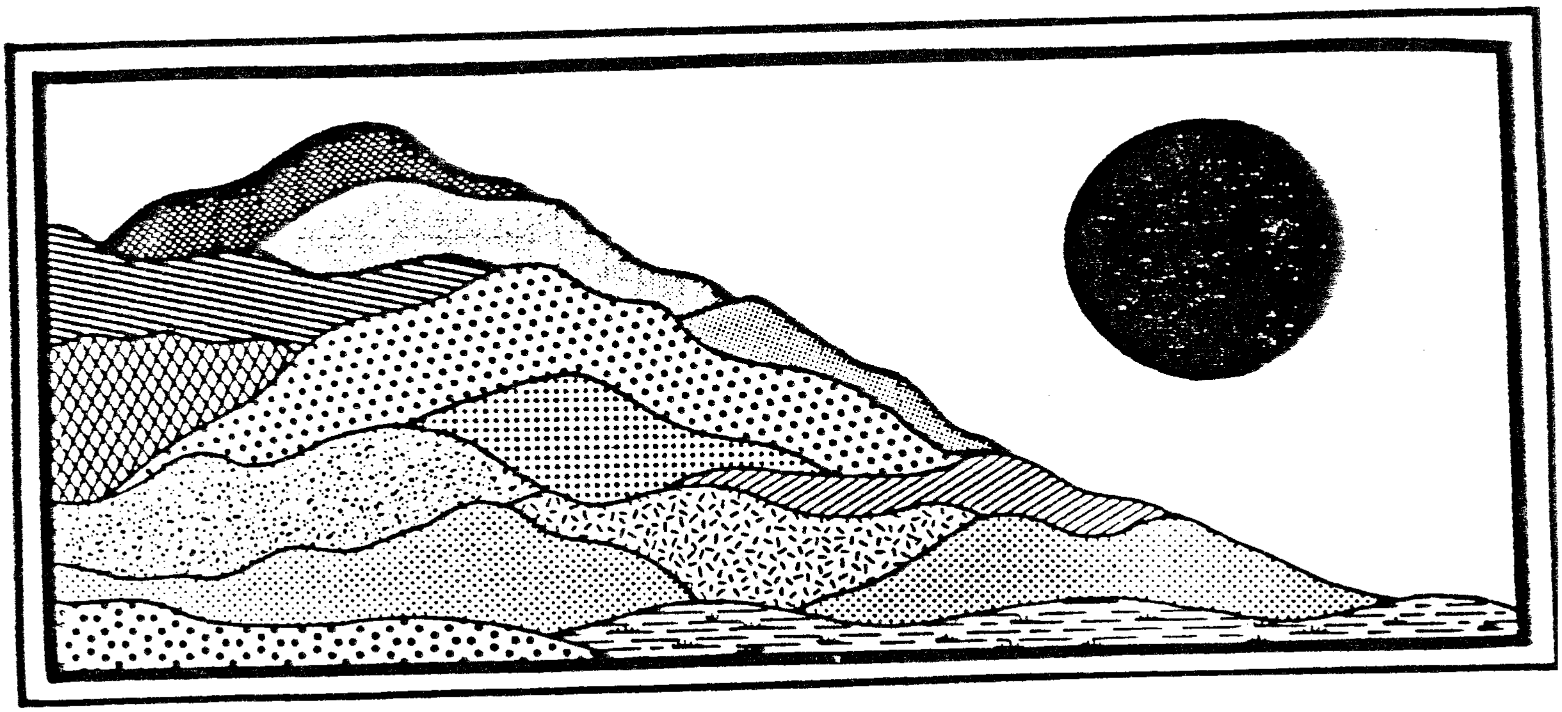
Andover Lake

Andover, Connecticut

September 1986



ENVIRONMENTAL REVIEW TEAM REPORT

EASTERN CONNECTICUT RESOURCE CONSERVATION AND DEVELOPMENT AREA, INC.

Andover Lake

Andover, Connecticut

Review Date: JULY 22, 1986

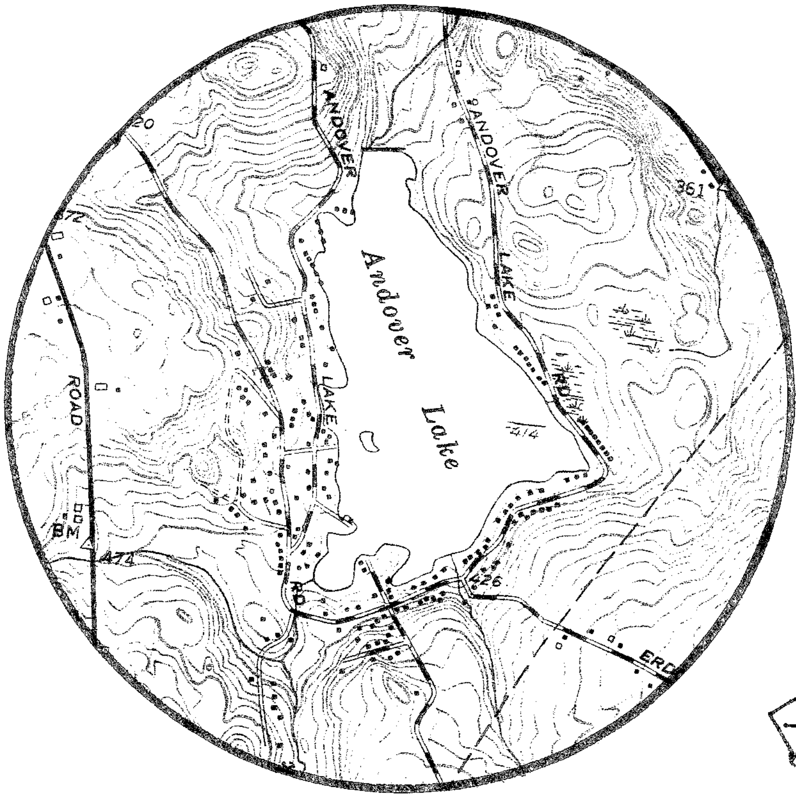
Report Date: SEPTEMBER 1986

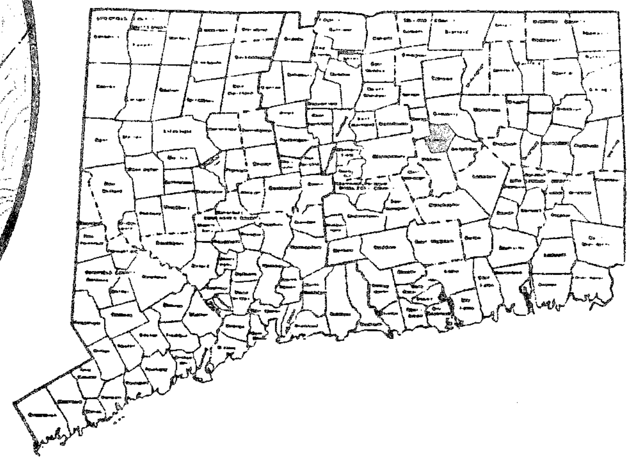
ENVIRONMENTAL REVIEW TEAM
PO BOX 198
BROOKLYN, CONNECTICUT 06234

Site Location

ANDOVER LAKE & IT'S WATERSHED

ANDOVER, CONNECTICUT





EASTERN CONNECTICUT

RESOURCE CONSERVATION

& DEVELOPMENT AREA

ENVIRONMENTAL REVIEW TEAM REPORT
ON
ANDOVER LAKE AND IT'S WATERSHED
ANDOVER, CONNECTICUT

THIS REPORT IS AN OUTGROWTH OF A REQUEST FROM ANDOVER PLANNING AND ZONING COMMISSION TO THE TOLLAND COUNTY SOIL AND WATER CONSERVATION DISTRICT (S&WCD). THE S&WCD REFERRED THIS REQUEST TO THE EASTERN CONNECTICUT RESOURCE CONSERVATION AND DEVELOPMENT (RC&D) AREA EXECUTIVE COMMITTEE FOR THEIR CONSIDERATION AND APPROVAL. THE REQUEST WAS APPROVED AND THE MEASURE REVIEWED BY THE EASTERN CONNECTICUT ENVIRONMENTAL REVIEW TEAM (ERT).

THE ERT MET AND FIELD CHECKED THE SITE ON JULY 22, 1986, TUESDAY. TEAM MEMBERS PARTICIPATING ON THIS REVIEW INCLUDED:

NANCY MARIN	--SR. ENVIRONMENTAL ANALYST -- DEP, LAKES MANAGEMENT UNIT
JOE NEAFSEY	--DISTRICT CONSERVATIONIST -- U.S.D.A., SOIL CONSERVATION SERVICE
JAMES PARDA	--FORESTER - CONNECTICUT DEPARTMENT OF ENVIRONMENTAL PROTECTION
ALFRED ROBERTS	--SOIL RESOURCE SPECIALIST - U.S.D.A., SOIL CONSERVATION SERVICE
ERIC SCHLUNTZ	--FISHERIES BIOLOGIST - CONNECTICUT DEPARTMENT OF ENVIRONMENTAL PROTECTION
ELAINE SYCH	--ERT COORDINATOR - EASTERN CONNECTICUT RC & D AREA
BILL WARZECHA	--GEOLOGIST - DEP, NATURAL RESOURCES CENTER

PRIOR TO THE REVIEW DAY, EACH TEAM MEMBER RECEIVED A SUMMARY OF THE PROPOSED PROJECT, A LIST OF THE TOWN'S CONCERNS, A TOPOGRAPHIC MAP, A SOILS MAP AND A LAKE DESCRIPTION SHEET FROM A FISHERY SURVEY. THE TEAM MET WITH, AND WERE ACCOMPANIED BY THE CHAIRMAN OF THE PLANNING AND ZONING COMMISSION. FOLLOWING THE REVIEW, REPORTS FROM EACH TEAM MEMBER WERE SUBMITTED TO THE ERT COORDINATOR FOR COMPILATION AND EDITING INTO THIS FINAL REPORT.

THIS REPORT REPRESENTS THE TEAM'S FINDINGS. IT IS NOT MEANT TO COMPETE WITH PRIVATE CONSULTANTS BY PROVIDING SITE DESIGNS OR DETAILED SOLUTIONS TO DEVELOPMENT PROBLEMS. THE TEAM DOES NOT RECOMMEND WHAT FINAL ACTION SHOULD BE TAKEN ON A PROPOSED PROJECT -- ALL FINAL DECISIONS AND CONCLUSIONS REST WITH THE TOWN AND LANDOWNER. THIS REPORT IDENTIFIES THE EXISTING RESOURCE BASE AND EVALUATES ITS SIGNIFICANCE TO THE PROPOSED DEVELOPMENT, AND ALSO SUGGESTS CONSIDERATIONS THAT SHOULD BE OF CONCERN TO THE DEVELOPER AND THE TOWN. THE RESULTS OF THIS TEAM ACTION ARE ORIENTED TOWARD THE DEVELOPMENT OF BETTER ENVIRONMENTAL QUALITY AND THE LONG-TERM ECONOMICS OF LAND USE.

THE EASTERN CONNECTICUT RC & D EXECUTIVE COMMITTEE HOPES YOU WILL FIND THIS REPORT OF VALUE AND ASSISTANCE IN MAKING YOUR DECISIONS ON THIS LAKE AND IT'S SURROUNDING WATERSHED.

IF YOU REQUIRE ANY ADDITIONAL INFORMATION, PLEASE CONTACT:

ELAINE A. SYCH
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EASTERN CONNECTICUT RC&D AREA
P. O. BOX 198
BROOKLYN, CT 06234
(203) 774-1253

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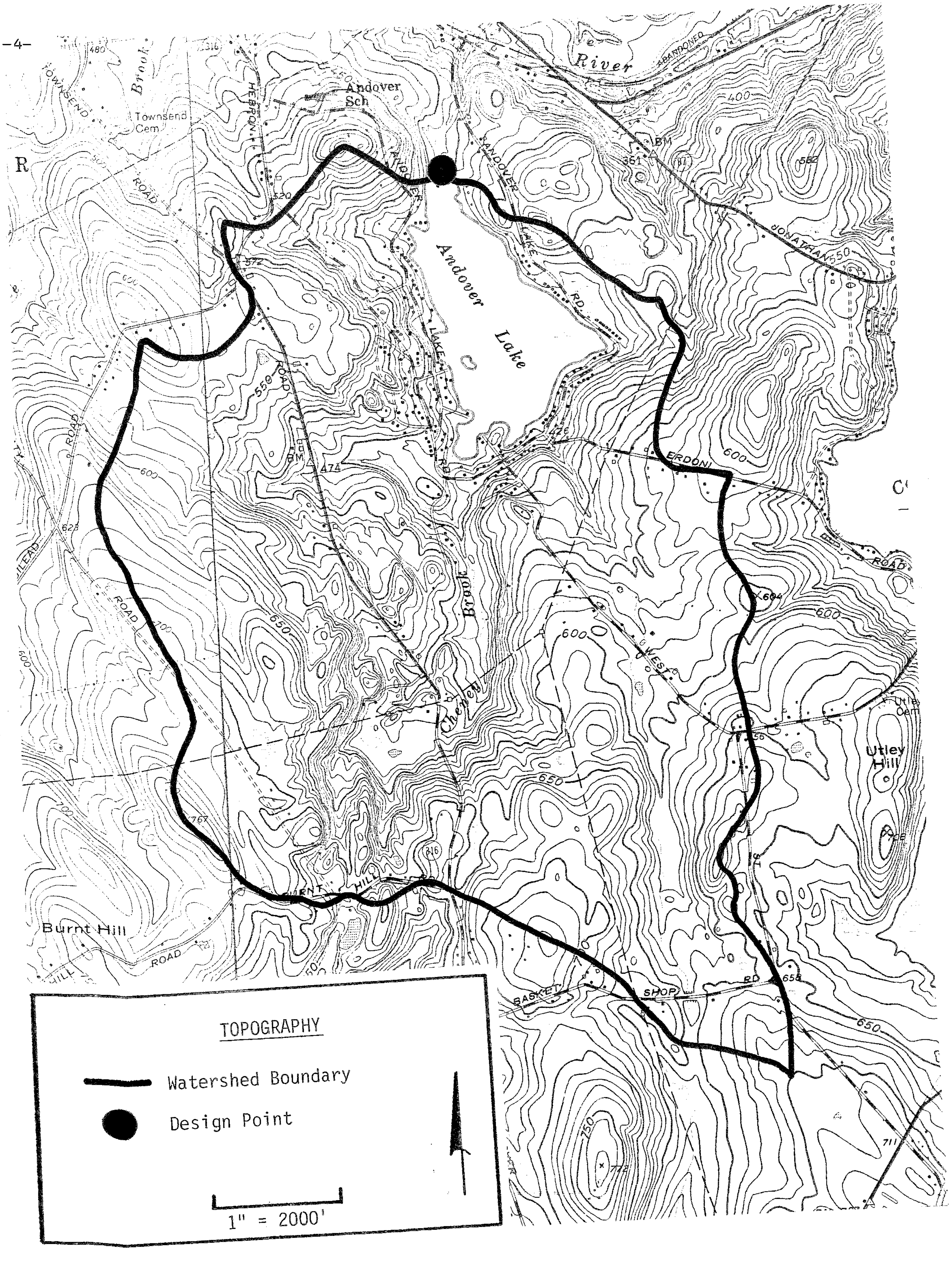
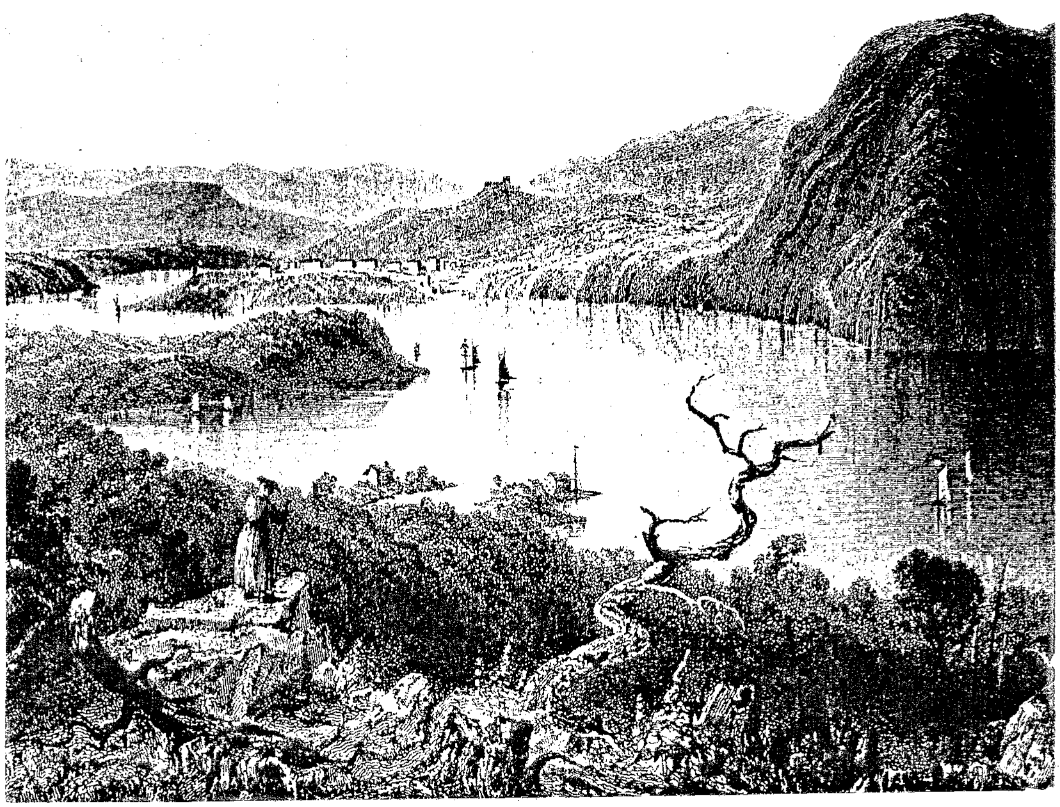
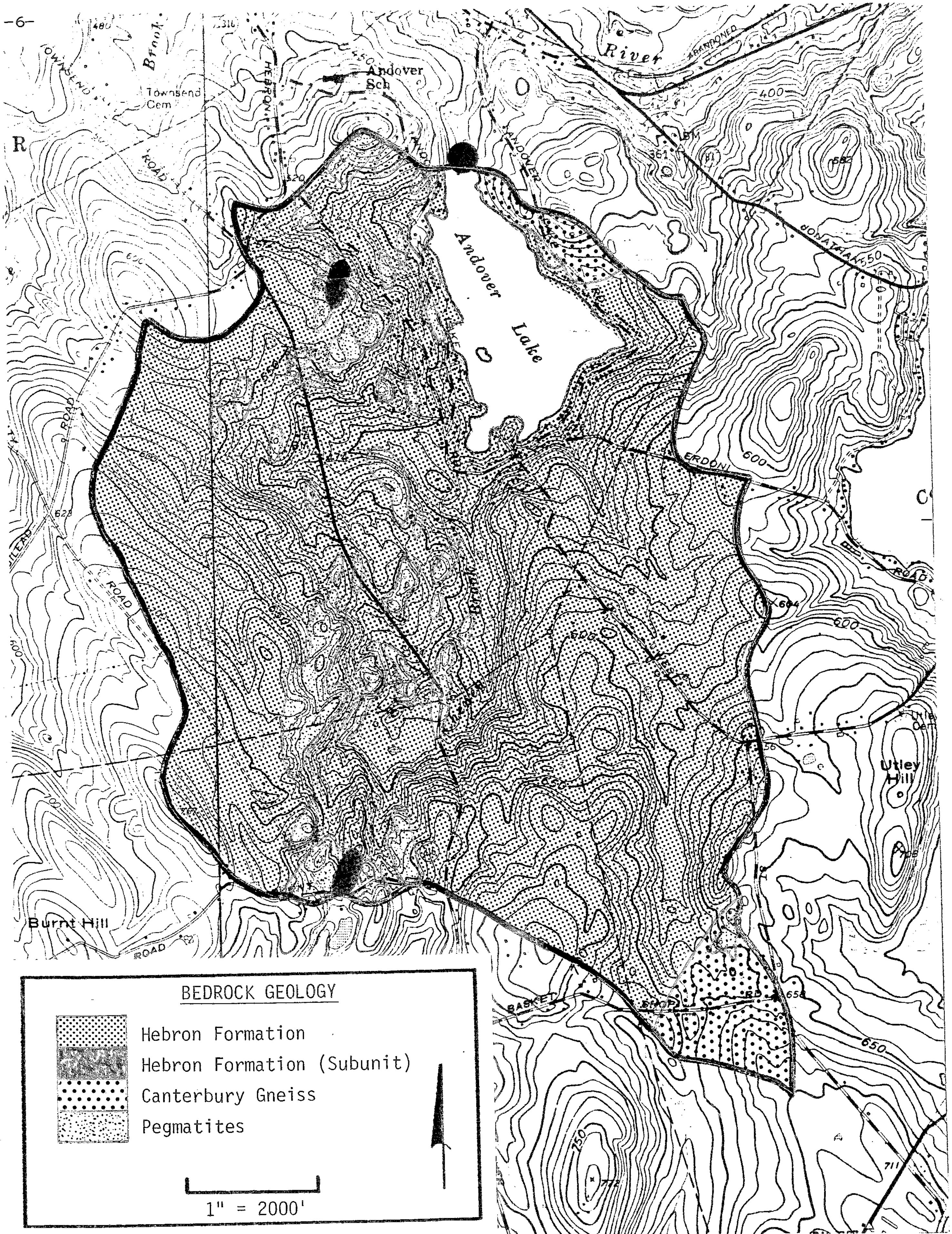

TOPOGRAPHY
Watershed Boundary
Design Point
1" = 2000'
Andover Lake
River
Andover Sch
Townsend Cem
Brook
Cheney Brook
Burnt Hill
Utley Hill
HEBRON
ANDOVER LAKE RD.
LAKE ROAD
JONATHAN
WEST ST.
BASKET SHOP RD
BURNT HILL RD
ABANDONED

INTRODUCTION

THE EASTERN CONNECTICUT ENVIRONMENTAL REVIEW TEAM WAS ASKED TO PREPARE A NATURAL RESOURCE INVENTORY AND EVALUATION OF ANDOVER LAKE AND IT'S WATERSHED. THE TOWN IS INTERESTED IN THE MANAGEMENT OF THE WATERSHED FOR FUTURE PLANNING, AND TO IMPROVE AND INSURE THE QUALITY OF THE ENVIRONMENT OF THE LAKE AND THE SURROUNDING AREA.

THE FOLLOWING SECTIONS OF THIS REPORT COVER THE NATURAL RESOURCE BASE OF THE WATERSHED AND LAKE AREA IN DETAIL. MANAGEMENT TECHNIQUES ARE INCLUDED IN THE APPROPRIATE SECTIONS. THE SUMMARY HIGHLIGHTS VERY BRIEFLY THE MAJOR CONCERNS AND RECOMMENDATIONS OF THE TEAM. THE APPENDIX CONTAINS SEVERAL USEFUL PUBLICATIONS.





Adapted from George Snyder's Bedrock Geologic Map for the Columbia Quad. (GQ -592)

I. TOPOGRAPHY

ANDOVER LAKE IS A RELATIVELY SHALLOW, PRIVATELY CONTROLLED ARTIFICIAL BODY OF WATER LOCATED IN THE SOUTHEASTERN CORNER OF TOWN. THE LAKE HAS A SURFACE AREA OF 155.4 ACRES, A MAXIMUM DEPTH OF 16 FEET AND AN AVERAGE DEPTH OF 10.9 FEET.

THE TERRAIN THROUGHOUT MOST OF THE LAKES' WATERSHED RANGES FROM MODERATE TO VERY STEEP. THERE ARE ALSO A FEW FLAT TOPPED HILLS IN THE WATERSHED. THE TOPOGRAPHY IN THE WATERSHED IS CONTROLLED MAINLY BY THE UNDERLYING BEDROCK. A NORTH-SOUTH TRENDING BELT OF ROCK OUTCROPS, AND THIN SOILS CHARACTERIZE THE WESTCENTRAL PARTS OF THE WATERSHED. MAXIMUM AND MINIMUM ELEVATIONS IN THE WATERSHED ARE 767 FEET AND 410 FEET ABOVE MEAN SEA LEVEL, RESPECTIVELY.

ANDOVER LAKE IS FED PRIMARILY BY TWO (2) NORTH FLOWING STREAMS, CHENEY BROOK AND AN UNNAMED STREAM, WHICH GENERALLY PARALLELS CHENEY BROOK.

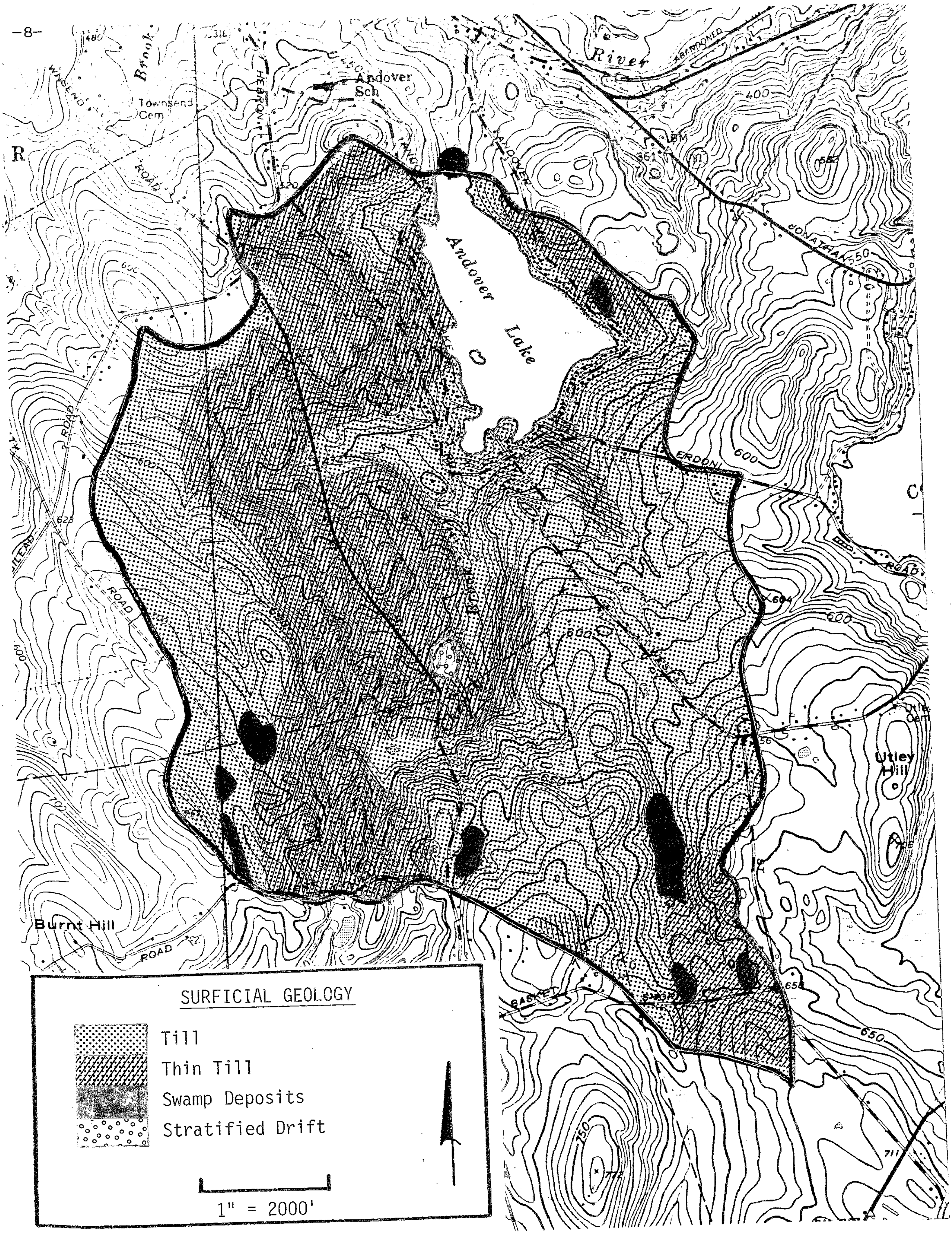
II. GEOLOGY

THE BEDROCK GEOLOGY OF THE COLUMBIA TOPOGRAPHIC QUADRANGLE WHICH ENCOMPASSES MOST OF THE WATERSHED WAS MAPPED BY GEORGE SNYDER IN 1959-61. THE U. S. GEOLOGICAL SURVEY PUBLISHED THE REPORT IN 1967. AN ACCOMPANYING BEDROCK GEOLOGIC MAP OF THE ANDOVER LAKE WATERSHED ADAPTED FROM SNYDER'S MAP IS INCLUDED WITH THIS REPORT.

ACCORDING TO SNYDER'S MAP, BEDROCK UNDERLYING OR CROPPING OUT WITHIN THE WATERSHED MAY BE GROUPED INTO THREE (3) PRINCIPAL ROCK TYPES. THE MOST EXTENSIVE TYPE IS DESCRIBED AS THE HEBRON FORMATION. IT UNDERLIES ALMOST THE ENTIRE WATERSHED. SNYDER DESCRIBES THE ROCKS COMPRISING THE HEBRON FORMATION AS FINE-GRAINED, GRAY-BLACK TO GRAY-GREEN, INTERLAYERED BIOTITE SCHIST, BIOTITE-HORNBLENDE SCHIST, CALC-SILICATE ROCK (ROCK COMPOSED LARGELY OF CALCIUM SILICATE MINERALS), AND MINOR LAYERED COARSE BIOTITE GNEISS. IT SHOULD BE POINTED OUT THAT THE HEBRON FORMATION ALSO INCLUDES A SILVERY-WEATHERING TO RUSTY WEATHERING MUSCOVITE SCHIST IN TWO (2) ISOLATED OUT-CROPS IN THE WATERSHED. OUTCROPS OF THE HEBRON FORMATION ARE FOUND PRIMARILY IN THE WESTCENTRAL PARTS OF THE WATERSHED, EXTENDING NORTH TO SOUTH.

UNDERLYING THE SOUTHERN TIP OF THE WATERSHED AND ALONG THE EAST SIDE OF THE LAKE IS A BEDROCK TYPE NAMED CANTERBURY GNEISS. SNYDER DESCRIBES THIS UNIT AS A UNIFORM, MEDIUM GRAINED, GRAY TO WHITE GNEISS COMPRISED PRIMARILY OF THE MINERALS, OLIGOCLASE, ORTHOCLASE, QUARTZ AND BIOTITE.

THE FINAL ROCK TYPE FOUND IN THE WATERSHED ARE SMALL INCLUSIONS OF PEGMATITES, A VERY COARSE GRAINED GRAY TO WHITE ROCK COMPOSED OF OLIGOCLASE, MICROLINE, QUARTZ, AND BIOTITE. PEGMATITES ARE TOUGH, COMPETENT ROCKS WHICH ARE RESISTANT TO WEATHERING, ESPECIALLY COMPARED TO THE SURROUNDING ROCK TYPES. AS A RESULT, PEGMATITE ROCKS OUTCROP EXTENSIVELY IN A NORTH-SOUTH BELT THROUGH-OUT THE WESTCENTRAL PARTS.



Adapted from the preliminary Surficial
Geologic Map for the Columbia Quadrangle
by M. Zizka

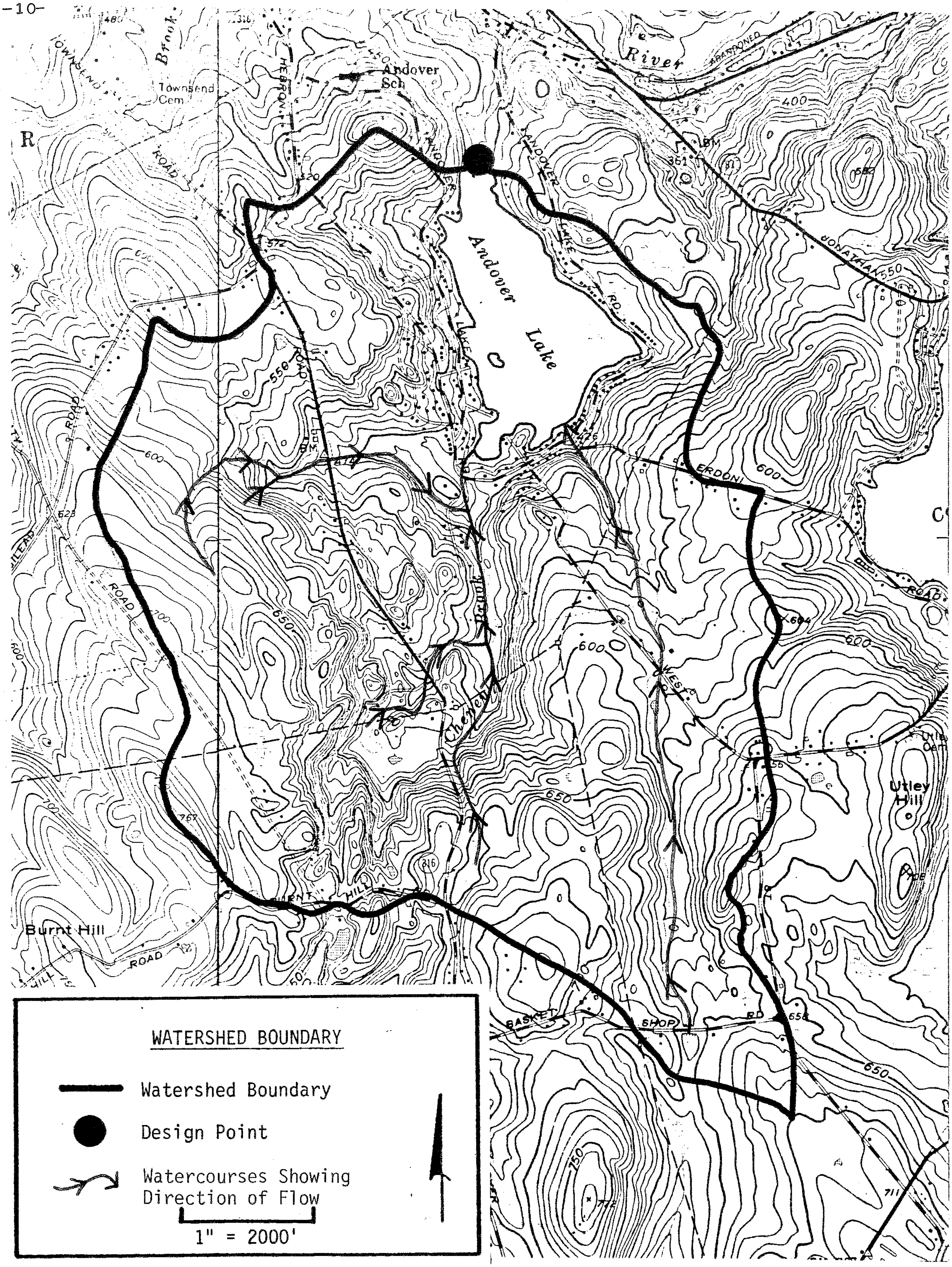
THE TERMS "SCHIST" AND "GNEISS" USED ABOVE REFER TO THE TEXTURAL ASPECTS OF THE ROCKS.

ALL OF THE ROCKS IN THE WATERSHED HAVE UNDERGONE DEFORMATION ONE OR MORE TIMES DURING THE PERIOD FOLLOWING THEIR CREATION (MORE THAN 350 MILLION YEARS AGO). THE STRESSES OF DEFORMATION CAUSED THE ALIGNMENT OF PLATY, FLAKY AND ELONGATE MINERALS INTO THIN SHEETS OR BANDS. WHERE THE ALIGNMENT HAS RESULTED IN A SLABBY ROCK (ONE THAT PARTS RELATIVELY EASILY ALONG SURFACES OF MINERAL ALIGNMENT), THE ROCK IS TERMED A "SCHIST". WHERE THE ALIGNMENT HAS RESULTED IN A BANDED BUT MORE MASSIVE ROCK, THE ROCK IS TERMED A "GNEISS". ONE FORM MAY GRADE INTO ANOTHER AND THE ACTUAL TERM USED MAY BE BASED ON INDIVIDUAL PREFERENCE. CONNECTICUT WATER RESOURCES BULLETIN #11 SUGGESTS THAT THE HEBRON FORMATION MAY BE MINERALIZED WITH RELATIVELY HIGH IRON AND MANGANESE. AS A RESULT, THE WATER QUALITY OF ANDOVER LAKE MAY BE AFFECTED BY ELEVATED IRON AND/OR MANGANESE LEVELS ALTHOUGH IT DOES NOT APPEAR THAT THE LEVELS OF THESE MINERALS ARE AFFECTING THE LAKES' ENVIRONMENTAL HEALTH.

SURFICIAL GEOLOGIC MATERIALS CONSIST OF THOSE UNCONSOLIDATED ROCK PARTICLES AND OTHER DEBRIS THAT OVERLIE BEDROCK. THE SURFICIAL GEOLOGY OF THE COLUMBIA QUADRANGLE WAS MAPPED IN 1975-1977 BY M. A. ZIZKA; THE MAP HAS NOT BEEN PUBLISHED TO DATE, BUT IT IS AVAILABLE FOR INSPECTION AT THE NATURAL RESOURCES CENTER. STATE OFFICE BUILDING, HARTFORD, CT. THE SURFICIAL GEOLOGY OF THE COLUMBIA LAKE WATERSHED ADAPTED FROM THE MAP IS SHOWN IN AN ACCOMPANYING ILLUSTRATION.

THE PREDOMINANT SURFICIAL GEOLOGIC MATERIAL IS TILL. TILL CONSISTS OF ROCK PARTICLES AND FRAGMENTS THAT WERE ACCUMULATED BY A MOVING SHEET OF GLACIER ICE AND LATER REDEPOSITED DIRECTLY FROM THE ICE. THE GLACIER ACTED AS A GIANT BULLDOZER, CHURNING UP PRE-EXISTING SOILS AND SCRAPING, GOUGING, AND BREAKING BEDROCK SURFACES. SINCE THE ICE COLLECTED ROCK PARTICLES OF ALL SIZES AND SINCE THESE PARTICLES WERE NOT SORTED BY MELT-WATER, TILL CONTAINS EVERYTHING FROM CLAY TO BOULDERS AND IT IS LOCALLY VERY VARIABLE IN TEXTURE. TWO (2) MAJOR TILL VARIETIES HAVE BEEN OBSERVED IN EASTERN CONNECTICUT: A FAIRLY LOOSE, COARSE-GRAINED, OLIVE-GRAY TO OLIVE-BROWN OR YELLOWISH-BROWN TILL AND A FINER-GRAINED, COMPACT, OFTEN CRUDELY LAYERED, OLIVE-BROWN TO LIGHT OLIVE-BROWN TILL. THE COARSER TILL IS MOST COMMON IN SURFACE EXPOSURES, BUT THE COMPACT VARIETY MAY UNDERLIE IT. THE THICKEST TILL IN THE WATERSHED APPEARS TO BE LOCATED ON THE HILL WHICH GILEAD ROAD PASSES OVER IN THE NORTHERN PARTS OF THE WATERSHED.

A VERY SMALL AREA COMPRISED OF STRATIFIED DRIFT (SORTED SEDIMENTS DEPOSITED BY GLACIAL MELTWATER) IS LOCATED ON THE EAST SIDE OF HEBRON BETWEEN CHENEY BROOK AND AN UNNAMED TRIBUTARY TO CHENEY BROOK. SWAMP SEDIMENTS ARE THE ONLY OTHER NATURAL AND SIGNIFICANT DEPOSITS IN THE WATERSHED. THESE SEDIMENTS WHICH ARE SCATTERED THROUGHOUT THE WATER-SHED CONSIST OF SAND, SILT, CLAY AND A HIGH PERCENTAGE OF ORGANIC MATERIAL (DECAYED PLANT MATTER).



Andover Lake
River
Andover Sch
Townsend Cem
Burnt Hill
Utley Hill
ROAD
BASKET SHOP RD
WATERSHED BOUNDARY
Watershed Boundary
Design Point
Watercourses Showing Direction of Flow
1" = 2000'

III. HYDROLOGY

Andover Lake has a watershed of approximately 3.9 square miles or 2,510 acres. The Lake has a maximum depth of 16 feet in the northern parts, an average depth of about 11 feet, and a maximum storage capacity of about 558 million gallons. The mean annual outflow for Andover Lakes' outlet stream at the point of outflow is estimated to be about 6.72 cubic feet per second or 4.3 million gallons per day.

Andover Lake is recharged by precipitation, but the path may be direct or indirect. Rainfall onto the lake is the shortest route. Rainfall in the form of surface runoff may also pass overland to the lake or to the inlet streams. Finally, water may move into and through the ground, being discharged downslope in a spring, seep, wetland, or stream, or directly into the lake. The quality of the lake's water, therefore, depends upon the initial quality. It is advisable to note in this regard that a natural route that water would take toward the Lake may be interrupted by a man-made diversion into a home through a well and back out again through an on-site waste disposal system.

Development in the watershed has been largely residential. The heaviest concentration of residential development in the watershed is in the immediate vicinity of Andover Lake. These homes consist mainly of seasonal homes, many of which have been converted to year round homes. The remaining part of the watershed has been only lightly developed, but based on a cursory inspection of the watershed, it appears that many new homes are presently under construction. Most of the residential homes outside of those surrounding Andover Lake, lie along Hebron Road/Wall Street, West Street and Basket Shop Road. Hardwood forests and some agricultural land characterizes the undeveloped parts of the watershed.

The natural quality of ground and surface water in the watershed can be adversely influenced by various sources of pollution such as malfunctioning or improperly installed septic systems, sedimentation and erosion, agricultural practices, lawn and garden fertilizing and stormwater runoff from roads, particularly those closest to the Lake. These sources of pollution, either singularly or in combination can severely impact the environmental health of a lake. Since most of the watershed has been only lightly developed. Town officials will need to closely monitor all future development in the watershed for properly constructed and installed septic systems, effective erosion sediment control measures, maintain catch basins, etc., to ensure that the water quality of Andover Lake is not adversely affected.

If a septic system is not properly designed, installed or maintained, there is a good chance it will malfunction. A malfunctioning septic system will either result in the backflow of sewage effluent into a house or the breakout of septic effluent on the surface of the ground. Sewage effluent discharging onto the ground surface may ultimately reach Andover Lake. The sewage effluent can contribute phosphorous, nitrates and other pollutants to the Lake's waters. A far more important consideration, however, is that

A FAILING SEPTIC SYSTEM IS A PUBLIC HEALTH HAZARD. THE PUBLIC HEALTH THREAT IS A CONCERN WHICH DEMANDS IMMEDIATE CORRECTION. LAKE ASSOCIATION MEMBERS NOTED ON THE FIELD REVIEW DAY THAT A FAILING SEPTIC SYSTEM NEAR THE LAKE HAD BEEN RECENTLY CORRECTED THROUGH THE TOWN SANITARIAN.

BASED ON VISUAL INSPECTION OF THE RESIDENCES SURROUNDING ANDOVER LAKE IT APPEARS THAT MOST WERE CONSTRUCTED ON UNDERSIZED LOTS AND ARE VERY CLOSE TO THE HIGH WATER MARK OF THE LAKE. IN ADDITION, DUE TO THE PRESENCE OF SHALLOW TO BEDROCK SOILS AND TILL-BASED SOILS (SOME OF WHICH MAY HAVE SLOW PERCOLATION RATES AND HIGH GROUNDWATER TABLES), IT SEEMS THAT MANY OF THESE LOTS WOULD BE ONLY MARGINALLY SUITED FOR ON-SITE SEWAGE DISPOSAL SYSTEMS AND WOULD PROBABLY NOT CONFORM TO PRESENT DAY CODES. AS A RESULT, UNLESS THESE SYSTEMS WERE PROPERLY DESIGNED, INSTALLED AND MAINTAINED, IT SEEMS LIKELY THAT THE EXISTING SYSTEMS COULD MALFUNCTION AND ULTIMATELY DISCHARGE SEPTIC EFFLUENT INTO THE LAKE, PARTICULARLY DURING PERIODS OF HEAVY PRECIPITATION AND/OR DURING SUMMER MONTHS WHEN COTTAGES GET HEAVY USAGE BY RESIDENTS. THE POTENTIAL FOR SEPTIC DISCHARGES IN THESE AREAS MAY ULTIMATELY THREATEN THE WATER QUALITY OF THE LAKE AS WELL AS CREATE A PUBLIC HEALTH NUISANCE CONDITION.

THE CORRECTION OF INDIVIDUAL OR SCATTERED FAILING SEPTIC SYSTEMS IS THE RESPONSIBILITY OF THE TOWN AND HEALTH OFFICIALS. THERE ARE A NUMBER OF STEPS WHICH CAN BE TAKEN TO REDUCE THE POTENTIAL ADVERSE EFFECTS OF EXISTING AND PROPOSED SEWAGE DISPOSAL SYSTEMS IN THE ANDOVER LAKE WATERSHED. THESE INCLUDE:

1. CONDUCTING A SANITARY SURVEY IN THE WATERSHED TO IDENTIFY POTENTIAL SOURCES OF POLLUTION. THIS MAY INCLUDE INTRODUCING FLUORESCENE DYE INTO RESIDENTIAL TOILET SYSTEMS DURING THE WET SPRING MONTHS IN ORDER TO DETERMINE WHETHER OR NOT SYSTEMS ARE FUNCTIONING PROPERLY.

2. STRICT ENFORCEMENT OF THE PUBLIC HEALTH CODE REQUIREMENTS WITH RESPECT TO NEW CONSTRUCTION IN THE ANDOVER LAKE WATERSHED. OF PARTICULAR CONCERN, WILL BE THE UNDEVELOPED AREAS THROUGHOUT MOST OF THE WATERSHED. THE PRESENCE OF BEDROCK AT OR NEAR GROUND SURFACE, MODERATE TO STEEP SLOPES AND TILL-BASED SOILS WILL GREATLY LIMIT THE DEVELOPMENT POTENTIAL IN THE WATERSHED. THESE LIMITATIONS WILL WEIGH MOST HEAVILY ON THE ABILITY TO PROVIDE ADEQUATE SUBSURFACE DISPOSAL.

3. EDUCATING LAKESIDE RESIDENTS ABOUT THE PROPER OPERATION AND MAINTENANCE OF SEPTIC SYSTEMS VIA AN INFORMATION PAMPHLET. THE PAMPHLET SHOULD ADVISE HOMEOWNERS ABOUT THE CONSEQUENCES OF FAILURES, LIST MATERIALS WHICH SHOULD NOT BE DISPOSED OF IN A SEPTIC SYSTEM, DISCUSS WATER CONSERVATION MEASURES AND STRESS THE NEED FOR ROUTINGE SEPTIC TANK PUMPING. AN EXCELLENT PAMPHLET FOR THESE PURPOSES WAS DEVELOPED BY THE NORTHEASTERN CONNECTICUT REGIONAL PLANNING AGENCY AND THE NORTHEAST DISTRICT DEPARTMENT OF HEALTH ENTITLED, "HOMEOWNER'S GUIDE TO SEPTIC SYSTEM MAINTENANCE - OR HOW TO SAVE THOUSANDS OF DOLLARS". (INCLUDED IN THE APPENDIX)

4. ENCOURAGING LAKESIDE RESIDENTS TO USE NONPHOSPHATE LAUNDRY DETERGENTS. THE PHOSPHORUS PASSING THROUGH A RESIDENTIAL SEPTIC SYSTEM CAN BE REDUCED 30 TO 40% BY THE USE OF NONPHOSPHATE LAUNDRY DETERGENTS.

5. STRICT ENFORCEMENT OF SEC. 19-13-B100. BUILDING CONVERSION OF THE CONNECTICUT PUBLIC HEALTH CODE AND CONSIDERATION OF ADOPTING A TOWN ORDINANCE WHICH REQUIRES THE INSTALLATION OF SEWAGE DISPOSAL SYSTEMS MEETING ALL HEALTH CODE REQUIREMENTS AT THE TIME OF BUILDING CONVERSION FROM SEASONAL TO YEAR ROUND USE.

EROSION AND SEDIMENTATION AND STORMWATER RUNOFF - EROSION AND SEDIMENTATION WITHIN A LAKE WATERSHED IS A NATURAL PROCESS, THE RATE OF WHICH CAN BE GREATLY INCREASED BY HUMAN ACTIVITIES THAT DISTURB THE LAND.

ERODED SOIL CONTRIBUTES TO EUTROPHICATION IN SEVERAL WAYS. NUTRIENTS ASSOCIATED WITH THE SOIL PARTICLES ARE INTRODUCED TO LAKE WATERS. SEDIMENTATION REDUCES WATER DEPTHS CREATING CONDITIONS CONDUCIVE TO THE GROWTH OF AQUATIC WEEDS. ORGANIC MATTER, ASSOCIATED WITH THE SOIL PARTICLES, IS DECOMPOSED BY THE SOIL BACTERIA WHICH DEPLETES OXYGEN OVERLYING THE LAKE SEDIMENTS.

IN 1983, THE CONNECTICUT GENERAL ASSEMBLY ENACTED LEGISLATION ENTITLED "AN ACT CONCERNING SOIL AND SEDIMENT CONTROL" WHICH AMENDS LOCAL ZONING PURSUANT TO SECTION 2-8 OF THE CONNECTICUT GENERAL STATUTES. THIS LEGISLATION REQUIRES THE CONNECTICUT COUNCIL ON SOIL AND WATER CONSERVATION TO DEVELOP EROSION AND SEDIMENT GUIDELINES AND MODEL REGULATIONS FOR MUNICIPALITIES. THE LEGISLATION ALSO MANDATED THE ADOPTION OF MUNICIPAL EROSION AND SEDIMENT CONTROL PROGRAMS BY JULY 1, 1985.

LAKESIDE RESIDENTS AND LAKE USERS SHOULD URGE THEIR TOWN TO ADOPT AND UTILIZE EROSION AND SEDIMENTATION ORDINANCES IN THEIR ZONING REGULATIONS.

LOCAL OFFICIALS SHOULD SEE TO THE CORRECTION OF ANY EXISTING SOURCES OF EROSION, SEDIMENTATION AND RUNOFF WITHIN THE ANDOVER LAKE WATERSHED. FOR EXAMPLE, CATCH BASINS, ESPECIALLY THOSE THAT ULTIMATELY OUTLET TO ANDOVER LAKE OR A FEEDER STREAM TO THE LAKE, SHOULD BE CLEANED OF SEDIMENT ON A REGULAR BASIS. ALSO, ROAD SANDING SHOULD BE KEPT TO MINIMAL IN THESE AREAS. IN THE EARLY SPRING, ROADS THROUGHOUT THE WATERSHED SHOULD BE SWEPT OF ROAD SAND.

LAWN AND GARDEN FERTILIZERS - LAWNS AND GARDENS ARE VERY EFFICIENT AT UTILIZING SOIL NUTRIENTS AND PREVENTING THEIR LOSS THROUGH RUNOFF AND LEACHING. HOWEVER, RUNOFF AND LEACHING OF NUTRIENTS CAN OCCUR IF FERTILIZER APPLICATIONS EXCEED NUTRIENT REQUIREMENTS, OR IF FERTILIZERS ARE APPLIED PRIOR TO STORM EVENTS WHICH CAUSE RUNOFF. THESE SITUATIONS CAN BE AVOIDED IF FERTILIZERS ARE MATCHED TO SOIL REQUIREMENTS, AND IF APPLICATIONS ARE TIMED TO AVOID PERIODS OF RUNOFF. SOIL TEST KITS CAN BE PURCHASED AT A NOMINAL CHARGE FROM THE UNIVERSITY OF CONNECTICUT COOPERATIVE EXTENSION SERVICE COUNTY OFFICES. THE SAMPLES ARE ANALYZED AT THE EXTENSION SERVICE LABORATORY AND THE RESULTS IDENTIFY SOIL NUTRIENT DEFICIENCIES.

AGRICULTURE - AGRICULTURAL ACTIVITIES IN THE WATERSHED ARE NOT THAT EXTENSIVE. MOST OF THE FARMLAND IS CONCENTRATED ALONG HEBRON ROAD, WALL STREET AND WEST STREET. BECAUSE OF ITS REMOTENESS FROM THE LAKE, IT IS PROBABLY NOT POSING ANY MAJOR PROBLEMS TO WATER QUALITY IN THE LAKE.

Based on visual observations made on the review day, Andover Lake appeared to be relatively free of weed growth. This is probably a result of lowering the water level of the lake during the winter months. According to a Lake Association member, the water level in the Lake is lowered in the late fall - early winter to allow lake front residents to work on their beaches. The result of lowering the water level during the winter months has allowed freezing temperatures to kill the weeds and root systems.

IV. Lake Management

Lake Features

Andover Lake is an artificial lake created by the impounding of Cheney Brook. The dam and the lake's outlet are located at the northern end of the lake. The outlet flows northward to the Hop River which then flows easterly to its confluence with the Willimantic River.

As reported in the 1959 Fishery Survey the lake has a surface area of 155.4 acres, a maximum depth of 16 feet and an average depth of 10.9 feet. Water clarity appears to have improved significantly over the 1959 data as the tea stain coloring no longer exists. The Fishery Survey reports that the lake is too shallow to stratify.

Watershed Management

One water quality/watershed management problem which requires attention is the accumulation of sediment at the mouth of Cheney Brook and Erdoni Brook. The excavation of these sediments would be best accomplished during the annual winter drawdown of the lake. The excavation may require local Inland Wetlands permits. Much of the material appears to be road sand. Provisions should be made to reduce the transport of this material to the lake such as early spring street sweeping and the installation of catch basins, ideally wherever stormwater is discharging to the lake.

The lake association's newsletter could be an effective vehicle for conveying to the public useful information on septic system maintenance, erosion and sedimentation, lawn fertilizers and waterfowl. Information on all of these subject areas and more is available in the DEP publication A Watershed Management Guide for Connecticut Lakes 1986. Copies are available free of charge by calling 566-2588. (A copy is also included in the Appendix)

This handbook has been developed to assist concerned citizens in understanding the process of eutrophication and the principles of eutrophication control through the management of the lake's surrounding watershed land. The handbook is a synthesis of information assimilated by the DEP through its eutrophication abatement activities in recent years. Material in the handbrook was selected to fulfill basic information needs of the general public, as determined by our experiences with a variety of lake projects and our contact with numerous individuals and lake organizations. The handbook is

INTENDED TO ASSIST THE LAYMAN IN WORKING MORE EFFECTIVELY WITH TECHNICAL EXPERTS IN GOVERNMENT AGENCIES AND PRIVATE INDUSTRY TO PROTECT AND RESTORE CONNECTICUT'S LAKES.

IN-LAKE MANAGEMENT

AT THE PRESENT TIME THERE DOES NOT APPEAR TO BE ALGAE OR AQUATIC WEED PROBLEMS WHICH WOULD REQUIRE MANAGEMENT. THE ASSOCIATION'S ANNUAL OVER-WINTER DRAWDOWN OF 4-4.5 FEET SEEMS TO BE EFFECTIVE IN KEEPING AQUATIC WEEDS IN CHECK.

IF AT SOME FUTURE POINT ALGAE AND WEEDS BECOME A PROBLEM, TECHNIQUES FOR THEIR CONTROL ARE OUTLINED IN THE DEP PUBLICATION A MANAGEMENT GUIDE FOR CONNECTICUT LAKES, A PRIMER ON THE CONTROL OF ALGAE AND AQUATIC WEEDS. THIS PUBLICATION IS AVAILABLE AT NO CHARGE BY CALLING 566-2588. (A COPY IS ALSO INCLUDED IN THE APPENDIX) THE EFFECTIVENESS OF ANY ALGAE OR WEED CONTROL TECHNIQUE IS GREATLY ENHANCED BY A SOUND WATERSHED MANAGEMENT PLAN.

V. EROSION AND SEDIMENT CONTROL

THE ANDOVER LAKE WATERSHED WAS INSPECTED FOR MAJOR SEDIMENT SOURCES. THE THREE (3) MAIN INLETS TO THE LAKE WERE VIEWED AND IT APPEARS THAT THE INPUTS OF WATERBORNE SEDIMENTS FROM CHENEY BROOK AND THE UNNAMED FEEDER STREAM TO THE EAST NEAR THE JUNCTION OF ERDONI ROAD AND LAKE ROAD ARE SIGNIFICANT AS EVIDENCED BY THE LARGE DELTAS OF SEDIMENT AT THE POINTS WHERE THESE STREAMS DISCHARGE INTO THE LAKE. THE DEPOSITS APPEAR TO CONSIST OF A MIX OF SANDS AND SMALLER AMOUNTS OF ORGANIC MATERIAL LAID DOWN IN LAYERS. THIS SUGGESTS THAT ROAD SAND AND STREAM DEBRIS ARE DEPOSITED ANNUALLY DURING SPRING RUNOFF AND STORM EVENTS. SINCE THE LAKE WATER ELEVATION IS LOWER DURING THE LATE FALL THROUGH LATE SPRING PERIOD, DEBRIS IS TRANSPORTED SLIGHTLY FURTHER INTO THE LAKE AND IS SUBMERGED WHEN THE LAKE LEVEL RISES IN THE SUMMER.

ROAD SAND APPEARS TO BE THE MOST LIKELY SEDIMENT SOURCE. THE WEST STREAMBANK OF CHENEY BROOK IMMEDIATELY DOWNSTREAM TO LAKE ROAD IS ERODING AND MAY CONTRIBUTE SMALL AMOUNTS OF SEDIMENT TO THE STREAM. THIS BANK SHOULD BE INSPECTED PERIODICALLY TO DETERMINE IF STABILIZATION IS WARRANTED. STREAMBANKS IN THE REMAINDER OF THE WATERSHED WERE INSPECTED AT SEVERAL POINTS AND APPEAR TO BE STABLE. A DETAILED EXAMINATION OF STREAMBANKS WAS NOT PERFORMED BECAUSE OF TIME CONSTRAINTS. THIS PROJECT COULD BE CARRIED OUT AS AN ACTIVITY OF THE CONSERVATION COMMISSION, WETLANDS COMMISSION OR LAKE ASSOCIATION.

AGRICULTURAL LAND IN THE WATERSHED IS CONCENTRATED ON THE RIDGE TOPS ALONG THE WATERSHED BOUNDARIES (UTLEY HILL AND ALONG HEBRON ROAD). THE MAJORITY OF THIS LAND IS IN PERMANENT COVER AND USED AS HAYLAND, PASTURELAND AND CHRISTMAS TREE PLANTATION. THE POTENTIAL FOR CONTRIBUTION OF SEDIMENTS TO THE STREAMS FROM THESE AREAS ARE VERY LOW.

Residential construction activities in the watershed are substantial. These areas have a medium to high potential for sediment contributions depending on location and proximity to drainage systems and watercourses.

Water Quality

It does not appear that the sediment alone consititutes a major threat to water quality as reports or complaints about high turbidity levels in the lake water have not been documented. However, the relatively large sediment deltas at the major inlets indicate that the inlet streams can transport large amounts of both sediment and dissolved material into the lake. It points out that proper management of the streambelt zone within the watershed area is critical to the future water quality conditions in the lake.

Streambelts are defined as watercourses, floodplains, associated wetlands, contiguous lands with special environmental values (buffer areas), lake and pond shorelines and buffer areas, potential water development site of public significance, areas of special concern in proximity to the stream and other areas needed as links to form a continuous streambelt system. The Andover Planning and Zoning Commission or wetland agency may want to consider establishing streambelts along major watercourses and regulations to give the Planning and Zoning Commission additional authorities in these areas.

General Recommendations

1. Identify, establish and protect streambelt zones within the watershed.

2. Require on-site delineation of inland wetlands by applicants who make permit requests to the Inland Wetland Commission and on-site verification of the wetlands by the commission or its agent. Set up a policy for protection of wetlands within the watershed and revise or adopt new wetland regulations to cover these requirements. Require strict adherence to permit conditions through enforcement activities.

3. Require strict adherence to soil erosion and sediment control regulations.

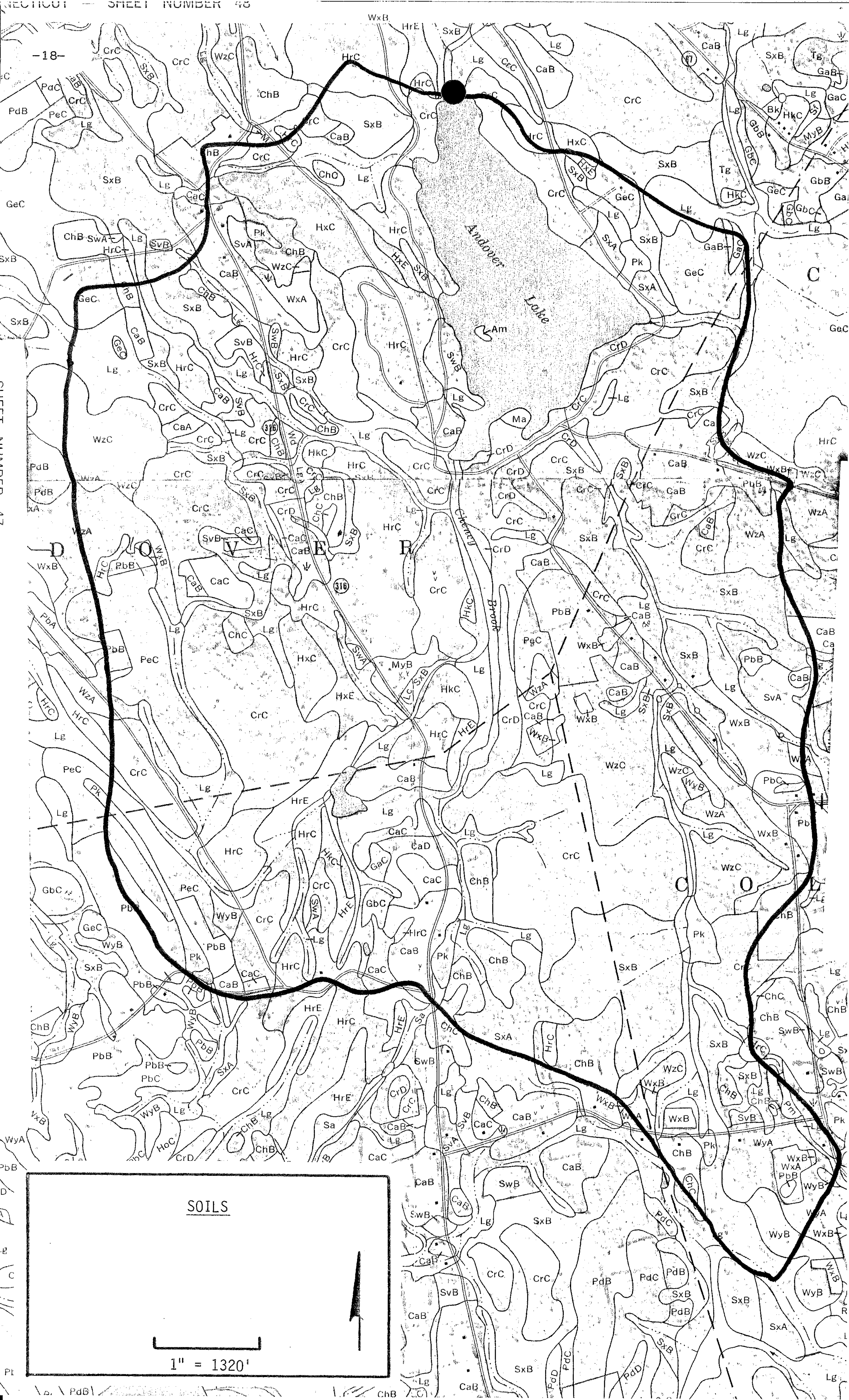
4. Work with the Department of Public Works to assure timely maintenance of the storm drainage system (especially cleaning of catch basin sumps) and annual street sweeping.

VI. SOILS

Enclosed are detailed soil descriptions of soils within the watershed. In all cases, map symbols which appear in the published soil survey report were used, however, due to current interpretations, some map unit delineations may have been combined or renamed.

LISTED BELOW ARE THE SOIL MAP SYMBOLS WITH THEIR CURRENT INTERPRETIVE NAME FOLLOWED BY THE DETAILED DESCRIPTIONS.

MAP SYMBOL	SOIL NAME
AM	FLUVAQUENTS-UDIFLUVENTS, FREQUENTLY FLOODED
CAA, CAB	CANTON AND CHARLTON SOILS, 0 TO 8 PERCENT SLOPES
CAC	CANTON AND CHARLTON SOILS, 8 TO 15 PERCENT SLOPES
CAD	CANTON AND CHARLTON SOILS, 15 TO 25 PERCENT SLOPES
CHB	CANTON AND CHARLTON SOILS, 3 TO 8 PERCENT SLOPES, VERY STONY
CHC	CANTON AND CHARLTON SOILS, 8 TO 15 PERCENT SLOPES, VERY STONY
CRC, GEC	CANTON AND CHARLTON SOILS, 3 TO 15 PERCENT SLOPES, EXTREMELY STONY
CRD	CANTON AND CHARLTON SOILS, 15 TO 35 PERCENT SLOPES, EXTREMELY STONY
GAC	GLOUCESTER GRAVELLY SANDY LOAM, 8 TO 15 PERCENT SLOPES
GBC	GLOUCESTER GRAVELLY SANDY LOAM, 8 TO 15 PERCENT SLOPES, VERY STONY
HKC	HINCKLEY GRAVELLY SANDY LOAM, 3 TO 15 PERCENT SLOPES
HRC	CHARLTON-HOLLIS COMPLEX, 3 TO 15 PERCENT SLOPES, VERY ROCKY
HRE	CHARLTON-HOLLIS COMPLEX, 15 TO 45 PERCENT SLOPES, VERY ROCKY
HXC	HOLLIS-CHARLTON-ROCK OUTCROP COMPLEX, 3 TO 15 PERCENT SLOPES
HXE	HOLLIS-CHARLTON-ROCK OUTCROP COMPLEX, 15 TO 45 PERCENT SLOPES
LC	LEICESTER FINE SANDY LOAM
LG	RIDGEBURY, LEICESTER AND WHITMAN SOILS, EXTREMELY STONY
MA	UDORTHENTS, SMOOTHED
MYB	MERRIMAC SANDY LOAM. 3 TO 8 PERCENT SLOPES
PBB	PAXTON AND MONTAUK SOILS, 3 TO 8 PERCENT SLOPES
PBC	PAXTON AND MONTAUK SOILS, 8 TO 15 PERCENT SLOPES
PEC	PAXTON AND MONTAUK SOILS, 3 TO 15 PERCENT SLOPES, EXTREMELY STONY
PK	CARLISLE MUCK
PM	ADRIAN AND PALMS SOILS
SVB	SUTTON FINE SANDY LOAM, 3 TO 8 PERCENT SLOPES
SWA	SUTTON FINE SANDY LOAM, 2 TO 8 PERCENT SLOPES, VERY STONY
SXA, SXB	SUTTON FINE SANDY LOAM, 2 TO 15 PERCENT SLOPES, EXTREMELY STONY
WD	WALPOLE SANDY LOAM
WXA	WOODBRIDGE FINE SANDY LOAM, 0 TO 3 PERCENT SLOPES
WXB	WOODBRIDGE FINE SANDY LOAM, 3 TO 8 PERCENT SLOPES
WYA, WYB	WOODBRIDGE FINE SANDY LOAM, 2 TO 8 PERCENT SLOPES, VERY STONY
WZA, WZC	WOODBRIDGE FINE SANDY LOAM, 2 TO 15 PERCENT SLOPES, EXTREMELY STONY


NECTICUT — SHEET NUMBER 48
SHEET NUMBER 47
Andover Lake
Cheney Brook
SOILS
1" = 1320'

THE ENCLOSED SOIL MAP WAS NOT REVISED. BECAUSE THIS REPORT WAS GENERAL IN NATURE, THE EXISTING SOILS INFORMATION WAS USED WITH EXTENDED DESCRIPTIONS. ANY SPECIFIC SOIL CONCERNS IN THE WATERSHED AREA MAY NEED ON-SITE INVESTIGATIONS TO CONFIRM OR IDENTIFY SPECIFIC PROBLEMS AT THAT SITE.

SOILS DESCRIPTIONS

Am - Fluvaquents - Udifluvents, frequently flooded - The soils in this mapping unit are nearly level to level and range in drainage from well to very poorly drained. They are on the lowest parts of the flood plains of streams and their tributaries. Textures range from sand to silt loam.

Inclusions in this soil unit are the named soil components. The well drained and moderately well drained soils are on the high knobs along the streams and are usually sandy. The lower areas have the wetter soils which usually have finer textures.

These soils have seasonal high water tables at varying depths. They are subject to frequent flooding, mainly from fall to spring.

Frequent flooding and the seasonal high water tables are major limitations of soils in this unit for community development.

CaA, CaB - Canton and Charlton soils, 3 to 8 percent slopes - This unit consists of gently sloping, deep well drained soils on ridges, hills, and side slopes of glacial till uplands. The areas are mostly rectangular or irregular in shape. Slopes are generally smooth and convex and 200 to 400 feet long. About 45 percent of this unit is Canton soils, 40 percent is Charlton soils, and 15 percent is other soils. Some areas of this unit consist almost entirely of Canton soils, some almost entirely of Charlton soils, and some of both. The soils were mapped together because they have no significant differences in use and management.

Typically, the Canton soils have a surface layer of very dark grayish brown fine sandy loam 2 inches thick. The subsoil is yellowish brown fine sandy loam, gravelly fine sandy loam, and gravelly loamy sand to a depth of 60 inches or more.

Typically, the Charlton soils have a surface layer of dark yellowish brown fine sandy loam 5 inches thick. The subsoil is yellowish brown fine sandy loam and sandy loam 20 inches thick. The substratum is light yellowish brown and light brownish gray sandy loam to a depth of 60 inches or more.

Included with these soils in mapping are small areas of somewhat excessively drained Gloucester and Hollis soils, well drained Paxton soils, and moderately well drained Sutton soils. Also included are a few large, nearly level areas and a few areas that have a compact substratum at a depth of 40 to 50 inches.

The water table in these Canton and Charlton soils is commonly at a depth of more than 6 feet. The permeability of the Canton soils is moderately rapid in the surface layer and subsoil and rapid in the substratum. The permeability of the Charlton soils is moderate or moderately rapid. Both soils have medium to rapid runoff, have moderate available water capacity.

Instability of some excavations in the Canton soils is the main limitation of these soils for community development.

CaC- Canton and Charlton soils, 8 to 15 percent slopes - This mapping unit consists of sloping, deep well drained soils on ridges, hills, and side slopes of glacial till uplands. Slopes are mainly smooth and convex and less than 200 feet long. The soils of this unit are the same as those described for the Canton and Charlton soils, 3 to 8 percent slopes except for slope gradient. Included with these soils in mapping are a few areas with slopes greater than 15 percent.

Slope is the main limitation of these soils for community development, especially for onsite septic systems. Excavations in these soils are unstable.

CaD- Canton and Charlton soils, 15 to 25 percent slopes - This mapping unit consists of moderately steep to steep, deep well drained soils on ridges, hills, and side slopes of glacial till uplands. Slopes are mainly smooth and convex and less than 200 feet long. The soils of this unit are the same as those described for the Canton and Charlton soils, 3 to 8 percent slopes except for slope gradient. Included with these soils in mapping are a few areas with slopes greater than 25 percent.

Slope is the main limitation of these soils for community development, especially for onsite septic systems. Excavations in these soils are unstable.

ChB - Canton and Charlton soils, 3 to 8 percent slopes, very stony. This mapping unit consists of gently sloping, well drained soils on ridges, hills, and side slopes of glacial till uplands. The areas are mostly rectangular or irregular in shape. Slopes are generally smooth and convex and less than 200 feet long. About

45 percent of this unit is Canton soils, 40 percent is Charlton soils, and 15 percent is other soils. In some areas, this unit will consist almost entirely of Canton soils or almost entirely of Charlton soils. The soils were mapped together because they have no significant differences in use and management. Stones cover 1 to 8 percent of the soil surface.

Typically, the Canton soils have a surface layer of very dark grayish brown fine sandy loam 2 inches thick. The subsoil is yellowish brown fine sandy loam, gravelly fine sandy loam, and gravelly sand loam 21 inches thick. The substratum is pale brown gravelly loamy sand to a depth of 60 inches or more.

Typically, the Charlton soils have a surface layer of dark yellowish brown fine sandy loam 5 inches thick. The subsoil is yellowish brown fine sandy loam and sandy loam 20 inches thick. The substratum is light yellowish brown and light brownish gray sandy loam to a depth of 60 inches or more.

Included with these soils in mapping are small areas of somewhat excessively drained Gloucester and Hollis soils; well drained Paxton soils; and moderately well drained Sutton soils. Also included are a few areas that have a compact substratum at a depth of 40 to 50 inches.

The water table in these soils is commonly at a depth of more than six feet. The permeability of the Canton soils is moderately rapid in the surface layer and subsoil and rapid in the substratum. The permeability of the Charlton soils is moderate or moderately rapid. Both soils have medium to rapid runoff, and have moderate available water capacity.

Instability of some excavations in the Canton soils is the main limitation for community development.

ChC - Canton and Charlton soils, 8 to 15 percent slopes, very stony. This mapping unit consists of sloping, well drained soils on ridges, hills, and side slopes of glacial till uplands. The areas are mostly rectangular or irregular in shape. Slopes are generally smooth and convex and less than 200 feet long. About 45 percent of this unit is Canton soils, 40 percent is Charlton soils, and 15 percent is other soils. In some areas, this unit will consist almost entirely of Canton soils or almost entirely of Charlton soils. The soils were mapped together because they have no significant differences in use and management. Stones cover 1 to 8 percent of the soil surface.

Typically, the Canton soils have a surface layer of very dark grayish brown fine sandy loam 2 inches thick. The subsoil is yellowish brown fine sandy loam, gravelly fine sandy loam, and gravelly sand loam 21 inches thick. The substratum is pale brown gravelly loamy sand to a depth of 60 inches or more.

Typically, the Charlton soils have a surface layer of dark yellowish brown fine sandy loam 5 inches thick. The subsoil is yellowish brown fine sandy loam and sandy loam 20 inches thick. The substratum is light yellowish brown and light brownish gray sandy loam to a depth of 60 inches or more.

Included with these soils in mapping are small areas of somewhat excessively drained Gloucester and Hollis soils; well drained Paxton soils; and moderately well drained Sutton soils. Also included are a few areas that have a compact substratum at a depth of 40 to 50 inches.

The water table in these soils is commonly at a depth of more than six feet. The permeability of the Canton soils is moderately rapid in the surface layer and subsoil and rapid in the substratum. The permeability of the Charlton soils is moderate or moderately rapid. Both soils have medium to rapid runoff, and have moderate available water capacity.

Instability of some excavations in the Canton soils is the main limitation for community development.

CrC, GeC - <u>Canton and Charlton soils, 3 to 15 percent slopes, extremely stony</u> - This mapping unit consists of gently sloping to sloping, well drained soils on ridges, hills, and side slopes of glacial till uplands. The areas are oval or irregular in shape. Slopes are mostly smooth and convex and are 100 to 600 feet long. Stones cover 8 to 25 percent of the surface. About 45 percent of this unit is Canton soils, 40 percent is Charlton soils, and 15 percent is other soils. Some areas of this unit consist almost entirely of Canton soils, some almost entirely of Charlton soils, and some of both. The soils were mapped together because they have no significant differences in use and management.

Typically, the Canton soils have a surface layer of very dark grayish brown fine sandy loam 2 inches thick. The subsoil is yellowish brown fine sandy loam, gravelly fine sandy loam, and gravelly sandy loam 21 inches thick. The substratum is pale brown gravelly loamy sand to a depth of 60 inches or more.

Typically, the Charlton soils have a surface layer of dark yellowish brown fine sandy loam 5 inches thick. The subsoil is yellowish brown fine sandy loam and sandy loam 20 inches thick. The substratum is light yellowish brown and light brownish gray sandy loam to a depth of 60 inches or more.

Included with these soils in mapping are small areas of somewhat excessively drained Gloucester and Hollis soils, well drained Paxton soils, and moderately well drained Sutton soils. Also included are a few nearly level areas and a few areas that have a compact substratum at a depth of 40 to 50 inches.

The water table in these Canton and Charlton soils is commonly at a depth of more than 6 feet. The permeability of the Canton soils is moderately rapid in the surface layer and subsoil and rapid in the substratum. The permeability of the Charlton soils is moderate or moderately rapid. Both soils have moderate available water capacity and medium to rapid runoff.

Slope is the main limitation of these soils for community development, especially for onsite septic systems. Slopes of excavations in these soils are unstable. The stones on the surface hinder landscaping.

CrD - Canton and Charlton soils, 15 to 35 percent slopes, extremely stony - This mapping unit consists of moderately steep to steep, well drained soils on ridges, hills, and side slopes of glacial till uplands. The areas are mostly long and narrow. Slopes are smooth and convex and are mainly less than 200 feet long. Stones cover 8 to 25 percent of the surface. About 45 percent of this unit is Canton soils, 40 percent is Charlton soils, and 15 percent is other soils. Some areas consist almost entirely of Canton soils, some almost entirely of Charlton soils, and some of both. The soils were mapped together because they have no significant differences in use and management.

Typically, the Canton soils have a surface layer of very dark grayish brown fine sandy loam 2 inches thick. The subsoil is yellowish brown fine sandy loam, gravelly fine sandy loam, and gravelly sandy loam 21 inches thick. The substratum is pale brown gravelly loamy sand to a depth of 60 inches or more.

Typically, the Charlton soils have a surface layer of dark yellowish brown fine sandy loam 5 inches thick. The subsoil is yellowish brown fine sandy loam 20 inches thick. The substratum is light yellowish brown and light brownish gray sandy loam to a depth of 60 inches.

Included with these soils in mapping are small areas of somewhat excessively drained Gloucester and Hollis soils and well drained Paxton soils. Also included are a few large areas where stones cover less than 8 percent of the surface and areas with a compact substratum at a depth of 40 to 50 inches.

The water table in these Canton and Charlton soils is commonly at a depth of more than 6 feet. The permeability of the Canton soils is moderately rapid in the surface layer and subsoil and rapid in the substratum. The permeability of the Charlton soils is moderate or moderately rapid. Both soils have moderate available water capacity and rapid runoff.

Slope limits the soils of this unit for community development, especially for onsite septic systems. Slopes of excavations in the soils are unstable and the stones on the surface hinder landscaping.

GaC **Gloucester gravelly sandy loam, 8 to 15 percent slopes**

This soil is sloping and somewhat excessively drained. It is on ridges and hills of the glacial till uplands. The areas are mostly long and narrow or sometimes oval in shape. Slopes are mostly smooth and convex and 200 to 400 feet long.

Typically, this soil has a surface layer of very dark grayish brown sandy loam 4 inches thick. The subsoil is dark yellowish brown and yellowish brown gravelly sandy loam and loamy sand 21 inches thick. The substratum is light olive brown and light brownish gray gravelly loamy coarse sand to a depth of 60 inches or more.

Included with this soil in mapping are small areas of excessively drained Hinckley soils and well drained Canton, Charlton, and Paxton soils. Also included are a few areas where stones cover up to one percent of the surface. Included areas make up about 15 percent of this mapping unit.

The water table in this Gloucester soil is commonly below a depth of six feet. The available water capacity is low. The permeability of this soil is rapid and runoff is medium to rapid.

Most areas of this soil is in pasture. Some areas are in woodland and a few are in community development. This soil is generally too drought and stony for cultivation. It is suited to woodland, but droughtiness causes a high rate of seedling mortality.

This soil is generally suited to community development but slope and soil permeability are major limitations. The rapid permeability causes a hazard of groundwater pollution in areas used for septic systems. Effluent from septic systems may come to the surface if absorption fields are installed on steep slopes.

GbC **Gloucester gravelly sandy loam, 8 to 15 percent slopes, very stony.**

This soil is sloping and somewhat excessively drained. It is on ridges and hills of glacial till uplands. The areas are mostly long and narrow or oval in shape. Stones and boulders cover 1 to 8 percent of the surface. Slopes are mainly smooth and convex and 200 to 400 feet long.

Typically, this soil has a surface layer of very dark grayish brown sandy loam 4 inches thick. The subsoil is dark yellowish brown and yellowish brown gravelly sandy loam and loamy sand 21 inches thick. The substratum is light olive brown and light brownish gray gravelly loamy coarse sand to a depth of 60 inches or more.

Included with this soil in mapping are small areas of excessively drained Hinckley soils and well drained Canton, Charlton, and Paxton soils. Included areas make up about 15 percent of this mapping unit.

The water table in this Gloucester soil is commonly below a depth of 6 feet. The available water capacity is low. The soil has rapid permeability and runoff is medium.

Most areas of this soil are in woodland. A few small areas are used for pasture or community development.

This soil generally is too stony and too droughty for cultivation. The soil is suited to woodland, but droughtiness causes a high rate of seedling mortality and the stones and boulders on the surface hinder the use of some woodland harvesting equipment.

This soil is generally suited to community development, but slope is a limitation for on-site septic systems and the rapid permeability causes a hazard of groundwater pollution in areas used for septic tanks. Some slopes of excavations in this soil are unstable. The stones on the surface hinder landscaping.

HkC - <u>Hinckley gravelly sandy loam, 3 to 15 percent slopes</u>. This is a gently sloping to sloping, excessively drained soil on terraces of stream valleys and on glacial outwash plains. The areas of this soil are oval or irregular in shape. Slopes are convex or undulating and are mostly less than 200 feet long.

Typically, the surface layer is very dark grayish brown gravelly sandy loam 2 inches thick. The subsoil is dark yellowish brown, yellowish brown, and brownish yellow gravelly sandy loam and gravelly loamy sand 16 inches thick. The substratum is pale yellow gravelly sand to a depth of 60 inches or more.

Included with this soil in mapping are small areas of excessively drained Windsor soils: somewhat excessively drained Merrimac soils: well drained Agawam soils: and moderately well drained Sudbury soils.

The water table in this Hinckley soil is commonly below a depth of 6 feet. The available water capacity is low. Runoff is rapid. This soil has rapid permeability in the surface layer and subsoil and very rapid permeability in the substratum.

This soil is generally suited to community development, but the rapid permeability imposes a hazard of groundwater pollution in areas used for septic tanks. The slopes in some excavated areas are unstable.

HrC - <u>Charlton-Hollis complex, 3 to 15 percent slopes, very rocky</u> - This complex consists of gently sloping to sloping, somewhat excessively drained and well drained soils on hills and ridges of glacial till uplands. The areas of this unit are mostly irregular in shape. Slopes are mostly complex and are 100 to 200 feet long. Stones cover 1 to 8 percent of the surface.

This unit is about 55 percent Charlton soils, 20 percent Hollis soils, 15 percent other soils, and 10 percent exposed bedrock. The Charlton and Hollis soils are in such a complex pattern that it was not practical to map them separately.

Typically, the Charlton soils have a thick, fine sandy loam topsoil and subsoil over a sandy loam substratum. The soils are commonly deeper than 60 inches.

The Hollis soils have fine sandy loam topsoil and subsoil from 10 to 20 inches thick over hard, unweathered schist bedrock.

Included with these soils in mapping are small areas of well drained Canton and Paxton soils; moderately well drained Sutton and Woodbridge soils; and poorly drained Leicester soils. Also included are small areas with bedrock at a depth of 20 to 40 inches.

The water table of these soils is commonly at a depth of more than 6 feet. The available water capacity is moderate in the Charlton soils and very low or low in the Hollis soils. Both soils have moderate or moderately rapid permeability and medium to rapid runoff.

The areas of exposed rock and the depth to bedrock in the Hollis soils limit the use of these areas for community development, especially as a building site or as a site for onsite septic systems. The stones on the surface restrict landscaping.

HrE - <u>Charlton-Hollis complex, 15 to 45 percent slopes, very rocky</u> - This complex consists of moderately steep to steep, somewhat excessively drained and well drained soils on hills and ridges of glacial till uplands. Areas of this unit are mostly long and narrow or oval in shape. Slopes are mainly convex and are 100 to 500 feet long. Stones and boulders cover 1 to 8 percent of the surface. This unit is about 55 percent Charlton soils, 20 percent Hollis soils, 15 percent other soils, and 10 percent exposed bedrock. The Charlton and Hollis soils are in such a complex pattern that it was not practical to map them separately.

Typically, the Charlton soils have a surface layer of dark yellowish brown fine sandy loam 5 inches thick. The subsoil is yellowish brown fine sandy loam and sandy loam 20 inches thick. The substratum is light yellowish brown and light brownish gray sandy loam to a depth of 60 inches or more.

Typically, the Hollis soils have a surface layer of dark grayish brown fine sandy loam 2 inches thick. The subsoil is yellowish brown gravelly fine sandy loam 12 inches thick. Hard, unweathered schist bedrock is at a depth of 14 inches.

Included with these soils in mapping are small areas of well drained Canton and Paxton soils; and moderately well drained Sutton and Woodbridge soils. Also included are areas with bedrock at a depth of 20 to 40 inches and a few small areas with slopes of more than 35 percent.

The water table of these soils is commonly at a depth of more than 6 feet. The available water capacity is moderate in the Charlton soils and very low or low in the Hollis soils. Both soils have moderate to moderately rapid permeability and rapid runoff.

The slope, exposed rock, and the depth to bedrock in the Hollis soils limit these areas for community development, especially as a site for onsite septic systems and buildings.

HxC

Hollis-Charlton-Rock outcrop complex, 3 to 15 percent slopes

This unit consists of gently sloping to sloping, somewhat excessively drained and well drained soils and areas of exposed bedrock. The unit is on hills and ridges of glacial till uplands in long and narrow or irregularly shaped areas. Slopes are mostly convex and 100 to 200 feet long. Stones cover 8 to 25 percent of the surface, which is marked by narrow, intermittent drainageways and a few small, wet depressions. The unit is about 35 percent Hollis soils, 30 percent Charlton soils, 15 percent exposed bedrock, and 20 percent other soils. The Hollis and Charlton soils and exposed rock are in such a complex pattern that it was not practical to map them separately.

Typically, the Hollis soils have a surface layer of dark grayish brown fine sandy loam 2 inches thick. The subsoil is yellowish brown gravelly fine sandy loam 12 inches thick. Hard, unweathered schist bedrock is at a depth of 14 inches.

Typically, the Charlton soils have a surface layer of dark yellowish brown fine sandy loam 5 inches thick. The subsoil is yellowish brown fine sandy loam and sandy loam 20 inches thick. The substratum is light yellowish brown and light brownish gray sandy loam to a depth of 60 inches or more.

Included with this unit in mapping are small areas of somewhat excessively drained Gloucester soils, well drained Canton and Charlton soils, moderately well drained Sutton soils, and poorly drained Leicester soils.

The water table in this unit is commonly below a depth of six feet. The available water capacity is very low or low in the Hollis soils, and moderate in the Charlton soils. Both soils have moderate or moderately rapid permeability and medium to rapid runoff.

Most areas of this unit are in woodland. A few small areas are in pasture.

This unit is too stony for cultivation. The stones on the surface, the areas of exposed rock, and the depth to bedrock in the Hollis soils make the unit poorly suited to woodland and are the major limitations for community development. Droughtiness in the Hollis soils causes a high rate of seedling mortality, and trees on the Hollis soils are subject to uprooting because of the depth to bedrock.

HxE Hollis-Charlton-Rock outcrop complex, 15 to 45 percent slopes.

This unit consists of moderately steep to steep, somewhat excessively drained and well drained soils and areas of exposed bedrock. The unit is on hills and ridges of glacial till uplands in long and narrow or irregularly shaped areas. Slopes are mostly convex and 100 to 400 feet long. Stones cover 8 to 25 percent of the surface, which is marked by a few small, intermittent drainageways. This unit is about 35 percent Hollis soils, 30 percent Charlton soils, 15 percent exposed bedrock, and 20 percent other soils. The Hollis and Charlton soils and exposed rock are in such a complex pattern that it was not practical to map them separately.

Typically, the Hollis soils have a surface layer of dark grayish brown fine sandy loam 2 inches thick. The subsoil is yellowish brown gravelly fine sandy loam 12 inches thick. Hard, unweathered schist bedrock is at a depth of 14 inches.

Typically, the Charlton soils have a surface layer of dark yellowish brown fine sandy loam 5 inches thick. The subsoil is yellowish brown fine sandy loam and sandy loam 20 inches thick. The substratum is light yellowish brown and light brownish gray sandy loam to a depth of 60 inches or more.

Included with this unit in mapping are small areas of somewhat excessively drained Gloucester soils, well drained Canton and Charlton soils, and poorly drained Leicester soils. Also included are a few areas where stones and boulders cover less than 8 percent of the surface.

The water table in this unit is commonly below a depth of 6 feet. The available water capacity is very low or low in the Hollis soils and moderate in the Charlton soils. Both soils have moderate or moderately rapid permeability and medium to rapid runoff.

Most areas of this unit are in woodland. A few small areas are used for pasture.

This unit is too stony for cultivation. The depth to bedrock in the Hollis soils, the stones on the surface, the areas of exposed rock, and the slope make the unit poorly suited to woodland and are major limitations for community development. Droughtiness causes a high rate of seedling mortality on the Hollis soils, and trees on the Hollis soils are subject to uprooting during windy periods because of the depth to bedrock.

Lc <u>Leicester fine sandy loam</u>

This is a nearly level, poorly drained soil in drainageways and depressions of glacial uplands. Slopes are 0 to 3 percent and are smooth and concave. They are generally 50 to 300 feet long. The areas dominantly are long and narrow or irregular in shape.

Typically, the surface layer is black fine sandy loam 6 inches thick. The subsoil is grayish brown, light grayish brown, and pale brown, mottled fine sandy loam 17 inches thick. The substratum, to a depth of 60 inches, is dark yellowish brown, mottled, friable gravelly fine sandy loam that has discontinuous firm lenses up to 4 inches thick.

Included with this soil in mapping are small intermingled areas, generally less than 1 acre in size, of moderately well drained Sutton and Woodbridge soils and poorly drained Ridgebury, Walpole, and Rumney soils. Also included are areas where the surface layer is silt loam and a few areas where up to 3 percent of the surface is covered with stones and boulders. Included areas make up 5 to 20 percent of this map unit.

This soil has a seasonal high water table at a depth of about 6 inches from late fall until mid-spring. During the summer, the water table can drop to a depth of 5 feet or more. This soil has moderate or moderately rapid permeability. It has a high available water capacity. Runoff is slow.

Most areas of this soil are idle or used for pasture. Only a small acreage is used as cropland.

This soil has poor potential for community development. It is limited mainly by the high water table during much of the year. This soil is difficult to excavate because the high water table inundates the excavations. The steep slopes of excavations tend to slump when saturated. This soil has poor potential for building foundations and basements because footings are placed below the depth of the high water table. Waste disposal systems, such as septic tank absorption fields, do not function satisfactorily without unusual and costly design and installation. Even then, septic systems are subject to a high rate of failure. Many areas are subject to ponding during the winter months. This soil has poor potential for landscaping because it is wet. Even during the summer, this soil remains wet for several days after rains and is frequently soggy and difficult to mow. Many plants do not adapt to the wetness of this soil.

This soil is fairly well suited to crops. Wetness is the major limitation for most crops, and drainage is needed for good crop production.

This soil is suited to trees. Productivity is moderate. The use of equipment is severely limited by wetness. Machine planting is practical in open areas. Seedling mortality is high, and tree windthrow is common because the rooting depth is restricted by the high water table.

Lg - <u>Ridgebury, Leicester, and Whitman soils, extremely stony</u> - This mapping unit consists of nearly level, poorly drained, and very poorly drained soils in depressions and drainageways of glacial till uplands. The areas are mostly long and narrow or irregular in shape. Slopes range from 0 to 3 percent and are mainly 100 to 300 feet long. Stones cover 8 to 25 percent of the surface. About 40 percent of this unit is Ridgebury soils, 25 percent is Leicester soils, 15 percent is Whitman soils, and 10 percent is other soils. Some areas of this unit will consist of one of these soils, and other areas will consist of two or three. The soils of this unit were mapped together because they have no significant differences in use and management.

The Ridgebury soils have a seasonal high water table at a depth of about 10 inches from fall through spring. The permeability of the soils is moderate to moderately rapid in the surface layer and the subsoil and slow to very slow in the substratum. Runoff is slow. The Ridgebury soils have a moderate available water capacity.

The Leicester soils have a seasonal high water table at a depth of about 10 inches from fall through spring. The permeability of the soils is moderate or moderately rapid throughout. Runoff is slow. The Leicester soils have a moderate available water capacity.

The Whitman soils have a seasonal high water table at or near the surface from fall through spring. The permeability of the soils is moderate or moderately rapid in the surface layer and subsoil and slow to very slow in the substratum. Runoff is slow. The Whitman soils have a moderate available water capacity.

The high water table and slow to very slow permeability are major limitations of the soils of these areas for community development. Steep slopes of excavations in these soils slump when saturated. The stones on the surface restrict landscaping, and lawns are soggy most of the year.

Ma — Udorthents, smoothed

This unit consists of nearly level to sloping, excessively drained to moderately well drained soils. The areas of this unit have been altered by excavating or filling. They are mostly irregular in shape or are rectangular or long and narrow. Slopes range from 0 to 15 percent.

Included with this unit in mapping are small areas of mainly Agawam, Canton, Charlton, Paxton, and Woodbridge soils. Also included are a few small areas covered by buildings and pavement and a few areas that have soil material mixed with logs, tree stumps, and concrete fragments. Included areas make up about 25 percent of the unit.

Determination of the suitability of this unit for any use requires on-site investigation and evaluation.

At this site, and for this report, this area is mostly sandy and is currently being used as a beach for recreation.

MyB - Merrimac sandy loam 3 to 8 percent slopes. This soil is gently sloping and somewhat excessively drained. It is on terraces and outwash plains of stream valleys. The areas are mostly irregular in shape. Slopes are smooth and convex and less than 200 feet long.

Typically, the surface layer is dark brown sandy loam 8 inches thick. The subsoil is yellowish brown sandy loam and loamy sand 16 inches thick. The substratum is yellowish brown gravelly sand and stratified sand and gravel to a depth of 60 inches or more.

Included with this soil in mapping are small areas of excessively drained Hinckley and Windsor soils; well drained Agawam soils, and moderately well drained Sudbury soils. Included areas make up about 15 percent of the unit.

The water table of this Merrimac soil is commonly below a depth of 6 feet. The available water capacity is moderate. The soil has moderately rapid permeability in the surface layer and upper part of the subsoil, moderately rapid or rapid permeability in the lower part of the subsoil, and rapid permeability in the substratum. Runoff is slow to medium.

This soil generally is suited to community development, but the rapid permeability of the substratum causes a hazard of pollution to the ground water in areas used for septic tanks. Some slopes of excavations in this soil are unstable.

PbB - Paxton and Montauk Soils, 3 to 8 percent slopes - These gently sloping, well drained soils are on drumloidal, glacial till, upland landforms.

This mapping unit is about 45 percent Paxton soil, 40 percent Montauk soil, and 15 percent other soils. Areas consist of Paxton soil or Montauk soil, or both. These soils were mapped together because there are no major differences in their use and management.

Typically, the Paxton soil has a very dark grayish brown, fine sandy loam surface layer 8 inches thick. The subsoil is dark yellowish brown, yellowish brown, and light olive brown fine sandy loam 19 inches thick. The substratum is firm, very firm, and brittle, olive brown fine sandy loam to a depth of 60 inches or more.

Typically, the Montauk soil has a very dark grayish brown, fine sandy loam surface layer 7 inches thick. The subsoil is dark yellowish brown fine sandy loam and yellowish brown sandy loam 16 inches thick. The substratum is brown loamy sand and firm, very firm, and brittle, grayish brown loamy sand to a depth of 60 inches or more.

Included with these soils in mapping are small areas of well drained Broadbrook, Canton, and Charlton soils; moderately well drained Woodbridge soils; and poorly drained Ridgebury soils.

Permeability of the Paxton soil is moderate in the surface layer and subsoil and slow or very slow in the substratum. The available water capacity is moderate. Runoff is medium. The Paxton soil warms up and dries out rapidly in the spring.

Permeability of the Montauk soil is moderate or moderately rapid in the surface layer and subsoil and slow or moderately slow in the substratum. The available water capacity is moderate. Runoff is medium. The Montauk soil warms up and dries out rapidly in the spring.

The major limiting factor for community development is the very slow, slow, or moderately slow permeability in the substratum. Onsite septic systems need special design and installation to prevent effluent from seeping to the surface. Steep slopes of excavations slump when wet. Quickly establishing a plant cover and using mulch, temporary diversions, and sediment basins help to reduce erosion during construction.

PbC - Paxton and Montauk soils, 8 to 15 percent slopes. These sloping, well drained soils are on drumloidal, glacial till, upland landforms.

This mapping unit is about 45 percent Paxton soil, 40 percent Montauk soil, and 15 percent other soils. Mapped areas consist of Paxton soil or Montauk soil, or both. These soils were mapped together because there are no major differences in use and management.

Typically, the Paxton soil has a very dark grayish brown, fine sandy loam surface layer 8 inches thick. The subsoil is dark yellowish brown, yellowish brown, and light olive fine sandy loam to a depth of 60 inches or more.

Typically, the Montauk soil has a very dark grayish brown, fine sandy loam surface layer 7 inches thick. The subsoil is dark yellowish brown fine sandy loam and yellowish brown sandy loam 16 inches thick. The substratum is brown loamy sand and firm, very firm, and brittle, grayish brown loamy sand to a depth of 60 inches or more.

Included with these soils in mapping are small areas of well drained Broadbrook, Canton, and Charlton soils; moderately well drained Woodbridge soils; and poorly drained Ridgebury soils.

Permeability of the Paxton soil is moderate in the surface layer and subsoil and slow or very slow in the substratum. The available water capacity is moderate. Runoff is rapid. Paxton soil warms up and dries out rapidly in the spring.

Permeability of the Montauk soil is moderate or moderately rapid in the surface layer and subsoil and slow or moderately slow in the substratum. The available water capacity is moderate. Runoff is rapid. Montauk soil warms up and dries out rapidly in the spring.

The major limiting factor for community development is the very slow, slow, and moderately slow permeability in the substratum. Onsite septic systems need careful design and installation to prevent effluent from seeping to the surface in areas downslope from the leaching system. Quickly establishing a plant cover and using mulch and netting, temporary diversions, and sediment basins help to control erosion during construction.

PeC - <u>Paxton and Montauk soils, 3 to 15 percent slopes, extremely stony</u> - These gently sloping to sloping, well drained soils are on drumloidal, glacial till, upland landforms. Stones and boulders cover 8 to 25 percent of the surface.

This mapping unit is about 45 percent Paxton soil, 40 percent Montauk soil, and 15 percent other soils. Mapped areas are composed of Paxton soil or Montauk soil, or both. These soils were mapped together because there are no major differences in use and management.

Typically, the Paxton soil has a very dark grayish brown, fine sandy loam surface layer 3 inches thick. The subsoil is dark yellowish brown, yellowish brown, and light olive brown fine sandy loam, 24 inches thick. The substratum is firm, very firm, and brittle, olive brown fine sandy loam to a depth of 60 inches or more.

Typically, the Montauk soil has a very dark grayish brown, fine sandy loam surface layer 3 inches thick. The subsoil is dark yellowish brown fine sandy loam and yellowish brown sandy loam 20 inches thick. The substratum is brown loamy sand and firm, very firm, and brittle, grayish brown loamy sand to a depth of 60 inches or more.

Included with these soils in mapping are small areas of well drained Broadbrook, Canton, and Charlton soils; moderately well drained Woodbridge soils; and poorly drained Ridgebury soils.

Permeability of the Paxton soil is moderate in the surface layer and subsoil and slow or very slow in the substratum. The available water capacity is moderate. Runoff is medium or rapid. Paxton soil warms up and dries out rapidly in the spring.

Permeability of the Montauk soil is moderate or moderately rapid in the surface layer and subsoil and slow or moderately slow in the substratum. The available water capacity is moderate. Runoff is medium to rapid. Montauk soil warms up and dries out rapidly in the spring.

The major limiting factor for community development is the very slow, slow, and moderately slow permeability in the substratum. Onsite septic systems need careful design and installation to prevent effluent from seeping to the surface in areas downslope from the leaching system. Stones and boulders need to be removed for landscaping. Quickly establishing a plant cover and using mulch and netting, temporary diversions and sediment basins help to control erosion during construction.

Pk - <u>Carlisle muck</u> - This soil is nearly level to level and very poorly drained. It is in low depressions on outwash terraces and glacial till plains. Areas of this soil are mostly oval in shape. Slopes range from 0 to 2 percent but are mostly less than 1 percent.

Typically, this soil is black, very dark brown, and dark reddish brown muck to a depth of 60 inches or more.

Included with this soil in mapping are small areas of very poorly drained Adrian, Palms, Saco, Scarboro, and Whitman soils. A few small areas have a thin mineral layer on the surface. Included areas make up about 25 percent of the unit.

The water table of this Carlisle soil is at or near the surface during most of the year. The available water capacity is high. Permeability is moderately rapid. Runoff is very slow, and water is on the surface of some areas from autumn to spring and after heavy rains.

Most areas of this soil are wooded or are covered by marshgrasses and sedges. Most areas do not have adequate drainage outlets. Although this soil supports red maple, ash, and alder, it is poorly suited to woodland production. The organic material will not support heavy equipment, and uprooting is common during windy periods.

The high water table and the low strength of the organic material make this soil generally unsuitable for community development.

Pm - Adrian and Palms mucks - This mapping unit consists of very poorly drained soils with an organic layer at least 16 inches thick, but not more than 51 inches thick over sandy and loamy mineral soil materials. These soils are on the landscape commonly in low depressions and along drainageways of outwash plains and glacial till uplands. Slopes are commonly less than one percent.

Adrian and Palms soils have a high water table at or near the surface for most of the year. Permeability is moderately rapid in the organic layers and moderately slow to rapid in the underlying mineral materials. Included in these soils in mapping are small areas of soils with organic material less than 16 inches thick and small areas with organic materials greater than 51 inches thick. These soils are generally not suited to agricultural use or building site development without major reclamation.

SvB - Sutton fine sandy loam, 3 to 8 percent slopes - This gently sloping, moderately well drained soil is on upland glacial till plains, hills, and ridges. Areas are dominantly irregular in shape.

Typically, this Sutton soil has a very dark grayish brown, fine sandy loam surface layer 9 inches thick. The subsoil is yellowish brown, dark yellowish brown, and dark brown, mottled fine sandy loam and sandy loam 24 inches thick. The substratum is olive brown, mottled sandy loam to a depth of 60 inches or more.

Included with this soil in mapping are small areas of well drained Canton and Charlton soils; moderately well drained Woodbridge soils; and poorly drained Leicester soils. Included areas make up about 10 percent of this map unit.

The Sutton soil has a seasonal high water table at a depth of about 18 inches. Permeability is moderate or moderately rapid. The available water capacity is moderate. Runoff is medium. Sutton soil warms up and dries out slowly in the spring.

The major limiting factor for community development is the seasonal high water table. Onsite septic systems need special design and installation to prevent effluent from seeping to the surface. Foundation drains help to prevent wet basements.

Lawns are wet and soggy in the fall and spring. Quickly establishing a plant cover and using mulch, temporary diversions and sediment basins help to control erosion during construction.

SwA - <u>Sutton fine sandy loam, 2 to 8 percent slopes, very stony</u> - This nearly level to gently sloping moderately well drained soil is on upland glacial till plains, hills, and ridges. Stones and boulders cover 1 to 8 percent of the surface. Areas are dominantly irregular in shape.

Typically, this Sutton soil has a very dark grayish brown, fine sandy loam surface layer 4 inches thick. The subsoil is yellowish brown, dark yellowish brown, and dark brown, mottled fine sandy loam and sandy loam 29 inches thick. The substratum is olive brown, mottled sandy loam to a depth of 60 inches or more.

Included with this soil in mapping are small areas of well drained Canton and Charlton soils; moderately well drained Woodbridge soils; and poorly drained Leicester soils. Included areas make up about 10 percent of this map unit.

The Sutton soil has a seasonal high water table at a depth of about 18 inches. Permeability is moderate or moderately rapid. The available water capacity is moderate. Runoff is slow or medium. Sutton soil warms up and dries out slowly in the spring.

The major limiting factor for community development is the seasonal high water table. Onsite septic systems need special design and installation to prevent effluent from seeping to the surface. Foundation drains help to prevent wet basements. Lawns are wet and soggy in the fall and spring. Quickly establishing a plant cover and using mulch, temporary diversions, and sediment basins to help control erosion during construction.

SxA, SxB - <u>Sutton fine sandy loam, 2 to 15 percent slopes, extremely stony</u> - This nearly level to gently sloping, moderately well drained soil is on upland glacial till plains, hills, and ridges. Stones and boulders cover 8 to 25 percent of the surface. Areas are dominantly irregular in shape.

Typically, this Sutton soil has a very dark grayish brown, fine sandy loam surface layer 4 inches thick. The subsoil is yellowish brown, dark yellowish brown, and dark brown, mottled fine sandy loam and sandy loam 29 inches thick. The substratum is olive brown, mottled sandy loam to a depth of 60 inches or more.

Included with this soil in mapping are small areas of well drained Canton and Charlton soils; moderately well drained Woodbridge soils; and poorly drained Leicester soils. Included areas make up about 10 percent of this map unit.

The Sutton soil has a seasonal high water table at a depth of about 18 inches. Permeability is moderate or moderately rapid. The available water capacity is moderate. Runoff is slow or medium. Sutton soil warms up and dries out slowly in the spring.

The major limiting factor for community development is the seasonal high water table. Onsite septic systems need special design and installation to prevent effluent from seeping to the surface. Foundation drains help to prevent wet basements. Stones and boulders need to be removed for landscaping. Quickly establishing a plant cover and using mulch, temporary diversions, and sediment basins help to control erosion during construction.

Wd - <u>Walpole sandy loam</u>

This soil is nearly level and poorly drained. It is in depressions and drainageways on stream terraces and outwash plains. The areas are mostly irregular in shape. Slopes range from 0 to 3 percent.

Typically, the surface layer is very dark brown sandy loam 6 inches thick. The subsoil is mottled, dark grayish brown and grayish brown sandy loam and gravelly sandy loam 17 inches thick. The substratum is mottled, light brownish gray gravelly loamy sand and gravelly sand to a depth of 60 inches or more.

Included with this soil in mapping are small areas of moderately well drained Ninigret, Pootatuck, and Sudbury soils; poorly drained Rippowam soils; and very poorly drained Scarboro soils. A few large areas have a surface layer of silt loam. Included areas make up about 10 percent of the unit.

This Walpole soil has a seasonal high water table at a depth of about 10 inches during fall and spring. This soil has moderately rapid permeability in the surface layer and subsoil and rapid or very rapid permeability in the substratum. Runoff is slow. The soil has moderate available water capacity.

This soil is mostly in woodland. Some areas are used for pasture or hay, and a few areas are in community development.

Drained areas of this soil are suited to cultivated crops. Even when drained, however, this soil remains wet for several days after heavy rains, restricting the use of farming equipment.

The soil is suited to woodland, but seasonal wetness causes a high rate of seedling mortality and restricts the use of some types of harvesting equipment. Uprooting is a hazard during windy periods.

The seasonal high water table is a major limitation of this soil for community development, especially for on-site septic systems. Steep slopes of excavations in this soil are unstable. Lawns on this soil are soggy in fall and spring and after heavy rains.

WxA - <u>Woodbridge fine sandy loam, 0 to 3 percent slopes</u>

This soil is nearly level and moderately well drained. It is on the top and lower side slopes of large drumlins and hills on glacial till uplands. The areas are mostly oval or irregular in shape.

Typically, the surface layer is very dark grayish brown fine sandy loam 8 inches thick. The subsoil is mottled, dark yellowish brown and yellowish brown fine sandy loam 22 inches thick. The substratum is firm and very firm, olive gray fine sandy loam and gravelly fine sandy loam to a depth of 60 inches or more.

Included with this soil in mapping are small areas of well drained Paxton soils, moderately well drained Sutton soils, and poorly drained Leicester and Ridgebury soils. A few small areas have stones on the surface, and a few large areas have a surface layer and subsoil of silt loam. Included areas make up about 10 percent of the unit.

This Woodbridge soil has a seasonal high water table at a depth of about 20 inches from fall to spring. It has moderate available water capacity. This soil has moderate permeability in the surface layer and subsoil and slow to very slow permeability in the substratum. Runoff is medium.

This soil is well suited to woodland and cultivated crops. The main limitation for crops is the seasonal high water table, which causes the soil to dry slowly in the spring. Providing drainage helps to dry this soil earlier in the spring, but even drained areas remain wet for several days after heavy rains.

The water table and the slow or very slow permeability in the substratum are the main limitations of this soil for community development, especially for on-site septic systems. Lawns on this soil are soggy in the autumn and spring and after heavy rains.

WxB - <u>Woodbridge fine sandy loam, 3 to 8 percent slopes</u>

This soil is gently sloping and moderately well drained. It is on the tops and lower side slopes of large drumlins and hills on glacial till uplands. The areas are mostly long and narrow.

Typically, the surface layer is very dark grayish brown fine sandy loam 8 inches thick. The subsoil is mottled, dark yellowish brown, and yellowish brown fine sandy loam 22 inches thick. The substratum is firm to very firm, olive gray fine sandy loam and gravelly fine sandy loam to a depth of 60 inches or more.

Included with this soil in mapping are small areas of well drained Paxton soils, moderately well drained Sutton soils, and poorly drained Leicester and Ridgebury soils. A few small areas have stones on the surface, and a few large areas have a surface layer and subsoil of silt loam. Included areas make up about 15 percent of the unit.

This Woodbridge soil has a seasonal high water table at a depth of about 20 inches from fall to spring. It has moderate available water capacity. The soil has moderate permeability in the surface layer and subsoil and slow to very slow permeability in the substratum. Runoff is medium.

This soil is well suited to woodland and cultivated crops. The main limitation for crops is the seasonal high water table, which causes the soil to dry slowly in the spring. Providing drainage helps to dry the soil earlier in the spring, but even drained areas remain wet for several days after heavy rains.

The water table and the slow or very slow permeability in the substratum are the main limitations of this soil for community development, especially for on-site septic systems. Lawns on this soil are soggy in the autumn and spring and after heavy rains.

WyA, WyB - Woodbridge fine sandy loam, 2 to 8 percent slopes, very stony.

This soil is nearly level to gently sloping and moderately well rained. It is on the tops and side slopes of drumlins and hills on glacial till uplands. The areas are mostly long and narrow or irregular in shape. Stones cover 1 to 8 percent of the surface.

Typically, the surface layer is very dark grayish brown fine sandy loam 8 inches thick. The subsoil is mottled, dark yellowish brown, and yellowish brown fine sandy loam 22 inches thick. The substratum is firm to very firm, olive gray fine sandy loam, and gravelly fine sandy loam to a depth of 60 inches or more.

Included with this soil in mapping are small areas of well drained Paxton soils, moderately well drained Sutton soils, and poorly drained Leicester and Ridgebury soils. A few small areas do not have stones on the surface. Included areas make up about 10 percent of the unit.

This Woodbridge soil has a seasonal high water table at a depth of about 20 inches from fall to spring. The available water capacity is moderate. This soil has moderate permeability in the surface layer and subsoil and slow to very slow permeability in the substratum. Runoff is medium.

Most areas of this soil are in woodland. A few areas are in pasture, and a few are in community development.

This soil generally is too stony for cultivation, but is well suited to woodland. Stone removal makes the soil well suited to cultivated crops, but is difficult. Seasonal wetness is an additional limitation of the soil for crops.

The water table and the slow or very slow permeability in the substratum are the main limitations of this soil for community development, especially for on-site septic systems. Lawns on this soil are soggy in the autumn and spring and after heavy rains.

WzA, WzC - <u>Woodbridge fine sandy loam, 2 to 15 percent slopes, extremely stony</u>

This soil is gently sloping to sloping and moderately well drained. It is on the tops of large drumlins and hills on glacial till uplands. The areas are mostly oval or irregular in shape. Stones cover 8 to 25 percent of the surface.

Typically, the surface layer is very dark grayish brown fine sandy loam 8 inches thick. The subsoil is mottled, dark yellowish brown and yellowish brown fine sandy loam 22 inches thick. The substratum is firm to very firm, olive gray fine sandy loam and gravelly fine sandy loam to a depth of 60 inches or more.

Included with this soil in mapping are small areas of well drained Paxton soils, moderately well drained Sutton soils, and poorly drained Ridgebury soils. Included areas make up about 15 percent of the unit.

This Woodbridge soil has a seasonal high water table at a depth of about 20 inches from fall to spring. It has moderate available water capacity. The soil has moderate permeability in the surface layer and subsoil and slow to very slow permeability in the substratum. Runoff is rapid.

This soil is mostly in woodland. A few areas are in pasture, and a few are in community development.

This soil generally is too stony for cultivation but is well suited to woodland. Stone removal makes the soil well suited to crops but is difficult. Seasonal wetness in fall and spring is an additional limitation for crops.

The water table and the slow or very slow permeability in the substratum are the main limitations of this soil for community development, especially for on-site septic systems. Lawns on this soil are soggy in the autumn and spring and after heavy rains.

VII. VEGETATION

THE FOREST TYPE THROUGHOUT THE WATERSHED IS MIXED HARDWOOD (COMPOSED OF BALCK, RED SCARLET AND WHITE OAK, BLACK BIRCH, RED MAPLE, PIGNUT AND SHAG-BARK HICKORY, SUGAR MAPLE, WHITE ASH) WHICH OCCUPIES ABOUT 80% OF THE ACREAGE. THE TREES ARE GENERALLY IN THE POLE-SAW SIZE CLASS (6" DIAMETER AT BREAST HEIGHT TO IN EXCESS OF 18" DIAMETER AT BREAST HEIGHT). ABOUT 15% OF THE WATERSHED IS OPEN AGRICULTURAL LAND PRESENTLY IN USE OR JUST RECENTLY ABANDONED. ANOTHER 5% OF THE AREA IS HARDWOOD SWAMP. THESE FORESTED WETLANDS ARE PREDOMINANTLY RED MAPLE, YELLOW BIRCH, WHITE ASH AND ELM.

FOREST MANAGEMENT AND WATER QUALITY

HEALTHY WOODLANDS PROVIDE A PROTECTIVE INFLUENCE ON WATER QUALITY BY STABILIZING SOILS, REDUCING IMPACT OF PRECIPITATION AND RUN OFF, AND MODERATING THE EFFECTS OF ADVERSE WEATHER CONDITIONS. WOODLANDS THEREFORE HELP TO REDUCE EROSION, SEDIMENTATION, SILTATION AND FLOODING. RESEARCH HAS SHOWN THAT SOIL PROTECTED BY THE COVER OF LITTER AND HUMUS FOUND IN WOODLAND AREAS CONTRIBUTES LITTLE OR NO SEDIMENT TO STREAMS.

TO MAINTAIN A HEALTHY AND PRODUCTIVE FOREST ONE MUST PROPERLY HARVEST THE FOREST. RESEARCH HAS SHOWN THAT NUTRIENT LOSS FROM GOOD SILVICULTURAL PRACTICES (THE ART OF TENDING, CULTIVATING AND HARVESTING TIMBER) DOES NOT RESULT IN SIGNIFICANT DETERIORATION OF WATER QUALITY. HEALTHY FORESTS ALSO PROVIDE OXYGEN TO THE ATMOSPHERE, VISUAL AND AUDIO BARRIERS AND HAVE A CLEANSING EFFECT ON THE ATMOSPHERE AS A POLLUTION COLLECTOR. ANY ADVERSE IMPACTS ON WATER QUALITY CAN BE MINIMIZED THROUGH GOOD PLANNING, PROFESSIONAL CONSULTATION AND RESPONSIBLE IMPLEMENTATION AS A PRODUCTIVE FOREST IS A VITAL PART OF AN OVERALL HEALTHY ENVIRONMENT. A PAMPHLET ENTITLED: "LOGGING AND WATER QUALITY IN CONNECTICUT" IS AVAILABLE FROM THE DEPARTMENT OF ENVIRONMENTAL PROTECTION. RECOMMENDATIONS IN THE PAMPHLET CAN MINIMIZE THE IMPACT OF SILVICULTURAL PRACTICES ON WATER QUALITY. THE PAMPHLET IS AVAILABLE UPON REQUEST FROM 295-9523.

FOREST MANAGEMENT CONSIDERATIONS

THE FORESTRY BUREAU OF THE DEPARTMENT OF ENVIRONMENTAL PROTECTION ENCOURAGES ALL WOODLAND OWNERS TO MANAGE THEIR FOREST LAND. 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 ECOSYSTEM. TREES ON GOOD GROWING SITES WILL RESPOND WELL TO PERIODIC THINNINGS TO REMOVE THE POORER QUALITY TREES LEAVING THE TALL, STRAIGHT, WELL-FORMED TREES TO GROW. HEALTHIER TREES GROW FASTER, PRODUCE HIGHER QUALITY WOOD FOR LUMBER, ARE ABLE TO MAINTAIN HEALTHIER WILDLIFE POPULATIONS AND ARE MORE RESISTANT TO DISEASE AND INSECT OUTBREAKS, NAMELY GYPSY MOTH CATERPILLAR.

TO REACH A HEALTHY AND PRODUCTIVE STATE, INDIVIDUAL FOREST STANDS SHOULD BE PERIODICALLY EVALUATED TO DETERMINE PRESENT AND FUTURE MANAGEMENT NEEDS. A PUBLIC FORESTER FROM THE DEPARTMENT OF ENVIRONMENTAL PROTECTION CAN BE CONTACTED AT 295-9523 TO PROVIDE PRELIMINARY ADVICE AND ASSISTANCE IN WOOD-LAND MANAGEMENT. SERVICES OF A MORE INTENSIVE NATURE ARE AVAILABLE FROM PRIVATE CONSULTING FORESTERS.

Conclusion

Following best management practices, professional forestry advice and using common sense will help to avoid water quality degradation from silvicultural operations. Educational and incentive programs may be reienforced through landowner groups, adult education, field tours of D.E.P. lands for citizens, the use of thorough timber sale contracts and reasonable performance deposits. A public or private forester can assist a landowner in developing a good timber sale contract. Periodic on-site inspections are also essential to ensure that the terms of harvesting contracts are met. Most important however is the use of a competent professional forester in cooperation with the education of landowners and loggers as the key to the successful use of best management practices in forest management. Further guidelines to maintain water quality on managed woodlands can be found in the pamphlet "Timber Harvesting Guidelines" by the Wood Producers Association of Connecticut (WOODPAC). The guidelines in this publication are aimed at protecting the forest ecosystem from thoughtless timber harvesting practices that can lower environmental quality in the long and short run. Copies of the pamphlet are available from WOODPAC or the Department of Environmental Protection 295-9523.

VIII. Fish Resources

Andover Lake is a typical warm-water lake. Shoreline development is heavy. Fishing pressure is light because of limited access.

The lake supports the following warm-water fish species: largemouth bass, chain pickeral, yellow perch, black crappie, redbreast sunfish, pumpkinseed sunfish, blue gill sunfish, brown bullhead, white catfish, banded killifish, and golden shiner. In recent years, over twenty (20) trophy sized bass (6 pounds +) have been reported by fishermen.

The present warm-water fish species in Andover Lake is ideal. The annual draw-down may benefit gamefish by concentrating forage fish into areas where they are more apt to be preyed upon. The lake's water level should be raised to its normal level by April 1st and maintained throughout the summer to insure successful reproduction of fishes. No stocking of additional fish species is recommended.

IX. SUMMARY

NOTE: This is a brief summary of the major concerns and recommendations of the Team. You are strongly urged to read the entire report, and to refer back to the specific sections in order to obtain all the information about a certain topic.

--TOWN OFFICIALS WILL NEED TO CLOSELY MONITOR ALL FUTURE DEVELOPMENT IN THE WATERSHED FOR PROPERLY CONSTRUCTED AND INSTALLED SEPTIC SYSTEMS, EFFECTIVE EROSION AND SEDIMENT CONTROL MEASURES, MAINTAIN CATCH BASINS, ETC. TO ENSURE THAT THE WATER QUALITY OF THE LAKE IS NOT ADVERSELY AFFECTED.

--A NUMBER OF STEPS CAN BE TAKEN TO REDUCE THE POTENTIAL ADVERSE EFFECTS OF EXISTING AND PROPOSED SEWAGE DISPOSAL SYSTEMS IN THE WATERSHED:

1) CONDUCTING A SANITARY SURVEY 2) STRICT ENFORCEMENT OF THE PUBLIC HEALTH CODE REQUIREMENTS 3) EDUCATING LAKESIDE RESIDENTS 4) ENCOURAGING THE USE OF NON-PHOSPHATE LAUNDRY DETERGENTS AND 5) STRICT ENFORCEMENT OF SECTION 19-13-B100. BUILDING CONVERSION OF THE CONNECTICUT PUBLIC HEALTH CODE AND CONSIDERATION OF ADOPTING A TOWN ORDINANCE WHICH REQUIRES THE INSTALLATION OF SEWAGE DISPOSAL SYSTEMS MEETING ALL HEALTH CODE REQUIREMENTS AT THE TIME OF BUILDING CONVERSION FROM SEASONAL TO YEAR ROUND USE.

--LAWN AND GARDEN FERTILIZER APPLICATIONS SHOULD BE MATCHED TO SOIL REQUIREMENTS AND APPLICATION TIMES TO AVOID PERIODS OF RUNOFF.

--ONE WATER QUALITY/WATERSHED MANAGEMENT PROBLEM WHICH REQUIRES ATTENTION IS THE ACCUMULATION OF SEDIMENT AT THE MOUTH OF CHENEY BROOK AND ERDONI BROOK. THE EXCAVATION OF THESE SEDIMENTS WOULD BE BEST ACCOMPLISHED DURING THE ANNUAL WINTER DRAW-DOWN OF THE LAKE. THIS MAY REQUIRE LOCAL INLAND WETLANDS PERMITS.

--PROVISIONS SHOULD BE MADE TO REDUCE TRANSPORT OF ROAD SAND, ETC. TO THE LAKE BY STREET SWEEPING AND THE INSTALLATION OF CATCH BASINS WHEREVER STORMWATER IS DISCHARGING TO THE LAKE.

--AT THE PRESENT TIME, THERE DOES NOT APPEAR TO BE ALGAE OR AQUATIC WEED PROBLEMS WHICH WOULD REQUIRE MANAGEMENT.

--THE WEST STREAMBANK OF CHENEY BROOK IMMEDIATELY DOWNSTREAM TO LAKE ROAD IS ERODING, THIS BANK SHOULD BE INSPECTED PERIODICALLY TO DETERMINE IF STABILIZATION IS WARRANTED.

--A DETAILED EXAMINATION OF ALL STREAMBANKS COULD BE CARRIED OUT AS AN ACTIVITY OF THE CONSERVATION COMMISSION, INLAND WETLANDS COMMISSION OR THE LAKE ASSOCIATION.

--PROPER MANAGEMENT OF THE STREAMBELT ZONE WITHIN THE WATERSHED AREA IS CRITICAL TO THE FUTURE WATER QUALITY CONDITIONS IN THE LAKE.

--The Town may want to consider establishing streambelts along major watercourses and regulations to give the Planning and Zoning Commssion additional authority in these areas.

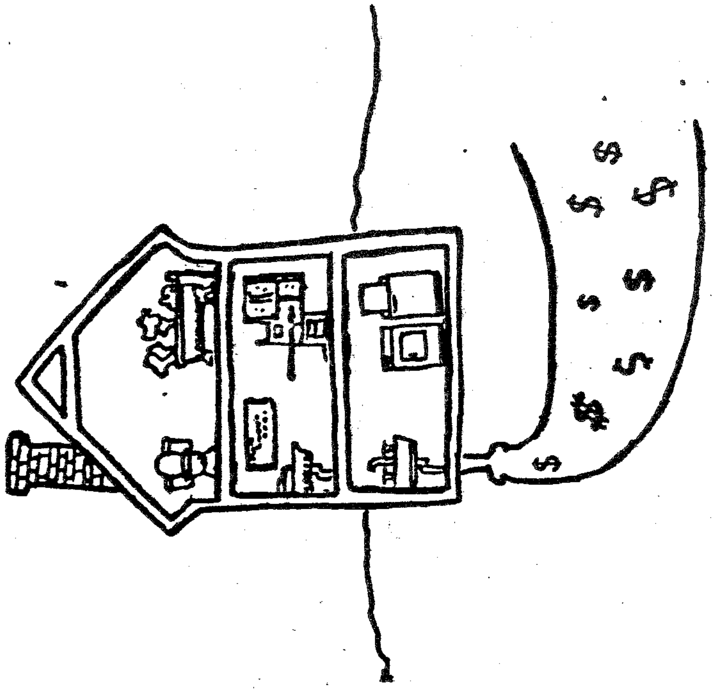
--Any specific soil concerns in the watershed area may need on-site investigations to confirm or identify specific problems at a particular site.

--Following best management practices, professional forestry advice and using common sense will help to avoid water quality degradation from silvicultural operations.

--The present warm water fish species in Andover Lake is ideal. No stocking of additional fish species is recommended.

Appendix

HOMEOWNER'S GUIDE TO SEPTIC SYSTEM MAINTENANCE



(or how to save thousands of dollars)

NORTHEASTERN CONNECTICUT
REGIONAL PLANNING AGENCY
P. O. Box 198
Brooklyn, CT 06234

SEPTIC SYSTEM MAINTENANCE MAKES SENSE!

A new septic system costs about $1,500-$2,000 to install. If it is not taken care of properly, it will become clogged and will either back up into the building or come out on the surface of the ground. When a septic tank is ignored, solids accumulate excessively and finally flow out of the tank into the pipes of the underground leaching system. Gradually the seepage holes in the pipes, and the surrounding earth, become clogged and no longer function. Rebuilding or replacing the system is a major expense and an inconvenience. *System failure is expensive.* It is easier to *prevent* than it is to *correct*. By keeping harmful materials out of the system, and by having the septic tank pumped out regularly (at least every three years), the homeowner can help protect his system against premature failure. The $35-$60 cost of having the tank pumped is cheap insurance to protect an investment worth $1,500-$2,000.

Septic system failure can also be costly to you as a taxpayer. As septic systems fail throughout the town, the streams and rivers become polluted and surfacing sewage becomes a public health nuisance. It will be the responsibility of the Lake Association and the Town of Thompson to correct such pollution problems, and extremely costly sewer and treatment systems will be required. Add to this the fact that the federal government will not kick in 90% of the costs of the sewers, and the prospect becomes awesome indeed - sewer hookups could very realistically cost a homeowner $10,000!

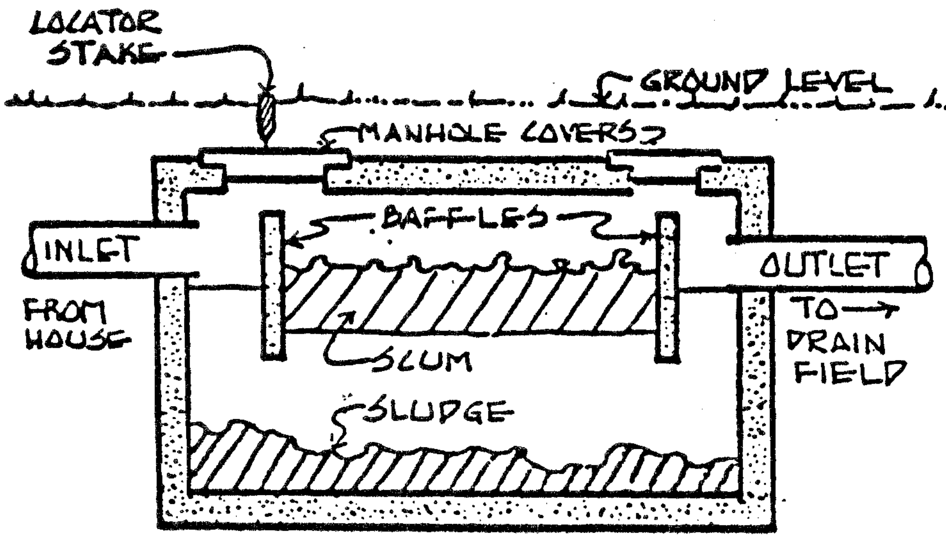
Septic Tank Pumping

Septic tanks must be pumped out by contractors licensed by the State of Connecticut. You should make certain that the person providing this service has a current license. A list of operators licensed to work in the Northeast Region is included in this booklet.

While your tank is being pumped out, ask the operator to inspect the inlet and outlet baffles. If either is broken, it should be repaired immediately. Failure to repair a broken baffle may result in failure of the septic system. The inlet should also be checked to see if wastewater is continuously flowing into the tank from previously undetected plumbing leaks.

It is not necessary to leave any of the sludge in the tank as a "seed." Incoming sewage contains all the bacteria needed for proper operation of the septic tank. The use of acids or bleaches to clean the tank is not recommended as a part of normal maintenance.

The use of enzymes and other "miracle" septic system additives has not been shown to be of any value. While their use may not harm your system, they do not take the place of regular pumping. Furthermore, some of these materials can cause chemical contamination of the groundwater and ultimately contaminate your well. Contamination of this type has occurred in Connecticut, and you are strongly advised not to use chemical additives to make your sewage disposal system work!



Septic Tank
CROSS SECTION

If solids are allowed to reach the level of the outlet pipe, the system acquires a high probability of future failure.

PREVENTING SYSTEM FAILURE

To help protect a septic system against premature failure, the homeowner should follow these simple procedures:

1. Have your tank pumped at least every three years. Do not wait until the symptoms of failure show up; it will be too late to prevent failure!

2. Minimize water use in the home. Excess water will decrease the effectiveness of the septic tank and lead to flooding of the leaching area. Never empty basement sumps or other sources of clear water into the septic system. Run dishwashers and washing machines with full loads only. Fix leaky faucets and toilets promptly.

3. Do not dispose of large quantities of the following materials into the septic system: vegetable trimmings, ground garbage, sanitary napkins, coffee grounds, fats, greases, acids, disinfectants, medicines, paint, paint thinner or other chemicals. These materials may adversely affect the functioning of the sewage disposal system or cause complete failure. Please dispose of these and other materials in an environmentally safe manner.

4. Do not plant deep-rooted trees or bushes over the leaching area. Their roots may clog pipes.

5. Do not discharge salt brine backflush solution from water softeners into the septic system. The discharge of water softener backwash into the septic system is a violation of the Public Health Code and may result in contamination of wells with salt.

SUGGESTIONS FOR MAXIMIZING THE SERVICE OF A SUBSURFACE SEWAGE DISPOSAL SYSTEM

1. Have the septic tank pumped, unless it is known to have been pumped within the past few years. The previous owner may have knowledge of the location and size of the septic tank. If so, be sure to record this information.

2. If you know the size of the tank, you may call two or three pumping contractors for competitive bids. If the size of the tank is not known, be sure to ask the contractor the size (in gallons) once it has been pumped.

3. If the exact location of the tank is not known, when the tank is pumped, measure the distance to the clean-out hole of the tank to two points on the house. This procedure will allow you to easily locate the tank for inspection and pumping thereafter.

4. If the septic tank is undersized (relative to the expected water use) and/or significantly less than 1,000 gallons, it should be replaced or pumped routinely to prevent solids in the tank from entering the leaching system.

5. Ask the contractor about the condition of the tank baffles. If one or both baffles are broken or missing, replace the tank or baffles as soon as possible.

6. If the clean-out for the septic tank is deep in the ground, a small diameter tile pipe may be installed and extended close to surface grade for easy access. This procedure will facilitate inspection and pumping.

(This document has been primarily excerpted from a publication of the Northeast District Department of Health, entitled, "Homeowner's Guide." Publication of this leaflet was provided by the Northeastern Connecticut Regional Planning Agency under an EPA

LICENSED SEPTIC TANK CLEANERS IN NORTHEASTERN CONNECTICUT

A-1 Septic Service Steve Steniger	Phelps Road, Woodstock
Coughlin Bros. Inc.	Fairview Avenue, Jewett City
LaPorte & Sons	Lovers Lane, RFD 2, Plainfield
Parent Sanitation	13 Sayles Avenue, Dayville
Francis L. Strmiska	Route 14, RFD 1, Canterbury
Will-Du Septic Service Mike Kaskela	Walker Road, Quinebaug

A WATERSHED MANAGEMENT GUIDE FOR CONNECTICUT LAKES

CONNECTICUT DEPARTMENT OF ENVIRONMENTAL PROTECTION
WATER COMPLIANCE UNIT

REVISED 1986

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INTRODUCTION

Connecticut's lakes and ponds are valuable natural resources which are used intensively for swimming, fishing, sailing, waterskiing, and many other forms of water based recreation. Lakes and ponds add diversity and aesthetic interest to the landscape and contribute immeasurably to the enjoyment of daily life in lakeside communities. They are important economic entities as well, with money spent in the pursuit of recreation contributing to local and regional economies. Lakes and ponds also enhance local property values, thereby augmenting the tax revenues of local communities.

Unfortunately, all lakes and ponds undergo the aging process called eutrophication, a form of water pollution which results in a decline in recreational utility and aesthetic appeal. Eutrophication is a gradual natural process which is accelerated by man's use of the lands which surround the waterbody. Through awareness and considerable effort and commitment, the eutrophication process is controllable and manageable. Every lake and pond in Connecticut will benefit from "preservation" oriented management which slows the eutrophication process and prolongs the useful life of the waterbody. Many lakes and ponds are also in need of "restoration" oriented management to correct or reverse undesirable conditions brought about in the absence of prudent management in past years.

This handbook has been developed to assist concerned citizens in understanding the process of eutrophication and the principles of eutrophication control through the management of the lake's surrounding watershed land. The handbook is a synthesis of information assimilated by the DEP through its eutrophication abatement activities in recent years. Material in the handbook was selected to fulfill basic information needs of the general public,as determined by our experiences with a variety of lake projects and our contact with numerous individuals and lake organizations. The handbook is intended to assist the layman in working more effectively with technical experts in government agencies and private industry to protect and restore Connecticut's lakes.

EUTROPHICATION

The Process of Eutrophication

Eutrophication is the process of lake aging, caused by enrichment of the lake with plant nutrients from its surrounding watershed land. During the aging process many lake characteristics undergo dramatic changes. To lake users, changes observed include algae blooms increasing in frequency, intensity, and duration; beds of aquatic plants becoming dense and more extensive in coverage of the lake bottom; sediment deposits accumulating, shoal areas developing, and the lake becoming shallower; and the oxygen content of bottom waters declining. As these conditions become pronounced, recreation opportunities become seriously impaired. During the latter stages of the eutrophication process, the lake evolves to a wetland - a swamp, marsh, or bog - and no longer can support its former recreation uses.

The Rate of Eutrophication

The rate at which eutrophication advances is determined by the rate at which the lake is fertilized by its watershed. Under natural conditions, nutrient inputs from a forested watershed are minimal and it may take many centuries for a lake to change in appearance. However, man's development and use of watershed land inevitably results in greater nutrient export from the watershed, and an acceleration in the rate of eutrophication. If man's watershed activities are not controlled, severe lake eutrophication can be brought about in a matter of decades.

Stages of Eutrophication

There are three basic stages of eutrophication which are used to describe the age of a lake. These stages are termed "oligotrophic", "mesotrophic" and "eutrophic". Oligotrophic refers to lakes in the early stages of the eutrophication process, while eutrophic refers to lakes in the late stages. Mesotrophic refers to middle-age lakes in transition between oligotrophic and eutrophic states. These stages are also referred to as trophic states or trophic classifications.

Each stage of eutrophication is characterized by a distinct set of lake conditions. Oligotrophic lakes are deep lakes with clear, infertile waters. They are low in biological productivity, having sparse amounts of algae and aquatic plants. They have minor accumulations of bottom sediments, and have well oxygenated bottom waters. Oligotrophic lakes are prime recreation lakes. Eutrophic lakes are relatively shallow lakes with fertile, turbid waters. They are high in biological productivity, having dense blooms of algae and dense beds of vascular aquatic plants. Eutrophic lakes have substantial accumulations of bottom sediments and have poorly oxygenated bottom waters. Eutrophic lakes have limited recreational utility. Mesotrophic lakes exhibit a mid-range of fertility, productivity, depth, and sedimentation.

Studies of the trophic conditions of Connecticut lakes have resulted in the development of a formal classification system which defines trophic states on the basis of scientific measurements of water quality. A "highly eutrophic" stage was included in the eutrophic lakes. The mesotrophic state was subdivided into "early mesotrophic", "mid mesotrophic", and "late mesotrophic" conditions in order to further differentiate among lakes in this relatively broad category. A list of Connecticut lakes which have been formally classified is presented on pages 26 and 27 of this handbook.

These classification categories are useful tools for comparing the water quality of different lakes, for establishing benchmarks for short and long term trend comparisons, and for estimating the probable level of management required to meet lake use objectives. Trophic classifications are not rigid, and a lake may be eutrophic in some respects and mesotrophic in others. Also, the designation of a lake as eutrophic does not indicate that it is unsuitable or undesirable for all types of recreation, nor should it discourage efforts to manage the lake resource. Similarly, the classification of a lake as oligotrophic should not engender complacency towards management. In both instances, water quality can be maintained and improved through a management program.

Eutrophication of Artificial Lakes and Ponds - When initiating a lake study, it is important to recognize that many lakes and ponds in Connecticut were formed by the construction of a dam across a stream or across the outlet of a wetland. These artificial waterbodies often exhibit an advanced stage of eutrophication. They are relatively shallow waterbodies which are enriched by the nutrients accumulated by the predecessor wetland or terrestrial ecosystem. However, these water quality conditions do not evolve from the oligotrophic state - these lakes experience an advanced state of eutrophication from the time they are formed. Improvement of conditions in these lakes is exceptionally difficult because restoration does not involve the return to previous water quality conditions, but rather involves the creation of conditions which had never existed previously. Examples of this type of lake are Silver Lake in Berlin/Meriden, North Farms Reservoir in Wallingford, Mamanasco Lake in Ridgefield, Lake Winnemaug in Watertown, and Winchester Lake in Winchester.

Eutrophication as Water Pollution - Eutrophication is widely recognized as a form of water pollution which seriously impacts the recreational value of lakes and ponds. Programs to address eutrophication problems are mandated by both state and federal legislation.

Section 25a-338 of the Connecticut General Statutes requires the DEP to conduct a study of the growth and cause of algae and other plant life in the inland waters of the State, and to undertake programs of algae abatement and weed control in cooperation with other public and private agencies.

Section 314 of the Federal Clean Water Act (P.L. 95-217) requires that each State submit to the Environmental Protection Agency an identification of publicly owned freshwater lakes and a classification of those lakes according to trophic condition. The statute further requires states to submit to the EPA procedures, processes, and methods to control sources of pollution to lakes, and methods and procedures to restore the quality of lakes.

The Limiting Nutrient, The Key to Controlling Eutrophication

In order for any form of life to grow and multiply, the basic building blocks of life must be available in the environment. Those essential substances are commonly referred to as nutrients. In a lake, algae depend on nutrients in the water column to satisfy their growth. The larger rooted aquatic plants also depend on nutrients in the water column, although to a lesser extent since many species can also extract nutrients from lake sediments.

The term "limiting nutrient" refers to that particular nutrient which is in shortest supply relative to the growth needs of an organism grows. When the limiting nutrient becomes depleted, growth stops even though other nutrients are still available in surplus. Any increase in the supply of the limiting nutrient will result in a corresponding increase in growth. Conversely, any decrease in the supply of the limiting nutrient will result in a corresponding decrease in growth. The key to controlling the growth of algae and vascular plants in a lake - the key to controlling eutrophication - is to reduce the supply of the growth limiting nutrient.

Carbon, nitrogen, and phosphorus are the three basic plant nutrients which could hypothetically be limiting to the growth of algae and aquatic plants in a lake. Surface waters have an abundant supply of carbon because carbon dioxide gas (CO_2) readily dissolves in lake waters from the atmosphere. Similarly, nitrogen gas (N_2) readily dissolves in lake waters from the atmosphere and is present in abundance. There are many forms of common nuisance blue-green algae which are physiologically capable of "fixing" N_2 and utilizing this form of nitrogen for growth. These algae thrive even when dissolved mineral nitrogen forms (ammonia, nitrate) are scarce. Thus, carbon and nitrogen are not generally limiting to the eutrophication process.

Phosphorus, the third basic plant nutrient, has been found to be the growth limiting nutrient in the eutrophication process of most lakes and ponds. Phosphorus is not readily available as a gas from the atmosphere, and it is usually present in relatively scarce quantities in lake waters. Lake water quality studies have found that most lakes have a scarce supply of phosphorus relative to other nutrients and are phosphorus limited. Some highly eutrophic lakes have been found to be nitrogen limited, although this is not due to a low nitrogen supply but rather to an excessive phosphorus supply. In these lakes, restoration strategies focus on phosphorus control to reduce the supply to a level where it becomes limiting.

The key to controlling the eutrophication process, therefore is controlling phosphorus enrichment.

WATERSHED MANAGEMENT OVERVIEW

Objectives

The watershed of a lake is that land area which drains to the lake. The watershed is therefore the source of water for the lake. Water quality of a lake, to a large extent, is determined by qualities imparted to water by watershed land as the water drains to the lake.

Watershed management is aimed at identifying and controlling existing and potential watershed characteristics which ultimately influence a lake's trophic condition. Since phosphorus is the nutrient which governs the productivity of algae and aquatic plants, watershed management is first and foremost concerned with reducing phosphorus enrichment. An important secondary consideration is the reduction of sediment inputs which contribute to physical lake filling and the development of shallow shoal areas where tributaries and storm waters enter the lake.

Watershed management is imperative for each and every lake, regardless of the lake's trophic condition. If a lake is oligotrophic, watershed management will serve to preserve its superior quality and prolong its useful life for recreation. If a lake is eutrophic, watershed management will serve to temper the eutrophication process and enhance the effectiveness of restoration measures within the lake. Watershed management must be the foundation for all lake preservation and lake restoration programs.

Point Sources and Non-point Sources

Sources of phosphorus and sediment are divided into two broad categories, point sources and non-point sources. Point sources are concentrated, localized discharges such as outfalls from sewage treatment plants. Non-point sources are diffuse and are not easily identified because they do not enter a watercourse at a single point. Rainstorm runoff from a residential area and drainage from a cornfield are examples of non-point sources.

In Connecticut, State policy has prohibited point source discharges to a natural lakes and ponds and many artificial impoundments (including their tributary watercourses). In a relatively few cases, artificial river impoundments are significantly enriched with point sources of phosphorus. State and federal point source control programs are responsible for implementing advanced waste treatment to control eutrophication in these lakes. Thus, the primary concern for management of eutrophication in lakes and ponds in Connecticut is the identification and control of non-point sources.

<u>Connecticut 208 Program</u> - Connecticut's program for controlling non-point sources was developed through the Connecticut Areawide Waste Treatment Management Planning Program (Connecticut 208 Program). This program, established and funded under Section 208 of the 1972 Federal

Water Pollution Act Amendments, was instrumental in developing information on the nature and characteristics of non-point sources, non-point source control measures, and institutional arrangements for implementing controls. Lake watershed management principles draw substantially from information provided by the Connecticut 208 Program efforts.

WATERSHED RESOURCE MAPS

The first step in developing a lake management program is to obtain information about the lake watershed which is pertinent to existing and potential non-point sources of phosphorus and sediment. Several recent statewide natural resource and land use inventories have produced valuable baseline information which is portrayed on maps at 1/24,000 scale (USGS topographical guadrangle scale). This baseline information can be used to construct various lake watershed maps which show features related to eutrophication.

Lake Watershed Boundary Map

The Natural Resources Center of DEP has delineated watershed boundaries on mylar overlays which are on file at the State Office Building in Hartford. A boundary map for a lake watershed can be traced from the mylar onto USGS topographical maps. This serves as a base map on which various watershed characteristics can be portrayed.

Land Use Map

The Connecticut 208 Program developed maps of predominant land use in 5.7 acre grids. Fifteen land use categories were considered - low density residential, moderate density residential, high density residential, institutional, commercial, industrial, open land, cropland, orchard land, dairy production, forest production, resource extraction, wetland, water, and woodland. This information is on file at Regional Planning Agency offices on mylar overlays. A watershed land use map can be constructed by tracing this information onto a lake watershed boundary map.

Wetlands Map

The Connecticut 208 Program developed "water quality sensitive areas" maps which portray legally defined wetlands as well as flood prone areas of environmental or historic interest. This information is on file at Regional Planning Agency offices on mylar overlays. A map of wetlands and other sensitive areas in a lake watershed can be constructed by tracing this information onto a watershed boundary map.

Erosion and Sediment Source Map

The Connecticut 208 Program conducted a statewide inventory of active erosion and sediment sources in 1977 and 1978. The inventory considered cultivated cropland sites greater than two acres, construction sites greater than two acres, surface mines, stream banks, road banks, gravel roads, and unpaved driveways. Active sites were mapped on mylar overlays which are on file at Regional Planning Agency offices and at Soil and Water Conservation District offices. An erosion and sediment source map for the lake watershed can be developed by tracing sites onto a watershed boundary map. This map can serve as a baseline for developing an updated erosion and sediment source maps based on field observations. It is possible that some sites identified in the 1977-78 inventory have stabilized and no longer are active sources. It is also possible that new sites developed in the lake watershed since the 1977-78 inventory.

Areas of High Erosion Potential Map

The Connecticut 208 Program conducted a statewide inventory of high erosion potential areas based on slope of the land and soil type. This information is portrayed on mylar overlays on file at Regional Planning Agency offices. A map of high erosion potential areas for the lake watershed can be constructed by tracing this information onto a watershed boundary map.

Detailed Soils Group Map

The U. S. Department of Agriculture Soil Conservation Service has developed a statewide mapping of detailed soils groups in cooperation with the Natural Resources Center of DEP. This information is on file at the Natural Resource Center in Hartford as mylar overlays. A map of soils groups for a lake watershed can be constructed by transferring this information onto a watershed boundary map. This information can be used to evaluate the suitability of watershed land for on-site sewage disposal (septic systems), and to evaluate erosion potential of watershed land. Technical assistance may be needed to properly interpret the soils information.

Accessory Land Use Maps

The Connecticut 208 Program conducted two additional statewide inventories which can be used to construct useful lake watershed maps. The "Open Space and Dedicated Lands" inventory portrays land in public ownership, quasi-public ownership, and non-profit organization ownership. These lands include water utility property, land trust property, golf courses, recreation areas, nature preserves, and institutional property. This information is portrayed on mylar overlays at Regional Planning Agency offices. A map of open space and dedicated lands in the lake watershed can be constructed by tracing this information onto a watershed boundary map.

A statewide inventory of "lands Unavailable for Development" portrays flood hazard areas, wetlands, watercourses, waterbodies, urban areas, and dedicated lands. This information is available on mylar overlays at Regional Planning Agency offices. A map of property in the lake watershed which is unavailable for development can be constructed by tracing this information onto a watershed boundary map.

NON-POINT SOURCES AND CONTROLS

Erosion and Sedimentation

Erosion is a natural process whereby soil is worn away from the land by running water. Sedimentation is the deposition of eroded material in a watercourse. The severity of erosion and sedimentation is influenced by soil type, slope of the land, type of vegetative cover, intensity and duration of precipitation, and proximity to a watercourse. Some erosion and sedimentation from a lake watershed is inevitable, since this occurs as a natural process. Erosion and sedimentation can be greatly increased by activities of man which disturb the land, remove vegetation, and expose soil to the direct forces of rainfall and surface runoff.

The transport of eroded soil to a lake contributes to eutrophication in several ways. Most importantly, phosphorus and other plant nutrients associated with soil particles are introduced into the lake. Erosion and sedimentation is a dominant cause of phosphorus enrichment of lake waters. Another important effect is the physical presence of solid particles in the lake. Sedimentation reduces water depths, creating shoals which are conducive to the growth of aquatic plants. In addition, organic matter associated with soil particles is decomposed by micro organisms, contributing to the depletion of oxygen in waters overlying the lake sediments.

Serious natural erosion can occur on land with steep slopes, along streambanks, and along lake shorelines. Common man-made sites of erosion are cultivated fields, roadway embankments, roadway drainage ditches, timber harvesting, and construction sites. Erosion associated with specific land features or specific land uses can be controlled by utilizing the "best management practices" which are addressed in subsequent sections of this report. Erosion associated with construction activities is a serious source of erosion which is not restricted to any particular land use of land feature, but rather can occur anywhere in the lake watershed. Special consideration of this erosion source follows:

Construction Site Erosion - Research has shown that soil erosion from construction sites may be 10 to 100 times greater than erosion from agricultural land of the same size, slope, and soil type. The demand to develop lake watershed land, especially land near the lake, is exceptionally strong Construction site erosion must therefore be regarded as a major causative factor in the lake eutrophication process.

Methods for controlling construction site erosion and sedimentation are described in Guidelines for Soil Erosion and Sediment Control, CT Council on Soil Water Conservation, January 1985. This document can be obtained from the DEP Natural Resources Center. This publication is a technical handbook which was developed to assist government officials, developed, engineers, contractors, and others to minimize erosion and sedimentation from sites undergoing development. Among the erosion control topics which are discussed in detail are site planning;

vegetative controls such as seeding, sodding, and tree planting; non-structural controls such as hay bale checks, mulching, land grading, and traffic control; and structural controls such as diversions, rip rap, and sediment basins. This handbook should be used as the basic guidance manual for controlling construction site erosion in lake watersheds.

Erosion and Sediment Control Regulations - Excessive sedimentation from construction activities can be reduced when erosion and sedimentation (E & S) control needs are recognized and BMP's are employed. In Connecticut, E & S control management roles are well defined and E & S control management is a shared responsibility. Municipal government through its Inland Wetlands Agency, Zoning Commission, or General Site Plan Review procedures, are required by State Statues to evaluate E & S control needs. The Connecticut Council on Soil and Water Conservation, the Soil and Water Conservation Districts, and Regional Planning Agencies routinely promote the need for thorough municipal E & S control programs and are available to provide technical assistance.

Similarly, DEP's role is to encourage the development of municipal programs. Furthermore, DEP - Water Resources Unit is the E & S control plan reviewer and regulator for State sponsored projects requiring Inlands Wetlands Permits and manager of local Inland Wetland Permit Programs where municipalities have not assumed such authority.

In 1983, major E & S control legislation was passed (P. A. 83-388) to strengthen this program in Connecticut. Key provisions of this statute require:

- development of E & S control guidelines and model regulations for municipalities by the Connecticut Council on Soil and Water Conservation (completed in 1985); and

- mandatory adoption of municipal E & S control programs by July 1, 1985.

This law was amended in 1985 to defer mandatory municipal adoption to June 30, 1986.

Residential Land

An acre of residential land will contribute much more phosphorus to a spell than an acre of woodland in the same location. Residential land adjacent to the lake will contribute more to eutrophication than residential land in distant areas of the watershed. The importance of residential land in the eutrophication of a lake is readily appreciated when on observes the amount of land adjacent to any particular lake which is occupied by seasonal or permanent residences.

Sources of phosphorus associated with residential land include construction site erosion, failing septic systems, properly functioning septic systems, fertilization of lawns and gardens, disposal of vegetation from yard upkeep, and stormwater runoff. Construction site erosion has been discussed in the preceding section, and stormwater runoff will be addressed in a later section. The remaining sources and their controls will be discussed below.

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

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

The correction of individual or scattered failing septic systems in a residential area is the responsibility of town health official. The correction of widespread failures within a residential community is initiated by facility planning as provided by state and federal water pollution control statutes. A community sewage disposal system is a likely outcome in these cases.

Prevention of Failing Septic Systems - The first safeguard against septic system failure is the proper design and installation of the system. The DEP has published a document entitled Septic System Manual to guide local land use officials on the legal and technical aspects of the design and installation of on-site subsurface sewage disposal systems. The manual provides a brief explanation of the actual process of sewage treatment that takes place in a septic tank, leachfield and surrounding soil. It is intended to enhance the knowledge of local officials and provide for a more informed review of development proposals. This manual should be consulted by local commissions when reviewing applications for planning, zoning, and wetlands permits which involve the installation of new septic systems in the lake watershed.

Proper operation and maintenance practices will serve to prevent the premature failure of existing septic systems in the lake watershed. The septic system should not be used for the disposal of garbage, solvents, paints, household chemicals, and medicines because these materials can cause clogging or can interfere with biological treatment processes. Water conservation should be practiced in the household since heavy water use can hydraulically overload a septic system and cause failure. A poster detailing water conservation practices is available from the DEP:

Water Compliance Unit. For maintenance, a septic tank should be pumped routinely every 3-5 years to remove accumulated scum and sludge which would otherwise move into the distribution system and leaching system, causing clogging and eventual failure.

The Connecticut 208 Program has de eloped three reports which can guide a lake organization in the development of a community wide septic system management program. Theses are "A Proposed Septic System Inspection and Maintenance Program for Killingworth, Connecticut" by the Connecticut River Estuary Regional Planning Agency; "Voluntary Septic System Management Program for the Towns of Canterbury, Killingly, and Woodstock" by the Northeastern Connecticut Regional Planning Agency; and "Voluntary Septic System Management Program For Quaddick Lake, Thompson" by the Northeastern Connecticut Regional Planning Agency.

A simple and effective means of educating lakeside residents about the proper operation and maintenance of septic systems is an information pamphlet distributed by a lake organization to property owners. The pamphlet should advise homeowners about the consequences of failures, list materials which should not be disposed of in a septic system, explain water conservation measures, and stress the need for routine septic tank pumping. An excellent pamphlet for these purposes was developed by the Northeastern Connecticut Regional Planning Agency and the Northeast District Department of Health entitled "Homeowners Guide to Septic System Maintenance - Or How To Save Thousands of Dollars."

<u>Non-failing Septic Systems as Phosphorus Sources</u> - The liquid effluent which flows from the leaching field of a septic system passes into the surrounding soil and enters the ground water system. This leachate has a high concentration of soluble phosphorus. The ground water flow is generally in the direction of the lake, where it enters the lake as springs. Whether phosphorus travels with the ground water to the lake depends on interactions between soil particles and phosphorus. Many factors are involved, including the proximity of the septic system to the lake, the age of the septic system, the soil type and its capacity to attenuate phosphorus, the path of travel of leachate, the time of travel of leachate, the time of travel of leachate, and the elevation of the ground water table.

At present, the incomplete scientific understanding of the interactions between soil particles and ground water phosphorus makes it difficult to predict if or when a septic system will become a source of phosphorus to lake waters. Some soil studies in Connecticut have suggested that soils have an enormous capacity to adsorb and retain phosphorus. More recent Connecticut studies have suggested that leachate may travel in preferential channels through the soil, limiting the exposure of phosphorus to soil adsorption sites. The studies also found that soils will release phosphorus to the ground water when the water table is high and the soils are flooded for several weeks.

In view of this information, it is apparent that the likelihood of a septic system contributing phosphorus to lake waters is enhanced if the septic system is located in thin soils on ledgerock, or if the septic system is located in an area which experiences a seasonally high water table which saturates soils with water. If many lakeside septic systems fall into these categories, it is probable that septic systems are an important factor in the eutrophication of the lake.

In homes with laundry facilities, the phosphorus passing through the septic system can be reduced 30-40 percent by the use of nonphosphate laundry detergents. Concerned lakeside residents should adopt a "better safe than sorry" attitude towards phosphate detergents. The use of nonphosphate laundry detergents by lakeside residents would constitute a sincere personal commitment to taking every available step to abate eutrophication of the lake.

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Section 25-54oo of the Connecticut General Statutes enables the DEP to an the use of phosphate detergents in a lake watershed to protect lake water quality. Originally, this authority was developed to enable the DEP to control eutrophication in cases where community-wide septic system failures had been identified but the construction of community sewers was not imminent. The exercise of this authority to control phosphorus from non-failing septic systems is a new concept which warrants consideration as lake diagnostic studies develop detailed information about septic systems and soils in lake watersheds.

<u>Cottage Conversions</u> - In many lakeside communities, seasonal cottages have been winterized and converted to permanent homes. If a septic system is not expanded and upgraded when a conversion occurs, it may not conform to minimum requirements of the Public Health Code. Local health officials must evaluate the adequacy of septic systems serving converted cottages, and oversee the timely correction of inadequate systems. Cottage conversions are usually subject to local building permits and zoning approval.

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

<u>Yard and Garden Vegetation Disposal</u> - Leaves, grass clippings, and other vegetative material from yard and garden maintenance should not be deposited in a location where the material may be washed into the lake.

Vegetative material will add to the sediment in the lake and will provide plant nutrients upon decomposition. Each property owner should select a suitable site away from the lake and its watercourses for the composting of vegetative material.

Agricultural Land

An acre of agricultural land will contribute less phosphorus to a lake than an acre of residential land in the same location, but more phosphorus than an acre of woodland in the same location. Agricultural sources of phosphorus and sediment are associated with cropland, with pasture land and feed lots, and with manure storage and handling.

The Connecticut 208 Program, through the Connecticut Council on Soil and Water Conservation, conducted a statewide study of agricultural non-point sources of pollution and developed a program for the implementation of Best Management Practice (BMP) controls. The most effective agricultural BMP's identified by the Connecticut 208 Program are cover crops, field border filter strips, critical area planting, diversions, grassed waterways, streambank protection, animal waste management, optimum manure and fertilizer application rates, and changing from cultivated crops to permanent vegetation. Additional effective practices, very effective in some areas, are contour farming, contour strip cropping, no-till planting, conservation cropping, pasture and hayland management, planned grazing, protection of heavy use areas, subsurface drainage, roof gutters in barn areas, mulching, fencing to keep livestock from streams and stream banks, proper manure spreading and fertilization techniques, and prompt incorporation of manure into soils.

Implementation of the statewide agricultural BMP Program is being managed by the Connecticut Council on Soil and Water Conservation. The program relies on voluntary participation through education and incentives, resorting to regulatory authority only in major problem areas where voluntary initiative is unsuccessful. Technical expertise is provided by the USDA Soil Conservation Service and State Soil and Water Conservation Districts. A primary source of federal cost sharing for BMP's is the USDA Agricultural Stabilization and Conservation Service, which can provide up to 75% funding for erosion and sedimentation controls, and soil and water conservation.

A basis goal of the statewide program is to promote accelerated implementation of BMP's in watersheds designated "high priority" by the 208 Program agricultural study. Several lakes will benefit from this strategy. The watersheds of Roseland Lake and Wappaquassett Lake are designated "Highest Priority" by the 208 study. The impact of agricultural activity on the water quality of Roseland Lake was estimated to be highly significant. The impact on Wappaquassett Lake was estimated to be moderately significant. The Watersheds of Lake Wononpakook, Mudge Pond, Beardsley Pond, and Fitchville Pond were designated as "High Priority" by the 208 study. The impact of agricultural activity on water quality was estimated to be highly significant for Mudge Pond and moderately significant for Wononpakook, Beardsley, and Fitchville.

The agricultural BMP Program also includes the implementation of several statewide objectives over the next 15-20 years. These consist of the implementation of erosion controls on sites with high calculated soil loss; the implementation of BMP's for retention of soils on critical sites near watercourses; the establishment of vegetated buffer strips between cultivated fields and watercourses, and between barnyards and watercourses; the establishment of winter cover crops on cultivated fields; and the development of farm waste management systems with routine review and follow-up inspections.

A lake organization should consult with the local Soil and Water Conservation District to obtain information on the status of agricultural activities in its particular lake watershed. The lake organization should establish cooperative, working relationships with District personnel, Soil Conservation Service personnel, and local farmers in order to develop a strategy for the timely implementation of agricultural BMP's needed to protect lake water quality.

Woodland and Timber Harvesting

An acre of properly managed woodland in a lake watershed contributes much less phosphorus to the lake than an acre of residential land in the same location. However, harvesting of timber for firewood or lumber is aland disturbance activity which has the potential to cause serious erosion and sedimentation. Under the Connecticut 208 Program, a Forestry Advisory Committee undertook a statewide study of the impacts of timber harvesting on water quality. A field study and analysis of 80 logging sites was conducted by the committee in 1979. In general, it was found that harvesting practices in Connecticut are limited in scope and intensity, and rarely involve types of timber, slopes, harvesting equipment, or management practices which lead to severe water quality degradation. The committee concluded that harvesting operations did not affect nutrient export levels, but could cause site specific problems with sedimentation.

The Forestry Advisory Committee has adopted a policy of advocating voluntary compliance with best management practices to control erosion and sedimentation by timber harvesting. Appropriate practices are described in the Committees' handbook entitled "Logging and Water Quality in Connecticut - A Practical Guide for Protecting Water Quality While Harvesting Forest Products". This document is available from the Connecticut 208 Program or the Connecticut Forest and Park Association, Inc. The handbook describes effective and practical erosion and sedimentation controls related to haul roads, skid trails, stream crossings, harvesting practices, and job termination practices. A lake organization should develop cooperative working relationships with landowners, loggers, and foresters to ensure that these best management practices are employed in the lake watershed.

Wetlands

Scientific research has demonstrated that wetlands in a lake watershed play a vital role in regulating the timing of transport of phosphorus to the lake. During the spring and summer biological growth period, wetlands remove significant amounts of phosphorus from overlying waters and effectively withhold that phosphorus from transport downstream. Mechanisms by which wetlands retain phosphorus include physical entrapment of particulate phosphorus, chemical sorption by organic matter and soil particles, uptake by aquatic plants and attached algae, and utilization by bacteria and other microorganisms. During the fall and winter, wetlands release phosphorus as decomposition of wetland vegetation takes place. Consequently, transport of this phosphorus to downstream waters and to the lake occurs at a time of the year when the phosphorus is least likely to contribute to nuisance algae blooms and weed growth.

Thus, although little phosphorus is permanently withheld by wetlands on an annual basis, the "spring and summer storage; fall and winter release" pattern of phosphorus flux through a wetland serves to minimize summer algae blooms and weed problems in a downstream lake. Wetlands in a lake watershed should be appreciated for this valuable service provided to lake water quality.

The perpetuation of a wetland's phosphorus regulatory function involves, quite simply, maintaining the wetland in a natural state. Alteration or elimination of the wetland reduces or eliminates the effectiveness of this regulatory role and contributes to the degradation of the trophic condition of a downstream lake.

Another important function of wetlands relevant to lake water quality is the control of flooding and associated erosion. Wetlands retain water during periods of high runoff and gradually release water at moderate rates of flow. This flow regulation reduces flooding and erosion which could contribute sediment and phosphorus to a lake. The importance of this function for a particular wetland depends on the topography of the surrounding land, the location within the lake drainage basin, and the size of wetland area relative to the size of its drainage area. Alteration or elimination of wetlands would impair the regulation of runoff, and sediment and phosphorus loads to a downstream lake would increase.

It is recommended that the appropriate wetlands regulatory agency utilize the authorities of Connecticut's Inland Wetlands and Watercourses Act (Sections 22a-36 through 22a-45 Connecticut General Statutes) to maintain the wetlands in a lake watershed in their natural states. This is particularly important for wetlands which are contiguous with the lake or its tributary watercourses. Maintaining wetlands in their natural states will protect lake water quality by providing for continued regulation of seasonal phosphorus loads, and continued control of flooding which could cause erosion.

Specifically, a wetlands agency should give due consideration to wetlands functions which enhance lake water quality when acting on permit application for regulated activities in legally defined wetlands. This consideration is appropriate since the review of application must, by statute, weigh environmental impacts of proposed actions, and weigh irreversible and irretrievable commitments of resources associated with proposed actions. In order to facilitate the implementation of this recommendation, a wetlands agency should make special recognition of lake watershed wetlands on working maps used by agency members.

Stormwater Runoff

Stormwater runoff is the overland flow of water associated with precipitation events of periods of snowmelt. Runoff from residential areas and roadways in a lake results in the transport of sediments, phosphorus, and other pollutants to lake waters. A watershed management program should include measures for minimizing the impacts of stormwater runoff. The following measures should be considered:

Preservation of Wetlands - Wetlands provide for the temporary storage and gradual release of stormwater runoff, and provide for the retention of phosphorus, sediments, and other pollutants. Preservation of wetlands in accordance with Sections 22a-36 through 22a-45 of the Connecticut General Statutes is an important way to control stormwater runoff.

Existing Residential Areas - Stormwater transport of sediment from residential areas to a lake can be controlled by the installation of storm sewers with sediment traps at catch basins and points of discharge. Sediment traps must be cleaned of sand, leaves, and other debris on a regular basis to maintain their effectiveness. Routine street sweeping in the early spring should be conducted in lakeside residential areas to minimize the amount of sand and debris susceptible to stormwater transport. The rate of stormwater runoff can be reduced by employing artificial stormwater detention ponds and by minimizing the amount of impervious and semipervious pavements and surfaces.

New Residential Areas - Stormwater runoff from planned residential areas can be controlled by including stormwater management as part of the overall site development plan. Stormwater control measures should be incorporated into the site plan so that the runoff rate from the developed site is the same as it had been prior to development. Methods of stormwater control which can be considered include preservation of wetlands, installation of artificial stormwater detention ponds, temporary storage in open spaces, temporary storage in underground tanks, and the use of permeable pavements.

An effective means of implementing stormwater management is through town planning and zoning regulations which require Stormwater Runoff Control Plans for the detention and controlled release of stormwater runoff from new developments. Generally, plans should be required for sites where impervious surfaces exceed 60 percent of the total area. The Guidelines for Soil Erosion and Sediment Control can be used as a guide for local regulations.

Roadway Runoff - State highways, town streets, and unpaved roads can be significant sources of sediments in lake watersheds. Under the Connecticut 208 Program, the Northwestern Connecticut Regional Planning Agency developed a report entitled "Best Road Maintenance Practices for Critical Watersheds" which should be used as a guide to minimizing erosion and sedimentation from roadways in lake watersheds. The report presents detailed information on the design of roadway drainage systems; the management of paved roadways, including sanding operations and early spring street cleaning; the stabilization of road banks with vegetation and proper grading; and the grading and surfacing of unpaved roads. A lake organization should establish cooperative working relationships with appropriate town and/or state maintenance officials in order to implement a sound management program for lake watershed roads.

Waterfowl

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

Waterfowl can be controlled by methods which discourage large flocks from frequenting the lake. The U. S. Fish and Wildlife Service regulates all migratory bird activities that involve handling the birds, such as trapping, banding, and hunting. This agency also provides information on methods of harassment. These activities include mechanical barriers, landscaping techniques, scarecrows and other foreign objects, automatic exploders, flashing lights, balloons, and chase dogs. Information on these methods can be obtained from U. S. Fish and Wildlife Service, 4 Whalley Street, Hadley, Massachusetts 01035.

The DEP Wildlife Bureau lends assistance and cooperation in controlling nuisance waterfowl whenever possible. The DEP is studying the potential of special goose hunting by certified, competent hunters to control nuisance populations in areas where safety considerations are not prohibitive. Assistance regarding special goose hunting can be obtained from the DEP Wildlife Bureau in Hartford.

Streambanks and Shorelines

Streambanks and shorelines are sites where erosion can cause serious cause sedimentation which immediately impacts a lake. Activities which disturb the land surface should be avoided in these areas, and maintenance of a zone of natural vegetation, or a greenbelt, should be encouraged. Construction activities in these areas should employ erosion and sediment controls as described in Guidelines for Soil Erosion and Sediment Control.

General guidance for stabilizing streambanks and protecting streambanks and protecting streambanks against scour and erosion is presented in the Guidelines for Soil Erosion and Sediment Control. Measures to be considered for critical streambank sites include bank sloping, riprap, vegetation, jetties, fencing, and removal of obstructions. Each streambank site is unique, and implementation of controls should be done under the guidance of the federal Soil Conservation Service and/or the county State Soil and Water Conservation District.

It is a common practice for lakeside property owners to construct masonry retaining walls along shorelines which are vulnerable to erosion. Retaining walls absorb the shock of waves, and prevent soil from moving off the land and into the lake. General guidance on the construction of retaining walls is provided in the Guidelines for Soil Erosion and Sediment Control. Additional guidance should be obtained from professional builders.

Erosion and sediment control measures undertaken along streambanks and shorelines may require approval of the Inland Wetland Agency and/or the U. S. Army Corps of Engineers.

Atmosphere

Recent eutrophication studies have shown that measurable amounts of phosphorus may enter a lake through precipitation and dry atmospheric fallout. Precipitation data at one Connecticut lake suggested that atmospheric phosphorus was associated with pollen dispersion. Other research has suggested that atmospheric phosphorus emanates from local and distant sources of air pollution. Although atmospheric phosphorus is a factor in lake eutrophication, control of atmospheric loadings is not within the scope of a local lake management program.

Lake Sediments

Under certain conditions, sediments on the lake bottom can release phosphorus and nitrogen to overlying waters. Depending on lake mixing characteristics and algae bloom sequences, these recycled nutrients may contribute to nuisance algae blooms. The identification of internal enrichment can only be made through detailed lake water quality monitoring. Control of this source involves in-lake technology which is outside the scope of this handbook. However, it is important to recognize that for some Connecticut lakes, lake sediments are a significant source of enrichment of lake waters.

Resource Agencies

State and Federal

Department of Environmental Protection
Natural Resources, Water Compliance, Water Resources, Wildlife &
Forestry Units
165 Capitol Avenue
Hartford, Connecticut 06106

Connecticut 208 Program
c/o Connecticut DEP Water Compliance Unit
165 Capitol Avenue
Hartford, Connecticut 06106

Connecticut Council on Soil & Water Conservation
State Office Building
165 Capitol Avenue
Hartford, Connecticut 06106

USDA Soil Conservation Service
Mansfield Professional Park
Storrs, Connecticut 06268

Connecticut Agricultural Experiment Station
123 Huntington Street
New Haven, Connecticut 06054

U. S. Geological Survey
450 Main Street
Hartford, Connecticut 06103

U. S. Fish and Wildlife Service
4 Whalley Street
Hadley, Massachusetts 01035

Connecticut Forest and Park Association, Inc.
1010 Main Street
P. O. Box 389
East Hartford, Connecticut 06108

U. S. Army Corps of Engineers
Regulatory Branch
424 Trapelo Road
Waltham, Massachusetts 02254

Regional Planning Agencies

South Central RPA
96 Grove Street
New Haven, Connecticut 06510

Housatonic Valley CEO
256 Main Street
Danbury, Connecticut 06810

Greater Bridgeport RPA
525 Water Street
Bridgeport, Connecticut 06604

CT River Estuary RPA
Hitchcock Corners
Essex, Connecticut 06426

Central CT RPA
1019 Farmington Avenue
Bristol, Connecticut 06010

Northeastern CT RPA
Sackett Hill Road
Warren, Connecticut 06754

Windham RPA
Main Street
Willimantic, Connecticut 06226

Capitol Region COG
214 Main Street
Hartford, Connecticut 06106

Southeastern CT RPA
139 Boswell Avenue
Norwich, Connecticut 06360

Northeastern CT RPA
P. O. Box 198
Brooklyn, Connecticut 06234

Central Naugatuck Valley RPA
20 East Main Street
Waterbury, Connecticut 06702

Midstate RPA
100 DeKoven Drive
Middletown, Connecticut 06457

Valley RPA
Derby Train Station
Main Street
Derby, Connecticut 06418

Southwestern CT RPA
213 Liberty Square
E. Norwalk, Connecticut 06855

County Offices

USDA Soil Conservation Service District Conservationist (SCS)
Soil and Water Conservation Districts (S&WCD's)
UConn Cooperative Extension Service Extension Agents (UCONN)

Fairfield County SCS, S&WCD
UConn Agricultural Center
Route 6 Stony Hill
Bethel, Connecticut 06801

Hartford County, SCS, S&WCD
Agricultural Center
340 Broad Street
Windsor, Connecticut 06095

Hartford County UCONN
Extension Service
Carriage House
Hartford, Connecticut 06105

Litchfield County SCS, S&WCD
UConn Agricultural Center
Litchfield, Connecticut 06759

Middlesex County SCS, S&WCD
UConn Extension Center
Route 9-A
Haddam, Connecticut 06438

New Haven County SCS, S&WCD
UConn Extension Service
322 North Main Street
Wallingford, Connecticut 06492

New London County SCS, S&WCD
UConn Extension Service
562 New London Turnpike

Tolland County SCS, S&WCD
UConn Agricultural Center
24 Hyde Avenue
Vernon, Connecticut 06066

Windham County SCS, S&WCD
UConn Extension Center
P. O. Box 112
Wolf Den Road
Brooklyn, Connecticut 06234

Resource Maps

Title	Prepared by*	Scale
Watershed Boundary (Drainage Basins)	RPA's, DEP NRC	1:24,000
Land Use	RPA's	1:24,000
Water Quality Sensitive Areas	RPA's	1:24,000
Erosion & Sediment Source Inventory	RPA's, S&WCD's	1:24,000
Areas of High Erosion Potential	RPA's	1:24,000
Open Space & Dedicated Lands	RPA's	1:24,000
Detailed Soils Groups	SCS DEP NRC	1:24,000

* RPA - Regional Planning Agency
S&WCD's - Soil & Water Conservation Districts
SCS - Soil Conservation Service
DEP NRC - Department of Environmental Protection Natural Resources Center

Resource Publications

Title	Source
"Erosion & Sediment Source Inventory"	CCSWC, RPA's, S&WCD's
"Guidelines for Soil Erosion and Sediment Control"	CCSWC
"Septic System Manual"	DEP Water Compliance Unit
"A Proposed Septic System Inspection & Maintenance Program for Killingworth, Ct."	CRERPA
" Voluntary Septic System Management Program for Canterbury, Killingly, and Woodstock"	NERPA
"A Voluntary Septic System Management Program for Quaddick Lake, Thompson"	NERPA
"A Homeowners Guide to Septic System Maintenance"	NERPA, NDDH
"Logging & Water Quality In Connecticut - A Practical Guide for Harvesting Forest Products & Protecting Water Quality"	Ct. 208 Forestry Advisory Committee
"Best Road Maintenance Practices for Critical Watersheds	NWRPA
"Connecticut AG 208 Project"	CCSWC
"Inventory of the Trophic Classifications of Seventy Connecticut Lakes"	DEP Natural Resources Center
"Lake Management Handbook - A Guide To Quantifying Phosphorus Inputs to Lakes"	DEP Water Compliance Unit, Windham RPA
"Lake Waramaug Watershed Management Plan"	DEP Water Compliance Unit, Northwestern CT RPA

Connecticut Lake Trophic Conditions

Trophic Condition	Lake	Town(s)	Surface Area (Acres)
Oligotrophic	Alexander	Killingly	190.4
	Bashan	East Haddam	276.3
	Beach	Voluntown	394.3
	Billings	North Stonington	105.1
	Highland	Winchester	444
	Mashapaug	Union	297.1
	Uncas	Lyme	69
	West Hill	New Hartford	263
Early Mesotrophic	Bigelow	Union	18.5
	Candlewood	New Fairfield Sherman New Milford Danbury Brookfield	5,542.0
	Columbia	Columbia	277.2
	Crystal	Ellington, Stafford	200.9
	Dodge	East Lyme	33
	Long	Ledyard, North Stonington	98.6
	Mount Tom	Litchfield, Morris Goshen	61.5
	Norwich	Lyme	27.5
	Rogers	Lyme, Old Lyme	264.9
	Quassapaug	Middlebury	271
	Waumgumbaug	Coventry	378
	West Side	Goshen	42.4
	Wyassup	No. Stonington	92.4
Mesotrophic	Amos	Preston	105.1
	Black	Woodstock	73.4
	Burr	Torrington	85
	Cedar	Chester	68
	Cream Hill	Cornwall	72
	East Twin	Salisbury	562.2
	Gardner	Salem, Montville Bozrah	486.8
	Glasgo	Griswold	184.2
	Gorton	East Lyme	53
	Hayward	East Haddam	198.9
	Little School house	Thompson	68.4

(continued)

Trophic Condition	Lake	Town(s)	Surface Area (Acres)
Mesotrophic	Lower Bolton	Bolton, Vernon	178.4
	Pachaug	Griswold	830.9
	Pattagansett	East Lyme	123
	Pocotopaug	East Hampton	511.6
	Powers	East Lyme	152.6
	Quaddick	Thompson	466.8
	Quonnipaug	Guilford	111.6
	Shenipist	Vernon, Ellington Tolland	52.8
	Squantz	New Fairfield Sherman	288
	Terramuggus	Marlborough	83
	Tyler	Goshen	182
Late Mesotrophic	Ball	New Fairfield	89.9
	Black	Meriden Middlefield	75.6
	Hitchcock	Wolcott	118.4
	Middle Bolton	Vernon	114.9
	Moodus	East Haddam	451
	Mudge	Sharon	201
	Taunton	Newtown	126
	Waramaug	Warren, Washington Kent	680.2
Eutrophic	Bantam	Litchfield, Morris	916
	Batterson Park	Farmington New Britain	162.7
	Beseck	Middlefield	119.6
	Eagleville	Mansfield	80
	Housatonic	Shelton	382.2
	Kenosia	Danbury	56
	Linsley	No. Branford Branford	23.3
	Long Meadow	Ledyard, No. Stonington	11.7
	Mamanasco	Ridgefield	95
	Roseland	Woodstock	88
	Wononpakook	Salisbury	164
	Wononscopomuc	Salisbury	352.6

(continued)

Trophic Condition	Lake	Town(s)	Surface Area (Acres)
Highly Eutrophic	Cedar	North Branford	21.8
	1860 Reservoir	Wethersfield	35
	Lillinonah	Southbury Bridgewater Brookfield, Newton	1900
	North Farms	Wallingford	62.5
	Silver	Berlin, Meriden	151
	Winnemaug	Watertown	120
	Zoar	Newtown, Monroe Oxford, Southbury	975

A MANAGEMENT GUIDE FOR CONNECTICUT LAKES

A Primer on the Control of Algae and Aquatic Weeds

STATE OF CONNECTICUT
DEPARTMENT OF ENVIRONMENTAL PROTECTION
WATER COMPLIANCE UNIT

JUNE 1986

For more information contact:
Charles Fredette
Nancy Marin
DEP Water Compliance Unit
Lakes Management Section
165 Capitol Avenue
Hartford, Connecticut 06106
(203) 566-2588

A MANAGEMENT GUIDE FOR CONNECTICUT LAKES

INTRODUCTION

Connecticut's lakes and ponds are valuable natural resources which are used intensively for swimming, fishing and boating. Our lakes are also important economic entities, adding to local property values and augmenting the tax revenues of local communities. Connecticut's lakes are resources deserving of our protection and, in many cases, our commitment to restoration.

CONNECTICUT'S LAKES PROGRAM

The Lake's Management section of the DEP Water Compliance Unit is the agency which oversees lake water quality and related issues. Our staff of biologists and engineers are available for assistance on the following:

- in-lake algae and weed control techniques
- watershed management guidelines
- general information on algae and weeds
- general water quality data on a large number of Connecticut lakes
- technical assistance and review of proposed plans for lake projects
- Environmental Review Team Projects
- information on financial assistance programs for algae and weed control activities.

EUTROPHICATION

Unfortunately all of our lakes and ponds undergo a natural aging process called eutrophication. Eutrophication is a form of water pollution which results in the decline of a lake's recreational utility and aesthetic appeal. The process generally advances over many, many years, however it can be accelerated by human activities in the lake's watershed. Through awareness and commitment the process is controllable and manageable. "A Watershed Management Guide for Connecticut Lakes" (1986) presents the principles of eutrophication control through prudent management of the land surrounding the lake. This publication is available at no charge from the Department of Environmental Protection (DEP) Water Compliance Unit at (203) 566-2588. The effectiveness of the lake management techniques described in this handout will be greatly enhanced by the implementation of a sound watershed management plan.

It is generally accepted that there are 3 stages of eutrophication. These stages are termed oligotrophic, mesotrophic and eutrophic. Oligotrophic lakes are in the earliest stages of the process. These are deep lakes with clear, infertile waters and little or no algae and aquatic weed growth. There are only minor accumulations of sediments on the bottom and even the deepest waters are well oxygenated. Eutrophic lakes are in the latter stages of the process, with water quality characteristics exactly opposite those found in oligotrophic lakes. These lakes have limited recreational utility. Mesotrophic lakes fall somewhere between these two extremes.

The preceding description of the eutrophication process applies to natural lakes. There are many man-made lakes and ponds in Connecticut, formed by damming a stream or excavating a wet area. These artificial waterbodies often exhibit an advanced stage of eutrophication from the time they are created. Improvement of water quality conditions in man-made lakes is extremely difficult because restoration does not involve the return to previous conditions, but rather involves the creation of conditions which never existed previously.

MEASURES OF WATER QUALITY

Every lake is a complex system of interactions between chemical, physical and biological components. In order to better understand the lake system, it is essential to have a basic understanding of many of these elements. Selection of the most appropriate management option depends on a sound knowledge of the lake system. The following is a brief description of the most common parameters used to assess lake water quality.

Nutrients: Algae and aquatic weeds, not unlike their terrestrial counterparts require nutrients to grow. The most common of these plant nutrients are phosphorus and nitrogen. Enrichment of a lake with these nutrients is the fundamental cause of eutrophication. The nutrient most often in the shortest supply in the lake system is phosphorus, therefore, controlling phosphorus inputs to lake waters is the key to controlling eutrophication.

Water Temperature/Dissolved Oxygen: Water temperature and dissolved oxygen levels play extremely important roles in the lake ecosystem. The two parameters are very closely linked. Water temperature determines the lake's mixing characteristics, dissolved oxygen levels and the type and extent of the fishery. Dissolved oxygen (D.O.) is essential to the metabolism of nearly all aquatic organisms.

Summer Stratification: Deep lakes thermally stratify into distinct "thermal zones" during the summer months. These zones are depicted in Figure 1. Each zone is physically separated from the other by temperature/density differences between the layers.

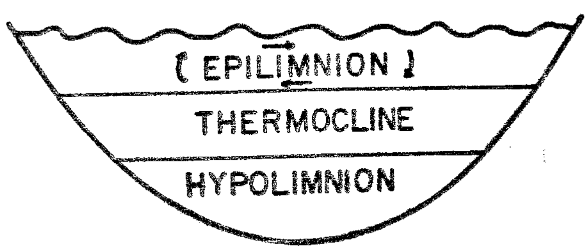

Figure I.

TYPICAL SUMMER STRATIFICATION OF A DEEP LAKE

Typical Summer Stratification of a Deep Lake: The epilimnion, or top layer, is fairly uniform in temperature and well mixed. Aquatic weeds

and most summer algae blooms occur in this zone. Oxygen levels are generally high due to atmospheric diffusion and photosynthetic activity. The thermocline or metalimnion is a transition zone in which the water temperature drops approximately 1°C with each meter increase in depth. The hypolimnion or bottom layer contains the lake's coldest waters.

The distribution of D.O. is within a lake is dependent upon water temperature and biological activity. The colder water is, the more oxygen it can "hold." During the summer months the cold bottom waters of unproductive, oligotrophic lakes are generally well oxygenated. In a highly productive, eutrophic lake, biological processes like as the decay of organic material such as dead aquatic weeds, "robs" oxygen from the overlying waters of the hypolimnion. During stratification when the bottom zone is separated from the upper layers, the oxygen supply cannot be replenished by the well oxygenated epilimnion and the oxygen supply can become depleted. If this occurs, only those organisms which can live in the absence of oxygen can survive. Lack of oxygen or anaerobic conditions results in the loss of fish habitat and sets up conditions which allow for the release of nutrients like phosphorus and ammonia nitrogen into the overlying waters. Lakes in which anaerobic conditions exist for a long period of time may have significant quantities of nutrients recycled from the sediments into lake waters.

Fall Overturn: In the fall the epilimnion cools off, becomes more dense and consequently sinks and mixes with the underlying waters. This is referred to as fall overturn. Eventually the entire lake mixes surface to bottom and temperature and nutrient levels are uniform throughout the water column. Dissolved oxygen concentrations are replenished to all depths.

Winter Stratification: Winter stratification differs from summer stratification in that the coldest waters are found at the lake's surface. When the lake or pond freezes over, D.O. levels can once more become low or depleted. The formation of the ice cover eliminates the atmospheric oxygen contribution. If there is snow on the ice, light penetration is greatly reduced and consequently so is photosynthetic activity, of which oxygen is a product. In shallow, eutrophic lakes winter fish kills can result when oxygen levels become insufficient.

Spring Turnover: In the spring, when the ice melts. the lake turns over a second time. The spring turnover is accomplished primarily by wind action. At this time the water column is again uniform in it's physical and chemical characteristics. The lake will remain mixed until the surface waters warm, bringing about the onset of summer stratification and the stratification cycle begins again.

Stratification of Shallow Lakes and Impoundments: There are some exceptions to the typical stratification pattern. These exceptions include artificial impoundments with short residence times and shallow lakes and ponds. In these cases, there may be a temperature gradient where surface waters may be only slightly warmer than bottom waters or the temperature and chemical characteristics may be nearly uniform throughout the water column. In many shallow ponds, such as man-made ponds, D.O. depletion of the bottom waters by decay processes and subsequent nutrient release into overlying waters may be a significant source of nitrogen and phosphorus. In lakes that don't stratify, these nutrients are readily available to algae and weeds in the surface waters.

Algae and Aquatic Weeds: Perhaps the most familiar characteristic of a eutrophic lake is the presence of nuisance populations of algae and aquatic weeds.

Algae: There are three basic types of algae: planktonic, filamentous and macrophytic. Planktonic algae are microscopic single cells or filaments and are suspended in the water column. These include the diatoms, green and blue green algae. Filamentous algae are the long green thread-like algae that many times form floating mats but also may grow on the lake bottom. Most often these mats are composed of members of the blue green algae. Macrophytic algae resemble rooted plants but are actually advanced forms of algae. The two most common types are Chara and Nitella, the stoneworts, which grow on the lake bottom.

Aquatic Macrophytes: There are four types of aquatic macrophytes: free floating, emergent, rooted with floating leaves and submergent. The free-floating aquatic plants are commonly referred to as duckweed and watermeal. These plants are non-rooted forms that appear like small clovers. Frequently their growth is so dense that a dense mat may form over the entire water surface. Emergent forms of weeds are rooted in the lake bottom but extend through the water on into the air. Examples of emergent weeds are cattails, pickerelweed, and arrowhead. Waterlilies and the smaller-leaved watershield are types of rooted plants with leaves that float on the water's surface. Submergent macrophytes are rooted in the sediments and the entire plant grows under the water. Many of these plants grow right to the water surface, and some have floral bracts which may extend out of the water. Most forms which are considered the greatest nuisance are found in this group: the pondweeds (Potamogetons), coontail (Ceratophyllum), and the water milfoil (Myriophyllum).

The mere presence of algae and/or aquatic weeds does not indicate that a water quality problem exists. Algae and aquatic weeds provide fish and other aquatic organisms with food, habitat, spawning areas, as well as supply oxygen through the process of photosynthesis.

When algae or weed growth becomes so extensive that it interferes with the desired uses of the lake or pond, then some sort of balance between intended uses and nature must be achieved, and some measure of control or management technique must be employed.

The following is a brief discussion of the most common methods of algae and weed control. As stated earlier in the handout, it is extremely important to understand that the effective life of each of these methods will greatly enhanced if a prudent management plan is instituted for the watershed. It is also important to realize that a basic understanding of the lake system is necessary to enable the proper choice of method.

ALGAE CONTROL METHODS

Aeration/Destratification: Aeration is the process of artificially mixing the waterbody with compressed air or mechanical aerators (fountins). The purpose of aeration is actually two-fold. First by maintaining elevated levels of oxygen in the water column the nutrient contribution from the sediments is sealed off and secondly, the turbulence created by the system selects for growth of certain algal types which are less likely to become a nuisance.

Chemical Treatments: The use of any algicide or herbicide within Connecticut's lakes and ponds is regulated by state statute (section 430 of Public Act 872) and permits are required from the pesticides control section of the DEP. Prior to its approval, the permit application is reviewed by the DEP Pesticides Control staff, DEP Fisheries Bureau personnel and if the lake if located in a public water supply watershed, it is also reviewed by the State Department of Health Services.

The Pesticides Control Section offers a publication "Control of Water Weeds and Algae" available at no charge from (203) 566-5148. This booklet explains the types of chemicals available and the algae and weed types on which they are most effective. Chemical treatments are only cosmetic, providing immediate short term relief. Repeated applications may be necessary during the growing season.

Lakewide herbicide treatments may actually be detrimental to water quality. When all of the weeds die off at once, they are all decomposing on the lake bottom at the same time. This creates a tremendous drain on the oxygen supply of the bottom waters, setting up the proper condition for sediment recycle of nutrients as explained earlier. In a shallow, unstratified lake these nutrients are readily available for uptake by algae and blooms may result. Reduced competition for the nutrients by the weeds may also induce increased algae growth.

Hypolimnetic Withdrawal: This technique is a new experimental method which is currently in use at two Connecticut lakes. Prior to consideration of this technique, a diagnostic study must be completed to investigate the lake's nutrient cycling patterns.

AQUATIC WEED CONTROL METHODS

Aquashade: Aquashade is an inert blue coloring agent or dye which filters out the wavelengths of light which are required by aquatic plants to grow. Lakes which are candidates for aquashade treatments should have a relatively small volume of water and a long retention time (time it takes lake to flush). Aquashade however, is non-selective in the weeds it controls and also may not control some of the more vigorous weed growth. Aquashade does not control weeds growing in water less than 3 feet deep, nor does it prevent surface blooms of planktonic algae. The application of Aquashade requires a permit from the DEP Pesticides control section. Permit applications and additional information on Aquashade may be obtained by calling (203) 566-5148.

Benthic Weed Barriers: Benthic weed barriers consist of various grades of fiberglass mesh screening or perforated black nylon screening which is laid down upon the sediments to prevent weeds from growing by "mulching" them. Bottom barriers are useful at beach areas, docks and to create boating lanes.

Chemical Treatments: (see discussion in the algae control section above).

Drawdown and Excavation: If the spillway has the capacity to effectively lower the water level, lakes and ponds may be drawn down to expose the sediments in order to dry them out. In other cases when there is no water level control structure, the lake may be pumped or siphoned out. The water level is generally lowered following the recreation season.

Drawdown and excavation is sometimes employed to remove the substrate utilized by the plants for growth. The process increases water depth to levels where plants growing on the bottom will not receive enough light to survive. The effects of this method are generally long-termed. Selective excavation allows some areas to remain untouched as aquatic habitat. The DEP Fisheries Bureau should be consulted on the impact on the fishery.

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

This method has a relatively high capital outlay; however, the restorative effects are long termed. It is relatively quick and inexpensive compared to hydraulic dredging. State and/or local inland wetlands permits are required.

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

Hydraulic Dredging: Hydraulic dredging is the process of removing lake sediments without draining the water from the lake. Specialized dredges are employed which remove the sediments by suction as a slurry. The slurry is approximately 90% water and 10% sediments. This sediment must be "dewatered" prior to disposing of it, and the remaining water usually must be treated before it can be discharged. The development and construction of dewatering,containment basins is a major and expensive undertaking. State discharge and state and/or local inland wetlands permits are required.

A great deal of feasibility work must be completed by a qualified engineering/environmental firm prior to undertaking project of this scale. Capital outlay is extremely high, however the benefits of this method are generally long-termed.

<u>Weed Harvesting</u>: Weed harvesting entails the mechanical cutting of the weeds. After the weeds are cut they are drawn up into the harvester by a conveyer belt. When the harvester is full it is unloaded at a shoreline location. The weeds must then be disposed of at a site far removed from the lake so as not to become a source of nutrient enrichment. One benefit of harvesting is the actual removal of nutrients from the lake system. Another is that selected areas may be left untouched while others are harvested thus creating fishery habitat while increasing recreational utility. Although harvesting provides immediate relief it too may have to be repeated at periodic intervals and is a moderately expensive measure.

There are a few lakes in Connecticut whose lake associations have purchased their own weed harvesters for use on their particular lake. Many other lake associations contract out to weed control specialists for this service.

No state or local permits are required for weed harvesting activities.

<u>Hydroraking</u>: Hydroraking is a specialized type of weed harvesting which involves the mechanical removal of aquatic plants and their root systems. Hydroraking is more effective on certain weed types than on others. Adequate control over water lilies has been achieved with the hydrorake in some cases. As with weed harvesting there is the benefit of removing both weeds, and nutrients from the system.

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

<u>Winter Drawdown:</u> If the spillway has the capacity to effectively lower the water level, lakes and ponds may be drawn down to expose the sediments. In some cases lakes may be siphoned or pumped out. Over the winter, the bottom freezes and destroys roots, vegetative parts and susceptible seeds. Winter drawdown does not kill algae. Several Connecticut Lakes have gained control over weed problems using this method.

There are several advantages to overwinter drawdown including: no loss of summer recreational utility during project, virtually no-cost, and by concentrating fish populations there may be an increase in the growth rates of predator fish because of a reduction in the energy used for foraging for prey species. While the water level is down it is possible to selectively excavate sediments from areas that are particularly shallow or weed infested. These nutrient rich sediments should be deposited at a site removed from the lake so as not to become a source of sedimentation or nutrients to lake waters. Excavation activities may require state or local inland wetlands permits.

There are some disadvantages to overwinter drawdown including: lowering the water table significantly may dry up shallow wells around the lake, there may be possible downstream flooding during the drawdown, some species of weeds are not controlled by this method, and the method is non-selective and may result in the loss of fish and aquatic organism habitat. All of these considerations should be thoroughly examined prior to lowering the lake level.

About The Team

The Eastern Connecticut Environmental Review Team (ERT) is a group of professionals in environmental fields drawn together from a variety of federal, state, and regional agencies. Specialists on the Team include geologists, biologists, foresters, climatologists, soil scientists, landscape architects, archeologists, recreation specialists, engineers and planners. The ERT operates with state funding under the supervision of the Eastern Connecticut Resource Conservation and Development (RC&D) Area--an 86 town area.

The Team is available as a public service at no cost to Connecticut towns.

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 reviewing a wide range of projects including subdivisions, sanitary landfills, commercial and industrial developments, sand and gravel operations, elderly housing, recreation/open space projects, watershed studies and resource inventories.

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 officials of a municipality or the chairman of town commissions such as planning and zoning, conservation, inland wetlands, parks and recreation or economic development. Requests should be directed to the Chairman of your local Soil and Water Conservation District. This request letter should include a summary of the proposed project, a location map of the project site, written permission from the landowner allowing the Team to enter the property for purposes of review, a statement identifying the specific areas of concern the Team should address, and the time available for completion of the ERT study. When this request is approved by the local Soil and Water Conservation District and the Eastern Connecticut RC&D Executive Council, the Team will undertake the review on a priority basis.

For additional information regarding the Environmental Review Team, please contact Elaine A. Sych (774-1253), Environmental Review Team Coordinator, Eastern Connecticut RC&D Area, P.O. Box 198, Brooklyn, Connecticut 06234.