Lake Cochituate Nonpoint Source Pollution Watershed Management Plan

Introduction and Background

Lake Cochituate is a critical water resource for the region west of Boston known as MetroWest. It features Cochituate State Park, which provides public access for swimming, boating, fishing, hiking, and picnicking, as well as several town beaches, parks, and recreational facilities. The lake is also within the recharge area of two of the town of Natick's public water supply wells. Numerous homes in neighborhoods of Framingham, Natick and Wayland enjoy lake-front property and access to the lake for boating and fishing, and several businesses and institutions make their home on or near the lake. Clearly Lake Cochituate is important to its host communities, and requires careful management to restore and protect its resources.

The Commonwealth of Massachusetts and the towns on Lake Cochituate have long been concerned about water quality and resource management. This project reviewed previous studies, assessments, and plans for Lake Cochituate spanning the 1970's, 1980's, and 1990's. Most recently, the Dept. of Environmental Management (now the Dept. of Conservation and Recreation) completed a Management Plan for Cochituate State Park. Water quality concerns were one of the issues featured in the plan.

This project had its origin in the Massachusetts Watershed Initiative (MWI), which was a program administered by the Executive Office of Environmental Affairs (EOEA) from 1993 to 2003. The MWI was organized around the 27 major watersheds of the state. Lake Cochituate lies within the "SuAsCo" Watershed, so named because it includes the drainage area of three rivers, the Sudbury, Assabet, and Concord rivers. Under the MWI, each of the 27 watersheds had assigned to it a "Watershed Team Leader" who led a multi-agency Watershed Team that also included the participation of local communities, watershed organizations, businesses, and interested citizens.

In 2001, the team leader of the SuAsCo Watershed Team, Mike Flemming, arranged for a survey of stormwater outfalls on Lake Cochituate, which was conducted by student interns from Brandeis University. Knowing where the oufalls are located was just a first step in developing a watershed management plan for Lake Cochituate. The outfalls are literally the "end of the pipe;" but control of nonpoint source pollution requires an evaluation of the ultimate sources of pollutants where they are generated, a numerous locations throughout the land area of the watershed. Thus, after the outfall survey was completed, Mike Flemming sought to have a watershed plan developed by the Metropolitan Area Planning Council, working through the DEP's 604(B) grant program. The result of that work is presented here in this report. In the chapters that follow, the reader will find maps and inventories portraying the resources of the Lake Cochituate watershed, the land uses and development activities that have an impact on its water quality, a listing of priority sites for remediation and recommendations for both structural and non-structural Best Management Practices as well as local bylaws and regulations, with the goal of long-term improvement of water quality in the lake and its tributaries.

The long term success of this plan will depend on the ability of the towns in the watershed as well as the relevant state agencies, businesses, and residents to implement the recommendations presented. The nature of nonpoint source pollution is that it derives from many diffuse sources, thus it will require widespread adoption of different management practices to reduce pollution loads and yield a cleaner lake.

Description of the Watershed

Lake Cochituate is actually a series of four connected ponds that are fed by flow through a fifth pond, Fisk Pond. The lake is located in Natick, Framingham, and Wayland, but its 17.7 square mile watershed also includes parts of Ashland and Sherborn. The contributing watershed area includes four major tributaries: Beaver Dam Brook, Course Brook, Pegan Brook, and Snake Brook. In addition, the lake receives flow from several shoreline subwatershed areas that drain directly to the lake (see Map 1).

About 55 percent of the watershed is developed, and only 38 percent is undeveloped (the remaining 7 percent is the open water of Lake Cochituate and several other smaller ponds). Of the 55 percent developed land, residential land predominates, at 41 percent. The next largest development categories are commercial, at 6 percent, and industrial, at 3 percent. The combination of commercial, industrial, transportation, mining, and utilities amount to 13 percent of the watershed.

In the 40 year period from 1960 to 2000, the total population of the five watershed towns increased from 93,396 to 131,054. This increase of 37,668 people represented a percentage increase of over 40 percent in 40 years.

Key Issues in the Lake Cochituate Watershed

As the land use and demographic data indicate, much of the watershed is a densely populated urbanized area, and as a result of urban stormwater runoff the lake is failing to meet its water quality criteria due to nutrients, organic enrichment/low dissolved oxygen and the presence of noxious aquatic plants. One of the key features of urbanization as it affects water quality is the amount of impervious surfaces. The water quality impacts associated with imperviousness are generally caused by the wash off by storm water of accumulated sediments and other pollutants that have been deposited on roads, parking lots, and other paved or disturbed lands. Virtually all municipal stormwater systems, including those in the Lake Cochituate watershed, are designed to collect stormwater from streets and parking lots as quickly as possible and transmit it through pipes and culverts to ultimately discharge in water bodies or wetland areas. Thus, the vast majority of the sediments and pollutants picked up by stormwater over impervious surfaces are transmitted directly to Lake Cochituate and its tributaries, with little or no mitigation of the pollutant load it carries.

The analysis in this report shows that the Lake Cochituate watershed has about 16 percent of its land in the “highly impervious” category (greater than 35% impervious); and 41 percent of the watershed land area is in the “medium impervious” category (from 10 percent to 35 percent impervious). The combined high and medium impervious areas encompass 6,105 acres, nearly 60 percent of the total watershed area. This is considered a very high level of imperviousness with respect to impacts on a watershed.

These statistics portray a watershed that is heavily impacted by nonpoint source pollution, primarily by urban stormwater runoff. This project is designed to address these water quality issues and present the communities, agencies, and residents with recommendations and tools to mitigate these impacts and protect and restore “MetroWest’s prime water resource,” Lake Cochituate. The success of these efforts will ultimately depend on the willingness and ability of those who work, live, and play in the watershed to provide stewardship of this important resource.

Lake Cochituate Nonpoint Source Pollution Watershed Management Plan

1.0 Executive Summary

1.1 Purpose and Goals of the Project

This project focuses on Lake Cochituate, a major recreational and water supply resource in the MetroWest area, and on the 17.7 square mile watershed that contributes flow to the lake. Lake Cochituate is actually a series of four connected ponds located in Natick, Framingham, and Wayland, and its watershed also includes parts of Ashland and Sherborn. The contributing watershed area includes four major tributaries: Beaver Dam Brook, Course Brook, Pegan Brook, and Snake Brook. In addition, the lake receives flow from Fisk Pond and several shoreline subwatershed areas that drain directly to the lake (see Map 1).

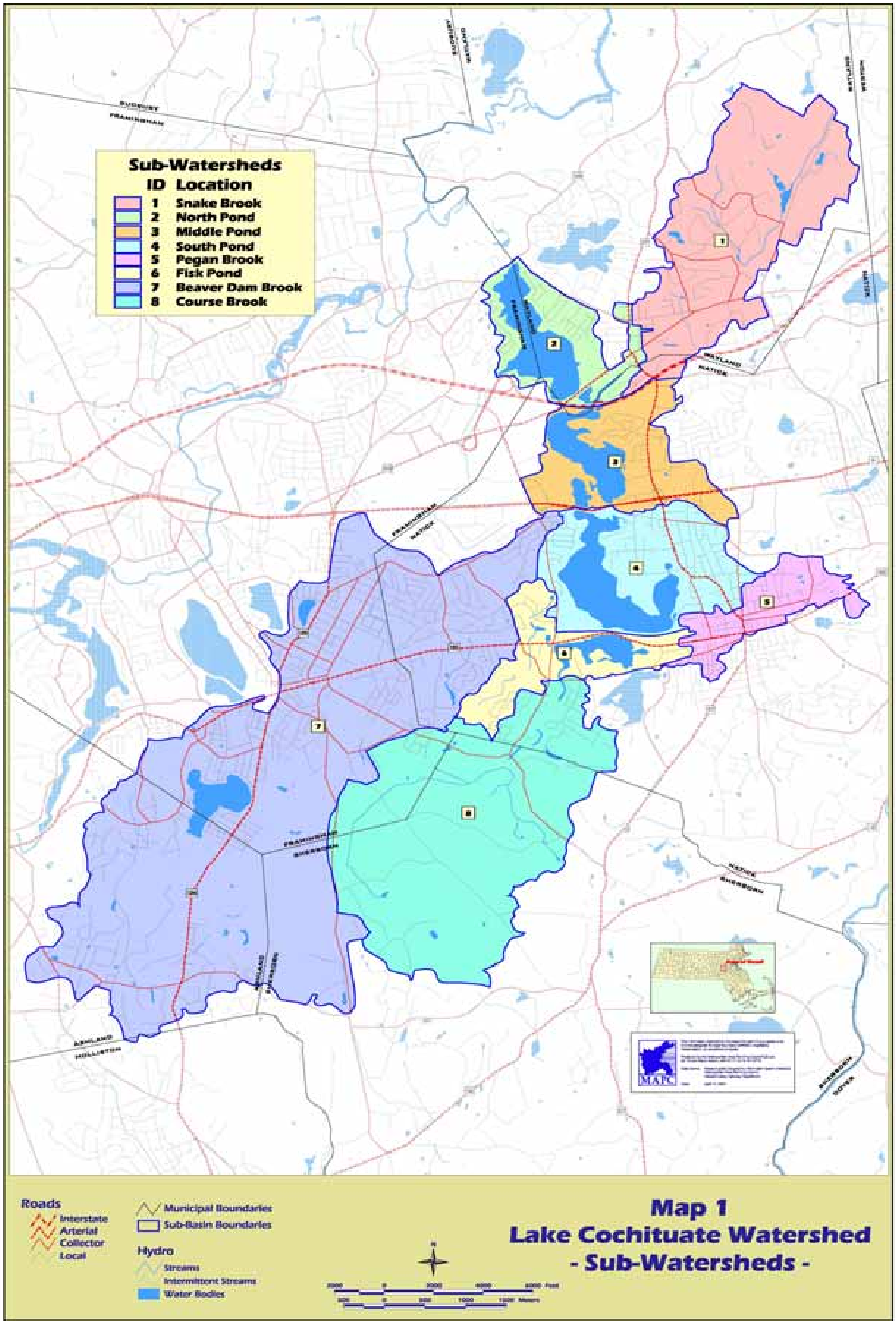
Lake Cochituate is an intensively used recreational resource, with a major state park providing a public swimming beach, two boat access ramps, fishing, and picnicking, and several town facilities also offering swimming beaches. Much of the watershed is a densely populated urbanized area, and as a result of urban stormwater runoff the lake is failing to meet its water quality criteria due to nutrients, organic enrichment/low dissolved oxygen and the presence of noxious aquatic plants. The lake is also in close proximity to two of Natick's well fields, and USGS studies have confirmed that the wells induce recharge from the lake.

Urbanization and increased impervious surfaces within the Lake Cochituate watershed are having negative impacts on the watershed's resources. These impacts include the degradation of water quality, impairment of recreational uses, a decreased ability to sustain aquatic life, and altered flow dynamics that result in increased peak runoff and suspended sediments and decreased groundwater recharge.

These negative impacts can in many cases be minimized and mitigated through protection of stream and lake buffers, improved site planning, pollution prevention, and the use of both structural and non-structural Best Management Practices (BMP's) that remove or prevent pollutants and work to sustain the natural hydrodynamics of the watershed.

The purpose of this project is to provide the watershed communities with a recommended action plan to improve water quality, and appropriate implementation tools to achieve the goals of the plan. The plan includes the following components:

- A summary of water quality impacts on Lake Cochituate based on a review of historic state and federal water quality data from previous assessments and studies conducted from the mid-1970's through the mid-1990's.
- An analysis of land use and imperviousness within the watershed
- GIS mapping and database of potential sources of contamination
- A review of existing stormwater control measures in Ashland, Framingham, Natick, Sherborn, and Wayland
- Recommendations for stormwater Best Management Practices by priority sub-watershed
- Recommendations for nonstructural stormwater Best Management Practices such as land use regulations, DPW maintenance practices, and public education


Sub-Watersheds
ID Location
1 Snake Brook
2 North Pond
3 Middle Pond
4 South Pond
5 Pegan Brook
6 Fisk Pond
7 Beaver Dam Brook
8 Course Brook
Roads
Interstate
Arterial
Collector
Local
Municipal Boundaries
Sub-Basin Boundaries
Hydro
Streams
Intermittent Streams
Water Bodies
Map 1
Lake Cochituate Watershed
- Sub-Watersheds -
MAPC

1.2 Methodology

To accomplish the project's goals MAPC worked with the watershed communities through the formation of a Lake Cochituate Water Quality Advisory Committee. The Committee includes representatives from local boards such as the Planning Board, Conservation Commission, Public Works, town engineer, as well as representatives of Cochituate State Park, the Department of Environmental Protection, Department of Conservation and Recreation, the Cochituate State Park Advisory Committee, and the MetroWest Growth Management Committee. The committee met four times during the preparation of the project and provided invaluable input on local conditions, sources of data, historical trends, and public concerns. A fifth meeting will be held to review this draft report.

MAPC conducted a review of existing sources of data on water quality, development, land use, and potential sources of contamination, including previous planning and engineering studies conducted by USGS, state agencies, and private consultants, as well as the Mass GIS office and town boards and commissions. A 1999 shoreline survey of stormwater outfalls conducted by student interns under the supervision of the Department of Environmental Management, corroborated by a 2003 MAPC staff shoreline survey, was incorporated into the mapping, as were the municipal separate stormwater systems (MS4's) in areas of Framingham, Natick, and Wayland contributing stormwater to the lake.

Working with the advisory committee, three priority subwatersheds were selected for more detailed analysis, including Beaver Dam Brook, Pegan Brook, and the North Pond subwatershed. MAPC conducted field surveys of conditions in these subwatersheds and identified several priority sites for mitigation and restoration.

In order to support public education efforts in the watershed, MAPC also produced a public information brochure titled "A Guide to Enjoying and Protecting Lake Cochituate," and a public information workshop will be conducted to disseminate the findings of the project and encourage implementation of the recommendations.

1.3 Findings of the Assessment of Lake Cochituate

The major findings of this project are summarized below:

- Lake Cochituate serves two major public purposes. First, the pond is a heavily used recreational resource for the adjacent towns and the entire MetroWest region. Second, the pond lies within the wellhead protection area of two of the town of Natick's water supply well fields, Evergreen and Springdale.

- Water quality in Lake Cochituate does not support its designated uses. Lake Cochituate is listed on the Massachusetts *Integrated List of Waters* that are not expected to meet their surface water quality standards under the Clean Water Act. The reasons for listing the lake include organic enrichment, low dissolved oxygen, and priority pollutants.

- Stormwater runoff from developed areas and roadways is considered to be the major and primary source of pollution in the lake and its tributaries. There are no permitted NPDES point source discharges into the lake.

- Lake Cochituate is a highly impacted resource that suffers from eutrophication, due in part to high inflows of phosphorous into the lake from stormwater runoff due to high levels of impervious cover. Beaver Dam Brook is the largest single source of nutrient loads.

- Sources of phosphorous to the pond may include animal waste and lawn fertilizers. Excess phosphorous in Fisk Pond's bottom sediments contributes to an over abundance of aquatic weeds and also elevates phosphorous levels within the pond's water column during spring and fall turnover of the lake's epilimneon, according to a 1978 study by Jason Cortell and Camp Dresser McKee.

- A combination of steep slopes, development along parts of the lake's shores, heavy recreational use, and highway crossings contribute to erosion in sections of the shoreline.

- The watershed of Lake Cochituate is one of the most heavily urbanized basins in the area west of Boston (MetroWest). The lake, along with its tributaries in the Sudbury River basin; suffer from the effects of urbanization and stormwater runoff.

- The land use in the Lake Cochituate watershed is predominantly urban, with 41 percent in residential uses and about 12 percent in commercial, industrial, transportation, and utility uses. Only 38 percent is undeveloped of that, 29 percent is forested and 3 percent in agriculture.   Such a land use pattern results in a high percentage of impervious surfaces in the watershed, which is characteristic of significant urban stormwater impacts.

- It has been noted by the USGS that withdrawals from the Natick wells cause an induced infiltration of lake water into the adjacent aquifer as a result of the wells' cones of depression in the water table.

- Lake Cochituate has recently suffered an outbreak of the invasive aquatic Eurasian Milfoil. The outbreak first occurred in South Pond in 2002, and Milfoil is now found in all three basins. To date there does not appear to be any Eurasian Milfoil in North Pond. The Department of Conservation and Recreation is taking steps to control the outbreak though placement of barriers at the outlets between each pond, and a treatment plan has been proposed and is undergoing review.

- Numerous sites were identified in the three priority subwatersheds that contribute to the water quality impacts on the lake. The most common issues identified include stormwater runoff from paved sites with little or no treatment or mitigation; discharge of sediments from highway runoff, and erosion.

- The water quality impacts of stormwater runoff may be mitigated or reduced by the implementation of "Low Impact Development" techniques, which should be applied to new development and where possible retrofitted at existing development sites. Low Impact Development techniques include Best Management Practices such as rain gardens, recharge of roof runoff, bioretention cells, pervious pavement, vegetated buffers, and other measures to reduce runoff and retain and recharge stormwater.

1.4 Recommendations for Management of Nonpoint Sources of Pollution

The plan contains a series of recommendations to the five watershed towns as well as the Mass. Highway Department. The recommendations include both structural Best

Management Practices (BMPs) as well as non-structural measures such as development regulations, maintenance practices, and public education. The recommendations are described in detail in Section 5, Watershed Action Plan for Priority Subwatersheds, and in Section 6, Assessment of Water Quality Protection Measures and Recommendations. The highest priority recommendations are summarized in the tables below.

1.4.1 Structural Best Management Practices

The table below summarizes the priority structural BMPs that should be considered by the watershed towns and state agencies in order to mitigate existing water quality problems and/or help restore the quality and health of Lake Cochituate. For all structural BMP projects, pre- and post-construction water quality monitoring should be conducted to verify the extent and nature of site specific water quality problems and the effectiveness of BMP's.

Table 1-1 Recommended Structural Best Management Practices

Town	Site/Subbasin	Priority	Recommended BMPs
Framingham	Lakeview Road North Pond	High	• Cleaning of clogged catch basins • Installation of deep sump catch basins or hydrodynamic separators to control discharge of suspended solids to North Pond (estimated cost, $50,000)
Framingham	Saxonville Beach North Pond	High	• Control eroding slopes through drainage alterations • Control of parking lot runoff near the beach through installation of hydrodynamic separators (estimated cost, $150,000)
Wayland	Town Beach North Pond	High	• Mitigate parking lot and road drainage with Low Impact Design techniques and installation of a hydrodynamic separator to control discharge of suspended solids and pollutants near the beach (estimated cost, $50,000)
Natick	Central Street Used Auto Parts, Beaver Dam Brk.	High	• Channel drainage with berms on two sides and direct flow to vegetated swale with check dams for TSS removal. Construct detention basin with overflow to stream (estimated cost, $300,000)
Framingham	A-1 Used Auto Parts, Beaver Dam Brook	High	• Intercept sheet flow with berm along stream and channel to series of catch basins set in a pitched swale. TSS removal units with overflow to stream to accompany each catch basin (estimated cost, $300,000)
Natick	Settling Basins, Beaver Dam Brook	High	• Creation of a rock forebay to slow water and allow for settling of sediments (estimated cost, $500,000) • O&M plan to address maintenance of new structure • An alternative solution would be to dredge the basins to restore their original function.

Table 1-1 Recommended Structural Best Management Practices (continued)

Town	Site/Subbasin	Priority	Recommended BMPs
Natick	Pegan Cove Park Pegan Brook	High	• Mitigate pollution loads from highly urbanized upstream area with constructed wetland system containing wetland chambers and detention ponds (estimated cost, $500,000)
Natick	Pegan Cove Park Pegan Brook, southern tributary	High (Alter-native)	• As an alternative to the constructed wetland in Pegan Brook, create pond/wetland system in the southern tributary below the railroad bed (estimated cost, $500,000)
Wayland	Route 30, North/Snake Brook Pond	Med.	• Control direct discharge of highway runoff through installation of catch basins and hydrodynamic separators (estimated cost, $250,000)
Natick	West Natick Business Center, Beaver Dam Brk.	Med.	• Three separate sites delineated. All would use combination of catch basins and/or TSS removal units to treat stormwater (estimated cost, $200,000)
Natick	Confluence of Saxonville Rail-trail & RR tracks Pegan Brook	Med.	• Restore stream channel (estimated cost, $50,000) • Create a constructed wetland system to address storm water from north of Downtown Natick (estimated cost, $100,000)l
Natick	Route 9 segment draining into Middle Pond and Carling Pondk	Med.	• Improved pre-treatment with TSS removal BMP's such as hydrodynamic separators or deep sump catch basins (estimated cost, $120,000)
Natick	Mass. Turnpike Natick Service Plaza drainage into Middle Pond	Med.	• Retrofit the drainage system with BMP's for pre-treatment, such as hydrodynamic separators (estimated cost, $140,000) • Redesign the drainage ditch to create a vegetated retention area (estimated cost, $100,000)
Natick	Channelized brook from RR to Pegan Cove Park Pegan Brook	Low	• Public education for homeowners • Storm drain inserts to capture sediments and trash (estimated cost, $5,000) • Creation of small impoundment to treat flows from a 4' culvert south of RR tracks (estimated cost, $75,000)
Natick	Catchbasin and outfall off of Lake Street Pegan Brook	Low	• Sump needs to be cleaned • Rip-rap and or a level spreader needs to be added at the system's outfall (estimated cost, $15,000)

Potential sources of funding for some of theses structural BMP project include:

- DEP Section 319 Nonpoint Source Grant Program
- DEP Sectoin 104(b)(3) Wetlands and Water Quality Grant Program
- DEP Research and Demonstration Grant Program
- EOTC, Transportation Enhancement Project funding
- Massachusetts Clean Water State Revolving Loan Fund (SRF)
- Coastal Zone Management, Coastal Pollution Remediation Grant Program
- Massachusetts Environmental Trust Grant Program

1.4.2 Non-Structural Best Management Practices

The table below summarizes the non-structural and BMPs that should be implemented in order to mitigate existing water quality problems and/or help restore the quality and health of Lake Cochituate: Some of these are related to a specific site, while others have broad applicability with respect to a particular issue, as noted in column 2 of the table.

Table 1-2 Recommended Non-Structural Best Management Practices

Town	Site/Subbasin Or Issue	Priority	Recommended BMPs
All Towns, MHD & MTA	Clogging of catch basins and sedimentation	High	• More frequent street sweeping and catch basin cleaning is recommended for the towns, the Mass. Highway Department, and Mass. Turnpike Authority. • Reduced sand and salt application
All Towns	Residential and business activities that affect water quality	High	• Potential pollution sources from residential and business activities such as lawn maintenance, septic system maintenance, car washing, and use and disposal of household chemicals should be addressed by public education measures.
All Towns	Erosion at construction sites, especially single lot ANR's (Approval Not Required)	Med	• Erosion control measures such as silt fences and hay bales should be used on all construction sites. The towns should adopt erosion and sedimentation measures that apply even when subdivision approval is not required.
Natick	Duralectric site, Pegan Brook	Low	• Further investigation of sources of sedimentation and heated water coming from the site; follow-up mitigation and/or enforcement as appropriate.
Framingham	NSTAR ROW North Pond	Low	• Inspect area used for vehicle storage and ensure that adequate erosion and runoff controls are in place

1.4.3 Findings and Recommendations for local bylaws and regulations

Ashland

Ashland has incorporated the DEP Stormwater Standards into its subdivision review, requires onsite treatment of stormwater, erosion and sedimentation controls and maximization of groundwater recharge for all site plan reviews involving 6 or more parking spaces and has included a 20-foot “no-disturb” rule in its wetland bylaw. Ashland should also look into controlling erosion and stormwater on Approval Not Required lots and extend its site plan review process to all land disturbances of 10,000 feet or more.

Framingham

Framingham requires that subdivision development follows the DEP Stormwater Standards and requires an Environmental Impact Statement for most site plan and special permit. The town should complete its drafting and adoption of bylaws governing illicit connections to its storm drain system, and post construction runoff from new development (other than subdivisions) or redeveloped areas. The town should consider adopting a town wide Stormwater Overlay District or a Stormwater Management District.

Natick

A Special Permit for projects within the Aquifer Protection District with greater than 20% impervious coverage is required and the town wetlands bylaw has a 25-foot “no disturb” zone. The highest regulatory priorities for the town should be to strengthen its subdivision and site plan review practices to include specific review and measurable standards for stormwater management and erosion control. In addition, the town should consider accelerating its Stormwater Management Plan implementation schedule and adopt bylaws addressing discharges to its municipal storm water system, land use disturbance and post construction stormwater management.

Sherborn

Sherborn’s subdivision controls are strong and emphasize limiting nutrient loading and reducing disturbed areas. Site plan review for erosion control and stormwater are required within the business, flood plain and wireless communications districts and the wetlands bylaw includes a 50-foot no-alteration zone. The town’s highest regulatory priority should be to extend its site plan review requirements for all land disturbances of greater than 10,000 square feet and to create bylaws to address illicit discharges to its storm drain system and control post construction storm water management.

Wayland

There are somewhat limited stormwater controls within Wayland’s subdivision regulations with no defined standards in place. Stormwater is reviewed under site plan review for all development (except single and two-family, cluster and Planned Unit Development) of 5,000 square feet or more, but no quantitative standards are given. Non residential lots requiring more than 15% impervious cover or greater than 2500 square feet impervious cover require a groundwater recharge system in the Aquifer Protection District. The highest regulatory priority should be to strengthen stormwater and erosion regulations, including specific standards, for all subdivision and site plan review applications outside the Aquifer Protection District.

2.0 OVERVIEW OF WATERSHED RESOURCES AND WATER QUALITY

2.1 Environmental Characteristics

2.1.1 Watershed Topography and Hydrography

Lake Cochituate drains a watershed of 17.7 square miles (11,139 acres) within the towns of Ashland, Framingham, Natick, Sherborn, and Wayland. Topographic relief in the watershed is generally moderate, with elevations ranging from 130 feet above mean sea level at the dam at the outlet from North Pond, to about 400 feet at the tops of the ridges which form the watershed divide in the headwater area in Ashland and Sherborn. Due to moderate topographic relief, the tributary streams are generally low-gradient, allowing wetlands to form next to stream channels, particularly in the Beaver Dam Brook and Course Brook basins. However, locally along the shoreline of the lake there are some areas of very steep slopes.

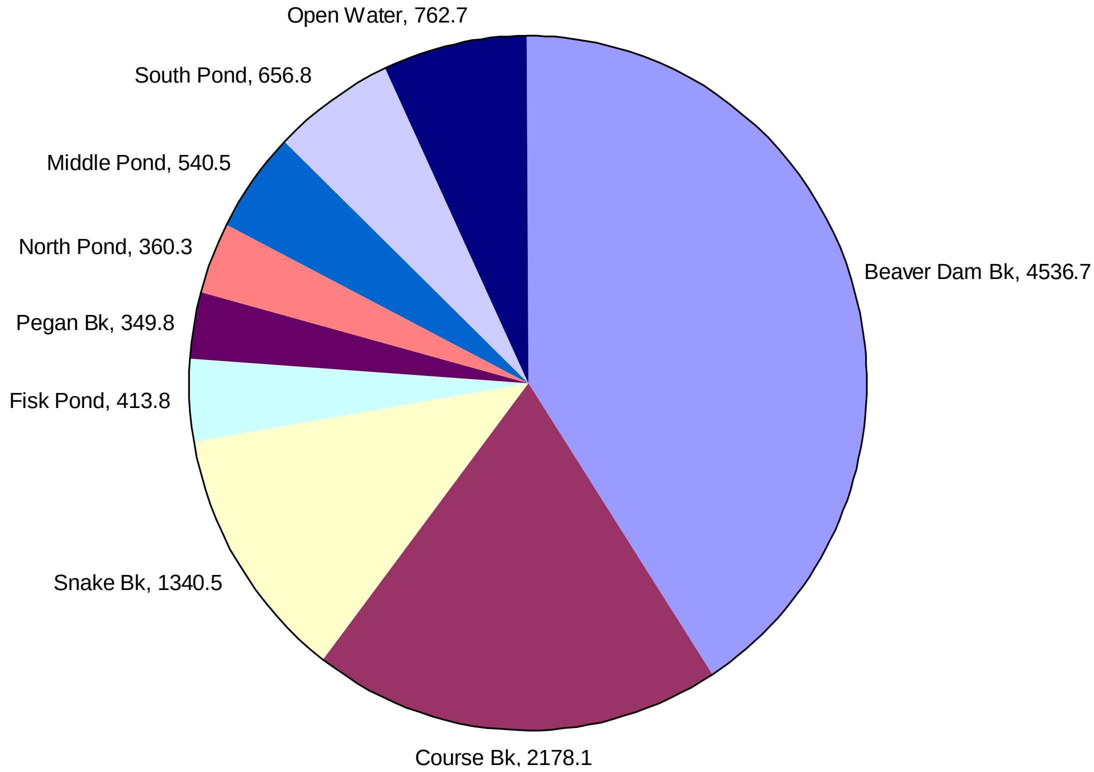
Lake Cochituate is actually a series of four ponds linked in series, all of which are fed through Fisk Pond. Flow through the system runs from south to north, from Fisk Pond, to South Pond, Middle Pond, Carling Pond, and finally to North Pond. The outlet of the system is a series of two dams on North Pond, discharging to Cochituate Brook, a tributary of the Sudbury River. The entire Lake Cochituate watershed is a subbasin of the Sudbury River watershed, which in turn is part of the "SuAsCo" watershed (Sudbury-Assabet-Concord). The SuAsCo, also known as the Concord in the state's classification, is one of 27 major watersheds in Massachusetts, and ultimately flows into the Merrimack River at the city of Lowell.

Lake Cochituate is feed by a watershed comprised of several tributaries, including Beaver Dam Brook, Course Brook, Pegan Brook, and Snake Brook, as well as several sub-areas that drain directly to each of the ponds, often through stormwater drainage systems (see Map 1). The size of each tributary subbasin and its relative percentage of the total watershed are summarized in Table 2-1 below, and displayed graphically in Map 1.

Table 2-1 Lake Cochituate Watershed Subbasins

Subbasin Name	Area (acres)	Percent of Total Watershed	Towns
Beaver Dam Brook	4,536	40.7%	Ashland, Framingham, Natick
Course Brook	2,178	19.6%	Sherborn, Framingham, Natick
Snake Brook	1,340	12.0%	Wayland, Natick
South Pond	656	5.9%	Natick
Middle Pond	540	4.9%	Natick
Fisk Pond	413	3.7%	Natick
North Pond	360	3.2%	Framingham, Natick
Pegan Brook	349	3.1%	Natick
Open Water	762	6.8%	Framingham, Natick, Wayland
Watershed Total	**11,139**	**100%**	

Figure 2-1 Lake Cochituate Subwatershed Areas (Acres)



2.1.2 Geologic Setting

Lake Cochituate is underlain by a bedrock valley that trends from north to south, parallel to the axis of the lake itself. The bedrock material is primarily granodiorite, but gabro and diabase found beneath the eastern shore of South Pond, where these rocks outcrop near the shoreline. Depth to bedrock ranges from zero to 200 feet below the surface. The bedrock is overlain by unconsolidated glacial deposits, including till and stratified drift. Till is composed of poorly sorted mixtures of sediments ranging in particle size from clay to boulders. Till deposits are concentrated on the eastern side of the watershed, and well-sorted stratified drift deposits cover the remainder of the watershed. Stratified drift consists of well-sorted layered sediments ranging in size from clay to gravel. The stratified drift deposits are of ice-contact, deltaic, and lacustrine origin, and were deposited in or adjacent to fine sand and silty clay, with isolated layers of sand and gravel (Gay, 1981). The thickness of unconsolidated deposits ranges up to 200 feet.

The lake's four ponds were formed during the retreat of the last glacier. As the glacier melted, large blocks of ice remained in the deep bedrock valley underlying the lake. Sediments carried by meltwater were deposited around and over the ice blocks as the glacier melted. When the ice blocks finally melted, they left depressions which formed the lake, and the sediments that had been deposited on top of the ice blocks formed the bottom sediments of the lake. A thin elongated swamp area, consisting of peat and organic-rich sediment, extends along the northwestern shore of the east part of South Pond.

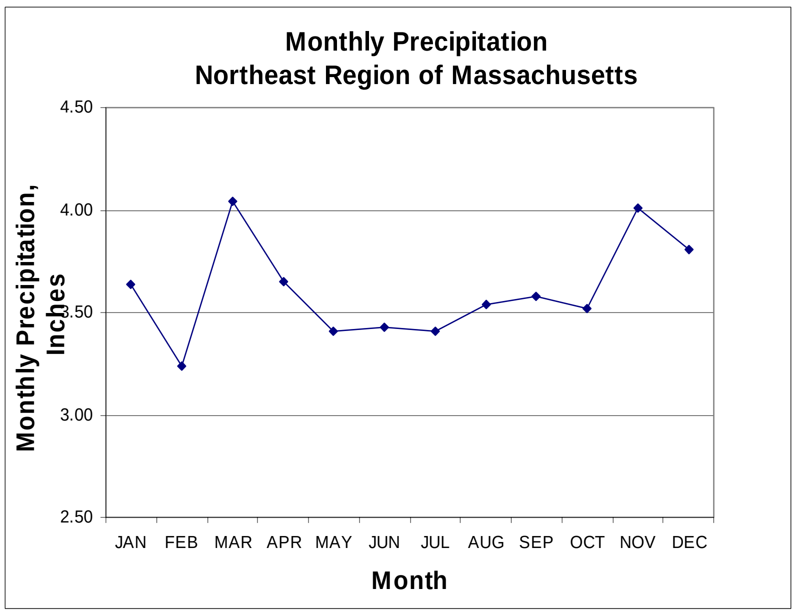
2.1.3 Precipitation

Average annual precipitation in the northeast region of Massachusetts is 43.28 inches (see Table 2-2). Precipitation is distributed fairly evenly over most of the year, at about 3.5 inches per month for most months, with an increase to 4 inches in the months of March and November. This precipitation pattern suggests that stormwater would be generated relatively evenly over the year, however because of freezing conditions in the winter months, there is normally reduced runoff in the winter as most precipitation is stored in the form of ice and snow. This typically leads to annual peak stormwater runoff rates in the early spring, when melting ice and snow combines with spring rainfall.

Table 2- 2 Average Monthly Precipitation in the Northeast Region of Massachusetts

Month	Northeast
JAN	3.64
FEB	3.24
MAR	4.04
APR	3.65
MAY	3.41
JUN	3.43
JUL	3.41
AUG	3.54
SEP	3.58
OCT	3.52
NOV	4.01
DEC	3.81
ANNUAL	**43.28**

Figure 2-2 Average Monthly Precipitation in the Northeast Region of Massachusetts



Source: MA Dept. of Conservation & Recreation, http://www.mass.gov/dem/programs/rainfall/norms.xls

2.1.4 Groundwater Resources

Groundwater flow is governed by the permeability and porosity of subsurface geologic materials, which is determined by the size and degree of interconnection of pore spaces within the materials. Flow of groundwater occurs in the pores of unconsolidated materials and in the joints and fractures in the bedrock. In the Lake Cochituate watershed, the principal direction of groundwater flow is from the tops and sides of the stream valleys to discharge areas in low-lying areas, including wetlands, stream channels, and the lake itself. The water table near the lake's shoreline is above lake level in most areas, and below lake level in others, particularly in the northern portion of North Pond, and in the wellhead areas of Natick's water supply wells in Middle Pond. In such areas, rather than seeping into the lake, the movement of groundwater is from the lake into the adjacent unconsolidated deposits. In the case of North Pond, groundwater flows away from the pond as a result of natural hydraulic gradients, which direct groundwater flow toward downgradient surface water bodies, Cochituate Brook and the Sudbury River. In the case of Middle Pond, large capacity pumping wells adjacent to the lake create a localized cone of depression in the water table, directing groundwater flow from the lake towards the wells. A recent Water Resources Investigation by the US Geologic Survey (Friesz and Church, 2001), estimated that nearly two-thirds of the water withdrawn at Natick's Springdale wells was derived from Lake Cochituate, and the rate of infiltration of lake water into the aquifer and discharging to the well-field was estimated at 1.0 million gallons per day at the average pumping rate.

2.1.5 History of Lake Cochituate Development

"Cochituate" is a Native American term that means "swift river" in the Algonquin language. Lake Cochituate was called Long Pond before 1846, when the city of Boston acquired the water supply rights, built a dam at the outlet of North Pond to Cochituate Brook to raise the water level 9 feet, and renamed the enlarged water body Cochituate Reservoir. In 1859, the main dam was raised an additional 4 feet. From 1848 until 1931, Cochituate Reservoir was a source of water supply for Boston, and from 1931 to 1947 it was used only as a standby water source due to deteriorating water quality. It was finally removed from water supply use in 1947 after the Quabbin Reservoir came on line. At that time it was designated a recreational lake under the ownership of the Massachusetts Department of Natural Resources, which in the 1970's became the Department of Environmental Management, and then in 2003 became the Department of Conservation and Recreation. Lake Cochituate and a portion of its shoreline lands are part of Cochituate State Park.

2.1.6 Wetlands and River Buffers

According to resource mapping available from the Massachusetts Geographic Information System (Mass GIS), there are a total of 360 acres of wetland in the Lake Cochituate watershed, accounting for about 3 percent of the land area. These are distributed most heavily in the Beaver Dam Brook and Course Brook subwatersheds (see Table 2-3 and Map 2, Watershed Resources)

Riverine buffer zones as defined by the Mass. River Protection Act are present in five subwatersheds, Beaver Dam Brook, Course Brook, Fisk Pond, Pegan Brook, and Snake Brook. These total 487 acres across the watershed, more than 4 percent of the total land area. (Some of the stream buffers within the priority sites in the subwatersheds of Beaver Dam Brook and Pegan Brook were surveyed by MAPC staff. See Chapter 5).

Table 2-3 Summary of Resource Areas in Lake Cochituate Watershed

Resource Type	Acres	Percent of Watershed
River Protection Zones	487	4.4
Wetlands	360	3.2
Agricultural Land	346	3.1
Protected Open Space	2831	25.4

2.1.7 Open Space and Recreational Resources

The combination of federal, state, municipal, and privately owned protected open space lands totals 2831 acres, representing 25 percent of the watershed land area. Chief among these is Cochituate State Park, which serves over 200,000 visitors per year. Lake Cochituate is one of the largest publicly accessible water bodies in the entire MetroWest area between Boston and Worcester. A 1998 DEM survey indicates that the park is a resource of regional significance, as 73 percent of the visitors came from greater Boston, and only 21 percent were local. The same survey indicated that 94 percent of the visitors used the park for swimming, underscoring the importance of water quality that supports water-based recreation. The state park has a public swimming beach at the Day Use Area on Middle Pond. This area also has picnic tables and playing fields, and has the capacity to accommodate up to 2000 visitors.

Two other swimming areas are located on town beaches on North Pond. Both the Wayland town beach and the Framingham (Saxonville) town beach are operated by the respective towns under leases with the Commonwealth of Massachusetts (25 year leases that expired in 2000 are in the process of being renewed). The Wayland Town Beach is a 2.4 acre site, and the Framingham Town Beach area is about 0.75 acre. Both beaches have parking areas on adjacent town-owned land (see Chapter 5, Watershed Action Plan, for more information on stormwater issues associated with the town beach parking areas).

Boating and fishing are also major water-based recreation activities on the lake. The state park Day Use Area has a large boat launching ramp, and there is a canoe and kayak rental concession there. There is also a non-motorized boat launch on North Pond. In addition, numerous private homes on the shoreline have private docks and moorings for both motor boats and non-motorized boats.

Several other shoreline parks provide recreation opportunities, including:

- Pegan Cove Park in Natick
- J. J. Lane Park on South pond in Natick
- AMVETS park on Middle Pond in Natick
- Camp Arrowhead – Amputee Veterans Association on Middle Pond in Natick

The total amount of protected open space in the Lake Cochituate watershed, 2831 acres, includes lands owned by the state and federal governments, the towns, and private organizations. These are summarized in Table 2- 4 and shown on Map 2.

Table 2- 4 Open Space in Lake Cochituate Watershed

Ownership Type	Acres	Percent of Total
Municipal	948.4	33.5%
State	1,256.6	44.4%
Federal	124.2	4.4%
Private, Non-Profit	178.9	6.3%
Private, for Profit	323.2	11.4%
Grand Total	**2,831.3**	**100%**

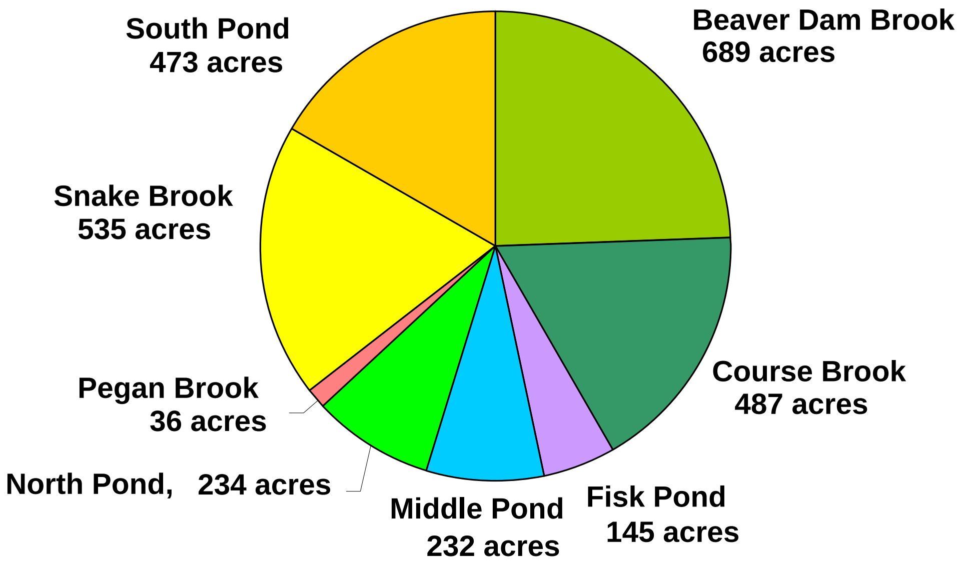
Open space lands are not evenly distributed across the eight subwatersheds, but rather tend to be concentrated in greatest amounts in the headwater portions of the Beaver Dam Brook, which has a quarter of the total, as well as the Snake Brook, South Pond, and Course Brook subwatersheds, each of which has from 17 to 19 percent of the total open space in the Lake Cochituate watershed.. The distribution of open space by subwatersheds is shown in Table 2-5 and in Figure 2-3.

Table 2- 5 Open Space Lands by Subwatershed

Subwatershed	Owner Type	Acres	Percent of Total (Per Subbasin)
Beaver Dam Brook	Municipal	283	41%
Beaver Dam Brook	State	115	17%
Beaver Dam Brook	Private, Non-Profit	95	14%
Beaver Dam Brook	Private, for Profit	196	28%
Beaver Dam Brook Total		**689**	**24%**
Course Brook	Municipal	265	55%
Course Brook	State	214	44%
Course Brook	Private, for Profit	7	1%
Course Brook Total		**487**	**17%**
Fisk Pond	Municipal	36	25%
Fisk Pond	State	108	75%
Fisk Pond Total		**145**	**5%**
Middle Pond	Municipal	25	11%
Middle Pond	State	206	89%
Middle Pond Total		**232**	**8%**
North Pond	Municipal	30	13%
North Pond	State	204	87%
North Pond Total		**234**	**8%**
Pegan Brook	Municipal	12	34%
Pegan Brook	State	24	66%
Pegan Brook Total		**36**	**1%**
Snake Brook	Municipal	241	45%
Snake Brook	State	91	17%
Snake Brook	Private, Non-Profit	84	16%
Snake Brook	Private, for Profit	120	22%
Snake Brook Total		**535**	**19%**
South Pond	Municipal	55	12%
South Pond	State	294	62%
South Pond	Federal	124	26%
South Pond Total		**473**	**17%**
Grand Total		**2831**	**100%**

A recreational resource of regional significance is the proposed Cochituate Rail Trail, which will be located on an abandoned rail line, the Saxonville spur, beginning in Natick center and extending northward to Saxonville. The trail will provide a dedicated right-of-way for bicyclists and pedestrians, and will increase non-motorized access to Cochituate State Park. The towns of Framingham and Natick and the Framingham and Natick Bicycle Advisory Committees are working to develop the trail.

Figure 2- 3 Open Space Lands by Subwatershed (Acres)



2.2 Water Quality

2.2.1 Review of Previous Water Quality Studies

2.2.1.1 <u>Lake Cochituate Data & Summary Report</u>, MA DEQE, June 1982

This study summarizes water quality sampling conducted from 1976 to 1980 and evaluates techniques for reducing nutrient inputs to Lake Cochituate.

- <u>Major Findings:</u>

Pollution sources to the Lake come from three primary sources:

1. Stormwater runoff
2. Leachate from septic systems
3. Sediments within the lake and its tributaries

- <u>Water Quality Sampling</u>

Water quality sampling was conducted from 1976 to 1980 for the following parameters:

1. <u>Physical</u>: Temperature, Color, Secchi Disk Transparency
2. <u>Chemical</u>: Dissolved Oxygen, Specific Conductivity, pH, Alkalinity, Hardness, Chloride, Iron, Manganese, Total Solids, Suspended Solids, Total Phosphorus, Total Kjeldahl Nitrogen, Ammonia Nitrogen, Nitrate Nitrogen
3. <u>Biological</u>: Total & Fecal Coliform Bacteria, Chlorophyll a, Phytoplankton, Aquatic Macrophytes

- Summary of Results for Phosphorus

Lake Cochituate is very rich in phosphorus compounds. The hypolimnetic waters of the four basins all appear to have increasing total phosphorus levels during periods of anoxia. This phosphorus is released to the hypolimnion from the underlying sediments under anoxic conditions. This phosphorus is then released to the entire lake when fall turnover occurs. The overall concentrations of total phosphorus are quite high and indicate that Lake Cochituate is eutrophic. The EPA has set water quality criteria for lakes at 0.025 milligrams per liter (mg/l) total phosphorus for open waters and 0.05 mg/l for tributaries entering a lake. Hutchinson also states that most uncontaminated lakes have surface waters which contain 0.010 to 0.030 mg/l of total phosphorus. The average epilimnetic total phosphorus values in Lake Cochituate usually equaled or exceeded these recommended levels. There can be little doubt that the excesses of this nutrient are a contributing factor to the algal blooms which intermittently infest the lake.

Table 2-6 Phosphorus Loading to Lake Cochituate, 1977 – 1979

Subwatershed	Phosphorus Load (kg) 11/77 – 10/78	Phosphorus Load (kg) 11/78 – 5/78	Total Phosphorus Load (kg) 11/77 – 5/79	Percent of Total Phosphorus Load
Beaver Dam Brook	500	744	1244	60%
Course Brook	167	200	367	18%
Fisk Pond Outlet*	714*	763*	1477*	71%
Pegan Brook	46	60	106	5%
Snake Brook	82	121	203	10%
Ungaged Drainage	108	174	282	14%
TOTAL INPUT	**949**	**1,119**	**2,068**	

* Loads from Fisk Pond Outlet include combined loads of Beaver Dam Brook and Course Brook

- Summary of Results for Nitrogen

The data indicate that the waters of Lake Cochituate are well supplied with the various forms of nitrogen based nutrients. Wetzel (1975) has described lakes which have nitrogen concentrations in a range similar to that found in Lake Cochituate to be mesotrophic-eutrophic. There also appears to be large amounts of ammonia within the hypolimnetic waters of all basins during periods of anoxia. In North Basin concentrations of ammonia reach levels where it may be toxic to wildlife in the lake. The excesses of the various nitrogen species are also contributing factors to the algal blooms which intermittently infest the lake.

- Summary of Results for Total and Fecal Coliform Bacteria

Coliform counts at Lake Cochituate were typically low during the four-year study period. Only in December 1978 in South Basin did the fecal coliform counts ever equal the Class B water quality standard (log mean of 200 bacteria per 100 ml). However, in this case contamination was not considered significant as the coliform levels returned to normal levels by the following sampling date.

- Nutrient Loading

Beaver Dam Brook and Course Brook are, by far, the major sources of phosphorus and nitrogen loading to the lake. Beaver Dam Brook contributes 47% of the Total Nitrogen load to Lake Cochituate and 52% of the Total Phosphorus load. Course Brook contributes 17% of the Total Nitrogen load and 17% of the Total Phosphorus load.

The types of land uses which contribute the most nutrients to Beaver Dam Brook and Snake Brook are delineated. Residential land use was the highest contributor of phosphorus to both of these brooks.

2.2.1.2 Estimated Water and Nutrient Inflows and Outflows, Lake Cochituate, 1977-79, U.S. Geological Survey in cooperation with MA DEQE, DWPC

This study models inputs to Lake Cochituate of phosphorus and nitrogen from streamflow, groundwater inflow, and precipitation, broken down by tributary subbasins.

- Findings:

There is a significant difference in the nutrient input from the various subwatersheds of Lake Cochituate, with the greatest amount, 1700 pounds, coming from Beaver Dam Brook. This is 56 percent of the total phosphorus load to Lake Cochituate, while the subbasin represents 40 percent of its contributing watershed (see Table 2 - 7).

Table 2 – 7 Total Nitrogen and Total Phosphorus Loads (lbs), 1978–1979

Subwatershed	Total Nitrogen	Total Phosphorus
Beaver Dam Brook	28,000	1,700
Course Brook	12,000	480
Ungaged drainage into Fisk Pond	3,000	140
Fisk Pond Outlet	38,000	2,000
Pegan Brook	4,300	180
Snake Brook	10,000	300
Ungaged drainage into Lake Cochituate	11,000	490
TOTAL LOADS	63,000	3,000

A chart of the estimated nitrogen and phosphorus loads to Lake Cochituate during the sampling period of April 1978 to March 1979 is found in the Appendix.

- Nutrient Concentrations in Storm Sewers

The study measured concentrations of selected nutrients from samples collected at storm sewers during three storm events (December 8 and 9, 1978, January 24-26, 1979, and April 26 and 27, 1979). Average total nitrogen at 17 storm outfalls was 0.63 mg/l. Average total phosphorus concentrations were 0.147 mgl. Concentrations of nitrogen and phosphorus in stormwater discharges varied considerably at each site as well as between sites.

2.2.1.3 Nutrient Budgets for Fisk Pond and South Pond and the Impact of Nutrient Controls on the Waterbodies, Jason Cortell Associates, 1978

This study presents a nutrient budget for Fisk Pond and South Pond of Lake Cochituate.

- Major findings:

Fisk Pond, had the highest phosphorus concentration, 0.63 mgl, which is more than ten times greater than concentrations in Beaver Dam Brook and Course Brook, and 20 times greater than Pegan Brook (see Table 2 - 8).

Table 2 - 8 Summary of Average Nutrient Concentrations (mg/l)

Subbasin	Inorganic Nitrogen	Total Phosphorus
Beaver Dam Brook	0.79	0.06
Course Brook	0.44	0.05
Fisk Pond	0.28	0.63
Pegan Brook	1.69	0.03

2.2.1.4 Snake Brook Dredging and Watershed Evaluation, ENSR, February 1998

This study presents an evaluation of the feasibility for dredging the Snake Brook outlet area of Lake Cochituate, and an assessment of nutrient and pollutant loading into Snake Brook with recommendations for remediation.

- Snake Brook Nutrient Loading

Four rounds of water quality sampling were done in 1997 in each of five subbasins of Snake Brook. Sampling for phosphorus (dissolved and total) and nitrogen (nitrate and ammonia) was conducted. A spreadsheet model using export coefficients for nitrogen and phosphorus estimated total loads to Lake Cochituate from Snake Brook to be 325 kg per year of phosphorus and 7,310 kg per year of nitrogen.

- Nutrient Management/Control

Phosphorus reduction is a priority. The average phosphorus concentration in Snake Brook is 0.09 mg/l. Under most conditions, this concentration of phosphorus to a receiving water would be detrimental and would certainly result in poor water clarity and a reduced recreational resource. The overall reduction of average phosphorus levels to 0.05 mg/l would be considered beneficial, but a reduction to levels approaching 0.03 mg/l would probably represent the best conditions reasonably attainable in this watershed. In terms of phosphorus loading on a per acre basis, a loading rate of 0.1 kg per acre per year is considered desirable. A loading rate of 0.2 kg/ac/yr is slightly high, and a loading rate of 0.3 kg/ac/yr is excessive. The five subbasins of Snake Brook are estimated to export phosphorus at the following rates: subbasin 1 exports 0.37 kg/ac/yr; subbasin 2 exports 0.25 kg/ac/yr, and Basin 3 exports 0.30 kg/ac/yr. Both subbasins 4 and 5 are below 0.2 kg/ac/yr (see delineation of the five subbasins in Appendix 14).

The major concern, and area for greatest potential improvement, lies in the phosphorus load reduction associated with stormwater management. Base flow conditions have phosphorus concentrations ranging from 0.01 to 0.05 mg/l, while storm flow conditions exhibited concentrations greater than 0.4 mg/l in Snake Brook.

2.2.1.5 Survey Report: Lake Cochituate, DEM, Office of Water Resources, 1995

This study included sampling at seven locations for total phosphorus, ammonia nitrogen, total alkalinity, dissolved oxygen, pH, specific conductivity, and chlorophyll-A. The sampling was conducted by DEM staff on August 16 and 17, 1994. The sample results are summarized below in Table 2 – 9.

Table 2 – 9 Water Quality Sampling Results, August 16 & 17, 1994

Sampling Station	Total Phosphorus	Ammonia Nitrogen
1 South Pond – deep hole	0.032	<0.05
	0.033	<0.05
	0.045	0.05
2 Fisk Pond Outlet	0.037	<0.05
3 Pegan Brook	0.040	<0.05
4 Middle Pond – deep hole	0.035	<0.05
	0.046	<0.05
	0.140	0.33
5. Snake Brook	0.058	<0.05
6 North Pond – deep hole	0.040	<0.05
	0.042	0.13
	0.771	1.67
7 North Outlet	0.027	<0.05

2.2.2 Water bodies on the Mass. Integrated List of Waters (2002)

As required by the federal Clean Water Act, the Massachusetts Department of Environmental Protection publishes an *"Integrated List of Waters"* every two years. This includes a section called "Waters requiring a TMDL," which identifies waterbodies that are not expected to meet surface water quality standards after the implementation of technology based controls, and require the preparation of a Total Maximum Daily Load (TMDL).

The currently published *Integrated List of Waters*, for 2002, includes several waterbodies in the Lake Cochituate watershed on the section 5 list, as shown in Table 2-10.

Table 2-10 Waters Requiring a TMDL on the *MA Integrated List of Waters* (2002)

Description	Town	Size (Acres)	Pollutant Needing TMDL
North Basin	Framingham/Natick	195	Organic Enrichment/Low DO Priority organics
Middle Basin	Natick/Wayland	131	Organic Enrichment/Low DO Priority organics
Carling Basin	Natick	13	Priority organics
South Basin	Natick	233	Organic Enrichment/Low DO Priority organics

It is notable that organic enrichment, low dissolved oxygen, and priority organics are listed as the pollutants of concern. These are typical pollutants associated with nonpoint source pollution, particularly urban stormwater runoff.

2.2.3 Summary of Priority Water Quality Issues

The preponderance of water quality studies over the last 25 years all point to nutrient enrichment, specifically phosphorus, as the primary pollutant of concern in Lake Cochituate. While nitrogen plays a role, phosphorus is the “limiting nutrient” in most freshwater systems like Lake Cochituate. This is the primary “fuel” for episodic algae blooms, and the long term gradual eutrophication of the lake. These impacts degrade the habitat value as well as the recreational value of Lake Cochituate.

All of the previous water quality assessments point to the Beaver Dam Brook subwatershed as the single largest source of phosphorus loading to Lake Cochituate. This is the subwatershed with the largest drainage area, but more significantly, it is the subwatershed with the greatest amount of commercial, industrial, and residential development (see Chapter 3, Land Use and Development Trends). Most of this development occurred in the decades prior to the 1970’s at which time there were little or no land use control measures to mitigate the impacts of development on stormwater (such as detention or retention basins, vegetated buffers, bioretention, etc.) The cumulative impact of these historic development practices is now being felt in Lake Cochituate and several of its tributaries, as the water quality data bear out.

This plan is intended to identify some of the most significant sites and activities in the watershed that have an impact on Lake Cochituate, and make recommendations for both structural and non-structural Best Management Practices to mitigate those impacts and help restore the quality of the lake. These analyses and recommendations are presented in the following chapters.

3.0 LAND USE AND DEVELOPMENT TRENDS

3.1 Population and Development Trends

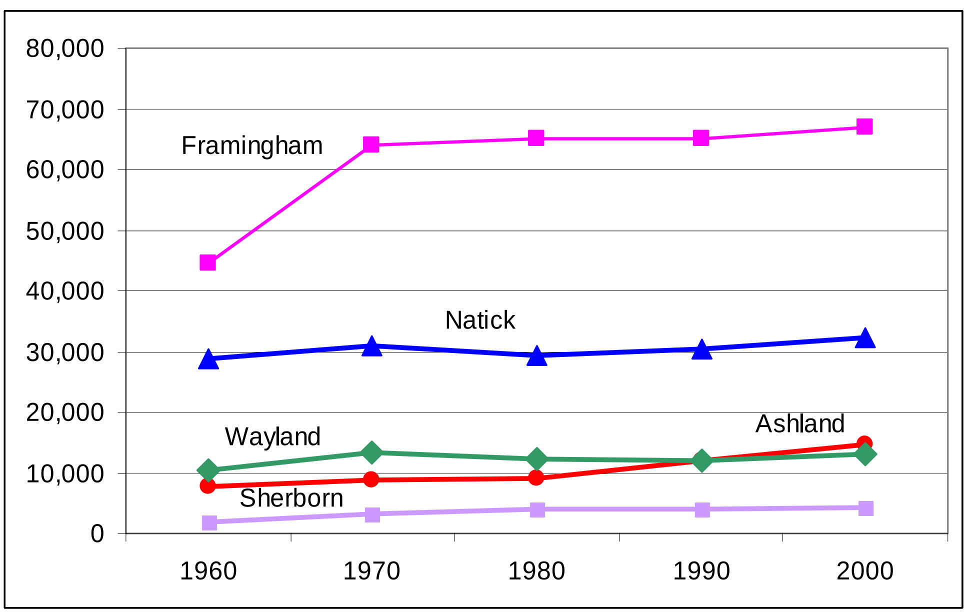
Due to its location in the growing Boston metropolitan area, the watershed of Lake Cochituate has experienced significant development over the last century or more. Some of the earliest development in the watershed, dating back to the 19th century, includes the town center areas of both Natick and Framingham, both of which have access to the MBTA Commuter Rail. When the era of automobile commuting began in earnest after World War II, new lower density development spread to the corridors of several major state highways that bisect the watershed, including the Massachusetts Turnpike, Route 9, Route 30, and Route 135. Some of the first suburban retail malls in Massachusetts were developed on Route 9 in the 1960's (Shoppers World in Framingham and the original Natick Mall), and access to highways continued to facilitate more intensive commercial and residential development over the last several decades. As a result, the population of the five watershed communities increased significantly, especially in the decades between 1950 and 1970 (see Table 3-1 and Figure 3-1).

Table 3-1 Population Trends, 1960-2000

	1960	1970	1980	1990	2000
Ashland	7,779	8,882	9,165	12,066	14,674
Framingham	44,526	64,048	65,113	64,989	66,910
Natick	28,831	31,057	29,461	30,510	32,170
Sherborn	1,806	3,309	4,049	3,989	4,200
Wayland	10,444	13,461	12,170	11,874	13,100
TOTAL	93,386	120,757	119,958	123,428	131,054

Source: U.S. Census Bureau

Figure 3-1 Population Trends, 1960-2000



Source: U.S. Census Bureau

In the 40 year period from 1960 to 2000, the total population of the five watershed towns increased from 93,396 to 131,054. This increase of 37,668 people represented a percentage increase of over 40 percent in 40 years. Just the increase over this period four decade period represents nearly the total combined 1960 population Ashland, Natick, and Sherborn. Within the Lake Cochituate Watershed, much of the Beaver Dam Brook and Snake Brook Watersheds experienced significant growth during this period.

MAPC regularly conducts and updates population projections for communities in the greater Boston area. Population projections to the year 2025 for the five watershed communities are summarized in Table 3-2. According to the projections, the rate of growth over the next several decades is expected to continue high for Ashland and moderate for Wayland, while Framingham, Natick, and Sherborn are all projected to reverse earlier trends and lose small amounts of population from 2000 to 2025.

Table 3-2 Population Projections, 2005-2025

Town	2010	2015	2020	2025
Ashland	16,289	17,174	17,751	17,959
Framingham	64,308	65,048	65,102	65,372
Natick	30,455	30,161	29,345	29,562
Sherborn	4,314	4,220	3,912	4,007
Wayland	14,353	14,807	14,578	14,850
TOTAL	**129,719**	**131,411**	**130,687**	**131,751**

Source: Metropolitan Data Center, MAPC

Table 3-3 summarizes and compares the historical population trends (1960-2000) and the future projections (2000-2025) in percentage terms. This comparison underscores the sharp difference between the past period of high growth versus the much lower projected growth in the future. Over the next 25 years, the five towns as a whole are only projected to increase by about 700 people, or only a one percent rate of growth. From the perspective of watershed impacts, this suggests that most of the watershed's development is already in place today, and that the biggest challenge for water quality will be better management and eventual retrofitting of existing development with BMP's.

Table 3-3 Percent Population Change, 1960-2000 and 2000-2025

Town	Historic Population Change, 1960-2000	Percent Change, Historic Population 1960 - 2000	Projected Population Change, 2000-2025	Percent Change, Projected Population 2000 - 2025
Ashland	6,895	89%	3,285	22%
Framingham	22,384	50%	-1,538	-2%
Natick	3,339	12%	-2,608	-8%
Sherborn	2,394	133%	-193	-5%
Wayland	2,656	25%	1,750	13%
TOTAL	**37,668**	**40%**	**697**	**1%**

Sources: U.S. Census Bureau and Metropolitan Data Center, MAPC

3.2 Existing land use

3.2.1 Lake Cochituate Watershed Land Use

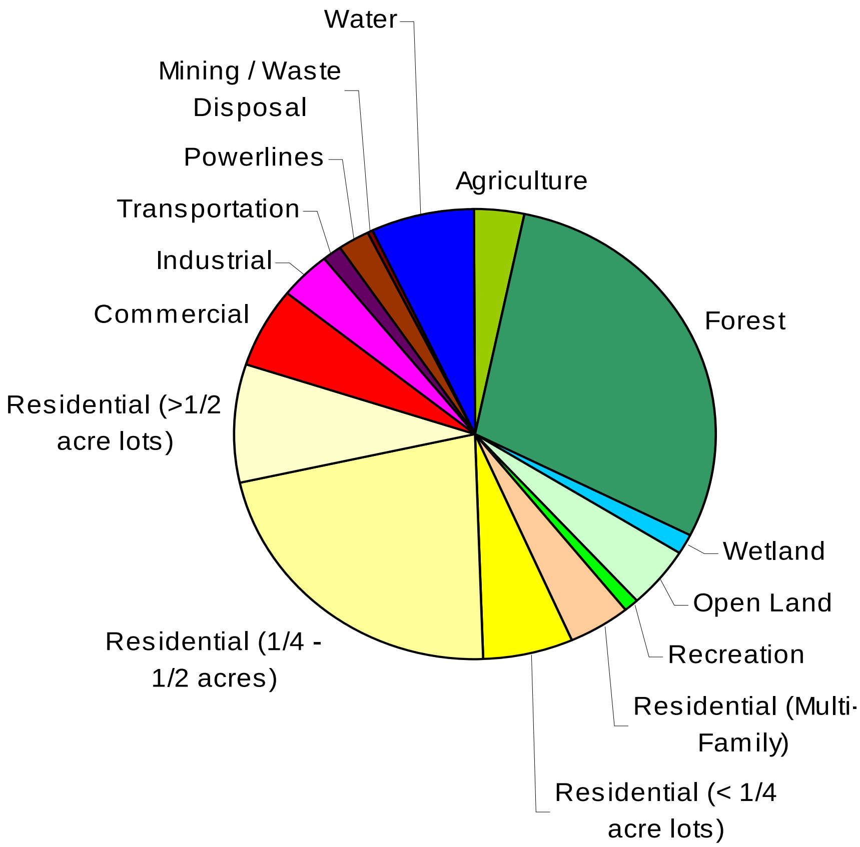
Much of the Lake Cochituate watershed is moderately to heavily urbanized, which has significant implications for nonpoint source pollution impacts on the lake. As the above population trends would expect, as the watershed communities grew over the last several decades, much land that was previously undeveloped was converted to medium to high density residential, commercial, and industrial uses as well as associated infrastructure, of particular importance roadways and parking lots. All of this development has significantly increased the impervious surfaces in the watershed, which in turn disrupts the hydrologic cycle, both in terms of water quantity and water quality. This section summarizes the existing land use in the Lake Cochituate watershed as a whole, as well as each of the eight major subwatersheds that are tributary to the lake.

Land use data for the year 1999 is available from William McConnell at the University of Massachusetts. These data are based on interpretation of aerial photographs, and all land use is categorized according to a standard classification scheme across the state. The 1999 McConnell land use data for the Lake Cochituate watershed is shown on Map 2 and summarized in Table 3-4 and Figure 3-2. About 55 percent of the watershed is developed, and only 38 percent is undeveloped (the remaining 7 percent is the open water of Lake Cochituate and several other smaller ponds). Of the 55 percent developed land, residential land predominates, at 41 percent, although this is further divided into four categories of density (or lot size). The next largest category is commercial, at 6 percent, and industrial, at 3 percent. The combination of commercial, industrial, transportation, mining, and utilities amount to 13 percent of the watershed.

Table 3-4 Summary of 1999 Land Use in Lake Cochituate Watershed

LAND USE CATEGORY	ACRES	PERCENT
Agriculture	370.7	3%
Forest	3,265.5	29%
Wetland	141.8	1%
Open Land	500.4	4%
Subtotal Undeveloped Land	**4,278.4**	**38%**
Recreation	78.7	1%
Residential (Multi-Family)	482.0	4%
Residential (< 1/4 acre lots)	690.7	6%
Residential (1/4 - 1/2 acres)	2,423.4	22%
Residential (>1/2 acre lots)	965.2	9%
Commercial	648.3	6%
Industrial	382.1	3%
Transportation	155.8	1%
Power Lines	234.7	2%
Mining / Waste Disposal	58.4	1%
Subtotal Developed Land	**6,119.3**	**55%**
Water	**762.7**	**7%**
SUBBASIN TOTAL	**11,160.4**	**100%**

Figure 3-2 Summary of 1999 Land Use in Lake Cochituate Watershed



3.2.2 Subwatershed Land Use

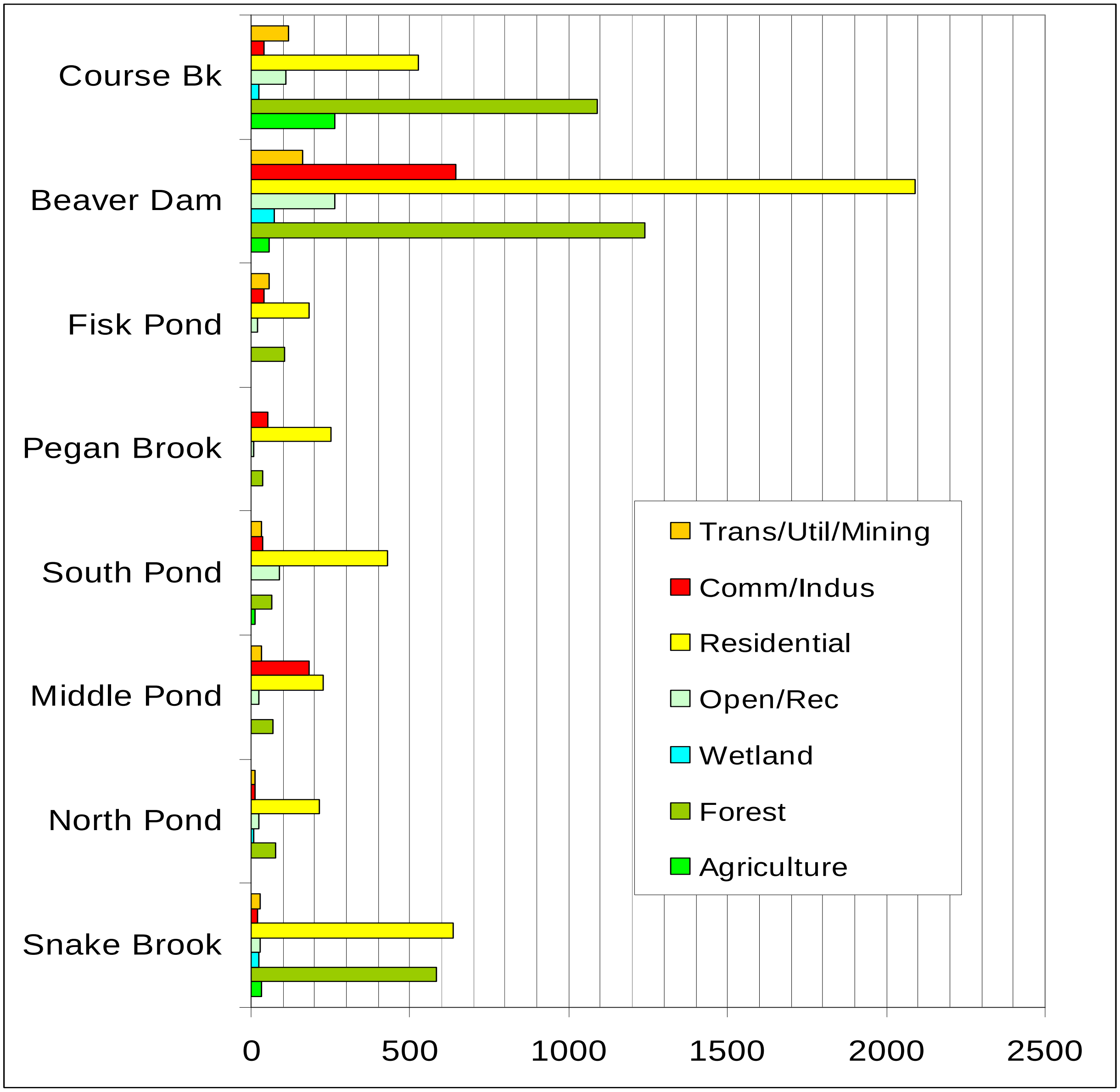
The land use pattern of the Lake Cochituate watershed varies considerably over the several subwatershed areas that contribute flow to the lake. For the purposes of this project, the watershed has been divided into eight subwatersheds (see Map 1) representing the four major streams that flow to the lake (Beaver Dam Brook, Course Brook, Pegan Brook, and Snake Brook), as well as several areas that drain directly to the separate ponds (North Pond, Middle/Carling Pond, South Pond, and Fisk Pond).

The land use data have been divided into these eight subwatersheds in Table 3-5 and Figure 3-5. This shows that the greatest amount of development by far is in the Beaver Dam Brook watershed, which contains over 2090 acres of residential land, covering 45 percent of the subwatershed land area, and representing nearly half of all the residential development throughout the Lake Cochituate watershed. Likewise with commercial and industrial land use, the Beaver Dam Brook subwatershed leads with 645 acres, covering 15 percent of the subwatershed's land area, and representing over 62 percent of the total industrial and commercial land in the Lake Cochituate watershed. Following Beaver Dam Brook, the next most developed subwatersheds are Snake Brook, with over 600 acres of residential land use, and Course Brook with over 500 acres. The balance of the commercial and industrial development is found in Middle Pond (183 acres), Pegan Brook (53 acres), Fisk Pond (41 acres), and Course Brook (40 acres).

Table 3-5 Land Use by Subwatershed in Acres (1999)

LAND USE CATEGORIES	Snake Bk	North Pond	Middle Pond	South Pond	Pegan Bk	Fisk Pond	Beaver Dam	Course Bk	TOTAL
Agriculture	31.6		3.1	10.6	4.2	0.5	57.7	263.2	**370.8**
Forest	581.9	78.9	69.6	64.9	35.0	105.3	1,238.6	1,091.5	**3,265.5**
Wetland	26.0	7.1		4.0		5.8	72.7	26.2	**141.8**
Open/Urban Open	20.4	19.1	14.7	85.1	7.0	20.2	211.0	109.7	**500.4**
Recreation	9.2	3.8	8.1	5.3		1.4	50.9		**78.7**
Residential (Multi-Family)	73.2			12.1		29.8	366.88		**482.0**
Residential (< 1/4 acre lots)			26.3	26.2	123.3	31.5	483.44		**690.7**
Residential (1/4 - 1/2 acres)	191.2	210.3	182.1	368.5	124.0	111.2	1,077.7	158.4	**2,423.4**
Residential (>1/2 acre lots)	371.3	2.6	19.2	24.6	3.3	11.3	162.72	370.2	**965.2**
Commercial	19.2	13.7	183.4	13.3	52.6	35.3	303.2	27.6	**648.3**
Industrial				21.1	0.3	6.3	342.3	12.1	**382.1**
Transportation	12.0	8.6	31.7	31.7		7.7	64.1		**155.8**
Power lines	15.2	2.9				20.5	82.3	113.80	**234.7**
Mining, Waste Disposal				-		27.0	15.9	3.7	**46.6**
Water	13.7	197.5	147.7	236.8		69.0	93.9	4.01	**762.7**
TOTAL	1,354.20	557.9	688.2	893.6	349.8	482.8	4,630.7	2,182.1	**11,160.6**

Figure 3-3 Land Use by Subwatershed in Acres (1999)



The greatest amount of undeveloped land is also found in the Beaver Dam Brook subwatershed, with 1239 acres of forested land and 261 acres of open space, recreation, and urban open land. Next is the Course Brook subwatershed, with 1091 acres of forested land and 263 acres of agricultural land, which is the only significant agricultural land in the overall Lake Cochituate watershed. Finally, the Snake Brook subwatershed has 592 acres of forested land. In general, the greatest amount of forested and agricultural lands is located in the headwater portions of Beaver Dam Brook and Course Brook to the south and Snake Brook to the north. The most heavily urbanized areas are in the portions of the subwatersheds in closest proximity to Lake Cochituate. This development pattern creates significant direct discharges of stormwater from developed areas to the lakes and the downstream portions of its tributary streams, leaving little opportunity for stormwater impacts to be attenuated before reaching Lake Cochituate.

3.3 Projected Land Use at Buildout

An important indicator of potential future development in any community is the zoning code. This directs specific types of development to geographically defined districts that are laid out on an official zoning map. MAPC has developed a "buildout analysis," or a method of analysis to estimate future development, which was adapted by the Executive Office of Environmental Affairs and implemented for every city and town in Massachusetts over the last several years. The methodology is based on an accounting of the amount of undeveloped land that is not protected, and an analysis of what kind of and how much development would be allowed on those lands under the zoning code.

MAPC's buildout analysis for the Lake Cochituate watershed is summarized in Table 3-6 and Figure 3-4, and the developable land areas are shown on Map 7. The analysis shows that there are 1870 acres of potentially developable land. The greatest amount of developable land is in the Course Brook subwatershed (950 acres), followed by Beaver Dam Brook (590 acres). Lesser amounts are found in Snake Brook subwatershed (230 acres), South Pond subwatershed (46 acres), and Fisk Pond subwatershed (22 acres). Minor amounts are found in the remaining subwatersheds of Middle Pond, Pegan Brook, and North Pond.

Table 3-6 Buildout Potential by Subwatershed

Subwatershed	Developable Land (Acres)	Percent of Total
Beaver Dam Brook	590	32%
Course Brook	950	51%
Fisk Pond	22	1%
Middle Pond	13	1%
North Pond	8	0%
Pegan Pond	12	1%
Snake Brook	230	12%
South Pond	46	2%
TOTAL	**1870**	**100%**

The combined developable lands in the contiguous areas of the Beaver Dam Brook and Course Brook subwatersheds represent 83 percent of the total for the watershed.

The types of land uses that can be added to these potentially developable lands are determined primarily by the zoning of these lands by the respective towns. By overlaying the zoning district maps of the five communities with the developable land, it is possible to estimate how many acres of each type of land-use can be expected in the future on the 1870 acres of developable land. The results of this analysis, shown in Table 3-7, show that half of the land could be developed with industrial land uses, and 48 percent could be developed for residential uses (single family and multi-family).

Table 3-7 Zoning of Potentially Developable Land

Zoning Type	Acres	Percent
Industrial	936	50%
Commercial	44	2%
Residential SF	222	12%
Residential MF	669	36%
TOTAL	**1870**	**100%**

A more detailed breakdown of zoning of developable land by subwatershed is presented below in Table 3-8. This shows that all of 950 acres of industrially zoned land is in the Beaver Dam Brook and Course Brook subwatersheds. All of the developable land in the other six watersheds is zoned for residential uses of various densities (e.g., single family and multi-family residential).

Table 3-8 Zoning of Developable Lands By Subwatershed

Subwatershed	Zoning Code	Zoning District	Area (acres)
Beaver Dam Brook			0.14
Beaver Dam Brook	GI	Industrial	31.73
Beaver Dam Brook	HB	Business-Highway	42.36
Beaver Dam Brook	LB	Commercial	1.71
Beaver Dam Brook	LI	Industrial	136.62
Beaver Dam Brook	R1	Light Industrial	99.43
Beaver Dam Brook	R3	Multi-Family Residence A	150.14
Beaver Dam Brook	R4	One-Family Residential	26.21
Beaver Dam Brook	R5	Residence C	101.49
		Subwatershed Total	**589.83**
Course Brook	GI	Industrial	61.79
Course Brook	R1	Light Industrial	606.31
Course Brook	R2	Single Residence C	176.79
Course Brook	R4	One-Family Residential	36.28
Course Brook	R5	Residence C	68.54
		Subwatershed Total	**949.71**
Fisk Pond	R4	One-Family Residential	22.19
			22.19
		Subwatershed Total	
Middle Pond	R3	Multi-Family Residence A	2.01
Middle Pond	R4	One-Family Residential	11.15
		Subwatershed Total	**13.16**
North Pond	R3	Multi-Family Residence A	2.40
North Pond	R5	Residence C	5.29
		Subwatershed Total	**7.69**
Pegan Brook	R3	Multi-Family Residence A	11.78
		Subwatershed Total	**11.78**
Snake Brook	R2	Single Residence C	204.28
Snake Brook	R3	Multi-Family Residence A	25.89
		Subwatershed Total	**230.17**
South Pond	R3	Multi-Family Residence A	29.42
South Pond	R4	One-Family Residential	15.44
South Pond	R5	Residence C	0.85
		Subwatershed Total	**45.71**

3.4 Impervious Surface Analysis

3.4.1 Impacts of Imperviousness on water quantity and quality

One of the most critical factors in the relationship between watershed development and impacts on water quality is the degree of imperviousness of the watershed. All kinds of development activities increase imperviousness by adding pavement, buildings, and compaction of soils. Increased imperviousness causes changes to both the quantity and the quality of stormwater runoff, which results in impacts on receiving waters like Lake Cochituate and its tributary streams.

The quantity of stormwater runoff increases with impervious surfaces in the watershed, and the time of collection becomes shorter, because paved surfaces allows the stormwater to flow and gather more quickly than vegetated areas. This leads to changes in the flow regime such that peak storm event runoff increases in volume and intensity, while base flows in periods between storms often decrease due to reduced recharge and retention of water in the watershed. Since the 1970's these issues have been generally recognized by local and state governments, and mitigation measures such a detention and retention basins have been required on much new development over the last several decades. These measures, however, are generally not designed to address water quality impacts.

The water quality impacts associated with increased imperviousness are generally associated with the wash off by storm water of accumulated sediments and other pollutants that have been deposited on roads, parking lots, and other paved or disturbed lands. Virtually all municipal stormwater systems, including those in the Lake Cochituate watershed, are designed to collect stormwater from streets and parking lots as quickly as possible and transmit it through pipes and culverts to ultimately discharge in water bodies or wetland areas. Thus, the vast majority of the sediments and pollutants picked up by stormwater over impervious surfaces are transmitted directly to rivers, streams, lakes, and wetlands, with little or no mitigation of the pollutant load.

3.4.2 Imperviousness of the Lake Cochituate Watershed

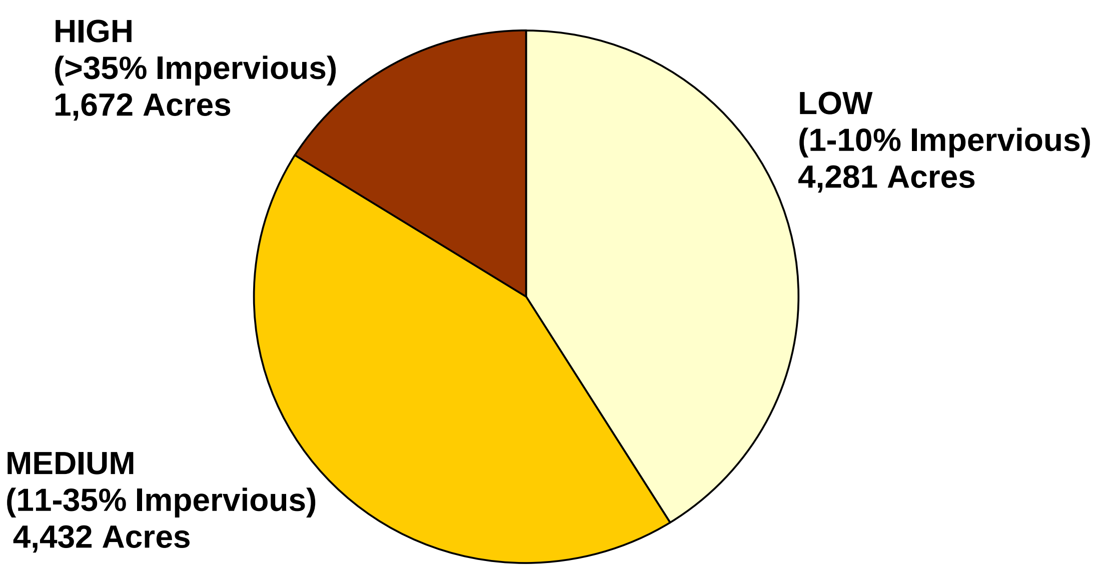
In the Lake Cochituate watershed a significant amount of land is moderately to highly impervious. An analysis was done using GIS mapping tools and McConnell land use data. The land use categories have each been assigned an average percentage of imperviousness by the Executive Office of Environmental Affairs. These land use imperviousness coefficients are listed in Table 3-9. By applying these coefficients to the land uses in Lake Cochituate's eight subwatersheds, an imperviousness map was developed (see Map 5), along with corresponding statistics that summarize how many acres of land are classified as low imperviousness (1 to 10 percent impervious), medium imperviousness (11 to 35 percent impervious), and high imperviousness (greater than 35 percent impervious.

The analysis shows that the watershed as a whole is about 16 percent highly impervious, 41 percent medium impervious, and 42 percent low impervious (see Figure 3-4). The combined medium and high impervious areas are 6,105 acres, nearly 60 percent of the total watershed area. This is considered a very high level of imperviousness with respect to impacts on watersheds.

Table 3-9 Land Use Imperviousness Coefficients

Land Use Category	Impervious Coefficient
Cropland	0.03
Pasture	0.02
Forest	0.02
Wetland	0.00
Mining	0.02
Open Land	0.06
Participation Recreation	0.10
Spectator Recreation	0.20
Water-based Recreation	0.17
Residential – Multi-family	0.46
Residential < ¼ acre	0.35
Residential ¼ - ½ acre	0.19
Residential > ½ acre	0.15
Salt Wetland	0.01
Commercial	0.77
Industrial	0.65
Urban Open	0.21
Transportation	0.66
Waste Disposal	0.03
Water	0.02
Woody Perennial	0.02

Figure 3-4 Lake Cochituate Watershed Imperviousness



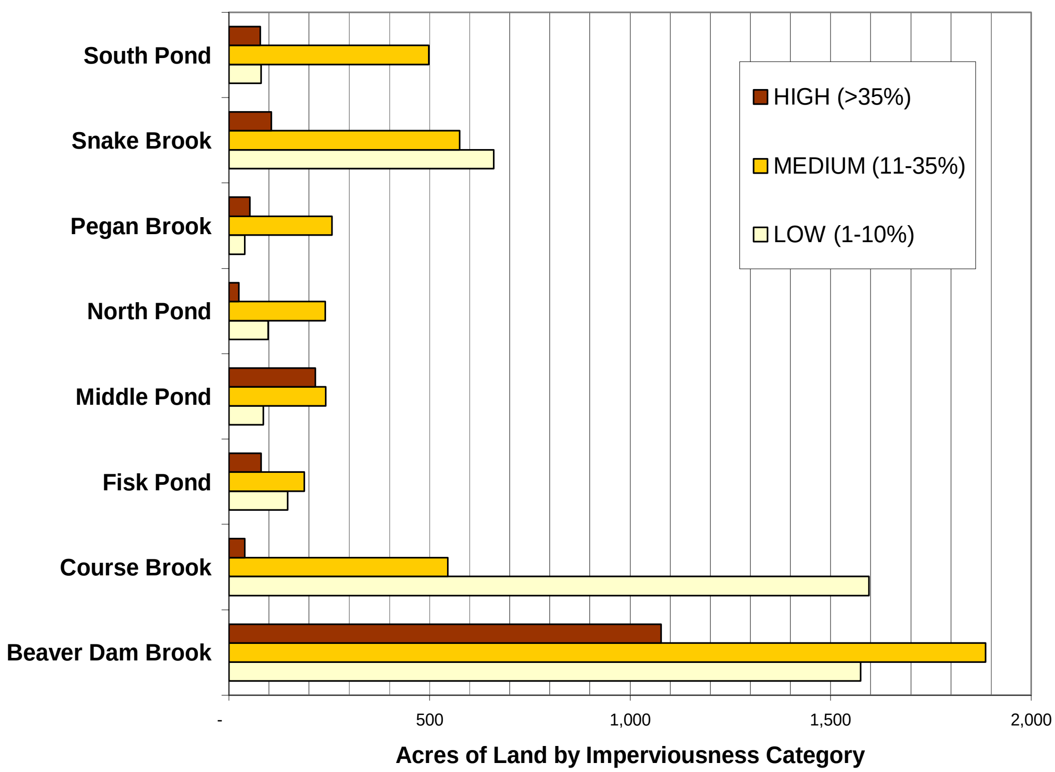
3.4.3 Imperviousness by Subwatershed

The data above portrays the imperviousness of the entire Lake Cochituate Watershed, but the degree of imperviousness varies greatly across the eight subwatersheds (see Table 3-10 and Figure 3-5). The greatest area of combined medium and high impervious land uses, nearly 3,000 acres, is in the Beaver Dam Brook watershed, while the highest percentage of medium and high impervious land, 89 percent, is in the Pegan Brook subwatershed, and at 88 percent, the South Pond subwatershed. These are extremely high levels of imperviousness.

Table 3-10 Watershed Imperviousness by Subwatershed (Acres)

Subwatershed	LOW (1 - 10 %)	MEDIUM (11 – 35 %)	HIGH (> 35 %)
Beaver Dam Brook	1,575	1,886	1,077
Course Brook	1,596	546	40
Fisk Pond	146	188	80
Middle Pond	86	241	215
North Pond	98	241	25
Pegan Brook	40	257	53
Snake Brook	660	575	105
South Pond	80	498	78
Lake Cochituate Total	**4,281**	**4,432**	**1,673**

Figure 3-5 Watershed Imperviousness by Subwatershed (Acres)



3.4.3 Mitigating Impervious Cover with Low Impact Development

The problems with excessive impervious surfaces described above have become well known to planners, engineers, and landscape designers. As a result, new approaches to site development have evolved, many of them referred to as "low impact development" techniques. These site development techniques seek to reduce the amount of imperviousness on a site, maximize the retention and recharge of stormwater on site or close to the place where it was generated, and utilize engineered Best Management Practices that take advantage of natural processes. The affect of these techniques is to handle stormwater in a manner that more closely mimics the natural water cycle, thus helping to restore the water balance and reduce impacts on both water quality and quantity. Some examples of these techniques include:

- Rain gardens
- Green roof designs
- Pervious parking lots
- Bioretention cells
- Stream buffers
- Vegetated swales and open drainage systems

Proper maintenance of all BMP's is critical to reduce mosquito breeding habitat. More information on Low Impact Design techniques is available from the Low Impact Development Center, which has a web site at **www.lowimpactdevelopment.org**

3.5 Infrastructure: water supply, wastewater, transportation

3.5.1 Water Supply

Four of the five towns in the watershed are provided with a municipal public water system. Only Sherborn has no central water system, relying on individual private wells on each lot. The town of Framingham is supplied by the Massachusetts Water Resources Authority (MWRA), which delivers water from the Quabbin and Wachusset Reservoirs through the MetroWest tunnel. The towns of Ashland, Natick, and Wayland are self-supplied with local sources of groundwater through a series of municipal wells. Of these, only Natick has wells that are located within the Lake Cochituate watershed. The town owns and operates two wellfields, Springdale and Evergreen, both of which are in close proximity to Middle and South Ponds. The wells and their wellhead protection areas are shown on Map 2. USGS hydrological investigations have estimated that nearly two-thirds of the water withdrawn at Natick's Springdale wells was derived from Lake Cochituate's Middle Pond.

3.5.2 Wastewater

Municipal wastewater collection systems are in place in the Ashland, Framingham, and Natick portions of the watershed. Wastewater from Ashland and Framingham flows to the MWRA's Deer Island wastewater treatment plant, and after treatment is discharged to Massachusetts Bay. There are no known impacts on Lake Cochituate associated with municipal sewer systems.

The towns of Sherborn and Wayland have no municipal sewer systems. All wastewater is treated on-site with Title 5 systems. Board of Health agents have not identified any septic system problem areas within the Lake Cochituate watershed. However it should be noted that even properly designed and operating Title 5 septic systems may have some long-term impacts on water quality, as wastewater effluent flows into the groundwater system, which eventually recharges nearby surface waters in most cases. Processes such as filtration in the soil profile, biological breakdown of pollutants, and dilution in groundwater tend to mitigate most, but not necessarily all, of the pollutant load of wastewater discharged into septic systems.

3.5.3 Transportation

There are several major state highways located in the watershed. A segment of about 500 linear feet of the Massachusetts Turnpike, a six-lane highway, passes through the North Pond subwatershed. Route 30 has approximately one-quarter mile of two-lane roadway that passes along the shores of North Pond north of the Massachusetts Turnpike and the same length and width south of the Massachusetts Turnpike along the shores of Middle Pond. The Massachusetts Turnpike's Natick Service Plaza is located in the Middle Pond subwatershed.

A segment of Route 9, a four lane highway, about one-half long passes between South Pond, Middle Pond, and Carling Pond. To the south, a segment of Route 135, a two-lane roadway, runs between South Pond and Fisk Pond.

All of these highways directly discharge untreated stormwater runoff into Lake Cochituate. Several of these are highlighted in the priority watershed action plan in Chapter 5.

4.0 POTENTIAL SOURCES OF NONPOINT SOURCE POLLUTION

Nonpoint source (NPS) pollution is the nation's leading source of water quality degradation. Although each individual home or businesses might contribute only a minor amount of NPS pollution, the combined effect of an entire community can be serious. These include eutrophication, sedimentation, and contamination with unwanted pollutants. In Massachusetts it is estimated that 75 percent of the state's water pollution problems are due to nonpoint source pollution (DEP, Nonpoint Source Pollution Introduction, online at http://www.mass.gov/dep/brp/wm/nonpoint.htm).

The severity of impacts of nonpoint source pollution on any water body such as a lake, river, or stream is directly related to the level of urbanization and the specific types of land development within the watershed area contributing to the flow in the water body. As shown in the previous chapter, much of Lake Cochituate's watershed area is highly urbanized and has a relatively high percentage of impervious surfaces. While this provides a general overview of the status of the watershed, a more detailed inventory of specific land uses is needed to characterize the potential sources of nonpoint source pollution in the watershed. This chapter and its corresponding maps provide such an inventory of the major types of potential sources of nonpoint source pollution.

4.1 Underground Storage Tanks

Underground storage tanks (UST's), typically containing gasoline or diesel fuel, are a potential threat to water quality due to leakage of the tank itself or the associated piping. There is also a risk of spillage during filling and fueling operations. Because of the threat posed by UST's to water resources, federal and state regulations on UST's have become much more stringent over the last decade, reducing but not eliminating the risk of contamination of water resources. Whereas commercial gasoline UST's used to be constructed of metal and had little if any corrosion protection or leak detection, all UST's today must meet the requirements of the Massachusetts Fire Prevention Code, which mandates corrosion resistant tank designs such as double-walled fiberglass tanks with continuous leak detection monitoring devices. However, in an urbanized area like the Lake Cochituate watershed, there are a significant number of UST in place, many of which are located in areas that could have in impact on water quality should there be a spill or leak. The number of UST's is summarized by subwatershed in Table 4-1, and the complete inventory of UST's in the watershed is provided in Table 4-2. The location of the UST's in the inventory is shown on Map 8, Potential Sources of Contamination.

Table 4-1 Summary of Underground Storage Tanks by Subbasin and Town

Subbasins	Ashland	Framingham	Natick	Sherborn	Wayland	TOTAL
Snake Brook					6	6
Pegan Brook			5			5
Beaver Dam Bk	3	30	4			37
Course Brook						
Fisk Pond			1			1
North Pond						
Middle Pond			3			3
South Pond						
Total	**3**	**30**	**13**		**6**	**52**

Source: Mass. Department of Fire Services, UST Registryll

Table 4-2 Underground Storage Tank Inventory (page 1 0f 2)

ID #	FACIL_NAME		STREET	TOWN	Watershed
1	MASCHESTER CO. INC.	158	BUTTERFIELD DR	ASHLAND	Beaver Dam Brook
2	GIBBS OIL	196	POND ST	ASHLAND	Beaver Dam Brook
3	GRANSTON CORP.	409	ELIOT ST	ASHLAND	Beaver Dam Brook
4	CDF REALTY TRUST	390	R WAVERLY ST	FRAMINGHAM	Beaver Dam Brook
5	ANCHOR MOTOR FREIGHT	35	WESTERN AVE	FRAMINGHAM	Beaver Dam Brook
6	AVERY-DENNISON MANUFACTURING	300	HOWARD ST	FRAMINGHAM	Beaver Dam Brook
7	ERRICO SERVICE STATION	22	WAVERLY ST	FRAMINGHAM	Beaver Dam Brook
8	TOWN OF FRAMINGHAM	160	HOLLIS ST	FRAMINGHAM	Beaver Dam Brook
9	FIRE DEPT	520	CONCORD ST	FRAMINGHAM	Beaver Dam Brook
10	Adesa Auctions of Boston	63	WESTERN AVE	FRAMINGHAM	Beaver Dam Brook
11	GIBBS SERVICE STATION # 7401 1	284	HOLLIS ST	FRAMINGHAM	Beaver Dam Brook
12	GLEASONS INC. OF FRAMINGHAM	35	CLAFLIN ST	FRAMINGHAM	Beaver Dam Brook
13	GRANET DIV.W G M SAFETY CORP.	25	LORING DR	FRAMINGHAM	Beaver Dam Brook
14	GEORGE KAPALOIS	472	CONCORD ST	FRAMINGHAM	Beaver Dam Brook
15	CROWN CITGO	112	WAVERLY ST	FRAMINGHAM	Beaver Dam Brook
16	ORGANIZATIONAL MAINT.SHOP #7	522	CONCORD ST	FRAMINGHAM	Beaver Dam Brook
17	MOBIL	655	WAVERLY ST	FRAMINGHAM	Beaver Dam Brook
18	VERIZON TELEPHONE	146	LELAND ST	FRAMINGHAM	Beaver Dam Brook
19	PEOPLES REALTY TRUST	39	SOUTH ST	FRAMINGHAM	Beaver Dam Brook
20	PROFESSIONAL TREE & LANDSCAPE	27	TAYLOR ST	FRAMINGHAM	Beaver Dam Brook
21	SARKY & SONS	386	HOLLIS ST	FRAMINGHAM	Beaver Dam Brook
22	SUNOCO #0005-2407	506	CONCORD ST	FRAMINGHAM	Beaver Dam Brook
23	SUNOCO	498	CONCORD ST	FRAMINGHAM	Beaver Dam Brook
24	TEXACO SERVICE STATION	230	BEAVER ST	FRAMINGHAM	Beaver Dam Brook
25	UNITED BUILDERS SUPPLY	40	WAVERLY ST	FRAMINGHAM	Beaver Dam Brook
26	DURALECTRA INC.	61	NORTH AVE	NATICK	Pegan Brook
27	NATICK AUTO SALES INC	161	WEST CENTRAL ST	NATICK	Beaver Dam Brook
28	Herb Connelly's Natick Mitsubishi	157	WEST CENTRAL ST	NATICK	Beaver Dam Brook
29	NEW ENGLAND HOUSEHOLD MOVING	241	WEST CENTRAL ST	NATICK	Beaver Dam Brook
30	BOSTONIA BEVERAGE INC	14	MILL ST	NATICK	Beaver Dam Brook

Table 4-2 Underground Storage Tank Inventory (page 2 0f 2)

31	NATICK CITGO	67	EAST CENTRAL ST	NATICK	Pegan Brook
32	COACH & CARRIAGE	55	MIDDLESEX AVE	NATICK	Pegan Brook
33	SUNOCO #0013-1086	20	NORTH MAIN ST	NATICK	Pegan Brook
34	THE WHIPPLE COMPANY	58	NORTH MAIN ST	NATICK	Pegan Brook
35	COCHITUATE MOTORS INC	36	MAIN ST	WAYLAND	Snake Brook
36	COCHITUATE MOTORS #7689	3	MAIN ST	WAYLAND	Snake Brook
37	SUNOCO INTERSTATE PETROLEUM	322	COMMONWEALTH RD	WAYLAND	Snake Brook
38	CUMBERLAND FARMS ,INC #2405	130	MAIN ST	WAYLAND	Snake Brook
39	MOBIL OIL CORP	315	COMMONWEALTH AVE	WAYLAND	Snake Brook
40	SUNOCO #0005-3579	19	MAIN ST	WAYLAND	Snake Brook
41	DENNISON MFG. CO	300	HOWARD ST	FRAMINGHAM	Beaver Dam Brook
42	FRAMINGHAM SERIVCE CENTER	15	BLANDIN AVE	FRAMINGHAM	Beaver Dam Brook
43	EXXON STA #3-1569	483	CONCORD ST	FRAMINGHAM	Beaver Dam Brook
44	NATICK EXECUTIVE PARK II	721	WORCESTER ST	NATICK	Middle Pond
45	NATICK EXECUTIVE PARK	721	WORCESTER RD	NATICK	Middle Pond
46	FEDERAL EXPRESS	33	SPEEN ST	NATICK	Fisk Pond
47	MANN INDUSTRIES	225	ARLINGTON ST	FRAMINGHAM	Beaver Dam Brook
48	TOSTI'S SERVICE STATION	47	WAVERLY ST	FRAMINGHAM	Beaver Dam Brook
49	R H LONG MOTOR SALES TRUST	624	WAVERLY ST	FRAMINGHAM	Beaver Dam Brook
50	C AND N GAS	324	WAVERLY ST	FRAMINGHAM	Beaver Dam Brook
51	FOREIGN MOTORS WEST INC	253	NORTH MAIN ST	NATICK	Middle Pond
52	AUTO BRITE CAR WASH INC	105	HOLLIS ST	FRAMINGHAM	Beaver Dam Brook

Source: MA Department of Fire Services, UST Registry

4.2 Hazardous Waste sites under Chapter 21E

Hazardous waste sites are regulated by the Department of Environmental Protection under Chapter 21E of the Mass. General Laws. DEP maintains a detailed inventory of hazardous waste sites, both confirmed and suspected, and tracks the progress of remedial actions and clean up plans. In the Lake Cochituate watershed there are 44 hazardous waste sites. These are summarized by subwatershed and town in Table 4-3 and listed in detail in Table 4-4. These sites are shown on Map 8. The vast majority of these sites, 34, or 77 percent, are located in the Beaver Dam Brook subwatershed, and the majority of these, 23, are in the Framingham portion of the watershed.

Table 4-3 Summary of 21E Hazardous Waste Site in Lake Cochituate Watershed

Subbasins	Ashland	Framingham	Natick	Sherborn	Wayland	TOTAL
Snake Brook					2	2
Pegan Brook			1			1
Beaver Dam Bk	6	23	5			34
Course Brook				1		1
Fisk Pond						
North Pond						
Middle Pond			3			3
South Pond			3			3
Total	**6**	**23**	**12**	**1**	**2**	**44**

Table 4-4 Hazardous Waste Site Inventory (page 1 of 2)

Map #	Property Name	Location	Town	DEP Status	Watershed
15	GASOLINE STATION FMR	POND ST KINGS PLZ	ASHLAND	DEF TIER 1B	Beaver Dam Brook
17	PELS SUNOCO	126 POND ST	ASHLAND	TIER 2	Beaver Dam Brook
25	PROPERTY	11 MULHALL DR	ASHLAND	DEF TIER 1B	Beaver Dam Brook
26	COMMERCIAL PROPERTY	230 ELIOT ST	ASHLAND	DEF TIER 1B	Beaver Dam Brook
27	NO LOCATION AID	32 NICKERSON RD	ASHLAND	DEF TIER 1B	Beaver Dam Brook
	NO LOCATION AID	196 POND ST	ASHLAND	TIER 2	Beaver Dam Brook
8	COMMONWEALTH GAS CO	350 IRVING ST	FRAMINGHAM	TIER 1B	Beaver Dam Brook
10	300 FT WEST OF NATICK TOWN LINE	22-24 WAVERLY ST	FRAMINGHAM	TIER 2	Beaver Dam Brook
11	AUTO BODY SHOP FMR	59 BEAVER ST	FRAMINGHAM	DEF TIER 1B	Beaver Dam Brook
13	CORNER OF LINDBURGH RD	472 CONCORD ST	FRAMINGHAM	TIER 2	Beaver Dam Brook
16	MANHOLE	CONCORD ST LINCOLN ST	FRAMINGHAM	DEF TIER 1B	Beaver Dam Brook
18	MURRY CONSTRUCTION CO	39 TAYLOR ST	FRAMINGHAM	TIER 2	Beaver Dam Brook
20	NO LOCATION AID	47 BLANDIN AVE	FRAMINGHAM	TIER 2	Beaver Dam Brook
21	BISHOP TERRACE CONDOMINIUMS	BISHOP DR	FRAMINGHAM	TIER 2	Beaver Dam Brook
28	SUNOCO GASOLINE STATION	506 CONCORD ST	FRAMINGHAM	TIER 2	Beaver Dam Brook
33	BECO STATION 240	LELAND ST	FRAMINGHAM	TIER 2	Beaver Dam Brook
34	PROPERTY	36 BERKSHIRE RD	FRAMINGHAM	DEF TIER 1B	Beaver Dam Brook
39	MUNICIPAL PROPERTY	ARTHUR ST	FRAMINGHAM	DEF TIER 1B	Beaver Dam Brook
42	GETTY SERVICE STATION	112 WAVERLY ST	FRAMINGHAM	TIER 2	Beaver Dam Brook
45	LUDLOW CORP FMR	387-699 WAVERLY ST	FRAMINGHAM	TIER 2	Beaver Dam Brook
46	NO LOCATION AID	697-705 WAVERLY ST	FRAMINGHAM	TIER 2	Beaver Dam Brook
49	GMC SETTLING LAGOON	63 WESTERN AVE	FRAMINGHAM	DEF TIER 1B	Beaver Dam Brook
50	GENERAL MOTORS BEAVER BROOK	63 WESTERN AVE	FRAMINGHAM	DEP TIER 1B	Beaver Dam Brook
53	GMC GM ASSMBLY DIVISION FMR	63 WESTERN AVE	FRAMINGHAM	DEP TIER 1B	Beaver Dam Brook
54	GMC FMR LANDFILL	63 WESTERN AVE	FRAMINGHAM	TIER 2	Beaver Dam Brook
	Granet Division WGM Safety Corp	25 LORING DR	FRAMINGHAM	TIER 2	Beaver Dam Brook
	NO LOCATION AID	21 BEAVER COURT EXT	FRAMINGHAM	TIER 2	Beaver Dam Brook
	GULF GASOLINE STATION	655 WAVERLY ST	FRAMINGHAM	TIER 2	Beaver Dam Brook
	OLD COLONY RAIL SPUR	IRVING ST	FRAMINGHAM	TIER 2	Beaver Dam Brook
1	NO LOCATION AID	45 KENDALL LN	NATICK	TIER 2	Beaver Dam Brook

Table 4-4 Hazardous Waste Site Inventory (page 2 of 2)

Map #	Property Name	Location	Town	DEP Status	Watershed
5	DEROSA FLORIST INC	54 HIGHLAND ST	NATICK	TIER 2	Pegan Brook
23	BEAVER DAM BROOK	196 WEST CENTRAL ST	NATICK	TIER 2	Beaver Dam Brook
29	MUNICIPAL WELLS	OFF MASSACHUSETTS TPKE	NATICK	DEF TIER 1B	Middle Pond
43	PROPERTY	17 GREENLEAF RD	NATICK	DEF TIER 1B	Beaver Dam Brook
44	PARCEL	307 WEST CENTRAL ST	NATICK	DEF TIER 1B	Beaver Dam Brook
48	FRAMINGHAM EXT RELIEF SVS	327 WEST CENTRAL ST	NATICK	DEF TIER 1B	Beaver Dam Brook
51	US ARMY LAB BOILER ROOM	KANSAS ST	NATICK	TIER 2	South Pond
52	ARMY RESEARCH CENTER	KANSAS ST	NATICK	TIER 1A	South Pond
31	INTERSECTION WITH RTE 27	891 WORCESTER RD	NATICK	TIER 1C	South Pond
40	CLEAN CORP	229 NORTH MAIN ST	NATICK	TIER 1A	Middle Pond
	U HAUL MOVING CENTER	843 WORCESTER TURNPIKE ROUTE 9	NATICK	TIER 2	Middle Pond
	SPEEN ST	43 KENDALL AVE	SHERBORN	TIER 2	Course Brook
35	WAYLAND AUTOMOTIVE	322 COMMONWEALTH RD	WAYLAND	TIER 2	Snake Brook
	MOBIL STATION 01 515	315 COMMONWEALTH RD	WAYLAND	TIER 2	Snake Brook

Key to DEP Status:

Note: Sites are usually Tier Classified using the Numerical Ranking System (NRS). The NRS scores sites on a point system based on a variety of factors. These include the site's complexity, the type of contamination, and the potential for human or environmental exposure to the contamination. In addition, some sites are automatically classified as Tier 1 sites if they pose an imminent hazard, affect public water supplies, or miss regulatory deadlines.

- **TIER 1A:** A site/release receiving a total NRS score equal to or greater than 550. These sites/releases require a permit and the person undertaking response actions must do so under direct DEP supervision.

- **TIER 1B:** A site/release receiving an NRS score of less than 550 and equal to or greater than 450. These sites/releases also require a permit, but response actions may be performed under the supervision of a Licensed Site Professional (LSP) without prior DEP approval.

- **TIER 1C:** A site/release receiving a total NRS score of less than 450 and equal to or greater than 350. A site/release receiving a total NRS score of less than 350, but which meets any of the Tier 1 Inclusionary Criteria specified in 310 CMR 40.0520(2)(a), is also classified a Tier 1C. These sites/releases also require a permit, but response actions may be performed under the supervision of an LSP without prior DEP approval.

- **TIER 2:** A site/release receiving a total NRS score of less than 350, unless the site meets any of the Tier 1 Inclusionary Criteria (see above). Permits are not required at Tier 2 sites/releases and response actions may be performed under the supervision of an LSP without prior DEP approval. All pre-1993 transition sites that have accepted waivers are categorically Tier 2 sites.

- **TIER 1D:** A site/release where the responsible party fails to provide a required submittal to DEP by a specified deadline. Note: formerly **Default Tier 1B**.

Due to their proximity to sensitive receptors, including Natick's drinking water wells, one or more of the ponds of Lake Cochituate, or tributaries that flow directly into the lake priority sites are listed below. Accordingly any spill or leak at one of these sites potentially could have a greater chance of impacting water quality and allowing the movement of contaminants more rapidly to a proximate water body. Of the total 44 hazardous waste sites in the watershed, 2 should be considered high priority. Correspondingly there are 15 classified as DEF TIER 1B meaning the responsible party has failed to provide a required submittal to DEP by a specific deadline. Thus the necessary information that could make this site drop lower in the priority scale is missing.

All of these sites are listed in Table 4-5.

Table 4-5 Recommended Priority 21 E Sites in Lake Cochituate Watershed

TIER 1A Priority 21E sites are:

- US Army Research Center
  Kansas Street, Natick

- Clean Corp
  229 North Main Street, Natick

Default TIER 1B sites are:

- Former Gas Station
  Pond St Kings Plaza,
  Ashland

- Property
  11 Mulhall Drive, Ashland

- Commercial property
  230 Elliot Street, Ashland

- 32 Nickerson Road, Ashland

- Auto Body Shop, former
  59 Beaver St, Framingham

- Manhole
  Concord & Lincoln Street
  Framingham

- 36 Berkshire Road
  Framingham

- Municipal Property
  Arthur Street, Framingham

- GMC Settling Lagoon
  63 Western Avenue
  Framingham

- GM Beaver Brook
  63 Western Avenue
  Framingham

- (former) GMC GM Assembly
  Division
  63 Western Avenue
  Framingham

- Municipal Wells
  Off Mass Turnpike, Natick

- 17 Greenleaf Road, Natick

- 307 West Central St, Natick

- Framingham Ext Relief SVS
  327 West Central Street
  Natick

4.3 Waste disposal: Junkyards and Landfills

There are two auto salvage yards, both in the Beaver Dam Brook subwatershed.:

- Central Street Auto Parts of Natick
  327 West Central Street, Natick

- A-1 Used Auto Parts
  Rear of 115 Beaver Street, Framingham

There is one former landfill in the Beaver Dam Brook subwatershed. The site is listed as #54 in the 21E site listings.

- The former GM plant landfill site, Western Avenue, Framingham

4.4 Salt Storage and snow dumping areas

Ashland's snow dump site and salt storage area is the town's DPW yard at 20 Ponderosa Road in Ashland. This site is located outside the Lake Cochituate watershed.

Framingham no longer has a snow dump. Siting and associated costs have lead to a change in the town's snow removal policy. Framingham's salt storage is located at the town's Henry Street Extension DPW annex (corner of Henry & Franklin Sts.). This site was chosen due to its central location in relation to where the salt is needed.

Natick's snow dump location is one of Natick High School's parking lots located off West Street. Natick High School and its parking lots are located in the Dug Pond sub-watershed, which is in the Charles River watershed. Natick's salt storage is at 75 West Street, the town's DPW facility, which is also in the Dug Pond subwatershed.

Sherborn does not collect snow and thus has no need for a snow dump site. Sherborn's salt storage area is located at the intersection of Routes 16 &27 in a shed behind the town's Highway garage. This location is outside the Lake Cochituate watershed, in the Indian Brook subwatershed which drains to the Charles River.

Wayland has two snow dump areas. The first is located on a small grassy field across from the DPW headquarters at 195 Main Street. The second, and the town's main site, is located on a field adjacent to the Town's landfill area off Route 20. These sites are located outside the Lake Cochituate watershed. Wayland's salt storage area is also at the DPW facility located adjacent to the Town's landfill area.

4.5 Septic system general areas

Of the five watershed towns, only Sherborn and Wayland do not have public sewer systems, and rely totally on Title 5 on-site septic systems for wastewater disposal. The Wayland portion of the watershed includes the Snake Brook and North Pond subwatersheds. The Sherborn portion includes the headwater areas of the Course Brook and a small amount of the Beaver Dam Brook subwatersheds. The Town of Natick, though sewered, has a small section located on the east side of Middle Pond that is not sewered. Board of Health agents do not have any indication of septic system problem areas in the Lake Cochituate watershed.

4.6 Golf courses

There are two golf practice centers both in the Beaver Dam Subwatershed.

- Natick Golf Learning Center, 218 Speen Street, Natick
- Golf-It Practice Range, Butterfield Drive, Ashland

4.7 Highway Runoff

Roadway drainage that causes sedimentation was observed by MAPC field surveys at several key highway crossings (the depth of sedimentation was not quantified). These include Route 30 in Wayland, as it crosses North Pond and Snake Brook Pond; Route 9 in Natick, as it crosses between South Pond and Middle Pond, the Massachusetts Turnpike, as it crosses between North Pond and Middle Pond. The Route 30 site is described in more detail in Chapter 5 (page 5-17).

Route 9, a four lane highway, crosses Lake Cochituate east of the intersection with Speen Street in Natick. There are three segments that drain to the lake:

- A segment from the western edge of the lake to Hartford Street drains to an outfall in Middle Pond (see Figure 4-1)
- A segment from the Natick pumping station westward to Carling Pond is connected to an outfall in Carling Pond. Many of the catch basins are clogged with sands and sediments, and appear not to be functioning. As a result, there is evidence that stormwater is overtopping the curb and flowing over a steep embankment and directly into Middle Pond (see Figures 4-2 and 4-3).
- A segment of the highway east of the lake, beginning at Sunnyside Road, which discharges to Middle Pond through an 18 inch outfall in the Veterans Park area.

Recommendations for Route 9: At a minimum, maintenance needs to be conducted to clean out clogged catch basins and restore proper functioning of the stormwater system on this segment of Route 9. This may relieve the problem of stormwater overtopping the curb and flowing over the embankment to Middle Pond. But due to the heavy sediment loads in this area, the installation of hydrodynamic separators in the three segments of the drainage system that drain to the lake is recommended. The estimated cost of three units is about $120,000 (see Best Management Practices details in Appendix).

Upon review of these recommendations in the draft report, the Mass. Highway Department commented that more emphasis should be put on non-structural measures such as minimizing winter road sanding, stabilizing eroding road shoulders, regular sweeping of paved areas, and more thorough catch basin cleaning. MHD recommends less emphasis on structural BMP's, particularly hydrodynamic separators, which MHD does not approve of due to their expense, difficulty to maintain, and what they believe to be "dubious water quality benefits."

In reviewing these comments, MAPC agrees that a high priority should be placed on the nonstructural BMP and maintenance suggested by MHD. Given the observed problems on Route 9 and Route 30, this may go a long way towards addressing water quality problems. However, until such nonstructural measures are implemented and their impacts and benefits evaluated, it seems premature to dismiss the possibility that structural BMP's might be beneficial in some cases, particularly on Rt. 30, which has direct runoff to the lake via a spillway. However, MAPC acknowledges that there are alternatives to hydrodynamic separators, such as deep sump catch basins and baffle boxes, which are less expensive and easier to maintain. Any definitive decision about structural BMP's would require more detailed site specific evaluations. MAPC will continue to discuss these options in consultation with MHD, and will seek opportunities to consult with the Mass. Turnpike Authority (see MHD's comment letter, Appendix 15).

Figure 4-1   Route 9 Stormwater Outfall to South Pond

Figure 4-2   Clogged Catch Basins, Route 9 at South Pond

Figure 4-3 Stormwater overtops curb onto embankment, Route 9 at South Pond

Stormwater runoff from an approximately ½ mile segment of the Mass. Turnpike discharges to North Pond from the westbound lanes and to Middle Pond from the eastbound lanes. All runoff from the Natick service plaza also discharges to Middle Pond through an open paved drainage swale. Further, the embankment for the eastbound lanes on the shore is Middle Pond is unstable and eroding (Figure 4-4).

The Mass. Turnpike runoff discharges to Lake Cochituate with no pre-treatment to mitigate stormwater quality. This type of discharge would not be allowed under current DEP Stormwater Guidelines. The drainage system shows evidence of sedimentation and lack of maintenance. The drainage outlets from the service island to the drainage ditch are full of sediments (Figure 4-6). Runoff from the fueling area and truck stop is also a potential source of polluted runoff due to spills and leaks (Figure 4-7). Stockpiling of plowed snow was observed within the drainage ditch, and the snow contained considerable sediment load (Figure 4-8)

Recommendations for the Massachusetts Turnpike: The Mass. Turnpike Authority should improve maintenance of the existing drainage system, and stabilize the eroding embankment on Middle Pond. The MTA should consider retrofitting the drainage system of the service plaza with BMP's to provide pre-treatment for sediments and oils, such as hydrodynamic separators. The estimated cost of these units is $35,000 each, and two to four units would probably be need to handle runoff from this site. The MTA should also consider redesigning the existing drainage ditch to create a more functional vegetated retention area that could remove more of the pollutant load before stormwater is discharged to Middle Pond. Finally, the practice of dumping snow into the drainage ditch should be discontinued, as this increases the sediment load to the drainage system.

Figure 4-4 Unstable Turnpike Embankment on Middle Pond

Figure 4-5 Drainage ditch at Natick Service Plaza

Figure 4-6 Clogged Drainage Outlet at Natick Service Plaza

Figure 4-7 Truck Stop in proximity to Catch Basin, Natick Service Plaza

Figure 4-8 Sediment laden snow pile in drainage ditch, Natick Service Plaza

Figure 4-9 Pictometry view of Natick Service Plaza

4.8 Inventory of Large Impervious Sites

Individual impervious sites over one acre have been identified and inventoried throughout the watershed. These impervious sites are shown on Map 6 and are summarized in Table 4-6 and listed in detail in Table 4-7. The inventory includes 142 impervious sites; the distribution of these sites across the eight subwatersheds is summarized in Table 4-6. The greatest number of sites is found in the Beaver Dam Brook subwatershed, which has 78 sites, or 55 percent of the total sites in the Lake Cochituate watershed.

Table 4-6 Summary of Impervious Site Inventory

Subwatershed	Number of Impervious Sites	Impervious Site Area (acres)	Percentage of Sites by Subwatershed
Beaver Dam Brook	78	475.95	55
Course Brook	1	2.43	.70
Fisk Pond	8	13.15	5.63
Middle/Carling Pond	19	139.88	13.38
North Pond	2	1.19	1.41
Pegan Brook	15	41.42	10.56
Snake Brook	8	28.84	5.63
South Pond	11	111.77	7.75
TOTAL	**142**	**814.66**	**100%**

A number of techniques could be use to reduce runoff from many of these existing impervious sites. Most of them were developed before the implementation of the DEP Stormwater Guidelines and local land use controls such as site plan review. Such sites are candidates for retrofitting with stormwater Best Management Practices that could control runoff and reduce the volume and/or the pollution load of runoff leaving the site. These measures include the installation of structures such as deep sump catch basins, leaching catch basins, baffle boxes, and hydrodynamic separators in areas with limited available space. In areas with more space, it may be possible to install detention or retention basins. Finally, as mentioned above in Chapter 3, there are a number of emerging “Low Impact Development” techniques that could be appropriate for many of these sites. Finally, non-structural measures such as sweeping of paved areas, catch basin and drainage system cleaning and maintenance, and reduced use of sand and salt could reduce the degree of water quality impacts from impervious sites.

Town should consider using their land use regulatory authority to require the retrofitting of appropriate BMP’s whenever an existing site comes up for redevelopment or site modification. Similar to the Title 5 program, it may also be possible to require stormwater upgrades at the time of sale or transfer of a property. For sites which are not in compliance with the current DEP Stormwater Policy, any retrofits should seek to meet the current requirements to the greatest degree practicable. The specific stormwater BMP measures that are appropriate and feasible will vary at each site, and will require site-specific evaluation, design, and engineering.

Table 4-7 Inventory of Large Impervious Sites (page 1 of 5)

NUM	**Name** (Where Known)	**Address** (where known)	Town	Subwatershed	Parcel size (acres)
1			Ashland	Beaverdam	3.54
2	Regis College Framingham Campus		Framingham	Beaverdam	8.07
3	retail strip	East Central Street	Natick	Pegan Brook	1.13
4	retail strip	148 East Central Street	Natick	Pegan Brook	1.63
5	154 Limited Partnership	154 East Central Street	Natick	Pegan Brook	1.02
6	Leo MacNeil	East Central Street	Natick	Pegan Brook	0.97
7	Anthony Francoise	East Central Street	Natick	Pegan Brook	0.83
8	DeRosa Florist, Inc	54 Highland Street	Natick	Pegan Brook	2.13
9	Walnut Hill School	12 Highland Street	Natick	Pegan Brook	1.85
10	1 Apple Hill	1 Apple Hill	Natick	South Pond	14.38
11	Route 9 Roadway	Worcester	Natick	South Pond	12.62
12	Shell Oil Station	225 North Main Street	Natick	Middle Pond	1.19
13	CSX		Framingham	Beaverdam	22.84
14	Shopping plaza	Shopping Plaza	Natick	Middle Pond	12.44
15	Brigham-Gill Jeep	817 Worcester Street	Natick	Middle Pond	2.26
16	Whitney Hill Assisted Living		Natick	Middle Pond	3.16
17	Wilson Middle School	24 Rutledge Rd.	Natick	Middle Pond	3.64
18	Vision Drive (Cognex & Vision Drive Inc.)	Vision Drive	Natick	Middle Pond	20.90
19	Foreign Motors West	260 Elliot Street	Natick	Middle Pond	5.52
20	Nickinello Realty Corp.	212 North Main Street	Natick	Middle Pond	1.36
21	Lakewood Office Complex	214 North Main Street	Natick	Middle Pond	3.53
22	Manpower & Tool Mex Corp.	1075 Worcester Road	Natick	Middle Pond	1.86
23	Sam's Club		Natick	Middle Pond	9.04
24			Framingham	Beaverdam	3.61
25	offices	313 Speen Street	Natick	Middle Pond	3.90
26	Filenes Distribution center		Natick	Middle Pond	10.35
27	Hampton Inn	319 Speen Street	Natick	Middle Pond	4.48
28	Cochituate Place	24 Prime Parkway	Natick	Middle Pond	4.93
29	Boston Scientific	Worcester Road	Natick	Carling Pond	23.25
30	Mass Turnpike Roadway	Mass. Turnpike	Natick	Middle Pond	15.27

Table 4-7 Inventory of Large Impervious Sites (page 2 of 5)

NUM	**Name** (Where Known)	**Address** (where known)	Town	Subwatershed	Parcel size (acres)
31	Mass Turnpike Service Area	Mass. Turnpike	Natick	Middle Pond	8.04
32	Wayland Town Beach Parking		Wayland	North Pond	0.88
33	strip mall, gas station, bank	Rt. 27 & Commonwealth Rd.	Wayland	Snake Brook	9.01
34		West Plain Street	Wayland	Snake Brook	1.65
35			Framingham	Beaverdam	2.52
36		East Plain Street	Wayland	Snake Brook	1.43
37	Wayland Middle School	Main Street	Wayland	Snake Brook	3.96
38		Commonwealth Road	Wayland	Snake Brook	2.56
39		Commonwealth Road	Wayland	Snake Brook	2.17
40		Loker Street	Wayland	Snake Brook	4.48
41	Loker School	47 Loker Way	Wayland	Snake Brook	3.58
42	Framingham Town Beach		Framingham	North Pond	0.31
43	Central Auto Parts	327 West Central Street	Natick	Beaverdam	2.44
44	Cochituate State Park	Commonwealth Ave	Framingham	Middle Pond	4.76
45			Framingham	Beaverdam	1.87
46	CSX		Framingham	Beaverdam	7.75
47	Arlington Square		Framingham	Beaverdam	8.82
48	commercial buildings		Framingham	Beaverdam	6.94
49	Wellington Park		Framingham	Beaverdam	5.02
50	Adesa Auctions of Boston	63 Western Avenue	Framingham	Beaverdam	116.47
51	Ledgemere Park & Plaza	300 Elliot Street	Ashland	Beaverdam	19.55
52	Framingham DPW Facility	100 Western Ave	Framingham	Beaverdam	6.64
53	31-51 Loring		Framingham	Beaverdam	0.40
54	same site as 21		Framingham	Beaverdam	2.51
55	Framingham Fire Department		Framingham	Beaverdam	2.00
56	MA Correctional Institution Framingham	26 Loring Drive	Framingham	Beaverdam	3.07
57	apartments	45 Leland Street	Framingham	Beaverdam	7.81
58	Wilson Elementary School	169 Leland Street	Framingham	Beaverdam	4.82
59			Sherborn	Course Brook	2.43
60			Framingham	Beaverdam	3.86

Table 4-7 Inventory of Large Impervious Sites (page 3 of 5)

NUM	**Name** (Where Known)	**Address** (where known)	Town	Subwatershed	Parcel size (acres)
61			Framingham	Beaverdam	7.08
62	Shaws Supermarket		Ashland	Beaverdam	9.97
63	General Chemical & Framingham Welding & Engineering	138 Leland Street	Framingham	Beaverdam	5.31
64			Framingham	Beaverdam	4.95
65	MetroWest Antique Center		Framingham	Beaverdam	3.53
66	Exceptional Automotive Services, Suburban Athletic Company	Henry Street	Framingham	Beaverdam	15.10
67	Estes Express Lines		Framingham	Beaverdam	10.27
68	Grossman's Outlet Store		Framingham	Beaverdam	1.81
69	Paramount Harley Davidson		Framingham	Beaverdam	7.67
70	NSTAR & Canaglobe		Framingham	Beaverdam	6.17
71	Salvation Army	1 Howard Street	Framingham	Beaverdam	1.11
72	Downtown Framingham		Framingham	Beaverdam	5.72
73	Framingham Town Hall	150 Concord Street	Framingham	Beaverdam	2.77
74	Downtown Framingham	Concord Street	Framingham	Beaverdam	3.17
75	Sears Hardware, Blockbuster, Radio Shack	310 Pond Street	Ashland	Beaverdam	6.03
76	Fabric Place	Concord Street	Framingham	Beaverdam	0.78
77	multiple owners	Howard Street	Framingham	Beaverdam	7.28
78	Multi-Color Corporation (Decorating Technologies Division)	Lawrence Street	Framingham	Beaverdam	5.67
79	LifeLine	111 Lawrence Street	Framingham	Beaverdam	5.31
80	(Avery-Dennison) Framingham 300 Howard, LLC	300 Howard Street	Framingham	Beaverdam	11.73
81	Avery-Dennison		Framingham	Beaverdam	3.51
82	LifeLine	One Clarks Hill	Framingham	Beaverdam	3.50
83	Meridian Condominiums		Framingham	Beaverdam	6.72
84	Town of Framingham, (sewer department)	229 Arthur Street	Framingham	Beaverdam	3.96
85	Waverly Street commercial strip		Framingham	Beaverdam	2.32
86	Ashland Mini-Storage	11 Nickerson Road	Ashland	Beaverdam	4.77
87	United Builders	40 Waverly Street	Framingham	Beaverdam	3.45

Table 4-7 Inventory of Large Impervious Sites (page 4 of 5)

NUM	**Name** (Where Known)	**Address** (where known)	Town	Subwatershed	Parcel size (acres)
88	gas stations, auto repair, auto radiator repair	Waverly Street	Framingham	Beaverdam	2.26
89	Framingham Auto City	154 Waverly Street	Framingham	Beaverdam	6.19
90	Perdoni Construction		Framingham	Beaverdam	3.09
91	Framingham Salvage Company	120 Waverly Street	Framingham	Beaverdam	2.54
92	Burger King		Framingham	Beaverdam	1.38
93	Kentucky Fried Chicken		Framingham	Beaverdam	1.09
94	Shell Gas Station		Framingham	Beaverdam	0.47
95	Retail mall	208-212 Waverly Street	Framingham	Beaverdam	3.75
96	Office Building	307 West Central Street	Natick	Beaverdam	0.85
97	Wendy's Restaurant	303 West Central street	Natick	Beaverdam	0.70
98	Route 126 Self Storage		Ashland	Beaverdam	6.53
99	Natick Crossings	251-273 West Central Street	Natick	Beaverdam	3.27
100	MBTA West Natick parking	249 West Central Street	Natick	Beaverdam	1.50
101	Mass Diving Inc.	247 West Central Street	Natick	Beaverdam	1.48
102	Snap-On Tools	245 West Central Street	Natick	Beaverdam	2.44
103	Comcast	West Central Street	Natick	Beaverdam	2.23
104	office building	235 West Central Street	Natick	Beaverdam	1.63
105	Office Building	233 West Central Street	Natick	Beaverdam	1.62
106	NTB (National Tire & Battery)	217 West Central Street	Natick	Beaverdam	1.65
107	Barber Bros.	215 West Central Street	Natick	Beaverdam	2.41
108	Natick Office park	209 West Central Street	Natick	Beaverdam	2.82
109	UPS	126 Commerce Drive	Ashland	Beaverdam	3.95
110	OB Hill Trucking & Rigging	197 West Central Street	Natick	Beaverdam	3.39
111	Hess Gas station & Coan Fuel Oil Company	194 West Central Street	Natick	Beaverdam	3.57
112	Mill Street Plaza	Mill Street & West Central	Natick	Beaverdam	1.10
113	Natick Auto Sales (Mitsubishi dealer)	157 West Central Street	Natick	Beaverdam	3.43
114	Roche Bros. & Walgreen's Shopping Center	148 West Central Street	Natick	Beaverdam	5.75
115	All American Self Storage	14 Mill Street	Natick	Fisk Pond	2.90
116	Mill & Speen Corner		Natick	Fisk Pond	2.07
117	CVS	137 West Central Street	Natick	Fisk Pond	1.49

Table 4-7 Inventory of Large Impervious Sites (page 5 of 5)

NUM	**Name** (Where Known)	**Address** (where known)	**Town**	**Subwatershed**	**Parcel size / acres**
118	Pierce Collision Center & Mobil Gas Station	135 West Central Street	Natick	Fisk Pond	1.94
119	West Central Associates	125 West Central Street	Natick	Fisk Pond	1.68
120	Market Basket Plaza		Ashland	Beaverdam	1.99
121	Natick Animal Clinic, Inc.	121 West Central Street	Natick	Fisk Pond	1.61
122	Natick VFW Post 1274	113 West Central Street	Natick	Fisk Pond	0.94
123	offices	West Central Street	Natick	Fisk Pond	0.52
124	Commonwealth of MA (National Guard depot)	Guard House/Speen Street	Natick	South Pond	12.25
125	Brown Elementary School	1 Jean Burke Drive	Natick	South Pond	3.74
126	Kennedy Middle School	1 Philip J. Lucier Drive	Natick	South Pond	4.09
127	Natick Golf Learning Center	Speen Street	Natick	South Pond	1.30
128	US Army Labs	Kansas Street	Natick	South Pond	46.78
129	US Army Labs	Kansas Street	Natick	South Pond	2.63
130	Whipple Company	Washington Street	Natick	South Pond	0.91
131	Pond Plaza		Ashland	Beaverdam	10.17
132	commercial warehouses	North Main Street	Natick	South Pond	8.31
133	commercial	North Main Street	Natick	South Pond	4.76
134	Natick Outdoor & Sports Store	38 North Avenue	Natick	Pegan Brook	0.92
135	Duralectric	61 North Avenue	Natick	Pegan Brook	0.83
136	Duralectric	61 North Avenue	Natick	Pegan Brook	1.35
137	Downtown Natick	Middlesex, Main, & North	Natick	Pegan Brook	14.60
138	commercial buildings	South Street	Natick	Pegan Brook	3.75
139	commercial building	East Central Street	Natick	Pegan Brook	2.39
140	commercial buildings	Main Street	Natick	Pegan Brook	2.23
141	Natick Public Library & Fire Station	East Central Street & South Street	Natick	Pegan Brook	5.79
142	offices with commercial		Framingham	Beaverdam	2.52

Source: Analysis of Orthophotos and town Assessors data by MAPC