element is the Classification Maps that show the Class assigned to each surface and groundwater resource throughout the State. These maps also show the goals for the water resources, and in that manner provide a blueprint and set of priorities for our efforts to restore water quality.

Section 22a-426 of the Connecticut General Statutes requires that the Commissioner of Environmental Protection adopt standards of water quality consistent with the federal Clean Water Act. The Standards establish a goal of restoring and maintaining the chemical, physical, and biological integrity of Connecticut surface waters, and wherever attainable, providing for the protection and propagation of fish, shellfish, and wildlife and provide for recreation in and on the water. The purpose of these Standards is to provide clear and objective statements for existing and projected water quality and the general program to improve Connecticut's water resources.

Water Quality Classifications, based on the adopted Water Quality Standards, establish designated uses for surface and ground waters and identify the criteria necessary to support those uses. The designated use and criteria serve to focus the department's water quality management activities, including establishment of water quality based treatment controls and strategies required by the federal Clean Water Act.

SURFACE WATER QUALITY STANDARDS

1. It is the State's goal to restore or maintain the chemical, physical, and biological integrity of surface waters. Where attainable, the level of water quality that provides for the protection and propagation of fish, shellfish, and wildlife and recreation in and on the water shall be achieved.
2. Existing and designated uses such as propagation of fish, shellfish, and wildlife, recreation, public water supply, agriculture, industrial use and navigation, and the water necessary for their protection is to be maintained and protected.

3. Surface waters with an existing quality better than the criteria established in these Water Quality Standards shall be maintained at their existing high quality, unless the Commissioner finds, after adequate opportunity for intergovernmental review and public participation, that allowing lower water quality is necessary to accommodate overriding statewide economic or social development, and that existing and designated uses will be fully protected. The implementation procedures for the anti-degradation provisions of these Water Quality Standards are provided in full in Appendix E.

INLAND SURFACE WATER CLASSIFICATIONS AND CRITERIA

CLASS AA Designated Uses: existing or proposed drinking water supplies; habitat for fish and other aquatic life and wildlife; recreation; and water supply for industry and agriculture.

CLASS A Designated Uses: habitat for fish and other aquatic life and wildlife; potential drinking water supplies; recreation; navigation; and water supply for industry and agriculture.

CLASS B Designated Uses: habitat for fish and other aquatic life and wildlife; recreation; navigation; and industrial and agricultural water supply.

CLASS C - Water quality results from conditions that are usually correctable through implementation of established water quality management programs to control point and nonpoint sources. Present water quality conditions frequently preclude the attainment of one or more designated uses for Class B waters or one or more Criteria for Class B waters are not being consistently achieved. Class C waters may be suitable for certain fish and wildlife habitat, certain recreational activities, industrial use and navigation. Class C waters may have good aesthetic value. Examples of conditions that warrant a Class C designation include: combined sewer overflows, urban runoff, inadequate municipal or industrial wastewater treatment, and community-wide septic system failures.

GROUND WATER CLASSIFICATIONS AND CRITERIA

CLASS GAA Designated Uses: existing or potential public supply of water suitable for drinking without treatment; baseflow for hydraulically-connected surface water bodies.

CLASS GA Designated Uses: existing private and potential public or private supplies of water suitable for drinking without treatment; baseflow for hydraulically connected surface water bodies.

CLASS GB Designated Uses: industrial process water and cooling waters; baseflow for hydraulically-connected surface water bodies; presumed not suitable for human consumption without treatment.

GB Criteria - Ground waters of this class are assumed by the Department to be degraded due to a variety of pollution sources. No specific groundwater quality criteria apply except those that may be promulgated as part of the Site Remediation Regulations required by Section 22a-133k of the General Statutes.

CLASS GC Designated Uses: assimilation of discharges authorized by the Commissioner pursuant to Section 22a-430 of the General Statutes.

GC Criteria - No quantitative criteria are specifically determined until such time as a person applies to the Department under Section 22a-430 of the General Statutes to discharge leachate to ground water. The most important consideration in making a determination to classify ground water as GC is the impact of any authorized ground water discharges on adjacent surface waters.

The minimum acceptable classification goal for surface and ground waters is Class B. Class B waters are those that meet designated recreational standards (fishable and/or swimmable); provide suitable fish and wildlife habitat; and allow for agricultural and industrial supply, and other legitimate uses such as navigation. This minimum will only be waived if one or more uses are demonstrated to be unattainable through a CTDEP and EPA approved use attainability analysis.

When surface and ground waters do not meet the minimum goal of Class B (i.e. Classes C and D) then current water quality conditions have precluded the full attainment of one or more designated uses. This condition could result from nonpoint source pollution, community-wide septic system failures, sediment contamination, and historic industrial spills. Class C waters may be suitable for certain fish and wildlife habitat, certain recreational activities, industrial use, and other legitimate uses including navigation. Class C waters may also have good aesthetic value. Class C conditions can usually be corrected using an established water quality management program.

In April 1997, CTDEP adopted a classification map titled "Water Quality Classifications Map for the Southwest Coastal Basins". The surface water classifications depicted on the map required EPA approval. In the spring of 1998, EPA notified CTDEP that certain coastal classifications should be reevaluated to consider long-term goals. CTDEP subsequently revised the Southwest Coastal Classifications for saline waters in several areas.

Appendix 2

Contacts and Resource Information

VOLUNTEERING

The following organizations are engaged in various river improvement activities and offer many opportunities for volunteer involvement.

Quinnipiac Watershed Partnership

90 Sargent Drive
New Haven, CT 06511
Contact: Jerry Silbert (203) 401-2718
jsilbert@rwater.com

Quinnipiac River Watershed Association

99 Colony Street
Meriden, CT 06451
Contact: Mary Mushinsky (203) 237-2237
qrwa@qrwa.org

Trout Unlimited - Hammonasset Chapter

260 High Meadow Lane
Middletown, CT 06457
Contact: Steve Butcher (860) 346-3382

TECHNICAL ASSISTANCE

The following organizations provide services which may include educational materials, resource publications, and hands-on project assistance.

New Haven County Soil and Water Conservation District

North Farms Executive Park
900 Northrop Road, Suite A
Wallingford, CT 06492
Contact: Roman Mrozinski (203) 269-7509
nhcswcd@aol.com

Hartford County Soil and Water Conservation District

627 River Street
Windsor, CT 06095
Contact: Mike Kallen (860) 688-7725

Nonpoint Education for Municipal Officials (NEMO)

UCONN Cooperative Extension Center
1066 Old Saybrook Road, P.O. Box 70
Haddam, CT 06438
Contact: (860) 345-4511

Natural Resources Conservation Service

344 Merrow Road, Suite A
Tolland, CT 06084
Contact: Phil Renn (860) 871-4016
phil.renn@ct.usda.gov

CT Department of Environmental Protection

Bureau of Water Management
Planning and Standards Division
Watershed Management Program
79 Elm Street
Hartford, CT 06106
Contact: Sally Snyder (860) 424-3869
sally.snyder@po.state.ct.us

EDUCATIONAL MATERIALS

The following organizations provide educational guides and materials on enhancing and protecting your watershed.

Quinnipiac River Watershed Association

99 Colony Street
Meriden, CT 06451
Contact: Mary Mushinsky (203) 237-2237
qrwa@qrwa.org

Rivers Alliance of Connecticut

111 Main Street
Collinsville, CT 06022
Contact: Margaret Miner (860) 693-1602

CT Department of Environmental Protection

79 Elm Street
Hartford, CT 06106-5127
Contact: General Information (860) 424-3000

US Environmental Protection Agency

Connecticut State Program Unit
Office of Ecosystem Protection
Nonpoint Source
One Congress Street
Suite 1100 (CCT)
Boston, MA 02114-2023
Contact: (617) 465-3564
Steve Winnett, (617) 918-1687

Appendix 3

Partnership Participants

Edward Albrecht
Miles Alderman
Nancy Alderman
Mark Alexander
Kenneth Allen
Peggy Allen
Shimon Anisfeld
Phillip Ashton
Daniel Barvik
Nancy Beals
Michael Beauchene
Gaboury Benoit
Barbara Blumeris
Rose Bonito
Richard Branigan
Gregory Brezicki
Lauren Brown
Linda Bush
Paul Capotosto
Charles Cappannari
Dominick Caruso
Gail Collins
Roger Dann
Peter Davis
Virginia DeLima
Michael Dooman
M. Hope Fish
Diana Fischer
Susan Forster
Anne Foster
Peter Foster
Randi Frank
Charles Fredette
Sigrun Gadwa
David Galt
Nancy Gaumer
William Gere
Karen Gilvarg
Barry Gorfain
Richard Graham
Tom Grimshaw
Donna Hall
David Holstein
Walter Hylwa
Katherine Ing
Bob Jahn
Mark Kasinskas
Kenneth Kells
Stephen Knight
John Kotchian
Michael Korby
Margus Laan
James Link
Wesley Lubee, Jr.
Martin Mador
Christopher Malik
Robert Marino
Elizabeth Marks
Virginia Mason
George Mattei, Jr.
George McGoldrick
Emly McDiarmid
Larry MacMillan
Peter McPhedran
JoAnn Moran
Kristin Morico
Thomas Morrissey
Roman Mrozinski
Thomas Mudry
Mary Mushinsky
Donald Mysling
Theresa Niemiec
Michael Piscitelli
Ernest Pizzuto
Phillip Renn
William Root
Nancy Rosenbaum
Denise Ruzicka
Kenneth Shooshan-Stoller
Jerry Silbert
Cory Silfstein
John Sima
Brent Smith
Martha Smith
Walter Smith
Sally Snyder
Peter Spangenberg
Gertrude Sternberg
Sandy Stetson
Richard Stoecker
John Strillacci
Richard Sullivan
Anthony Tall
Lawrence Tarducci
Ellie Tessmer
Steve Theriault
Mary Tyrrell
Mike Walker
Ron Walters
Robert Welch
David Wescott
Thomas West
Charles Williams
Nancy Wilson
Steven Winnett
Kristen Wolfe
Thomas Yasensky
Norman Zimmer

Affiliations

Center for Coastal and Watershed Systems, Yale University School of Forestry and Environmental Studies

Council of Governments of the Central Naugatuck Valley

Central Connecticut Regional Planning Agency

City of Meriden

City of New Britain

City of New Haven

Connecticut Steel Corporation

CT Department of Environmental Protection

CT Department of Agriculture - Bureau of Aquaculture

CT Department of Transportation

Cytec Corporation

Natural Resources Conservation Service, US Department of Agriculture

New Haven County Soil and Water Conservation District

Quinnipiac River Linear Trail Advisory Committee

Quinnipiac River Watershed Association

The Soundkeeper Fund

South Central Connecticut Regional Growth Partnership

South Central Connecticut Regional Water Authority

South Central Regional Council of Governments

Town of Cheshire

Town of Hamden

Town of North Haven

Town of Plainville

Town of Prospect

Town of Southington

Town of Wallingford

Trout Unlimited

University of New Haven

University of Connecticut, Cooperative Extension System

US Army Corps of Engineers

US Environmental Protection Agency

US Geological Survey