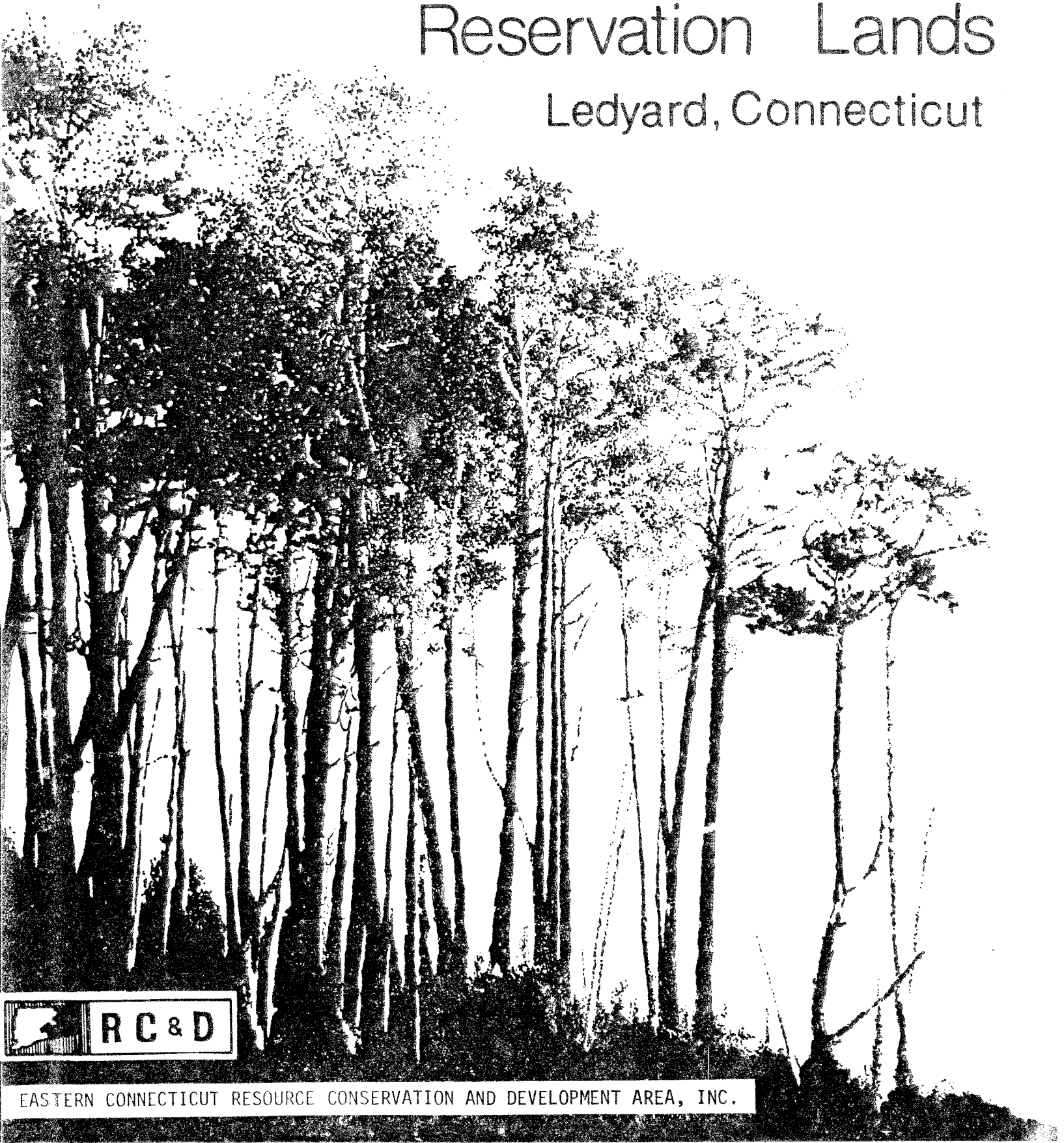
Environmental Review Team Report

Mashantucket Pequot Reservation Lands

Ledyard, Connecticut



RC&D

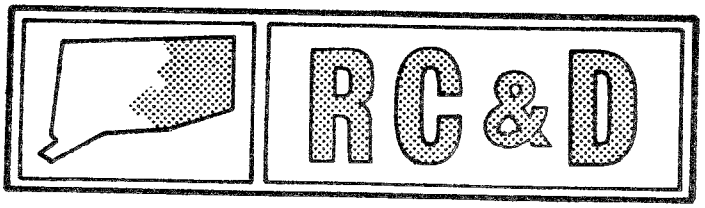
EASTERN CONNECTICUT RESOURCE CONSERVATION AND DEVELOPMENT AREA, INC.

Environmental Review Team
Report

Mashantucket Pequot Reservation Lands

Ledyard, Connecticut

April 1985



Eastern Connecticut Resource Conservation & Development Area

Environmental Review Team
PO Box 198
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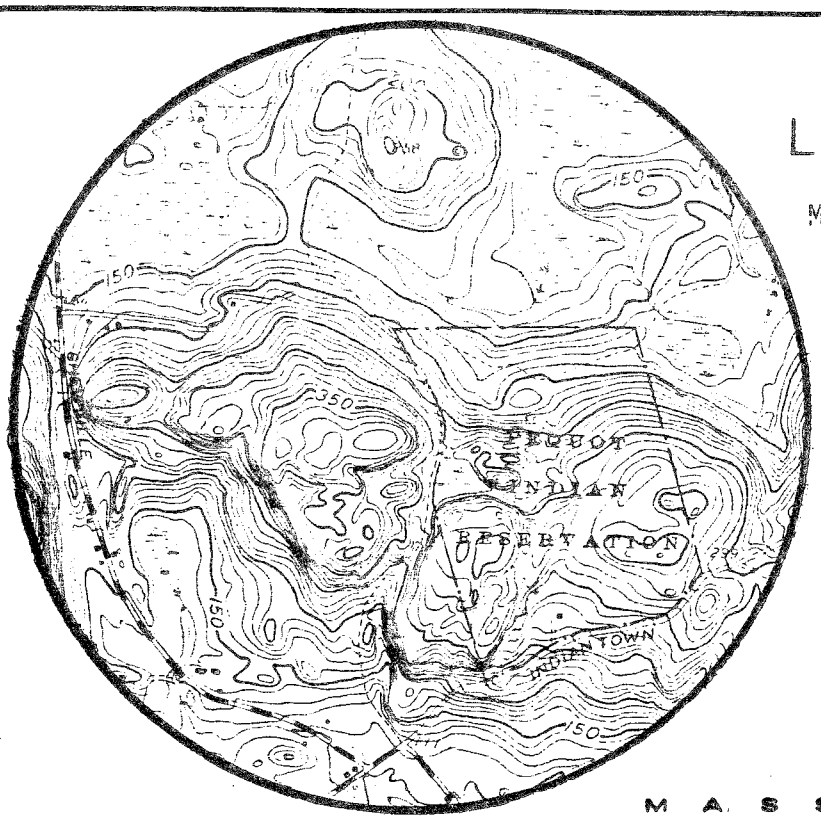


Location of Study Site

MASHANTUCKET PEQUOT RESERVATION LANDS
LEDYARD, CONNECTICUT

EASTERN CONNECTICUT
RESOURCE CONSERVATION AND DEVELOPMENT PROJECT

ENVIRONMENTAL REVIEW TEAM REPORT
ON
MASHANTUCKET PEQUOT INDIAN RESERVATION
LEDYARD, CONNECTICUT

This report is an outgrowth of a request from the Mashantucket Pequot Tribal Council to the New London County Soil and Water Conservation District (S&WCD). The S&WCD referred this request to the Eastern Connecticut Resource Conservation and Development (RC&D) Area Executive Committee for their consideration and approval. The request was approved and the measure was reviewed by the Eastern Connecticut Environmental Review Team (ERT).

The soils of the site were mapped by a soil scientist from the United States Department of Agriculture, Soil Conservation Service (SCS). Reproductions of the soil survey map, a table of soils limitations for certain land uses and a topographic map showing property boundaries were distributed to all Team members prior to their review of the site.

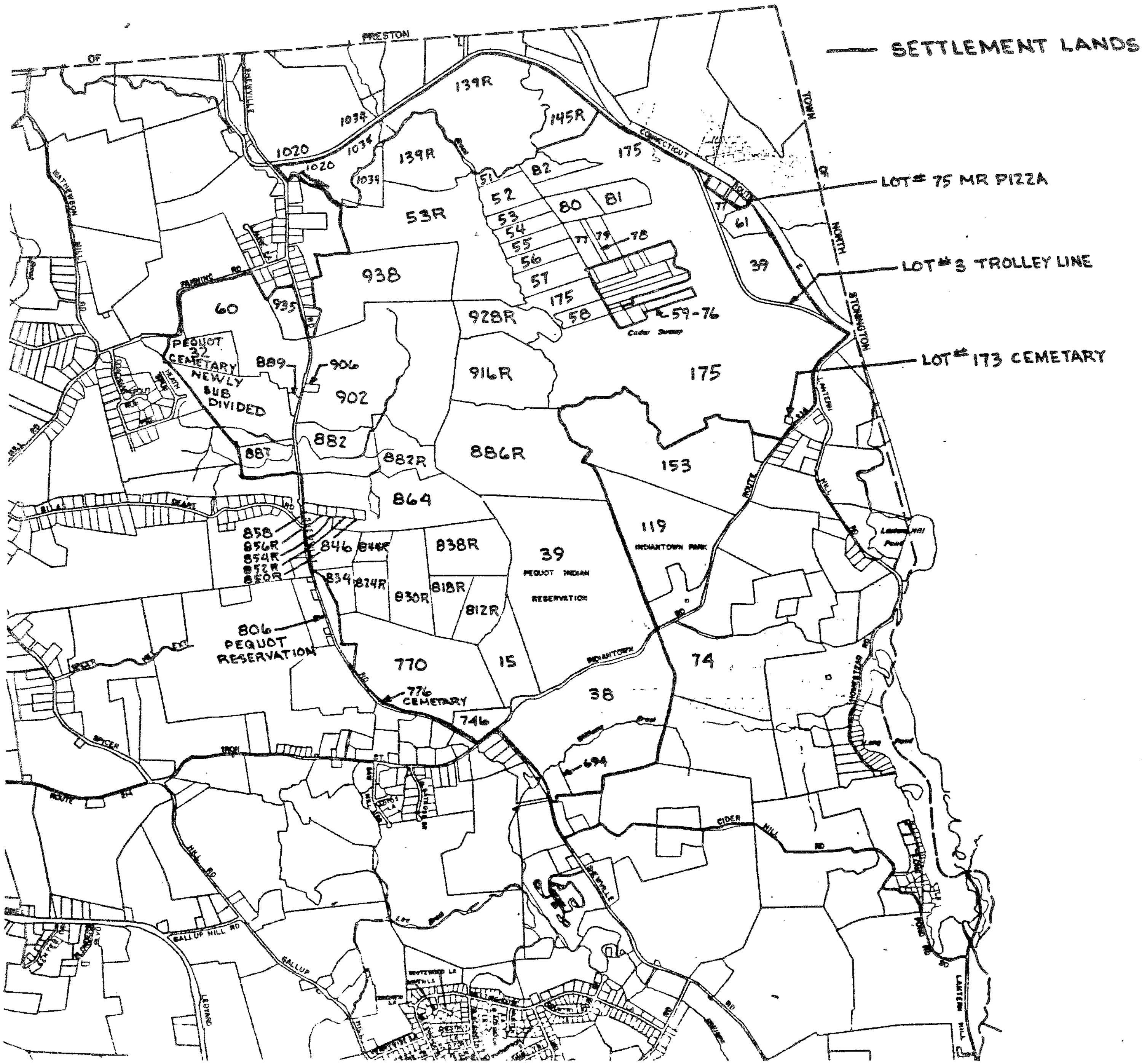
The ERT that field checked the site consisted of the following personnel: Barry Cavanna, District Conservationist, Soil Conservation Service (SCS); Tim Dodge, Resource Conservationist (SCS); Bill Warzecha, Geologist, Connecticut Department of Environmental Protection (DEP); Pete Merrill, Forester, DEP; Ken Metzler, Ecologist, DEP; Judy Wilson, Biologist, DEP; Kevin McBride, Archaeologist, Public Archaeology Research Teams, and Jeanne Shelburn, ERT Coordinator, Eastern Connecticut RC&D Area.

The Team met and field checked the site on Thursday, June 21, 1984. Reports from each contributing Team member were sent to the ERT Coordinator for review and summarization for the final report.

This report is not meant to compete with private consultants by supplying site designs or detailed solutions to development problems. This report identifies the existing resource base and evaluates its significance to the proposed development and also suggests considerations that should be of concern to the developer and the Mashantucket Pequot Tribal Council. The results of this Team action are oriented toward the development of a better environmental quality and the long-term economics of the land use.

The Eastern Connecticut RC&D Area Committee hopes that this report will be of value and assistance in making any decisions regarding this particular site.

If you require any additional information, please contact: Ms. Jeanne Shelburn, Environmental Review Team Coordinator, Eastern Connecticut RC&D Area, Rte. 205, Box 198, Brooklyn, Connecticut 05234, 774-1253.



SETTLEMENT LANDS
LOT# 75 MR PIZZA
LOT# 3 TROLLEY LINE
LOT# 173 CEMETARY
PRESTON
TOWN OF NORTH STONINGTON
139R
145R
175
1020
1034
139R
51
82
52
80
81
53R
53
54
55
56
57
77
79
78
61
39
938
175
58
59-76
60
935
928R
PEQUOT 32 CEMETARY NEWLY SUB DIVIDED
889
906
902
916R
175
882
887
882R
886R
153
864
119
INDIANTOWN PARK
858
856R
854R
852R
850R
846
844R
838R
39
PEQUOT INDIAN RESERVATION
834
874R
830R
818R
812R
806 PEQUOT RESERVATION
770
15
74
776 CEMETARY
38
746
694
ROUTE 214
CIDER HILL RD
GALLUP HILL RD

INTRODUCTION

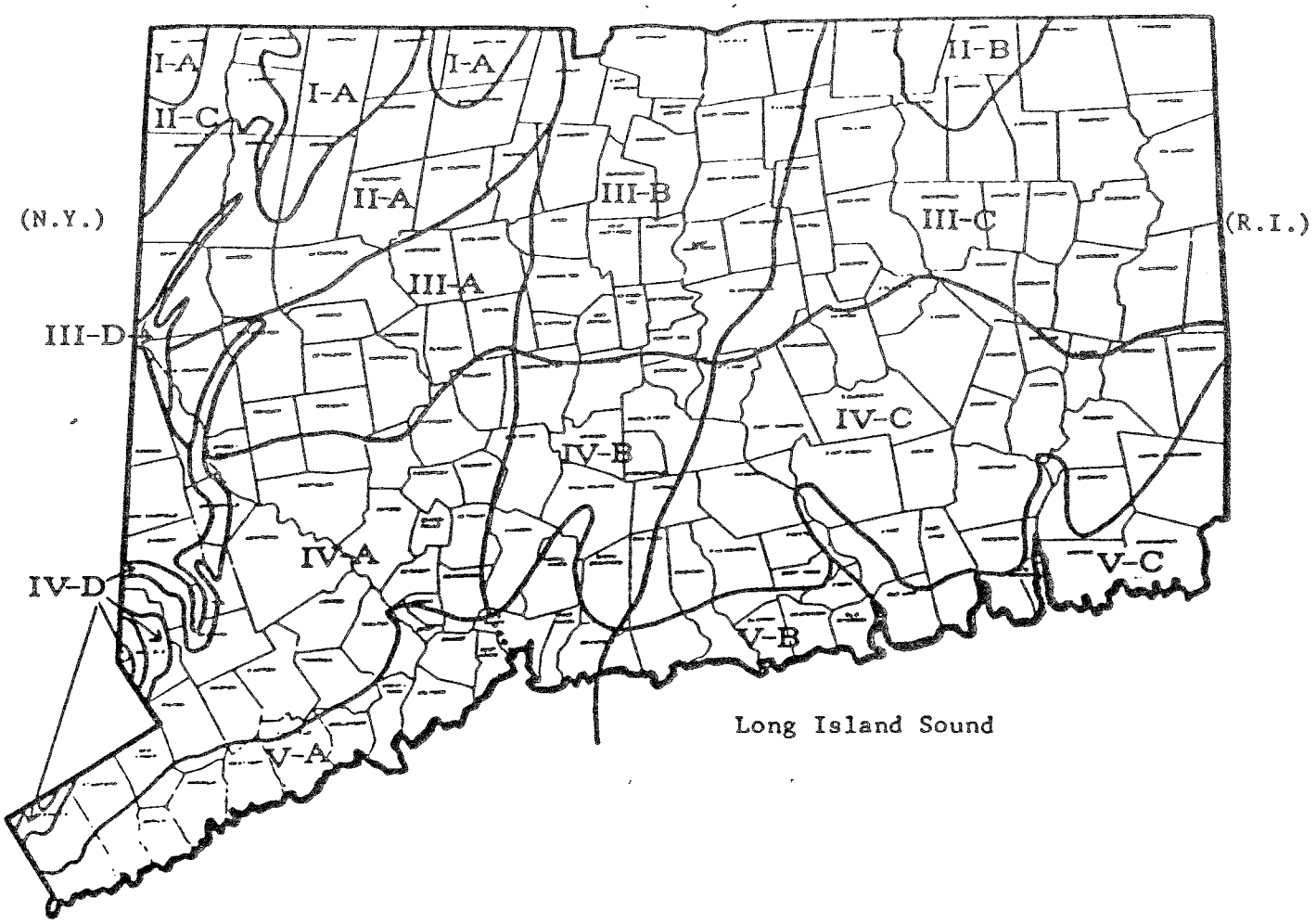
The Eastern Connecticut Environmental Review Team was asked to prepare a natural resource inventory for the Mashantucket Pequot Tribal Council "Trust Lands." The Mashantucket Pequot Tribe has recently been awarded funding from the federal government for acquisition of additional reservation lands. The Tribe hopes to use the information in this report to help them make informed acquisition decisions and for use in future planning of development projects. The project site is roughly bounded by Connecticut Route 2 on the north, Indiantown Road on the southeast and Shewville Road on the west. It is comprised of approximately 1200 acres.

The proposed Mashantucket Pequot tribal reservation is located in the Southeast Hills ecoregion as identified by Dowhan & Craig (1976). An ecoregion is an area of land characterized by a distinctive pattern of landscapes and regional climate as expressed by the vegetation. The proposed reservation has a characteristic landscape for this ecoregion and its low, rolling hills interspersed with deposits of stratified sands and gravels and swamp materials make this land not unlike the surrounding area. Geologically, the Southeast Hills ecoregion is similar to much of Connecticut, underlain by metamorphic gneisses and schists of Paleozoic age, complexly folded into north-trending belts. Soils have developed primarily on glacial till and, in the valley areas, on glacial meltwater deposits or on organic peats and mucks of various depths. The climate of this region is quite similar to most of southern Connecticut, with a mean annual temperature of about 49°F, seasonal snowfall accumulation of approximately 40 inches and an average frost-free season of 140-170 days.

Within the proposed reservation two major landscapes are present. The till uplands occurs over much of the western and southern portion of the land, occupying the higher bedrock-controlled terrain. Till uplands are the predominant landscape in southeastern Connecticut.

Undulating terraces occur in the northeastern portion of this property, and in contrast to the unsorted tills covering the upland areas, these are composed of irregular deposits of water-worked sand, silts and gravels. The terrace landscape is well-expressed northwest of the proposed reservation land, and known as the Preston Plain, represents some of the best agricultural land in the State.

As previously mentioned, the till upland landscape is distinguished by its rolling, sometimes rugged terrain overlain by rocky glacial till. Soils are variable in depth with shallow well-drained soils found primarily on the summits of the hills and on steep slopes. On the lower slopes and in depressions, the soils are deeper and progressively more poorly drained. In some deep bedrock pockets, organic materials have accumulated due to the poorly drained conditions. The vegetation of these hills is primarily mixed oak forests, although some areas of mixed transitional hardwoods do occur, especially on moist soils of the lower slopes.



ECOREGIONS OF CONNECTICUT (Dowhan & Craig 1976)

I. Northwest Highlands-Northern Hardwoods zone
   A. Northwest Highlands ecoregion

II. Northern Uplands-Transitional Hardwoods zone
   A. Northwest Uplands ecoregion
   B. Northeast Uplands ecoregion
   C. Northern Marble Valley

III. Northern Hills-Central Hardwoods-White Pine zone
   A. Northwest Hills ecoregion
   B. North-Central Lowlands ecoregion
   C. Northeast Hills ecoregion
   D. Central Marble Valley

IV. Southern Hills-Central Hardwoods zone
   A. Southwest Hills ecoregion
   B. South-Central Lowlands ecoregion
   C. Southeast Hills ecoregion
   D. Southern Marble Valley

V. Coastal Hardwoods zone
   A. Western Coastal ecoregion
   B. Central Coastal ecoregion
   C. Eastern Coastal ecoregion

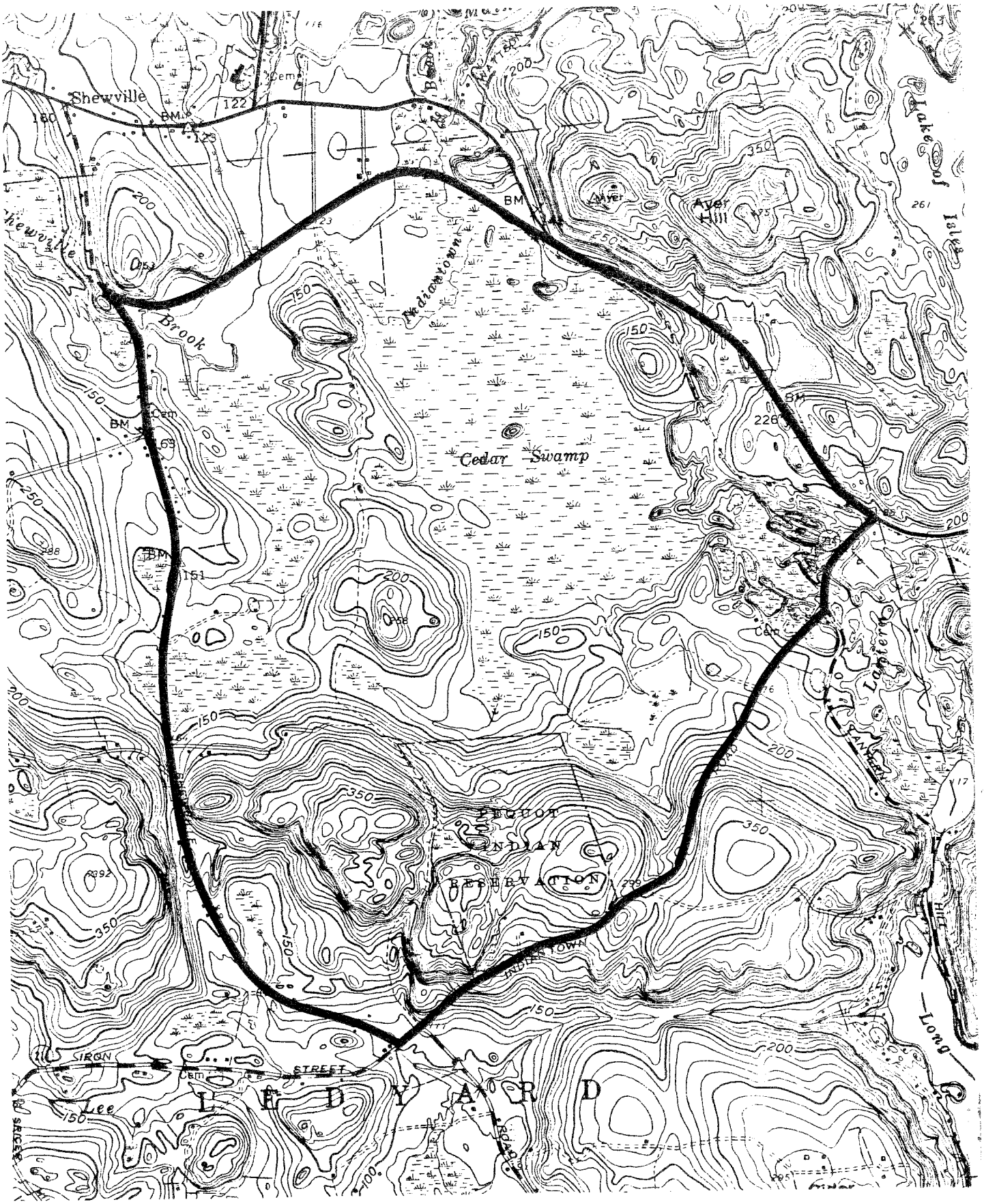
In contrast, the terrace landscape is distinguished by an undulating to pitted topography grading, sometimes rather abruptly, to a large wetland. This wetland, the "cedar swamp," occupies a large kettle formed by the melting of an ice block buried by water washed glacial material, resulting in a collapsed, previously level surface. Similar but smaller kettles are found on the far eastern portion of this property. Here, the soils are variable in texture and drainage with the moisture-holding capacity related to the amount of silt in the upper soil layers. Soil drainage ranges from somewhat excessive on the higher sandy knolls on the northern border of the property to somewhat poorly along the wetlands edge, with the best soils found in the northwestern portion of the land. The vegetation of the terraces is primarily mixed oak forests with a considerable, sometimes dominant mixture of conifers. The wetland vegetation ranges from red maple-hardwoods to mixed conifers to dense shrub thickets, depending on land-use history and depth to standing water.

The Team hopes that the information contained in this report will help the Tribe in future acquisition and planning for tribal lands.

Topography

Site Boundary

0 2000' scale



ENVIRONMENTAL ASSESSMENT

TOPOGRAPHY

The additional reservation land currently being considered for future acquisition by the Mashantucket-Pequot Tribal Council is located in the northeast corner of Town. The site is bounded on the north by Route 2, on the south and east by Indiantown Road (Route 214), and Shewville Road on the west. It should be noted that portions of the acquisition land extend southward beyond Indiantown Road (Route 214) as well as west of Shewville Road.

With the exception of residential dwellings on the present Pequot Indian Reservation of Indiantown Road, the study site is largely undeveloped and is characterized by a diverse topography. Slopes vary widely from relatively flat to very steep. Steepest slopes throughout the study site, which are precipitous in some areas are associated with bedrock exposures. There are also steep slopes along ridges in the eastern limits of the site. However, these slopes are controlled largely by those unconsolidated materials (surficial deposits) overlying the bedrock (see Geology section of this report). They are visible on the sides of ridges between the Cedar Swamp and Route 2. Maximum and minimum elevations on the study site are ±390 feet and 110 feet above mean sea level (see Topographic map).

The most distinct topographic feature on the site is Cedar Swamp. It occupies approximately 480 acres in the central portion of the study area. Indiantown Brook traverses the northern section of Cedar Swamp. There are several other unnamed perennial watercourses flowing through the site. These watercourses discharge either into Cedar Swamp, Indiantown Brook or into Williams Brook south of the study area.

GEOLOGY

The future acquisition land is encompassed entirely by the Old Mystic topographic quadrangle. Bedrock and surficial geologic maps for the quadrangle have not been completed to date. There is unpublished information regarding both maps which are available for review purposes only at the Department of Environmental Protection's Natural Resources Center. It should be noted that the "Preliminary Bedrock Geological Map of Connecticut" by John Rodgers was referenced for the purpose of this report.

The bedrock within the study area is predominantly metamorphic rock (i.e., rock altered by great heat and/or pressure deep with the earth's crust), as well as igneous rock (i.e., rock which has formed from the solidification of molten magma). All of these rocks have been subjected to much deformation and have

Bedrock Geology

0 2000'
scale

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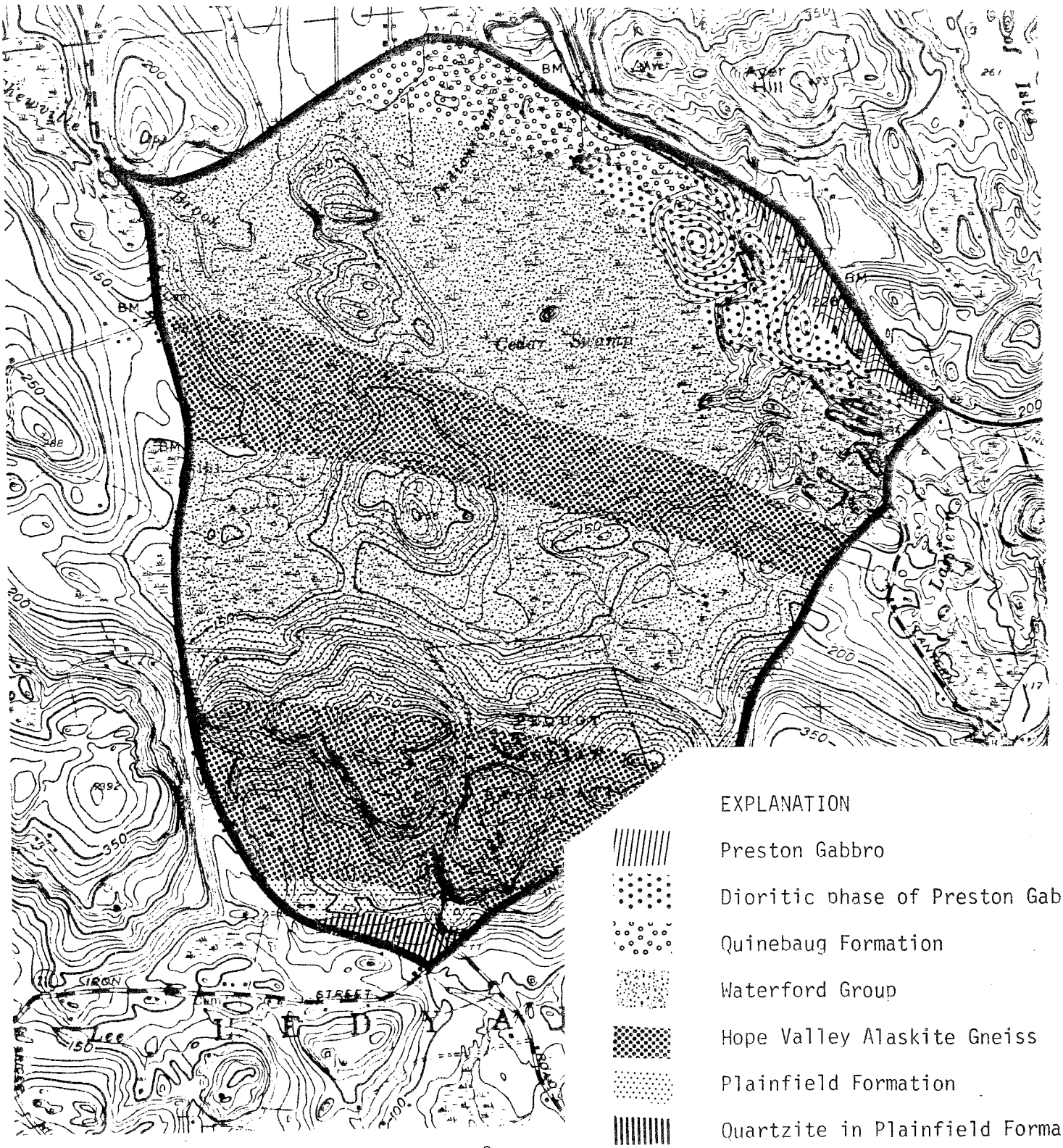
* This map shows the approximate distribution of rock units crossing the study area. It has been adapted from the unpublished Bedrock Geologic Map for the Old Mystic Quadrangle by Richard Goldsmith and the "Preliminary Bedrock Geologic Map of Connecticut" by John Rodgers.



been cut by several faults since they were formed during the early to late Paleozoic geologic period (575-250 million years ago). The various rock formations generally cross the site in an east-west direction.

Most of the bedrock that underlies or outcrops within the study area is gneissic. "Gneisses" are cyrstalline metamorphic rocks in which layers of granular mineral grains are interspersed with bands. These rocks are composed chiefly of the minerals quartz, micas, and feldspars. Other types of metamorphic rocks found in the study area include schists and quartzites. These rocks are associated with the Plainfield Formation in the southern parts of the review area. "Schists" are crystalline, metamorphic rocks in which elongate, platy or flaky minerals (micas, hornblende) are predominant and parallel, giving the rock a slabby appearance. "Quartzites" are also metamorphic rocks, however, they consist essentially of the mineral quartz.

Rocks of igneous origin underlies or crops out in the northeast corner of the study area south of Route 2. A "diorite" is a relatively dark, medium to coarse grained igneous rock composed essentially of the mineral feldspar (plagioclase). Other minerals include biotite and/or hornblende. The mineral quartz is usually absent or found in small quantities in the rock. The term "gabbro" refers to a coarse-grained, dark-colored rock which is composed of the minerals plagioclase, feldspar and pyroxene. This rock unit is referred to as Preston Gabbro. The "diorite" rock mentioned above is geologically associated with the Preston Gabbro.

A bedrock geologic map accompanying this report, which is adapted from Rodgers' map, shows the approximate distribution of the various rock types within the future acquisition lands. The principal minerals that make up the rocks, shown on the accompanying map, have little economic value in themselves; however, some of the gneissic rocks, in particular, the Hope Valley Alaskite Gneiss and the gneisses of the Waterford group, have been quarried for building stone in some places in the area. Because of its toughness and high crushing strength, diorite has been used for rip-rap.

Bedrock in most of the study area is overlain by unconsolidated materials which are mostly of glacial origin. Based on the soils map submitted to Team members on the day of the field review, the most widespread surficial deposit is till. It covers nearly 55 percent of the study area. Till is a non-sorted, unconsolidated sediment that was deposited directly from the glacier ice, consisting of a complex mixture of sand, silt, clay, gravel, and boulders. The texture of till is commonly sandy, stony and relatively loose in the upper few feet. At depth, it becomes much more silty and compact. Due to the compact layer associated with till soils, it is often difficult to penetrate these layers with handtools; hence, the name "hardpan." In addition, these compact layers often impede the downward movement of groundwater, resulting in a high groundwater table, especially during the wet times of the year. Thicknesses of the till range from zero, where rock outcrops, to probably not more than 10 feet at various points between outcrops. It may be thicker on north facing slopes, perhaps in excess of thirty feet in some places.

The other type of glacial sediment, stratified drift, covers the site in scattered areas throughout the eastern, southern and northern sections. It covers nearly 15 percent of the study area (see Surficial Geologic Map). Unlike till,

Surficial Geology

0 2000'
scale

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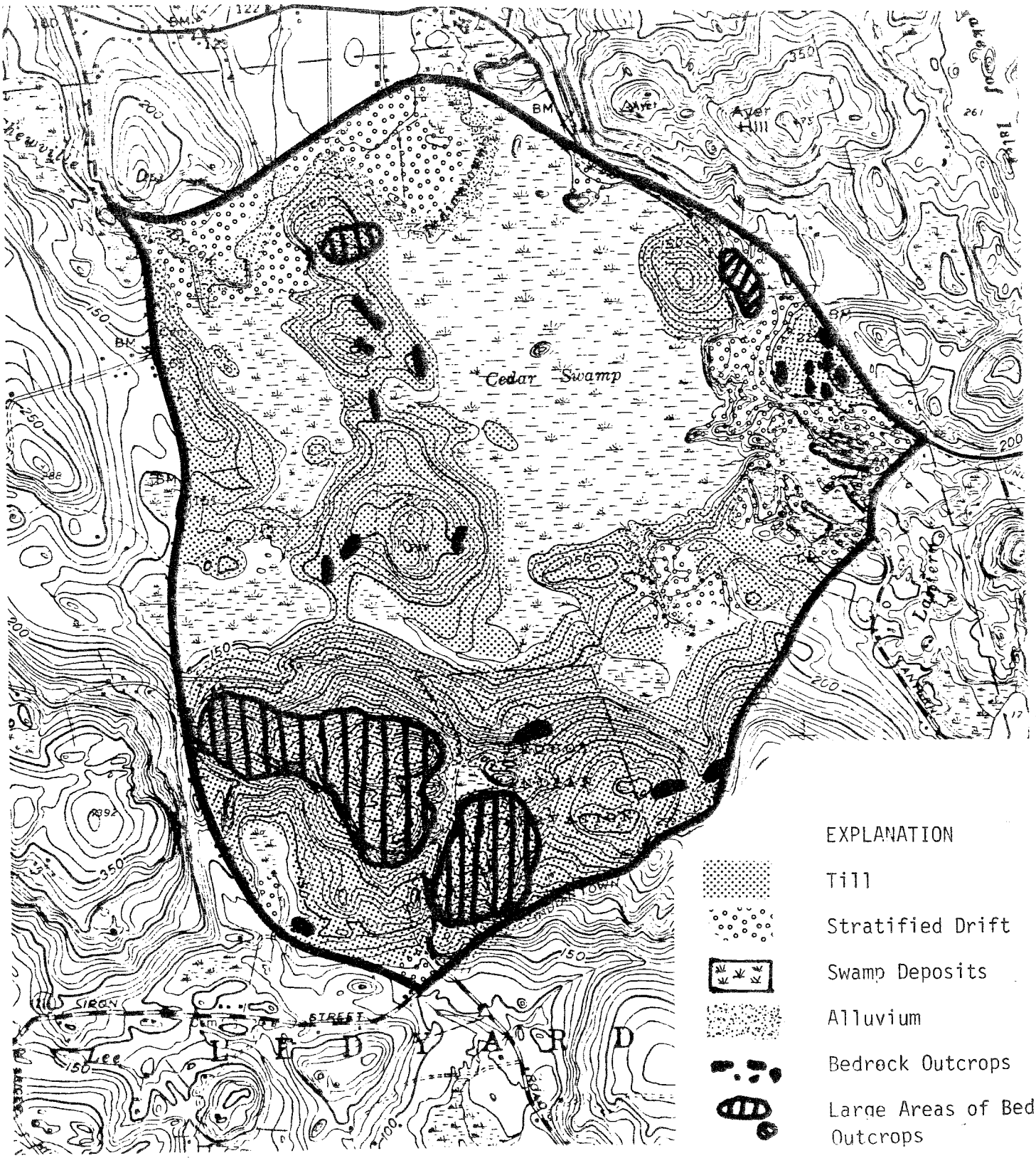
* Adapted from the unpublished Surficial Geologic Map for the Old Mystic Topographic Quadrangle (Gafney) and the Soil Survey for New London County, Connecticut published by the USDA Soil Conservation Service-



stratified drift consists of sediments (silt, sand, and gravel) which were transported and deposited away from the mass or adjacent to wasting ice by meltwater streams. As the glacier ice retreated, tongues of ice became restricted to low-lying areas and valleys. Meltwater streams emanating from the wasting ice carried tremendous volumes of rock material that had been formerly been incorporated in the ice mass. The meltwater streams sorted the sediments to some degree and deposited them into layers (stratified).

The topography throughout the eastern limits of the site include geologic structures of ice contact stratified drift (sediments deposited on, under or adjacent to wasting block(s) of ice). Striking examples of kames, kame terraces, crevasse fillings and kettle are visible in the eastern limits of the study area between Cedar Swamp and Route 2. A "kame" is an ice contact geologic structure consisting of a conical-shaped hill of sand and gravel. One example of a kame in the study area is the small island in the middle of Cedar Swamp. "Kame terraces" are defined as terrace like bodies of stratified drift which were deposited between an ice mass and an adjacent valley wall. The kame terraces formed these steep sided hills when the ice wasted away leaving behind the sediments. "Crevasse fillings" formed when fractures in the ice mass filled with meltwater sediments and later when the ice mass wasted away left behind steep-sided, sinuous ridges. Another striking example of an ice-contact stratified drift feature in the eastern limits of the site are kettles. "Kettles" were formed when ice blocks buried by glacial sediments melted away causing the sediments to collapse into irregular, often deep basins. Kettles are visible just north of the old Main cemetary in the eastern section of the study area.

The future acquisition lands which are covered by stratified drift are delineated by the symbols Afa (Agawam), HcA (Haven, HkD (Hinckley), Nn (Ninigret), Ts (tisbury), and MyB,C (Merrimac) on the accompanying soils map. Thickness of the stratified drift range between zero in rock outcrop areas to probably not more than 120 feet (Source: Connecticut Water Resources Bulletin No. 15). It is thickest southeast of the Hall Farm (near Indiantown Brook) in the northern limits of the study area.

Depending upon the textural quality and uniformity of the stratified drift covering the study area, it may be usable as aggregate and local fill. Vitali (1968) has mapped the deposits suitable for aggregate that are available in the Old Mystic quadrangle.

Overlying till, stratified drift and/or bedrock throughout 30 percent of the study area are swamp sediments. "Swamp sediments," which formed generally after the glacier ice retreated from the area, consists of decayed organic material (peak and muck) mixed with some silt, clay, and sand which accumulated in a fairly stagnant environment. The most notable wetland area within the study area is "Cedar Swamp." Although there is no test hole data available for the swamp, the swamp deposits are probably quite thick. A large portion of Cedar Swamp is probably underlain by fine-grained stratified drift deposits (Source: "Glacial Geology of the Old Mystic Quadrangle, New London County, Connecticut," Joseph W. Gaffney). Areas covered by regulated wetland soils are delineated by the symbols Aa (Adrian and Palms muck), Ce (Carlisle Muck), Rc (Raypol silt loam), Sf (Scarboro muck, fine, sandy loam), Wd (Walpole soils), Ro (Rippowam soils), and Rn (Ridgebury, Leicester and Whitman soils) on the accompanying

soils map. With exception of the Ridgebury, Leicester and Whitman soils, the water table is at or near ground level in these soils throughout most of the year. These soils characteristically have a seasonally high water table and generally run parallel to perennial and/or intermittent drainage channels.

Due to the high groundwater table associated with the above mentioned soils, most types of development (i.e., residential, light industrial, commercial) would not be well suited in these areas. From a hydrological viewpoint, these wetland areas serve many valuable functions. They act as natural runoff retention basins, reducing downstream flood flows during periods of heavy precipitation. They trap sediment from upstream areas. They also change water quality through a natural biochemical process, often resulting in cleaner water. In addition, wetlands serve as habitat for many species of animals and plants. For these reasons and others, construction in wetlands or wetland fillings/ modification should be strongly discouraged and avoided, if possible.

Another post-glacial sediment found within the study area are alluvial deposits. "Alluvial deposits," which are delineated by the symbol Ro (Rippowam soils) on the soils map, consists mostly of sand, silt and gravel that was deposited along Indiantown Brook.

Development Concerns

On the review day, Mr. Hayward indicated to Team members that there are generally three areas within the future acquisition lands in which the Tribal Council may consider some type of residential, commercial and/or light industrial development. The potential residential development areas include the land south of Indiantown Road (Route 214) and in areas within the existing Pequot Indian Reservation, north of Indiantown Road. The land being considered for light industrial and/or commercial development consists primarily of the land situated between Cedar Swamp and Route 2 in the eastern limits of the study area.

Because a municipal sewer line is not available to the study area, any potential development whether residential, light industrial, or commercial, would require the installation of onsite sewage disposal systems. It was indicated to Team members at the field review that a public water supply currently serving the Indian Reservation would be extended to serve future residential development within the Indian Reservation as well as to serve the residential area being considered along the southside of Indiantown Road. Unless the public water supply line was extended to serve the future acquisition lands, especially the land being considered for light-industrial or commercial development, individual onsite wells will also be required.

From a geological standpoint, it appears that the following conditions will limit the development potential within the study area: (1) areas where bedrock is at or near ground surface (primarily in areas delineated as Crc, Crd, Hrc and HrD on the soils map); (2) the moderately to steeply sloping areas; (3) the presence of compact till soils, which commonly have slow percolation rates and which also commonly have seasonally high groundwater tables resulting from the compact soil layers at depth; and (4) the presence of wetlands, which may have year around and/or seasonally high groundwater tables. These geologic conditions will weigh heaviest on the ability to provide adequate subsurface

sewage disposal systems. However, properly engineered septic systems, which are properly installed and maintained, may be able to surmount some of these limitations. In order to determine whether or not subsurface sewage disposal is feasible in areas being considered for development, it will be necessary to conduct detailed soil testing (deep test pits, percolation tests) on each lot. Once detailed analysis of the soils has been conducted, it should enable the project engineer to determine the soils relative ability to absorb sewage effluent and ultimately an acceptable density for a particular area.

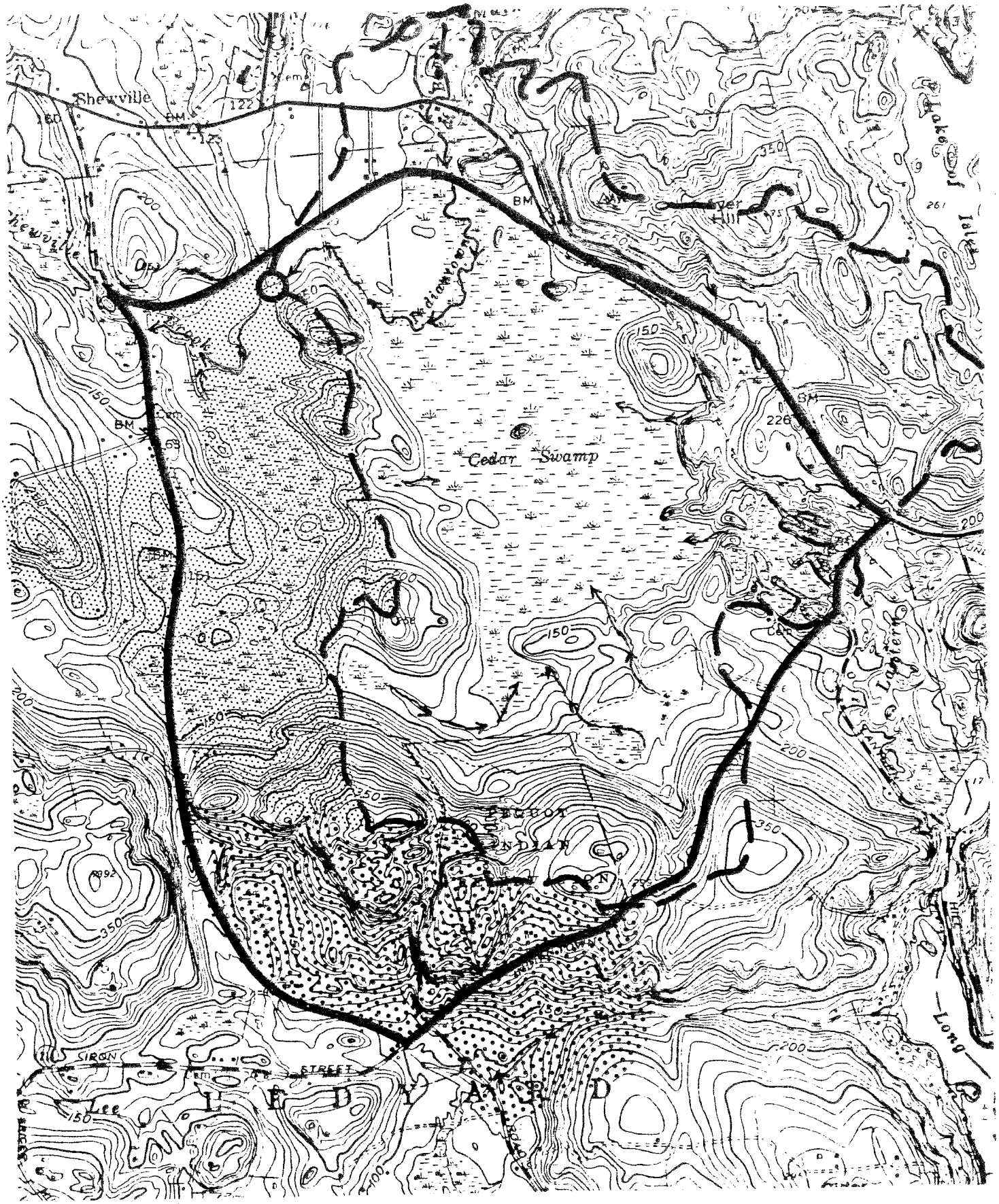
Based on visual inspection and soil mapping information, some of the land situated between Cedar Swamp and Route 2 would appear to be acceptable for light industrial or commercial use. This area is covered predominantly by stratified drift deposits as well as some thick till soils which would probably be favorable for construction of onsite sewage disposal systems. As mentioned earlier, extensive site investigations and detailed soils analysis first would be required in order to determine whether or not the land is really suited for commercial and/or light industrial use. Since onsite well(s) would be required to serve development in this area, a commercial or light industrial use which would require major wastewater discharges should be discouraged. Groundwater discharges in that area may result in pollution of the bedrock and/or sand and gravel aquifer, which would probably be the principal water supply sources in the area. This is compounded by the fact that the soils in the proposed light industrial, commercial area are commonly highly porous in nature. Any pollutants that are disposed of directly, or otherwise make their way into the ground, will have little opportunity to be renovated by the soil components. It seems likely that septic discharges from small or possibly moderately sized sewage systems would be acceptable in some areas in the eastern section of the study area, assuming the systems were properly designed and installed.

HYDROLOGY

Most of the future acquisition lands, which comprise approximately 1,214 acres, lies within the drainage area of Indiantown Brook. The Brook traverses the northern parts of the study area. The drainage area for Indiantown Brook may be defined as the entire area from which surface runoff may be carried into the brook, either by sheet flow or streamflow. The western section of the study area drain into Shewville Brook, which flows eastward. The remaining portions of the study area (southern section) lie in the watershed of an unnamed tributary to Williams Brook. This unnamed stream flows westward through the southern portion of the study area. The watershed boundary for each of the watercourses mentioned above, which trends along the upper crests of hills and ridges (i.e., Ayer Hill, Lantern Hill, Cider Hill) surrounding the site is delineated on the attached Drainage Area Map.

Both residential and commercial/light-industrial uses in the respective areas presently being considered for development would be expected to increase the amount of runoff during periods of rainfall. These increases would result from soil compaction, removal of vegetation, and placement of impervious surfaces (roofs, driveways, parking areas, etc.) over the soil. Since the commercial

Drainage Areas

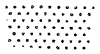


Drainage Areas

EXPLANATION


Indian Brook Watershed


Design Point


Portion of study area draining to Shewville Brook


Portion of study area draining to unnamed tributary of Williams Brook

Watercourses - showing direction of flow

and light industrial uses would tend to require more impervious surface area (for parking lots and bigger buildings), the runoff increases for that type of development would tend to be higher than for residential development. As a result, it is recommended that a judicious stormwater management plan which incorporates erosion and sediment control measures be formulated with implementation of residential and/or commercial, light-industrial development. An effective stormwater management plan, along with judicious planning, will help protect the water resources within the study area. Some of the wetland areas in the study area might also be useful for controlling postdevelopment increases in runoff.

As mentioned earlier, public water facilities would be extended to serve the residential area presently being considered south of Indiantown Road. Unless public water facilities become available to the area being considered for commercial and light-industrial use, bedrock and/or the stratified drift deposits are potential sources of water for this area. Bedrock is commonly capable of providing small but reliable yields of groundwater to individual wells. Groundwater moves through bedrock by way of an interconnected fracture system. Most wells that penetrate 150 to 200 feet of bedrock will intersect enough fractures to supply at least 2 to 3 gallon per minute (gpm). Some wells, however, fail to intersect any water bearing fractures. There is no practical way of predicting whether any particular location will be good for drilling a well. A survey of bedrock wells in Connecticut Resources Bulletin No. 15 (Lower Thames and Southeastern Coastal River Basin) indicates that more than 90 percent of these wells that were drilled into a rock type similar to that found in the study area yielded 3 gpm or more. This yield is equivalent to 4,320 gallons per day. Land uses requiring a substantial amount of water would probably necessitate the drilling of more than one well. On the other hand, short term daily needs for high flow rates might be met by a low yielding well in conjunction with a water storage tank.

Stratified drift deposits may have a high potential for serving as a public groundwater supply source. The potential of any particular location depends upon the texture and thickness of the deposits at that location, the proximity to streams and the size of those streams, and other hydrogeologic factors. If coarse-grained layers of substantial thickness are present at depths of 40 feet or more, there is a good potential for a well yield in excess of 100 gpm. The "Groundwater Availability Map for Connecticut," by Daniel B. Meade suggests that the stratified drift underlying and in the general vicinity of Cedar Swamp may be fine-grained. Because the pore spaces in the fine-grained stratified drift are relatively close together, they may not transmit water as easily as coarse-grained stratified drift, which would have larger pore spaces available for storing and ultimately transmitting the water. As a result, the presence of fine-grained stratified drift in this area may only have potential for yielding small to moderate amounts of groundwater to wells (1-100 gpm). In order to determine the adequacy of the fine-grained stratified drift deposits in this area for supplying water, it will be necessary to drill test wells in different locations.

Based on Meade's map, as well as unpublished information on file at the Department of Environmental Protection's Natural Resources Center in Hartford (Potential Aquifer Map for the Old Mystic Quadrangle), it appears that the stratified drift

deposits to the north of the old Main cemetery (off Indiantown Road) may be most favorable for yielding a high producing well (between 50-2,000 gpm). The stratified drift in this area is thought to be coarse-grained (Source: "Groundwater Availability Map of Connecticut," D. E. Meade). However, it will be necessary to conduct a detailed hydrogeologic study of the area, which includes test wells, in order to determine the adequacy of the stratified drift.

The quality of groundwater at the subject property should be satisfactory. The bedrock underlying the site may contain iron-bearing minerals. As a result, there is a chance that some undesirable level of iron and/or manganese may occur in well water drawn from the study area. Since the stratified drift in the study area is derived from the local bedrock, there is also a chance of elevated iron and/or manganese levels in a sand and gravel well.

If test wells are drilled to determine the adequacy of the stratified drift deposits, it is advisable to collect water samples and have them submitted for water quality analysis.

All well(s) should be properly located and protected from all possible sources of contamination. This may be accomplished by proper installation of all well(s), sufficiently separating well(s) from possible contaminants and in a location which would be away from the normally expected flow of groundwater and contaminants which could be introduced by subsurface sewage disposal systems, industrial wastes, etc.

SOILS

Most of the soils within the boundaries of the study site are of loamy glacial till origin. Some areas are of sandy and gravelly gacial outwash origin and are along drainageways and near large wetland areas. The largest single area of wetland soils are in the northeast section of the parcel. Most of the sandy and gravelly outwash soils are east and southeast of this area.

Generally, the parcel consists of rolling hills, ridges, steep slopes and areas of rock outcrops. It is mostly wooded and very stony. The cleared areas are along the parcels north and northwestern boundaries on active farms. The reservation, which is located in the south central part of the parcel, is partly urbanized with modern housing over a few acres.

Most of the soils of the parcel suited to agriculture uses are currently being farmed. A few small isolated areas are located along Connecticut Route 2, but are forested. These soils also meet the criteria established for prime farmland soils. A complete list of soils on the property with map symbol and name is located in the appendix of this report. Important farmland soils along with wetland soils are also identified on this list.

Prime farmland is defined as land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops. The land could be cropland, pastureland, forestland, or other land, but not urban built-up land or water. Prime farmland has the soil quality,

growing season, and moisture supply needed to economically produce sustained high yields of crops when treated and managed according to modern farming methods.

Additional farmlands of statewide importance include those that are nearly prime farmland and that economically produce high yields of crops when treated and managed according to modern farming methods. Some may produce as high a yield as prime farmland if conditions are favorable.

Most of the soils are suited to building site development, but with some restrictions. The prime building areas are naturally the areas that are prime for agriculture. However, some areas along Route 2 and to the west along Shewville Road are well suited to building site development use, but are not suited to agriculture.

The property is a natural for recreational activities such as paths and trails. The steepest and roughest area of the parcel is in the south and southwestern portions. Here the slopes are too steep for most recreational activities.

Wetlands are scattered throughout the property along small stream channels and between high ridges. The larger wetland areas are in the north portion around Cedar Swamp and Shewville Brook. The soils in these areas are mostly deep organic mucks. Some areas have muck as deep as 51 inches over sandy and loamy mineral materials. They are identified on the soil map with the symbols "Aa." Other organic soils identified with the symbol "Ce" have muck deeper than 51 inches and extending to some undetermined depth.

Accompanying this report are interpretations relative to building site development for the area along Route 2. The loamy till soils in this area are the Canton, Charlton and Hollis soils. They are located between the old trolley track and Route 2. Limitations to use on these soils are slope and the shallow depth to bedrock which is a characteristic of the Hollis soils. West of the trolley tracks are the sandy and gravelly outwash Agawam, Hinckley and Merrimac soils. The principle limitations on these soils are slope and rapid permeability. Sanitary facilities require special design in these areas. Wet soils have their obvious problems and should be avoided whenever possible. The soils are on the landscape in the pattern they appear on the accompanying soils map.

Soils are rated in their "natural state," that is, no unusual modification of the soil site or material is made other than that which is considered normal practice for the rated use. Only the most restrictive features are listed. There may be other features that need to be treated to overcome soil limitations for a specific purpose. Therefore, a soil rated severe gives those soil features that cause the soil to be rated severe. Because a soil is rated severe does not mean it cannot be used. This rating only means major reclamation or special design is required. The definitions of the ratings are as follows:

Slight - The degree of limitation is minor and can be overcome easily.

Moderate - This degree of limitation can be overcome or modified by special planning, design, or maintenance.

Severe - This degree of limitation generally requires major soil reclamation, special design, or intensive maintenance.

This report, along with a copy of the New London County Soil Survey Report, should be an adequate guide to planning the future use of this property. If additional and more detailed information is needed, the Soil Conservation Service staff at the New London County Soil and Water Conservation District will offer further assistance.

VEGETATION

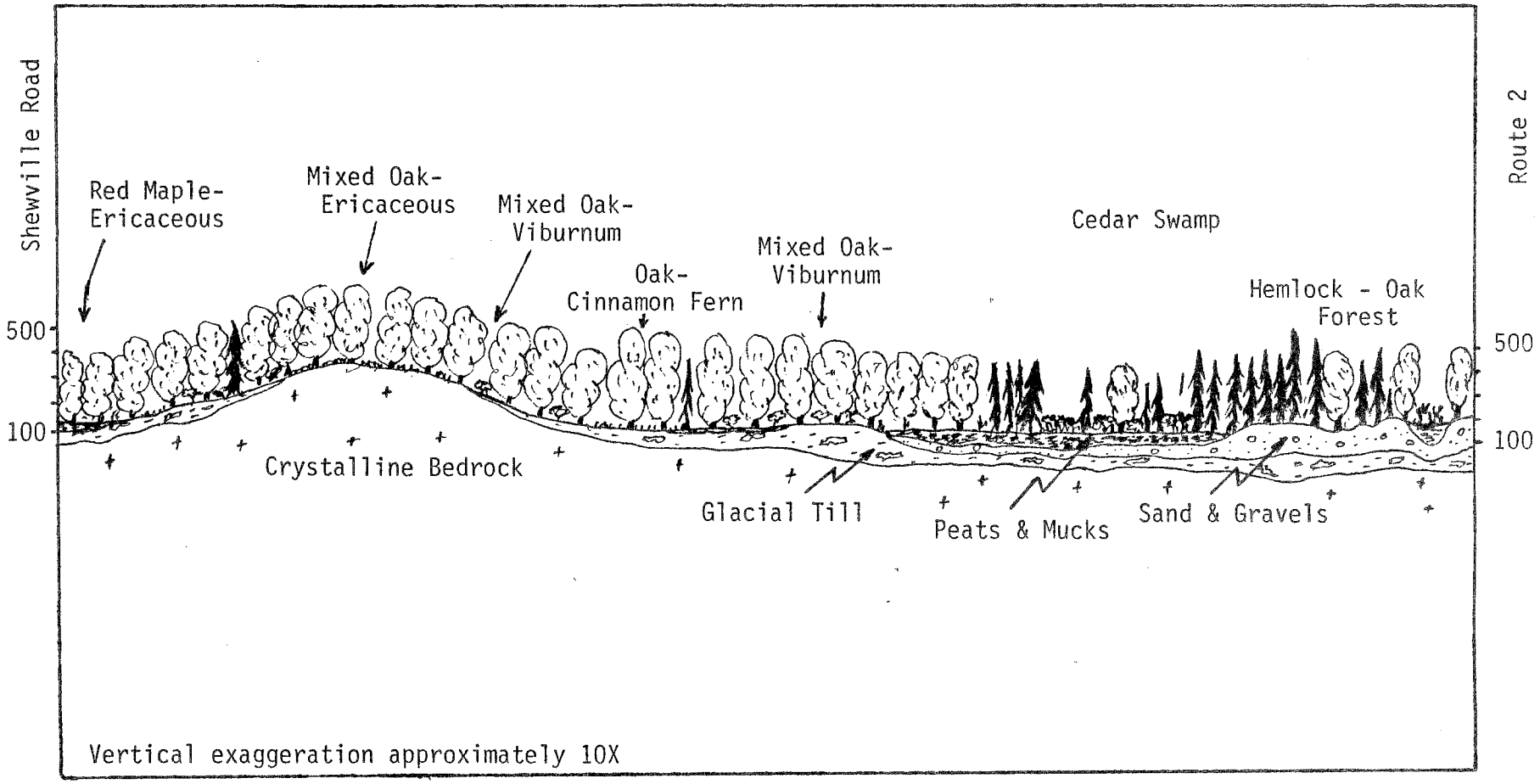
Within southern New England, the proposed reservation can be categorized as occurring in the Central Hardwoods-Hemlock zone (Westfeld, 1956). Major tree dominants on "typical" well-drained soils of this zone include red, black, and white oak and shagbark, pignut, and bitternut hickories. Chestnut was a dominant tree in this zone until 1920, when it was nearly exterminated by the Chestnut Blight. Hemlock and white pine are also frequent or even locally abundant or dominant, especially on sandy soils. Abandoned fields are dominated in the early phases by red cedar and/or gray birch.

Within this forest zone, a number of vegetation types occur with respect to soil texture, soil drainage, and topographic position. The forest types that occur within the proposed reservation area are described below. Although individual occurrences of vegetation types will not be mapped in this report, a generalized toposequence of the vegetation is shown in an accompanying illustration. However, since the vegetation for this region has not been adequately sampled or described in order to develop a uniform classification, the community names employed are solely developed for this report. All taxonomic nomenclature used in this report follows Dowhan (1979).

Mixed Oak Forest Types

Mixed oak forest types occur on acid, nutrient-poor soils. Oak species predominate, especially on the well-drained sites. Pine species and hemlock are common in the drier communities. Mixed oak forest types are quite variable in their vegetation structure ranging from dry forest with a well-developed dwarf ericaceous shrub layer to mesic forests with a well-developed shrub layer with few ericaceous shrubs to poorly-drained forests with a ground cover of ferns. Mixed oak forest types predominate the region, covering the major portion of the proposed reservation. Each plant community type is further described.

Oak ericaceous type: Dry, poorly-growing forests with a dominance of oak species. On the driest sites, scarlet and chestnut oak predominate. On the less droughty sites, the forest canopy is a mixture of oaks, hickories, red maple, and conifers. This forest type is distinguished by the dwarf ericaceous shrub layer of huckleberry and/or low bush blueberries and the presence of species such a pink lady slipper, bracken, spotted wintergreen, pin-cushion moss, and hair-cap moss. The oak-ericaceous type occupies the higher bedrock knolls on the present reservation, the ridge tops to the west, and the sandy knolls in the northern portion of the proposed reservation where not masked by the dominance of conifers. Associated soil types include the Hollis on the uplands and the Hinckley on the terraces.



Schematic diagram showing the topographical relationships
between vegetation and ground materials on the proposed tribal lands.

Oak-maple leaved viburnum type: Mesic forests dominated by red oak with a mixture of other species such as black birch, red maple, and in some areas, beech. The shrub layer is generally well-developed and is dominated by maple-leaved viburnum and beaked hazelnut with a sparse occurrence of ericaceous shrubs. The forest canopy of this vegetation type is diverse with species such as sugar maple, white ash, and sometimes flowering dogwood occurring. This forest type is present throughout the proposed reservation in a mid-slope position and occasionally on the silt-capped terrace soils. Associated soil types include the Charlton, Narragansett, Haven and possibly the Merrimac.

Oak-red maple-cinnamon fern type: The cinnamon fern type is distinguished by the abundance of red maple and red oak in the tree canopy with scattered yellow birth. The ground cover is dominated by cinnamon fern with an open shrub layer of spicebush, arrow-wood, and ericaceous species such as highbush blueberry and swamp azalea. The cinnamon fern type occurs regularly in transitional areas between the upland and wetland areas on associated soils such as the Sutton, Woodbridge and Leicester series.

Red Maple Forest Types

Red maple forest types dominate the wetlands area where not replaced by conifers. Red maple predominates, with yellow birch, white pine, and hemlock common associates. These swamps are characterized by an abundance of skunk cabbage in the spring and early summer. During the vegetative season, the herb layer is very diverse and includes many spring ephemerals, ferns, and fall composites. The shrub layer is well-developed and is dominated by species such as winterberry, silky dogwood, spicebush, and ericaceous species such as highbush blueberry and swamp azalea, and/or sweet pepperbush. A further subdivision of this forest type is described below.

Red maple-ericaceous shrub type: Wetland forests often dominated by red maple with a well-developed shrub layer of ericaceous shrubs such as highbush blueberry, swamp azalea and/or sweet pepperbush, a variable herbaceous cover, and often a well-developed moss layer. Red maple-ericaceous forest types are distinguished by their location in undrained basins and depressions, by seasonal surface flooding and saturated soil conditions, by the accumulation of decomposed organic materials, and floristically by a number of species indicative of wet, nutrient-poor acidic sites. With exception of the cedar swamp, red maple-ericaceous swamps are the major wetland type in the proposed reservation occurring on the Carlisle, Adrian, Palms and other undifferentiated peats and mucks.

The cedar swamp is a variation of the red maple-ericaceous forest in which deciduous types are replaced by conifers. Within this swamp, Atlantic white cedar was probably more abundant prior to man's activities (e.g., logging) reflecting its name. Presently cedar is an associate species along with hemlock, the dominant conifer, white pine, red maple, and yellow birch. Throughout much of the swamp, great laurel forms an impenetrable thicket to the near exclusion of other shrubs. Within this swamp, windthrows are also common, creating openings which possibly encourage the dense growth of laurel.

Red maple-Spicebush type: Wetland forests dominated by red maple with a well-developed shrub layer of spicebush and a variable herbaceous cover. These forests are distinguished by their topographic position on lower slopes or along gently sloping streams and brooks with seepage water, and by their floristic composition. Although this wetland type has a seasonally flooded/saturated water regime, in most years the water table can lie well below the soil surface during the vegetative season. This forest type occurs on the western edge of the cedar swamp and in areas that have groundwater seepage.

Winterberry-Azalea type: This is a shrub thicket with scattered red maple, hemlock, and black gum trees. Highbush blueberry, swamp azalea, winterberry, sweet pepperbush, and sometimes buttonbush dominate the shrub layer. The ground cover is variable, forming a dense sphagnum moss mat or shrub hummocks with standing water in the depressions. This vegetation type differs from other red maple types in its highly fluctuating water table and few trees. This type occurs in the deep kettles in the northeastern portion of the proposed reservation.

Findings

1) The cedar swamp is a valuable resource, not only in terms of wildlife habitats and natural diversity, but in its educational and scientific value. In addition, the dense shrub cover of great laurel make this wetland an unusual resource for the State of Connecticut. The best use of this land is for nature study, etc., and with construction of the boardwalk into the wetland interior, this unusual wetland could be appreciated by many individuals.

2) In addition to the great laurel, an additional Connecticut rare species is located on the proposed reservation. This species, white milkweed, is located on dry soil west of the present reservation. It is suggested that the tribe maintain contact with the Connecticut Natural Diversity Data Base before conducting future activities within this area.

3) There appear to be few or no limitations for development of the land that border Route 2. However, runoff should be carefully controlled since the steep gravelly slopes are highly erodible. This concern can be easily overcome through proper erosion/sedimentation control and management.

WILDLIFE CONCERNS

The presence of and abundance of wildlife in an area is dependent on the physical features of the land, the fertility of the soil, the available water, and the type and quality of vegetation present. Each species has specific requirements for survival which are provided for by certain vegetative classes or different stages of succession. If the animal's requirements are not met, the animal will move to another area.

To attract and/or increase the number and type of wildlife in an area, the requirements of each species must be determined and these requirements provided for. By providing different types of habitat or habitat diversity, these needs can be met. Food, cover, a water source, nesting and roosting and brood rearing

sites must be within reach of the daily movements of the animals. The greater the interspersion or degree to which different habitats are mixed or repeated, the greater the wildlife use of the area will be.

Often times an animal's requirements can be met in a small area. Sometimes a species has a large home range and requires much space for survival. Neighboring land adjacent to that under management can sometimes supply a habitat requirement which is lacking. Each animal must have all the requirements for survival within its home range or it will migrate to a new area. The home range can vary with seasonal and migratory needs.

All species need a certain amount of space to call their own. They need space for nesting, breeding, feeding and rearing young. Some species have a high tolerance to crowding within their own species and with other species while others do not. Others need large areas with little competition with their own kind or with other species. This is why a fertile piece of land will not produce unlimited amounts of wildlife.

If a certain factor which a species requires is lacking, or in short supply, it is said to be a "limiting factor." The lack of it will limit the population or perhaps even the presence of the species itself.

Within the limitations imposed on an area by the quality and quantity of natural physical features, management can ensure the maximum production of sustained wildlife populations through manipulation of vegetative types and age classes.

One can concentrate on providing the requirements for certain specific or "target species." Ideally, this will allow these species to proliferate to their maximum within the limits of the habitat provided. This may incidently benefit other wildlife, but could also be detrimental and lead to their emmigration of the area. A species not being managed for may have the same requirements as the target species and may become an unwanted pest.

By providing a number or variety of habitats or different vegetative classes in different successional stages in a desirable mix or interspersion for the individual, good wildlife habitat can be provided for a variety of species.

Mature woodlands often make up more than half a management area. Ideal habitat can be managed for by having approximately three-fourths of the property in even-aged stands (trees all the same age, but not necessarily the same size) and one-quarter in uneven aged stands. Eventually the management unit would approximate one-quarter seedling/sapling stands, one-quarter pole stands, one-half sawtimber stands. If these stands of different ages were well mixed, optimum wildlife habitat will result and it will be sustained. Open areas are very useful to wildlife for feeding, brood rearing and nesting sites. About two percent of an area should be kept in permanent grass/legume plots. Approximately five percent should be kept in early successional native vegetation.

Management Considerations

The following general recommendations will create diversity of habitats in the area, and thus will increase interspersion and edge. Because more general

LAND AREA - WESTERN PEQUOT INDIAN RESERVATION
LEDYARD, CONNECTICUT

SOIL LEGEND

*Aa	Adrian and Palms mucks
#AfA	Agawam fine sandy loam, 0 to 3 percent slopes
#AfB	Agawam fine sandy loam, 3 to 8 percent slopes
#CbB	Canton and Charlton fine sandy loams, 3 to 8 percent slopes
CbD	Canton and Charlton fine sandy loams, 15 to 25 percent slopes
CcB	Canton and Charlton very stony fine sandy loams, 3 to 8 percent slopes
CcC	Canton and Charlton extremely stony fine sandy loams, 8 to 15 percent slopes
CdC	Canton and Charlton extremely stony fine sandy loams, 3 to 15 percent slopes
CdD	Canton and Charlton extremely stony fine sandy loams, 15 to 35 percent slopes
*Ce	Carlisle muck
CrC	Charlton-Hollis fine sandy loams, very rocky, 3 to 15 percent slopes
CrD	Charlton-Hollis fine sandy loams, very rocky, 15 to 45 percent slopes
#HcA	Haven silt loam, 0 to 3 percent slopes
#HcB	Haven silt loam, 3 to 8 percent slopes
xHkC	Hinckley gravelly sandy loam, 3 to 15 percent slopes
HkD	Hinckley gravelly sandy loam, 15 to 35 percent slopes
HrC	Hollis-Charlton-Rock outcrop complex, 3 to 15 percent slopes
HrD	Hollis-Charlton-Rock outcrop complex, 15 to 45 percent slopes
#MyB	Merrimac sandy loam, 3 to 8 percent slopes
xMyC	Merrimac sandy loam, 8 to 15 percent slopes
#Nn	Ninigret fine sandy loam
PbD	Paxton and Montauk fine sandy loams, 15 to 25 percent slopes
PdB	Paxton and Montauk fine very stony fine sandy loams, 3 to 8 percent slopes
PdC	Paxton and Montauk very stony fine sandy loams, 8 to 15 percent slopes
PeC	Paxton and Montauk extremely stony fine sandy loams, 3 to 15 percent slopes
PeD	Paxton and Montauk extremely stony fine sandy loams, 15 to 35 percent slopes
x*Rc	Raypol silt loam
x*Rd	Ridgebury fine sandy loam
*Rn	Ridgebury, Leicester, and Whitman extremely stony fine sandy loams
x*Ro	Rippowam fine sandy loam
*Sf	Scarboro mucky fine sandy loam
#Sg	Sudbury sandy loam
#SvA	Sutton fine sandy loam, 0 to 3 percent slopes
SwB	Sutton very stony fine sandy loam, 0 to 8 percent slopes
SxB	Sutton extremely stony fine sandy loam, 0 to 8 percent slopes
#Ts	Tisbury silt loam
Ud	Udorthents-Urban land complex
x*Wd	Walpole fine sandy loam
WyB	Woodbridge very stony fine sandy loam, 0 to 8 percent slopes
WyC	Woodbridge very stony fine sandy loam, 8 to 15 percent slopes
WzC	Woodbridge and Rainbow extremely stony soils, 3 to 15 percent slopes

* Designated Inland Wetland Soil by Public Act 155
# Prime farmland soil
x Additional farmlands of statewide importance

INTERPRETATIONS FOR BUILDING SITE DEVELOPMENT
MASHANTUCKET-PEQUOT INDIAN RESERVATION
LEDYARD, CONNECTICUT

SOIL MAP SYMBOL AND SOIL NAME	SEPTIC TANK ABSORPTION FIELDS	DWELLINGS WITH/ WITHOUT BASEMENTS	SMALL COMMERCIAL BUILDINGS	LOCAL ROADS AND STREETS	LAWNS AND LANDSCAPING
*Aa					
Adrian	Severe-poor filter, ponding	Severe-ponding, low strength	Severe-ponding, low strength	Severe-ponding low strength frost action	Severe-excess humus, ponding
Palms	Severe-ponding	Severe-ponding, low strength	Severe-ponding, low strength	Severe-ponding, frost action, low strength	Severe-ponding, excess humus
#AfB - 3 to 8%					
Agawam	Severe-poor filter	Slight	Moderate - Slope	Slight	Slight
CcB - 3 to 8%, stony					
Canton	Slight	Slight	Moderate-slope	Slight	Moderate-large stones
Charlton	Slight	Slight	Moderate-slope	Slight	Moderate-large stones
CcC, CdC - 3 to 15%, stony					
Canton	Moderate-slope	Moderate-slope	Severe-slope	Moderate-slope	Moderate-slope, large stones
Charlton	Moderate-slope	Moderate-slope	Severe-slope	Moderate-slope	Moderate-slope, large stones
CdD - 15 to 35%, stony					
Canton	Severe-slope	Severe-slope	Severe-slope	Severe-slope	Severe-slope
Charlton	Severe-slope	Severe-slope	Severe-slope	Severe-slope	Severe-slope
Ce					
Carlisle	Severe-ponding	Severe-ponding, low strength	Severe-ponding, low strength	Severe-ponding, low strength frost action	Severe-ponding, excess humus

INTERPRETATIONS FOR BUILDING SITE DEVELOPMENT
MASHANTUCKET-PEQUOT INDIAN RESERVATION
LEDYARD, CONNECTICUT

SOIL MAP SYMBOL AND SOIL NAME	SEPTIC TANK ABSORPTION FIELDS	DWELLINGS WITH/ WITHOUT BASEMENTS	SMALL COMMERCIAL BUILDINGS	LOCAL ROADS AND STREETS	LAWNS AND LANDSCAPING
CrC - 3 to 15%, rocky Charlton	Moderate-slope	Moderate-slope	Severe-slope	Moderate-slope	Moderate-slope, large stones
Hollis	Severe-depth to rock	Severe-depth to rock	Severe-depth to rock	Severe-depth to rock	Severe-thin layer
HkC - 3 to 15% Hinckley	Severe-poor filter	Moderate-slope, large stones	Severe-slope	Moderate-slope, large stones	Severe-small stones
HkD - 15 to 35% Hinckley	Severe-poor filter	Severe-slope	Severe-slope	Severe-slope	Severe-small stones, slope
HrD - 15 to 45%, rocky Hollis	Severe-slope, depth to rock	Severe-slope, depth to rock	Severe-slope, depth to rock	Severe-slope, depth to rock	Severe-slope thin layer
Charlton	Severe-slope	Severe-slope	Severe-slope	Severe-slope	Severe-slope
Rock outcrop					
#MyB - 3 to 8% Merrimac	Severe-poor filter	Slight	Moderate-slope	Slight	Slight
MyC - 8 to 15% Merrimac	Severe-poor filter	Moderate-slope	Severe-slope	Moderate-slope	Moderate-slope
#Nn Ninigret	Severe-wetness, poor filter	Moderate-wetness	Moderate-wetness	Moderate-frost action, wetness	Moderate-wetness

INTERPRETATIONS FOR BUILDING SITE DEVELOPMENT
MASHANTUCKET-PEQUOT INDIAN RESERVATION
LEDYARD, CONNECTICUT

SOIL MAP SYMBOL AND SOIL NAME	SEPTIC TANK ABSORPTION FIELDS	DWELLINGS WITH/ WITHOUT BASEMENTS	SMALL COMMERCIAL BUILDINGS	LOCAL ROADS AND STREETS	LAWNS AND LANDSCAPING
*Rn - 0 to 5%, stony Ridgebury	Severe-percs slowly, wetness	Severe-wetness	Severe-wetness	Severe-wetness, frost action	Severe-wetness
Leicester	Severe-wetness	Severe-wetness	Severe-wetness	Severe-wetness, frost action	Severe-wetness
Whitman	Severe-percs slowly, ponding	Severe-ponding	Severe-ponding	Severe-frost action, ponding	Severe-ponding
*Ro Rippowam	Severe-flooding, wetness, poor filter	Severe-flooding, wetness	Severe-flooding, wetness	Severe-flooding, wetness, frost action	Severe-wetness, flooding
Ud Udorthents	Requires on-site investigation.				
Urban land	Requires on-site investigation.				

*Designated inland wetland soil by Public Act 155
#Prime farmland soil

About the Team

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

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

PURPOSE OF THE TEAM

The Environmental Review Team is available to help towns and developers in the review of sites proposed for major land use activitis. To date, the ERT has been involved in reviewing a wide range of projects including subdivisions, sanitary landfills, commercial and industrial developments, sand and gravel operations, elderly housing, recreation/open space projects, watershed studies and resource inventories.

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

REQUESTING A REVIEW

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

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