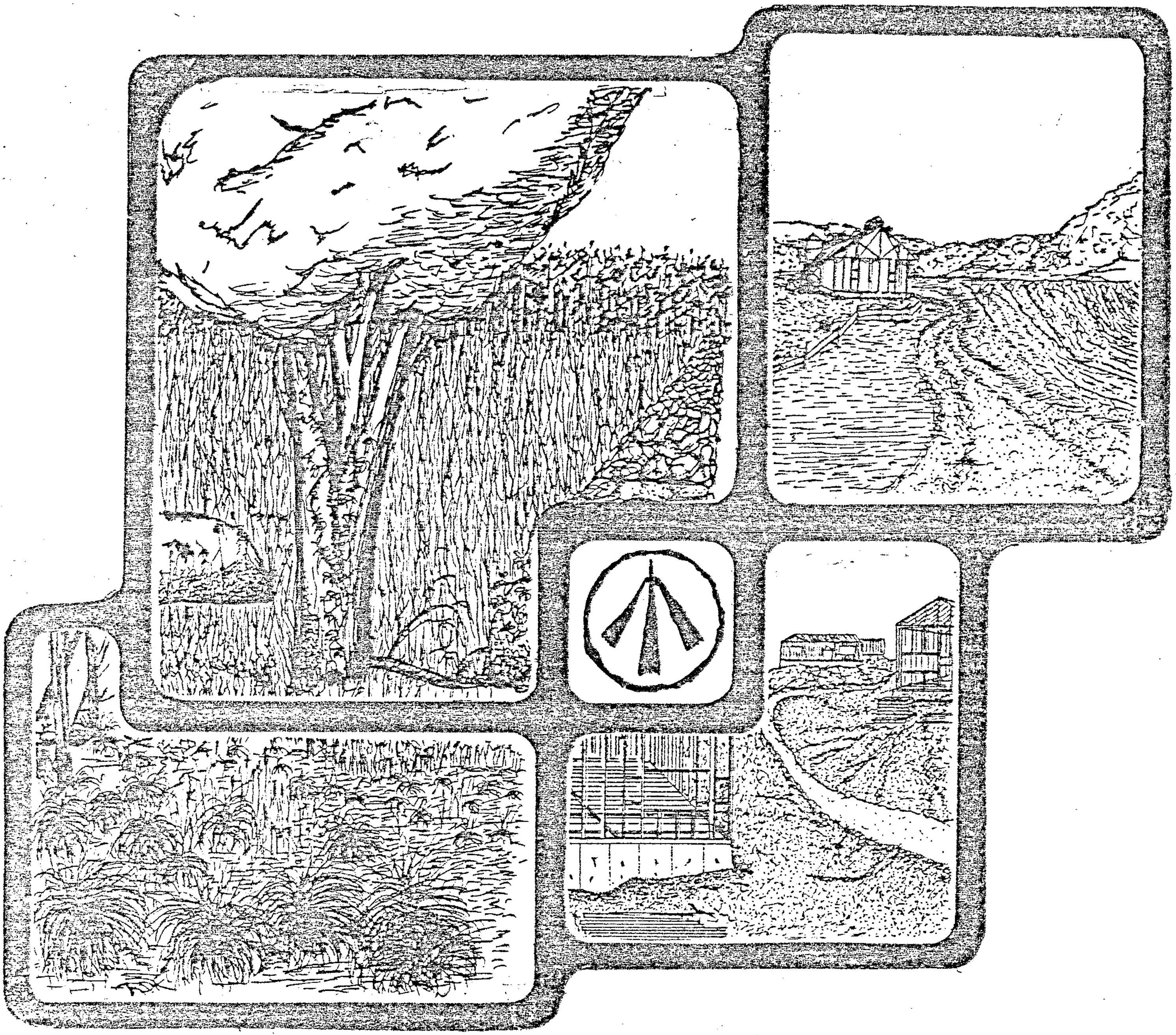
ENVIRONMENTAL REVIEW TEAM REPORT



LONG MEADOW POND
MIDDLEBURY, CT

KING'S MARK
RESOURCE CONSERVATION & DEVELOPMENT AREA

KING'S MARK
ENVIRONMENTAL REVIEW TEAM REPORT

LONG MEADOW POND
MIDDLEBURY, CT
APRIL 1985

King's Mark Resource Conservation and Development Area
Environmental Review Team
Sackett Hill Road
Warren, Connecticut 06754

ACKNOWLEDGMENTS

The King's Mark Environmental Review Team operates through the cooperative effort of a number of agencies and organizations including:

Federal Agencies
- U.S.D.A. Soil Conservation Service

State Agencies
- Department of Environmental Protection
- Department of Health
- University of Connecticut Cooperative Extension Service
- Department of Transportation

Local Groups and Agencies
- Litchfield County Soil and Water Conservation District
- New Haven County Soil and Water Conservation District
- Hartford County Soil and Water Conservation District
- Fairfield County Soil and Water Conservation District
- Northwestern Connecticut Regional Planning Agency
- Valley Regional Planning Agency
- Central Naugatuck Valley Regional Planning Agency
- Housatonic Valley Council of Elected Officials
- Southwestern Regional Planning Agency
- Greater Bridgeport Regional Planning Agency
- Regional Planning Agency of South Central Connecticut
- Central Connecticut Regional Planning Agency
- American Indian Archaeological Institute
- Housatonic Valley Association

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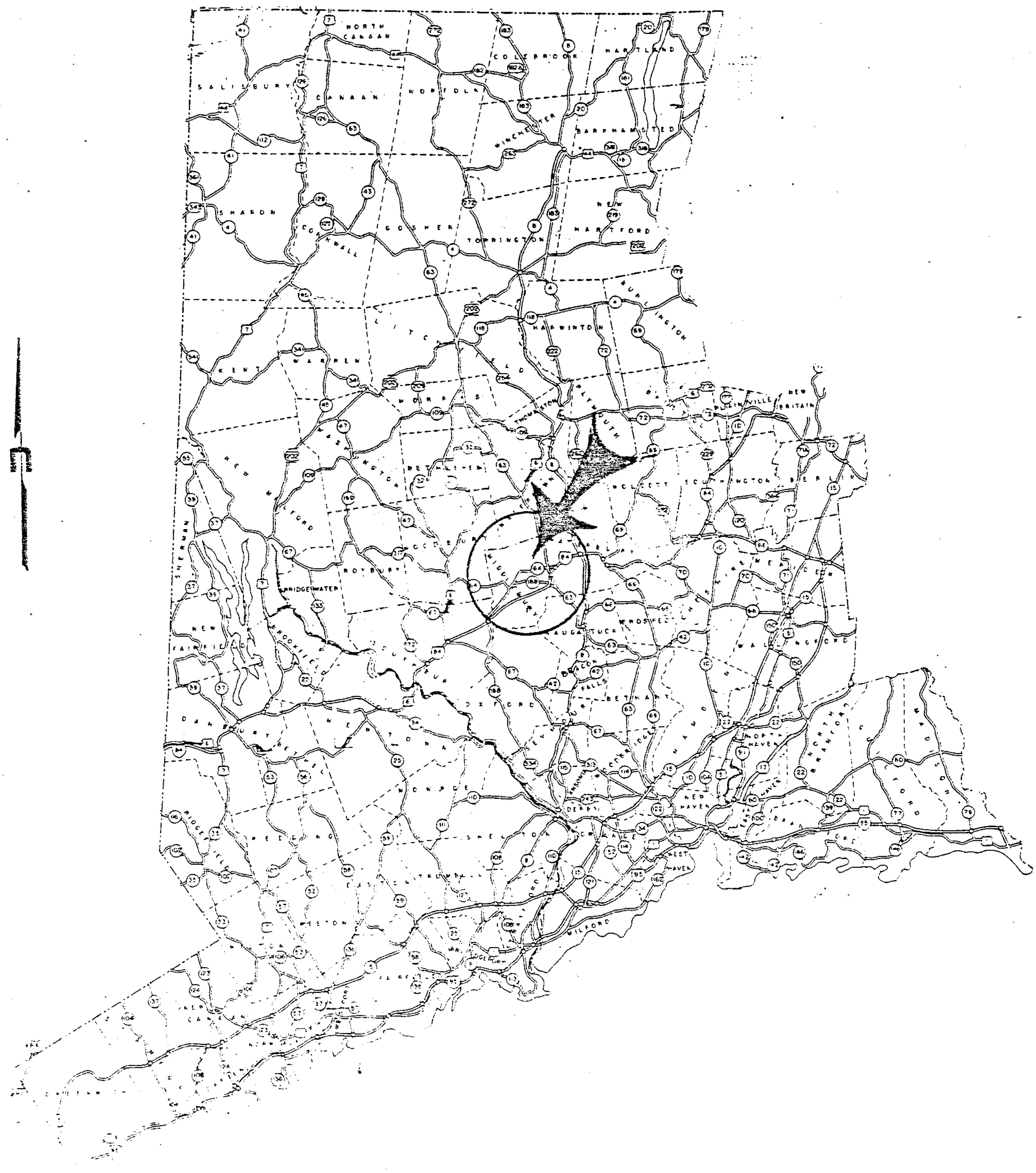


Scale 1" = 10 miles

10 0 5 10 miles

LONG MEADOW POND

I. Introduction

The preparation of this report on Long Meadow Pond was requested by the Middlebury Conservation Commission.

Long Meadow Pond is located in the southern portion of town and is ± 117 acres in size. The watershed or drainage area feeding Long Meadow Pond is approximately 2,120 acres. As shown in Figure 1, land use within the watershed is characterized by undeveloped wooded land with pockets of wetland and residential development. Major access roads in the watershed include Long Meadow Road, I-84, and Route 188.

Recently, concern has been expressed by local residents regarding the environmental health of Long Meadow Pond. Of major concern is the prolific growth of aquatic weeds and algae which are interfering with the recreational use and aesthetic enjoyment of the pond.

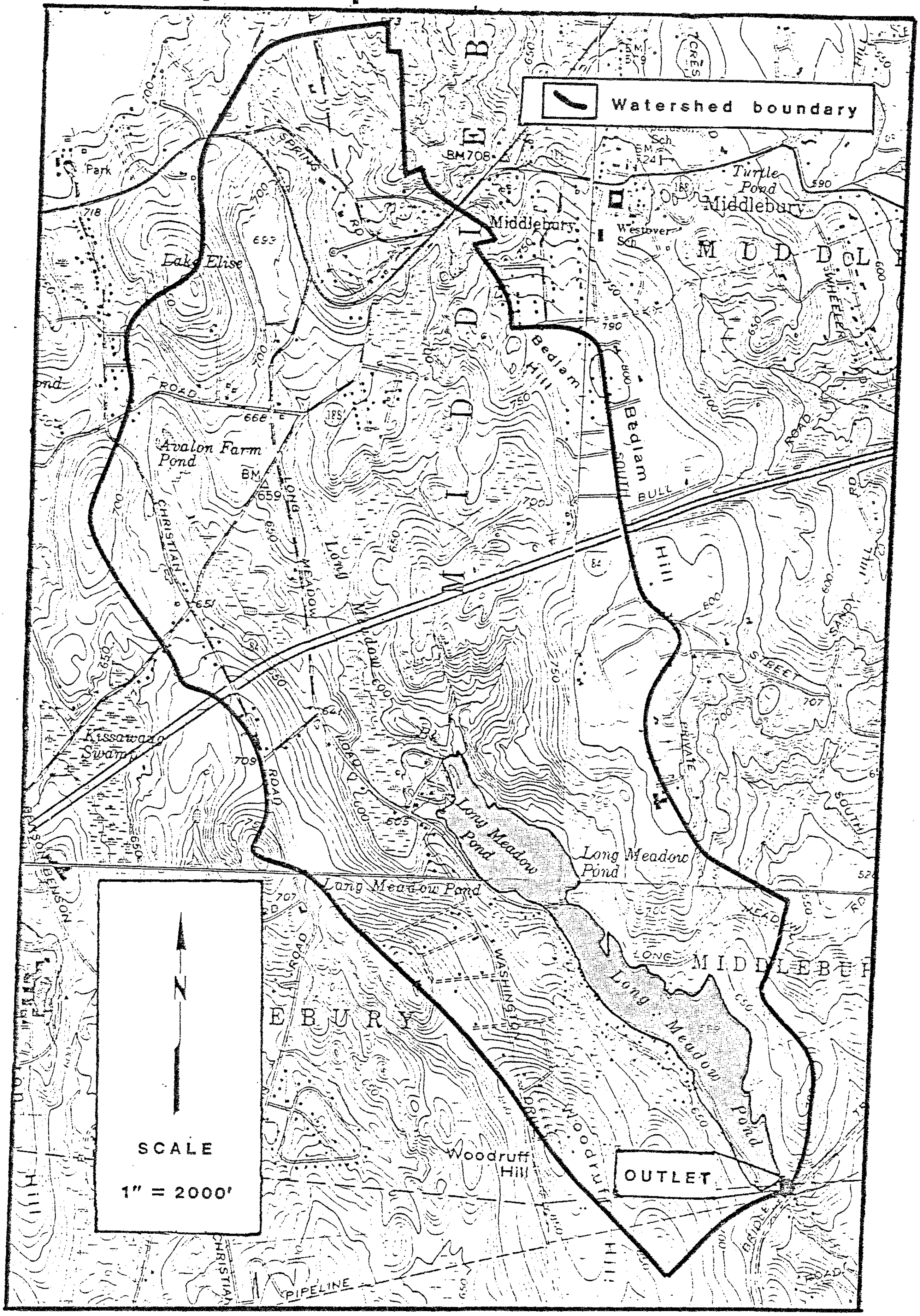
The Middlebury Conservation Commission requested this ERT study to learn more about the pond and its watershed. Specifically the ERT was asked to 1) provide a natural resource inventory and evaluation of the pond and its watershed, 2) identify what factors are contributing to the above mentioned problems at the pond and 3) discuss alternatives available for effective pond management. This information will assist the town of Middlebury and Uniroyal Inc. (which owns the pond) in determining how best to protect the future water quality of the pond. Presently, Uniroyal Inc. operates a 11' - 6" concrete dam at Long Meadow Pond where water discharge to the outlet stream is controlled by an outlet gate and by flashboards on the spillway. The water discharged from Long Meadow Pond ultimately flows to Thurston Pond which Uniroyal Inc. utilizes as a source for cooling water.

The King's Mark Executive Committee considered the town's request for an ERT study, and approved the project for review by the Team.

The ERT met and field reviewed the watershed on December 19, 1984. Team members participating on this review included William Hyatt, Fishery Biologist, Connecticut Department of Environmental Protection; Richard M. Lynn, ERT Coordinator, King's Mark RC & D Area; Nancy Marin, Lake Ecologist, Connecticut Department of Environmental Protection; William Warzecha, Geohydrologist, Connecticut Department of Environmental Protection; and Irene Winkler, Soil Conservationist, U.S.D.A. Soil Conservation Service.

Prior to the review day, each team member was provided with a summary of the proposed study, a checklist of concerns

Figure 1
Topographic Map



to address, and a detailed soil survey map and topographic map of the subject area. On the review day, team members met with representatives from the town of Middlebury and Uniroyal, Inc. and toured the watershed area. Following the field review, individual reports were prepared by each team member and forwarded to the ERT Coordinator for compilation and editing into this final report.

This report presents the team's findings. It is hoped the information contained in this report will assist the town of Middlebury and Uniroyal, Inc. in making environmentally sound decisions.

If any additional information is required, please contact Richard M. Lynn, (868-7342), Environmental Review Team Coordinator, King's Mark RC&D Area, Sackett Hill Road, Warren, Connecticut, 06754.

*   *   *

II. Highlights

1. *It was indicated during the ERT's field review that Uniroyal is considering raising the water level of the pond by 1-2 feet to improve water quality in the Pond. Based on a cursory inspection of the culvert passing under the causeway at Long Meadow Road, it appears that flooding could occur if the water level was raised by 2 feet, especially during periods of heavy precipitation. As a result, it may be necessary to raise the road level sufficiently so that it does not become impassable during flooding events. In the opinion of the ERT, it is doubtful that raising the water level in the pond by one or two feet would be significant in terms of controlling aquatic growth in the pond.* (p. 13)

2. *The limited development within the watershed, low impact landuses, widespread vegetative cover and interspersed depressional areas on the landscape all help to keep soil erosion to a minimum and protect the pond from sedimentation. Effective implementation of Connecticut's new erosion and sedimentation control law will help to keep erosion from new developments within the watershed to a minimum.* (p. 16)

3. *There is evidence of road sand building up on an access point to the pond along the western shoreline. Efforts should be taken to control such erosion and sedimentation from the roadways within the watershed.* (p. 16)

4. *A 1959 survey of the lakes and ponds of Connecticut found Long Meadow to be inhabited by largemouth bass, chain pickerel, bluegill sunfish, pumkinseed sunfish, yellow perch and golden shiner. It appears that Long Meadow Pond currently provides local residents with a warm water fishery (primarily for sunfish and largemouth bass) which is of moderate quality.* (p. 17)

5. *Weed growth was observed to cover roughly 80% of the surface area of the pond's north basin, while between 15 and 35% of the larger southern basin was choked by weeds. It is the opinion of the team's fishery biologist that the excessive proliferation of aquatic vegetation in the north basin is harmful to the pond's warmwater fisheries and that some means should be undertaken to control weed growth. However, it is believed that weed growth in this area acts as a buffer zone by trapping silt and nutrients, thereby protecting the rest of the lake. Because of this positive effect on*

the rest of the lake it is recommended that the objective of any future weed control efforts in the north basin should be to reduce vegetation cover to between 40 and 50% of the total surface area (rather than the 20% level optimum to fisheries). (p. 17, 18)

6. *Weed abundance in the south basin is also greater than that which is generally considered optimum for warmwater fisheries. Reducing the weed cover to between 20 and 25% of the south basin surface area would benefit the pond's fisheries. Priority, however, should be given to the north basin as it appears to be well on its way to becoming a swamp.* (p. 18)

7. *It is recommended that property owners around the pond form a lake association and develop a lake and watershed management plan for Long Meadow Pond. The plan should focus on 1) watershed management and 2) in-lake controls. The watershed management portion of the plan should target specific strategies for preventing watershed nutrients and sediments from reaching the pond. Examples of these strategies are presented in the text.* (p. 26)

8. *Appropriate in-lake control measures to a large extent depend upon financial capabilities. Alternatives include dredging, winter drawdown, weed harvesting, and chemical treatment. The best long-term control measure would entail dredging the Pond to a mean depth of 10+ feet. Dredging is a very expensive proposition however. A winter drawdown of Long Meadow Pond without a corresponding dredging operation is not recommended due to adverse impacts on the fisheries resource. Without the implementation of a lake-wide dredging operation, weed harvesting and/or chemical treatment may need to be relied upon to control the aquatic growth. The purchase, renting, or sharing of a weed harvester should be explored. The DEP has available a publication entitled "Control of Water Weeds and Algae" which provides information on the chemicals which may be used in the control of different types of nuisance vegetation.* (p. 27)

9. *In conclusion, without a major capital outlay, weed harvesting and chemical treatment appear to be the best "in-lake" management alternatives for controlling the weed growth at Long Meadow Pond. It should be noted, however, that some new methods of in-lake weed control are being developed. These methods focus on light-control and consideration should be given to including one or more of these methods in developing a management plan for Long Meadow Pond.* (p. 27)

III. Topography and Setting

Long Meadow Pond is located in the southern part of Middlebury and is roughly 117 acres in size. The watershed area feeding Long Meadow Pond encompasses a relatively linear tract of land, consisting of approximately 2,120 acres. The watershed of Long Meadow Pond may be defined as that land area from which all of the natural water input to the lake is derived. Long Meadow Pond is natural in origin, but the level has been raised by a low earthen and masonry dam at the southern end.

The Pond, its feeding swamp and stream (Long Meadow Brook), as well as Lake Elise occupy a pronounced valley which bisects the watershed lengthwise. The valley probably resulted from the erosion of a belt of relatively weak rocks, glaciation and/or the breakup of the rock by faulting. The maximum elevation in the watershed is 973 feet above mean sea level at the top of Great Hill. The minimum elevation is the same as the existing lake level (usually 599 feet). Of the hills surrounding the watershed, most appear to have bedrock controlled topography. Exceptions would be the streamlined hills along the western border of the watershed. These hills which are orièntated in a south-southeast direction are commonly associated with glacial activity. They are referred to as drumlins.

The terrain throughout the watershed ranges from gentle to steep. The steepest slopes are associated with rock outcrop areas and where corresponding shallow underlying bedrock is also present. Flatter areas are associated mainly with the wetlands in the northern half of the watershed and on tableland of some upland areas.

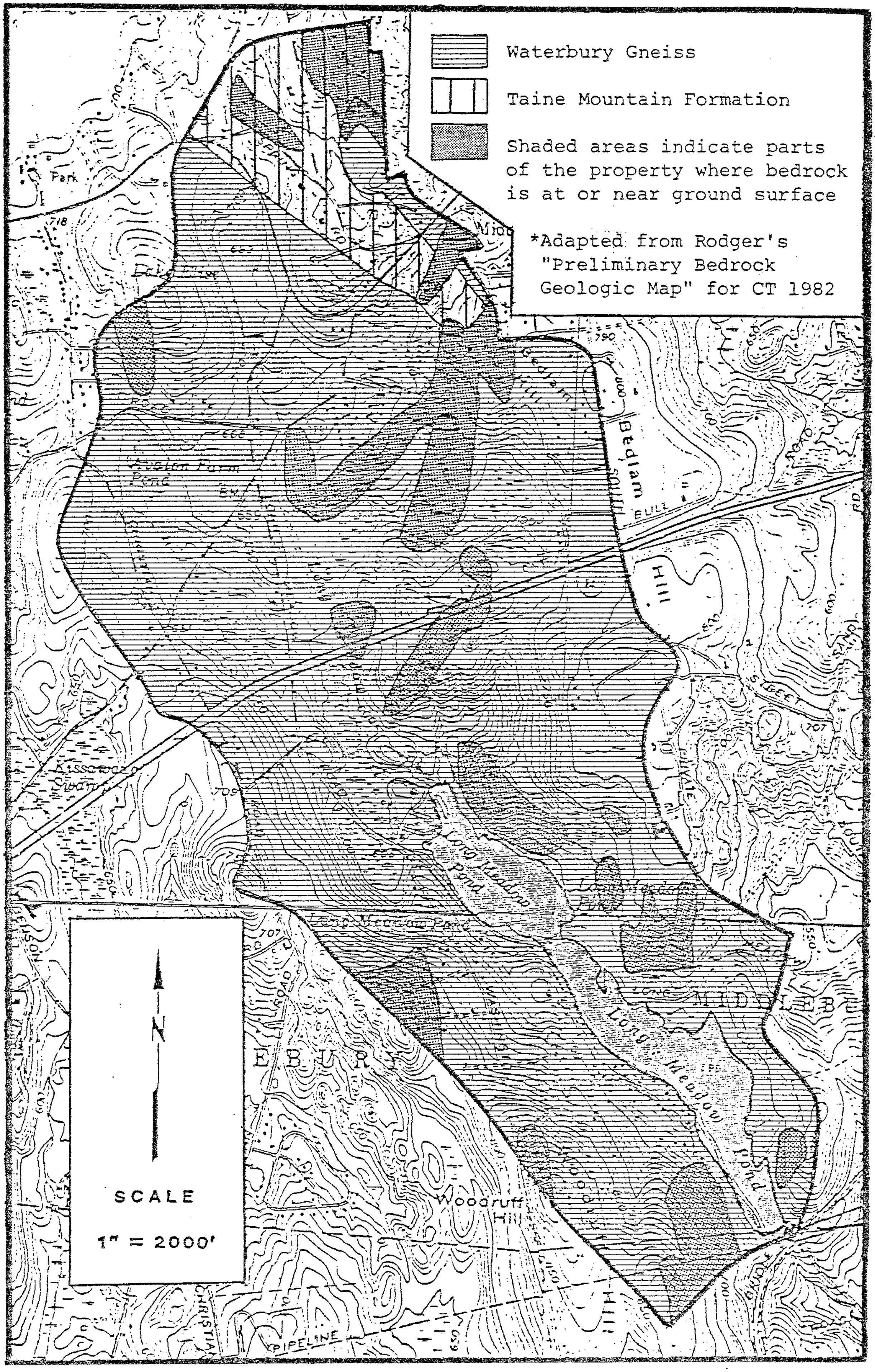
IV. Geology

A. BEDROCK GEOLOGY

According to John Rodger's Preliminary Bedrock Geological Map of Connecticut, 1982, two rock types outcrop and/or underlie the watershed: Waterbury Gneiss and Taine Mountain Formation (see Figure 2). Rodger's describes the Waterbury Gneiss, which predominates in the watershed, as an inter-layered, gray to dark gray, fine to medium grained schist and gneiss. Major minerals in the rock include biotite, quartz, oligoclase, kyanite and garnet. The Taine Mountain Formation underlies and/or crops out in the northern limits of the watershed. The rock consists of well layered granofels, composed primarily of the minerals quartz and feldspar.

The terms schist, gneiss and granofels used above relate to the structural and textural aspects of the local rocks. All of the rocks in the watershed have undergone

Figure 2
Bedrock Geology



deformation one or more times during the period following their creation. The stresses of deformation caused the alignment of platy, flaky and elongate minerals into thin sheets or bands. Where the alignment has resulted in a slabby rock (one that parts relatively easily along surfaces of mineral alignment), the rock is termed a "schist". Where the alignment has resulted in a banded but more massive rock, the rock is termed a gneiss. Granofels are rocks which are commonly light to dark in color, medium to coarse grained and massive to poorly layered. It lacks the compositional banding of a gneiss. All three rocks are metamorphic (geologically altered by heat and pressure within the earth's crust) and one rock may grade into another in a single outcrop. As a result, the actual term used may be based on individual preference. Depth to bedrock ranges from zero where it is exposed at ground surface to at least 40 feet on some drumlin hills along the western border.

It should be pointed out that detailed bedrock geologic maps have been published by the Connecticut Geological and Natural History Survey for the four topographic quadrangles which encompass the watershed. These maps are as follows and may be purchased or reviewed at the Department of Environmental Protection, Natural Resources Center in Hartford:

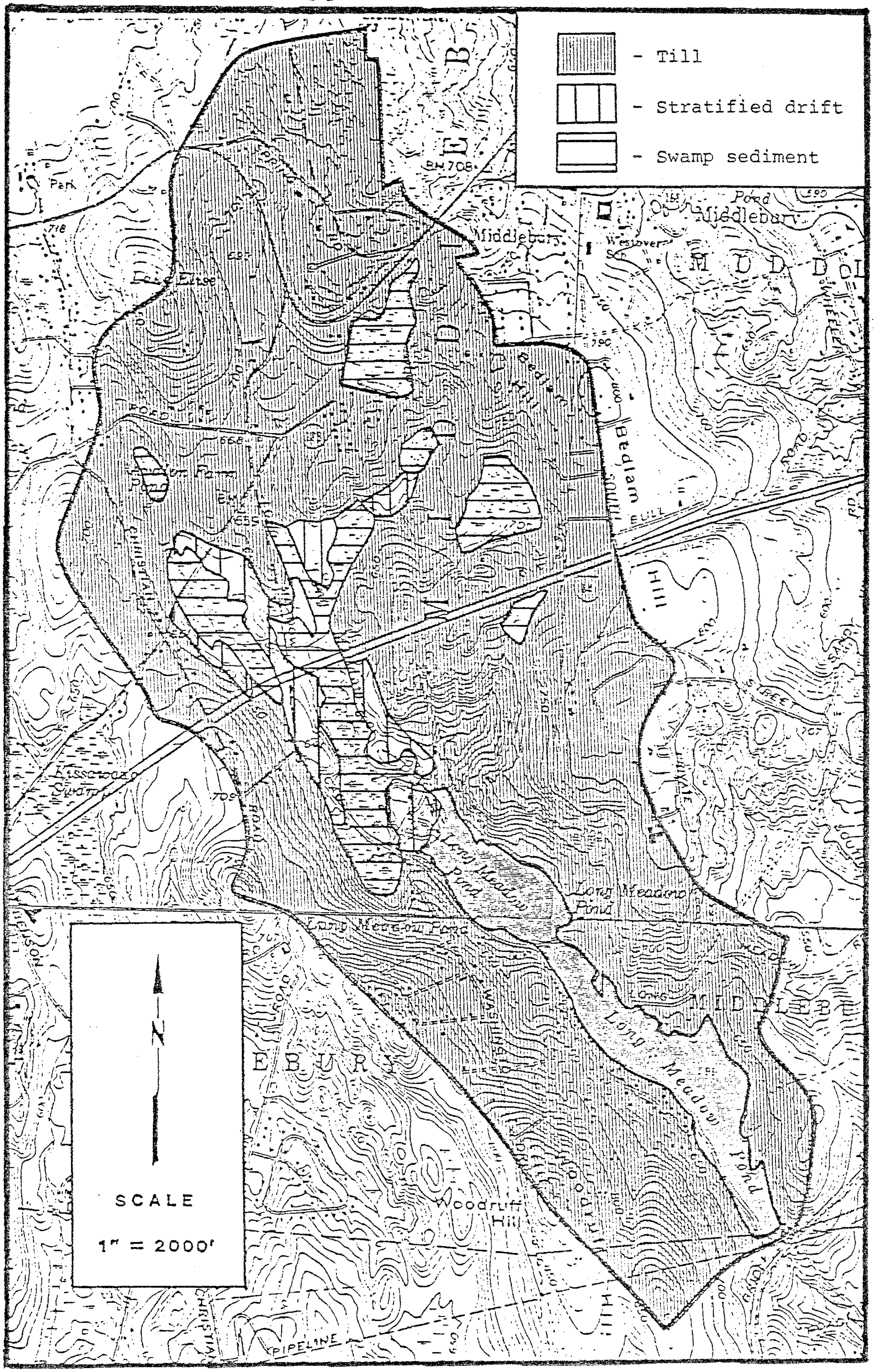
1. Map QR-3 by Robert M. Gates for the Woodbury quadrangle.
2. Map QR-30 by R. B. Scott and W. Raymon for the Southbury quadrangle.
3. Map QR-22 by Robert M. Gates and C. W. Martin for the Waterbury quadrangle.
4. Map QR-9 by Michael H. Carr for the Naugatuck quadrangle.

B. SURFICIAL GEOLOGY

Surficial geologic materials consist of those unconsolidated rock particles or other debris that overlie bedrock. The surficial geology of the Woodbury quadrangle (GQ-896, by Fred Pessl, Jr.) and the Naugatuck quadrangle (QR-35, by Richard Foster Flint) have been published by the Connecticut Geological and Natural History Survey and the U.S. Geological Survey, respectively. The surficial geologic map for the Southbury quadrangle has not been published to date, but there is preliminary information available at the Natural Resources Center in Hartford. No surficial geologic map has been produced for the Waterbury quadrangle to date. The Soil Survey for New Haven County was referenced for surficial geologic information for this portion of the watershed.

The surficial geologic material comprising most of the watershed is till (see Figure 3). Till is a non-sorted

Figure 3
Surficial Geology



mixture of rock particles ranging in size from clay to boulders. The rock materials were scraped, abraded, and plucked from pre-existing bedrock and soil surfaces by glacier ice, and were redeposited directly from the ice without significant redistribution by meltwater. The texture of the till may be highly variable, ranging from a relatively clean sand to the silty, stony, tightly compact material that colloquially is termed "hard pan". In many areas, several feet of relatively loose, sandy till may overlie a compact, silty, crudely layered till. In the western portions, the watershed boundary passes over, and the watershed itself includes, numerous streamlined hills, generally oval in shape. These hills, which are composed primarily of relatively thick till (at least 40 feet) are called drumlins; they were formed by the molding action of glacier ice, which overrode the till masses as it expanded southward.

Another type of surficial geologic material found in the watershed, which is relatively minor in terms of both thickness and aerial extent is stratified drift. Stratified drift consists of sand and gravel deposits that were laid down by glacial meltwaters during the period of ice retreat. These deposits are found primarily in the Long Meadow Brook valley north of the pond. Thicknesses of the stratified drift in these areas are probably not much more than 10 feet.

Sand, silt, clay and decomposing plant materials have accumulated post-glacially in several large areas north of the pond where topography is relatively flat and where shallow standing water is present throughout most of the year. These swamp sediments coincide to a great extent with the swamp and marsh symbols shown on the topographic map. Other seasonally wet areas parallel intermittent drainage channels within the watershed. Based on Connecticut Water Resource Bulletin No. 31, the natural mineral composition of the surficial geologic deposits and underlying bedrock within the Long Meadow Pond watershed is not a source for elevated iron and/or manganese levels or hardness levels in groundwater or surface water.

V. Hydrology

Long Meadow Pond is an artifically controlled body of water with a surface area of ± 117 acres and a watershed of approximately 3.3 square miles. The pond has a maximum depth of 8* feet, an average depth of 4.4* feet and a maximum

*Source: "A Fishery Survey" of the Lakes and Ponds of Connecticut (Report No. 1) by the State Board of Fisheries and Game, Lake and Pond Survey Unit, 1959.

storage capacity 179 million gallons. The retention time (the time period required for a body of water to flush through once) was calculated to be 46.57 days. Long Meadow Brook is the principal inlet stream and enters the pond at the northern end. Based on the topographic map, soil survey maps and air photos, there is at least one other unnamed perennial stream entering the pond at the northern end as well as numerous intermittent drainage channels feeding the pond throughout the southern half. Other major surface water bodies found within the watershed include Lake Elise and Avalon Farm Pond. In addition, several small ponds are scattered throughout the northern half of the watershed.

There is no gaging station at the outlet of Long Meadow Pond. Nevertheless, it is possible to estimate the flow duration characteristics of the unnamed outlet stream using a method described in Connecticut Department of Environmental Protection, Bulletin No. 35, "Streamflow Information for Connecticut with Applications to Land-Use Planning" by Michael A. Cerviones, Jr., 1982. The estimates are tabulated in the following table in units of both million gallons per day and cubic feet per second.

TABLE 1. Flow Duration Characteristics for Long Meadow Brook at the outlet of Long Meadow Pond

Percent of Time flow equalled or exceeded	1	5	10	30	50
Flow equalled or exceeded in mgd	20.13	11.22	8.25	4.8	3.96
Flow equalled or exceeded in cfs	31.145	17.36	12.80	7.43	6.1

Percent of Time flow equalled or exceeded	70	90	95	99
Flow equalled or exceeded in mgd	3.3	2.24	1.95	.73
Flow equalled or exceeded in cfs	5.1	3.5	3.0	1.13

The mean annual outflow from Long Meadow Pond is estimated to be 5.94 cubic feet per second or 3.84 million gallons per day.

The general groundwater flow pattern in the watershed parallels the surface flow pattern to a great extent. The shape of the water table (the level below which all spaces in the soil and bedrock are filled with water) is largely conformable with the surface topography. Rainfall reaching the ground may be evaporated back to the atmosphere, pass overland as surface runoff or it may be absorbed into the ground. If absorbed, the water may either be returned to the atmosphere through transpiration, or it may percolate down to the water table and become groundwater. Groundwater is ultimately discharged at the surface in the form of a spring, seep, wetland, stream, or pond.

The natural water quality in a watershed can be adversely influenced by various sources of pollution such as septic systems, sedimentation and erosion, agricultural practices, and stormwater runoff from roads. These sources of pollution, either singularly or in combination, can severely impact the environmental health of the pond.

If a septic system is not properly designed, installed or maintained, there is a good chance it will malfunction. A malfunctioning septic system will either result in the backflow of sewage effluent into a house or the breakout of septic effluent on the surface of the ground. Sewage effluent discharging onto the ground surface may ultimately reach Long Meadow Pond. The sewage effluent can contribute phosphorus, nitrates, and other pollutants to the pond's waters. A far more important consideration, however, is that a failing septic system is a public health hazard. The public health threat is a concern which demands immediate correction. According to the Town Sanitarian, failing septic systems are not a major problem around the pond at the present time. If a failure does occur, it is repaired as expeditiously as possible. It should be pointed out that there is a public sewer line in the watershed near Long Meadow. As a result, there is a possibility that the sewer line could be extended to service problem areas around the pond should the need arise. Residential development around the pond is heaviest along the western shoreline south of Long Meadow Road. These residences for the most part are year-round homes according to town officials.

The eastern shoreline of the pond is largely undeveloped. The remaining portions of the watershed are lightly to moderately developed.

Sources of contamination will generally have a greater impact on the water quality of the pond if they are relatively close to the pond. Runoff originating in the upper reaches of the watershed must pass through wetlands or other water bodies wherein removal of many contaminants may occur. Runoff will also be renovated, at least in part, by passage through soils.

Based on the discussion above, it seems likely that the areas of the watershed in which development would be least likely to have an adverse impact on Long Meadow Pond are the upland areas north of I-84. Further development of the land surrounding the lake would be more likely to have a negative effect. Due to the presence of moderate to steep slopes, till-based soils (slow percolation rates, compact layer, elevated groundwater table), and shallow to bedrock areas, it seems likely that some of this land would be only marginally suited for on-site sewage disposal systems and would probably require engineered septic systems. Another possible alternative would be to extend the public sewer line to these areas.

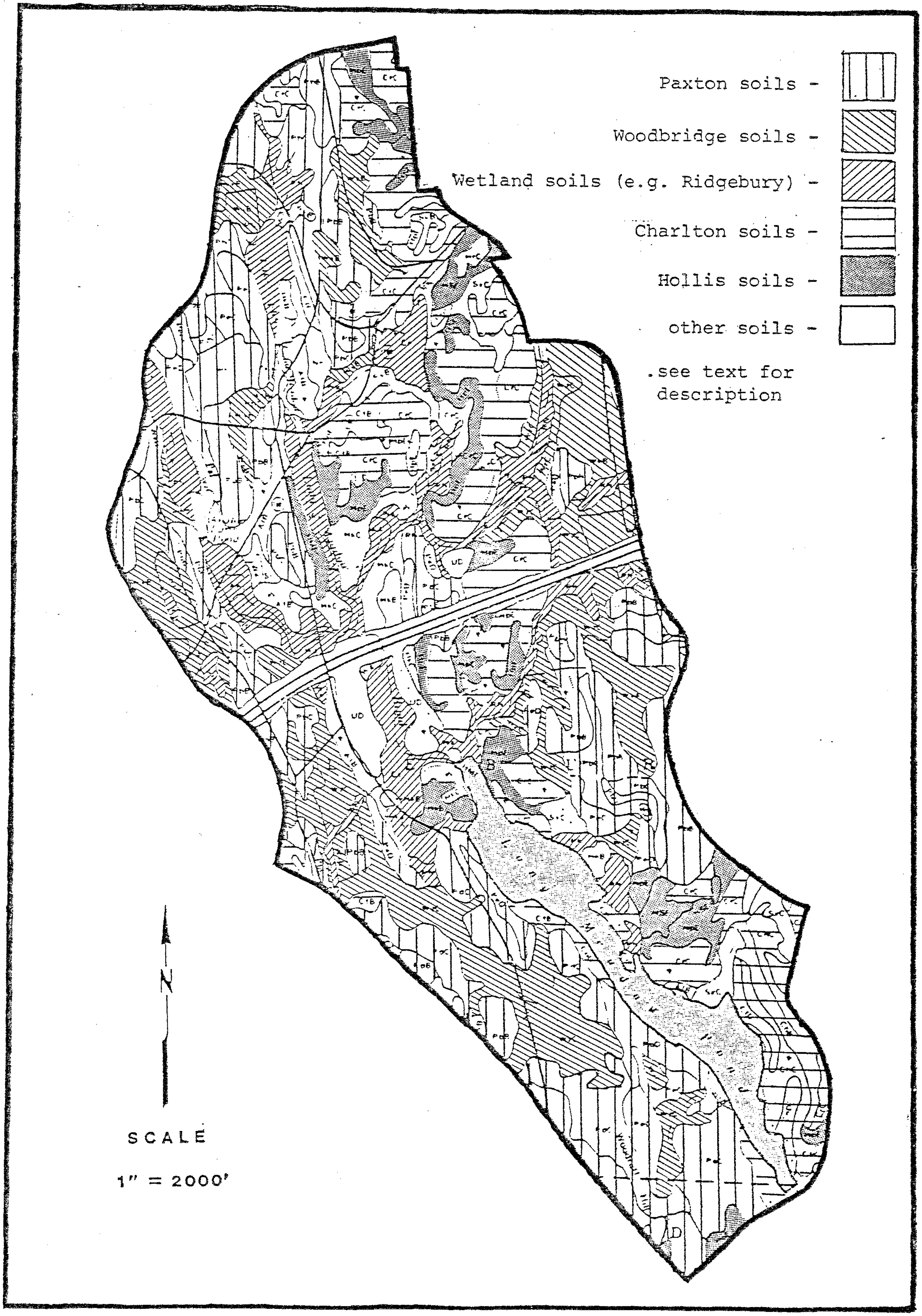
In terms of transportation related activities such as road salting and sanding, and automobile residue, there is a chance that road drainage laden with salt, soil, and/or sand may find its way into Long Meadow Pond. At the present time, the team has no reason to suspect the above mentioned transportation related contaminants (i.e., de-icing compounds, oil, etc.) are a potential threat to the water quality of Long Meadow Pond. Based on visual inspection of Long Meadow Brook at a point where it passes under I-84 (southside), minimal accumulation of road sand is being deposited in the watercourse. It should be pointed out, however, that there is evidence of road sand building up on an access point to the pond along the western shoreline. Every effort should be made by the state and/or town to control erosion and sedimentation from roadways within the watershed.

During the pre-review meeting, Team members were informed by Commission members that Uniroyal, Inc. owns the water rights on the Pond. This water supply is used by the company for cooling purposes. It was also indicated during the field review that Uniroyal is considering raising the water level of the pond by 1-2 feet to improve water quality in the Pond. Based on a cursory inspection of the culvert passing under the causeway at Long Meadow Road, it appears that flooding could occur if the water level was raised by 2 feet especially during periods of heavy precipitation. As a result, it may be necessary to raise the road level sufficiently so that it does not become impassable during flooding events. Also, it would probably entail elevating the sewer transmission lines. This, no doubt would be a very costly project. It is also doubtful that raising the water level in the pond by one or two feet would be significant in terms of controlling aquatic growth in the pond.

VI. Soils

As shown in Figure 4, five different soil types predominate within the watershed. Each of these soil types is briefly described below.

Figure 4
General Soils Map



Paxton soils are found on the top and sides of drumlins, hills and ridges of glacial uplands. They are deep, well drained, and loamy and have a slowly permeable hardpan. Paxton soils are gently sloping to steep and are in convex positions on the landscape. Stones and boulders are common on the surface.

Woodbridge soils are deep, gently sloping and sloping, moderately well drained soils on the top and sides of ridges and hills on glacial uplands. They also have a slowly permeable hardpan. Stones and boulders are common on the surface.

Ridgebury soils are nearly level or gently sloping and are in concave areas in depressions, on the top of broad, nearly level hills and in drainageways. Stones and boulders are also common. These are inland wetland soils.

Charlton soils occupy hilltops and convex side slopes of till plains. They are deep, well drained and loamy. They are dominantly gently sloping and sloping. Some stones and boulders may be found on the surface.

Hollis soils occupy hilltops, small ridges and side slopes in bedrock controlled areas. Slopes are mainly complex. Some surface stones and boulders exist and bedrock outcrops are common in some places.

Minor soils such as moderately well drained Sutton soils occupy concave and slightly depressional areas on the till plain. Other minor soils present within the watershed include:

. Hinckley soils which are deep, excessively drained, coarse textured soils that formed in sands and gravel. They are gently sloping to sloping and occupy terraces of the Long Meadow Brook stream valley.

. Agawam soils which are nearly level to sloping and occupy broad terraces. They are deep, well drained, loamy soils underlain by sand and gravel at a depth of about 22 inches.

. Walpole soils which are mainly level, deep, poorly drained, sandy soils that occupy low depressions on glacial outwash plains and terraces.

. Adrian and Palms muck which are organic deposits over mineral material found in the lowest depressions on the landscape. The organic layer of these soils is 16 to 30 inches thick.

. Very poorly drained, nearly level Carlisle Muck also occupies low depressions on outwash terraces and glacial till plains. The organic layer can range from 50 inches to more than 30 feet in depth.

. Walpole sandy loam occupies depressions, broad outwash terraces on the narrow stream valley of the Long Meadow Brook and its tributaries. Walpole soils are nearly level and are poorly drained.

A more complete discussion of each soil type, and larger scale mapping of the watershed area, is present in the New Haven County Soil Survey. This publication is available at the New Haven County Conservation District (269-7509)

VII. Land Use and Soil Erosion Potential

The majority of the Long Meadow Pond watershed is wooded. Woodland, with a good canopy cover, protects the soil surface from the impact of raindrops. Well managed woodland can offer the best protection against soil erosion.

Soils that are used for cornland are more susceptible to water erosion. Soil conservation measures, such as winter rye cover crop, no-till corn planting and planting rows across the slope, will reduce the amount of soil moved off of fields. The nearest corn field is greater than 1,200 feet from Long Meadow Pond. Between them is woodland, an effective buffer for trapping sediment that may move off of the corn fields.

Another agricultural land use within the watershed is hayland. Grassland or hayland can offer good protection against soil erosion. Dense root systems hold soil in place. Stems and leaves intercept raindrops, protect the soil from their impact and allows for their chance to be evaporated into the atmosphere.

Development within the watershed is limited to the road network and some residences.

The limited development within the watershed, low impact landuses, widespread vegetative covers of woodland, hayland, and cornland with cover crop or no-till practices, and interspersed depressional areas on the landscape all help to keep soil erosion to a minimum and protect the pond from sedimentation. Effective implementation of Connecticut's new erosion and sedimentation control law will help to keep erosion from new developments within the watershed to a minimum.

VIII. Fisheries

Historically, Long Meadow Pond has been stocked at one time or another with rainbow trout, yellow perch, smallmouth bass, chain pickerel, calico bass, bullhead, sunfish and golden shiners. A 1959 survey of the lakes and ponds of Connecticut found Long Meadow to be inhabited by largemouth bass, chain pickerel, bluegill sunfish, pumkinseed sunfish, yellow perch and golden shiner. All except golden shiner were found to be common or abundant. Growth rates were good for all species. In the same survey comments were made to the effect that both submerged and emergent vegetation were abundant and that the pond was rapidly filling with silt. The pond is open to public fishing and a launch area capable of handling canoes and car-top boats is present. It appears that Long Meadow Pond currently provides local residents with a warm water fishery (primarily for sunfish and largemouth bass) which is of moderate quality.

The Fisheries Bureau of the D.E.P. has provided technical advice to residents along Long Meadow Pond on several occasions during the 1960's and 1970's. Chemical treatment with both 2,4-D Ester and Diquat have been recommended as a means of temporary weed control. White water lilly (Nymphae spp), spatterdock (Nuphar advena), pondweed (Najas spp), wild celery and waterweed were all identified as contributing to the problem.

Weed growth was observed to cover roughly 80% of the surface area of the pond's north basin, while between 15 and 35% of the larger southern basin was choked by weeds. Weed growth becomes detrimental to the fisheries of a lake at a density where efficient predation by bass and pickerel on forage species is inhibited. When this density is reached, overcrowded and stunted populations of sunfish, bullheads and perch (where present), and depressed growth rates in bass often result. Additionally, large numbers of stunted sunfish tend to prey heavily on bass eggs and fry, drastically reducing spawning success and the subsequent recruitment of bass into the fishery. A population made up of a few old bass, unable to produce a large successful spawn and insufficient in number to support truly good fishing, often results. Moderate weed growth, however, should be considered beneficial in that it provides escape cover for all fish species, and spawning habitat for pickerel, largemouth bass and yellow perch. Recent research has shown that the total biomass of largemouth bass, and the numbers of legal sized bass, increase with corresponding increases in the amount of macrophyte cover until vegetation cover exceeds 20% of the entire lake surface. Once weed cover exceeds 20% of the total lake acreage, decreases in the capture rate of prey are likely to lead to prey overabundance and to a decrease in bass biomass.

A second means by which weed growth may become detrimental to the fisheries of a lake or pond is via the inducement of "winterkill" in bodies of water having marginal depth. Winterkill occurs when light penetration into the water is reduced under the cover of ice and snow. This results in conditions where life supporting oxygen is being removed from the water by bacterial decay of abundant plant matter, while it is not being added by photosynthesis. A fish kill results when oxygen concentrations drop to critical levels. A bass fishery can be severely impacted by winterkill as the larger fish present are particularly sensitive to low oxygen concentrations.

It is the opinion of the team's fishery biologist that the excessive proliferation of aquatic vegetation in the north basin is harmful to the pond's warmwater fisheries and that some means should be undertaken to control weed growth. However, it is believed that weed growth in this area acts as a buffer zone by trapping silt and nutrients, thereby protecting the rest of the lake. Because of this positive effect on the rest of the lake it is recommended that the objective of any future weed control efforts in the north basin should be to reduce vegetation cover to between 40 and 50% of the total surface area (rather than the 20% level optimum to fisheries). It is also recommended that the vegetation be divided up rather than confined to one dense area (if chemical or weed harvesting techniques are applied). Doing this will provide a "patchy" environment and thus increase the amount of "edge" habitat. This will most likely increase the number of bass the pond is capable of supporting and will allow anglers access to some of the best bass cover. Weed abundance in the south basin is also greater than that which is generally considered optimum for warmwater fisheries. Reducing the weed cover to between 20 and 25% of the south basin surface area would benefit the pond's fisheries. Priority, however, should be given to the north basin (if lake-wide techniques are not applied) as it appears to be well on its way to becoming a swamp.

The most economical means by which the weed growth in Long Meadow Pond can be controlled is by treatment with aquatic herbicides. Granular 2,4-D Ester (a systemic herbicide) may be applied in the spring to control water lillies and spatterdock in specific areas of the pond, and Diquat (a contact herbicide) may be applied later in the spring/early summer to control floating leaf pondweeds, elodea and duckweed (treatment may have to be repeated on a yearly basis). Still, it should be noted that the application of herbicides may result in a quick release of nutrients into the water as dead plant matter decays. This is usually accompanied by an increase in phosphorous levels and may result in greater plankton productivity. Additionally, in a lake or pond ecosystem, macrophytes act as buffers of exogenous nutrients and may thus repress phytoplankton productivity by limiting nutrient availability. If the biomass of plants and the corresponding foliar uptake of nutrients is reduced, runoff will proceed to enrich the water column. Phytoplankton may therefore increase due to the greater availability of limiting nutrients. Algae blooms and turbidity may then serve to reduce both the fishing quality and aesthetic value of the pond, particularly if blue-green blooms occur. The use of copper sulfate is most often recommended for the control of algae in lakes and ponds not containing trout. Some aluminum compounds may be used to precipitate phosphorus (usually the limiting nutrient) from the water, thus limiting algae growth. However, aluminum is highly toxic to fish and is thus not recommended. The D.E.P. has available a publication entitled "Control of Water Weeds and Algae" which provides information on the chemicals which may be used in the control of different types of nuisance vegetation, instructions for determining the proper dosage, and the procedures to follow in order to apply for a permit.

Alternatives to chemical treatment are more effective but unfortunately also initially much more expensive. While the initial capital layout for alternate treatment measures is generally greater, chemical treatment must be repeated yearly; therefore, the long term cost difference is not as great as it may first appear. Two advantages of alternate treatment methods include 1) chemicals foreign to the ecosystem are not introduced to the water, and 2) the removal of harvested or killed plant material prevents the quick release of nutrients into the water as dead plant matter decays (thus preventing the often associated increase in phosphorous levels and phytoplankton productivity). Dredging the pond bottom offers the most permanent method of weed control available. A depth of 10 feet or more is best for preventing the development of nuisance vegetation as sunlight penetration is usually insufficient for the stimulation of plant growth. Additionally, dredging removes nutrients from the pond ecosystem which have built up in the sediments through years of decay. Concurrent with this could be the use of the existing drainage facilities to drawdown the water level of the pond by approximately 3 feet. The water level could be reduced during the late fall and allowed to remain down until early February. Exposed plant material would be killed by freezing and should be physically removed from the lake basin. Lilly pad roots and tubers are resistant to freezing and would require the removal of up to 12 inches of exposed sediment or chemical treatment with a systemic herbicide the following spring. Also, it should be recognized that drawdowns do not help in the control of unicellular phytoplankton blooms. Periodic drawdowns often benefit fish populations by concentrating all fish into a smaller volume of water, temporarily increasing the efficiency of predation on sunfish and perch, thus helping to prevent overpopulation. In the opinion of the team's fishery biologist, a drawdown should not be attempted on Long Meadow Pond unless the pond's depth is increased substantially (e.g., much of the pond at 10 feet) as it will exacerbate the chances of a fish winter-kill.

Commercial weed harvesters may also be used to remove weeds from selected areas of the pond. Harvesters allow the greatest control over where and when the weeds are to be removed. As with the drawdown technique, plant material should be transported far enough from the pond so as to prevent the re-entry of nutrient-rich leachate. Done correctly this will prevent the quick release of nutrients into the water from decay, however an increase in the concentration of nutrients from runoff would still occur and some increase in turbidity may result.

The introduction of weed eating fish species is prohibited by law as the effects of such introductions on the complex biology of lakes, ponds and rivers has not yet been adquately quantified. Contrary to what has been published in much of the popular literature, there is substantial evidence that the weed eating white amur, also called grass carp (members of the minnow/carp family), does effect the food chain in lakes and ponds. Some of the negative impacts observed during scientific studies are: 1) a reduction in crayfish production, 2) an increase in the populations of some plant species due to preferential feeding on others, 3) the inducement of algal blooms due to the concurrent elimination of macrophytes and influx of nutrients via grass carp feces, 4) interference with the reproduction of gamefishes requiring vegetation for spawning, 5) reduced production of fishes requiring weed beds for refuge, and 6) the creation of unbalanced ecosystems where species diversity was reduced and fish populations become unstable. These negative effects do not occur in all cases. However, we do not yet have the knowledge to predict what will happen in a specific pond or lake and therefore cannot allow grass carp introductions to be made. The danger that introduced fish may be caught and subsequently transported to other bodies of water is another consideration.

IX. Pond Features, Eutrophication, and Nutrient Sources

A. POND FEATURES

The approximate morphological characteristics of Long Meadow Pond are as follows:

Surface Areas = 117 acres*
Maximum Depth = 8 feet*
Mean Depth = 4.4 feet*
Volume = 23,902,000 cubic feet
Watershed Area = 2120 acres
Retention Time = 46.57 days

Long Meadow Pond is fed by surface runoff and by Long Meadow Brook which enters the pond on its north shore and exits at the southern tip.

The 1959 Fishery Survey reports that the north end of the pond was rapidly filling in with silt and that these waters were slowly reverting to a swamp. The survey goes on to say that submerged and emergent vegetation were abundant although the fertility of the water was below average. The pond has a bottom consisting mostly of muck and swampy ooze.

B. EUTROPHICATION

Eutrophication is a natural aging process through which a waterbody gradually increases in fertility and biological productivity, and fills in with accumulations of organic deposits. As eutrophication proceeds, algae blooms increase in both intensity and duration, and aquatic plant growth becomes more prolific. The lake becomes shallower and the deep, cold waters are lost. During the latter stages of this process, the waterbody becomes a boggy or marshy wetland.

Under natural conditions the eutrophication process usually advances very slowly over thousands of years. The process can be accelerated by activities of man which increase nutrient and sediment inputs to a waterbody.

In general there are three accepted stages of eutrophication which are defined as follows:

1) Oligotrophic - early stages of the process, very infertile, low biological productivity, high transparency, usually highly oxygenated and relatively deep with little accumulation of organic sediments on the bottom.

2) Mesotrophic - a mid-range between the two extremes of oligotrophic and eutrophic.

3) Eutrophic - late stages of the process, very fertile (high in plant nutrients such as nitrogen and phosphorus), high in biological productivity, low in transparency, bottom waters usually show reduced levels of dissolved oxygen with an abundance of organic matter on the bottom.

Nutrient data supplied by Uniroyal, the accumulation of sediments, and dense growths of aquatic weeds appear to place Long Meadow Pond in the eutrophic state.

Phosphorus has been identified as the growth limiting nutrient in the majority of Connecticut lakes. The term "limiting nutrient" refers to the nutrient which is in the shortest supply relative to growth requirements. In general, algae and macrophytes will grow until the supply of some basic nutrient is depleted. Then any increase in that nutrient will result in a corresponding increase in biological productivity. Similarly, a reduction in that nutrient will reduce potential biological productivity. Enrichment of a lake with plant nutrients is the fundamental cause of eutrophication.

Undisturbed woodland contributes lower nutrient loads to a lake than other land uses. The nutrient loading from agricultural land is generally about five times greater than woodland. Residential and commercial land typically contribute more than ten times the nutrient loading that results from woodlands. Thus, as woodland is converted to other uses, or as agricultural land is converted to residential land, the nutrient contribution to the lake increases, advancing the eutrophication process. Although much of this increase in nutrient export from the watershed is inevitable and unavoidable, best management practices can provide for some degree of mitigation.

It should be noted that the Connecticut DEP has recently revised (1984) a report entitled "A Watershed Management Guide for Connecticut Lakes". The DEP report discusses in detail the process of eutrophication and methods of control. According to the DEP's report, the following factors may contribute nutrients to a waterbody and therefore accelerate the eutrophication process: erosion and sedimentation, septic systems, lawn and garden fertilizers, yard and garden vegetation disposal, agricultural land, timber harvesting, stormwater runoff, waterfowl, atmosphere, lake sediments. The key to controlling the eutrophication process is controlling the nutrient enrichment from these sources. The DEP's "Watershed Management Guide" is recommended reading and is available from the Department at 566-2588.

Long Meadow Pond is presently experiencing conditions typical of eutrophic lakes. Additional residential development or agricultural activities which do not employ best management practices will serve to worsen these conditions. Local agencies should consider developing and implementing watershed management practices to mitigate the effects of land-use changes in the watershed. The nutrient sources believed to be the most significant at Long Meadow Pond are discussed in the next section of this report.

It is recommended that property owners around the pond form a lake association and develop a watershed management plan as outlined in the "DEP Watershed Management Guide for Connecticut Lakes".

C. POTENTIAL NUTRIENT SOURCES

EROSION AND SEDIMENTATION

Erosion and sedimentation within a lake watershed is a natural process, the rate of which can be greatly increased by human activities that disturb the land.

Eroded soil contributes to eutrophication in several ways. Nutrients associated with the soil particles are introduced to lake waters. Sedimentation reduces water depths creating conditions conducive to the growth of aquatic weeds. Organic matter, associated with the soil particles, is decomposed by the soil bacteria which depletes oxygen overlying the lake sediments.

In 1983, the Connecticut General Assembly enacted legislation entitled "An Act Concerning Soil and Sediment Control" which amends local zoning pursuant to Section 2-8 of the Connecticut General Statutes. This legislation requires the Connecticut Council on Soil and Water Conservation to develop erosion and sediment guidelines and model regulations for municipalities. The legislation also mandates the adoption of municipal erosion and sediment control programs by July 1, 1985.

Lakeside residents and lake users should urge their town to adopt and utilize erosion and sedimentation ordinances in their zoning regulations.

Local officials should see to the correction of any existing sources of erosion and sedimentation within the Long Meadow Pond watershed.

SEPTIC SYSTEMS

Sewage disposal in residential areas not serviced by sanitary sewers is accomplished with on-lot subsurface disposal systems commonly referred to as septic systems. When functioning properly, septic systems provide for the sanitary breakdown of wastewaters into simple chemical substances including soluble phosphorus compounds. The basic components of the system include a house sewer, septic tank, distribution system, and leaching field. Sewage is delivered to the septic tank via the house sewer. In the septic tank, solids are physically separated from liquids (primary treatment) by the sedimentation of heavy solids to form a sludge blanket, and the flotation of light solids to form a scum layer. The distribution system delivers the liquids to the leaching field. The liquid effluent is decomposed biologically (secondary treatment) in the leaching system.

A septic system can fail if it is not properly designed, installed, or maintained. A failing system will either result in the backflow of wastewaters into the house, or the breakout of wastewaters on the surface of the ground. A failing septic system can contribute phosphorus and other pollutants to lake waters. A far more important consideration, however, is that a failing septic system is a public health hazard. The public health threat is an overriding concern which demands correction of the problem, irrespective of lake eutrophication.

Ideally the homes around the lakeshore which are not connected to the existing sewer system should be tied in if feasible.

LAWN AND GARDEN FERTILIZERS

Lawns and gardens are generally very efficient at utilizing soil nutrients and preventing their loss through runoff and leaching. However, runoff and leaching of nutrients can occur if fertilizer applications exceed nutrient requirements, or if fertilizers are applied prior to storm events which cause runoff. These situations can be avoided if fertilizers are matched to soil requirements, and if applications are timed to avoid periods of runoff. Soil test kits can be purchased at a nominal charge from the University of Connecticut Cooperative Extension Service county offices. The samples are analyzed at the Extension Service Laboratory, and the results identify soil nutrient deficiencies.

YARD AND GARDEN VEGETATION DISPOSAL

Leaves, grass clippings, and other vegetative material from yard and garden maintenance should not be deposited in a location where the material may be washed into the lake. Vegetative material will add to the sediment in the lake and will provide plant nutrients upon decomposition. Each property owner should select a suitable site away from the lake and its watercourses for the composting of vegetative material.

WATERFOWL

Ducks and geese are generally considered attractive wildlife assets which enhance the aesthetic appeal of a lake. However, large numbers of migratory waterfowl which spend considerable periods of time on a lake can contribute appreciable loadings of phosphorus and nitrogen to lake waters. In a study of one Connecticut lake, it was estimated that the phosphorus in the excrement of four geese in one month was equivalent to the total annual loading of phosphorus from 2.5 acres of watershed land. In order to quantify the impact of waterfowl on a lake, it is necessary to develop accurate information on waterfowl population numbers, feeding habits, resting areas, and periods of occupancy. In the absence of detailed information, it should be recognized that large flocks of migratory waterfowl which stop at a lake for many weeks can be an important factor in the eutrophication process.

X. Lake Management Alternatives

Long Meadow Pond is experiencing dense growths of aquatic macrophytes which interfere with recreation and the aesthetic enjoyment of the Pond. Lake management alternatives discussed here will therefore focus on aquatic weed control.

There are disadvantages to any weed control method. A few of the problems which may be encountered are:

1) Those macrophytes which are resitant to the control method employed may multiply due to a reduction in competitive pressures from other species.

2) If the weeds are removed, the loss of habitat, spawning areas and a food source for fish and other aquatic organisms may be incurred.

3) After the weeds are removed, nutrients could be made available to algae and subsequently "blooms" may occur.

The most common means of aquatic weed control are: winter drawdown, weed harvesting, chemcial treatments, drawdown and excavation, and hydraulic dredging. Each of these control methods is discussed below.

1. WINTER DRAWDOWN

If the spillway has the capacity to effectively lower the water level, the lake may be drawndown in the fall to expose the sediments. Over the winter, the bottom freezes and destroys roots, vegetative parts and suceptible seeds. Winter drawdown will not kill algae. As discussed in the fisheries section of this report, a winter drawdown on Long Meadow Pond should not be implemented without a corresponding dredging program to deepen the pond.

2. WEED HARVESTING

Weed harvesting entails the mechanical cutting of the weeds. Although the method provides immediate relief, it may have to be repeated at periodic intervals. This method appears to have good potential for controlling the weed growth in Long Meadow Pond.

3. CHEMICAL TREATMENT

The use of any algicide or herbicide within the waters of the State is governed by statute (Sec. 430 of Public Act 872) and permits are required from the Pesticide Compliance Unit of DEP.

Chemical treatments are generally only "cosmetic" and repeated applications may be necessary. Nevertheless, this weed control method is worthy of serious consideration at Long Meadow Pond due to its cost effectiveness.

4. DRAWDOWN AND EXCAVATION

Drawdown and excavation is sometimes employed to remove the substrate utilized by the plants for growth. The process increases water depth to levels where plants growing on the bottom will not receive enough light to survive. The effects of this method are generally long-termed.

The drawdown and excavation process requires the use of heavy equipment and it must be determined whether the pond bottom could support this weight.

This method has relatively high capital outlay; however, the restorative effects are long termed.

If this method is given further consideration, a feasibility study should be conducted to "map" lake sediments according to depth, composition, and underlying substances. Final disposal of excavated sediments should also be explored during the feasibility study. Hydraulic dredging (see discussion below) accomplishes the same goal as drawdown and excavation, but is more costly due to increased specialization and complexity.

5. HYDRAULIC DREDGING

Under this method, specialized sediment dredges are employed to remove underwater sediments by suction as a slurry. The slurry must be dewatered prior to final disposal, and the decant water usually must be treated to remove solids and nutrients prior to disposal. The development of dewatering containment basins of suitable size and location is a major and expensive undertaking. However, where environmentally and financially feasible, this method can provide improvement if other methods are unsatisfactory.

XI. Conclusion

It is recommended that property owners around the pond form a lake association and develop a lake and watershed management plan for Long Meadow Pond. The plan should focus on 1) watershed management and 2) in-lake controls.

The watershed management portion of the plan should target specific strategies for preventing watershed nutrients and sediments from reaching the pond. This might include: 1) encouraging early town sweeping of winter road sand, 2) constructing and maintaining settling basins at culvert outlets to filter out road sand and sediment, 3) constructing (and maintaining) roadside catch basins with sumps to collect sand and debris, 4) effective town enforcement of erosion and sediment controls on any new subdivision and homesites constructed in the watershed, 5) identifying and correcting any erosion and sedimentation "hot spots" currently existing within the watershed, 6) encouraging watershed residents to use non-phosphate detergents and discretion in the application of lawn and garden fertilizers, 7) requesting a sanitary survey of the lakeshore area to identify any failing septic systems (and insisting on their timely correction), 8) encouraging watershed residents to properly maintain their septic systems, 9) encouraging the proper design and installation of any new septic systems in the watershed, 10) encouraging owners of agricultural land in the watershed to implement any needed conservation measures, 11) keeping a watchful eye on the watershed to make sure that yard and garden vegetation disposal is not in a location where the material may be washed into the lake, and 12) monitoring the waterfowl use of Long Meadow Pond to ensure it does not become excessive. Effective implementation of the above will help keep the nutrient loading and sedimentation of Long Meadow Pond to a minimum.

Appropriate in-lake control measures to a large extent depend upon financial capabilities. The best long-term control measure would entail dredging the Pond to a mean depth of 10+ feet. This could be accomplished either by hydraulic dredging or a drawdown and excavation operation. Dredging is a very expensive proposition however. A DEP excavation project at Gorton Pond in East Lyme is realizing a cost of approximately $5.00 per cubic yard. As discussed previously in this report, a winter drawdown of Long Meadow Pond without a corresponding dredging operation is not recommended due to adverse impacts on the fisheries resource.

Without the implementation of a lake-wide dredging operation, weed harvesting and/or chemical treatment may need to be relied upon to control the aquatic growth. The purchase, renting, or sharing of a weed harvester should be explored. The Mamanasco Lake Improvement Fund, Inc., in the town of Ridgefield, CT has had very positive results with the use of a weed harvester they purchased a few years ago. Residents of Middlebury may wish to contact this group for more information. As previously mentioned, the DEP has available a publication entitled "Control of Water Weeds and Algae" which provides information on the chemicals which may be used in the control of different types of nuisance vegetation.

In conclusion, without a major capital outlay, weed harvesting and chemical treatment appear to be the best "in-lake" management alternatives for controlling the weed growth at Long Meadow Pond. It should be noted, however, that some new methods of in-lake weed control are being developed. These methods focus on light-control and include:

1) "Aquascreening" - vinyl coated fiberglass mesh placed on pond bottom can be effective in compressing weeds and blocking sunlight. Thus existing weeds are killed and potential weeds inhibited from growing. The screen was most effective against Eurasian watermilfoil (biomass reduction of 75%) when used in shallow Union Bay, Washington. This can be a very expensive method for a pond of any size; for more information, see article by Perkins, Boston & Curren, "The Use of Fiberglass Screens for Control of Eurasian Watermilfoil", in the Journal of Aquatic Plant Management, Vol. 18: 13-19, 1980; and brochure from Menardi-Southern Corp., Box 240, Augusta, Georgia, 30903.

2) "Black plastic" with perforations to allow gases to escape is another, less expensive, product used to control weed growth. This can be weighted down to keep it on the pond bottom.

3) "Dartek" is a black nylon film which has negative buoyancy, making it easier to keep on the bottom. This

material absorbs water, making it more flexible for contouring to a lake bottom. For more information, contact DuPond Canada, Inc., Box 2200, Streetsville, Mississauga, Ontario L5M 2H3, telephone 416-821-5276.

4) "Aquashade" is an inert blue liquid dye, registered by EPA as a "general use" pesticide for small natural or man made ponds. This substance is not a poison and has no direct chemical action on plants or animals, but controls aquatic plant growth by absorbing the sunlight which would otherwise get to the plant tissue and stimulate growth. It lasts from six to ten weeks in a pond and is slowly broken down into carbon dioxide and water. Of course, its effectiveness would be diminished in proportion to the flow through rate in the pond. Approximately 75% reduction of Nymphoides (waterlily-like plants) was accomplished using "Aquashade" in one pond in southeastern New York. For more information, see "Summary of Aquashade Trials in Myriophyllum spicatum (milfoil)" by Dr. John Peverly of the Department of Agronomy, Cornell University, Ithaca, New York, 14853; or contact Brad Robinson, Senior Analyst, Pesticide Compliance Section, DEP, 122 Washington St., Hartford, CT., 06106.

Interested parties may wish to consider adding one or more of these "light control" technologies to future management plans for Long Meadow Pond.

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ABOUT THE TEAM

The King's Mark Environmental Review Team (ERT) is a group of environmental professionals drawn together from a variety of federal, state, and regional agencies. Specialists on the team include geologists, biologists, foresters, climatologists, soil scientists, landscape architects, recreation specialists, engineers, and planners. The ERT operates with state funding under the aegis of the King's Mark Resource Conservation and Development (RC&D) Area - a 47 town area in western Connecticut.

As a public service activity, the team is available to serve towns and developers within the King's Mark Area --- free of charge.

PURPOSE OF THE TEAM

The Environmental Review Team is available to help towns and developers in the review of sites proposed for major land use activities. To date, the ERT has been involved in the review of a wide range of significant activities including subdivisions, sanitary landfills, commercial and industrical developments, and recreation/open space projects.

Reviews are conducted in the interest of providing information and analysis that will assist towns and developers in environmentally sound decision-making. This is done through identifying the natural resource base of the project site and highlighting opportunities and limitations for the proposed land use.

REQUESTING A REVIEW

Environmental Reviews may be requested by the chief elected official of a municipality or the chairman of an administration agency such as planning and zoning, conservation, or inland wetlands. Requests for reviews should be directed to the Chairman of your local Soil and Water Conservation District. This request letter must include a summary of the proposed project, a location map of the project site, written permission from the landowner/developer allowing the team to enter the property for purposes of review, and a statement identifying the specific areas of concern the team should address. When this request is approved by the local Soil and Water Conservation District and the King's Mark RC&D Executive Committee, the team will undertake the review. At present, the ERT can undertake two reviews per month.

For additional information regarding the Environmental Review Team, please contact your local Soil Conservation District Office or Richard Lynn (868-7342), Environmental Review Team Coordinator, King's Mark RC&D Area, P.O. Box 30, Warren, Connecticut 06754.