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WARNER'S POND MANAGEMENT PLAN
CONCORD, MASSACHUSETTS

September 1999

Prepared for:

Town of Concord
Division of Natural Resources
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Aquatic Control Technology Inc.
Lake Restoration

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INTRODUCTION

The origin of Warner's Pond reportedly dates back to the 1800's when Nashoba Brook was dammed to generate power for a mill. The resulting waterbody that was created encompasses approximately 54 surface acres (Figure 1). Warner's Pond is relatively shallow with an estimated maximum and mean water depth of 12 feet and 4.5, respectively. There is also a considerable accumulation of soft sediment on the pond bottom. These sediments are rich in nutrients and provide an excellent medium for the nuisance levels of aquatic plant growth that are plaguing the pond. Sediment and nutrient deposition has likely occurred at an accelerated rate due to the sizeable watershed that extends into several neighboring Towns.

Area residents and Town Officials voiced concerns over deteriorating conditions at the pond in recent years. The Town identified the need for a Pond Management Plan to document current conditions and address concerns over the loss of open-water habitat. This prompted the Town of Concord to seek a grant from the Lake and Pond Grant Program administered by the Massachusetts Department of Environmental Management. After successfully receiving the grant award, the study objectives were finalized and a wildlife and habitat assessment of the pond was included to determine if the proposed management activities that focused on improving recreational access to the pond were consistent with the existing utilization of the pond habitat by wildlife.

The team of Aquatic Control Technology, Inc. (ACT) of Sutton, MA and New England Environmental, Inc. (NEE) of Amherst, MA was selected for this study. ACT conducted the Pond Management Study. The findings and recommendations are presented in this report. The Wildlife and Habitat Assessment conducted by NEE is presented under a separate cover.

METHODS AND APPROACH

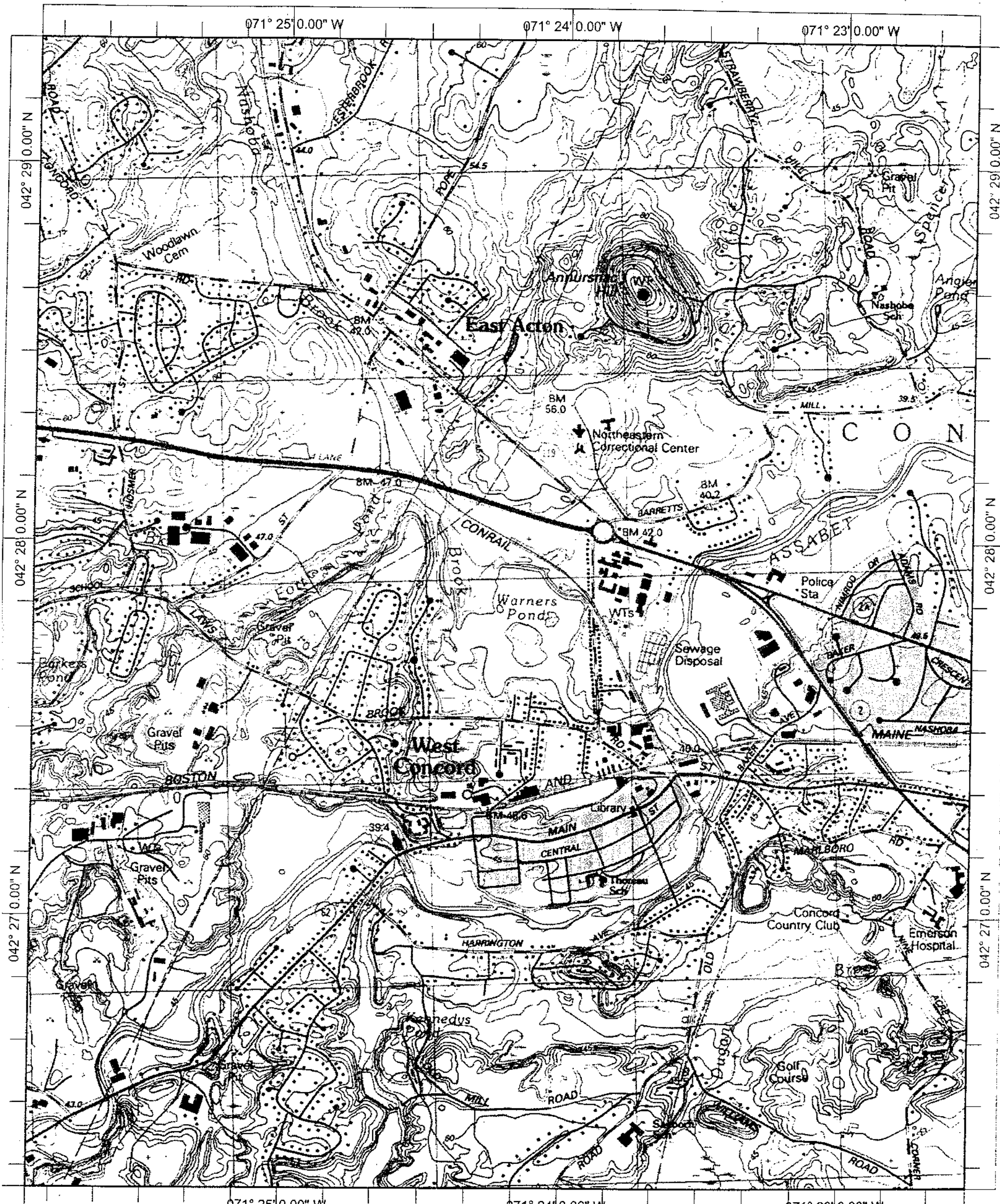
Aquatic Control Technology, Inc., (ACT) Biologists first met with Marcus Pinney, the Natural Resources Administrator for the Town of Concord, on April 23, 1999 to discuss study objectives and to review existing water quality data and information on Warner's Pond. A cursory inspection of the pond and collection of the first round of water quality sampling data was then performed on this date. The second round of water quality sampling and the remainder of the fieldwork was completed on August 6 and 9, 1999. Mid-summer was specifically chosen to document aquatic plant growth during its peak fluorescence and biomass.

The following water quality sampling sites were selected within the pond (Figure 2):

- <u>Inlet</u> – located on the western side of the pond, which receives inflow from the upstream confluence of Nashoba Brook and Fort Pond Brook.
- <u>Mid-Pond</u> – located east of Boy Scout Island.
- <u>Outlet</u> – located at the spillways in the southeastern end of the pond.

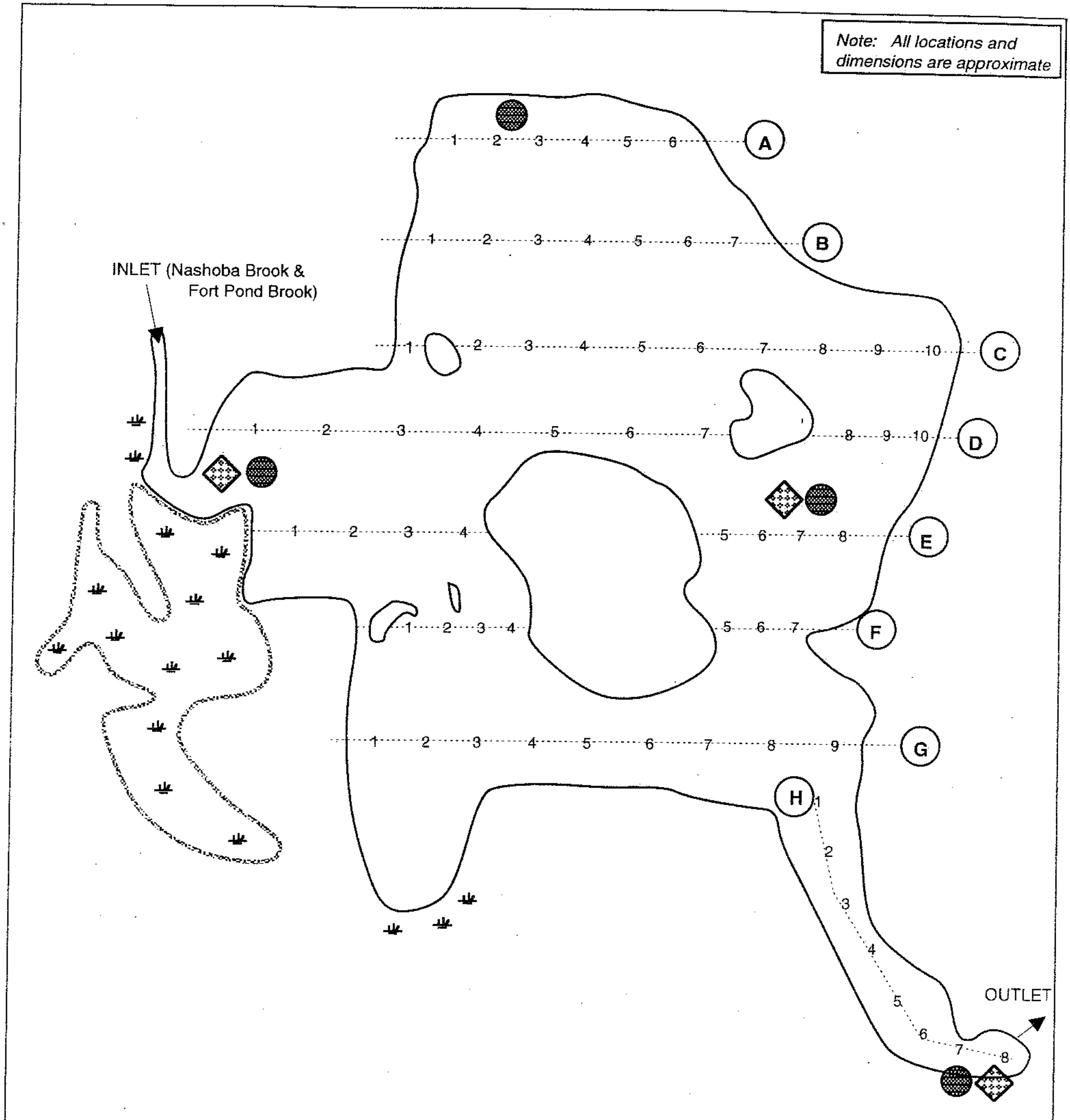
Surface grab water samples taken from approximately 1 foot below the water's surface were collected from each site. Samples were generally analyzed for the following water quality parameters: Kjeldahl-nitrogen, nitrate-nitrogen and total phosphorus. Microbac Laboratories, Inc. of Clinton, MA performed the water quality analyses work. Field testing of water temperature and dissolved oxygen content was performed at each sampling station using a YSI model 57 meter. A Secchi Disk was used to measure water transparency.

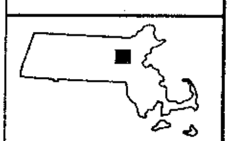
Sediment samples were collected on 8/6/99 from four locations in the pond and sent to the Soil and Plant Tissue Testing Laboratory at UMass Cooperative Extension for a screening analysis of some basic metal,



Name: MAYNARD
Date: 9/7/99
Scale: 1 inch equals 2000 feet

Location: 042° 27' 48.2" N 071° 24' 13.1" W
Caption: FIGURE 1 - SITE LOCUS
Warner's Pond
Concord, MA





USGS Quadrangle
Maynard, MA

WARNER'S POND
Concord, MA

Figure 2

Transect & Data Point Location Map

August 1999

LEGEND

Transect and Data Point Locations

Water Quality Sampling Locations

Sediment Core Sample Locations

Pond Area: ≈ 54 acres Scale: 1" ≈ 350'

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nutrient and textural parameters. Sampling locations included the Nashoba Brook inlet, Route 2 overflow, mid-pond and the pond outlet (Figue 2).

Eight transects were established running east to west across the pond and spaced approximately 250 feet apart using visual shoreline references. Each transect contained 6-10 data points depending upon the transect length. A total of 66 data points were established in Warner's Pond (Figure 2). At each data point the following information was recorded: water depth, sediment type and thickness, aquatic plants present in decreasing order of abundance, the total plant coverage was estimated and a plant biomass index was assigned. Information collected at each data point is compiled in Table 1.

A calibrated steel rod was used to measure water depth. The rod was then pushed through the unconsolidated (soft) sediments until a firm "hard pan" or refusal layer was reached, to provide thickness estimates. The bottom sediment was classified as mucky (M), sandy (S), rocky (R), gravelly (G) or a combination of these substrate types.

The plant community was also assessed at each data point. A long-handled rake and/or small Danforth anchor was dragged along the lake bottom to collect submersed plants; while floating, floating-leafed and emergent plants were visually inspected. Plants were identified to genus and species where possible. Plant cover was given a percentage rank based on the areal coverage of plants within an approximate 400 square foot area assessed at each data point. Generally, in areas with 100% cover, bottom sediments could not be seen through the vegetation. Percentages less than 100% indicated the amount of bottom area covered by plant growth.

Plant biomass was also estimated on a scale of 0-4, as follows:

- 0 No biomass; plants generally absent
- 1 Low biomass; plants growing only as a low layer on the sediment
- 2 Moderate biomass; plants protruding well into the water column but generally not reaching the water surface
- 3 High biomass; plants filling enough of the water column and/or covering enough of the water surface to be considered a possible recreational nuisance or habitat impairment
- 4 Extremely high biomass; water column filled and/or surface completely covered, obvious nuisance conditions and habitat impairment severe.

WATERSHED FEATURES

Warner's Pond is a shallow, impounded waterbody with an immense watershed/drainage area. The primary inlet is located on the western side of the pond. The confluence of Nashoba Brook and Fort Pond Brook lies only a few hundred feet to the northeast of Warner's Pond. Nashoba Brook receives drainage from several smaller streams located throughout a good portion of the Town of Acton, the southern portion of Westford and a small portion of eastern Littleton. Fort Pond Brook also has several smaller tributaries, with drainage extending through South and West Acton and into the southeastern portion of Boxborough and the northeastern portion of Stow. Previous estimates place nearly 95 percent of the watershed area outside of the Town of Concord.

Land use activities within the watershed include residential developments of varying density, Route 2 and other major roadways, commercial and industrial sites, agricultural usage, and undeveloped forest and wetland areas. Immediately adjacent to Warner's Pond there are approximately 33 residential houses along the eastern and southern shorelines. These houses are generally set back more than 100 feet from the edge of the pond and few have lawns that actually extend to the pond edge. Previous reports indicate only 5% of the shoreline is developed. Extensive wetlands border the western shoreline. Farmland abuts

TABLE 1 – FIELD SURVEY DATA

Transect Number & Sampling Point	Water Depth	Sediment Thickness	Sediment Type	Vegetation	Percent Cover	Biomass Index
A 1	2	3	M/S	Ny, F, Tn, L, Cd, Ec	100	4
2	3	3	M/S	Ny, Tn, Cd, L, Ec	100	3
3	4	6	M	Ny, Cd, Ec, Tn	75	2
4	6	4	M	Cd, Ny	25	1
5	8	> 12	M	---	0	0
6	7	6	M	Ny, Cd	25	1
B 1	2.5	2	M	Ny, Cd, Cc, L, Ec	100	4
2	3.5	6	M	Ny, Cc, Ec	100	3
3	6	> 14	M	---	0	0
4	10	> 10	M	---	0	0
5	11	> 9	M	---	0	0
6	11	> 9	M	---	0	0
7	6.5	4	M	Ny, Cd	25	1
C 1	1	2	M/S	Cd, Nu, Ny, Ec, L, W, Pn, F	100	3
2	1.5	2.5	M/S	Ec, Ny, Cd, L, F, Pe	100	4
3	2	2.5	M/S	Cd, Ny, Ec, L, F	100	4
4	4	2	M/S	Cd, Ny, Nu, Ec, Pe	75	2
5	3	2	M	Ec, Cd, Nu, Pe	50	2
6	4	4.5	M	Cd, Ec, Ny	50	2
7	5	7	M	Cd, Ec	25	1
8	3.5	7	M/S	Ec, Cd, Ny	25	1
9	4.5	1	G	Ny, Cd, Ec	75	3
10	3	5	M	Ny, Cd, F, Ca, Ec, Pe	75	3
D 1	1	2	M/S	Ny, Cd, F, L, W	50	2
2	1.5	4	M/S	Mh, F, L, W, Cd, Pe	75	3
3	2	4	M/S	Cd, Mh, F, L, W, Ny	100	3
4	1.5	3.5	M/S	Cd, Nu, F, L, Mh, W	100	3
5	2	2	M	Cd, Nu, L, Mh, F	75	3
6	2	2	M/S	Cd, Nu, Ec, Ny, Pe, F, L	100	3
7	3	2	M/S	Ny, Cd, Pe, L	75	3
8	3	5.5	M/S	Cc, Cd, Ny, Ec	75	2
9	4	4	M/S	Cd, Cc, Pe, Ec	75	2
10	3	1.5	M/S	Ny, Cd, L	75	2

Transect Number & Sampling Point	Water Depth	Sediment Thickness	Sediment Type	Vegetation	Percent Cover	Biomass Index
E 1	1.5	4	M	Cd, Ny, Ec, L	100	4
2	1.5	4	M	Cd, Nu, Ny, L, F	100	4
3	2	4	M	Ny, Nu, Cd, Ec, L	100	4
4	2.5	2	M	Cd, Nu, Ny, Ca, L, Ec	100	3
5	3	1.5	M/S	Ny, Cd, Nu, Ec, Cc, Pe, L	100	3
6	4	2.5	M	Ny, Pe, Cd, Cc	75	3
7	4	4	M/S	Cc	75	2
8	3.5	3.5	M	Ny, Cd, Pe, Cc	75	3
9	4	2	M/S	Cd	25	1
F 1	2	4	M	Ny, Cd, L, Ec, Nu	100	4
2	2	2	M	Ny, Cd, L, Ec	100	4
3	2	2	M	Ny, Cd, Ec, Nu, L	100	3
4	1.5	2	M	Cd, Nu, Pe, Ec, Ny, L	100	3
5	2.5	1.5	M/S	Ny, Cd, Pe, L	100	3
6	4.25	2	M/S	Ny	25	1
7	3	1	G	Ny, Cd, Cc, L, Pe	75	3
G 1	1	3	M	Ny, Nu, Po, Tn, D	100	4
2	2	2	M	Ny, Nu, Cd, L	100	4
3	1	2	M	Ny, Cd, L	100	4
4	2	2	M	Ny, Cd, L	100	4
5	3	2	M	Cd, Ny, Pe, Cc, Nu, L, Ec	100	4
6	3	1	M	Cd, Ny, Nu, Ec, L, B, Cc	100	4
7	4	3	M	Cd, Pe, Cc, Ny	75	2
8	5	2	M	Cd, Ny	50	2
9	3	1	M/S	Ny, Cd, L	75	3
H 1	5	2	M/S	Cd, Cc, Ny	25	1
2	5.5	0.5	S/G	Cd	25	1
3	6	0.5	S/G	Cd	25	1
4	6	0.5	S/G	Cd, Cc	25	1
5	5.5	0.5	S/G	Cd, Ny	25	1
6	6	0.5	S/G	Cd, Ny	25	1
7	5	0.5	S/G	Cd	25	1
8	4	0.5	R/G	---	0	0

the northern shoreline before encountering Route 2. MCI Concord also has several facilities within close proximity to the pond. Reportedly, there are no storm drains that empty into Warner's Pond and adjacent properties are connected to the Town of Concord Watershed Treatment Facility.

Accurately calculating the actual watershed area for Warner's Pond would be a formidable task considering the number of tributaries and amount of development. The watershed area is clearly several hundred times the size of the Warner's Pond. Typically, drainage basin to lake basin ratios greater than 25:1 suggest that in-pond water quality will be critically affected by land use and management practices within the watershed.

POND FEATURES

Morphology

Warner's Pond has a reported surface area of 54 acres. Pond acreage was verified by planimetering the USGS topographical quadrangle. The irregularly shaped coves shown on the quadrangle in the southwestern corner of the pond are included in the 54 acres. These coves are completely overgrown by emergent and wetland vegetation. NEE described this area as a shrub-scrub wetland. This overgrown area is estimated to be 5-6 acres in size. Dense emergent vegetation is also prevalent in other areas along the western shoreline and near the inlet. The surface area of the remaining standing-water portions of Warner's Pond is probably slightly less than 48 acres. There are three islands that support upland vegetation in the pond, the largest totals nearly 6 acres and is named Boy Scout Island.

Nashoba Brook and Fort Pond Brook (herein referred to as Nashoba Brook) provide the majority of inflow to Warner's Pond. Direct precipitation and overland flow from the remaining watershed area are also contributing water sources. The majority of the pond bottom is overlain with fine muck/silt that probably restricts groundwater discharge to the pond.

The pond outlet is located at the end of the long cove in the southeastern corner of the pond. There is a concrete spillway equipped with a low-level gate valve, but the water level and outflow appears to be regulated by an adjacent stone spillway/dam. Approximately 3 inches of water was flowing over the stone dam in April 1999, while only seepage through the stone dam was observed during the August 1999 inspections.

Water Depth

Based on measurements taken on the concrete spillway, the water level dropped approximately 1.25 feet between the end of April and beginning of August 1999. It should be mentioned that the months of June and July 1999 had some of the lowest rainfall totals on record. Approximately one foot of water depth was added to the actual water depths recorded at each data point location to produce a bathymetry (water depth contour) map for Warner's Pond (Figure 3). This assumes the top of the stone dam to be the normal full water level. A maximum water depth of 12 feet was encountered in the northeastern portion of the pond. The average water depth is estimated at 4.5 feet. The water depth is less than 4 feet throughout the entire western half of the pond. Locations near the inlet and in the southwestern corner were generally less than 2 feet. A channel approximately 5-6 feet deep runs from the northern end of the pond, around the eastern side of the islands and into the outlet cove.

Sediment Thickness

The unconsolidated sediment thickness ranged from ≤ 0.5 to >10 feet where measured, and the average thickness is estimated at 3.25 feet (see Figure 4). The more substantial accumulations were found in the northern end, and were composed of loosely packed muck. Soft sediment thickness exceeded 10 feet at a few of the data points along transects A & B. Fine sediments routinely migrate to the deepest area in a

Note: All locations and dimensions are approximate

WARNER'S POND

Concord, MA

Figure 3

Bathymetry Map

August 1999

LEGEND

- Depth contour lines are recorded in feet
- The depth contours shown are approximated based on water levels at the top of the stone spillway, or about one foot below the concrete spillway

Pond Area: ≈ 54 acres   Scale: 1" ≈ 350'

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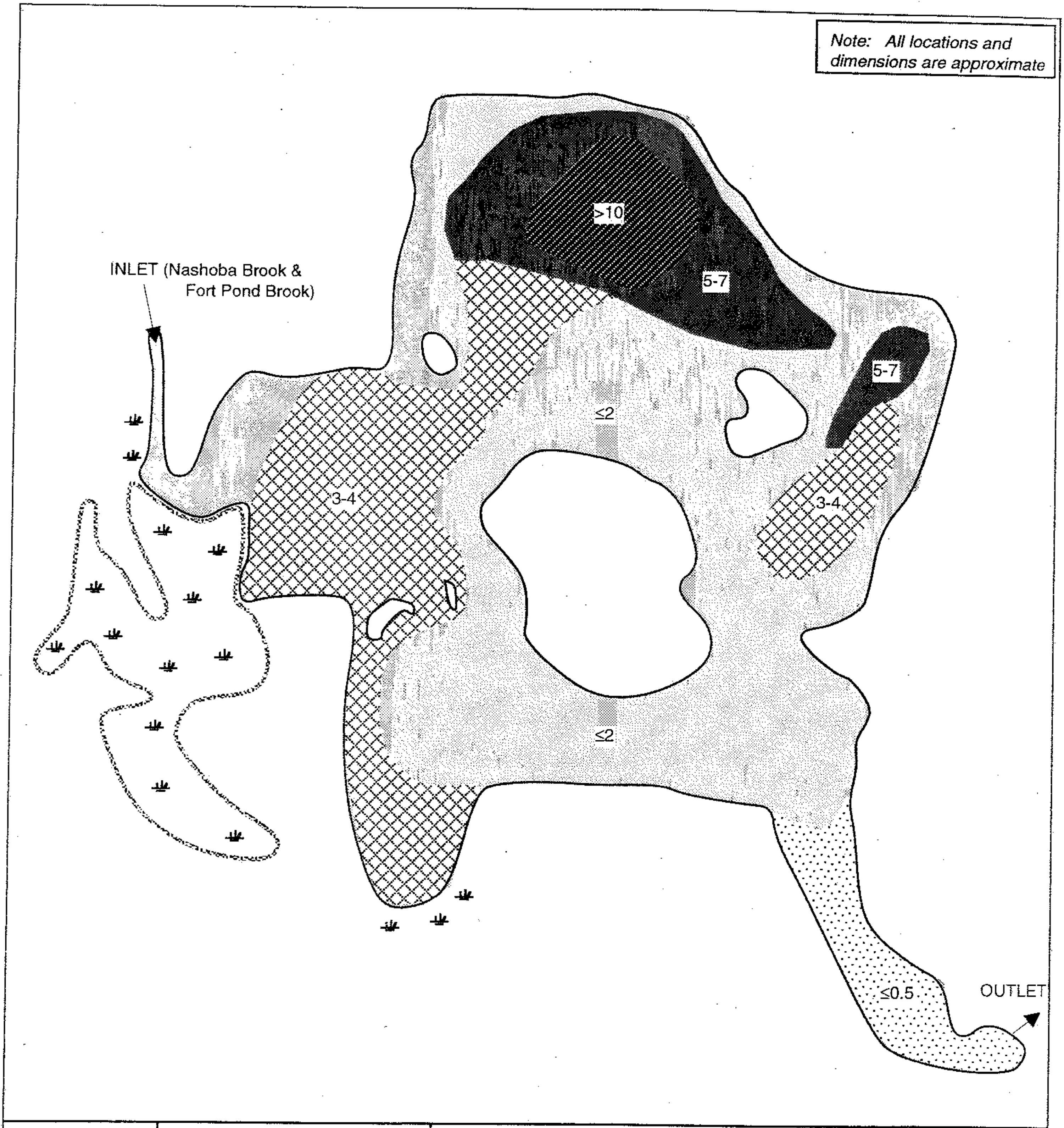


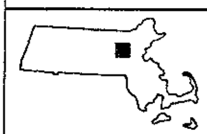
WARNER'S POND

Concord, MA

Figure 4

Soft Sediment Thickness Map

August 1999



USGS Quadrangle
Maynard, MA

LEGEND

- ≤0.5 feet
- ≤ 2.0 feet
- 3-4 feet
- 5-7 feet
- >10 feet

Shading represents approximate soft sediment accumulation before encountering a firm refusal layer

Pond Area: ≈ 54 acres Scale: 1" ≈ 350'

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waterbody. Soft sediment deposition in the inlet area generally ranged from 3-4 feet thick. The sediment composition in these areas was a sandy muck before encountering a refusal layer. A slightly less sandy muck with accumulations of 2 feet or less was found throughout the middle and southeastern portions of the pond. The outlet cove was the exception with less than 0.5 feet of sandy gravel.

Inorganic sediments usually enter a waterbody from erosion in surface runoff. Organic sediments can be added by decaying plants, algae and leaf litter. Once substantial plant growth is established, the eutrophication process may accelerate, as more and more plant biomass is deposited at the end of each growing season. As the sediment becomes more organic in composition it exerts a greater oxygen demand through decomposition processes, which can affect oxygen levels in the water column above. Under low oxygen conditions, transfer of nutrients (particularly phosphorus) back into the water column can be significant. Substantial amounts of soft sediments may negatively impact water quality or the general condition of the pond.

Sediment Analysis

Core samples were collected from the upper 2 feet of soft sediment from the following four locations in Warner's Pond: Nashoba Brook inlet, Route 2 overflow, mid-pond and the pond outlet. These samples were sent to Water and Tissue Testing Laboratory at the University of Massachusetts Cooperative Extension in Amherst, for analysis of some basic metal, nutrient and textural (grain size) analysis. The soil analyses that were performed are not comprehensive enough to fulfill the state permitting requirements associated with a dredging project. Instead, they provide an overview of the existing sediments in Warner's Pond and how they may influence dredging design or permitting efforts. Laboratory results are provided in Attachment A.

Differences in the textural analysis of the sediment samples reflect the primary sources of sediment deposition at the four sampling locations in the pond. Both the Nashoba Brook inlet and mid pond locations consisted of roughly 32-33% sand, 52-54% silt and 15% clay. This mix of substrate types suggests that considerable external nutrient loading has occurred. Stormwater and high flow conditions can readily transport heavier sand particles downstream. These mixed substrate deposits were observed in the immediate vicinity of the Nashoba Brook inlet and extend through the mid-pond sampling location. The Route 2 overflow sampling location was composed of 65% silt, 27% clay and 8% sand. The greater silt component of this substrate mixture is representative of fine suspended solids and sediments that accumulated through the decomposition of organic debris, namely aquatic vegetation and algae. These mucky sediments were found throughout the northern portion of the pond. The lack of sand at this location also indicates that there is not much sediment transport resulting from the direct overland flow of stormwater from Route 2. Sediments from the outlet cove were almost entirely composed of sand. Outflow is constricted by the narrow outlet cove, which likely produces a scouring effect, removing finer silts from the pond bottom.

Nutrient levels are obviously sufficient to support rooted aquatic plant growth. As expected, nutrient levels were higher sediments with a greater silt component. Ammonium-nitrate concentrations, which indicate organic content, were more than three times higher at the Route 2 overflow than at any other sampling location.

The limited metals screening revealed somewhat elevated lead concentrations, especially at the Route 2 overflow and outlet sampling locations. Results of the other tested parameters did not show any obvious contamination, but the finer silt component of the sediments throughout much of the pond may hold elevated concentrations of other metals or total petroleum hydrocarbons. This may be especially true given the amount of development throughout the watershed. The lead concentrations alone may yield a Category II and Type B or C classification during a 401 Water Quality Certification review with MA

DEP, which is required for dredging operations. These classifications would not be expected to prohibit dredging, but they may limit disposal options to either a lined landfill or site with limited public access.

Actual sediment analysis for a dredging project would require that several composite core samples be collected, throughout the area to be dredged and to the intended depth of dredging. More detailed analyses are also required, using approved EPA analytical methods and detection limits.

Water Quality

The water quality sampling was limited to a few parameters that influence aquatic plant and algal growth. Results from the laboratory analysis of water quality are presented in Table 2 with the original laboratory reports provided in Attachment A. Each parameter is discussed in detail below.

TABLE 2 - WATER QUALITY ANALYSIS RESULTS

Sampling Station	Date	Kjeldahl Nitrogen (mg/L)	Nitrate Nitrogen (mg/L)	Total Phosphorus (mg/L)
Nashoba Brook Inflow	4/23	0.58	0.7	0.03
	8/6	0.59	<0.3	0.05
Mid-Pond	4/23	0.67	0.8	0.07
	8/6	1.6	<0.3	0.14
Outlet	4/23	0.5	0.6	0.04
	8/6	0.89	<0.3	0.07

Two separate measures of nitrogen were analyzed. Total Kjeldahl-nitrogen (TKN) is a measure of organic and ammonium nitrogen forms. Elevated TKN values usually represents conditions of low oxygen and the natural decay of organic materials. The mid-pond sample collected in August was slightly elevated, but for the most part the results showed low to moderate concentrations.

Nitrate-nitrogen is the end product of the nitrogen cycle during aerobic decomposition and is available to aquatic plants as a nutrient source. Large concentrations of nitrate may indicate fertilizer or septic system inputs, and can stimulate nuisance algae and plant growth. Results during the April sampling round were slightly elevated, and may have been influenced by spring run-off. Nitrate-nitrogen was below the detection limit at each sampling location in August.

The combination of TKN and nitrate nitrogen approximates the amount of total nitrogen in a system. The total nitrogen values gleaned from these results would be elevated for an oligotrophic waterbody, but reasonably moderate for a mesotrophic or eutrophic pond.

Phosphorus is generally considered to be the limiting nutrient in freshwater systems. Values no greater than 0.02 mg/L are desirable for low algal biomass and high water clarity, while concentrations above 0.05 mg/L are considered excessive. The tested values ranged from 0.03 to 0.14 mg/L. The phosphorus values were elevated above desirable levels during each of the sampling rounds. Interestingly, phosphorus concentrations were higher at the mid-pond and outlet stations that at the inlet station. This may indicate that phosphorus concentrations are diluted in the inlet waters. It may also suggest, however, that phosphorus is internally recycled within the pond, as it is released from the bottom sediments under anoxic conditions. The pond wide average, combining the stations over all the sampling rounds, yields a phosphorus concentration of 0.07 mg/L. While these values are elevated, they are consistent with past sampling efforts and not atypical for mesotrophic and eutrophic ponds in Massachusetts.

Temperature and dissolved oxygen measurements were collected at each Station during August sampling round.

TABLE 3 - TEMPERATURE/DISSOLVED OXYGEN TESTING RESULTS

Sampling Station	8/6/99 Sampling Round		
	Depth (m)	Temp. (°C)	D.O. (mg/l)
Nashoba Brook Inflow	sur.	28.4	8.8
	Depth (m)	Temp. (°C)	D.O. (mg/l)
Mid-Pond	sur.	27.1	11.1
	0.5	26.6	10.0
	1.0	24.7	5.7
	2.0	24.2	1.3
	Depth (m)	Temp. (°C)	D.O. (mg/l)
Outlet	sur.	27.6	10.2
	0.5	25.8	7.5
	1.0	24.6	4.6
	1.5	24.3	1.4

Oxygen levels were super-saturated at the surface, which was probably caused by the extensive plant and algal growth. Warner's Pond is too shallow to become truly thermally stratified, but noticeable drops in dissolved oxygen concentrations were found along the bottom indicating decomposition of the organic material. Significant fluctuations in the diurnal and nocturnal oxygen concentrations are likely. Mid-summer water temperatures appear to be too warm to support cold water fish species (i.e. trout).

The Secchi Disk transparency reading dropped from 4.8 feet in April to 2.2 feet in August. This was likely caused by increased water coloration and elevated algal abundance, both of which are typical mid-summer conditions in shallow, eutrophic waterbodies.

Water samples were collected for algal analysis during ACT's two visits to the pond. The 4/23/99 sample was dominated by small chlorococcalean greens or Chlorophyta (*Scenedesmus, Ankistrodesmus*) and low densities of goldens or Chrysophyta (*Synura*), and diatoms or Bacillariophyta (*Fragilaria*). Total algal density was moderate in the sample, with counts estimated at 3,500 cells/ml. The composition also suggests that algae was undergoing succession from spring to early summer conditions, with nitrogen being more readily available than phosphours. The 8/6/99 sample was dominated by nitrogen-fixing blue-greens or Cyanophyta (*Anabaena*) and dinoflagellates or Phyroophyta (*Ceratium*), with lesser amounts of greens, euglenoids or Euglenophyta (*Trachelomonas*) and goldens. The algal density had increased almost three-fold, with counts exceeding 9,900 cells/ml. This algal composition suggests that there was ample availability of phosphorus. Overall, the results represent fairly typical seasonal phytoplankton succession for a nutrient rich pond.

The overall water quality indicates that Warner's Pond is a nutrient stressed system. External loading from stormwater and background inflow appears to be the primary nutrient source. While many nutrients are likely flushed through the pond during periods of high water flow, there is inevitably a considerable amount of nutrient and sediment detention. There is also an internal source of nutrients made available through the continual decay of organic material along the pond bottom. Nutrients are released from the bottom sediments and can become resuspended in the water column under anoxic conditions, which often develop during the warmer summer months. These nutrients are then readily available for algal or aquatic plant uptake.

Even if all external loading sources were eliminated, which is impractical in this situation, a substantial reduction of the existing nutrient sources within the pond would be needed to see reduced weed and algal densities. This should not discourage efforts to reduce sources of nutrients within the watershed, but should be considered when formulating management objectives and evaluating management alternatives.

Aquatic Plant Community

Warner's Pond supports extensive aquatic plant growth and several distinct plant assemblages. The dominant plants encountered during the field inspection are listed in Table 4 below:

TABLE 4 – DOMINANT AQUATIC PLANTS IN WARNER'S POND

Scientific Name	Common Name	Abbreviation Used in Field Survey Data and Maps	Plant Type	Distribution
Brasenia schreberi	Watershield	B	Floating-Leafed	Sparse – mixed in with other lily coverage at southern end of the pond
Callitriche	Water Starwort	Ca	Submersed	Sparse – found in a few locations west of Boy Scout Island
Cabomba caroliniana	Fanwort	Cc	Submersed (Non-Native)	Common – second most prevalent submersed plant in southeastern portion of pond, scattered in other locations
Ceratophyllum demersum	Coontail	Cd	Submersed	Abundant – most prevalent submersed plant throughout pond
Decodon verticillatus	Water Willow	Dv	Emergent	Abundant – along shoreline in western half of pond, patches elsewhere
Elodea canadensis	Waterweed (Elodea)	Ec	Submersed	Common – varying distribution throughout pond, especially in northern end
Lemna sp.	Duckweed	L	Floating	Common – trapped in areas with dense lily coverage
Lythrum salicaria	Purple Loosestrife	Ly	Emergent (Non-Native)	Scattered/Common – growing along shoreline margins, mixed into dense water willow stands
Myriophyllum heterophyllum	Variable Watermilfoil	Mh	Submersed (Non-Native)	Sparse – low density plants extending from inlet to northern side of Boy Scout Island
Nuphar luteum	Yellow Waterlily	Nu	Floating-Leafed	Abundant – extensive beds in western half of pond, scattered patches and shoreline growth elsewhere
Nymphaea odorata	White Waterlily	Ny	Floating-Leafed	Abundant – extensive beds in western half of pond, scattered patches and shoreline growth elsewhere
Potamogeton epihydrus	Ribbon-Leaf Pondweed	Pe	Submersed	Scattered – mixed in with other submersed plants in several locations
Potamogeton natans	Floating-Leaf Pondweed	Pn	Submersed	Sparse – confined to inlet area
Pontederia cordata	Pickerelweed	Po	Emergent	Sparse – mixed in with lily growth in southeast corner of pond
Wolffia sp.	Watermeal	W	Floating	Scattered/Common – trapped in areas with dense lily coverage
---	Filamentous Algae	F	Floating & Submersed Mats	Scattered/Common – most prevalent in areas with dense submersed plant growth and less lily coverage

Dominant aquatic plant assemblages are depicted in Figure 5. The different hatching patterns on the map represent shifts in dominance of the aquatic plant community, as well as changes in percent cover and biomass. Plants are listed in a decreasing order of abundance.

While the survey focused on documenting the aquatic plant coverage, the extensive emergent and wetland plant growth could not be ignored. Dense stands of water willow extend from a point north of the Nashoba Brook inlet southwards along the entire western shoreline of the pond. Water willow appears to be encroaching into shallow water areas that have contiguous waterlily coverage. Purple loosestrife growth is scattered throughout this dense stand of water willow, but its total coverage was only estimated at 15-20%. Narrow bands of water willow and scattered purple loosetrife plants are found along much of the remaining pond shoreline.

The most abundant and visible aquatic plant assemblage is the nearly contiguous growth of white and yellow waterlilies. This plant assemblage is found in the southwestern corner of the pond, it also extends around the northern end of the pond and is established in several large patches around the islands and along the shoreline in the eastern half of the pond. Also present in this plant assemblage is a dense understory of submersed plant growth that is dominated by coontail, elodea and pondweed. Duckweed, watermeal and filamentous algae are also floating around the waterlily leaves. There is 100% plant cover in these areas and it is assigned a biomass index of 4, which represents the most abundant plant growth.

The northwestern corner of the pond – extending from the inlet to mid-pond on the northern side of Boy Scout Island – supports the second most abundant aquatic plant assemblage. Lily coverage is secondary to submersed coontail and elodea growth in these areas, but still covers approximately 50% of the surface. Ribbon-leaf pondweed, filamentous algae, fanwort, duckweed and watermeal are commonly encountered in this assemblage. There is still nearly 100% plant cover in this assemblage and a biomass index of 3-4.

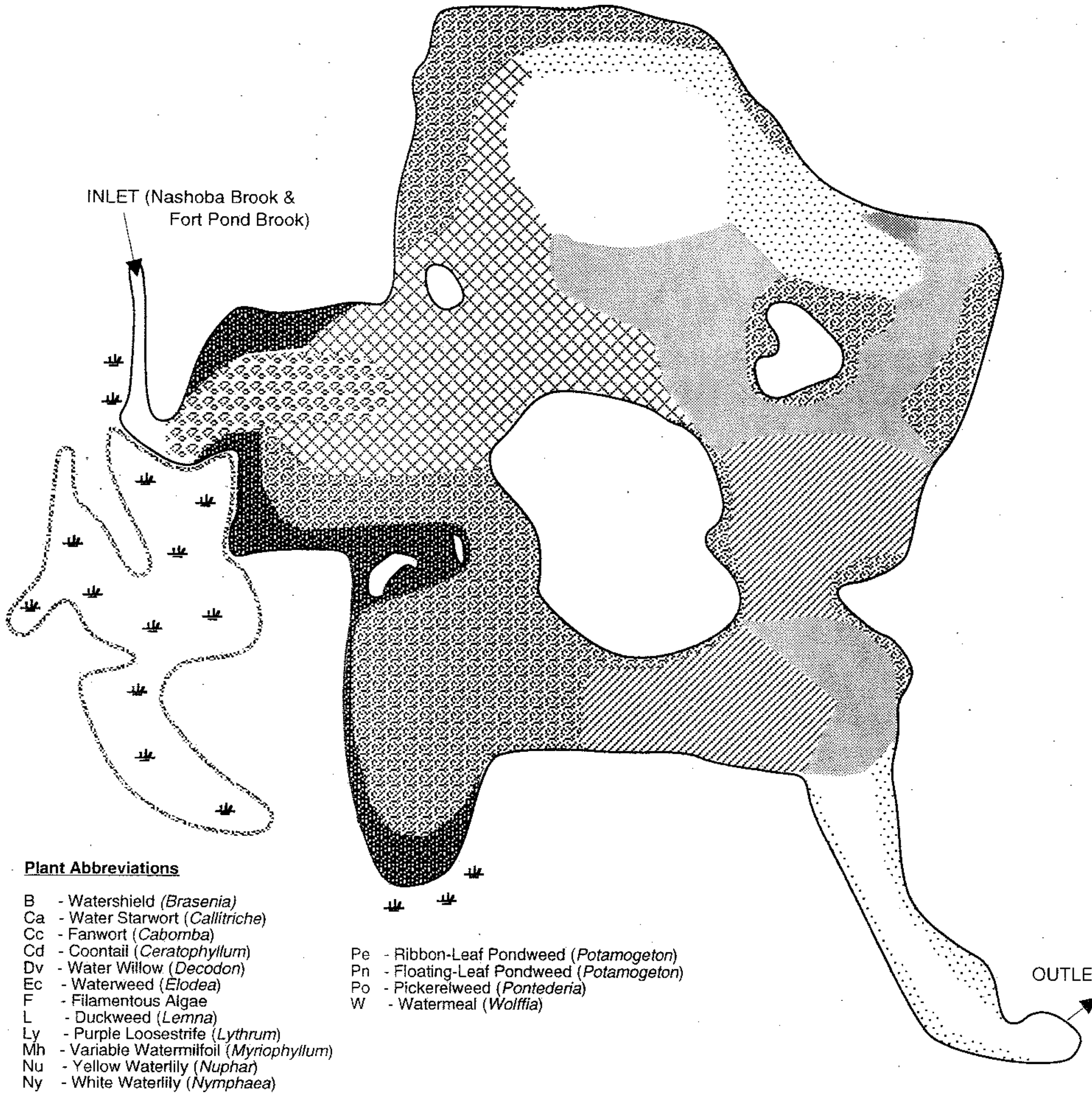
In the immediate vicinity of the Nashoba Brook inlet the plant community is dominated by submersed growth of coontail and variable watermilfoil. There are also scattered patches of white waterlilies, as well as filamentous algae, elodea, water starwort, ribbon-leaf pondweed, duckweed and watermeal. There is only 50-75% plant cover in this area, but with water depths of only 2-3 feet a biomass index of 3 was assigned.

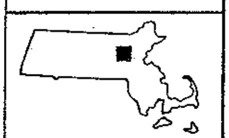
Where water depths range between 4-6 feet in the northeastern half of the pond and immediately north of the outlet cove in the southeastern corner, the plant community is dominated by submersed species including coontail, elodea and ribbon-leaf pondweed. Patches of white waterlilies are also scattered throughout this plant assemblage. The submersed plants are generally growing to within 1 foot of the surface, with the coverage ranging between 50-75% and it has a biomass index of 2.

Fanwort is most prevalent east and south of Boy Scout Island, but remains secondary to coontail in abundance. White waterlilies, ribbon-leaf pondweed, elodea and watershield are also commonly encountered in this assemblage. Plant cover was estimated at 75% and a biomass index of 3 was assigned, since plants were breaching the surface throughout much of the area.

The least abundant plant assemblage was limited to the northeastern portion of the pond and along the shorelines of the outlet cove. Coontail, white waterlilies and scattered fanwort growth were found in these areas. Total plant cover was only 25% and the biomass index was 1.

The only sections of the pond that did not support any aquatic plant growth was where water depths exceeded 6 feet at the northern end of the pond and in the center of the outlet cove.





USGS Quadrangle
Maynard, MA

WARNER'S POND

Concord, MA

Figure 5

Dominant Aquatic Vegetation Map

August 1999

LEGEND

Dominant Plants	%Cover/Biomass
Dv, Ly, Po, Ny, Nu	100 / 4
Ny, Nu, Cd, Ec, Pe, F, L, W, Tn	100 / 4
Cd, Ec, Ny, Nu, Pe, F, Cc, L, W	100 / 3-4
Cd, Ec, Ny, Pe	50-75 / 2
Cd, Mh, Ny, F, Ec, Ca, Pe, L, W	50-75 / 3
Cd, Cc, Ny, Pe, Ec, B	75 / 3
Cd, Ny, Cc	25 / 1

Pond Area: ≈ 54 acres Scale: 1" ≈ 350'

AQUATIC CONTROL TECHNOLOGY INC.
Lake Restoration

By mid-summer it is estimated that approximately 6 acres support little or no vegetation and another 4 acres have low density plant growth. This translates into potentially nuisance plant growth conditions throughout 80% of the open-water portions of Warner's Pond.

The non-native or exotic plant cover in Warner's Pond was mapped separately in Figure 6. The three non-native aquatic plants identified are fanwort, water chestnut and variable watermilfoil. Purple loosestrife, a non-native emergent/wetland plant is also widely scattered around the entire pond shoreline, and is well integrated into the dense stands of water willow found on the western side of the pond.

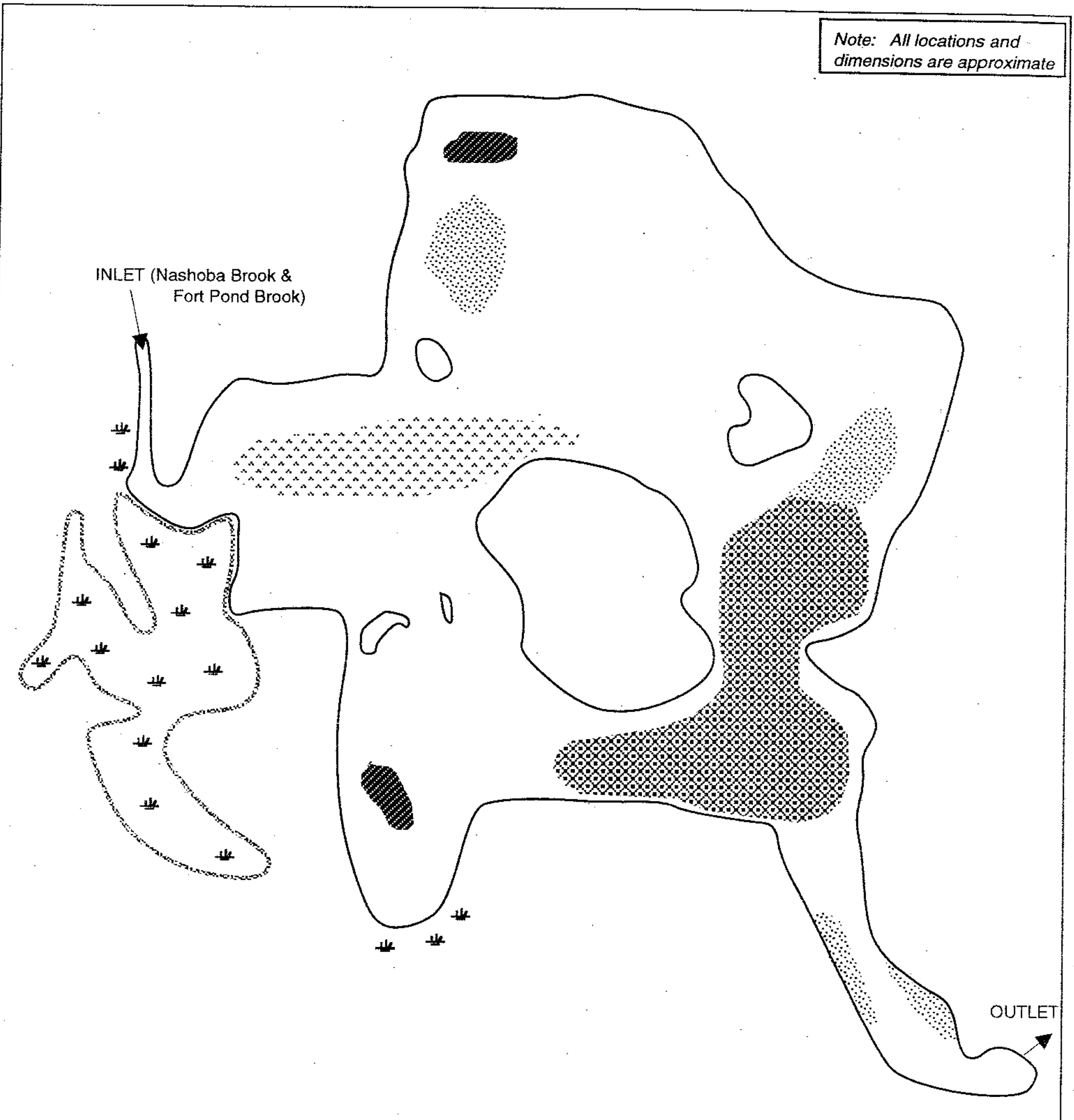
Fanwort was clearly the most widespread non-native plant, but never was it the most abundant plant in a given area. The greatest concentration of fanwort was found in the southeastern corner of the pond. Variable watermilfoil appeared to be limited to a narrow band extending from the Nashoba Brook inlet to the northern side of Boy Scout Island. Coontail appeared to be equally abundant in this area. The non-native plant that probably presents the greatest threat to further reducing open-water conditions in Warner's Pond is water chestnut. Only a few isolated patches of water chestnut growth were found interspersed in the dense waterlily cover at the northwestern and southwestern ends of the pond. The water chestnut coverage appears to have been kept at manageable levels through Town sponsored hand-pulling efforts over the past several years.

MANAGEMENT OBJECTIVES

The Town of Concord stated that the primary concern voiced by residents regarding Warner's Pond is continual loss of open-water. For the purposes of this study "open-water" is used to define pond areas that do not support abundant rooted vegetation reaching the surface by mid-summer. It is already acknowledged that the extensive aquatic plant growth and poor water clarity prohibits swimming at Warner's Pond, but further loss of open-water may adversely effect fish, waterfowl and wildlife habitat, and threaten the remaining recreational uses of Warner's Pond, which include fishing, boating and wildlife viewing. This study was intended to document existing conditions in the pond and develop a long-term management plan that will focus on specific objectives and potentially establish distinct management zones for preservation of a particular usage.

Documenting the existing conditions in Warner's Pond was the initial step in identifying management objectives. Specific pond characteristics that were investigated in addition to aquatic plant assemblages included water depth, soft sediment thickness and composition, and water quality. The previously presented results for each of these characteristics verify the obvious fact that sediment, nutrients and possibly other pollutants are readily transported to Warner's Pond from its extensive watershed. While most impounded waterbodies have higher eutrophication rates than waterbodies that are naturally occurring, development within the Warner's Pond watershed over the past several decades has undoubtedly increased the transport of sediment and nutrients to the system. This is increased rated of eutrophication is commonly referred to as cultural eutrophication. Controlling the sources of sediments and nutrients present in surface runoff is necessary to improve water quality and slow the rate of cultural eutrophication.

The Town of Concord has already recognized the importance of watershed management to the long-term "health" of Warner's Pond. Where practically the entire watershed is located in the Town of Acton and other surrounding communities, instituting and enforcing Best Management Practices (BMP's) that can often help reduce sediment and nutrient loading becomes a monumental task from an organizational and jurisdictional standpoint. Fortunately, the Town of Acton is reportedly working with DEP and other organizations to design an aggressive program targeting nutrient load reductions within the Warner's



USGS Quadrangle
Maynard, MA

WARNER'S POND
Concord, MA

Figure 6

Non-Native Aquatic Vegetation Map

August 1999

LEGEND

Non-Native Plant	%Cover/Biomass
Trapa natans	25 / 2
Cabomba caroliniana	50-75 / 3
Cabomba caroliniana	25 / 1
Myriophyllum heterophyllum	50 / 2

Pond Area: ≈ 54 acres Scale: 1" ≈ 350'

Aquatic Control Technology Inc.
Lake Restoration

Pond watershed as compensation for anticipated nutrient increases to the Assabet River that will be caused by proposed wastewater treatment plant. Even still, it is important that nutrient load reduction efforts begin "at home."

A generic list of watershed management alternatives is provided in Attachment B. Many of these techniques are not applicable at Warner's Pond, but should be suggested to the Town of Acton and other communities as they seek to reduce nutrient loads within the Warner's Pond watershed. Even though the abutting properties are sewered and they have a relatively good vegetative buffer strip intervening between the managed lot and Warner's Pond, property owners should be encouraged to institute Best Management Practices (BMP's). These behavioral modifications should target reducing potential sources of nutrient contamination to the groundwater or directly to the pond. Specific examples of BMP's include, limiting or modifying lawn fertilization practices, using low or no-phosphorus fertilizers and cleaning products, picking up pet waste, maintaining vegetative buffer zones and performing routine septic system maintenance. Often times, watershed residents need to be educated on how their activities directly or indirectly effect the pond. An example of an educational brochure is also provided in Attachment B. Developing a specific handout for Warner's Pond or simply providing some generic information on BMP's may be instrumental in raising the awareness and interest of watershed residents located within and outside of the Town of Concord.

Regardless of the effectiveness of future watershed management activities, in-pond management activities will be needed to restore and/or preserve desirable conditions. The abundant submersed plant growth is primarily responsible for limiting recreational access and reducing the amount of open-water in the pond. The direct correlation between the amount of plant growth and water depth, however, necessitates the investigation of whether increased sediment deposition is a possible cause of the abundant plant growth. It appears as if 2-4 feet of silt and muck have been deposited along most of the pond bottom. This is not surprising for an impounded waterbody that dates back to the 1800's. This probably accelerated the transformation of open-water to a shrub-scrub wetland in the 5-6-acre area directly south of the Nashoba Brook inlet. Loss of open-water is also progressing along the western shoreline where water willow is well established. Invasive emergent plants like water willow and purple loosestrife may hasten the loss of open-water by expanding their coverage and increasing the rate of sedimentation. Reversing the effects of eutrophication in the western half of the pond, however, would be a costly and disruptive undertaking. What this does is validate the need to preserve open-water conditions in other areas of the pond

The following sections propose a specific management plan and evaluate in-pond management activities to achieve the stated management objectives.

PROPOSED MANAGEMENT PLAN

The findings of this study and those of the Wildlife and Habitat Assessment conducted by NEE were considered when attempting to identify specific management activities within Warner's Pond. Each of the four habitat types identified by NEE – shallow marsh, water willow marsh, open-water and mixed upland forest – are to some degree utilized by wildlife. Management activities must therefore integrate the intended usage of the pond for recreational boating, fishing and wildlife watching, with wildlife habitat preservation. In addition, specific objectives need to be identified before in-pond evaluating management activities or creating distinct habitat preservation and management zones.

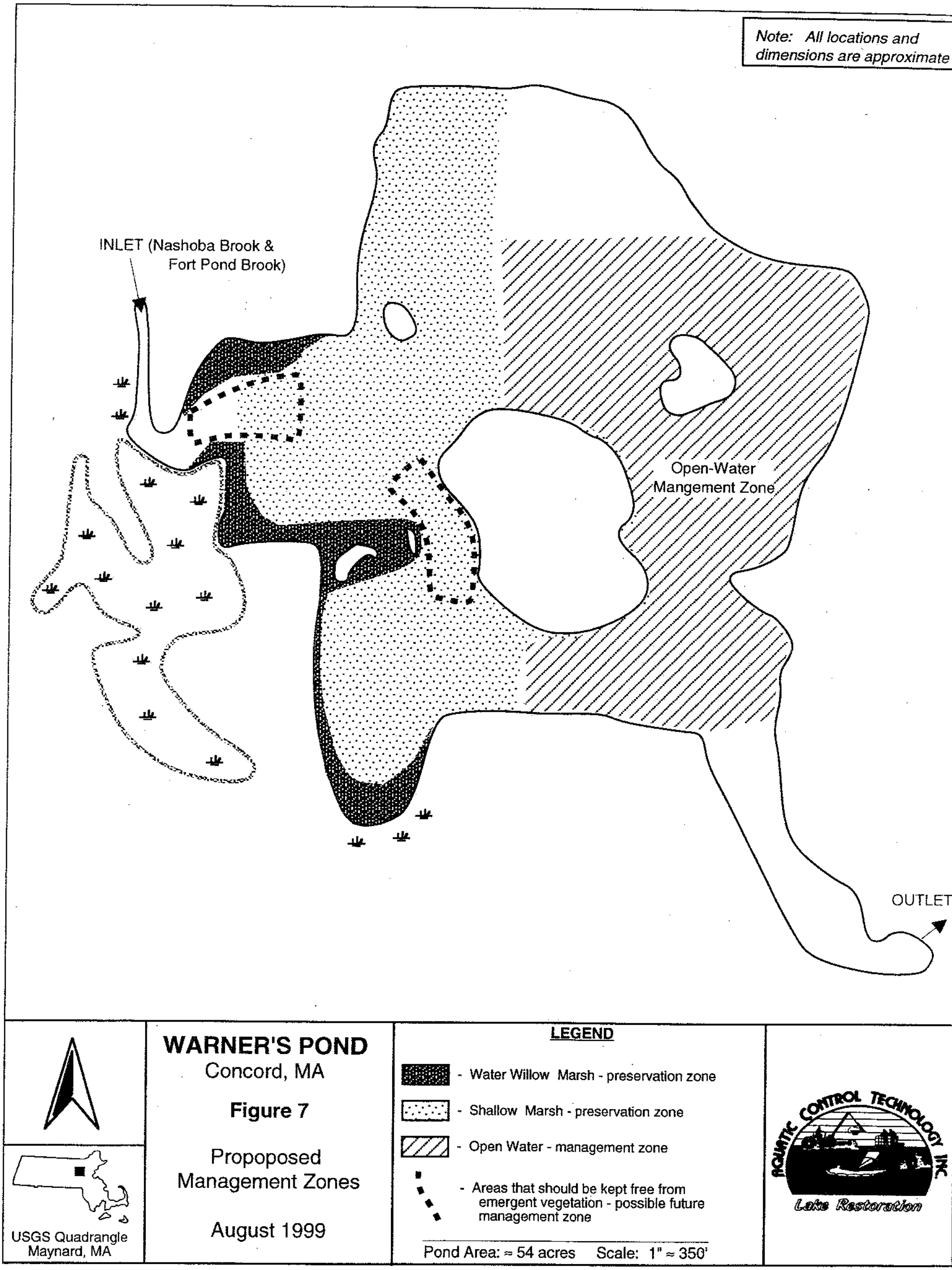
Specific in-pond management activities may vary from year to year, but should be guided by the following objectives:

- Increase open-water habitat
- Control non-native vegetation
- Preserve diverse habitat types

Increasing open-water habitat – areas that do not have abundant rooted vegetation reaching the surface by mid-summer – will improve access to the pond for recreational activities and restore a diminishing habitat type in the pond. Determining where to focus plant reduction efforts needs to take into account the type of plant cover and the benefits of restoring open-water conditions. Since the most abundant plant coverage occurs where water depths are 3 feet or less, which encompasses practically the entire western half of the pond, this area should be left unmanaged. The western half of the pond provides water willow and shallow marsh habitats that are heavily utilized by wildlife. Plant management efforts in this area would be the least cost-effective and offer the shortest duration of control. Recreational activities in this area would continue to be greatly limited by the 2-3 foot water depths. Leaving this area devoid of vegetation may increase the sediment-water interactions, resulting in further degradation of water quality and possibly lead to increased algal growth. Reducing the plant density to improve open-water habitat should be limited to the eastern half of the pond where water depths range between 4 and 5 feet. The only notable exception would be to prevent contiguous emergent plant cover from becoming established around the inlet or between the western side of Boy Scout Island and the smaller unnamed islands.

Lake Managers generally agree that between 40-60 percent plant cover in a waterbody is desirable to support a warm-water fishery. However, this should be interpreted as an overall biomass estimate, rather than the simple percent plant cover that was used to inventory the plants during this study. Ideally, areas would not be devoid of vegetation, but would support low-growing plants that leave the majority of the water column open. It was estimated than there are only about 10 acres with no or low-density plant growth in Warner's Pond by mid-summer, which means that nearly 80% is densely vegetated. Reducing the plant density in 15-20 acres on the eastern half of the pond would create a more favorable habitat, while improving access for recreational opportunities. The location of the proposed aquatic plant management zone is depicted in Figure 7. This area will ideally join with the areas of little or no vegetation found at the northern end of the pond and in the outlet cove. Effective plant reduction efforts throughout this management area may result in nearly 50% of the pond with open-water habitat, as opposed to the existing 10%. Techniques on how to achieve these plant reductions are discussed in the following section.

Controlling non-native vegetation will help to preserve open-water conditions and maintain a good diversity of native plants. Water chestnut probably poses the greatest threat to continued loss of open-water habitat. Fortunately, previous hand-pulling efforts appear to have effectively prevented its widespread establishment. Annual monitoring and hand-pulling efforts of this invasive species throughout the pond should be continued. Of the two submersed non-native plants, fanwort is much more widespread. It is most prevalent in the southeastern portion of the pond and should be targeted with efforts to increase open-water habitat in that area. Variable watermilfoil appears to be confined to the Nashoba Brook inlet area. Since it remains secondary to coontail in this area, control efforts are not warranted at this time. If future monitoring efforts document an increase in its range or density, chemical treatment will probably be the most effective management strategy. Purple loosestrife is the only other non-native plant presently found in Warner's Pond. It appears to be scattered along the pond shorelines and intermixed among the stands of water willow. Control alternatives such as cutting, hand-pulling and chemical treatment may be appropriate in accessible shoreline locations, but would be extremely difficult along the western shoreline of the pond. Biological control with herbaceous insects may be more suitable for this area.



WARNER'S POND
Concord, MA

Figure 7

Propoposed Management Zones

August 1999

Preserving diverse habitat types will be accomplished by leaving portions of the pond unmanaged and as a by-product of increasing the amount of open-water and controlling non-native plants. This should be considered the primary objective for maintaining desirable wildlife habitat in Warner's Pond.

EVALUATION OF IN-POND MANAGEMENT STRATEGIES

The following evaluation of in-pond management strategies focuses on the control of nuisance vegetation to improve open-water conditions in the eastern half of the pond. The applicability of commonly used in-pond management strategies at Warner's Pond is discussed below.

Dredging (not recommended)

Removing nutrient rich sediments and deepening waterbodies is sometimes used to control nuisance aquatic vegetation. This would be a major undertaking at Warner's Pond, when considering both the associated permitting issues and project expense. Most successful dredging operations to control rooted plant growth target reaching a mean depth of 8-10 feet. Currently, less than 5 acres of Warner's Pond have water depths exceeding 8 feet, and the estimated average depth of Warner's Pond is just 4.5 feet. In addition, the limited sediment analysis revealed potentially elevated concentrations of lead. This suggests that there may also be elevated concentrations of other metals, total petroleum hydrocarbons or poly-aromatic hydrocarbons. If this were the case, special treatment of the dredge spoils (i.e. disposal in a lined landfill) may be required making a dredging project even more cost-prohibitive.

Conventional dredging is usually accomplished by dewatering a waterbody and using track-driven excavation equipment. The current outlet structures do not appear as if they would facilitate gravity lowering of the pond more than 1-2 feet below the water level observed during the 8/6/99 inspection. This would likely leave standing water throughout nearly half of the pond area. Siphoning or pumping would be required to expose the remainder of the pond bottom. A water diversion channel would then need to be constructed to prevent the pond from refilling following a rain event. The pond bottom would likely need to remain exposed for several weeks or longer during the summer for the sediments to firm up enough to support tracked equipment. Concerns over adverse impacts to fish and other aquatic organisms, adjacent wetlands and water quality would likely be associated with this approach.

Hydraulic or suction dredging can be performed while the pond is full. This involves the use a barge with an auger head that grinds the pond sediments into a slurry and pumps them to a nearby containment basin. Locating and obtaining suitable upland location near the pond to create an adequate containment basin may prove to be the greatest obstacle to overcome. Another concern would be whether the desired 8-10 foot depths could be attained, since most suction-type dredges can only slurry the unconsolidated sediments and penetration into an existing refusal layer is not possible. If depths of only 6-8 feet could be achieved, they would not be deep enough to discourage rooted plant growth.

The costs associated with a limited dredging project of just 15-20 acres would be substantial. Feasibility, design and permitting fees alone would be expected to exceed $20,000. The actual operation costs would ultimately depend upon the approach and amount of material being dredged. Reasonable unit cost estimates for a limited dredging project at Warner's Pond may run between $5 and $15 per cubic yard removed. Removing 4 feet of sediment form a one-acre area yields approximately 6,400 cubic yards of material. If a partial dredging project targeting the removal 4 feet over 20 acres is considered at Warner's Pond, the total amount of material to be removed would be 128,000 cu. yds., which translates into $640,000-$1,920,000 in operation costs. Costs may also run higher, depending upon certain permit conditions or other complicating factors. It should also be noted that dredging does not always eliminate nuisance aquatic vegetation problems, and other in-pond management activities may be required in order maintain desired conditions.

Creation of a Sediment/Nutrient Detention Basin (not recommended)
Trying to localize sediment and nutrient deposition in a constructed forebay area that can be routinely cleaned out is often considered for waterbodies that are heavily influenced by stormwater flows. In order for this to be effective, the forebay must be large enough to allow sufficient settling time. Detention ponds in Massachusetts are typically designed to hold 0.5 inches over the contributing impervious area. In order to accurately calculate the forebay size, land use maps would need to be consulted for the entire watershed area and computer modeling (e.g. P8 Urban Catchment) would need to be run to determine the anticipated total suspended solids removal rate. Considering the watershed size and amount of development, it is doubtful that a large enough forebay could be constructed within the pond that would provide significant sediment and nutrient removal and enable routine and cost-effective cleaning. Creation of this type of forebay would also face many of the same permitting and operational difficulties described for a dredging operation. This approach would also not provide any control over the nuisance plant growth in the eastern half of the pond.

Nutrient Precipitation/Inactivation (not recommended)
Since rooted aquatic plants can access nutrients in the pond sediments, nutrient precipitation/inactivation is most effective when trying to control nuisance algal growth. The most commonly used nutrient precipitation/inactivation approach is to remove phosphorus from the water column using aluminum sulfate (alum). Alum injections to the hypolimnion of deep lakes will sometimes prevent algal blooms for 5-10 years. Treating shallow lakes that do not thermally stratify may only provide seasonal algal control. Even if algal blooms were problematic at Warner's Pond, alum treatments would probably not be effective alternative due to the pond's rapid rate of water turnover.

Drawdown (not recommended)
Water level lowering during the winter months to control aquatic vegetation by freezing and desiccation of the plant root structures sometimes offers a low or no-cost management alternative. It is usually most effective in deeper waterbodies, where an ample water volume will remain to support fish and other aquatic organisms. Warner's Pond is too shallow to be lowered enough to control rooted vegetation, without deleterious to the aquatic fauna and adjacent wetland areas.

Aeration (not recommended)
Aeration is sometimes effective at reducing the frequency of algal blooms, but does not offer any control over vascular plants.

Benthic Barriers (not recommended)
Bottom weed barriers are only beneficial for small applications around beach, swim or dock areas. Larger scale applications become cost prohibitive (>$25,000 for material alone) and would prevent necessary interactions with the bottom sediments by benthic macroinvertebrates and other aquatic organisms.

Hand-Pulling (recommended)
Hand-pulling has already proven effective at controlling water chestnut growth in Warner's Pond. These efforts should be continued, as long as the water chestnut growth remains at low densities. Hand-pulling submersed plants is generally only effective for widely scattered or isolated infestations. The submersed fanwort and variable watermilfoil coverage is too widespread to be effectively hand-pulled. It is doubtful that even lower densities of these plants could be effectively hand-pulled at Warner's Pond considering the density of native plants and limited water clarity. Hand-pulling scattered purple loosestrife growth along accessible shoreline areas may help to reduce the spread of this plant. Similar to water chestnut, this should be completed before the seed drop occurs in mid to late summer.

Biological Controls (recommended)
The only biological control that may be suitable for Warner's Pond would be the introduction of root-mining weevils (*Hylobious transversovittatus*) and leaf-eating beetles (*Galerucella spp.*) for purple loosetrife (*Lythrum salicaria*) control. Reportedly, these insects have been introduced to several sites throughout the northeast with promising results. DEP should be contacted to learn whether introductions have been successful in Massachusetts and what protocol is required for an introduction. Costs for this type of biological control are unknown, but a monitoring component is likely required.

Unfortunately, there are no herbaceous insects that target the nuisance aquatic vegetation in Warner's Pond. The State of Massachusetts does not currently permit the introduction of sterile, triploid grass-carp, which is the only other biological control alternative used to control submersed plants.

Mechanical Hydro-Raking (recommended)
A mechanical hydro-rake removes plants by digging through the sediments and pulling plants out by their root structures. It is very effective for controlling emergent or floating-leafed plants with well-defined root systems. It is less effective on submersed plants; especially ones that reproduce vegetatively like coontail, fanwort and milfoil.

Hydro-raking may be suitable at Warner's Pond to clear shoreline access areas, remove encroaching water willow growth or for area-selective removal of waterlilies and their root mats. Hydro-raking would not be a cost-effective alternative to maintain open water conditions throughout large portions of the pond.

The machine is best described as a floating backhoe equipped with a York rake attachment. The barge is propelled by paddle wheels to facilitate its operation into shallow water (2 feet) areas. There is no on-board storage on the hydro-rake, which requires each rake full of material to be deposited directly on shore or onto an awaiting transport barge. Hydro-raking work is usually contracted out hourly, plus an equipment mobilization change and costs to remove raked material from the temporary on-shore disposal site to a permanent upland location. Approximate unit costs of $2,500-$6,000 per acre depend upon the type of vegetation, equipment requirements and the size of the area being cleared.

An Order of Conditions is usually the only permit required for hydro-raking work in Massachusetts.

Mechanical Harvesting (recommended)
Cutting and removing the nuisance vegetation would be one way to maintain open-water conditions in eastern half of Warner's Pond. Mechanical harvesters used are paddle wheel driven barges equipped with a depth-adjustable cutting head and a conveyor-mesh storage area. Weeds are cut near the sediment water interface and collected on the barge for transport to a temporary on-shore disposal or transfer location. From the harvester, weeds can either be loaded directly into dump trucks or onto trailers with a shore or trailer-conveyor, or the weeds can be temporarily deposited on shore and then loaded into trucks with a backhoe or loader. While mechanical harvesting does not often carry many of the negative stigmas associated with chemicals, its cost-effectiveness is usually greatly reduced. Harvesting submersed, perennial plants can be likened to "mowing the lawn," with some plant regrowth expected in the same season and a return to pre-harvesting conditions by the following year. Waterlilies generally regrow to the surface within a few weeks of being harvested.

Harvesting is often discouraged in waterbodies that have non-native submersed plants like milfoil and fanwort that can be spread through vegetative fragmentation. Fanwort is already fairly well distributed, so it is doubtful that harvesting would cause major shifts in the plant community. It could be utilized to provide temporary control of submersed vegetation. On the other hand, harvesting is often the preferred management strategy to control water chestnut. Several consecutive seasons of cutting water chestnut before the seeds (nutlets) drop can result in dramatic population reductions. Another benefit of harvesting is the removal of organic material from the pond.

Harvester efficiency is largely dependent upon the travel distance to the temporary shoreline disposal/transfer sites. The boat launch on the eastern shoreline of the pond is the most accessible site for launching and retrieval of the machine, and to temporarily stockpile or transfer harvested vegetation. Fortunately, this is located near the middle of the proposed management zone, which will result in shorter transport/driving times. The maximum machine efficiency expected would be 3-4 machine hours to clear an acre of submersed vegetation. Figuring on a 15-20 acre project area, this translates into 60-80 machine hours per cutting. While two separate cuttings might be required to maintain desirable open-water conditions for the entire summer; one mid-summer harvest should greatly improve conditions for a good portion of the season.

Estimated costs to have a private contractor harvest a 15-20-acre area would be $500-$600 per acre or $8,500-$13,000 including equipment mobilization. This cost assumes that the Town can handle the shore-based disposal operations. Contracting out the disposal operations could add 50% to the unit costs shown above.

Another alternative for the Town to consider is the purchase and operation of its own harvester. This might make even more sense if the machine could be used to control nuisance vegetation on other Town waterbodies. Small to mid-sized harvesters (200-400 cu. ft. of storage) cost between $60,000 and $80,000 new. An annual operation and maintenance budget of $20,000-$25,000 should also be assumed. Several factors, including the effectiveness of a harvesting project, must be carefully considered before purchasing a machine. For that reason, at least one season of contract harvesting should precede a decision to buy a harvester.

An Order of Conditions should be the only permit required for a harvesting project at Warner's Pond.

Chemical Treatment (recommended)

Treating the nuisance vegetation with USEPA/MA DEP registered aquatic herbicides is probably most cost-effective management alternative at Warner's Pond. Herbicides often provide for area and species selective plant control. Typically a late spring or early summer treatment will provide season long control of the nuisance vegetation. Plant regrowth in subsequent seasons is often reduced, allowing reductions in the frequency and amounts of chemical required. Chemical treatment programs can also be focused on controlling any further spread of the non-native fanwort and milfoil plants. When licensed professionals apply registered products in accordance with their specimen labels, they present negligible risk to non-target organisms and humans. In fact, none of the currently registered products have any restrictions on swimming in treated waters, but prudent practice calls for closure of the treated area on the day of treatment. In most cases, the only temporary water use restrictions following a treatment are associated with the use of treated water for irrigation or domestic purposes. Most of the herbicides are either rapidly broken down or irreversibly bound to the sediment, becoming biologically inactivated within a matter of days. Thousands of lakes across the country are treated with aquatic herbicides each year, including well over 100 lakes in Massachusetts.

The mixed plant assemblage found within the open-water management zone on the eastern half of the pond limits treatment alternatives. Coontail and fanwort almost equally dominate the submersed plant community, while the waterlily coverage is still fairly extensive. A reduction of all these species is needed to improve open-water conditions. Fanwort should be managed in this area since it is a non-native plant.

Contact-acting herbicides like Reward® (Diquat) and Aquathol K® (Endothall) provide seasonal control of coontail, elodea, milfoil and pondweed, but do not control fanwort or waterlilies. The systemic action of Navigate® (2,4-D) provides good control of waterlilies, water chestnut and milfoil, but has little or no effect on the other plants. Rodeo® (Glyphosate) is only effective for emergent or floating-leafed plants that can be sprayed directly. It provides no control over submersed species. Copper-based products are usually reserved for control of algae and a few vascular plants. The only herbicide that will provide the desired systemic control of coontail, fanwort and waterlilies is Sonar™ (Fluridone). Sonar also happens to be the only herbicide currently registered for aquatics that provides any control of fanwort.

One of the attributes of Sonar is its favorable toxicology profile; in fact, it can be applied to potable (drinking) water reservoirs at low doses with no water use restrictions. At higher rates of application, there is a labeling advisory not to use treated water for irrigation purposes for a 14-30 day period following application. Sonar kills plants by interfering with carotenoid synthesis, which allows the plant's chlorophyll to be broken down by sunlight. Even though several aquatic plants are susceptible to Sonar, species selectivity can be achieved by manipulating the dose at which it is applied. Highly susceptible plants can be effectively controlled with low concentrations, while heartier plants are only partially or temporarily impacted.

The potential drawbacks of a Sonar application at Warner's Pond are that treatment effectiveness is a function of keeping the necessary concentration in contact with the target plants for a 30-45 day period, and effectiveness is reduced for spot or partial applications. Normally, the plant assemblage found in Warner's Pond could be effectively controlled with 10-20 parts per billion (ppb) of Sonar AS, which is the concentrated liquid formulation of Sonar. A series of low-dose applications would need to be performed to maintain the desired concentration for the required 30-45 day period, due to the amount of flow through Warner's Pond. The liquid formulation is so soluble, however, that there would be too much migration into the remainder of the pond. This would likely result in too much plant control and adversely impact the desired shallow marsh habitat. Extensive waterlily die-off may also exacerbate the formation of floating islands composed of decomposing lily roots and soft bottom sediments. Some floating islands may be formed following any herbicide treatment program at Warner's Pond, but limiting treatment to the eastern half of the pond should minimize this occurrence.

Use of the slow release pellet (SRP) formulation of Sonar is recommended at Warner's Pond. The SRP releases Sonar over approximately a 14-day period. The reduced solubility of the SRP formulation should result in less movement to other portions of the pond, which should reduce impact to waterlilies and other vegetation in the shallow marsh preservation zone. A higher total chemical concentration would be required, because the pellets will likely "plug" in the mucky bottom sediments and reduce the release rate of the herbicide. A total of 100 ppb of SRP would likely be required throughout the treatment area.

It is difficult to estimate the effectiveness of a Sonar SRP treatment in Warner's Pond. A reduction of 70-80% of the vegetation in the treatment area is anticipated. The estimated cost to treat 15-20 acres with Sonar SRP is $15,000-$18,000. Sonar's systemic-acting properties should also provide some carry-over plant control into a second and possibly a third season. This would likely result in cost savings over a 3-5 year period compared with a havesting effort on the same area.

Rodeo (Glyphosate) herbicide may be an effective means of controlling purple loosestrife, if it continues to expand its range along the accessible eastern shoreline and hand-pulling, cutting or herbaceous insects cannot be effectively used. Rodeo can often be applied to targeted vegetation without much off-target impact. Treatment is most effective when plants are in full fluorescence in mid-summer. Typical costs for this type of Rodeo application run between $800 and $1,200 per acre treated.

Normally, Rodeo may also be considered to create access lanes into dense waterlily growth, similar to what is found in the western half of the pond. However, the density of lily cover, water depths of just 2-3 feet and accumulation of soft sediment in this area would likely cause treated areas to become filled in with floating island material. Therefore, creation of access lanes using aquatic herbicides is not recommended at this time.

Despite a Secchi Disk transparency reading of only 2.2 feet during the August inspection, algal blooms were not a visible nuisance. Controlling algal growth in Warner's Pond would be limited to treating bloom conditions with USEPA/MA DEP registered algaecides. Nutrient precipitation/inactivation would likely provide little benefit, considering the shallow water depths and amount of water flow through the pond. Nearly all of the algaecides that are currently registered for aquatic use are copper-based products. They can often provide rapid control of algal blooms at low application rates. Concerns over the accumulation of copper in the bottom sediments and impacts to benthic organisms require that treatments be performed efficaciously. Algaecide treatments may be desired should algal blooms develop following control of aquatic plant growth. Partial pond algaecide treatments at Warner's Pond would be expected to cost in the $1,000-$2,000 range.

Permitting requirements for chemical treatment work at Warner's Pond include receipt of an Order of Conditions from the Town and a License to Apply Chemicals from the MA DEP Office of Watershed Management.

SUMMARY OF MANAGEMENT RECOMMENDATIONS

The continual loss of open-water habitat is the most visible result of the eutrophication processes that are occurring at Warner's Pond. This has inevitably been accelerated due to contributions from the pond's extensive watershed area. This has resulted in decreased water depths throughout much of the pond and abundant plant growth. Distinct plant assemblages have formed, providing valuable habitat for a variety of wildlife. However, further reductions of open-water habitat will degrade the pond's overall habitat value and impair access to the pond for recreational activities. The presence of four non-native plants poses an even greater threat to the loss of open water and plant diversity in the pond.

The Warner's Pond management plan should focus on increasing the amount of open water, controlling non-native species and preserving diverse habitat types. Current conditions, as well as the feasibility and costs associated with managing aquatic vegetation in Warner's Pond leads to the creation of different management areas. The proposed management zones shown on Figure 7 recommend preserving the water-willow and shallow marsh habitats found in the shallow western half of the pond, while focusing management efforts in the deeper and more developed eastern half.

The following specific management activities are suggested for consideration or inclusion in the development of a long-term management plan for Warner's Pond.

- Continue to support efforts to reduce non-point source pollution within the Warner's Pond watershed.
- Reduce the amount of aquatic vegetation growing in the eastern half of Warner's Pond. A management area of 15-20 acres in size is recommended. The two most suitable management approaches are chemical treatment with Sonar™ (Fluridone) herbicide or mechanical harvesting. Treatment is expected to provide 70-80% control of the targeted vegetation during the initial season, with the potential of carry-over benefits into a second and possibly third season. A Sonar treatment program is likely to cost in the $15,000-$18,000. Mechanical harvesting could also provide control of nuisance plant growth. Although two cuttings may be preferred, one properly timed cutting in mid-summer should provide reasonably good plant control for a good portion of the summer. Projected costs for a private contractor to harvest a 15-20-acre area is $8,500-$13,000, providing the Town can handle the shore-based disposal operations. A similar expenditure would likely be required

annually to maintain desirable conditions. Long-term harvesting costs may be reduced if the Town of Concord were to purchase its own harvesting equipment. This is probably only worth consideration if other waterbodies within the Town could benefit from annual harvesting efforts.

- Continue to monitor and manually hand-pull water chestnut from Warner's Pond. This non-native plant poses the greatest threat to an accelerated loss of open-water should it become established in the pond.

- Attempt to control non-native purple loosestrife growth along the accessible eastern shoreline through manual hand-pulling and cutting efforts. The potential for introduction of herbaceous insects should also be further investigated. If these efforts are not successful and purple loosestrife continues to expand its range along the eastern shoreline, spot-treatment with Rodeo-herbicide should be considered. Treatment costs will likely run $800-$1,200 per treated acre.

- Establish monthly monitoring program to monitor a few basic water quality parameters (temperature, dissolved oxygen, Secchi transparency, etc.) at the pond; and if budgets allow, include analysis of nutrients (nitrogen and phosphorus) and possibly other parameters. Perform a mid-late summer survey to map rooted plant growth and analyze phytoplankton (algae) composition and density. These monitoring efforts will serve to document the annual condition of the pond, track the progress of management efforts and potentially provide early warning of future problems (i.e. increase in non-native plant coverage). A professional survey could be performed every few years to supplement the Town's monitoring program and to recommend modifications to ongoing management efforts. The cost for a single-visit inspection of the pond by a professional lake manager, to survey the aquatic plant community, perform limited water quality analysis and provide a written report should be around $1,500.

ATTACHMENT A

Laboratory Results for Sediment and Water Quality Analyses

UNIVERSITY of MASSACHUSETTS

UMASS

UMass Extension

Agroecology Program
Soil and Plant Tissue Testing Laboratory
West Experiment Station
Box 38010
Amherst, MA 01003-8010
413.545.2311
413.545.1931 fax

TEXTURAL ANALYSIS RESULTS

Customer Name: Aquatic Control Tech., Inc.
Marc Bellard
11 John Road
Sutton, MA 01590-2509

Sample ID: S990817-101

Customer Designation: #1 Nashoba Brook Inflow MDB Warners Pond

Percentages based on less than 2 mm fraction

Fraction	Percent
Sand	31.7
Silt	53.6
Clay	14.7
	100.0

Sand Subfractions

Very Coarse	0.4
Coarse	0.2
Medium	0.6
Fine	8.6
Very Fine	21.9
	31.7

Silt subfractions

Coarse	22.8
Medium	17.9
Fine	12.9
	53.6

Under USDA criteria this sample classifies as a silt loam. Classification is based on particles that are sand size and finer (i.e. less than 2 millimeters in diameter). Those particles greater than 2 mm are included in the textural name as a modifier (ex. gravelly). The sample submitted contained 0.1 % gravel on a weight basis. Any questions pertaining to these results may be asked by calling the Soil Testing Lab.

UNIVERSITY of
MASSACHUSETTS

UMASS

UMass Extension

Agroecology Program
Soil and Plant Tissue Testing Laboratory
West Experiment Station
Box 38010
Amherst, MA 01003-8010
413.545.2311
413.545.1931 fax

TEXTURAL ANALYSIS RESULTS

Customer Name: Aquatic Control Tech., Inc.
Marc Bellard
11 John Road
Sutton, MA 01590-2509

Sample ID: S990817-102

Customer Designation: #2-Route 2 Overflow MDB Warner's Pond

Percentages based on less than 2 mm fraction

Fraction	Percent
Sand	8.1
Silt	65.2
Clay	26.7
	100.0

Sand Subfractions

Very Coarse	0.3
Coarse	0.3
Medium	0.3
Fine	1.2
Very Fine	6.0
	8.1

Silt subfractions

Coarse	13.6
Medium	26.7
Fine	24.8
	65.2

Under USDA criteria this sample classifies as a silt loam. Classification is based on particles that are sand size and finer (i.e. less than 2 millimeters in diameter). Those particles greater than 2 mm are included in the textural name as a modifier (ex. gravelly). The sample submitted contained 0.3 % gravel on a weight basis. Any questions pertaining to these results may be asked by calling the Soil Testing Lab.

UNIVERSITY of
MASSACHUSETTS

UMass Extension

Agroecology Program
Soil and Plant Tissue Testing Laboratory
West Experiment Station
Box 38010
Amherst, MA 01003-8010
413.545.2311
413.545.1931 fax

TEXTURAL ANALYSIS RESULTS

Customer Name: Aquatic Control Tech., Inc.
Marc Bellard
11 John Road
Sutton, MA 01590-2509

Sample ID: S990817-103

Customer Designation: #3-Mid Pond MDB Warners Pond

Percentages based on less than 2 mm fraction

Fraction	Percent
Sand	33.1
Silt	51.8
Clay	15.2
	100.0

Sand Subfractions

Very Coarse	0.2
Coarse	0.2
Medium	1.0
Fine	10.4
Very Fine	21.3
	33.1

Silt subfractions

Coarse	19.3
Medium	18.4
Fine	14.1
	51.8

Under USDA criteria this sample classifies as a silt loam. Classification is based on particles that are sand size and finer (i.e. less than 2 millimeters in diameter). Those particles greater than 2 mm are included in the textural name as a modifier (ex. gravelly). The sample submitted contained 0.0 % gravel on a weight basis. Any questions pertaining to these results may be asked by calling the Soil Testing Lab.

UNIVERSITY of
MASSACHUSETTS

UMASS

UMass Extension

Agroecology Program
Soil and Plant Tissue Testing Laboratory
West Experiment Station
Box 38010
Amherst, MA 01003-8010
413.545.2311
413.545.1931 fax

TEXTURAL ANALYSIS RESULTS

Customer Name: Aquatic Control Tech., Inc.
Marc Bellard
11 John Road
Sutton, MA 01590-2509

Sample ID: S990817-104

Customer Designation: #4-Pond Outlet Warners Pond

Percentages based on less than 2 mm fraction

Fraction	Percent
Sand	96.0
Silt	2.5
Clay	1.5
	100.0

Sand Subfractions	
Very Coarse	22.8
Coarse	42.7
Medium	22.6
Fine	6.5
Very Fine	1.5
	96.0

Silt subfractions	
Coarse	1.0
Medium	0.6
Fine	0.9
	2.5

Under USDA criteria this sample classifies as a coarse sand. Classification is based on particles that are sand size and finer (i.e. less than 2 millimeters in diameter). Those particles greater than 2 mm are included in the textural name as a modifier (ex. gravelly). The sample submitted contained 23.8 % gravel on a weight basis. Any questions pertaining to these results may be asked by calling the Soil Testing Lab.

SOIL ANALYSIS REPORT FOR RESEARCH

08/19/99

SOIL AND PLANT TISSUE TESTING LAB
WEST EXPERIMENT STATION
UNIVERSITY OF MASSACHUSETTS
AMHERST, MA 01003

LAB NUMBER: S990817-101
BAG NUMBER: 41260

DATE SENT: / /

SOIL WEIGHT: 2.45 g/5cc

AQUATIC CONTROL TECH. INC.
11 JOHN ROAD
SUTTON, MA 01590

CONCERNS: WARNERS POND, CONCOR
D

ANALYSIS REPORT

SAMPLE ID: NASHOBA BROOK INFLOW/MDB
SOIL TYPE:

SOIL PH 5.6
BUFFER PH 6.4

ALUMINUM (AL): 56 PPM (Soil Range: 10-300)
ORGANIC MATTER: 13.1 %. Desirable range 4-8%.

NUTRIENT LEVELS:		PPM	LOW MEDIUM HIGH VERY HIGH
PHOSPHORUS	(P)	3	XXXX
POTASSIUM	(K)	40	XXXXXXXXX
CALCIUM	(CA)	996	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
MAGNESIUM	(MG)	128	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
AMMONIUM	(NH4-N)	6	XXXXXXXXXXXX
NITRATE	(NO3-N)	2	X

CATION EXCH CAP
25.8 MEQ/100G

PERCENT BASE SATURATION
K= 0.8 MG= 8.3 CA=39.5

MICRONUTRIENT		PPM	SOIL RANGE
Boron	(B)	0.2	0.1-2.0
Manganese	(Mn)	17.8	3 - 20
Zinc	(Zn)	8.3	0.1- 70
Copper	(Cu)	0.3	0.3-8.0
Iron	(Fe)	20.7	1.0- 40

EXTRACTED LEAD (PB) 10 PPM.
EXTRACTED CADMIUM (CD) 0.2 PPM.
EXTRACTED NICKEL (NI) 0.6 PPM.

ESTIMATED TOTAL LEAD IS 149 PPM.

EXTRACTED CHROMIUM (CR) 0.3 PPM.

COMMENTS

SOIL ANALYSIS REPORT FOR RESEARCH 08/19/99

SOIL AND PLANT TISSUE TESTING LAB
WEST EXPERIMENT STATION
UNIVERSITY OF MASSACHUSETTS
AMHERST, MA 01003

LAB NUMBER: S990817-102
BAG NUMBER: 41260

DATE SENT: / /

SOIL WEIGHT: 1.72 g/5cc

AQUATIC CONTROL TECH. INC.
11 JOHN ROAD
SUTTON, MA 01590

CONCERNS: WARNERS POND, CONCORD

ANALYSIS REPORT

SAMPLE ID: ROUTE 2/OVERFLOW/MDB
SOIL TYPE:

SOIL PH 5.5 ALUMINUM (AL): 40 PPM (Soil Range: 10-300)
BUFFER PH 6.1 ORGANIC MATTER: 29.7 %. Desirable range 4-8%.

NUTRIENT LEVELS:		PPM	LOW MEDIUM HIGH VERY HIGH
PHOSPHORUS	(P)	3	XXXXX
POTASSIUM	(K)	43	XXXXXXXXXX
CALCIUM	(CA)	1387	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
MAGNESIUM	(MG)	122	XXXXXXXXXXXXXXXXXXXXXXXXXXXXX
AMMONIUM	(NH4-N)	25	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
NITRATE	(NO3-N)	3	XX

CATION EXCH CAP
52.5 MEQ/100G

PERCENT BASE SATURATION
K= 0.6 MG= 5.6 CA=38.5

MICRONUTRIENT		PPM	SOIL RANGE	MICRONUTRIENT		PPM	SOIL RANGE
Boron	(B)	0.3	0.1-2.0	Copper	(Cu)	0.4	0.3-8.0
Manganese	(Mn)	80.0	3 - 20	Iron	(Fe)	30.7	1.0- 40
Zinc	(Zn)	11.4	0.1- 70				

EXTRACTED LEAD (PB) 15 PPM. ESTIMATED TOTAL LEAD IS 215 PPM.
EXTRACTED CADMIUM (CD) 0.2 PPM.
EXTRACTED NICKEL (NI) 0.9 PPM. EXTRACTED CHROMIUM (CR) 0.5 PPM.

COMMENTS

COMPUTER PROGRAM & RECOMMENDATIONS BY DEPT OF PLANT & SOIL SCI UMASS-AMHERST.

SOIL ANALYSIS REPORT FOR RESEARCH

08/19/99

SOIL AND PLANT TISSUE TESTING LAB
WEST EXPERIMENT STATION
UNIVERSITY OF MASSACHUSETTS
AMHERST, MA 01003

LAB NUMBER: S990817-103
BAG NUMBER: 41260

DATE SENT: / /

SOIL WEIGHT: 2.37 g/5cc

AQUATIC CONTROL TECH. INC.
11 JOHN ROAD
SUTTON, MA 01590

D

CONCERNS: WARNERS POND, CONCOR

ANALYSIS REPORT

SAMPLE ID: MID POND/MDB
SOIL TYPE:

SOIL PH 5.5
BUFFER PH 6.4

ALUMINUM (AL): 47 PPM (Soil Range: 10-300)
ORGANIC MATTER: 13.8 %. Desirable range 4-8%.

NUTRIENT LEVELS:		PPM	LOW MEDIUM HIGH VERY HIGH
PHOSPHORUS	(P)	4	XXXXX
POTASSIUM	(K)	43	XXXXXXXXXX
CALCIUM	(CA)	879	XXXXXXXXXXXXXXXXXXXXXXXXXXXX
MAGNESIUM	(MG)	87	XXXXXXXXXXXXXXXXXXXX
AMMONIUM	(NH4-N)	8	XXXXXXXXXXXXXXXX
NITRATE	(NO3-N)	6	XXXX

CATION EXCH CAP
24.7 MEQ/100G

PERCENT BASE SATURATION
K= 1.0 MG= 6.1 CA=37.6

MICRONUTRIENT		PPM	SOIL RANGE
Boron	(B)	0.2	0.1-2.0
Manganese	(Mn)	65.9	3 - 20
Zinc	(Zn)	6.7	0.1- 70
Copper	(Cu)	0.3	0.3-8.0
Iron	(Fe)	29.9	1.0- 40

EXTRACTED LEAD (PB) 8 PPM.
EXTRACTED CADMIUM (CD) 0.1 PPM.
EXTRACTED NICKEL (NI) 0.5 PPM.

ESTIMATED TOTAL LEAD IS 120 PPM.

EXTRACTED CHROMIUM (CR) 0.3 PPM.

COMMENTS

COMPUTER PROGRAM & RECOMMENDATIONS BY DEPT OF PLANT & SOIL SCI UMASS-AMHERST.

SOIL ANALYSIS REPORT FOR RESEARCH

08/19/99

SOIL AND PLANT TISSUE TESTING LAB
WEST EXPERIMENT STATION
UNIVERSITY OF MASSACHUSETTS
AMHERST, MA 01003

LAB NUMBER: S990817-104
BAG NUMBER: 41260

DATE SENT: / /

SOIL WEIGHT: 6.41 g/5cc

AQUATIC CONTROL TECH. INC.
11 JOHN ROAD
SUTTON, MA 01590

D

CONCERNS: WARNERS POND, CONCOR

ANALYSIS REPORT

SAMPLE ID: POND OUTLET
SOIL TYPE:

SOIL PH 5.5
BUFFER PH 6.9

ALUMINUM (AL): 33 PPM (Soil Range: 10-300)
ORGANIC MATTER: 2.1 %. Desirable range 4-8%.

NUTRIENT LEVELS:	PPM	LOW	MEDIUM	HIGH	VERY HIGH
PHOSPHORUS (P)	3	XXXX			
POTASSIUM (K)	22	XXXXX			
CALCIUM (CA)	466	XXXXXXXXXXXXXX			
MAGNESIUM (MG)	36	XXXXXXXX			
AMMONIUM (NH4-N)	6	XXXXXXXXXXXX			
NITRATE (NO3-N)	4	XXX			

CATION EXCH CAP
3.6 MEQ/100G

PERCENT BASE SATURATION
K= 1.2 MG= 6.5 CA=51.7

MICRONUTRIENT		PPM	SOIL RANGE
Boron	(B)	0.1	0.1-2.0
Manganese	(Mn)	52.5	3 - 20
Zinc	(Zn)	15.8	0.1- 70
Copper	(Cu)	0.9	0.3-8.0
Iron	(Fe)	52.4	1.0- 40

EXTRACTED LEAD (PB) 16 PPM.
EXTRACTED CADMIUM (CD) 0.1 PPM.
EXTRACTED NICKEL (NI) 0.5 PPM.

ESTIMATED TOTAL LEAD IS 223 PPM.

EXTRACTED CHROMIUM (CR) 0.1 PPM.

COMMENTS

COMPUTER PROGRAM & RECOMMENDATIONS BY DEPT OF PLANT & SOIL SCI UMASS-AMHERST.

Microbac

Microbac Laboratories, Inc.
MASSACHUSETTS DIVISION
63 PLAIN STREET
CLINTON, MA 01510
(978) 368-7604

AIR • FUEL • WATER • FOOD • WASTES

CERTIFICATE OF ANALYSIS

Aquatic Control Technology
11 John Road
Sutton, MA 01590-2509

Date Reported: 5/10/99
Sample ID: 9904-0065b
Date Received: 4/23/99
Sampled by: CUSTOMER

PARAMETERS	RESULTS	DATE	TECH	METHOD
WATER FROM WARNERS POND, INLET, 4/23/99				
Total Kjeidal Nitrogen	0.58 mg/l	5/05/99	SUB	4500-N-B
Nitrate	0.7 mg/L	4/30/99	NB	SM 4500-NO3-E
Phosphorus as P	0.03 mg/l	4/26/99	NB	4500-P-E
WATER FROM WARNERS POND, MID-POND, 4/23/99				
Total Kjeldal Nitrogen	0.67 mg/l	5/05/99	SUB	4500-N-B
Nitrate	0.8 mg/L	4/30/99	NB	SM 4500-NO3-E
Phosphorus as P	0.07 mg/l	4/26/99	NB	4500-P-E
WATER FROM WARNERS POND, OUTLET, 4/23/99				
Total Kjeldal Nitrogen	0.50 mg/l	5/05/99	SUB	4500-N-B
Nitrate	0.6 mg/L	4/30/99	NB	SM 4500-NO3-E
Phosphorus as P	0.04 mg/l	4/26/99	NB	4500-P-E

Respectfully Submitted by: D Bennett

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WATER • AIR • WASTES • FOOD • PHARMACEUTICALS • NUTRACEUTICALS

CERTIFICATE OF ANALYSIS

Aquatic Control Technology
11 John Road
Sutton, MA 01590-2509

Date Reported: 8/20/99
Sample ID: 9908-00336
Date Received: 8/06/99
Sampled by: CUSTOMER

PARAMETERS	RESULTS	DATE	TECH	METHOD
WARNERS LAKE, MA: WATER FROM INLET, 8/6/99				
Total Kjeldal Nitrogen	0.59 mg/l	8/17/99	SUB	4500-N-C
Nitrate	<0.3 mg/L	8/16/99	NB	SM 4500-NO3-E
Phosphorus as P	0.05 mg/l	8/18/99	NB	4500-P-E
WARNERS LAKE, MA: WATER FROM MID-POND, 8/6/99				
Total Kjeldal Nitrogen	1.6 mg/l	8/17/99	SUB	4500-N-C
Nitrate	<0.3 mg/L	8/16/99	NB	SM 4500-NO3-E
Phosphorus as P	0.14 mg/l	8/18/99	NB	4500-P-E
WARNERS LAKE, MA: WATER FROM OUTLET, 8/6/99				
Total Kjeldal Nitrogen	0.89 mg/l	8/17/99	SUB	4500-N-C
Nitrate	<0.3 mg/L	8/16/99	NB	SM 4500-NO3-E
Phosphorus as P	0.07 mg/l	8/18/99	NB	4500-P-E

Respectfully Submitted by: ____________________

ATTACHMENT B

Watershed Management Information

LIST OF WATERSHED MANAGEMENT OPTIONS FOR REDUCING NUTRIENT LOADS

Technique	Descriptive Notes
1. Agricultural Best Management Practices	Application of techniques in forestry, animal, and crop science intended to minimize adverse impacts.
2. Bank and Slope Stabilization	Erosion control to reduce inputs of sediment and related substances.
3. Behavioral Modifications	Actions by individuals.
a. Use of Non-Phosphate Detergents	Elimination of a major wastewater phosphorus source.
b. Eliminate Garbage Grinders	Reduce load to treatment system.
c. Limit Lawn Fertilization	Reduce potential for nutrient loading to water body.
d. Limit Motorboat Activity	Reduce wave action, vertical mixing, and sediment resuspension.
e. Eliminate Illegal Dumping	Reduce organic pollution, sediment loads and potentially toxic inputs to a water body.
4. Detention or Infiltration Basin Use and Maintenance	Lengthening of time of travel for pollutant flows and facilitation of natural purification processes.
5. Increased Street Sweeping and Catch Basin Cleaning	Removal of potential runoff pollutants from roads and drainage systems.
6. Maintenance and Upgrade of On-site Disposal Systems	Proper operation of localized systems and maximal treatment of waste water to remove pollutants.
7. Provision of Sanitary Sewers	Community level collection and treatment of waste water to remove pollutants.
8. Storm Water or Waste Water Diversion	Routing of pollutant flows away from a target water body.
9. Zoning and Land Use Planning	Management of land to minimize deleterious impacts on water.
10. Treatment of Runoff or Stream Flows	Inactivation of nutrients or other treatments to chemically alter inflows.

*Source: Dr. Kenneth Wagner, ENSR Corporation

Framingham Conservation Commission
150 Concord Street
Framingham, MA 01702

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Framingham, MA
161

GLEASON POND

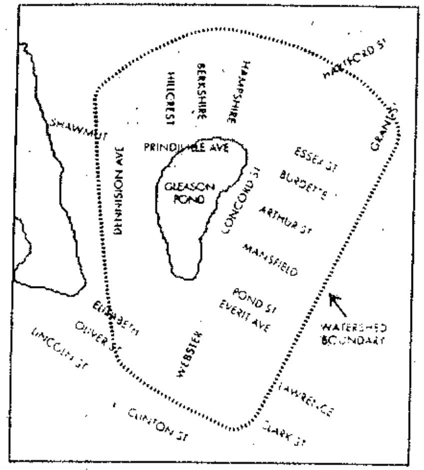
A Resident's Guide to Care and Protection

We are often attracted to ponds because of the many opportunities they offer – like boating, fishing, wildlife habitat and aesthetics – and of course, our water supply. Our human activities in and around these ponds can have detrimental effects. This publication is your Guide to the care of Gleason Pond, helping assure we all do our part to protect and preserve the Pond for enjoyment for years to come.

A publication of the
Framingham Conservation Commission
prepared by Aquatic Control Technology, Inc.
and ENSR Corporation

Gleason Pond

...Your Pond, Your Responsibility



Gleason Pond is a 12-acre, shallow, kettle hole pond formed by the glaciers as they passed through Massachusetts. Residential development is the primary land use in the pond's 36-acre watershed. Stormwater runoff from these residential areas is a primary source of nutrients (phosphorus) and sediment to the pond, causing nuisance weed and algae growth.

Excessive inputs of phosphorus and sediment causes *eutrophication* – increased growth of nuisance weeds and algae and accelerated filling in of your pond. Aquatic plants are an important part of a healthy pond ecosystem, yet too many plants or the invasion of exotic (non-native) plants can impair fish/wildlife habitats and recreational pond uses.

The information included in this brochure offers guidelines for the care of your pond. Take a look inside and see what YOU can do to make a difference.

Stormwater Runoff

The Pollution Pipeline

Stormwater runoff is the greatest cause of degradation in the rivers, streams, lakes and coastal waters of Massachusetts. All runoff ends up in a stream, river, pond or wetland. As it travels, stormwater runoff picks up pollutants deposited on the land and carries them to nearby surface waters. Runoff from streets, parking lots, lawns and other urban land gathers nutrients (phosphorus and nitrogen), heavy metals, petroleum hydrocarbons, pesticides and bacteria and deposit them in nearby waters.

In Massachusetts, urban runoff accounts for 50% of the nonpoint source pollution, 85% of the phosphates and 90% of the sediment entering our ponds

Your activities in the *watershed* – the land area that supplies water to a pond or river – contributes pollution to these resources. Your pond's watershed is shown on the inside panel of this pamphlet. Residents in the pond's watershed should take special care not to contribute needlessly to the degradation of the pond.

Household Hazardous Waste
Everyday Dangers

Paint thinner, chemical cleaning compounds, floor care products, poisons, pesticides, automotive products – things we use everyday in regular household chores. If not disposed of properly, each will find its way into your water.

Often we dispose of these products in the sink, down storm drains or out in the back yard. These toxic wastes are then gathered by stormwater runoff and carried to our local groundwater supplies, rivers and ponds.

Just 4 quarts of oil can contaminate up to 8 million gallons of drinking water or form an oil slick 8 acres in area (about the size of 8 football fields).

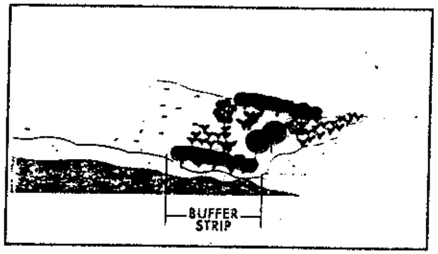
One-third of Massachusetts residents change their own motor oil. Of these, 20% dispose of the waste oil improperly. Nearly 70% of the do-it-yourself anti-freeze changers dispose of it improperly.

What YOU can do:

- Take advantage of household hazardous waste days to properly dispose of oil, anti-freeze, batteries, paints, pesticides, solvents and hazardous waste.
- Don't dispose of ANY hazardous waste in drains, storm drains or on the ground.
- Use products according to manufacturer's directions.

Shoreline Management
Your Pond's Pollution Defense System

Runoff from your lawn, rooftop and driveway carries pollutants to your pond. As a shoreline property owner YOU can reduce the negative impact on water quality and slow the rate of eutrophication by properly maintaining a *buffer zone*, a vegetative strip between your activities and the water's edge.



What YOU can do:

- Create an natural vegetated buffer zone at the shoreline: a strip 10-15 feet wide is usually sufficient.
- Check for evidence of erosion in buffer zones and reseed and stabilize as needed.
- Plant native vegetation rather than exotic (non-native species).
- Use terracing or provide a physical access (steps) on steep slopes.
- Don't use fertilizers or pesticides within the vegetated buffer zone.

Lawn Care
A Green Lawn Without A Green Pond

Many homeowners use *fertilizers* and *pesticides* on their lawns. Just as fertilizers promote vigorous growth of turf grass, they

also promote the growth of aquatic algae and weeds when they wash into nearby waterbodies. But with proper care, you can have a healthy green lawn without a green pond. Algae are especially responsive to fertilizer since most rely entirely on nutrients extracted from the water.

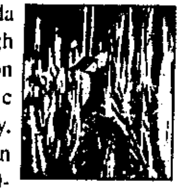
One tenth of a pound of fertilizer reaching your lake can grow about 2.5 pounds of algae.

Lawn areas also have a high potential to deliver pesticides to the water. Some common lawn-care pesticides are known to be toxic to fish, aquatic insects and/or waterfowl.

What YOU can do:

- Avoid application of fertilizers or pesticides near the shoreline area.
- Avoid application of fertilizers or pesticides before a rainstorm.
- Avoid application during the summer; use as needed during spring and fall.
- Apply fertilizers and pesticides according to manufacturer's directions – more is *not* always better.
- Water lawns in morning or evening to reduce loss to evaporation.
- Cut grass fairly long (2-2.5") to encourage deeper roots.

Canada Geese
Friend or Foul?



For centuries, Canada geese have passed through New England on migration to and from their Arctic breeding grounds. Today, Canada geese populations in Massachusetts exceed 10-20,000. More than half may be resident, or non-migrating. Why? Humans provide the geese with easy living conditions. This grazing animal finds well-fertilized lawns, particularly around our lakes, provides it with a convenient supply of nourishing grass.

Geese, as well as other non-migrating waterfowl, may adversely affect water quality. The fecal matter of the geese contain nutrients which cause *eutrophication*. Also, bacteria in the fecal matter may result in health concerns.

Waterfowl fecal matter contains as much as 33 million fecal coliform bacteria and 54 million fecal streptococcus bacteria.

In one day a single bird can contribute up to 40 times more bacteria than a single human. 10-15 non-migrating geese contribute as much phosphorus as found in the waste of a single person.

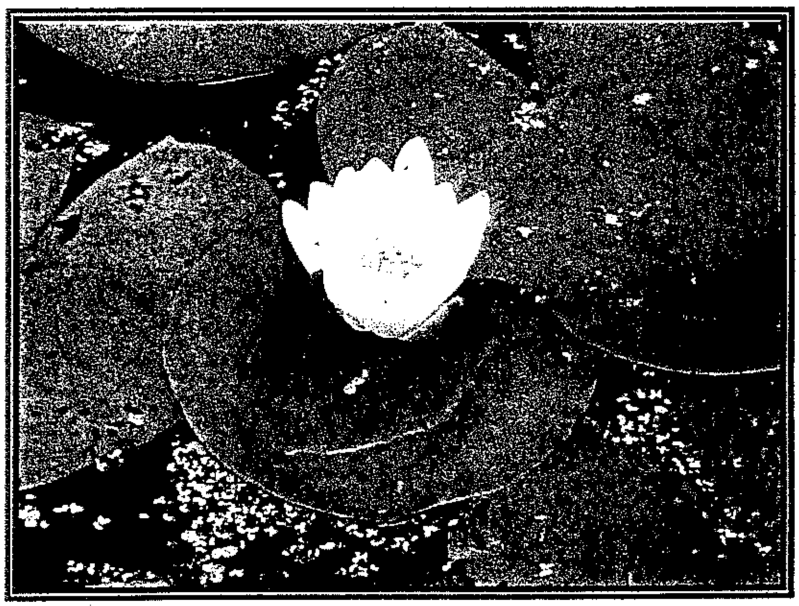
What YOU can do:

- Don't feed the geese or other waterfowl.
- Use scare tactics (scarecrows, streamers, flags).
- Install low fencing at the water's edge.
- Maintain or plant tall vegetation at the water's edge.

NEW ENGLAND ENVIRONMENTAL, INC.

WILDLIFE
AND
HABITAT ASSESSMENT
WARNER'S POND
CONCORD, MA

November 4, 1999



Prepared for:

Town of Concord
Division of Natural Resources
141 Keyes Road
Concord, MA 01742

Prepared by:

New England Environmental, Inc.
800 Main Street
Amherst, MA 01002

NEE file 99-1602

NEW ENGLAND ENVIRONMENTAL, INC.
Environmental Consulting Services

800 Main Street
Amherst, MA 01002
(413) 256-0202
FAX (413) 256-1092

November 4, 1999

Mr. Markus B. Pinney
Natural Resources Administrator
Town of Concord Division of Natural Resources
141 Keyes Road
Concord, MA 01742

RE: Warner's Pond Biological Survey
NEE file 99-1602

Dear Markus:

Please find eight final copies of our assessment of Warner's Pond. I would like to thank you and the Town of Concord Natural Resources Commission for your thoughtful comments of our draft report. This final report includes the changes you have suggested.

Warner's Pond is a wonderful resource for the Town of Concord, however it appears to have been neglected for too long and is now in need of a major restoration effort to restore it's former water quality. We have provided you with a general overview of the current wildlife use and habitats within the pond, as well as several suggested management tools which may be implemented as Best Management Practices.

I hope that the finding of this report will aid the Town of Concord in the implementation of a restoration effort for Warner's Pond.

Sincerely,
New England Environmental, Inc.

Michael J. Marcus
Senior Scientist
Principal

MJM/sl
enc.

Cc: ACT, Inc.
F:\Shared\LET99\1602 warner's pond draft report

INTRODUCTION

New England Environmental, Inc. (NEE) visited Warner's Pond in Concord between April and August 1999 to complete a biological assessment of the pond. Access to the pond was gained from the conservation land located off Commonwealth Avenue. NEE used a small boat to access the entire pond and islands.

Warner's Pond is fed primarily by a single surface inlet from Fort Pond and Nashoba Brook which join a short distance upstream of the northwest corner of the Warner's Pond. These are fed by a large complex of streams and ponds whose watershed extends over west Concord, the southern part of Westford, the northeast corner of Littleton, the southeastern portion of Boxborough, and all but the very southern portion of Acton. This watershed area includes housing developments, major roadways, such as Route 2 and Interstate 495, commercial and industrial sites and sewage treatment plants. The inlet is located in the northwestern corner of the pond, and the outlet, is located in the southwestern corner of the pond. There is an old mill pond dam and an adjacent newer outlet structure on the brook which flows only a short distance before flowing into the Assabet River.

In general, Warner's Pond appears to be acting as a giant detention basin for the upgradient watershed. The entire northern and western section of the pond has filled with sediment deposited in the Pond from Nashoba Brook and is now a shallow marsh habitat rather than an open water pond. The eastern section of the Pond contains deeper water, but is also densely vegetated with submerged and floating leaved aquatic vegetation. While the current conditions provide excellent waterfowl habitat, particularly in the extensive shallow marsh areas, it is evident that the pond is nutrient rich and that unless the sediment accumulation is prevented, the pond will revert to a shrub-scrub wetlands rather than open water habitat. This is already occurring in the extreme western sections of the pond.

HABITAT ASSESSMENT

This approximately seventy-seven acre man-made pond can be divided into four habitat types which are shown on the attached site locus map (see Figure 1):

- shallow marsh to the north and west of Boy Scout Island;
- a large water willow, *Decodon verticillatus*, marsh at the inlet;
- open water along the eastern side and in the north; and
- mixed upland forest habitat found on the islands.

Shallow Marsh

This habitat consists of areas where the depth of water is typically one to three feet deep, and includes occasional areas of mudflats. The dominant plants in this area consist of: White Water Lily, *Nymphaea odorata;* Yellow Water Lily, *Nuphar luteum*; Pondweeds, *Potamogeton spp.*; Water Milfoil, *Myriophyllum sp.*; and Duckweed, *Lemma sp.* Water chestnut is present, but is not a dominant plant. All submerged aquatic plants were covered with a thick growth of unidentified algae. The water clarity within this area is very poor, containing high levels of fine silt. Many small fish were noted within this area. NEE noted the following waterfowl and wading bird species using this area: Wood Duck; Mallard Duck; Canada Goose; Great Blue Heron; Little Green Heron; Spotted Sandpiper; and Belted Kingfisher. Dragonflies and damselflies also use this area extensively, and at least ten species were noted by NEE throughout the pond. In addition, this area is also used by painted turtles and green frogs. This is a rich area that is heavily used by a wide variety of wildlife. It is ideal waterfowl and warm water fish habitat, and it is likely an important feeding area for migratory waterfowl. Both wood ducks and mallard ducks were observed to be nesting on the small islands within the pond, as were Canada Goose. Several wood duck nesting boxes have been placed within the pond area.

Water Willow

There is an extensive area dominated by Water Willow, *Decodon verticillata* found near the inlet of Nashoba Brook in the northwest corner of Warner's Pond. Water Willow is a native but invasive plant species which once established diminishes the area of open water by rapidly expanding into the shallow pond fringes and accumulating sediments and organic debris. The shallow habitat area is densely overgrown with Water Willow making boat access into this area extremely difficult. Over much of this area, the water depth was only two to three inches, but the bottom substrate was firm, composed of sand and silt rather than muck. Although the vegetation was very dense and the bottom shallow except for the inlet stream channel, the water was relatively clear in this area. A number of small birds were noted in this area including: Goldfinch, Chimney Swift, Least Flycatcher, Eastern Kingbird, and Song Sparrow.

Open Water

The open water habitat in the northeast section of the Pond contains the deepest water found within of the pond with depths of over 6 feet. Canada Goose, Mallard Duck, Belted Kingfisher, and Double-crested Cormorant all used this area. The deep relatively cool water within this community allow fish to escape the warm shallow low oxygen water of the marsh habitats. This deeper community continues south of the islands to the outlet. The water in the deep area in the northeast does not appear to be carrying high loads of silt or sediment. In contrast, the water within the outlet channel is carrying an extensive load of silt and is a brown chalky color.

Upland Habitat

The final habitat found within Warner Pond is the upland habitat found on the small islands within the Pond. These areas are primarily forested with deciduous trees and a relatively dense shrub understory. The vegetation found on Boy Scout island, the largest of the islands, consisted of plants such as: Pin Oak (*Quercus palustris*); White Birch (*Betula alba*); Red Maple, (*Acer rubrum*); White Oak, (*Quercus alba*); Tupelo, (*Nyssa sylvatica*); Pitch Pine, (*Pinus rigida*); and White Pine (*Pinus strobus*) in the canopy. There was a very open shrub layer that contained Sweet Pepperbush, (*Clethra alnifolia*); Swamp Azalea,(*Rhododendron viscosum*); Alder, (*Alnus incana*), Highbush Blueberry, (*Vaccinium corymbosum*); Black Huckleberry, (*Gaylussacia baccata*); Lowbush Blueberry, (*Vaccinium angustifolium*); Sheep Laurel, (*Kalmia angustifolia*); European Buckthorn, (*Rhamnus frangula*); Spreading Dogbane, (*Apocynum androsaemifolium*); and Nannyberry, (*Viburnum lentago*).

Signs of beaver were noted on the island as well as numerous chipmunks and gray squirrels. Nesting cavities used by woodpeckers and other hole nesting species were common within the trees, however larger cavities such as those favored by Wood Ducks were not observed. Birds observed using these islands included: Downy Woodpecker; Morning Dove; Catbird; Yellow-shafted Flicker; Cedar Wax Wing; and Black-capped Chickadee. In addition, it appears that the Mallard Duck and Canada Goose are using islands as nesting sites as these may be relatively free of predators. It should be noted that there were several wood duck nesting boxes which had been erected within the shallow marsh areas of the Pond.

This island also sees some use by people. There are the remains of a house foundation on the largest island, and an existing fire circle (see photograph) indicates that this area continues to be used as an informal campground. Use by people appears to be minimal as there is much dead wood on the island despite the fire circle and a semi-worn trail system. Access to the islands is relatively easy from the conservation landing with a canoe or kayak. Use of a small motor boat is possible, but due to the large quantities of submerged aquatic weeds, not practical.

Other smaller islands within Warner's Pond are densely vegetated with shrubs and saplings and are used by nesting and resting areas by waterfowl, especially Canada Goose.

Fish

The Massachusetts Department of Fisheries and Wildlife has previously conducted fish inventories of Warner's Pond and the Nashoba Brook area upstream of the pond. The list of fish provided in Table 1 indicates that at one time Warner's Pond was stocked with and supported rainbow trout. At the present time, the pond is a warm water fishery and no longer provides suitable trout habitat.

Table 1. Fish Species from Warner's Pond and vicinity

Fish Species	Warner' Pond	Nashoba Brook
Golden Shiner	X	X
White Sucker	X	X
White Perch	X	
Pumpkinseed	X	X
Brown Bullhead	X	
Black Crappy	X	
Largemouth Bass	X	X
Yellow Perch	X	X
Bluegill	X	
Yellow Bullhead	X	X
Rainbow Trout	X	
American Eel	X	X
Red-breasted Sunfish		X
Pickerel		X
Banded Sunfish		X
Fall Fish		X

Rare Wetlands Wildlife

Warner's Pond was searched by NEE for occurrences of rare or threatened wildlife, however none were found. The Natural Heritage & Endangered Species Program was contacted for a search of their database of state protected rare species in and within the vicinity of Warner's Pond. Their response (attached) indicates that there are no known occurrences of any rare plants or animals, or exemplary natural communities in this area.

Recommendations for the Management of Warner's Pond

Warner's Pond is a diverse and rich natural resource for the Town of Concord which is in the process of being lost due to long term neglect and degradation from sediment and nutrient input from the upgradient watershed. Our observations lead us to conclude that heavy sediment loads have been deposited within Warner's Pond from the Nashoba Brook watershed and have converted the majority of the pond from open water to shallow marsh and water willow habitats.

We provide the following recommendations:

1. Use mechanical (dredging) techniques to recreate a flow through channel between the inlet and outlet of the Pond and to remove sediments deposited in the inlet area and *Decodon* marshes. It is likely that the water levels within the pond will need to be dropped via the outlet structure for this work. Since a man-made dam exists at the outlet, it should be possible to lower the water level within the pond for management and maintenance purposes.

2. Consider the use of chemical techniques to remove invasive submerged aquatic vegetation and algae within the deep water habitat area, and within other areas as required.

3. Consider the draw-down of Warner's Pond to remove invasive aquatic vegetation

4. Create a "sump" at the Nashoba Brook inlet to collect sediment entering the Pond from the upstream watershed by constructing a low berm of rock gabions (or other similar methods). This "sump" should be accessible via the adjacent corn fields, and should be cleaned out on a regular (yearly) basis, thereby preventing sediments from continually filling the Pond. The purpose of this sump, or sediment trap basin, is to provide a means to prevent sediment from upstream sources from

continually filling-in Warner's Pond.

5. Leave the majority of the extensive shallow marsh area intact as waterfowl habitat.

6. Add additional wood duck nesting boxes.

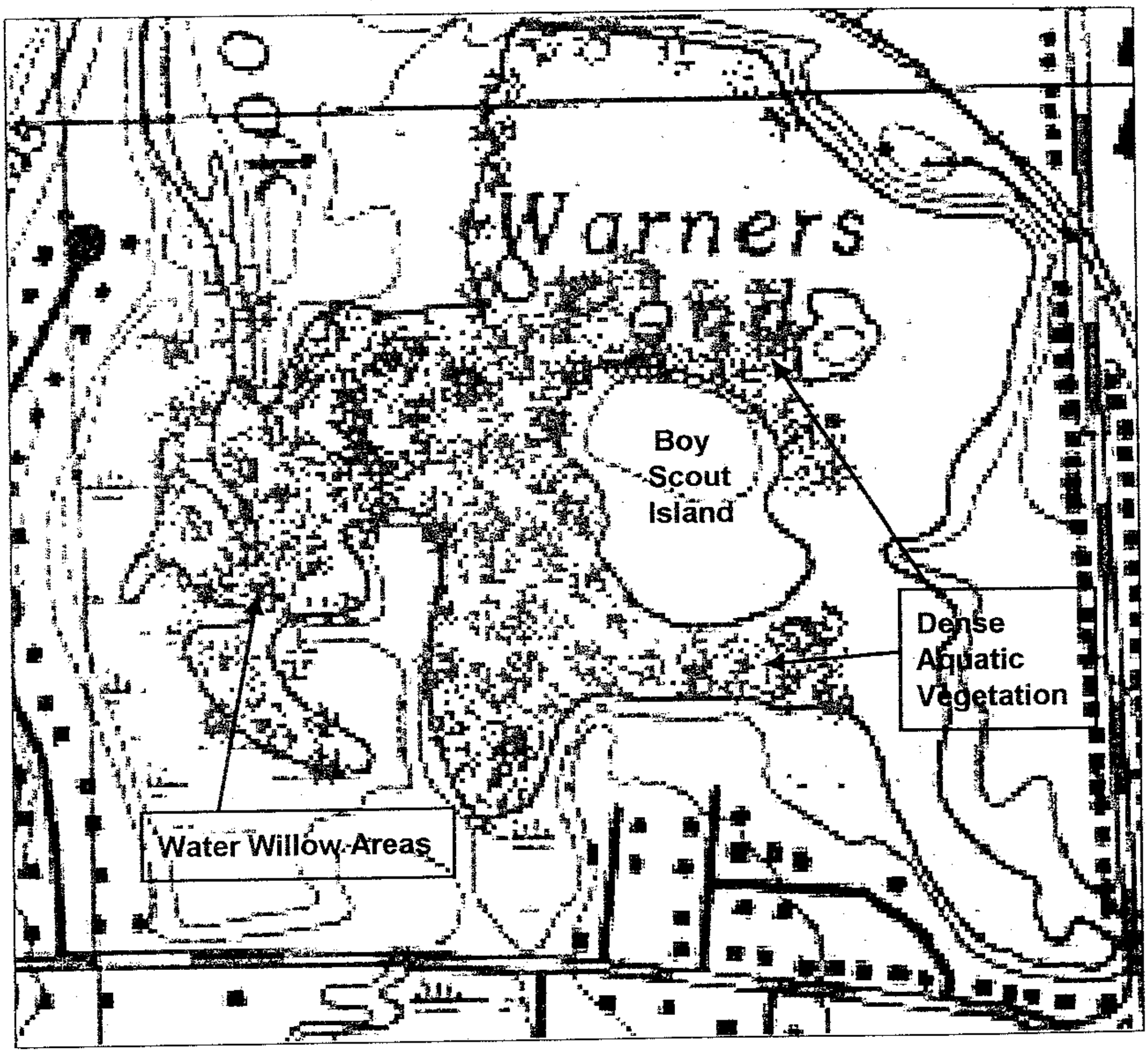
7. Place appropriate signs on the smaller islands to prevent people from landing canoes and walking on these areas which are used for waterfowl nesting.

8. Establish a policy for camping on Boy Scout Island.

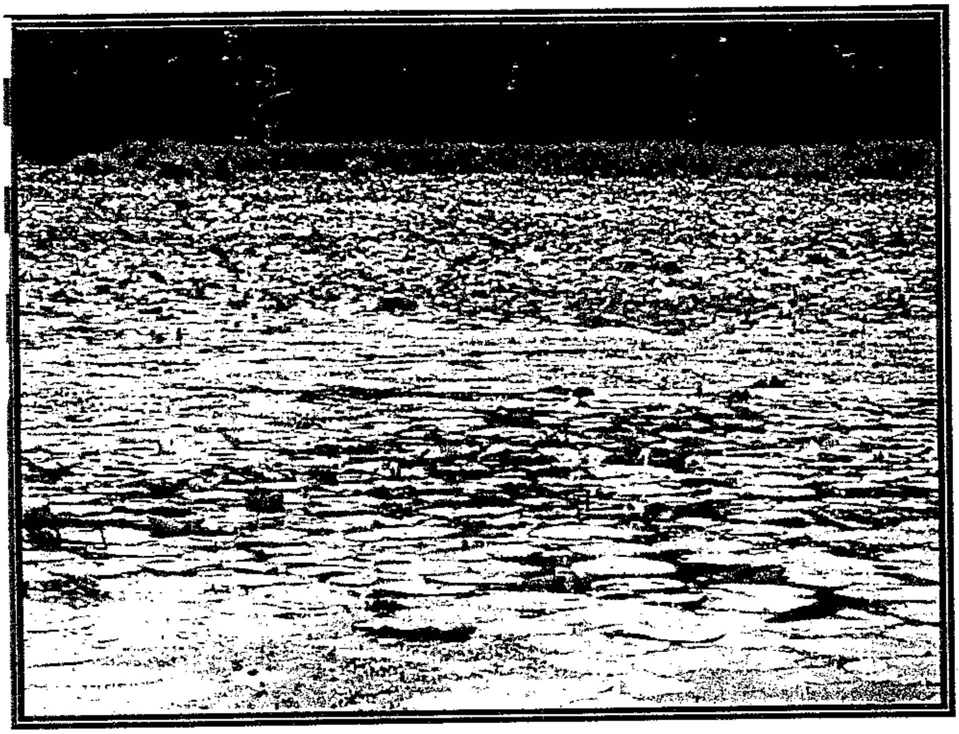
9. Consider the creation of a Town camping area on Boy Scout Island. This is a relatively undisturbed wooded island which has the feel of being far from civilization. Only a short canoe paddle away from the landing, it may serve as an interesting overnight area for nature groups, school groups, scouts, etc.

10. Consider the formation of a Warner's Pond advisory Committee composed of both members of the Natural Resources Commission and local citizens to review the recommendations reported here, and other recommendations as they become available, and to implement these recommendations as funding becomes available.

Figure 1. Topographical Map of Warner Pond, Concord, MA, Maynard Quad, 1987

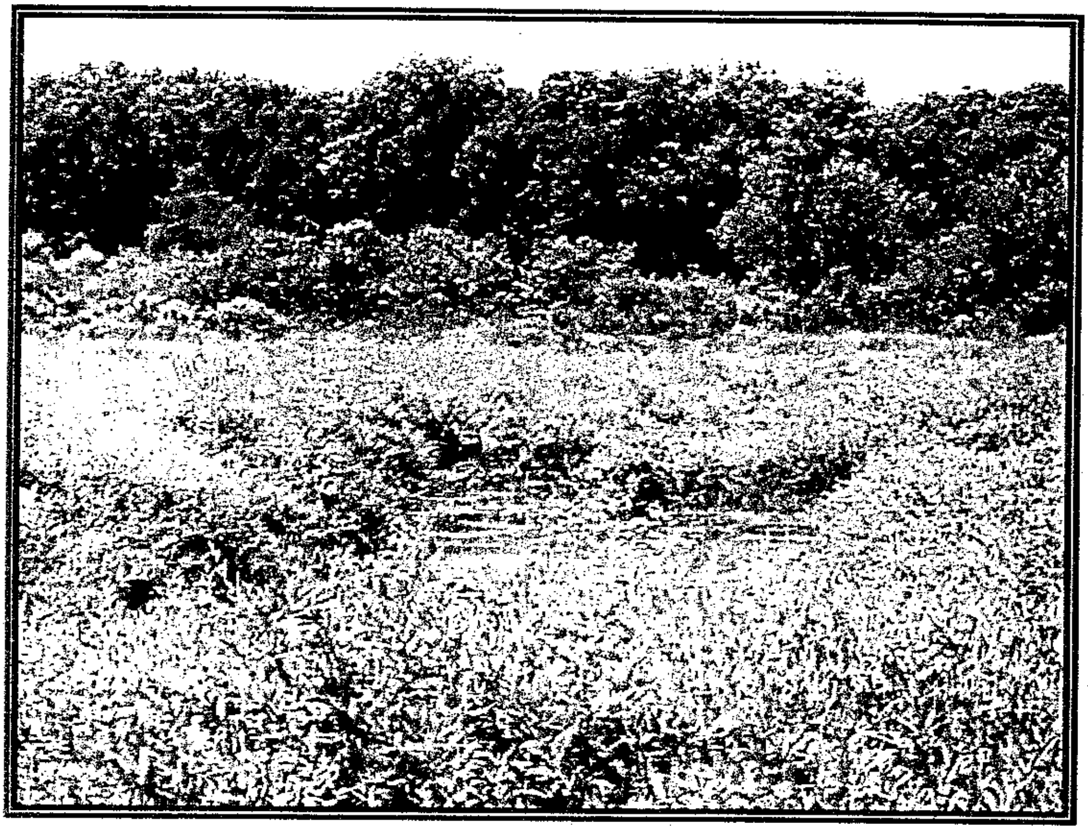


Photographs of Warner's Pond
August, 1999



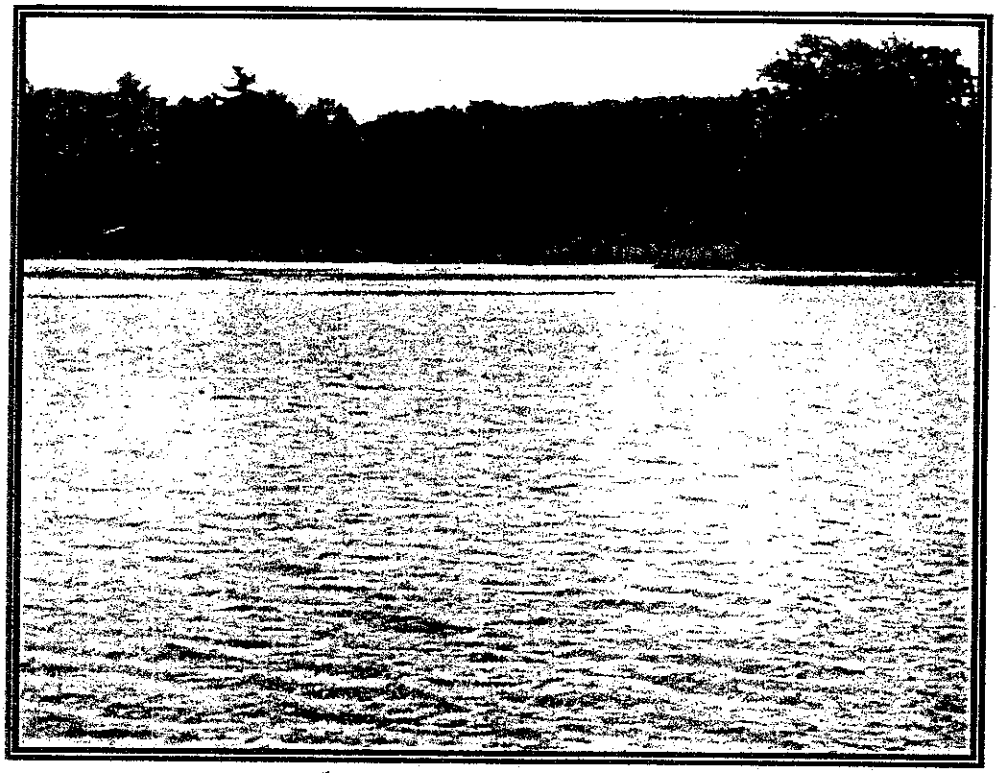
Typical Northwest Pond Shallow Marsh Vegetation Cover

Visible "trails" within the floating leaved aquatic plants are from swimming Wood ducks



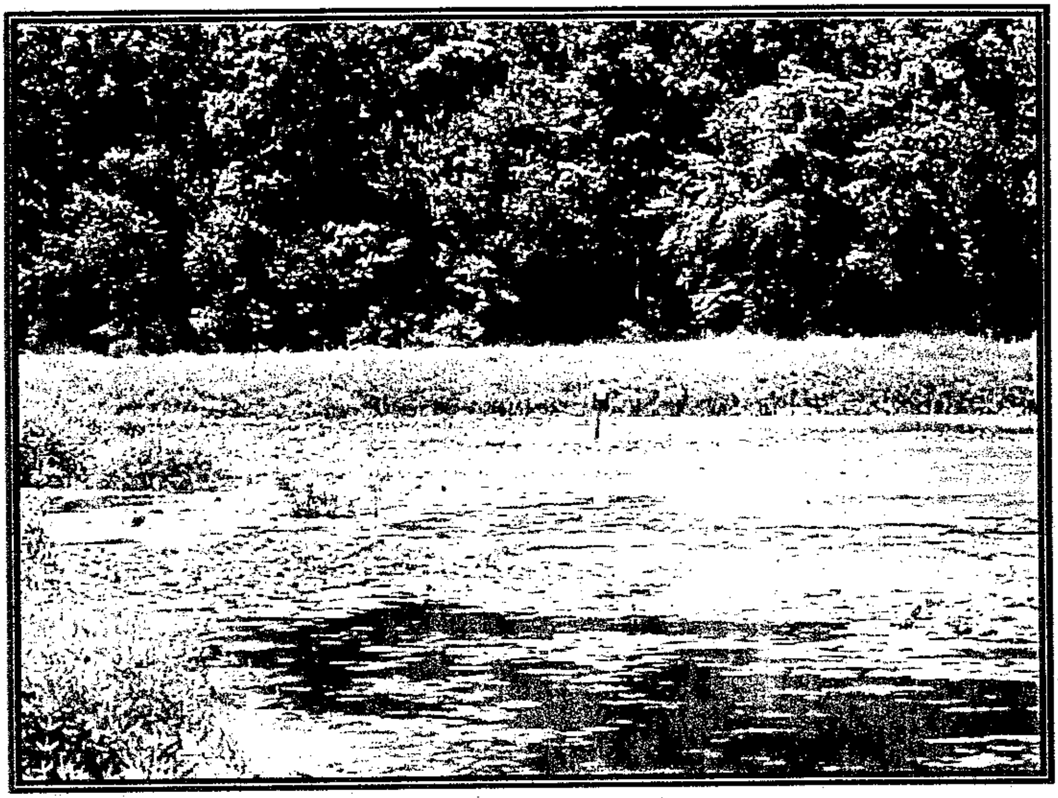
Typical Water Willow community cover at the Nashoba Brook inlet channel into Warner's Pond.

Nashoba Brook Channel into Warner's Pond



Northeast area of Warner Pond with open water habitat

Open Water outlet channel with silty water and typical channel shore line



The shorelines throughout the pond are vegetated with Purple Loosestrife, Lythrum salicaria. *A large corn field borders Warner's Pond to the northeast. This field is heavily used by the geese from Warner's Pond in both the spring and the fall, when portions of the field are flooded. Note* Decodon *fringed shoreline, and wood duck box*

Fire circle camping area and old foundation on Boy Scout Island.

Commonwealth of Massachusetts

Division of Fisheries & Wildlife

Wayne F. MacCallum, *Director*

22 July 1999

Karro A. Frost
New England Environmental, Inc.
800 Main St.
Amherst, MA 01002

Re: Warners Pond
Concord, MA
NHESP File: 99-5558

Dear Ms. Frost,

Thank you for contacting the Natural Heritage and Endangered Species Program for information regarding state-protected rare species in the vicinity of the site identified above.

At this time we are not aware of any rare plants or animals or exemplary natural communities in the area of this site.

This review concerns only rare species of plants and animals and ecologically significant natural communities for which the Program maintains site-specific records. This review does not rule out the possibility that more common wildlife or vegetation might be adversely affected if this site is developed, especially if it will modify currently undeveloped areas. Should site plans change, or new rare species information become available, this evaluation may be reconsidered.

Please call me at (508) 792-7270 x154 if you have any questions.

Sincerely,

Cindy L. Campbell
Environmental Review Assistant

Natural Heritage & Endangered Species Program
Route 135, Westborough, MA 01581 **Tel:** (508) 792-7270 x 200 **Fax:** (508) 792-7275
An Agency of the Department of Fisheries, Wildlife & Environmental Law Enforcement
http://www.state.ma.us/dfwele