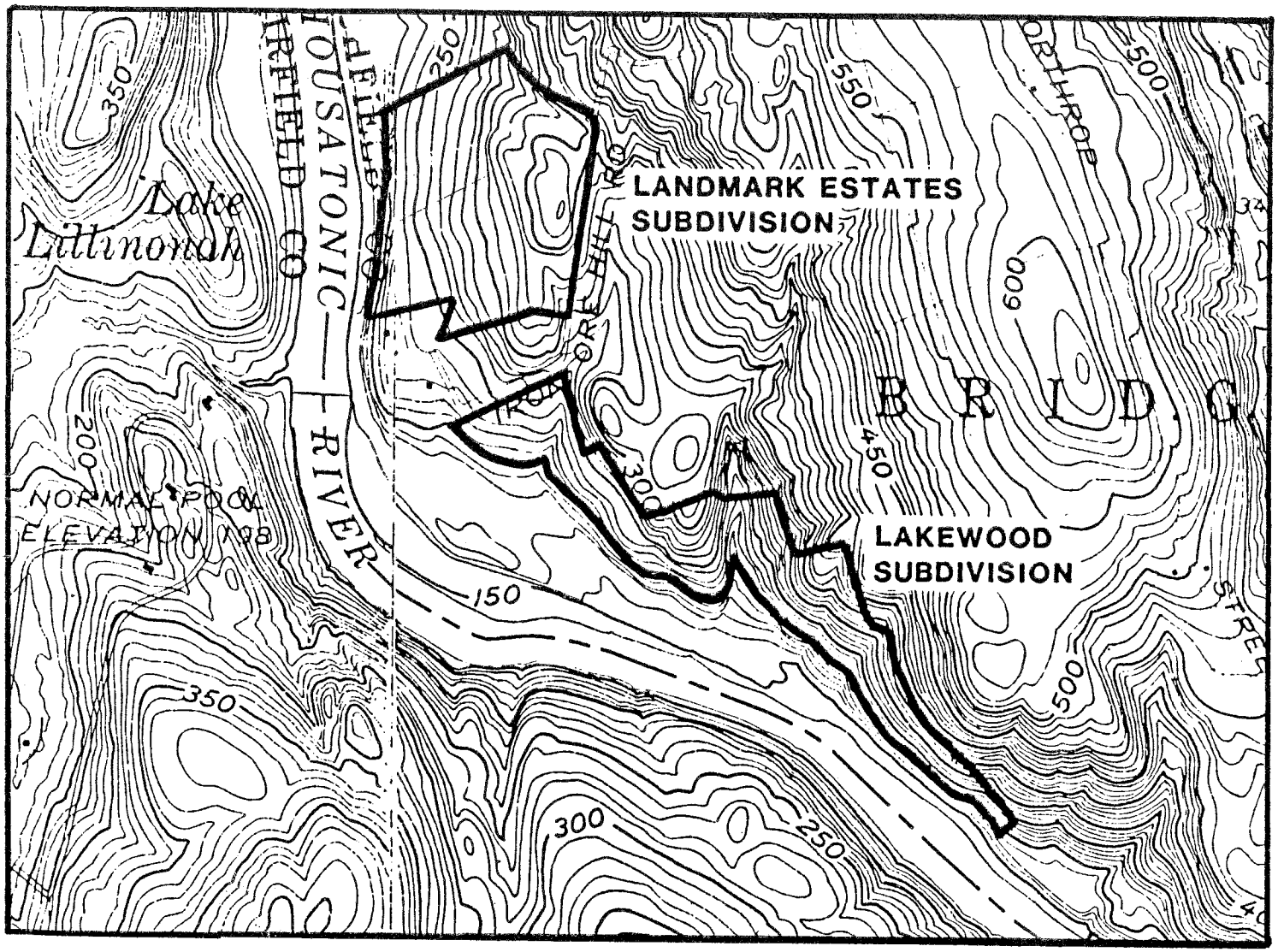
ENVIRONMENTAL REVIEW TEAM REPORT



Lakewood Subdivision
&
Landmark Estates Subdivision
Bridgewater, Connecticut

KING'S MARK RESOURCE CONSERVATION AND DEVELOPMENT AREA, INC.

LAKEWOOD SUBDIVISION

AND

LANDMARK ESTATES SUBDIVISION

BRIDGEWATER, 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

Bridgewater Conservation and Inland Wetlands 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 Bridgewater. 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.

OCTOBER 1986

ACKNOWLEDGEMENTS

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

* William Warzecha, Geohydrologist
  Department of Environmental Protection

* Paul Rothbart, Wildlife Biologist
  Department of Environmental Protection

* Steve Cashman, Soil Conservationist
  USDA - Soil Conservation Service

* Kip Kolesinskas, Soil Resource Specialist
  USDA - Soil Conservation Service

* Ralph Scarpino, Forester
  Department of Environmental Protection

* Richard M. Lynn, Senior Planner
  Housatonic Valley Council of Elected Officials

* Charles Fredette, Senior Sanitary Engineer (Lake Specialist), Department of Environmental Protection

* Dr. Russell Handsman, Archaeologist and Research Director
  American Indian Archaeological Institute

I would also like to thank Patricia Newton, 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 the following people for their cooperation and assistance during this environmental review: Mr. Burton Bernstein, Chairperson, Conservation and Inland Wetlands Commission, Town of Bridgewater, Mr. Joseph and Paul Russo, Mr. Paul Fagen of Surveying Associates, Mr. Henry Moeller of Soil Consulting Service, and Mr. Kevin McKee of Grumman Engineering Associates.

EXECUTIVE SUMMARY

The Town of Bridgewater Conservation and Inland Wetlands Commission requested that the King's Mark Environmental Review Team conduct an environmental review on two adjacent parcels of land proposed for subdivision development. The subject sites are located on Iron Ore Hill Road and adjacent to Lake Lillinonah.

Parcel 1, (Lakewood Subdivision) is approximately 40 acres in size and south of Iron Ore Hill Road abutting Lake Lillinonah. Seven (7) house lots are presently proposed for this parcel, with Lot 8 proposed to remain as open space. This parcel is characterized by steep slopes, intermittent streams, and mixed hardwood forest. There are also remnants of an old dam and icehouse along one of the streams. Individual on-site water and on-site septic systems are proposed to serve this parcel.

Parcel 2, (Landmark Estates Subdivision) is north of Iron Ore Hill Road is also approximately 40 acres in size. Seventeen (17) house lots, with a minimum of two acres are proposed for this parcel. This area consists of open woodland, scattered wetland communities, and moderate slopes. Individual on-site water and on-site septic systems are also proposed to serve this parcel.

* *

The Commission was primarily concerned with the potential impact the proposed subdivisions may have on existing resources, particularly wetland communities and Lake Lillinonah. Therefore, the

goal of this ERT was to inventory and assess existing natural resources and provide land use planning guidelines. Specific objectives included:

(1) Assess the hydrological and geological characteristics of the site.

(2) Determine the suitability of existing soils to support the proposed development.

(3) Discuss soil erosion and sedimentation concerns.

(4) Assess the capability of both parcels to support on-site wells and on-site septic systems.

(5) Inventory and assess forest and wildlife resources.

(6) Evaluate traffic and access concerns.

(7) Assess planning and land use issues.

* *

PHYSICAL CHRACTERISTICS

Geologic Development Concerns

In terms of the proposed Lakewood Subdivision, the major geologic limitations found on the parcel included: (1) areas where bedrock is at or near the surface of the ground; (2) areas of moderate to very steep slopes, which predominate in the central and eastern parts; (3) the presence of possible shallow, sandy soils in the western parts, and; (4) the presence of regulated inland wetland soils which generally parallel the major streamcourses on the site.

The major geologic limitations which may pose constraints with respect to the proposed Landmark Estates Subdivision included: (1) the eastern parts of the site where bedrock is at or near ground surface; (2) the presence of some till-based soils in the central and western parts of the site which have moderately slow percolation rates and elevated groundwater tables, and; (3) the presence of several bands of inland wetland soils in the northern and western parts.

Most of these geologic limitations for both parcels will weigh heaviest in the ability to provide adequate subsurface sewage disposal systems serving homes constructed on both subdivisions. In many cases, proper planning and engineering may overcome some of these limitations.

It appears that there may be a chance that bedrock may be encountered during the construction of the proposed road and/or house foundations on the proposed Lakewood Subdivision parcel. As a result, there may be a need to do some blasting.

Waste Disposal

Based on soil mapping and visual observations of the Lakewood Subdivision parcel, the areas of special concern on the site regarding subsurface sewage disposal are: (1) the presence of sandy soils in the western parts which may have excessively rapid seepage rates and may be relatively close to the bedrock surface; (2) the presence of shallow to bedrock soils in the central and western parts, and; (3) the presence of moderate to very steep slopes along the southern boundary of the site.

Leaching systems should be kept a minimum of 15 feet from tops of all embankments. This also includes reserve leaching areas.

Water Supply and Quality

Since public water is unavailable, individual on-site wells will need to be developed on each lot for both parcels. The underlying bedrock would be the most likely aquifer to be tapped since no extensive sand and gravel deposits appear to exist within the site.

The groundwater quality may be expected to be good for both parcels. However, there is a chance that water produced from wells tapping the underlying bedrock may be mineralized with elevated levels of iron and manganese.

Stormwater Runoff Concerns

The development of both parcels will lead to some increases in runoff. Since the overall development density of the watershed is low, any peak flow increases would be small and should not pose a problem.

Any increased runoff generated by the construction of impervious surfaces would drain into Lake Lillinonah, which will serve as a natural runoff control basin.

Soil Resources

The Lakewood Subdivision consists of soils formed in sloping to steep glacial outwash soils on the western part of the parcel, and deep, strongly sloping to very steep bedrock controlled landscapes on the remainder of the parcel.

The Landmark Estates Subdivision consists of soils formed in nearly level to very steep bedrock controlled landscapes on about half of the parcel, and keep to very deep soils formed in sloping, dense till materials on the remainder of the parcel.

* *

BIOLOGICAL ATTRIBUTES

Forestry Considerations

In general terms, both parcels areas are wooded. The only exception to this is a small area of "old field" located in the Lakewood Subdivision parcel. The tree species present are common in Connecticut.

The large expanse of diverse vegetation on both parcels plays an important role in the aesthetics of the area as well as the water storage capacity of the landscape. In addition, woodlands provide a rich renewable resource in the form of wood and a diversified wildlife habitat.

Natural landscaping of proposed subdivisions can be accomplished with native trees and shrubs. Berry-producing shrubs intermixed with conifers provide wildlife cover and an attractive landscape.

Any tree cutting, whether it is done for thinnings, house sites, or roadways should be done to take advantage of the high demand for wood products. Products will include firewood, logs, and cedar posts/logs.

Wildlife Resources

Wildlife habitats present are mixed hardwoods, conifers, reverting fields, and streamside riparian/wetland sites. Wildlife typically utilizing such habitats include ruffed grouse, gray squirrels, flying squirrels, white-tailed deer, woodpeckers, various passerines, raccoon, fox, and a great variety of non-game species.

An issue of special interest is the occurrence of a major bald eagle wintering area located approximately four miles to the southeast of the project area at Shepaug Dam. Although no direct negative impacts should result from the project, all efforts should be made to retain as much lakeside tree cover as possible. This will serve as a buffer from development and maintain additional roosting sites. Since wintering eagles use Lake Lillinonah as a feeding area, pollutants entering the lake should be restricted.

Lake Lillinonah

Lake Lillinonah is a large run-of-the river impoundment on the Housatonic River. The lake is managed by DEP as a Class B "fishable/swimmable" waterbody and is used by the public for boating, fishing, swimming, and other forms of recreation.

Fishing in Lake Lillinonah is impaired by the presence of trace concentrations of PCB's (polychlorinated biphenols) in fish tissue

resulting from historical industrial activity. The DEP and the Department of Health Services have issued an advisory against the consumption of fish caught in the lake.

The most important effects of the proposed subdivisions on Lake Lillinonah are the localized impacts of erosion and sedimentation caused by construction activities and stormwater runoff from subsequent residential properties.

* *

ARCHAEOLOGICAL RESOURCES

Native American Activity

Site files and collection at the American Indian Archaeological Institute contain evidence of at least six prehistoric sites in Bridgewater. None of these sites are located within the boundaries of either of the proposed subdivisions.

The moderate slope of the Landmark Estates Subdivision north of Iron Ore Hill Road, may have been the focus for either early or late prehistoric use. Although no sites have been reported from the parcel, its spaces have been undisturbed and any archaeological sites there will be intact.

One rockshelter has been identified at the downstream end of the proposed Lakewood Subdivision site within the bounds of Lot 8, now designated as open space. As long as Lot 8 is undeveloped, this site will remain preserved for future research.

The developer should be encouraged to evaluate further the archaeological sensitivity of both parcels prior to construction. If additional archaeological sites were discovered, they too might be protected in parcels of open space.

* *

LAND USE AND PLANNING CONSIDERATIONS

Existing Planning Considerations

The proposed subdivisions appear to be generally consistent with the low density development intensities recommended in the State and Regional Plans, but are inconsistent with the Town Plan which calls for park and open space use of the land.

Traffic and Access

Iron Ore Hill Road is lightly used at the present time due to very limited development along this road. The road should easily be able to handle the additional traffic generated by the proposed projects.

One area of concern with regard to development of these parcels is the lack of an alternate or emergency access route. Should a fallen tree or accident block access between the project site and Northrup Road, no alternate exit from the site would be available.

Solar Orientation/Design Considerations

In preparing the final site plans for both parcels, efforts should be taken to re-orient many of these proposed building locations to take advantage of solar access. To accomplish this, the proposed houses would simply need to be re-oriented on the proposed lots so that the long axis of the house faces south.

Streambelt Protection

Two factors will serve to protect the streambelt area of the subdivision sites: (1) zoning regulations prohibit the construction of habitable buildings or septic systems within 100 feet of the high water mark of Lake Lillinonah and (2) the Connecticut Light and Power owns from the water's edge to the 210 foot contour interval on the property, a distance which in some areas may equal or exceed 100 linear feet under normal conditions.

Additional Design Considerations

During the ERT field review, the applicant indicated two alternatives for the Lakewood Subdivision. A cluster subdivision of seven lots of one or more acres in size with 22 acres of open space or a conventional subdivision of four larger lots with provision of the same 22 acres of open space. The conservation focus of the Town Plan for this area supports the latter of these two alternatives.

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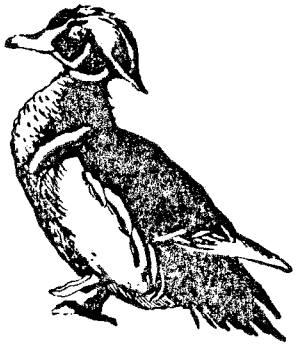


INTRODUCTION

Introduction

The Town of Bridgewater Conservation and Inland Wetlands Commission requested that the King's Mark Environmental Review Team conduct an environmental review on two adjacent parcels of land proposed for subdivision development. The subject sites are located in southwestern Bridgewater on Iron Ore Hill Road and adjacent to Lake Lillinonah. Access to the site is provided off Iron Ore Hill Road (Figure 1).

Parcel 1, (referred to as Lakewood Subdivision) is approximately 40 acres in size and south of Iron Ore Hill Road abutting Lake Lillinonah. Seven (7) house lots are presently proposed for this parcel, with Lot 8 (approximately 22 acres) proposed to remain as open space (Figure 2). This parcel is characterized by steep slopes, intermittent streams, and mixed hardwood forest. There is also remnants of an old dam and icehouse along one of the streams. Individual on-site water and on-site septic systems are proposed to serve this parcel.

Parcel 2, (referred to as Landmark Estates Subdivision) is north of Iron Ore Hill Road is also approximately 40 acres in size. Seventeen (17) house lots, with a minimum of two (2) acres, are proposed for this parcel (Figure 3). This area consists of open woodland, scattered wetland communities, and moderate slopes. Individual on-site water and on-site septic systems are also proposed to serve this parcel.

Goals and Objectives of the Environmental Review Team

The Commission was primarily concerned with the potential impact the proposed development may have on existing resources, particularly wetland communities and Lake Lillinonah. Other areas of concern included: soil erosion and sedimentation, stormwater drainage, wildlife, land use, and traffic. Thus, the goal of this ERT was to inventory and assess existing natural resources and provide land use planning guidelines. Specific objectives included:

(1) Assess the hydrological and geological characteristics of the site, including geological development limitations and opportunities, natural drainage patterns, postdevelopment stormwater runoff potential, and flooding.

(2) Determine the suitability of existing soils to support the proposed development.

(3) Discuss soil erosion and sedimentation concerns.

(4) Assess the capability of both parcels to support on-site wells and on-site septic systems.

(5) Inventory and assess forest and wildlife resources.

(6) Evaluate traffic and access concerns.

(7) Assess planning and land use issues.

The ERT Process

Through the efforts of the Bridgewater Conservation and Inland Wetlands Commission, the developer, and the King's Mark Environmental Review Team, this environmental review and report was prepared for the Town. This report is not designed or intended to compete with private consultant's proposals or plans for this site. Rather, it provides a natural resource data base allowing the Town and the

Figure 1

LOCATION OF STUDY SITE

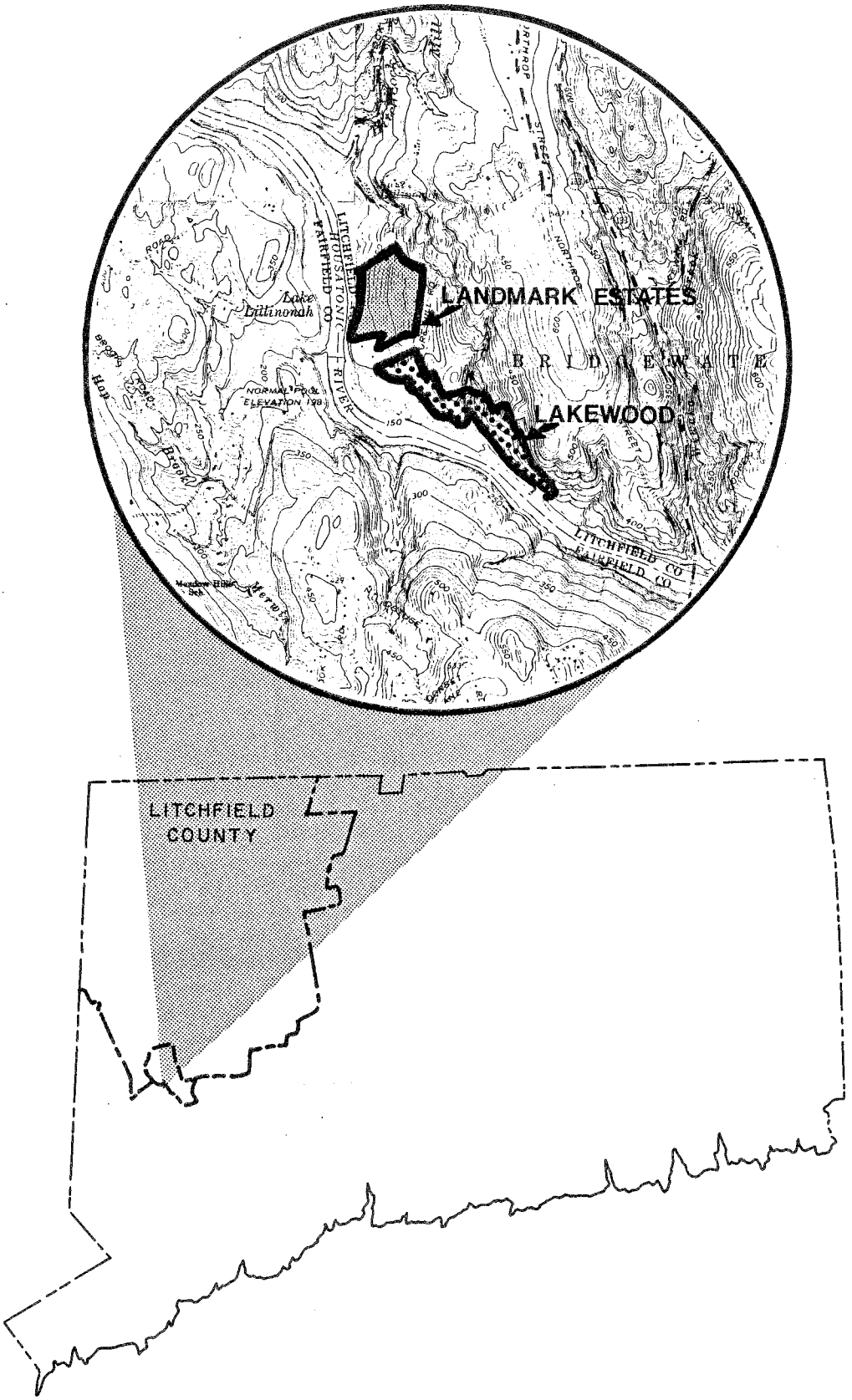
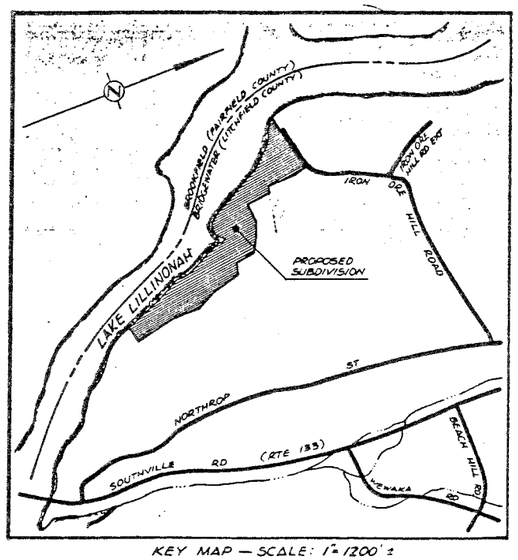
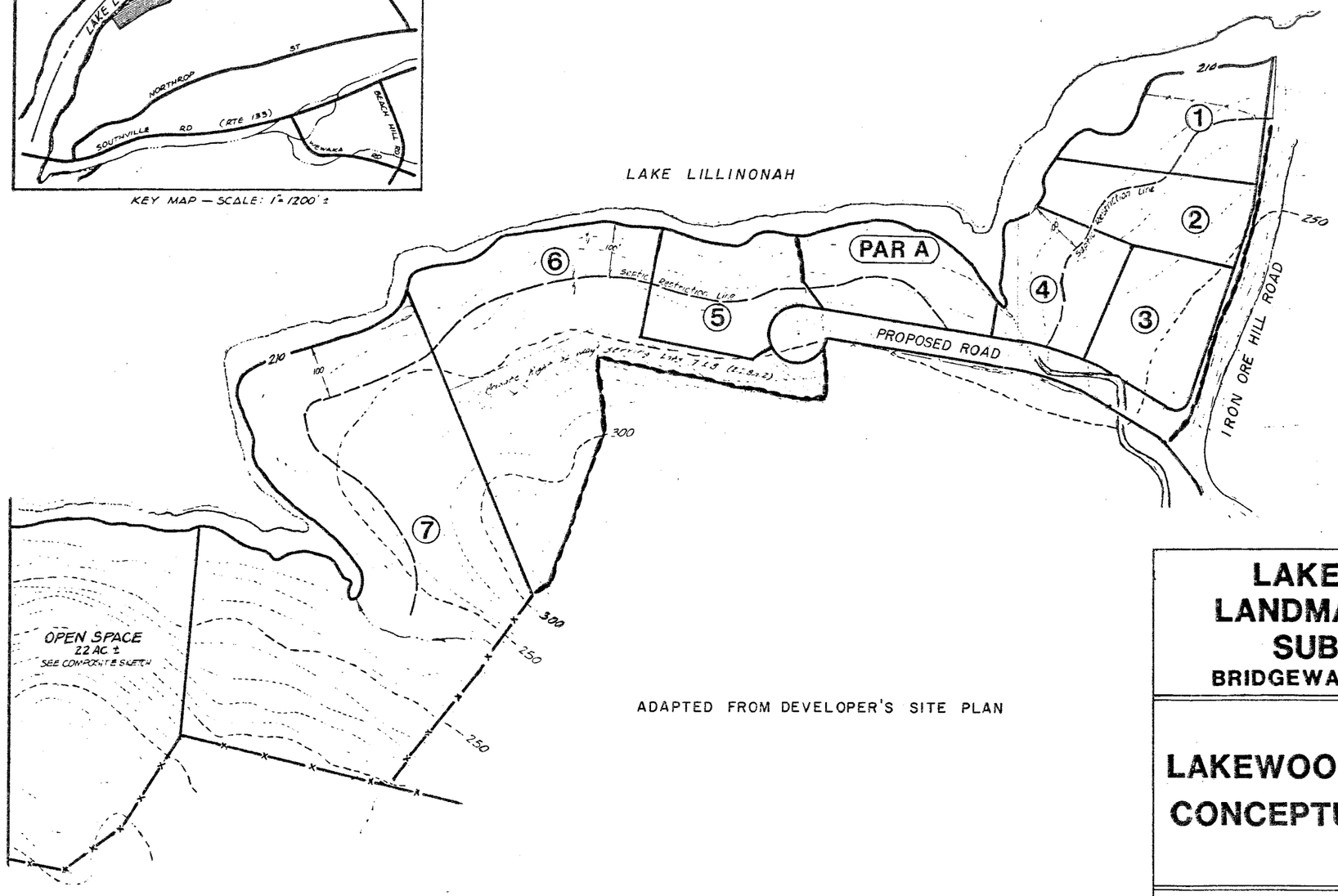


Figure 2



KEY MAP — SCALE: 1" = 1200' ±



ADAPTED FROM DEVELOPER'S SITE PLAN

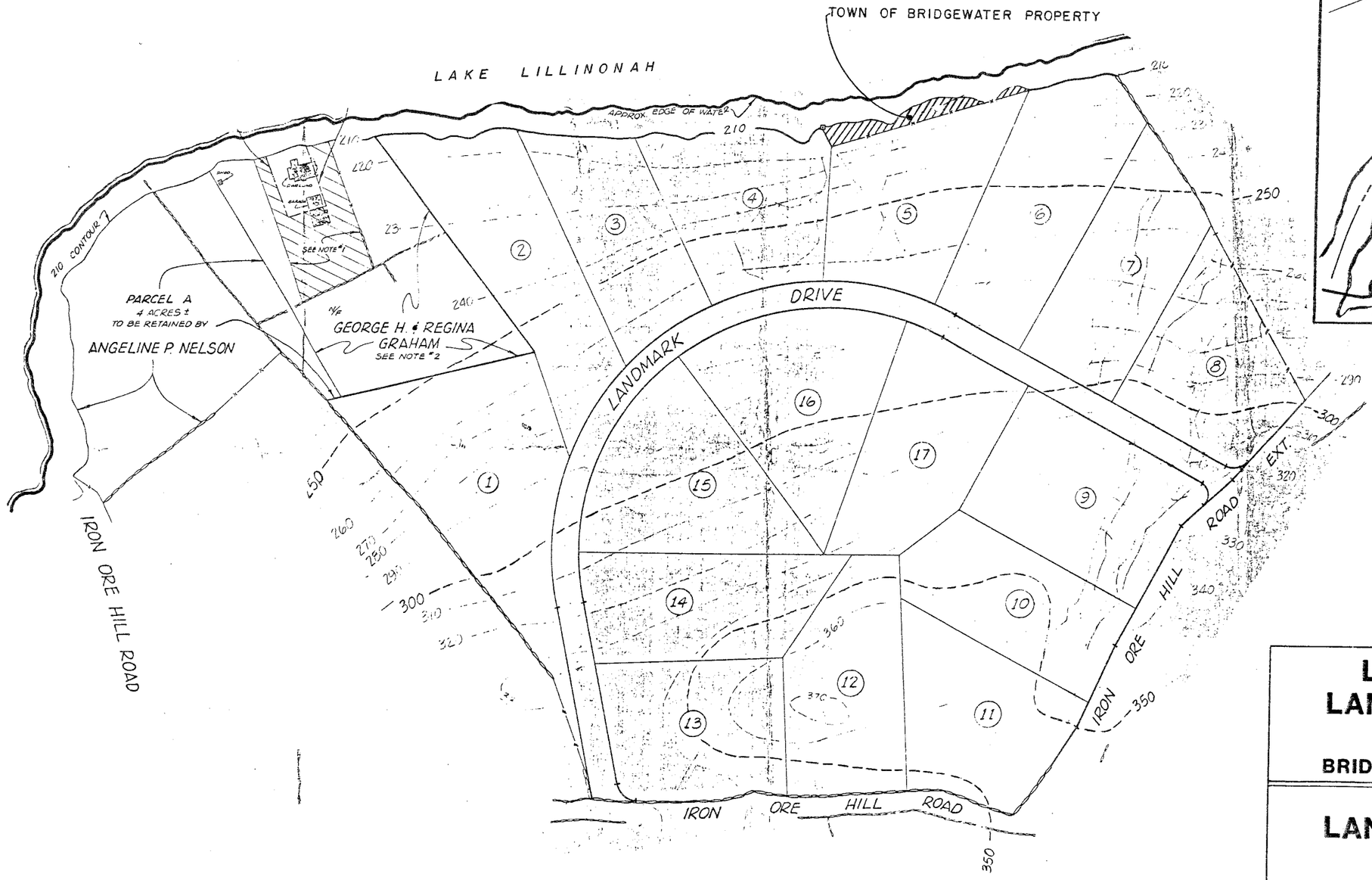
LAKEWOOD AND LANDMARK ESTATES SUBDIVISIONS
BRIDGEWATER, CONNECTICUT

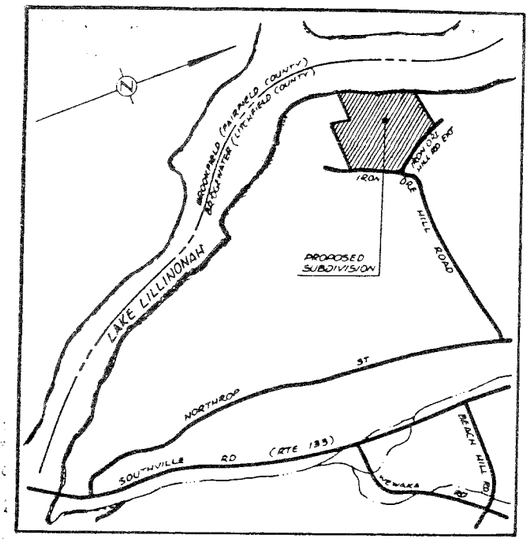
LAKEWOOD SUBDIVISION CONCEPTUAL SITE PLAN

King's Mark Environmental Review Team

0 250' approx.

Figure 3





KEY MAP — SCALE: 1" = 1200' ±

ADAPTED FROM DEVELOPER'S SITE PLAN

LAKEWOOD AND LANDMARK ESTATES SUBDIVISIONS
BRIDGEWATER, CONNECTICUT

LANDMARK ESTATES SUBDIVISION CONCEPTUAL SITE PLAN

King's Mark Environmental Review Team

0 250' approx.

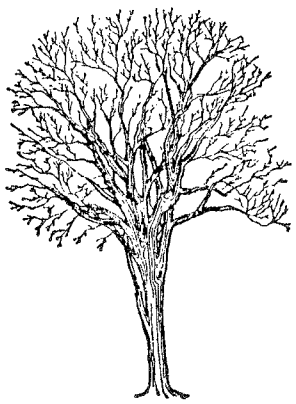
developer make informed decisions concerning the use of the proposed site.

The review process consisted of four phases: (1) inventory of the study sites's natural resources (collection of data); (2) assessment of these resources (analysis of data); (3) identification of natural resource capabilities, and; (4) presentation of planning and traffic guidelines.

The data collection phase involved both literature and field research. Mapped data, technical reports, or town plans were perused and specific information concerning the site was collected. 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. Being on site also allowed Team members to check and confirm mapped information and identify other resources.

Once the Team members had assimilated an adequate data base, it was then necessary 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.

PHYSICAL CHARACTERISTICS



PHYSICAL CHARACTERISTICS

LAKEWOOD SUBDIVISION (PARCEL 1)

Physical Setting

The proposed Lakewood Subdivision (Parcel 1) consists of a more or less 40 acre linear tract of land, parallelling the northern shores of Lake Lillinonah. It is located in the southern parts of Bridgewater. The property will be accessed via Iron Ore Hill Road at the northwest end of the property. The applicant proposes to subdivide the land into seven house lots. An eighth lot, approximately 22 acres and located at the eastern limits, is proposed for open space. A proposed more or less 750-foot cul-de-sac will serve the rear lots. It should be pointed out that under present plans, the open space land will be accessed via a private right-of-way serving lots 7 and 8. This will undoubtedly restrict the value of the open space land to potential users.

Except for some open areas in the western parts of the site which was probably used for agricultural purposes, the site consists mainly of woodlands.

Topography

As shown in Figure 4, Parcel 1 is bisected by two major drainage swales, both of which have cut fairly deep ravines. The land slopes moderately to very steeply to Lake Lillinonah. The landscape in the central and eastern parts is controlled largely by the underlying bedrock. Maximum and minimum elevations of the Lakewood Subdivision

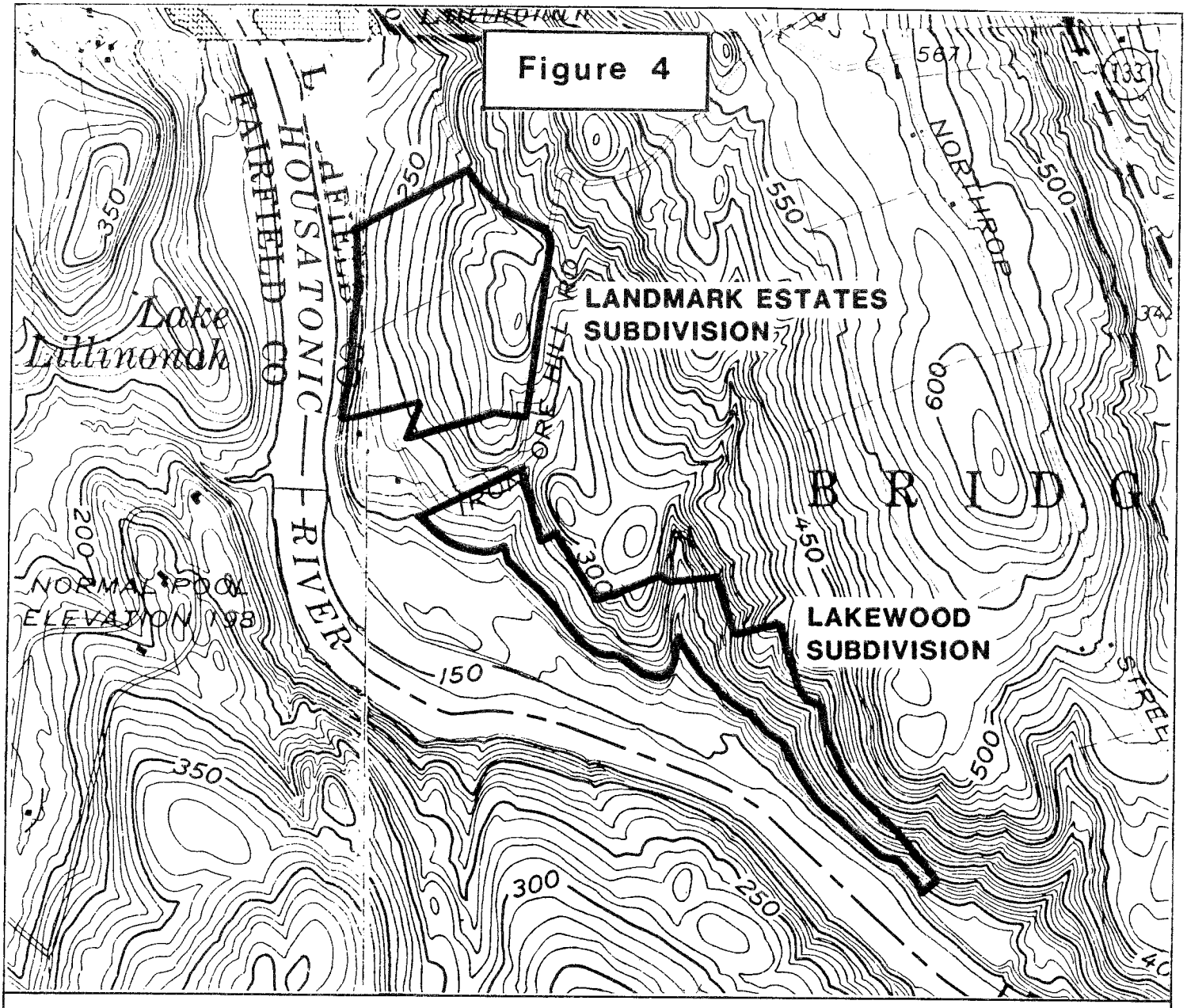
are about 450 feet and 160 feet below mean sea level.

Bedrock Geology

The bedrock geology of this parcel has been well described by Rolfe S. Stanley and Katherine G. Caldwell in Quadrangle Report No. 33 entitled The Bedrock Geology of the Newton Quadrangle. According to Map QR-33, the parcel is underlain by the Hartland I and II formations (Figure 5). It should be pointed out that each of these formations also includes a subunit which are also found within the parcel.

Stanley and Caldwell described the Hartland II formation as a light-brown to gray, slightly rusty, medium-grained schist composed primarily of the following minerals: muscovite, biotite, quartz and plagioclase feldspar. This rock unit is studded with well developed garnet and staurolite crystals. Garnets, staurolites, and other iron-manganese bearing minerals in the rock are the major sources of elevated iron and manganese levels in groundwater stored in the cracks and openings in the bedrock beneath the parcel. Rocks of the Hartland II formation underlie the central and southern parts of the parcel. A subunit of Hartland II forms a relatively thin north/south trending belt of rocks in the southcentral parts. These rocks consist of a non-rusty, medium-grained schist composed of the minerals mica, quartz and plagioclase. These rocks contain prominent kyanite and sillimanite minerals which stand out on the weathered surface of the rock.

Rocks comprising the Hartland I formation consists of a medium to dark gray gneiss composed of the minerals quartz, plagioclase feldspar, and biotite with sillimanite and/or garnet crystals. This



LAKEWOOD AND LANDMARK ESTATES SUBDIVISIONS

BRIDGEWATER, CONNECTICUT

TOPOGRAPHY

King's Mark Environmental Review Team

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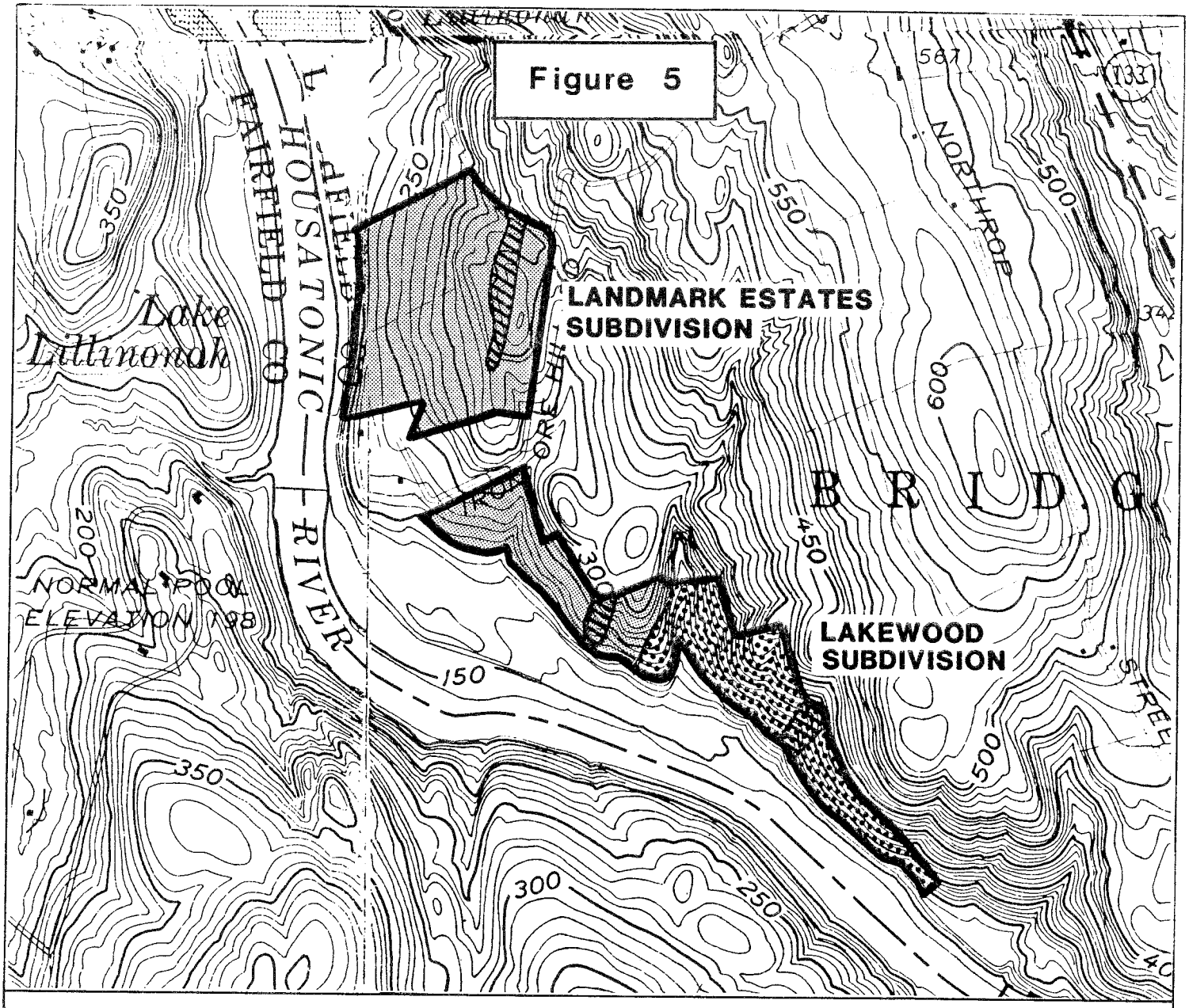

HARTLAND I FORMATION

HARTLAND I FORMATION (subunit)

HARTLAND II FORMATION

HARTLAND II FORMATION (subunit)

See report for full description of each rock unit

LAKEWOOD AND LANDMARK ESTATES SUBDIVISIONS

BRIDGEWATER, CONNECTICUT

BEDROCK GEOLOGY

King's Mark Environmental Review Team

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rock unit may also include zones of biotite-rich schists. These rocks underlie the northern half of the parcel. Its subunit consists of a black to dark gray, medium-grained amphibolite. The metamorphic foliation of the rocks dips within the site moderately westward.

"Schists," "amphibolites," and "gneisses" are crystalline, metamorphic rocks that have been geologically altered by great heat and pressure within the earth's crust. The terms "schist" and "gneiss" refers to the textural aspects of the rocks. "Amphibolites" are metamorphic rocks consisting mainly of minerals of the amphibole group, (i.e., plagioclase, hornblende). Quartz is generally absent in amphibolites.

All of the rocks underlying the parcel have undergone deformation one or more times during the period following their creation. The stresses of deformation caused the alignment of platy, flaky, and elongate minerals into thin sheets or bands. Where the alignment has resulted in a slabby rock (i.e., one that parts relatively easily along the surface of mineral alignment or foliation planes), the rock is termed a "schist." Where the alignment has resulted in a banded but more massive rock, the rock is termed "gneiss." All three rock types mentioned earlier may grade into another into a single outcrop.

Depth to the bedrock surface on the parcel ranges between zero in rock outcrop areas and probably does not exceed much more than 10 feet in areas between outcroppings.

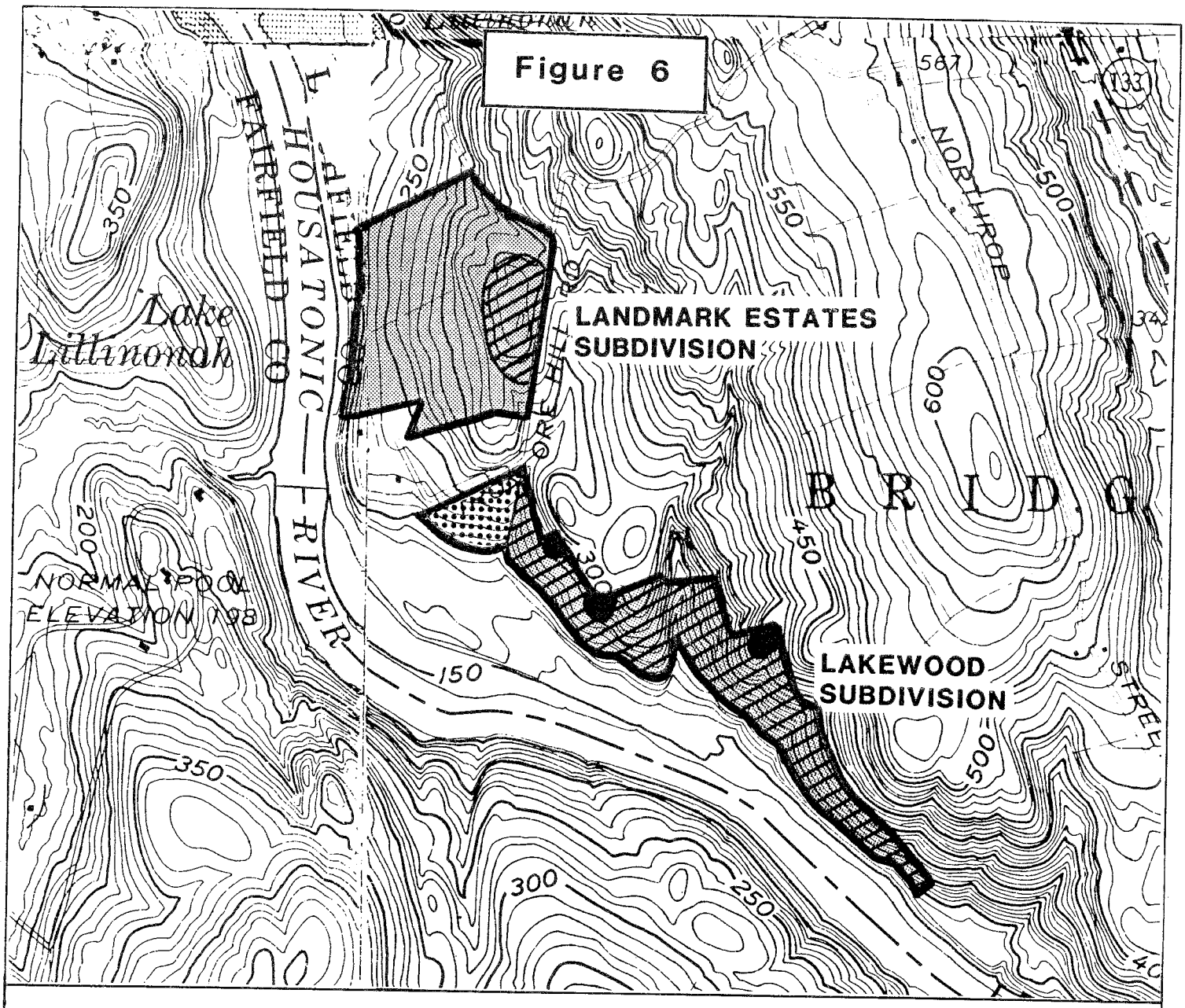
Surficial Geology

A surficial geologic map for the Newtown quadrangle has not been published to date. As a result, the Team's Geologist relied on the soil survey for the following portion of the report. It should be pointed out that although some subsurface exploration had been conducted throughout the parcel for the purposes of subsurface sewage disposal, the compiled information was not made available to Team members.

The bedrock is overlain by a relatively thin blanket (i.e., generally less than 10 feet) of unconsolidated materials of glacial origin. The distribution of these various surficial deposits adapted from the soil map distributed to Team members accompanies this report (Figure 6).

A glacial sediment called till is the most widespread type of overburden found on the site. It overlies bedrock in the central and eastern parts of the site. Till is a poorly-sorted mixture of rock fragments and particles deposited directly by glacier ice. Rock fragments and particles found in the soil were derived from the metamorphic rocks such as gneisses, schists, and amphibolites from the surrounding area. Most of the till on the site is relatively shallow, probably not exceeding much more than 10 feet. Based on mapped soils information, it appears that most of the till-based soils on the parcel are friable. At several points within the property, bedrock is exposed or lies close to the surface.

The second major glacial deposit found in the western parts of the parcel is stratified drift. Stratified drift, whose major



TILL

AREAS WHERE BEDROCK IS AT OR NEAR GROUND SURFACE

STRATIFIED DRIFT

INDIVIDUAL ROCK OUTCROP

LAKEWOOD AND LANDMARK ESTATES SUBDIVISIONS

BRIDGEWATER, CONNECTICUT

SURFICIAL GEOLOGY

King's Mark Environmental Review Team

0 1000'

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components consist of sand and gravel, was deposited by meltwater streams during periods of glacial ice retreat. In Connecticut, stratified drift deposits are usually restricted to valley areas. A small excavation in the western parts exposed mostly a sandy material.

Based on soil flagging of regulated inland wetland soils on the parcel by the applicant's certified soil scientist, it appears that relatively thin bands of wetland soils generally parallel the major streamcourses on the parcel.

Geologic Development Concerns

In terms of the proposed subdivision, the major geologic limitations found on the parcel included:

(1) Areas where bedrock is at or near the surface of the ground.

(2) Areas of moderate to very steep slopes, which predominate in the central and eastern parts.

(3) The presence of possible shallow, sandy soils in the western parts.

(4) The presence of regulated inland wetland soils which generally parallel the major streamcourses.

Most of these geologic limitations will weigh heaviest in the ability to provide adequate subsurface sewage disposal systems serving homes constructed in the subdivision. In many cases, proper planning and engineering may overcome some of these limitations. However, it should be pointed out there may be situations where engineering design cannot surmount certain limitations. As a result,

there may be a need to re-design the layout of lots or reduce the number of lots in a particular subdivision in order to properly address surface and subsurface conditions (see Waste Disposal section of the report for further discussion).

It appears that there may be a chance that competent bedrock may be encountered during the construction of the proposed road and/or house foundations. As a result, there may be a need to do some blasting. In view of the moderate to very steep slopes found in the parcel and the chance of blasting, there is a potential for erosion and sedimentation. Even if blasting is not required, the presence of moderate to very steep slopes throughout the site and particularly in view of Lake Lillinonah's close proximity to the parcel warrants the need for a sound erosion and sediment control plan. If disturbed areas are kept to a minimal, the chance for erosion and sedimentation problems should be small. Also, a 100-foot setback from Lake Lillinonah is required for construction purposes which should help protect the lake from siltation problems which may arise.

Based on the plans submitted to Team members on the review day, at least one major wetland crossing is proposed in the western portions of the site. It appears that the proposed cul-de-sac would be constructed over about 220 feet of a streamcourse/ravine system. Based on visual observations made during the field review, it appears that a considerably lesser wetland disturbance could be accomplished if the road was shifted either north or south of the proposed road crossing. The applicant's engineer and soil scientist should consider realigning the road so that there is minimal wetland disturbance.

Wetland crossings are generally feasible provided they are properly designed (e.g., culverts are properly sized and installed, permeable road base fill material is used). All unstable organic material should be removed before placing the permeable road base. The roads should be constructed sufficiently above the surface elevation of the wetlands. This will allow for better drainage of the roads and decrease the frost heaving potential of the road. It is advised that any road construction through wetland areas be done during the dry time of the year with adequate provisions for effective erosion and sediment control. Detailed plans for any proposed road crossing through wetlands should first be submitted to the proper town authorities or commissions for their review, comment and final approval prior to any construction.

Waste Disposal

Sewage disposal in this rural town depends upon the installation of private on-site subsurface sewage disposal systems. As mentioned earlier, some subsurface exploration on the parcel relative to subsurface sewage disposal has been conducted by the applicant. This soil information was not made available to Team members.

Individual lot testing will provide the Town Sanitarian with the necessary information to determine whether or not each of the proposed seven lots has a suitable area for leaching purposes. It may be necessary to flag the proposed road and property corners in order to accurately determine locations in the field. It is generally recognized that at least one acre of land is required for a residential development relying on an on-site sewage disposal system

and water supply well. Under present plans, Lots 1-5 are about one acre in size. It should be noted, however, that the ultimate size of the lot will depend upon subsurface conditions throughout the site. If soil testing on any of the proposed lots fail to identify a satisfactory leaching area and unsuitable conditions as identified in Section 19-13-B103c(a)(3), the lot or lots should be combined or otherwise removed.

Based on soil mapping and visual observations, the areas of special concern on the parcel regarding subsurface sewage disposal were:

(1) The presence of sandy soils in the western parts which may have excessively rapid seepage rate and which may be relatively close (i.e., 10 feet or less) to the bedrock surface.

(2) The presence of shallow to bedrock soils in the central and western parts.

(3) The presence of moderate to very steep slopes along the southern boundary of the parcel.

Regarding the latter concern, leaching systems should be kept a minimum of 15 feet from tops of all embankments. This also includes reserve leaching areas.

Thorough soil testing, percolation tests, and the determination of a good profile of the bedrock surface will be required on all lots. Because the texture of the soils in the western part would be expected to have rapid seepage, it would not afford ideal conditions for filtering and renovating the effluent to a stabilized form. As a result, leaching systems in such soils, require special design

considerations in order to ensure that they will not pollute nearby wells or ground and surface waters. If the percolation rate is slower than one inch per minute, the Public Health Code requires a minimum separating distance of four feet between the bottom of the leaching system and bedrock. However, the Public Health Code requires that where the soil has a minimum percolation rate faster than one inch per minute, the bottom of the leaching system must be not less than 10 feet above ledge rock or 500 feet from any wells. The intent of this requirement is to discourage the use of individual wells and sewage disposal systems in areas of highly permeable soils and shallow ledge rock. If such areas are to be developed, a public water supply or community well should be used. Also, because five homes would be concentrated on the sandy soils, it may increase the chances of contaminating on-site wells by sewage systems if proper precautions are not taken. As a result, sewage systems should be located as far as possible from neighboring wells (see Water Supply section).

The potential for shallow to bedrock soils combined with the presence of moderate to very steep slopes on Lots 6 and 7 in the central parts may require detailed plans prepared by a registered professional engineer. Since septic systems are not permited to be constructed within 100 feet of Lake Lillinonah's high water mark, contamination of water quality from possible untreated domestic wastes should be minimized.

Water Supply

Since public water is unavailable, individual on-site wells will need to be developed on each lot of the subdivision. The underlying bedrock would be the most likely aquifer to be tapped since no extensive sand and gravel deposits appear to exist within the site. Sand and gravel deposits, if saturated, can generally yield water at a high rate compared to wells tapping crystalline metamorphic bedrock. Nevertheless, bedrock wells can generally yield quantities of water adequate for most domestic uses. The exact yield of a bedrock-based well is a function of many hydrogeologic factors including the number and size of fractures present in the bedrock. Because the fractures are unevenly spaced throughout the rock, there is no practical way, short of expensive geophysical tests, to assess the potential of any particular site for a satisfactory well.

An assessment of presently installed bedrock based wells has been conducted for the upper Housatonic River basin which includes the subject site (Source: Connecticut Resources Bulletin No. 21, Upper Housatonic River Basin). This assessment allows one to predict the chances for any new well to achieve certain minimum yields.

According to this report, 80 percent of the bedrock-based wells analyzed in the basin area which tapped the type of rock underlying the parcel yield about three gallons per minute (gpm) or more; 50 percent yielded about seven gpm or more; and only 10 percent yielded 25 gpm or more. A well yielding three gpm should adequately meet the needs of most domestic households.

A survey of well completion reports for drilled wells serving homes along Northrop Street indicate varying yields: (1) one gpm

at a depth of 700 feet; (2) 50 gpm at 235 feet, and; (3) 5.5 gpm at 215 feet.

The water quality of the groundwater may be expected to be good. However, there is a chance that water produced from wells tapping the underlying bedrock may be mineralized with elevated levels of iron and manganese. Elevated levels of iron in water is objectionable because it imparts a brownish color to laundered goods and may affect the taste of the water or beverages such as tea and coffee made with the water. For the most part, elevated manganese levels are objectionable for the same reasons as iron. The recommended limit for iron in water is 0.3 milligrams per liter (mg/l) and parts per million (ppm) and .05 mg/l and ppm for manganese (Source: National Interim Primary Drinking Water Regulations, U.S. Environmental Protection Agency, Office of Drinking Water). Some methods or treatments used to eliminate or remove elevated iron and manganese levels include:

(1) A combination of automatic chlorination and fine filtration.

(2) Aeration followed by filtration.

(3) Iron exchange with green sand.

(4) Treatment with potassium permanganate followed by filtration.

As mentioned in the Waste Disposal section of the report, sufficient areas will be required on each of the proposed lots in order to properly locate wells from on-site septic system and other potential sources of contamination. Of particular concern will be

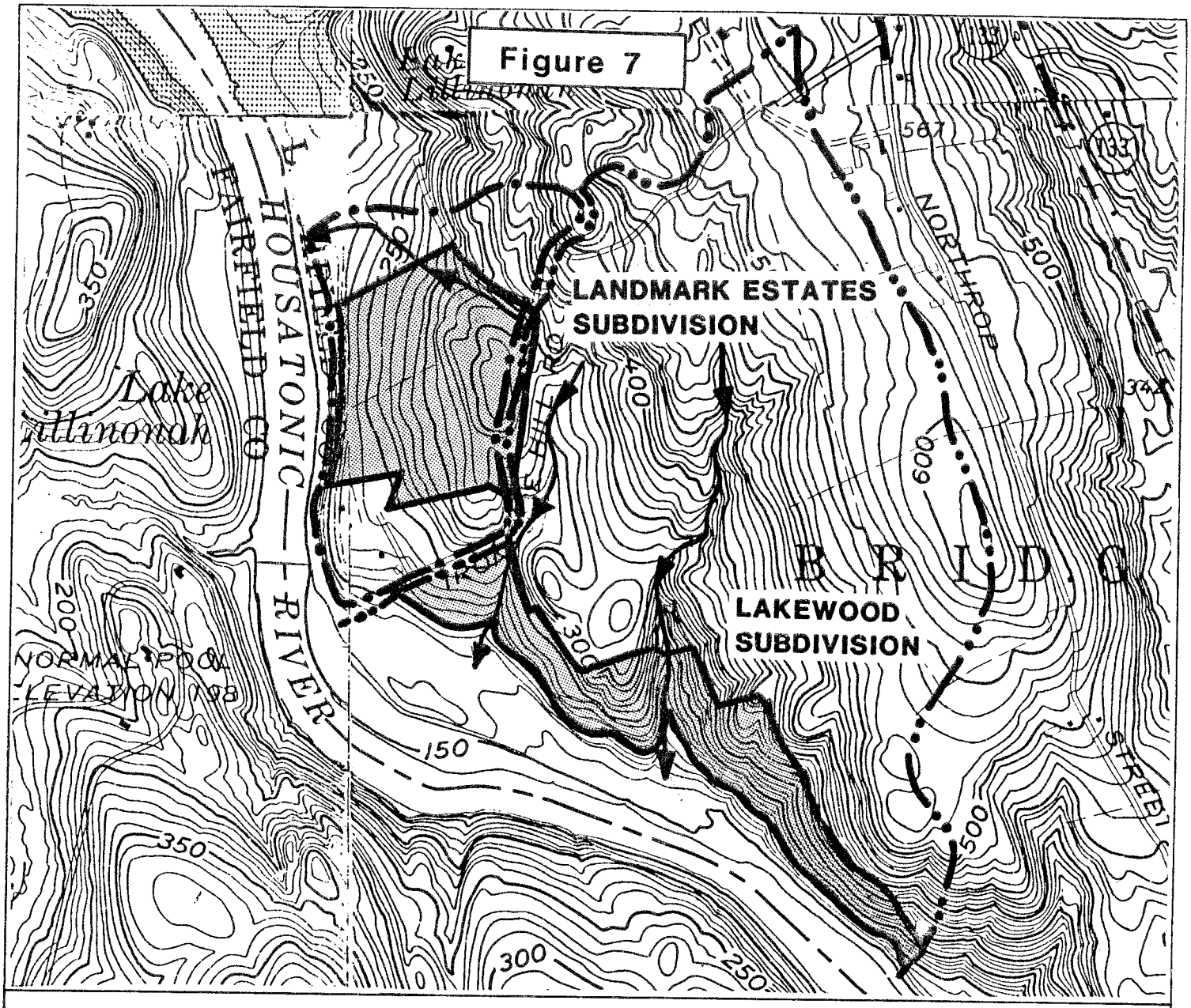
the western parts where the bulk of development is proposed and where permeable sandy soils predominates. Shallow depths to bedrock conditions (i.e., 10 feet or less) may also be present in this area. If the soil percolation rate is faster than one inch per minute, the minimum separating distance between a subsurface sewage disposal system and water supply well should be doubled. Since most wells serving households have a withdrawal rate of less than 10 gpm, a minimum separating distance of 150 feet would be required rather than 75 feet for soil percolation rates of one inch per minute or slower.

In order to prevent possible contamination in this area, it is suggested that wells be located on a relatively high portion of each lot in a direction opposite the expected direction of groundwater movements. Also, the Public Health Code requires that all wells drilled into bedrock be cased and sealed where overlying soil is less than 20 feet deep.

Hydrology

Surface and groundwater on the site flows downslope towards Lake Lillinonah (Figure 7). Lake Lillinonah is an impoundment on the Housatonic River. It is approximately 1,900 acres in size. (A Connecticut Fishery Survey, 1959).

The subdivision of the property as planned, followed by the construction of new homes, driveways, or cul-de-sacs will lead to some increases in runoff from the property. Ordinarily, the Team's Geologist would suggest measures that would mitigate the effects of these increases (e.g., a stormwater detention basin). In this case,



WATERSHED AREA WHICH DRAINS PARCEL II

WATERSHED AREA WHICH DRAINS PARCEL I

MAJOR DRAINAGE CHANNELS SHOWING DIRECTION OF FLOW

LAKEWOOD AND LANDMARK ESTATES SUBDIVISIONS

BRIDGEWATER, CONNECTICUT

WATERSHED BOUNDARY

King's Mark Environmental Review Team

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however, the overall density of the subdivision in the watershed, is so low that any peak flow increases would be small. Also taken into consideration was the watershed area (e.g., about 315 acres), which includes the parcel and the fact that it is virtually undeveloped. Any increased runoff generated by the construction of impervious surfaces would drain into Lake Lillinonah. The lake will serve as a natural runoff control basin. Under these circumstances, on-site runoff retention does not seem to be necessary.

Besides flooding problems, increased runoff can lead to additional water-related problems such as streambank erosion and gullying. In view of the moderate slopes present in the area of Lots 1-5 and steeper slopes Lots 6 and 7, every effort should be provided to prevent potential erosion and siltation problems, particularly from reaching Lake Lillinonah. In this regard, it is encouraged that a comprehensive erosion and sediment control plan be developed covering each stage of the proposed subdivision. Disturbed areas should be kept to a minimum under such a plan. The erosion and sediment control measures called for under the plan should be shown on the subdivision plan.

LANDMARK ESTATES SUBDIVISION (PARCEL 2)

Physical Setting

The proposed Landmark Estates Subdivision (Parcel 2) consists of more or less 40 acres and is located northwest of the proposed Lakewood Subdivision. The land consists primarily of a mixed hardwood and softwood forest. No major streamcourses traverse the parcel, but there are numerous west-flowing intermittent drainage channels throughout the western half of the parcel. This may be a result of a compact soil zone at varying depths throughout this part of the parcel, impeding the downward movement of water. This water originates from the upland parts of the parcel. The applicant wishes to subdivide the land into 17, two-acre lots which would be served by individual on-site wells and septic systems.

Topography

This parcel is controlled largely by underlying bedrock and slopes moderately westward towards Lake Lillinonah. Maximum and minimum elevations on the parcel are 370 feet and 200 feet above mean sea land, respectively (see Figure 4).

Bedrock Geology

Except for the extreme western limits of property near Lake Lillinonah, the parcel lies within the Newtown topographic quadrangle, which is the same as Parcel 1. Therefore, the references cited in the Lakewood Subdivision parcel also apply to this parcel. It should be noted that the remaining land in the western

limits lies within the Danbury topographic quadrangle.

Bedrock is at or near ground surface throughout the elevated, eastern parts of the parcel. Except for a relatively thin bank of black to dark gray medium-grained amphibolite rocks in the eastern parts, this parcel is underlain by rocks of the Hartland I formation. These rocks consist mainly of gneisses with some zones of biotite-rich schist. These rocks, which also underlie Lakewood Subdivision (Parcel 1), have already been described in detail in this report (see Lakewood Subdivision, Bedrock Geology section).

Based on deep test pit information supplied to Team members on the review day, bedrock is shallowest in the eastern parts of the parcel.

The underlying bedrock will be the source of water to individual wells drilled on each of the proposed 17 lots.

Surficial Geology

A relatively thin blanket of glacial sediment known as till covers the bedrock on this parcel (see Figure 6). The till consisting of a non-sorted, non-stratified mixture of rock particles of widely varying shapes and sizes, was deposited directly from glacier ice without substantial reworking by meltwater.

Glacier ice moved across the region from north to southeast. Where the till is less than five feet thick, it is commonly sandy, very stony and loose. Where the till is more than five feet thick, the upper few feet are commonly sandy (as previously described); the lower portion of the deposit, however is often siltier and tightly

compact. The latter variety of till covers the western and central parts of the parcel. Shallow till appears to predominate in the eastern or elevated parts of the parcel.

According to soils information supplied to Team members by the applicant's soil scientist, several west-flowing intermittent streams which are parallelled by relatively thin bands of regulated inland wetland soils are found in the northern and western parts of the parcel. A few of these wetland areas terminate on the site as they encounter more permeable soils. The remaining wetland areas continue to flow westward in incised gullies enroute to Lake Lillinonah.

Geologic Development Concerns

Based on visual observations, deep test hole information (May 6, 1986) provided by the project engineer, soils information supplied by the applicant's soil scientist (May 14, 1986), and available bedrock and soil mapping, the major geologic limitations which may pose constraints with respect to the proposed Landmark Estates Subdivision included:

(1) The eastern parts of the parcel where bedrock is at or near ground surface.

(2) The presence of some till-based soils in the central and western parts which have moderately slow percolation rates and elevated groundwater tables. The latter two conditions may be a result of compact soil zone found at relatively shallow depths throughout this parcel.

(3) The presence of several bands of inland wetland soils in the northern and western parts.

Waste Disposal

In terms of subsurface sewage disposal systems, properly engineered and installed septic systems may be able to overcome the aforementioned limitations in some instances. Careful planning and testing is imperative on each lot, however, so that potential septic system problems can be avoided. The actual location of the septic system will ultimately depend on the location of a prospective house on each lot.

In areas where rock outcrops extensively and/or shallow depths to bedrock are present (eastern parts), there is concern for having a sufficiently large, suitable area for on-site septic systems. In order to accurately assess that such an area would be available, a sufficient number of deep test pits are needed on each lot to establish a bedrock profile. Based on the Connecticut Public Health Code, the ledge rock surface would need to be at least four feet below the bottom area of any leaching system. Because depth to bedrock may be highly variable throughout the eastern parts, it is likely that leaching systems will need to be kept shallow and spread out over a comparatively wide area. Another concern in the shallow to bedrock areas is well pollution, particularly where there are several building lots, each served by individual on-site sewage disposal systems.

In areas where bedrock is at or near the ground surface, it may be necessary to blast in order to construct access roads and/or place house foundations. Since the steepest slopes on the parcel are associated with these areas, it is suggested that a detailed erosion and sediment control plan be formulated and followed very closely with implementation of the project.

Lots having soils with a seasonal high ground watertable will also need to be carefully planned. Leaching systems should be kept elevated and spread out where seasonally high groundwater tables are encountered. In some cases, it may be necessary to install a curtain drain and/or place proper fill material in the leaching system area in order to overcome high ground water table conditions. It should be pointed out that soil testing was conducted during mid-January. Deep test hole data supplied to Team members indicated that all lots will probably require engineered septic systems. In order to accurately determine the maximum groundwater levels, particularly throughout the central and western partions, it is advised that soils be retested during the wettest time of the year. According to the Connecticut Public Health Code, investigations for maximum groundwater levels should be made between February 1 and May 31. Soil mottling can usually be an indicator of seasonal or perched water tables, particularly in the type of soils found in the central and western parts. This was not noted in soils information supplied to Team members.

According to the proposed Landmark Estates site plan, Lots 4, 5 and 7 contain inland wetland soils. In fact, the proposed primary and reserve leaching systems on Lot 7 is bisected by regulated inland wetland soils. Also, potential dwelling sites and leaching systems located for Lots 4 and 5 are not depicted on the site probably because of limited non-wetland soils. Pending the outcome of detailed soil testing on these lots, there appears a chance that these lots may need to be combined with adjoining lots in order to properly locate a septic system, house, and well, in compliance with all necessary Public Health Code regulations.

Because lots are about two acres in size, the project engineer should have at least some flexibility when searching for favorable leaching field areas. However, it should be pointed out that there may be a particular lot or lots whereby a suitable area for the leaching system cannot be located due to any or a combination of the geologic limitations previously mentioned. In areas where the water table is close to the ground surface, it is advised that building footing drains be installed. This should hopefully help prevent the chance for wet basements.

It is understood that a 100-foot setback for building and septic systems is required from the high water mark of Lake Lillinonah. This setback boundary was not indicated on the subdivision plan distributed to Team members. It is suggested that it be superimposed so as to ensure compliance of the setback requirement.

Based on the proposed site plan submitted to Team members on the review day, a total of about 125 feet of inland wetland soils will need to be crossed in order to construct the proposed Landmark Drive. Although undesirable, wetland road crossings are feasible provided they are properly engineered. The road should be constructed adequately above the surface elevation of the wetlands. This will allow for better drainage of the road and also decrease the frost heaving potential of the road. Road construction through wetlands should preferably be done during the dry time of the year and should include provisions for effective erosion and sediment control. Finally, culvert(s) should be properly sized and located so as not to alter the water levels in the wetland or cause flooding problems. Also, there is a chance the driveways may need to cross

wetlands. The aforementioned engineering measures also will need to be implemented for driveway wetland crossings.

Water Supply

Each lot in the proposed subdivision will be served by individual on-site water supply wells. The water will be derived from drilled wells which tap the underlying metamorphic bedrock. A well drilled no more than 200 feet into the underlying bedrock should be capable of yielding a few gallons of water per minute (gpm), but there is at least a slight chance that drilling in any particular location will result in a very low yield (i.e., less than a one gpm) or a very high yield (i.e., greater than 10 gpm). A yield of 2 to 3 gpm is usually sufficient for residential demands.

In order to ensure that water quality throughout the parcel and off-site is adequately protected, all wells will need to be installed in accordance with all applicable Town regulations, the Public Health Code, and the State Well Drilling Board. The Town Sanitarian will need to inspect all well locations before the wells are drilled. Also, all wells will need to be properly cased into the underlying bedrock.

The natural water quality should be generally adequate but, because of the particular mineralogy of the bedrock underlying the parcel, there is a chance that the water will have elevated concentrations of iron or manganese, which will discolor the water and cause a metallic taste. Depending upon the ultimate concentrations of these minerals, there may be a need for filtration devices.

Hydrology

Surface and groundwater on the site generally flows downslope toward local discharge points such as seasonal drainage channels and ultimately Lake Lillinonah (see Figure 7).

Lake Lillinonah is an impoundment on the Housatonic River. It was impounded by Connecticut Light and Power Company (CL & P) for generating hydrogelectric power. The surface water quality of Lake Lillinonah is classified by the Department of Environmental Protection as D/B. The "D" classification means that surface water body may be suitable for:

(1) Bathing or other recreational purposes.

(2) Certain fish and wildlife habitat.

(3) Certain industrial processes and cooling waters.

(4) May have good aesthetic value.

Present conditions, however severely inhibit or preclude one or more of the above resource values. The "D" classification is due to the presence of PCB's (polychlorinated biphenols) in bottom lake sediments and fish population. Water quality goal is Class B, which would be suitable for bathing, other recreational purposes, agricultural uses, certain industrial processes and cooling waters; excellent fish and wildlife habitat, and; good aesthetic value.

Development of Parcel 2 will lead to at least some increases in runoff. The amount of the increases will depend upon the extent of development, the amount of impervious surfaces created, and the amount of vegetation removed or preserved.

The Team's Geologist estimated the runoff changes likely to occur as a result of the proposed subdivision. A simplification of Technical Release No. 55 of the Soil Conservation Service provides a technique which may be used in formulating runoff estimates. This method involves the determination of runoff curve numbers, which relate the amount of precipitation to amounts of runoff. The rainfall figures used in the hydrologic calculations represent an amount of precipitation to amounts of runoff. The rainfall figures used in the hydrologic calculations represent an amount that would occur within a 24-hour period. A higher curve number indicates that a greater volume of runoff would occur following a given amount of runoff. It appears that all of the proposed development would occur in the watershed area accompanying this report (see Figure 7). Since the proposed subdivision property encompasses most of the watershed delineated, it appears that much more development could not take place in the watershed. Therefore, additional increases in runoff due to other developments within the watershed should not pose a problem.

Based on the proposed Landmark Estates site plan and some assumptions made by the Team's Geologist regarding amounts of impervious surfaces to be created by the subdivision, it was estimated that development of the site would increase the curve number by 1 (from 70 to 71). Under these conditions, runoff depths for a 10, 25, and 100 year storm event would increase between 4 and 5 percent. These increases should not pose any flooding problems on or off the site. The increased runoff will be naturally detained in Lake Lillinonah. It should be pointed out that in order to avoid potential flooding problems along the proposed Landmark Drive or

driveways serving homes in the subdivision, drainage pipes and culverts will need to be properly sized. The applicant's engineer should submit a stormwater management plan for the project which includes detailed drainage calculations. The other concern related to increases is runoff from the site is the potential for erosion. Because it takes the form of sheetflow in the western parts of the parcel and slopes are moderate in these areas, the potential for erosion should be of concern. For this reason, it is urged that a sound erosion/sediment control plan accompany the stormwater management plan. Erosion and sediment control measures should be shown on the subdivision site plan. Once the control devices have been installed, town officials should inspect them for proper installation and effectiveness.

In order to protect Lake Lillinonah from possible siltation, consideration should be given for the installation of a temporary sediment pool(s) during construction phases. If the sediment pool is constructed, it should be located on upland soils rather than wetland soils. This will minimize wetland disturbances.

Soil Resources

Introduction

The Lakewood Subdivision (Parcel 1) property consists of soils formed in sloping to steep glacial outwash soils on the western part of the parcel, and deep, strongly sloping to very steep bedrock controlled landscapes on the remainder of the parcel.

The Landmark Estates Subdivision (Parcel 2) property consists of soils formed in nearly level to very steep bedrock controlled landscapes on about half of the parcel, and keep to very deep soils formed in sloping, dense till materials on the remainder of the parcel.

The soil map included in this report (Figure 8) are slightly modified from the Soil Survey of Litchfield County (1970) to represent current changes in the way the Soil Conservation Service classifies and interprets soils. This map can be used for a general discussion of soil limitations on both parcels; more specific soils information has been provided by a private soil scientist retained by the developer and Grumman Engineering Associates. All discussions about inland wetland locations and boundaries should use the wetland boundary maps provided by the developer. They show much more mapping detail than could possibly be shown at the scale mapped in the original soil survey. Below is some additional information about the map units on the parcels.

Soil Map Units

Map Units HrE, HxE, and HrC

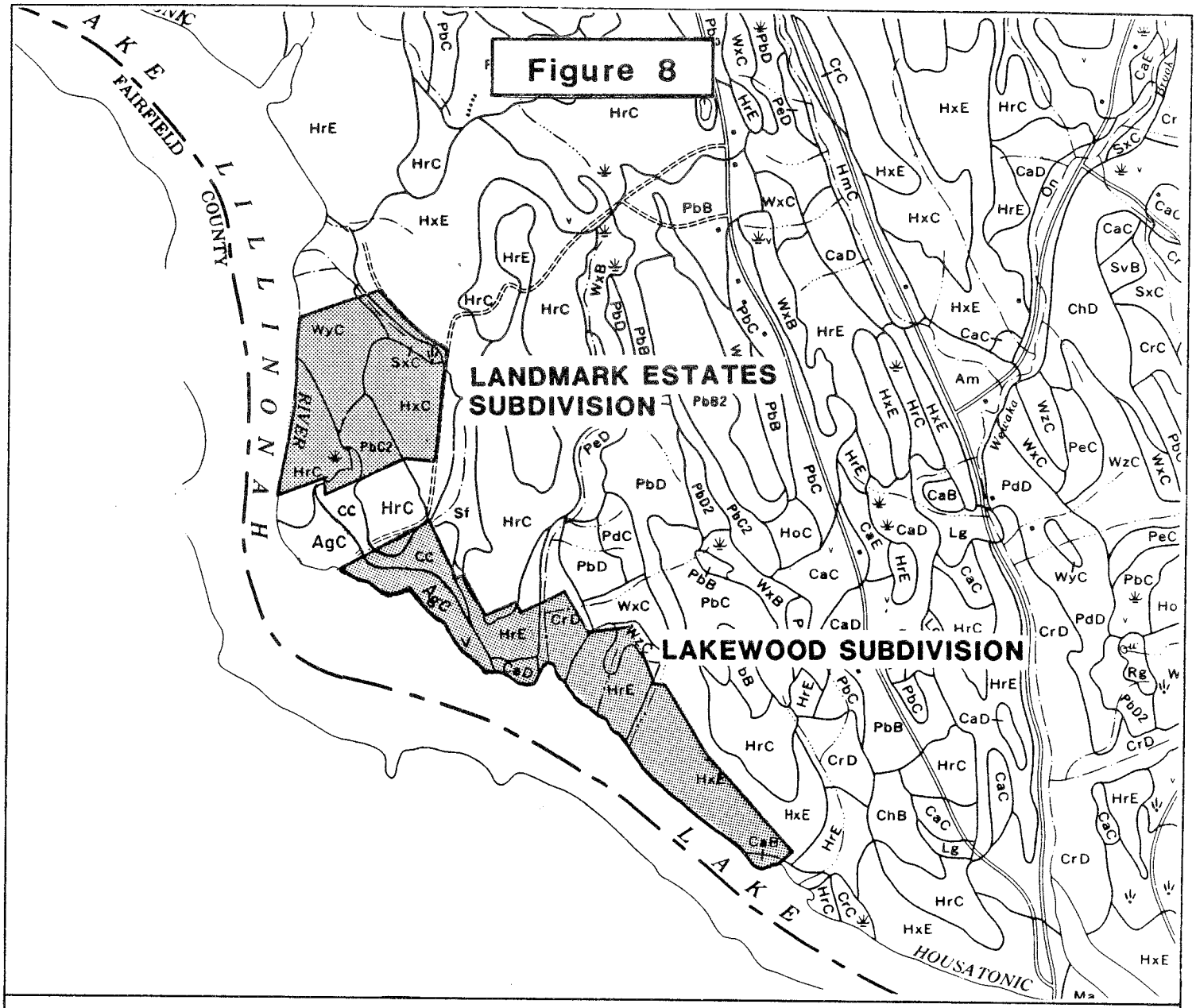
These map units are complexes of deep, moderately deep, and shallow, well-drained soils on portions of both parcels. The deep (greater than 40 inches to bedrock), moderate deep (20-40 inches), and shallow (less than 20 inches to bedrock) are so intermingled on the landscape that it was not practical to separate them at the scale mapped. Rock outcrops can cover up to 10 percent of the surface in the HrC, HrE units and up to 20 percent in the HxE unit. Included with these soils in mapping are areas of Paxton soils. This is especially true on the Landmark Estates Subdivision (Parcel 2). Careful site selection is necessary to locate deep soils for the septic systems. Blasting of bedrock, and cutting and filling may be necessary for the installation of roads and utilities.

Map Units AgC and CC

Included with these soils in mapping are small areas of moderately deep to shallow to bedrock soils. Deep test pits are important in the siting of homes and septic systems. Also included are small areas with a gravelly substratum.

Map Units WxC, WyC, and WzC

These map units are dominated by moderately well drained soils, but have large inclusions of poorly-drained Ridgebury soils and somewhat poorly drained soils. Those areas of poorly-drained soils are large enough to map out at 1" = 100' are shown on various maps



LAKEWOOD AND LANDMARK ESTATES SUBDIVISIONS

BRIDGEWATER, CONNECTICUT

DISTRIBUTION OF SOILS

SMALL AREA OF POORLY OR VERY POORLY DRAINED SOILS

v SMALL AREA OF BEDROCK OUTCROP

King's Mark Environmental Review Team

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the shoreline. The proposed access road should be positioned to limit the disturbances in the stream. The road should run parallel to or cross the stream at one specific point. A crossing design should then be included for review.

Information showing the disturbance between the construction areas and the lake should be shown.

An erosion and sediment control plan needs to be developed as mandated by P.A. 83-388 prior to any approval for subdivision. The existing plans are too general for detailed comments on erosion and sedimentation. The Soil Conservation Service is available to review erosion and sedimentation control plans when they are prepared for either the developer or the town.

Landmark Estates Subdivision (Parcel 2)

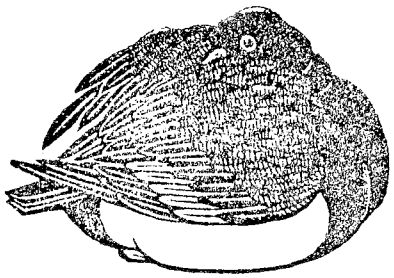
The proposed site development plan does not show the 100-foot septic system setback from Lake Lillinonah. Ten-foot contour intervals are not detailed enough for planning. Many drainageways were observed during the field review and they do not show on a map of this scale. That information is very important when reviewing land disturbances. Several culvert crossings are necessary and are not located on the plans. Pipe crossings need to be sized and properly installed to eliminate future drainage problems. Several dwellings as well as septic systems are shown being built in existing drainageways on somewhat poorly drained soils. No information is shown on how this water will be handled. Many serious problems can arise if the drainageways are not properly handled. Fill alone will not be sufficient. Deep test pits should be dug at the location of

each septic system because of soil limitations. Due to the extent of wetlands on Lots 4 and 5, they may need to be combined into one lot or eliminated. Again because of the lack of detailed topographic information there may be other drainageways that could cause problems on Lots 7 and 8. Storm drains for the roadway do not show any detail for inlet or outlet protection. Storm drain calculations should also be included for review. Stormwater runoff would have a minimal effect on the lake.

Due to wetness of soils, a curtain drain system should be installed and outlets shown. Outlet areas should be stable and animal guards installed.

Erosion and sediment control plans need to be developed as stated by P.A. 83-388. No erosion and sediment control details were shown on the site map. Activities from the construction area and the lake should have a natural buffer zone or construct a sedimentation filter for runoff.

BIOLOGICAL RESOURCES



BIOLOGICAL ATTRIBUTES

Forestry Considerations

The two parcels proposed for subdivision development can be divided into six broad vegetation types. Each parcel, Lakewood Subdivision and Landmark Estates Subdivision contain three forest cover types. They are described in more detail under the Vegetative Type Descriptions section below. In general terms, both of these areas are wooded. The only exception to this is a small area of "old field" located in the Lakewood Subdivision parcel.

The tree species present are common in Connecticut. The dominance of one species over another is dictated by available moisture. In areas where the ledge is close to the surface of the ground, droughty conditions exist. Here one is apt to find oaks and hickories. Other sections of the woodlands have excess moisture due to a high water table and moisture-loving species survive here, notably maples and some elm.

There is some commercial value in the trees on both parcels. Large trees (i.e., greater than 12 inches in diameter measured at breast height or dbh) are considered sawtimber size. These have value as logs. As a general rule, hardwood species (i.e., oaks, maples, and birches) are more valuable than softwood species (i.e., hemlock and white pine). A good portion of the Landmark Estates Subdivision parcel has a concentration of red cedar, many of which are quite large in diameter (i.e., 10-14 inches dbh). These have value for fencing and cabinetry work.

The large expanse of diverse vegetation plays an important role

in the aesthetics of the area as well as the water storage capacity of the landscape. In addition, the woodlands provides a rich renewable resource in the form of wood and a diversified wildlife habitat. As more land gets intensely utilized, the loss of these forest attributes becomes increasingly important.

Vegetative Type Descriptions

Lakewood Subdivision (Parcel 1)

Area 1

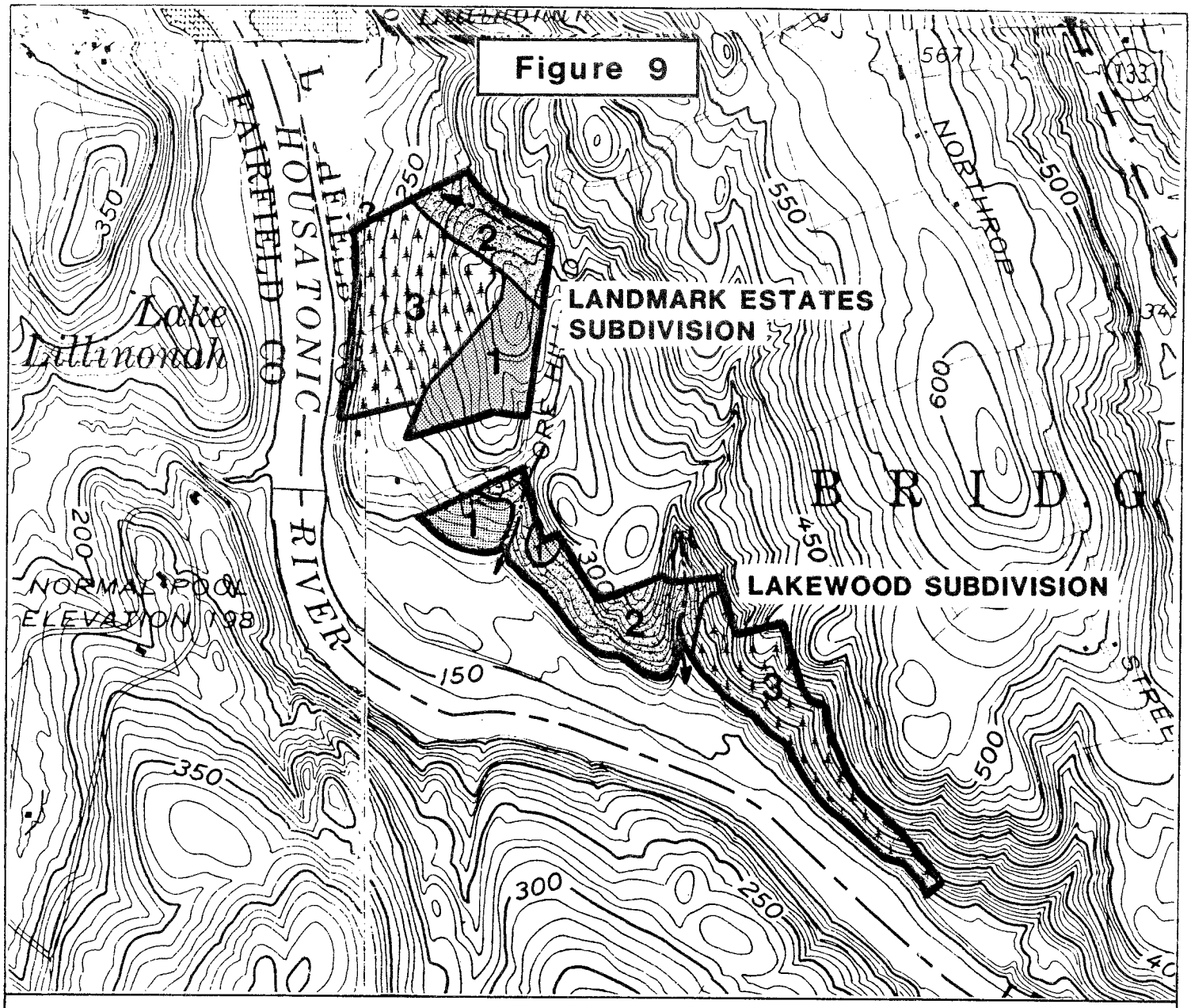
This area is characterized by "old field" vegetation. Grasses and sedges predominate. However, this habitat will be giving way to pioneer tree species which are now just beginning to make there presence felt (Figure 9).

Area 2

This forest cover type would be considered a mixed hardwood forest. Where the intermittent stream bisects the old field, the species tend to be sugar maple, ash, birch, and tulip poplar. On the drier hillsides, the tree species tend toward hickories and oaks. The understory contains similiar tree species, an occassional red cedar, blue beech, and hop hornbeam (see Figure 9).

Area 3

This area tends to be quite steep. Tree species here mix in to combine the hardwood and softwood species. The hardwood tree species consist of oaks, hickories, and birches. In many cases, hemlock is present and at times, creates a dense "thicket" in the understory.



LAKEWOOD

- AREA 1 - Old Field Vegetation (grasses and sedges)
- AREA 2 - Mixed Hardwood Forest (sugar maple, ash, birch, tulip poplar)
- AREA 3 - Oak, hickory, birch, hemlock

LANDMARK ESTATES

- AREA 1 - Red cedar, black birch, red oak, hickory
- AREA 2 - Red maple, sugar maple, tulip poplar, basswood, elm, red cedar
- AREA 3 - Black birch, sugar maple, red maple, red cedar, hemlock

LAKEWOOD AND LANDMARK ESTATES SUBDIVISIONS

BRIDGEWATER, CONNECTICUT

DISTRIBUTION OF VEGETATION

King's Mark Environmental Review Team

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Forest Management Considerations

Much of the present vegetation will not be present after these parcels are developed. If possible, as much of the present vegetation should be left where it can fit into the final site plan. This is especially important in sensitive areas such as inland wetlands and ledge outcrop areas. Not only are these areas more difficult to develop but they restrict the use of "natural" landscaping techniques. Clumps of vegetation are more desireable than individual tree stems. Clumps also lower the possibility of soil disturbance and mechanical injury to individual trees during construction. Scattered clumps of natural forest species or types in a variety of sizes and shapes creates an attractive landscape. These "islands" of vegetation and woodlands can add beauty to subdivision developments and attract wildlife.

Trees which are presently unhealthy and not growing vigorously due to overcrowded conditions are very susceptible to further degradation from environmental stresses brought on by development, disease, insect infestation, and adverse weather conditions. It would therefore be desireable to remove unhealthy trees. This will reduce competition for sunlight, nutrients, and water from the residual or remaining tree stems. This improvement thinning can be done on a small scale such as clumps. Thinnings are designed over time to allow residual trees to improve in health, vigor, quality, and stability. Thinnings, if applied properly can:

(1) Improve the aesthetic value of an area.

(2) Improve tree health and vigor.

(3) Improve wildlife habitiat.

(4) Provide wood products.

Additional landscaping, in many instances is best done with native trees and shrubs that can complement existing natural areas. Berry-producing shrubs intermixed with conifers provide additional wildlife cover and scenery.

Any cutting whether it is done for thinnings, house sites, or roadways, should be done to take advantage of the high demand for wood products. Products will include firewood, logs, and cedar posts/logs. The proper marketing for these products should be a concern and can be planned for. A public service forester or a private forester may be of assistance in either on the ground planning of the marketing of wood products.

A 22-acre open space area is proposed in the Lakewood Subdivision (Parcel 1). However, active forest management work of any kind in this parcel will be restricted due to steep slopes and inaccessibility. Though lacking forest management capabilities, this open space area will play an important role in protecting the lakes's shoreline.

Wildlife Habitat Types

Both parcels are forested areas adjacent to Lake Lillinonah. Wildlife habitats present are mixed hardwoods, conifers, reverting fields, and streamside riparian/wetland sites.

Mixed Hardwoods

This habitat type consists of a variety of hardwood species including sugar maple, red maple, birch, oak, hickory, cherry, beech, and ash. There are some scattered conifers such as hemlock, cedar, and white pine. Understory composition includes sumac, grape, dogwood, barberry, ferns, grasses, Indian pipe, and hardwood seedling/saplings.

Wildlife typically utilizing such sites include ruffed grouse, gray squirrels, flying squirrels, white-tailed deer, woodpeckers, various passerines, raccoon, fox, and a great variety of non-game species (i.e., chipmunks, voles, white-footed mice).

Fields

This habitat type consists of several reverting fields comprised of grasses, goldenrod, wild bergamot, Virginia day flower, Virginia creeper, sumac, dogwood, cedar, and oak.

Wildlife frequenting such habitat types include white-tailed deer, turkey, fox, rabbits, raccoon, meadowlarks, sparrows, cedar waxwings, and numerous non-game species.

Wetlands

Wetland habitat consists of seasonally flooded mixed hardwoods and intermittent stream/riparian zones. The mixed hardwood wetlands are dominated by red maple along with yellow birch, black birch, and ash. Stream corridors are dominated by hemlock. Understory vegetation includes spicebush, dogwood, skunk cabbage, club moss, trillium, grasses, and ferns.

Wildlife typically utilizing such wetland sites include white-tailed deer, woodcock, skunk, raccoon, woodpeckers, passerines, and various amphibians and reptiles.

Conifers

Conifer cover within the study area includes scattered white pine, cedar, and hemlock. There is also a heavy hemlock component adjacent to Lake Lillinonah located on the Lakewood Subdivision parcel designated as Lot 8 (proposed open space). This type provides suitable habitat for seed-eating birds such as black-capped chickadees, and ruby and golden crowned kinglets. It also serves as roosting and nesting cover for various birds including owls and hawks.

Discussion

Since Connecticut is a densely populated and developing state, where available wildlife habitat continues to decline on a daily basis, it is therefore prudent to consider maintaining and enhancing existing wildlife habitat. The following guidelines will help to lessen project impact and/or improve conditions within the various habitats.

Forestland Guidelines

(1) Create a diversity of habitats by making small irregularly shaped openings (1/4 to 1 acre) in an east to west direction (to maximize sunlight). This will encourage fruit-producing shrubs valuable to many species of wildlife.

(2) Pile brush along edges of openings for small mammals, birds, amphibians, and reptiles.

(3) Encourage mast producing trees (oak, hickory, beech).

(4) Leave five snag or den trees per acre. They are used by many birds and mammals for nesting, roosting, and feeding.

(5) Exceptionally tall trees (used by raptors for perching and nesting sites) should be encouraged.

(6) Trees with vines (fruit producers) should be encouraged.

Field Guidelines

(1) Stone walls and trees should be maintained along field borders.

(2) Native vegetation should be encouraged. Desirable species include apple, dogwood, sumac cedar, juniper, viburnum, barberry, and rose.

Wetland Guidelines

(1) Leave a buffer strip (i.e., 100 feet) of natural vegetation along wetland areas to help trap and filter silt and sediments.

(2) All culverts should have screens to lessen potential damage from beaver.

(3) Encourage natural landscaping concepts. Limiting chemical lawn applications will lessen potential habitat damage and possible wetland contamination.

Additional Wildlife Considerations

An issue of special interest is the occurrence of a major bald eagle wintering area located approximately four miles to the southeast of the project area at Shepaug Dam. Although no direct negative impacts should result from the project, all efforts should be made to retain as much lakeside tree cover as possible. This will serve as a buffer from development and maintain additional potential roosting sites. Also, no pollutants should enter Lake Lillinonah as it is used as a feeding area by wintering eagles. The proposed open space located on Lot 8 in the Lakewood Subdivision (Parcel 1), will help maintain potential roosting sites in the study area.

If the site is developed, there will be an immediate and lasting negative impact on wildlife. The primary impact will be the loss of habitat due to buildings, roads, and driveways. Another impact would be the change in habitat where forest and fields are cleared for lawns and landscaping. A third impact will be the increased human presence, vehicular traffic, and a number of roaming cats and dogs. This will drive the less tolerant wildlife species from the site, even in areas that have not been physically changed. Implementation of the aforementioned guidelines will help minimize the adverse impacts on local wildlife populations. In addition, the implementation of backyard wildlife habitat management practices should be encouraged. Such activities involve providing food, water, cover, and nesting areas (Table 1)

TABLE 1.

Suitable Planting Materials For Wildlife Food And Cover

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

Nesting sites can be provided for a great variety of birds with placement of artificial nest boxes.

Lake Lillinonah

Existing Conditions

Lake Lillinonah is a large run-of-the river impoundment on the Housatonic River which was created in 1955 with the construction of the Shepaug Dam. The lake is managed by DEP as a Class B "fishable/swimmable" waterbody and is used by the public for boating, fishing, swimming, and other forms of recreation. The lake is operated by the Connecticut Light and Power Company as a hydroelectric generating facility.

The lake is classified by DEP as highly eutrophic, and water-based recreation is impaired in summer months by blooms of blue-green algae. In recent years, a reduction in the frequency, severity, and duration of algae blooms has resulted from controls on phosphorus sources in the Housatonic River watershed (Appendix B). Additional phosphorus controls in the coming years could result in further improvements in the lake's trophic status.

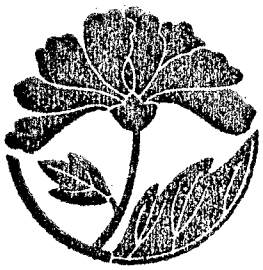
Fishing in Lake Lillinonah is impaired by the presence of trace concentrations of PCB's (polychlorinated biphenols) in fish tissue resulting from historical industrial activity. The DEP and the Department of Health Services have issued an advisory against the consumption of fish caught in the lake. PCB levels in fish have declined in recent years following the clean-up of an industrial source upstream (Appendix B). Monitoring of PCB levels in fish will continue to determine if the consumption advisory should be reconsidered.

Potential Environmental Impacts

The most important effects of the proposed subdivisions are the localized impacts of erosion and sedimentation caused by construction activities and stormwater runoff from subsequest residential properties. The impact of the proposed subdivisions on the trophic state of Lake Lillinonah would be negligible. Although any change in land use from woodland to residential land will contribute to an acceleration in eutrophication, the proposed land area undergoing change is minimal compared to the lake's total watershed area of more than 750,000 acres.

The Town of Bridgewater should exercise its authority under Sections 22a-325 to 22a-329 of the Connecticut General Statutes to ensure, through zoning and building permits, that best management practices are implemented for construction-related erosion and for stormwater runoff. The town should also consider utilizing the services of the USDA-Soil Conservation Service for technical oversite in this regard.

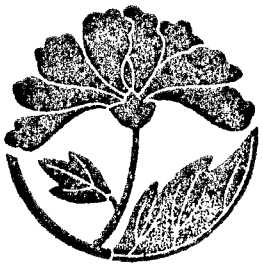
CULTURAL RESOURCES



along the same bedrock system in this parcel and could be disturbed or destroyed during the construction of the proposed homes. Similarly, the Landmark Estates Subdivision may adversely impact any prehistoric site which exists there.

The developers should be encouraged to evaluate further the archaeological sensitivity of both parcels prior to construction. If additional archaeological sites were discovered, they too might be protected in parcels of open space. Otherwise we may lose important evidence about the prehistory and early history of Bridgewater's Native Americans.

LAND USE
AND
PLANNING CONSIDERATIONS



The Housatonic Valley Council of Elected Officials (HVCEO) Regional Plan entitled, A Growth Management Option for the Housatonic Valley Region, classifies the study area as a "Remote" area. According to the Regional Plan, even lower densities than those derived from environmental carrying capacity are reasonable in remote areas in order to channel growth pressures to more energy efficient locations. A strategy of maintaining low densities at the subject sites is thus supported by the Regional Plan. In general, the proposed project appears to conform to the development intensity recommended in the Regional Plan.

The Bridgewater Plan of Development is currently in the process of being updated from its 1967 version. It is significant to note, however, that the proposed project is not in conformance with the goals established by the 1967 Town Plan. According to the Plan, the subject areas are proposed for "park and open space" with a hiking trail along the shore of Lake Lillinonah. The Plan further states that action should be taken by Bridgewater to protect the shores of Lake Lillinonah from private non-recreational development. In order to protect the lake, the Town Plan concludes that as much shorefront as possible should be kept in reserved open space.

To conclude, the proposed subdivisions appear to be generally consistent with the low density development intensities recommended in the State and Regional Plans, but are inconsistent with the Town Plan which calls for park and open space use of the land.

Traffic and Access Considerations

The proposed Lakewood Subdivision (Parcel 1) calls for the construction of a new more or less 750 linear foot road off of Iron Ore Hill Road to service the site. Sight line distances from where the new road is proposed to intersect with Iron Ore Hill Road appear adequate to the west (looking to the left while exiting from the new road), but are presently restricted to the east (looking to the right). It appears that clearing of a limited amount of vegetation at the curve on the opposite side of Iron Ore Hill Road could adequately improve the sight line to the east. According to the Connecticut Department of Transportation's, Interim Guidance for Implementation of AASHTO (1984) Green Book (1986), the minimum desirable sight line for a 30 mile per hour design roadway is 310 feet. This means that 10 feet back from the edge of the intersection, a driver in a car should be able to see about the length of a football field in either direction.

The Landmark Estates Subdivision (Parcel 2) proposes a new loop road of more or less 2,000 linear feet off Iron Ore Hill Road and Iron Ore Hill Road Extension to service the proposed lots. Sight line distances where the new road would intersect with Iron Ore Hill Road Extension appear adequate. However, the intersection of the new road with Iron Ore Hill Road has a limited sightline to the north and will require a bank cut and tree removal on the west side of Iron Ore Hill Road for significant improvement.

According to a report entitled, Trip Generation (Institute of Transportation Engineers, 1979), a single-family residence generates 10 vehicle trips (in and out) or five round trips, on an average

weekday. The 24 new lots created by both Lakewood and Landmark Estates subdivisions would therefore be expected to generate about 240 additional trips per day in the area.

All of these additional trips would utilize Iron Ore Hill Road. This road is classified as a collector road in the Bridgewater Town Plan whose function is to "....collect traffic from the residential and rural areas for the town center area or onto Routes 67 and 133...." It is a two-lane, two-way paved road currently in good condition.

Iron Ore Hill Road Extension is classified as a residential street and is the other existing town road providing frontage for the proposed Landmark Estates Subdivision. This road too will receive additional traffic as a result of the project. Iron Ore Hill Road Extension is currently in an unimproved condition and will require major improvement to meet town road specifications. The day of the field review, the applicant acknowledged the need to improve this road as a condition for subdivision approval. The sightline where Iron Ore Hill Road Extension and Iron Ore Hill Road intersect also needs improvement. Looking to the south from Iron Ore Hill Road Extension a cluster of trees will need to be removed. Looking to the north from this point, the sightline appears adequate.

The traffic generated by the project will flow northward along Iron Ore Hill Road to the intersection with Northrup Road. From this point, the major portion is expected to turn left to head towards the town center on Route 67. The remainder of the traffic will turn right heading towards Brookfield and Danbury. The sight lines at the intersection of Iron Ore Hill Road and Northrup Road are in need of

improvement. Looking to the left from Iron Ore Hill Road, a bank cut is required to provide safe sightlines. Looking to the right, some tree removal and a limited amount of bank cutting is needed. Careful attention to improving these limited sightline distances will help assure that the additional traffic generated by the project will be served by a safe road system.

To help put the traffic generated by the projects in perspective, the average daily traffic (ADT) in 1985 for Route 133 in Bridgewater ranged from 2,200 to 3,000 along various lengths according to the Connecticut Department of Transportation (DOT) statistics. The HVCEO has no record of any traffic volume statistics for local roads in Bridgewater. However, according to the Town Plan, collector streets such as Iron Ore Hill Road are proposed to service traffic in the 750 - 1,490 ADT range. Iron Ore Hill Road is lightly used at the present time due to very limited development along this road. The road should easily be able to handle the additional 240 trips per day generated by the proposed projects.

One area of concern with regard to development of these parcels is the lack of an alternate or emergency access route. Iron Ore Hill Road is basically a nearly mile long dead end road. Should a fallen tree or accident block access between the project site and Northrup Road, no alternate exit from the site would be available. This could prove to be more than just an inconvenience to residents if a fire or medical emergency developed while the road was blocked. There appears to be no easy way to mitigate this concern.

Design Considerations

Solar Orientation

The proposed subdivision site plan for Landmark Estates, dated 1/8/86, shows proposed building site locations for each of the proposed lots. In preparing the final site plan for this project, efforts should be taken to re-orient many of these proposed building locations to take advantage of solar access. In particular, Lots 11, 12, 13, 14, and 15 are characterized by southerly and southwesterly slopes and have good potential for the provision of solar-oriented houses. To accomplish this, the proposed houses would simply need to be re-oriented on the proposed lots so that the long axis of the house faces south. Research has shown that energy savings in the Northeast can be significant (e.g., 12 - 14 percent) simply by orienting houses to face south. Although future homeowners can generally orient their house on the lot as they wish, suggesting a solar orientation on the site plan encourages this energy efficient development pattern.

Lots 2-7 of the Landmark Estates project also have the potential for the development of solar oriented lots although it is likely that future homeowners would prefer to have the long axis of their houses facing to the west for more extensive views of Lake Lillinonah. On the Lakewood Subdivision, however, all of the proposed houses could easily be oriented to take advantage of both solar access and a view of the lake.

Streambelt Protection

Two factors will serve to protect the streambelt area of the subdivision sites. First, the Town of Bridgewater's zoning regulations prohibit the construction of habitable buildings or septic systems within 100 feet of the high water mark of Lake Lillinonah. This regulation serves to protect the water quality of Lake Lillinonah and the integrity of the streambelt area.

Secondly, CL & P owns from the water's edge to the 210 foot contour interval on the property, a distance which in some areas may equal or exceed 100 linear feet under normal conditions (i.e., lake level equals 198 feet).

As stated in Appendix C of this report, CL & P will allow certain uses of this land by abutting property owners, but prohibits uses that will deteriorate water quality or otherwise adversely impact the natural environment. Written permission must be received from CL & P prior to any construction activity on their property, including dock construction, clearing of vegetation, and earth excavation or filling. The location of CL & P property in relation to the subject sites should be clearly shown on the subdivision plans and in the field so as to avoid any future confusion on the part of homeowners in these subdivisions who might otherwise believe they own, or have unrestricted use of, the land below the 210 foot contour.

Additional Design Considerations

The day of the field review, the applicant indicated two alternatives for the Lakewood Subdivision. A cluster subdivision of

seven lots of one or more acres in size with 22 acres of open space or a conventional subdivision of four larger lots with provision of the same 22 acres of open space. The conservation focus of the Town Plan for this area supports the latter of these two alternatives.

Based on the 100-foot setback from the lake required by the Town's zoning regulations for buildings and septic systems, it appears that adequate building space may not be available for house and septic system on proposed Lots 1, 4 and 5 under the proposed cluster concept. Although there were no firm plans for "Parcel A" shown on the subdivision plan (NOTE: Parcel A is located within the Lakewood Subdivision. This should not be confused with Parcel 1 and Parcel 2), it appears that "Parcel A" too may not be able to accommodate a house and septic system with the 100-foot setback restriction.

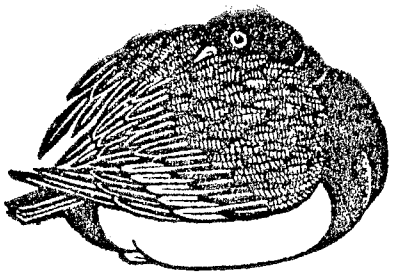
Another concern is the proposed new road crossing of the unnamed stream/drainage channel traversing Lots 3 and 4 in the Lakewood Subdivision. To avoid disruption of a sizable length of this stream channel, consideration should be given to relocating the northern portion of this road to the west between Lots 2 and 3.

Consideration should be given by the applicant as to the future ownership, use, and maintenance of the proposed 22 acres of open space. Access to the open space from the new road should also be detailed on the site plan. While the potential for active recreational use of the proposed open space area is very limited due to steep slopes, the area could accommodate a multi-purpose hiking trail. The existence of an undeveloped and underutilized town park on the shore of Lake Lillinonah on the northern border of the

Landmark Estates property reduces the need for the provision of such an active recreational facility at the two subdivision sites.

The proposed intersection of Landmark Drive with Iron Ore Hill Road is more or less 30 feet to the north of an existing driveway. This is less than desirable for safety reasons, and consideration should be given to negotiating with the owners of the driveway to connect this drive directly on to Landmark Drive.

APPENDICES



APPENDIX A

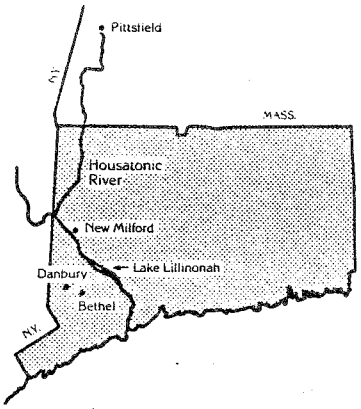
SOILS LIMITATION CHART

MAP UNIT	GENERAL SOIL PROPERTIES	DRAIN. CLASS AND DEPTH TO SEASONAL HIGH WATER TABLE
AgC - Agawam fine sandy loam, 8-15% slopes	Glacial outwash soils formed in loamy over sandy materials	Excessively drained >4 feet
CC - Canton fine sandy loam, 8-15% slopes	Glacial till soils formed in loamy over sandy materials	Well drained >4 feet
CaD - Charlton fine sandy loam, 15-25% slopes	Glacial till soils formed in loamy materials	Well drained >6 feet
CrD - Charlton very stony fine sandy loam, 15-35% slopes	Glacial till soils formed in loamy material	Well drained >6 feet
HrC - Hollis very rocky fine sandy loam, 3-15% slopes	Complex of glacial till soils from deep to shallow over bedrock. Formed in loamy materials	Excessively drained to well drained >6 feet
HxE - Hollis extremely rocky fine sandy loam 15-35% slopes	Complex of glacial till soils from shallow to deep over bedrock. Formed in loamy materials	Excessively drained to well drained >6 feet
PbC2 - Paxton fine sandy loam, 8-15% slopes	Glacial till soils formed in dense loamy materials	Well drained 1.5 - 2.5 feet Perched water table
Sf - Scarboro loamy fine sand, 0-3% slopes	Glacial outwash soils formed in sandy materials	Very poorly drained 0-1.5 feet
SxC - Sutton very stony fine sandy loam, 3-15% slopes	Glacial till soils formed in loamy materials	Moderately well drained 1.5-2.5 ft.
WxC - Woodbridge fine sandy loam, 8-15% slopes	Glacial till soils formed in dense loamy materials	Moderately well drained 1.5-2.5 ft. Perched water table
WyC - Woodbridge very stony fine sandy loam 8-15% slopes	Glacial till soils formed in dense loamy materials	Moderately well drained 1.5-2.5 ft. Perched water table
WzC - Woodbridge very stony fine sandy loam, 8-15% slopes	Glacial till soils formed in dense loamy materials	Moderately well drained 1.5-2.5 ft. Perched water table

United States Environmental Protection Agency
Monitoring and Data Support Division
Office of Water
Washington, DC 20460

EPA

Water Quality Progress Report



Housatonic River, Connecticut

The Housatonic River drains approximately 2000 square miles in western Connecticut, southwestern Massachusetts, and eastern New York State. As an important regional resource, the river has long supplied hydroelectric power from a series of dams and provided extensive recreational opportunities along its length. Principal recreational opportunities occur in a series of impoundments—Lake Lillinonah, Lake Zoar, and Lake Housatonic—on the lower Housatonic River in Connecticut. Although designated as Class B water bodies (fishable/swimmable), historically these impoundments have suffered from severe eutrophication. Recreation activities have often been impossible during the summer when scum or dense mats of blue-green algae covered the water.

Today, water quality in the three Housatonic Lakes is significantly improved as a result of Connecticut's basin-wide strategy to reduce nutrient loading to the river. Controls implemented at industries and publicly owned treatment works (POTWs) in Connecticut and Massachusetts have reduced phosphorus discharges, resulting in a corresponding decrease in nuisance algal growth.

ASSESSING THE PROBLEM

Starting with the U.S. Environmental Protection Agency's (EPA) National Eutrophication Survey in 1972, a series of studies documented the highly eutrophic condition of the Housatonic Lakes and also identified phosphorus as the growth-limiting nutrient for algae.

To better understand the transport and fate of pollutants in the Housatonic, the Connecticut Agricultural Experiment Station developed a hydraulic model (RVRFLO) and calibrated it for that portion of the river that included Lake Lillinonah. The phosphorus budget developed by the model showed that point sources were an important source of loading in the watershed and that Lake Lillinonah was the major source of phosphorus to the downstream impoundments. Based on the model results, the State conducted a study to assess the effects of phosphorus removal at one of the major point sources (the Danbury POTW) which is described below; in addition, a decision was made to focus on reducing phosphorus loads to the most upstream lake.

The RVRFLO model also supplied important information concerning the relationship between river flow and hydraulic residence time in the impoundments. During the spring high-flow period when nonpoint source input of phosphorus is relatively high, water moves through the impoundments in less than a week. During the July and August low-flow period, when point source phosphorus loads dominate, water takes 3 to 12 weeks to move through the impoundments. Since algal blooms had been observed to occur when the incubation period in quiescent water exceeded several weeks, it was particularly important to control point source input during the summer recreation period, when conditions were most likely to produce algal blooms.

INTERSTATE TRANSPORT OF POLLUTANTS

Previous water quality monitoring studies as well as the phosphorus budget indicated that a significant proportion of nutrients was transported into Lake Lillinonah from outside the State. To deal more effectively with this and other interstate pollution problems, EPA's Region I office formed the Working Group on the Interstate Transport of Pollutants. Quarterly meetings of the Working Group and the involvement of officials from Connecticut, Massachusetts, and New York (as well as representatives from business and municipalities) are resulting in a successful cooperative effort to control point source discharges.

INSTITUTING CONTROLS

In its Housatonic Basin Plan, the Connecticut DEP recommended a strategy of phosphorus controls for all significant point sources. Table 1 lists the important point source dischargers (of phosphorus) that affect the Housatonic Lakes, along with the approximate effluent loads before and after controls. In each case, the NPDES permits were modified to require phosphorus removal; for the Pittsfield plant, the revised permit required Connecticut to monitor water quality in the Housatonic River and Lakes for four years following the beginning of controls.

TABLE 1. Phosphorus Dischargers in the Lake Lillinonah Basin Before and After the Implementation of Controls (lb/day)

Source	Year controls were instituted	Discharge before controls (total P)	Discharge after controls (total P)
Danbury POTW	1977*	250	50
New Milford POTW	1982	12	1
Bethel POTW	1982	15	2
Kimberly-Clark, Inc.	1980	10	1.5
Nestle's, Inc.	1983	30	5
Pittsfield POTW (MA)	1982*	283	95
TOTAL		600	155

*The Danbury plant did not control for phosphorus in 1978, and Pittsfield did not control in 1983 or 1984.

Although nonpoint sources are less significant than point sources as a cause of nuisance algal blooms in the river system, they do represent an important source of nutrients. As a result, Connecticut has identified the Housatonic basin as a priority area for implementation of agricultural best management practices.

WATER QUALITY MONITORING: 1976-1977

To assess the water quality effects of point source phosphorus controls, Connecticut DEP, in cooperation with FMC Corporation, conducted several intensive monitoring studies. The first study was conducted during the summers of 1976 and 1977—before and during the first year of seasonal phosphorus removal at the Danbury POTW. Samples were collected biweekly from April through October for both years at five monitoring stations below the Dan-

bury plant, four monitoring stations on the Housatonic River, and four monitoring stations on Lake Lillinonah. The samples were analyzed for approximately 20 water quality parameters, including critical eutrophication measures such as phosphorus and nitrogen species, transparency, chlorophyll *a*, and phytoplankton composition.

Results from the 1976-77 Danbury study were not conclusive due to operational problems at the Danbury treatment facility and incomplete flushing of the impoundment; however, definite improvements in water quality were observed. This was true particularly in the comparison of August and September data for the two years. During this period in 1977, the lake was undergoing its second flushing since the initiation of phosphorus treatment, and cumulative system downtime improved from 33 to 16 percent. August and September were also the months when algal concentrations had reached peak levels in previous years. Analysis of the limnological data for these August and September months showed the following results:

- Mean chlorophyll *a* concentration was reduced from 35.2 μg/L in 1976 to 25.4 μg/L in 1977
- Mean soluble reactive phosphorus concentrations were reduced from 27.9 μg/L in 1976 to 18.6 μg/L in 1977
- Mean secchi disc transparency increased from 1.2 meters in 1976 to 2.6 meters in 1977.

WATER QUALITY MONITORING: 1981-82

A second intensive monitoring survey was undertaken as a cooperative effort between the EPA's Region I Office and the States of Connecticut and Massachusetts. This study, designed as a two-phase program, examined both the transport and the effects of phosphorus that was discharged (in the summer) from the Pittsfield, Massachusetts, POTW. This plant is located approximately 40 miles north of the State line and 100 miles north of Lake Lillinonah.

In 1981, the Pittsfield plant did not remove phosphorus, and in 1982 the plant removed phosphorus during the summer recreation season. The intensive survey measured flow rate and concentrations of total and dissolved phosphorus twice a month during the summer at four monitoring stations along the Housatonic River (from Pittsfield to the headwaters of Lake Lillinonah) and at three stations on Lake Lillinonah. The Lake stations were sampled for phosphorus, transparency, and chlorophyll *a*. Data from the two years were then compared to evaluate the effects of this change in treatment.

The 1981 survey revealed that a significant fraction of the Pittsfield phosphorus was transported by the river to Lake Lillinonah. In addition, sediment samples in the riverbed above the impoundments contained relatively little phosphorus, indicating that nutrients attenuated by the river during low flows were transported to the lakes during high flow periods.

During the second year (1982), attempts to measure water quality improvements attributable to controls at the Pittsfield treatment plant were complicated by several factors. These included heavy rains and a 100-year flood event in June (which dramatically increased nonpoint loading over that of 1981); a two-week suspension of phosphorus removal at the Danbury plant due to hydraulic problems caused by the flood; and the initiation of phosphorus removal at the New Milford and Bethel POTWs. In spite of these conditions, it was possible to attribute changes in phosphorus levels in the river, above the three Connecticut POTWs and major nonpoint sources, directly to the reduction in loading at Pittsfield. Removal of approximately 190 lb/day at Pittsfield resulted in a reduction of 80 to 100 lb/day at the State line, and a reduction of 50 to 70 lb/day at the headwaters of Lake Lillinonah.

Water quality at three fixed stations in Lake Lillinonah was monitored in 1976, 1981, 1982, and 1984. These data suggest trends as well as the effects of point source phosphorus controls. Summary statistics for three parameters during July and August are presented in Table 2. In the Table, the effects of phosphorus controls initiated at the Danbury plant in 1977 are evident when 1976 data are compared to 1981 or 1982 data. Further improvements, as a result of phosphorus controls at Pittsfield in 1982, are suggested by comparing 1981 data with 1982 data. In 1984, Pittsfield again did not remove phosphorus, and the data indicate a decline in water quality.

TABLE 2. Lake Lillinonah Survey Results: Mean Values for July and August

	1976	1981	1982	1984*
Total P (mg/L)	0.104	0.063	0.050	0.078
Secchi depth (m)	1.39	1.59	1.83	1.42
Chlor. *a* (μg/L)	91.416	16.207	21.167	13.93

*Data are from August only.

BIOMONITORING STUDIES

In 1975, phytoplankton studies conducted by the EPA found the dominant organisms to be the nitrogen-fixing blue-green algae *Anabaena sp.* and *Aphanizomenon sp.* Both species are capable of utilizing atmospheric nitrogen, and are typically found as mats or scum floating on the surface. Additional biosurveys for plankton were carried out as part of both the Danbury and Pittsfield phosphorus removal studies. In the 1976-77 Danbury study, the U.S. Geological Survey monitored for algal growth potential (AGP) during the study period. Stations below the Danbury plant showed a significant reduction in AGP. AGP data collected at a station downstream from the Danbury plant showed 121 mg/L (dry weight of algae) in 1976 compared with an average of 57 mg/L in 1977.

A qualitative study of species composition during the Pittsfield survey in 1982 indicated a shift in species composition. What had been dominated by *Anabaena/Aphanizomenon,* with *Spirogyra* and *Hydrodictyon* as minor dominates, appears to have shifted into a community co-dominated by *Anacystis cyanae* and *Lyngbya birgei.* While all are considered to cause nuisance conditions, the former species are more often found in highly eutrophied water bodies, and, unlike the latter species, form surface mats and scums.

FUTURE MONITORING

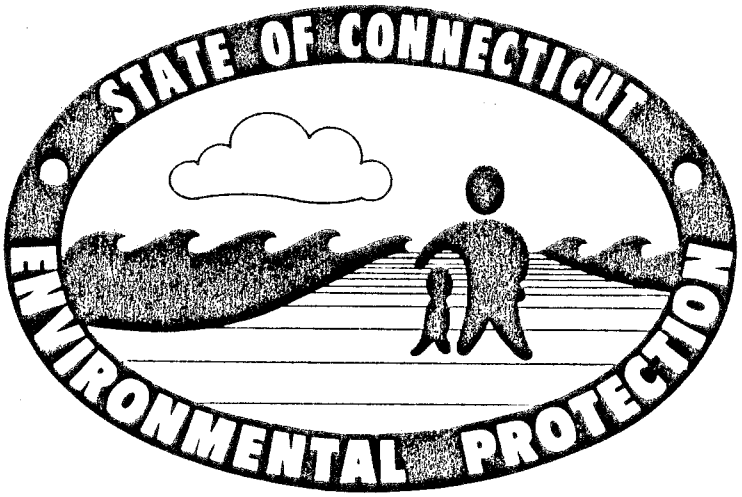
Results of the 1981/1982 monitoring study were inconclusive concerning the trophic response of Lake Lillinonah. This was largely the result of variability in river flow and in nonpoint source loadings due to flooding, and changes in point source loadings in addition to the change at Pittsfield. To resolve this question, Pittsfield's revised NPDES permit requires the Connecticut DEP to monitor water quality in the Housatonic River, including Lake Lillinonah, during the summers of 1985 through 1988. Again, the objective will be to compare conditions without phosphorus removal (1981 and 1984) to conditions with phosphorus removal (1982 and 1985-1988). During these future surveys, Connecticut will also monitor river flow records, precipitation records, and the operational records and effluent monitoring data for other phosphorus-regulated dischargers. The intention is to account for all the major factors that influence trophic conditions in Lake Lillinonah.

Efforts to assess water quality in this basin will continue, and additional controls developed as needed.

Material for this report was furnished by Charles Fredette, Principal Sanitary Engineer for the Connecticut Department of Environmental Protection, and Eric Hall, U.S. EPA Region I.

This report is produced by EPA to document progress achieved in improving water quality. Contributions of information for similar reports are invited. Please contact E. F. Drabkowski, EPA, MDSD, WH-553, 401 M Street S.W., Washington, D.C. 20460 (202) 382-7056.

1984 Housatonic River Fish Monitoring Study



A Report on PCB Levels in Several Species of Fish from the Housatonic River

Department of Environmental Protection
165 Capitol Avenue
Hartford, CT 06106

Introduction

Under an agreement effective June 1, 1984, with the Department of Environmental Protection (DEP), General Electric (GE) measured the PCB levels in various species of fish at four locations in the Housatonic River.

This report gives the results of those tests by species and location.

History of PCBs

PCBs, or polychlorinated biphenyls, are a family of stable and persistent chemical compounds manufactured in the United States from 1929 to 1977. They were used chiefly as a coolant in electrical transformers, capacitors, and heat exchangers. Other uses included components of paints, adhesives, carbonless copy paper, rubber products, printing ink, and plastic wrappers.

The manufacture of PCBs and use other than in certain electrical equipment, has been banned in the United States since 1977.

This ban was imposed by the Toxic Substances Control Act of 1976 after PCBs were found to break down only slowly in the environment and to enter the human food chain through certain foods, including PCB-contaminated fish.

The U.S. Food and Drug Administration (FDA) has responsibility for regulating the amount of PCB which can be present in fish sold in interstate commerce. In 1973, the FDA determined the acceptable level to be 5 ppm (parts per million). In 1984, the acceptable level was reduced to 2 ppm due to continuing concern about long-term human health effects.

PCBs in the Housatonic

From the 1930s until 1977, General Electric used PCBs in the manufacture of transformers at its plant in Pittsfield, Massachusetts, at the headwaters of the Housatonic River. During the 40 years PCBs were used in Pittsfield, some of the discharges of waste PCBs into the river appear to have migrated down the river into Connecticut. Some PCBs were also discharged from other industries along the river. These PCBs are now found in fish in various parts of the river and in some sediments in the Lake Zoar/ Lake Lillinonah area. Tests in 1979 showed PCB levels in fish in excess of 5 ppm in many cases.

The agreement between GE and DEP provides for a number of studies which examine the transport of PCBs within Connecticut, methods of managing PCBs in the Housatonic, the fishing habits of Housatonic River anglers, and the level of PCBs in fish.

The fish studies are to be conducted in three phases: the first phase in 1984, the second in 1986, and the third in 1988. This report includes results of the 1984 phase of the study.

The Fish Study

The fish study was conducted by the Academy of Natural Sciences of Philadelphia, Penn., under contract to General Electric. The Academy collected and analyzed a total of 277 fish of nine different species. Fish were obtained at Cornwall, Bulls Bridge, Lake Lillinonah, and Lake Zoar.

The fish samples were analyzed by a procedure approved by DEP. Table 1 summarizes the results of the analysis of the fish samples. Eleven of the samples were analyzed by both the State of Connecticut and the Academy. There was no significant difference between the two sets of analyses.

Table 1

Location	Species	No. of Fish	Mean PCB (ppm)	PCB Range	% Below 2 ppm
Cornwall	Brown Trout	36	3.5	0.35–14.6	47
	Smallmouth Bass	16	2.4	0.61–6.3	38
Bulls Bridge	Smallmouth Bass	12	1.9	0.88–2.9	50
	Largemouth Bass	24	1.3	0.34–2.8	71
	Yellow Perch	23	1.3	0.46–6.3	87
	Brown Bullhead	12	0.83	0.39–1.4	100
	Sunfish	4	1.25	0.59–1.6	100
	Carp	1	1.1	—	—
Lake Lillinonah	Smallmouth Bass	25	1.2	0.44–2.8	92
	Largemouth Bass	6	1.3	0.84–2.7	83
	White Perch	24	2.3	0.86–5.2	42
	Yellow Perch	3	0.66	0.34–1.2	100
	White Catfish	12	6.8	0.8–55	58
	Brown Bullhead	3	2.4	2.2–2.6	0
	Sunfish	4	1.01	0.52–1.9	100
	Carp	1	2.2	—	—
Lake Zoar	Smallmouth Bass	24	0.49	0.01–1.1	100
	Largemouth Bass	2	0.42	0.42	100
	White Perch	24	0.96	0.55–2.00	96
	Yellow Perch	2	0.065	0.06–0.07	100
	White Catfish	12	2.7	0.97–8.75	42
	Brown Bullhead	2	0.42	0.30–0.53	100
	Sunfish	4	0.55	0.07–1.3	100
	Carp	1	5.0	—	—

Study Results

This report presents the results of the analysis of fish collected in 1984. While 70 percent of the samples contained PCBs at a level below the Food and Drug Administration level of 2 ppm, the study will continue, with tests to

be completed in 1986 and 1988. After the results of the 1988 study have been analyzed and compared to earlier studies, a more definitive measure of the evolving levels of PCBs in the Housatonic will be available. However, it is encouraging to see, as shown in Table 2, a significant reduction in PCB levels from 1979 to 1984 in the five available cases in which comparable data are available. The 1979 data are from a state report and the 1984 data are from the present study. The data show that the PCB levels in these cases were lower by 47 to 84 percent in 1984.

Table 2

Location	Species	1979	1984	
		Mean PCB	Mean PCB	% Reduction
Cornwall	Brown Trout	16.5 ppm	3.5 ppm	79
Bulls Bridge	Smallmouth Bass	11.9 ppm	1.9 ppm	84
	Brown Bullhead	2.5 ppm	0.83 ppm	67
Lake Lillinonah	White Catfish	12.8 ppm	6.8 ppm	47
Lake Zoar	White Catfish	8.8 ppm	2.7 ppm	69

The PCB in Fish Advisory

While fish from the Housatonic are not normally sold in interstate commerce, the Connecticut Departments of Environmental Protection and Health have followed the federal PCB limits in advising state residents on the consumption of Housatonic River fish. The current advisory warns against the consumption of any fish from the study area of the river. The advisory is reviewed on a regular basis to determine whether it needs to be updated. Data such as that gathered in the 1984 Fish Monitoring Study are factored into this review.

The zero creel policy in the Cornwall area will continue as a trout management technique.

Future Reports

Upon completion of the 1988 Fish Monitoring Study, a summary report will be prepared and distributed. In the interim, DEP plans to make periodic presentations to the public on the results of the various studies conducted under the agreement with General Electric.

Department of Environmental Protection
165 Capitol Avenue
Hartford, CT 06106

APPENDIX C

LETTER OF CORRESPONDENCE

NORTHEAST UTILITIES

THE CONNECTICUT LIGHT AND POWER COMPANY
WESTERN MASSACHUSETTS ELECTRIC COMPANY
HOLYOKE WATER POWER COMPANY
NORTHEAST UTILITIES SERVICE COMPANY
NORTHEAST NUCLEAR ENERGY COMPANY

General Offices • Selden Street, Berlin, Connecticut

P.O. BOX 270
HARTFORD, CONNECTICUT 06141-0270
(203) 665-5000

August 22, 1986

Mr. Richard M. Lynn, Jr.
Senior Planner
Housatonic Valley Council of Elected Officials
Old Town Hall, Rt. 25
Brookfield Center, CT 06805

Dear Mr. Lynn:

Thank you for requesting input from Connecticut Light and Power Company (CL&P) - as landowner of the Lake Lillinonah shoreline - relative to the Environmental Review Team's current review of the proposed Landmark and Lakewood Subdivisions in the Town of Bridgewater.

I have reviewed our records and it does appear CL&P owns the shoreline property up to the 210 ft. contour at both proposed subdivisions. This property is part of our federally-licensed Shepaug Hydroelectric Project. The property line and CL&P's ownership of the property below the 210 ft. contour should be clearly marked on all plans of these subdivisions so as to avoid any future confusion on the part of the homeowners in these subdivisions who might otherwise believe they own - or have unrestricted use of - the land below the 210 ft. contour.

You have specifically requested a statement of what uses and construction activities CL&P would allow on its property by the homeowners in these subdivisions. It is our intention to protect and enhance the scenic, recreational, and environmental values of our hydro project and the surrounding area by strictly controlling the use of CL&P shore frontage.

In general, we would allow the use of our shore frontage for access to Lake Lillinonah and for other recreational purposes (one exception worthy of note is camping). However, no construction activity, including, but not limited to, dock/seawall construction, tree/brush clearing, filling/excavation; may be conducted on CL&P property without our specific written permission. In all likelihood we will limit construction activity on our property to the construction of docks for use by adjacent homeowners.

Finally, a thorough title search will have to be conducted by the developers in order to identify any deed rights which they may have to the CL&P shore frontage. We would welcome the opportunity to enter into a dialogue with the developers in order to definitively resolve such matters.

I trust this honors your initial request. Please contact me at 634-5918 should you have any further questions.

Very truly yours,

Ronald A. Pfeffer
Land Management Administrator

RAP/jzs

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 Keane Callahan, 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.