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TOWNSHIP OF CHATHAM

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A NATURAL RESOURCES INVENTORY

ENVIRONMENTAL RESOURCE CENTER
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1. REPORT

OLD MILL ROAD MILLINGTON NEW JERSEY July 1974

Mr. S. W. Averett, Chairman
The Environmental Commission
Township of Chatham, New Jersey

Dear Mr. Averett:

It is with great pleasure that we hereby transmit to you "A Natural Resources Inventory for Chatham Township":

1. The Report, which describes the environmental factors of Chatham Township and its environs, an inventory of the undeveloped land of the Township, and the methodology and sources of information employed in the course of assembling the Inventory.
2. A series of seventeen overlay maps of Chatham Township and its environs (scale: 1" = 1000').
3. Five related papers developed in the course of the Inventory work.
4. Various source maps and publications.

On the basis of this initial step of completing the Inventory, several further steps suggest themselves: review of the Township's Master Plan and ordinances in the light of the information assembled in the Inventory; more comprehensive reviews of Environmental Impact Statements; and the establishment of a clearly defined and consistent attitude by Township government towards the natural entity of The Great Swamp. In addition, material from the Inventory could be used to augment existing programs in the school system; for identification of unusual scenic, geologic or other features of the Township that should receive protection by easement, outright ownership or other measures; and for a study of the cost to the municipality and to private citizens of development by present methods in specific areas of the Township.

The volunteers who worked on this project have contributed many hours and much effort. They have been indispensable, and offer a praiseworthy demonstration of the results that citizens can achieve for their community.

We very much appreciate the opportunity we were given to work on the Inventory. We recognize particularly the constant support and encouragement you personally have given us throughout the past eighteen months.

With thanks and best wishes,

Elisabeth A. Fraser

Anne F. Morris

Elisabeth Fraser
Anne Morris

ASSOCIATION OF NEW JERSEY
ENVIRONMENTAL COMMISSIONS
300 MENDHAM ROAD, BOX 157
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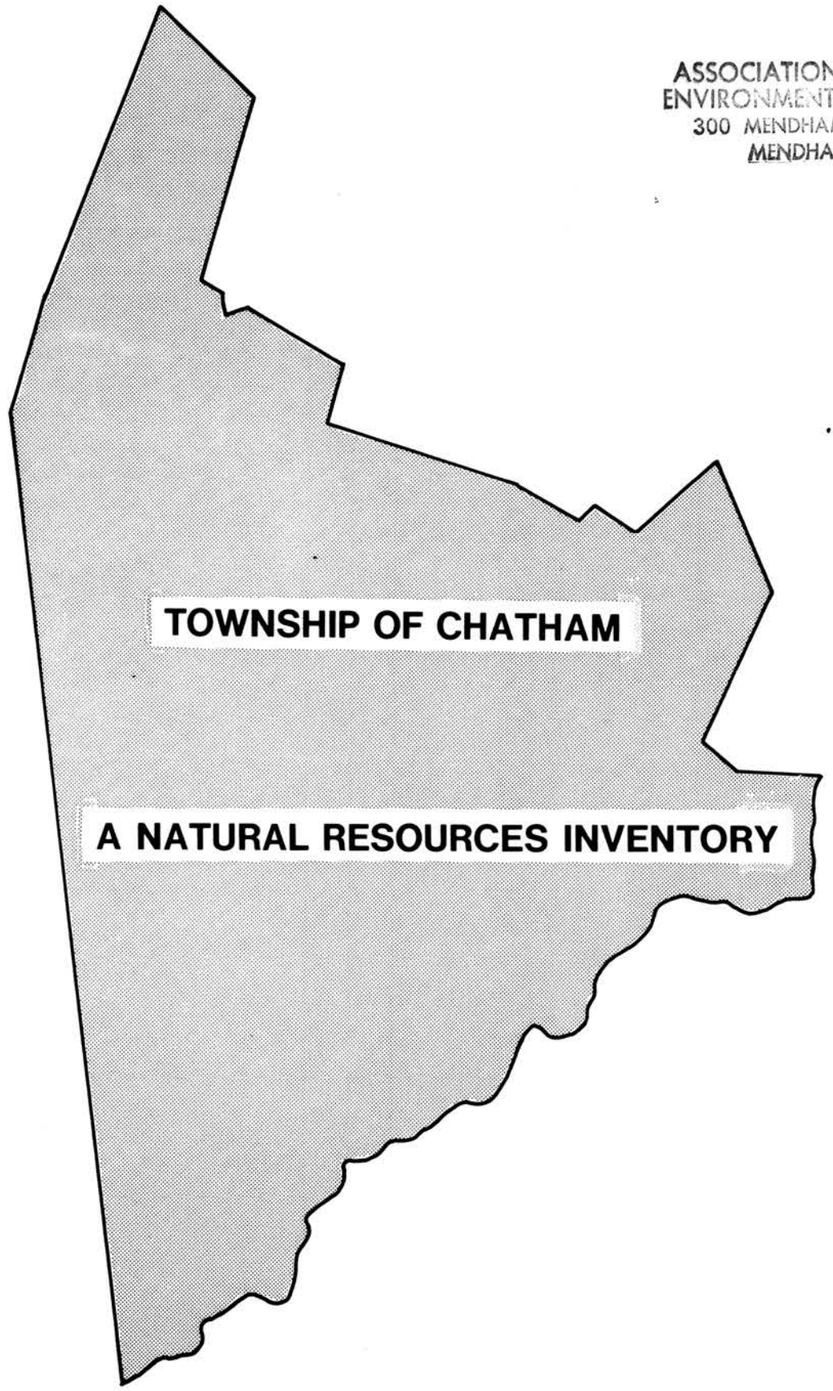

TOWNSHIP OF CHATHAM

A NATURAL RESOURCES INVENTORY

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ACKNOWLEDGMENTS

The Chatham Township Natural Resources Inventory has been aided by financial support from two external sources: the New Jersey Department of Environmental Protection and the Ford Foundation. Without this help the scope of the project would have been greatly diminished.

Representatives of three governmental agencies have been particularly supportive of this project. The U.S. Department of Agriculture's Soil Conservation Service (Mr. Wendell Kirkham, Assistant State Soil Scientist; Mr. Lester Seglin, Soil Conservationist; and the staff of the Morris County Soil Conservation District), the New Jersey Department of Environmental Protection (Mrs. JoAnn Stitt) and the U.S. Department of the Interior's Geological Survey (Mr. Everett Miller) have been generous with their time, patience and knowledge. The assistance provided by the staff of the Morris County Planning Board is also greatly appreciated.

Mr. Robert Kirkpatrick, Township Engineer, has cheerfully asked questions and given help at significant moments in the last eighteen months.

The Township Clerk's Office, the men of the Department of Public Works and the Township Police have all willingly provided help to the project.

The layout of this Report has been greatly improved, thanks to the practiced eye of Norma Rahn of the Rahn Studio, Bernardsville, New Jersey.

The Inventory has been formally reviewed by the following people:

Dr. Robert Hordon, Department of Geography, Rutgers University.
Mr. Wendell Kirkham, Soil Conservation Service
Mr. Everett Miller, U.S. Geological Survey
Mr. Thomas Norman, Institute of Environmental Studies, Rutgers University

We appreciate their willingness to help us. Their observations have contributed substantially to the final form of the Inventory.

Finally, the work done by the volunteers on this project has been a vital and integral part of the Inventory. The help given to the map production effort is especially appreciated. Joan Farrell's work on the Inventory of Undeveloped Land was a major contribution to the whole Inventory.

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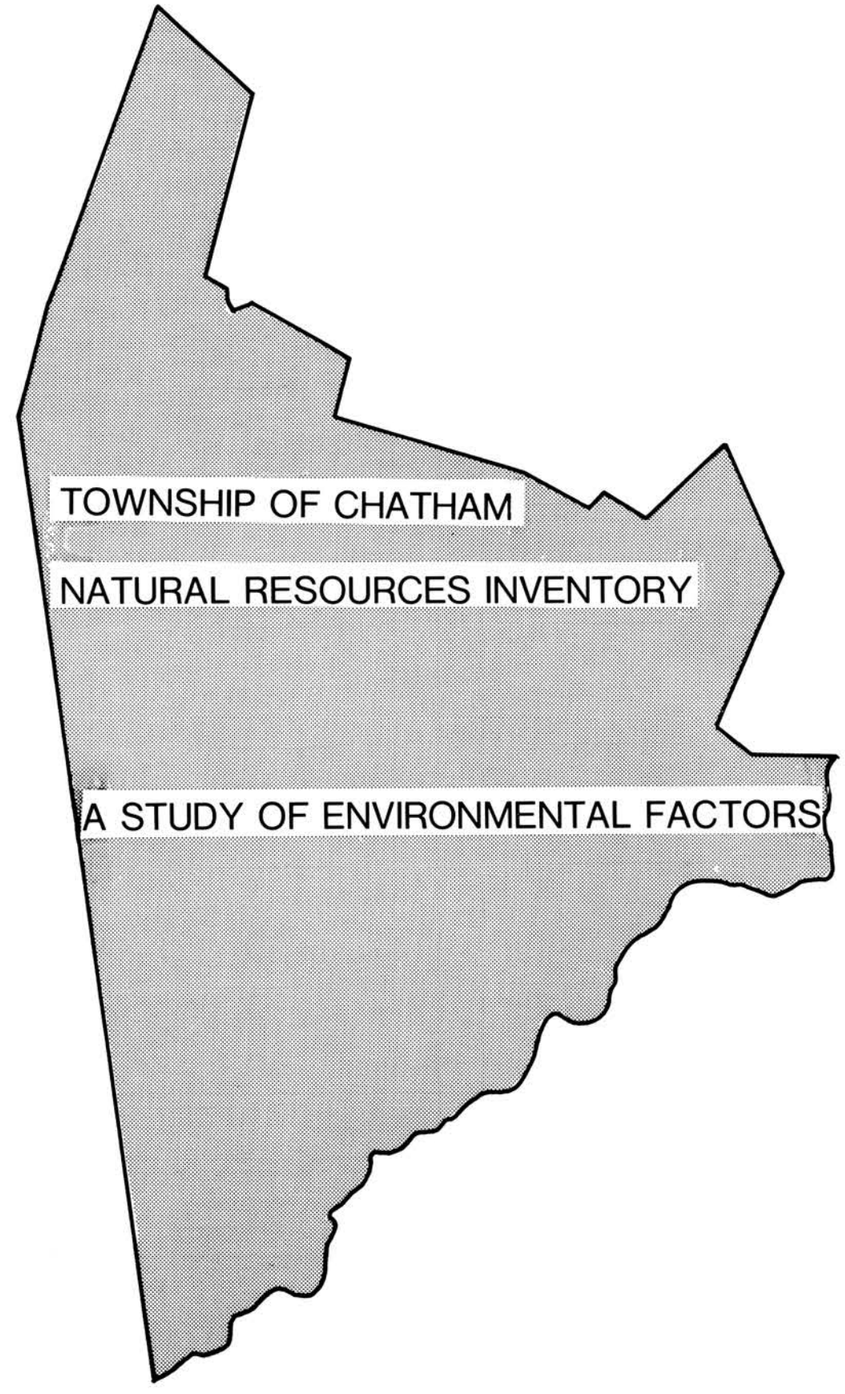

TOWNSHIP OF CHATHAM

NATURAL RESOURCES INVENTORY

A STUDY OF ENVIRONMENTAL FACTORS

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Chatham Township is located in Morris County, New Jersey, which lies in the north-central part of the State. It is primarily a residential community with a small amount of commerce and no industry. Railroad and road connections provide access to Morristown, Summit, Murray Hill, Newark and New York.

Since 1920 the Township's population has increased from 736 people to approximately 8,500 (see Fig. 1).

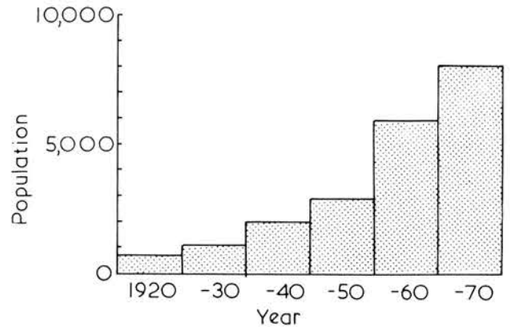


FIG. 1 Population of Chatham Township: 1920-70

Development in Chatham Township is concentrated in the eastern portion of the Township and along the slopes of Long Hill. A significant portion of the Township is owned by the U.S. Government's Great Swamp National Wildlife Refuge or by the Morris County Park Commission (see Fig. 2).

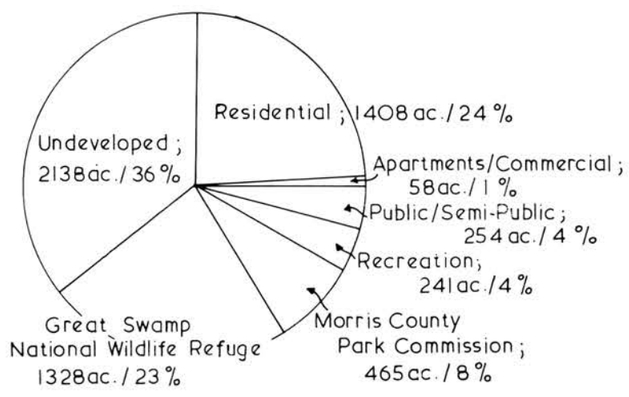


FIG. 2 Land Use in Chatham Township

Chatham Township is located in an area of considerable geologic diversity. It also has a rather varied climatic pattern. These are the principal factors that give rise to the natural circumstances of the Township—the configuration of the land, composition of the soils, the behavior of water, and the amount and types of vegetative cover and wildlife. These are circumstances with which the Township's residents live and in the context of which the continuing development of the Township takes place.

In order to understand these circumstances, they must be considered from a variety of different viewpoints. Chatham Township is part of the watershed of the upper Passaic River and part of the geologic area called the Piedmont Plateau. Its 9.2 square miles extend from the Passaic River, which forms the southern border, up over Long Hill and across the eastern end of the large basin that holds The Great Swamp. Its different regions include river banks and floodplains, steep hillsides, gently rolling areas, flat wet sections and heavily wooded swamps. The political entity of Chatham Township is an arbitrary piece of the local landscape and cannot be considered in isolation from its total setting.

The amount of undeveloped land remaining in Chatham Township allows many land use choices. Natural constraints, however, limit the number of choices to fewer than a calculation of undeveloped acreage would suggest. The Township's location on the fringe of the greater New York metropolitan area places pressure of time on these choices. Because the natural framework is dynamic, it will adapt to whatever choices and changes are made. Its adaptations, however, may not be either anticipated or desirable. Understanding the various factors, how they work and how they interact with each other is the key to balanced, harmonious and economical relationships between the people of Chatham Township and the natural world in which they live.

* * * * * *

Early in 1973 the Environmental Commission of Chatham Township undertook to sponsor the development of an Inventory of the Township's Natural Resources. The Inventory, completed in July 1974, is in four parts:—

I. A Study of Environmental Factors. Geologic and climatic factors are presented as the basis upon which soils, vegetation, water and wildlife relationships are established. For consideration of drainage, the Township has been divided into two major sections. One section drains directly into the Passaic River, and the other drains into The Great Swamp.

II. An Inventory of Undeveloped Land. The Township has been further divided into five regions that have similar characteristics. On the basis of these divisions the undeveloped land in the Township has been analyzed. Each area has been visited and mapped by the volunteers associated with the project. Vegetation patterns, current uses, personal impressions and other features are included in a separate description of each site.

III. Maps of the Township. Seventeen maps of various hydrological, soil, topographical and land use aspects of Chatham Township have been prepared. These maps are in color, at a common scale (1" = 1,000'), and on translucent film so that they can be overlaid with each other. Colored paper prints for each map have also been prepared.

IV. Reference Material. An extensive collection of books, reports, maps and other reference material related to the work of the Inventory has been assembled.

The study of Environmental Factors, the Inventory of Undeveloped Land and a section on map production methodology and sources of information are included in this Report. Black-and-white prints of the overlay maps, at a reduced scale, are included in the Report. The overlay maps, the colored paper prints of them and all the reference material are available through the Chatham Township Environmental Commission.

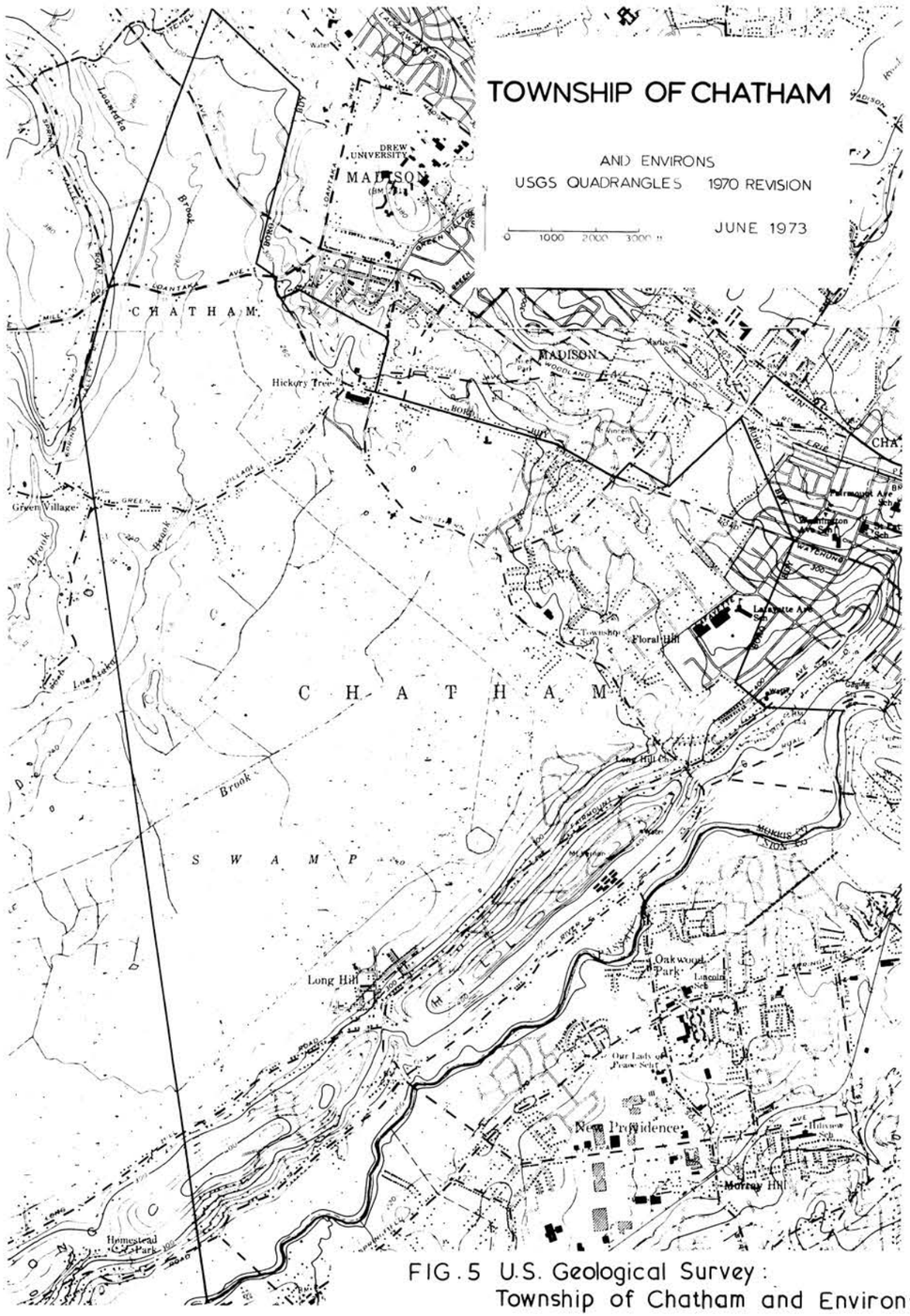


FIG. 5 U.S. Geological Survey : Township of Chatham and Environs.

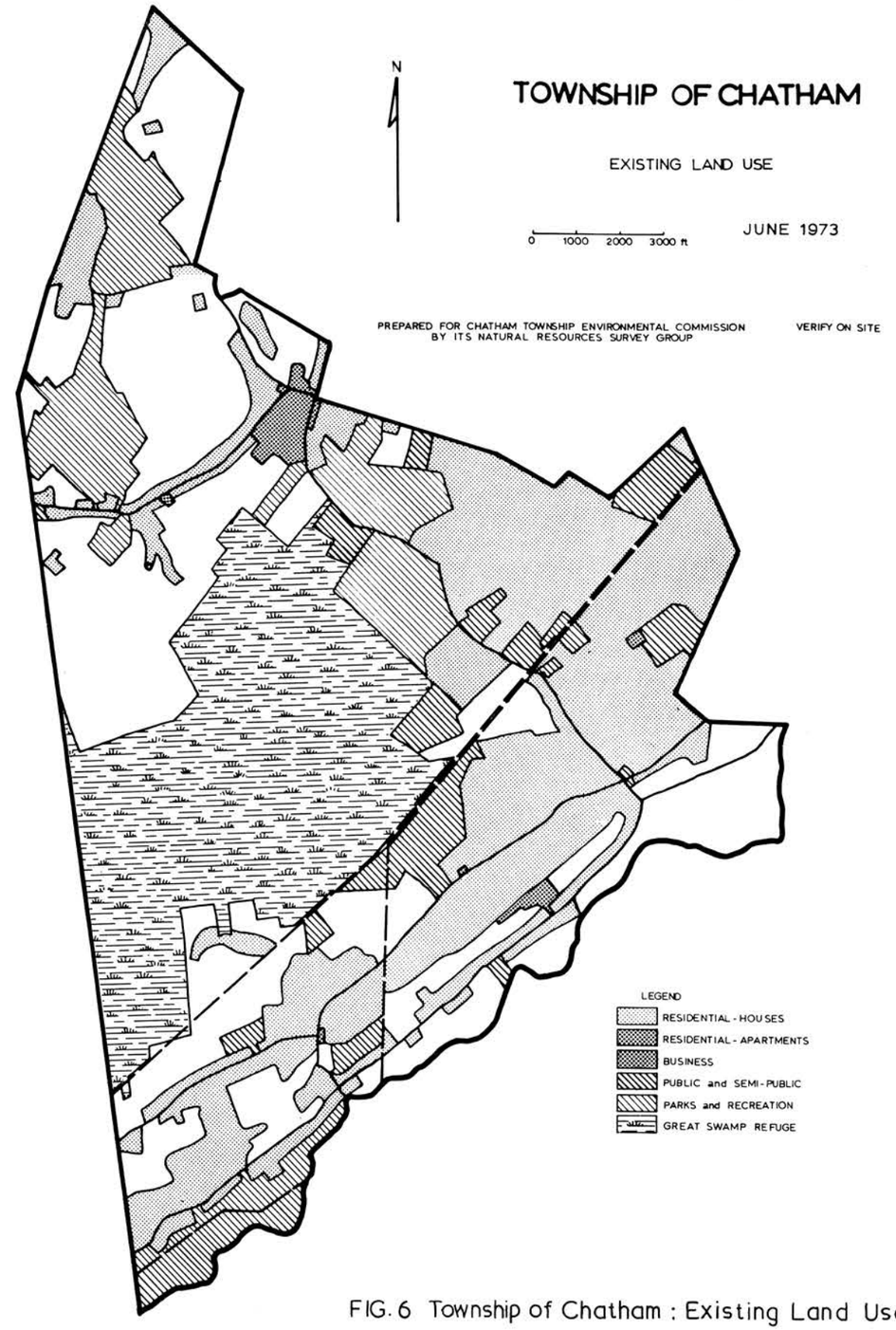


FIG. 6 Township of Chatham : Existing Land Use

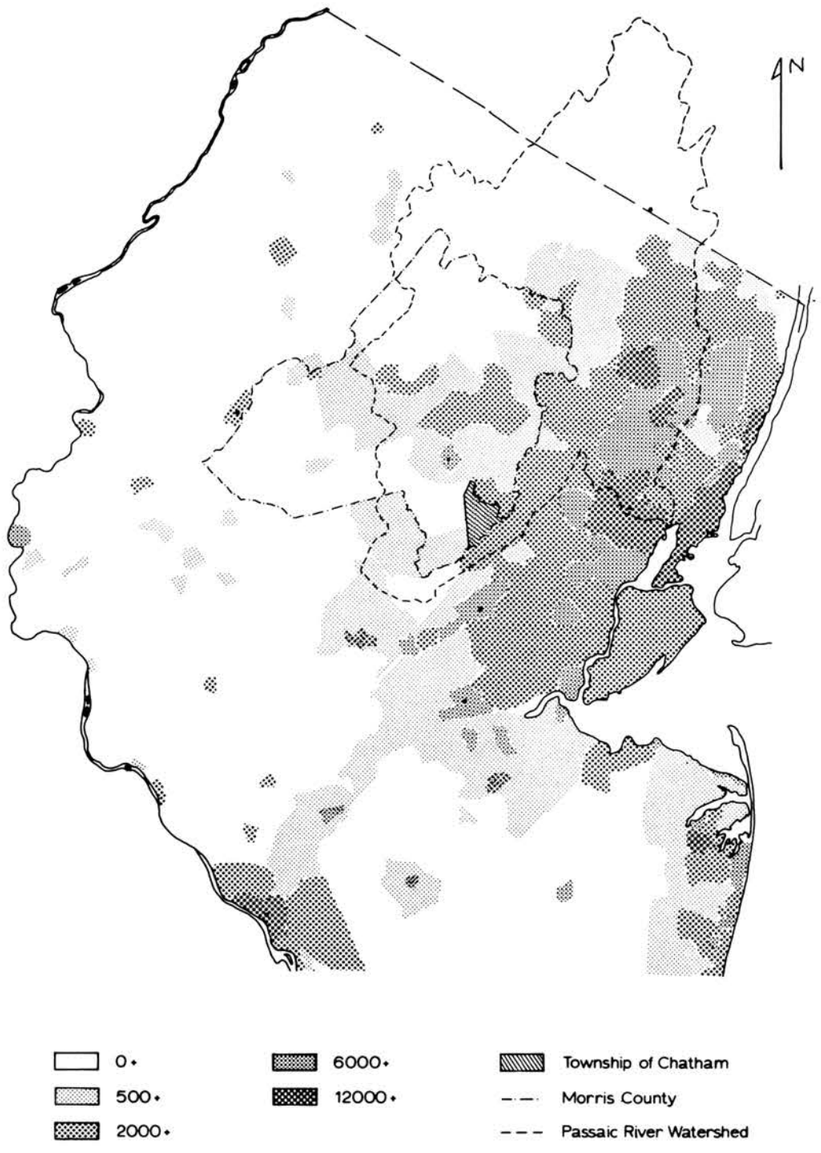


FIG.3 Population Density of Northern New Jersey : 1970
(in persons per square mile per municipality.)
(Use in conjunction with Fig 32 ; Transportation Overlay.)

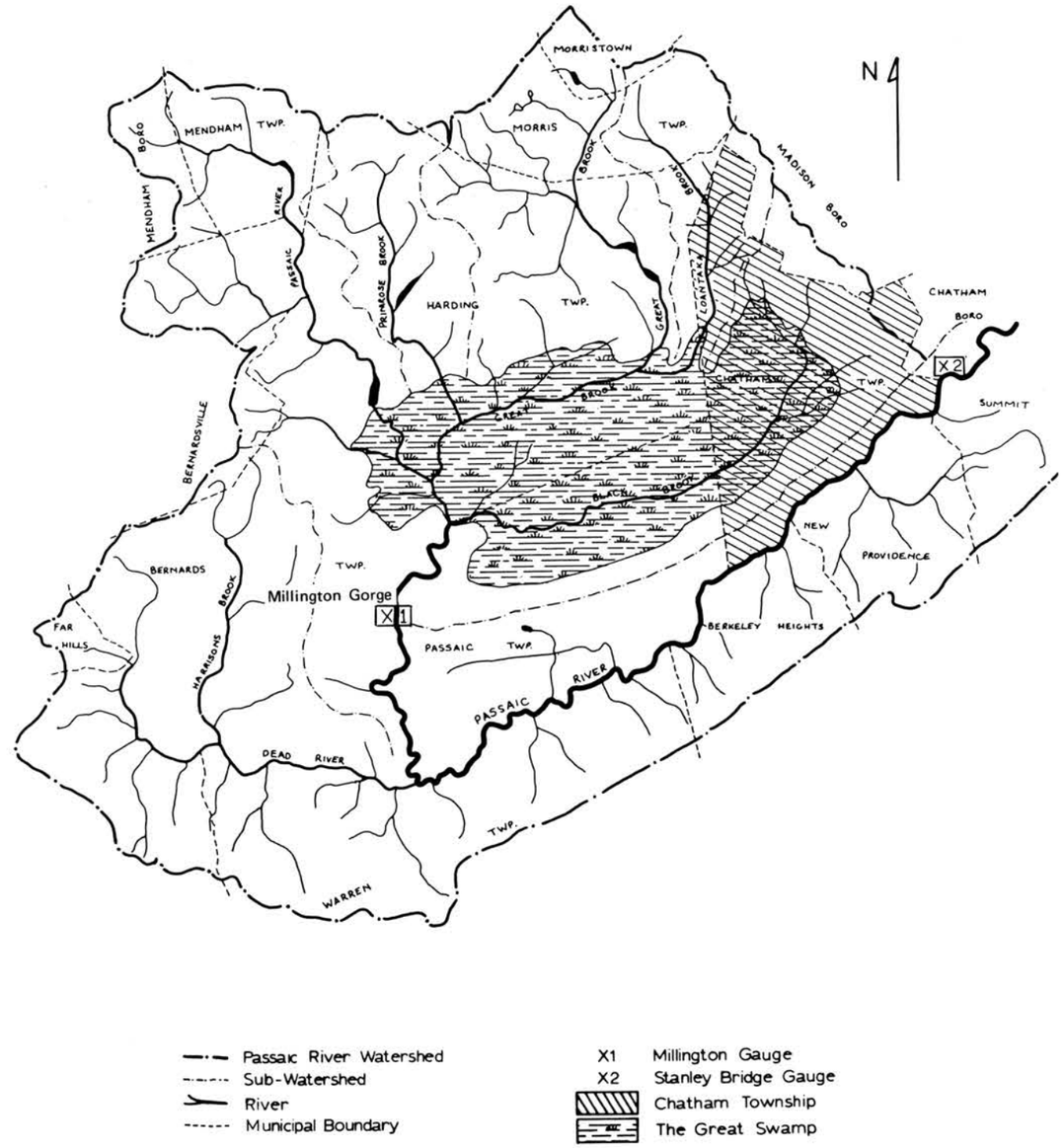


FIG. 4 Passaic River Watershed above the Stanley Bridge Gauge

Superimposed on this bedrock foundation of basalt, shale and sandstone are extensive deposits of the last glaciation. Locally, the Wisconsin, or most recent glacier, reached its line of furthest advance in Chatham Township. The forward progress of the ice brought enormous amounts of rocky rubble and finer material that the melting ice deposited as a long low ridge of unsorted stones. Present-day Route 24 now runs through Chatham Borough, Madison and into Morris Township along, or close to, the top of this "gravel heap" called the terminal moraine (see Fig. 8). The moraine's surface appearance is now that of a wide, gently rolling, wooded hill or ridge with occasional deep potholes, often filled with water, where glacial ice blocks melted while material was being deposited around them. Kelly's Pond, in the eastern part of the Township, is an example of such a pond.

The meltwater of the glacier washed material from the terminal moraine into the basin to the west, now known as The Great Swamp. Coarser stones and sands were deposited in irregularly-shaped patches and mounds near the moraine. The meltwater was caught in a natural basin formed by the Second Watchung Ridge and eventually filled it. For thousands of years, the region was inundated by a lake whose size and depth fluctuated with time. (See p.12 of this Report for a more extended discussion.) Fine particles of sediment carried by the water settled to the bottom of the lake, forming a thick layer of clay (see Fig. 9). (Description of geology based on Lewis & Kümmel, 1940; Widmer, 1964; Van Houten, 1969; Lucey, 1972.)

These geologic occurrences have determined the shape and form of the local landscape. The flow and storage of water on and beneath the surface of the land and the physical properties of the local soils also result from them.

* * * * * *

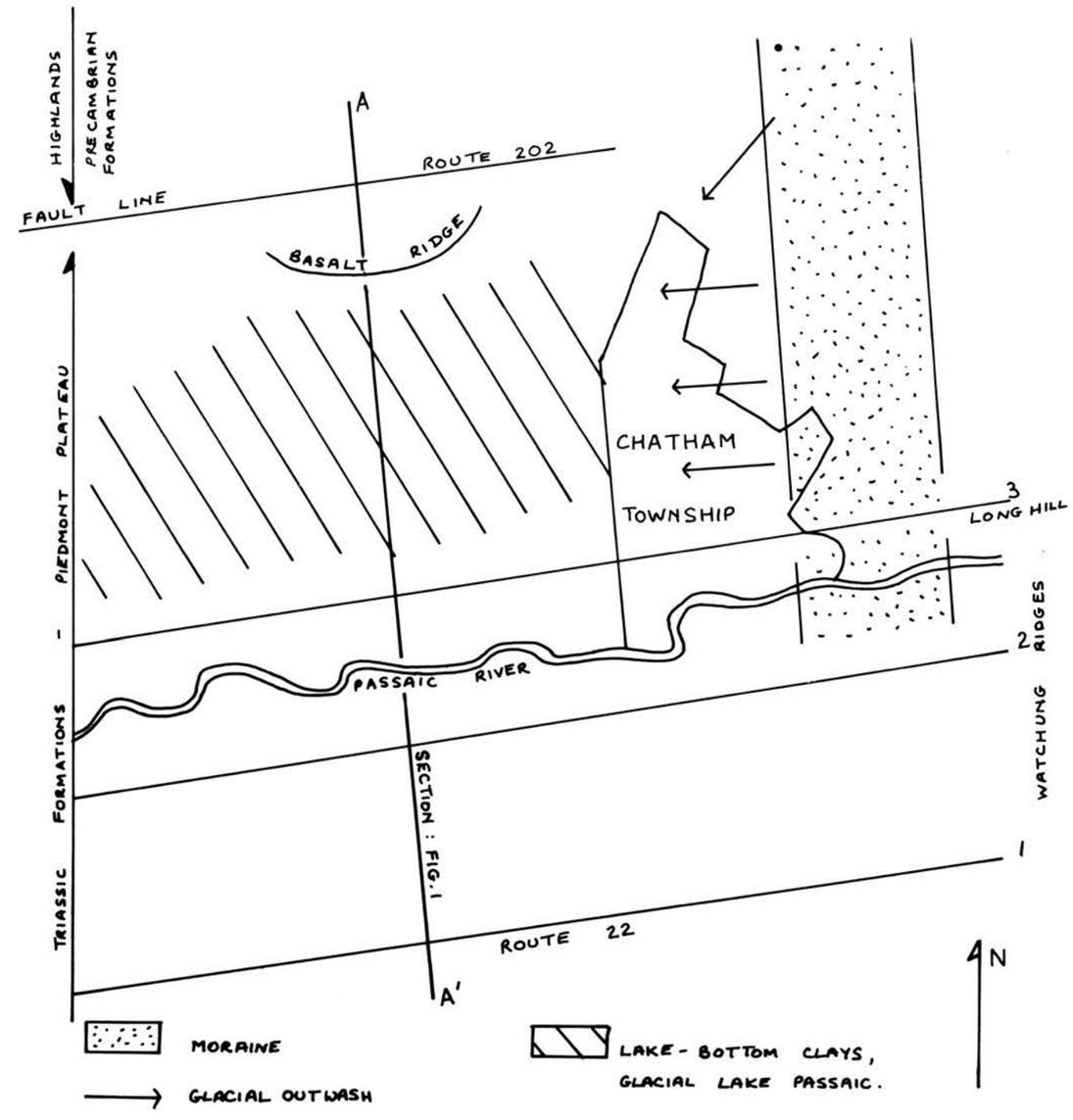


FIG.9 Generalized Geologic map in the vicinity of Chatham Township (Not to scale)

Chatham Township's physical features are dominated by Long Hill. It is one of three parallel ridges known as the Watchungs which rise 200 to 400 feet above the neighboring terrain (see Fig. 5, U.S.G.S. map). There were once extensive swamps and lakes in this area that were part of a system extending from eastern Pennsylvania up through northeastern New Jersey. Thousands of feet of sediment* settled in these swamps and lakes during the Triassic period of geologic history, eventually compressing into red-colored sandstones and shales. From time to time lava flows that cooled into hard, dark-colored rock called basalt were extruded over the sediments, and then covered by more sediment. The whole complex of softer layers of sandstone and shale and harder layers of basalt has been slowly uplifted along one side so that it now slopes downward 8-10 degrees towards the northwest to a fault close to the present alignment of Route 202. The softer layers of sandstone and shale have weathered and eroded more quickly, leaving long broad valleys between the three ridges formed by the more resistant basalt. Long Hill, as it passes through Chatham Township, rises 250 to 300 feet directly and steeply up from the Passaic River floodplain, then slopes more gently down its north side toward The Great Swamp (see Fig. 7).

*See Glossary of Terms, p. 23.

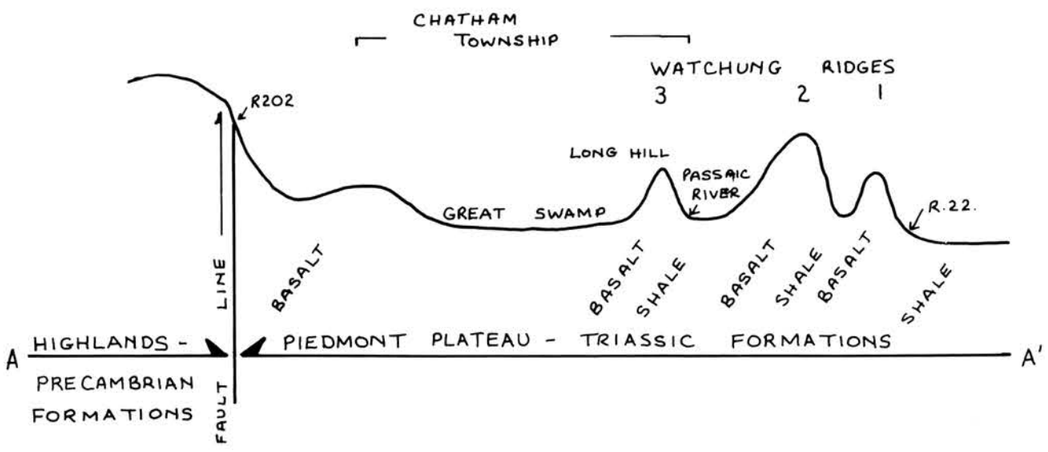


FIG.7 Generalized Geologic cross-section from Rte.202 to Rte.22
(Not to scale)

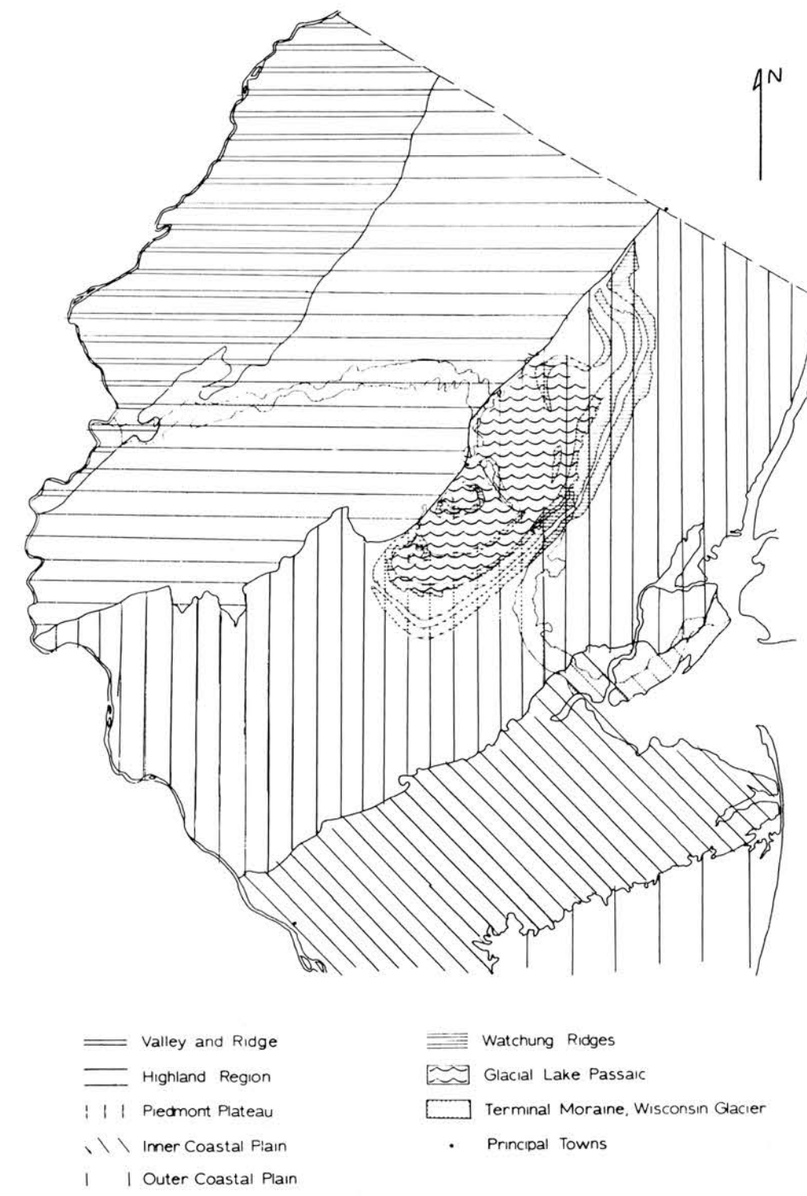


FIG. 8 Geologic map of northern New Jersey
(Use in conjunction with Fig. 32;
Transportation Overlay)

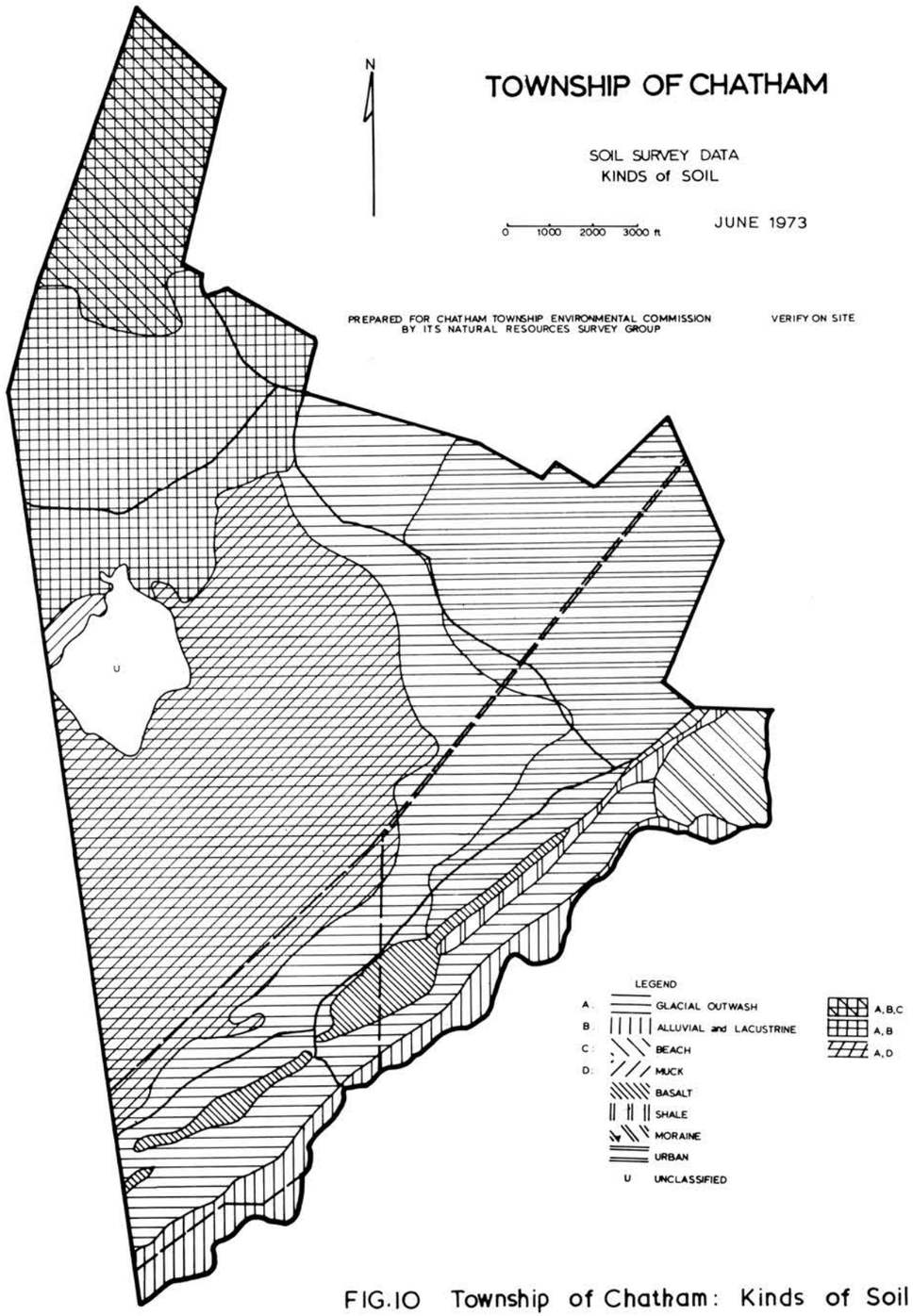


FIG.10 Township of Chatham: Kinds of Soil

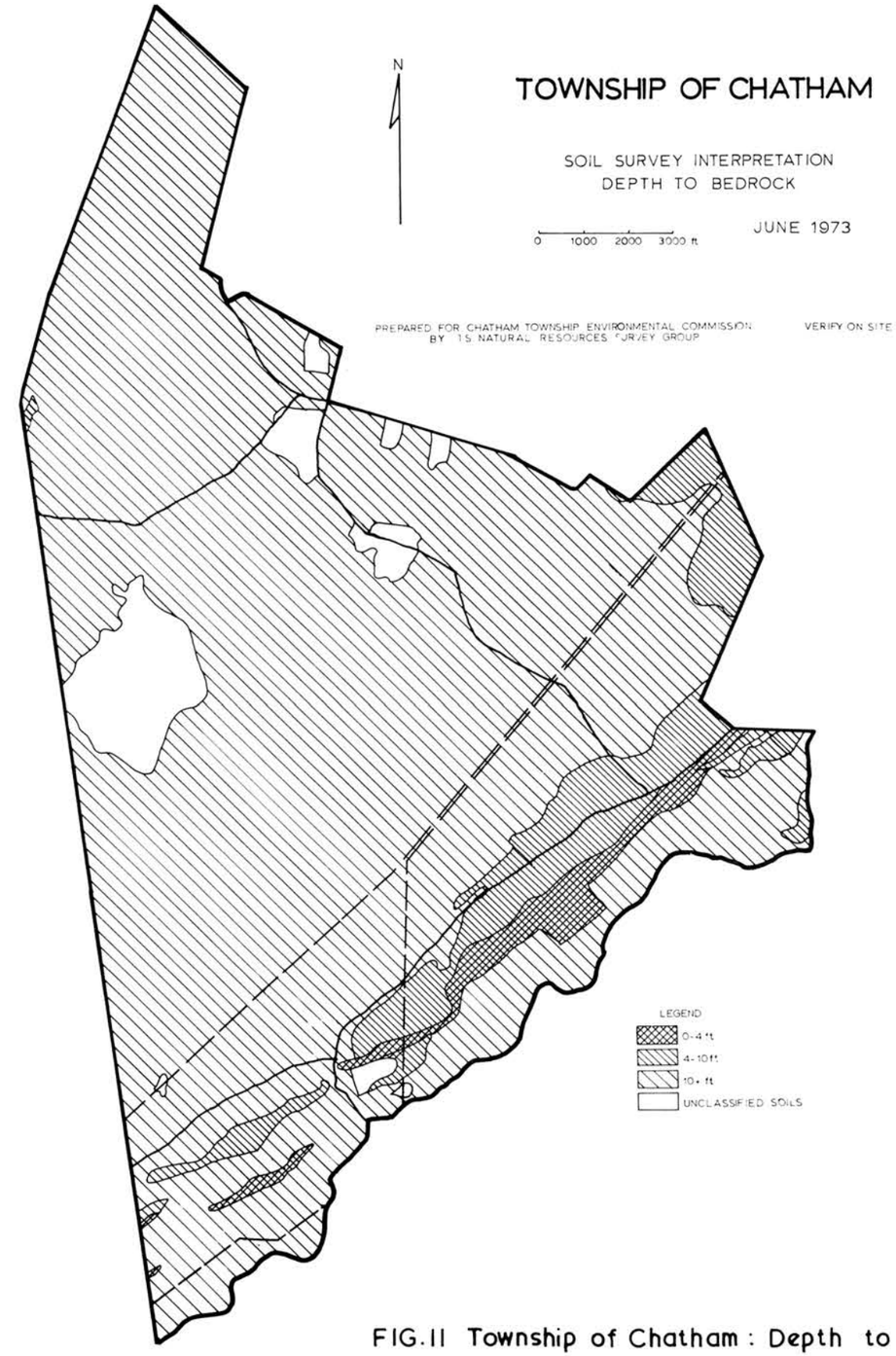


FIG.11 Township of Chatham : Depth to Bedrock

The natural process by which rocks disintegrate into smaller-sized soil particles is called weathering. Weathering may be chemical such as is caused by the action of atmospheric gases, acid from decaying organic matter or water which comes in contact with the rock. Mechanical weathering results from the freezing and thawing action of water, expansion and contraction of rocks caused by temperature changes, the growth of tree roots and other natural activity (Adams & Wyckoff, 1971). The process has been accelerated in areas that have been affected by glaciation. Animal and vegetable matter decaying at the surface become mixed with the rock particles. Spaces between particles are either filled with air or with water, which filters down into them. (The relative amount of water and air varies with time, depending upon local precipitation.) Infiltrating water sorts the material by carrying fine particles down into deeper pore spaces. These simultaneous processes of accumulation of material and differentiation of that material into layers (called "soil horizons") take place over a long period of time. The soil horizon structure can often be seen in road cuts or other sites where excavation has exposed the soil.

The total complex of rock particles, organic material, air and water that lies on a specific site between the vegetative cover and parent material is called soil. A soil is a cumulative result of regional surface geology and long-term climatic factors. A soil is specific to its location. It may, for historical reasons, occur in close proximity to several other kinds of soil (see Table I & Fig. 10).

The roots of living plants and the natural mulch supplied by leaves and dead plants help keep soil in place. They offset natural processes of erosion which cause rock and soil particles to be broken down and transported from one location to another. (An example in Chatham Township where erosion has taken place following the removal of vegetation can be seen on the south side of Long Hill from the parking lot of the Passaic River Park on River Road. The comparison between the tree-covered hillside and the eroded area is quite marked.)

Factors controlling erosion and transportation of the products of erosion are the physical characteristics of the soil itself, slope of the land, amount and intensity of precipitation, infiltration, runoff of water, land use, extent and type of vegetative cover and the capacity of the drainage system to carry sediment (the finer products of erosion) (Anderson & George, 1966). At higher velocities flowing water can carry a greater load of sediment; when water velocity drops the load settles to the bottom (Morisawa, 1968). This occurs, for example, when a stream's gradient decreases as river water spreads out over a floodplain or in the pond behind a dam, and when rivers reach the ocean. Soil materials lost to erosion in one location are eventually deposited as sediment elsewhere and contribute to the formation of a new soil in that location. The process of rock breakdown, and the transportation and subsequent deposition of soil materials at a lower point in the landscape is continuous and is offset by long-term geologic mountain-building activity. Removal of vegetation and the disturbance of soil, such as occurs in the process of building construction, make the total natural system more unstable and accelerates the rate of natural redistribution. Therefore the location of soil materials cannot be viewed as fixed.

TABLE I: KINDS OF SOIL FOUND IN CHATHAM TOWNSHIP

(See Figure 10.)

Map Symbol	Kind of Soil	Parent Material Origin/Process
‖ ‖ ‖	Shale	Triassic sedimentary rock
	Basalt	Triassic lava flows (igneous); sometimes with minor additions of glacial material
	Moraine	Glacial deposits (heterogeneous mixtures of rocks and unconsolidated material)
	Glacial outwash; also outwash over residual	Various combinations and predominances of: traprock, red and brown shale, red and brown sandstone, granitic gneiss, micacious gneiss, occasional quartzite
	Beach	Beaches or terraces formed by waves or currents working on sediments along the margin of Glacial Lake Passaic
	Alluvial and Lacustrine	Material deposited by Glacial Lake Passaic within its basin, or more recently by flooding or ponding along streams and the Passaic River
	Muck	Soil with unusually high organic content
	Urban	Soils of glacial, basalt or shale origin, 20% to 80% of which have been excavated, stirred or filled by man
U	Unclassified	Soils of glacial, alluvial or Glacial Lake Passaic origin which have been excavated, stirred or filled by man by more than 80%

Based on material supplied by U.S. Department of Agriculture, Soil Conservation Service.

Its active geologic history has provided Chatham Township with many sources of rock from which soils have formed. Because the physical properties of the rocks differ, the physical properties of the soils formed from them differ. The location of the dominant kinds of soil found in Chatham Township and their major mineral constituents are shown on Fig. 10, Kinds of Soil.

One of the standard systems used for analysis of the physical characteristics of soils has been developed by the U.S. Department of Agriculture's Soil Conservation Service (SCS). For each soil, various physical properties are described, such as depth to bedrock, drainage characteristics and texture (see Fig. 11).

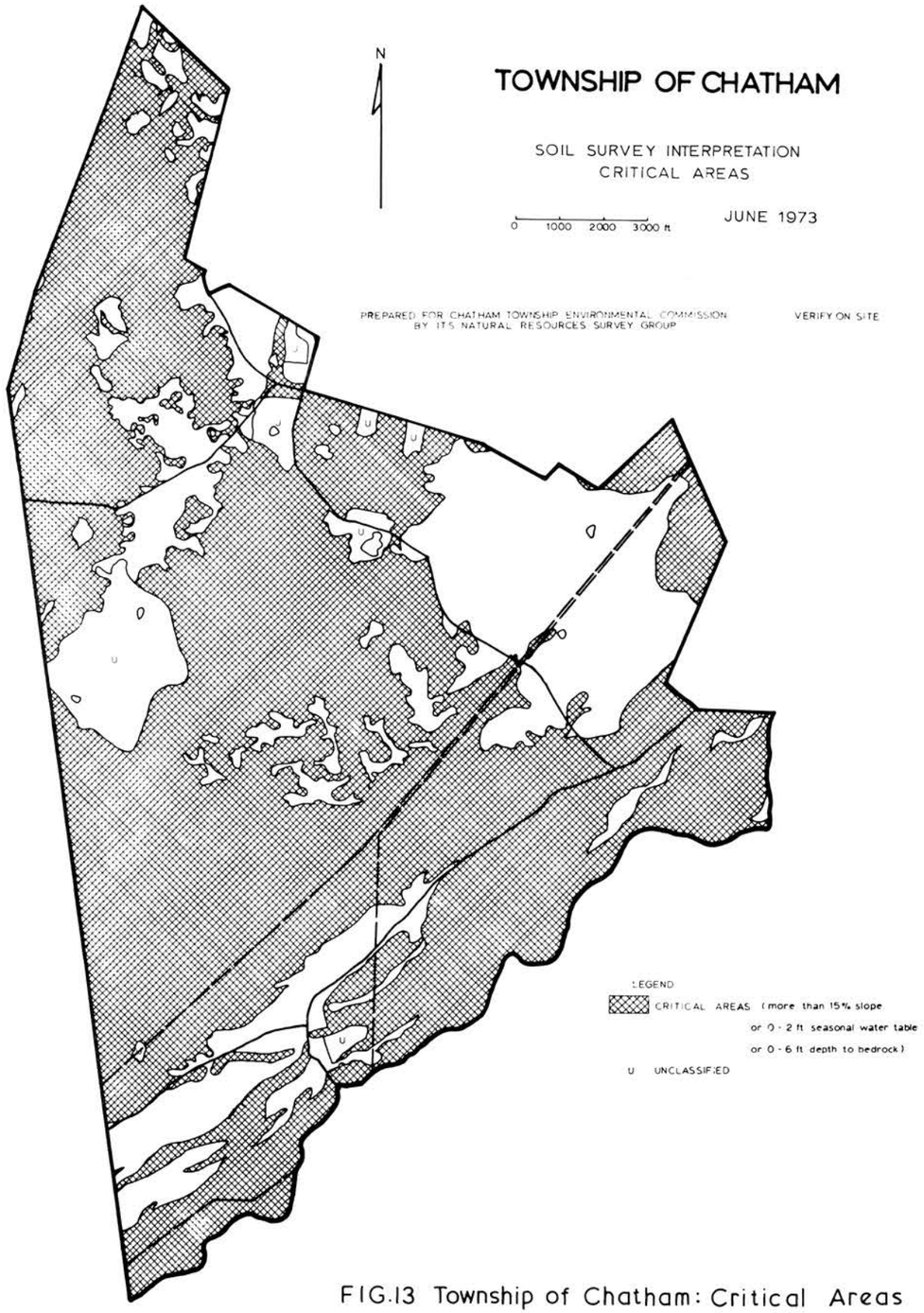


FIG.13 Township of Chatham: Critical Areas

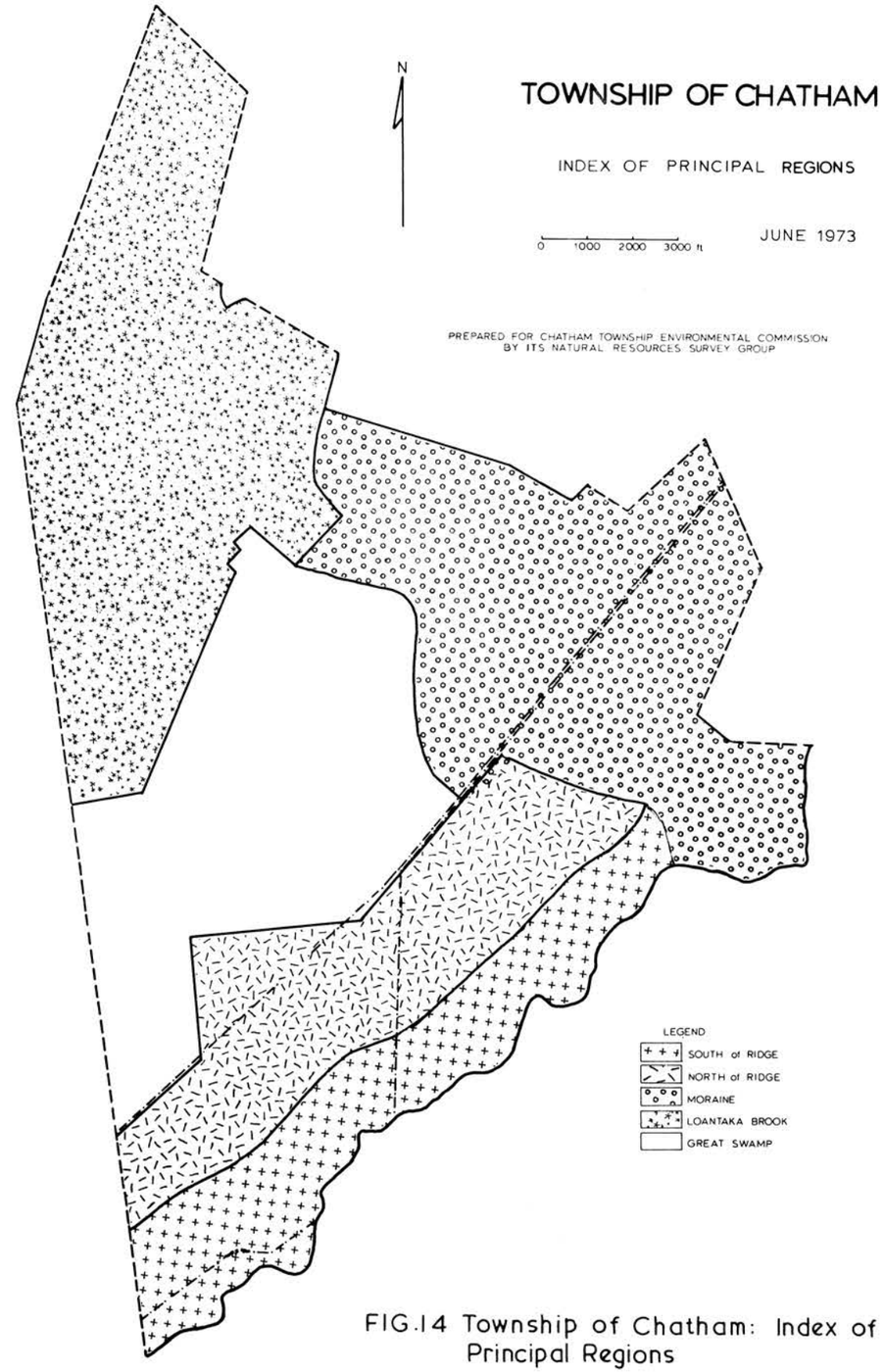


FIG.14 Township of Chatham: Index of Principal Regions

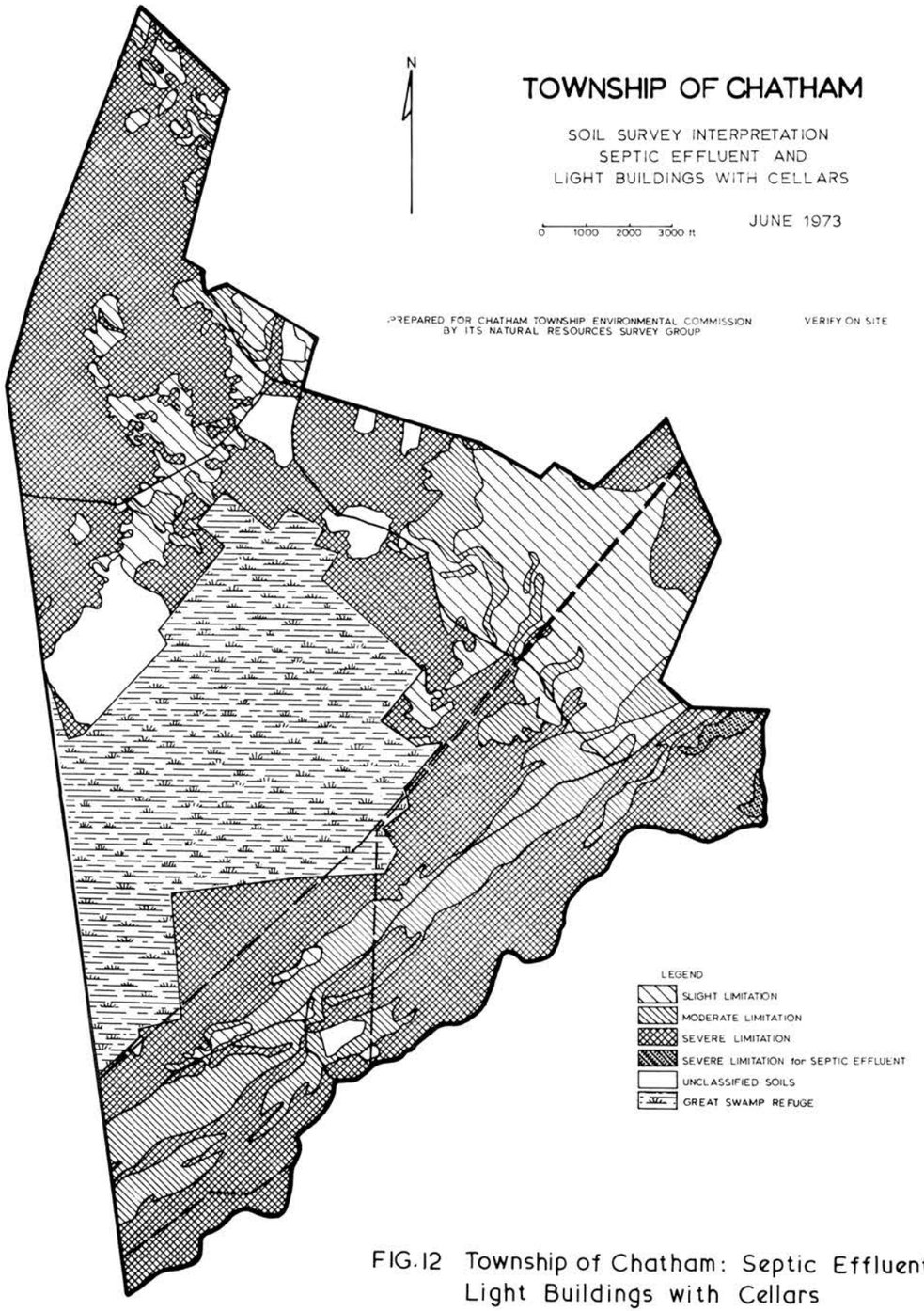


FIG. 12 Township of Chatham: Septic Effluent and Light Buildings with Cellars

These data are analyzed by the SCS to develop interpretations for certain engineering uses for each soil, such as the construction of Light Buildings with Cellars, the suitability for receipt of Septic Effluent, development of recreational areas and the construction of roads and parking lots. The interpretations are stated in terms of the degree to which the physical properties of the soil present limitations for the specified use. Limitations are classified as "slight," "moderate" or "severe." "Severe" is defined by the SCS to be those *". . . resulting from the effects of steep slopes, high water tables, stream flooding, unfavorable soil texture, acidity, large numbers of stones, rocks and so forth. The limitations are such that they can be overcome only by exceptional costly or complex measures"* (Interim Report, 1969). For example, the darkest areas (cross-hatched) of Fig. 12 represent those areas of Chatham Township which are classified as having severe limitations for Septic Effluent and Light Buildings with Cellars. (With two exceptions these two interpretations happen to be identical in Chatham Township.)

The Morris County Planning Board has designated the following physical properties, categorized by the SCS as "severe," as critically significant in this area: greater than 15 percent slope, less than 6 feet depth to bedrock and less than 2 feet to seasonal water table. Approximately 59 percent of Chatham Township, exclusive of The Great Swamp National Wildlife Refuge, falls within this composite definition of critical areas (see Fig. 13).

The accuracy of soils data is limited partially by the data collection process and partially by the nature of soil itself. Basic data are developed from vegetation characteristics and color tone presented by aerial photographs. Field work verifies and augments these data but does not refine it sufficiently for engineering in a specific location.

Between adjacent soils is a transitional area where the two soils grade from one into the other. The mapped boundary between two adjacent areas is therefore not precise. This transitional zone is of significance in Chatham Township, where in some areas the width or length of the minimum lot size approximates the soil's transitional zone. Soils information by this method of analysis is useful for guideline purposes, but necessitates on-site analysis for specific engineering decisions.

REGIONS OF THE TOWNSHIP

On the basis of land configuration and kinds of soil, Chatham Township can be divided into several principal regions (see Fig. 14). One is a long band that lies between the ridge line of Long Hill south to the river. The north slope of Long Hill and its extension to the power line form the second. The moraine area in the eastern part of the Township is the third, and the valley of Loantaka Brook is the fourth. These regions and their remaining undeveloped land are described in the Inventory of Undeveloped Land in this Report. Because most of the fifth area is owned by The Great Swamp National Wildlife Refuge, only the basic information is presented for it.

* * * * * *

Chatham Township now lies in a generally humid, continental climatic zone. This zone is a battleground for weather fronts from south and north that shift back and forth over it. This variability produces air patterns that are turbulent, frequently changing and moisture-producing. The patterns change on a short-term basis, but are predictably constant over a period of several years.

The prevailing winds in Chatham Township are from the southwest from May to September and from the northwest the rest of the year. Most arriving air masses have crossed over land rather than water, bringing precipitation from the direction of the Gulf of Mexico. Some other storms are maritime in origin—hurricanes, tropical storms and "northeasters"—which come from various parts of the Atlantic Ocean. Some details of Chatham Township's weather patterns are presented in Fig. 16.

Prevailing wind directions blow air and thermal pollution originating in the industrialized areas of New York and New Jersey away from Chatham Township. The continuing expansion of the heavily developed part of New Jersey may eventually place sources of air pollution upwind of Chatham Township. The Township would then be exposed to increasing sources of some human disease and deteriorating conditions for many kinds of plant life, as well as factors known to contribute to human anxiety and low morale (McHarg, 1969).

New Jersey as a whole ranks highest in all statistics gathered to show deterioration of air quality. It also has the highest density of population, cars and industry per square mile of any state in the Union. While Chatham Township is protected by prevailing wind directions from the heavy industrial emissions to the east, automobile emissions are chronic throughout. The principal airborne products of gasoline combustion are sulfur dioxide, particulate matter, carbon monoxide and hydrocarbons. In large enough quantities they can result collectively in irritation of the respiratory tract, injury to the lungs, and impairment of heart and brain activity of people. They also cause injury to plants and can weaken or erode steel, iron, marble and other materials (LWV, 1974).

Urban areas resemble some desert conditions of climate in that they heat up fast and cool rapidly and are, on a small scale, dry and windy (*Study of Man's Impact on Climate*, 1971). On the other hand, forests and other large areas of vegetation decrease wind velocities and turbulence, cool slowly, warm slowly, conserve moisture, produce oxygen for air replenishment and produce a clean airshed. The presence of vegetation is also a key factor in tempering climate on a smaller scale, such as a house lot. A single tree transpiring 100 gallons of water a day is equivalent to the cooling effect of five average room air conditioners, each of which runs 20 hours a day (Federer, 1970). Temperatures over grass are 10 degrees to 14 degrees cooler than over exposed soil on a sunny summer day. Vegetation can also play a variety of other climate-related roles, many of which are discussed in *Plants, People and Environmental Quality* by G. O. Robinette (1972).

* * * * * *

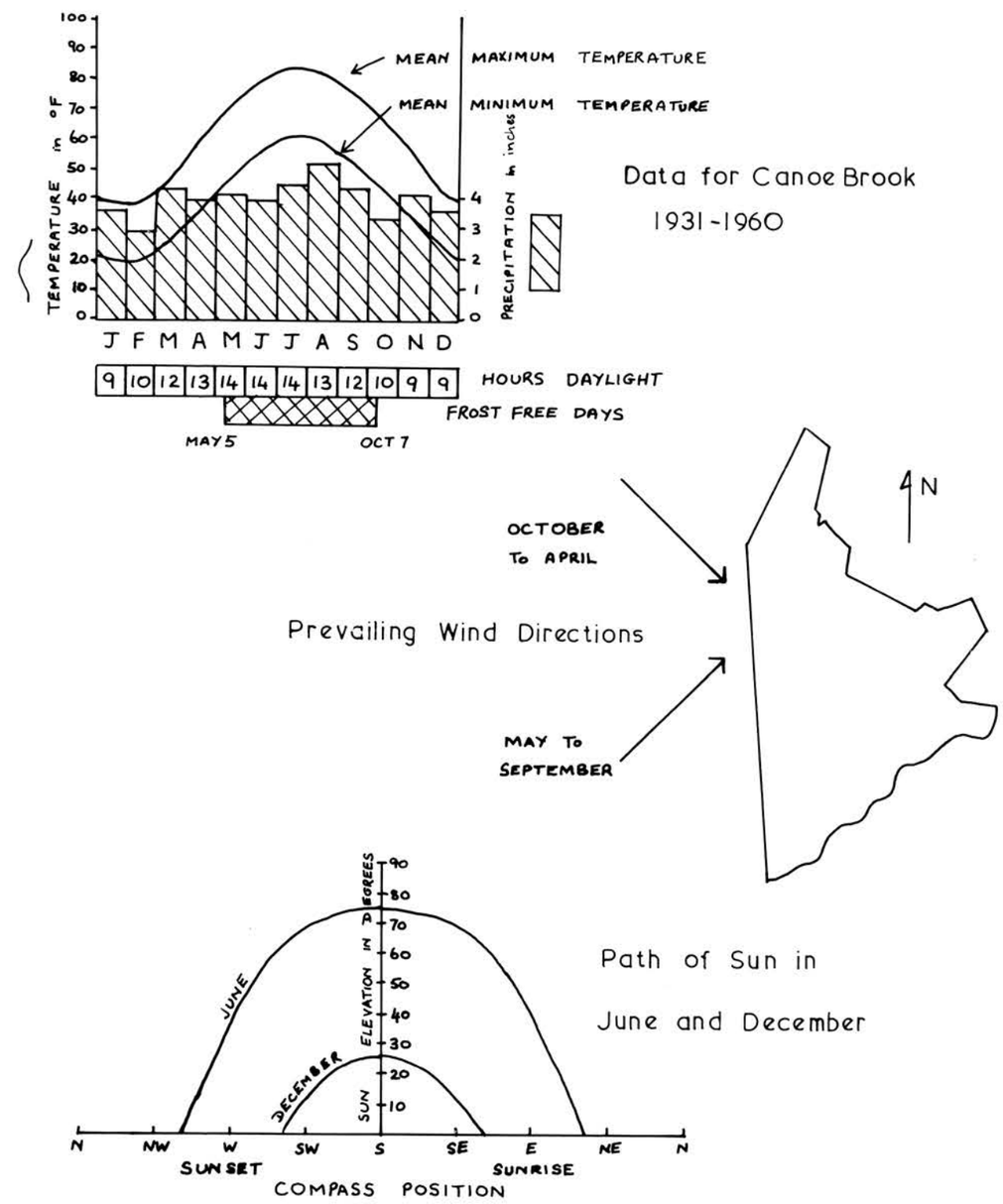
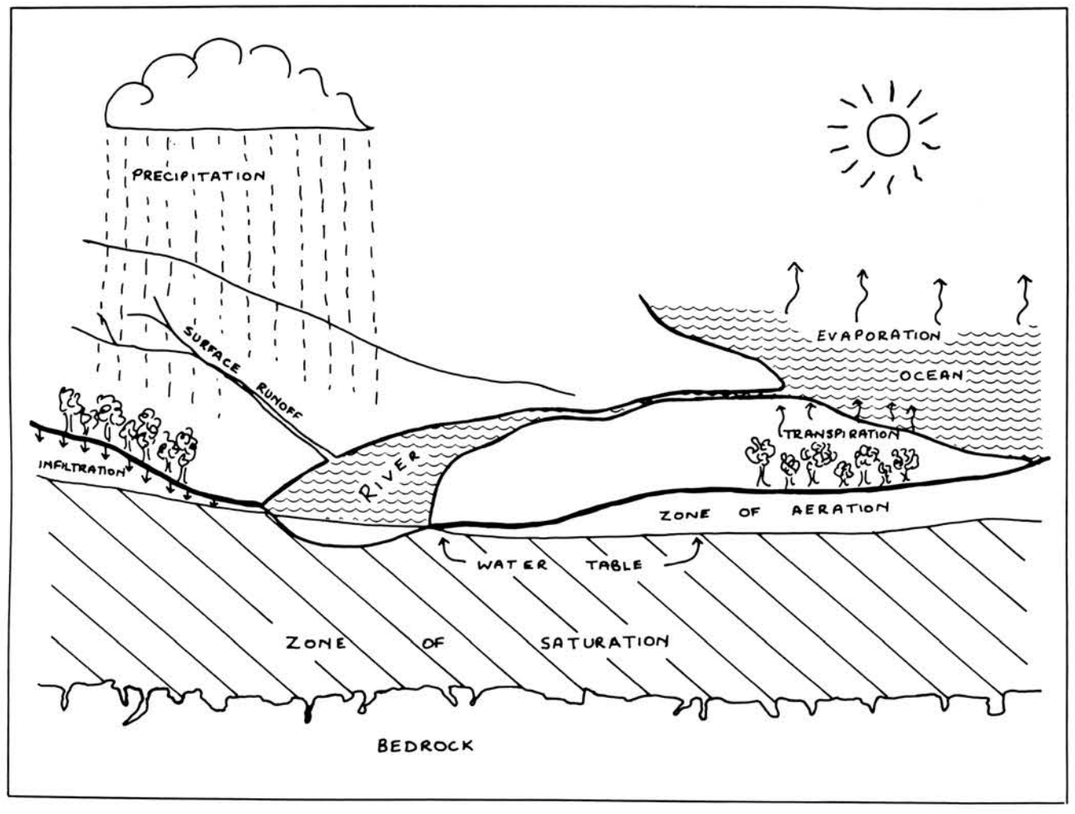


FIG.16 Basic Climatic Data



Water vapor condenses, forms clouds and precipitates as rain, snow, fog or hail.

Water evaporates from bodies of water and other exposed surfaces, and transpires from vegetation.

Some precipitation runs off the ground directly into bodies of water. Some infiltrates into the soil and either becomes stored in bedrock fissures or flows slowly in the zone of saturation into rivers and streams.

FIG.15 The Water Cycle

Conditions of climate combine with geological factors to establish drainage and vegetation patterns. Climate is the average condition of the atmosphere at a locality or over an area. It is determined by the daily weather events and their seasonal patterns. Climate is described in terms of average values, and departures from those values, of atmospheric variables such as temperature, precipitation, humidity, cloud cover, wind velocity and direction. The period used to calculate average values is usually 30 years or more.

Radiation from the sun, about half of which successfully penetrates the earth's atmosphere, provides the energy that keeps in motion the network of climatic and hydrological systems of the earth. As radiation raises the temperature on the surface of either land or water it causes water to evaporate into the atmosphere. There the water cools, condenses and eventually falls back to earth as precipitation—rain, snow, hail or fog. Some water evaporates again immediately, some flows across the surface of the landscape into channels and storage areas and the rest soaks into the ground. Some of this water in the ground is used by the roots of plants in the process of transpiration, some sinks down to be stored in bedrock fissures and the rest eventually reappears at the surface, either because it is pumped from wells or because it seeps out into rivers, lakes and oceans to be evaporated again (see Fig. 15). This whole process is called the water cycle.

The conditions of climate experienced in a particular location change over long periods of time. Northern New Jersey's climate, for instance, has been both wetter and drier, both colder and warmer, and much windier at various times in the past than it is now. Small changes of climate, such as raising the average annual temperature or raising the amount of annual rainfall a few inches, are significant if maintained sufficiently long. Vegetation types respond, and with changes in plant life come changes in animal life. The rate of erosion may also change.

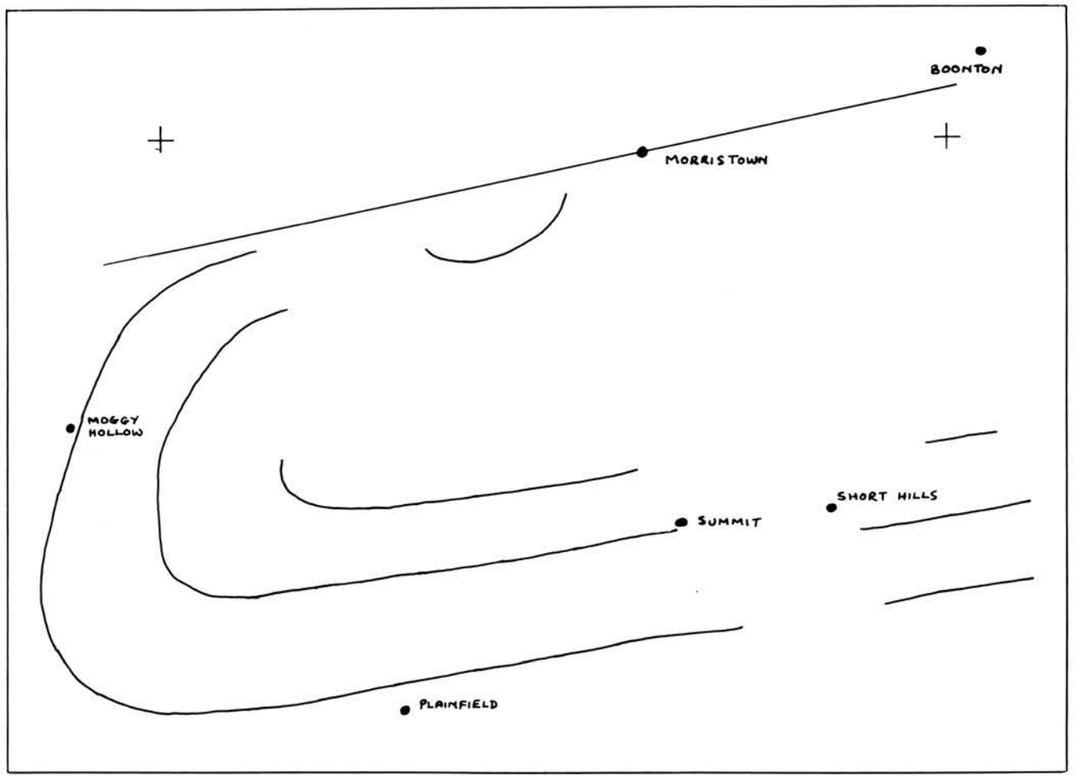


FIG.17 Diagrammatic sketch: History of the Regional Drainage Pattern with four overlays: 1. Pre-glacial drainage
2. Maximum advance of the glacier; also Glacial Lake Passaic
3. Maximum extent of Glacial Lake Passaic
4. Present-day drainage

Stream
Terminal Moraine
Front edge of glacier
Glacial Lake Passaic

The Passaic River now rises as a series of small brooks (see Fig. 4, Passaic River Watershed). Great Brook, Loantaka Brook, Black Brook and Primrose Brook drain the area to the south and west of Morristown, flow into The Great Swamp (one of the remaining vestiges of the glacial lake) and across The Great Swamp to the west. There they join the main channel of the river which rises in the hills behind Bernardsville and Mendham. The river flows southward through Long Hill at the Millington Gorge and then follows a well-defined channel, with a wide floodplain, in an easterly direction between Long Hill and the Second Watchung Mountain. In the southeast corner of Chatham Township, where the river cuts through the glacial moraine above Stanley Bridge, the floodplain diminishes until the surrounding land descends directly to the river banks. The slope of the river bed from Morris Township down Loantaka Brook, across The Great Swamp, through the Gorge and down to Stanley Bridge is shown in Fig. 18. In its passage onward from Chatham Township, the Passaic River is joined by its major tributaries—the Rockaway and Pompton rivers. Altogether, it is the second longest river in New Jersey, traversing seven counties and draining a total of 949 square miles before reaching Newark Bay and the Atlantic Ocean.

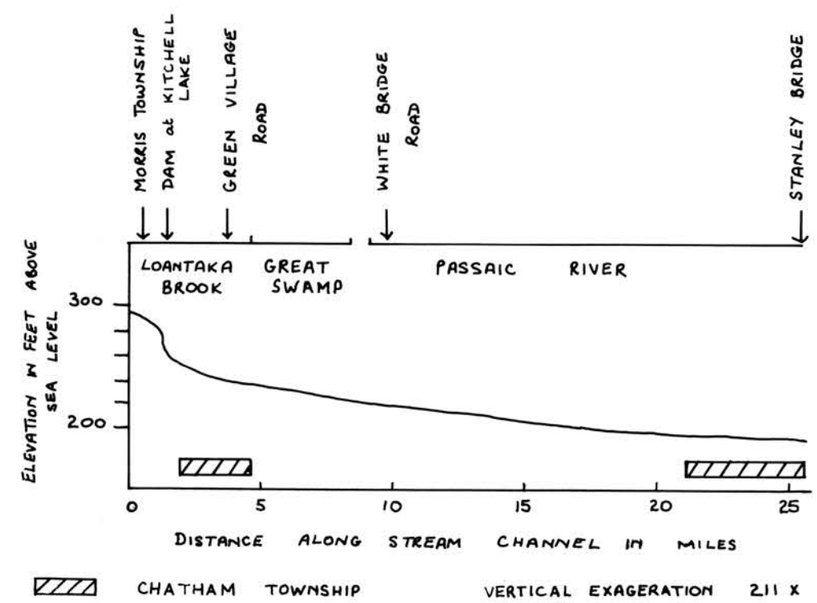


FIG.18 Headwaters of Loantaka Brook to Stanley Bridge Gauge on the Passaic River

Chatham Township's particular landform, soil and climatic conditions combine to make drainage considerations of considerable significance to the municipality. Extensive areas of the Township are poorly drained, and some areas experience regular flooding. Water for domestic usage is supplied from outside the Township.

The composite picture presented by the varied and variable natural factors does not lend itself readily to the kind of analysis used by the SCS for soils, which, being defined in terms of fixed locations and long periods of time, lend themselves to generalization. The hydrologic activity of a watershed is best understood in terms of that particular watershed and is, therefore, a specialized study.

THE WATERSHED

Precipitation falls on the local landscape with relatively uniform distribution, both in space and time. The water drains from the higher portions of the landscape over and through the soil until it eventually reaches rivers, streams, lakes, etc. The land area that contributes drainage to a particular body of water is called its watershed. It may be a few acres in size or many hundreds of square miles. A given watershed may be part of a larger one, or contain several smaller ones. The Loantaka Brook Watershed, for example, is composed of the smaller watersheds of its tributaries, as well as that of its main channel. It is also part of the larger watershed of the Passaic River. In order to fully understand local drainage conditions, a municipality must consider whole watersheds rather than just the area that lies within its political boundaries.

Chatham Township is part of the watershed of the Passaic River located upstream of Stanley Bridge, a major data collection point for the river because of the U.S. Geological Survey's stream gauging station sited there (see Fig. 4, Passaic River Watershed). The principal watershed divide within the Township is along the ridge line of Long Hill. Three thousand two hundred acres of the Township (54%), located north of the ridge line, drain into the basin of The Great Swamp and eventually into the main channel of the Passaic River. To the south of the ridge lie 895 acres of the Township (15%) which drain directly into the Passaic River. The remaining 205 acres (4%) of the Township drain to the northeast into the Passaic River basin, downstream from the Stanley Bridge gauge. The details of this drainage pattern have developed relatively recently in geologic time as a result of the profoundly disruptive nature of the most recent glaciation.

HISTORY OF THE DRAINAGE PATTERN

The principal flow of pre-glacial drainage in this area is thought to have been to the east. One river flowed in the valley between the Second Watchung ridge and Long Hill, and a second river flowed to the north of Long Hill, crossing the basin now occupied by The Great Swamp. They joined each other and then, with another tributary from the east, turned south to flow through a gap in the ridges located between present-day Summit and Short Hills.

As the Wisconsin glacier advanced from the north, it dislodged loose rock and surface materials from the landscape. These were carried along by the ice and then randomly deposited when the ice melted, often many miles from their original location. Hobart Gap, between Summit and Short Hills, through which the pre-glacial river had flowed, was blocked first with ice and then with loose rocky material, called drift, that was transported by the glacier. As the climate grew warmer again, the rate of melting equaled and then eventually exceeded the rate of formation of the ice. Increasing amounts of water ran into the natural basin now formed by the Second Watchung ridge, the hills to the north and the leading edge of the glacier itself. Eventually this basin filled until the body of water known as Glacial Lake Passaic was formed. Only the highest parts of Long Hill rose above the water as a series of small islands.

The lake water finally found an outlet across the hills into the Raritan River basin through a gap at Moggy Hollow near Far Hills. The size of the lake grew as the ice melted, finally reaching a maximum of approximately 30 miles in length, 8-10 miles in width and 240 feet at its deepest point. The finest sediments (mostly clay) settled to the bottom of this lake. These, together with the glacially-transported material, filled in the pre-glacial drainage pattern. The retreat of the ice beyond Little Falls eventually opened a drainage route at an elevation lower than that of Moggy Hollow. Gradually the lake receded, exposing the glacier's terminal moraine which divided the watershed of the pre-glacial river into the present watersheds of the Whippany and Upper Passaic rivers. (Glacial history based on Lewis & Kümmel, 1940.)

The succession of events described above is depicted diagrammatically by Fig. 17 and its four overlays. The overlays may be found in the pocket on the back cover of this Report.

The combined effects of glacier-related events in the vicinity of Chatham Township have been enormous. Local topography has been altered by the pre-glacial river channel and the surrounding area being filled and leveled by glacial material and lake-bottom sediments. The previous river basin is now divided by the terminal moraine, and a west-flowing drainage pattern has developed in the region of The Great Swamp, which previously drained to the east. The rate of drainage across the surface of The Great Swamp area has been reduced by the leveling effect of the sediments. Downward drainage of water into the ground is reduced or prevented because of the sediment's clay characteristics. The glacier also deposited parent material in complex patterns, from which a wide variety of soils has developed.

All along the river channel the proportion of effluent and other wastes increases during periods of lower water flow. These concentrations become more dilute with increased amounts of direct precipitation and runoff. However, the Passaic River in its passage downstream eventually receives so much waste material that it is one of the most polluted rivers in the United States.

Flowing water is able to cleanse itself of a wide range of impurities. A decrease in the speed of flow, for example, allows particles of solid material (sediment) to settle to the bottom. Exposure to light can raise the dissolved oxygen content, which is essential to the chemical processes which decompose organic matter (Rudolfs & Heukelekian, 1967). Wave action increases the surface area of the water exposed to the air, resulting in increased amounts of dissolved oxygen. Temperature and time are also important (*Water*, 1955).

Water flowing into The Great Swamp on its way to the Passaic River has already received 2 million gallons per day of effluent from two major treatment plants (Morris and Chatham Townships), as well as salt, petroleum, and rubber residue of street runoff and other material. The time necessary for water to flow across The Great Swamp is time in which the water is undergoing some purification by natural means. A comprehensive study of The Great Swamp watershed and its water quality is currently in progress (D. Guillaudeu, E. Moye and S. Syz, 1974). "Water Pollution in the Passaic River, New Jersey: Analysis of Problems and Recommendations for Possible Solutions" and "Pollution Abatement Study for Watersheds of Morris County" are completed studies that provide a more regional analysis.

WATER FLOW

A river receives water which has fallen in its watershed area and flowed above or below ground to the stream channel which then carries it out of the watershed. Many factors, both natural and man-made, complicate this process in real life until it becomes very difficult to predict, from knowledge of recent precipitation, the height of water in the river at any given moment. Upstream of Stanley Bridge the dynamics of water flow in the Passaic River are modified by the configurations of The Great Swamp and the Millington Gorge, increasing development in the watershed area, and the additional water introduced from outside the watershed.

The highest flood ever recorded at the Millington Gorge gauge occurred in January 1905. The flow was measured at 2,000 cubic feet per second ("Water Resources Data for New Jersey," 1972). This watershed area, if it did not contain the storage area provided by The Great Swamp, could have been expected to discharge 6,500 cubic feet per second (computation based on the method developed by Stankowski, 1973). However, while the Gorge is large enough to allow free passage of average flows, it restricts passage of flood levels. The excess water backs up into the broad, nearly level expanses of The Great Swamp, which constitutes 25 percent of the 55-square-mile watershed upstream of the Gorge. The stored water is discharged through the Gorge as the river level falls. Spacing out the time of discharge in this way substantially prolongs the time of higher-than-average water levels downstream from the Gorge but reduces the highest level of the flood peak (Ebasco, 1961).

Observed discharge in cubic feet per second for the Passaic River at the Millington Gorge is given in Fig. 19 for 2-, 5-, 10-, 25-, 50- and 100-year design storms (storms the recurrence rate of which is statistically determined as being of those intervals). Two-year storms are smaller and may recur more frequently than 100-year storms which are of unusual magnitude. Computations of estimated discharge were also

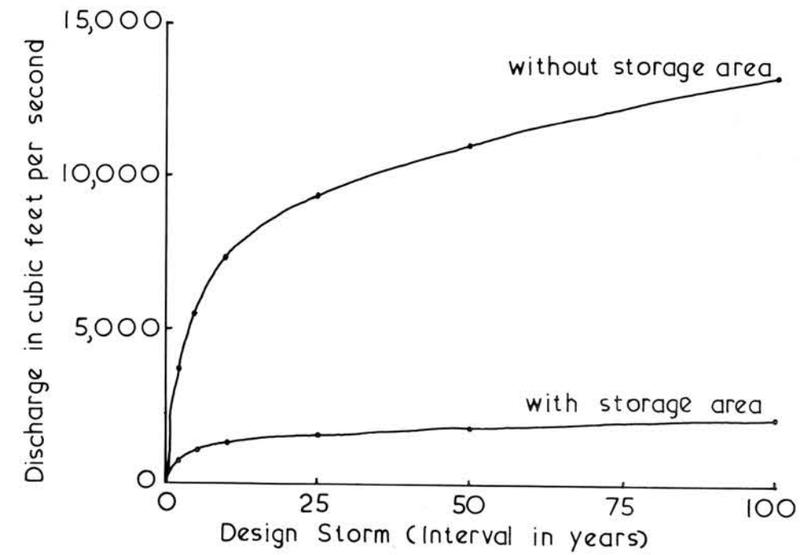


FIG. 19 Observed discharge of Passaic River at Millington Gauge; Hypothetical discharge (storage area of The Great Swamp excluded)

done for the same area, omitting the storage effects of The Great Swamp. The divergence of these lines, as shown in the Figure, demonstrates that the greater the flood, the more the peak discharge is reduced.

The effect of the Gorge on river flow is also indicated by Fig. 20, which plots the drainage area against the peak flow of the maximum recorded flood for 53 small streams in the northeastern United States. Watershed areas range from 20.9 to 97.4 square miles in size. The Passaic River presents the lowest amount of discharge. The next-to-lowest discharge has 2.25 times as much water contributed by less than half as much area as the Passaic River. While these relationships are influenced by the degree to which the watershed area is developed, the anomalous position of the Passaic River as measured at the Gorge is attributable to the natural configurations of the local landscape.

Peak flow from any design storm will increase with increased development in the watershed. Precipitation which would have evaporated directly from leaf surfaces, been retained in the natural mulch of the forest floor, or retarded in its rate of runoff by natural conditions (and thereby be given more opportunity to sink into the ground and enter the water table), runs off the paved and roofed surfaces with no absorption into the ground and no time delay or interception by vegetation. A greater volume of water arrives at the stream in a shorter period of time, raising the height of floods and shortening the time that elapses between the onset of rainfall and the peak flow.

TOTAL WATER INPUT

The watersheds in which Chatham Township lies receive water from precipitation and other sources. Precipitation in New Jersey is fairly evenly distributed throughout the year, averaging about 2 million gallons per day per square mile. About 49 inches (approximately 18 million gallons per day) fall annually in the Chatham area. Estimating that about half of this quantity evaporates or is transpired by vegetation, the 9-square-mile area of Chatham Township retains precipitation at an average rate of about 9 million gallons per day (Tippetts, 1955; Widmer, 1968).

In addition to precipitation, the eastern end of The Great Swamp watershed receives another estimated 2,140,000 gallons per day from household and other users. Approximately 1.3 million gallons per day of this amount is discharged into Loantaka Brook from the Woodland Road sewage treatment plant in Morris Township (Morris Township, Woodland Road Treatment Plant, 1974). The Chatham Township treatment plant discharges an average of 655,000 gallons per day into Black Brook (Vopelius, O., 1974). Septic tanks in Chatham Township, the majority of which are in the Green Village area, discharge an estimated 185,600 gallons per day directly into the ground (566 unsewered houses in Chatham Township x 4 people per house x 82 gallons per day per person) (Morris County Planning Board, 1974).

Almost all of this additional water is supplied from commercial wells and reservoirs that are located outside the Passaic River watershed above Stanley Bridge (Commonwealth Water Company, 1974; Lundt, A., 1974). This water enters the natural drainage system of Chatham Township as runoff or groundwater, with no substantial loss to evaporation and transpiration. As such it represents an increase of nearly 20 percent over the 9 million gallons per day that enter the runoff/groundwater system from direct precipitation. This water would naturally have entered the Passaic River further downstream. Pumping it into Chatham Township brings it into the headwaters of the river system where it augments normal flow in the upper parts of the river. When the natural water level is low, the additional water helps to dilute the effluent that several sewage treatment plants put into the river. At times of high water levels, however, it constitutes a very small fraction of the flow through the Millington Gorge (U.S.G.S., 1974). Other municipalities in the Passaic River watershed above Stanley Bridge also discharge additional water from external sources into the river.

THE UPPER PASSAIC RIVER

Chatham Township's two major watershed areas function as entirely distinct hydrologic entities whose connecting link is several miles of winding river channel. Water from most of the Township flows into the basin of The Great Swamp, crosses it in a westerly direction and arrives at the main channel above the Millington Gorge, where the post-glacial river has carved a route through Long Hill (see Fig. 4, Passaic River Watershed).

Several miles downstream, the Passaic River, as it enters Chatham Township, is a small, slowly-flowing river whose immediate environs indicate considerable variation in water level. For 3½ miles it flows through a wide, nearly flat, stretch of woods and fields extending from low muddy banks across to the steeply rising slope of Long Hill. Many houses are built close to the river along the south bank, while the Chatham Township side is in a more natural state. Water-oriented animals appear to be abundant. The drainage area on the Chatham Township side, from the ridge top to the river, is of sufficiently small size that the ditches and brooks entering the river are infrequent and small. Two small sewage treatment plants on the Chatham Township side, serving 90 houses and Cardinal Hill apartments, discharge effluent into the river. The New Providence and Berkeley Heights municipal treatment plants discharge from the south side of the river.

In its final mile of passage through the Township, the river and its environs change character completely. The effects of glaciation are immediately apparent as the river flows through the moraine and into the glaciated portion of New Jersey. Muddy banks and channels bordered by a well-developed floodplain are replaced by a gravelly river bottom with small beaches and mounds of rounded stones of granite and other foreign material. The floodplain narrows and then disappears. The banks become high, with steep cliffs on the south side and a wooded hillside on the Chatham Township side. The vegetation changes from pin oak and red maple to oak, beech, ash and tulip, with a small natural grove of hemlock and a wide variety of wildflowers in the spring. The river flows more swiftly through this section, riffling around randomly located stones. It passes under Stanley Bridge and, once out of the Township, is soon encroached upon by industry and other development. In spite of being marred by the presence of the Summit dump, this last section in Chatham Township is a unique portion of the Passaic River, and very beautiful.

WATER QUALITY

The Passaic River forms a continuous natural link from one municipality to the next. Once the river leaves its headwaters, all municipalities along it are both givers and receivers of its water. The quality of the water is dependent to a large extent upon the actions of people within the watershed.

The Passaic River is northeastern New Jersey's largest source of water supply. The river's total potential yield has been estimated by the Division of Water Policy and Supply (New Jersey Department of Environmental Protection) at 420 million gallons a day. Regular measurements of both organic and inorganic content of the river are made by the U.S. Geological Survey, water companies, the N.J. Bureau of Water Control and others (*Handbook for Environmental Commissioners*, 1974).

Even before it reaches the earth's surface, precipitation contains dissolved minerals and gases as well as dust particles. In its passage over or through the soil and down streams, it can acquire a greater quantity of mineral content and gases (inorganic material), and by-products of living things (organic material).

The natural quality of water in the Passaic River as it enters Chatham Township has been altered by the discharge of at least six municipal sewage treatment plants located upstream, as well as leachate from dump areas, occasional domestic indiscretions, horse farms and agricultural enterprises. Dumping, treatment plant outflow, industrial waste, and the salt and petroleum residue of street runoff are added to the river from the Chatham Township/Berkeley Heights/New Providence area. As a result of diminished water quality, people along the Chatham Township portion of the river now forego some of the pleasures and amenities the river used to offer such as swimming. Because the ability of aquatic life to live in the river is controlled by the worst conditions it experiences, rather than by long-term averages, there is also less abundance and variety of river-dwelling animal and plant life in the Chatham Township stretch of the river than is found further upstream.

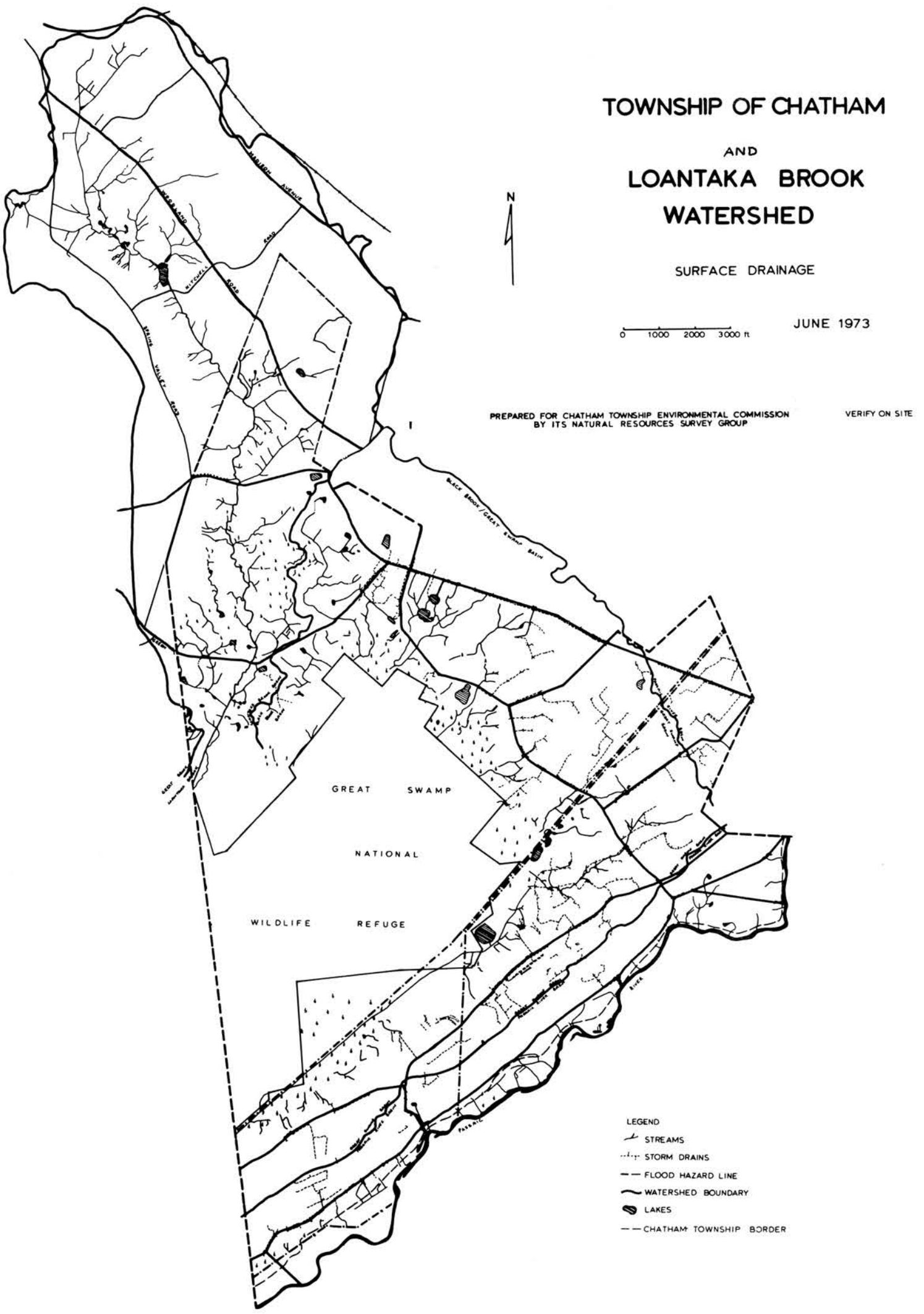


FIG.22 Township of Chatham and Loantaka Brook Watershed: Surface Drainage

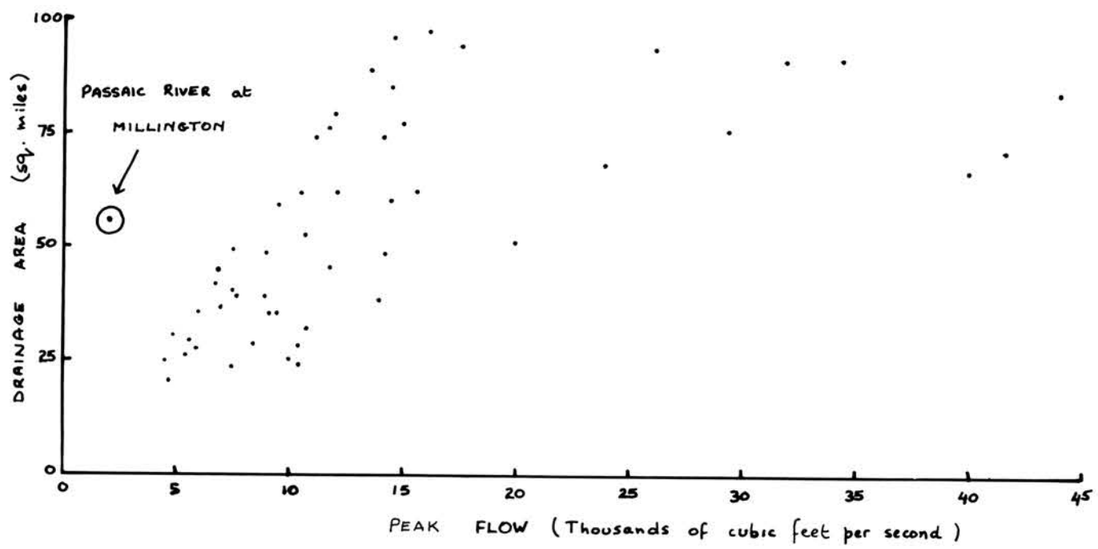


FIG. 20 Flood Peaks of 53 small streams in the northeast part of the United States

The proportion of runoff to rainfall also increases during long wet periods when the soil remains saturated and cannot absorb more precipitation (see Fig. 21). When a higher percentage of precipitation becomes runoff, less water is retained in the ground to eventually make its way to the channel during periods of low flow. In other words, increasing watershed development causes high water levels to become higher and flood levels to rise and recede more quickly.

A fuller discussion of the dynamics and implications of flooding in New Jersey is presented in "Flood Hazard Area Rules and Regulations—Basis and Background," which was prepared by the New Jersey Department of Environmental Protection to accompany its delineation of the floodplain of the Passaic River.

Floods are natural phenomena that occur whenever the amount of water exceeds the capacity of the channel that must carry it. Floods on the Passaic River are not limited to particular seasons, but may happen at any time because of the generally even distribution of rainfall throughout the year. When the defined river channel overflows, water spreads out into the floodplain adjacent to the river. The floodplain is an integral part of the structure of the river, just as the river is of the watershed.

The effects of flooding are intensified when the floodplain becomes restricted by filling and construction. When sediment is deposited in the river channel, the capacity of the channel to carry floodwater is decreased. Faster runoff due to upstream development in the watershed tends to raise flood levels.

Local variations in rainfall intensities and durations within the watershed during a particular storm cause different storms to produce floods with different characteristics of peak flow, time of flood crest, etc. Using a single flood to decide the extent of a river's floodplain is therefore not practical. The New Jersey Department of Environmental Protection has compiled a variety of historic data on local flooding for the years between 1903 and 1971. These data have been used to delineate the area on either side of the channel of the Passaic River and its principal tributaries that is necessary to allow for the storage and passage of floodwater. About 190 acres of this delineated floodplain lie in Chatham Township (see Fig. 22) ("Flood Hazard Area Delineation," 1973). Filling or construction in a floodplain restricts the passage of floodwater, contributing to greater flooding, consequent damage and economic loss to people both upstream and downstream.

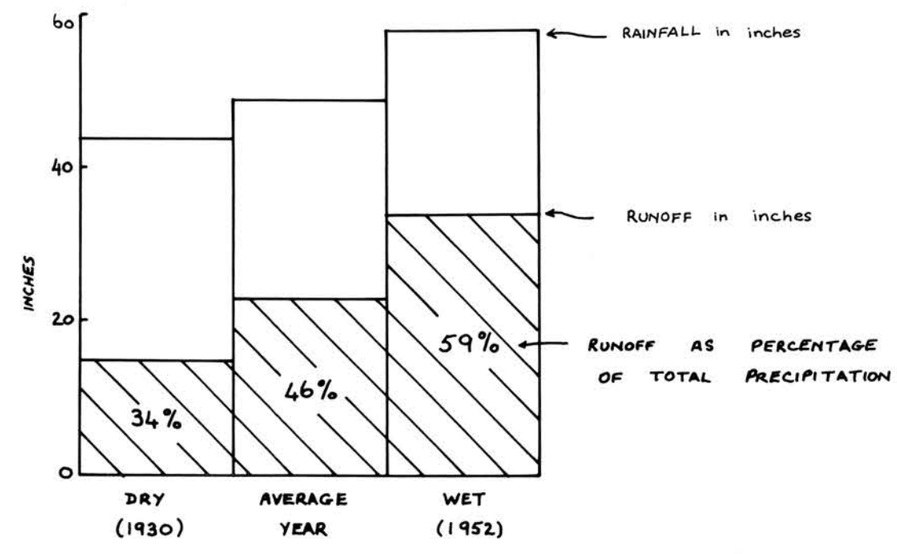


FIG. 21 The proportion of rainfall to runoff in a dry, average and wet year in Chatham Township, N.J.

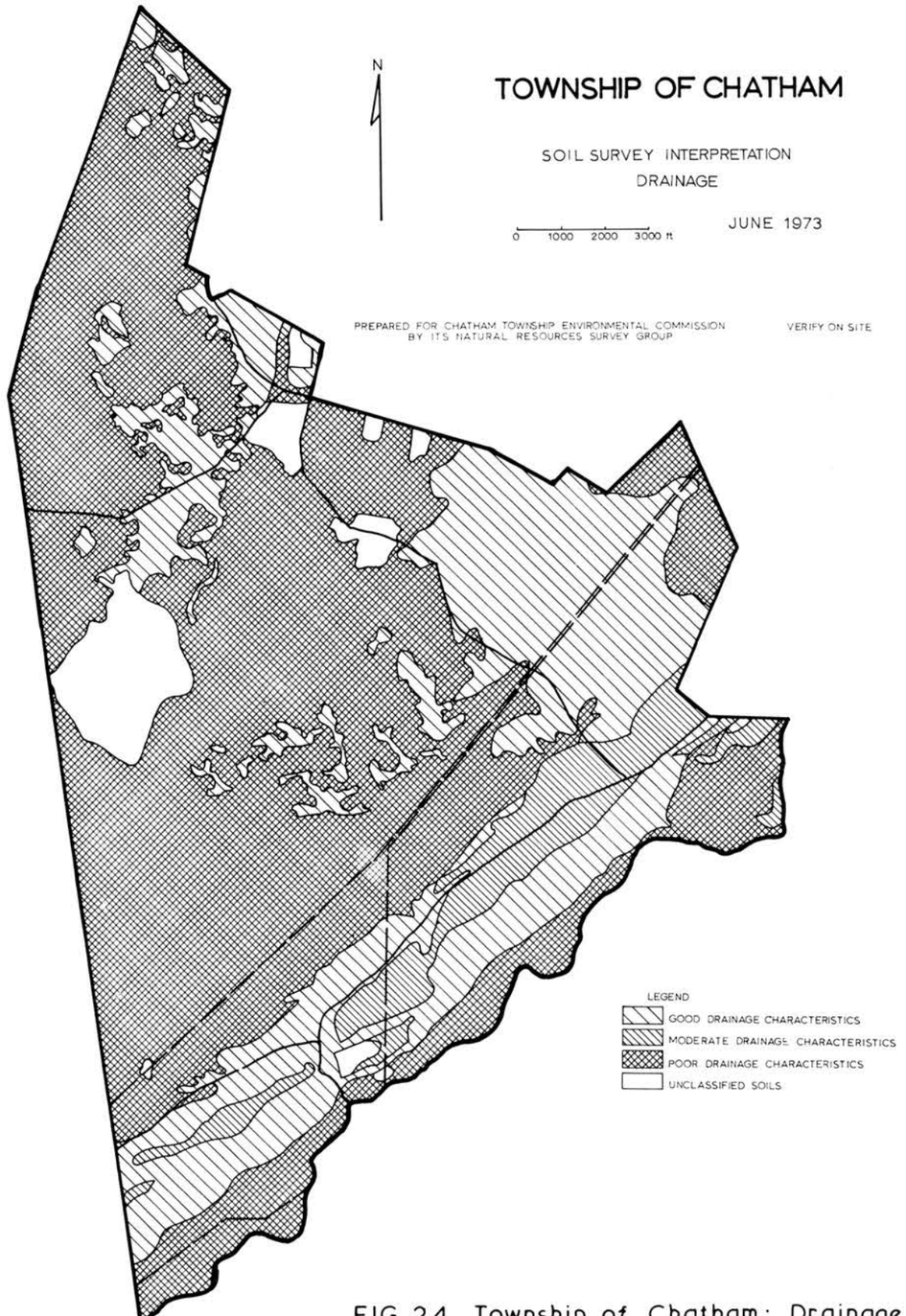


FIG. 24 Township of Chatham: Drainage

Throughout most of the valley, the processes of glaciation have created soil and topographic conditions that result in poor drainage. Interspersed throughout this generally low wet area are small rises formed by glacial outwash from the terminal moraine—intermixed sand, gravel and stones. Their higher elevations plus the nature of their soil and stone content make them dry and well drained (see Fig. 24).

A detailed description of the surface features of the valley of Loantaka Brook is given in the Inventory of Undeveloped Land, p. 27.

BLACK BROOK

A number of streams of varying size drain from the terminal moraine and the north side of Long Hill down into Black Brook, which runs across the south side of The Great Swamp (see Fig. 22, Surface Drainage). Black Brook also receives effluent from the Chatham Township treatment plant at an average rate of approximately 655,000 gallons per day. Many of these streams are short, with watershed areas of only a few dozen acres. A larger stream floods regularly in the vicinity of several houses as it crosses Green Village Road. It drains land with characteristics similar to those of Loantaka Brook. One stream, draining a few hundred acres, flows down through the Wickham Wood area of the Township, and another, just to the north, flows into The Great Swamp in the vicinity of the power lines. The latter two have areas of poorly drained soils associated with them (see Fig. 24).

Some of the area drained by these streams is described in the Inventory of Undeveloped Land, p. 27.

THE GREAT SWAMP

The Great Swamp is the focus of the natural systems of much of Chatham Township. From the crest of Long Hill northward almost all of the Township's water flows into it. The swamp's alternations of wet and drier areas, open and wooded sections, flowing water and ponded water provide extensive and varied habitat for most kinds of wildlife found in the Township. The swamp acts as a modifier of local climate, as well as an air and water purifier. It serves important flood control functions. It is of aesthetic and recreational value to people.

In all of these functions the presence of water is an essential element. In combination with geologic and soil conditions, it has given rise to a further dependent complex of vegetation and wildlife. For the swamp to maintain its multiplicity of function, its natural state as a swamp is essential. Construction of a jetport and building a dam across the Millington Gorge are plans for the swamp that have been rejected in the recent past as too destructive of its integrity. Similarly, impure water, too much water, rapid changes in water level and other conditions often created by a developing watershed can also be destructive of its functioning.

Like the river, The Great Swamp must be viewed in terms of its whole watershed. In addition to the precipitation that falls on it directly, water flows into the swamp in major brooks, storm drains, intermittent streams, treatment plant discharge, and by seepage and upwelling of water from beneath the clay. Great Brook receives water from the north side of the swamp (the majority of the watershed area) in three principal brooks—Loantaka Brook, Primrose Brook and the channel of Great Brook itself. Black Brook drains the terminal moraine area and the north side of Long Hill. For many decades, sur-

LOANTAKA BROOK

The valley of Loantaka Brook in the northern part of the Township is also subject to flooding. This primarily affects houses along Green Village Road.

The brook's valley in Chatham Township is largely undeveloped, descending from gently rolling, wooded hillsides and open fields to the mostly wooded environs of the brook itself. Since 1954, however, approximately 18 percent of the brook's watershed has been developed. Almost all of this area lies north of Kitchell Road in Morris Township, Madison and Morristown (based on the 1970 revision of the 1954 "Morristown" quadrangle, U.S. Geological Survey). This must cause a substantial increase in the quantity of runoff during storms.

Natural flow in the brook is also augmented by an average of 1.3 million gallons per day of effluent from the Woodland Road Treatment Plant in Morris Township, which began operations in 1968.

A prolonged severe drought during the mid-1960's lowered water tables and stream levels throughout the northeastern United States. This has been followed by record precipitation levels in 1972 and 1973. Because of these factors, the amount of water carried by Loantaka Brook has changed significantly in the last 15 years.

As part of the Inventory effort, two stream gauges were constructed and put up in Loantaka Brook (see Fig. 23). Water heights were recorded daily at each location. During and immediately after significant rainfalls, the gauges were read hourly. A third gauge, established by The Great Swamp National Wildlife Refuge, was also read on the same basis. Hydrographs developed from hourly gauge readings show that the height of floodwater in the brook from a particular storm is diminished below Green Village Road as the water begins to spread out into a long narrow section of the swamp that extends up between the slight ridges on which Britten Road and Meyersville Road are located.

A rain gauge was also set up and read daily. Preliminary data for correlating the amount of rainfall with the height of water in the brook have been assembled.

Responses to a questionnaire circulated in the Green Village/Britten Road area as part of this project indicate that, in addition to the flooding of Loantaka Brook, poor drainage conditions affect many people living in that part of Chatham Township.

TABLE II: QUESTIONNAIRE TOTALS

Number of responses	Average length of residence of respondee	No water problems reported	Chronic or occasionally wet cellars	Standing water in yard	Brook flooding	Water-related conditions over a long period of time considered to: have remained the same	became worse
25	27 years	7	13	5	5	8	13

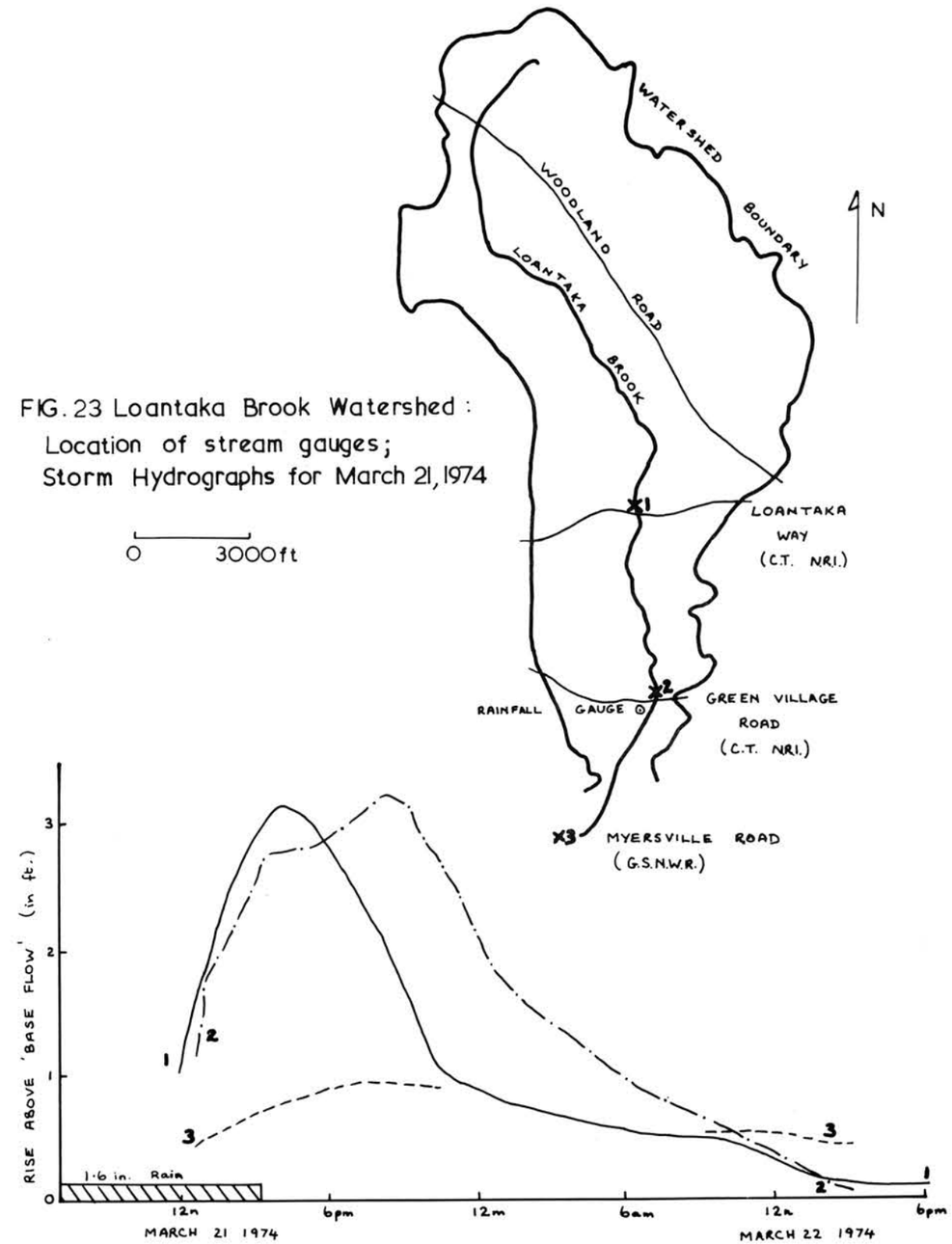


FIG. 23 Loantaka Brook Watershed: Location of stream gauges; Storm Hydrographs for March 21, 1974

FIG. 26 Township of Chatham and Loantaka Brook Watershed: Runoff

The amount and quality of runoff that flows into The Great Swamp is critical to the life of the swamp. Runoff is also important in its role as a transporter and depositor of eroded soil. Flood characteristics of a particular stream are dependent on runoff.

The amount of runoff contributed by a watershed and the speed with which it arrives in its stream (river, swamp, etc.) depend primarily on the characteristics of the soils, slope and vegetation. As part of the Inventory, a runoff map has been developed (see Fig. 26) reflecting the SCS curve numbers for Chatham Township and those parts of neighboring townships that lie in the Loantaka Brook and Black Brook watersheds. These numbers are an indication of the runoff from an area and range from 0 (no runoff) to 100 (total runoff).

The map is derived by directly combining the map of vegetation patterns of the area and the corresponding map of Hydrologic Soil Groups. The vegetation patterns were classified by the SCS into those areas that would produce similar amounts of runoff, all other conditions being the same. The delineation of these areas was accomplished using aerial photographs and field knowledge. The Hydrologic Soil Groups map reflects the SCS's classification of the slope and physical properties of the soils into four categories of increasing potential for surface runoff of water.

Estimates of the amount of runoff from an area of any size can be calculated on the basis of this mapped information, using the "SCS method." The implications of changes in land cover (woodland to house environs, for example) can also be predicted by using the table on the map. An explanation of how to use the "SCS method" is contained in *The Engineering Field Manual,* 1969, and *The National Engineering Handbook,* 1971.

* * * * * *

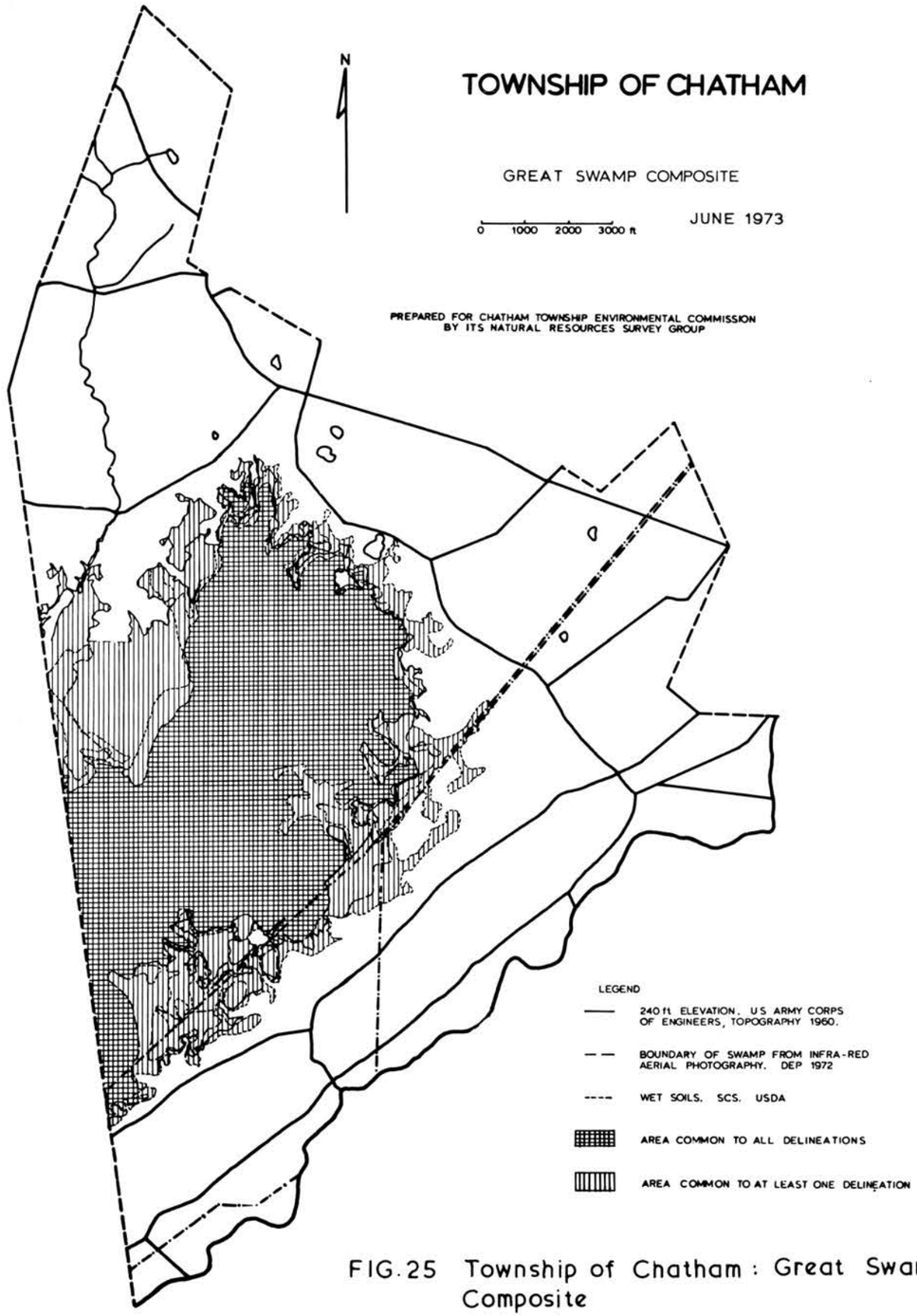


FIG. 25 Township of Chatham : Great Swamp Composite

face drainage in the swamp was augmented by an extensive system of man-made ditches that reduced the time required for water to reach an established channel.

The usual result of development in a watershed is to increase peak flows from storms. Streams in the watershed also carry an increased amount of salt, petroleum and rubber residue from street runoff, as well as sediment from construction projects. Vegetation and animal life of The Great Swamp are sensitive to these factors and cannot live with variable water levels, long periods of too much water, reduced water quality or inundations of sediment. Changes in The Great Swamp caused by watershed development could be interpreted as being in conflict with the spirit of the Federal Government's designation of the east end of The Great Swamp as a Wilderness Area (see p. 34).

The swamp is a composite of natural features and must be defined from that viewpoint. Chronically wet soils (SCS definition) and vegetation that reflects a requirement for water (information obtained from infrared photographs) have been used in this study to delineate the natural entity of the swamp (see Fig. 25). The 240-foot contour line is also part of the definition. (Combine Fig. 25, Great Swamp Composite map, with Fig. 6, Existing Land Use map.)

This mapped information can be augmented in the field by recognition of specific vegetation species whose growth habits require and/or tolerate considerable amounts of water. The tables in Appendices A and B, p. 22, list some of the species found in northern New Jersey that meet these requirements.

Much of the area defined by these various methods is part of The Great Swamp National Wildlife Refuge. The remaining 34 percent that is within the limits of the definition in Chatham Township, but outside the Refuge, is also important to the integrity of the swamp. Filling it in the process of construction, for instance, would raise water levels throughout the swamp, especially in times of flood. Many of the other beneficial features of the swamp would also be lost as the vegetation died from prolonged inundation.

Because they reflect historical conditions over a longer period of time, soils with poor drainage characteristics extend over an even wider area than the limits of the present-day swamp. (Combine Fig. 25, Great Swamp Composite map, with Fig. 24, Drainage map.) A realistic view of the implications of construction in areas of poor drainage can be predicted on the basis of those areas of poor drainage where development has already occurred in Chatham Township. (Combine Fig. 24, Drainage map, with Fig. 6, Existing Land Use map.)

* * * * * *

ALLUVIAL pertaining to material that is transported and deposited by running water (12)

BASE FLOW the sustained or dry-weather flow of a stream, whether or not affected by man (7)

BEDROCK a general term for the rock, usually solid, that underlies soil or other unconsolidated, superficial material (7)

CLAY a rock or mineral fragment or a particle of any composition, smaller than a very fine silt grain, having a diameter less than 0.00016 inches (7)

CUBIC FEET PER SECOND a measure of discharge; the amount of water passing a given point; expressed as the number of cubic feet in each second (8)

DISCHARGE outflow; the flow of a stream, canal or aquifer. One may also speak of the discharge of a canal or stream into a lake, river or an ocean (8)

DRIFT material of any sort deposited by geological processes in one place after having been removed from another. Glacial drift includes material moved by the glaciers and by the streams and lakes associated with them (3)

EFFLUENT effluent is the liquid that comes out of a treatment plant after completion of the treatment process (11)

EROSION (i) the wearing away of the land surface by running water, wind, ice or other geological agents, including such processes as gravitational creep. (ii) detachment and movement of soil or rock by water, wind, ice or gravity (3)

EVAPORATION the process by which water is changed from a liquid to a gas or vapor (8)

FAULT a fracture or fracture zone along which there has been displacement of one side with respect to the other (3)

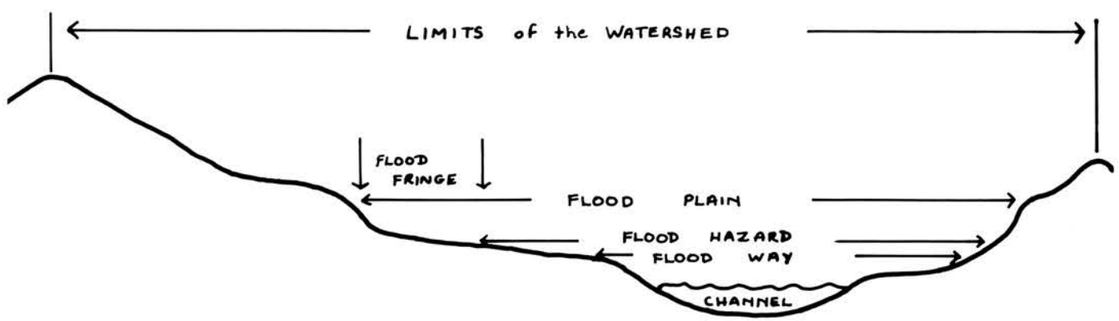


FIG. 27 Diagrammatic sketch of some Flood Plain Terminology

FLOOD FRINGE the area outside the floodway but within the flood hazard area is called the Flood Fringe Area; it carries a slower or slack flow and is inundated to a lesser extent than the floodway (5) (see Fig. 27)

FLOOD HAZARD AREA the Flood Hazard Area includes the floodway and additional portions of the floodplain for a specific design flood (5) (see Fig. 27)

FLOOD PEAK the highest value of the stage or discharge attained by a flood; thus, peak stage or peak discharge (6)

FLOODPLAIN the Floodplain is that relatively flat area adjoining the channel of a natural stream which has been or may be covered by floodwater (5) (see Fig. 27)

GLACIAL OUTWASH sorted drift spread broadly as low alluvial fans fringing an end moraine of a continental ice cap (1)

GLACIER glaciers are thick masses of slow-moving ice. In the higher lands and polar regions, the annual winter snowfall usually exceeds the summer loss by melting. Permanent snowfields build up, and their lowest boundary is the snow line, the actual height of which varies with latitude and climate. Buried snow recrystallizes to form ice, which moves slowly under its own weight. It moves most rapidly in the middle of the glacier (13)

GRADIENT change of elevation, velocity, pressure or other characteristics per unit length; slope (12)

GROUNDWATER water in the ground that is in the zone of saturation, from which wells, springs and groundwater runoff are supplied (6)

HORIZON, SOIL a layer of soil, approximately parallel to the soil surface, with distinct characteristics, produced by soil forming processes (3)

HYDROLOGY the science of the behavior of water in the atmosphere, on the surface of the earth and underground (8)

INFILTRATION the flow of a fluid into a substance through pores or small openings. The common use of the word is to denote the flow of water into soil material (8)

INORGANIC not the result of living or organic processes (10)

LACUSTRINE DEPOSIT material deposited in lake water and later exposed either by lowering of the water level or by the elevation of the land (3)

LAVA FLOW erupted materials [from volcanic action] are of two general kinds: pyroclastics, which are blown out of volcanoes as fragments of various sizes and shapes; and flow lavas, which come from pipes or fissures and may flow many miles before solidifying (1)

LEACHATE that material which has been leached or dissolved from soluble material. It usually refers to chemicals and compounds from sanitary landfills that have gone into solution and entered the ground (2)

APPENDIX A: TYPICAL HABITATS OF SOME LOCAL VEGETATION

Marsh

Bulrush	*Scirpus spp.*
Cattail**	*Typha spp.*

Swamp

Arrow-arum	*Peltandra virginica*
Arrowhead	*Sagittaria spp.*
Bur-reed	*Eleocharis spp.*
Cinnamon fern	*Osmunda cinnamonia*
Flag	*Iris*
Marsh marigold	*Caltha palustris*
Red maple	*Acer rubrum*
Royal fern	*Osmunda regalis*
Sedge	*Arex spp.*
Sensitive fern	*Onoclea sensibilis*
Skunk cabbage	*Symplocarpus foetidus*
Swamp white oak	*Quercus bicolor*

Floodplain

American elm	*Ulmus americana*
Black ash	*Fraxinus quadrangulata*
Black gum	*Nyssa sylvatica*
Box elder	*Acer negundo*
Pin oak	*Quercus palustris*
Red maple	*Acer rubrum*
Silver maple	*Acer saccharinum*
Sycamore	*Platanus occidentalis*
Willow	*Salix petiolaris*

Poorly Drained

Black alder	*Ilex verticillata*
Ironweed	*Vernonia noveboracensis*
	Vernonia glauca
Jewelweed	*Impatiens pallida*
(Touch-me-not)	*Impatiens bicolor*
Joe-pye-weed	*Eupatorium dubium*
	Eupatorium fistulosum
Steeplebush	*Spiraea tomentosa*
Swamp milkweed	*Asclepias incarnata*

Wet Uplands*

Beech	*Fagus grandifolia*
Chestnut oak	*Quercus prinus*
Grey birch	*Betula populifolia*
Red oak	*Quercus rubra*
Shag hickory	*Carya ovata*
Spicebush	*Lindera benzoin*
Spring flowers	
Sugar maple	*Acer saccharum*
White oak	*Quercus alba*

Many species found in swamps are also found in marshes.

Many species listed in Swamp, Floodplain or Poorly Drained categories are found in at least one of the other three groups also.

*Wet but never standing water.

**A cattail is often a dominant marsh species, but it may also be found in what appears to be an unmarsh-like habitat. Wherever it is found, its presence should be noted and further study given to the area for additional indicators of wet soil conditions.

Source: adapted from Robichaud and Buell, 1973.

APPENDIX B: LOCAL VEGETATION TOLERANT OF WET LOCATIONS

Trees

American elm	*Ulmus americana*
Black ash	*Fraxinus quadrangulata*
Black gum (sour gum)	*Nyssa sylvatica*
Cottonwood	*Populus deltoides*
Pin oak	*Quercus palustris*
Red maple	*Acer rubrum*
River birch	*Betual nigra*
Shagbark hickory	*Carya ovata*
Silver maple	*Acer saccharinum*
Swamp white oak	*Quercus bicolor*
Sycamore	*Platanus occidentalis*
Willow	*Salix petiolaris*

Shrubs

Arrowwood	*Viburnum spp.*
Black alder	*Ilex verticillata*
Box elder	*Acer negundo*
Buttonbush	*Cephalanthus occidentalis*
Meadowsweet	*Spiraea latifolia*
	Spiraea alba
Mountain laurel	*Kalmia latifolia*
Poison sumac	*Rhus vernix*
Smooth alder	*Alnus serulata*
Spicebush	*Lindera benzoin*
Swamp loosestrife	*Decondon verticillatus*
Sweet pepperbush	*Clethra alnifolia*

Ferns, Reeds and Grasses

Blue-joint grass	*Calamagustis canadensis*
Bulrush	*Scirpus spp.*
Bur-reed	*Sparganium spp.*
Cattails	*Typha spp.*
Cinnamon fern	*Osmunda cinnamonea*
Horsetail	*Equisetum spp.*
Lizards tail	*Saururus cernuus*
Marsh fern	*Dryopteris thelypteris*
Reed	*Phragmites communis*
Reed grass	*Phalaris spp.*
Royal fern	*Osmunda regalis*
Rush	*Juncus spp.*
Sedge	*Carex spp.*
Sensitive fern	*Onoclea sensibilis*
Spike reed	*Eleocharis spp.*

Herbs

Arrow-arum	*Peltandra virginica*
Arrowhead	*Sagittaria spp.*
Blue flag	*Iris versicolor*
Cardinal flower	*Lobelia cardinalis*
Forget-me-not	*Myosotis scorpioides*
	Myosotis arvensis
Ironweed	*Vernonia noveboracensis*
	Vernonia glauca
Jack-in-the-pulpit	*Arisaema spp.*
Joe-pye-weed	*Eupatorium dubium*
	Eupatorium fistulosum
Mad dog skullcap	*Sculellaria lateriflora*
Mallow rose	*Hibiscus palustris*
Mayapple	*Podophyllum peltatum*
Mermaid weed	*Proserpinaca palustris*
Monkey flower	*Mimulus ringens*
Pickerel weed	*Pontederia lanceolata*
Purple loosestrife	*Lythrum salicaria*
Skunk cabbage	*Symplocarpus foetidus*
Spring beauties	*Claytonia virginica*
Steeplebush	*Spiraea tomentosa*
Swamp milkweed	*Asclepias incarnata*
Swamp rose	*Rosa palustris*
Touch-me-not	*Impatiens pallida*
	Impatiens bicolor
Trout lily	*Erythronium americanum*
Turtlehead	*Chelone glabra*
Water hemlock	*Cicuta maculata*
Water parsnip	*Sium suave*
Woundwort	*Stachys palustris*
Yellow iris	*Iris pseudacorus*

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LOW-FLOW	the discharge which is maintained by the release of groundwater (12)
ORGANIC	organic matter is the carbonaceous waste contained in plant or animal matter and originating from domestic or industrial sources. [This definition applies to waste water treatment and is not a universal definition.] (11)
OVERBURDEN	loose soil, sand, gravel, rock, etc. which lies above bedrock (3)
PARENT MATERIAL	the unconsolidated (not sorted according to size, shape and type), chemically weathered mineral or organic material from which soils have developed (12)
PEAK FLOW	maximum discharge at a given point or from a given area during a specified period of time (7)
PRECAMBRIAN	[a period of geologic history in which] all rocks are more than 600 million years old (16)
PRECIPITATION	the deposition of moisture from the atmosphere upon the general surface of the earth (10)
RUNOFF	that portion of the precipitation on a drainage area that is discharged from the area in stream channels. Types include surface runoff, groundwater runoff or seepage (12)
SEASONAL WATER TABLE	the upper surface of groundwater that fluctuates seasonally. It is highest in late spring and lowest in late summer (12)
SEDIMENT	fragmental mineral material transported or deposited by water or air (8)
SLOPE	degree of deviation of a surface from the horizontal, usually expressed in percent or degrees (12)
SOIL	(i) a dynamic natural body on the surface of the earth in which plants grow, composed of mineral and organic materials and living forms. (ii) the collection of natural bodies occupying parts of the earth's surface that supports plants and that have properties due to the integrated effect of climate and living matter acting upon parent material, as conditioned by relief, over periods of time (3)
SOIL TYPE	the lowest unit in the natural system of soil classification; a subdivision of a soil series and consisting of or describing soils that are alike in all characteristics including the texture of the A horizon (3)
STREAM GAUGING	the quantitative determination of stream flow using gauges, current meters, weirs or other measuring instruments at selected locations. [This project installed surveyed calibrated stakes placed in the channel to measure water heights only.] (13)
STREAM PROFILE	the stream profile is usually presented as a plotting of horizontal distance along the main stream vs. elevation (9)
TERMINAL MORAINE	moraines are deposits of glacial till formed either as acruate mounds at the snout of the glacier (terminal moraines) or as sheets of till over considerable areas. . . . Moraines are made up of a variety of unsorted rock fragments in unbedded clay matrix (13)
TILL	unstratified glacial drift deposited directly by the ice and consisting of clay, sand, gravel and boulders intermingled in any proportion (3)
TOPOGRAPHY	(i) the detailed description of particular places; the art of representing on a map the physical features of a place. (ii) the physical features, collectively, of a region (10)
TRANSPIRATION	the process by which water vapor escapes from the living plant and enters the atmosphere (8)
TRIASSIC	[a period of geologic history] which began about 225 million years ago (16)
WATER CYCLE	the circuit of water movement from the atmosphere to the earth and return to the atmosphere through various stages or processes, as precipitation, interception, runoff, infiltration, percolation, storage, evaporation and transpiration (12)
WATER TABLE	the term "water table," as used in soil work, is defined as the locus of points in the soil-water system at which the water has atmospheric pressure (15)
WATER TABLE	the term "water table," as used in soil work, is defined as the locus of points in the soil-water system at which the water has atmospheric pressure (15)
WATERSHED OR DRAINAGE AREA	an area from which water drains to a single point; in a natural basin, the area contributing flow to a given place or a given point on a stream (8)
WEATHERING	all physical and chemical changes produced in rocks at or near the earth's surface, by atmospheric agents (3)
ZONE OF AERATION	[the region of soil] above the water table [in which] the pore spaces are partly filled with air (9)
ZONE OF SATURATION	the zone in which the functional permeable rocks are saturated with water under hydrostatic pressure. Water in the zone of saturation will flow into a well, and is called groundwater (6)

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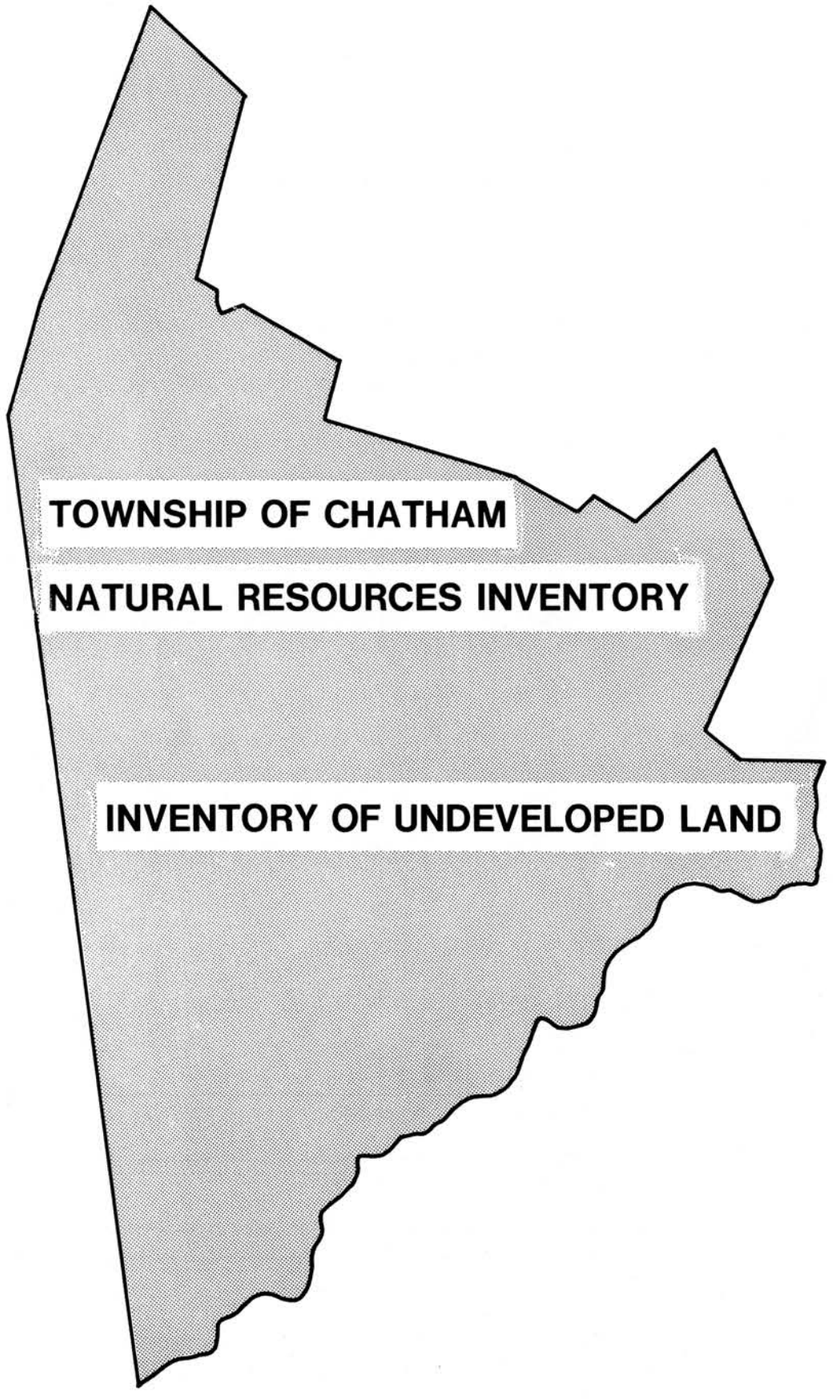


TOWNSHIP OF CHATHAM

NATURAL RESOURCES INVENTORY

INVENTORY OF UNDEVELOPED LAND

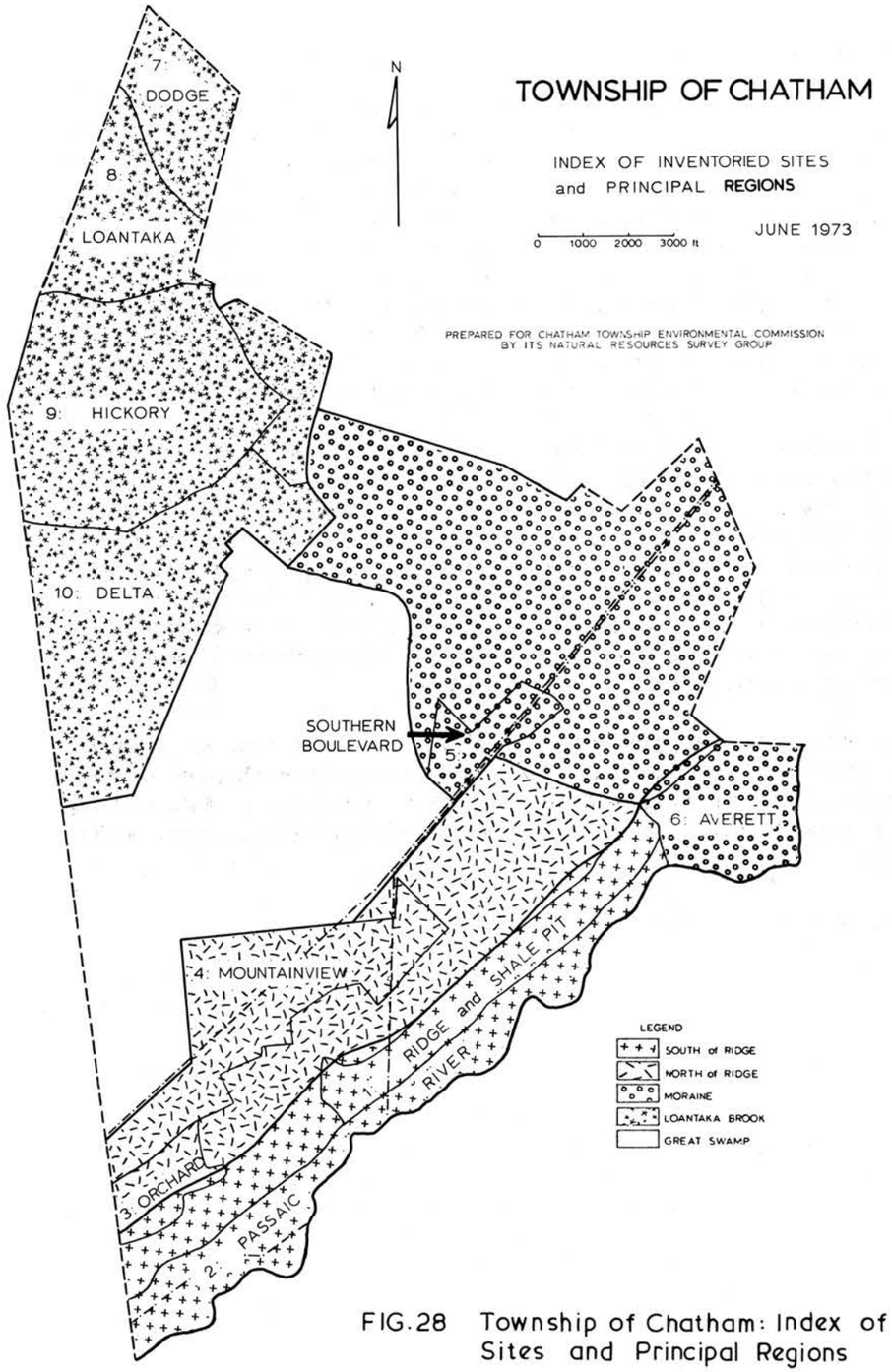


FIG. 28 Township of Chatham: Index of Inventoried Sites and Principal Regions

A few yards from this shady stream is a wide ditch with banks of crushed stone carrying water from a storm sewer system. The water is brown and murky (already silting up its brand-new culvert pipes) as it flows in a straight line toward The Great Swamp. The two watercourses eventually join.

In the open area of this site there is an interesting erosion process going on. A canyon about 125 feet long and 5 feet below ground level at its deeper points has developed. Various layers of the soil are exposed to view and at the bottom you can see the patterned zone between true rock and true soil. Toward the swamp side of the pit, the walls narrow and water seeps from the ground, starting a new stream which flows on toward the swamp.

Through the center of the Southern Boulevard site a broad swath has been cut to carry high tension wires on their huge towers, telephone lines, gas pipes, sewage systems, storm drains and a dry dirt road to service these utilities. Under the wires and above the pipes there is a great deal of activity. Numerous low spots impound enough water to support nesting ducks, noisy bull frogs, tiny duckweed plants and 8-foot tall swamp loosestrife with its lavender flowers. Birds and insects abound.

This site is frequently visited by Township residents and others. There is almost always someone walking a dog or two, strolling, jogging, taking pictures of birds, flowers, learning about nature in classes of adults and children from the Outdoor Education Center, hiking into the swamp, or tending the pipes and wires.

The owners of this site include private individuals, corporations, Morris County and the United States of America.

The undeveloped land of Chatham Township (exclusive of The Great Swamp National Wildlife Refuge) lies in three principal locations: along Loantaka Brook, between developed areas and The Great Swamp, or between developed areas and the Passaic River (see Fig. 6, Existing Land Use map, and also Fig. 28, Index of Inventoried Sites and Principal Regions). These locations are of particular significance in the natural context of the Township, as well as in economic, social and recreational contexts.

Information about the Township's undeveloped land was assembled in an impartial manner, using the following system:

1. The larger areas of undeveloped land were divided into 25 sites. The divisions were made geographically. The size of the sites was determined so that a walker could observe the whole site in 2 or 3 hours. Any divisions coinciding with property lines of particular landowners are purely coincidental.

2. Preliminary colored maps of each site were drawn from aerial photographs and personal knowledge.

3. A questionnaire concerning selected environmental factors was drawn up to guide the volunteers in surveying the site.

4. An orientation meeting was held to explain the project to approximately 35 people who offered to walk the sites and record their findings. The walkers were given binders containing the preliminary maps, the questionnaire and an aerial photograph for each site. Instruction was given on winter-time tree identification.

5. During November and December 1973, the volunteers walked the sites, corrected and added information to the maps and returned the binders to the project directors. Most of the sites were walked twice by different people.

6. One person consolidated the findings of the volunteers and with the additional help of topographic maps re-walked all of the sites.

7. All of Chatham Township was divided into five principal regions, each of which has similar characteristics of soil, topography and drainage (see Fig. 28). The inventoried sites, described on the following pages, are presented in the context of these divisions, for each of which the following basic information has been assembled.
   i) A table of statistics relating to land use in the Principal Region.
   ii) An outline map of the Township with the Principal Region marked in.
   iii) A cross-section of the region is presented, with certain features marked. A line showing the position of the cross-section is marked on the outline sketch (ii).
   iv) Under the cross-section is a table giving the present land use, the drainage characteristics, the vegetative cover and the kind of soil. Because of the limitation of space, this table is coded. The full legend may be found on p. 30

8. The 25 original sites have been regrouped into 10 larger sites. The following maps were drafted from the information obtained by steps 1-6 described above. Brief descriptions of each site are included.

Several undeveloped areas of Chatham Township have been omitted from this survey: small properties in developed regions, municipally owned lands set aside for specific uses, the Fairmount Country Club and the Noe Pond Club, the sanitary landfill at the end of Britten Road and The Great Swamp National Wildlife Refuge.

The Inventory of Undeveloped Land is augmented by a map showing Local Assets and Features of the Township—scenic views, historic houses and other points of local interest and significance. It may be found on p. 46 of this Report.

* * * * * *

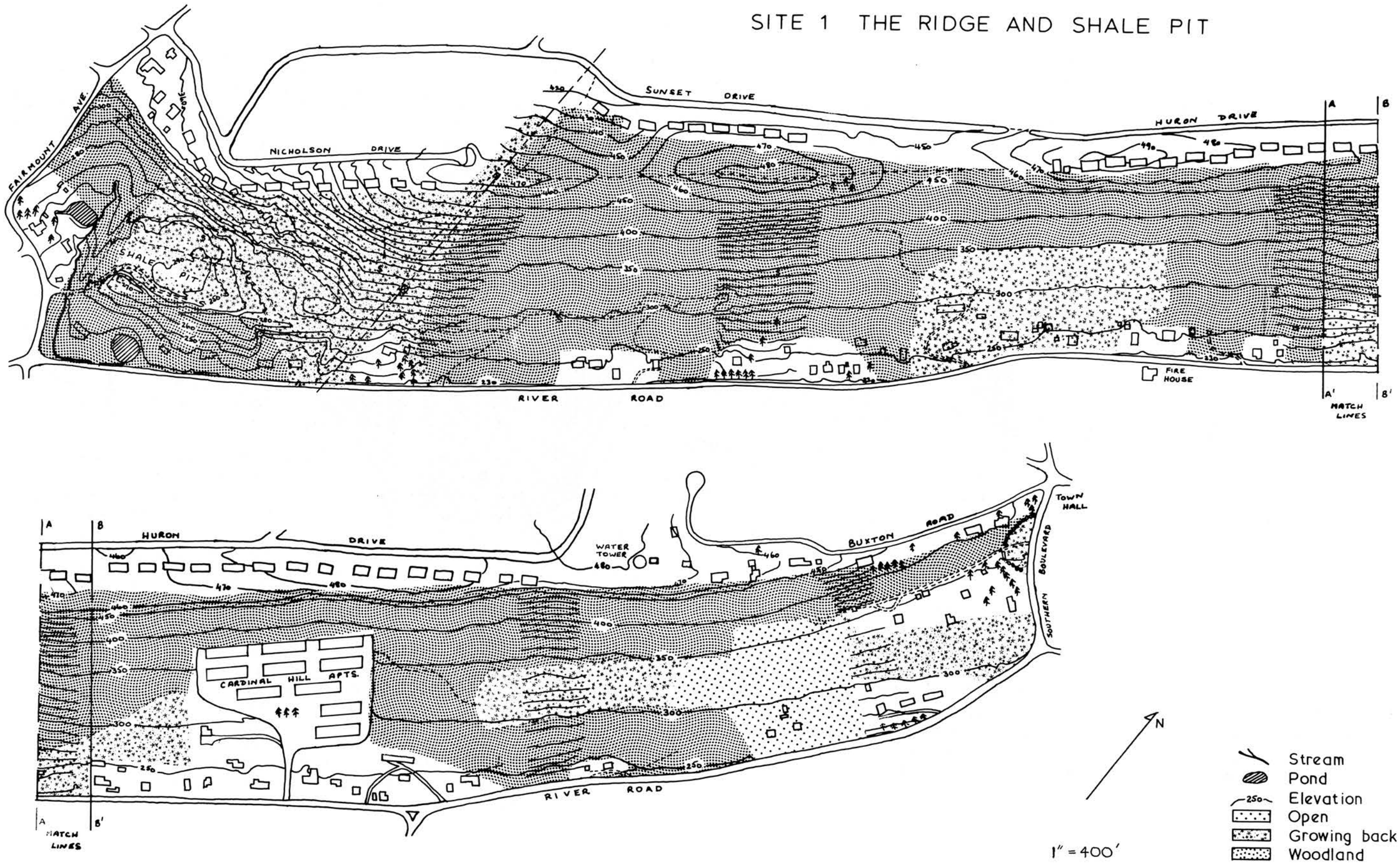
One of the inventoried sites (Southern Boulevard), although among the smallest in acreage, exemplifies many of the physical and political characteristics of Chatham Township. Its central location allows you to imagine that you could stand high above this site and have a panoramic view of the town. To the northwest you see the wet woodlands of Loantaka and Green Village with a few large estates and a patchwork of old and new homes, small agricultural and business concerns. Turning to your right, you see the garden apartments, shopping centers, gas stations, professional buildings, police station and restaurants of the "downtown" section at Hickory Tree. Further around is the green expanse of a golf course, the quiet planned housing development of Rolling Hills. You can then pick out the community life of schools, churches, the fire house, the recreational clubs and ball fields, and the Township Hall interspersed with houses. The near slope of Long Hill is filled with houses from its crest to its base. Looking over the top of the hill, the land is less developed. It drops abruptly to River Road and then flattens out along the Passaic River. Closing the circle to the west, you see the wide basin of The Great Swamp, wild and beautiful.

Coming down from your imaginary viewing platform, you are now in a place where you can see, on a small scale, many of the environmental features and conditions that are to be found on a larger scale in other undeveloped parts of Chatham Township.

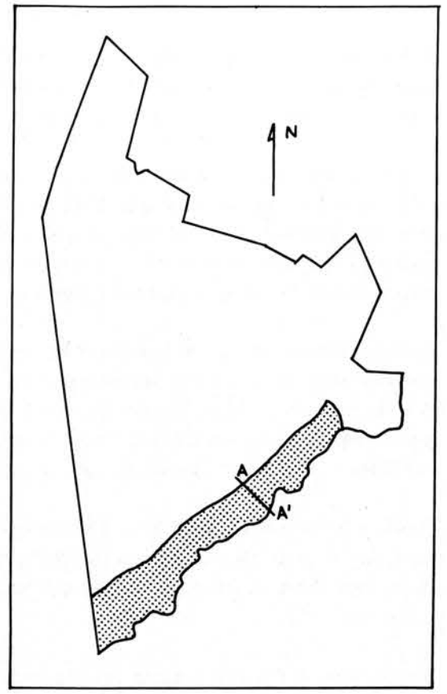
Here there are wooded slopes with young and mature trees typical of our area: beech, oak, hickory, tulip, dogwood, birch and maple. In one place the woods may be open, easy to amble through, with little undergrowth besides a few ferns and mayapples. In another spot the vegetation may be so dense that the woods must be skirted. In a short distance you may go from a dry, rocky terrain to a mucky depression filled with the giant leaves of the skunk cabbage.

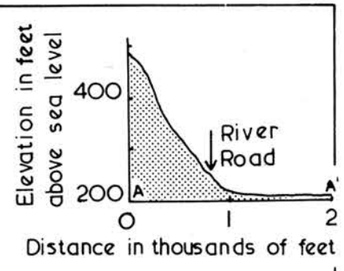
A beautiful stream drains the hillside. At its high point on this site, it is filled with large rocks brought here by the Wisconsin glacier. The water cuts deep into the earth tumbling the rocks, carrying, sorting and depositing its sands and silts, picking up tributaries along its course. The stream's bed and banks show the history of its dynamic life. In one place it has even left a miniature oxbow lake. Wild flowers thrive above its banks. As the land drops, the stream finds quiet places to entertain such guests as the dainty water strider and the dashing pickerel. At times the water is so clear you can see not only darting fish but also their shadows on the sandy bottom of the stream. Before it leaves this site, the water circles and saturates a natural retention basin filled with marsh grasses, reeds, cattails, pussy willows and many other water-loving plants.

SITE 1 THE RIDGE AND SHALE PIT



ACREAGE		%.
HOUSE ENVIRONS	196	28.7
APARTMENTS/COMMERCIAL	12	1.7
PUBLIC/SEMI-PUBLIC	18	2.6
RECREATION	126	18.5
GREAT SWAMP NATIONAL WILDLIFE REFUGE	—	—
UNDEVELOPED	330	48.4
TOTAL	682	99.9





DEVELOPMENT	H H
DRAINAGE - SCS	M.G ⟶ P ⟶
VEGETATION	S ⟶ W ⟶
SOIL	Bt→Bh ⟶ A ⟶

LEGEND

H	House Environs
PsP	Public/Semi Public
R	Recreation
P	Poor
M	Moderate
G	Good
O	Open
S	Scrub
W	Woodland
A	Alluvial
Bh	Beach
Bt	Basalt
G°	Glacial Outwash
L	Lacustrine
M	Muck
Mo	Moraine
S	Shale
U	Urban

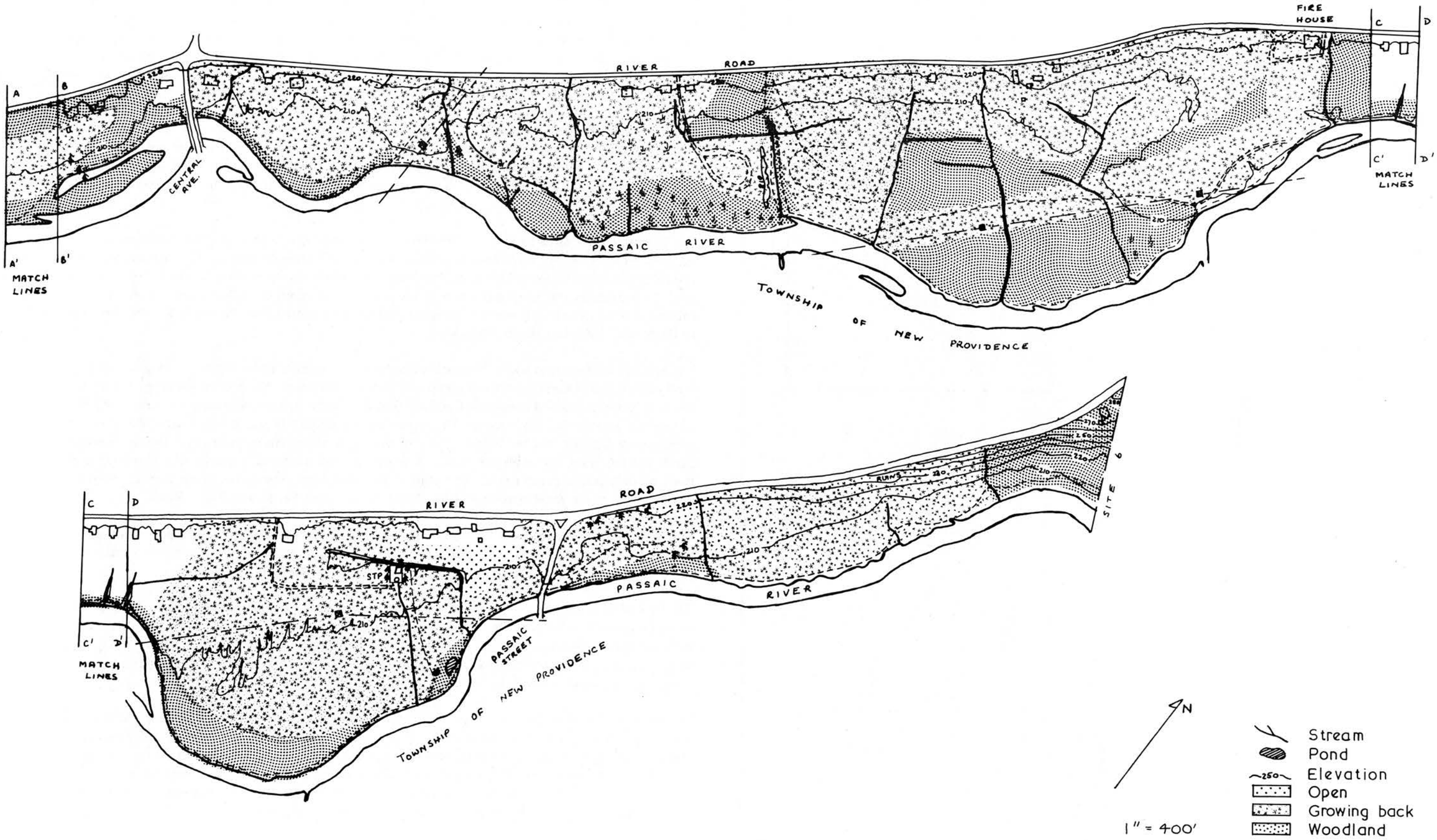
SITE 1 THE RIDGE AND SHALE PIT

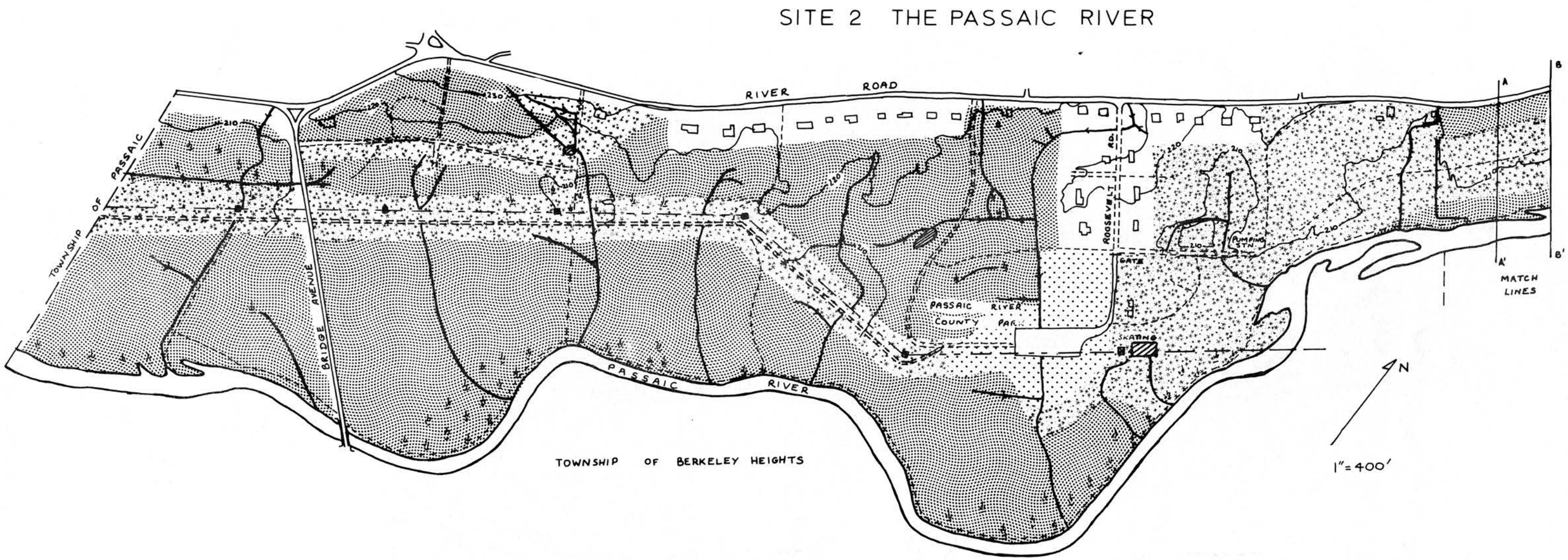
The land to the west of the power lines on this site has two distinct sections. The first is that along Fairmount Avenue, upon which is situated one of Chatham Township's historic houses (pre-1800). The house environs contain a pond, stream, many old trees, and several flowering trees and shrubs. The second section is the Shale Pit. The Shale Pit is unique in the Township. It was created years ago when the red shale on the south side of Long Hill was excavated. It is now like a huge outdoor theater gone wild. The southern exposure and scant soil support wild flowers and plants, and produce some unusual patterns of vegetation. Children take advantage of the pit's steep slopes, narrow terraces, and dense thickets for safe and imaginative play. People hunt for fossils embedded in the loose shale that litters the Pit. Motorcyclists and mini-bikers use the trails. Visitors to this site are struck by its unique formation and numerous possibilities for recreational, cultural and social uses. The Shale Pit is owned by Chatham Township. Because it cannot be seen from the roads around it, it is a secluded place.

The land to the east of the power lines in this site is a steep southern slope from the crest of Long Hill to River Road. With the exception of the Cardinal Hill Apartments, residential development is located near the base of the hill. Toward the crest of the site the vegetation is mature woodland of beech, oak, maple, ironwood, a few pines and unusually large numbers of flowering dogwood trees. As the land drops abruptly, the woods are filled with huge vines which climb the trees, giant thorny bushes and dense undergrowth. There is much erosion of the rocky slopes in the western section and below Huron Drive. There are many shale outcroppings and basalt boulders on the hillside. An exception to this general condition is the open area at the eastern end which is a gently sloping meadow. The Ridge is used by people for walking, horseback riding and tree-house building.

From several places on this site there are good views. One of the best spots is at the top of the hill under the power line. From here one can look across The Great Swamp to the hills beyond Morristown, to the Madison-Florham Park areas and in the opposite direction to the valley that lies between Long Hill and the Second Watchung Mountain. The noise generated by the traffic on River Road is audible at all points on this site.

Except where explicitly noted, the land described here is private property.


FIRE HOUSE
RIVER ROAD
CENTRAL AVE.
PASSAIC RIVER
TOWNSHIP OF NEW PROVIDENCE
MATCH LINES
A
B
A'
B'
C
D
C'
D'
P
220
210
RIVER ROAD
PASSAIC RIVER
PASSAIC STREET
TOWNSHIP OF NEW PROVIDENCE
STP
RUINS
SITE 6
MATCH LINES
N
1" = 400'
Stream
Pond
Elevation
Open
Growing back
Woodland



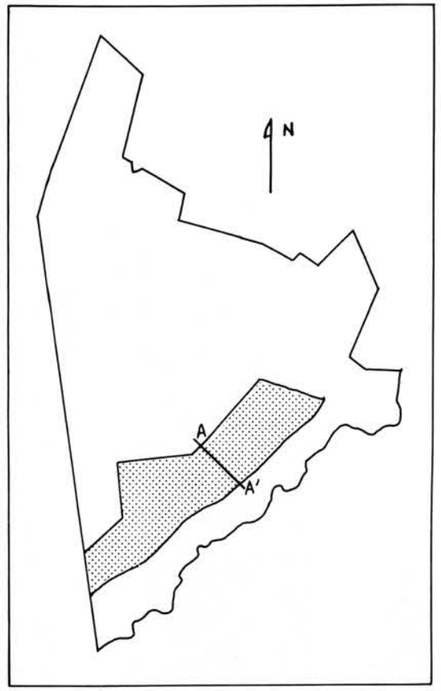
SITE 2 THE PASSAIC RIVER

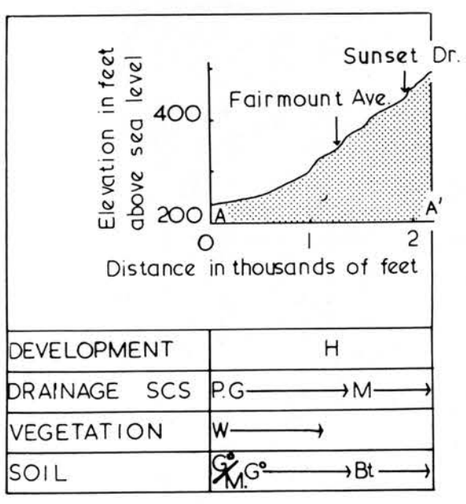
From the Passaic Township border of this site to the park at the end of Roosevelt Road, this low-lying land supports mostly mature swampy woods. The dominant tree species are pin oak and red maple. Several streams which receive drainage from Long Hill flow straight across the land to the Passaic River. From the park to Central Avenue the land is mainly young woods and fields. The river all along here has a wide, muddy floodplain. When the river is high, the flow of the streams is reversed for a considerable distance upstream. Except for the residential properties shown on the map, most of this section is owned by the Morris County Park System. The County has developed a quiet recreation area here with a ball field, skating rink and picnic facilities. Many people take advantage of the park and also use the power lines for walking and horseback riding.

The section of this site between Central Avenue and Passaic Street is also low and wet, but in many ways quite different from the area described above. Except for a border of mature trees along the river, most of the land supports open fields, marsh and brush. There is a great variety of low-growing vegetation such as grasses, reeds, smooth alder, phragmites, cattails, small trees and thorny bushes. The land shows much evidence of use for gardening, dumping and recreation. A section of the river bank just west of the north-south power line is a natural bird sanctuary. The river is eroding its banks just east of the Fire House as if it were trying to join River Road. In places, even during wet Spring conditions, the clay soil is dry, hard and cracked.

Except where explicitly noted, the land described here is private property.

ACREAGE		%
HOUSE ENVIRONS	398	45.2
APARTMENTS/COMMERCIAL	2	0.2
PUBLIC/SEMI-PUBLIC	103	11.7
RECREATION	—	—
GREAT SWAMP NATIONAL WILDLIFE REFUGE	26	3.0
UNDEVELOPED	352	40.0
TOTAL	881	100.1





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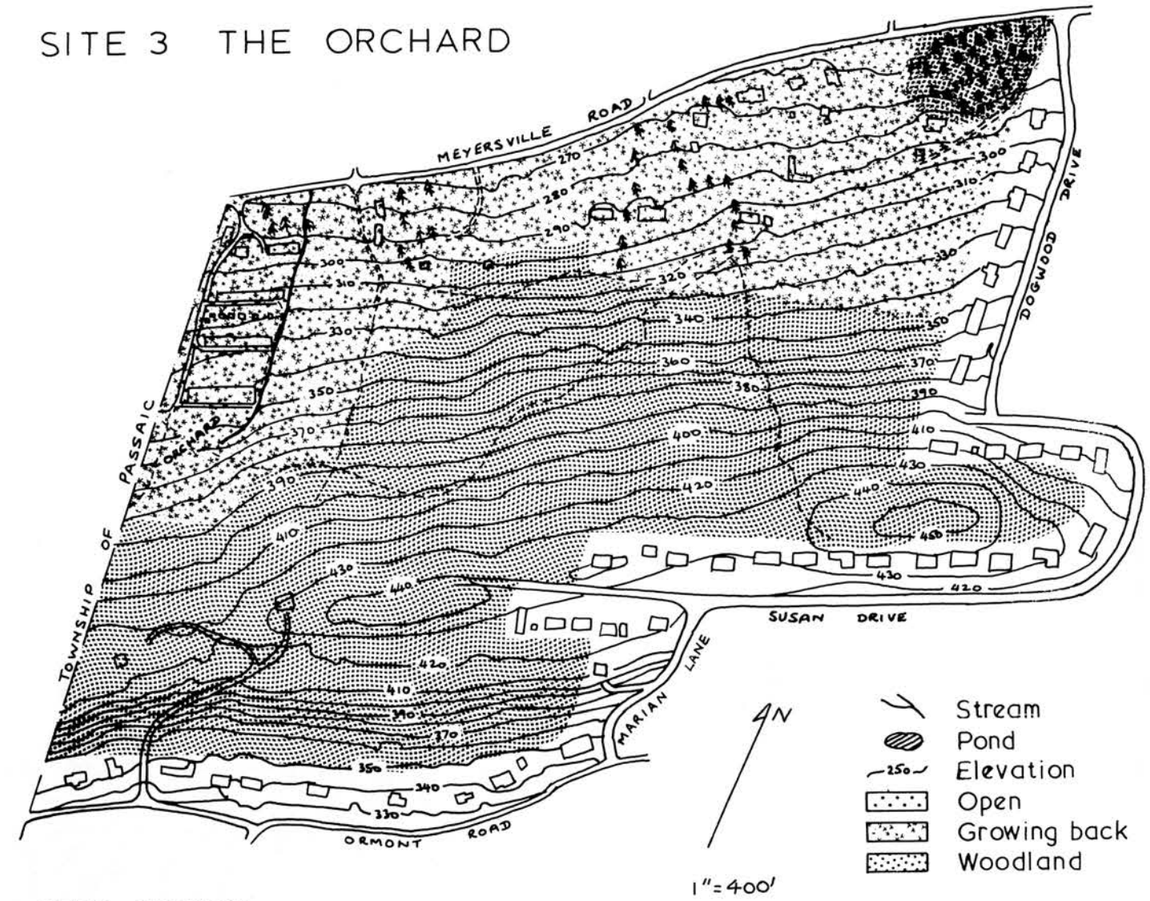
SITE 3 THE ORCHARD



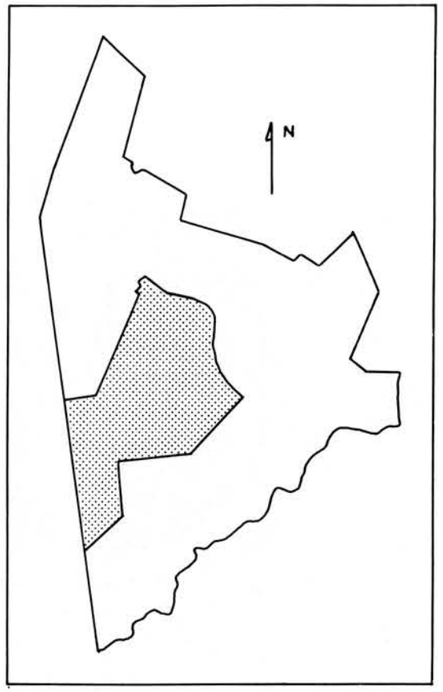
SITE 3 ORCHARD

Most of this site is uniform dry woodland, sloping west from the crest of Long Hill which rises 190 feet above Meyersville Road. The trees are mainly tulip, oak, beech, ironwood, maple, birch and dogwood. The trees are closely spaced, and although many of them are tall, they are still slender and straight. Many paths and sparse undergrowth make the site easy to walk through. The hillside is covered with small pieces of rust-colored rock (basalt) which, together with random clumps of laurel and evergreen fern, add color to the winter landscape. The Meyersville Road perimeter of the site contains many spring-blossoming trees and mature stands of evergreens, especially white pine.

A small portion of this site is on the steeper slope of Long Hill facing the Passaic River. The change in natural conditions is marked and interesting. The southern exposure is much more wild and varied. There are some huge old trees, a few young ones, many vines and brambles, small bushes and grasses and one dramatic place in which erosion has stripped the bedrock of all vegetation and soil. There are good views to the south from the area along Susan Drive.

Except where explicitly noted, the land described here is private property.

ACREAGE		%
HOUSE ENVIRONS	—	—
APARTMENTS/COMMERCIAL	—	—
PUBLIC/SEMI-PUBLIC	—	—
RECREATION	43	3.4
GREAT SWAMP NATIONAL WILDLIFE REFUGE	1227	95.4
UNDEVELOPED	16	1.2
TOTAL	1286	100.0



NO SECTION DATA AVAILABLE

Since William Penn acquired the territory in which The Great Swamp lies in 1667, and the Delaware Indians sold it to British investors in 1708, the primary uses of the swamp have been lumbering and farming. Extensive drainage systems were installed both by settlers and in the 1930's by the Works Projects Administration. More recently, the land was considered for an international jetport to serve the metropolitan area. This threat aroused many interested citizens to take action, resulting in most of the swamp being bought by the Federal Government and designated as a National Wildlife Refuge.

The United States Department of the Interior, Bureau of Sport Fisheries and Wildlife, manages the refuge. It is divided into two sections. The western portion is called the management area. Here the land may be changed to accommodate and encourage wildlife. The eastern portion, which comprises about two-thirds of the entire refuge, was designated as a wilderness area in 1968 and is to remain forever wild.

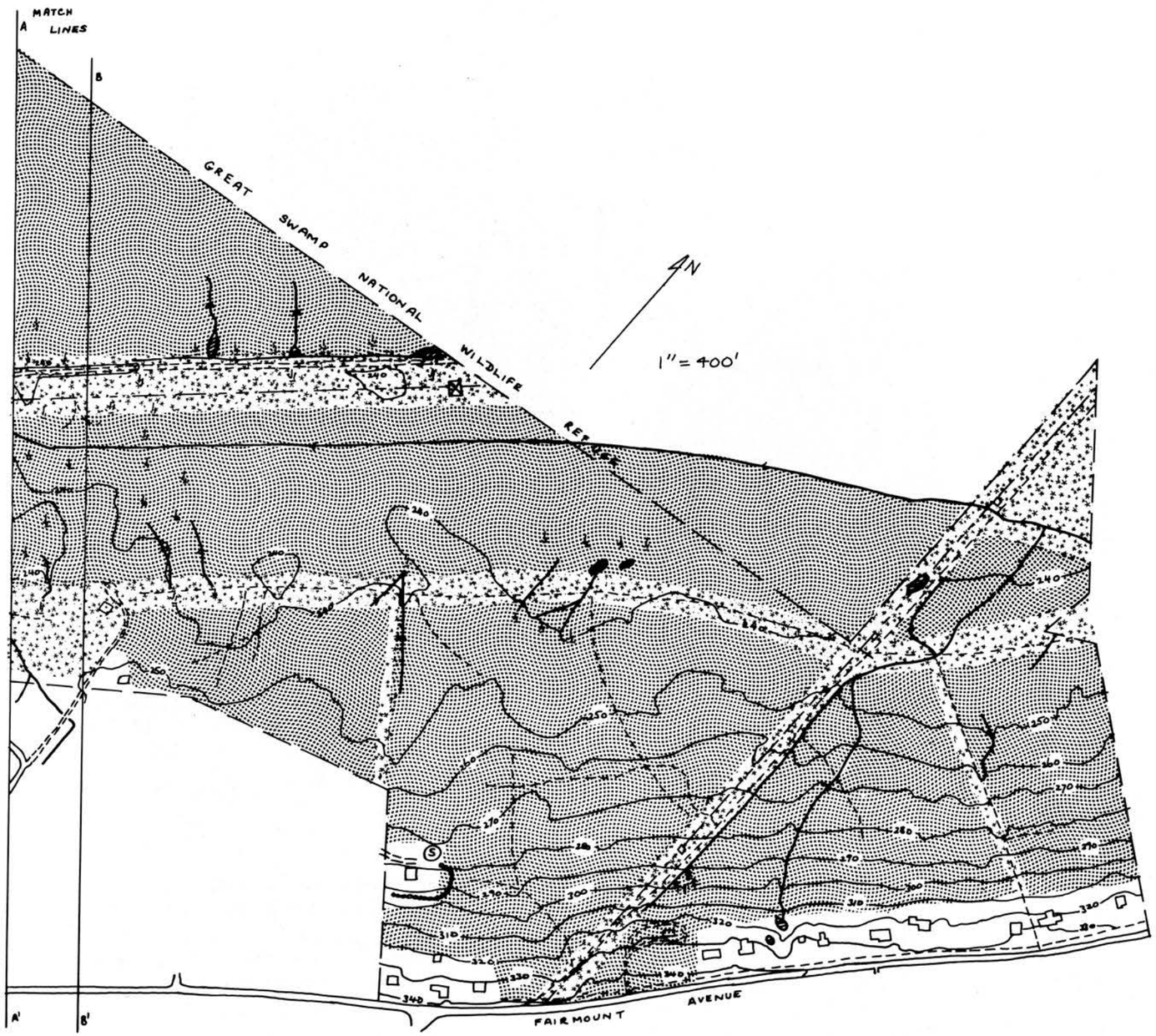
The Wilderness Act of September 3, 1964 (Public Law 88-577) provides (a) that wilderness areas be managed so as to protect and preserve wildlife, and (b) such areas provide public, recreational, scenic, scientific, educational, conservation and historical enjoyment insofar as these pursuits do not interfere with the protection and the preservation of the wildlife. No roads or buildings are permitted within the wilderness area, nor are any wheeled vehicles. Access is permitted only on foot. Aircraft are required to fly at least 1000 feet above the ground.

The portion of the refuge which lies within Chatham Township is called the M. Hartley Dodge Unit. It is all part of the wilderness area and comprises about 1,300 acres. Much of it is inaccessible to all but the most experienced and determined walkers, and during the summer months even they might find portions of it impossible to traverse. In general, the topography is one of low, water-filled areas interspersed with wooded hills and ridges. Many of the higher elevations support virgin timber, especially beech and oak trees, and abundant stands of laurel. Lower woodland is usually thin closely-spaced trees, often inundated with water. The marshes are filled with water-loving plants such as cattails. There are numerous small streams and two major ones: Great Brook and Black Brook.

Life in the swamp is extremely abundant. There are, for example, at least 31 kinds of mammals, 21 varieties of reptiles, 18 types of amphibians, 24 species of fish and over 140 visiting or resident kinds of birds. The plant list available at the Manager's Office covers 14 pages.

Once a walker enters the swamp, all influence of the surrounding well-populated areas of residential and commercial modern life with its attendant sights and sounds is lost. A quiet entry is usually rewarded with the opportunity to observe the birds and animals engaged in their normal activities. You might see deer grazing, muskrats constructing their lodges, ducks herding their chicks, or snapping turtles emerging from the mud looking like prehistoric relics.

The value of The Great Swamp to Chatham Township is enormous. In addition to the recreational, scenic, scientific, educational, conservation and historical objectives envisioned by The Wilderness Act, there are other important benefits derived from the existence of this undeveloped land. It provides a huge natural retention basin for most of the drainage which originates in the Township. The air we breathe is refreshed by the oxygen produced by its dense vegetation. The psychological and philosophical benefits of a primitive backyard in a suburban setting are also valuable.



SITE 4 MOUNTAINVIEW

This is low, wet land lying between Long Hill and The Great Swamp. In addition to natural drainage and storm sewer piping, all of the water discharged from the Chatham Township Sewage Treatment Plant is channelized through here. A variety of uses of the land over the years had produced some interesting conditions on this site. In one place there is a large stand of mature pine trees on a knoll. The floor of this little forest is a bed of pine needles, dark and cool. There is a small pond amid the trees. Immediately adjacent to this area is a large dump. Behind Mountainview School the swampy terrain has small mossy hummocks rising out of water supporting thin trees, water plants and animals. Large amounts of sediment have recently been deposited here.

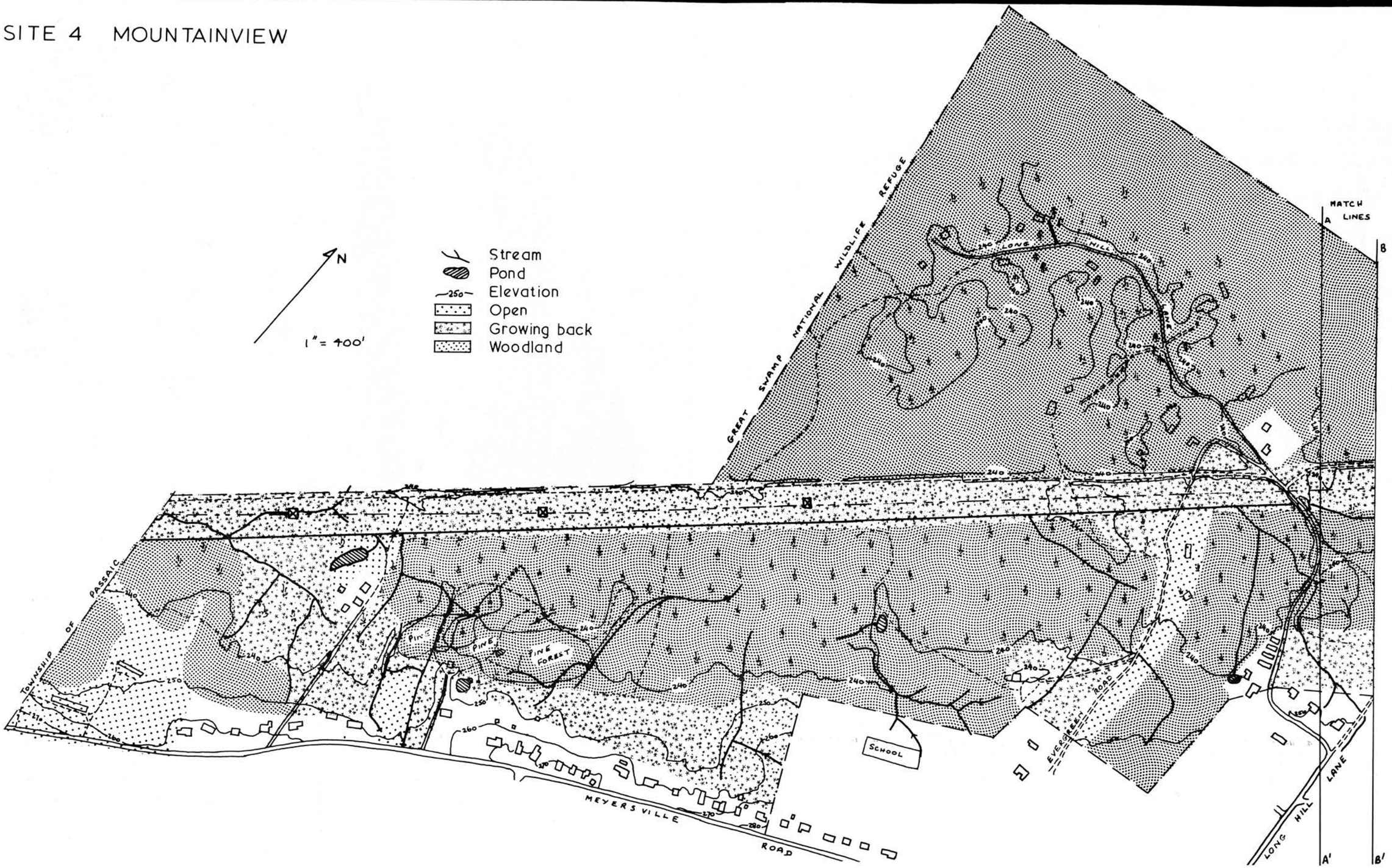
Long Hill Lane and Evergreen Road are built on a ridge of land slightly higher than the surrounding areas. To the northwest of the power lines, several homes are built on the high spots. They are surrounded by lush laurel bushes, huge beech trees and large evergreens. Along Evergreen Road much of the land has been stripped of vegetation.

The woodland in the eastern section is the only well-drained woods remaining on this site. It contains several springs and streams and is very dense in most places. Some trails and campsites show that people take advantage of the area's recreational possibilities.

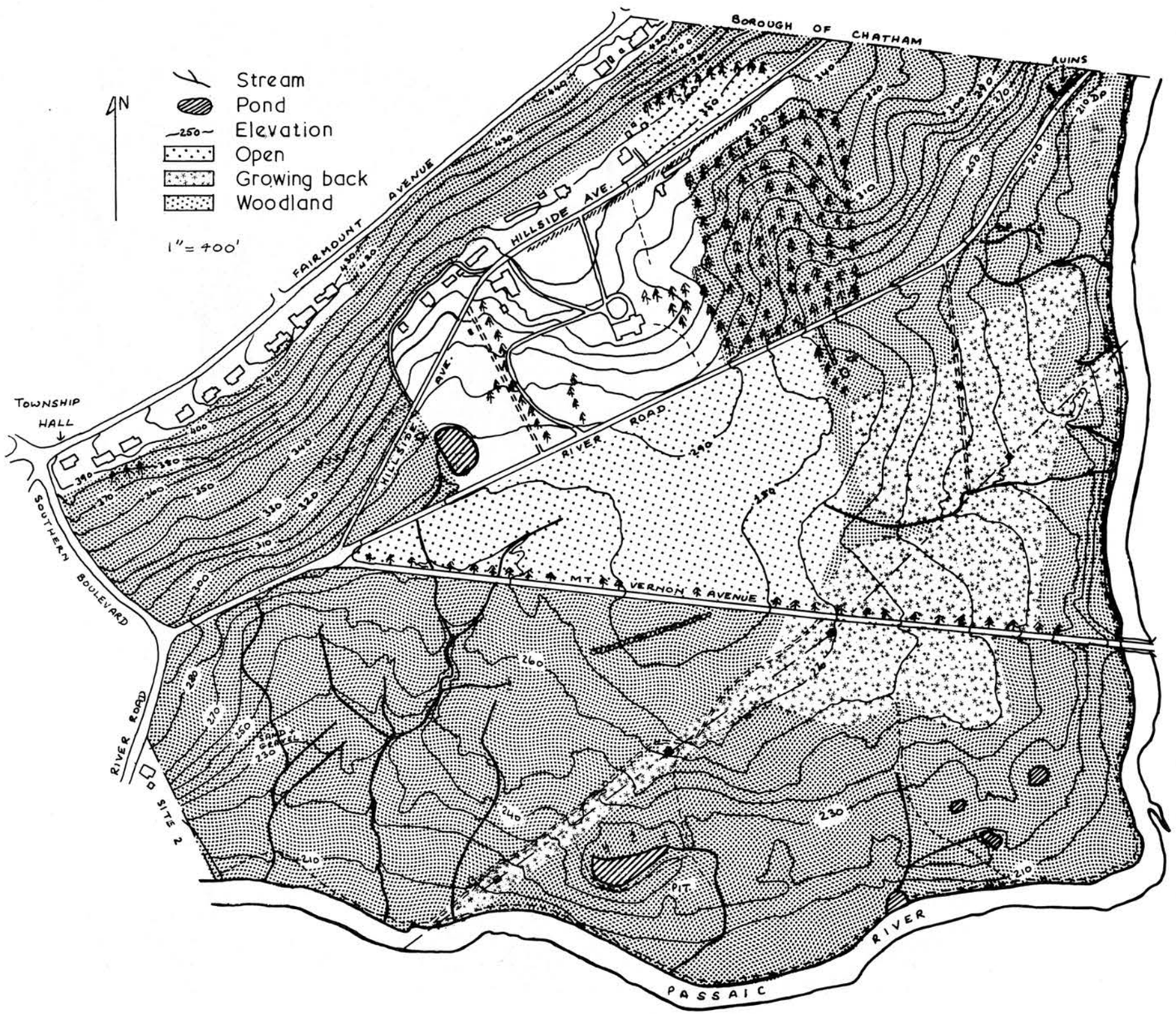
The power lines have a raised dirt road along them, but are otherwise very wet. Water-loving plants such as cattails and phragmites exist in great abundance. Wildflowers also abound, and the waterways are hosts to wild ducks and geese. The power lines are used for hiking, horseback riding and mini-bike riding. The dirt road is easily entered and traversed and provides access to the wet lands on either side.

Except where explicitly noted, the land described here is private property.

SITE 4 MOUNTAINVIEW



SITE 6 AVERETT



SITE 6 AVERETT

This site at the eastern end of Chatham Township is very different in character from the rest of the undeveloped land. These differences arise primarily from the glacial moraine and from the beach soils and clay deposits of the Glacial Lake Passaic, which are found here.

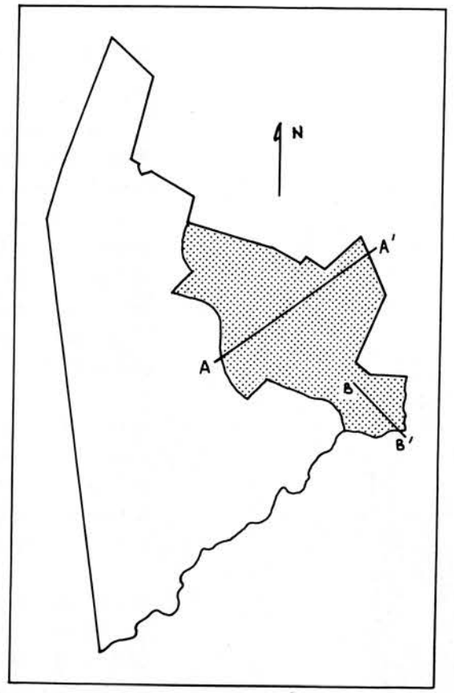
Descending from Fairmount Avenue is a steep wooded slope. From its top one has a good view of the land below. From here you can see a large brick house in the center of carefully landscaped lawns and gardens. The mature ornamental vegetation is beautiful. Along Hillside Avenue there are many horse chestnut trees and a high hemlock hedge which has been pruned and nurtured for over seventy years. A large section to the east of the house is devoted to the growing of evergreen trees, mostly spruce.

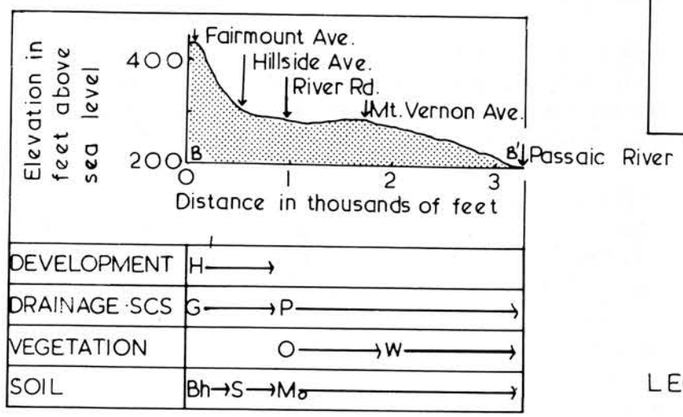
The triangular area between River Road and Mt. Vernon Avenue is primarily a gently sloping field in which two springs rise. There are some very large oak trees. On the river side of the power lines there are thickets and thin woods dropping down toward the water.

The area south of Mt. Vernon Avenue is heavily wooded. There are beech, maple, oak, pine, sweet gum, grey birch, aspen and dogwood trees, and unusually large numbers of black birch. There are large areas of ground pine. Wildlife species include deer, rabbit, fox, squirrel, pheasant, raccoon, skunk, muskrat, opossum and of course many birds. One of the most striking features of this section is the great abundance and variety of rocks. All of the streams are filled with them. There are also large deposits of sand and gravel, especially in the low eastern portion. The stream which runs from Mt. Vernon Avenue to the river has cut so deeply into the earth that it has formed canyons in the shale bedrock. The pond just to the east of the power line is in a lovely wooded setting, the land dropping off through very open woods to the river. An interesting view of the land can be seen from the river and also from the Summit dump on the opposite bank.

Except where explicitly noted, the land described here is private property.

ACREAGE		%
HOUSE ENVIRONS	704	48.5
APARTMENTS/COMMERCIA	2	0.1
PUBLIC/SEMI-PUBLIC	129	8.9
RECREATION	222	15.3
GREAT SWAMP NATIONAL WILDLIFE REFUGE	24	1.6
UNDEVELOPED	371	25.6
	1452	100.0





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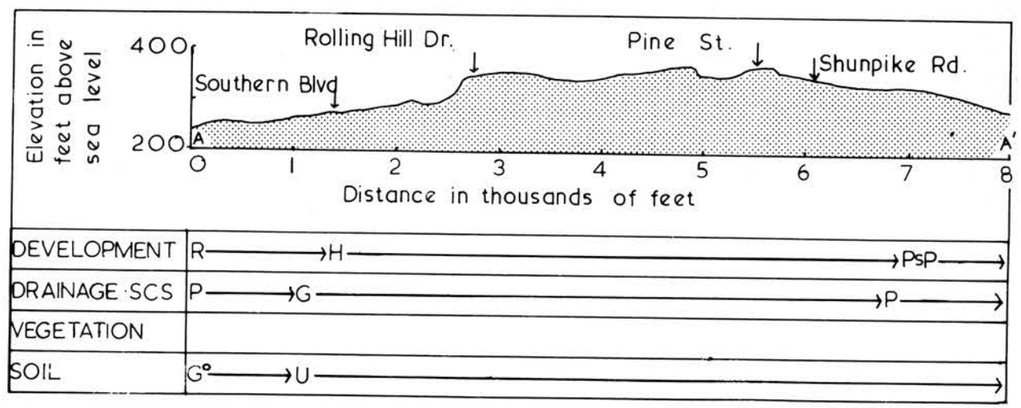
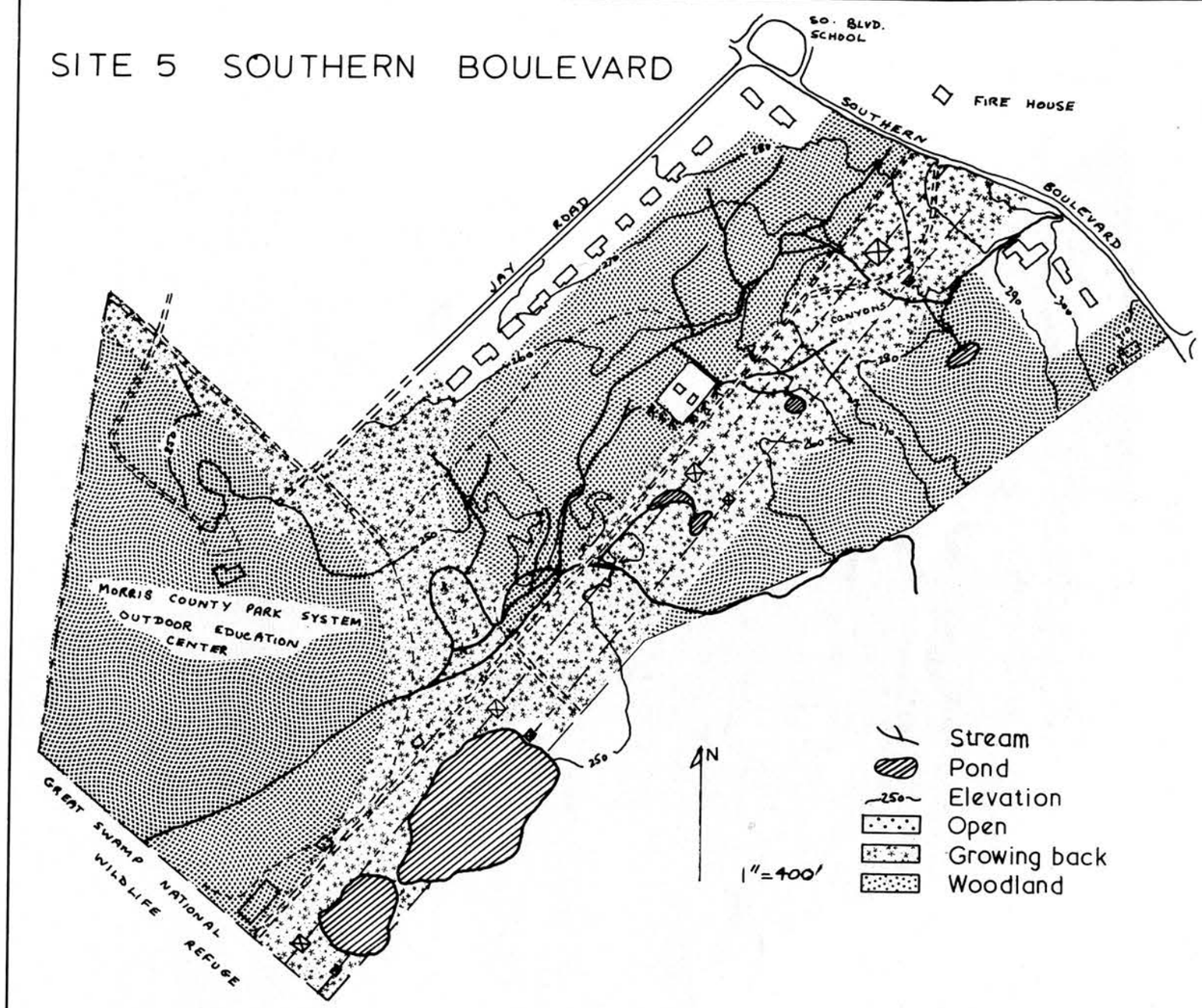




SITE 5 SOUTHERN BOULEVARD

This site, which is approximately in the center of Chatham Township, is two wooded areas divided by a 300-foot open strip under power lines. It drops about 50 feet in elevation to the west from Southern Boulevard. Water from extensive acreage on the other side of the road drains into this area mainly through storm sewers and eventually reaches The Great Swamp. The combinations here of high and low spots, shady and sunny areas, and very dry and very wet sections have produced a wealth of plant life and, in turn, a great variety of insect, bird and animal life which feed on and are sheltered by the vegetation. Many people use the site for recreational purposes and as an access route to residential and school districts, and to The Great Swamp (see also p. 28).

Except where explicitly noted, the land described here is private property.

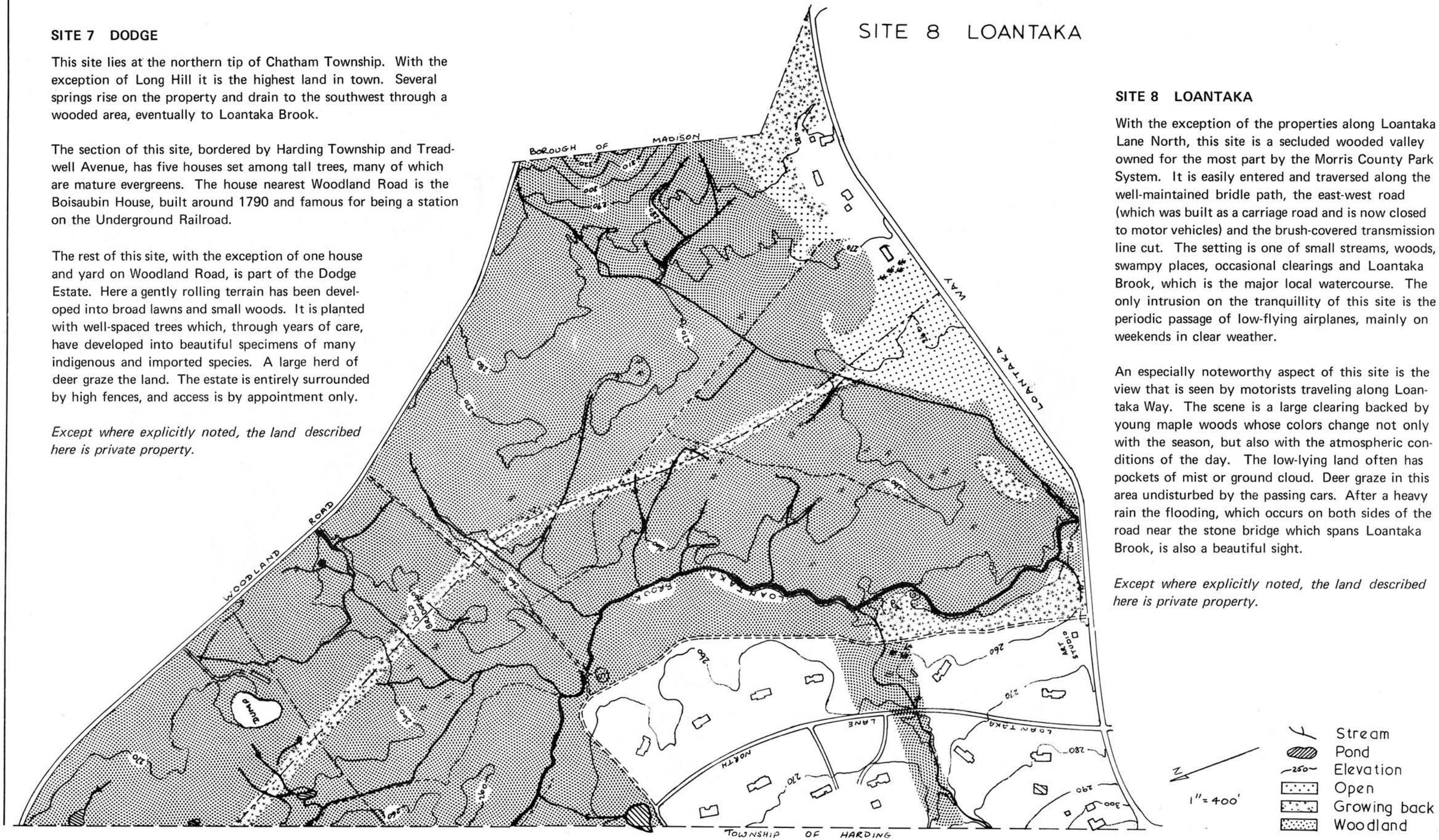
SITE 7 DODGE

This site lies at the northern tip of Chatham Township. With the exception of Long Hill it is the highest land in town. Several springs rise on the property and drain to the southwest through a wooded area, eventually to Loantaka Brook.

The section of this site, bordered by Harding Township and Treadwell Avenue, has five houses set among tall trees, many of which are mature evergreens. The house nearest Woodland Road is the Boisaubin House, built around 1790 and famous for being a station on the Underground Railroad.

The rest of this site, with the exception of one house and yard on Woodland Road, is part of the Dodge Estate. Here a gently rolling terrain has been developed into broad lawns and small woods. It is planted with well-spaced trees which, through years of care, have developed into beautiful specimens of many indigenous and imported species. A large herd of deer graze the land. The estate is entirely surrounded by high fences, and access is by appointment only.

Except where explicitly noted, the land described here is private property.



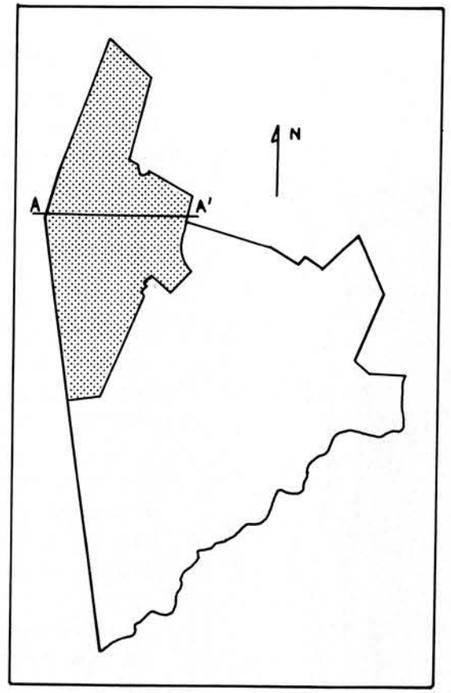
SITE 8 LOANTAKA

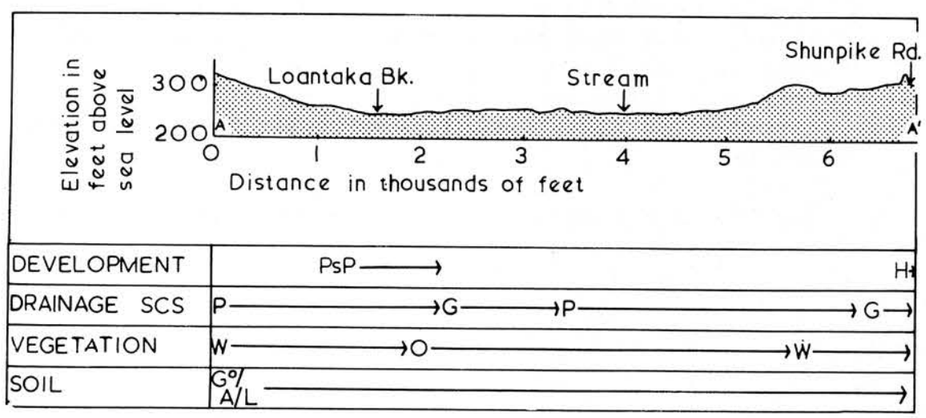
With the exception of the properties along Loantaka Lane North, this site is a secluded wooded valley owned for the most part by the Morris County Park System. It is easily entered and traversed along the well-maintained bridle path, the east-west road (which was built as a carriage road and is now closed to motor vehicles) and the brush-covered transmission line cut. The setting is one of small streams, woods, swampy places, occasional clearings and Loantaka Brook, which is the major local watercourse. The only intrusion on the tranquillity of this site is the periodic passage of low-flying airplanes, mainly on weekends in clear weather.

An especially noteworthy aspect of this site is the view that is seen by motorists traveling along Loantaka Way. The scene is a large clearing backed by young maple woods whose colors change not only with the season, but also with the atmospheric conditions of the day. The low-lying land often has pockets of mist or ground cloud. Deer graze in this area undisturbed by the passing cars. After a heavy rain the flooding, which occurs on both sides of the road near the stone bridge which spans Loantaka Brook, is also a beautiful sight.

Except where explicitly noted, the land described here is private property.

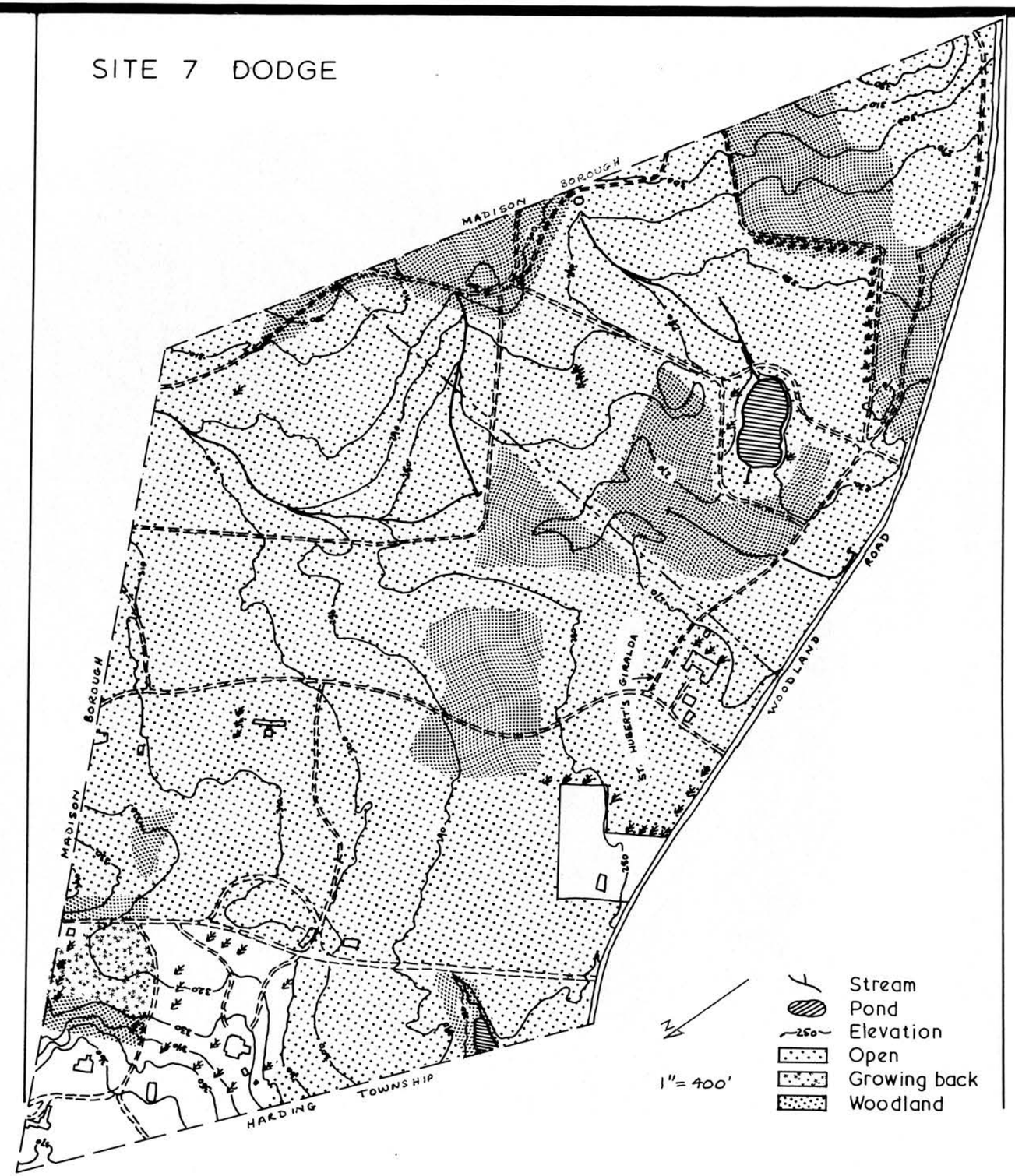
ACREAGE		%
HOUSE ENVIRONS	110	6.9
APARTMENTS/COMMERCIAL	42	2.7
PUBLIC/SEMI-PUBLIC	4	0.2
RECREATION	315	19.8
GREAT SWAMP NATIONAL WILDLIFE REFUGE	51	3.2
UNDEVELOPED	1069	67.2
TOTAL	1591	100.0

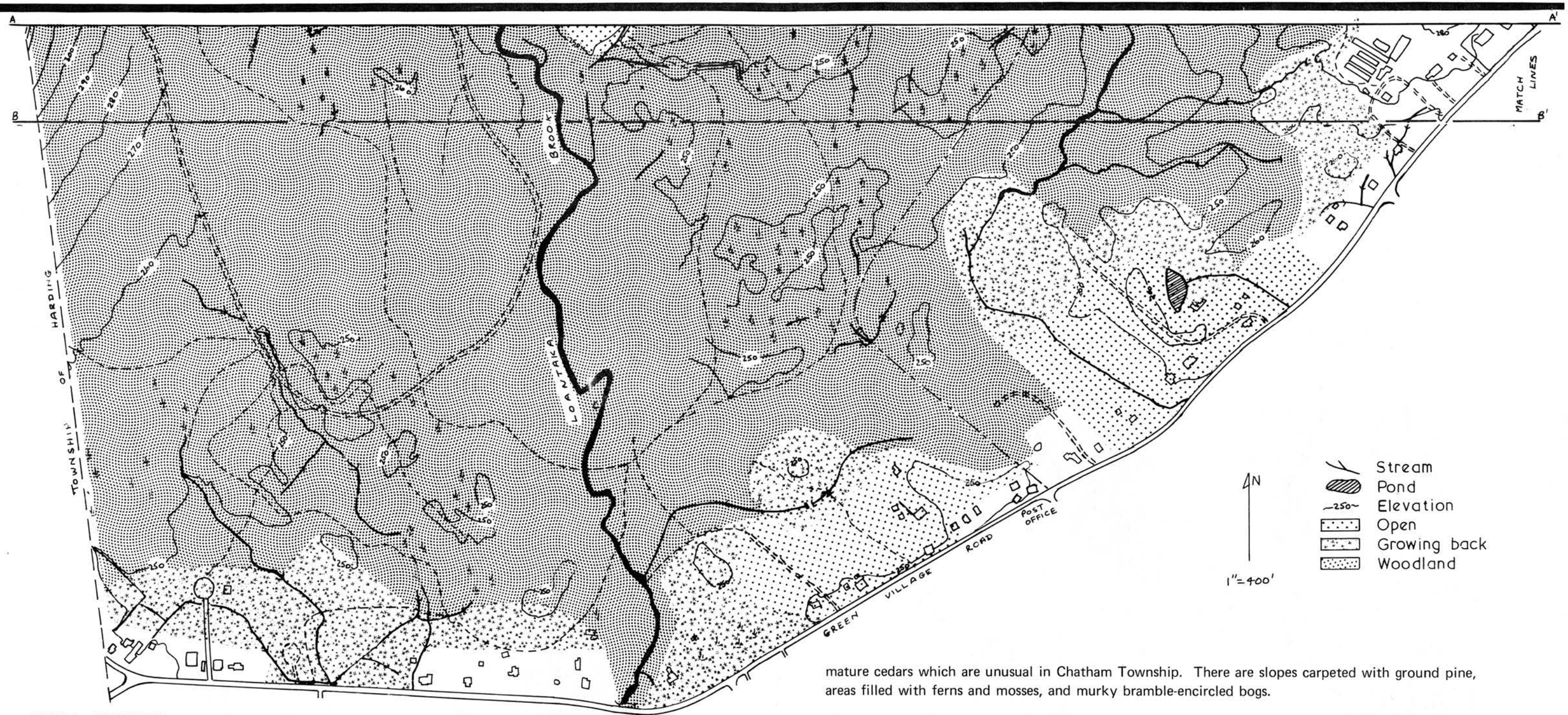




LEGEND: P. 30

SITE 7 DODGE





SITE 9 HICKORY

This site is a broad basin rather like a pie plate with a flattened southern edge. It has three more or less distinct natural divisions:

The northern portion of the site is cleared land, mostly grass with large, well-maintained rural homes. It is scenically gentle and peaceful. Among the few buildings is an especially handsome brick stable. Much of the grassland is used to pasture horses, adding to the picturesque quality of the site.

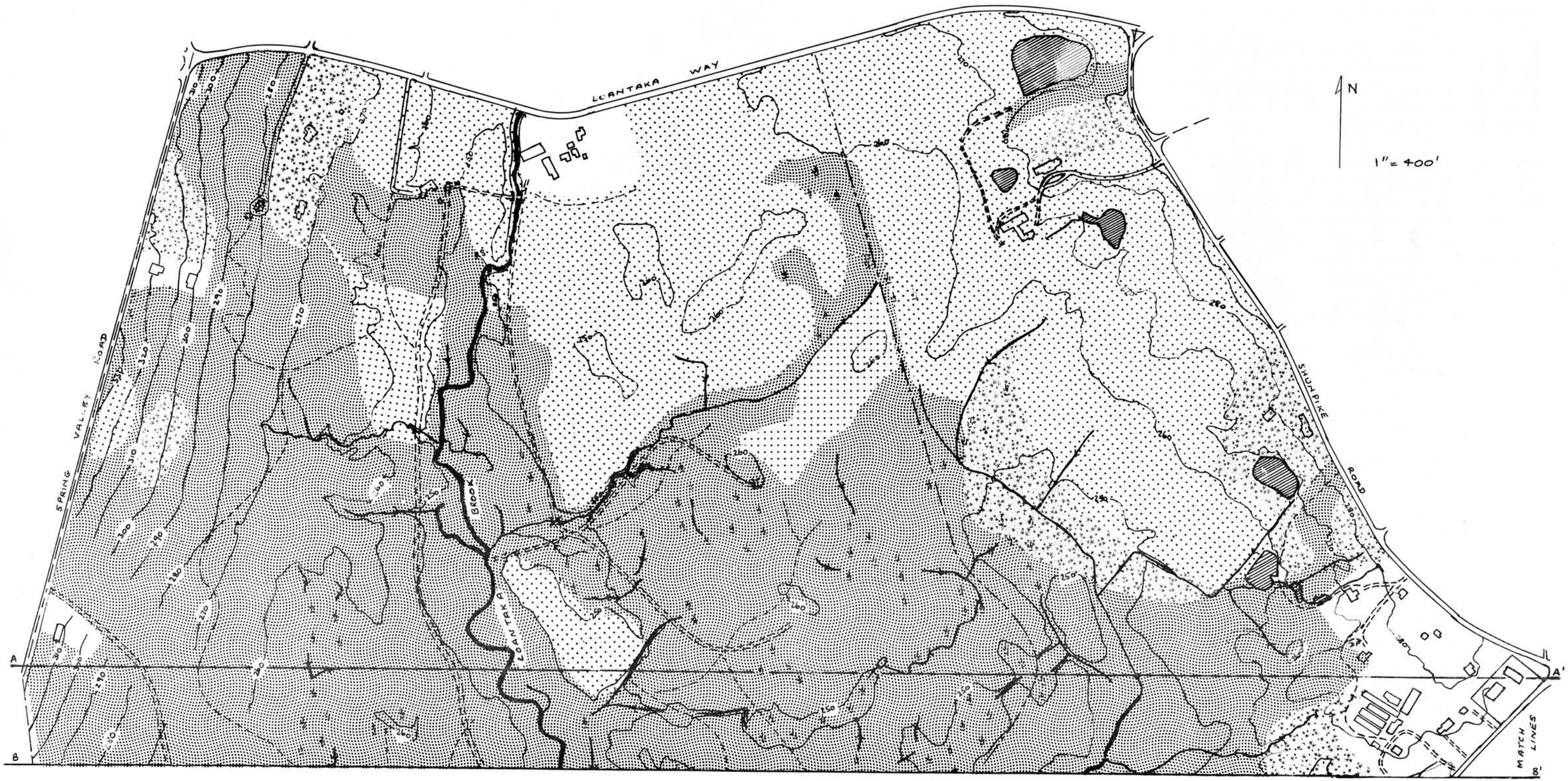
The central and largest portion of the site is wet lowland forest. It is a mixture of mature woods, swampy depressions, streams and trails. It has many huge old trees, especially beech. One section is filled with mature cedars which are unusual in Chatham Township. There are slopes carpeted with ground pine, areas filled with ferns and mosses, and murky bramble-encircled bogs.

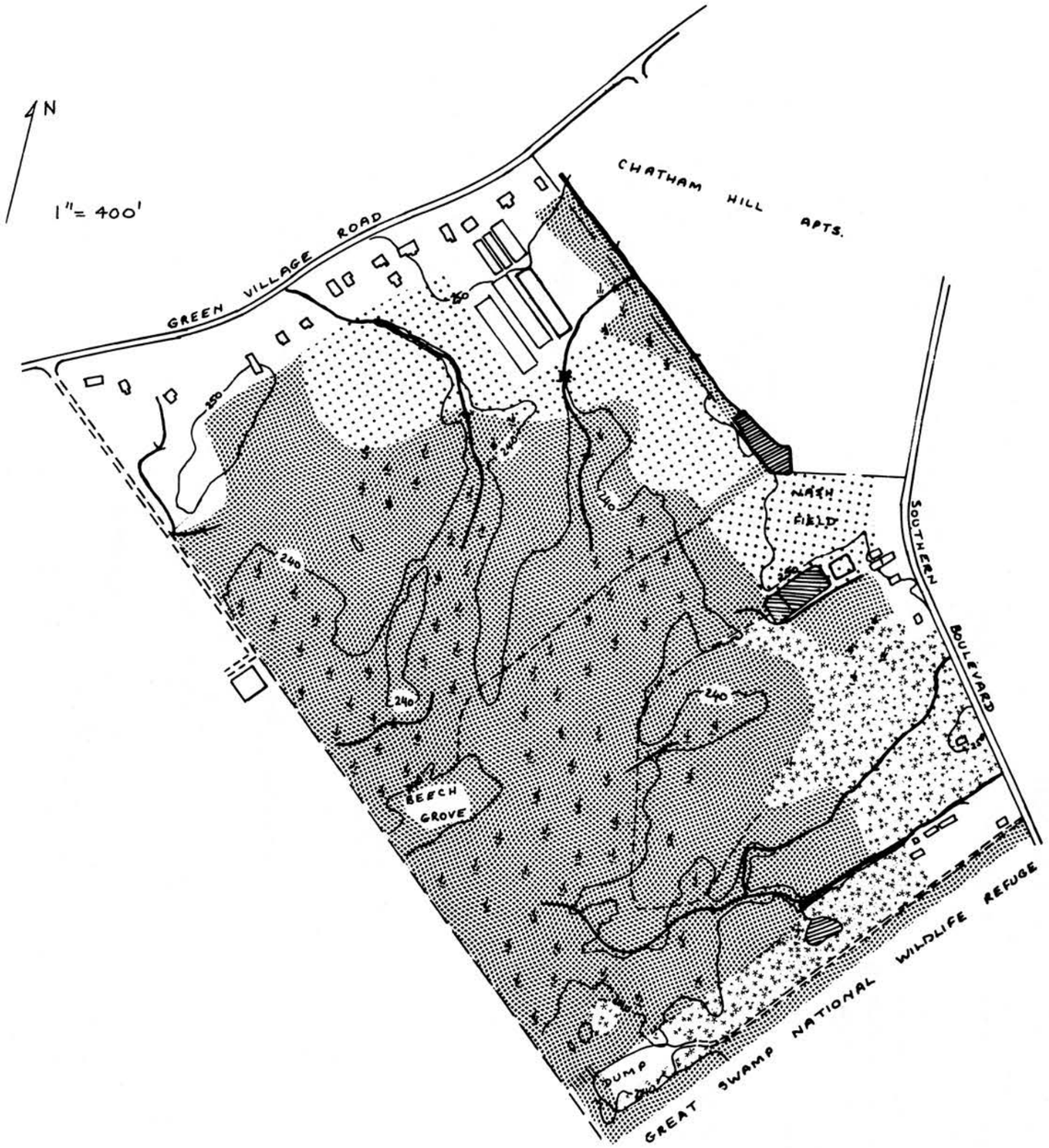
The third portion of this site lies along Green Village Road. This old section of Chatham Township has many houses, almost all of which have outbuildings of one sort or another. The land was used for years for small-scale farming and animal raising, but is now becoming overgrown. The resulting situation is a maze of marshes, fields, briar patches, yards, horse paddocks, vegetation in abundant variety, drainage systems, young woods, old wells and abandoned foundations.

Much of this site, in the eastern section, belongs to the Morris County Park System. The County maintains a gravel road through the area.

Except where explicitly noted, the land described here is private property.

SITE 9 HICKORY





SITE 10 DELTA

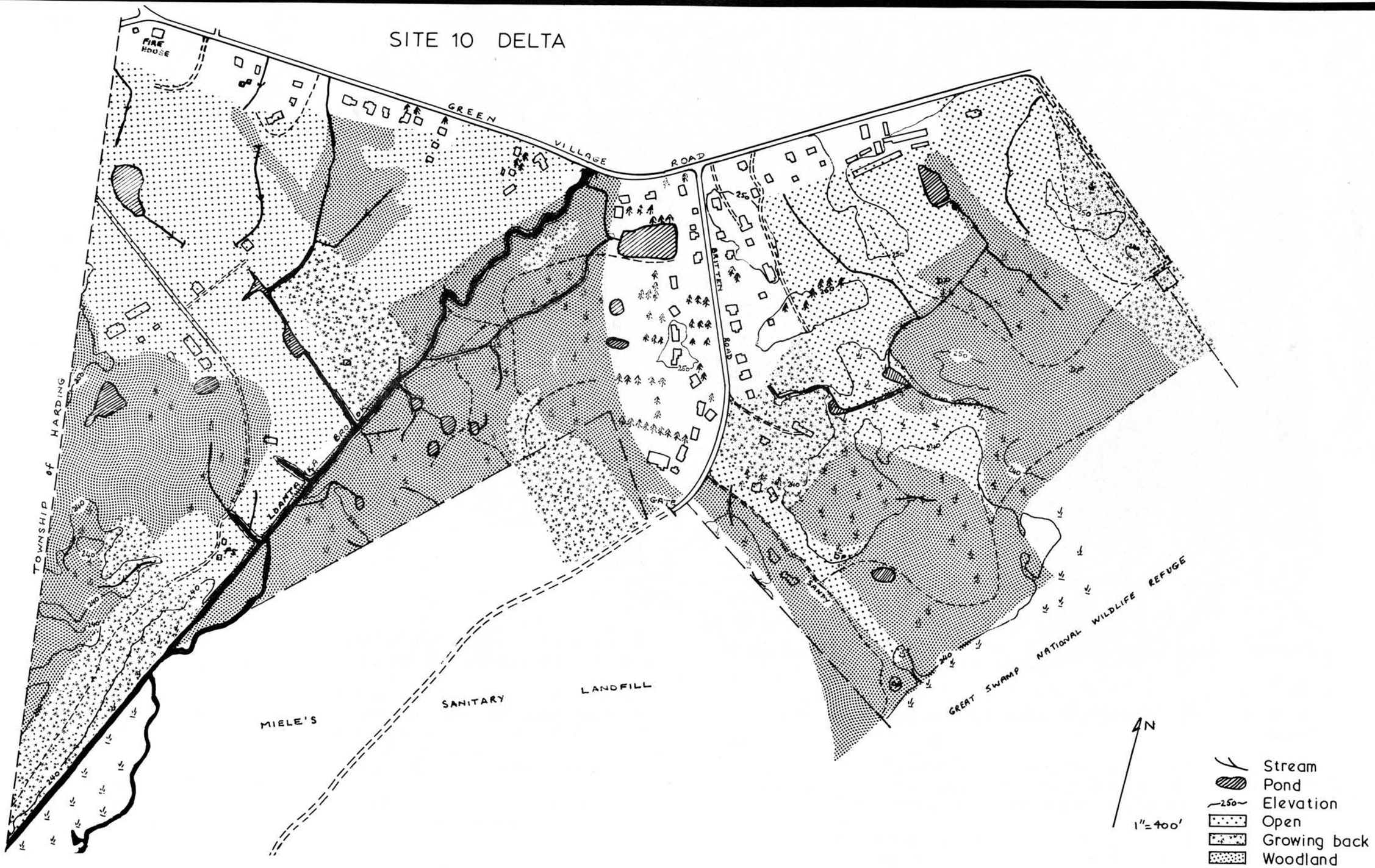
The most prominent feature of this site is water. The land receives runoff from a large area to the north and east and eventually discharges it into The Great Swamp. There is extensive use of drainage ditches and pipes to route water away from the buildings, cultivated fields, pastures and recreational areas. There are many low wet woods, swamps and marshes. Sandy ridges and knolls (principally along Britten Road and to the east) provide well-drained places for houses, businesses and garden farms. Practically all of the uncleared land is laced with dirt roads, trails and paths which skirt the chronically wet areas.

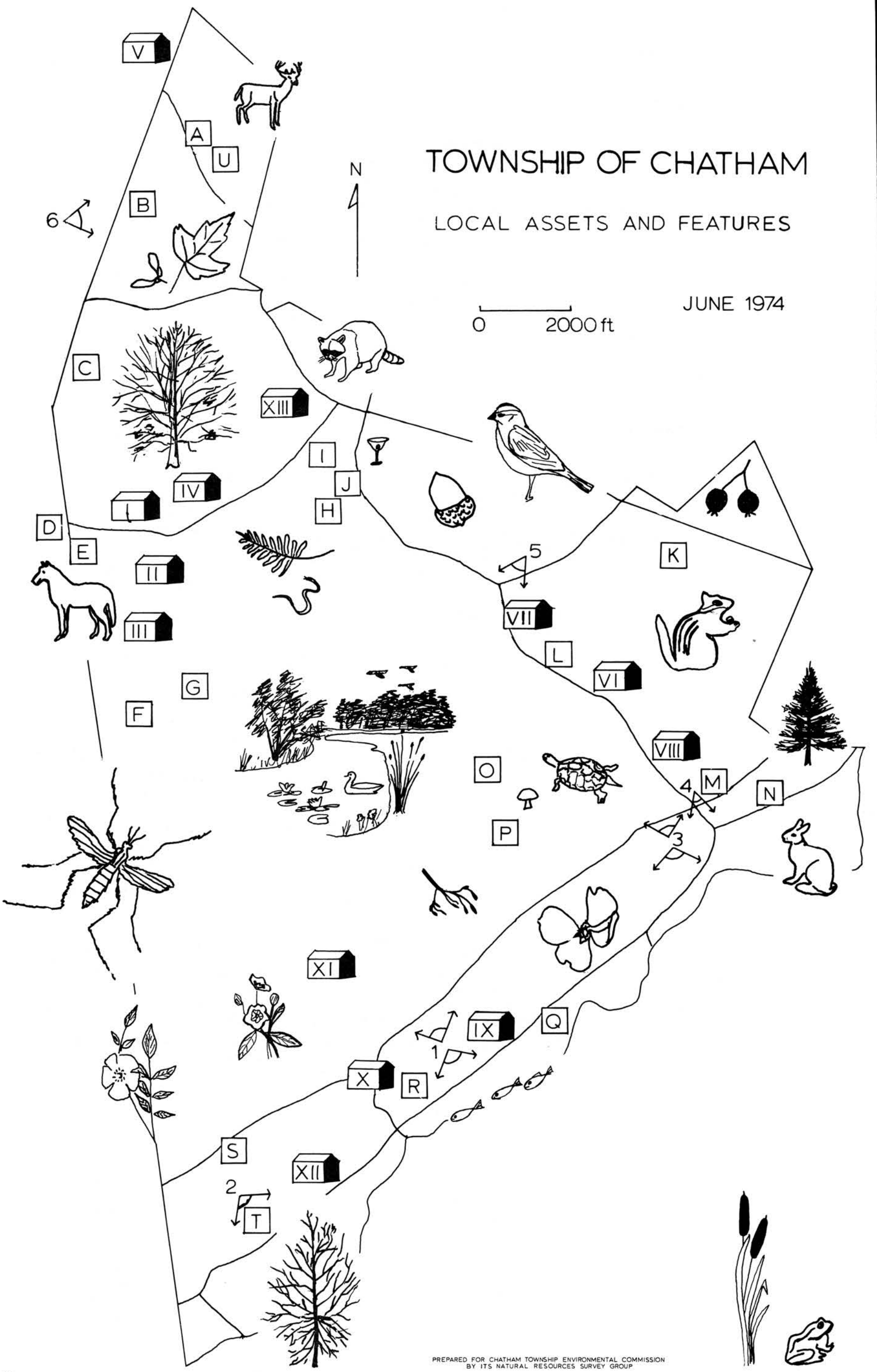
To the west of Loantaka Brook is a large area used by a construction business and for raising horses. It is a well-landscaped pastoral setting.

Township residents make use of the recreational facilities at Nash Field where there are ball fields, a skating rink, playground equipment, picnic tables and grills. Trails at the back of Nash Field are used for nature walks. The site is a natural habitat for water-oriented wild animals and birds. The dominant tree species here and on the rest of the Delta site are beech, oak and red maple.

At the end of Britten Road is "Miele's Dump" which was used as a large sanitary landfill until it was closed in 1968. The filling has raised this land above the level of the surrounding swamp.

Except where explicitly noted, the land described here is private property.


SITE 10 DELTA
FIRE HOUSE
GREEN VILLAGE ROAD
BITTEN ROAD
TOWNSHIP OF HARDING
LOANTAKA BROOK
MIELE'S SANITARY LANDFILL
GREAT SWAMP NATIONAL WILDLIFE REFUGE
N
1"=400'
Stream
Pond
250 Elevation
Open
Growing back
Woodland


TOWNSHIP OF CHATHAM
LOCAL ASSETS AND FEATURES
JUNE 1974
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T
PREPARED FOR CHATHAM TOWNSHIP ENVIRONMENTAL COMMISSION
BY ITS NATURAL RESOURCES SURVEY GROUP

Historic Houses I

I. 486 Green Village Road
II. 461 Green Village Road
III. 44 Britten Road
IV. 418 Britten Road
V. Treadwell Avenue—Boisaubin House
VI. 184 Southern Boulevard—Lewis Noe House
VII. 248 Southern Boulevard
VIII. 122 Southern Boulevard
IX. Long Hill Lane
X. 805 Fairmount Avenue
XI. 622 River Road
XII. 788 River Road
XIII. 667 Shunpike Road

Views 3

1. Top of power line at the end of Nicholson Drive
   a) Facing North: Great Swamp and hills of Morris County.
   b) Facing South: Passaic River, valley between Long Hill and Second Watchung Mountain.
2. Susan Drive: Wide view of Second Watchung Mountain, New Providence, Berkeley Heights, Summit.
3. Buxton Road: a) Great Swamp
   b) Limited view to the South
4. Town Hall
5. Noe Avenue
6. Loantaka Lane North and Spring Valley Road.

Points of Interest H

A. St. Hubert's Giralda, animal shelter.
B. Old cut stone bridge spanning Loantaka Brook.
C. Sugar maple trees at the King House, Spring Valley Road.
D. Vietnam War Memorial, Green Village Park.
E. Green Village Fire House.
F. Miele's Sanitary Landfill.
G. Oak Tree, 14-foot trunk circumference.
H. Old beech grove at the back of Nash Field.
I. Heyl's Greenhouses (roses).
J. Chatham Township Police Station (formerly Township Hall).
K. Kelly's Pond, glacial kettle hole.
L. Steeple of Presbyterian Church.
M. Township Hall (formerly an old schoolhouse).
N. House and landscaping.
O. Outdoor Education Center, Morris County Park System.
P. Sewage Treatment Plant.
Q. River Road Fire House.
R. Shale Pit.
S. Stand of white pine, Meyersville Road and Dogwood Drive.
T. Rock outcropping on Marian Lane.
U. Line of vision, Dodge Estate.

REPORT FIGURES AND SITE MAPS: SOURCES OF INFORMATION

Figure

1. State of New Jersey, Manual of the Legislature. 196th Legislature, First Session, 1974, J. Joseph Gribbins, ed.
2. Township of Chatham; Existing Land Use map (Fig. 6), 1973.
3. Outline, Town boundaries: County and Municipality map of New Jersey, 1956 (1" = 4 miles); Atlas Sheet #39, New Jersey Department of Conservation and Economic Development.

   Passaic River Watershed: Drainage Basin map of New Jersey, 1972 (1" = 4 miles); New Jersey Department of Environmental Protection, Division of Water Resources.

   Population data: "New Jersey Population Report," Department of Community Affairs Planning and Management booklet, 1972.
4. Topographic Sheet #25, 1954 (1" = 4 miles); New Jersey Department of Conservation and Economic Development.
5. U.S. Geological Survey's 7½-minute "Chatham" and "Morristown" quadrangles, 1970 (1" = 2000').
6. Existing Development map, Catlin, 1971, augmented and verified by field observation and the records of the tax assessor.
7. Generalized diagram.
8. Outline, Town boundaries: County and Municipality map of New Jersey, 1956 (1" = 4 miles); Atlas Sheet #39, New Jersey Department of Conservation and Economic Development.

   Geological data: Geologic map of New Jersey, 1910-12 (revised 1931, 1950), Lewis and Kümmel (1" = 4 miles); Atlas Sheet #40, New Jersey Department of Conservation and Economic Development.
9. Generalized diagram.
10. Interim Soil Survey for Morris County, USDA, SCS, 1969.
11. Interim Soil Survey for Morris County, USDA, SCS, 1969.
12. Interim Soil Survey for Morris County, USDA, SCS, 1969.
13. Interim Soil Survey for Morris County, USDA, SCS, 1969.
14. Fig. 10 and Fig. 5.
15. Agriculture Information Bulletin #326, "Conservation and the Water Cycle."
16. Precipitation, Temperature: based on Canoe Brook Station. Climatological Data of New Jersey, Annual Summary, 1972. U.S. Department of Commerce.

    Wind direction, hours of sun, frost-free days: H. E. Gill and J. Vecchioli, "Availability of Ground Water in Morris County, New Jersey." Report #25, U.S. Geological Survey in cooperation with State of New Jersey, 1965.

    Sun path diagram: C. G. Ramsey and H. R. Sleeper, *Architectural Design Standards,* New York, 1970.
17. Based on C. S. Lucey, "Geology of Morris County in Brief," Bureau of Geology and Topography, New Jersey Department of Environmental Protection, 1972.
18. U.S. Geological Survey's 7½-minute "Morristown," "Chatham" and "Bernardsville" quadrangles, 1970 (1" = 2000').
19. Estimates based on the method of computation developed by S. Stankowski, "Magnitude and Frequency of Floods in New Jersey with Effects of Urbanization," U.S. Geological Survey, 1973 (preliminary draft).

    Observed data supplied by U.S. Geological Survey, Trenton, N. J.
20. Data from Ebasco Services, Inc., "Engineering Investigation of Proposed New Jetport Site in Morris County, New Jersey," New York, 1961.
21. Data from Tippetts - Abbett - McCarthy - Stratton, *Survey of New Jersey Water Resources Development*, New York, 1955.
22. Large-scale topographic maps: Township of Chatham, 1962; U.S. Army Corps of Engineers, 1960; Morristown, 1961; Morris Township, 1961; Borough of Madison, 1966-67, (1" = 100', 2' contour interval).

    Passaic River Flood Hazard delineation, New Jersey Department of Environmental Protection, 1974.
23. Chatham Township Natural Resources Inventory.
24. Interim Soil Survey for Morris County, USDA, SCS, 1969.
25. Large-scale topographic maps: U.S. Army Corps of Engineers, 1960 (1" = 100').

    New Jersey Department of Environmental Protection, Infrared aerial photographs, 1972.

    Interim Soil Survey for Morris County, USDA, SCS, 1969.
26. Vegetation Patterns and Hydrologic Soil Groups Overlay maps (see p. 54).
27. Flood Hazard Area Rules and Regulations—Basis and Background, New Jersey Department of Environmental Protection, 1974.
28. Chatham Township Natural Resources Inventory.
29. Chatham Township Natural Resources Inventory.
30. U.S. Geological Survey's 7½-minute "Chatham" and "Morristown" quadrangles, 1970 (1" = 2000').

31. Fig. 5 and Fig. 6.

32. Large-scale topographic maps of Chatham Township, 1962 (1" = 100').

33. Outline, Town boundaries, Longitude and Latitude: County and Municipality map of New Jersey, 1956 (1" = 4 miles); Atlas Sheet #39, New Jersey Department of Conservation and Economic Development.

    Roads: Operating State Highways map of New Jersey, 1973 (1" = 4 miles); New Jersey Department of Transportation, Division of Planning.

34. Chatham Township Natural Resources Inventory.

SITE MAPS

Reduced composite of large-scale topographic maps of Chatham Township, 1962 (1" = 400').

Tri-State Transportation Commission, aerial photography, 1970, from Morris County Planning Board. Enlargements at 1" = 400'.

Enlargements of New Jersey Department of Environmental Protection infrared photography, 1972 (1" = 1000').

Independent on-site inspection by several groups of people.

LOCAL ASSETS AND FEATURES

Based on field observation by Township citizens.

OVERLAY MAPS: DEFINITIONS OF TITLES AND SOURCES OF INFORMATION

1. BASIC. This map is intended to be used in conjunction with other maps of the Inventory series for location purposes.

Information based on U.S. Geological Survey's 7½-minute "Chatham" and "Morristown" quadrangles, 1970.

2. U.S.G.S. This is a photographic image of the U.S. Geological Survey's 7½-minute "Chatham" and "Morristown" quadrangles showing Chatham Township and its environs, enlarged from 1" = 2000' to 1" = 1000'.

3. TOPOGRAPHIC MAP. This map shows elevations at 20-foot intervals as depicted on the large-scale topographic maps of Chatham Township (1962).

4. EXISTING LAND USE. This map represents present-day development and land use categories. Development is defined as existing structures plus actively utilized land associated with the structures. Unshaded areas indicate vacant land.

Information based on "Existing Development Map," Catlin, 1971, augmented and verified by field observation and the records of the tax assessor.

5. INDEX OF INVENTORIED SITES. This map shows the location of the ten sites within Chatham Township for which a detailed site report has been prepared as part of the Township's Natural Resources Inventory. Sites are delineated solely on the basis of physical features, with no reference to actual lot lines.

Information prepared by the Chatham Township Natural Resources Inventory Group.

6. SURFACE DRAINAGE. This map is a composite of various water-related properties of Chatham Township and the Loantaka Brook Watershed, including: (1) surface water courses as shown on large-scale topographic maps (Township of Chatham, 1962; Army Corps of Engineers, 1960; Morristown, 1961; Morris Township, 1961; Borough of Madison, 1966-67, 1" = 100', 2' contour interval); (2) watershed boundaries developed using the topographic maps; (3) location of storm sewers from information supplied by R. Kirkpatrick; (4) the Passaic River Flood Hazard delineation of the New Jersey Department of Environmental Protection, 1974.

7. GREAT SWAMP COMPOSITE. This is a composite of three separate delineations of the natural area of The Great Swamp. One is based on the Interim Soil Survey, one on large-scale topography and one on interpretation of infrared aerial photographs.

8. VEGETATION PATTERNS. This map groups areas which, by virtue of their use, support vegetation that provides similar runoff. Thus, for example, playing fields, golf courses and permanent pastures are grouped together as one category.

Groupings based on information supplied by USDA, SCS. Delineations based on the use of single and stereo aerial photographs (USDA, ASCS, 1971; New Jersey Department of Environmental Protection, 1972) and field observation.

9. KINDS OF SOIL. This map indicates the distribution of the basic kinds of soil present in Chatham Township.

Information based on the Interim Soil Survey for Morris County (USDA, SCS, March 1969).

10. SLOPE. This map classifies land surface in terms of percentage of slope (the number of feet of rise or fall in a horizontal distance of 100 feet). Slopes greater than 15 percent are rated by the SCS as having severe limitations for most developed uses.

Information based on the Interim Soil Survey for Morris County (USDA, SCS, March 1969).

11. DEPTH TO BEDROCK. This map presents the depth of the soil from its surface to the underlying bedrock. Excavation and drainage problems may arise from shallow depth to bedrock. Fractured shale is excavatable; harder rock, such as basalt, is more difficult.

Information based on the Interim Soil Survey for Morris County (USDA, SCS, March 1969).

12. DRAINAGE. This map interprets the natural drainage condition of each type of soil. It indicates the part of the year that the soil profile contains excess water. Well-drained soils contain little excess water at any time of the year. Very poorly drained soils are wet for 10 to 12 months. Factors considered are depth to seasonally high water table and permeability.

Information based on the Interim Soil Survey for Morris County (USDA, SCS, 1969).

13. HYDROLOGIC SOIL GROUP. This map presents the Hydrologic Soil Group (HSG) of each soil. The HSG is used in the calculation of the amount of water that will run off the surface of the soil as a result of a rain storm. A "D" soil has a greater potential for runoff than an "A" soil, all other conditions being the same. The more important factors considered in assessing soils for this map are depth of soil, permeability and natural drainage.

Information based on the Interim Soil Survey for Morris County (USDA, SCS, 1969).

14. CRITICAL AREAS. This map defines those areas considered to have severe limitations for development purposes for one or more of the following reasons: (1) slope of more than 15 percent, (2) seasonal high water table of 0-2 feet, (3) bedrock 0-6 feet from the surface.

Criteria developed by the Morris County Planning Board, in conjunction with the Morris County Soil Conservation District using the Interim Soil Survey for Morris County.

15. LIGHT BUILDINGS WITH CELLARS are three stories or less in height and have cellars five feet or more below ground level. Factors considered by the SCS for this interpretation are soil drainage, depth to bedrock, slope, flooding and rockiness. Sewage disposal, water supply, access roads and other factors which are part of the development of a site are not considered.

Information based on the Interim Soil Survey for Morris County (USDA, SCS, 1969).

SEPTIC EFFLUENT DISPOSAL is an evaluation of soils by the SCS based on the New Jersey Board of Health Standards Code 199. In interpreting ease of construction and proper functioning of disposal systems, it is assumed that building lots range from ½ to 1 acre with 3-6 people per house. Soil drainage, permeability rate, depth to bedrock, rockiness, slope and flooding are of prime concern.

Information based on the Interim Soil Survey for Morris County (USDA, SCS, 1969).

The interpretation of limitations for each of the two previous separate categories happens, with two noted exceptions, to be identical in Chatham Township.

16. ROADS AND PARKING LOTS. It is assumed that *Roads* will be prepared and hard-surfaced in the manner of better county and township roads. The more important soil factors are drainage, depth to seasonal water table, slope, depth to bedrock, texture and flooding. It is assumed that *Parking Lots* will be hard-surfaced in the manner of those in large shopping centers. Soil properties considered are similar to those for roads; steep slopes are more restrictive for parking lots.

Information based on the Interim Soil Survey for Morris County (USDA, SCS, 1969).

17. RUNOFF. This map shows curve numbers for different combinations of soil and vegetation. These numbers are used as part of a procedure developed by the SCS for computing the actual runoff from a particular site or area for a storm of given size. The map may also be used independently to compare the potential for surface runoff from different areas.

Based on data supplied and verified by USDA, SCS. This map is a direct combination of the Vegetation Patterns map and the Hydrologic Soil Groups map developed for the Chatham Township Natural Resources Inventory.

OVERLAY MAPS: PRODUCTION METHODOLOGY

All enlargements and reductions referred to in this section were done by Keuffel and Esser (K&E) using standard photographic techniques. The final scale of all overlay maps developed for the Inventory is 1" = 1000'.

Development of the Base Map

1.1 Using the U.S. Geological Survey's 7½-minute quadrangles "Chatham" and "Morristown" (1" = 2000'), the border of Chatham Township was traced onto polyester film. An error in the representation of the border shown on the "Morristown" quadrangle was corrected, using the map of Existing Development [A]. Also included on the Base Map were the principal roads, principal streams, ponds and the Power Company right-of-way.

1.2 The tracing was enlarged to the scale of 1" = 1000' and printed on polyester film that had a matte surface on both sides.

2.1 The Existing Development map was reduced in scale to 1" = 1000' and printed on paper.

2.2 The boundary of the property owned by The Great Swamp National Wildlife Refuge was transferred from (2.1) to (1.2).

2.3 Lettering and border lines common to all maps were added.

2.4 Several copies were printed onto 7 ml matte-surface polyester film. The product (2.4) is referred to as the **Base Map.** It is used as the base for all maps in the overlay series.

Development of the Master Soil Base

3.1 The tracing (1.1) was enlarged to 1" = 815' and printed onto film. (This scale matched as closely as possible the scale of the Soil Conservation Service (SCS) soil survey.)

3.2 By taking a small well-defined section (for example, an area that was surrounded by roads or the river or the power lines), the soil survey map was matched to the enlarged base (3.1). The outlines of each soil area were traced onto the base, and each area labeled with the soil name. Where discrepancies between the two maps occurred in matching section boundaries, they were reduced by distributing the difference uniformly across the section. This technique and the resultant product were approved by Lester Seglin, Soil Conservationist, of the U.S. Department of Agriculture, Soil Conservation Service.

3.3 The map (3.2) showing soil areas was reduced in scale to 1" = 1000' and a copy printed on 7 ml matte-surface film. The product (3.3) is referred to as the **Master Soil Base.**

Procedure for the Development of Maps Based on the Soil Survey

The maps developed using this procedure were:

Kinds of Soil	Drainage
Slope	Light Buildings with Cellars
Depth to Bedrock	Septic Effluent Disposal
Hydrologic Soil Groups	Roads and Parking Lots
Critical Areas	

4.1 Two blue-line prints of the Master Soil Base were made.

4.2 All the soils occurring in Chatham Township, together with the slopes on which they occur, were listed in order on sheets of paper. For example,

		Slight (yellow)	Moderate (orange)	Severe (brown)
BT12	B			
	C			
	D			
BT20	A			
	B			

For each map a copy of these sheets was coded according to the coloring required on the final map. For example, for one particular map,

BT12	B	was painted	yellow
	C		orange
	D		brown
BT20	A		brown
	B		brown

The coloring used here corresponded to the category established by the SCS for each soil for each property or use depicted on the maps (see p. 55 of this Report). The colors were chosen from the range available to reflect a "dark is bad" philosophy, as well as to produce cumulative effects when overlayed.

4.3 For each map in the series two volunteers each took one print of the Master Soil Base, one copy of the coded soil sheets and one piece of tracing paper. The tracing paper was taped to the Master Soil Base and an outline of the Township was drawn. For each occurrence of each soil type the color coding (4.2) was used to determine the color to be used on the tracing paper. (Magic markers were used for this purpose.)

4.4 The two versions of each map (4.3), each independently completed, were compared visually for differences. Any differences were checked back with the Master Soil Base and corrected. It was hoped that almost all errors would be eliminated by this system of cross-checks.

4.5 A "sandwich" was formed as follows:

top . . . . . a base map
middle . . . . . master soil base
bottom . . . . . corrected colored tracing paper version of map

Following the outlines on the master soil base, a line was drawn onto the base map around each area of *color,* shown on the tracing paper, isolating that area from all other colors.

4.6 Titles and legend were added. (Negatives should have been made to facilitate reproduction in case of loss.)

4.7 Blue-line prints were made. These were colored using magic markers to correspond with the finished map. These will be used for various purposes in place of the originals.

4.8 The map (4.6) was painted using special paints designed for use on developed polyester film.

Notes Relating to — Particular Maps Based on the Soil Survey

5. **Kinds of Soil Map.** The grouping of the soils was done by Lester Seglin, Soil Conservationist, USDA, SCS.

6. **Drainage Map.** The classification of soils into categories of poor, moderate and slight drainage characteristics was done by Lester Seglin, Soil Conservationist, USDA, SCS.

7. **Critical Areas Map.** The criteria used here are those adopted by the Morris County Planning Board in conjunction with the Morris County Soil Conservation District.

All Soil Survey data were obtained from the Interim Soil Survey for Morris County (1969), updated by reference to the manuscript for the Published Soil Survey (1973).

— Maps Developed as Tools

8. An enlargement of the New Jersey Department of Environmental Protection aerial photographs (1972) [B] showing Chatham Township and its environs was obtained from Mark Hurd Inc. at a scale of 1" = 1000'. The enlargement was in the form of a screened master, thus allowing an unlimited number of blue-line prints to be made from it.

9.1 The large-scale topographic maps of Chatham Township [C] were reduced to 1" = 400' and printed as negatives.

9.2 The negatives (9.1) were spliced together to form a composite.

9.3 A positive of the composite (9.2) was printed on clear film.

9.4 Several blue-line prints of (9.2) were made.

— Other Maps in the Overlay Series

10. **Basic Map.** This is the basic locator map showing the Township's boundaries, major roads, The Great Swamp Refuge and bordering municipalities. Map (11) with the correction indicated in (1.1) and a delineation of The Great Swamp National Wildlife Refuge obtained from (2.1) corrected by D. Janes (May 1974) were used to prepare this map.

11. **USGS.** This is a photographic image of the U.S. Geological Survey's 7½-minute quadrangles showing Chatham Township and its environs, enlarged from the original scale of 1" = 2000' to 1" = 1000'.

12. **Existing Land Use.** This map presents present-day development and land use categories. The Existing Development map [A] was used as the basis for this information, augmented and verified by field observation and the records of the tax assessor.

13. **Index of Inventoried Sites.** This map shows the location of the ten sites within Chatham Township for which a detailed site report has been prepared as part of the Township's Natural Resources Inventory. The sites were delineated solely on the basis of physical features, with no reference to actual lot lines. Maps (11) and (12) were used to delineate the sites for this map.

Surface Drainage — Watercourses

14.1 Using map (9.4), the surface watercourses, ponds and marsh areas in Chatham Township were delineated.

14.2 On the basis of field knowledge, use of (8) and the topographic maps of the U.S. Army Corps of Engineers [D], reduced in scale to 1" = 400', the delineation (14.1) was augmented and verified.

14.3 The corrected information (14.2) was reduced in scale to 1" = 1000' and transferred to a base map by hand.

— Storm Drain System

These data were supplied by R. Kirkpatrick on a copy of the large-scale topographic map of the Township.

15.1 The data were transferred manually to a copy of (9.4).

15.2 The data from (15.1) were traced and reduced in scale from 1" = 400' to 1" = 1000'.

15.3 For those few areas where the mapping of the topography was incomplete, the full information of streets and storm drains was traced from the data supplied by R. Kirkpatrick and reduced in scale to 1" = 1000'.

15.4 The data from (15.2) and (15.3) were transferred to the map (14.3) by hand.

— Watersheds

16.1 Using (9.4) the watershed boundaries within the Township were delineated.

16.2 These lines were traced and reduced in scale from 1" = 400' to 1" = 1000'.

16.3 The boundary lines were transferred to the map (14.3) by hand.

— Passaic River Flood Hazard

17.1 The delineation developed by the New Jersey Department of Environmental Protection [E] was traced and reduced in scale from 1" = 500' to 1" = 1000'.

17.2 The Flood Hazard line was transferred to the map (14.3) by hand.

Great Swamp: Composite Delineation

The Composite is derived from the following:

18.1 The 240' contour line traced from (9.4), reduced in scale to 1" = 1000' and transferred to a tracing paper base map.

18.2 The 240' contour line traced from Source D, reduced in scale to 1" = 1000' and transferred to a tracing paper base map.

18.3 A line was drawn delineating the extremely wet areas on the basis of the texture and tonal quality of the vegetation exhibited on the aerial photographs (8), in conjunction with copies of the original infrared masters (used with guidance from JoAnn Stitt and Steven Whitney of the New Jersey Department of Environmental Protection). This was transferred to a tracing paper base map.

18.4 Using (8) in conjunction with aerial photographs taken for the New Jersey Department of Environmental Protection in 1940 [F], another delineation was made on the same basis as for (18.3) and transferred to a tracing paper base map.

18.5 From the Interim Soil Survey for Morris County, Mr. W. Kirkham, Assistant State Soil Scientist, USDA, SCS, itemized those soils which are regarded by the SCS as "wet soils." These are those soils for which the water table is at the surface for a major part of each year and which are adjacent to permanently wet areas. This line was transferred to a tracing paper base map.

18.6 A composite of maps (18.1) through (18.5) was formed and transferred to a base map.

Hydrologic Soil Groups, Vegetation Patterns and Runoff

These three maps were made for an area larger than Chatham Township. They each cover the whole of the watersheds of Loantaka Brook and Black Brook above Chatham Township.

19.1 Large-scale topographic maps of Morristown, Morris Township and Madison were obtained [G, H].

19.2 Using the maps (19.1), the watershed boundaries were delineated.

19.3 Using the maps (19.1), the line (19.2) and principal roads were traced and reduced in scale to 1" = 1000'.

20.1 For the small section which lies in Harding Township the watershed boundary was based on stereoscopic viewing of aerial photographs [I].

20.2 The line 20.1 was transferred to a copy of map (8).

21.1 An enlargement of parts of the U.S. Geological Survey's 7½-minute quadrangles similar to 1.1 was made for the area of the watersheds.

21.2 Using (19.3) and (20.2), the watershed boundary was transferred to the map (21.1). Thus a standard base with the watershed boundaries marked in was obtained for Loantaka Brook and Black Brook.

Vegetation

The categories used here were designed to be appropriate for the development of a Runoff map. They were discussed with Mr. W. Kirkham, Assistant State Soil Scientist, USDA, SCS.

22.1 Using (8), the original infrared photography (viewed stereoscopically), the 1971 photography of the SCS (also viewed stereoscopically) and from field knowledge, the vegetation patterns were outlined onto a copy of (8).

22.2 These data (22.1) were transferred to a base map, section by section, in order to ensure a uniform distribution of the discrepancies between the two maps.

22.3 Titles and legend were added.

22.4 Blue-line prints were made and colored.

22.5 The map (22.3) was painted using the special paints.

Runoff Map

23.1 For each combination of vegetation grouping and Hydrologic Soil Groups a Curve Number was assigned. These numbers and groupings were obtained in consultation with Mr. W. Kirkham, Assistant State Soil Scientist, USDA, SCS.

23.2 Taking the vegetation map and the map of Hydrologic Soil Groups, a direct composite was formed and outlined.

23.3 Titles and legend were added.

23.4 Blue-line prints were made and colored.

23.5 The map (23.3) was painted using the special paints.

SOURCES

A. R. Catlin, Existing Development Map of Chatham Township, 1971.

B. New Jersey Department of Environmental Protection (Mark Hurd Inc.), High Altitude Photography, April 1972.

C. Township of Chatham, Large-scale topography, 1962.

D. U.S. Army Corps of Engineers, Large-scale topography, Passaic River Basin Great Swamp Area, New Jersey, 1960.

E. New Jersey Department of Environmental Protection, Passaic River Basin Flood Hazard Area Delineation, 1973.

F. New Jersey Department of Environmental Protection (Aero Service Corp.), Aerial Photography, 1940.

G. Township of Morris and Borough of Morristown, Large-scale topography, 1961.

H. Borough of Madison, Large-scale topography, 1966-67.

I. U.S. Department of Agriculture, Agricultural Stabilization Control Service, Aerial Photography, 1971.

A COLORING GUIDE FOR THE MAPS IN THIS REPORT

MAP LEGEND:												
EXISTING LAND USE		yellow	orange	blue	green	green						
DEPTH TO BEDROCK	red				orange		yellow	brown				
SEPTIC EFFLUENT AND LIGHT BUILDINGS	red				orange		yellow	brown	brown			
CRITICAL AREAS								brown				
DRAINAGE	red				orange		yellow	brown				
GREAT SWAMP COMPOSITE										orange	brown	
RUNOFF		red			grey		yellow	brown				orange
POPULATION	yellow	orange	All other patterns; brown.									
KINDS OF SOIL		= blue		= purple		= red		= orange		= grey		= yellow
		= dark green		= light green		= brown						
SITE MAPS		= pale green			= pale brown			= pale yellow			= pale red	

Pale colors should be used so that printed information is not obscured.

The following reports were developed as part of the Chatham Township Natural Resources Inventory and are supplemental to this Report. They may be obtained from the Township Clerk, Township Hall, Southern Boulevard, Chatham Township, New Jersey 07928.

AIR POLLUTION CONTROL by V. van Dyke
A summary of air pollution conditions and related legislation on the Federal, State and municipal levels.

GREAT SWAMP BIBLIOGRAPHY, assembled by E. Fraser and A. Morris

SUPPLEMENTARY REFERENCES assembled by E. Fraser and A. Morris.

USING VEGETATION AS INDICATORS OF WET SOIL CONDITIONS by A. Nagy

Set of four reports $1.50

BIRDS OF CHATHAM TOWNSHIP, NEW JERSEY by J. Mahoney, Ph.D.
A brief description of the occurrence, habitat preference and foods of birds of Chatham Township, New Jersey.

Report $1.50

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32. Township of Chatham: Topographic Map
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ENVIRONMENTAL RESOURCE CENTER
P.O. BOX 157, MENDHAM, N.J. 07945
300 MENDHAM RD.
201-539-7547

C.2

Loaned to Alex Lesnik (w Long Branch E.C.)
6/27/89

333.71
CHAT TR

TOWNSHIP OF CHATHAM: A NATURAL RESOURCE INVENTORY.

ASSOCIATION OF NEW JERSEY
ENVIRONMENTAL COMMISSIONS
300 MENDHAM ROAD, BOX 157
MENDHAM, NJ 07945