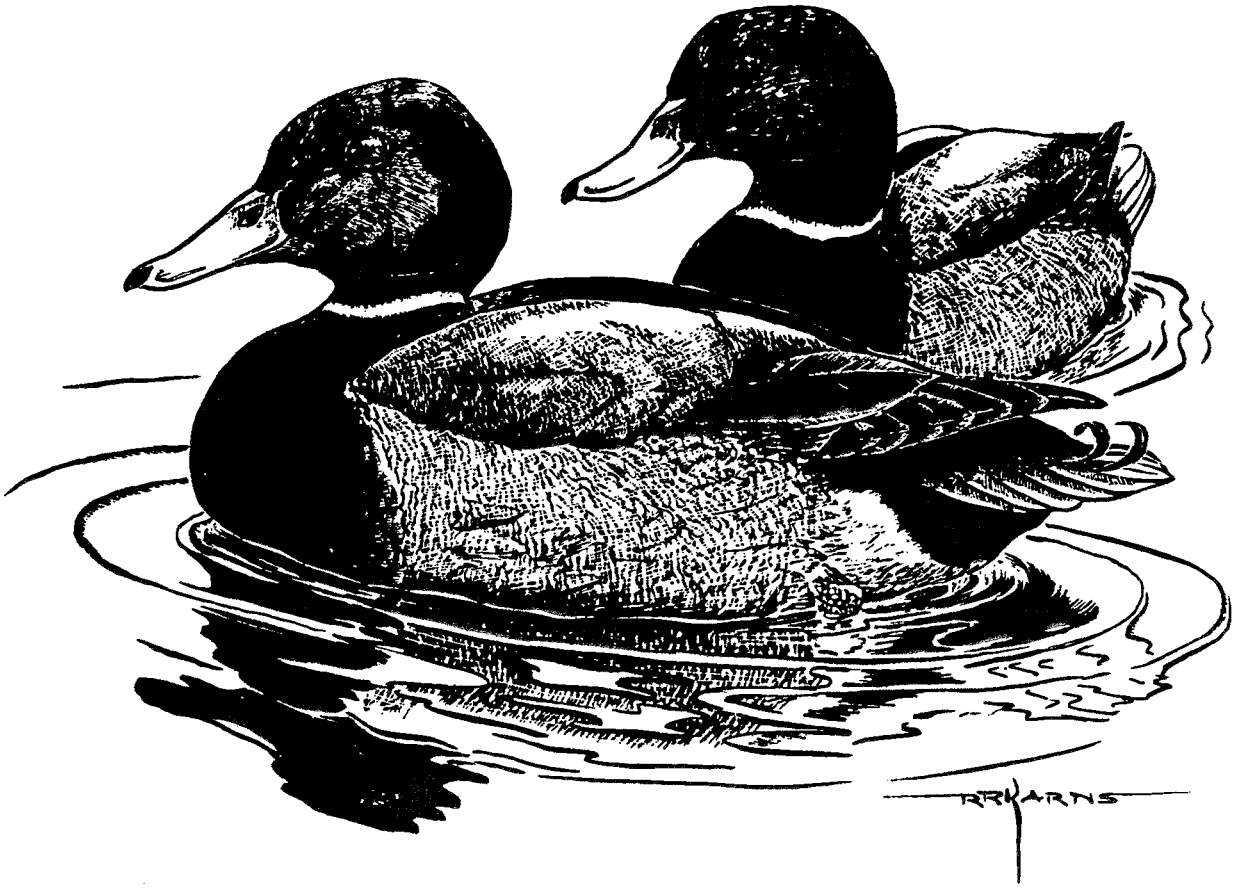
ECHO LAKE WATERSHED

WATERTOWN, CONNECTICUT



KING'S MARK ENVIRONMENTAL REVIEW TEAM

King's Mark Resource Conservation and Development Area, Inc.

ECHO LAKE WATERSHED

WATERTOWN, CONNECTICUT

Environmental Review Team Report

Prepared by the King's Mark Environmental Review Team
of the King's Mark Resource Conservation
and Development Area, Inc.

Wallingford, Connecticut

for the

Watertown Town Manager

This report is not meant to compete with private consultants by supplying site designs or detailed solutions to development problems. 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 Town. The results of the Team action are oriented toward the development of a better environmental quality and long-term economics of the land use. The opinions contained herein are those of the individual Team members and do not necessarily represent the views of any regulatory agency with which they may be employed.

AUGUST 1990

ACKNOWLEDGMENTS

The King's Mark Environmental Review Team Coordinator, Nancy Ferlow, would like to thank and gratefully acknowledge the following Team members whose professionalism and expertise were invaluable to the completion of this study:

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I would also like to thank Susan Anderson, Secretary of the King's Mark Environmental Review Team for assisting in the completion of this report.

Finally, special thanks to Dr. Novello Ruggiero and George McCleary for their cooperation and assistance during this environmental review.

EXECUTIVE SUMMARY

Introduction

The Watertown Town Manager requested that an environmental review be conducted on Echo Lake, a Town recreation area currently slated for dam renovations, and its watershed. The watershed is located in central Watertown. The area around Echo Lake contains hardwood forest with several areas of wetlands. Echo Lake Brook feeds the lake. The site was once used for recreation and swimming. Currently, the lake is experiencing siltation problems from developments upstream, and the dam needs repairs. The Town must determine an appropriate use for the property so the dam can be designed to meet that use. The Town also requested advice concerning E&S control to resolve existing problems and to prevent future problems in the watershed.

The review process consisted of 4 phases: 1) inventory of the site's natural resources; 2) assessment of the resources; 3) identification of resource problem areas; and 4) presentation of planning and land use guidelines. Based on the review process, specific resources, areas of concern, development limitations and development opportunities were identified.

Setting, Land Use and Zoning

Echo Lake and its accompanying watershed are located in southcentral Watertown. Land use in the watershed includes single-family homes, wooded land and agricultural fields. Industrial/commercial buildings and an elderly housing complex are located along Buckingham Street. A Town-owned swimming area is located at the southeast corner of Echo Lake. The watershed area is zoned R-10 and R-20, which allows single-family homes on lots that are at least 10,000 and 20,000 square feet, respectively. Except for the area close to Echo Lake, public sewers and water mains are available in the watershed.

Topography

The majority of the watershed is characterized by moderate slopes with some gentle and steep slopes. Elevations range from 550 to 860 feet above mean sea level. Due to the watershed topography and geology, potential for erosion and sedimentation problems is high. Sedimentation caused the high turbidity levels in Echo Lake last year, forcing the Town to close the lake for swimming purposes. The high turbidity levels may have resulted from a failed sediment/detention basin constructed on the Mount Fair Farm subdivision site. Proper E&S control measures, construction phasing and reduction in disturbed areas are imperative to minimize potential adverse impacts. E&S controls must be policed regularly to ensure that they remain effective.

Geology

Bedrock underlying the site consists of the Hitchcock Lake Member, the Hartland Unit I Member and granite. Depth to bedrock is 10 feet or less in most places, but may be as much as 40 feet deep in the northern, western and eastern parts. Shallow bedrock can limit excavations for roads, utilities and foundations, and blasting may be required. Overlying the bedrock is glacial till. Texture of the till ranges from sandy and loose to silty and compact. The sandier version of till is found in areas that are shallow to bedrock. Compact till is found in areas of deeper bedrock. The compact layer causes a seasonally high watertable which is a design constraint for septic systems and slope stabilization. According to the Soil Survey, regulated wetlands are found in several areas. E&S control is important for water quality protection.

Geologic Development Concerns

The geology should not pose any major problems for improving the swimming area. Flat slopes and well-drained sandy soils in the area are conducive for recreational uses such as swimming, playground equipment, picnic tables and pavilion. Construction of a small on-site sewage disposal system for sanitary facilities appears feasible, provided that it is kept shallow and set back a minimum of 50 feet from the high water mark of Echo Lake. Also, a bedrock well could serve the facility. The west side of Echo Lake can be used for hiking, fishing and picnicking, although wet areas and rocky, steep slopes may present obstacles. Hiking trails should be maintained on a regular basis. A parking area at the north end of Echo Lake is used as a disposal area. All dumping should be stopped.

Hydrology

The watershed is estimated to be 355 acres in size. Surface waters have not been classified by the DEP, but are assumed to be Class A. Groundwater is classified GA. The Health District indicated that the swimming area was closed by the Town for turbidity and not for elevated coliform levels. One likely source of sediment is Mount Fair Farms Subdivision located along the Echo Lake feeder stream. The Town should take immediate action to prevent further deposition into the lake or stream. Adequate E&S controls should be developed and followed for all future development in the watershed. Much of the remaining land is steep and rocky and is unfavorable for development. The potential for deposition should diminish once the active developments have stabilized. A sediment basin could be constructed upstream from Echo Lake to trap sediments before they reach the lake.

Potential of Echo Lake for Swimming Purposes

The health department formula was used to estimate the maximum number of swimmers that the lake could support. Using an approximation for the depth and acreage and low flow levels of the lake, the permissible number of swimmers is 112 per day. This is less than 1/2 of 1% of the population of Watertown. The minimum area for swimmers should be accommodated by the present beach. The Health

District should be contacted for more information. Continuing to use the lake for swimming is practical only if erosion and sedimentation is controlled.

Soil Resources

The watershed is dominated by Paxton, Woodbridge and Charlton soils. Limitations include perched watertables, slope and stony soils.

Erosion and Sediment Control

The accumulation of sediments has decreased the lake's value for recreation. Subdivisions in the watershed are the probable source for much of the sediment. Increases in water flow from the developed land can cause streambank erosion. Streambank erosion can be stabilized by gabions and/or a retaining wall or piping the stream. Most sediments enter the lake through the inlet stream. A sediment basin could be constructed off of the stream to trap sediments before they reach the lake. The basin must be placed where it is accessible to maintenance equipment. Seeding the channel is also recommended. Reducing the beach area will also reduce the amount of runoff. The steep access road to the west side of the lake is another source of sediment. Waterbars will divert the water off of the road.

Prime Farmland

Portions of the watershed contain prime farmland soils. Landowners interested in preserving farmland can participate in the State's Purchase of Development Rights Program.

Wildlife Considerations

Habitat within the watershed consists of open water, hardwood forest, old fields and wetlands. The amount of disturbance and use by humans limits the habitat value for wildlife. Solving the siltation problem would be beneficial to wildlife. Some management suggestions include limiting hiking to specific trails, maintaining an uneven aged forest, utilizing a vegetation buffer around the lake and maintaining the old field habitat by mowing. Open space is beneficial to wildlife if it is connected to other parcels of open space. Measures which can reduce the impacts of development include maintaining a buffer around all wetlands, using natural landscaping techniques, keeping detention basins out of wetlands, using Best Management Practices to maintain good water quality, utilizing proper E&S controls, using bridges instead of culverts, restricting activities allowed in wetlands and maintaining forest wildlife requirements.

Fisheries Resources

Echo Lake is an artificial waterbody created by impounding Echo Lake Brook. Development in the watershed has increased the intensity and duration of stormwater runoff and deposited sediment into the lake. Still, the water quality of the lake is adequate to support a healthy fishery population. The lake is classified as warmwater, and fish species present could include largemouth bass, bluegill

sunfish, common (pumpkinseed) sunfish, yellow perch, chain pickerel, golden shiner and brown bullhead. Potential impacts include soil erosion and sedimentation, road salts, sands and oils entering the lake degrading water quality and runoff stimulating excessive aquatic plant growth. Recommendations include providing fishing areas, installing an outlet control device with the capability of regulating lake volume, maintaining a buffer zone around the lake, designing and implementing a comprehensive E&S control plan for developments, constructing a sediment basin or series of basins within Echo Lake Brook, designing an effective stormwater management plan and limiting lime, fertilizer and lawn chemicals within the watershed.

Threatened and Endangered Plant and Animal Species

According to the Natural Diversity Data Base, there are no Threatened or Endangered Species or Connecticut "Species of Special Concern" in the watershed.

Recreational Considerations

Watertown must choose from a cost benefit standpoint how to meet its responsibility of providing swimming opportunities to its residents. Options include rehabilitating Echo Lake, abandoning Echo Lake as a swimming area and utilizing it as a passive park, developing an artificial outdoor pool, fed by municipal water and with an appropriate filtration and chlorination system. A careful cost-benefit analysis of the various options is recommended.

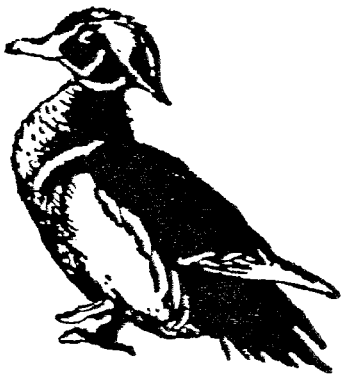
TABLE OF CONTENTS

LAND USE AND PLANNING CONSIDERATIONS

LIST OF APPENDICES

LIST OF FIGURES

INTRODUCTION



INTRODUCTION

The Watertown Town Manager requested that an environmental review be conducted on Echo Lake, a Town recreation area currently slated for dam renovations, and its watershed. The watershed is located in central Watertown. Access is provided by Echo Lake Road, Old Ice House Road and French Street.

The area around Echo Lake contains hardwood forest with several areas of wetlands. Echo Lake Brook feeds the lake. The site was once used for recreation and swimming. Currently, the lake is experiencing siltation problems from developments upstream, and the dam needs repairs. The Town must determine an appropriate use for the property so the dam can be designed to meet that use. The Town also requested advice concerning erosion and sediment (E&S) control to resolve existing problems and to prevent future problems in the watershed.

The purpose of this review is to inventory and assess existing natural resources and discuss recreational opportunities, E&S controls and the impacts of development. This environmental information will be used to assist the Town in guiding conservation and development in this area. Specific objectives include:

1) Assess the hydrological and geological characteristics of the site, including geological development limitations and opportunities;

2) Determine the suitability of existing soils to support recreational development;

3) Discuss soil erosion and sedimentation concerns;

4) Assess the impact of recreation on the lake and watercourses;

5) Assess the impact of development on wildlife, including alternatives for consideration; and

6) Assess planning and recreational issues.

THE ERT PROCESS

Through the efforts of the Town and the King's Mark ERT, this environmental review and report was prepared. This report primarily provides a description of on-site natural resources and presents planning and land use guidelines. The review process consisted of 4 phases:

1) Inventory of the site's natural resources (collection of data);
2) Assessment of these resources (analysis of data);
3) Identification of resource problem areas; and
4) Presentation of planning and land use guidelines.

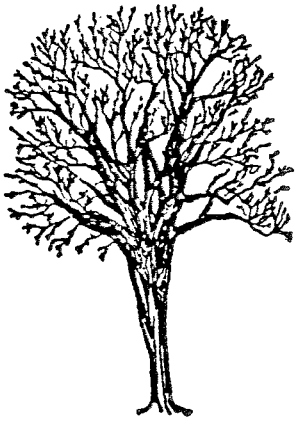
The data collection phase involved both literature and field research. The ERT field review took place on June 20, 1990. Field review and inspection of the site proved to be a most valuable component of this phase. The emphasis of the field review was on the exchange of ideas, concerns or alternatives. Mapped data or technical reports were also perused, and specific information concerning the site was collected. Being on-site also allowed Team members to check and confirm mapped information and identify other resources.

Once Team members had assimilated an adequate data base, they were able to analyze and interpret their findings. The results of this analysis enabled the Team members to arrive at an informed assessment of the site's natural resource development opportunities and limitations. Individual Team members then prepared and submitted their reports to the ERT Coordinator for compilation into the final ERT report.

Figure 1

LOCATION OF STUDY SITE

PHYSICAL CHARACTERISTICS



SETTING, LAND USE AND ZONING

Echo Lake, an approximately 9-acre Town-owned surface waterbody, and its accompanying watershed are located in southcentral Watertown. The term watershed refers to all land areas from which water derived from precipitation may drain into Echo Lake. The principal roads located in the watershed area include Echo Lake Road, an east-west road that bisects the central parts of the watershed; Buckingham Street, a northwest-southeast road that traverses the northcentral parts of the watershed; and Ice House Road, a north-south road that is located along the east side of Echo Lake in the southern half of the watershed. Segments of Oak Street, Longview Avenue, East Street, Gorham Street, Portland Street and Augusta Street also occur in the watershed and serve residential areas. Mount Fair Farms, a major residential subdivision, is presently under construction in the northcentral parts of the watershed.

The 1986 air photos indicate that the watershed area includes single-family homes mainly along Echo Lake Road, wooded land in the southern half of the watershed and agricultural fields in the northern half of the watershed. Industrial/commercial buildings and an elderly housing complex are located along Buckingham Street. The major land use activity impacting the watershed since 1986 is the development of residential properties on the farm fields in the northern half of the watershed.

A Town-owned swimming area, which was closed last season due to high turbidity levels, is located at the southeast corner of Echo Lake. The swimming area includes a wooden structure.

According to Town officials, the watershed area is zoned R-10 and R-20, which allows single-family homes on lots that are at least 10,000 and 20,000 square feet,

respectively. An official road map for the Town indicates that the watershed area south of Buckingham Street is located in the Town's urban zone.

Except for the area close to Echo Lake along Ice House Road, public sewers and water mains are available in the watershed area.

TOPOGRAPHY

Except for some gentle slopes at the northern and eastern limits of the watershed and north of Echo Lake, the majority of the watershed is characterized by moderate slopes. Additionally, areas of steep slopes bisect the central parts of the watershed north of Echo Lake Road and occur on the west side of Echo Lake. Slopes in both of these areas are controlled by the underlying bedrock. Elevations in the watershed range from approximately 550 feet above mean sea level at the outlet of Echo Lake to 860 feet above mean sea level at the northern limits of the watershed (see Figure 2). This represents a difference in elevation of 310 feet. Due to the watershed topography and geology, potential for erosion and sedimentation problems is high in the watershed, underscoring the need for proper E&S control measures with respect to new developments.

Sedimentation caused the high turbidity levels in Echo Lake last year, forcing the Town to close the lake for swimming purposes. The high turbidity levels may have resulted from a failed sediment/detention basin constructed on the Mount Fair Farm subdivision site. The basin is located in Echo Lake's main feeder stream. Proper E&S control measures, construction phasing and reduction in disturbed areas are imperative to minimize potential adverse impacts to local water resources in the watershed. E&S controls must be policed regularly by Town officials to ensure that they remain effective.

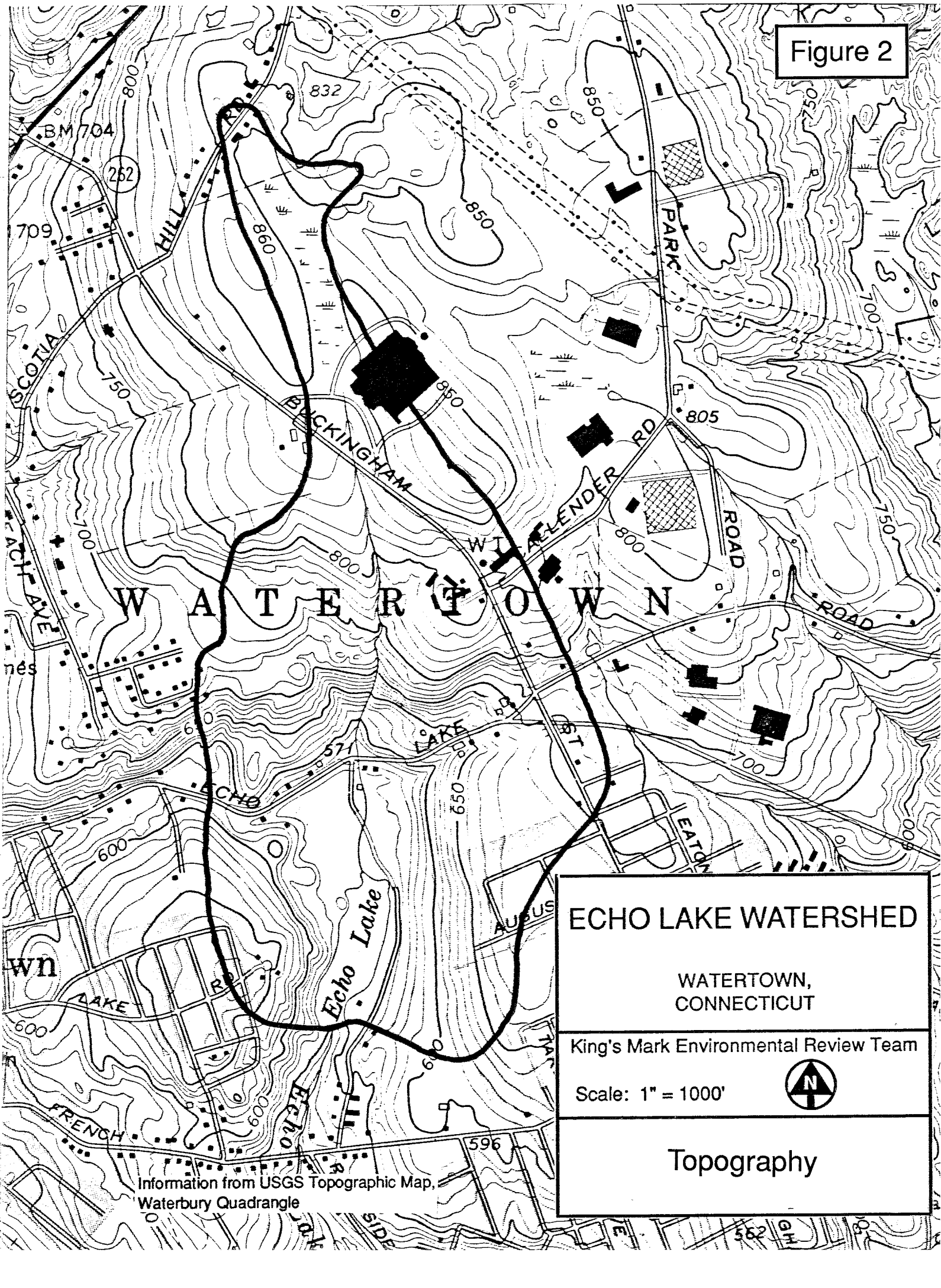


Figure 2
WATERTOWN
BM 704
262
709
HILL
832
860
850
PARK
700
750
SCOTIA
BUCKINGHAM
805
WALLENDER RD
ROAD
800
ACH AVE
LAKE
571
ECHO
650
600
EATON
Echo Lake
FRENCH
596
562
ECHO LAKE WATERSHED
WATERTOWN,
CONNECTICUT
King's Mark Environmental Review Team
Scale: 1" = 1000'
N
Topography
Information from USGS Topographic Map,
Waterbury Quadrangle

GEOLOGY

The Echo Lake Watershed Area is located in the Waterbury topographic quadrangle. A bedrock geologic map (QR-22, by R.M. Gates and Charles W. Martin, 1962-64) for the quadrangle has been published by the Connecticut Geological and Natural History Survey. No surficial geologic map exists for the quadrangle at present. The Soil Survey of Litchfield County, Connecticut and the unpublished Surficial Materials Map of Connecticut (J. Stone et. al., 1985) were also referenced.

Bedrock Geology

According to map QR-22, 3 rock types underlie the watershed area (see Figure 3). They are:

1) The Hitchcock Lake Member;
2) A granite rock body that is unnamed; and
3) The Hartland Unit I Member.

The most widespread rock type underlying the watershed is the Hitchcock Lake Member, a thin to thick interlayered finely streaked granulite composed mainly of the minerals oligoclase and quartz and coarsely streaked gneiss composed mainly of mica, quartz and oligoclase. This rock unit underlies the southcentral, central and northern parts of the watershed and is widely exposed on the steep slopes just north of Echo Lake Road. The western end of a fine- to medium-grained, white to gray granite mass extends north and northwest of Echo Lake. It intruded the Hitchcock Lake Member as molten magma. This rock outcrops in a few places in the watershed, but mainly on the steep slopes just north of Echo Lake Road. The final rock type, which underlies the southern limits of the watershed, is the Hartland Unit I Member, a fine-grained, light gray granulite or granulitic gneiss. Major minerals in this rock include muscovite, biotite, plagioclase and quartz.

The terms gneiss and granulite indicates that the rock is metamorphic. These rocks have been altered by tremendous heat and pressure within the earth's crust. Gneisses are generally recognizable by compositional banding of light and dark minerals which consist of quartz, feldspar and various amounts of dark-colored minerals (e.g., biotite). Gneiss is a common rock type found in the upland sections of western and eastern Connecticut. Granulites are metamorphic rocks that are composed of even-sized, interlocking granular minerals. In contrast, granites are massive-appearing intrusive igneous rocks that formed from molten magma and are light-colored and medium- to very coarse-grained. Granites lack the banding that characterizes the gneissic rocks. Common minerals in granite include quartz, feldspar and often muscovite mica with small amounts of dark minerals. Granites were quarried for use as dimension stone in Connecticut.

Generally, depth to bedrock is 10 feet or less in most places in the watershed. Depth to bedrock may be as much as 40 feet deep in the northern, western and eastern parts, where thick unconsolidated deposits overlie bedrock. Primary geological considerations with respect to site development in the watershed include depth of bedrock and distribution of surficial (soil) deposits. In the shallow to bedrock areas, excavation for foundations, utility lines or to achieve desired road and driveway grades may be difficult, and blasting may be required. Blasting usually increases development costs for sites in steep, rocky areas.

The underlying bedrock is a source of domestic water to many homes in Watertown that are not served by municipal water mains.

Surficial Geology

Overlying bedrock in the watershed area is a blanket of unconsolidated sediments of glacial origin. As ice advanced over Connecticut one or more times during the last million years or more, it scraped and chipped bedrock outcrops and bulldozed pre-existing soils, incorporating the rock particles into the ice mass. These

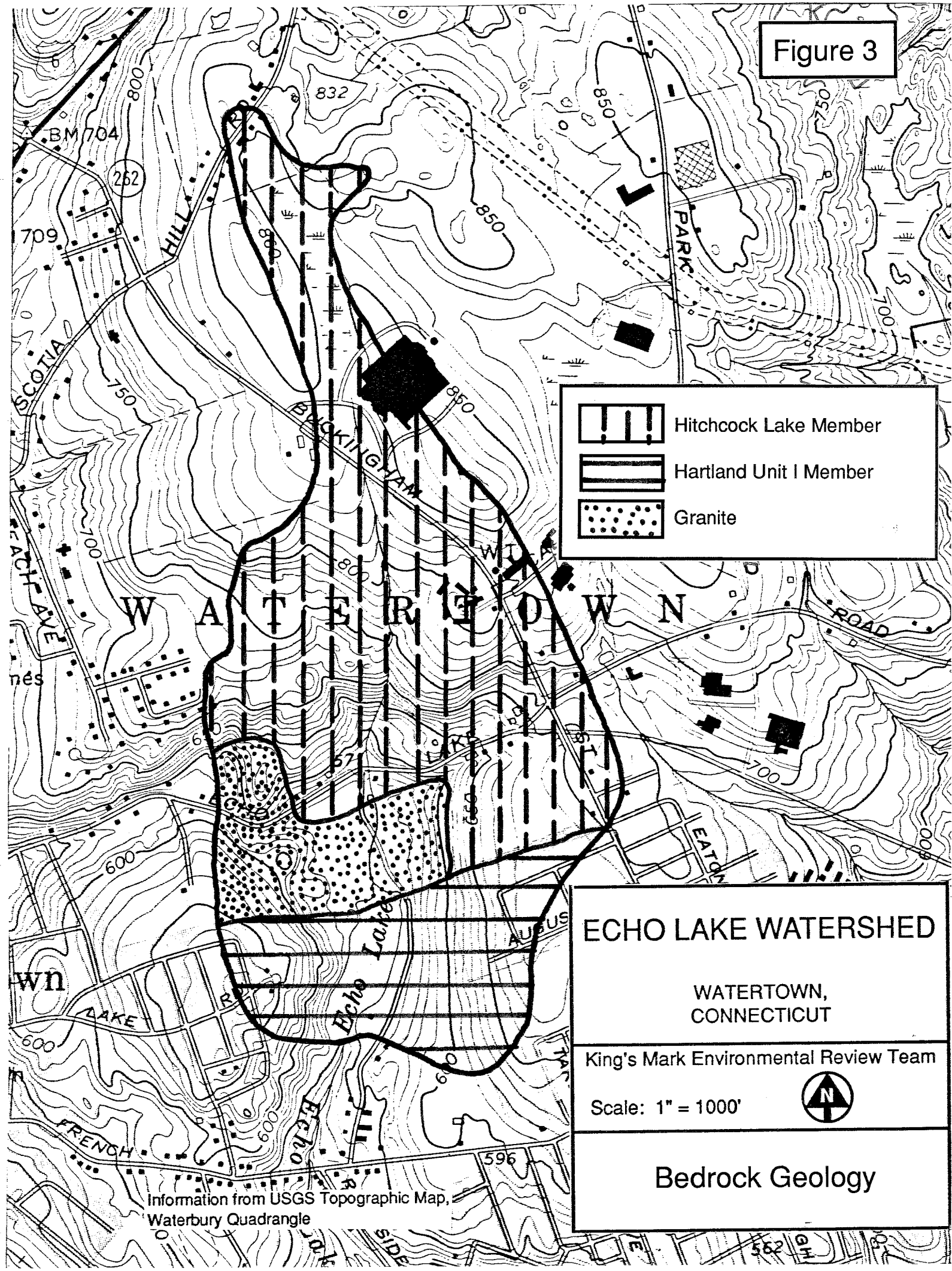


Figure 3
Hitchcock Lake Member
Hartland Unit I Member
Granite
ECHO LAKE WATERSHED
WATERTOWN, CONNECTICUT
King's Mark Environmental Review Team
Scale: 1" = 1000'
N
Bedrock Geology
Information from USGS Topographic Map, Waterbury Quadrangle
WATERTOWN
BM 704
262
709
HILL
PARK
ROAD
LAKE
Echo Lake
FRENCH
832
850
800
750
700
600
596
562

particles were then plastered against bedrock ridges and knobs by the ice as it advanced or were let down gently from the ice as it began to waste away. The non-sorted accumulation of rock fragments that resulted includes a wide range of sizes and shapes and is known as till (see Figure 4).

The texture of the till in the watershed varies from sandy, stony and relatively loose to silty, less stony and compact. The compact variety occurs mainly in the northern parts of the watershed and east of Echo Lake and probably is characterized by a compact soil zone that ranges between 1.5 to 3 feet below ground surface. Till deposits in these areas are believed to be relatively thick, perhaps 40 feet or more. The compact soil zone, locally referred to as hardpan, is composed of fine-grained sediments (i.e., fine sand and silt). Seasonally high watertable conditions often characterize hardpan soils. Seasonal high watertable conditions are an important design constraint for on-site septic systems, keeping basements dry and for slope stabilization where deep earth cuts occur. In general, the looser variety of till occurs in the shallow to bedrock areas and in the upper few feet of the deposit. This variety of till occurs mainly west of Echo Lake and in the interior portions of the watershed.

According to the Soil Survey of Litchfield County, Connecticut, the principal regulated soils found in the watershed area:

1) Parallel Echo Lake's major feeder streams;

2) Occupy the flat area north of Echo Lake; and

3) Occur in a relatively long, narrow pocket northwest of the Crystal Rock Water Company building.

Regulated wetland areas have several important hydrological functions, including streamflow regulations, erosion control, sediment retention and surface water quality protection. In addition, they may be a valuable ecological asset.

The availability of municipal sewers and water mains for most of the watershed area (except along Ice House Road) will soften the principal hydrogeologic and environmental concerns that are often raised when these utilities are not available. Despite the availability of these utilities, the presence of steep slopes, hardpan soils that are characterized by seasonal high watertables and shallow to bedrock soils that may require blasting will be major obstacles for development in the watershed area. Therefore, developments that encounter these geologic limitations represent a potential threat to the surface water quality of Echo Lake and its feeder streams and require stringent E&S control measures. Any development that occurs in the watershed should be accompanied by a comprehensive site specific E&S control plan that is properly enforced.

GEOLOGIC DEVELOPMENT CONCERNS

The geology of the east side of Echo Lake should not pose any major problems for improving the existing swimming area. Flat slopes and the presence of well-drained sandy soils in the area of the existing Town facility will be conducive for low to medium density recreational uses such as swimming, playground equipment, picnic tables and pavilion. Although municipal sewer mains are not available in the area, the construction of a small on-site sewage disposal system for sanitary facilities appears feasible, provided that it is kept shallow and set back a minimum of 50 feet from the high water mark of Echo Lake. Also, if municipal water mains are not available to the swimming area, a bedrock well, 150 to 200 feet deep, could adequately serve the facility. Bedrock wells generally are capable of yielding 2 to 5 gallons per minute. If an on-site septic system or well is desired, Town officials should contact the Chesprocott Health District for assistance.

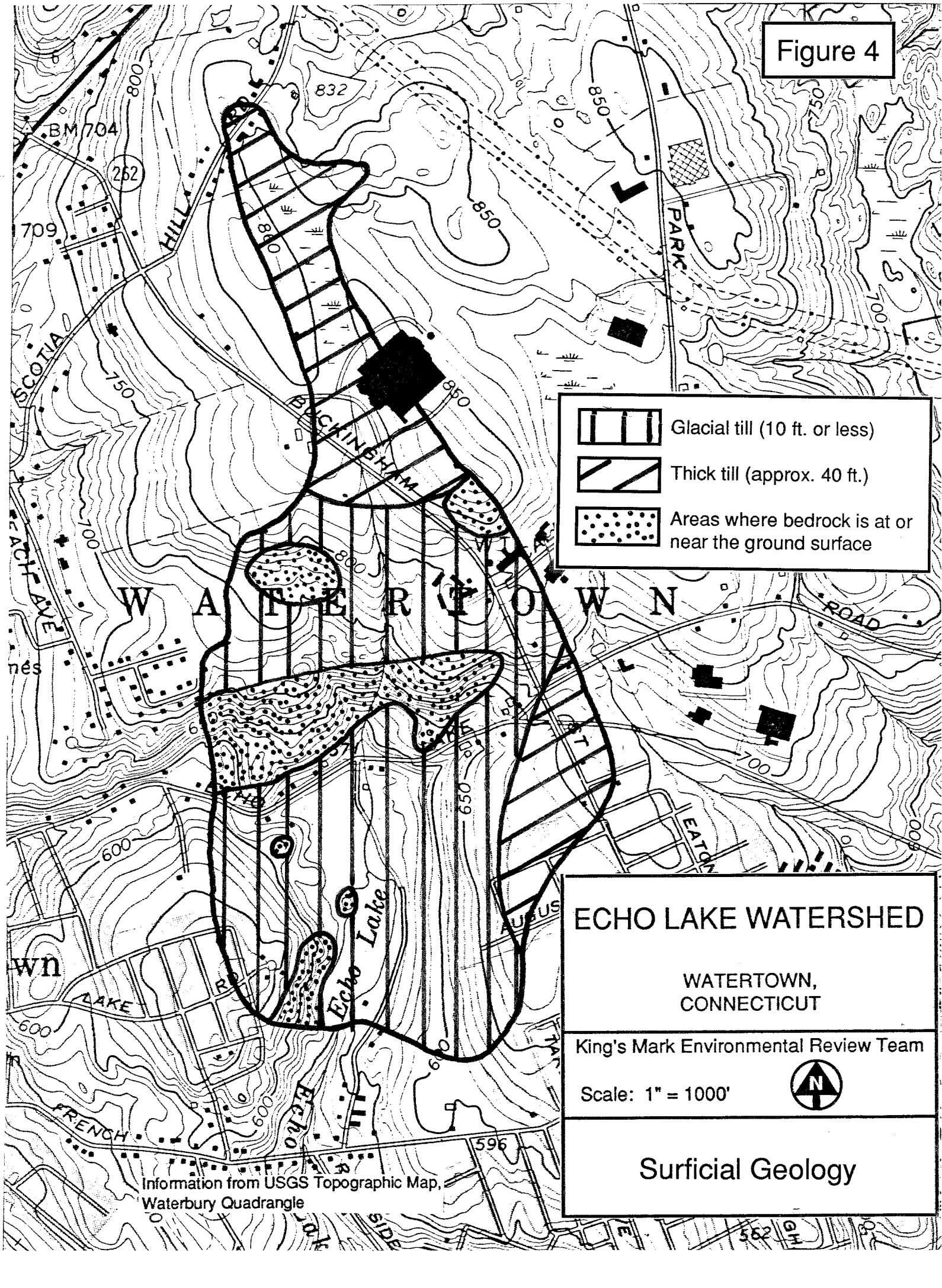


Figure 4
Glacial till (10 ft. or less)
Thick till (approx. 40 ft.)
Areas where bedrock is at or near the ground surface
ECHO LAKE WATERSHED
WATERTOWN, CONNECTICUT
King's Mark Environmental Review Team
Scale: 1" = 1000'
Surficial Geology
Information from USGS Topographic Map, Waterbury Quadrangle
WATERTOWN
Echo Lake
BM 704
262
709
832
800
850
750
700
600
596
HILL
PARK
ROAD
LAKE
FRENCH
BUCKINGHAM
SCOTIA
EATON
N

The west side of Echo Lake can be used for hiking, fishing and picnicking, although the presence of some wet areas and small areas of rocky, steep slopes may present obstacles. Hiking trails, especially those close to the lake, should be maintained on a regular basis to ensure that trails do not erode and add silt to the lake, which will result in water quality degradation.

A parking area at the north end of Echo Lake is used as a disposal area for brush, garbage and appliances. Steps should be taken immediately to stop this activity.

HYDROLOGY

The Echo Lake Watershed Area is estimated to be approximately 355 acres or 0.55 square miles in size. All runoff from the watershed flows either directly into Echo Lake or its major feeder stream (see Figure 5). The outlet for the lake, Echo Lake Brook, is tributary to Steele Brook. The principal feeder stream which is unnamed originates in the wetland area northwest of the Crystal Rock Water Company facility on Buckingham Street. There are a few smaller unnamed streamcourses that feed Echo Lake. They arise from the northwest and northeast parts of the watershed.

According to the Water Quality Classification Map of Connecticut (Murphy, 1987), the surface waters in the watershed have not been classified by the Department of Environmental Protection (DEP) and are considered Class A water resources by default. Class A water resources are suitable for drinking water, recreational or other uses and may be subject to absolute restrictions on discharges, although certain discharges may be allowed.

Groundwater within the watershed area is classified as GA which means it is suitable for private drinking water supplies without treatment.

Based on surficial geologic mapping data, the entire watershed area is covered by glacial till. The watershed area is characterized by medium to high density residential use, woodland and some agricultural land. Using standard surface flow criteria, it is estimated that run-off from the watershed averages approximately 700,000 gallons per day annually.

Using a computerized planimeter, Echo Lake was computed to be approximately 9 acres in size. Bathymetric (depth) information for the lake is not available, but Town officials believe that it is probably 15 feet in the deepest part.

A Chesprocott Health District official indicated that due to high turbidity levels in Echo Lake last season (1989), the Town, not Health District, closed the lake to swimmers. Elevated coliform levels were not a problem at the lake at the time. One likely source of the sediment is Mount Fair Farms located on the agricultural fields south of Buckingham Street in the northcentral parts of the watershed. Site conditions are susceptible to erosion due to the presence of hardpan soils, moderate to steep slopes and the potential for concentrated and uncontrolled runoff from the former farm fields. Additionally, the main feeder stream for Echo Lake bisects the subdivision site in a north-south direction. Unless proper E&S control measures such as haybales, silt fences, off-line settling basins and anti-tracking devices are utilized, sediment deposition will probably continue to be a problem. The Town should take immediate action to prevent further deposition of sediment into Echo Lake or its feeder streams.

Adequate E&S control plans should also be developed and closely followed for all future developments in the watershed, especially those close to Echo Lake feeder streams. The 1990 air photo indicates that there is limited developable land left in the watershed area. Much of the remaining land is steeply sloping, rocky land unfavorable for most types of development. Therefore, the potential for sediment

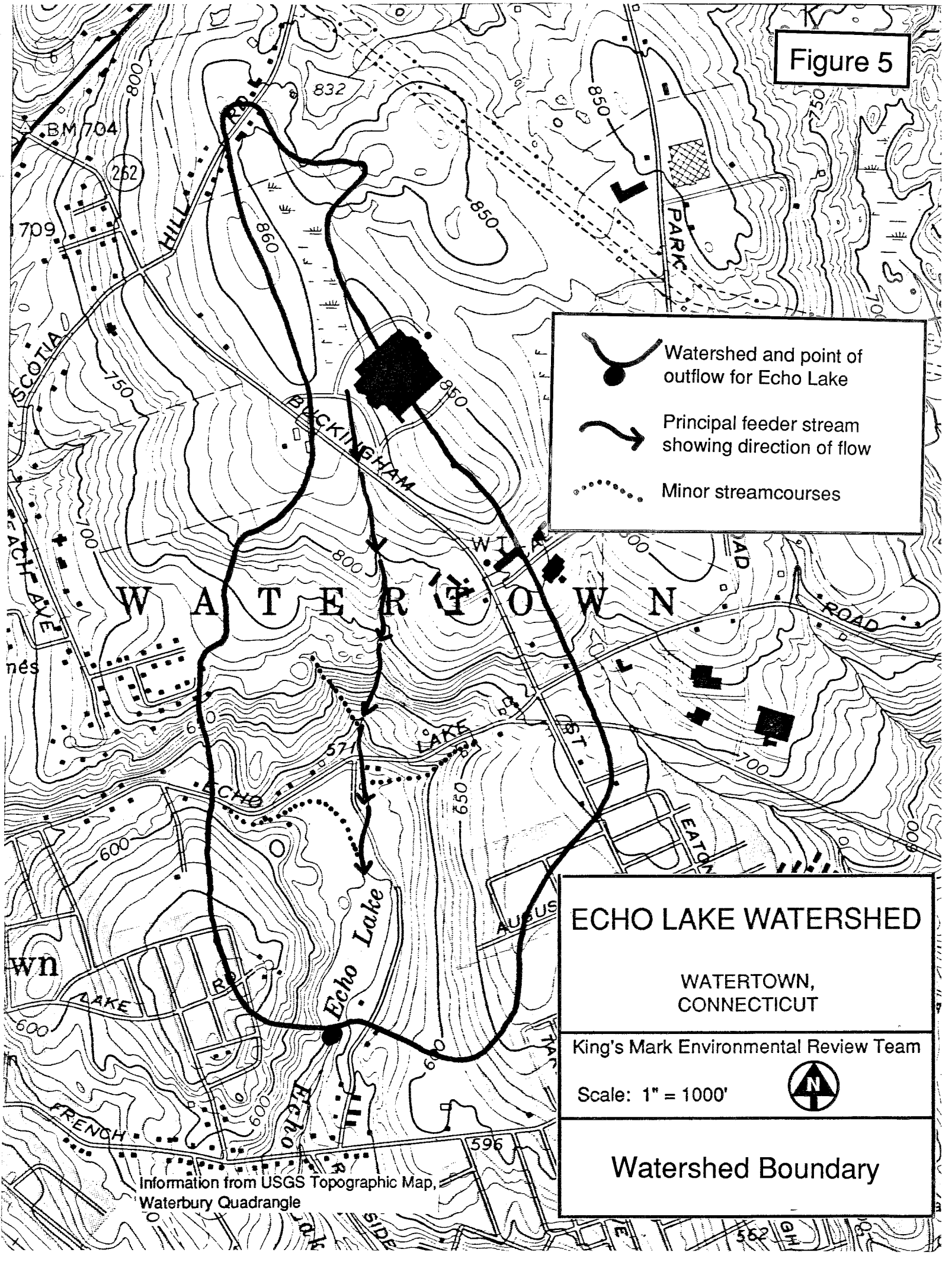


Figure 5
Watershed and point of outflow for Echo Lake
Principal feeder stream showing direction of flow
Minor streamcourses
WATERTOWN
ECHO LAKE WATERSHED
WATERTOWN, CONNECTICUT
King's Mark Environmental Review Team
Scale: 1" = 1000'
Watershed Boundary
Information from USGS Topographic Map, Waterbury Quadrangle
Echo Lake
BUCKINGHAM
HILL
PARK
ECHO
LAKE
ROAD
FRENCH
BM 704
709
832
850
860
800
750
700
650
600
571
596
562

deposition should diminish, particularly once the active developments become stabilized.

The Town might consider constructing a sediment basin above Echo Lake to trap unwanted sediments before they reach the lake. To be effective over the long-term, the basin must be maintained on a regular basis and should be easily accessible for maintenance equipment.

The Echo Lake dam is constructed of an earthen embankment, and water flow is controlled by a riser pipe. The dam is in need of repair, and the DEP Dam Safety Unit should be contacted at 566-7245 regarding this matter.

POTENTIAL OF ECHO LAKE FOR SWIMMING PURPOSES

The Department of Health Services uses the following formula to estimate the maximum number of swimmers per day that should be allowed to utilize a waterbody: $N = (V/180 + F/1000)$, where N is the number of swimmers, V is the volume of the waterbody and F is the inflow provided by streams or other sources. This formula is useful only if the initial natural quality of the water is acceptable and if other safety factors such as beach space and lake bottom conditions are satisfactory. Elevated turbidity levels in the lake last season forced the Town to close the lake for swimming purposes. At the field review, the water in the lake appeared to be only slightly tea-colored, indicating possible problems with tannins. The lake was not highly turbid.

Since no volumetric information was available for the lake, the volume of the lake was estimated by planimetering the surface areas of the lake and assuming an average depth of 5.5 feet. Bathymetric data must be collected to determine the exact average depth of the lake. Nevertheless, using an average depth of 5.5 feet and a surface area of 9 acres, the volume of the lake was estimated to be approximately 49.5

acre feet or approximately 16 million gallons. The inflow rate (F) is variable, but for the purpose of this report the amount of dilution water available was estimated by determining the area of watershed tributary to the bathing area and using a standard estimated minimum stream flow for the 7 day - 2 year and 7 day - 10 year low flow conditions. These estimates, which are found in Table 1, indicate flow rates which statistically occur for 7 consecutive days at 2-year and 10-year intervals, respectively, and which may occur for shorter periods at smaller intervals. Alternatively, these parameters may be considered to be flow rates which statistically are exceeded 90% and 99% of the time. These estimates were used since peak demand for swimming and low flow rates tend to occur simultaneously in the hot summer months.

Table 1: Low Flow Estimates for Echo Lake Watershed

	Gallons/day
7 day - 2 year: (flows equalled or exceeded 90% of the time)	22, 584
7 day - 10 year: (flows equalled or exceeded 99% of the time)	5,610

Using the numbers in Table 1 and the Department of Health Services' formula, the number of swimmers that could use the lake each day during worst case conditions (e.g., for flows equalled or exceeded 99% of the time) is estimated to be 95. During more typical summer in-flow conditions (e.g., an in-flow rate equalled or exceeded 90% of the time), the permissible number of swimmers per day is approximately 112.

Considering Watertown's population is approximately 20,900, only around 1/2 of 1% of Town residents may be able to use Echo Lake during a given day using the 112 swimmer figure. Note this is use per day, not persons in water at one time.

If swimmers are concentrated in a small area, localized bacterial pollution can occur, even with sufficient dilution water flowing through the lake. The Department of Health Services suggests that there be at least 1,000 gallons of water within the immediate swimming area for each swimmer using the area during the course of the day. If 50 square feet contains approximately 1,000 gallons of water, then there should be 50 square feet of area allocated per swimmer. This will prevent the possibility of bacterial deterioration and allow for swimming activity. Using the 112 swimmer load figure for the existing Town beach, a swimming area of 5,600 square feet should be required. This represents an area of approximately 125 feet by 45 feet. This area should be easily accommodated by the existing Town beach. The Town should contact the Chesprocott Health District and Department of Health Services (566-1259) for recommendations regarding any changes or improvements to the swimming area at Echo Lake.

Continuing to use Echo Lake as a public swimming facility seems to be practical, but only if erosion and sedimentation can be effectively controlled in the watershed. The availability of municipal sewers for most of the watershed will minimize the chance for bacterial contamination in the lake.

SOIL RESOURCES

The Echo Lake Watershed Area is dominated by Paxton, Woodbridge and Charlton soils (see Figure 6). The Paxton soil series consists of deep, well-drained soils that developed on glacial till. Their permeability is moderate on the surface layer and subsoil, but slow or very slow in the substratum. These soils have a compact layer at a depth of approximately 2 feet. Paxton soils have a perched watertable at a depth that ranges between 1.5 and 2.5 feet. These soils are slightly unfavorable for urban development because of their wetness and slope, but these

conditions can be easily overcome. The Woodbridge soil are moderately well-drained, nearly level to sloping soils that developed on compact glacial till. These soils are underlain by a compact layer at a depth of approximately 2 feet. Their permeability is moderate in the surface layer and subsoil, but is slow or very slow in the substratum. The watertable is perched and ranges in depth from between 1.5 and 2.5 feet. These soils are slightly unfavorable for urban development because of their wetness, but this limitation can be easily overcome. The Charlton series consists of deep, well-drained soils that developed on friable or firm glacial till. They are stony soils, and their permeability is moderately rapid in the surface layer and subsoil. The watertable is deeper than 6 feet. These soils are well-suited for development.

The soils of the watershed are described more fully in the Soil Survey of Litchfield County, Connecticut (1970). A summary of soil characteristics is found in Appendix A Tables 1-3.

EROSION AND SEDIMENT CONTROL

The accumulation of sediments in Echo Lake has decreased the lake's value as a recreational area. The subdivision developments that have taken place within the watershed are probable sources of sediments. When construction takes place, disturbed soils are exposed to rainfall and stormwater runoff, causing erosion. A large amount of development has taken place in soils classified as Prime Farmland. Soils classified as Additional Farmland of Statewide Importance are also found within the watershed. The majority of these soils are highly erodible and have also undergone some development. After development takes place, paved areas increase the amount and velocity of stormwater that washes down to the streams. The increase in waterflow can cause streambank erosion.

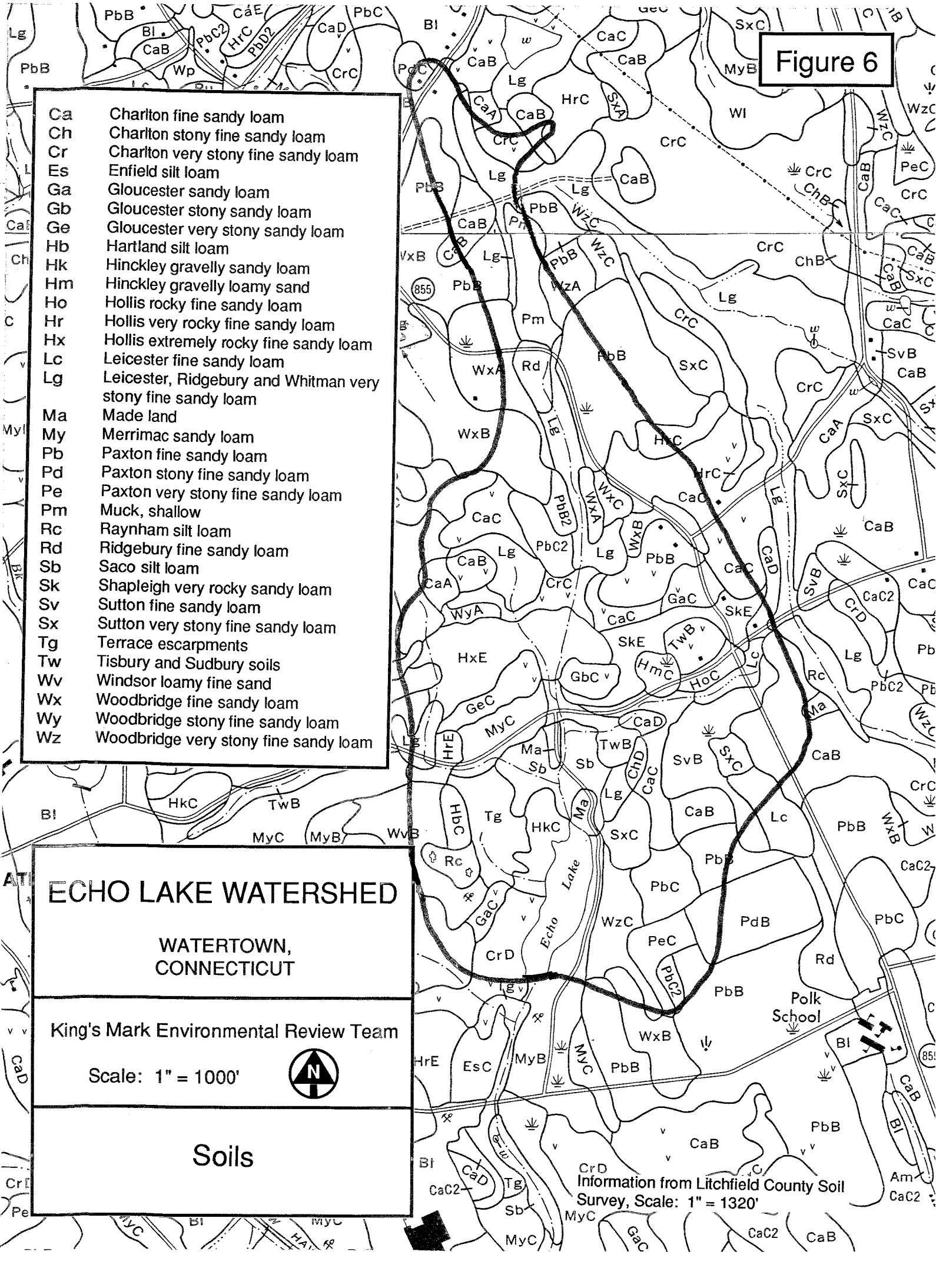


Figure 6
Ca Charlton fine sandy loam
Ch Charlton stony fine sandy loam
Cr Charlton very stony fine sandy loam
Es Enfield silt loam
Ga Gloucester sandy loam
Gb Gloucester stony sandy loam
Ge Gloucester very stony sandy loam
Hb Hartland silt loam
Hk Hinckley gravelly sandy loam
Hm Hinckley gravelly loamy sand
Ho Hollis rocky fine sandy loam
Hr Hollis very rocky fine sandy loam
Hx Hollis extremely rocky fine sandy loam
Lc Leicester fine sandy loam
Lg Leicester, Ridgebury and Whitman very stony fine sandy loam
Ma Made land
My Merrimac sandy loam
Pb Paxton fine sandy loam
Pd Paxton stony fine sandy loam
Pe Paxton very stony fine sandy loam
Pm Muck, shallow
Rc Raynham silt loam
Rd Ridgebury fine sandy loam
Sb Saco silt loam
Sk Shapleigh very rocky sandy loam
Sv Sutton fine sandy loam
Sx Sutton very stony fine sandy loam
Tg Terrace escarpments
Tw Tisbury and Sudbury soils
Wv Windsor loamy fine sand
Wx Woodbridge fine sandy loam
Wy Woodbridge stony fine sandy loam
Wz Woodbridge very stony fine sandy loam
ECHO LAKE WATERSHED
WATERTOWN, CONNECTICUT
King's Mark Environmental Review Team
Scale: 1" = 1000'
N
Soils
Information from Litchfield County Soil Survey, Scale: 1" = 1320'
Echo Lake
Polk School

Different types of wetland soils are found in the watershed area. Wetlands are natural sediment traps and nutrient filters, and special attention should be paid to these areas.

Future E&S control plans for disturbed areas should be closely reviewed and supervised. E&S control plans should include:

1) A narrative describing the project, the conservation measures planned, the sequence of installation and the maintenance plan;

2) A map locating the conservation measures proposed and adequately showing the natural features and proposed activities; and

3) E&S control details which show how each measure is to be installed.

The section of the brook that goes through the Dobos Property is undergoing streambank erosion. The streambank erosion can be stabilized by placing gabions and/or constructing a retaining wall. These structures will protect the banks and will prevent the soil from being washed off by the stream's waters. An alternative is placing a pipe that will contain the stream's waters, but this will eliminate the stream.

Most sediments enter Echo Lake through the inlet that goes across Old Ice House Road. The construction of a sediment pool on the upstream side of the road will trap sediments being washed down the stream. The sediment pool must be placed where it is easily accessible for cleaning and maintenance. The sediment pool could be placed at the inlet of the lake, but a road is needed to access the pool for maintenance purposes which will increase the cost. For a more efficient structure, the pool should be placed off the course of the stream. In this system, water is diverted into the pool where sediments settle, then the water is directed back into the stream. By diverting the water from the regular course of the stream, the velocity of the water is decreased, allowing for more sediments to settle. The design for an off-stream sediment pool is more expensive than a regular sediment pool.

A grass seeding in the stream channel is also recommended. Grass cover will slow down the water flow and protect soil from being washed off. Reed Canary Grass (*Phalaris arundinacea*) and Tall Fescue (*Festuca arundinacea*) are grasses recommended for seeding waterways.

The sand area on the beach can be reduced by planting grass. This grassed area will serve as a buffer to slow down runoff from unvegetated areas. Reducing the beach area will reduce the amount of sand going into the water. A berm above the sandy area will divert the runoff water from washing away the sand.

The steep access dirt road on the west side of Echo Lake (across from the dam) is a source of sediments. Waterbars going across the road, placed at intervals of approximately 50 feet, will divert the water off the road, reducing erosion.

There is concern over the size of the proposed emergency spillway included in the plan for dam renovation. If a concrete weir structure is built as the main spillway, it could be made larger than necessary to reduce the size of the spillway. The spillway could be grassed or rock lined to control erosion. Grass spillways cover a large area, but they can serve as recreational areas when they are not wet.

PRIME FARMLAND

The areas containing Prime Farmland soils have been developed, are used for pasture and hay, or are idle (see Figure 7). When farmed, this land is highly productive, requires less energy and has less potential for environmental hazards. Landowners interested in preserving farmland can pursue participation in the State's Department of Agriculture's Purchase of Development Rights program. Under this program the State pays the owner the difference between the value of the farmland for agriculture and its value for development. In exchange, the owner agrees not to develop the farmland and use it for agriculture.

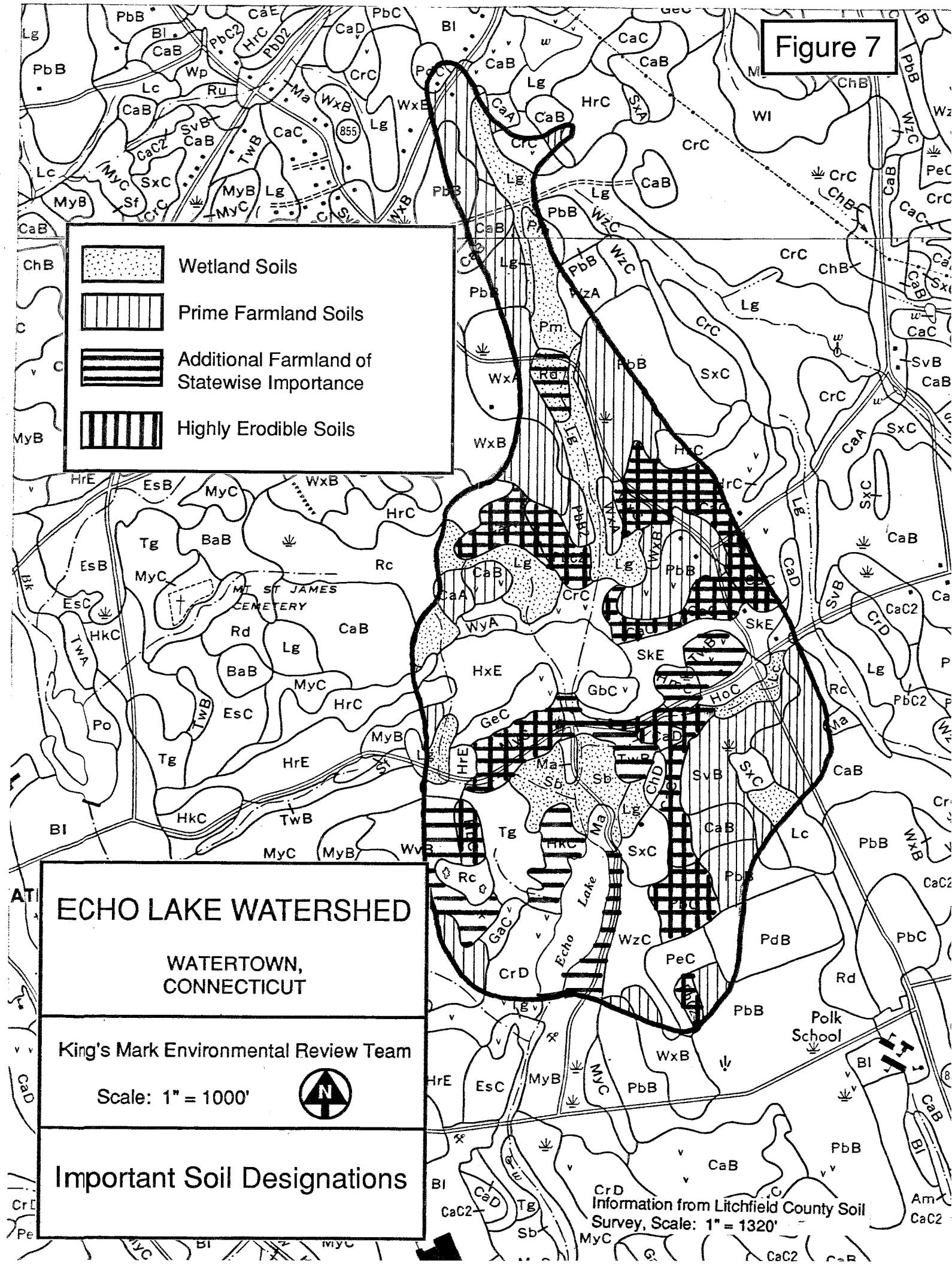


Figure 7
Wetland Soils
Prime Farmland Soils
Additional Farmland of Statewise Importance
Highly Erodible Soils
ECHO LAKE WATERSHED
WATERTOWN, CONNECTICUT
King's Mark Environmental Review Team
Scale: 1" = 1000'
Important Soil Designations
Information from Litchfield County Soil Survey, Scale: 1" = 1320'
MT ST JAMES CEMETERY
Polk School
Echo Lake

BIOLOGICAL RESOURCES

WILDLIFE CONSIDERATIONS

Description of Area/Habitats

The Echo Lake Watershed Area is located in a developed portion of Watertown. In addition to the open water habitat provided by Echo Lake, the watershed also contains hardwood forest, old field and deciduous tree/shrub wetland. There is a brook associated with the wetland which feeds Echo Lake.

Wildlife habitat is the complex of vegetative and physical characteristics that provide for all the requirements of wildlife, including food, shelter, resting, nesting and escape cover, water and space. Generally, the greater the habitat diversity and degree of interspersion of various habitat types, the greater the variety of wildlife there is using an area. Despite its small size, the Town-owned parcel provides a diversity of habitats and provides fair to good habitat for many species of wildlife. The wetlands on the parcel increase its value for wildlife. Factors that limit the value of this area include the amount of use/abuse by people (i.e., ATV traffic, littering and general disturbance), the increasing amount of development in the area and the parcel's small size.

A variety of wildlife species utilize the parcel to serve all their needs, while many other species find it a place to meet some requirements. These species include, deer, weasel, raccoon, fox, opossum, catbirds, sparrows, juncos, chickadees, reptiles and amphibians.

Forestland: Much of the area around Echo Lake is covered by mixed hardwood forest. Hardwood species include oak, sugar and red maple, black and yellow birch, white ash and beech. The forest has small openings created by a past storm. These open areas have become a thick growth of saplings, briars and grape vines and provide food and thick cover for many wildlife species.

Forests provide wildlife with cover, food, nesting places, denning sites and roosting places. Softwood stands provide important year-round cover for species such as turkey, grouse and various songbirds. Stands of hemlocks are preferred nesting sites for species such as the veery and junco. The winged seeds produced by the hemlock are readily sought by red squirrel, pine siskin and chickadees. Oak trees provide a source of acorns or mast for a variety of species. The beech trees provide beech nuts. Larger diameter sized trees generally produce more mast and are typically more valuable to wildlife. Birch trees provide catkins and seeds which are used by ruffed grouse, chickadees, pine siskins and tree sparrows. Deer browse on the twigs. The snag trees (dead trees) are a source of insects which serve as food for many species such as woodpeckers and chickadees. Den trees (trees with cavities) can serve as a nesting or denning place for animals such as squirrels and raccoons.

Old Field: Although very limited, there is some old field type habitat on the parcel. The eastern and northern ends of Echo Lake contain old field/early successional stage habitat. This type of habitat provides a diversity of vegetation, including grasses, herbs, shrubs, small saplings and trees. Shrub species include dogwood, alder, multiflora rose and autumn olive. Tree species include cherry, elm and red maple.

Because of their vegetational diversity, field areas provide abundant food and cover to a variety of wildlife species. These areas also increases the "edge" or "edge effect." Edge effect is the phenomena that occurs where vegetational types meet with a high degree of interspersion, vegetational diversity or richness is achieved, and the needs of a wide variety of wildlife species can best be met.

Wetlands: Because wetlands increase the habitat diversity of an area and offer a variety of food and cover to wildlife, they are important areas to consider for protection. Acre for acre, wetlands and their associated riparian zones exceed all

other land types in wildlife productivity. In addition to their value as wildlife habitat, wetlands serve other valuable functions, including water recharge, sediment filtering, flood storage, etc. For these reasons, the development of, filling in and/or crossing of wetlands should be avoided or limited whenever possible.

The deciduous tree/shrub wetlands contain a variety of vegetation types, including emergent plants concentrated at the north end of Echo Lake. Wetland vegetation includes various dogwoods, viburnums, red maple, azalea, blueberry and emergents such as cattails and pickerel weed. These areas are useful to a variety of wildlife, including songbirds, mammals, reptiles and amphibians. Wetlands are important places for amphibian and reptile reproduction.

Echo Lake offers open water habitat for wildlife, although its value is limited due to its small size, limited emergent vegetation (i.e., cover) and the degradation of water quality due to erosion and siltation. Siltation can smother invertebrate life forms, thereby drastically effecting the food chain and directly effecting the wildlife using the lake. With more emergent cover, the usefulness of Echo Lake would be somewhat increased for wildlife. The lake currently offers habitat for raccoons and opossums who forage around the edge, birds who utilize the thick cover along the edge and probably an occasional duck or Canada Goose. However, improvement in the cover available would produce limited benefits for wildlife. Solving the siltation problem and improving the water quality would be very beneficial to the quality of the available wildlife habitat.

Specific Management Suggestions

1) Limit use of the site to hiking on specified trails to prevent further erosion and habitat degradation.

2) Try to maintain an uneven-aged forest stand or provide for a variety of even-aged classes to provide for the general needs of forest-dwelling wildlife.

3) Where possible, maintain a 100-foot wide buffer of undisturbed vegetation around Echo Lake and wetland margins.

4) Where and when possible, maintain the old field habitat by brushcutting or mowing on a periodic basis.

Open Space Areas: In general, it is beneficial to wildlife if open space areas are connected to other open spaces through the use of corridors or strips of open space. This gives wildlife a path to travel or move from an open space area to another. Ideally, open space areas should contain various types of habitats, and larger areas are better. Setting aside an island of open space surrounded by development is undesirable. In a small but heavily developed and populated State like Connecticut where available habitat continues to decline on a daily basis, it is critical to maintain and enhance where possible existing wildlife habitat.

There are measures which can reduce some of the negative impacts of development to wildlife. These measures may be useful in planning for future developments within the Echo Lake Watershed Area:

1) Where possible, maintain a 100-foot (minimum) wide buffer zone of natural vegetation around all wetland/riparian areas to filter and trap silt and sediments and to provide some habitat for wildlife.

2) Utilize natural landscaping techniques, avoiding lawns and chemical runoff, to lessen acreage of habitat lost and possible wetland contamination.

3) Stonewalls, shrubs and trees should be maintained along field borders.

4) Early successional stage vegetation (i.e., field) is an important habitat type and should be maintained, if possible.

5) Detention basins should be excavated outside of wetland boundaries.

6) Water draining into any wetland should be of the best quality possible to prevent degradation of the wetland. Best Management Practices should be used. Oil separators should be installed in catch basins.

7) Proper E&S controls should be maintained throughout the length of construction. Degradation can also occur after construction.

8) Where possible, bridges should be used instead of culverts.

9) Where applicable, some provision such as a deed restriction or conservation easement should be made to restrict activities such as pasturing animals in a wetland or filling in wetlands for extra lawn and/or garden space after construction.

10) During land clearing, care should be taken to maintain certain forest wildlife requirements:

   a) Encourage mast producing trees (i.e., oak, hickory and beech). A minimum of 5 oaks/acre, 14 inches dbh or greater should remain.

   b) Leave 5 to 7 snag/den trees per acre because they are used by birds and mammals for nesting, roosting and feeding.

   c) Exceptionally tall trees, used by raptors as perching and nesting sites, should be encouraged.

   d) Brush debris from tree clearing should be piled to provide cover for small mammals, birds, amphibians and reptiles.

   e) Vines, shrubs and trees which produce fruit should be encouraged or can be planted as part of the landscaping in conjunction with the development, especially those that produce fruit which persists through the winter (i.e., winterberry). See Appendix B for a list of suggested shrub and tree species that can be encouraged and/or planted to benefit wildlife.

FISHERIES RESOURCES

Site Description

Echo Lake is an artificial waterbody created by impounding flows of Echo Lake Brook. Echo Lake is approximately 9 acres in surface area, has a reported maximum depth of 15 feet and an average depth of 5 feet. The surface waters of Echo Lake are considered Class A by the DEP. Designated uses for Class A surface waters are potential drinking water supply, fish and wildlife habitat, recreational use, agricultural and industrial supply and other purposes.

Land immediately surrounding Echo Lake is owned by the Town of Watertown and has not been developed (with the exception of the beach area), serving to

maintain the lake in a "natural state." Fallen trees and limbs and submergent/emergent aquatic plant growth provide fisheries habitat. Areas near the Echo Lake Brook headwaters are experiencing both industrial and residential development. This development has increased the intensity and duration of stormwater runoff into Echo Lake Brook and transported/deposited a heavy load of sediments into Echo Lake. Still, flows entering Echo Lake should be of a quality to support a healthy fishery population. However, sediment deposition and nutrient influx can, over a period of time, cause a filling of the lake volume and an overabundance of aquatic plants. Both conditions can limit fisheries habitat.

Aquatic Resources

The DEP Inland Fisheries Division does not have a recorded fisheries investigation of Echo Lake nor a record of previous fish liberation. The shallow water depth categorizes this waterbody as warmwater. Fish species associated with this type of environment include largemouth bass, bluegill sunfish, common (pumpkinseed) sunfish, yellow perch, chain pickerel, golden shiner and brown bullhead. Bluegill sunfish, common sunfish and largemouth bass were observed at the field review. Considering existing conditions, all species should have self-sustaining populations.

Impacts

If the land immediately surrounding Echo Lake remains as park land, direct impacts to the waterbody will be minimal or nonexistent. However, increased development within the watershed will have potential impacts, including:

1) During construction the potential for soil erosion and sedimentation of both Echo Lake Brook and Echo Lake through increased surface runoff from unvegetated zones can cause waterbody degradation. There exists a great potential for increased surface runoff considering the steep terrain of the area.

2) Surface drainage from roads and driveways may allow road salts, sands and oils to enter the lake and feeder stream, resulting in water quality and in-lake habitat degradation.

3) Runoff and leaching of nutrients from fertilizers will stimulate excessive aquatic plant growth. Introduction of lawn chemicals may result in "fish kills" and water quality degradation.

4) Any water quality problems and habitat degradation within Echo Lake due to increased sedimentation, road drainage, stormwater drainage, lawn chemicals and fertilizers will eventually be observed in downstream areas.

Recommendations

1) Considering Echo Lake's close proximity to high density population areas, there exists great potential for water-based recreation such as fishing. To provide access for fishing these provisions should be made:

   a) An established parking area;

   b) A lakeside trail system to allow access for shore fishing; and

   c) An access for car-top boats and/or canoes.

2) The Town of Watertown is under DEP mandate to repair the existing dam. Although the exact repair procedure is unspecified, it would be beneficial to install an outlet control device with the capability of regulating lake volume. General shoreline or in-lake maintenance and aquatic plant control can be readily achieved with the ability to manipulate the pond volume.

3) The impacts of development within the watershed can be minimized by implementing these precautionary measures:

   a) Maintain a minimum 100-foot open space buffer zone along any intermittent or perennial watercourses tributary to Echo Lake Brook or Echo Lake. No construction or alteration of riparian habitat shall take place within this zone. The buffer zone should be widened in areas of steeper terrain.

   b) A comprehensive E&S control plan should be submitted and installed prior to the start of any construction and maintained through all construction phases. Mitigative measures should include, but not be limited to, detention basins, catch basins, silt fences and hay bales. Surface runoff must not be allowed to directly enter watercourses leading into Echo Lake. Once construction is initiated, officials from the Town should regularly police developments to ensure that all E&S controls are properly emplaced and are regularly maintained.

c) Construct a sediment basin or series of basins within Echo Lake Brook at a site or sites prior to its entry into Echo Lake to prevent or limit the amount of sediments entering Echo Lake. The basin(s) should be constructed in an area(s) which provides access for periodic sediment removal.

d) An effective stormwater management plan should be designed and implemented. Stormwaters should not directly enter watercourses leading into Echo Lake.

e) Limit liming, fertilizing and the introduction of chemicals to manicured lawns within the watershed will abate the amount of additional nutrients to Echo Lake.

THREATENED AND ENDANGERED PLANT AND ANIMAL SPECIES

According to the Natural Diversity Data Base, there are no Endangered and Threatened Species or Connecticut "Species of Special Concern" occurring in the watershed.

Natural Diversity Data Base information includes all information regarding critical biologic resources available at the time of the request. This information is a compilation of data collected over the years by the Natural Resources Center's Geologic and Natural History Survey and cooperating units of DEP, private conservation groups and the scientific community. This information is not necessarily the result of comprehensive or site-specific field investigations. Consultation with the Data Base should not be substituted for on-site surveys required for environmental assessments. Current research projects and new contributors continue to identify additional populations of and locations of habitats of concern, as well as enhance existing data. New information is incorporated into the Data Base as it becomes available.

LAND USE AND PLANNING CONSIDERATIONS

RECREATIONAL CONSIDERATIONS

Without effective control of land uses in a watershed, the watershed and the water produced by it become degraded and the downstream swimming area becomes increasingly marginal, if not submarginal in quality. This is true of many inland State swimming areas which are/were either former mill ponds or bypass pools fed by a brook. Examples include the former swimming area at Fort Shantok State Park in Montville which closed because of degraded water quality and Wharton Brook State Park in Wallingford-North Haven where an upstream development caused serious siltation problems in the swimming pond.

Echo Lake is a small 9-acre pond with a maximum depth of 15 feet and a small watershed (0.55 square miles). Its maximum listed volume was 88 acre feet in the 1970s, but as of 1983 it was listed as having 56 acre feet, presumably due to siltation. When these figures are plugged into the Department of Health Services' formula for allowable number of swimmers, the maximum number of swimmers which can be handled on a sustained basis is 200 per day utilizing the 88 acre foot figure or 130 per day at the 56 acre feet level. Figures based on the current size indicate that the lake could support 112 swimmers per day.

Watertown must choose from a cost benefit standpoint how to meet its responsibility of providing swimming opportunities to its residents. (A standard of instant swimming capacity of 4% of the Town's population is suggested.) Options include:

1) Rehabilitate Echo Lake (i.e., removing silt, repairing dam, etc), recognizing that upstream development may cause further siltation and that the quality of the water feeding it will probably decrease steadily over time as it increasingly becomes stormwash off developed areas.

2) Consider the physical and fiscal feasibility of meeting local swimming demand at other existing Town-owned swimming areas in terms of both immediate and long-term costs likely to be incurred. This involves

abandoning Echo Lake as a swimming area and utilizing it as a passive park. However, dam repair is still necessary if the pond is to be retained.

3) Consider developing an artificial outdoor pool, fed by municipal water and with an appropriate filtration and chlorination system. This is the only way that swimming water of suitable quality can be guaranteed. This also involves abandoning Echo Lake as in #2.

A careful cost-benefit analysis of the various options is recommended. The popular sentiment attached to Echo Lake is recognized because of its long-term usage, but substantial public investment may prove to be fiscally imprudent because of the changing character of the Echo Lake Watershed Area.

APPENDICIES

Appendix A: Soil Limitations Chart

TABLE 1: SOIL SYMBOLS AND MAPPING UNIT NAMES

Soil Symbol	Soil Mapping Unit Name
CaA	Charlton fine sandy loam, 0-3% slopes
CaB	Charlton fine sandy loam, 3-8% slopes
CaB2	Charlton fine sandy loam, 3-8% slopes, eroded
CaC	Charlton fine sandy loam, 8-15% slopes
CaC2	Charlton fine sandy loam, 8-15% slopes, eroded
CaD	Charlton fine sandy loam, 15-25% slopes
CaE	Charlton fine sandy loam, 25-35% slopes
ChB	Charlton stony fine sandy loam, 3-8% slopes
ChC	Charlton stony fine sandy loam, 8-15% slopes
ChD	Charlton stony fine sandy loam, 15-25% slopes
CrC	Charlton very stony fine sandy loam, 3-15% slopes
CrD	Charlton very stony fine sandy loam, 15-35% slopes
EsC	Enfield silt loam, 8-15% slopes
GaB	Gloucester sandy loam, 3-8% slopes
GaC	Gloucester sandy loam, 8-15% slopes
GaD	Gloucester sandy loam, 15-25% slopes
GbB	Gloucester stony sandy loam, 3-8% slopes
GbC	Gloucester stony sandy loam, 8-15% slopes
GbD	Gloucester stony sandy loam, 15-25% slopes
GeC	Gloucester very stony sandy loam, 3-15% slopes
GeE	Gloucester very stony sandy loam, 15-35% slopes
HbC	Hartland silt loam, 8-15% slopes
HkA	Hinckley gravelly sandy loam, 0-3% slopes
HkC	Hinckley gravelly sandy loam, 3-15% slopes
HmA	Hinckley gravelly loamy sand, 0-3% slopes
HmC	Hinckley gravelly loamy sand, 3-15% slopes
HoC	Hollis rocky fine sandy loam, 3-15% slopes
HrC	Hollis very rocky fine sandy loam, 3-15% slopes
HrE	Hollis very rocky fine sandy loam, 15-35% slopes
HxC	Hollis extremely rocky fine sandy loam, 3-15% slopes
HxE	Hollis extremely rocky fine sandy loam, 15-35% slopes

Soil Symbol	Soil Mapping Unit Name
Lc	Leicester fine sandy loam
Lg	Leicester, Ridgebury and Whitman very stony fine sandy loam
Ma	Made land
MyA	Merrimac sandy loam, 0-3% slopes
MyB	Merrimac sandy loam, 3-8% slopes
MyC	Merrimac sandy loam, 8-15% slopes
PbA	Paxton fine sandy loam, 0-3% slopes
PbB	Paxton fine sandy loam, 3-8% slopes
PbB2	Paxton fine sandy loam, 3-8% slopes, eroded
PbC	Paxton fine sandy loam, 8-15% slopes
PbC2	Paxton fine sandy loam, 8-15% slopes, eroded
PbD	Paxton fine sandy loam, 15-25% slopes
PbD2	Paxton fine sandy loam, 15-25% slopes, eroded
PbE	Paxton fine sandy loam, 25-35% slopes
PdB	Paxton stony fine sandy loam, 3-8% slopes
PdC	Paxton stony fine sandy loam, 8-15% slopes
PdD	Paxton stony fine sandy loam, 15-25% slopes
PeA	Paxton very stony fine sandy loam, 0-3% slopes
PeC	Paxton very stony fine sandy loam, 3-15% slopes
PeD	Paxton very stony fine sandy loam, 15-35% slopes
Pm	Muck, shallow
Rc	Raynham silt loam
Rd	Ridgebury fine sandy loam
Sb	Saco silt loam
SkE	Shapleigh very rocky sandy loam, 15-35% slopes
SvB	Sutton fine sandy loam, 3-8% slopes
SxC	Sutton very stony fine sandy loam, 3-15% slopes
Tg	Terrace escarpments
TwB	Tisbury and Sudbury soils, 3-8% slopes
WvB	Windsor loamy fine sand, 3-8% slopes
WxA	Woodbridge fine sandy loam, 0-3% slopes
WxB	Woodbridge fine sandy loam, 3-8% slopes
WxC	Woodbridge fine sandy loam, 8-15% slopes

Soil Symbol	Soil Mapping Unit Name
WyA	Woodbridge stony fine sandy loam, 0-3% slopes
WyB	Woodbridge stony fine sandy loam, 3-8% slopes
WyC	Woodbridge stony fine sandy loam, 8-15% slopes
WzA	Woodbridge very stony fine sandy loam, 0-3% slopes
WzC	Woodbridge very stony fine sandy loam, 8-15% slopes

TABLE 2: SOIL CHARACTERISTICS IMPORTANT TO DEVELOPMENT

Soil Symbol	Permeability (in/hr)	K	Corrosivity to Steel	Corrosivity to Concrete	Flooding	Water Table Depth (ft)	Water Table Kind	High Water Months	Depth to Rock (in)	Frost Action
CaA	0.6-6.0	0.24	low	high	none	>6.0	---	---	>60	low
CaB	0.6-6.0	0.24	low	high	none	>6.0	---	---	>60	low
CaB2	0.6-6.0	0.24	low	high	none	>6.0	---	---	>60	low
CaC	0.6-6.0	0.24	low	high	none	>6.0	---	---	>60	low
CaC2	0.6-6.0	0.24	low	high	none	>6.0	---	---	>60	low
CaD	0.6-6.0	0.24	low	high	none	>6.0	---	---	>60	low
CaE	0.6-6.0	0.24	low	high	none	>6.0	---	---	>60	low
ChB	0.6-6.0	0.20	low	high	none	>6.0	---	---	>60	low
ChC	0.6-6.0	0.20	low	high	none	>6.0	---	---	>60	low
ChD	0.6-6.0	0.20	low	high	none	>6.0	---	---	>60	low
CrC	0.6-6.0	0.20	low	high	none	>6.0	---	---	>60	low
CrD	0.6-6.0	0.20	low	high	none	>6.0	---	---	>60	low
EsC	0.6-2.0	0.49	low	mod	none	>6.0	---	---	>60	mod
GaB	6.0-20	0.24	low	high	none	>6.0	---	---	>60	low
GaC	6.0-20	0.24	low	high	none	>6.0	---	---	>60	low
GaD	6.0-20	0.24	low	high	none	>6.0	---	---	>60	low
GbB	6.0-20	0.17	low	high	none	>6.0	---	---	>60	low
GbC	6.0-20	0.17	low	high	none	>6.0	---	---	>60	low
GbD	6.0-20	0.17	low	high	none	>6.0	---	---	>60	low
GeC	6.0-20	0.17	low	high	none	>6.0	---	---	>60	low
GeE	6.0-20	0.17	low	high	none	>6.0	---	---	>60	low
HbC	0.6-2.0	0.49	low	mod	none	>6.0	---	---	>60	high
HkA	6.0-20	0.20	low	high	none	>6.0	---	---	>60	low
HkC	6.0-20	0.20	low	high	none	>6.0	---	---	>60	low
HmA	6.0-20	0.20	low	high	none	>6.0	---	---	>60	low
HmC	6.0-20	0.20	low	high	none	>6.0	---	---	>60	low
HoC	0.6-6.0	0.17	low	high	none	>6.0	---	---	10-20	mod
HrC	0.6-6.0	0.17	low	high	none	>6.0	---	---	10-20	mod

Soil Symbol	Permeability (in/hr)	K	Corrosivity to Steel	Corrosivity to Concrete	Flooding	Water Table Depth (ft)	Water Table Kind	High Water Months	Depth to Rock (in)	Frost Action
HrE	0.6-6.0	0.17	low	high	none	>6.0	---	---	10-20	mod
HxC	0.6-6.0	0.17	low	high	none	>6.0	---	---	>60	mod
HxE	0.6-6.0	0.17	low	high	none	>6.0	---	---	10-20	mod
Lc	0.6-6.0	0.28	low	high	none	0-1.5	apparent	Nov-May	>60	high
Lg	0.6-6.0	0.20	low	high	none	0-1.5	apparent	Nov-May	>60	high
Ma	---	0	---	---	---	---	---	---	---	---
MyA	2.0-6.0	0.24	low	high	none	>6.0	---	---	>60	low
MyB	2.0-6.0	0.24	low	high	none	>6.0	---	---	>60	low
MyC	2.0-6.0	0.24	low	high	none	>6.0	---	---	>60	low
PbA	0.6-2.0	0.24	low	mod	none	1.5-2.5	perched	Feb-Apr	>60	mod
PbB	0.6-2.0	0.24	low	mod	none	1.5-2.5	perched	Feb-Apr	>60	mod
PbB2	0.6-2.0	0.24	low	mod	none	1.5-2.5	perched	Feb-Apr	>60	mod
PbC	0.6-2.0	0.24	low	mod	none	1.5-2.5	perched	Feb-Apr	>60	mod
PbC2	0.6-2.0	0.24	low	mod	none	1.5-2.5	perched	Feb-Apr	>60	mod
PbD	0.6-2.0	0.24	low	mod	none	1.5-2.5	perched	Feb-Apr	>60	mod
PbD2	0.6-2.0	0.24	low	mod	none	1.5-2.5	perched	Feb-Apr	>60	mod
PbE	0.6-2.0	0.24	low	mod	none	1.5-2.5	perched	Feb-Apr	>60	mod
PdB	0.6-6.0	0.20	low	mod	none	1.5-2.5	perched	Feb-Apr	>60	mod
PdC	0.6-6.0	0.20	low	mod	none	1.5-2.5	perched	Feb-Apr	>60	mod
PdD	0.6-6.0	0.20	low	mod	none	1.5-2.5	perched	Feb-Apr	>60	mod
PeA	0.6-6.0	0.20	low	mod	none	1.5-2.5	perched	Feb-Apr	>60	mod
PeC	0.6-6.0	0.20	low	mod	none	1.5-2.5	perched	Feb-Apr	>60	mod
PeD	0.6-6.0	0.20	low	mod	none	1.5-2.5	perched	Feb-Apr	>60	mod
Pm	0.2-6.0	-0-	high	mod	none	+1.0-1.0	apparent	Nov-May	>60	high
Rc	0.2-2.0	0.49	high	mod	none	0.5-2.0	apparent	Nov-May	>60	high
Rd	0.6-6.0	0.24	high	high	none	0-1.5	perched	Nov-May	>60	high
Sb	0.6-2.0	0.49	low	mod	freq	0-0.5	apparent	Sep-Jun	>60	high
SkE	0.6-6.0	0.17	low	high	none	>6.0	---	---	10-20	mod
SvB	0.6-6.0	0.24	low	high	none	1.5-2.5	apparent	Nov-Apr	>60	high
SxC	0.6-6.0	0.21	low	high	none	1.5-2.5	apparent	Nov-Apr	>60	high

Soil Symbol	Permeability (in/hr)	K	Corrosivity to Steel	Corrosivity to Concrete	Flooding	Water Table Depth (ft)	Water Table Kind	High Water Months	Depth to Rock (in)	Frost Action
Tg	6.0-20	0.21	low	high	none	>6.0	---	---	>60	low
TwB	0.6-2.0	0.49	low	mod	none	1.5-2.5	apparent	Nov-Apr	>60	high
WvB	>6.0	0.17	low	high	none	>6.0	---	---	>60	high
WxA	0.6-2.0	0.24	low	mod	none	1.5-2.5	perched	Nov-May	>60	high
WxB	0.6-2.0	0.24	low	mod	none	1.5-2.5	perched	Nov-May	>60	high
WxC	0.6-2.0	0.24	low	mod	none	1.5-2.5	perched	Nov-May	>60	high
WyA	0.6-2.0	0.20	low	mod	none	1.5-2.5	perched	Nov-May	>60	high
WyB	0.6-2.0	0.20	low	mod	none	1.5-2.5	perched	Nov-May	>60	high
WyC	0.6-2.0	0.20	low	mod	none	1.5-2.5	perched	Nov-May	>60	high
WzA	0.6-2.0	0.20	low	mod	none	1.5-2.5	perched	Nov-May	>60	high
WzC	0.6-2.0	0.20	low	mod	none	1.5-2.5	perched	Nov-May	>60	high

--- no data available

K - Erodibility Factor
- .10-.24 - Low Erodibility
- .28-.37 - Medium Erodibility
- .43-.64 - High Erodibility

Flooding Classes
- None
- Occasional
- Common
- Frequent

TABLE 3: MAJOR SOIL LIMITATIONS FOR DEVELOPMENT

Soil Symbol	Septic System	Excavations	Dwellings	Basements	Commercial	Roads	Lawns	Fill	Ponds
CaA	A	A	A	A	A	A	A	A	C-11
CaB	A	A	A	A	B-9	A	A	A	C-11
CaB2	A	A	A	A	B-9	A	A	A	C-11
CaC	B-9	B-9	B-9	B-9	B-9	B-9	B-9	A	C-11
CaC2	B-9	B-9	B-9	B-9	B-9	B-9	B-9	A	C-11
CaD	C-9	C-9	C-9	C-9	C-9	C-9	C-9	B-9	C-11
CaE	C-9	C-9	C-9	C-9	C-9	C-9	C-9	C-9	C-11
ChB	A	A	A	A	B-9	A	B-16	A	C-11
ChC	B-9	B-9	B-9	B-9	C-9	B-9	B-16,9	A	C-11
ChD	C-9	C-9	C-9	C-9	C-9	C-9	C-9	C-9	C-11
CrC	B-9	B-9	B-9	B-9	C-9	B-9	B-16,9	A	C-11
CrD	C-9	C-9	C-9	C-9	C-9	C-9	C-9	C-9	C-11
EsC	C-3	C-5	B-9	B-9	C-9	B-9,8	B-9	A	C-11
GaB	C-3	C-5	B-16	B-16	B-16	B-16	B-17,22	B-16	C-11
GaC	C-3	C-5	C-9,16	B-9,16	C-9	B-9,16	B-9,17,22	B-16	C-11
GaD	C-9,3	C-9,5	C-9	C-9	C-9	C-9	C-9	B-9,16	C-11
GbB	C-3	C-5	B-16	B-16	B-17,9	B-16	B-17,22	B-16	C-11
GbC	C-3	C-5	B-16,9	B-16,9	C-9	B-9,16	B-9,17,22	B-16	C-11
GbD	C-9,3	C-9,5	C-9	C-9	C-9	C-9	C-9	B-9,16	C-11
GeC	C-3	C-5	B-16,9	B-16,9	C-9	B-9,16	B-9,17,22	B-16	C-11
GeE	C-9,3	C-9,5	C-9	C-9	C-9	C-9	C-9	C-9	C-11
HbC	B-9	C-5	B-9	B-9	C-9	C-8	B-9	A	C-11
HkA	C-3	C-5	A	A	A	A	C-22	A	C-11
HkC	C-3	C-5	B-9	B-9	C-9	B-9	C-22	A	C-11
HmA	C-3	C-5	A	A	A	A	C-22	A	C-11
HmC	C-3	C-5	B-9	B-9	C-9	B-9	B-22	A	C-11
HoC	C-15	C-15	C-15	C-15	C-15	C-15	C-15	C-23,15	C-11
HrC	C-15	C-15	C-15	C-15	C-15,9	C-15	C-15	C-23,15	C-11
HrE	C-15,9	C-15,9	C-9,15	C-15,9	C-9,15	C-15,9	C-9,15	C-23,15,9	C-11
HxC	C-15	C-15	C-15	C-15	C-9,15	C-15	C-15	C-23,15	C-11

Soil Symbol	Septic System	Excavations	Dwellings	Basements	Commercial	Roads	Lawns	Fill	Ponds
HxE	C-15,9	C-15,9	C-9,15	C-15,9	C-9,15	C-15,9	C-9,15	C-23,15,9	C-11
Lc	C-2	C-2	C-2	C-2	C-2	C-2,8	C-2	C-2	B-18
Lg	C-2	C-2	C-2	C-2	C-2	C-2,8	C-2	C-2	B-18
Ma	---	---	---	---	---	---	---	---	---
MyA	C-3	C-5	A	A	A	A	A	A	C-11
MyB	C-3	C-5	A	A	B-9	A	A	A	C-11
MyC	C-3	C-5	B-9	B-9	C-9	B-9	B-9	A	C-11
PbA	C-6	B-13,2	B-2	B-2	B-2	B-2	A	A	C-11
PbB	C-6	B-13,2	B-2	B-2	B-2,9	B-2,8	A	A	C-11
PbB2	C-6	B-13,2	B-2	B-2	B-2,9	B-2,8	A	A	C-11
PbC	C-6	B-13,2	B-2,9	B-2,9	C-9	B-2,9,8	B-9	A	C-11
PbC2	C-6	B-13,2	B-2,9	B-2,9	C-9	B-2,9,8	B-9	A	C-11
PbD	C-6,9	C-9	C-9	C-9	C-9	C-9	C-9	B-9	C-11
PbD2	C-6,9	C-9	C-9	C-9	C-9	C-9	C-9	B-9	C-11
PbE	C-6,9	C-9	C-9	C-9	C-9	C-9	C-9	C-9	C-11
PdB	C-6	C-13,2	B-2	B-2	B-2,9	B-2,8	B-16	A	C-11
PdC	C-6	C-13,2,9	B-2,9	B-2,9	C-9	B-2,9,8	B-16,9	A	C-11
PdD	C-6,9	C-9	C-9	C-9	C-9	C-9	C-96	B-9	C-11
PeA	C-6	C-13,2	B-2	B-2	B-2	B-2,8	B-16	A	C-11
PeC	C-6	B-13,2,9	B-2,9	B-2,9	C-9	B-2,9,8	B-16,9	A	C-11
PeD	C-6,9	C-9	C-9	C-9	C-9	C-9	C-9	C-9	C-11
Pm	C-12,4	C-14,12	C-12,4,10	C-12,4,10	C-12,4,10	C-4,8,12	C-4,14	C-2	C-18
Rc	C-3,2	C-2	C-2	C-2	C-2	C-8,2	C-2	C-2	C-18
Rd	C-6,2	C-2	C-2	C-2	C-2	C-2,8	C-2	C-2	C-11
Sb	C-7,2,3	C-2,5	C-7,2	C-7,2	C-7,2	C-7,2,8	C-7,2	C-2	C-5
SkE	C-15,9	C-15,9	C-15,9	C-15,9	C-9,15	C-15,9	C-15,9	C-23,15,9	C-11
SvB	C-2	C-2	B-2	C-2	B-2,9	C-8	B-2	B-2	B-18
SxC	C-2	C-2	B-2,9	C-2	C-9	C-9,8	B-9,16,2	B-2	B-18
Tg	C-3	C-5	A	A	A	A	B-22	A	C-11
TwB	C-2,3	C-5,2	B-2	C-2	B-2,9	C-8	B-2	B-2	B-5,11
WvB	C-3	C-5	A	A	B-9	A	B-22	A	C-11
WxA	C-2,6	C-2	B-2	C-2	B-2	C-8	B-2	B-2	C-11

Soil Symbol	Septic System	Excavations	Dwellings	Basements	Commercial	Roads	Lawns	Fill	Ponds
WxB	C-2,6	C-2	B-2	C-2	B-2,9	C-8	B-2	B-2	C-11
WxC	C-2,6	C-2	B-2,9	C-2	C-9	C-8	B-2,9	B-2	C-11
WyA	C-2,6	C-2	B-2	C-2	B-2	C-8	B-16,2	B-2	C-11
WyB	C-2,6	C-2	B-2	C-2	B-2,9	C-8	B-16,2	B-2	C-11
WyC	C-2,6	C-2	B-2,9	C-2	C-9	C-8	B-16,2,9	B-2	C-11
WzA	C-2,6	C-2	B-2	C-2	B-2	C-8	B-16,2	B-2	C-11
WzC	C-2,6	C-2	B-2,9	C-2	C-9	C-8	B-16,2,9	B-2	C-11

--- no data available

Degree of Limitations

A - Soil properties and site features are generally favorable for indicated use, and limitations are easily overcome.

B - Soil properties are not favorable for indicated use, and special planning, design or maintenance is needed.

C - Soil properties or site features are so unfavorable to overcome that special design, increases in cost and possibly increased maintenance are required.

Types of Limitations

1 Seepage	2 Wetness	3 Poor Filter	4 Ponding	5 Banks Cave	6 Slow Perc
7 Flooding	8 Frost Action	9 Slope	10 Low Strength	11 No Water	12 Subsides
13 Dense Layer	14 Humus	15 Shallow Depth	16 Large Stone	17 Small Stone	18 Slow Refill
19 Piping	20 Dam Seepage	21 Erosion	22 Droughty	23 Area Reclaim	

Appendix B: Suitable Planting Materials for Wildlife Food and Cover

SUITABLE PLANTING MATERIALS FOR WILDLIFE FOOD AND COVER

Herbaceous/Vines	Shrubs	Small Trees
Panicgrass	Sumac	Hawthorn
Timothy	Dogwood	Cherry
Trumpet creeper	Elderberry	Serviceberry
Grape	Winterberry	Cedar
Birdsfoot trefoil	Autumn olive	Crabapple
Virginia creeper	Blackberry	
Switchgrass	Raspberry	
Lespedeza	Honeysuckle	
Bittersweet	Cranberrybush	
Boston ivy		

NOTES

ABOUT THE TEAM

The King's Mark Environmental Review Team (ERT) is a group of environmental professionals drawn together from a variety of federal, state and regional agencies. Specialists on the Team include geologists, biologists, soil scientists, foresters, climatologists, landscape architects, recreational specialists, engineers and planners. The ERT operates with state funding under the aegis of the King's Mark Resource Conservation and Development (RC&D) Area - an 83-town area serving western Connecticut.

As a public service activity, the Team is available to serve towns and/or developers within the King's Mark RC&D Area - free of charge.

Purpose of the Environmental Review Team

The Environmental Review Team is available to assist towns and/or developers in the review of sites proposed for major land use activities. For example, the ERT has been involved in the review of a wide range of significant land use activities including subdivisions, sanitary landfills, commercial and industrial developments and recreational/open space projects.

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

Requesting an Environmental Review

Environmental Reviews may be requested by the chief elected official of a municipality or the chairman of an administrative agency such as planning and zoning, conservation or inland wetlands. Environmental Review Request Forms are available at your local Soil and Water Conservation District and through the King's Mark ERT Coordinator. This request form must include a summary of the proposed project, a location map of the project site, written permission from the land owner/ developer allowing the Team to enter the property for purposes of review and a statement identifying the specific areas of concern the Team should investigate. When this request is approved by the local Soil and Water Conservation District and King's Mark RC&D Executive Committee, the Team will undertake the review. At present, the ERT can undertake approximately two (2) reviews per month.

For additional information regarding the Environmental Review Team, please contact your local Soil and Water Conservation District or Nancy Ferlow, ERT Coordinator, King's Mark Environmental Review Team, King's Mark RC&D Area, 322 North Main Street, Wallingford, Connecticut 06492. King's Mark ERT phone number is 265-6695.