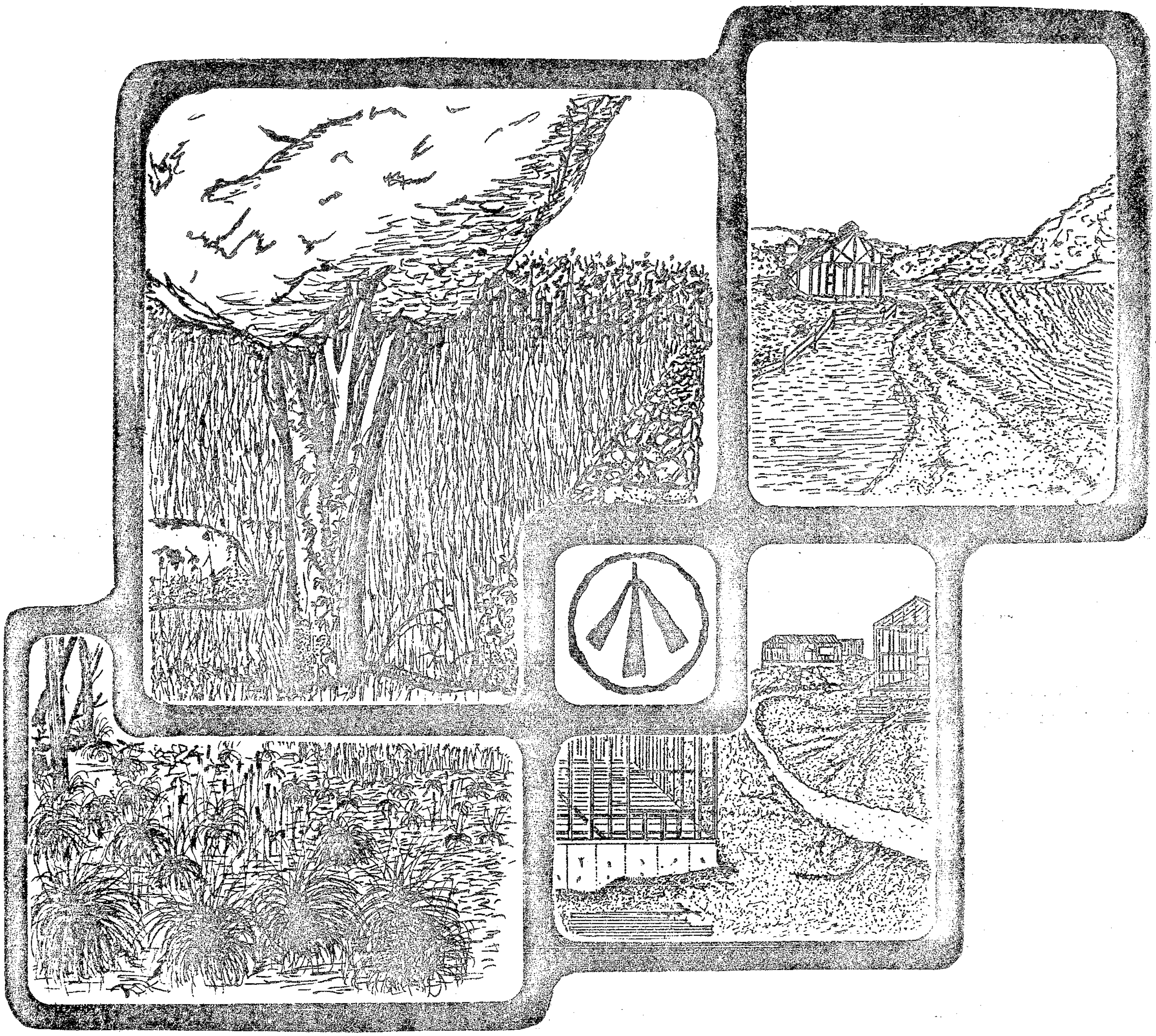
ENVIRONMENTAL REVIEW TEAM REPORT



MUDGE POND WATERSHED

SHARON, CONNECTICUT

KING'S MARK
RESOURCE CONSERVATION & DEVELOPMENT AREA

KING'S MARK ENVIRONMENTAL REVIEW TEAM REPORT

MUDGE POND WATERSHED
SHARON, CONNECTICUT

JULY, 1982

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

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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

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
- Capitol Regional Council of Governments
- American Indian Archaeological Institute
- Housatonic Valley Association

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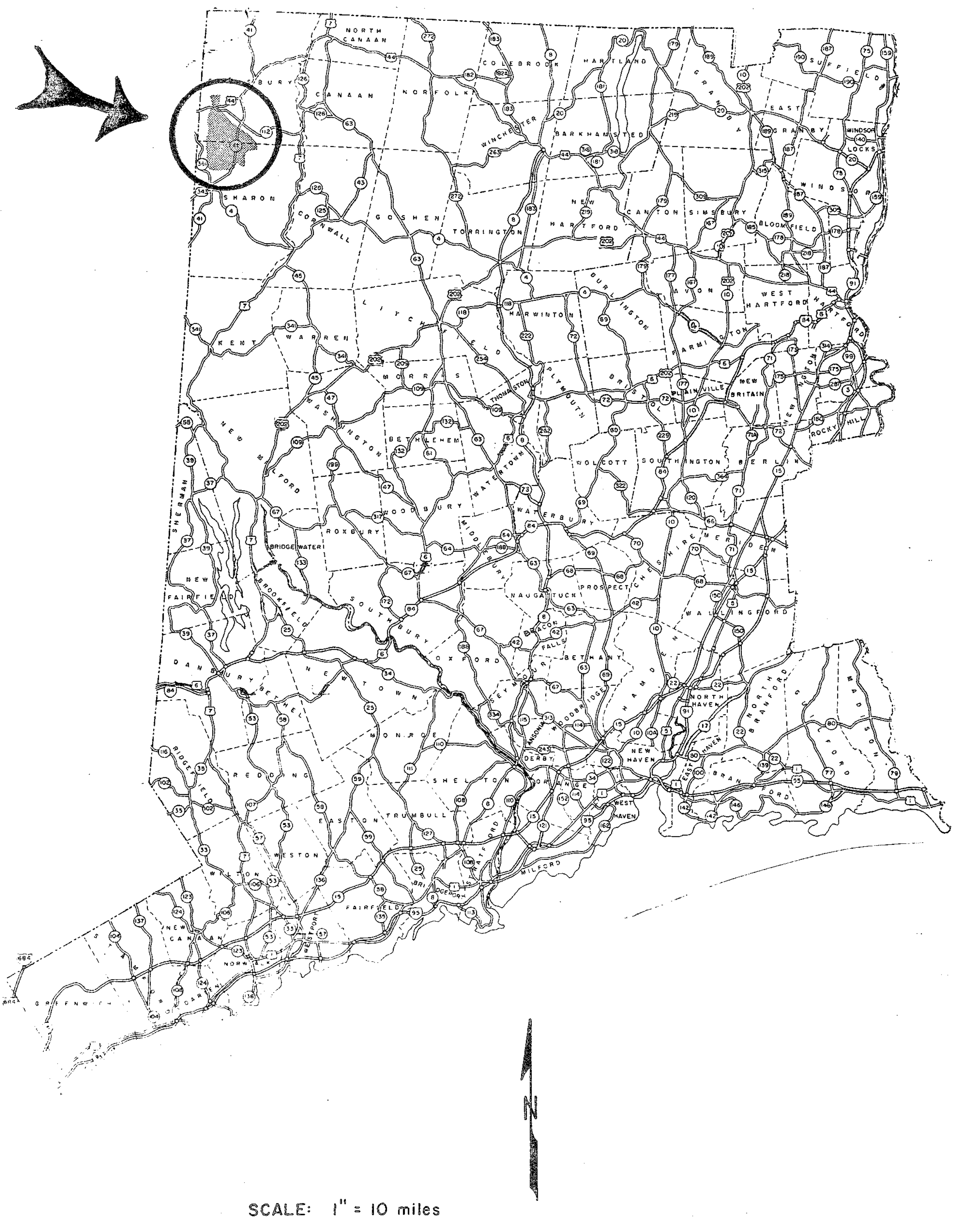
LOCATION OF STUDY SITE

MUDGE POND WATERSHED

SHARON, CONNECTICUT



SCALE: 1" = 10 miles

10 0 5 10 miles

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ENVIRONMENTAL REVIEW TEAM REPORT
ON
MUDGE POND WATERSHED
SHARON AND SALISBURY, CT

I. INTRODUCTION

As shown in Figure 1, the Mudge Pond Watershed is about 11.5 square miles in size. The land is zoned for residential use and is characterized by farm fields, wooded land, and scattered residential development. Several camps are present within the watershed together with a private school. The land varies from gently sloping farm land to steeply sloping wooded land. Several small ponds are located within the watershed in addition to Mudge Pond and Wononpakook Lake. The Salisbury and Sharon town line bisects the central portion of the watershed. Major access roads in the watershed include Route 41 and Indian Mountain Road.

By definition, all of the land in the Mudge Pond watershed may drain ultimately to Mudge Pond. Protecting the water quality of Mudge Pond therefore depends largely on protecting the quality of the water throughout the watershed.

The Sharon Planning and Zoning Commission requested the assistance of the King's Mark Environmental Review Team to help them in better understanding the characteristics of the Mudge Pond Watershed and the ecology of Mudge Pond. In recent years, the recreational use of Mudge Pond has been impaired by the nuisance growth of aquatic weeds and algae. This trend is of concern to the Planning and Zoning Commission as well as other townspeople in that Mudge Pond has a town beach and is widely used for recreational purposes. Specifically, the ERT was asked to 1) provide a natural resources inventory and evaluation of the Mudge Pond watershed, 2) identify what factors might be contributing to the weed and algae problem at the lake, and 3) discuss what alternatives are available for effective lake management. The Team was also asked to comment on the probable impact of future residential development in the watershed on lake water quality.

The Sharon Planning and Zoning Commission requested this information to serve as a basis for decision making on how best to protect the future water quality of the Lake for recreational purposes. The King's Mark Executive Committee considered the Town's request, and approved the project for review by the Team.

The ERT met and field reviewed the watershed on August 10, 1981. Team members participating on this review included:

Brant Burz..............Wildlife Biologist.............Conn. Department of Environmental Protection
Art Cross...............District Conservationist.......USDA Soil Conservation Service
Charles Fredette........Lake Ecologist.................Conn. Department of Environmental Protection
Lee Markscheffel........Regional Planner...............Northwestern Connecticut Regional Planning Agency
Bob Orciari.............Fishery Biologist..............Conn. Department of Environmental Protection
Rob Rocks...............Forester.......................Conn. Department of Environmental Protection
Frank Schaub............Sanitary Engineer..............Conn. Department of Health
Mike Zizka..............Geohydrologist.................Conn. Department of Environmental Protection

Prior to the review day, each team member was provided with a summary of the proposed project, a checklist of concerns to address, and a detailed soil survey map and topographic map of the subject 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 important to understand that the ERT is not in competition with private consultants and hence does not perform design work or privide detailed solutions to development problems. The ERT concept provides for the presentation of natural resources information and preliminary land use analyses. All conclusions and final decisions rest at the local level. It is hoped the information contained in this report will assist the town of Sharon in making environmentally sound decisions.

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

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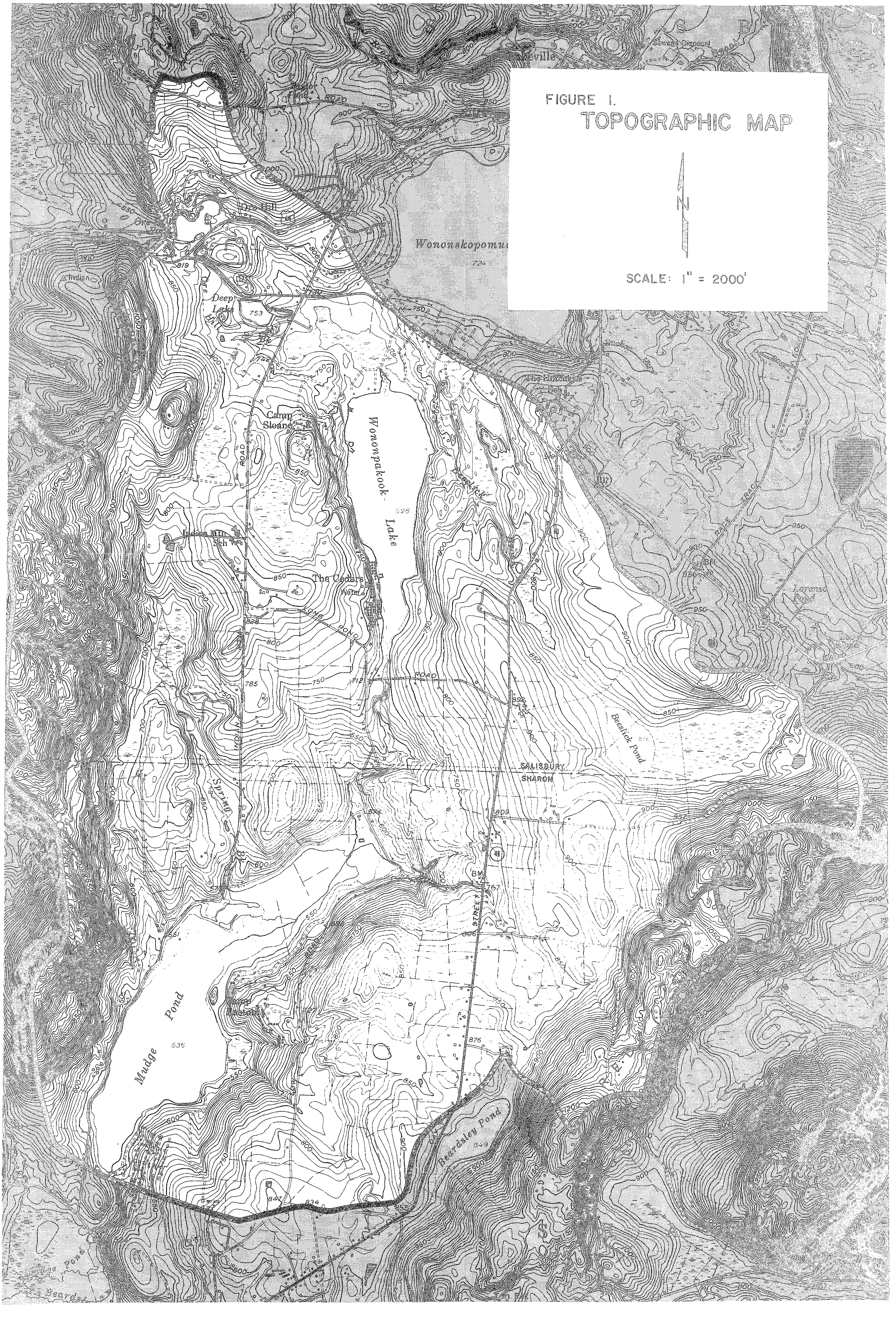


FIGURE 1.
TOPOGRAPHIC MAP

SCALE: 1" = 2000'

II. GEOLOGY

The Mudge Pond watershed may be divided into three major bedrock geologic zones. The most expansive zone comprises all of the rolling landscape at the heart of the watershed. This zone is underlain by an assemblage of rocks that includes marble, quartzite, and minor quartz schist. The relatively moderate topographic relief in this zone may be explained by the nature of the predominant bedrock, marble. Marble is composed of relatively soft minerals (calcite and dolomite) that are, in addition, highly susceptible to weathering by acid. The combination of normal weathering and erosion in conjunction with the relatively recent periods of glaciation have worn down the marble to a much greater extent than it has worn down the surrounding bedrock. The comparative nonresistance of the marble to erosional forces also helps to explain the paucity of surface exposures of marble in the area east of the Mudge Pond-Wononpakook Lake valley. Nevertheless, extensive areas of marble outcrops are found immediately east and west of Wononpakook Lake and in the valley of Spring Brook. The marble-quartzite-schist assemblage is collectively classified as Stockbridge Formation.

Indian Mountain, a ridge that forms the western limit of the watershed, is composed largely of various schists. These rocks are classified as part of the Walloomsac and Everett Formations. The term "schist" is applied to metamorphic rocks (rocks that have been geologically altered by high temperatures and/or pressures) in which elongate, platy, or flaky minerals are predominant and generally parallel. Mica and chlorite are the most abundant of these minerals. Quartz and feldspar, which are more granular, are also abundant in the schists.

Red Mountain, another high ridge, forms the southeastern boundary of the watershed. The schists that make up Indian Mountain underlie part of Red Mountain, but the latter also contains an assemblage of gneisses. "Gneisses" are metamorphic rocks in which granular minerals are prevalent, but which also have thin bands of elongate mineral grains. The gneisses in the watershed are part of a structure known as the Housatonic Highlands Massif.

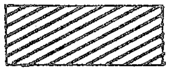
The bedrock geology of the Sharon topographic quadrangle, an area that includes the entire watershed of Mudge Pond, was mapped by R. M. Gates. The Connecticut Geological and Natural History Survey has published the map and an accompanying report as Quadrangle Report No. 38. The bedrock geology of the watershed, as adapted from that report, is shown in Figure 2.

The unconsolidated materials which overlie bedrock in the watershed may be collectively described as the surficial geology of the area. Most of the unconsolidated material consists of till, a glacial sediment composed of rock particles that range in size from clay to boulders. The textural components of the till are not sorted; i.e. fine particles and coarse particles may be thoroughly mixed. The upper portion of a till deposit will commonly be sandy, stony, and friable. Where the till exceeds 10 feet in depth, there will often be a tightly compact, crudely fissile till underlying the friable till layer.

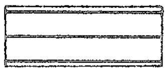
LEGEND FOR FIGURE 2.

BEDROCK GEOLOGY MAP

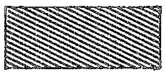
EXPLANATION



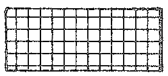
Everett Formation. Pale greenish gray phyllite to fine-grained schist composed of muscovite, chlorite, quartz, and albite-oligoclase. Commonly contains megacrysts of almandine-rich garnet, albite-oligoclase, chloritoid, and staurolite.



Walloomsac Formation. Medium gray to nearly jet black, fine- to medium-grained schist composed of variable amounts of biotite, muscovite, quartz, plagioclase, and carbonaceous material. Commonly characterized by 1-5 mm clots or flakes of biotite.

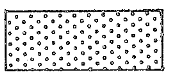


Walloomsac Formation. Interlayered, heterogeneous assemblage of schistose calcitic marble; massive white calcitic marble; gray to black, rusty-weathering impure quartzites; and gray-weathering calcite-diopside-quartz granulite.

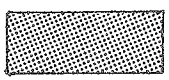


Stockbridge Formation. Mottled, white, gray, or cream-colored, coarse-grained calcite marble with minor micaceous quartz-schist layers. Excessive groundwater hardness likely in this area.

Stockbridge Formation. Interlayered assemblage of rusty-weathering quartzite; sheared, light gray, fine-grained dolomitic marble; brownish micaceous calcite marble; and calcitic dolomite marble with white quartz pods. Excessive groundwater hardness likely in this area.



Stockbridge Formation. Massive to sheared, iron-gray to white, fine-grained calcite-cemented dolomite marble (white quartz pods, rusty-weathering quartz streaks, and coarse dolomite crystals characterize some layers); and massive friable dolomite marble with white platy diopside crystals. Excessive groundwater hardness likely in this area.



Housatonic Highlands Massif. Gray to white, fine- to medium-grained grandioritic to granitic gneisses. Strongly cataclastic (i.e. shows evidence of historically severe stresses).

Housatonic Highlands Massif. Dark gray to black, fine- to medium-grained plagioclase-hornblende amphibolites and quartz-biotite-plagioclase-hornblende gneisses with subordinate microcline.

Dalton Formation. Flaggy, tan-weathering, very fine-grained muscovitic, feldspathic quartzites and schists.

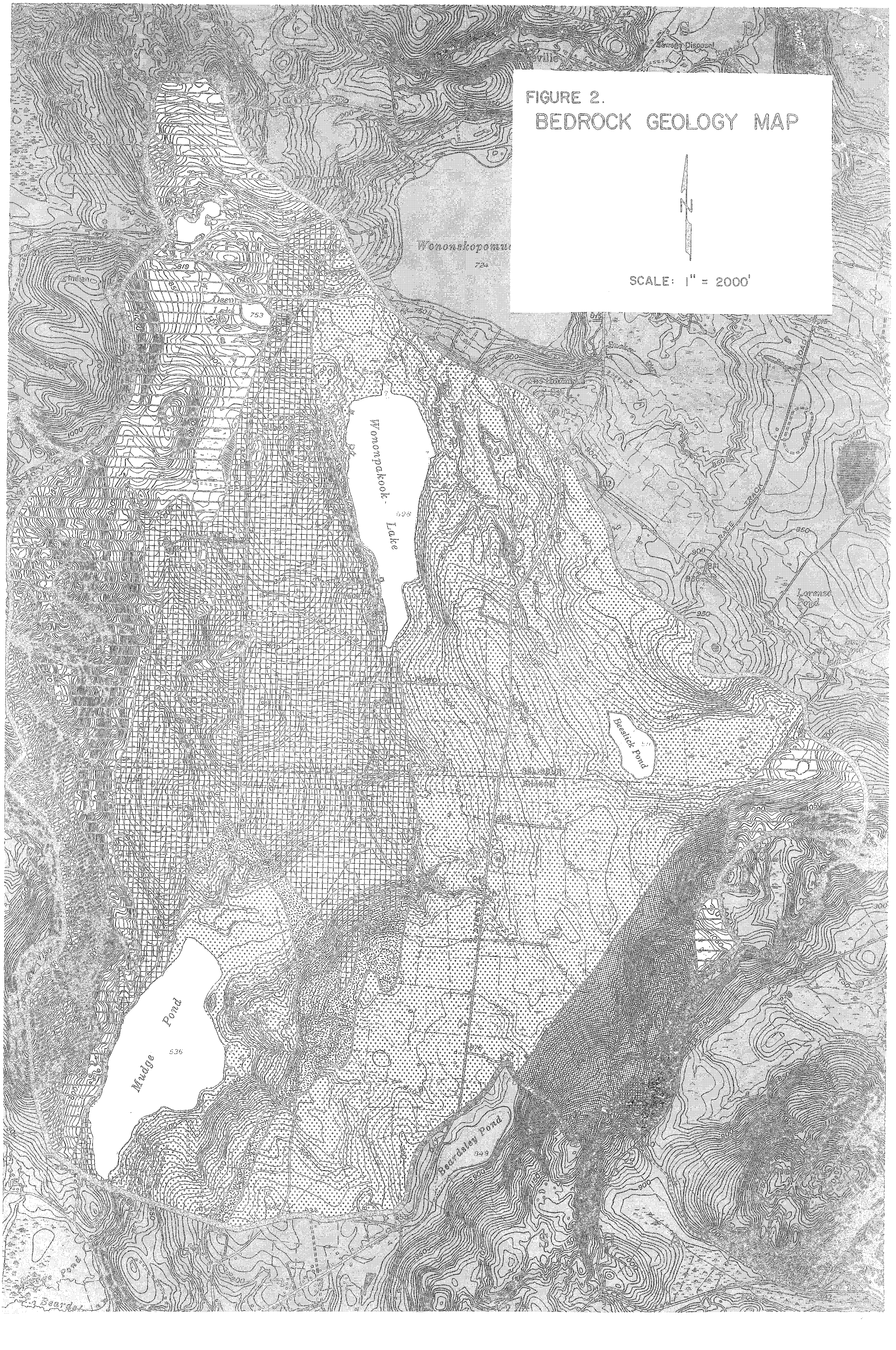


FIGURE 2.
BEDROCK GEOLOGY MAP

SCALE: 1" = 2000'

Some of the surficial materials were deposited by meltwater streams that flowed from wasting glacier ice. These sediments, which are known as stratified drift, were sorted and deposited in layers by the meltwater. Sand and gravel are the predominant constituents of the stratified drift. Most of the stratified drift in the watershed is found in the valleys north of Mudge Pond, but some is found north of Wononpakook Lake and near the swamp east of Beeslick Pond.

Recent floodplain sediments, which are also known as alluvium, are found in many of the watershed's valleys. In most places, these sediments are probably less than 10 feet thick. Sand, silt, and fine gravel are the predominant constituents of the alluvium; smaller amounts of clay and coarse gravel are also included.

In wet, relatively low-lying areas of the watershed, the surficial deposits may include accumulations of sand, silt, clay, and partly decayed organic material. These materials are known as swamp sediments.

The surficial geology of the Sharon topographic quadrangle has not been mapped to date. The surficial geology of the Mudge Pond watershed, as shown in Figure 3, is based on soils maps, topography, and aerial-photo interpretation.

III. HYDROLOGY

By definition, the watershed of Mudge Pond comprises all land areas from which water may drain into the pond. A raindrop falling on the watershed boundary would have a 50-percent chance of passing into or out of the watershed. As shown on the topographic base map, the watershed boundary, or drainage divide, tends to follow the crests of local hills and ridges. It is to be expected that the spatial layout of the boundary as shown herein differs somewhat from the actual location of the divide. The differences may be attributed to slight inaccuracies in the topographic contour lines on the base map. Nevertheless, the boundary as shown should be substantially correct. The watershed as depicted comprises approximately 7400 acres (about 11.5 square miles).

According to Connecticut Water Resources Bulletin (CWRB) No. 22, a gaging station used to be present at the outlet of Mudge Pond. No records from that station were available to the Team, but it is possible to estimate the flow-duration characteristics of the outlet stream using a method described in CWRB No. 21. The estimates are tabulated below in units of both cubic feet per second (cfs) and million gallons per day (mgd).

LEGEND FOR FIGURE 3.

SURFICIAL GEOLOGY MAP

EXPLANATION

Till. Depth to bedrock probably exceeds 10 feet in most places.

Till and scattered bedrock outcrops. Depth to bedrock is probably less than 10 feet in most places.

Areas of numerous, closely spaced bedrock outcrops or individual rock outcrops.

Stratified drift. Consists largely of sand and gravel.

Floodplain sediments. Consists largely of sand and silt but includes some gravel and clay. Also includes some areas of swamp sediments (described below).

Swamp sediments. Silt, sand, and clay mixed with substantial quantities of partly decomposed organic materials.

Artificial fill.

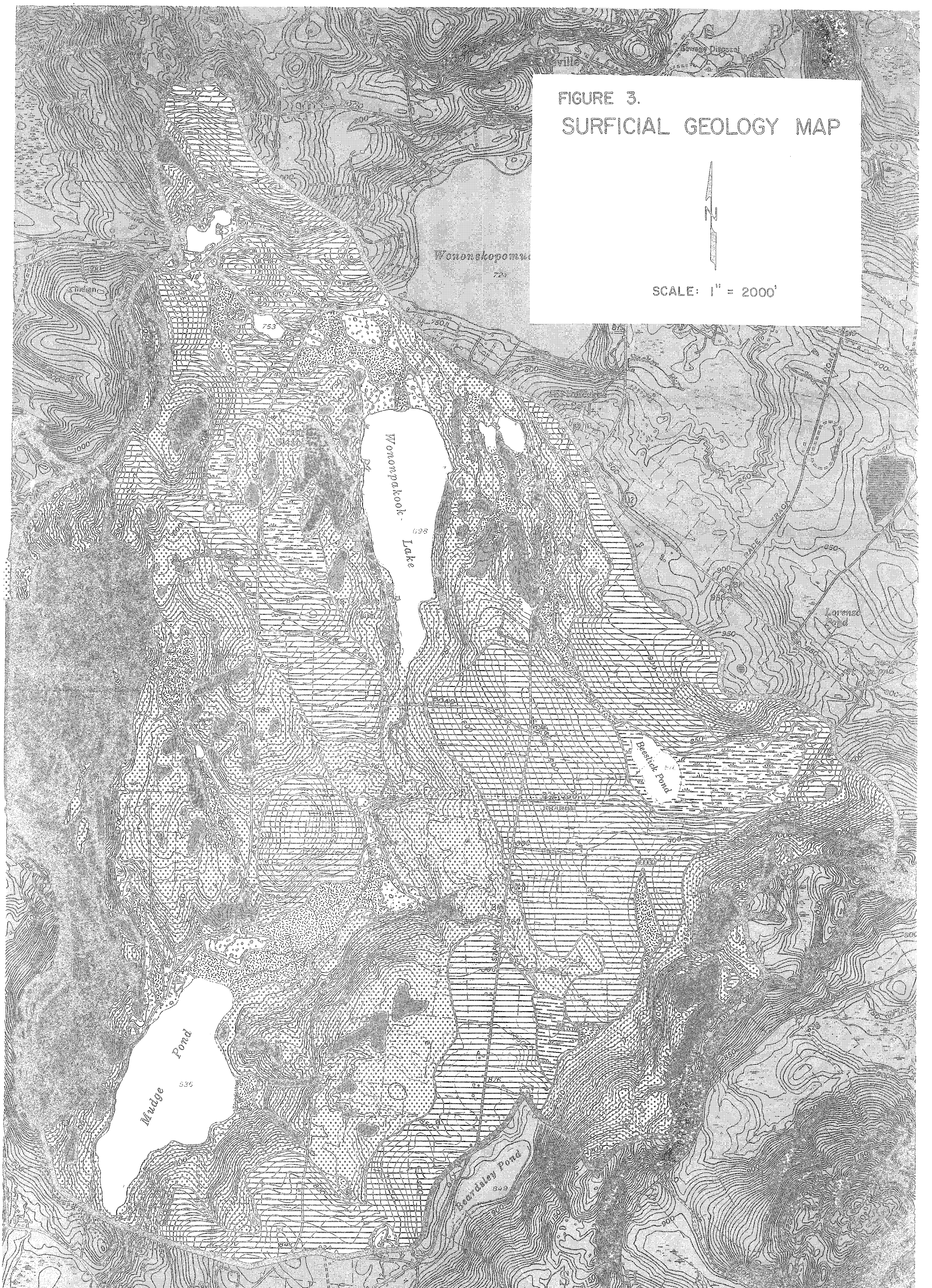


FIGURE 3.
SURFICIAL GEOLOGY MAP
N
SCALE: 1" = 2000'
Mudge Pond
Wononpakook Lake
Beardsley Pond
Beeslick Pond
Wononskopomuc
Lorenze Pond

Table 1. Estimated flow duration characteristics of Mudge Pond Brook at the outlet of Mudge Pond.

Percent of time flow equalled or exceeded	1	5	10	30	50	70	90	99
Flow equalled or exceeded, in mgd	86.35	37.90	24.95	9.60	4.80	2.21	0.48	0.05
Flow equalled or exceeded, in cfs	133.58	58.63	38.60	14.85	7.43	3.41	0.74	0.08

The mean annual outflow from Mudge Pond is estimated to be 11.13 mgd, or about 17.27 cfs.

Two major surface-water bodies are located within the Mudge Pond watershed: Mudge Pond itself and Wononpakook Lake. Mudge Pond has a surface area of approximately 200 acres, a maximum depth of 35 feet, a mean depth of 22 feet, and a volume of about 1,441 million gallons. Wononpakook Lake has a surface area of approximately 165 acres, a maximum depth of 24.5 feet, a mean depth of 11.5 feet, and a volume of about 614.5 million gallons. The watershed of Wononpakook Lake is about 4.34 square miles, an area that represents approximately 38 percent of the total drainage area of Mudge Pond. Both lakes have been reported to have relatively "hard" water (water that contains substantial amounts of mineral salts that interfere with the lathering and cleansing properties of soap). The hardness is undoubtedly due to the predominance of carbonate bedrock in the watershed (see Figure 2). CWRB No. 21 reports that the surface waters in the Mudge Pond watershed are also relatively high in dissolved solids.

Since the watershed of Wononpakook Lake comprises more than one-third of the total drainage area of Mudge Pond, and since the lake is less than two miles upstream from the pond (the terms "lake" and "pond" are used in a representative sense only), it may be presumed that the quality of water in the lake may have a substantial impact on the quality of water in the pond. Nevertheless, it should not be assumed that Mudge Pond can be adequately protected merely by taking steps to improve or preserve Wononpakook Lake. One of the background materials reviewed by the Team was a report which included the following statement: "Judging from the small difference in the hardness of Mudge Pd. water in comparison to Long Pd. (Wononpakook Lake), 95% of the water comes from Long Pd". The Team geohydrologist disagrees with this conclusion and believes that the similarity in hardness between the two lakes is largely a function of the similarities in the hydrogeologic settings of the two water bodies.

The general groundwater flow pattern in the watershed parallels the surface flow pattern to a great extent. The shape of the water table (that level below which all spaces in the soil and bedrock are filled with water) is largely conformable with the surface topography, although minor surface features may not be reflected in the water table. Rainfall reaching the ground may 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 evaporation or transpiration, or it may trickle down to the water table and become groundwater.

Ultimately, groundwater may be discharged at the surface in the form of a spring, seep, wetland, or stream. The quality of surface water therefore depends in part upon the route by which precipitation has been "transformed". More particularly, water quality is determined by the nature of the materials with which the water comes in contact and by the length of time in which the contact occurs.

Although groundwater is generally discharged to the surface, rather than vice versa, surface flows can sometimes become groundwater flows. A stream flowing down a till-covered hillside may disappear into coarse stratified drift flanking a valley. Also, artificially induced flows of surface water into the ground may occur when groundwater wells are placed near streams or ponds and the "cone of depression" (the localized drawdown of the water table in the vicinity of the pumping well) extends beneath the surface water body.

Natural soils are regarded as highly effective media for removing contaminants from water. Soil organisms and oxygen help to destroy harmful bacteria and viruses in wastewater, while fine soil particles filter out and adsorb suspended materials. The soil does not always provide complete treatment, however. In particular, dissolved chemical agents such as nitrates may not be eliminated from percolating groundwater. In addition, minerals in the bedrock and overburden may be a source of carbonates, calcium, magnesium, iron, manganese, and other elements. Nevertheless, runoff from developed areas and discharges of wastewater from houses or other buildings may receive a considerable cleansing in the soil. The problem is determining how much stress (in the form of polluted water) can be placed on the soils before their renovative abilities are overtaxed. The answer to this problem varies from soil to soil and from contaminant to contaminant. For instance, bacteria are more effectively removed from soils with a deep water table while nitrates tend to be less of a problem in soils with a shallow water table.

The rate at which groundwater moves through various earth materials depends in part upon the size, the percentage, and the degree of interconnection of the pore spaces or cavities in the material. Coarse-grained materials, such as gravelly stratified drift, tend to transmit groundwater more rapidly than other types of surficial geologic materials and more rapidly than fractured bedrock. Because of this high transmissibility, coarse stratified drift is a particularly important resource for the development of high-yielding wells. On the other hand, bedrock is undoubtedly the most common source of drinking-water for individual residential wells in Connecticut. Bedrock wells can usually supply water at small but reliable yields that are adequate for the needs of most households. In most of the Mudge Pond watershed, the quality of water may be affected by excessive hardness. This is true whether the source is bedrock or stratified drift because most of the local bedrock is carbonate and because the local stratified drift was largely derived from carbonate rocks. Several filtration or softening systems are available to overcome hardness problems, but the use of some such systems may cause salt contamination of groundwater. Figure 2 indicates the areas where excessive groundwater hardness is likely.

The stratified drift deposits within the watershed are concentrated largely in the flat valley areas north of Mudge Pond and Wononpakook Lake.

Although little information was available to the Team with respect to the thickness and texture of these deposits, preliminary investigations indicate that the deposits are not particularly favorable for the development of substantial public water supplies. The widespread swampiness in the valleys suggests that fine-grained materials are predominant, although the upper 10 to 20 feet of the deposits in the higher areas bordering the swamps may be more gravelly. The Team believes that individual on-site wells will continue to be the most important sources of water to residences within the watershed, and that bedrock will be the most widely used aquifer. Stratified drift may nevertheless be suitable for some small or moderate water supplies.

IV. FISHERIES

Mudge Pond is inhabited by a wide variety of fish species. In the Pond, largemouth bass, bluegill sunfish, common sunfish, and yellow perch are abundant, while brown bullhead, white sucker, golden shiner, red-breasted sunfish, and rock bass are common. Smallmouth bass, calico bass, redfin pickerel, and chain pickerel tend to be fairly scarce. Occassionally, naturally occurring redfin pickerel (chain pickerel hybrids) are also present.

Mudge Pond is a relatively shallow body of water, having an average depth of only 22 feet. Although thermal stratification does occur during the summer, the deeper cold waters are deficient in dissolved oxygen and are not capable of supporting fish. Because of the anoxic conditions of the cold bottom water, Mudge Pond is not suitable for cold water species of fish, such as trout. Instead, it is best managed as a warm water fishery. Present regulations to preserve this fishery include a 12 inch size limit with a six fish daily creel limit on both bass species and a 15 inch size limit with a six fish daily creel limit on chain pickerel. Largemouth bass, yellow perch, brown bullheads, and bluegill sunfish should provide an excellent recreational fishery. There is ample public access to Mudge Pond for fishing, as a state-owned boat launching facility is present at the lake's southeastern end and several undesignated access points are available along the lake's western shore.

Yellow perch, bluegill sunfish, and largemouth bass have an average to below average growth rate in Mudge Pond. Growth rates for these species could be increased by controlling the dense growths of aquatic weeds. Removal of some macrophytes would appreciably reduce escape cover for bluegill sunfish and yellow perch and would make them more available as forage for bass. With an increased food supply, growth rates for bass should improve. Growth for perch and bluegills would likewise improve, since there would be fewer individuals competing for a limited food supply. Although some weed removal would be beneficial, it would not be advisable from a fisheries standpoint to remove all aquatic macrophytes, as some patches of vegetation should be present to provide hiding areas for fish predators and to allow spawning of yellow perch and pickerel.

Future increased development in the watershed of Mudge Pond would add nutrients and silt to its tributaries. Fortunately, these streams flow through swamp and/or marsh areas just before entering Mudge Pond. Thus substantial loads of silt and nutrients may be removed in these areas, which should provide some long term protection to the Pond. Also, since Mudge Pond is already in an advanced state of eutrophication, moderate increases of nutrients will not seriously affect the existing fish populations. However, heavy loads of silt and nutrients could negatively affect the excellent recreational fishery at Mudge Pond and precautions for proper land management practices should be instituted.

V. VEGETATION

The 7400 acre Mudge Pond watershed is located within Connecticut's Northern Marble Valley Subregion of the Northern Uplands--Transitional Hardwoods Zone.[1] According to Dowhan and Craig (1976) the dominant "transition hardwoods" of this region include Northern red oak, basswood, white ash and black birch. Included also are tree species of the northern hardwood zone, such as sugar maple, American beech and yellow birch, as well as southern and mid-western species more characteristic of the central hardwoods zone, such as white oak, black oak, shagbark hickory and bitternut hickory. White pine and hemlock are also frequent and locally dominant. The early phases of old field vegetation development are dominated by white pine and eastern red cedar. Several northern shrub species such as hobblebush and mountain winterberry are near their southern range limits in the state here. A number of other northern bog and forest species reach their extreme southern range limits in the cooler habitats of this region. Some rare plant species of the region are bog rosemary, marsh willow-herb, Canada violet, and stiff club moss. Some of the unusual plant species which are present in the northern Marble Valley subregion include spreading globe flower, North American wall rue, narrowleaved spleenwort, arbor vitae, dwarf birch, purple cress, seneca snake root, meadow horsetail, buroak, sweet colts foot, and many midwestern pond weeds. The high fertility of the calcium rich soils which are present allow these species to survive.

For the purposes of this report, the Mudge Pond watershed may be divided into six vegetation types. For the most part the boundaries of these vegetation types as shown in Figure 4, are only approximate. In some places the vegetation types gradually grade into one another, causing wide transition zones where tree species dominant in one type are present in another. These conditions cause difficulty in mapping. In other areas, transition zones are almost non-existent and mapping is greatly simplified. The composition and potential for management of the six major vegetation types is discussed below.

A. GENERAL VEGETATION DESCRIPTIONS (refer to Figure 4)

TYPE A. Open Fields/Agricultural Land - Some of the most highly productive areas in the study area are occupied by open fields. These areas are at present being utilized as either cropland, mowed fields vegetated with grasses and assorted wild flower and weed species, and somewhat less productive pasture land vegetated primarily with grasses. Many of these areas have the potential to produce high quality timber if planted to softwoods or allowed to revert to woody vegetation.

---

[1] Dowhan, J. J. and Craig, R. J., 1976, Rare and Endangered Species of Connecticut and Their Habitats; CT Geol. Nat. Hist. Survey Report Invest. #6.

TYPE B. Transition Mixed Hardwoods and Northern Hardwoods - For the purposes of this report, the transition mixed hardwood and northern hardwood vegetation types are mapped together. In many places the vegetation types merge together and are characterized by a mixture of the species present in each. The overstory in the mixed hardwood area is dominated by white oak, red oak, black oak, sugar maple, red maple, shagbark hickory, pignut hickory, bitternut hickory, black birch and basswood, while the northern hardwood areas are dominated by sugar maple, yellow birch, paper birch, American beech and white ash. The understory and ground cover vegetation varies widely within this mapping unit. Hardwood tree seedlings and saplings, including American chestnut, are widespread, along with many shrub species which include but are not limited to blue beech, tartarian honeysuckle, witchhazel, hazelnut, mountain laurel, large leafed holly, flowering dogwood and ironwood. Ground cover is dominated by club moss, grasses, sedges and many species of ferns.

Many of the tree species which are present in the transition mixed hardwood and northern hardwood vegetation types have high commercial value for sawtimber and fuelwood. The condition of the trees is quite variable, as dictated by site conditions, past land use, and past vegetation management. Areas which are not designated as having major limitations (see Figure 5) have high forest product productivity potential which can be increased significantly through proper forest management. Trees in these areas will respond well to periodic thinnings aimed at removing the poorer quality trees. These thinnings will reduce competition between desirable species and result in a healthier, higher quality stand.

TYPE C. Hardwood Swamp - Forested wetlands are common throughout the study area. Red maple is the dominant tree species along with scattered white ash, American elm, black willow and yellow birch. The understories throughout these areas vary widely in both species composition and diversity. High bush blueberry, spice bush, sweet pepper bush, elderberry, and several species of viburnum are common throughout. Skunk cabbage, tussock sedge, cinnamon fern, sensitive fern and sphagnum moss are widespread as ground cover. The commercial utility of the trees in these areas must be evaluated on an individual wetland basis. Generally, tree growth potential is somewhat limited by the high water table and saturated soils which are present. Under these conditions, trees are shallow rooted and unable to become securely anchored, causing high potential for windthrow. These soil conditions also limit access and operability. Depending on the severity of these limitations, the feasibility of implementing timber management practices may be severely reduced or eliminated completely.

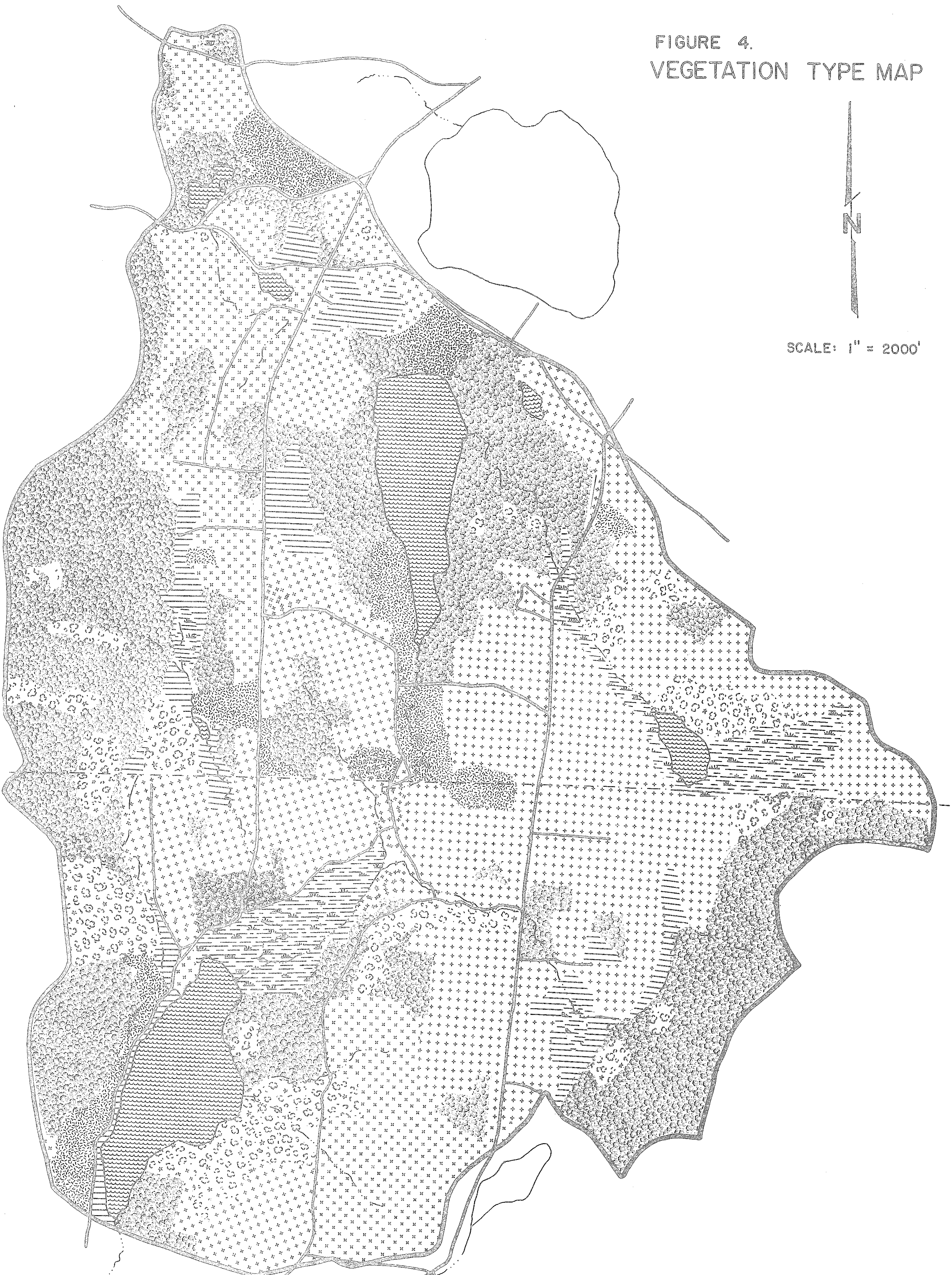
TYPE D. Softwoods/Hardwoods - Eastern white pine and eastern hemlock are the dominant tree species present in this vegetation type. Scattered throughout are sugar maple, black oak, white oak, red maple, black cherry, basswood, American beech, black birch and yellow birch. Eastern white pine seedlings, hemlock seedlings, moosewood, low bush blueberry, huckleberry and mountain laurel are the most abundant vegetation forms in the understory. Ground cover is scarce throughout much of this area. Where it is present, club moss, grasses, sedges and Christmas fern dominate. The tree species present in this area do have commercial value. However, because of poor growth conditions, poor access and poor operability (discussed in the "limitations" section below), this value may be low.

LEGEND FOR FIGURE 4.

VEGETATION TYPE MAP

- OPEN FIELDS/AGRICULTURAL LAND
- TRANSITION MIXED HARDWOODS, AND NORTHERN HARDWOODS
- HARDWOOD SWAMP
- SOFTWOODS/HARDWOODS
- OPEN SWAMPS/MARSHES/WET MEADOWS/BOGS
- OLD FIELDS
- LAKES AND PONDS

FIGURE 4.
VEGETATION TYPE MAP



SCALE: 1" = 2000'

TYPE E. Open Swamps/Marshes/Wet Meadows/Bogs - Many non-forested wetland areas are present within the study area. The diversity of vegetation within and between individual wetlands is very great. Some of these areas are dominated by red maple seedlings, but the majority of these areas are dominated by shrub species including high bush blueberry, sweet pepper bush, swamp azalea, red alder, speckled alder, spirea, leather leaf, silky willow, pussy willow, button-bush, large cranberry and arrowwood. The herbaceous vegetation which is common within these wetland areas includes many species of sedges, grasses and sphagnum moss, along with purple loose strife, swamp loose strife, cattail and phragmities.

TYPE F. Old Fields - The old field areas which are present are either open fields which were abandoned and allowed to revert to woody vegetation, or areas which do not have enough soil or soil moisture to support trees. Generally these old field areas are understocked with quality tree species. Those tree species which are present include eastern red cedar, eastern white pine, gray birch, quaking aspen, big tooth aspen, red maple, sugar maple, white ash, apple trees and black oak. Shrub species are abundant throughout, with gray stemmed dogwood, silky dogwood, arrowwood, high bush blueberry, multiflora rose, hawthorn male berry and staghorn sumac being most common. Ground cover is dominated by grasses, goldenrod, Queen Anne's lace, and milkweed. The commercial utility of the tree species found within this vegetation type is poor at the present time.

B. MAJOR LIMITATIONS TO FOREST MANAGEMENT

Areas which may present limitations to forest management activities are designated in Figure 5. These areas fall into two major categories: Areas where poor access, extremely steep slopes and rockiness may limit forest management practices and areas designated as inland wetlands where poorly drained and saturated soils may limit forest management feasibility.

In both areas, poor operability as related to forest management activities may restrict or even preclude the actual implementation of forest management and harvest operations.

Tree growth, quality and health may be limited by the excessively drained soils, shallow to bedrock soils or saturated wetland soils found in these areas. These conditions may be severe enough to cause the trees which are present to have little or no commercial value.

It should be recognized, however, that the limitations described above do not necessarily preclude forest management. The feasibility of forest management within these areas should be evaluated by a qualified forester on an individual stand or woodlot basis. Proper planning and implementation is particularly important in these areas to insure effective, efficient and environmentally sound forest management operations.

C. FURTHER MANAGEMENT CONSIDERATIONS

The Forestry Unit of the Department of Environmental Protection encourages all woodland owners to manage their forest lands. When properly prescribed and executed, forest management practices will increase the production of forest products, improve wildlife habitat and enhance the overall condition of the woodland with minimum negative environmental impact.

Forest Management and Water Quality

Healthy woodlands provide a protective influence on water quality: they stabilize soils, reduce the impact of precipitation and runoff, and moderate the effects of adverse weather conditions. By so doing, woodlands help to reduce erosion, sedimentation, siltation and flooding. Research has shown that soil protected by the cover of litter and humus associated with woodland areas contributes little or no sediment to streams.

Improper cultivation and harvesting of timber for commercial purposes may, however, lower water quality in several ways: 1) Erosion, siltation and sedimentation caused by improperly located and improperly constructed access roads, skid trails, yarding areas and stream crossings; 2) Siltation and sedimentation caused by logging debris left in streams, interfering with natural flows; 3) Thermal pollution resulting from complete or partial harvesting of streambank vegetation, eliminating shade; 4) Chemical pollution caused by improper application of herbicides and insecticides (it should be noted however that in Connecticut the widespread use of chemicals in forest mangement is not prevalent and therefore does not constitute a great threat to water quality at this time); 5) Influx of nutrients caused by the application of fertilizer, soil conditioners and wetting agents (used in forest fire control). Research has determined that nutrient loss from normal silvicultural practices (i.e. practices involving the cultivation and harvesting of timber) does not, for the most part, result in significant deterioration of water quality.

Despite the potential adverse impacts to water quality, the harvesting of trees is a major and necessary tool used in forest land management. Adverse impacts to water quality can be minimized through good planning and responsible implementation.

A pamphlet entitled "Logging and Water Quality in Connecticut: A Practical Guide for Harvesting Forest Products and Protecting Water Quality" has recently been published by the Department of Environmental Protection's Forestry Unit. A series of Best Management Practices (BMP's), which are recommendations designed to minimize the negative impact of silvicultural activities on water quality, are presented in this pamphlet.

A "BMP" as defined in the pamphlet is "a practical, economical and effective management or control practice which will reduce or prevent the generation of pollution".

Examples of recommended BMP's for preventing or reducing degradation of water quality resulting from silvicultural activities include:

Phase I. Planning the Job.

a. Locate all streams, wetlands and poorly drained soils (sensitve areas) on USGS topographic maps and/or county soils maps.

b. Plan preliminary locations of access roads, skid roads and yarding areas to avoid the sensitive areas. Locate potential stream crossings.

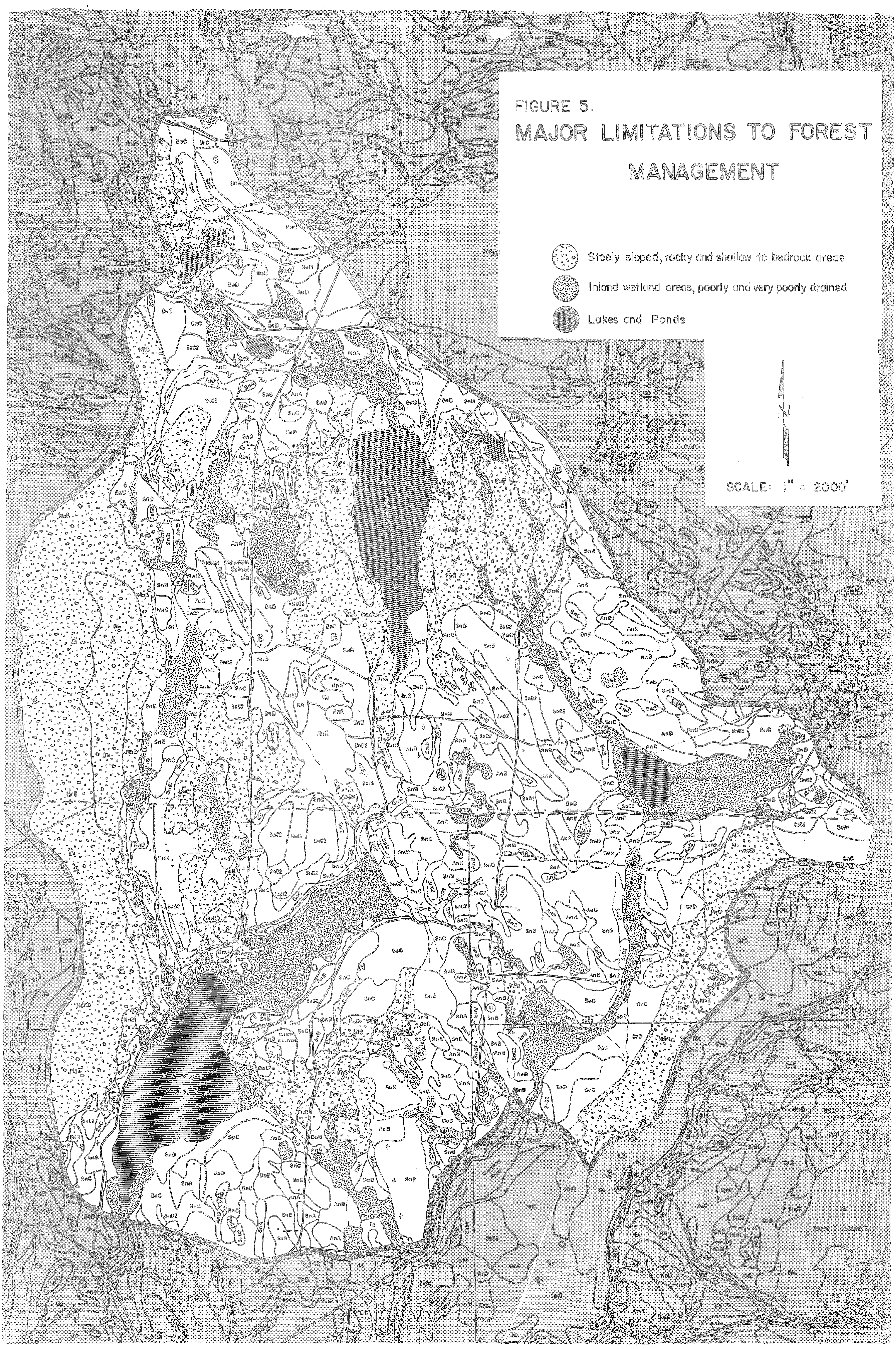


FIGURE 5.
MAJOR LIMITATIONS TO FOREST MANAGEMENT

Steely sloped, rocky and shallow to bedrock areas

Inland wetland areas, poorly and very poorly drained

Lakes and Ponds

SCALE: 1" = 2000'

c. Plan for the best time of year to implement individual silvicultural activities. Sensitive areas that cannot be avoided should be planned for winter when the ground is frozen and more stable.

d. Plan Stream Management Zones which are aimed at protecting stream beds and stream banks.

Phase II. Implementing the Job.

a. Locate logging roads and skid trails so that the slopes of these roads do not exceed 10% except for short distances.

b. Locate yarding areas on well drained soils with a slight slope, avoiding drainage discharge directly into access roads or streams.

c. Locate Stream Management Zones and avoid equipment operation in these areas to the greatest extent possible.

d. Provide undisturbed buffer strips between streams and roads or yarding areas. The width of these buffer strips is generally between 30 and 100 feet but should depend on slope, soil erodability and the magnitude of road or yarding area drainage discharge.

e. Avoid, when possible, equipment operation on poorly drained soils, in swales and around or in stream channels.

f. Avoid complete clearing of vegetation in the Stream Management Zone.

g. Avoid disturbing understory vegetation within 30 feet of a stream channel.

h. Avoid reducing overstory crown cover below 50% within 30 feet of stream channel.

i. Avoid felling trees in streams; if this occurs, remove debris as soon as possible.

j. Avoid stream crossings if possible; if not, consider building temporary bridges. Crossings should be made at right angles to the stream over stable rock or gravel bottoms, and should avoid steep or unstable banks.

Phase III. Completing the Job.

a. Install erosion control measures on access roads and primary skid trails, including properly placed waterbars and reconditioned cross drains, located at intervals which take into account road length, slope and common sense.

b. Remove all temporary bridges and culverts from streams.

c. Lime and seed specific critical areas, such as steeply sloped roads or problem areas.

d. Close roads to prevent continuing access.

Following these BMP's along with the use of common sense will help to avoid water quality degradation resulting from silvicultural operations.

The implementation of the recommended BMP's will most likely be of a voluntary nature, aided through an accelerated educational program and perhaps an incentive program, rather than through regulation. At this time, local regulation of forest product harvesting is contrary to State forestry policy.

Educational and incentive programs may be reinforced by the use of timber sale contracts which reflect the use of BMP's between landowners and loggers. A public or private professional forester can assist landowners in developing an effective timber sale contract. The posting of reasonable performance bonds by the logger may be necessary to help insure proper completion of the logging operation. Periodic on-site inspection may also be essential to see that the logging activities meet the contract terms. Proper education of the landowner and logger can be the key to successful use of BMP's in forest management.

Further guidelines to maintain water quality on managed woodlands may be found in the pamphlet "Timber Harvesting Guidelines" by the Wood Producer's Association of Connecticut. The principles set forth in this publication are aimed at protecting the forest ecosystem from thoughtless timber harvesting practices that may lower environmental quality in both the long and short run. Copies of this pamphlet are available from the Department of Environmental Protection's Forestry Unit and members of the Wood Producers' Association of Connecticut.

D. CLUSTER DEVELOPMENT AND FOREST MANAGEMENT

The concept of cluster development has several advantages over the conventional concept of single lot subdivision development in terms of multiple use forest management. Generally, cluster development, which does not exceed the number of individual dwelling units permissible under existing single lot subdivision regulations for a given parcel, will favor common open space areas. These open space areas are usually large enough in size to allow for long term multiple use forest management. Ideally, actual development will be restricted to areas where environmental conditions are suitable, leaving environmentally sensitive areas undeveloped. Under this type of cluster design, the potential for management of the open space areas for recreation, wildlife habitat and the production of forest products is not lost, as it would be under conventional single lot subdivision design. Periodic revenues, which are generated by properly prescribed fuelwood or timber harvests, can be utilized for improvements and maintenance of these open space areas.

VI. WILDLIFE

In the Mudge Pond Watershed there are four major wildlife habitat types. These include fresh water habitat, woodland habitat, wetland habitat, and openland habitat. For a description of the vegetation present and locations of these habitat types, please see the vegetation type descriptions and vegetation type map presented in the preceeding section.

The habitats within the watershed provide a home for a wide variety of aquatic, avian, and terrestrial wildlife. These include:

Wetland habitat: ducks, woodcock, numerous furbearers, herons and a variety of small birds and mammals.

Woodland habitat: squirrels, birds of prey, deer, ruffed grouse, woodchucks, raccoons, turkeys and a variety of small birds and mammals.

Openland habitat: pheasants, coyotes, foxes, rabbits, hawks, owls, deer, and a variety of small birds and mammals.

Fresh water habitat: aquatic animals, reptiles, amphibians, and various aquatic food/chain animals. This habitat also provides food and resting areas for possible ospreys, eagles, geese and numerous ducks.

The large wetlands in close proximity to Mudge Pond are very valuable to wildlife. The "edges" where farmland meets woodland are also very important wildlife areas. Where possible, these important wildlife areas should be maintained and protected from development.

Significant development proposals should include consideration of the impact of the project on wildlife. In general, the greater the density of development, the greater the potential conflict between wildlife and human populations. The Wildlife Unit of DEP is available to provide assistance in land management for wildlife; a regional wildlife biologist can be reached at 379-0771.

VII. SOILS AND LAND USE

As shown in Figure 6, the Mudge Pond Watershed may be divided into five major types of land use. The acreage and percentage of coverage of each land use is presented in Table 2. It should be noted that over a third of the watershed is forested, and nearly a third consists of agricultural land. The problems and potentials of the five major land uses in the watershed are discussed below.

TABLE 2. LAND USE CHARACTERISTICS OF MUDGE POND*

Categories of Land Use	Area	Percent of Total Watershed
1) Forest Land	2700 acres	36.4%
(over shallow soils)	(1700 acres)	(23%)
(over deep soils)	(1000 acres)	(13.4%)
2) Agricultural Land	2350 acres	31.8%
(Cropland)	(650 acres)	(8.8)
(Hayland)	(900 acres)	(12.2)
(Pasture)	(800 acres)	(10.8)
3) Urban Land (includes indiv. homesites, & estates)	1200 acres	16.2%
4) Significant Inland Wetlands (not in agricultural use)	650 acres	8.8%

*Determined from 1980 aerial photos using acreage calculating grid and planimeter.

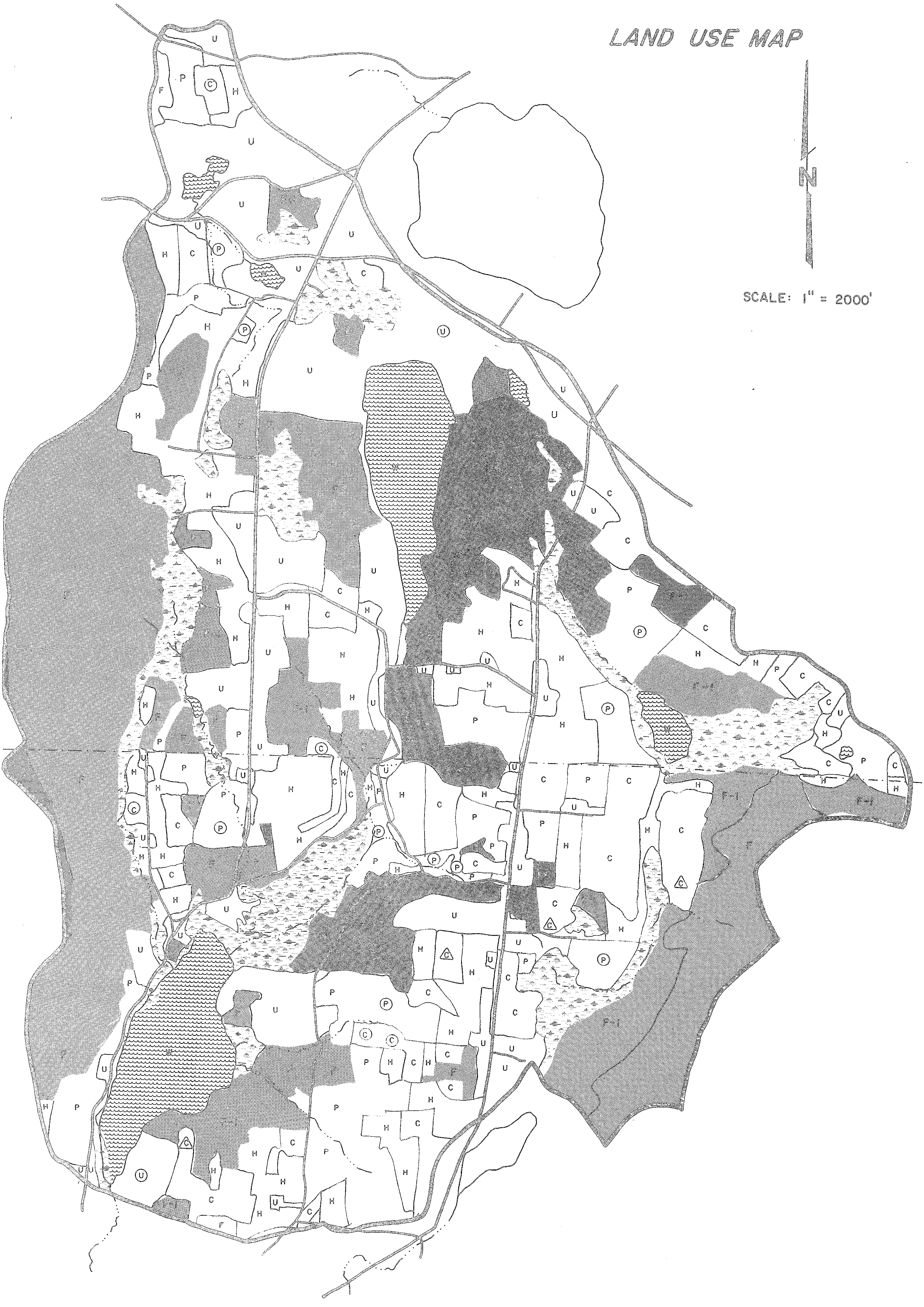
LEGEND FOR FIGURE 6.

Land Use Map

	C	Cropland
	F	Forest (over shallow to Bedrock soils)
	F1	Forest (over deep soils)
	H	Hayland
	P	Pasture
	U	Urban/Residential
	W	Water
	IW	Inland Wetland (and Floodplains) Non-Agric.
	△C	Cropland (not directly near stream but with erosion potential)
	Ⓒ	Cropland (near streams with high erosion potential)
	Ⓟ	Pasture (near streams)

FIGURE 6.

LAND USE MAP



SCALE: 1" = 2000'

TABLE 2. Land Use Characteristics of Mudge Pond (Cont'd)

Categories of Land Use	Area	Percent of Total Watershed
5) Water bodies	425 acres	5.4%
(Mudge Pond)	(200)	
(Wononpakook Lake)	(160)	
(Beeslick Pond)	(28)	
(Ore Hill Pond)	(15)	
(Deep Lake)	(7)	
(Other small ponds)	(15)	
6) Miscellaneous (e.g. brushland)	100	1.4%

A. Water Bodies

1. Wononpakook Lake (Long Pond)

This lake is classified as being eutrophic according to the Connecticut Department of Environmental Protection. It has had a weed and algae problem for many years. This has been documented as being caused by the lake's shallowness and a nutrient rich blanket of original organic sediment covering the lake bottom. The recreational value (swimming, fishing, etc.) of the lake in its present condition is limited.

Dredging of portions of most of the lake, to a depth of six to ten feet, was proposed in 1972. Disposal of up to 300,000 cubic yards of dredged material was tentatively proposed in wetland areas 2,000-11,000 feet from the lake. Although dredging of the lake is a method to consider to improve the water, filling of wetlands is not considered a wise means of spoil disposal. Other means of disposal, such as upland sites, should be investigated if dredging is seriously considered.

Costs in 1972 for the "full scale" dredging project were estimated at $150,000-$250,000. Costs today would be considerably higher (perhaps as much as ten times higher). Environmental and economic assessments today may or may not determine the project still feasible. Bottom withdrawal, as on Lake Wononscopomuc (Lakeville Lake) may be a more appropriate alternative. More research would be need to determine this however.

The dam at Long Pond, in need of repair, was studied by the USDA, Soil Conservation Service in 1962 and recommendations were made for improvements. As of June 1976, the State DEP recognized that the dam still was in need of repair. However, structure failure was considered of low hazard in that there was little development downstream.

There appears to be no "glaring" sources of non-point or point pollution within the Wononpakook Lake watershed. Implementation of the proposed sewering of homes and inn at the north end of the lake may help. Fencing of streams within cattle pastures (with off-stream stockwater ponds, where feasible) and stabilizing streambanks would be desirable where needed.

Almost all of the lands within 500 feet of the lake shoreline are mapped as shallow to bedrock soils on steep slopes. These soils have severe limitations for urban development (septic systems, homesites, roads, drives, etc.). Future misuse of these soil areas could have further detrimental effects on the quality of this lake.

2. Mudge Pond

This lake is classified as being in a late mesotrophic state according to the Connecticut Department of Environmental Protection (somewhat less eutrophic than Wononpakook Lake). The pond has similar weed and algae problems to Wononpakook Lake.

As shown in Figure 6, there are seven possible sources of non-point pollution within the immediate watershed of Mudge Pond, predominantly along or near the perennial streams. These possible sources are either from fields that are in continuous corn with no conservation practices (excessive soil erosion) or from pastures where cattle may have direct access to the streams (nutrients and erosion of streambanks).

Conservation practices to consider, singly or in combination, on cropland fields are: no-till planting, rotations, cover crop, contouring, contour strip-cropping, and animal waste management. In pasture, fencing of streams, off-stream stockwater ponds, and stabilization of streambanks are practices to consider.

Five other cornfields, either not directly near streams or in their first or second year of corn, may also be contributing sediment and nutrients.

The old subdivision at the southeast end of the lake also could be contributing sediment and nutrients to the lake from eroding roads, drives, and septic leachate.

Rather steep slopes and hardpan soils border most of the undeveloped land around Mudge Pond. These soils have a severe limitation for septic systems due to slow percolation rates and, in places, seasonal high water tables. Thus, if developed, special management practices, proper installation, and maintenance will be needed to prevent septic system failures and nutrient enrichment of the pond.

B. Inland Wetlands and Floodplain Soils

There are according to a comparison of 1980 aerial photos with soil maps, approximately 650 acres of "natural" inland wetland and floodplain soils within the entire watershed. (Note: "natural" = not a part of a pasture, hayfield, or crop field.) These wetlands and floodplains directly associated with the perennial streams and the water bodies should remain undeveloped.

Consideration should be given to adopting a "streambelt ordinance" for the watershed to protect perennial streams and lakeshores. Assistance in preparing a streambelt ordinance is available from the Litchfield County Conservation District (567-8288).

C. Agricultural Lands

1. Cropland

Either silage corn or grain corn is grown on the +650 acres of cropland within the watershed.

In 1977, under the Connecticut "208" program, an erosion and sediment source inventory was conducted by the Litchfield County Soil and Water Conservation District. A high rate of soil movewment (sheet and rill erosion) was calculated for this watershed as most fields are on very sloping land. Since 1977, "conservation tillage" (little or no plowing and harrowing) has been practiced on considerable acreage. It should be noted that conservation tillage is the single most effective erosion control practice on cropland. Continued and increased use of conservation tillage (no-till and minimum till) along with other conservation practices such as rotations and strip-cropping would significantly reduce soil movement on the cropland within the watershed.

Improved water quality and maintaining the soil resource are worthwhile objectives which can be obtained through proper management.

Several active, large gullies are present at the edges of cropland within the watershed. Although little sediment may be directly reaching the lakes and other water bodies because of the location of the gullies, streams and wetlands are being impacted. Reshaping, seeding, stoning centers, etc. are corrective measures which could and should be implemented.

2. Hayland

Hayland of approximately 900 acres generally experiences only slight erosion due to adequate cover that protects the soil.

3. Pasture

Other than fencing cattle from streams as previously noted, practices to consider are rotation of pastures, adjustment of stocking rates so as to maintain adequate cover, reseeding (conventional and no till), and avoidance of pasturing when soil surface is saturated (so "punching" will not occur). It should be noted that in both hayland and pasture, if fertilizer is applied according to soil tests, overfertilizing, nutrient runoff and water enrichment should be minimal.

4. Animal Waste Management

Within the watershed, there are 9 farms which use most of the agricultural lands (5 dairy, 1 dairy heifer and corn, 2 beef, and 1 grain corn and horse). Optimum animal waste management involves storing manure in pits or other structures during winter and spring months. Then, manure is spread on the land at specified rates and incorporated into the soil within a few days, where possible. Avoidance of winter spreading of manure prevents nutrient runoff into streams which flow into the lakes and ponds.

Waste waters from milk rooms and parlors can also be run into lagoons or storage ponds. It should be noted that one dairy farm within the watershed has a manure storage pond and lagoon.

5. Agricultural Land Preservation

There are approximately 3,000 acres of prime and additional important farmland soils within the watershed (of the 3,000 acres, 2200 are prime, 800+ important additional). The largest, contiguous areas are east and west of Route 41. It should be recognized that many of these farms are among the largest and most easily worked fields found anywhere in New England.

With the exception of one small subdivision on the west side of Route 41, south of Low Road, there has been very little recent change in the amount of prime and important farmland soils in the watershed. However, this by no means assures that this irreplaceable natural resource, of great importance to the area, will remain available for future agricultural uses. The towns of Sharon and Salisbury should implement any and every agreed upon method to preserve the most valuable of these farmland soils. Information on the mechanisms which are presently available to accomplish this is available from the Litchfield County Conservation District (566-8288).

D. Forest Lands

There are approximately 2,700 acres of forest land in tracts 10 acres or larger within the watershed. Approximately 1,000 acres are on soils and slopes with good potential for desirable tree growth and management (i.e. low erosion hazards, slight-moderate equipment limitations, slight chances of seedlings not surviving, and low windthrow hazard).

Approximately 1,700 acres of forest land are on soils that are shallow to bedrock and have slopes ranging from 3 percent to over 35 percent. In these areas, tree growth is much slower and seedling mortality is high. Management problems such as equipment operation and erosion hazards are considerably more on these soils as the slopes increase. Erosion and sediment control measures are important to plan and implement when managing these areas for wood products. Additional discussion of forest management opportunities is found in the "Vegetation" section of this report.

E. Urban Lands

1. Use of Soils Information

There are a number of publications available which can be used as "tools" to help ensure that future development in the watershed is accomplished in an environmentally sound manner. These publications include:

"Soil Survey of Litchfield County", USDA Soil Conservation Service, 1970.
"Know Your Land", CT Cooperative Extension Service, et. al.
"Soil Interpretations for Waste Disposal", David E. Hill, CT Ag. Exp. Sta., 1979
Erosion and Sediment Control Handbook, CT", USDA Soil Conservation Service, 1976.

Consideration should also be given to utilizing soil information more assertively by incorporating it in subdivision, zoning, and erosion and sediment control regulations.

Finally, perennial streams and lakeshores can be protected by using soils information to delineate streambelts. A streambelt is a continuous corridor on both sides of a perennial stream and associated wetlands. Assistance in streambelt planning and management is available from the Litchfield County Conservation District (567-8288).

2. Erosion and Sediment Control

The "framework" to control possible erosion and resultant sedimentation from future urban development can be set now via erosion and sediment control regulations. Soil regulations could require that an erosion and sediment control plan be prepared (and reviewed) and implemented wherever urban development was to take place. It should be recognized that sediment is the largest pollutant by volume in the U.S. It has filled many lakes and streams. "An ounce of prevention is worth a pound of cure" for the future when it comes to erosion and sedimentation.

3. Storm Water Management

Impervious surfaces (roads, drives, rooftops, parking areas, etc.) created by urban development can add significant amounts of runoff water into streams. The accumulative runoff may overburden the natural capacity of the streams. The results are flooding, streambank erosion, increased sedimentation and lowering of water quality. Loss of life, property, decreased property value, increased taxes for flood and erosion control, etc. are other possible impacts. If new development in non-intensive, the problems should be minimal. Any intensive development proposals, however, should be accompanied by strict erosion control measures and, where possible, runoff control measures.

Increased storm water can be managed by various methods, depending upon the site. Tables 7-1 and 7-2 found on page 7-2 to 7-4 of Urban Hydrology for Small Watersheds, USDA, Soil Conservation Service, January 1973 lists many methods for controlling peak discharges from urbanization.

A Storm Water Management regulation, properly implemented, can be very beneficial to the health of streams and lakes.

4. Land Use Planning

The development of a comprehensive town-wide or watershed plan would be highly desirable. Comprehensive plans for future development should address all existing and proposed land uses. It should start with identifying critical natural resource areas such as areas desired or best used for agriculture, forest, wetlands preservation, streambelts, water supply (aquifers), and recreation. What is left is where urban development should logically take place. Following the preparation of a "plan", implementation policies and programs should be arrived at and followed.

There are a number of agencies or organizations offering technical assistance in town planning. These include:

Litchfield County Conservation District
Northwestern Ct. Regional Planning Agency
Private consultants
Ct. Department of Health

VIII. LAKE FEATURES AND MANAGEMENT ALTERNATIVES

A. LAKE FEATURES

Mudge Pond has the following characteristics:

a. surface area - 201 acres

b. mean depth - 22 feet

c. volume - 192,600,000 cubic feet (2)
5,450,000 cubic meters (2)

d. retention time - 135 days

e. bottom characteristics - mud and swampy ooze (1)

f. general water quality - late mesotrophic state based on 1973 and 1974 water quality data developed by Connecticut Agricultural Experiment Station; measured transparency, chlorophyll a, phosphorus, nitrogen, temperature, dissolved oxygen (2). "The water is hard and the fertility level is average for the region....Emergent vegetation is abundant in the shallows... Submerged vegetation is abundant in most areas where the depth is 10 feet or less" based on observation made in the 1950's (2)

g. watershed area - 11.5 square miles (1)
Lake Wononpakook subwatershed - 4.34 square miles (1)

Mudge Pond and its tributary waters are Class A waters which do not receive point source discharges of wastewater (3). Enrichment of lake waters is the result of watershed contributions from nonpoint sources. Lake Wononpakook serves to reduce nutrient input to Mudge Pond (4). Fertility and productivity (algae and weeds) is above average and has been for many years (1).

Mudge Pond has a ranking of 24 on DEP's priority system for lakes management grants under Section 314 of the Federal Clean Water Act (P.L. 95-217) (5). Funding for this program has been discontinued however.

B. LAKE MANAGEMENT AND WATER QUALITY CONSIDERATIONS

1. Direct lake use.

Motor boats - Engine exhaust under normal recreational use levels causes no discernable effects of a permanent nature on water quality, aquatic biology, or sediment chemistry (6). Oil slicks may be an aesthetic problem in local areas. Prop wash may suspend bottom sediments, causing temporary turbidity increases which may be aesthetically unpleasant.

2. Eutrophication and Lake Managment

Eutrophication is the natural process of lake aging by nutrient enrichment. As a lake eutrophies, many water quality changes occur. Fertility increases and macrophyte (weed) beds become denser and more extensive. Algae blooms occur more frequently and water clarity decreases. Organic matter accumulates on the lake bottom from decaying plants and animals. The lake gradually fills in. Decomposition of lake bottom material reduces oxygen levels in the bottom waters. In general, as these changes occur, recreation opportunities decline.

The eutrophication process can be accelerated by man's activities in the lake watershed which increase nutrient inputs to the lake (4). Undisturbed woodland contributes lower nutrient loads to a lake than other land uses. The nutrient loading from agricultural land is approximately five times greater than woodland. Residential and commercial land contributes 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.

Mudge Pond is presently in an advanced state of eutrophication. Algae blooms and weed beds have diminished recreation opportunities to some degree for many years. Additional land development in the watershed will serve to worsen these conditions. It is feasible for local agencies to develop and implement watershed management practices to mitigate the effects of land use changes in the watershed. Appropriate practices are described in Section VI, VII, and IX of this report, and in other Connecticut lake watershed studies (9, 10).

Management of algae blooms and macrophyte beds in the pond may be necessary as an adjunct to watershed management in order to improve recreation opportunities. Methods for controlling algae blooms include algicide treatments, artificial aeration, chemical precipitation, and hypolimnetic withdrawal. Each of these is described below.

Algicide treatments are commonly conducted in Connecticut lakes to provide temporary, cosmetic relief from nuisance algae blooms. This method does not correct the source of the problem--nutrient enrichment--and usually needs to be repeated annually. One treatment at Mudge Pond would cost approximately $1,000. A DEP pesticides permit must be obtained prior to each treatment. The permit specifies treatment conditions which will protect aquatic life and recreation activities.

Artificial aeration is a high cost method which is employed to increase oxygen levels in a lake's water column to prevent anoxic recycle of plant nutrients from the lake sediments. This method would not be appropriate for Mudge Pond since the lake apparently does not establish anoxic conditions which cause significant nutrient recycle (2).

Chemical precipitation of nutrients is an experimental approach which utilizes metals, usually aluminum, to precipitate soluble phosphorus from lake waters. This method is most effective when a significant fraction of phosphorus occurs as soluble forms which can be removed from the water column. It is also most effective when a lake has a hydraulic residence time of several years, so that treated water is not rapidly replaced with untreated, enriched water. Mudge Pond is not a good candidate for chemical precipitation since only a small fraction of phosphorus at spring overturn is soluble phosphorus (2). Also, since the pond flushes three times a year, one treatment would not provide benefits for much more than one summer season.

Hypolimnetic withdrawal is a high cost, experimental method which may provide relief from algae blooms in lakes where nutrients recycled from sediments contribute to algae blooms. More research on this method, and more detailed water chemistry information for Mudge Pond, would need to be developed in order to evaluate its applicability. However, available water chemistry data indicates that recycle of sediment nutrients is not a major factor in the enrichment of surface waters in Mudge Pond (2).

It is apparent from this cursory discussion of alternatives that treatment with an algicide is the only phytoplankton management alternative which will provide effective relief at a reasonable cost at this time.

Methods which are commonly considered for control of macrophytes include overwinter drawdown, herbicides, harvesting, and dredging. Overwinter drawdown involves lowering the lake level for several weeks to expose plants to dessication and freezing. This is a low cost alternative where feasible since drawdown requires negligible labor and no equipment or chemicals. Some species are resistant to this method, but excellent control of Myriophyllum and other species has been achieved in Connecticut. The feasibility of this method depends on an evaluation of several factors, including the presence and condition of drawdown facilities, stresses on lake fisheries, lake refill rate, potential for downstream flooding during drawdown, and potential hydraulic effects on well water levels along the lake shore. The dam at Mudge Pond does not have gates which allow for control of the pond's water level; however siphoning or pumping may be feasible.

In comparison to drawdown, other macrophyte control methods have higher costs but more predictable success. Herbicides provide for effective control of macrophytes by killing plants in local areas of application. The effects are cosmetic and temporary, and repeated treatments on an annual basis would be required to maintain control. Treatment of water-milfoil with Diquat would require the application of two gallons per acre, with a present chemical cost of approximately $100 per acre. A DEP pesticides permit must be obtained prior to each treatment. The permit specifies treatment conditions which will protect aquatic life and recreation activities.

Harvesting is a method which physically removes plants from the lake with specialized barges equipped with harvesting machinery. This is a cosmetic method which needs to be repeated when macrophyte beds recover from cutting. Recent harvesting experiences in Connecticut indicate that costs can exceed $250 per acre for one cutting.

Dredging is a high cost "last resort" method which is considered for recreational lakes with severe macrophyte problems. The objective is to eliminate macrophyte habitat by removing sediment and increasing water depth. This is accomplished by either drawdown and excavation, or hydraulic dredging. A recent drawdown and excavation project in Connecticut conducted with town resources incurred a cost of approximately $1.75 per cubic yard, or $4,000 per acre. A hydraulic dredging project being planned for another Connecticut lake has an estimated cost of $3.00 per cubic yard, or $15,000 per acre. Long term control of macrophytes is a benefit of dredging which is not obtained by other methods.

References for additional lake management information include references 7, 8, 9 and 10 in the Appendix of this report. The "Lake Unit" of DEP is also available to provide assistance at 566-2588.

IX. ADDITIONAL WATER QUALITY CONSIDERATIONS

A. SEPTIC SYSTEMS

Septic systems are certain to be the most widespread sources of artificial discharge to the groundwater in the watershed. The characteristics of different soil groups make them variably suitable for septic systems. Many soil limitations can be overcome by suitable engineering practices while other limitations may have no satisfactory solution. A shallow depth to bedrock, for instance, may be overcome in some cases by placement of fill over the natural soil. The limitations of a deep peat-and-muck soil, on the other hand, may be effectively insoluble. Of course, even soil with limitations that can be "engineered around" should not be treated as automatically appropriate for development. In many instances, poor design of rectifying measures or poor implementation of a good design may leave the soil conditions as bad as or worse than they were initially. For example, it is easy to claim that a shallow depth to bedrock may be overcome by the use of fill; however, the fill must have appropriate textural characteristics and must be placed in such a way that wastewater won't leak out at the base of the fill before it has been adequately renovated. In order to protect groundwater quality in marginal soil areas, town officials and landowners must carefully monitor the implementation of proposed engineering measures.

Residential development around the Mudge Pond shore is relatively light with the exception of a former cottage community located at the pond outlet in the southeast section. Many of these small former cottage units have been converted to year-round use on undersized lots which are marginally suited for sewage disposal purposes. Drainage on the privately owned roadways is extremely poor and seasonally high ground water undoubtedly floods many of the existing sewage disposal systems during the wet times of the year. This residential development undoubtedly represents the greatest threat of direct pollution from development adjacent to the pond. Inadequately sized sewage disposal systems most likely overflow to road drainage ditches during wet periods of the year and discharge to the pond.

A second main source of sewage generated by development adjacent to the pond is Camp Easton located along the easterly shore. A review of annual inspections performed by State Health Department staff as part of the State camp licensing program has not identified any probable sources of pollution to Mudge Pond from this facility. Peak usage of camps in general occurs during the dry times of the year, which permits maximum absorption by the soils. The camp buildings and sewage disposal systems are not located adjacent to the pond and that further minimizes the possibility of polluting the pond.

A review of the soils in the Mudge Pond watershed indicates that a large majority of well drained soils are present which are favorable for on-site disposal. The Amenia, Farmington, and Stockbridge series of moderately to well drained soils occupy a large percentage of the watershed. The Indian Mountain and Red Mountain sections of the watershed are underlain by bedrock at relatively shallow depths and therefore are less suitable for on-site sewage disposal. Based upon this general soil information, it does appear feasible to develop a large portion of the subject watershed for residential use. Many of the soil types identified would permit development of on-site private water supplies and subsurface sewage disposal systems on minimum one acre lots without adversely affecting ground or surface water systems.

Residential development within the Salisbury watershed tributary to Mudge Pond is relatively sparse and would not be considered a major threat to water pollution. Subsurface sewage disposal systems serving Camp Sloane in Salisbury appear to be working satisfactorily and the recent addition to the sewage disposal system serving the Interlaken Inn has abated previous sewage discharges.

Subsurface sewage disposal systems serving single family residences do discharge small quantities of phosphates and nitrogen in addition to bacteria. Sewage disposal systems constructed in strict compliance with Public Health Code requirements would not significantly affect ground water quality considering the relatively good renovative capacities of the major soil types. With careful application of existing planning and conservation commission regulations combined with strict enforcement of public health code regulations, land development may be permitted within the watershed without environmental harm. A heavy emphasis should be placed on soil testing within properties to be developed in order to assure individual lots can adequately disperse projected sewage flows. Qualified health department staff should serve in an advisory role to local planning and zoning commissions. Reports of soil observations, subdivision feasibility, storm drainage, erosion control, private water supply development and other items should be available to commission members prior to making any decision. The critical concerns of environmental protection, public sewer avoidance programs and protection of public health are best served by land use planning and zoning which allows long term effective on-site sewage disposal without endangering the subsurface or surface ground waters which also supply potable water.

The concept of cluster zoning with respect to sewage disposal may be desirable when favorable soil conditions exist. Development of properties with cluster zoning and/or community sewage disposal systems tends to concentrate residential development to a smaller area within the subject parcel. If these development concepts were incorporated in town planning and zoning regulations, some method of determining maximum development density per acre should be determined. Use of cluster zoning and community sewage disposal systems could be considered a developer's option with the provision that housing unit density does not exceed the number of individual dwelling units permitted by existing single lot subdivision regulations.

A major concern of this study was focused on the prevention of ground and surface water pollution by all aspects of property development including siltation and subsurface sewage disposal systems. A major effort should be made by the Town of Sharon to assure well trained individuals are available to witness all soil testing and provide valuable feedback to town planning and zoning commissions prior to the approval of property development. Typically, local health department staff have provided these essential services and follow through with all property construction in order to assure compliance with Public Health Code regulations. Some towns have adopted more stringent health code regulations in an attempt to further reduce the chance of pollutions. The experience of the State Health Department has shown that strict enforcement of existing regulations produces more positive results than adoption of more stringent regulations without qualified personnel backup. Hiring of well trained registered sanitarians to provide full time coverage for small communities is sometimes too expensive for municipalities. The formation of public health districts in compliance with State Statutes may relieve some of the financial burdens in providing full time coverage by well trained professional staff. Rather than adopting more stringtent health regulations at this time, the State Health Department would recommend the hiring of competent health department staff to provide not only the day by day services required by local residents, but to serve as technical advisors to the planning, zoning, inlands wetlands, and town engineering offices on all matters concerning property development and environmental protection. The additional expenses incurred by providing this professional service can be realized in the forthcoming years by precluding expansion of extensive municipal public sewerage systems to those areas of the town which were developed with little concern for sewage disposal and ground water protection.

To conclude, based upon the ERT's review of data available, it is highly doubtful that existing subsurface sewage disposal systems within the watershed are degrading surface and subsurface water quality significantly. It is suspected that the existing systems have little effect upon aquatic weed and algae growth in Mudge Pond. A more critical factor would likely be the large farming industry within the watershed, or other residentially related contributors such as fertilizers, detergents, or dog manure. The relatively steep slopes indicated on U.S.G.S. maps also cause rapid runoff of surface flows which in turn create erosion and siltation problems. (See Section VII of this report.)

B. TRANSPORTATION-RELATED ACTIVITIES

Transportation-related activities may be a source of substantial groundwater or surface-water pollution in some areas. Road salts may be a particularly nettlesome contaminant. However, the Mudge Pond watershed seems relatively safe from serious salt pollution. No salt-storage piles are located within the watershed. In addition, both Sharon and Salisbury appear to use a relatively small amount of salt on their roads in winter. A U.S. Geological Survey report (Map MF-981-A) showed that during the winter of 1976-1977, road salt usage in Connecticut ranged from a low of 0.6 tons per mile of road (towns of Guilford and Goshen) to a high of 23.1 tons per mile (Town of Norwich). Sharon used 2.4 tons per mile, and Salisbury used 2.3 tons per mile. Only 16 of Connecticut's 169 towns used less. Still, the Town of Sharon could further minimize the risk of salt contamination in Mudge Pond by restricting or eliminating the use of salt on the road that follows the pond's western shore (Mudge Pond Road).

Other potential transportation-related pollutants include sand, road oils, and spilled fuels or other materials. There is little that can be done to avoid an occasional accidental spill, but unless the spill is substantial and the clean-up operation slow, it is unlikely that serious long term damage will be done. However, town officials should be judicious with regard to the application of road oils and sands, especially in the vicinity of streams or other surface waters.

C. AGRICULTURAL LANDS

Conservation practices which should be considered for agricultural lands in the watershed are discussed in Section VII of this report.

D. EROSION, SEDIMENTATION, AND RUNOFF

These items are also discussed in Section VII of this report.

E. 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, of if fertilizers are applied prior to storm events which cause significant runoff. These situations can be avoided if fertilizer applications are matched to soil requirements, and if fertilizer applications are timed to avoid periods of runoff.

X. FURTHER PLANNING CONSIDERATIONS

During the ERT's field review it became evident that there is a great concern among townspeople for maintaining the scenic rural character of the watershed. This concern includes not only water quality but visual quality. It is recommended that this concern be recognized through the formation of a permanent group of concerned citizens. The goal of such an organization could be four-fold.

1) Maintain or improve water quality in watershed.

2) Preserve scenic views.

3) Preserve prime farm land and insure that farm practices do not significantly impair water quality.

4) Assist those property owners interested in developing their land in finding technical assistance to allow property development while furthering goals 1-3 above.

In furthering the above goals the following concepts are important. Many of these ideas are expressed in: "A Preservation and Conservation Study/ Northwestern Connecticut Regional Planning Agency" prepared by J. Dougherty, M. Everett, and T. McGowan.

A. PROTECTION OF FARMLAND

The ideal goal of farmland preservation should be the protection of all prime agricultural lands as identified by the U.S.D.A. Soil Conservation Service from development. However the protection of all lands may not be feasible. An alternative to protecting all lands is the protection of those prime agricultural lands which are: 1) still under cultivation, 2) meadows, or 3) fields recently abandoned which have not yet reverted back to forest.

The State of Connecticut since 1978 has been engaged in the preservation of farm land through the purchase of development rights from farmers. While the concept of this program is excellent, lack of sufficient funds has, in part, prevented the implementation of this program on a wide scale. There are other options which may be available to help protect farm land. They are: 1) Acquisition of land by a foundation or land trust who, in turn, can lease the land to a farmer; 2) Acquisition of land by the town who in turn can lease it to a farmer; 3) Transfer of the development rights from the farm land to another area in town such as Sharon Center. Land receiving development rights would be allowed to be developed at densities higher than normally allowed. Sharon Center is recommended as a receiver area for development rights because existing water and sewer lines would permit higher densities without the limitations of on-site wells and septic systems; and 4) Preservation through clustering of homes on non-prime agricultural land.

B. SCENIC ROADS

A town's road network plays a significant role in shaping its image. Land that is not within 500 to 1,000 feet of a road is generally less likely to be developed than land alongside an existing road, especially in a rural area. The quality of development alongside the road corridors, therefore, to a large extent determines the character of an area. Any construction in this area tends to be very visible and if not in keeping with existing development it will be intrusive unless adequately buffered. It should be remembered that a landscape of varied topography will accept significantly more development without significant visual change than will a landscape that is flat, open and extensive.

A combination of innovative regulation techniques and a private conservation program could succeed in protecting the scenic roads and related views. Because visual boundaries are often extensive, controls that will preserve scenic roads and panoramic views are difficult to establish and enforce. However, it is recommmended that special emphasis be directed towards preserving existing high quality scenic views and roads especially through the use of such techniques as conservation or scenic easements and purchase of development rights. Zoning regulations along scenic roads are another possibility. The following are examples of regulations which can be adopted to preserve scenic roads:

- ordinances controlling driveway access to the road
- design standards for new roads to limit overbuilding of local roads, and to protect the dedicated right-of-way
- reduction or elimination of through truck traffic
- parking area limitations, especially on-street parking
- procedures for preserving dirt roads including special road surface treatments

- replacement of off-premise outdoor advertising with directional signs such as implemented in Vermont
- protection of tall trees from cutting by utility and highway maintenance crews
- regulating building height
- setback regulations for fences and structures from the roads
- reduce traffic demand by zoning for low density development
- restricting the moving or removal of stone walls adjacent to the road

The impact of a scenic overlook preserved for future generations may well add more to a town's open space character than will the purchase of large acreage.

In portions of the watershed where forested land is near the highways it is worthwhile to evaluate how new individual lots and homes will fit into the landscape along a road. New houses are sited either within full view of the road (suburban model) or behind a vegetative buffer (rural model). If the rural wooded consistency of the area is desirable, then the suburban model is inappropriate. This suggests that all new residential construction be required to conform to certain performance standards that insure the retention of rural roadside vegetation.

Another suggestion concerns the traditional practice of permitting numerous lots along state highways. Over time, this practice will have the result of reducing the traffic carrying capacity of the road causing it to be widened or even replaced. For immediate safety reasons and in the long run to preserve the region's scenic quality, individual lot development along state roads should occur at a depth from the road and the driveway intersection should be located widely separated from sharp curves, hills and neighboring driveways. Also, subdivision lots should, for safety reasons, be located on a new road rather than along state road frontage. Preserving traffic volume capacity of the state roads will produce long range scenic and safety benefits for the town.

D. HILLSIDE AND RIDGETOP DEVELOPMENT

Incompatibility between new development and existing landscape patterns is of particular concern on accessible open ridges and hillsides. These sites command dramatic views which are especially attractive to the land developer. Development of these areas may, however, mar the view from other places. Emphasis should be placed upon the preservation of scenic vistas and views where possible to protect the character of the watershed.

E. LAND USE TRENDS AND PATTERNS

The minimum lot size under existing zoning regulations in both Sharon and Salisbury is two acres. Salisbury permits a reduction of lot size to one acre in cases where favorable soil conditions exists.

Development within the Mudge Pond Watershed has followed the pattern typical in a rural area. Residences exist and have been built along existing roads. This is particularly true along Routes 41, 112, 44 and Indian Mountain Road. A notable exception is the former bungalow colony on the southeastern shore of

Mudge Pond known as Silver Lake Shores. This development, while proximate to the pond is isolated from any major road.

It is anticipated that development will continue to follow this same general pattern. Pressures of development should continue to be high as the Lakeville Center and Sharon Centers continue their growth towards one another. Evidence of this growth pattern is seen in the development that has spread north from the historic center of Sharon along Route 41 towards Lakeville.

A large number of parcels in public or semi-public ownership are present in the watershed. These parcels include: Beeslick Preserve of the Nature Conservancy, Hotchkiss School, Indian Mountain School, Camp Sloane (operated by the YMCA), Silver Lake Conference Center run by the United Church of Christ, and the Salisbury town land on the site of the former camp, The Cedars. These parcels may or may not be subject to future development.

Population projections by the State Office of Policy and Management indicate that through the year 2000, Sharon's population will increase roughly 1% every 5 years. The Mudge Pond Watershed can be expected to absorb a portion of this growth.

XI. CONCLUSION

The foregoing inventory and analysis indicates that many factors may be contributing to the weed and algae problem at Mudge Pond. In the opinion of the Team's ecologist, local efforts should be directed to correcting the apparent non-point sources of pollution within the watershed (identified in text). It appears that even with the best watershed management, however, "in-lake" treatment measures will be needed to ensure the recreational use of Mudge Pond. Chemical treatment appears to be the only suitable alternative for controlling the algae blooms in the lake; weed harvesting and perhaps over-winter drawdown appear to be the best alternatives for controlling the growth of macrophytes (weeds). Weed harvesting and algicide treatment do not have to be done throughout the lake; they can be restricted to "hot spots" where the problem is particularly severe and noticeable (e.g. high use areas such as the town beach).

Local people are encouraged to establish a mechanism for monitoring lake water quality, encouraging appropriate watershed management measures, and funding needed lake treatment measures. While these measures cannot be expected to create a "pristine" Mudge Pond, they will help improve the environmental health and recreational use potential of the Pond.

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XII. APPENDIX

REFERENCES

(1) A Fishery Survey of the Lakes and Ponds of Connecticut, State Board of Fisheries and Game, 1959.

(2) Inventory of the Trophic Classifications of Seventy Connecticut Lakes, Connecticut DEP Water Compliance Unit, 1980.

(3) Connecticut Water Quality Standards and Criteria Connecticut DEP Water Compliance Unit, 1980

(4) Norvell et al "Phosphorus in Connecticut Lakes Predicted by Land Use", Applied Biology, Vol. 76, No. 41, November 1979.

(5) Lake Priority Ranking, Connecticut DEP, November 1980

(6) Effects of Exhaust from Two-Cycle Outboard Engines, Rensselear Polytechnic Institute, July 1974

(7) Lake Restoration - Proceedings of a National Conference USEPA, March 1979 (EPA 440/5 - 79 - 001)

(8) Restoration of Lakes and Inland Waters, USEPA, December 1980 (EPA 440/5-81/010)

(9) Phase I Diagnostic Feasibility Study Middle and Lower Bolton Lakes, DEP Water Compliance Unit, 1979.

(10) Lake Waramaug Watershed Management Plan, Lake Waramaug Task Force and Northwestern Connecticut Regional Planning Agency, 1978.

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 industrial 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.