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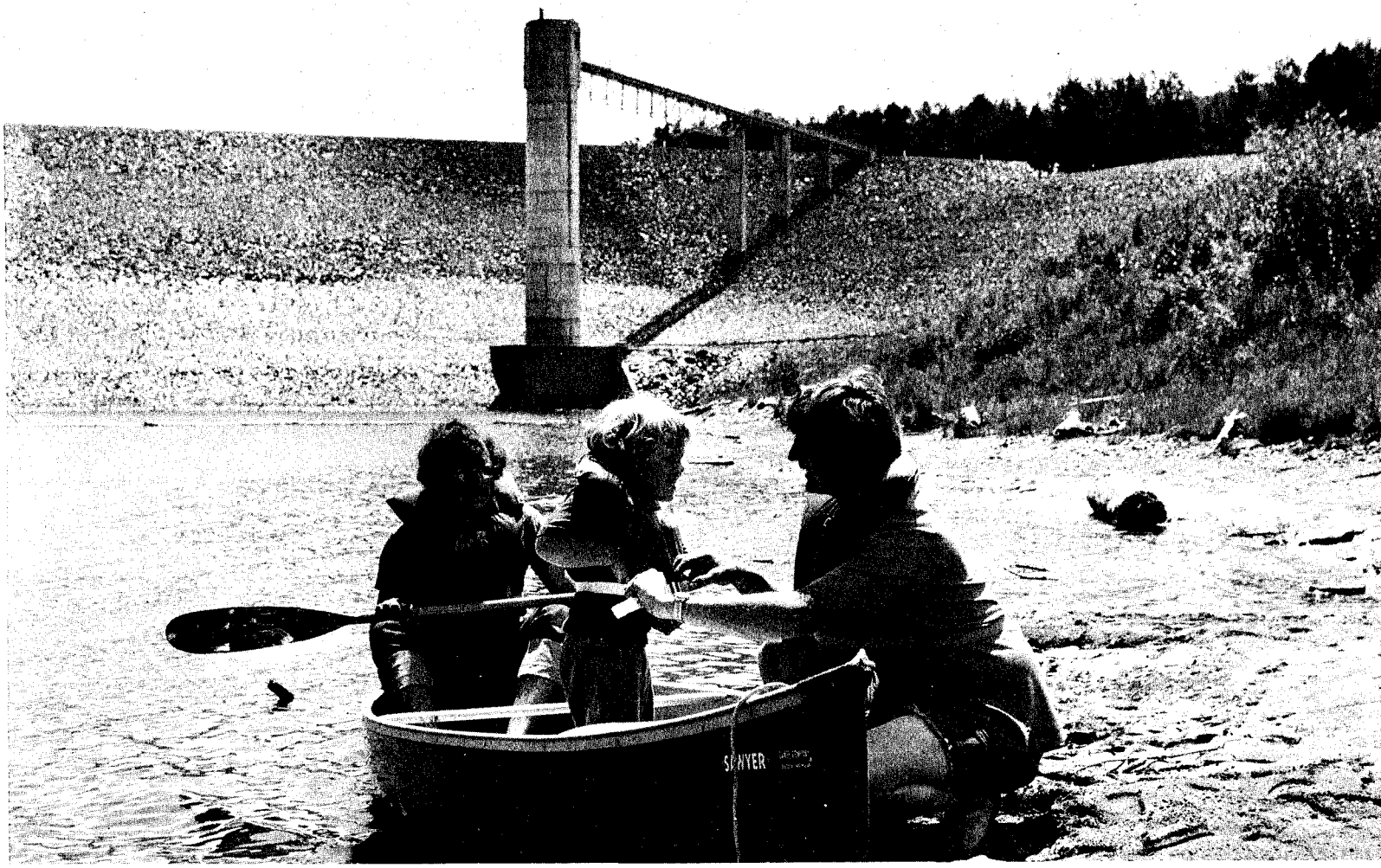
PROJECT PLAN
FOR RECREATION RESOURCES DEVELOPMENT

NORTH HARTLAND LAKE
HARTLAND AND HARTFORD, VERMONT



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NORTH HARTLAND LAKE

HARTLAND AND HARTFORD VERMONT

PROJECT PLAN

FOR THE DEVELOPMENT

OF THE

RECREATION RESOURCES

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

PREFACE

This Project Plan provides a comprehensive review of the Corps of Engineers role in providing outdoor recreation opportunities that enhance fish and wildlife resources, preserve the scenic attractiveness of the reservoir area, and are compatible with the flood control objectives of the project.

The plan has been developed from a study of the recreational requirements of the North Hartland Lake region consistent with consideration for the environment, fish and wildlife enhancement and conservation of project resources. Optimum development of recreation facilities with emphasis on quality and compatibility, rather than quantity, have been the primary objectives in planning the recreational use potential of North Hartland Lake.

The available recreation facilities offer an important addition to public use opportunities in Vermont, particularly for day-use activities. Important passive recreation opportunities, however, are also available. Planning of the recommended recreational development, as well as preservation and improvement of wildlife and fisheries habitat, has been coordinated with both State and local interests.

C. E. EDGAR, III
Colonel, Corps of Engineers
Commander and Division Engineer

ACKNOWLEDGEMENTS

The North Hartland Lake Project Plan was developed as a cooperative effort by several people with diverse technical backgrounds and specialties in data research and analysis, land use planning and report preparation.

Douglas A. Cleveland, Supervisory Civil Engineer and Chief of the Recreation and Natural Resources Section, supervised and coordinated the recreational planning analysis and report preparation.

Captain Marcia J. West, Recreation Resource Planner, gathered and analyzed the base data and input for the recreational development plans, coordinated the public involvement and prepared the written and graphic content of the Project Plan.

Townsend G. Barker, Hydraulic Engineer, prepared the evaluation of existing water quality conditions.

John Wilson, Archaeologist, prepared the cultural resource section of the Project Plan.

Frank L. Chisholm, Jr., Engineering Technician, coordinated the report reproduction and graphic preparation.

SUMMARY

The intent of this Project Plan is to make a comprehensive review of the Corps of Engineers' role in providing the type of outdoor recreational opportunities that enhance fish and wildlife resources, preserve the scenic attractiveness of the reservoir area, and are compatible with the original flood control objectives of the project.

The recommended plan of future development includes expansion of the Quechee Gorge State Park and the multi-use trail system, improvement of the picnic overlook area and parking at Quechee Gorge, development of a walk-in campground adjacent to the day-use area and establishing an informal swimming beach in the vicinity of the boat ramp. Existing fish and wildlife management programs will continue.

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I. INTRODUCTION

a. Project Authorization and Purposes

North Hartland Lake was authorized by the Flood Control Act of 1938 (Public Law 761, 75th Congress, 1st Session), the Flood Control Act of 1941 (Public Law 228-77th Congress, 1st Session), the Flood Control Act of 1944 (Public Law 534, 78th Congress, 2nd Session) and in the Flood Control Compact adopted by the States of Connecticut, Massachusetts, New Hampshire, and Vermont in 1953 (Public Law 52, 83rd Congress). Construction of the project was initiated in June 1958 at a cost of $7,120,000, and the project was placed in operation in 1961.

The project, in conjunction with other units in the comprehensive plan for flood control and other purposes in the Connecticut River Basin, provides flood protection for potential downstream damage centers along the Connecticut River in Vermont, New Hampshire, Massachusetts and Connecticut. The dam, located on the Ottauquechee River, regulates a drainage area of approximately 220 square miles. It has been estimated that $9,713,700 in flood damages have been prevented by North Hartland Dam through 1980.

b. Prior Pertinent Reports

A master plan for reservoir development was prepared by the New England Division, U.S. Army Corps of Engineers, in March 1962. The master plan was a comprehensive and coordinated plan for the development and management of the North Hartland Flood Control Reservoir area for public purposes which did not conflict with the authorized project purpose.

c. Purpose and Scope

The purpose of this project plan is to present a comprehensive and coordinated program for the development, enhancement, sound management and use of the recreational resources of the lands and waters owned by the U.S. Government at North Hartland Lake. This plan will serve as a guide to maximize public use of project resources, within the constraints of land suitability, recreation demand and flood control operations of the project.

A description of project features, evaluation of natural resources, analysis of recreational potential, plan of public use development, and discussion of reservoir management are included within the scope of this project plan. The plan represents a culmination of knowledge gathered from past operational experience and project analyses by Federal, State, and local interests. This plan is designed to be flexible enough to allow for changes in public attitudes, interests, desires, and area land uses.

The scope of the project plan includes an evaluation of the existing uses of the project lands and waters for public recreational purposes and

their relationship to other recreational opportunities available in the surrounding area. The plan recommends development of the project resources based upon the need to create additional recreational opportunities and to maintain, restore and enhance the quality of the environment.

d. Application of Public Laws

The Flood Control Act of 1944, Public Law 78-534, as amended, authorizes the Secretary of War (now Secretary of Defense) to construct, maintain, and operate public park and recreational facilities in reservoir areas and to grant such leases on land or facilities to non-Federal bodies as is reasonable and consistent with the major purposes of the dam and reservoir.

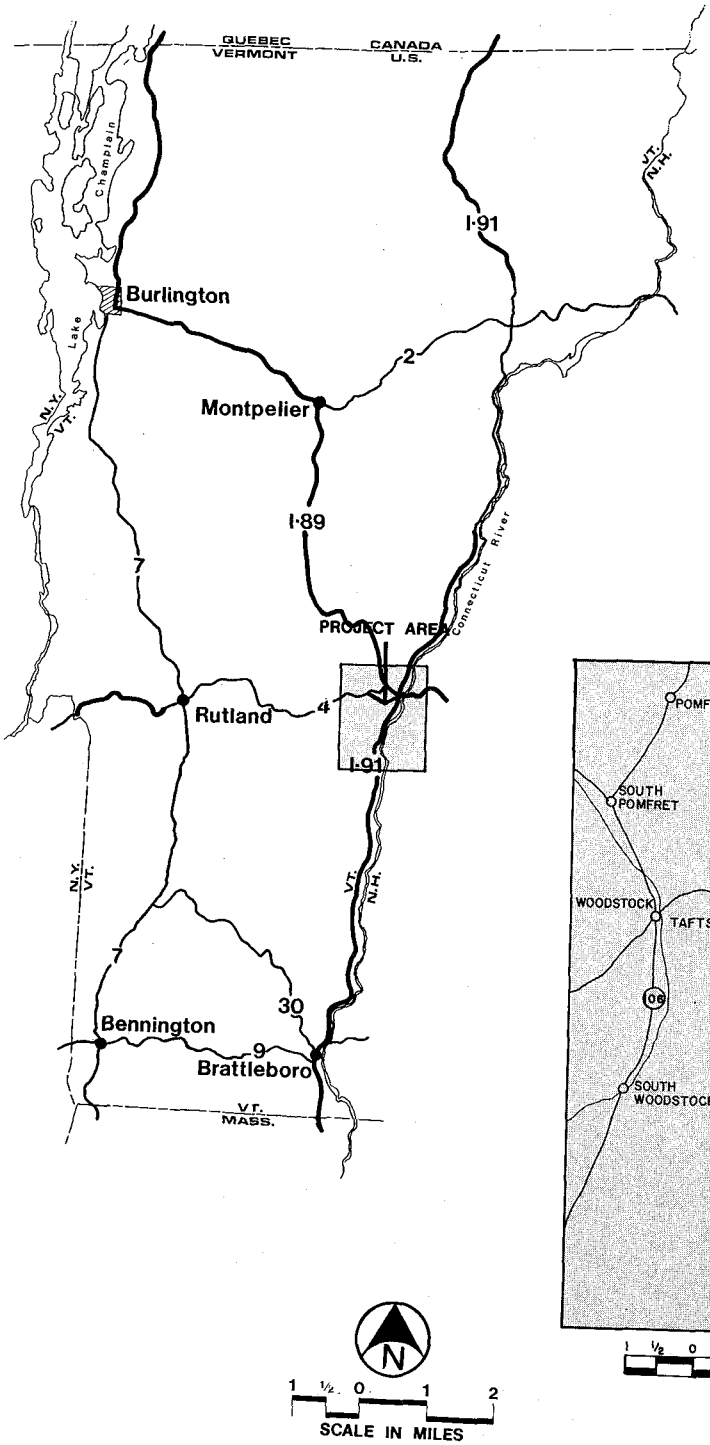
The Fish and Wildlife Coordination Act of 1958, Public Law 85-624, directs Federal agencies to coordinate the use of impounded bodies of water with the U.S. Fish and Wildlife Service, and directs State wildlife resource agencies to determine the extent of damage caused to wildlife by such projects. It also charges governmental bodies to promote the development and improvement of such resources by the preparation of wildlife resource plans and reports; to provide assistance in the development, protection, rearing, and stocking of all species of wildlife; to assist in controlling losses from disease; and to minimize damages from over abundance by providing public hunting and fishing areas, including easements over public lands thereto. It further authorizes modifications of, or additions to, projects not completed by March 10, 1934 (the date of the Fish and Wildlife Coordination Act), in order to acquire lands to accommodate the means and measures for the conservation of wildlife resources as integral parts of the project.

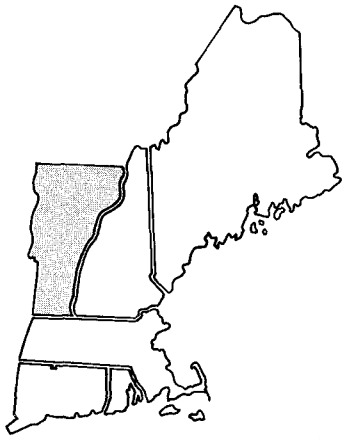
Under Public Law 89-72, the Federal Water Project Recreation Act of 1965, where a project has been completed as of July 9, 1965, and non-Federal bodies agree to administer project land and water areas for recreation, fish, and wildlife enhancement purposes and to bear the cost of operation, maintenance, and replacement of existing facilities serving those purposes, such facilities and appropriate project lands may be leased to non-Federal public bodies. The law specifically states that it is not to be construed as preventing or discouraging post-authorization development by non-Federal agency having jurisdiction over the project. At least 50 percent of the separable costs of the proposed recreation development must be borne by the non-Federal public bodies.

Public Law 89-90 authorizes the establishment of the National Water Resources Commission, which has the authority to set forth planning standards and water quality criteria and to maintain a continuing study of regional or river basin plans and programs in relation to national water resource requirements.

NORTH HARTLAND LAKE
HARTLAND & HARTFORD, VERMONT

VICINITY MAP





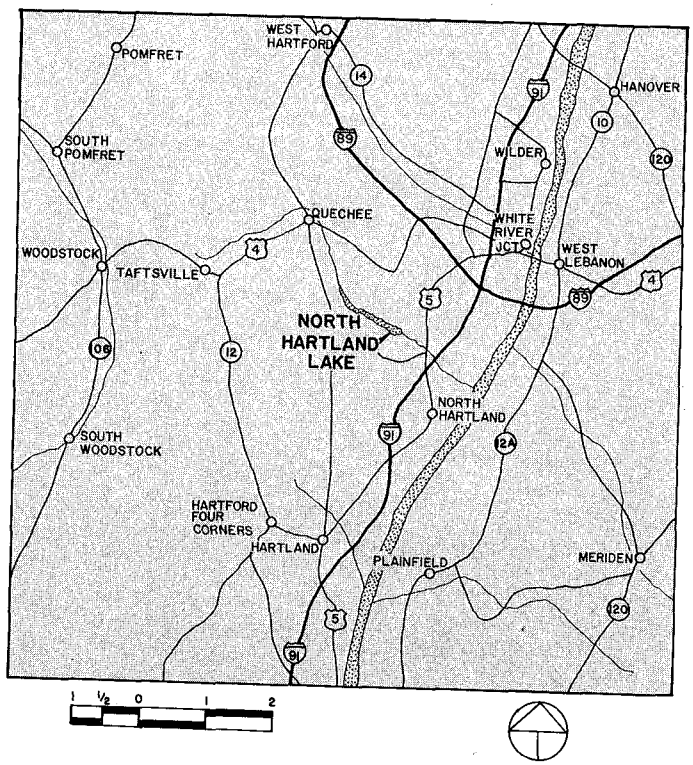


Figure 1

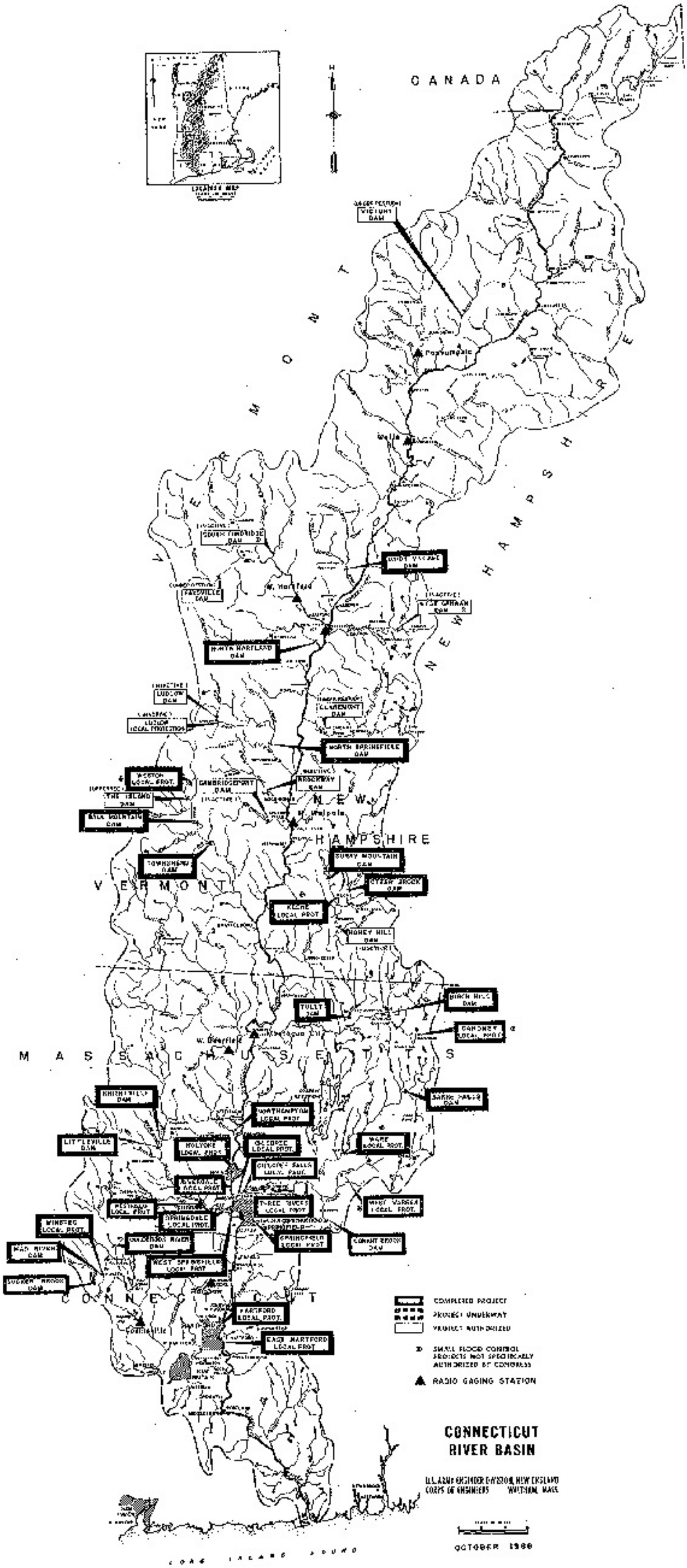

CANADA
VERMONT
NEW HAMPSHIRE
MASSACHUSETTS
CONNECTICUT
COMPLETED PROJECT
PROJECT UNDERWAY
PROJECT AUTHORIZED
SMALL FLOOD CONTROL PROJECTS NOT SPECIFICALLY AUTHORIZED BY CONGRESS
RADIO GAGING STATION
CONNECTICUT RIVER BASIN
U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS WALTHAM, MASS.
OCTOBER 1980

Figure 2

II. REGIONAL ANALYSIS

a. Regional Setting

The Ottauquechee River Basin is located in south central Vermont, primarily in Windsor County with a small portion extending westward into Rutland County. The watershed is roughly oval-shaped, and about 25 miles long with a maximum width of 13 miles. It has a drainage area of 222 square miles of which 220 lie upstream of North Hartland Dam.

This region of Vermont and New Hampshire plays a major role in helping to satisfy the growing recreational demands of the populous northeast section of the United States and eastern Canada. The Connecticut River Valley is the centerpiece for national forests in both the Green Mountains of Vermont and the White Mountains of New Hampshire.

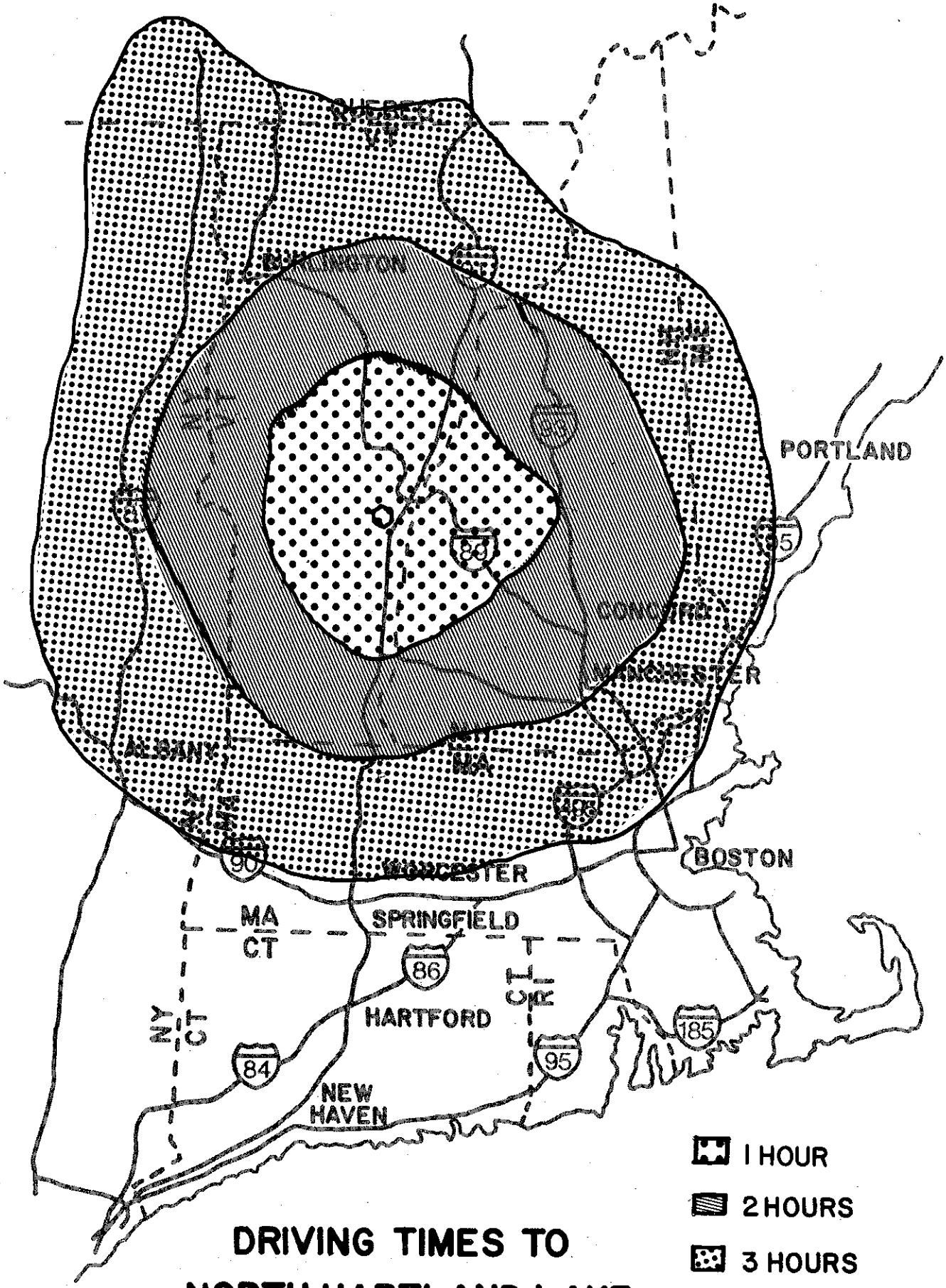
The scarcity of publicly owned water areas in central Vermont is a primary factor in the recreational demand on North Hartland Lake. The project is readily accessible to all sections of the region over an excellent network of State roads and interstate highways. This makes the recreation resources at North Hartland Lake within reach of southern New England's increasing population.

In many of the small communities in the vicinity of the project, tourism contributes substantially to the economic base. The area is becoming increasingly attractive for year-round retirement residences as well as vacation homes. Eight percent of the basin's work force was employed in agriculture in 1978. Approximately 35 percent of the area's work force was employed in manufacturing, including printing, publishing, textiles, lumber and wood products. The remaining 57% of the work force was employed in service and recreation related businesses, which are important features of the basin's economy because of both winter and summer recreational and tourism-related activities.

Public outdoor recreation areas in New England have experienced increased popularity. Increasing use is due to both the rising metropolitan populations and greater awareness and understanding of nature. In recent years, growing numbers have participated in non-organized outdoor activities and rising transportation costs have caused many people to seek public recreation close to home. The table on the following pages lists the major public recreation areas, with the activities offered at each, within 30 miles of North Hartland Lake.

b. Problems and Needs

According to the 1978 Vermont Statewide Comprehensive Outdoor Recreation Plan (SCORP), the most popular summer outdoor recreation activities are swimming, horseback riding, jogging, biking and golf. Popular winter outdoor activities include cross-country and downhill



DRIVING TIMES TO NORTH HARTLAND LAKE

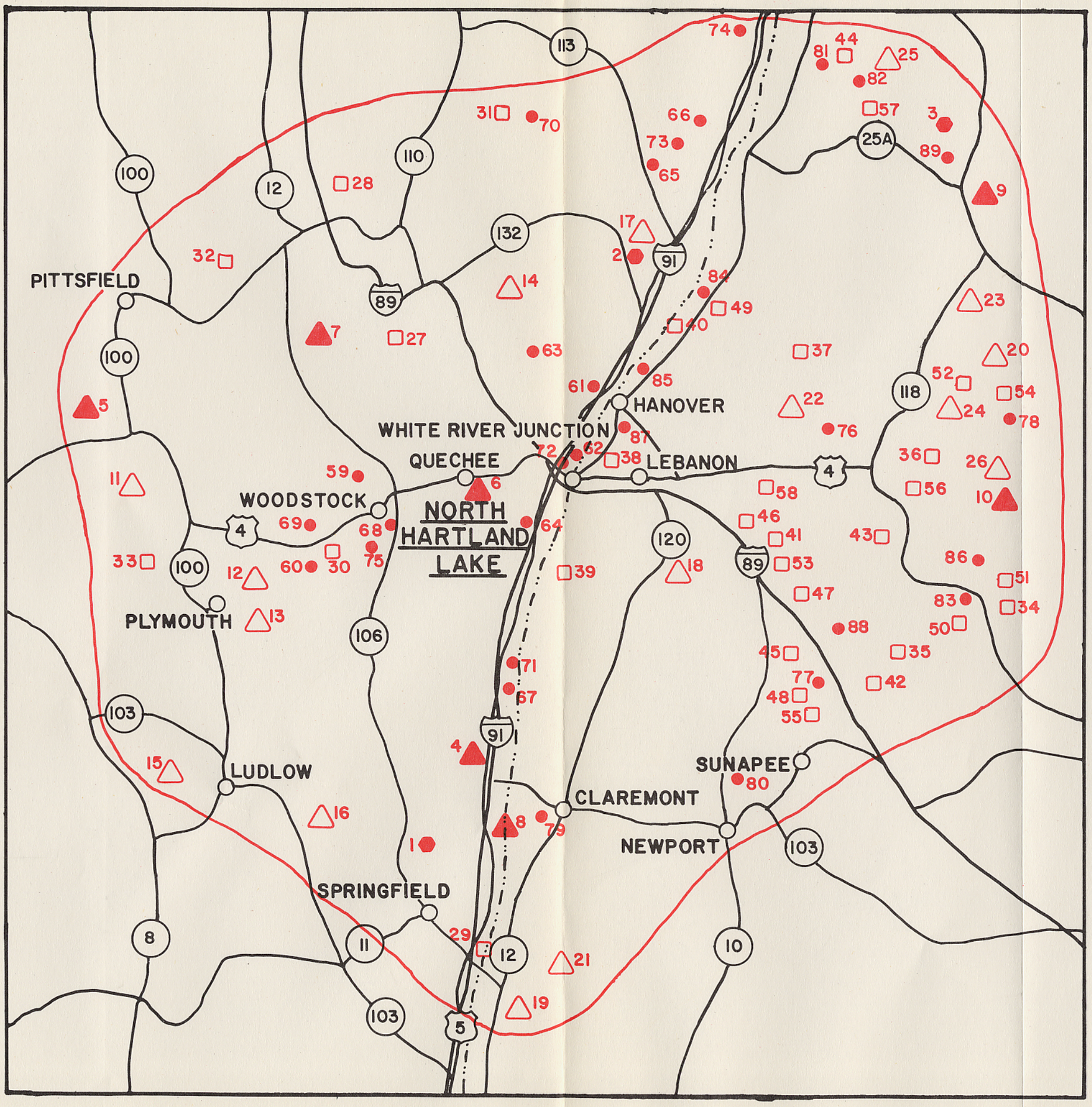
Figure 3

NORTH HARTLAND LAKE

HARTLAND
VERMONT

REGION RECREATIONAL FACILITIES

- Federal Facilities
- State Park
- State Forest
- State-Other
- Town Facilities
- 30 Mile Driving Radius



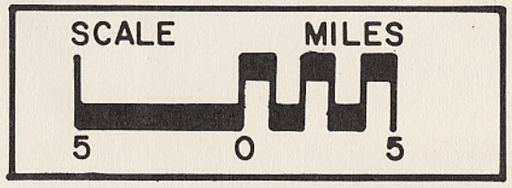


Figure 4

TABLE 1

Regional Recreation Facilities

MAP KEY	AREA	DISTANCE (Miles)	BOATING	CAMPING	FISHING	HIKING	HUNTING	PICNICKING	SKI-TOURING	SNOWMOBILING	SWIMMING
	FEDERAL										
1	N. Springfield Reservoir Area (VT)	25	X	-	X	X	X	X	X	X	X
2	Union Village Picnic Area	26	-	-	X	-	X	X	-	X	X
3	White Mountain National Forest (NH)	30	-	X	X	X	X	X	X	X	-
	STATE PARKS										
4	Ascutney State Park (VT)	15	-	X	X	X	X	X	-	-	-
5	Gifford Woods State Park	30	-	X	X	X	X	X	-	-	-
6	Quechee Gorge State Park	7	-	X	X	X	X	X	-	-	-
7	Silver Lake State Park	19	X	X	X	X	X	X	-	-	X
8	Wilgus State Park	21	-	X	X	X	X	X	-	-	-
9	Plummers Ledge S.P. (NH)	30	-	-	-	-	-	X	-	-	-
10	Wellinston Beach S.P.	30	-	-	-	X	-	X	-	-	-
	STATE FORESTS										
11	Calvin Coolidge SF (VT)	29	-	-	X	X	X	-	X	-	-
12	Calvin Coolidge SF - Camping Area	22	-	X	X	-	-	-	X	X	-
13	Calvin Coolidge SF - Day Use	25	X	-	X	-	-	X	-	-	-
14	Charles Downer SF	20	X	-	X	-	-	-	-	-	-
15	Okemo SF	30	-	-	-	X	-	-	X	X	-
16	Proctor-Piper SF	27	X	-	X	-	X	-	-	X	-
17	Thetford Hill SF	26	-	X	X	X	X	X	X	X	-
18	Annie Duncan SF	14	-	-	-	-	-	X	-	-	-
19	Connecticut River SF (NH)	30	-	-	-	-	X	-	-	-	-
20	Crosby Mt. SF	30	-	-	-	-	X	-	-	-	-
21	Hubbard Hill SF	29	-	-	-	-	X	-	-	-	-
22	Mascoma SF	21	-	-	X	-	X	X	-	-	-
23	Province Road SF	30	-	-	-	-	X	-	-	-	-
24	Province Road SF	26	-	-	-	-	X	-	-	-	-
25	Sentinel Mt. SF	30	-	-	-	X	X	-	-	-	-
26	Weiton Falls SF	30	-	-	-	X	-	-	-	-	-

TABLE 1 (Cont'd)

Regional Recreation Facilities

MAP KEY	AREA	DISTANCE (Miles)	BOATING	CAMPING	FISHING	HIKING	HUNTING	PICNICKING	SKI-TOURING	SNOWMOBILING	SWIMMING
	OTHER STATE AREAS										
27	Amity Pond Natural Area (VT)	20	-	-	X	X	-	-	-	-	-
28	Ausel Pond Fishing Access	28	-	-	X	-	-	-	-	-	-
29	Black River Fishing Access	29	-	-	X	-	-	-	-	-	-
30	Bragdon Nature Preserve	13	-	-	X	-	-	-	X	-	-
31	Justin Smith Morrill Homestead	24	-	-	X	-	-	X	-	-	-
32	Les Newell Wildlife Management Area	24	-	-	-	X	-	-	-	-	-
33	Tinker Brook Natural Area	29	-	-	-	X	-	-	X	-	-
34	Bog Pond Access (NH)	30	X	-	-	-	-	-	-	-	X
35	Butterfield Pond DRED	29	X	X	X	X	-	-	-	X	-
36	Cardigan Mt.	23	-	-	-	X	X	X	X	-	-
37	Clark Pond	24	X	-	X	-	-	-	-	-	-
38	Conn. River DPWH	9	X	-	X	-	-	-	-	-	-
39	Conn. River AC NHFG	9	-	-	X	-	-	-	-	-	-
40	Conn. River Marsh NHFG	15	-	-	-	-	-	X	-	-	-
41	Crystal Lake DPWH	19	X	-	X	-	-	-	-	-	-
42	Gile Forest	30	-	-	-	-	-	X	-	-	-
43	Halfmoon Pond DPWH	27	X	-	X	-	-	-	-	-	-
44	Indian Pond DPWH	30	X	-	X	-	-	-	-	-	-
45	Long Pond DPWH	28	X	-	X	-	-	-	-	-	-
46	Mascoma Lk, DPWH	18	X	-	X	-	-	-	-	-	-
47	McDaniel S Mash NHFG	27	-	-	-	-	-	-	X	-	-
48	Perkins Pond DPWH	29	X	-	X	-	-	-	-	-	-
49	Post Pond DPWH	22	X	-	X	-	-	-	-	-	-
50	Pleasant Pond DPWH	29	X	-	X	-	-	-	-	-	-
51	School Pond DPWH	29	X	-	X	-	-	-	-	-	-
52	Sculptured Rocks DRED	28	-	-	-	X	X	X	-	-	-
53	Shaker Mt. Wld Mgt. NHFG	23	-	-	-	-	X	-	-	-	-
54	Spectale Pond DPWH	30	X	-	X	-	-	-	-	-	-
55	Sunapee Wildlife Mgt NHFG	30	-	-	-	-	X	-	-	-	-
56	Tewksbury Pond DPWH	28	X	-	X	-	-	-	-	-	-
57	Upper Baker Pond DPWH	18	X	-	X	-	-	-	-	-	-
58	Webster Wildlife Mgt. NHFG	16	-	-	-	X	-	-	-	-	-

TABLE 1 (Cont'd)

Regional Recreation Facilities

MAP KEY	AREA	DISTANCE (Miles)	BOATING	CAMPING	FISHING	HIKING	HUNTING	PICNICKING	SKI-TOURING	SNOWMOBILING	SWIMMING
	TOWN AREAS										
59	Billings Park	11	-	-	-	-	-	X	-	-	-
60	Bragdon Nature Trail	12	-	-	X	-	-	X	-	-	-
61	Connecticut River Boat Access	16	X	-	-	-	-	-	-	-	-
62	Frost Park	7	-	-	-	X	-	X	-	-	-
63	Gile Mountain Recreation Area	20	-	-	-	X	-	-	X	-	-
64	Hartland Recreation Center	1	-	-	X	-	-	X	-	-	-
65	Lake Fairlee	25	-	-	-	-	-	X	-	-	X
66	Lake Morey Public Beach	25	X	-	-	-	-	-	-	-	X
67	Mill Park	12	X	-	-	-	-	-	-	X	-
68	Mount Peg Park	11	-	-	-	X	-	X	-	-	-
69	Mount Tom Park	11	-	-	-	X	-	X	-	-	-
70	Old City Falls	26	-	X	-	-	-	X	-	-	-
71	Paradise Park	12	-	-	X	X	-	-	-	-	-
72	Point Park	8	-	X	-	-	-	X	-	-	-
73	Treasure Island	25	X	-	-	-	-	-	-	-	X
74	Tug Mountain	30	-	-	-	X	-	X	X	-	-
75	Woodstock Recreation Center	11	X	-	-	-	-	-	-	-	X
76	Cannaan Town Beach	24	-	-	-	-	-	-	-	-	X
77	Georges Mills	29	-	-	-	-	-	X	-	-	X
78	Groton Beach	30	X	-	-	-	-	-	-	-	X
79	Moody Park	25	-	-	-	X	-	X	-	-	-
80	Newport Nature Study Area	29	-	-	-	X	-	X	-	X	-
81	Orford Town Beach	30	-	-	X	-	-	X	-	-	X
82	Orford Town Beach, North	28	X	-	-	-	-	X	-	-	X
83	Pleasant Pond	29	X	-	X	-	-	-	-	-	-
84	Post Pond Beach	22	X	-	-	-	-	-	-	-	X
85	Rinker Track	18	-	-	X	X	-	X	-	-	-
86	School Pond	28	X	-	X	-	-	X	-	-	X
87	South Esker Park	10	-	-	-	X	-	X	-	-	-
88	Springfield Community Beach	27	-	-	X	-	-	-	-	-	X
89	Wentworth Town Forest	30	-	-	-	-	-	X	-	-	-

skiing, sledding, and snowmobiling. Outdoor regional-scale resources such as water access, multipurpose train systems, and public open space are important and are expected to be more in demand in the future.

The State has developed the following recommended priorities for the Upper Connecticut River Valley:

1. Expand opportunities for water-oriented day use.
2. Protect existing trail corridors and expand multipurpose trail systems.
3. Protect primary natural areas.
4. Develop nature interpretation facilities.
5. Ensure opportunities for the handicapped and the elderly.

c. Hydroelectric Power

An application for hydroelectric power generation at North Hartland Dam has been submitted by the Vermont Electric Cooperative. The proposal is still in the planning phase and currently calls for a small daily fluctuation in the pool level of about two feet. Any impacts that effect recommendations in this project plan will be addressed when the proposal is reviewed by the Corps. The dam at Dewey's Mills is also being considered by private interests to be refitted for hydropower, and to have five feet of new flash boards installed to increase the depth of the pool. This would not affect Dewey's Mills Pond, however, which is already held at the higher elevation.

d. Public and Agency Involvement

Recreational planning activities in association with this project plan have involved coordination with or input from several Federal, State and local interests, including the following:

Federal

U.S. Fish and Wildlife Service

State

Vermont Agency of Environmental Conservation
Vermont Department of Fish and Game
Vermont Department of Forests and Parks
Vermont Department of Water Resources

Local

Town of Hartford, Vermont
Town of Hartland, Vermont
Ottauquechee Regional Planning Commission

The above interests have contributed valuable information and made important recommendations that have been incorporated into this project plan.

The campground at Quechee Gorge is leased to the State of Vermont. Development of facilities at the park must be coordinated for the planning and management of the project's recreation resources. In meeting with the State of Vermont Agency of Environmental Conservation, interest was indicated in planning for expansion and improvement of the campground as funds became available. The planning commission of the town of Hartland is interested in a camping facility in Hartland near the dam. All agencies and towns expressed a strong desire for a small swimming area at the reservoir, and for future development of multiuse trails.

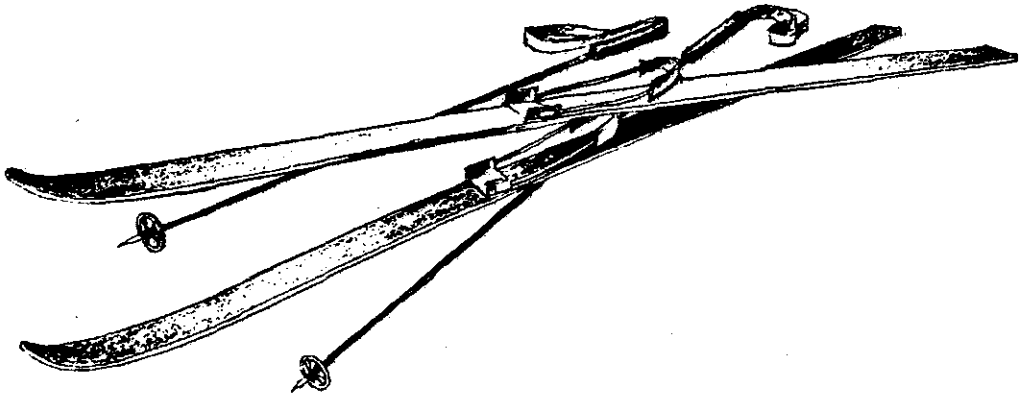


FIGURE 5 NORTH HARTLAND LAKE

FIGURE 6 QUECHEE GORGE

III. PROJECT DESCRIPTION

a. Location

North Hartland Lake is located on the Ottauquechee River about 1.4 miles upstream of the confluence of the Connecticut and Ottauquechee Rivers. The site is 4 miles southwest of White River Junction, Vermont. The reservoir includes portions of the townships of Hartland and Hartford, Windsor County, Vermont.

b. Project Data

Project Structures

North Hartland Dam consists of a rolled earth embankment with rock slope protection. The embankment is approximately 1,640 feet long with a maximum height of 185 feet above the stream bed. The top of the embankment is at an elevation of 572 feet above sea level, which is 25.5 feet above the spillway crest. An L-shaped channel spillway, 465 feet long, built in rock is located on the left abutment of the dam with the approach channel floor at elevation 546.5 feet. After discharging into a 50-foot wide channel, the flows are returned through the 1400-foot long channel back to the Ottauquechee River.

A dike, consisting of a compacted earth embankment with rock slope protection, is used for closure of a low saddle approximately 1/2 mile south of the main dam. It has a maximum height of 52 feet and is 2,110 feet long with a top elevation varying from 572 to 574 feet.

The outlet works consist of an approach channel, intake structure, discharge conduit, and discharge channel. The intake channel is about 610 feet long with an invert at elevation 390 feet. The concrete intake structure houses the necessary equipment to operate the three 5'8" x 10'0" slide gates with hydraulic hoists. These gates regulate the discharge through the 14'4" diameter horseshoe conduit. The total length of the discharge conduit measures 625 feet with the entrance invert at elevation 390.0 feet and exit invert at elevation 384.5 feet. The rock cut discharge channel is 25 feet wide and approximately 700 feet long.

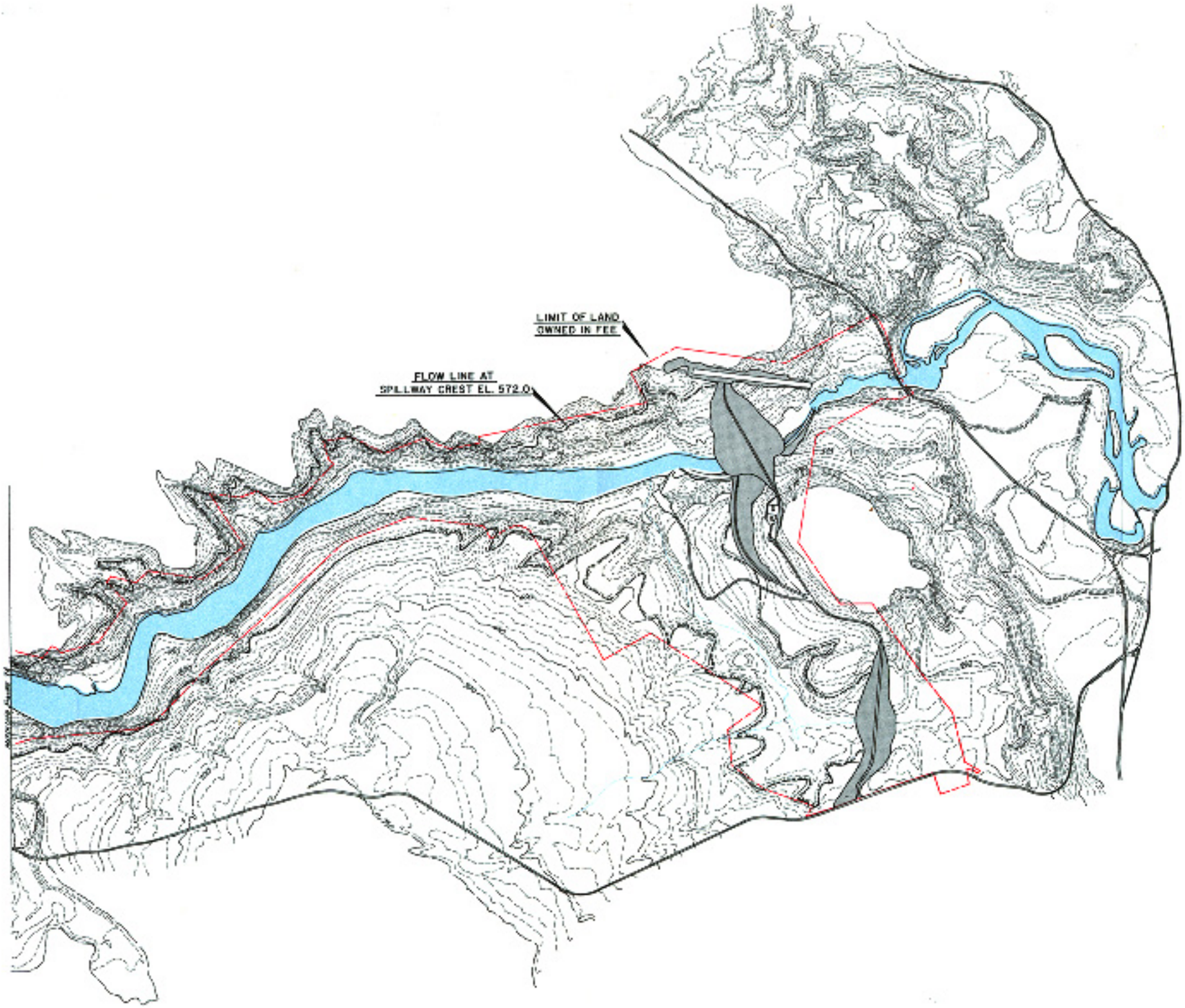
Reservoir General Character

The reservoir, when filled to spillway crest elevation, has a total capacity of 71,800 acre-feet, a surface area of about 1,100 acres and a length of 5 miles with about 7.5 miles of shoreline. The net storage of 71,100 acre-feet is equivalent to 6.1 inches of runoff from the 220-square mile drainage area.

A permanent pool at elevation 425 feet is maintained year round. It has a maximum depth of 35 feet and an area of 215 acres with a net storage of 2,350 acre-feet.

NORTH HARTLAND LAKE

HARTLAND, VERMONT



PROJECT AREA

PROJECT BOUNDRY

CONTOUR INTERVAL 10 FEET

572 FEET FLOW ELEVATION

SCALE IN FEET

500 0 500 1000

Figure 7

NORTH HARTLAND LAKE

HARTLAND, VERMONT

PROJECT AREA

PROJECT BOUNDRY

CONTOUR INTERVAL 10 FEET

572 FEET FLOW ELEVATION

SCALE IN FEET

500 0 500 1000

Figure 7A

TABLE 2

SIGNIFICANT STORAGES
AT NORTH HARTLAND*
(1961 - 1980)

Date	Maximum Stage	Storage Utilized		
		Inches	Acre-Feet	Percent
1962 Apr	56.0	0.7	8,900	11
1962 Apr	67.0	1.1	12,900	17
1964 Mar	60.8	0.9	10,500	14
1964 Apr	56.8	0.8	9,175	12
1967 Apr	70.8	1.2	14,400	19
1968 Mar	64.3	1.0	11,900	16
1969 Apr	129.0	3.9	46,200	64
1970 Apr	57.0	0.8	9,250	12
1972 Apr	50.8	0.6	6,475	9
1972 May	78.0	1.4	16,740	24
1973 Mar	65.9	1.0	11,500	16
1973 Jul	113.8	3.0	34,800	50
1973 Dec	51.3	0.6	6,650	9
1975 Oct	50.8	0.6	6,475	9
1976 Apr	84.1	1.7	19,550	27
1976 Aug	74.5	1.3	15,300	21
1977 Mar	90.5	1.9	23,000	31
1977 Oct	48.7	0.5	6,050	8
1978 Jan	47.8	0.5	5,525	8
1979 Mar	84.1	1.7	19,550	27
1979 May	54.5	0.7	7,800	10
1980 Apr	63.5	0.9	10,500	14

*Stage above 45', 6 percent storage
1" Runoff = 11,725 acre-feet

DA = 220 sq. mi.
Zero stage = 390 ft. msl

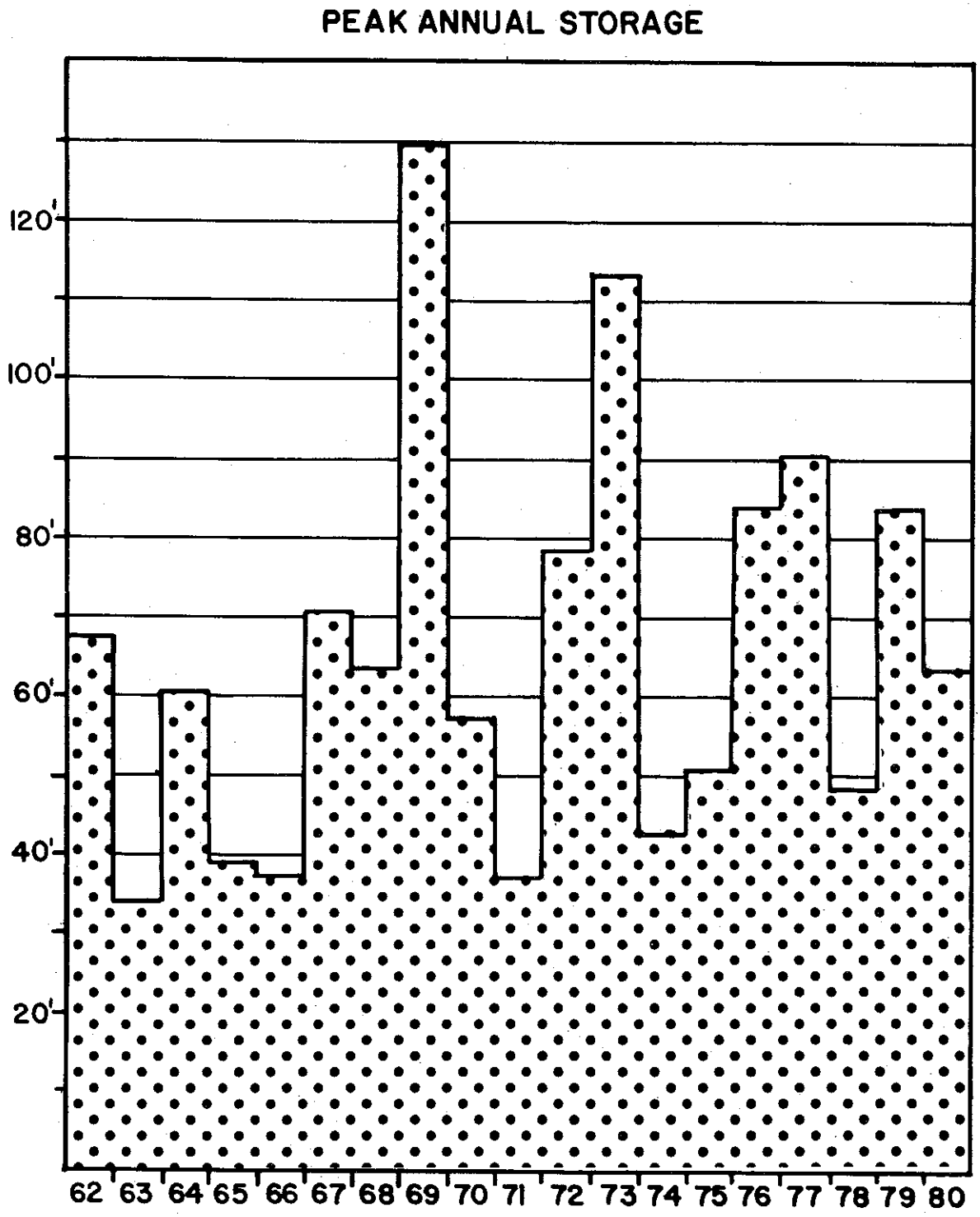
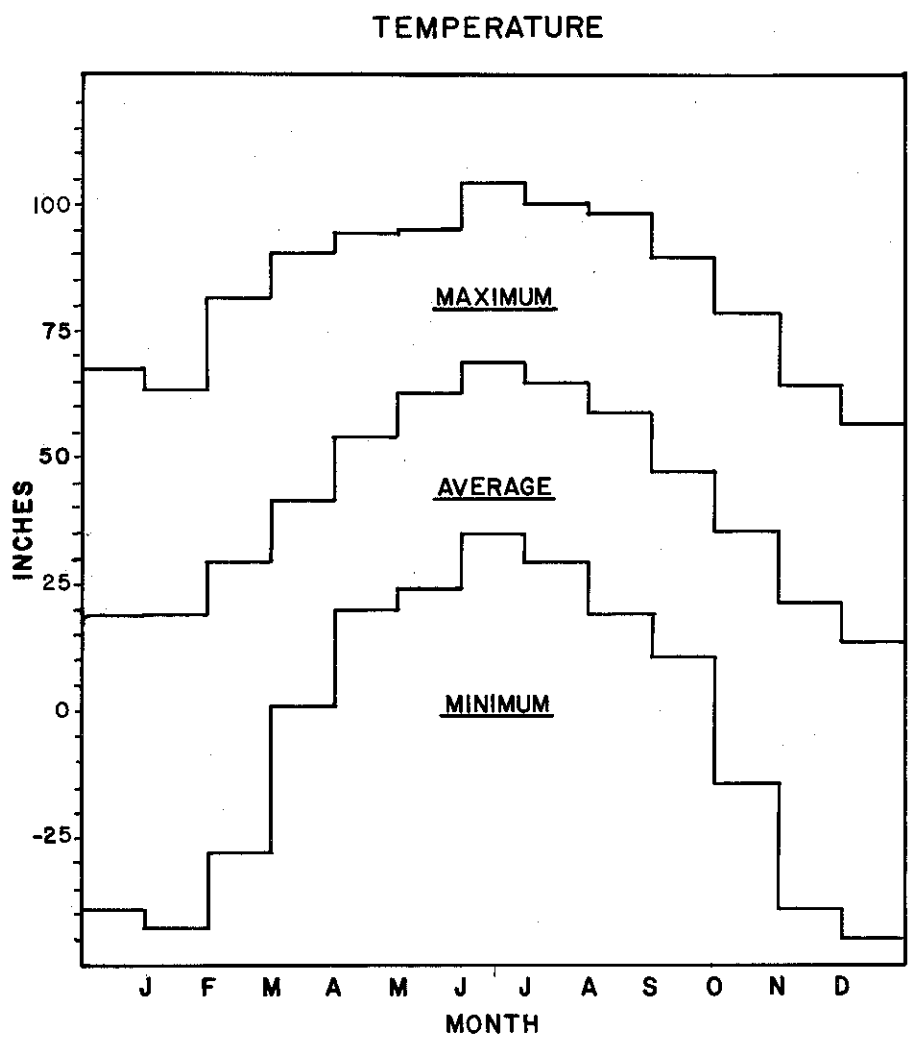

PEAK ANNUAL STORAGE
120'
100'
80'
60'
40'
20'
62
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80

Figure 8


TEMPERATURE
INCHES
100
75
50
25
0
-25
MAXIMUM
AVERAGE
MINIMUM
J F M A M J J A S O N D
MONTH

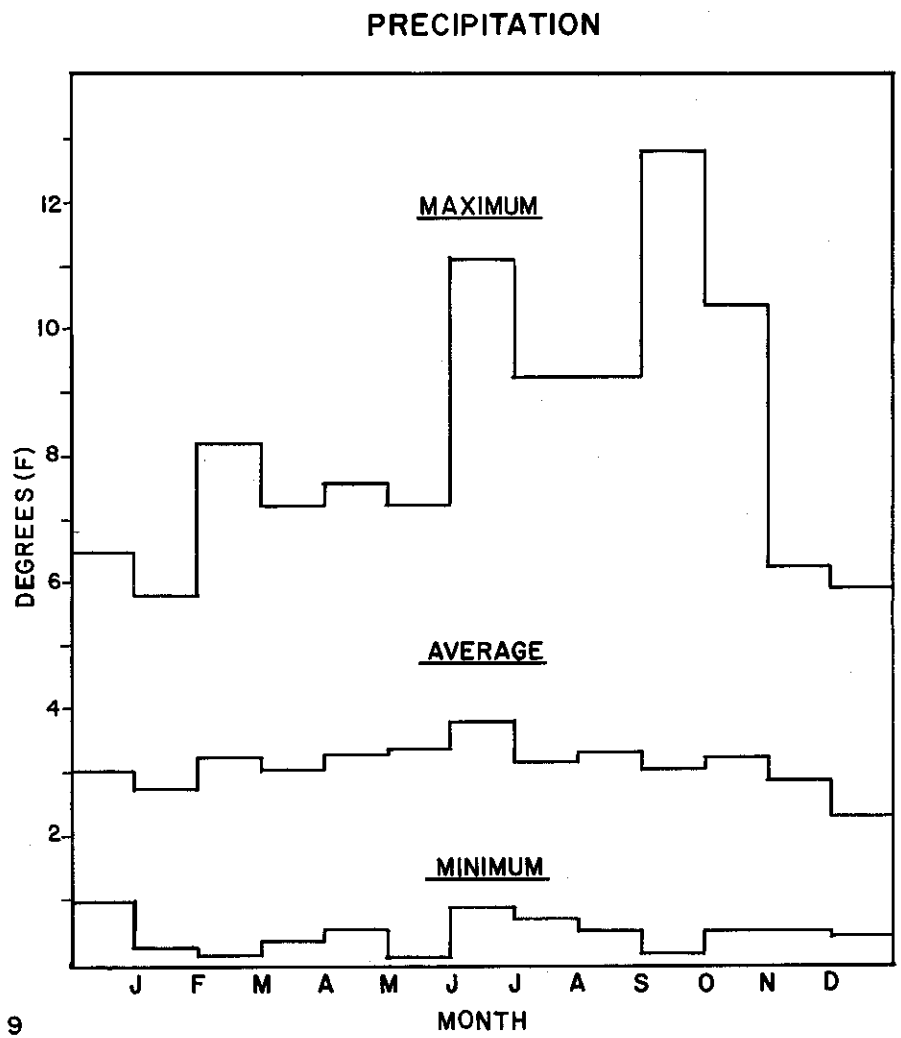

PRECIPITATION
DEGREES (F)
12
10
8
6
4
2
MAXIMUM
AVERAGE
MINIMUM
J F M A M J J A S O N D
MONTH

Figure 9

Basin Hydrologic and Climate Survey

The Ottauquechee River basin has a variable climate characterized by frequent but short periods of heavy precipitation. It lies in the belt of the "prevailing westerlies," and is exposed to the cyclonic disturbances that cross the country from the west or southwest, producing frequent weather changes. The area is also exposed to coastal storms, occasionally of tropical origin, that travel up the Atlantic seaboard.

The average annual temperature of the basin is about 43° Fahrenheit. Average monthly temperatures vary widely throughout the year from 18°F in January to 68°F in July. Extremes in temperature range from occasional highs slightly in excess of 100°F to infrequent lows in the minus 40°F.

Precipitation is fairly well distributed throughout the year, with a mean annual precipitation over the basin of about 39 inches. Average monthly rainfalls at Woodstock range from a minimum of 2.74 inches in February to a maximum of 3.87 inches in July. The mean annual snowfall in the middle of the Ottauquechee River basin is 87.9 inches with about 50 percent of this amount occurring in January and February.

c. Visitation

Public utilization of North Hartland Lake has varied greatly from 1971 to 1980, due to the large scale flooding in the summer of 1973. A decline in use was associated with cleanup operations and loss of aesthetic appeal. In recent years visitation has gradually increased as the area has undergone continuing improvements.

People utilize the project year round for such recreational activities as fishing, hunting, camping, picnicking, sightseeing, snowmobiling and cross-country skiing. Visitation data collected by the Corps of Engineers are illustrated on the following charts. The data indicate a trend upward toward more active recreation, although attendance figures vary in response to weather and flood control operations.

With the ever-increasing public demand for outdoor recreational activities, an area that retains its natural qualities while providing the resources for a variety of recreational uses can be expected to be in constant demand. Being located in close proximity to a growing population makes this project all the more attractive to the local area, especially in times of increasing transportation costs.

TABLE 3

North Hartland Lake Visitation-Quechee Gorge

	80	79	78	77	76	75	74	73	72	71
Picnicking	2913	2401	3113	2933	3459	3400	3026	4646	10982	10167
Camping	10555	9432	12902	13424	11235	11024	10689	10588	12731	12118
Boating	----	----	----	----	----	----	----	----	----	----
Sightseeing	202	20	----	83	232	603	20	15302	24715	23834
Fishing	----	----	----	----	----	51	10	185	532	225
Hunting	----	----	----	----	50	10	----	23	698	85
Snowmobiling	----	----	----	----	----	----	----	825	150	----
Other	213	74	135	196	199	497	54	----	----	----
Total	13883	11927	16150	16636	15175	15585	13799	31569	49808	46429

TABLE 3 (Cont'd)

North Hartland Lake Visitation-Dam and Reservoir

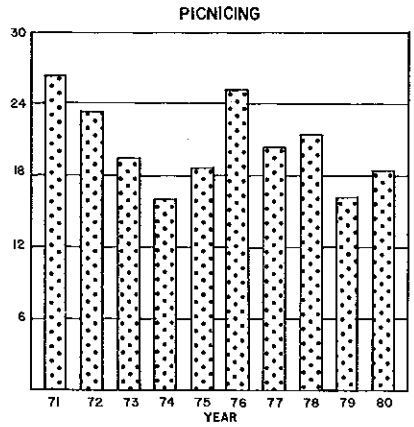
	80	79	78	77	76	75	74	73	72	71
Picnicking	15319	13563	18132	17230	21606	15357	12423	14606	12082	16131
Camping	----	----	----	----	----	----	250	----	----	----
Boating	2614	960	1027	940	749	1460	1119	72	2393	224
Sightseeing	6979	4520	4020	6597	6395	5875	6727	32127	48754	50164
Fishing	722	469	204	680	999	909	411	344	1181	1315
Hunting	1833	1734	1905	2010	1893	1521	1342	1382	2691	2820
Snowmobiling	23	950	1182	1019	780	1006	685	645	2450	3181
Other	583	299	463	533	670	1564	1910	----	----	----
Total	28073	22495	26933	29009	33092	27692	24867	49176	69551	73835

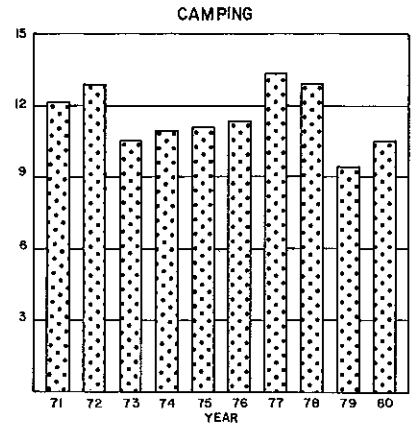
TABLE 3 (Cont'd)

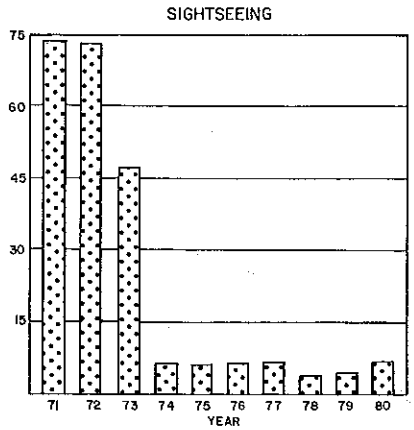
North Hartland Lake Visitation
Total

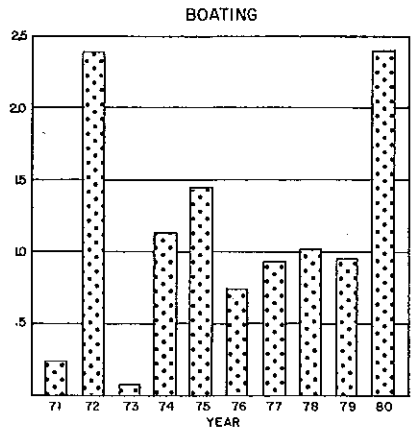
	80	79	78	77	76	75	74	73	72	71
Picnicking	18232	15964	21245	20163	25065	18757	15449	19252	23064	26298
Camping	10555	9432	12902	13424	11235	11024	10939	10588	12731	12118
Boating	2614	960	1027	940	749	1460	1119	72	2393	224
Sightseeing	7181	4540	4020	6680	6627	6478	6747	47429	73469	73998
Fishing	722	469	204	680	999	960	421	529	1713	1540
Hunting	1833	1734	1905	2010	1943	1531	1342	1405	3389	2905
Snowmobiling	23	950	1182	1019	780	1006	685	1470	2600	3181
Other	806	373	598	729	860	2061	1964	----	----	----
Total	41966	34422	43083	45645	48258	43277	38666	80745	119359	120264

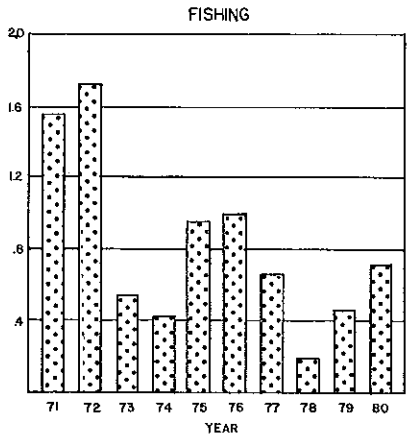
VISITATION DATA
(ANNUAL ATTENDANCE IN THOUSANDS)

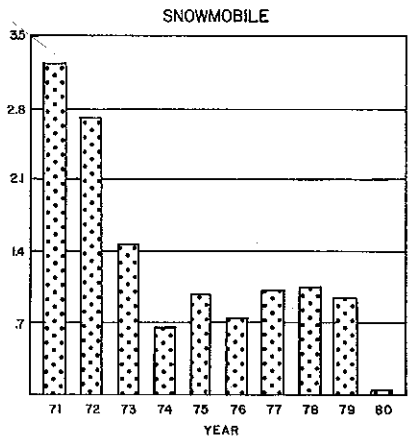


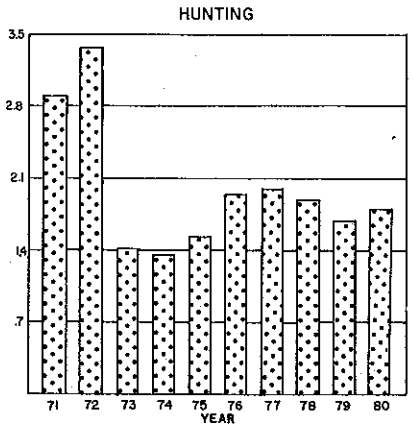












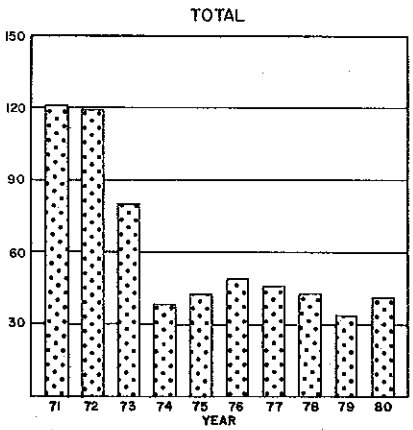


Figure 10

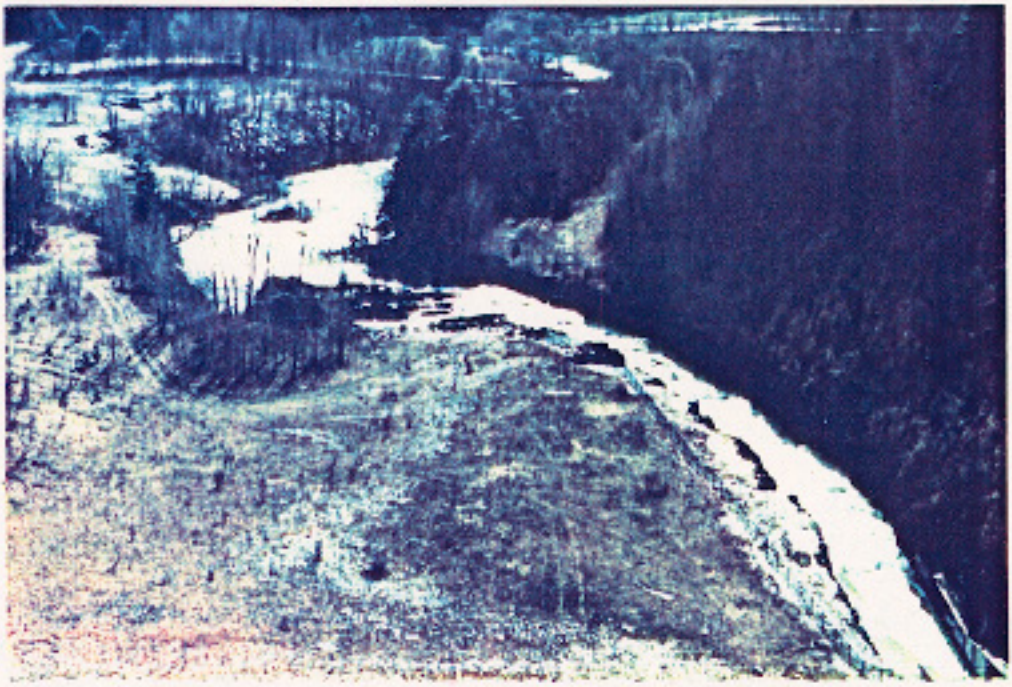


FIGURE 11 DOWNSTREAM FROM NORTH HARTLAND DAM

FIGURE 12 DEWEY MILLS POND AND WATERFOWL AREA

IV. RESOURCES OF THE PROJECT AREA

a. Natural and Scenic Qualities

The Ottauquechee River Watershed is typical of much of the upland New England physiographic province. The watershed is extremely narrow and surrounding terrain is characterized by steep topography which is conducive to rapid runoff. The elevation varies from 4,240 feet in the western headwaters to 1,000 feet at its confluence with the Connecticut River near White River Junction. Most of the Ottauquechee's tributaries are swift mountain streams.

North Hartland's underlying base-rock foundations are Paleozoic in origin. At the upper end of the reservoir lies Quechee Gorge, which is about 165 feet deep and has been cut through sheer rock by the Ottauquechee River. The soil type found on the bedrock-dominated upland portion is primarily Woodstock, Very Rocky. This soil is well-drained, loamy and shallow to bedrock. Slopes vary from 3 to 25 percent. Permeability is rapid, available moisture capacity is low, and natural fertility is medium.

The principal soil type found in the reservoir area is the Windsor series, which consists of loamy sand, loamy fine sand and gravelly subsoil. Soils in this series are excessively well-drained and occupy the terraces along the Ottauquechee River. Slopes range from 0 to 25 percent. Permeability ranges from rapid to very rapid; available water capacity is generally low. The depth to water table and bedrock is typically greater than 5 feet.

Forest vegetation comprises 60 percent of the cover of the Ottauquechee Watershed. The forest cover on the steep slopes along the valley is mainly white birch, yellow birch, hemlock, white pine, beech and butternut. Black cherry, sugar maple and basswood are found on abandoned pasture with brake fern, steeple bush, and blackberry as undergrowth. Along the river, willow, elm, alder, and aspen comprise the dominant cover types. The timber resources are of primary value for watershed protection, wildlife food and cover, and aesthetic qualities of the area.

b. Fish & Wildlife Resources

The North Hartland Lake project area contains a diverse assortment of vegetation and habitat type that supports a variety of native wildlife including ruffed grouse, cottontail rabbit, snowshoe hare, American woodcock, and whitetail deer. Fur-bearing animals include muskrat, mink, fisher, red fox, raccoon, weasel, beaver and skunk. There is some trapping activity on the project for beaver and muskrat. Migrating waterfowl visit seasonally, and their visits are encouraged by current wildlife management programs.

North Hartland Lake is a warm-water lake and contains suckers, bullheads and shiners. The pool fluctuations in the past have prevented North Hartland from providing a good sport fishery. With the establishment of a permanent pool level, a largemouth bass population could be established at a fishable population. Additional details on fish and wildlife resources are contained in the Fish and Wildlife Appendix to this Master Plan.

c. Visual Resources

In the immediate area of North Hartland Lake the storage of floodwaters has had a serious effect on the stabilization of banks. Several large areas of slumpage have occurred and the process of stabilizing and revegetating the slopes is ongoing. The vegetation in the lower elevations of the project area is comprised of species that tolerate inundation with little apparent damage.

The scenic quality of Quechee Gorge is a primary resource for the project area. The gorge provides an excellent location for camping and picnicking. The wildlife and wetland resources of Dewey's Pond Marsh make this area a unique location for developing a wildlife refuge and interpretive center.

d. Recreation Resources

Recreation development of the project lands has taken place at the dam and at Quechee Gorge. The day-use area at the dam includes 18 picnic sites, a double boat launch, ballfield, small playground, volley ball net, two horseshoe pits, one drinking fountain and parking for 30 automobiles. Sanitary facilities are located next to the ballfield and above the picnic area. The parking area for the boat ramp has spaces for 17 car/trailer combinations.

The Quechee Gorge area, which is leased to and maintained by the State, consists of a small picnic/overlook area and a campground. The campground has 30 sites and one washhouse/restroom. The picnic area consists of 14 picnic tables, five fireplaces and ten gravel parking spaces. The overlook picnic area has no water or sanitary facilities.

Most of the land area at North Hartland Lake is undeveloped and available for a variety of recreational activities including nature study, hiking, snowmobiling, cross-country skiing, hunting, fishing and horseback riding. The large amount of open and wooded land provides numerous opportunities for passive recreation throughout the year.

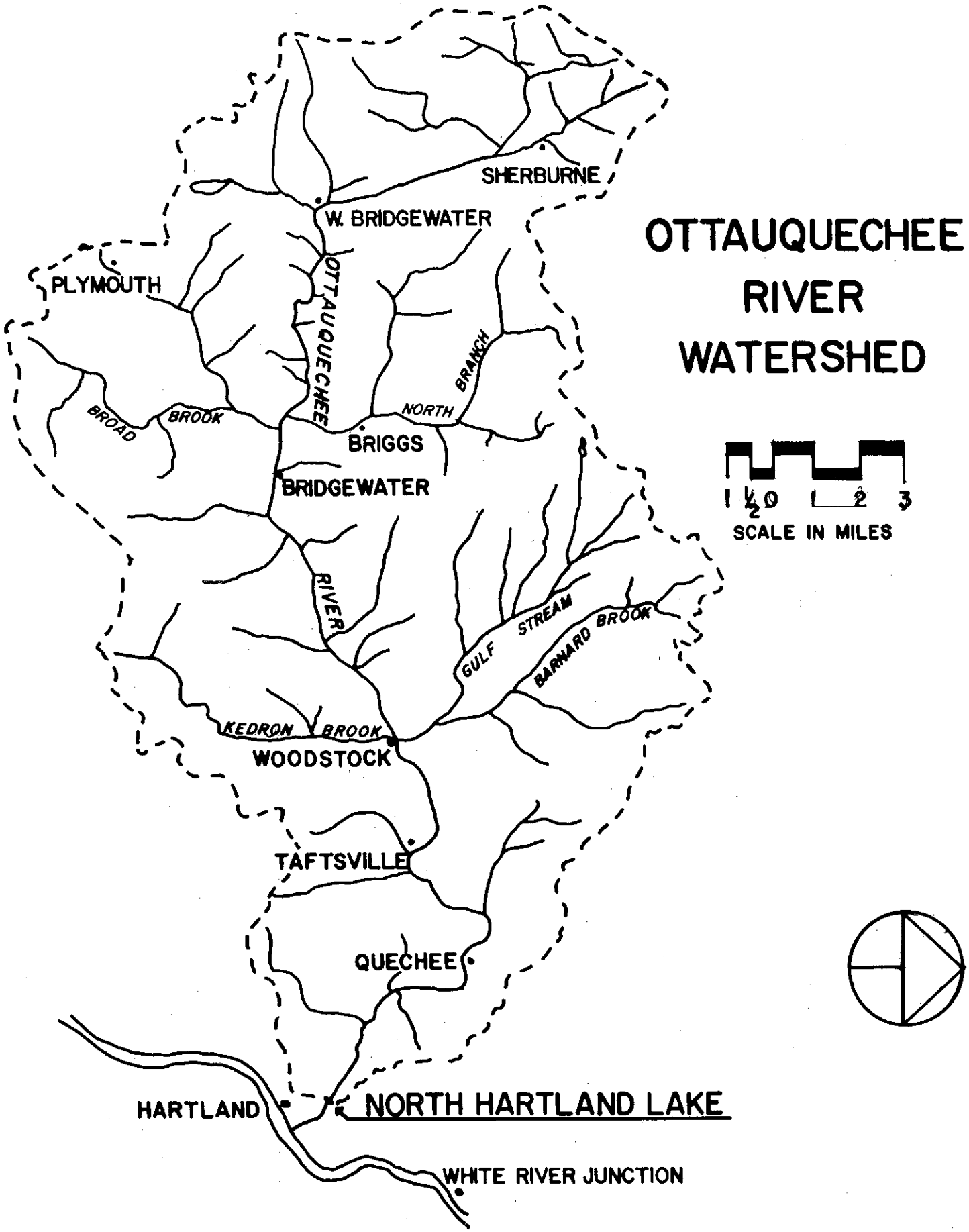

OTTAUQUECHEE
RIVER
WATERSHED
SHERBURNE
W. BRIDGEWATER
PLYMOUTH
OTTAUQUECHEE
BRANCH
NORTH
BROAD
BROOK
BRIGGS
BRIDGEWATER
1 ½ 0 1 2 3
SCALE IN MILES
RIVER
GULF
STREAM
BARNARD BROOK
KEDRON BROOK
WOODSTOCK
TAFTSVILLE
QUECHEE
HARTLAND
NORTH HARTLAND LAKE
WHITE RIVER JUNCTION

Figure 13

e. Cultural Resources

While there are no recorded prehistoric archaeological sites within the North Hartland Lake property bounds, potential site locations exist within several areas scattered throughout the project, most notably near the dam at Dewey's Mill Pond and on glacial terraces west of North Hartland Dam. Both these areas are near falls which could have provided stations for taking anadromous fish.

Recorded historic period resources at North Hartland Lake include of approximately 8, 18th and 19th century farm sites and portions of a 19th century woolen mill village at Dewey's Mills. The latter included a mill, boarding house, office, and mill owner's house. The mill dam was altered in the late 19th century, but remains intact.

There are a number of standing 18th and 19th century farm structures near North Hartland Lake, but all are outside government property. One such dwelling, the Jedediah Strong House (built 1815), is on the National Register of Historic Places. Though within the maximum floodpool of North Hartland Lake this dwelling was not demolished during project construction but was sold to private interests with the provision that it not be used as a dwelling and that it be restored and maintained in perpetuity as a historic structure. The present owner recently completed restoration and conversion of the structure to office use.

f. Water Quality

1. State Classifications and Standards

The waters of the Ottauquechee River in the North Hartland Lake project area and downstream to the confluence with the Connecticut River have been classified as Class B and C by the State of Vermont Water Resources Board. The Class C zone applies only to that portion of the river immediately upstream and downstream of Quechee Pond (Dewey's Mills Pond) in the village of Quechee. All other portions of the river, including the reaches affected by the permanent pool are Class B. Class B waters are suitable for bathing and recreation, irrigation and agricultural uses, fish habitat and public water supply, with filtration and disinfection and are of good aesthetic value. Technical requirements for these waters include color not to exceed 25 units; total and fecal coliform bacteria not to exceed 500/100 ml and 200/100 ml, respectively; pH in the range of 6.5 to 8.0; and other parameters not to be in such concentrations as to impair any applicable uses of the waters or affect or interfere with river bottom fauna and fisheries resources. Class C criteria are essentially the same as for Class B with the exceptions of coliform bacteria and pH. There is no standard for total coliform; the standard for fecal coliform is 1000/100 ml and the allowable pH range is 6.0 to 8.5.

The requirements for dissolved oxygen, turbidity and temperature for both classes are determined by the "water management type" applicable to the reach of river being investigated. Water management types were promulgated to provide for the protection and management of aquatic life. The designation applicable to the free-flowing reaches of the Ottauquechee River is either Type I or Type II. Type I denotes streams capable of supporting cold water fish populations and spawning activity; Type II streams support mixed fish populations. Dissolved oxygen levels shall not be less than 7 mg/l at or near spawning areas for Type I and 6 mg/l in other reaches for both Types I and II. The Vermont Department of Water Resources has recommended that the Ottauquechee River throughout the project area be recognized and regulated as Type I non-spawning, and Type II mixed fishery, therefore the 6 mg/l standard applied. Turbidity levels for both types shall not exceed 10 Jackson Turbidity Units (JTU) and any temperature rise is limited to 1°F. The section of the river encompassing the permanent pool falls under either management Type IV or V, depending upon the trophic status of the reservoir and fish species present. Type IV requires dissolved oxygen levels to be not less than 6 mg/l and turbidity not greater than 10 JTU. The dissolved oxygen standard for Type V is that concentrations be not less than 5 mg/l and turbidity shall not exceed 25 JTU.

2. Corps Water Quality Monitoring

The New England Division has monitored the quality of water in the Ottauquechee River in the vicinity of North Hartland Lake by sampling on an aperiodic basis since 1971. Two sampling stations, one located in the village of Quechee upstream from the dam and the other at the USGS gauging station downstream from the dam, are currently being monitored. Data from these two stations for the period 1 January 1977 to 5 June 1978 are used in this analysis as being indicative of present water quality conditions. Data have not been collected in the permanent pool, therefore, definitive statements concerning the lake quality cannot be made. However, qualitative judgements will be made where possible. The location of the two water quality sampling stations are shown along with the applicable water quality classification reaches on Figure 14.

3. Existing Water Quality Conditions

A. Inflow

The upstream inflow station is situated on the Class C portion of the Ottauquechee River below the discharge point of the Quechee wastewater treatment plant. Here the river generally conforms to the Class C criteria with only pH exceeding the criteria more than once; the observed pH range was 5.7 to 9.1 with two values exceeding the maximum allowable of 8.5 and one value below 6.0, the minimum allowable. Dissolved oxygen and apparent color always met their respective standards. Turbidity levels

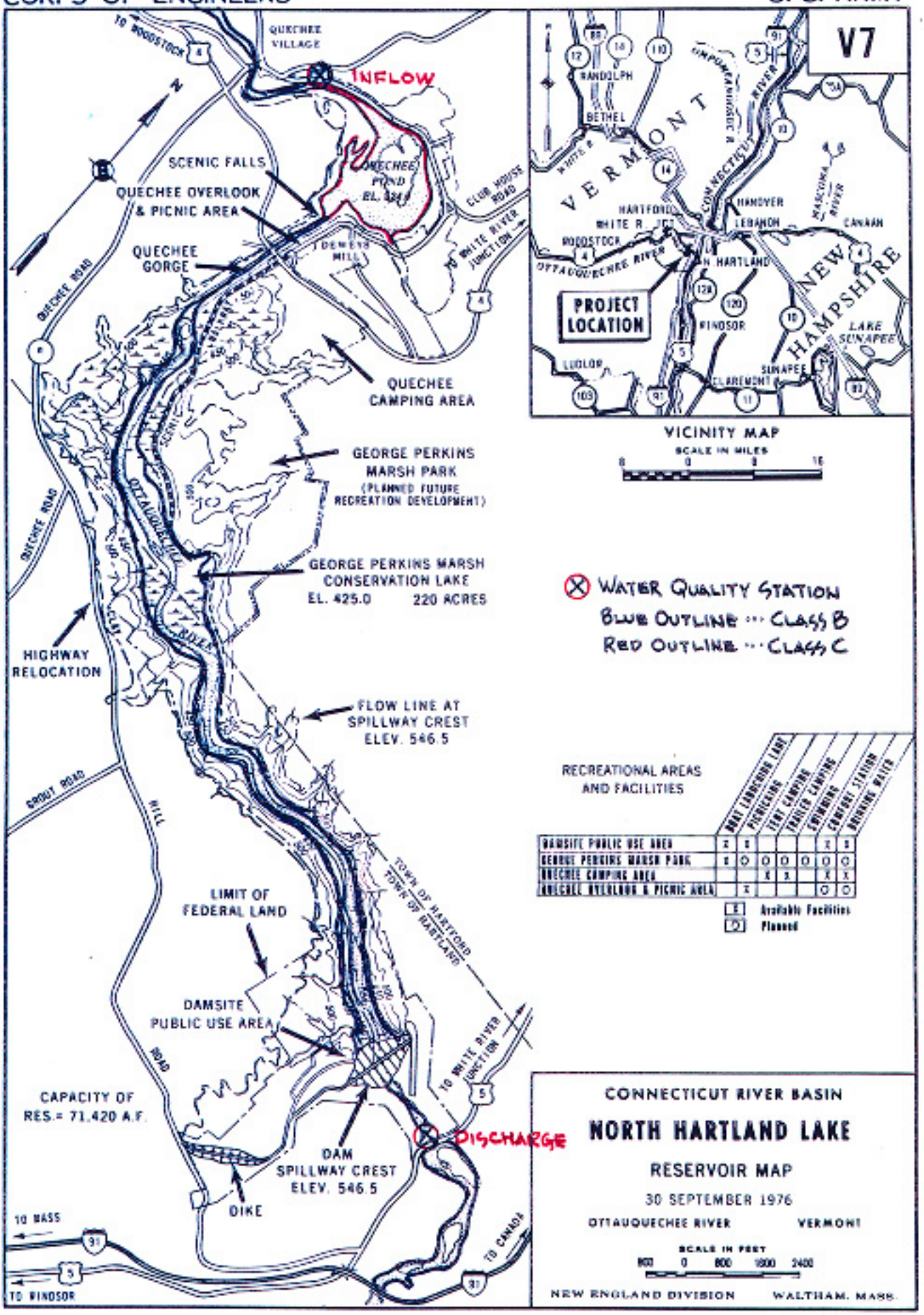

V7
TO WOODSTOCK
QUECHEE VILLAGE
INFLOW
QUECHEE POND EL. 424
SCENIC FALLS
QUECHEE OVERLOOK & PICNIC AREA
QUECHEE GORGE
CLUB HOUSE ROAD
TO WHITE RIVER JUNCTION
QUECHEE ROAD
QUECHEE CAMPING AREA
GEORGE PERKINS MARSH PARK (PLANNED FUTURE RECREATION DEVELOPMENT)
GEORGE PERKINS MARSH CONSERVATION LAKE EL. 425.0 220 ACRES
HIGHWAY RELOCATION
FLOW LINE AT SPILLWAY CREST ELEV. 546.5
GROUT ROAD
LIMIT OF FEDERAL LAND
DAMSITE PUBLIC USE AREA
TOWN OF HARTFORD
TOWN OF HARTLAND
TO WHITE RIVER JUNCTION
CAPACITY OF RES. = 71,420 A.F.
DISCHARGE
DAM SPILLWAY CREST ELEV. 546.5
DIKE
TO MASS
TO WINDSOR
TO CANADA
VERMONT
NEW HAMPSHIRE
RANDOLPH
BETHEL
HARTFORD
WHITE R. JCT.
HANOVER
LEBANON
CANAAN
WOODSTOCK
OTTAUQUECHEE RIVER
N. HARTLAND
WINDSOR
LUDLOW
CLAREMONT
SUNAPEE
LAKE SUNAPEE
PROJECT LOCATION
VICINITY MAP
SCALE IN MILES
WATER QUALITY STATION
BLUE OUTLINE ··· CLASS B
RED OUTLINE ··· CLASS C
RECREATIONAL AREAS AND FACILITIES
BOAT LAUNCHING LANE
PICNICKING
TENT CAMPING
TRAILER CAMPING
SWIMMING
COMFORT STATION
DRINKING WATER
DAMSITE PUBLIC USE AREA
GEORGE PERKINS MARSH PARK
QUECHEE CAMPING AREA
QUECHEE OVERLOOK & PICNIC AREA
X Available Facilities
O Planned
CONNECTICUT RIVER BASIN
NORTH HARTLAND LAKE
RESERVOIR MAP
30 SEPTEMBER 1976
OTTAUQUECHEE RIVER
VERMONT
SCALE IN FEET
NEW ENGLAND DIVISION
WALTHAM, MASS.

Figure 14

exhibited a fairly wide variation with a maximum observed value of 20 JTU and normal background levels of 1 to 2 JTU. The occasional high turbidity levels correspond in time with the occurrence of significant rainfall events in the watershed. Fecal coliform data were well below the maximum criterion of 1,000 colonies/100 ml with only 1 of 21 values exceeding 200 colonies/100 ml, the Class B criterion. The average value was 40 colonies/100 ml. There is no criterion for total coliform bacteria for Class C water, however, the data indicates that the river generally meets the requirement for Class B with only 1 of 23 values exceeding the standard of 500 colonies/ 100 ml. The average total coliform count was 141 colonies/100 ml.

Concentrations of the primary nutrients, nitrogen and phosphorus, were variable and occasionally above threshold levels for algae bloom development. Nitrite nitrogen was found only in trace amounts averaging 0.006 mg/l for four analyses. Nitrate nitrogen, however, was found in higher concentrations averaging 0.20 mg/l with a high value of 0.40 mg/l. The accepted threshold level for inorganic nitrogen is 0.3 mg/l. The lack of ammonia nitrogen data makes it impossible to accurately evaluate the the total inorganic nitrogen load, however, it does appear than an adequate supply exists to promote periodic algae formation. Total phosphate concentrations were always above the 0.01 mg/l threshold level with an average value of 0.12 mg/l for 11 analyses.

Zinc has been measured in concentrations as high as 0.1 mg/l. Levels this high have been reported to be toxic to certain fish species, however, calcium and hardness are known to exert an antagonistic effect on zinc toxicity, and the observed levels of these parameters are in the range known to significantly increase the lethal threshold concentration for zinc.

B. Outflow

The river downstream from North Hartland Dam does not meet the criteria for its Class B designation. The primary offenders here are total coliform bacteria and pH. Twenty-two percent of the coliform data exceeded the 500 colonies/100 ml standard. The maximum and average counts were 3,450 and 400 colonies/100 ml, respectively. As with the inflow, the pH exhibited a wide range in values between 5.8 and 8.3 with 6 of 70 values falling outside the approved range. A maximum fecal coliform count of 388 colonies/100 ml was measured, however, that was the only value among 21 that exceeded the standard. The average for that parameter was 28 colonies/100 ml. Two turbidity measurements exceeded the criterion of 10 JTU, but, like the inflow station, the high values correspond to rain events. Color and dissolved oxygen levels always conformed with their respective standards. It is noteworthy that dissolved oxygen never fell below 6.6 mg/l. Zinc concentrations were generally below detectable levels, however, a value of 0.23 mg/l was measured. Here again it is possible that calcium and hardness levels in the discharge will decrease zinc's toxicity to aquatic life.

C. Reservoir

Based upon the data for the inflow and outflow stations, water quality conditions within the reservoir are not readily evident. Nutrient input is sufficient to support algae growth, but the outflow data do not indicate a problem. The average nitrate concentration in the outflow is exactly the same as that in the inflow, however, individual values are variably higher and lower than corresponding inflow data. Total phosphate concentrations in the outflow are consistently lower than in the inflow. The phosphate data indicate that biological uptake may be occurring, but the location is unclear. In effect, the inflow station may not be indicative of inflow quality to North Hartland Lake because it is upstream from Quechee Pond where biological uptake, sedimentation and other processes are probably mediating various water quality changes.

Dissolved oxygen data for the outflow station are probably not indicative of reservoir conditions, due to the potential for reaeration by the dam outlet works and the river downstream to the sampling station. Total coliform bacteria and turbidity data may provide some insight into reservoir conditions. Total coliform counts in the discharge are much higher than the inflow station. This indicates that the river and/or reservoir is being contaminated in the intervening reach. The source is unknown, however, possible sources are bathers, vegetation, wildlife or runoff from the watershed. Turbidity is slightly higher in the discharge indicating either shore and bank erosion in the reservoir or additional sediment load from the tributaries. The intervening watershed may also be the source of the occasional higher nitrate concentrations in the outflow.

A final consideration with regard to water quality is the existence of several wastewater treatment plant discharges in upstream communities. Although the maximum combined flow of all facilities is only approximately 600,000 gpd (one cfs), the long term effect will be to provide a continuous supply of nutrients and other materials to the river and reservoir. Malfunction or overload of any of these facilities could adversely affect water quality in general and reservoir usage in particular.

4. Conclusions

Water quality at the inflow station of North Hartland Lake is variable but meets the criteria associated with its Class C designation. Nutrient levels here are near and sometimes greater than those associated with algae bloom development. Use of the data to represent inflow to the reservoir area is questionable since the station is upstream of Quechee Pond, in which biochemical and physicochemical processes are probably affecting various water quality constituents.

At the outflow station the river is designated Class B, and water quality conditions are frequently below the prescribed standards for that class. Of significant importance are high counts of total coliform bacteria that average about four times higher than those at the inflow station.

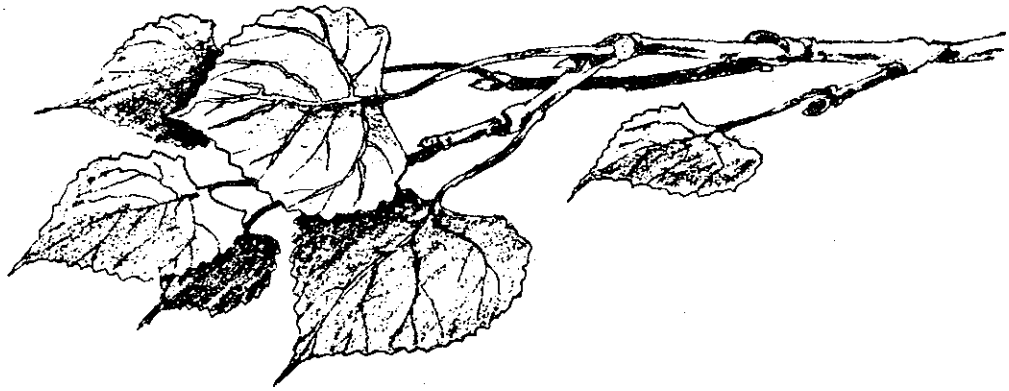
Predictions of conditions within the lake based solely upon available inflow/outflow data are not possible or advisable. In the absence of more detailed sampling and investigation of the lake water quality, it is speculated that bathing could be hindered by possible high coliform and turbidity levels and algae blooms. Other uses such as boating, fishing and fish and wildlife management should not be adversely affected by existing water quality conditions.

g. Borrow Areas

The two borrow areas at North Hartland have been graded and naturally revegeted since completion of construction. The sites were located in the immediate area of the dam on either side of the river.

h. Adjacent Land Use

Most of the land adjacent to the project area is wooded or used for pasture and hayfields. Some commercial development has taken place along U.S. Route 4 near the Quechee Gorge overlook. The village of Quechee has seen an increase in population over the past 10 years with many new seasonal and year-round residences recently constructed.



V. RESOURCE USE OBJECTIVES

In order to best serve the needs of the public while also enhancing and protecting the project resources at North Hartland Lake, the following resources use objectives have been developed.

1) Provide high quality day-use areas for a variety of recreation opportunities including picnicking, game and ball playing, swimming, and boating. The recreation area at the dam offers a variety of day-use opportunities and the facilities are designed to accommodate the handicapped. This area provides important local recreation opportunities, offering a large picnic/game area for use by local business and community groups as well as individuals. While it is not feasible to significantly expand the picnic areas, some improvements at the Quechee Gorge overlook area are planned in order to upgrade the existing facilities and grounds.

2) Continue the present wildlife conservation and management program under the direction of the Vermont Fish and Game Department in order to protect valuable wildlife habitat and provide public hunting and fishing opportunities. Because 75 percent of Vermont is now wooded there is a pressing need to maintain and increase open areas for the benefit of wildlife wherever feasible. Maintenance of deer wintering areas is extremely important; the deer population in the vicinity of the project is very large and provides excellent hunting opportunities.

3) Expand and improve the multiuse trail system. At present, there are designated snowmobile trails and areas and a system of trails in the vicinity of Quechee Gorge. Excellent potential exists for a loop trail system around the reservoir along former town roads connecting with the existing trails through the gorge.

4) Expand and improve the camping area at Quechee Gorge. The location of the campground adjacent to U.S. Route 4 and the gorge makes it a very accessible and attractive camping site with excellent potential for expansion. With careful attention to design and the quality of the outdoor recreation experience offered, future development can meet the growing need for camping areas and avoid adverse environmental impact.

5) Develop a primitive walk-in campground in conjunction with the day-use area at the dam. The facility would meet an increasing need for camping in the area and provide an alternative to the type of camping available at Quechee Gorge.

VI. PHYSICAL PLAN OF DEVELOPMENT

a. Designation of Resource Use

In order to provide a framework for the planning proposals outlined in this project plan, the reservoir lands and waters have been designated for various land uses, as shown in Figure 15. These designations are based on existing land use patterns, operation requirements and the unsuitability analysis. The following land use allocation categories are based on those given in Engineering Regulation 1120-2-400. All reservoir lands were acquired for project operations but most of the land area has been allocated for various other conjunctive land uses.

Project Operations

Lands that are required for essential activities of the operation and maintenance of North Hartland Dam and appurtenant structures such as the spillway, intake and outlet tunnel, project manager's office and surrounding area, are designated under the project operations land use category.

Intensive Recreation

Lands allocated for use as developed public use areas for intensive recreational activities by the visiting public include areas for picnicking and camping. No agricultural uses are permitted on these lands except on an interim basis for maintenance of open space and/or scenic values. At North Hartland this area totals 732 acres.

Low Intensity Recreation

Lands allocated for low density recreation activities by the visiting public includes areas suitable for widely spaced recreation activities requiring few if any facilities. Suitable activities include fishing, hunting, hiking, ski-touring, snowshoeing and snowmobiling.

Fish and Wildlife Management

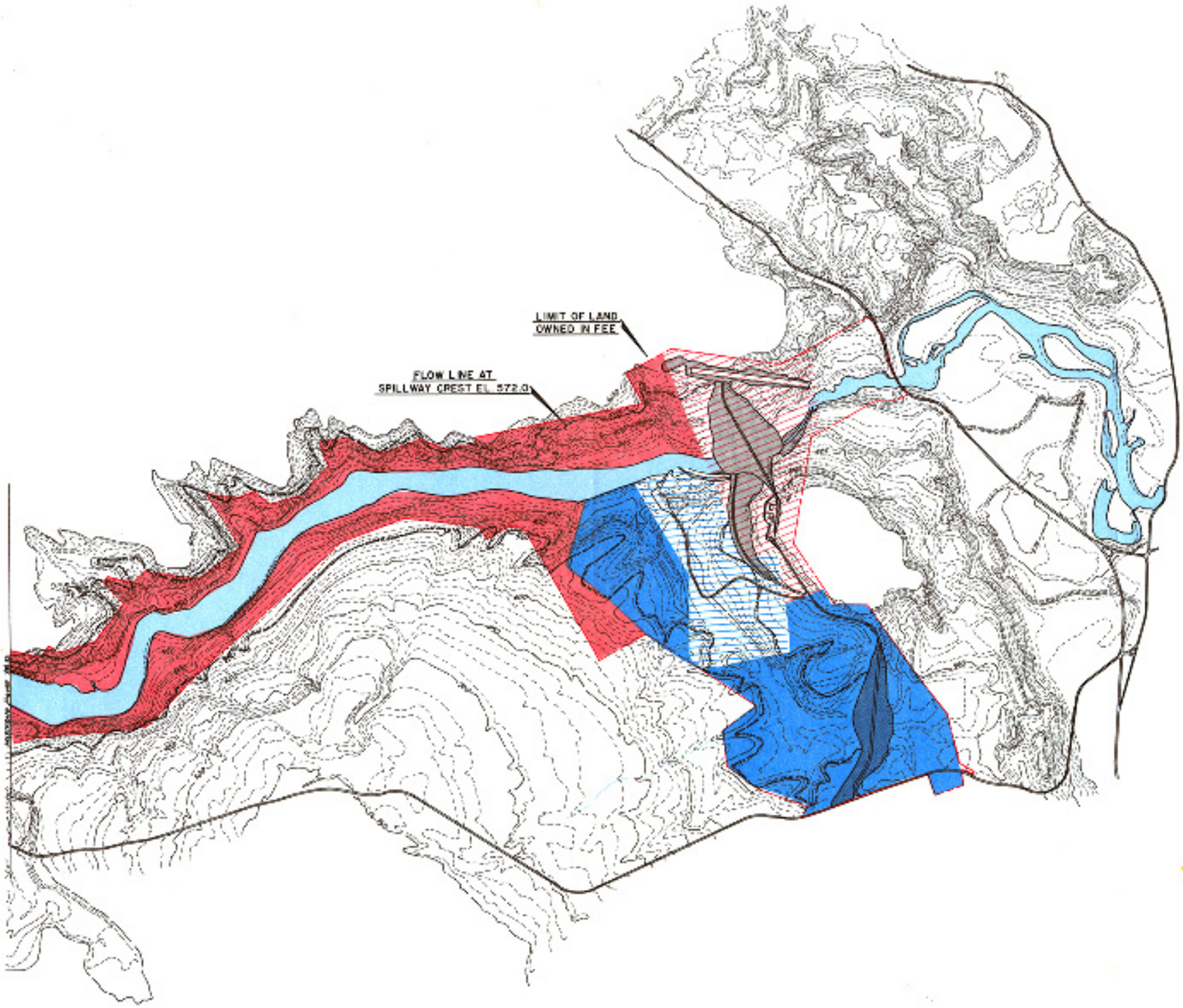
Lands managed specifically for the enhancement of resident and migratory wildlife species are designated for wildlife management. These lands may also be used for low-intensity recreation activities as long as such activities do not interfere with the requirements of wildlife management.

b. Site Analysis and Planning

The recreation development potential is high at North Hartland Lake and the need exists to schematically arrange recreation activities during the planning process in order to determine basic design relationships. Some activities are related, but must be physically separated in order to

NORTH HARTLAND LAKE

HARTLAND, VERMONT



LAND USE ALLOCATION PLAN

- PROJECT BOUNDRY
- INTENSIVE RECREATION
- OPERATIONS: LOW INTENSITY
- OPERATIONS: FISH AND WILDLIFE
- PROJECT OPERATIONS
- LEASED LAND: STATE PARK

SCALE IN FEET

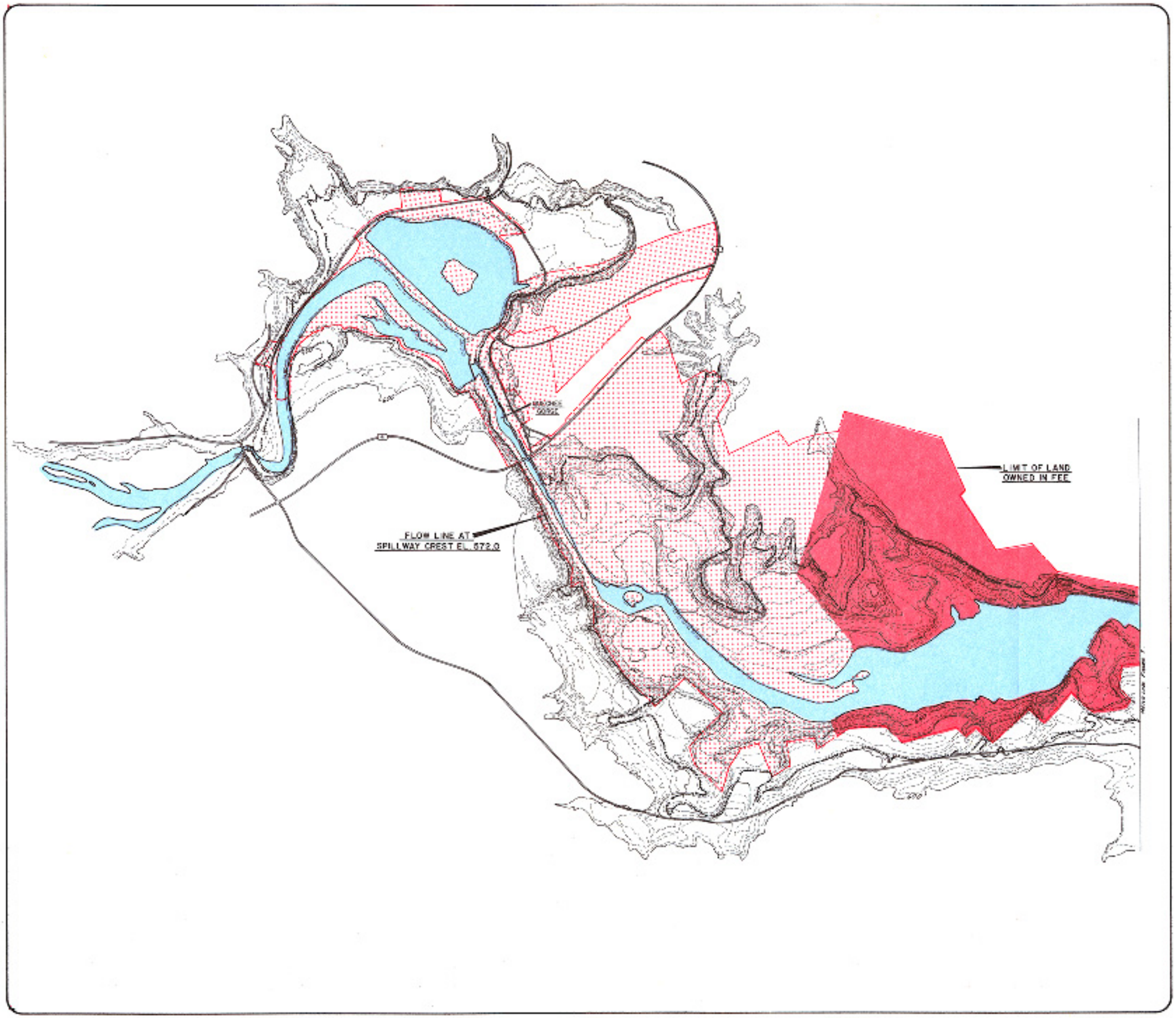
500 0 500 1000

Figure 15

NORTH HARTLAND LAKE

HARTLAND, VERMONT

LAND USE ALLOCATION PLAN



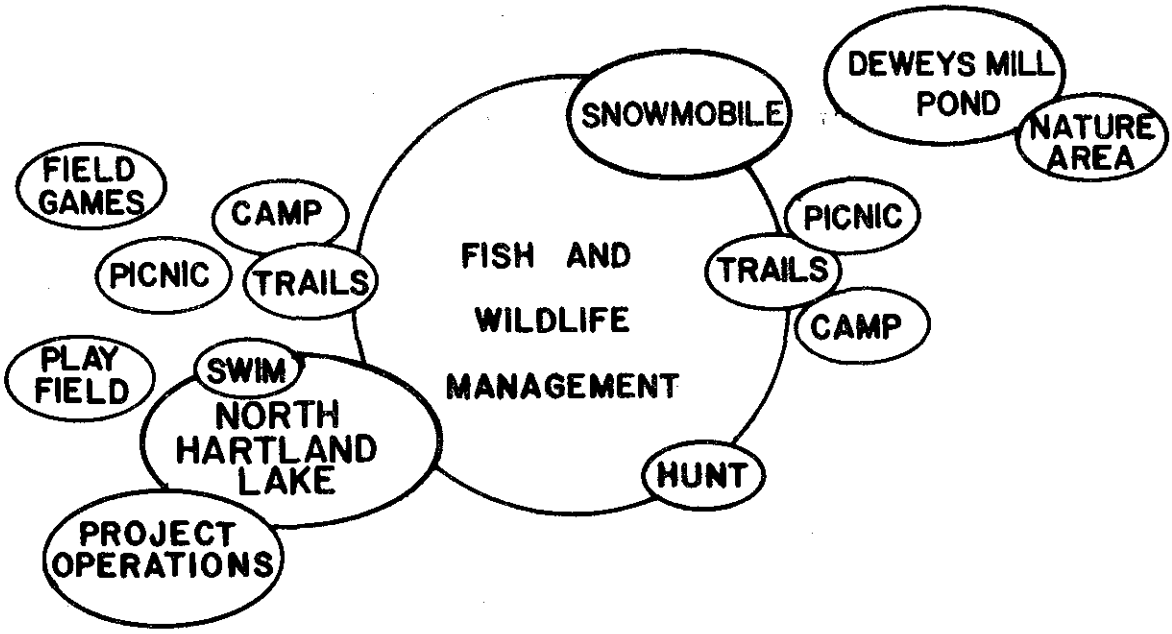
- PROJECT BOUNDRY
- INTENSIVE RECREATION
- OPERATIONS: LOW INTENSITY
- OPERATIONS: FISH AND WILDLIFE
- PROJECT OPERATIONS
- LEASED LAND: STATE PARK

SCALE IN FEET
500 0 500 1000

Figure 15A

remain compatible. Other activities that are commonly recognized as incompatible must be adequately separated to avoid conflict. Hunting, for example, can conflict with the trail use generated by the Quechee Gorge area. Some conflicting activities are naturally warranted and do not require specific consideration. Finally, some activities are unrelated because they occur during different seasons.

The compatibility matrix in Figure 17 analyzes the relationships between recreation activities occurring at the project. From this analysis and the soil suitability analysis, a schematic diagram of special relationships for activities, shown in Figure 16 was developed.



SCHEMATIC SITE PLAN

Figure 16

The principal uses in the area not restricted by flood control operation requirements are day-use picnicking, camping and wildlife management. The location of the day-use area near the dam provides concentrated recreation opportunities and minimal disruption to wildlife in the wildlife management area. The day-use area is easily accessible by automobile. Because of the open space available next to an attractive pine grove, the site is able to accommodate a large playing field, a double boat launch and an 18-table picnic area. The area adjacent to the

ACTIVITY COMPATIBILITY MATRIX

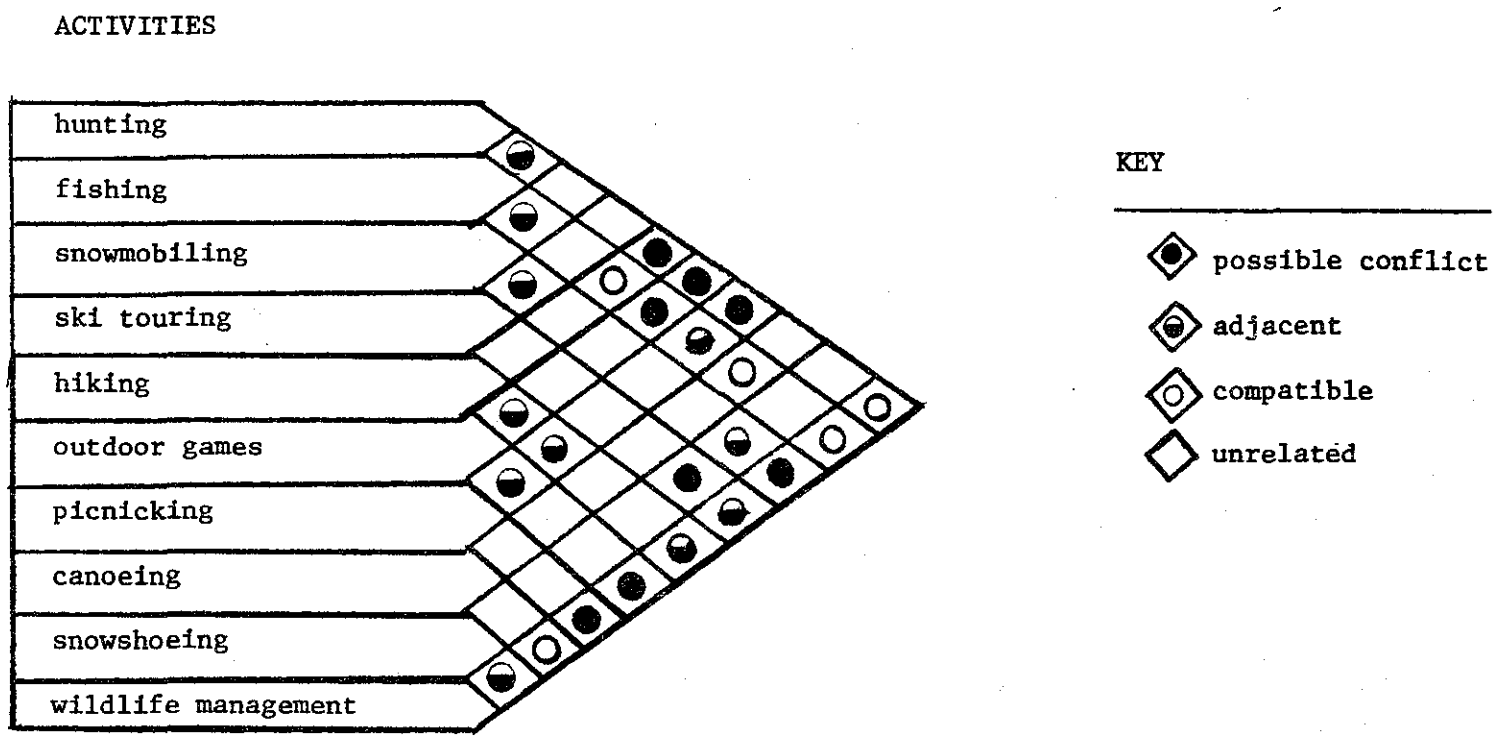


Figure 17

day-use area is also suitable for a small walk-in campground. It is moderately forested and has existing trails and "woods" roads through the site. A well laid out nature trail runs from the picnic area, through the wooded high ground and down the hill to the boat launch area. A small informal swimming beach can be developed upstream of the boat launch. The site can also be tied into a multiuse trail linking the dam with Quechee Gorge. The Quechee Gorge State Park campground is located next to U.S. Route 4 and is in a forested, level site. It is suitable for expansion and increased recreation development. The picnic/overlook area at Quechee Gorge is limited by size and the amount of land available for parking. The area does have scenic potential and can provide picnicking for a small number of groups.

Restroom facilities are available at the day-use area and the campground. The facilities at the day-use area are also designed for handicapped use. No additional facilities are planned at this time, however, when expansion of the campground becomes feasible additional restroom facilities will be necessary.

Parking for the day-use and boat launch areas is adequate. However, parking for the Quechee Gorge picnic/overlook area needs to be expanded and should be designed to meet the capacity of the picnic area.

The remaining land area is managed for fish and wildlife purposes and is also suited to low-intensity recreational uses. In addition to hunting and fishing, hiking and nature study can be accommodated in the areas surrounding the lake. The existence of former town roads and trails paralleling the gorge form the basis for the development of a loop trail around the reservoir area.

The frozen ground and snow cover during the winter months open up many areas for trail use that are otherwise too wet for year-round usage. A system of trails for snowmobiling has been established throughout the project. These trails are connected into a larger system in the surrounding area. Recently there has been a growing demand for additional cross-country skiing trails. The development of a loop trail around the project for hiking and cross-country skiing would meet the increased demand.

North Hartland Lake is suitable for small boats and canoes. Due to the narrow width of the lake and the passive recreation emphasis of the area the size of boat motors should be limited to 10 hp. The present boat launch is located near the dam, and has excellent parking and turnaround space.

c. Special Problems

The addition of hydropower generating facilities at North Hartland Lake has been proposed by the Vermont Electric Corporative, and if installed could result in a 2-foot daily pool fluctuation. If this construction and operation takes place the primary effect on recreation will be the visual impact due to the fluctuating pool. The effects of additional siltation on the already marginal fishery are unknown at this time. The addition of a swimming beach would also have to be reevaluated.

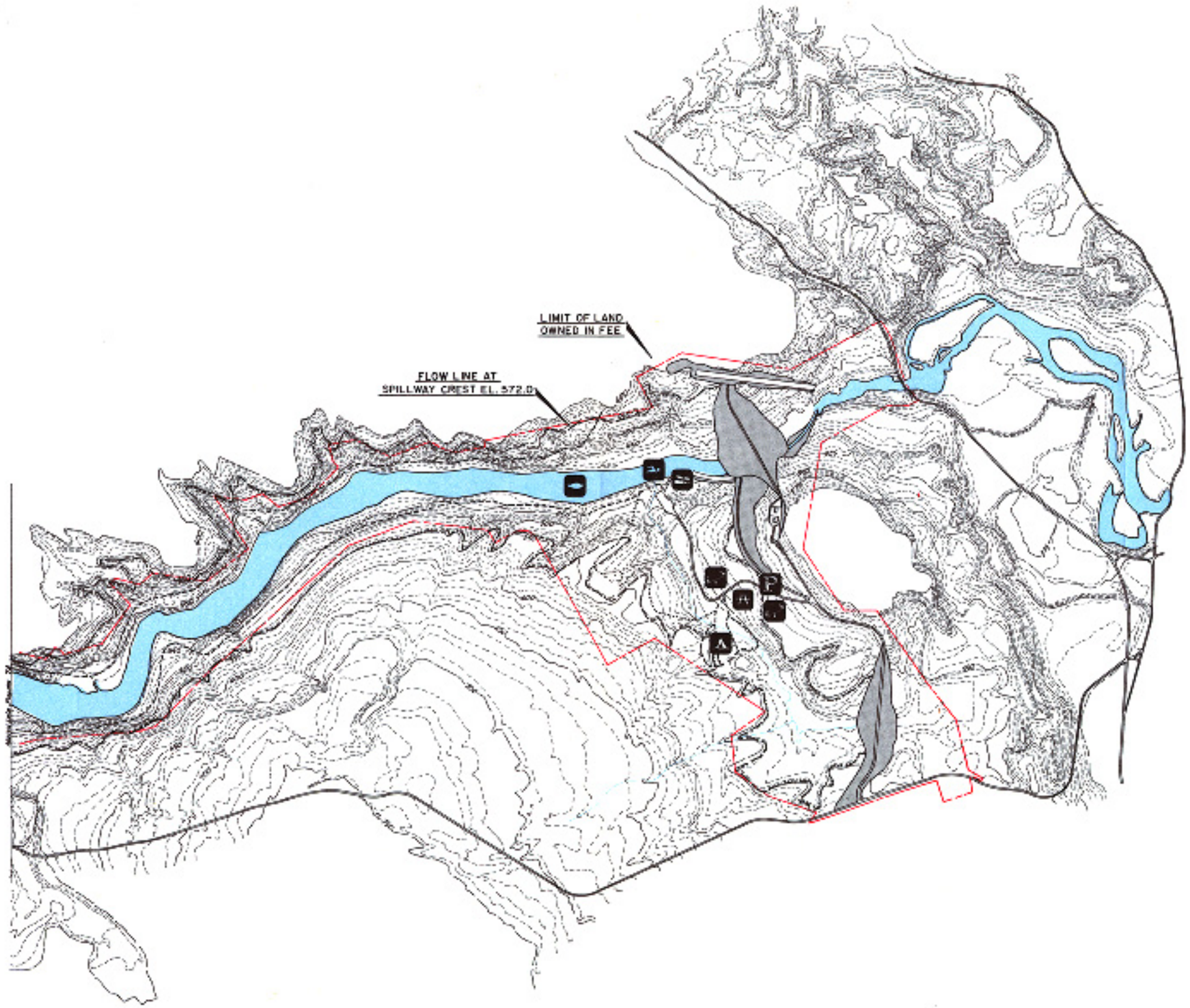
d. Cost Estimates

The following table provides a breakdown of the estimated costs for the proposed improvements to the recreation facilities at North Hartland Lake:

Item	Unit	Unit Cost	Qty.	Cost
Quechee State Park				
Campsites	EA	$1,000	50	$50,000
Rest Rooms	EA	80,000	1	80,000
Water Supply System	LS	20,000	1	20,000
Sewage Disposal System	LS	20,000	1	20,000
Campground Circulation Road	LS	50,000	1	50,000
Parking at Picnic Area	LS	20,000	1	20,000
Day-Use Area at Dam				
Walk-in Campsites	EA	200	20	4,000
Additional Parking	LS	20,000	1	20,000
Pit Toilets	EA	2,000	2	4,000
Multiuse Trails	MI	1,000	5	5,000
	Construction Cost			$273,000
	E&D and S&A			57,000
	Total Cost			$330,000

NORTH HARTLAND LAKE

HARTLAND, VERMONT



CONCEPTUAL PLAN

- PROJECT BOUNDRY
- MULTI-USE TRAILS
- NATURE TRAIL
- BOAT RAMP
- CAMPING, STATE PARK
- CAMPING, WALK-IN
- FISHING
- INTERPRETIVE AREA
- PARKING
- PICNICING
- PLAY AREA
- SCENIC OVERLOOK
- SWIMMING
- WILDLIFE AREA

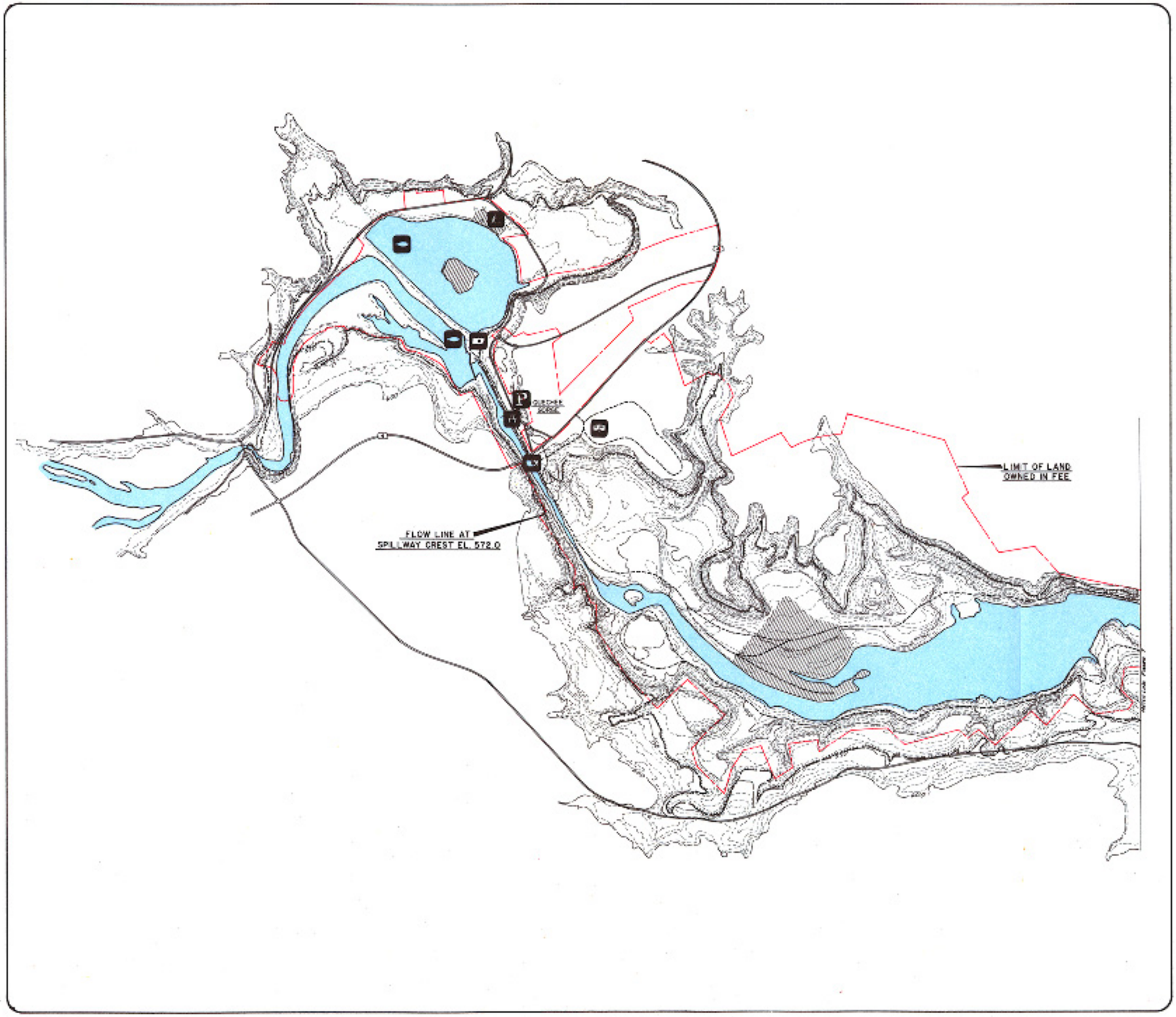
SCALE IN FEET

500 0 500 1000

Figure 18

NORTH HARTLAND LAKE

HARTLAND, VERMONT



CONCEPTUAL PLAN

- PROJECT BOUNDRY
- MULTI-USE TRAILS
- NATURE TRAIL
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- INTERPRETIVE AREA
- PARKING
- PICNICING
- PLAY AREA
- SCENIC OVERLOOK
- SWIMMING
- WILDLIFE AREA

SCALE IN FEET

500 0 500 1000

Figure 18.A

FIGURE 19 CAMPING, QUECHEE GORGE STATE PARK

FIGURE 20 BOY SCOUT JAMBORIE AT NORTH HARTLAND LAKE

VII. FACILITY DESIGN RATIONAL

The purpose of this section is to analyze and describe the facilities required, to identify the design problems associated with the construction of these facilities, and to establish criteria that deals with design problems.

a. Relationship Between Facilities and Activities

The facilities requirements matrix shown in Figure 21 analyzes the design relationship between proposed recreational activities and the required facilities. The matrix analyzes direct relationships, supporting relationships, desirable relationships, and likely conflicts as follows:

-- Direct Relationship: A direct relationship is indicated where the use of the facility is immediately involved with the performance of the activity, such as the relationship between the activity swimming and the provision of a swimming beach.

-- Supporting Relationship: Supporting relationship is indicated where the facility is necessary, but not directly involved with the activity itself, such as the provision of a parking lot to support use of a picnic area.

-- Desirable Relationship: Facilities which are not necessary but would be a positive addition in most cases are indicated as "desirable," such as a picnic area having a viewpoint at the same location.

-- Likely Conflict: In some cases, activities are located in proximity to facilities with which they are not compatible as a function of noise, safety, preference, etc. Those conflicts that are likely to occur are indicated, such as that between the activity of hiking and the provisions of roads.

b. Facility Requirements

Facilities were allocated to the project site based on the carrying capacity as limited by the resource capacity and the social capacity of each site. The carrying capacity is the maximum potential level of use that avoids overcrowding and overuse. Carrying capacities by activity are given in Figure 22.

Future recreation demands are projected to exceed the carrying capacity of the project, therefore, the carrying capacity was set equal to the social capacities of the project area. The social capacity is based on the preference distributions and social capacity factors. The preference distributions define for each activity the range of distances that the majority of users have indicated they prefer to be from other users. The social capacity factors for each activity consist of a list of site and user characteristics that affect the preference distribution of users.

	roads	parking areas	picnic site	swim beach	bathhouse	viewpoint	restroom	trail	buffer	landscape	boat ramp	REMARKS
hiking	⊠	◒						●				wilderness emphasis
fishing		◒		⊠			○				●	
viewing	●	◒				●	◒			○		
power boating		◒		⊠			◒				●	may cause shore erosion limited size of lake
other boating		◒										
swimming		◒	◒	●	●		◒		○	◒	⊠	
sunbathing		◒		○	◒		○		○			
pleasure walking	⊠	◒	○				◒	●				
picnicking		◒	●			○	◒	○	○	○		
hunting		◒							○		◒	general conflict with other activities
nature walk		◒				●		●				minimize development and impact

KEY:

- ● direct relationship
- ◒ support relationship
- ○ desirable
- ⊠ likely conflict

FACILITIES REQUIREMENT MATRIX

Figure 21

CARRYING CAPACITY GUIDELINES

Activity	Activity Setting	Area Sq. Ft.	Area Guideline Sq. Ft./Group	Carrying Capacity Guideline	# of Users Per Activity Group	Load Factor Users/Auto	# or Parking Spaces Required
Boating	N. Hartland Lake	9,365,400	336,230	23	3	3	23
Boat Fishing	N. Hartland Lake	9,365,400	517,769	3	2	2	3
Camping	Quechee Gorge Area	479,160	3,910	122	4	3.3	122 campsites
Picnic	Day-Use Area	105,000	3,261	32	5	3.3	48
Picnic	Quechee Gorge Area	33,000	5,771	6	5	3.3	9
Sunbathing	Beach	8,750	328	27	3	3.3	25
Swimming	N. Hartland Lake, Swim Area	52,500	733	72	3	3.3	Limited by Sunbathi Area

Figure 22

The limiting social capacity should be used as a guideline to develop parking areas and other support facilities at the appropriate level. The facilities can then be used to determine when the social capacity of the area has been reached. Carrying capacity of the picnic area at Quechee Gorge is lower than the current number of picnic sites. This situation causes overuse of the resources and a deterioration of the area. The number of picnic sites should be reduced to meet the capacity of the area and adequate parking provided for approximately 10 automobiles. The campground can support three times its current number of campsites. The development of new sites must be carefully planned and sited before expansion. Necessary additional support facilities must also accompany the development. The proposed swimming area would be limited in size and would not require additional parking for visitors. Both the day-use and boat launch areas have a facility capacity that corresponds to the capacity guidelines. The current parking area can be used as a valid measuring device to determine when the capacity of the recreation area is being exceeded. The addition of the walk-in primitive campground area would require expansion of the current day-use parking area. The parking area would need to be expanded one space per campsite. The informal, rustic setting of the area would permit the development of approximately 20 sites.

c. General Criteria

Siting

The siting of recreation facilities has been based on a detailed inventory and analysis of the projects natural resources in order to minimize environment and aesthetic impact, promote logical development and minimize development costs. Factors inventoried included soil types, vegetation, topography, wildlife, surface geology, historical/ archaeological sites and land use patterns.

Recreation facilities design takes into consideration soil conditions, topography, preservation of native vegetation, revegetation of disturbed soil areas and careful selection of building design and materials. Soil maps combined with onsite analysis of the local soils should always be the basis for determining the final facility siting.

The selection, sizing and location of recreation facilities should take into consideration anticipated demand for planned activities and the extent to which this demand is already being met by other public or private recreation areas in the region.

Site Improvements

Minimum alteration of the natural environment has been a major consideration in the design of site improvements. The following criteria have guided the design and location of the facilities proposed on the project:

-- Trail alignment will parallel elevation contours where possible and follow a careful analysis of habitat types.

-- Trail alignments will respect existing vegetation and sensitive drainage areas.

-- Existing paths and clearings will be used wherever possible instead of clearing heavily vegetated areas.

-- Existing disturbed areas will be used wherever possible.

d. Typical Facilities

Water System

Water for public and project use at the dam is provided by a well with a large storage tank, both of which are located above the spillway crest elevation. Drinking water is supplied by bubblers located at the restrooms at both public use areas.

Water Collection and Treatment System

Existing sanitary facilities at the campground area are of the waterborne sewerage type with flush toilets. The facilities at the dam day-use area are a self contained recirculating oil based system and were designed for handicapped access.

Roads

Access to most parts of the reservoir area as well as North Hartland Dam, the project manager's office, the picnic area and boat ramp is provided over paved roads. Direct access to Quechee Gorge is provided from U.S Route 4 and Town Highway 69. Gravel surfaced two-way project roads should be maintained to a 20-foot minimum width.

Parking

Parking for the Corps operated recreation area at the dam is available off the project access road, adjacent to the picnic area. The parking area is currently satisfactory for the capacity of the recreation area.

Any future parking areas should be laid out in accordance with standard parking lot dimensioning criteria. Siting should utilize existing topography as much as possible to minimize cost and reduce visual impact. Any clearing of natural vegetation should also be minimized in order to reduce visual impact. Parking areas should be located away from roadways for visitor safety, but within view of passing traffic for vehicle security.

Launching Ramps

There is a double boat launching ramp just upstream of the dam. The ramp has adequate parking and turnaround space and no additional launching ramps are planned.

Picnic Sites

Picnic sites are designed to accommodate either a single party or groups. No expansion of these facilities is planned as the current number of tables makes maximum use of the area available. Each picnic site is within walking distance of the parking area and suitable for use by the handicapped.

Game Areas

Two game areas are provided in the vicinity of the picnic area: one is developed for softball, and the other has facilities for horseshoes and volleyball. They are located adjacent to the picnic area, but not so close as to interfere with picnicking activities.

Trails

Trail development is an important part in the overall recreation program at North Hartland Lake. Hiking, ski-touring and snowmobiling trails provide access throughout the project. The expected increase in use requires that special considerations be made in trail design, layout and maintenance. Consideration must be given to soil conditions for hiking trails to avoid excessively wet or easily erodable soils. Ski-touring trails should provide a range of conditions to safely accommodate the novice, as well as challenge the more experienced skier.

Where regrading is required, grades should not exceed 8.5 percent, except for short stretches of no more than 15 percent. Whenever practicable, the rules of barrier-free design should be followed in order to allow maximum participation by the handicapped, elderly and visually impaired.

In areas that are continually damp or frequently flooded, provisions must be made to maintain a dry walking surface. This may be done by regrading to raise the trail surface level, or by surfacing the trail with gravel, wood chips, logs, railroad ties or other low cost durable material.

Natural drainage patterns must be analyzed to prevent trail erosion. On sloping trails, drainage diversions made of small logs or rows of rocks placed diagonally across the trail will divert water flow off the trail and into vegetated areas.

Where trails cross existing roads, gates or posts should be used to restrict vehicle use of the trails.

Signs

Signs should communicate easily understandable directional, informational and regulatory messages. Information signs should be of similar colors and graphic style for visual continuity and to establish a physical identity for the area. International symbols should be used for clarity, quick readability at highway travel speeds, and for standardized identification. Facility information signs should be located on both project lands and nearby major highways. Signs on major highways should be located before the intersection instead of at the intersection to allow driver reaction time at highway speeds.

For safety of hikers, a sign should be placed at each trail entrance to indicate hunting season dates.

The visitor information sign board located near the parking area at the Corps picnic area should contain a large scale project map with locations of trails and facilities.

Camping Units

Walk-in camp sites are designed to provide a low-cost, low-maintenance camping area for those desiring a less developed camping environment. The number of sites must be limited and carefully located to provide a wilderness experience and minimize the impact on the area.

Interpretive Devices

Interpretive devices in natural areas should consist of signs explaining natural features, plant and animal species, and ecological processes. Man's relationship to, or impact on, these elements should also be explained. The adverse impacts caused by people who fail to stay on the trails need to be emphasized. All interpretive devices must relate to their surroundings and enhance the recreational experience available at North Hartland Lake.

VIII. OPERATION AND ADMINISTRATION

The authorized purpose of North Hartland Lake is to act in conjunction with other flood control reservoirs in the Connecticut River Basin in providing flood protection to downstream damage centers primarily along the mainstream of the Connecticut River in Massachusetts and Connecticut. Management for recreation at the reservoir is a secondary priority that should remain compatible with the primary function of flood control. Within this context, management objectives for recreation are:

a. To encourage sustained public use up to the maximum practical carrying capacity, consistent with aesthetic and ecological values.

b. To avoid or minimize use conflicts while developing project resources.

c. To be aware of and responsive to user needs and desires.

A staff consisting of a project manager and assistant project manager performs the continual operation and maintenance duties that are required at North Hartland Dam. A temporary employee is usually hired in the summer to aid and assist the project manager. In addition, a Corps of Engineers ranger from the Upper Connecticut River Basin office located at North Springfield Lake regularly patrols the reservoir area to assist visitors and enforce rules and regulations.

In addition to overseeing the operation of the dam, the field personnel supervise the use of lands and waters of the project, protect and maintain government property, and enforce high standards of public health and safety. Project personnel refer problems concerning compliance inspections and outgrant management directly to the Real Estate Division.

Overall administration of the recreation and fish and wildlife management programs at North Hartland Lake is carried out jointly by the Corps of Engineers and the Agency of Environmental Conservation, Department of Forests, Parks and Recreation respectively. The Corps of Engineers is concerned mainly with determining the nature and extent of development, preparing site layout plans and construction requirements, maintaining public relations with other interests, and carrying out project management policies.

All laws and regulations concerning proper use of the project resources are enforced by the local police, fish and game conservation officers and Corps of Engineers rangers, with the cooperation of the project manager.

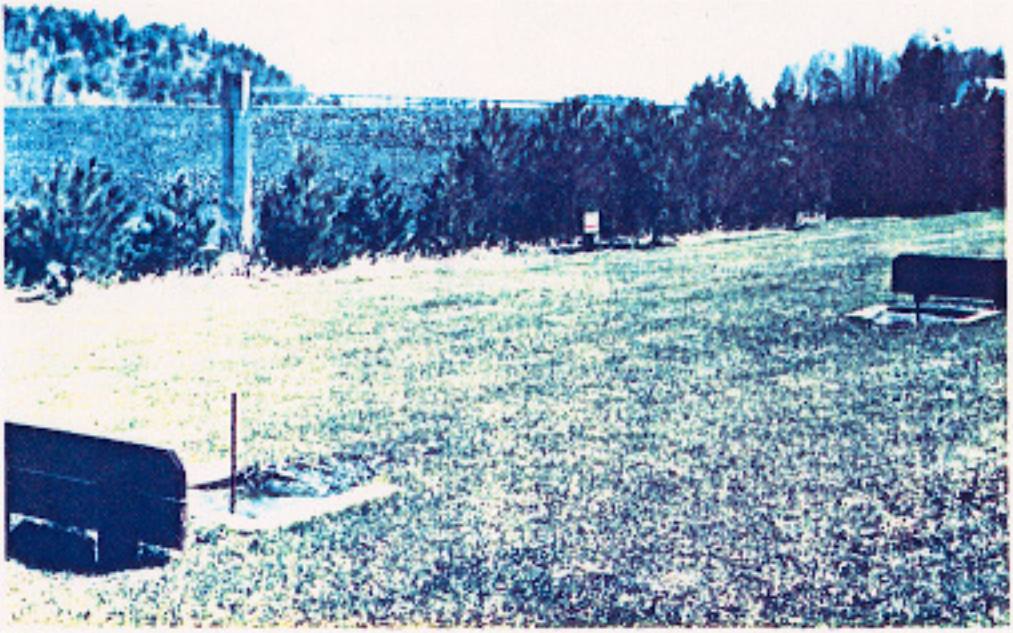

FIGURE 23 PLAYING FIELDS NEXT TO THE PICNIC AREA

FIGURE 24 RESTROOMS AND BALLFIELD ABOVE THE PICNIC AREA

IX. RECOMMENDATION

North Hartland Dam was originally conceived for the purpose of flood control. A number of recreational uses have evolved in the reservoir area, in keeping with the natural setting. The following improvements as proposed and discussed in this project plan are recommended in order to optimize and enhance, to the greatest extent possible, the recreation potential of North Hartland Lake.

1. Develop a multiuse trail system around the lake to serve hikers, snowmobilers, cross-country skiers and horseback riders. This trail would require some selective clearing along the south bank of the reservoir.

2. Develop additional campsites and restroom facilities at the Quechee Gorge State Park Campground in accordance with applicable cost sharing requirements with the State of Vermont at such time as desired by the State. Develop a small walk-in campground adjacent to the day-use area near the dam.

3. Continue the present fish and wildlife management and enhancement programs in cooperation with the Vermont Fish and Game Department.

4. Improve the picnic overlook area at Quechee Gorge and provide adequate off-road parking for the picnic sites.

5. Develop a swimming beach on North Hartland Lake. This recommendation is dependent on the continued improvement in water quality and the outcome of the present hydropower study. The swimming beach would not be developed until repeated testing determined the water quality condition acceptable for swimming.