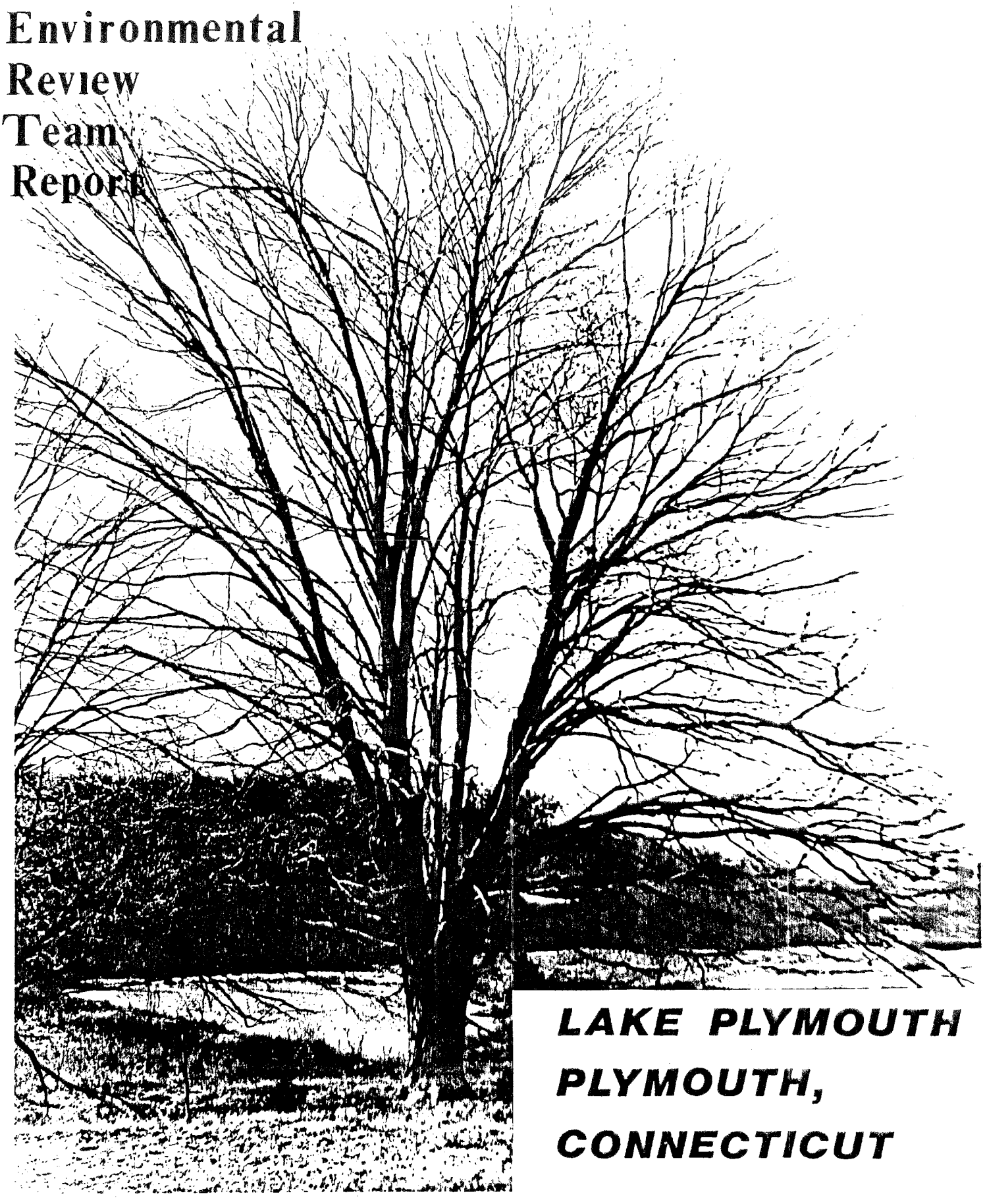
King's Mark Environmental Review Team Report



LAKE PLYMOUTH
PLYMOUTH, CONNECTICUT

LAKE PLYMOUTH

PLYMOUTH, 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

Plymouth Planning and Zoning Commission

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 signficance to the proposed development and also suggests considerations that should be of concern to the developer and the Town of Plymouth. 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 1987

ACKNOWLEDGEMENTS

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:

* Williamm Warzecha, Geologist
  Department of Environmental Protection - Natural Resources Center

* Cliff Bienko, District Conservationist
  U. S. Department of Agriculture - Soil Conservation Service

* Donald Mysling, Fishery Biologist
  Department of Environmental Protection - Fisheries Bureau

* Ann Burcroff, Environmental Analyst
  Department of Environmental Protection - Water Resources Unit

* Anthony Sullivan, Planner
  Office of Policy and Management

I would also like to thank Laverne Mendela, Secretary, and Janet Jerolman, Cartographer of the King's Mark Environmental Review Team for assisting in the completion of this report.

Finally, special thanks to Ralph Ciarmella and Al Saucier, Plymouth Planning and Zoning Commission, Barbara Bastenbeck, Lake Plymouth Association and Charlene Berube, Fall Mountain Lake Association for their cooperation and assistance during this environmental review.

EXECUTIVE SUMMARY

The Town of Plymouth Planning and Zoning Commission requested that an environmental review be conducted for the Lake Plymouth Area. The area immediately surrounding the lake is dominated by single family homes on small lots. Areas not devoted to housing are characterized as either beach and recreation area or as second growth forest.

The area is currently under a building moritorium as of October, 1986.

The purpose of this review was to inventory and assess existing natural resources and the effects that new development might have on the lake and surrounding land. The environmental and planning information generated by the ERT will be used by the Planning and Zoning commission to guide them in creating regulations for the lake area.

Below is a summary of the major findings of the ERT study.

Geology

Depth to bedrock is shallow throughout the entire watershed. The bedrock is identified as Straits Schist in the northern part of the watershed and Collinsville Formation underlying Lake Plymouth and in the southern parts of the watershed.

The surficial geologic material in most of the watershed is glacial till. The variety of till in the watershed is generally loose and sandy. The thickest till is located in the northern parts of the watershed area. In the rest of the area, the till is mostly shallow.

Hydrology

Lake Plymouth has a watershed area of approximately 243 acres. The watershed boundary tends to follow the crests of local hills and ridges.

Water quality in the watershed is affected by various sources of pollution such as septic systems, sedimentation, agricultural practices, lawn fertilizers and stormwater runoff. Most of the homes are tied in to the municipal sewer. Efforts should be made to connect all remaining houses to the municipal sewer line. Any remaining septic systems should be checked periodically for failier. There should be strict enforcement of the public health code requirements regarding septic system design and installation for any new construction in the watershed.

Erosion and sedimentation may affect water quality. A major source of sedimentation is the road system. Another is increased runoff from the developed area. A comprehensive erosion and sediment control plan and carefull monitoring should minimize new problems in the watershed.

Lawn and garden fertilizing can affect water quality by adding nutrients to the water. This situation can be avoided if fertilizers are matched to the soil requirements and timed to avoid periods of runoff. Agricultural activity is not extensive in the watershed area.

Water Supply

The major water bearing formation is the underlying crystaline metamorphic rock. Bedrock in this area is capable of yielding 2 gallons per minute. Some wells in the area have experienced low yields. One method of preventing this is to adequately separate the wells. A general 'rule of thumb' is to separate the wells by a distance double the depth. This may necessitate large lot sizes.

Soil Concerns

The soil types in the watershed are Charlton, Hollis, Leicester, Paxton, Rockland, Sutton and Woodbridge. There are some building limitations on each of these soils including rocks, steep slope and drainage.

Erosion and Sediment Control

Engineers and contractors should use the 1985 "Connecticut Guidelines for Soil Erosion and Sediment Control" as a reference when they plan and install erosion and sediment controls. Enforcement of erosion and sediment controls is needed. One method is for the developer to post a bond to insure compliance with local regulations.

To lessen sedimentation, erosion should be minimized, stormwater sewers should have catch basins which are cleaned periodically and sedimentation basins should be installed wherever possible.

The Town should view the entire watershed when making development decisions. To handle increased runoff from development the town might consider additional storm sewers and setting a maximum amount of impervious surface area for each lot. Requiring an engineering report for lots on steep slopes should be considered to insure that the lot can be safely developed. The town might also consider protecting the remainder of the land in the watershed. Further development will only intensify existing problems.

Fisheries

Lake Plymouth is an artificial warmwater lake. The fish population includes largemouth bass, common sunfish, chain pickerel, yellow perch, calico bass, bluegill sunfish, golden shiner and brown bullhead.

Sedimentation and increased nutrients have lead to an abundance of aquatic vegetation. Further development could increase the nutrient loads and the amount of vegetation. Over abundance of vegetation can deplete the oxygen in the water during the summer and winter months. This could lead to a kill of fish in the lake, which could alter the balance of populations.

Water Quality

Lake Plymouth was created over nutrient rich crop land. The lake started in an advanced state of eutrophication. Sedimentation and nutrient loading from septic systems and surface runoff have increased the rate of eutrophication. Further construction will increase erosion and sedimentation which will in turn add more nutrients to the lake. The aquatic vegetation will increase to nuisance proportions. Some methods of controlling sedimentation are installation of storm sewers with sediment traps that are cleaned periodically, routine street sweeping, detention ponds, and minimizing the impervious surface area in the watershed. A method for controling weeds is a draw-down of water in the lake and removal of some of the nutrient rich bottom sediments. Other suggestions for improving the water quality is reduction in lawn fertilizing, especially close to the lake and planting natural vegetation buffers along the lake shore.

Planning Considerations

There needs to be an in-depth study of the ability of the Lake Plymouth area to absorb more development. Unregulated development may damage the environment and reduce the quality of life in the area. Some State programs that are available to help the Town are the Transfer of Development Rights, Capitol Improvements Program, and the Farmland Preservation Program.

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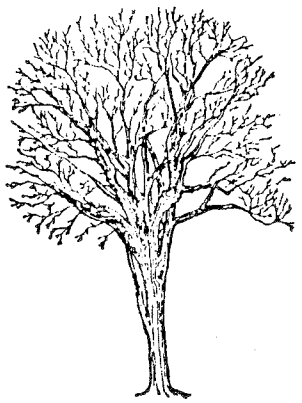


INTRODUCTION

The Plymouth Planning and Zoning Commission requested that an environmental review be conducted for the Lake Plymouth area. The lake was created many years ago by damming low-lying portions of the land and letting the depression fill naturally. The lake is fed by small brooks and springs.

The area surrounding the lake is dominated by single-family houses on small lots. Historically, these were summer cottages but most have been converted to year-round homes. Most of the lakefront property is developed and houses are being built in tiers up the hillsides overlooking the lake. Areas not devoted to housing are characterized as either beach and recreation areas or second growth forest.

The region is currently under a building moratorium as of October 1986. The purpose of this review is to inventory and assess existing natural resources and the effects that new development would have on the lake and surrounding land. The environmental and planning information generated by the ERT will be used by the Planning and Zoning Commission to guide them in creating new regulations for the lake area and by the Lake Association to help manage the lake.

Below is a brief description of issues and concerns to be addressed by the ERT as outlined by the Town in the ERT request form.

SOILS: The region contains several varieties of soil types including sandy soils and wetland soils. There are soil erosion problems associated with the current development.

GEOLOGY: Will the type of geologic formation affect development of the area?

HYDROLOGY: Review the hydraulic relationship between the lake valley and contiguous upland areas.

WATER QUALITY: Will the continued growth of the region have a pronounced impact on the water quality of the lake? How are erosion and siltation affecting water quality?

LAKE ECOLOGY: The lake is bordered by extensive development. How has this affected lake ecology? What mitigation measures are available?

FISHERIES: Will further development affect the fish populations?

LAND USE/PLANNING: Will the Towns existing zoning regulations and policies have a significant impact on the resources in the Region?

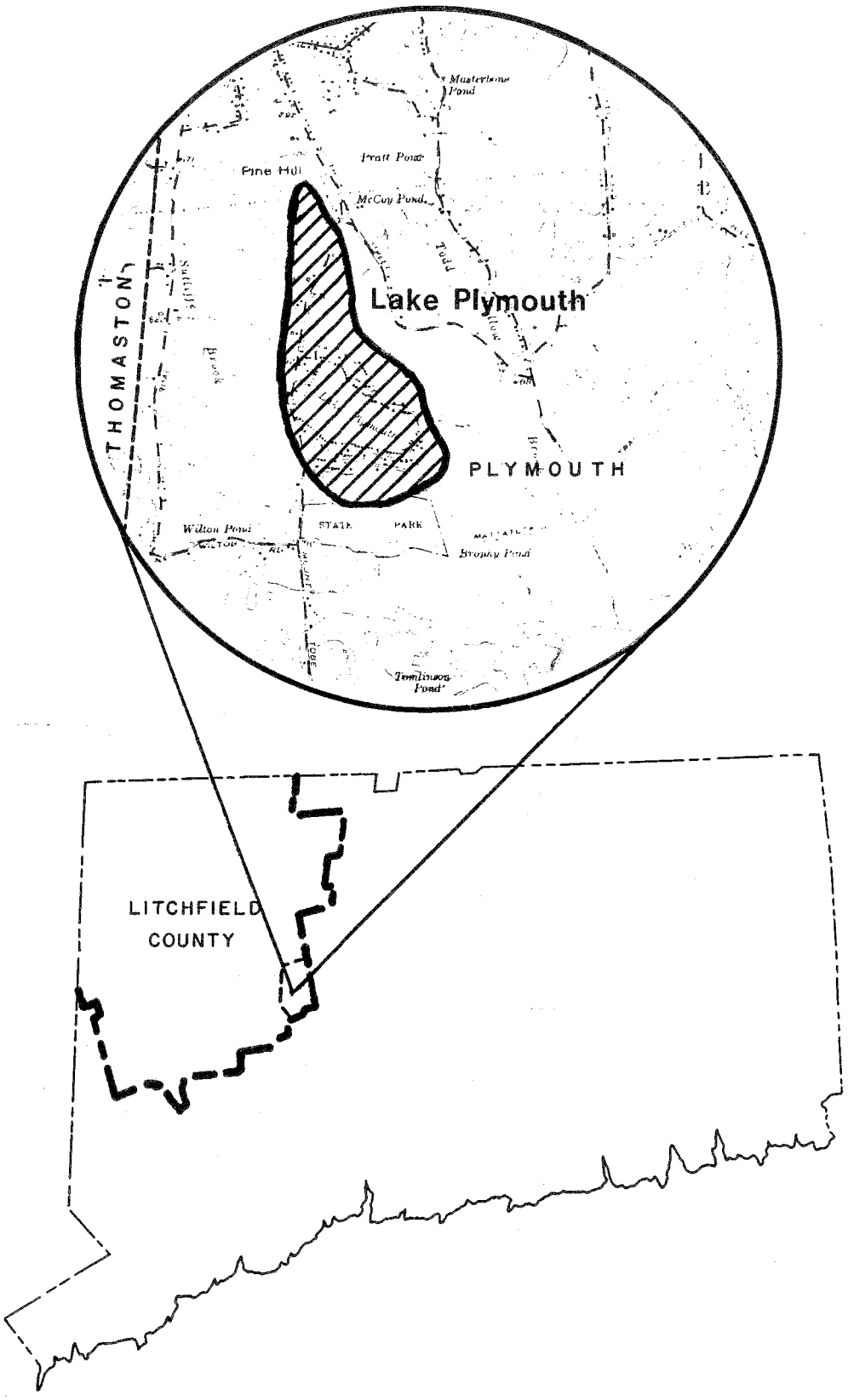
WATER SUPPLY: Current residents are having trouble with water supply during the late summer and fall. How will further development affect the water supply?

STORMWATER DRAINAGE: The Town has recently received several complaints concerning increased siltation of the catch basins and culverts leading into the lake and erosion of the roadsides. Flooding is becoming a problem in low-lying areas.

TRAFFIC AND ACCESS: The roads are currently sub-standard. How will further development affect the traffic flow and roadways?

Figure 1

LOCATION OF STUDY SITE



TOPOGRAPHY AND SETTING

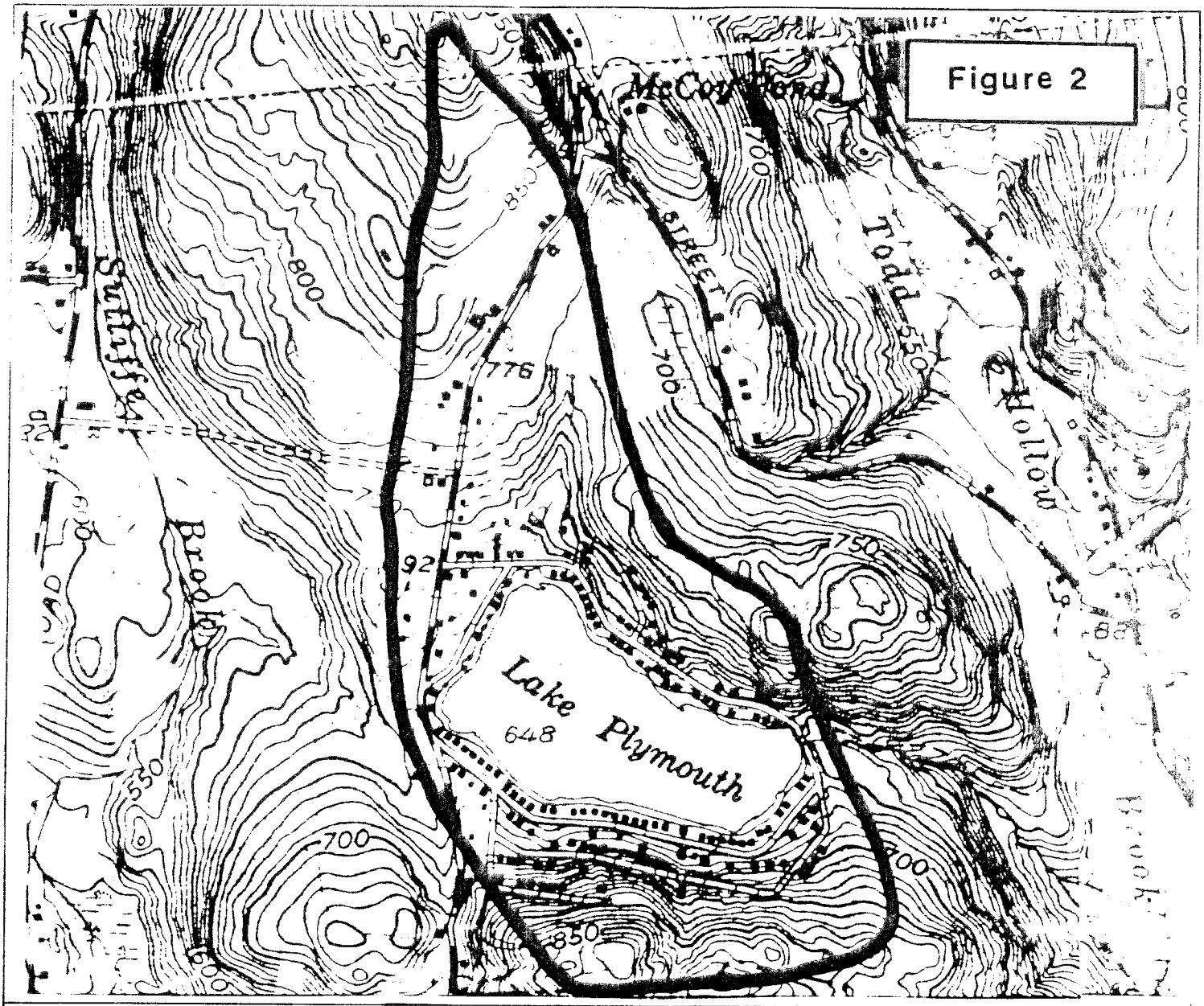
Lake Plymouth is an approximately 38 acre surface water body, which is under the ownership of property owners within the Lake Plymouth district. The nearly rectangular shaped pond is artificial in origin and was created by the impoundment of an unnamed tributary to Todd Hollow Brook. The masonry and earthen dam is found at the eastern end of the pond.

Most of Lake Plymouth's drainage area is located north of the Pond. The primary source of surface water to the pond appears to originate from these parts. The point of outflow for the pond is located at the pond's eastern end (see Figure 2).

The terrain throughout the watershed ranges from gentle to steep slopes, with the latter predominating. The topography throughout most of the drainage area is controlled by the underlying bedrock.

Elevations in the watershed range from a high of approximately 990 feet above mean sea level at Pine Hill in the northern part of watershed to a low of 648 feet above mean sea level at the surface of Lake Plymouth.

The watershed is comprised mainly of wooded land with some open fields along Mount Tobe Road. The Mattatuck State Forest lies to the south of the lake. The entire area surrounding Lake Plymouth has undergone intense residential development during the past thirty-five years. Although these homes were originally constructed for seasonal use, most have been converted to year-round homes. Nearly all the homes in the lake district have been connected to a municipal sewer, however there may be a few which have not connected. According to town officials the homes in the lake district are served by individual, on-site wells.



LAKE PLYMOUTH

PLYMOUTH, CONNECTICUT

TOPOGRAPHY

King's Mark Environmental Review Team

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GEOLOGY

The bedrock geology of the Thomaston quadrangles, which encompasses the entire Lake Plymouth drainage area, has not been completed to date. There is, however, preliminary bedrock geologic information available for review purposes at DEP's Natural Resource Center in Hartford. The Team's Geologist, also referenced John Rodger's Bedrock Geological Map of Connecticut (1985) for the purpose of this review.

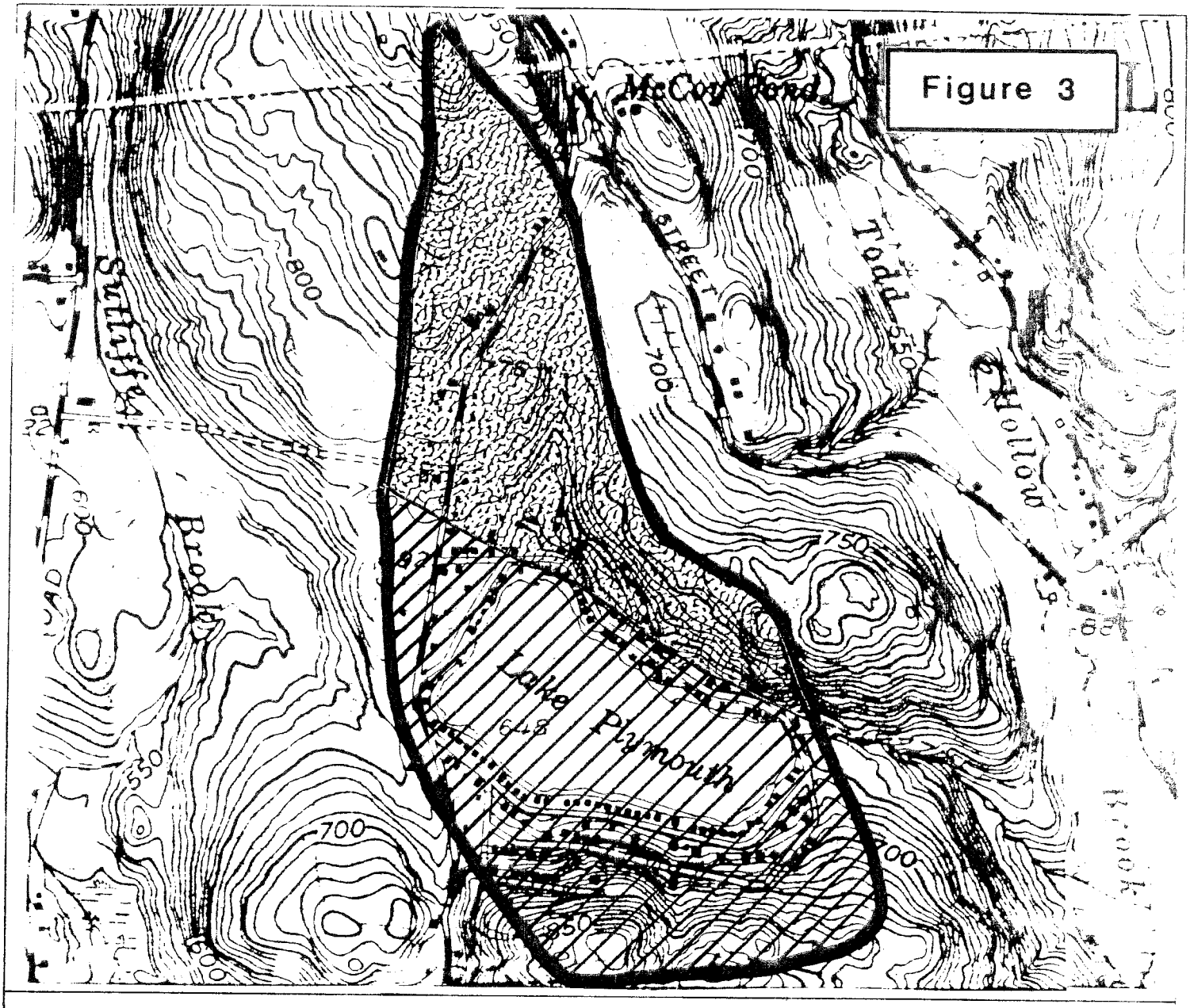
Bedrock Geology

Bedrock is shallow throughout the entire watershed area. Rodgers identifies two principal rock units in the watershed: (1) Collinsville Formation and (2) Straits Schist (Figure 3).

Underlying the northern parts of the watershed is the Straits Schist. These rocks consist of a silvery to gray, coarse grained schists.

Underlying Lake Plymouth and the southern parts of this drainage area is the Collinsville Formation. These rocks are described as gray and silvery, medium to coarse grained schists, dark, fine to medium grained amphibolites and hornblende gneisses.

All of the above mentioned rock types (schists, gneisses, amphibolites) are classified as crystalline metamorphic rocks; that is, rocks that have been geologically altered by great heat and pressure within the earth's crust. All of these rocks are very old, ranging between 360-505 million years old, and have complex histories. "Schists" are characterized by layering defined by the parallel arrangement of platy, flaky or elongated minerals. "Gneisses" are also characterized by strong layering but commonly have a banded appearance. This is caused by layers of granular, light colored minerals such as quartz,



STRAITS SCHIST

COLLINSVILLE FORMATION

LAKE PLYMOUTH

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BEDROCK GEOLOGY

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alternating with layers of dark, platy or elongate minerals such as biotite and hornblende. The amphibolites are commonly dark colored and are chiefly composed of the minerals hornblende and plagioclase feldspar.

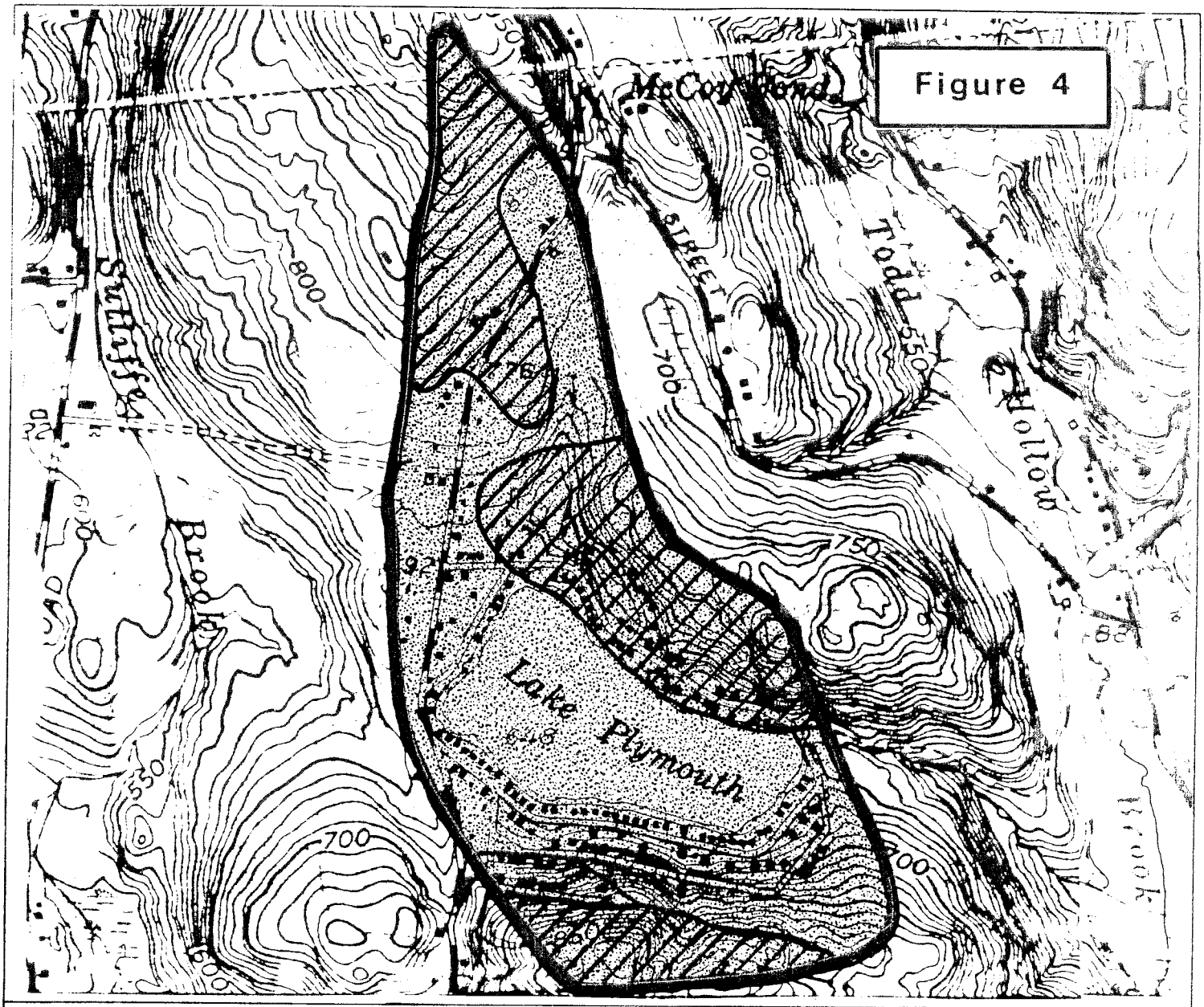
Depths to the bedrock surface in the watershed ranges from zero in rock outcrop areas, to probably not more than ten feet in areas in between the outcrops.

Many homes in the Lake Plymouth drainage area rely on the underlying bedrock for a domestic water supply source (see Water Supply section).

Surficial Geology

Surficial geologic materials consist of those unconsolidated rock particles or other debris that overlie bedrock in the watershed. A surficial geologic map (GQ-984, by Charles Warren) for the Thomaston quadrangles has been published by the Connecticut Geological and Natural History Survey. The Team's Geologist also referenced the "Soil Survey for Litchfield County", published by the Soil Conservation Services, Department of Agriculture, for the purposes of the following sections (Figure 4).

Overlying bedrock throughout the watershed is a surficial geologic material known as 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 meltwater, till contains everything from clay to boulders and it is locally very variable in texture. Two major till varieties have been observed in western 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



TILL

AREAS WHERE BEDROCK IS AT OR NEAR GROUND SURFACE

LAKE PLYMOUTH

PLYMOUTH, CONNECTICUT

SURFICIAL GEOLOGY

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surface exposures, but the compact variety may underlie it. The thickest till in the watershed is probably located along Rt. 262 in the northern parts of the watershed, while the remainder is characterized by shallow deposits.

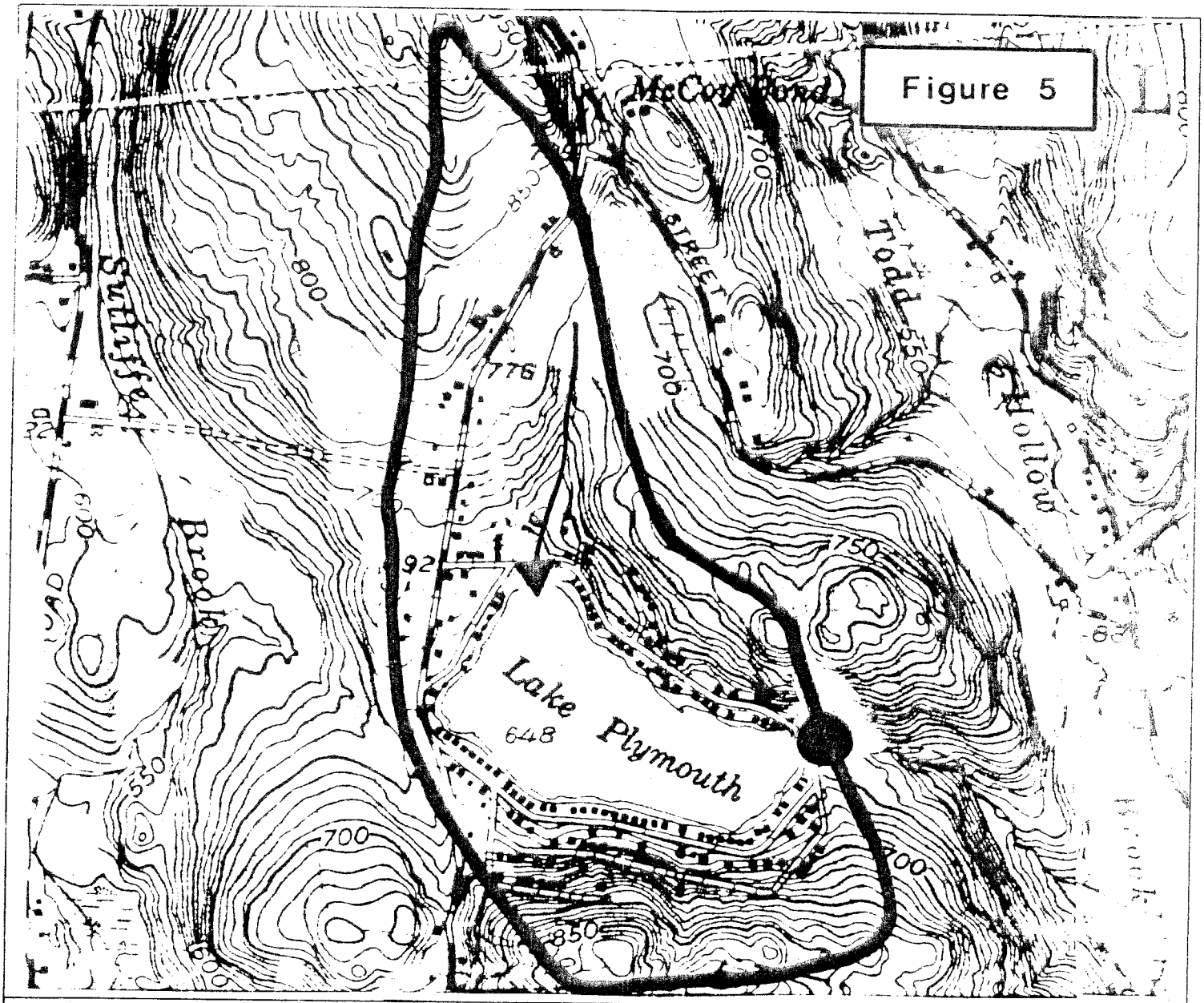
Seasonally wet areas overlie till deposits, mainly along drainageways in the watershed.

HYDROLOGY

Hydrology

The watershed of Lake Plymouth may be defined as that land area from which all of the natural water input to the lake is derived. As shown by Figure 5, the watershed boundary tends to follow along the crests of local hills such as Pine Hill. The watershed as depicted comprises about 243 acres or about .38 square miles.

Precipitation which takes the form of surface runoff flows across the surface of the land until it reaches a brook or other body of water. Precipitation may also be absorbed into the ground. Once it is absorbed, the water may either be returned to the atmosphere through evaporation and transpiration or percolate downward to the water table and become groundwater. Once the water reaches the groundwater table it moves slowly downslope by the force of gravity, ultimately discharging to the surface in the form of a spring, wetland, stream, or directly into the lake. Generally speaking, groundwater flow in the watershed parallels the surface flow pattern and is largely controlled by the underlying bedrock or compact layer present in some of the till-based soils.



WATERSHED AREA AND POINT OF OUTFLOW FOR LAKE PLYMOUTH

WATERCOURSE SHOWING DIRECTION OF FLOW

LAKE PLYMOUTH

PLYMOUTH, CONNECTICUT

WATERSHED BOUNDARY

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No major streams feed Lake Plymouth. It relies mainly on seasonal drainage channels arising in the northern and southern parts.

Although there is no gauging station at the outlet of Plymouth Lake, it is possible to estimate the flow duration characteristics of the outlet stream using a method described in "Stream Flow Information for Connecticut with Applications to Land-Use Planning", Connecticut Dept. of Environmental Protection No. 35, by Michael A. Cervione, Jr. The following Table (1) gives the estimates for the outlet stream in cubic feet per second and million gallons per day.

TABLE 1

Estimated flow duration characteristics of unnamed stream at the outlet of Lake Plymouth.

Percent of time flow equalled or exceeded	1	5	10	30	50	70	90
Flow equalled or exceeded in cubic feet per second	4.3	2.3	1.6	.8	.4	.18	.0176
Flow equalled or exceeded in million gallons per day	2.78	1.48	1.03	.5	.26	.116	.0114

The mean annual outflow from Lake Plymouth is estimated to be .7 cubic feet per second or about .45 million gallons per day.

Based on visual observations made on the review day, the overall environmental health of Lake Plymouth appeared satisfactory. This is probably attributed to (1) the lowering of the water level during winter months for beach front maintenance, which has also helped to control weed problems and (2) the presence of a municipal sewer line to which most homes around the lake are connected, which significantly reduces the chances of failing septic system discharges reaching the lake. A failing septic system can contribute phosphorus and other pollutants to the lake's water, accelerating eutrophication (a natural aging process of surface water bodies) and, far more, creating a public health nuisance condition. According to local officials, all except a few homes around the lake have tied into the municipal sewer line. Every effort should be made to tie all homes around the lake into the sewer line.

Development that has taken place in the watershed has been largely residential. As mentioned earlier, the heaviest concentration of residential development in the watershed is in the immediate vicinity of Lake Plymouth. These homes consisted mainly of seasonal homes, many of which have since been converted to year-round homes. The remaining parts of the watershed have been lightly developed but it appears that many new homes are presently under construction. Most of the residential homes outside of those surrounding Lake Plymouth lie along Rt. 263 (Mt. Tobe Road).

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 which are 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 (excluding the area surrounding Lake Plymouth) 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 and sediment control measures, maintain catch basins, etc., to ensure that the water quality of Lake Plymouth is not adversely effected.

The correction of individual or scattered failing septic systems is the responsibility of the town health official(s). 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 Lake Plymouth watershed. These include:

1. Conducting a sanitary survey in the watershed to identify potential sources of pollution such as overflowing septic systems. This should be conducted during the spring months when septic systems are most likely to fail.
2. Strict enforcement of the Public Health Code requirements with respect to new construction in the Lake Plymouth 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 sewage disposal.

3. Strict enforcement of Sec. 19-13-B100, Building Conversion of the Connecticut Public Health Code, 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, 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.

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 of Soil and Water Conservation to develop erosion and sediment guidelines and model regulations for municipalities. The legislation also mandates the adoption of municipal erosion and sediment control programs by July 1, 1985.

Lakeside residents and lake users are encouraged to 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 Lake Plymouth watershed. Catch basins, especially those that discharge directly to Lake Plymouth or feeder streams to the lake, need to be cleaned of sediment on a regular basis. Also, it is recommended that road sanding be kept to minimum in these areas. In the early spring, roads throughout the watershed need to be swept of road sand.

Furthermore, all development proposals in the watershed should be accompanied by a thorough soil and erosion control plan that is fully effective. All control measures should be checked on a regular basis by a town

representative (i.e., zoning enforcement officer) for effectiveness. For example, signs of uncontrolled runoff were quite visible in the new development along roads overlooking the lake.

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. Lakeside residents whose lawns drain directly to the lake are encouraged to fertilize at a minimum and have their soils analyzed to ensure proper application of fertilizer. In regard, to the latter, interested persons should contact the University of Connecticut Cooperative Extension Service Office.

Agricultural Activity

Agricultural activities in the watershed are not extensive. Most of the farmland is concentrated in the upper parts along Rt. 263 (Mt. Tobe Road). Because of its remoteness from the lake, it probably presents little or no problems to water quality in the lake.

WATER SUPPLY

Based on geologic mapping and water resources data, the major water bearing formation is the underlying crystalline metamorphic rock. Although there may be some homes in the study area served by dug wells excavated into till soils, they are generally unreliable during dry periods. This is due to the hydrogeologic setting, which results in highly fluctuating and seasonal water table.

Bedrock is commonly capable of supplying small (2 to 3 gallons of water per minute) but reliable yields of groundwater to individual wells. Groundwater moves through bedrock by way of an interconnected fracture system. Most wells that penetrate 150 to 200 feet of bedrock will intersect enough fractures to supply at least 2 to 3 gallons per minute. Some wells, however, fail to intersect any water-bearing fractures. There is no practical way of predicting whether any particular location will be good for drilling a well.

According to Connecticut Water Resources Bulletin No. 19 (Lower Housatonic River Basin), which encompasses the subject site, approximately 80 to 90 percent of the bedrock wells surveyed were capable of yielding 2 gallons per minute. A well yielding 2 to 3 gallons per minute would be acceptable for most domestic purposes.

Town officials noted on the review day that bedrock wells in the Lake Plymouth area have experienced low yields and in some cases have gone dry. As mentioned earlier, it is very difficult to determine where the water bearing fractures in the bedrock are, even with geophysical equipment. However, one way of protecting wells from mutual interference during pumping periods, would be to adequately separate them. A general 'rule of thumb' is to separate wells by doubling the distance of the water bearing zones. Typically, the most productive zones in crystalline, metamorphic bedrock are found in the upper 150 to 200 feet of the bedrock surface. Therefore, keeping 300 to 400 feet between neighboring wells will help to minimize the chance for mutual interference, particularly during pumping periods. In order to accomplish this, it may be necessary to make lots 1.5 to 2.0 acres in size where on-site well and septic systems are required.

SOIL CHARACTERISTICS

The landscape of the Lake Plymouth watershed is characterized by rolling topography to the west and very steep terrain in the remaining watershed. Soils are mostly well drained with several small areas of moderately well drained soils and a small area of poorly drained soil. There are significant areas where bedrock is at a depth of less than 2 feet (see Figure 6).

Specific Soil Concerns

The following discussion addresses concerns for each soil type. The map unit symbols on the accompanying map are unique to Litchfield County. All comments are based on the fact that homes are served by sanitary sewers.

Charlton - The Charlton soil series is deep, well drained and has developed in friable to firm glacial till.

CaB — This map unit has 3 to 8% slopes. Building limitations are slight.

CrC — This map unit is very stony and has 3 to 15% slopes. New building sites need to be cleared of boulders.

CrD — This map unit is very stony and has 15 to 35% slopes. Building limitations for this map unit are severe. The problems increase as the steepness of the slope increases. 40 foot by 100 foot lot sizes cannot always be adequate for safe homesites on these type slopes.

Hollis - The Hollis series consists of well drained to somewhat excessively drained soils that are very shallow to shallow crystalline bedrock. Bedrock is typically at a depth of less than 2 feet. Outcrops are common, in severe cases outcrops occupy 50% of the land surface.

HrC — This map unit is very rocky with 3 to 15% slopes. The main limitation is depth to bedrock. Homesites where basements are desired usually require blasting. Blasting is likely to be needed for driveways, roads, sewer connections and storm sewers.

HrE — This map unit is very rocky and steep with 15 to 35% slopes. See comments for HrC regarding basement, driveways, roads, sewer connections and storm sewers.

Steep slopes make it very difficult to maintain gravel driveways and during heavy rainstorms road ditches may actively erode.

HxE This map unit is extremely rocky with 15 to 35% slopes. Rocks are more prevalent then the HrC and HrE map units. Steep slopes are a problem here as with the HrE map unit.

Leicester - The Leicester series consists of poorly drained or somewhat poorly drained soils that developed in very friable to firm glacial till.

Le This map has surface stones. No building should occur in this wetland soil. Filling of wetlands should be severely limited or excluded. Wetlands serve to detain stormwater naturally, and wetlands clean surface runoff by filtering out sediment and other pollutants.

Paxton - The Paxton series is a well drained soil that developed in glacial till. A layer of compact basal till underlies the soil at a depth of about 2 feet.

PbB This map unit has a slope of 3-8%. Building limitations for this soil are slight. Buildings should have footing drains.

PbC,PbC2 These map units have a slope of 8-15%. Building limitations are similar to PbB map unit with slopes being somewhat more important.

Rockland - Rockland is in areas where exposed bedrock occupies more that 50% of the surface.

Rh Building structures requires extensive blasting. Not generally suitable for building.

Sutton - The Sutton series consists of moderately well drained soils that developed in glacial till.

SuA This map unit has 0 to 3% slopes. A seasonal high water table requires use of footing drains around buildings.

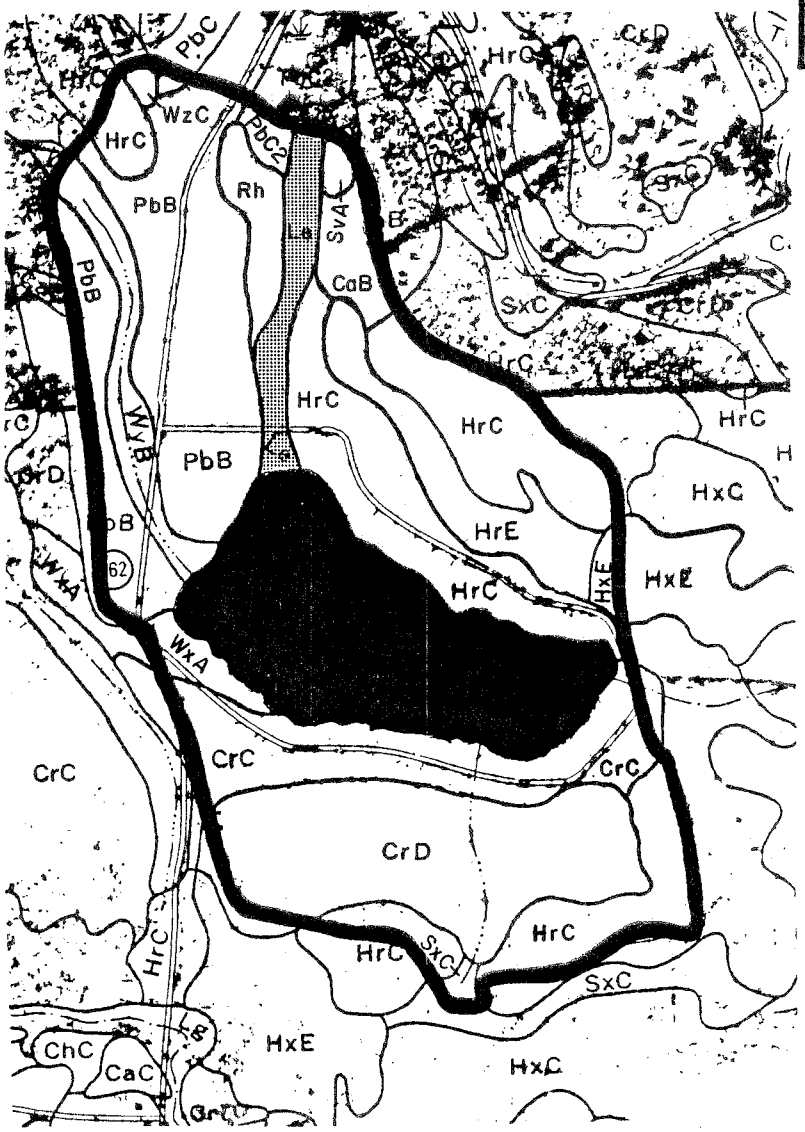
Woodbridge - The Woodbridge series consists of moderately well drained soils that developed in compact glacial till. These soils are underlain by compact basal till at about 2 feet of depth.

WxA This map unit has a 0-3% slope. Due to seasonal high water tables, houses need to be protected by footing drains and diversions. Streets are subject to heaving during the winter months.

WyB This map unit is stony and has a 3-8% slope. See WxA limitations.

WzC This map unit is very stony and has a 3-15% slope. Slope and stones may limit this unit somewhat more than the other Woodbridge map units. See WxA for other limitations.

Figure 6



CaB	Charlton fine sandy loam, 3 - 8 % slopes
CrC	Charlton very stony fine sandy loam, 3-15 % slopes
CrD	Charlton very stony fine sandy loam, 15-35 % slopes
HrC	Hollis very rocky fine sandy loam, 3-15% slopes
HrE	Hollis very rocky fine sandy loam, 15-35% slopes
HxE	Hollis extremely rocky fine sandy loam, 15-35 % slopes
Le	Leicester stony fine sandy loam
PbB	Paxton fine sandy loam, 3-8 % slopes
PbC	Paxton fine sandy loam, 8-15 % slopes
PbC2	Paxton fine sandy loam, 8-15 % slopes, eroded
SvA	Sutton fine sandy loam, 0-3 % slopes
WxA	Woodbridge fine sandy loam, 0-3 % slopes
WyB	Woodbridge stony fine sandy loam, 3-8 % slopes
WzC	Woodbridge very stony fine sandy loam, 3-15 % slopes

Wetland Soils Water

LAKE PLYMOUTH

PLYMOUTH, CONNECTICUT

SOILS

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N

EROSION AND SEDIMENT CONTROL

Lake Plymouth is typical of many Connecticut lakes in that it is susceptible to damage due an intensely developed watershed. Individual actions by companies, associations, and government are all important in protecting the lake.

Erosion Control

Engineers and contractors can use the 1985 "Connecticut Guidelines for Soil Erosion and Sediment Control" as a reference when they plan and install erosion and sediment control measures on developing land.

During the site review good and bad examples of erosion and sediment control were seen. On the plus side was the use of fiber netting over a new lawn seeding on a steep slope. On the negative side were haybales and silt fence merely staked on top of the ground. Silt passed freely beneath both the bales and the silt fence. Both the bales and the fence should be keyed into the ground.

Enforcement of erosion and sediment control is needed. One method of control is for the building applicant to post a cash bond or a savings account bond to insure compliance with local soil erosion and sediment control regulations. Contact the Litchfield County Soil and Water Conservation District for more details.

Sediment Control

The streets and storm sewers serve as conduits for sediment as it moves to the lake. The first line of defense is to minimize erosion on individual lots and capture all sediment on each individual lot.

The sediment that is on the streets and in the storm sewers must be stopped before entering the lake. All storm sewers need catch basins and all basins should be cleaned periodically whether it is the Town's or State's responsibility. Where possible sediment detention basins should be installed as the final line of defense to capture sediment before it reaches the lake. Sediment detention basins should be cleaned out periodically.

Watershed Planning

Town commissions should view the entire watershed when making decisions. Looking at each lot as a separate entity ignores the fact that an individuals action on his lot may profoundly affect many other property owners. This is particularly true due to the 40 by 100 foot size lots around the lake.

Stormwater sewers are not installed on all roads surrounding the lake. More development will result in more runoff due to the increase in impervious surface. An increase in runoff will further tax roads and road ditches where they exist. Houses downslope that now have problems with runoff will be further inundated. To minimize the problems from increase runoff that results from building, the Town can consider setting a maximum area of impervious surface for each lot. This could be done in conjunction with installation of storm sewers. All storm sewers should have catch basins which are cleaned periodically.

Due to the presence of bedrock and very steep slopes, not every lot can be safely developed. On Hosier Road there are two new homes sitting on level building pads. The narrow width of the upper lot necessitated that a 6 to 10 foot vertical wall of earth was left at the property boundary. A wood retaining wall has been constructed to support the vertical bank. During the site review it was noted that a portion of the wall leans toward the house.

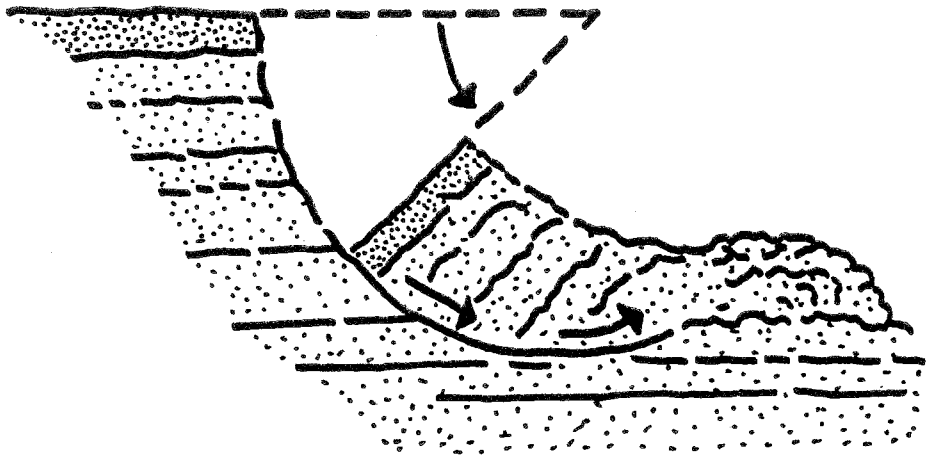
The grading of these two particular lots has created a situation where a landslide may occur. By removing the slope toe, the hillside has lost some physical support. During a prolonged period of wet weather, the soil and glacial till below may saturate and then move in a slump block (see Figure 7). A severe slump may destroy the house, while a lesser slump may damage the house.

Filling to create level lots on the downhill side of Hosier Road may also cause problems. The danger here is that unconsolidated fill once saturated will move in a slide or slump (see Figures 7 and 8). This would endanger any future homes built on the fill and the existing homes downslope could also be endangered.

The Town needs a geo-technical engineering report regarding slope stability for cuts and fills along Hosier Road and above where the CrD map unit is shown (see Figure 6). Applicants for building permits on these steep slopes should provide documentation from a registered professional engineer that proves that each lot can be safely developed.

To protect the lake and to maintain the streets and storm sewers, it is recommended that the remaining undisturbed lake watershed be protected. In this case protection may mean purchase of development rights. On July 1, 1987 a new law went into affect that allows the transfer of development rights (see Appendix A). If the Town followed this option, a developer would buy the development rights to critical lots, place a restricted use easement on those lots, and then the developer would be granted the right to more intensively develop another parcel of property in a designated area. If this option is not acceptable, other options should be pursued. The road system and lake are overtaxed now, further development will intensify the existing problems.

Figure 7



From: Introduction to Physical Geography
2nd Edition
Arthur N. Strahler
John Wiley & Sons, Inc.
N.Y., London, Sydney, Toronto

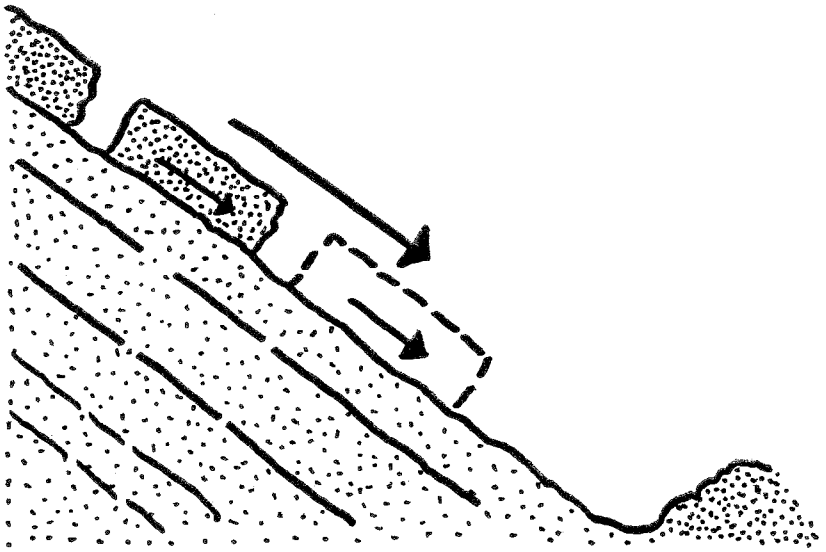
LAKE PLYMOUTH

PLYMOUTH, CONNECTICUT

SLUMP

King's Mark Environmental Review Team

Figure 8



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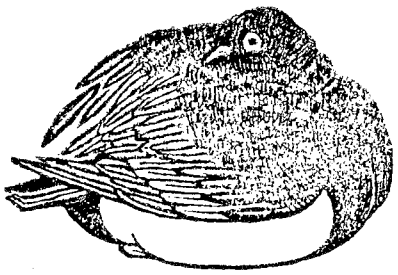
LAKE PLYMOUTH

PLYMOUTH, CONNECTICUT

SLIDE

King's Mark Environmental Review Team

BIOTA



FISHERIES

Lake Plymouth is an artificial warmwater body approximately 38 acres in surface area, reportedly having a maximum depth of 8 feet and an average depth of 4 feet. In a report dated July 24, 1960, the fishery population of the lake was sampled by gill net. The purpose was to determine the species composition and serve as a basis for future fisheries management. At that time the fishery population was composed of smallmouth bass, calico bass, yellow perch, and golden shiners. The golden shiners were found to be overabundant. A stocking of largemouth bass was recommended to feed on the shiners and also to provide a sport fish. Through visual observations and angler interviews, the lake currently contains a population of largemouth bass, yellow perch, chain pickerel, bluegill sunfish, common sunfish, calico bass, golden shiner, and brown bullhead. From angler interviews, the species present are caught in several size categories indicating a balanced self-reproducing population.

The lake is eutrophic by nature and, having been developed over agricultural land, has always had a nutrient source to nurture an abundance of aquatic vegetation. The clarity of the water allows for plant growth throughout the lake basin. With increased shoreline development came an increase in nutrients entering the lake system. These nutrients came in the form of septic tank leachate, siltation, and fertilizer runoff from lawns and gardens. These nutrients have accelerated the eutrophication process made evident by an increase of aquatic plants. The aquatic plant growth has been controlled to some extent by the construction of sewers, the chemical treatments applied to the vegetation, and an annual lake draw-down. However problems within the watershed still remain. Storm sewers drain directly into

the lake efficiently carrying in nutrients from the entire developed area. The catch basins installed to trap the nutrient carrying sediments are not maintained intensifying the problem.

An increase in development within the watershed will bring with it an increase of nutrients. This cultural eutrophication will accelerate the "aging" of the lake causing an overabundance of aquatic vegetation to a point where control methods are not effective. An overabundance of vegetation can be detrimental to the fishery population. Large amounts of aquatic vegetation can remove substantial quantities of oxygen from the water. This occurs through a process called respiration whereby during periods of little or nonexistent light, plants will take in oxygen for their life processes. This is a problem twice yearly. During the summer months when plant growth is at a maximum and water temperatures are at their greatest, oxygen will be removed and the potential is there to deplete the oxygen supply to a point where a kill of fish can occur. The second time of concern is during winter months when the lake is under ice cover. At this time there is limited light penetration and the respiration period may be over extended periods of time. A fish kill at this time may not be noted until the ice melts. While a total fish kill is unlikely on a lake the size of Lake Plymouth, it may alter the balance of the entire population.

As the lake is under private ownership access, recreational fishing appears limited to lake residents and their guests. Anglers are either shore based or water based from boats or canoes. The water based angler will experience greater catch rates given the factor of mobility and the potential to fish different water depths and habitats.

WATER QUALITY

Lake Plymouth, as a man-made lake created by damming up a stream on organic-rich former cropland, is naturally prone to eutrophication problems. The Connecticut Watershed Management Guide, 1986 revision, says ..."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 water bodies 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."

Lake Plymouth's major problem of very small lot size and intensive building, with its resultant increased erosion and sedimentation, was emphasized at the King's Mark field review on July 1, 1987. Watershed Guide, 1986, describes erosion and sedimentation as follows: 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.

Considering pressures for further high density development in the Lake Plymouth watershed, the following should be kept in mind. 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. Construction site erosion must therefore be regarded as a major causative factor in the lake eutrophication process, according to the Watershed Guide, 1986.

The transport of eroded soil to a lake contributes to eutrophication in several ways. Most important, 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.

Roadside runoff in the Lake Plymouth watershed is presently having a negative impact on water quality. In general, 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. But 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 could 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.

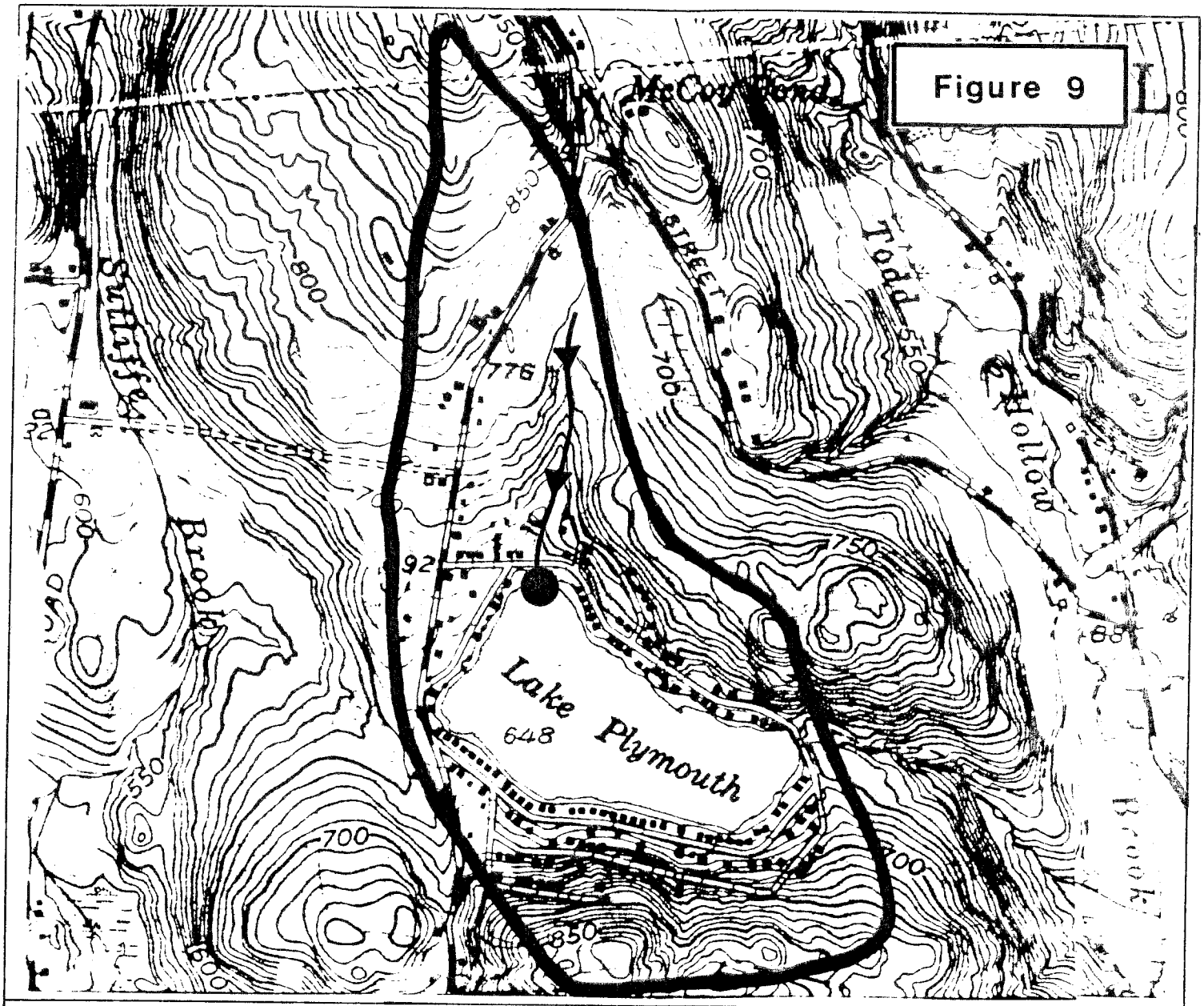
Stormwater runoff from planned residential areas can be controlled by including stormwater management as part of the overall site development plan. Stormwater control measures should be incorporated into the site plan so that the runoff rate from the developed site is the same as it had been prior to development. Methods of stormwater control which can be considered include preservation of wetland, 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. The Guidelines for Soil Erosion and Sediment Control can be used as a guide for local regulations.

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 can 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 could establish cooperative working relationships with appropriate town and/or state maintenance officials in order to implement a sound management program for lake watershed roads.

Many efforts have been made to preserve the valuable natural resource of Lake Plymouth for the recreational uses of swimming, boating and fishing. Installing sewers around the lake in 1978 and banning motor boats have been

positive steps in preventing further lake degradation. The Lake Association is also currently considering dredging a catchment basin below the tributary from Pickerel Pond to trap sediments (see Figure 9).

Suggestions for further protection improvement of the lake are: discouraging lawn fertilization and encouraging the planting of natural vegetation buffer strips along the lake shore. The present lawns, sloping steeply down to the water's edge, are surely contributing unwanted nutrients to the lake from surface runoff at every rain storm and spring thaw. A final suggestion for improving water quality would be to implement the dry-dredging plan to remove significant amounts of nutrient-rich soil from the bottom, as proposed in The Lombardi Associates, Inc. study of 1982 (see Appendix B).



WATERCOURSE SHOWING DIRECTION OF FLOW

PROPOSED CATCHMENT BASIN

LAKE PLYMOUTH

PLYMOUTH, CONNECTICUT

PROPOSED CATCHMENT BASIN

King's Mark Environmental Review Team

0 1000'

LAND USE
AND
PLANNING CONSIDERATIONS

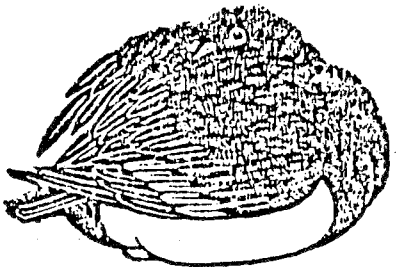
PLANNING CONSIDERATIONS

In order for the Town of Plymouth to have desirable development, there needs to be a wedding of public and private policies and actions that will strive to maintain the value and attractiveness of the area. Residents of the lake area are trying to maintain and upgrade the quality of the real property, the water quality, and the recreational facilities. Development of small, inadequate lakefront lots should not be continued until an in-depth evaluation of the ability of this area to absorb any more development is completed (see Water Supply Section).

While legal zoning and subdivision methods are available that will help encourage the proper development of the area, what is proceeding is the use of existing regulations to exploit this area for the desirable amenities. In the long run, this will further damage the local environment and reduce the quality of life in the lake community. The moratoria, presently being employed, are reflective of problems in the area. While one copy of the zoning regulations was available in the Town Hall, none was made available for study purposes.

There are programs of the State that could be helpful to Plymouth in addressing some of these problems. One is the recently adopted P.A. 87-490, Transfer of Development Rights (see Appendix A). Another is a Capitol Improvements Program. Farmland can be protected through the use of a farmland preservation program, under the auspices of the State Department of Agriculture. Help with some of these programs can be obtained from the Office of Policy and Management in Hartford. Also, the Department of Environmental Protection has some new programs for improving water quality in recreational lakes.

APPENDICES



Appendix A

Transfer of Development Rights

Substitute House Bill No. 7383

PUBLIC ACT NO. 87-490

AN ACT CONCERNING MUNICIPAL AND REGIONAL PROGRAMS OF TRANSFERS OF DEVELOPMENT RIGHTS, AND ZONING APPROVAL FOR CERTAIN VAULTS, CRYPTS, COLUMBARIUMS AND MAUSOLEUMS.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Section 1. Section 8-2 of the general statutes is repealed and the following is substituted in lieu thereof:

The zoning commission of each city, town or borough is authorized to regulate, within the limits of such municipality, the height, number of stories and size of buildings and other structures; the percentage of the area of the lot that may be occupied; the size of yards, courts and other open spaces; the density of population and the location and use of buildings, structures and land for trade, industry, residence or other purposes, and the height, size and location of advertising signs and billboards. Such zoning commission may divide the municipality into districts of such number, shape and area as may be best suited to carry out the purposes of this chapter; and, within such districts, it may regulate the erection, construction, reconstruction, alteration or use of buildings or structures and the use of land. All such regulations shall be uniform for each class or kind of buildings, structures or use of land throughout each district, but the regulations in one district may differ from those in another district, and may provide that certain classes or kinds of buildings, structures or uses of land are permitted only after obtaining a special permit or special exception from a zoning commission, planning commission, combined planning and zoning commission or zoning board of appeals, whichever commission or board the regulations may, notwithstanding any special act to the contrary, designate, subject to standards set forth in the regulations and to conditions necessary to protect the public health, safety, convenience and property values. Such regulations shall be made in accordance with a comprehensive plan and shall be designed to lessen congestion in the streets; to secure safety from fire, panic, flood and other dangers; to promote health and the general welfare; to provide adequate light and air; to prevent the overcrowding of land; to avoid undue

concentration of population and to facilitate the adequate provision for transportation, water, sewerage, schools, parks and other public requirements. Such regulations shall be made with reasonable consideration as to the character of the district and its peculiar suitability for particular uses and with a view to conserving the value of buildings and encouraging the most appropriate use of land throughout such municipality. Such regulations shall also encourage the development of housing opportunities for all citizens of the municipality consistent with soil types, terrain and infrastructure capacity. Zoning regulations may be made with reasonable consideration for the protection of historic factors and shall be made with reasonable consideration for the protection of existing and potential public surface and ground drinking water supplies. On and after July 1, 1985, the regulations shall provide that proper provision be made for soil erosion and sediment control pursuant to section 22a-329. Such regulations may also encourage energy-efficient patterns of development, the use of solar and other renewable forms of energy, and energy conservation. The regulations may also provide for incentives for developers who use passive solar energy techniques, as defined in subsection (b) of section 8-25, in planning a residential subdivision development. The incentives may include, but not be limited to, cluster development, higher density development and performance standards for roads, sidewalks and underground facilities in the subdivision. SUCH REGULATIONS MAY PROVIDE FOR A MUNICIPAL SYSTEM FOR THE CREATION OF DEVELOPMENT RIGHTS AND THE PERMANENT TRANSFER OF SUCH DEVELOPMENT RIGHTS, WHICH MAY INCLUDE A SYSTEM FOR THE VARIANCE OF DENSITY LIMITS IN CONNECTION WITH ANY SUCH TRANSFER. Such regulations shall not prohibit the continuance of any nonconforming use, building or structure existing at the time of the adoption of such regulations. Any city, town or borough which adopts the provisions of this chapter may, by vote of its legislative body, exempt municipal property from the regulations prescribed by the zoning commission of such city, town or borough; but unless it is so voted municipal property shall be subject to such regulations.

Sec. 2. (NEW) Any two or more municipalities which have adopted the provisions of chapter 124

or 125a of the general statutes or which are exercising zoning power pursuant to any special act may, with the approval of the legislative body of each municipality, execute an agreement providing for a system of development rights and the transfer of development rights across the boundaries of the municipalities which are parties to the agreement. Such system shall be implemented in a manner approved by the legislative body of each municipality and by the commission or other body which adopts zoning regulations of each municipality.

Sec. 3. (NEW) Any zoning regulations adopted pursuant to section 8-2 of the general statutes, as amended by section 1 of this act, concerning development rights shall authorize the transfer of the development rights to land only upon joint application of the transferor and transferee.

Sec. 4. Section 19a-310 of the general statutes is repealed and the following is substituted in lieu thereof:

No person shall construct any vault, crypt, columbarium or mausoleum for public use, wholly or partially above the surface of the ground, to be used to contain the body of any dead person (1) unless the same is located within the confines of an established cemetery containing not less than five acres, which cemetery has been in existence and operation for a period of at least five years immediately preceding the time of the erection thereof, OR (2) IF LOCATED WITHIN A CEMETERY CONTAINING LESS THAN FIVE ACRES, SUCH LOCATION HAS BEEN APPROVED BY THE SELECTMEN OF ANY TOWN, THE MAYOR AND COUNCIL OR BOARD OF ALDERMEN OF ANY CITY AND THE WARDEN AND BURGESSES OF ANY BOROUGH; EXCEPT THAT IN ANY TOWN, CITY OR BOROUGH HAVING A ZONING COMMISSION OR COMBINED PLANNING AND ZONING COMMISSION, SUCH COMMISSION SHALL HAVE THE AUTHORITY TO GRANT SUCH APPROVAL; nor until plans and specifications [thereof] FOR SUCH VAULT, CRYPT, COLUMBARIUM OR MAUSOLEUM are approved by the department of health services, provided a columbarium which is used solely as a repository for the remains, after cremation, of deceased persons and is located on the premises of any religious society or corporation shall not be subject to the provisions of this section. Such plans and specifications shall set forth the sections, halls, rooms, corridors, elevators or other subdivisions thereof, with their descriptive names and numbers, and shall provide: (a) That

such structure be so arranged that the cell, niche or crypt may be readily examined at any time by any person authorized by law to do so; (b) that the materials of which such structure is to be constructed are to be of the best quality and of a character best suited for the purposes intended; and (c) that the structure shall be so constructed as to insure its durability and permanence as well as the safety, convenience, comfort and health of the community in which it is located, as dictated and determined at the time by modern mausoleum construction and engineering science. The person making the application shall file a certificate of such approval, signed by the commissioner of health services, with a copy of such plans and specifications, in the office of the town clerk of the town wherein such structure is to be erected, and such clerk shall retain the same on file.

Certified as correct by

_____

Legislative Commissioner.

_____

Clerk of the Senate.

_____

Clerk of the House.

Approved _____, 1987

_____

Governor, State of Connecticut.

Appendix B

Lake Plymouth Management Study

Lombardi Associates, Inc.

A Report
to the
Lake Plymouth Association
Plymouth, Connecticut

LAKE PLYMOUTH MANAGEMENT STUDY

December 1982

AR LOMBARDI ASSOCIATES, INC
"CONSULTING ENVIRONMENTAL ENGINEERS"
25 Terrace Drive
Vernon, Connecticut 06066
Telephone (203) 872-2703

1.0 INTRODUCTION

Lake Plymouth, located in Plymouth, CT, is a shallow impoundment which has experienced excessive rooted aquatic weed and algae growth during recent years. The lake, created in the 1930's by inundating 38 acres of productive crop land, is a high-value recreation resource used for boating, fishing and swimming by area residents. The weed growths limit full use of the resource.

This report presents results of a Lake Plymouth management study, commissioned by the Lake Plymouth Association and directed to determining the causes of the weed growth problem and assessment of alternative measures for its reduction. Basic data were collected and evaluated to obtain a limnological diagnosis of Lake Plymouth and its nutrient sources. These data and evaluations provide the basis for assessment of the effectiveness of alternative lake eutrophication control measures.

2.0 LIMNOLOGICAL DESCRIPTION

2.1 Watershed Description

Major land uses within the 264 acre Lake Plymouth watershed include forest (58%), residential (20%), and pasture/crop (8%). The lake itself comprises 14 percent of the watershed area. Watershed soils are classified as highly erodible but erosion appears to be a problem only where new home construction on steep slopes is occurring. There are approximately 136 permanent and seasonal residences in the watershed (Figure 1).

2.2 Hydrology

The Lake Plymouth watershed area has limited hydrologic capacity to sustain inflows to the lake during dry weather periods. The total estimated inflow of 26 million cubic feet per year, which occurs mostly during the spring, is sufficient to flush the lake only twice per year. Approximately 7 percent of the water budget is pumped out of the watershed through the sewer system, which began operation in 1978. Although the export of water is significant to the water budget, the sewer also removes a large nutrient source.

2.3 Lake Morphometry

The Lake Plymouth bottom configuration has an important influence on the feasibility of lake level control as a weed growth control measure. The bottom is quite flat at a depth of 6 to 7 feet with no deep holes or channels (Figure 2). Long-time residents suggest that much of the lake bottom was cultivated prior to its formation.

2.4 Biological Characteristics

Lake Plymouth is subject to nuisance weed and algae growth due to the high level of plant nutrients. The spring 1982 phos-

phorous concentration of 0.1 mg/l is quite high and places the lake in the eutrophic category. Lake biological characteristics have varied considerably during recent years as a result of chemical treatments, sewering and rainfall variablilty. The habitat for both weeds and algae is very good and results in interspecific competition. As long as spring algae blooms restrict light penetration, weeds will not reach nuisance abundance and algae will dominate. Usually, light penetration is not limited and this coupled with the shallow and fertile character of the lake provides an excellent weed habitat.

3.0 NUTRIENT SOURCES

Sources of the nutrient phosphorous to Lake Plymouth include: 1. watershed sources, and 2. in-lake sources. Quantification of the nutrient amounts attributable to the various sources is most important for development of an effective lake management program.

3.1 Watershed Nutrient Sources

Watershed sources of nutrients relevant to Lake Plymouth include 1) erosion-related sources; 2) atmospheric fallout; and 3) septic systems. Erosion-related sources are related to land use (eg. forest, residential and pasture) and are estimated to be 69 kg P/year (kilograms phosphorous per year). Atmospheric fallout (eg. rain, snow, and dust) of phosphorous onto the lake surface accounts for an estimated 12 kg P/year.

Household septic systems adjacent and near the lake are now connected to the sewerage system so that this nutrient source is removed. It is noteworthy that as much as 660 kg P/yr could have been attributed to septic systems prior to installation of the sewerage system. It is possible that some residual phosphorous is still leaching from the soil but this should be decreasing with time.

The total estimated watershed mutrient load to Lake Plymouth of 80 kg P/yr is insufficient to support the highly eutrophic condition of Lake Plymouth. Therefore, the in-lake nutrient sources must be significant.

3.2 In-Lake Nutrient Sources

The concentration of total phophorous in Lake Plymouth was about 0.1 mg/l in spring and increased to 0.16 mg/l by August. These concentrations are high and place the lake in the eutrophic category as evidenced by the large weed and algae growths. As noted it is not likely that these high concentrations are from watershed sources.

Lake bottom sediments are highly fertile and are considered a major source of nutrients. Field data indicate that more than 100 kg P is attributable to sediment release. Also, rooted aquatic weeds can extract nutrients directly from the sediments. Diver probing of the sediments indicated that about 1.5 to 2 feet of

enriched organic sediment covers the bottom. These organic sediments exert a high oxygen demand due to decomposition processes which depletes the oxygen content of the overlying water. This is particularly so during winter ice-cover conditions when wind mixing of lake water is inhibited. The anaerobic (i.e. low or zero oxygen) conditions created promote release of phosphorous from the sediments which is then available for aquatic plant growth during the warm seasons.

4.0 LAKE QUALITY MANAGEMENT ALTERNATIVES

Alternative lake quality management alternatives are categorized according to the nutrient sources. That is, those applied to (1) watershed sources, and (2) in-lake sources. The effectiveness of alternative management methods are influenced greatly by the physical characteristics of Lake Plymouth as reflected by the relative contributions of nutrients from the various sources. Lake Plymouth is a shallow lake which covers an area of about 38 acres of fertile (terrestrial) fine sandy loams and silt. Nutrient input was dramatically reduced by sewering but the fertile sediments and in-lake nutrient recycling continue to support excessive weed and/or algae growths, depending on chemical application schedules.

4.1 Watershed Methods

Watershed methods are directed to maintaining the lake's current - or projected improved - condition by avoiding actions which would increase external nutrient loads.

(a) Creation of sediment ponds and regular maintenance of existing catch basins would contribute to reducing erosion-related nutrients and sediment entering the lake.

(b) Homeowner awareness and actions recommended include household wastewater management, on-site erosion control, and discouragement of duck and geese congregations on the lake.

4.2 In-Lake Methods

Two general strategies for in-lake control of aquatic weed growths which can be used include: (a) annual or periodic activties directed to maintenance of beneficial uses, and (b) one-time fix. Tradeoffs between the two strategies relate to their expected effectiveness as well as the magnitude and timing of expenditures.

(a) Use-maintenance is a continuation of the current strategy with perhaps some fine-tuning. Methods include the following:

(1) Limited water-level control for weed exposure could reduce weed growths near shore. However, algae growths are likely to substitute for weeds and watershed inflows may be inadequate to completely refill the lake. Lake bathymetry limits the effectiveness of the drawdown method.

(2) Aquashade, a commercially available color dye, could be applied to limit light penetration into lake waters and thereby reduce both weed and algae growths. Costs are estimated at $3500 per application.

(3) Aquascreen is a commercially available fiberglass mesh which can be fixed to the lake bottom to prevent weeds from rooting. It could be used to provide limited areas for "weed-free" recreation. Costs are estimated at $2800 for a 100 ft. by 100 ft. area.

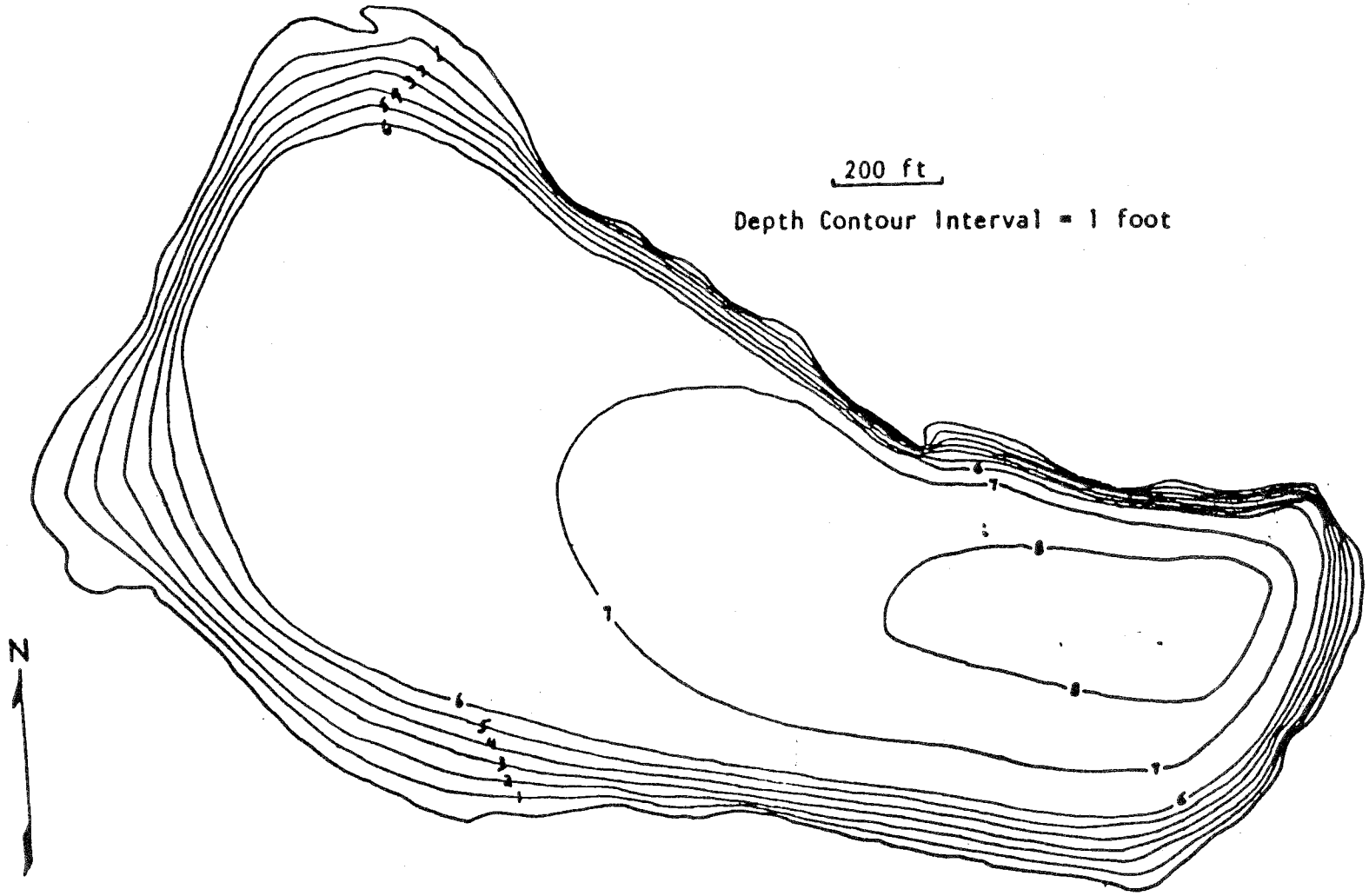
(4) Withdrawal of nutrient-rich lake water could limit weed and algae growths. This option is limited by the shape of the lake bottom as there is no single deep hole from which withdrwals could be made.

(5) Limited chemical applications to kill weed and algae growths are approprate for cosmetic improvement but are not recommended as a regular control measure because decayed plant material nutrients can be recycled from the bottom and the chemicals upset the lake's ecological balance.

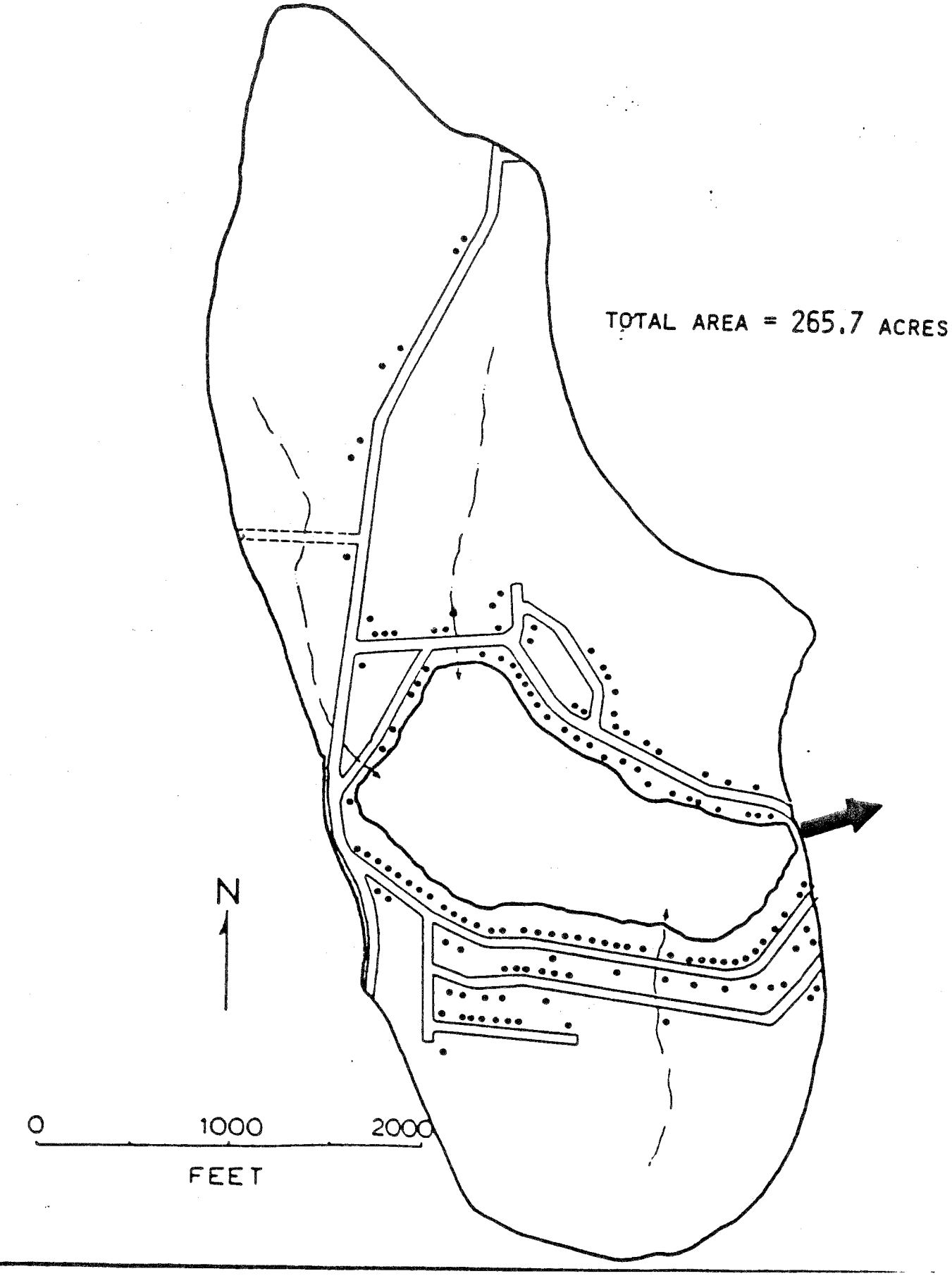
(b) One-Time Methods involve significant planning and expense but hold promise for permanent resolution of the weed and algae growth problem.

(1) Dry-dredging consists of lake-level drawdown, waiting till sediments dry, followed by excavation of nutrient-rich bottom sediments using conventional earth-moving methods. Dry-dredging is preferred over wet-dredging because it is cheaper, results in less environmental impact, and is relatively easy to apply give Lake Plymouth's flat bottom. An estimated 70,000 cu. yds. of fertile and weed-free soil conditioner is available. Additional planning is required but it is possible that the excavated soil could be sold which would reduce the cost. Costs for sediment removal run about $3 to $5 per cu. yd. depending on project specifics. Resale value may be as much as $2 per cu. yd. Advantages of the method are that it could turn out to be economical and would effect a relatively permanent solution. Disadvantages include temporary loss of the fishery and recreational potential -- perhaps for one summer season -- and the likelihood that some residents' wells will go dry when the lake level is drawn down.

LAKE PLYMOUTH BATHYMETRY



LAKE PLYMOUTH WATERSHED



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 - a 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 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 landowner/developer allowing the Team to enter the property for purposes of review, and a statement identifying the specific areas of concern the Team should 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 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 Resource Conservation and Development Area, 322 North Main Street, Wallingford, Connecticut 06492. King's Mark ERT phone number is 265-6695.