Conservation Master Plan for the Town of Rye, New Hampshire

by

Phillip E. Reynolds, Ph.D.

Final Report submitted to The Town of Rye Conservation Commission, Rye, New Hampshire, in fulfillment of Service Contract dated 5-17-1978.

December, 1978

13 Griffiths Drive
Durham, New Hampshire
13 December 1978

Mr. Ralph Brown, Chairman
Rye Conservation Commission
Town of Rye
Rye, New Hampshire 03870

RE: CONSERVATION MASTER PLAN FOR THE TOWN OF RYE, NEW HAMPSHIRE

Dear Sir:

Pursuant to our agreement of 17 May 1978, I am transmitting herewith my report and conservation master plan for the Town of Rye, New Hampshire.

Included is an analysis and draft document reflecting the location and condition of selected natural resources and cultural resources, the impact of past Commission programs, and future conservation goals for the Town of Rye, New Hampshire.

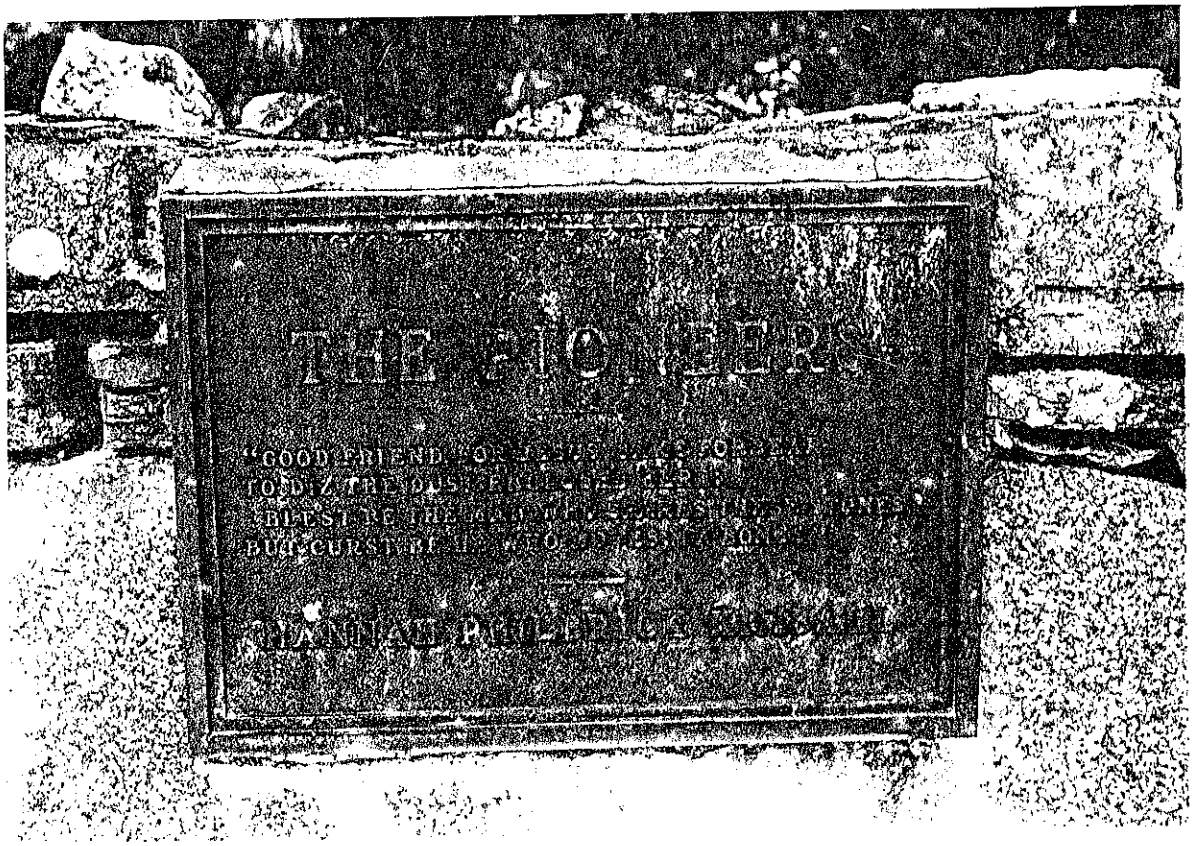
I hope that the recommendations and conclusions contained herein will assist your Commission in identifying Rye's conservation needs and in developing future conservation goals for Rye's unique natural resources.

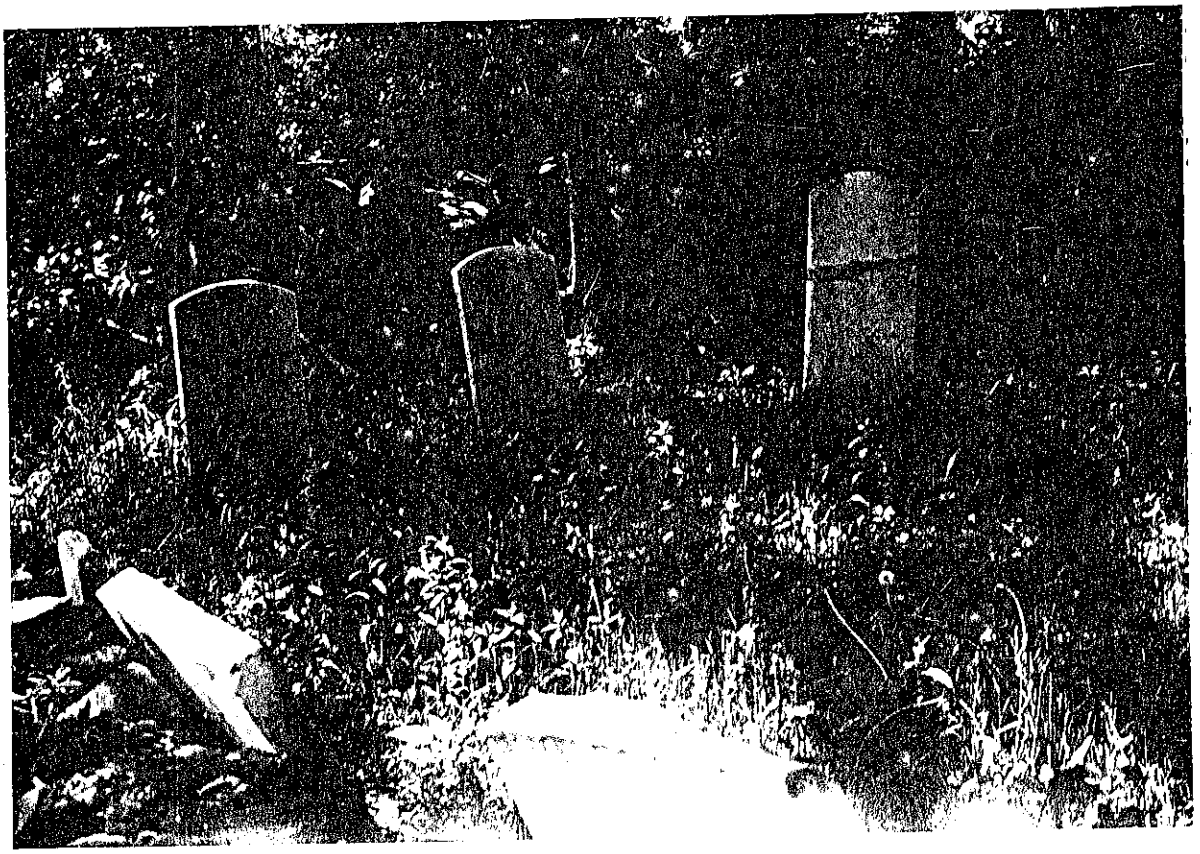
I would like at this time to express my appreciation for the opportunity to work on this unusual and interesting project. The report is intended to satify your immediate needs and to serve as a guide for the ultimate development of Rye's future conservation goals.

Sincerely,

Phillip Reynolds

Phillip E. Reynolds, Ph.D.
Consultant Forest Ecologist


THE PIONEERS



GOOD FRIEND FOR JESUS SAKE FORBEAR

TO DIG THE DUST ENCLOSED HERE:

BLEST BE THE MAN WHO SPARES THESE STONES,

BUT CURST BE HE WHO MOVES MY BONES

Table of Contents

Preface

There were several important reasons for initiating this contract. First, and foremost, the project was undertaken as an effort to aid, facilitate, and accelerate communication and coordination of the various Rye public groups and citizens involved with and concerned with preserving, developing, and properly utilizing Rye's unique, irreplaceable, and often fragile natural resources. Because developing a wise, sound, and well developed land use plan for Rye's future development is so crucial and urgent at this time, it was first important and necessary to compile a report documenting the location and description of selected natural resources belonging to (representative of) Rye. As part of an overall attempt to do this, it was also important to look at and document Rye Conservation Commission activities from a historical perspective. I should stress from the offset, however, that this report is not a comprehensive land use or development plan for Rye. Such a plan would require an in depth examination of political, legal, economic, sociological, and psychological factors, as well as those factors pertaining to physical and biological characteristics of Rye's natural environments and vegetation addressed in this report. Such a plan would require considerably more time, money, and most importantly, the expertise of social scientists in addition to physical or

biological scientists, to prepare. However, if Rye is to retain its present unique qualities, such a plan should be undertaken immediately. In summary, the objectives of this Conservation Master Plan, as outlined in my contract, were twofold: (1) to produce a draft document reflecting the location and condition of selected natural resources and cultural resources, the impact of past Commission programs, and future conservation goals, for the Town of Rye, New Hampshire and (2) to involve the general public and other local Boards and Commissions in the identification of Rye's conservation needs and in the development of future conservation goals.

This present report contains a brief description of past and current Conservation Commission programs. More importantly, it contains a description of Rye's conservation problems or needs as identified by personal contacts, public meetings, or on-site natural resource inspections, covering a broad range of concerns. Most important of these are: (1) land use planning or its lack, (2) public land management and coordination, (3) trends in open space, (4) condition and trend of urban shade trees, (5) landscaping and beautification needs for urban streets and public places, (6) wetlands encroachment, (7) public access to natural resources, (8) enforcement of existing environmental laws,

(9) environmental awareness of public officials, (10) protection for rare or scarce plant species, (11) wildlife habitat needs and condition trends, (12) urban roadside conditions (including salting), (13) interest in a Town Forest, and (14) needs for technical and educational assistance to land owners. In addition, this report contains statements reflecting the contractor's views regarding the urgency of finding solutions to certain identified problems or needs. Accompanying these statements, is a listing or ranking according to priority (again from the viewpoint of the contractor) of the urgency for immediate action on these needs. Suggested methodology or alternative strategies for acting upon these needs, with the hope of resolving them, are also provided. I should caution that the decision of which of these alternatives to pursue is up to the Rye Conservation Commission, other Rye public groups, and in the final analysis, Rye's citizens. No one alternative is likely to be appropriate for all situations covered. A combination of approaches will need to be pursued, with competent legal advice, which the present contractor is not qualified to give. Brief statements about and explanations of these alternative strategies are provided, along with a listing of suggested follow-up readings. Every effort has been made not to betray the contractor's personal

bias with regard to these alternative strategies for specific situations, insofar as human frailty permits. Finally, the report contains a selection of maps and photos, with accompanying statistical information where possible, of natural resources occurring within the borders of Rye. Some of these include wetlands maps, surface water maps, slope maps, vegetation cover maps, public ownership maps, and maps showing the locations of the various natural areas described.

This contractor was hired as a private consultant without any vested interests in the many private or public groups existing in or chartered by Rye. Every effort has been made to present accurate, factual information as supplied to this consultant by the various groups or persons cited in the list of contacts section of this report.

As an independent, investigative consultant and reporter, my information is presented exactly as I have found it to be and without bias. These findings are presented without censorship from any of the groups or persons listed in this report.

This writer acknowledges full responsibility for preparation of this final document insofar as correct information was furnished by cooperating parties. The analysis and discussion section represents solely this consultant's

honest appraisal and interpretation of the present state of preservation of Rye's natural resources.

The value of the report cannot be discredited because the total problem of planning for Rye's future development and preservation of its most important natural resources is very complex and requires immediate attention. This document is only a beginning. This report should be valuable to the Rye Conservation Commission and future Town Planners as well as to the Selectmen, The Planning Board, The Sounding Board, The Rye Recreation Commission, and to Rye citizens in general. Information presented in the report should be helpful to the Conservation Commission and other Town bodies in guiding them as to what natural areas of Rye should be protected from further development, and left in their present condition, allowing for passive recreational use and preservation of open space. The report should be valuable to future Rye planners seeking to create a blueprint for future balanced development. Development in itself is not bad. Development without a plan or advanced anticipation of problems is. Such planners will have a scientific descriptive base of Rye's natural resources as a foundation upon which to build onto by extending the plan into those social science aspects not covered in depth in this report. Finally, the report should be of

help and serve as a possible model to other Towns, Conservation Commissions, or Planning Boards wishing to undertake similar studies.

This report will need to be extended in follow-up reports by other consultants or social planners in order to pursue problems addressed in this report on a more advanced or complete basis. These include: (1) the hiring of a consulting urban forester (expertise in tree pathology and forest ecology) to develop an inventory and comprehensive urban tree management program for Rye, (2) the hiring of a consulting forester to develop a comprehensive multiple-use plan for managing the proposed new Town Forest (Parson's homestead and woods), and (3) the hiring of a planner with demonstrated expertise in the social sciences and the law (preferably with sufficient science and forestry background to understand this present report) to develop a new, comprehensive, and meaningful plan for future Town development. It is possible that the first and second contractors could be combined into one individual.

Acknowledgements

I wish to thank the several members of the Rye Conservation Commission for the helpful information which they supplied to me during the course of this report. Current members of the Commission include: Mr. Ralph Brown, Mr. John Grimes, Mr. Wilbur LaPage, Mrs. Corinne MacDonald, Mr. John Clark, Mrs. Louise Tallman, and Mrs. Hope Wright. I extend my deepest special thanks to Mrs. Tallman for the many hours she spent in the field with me prior to writing this report. The critical insight and attention to detail often rendered by Mr. Wilbur LaPage and Mr. Ralph Brown has been appreciated. I also wish to extend my appreciation to (Dr.) Mrs. Clotile Strauss, Chairman of the Portsmouth Conservation Commission, who helped me on a number of field trips and provided me with many helpful suggestions concerning the preservation of natural areas of mutual interest to both Portsmouth and Rye.
Last but not least, I am especially grateful to The Urban Forestry Center (New Hampshire Division of Forests and Lands, Department of Resources and Economic Development), headed by Mrs. Mary K. Reynolds, which as a financial cooperator with the Rye Conservation Commission, provided fifty percent of the funding for this investigation and report. Funds administered and supplied by the Urban Forestry Center are part of a federal U.S. Forest Service grant to the State of New

Hampshire to be used for projects in urban and community forestry. In addition to Mrs. Reynolds, these funds are being handled by Mr. Stanley Knowles, Rockingham County Forester, who provided me with many helpful ideas during the course of this endeavor.

General Description of Rye's Natural Resources

The Town of Rye, New Hampshire, is located in Rockingham County and is an integral part of the New Hampshire Seacoast region. It is bordered on the north by the Town of Newcastle and on the south by the Town of North Hampton. Inland and to the west of Rye is the City of Portsmouth (see map). Rye is approximately 8,300 acres in size, and is considerably longer in length (north to south) than in width (east to west). By virtue of its location on the New Hampshire coast, Rye is blessed with certain natural resources not found in other New Hampshire towns. In addition to its bogs, swamps, freshwater marshes, forests, and open fields, Rye is also characterized by lengthy beaches, large tidal marshes, and far-inland-reaching estuaries.

The character of Rye, like many New Hampshire towns, has been continually changing during the past 2-3 decades. Rye's location in Rockingham County, the most rapidly growing County in New Hampshire and in New England, has contributed significantly to this change. Growth frequently means changing patterns of land use, and these have recently been described for Rye by Coppelman, Pilgrim, and Perchel (1978). Most significant of these changes has been a decline in land in agricultural or forest use accompanied by a concurrent increase in land in development (see accompanying tables for specific

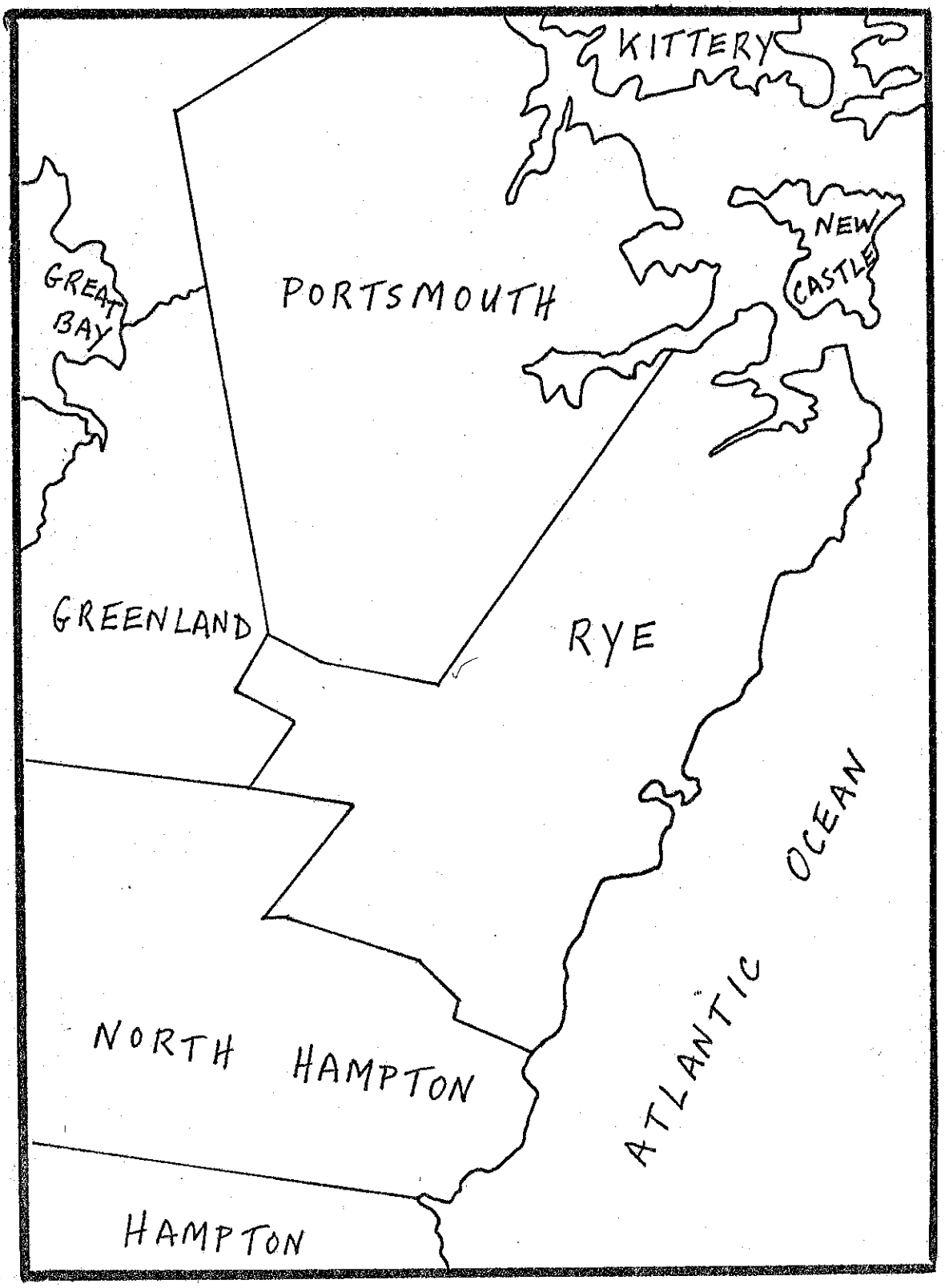

KITTERY
NEW CASTLE
GREAT BAY
PORTSMOUTH
GREENLAND
RYE
ATLANTIC OCEAN
NORTH HAMPTON
HAMPTON

Table 1. LAND USE CLASSIFICATION SYSTEM

USE	DEFINITION
AGRICULTURE	Tilled cropland; pasture; hayland; orchards; nurseries; greenhouses; and any open area being cultivated, hayed, mowed, etc.
FOREST	Land supporting tree growth with a minimum of thirty percent (30%) crown closure.
IDLE	Land formerly in agriculture, now abandoned with woody plant growth beginning.
DEVELOPED	Residential; commercial, industrial; recreational including golf courses and ski areas; extractive operations (gravel and borrow pits, etc.); and cemeteries.
OTHER	Wetlands excluding open water but including swamps, marshes, beaches, open sand areas, and bare rock areas.

Table 2. AGRICULTURAL LAND QUALITY GROUPS

GROUP	LAND CAPABILITY CLASSES[1]
Best agricultural land	I and II
Good agricultural land	III
Fair to unsuited for agriculture	IV - VIII

[1]Source: U. S. Department of Agriculture Handbook No. 210.

Tables are from G.G. Coppelman, S.A.L. Pilgrim and D.M. Peschel. 1978. Agriculture, forest and related land use in New Hampshire, 1952 to 1975. New Hampshire Agr. Expt. Sta. Research Report No. 6[illegible] 97 p.

TOWN		LAND ACREAGE		
RYE		8,270		
SOIL CAPABILITY	USE	1950's	1970's	NET CHANGE
I + II	AGR.	935	435	-500
	IDLE	117	174	+ 57
	FOR.	358	306	- 52
	DEV.	50	545	+495
	OTHER	27	27	0
III	AGR.	227	89	-138
	IDLE	33	74	+ 41
	FOR.	122	124	+ 2
	DEV.	42	137	+ 95
	OTHER	0	0	0
IV - VIII	AGR.	816	276	-540
	IDLE	432	311	-121
	FOR.	3,660	3,705	+ 45
	DEV.	618	1,223	+605
	OTHER	833	844	+ 11

Table is from G.G. Coppelman, S.A.L. Pilgrim and D.M. Peschel. 1978. Agriculture, forest and related land use in New Hampshire, 1952 to 1975. New Hampshire Agr. Expt. Sta. Research Report No. 64, 97 p.

figures). Such changes in themselves are not inherently bad, as life in itself is not static but rather continuously evolving. They do, however, signal a need to stop, look, and examine where the Town is, and more importantly, where the Town wishes to go eventually.

Development in itself is not bad, neither are developers. Development without a plan is neither sane nor rational, and in itself is irresponsible. Thus, before a Town can rationally proceed with its growth and development, it needs a plan. It needs several plans. It needs a Conservation Master Plan detailing those lands which ought to be preserved at the expense of development. It needs a land use plan detailing what lands are suitable for development and may be developed in certain instances at the expense of their preservation.

How does the Town decide what lands ought to be preserved and what lands may be slated for development? This is a difficult question and certainly one given to personal bias. Despite human falacy, certain objective criteria may be applied. Areas which should not be developed, and may be extremely desirable for open space, include: (1) wetlands; (2) areas with shallow bedrock or excessive slope; (3) areas with unique naturalistic characteristics; and (4) areas which may be suitable physically for development, but which are adjacent to

sensitive areas desirable for preservation. Wetlands may include bogs, permanent swamps, seasonal swamps, freshwater and tidal marshes, and floodplains. Development in these areas, along with those with shallow bedrock or excessive slope, generally leads to sewage problems along with various other ecological problems discussed elsewhere in this report.

Soils, Water, Geology

Given these criteria, can one assess Rye's natural and land resources in terms of what should be preserved and what is suitable (not necessarily desirable) for development? Yes. The results may be disappointing to some. Despite its acerage and diversity of natural resources, Rye does not possess very much land which is suitable for development. In 1975, the Soil Conservation Service completed a comprehensive study of Rye's soils which has been invaluable in making these decisions. Using information in the report coupled with on-site field observations, I have constructed a series of maps which depict, objectively, Rye's natural resources.

Figure 1 shows those land areas in Rye considered to be bogs, muck, or peat. Two major areas show up. One is located in the north end of Town and is properly known as the Bellyhack Bog and will figure prominently into later sections of this report. The second is located

in the south end of Town and is part of the overall Cedar Run ecosystem and will also figure prominently in later sections of this report. Those areas shown on this map do not constitute the total parts of these two ecosystems. When Figure 1 is coupled with a series of other maps, one begins to get a feeling for Rye's scarcity of land suitable for development. Figure 2 depicts freshwater and tidal marshes in Rye. Figure 3 shows those areas of Rye having a continuously high water table. These are permanent swamps consisting of soils which are poorly drained or very poorly drained. Under the auspices of the Wetlands Zoning Ordinance passed by Rye in 1975, those areas designated in Figures 1-3 are protected from further single dwelling development. Numerous individuals have charged that this legislation is not being carried out to the fullest intent of the law. In addition, the legality of the legislation, in the absence of a previously existing land use plan, has not been tested.

Other lands exist in Rye unsuited for development but not covered by the 1975 Ordinance. Figure 4 shows those lands having a seasonal high water table. These seasonal swamps which have moderately well drained soils may be flooded for up to six months of the year. The Wetlands Ordinance should be immediately extended to

cover these lands. No zoning ordinance currently exists protecting lands from development which are characterized by having shallow bedrock or excessive slope. Such an ordinance should be established. Figure 5 shows those land areas characterized by "shallow to bedrock". Most of these are in the north end of Town. From a land use stand point, lands having slopes in excess of 12 percent are generally considered to be undesirable for development. Figure 6 shows those Rye lands where slopes may be in excess of 12 percent.

If one combines the information contained in Figures 1-6, it is not difficult to conclude that there is no land suitable for development remaining in the Town of Rye. If one screens all lands for multiple problems and eliminates those lands where water, bedrock, slope, or some combination of these is involved, then one is left with only those lands where slope may or may not be in excess of 12 percent. The proper designations for these areas as delineated in the Rye Soil Survey Report are 62, 63, 42, 43, 12, 510, and 26. These land areas are shown in Figure 7, and may be suitable for development provided certain criteria are met. All such lands would have to be inspected on-site to determine their suitability for development. Criteria which need to be met for development of these lands include:

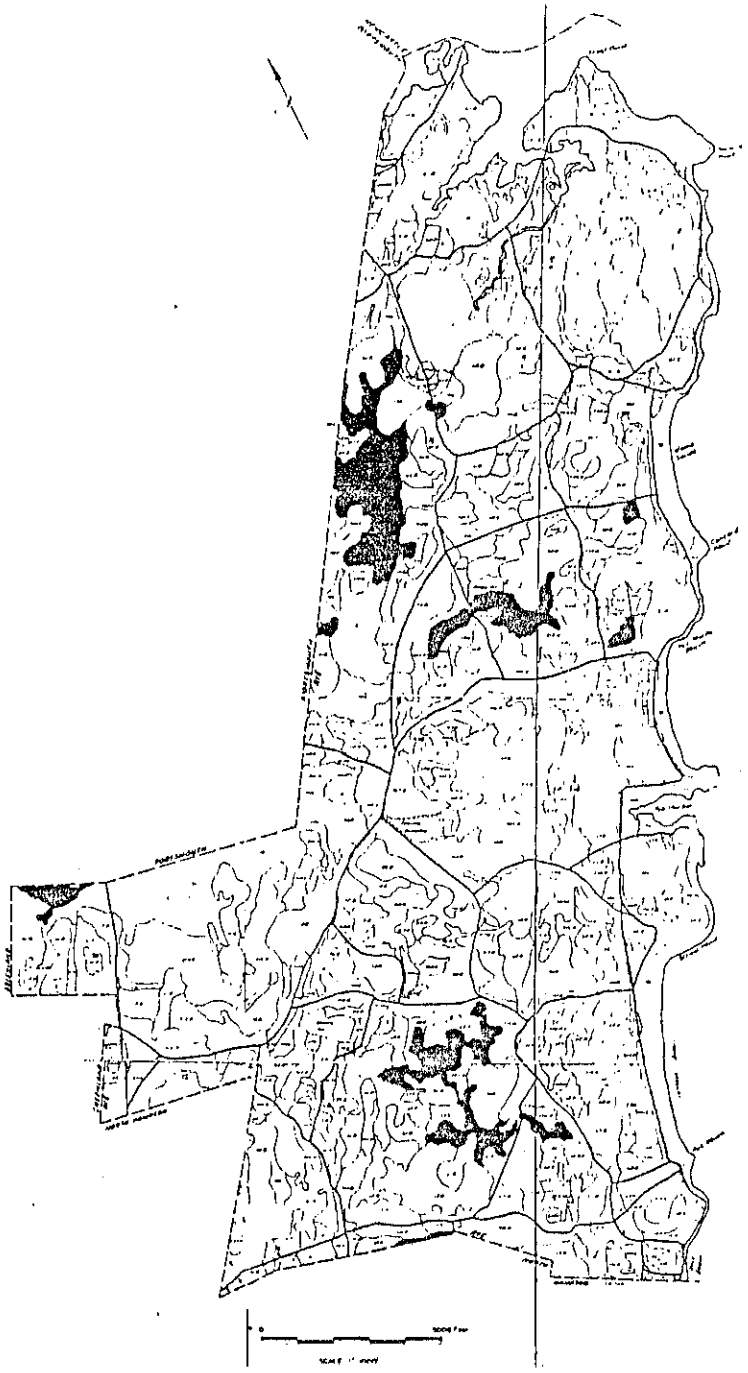


Figure 1 - Land areas of Rye which are considered to be bogs, muck, or peat.

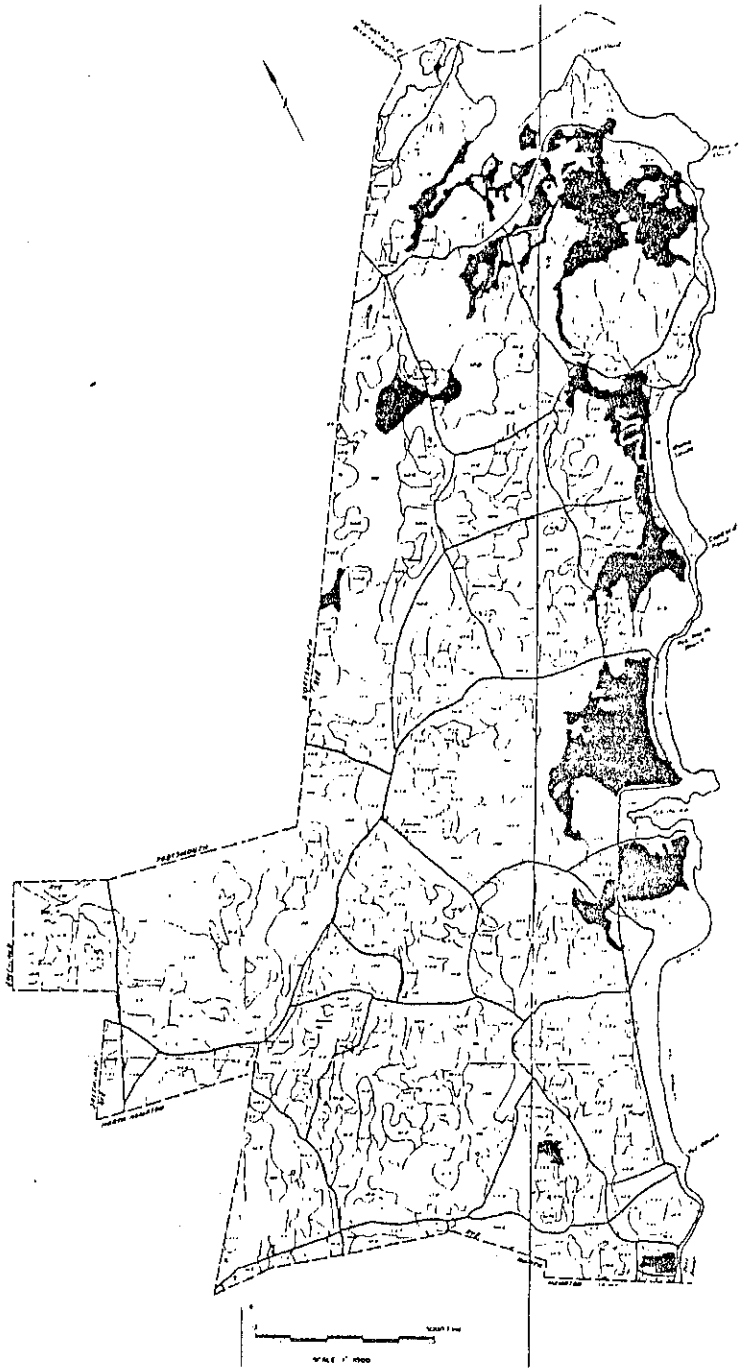


Figure 2 - Land areas of Rye which are either freshwater or tidal marsh. Soils of such areas are continuously flooded or flooded on a daily basis.

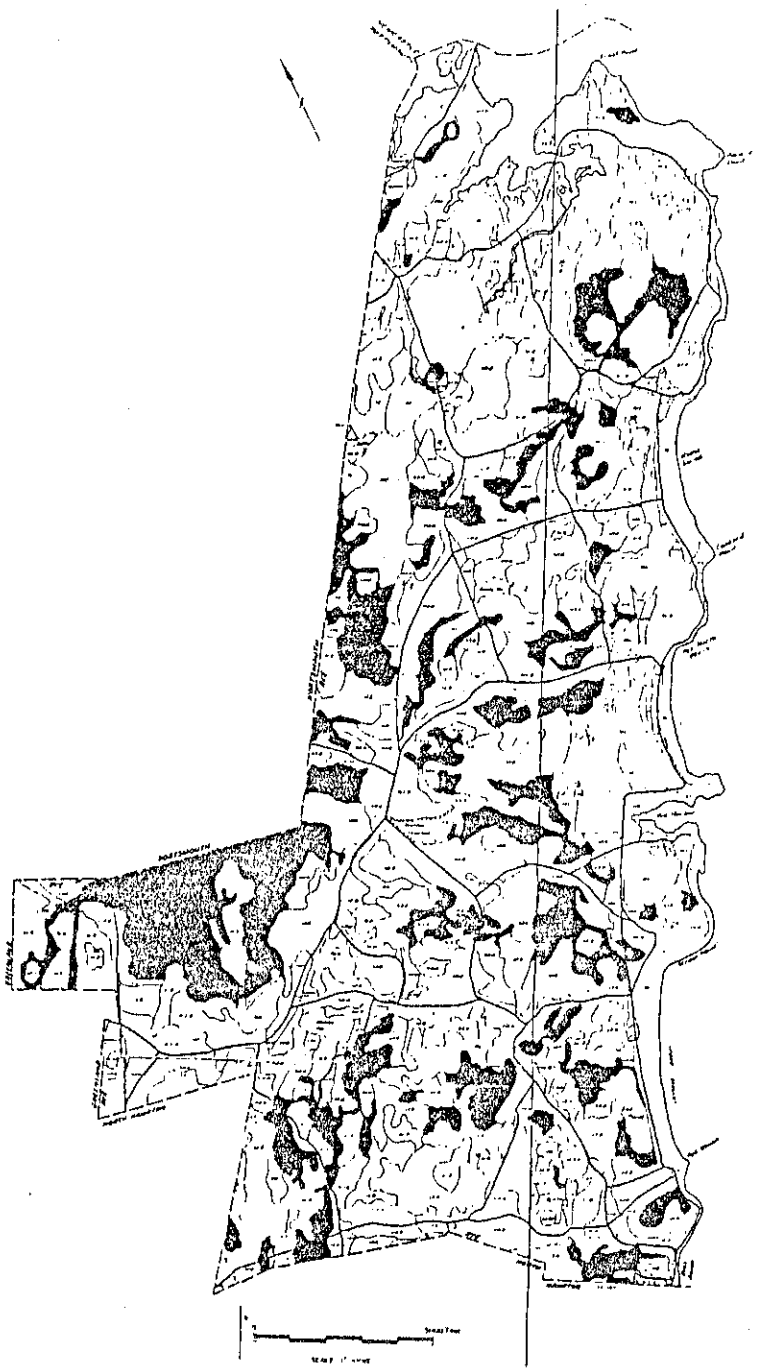


Figure 3 - Land areas of Rye characterized by a continuously high water table. Soils in these areas are generally termed very poorly drained or poorly drained, and may be periodically flooded 12 months a year.

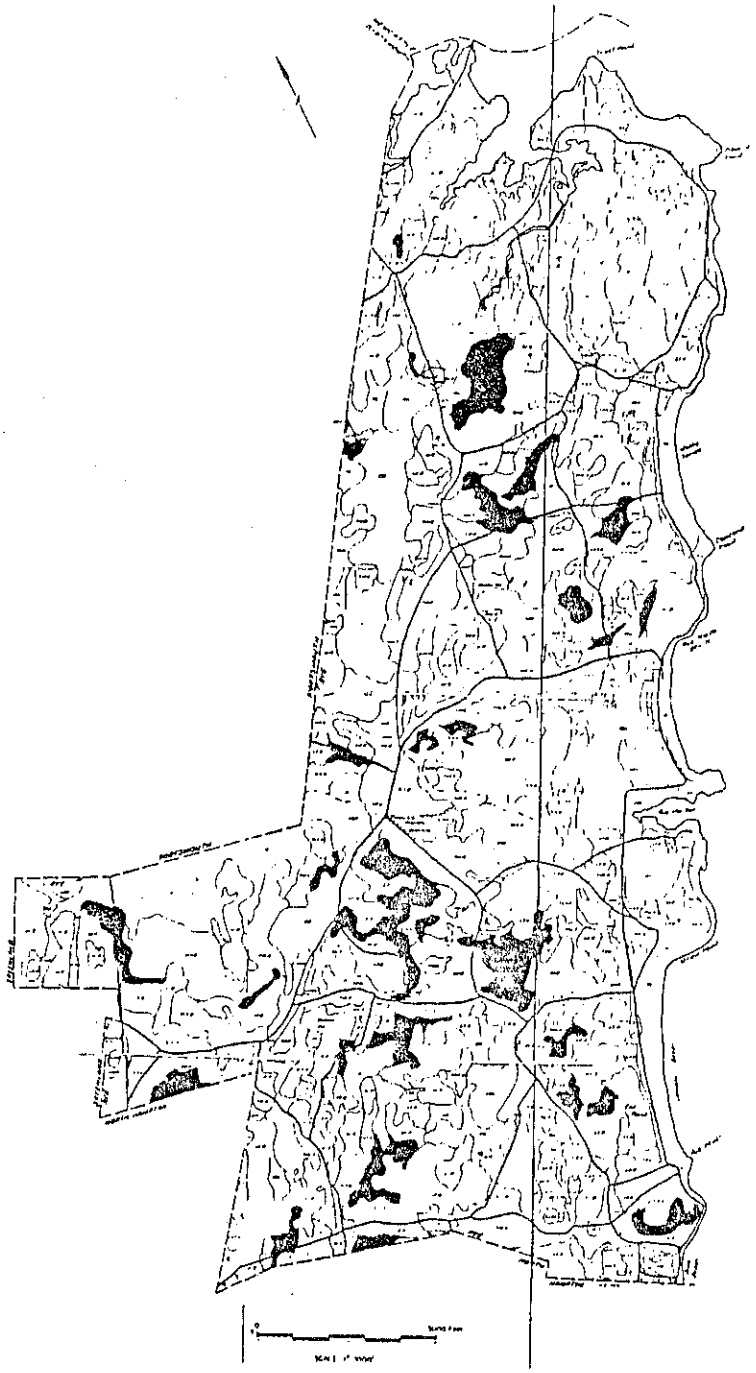


Figure 4 - Land areas of Rye characterized by a seasonal high water table. Soils in these areas are generally termed moderately well drained, and may be flooded for up to 6 months of the calender year.

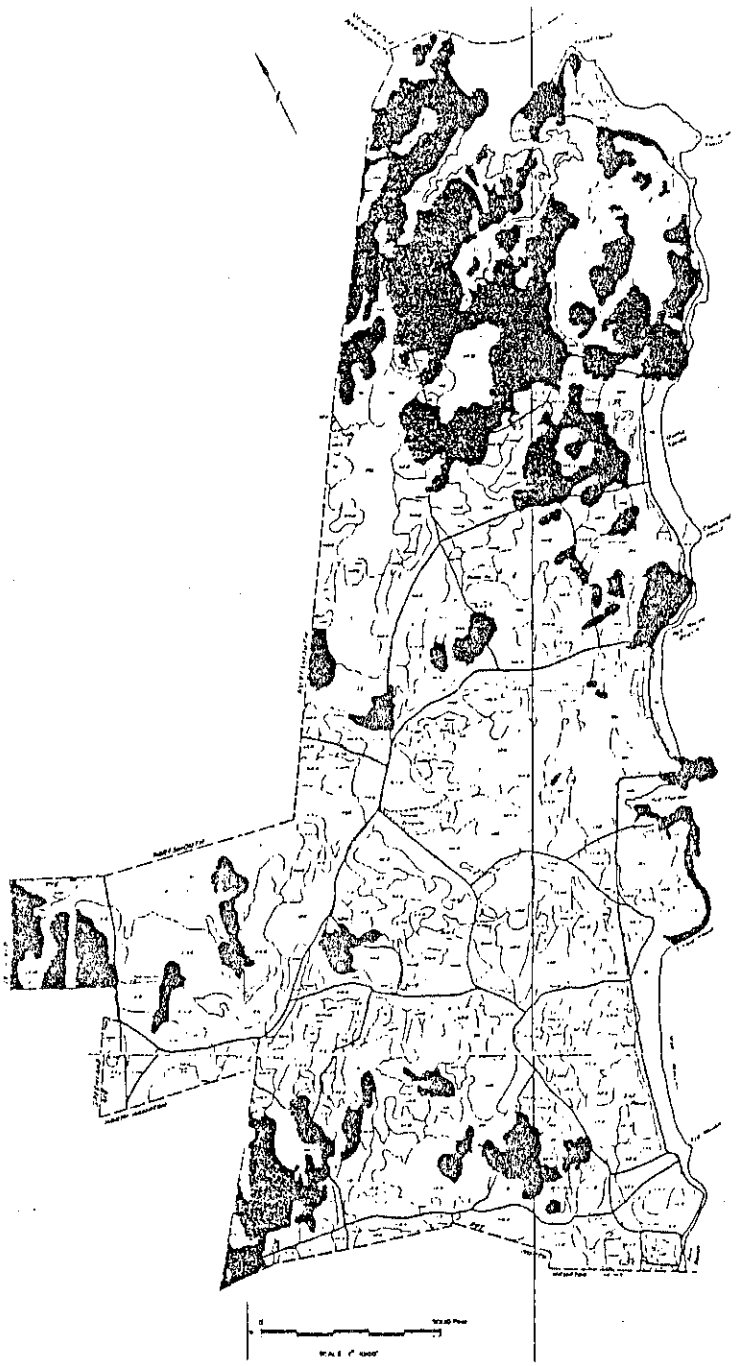


Figure 5 - Land areas of Rye exhibiting shallow bedrock soil conditions. Such soils are generally characterized by bedrock depths of 15 inches or less from soil surface.

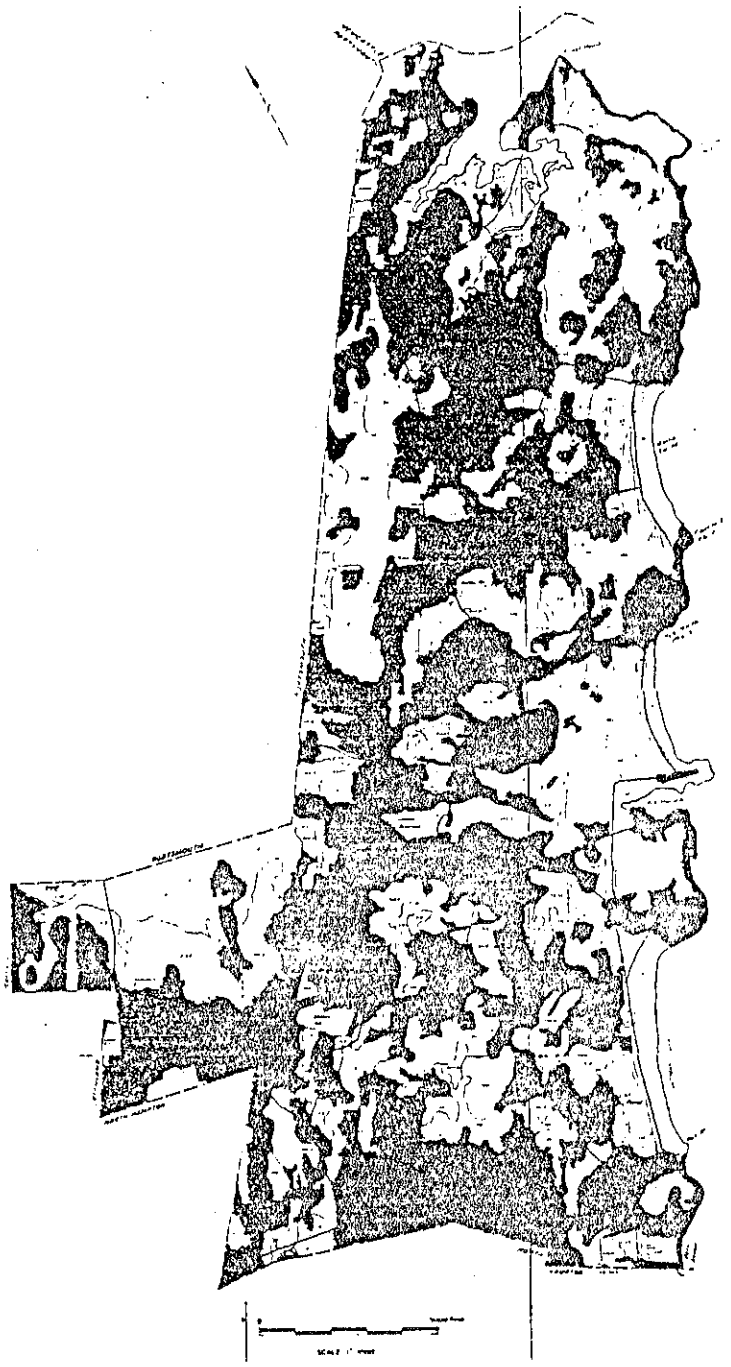


Figure 6 - Land areas of Rye for which there may be excessive slope conditions which would preclude their development. Slopes in excess of 12% are considered undesirable for development.

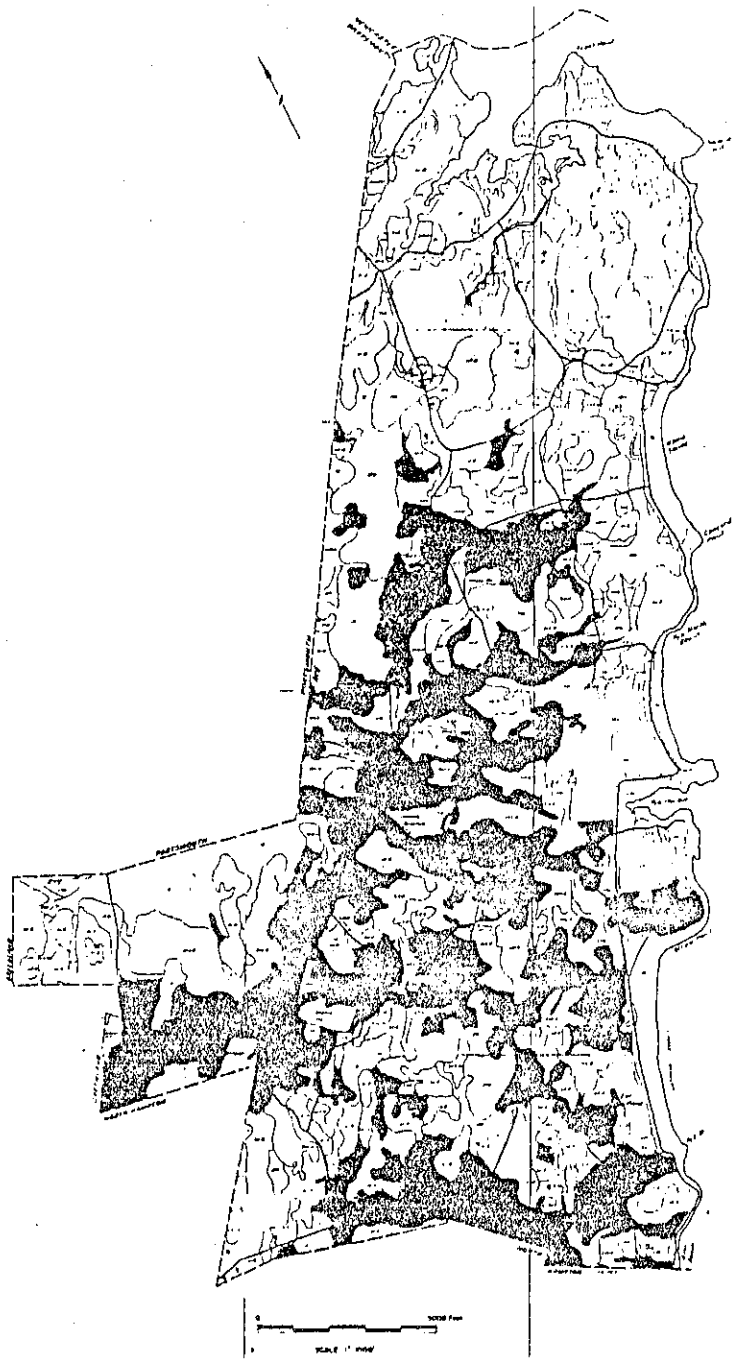


Figure 7 - Land areas of Rye which are potentially suitable for development. See text for major restrictions affecting development.

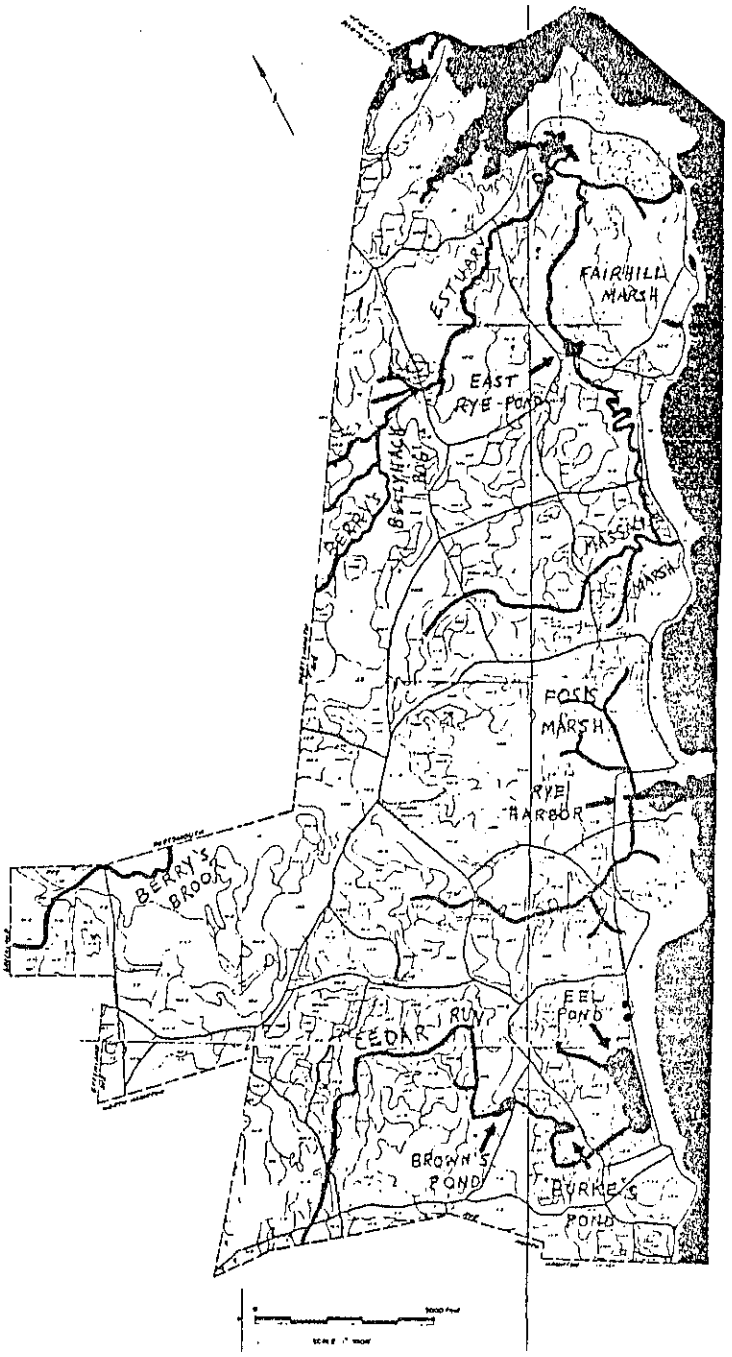


Figure 8 - Major water resources occurring in the Town of Rye. Included are streams, ponds, major tidal marshes, and the Atlantic Ocean boundary.

(1) slope is not greater than 12 percent; (2) the land is not in a designated conservation area (land areas requiring preservation and suitable for preservation are described elsewhere in this report) nor is it populated by endangered plant or animal species; (3) the land must be accessible and cannot be land locked by land unsuitable for development - one cannot build a road through a swamp to get to it; (4) the land cannot be reserved for some other use such as a park, cemetary, previously existing building, Town forest, farm land, prime forest land, etc.; and (5) development will not lead to problems on adjoining lands which the Town is attempting to preserve.

Vegetation

Rye's natural forest vegetation consists of a variety of northern hardwoods and conifers. The distributions of these are shown in Figures 9-16. Exact species composition of areas designated for preservation are given elsewhere in the report. Contrary to popular belief, many of these tree species do not grow exclusively on certain habitat sites, and cannot be used as reliable indicators of soil type, water table height, etc. Only generalized trends exist. White pine (Pinus strobus), the most dominant tree species found in Rye, grows on a multitude of soil types exemplifying a variety of moisture

conditions (Figure 9). It grows on good sites as well as poor sites and is evenly distributed throughout the Town. Eastern hemlock (Tsuga canadensis), Figure 10, is also widely distributed, but is especially prominent in the north end of Town. Red spruce (Picea rubens), Figure 11, is more prominent in the central and southern portions of the Town. Red oak (Quercus rubra), Figure 12, is very broadly distributed in the Town, and may be found growing in seasonally drained swamps as well as on more upland sites. In a broad sense, it does not grow on poorly drained or very poorly drained sites, but due to its intermediate flooding tolerance, is able to persist on moderately well drained sites where seasonal flooding occurs. The distributions of yellow birch (Betula lutea) and sugar maple (Acer saccharum), Figure 13, correspond nearly perfectly with those areas of Town where there is shallow bedrock or where slope may exceed 12 percent. A heavy concentration of yellow birch and sugar maple occurs in the north end of Rye. Red maple (A. rubrum) is particularly plentiful in New Hampshire where it is capable of maintaining a dominant or codominant position over a range of microhabitat sites from dry ridges and southwest slopes to peat bogs and swamps. In Rye, Figure 14, it appears to occur mostly in permanently swampy areas. The distributions of balsam fir (Abies

balsamea) and white ash (Fraxinus americana) in Rye, Figures 15 and 16, are more restricted. Balsam fir occurs on certain lands with poor or very poor drainage, and its distribution bears a resemblance to that for Atlantic white cedar (Chaemaecyparis thyoides) in Rye. White ash occurs on certain lands characterized by a seasonal high water table, reflecting its intermediate tolerance to flooding.

Historical

Figure 17 shows the location of historic mill sites located in the Town of Rye.

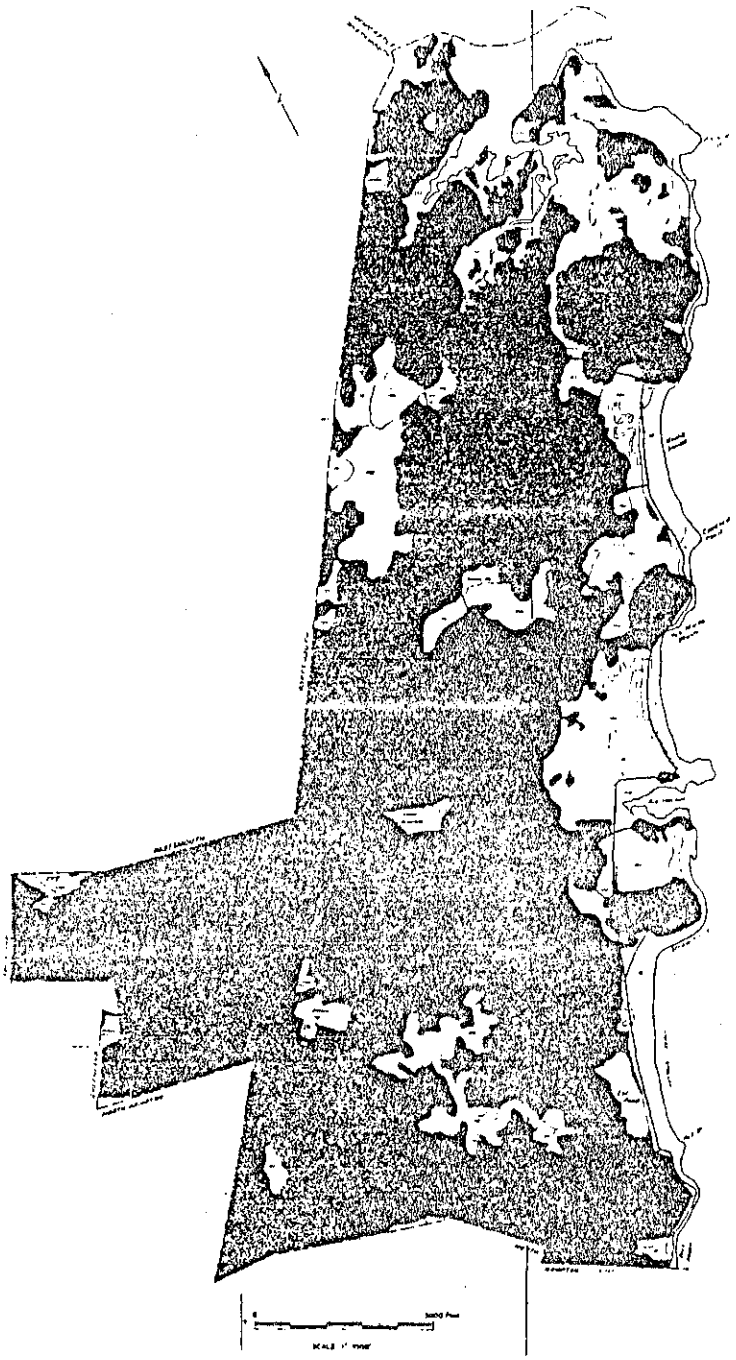


Figure 9 - Land areas of Rye characterized by white pine (Pinus strobus) growth.

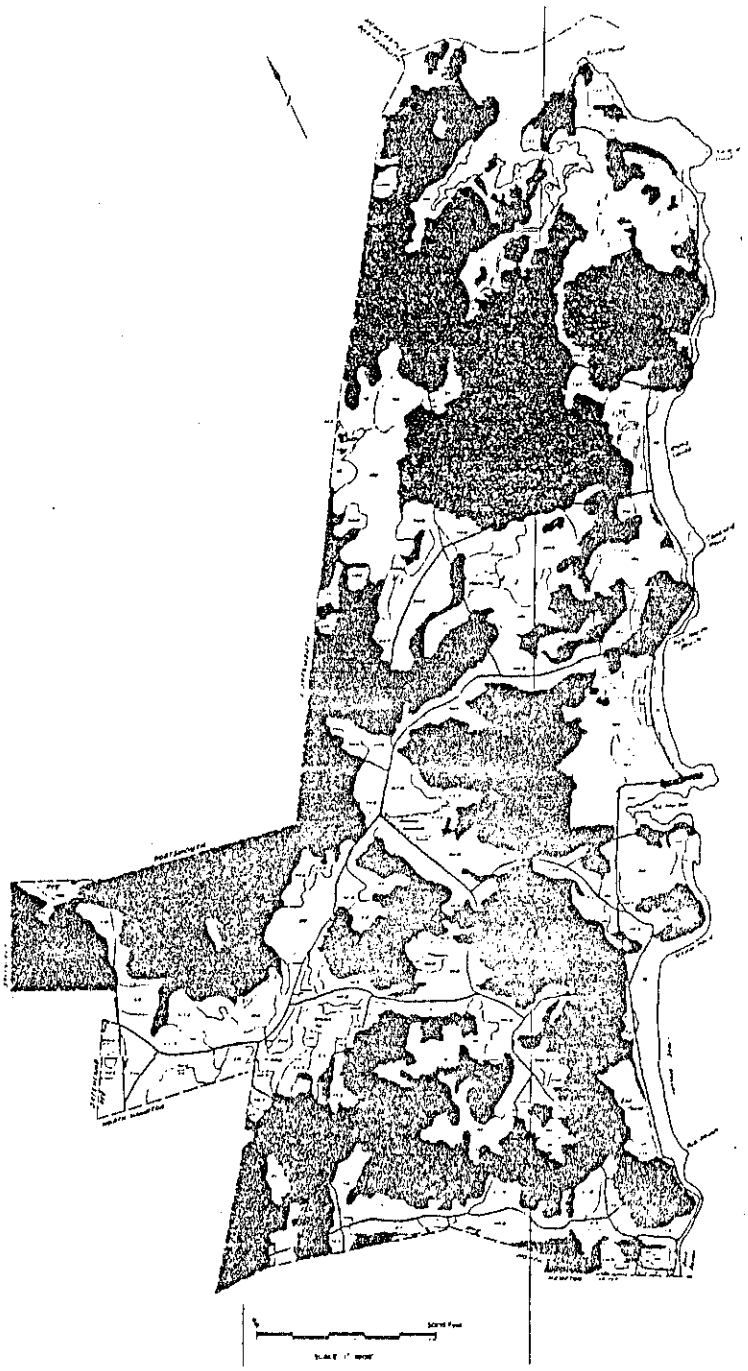


Figure 10 - Land areas of Rye characterized by eastern hemlock (Tsuga canadensis) growth.

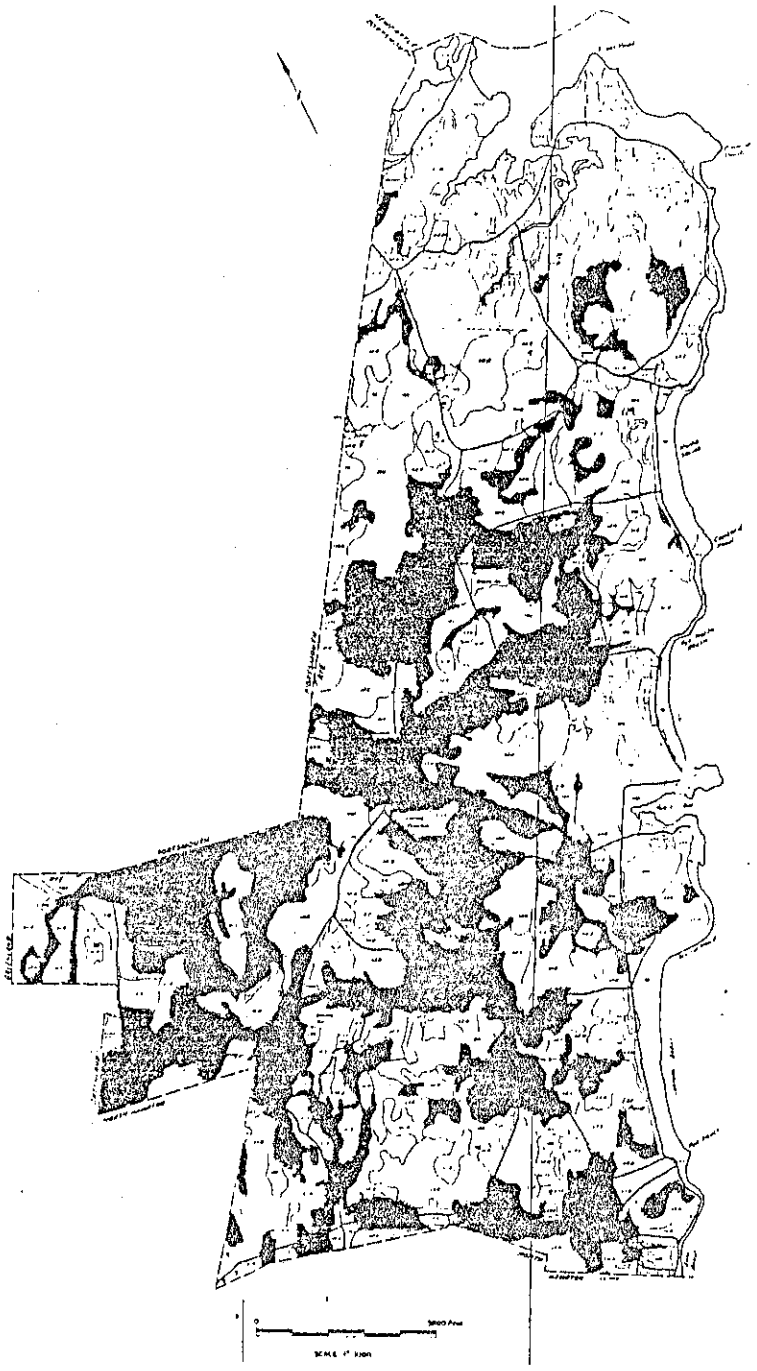


Figure 11 - Land areas of Rye characterized by red spruce (Picea rubens) growth.

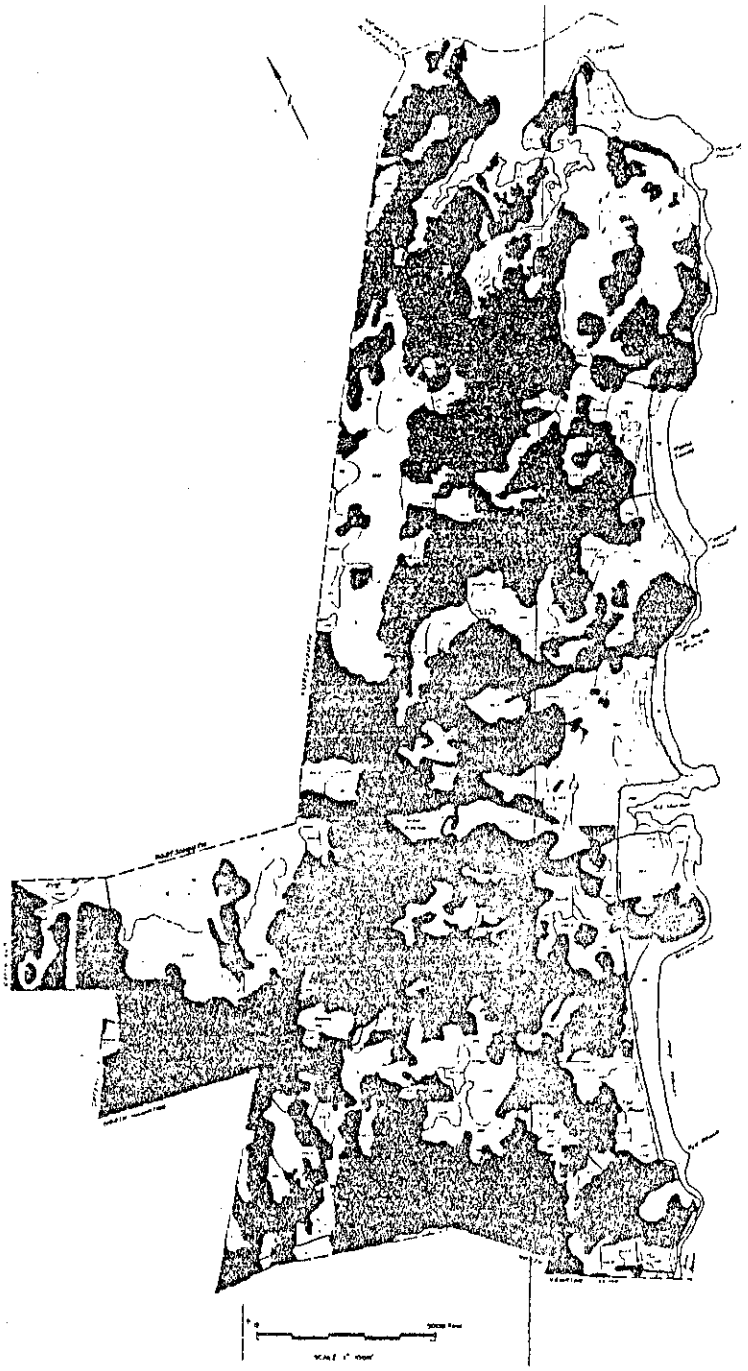


Figure 12 - Land areas of Rye characterized by red oak (Quercus rubra) growth.

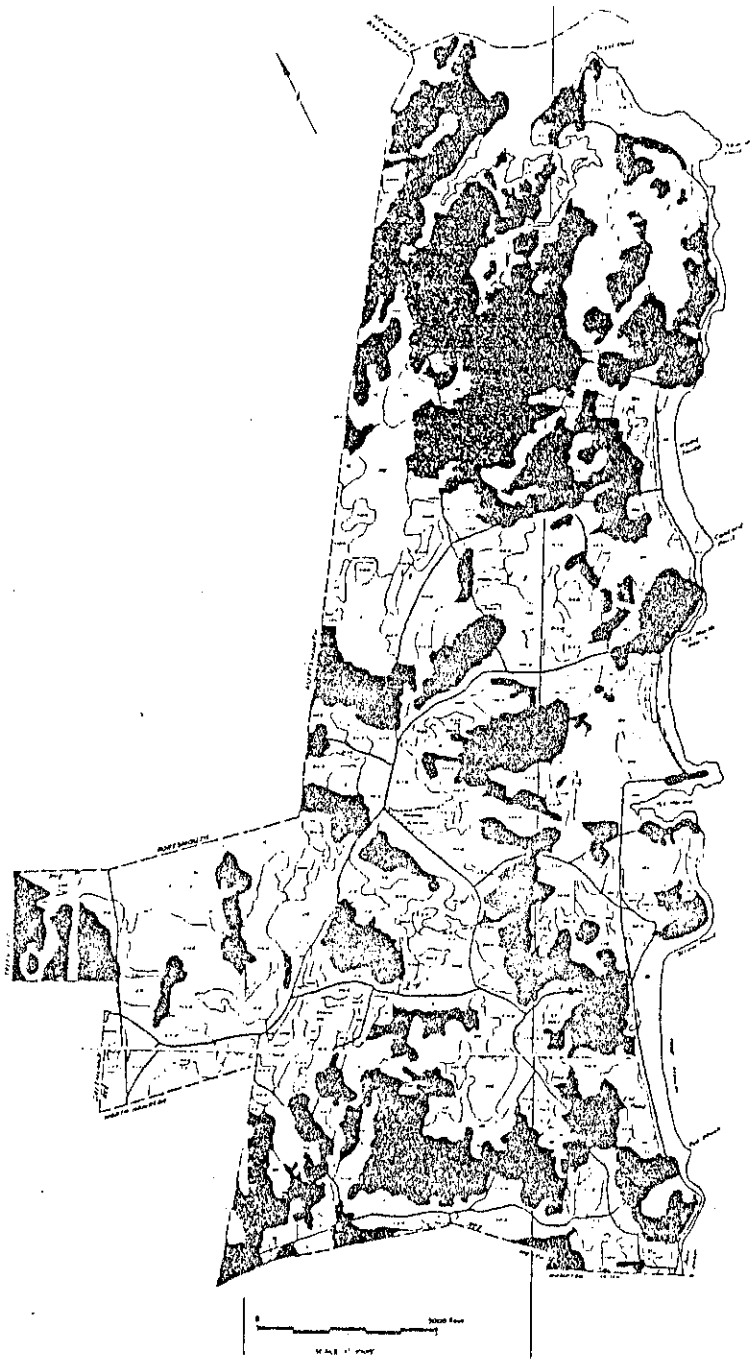


Figure 13 - Land areas of Rye characterized by yellow birch (Betula lutea) or sugar maple (Acer saccharum) growth.

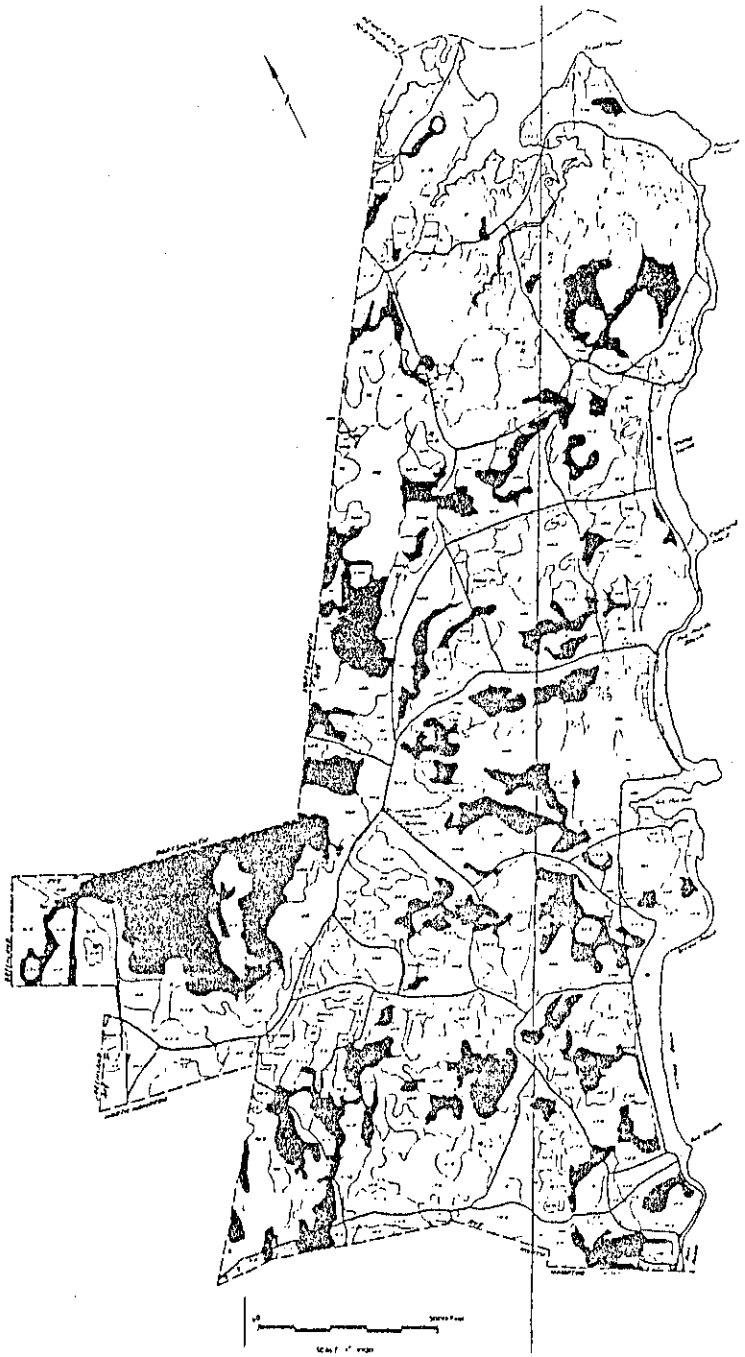


Figure 14 - Land areas of Rye characterized by red maple (Acer rubrum) growth.

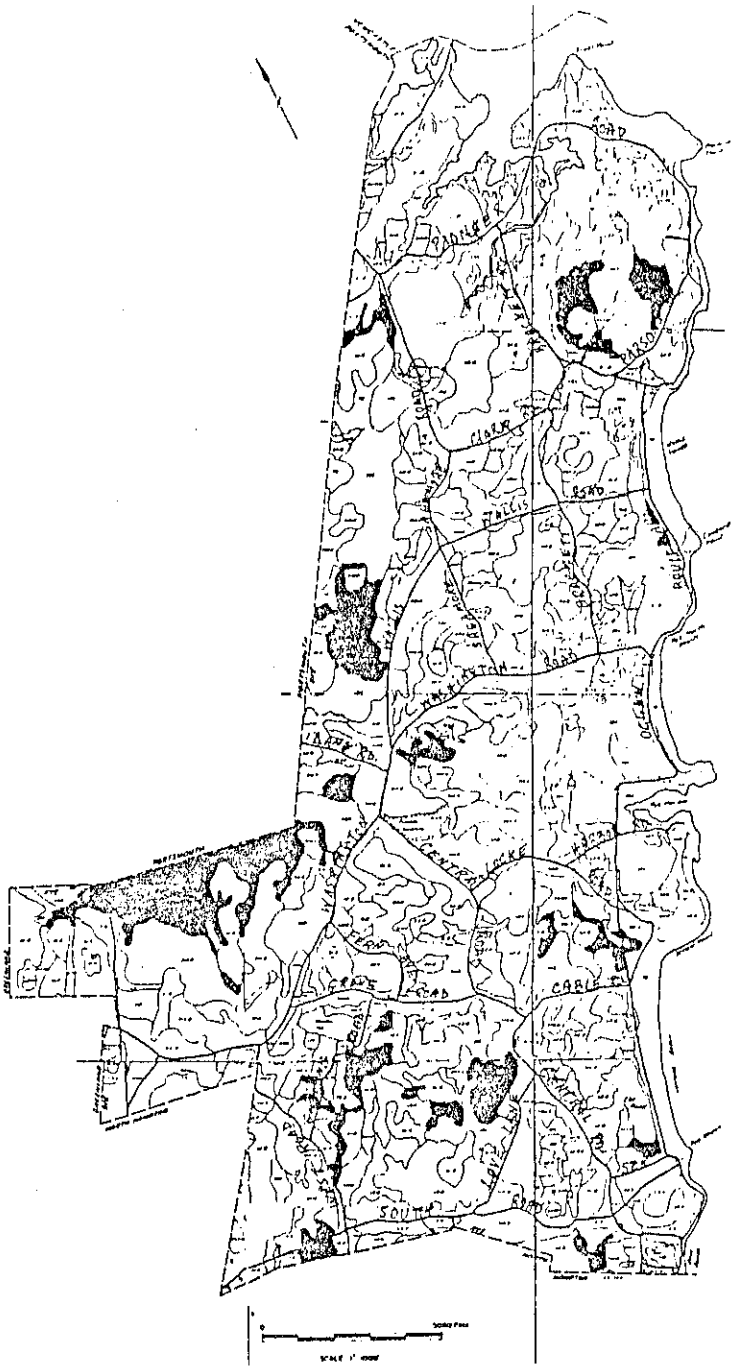


Figure 15 - Land areas of Rye characterized by balsam fir (Abies balsamea) growth.

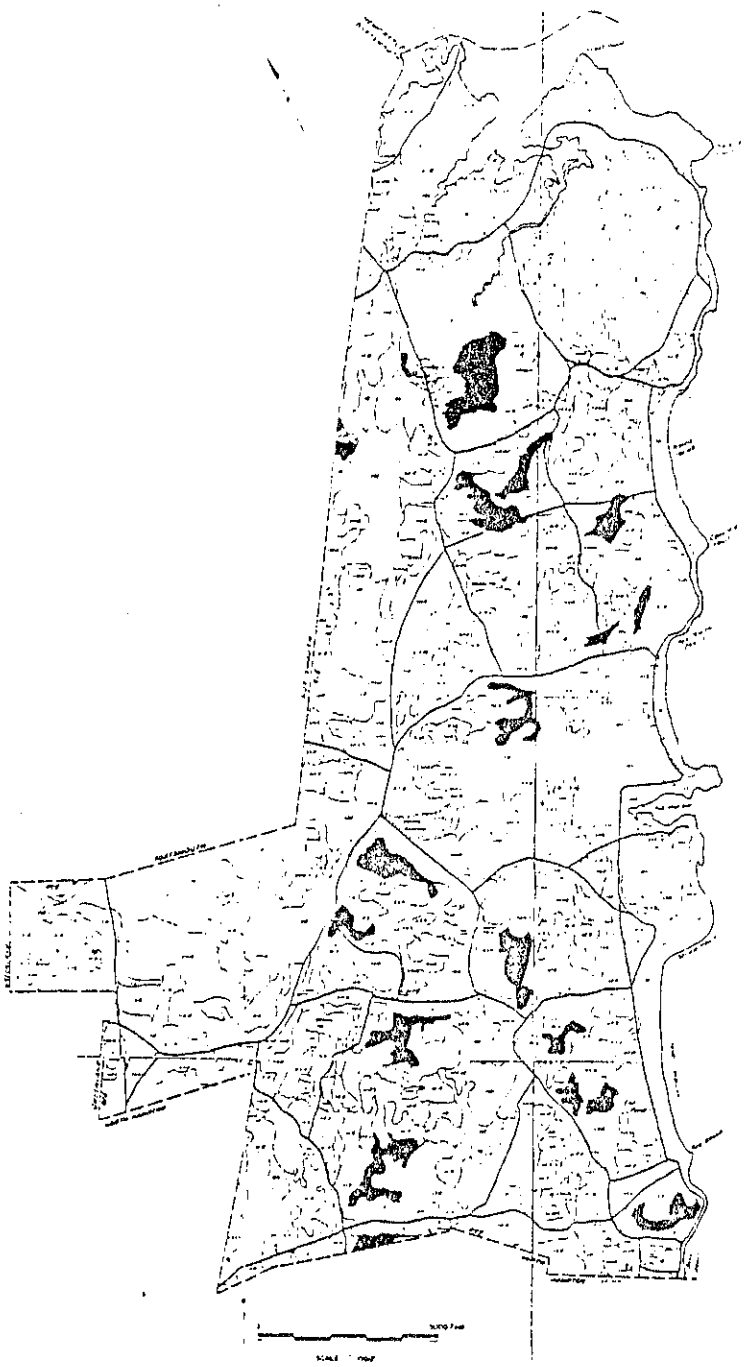


Figure 16 - Land areas of Rye characterized by white ash (Fraxinus americana) growth.

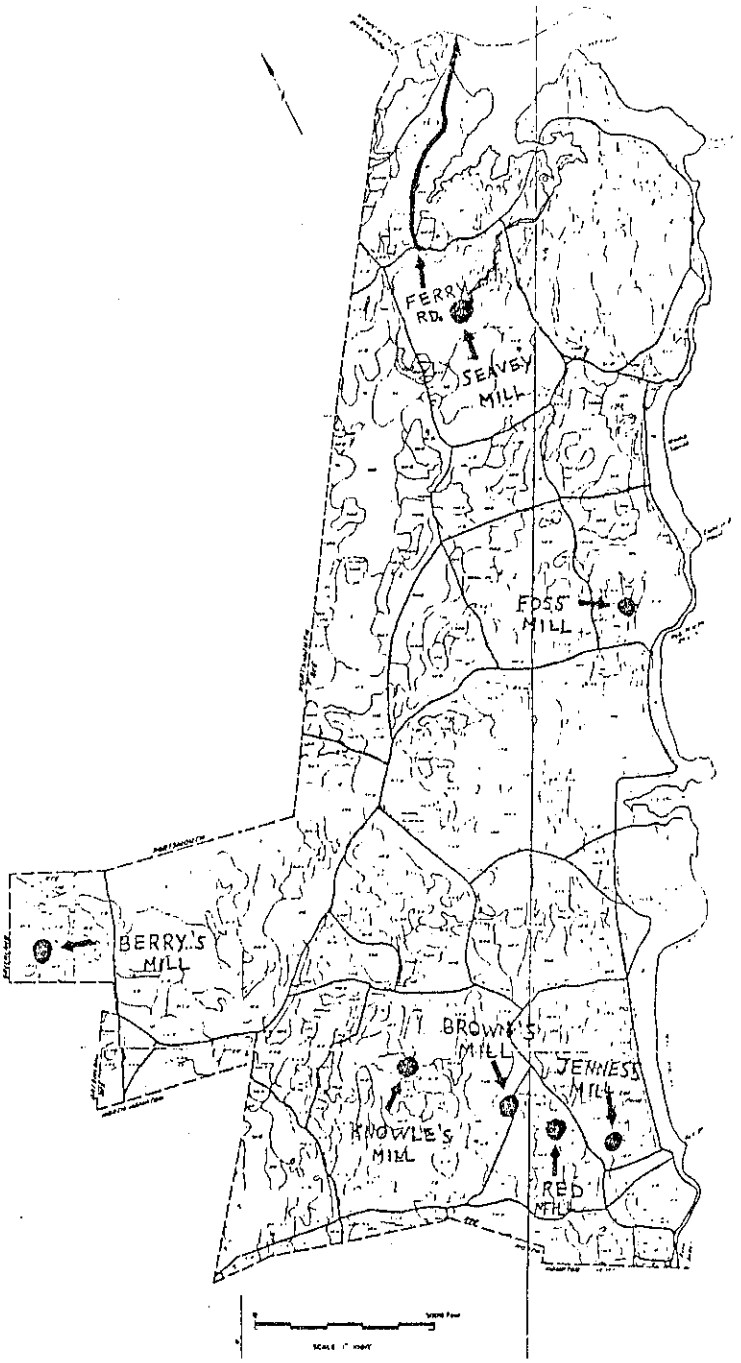


Figure 17 - Historic mill sites located in the Town of Rye. Also shown is the location of Ferry Road, an historic road dating back to the Colonial Period.

References

Annonmous. 1975. Soil Survey Report: Rye, New Hampshire. USDA Soil Conservation Service, 41 p.

Coppelman, G.G., S.A.L. Pilgrim and D.M. Peschel. 1978. Agriculture, forest and related land use in New Hampshire, 1952 to 1975. New Hampshire Agr. Expt. Sta. Research Report No. 64, 97 p.

Past and Present Efforts of the Rye Conservation Commission

The Rye Conservation Commission was founded in 1965, and charged with the task of identifying Rye lands needing protection. Using a modest Conservation Fund set aside at various annual Town Meetings, the Commission has been able to provide protection for several tracts of land in Rye. The Commission has purchased lands were possible (generally the present price [1] is prohibitive) and has taken other legal action to protect endangered lands where appropriate. In addition, various Rye citizens have donated lands to the Rye Conservation Commission for protection. At present, approximately 130 acres of Rye land is afforded protection by the Conservation Commission. In 1977, the Commission was successful in promoting and in achieving passage of the Wetland Zoning Ordinance.[2] Passage of this landmark zoning ordinance, which presently offers protection from dredging, filling, and construction for approximately 38% of Rye's lands, took nearly two years of research, planning, and up-hill promotion by the Conservation Commission working with the Rye Planning Board.

---

1 Prior to a State mandated Town lands re-evaluation in 1971, most saltmarsh lands in Rye could be purchased for approximately $50 an acre. After re-evaluation, prices of saltmarsh land escalated to $300-1000 an acre depending upon proximity to a road. With a Town appropriation of only $5000 a year, the Commission could buy only 5 acres of roadside saltmarsh. Prior to re-evaluation, the same amount of money would have purchased as much as 100 acres of saltmarsh land.

[2] State law RSA 483, "Dredge and Fill", protects coastal tidal marshes from disturbance. The authority of the Rye Wetland Zoning Ordinance is presumed to exceed that of RSA 483. In instances where a variance might be granted under State law, persons wishing to dredge or fill a Rye tidal marsh would also have to obtain a variance under the Rye Wetland Zoning Ordinance.

Present land holdings of the Conservation Commission include: (1) ¼ ownership in the 71 acre Foss Marsh located off of Ocean Boulevard to the rear of Foss Beach, (2) ownership of Massacre Marsh located off of Brackett Road (described in a later section of this report), (3) ownership of a part of East Rye Pond (5 acres) located at the corner of Brackett and Parsons Roads, (4) two acres of marsh (former Drake property) located off of Ocean Boulevard near Foss Marsh, (5) two acres of marsh and forest grove known as Ivy Brown's Grove located at the corner of Locke Road and Ocean Boulevard, (6) five acres of marshland donated by Ralph and Helen Brown located off of Pioneer Road, and (7) a 100 foot street frontage lot located on Huntervale Road (off Cable Road). Nearly all of the Conservation Commission holdings involve wetlands. Much greater expense of upland forested areas versus wetlands coupled with far fewer donations of these lands, has resulted in this pattern.

Activities of the Conservation Commission in 1977 attest to its commitment to wetlands preservation. In

that year, the Conservation Commission "conducted 17 on-site inspections of development proposals involving wetlands, and participated in two coastal zone management hearings". It assisted several State and Federal agencies including the Water Resources Board, the Coastal Zone Management Office, and the U.S. Army Corps of Engineers concerning socio-economic impacts of dredging Rye Harbor.

At the present time, the Conservation Commission is concerned with further protecting its current land holdings, acquiring or establishing protection for forested tracts of land requiring protection, providing for preservation of certain historic sites, and in correcting various abuses of the current Wetlands Zoning Ordinance or other environmental abuses. The Conservation Commission would very much like to acquire the following pieces of land: (1) a parcel owned by Mrs. Emily Gray, bordering East Rye Pond, (2) remaining ownership in Foss Marsh, and (3) a parcel of land owned by Mrs. Analesa MacLeod, bordering the Massacre Marsh woodlot. The Conservation Commission is also interested in securing permanent protection for certain parcels of land having historical significance for the Town of Rye. These include various old mill sites (Jenness Mill, Berry's Mill, and Seavey Mill) and Ferry Road (an old Colonial road accessable off of Pioneer

Road). At the present time, Foss Mill is afforded partial protection as part is included in the Massacre Marsh site.

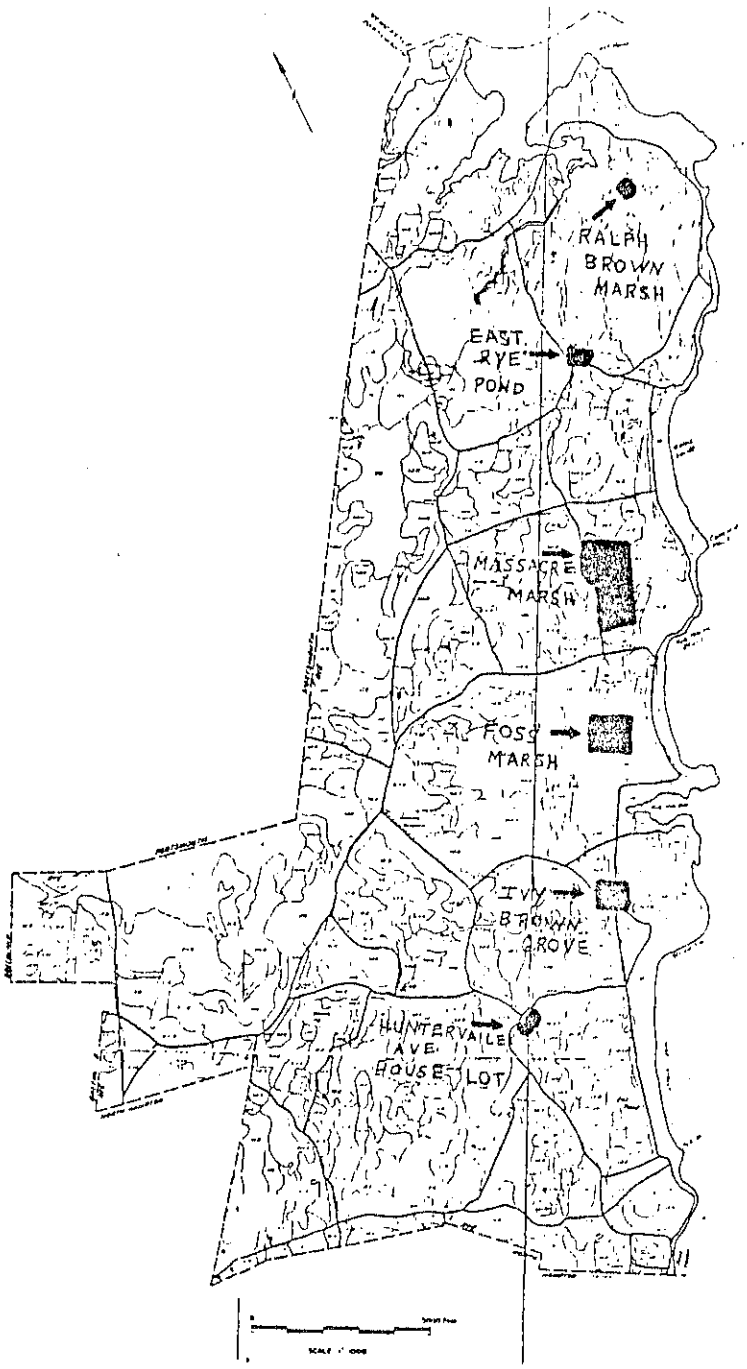


Figure 1 - Location of lands owned by the Rye Conservation Commission.

Conservation Abuses

(1 & 2) Abandoned single-dwelling structure located on Ocean Boulevard is constructed atop saltmarsh fill. Although such structures erected on dredged and filled tidal marshes are in violation of the Rye Wetlands Zoning Ordinance, no efforts are being made to remove abandoned structures such as these. As shown in #2, further efforts to fill in around the building are being made.

(3) A variance to the Wetlands Ordinance was granted to fill this tidal marsh, allowing for construction of this new restaurant located on Ocean Boulevard.

(4) Stakes have been driven in along the edges of this saltmarsh ditch in order to stabilize the house to the rear. The location is off ~~Washington~~ Wallis Road near Ocean Boulevard.

(5-8) An abandoned quarry located off Wentworth Road is the sight of a non-designated dump. Members of the Conservation Commission have been repeatedly told by the owner that the trash at the site has been removed and the area cleaned up, only to find that in fact it has not.

(7-8) The quarry lake constitutes a health hazard, safty hazard (particularly young children), and is an unsightly blight on the Town. Abandoned refrigerators, tires, etc. float in the water and muck. While visiting the site, I spotted what appeared to be a very old tombstone which had

been trucked in along with other debris from a construction site. This debris had been dumped over the edge of the quarry wall into the water.

(9) The appearance of Lafayette Road in Rye is rapidly changing with little or no planning or control.

(10) Located off of Lafayette Road is a trailer park where serious legal violations are occurring.

(11-18) In an effort to expand the trailer park, new trailer sites and septic tanks are being installed. No building permits have been issued for any of this work.

(12) Septic tanks have been placed squarely in the middle of a streambed flowing into Berry's Brook.

(13-14) Stream water is seen flowing through the newly installed septic tanks. This secret operation is (a) unpermitted, (b) in violation of the Wetlands Ordinance, and (c) is in violation of several health codes. It is the most flagrant and serious violation witnessed anywhere in Rye.

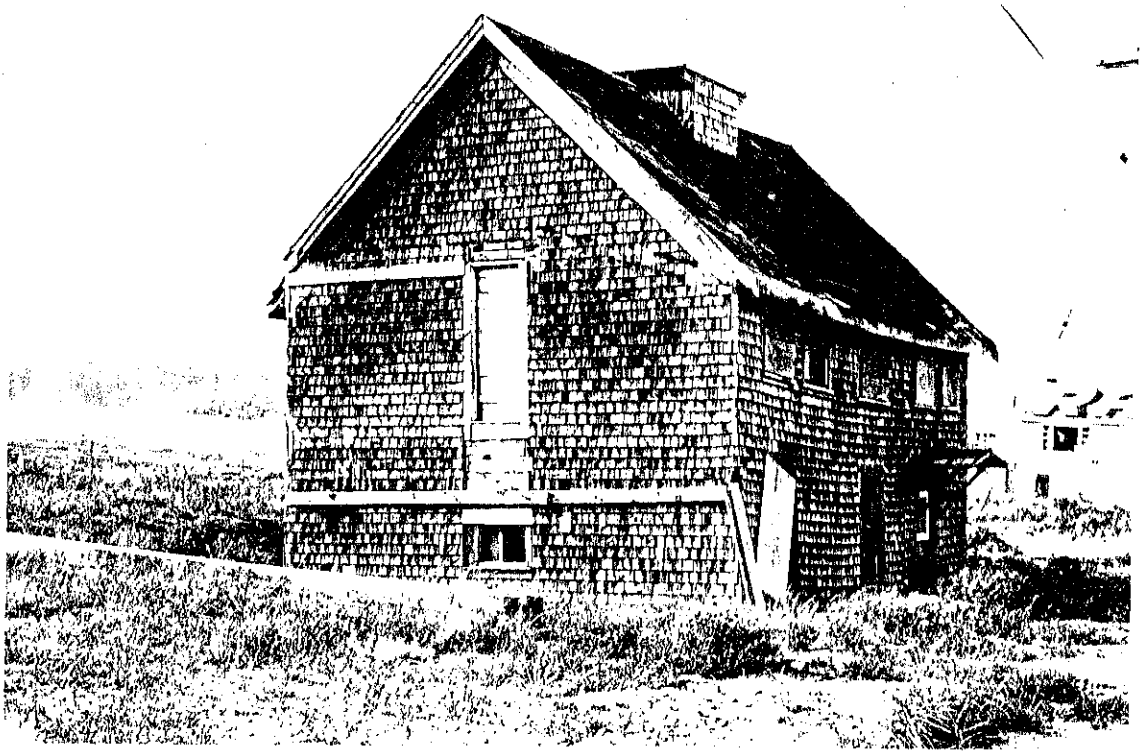
(15-16) Further back from Lafayette Road, deep in the woods, the trailer park developer is creating new trailer sites with sewage hook-ups. Creation of these sites is both without Town permit, and the sewage will enter the septic system shown and described above.

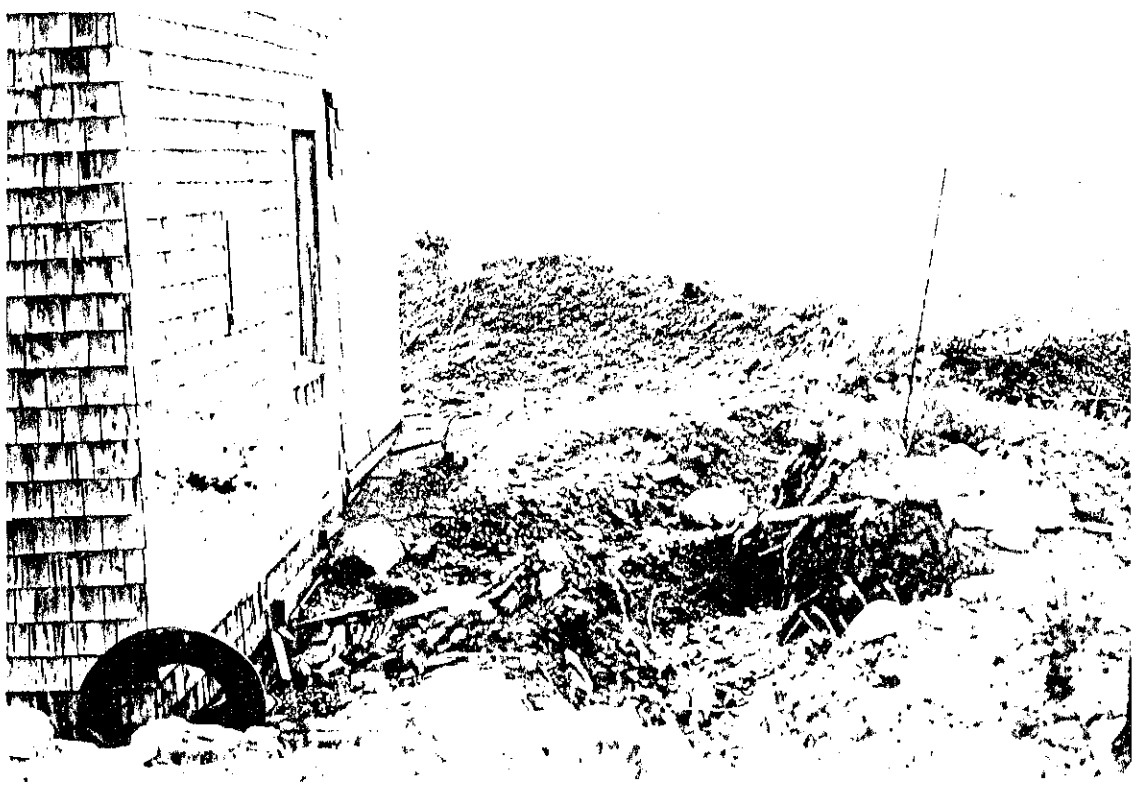
(17-18) Other portions of the streambed system crossing the trailer park property are being filled with debris in order to establish more trailer sites.

(19) Numerous elms died around Town during the summer of 1978. Several people charged the trees were allowed to die when chemicals, spray equipment, and injection equipment existed for treating the trees.

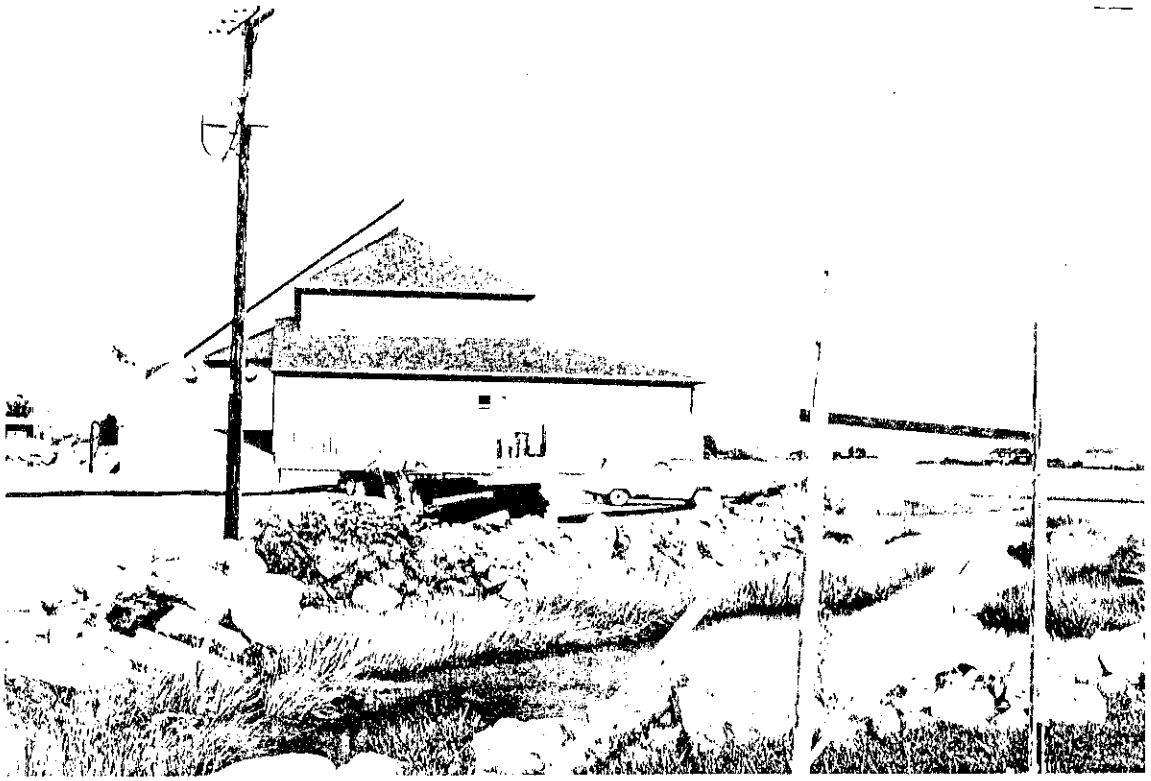
(20) Careless attitudes inflicted on the environment are evident all over Town. One of these is an area which was clear-cut off of Lafayette Road. Large tree trunk stumps were left standing all over the place rather than cutting the stumps off flush with the ground.

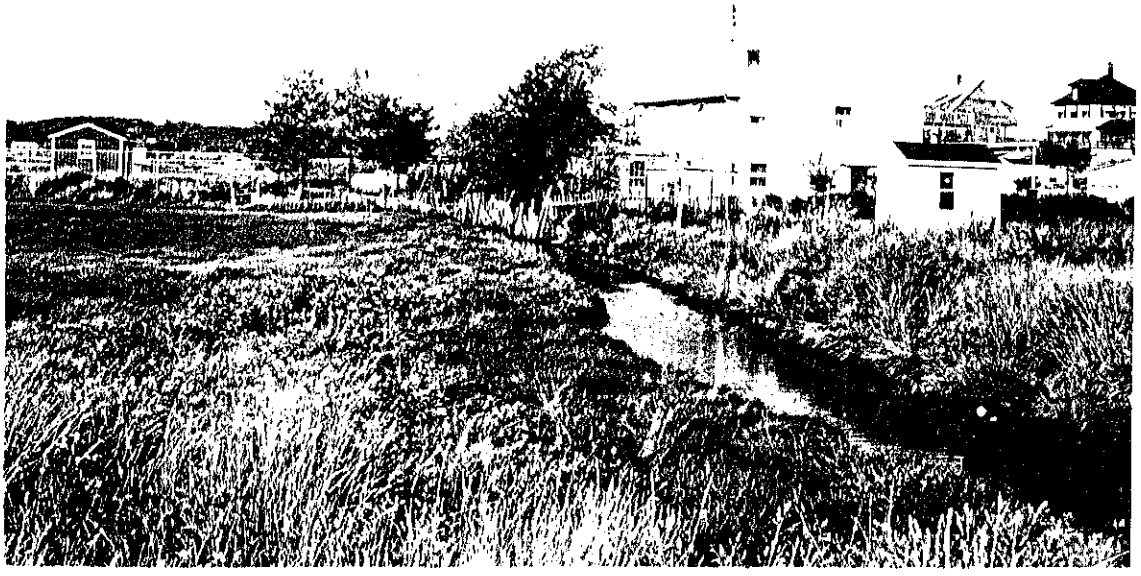
CONSERVATION ABUSES





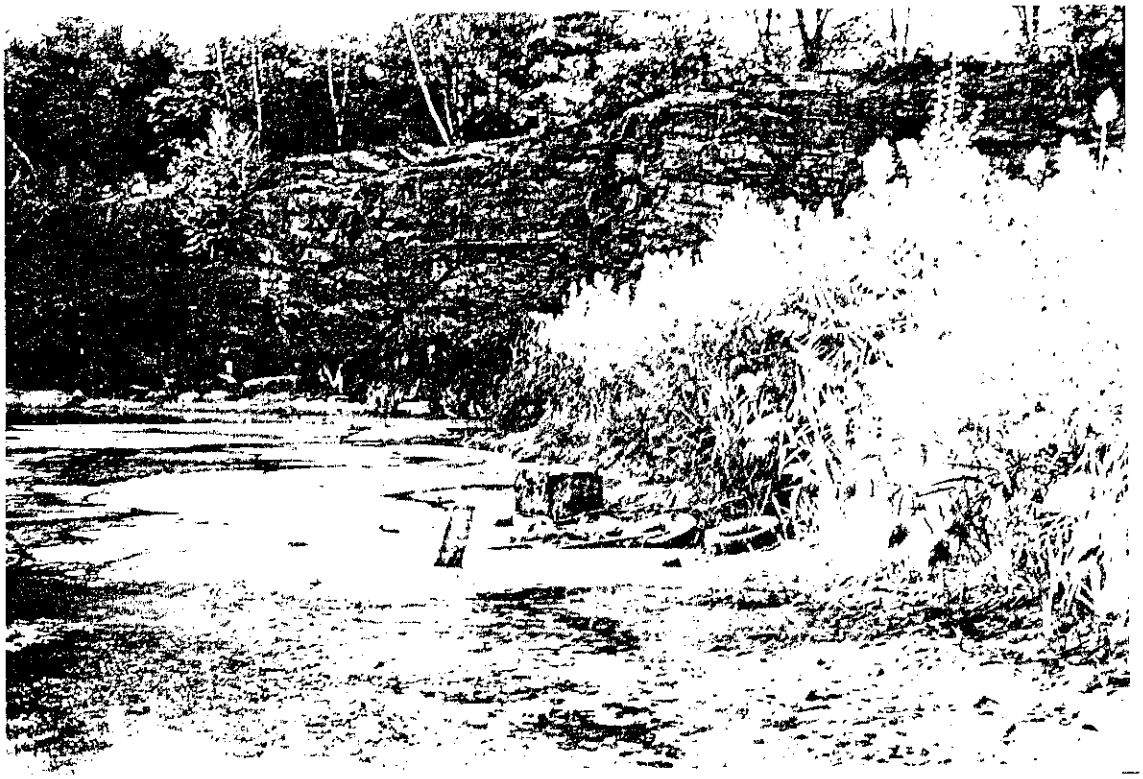
CONSERVATION ABUSES

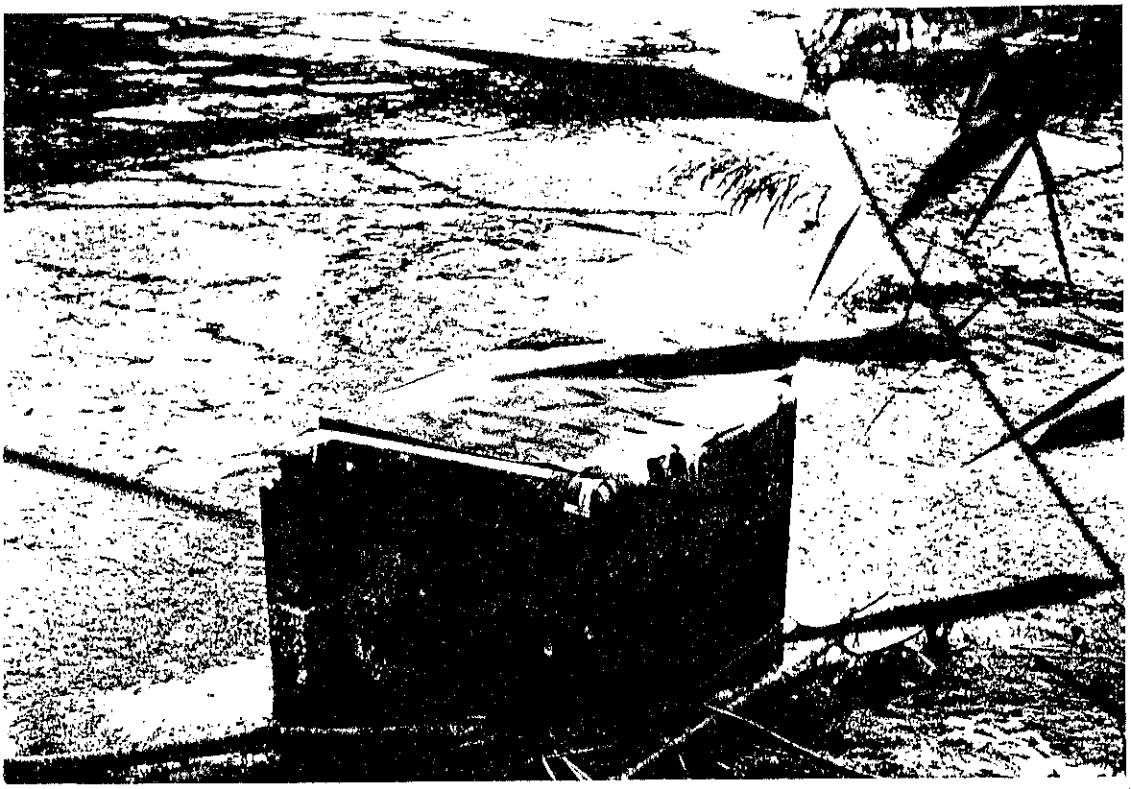




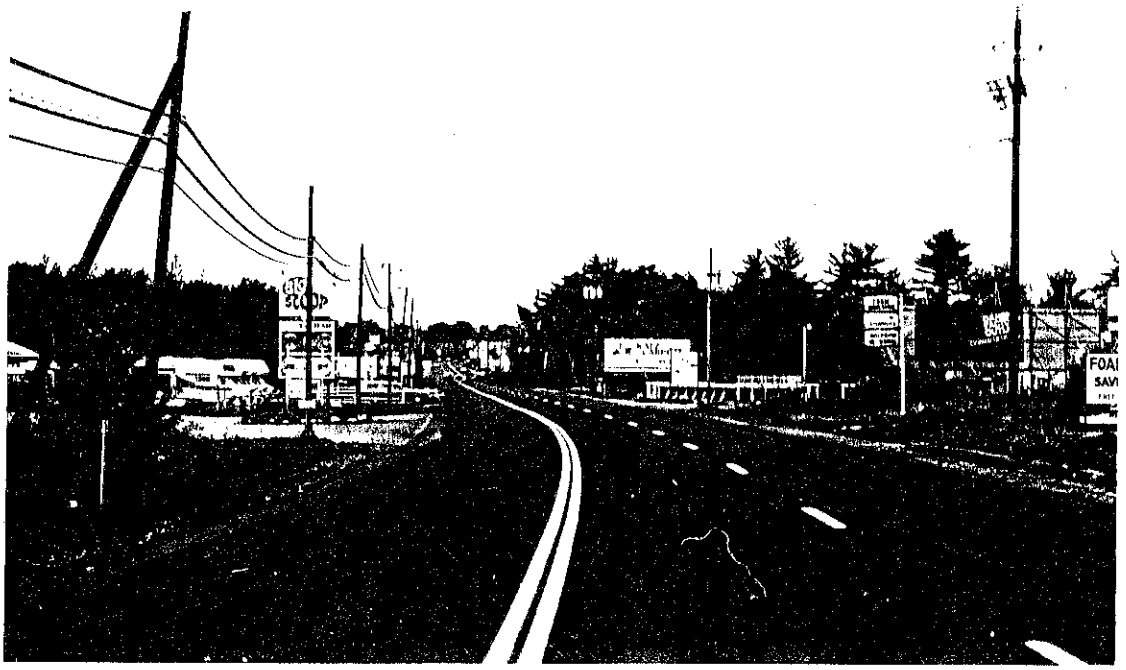
CONSERVATION ABUSES

CONSERVATION ABUSES

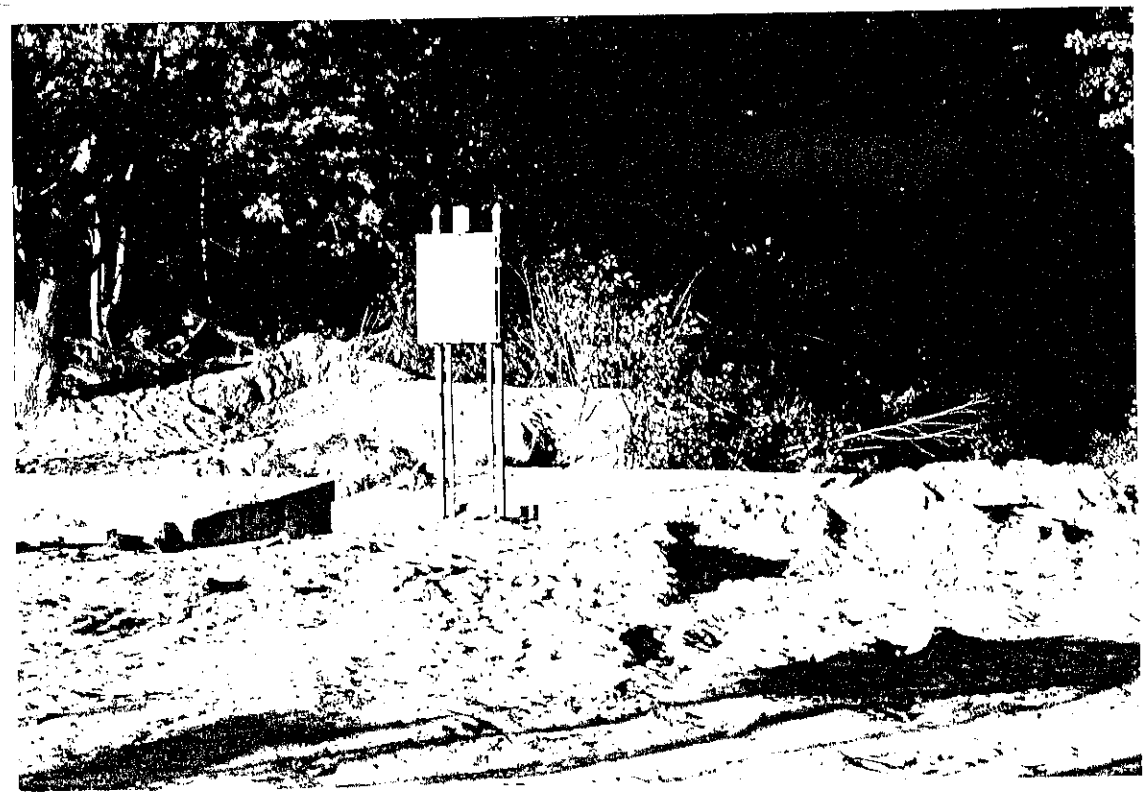


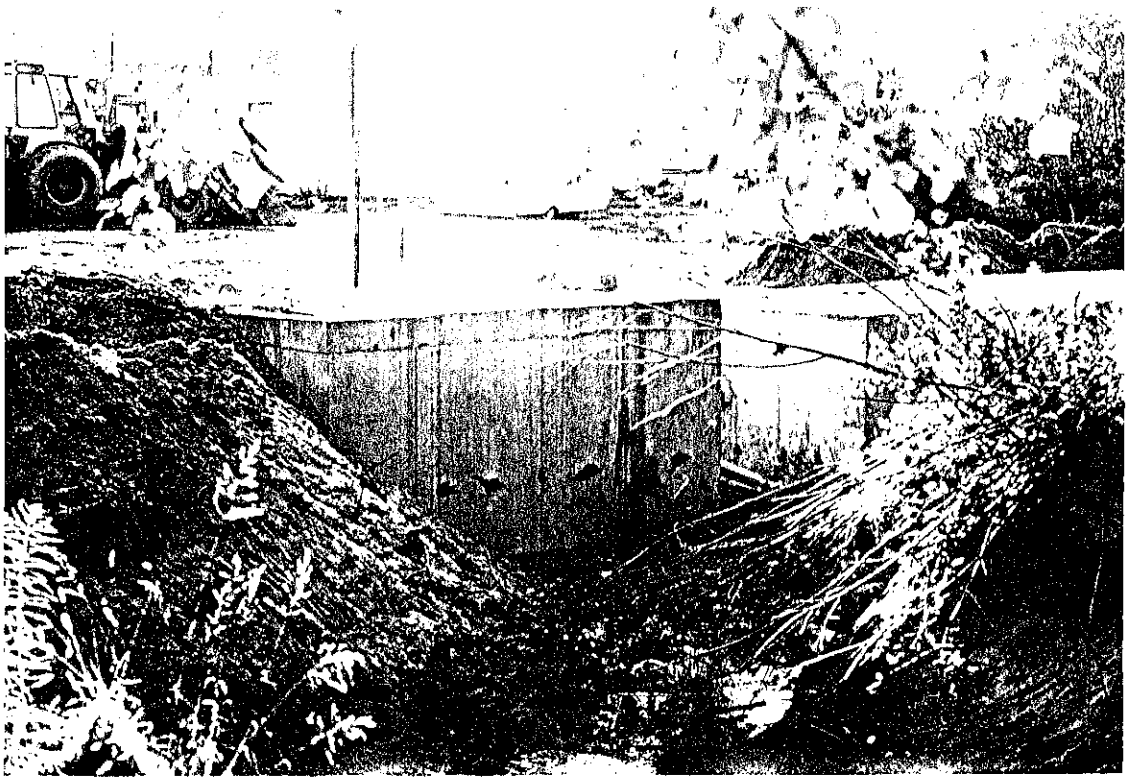


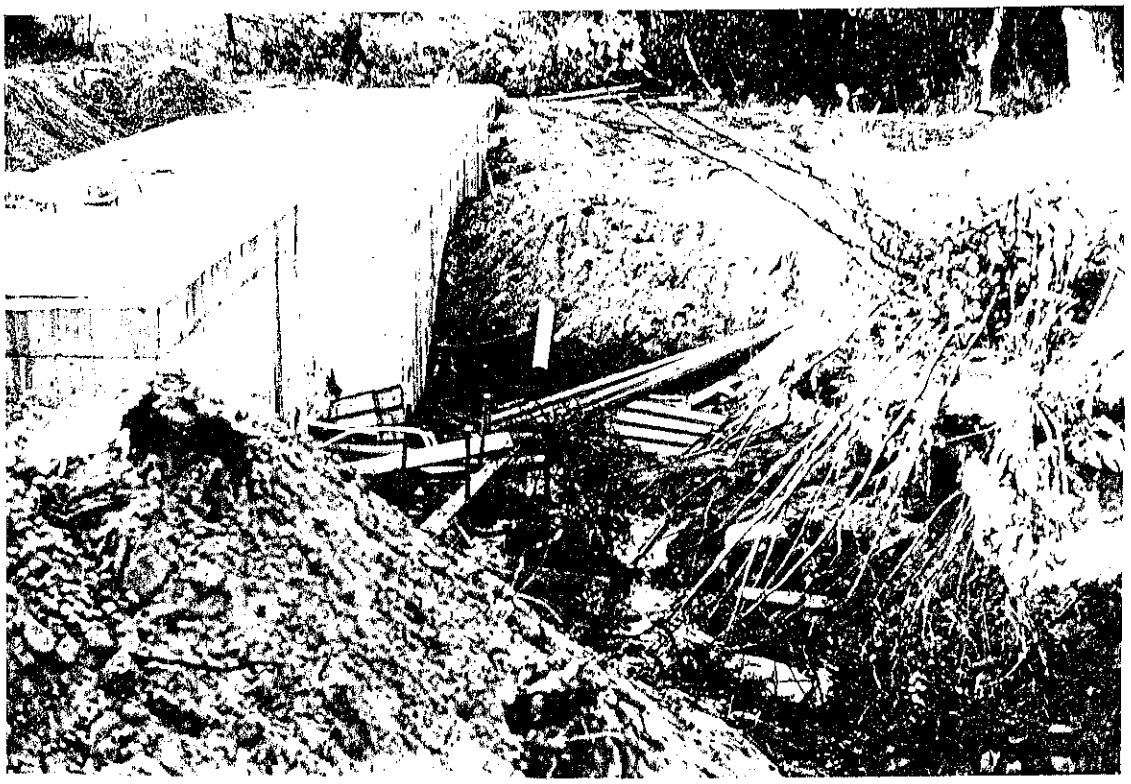
CONSERVATION ABUSES

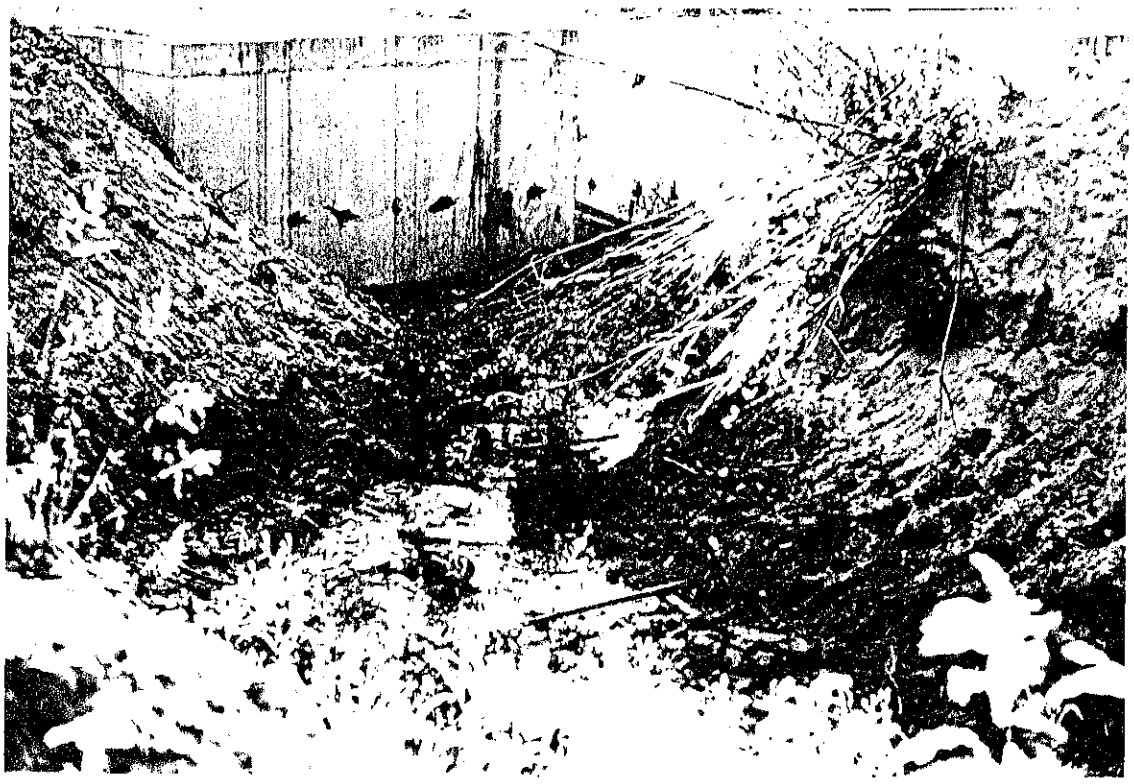


CONSERVATION ABUSES



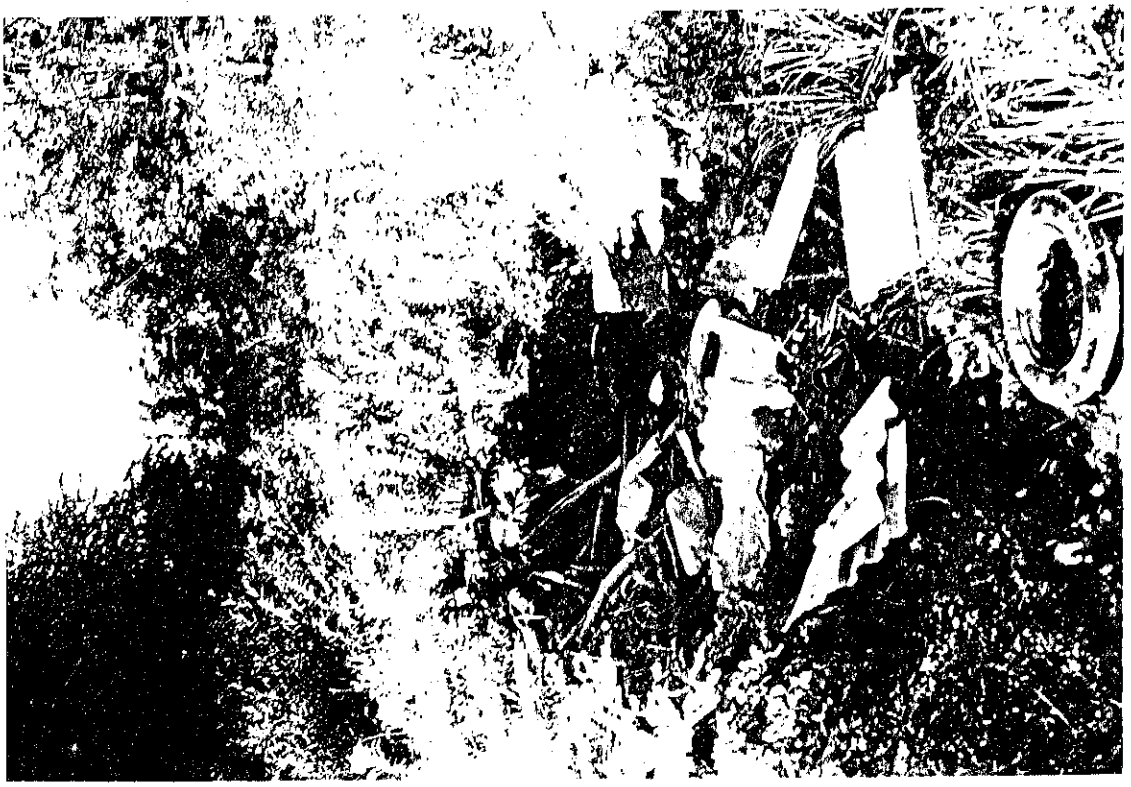






CONSERVATION ABUSES

CONSERVATION ABUSES



CONSERVATION ABUSES

Massacre Marsh

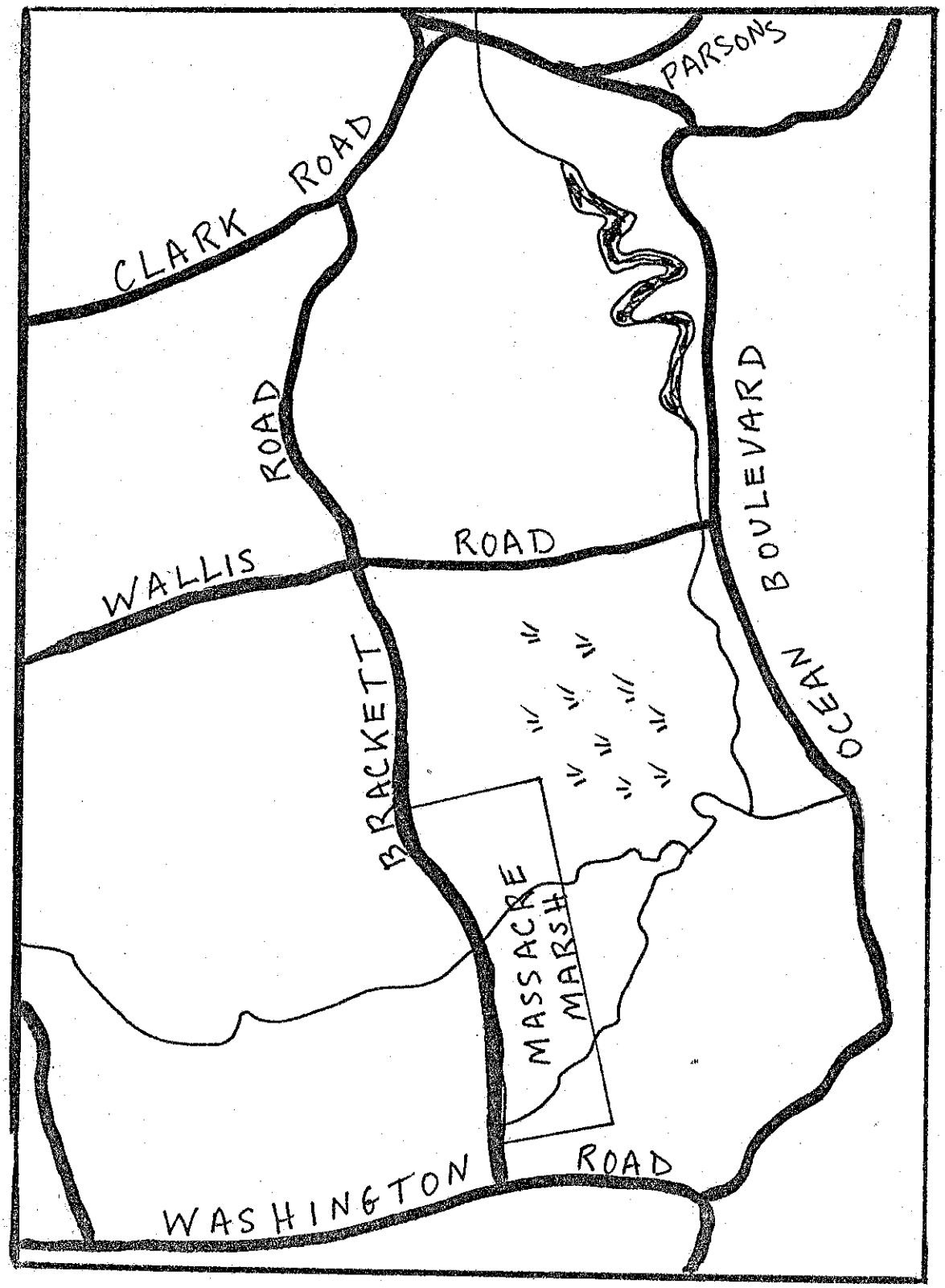
Massacre Marsh represents a fine example of a saltwater marsh and of the interface of such a marsh with inland coastal New Hampshire forest. Fortunately, the Rye Conservation Commission has been successful in preserving this 42 acre natural area so that Rye residents may enjoy and appreciate this dramatic transition from marsh to forest. In addition to its educational, aesthetic, and recreational values, Massacre Marsh serves as a preserve for two Rye historical sites (Brackett Massacre Burial Ground, 1691 and the remains of Foss Mill), provides for a diversified wildlife habitat, and functions to carefully regulate the delicate water balance of the area. A good description of the environs of Massacre Marsh has been provided by Tallman (1973).[1]

The composition and character of the forest at Massacre Marsh is somewhat unique for the area. It consists of a good mixture of red spruce (Picea rubens), American hornbeam (Ostrya virginiana), and shagbark hickory (Carya ovata). The presence of several large hornbeam trees in one location, as is the case at Massacre Marsh, is unusual in coastal New Hampshire. The large (up to 20 inches) red spruce trees present in the stand are a fine example of a mature red spruce stand typical of

---

[1] Louise H. Tallman. "Massacre Marsh", Forest Notes (Society for the Protection of New Hampshire Forests), Fall 1973, p. 8-9.

northern coastal New England. A mature stand consisting of oak species and beech is adjacent to this spruce-hornbeam-hickory stand, and is currently owned by Mrs. Analesa MacLeod of Exeter. Acquisition of this parcel of land by the Conservation Commission, in order to round out and further protect its' Massacre Marsh holdings, should be accomplished as soon as possible. Such an acquisition would add to the value of the present forest, since shagbark hickory is normally found growing in association with oak species or beech.


PARSONS
CLARK ROAD
ROAD
BOULEVARD
WALLIS
ROAD
BRACKETT
OCEAN
MASSACRE MARSH
WASHINGTON
ROAD

Massacre Marsh

(1) Massacre Marsh is an excellent place to learn a bit of Rye history as well as to see and come to understand the transition between upland forest and coastal saltmarsh. Various members of the Brackett, Rand, and Berry families were murdered near the Marsh in September, 1691, by an Indian raiding party. Anthony Brackett was engaged in cutting saltmarsh hay at the time of the incident.

(2) Proceeding out onto the Marsh, one encounters various terrain features prominent in saltmarshes. One of these is a sinkhole. Don't get too close, since it drops off suddenly and the water is likely to be over your head.

(3) Also prominent are mosquito ditches. Looking around will reveal the presence of several saltmarsh plants including cordgrass (Spartina alterniflora), the shorter form (S. patens), arrowgrass, silverweed, blackgrass, sea lavender, and Salicornia. On the edges of the Marsh, one may also see beach pea or beach plum.

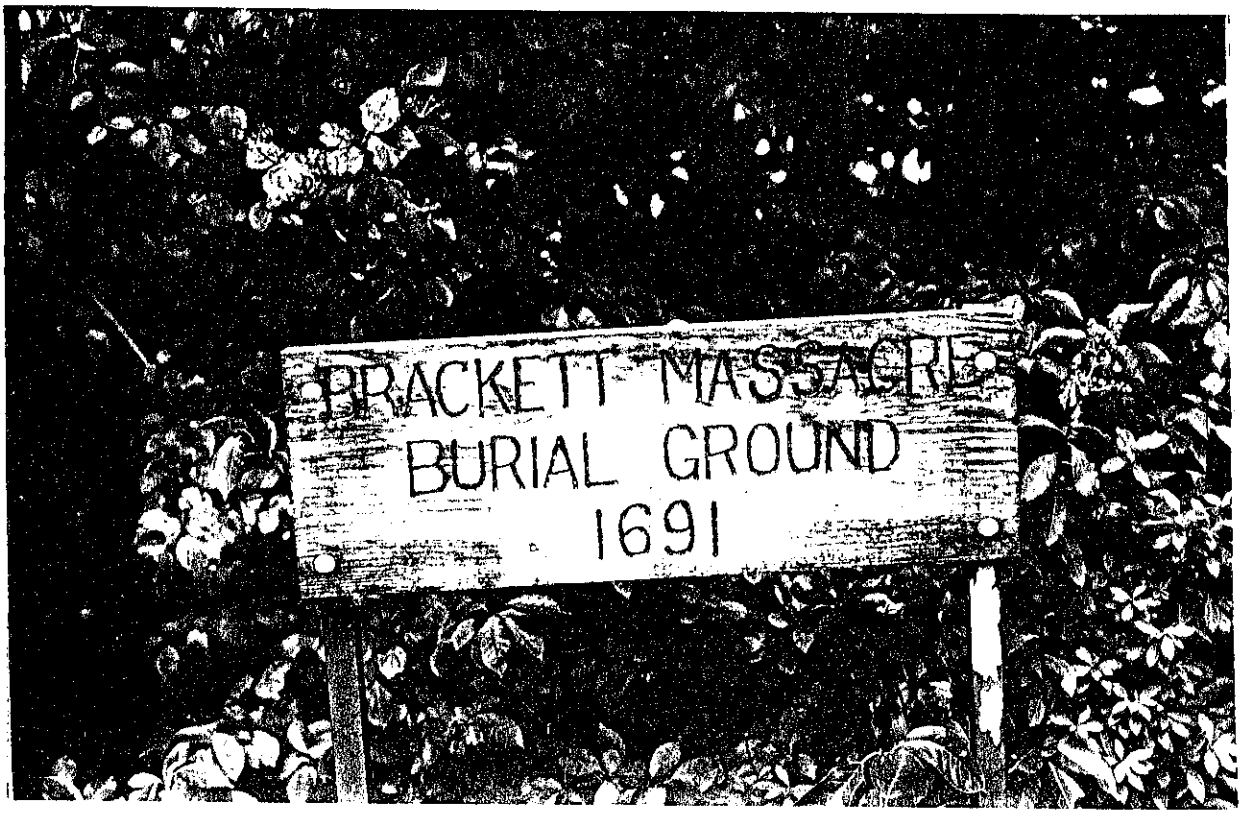
(4) Looking across the Marsh, one catches a view of the red spruce (Picea rubens) stand growing on "Remick's Island". Looking at the edge of the Marsh and the forest, one may see trees and shrubs with stunted growth forms attributable to salt spray.

(5) Further inland, one comes to the remains of Foss Tide-Mill. This historic site dates to about 1813.

(6) Leaving the Mill site and entering the woods, one first comes into contact with some rather large shagbark hickory trees (Carya ovata).

(7) Further inland is a stand of good sized ironwood or hornbeam trees (Ostrya virginiana). Such a stand is quite unusual for this region.

(8) Just before leaving the mainland portion of "Remick's Island" and returning to Brackett Road, one passes through the red spruce stand previously observed while on the Marsh. This is a real treat, since the trees are quite large. Most are 18-20 inches in diameter, and 80+ feet tall.


BRACKETT MASSACRE
BURIAL GROUND
1691

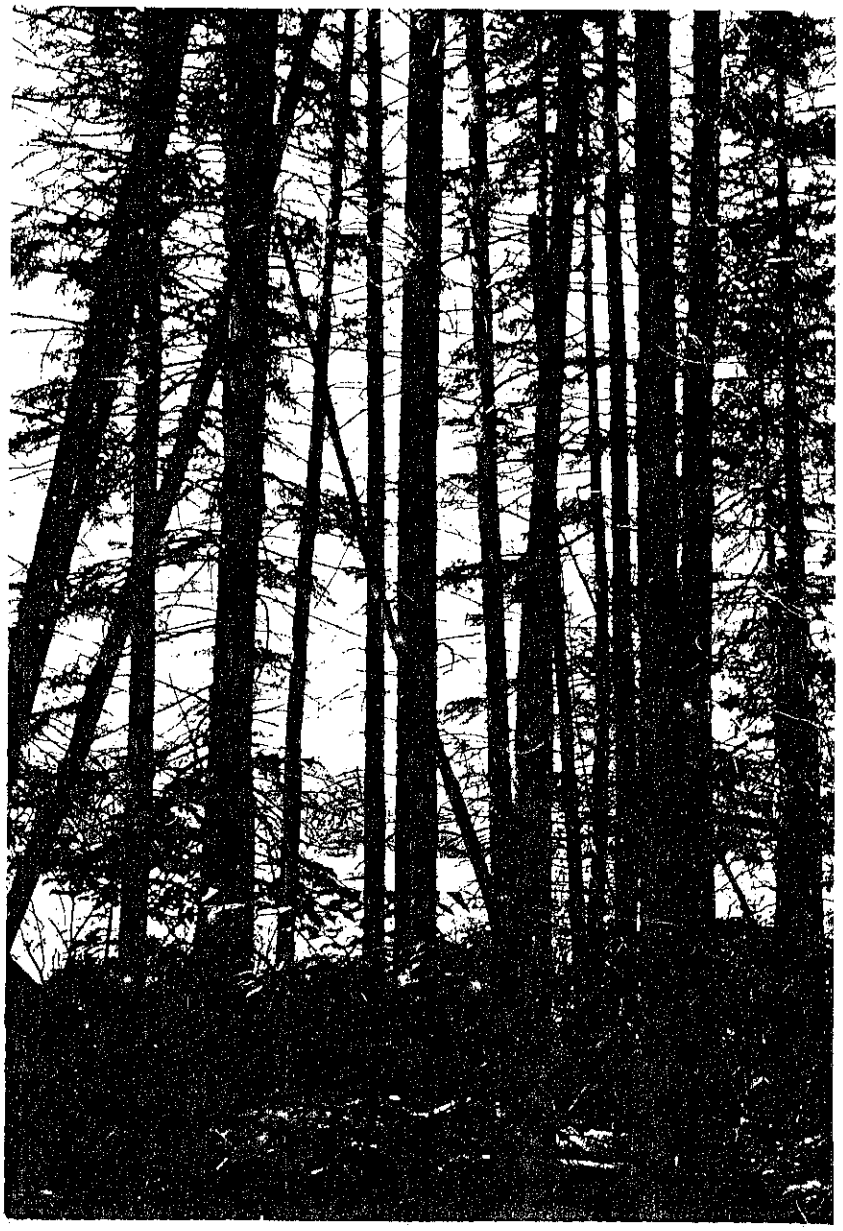
MASSACRE MARSH TRACT

MASSACRE MARSH TRACT

MASSACRE MARSH TRACT

MASSACRE MARSH TRACT

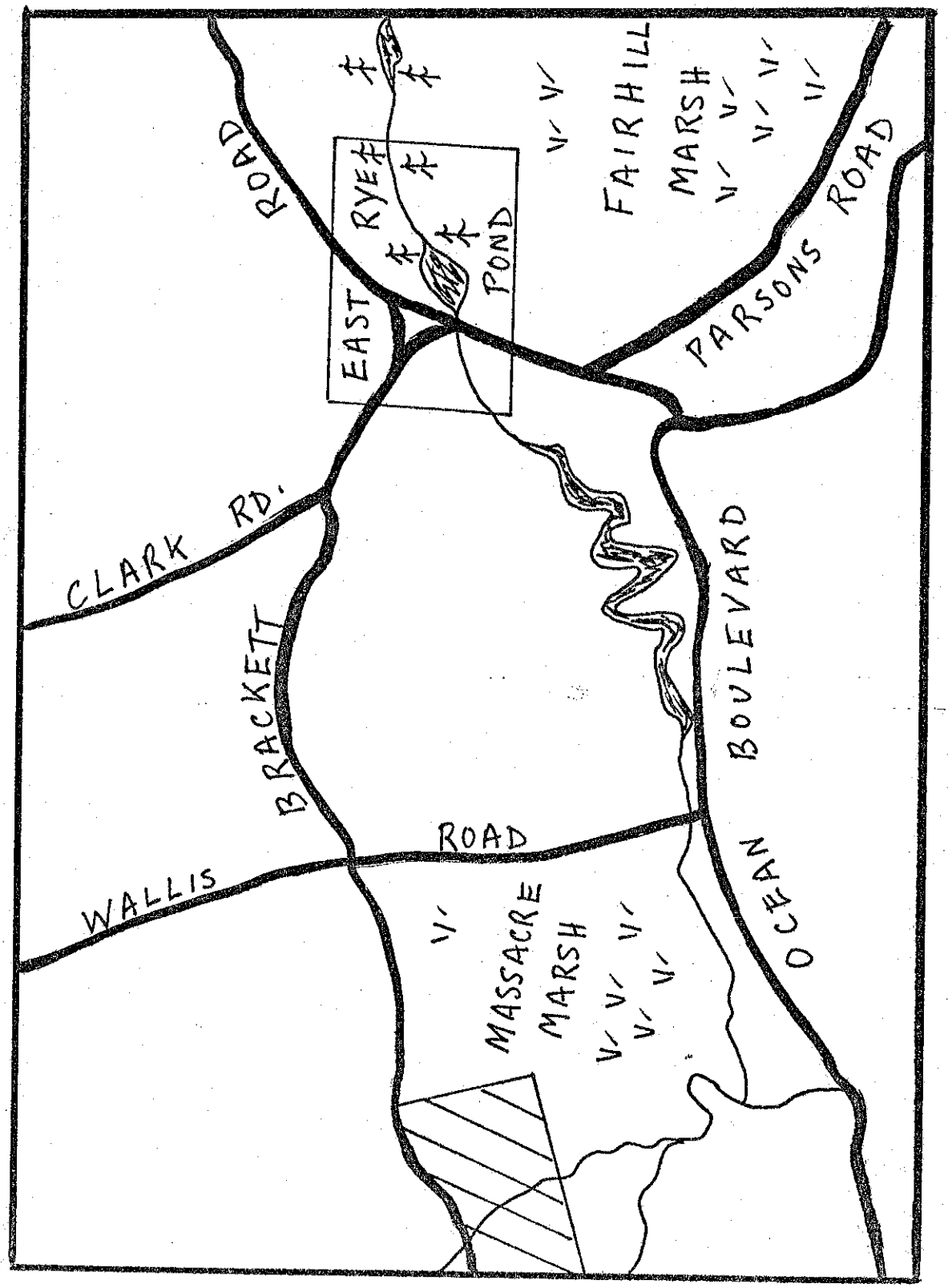
MASSACRE MARSH TRACT



East Rye Pond

A five acre tract at East Rye Pond, near the junction of Brackett and Parsons Roads, was purchased by the Rye Conservation Commission in March 1972. Ten acres of land bordering the pond were recently acquired by the Town, and are believed to contain a small stand of Atlantic cedar. This land is on the back side of East Rye Pond, and extends into Fairhill Marsh, near the site of a larger cedar stand. This stand is the subject of another section of this report. At the present time, with the exception of a very small piece of land bordering the pond owned by Mrs. Emily Gray, all lands surrounding the pond are protected. Since Mrs. Gray's land constitutes the remaining piece, the Conservation Commission would very much like to acquire it.

In 1972, Professor Albion Hodgdon, a botanist at the University of New Hampshire, investigated the East Rye Pond site and wrote a report on it. This report contains much information on the vegetation of the site, and is included in the Appendix of this report for reference.


ROAD
EAST RYE
POND
FAIRHILL
MARSH
PARSONS ROAD
CLARK RD.
BRACKETT
ROAD
BOULEVARD
WALLIS
MASSACRE
MARSH
OCEAN

East Rye Pond

(1) East Rye Pond provides a perfect place for learning to identify plants. One can choose from the aquatic plants or the nearby trees and shrubs.

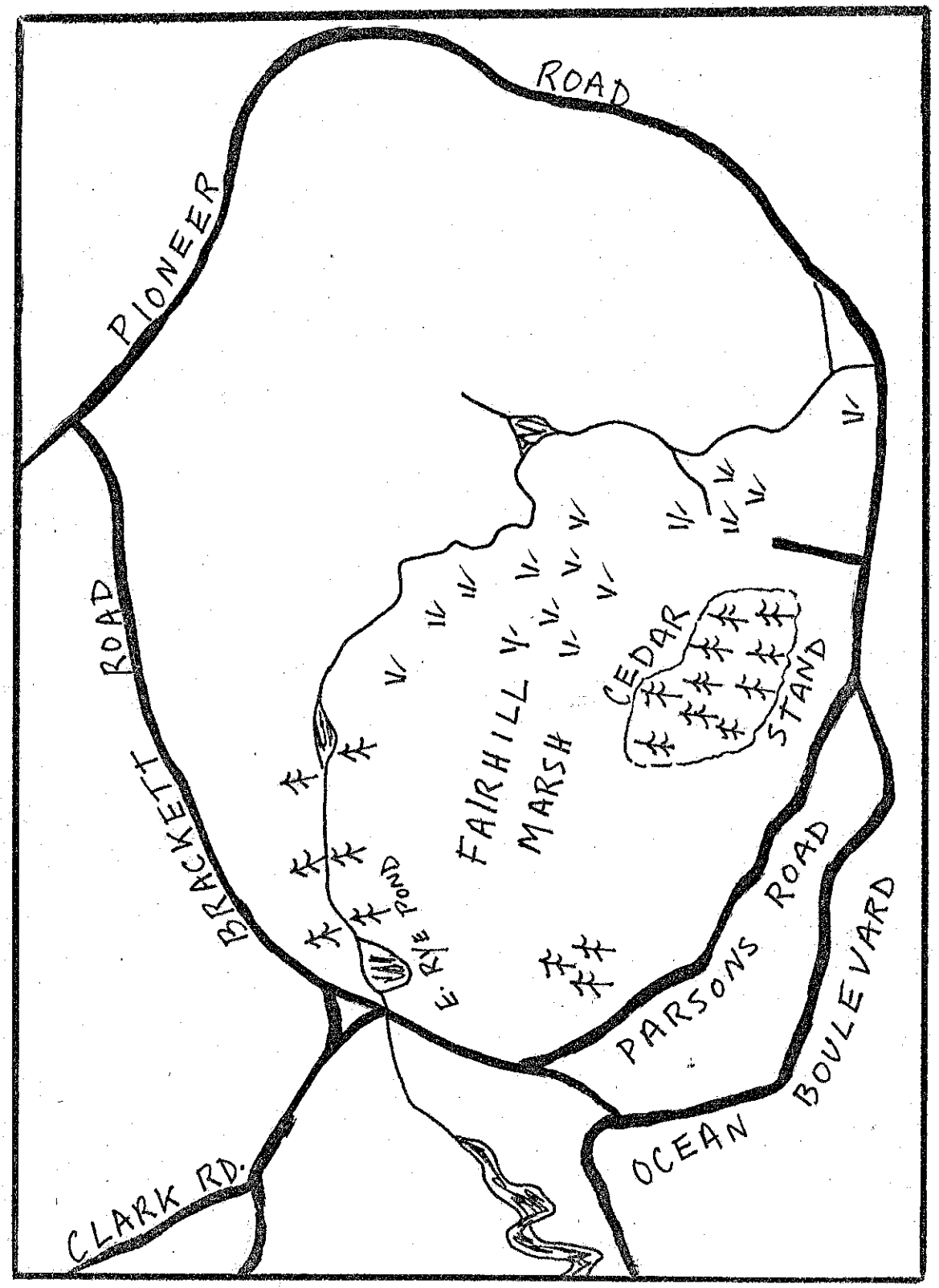
(2) While at the Pond, you may also see wildlife since its environs provides perfect habitat for numerous wild creatures.

EAST RYE POND

Fairhill Marsh Cedar Stand

The Fairhill cedar (Chamaecyparis thyoides) swamp marsh is currently owned by Mr. Robert Hotin, and was formerly owned by Mr. Russel Davis. The stand is located between Pollock Drive and Parsons Road. This intermediate age cedar stand is approximately 30 acres in size, and was last clear-cut in 1923. Trees in the stand range in size from 3 to 11 inches diameter. Red spruce (Picea rubens) is the codominant tree species present in the stand. The presence of a cedar stand at this location has evidently existed for quite some time, since the 1805 Town Map of Rye notes the presence of cedar at this site.

The Fairhill cedars represent a nice contrast when compared with other cedar stands present in the Town, and for this reason, combined with their nearly endangered status in New Hampshire, they should be preserved. This stand of cedars is of intermediate age as cedars go, and in this sense is reflective of an intermediate stage of cedar stand forest succession. This stand may be contrasted with those young cedars growing to the rear of the pump station along Lafayette Road or with the mature stand of cedar growing at Brown's Pond.


ROAD
PIONEER
ROAD
BRACKETT
CLARK RD.
E. RYE POND
FAIRHILL MARSH
CEDAR STAND
PARSONS ROAD
OCEAN BOULEVARD

Fairhill Marsh

(1) Looking across Fairhill Marsh, while standing at the end of Pollock Drive, one can see the tops of cedars on the horizon.

(2) Crossing the Marsh, one is able to get a better view of this fairly good sized Atlantic white cedar stand (Chaemaecyparis thyoides), which dates back to around 1923.

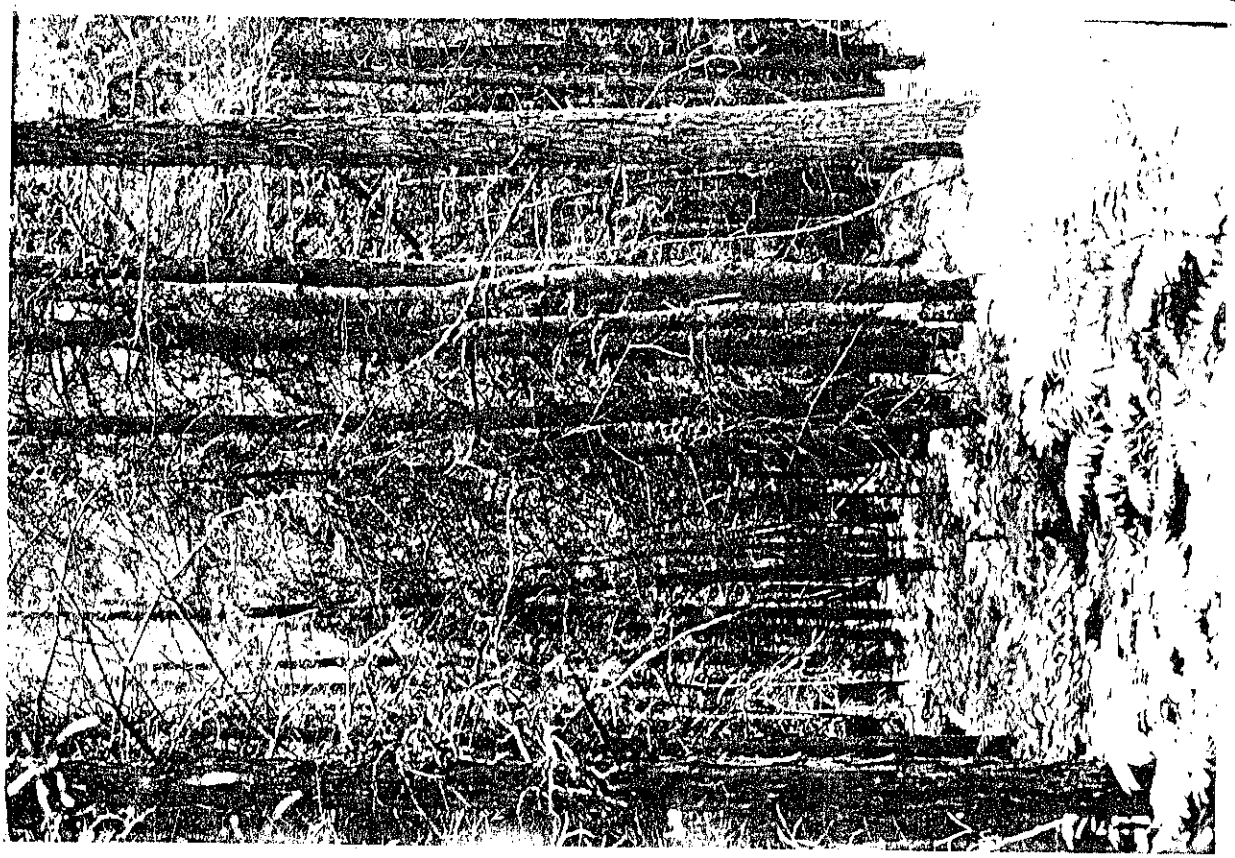
(3) Most of the cedars in the stand range from 3 to 11 inches in diameter. The stand, which is approximately 30 acres in size, stretches from the edge of Fairhill Marsh to the backside of Parsons Road.

(4) Nearly all cedars in the stand are 40 feet in height. They are mixed in with red spruce (Picea rubens), which is codominant in the stand.

(5) A closeup of the herbaceous layer of the stand shows that there are many young hickory seedlings and ferns.

FAIRHILL MARSH CEDAR STAND

FAIRHILL MARSH CEDAR STAND



FAIRHILL MARSH CEDAR STAND

Brown's Pond Cedar Stand

The Brown's Pond cedar stand is in all probability the best example of a mature Atlantic white cedar (Chamaecyparis thyoides) forest in coastal New Hampshire. In this sense, it is unique to New Hampshire as a whole, unique to the New Hampshire seacoast in particular, and should be considered a unique resource of Rye specifically.

Brown's Pond is located off Love Land and is currently owned by Mr. C.J. Brown of Rye. Major tree species of importance present in the stand include in addition to cedar, eastern hemlock (Tsuga canadensis), white pine (Pinus strobus), and red spruce (Picea rubens). Nearly all individuals are 18-22 inches diameter. In terms of dominance, hemlocks appear to be more prevalent than spruce, and spruce more prevalent than white pine. Other tree species present in the stand, of lesser importance include black birch (Betula lenta) and red maple (Acer rubrum). Pepperbush (Clethra alnifolia) and highbush blueberry (Vaccinium corymbosum) are the dominant shrubs.

Brown's Pond is a part of a larger streambed swamp ecosystem consisting of Cedar Run and Burke's (Beal's) Pond (see map). Cedar Run flows into Brown's Pond, a man-made impoundment, crosses Love Lane and continues onward toward South Road where it enters Burke's Pond, another man-made impoundment and the site of another clus-

tering of cedars. Cedar Run has its origins near Grove and West Roads, flowing toward Love Lane and Brown's Pond, and should be thought of in terms of its capacity to drain a very large watershed ecosystem in Rye. At present, this watershed is one of the few truly undisturbed (relatively) wildernesses in Rye. From preliminary examination, cedar growth along Cedar Run appears to be extensive. Most trees in this region seem to be in the 7-14 inch diameter range. The extremely important role played by these trees in regulating the water balance of this large watershed should be carefully considered by anyone that might entertain thoughts of logging operations or other development in this area. Should extensive numbers of trees be disturbed in this area, the entire water balance of the watershed would be thrown out of balance, and might result in serious flooding or water table fluctuations affecting nearby residents.

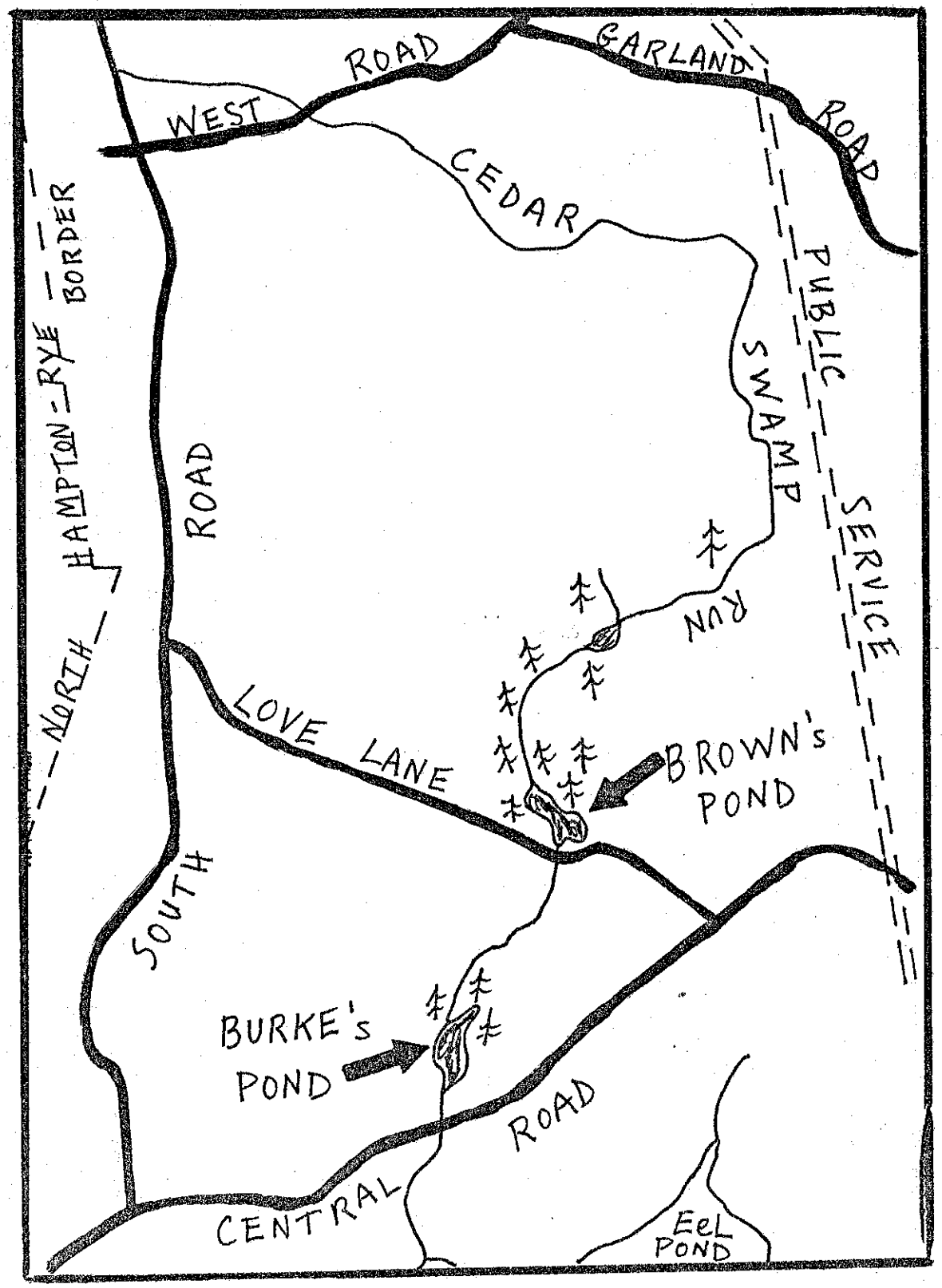
The swampy, mesic character of this watershed is illustrated by the species composition of the forest immediately adjacent to the power line right-of-way just off Central Road. Typical species found in this forest include red maple (Acer rubrum), tupelo (Nyssa sylvatica), mockernut hickory (Carya tomentosa), red elm (Ulmus fulva), black birch (Betula lenta), witchhazel (Ham

virginiana), and locust (Robinia pseudoacacia). This forest is most similar to the recently acquired (Portsmouth Conservation Commission) Wentworth Area, which shall be discussed briefly in a later section of this report.

A general discussion of the ecology of cedar forests similar to the forest at Brown's Pond is provided in a paper by Reynolds (1978). [1] The paper is enclosed in the Appendix for reference.

---

[1] Phillip E. Reynolds, Kenneth G. Carlson, Thomas W. Fromm, Kenneth A. Gigliello, Richard J. Kaminski, Mary K. Reynolds, and Marjorie Sims. 1978. How much does a forest weigh? Studies that reflect on New Hampshire's few remaining Atlantic white cedar swamps. Forest Notes 133: 2-6. Society for the Protection of New Hampshire Forests.


WEST
ROAD
GARLAND
ROAD
CEDAR
PUBLIC
SERVICE
SWAMP
RUN
NORTH
HAMPTON-RYE
BORDER
ROAD
LOVE LANE
BROWN's
POND
SOUTH
BURKE's
POND
ROAD
CENTRAL
EEL
POND

Brown's Pond

(1) The Atlantic white cedar stand (Chaemaecyparis thyoides) at Brown's Pond can only be described as spectacular. Nearly all individuals are 18-22 inches in diameter. Dryopteris sp. ferns are numerous.

(2) Compared with the cedars at Fairhill Marsh, most of these trees easily attain 60 feet in height as they reach into the canopy in search of light. Most of the trees in the stand probably date back to the Civil War era.

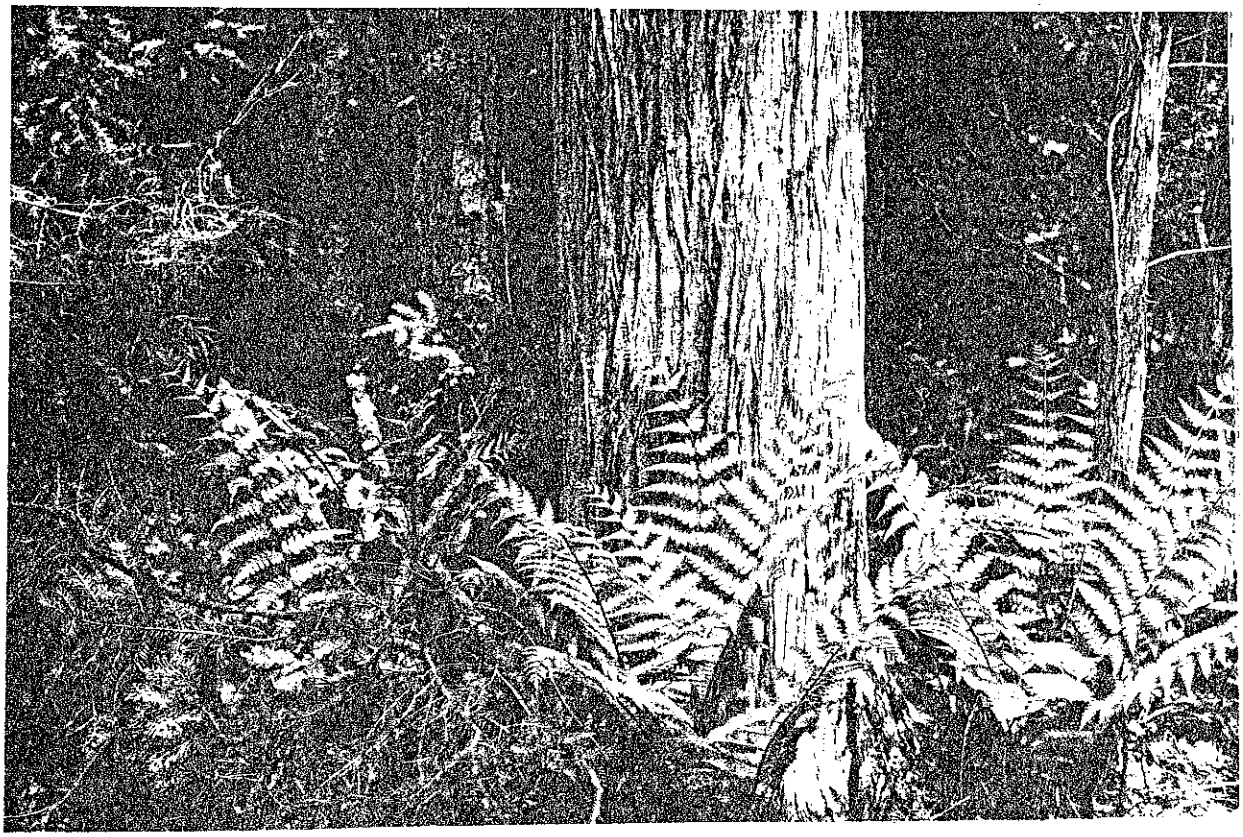
(3) Growing near a large cedar is a young tupelo tree (Nyssa sylvatica). Also present in the stand are numerous red maples (Acer rubrum).

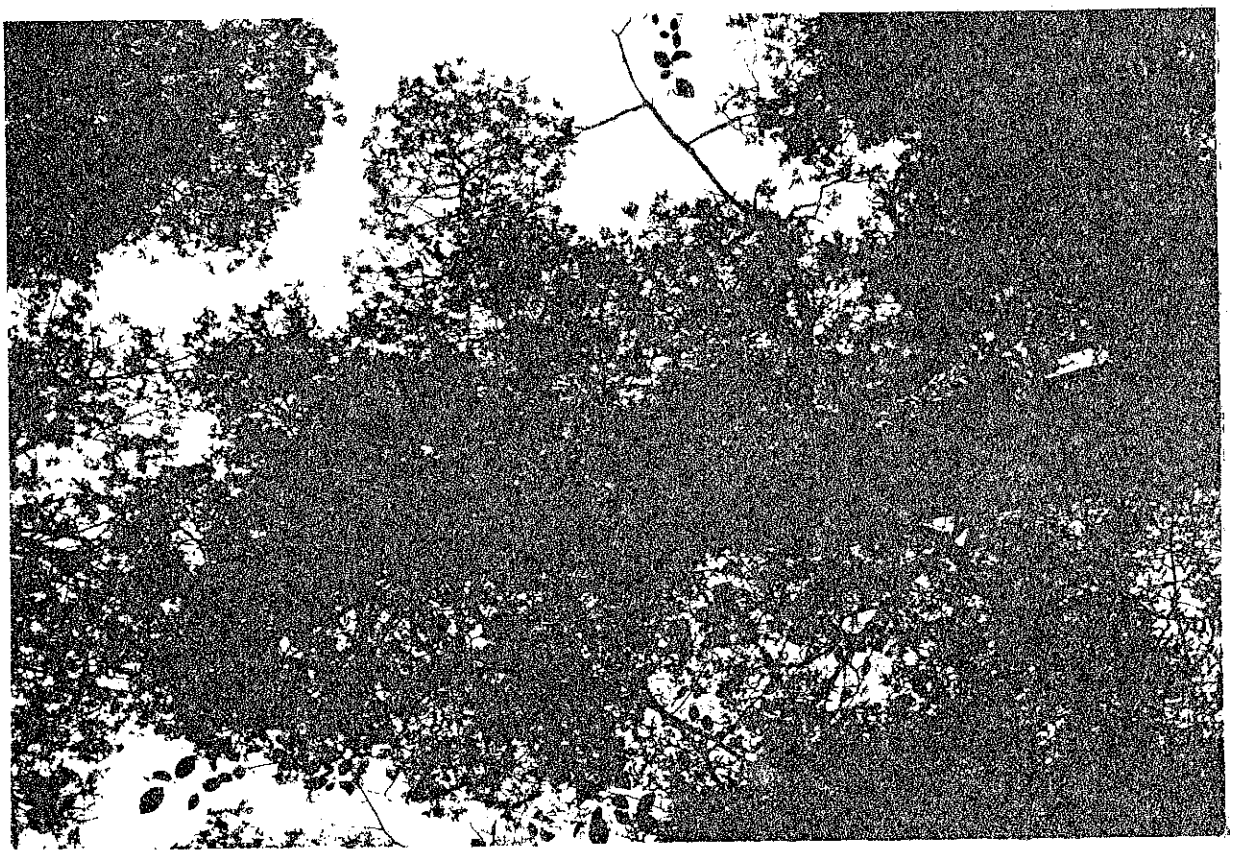
(4) Mixed in with the cedar are other equally massive trees. Most important of these are Eastern hemlock (Tsuga canadensis), shown in the center of this photo, red spruce (Picea rubens), and Eastern white pine (Pinus strobus).

(5) In many places in the stand, the cedars are closely clumped, and the stem density is high. This feature combined with the shear size of the trees, creates the feeling of a dark medieval forest.

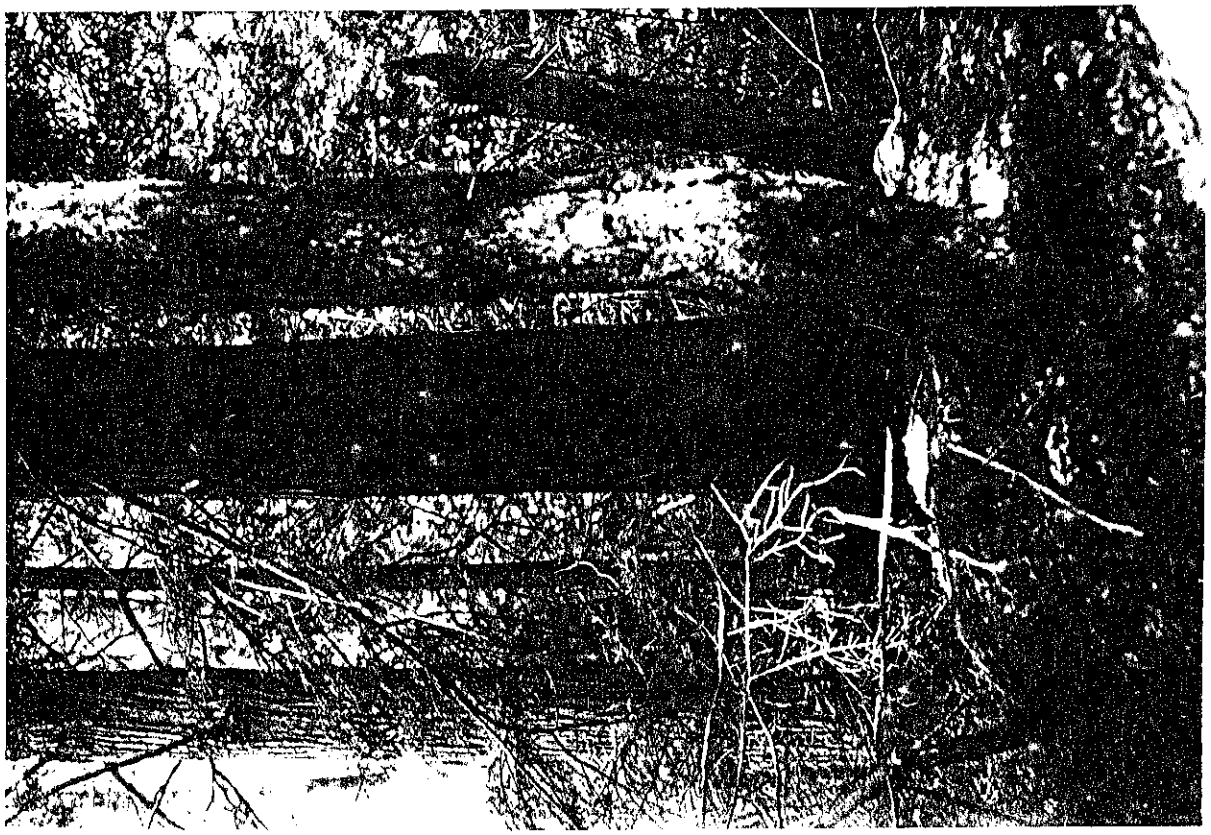
(6) In other spots in the stand, the cedars are more spread out, and numerous shrub species abound. Particularly important are highbush blueberry (Vaccinium

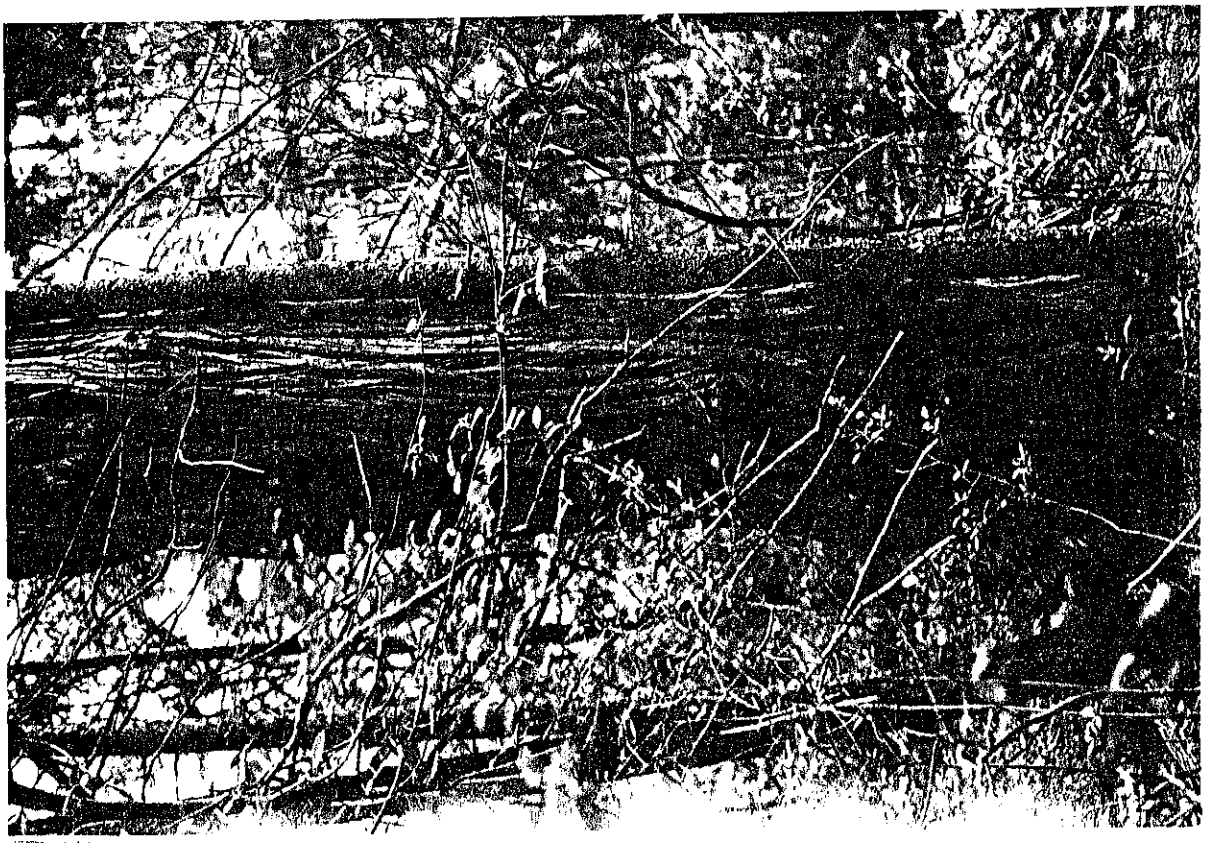
corymbosum) and pepperbush (Clethra alnifolia). The cedar stand at Brown's Pond is probably the most unique cedar forest to be located anywhere along the New Hampshire coastline.



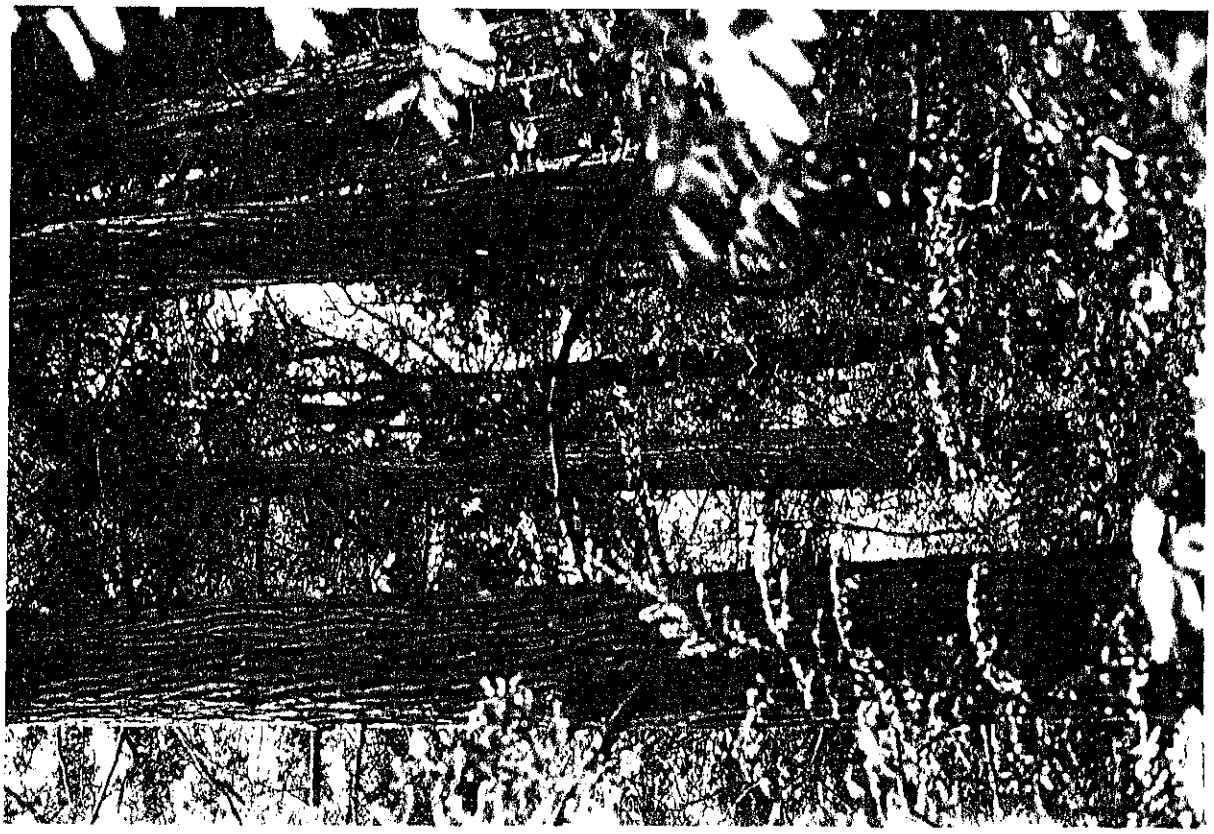


BROWN'S POND CEDAR STAND





BROWN'S POND CEDAR STAND



Burke's Pond Cedar Stand

The forest stand at Burke's (Beal's) Pond is similar in species composition to the one at Brown's Pond, with a few notable additions. These include yellow birch (Betula lutea) and some sugar maple (Acer saccharum). Common species include cedar (Chamaecyparis thyoides), hemlock (Tsuga canadensis), white pine (Pinus strobus), and red spruce (Picea rubens). Unlike Brown's Pond, the cedars tend to occur as isolated individuals ringing the pond rather than as clumps of individuals constituting a stand. In addition, most of these individuals are smaller in diameter than those growing at Brown's Pond. They are similar in size to those at Fairhill Marsh, but as mentioned, tend to occur as individuals rather than in stands as at Fairhill Marsh. For this reason, Burke's Pond does not represent a prime area for cedar preservation when compared with either Brown's Pond or Fairhill Marsh. The most significant reason for not disturbing this area is the threat posed by such a disturbance on water table imbalance. Problems associated with such an imbalance are discussed in detail elsewhere in this report.

Preservation of Burke's Pond, like Massacre Marsh, has historical importance. The site of Jenness Mill is located at Burke's Pond.

Central Road Beech Grove

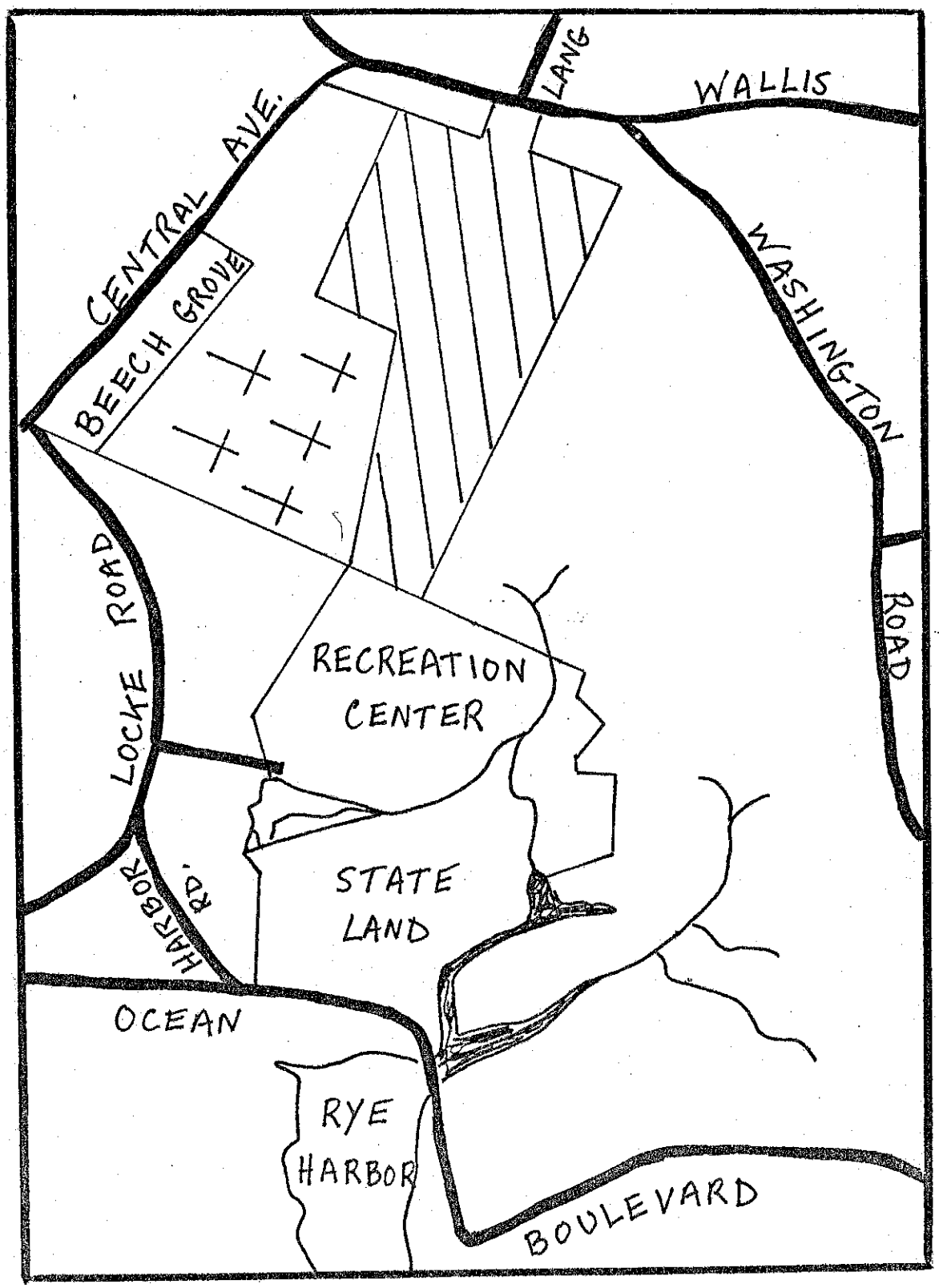
Immediately adjacent to the cemetary and bordered by Central Road is a good size stand of American beech (Fagus grandifolia). Although beech is not uncommon for southern New Hampshire, large relatively pure stands of it are. This stand is one of the largest which I personally know of in the New Hampshire seacoast region.

Several other tree species occur in the stand in much lesser quantities. The most important of these is black birch (Betula lenta) which occupies a codominant position relative to beech. The third most numerous species is white pine (Pinus strobus). A few individuals of yellow birch (Betula lutea) and red spruce (Picea rubens) are also present. Although sugar maple (Acer saccharum) is a frequent component of beech-yellow birch stands, no individuals were observed in this stand. The understory of the stand is primarily dominated by young beech saplings, with occassional white pine in certain areas. Reproduction of beech is good indicating that the stand has a strong capability of sustaining itself in the absence of man-made disturbance or some sort of natural perturbation.

Beech stands represent a climax forest successional stage contrasting with early successional species such as aspen (Populus tremuloides), cherry (Prunus spp.), or red cedar (Juniperus virginiana). Such stands (beech)

normally perpetuate themselves by vegetative reproduction, with older individuals giving rise to new trees via root suckers. In addition, beech trees reduced competition from other species by producing toxic chemicals (allepathy) which are leached from their leaf litter into the soil, and subsequently inhibit the germination and growth of other competing plant species.

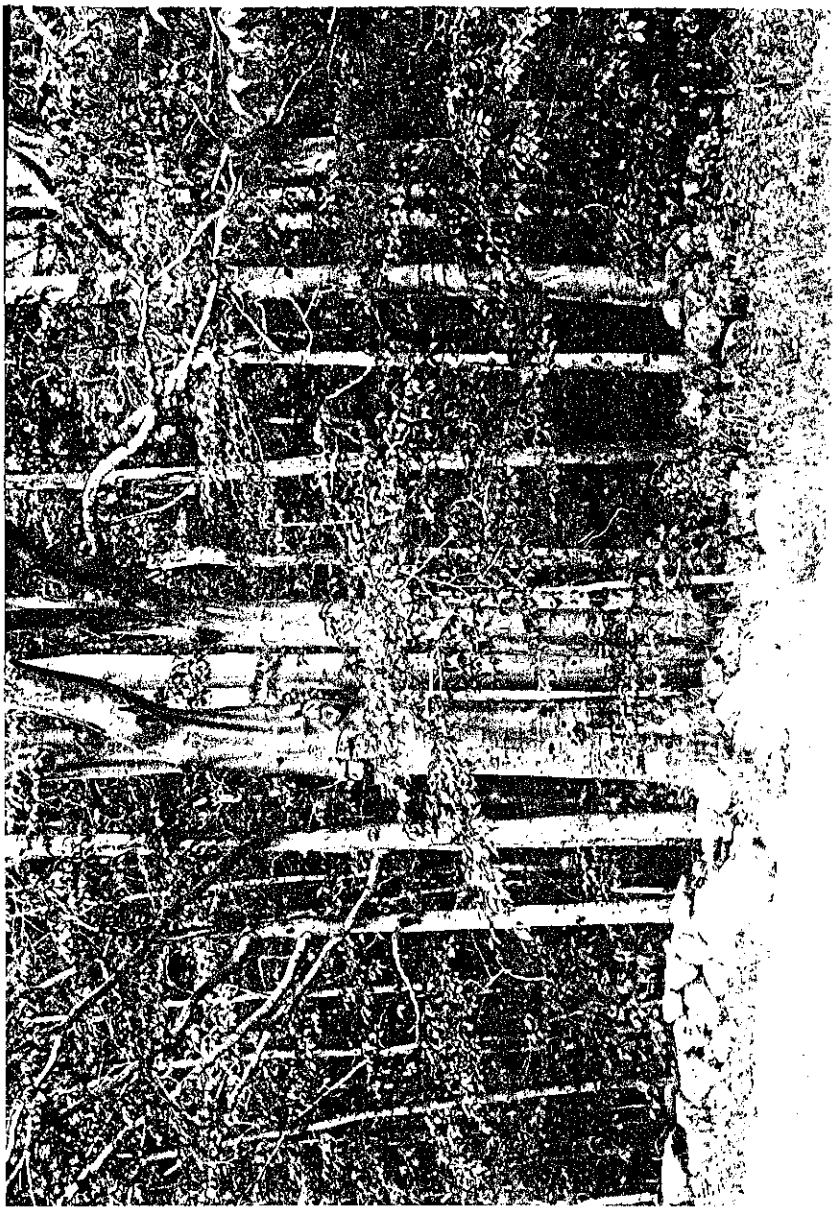
The unique character of this advanced successional stand merits its preservation as an outdoor teaching laboratory and as a place for recreational activity. Trees growing in this stand may be contrasted with other advanced successional or early seral species growing at the nearby Town Forest. The Conservation Commission should treat this area as a high priority parcel warranting preservation, and take immediate steps to secure its protection.


LANG
WALLIS
CENTRAL AVE.
BEECH GROVE
WASHINGTON
ROAD
LOCKE ROAD
RECREATION CENTER
HARBOR RD.
STATE LAND
OCEAN
RYE HARBOR
BOULEVARD

Beech

(1) The American beech (Fagus grandifolia) stand located along Central Avenue and adjacent to the Town Cemetary, is probably one of the more unique stands of beech located in the New Hampshire Seacoast region. One of the assets of the stand is its easy accessibility for recreation and enjoyment.

CENTRAL ROAD BEECH GROVE

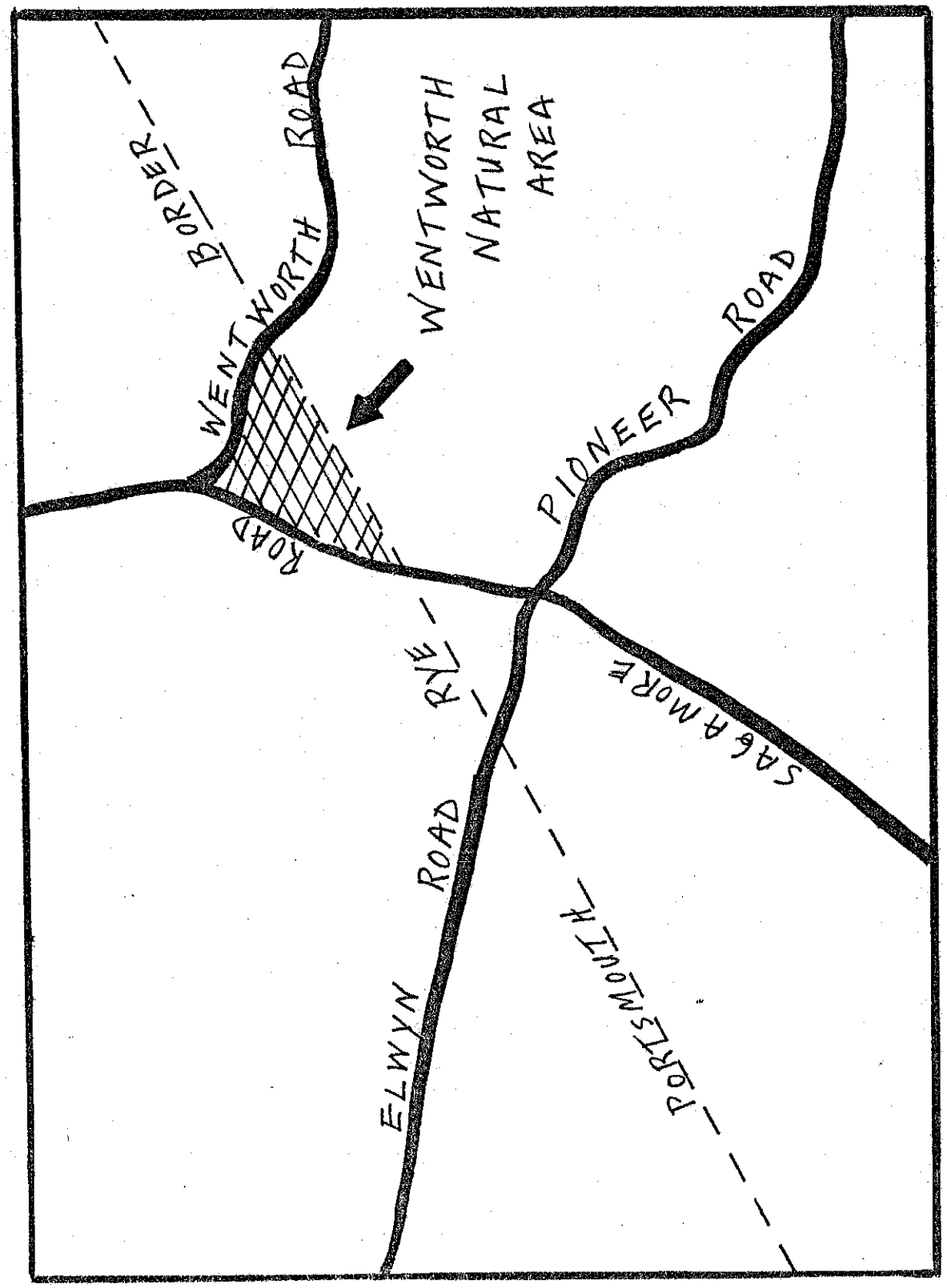


Wentworth Grove (Portsmouth)

Wentworth Grove (40+ acres), a forested tract of land on the Rye-Portsmoth border, was recently purchased by the Portsmouth Conservation Commission. This parcel of land is located at the intersection of Sagamore and Wentworth Roads (see map for details).

Various tree species commonly occurring in Wentworth Grove include tupelo (Nyssa sylvatica), red maple (Acer rubrum), red elm (Ulmus fulva), swamp white oak (Quercus bicolor), red oak (Quercus rubra), black birch (Betula lenta), white ash (Fraxinus americana), and cherry species (Prunus spp.). Various shrubs include Viburnum spp., witchhazel (Hamamelis virginiana), highbush blueberry (Vaccinium corymbosum), and pepperbush (Clethra alnifolia). Smilax species are also common. Other species occurring in far lesser quantities include hemlock (Tsuga canadensis), white pine (Pinus strobus), and aspen (Populus tremuloides).

Topography at the Wentworth Grove is hilly with wet lowlands and drier ledge outcroppings. A stream traverses the property, and a small pond ringed with red maple and tupelo is present. The area is quite scenic, and certainly is worth a visit during peak fall coloration.


BORDER
WENTWORTH ROAD
WENTWORTH NATURAL AREA
ROAD
PIONEER ROAD
RYE
SAGAMORE
ELWYN ROAD
PORTSMOUTH

Berry's Brook-Bellyhack Bog Ecosystem

The Berry's Brook-Bellyhack Bog ecosystem is the largest wilderness watershed in the Town of Rye. The watershed has its origins in Portsmouth near Packer's Bog and in Greenland to the west of Breakfast Hill Road. Starting at these points of origin, its waters flow into Rye, crossing Lafayette Road near the sewage pump station. Berry's Brook flows from Lafayette Road toward Lang Road, where it splits into several feeder streams prior to its crossing Lang Road in its continued northeastward journey towards Wallis Road. Near Wallis Road, the stream flows roughly parallel to the road for approximately two miles before crossing Sagamore Road in its final eastward journey towards the ocean. Prior to crossing Sagamore Road, these waters fan out into a large wetlands area known as Bellyhack Bog. Having crossed Sagamore Road, the headwaters of the Bellyhack Bog flow eastward roughly parallel with Pioneer Road as they enter the wooded estuary between Sagamore and Brackett Roads. South of Brackett Road, these waters flow into a large brackish marsh near Odiorne Point, which may be viewed from the wooden decked bridge on Pioneer Road just prior to reaching Odiorne Point State Park.

Access to this large watershed ecosystem is difficult, and certain portions are most easily reached during the winter months when frozen ice conditions exist. During the winter months, one may cross-country ski or snow-shoe into

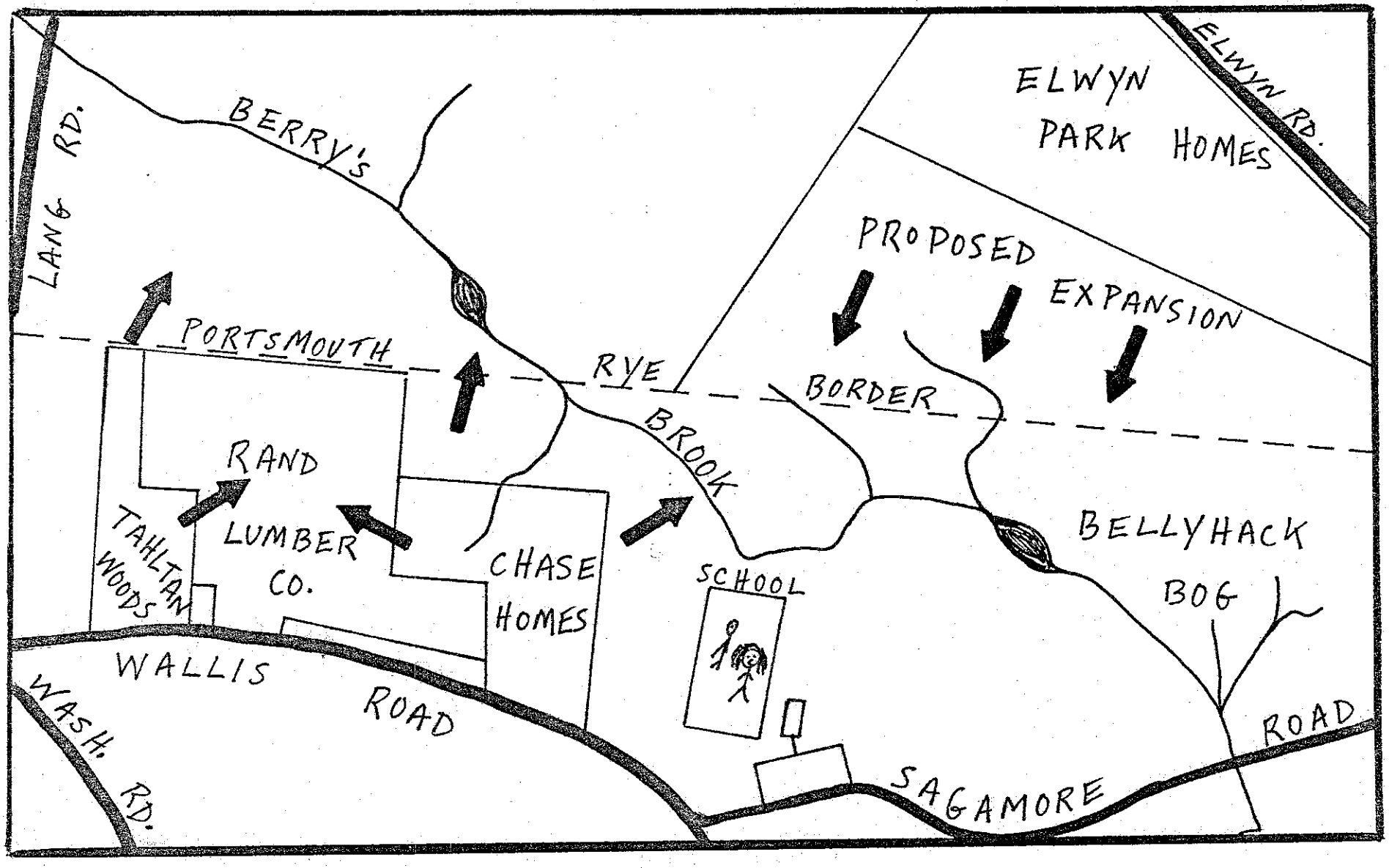
areas requiring deep wading at other times of the year. Other access to the area is possible using canoes, but considerable portaging is required. Walking access to this ecosystem is most easily achieved from various points off of Wallis Road, where the waters of Berry's Brook come in closest contact with civilization. Other access is more easily possible by walking into the estuary located at the far northeastern end of the ecosystem.

At the present time, many portions of this watershed are largely free of human impact in the form of frequent human visitations. As a result, wildlife (several beaver dams, reports of red fox, weasel, and fisher) thrives in these more remote wilderness areas. Despite this wilderness quality for the watershed, portions of the ecosystem are currently being impacted with man-made pollutants. This problem is especially serious in the Lafayette and Lang Road areas. Future potential threats to the ecosystem exist from current or planned housing developments in both Portsmouth and Rye. Probable impacts from such developments are numerous and include: (1) run-off and siltation problems, (2) changes in water table levels and surface water flow patterns resulting from mass cutting of trees, excavations, and man-made changes in topography, and (3) increased uncontrolled human contact with the more remote

wilderness areas of this watershed ecosystem. Given the vast and continuous nature of this ecosystem, one cannot realistically expect than man's tampering with this watershed at any point along its flow will not have deleterious effects elsewhere in the ecosystem, perhaps miles from the point of inflicted injury. For this reason, any attempts to preserve various portions of the ecosystem are doomed to failure if concurrent and complementary efforts to preserve other portions of the system are not made. One cannot independently protect the estuary portion of this watershed without first taking steps to protect the Bellyhack Bog, since what happens in the Bellyhack Bog is bound to have repercusions on the estuary. The domino theory with regard to ecosystem damage applies, and must be fully appreciated by any or all who would seek to protect only parts of the whole.

Since this large watershed ecosystem is located in two towns, its protection is by necessity a joint effort. Both Portsmouth and Rye officials must see that their actions taken independently or collectively affect the well-being of citizens residing in both towns. With this latter point in mind, several parcels of land located in Rye, near Washington or Wallis Roads and bordering the Berry's Brook-Bellyhack Bog ecosystem, will be discussed. These include:

(1) Parsonage Woods, (2) Tahltan Woods, (3) Rand Lumber Co., (4) the Chase housing development, and (5) the outdoor nature center located at the Rye Elementary School. The tracts of land begin slightly to the south of the intersection of Lang Road and Washington Road and extend up Wallis Road for nearly two miles until reaching the intersection of Bellyhack Bog with Sagamore Road. Access to this large watershed ecosystem, on foot, is more easily obtained from the sites located near the crossing of Wallis & Sagamore Rds., and is most readily obtained near the Rye Elementary School where Bellyhack Bog makes its closest encroachment on civilization. In addition, the large estuary area located to the east of Sagamore Road will be discussed.


LANG RD.
BERRY'S
ELWYN PARK HOMES
ELWYN RD.
PROPOSED
EXPANSION
PORTSMOUTH
RYE
BORDER
BROOK
RAND
LUMBER
CO.
TAHLTAN WOODS
CHASE HOMES
SCHOOL
BELLYHACK
BOG
WALLIS
ROAD
WASH. RD.
SAGAMORE
ROAD

Areas delineated on this and other Berry's Brook-Bellyhack Bog Ecosystem maps are not intended to reflect the exact survey locations of certain lands (Tahltan Woods, Parsonage Woods, Chase lands, Rand lands, etc.). Areas marked with the above names are intended only to mark the rough locations of these lands. They are not necessarily accurate from a surveyor's standpoint.

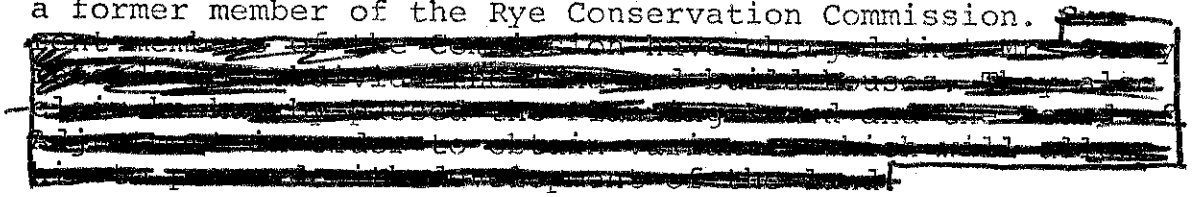
Parsonage Woods

Parsonage Woods is located to the rear of Olde Parrish Road (behind the old parsonage house), and borders the Berry's Brook-Bellyhack Bog ecosystem at the south end of Berry's Brook, prior to its crossing of Lang Road on the Portsmouth-Rye line. It is currently owned by Ricci-Hayes Developers of Portsmouth,[1] and consists of a substantial acreage. The lands were previously owned by the Wilson family, and were earlier owned by members of the Rand family.

The forest composition of these lands is similar to that of the Rand Lumber Co. lands. Large unmanaged stands of white pine (Pinus strobus), possessing considerable potential for management, are present. In addition, large, tall, straight hemlock (Tsuga canadensis) and spruce trees (Picea rubens) grow in these woods. In terms of growth form, they are superior to anything growing in the proposed Town Forest, and in terms of harvestable potential compare in their present condition only with trees growing on the Rand lands. Trees in this

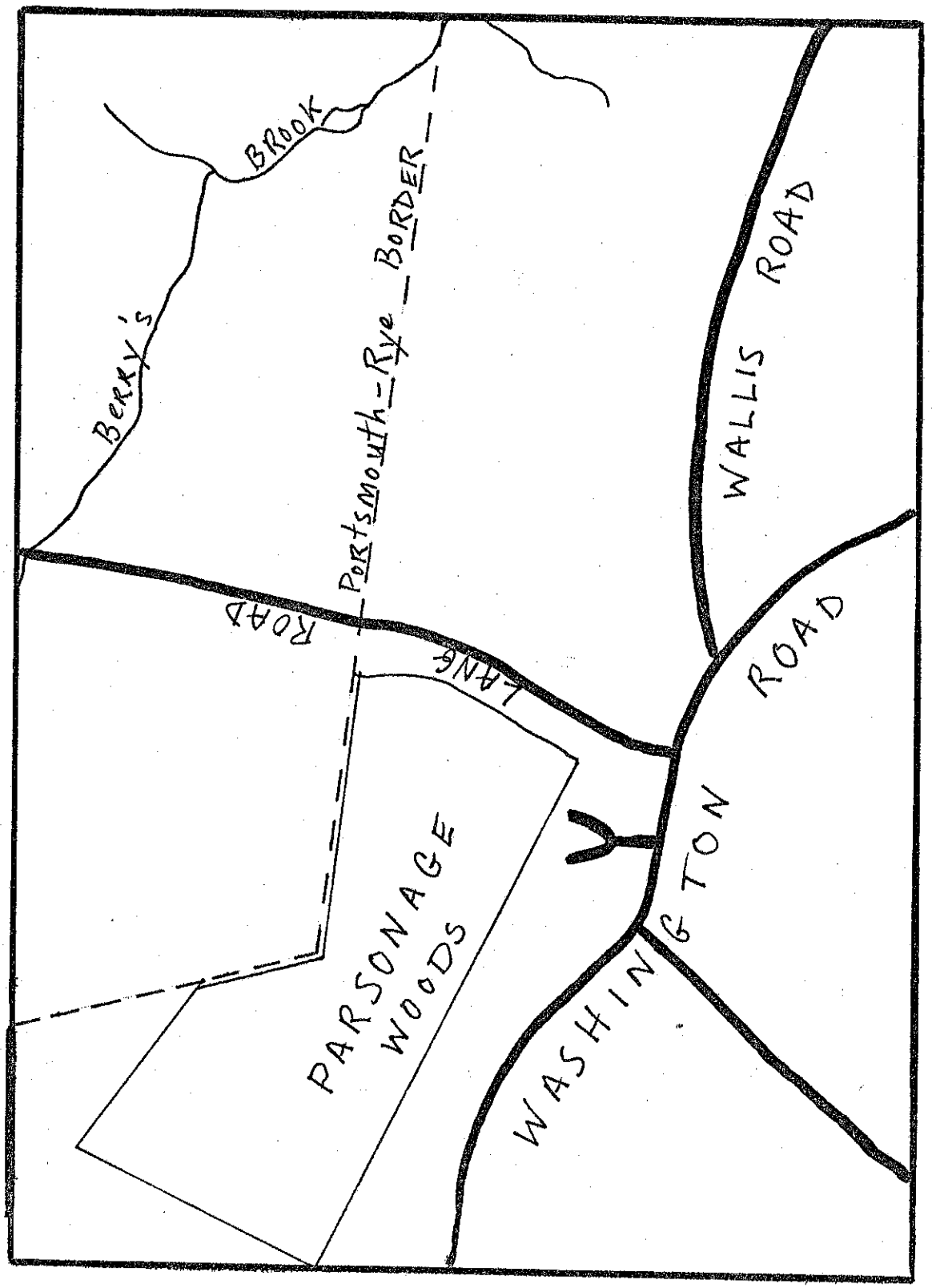
---

[1] Parsonage Woods was recently purchased from Ricci-Hayes Developers by Mr. Richard Carey, formerly of Rye and most recently a resident of Connecticut. Mr. Carey is a former member of the Rye Conservation Commission.



forest exhibit exceedingly high potential for forest management and show capability for immediate timber harvest as well as sustained timber yield.

In addition to the aforementioned species, beech (Fagus grandifolia) is particularly plentiful in these woods. Although large relatively pure stands of it do not exist as typified by the beech grove off Central Road, numerous large individuals are present. The possibility of managing these woods for beech production also makes them particularly attractive for forest management purposes. In this regard, these woods are somewhat unique for Rye, and should be left in a natural, but managed state, if at all possible.


BERRY'S BROOK
PORTSMOUTH-RYE BORDER
WALLIS ROAD
ROAD
LANE
PARSONAGE WOODS
WASHINGTON ROAD

Parsonage Woods

(1) and (2) Parsonage Woods is located to the rear of the Olde Parsonage Apartments.

(3) Upon first entering the woods, one is treated to a prime example of the early history of this region. As shown here, large rocks were used to construct a bridge fording a stream in Colonial days.

(4) Further into the Woods, one comes upon a large stand of beech (Fagus grandifolia).

(5) Beech is a climax forest species which tends to perpetuate itself on sandy loam soils via vegetative reproduction. Far reaching root suckers give rise to young beech saplings. Although beech is not uncommon in this area, large stands of it are rare. Beech nuts provide food and forage for wildlife.

(6) In many places, the herbaceous layer of these forests is dominated by may apple (Podophyllum The may apple is probably escaped, since its occurrence elsewhere in Rye has not been observed, and herbaceous ground cover in beech groves is exceedingly unusual.

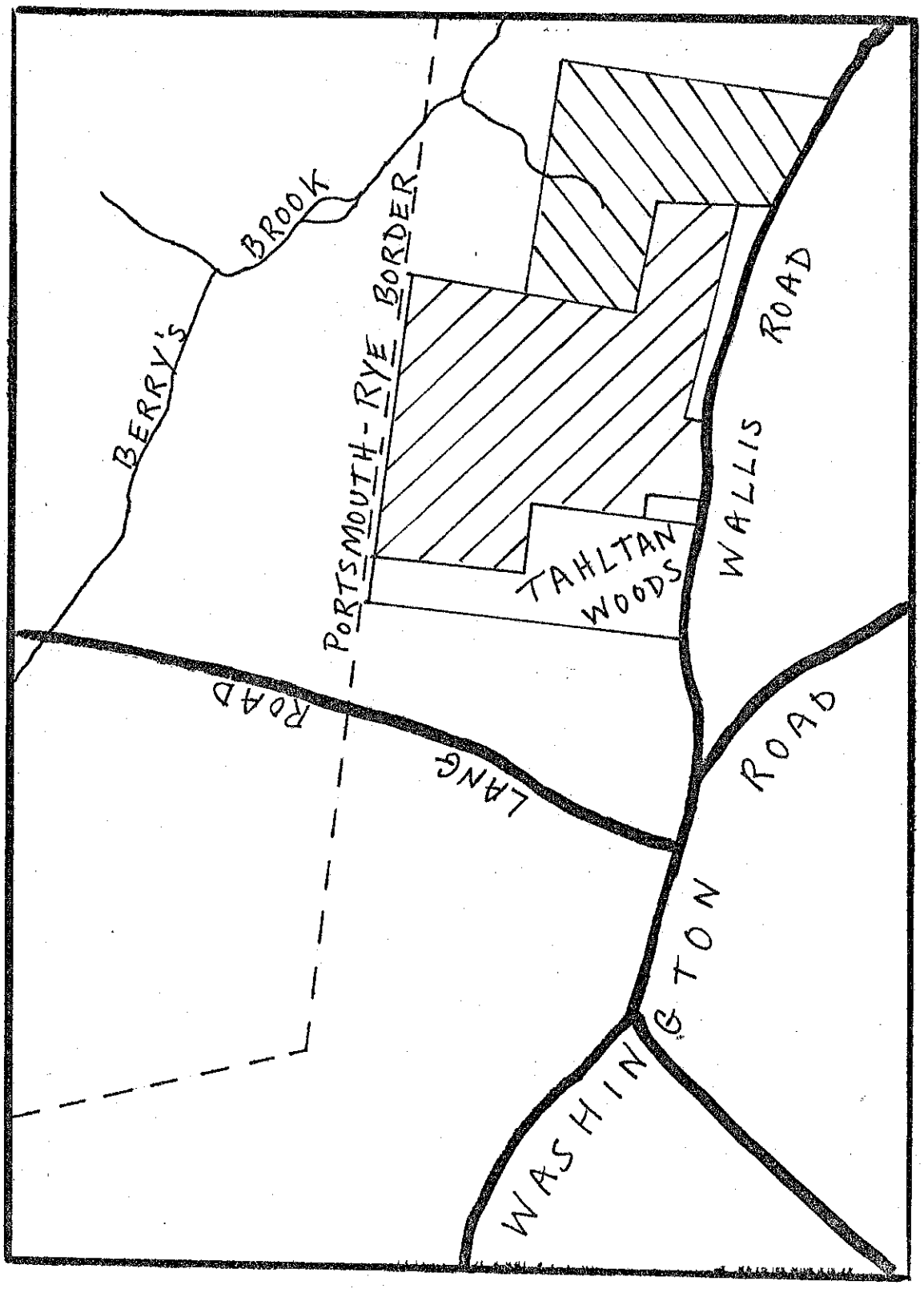

Olde
Parsonage
Apartments
RUCH HAYES

PARSONAGE WOODS

Tahltan Woods

Tahltan Woods is owned by Shanley-Tucker Realtors, and is adjacent to the former Joseph Rand house, circa 1765. The general nature of the land at Tahltan Woods is wet and swampy. In contrast with most of the Rand Lumber Co. and Chase holdings to the north, it is very poorly drained and is characterized primarily by lowland wetlands species, the most important being red maple (Acer rubrum) and tupelo (Nyssa sylvatica). White pine (Pinus strobus), which is capable of persisting in low swampy (mesic) areas as well as higher drier (xeric) areas is also present.

Unlike the Chase development, the construction of new housing in this area is totally unsound, and under no circumstances should have been allowed. Decisions regarding land use in this area should be simple. No real choice needs to be made. The land is unsuitable for either new construction or forest management, and should be left undisturbed in its role of regulating water flow within the Berry's Brook-Bellyhack Bog ecosystem. The high persistent water table of this area makes it completely impractical for building as evidenced by flooding and sewage problems for those houses already constructed. Further development in this area should not be permitted.


BERRY'S BROOK
PORTSMOUTH - RYE BORDER
TAHLTAN WOODS
WALLIS ROAD
ROAD
LANE
WASHINGTON ROAD

Tahltan Woods

(1) Tahltan Woods housing development is located adjacent to Rand Lumber Company lands and borders the former Joseph Rand house, circa 1765.

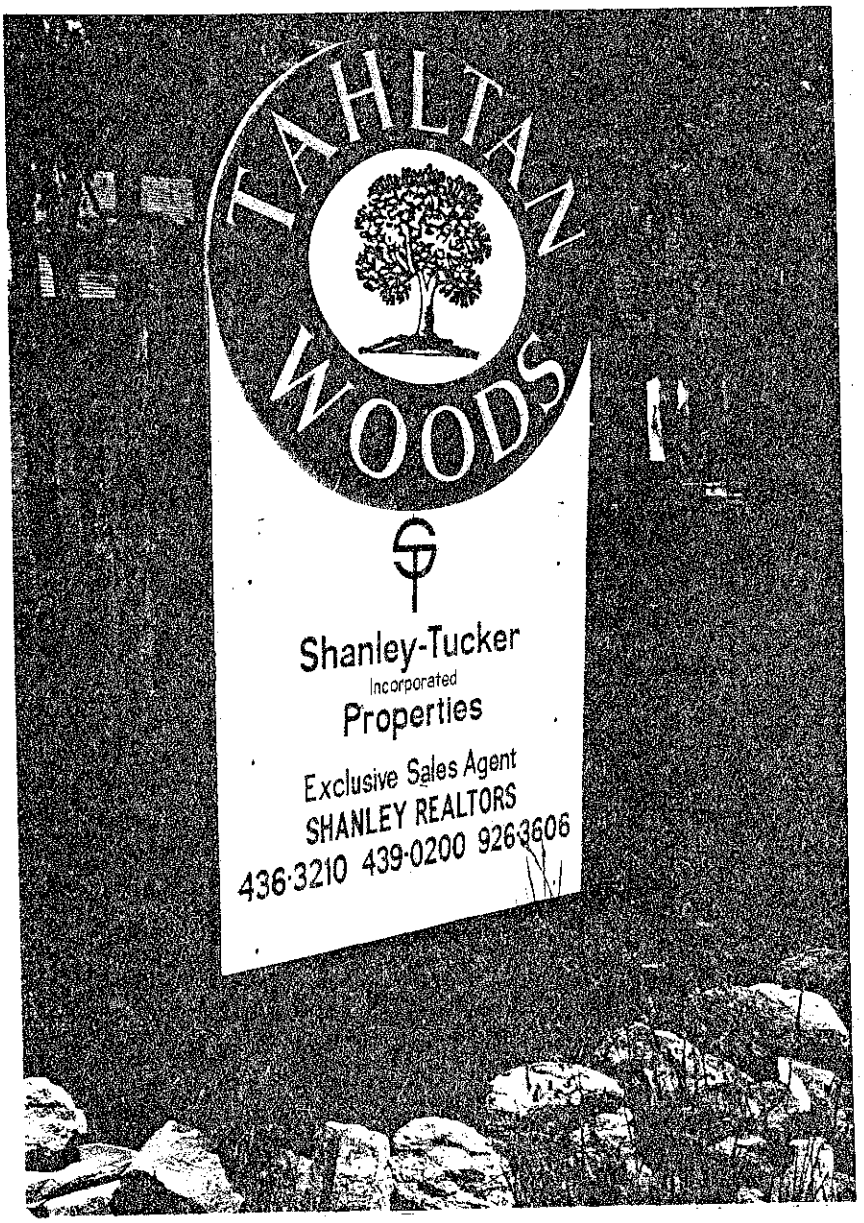
(2) The former Joseph Rand house, circa 1765.

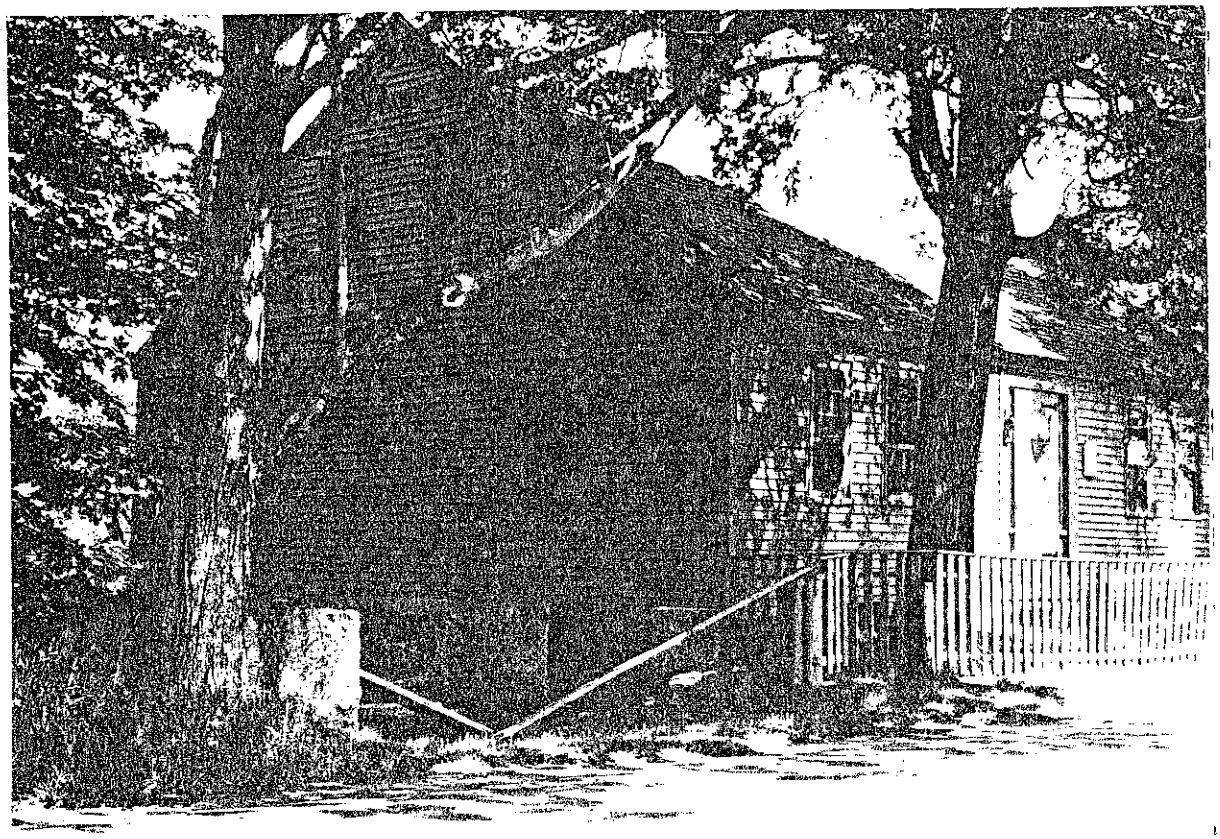
(3) Lands to the rear of Tahltan Woods are extremely wet and swampy. Looking at these lands from Wallis Road, one sees several old sugar maples (Acer saccharum) on what high ground exists near the road, and much red maple (Acer rubrum) and alder (Alnus spp. in the swampy areas to the rear of the road.

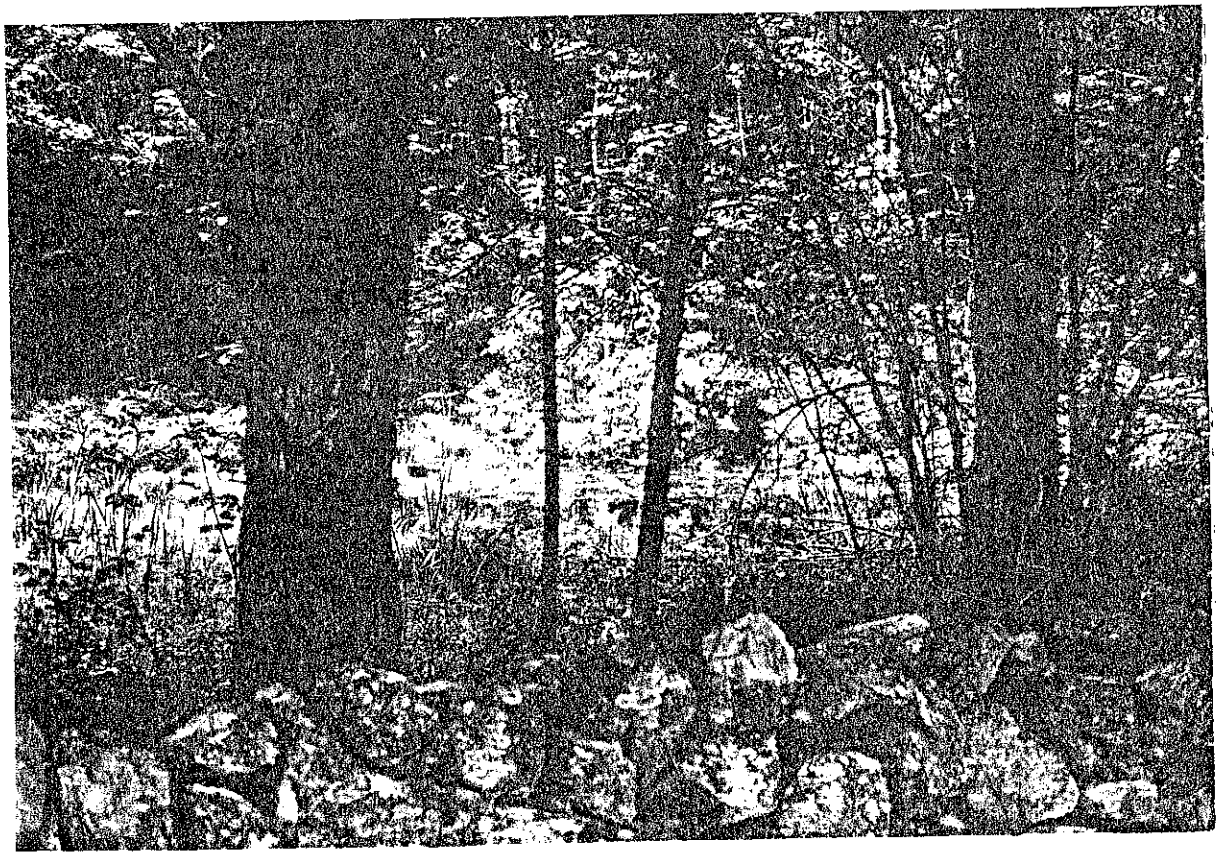
(4) A close-up of the alder in these swamps.

(5) A considerable distance inland from these swamps, and near the Portsmouth border, one encounters stands of white pine (Pinus strobus). A few old sugar maples (A. saccharum) grow in these stands.

(6) A close-up of one of these old sugar maples.


TAHLIAN
WOODS
Shanley-Tucker
Incorporated
Properties
Exclusive Sales Agent
SHANLEY REALTORS
436-3210 439-0200 926-3606





TAILTON WOODS

Chase Housing Development

The lands at the current on-going Chase Development were examined for their forest composition, since they border a sector of the Bellyhack Bog-Berry's Brook ecosystem and are representative of the upland and lowland forests of this area. Construction at the Chase housing development was initiated in 1977, and involves a total of approximately 70+ acres formerly owned by members of the Rand family.

Forest composition of the Chase lands is nearly identical to that of the Rand Lumber Co. lands, which are adjacent to the development. The major difference between the two tracts of land is that the Rand lands have been subjected to intensive forest management for a number of years, whereas the Chase lands are representative of unmanaged natural woodlands. Both tracts of land contain lowland swamp forests as well as drier upland forests. The lowland forests consist of red maple (Acer rubrum) mixed in with red elm (Ulmus fulva) and some black birch (Betula lenta). Upland areas are characterized by white pine (Pinus strobus), red spruce (Picea rubens), hemlock (Tsuga canadensis), beech (Fagus grandifolia), sugar maple (Acer saccharum), red oak (Quercus rubra), and yellow birch (Betula lutea). Most of the white pine in these areas exhibits a "pasture" broadly branched growth form, indicating that the forests have grown back from former abandoned pastures or cropland. Numerous stump sprouts also exist

indicating that these are abandoned pasture lands. The lands were most probably allowed to return to forests around the beginning of the present century.

Trees growing on the Chase lands do not reflect a unique forest or tree resource for Rye. They do, however, have considerable potential if managed for various forest products. Since such management is not planned for these lands, it is appropriate that future planning for Rye consider whether similar lands should be so managed or used for development. Both demands are important, and necessary. However, once development has begun, it is too late to consider these options or to lament not having considered the matter sooner. Various options are available allowing for new housing, accomodation of increasing population numbers, and reduced consumption of land for new housing. If one wishes to control population growth, 2-3 acre houselot zoning will reduce the number of new houses, and prevent development in areas too small to meet minimum zoning standards. However, it will not halt the continued use of large tracts of land to any appreciable extent. In addition to population control, 2-3 acre zoning should allow for the construction of houses on substantially more wooded lots, offering the Town greater opportunity to retain its rural appearance. If large population

increases are to be accomodated, while simultaneously retaining large tracts of open space (possibly for forest management), some form of cluster housing should be considered.

In my travels about town, the Chase Development has been praised by many as a good example of a restrained planned housing development.[1] Nearly all of the house lots at the site will be wooded. In addition, no development is planned for the more wet swampy areas of the property. Looking ahead, the Chase developers have agreed to provide protection for the Bellyhack Bog area by setting aside a buffer zone of forested land located between the houses and the bog area. Despite these many enlightened measures, the Chase Development in its present location, or any other development in nearby proximity of Berry"s Brook, poses a threat to the Bellyhack Bog ecosystem.

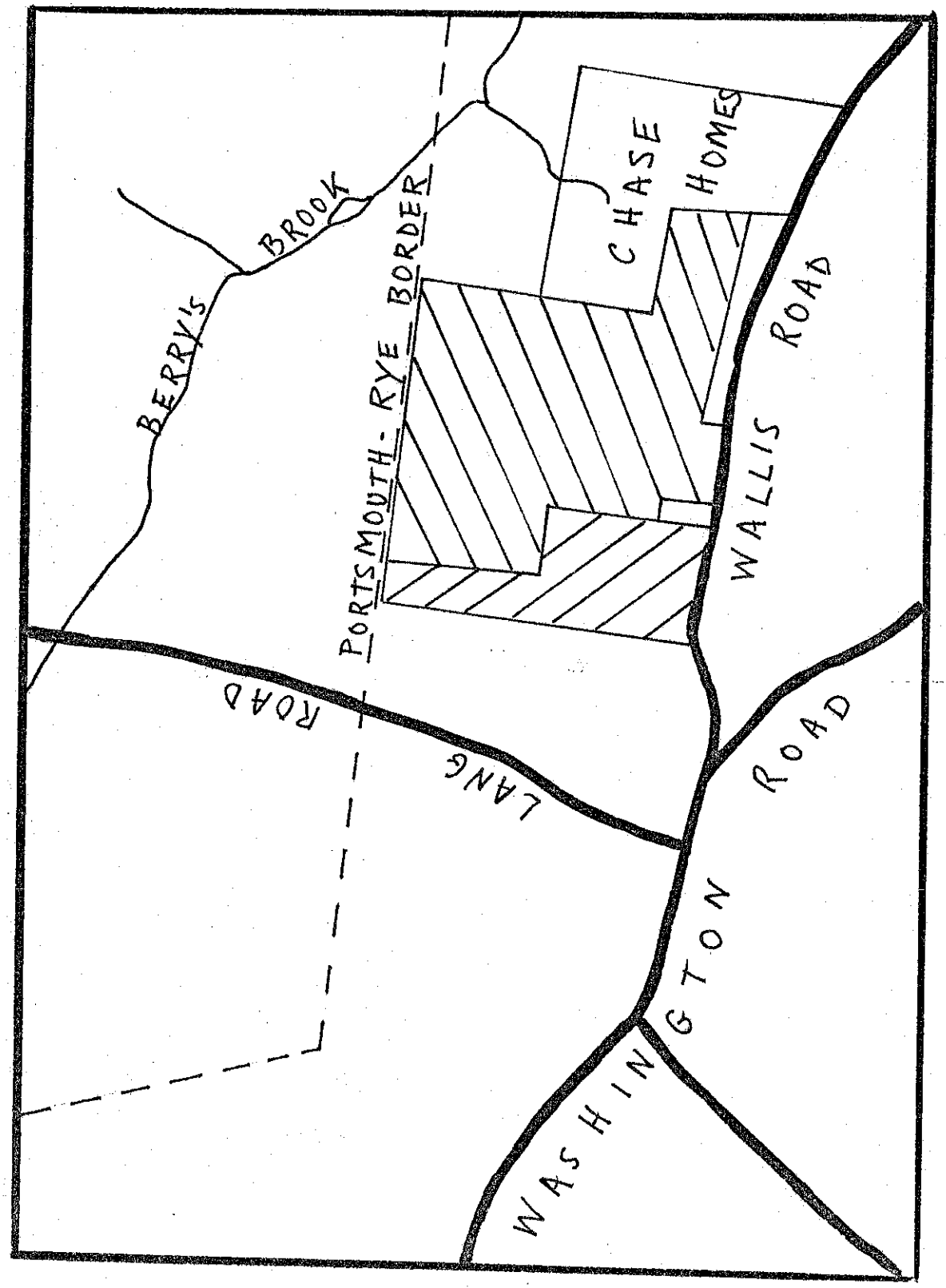
Protection of this ecosystem is a regional as well as a Town problem, since this natural ecosystem adheres to no political boundaries, and lies in part in the Town of Rye as well as the Town of Portsmouth. If this ecosystem is to be saved, both Towns must act. It will do Rye very little good to try to protect this ecosystem if Portsmouth does not provide equal protection, or visa versa. Thus, Rye and Portsmouth must become unified and coordinated partners in

---

[1] Complaints of flooding supposedly caused by the development have recently (late Fall 1978) been voiced by neighbors abuting the development.

this effort.

At the present time, lands both in Rye and in Portsmouth and adjacent to the Bellyhack Bog-Berry's Brook ecosystem, are owned by developers. In Portsmouth, the present Elwyn Park area is scheduled for expansion (House of Three Developers). Although this expansion has been considerably reduced in scale from its original intent, permission to proceed has been granted. Over time, in the absence of permanent protection for this ecosystem, it is possible to envision further housing expansion in Portsmouth in the direction of the Rye border accompanied by concurrent expansion in Rye toward the Portsmouth border. As this expansion proceeds, increasing pieces of this ecosystem will be developed and remaining portions will be subjected to ever greater pollution and human impact. The wilderness quality of this area will be lost, and plans for connecting Rye and Portsmouth by building new roads through the area could emerge. The problem with compromise, when delicate natural ecosystems requiring protection are at stake, is that future development is given a "green light" by simply "getting its foot in the door".


CHASE HOMES
BROOK
BERRY'S
PORTSMOUTH - RYE BORDER
WALLIS ROAD
LANG ROAD
WASHINGTON ROAD

Chase Development

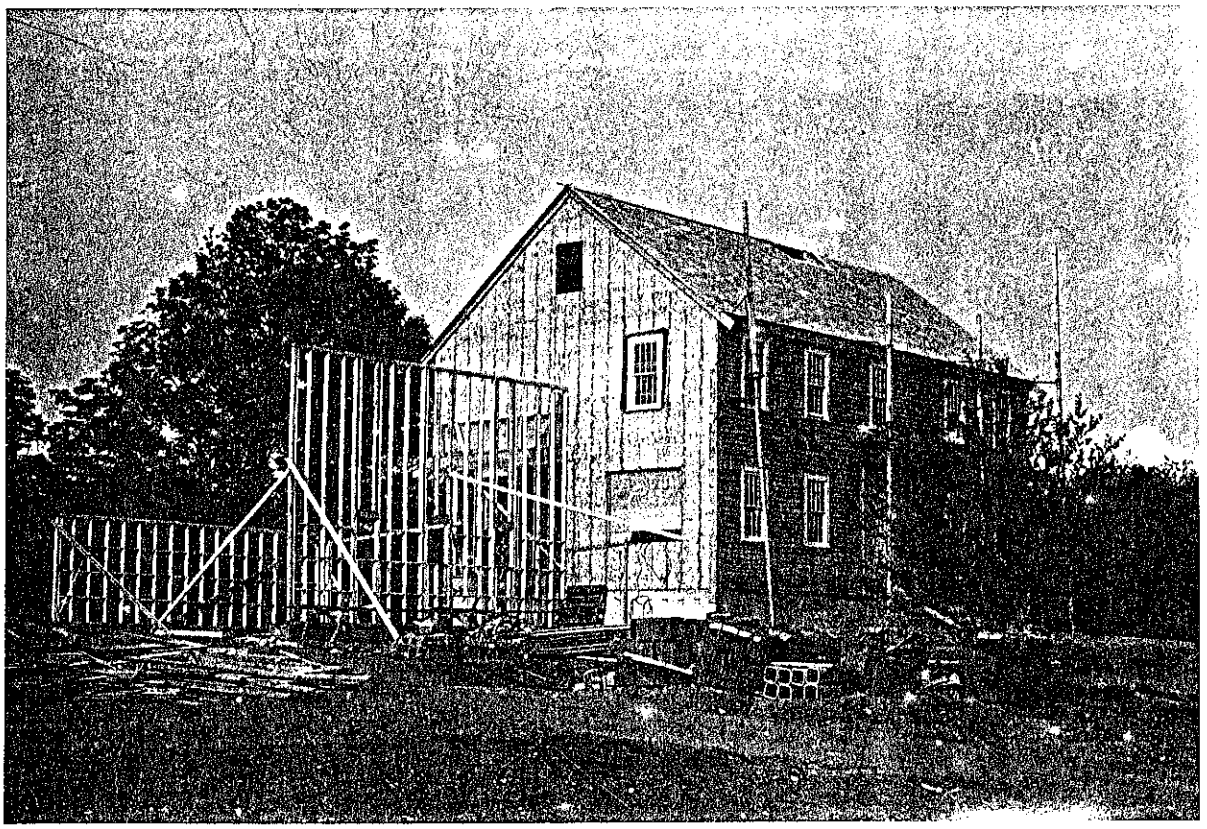
(1) New colonial style home being constructed by Chase Developers. Summer 1978.

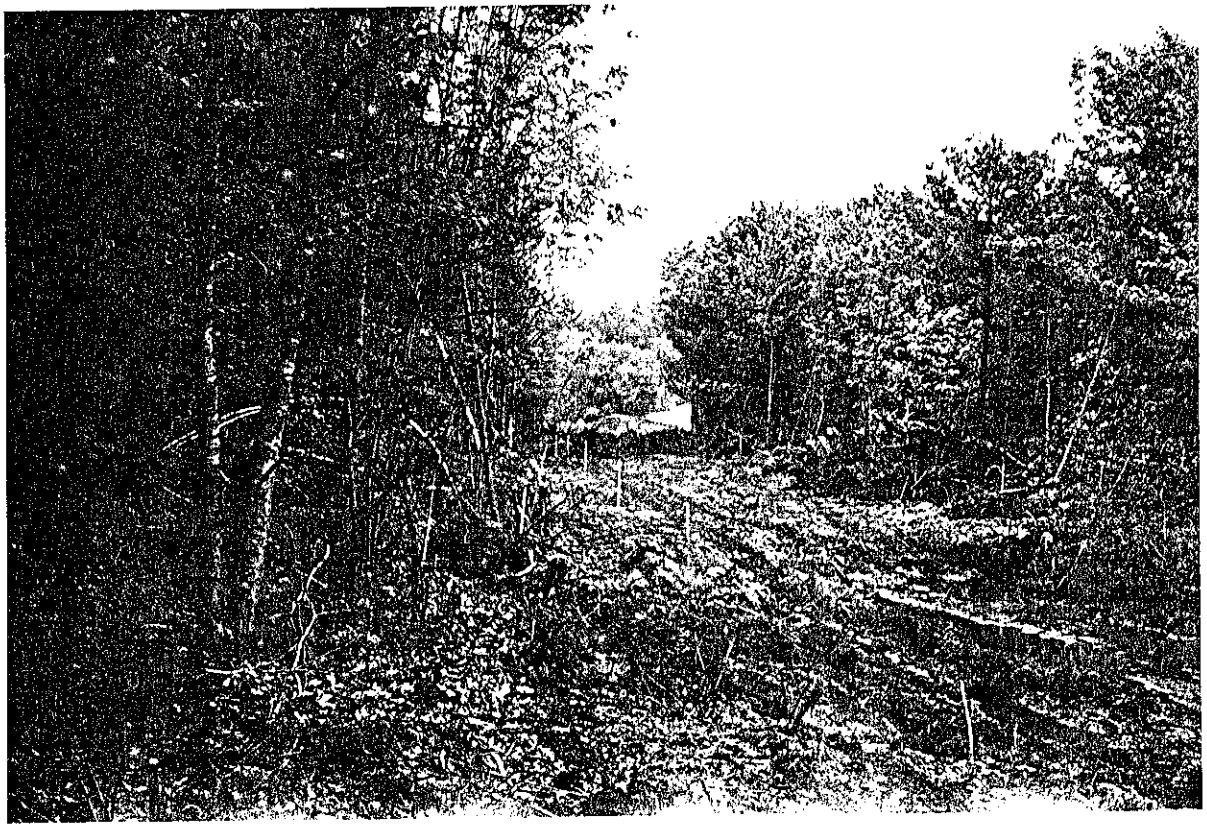
(2) New road construction at the Chase Development site fords a stream feeding into the Berry's Brook-Bellyhack Bog ecosystem.

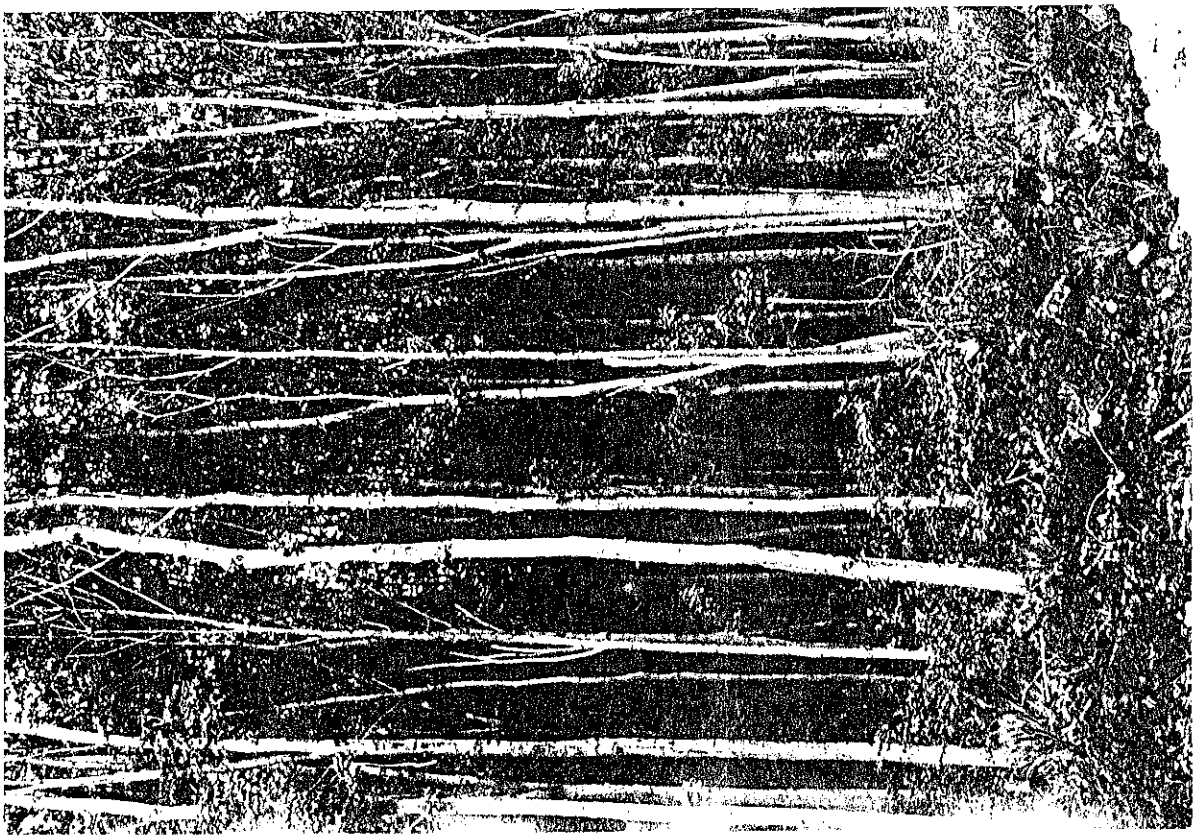
(3) Feeder stream is dominated by red maple (Acer rubrum). No development plans exist for this area other than a road crossing.

(4) Upland woods being developed for homesites are dominated by old "pasture" white pines (Pinus strobus). In addition to the pine shown here, other major trees include red spruce (Picea rubens), Eastern hemlock (Tsuga canadensis), American beech (Fagus grandifolia), red oak Quercus rubra), and yellow birch (Betula lutea).

CHASE HOUSING DEVELOPMENT







Rand Lumber Company

The Rand Lumber lands provide an outstanding example of how to manage larger tracts of land for multiple-use purposes. The major Rand lands occur off of Wallis Road, and consist of 90+ acres owned by Mr. Wilford Rand and Mrs. Irene Rand. Other Rand lands include 16 acres off Washington Road (the land abuts the Rye Recreation Area and the Tilton property), 9 acres of land off of West Road near Cedar Run, and 2 acres of land off of Breakfast Hill Road near the old Berry's Brook Mill site.

Forest composition of the Rand lands off of Wallis Road is similar to that described for the Chase Development. Forest management is geared primarily towards producing merchantable size white pine (Pinus strobus), hemlock (Tsuga canadensis), and red spruce (Picea rubens) trees for use as sawlogs in the Rand saw mill. Production of these trees is brought about using a combination of small clear-cuts and selective thinning of Rand woodlots. Using the selective thinning method, larger trees are removed, resulting in openings in the canopy, and allowing space and light for the remaining smaller diameter trees to grow. Using the clear-cut method, small openings (half-acre size) in the forest are created allowing for new young forest growth to develop. Large residual trees are left within these openings to provide seed stock for the newly opened up areas of the forest. After a few years,

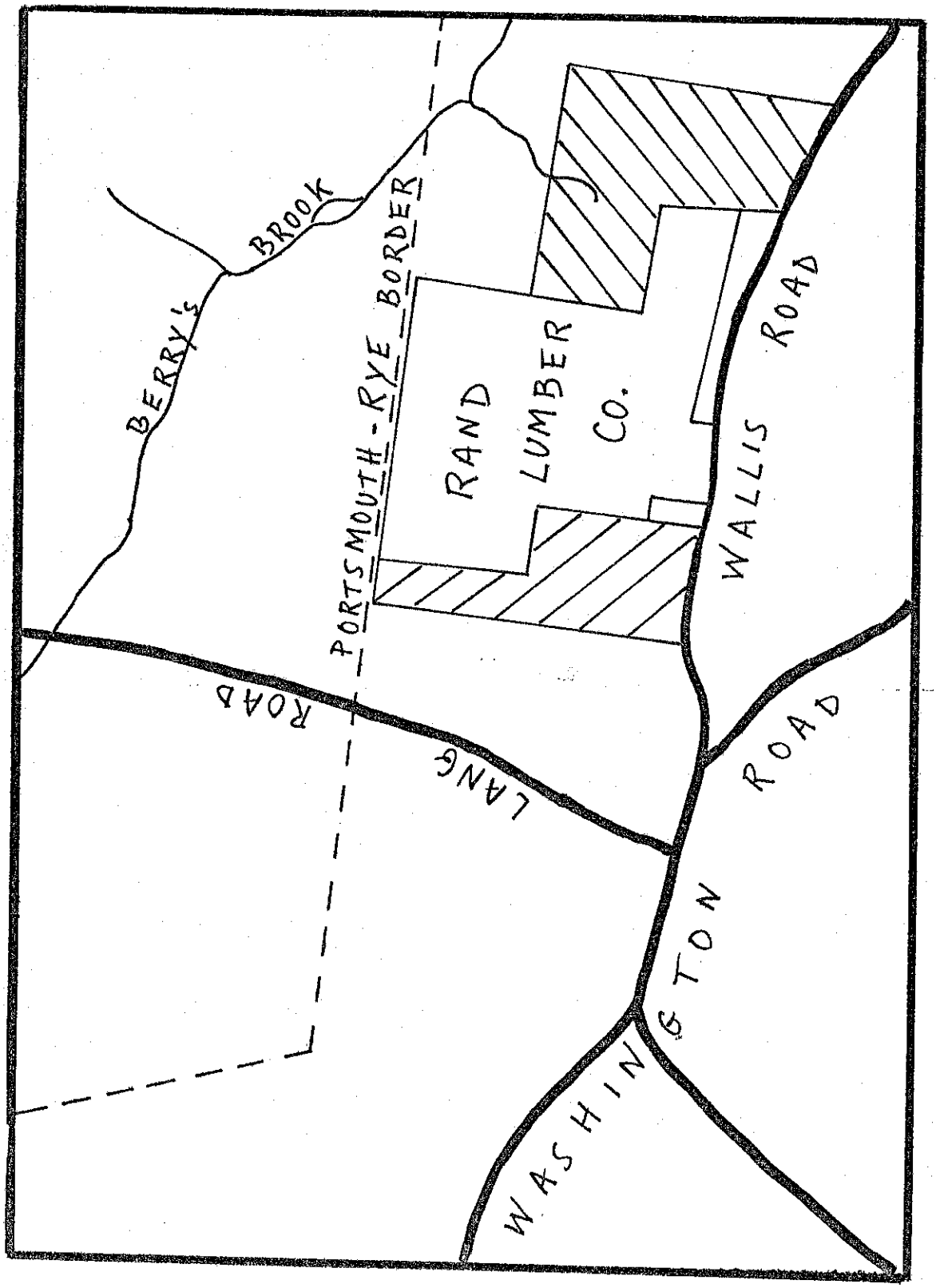
these clear-cut areas are filled with hundreds of young pine, spruce, hemlock, or oak seedlings which grow rapidly in response to their unrestricted light supply.

Both of these management techniques provide for excellent wildlife habitat within the forest. Residual slash left behind from harvesting provides homes and nesting sites for numerous wild creatures (grouse, quail, rabbits, and other game birds). The young succulent leafy growth of young trees in clear-cut areas provides cover and browse for deer. In addition, the diversity in tree age in these woodlots, from young seedlings to mature trees, provides numerous nesting sites for several species of song birds.

For many of the same reasons, these managed woodlots are more aesthetically pleasing for recreational use. Similarly managed woodlots might be used for hunting or conserved as wildlife refuges where people could come and be assured of seeing various forms of wildlife. The mixed age character of these woodlots imparts greater diversity to the forest and makes them more aesthetically pleasing for people seeking their use in hiking, cross-country skiing, snow-shoeing, or botanizing.

As is the case for several other parcels of land described in this report, the Rand lands border the Bellyhack

Bog ecosystem. Unlike some of these other land holdings, the present character and integrity of the Rand lands is not jeopardized, nor does their current or projected management pose any immediate threat to their security or that of the Bellyhack Bog ecosystem. In this regard, the Rand lands are similar to those owned and held by the Rye Elementary School. They are dissimilar and represent a direct contrast to the projected use of the Chase lands or the potential long-range use of Parsonage Woods. As stated in the discussion of the Chase Development, any use of lands bordering the Bellyhack Bog-Berry's Brook ecosystem for purposes other than their use "as is" or in a managed state such as that being carried out by Rand Lumber Co., poses a potential threat to the security of this ecosystem. Housing developments in this part of Town should be discouraged, and new housing should be encouraged elsewhere in the Town where it does not pose any long-range threat to a major natural watershed or wilderness area such as is the case for Bellyhack Bog. Lands bordering this watershed are much more suited for forest management or passive recreational use, and should be used only for these purposes.


BERRY'S BROOK
PORTSMOUTH - RYE BORDER
RAND LUMBER CO.
WALLIS ROAD
LANG ROAD
WASHINGTON ROAD

Rand Lumber

(1) Rand Lumber Company, located off Wallis Road, provides an excellent example of how to manage the potential Town Forest. In this photo, saw logs are lined up awaiting their turn to be processed in the Rand sawmill. While timber production is the prime goal of the Rand Company, balanced management of their lands leads to a number of other important benefits. These include wildlife habitat, recreation, aesthetics, and watershed stabilization.

(2) Piles of sawdust attest to the number of saw logs which have been processed through the mill.

(3) Natural Rand woodlands consist of northern hardwoods and confiers. Here we see a young specimen of yellow birch (Betula lutea) growing next to a younger red spruce (Picea rubens).

(4) Lowland sections of the Rand lands consist of red elm (Ulmus fulva) and red maple (Acer rubrum). These sections, which are a part of the Berry's Brook-Bellyhack Bog ecosystem, are left undisturbed and are not managed for timber.

(5) Management of the upland Rand lands for timber production follows two approaches. One of these is rapid forest regeneration fostered by very small well-excuted clear-cuts. Small openings in the forest are created, and young trees representative of the pre[illegible]

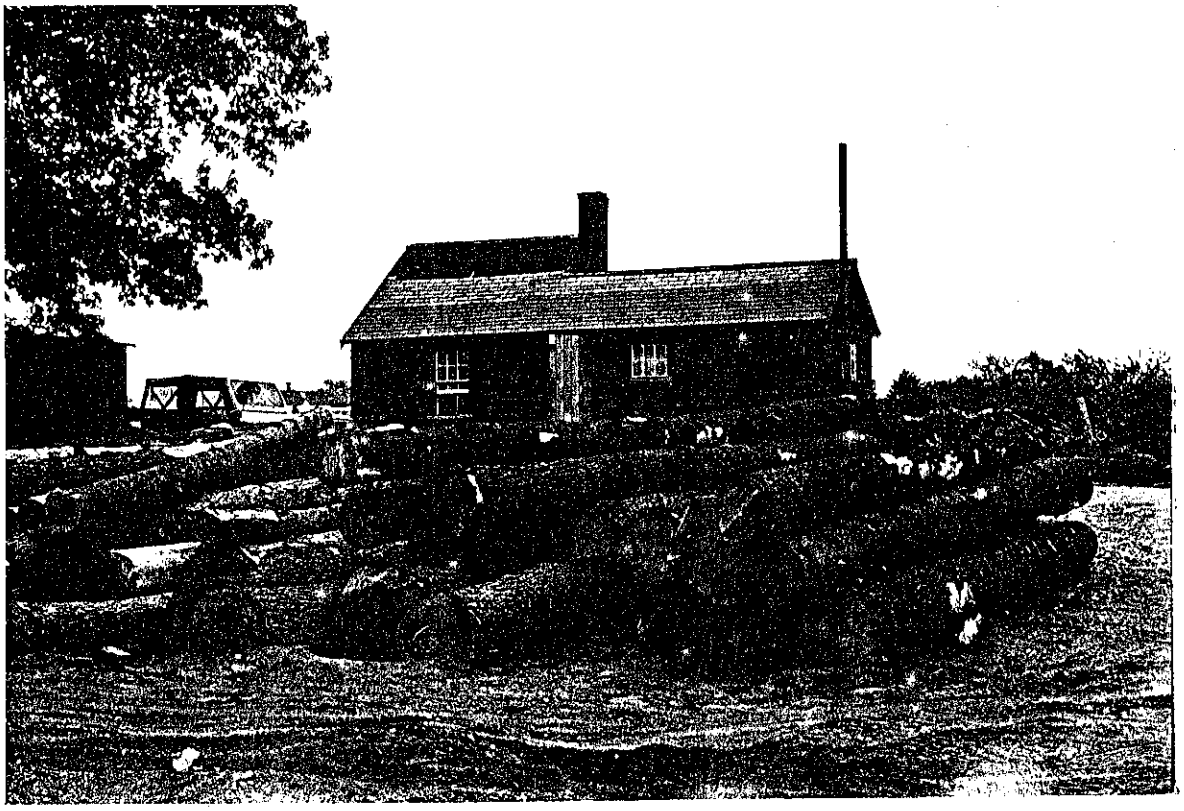
forest composition are able to seed in, germinate, and grow. Forest openings too large would result in species compositional changes.

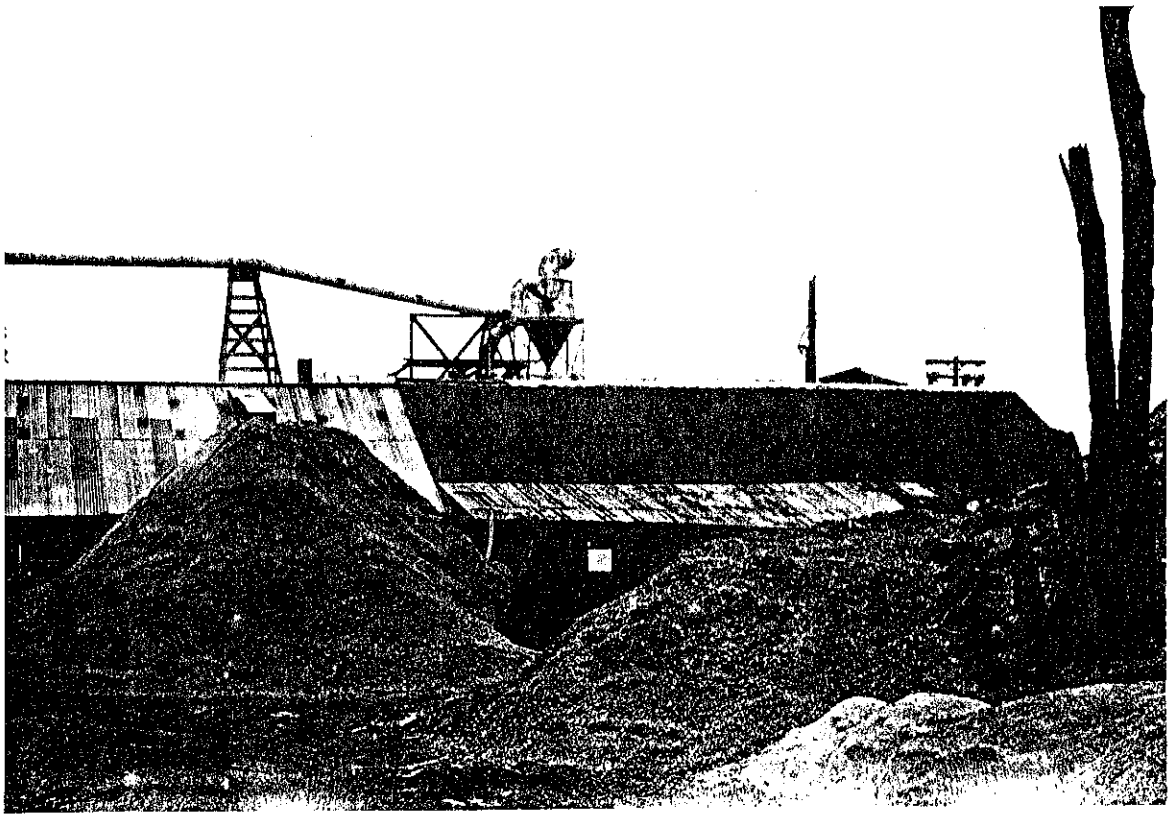
(6) A few mature genetically superior trees are left in these openings in order to provide a seed source for the new forest.

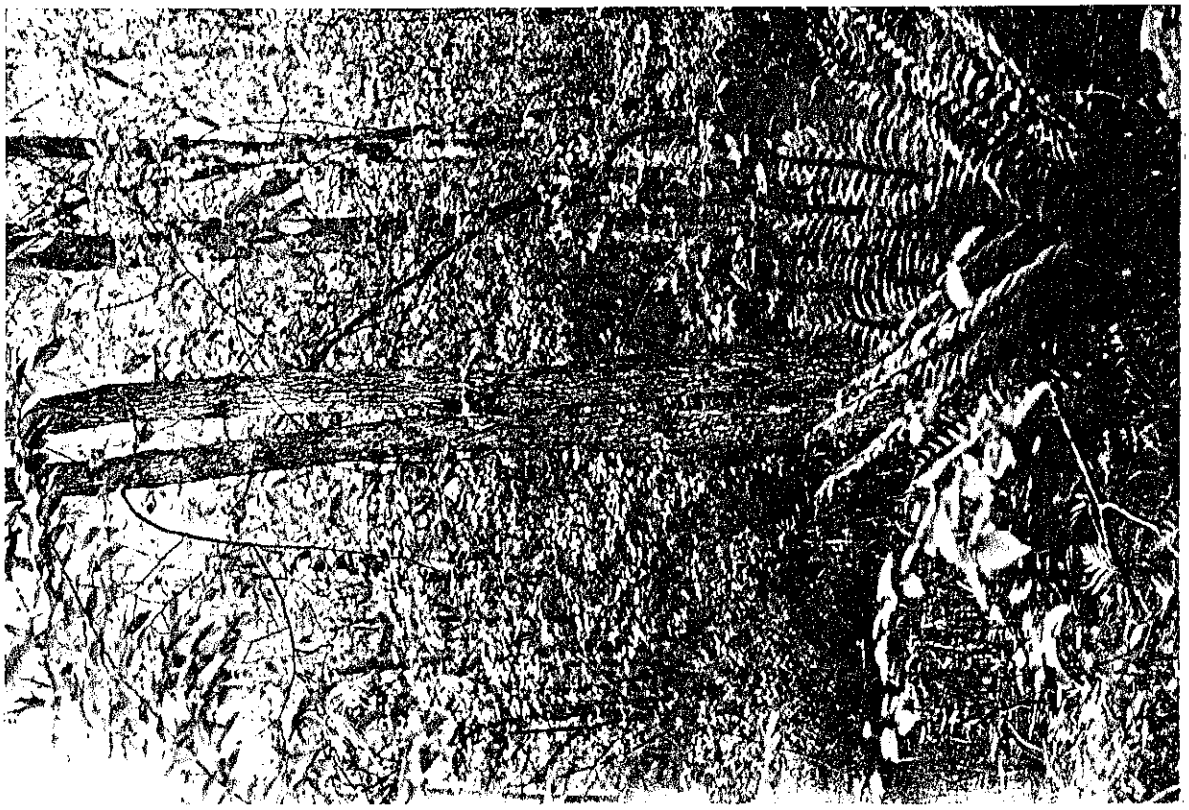
(7) In the second management approach, existing forest stands are thinned. The forest canopy is openned, allowing more light for the growth of the remaining trees. In addition, young seedlings left in the understory will now grow better.

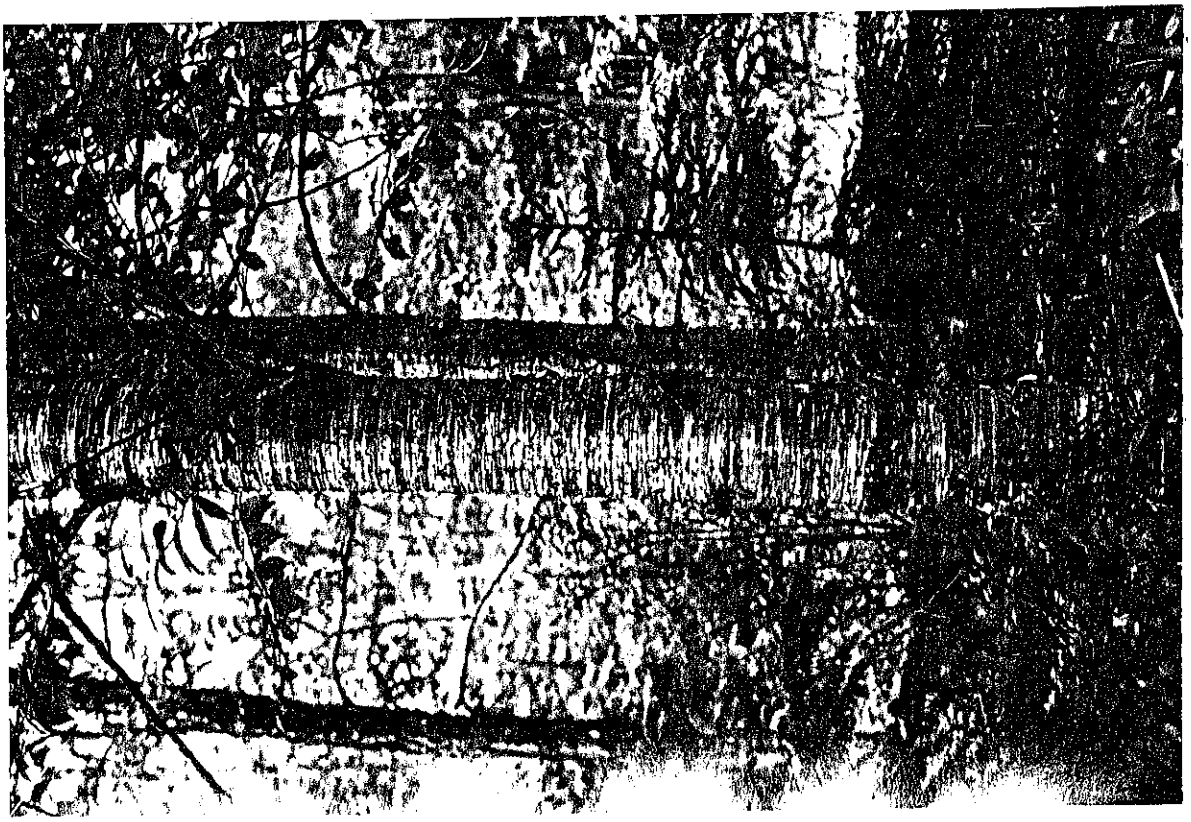
(8) With a new burst of light, seedlings in the understory take off in growth. Brush or slash left on the ground provides wildlife habitat. Young seedling growth from either management method provides food for wildlife, in particular, deer browse. Growth of shrubby fruits in clear-cut areas also attracts wildlife.

RAND LUMBER COMPANY

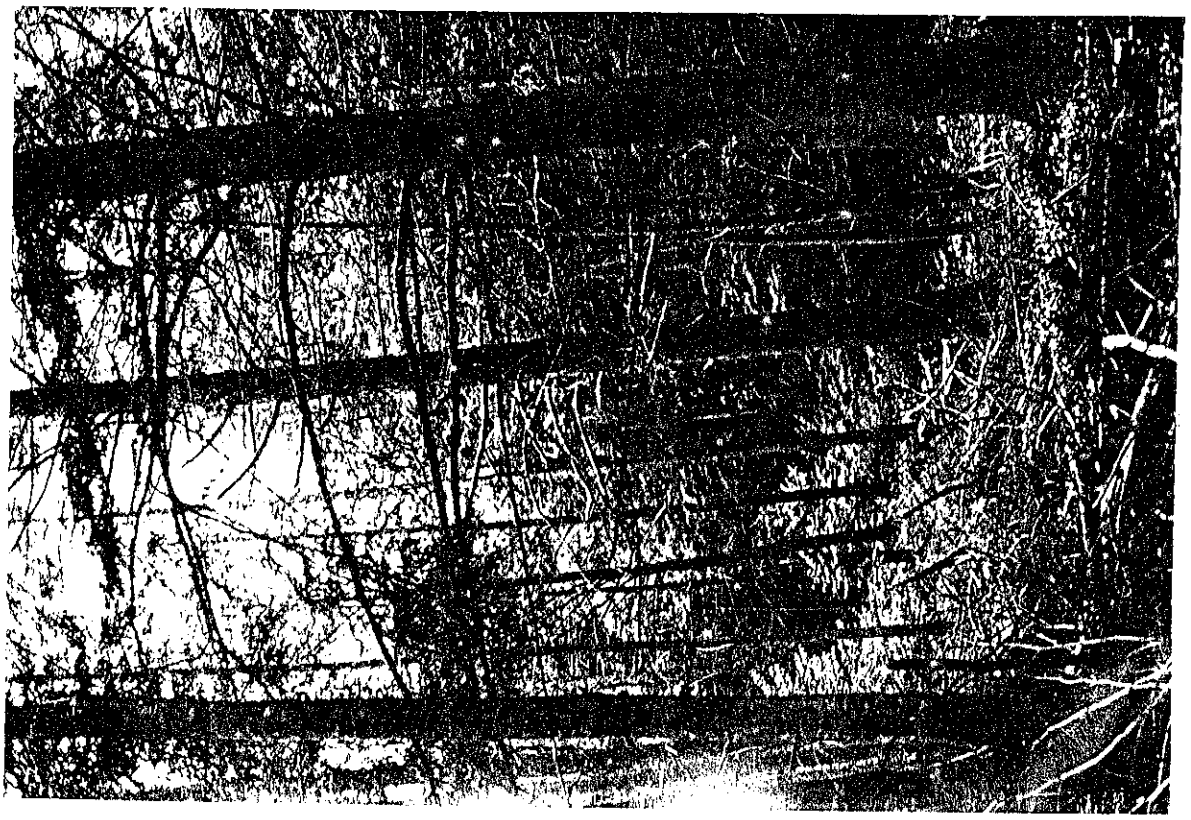


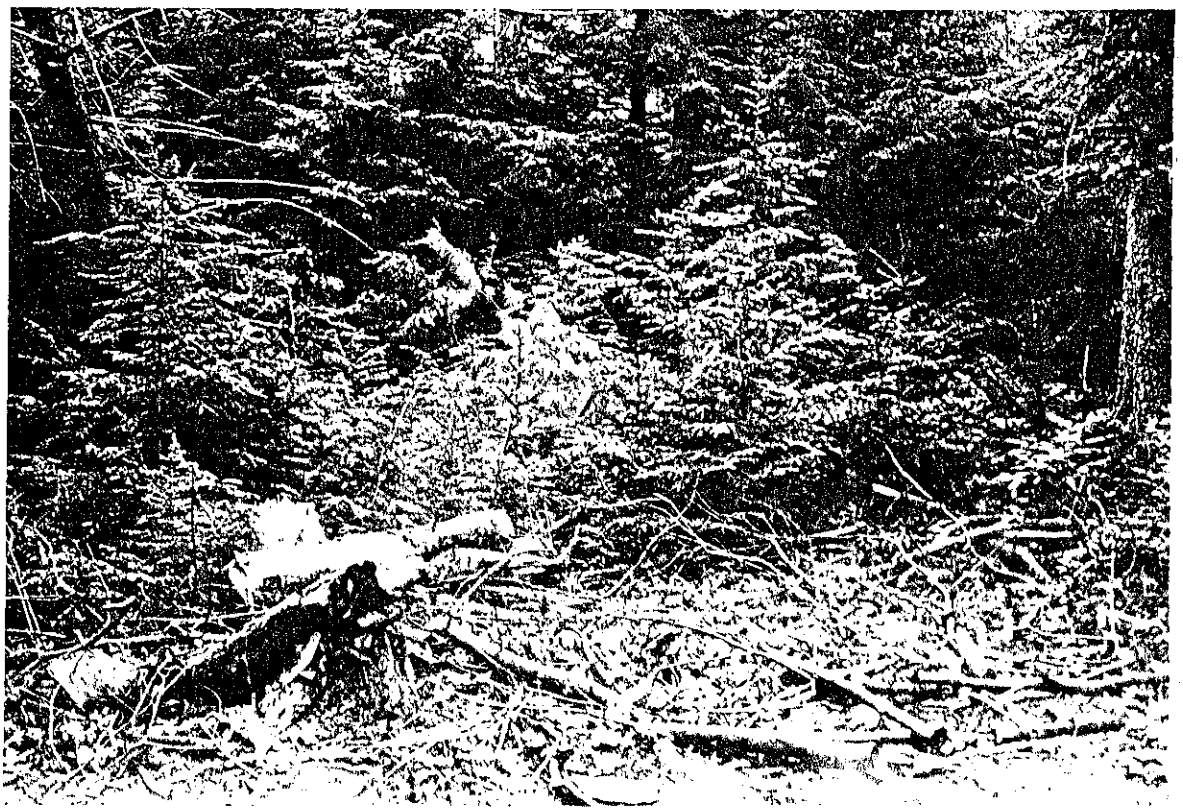






RAND LUMBER COMPANY



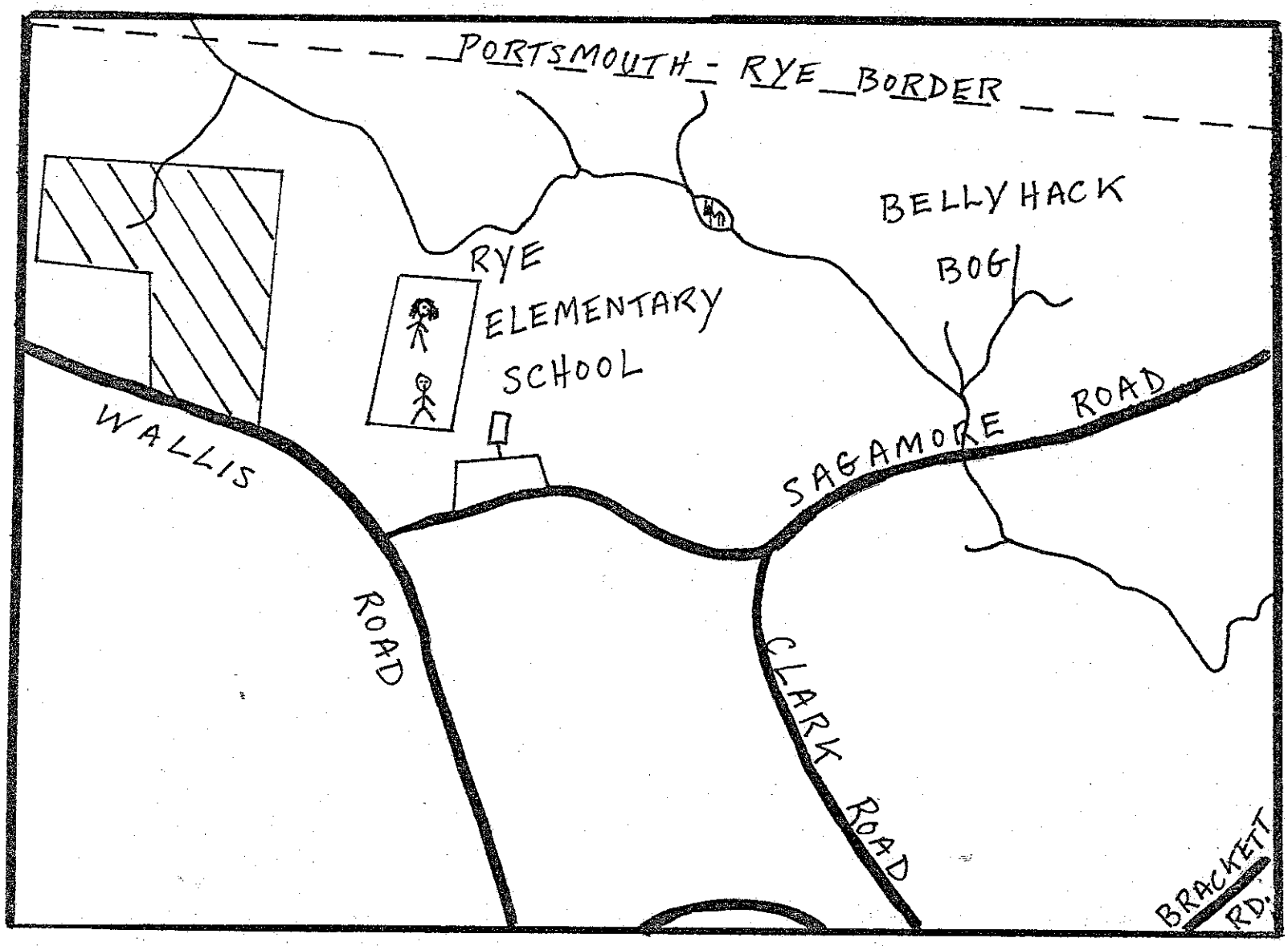


Rye Elementary School Nature Center

The Outdoor Nature Center at the Rye Elementary School is at present one of (also Odiorne Point State Park) the best existing formally set-up environmental education centers in Rye. Unfortunately, few people know of its existance, or make full use of what it has to offer. The extremely close proximity of the Center to the Bellyhack Bog makes it highly strategic for those wishing to view the Bog, and provides absolutely the best example of forest transitional changes as one proceeds down into the Bog, anywhere in Rye.

The nature trail at the School follows a straight-line transect into the Bog, beginning in the open field in front of the School and passing through three forest types before reaching the Bog area. The first of these is a pioneer species forest consisting of black cherry (Prunus serotina) and aspen (Populus deltoides) mixed into an abandoned apple orchard. Other species present include white ash (Fraxinus americana), witchhazel (Hamamelis virginiana), red maple (Acer rubrum), and red elm (Ulmus fulva). The latter two species occur along a streambed at the base of an upland northern hardwoods forest. This second forest type consists of hemlock (Tsuga canadensis), yellow birch (Betula lutea), beech (Fagus grandifolia), sugar maple (Acer saccharum), white birch (Betula papyrifera), black birch (Betula lenta), and white pine (Pinus strobus) growth. Upon leaving this upland predominantly

northern hardwood forest, one descends into the Bog and is surrounded by the third forest type, a pure red maple (A. rubrum) swamp. Ferns and various other freshwater macrophytic plants abound in this area and the edge of the swamp is surrounded by numerous alder (Alnus spp.) stems. Not far from this swamp, in a nearby portion of the Bog, beavers have built dams resulting in massive flooding and the presence of large numbers of standing dead red maple trees. These areas serve as wildlife habitat for numerous amphibian, reptile, and nesting bird populations. This area is currently owned by Mr. J. Bromfield (Wallis Road), and should preferably be acquired by the Rye Elementary School or the Rye Conservation Commission in order to further protect this area. The relatively short distance to Portsmouth at this location makes this site an ideal location for constructing a new road which would interconnect the present Elwyn Park development with Rye.


PORTSMOUTH - RYE BORDER
BELLY HACK BOG
RYE ELEMENTARY SCHOOL
WALLIS ROAD
SAGAMORE ROAD
CLARK ROAD
BRACKETT RD.

Rye Elementary School

(1) Nature trail at Rye Elementary School begins behind the school.

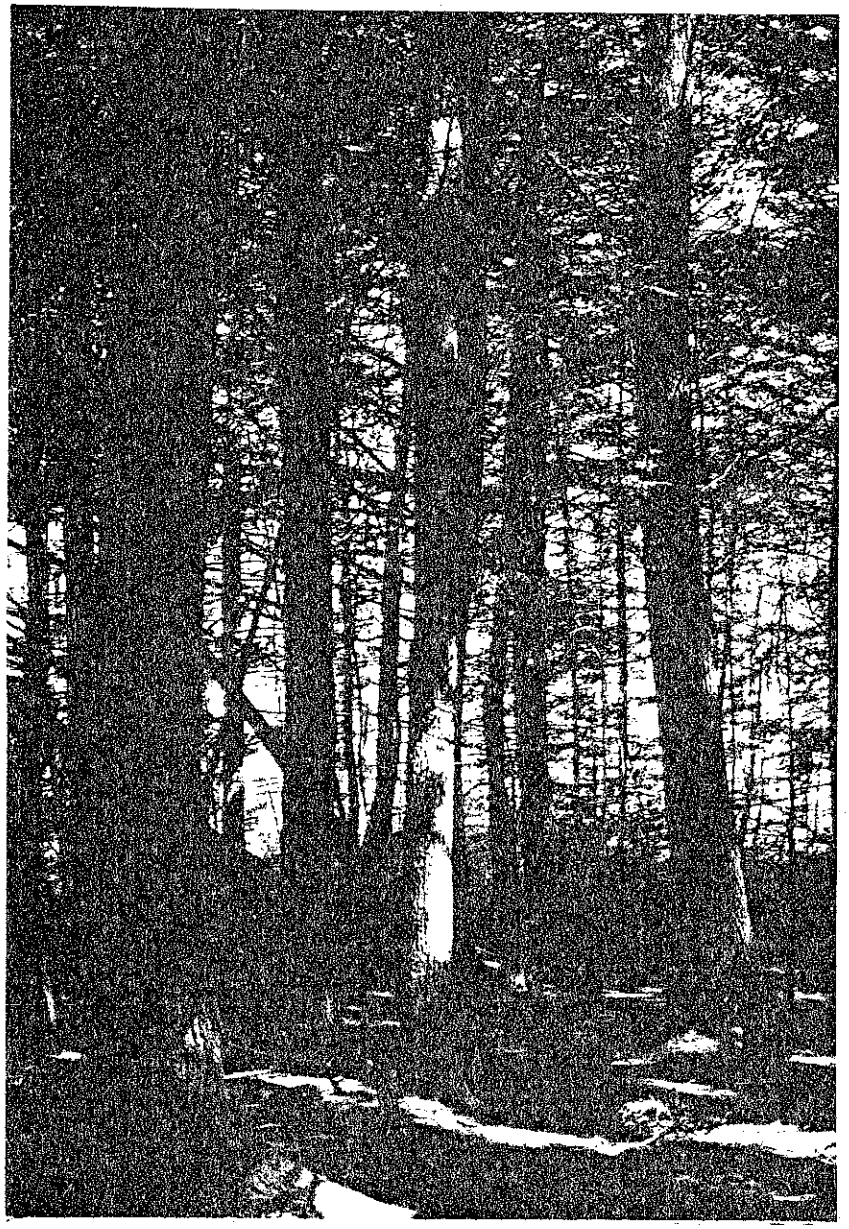
(2) Early on the trail is a stream crossing and lowland wet area characterized by red elm (Ulmus fulva) and red maple (Acer rubrum).

(3) Farther along the trail is an upland forest composed of hemlock (Tsuga canadensis), yellow birch (Betula lutea), beech (Fagus grandifolia), sugar maple (A. saccharum), white pine (Pinus strobus), and white birch (Betula papyrifera).

(4) Leaving this upland forest, one descends into a bog (back side of Bellyhack Bog) and is surrounded by a pure red maple (A. rubrum) swamp. Ferns and various other macrophytic plants abound.

(5 - 7) Many of the red maples have died as a result of flooding from beaver dams.

(6) Alder shrubs (Alnus sp.) provide an abundance of food for wildlife.



RYE ELEMENTARY SCHOOL
NATURE CENTER

RYE ELEMENTARY SCHOOL
NATURE CENTER

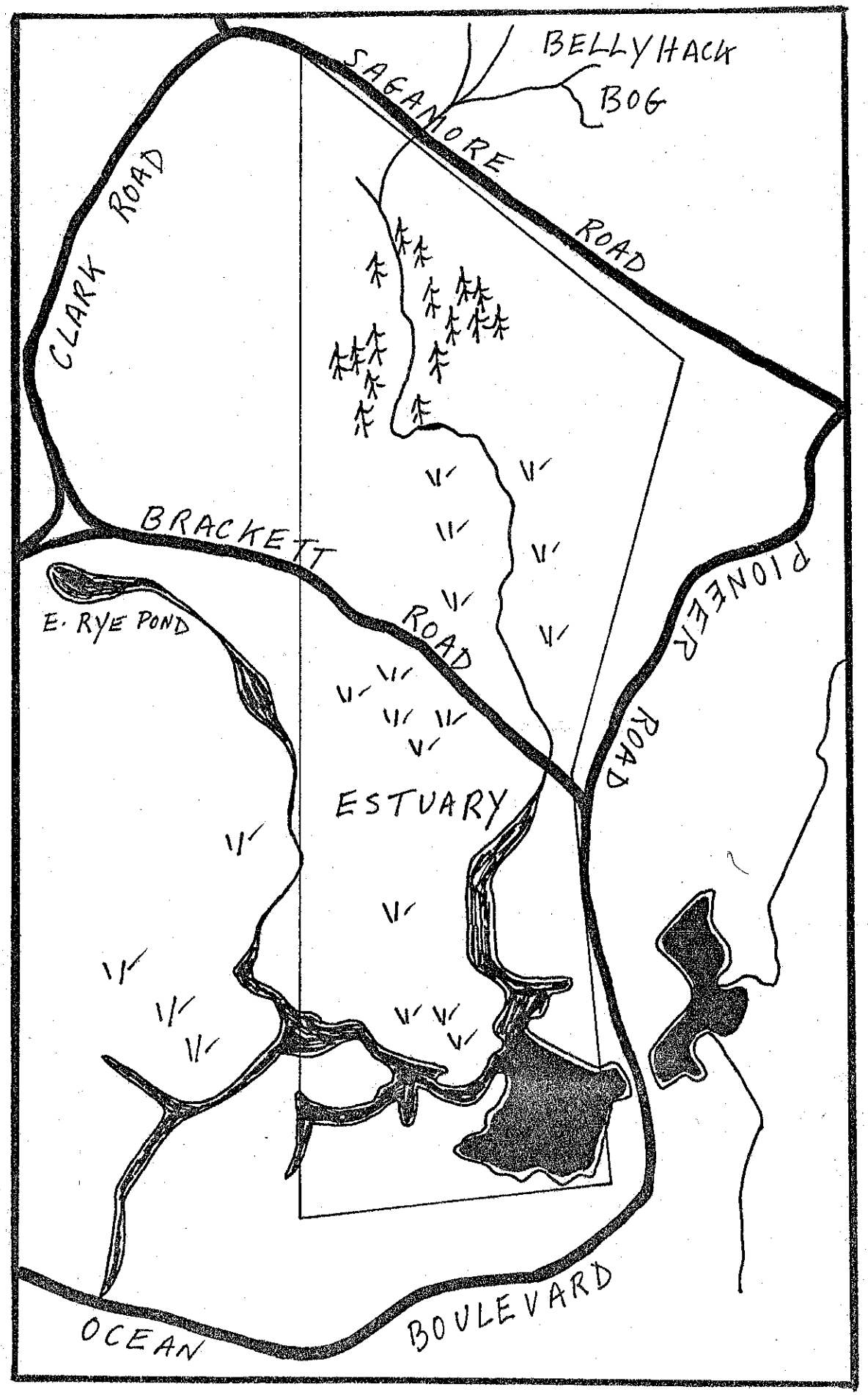
Pioneer-Brackett-Sagamore Roads Estuary

The estuary which originates at Pioneer Road and extends inland from Brackett to Sagamore Roads is the final sector of the Berry's Brook-Bellyhack Bog ecosystem. This estuary, which affords one of the nicest views of the Berry's Brook-Bellyhack Bog ecosystem, is by far one of the most spectacular natural areas in Rye. Much of the land in the estuary is currently owned by Mr. John L. Adams, who presently resides in California. Attempts to contact Mr. Adams have been made by members of the Rye Conservation Commission on numerous occassions with little or no success.

In addition to a complete array of saltwater marsh plants, the estuary contains various forest species between Brackett and Sagamore Roads. After crossing Sagamore Road Berry's Brook flows through an extensive hemlock (Tsuga canadensis) ravine forest before entering the marsh to the east of Brackett Road. This hemlock forest contains many mature old trees, and is very dense and shaded in character. Mixed in with the hemlocks are numerous white pine (Pinus strobus) trees. At the point where the stream leaves the hemlock forest and begins to enter the marsh estuary numerous transitional species grow. Some of these include white cedar (Chamaecyparis thyoides), white oak (Quercus bicolor), tupelo (Nyssa sylvatica), red cedar (Juniperus virginiana), and bayberry

(Myrica pennsylvatica).

The estuary provides a diversity of habitats for both marine and freshwater organisms. The high diversity of plant and animal life in this area is unmatched by any other natural area in Rye. These characteristics coupled with its unusual scenic beauty make it a candidate for immediate high priority action by the Rye Conservation Commission.


BELLYHACK
BOG
SAGAMORE
ROAD
CLARK ROAD
BRACKETT
ROAD
E. RYE POND
PIONEER
ROAD
ESTUARY
OCEAN
BOULEVARD

Estuary

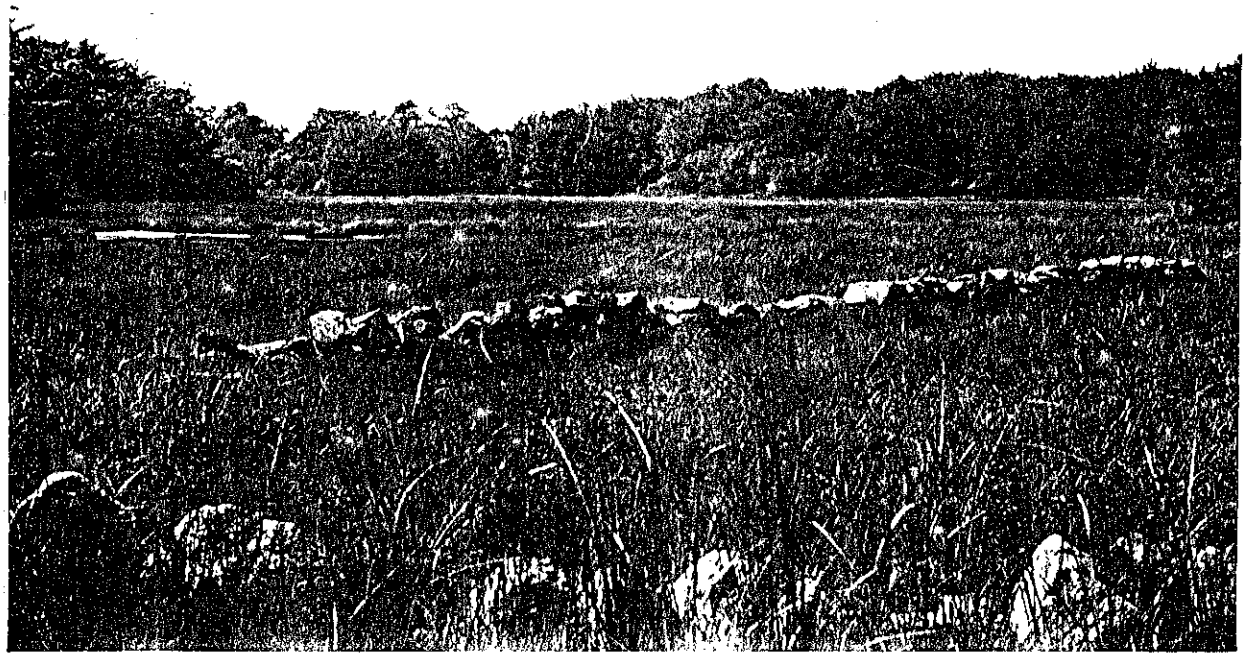
(1) Looking out across the saltmarsh, as seen from near Pioneer Road just above Brackett Road, one is able to see the massive estuary forest which stretches inland to Sagamore Road.

(2) At the mouth of the forest, if one turns around and looks east, it is possible to see houses along Brackett or Pioneer Roads. One of these is the home of Ralph Brown, a Conservation Commission member.

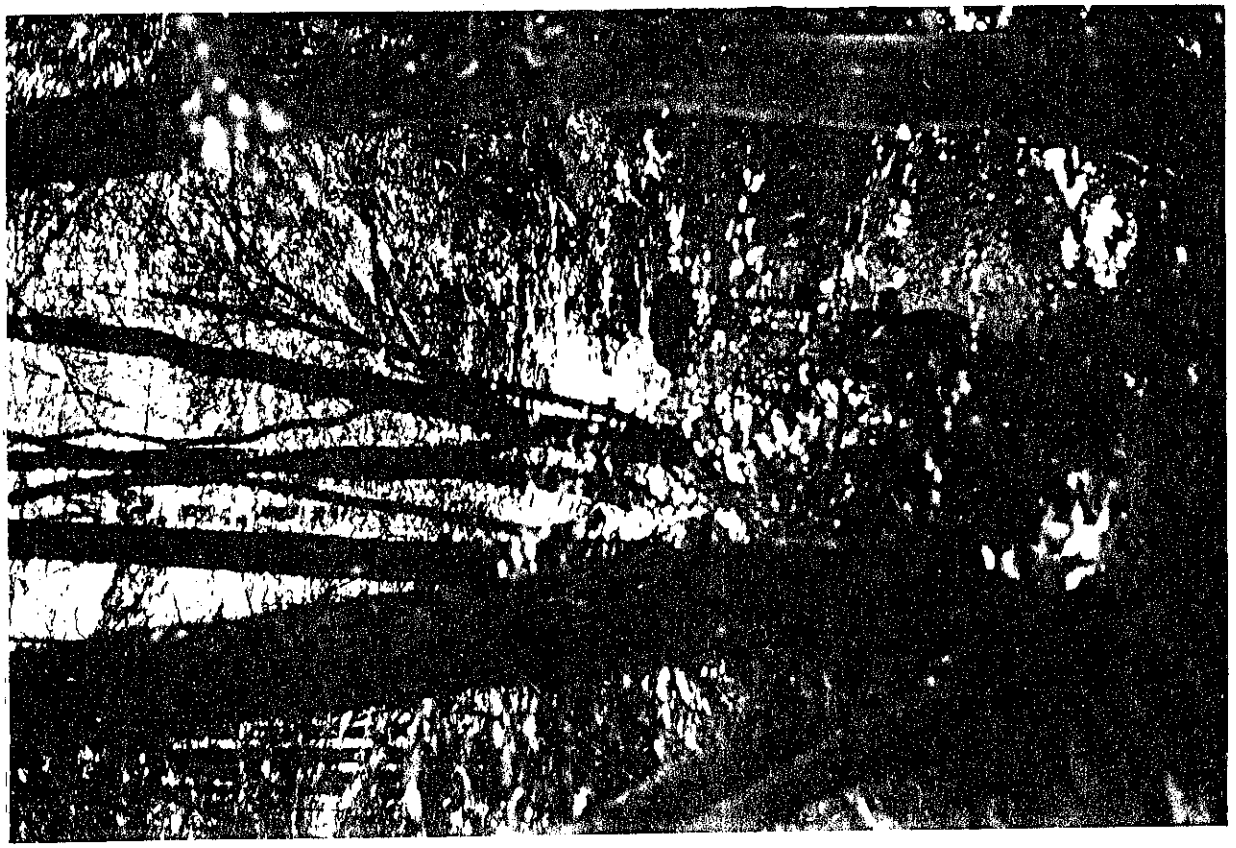
(3) The estuary forest is characterized by a dense hemlock grove lining a rocky ravine streambed, the waters of which originate in Berry's Brook-Bellyhack Bog above Sagamore Road.

(4) Near Sagamore Road, the forest changes abruptly to freshwater marsh.

PIONEER - BRACKETT - SAGAMORE ROADS ESTUARY



PIONEER-BRACKETT-SAGAMORE ROADS ESTUARY



Parson's Tract - Town Forest

The proposed Town Forest is located in the area currently known as the Parsons tract or homestead. This 46 acre parcel of land has recently been purchased by the Town of Rye, and is currently unmanaged. It is bounded by the Town cemetary and the Rye Recreation Area.

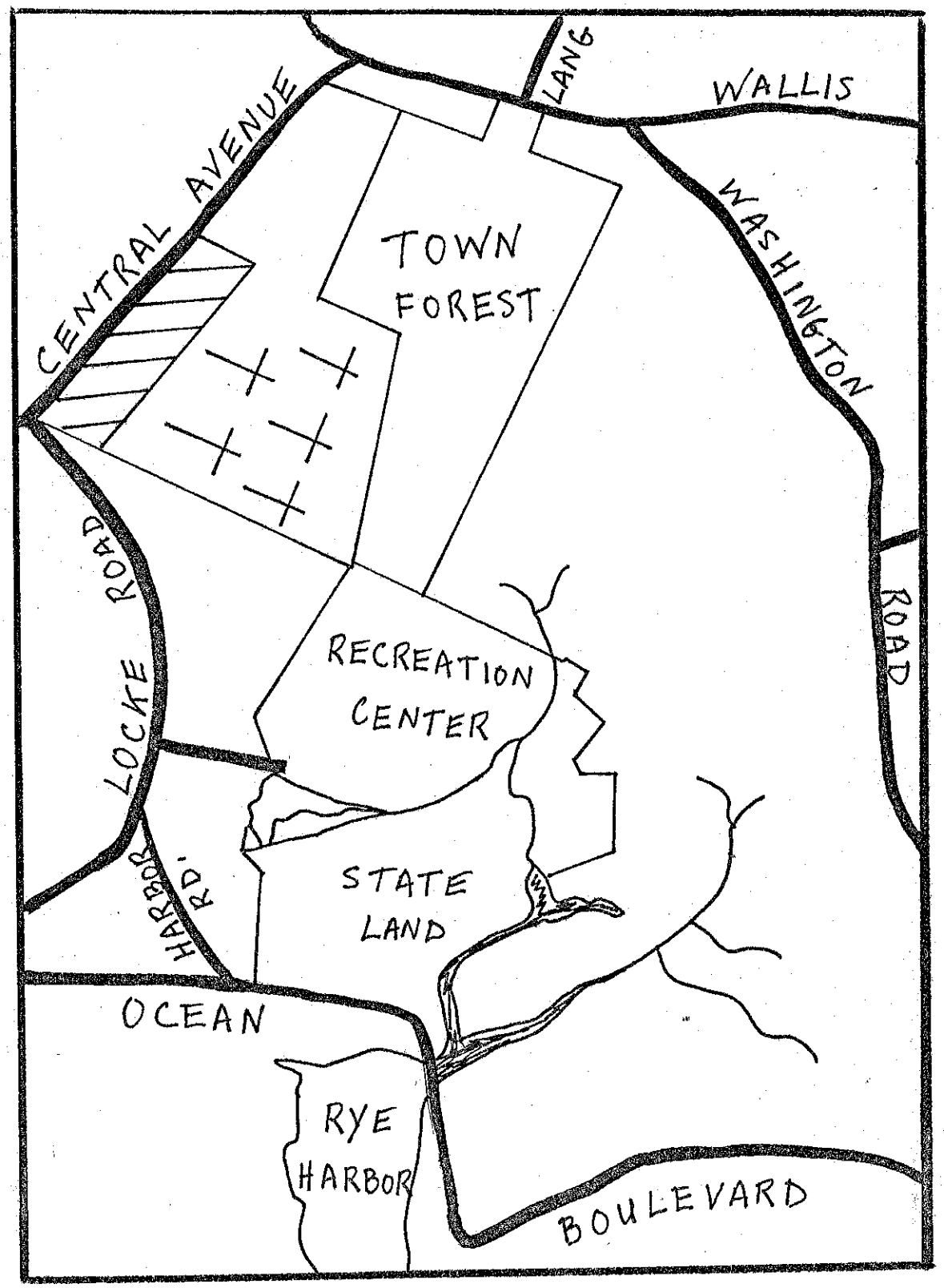
Numerous forest habitats representative of all phases of forest succession can be observed in this area. Some of these include open fields, abandoned patureland which is currently undergoing succession, & old mature stands of white pine (Pinus strobus). Younger pines exhibiting good growth form occur near the Recreation Area and along the cemetary border. These trees reflect a high potential for future sustained yield timber production if properly managed. Older pasture pine exhibiting exceedingly poor growth form may be observed within the Parson's tract near the open fields off Washington Road. These trees have little value for lumber and would have to be displaced with new tree stands (plantations) in order for this area of the forest to have any long-term commercial value. Although these pasture pine lack commercial value, they do possess other more intangible values not measureable in economic terms. These include their value for wildlife habitat and their aesthetically pleasing appearance to those using the area for recreational purposes.

The latter point raises the issue of multiple-use management of the prosposed forest as opposed to straight forward management for commercial purposes only. Current demands on the part of the public for additional open space dictate that this tract of land should be managed with regard to a multiple-use concept. Such a concept would include managing for wildlife, passive recreation (for example, cross-country skiing, hiking, environmental education, etc.), and community firewood production as well as timber production. Developing such a plan of management will require an in-depth examination of the property's resources and potential by a qualified consulting forester prior to embarking upon any use of the land. Failure to do so could result in irrepairable damage to unique resources located on the property.

In terms of multiple-use management, perhaps the most valuable aspect of the property is its potential use as a resource tool for environmental education. This is most obvious in the diversity of habitats and successional stages found in or adjacent to the forest. In addition to the white pine areas described above, some of these include: (1) open areas within the forest exhibiting early seral species successsion (these are characterized by young aspen (Populus deltoides) & blueberry (Vaccinium corymbosum) growth, and provide excellent wildlife habitat), (2) a

wet swampy area within the forest containing red maple (Acer rubrum) and highbush blueberry (Vaccinium corymbosum) growth, and (3) an assortment of old fields adjacent to the forest undergoing succession, and characterized by the presence of red cedar (Juniperus virginiana), ground cedar, wild black cherry (Prunus serotina), oak (Quercus rubra), and young white pine (Pinus strobus) growth. The proximity of the Rye Junior High School makes development of this area for environmental education extremely desirable.

Management practices on-going at Rand Lumber Co. for sustained yield lumber should serve as a good example of how to properly manage the property for commercial purposes. Some of these practices are described in the section dealing with Rand Lumber Co. holdings.


LANG
WALLIS
CENTRAL AVENUE
TOWN FOREST
WASHINGTON
ROAD
LOCKE ROAD
RECREATION CENTER
ROAD
HARBOR RD.
STATE LAND
OCEAN
RYE HARBOR
BOULEVARD

Town Forest

(1) and (2) The site of the proposed Town Forest is located on the land formerly a part of the Parson's homestead depicted here.

(3) The massive forest tract is composed of a diversity of forest species and successional types. Here, an early forest successional stand of aspen (Populus tremuloides) may be observed. Numerous highbush blueberry shrubs (Vaccinium corymbosum) dominate the understory of this stand.

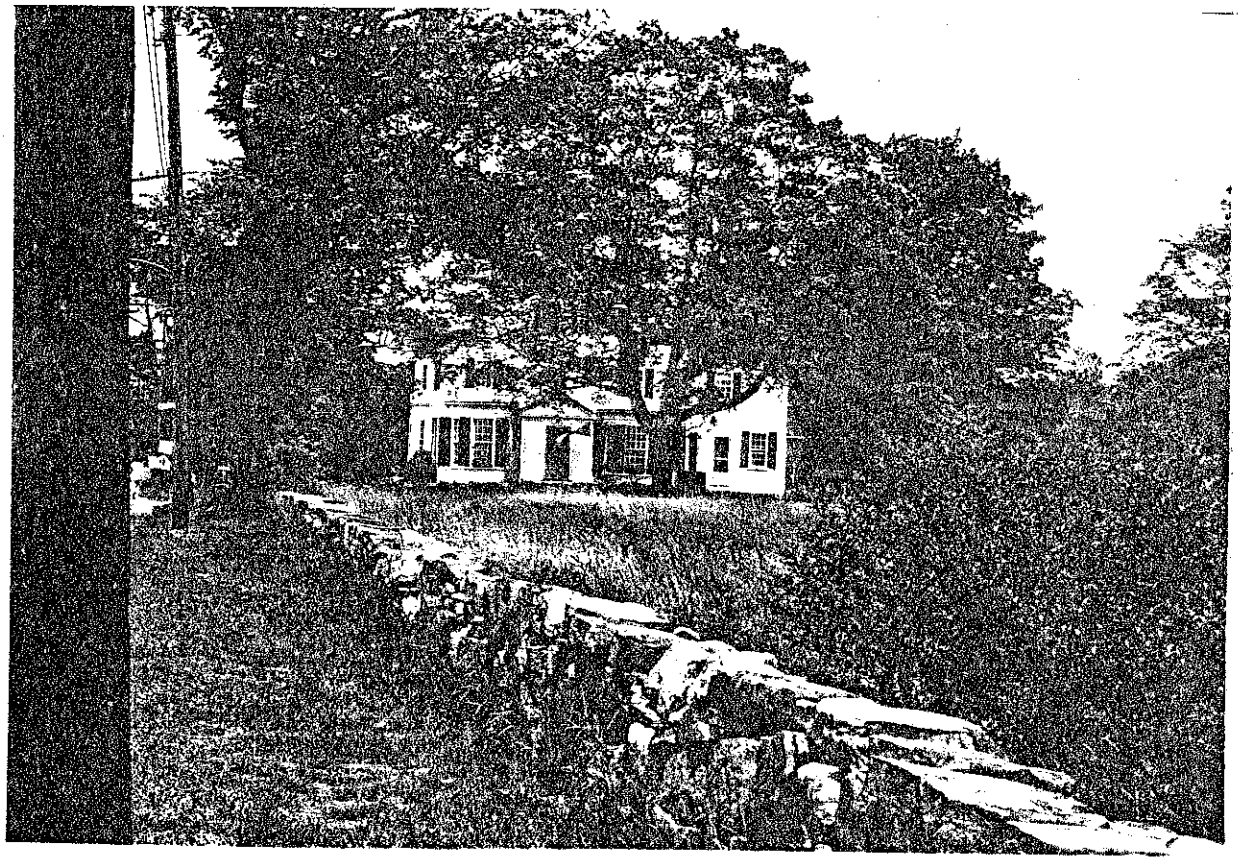
(4) Contrasting nicely with the young aspen stand is a nearly mature climax stand of white pine (Pinus strobus). The good growth form of these trees indicates they will be suitable for harvesting in a few years.

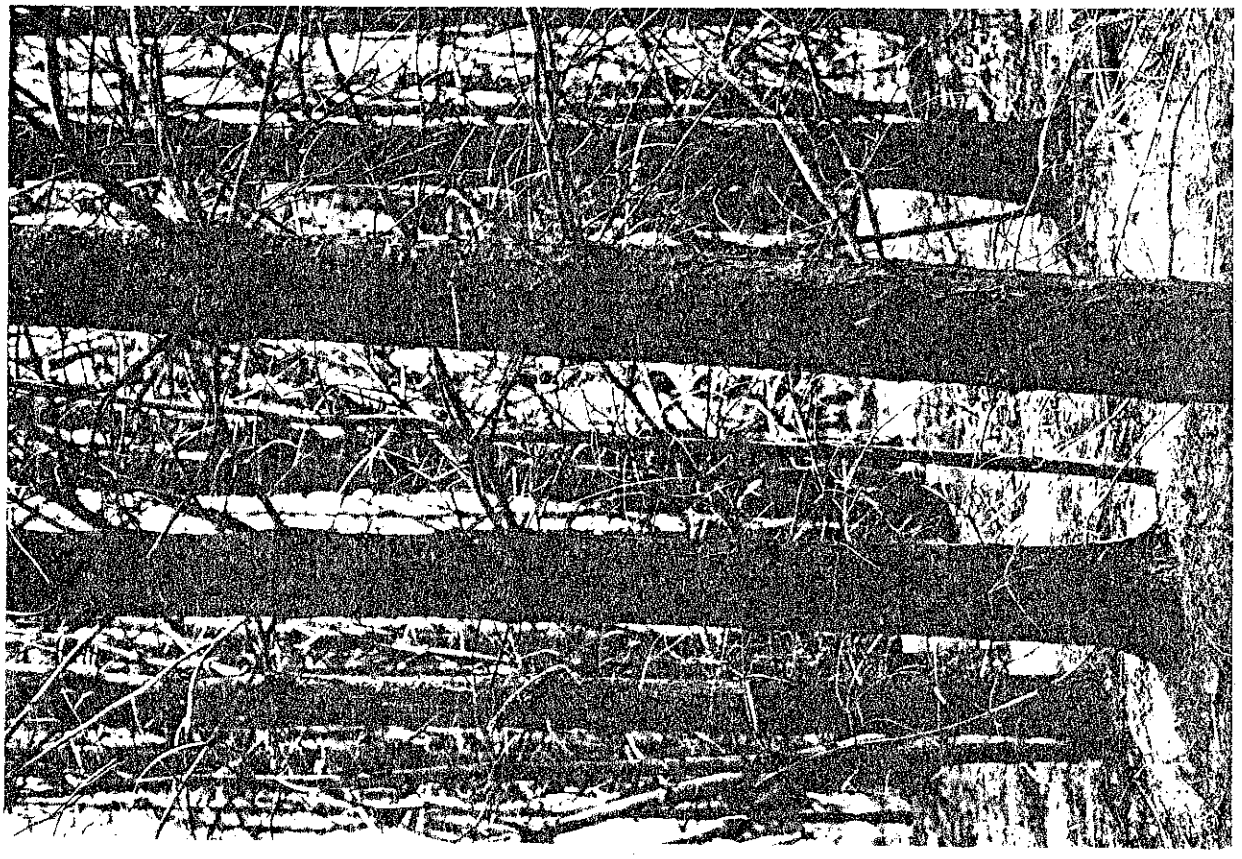
(5) Other parts of the forest are dominated by poor-growth pine which will gradually have to be displaced if the forest is to be managed with timber production as one of its goals.

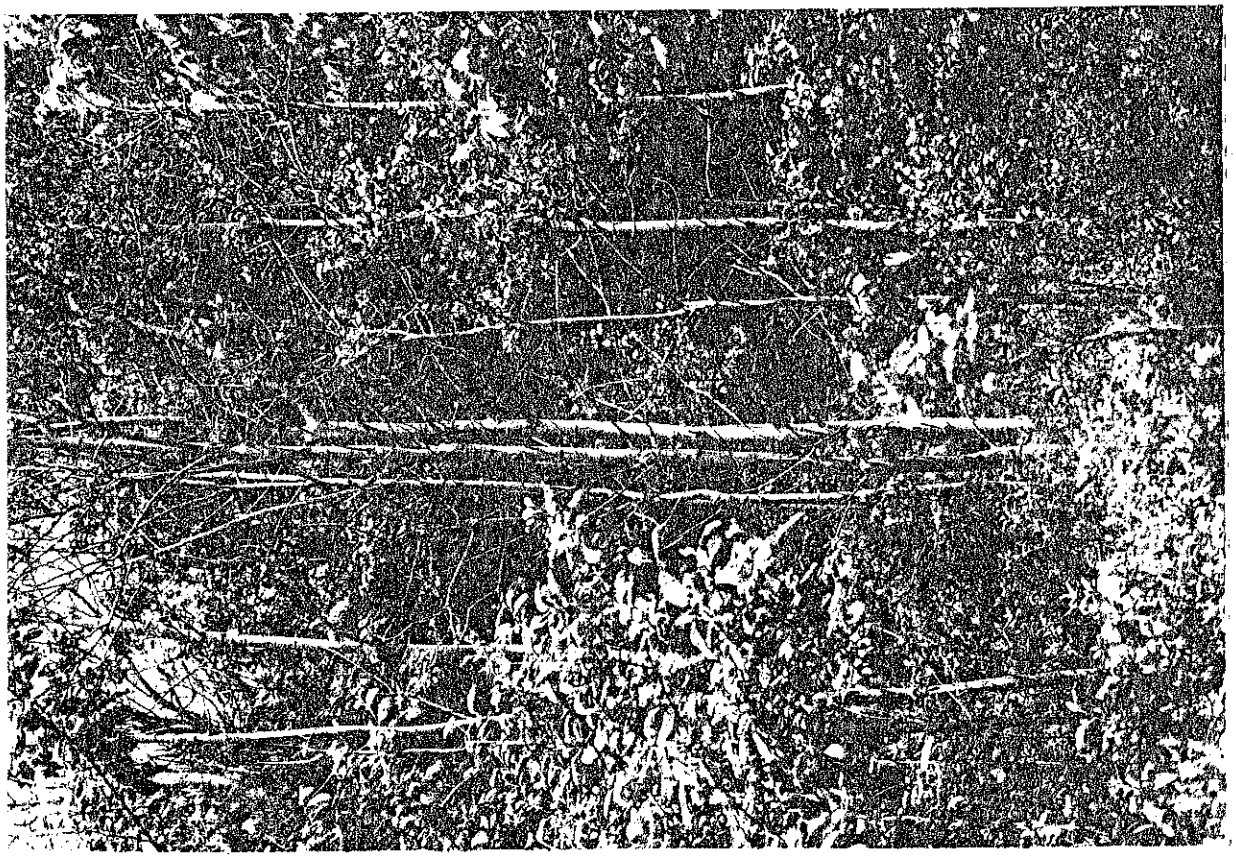
(6) and (7) Near the center of the forest is a red maple - alder swamp (Acer rubrum, Alnus sp.). While unproductive from a timber production standpoint, this area provides excellent wildlife habitat and provides both recreational and wildlife needs if multiple-use management of the forest is an intended goal.

(8) Adjacent to the forest, and near the Town Cemetary,

are numerous fields undergoing plant succession. Many of the fields are dominated by redcedar juniper (Juniperus virginiana) and ground juniper along with various species of cherry and oak. These fields offer excellent outdoor laboratories for environmental education.







PARSONS TRACT - TOWN FOREST

PARSONS TRACT - TOWN FOREST

Rye's Urban and Community Forestry Needs

Developing a comprehensive urban tree management plan for the Town of Rye should be considered a top priority. Such a plan would include: (1) an in depth inventory of all urban street and park trees and (2) the preparation of a specific blueprint for replacement, care, and maintenance of these street or ornamental trees. As a minimum, this urban street and ornamental tree inventory should include information on (1) the exact location of all trees, (2) the species of all trees, and (3) the age, diameter, and health condition of all trees. Such an inventory, by necessity, must predate the preparation of an urban tree management plan, as one could not accurately or intelligently project removal, replacement, care, or maintenance needs without it.

Trees in an urban setting have numerous values. These values which are measurable in both economic and non-economic terms, necessitate that all existing communiti take stock of their urban tree resources and begin to them with the intent of perpetuating them on a long basis. Trees modify the microclimate of our citie provide shade for our streets and thereby reduc air temperatures. By the process of transpira remove water from the soil, and expel it i By this process they modify the moisture

of our urban atmosphere. In addition, trees filter particulates from the air and reduce by consumption, the level of air pollutants in the air we breath. By the process of photosynthesis, trees capture the energy of the sun, remove carbon dioxide from the air, and produce carbohydrates and oxygen. Carbon dioxide is a waste product of our own respiration, and oxygen is a necessary gas for sustaining it. Without plants, of which trees are the most dominant inhabitants of the Earth, nearly all forms of life on this planet would cease. In addition to its use in mammalian respiration, oxygen also enters the atmosphere where it is converted to ozone and affects the levels and qualities of incoming radiation reaching the Earth surface. The presence of ozone in the atmosphere also modifies Earth temperatures on a macroclimatic basis. Trees also serve an important role in urban noise abatement. Urban trees provide a home for various forms of urban wildlife including songbirds and squirrels. The role played by urban trees in aesthetic appreciation of our surroundings is more difficult to measure in economic terms, but is of substantial importance. Perhaps the most important index of the value of urban trees from an amenity standpoint is linked with our state of mental health. There can be no doubt that having trees in our urban setting substantially improves our

mental state as we derive recreational and aesthetic values from having them in our immediate working or living environment. Our work productivity is increased and our zest for life is renewed on a daily basis. It's not really all that hard to imagine how dull our world would be without trees. Here in New England, one of the true joys of living is the magnificent burst of color which we are treated to each autumn.

Background Information on Urban Tree Stresses

Since the health status of the existing urban trees is so important in establishing a sound urban management plan, gaining some insight of urban tree pathology and ecology is most crucial. As Smith has stated in his 1970 textbook on Tree Pathology, "to those involved in managing ecosystems, especially artificial ones (of which urban and ornamental street trees are an example), pathological knowledge assumes an economic as well as ecologic importance". As a basis for understanding this knowledge, a few basic principles or concepts are important. According to Smith, plants, of which trees are prime examples, are subject to various factors which interfere with their normal development during the course of their lives. Smith has conveniently termed these factors, stresses. These stress factors are diverse and varied in character, and may in-

clude other living organisms or nonliving environmental extremes (Table 1).

"The science of pathology deals with those stress factors which cause injury or disease. Injury refers to abnormal physiology caused by a short-term interaction of a plant and a stress factor. Generally stress factors which cause injuries are nonliving, or abiotic. Disease, on the other hand, is characterized by abnormal physiology occassioned by an extended interaction between a plant and a stress factor. In the case of most diseases the stress factors are living or biotic entities". Some stress factors, for example, insects, are normally treated by other disciplines than pathology (in the case of insects this discipline is entomology). According to Smith, such an arbitrary and/or traditional division is unfortunate, and "may lead to the impression that the factors operate independently of one another. In fact, plants at any point in time are generally subjected to the concurrent influence of several stress factors. The healthfulness of the plant will be determined by the total effect of all stresses. In addition, many stress factors facilitate or enhance the significance of others". Abiotic injuries may provide ingress for biotic microbial disease agents. "Some stress factors are obligately dependent on

PATHOLOGICAL STRESS FACTORS OF PLANTS

Cause injury		*Cause disease*	
Abiotic	*Biotic*	*Abiotic*	*Biotic*
Moisture extremes	Birds	Air pollutants	Nematodes
Temperature extremes	Mammals	Mineral deficiencies and excesses	Viruses
Wind			Bacteria
Snow			Fungi
Ice			Plants (higher)
Lightning			
Salt			
Radiation			
Pesticides			

Table 1 - Table is from William H. Smith. 1970. Tree Pathology: A Short Introduction. Academic Press, New York and London, 309 p.

others for meaningful persistence". Certain fungus disese agents, for example, the Dutch Elm fungus, have critically important insect vectors (in the case of the Dutch Elm fungus, the elm bark beetle).

Any attempt at developing a successful urban street or ornamental tree management plan must place its greatest emphasis on understanding the role and the importance of abiotic injuries. In an urban setting, biotic stress factors which cause disease (for example, bacteria, viruses, or fungi) are of lesser importance than those abiotic stress factors which cause tree injury. Of the biotic stress factors which cause disease, fungi are by far of the most widespread occurrence and importance, and tend to become a major concern in tree health only after abiotic injuries have provided ingress for these biotic microbial disease agents. Thus, in a good urban tree management program, the best way to prevent the occurrence of biotic microbial disease agents is to eliminate if at all possible, or at the very least to reduce the level of abiotic injuries. Since these abiotic injuries are so important in maintaining a desirable or acceptable level of urban tree health, special attention will be given to those abiotic stress factors which cause tree injury. Some of the most important of these include wounding, salt damage, ice and snow damage, wind damage, flooding and drought damage, poor

aeration, and tree injuries caused by temperature extremes. Any comprehensive urban tree management plan should pay special attention to the definition, occurrence, symptoms, mechanisms, and the various prevention management practices for each type of abiotic injury. In establishing an urban street tree inventory for Rye, those abiotic stress factors causing tree injury which are of greatest prevalence and therefore importance, should surface. When those abiotic stress factors of greatest importance are fully known and appreciated, special attention can be given to the prevention of these in the preparation of an urban tree management program.

The above use of the three word phrase, abiotic stress factor, leads one to a preliminary discussion of two other previously unmentioned stress factors which may result in a decline in urban tree health. These include air pollutants and mineral deficiencies. Both are examples of abiotic diseases, as opposed to the aforementioned abiotic injuries, and as in the case of abiotic injuries, may be considered to be of greater importance in preventing the establishment of acceptable urban tree health and vigor than biotic stress factors which cause tree disease. As in the case of abiotic injuries, these two abiotic diseases weaken, further stress, facilitate, or predispose urban trees to infection by biotic microbial disease agents. There-

fore, the most appropriate way to prevent the establishment of biotic disease agents would be to eliminate if possible or to substantially reduce the level of importance of these two abiotic diseases.

Up to this point in the discussion, I have placed little emphasis on biotic disease agents, and have placed greatest emphasis on the elimination or reduction of abiotic injuries or abiotic diseases. This has been deliberate, purposeful, and intentional. Many biotic tree diseases, for example, fungal decay or wilt diseases, are far easier to prevent than to treat once they have established themselves. Certain of these biotic disease agents, as in the case of certain human diseases, may therefore, be considered to be terminal or fatal. They are, once established, treatable to the extent of slowing down the rate of disease progression rather than being curable. One such example, despite the sentimentality associated with it, is Dutch Elm Disease.

Despite this gloomy note, tree pathologists do have various methods of controlling biotically caused diseases. Some of these include: (1) exclusion or quarantine, (2) eradication, (3) protection, and (4) resistance. Trees like several other higher organisms exhibit some degree of immunity, defense, or resistance to disease. These mechanisms, unfortunately, are not as well defined in plants as in

people, for example. As a result, trees frequently respond to disease treatment in a less desirable way than people. Coupled with this observable fact are at least two other factors which bear importance on tree disease. Both have characteristics in common with other higher organisms, including people, and both have a genetic basis. The first of these is the strength of immunity as related to age. And the second of these is genetic variability among a population of trees which allows certain individuals or their descendants (varieties) to possess greater resistance to specific biotic disease agents than other members of the same tree species population. Trees, like people, age. As they age, their natural immunity to biotic disease agents is weakened, and they fall victims to these agents. This important fact is coupled with the additional facts that (1) these trees possess lesser strength immunity defense mechanisms than people and (2) that ingress for these biotic disease agents can most probably be traced to previous abiotic injuries providing ingress or abiotic diseases predisposing tree weakness occurring earlier in the life of the tree. Linked with tree aging is a resistance on the part of the public to admit that trees are mortal and that they, like people, do have finite life spans. This is often difficult to appreciate or accept since trees fr

quently live much longer than we do. Nonetheless, they do age, mature, become less resistant to disease, succumb, and eventually die. It is futile to assume that certain urban trees once infected by biotic disease agents, can be cured and continue to live forever.

Genetic variability among populations of a given tree species does offer considerable hope for preserving as a species favored urban trees. Even though old, less resistant, infected trees may be lost, young and genetically more resistant varieties of the same species may help to perpetuate the species. Support for and strong fianancial spending to aid urban tree genetic improvement research, offer the best hope in this area. This is especially so when the other methods of biotic disease control are considered. Exclusion or quarantine is too late for those biotic tree diseases already established in this country. This method can be of help in keeping out microbial agents not yet present in this country, but can do little to control those that are. Chemical protection of trees offers hope only in the case of unidentified trees. Even in the case of healthy trees this control method may ironically result in infection of the same trees one seeks to protect. Frequent wounding of healthy trees while injecting chemicals provides courts of entry for these biotic microbial disease

agents. This method of control may therefore be considered to be self-defeating. As mentioned before, in the case of most biotic tree diseases, chemical injection of diseased trees with fungistats, will only retard disease progression, and not lead to a cure. For certain biotic tree diseases, where internal structural infection does not exist, and where infection is of an external nature, chemical spraying may yield satisfactory disease control, elimination, or cure. The final method of disease control, eradiacation, offers the best method of controlling biotic disease where such disease is of an internal, advanced, or terminal nature. Sanitation is of vital importance in preventing the spread of biotic disease agents. Where chemical treatment will do little more than prolong the life of a terminally ill tree, complete removal and immediate burning of the tree tissues is in order. Such action, however drastic, will do more to preserve adjacent uninfected trees than ludicrous short-term efforts to save an already doomed tree. This has been particularly so in the case of the American elm, where sick trees are often treated under the hoax of saving the tree, or where the tree is cut and left in various forms on site or at a nearby dump rather than being immediatedly burned. Burying will not help, as most fungi are quite capable of growing or persisting in the soil. In

the case of decayed trees, external fungal fruiting bodies serve as a means of spreading infection to healthy trees. In addition, such structurally weakened trees often pose an extreme accident hazard in urban areas, and should be considered hazard trees. These trees should be removed.

Changing Attitudes with Regard to Urban Street Trees

The establishment of a comprehensive workable urban tree management program will require a substantial change in public attitudes regarding urban trees. Understanding these needed changes is important before proceeding to a specific discussion regarding various abiotic stress factors. For Rye, as is the case for many other New Hampshire towns, perhaps the most fundamental change in attitude required is directly linked with the Town's historic past. Historically, Rye's streets, in many cases by accident, were lined with magnificent old sugar maples. Other streets, according to plan, were planted with American elm seedlings nearly two hundred years ago. However beautiful these trees may be or may have been, their days are numbered. Changes in our society and culture, as well as unforeseen circumstances, necessitate these changes without regard to how unacceptable or undesirable they may seem at the time. Sugar maples, with all due regard to the historical charcter which they have imparted to New England

towns in the past, are extremely susceptible to salt injury, which if unabated eventually results in their death. This is fundamentally a by-product of our modern society of super-convenience, two-car families, and paved streets and highways coupled with our insistance upon keeping these roads absolutely ice and snow cleared to the point of salt overkill. Since cars, highways or other forms of modern transportation are not likely to go away in the near future, sugar maples unfortunately must yield to progress.

Salt is not the only modern change along urban highways which has threatened our trees, however. Power lines, another modern invention, have taken their toll among maples, elms, and every other urban street tree species. Thus, we see it is easy to cling to nostalgia when thinking about urban trees while simultaneously ignoring modern changes which have made urban trees which were acceptable of desirable 50-100 years ago, unacceptable or undesirable today. This type of thinking has lead many communities to replace dead or dying maples with new young maple trees obtained from local nurseries.

Linked directly with this nostalgia for favored trees has been the problem of monoculture. We have liked elms, chestnuts, maples, etc. so well, that entire streets have been planted with each of these species. The unfortunate and unsuspected result of this action has been that many of

these same streets are now treeless. Unforeseen biotic disease agents or recently arrived abiotic stress factors have arrived and destroyed entire tree-lined streets. It is trully ironic that many of our favored tree species have also proven to be our most susceptible species with regard to tree disease or injury. Despite the fact that we now have before us as evidence, the results of mono-culture, we still continue, on a wide-spread basis, to plant whole streets with one tree species type. Entire streets planted with elm, maple, oak, ash, or any other species are not good. Several differing species should be planted on any given street. In addition, some serious attention should be given to alternating or mixing up these species, so that a variety along any given segment of the street exists. In this manner, all oaks on one side of the street and all ashs on the other side may be avoided. The benefits of such a planting scheme are varied and substantial. Such variety is aesthetically more pleas-ing. Such variety will prevent all trees on a particular street from being wiped out should a new unforeseen abiotic stress factor or biotic disease agent come along. Finally, such variety will tend to slow down the rate of spread of a new biotic disease agent should it occur.

Also linked with developing a workable urban tree

policy, is the need to change our attitudes about urban tree size. This change is also necessitated by modern invention. Historically (as long as can be remembered by those living today) our urban trees have been big trees. We fail to realize that big trees were once little trees or had their origins as seeds. We fail to realize that big trees have in many instances taken 200 years to grow. As a result, we try to measure our current urban tree replacement plantings according to the same standards of "big" which we have grown so accustomed to. When this is done, our current plantings are often found lacking, unacceptable, and are sometimes doomed to fail by those who insist upon measuring todays urban tree stock according to yesteryears standards. Those who are guilty of these actions need to be reminded that the big massive dead elm on their street was not always massive, but was a mere seedling itself 200 years before.

Another dimension of the acceptance of smaller urban street trees is the fact that smaller trees may be considered desirable for several reasons. Power lines have resulted in the butchering of many of our older more massive trees. Smaller trees (dwarf varieties where power lines are a problem) which do not grow to the height of power lines would eliminate this problem. The use of such varieties or the

reduction in tree planting along street sides where power lines are present is a necessity. Coupled with smaller urban street trees is the phenenomenon of shorter tree rotations. Smaller trees may be obtained by allowing the trees to grow for only a more limited number of years. As we have seen in the case of our elms, massive dead trees are both difficult and expensive to remove. One way of eliminating this difficulty and expense is to plant and remove urban street trees according to a planned follow-up schedule, on a regular basis. This method would result in possibly higher nursery stock costs, but would substantially reduce removal costs while increasing to a more desirable level urban tree community health. Planting of dwarf tree varieties serves as an alternative for decreasing the number of tree removals. As we have seen, however, older trees are less resistant to disease. Therefore, from a strictly urban tree health standpoint, more frequent removal of urban street trees accompanied by new plantings is more desirable. In this fashion, trees are removed before reaching overmaturity and becoming more susceptible to disease. The removal of these trees also tends to protect younger trees from infection, since the older trees no longer remain in the community to spread disease.

Urban Tree Stress Factors & What Can Be Done to Reduce Their Impact

Drought damage is a frequent problem of urban trees. Drought may be assumed to exist when the soil contains little or no water that is available for tree growth. Drought symptoms are particularly aggrevated in urban settings where asphalt paving prevents water from reaching tree roots. The extent of drought injury can be reduced in urban trees by following certain common sense management practices. Where possible, trees should not be planted where they will be surrounded with asphalt. Preferably, trees should not be planted in such locations at all. Most importantly, since tree species vary genetically in their resistance to drought injury, species which possess a high degree of drought resistance should be planted. Such planting should not take place in shallow soils. Examples of drought resistant species include elm, ash, red oak, and red cedar. White pine has intermediate resistance to drought, and various maple and fir species are particularly sensitive. Drought injury of urban trees may also be reduced by irrigation, shelter, or most importantly mulching. In addition, injury may be prevented by planting only in early spring or fall. Spring planting is preferable. Various plastic-based emulsions have been deve'

oped for spraying ornamental tree leaves to reduce transpiration and thereby control drought injury.

Flooding injury is also common in urban settings. Roadside trees are often damaged or killed when road construction changes involving grade alterations alter drainage patterns. As in the case of drought injury, tree species vary with regard to susceptibility to damage. Where natural roadside or street flooding is anticipated, flood tolerant species should be chosen. Table 2 lists various tree species according to flood tolerance. Road construction changes which will result in undesirable drainage changes should be avoided.

Heat injury is particularly common in seedlings growing in sandy-dark soils. Such soil surfaces when exposed to direct sunlight often reach temperatures up to 168^{o}F causing intracellular collapse and cytoplasmic denaturation. Other forms of heat injury may also be sustained by urban trees including sun scorch, sunscald, and leaf burning. Sun scorch is a special problem for thin-barked trees. It is commonly found on the south or southwest sides of beech, sycamore, or maple trees which have suddenly been exposed to direct insolation. Sunscald generally occurs to roadside plantings which are exposed to excessive heat reflected from nearby roadways or buildings.

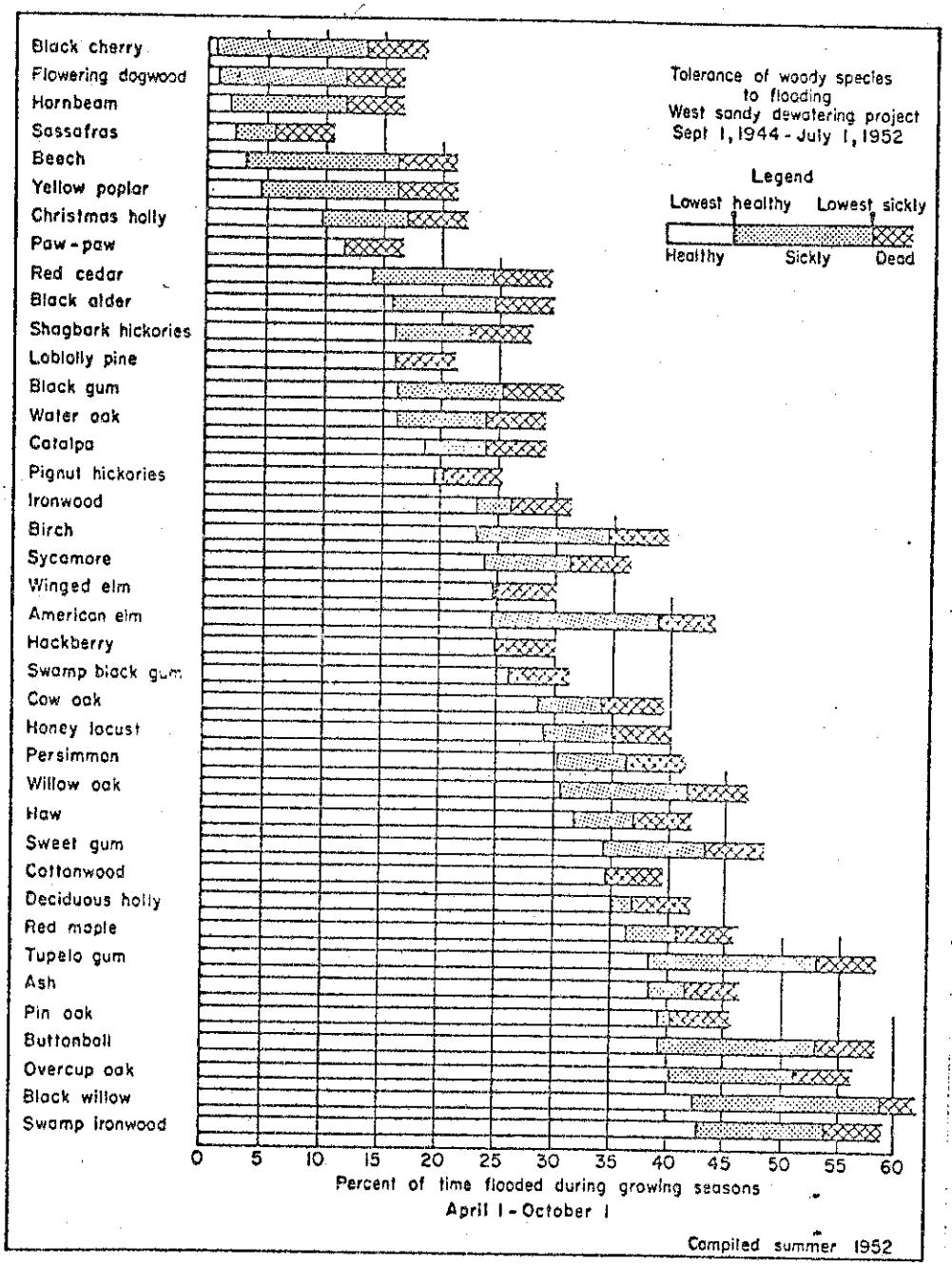


Fig. 2. Tolerance of Kentucky woody species to flooding during the growing season. [From Hall and Smith (1955). Reproduced by permission of Society of American Foresters.]

Table 2 - Above figure is from William H. Smith. 1970. Tree Pathology: A Short Introduction. Academic Press, New York and London, 309 p.

Figure originally appeared in T.F. Hall and G.E. Smith. 1955. Effects of flooding on woody plants, West Sandy Dewatering Project, Kentucky Reservoir. J. Forestry 53: 281-285.

As preventative measures, sudden sunlight exposures of particularly thin-barked trees should be avoided. Young saplings rather than seedlings should be planted to avoid heat killing from surrounding soil. In addition, dark sandy soils which tend to accumulate heat should be avoided. Shading of young plantings, if possible, is also desirable.

Cold injury of urban trees as the result of late spring or autumn frosts is a problem which can be avoided. Tree species vary in their susceptibility to late spring frosts, and the possibility of sustaining such damage can be avoided by planting those species which are least susceptible to injury. Table 3 shows these species as well as those which are considered to be highly susceptible to late spring frost damage. Damage from autumn frosts can be avoided by ceasing all activities in late summer or especially early autumn which might encourage continued or renewed fall growth. Such activities would include last-season irrigation, fertilization, or pruning. During winter, young trees are often frost lifted. This problem can be controlled by encouraging better tree root systems during the active growing season (late spring to mid-summer). Activities which will encourage stronger root systems include fertilization, irrigation, early planting, and mulching. For many o

SUSCEPTIBILITY OF GENERA AND SPECIES OF HARDWOODS TO FOLIAGE DAMAGE BY LATE FROSTS[a]

Highly susceptible	*Moderately susceptible*	*Less susceptible*	*Least susceptible*
American chestnut	Magnolia	Basswood	Birch
Ash	Oak	Maple	Cherry
Beech			Elm
Black locust			Hawthorn
Sassafras			Willow
Sycamore			
Walnut			
Yellow poplar			

[a]From Tryon and True (1964). Reproduced by permission of West Virginia Agricultural Experiment Station.

Table 3 - Table appears in William H. Smith. 1970. Tree Pathology: A Short Introduction. Academic Press, New York and London, 309 p.

Table originally appeared in E.H. Tyron and R.P. True. 1964. Relative susceptibility of Appalachian hardwood species to spring frosts occurring after bud break. West Va. Univ., Agr. Expt. Sta., Bull. 503, 15 p.

the reasons given above, as well as numerous other physiological ones, fall tree plantings are less desirable than those performed in late spring, and should be avoided if a choice is possible.

Wind damage to urban trees can be a major problem which can be avoided. Several forms of wind damage can occur including windthrow (uprooting), windbreak (branch breakage is more common than trunk breaks), windbend (the tree is displaced from an upright position), and windrock (in which the bark is chaffed at the root collar by abrasive contact with stones, soil, asphalt, grates, etc.). Young street plantings are particularly sensitive to all of these types of damage if not properly staked. The problem is also exacerbated in young street plantings by choosing young trees of too small of caliper. Trees of at least 2 inches diameter, although more expensive, should be chosen for planting. Cheaper one inch or smaller tree saplings are often subjected to windbreak (trunk type) even when staked. If not staked, the slender, pliable stems of such small saplings are especially susceptible to windbend. A major cause of either windthrow or windrock is restricted root penetration. If root development is impeded by shallow rootable soil, restricted by underlying strata or drainage impedence, predisposition to windthrow or wind-

rock is enhanced. In addition, heavy pruning may make trees top-heavy predisposing them to windthrow or windrock. In general, taller trees are more susceptible to either form of damage. Windrock has potential long-range impact, as the wounding which occurs in this form of injury provides ingress for root rot pathogens. In addition to making trees top-heavy, poor pruning or the lack of it, increases the chances of windbreak injury. This is especially so in the case of branch breakage. Poor pruning practices also provide ingress courts for biotic disease agents, particularly wood-rot fungi. Good pruning done at the proper time of year can be the best thing you can do for a tree. Bad pruning done at the wrong time of year can be the worst thing you can do for a tree. Since tree height can be correlated with wind damage, the selection of less massive trees for planting is desirable. This might be accomplished by using dwarf varieties or with a program of shorter tree rotations. Although conifers might be a logical choice for far north communities, with regard to reducing cold injury, they are not good choices when it comes to preventing wind damage, since they are quite shallow-rooted.

Snow damage is common in New England communities such as Rye. Tree species variability with regard to snow damage does exist. By choosing less susceptible species, the extent of damage can be reduced. Trees with asymmetric

crowns, such as hemlock, are most damaged as they tend to accumulate snow on the side with greatest branch development. More symetrical trees like spruce are less damaged as they tend to shed intercepted snow. Paper and yellow birch show low susceptibility to snow damage. The intensity of snow damage (branch breakage, uprooting, bending) is influenced by other factors including wind and temperature. Temperatures which result in wet heavy snows are more damaging and the extent of snow damage is generally coupled with severe winds. As in the case of wind damage, improper pruning tends to increase the incidence of snow damage.

Ice damage may result from glazed frost, freezing rain, or hail. The character of such damage, with the exception of leaf damage caused by hail, is similar to that caused by wind or snow. The extent of damage is dependent upon several factors. Winds increase damage. Greatest damage generally occurs on northern or eastern aspect exposures. Taller and older trees are most damaged. Older trees have larger crowns, more internal decay (which weakens their structural strength), and have less branch and stem flexibility. In addition, thin-barked trees may be damaged by ice cuts in their bark. Since tree species vary in their susceptibility to ice injury, the best way to avoid

such damage is to choose those species which sustain little or no injury. Norway spruce, other spruce species, and eastern red cedar are good examples. Eastern white pine and Scotch pine are heavily damaged by ice. Northern white cedar and Austrian pine are intermediate in their tolerance. Table 4 gives a more complete listing of species ussceptibility. Thin-barked trees such as maple, sycamore, or beech are susceptible to bark ice cuts. As is the case with wind or snow damage, proper pruning can reduce ice damage. The use of smaller size, younger trees also helps to diminish the problem.

Roadside salt damage to urban trees is a major problem in New Hampshire. In addition, Rye being a coastal community, has the additional problem of salt spray damage. The use of road salt is by far the most severe of these two problems. Salt spray is carried in the air from the adjoining ocean, and has its greatest impact on vegetation immediately adjacent to the waterfront areas. This has the potential of being a problem along Ocean Boulevard. Trees suffering salt damage may exhibit dwarfed or asymetric growth (particularly on the windward side of the tree), may have necrotic leaves, leaf scorch, or may exhibit twig necrosis. Since tree species vary in their tolerance to salt spray or road salt, only those species showing low sensitivity to salt should be planted along streets or yards with-

SUSCEPTIBILITY OF TREES TO BREAKING BY ICE ACCUMULATION[a]

Species	Number examined	Percent injured little	Percent injured moderately	Percent badly broken
Salix babylonica	2	0	0	100
Betula alba	3	0	0	100
Betula lutea	5	0	0	100
Ulmus americana	111	6	10	84
Populus deltoides and hybrid poplars	34	9	41	50
Betula pendula	10	10	30	60
Acer saccharinum	117	11	21	68
Platanus occidentalis	6	17	33	50
Castanea dentata	11	27	46	27
Populus nigra var. *italica*	29	34.5	31	34.5
Pinus strobus	11	36	9	55
Prunus americana	29	38	17	45
Acer saccharum	102	41	26	33
Prunus sp. (Cherry)	26	42	16	42
Robinia pseudoacacia	11	55	9	36
Juniperus virginiana	88	55	19	26
Liriodendron tulipifera	7	57	43	0
Pyrus malus	37	73	16	11
Carya ovata	4	75	0	25
Tsuga canadensis	4	75	0	25
Acer negundo	8	75	25	0
Diospyros virginiana	21	76	24	0
Picea abies	39	77	18	5
Acer platanoides	9	77	23	0
Thuja occidentalis	29	79	14	7
Quercus alba	10	80	0	20
Salix discolor	7	86	14	0
Pinus sylvestris	7	86	14	0
Prunus sp. (Plum)	18	89	11	0
Catalpa speciosa	36	94	6	0
Pyrus communis	30	97	3	0
Juglans nigra	48	98	2	0
Pseudotsuga taxifolia	2	100	0	0
Pinus nigra	3	100	0	0
Magnolia tripetala	3	100	0	0
Gleditsia triacanthos	5	100	0	0
Ailanthus glandulosa	42	100	0	0

[a] From Croxton (1939). Reproduced by permission of the Ecological Society of America.

Table 4 - Table appears in William H. Smith. 1970. Tree Pathology: A Short Introduction. Academic Press, New York and London, 309 p.

Table originally appeared in W.C. Croxton. 1939. A study of the tolerance of trees to breakage by ice accumulation. Ecology 20: 71-73.

in close proximity to the ocean front. Table 5 gives a listing of those species showing susceptibility or resistance to salt spray. This table is also useful in assessing the likelihood of road salt damage. The symptoms of roadsalt damage are similar to salt spray, and are often of a more pronounced nature. These may include leaf scorch, early autumn coloration, defoliation, and crown dieback. The pictures accompanying this section illustrate urban trees occurring in Rye suffering from road salt damage. Studies by Dr. Avery Rich at the University of New Hampshire have shown that Norway maple and oak species are more tolerant of road salt than white pine, hemlock, or balsam fir. Red pine is intermediate in its tolerance. Some caution is required in interpreting the degree of salt tolerance of Norway maple. It is true that it is more tolerant than sugar maple of road salt.However, both species are extremely susceptible to salt damage, and should not be planted if other more tolerant species are available. In this regard, oak species are preferable for roadside plantign. Other methods of reducing road salt damage include restricting planting of trees closer than 40 feet of adjoining roads, using new materials to deice roads, using less salt on our roads, or improving our drainage and sewer systems so road salt is carried away from street trees.

Heavy metals accumulation and toxicity of trees has

RELATIVE SUSCEPTIBILITY TO SALT SPRAY INJURY DURING THE 1938 HURRICANE[a]

Susceptible	*Intermediate*	*Resistant*
1. Conifers		
White pine	Northern white cedar	Colorado blue spruce
Eastern red cedar		Austrian pine
Atlantic white cedar		Yew
Hemlock		
Scotch pine		
2. Hardwoods		
Norway maple		Horse chestnut
Sugar maple		
Elm		
Magnolia		
Yellow poplar		

[a]From Wallace and Moss (1939). Reproduced by permission of International Shade Tree Conference, Inc.

Table 5 - Appears in William H. Smith. 1970. Tree Pathology: A Short Introduction. Academic Press, New York and London, 309 p.

Table originally appeared in R.H. Wallace and A.E. Moss. (1939). Salt spray damage from a recent New England hurricane. Proc. 15th. Natl. Shade Tree Conf., Aug. 1939, New York, N.Y., p. 112-119.

been a problem in certain urban areas. Smith has made an excellent study of this problem in southern Connecticut communities adjoining the Connecticut turnpike. High levels of lead, cadmium, and mercury have been found deposited on the leaves of roadside trees. Concentrations varied depending upon proximity to the roadway. Ongoing studies by Smith and other researchers are aimed at understanding what effect these metals may have on urban vegetation. With the advent of non-leaded gasoline, a whole range of new urban tree health problems may be developing. These non-lead based gasolines contain aromatic hydrocarbons to prevent engine knocking. While it is known that many of these same compounds induce human cancers, their impact on urban vegetation is yet unknown.

Urban tree mineral deficiencies may result in a whole array of symptom expressions which are very similar, and often difficult to distinguish, for several mineral elements. Since the basis for these symptoms are explainable only in physiological or biochemical terminology, I shall refrain. For details on this topic, I refer those with further interest to Smith's 1970 text on Tree Pathology. For those wishing a general knowledge of these matters, essential plant nutrients for plant growth can be divided into two categories. These include macro- and micronutrients.

Macronutrients include nitrogen, phosphorus, potassium, calcium, and magnesium. Since these elements are required in greater quantity than micronutrients for healthy tree growth, they are more probably lacking in cases of suspected nutrient deficiency than are micronutrients. The latter include iron, zinc, boron, manganese, copper, and molybdenum which are required in only trace amounts. These amounts are generally always available in the soil. Deficiencies of nitrogen, phosphorus, or potassium (N,P,K) are most common, and can be best allievated, if suspected, by a yearly application of 10:10:10 fertilizer in late spring. If growth is severely reduced, there may be a soil pH problem affecting nutrient availability. Soil nutrients may be available, but soil acidity may be such as to prevent their uptake. Liming in such cases will generally correct the problem. Nitrogen fertilization has been shown to have the greatest impact on tree growth (Safford & Filip 1974). Most nutrient problems are related to deficiencies; however, other nutrient problems can result from an oversupply of micronutrients. Most micronutrients are toxix to tree growth when in oversupply. Careful diagnosis of micronutrient deficiencies is therefore in order. A general shot-gun approach to tree fertilization, where all essential plant nutrients would be applied regardless of demonstrated need, would be bad and could lead to severe toxicity problems.

Finally, when fertilization is performed, an even spread of fertilizer pellets on the ground beneath the entire tree canopy is preferable to the use of spikes or slow-release injections placed in the tree root collar. This may be difficult along urban streets where the trees may be surrounded by asphalt. Under these circumstances, Other methods of application may be required. Preferably to reduce the extent of urban tree mineral deficiencies and to increase the success of fertiliztion when required, new plantings should be placed away from sidewalks, paved roads, etc. This may be accomplished by easements allowing for tree planting in the yards of persons living on a given street. Such yard plantings allow tree leaf litter to fall to the ground, decompose to some extent, and return some nutrients to the soil prior to autumn leaf disposal. Urban street trees surrounded by asphalt have this nutrient cycle interupted, and hense are in a more drastic need of fertilization than forest trees or yard trees. Planting trees in adjoining yards also helps to reduce salt damage, moisture deficiencies, and poor root-soil aeration problems which are common for trees surrounded by asphalt or subjected to periodic street flooding.

The effects of air pollutants on urban trees is substantial. These have been described in a recent article by

my wife and myself, which is enclosed in this section for reference. Since this article goes into detail about the problem, I shall not here. Trees do vary in their resistance to urban air pollutants, and this information can be invaluable in selecting trees for urban plantings. This information is contained in the enclosed article, and should be understood before selecting trees for planting along Rye streets or in Rye parks.

Current Thinking on What Should Be Planted

Several species of trees have been found superior for urban planting. These include pin oak, crabapple, Bradford pear, moutain ash, little leaf linden, black locust, Norway maple, and sweetgum. These should not be interpreted to be the only species which should be planted, as other desirable species may be found by utilizing the tables enclosed in this section. As a final note, common sense should dictate that southern tree species of proven inability to survive our harsh winters, should not be planted.

References

Croxton, W.C. 1939. A study of the tolerance of trees to breakage by ice accumulation. Ecology 20: 71-73.

Hall, T.F. and G.E. Smith. 1955. Effects of flooding on woody plants, West Sandy Dewatering Project, Kentucky Reservoir. J. Forestry 53: 281-285.

Lacasse, M.L. and A.E. Rich. 1964. Maple decline in New Hampshire. Phytopathology 54: 1071-1075.

Mondano, M. and W.H. Smith. 1974. Mercury contents of soil, mosses, and conifers, along an urban-suburban transect. Environmental Conservation 1(3): 201-204.

Reynolds, M.K. and P.E. Reynolds. 1978. Selecting trees and shrubs tolerant of sulfur dioxide and ozone. Forest Notes 131: 23-24, (Society for the Protection of New Hampshire Forests).

Rich, A.E. 1968. Effect of de-icing chemicals on woody plants. Proc. Symp. Pollutants Roadside Environ., Univ. Connecticut, Feb. 29, 1968, pp. 46-47.

Riddle, J.R., G.H. Moeller, and William H. Smith. Breaking new ground in urban America. American Forests, November 1976, pp. 26-30 & 66.

Safford, L.O. and S.M. Filip. 1974. Biomass and nutrient content of 4-year-old fertilized and unfertilized northern hardwood stands. Canadian J. Forest Research 4: 549-554.

Smith, William H. 1970. Tree Pathology: A Short Introduction. Academic Press, New York and London, 309 p.

Smith, W.H. 1973. Metal contamination of urban woody plants. Environmental Science & Technology 7: 631-636.

Smith, W.H. 1976. Lead contamination of the roadside ecosystem. J. of the Air Pollution Control Association 26(8): 753-766.

Smith, W.H. 1972. Lead and mercury burden of urban woody plants. Science 176: 1237-1239.

Tyron, E.H. and R.P. True. 1964. Relative susceptibility of Appalachian hardwood species to spring frosts occurring after bud break. West Va. Univ., Agr. Expt. Sta., Bull. 503, 15 p.

Wallace, R.H. and A.E. Moss. 1939. Salt spray damage from a recent New England hurricane. Proc. 15th. Natl. Shade Tree Conf., Aug. 1939, New York, N.Y., p. 112-119.

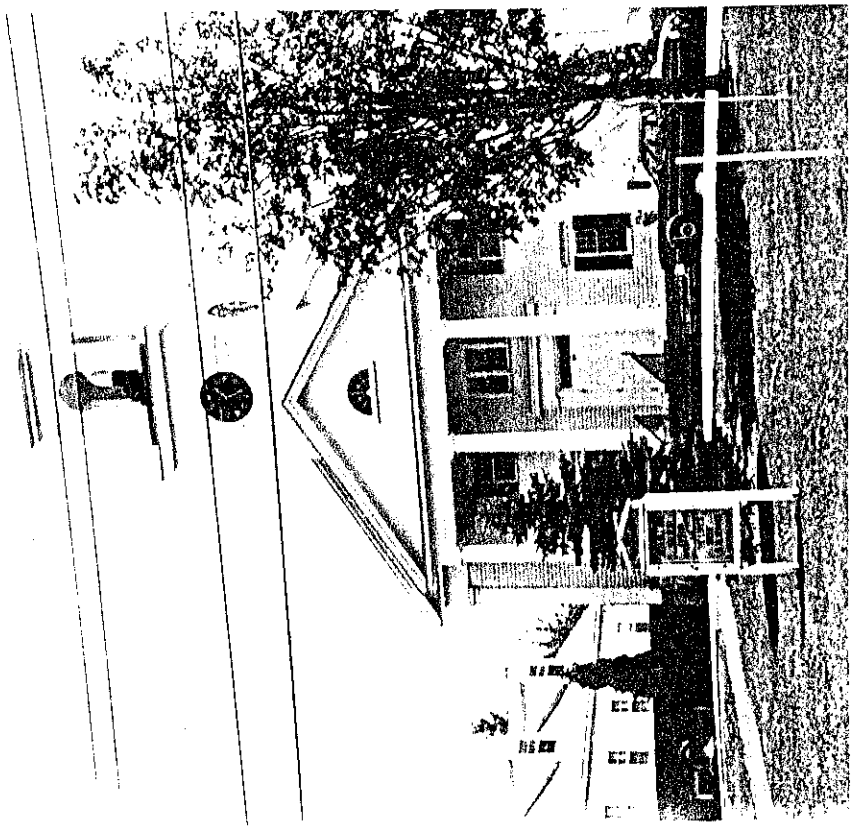
Urban Trees

(1) Urban trees in Rye suffer from a number of stresses or injuries. One of these is power lines.

(2) Some replacement planting is being practiced. Unfortunately, too many of these trees are the wrong species to plant. In addition, the small caliper of their trunks subjects them to breakage.

(3) It is difficult to say what has caused more damage to this sugar maple (Acer saccharum) - power lines or road salt?

(4) The crown of this sugar maple shows the characteristic symptoms of dieback caused by excessive application of road salt. The tree will not recover.



RYE'S URBAN TREES

List of Contacts

Contacts made during the course of this study were far less than I would have liked. Had time and money permitted, I would have liked to have contacted several more individuals to have sought out their opinions, statements, and recommendations. In particular, I hope I have not seemed to be overly critical of developers without giving them equal opportunity to express their views. If I have, I apoligize and fully anticipate that their views along with those of other Town officials will be expressed in a more in-depth, better funded, land use plan.

Contacts made were as follows:

Mr. Ray Broeder, Principal, Rye Elementary School.

Mr. Ralph Brown, Chairman Rye Conservation Commission.

Ms. Patricia Jenness, Tax Collector, Town of Rye.

Ms. Jane Kenney, Southeast Regional Planning Commission.

Ms. Joan LaFrance, Washington Road, Rye.

Mr. Wilbur LaPage, Vice-Chairman Rye Conservation Commission.

Mr. Ralph Morang, Jr., Rye Selectman.

Mrs. Irene Rand, Rand Lumber Co., Rye.

Mr. Wilford Rand, Rand Lumber Co., Rye.

Mr. R.A. Stetson, Sr., Lang Road, Portsmouth.

Dr. Clotile Strauss, Chairman Portsmouth Conservation Commission.

Mrs. Louise Tallman, Former Chairman Rye Conservation Commission.

Mrs. David Wade, Parsons Road, Rye.

Mrs. Cheryl Wyman, Wallis Road, Rye.

Solicited Recommendations, Statements, and Opinions

During the course of this study, several recommendations, statements, and opinions were made or expressed by concerned citizens of Rye. Many of these were solicited at a public meeting held on 4 August 1978 and are intended only as examples of the types of concerns shared by Rye citizens. They are in no way a complete listing.

(1) The Town needs to act post-haste in deciding on development. However, it may be too late already.

(2) The problem of conserving Rye's natural resources is twofold. The easy part, while time-consuming, is to identify those resources warranting preservation. The difficult part is setting priorities on these resources. Which of these resources really need protection, and which can be temporarily ignored?

(3) Having identified and assigned priorities to those resources warranting preservation, how does the Town go about protecting them? There are many options. Which are appropriate?

(4) Perhaps instead of identifying those areas of the Town warranting preservation, we should identify those areas of Town which are suitable for development.

(5) The Town needs to identify the owners of desirable parcels of land warranting preservation.

(6) There is much confusion concerning land ownership in Rye. Although it is known that certain

persons own land and pay taxes on it, the exact location of the land is neither known by the owner nor the Town. Ownership is frequently based on a Colonial Period survey which is lacking in necessary detail with regard to boundaries. Thus, two land owners in the same general area of Town may claim to own the same land, and no one really knows for sure. This confusion makes direct acquisition of lands warranting preservation difficult or even impossible.

(7) Some parcels of land warranting preservation are currently being protected by enlightened private owners. Private management of valuable natural resources is sometimes better than public management which does nothing. Should enlightened private land owners be forced to give up thier land for the sake of public protection?

(8) "No one has a 100 percent right on land". Historically, the State (government, police power) retains more power over land than may be thought. People can use the land, but they don't have exclusive rights on it.

(ix) What is involved in individual efforts to preserve land? Can you explain current use assessment?

(9) New zoning or public acquisition (Town purchase) of lands meriting conservation may be desirable ways of preserving Rye's natural resources.

(10) Since much of Rye's land is unsuitable for development, the Town may need zoning which would allow for building of houses of specified sizes on differing size lots.

(11) Cluster zoning may allow for better utilization of developable land, allowing for a larger Rye population.

(12) New zoning bases upon a specified acreage (for example, 2-5 acre house lots), aimed at limiting Rye's future population level and thus restricting land development, may exclude younger people from the community who cannot afford to build bigger houses on larger lots or larger pieces of land.

(13) What is the optimal maximum population level for Rye?

(14) What is the legality of regulating Rye's population level? It is probably illegal to limit the total number of houses which can be built over time (discrimination?).

(15) The Planning Board has no legal means of stopping development in certain areas (for example, upland areas) in the absence of new zoning or limits on growth (number of houses per year, etc.).

(16) In terms of new zoning: a) how does the Town decide where to draw the zoning line on a map? b) how far back off the road should the zoning line be?

and c) is there some proper, specified distance which could be applied in zoning?

(17) Developments will raise the tax base and make it more difficult for other people to hold onto land. People wishing to keep their land as farm or forest land will be unable to do so.

(18) It is difficult to stop a developer with new zoning regulations when he/she has already invested several thousands of dollars to buy the land.

(19) Development on upland areas may pollute low-land areas.

(20) Town purchases of lands for conservation remove land from a taxable status and increase (shift) the tax burden to the remainder of the land owners.

(21) Town purchase of lands for preservation would not significantly reduce revenue in Rye.

(22) Why, other than trees, wildlife, and water, should people be concerned with preserving land?

(23) In answer to #22, trees use up carbon dioxide and trap air pollutants. They also provide oxygen so vital to people's lives.

(24) In answer to #22, development leads to other costs including schools, roads, and hospitals.

(25) Does not Rye's current Wetlands Zoning Ordinance protect most of Rye?

(26) The Town may not need new zoning regulations or laws as much as it needs good enforcement of existing laws or zoning ordinances. Too many variances are being granted.

(27) If Rye's current Wetlands Zoning Ordinance is not being strictly enforced, perhaps what is needed is a new building inspector or new selectmen who will not allow it to be violated.

(28) Public attention to care and maintenance of urban street trees has been lacking. This has been particularly so in the case of dying elms.

(29) Personal self-interest of various Town officials has lead to a lack of cooperation among various Town organizations and has resulted in a lack of comprehensive Town planning.

(30) Easements may provide a means of preserving certain pieces of land in Rye.

The above statements do not necessarily reflect the viewpoint of the author of this report. They are presented as stated to me by various Rye citizens during the course of this study. In addition, they should not be interpreted to be the statements of those persons listed in the contacts section of the report. Many statements have been included which were not made specifically by these individuals

Discussion and Personal Analysis

Rye's Conservation Problems and Needs

In the preface, I began by stating that this report would address itself to Rye's conservation problems or needs. With regard to these, I listed 14 points of interest, many of which have been examined in the preceeding pages of this report. In the sentences which follow, I hope to summarize my major findings with regard to these 14 points.

(1) Sound land use planning for the Town of Rye is virtually non-existant. Rye is in a time of crisis, and I cannot overstress the urgency for prompt enlightened planning. Unfortunately many of the natural areas in Rye needing protection and worthy of preservation as open space are already in the hands of developers. Very little can be done to correct this problem, except to buy back these lands, or pass new zoning regulations making their development virtually impossible. Much land in Rye remains undeveloped, although currently owned by developers. If the Conservation Commission, The Planning Board, and the Selectmen act now, much of this land can be saved and remain as open space.

(2) Public land management and coordination for Rye has been severely criticized with regard to its urban and community forestry program. For specific comments, please refer to the solicited comments and opinions section.

(3) Trends in open space for Rye are just emerging, in large part due to the Town's lack of land use planning. A Town Plan developed in 1964 shows a total lack of understanding for open space or environmental matters. According to the plan, proposed development is targeted for those very areas which by today's environmental standards should be considered open space. By today's environmental standards, open space generally is, but does not have to be limited to, parcels of land unsuitable for development for various reasons. These may include unacceptable topographic features, hydrologic problems, rare or endangered species, etc. The Rye Conservation Commission has taken the lead in defining open space needs and in specifying suitable areas in Rye for their implementation by contracting for the preparation of this report. Responsibility for implementing these needs is incumbent upon the Commission, the Planning Board, the Selectmen, and Rye's citizens as a whole.

(4) The condition and trend of Rye's urban shade trees has been elaborated on in the section on urban and community forestry. To summarize, their condition is less than desirable. Attitude changes affecting what types of trees are planted are needed. In 1977, according to a Conservation Commission report, 200 resistant elms were planted. Current research is showing that many so-called resistant varieties

are not in fact resistant. Too many elms, sugar maples, and Norway maples are being planted. Greater variety is needed. Efforts to save dying elms are futile, and should be abandoned in favor of more tree removal and plantings of species other than those being removed. Salt damage to trees is a major problem. Reduction of salt use coupled with planting salt resistant varieties should help. Finally, development of a long-range plan for the care and maintenance of urban trees is needed. Before such a plan can be developed, an intensive urban tree inventory must be conducted.

(5) Landscaping and beautification needs for Rye's urban streets and public places is also addressed in the urban and community forestry section. Many of the above comments also apply to this topic.

(6) Wetlands encroachment is well on its way to control thanks to the efforts of the Rye Conservation Commission. The Wetlands Zoning Ordinance of 1977, in theory, protects 38% of the Town's lands. If properly enforced, future development of these lands should be abated. Proper enforcement seems to be the major problem in preventing further encroachment. Far too many variances are being granted, resulting in serious and often flagrant violations. No exceptions can be made. Although members of the Conser-

vation Commission are doing their utmost to prevent violations, closer cooperation of the Building Inspector and the Planning Board with these members would do much to eliminate this problem of too many waivers. In addition, greater solidarity on the part of the Conservation Commission members in granting no variances is absolutely essential.

The Town should not mistakenly lull itself into believing that the wetlands are protected by virtue of the 1977 Wetlands Zoning Ordinance, however. Public officials and Rye citizens must remember that destruction of these natural areas is not exclusively prevented by prohibiting new construction to occur in them. What happens on upland areas adjacent to these areas has a great deal to do with their own well being. If drainage patterns of an upland forest adjacent to a marsh are changed due to construction practices, run-off and siltation affecting the marsh will occur. Thus, in order to fully protect these wetlands, the Town should pass zoning controlling development on adjacent parcels of land or the Conservation Commission should take steps to acquire or protect these adjacent upland areas.

In addition, much misunderstanding exists concerning the definition of wetlands. This must be eliminated before proper implementation of the new legislation can occur. Wetlands consist of considerably more areas than just salt

or freshwater marshes. Wetlands consist of a broad range of floodplain ecosystems consisting of lowland swamp forests, streambeds, bogs, etc. in addition to marshes. At present, the 1977 Wetlands Zoning Ordinance does not completely encompass all of these areas, and should be expanded and more precisely defined. Even excluding its minor oversights, there are currently many wetland areas protected by the current zoning ordinance, which are not being afforded equal protection as that given to marshes.

(7) Public access to natural resources should be made possible whereever feasible. Access should be controlled where particularly fragile ecosystems or endangered species are involved. The Town should make available sufficient open space, reflecting diversified habitats, as to allow for multiple-use of public lands. The multiple-use concept, as described in previous sections of this report, embodies the use of land for a number of purposes including aesthetic and passive recreational use (cross-country skiing, hiking, nature walks, etc.) as well as for wildlife enjoyment.

There are a number of problems associated with public access to natural resources. The most important seems to be that use breeds abuse. The inconsiderate few spoil things for everyone else. Funds for clean-up would be considerable

to say nothing of the logistical problems. Who would bear the cost is not unreasonable to ask. Who would police the areas is another fair question. Public access to private lands protected by easements reflects a whole new ballpark of problems. The mere ability to secure these easements may be linked to this very problem. People willing to keep their land in its natural state of preservation, may not want or be willing to grant public access to it. Balanced against these problems is the most important need of getting the public to accept the idea, and the cost, of achieving open space. If the public is barred from using all publicly owned or controlled lands, it will not take too long before the purse-strings are withheld.

(8) Enforcement of existing environmental laws is lax as already adequately pointed out above. Attempts to seriously correct this problem, to crack down and not grant variances for development, would do much to protect Rye's natural environments. Rye needs planning and it needs some new zoning regulations, but major legal weapons for protecting its environs already exist if properly enforced.

(9) Environmental awareness of some public officials is great and that of others is exceedingly poor. Since many of those whose knowledge is poor also care, I am encouraged. To my knowledge, no blatant conflicts of interest exist, as is the case for other New Hampshire towns. For a developer

or real estate agent to serve on the Conservation Commission, the Planning Board, or as a Selectman constitutes a reasonable conflict of interest. Patterns such as these should be avoided. Most Town officials have been fairly open and honest in answering my questions. Others, unfortunately, have been evasive and in some instances deliberately misleading in their responses.

Acceptance of an environmental opinion by public officials is closely akin to accepting a medical diagnosis. Two or three opinions should be sought, but in the end the diagnosis must for the most part be accepted on blind faith. One is not always likely to be wild about the diagnosis. Just as a physician renders a professional opinion, so does an environmentalist. Although this opinion can be explained in laymens language within limits, it would be too much to ask for public officials to gain as full a facility with these matters as the person(s) rendering them. What is required is that public officials listen, and then act. Just as it would not be wise to not follow the advice of your doctor, it is equally foolish not to follow the advice of a trained environmentalist.

(10) Protection for rare or scarce plant species in Rye is exceedingly poor. Rare or scarce species are presently safe at present, in certain instances, due to circumstance or due to land protection by the Conservation Com

mission. One of the major rare or scarce species present in Rye, Atlantic white cedar, is currently totally without public protection. Rye is privaledged to have perhaps the best cedar stands in the seacoast region, but has not made any efforts to protect them. In contrast, the Town of Portsmouth has placed all of its known cedar stands under protection. One of the major cedar stands in Rye is owned by a developer and the other by a private individual. In the case of the former, the stand remains largely because it has not been advantageous for development to proceed. Conservation awareness on the part of the second owner has resulted in the safe-keeping of this stand. Despite this owner's conservation awareness, it seems questionable whether any private individual has the right to own an endangered resource. Should this owner die or sell his land, what is to say the next owner would be as enlightened. Some sort or easement arrangements should be made to protect these two cedar stands. Or some sort of new rare or scarce plants ordinance should be enacted.

(11) The condition of much wildlife in Rye is good. This is largely because much of Rye is still in a wilderness state, and its wildlife habitat needs are being met. The condition of urban wildlife is likely to deteriorate if something is not done to properly manage Rye's urban

tree resource. Without planning and especially controlled housing development, the current condition of much of Rye's wilderness wildlife could easily be reversed in the next 10 years. Much of Rye's wilderness areas (in particular the Berry's Brook-Bellyhack Bog ecosystem and the Cedar Run ecosystem) are privately owned. Large tracts of land within these are owned by developers, or if land transfer trends continue, will soon pass into the hands of developers. Wilderness areas already controlled by developers include the Chase lands, Tahltan Woods, Parsonage Woods, and Fairhill Marsh. Serious efforts to protect wildlife in many of these already acquired wilderness areas will require new Town zoning ordinances making development of these areas either impossible or highly undesirable economically.

(12) Urban roadside conditions for Rye are in need of improvement. Many or these conditions are discussed in the urban and community forestry section. As has been pointed out, road salt is killing many of Rye's sugar maples. Many elms are falling victims to Dutch Elm Disease. And many trees have been damaged as the result of power lines. Increased funding for tree removal and transplanting of a variety of new species needs to be made. I should point out that federal funds for assistance in urban and community forestry are available on a matching basis by contacting of-

ficials at the Urban Forestry Center in Portsmouth.

(13) Interests in a Town Forest are high, but at the moment highly unfocused, undirected, and chaotic. The recently acquired Parsons' tract appears to be the best candidate, and is discussed in another section of this report. At present competing and potentially conflicting interests for the land exist. Its proximity to the Rye Recreation Area and the Town Cemetary is both an asset and a potential liability. Use of the forest to supplement the non-passive recreational activities at the Recreation Center would be good. Use of the recently acquired lands for the construction of new ball fields, etc. is potentially a very unwise use of the land. Hopefully, recreation in the forest could be of a passive nature (cross-country skiing, nature walks, hikes, snow-shoeing, tree identification trails, wildlife trails, par-course, etc.) rather than the non-passive activities of the Recreation Center. In this manner, the forest would (1) supplement the recreational facilities of the Recreation Center, (2) satisfy demands for multiple-use of public lands, and (3) provide a place for public access to public lands, thereby providing public support for an open-space concept. The close proximity of the Parsons' land to the Rye Junior High School provides an excellent opportunity for developing a pub-

lic school program in environmental education. Finally, any projected plans for use of the Parsons' lands for cemetary expansion would not be in the long-range best interest of the Town.

Since development of a meaningful Town Forest concept requires a professional opinion, a consulting forester should be hired to develop a multiple-use Town Forest Plan. A committee, representing all interests involved, might be established to confer with this forester. The multiple-use concept is important as many examples of Town Forests in New Hampshire which have failed may be cited, where timber yield became the major concern of Town officials. Many beautiful tracts of land which started off as potentially desirable Town Forests have been destroyed when all or too much of the merchantable timber on the lands was harvested. An interesting concept for preventing this and and achieving multiple use was recently presented to me by Wilbur LaPage. The concept is roughly this. The Town ought to own several disjunct and vegetatively varied tracts of land constituting a Town Forest. None of these tracts would be large enough or contain sufficient timber volume to make complete harvesting at any given point in time excessively profitable. In this manner, sustained timber yield could be achieved, but never at the expense of

other forest uses. Greater recreational enjoyment of the forests would be had, since people would be exposed to a diversity of forest types.

(14) The need for technical and educational assistance to land owners is great. The lack of environmental awareness on the part of many land owners often leads to disasterous effects. Many land owners, I am sure, would not sell their lands to developers if they were fully aware of the environmental consequences of their actions. On the other hand, unfortunately, many would. In the final analysis, money generally talks. People whose conservationist values have been notably strong, will often sell out if the price is right. The best way to combat this problem is often to fight it on an equal ground. Increased environmental education will help, but should not be counted upon in the case of endangered resources of critical value. If preservation of these resources cannot be achieved by other legal means, the Town should not hesitate to buy such property.

Conservation Priorities For Rye

The number one priority for conservation facing Rye is the preservation and protection of the Berry's Brook-Bellyhack Bog ecosystem. This ecosystem is the most threatened in Rye, and will require the greatest effort to save. Strict enforcement of existing environmental laws will help. Passage

of new zoning ordinances to protect lands not adequately covered under existing legislation will be necessary. A possible example is a Slope-Hydrologic-Soils Zoning Ordinance prohibiting development in areas not meeting acceptable standards. Another might be a Rare or Endangered Species Ordinance. Easements on private lands not currently owned by developers should be initiated. How to reclaim the vast amount of acreage which is a part of this ecosystem, and currently owned by developers is the most difficult and perplexing problem. New ordinances may be the best answer, since new zoning regulations may make development of these areas so undesirable that the developers will ultimately be willing to sell their lands back for a "fair" market price. Protection of this ecosystem is a joint matter, and requires the full cooperation of Portsmouth officials to succeed. In addition, preservation of portions of the ecosystem cannot be accomplished without strict protection for the entire ecosystem.

The number two conservation priority facing Rye is the protection of the Cedar Run ecosystem consisting of Cedar Run, Brown's Pond, and Burke's Pond. Protection of this ecosystem is of no lesser importance than that of the Berry's Brook-Bellyhack Bog ecosystem. It is number two simply based upon the fact that this ecosystem is currently less threatened than the Berry's Brook-Bellyhack Bog ecoystem. Rye

officials should not wait, however, for this ecosystem to become a close rival of the Berry's Brook-Bellyhack Bog ecosystem in terms of endangered status. Protection for this ecosystem should not be as complicated as that for the Berry's Brook-Bellyhack Bog ecosystem, since most land ownerships for the Cedar Run ecosystem are strictly private. Land easements coupled with the passage of a Rare or Endangered Species Ordinance offer the best means of protecting this ecosystem. In addition, strict enforcement of the Wetlands Zoning Ordinance should apply to large portions of this area. Possible amendments to this ordinance to cover wetlands not presently covered under the zoning regulation would help to further protect this area. An examination of the Wetlands Map should provide information regarding which wetlands areas are not currently covered for the Cedar Run ecosystem.

The number three conservation priority for Rye is protection of Fairhill Marsh and its rare cedar stands. Perhaps the best approach here is to strictly enforce the current Wetlands Zoning Ordinance and to enact a new ordinance giving protection to rare plants, and specifying cedar. Purchase of the marsh would be highly desirable.

The number four conservation priority for Rye is to protect the beech grove near the cemetary on Central Road.

Since the grove is privately owned, an easement might serve this need. If the grove could be purchased for a reasonable price, it should be.

The above four conservation priorities are not necessarily listed in accordance with their ease of attainment. Quite the contrary. Those having the highest priority are also likely to be the most difficult to achieve. They should be approached concurrently rather than sequentially. I have not listed the establishment of a Town Forest or the development of an urban tree management plan under any of these priorities. This is because they do not constitute, in the strictest sense, an endangered resource requiring protection as do the other priority needs. Both are currently in good hands and need only to be developed in order to reach full fruition. In the absence of better controls, lands which would be desirable for the Conservation Commission to own include: the Estuary, Bellyhack Bog, Brown's Pond, Fairhill Marsh, and the Beech Grove.

Suggested Strategies for Acting on Rye's Conservation Needs

Excellent discussions of land use needs and its control have been provided by (1) David Ehrenfeld in his book on Biological Conservation, (2) Richard Wagner in his book on Environment and Man, and (3) Kenneth Davis in his book on Land Use. Ehrenfeld's discussion provides the best intro-

ductory discussion of these matters for the layman. Davis' discussion is perhaps the best available anywhere, is complex, very detailed, and best approached after gaining some previous background on the topic.

Ehrenfeld in his discussion on the protection of natural communities highlights the findings of leading land planners. Perhaps the foremost of these is Ian McHarg (Department of Landscape Architecture & Regional Planning of the University of Pennsylvania). McHarg has formulated a total of eight criteria for selecting open space. These include:

> (1) "Surface water and waterfront land should be used only for functions that cannot occur elsewhere, including harbors and water-using industries.
>
> (2) The wastes entering streams should be regulated according to the ability of the waterway to absorb pollutants without seriously altering the aquatic flora and fauna.
>
> (3) Marshes must be protected from drainage or filling in order to serve as wildlife reservoirs and flood storage areas.
>
> (4) Flood plains that are under water once every 50 years or more should be closed to all residential and commercial building construction. Recreational, agricultural, and open-space uses and related functions are excepted.
>
> (5) Ground water resources, or aquifers, must be protected by careful management of deep-well injection. sewage disposal, rate of water withdrawal, and simi[illegible] practices.
>
> (6) Good soil is an irreplaceable asset, slow to [illegible] and like many complex living systems, easily ki[illegible] The best agricultural land should be used as s[illegible], not be permitted to be developed for other pur[illegible]

> (7) Steep slopes (12^{o} or more) erode rapidly when their natural cover is disturbed. This in turn causes siltation of waterways, flooding, failure to replenish aquifers, and destruction of terrestrial and aquatic habitats. Steep slopes should remain completely untouched if unforested, and sparsely developed (less than one house per 3 acres) if forested.
>
> (8) Forests and woodlands, which are ' the major regulators of equilibrium in the water system,' which 'exercise a profound effect upon climate,' and which are 'a prime scenic and recreational resource,' should be used for forestry, water catchment areas, airsheds, recration, and cluster housing restricted to an over-all density of one house per acre or less."

For McHarg, the key to land acquisition in any regional conservation program is the distribution of water. As stated by Ehrenfeld, "only after this has been carefully studied can conservationists and planners decide what land ought to be preserved as open space. If 'environmental corridors' are maintained intact...the result is a network of park land and scenic areas readily accessible to nearly all the population." In studies of the Mississippi Basin, land planner Philip H. Lewis, Jr. made the startling discovery "that 85-90 percent of all identified natural and cultural features could be seen to lie within 'environmental corridors' that coincided with topographic corridors delineated by waterways and associated ridges." Based upon these findings, the designation of wetlands as open space for recreational enjoyment makes very good sense psychologically and sociologically as well as ecologically. Wetlands need not be thought of as wasted space. Their preservation

fullfills both recreational and environmental needs.

Once various wetlands meriting protection have been determined, the problem of gaining control or title arises. There are a number of ways "in which local governments can acquire land without going bankrupt or alienating large segments of the community." A number of these are discussed by Charles Little in his book, Challenge of the Land and are also covered by William Whyte in his book, The Last Landscape. More detailed descriptions of these ways are provided by Davis in his Land Use book. Various methods for gaining title or control include: (1) direct Town acquisition by purchase (may be financed by bond issues or assisted by federal or state grants), (2) cluster development, (3) land donations, (4) easements ("the owner of land agrees to give permanent protection to some natural feature of his land without surrendering actual ownership. This method has not been very popular..."), (5) municipal zoning, and (6) purchase by the Nature Conservancy, Conservation Commission, or other conservation organization.

Once a parcel of land has been afforded protection, the question of how to manage it arises. Ehrenfeld provides an excellent discussion of the pros and cons of management of natural communities. Some of his more important

points include the following: (1) "most small and open space parcels of land are best managed by limiting recreational and related uses to a reasonable level and by interfering with natural processes only when there is no alternative," (2) "good management of natural communities is not synonomous with blanket protection of all species ...occasionally, populations of some species must be thinned to protect the rest of the community...populations must be kept at less than their maximum possible density," (3) "the extreme form of population control is population elimination...there is debate on the value of many over-simplified communities (e.g., single-species tree farms)... ecologists like Margalef base their...theories on the idea that high species diversity generates stability in a natural community...anything that greatly reduces species diversity will induce excessive and possibly ruinous population fluctuations in the remaining species of the community," (4) "one of the best ways of shaping and manipulating natural communities is by the careful use of fire...fire is an important component of many ecosystems...complete fire protection over a long period of time may cause a drastic change in the local community...fire is often far more useful than complete fire prevention in ecosystem management," and (5) "active intervention is often necessary

preserve natural communities...nevertheless, this is one of the most difficult aspects of conservation...when in serious doubt, the wisest management is none at all."

Richard Wagner in his book, Environment and Man, provides a deeper discussion of the psychological and sociological needs for open (urban) space. He summarizes by stating, "a lack of these amenities (open space) contributes to the poor mental health of many urbanites...space assumes a far more important role in ameliorating the city environment than merely that of an aesthetic afterthought of the developer." Wagner has praise for three American cities which have wisely used their floodplains for parkland. "Cleveland, ...(Baltimore), ...and Washington, D.C. have attempted to preserve some open space by creating parks from the flood plains of many small streams that drain the region. These parks form necklace-like skeins running through the city which help break up the monotony of heavily urbanized areas and provide open space for nearby residents." Wagner alos points out the importance of vegetation (trees) in urban areas with regard to diluting gaseous pollutants (SO_2), settling out particulate matter (dust), and ameliorating urban microclimate.

Despite the many strong defenses for open space other than ecological justifications, in the final analysis, per-

haps the strongest argument of all for the control of land use is ecological. Since many desirable areas for open space are in fact floodplains or drainage basins, this ecological defense is best assessed in terms of watershed problems and/or floodplain destruction. "The need for ecological control over land use has been demonstrated again and again. But assuring that an ecologist plays a significant part in land use planning does not necessarily lead to ecologically sound land usage, for there are strong local political and economic pressures and financial control always seems to be in someone else's hands." The strength of the ecological argument is observable in the following scenario by Wagner:

> "Imagine, for example, a narrow rural valley with a stream flowing through it year round. The slopes are covered with trees and perhaps an occassional house built to take advantage of the rustic qualities of the environment. One day a bulldozer appears on the hillside above the valley and intensive development begins. During the construction period many tons of soil wash into the stream, followed by runoff from roofs and paved streets of the completed development. This rainwater no longer seeps into the ground and recharges the water table; instead it pours from storm sewers into the stream. Deprived of its source of recharging, the water table is lowered, requiring deeper and deeper wells for local water supply. The excess water in the stream causes flooding downstream where basements, previously dry, must be periodically drained or waterproofed. During periods of high water, septic tanks are flooded, the stream is polluted, and sewers become necessary to avoid public health problems. Because of previous

silting the stream is dredged to handle the recurring flood waters, but this seems to make matters worse. Then the Corps of Engineers is asked to build an expensive dam upstream, which in turn permanently floods much valuable bottom land behind the dam. Wells are running dry now, so a municipal water system must be installed. What is left of the stream alternates between feast and famine, flooding one season, dry the next. Finally it is agreed to confine it to a culvert to avoid future problems. This chain of consequences is not at all unlikely, but is it inevitable? By no means.

If the area including the wooded valley had available a planning commission, or an ecologist who is trained to recognize potentially troublesome sites, the whole destructive process might have been avoided. Quite clearly there are some places where houses should not be built or at least built only with extreme care and foreknowledge or the dangers involved. The function of a planning commission is to remove the trial and error approach and to suggest on a rational basis which land is most suitable for development and which land is better left undisturbed. The developer sees a swamp as reclaimable land capable of being filled in and covered with houses: an environmentally informed planning commission might view that swamp as a sponge capable of absorbing 300,000 gallons of water per acre for every foot of rainfall added to it and wonder where all that water will go if the sponge is destroyed.

The usual alternative to a floodplain as a sponge is the construction of flood control dams upstream. But such structures are effective only if the storm falls in the fixed catchment basin and the storage capacity of the reservoirs is adequate to contain the runoff. Even then as General Clark, former head of the Army Corps of Engineers, recently said, 'We can't guarantee that no place will get flooded. People have to expect it every so often. Dams, levees and flood walls are not the cure-all against flood damage. We also need strong local laws to prevent encroachment on the flood plain of our streams. We do not seek, nor can we ever attain, 100 percent flood control.'"

Earlier in this discussion and personal analysis section, it was stated that money talks. In many instances, persons who will not respond to ecological, sociological, psychological, or other arguments, may be won over by economic justifications. As stated by Ehrenfeld, "contrary to popular belief, the addition of new residential property to the tax rolls, particularly in development blocs, rarely helps the community economically. Although tax returns increase, the cost of services to be borne by the entire community increases more." Since land use planners are always faced with the decision of whether to develop a particular piece of land or preserve it as open space, the following scenario as related by Ehrenfeld warrants repeating.

> "Charles E. Little, recounts the story of Closter, New Jersey, which in 1965 wanted to acquire seven parcels of land totaling 80 acres, to be set aside for limited recreational purposes. Acquisition costs were approximately $500,000, and some residents wondered if the town might not be better off by letting the owners sell their property to residential builders. At this point, Mayor James E. Carson carried out some calculations: Assuming that the 80 acres could accommodate 160 houses, these houses in turn would produce approximately 200 children to be educated at $720 per pupil per year, for an annual total of $144,000. Additional garbage collection, police services, fire protection, lighting, and other services would cost about $12,000 annually. Thus the total annual increase in municipal costs would be $156,000. Tax returns from these proposed new residences would amount to approximately $100,000, leaving a $56,000 annual deficit to be shared by all residents in the form of permanently increased taxes. On the other hand, if the community bought the land for parks -- even assuming no federal or state aid (which they have received) -- the

land would be completely paid for in 10 years, at approximately the same annual cost but with no subsequent expenses except for nominal maintenance costs."

Before proceeding to a more in-depth look at various land acquisition methods as outlined by Davis, two final points need to be made. As stated by Ehrenfeld, (1) "ecological balances are too delicate and land is too expensive for conservation to proceed in a haphazard way. Conservation and development must be planned together, and with equal care" and as stated by Wagner (2) "a rational alternative (referring to his scenario of watershed problems and floodplain destruction) is to return floodplains to their natural function -- the temporary storage of excess stream flow." No development should be permitted on lands in or adjacent to the Berry's Brook-Bellyhack Bog, the Cedar Run, or the Fairhill Marsh ecosystems.

In chapter 5 of his book entitled Land Use, Kenneth Davis discusses various land-use controls. Davis' discussion provides some insight into the legal ramifications of various land use controls. Davis divides land-use controls into three categories including: (1) title ownership of land, (2) legal controls less than title ownership, and (3) public powers and influences. The first, title ownership of land, includes: (1) land purchase, (2) eminent domain, (3) transfer and exchange, and (4) donations.

As Davis points out, "the best way to control lan

to own title to it free of all encumbrances." When lands are purchased they are subject to existing liens or encumbrances. These may entail unpaid taxes, easements, leases, etc. The disadvantage here is that some of these "may be difficult if not impossible to extinguish" (for example, easements or long-term leases). Thus title purchase may entail the inclusion of restrictive covenants, restrictions, or other land controls. Davis points out that the principle of "strategic or preemptive purchase" may be advantageous where conservation matters are concerned. "By buying certain well-located parcels of land in a particular area, the purchaser may be in a position to control or modify land uses over the rest of the area. This tactic can be equally effective in urban-related open space and in nonurban situations. In the latter, a strategically located parcel of land could control access to timber or to wildland recreation development." Acquisition of the Bromfield property near Rye Elementary School could conceivably fall into this category.

Eminent domain is both a public power and a means of land ownership. It is frequently thought of as occurring only at the federal or state level, whereas it may occur at any governmental level having jurisdictional authority, including local government. "Such action is taken where purchase at reasonable cost is not possible or less-than-title land-use agreements, such as rights obtained under an

ment, are not considered satisfactory." This method offers a possible method for regaining land currently held by developers where other methods of achieving land control may have failed. The power does exist, should not be overlooked, and should be used if necessary.

Transfer and exchange of lands offers another possible, certainly more equitable, way of dealing with developers. The Town of Rye could put a moratorium on all housing construction until suitable lands for development have been defined via a land use plan. Once these lands have been located, the Town could then purchase them, and exchange them with developers for parcels currently owned by developers in areas involving critical ecosystems.

Donations of land, where the owner of the land has expressed his/her desire to do so, may be complicated by the owner's desire to see that the land will continue to be used in accordance with their wishes. How to achieve this is not often easy and generally involves complicated legal documents such as trusts. Another overriding problem is who to give the land to. "Public agencies are normally permanent, but their policies and practices may change, as may those of private corporations or trusts." A person wanting to donate their land for a given purpose may face difficulties in arriving at a mutually exceptable agreement

with the recipient. "Some recipients are cautious of making legal commitments in perpetuity for certain land uses. The reason is that circumstances may change and a particular land use may become undesirable or impractical." Coupled with this problem is the fact that judges and administrators generally disdain agreements involving perpetuities. Unless written in an air-tight manner, such agreements are often ruled against if taken to court.

Before closing this section on land ownership, it should be mentioned that the Nature Conservancy offers a possible route for securing critical lands. "It not only accepts land donations with or without restrictions but buys and sells land for conservation purposes. Having capital and freedom to act quickly, it often performs the vital function of buying lands promptly that are critically needed by a public agency and later selling them to the agency. Consequent saving in cost may be substantial."

Legal controls less than title ownership entail (1) easements, (2) restrictive covenants, conditions, and other limitations, and (3) contractual leases. Easements "grant specified land-use rights to other than the title owner." Easements "limit the use which the possessor (owner) of that land might otherwise make of it." They are "a posse[illegible] and legal right to a land use that is held by someone [illegible] than the title owner." In addition, "an easement run[illegible]

the land, to use a legal phrase, and hense is binding on heirs and assigns when title changes hands." For this reason, easements are often very unpopular with land owners. "Easements are a serious and rather permanent matter. They often affect the value and sale price of a property in ways that may be difficult to anticipate or evaluate." For these reasons, easements are appropriate and will work only when certain conditions are met. (1) "All parties concerned must thoroughly understand the nature and purpose of easements...that the easement agreement be clearly and accurately executed." Many misunderstandings often exist for both parties involving easements. They are not sure what can or cannot be done. Landowners may think that an easement will give rights of public entry to their land. (2) "The lands should be of relatively low market value and the easement should be essentially negative...the easement...requires only continuation of what the owner has been doing." There are two types of easements, negative and positive. These will be explained momentarily. (3) "The rights actually needed for land-use controls can be obtained through easements for much less cost than buying the rights." Essentially easements are the best means of land control, and should not be undertaken if the land can be purchased.

A number of other points about easement

made. First, "a positive easement is one that gives someone other than the title owner the right to do something regarding the land (for example, utility right-of-way). A negative easement requires that the owner not do something regarding his or her use of the land." Many of these are conservation oriented and examples cited by Davis are listed below.

> Scenic -- preservation of natural scenery, limitations on building or other land uses; to keep a farm or other area in its present use and condition.
>
> Fish and wildlife -- to preserve present habitat, not to drain or fill, burn, dam, etc.
>
> To conserve and protect stream and stream bank habitat, or to effect stream improvement; may or may not include the right of public access.
>
> Not to drain, fill, or otherwise change wetlands.
>
> To preserve an area, as an attractive woodland, in its natural condition.
>
> Not to permit billboards or to clear forested land.

Second, "an easement normally includes a reverter clause specifying that if the terms of the easement are not met, the rights so conveyed revert to the title owner."

Third, it was stated that easement lands should have a low market value. It should not mistakenly be assumed "that conservation-type easements do not apply where land values are high. They do apply, and the reason is that there are high relative differences between the use values of different parcels of land. In a housing development, for

example, both the desirability of sites for building and development costs often vary substantially over the tract. There is frequently a strong positive correlation between high development costs and areas that have natural scenic, conservation, and general open-space values. Some examples are poorly drained land, steep or rocky land, and some wooded areas. In such situations, easements can be an economic and also an aesthetically desirable means of preserving open-space areas." A combination of cluster housing coupled with negative easements offers a compromise for protecting much of the land adjacent to the Berry's Brook-Bellyhack Bog ecosystem while also providing for some development in the areas currently owned by developers. Cluster units would be restricted to areas suitable for construction, as determined by an ecologist, and the remaining areas unsuitable for development would be retained for open-space and protected by strict negative easements. This method is a compromise, and is not recommended if complete prevention of construction in these areas can be prevented.

A fourth point regarding easements goes back to the "judicial dislike of perpetuating meaningless covenants." An example might be "a right-of-way easement for an inter-urban trolly line which has been permanently abandoned."

For this reason, "a number of states have enacted laws limiting conservation easements to some set period such as 30 to 60 years." I do not know if New Hampshire is one of these states, and if not, cannot guarantee that such legislation may not be forthcoming, considering increasing growth and development in this state. The point which needs to be made is that easements may only offer temporary, rather than permanent, solutions to conservation or open-space needs. From this standpoint they are very undesirable, and should not be used if more permanent solutions can be found. This is especially so where critical ecosystems are involved. In addition, compromise developments such as mentioned above could be legally gotten out of within reasonable periods of time.

Despite their disadvantages, easements may offer possible avenues of approach for two Rye natural areas requiring protection. These include, the Cedar Run ecosystem (especially Brown's Pond) and a large portion of the estuary lands. I would again urge that purchase of these lands be made if possible.

Conditions, limitations, and restrictive covenants "do not constitute a granting by the title owner of specified rights to land use. Legal conditions and limitations are restrictions regarding future use of the land attached

to a sale or transfer of land title." They are written into the deed. These provisions go "with the land, continue without time limit, and consequently apply to all future title owners. The penalty for violating these provisions is not in monetary damages but in reversion of the land title to the original owner, or possibly heir, together with right of entry and without any further legal action." The courts not liking perpetuities, frown on these methods of land control.

"Restrictive convenants are contractual agreements between the seller and buyer of a property in which the buyer agrees to do or not do certain stipulated things. They differ from situations previously discussed in that there is no possibility of the title reverting to the original owner because of nonperformance." They differ from easements in that they do not entail a partial sale of owner use rights. They also differ from trusts in that "no corporate entity to hold and administer the land is involved." Restrictive covenants are subject to the "doctrine of change and may become unenforceable if the stated original purposes have so changed that the covenant is oppressive or inequitable." Many states have statutes limiting covenants to 30-60 years. There are two types of covenants depending upon the penalty for breach of contract. In a common law covenant, the penalty for breach is money

damages. "From a land-use standpoint, monetary recompense after a breach of covenant is often not very satisfactory; the damage is done." Redress for breach of equitable covenants is in the form of remedial action rather than monetary. Most important, "an injunction may be granted before damage occurs or to stop actions in violation of the covenant." Covenants have use where (1) a person wishes to sell his/her land to a developer, while specifying how the land will be developed and (2) where conservation organizations may wish to transfer lands to other corporate organizations (for example, Town government) with the assurance the lands will be used for specified purposes. In either case, however, caution is warranted as covenants are subject to the "doctrine of change" and may have statutory limits. They are temporary measures, which may be absolutely inappropriate where crucial ecosystems are involved.

Leases offer an interesting possibility for land control. They are "contractual, legal, and enforceable agreements" and constitute a "form of covenant." They 'transfer possession or specified uses of property for a period of time, with right of reversion for nonperformance retained by the owner." Leases specify penalties for their violation. Leases are also renewable, if conditions and circumstances

are right. "Leases are applied widely in land use and can include some or all use rights of property ownership except title." Long-term leases involving environmental matters may pose problems, since both "circumstances and needs change over time in land-use matters." The result is that an individual owning land is not likely to grant a long-term lease to a conservation oriented group.

The tables may be turned, however, by taking advantage of the possibility of combining land purchase with a lease back to the original owner. In this fashion, the Town of the Conservation Commission might buy up critical pieces of land from private owners or developers, and then lease the lands back to the private owners or developers with specified environmental limitations. This is again a compromise measure, and gets particularly complicated when developers are involved. In the case of private owners, rather permanent protection for critical lands could be achieved while allowing original owners to go right on using the lands with certain restrictions. Capital gained from the lease would defray the cost of original purchase. The landowner would avoid future property taxes, receive immediate cash for his/her land, continue to use the land, and have to pay a capital gains tax. If installment payments were made to the original owner, the extent of this tax could be considerably reduced. In

order for this arrangement to work, the lease price would have to be fair in terms of the original landowners capital gain. In the case of developers, the Town could buy the land, lease it back to the developer allowing for construction in specified areas (determined by an ecologist), and the developer would subsequently long-term sub-lease the new properties rather than following classical sale practices. This method might also offer substantial relief to would-be homeowners who cannot afford to buy a house in todays inflationary market. This measure applied to developers is a compromise, because it again allows for some housing development (cluster) in ecologically critical areas. Outright purchase or transfer of properties would be better.

In closing, it should be remembered that (1) "a lease may be considered as an alternative to an easement which offers difficulties because of its binding long-term nature and possible legal complexities" and (2) "the possibilities of combining legal devices concerning ownership rights are almost endless in effecting land-use controls."

Public powers and influences affecting land-use controls may be broken down into the following categories: (1) taxation, (2) police and regulatory powers, (3) public

and private grants-in-aid, (4) intergovernmental compacts, and (5) land-location controls. In the transfer of land for conservation purposes involving its sale, donation, or easement, taxation matters often become of prime concern. This comes into play in terms of income tax deductions, gift taxes, and capital gains taxes. The difference between the sale value of land and its original cost traceable to the last previous sale constitutes a capital gain. For some land owners this may be considerable enough to desuade them from selling their land. If land title transfer can be spread out over a period of years, the bite of the capital gains tax may be reduced. In the transfer of lands by donation, estate and gift taxes may have to be paid. If a receiving organization does not have tax exemption, receipt of a gift may pose financial problems. Finally it should be stated that easements, which may be transferred by gift or sale, may also be tax deductible.

Land taxes may often shape the directions of land-use. Land property taxes are based upon land value, and how this valuation is determined can be of critical importance in achieving desirable land use and open space. Preferential taxation, or "current-use assessment" as it is referred to here in New Hampshire, can provide a useful tool to local

governments for establishing and maintaining open space. Forest or agricultural lands may be kept in their present status by offering substantially lower land taxes to their owners. The key, and the problem here, is getting landowners to take advantage of these tax reliefs. Despite the fact that one would think that landowners would be breaking down doors to qualify for current-use assessment, they are not. The concept is too new to be fully understood or appreciated. Local governments can lose substantial tax revenues if it gets out of hand, and one has too much of a good thing. Finally, and most importantly, there are severe penalties (in the form of taxes) for breaching their contract once they have been granted current-use. Their land is encumbered so to speak. Sales may be jeopardized if the new owner is not willing to continue the current use. A change in use, accompanying a sale, may require the seller to pay considerable taxes as a penalty.

There are substantial problems with or without preferential taxation. Without it, agricultural and forested lands are taxed out of existance due to equal valuation of lands. Large land owners, unable to pay their increasing property taxes, must sell to developers to stay above water. With it, "tax intent can be circumvented; people are very ingenious." Many developers have bought up land, leased

it back to its original owner who continues his original use, and the developer thereby avoids higher taxes (tax shelter), since the land is not reclassified until such time as he develops it. Many states, including New Hampshire, have blocked this loop-hold by establishing a roll-back tax which the original owner must pay if any attempt is made to pull this stunt. Even if no harm was intended, the original owner, as alluded to in the previous paragraph, pays a penalty for changing land use.

The major police and regulatory powers available to local governments come in the form of land-use zoning ordinances. These may, for all practical purposes, be as broad and intimidating as the power of eminent domain. Towns can zone for or against almost anything as long as the new ordinances do not violate federal civil rights laws. This method, if one is not too concerned about equity, can be positively ruthless and lethal to developers. If more reasonable means fail, the Town of Rye should not hessitate to use this powerful tool. Where environmental matters are concerned, the end does justify the means. As examples, land-use zoning may be applied to floodplains, wetlands, recreation areas, wilderness areas, wildlife areas, or wild or scenic rivers. In addition to zoning ordinances, Towns may establish regulatory bodies with the

powers to fine environmental violators.

Public and private grants-in-aid should not be overlooked by Towns seeking to acquire, establish, or develop parks, recreational areas, or other open-space areas. Such grants-in-aid are "usually done on a cost-sharing basis. For example, the federal government puts up a part, the state another, and the local governmental unit the rest of the total cost." In addition, "foundations, land trusts, and other private organizations and entities also give financial assistance to open-space land acquisitions."

The concept of intergovernmental compacts is particularly relevant with regard to the Berry's Brook-Bellyhack Bog ecosystem, since this ecosystem is located both in Portsmouth and in Rye. On a grander scale, the Tennessee Valley Authority is representative of a federal-state compact. Intergovernmental compacts "constitute marriages of necessity to meet situations in which nobody can go it alone and prosper. The scale of compact agreement naturally varies with need. They range from intermunicipal to international agreements." For Rye and Portsmouth, an intermunicipal compact prohibiting further development of lands constituting an integral part of the Berry's Brook-Bellyhack Bog ecosystem (as determined by a professional ecologist) would be highly appropriate.

Land-location controls are very important in land-use planning decisions, and have already been partially discussed in reference to preemptive or strategic land purchases. These controls may be direct or indirect, and this difference provides a key for future land development. Indirect controls are "where a key ownership does not require the same or similar use, and direct, where a key ownership does tend to enforce the same use or control another use. A big airport, for example, certainly strongly affects but does not require the same use of surrounding lands. A large ski run or a national park likewise promotes development of ancillary services and facilities. These often have substantial effects on private land values and consequent influence on agricultural, forest, or other nearby land uses. The point of emphasis is that a land-use pattern tends to develop around a dominant ownership use." Direct land-location controls involve strategic or preemptive ownerships. By owning even a small piece of land in precisely the right place, a Town or a Conservation Commission can "prevent or limit other construction development." The method is particularly good where (1) "strategic landownership may control access to a lake or stream with high recreational potential or to timberlands" or (2) where funds for land purchase are

especially limited.

"Land-hungry people with money are increasingly buying land in all sorts of parcel sizes and places for all sorts or reasons. The result can be a hodgepodge of land-ownership and land-use objectives, that once imprinted on the land by private ownership, are extremely difficult to change and put into any sensible pattern. The importance of land-location controls inevitably and naturally points toward the necessity for planned land development."

References

Malcolm Baldwin and James K. Page, Jr. (eds.). 1970. Law and the Environment. Walker Publishing Company, Inc., New York, 432 p.

George W. Cox (ed.). 1969. Readings in Conservation Ecology. Appleton-Century-Crofts (Meredith Corp.), New York, 595 p.

F. Fraser Darling and John P. Milton (eds.). 1966. Future Environments of North America. The Natural History Press, Garden City, New York, 767 p.

Kenneth Davis. 1976. Land Use. McGraw-Hill Publishers, New York, 324 p.

David W. Ehrenfeld. 1970. Biological Conservation. Holt, Rhinehart and Winton, Inc., New York, 226 p.

Philip H. Lewis, Jr. 1969. Regional Design for Human Impact. Thomas, Kaukauna, Wisconsin.

Charles H. Little. 1968. Challenge of the Land. Open Space Action Institute, New York.

Ian L. McHarg. 1969. Design with Nature. Natural History Press, Garden City, New York.

Richard H. Wagner. 1974. Environment and Man. W.W. Norton & Company, Inc., New York, 528 p.

William H. Whyte. 1968. The Last Landscape. Doubleday, Garden City, New York.

Kenneth P. Davis and William H. Smith. Land use apprenticeship at Yale. American Forests, March 1974.

APPENDIX

Rye conservation group sponsors meeting to discuss Master Plan

RYE — Concerned citizens of Rye and surrounding communities are reminded that the Rye Conservation Commission will sponsor a public meeting this Friday night to present and discuss a proposed Conservation Master Plan for the Town of Rye. The meeting will be at 7:30 p.m., August 4, in the conference room of the Town Library.

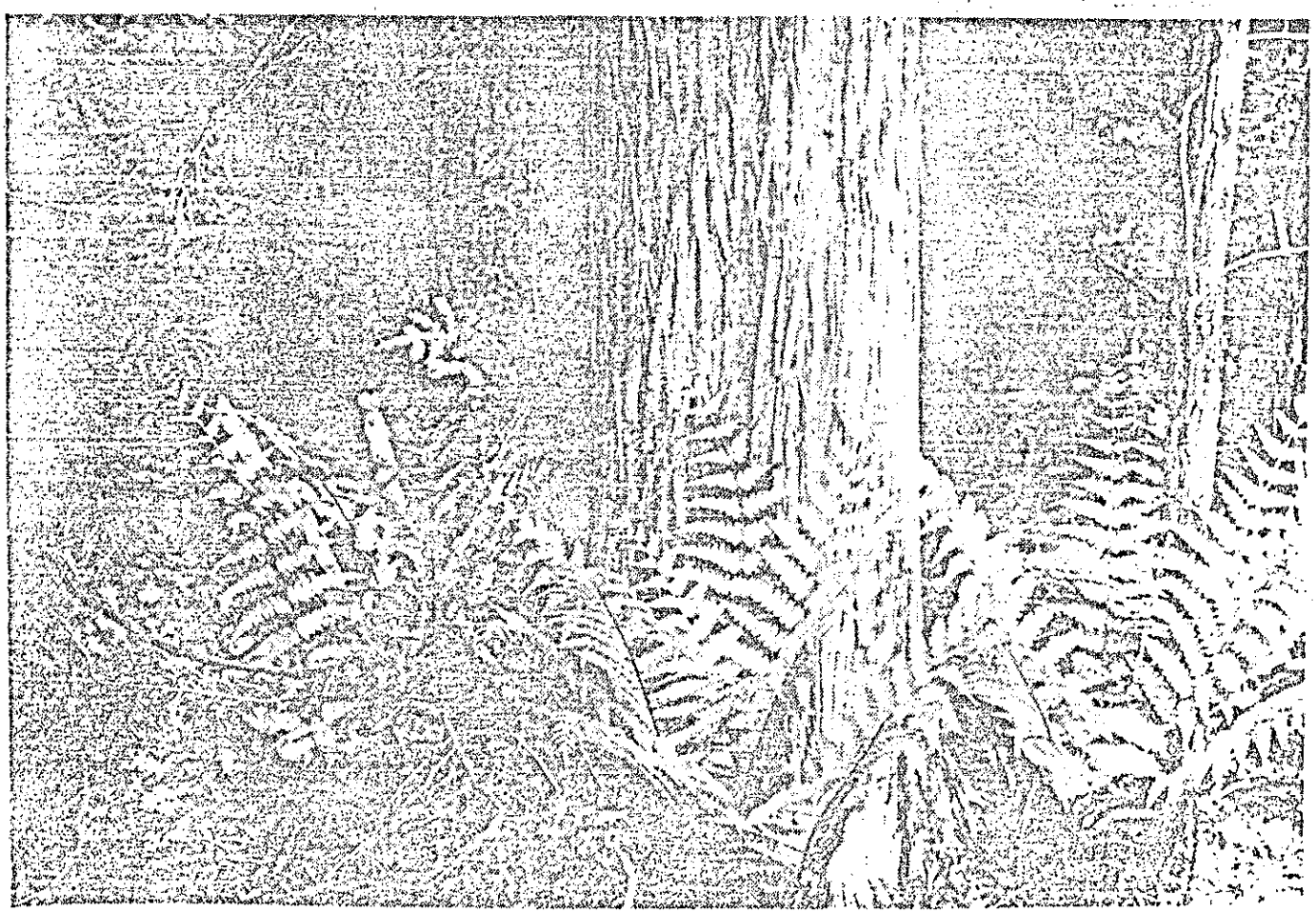
At the meeting, Phillip Reynolds, a local forester and ecologist, hired to prepare the Conservation Master Plan, will present a talk accompanied by slides and other descriptive materials pertaining to Rye's natural areas proposed for preservation and recreational use by the public.

In depth descriptions of various natural areas including those under development, threatened by development, or already protected will be given.

With regard to those areas requiring protection, particular attention will be given to (1) the Estuary originating at Pioneer Road and extending inland from Brackett to Sagamore Roads, (2) the Bellyhack Bog - Berry's Brook Area extending along the Portsmouth-Rye town border, and (3) the various Atlantic white cedar stands occurring in Rye. In addition, possible plans for a Town Forest and a long-range urban forestry plan will be discussed.

Funding for the study has been provided jointly by the Rye Conservation Commission and by a federal Forest Service grant for urban and community forestry, administered by the Urban Forestry Center in Portsmouth. Concerned Rye citizens interested in achieving a balanced, controlled, and meaningful land use plan for the Town's future development are especially urged to attend and to offer their ideas on how to achieve satisfactory protection for particularly sensitive areas.

Portsmouth citizens concerned about adjoining natural areas located in Rye, of mutual interest to the Portsmouth community, are also urged to attend. Finally, concerned citizens of other New Hampshire communities interested in planning for the future, and in developing land use plans for their own communities, should plan to attend to view first-hand the Conservation Master Plan which is being developed for Rye.



THE ATLANTIC WHITE CEDARS will be discussed by Phillip Reynolds, a local forester and ecologist, at the Conservation Commission public hearing, to be held August 4 at the Rye Library.

PARTICULAR ATTENTION will be given to the Estuary, which originates at Pioneer Road and extends inland from Brackett to Sagamore roads, at the Rye Conservation Commission public hearing August 4 at 7:30 p.m.

.C

HOW MUCH DOES A FOREST WEIGH?

STUDIES THAT REFLECT ON NEW HAMPSHIRE'S FEW REMAINING ATLANTIC WHITE CEDAR SWAMPS

Phillip E. Reynolds[1], Kenneth G. Carlson, Thomas W. Fromm, Kenneth A. Gigliello, Richard J. Kaminski, Mary K. Reynolds[2], and Marjorie Sims.

[1] formerly Assistant Professor of Forest Ecology, Richard Stockton State College, Pomona, New Jersey 08239 and

[2] Conservation Educator, New Hampshire Urban Forestry Center, Portsmouth, New Hampshire 03801.

Editor's Note: This article about Atlantic white cedar is research oriented and in greater depth than is usual for *Forest Notes*. There are two reasons for this; one, the Society owns two white cedar areas, "The Webster Natural Area" in Kingston and the "Cooper Cedar Woods" in New Durham and two, the publication's questionnaire indicated that *Forest Notes* readers enjoy having articles of this nature from time to time.

ACKNOWLEDGMENTS

I wish to thank Larry Safford, Jim Hornbeck and Tim McDevitt (USDA, Forest Service, Durham, N. H.) for their support in completing the nutrient studies reported upon in this paper.

INTRODUCTION

Atlantic white cedar *(Chamaecyparis thyoides)* is a magnificent tree species once plentiful along the New Hampshire seacoast. Today with increasing urbanization of this region it is rapidly disappearing and now grows in the State in only a few scattered pockets. Most of these cedar stands are in private ownership and therefore vulnerable to sale, development and ultimate destruction. Recent efforts to save these few remaining forests have been made by members of the Society for the Protection of New Hampshire Forests (SPNHF), the Portsmouth Conservation Commission and the Rye Conservation Commission. Currently, the SPNHF owns two tracts of cedar. One is near Kingston, the other near New Durham, New Hampshire. The Webster Natural Area in Kingston, is an 85-acre forest acquired in 1972 as a gift to the SPNHF by the Webster family. The Cooper Cedar woods is off route 11 near New Durham.

BACKGROUND INFORMATION ON ATLANTIC WHITE CEDAR

Geographically, Atlantic cedar is distributed in a narrow coastal belt from Maine to Florida (Silvics Handbook 1965). In the deep South, these trees occur in coastal Alabama, Mississippi and Louisiana. The species has always been most abundant and commercially important in southern New Jersey, southeastern Virginia, eastern North Carolina and the Florida Panhandle. In its northward extension, occurrence of the species along the New Hampshire seacoast was probably once very extensive. Fossil remains of this species, known as the "sunken forest" off the coast near the town of Rye, have been aged to be about 3,640 years old (The Portsmouth Herald, January 17, 1978). Stumps and preserved logs of the species periodically spotted during periods of low tide are evidence that the species was once widely distributed in this region. Melting of the glaciers after the last Ice Age (10 - 12,000 years ago) resulted in a significant rise in sea level, a change in coast-line features and a flooding out of species once grown on dry land (Belling 1977).

Volume 133, Summer 1978, Society for the Protection of N.H. Forests

Commercially, Atlantic white cedar has always been a prized tree species. The straight, tall, and frequently large diameter trunks of these trees have made them sought after for lumber, cedar-shakes and boat building. The light weight wood is relatively impermeable to water, resistant to microbial decay and generally safe from insect damage. The largest trees have been observed in North Carolina and Virginia, where they sometimes reach a height of 120 feet and a diameter of 5 feet (Korstian and Brush 1931). The colder climates of New England act to reduce these sizes. Trees in coastal Connecticut, Rhode Island, Massachusetts, New Hampshire or Maine rarely grow to more than 40 - 60 feet tall and 16 inches diameter (Little 1950). Pure stands of these trees are frequently only 100 - 125 years old and may be third or fourth regeneration forests since Colonial settlement (Harshberger 1916).

Due to the wide geographic range of Atlantic cedar, it is found growing in association with differing tree and shrub species depending upon latitude (Korstian and Brush 1931, Buell and Cain 1943, and Little 1950). Although cedars grow in predominantly pure stands, they are almost always associated with red maple (*Acer rubrum*). In New England, other tree species sometimes found growing in cedar stands include eastern hemlock, eastern white pine, blackgum, yellow birch, black spruce and gray birch. At mid-latitude, such as in southern New Jersey, tree species generally associated with white cedar forests include blackgum or tupelo, sweetbay magnolia, gray birch and pitch pine. Farther south, trees such as pond pine, slash pine, water tupelo and southern bald cypress grow in association with white cedar. Common shrubs found growing in the understory of cedar stands include sweet pepperbush, highbush blueberry and swamp azalea. Other shrub species include leatherleaf, black huckleberry, sheep laurel, mountain laurel, swamp leucothoe or fetterbush, dangleberry, inkberry and lowbush blueberry.

Distributions of these cedar forests generally corresponds with low-lying, poorly-drained sites and these pure stands are sometimes referred to as cedar swamps for this reason. Swamps may be defined as "lowlands on which standing water is present for only part of the year, most often in spring and late fall." They have better drainage, and are, therefore, not as acid as bogs (Robichaud and Buell 1973). Soils in these swamps are generally peaty, sometimes sandy, and acid (pH 3.5 to 5.5). Peat, or partially decayed organic deposits, is high in sulfur and nitrogen and may be several feet deep. These deposits usually do not contain significant amounts of clay or silt (Korstian and Brush 1931, Little 1950, and Bernard 1963). Typical elevations above sea level range from 3 to 140 feet for these swamps.

Natural regeneration and forest succession in cedar swamps seems to be controlled by tree species tolerance or the lack of it to flooding and shading (Buell and Cain 1943 and Little 1950). Since cedar trees are shade-tolerant, these swamps are inevitably replaced by shade-tolerant hardwoods such as red maple, sweetbay magnolia and blackgum (Putnam et al. 1960) or shade-tolerant conifers such as eastern hemlock, eastern white pine or black spruce. Man's cutting of these swamps has not only reduced their size (at the time of Colonial settlement, these swamps possessed substantially larger trees than are found in them today) but has changed their composition as well (Harshberger 1916). Complete clear-cutting of cedar swamps tends to favor the reestablishment of cedar, since this species is shade intolerant. Partial cutting favors the development of hardwood swamps, since these species are shade-tolerant and vigorous stump-sprouters. Establishment of cedar, by contrast, depends upon natural reseeding. Cedar seeds will germinate on suitable seedbeds of peat or rotten wood only if there is abundant light. In addition, the seedbed must be moist but not flooded.

Uncontrolled fires have also shifted the cedar swamps away from cedar in favor of hardwoods, since the former is very intolerant of fire, whereas the latter are more tolerant. Other of man's activities have reduced the formerly more widespread distribution of cedar swamps. In Massachusetts and southern New Jersey, many old cedar swamps were clear-cut, flooded and converted into cranberry bogs (Harshberger 1916).

Current disturbances by man also threaten the safety of these swamps. Serious environmental disturbances, such as changes in water level resulting from new construction, might eliminate the few remaining cedars still occurring in New Hampshire and favor their replacement by far more common or aesthetically less desirable tree species. On Cape Cod, Massachusetts, recent housing developments have changed the drainage patterns of remnant cedar stands, allowing septic tank wastes to flow into these swamps. Some trees have been killed by flooding and undesirable herbaceous species, formerly foreign to these swamps, have been favored by the nutrient rich sewage flowing into them (Laderman 1977).

In addition, attempts to clean-up these swamps by removing dead or windthrown trees may also pose a threat to their security. Since these trees normally grow in high density (1000 - 2000 stems per acre), removal of trees from these stands predisposes the remaining trees to further wind damage. Although openings created in the canopy by tree removal may provide adequate light for cedar reproduction, it is also likely to release or stimulate the growth of shade-tolerant hardwoods in the stand. Such stimulation may ultimately lead to the replacement of the remaining cedars by these shade-tolerant species.

OBSERVATIONS ON THE QUANTITATIVE [illegible] OF WHITE CEDAR

Very recent studies by [illegible] 1977 and [illegible]

TABLE 1

Oven dry weights of trunk, branch and leaf components of trees of differing diameters.

CEDAR

	4-inch tree	8-inch tree	12-inch tree	16-inch tree
trunk	37.4*	185.0	482.4	944.9
live branches	7.3	30.8	72.7	132.2
dead branches	0.97	4.4	12.3	24.2
needles	4.4	17.6	36.6	61.7
total	50.07	237.8	604.0	1163.0

MAPLE

	4-inch tree	8-inch tree	12-inch tree	16-inch tree
trunk	273.1*	1359.0	3477.9	6775.2
live branches	77.1	193.8	328.2	478.0
leaves	2.0	7.6	16.3	28.2
total	352.2	1560.4	3822.4	7281.4

*all values are expressed as pounds. For conversion purposes, 1.0 kilogram = 2.2026 pounds and 1.0 pound = 454 grams or 0.454 kilograms. For those wishing to estimate the dry weights of other cedar or red maple trees of differing d.b.h. from those presented in this table, the following linear regressions may be applied. All regressions are log 10 d.b.h.-log 10 dry weight and are described by the formula $y=A + BX$, where y=log 10 oven dry weight and X= log 10 d.b.h. in centimeters. For cedar trunk weight, A= -1.1413 and B= 2.3456. For cedar live branch weight, A= -1.5958 and B= 2.0994. For cedar dead branch weight, A= -2.6380 and B= 2.2815. For cedar needle weight, A= -1.5654 and B= 1.8769. For red maple trunk weight, A= -0.2375 and B= 2.3151. For maple branch weight, A= 0.2294 and B=1.3100. Finally, for maple leaf weight, A= -1.9475 and B= 1.8989.

swamps have revealed new information regarding the biology of these forests. Research conducted on a southern New Jersey cedar swamp, located on the Stockton State College campus in Pomona, New Jersey, has allowed us (1) to estimate how much these forests weigh on an area basis, (2) to estimate how much individual trees with differing diameters weigh and (3) to determine the total amounts of soil nutrients which are bound-up in the various tissues (i.e., trunks, live or dead branches and needles) of these trees. Hopefully, this research will better enable us (1) to understand how these forests grow, (2) to understand how rapidly these forests grow and (3) to potentially increase the rate of growth of these forests.

The southern New Jersey cedar swamp upon which these observations are based has a stand density of 901 stems per acre and 207 square feet of basal area per acre. Most of the trees in this swamp are under 18 inches in diameter and are not more than 60 feet tall. Combined board footage for this particular cedar swamp is currently about 41,500 board feet per acre (Reynolds et al. 1978a). Previous studies of other cedar stands indicate that combined stand basal areas may exceed 300 square feet per acre. Stem densities up to 1700 stems per acre and board foot yields up to 75,000 board feet per acre have been noted for certain cedar swamps (Korstian and Brush 1931). Thus, in all respects, this cedar swamp may be regarded as an intermediate size forest with regard to the complete size range for these forests. Co-dominant red maple trees present in the stand have a density of 172 stems per acre and a combined basal area of 14 square feet per acre. Red maple board footage is about 2,800 board feet per acre (Reynolds et al. 1978a).

Estimates of community weight (biomass) for this forest are 126,994 pounds per acre for cedar trunks; 20,686 pounds per acre for cedar live branches; 3,310 pounds per acre for cedar dead branches; and 11,180 pounds per acre for cedar needles. Total trunk, live branch and leaf biomass values for all red maples growing in the cedar stand are 60,430; 12,649; and 380 pounds per acre (Reynolds et al. 1978a & b). All of these weights are oven-dry weights. They are based upon what all the cedar or red maple trees in the forest would weigh if all the water in these trees were removed prior to weighing each of the individual trees. Individual trees of differing diameters vary with regard to dry weight for various tissue components (i.e., trunks, branches or leaves). The relationship of weight to tree size for cedar or red maple is shown in Table 1.

In many instances, weighing each tree within a forest would be both physically impossible as well as destructive to the forest as a whole. Since it is impossible to weigh each tree individually, ecologists have worked out procedures for determining this information based upon very limited sampling. A limited number (usually 6-10) of trees of differing diameters are cut down, carefully taken apart, separated into tissue components, dried in the laboratory and weighed. This information is then used for developing mathematical relationships which allow forest ecologists to accurately predict the weights of similar trees within the forest, without ever having to cut these trees. This technique of determining living or dead biomass of an existing forest is called "dimension analysis" (Reichle 1970).

TABLE 2

Total amounts of nutrients contained in all tissue components (trunks, branches, and leaves) for trees of differing diameters.

CEDAR

	N	Ca	K	Mg	P	Fe	Mn	Zn
4 inch tree	52.1*	30.5	72.8	4.7	4.0	0.74	0.19	0.14
8 inch tree	233.8	134.5	64.8	24.9	18.0	3.53	0.87	0.63
12 inch tree	557.1	322.3	152.6	50.4	43.6	9.05	2.17	1.59
16 inch tree	1017.9	596.1	278.9	93.1	80.2	17.4	4.21	3.12

MAPLE

	N	K	Ca	P	Mg	Mn	Fe	Zn
4 inch tree	484.0*	209.3	446.9	48.6	36.4	3.33	2.6	0.61
8 inch tree	1747.4	833.5	1883.0	190.6	153.4	14.9	12.3	2.8
12 inch tree	3890.8	1943.1	4509.4	441.4	367.3	36.4	31.0	6.8
16 inch tree	7009.8	3602.9	8486.9	815.9	691.0	69.8	59.5	13.1

* all values are expressed as grams. For conversion purposes, there are 454 grams in one pound. There are 1000 grams in a kilogram.

Trees like all other plants grow in response to sunlight (i.e., photosynthesis) when there is an adequate supply of water and soil nutrients available. Over the years, certain elements (nutrients) have been discovered to be essential for plant growth. All higher plants, regardless of whether they be trees or tomatoes, require these nutrients if they are to grow. Some of these include nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), iron (Fe), manganese (Mn), and zinc (Zn). The first five are so-called macronutrients and are required in much larger quantities than the last three which are micronutrients. A shortage of any one of these nutrients could retard growth. If such shortages are alleviated by fertilization, growth should increase, assuming that all other conditions for growth are adequate and that an oversupply of the deficient nutrient has not been given.

Since nutrients are so important for the growth of healthy forests, ecologists are interested in knowing the nutrient status of these forests. This information is obtained by combining nutrient tissue analysis studies with biomass determinations such as those described above (Reichle 1970 and Fortescue and Marten 1970). For our model cedar forest, the following estimates of nutrient biomass for individual trees of differing diameters were made (see Table 2). For the five macronutrients, total amounts of N were highest and total amounts of P were lowest for cedar. For maple, total amounts of Ca were highest and total amounts of Mg were lowest. With regard to the three micronutrients, total amounts of Fe were highest for cedar. For maple, total amounts of Mn were highest. The three most abundant elements found in cedar or maple tissues were N, Ca and K. A similar pattern has been observed for plant tissues collected at the Hubbard Brook Experimental Forest here in New Hampshire (Likens and Bormann 1970).

Nutrient concentrations in plant tissues vary considerably depending upon a number of factors. It is most important that these factors be fully recognized and taken into consideration prior to ascribing a nutrient deficiency to a given forest site. Those factors which affect the levels of nutrients in plant tissues most are (1) chemical differences in forest soils, (2) seasonal variations in plant nutrient uptake and (3) genetic differences affecting plant species mineral uptake and accumulation. In general, forest species are far more capable of persisting on nutrient impoverished soils than are cultivated plants such as tomatoes or beans. Furthermore, coniferous species such as cedar, can exist on more nutrient deficient soils than deciduous trees, and do so by absorbing far lower levels of nutrients from forest soils than do hardwood trees growing on the same soils (Reichle 1970 and Fortesque and Marten 1970). Thus, the accurate assessment of a nutrient deficiency is tricky.

The large quantities of Fe in southern New Jersey cedars are a combination of high Fe content in these New Jersey soils, and more importantly, the preferential uptake and/or accumulation of Fe by cedar. No other species studied (data not reported on here) showed such a high affinity for Fe uptake/accumulation as did cedar. Accumulation of Fe in this species is notable for this type of forest ecosystem, but is in no way novel as other tree species, such as spruce, accumulate Fe (Safford and Young 1968).

For the New Jersey cedar stand, the low levels of all nutrients except N in the soils of the cedar swamp (Table 3) suggests that there is a deficiency of nutrients for tree growth. Fertilization of these soils might therefore increase the productivity of these swamps. Although a nutrient deficiency most probably exists for the New Jersey cedars, it should not be assumed that a similar deficiency exists for New Hampshire cedar forests. Careful testing of soils and cedar tissues for nutrient contents is necessary before making such a judgment. If the soils in these swamps are of more or less uniform composition and chemical content, it may be that such a deficiency exists, and its elimination might lead to increased productivity of these New Hampshire forests. However, differences in species composition between New Hampshire and New Jersey cedar swamps could lead to soil chemical differences, not as readily observed without laboratory testing, as physical soil differences. Major physical soil differences among these swamps are not nearly as likely. Given the present status of coastal New Hampshire cedar swamps, research investigations of this type could be well worth-while.

Individual differences in nutrient content for cedar or red maple trees of differing diameters may be added up to give the total tree nutrient biomass for the forest as a whole. This has been done for the southern New Jersey cedar swamp and these final results are given in Table 4 (Reynolds et al. 1978b). These results may be surprising to some. Although cedar is definitely the dominant tree in these forests, and maple is only of minor importance, the total amounts of Ca and Mn bound-up in maple tissues exceeds that for cedar. The total

TABLE 3

SOIL CHEMISTRY OF THE CEDAR SWAMP

Horizon	Color	Thickness	Organic Content	N	Mg	P	K	Fe	Ca	Zn	Mn
organic	black	12.5 inches	98.3%	4330*	114	105	57.6	48.4	11.6	2.6	1.2
A	dark gray	12.5	15.1	270	4.8	30	29.6	1.2	***	1.3	***

* nutrient values are expressed as ppm per gram of soil. One ppm (part per million) is equal to 0.000001 gram.

*** indicates the level of nutrient was too low to measure.

amounts of K and P bound-up in either cedar or maple tissues is very similar. Total amounts of N, Mg, Fe, and Zn contained in all the cedar trees in this forest exceed the total amounts of these elements bound-up in all the red maple trees in the forest. Although cedar is clearly the dominant tree in the forest in terms of density, basal area, board footage, and total combined weight, it is not the major tree of importance in terms of accumulation of all mineral elements in the forest.

SUMMARY

Results of a recent forest ecosystem analysis pertaining to Atlantic white cedar in southern New Jersey, provide information regarding the biology and ecology of these forests, which may aid in preserving and perpetuating the existence of these forests in coastal New Hampshire. Few remaining cedar swamps exist in New Hampshire at present. Results of the New Jersey study provide new information pertaining to the structure of these forests (i.e., biomass) and pertaining to nutrient cycling in these forests. Based upon the results of nutrient studies for New Jersey cedars, similar studies performed in New Hampshire cedars would very probably provide information which could be used in saving these swamp forests, as well as information which could be used for increasing the growth and increased distribution of these forests.

LITERATURE CITED

Belling, A. J. 1977. Postglacial migration of *Chamaecyparis thyoides* in the northeastern United States. Annual Supplement, American Journal of Botany, Volume 64.

Bernard, J. M. 1963. Lowland forests of the Cape May Formation in southern New Jersey. Bulletin of the New Jersey Academy of Science 8: 1 - 12.

Buell, M. F. and R. L. Cain. 1943. The successional role of southern white cedar, *Chamaecyparis thyoides*, in southeastern North Carolina. Ecology 24: 85 - 93.

Fortescue, J. A. C. and G. G. Marten. 1970. Micronutrients: forest ecology and systems analysis, pp. 173 - 198. In: Reichle, D. E. (ed.), *Analysis of Temperate Forest Ecosystems*. Springer-Verlag, New York.

Harshberger, J. W. 1970. *The Vegetation of the New Jersey Pine-Barrens: An Ecologic Investigation*. Dover Publications, Inc. New York. Originally published by Christopher Sower Co., Philadelphia, in 1916.

TABLE 4

Total amounts of nutrients bound-up in all cedar or red maple trees in a typical cedar swamp. These amounts are broken down according to major tissue components, and are expressed on an area basis.

CEDAR

	N	K	Ca	Mg	P	Fe	Mn	Zn
trunk	131.9*	36.1	65.2	10.5	11.0	4.6	0.9	0.71
live branches	75.8	22.3	87.1	6.7	7.0	0.21	0.18	0.13
dead branches	9.8	0.56	7.8	4.5	0.52	0.33	0.11	0.08
needles	127.5	36.4	38.8	9.5	8.2	0.11	0.12	0.04
total	345.0	95.36	198.9	31.5	26.72	5.25	1.31	0.96

MAPLE

	N	Ca	K	P	Mg	Mn	Fe	Zn
trunk	101.6*	149.2	59.1	13.4	12.0	1.3	1.1	0.24
live branches	93.6	50.1	29.8	7.3	4.0	0.26	0.10	0.04
leaves	7.0	0.98	2.5	0.39	0.3	0.0012	0.0035	0.0028
total	202.2	200.3	91.4	21.1	16.3	1.56	1.20	0.28

* all values are expressed as pounds per acre.

Korstian, C. F. and W. D. Brush. 1931. Southern white cedar. U. S. Dept. Agr. Tech. Bull. 251, 75 pp.

Laderman, A. D. 1977. The role of *Decodon verticillatus* in the Woods Hole Atlantic white cedar swamps. Bulletin of the Ecological Society of America 58(2): 20.

Likens, G. E. and F. H. Bormann. 1970. Chemical analyses of plant tissues from the Hubbard Brook ecosystem in New Hampshire. Yale Univ. School of Forestry Bulletin No. 79, 25 pp.

Little, S. 1950. Ecology and silviculture of white cedar and associated hardwoods in southern New Jersey. Yale Univ. School of Forestry Bulletin No. 56, 103 pp.

Putnam, J. A., G. M. Furnival, and J. S. McKnight. 1960. Management and inventory of southern hardwoods. USDA Agriculture Handbook No. 181, 102 pp.

Reichle, D. E. (ed.). 1970. *Analysis of Temperate Forest Ecosystems*. Springer-Verlag, New York.

Reynolds, P. E., K. G. Carlson, T. W. Fromm, and K. A. Gigliello. 1977a. Biomass and productivity of a southern New Jersey swamp ecosystem. Bulletin of the Ecological Society of America 58(2): 20.

Reynolds, P. E., R. J. Kaminski, K. G. Carlson, T. W. Fromm, and K. A. Gigliello. 1977b. Aerial crown mapping of a southern New Jersey Atlantic white cedar swamp. Bulletin of the Ecological Society of America 58(2): 20.

Reynolds, P. E., K. G. Carlson, T. W. Fromm, K. A. Gigliello, R. J. Kaminski, and M. K. Reynolds. 1978a. Phytosociology, biomass, productivity, and nutrient budget for the tree stratum of a New Jersey Pine Barrens Atlantic white cedar swamp. Bulletin of the New Jersey Academy of Science, Volume 23, No. 2.

Reynolds, P. E., K. G. Carlson, T. W. Fromm, K. A. Gigliello, R. J. Kaminski, and M. K. Reynolds. 1978b. Nutrient biomass for the tree stratum of a New Jersey Pine Barrens Atlantic white cedar swamp. Annual Supplement, Plant Physiology.

Robichaud, B. and M. F. Buell. 1973. *Vegetation of New Jersey: A Study of Landscape Diversity*. Rutgers Univ. Press. New Brunswick, New Jersey.

Safford, L. O. and H. E. Young. 1968. Nutrient content of the current foliage of red spruce growing on three soils in Maine. Research in the Life Sciences (April): 27 - 31.

Silvics of Forest Trees of the United States. 1965. Agriculture Handbook No. 271, 762 pp.

SELECTING TREES AND SHRUBS TOLERANT OF SULFUR DIOXIDE AND OZONE

Mary K. Reynolds and Phillip E. Reynolds

Numerous factors affect the growth, productivity and well-being of trees and shrubs in an urban or suburban environment. One of the most important of these is chemical air-borne pollutants. Of these, two pollutants are most important. These are sulfur dioxide (SO_2) and ozone (O_3). The existence of sulfur dioxide has been known for quite some time, whereas the existence of and importance of ozone has only more recently been appreciated. Knowledge of which tree or shrub species are most adversely affected by these air pollutants, along with insight regarding the mechanisms of injury, has been gained only within the past five to ten years.

Before examining: (1) which species are affected and to what degree and (2) the mechanisms of injury, let us look briefly at the origins of these two air pollutants.

Most of the sulfur compunds in the atmosphere are from the burning of sulfur-containing fossil fuels, the decomposition and combustion of organic matter, from the ocean and from volcanoes. Sulfur dioxide constitutes about 95 per cent of man's emissions to the atmosphere. There are several sources of sulfur dioxide. Some of the most important are: (1) petroleum refining; (2) combustion of coal; (3) refining of metal ores such as copper, lead, nickel and zinc; and (4) industrial chemical production such as the making of sulfuric acid. Whatever the source, the production of sulfur dioxide is not small. In New York City alone, 600,000 tons of sulfur dioxide were produced during 1967 while in the state of Connecticut, 300,000 tons were produced for that same year (Smith, 1970).

Ozone is a primary component of urban smog and only recently (25 years ago) have the chemical origins of ozone been appreciated. Ozone is a product of the interaction of nitrogen oxides and hydrocarbons in the presence of sunlight. Sunlight is the key word indicating that ozone is formed indirectly or secondarily by means of a photochemical reaction. The nitrogen oxides and hydrocarbons are produced from many of the same industrial sources as sulfur dioxide. In addition, another important source of these pollutants is automobile exhaust.

There are two other sources of ozone in addition to the source described above. The troposphere, or the lowest region of the earth's atmosphere, is rich in ozone. Ozone may be brought near the earth's surface by disruptive weather phenomena such as polar cold fronts, jet streams, hurricanes and other violent storms. Ozone may also be formed during electrical discharges in thunderstorms. These natural processes, however, do not contribute significantly to ozone pollution.

As an urban or suburban dweller, you can reduce the deleterious impact of these air pollutants on woody vegetation by: (1) planting those species which are relatively tolerant of exposure to sulfur dioxide or ozone and (2) by assisting your town planning and conservation commissions in selecting only those species for public projects which show resistance to these two pollutants. Listed below are two tables which give species sensitivity to the two pollutants. You will probably note that many species tolerant of sulfur dioxide damage are most sensitive to ozone damage. Variation among species as to sensitivity or tolerance is genetically controlled and at present incompletely understood. Continuing studies by researchers (forest geneticists) are being conducted to develop tree and shrub varieties which will be resistant not only to urban air pollutants but also to other urban pollutants such as salt injury.

The observed phenomenon that many species sensitive to ozone damage are tolerant of sulfur dioxide damage is also reflective of differing mechanisms of damage by the two pollutants. Sulfur dioxide enters the leaves of trees and shrubs through tiny openings known as stomata and is promptly converted to the sulfite form of sulfur. Sulfite is quite toxic and plant tissues, under normal conditions, make every effort to detoxify sulfite by converting it to sulfate. If external sulfur dioxide levels are not too great, sulfite is normally detoxified to sulfate as rapidly as it is formed. When sulfur dioxide levels are high, the detoxification cannot occur rapidly enough and the process is overwhelmed. Such high levels of sulfur dioxide also stimulate the stomata to remain open. This can be particularly damaging during times of drought because it is a normal response of plant stomata to close during periods of water shortage in order to conserve water.

High levels of ozone by contrast, cause the stomata to close, preventing normal gas exchange. As a result, the uptake of oxygen is prevented and cellular respiration is impaired. Ozone is also thought to interact with fats contained in cellular membranes, bringing about changes in membrane permeability. In the case of sulfur dioxide damage, undetoxified sulfite reacts with various enzymes necessary for photosynthesis rendering them inoperative. Sulfite also reacts with chlorophyll, the compound essential for photosynthesis, resulting in its conversion to a colorless compound lacking biological activity.

Distinguishing between plant symptoms for the two types of air pollution injuries is not always easy even for the expert, and frequently requires additional information. Although the symptoms

Mary K. Reynolds and Phillip E. Reynolds. Respectively, Conservation Educator, Urban Forestry Center, N. H. Division of Forests and Lands; and Research Forest Ecologist.

Table 1. Species sensitivity to sulfur dioxide for native and planted woody vegetation commonly growing in New England.

Sensitive	Intermediate	Tolerant
Eastern white pine	Beech	Sugar maple
White birch	Red maple	Arborvitae or white cedar
Large tooth aspen	Balsam fir	Northern red oak
Trembling aspen	White spruce	Common juniper
Yellow birch	Chokecherry	Smooth sumac
Gray birch	White oak	Barberry
Alder	American elm	Hackberry
Red pine	American hornbeam	Norway maple
Chestnut	Eastern cottonwood	Silver maple
Staghorn sumac	Witch hazel	Ginko
Low-bush blueberry	European mountain ash	Tree-of-heaven or *Ailanthus*
Ribes species	Red osier dogwood	Tulip poplar
Green ash	Apple	Colorado blue spruce
Black willow	Pear	American holly
Chinese elm	Peach	Rhododendron (some species)
	Common lilac	*Forsythia*
	Honeysuckle (some species)	
	Hydrangea	
	Wild grape	
	Viburnum (some species)	
	Serviceberry (some species)	

Table 2. Species sensitivity to ozone for native and planted woody vegetation commonly growing in New England.

Sensitive	Intermediate	Tolerant
Trembling aspen	Eastern hemlock	Sugar maple
White oak	Eastern white pine	European white birch
White ash	Pitch pine	Balsam fir
Black cherry	Black oak	Northern red oak
Tulip poplar	European mountain ash	Arborvitae or white cedar
Honey locust	Chinese elm	White spruce
Tree-of-heaven or *Ailanthus*	*Forsythia*	Gray dogwood
European larch	Scarlet oak	Flowering dogwood
American sycamore	Pin oak	Black gum
Azalea (some species)	Eastern redbud	Red pine
Common lilac	*Rhododendron* (some species)	Black walnut
Green ash	*Viburnum* (some species)	Red maple
	Sweet gum	Black locust
		Norway spruce
		European beech
		Mountain laurel
		Norway maple
		Colorado blue spruce
		Dwarf winged euonymus
		Yew (some species)
		American holly

of injury are quite different for each pollutant, the resulting symptoms frequently are not. Conifers suffering from either type of damage show necrotic (dead) needle tips and chlorosis (absence of green pigment) in adjacent tissue. Deciduous species may show interveinal white or brown blotches in the case of sulfur dioxide damage or flecking on the upper leaf surface where ozone injury has occurred.

Literature Cited:

Davis, D. D. and R. G. Wilhour. 1976. Susceptibility of Woody Plants to Sulfur Dioxide and Photochemical Oxidants. Ecological Research Series: EPA – 600/3-76-102. Environmental Research Laboratory, Office of Research and Development, U. S. Environmental Protection Agency, Corvalis, Oregon.

Missouri Botanical Garden. April 1975. *Sulfur in the Environment.* In cooperation with Union Electric Company, St. Louis, Missouri.

Smith, W. H. 1970. *Tree Pathology: A Short Introduction.* New York: Academic Press. 309 pp.

Tree Farm Facts

This Society has 5,341 acres in the Tree Farm Program.

Total Tree Farm acreage in the United States: 77,555,030

The New Hampshire Tree Farm Program is co-sponsored by the Society for the Protection of New Hampshire Forests, the New Hampshire Timberland Owners Association and the New Hampshire Cooperative Extension Service.

Washington was the first state to initiate the Tree Farm Program; New Hampshire was the 29th state to join in 1950.

The four largest Tree Farms in New Hampshire are: Brown Company, Berlin with 173,340 acres; St. Regis Paper Company, West Stewartstown with 171,083 acres; Tree Growers Inc., Wayland, Mass. 9,845 acres and Andorra Forest, Stoddard with 8,917 acres.

The Tree Farm Family concept was initiated by mill operators interested in telling their forest management story to the public. This effort soon evolved into a close working relationship between the operators and local woodland owners, thus precipitating the name . . . Tree Farm Family.

Company foresters evaluate the woodland owner's objectives and, if needed, supply a list of consulting foresters and surveyors.

Workshops are held periodically to keep "family" members informed of the latest information on forest practices, land use and environmental regulations, taxes, new legislation, record keeping and safety in the woods.

In exchange for these services, the mill operators have first option on the purchase of stumpage from its family members. If the members prefer not to sell to the "family mill', they are furnished with a list of competent logging operators. The family mill will also provide marketing guidance for those wood products considered undesirable for their particular operation.

The Draper Division of Rockwell International in Beebe River, New Hampshire is making plans to start a Tree Farm Family. If you are interested in joining, contact William R. Parmelee, Manager of Forest Operations, Rockwell-Draper Division, Beebe River, NH 03219.

Reprint from FOREST NOTES, Winter 1978

SOCIETY FOR THE PROTECTION OF N.H. FORESTS
5 So. State St., Concord NH 03301

MASSACRE MARSH

LOUISE H. TALLMAN

Louise H. Tallman is chairman of the Rye Conservation Commission. But her interest in conservation goes back much farther than her tenure as a town official, which started in 1969. She majored in landscape architecture at the University of Massachusetts and nurtured a life-long interest in growing things. This led to an interest in Odiorne Point, now a state park. She compiled a history of the first human settlement there. She also worked closely with Dr. Clotilde Straus, chairman of the Portsmouth Conservation Commission, in classifying the vegetation of the park.

Anthony Brackett was engaged in the cutting of saltmarsh hay when surprised and murdered by the Indians in September 1691. The Indian raiding party continued with a trail of fire and blood on Brackett and Wallis Roads in Rye, taking along a few captives as they left town. The Militia investigated next day, and buried eleven victims on a corner of Anthony's land beside the saltmarsh, members of the Brackett, Rand, and Berry families.

The Massacre Saltmarsh and Burial Ground are part of a tract of 42 acres recently purchased by the Rye Conservation Commission. This contains about 30 acres marsh, and 12 acres woods. Purchase was handled through the Rye Conservation Fund. Some funding is added at each town meeting. Our objective is the acquisition and preservation of wetlands.

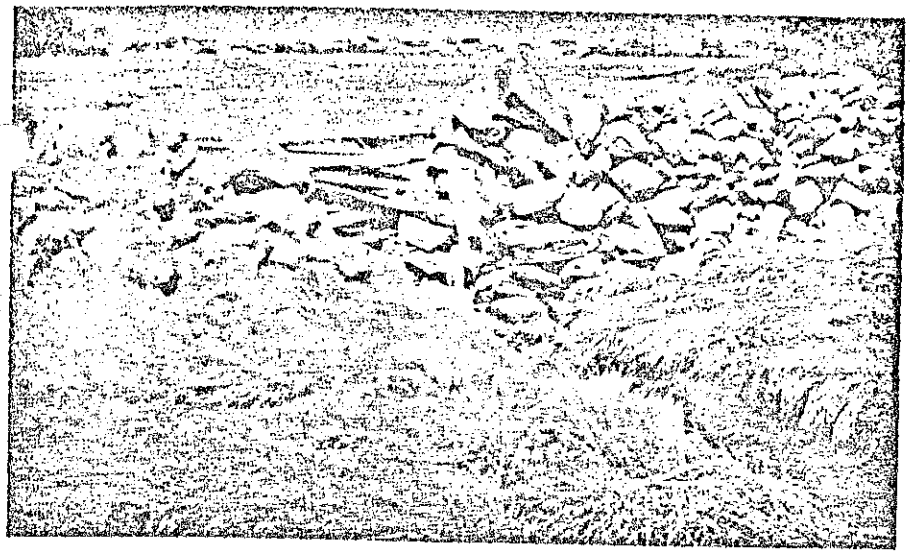
This is a particularly good area to examine the upper edge of a saltmarsh with its wealth of plant materials. There is also the sharp contrast between marsh and mature forest. Features will be described in the manner of a field walk.

Starting point is at the "Brackett Massacre Burial Ground" marked by a sign on Brackett Road, between Washington and Wallis. Besides its historic interest, the Burial Ground has a good view across the marsh. Nearby are the creek, and some shallow pools which attract water birds. Here is a cross-section of marsh edge: the grove of trees (Pine, Oak); the shrub edge (Blueberry, Arrowwood, Black Alder); the herbaceous edge (Blue Flag, Meadow Rue, Beach Pea); and finally the saltmarsh itself with the broad reach of Spartina patens, mixed nearby with Arrowgrass, Silverweed, and Blackgrass.

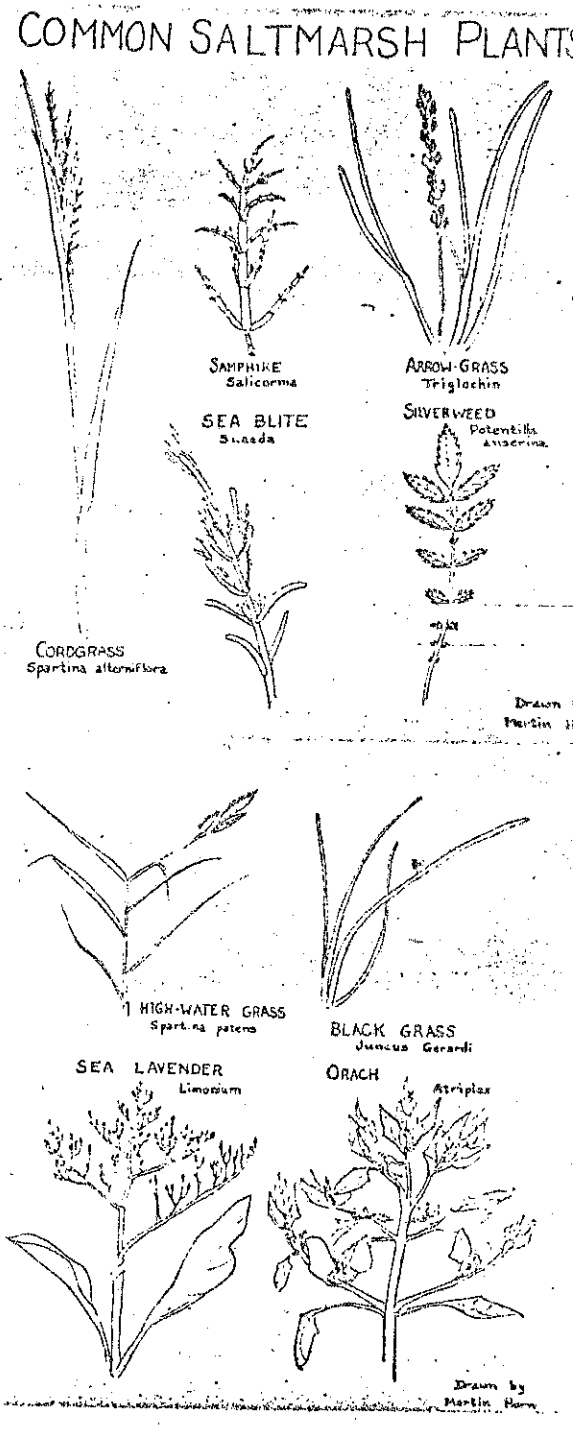
For the field walk, prepare for about 6 inches water, and a bit of bushwhacking. Cross the creek at Brackett Road to head east across the marsh to the prominent point of land. Watch your footing to step over mosquito ditches and any other pitfalls. Half way across to the point is a brackish cove on your right. Note the change in marsh vegetation. A tall sedge, Scirpus paludosus, is prominent. Around the edge is quite a variety of shrubs, with a background of Alder at the head of the cove. This brackish area is a favorite with Redwing Blackbirds that feed on the marsh, and nest at the edge.

Across the open marsh, watch for other characteristic plants that grow with

Portion of Brackett Massacre Burial Ground, with saltmarsh in the background.



Site of Foss Tide-Mill. Looking toward salt-marsh.



Spartina: Samphire (Salicornia), Orach (Atriplex), Sea-Blite (Suaeda), and Sea Lavender (Limonium). In the shallow pools there are algae of various colors, part of the normal chain of plant life of the marsh.

As you approach the exposed point, note the extent that storms have broken the older trees, opening space for new growth. The result is a thick cover of shrubs and stunted trees which is enjoyed by birds and other wildlife. Beyond the point is a deep, round sinkhole, with an edging of Spartina alterniflora. Nobody knows just how a deep pool like this was formed in the marsh. It may be as old as the marsh itself.

Take a right-angle at this point and head south across the marsh to the pile of sea-junk up against a wide stone wall. This is the site of the Foss Tide-Mill. Most of the mill-dam is in private ownership, conservation minded. At the center of the wall is a narrow sluice of carefully fitted stone. An oak frame held the sluice boards to impound the water at extreme high tide. Milling would then be done at low tide, a small operation for grinding the grain of a few families. The extent of the "mill field" above the dam may be traced by the reach of Spartina patens. Deeds from 1813 to the present mention this site.

We will now leave the marsh and head west across "Remick's Island," crossing through the woods back to Brackett Road. Once through the jungle edge, the old woods are fairly open. Dominant are giant Shagbark Hickory, with an understory of Ironwood (Ostrya). Rock ledges have their own assortment of plants. The glacier with its picking action left a small cliff at the southwest side of the ledges. Near here a group of Ironwood has grown quite large for the species. The largest measures 4 feet circumference, with the next smaller 3 feet 3 inches. Spring flowers include carpets of Trout Lily and Anemone. In forest types, there is a sharp transition from hardwood to a stand of mature Red Spruce with White Pine. Saltmarsh is only a short distance beyond. Wildlife enjoy the "Island", with active ground holes in evidence. Fox and rabbit are among the inhabitants. Muskrats live at the edge of the brackish cove.

Further bushwhacking to the west will take you through swamp and woods back to Brackett Road. Roadside litter is a problem. More than 10 bushels of cans and bottles are collected here each year.

Times have changed in many ways since Anthony Brackett knew this area. The old fields, orchards, and pastures have reverted to woods or houselots. The saltmarsh, however, remains just about the same here as when Anthony was cutting his salt hay in 1691.

Ecology Study of the EAST RYE POND CONSERVATION AREA

by. Prof. Albion Hodgdon, Botanist, U.N.H.

Vegetational and floristic survey of a five acre lot near the junction of Brackett and Parsons Roads in Rye, Rockingham County, New Hampshire. This is the lot that was purchased by the Rye Conservation Commission in March 1972.

This survey herein discussed was carried out on May 18, 1972 in company with Mrs. Charles Tallman and Ralph Brown, both members of the Rye Conservation Commission.

The area involved on its southwest side extends about 700 feet along a highway, about 500 feet on the northwest side a considerable part of which boundary lies across a body of fresh water, and 400 feet, most of which lies across the pond, on the southeast edge. Much of the area therefore is fresh water. It being too early in the season to assess the aquatic plants, this part of the survey will have to wait until summer or early fall when it is planned to visit the area again for this purpose.

The land area visited by us on May 18 lies between the road and the pond and is very diverse ecologically consisting 1) of a flanking wet cattail marsh next to the water and in low areas where the road lies near the pond; 2) of swamp hardwoods and thickets bordering the marsh toward higher land; 3) of an upland forest of about 50 years of age with good sized trees of several species at the northwest part of the tract; 4) forest-roadside edge.

The upland forest area will be discussed first. There are old apple trees and dead red cedars under a fairly dense canopy of such trees as Black cherry (Prunus serotina), White ash (Fraxinus Americana), Red maple (Acer rubrum), White pine (Pinus Strobus), and Pitch pine (Pinus rigida). This area of about one-half to

two-thirds of an acre was a field or pasture until about 50 years ago. Some large Red oaks (Quercus rubra) also are present. The indications are that this area will be a high quality bit of forest within the next 10 to 20 years since there is abundant moisture in this area and good soil. One small hemlock was observed near the wall that separates the tract from adjoining property. Young White pines and seedlings of several kinds of hardwood species were observed on the forest floor along with such species as Partridge berry (Mitchella repens), Indian cucumber (Medeola virginiana), Starflower (Trientalis borealis), Rattlesnakeroot (Prenanthus trifoliolata), Clintonia borealis. Wood anemone (Anemone quinquefolia), Horsetail (Equisetum sylvaticum), Arrow-wood (Viburnum dentatum), Smooth Gooseberry (Ribes hirtellum), Chike cherry (Prunus virginiana), Canada-mayflower (Maianthemum canadense), Clubmoss (Lycopodium complanatum) Sensitive-fern (Onoclea sensibilis), Bellwort (Uvularia sessilifolia), and Pennsylvania sedge (Carex pensylvanica).

2. The forest-roadside edge is of very great importance because of several interesting species that can be seen from the road. The most unusual ones are the Bastard-Toadflax (Comandra umbellata) and a very rare hybrid shrub known as Sorbaronia. This is a cross between the Black Chokeberry (Pyrus melanocarpa) and the cultivated European mountain-ash (Surbus aucuparia). This is a splendid example of this very rare natural occuring hybrid; it consists of about 10 stems up to about 18 feet high. This is the only specimen I have seen of this plant which has been found only a few times in nature. Other species found along the road-edge are Horsetail (Equisetum), Catbrier (Smilax), High blueberry (Vaccinium corymbosum), Meadow-rue (Thalictrum polygamum), Wild Geranium (Geranium maculatum),

Arenaria lateriflora and a number of others.

3) The swamp hardwood forest and wet shrub thicket intermingle and lie between the upland forest and the cattail marsh. Bordering the marsh are High Blueberry, Shadbush (Amelanchier), Poison Ivy (Toxicodendron), Black alder (Ilex verticillata), Chokeberry, wild raisin (Vibernum cassinoides), Arrow-wood (V. recognitum), Sweet Gale (Myrica), Rosa sp. Hardhack (Spirea tomentosa), Maleberry (Lyonia ligustrina) Catbrier, and Royal ferns (Osmunda regalis). The above described shrub thicket is backed up toward the road by a hardwood forest chiefly of Red Maple (Acer rubrum) but with some unexpected trees including a few dwarfed Red Spruce (Picea rubens) and q White Oak (Quercus alba) at the side toward the marsh.

The four vegetational areas are by no means clearly defined. Each grades at times into one or more of the others in the sense of sharing species.

The area is important in terms of possessing some unique plants such as the Sorbaronia hybrid which unfortunately lies rather close to the road and which should at all costs be protected in situ. This means that road widening and roadside brush cutting should be avoided where this plant grows. The tract has a great potential for wildlife. Many berry bearing species such as Roses, Blueberry, Black Alder (Ilex), Bayberry (Myrica), and Chikeberry occur there in abundance. I recommend that the area be left alone to develop with a minimum of disturbance. The area is excellent habitat for some desirable types of wildlife and is likely to retain this character if left alone. Rye is fortunate to have this tract of wetland forest and edge under protection.