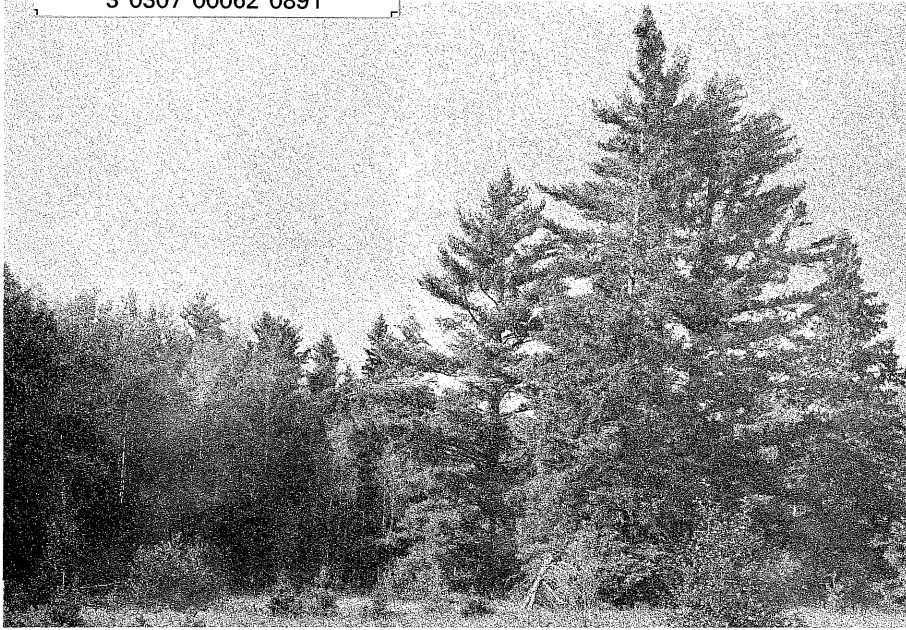




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RED LAKE WILDLIFE MANAGEMENT AREA MASTER PLAN, 1980-1989

Minnesota Department of Natural Resources



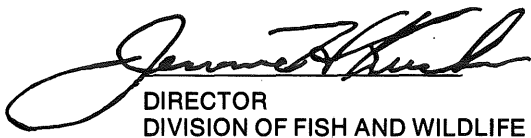
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RED LAKE WILDLIFE MANAGEMENT AREA MASTER PLAN, 1980-1989

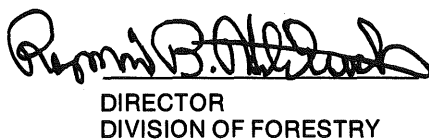
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Minnesota Department of Natural Resources
Division of Fish and Wildlife
St. Paul, Minnesota
December, 1980



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PREFACE

Concurrent with our population growth, our natural resources have been increasingly exploited through demands for raw materials and outdoor recreational opportunities. Recognizing Minnesota's existing and potential recreation and natural resource use problems, the 1969 legislature requested a "Study of the Total Environment" called Project 80. The study, to guide the legislature in reviewing appropriation requests for the acquisition, development, and maintenance of state-owned lands used for outdoor recreation, was conducted by the State Planning Agency and the Department of Natural Resources.

Project 80 recommendations led to the Outdoor Recreation Act of 1975. The act established an outdoor recreation system to preserve and properly use Minnesota's natural, cultural, and historical resources. The system is composed of 11 different classes of state-owned lands administered by the Department of Natural Resources, the Minnesota Historical Society, and the Department of Transportation (Appendix A). Each class within the system has an unique purpose and use. In this way, the system provides a variety of recreational opportunities with minimal use conflicts.

The Department of Natural Resources is preparing comprehensive management plans for the nine wildlife management areas in the state having resident managers. The plans include present and projected regional perspectives, resource inventories, and demand and use analyses, as well as acquisition and development plans, cost estimates, and resource management programs. These are ten-year management plans, and will be revised as new management practices develop, new resource philosophies evolve, and new problems are encountered.

Under a cooperative agreement with the State Planning Agency, the Department of Natural Resources completed plans for the Whitewater, Carlos Avery, Mille Lacs, Talcot Lake, and Lac qui Parle Wildlife Management Areas during the 1976-77 biennium. Plans for the Roseau River, Red Lake, Hubbel Pond, and Thief Lake Wildlife Management Areas will be completed during the 1980-81 biennium.

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INTRODUCTION

Minnesota has an abundance of natural resources. To many people, Minnesota's wildlife management areas and their associated wildlife and plant communities are among the state's most precious resources. In accord with the Outdoor Recreation Act of 1975, this master plan outlines the management of the Red Lake Wildlife Management Area (WMA) through 1989. The plan was developed by defining area goals, examining existing conditions and resources, identifying management considerations, and then developing appropriate management programs.

DESCRIPTION

The Red Lake WMA, the largest in the state, covers 417,456 acres in northcentral Beltrami and southwestern Lake of the Woods Counties. It is 340 highway miles northwest of the Twin Cities and 37 miles southwest of Baudette (Figure 1). Access is

provided from county and state forest roads connected to State Highways 72, 11, and 89. The Beltrami Island State Forest incorporates a major portion of the WMA. Upper Red Lake and the Red Lake Indian Reservation border the unit to the south.

The area is mostly low and flat, interrupted by remnant beach ridges and upland islands. Vast open bogs and lowland conifer forests characterize the low areas, while mixed coniferous-deciduous forests dominate the uplands. The South Branch of the Rapid River, flowing easterly through the center of the WMA, is bordered by river-bottom hardwoods.

Originally established as a game refuge, the WMA has been open to public hunting and trapping since 1957. The unit is managed primarily for white-tailed deer, ruffed grouse, and other forest wildlife. Hunting, trapping, and fishing are the principal recreational uses. Other public uses include logging, wildlife research, and environmental education.

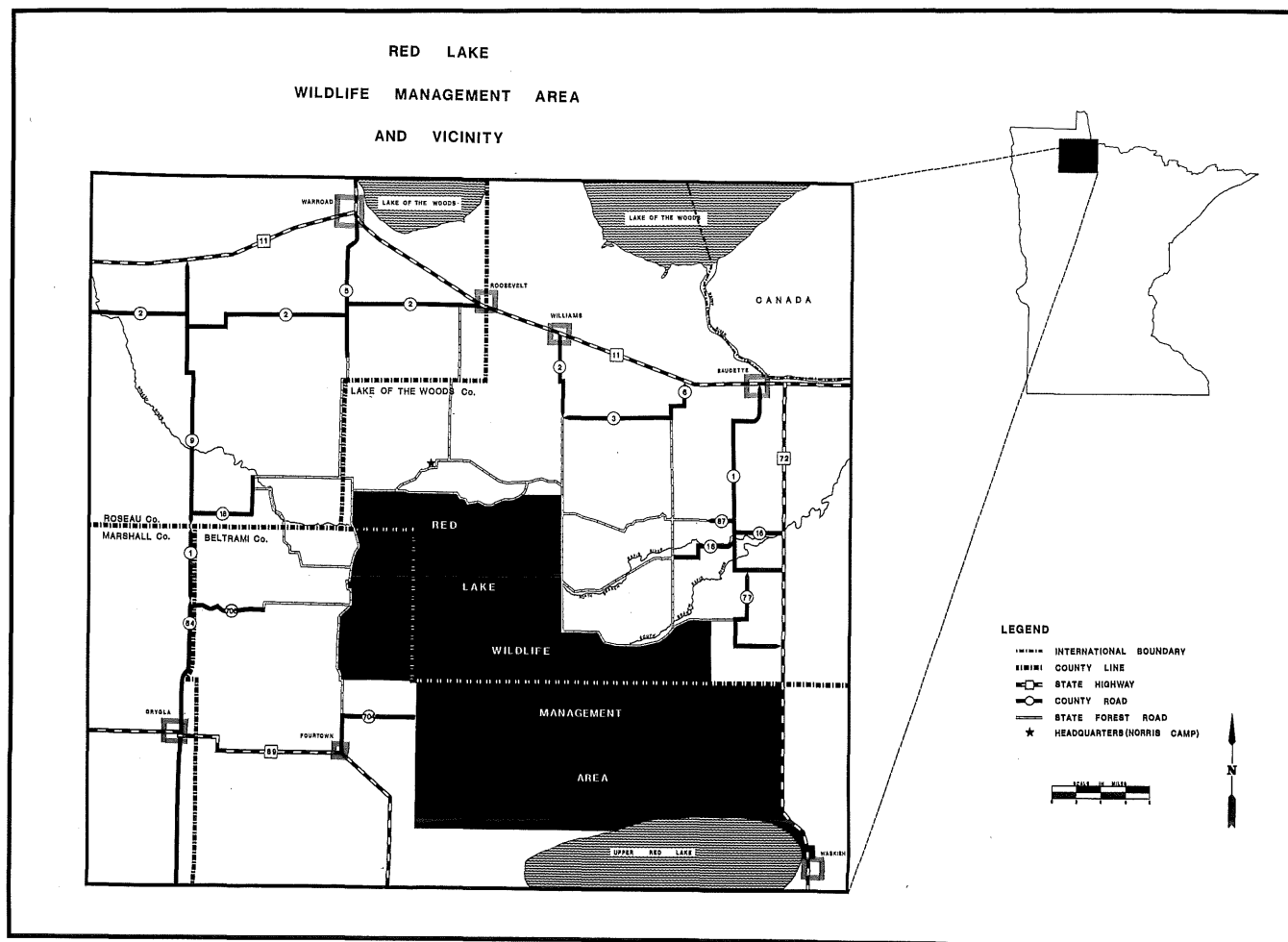


Figure 1

LEGAL PURPOSE

Minnesota's wildlife management areas are lands and waters with a high potential for wildlife production. They are managed and developed by the Commissioner of the Minnesota Department of Natural Resources (DNR) to perpetuate and, if necessary, re-establish habitats for the maximum production of a variety of wildlife and to provide hunting, fishing, trapping and other compatible outdoor recreational uses. Public use must be consistent with the units' resource limitations, and developments must minimize intrusion on the natural environment (Minnesota Statutes, Sec. 86A.05, Subd. 8, 1978).

Public lands have a limited potential for multiple recreational use. Minnesota has never actively encouraged the multiple recreational use of wildlife lands. The Commissioner of Natural Resources recognized those public uses associated with the observation, interpretation, and understanding of fish and wildlife populations and habitats as recreational uses compatible with Minnesota's wildlife management areas. Similarly, the U.S. Fish and Wildlife Service has recently realized that national wildlife refuge goals are endangered by conflicts between the demand for recreation and the ability of the resource to accommodate the use (Pulliam 1974).

Since the development, management, and administration of state wildlife lands are financed primarily through revenues derived from the sale of

hunting, trapping, and fishing licenses, recreational uses of these lands are limited to activities directly oriented towards wildlife and fish. In addition, wildlife lands purchased with federal matching funds derived from the Pittman-Robertson Act were acquired with the understanding that they would be managed for the benefit of wildlife and fish populations and/or for the public use and understanding of those resources.

The greatest contribution from our country's wildlife lands is the fostering of public uses directly associated with fish and wildlife and their habitats. To achieve these goals, the Minnesota DNR will continue to restrict public uses that are not related to fish and wildlife.

LONG-RANGE GOALS

The primary goal of the Red Lake WMA is to provide diverse and productive habitats for white-tailed deer, moose, ruffed grouse, and other forest wildlife by maintaining and developing an interspersed forest types, age classes, and openings. Accomplishment of this goal will perpetuate native plant and animal communities in a relatively undeveloped and unique region of the state.

A second management goal of the unit is to provide quality public hunting, trapping, and fishing. Other forms of outdoor recreation will be accommodated only if compatible with wildlife and fish.

HISTORICAL AND ARCHAEOLOGICAL ASPECTS

Historical knowledge is valuable to natural resource management. Many of the land use problems and attitudes toward natural resource use arose with settlement of the region. An understanding of the historical use of an area's natural resources, the strong points and shortcomings of these practices, and the policies regarding natural resource use is necessary to develop a comprehensive management plan.

HISTORY OF THE RED LAKE AREA

The history of the Red Lake area is complex, involving two Indian tribes, the federal government, the State of Minnesota, and its counties. Land ownership patterns resulted from a variety of Indian treaties and cessions; state and federal land grants, sales, programs, and laws; and private and corporate actions.

Presettlement. The Sioux Indians originally inhabited the shores of the Red Lakes. The Chippewa Indians gained control of the area by 1740, and settled permanently on the Red Lakes as part of a hunting and trapping contingent of the French explorer Jean B. Cadotte in 1792 (Lund 1977).

The first whites to settle the area were fur traders who dealt with the Chippewas. Both the Northwest Company and the American Fur Company had permanent posts on the Red Lakes during the early 1800's (Lund 1977). Except for occasional hunters or trappers, the area north of the Red Lakes received little use until the beginning of the present century.

Land Settlement. The area surrounding what is now the Red Lake WMA was part of the lands ceded by the

Red Lake and Pembina Bands of the Chippewa Indians to the federal government in 1889 (Dana et al. 1960). The area was opened to homesteading in 1896, but these poorly drained, inaccessible lands attracted few settlers before 1905.

The principal immigration to the area took place between 1910 and 1920. Early immigrants, mostly English, Scandinavians, and Germans, homesteaded on the forested uplands and near the rivers and subsisted by logging spruce, pine, and tamarack (Murchie and Wasson 1937). Others settled near the vast open bogs, believing that this swampland could be drained for agricultural use.

Drainage. The decline of logging during the early 1900's brought a growing demand for agricultural lands. Pressures mounted for the development of drainage projects to reclaim the swamplands for agriculture.

State legislation (1887) had already authorized the organization of county drainage districts to be financed by bonds issued by the county. The Volstead Act of 1908 subjected federal lands in drainage projects to ditch assessments. Later legislation (1909) subjected state lands in drainage projects to assessments the same as privately owned lands. Prior to 1925, legislation also authorized drainage construction at the initiation of only a small minority of the property owners who would have to pay for the project. With this encouragement, over 1500 miles of ditches costing approximately \$3 million dollars were dug in Beltrami and Lake of the Woods Counties between 1909 and 1917 (Vandersluis 1963).

The drainage program in the Red Lake area was largely unsuccessful. Much of the drained land was never settled; other areas were abandoned soon after settlement. Poor soils, severe climate, inefficiency of drainage ditches, and distance from markets made farming impossible (Dana et al. 1960).

Volstead Lands. The Volstead Act provided for the patent of federal lands in drainage systems upon payment of the drainage taxes accruing to the land; all other provisions of homesteading were waived. Many of the Volstead lands were quickly patented by settlers and absentee owners, regardless of the suitability of the land for agriculture.

The federal government refused to pay the taxes assessed against the unsold Volstead lands adjoining drainage ditches, and, as a result, the state included these tracts in their list of tax-forfeited lands. The legality of this action was disputed until 1963, when the state purchased these lands from the federal government.

Tax Delinquency and Forfeiture. The economy of the area was distressed following drainage. Because of timber depletion and crop failures, income from private lands could not meet the taxes and ditch liens. By the late 1920's, several million acres of land in northwestern Minnesota were forfeitable for nonpayment of taxes (Dana et al. 1960). In 1931, Beltrami, Lake of the Woods, and Koochiching Counties had approximately 51, 60, and 28 percent, respectively, of their lands tax-delinquent (Minnesota Conservation Dept. 1932). Adding to the dilemma were numerous fires originating from logging, land clearing, and drainage.

Diminishing tax revenues forced many northern counties into such extreme financial difficulty that the state was forced to intervene. Beginning in 1925, a series of laws dealing with tax delinquency and forfeiture were passed in an attempt to get tax-delinquent lands back on the tax rolls or to reimburse the counties for all or part of the delinquent taxes and principal and interest on drainage bonds assessed on these lands.

WILDLIFE MANAGEMENT AREA HISTORY

Red Lake Game Preserve. In 1929, the legislature established the Red Lake Game Preserve (Laws Minn. 1929, ch. 258) in Beltrami, Lake of the Woods, and Koochiching Counties to prevent default on drainage bonds issued by these counties (Figure 2). The state was authorized to take absolute title to approximately 1.3 million acres of tax-delinquent lands within the preserve and assumed the responsibility for paying the outstanding principal and interest on the drainage bonds. These lands (classified as Consolidated Conservation lands) were placed under the jurisdiction of the Department of Conservation (now the DNR) to be managed as a state wildlife preserve and hunting grounds for the propagation, preservation, and use of wildlife, timber, and other resources. The department was required to classify all tax-forfeited lands with respect to their suitability for agriculture, forestry, and wildlife production. Lands classified more suitable for agriculture were to be sold at public auctions. As of 1978, approximately 146,000 acres of tax-forfeited lands in the Red Lake Game Preserve had been sold.

Red Lake Game Refuge. The last stronghold of the woodland caribou in the contiguous United States was the "big bog" area in the Red Lake Game Preserve (Minnesota Conservation Dept. 1932). To protect and propagate the remaining caribou, and also migratory

waterfowl, furbearers, and other big game species, the Department of Conservation in 1932 established a 266,500-acre game refuge north of Upper Red Lake (Figure 2). Further additions between 1932 and 1954 (Appendix B) established the present boundary of the Red Lake Game Refuge (WMA).

This vast region was practically undeveloped before 1935. The federal government authorized extensive relief work projects in the area starting in that year. During the next five years, the Works Progress and Federal Resettlement Administrations constructed roads, fire lanes, telephone lines, dams, patrolmen's cabins, and other buildings on the Red Lake Game Refuge.

Between 1932 and 1950, all hunting and trapping on the refuge was prohibited. Selective hunting and trapping seasons were opened in 1951 (Appendix B). Since 1958, the refuge has been open by Commissioner's Orders to the hunting and trapping of all game species during their established seasons.

Beltrami Island State Forest. In 1931, the Minnesota Legislature designated approximately 230 square miles north of the 1932 Red Lake Game Refuge boundary as a state forest (Appendix B). The area was expanded in 1933 and designated the Beltrami Island State Forest. Further additions in 1943 and 1963 established the present boundary which encompasses 669,000 acres, including approximately 60 percent of the Red Lake WMA.

Federal Resettlement Program. By the early 1930's, much of the land settled during the drainage period had been abandoned or tax-forfeited. A few scattered settlers, however, still lived on the area. The combination of unproductive lands and the economic depression of the 1930's, forced many settlers into an extreme financial crisis. In 1933, the federal government responded by initiating the Land Utilization Project (L.U.P.) under the National Industrial Recovery Act. The L.U.P. authorized the federal government to purchase submarginal lands from isolated and distressed settlers and to relocate these people on more accessible and productive lands.

The Beltrami Island Development Project in Beltrami, Lake of the Woods, and Roseau Counties was initiated in 1935 at the request of the Minnesota Department of Conservation and the Minnesota Rural Rehabilitation Corporation. By 1936, over 300 families had been relocated on more productive lands within these counties (Murchie and Wasson 1937).

In 1940, the 80,781 acres of scattered Beltrami Island L.U.P. lands were leased to the State of Minnesota. The term of the lease was for a period of 50 years with provisions for automatic renewal for three successive terms of 15 years each. An additional 651 acres were added to the lease by Public Land Order No. 495 in 1948. These lands were placed under the jurisdiction of the Department of Conservation, Division of Game and Fish (now the Division of Fish and Wildlife) to be managed for wildlife, forest resources, and recreation. There are 20,595 acres of scattered L.U.P. lands within the present boundaries of the Red Lake WMA and 60,837 acres outside the unit.

Norris Camp, two miles north of the present WMA boundary, was built in the 1930's for the Beltrami Island Resettlement Program. The 30 or more buildings and federally-owned equipment were made available to the state under the terms of the 1940 lease. The camp now serves as the Red Lake WMA headquarters.

RED LAKE GAME PRESERVE, GAME REFUGE, AND WILDLIFE MANAGEMENT AREA

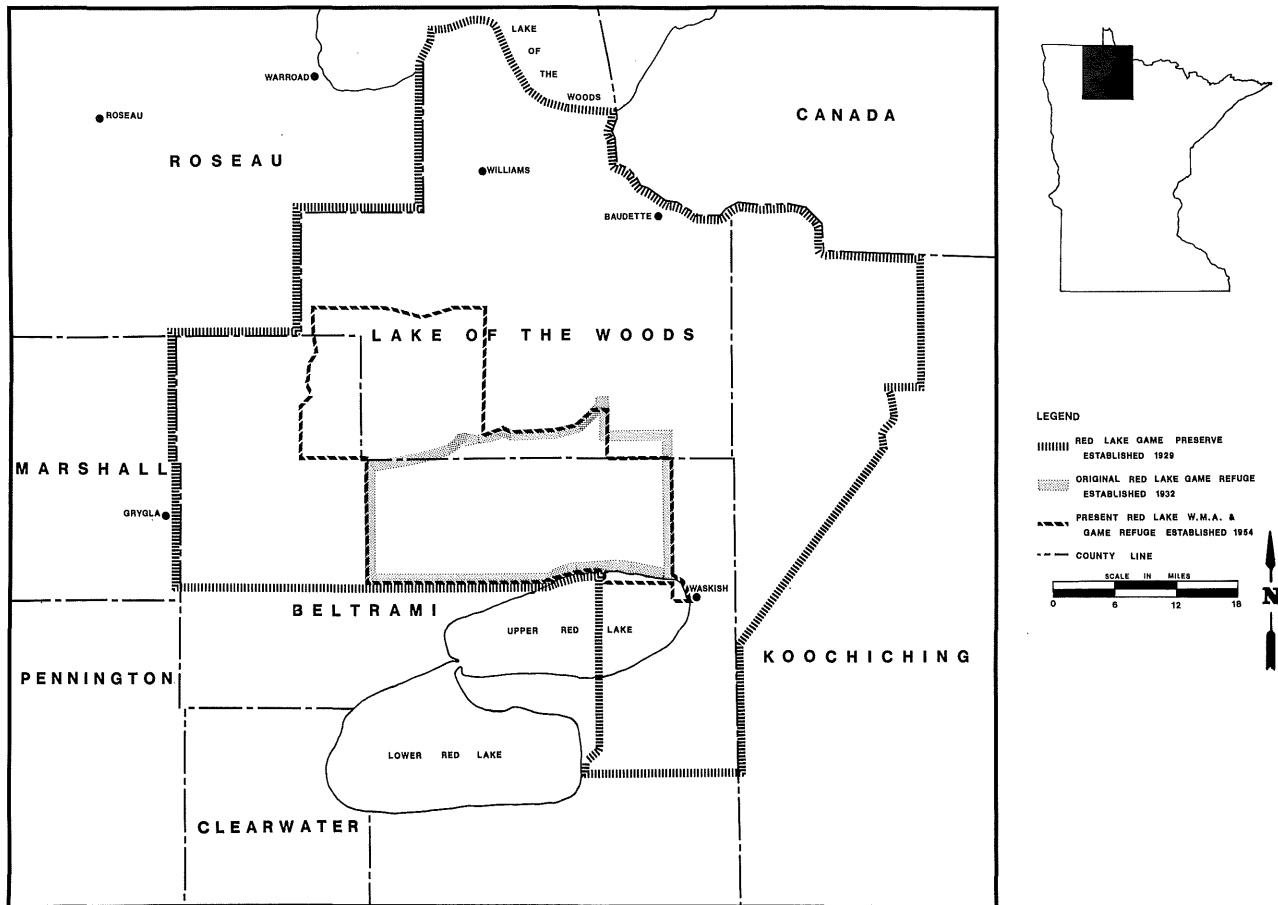


Figure 2

In 1942, Presidential Executive Order #9091 established the Beltrami Wildlife Management Area from the Beltrami Island lease lands (L.U.P.), as a refuge and breeding ground for native birds and wildlife.

Indian Lands. In 1934, the Indian Reorganization Act authorized certain public lands ceded to the United States in 1889 to be restored to appropriate Indian tribes. The Red Lake Band obtained 157,561 scattered acres of land outside the reservation proper, of which 29,817 acres were located within the Red Lake WMA.

ARCHAEOLOGICAL ASPECTS

One prehistoric Indian habitation site is located in the extreme southeast corner of the WMA near the town of Waskish (Johnson 1977). The site was occupied intermittently from about 800 A.D. to 1200 A.D. The majority of known archaeological sites in the region are south of the management area on Lower Red Lake and Ponemah Point.

Johnson (1977) assessed the archaeological potential of the unit as follows: "The major portion of this . . . management area is low lying marsh and bog and has a very low probability of archaeological sites. It is possible, though not probable, that sites may exist on the north shore of Red Lake.

HISTORICAL SITES

The Beltrami and Lake of the Woods County Historical Societies and the Minnesota State Historical Society were consulted to identify historical sites on the Red Lake WMA. A British fur post site at Waskish, dating back to 1806, and an old post office building, the Smith Post, built in 1914 on the north shore of Upper Red Lake (Minnesota DNR 1971), are the only documented sites existing on the management area.

Norris Camp may have sufficient historical value to merit its preservation and restoration, as it is one of the few federal resettlement camps remaining nearly intact.

RESOURCE INVENTORY

An inventory of the resources and conditions in the area is essential to developing comprehensive management programs. The resources can be divided into two classes: abiotic and biotic. While each category influences the other, the abiotic conditions generally determine the diversity, distribution, and density of the biotic resource. Examination of the existing resources in conjunction with the habitat requirements, population dynamics, and behavior of game and nongame wildlife is needed to develop programs for the sustained production and use of these populations.

ABIOTIC RESOURCES

Climate. The climate of the Red Lake WMA vicinity is humid-continental with short, mild summers and long, cold winters. The average temperature for July is 67.3°F and for January 2.7°F (Table 1). Winter temperatures of -40°F are common. The average growing season is approximately 100 days long. The first killing frost is expected by about September 10 and the last normally no later than June 1. However, low-lying bog areas may experience frost throughout the summer. Average annual precipitation is 22.55 inches, ranging from 0.46 inches in February to 4.07 inches in June.

Table 1. Average temperature, precipitation, snowfall, and snow depth for the Red Lake WMA vicinity.

Month	Average ¹ Temperature(°F)	Average ¹ Precipitation (Inches)	Average ¹ Snowfall (Inches)	Average Snow ² Depth (Inches)
January	2.7	0.59	8.4	12.8
February	7.6	0.46	5.5	14.9
March	20.9	0.79	6.8	10.0
April	39.5	1.42	5.8	1.3
May	51.9	2.43	T ³	T
June	61.9	4.07	0	0
July	67.3	3.49	0	0
August	65.1	3.39	0	0
September	55.1	2.84	0	0
October	45.5	1.50	0.6	T
November	26.9	0.91	8.8	1.8
December	10.1	0.66	7.7	8.4
Total		22.55	43.6	

¹ Data from weather reporting station at Baudette, Minnesota 1941-1970.

² Data from weather reporting station at Thorhult, Minnesota 1961-1975.

³ Trace.

Sources: U.S. Department of Commerce 1973.

State Climatology Office, University of Minnesota, St. Paul.

About 16 inches, or 72 percent of the annual precipitation, falls during May through September. Annual snowfall averages 43.6 inches. Greatest snow depths generally occur in January and February, averaging 12 to 15 inches (Table 1). Prevailing winds are from the northwest during winter, changing to the south and southwest during the spring and summer.

Geology. Intrusive Precambrian bedrock formations underlie the management area. Granites, gneisses, and older metavolcanic rocks, including Ely-Greenstone and Sudan-Iron formations, are the predominant bedrock types (Sims and Morey 1972). A major fault (Vermilion) extends northwestward across the management unit approximately through the boundary between Beltrami and Lake of the Woods Counties (Sims 1970).

The present soils and topographic features of the area are a result of three geological stages: (1) late Pleistocene glaciation, (2) glacial Lake Agassiz and, (3) postglaciation. Glacial ice sheets covered the area several times during the Pleistocene epoch, but present landforms and surface deposits are the result of the most recent (Wisconsin) glaciation, approximately 50,000-10,000 years ago. From 50-200 feet of unconsolidated glacial drift derived from limestone, dolomite, and shale of Manitoba was deposited over the bedrock surface (Heinselman 1963).

As the glacial ice sheets retreated late during the Wisconsin stage (approximately 12,000 years ago), melt-waters were impounded behind a major drainage divide crossing northern South Dakota and south-central Minnesota, forming glacial Lake Agassiz (Elson 1967). During its maximum extent, Lake Agassiz covered over 200,000 square miles in parts of North Dakota, South Dakota, Minnesota, Saskatchewan, Manitoba, and Ontario (Arndt 1977). Calcareous lacustrine clay, water-sorted sand and gravel, and lake-modified till were deposited over the area (Heinselman 1963). As new discharge outlets formed and the ice margin alternately retreated and advanced, the lake level fluctuated, creating a series of discontinuous sand and gravel beach ridges. The Red Lake WMA lies between two of the major beaches, the Herman and Campbell, and has presumably remained above lake level since approximately 11,500 years ago (Griffin 1977).

Final drainage of the lake occurred around 7,300 years ago, when the Hudson Bay outlet was exposed (Elson 1967). Remnants of Lake Agassiz within Minnesota include the Red Lakes in Beltrami County, Thief and Mud Lakes in Marshall County, and Rainy Lake and Lake of the Woods on the Canadian border (Wright 1972).

Postglacial geological changes have been minor compared to the drastic changes in landscape brought about by glaciation. The drainage of Lake Agassiz left the area with gently rolling topography, sloping generally northward at 2 to 10 feet per mile, interrupted by intermittent sand and gravel beach ridges (Heinselman 1963). In the 10,000 years since the last glaciation, erosion and deposition has had only a minor effect on the area's landscape.

Soils. Soil development in the Red Lake vicinity was influenced by parent materials, topography, climate, and vegetation. Underlying parent materials consist of unconsolidated lacustrine deposits of silts, clays, and sands plus lake-modified till. Highly organic peats (histosols) accumulated over mineral subsoils on the low-lying, relatively flat, and poorly drained glacial lake

bed areas. Mineral soils (podzols) developed on better drained sites, generally on remnant beach ridges and elevated sand and gravel "islands."

Peat deposition began approximately 3,000 to 4,000 years ago with the onset of a cooler and wetter climate, which favored the growth of reeds and sedges and inhibited plant decomposition (Griffin 1977). As peat accumulated, local drainage was altered enough to favor the radial expansion of the peat-forming environment, a process termed paludification (Minnesota DNR 1978a). About 3,000 years ago, accumulating peat deposits became increasingly isolated from groundwater influence. This favored the growth of sphagnum moss, which has since been an important component of peat deposition (Boelter and Verry 1977). Peat depths on the Red Lake WMA range from less than one foot near bog edges to a maximum of 16 feet, but average 6 to 12 feet (Soper 1919). Most peat belongs to the Waskish-Seelyeville-Cathro-Haug soil association (Table 2, Figure 3) and varies from brown, coarse, fibrous material to black, finely divided material (U.S. Department of Agriculture 1926, 1976). These organic soils are generally underlain by sands or sandy loams. Peat soils on the WMA are generally unsuitable for agriculture even after drainage because of high frost action, excess humus, high acidity, high water retention, and a high water table (U.S. Department of Agriculture 1976).

Mineral soils on the management unit (Table 2) are restricted to better drained sites (Figure 3) and belong to the Redby-Cormant-Hiwood and the Chilgren-Garnes soil associations (U.S. Department of Agriculture 1976). These soils were formed from lacustrine sands and calcareous glacial till under mixed coniferous-deciduous forests. The soil surface is characterized by a covering of leaf litter, mold, and humus underlain by an organic-mineral horizon of gray to brown sands or sandy loams. Subsoil layers typically consist of grayish-brown fine sands or dark brown sandy clay loams. Agricultural potential for these soils is low due to their low inherent fertility, forest cover, and low available water capacity (U.S. Department of Agriculture 1976).

Mineral Potential. The Minnesota DNR has rated the mineral potential for the area as high, based on a good understanding of local geology. Deposits of iron, nickel, copper, zinc, lead, gold, and silver may occur on the management area (David Meineke, Minnesota DNR, personal communication).

Mining companies have expressed interest in leases for exploration and possible mining on the state lands in northwestern Minnesota. The Division of Fish and Wildlife will not oppose mineral leases on the Red Lake WMA as long as the areas involved do not include sen-

Table 2. Major soil associations and approximate percentage of occurrence on the Red Lake WMA.

Association	Percent
Organic Soils (Histosols)	
Waskish	21
Seelyeville-Cathro-Haug-Markey	66
Total	87
Mineral Soils (Podzols)	
Redby-Cormant-Hiwood	10
Chilgren-Garnes-Roliss	3
Total	13

Source: U.S. Department of Agriculture 1976

RED LAKE WILDLIFE MANAGEMENT AREA SOILS

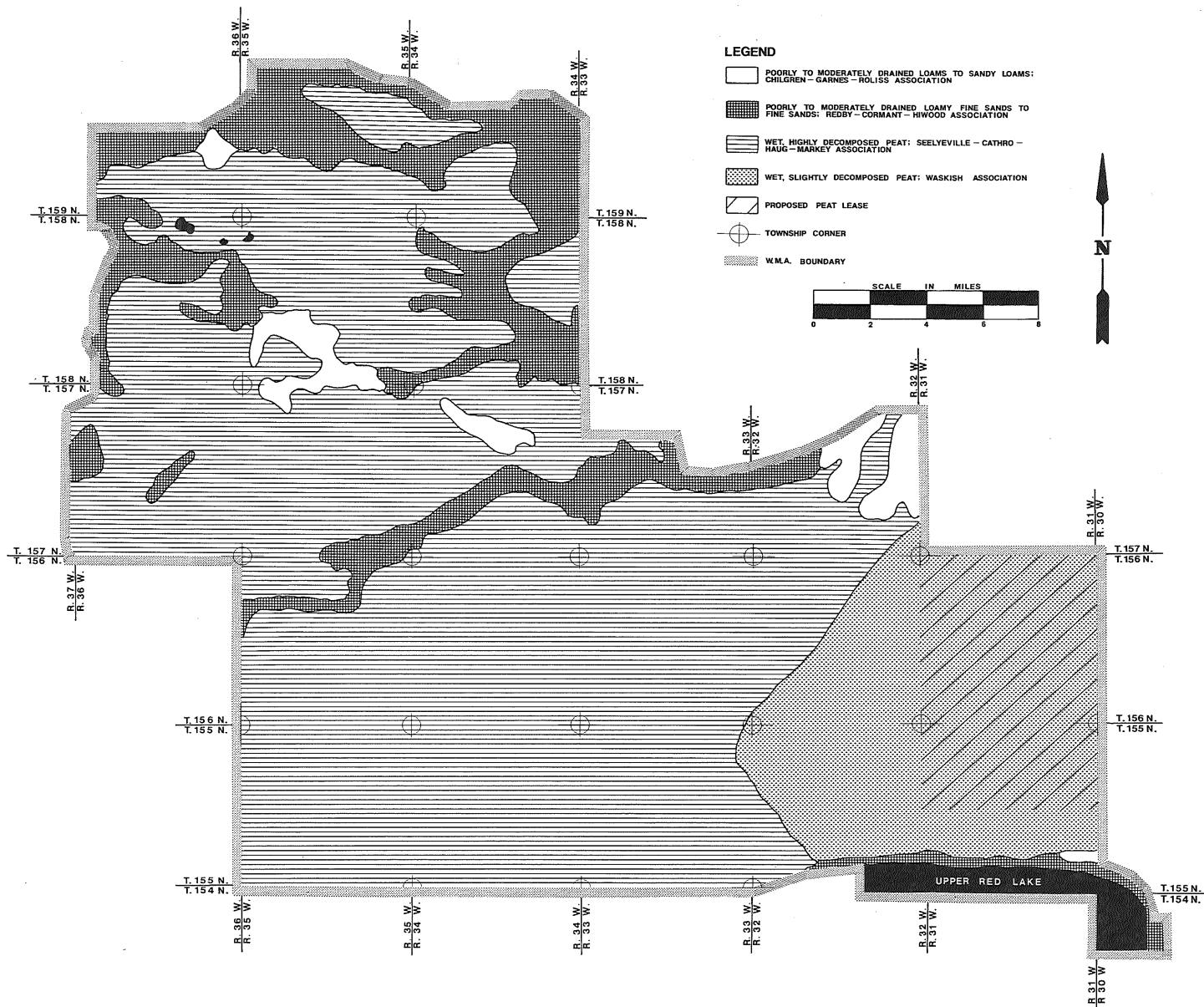


Figure 3

sitive wildlife areas such as sanctuaries, impoundments, and critical winter habitat. The division will require mitigation or the replacement of lands adversely altered by mining operations. The division will review leases on an individual basis for their potential impact on the natural resources of the proposed site and surrounding area. Proposals for mining operations are subject to state environmental impact statement requirements (Minnesota Statutes 116D.04, 1978), DNR water and mining permit procedures (Minnesota Statutes Chapter 105 and Section 93.481, 1978, respectively), and state reclamation policy (Minnesota Statutes, Section 93.44, 1978).

The potential for commercial peat development on the Red Lake WMA is high. Peat and peat products are in increasing demand for chemical and industrial uses, horticultural products, and alternative fuel sources. Extensive deposits of peat occur in both Beltrami and Lake of the Woods Counties (Table 3).

The Minnesota Gas Company has applied to the DNR for a lease to mine peat on about 200,000 acres of state-owned lands in Beltrami, Lake of the Woods, and Koochiching Counties, including about 34,500 acres of the Red Lake WMA (Figure 3). The largest deposit of high quality sphagnum moss peat in the state is also on the management area. It contains over 3,800 acres of commercial-grade sphagnum peat with total resources estimated at 700,000 to 900,000 tons dry weight (Farnham and Grubich 1966). The Division of Fish and Wildlife will require an assessment of potential environmental impacts before considering any lease for peat mining.

Underground Hydrology. Impermeable Precambrian bedrock forms the base of the groundwater reservoir. Except for possible deposits in bedrock fractures or joints, the primary source of groundwater is from porous sand and gravel aquifers buried in glacial till (Helgesen et al. 1975) or shallow aquifers within peat deposits (Walter Butler Co. 1978). Raised bog areas may contain aquifers perched above the water table.

The direction and volume of groundwater movement is not well known, but the general pattern of flow is from recharge areas in the higher sand and gravel beaches and islands to discharge areas in lowlands and streams (Helgesen et al. 1975). Irregularities in the bedrock surface alter the groundwater flow.

Annual groundwater recharge is primarily from precipitation and snow melt, and usually about equals losses. Approximately 74 percent (17 inches) of the annual precipitation is dissipated through evapotranspiration, mostly from lowland bog areas; 26

percent (six inches) is lost through runoff (Helgesen et al. 1975).

Well depths and water-yielding capabilities vary considerably depending on the type, capacity, and depth of the groundwater source. Yields adequate for domestic and livestock use, generally less than 15 gallons per minute, can be obtained from wells less than 100 feet deep on most upland sites. In the bog area, the water table generally remains at or near the surface.

Groundwater quality in the area varies widely, depending on the distance of movement, physical and chemical characteristics of the water-bearing materials, and the contact time with these materials. Most groundwater is of the calcium-magnesium-bicarbonate type, high in total hardness. Levels of manganese, iron, nitrites, nitrates, and dissolved solids and sulfates may exceed Minnesota Pollution Control Agency (1972) limits for domestic consumption (Table 4). Groundwater in the recharge areas is generally softer and lower in dissolved solids, but becomes increasingly mineralized as it flows toward discharge areas. Waters in peat bog aquifers are generally lower in dissolved minerals (especially calcium) and higher in acidity than waters in glacial deposits (Table 4).

More extensive studies of peatland hydrology in the Red Lake area are currently being undertaken by the Minnesota DNR, Division of Minerals.

Surface Hydrology. Three watersheds drain the Red Lake WMA. Approximately 50 percent of the management area is within the 2,900 square mile Lake of the Woods watershed (Helgesen et al. 1975), 40 percent in the 5,990 square mile Red Lake River watershed (Bidwell et al. 1970), and 10 percent in the 1,150 square mile Roseau River watershed (Winter et al. 1967). Drainage is generally northward towards the Rainy River, Lake of the Woods, and the Roseau River. The southern portion of the "big bog" area drains into Upper Red Lake.

The Rapid River and the North Branch of the Roseau River originate on the area. The Tamarac River flows into Upper Red Lake at Waskish. Annual base flows for rivers and streams on the management area are highly variable, depending on precipitation, rapidity of snow-melt, runoff conditions, and the amount of groundwater discharge. Base flow for the Rapid River and its tributary streams in the unit during summer ranges from less than 0.4 to more than 25 cubic feet per second (Helgesen et al. 1975).

Surface waters are derived primarily from runoff and groundwater discharge to stream channels. A

Table 3. Estimated acreage of potential peat resources in Lake of the Woods and Beltrami Counties.

Peat Type	Lake of the Woods County	Beltrami County	Total Peat Types	Percent of Total
Highest Energy Potential	201,400	263,200	464,600	45
Moderate Energy Potential	197,320	294,280	491,600	48
Agricultural/Horticultural Value	22,880	42,600	65,480	7
Total	421,600	600,080	1,021,680	100

Source: Minnesota State Planning Agency, Minnesota Land Management Information System 1978.

Table 4. Chemistry of samples of groundwater from glacial drift and peat bog aquifers near the Red Lake WMA.

Parameters ¹	Glacial Drift			Peat Bog Median	Raised Peat Bog Median	Consumption Limits ²
	Maximum	Median	Minimum			
Silica	26	19	8.0	4.9	2.7	
Iron	2.1	0.2	T ³	0.98	1.35	0.03
Manganese	0.47	0.07	0	0.08	0.06	0.05
Calcium	120	62	30	16.6	2.4	
Magnesium	56	28	9.4	2.88	0.97	
Sodium	120	38	1.9	2.0	0.6	
Potassium	14	4.2	0.3	1.1	1.3	
Bicarbonates	539	357	130	—	—	
Sulfate	290	23	3.5	6.0	4.6	250
Chloride	27	6.0	1.0	0.4	0.7	250
Fluoride	1.5	0.2	0	—	—	1.5
Nitrate and Nitrite	26	0.06	0	0.1	0.2	10
Boron	0.45	0.13	0.01	—	—	
Dissolved Solids	764	440	160	—	—	500
Hardness as CaCO ₃	510	270	110	54.2	48.2	
pH	8.0	7.7	7.2	6.5	3.6	

¹ Measurements in parts per million except pH.

² Recommended domestic consumption limits (Minnesota Pollution Control Agency 1972).

³ Trace

Sources: Helgesen et al. 1975, Boelter and Verry 1976.

network of abandoned drainage ditches may contribute to streamflow, but most ditches are obstructed with sediments and vegetation or dammed by beavers.

Other than the 118,000-acre Upper Red Lake bordering the management area to the south, the only natural lakes of significant size on the unit are Mulligan, Roseau, and Lost Lakes (Figure 4, page 23). Mulligan Lake covers about 87 acres; average depth is three feet. The Roseau River flows through the lake at approximately 0.5 cubic feet per second (Minnesota DNR unpublished lake survey 1952). Roseau and Lost Lakes, located upstream from Mulligan Lake, cover about 31 and 59 acres and form the headwaters of the North Branch of the Roseau River.

Three impoundments, totaling 700 acres, have been developed on the management area (Table 5). Dikes and dams constructed across the South and North Branches of the Rapid River and the North Branch of the Roseau River form the Shilling, Spina, and Roseau impoundments, respectively. Nine other impoundments totaling approximately 2,100 acres have been developed on Beltrami Island lease lands (L.U.P.) outside the WMA boundaries and are maintained by Red Lake WMA personnel (Table 5). Beaver dams also impound waters on rivers, streams, and drainage ditches throughout the area. Impoundment acreages fluctuate depending on precipitation levels and beaver numbers and activity.

Water samples taken from the Rapid and Roseau Rivers and Upper Red Lake in July and October, 1978, were analyzed at the DNR, Section of Ecological Services' laboratory at the Carlos Avery WMA. Water

quality measurements for these samples are presented in Table 6. Nutrient levels were similar for the four areas sampled. Total Kjeldahl nitrogen (0.96 to 1.72 ppm) and phosphorous (0.05 to 0.103 ppm) concentrations were high, suggesting high fertility. Water in all four areas was hard, which often indicates high productivity. Sulfate and chloride concentrations were within normal ranges for Minnesota lakes and streams (Howe and Carlson 1969).

BIOTIC RESOURCES

Vegetation. Vegetation is continuously changing with short-term disturbance, such as fires or storms, and long-term events, such as climatic changes or soil development. The process of change from one vegetation type to another is succession.

Postglacial plant succession in northwest Minnesota was reconstructed by Griffin (1977) from analysis of pollen and plant fossils in peat samples. Approximately 11,000 years ago, spruce forests developed along the receding shoreline of glacial Lake Agassiz. By 9,000 years ago, a boreal conifer forest covered most of the former lake bed. As the climate turned warmer and drier between 8,000 and 4,000 years ago, prairie and oak savanna dominated the lake plain; marshes occupied the poorly drained sites. Vegetation similar to the present type developed about 4,000 years ago with the onset of wetter and cooler conditions. Reed-sedge communities dominated the lowlands; black spruce, tamarack, white cedar, and sphagnum moss became established on portions of the bog. Aspen

Table 5. Impoundments under Red Lake WMA management.

Name	Open Water (Acres)	Approximate Dike Length (Feet)	Control Structure		Date Constructed	Township	Range	Section
			Type	Condition				
Spina ¹	100	200	One bay wooden stoplog	Not functional	U ²	158	34	3,9,10
Shilling ^{1,4}	400	1,500	Two bay wooden stoplog	Not functional	U	157	35	33,34
Roseau ¹	200	1,700	Two bay wooden stoplog	Not functional	1933	159	36	32
Keller	150	500	Drop inlet wooden stoplog	Excellent	1977	160	34	32
Brown's Lake	450	11,880	Drop inlet wooden stoplog	Excellent	1977	159	35	2,3,10,11
Bednar	240	400	Drop inlet wooden stoplog	Excellent	1977	161	35	33,34
No. 1	300	400	Two bay wooden stoplog	Not functional	1958	150	36	7,8
No. 2	U	600	Two bay wooden stoplog	Not functional	U	159	37	11
No. 3	300	2,000	Two bay wooden stoplog	Not functional	1958	159	37	36
No. 4	400	1,300	Two bay wooden stoplog	Not functional	U	159	37	34
Manweiler ⁴	100	300	One bay wooden stoplog	Not functional	U	160	34	32
Winner	200	900	Two bay wooden stoplog	Not functional	U	159	37	34

¹ Within the Red Lake WMA boundary.

² Unknown.

³ Control structure replaced in 1962.

⁴ Portions lie on Red Lake Indian lands.

Table 6. Chemistry of surface water samples from the Red Lake WMA.

Parameters ¹	Rapid River South Branch		Rapid River North Branch		Roseau River North Branch		Upper Red Lake at Waskish	
	7/78	10/78	7/78	10/78	7/78	10/78	7/78	10/78
Date of sample	7/78	10/78	7/78	10/78	7/78	10/78	7/78	10/78
Sulfate	< 1	1	< 1	1	< 1	1	< 1	1
Total Phosphorous	< 0.050	0.077	< 0.050	0.063	< 0.050	0.067	< 0.050	0.103
Soluble Phosphorous	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.020	0.015	< 0.016
Chloride	2.3	2.3	2.3	2.7	2.3	3.1	3.5	4.2
Nitrogen Ammonia	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	0.027	< 0.025	< 0.025
Nitrite	0.001	0.002	< 0.001	< 0.001	< 0.001	0.001	0.001	0.003
Nitrate	0.054	0.063	0.050	0.059	0.068	0.084	< 0.050	0.072
Total Kjeldahl	0.98	1.72	1.06	1.03	1.05	0.96	1.60	1.40
Total Alkalinity ²	100.0	108.0	128.0	132.0	95.0	112.0	80.0	88.0
pH	7.35	7.55	7.60	7.50	7.00	7.60	7.40	7.55
Conductivity ³	160.0	200.0	210.0	210.0	160.0	185.0	139.0	145.0

¹ Measurements in parts per million (ppm) except pH and conductivity.

² Expressed as ppm of calcium carbonate (CaCO₃).

³ In micro-mhos.

parklands covered the surrounding uplands. These stands developed into mixed coniferous-deciduous forests with the reinvasion of white pine, red pine, and jack pine.

The presettlement vegetation of the area was altered by logging, land clearing, drainage, and fires early in the 1900's. Most of the mature pine was harvested for sawtimber. Other timber stands were logged for posts, ties, or pulpwood. Small tracts of land were cleared for farming. The extensive drainage projects in the peatlands proved unsuccessful, and little land was cultivated. Ditching and road building did, however, alter the natural water flow, leading to flooding upstream, drying out downstream, and consequent changes in the original vegetation (Gorham et al. 1978). Fires originating from logging, land clearing, and drainage were prevalent throughout the region. The last major fire burned over 900,000 acres in the Red Lake area in 1931. Major disturbances lessened as settlement pressure decreased and existing settlers abandoned their homesteads during the 1930's. Many of the ditches were dammed by beaver and the Department of Conservation (DNR), raising the water table and greatly reducing the fire hazard.

Present vegetation communities on the Red Lake WMA were mapped from black-and-white, aerial, infrared photographs taken in 1975 and 1976. Classification was aided by forestry inventory records prepared by the Minnesota DNR, Division of Forestry in 1958-63. Vegetation types were classified according to the dominant overstory species. In cases where more than one species predominates, the two major species are listed. For example, S/T designates a stand dominated by black spruce with tamarack as a subdominant. Wetlands were classified using criteria modified from Stewart and Kantrud (1971) and Cowardin and Johnson (1973). Species composition and dominance in the various communities were determined from previous vegetation studies and by ground-checking. The smallest mapping unit was about 15 acres. Seven upland, five lowland, and three wetland vegetational types were mapped (Appendix K, Figure 1 A,B,C). Successional trends were inferred from published sources. Names of plants follow Gleason and Cronquist (1963), and a complete list of plant species mentioned in the text is found in Appendix C. Acreages of each type in the WMA are listed in Appendix D.

LOWLAND CONIFER. The lowland conifer type occupies poorly drained peat soils which are acidic and low in oxygen. Black spruce, tamarack, and white cedar are the dominant overstory species and occur as either pure stands or mixed associations. Densities vary from savannah-like muskegs with 5-25 percent cover to dense forests with 70-95 percent cover.

The distribution, species composition, and productivity of the various associations depend on the topography, water movement, and water chemistry of the site. Stands dominated by white cedar are generally restricted to the peatland margins, downslope from mineral soils; black spruce and tamarack may be subdominants. This type often merges with mixed coniferous-deciduous forests on adjacent mineral soils and black spruce-tamarack stands toward the bog interior (Heinselman 1970).

The most extensive stands of lowland conifers consist of black spruce and tamarack, which occur in nearly all physiographic locations of the bog except in major watertracks (Heinselman 1970). Growth rates of black spruce and tamarack vary depending on site characteristics. On poorer sites, tree growth is stagnant, and savannah-like stands of stunted black spruce and tamarack less than six feet

high and 80 years old or more are common (Curtis 1959).

A series of black spruce and tamarack-dominated ridges and islands occur in an expanse of treeless bog and fen. The most unique of these features are the teardrop-shaped islands, which vary in size from small stands to large bands several miles long. The long axes of these islands parallel the direction of water movement, with a tapering tail of shrubs, chiefly bog birch and leatherleaf, pointing downstream (Heinselman 1963).

Understory species composition in the various lowland conifer types is generally similar. Common species include speckled alder, bog birch, willow, and a variety of ericaceous shrubs such as labrador tea, leatherleaf, bog-rosemary, bog-laurel, wild cranberry, and blueberry. Mosses, especially sphagnum, blanket most of the forest floor, while feathermosses generally dominate under the densest canopies.

The lowland conifer type is stable, and successional developments are extremely slow. In the absence of fire and water level changes, white cedar will eventually invade many spruce-tamarack stands. Once established, the dense cedar canopy prevents the regeneration of the shade-intolerant spruce and tamarack. Further succession is dependent on gradual changes in the peat leading to drier conditions and allowing deciduous trees, especially black ash, to become established (Curtis 1959). Fire is important in setting back succession, as both black spruce and tamarack are highly fire-susceptible.

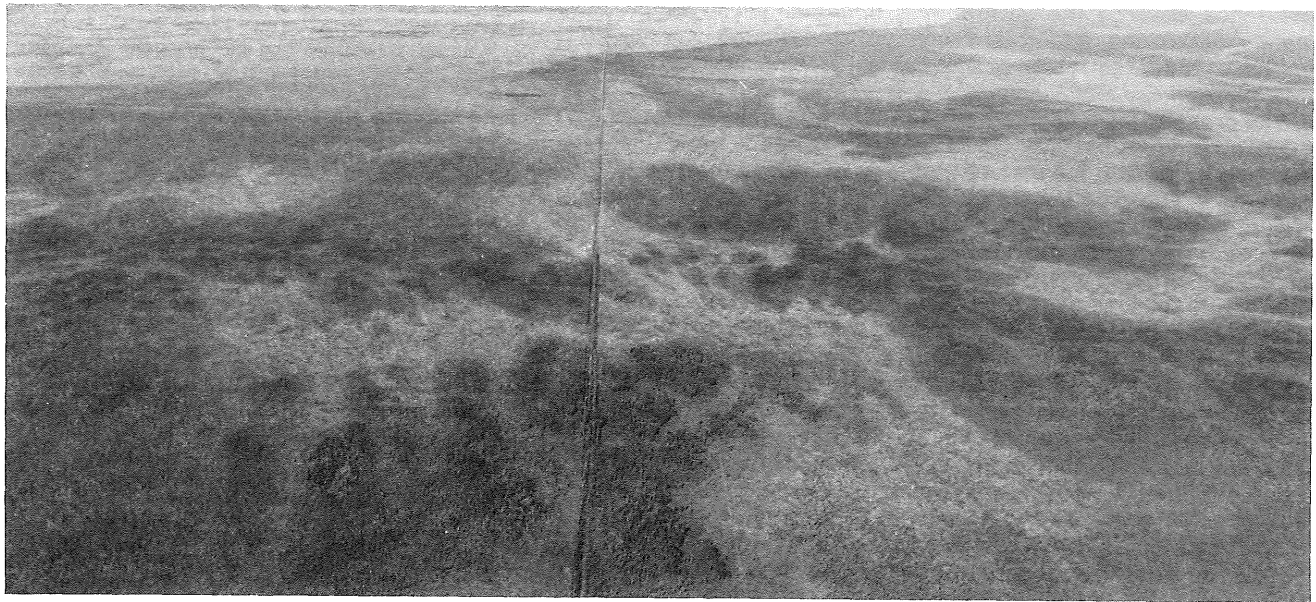
LOWLAND BRUSH. The lowland brush type is a wet-ground, tall shrub community dominated by alder or willow, often reaching heights of 12 to 18 feet. Bog birch and red-osier dogwood may also be present. This type ordinarily occurs on low-acid muck soils along peatland margins. Prevalent ground layer species include fireweed, Joe-Pye weed, asters, water-hemlock, bedstraw, sedges, loosestrife, marsh cinquefoil, and chickweed (Janssen 1967).

This vegetational type is an intermediary successional stage between open fen and lowland conifer or hardwoods. In the absence of major disturbances this type may persist for long periods. White cedar and alder have similar optimum site requirements, and cedar may very slowly invade alder communities. (Curtis 1959).

OPEN BOG/FEN. This type occupies wet, peat soils and consists of two distinct communities, bog and fen, depending on the dominant plant cover. Heinselman (1963) defined a bog as a peat-covered area dominated by mosses, especially sphagnum, in which the upper peat layers and bog waters are strongly acidic and deficient in mineral nutrients. Low-growing ericaceous shrubs, including bog-rosemary, bog-laurel, leatherleaf, and cranberry, may cover much of the bog surface; scattered tussocks of sedges are common (Gorham et al. 1978). Bog birch and scattered, stunted black spruce or tamarack may also be present.

Fens typically occupy peat areas lower in acidity and higher in nutrients. Sedges, especially *Carex lasiocarpa*, *C. ilmosa*, and *C. livida*, are the dominant vegetation, but cotton grass, wool grass, and beak-rush are common. Sphagnum moss is rare or absent. Scattered tamarack and low shrubs may also occur (Hoffstetter 1976).

The bog/fen complex exhibits several vegetative patterns. The most distinctive consists of a series of almost parallel ridges, 6 to 12 inches high and frequently discontinuous, lying transverse to the direction of water movement. Areas with ridges dominated by sphagnum moss and ericaceous shrubs are classified as strong bogs or *strangmoors* (Heinselman 1963). In the Red Lake peatland, however, these ridges tend to be dominated by sedges and form patterned fens or ribbed fens. Bog birch, leatherleaf, or bog-rosemary may also be present. The furrows between the ridges are normally submerged and support such species as beak-rush, arrow-grass, bladderwort, buckbean, marsh cinquefoil, pitcher plant, sundew, and sedges (Griffin 1976).



The open bog/fen community, viewed from the air, shows unusual vegetative patterns.

Another peatland feature, raised bogs, consist of elevated, convex domes or elongated ridges formed by sphagnum peat accumulation. Stands of black spruce or tamarack, often with a scattering of low shrub species, may develop at or near the crest of a raised bog.

In the absence of major disturbances, the bog/fen complex is very stable. Invasion by woody species such as black spruce, tamarack, willow, or alder is very slow as the physical-chemical conditions created by the bog/fen type are generally not conducive to woody growth.

Sixteen vascular plants considered to be rare in Minnesota were found in the Red Lake peatland (Table 7). Nine of these plants are protected under the Minnesota Wild Flower Conservation Law (Minnesota Statutes, Sec. 17.23, 1978). Five more are listed by Morley (1972) as rare plants of Minnesota. Two of these plants are at or near the edge of their ranges and have not been found elsewhere in Minnesota (Gorham et al. 1978).

BOTTOMLAND HARDWOODS. The bottomland hardwood type is confined to moist, fertile, mineral soils along stream margins. American elm, basswood, green ash, black ash, and balsam poplar

(balm of Gilead) are the dominant trees. Prominent understory vegetation includes beaked hazel, redosier dogwood, round-leaved dogwood, chokecherry, raspberry, gooseberry, and several vines including wild hops, hog peanut, and wild cucumber. Ground-cover is dominated by woodnettle, aster, and carrion-flower.

The major dominants of this type are capable of self-regeneration and forming a semi-stable community (Curtis 1959). Invasion by more mesic species is limited by the unfavorable soil moisture conditions and regular floods.

ASPEN. This type has more than 50 percent of the canopy in aspen. Aspen stands occupy a wide range of forest sites but occur most frequently on dry to moist uplands of moderate nutrients (Hansen and Kurmis 1972). Stand distribution generally reflects past disturbances such as fire, logging, or wind damage (Hansen et al. 1974). Trembling aspen is the primary aspen species, but balsam poplar also occurs and may dominate stands on stream margins, ditch spoil banks, and other wet areas. On dryer sites, white pine, red pine, jack pine, and paper birch are commonly associated with aspen. White spruce, black spruce, balsam fir, black ash, and willows of-

Table 7. Rare plants found in the Red Lake peatlands.

Family	Common Name	Scientific Name
Sedge	—	<i>Carex exilis</i> ¹
	Twig rush	<i>Caldium mariscoides</i>
	Beak-rush	<i>Rhynchospora fusca</i>
Sundew	—	<i>Drosera anglica</i> ¹
	—	<i>Drosera linearis</i>
Gentian	Gentian	<i>Gentiana rubricaulis</i> ²
Rush	—	<i>Juncus stygius</i>
Yellow-eyed grass	—	<i>Xyris montana</i>
Orchid	Dragon's mouth orchid	<i>Arethusa bulbosa</i> ²
	Moccasin flower	<i>Cypripedium acaule</i> ²
	Ragged fringed orchid	<i>Habenaria lacera</i> ²
	Yellow twayblade	<i>Liparis Loeselii</i> ²
	Heartleaf twayblade	<i>Listeria cordata</i> ²
	Adder's mouth orchid	<i>Malaxis unifolia</i> ²
	Snake-mouth orchid	<i>Pogonia ophioglossoides</i> ²
		<i>forma albiflora</i> ²

¹ Collected in Minnesota only on the Red Lake peatlands.

² Protected under Minnesota Statute, Sec. 17.23, 1978.

Source: Gorham et al. 1978.

ten occur as subdominants on wetter sites. Prominent understory species include juneberry, beaked hazel, bush honeysuckle, chokecherry, red-osier dogwood, round-leaved dogwood, and wild rose. Bracken fern, wild sarsaparilla, dogbane, meadow rue, fireweed, aster, and wild pea are common ground layer species.

Aspen is a pioneer species which reproduces vigorously following disturbances. In the absence of major disturbances, however, the short-lived aspen stands begin to deteriorate after 60 to 80 years. As the forest canopy opens, the understory shrub component, especially beaked hazel, greatly increases. In mixed stands, the shade-intolerant aspen eventually gives way to longer-lived, more tolerant tree species such as black ash, white pine, red pine, spruce, and balsam fir (Curtis 1959).

MIXED DECIDUOUS/CONIFEROUS. This upland type is a mixture of trembling aspen, paper birch, red pine, white pine, jack pine, white spruce, and balsam fir. Aspen is generally the most abundant overstory species, but in certain stands the frequency of paper birch, red pine, and jack pine may approach or exceed aspen. Understory shrub and ground cover species composition is similar to the aspen type.

Without disturbance, succession will favor the replacement of the shade-intolerant, short-lived species such as aspen and birch by upland conifer species with greater longevity and shade-tolerance such as red pine, white pine, spruce, and balsam fir. Mature forests, or climax communities, will be dominated by pines on drier, sandy soils; white spruce and balsam fir will dominate sites with moister, heavier soils.

UPLAND CONIFER. The upland conifer type has more than 50 percent conifer cover and is generally confined to sandy, well-drained mineral soils. Jack pine, red pine, white pine, and white spruce are the dominant overstory species, occurring as pure stands or mixed associations. Most stands resulted from natural regeneration, but since 1938 many cutover upland areas have been planted with red pine, white pine, jack pine, and white spruce. Due to the dense overstory canopy, understory coverage is sparse. Common understory shrubs include beaked hazel, juneberry, chokecherry, willow, wild rose, bush honeysuckle, and raspberry. Bracken fern, dogbane, and aster are prevalent ground layer species.

The upland conifer type, characterized by long-lived species, is relatively stable. Successional trends are similar to those in the mixed deciduous/coniferous type. Jack pine stands will be maintained on the driest sites, especially if subjected to periodic fires (Curtis 1959).

STAGNANT TIMBER. Stagnant stands of aspen, tamarack, black spruce, and white cedar occur where physical-chemical conditions hinder normal tree growth. These sites are generally excessively wet and low in nutrients.

LOGGED. This type includes logged sites still in the early stages of regeneration, but does not include cutover areas planted to conifers. Areas where regeneration is more advanced were included in the appropriate type according to the dominant regenerating species. Natural species regeneration following logging is dependent on the site characteristics, prelogging vegetation, and postlogging site treatments.

EXPERIMENTAL BURN. This two square mile area is part of a study to evaluate prescribed burning as a technique to create brushland habitat for sharp-tailed grouse. Burning transformed a predominately aspen forest to relative open brushland with only scattered aspen clones. Dominant regenerating species include aspen, willow, chokecherry, and beaked hazel. Bracken fern, asters, fireweed, goldenrod, and grasses are common ground layer species. Numerous, fire-killed trees remain standing. The area was last burned in the spring of 1975.

OLD FIELDS. Old fields include abandoned cropland and remnant openings created by settlement. These areas are generally dominated by grasses such as brome grass and quack grass. They



Aspen, one of the most important components of forest wildlife habitat, resprouts vigorously after clear-cutting.

will eventually be invaded by woody species such as aspen, willow, and raspberry, unless they are periodically mowed, burned, or cultivated.

AGRICULTURAL FIELDS. This type includes active cropland, fallow legume fields, and wild rice paddies. A total of 23 acres of small grains in four fields were planted by WMA personnel in 1979 as wildlife food plots. In addition, 111 acres of small grains and grassy nesting cover were planted in the Brown's Lake Waterfowl Refuge. Six private wild rice paddies, totaling 450 acres, are cultivated on the north shore of Upper Red Lake.

SHALLOW MARSH. This wetland type retains surface water for an extended period in spring and early summer. An open-water zone may occur during high water. Soils are sedge peats and mucks, and the water table remains at or near the surface throughout the year. Characteristic vegetation includes cattail, sedges, blue-joint, common reed, and smartweed.

As the marsh basin fills, a hydric shrub community of alders or willows will gradually dominate. Tamarack, black spruce, or white cedar will eventually become established. Increasing water levels will encourage deep marshes.

DEEP MARSH. Community composition of this type is similar to the shallow marsh except that the water is deeper and more permanent. Water depths of five feet or more are common in spring and surface waters are retained during all but the driest years. An open-water zone usually occupies deeper areas. Emergent plant species include cattail, common reed, wild rice, and bulrushes. The increased stability of water levels allows a more diverse emergent and submergent plant community to develop than occurs in shallow marshes. Typical submerged aquatics include bladderwort, yellow pond lily, water milfoil, coontail, and pondweed. Successional trends follow a pattern similar to shallow marshes.

FLOATING BOG. This type consists of cattails and sedges occurring on a dense floating mat of interlaced roots and rhizomes surrounding open water. With continued growth of the surface layers, the mat gradually thickens and expands. Willow, alder, tamarack, and black spruce gradually invade the thicker, semisolid portions of the mat. Over a long time period, the mat may cover the open water and fill the basin, creating a bog or fen.

OPEN WATER. Permanent open water over five feet deep occurs in ponds, lakes, and impoundments that maintain fairly stable water levels. Emergent and submergent vegetation is limited by water depth and turbidity and occurs near shore and in shallows.

Birds. A list of bird species likely to occur on the

Red Lake WMA was compiled by comparing lists furnished by Robert Janssen of the Minnesota Ornithologists' Union, Dr. Dwain Warner of the University of Minnesota, and WMA personnel with species lists and accounts available in the literature. Many species, especially migrants, may be uncommon or rare because the amount, quality, or distribution of preferred habitat on the area may be deficient, or because the unit lies near the normal limit of a species' range.

Of the 188 species that may occur on the management area (Table 8), 146 are permanent or summer residents and commonly nest on the area. Fall and spring migrants account for 29 species and 13 occur only as winter residents.

Thirty-two bird species are protected under Minnesota Statutes, Sec. 100.27, 1978, and may be taken only during authorized hunting seasons. All other species, except house sparrows, starlings, and rock doves, are protected by state or federal laws and have no open season in Minnesota. Among the game birds found on the management area are 23 duck species. Thirteen of these species nest on the area, but populations and production are low because suitable wetland habitat is limited. Mallard, American wigeon, wood duck, and ring-necked duck are the most common migrants and summer resident waterfowl. Other resident game birds associated with wetlands include the American coot, sora, Virginia rail, and the common snipe.



The spruce grouse is a game bird species which is found in conifer habitat on the Red Lake WMA.

Table 8. Bird species and their relative abundance in the Red Lake WMA vicinity.

Common Name	Permanent Resident	Migrant	Summer Resident	Winter Resident	Common Name	Permanent Resident	Migrant	Summer Resident	Winter Resident
Common loon		C	C		*Sora		U	U	
Eared grebe		R			Yellow rail		R		
Western grebe		R	R		*American coot		A	A	
Pied-billed grebe		A	A		Killdeer		C	C	
White pelican	R				*American woodcock		C	C	
Great blue heron		C	C		*Common snipe		C	C	
American bittern	U	U			Upland sandpiper		U	U	
Whistling swan ¹		U			Spotted sandpiper		U	U	
*Canada goose		A	A		Solitary sandpiper		U		
*White-fronted goose	R/VR				Black tern		R		
*Snow goose	A				Mourning dove ¹		C	C	
*Mallard		A	A		Black-billed cuckoo		U	U	
*Black duck		C	C		Great-horned owl	U			
*Gadwall		C			Snowy Owl		U		V
*Pintail		U/C	U/C		Hawk owl		R		R
*Green-winged teal		C	C		Barred owl	U			
*Blue-winged teal		C	C		Great gray owl		R		R
*American wigeon		A	A		Long-eared owl		U	U	
*Northern shoveler		A	C		Saw-whet owl		U	U	
*Wood duck		A	A		Whip-poor-will		U	U	
*Redhead		U/C	U/C		Common nighthawk		C	C	
*Ring-necked duck		A	A		Chimney swift		C	C	
*Canvasback		A			Ruby-throated hummingbird		U	U	
*Greater scaup		U			Belted kingfisher		R	U	
*Lesser scaup		C			Common flicker		U	U	
*Common goldeneye		U	U		Pileated woodpecker	U			
*Bufflehead		U/C			Red-headed woodpecker		U	U	
*White-winged scoter		VR/R			Yellow-bellied sapsucker		U	U	
*Ruddy duck		R			Hairy woodpecker	U			
*Hooded merganser		A	A		Downy woodpecker	U			
*Common merganser		C			Black-backed 3-toed woodpecker	R			
Turkey vulture		U	U		Eastern kingbird		R	R	
Goshawk		U		U	Great crested flycatcher		U	U	
Sharp-shinned hawk		U/C	U/C		Eastern phoebe		R	R	
Cooper's hawk		R	R		Yellow-bellied flycatcher		C	C	
Red-tailed hawk		C	C		Alder flycatcher		A	A	
Broad-winged hawk		C	C		Least flycatcher		A	A	
Rough-legged hawk		U		U	Eastern wood pewee		C	C	
Golden eagle		R			Olive-sided flycatcher		U	U	
Bald eagle		U	U		Tree swallow		C	C	
Osprey		R	R		Barn swallow		R	R	
Marsh hawk		R	R		Cliff swallow		R	R	
Peregrine falcon		VR			Gray jay	R			
Merlin		R	R						
American kestrel		R	R						
*Spruce grouse	C								
*Ruffed grouse	C								
*Sharp-tailed grouse	C								
*Sandhill crane ¹		R	R						
*Virginia rail		U	U						

Table 8. (continued)

Common Name	Permanent Resident	Migrant	Summer Resident	Winter Resident	Common Name	Permanent Resident	Migrant	Summer Resident	Winter Resident
Blue jay	C				Pine warbler		R	R	
Black-billed magpie		U		U	Palm warbler		C	C	
Common raven	U				Ovenbird		A	A	
Common crow		C	C		Northern waterthrush		R	R	
Black-capped chickadee	C				Connecticut warbler		A	A	
Boreal chickadee	U				Mourning warbler		U	U	
White-breasted nuthatch	R				Common yellowthroat		A	A	
Red-breasted nuthatch	R				Wilson's warbler		A	A	
Brown creeper		U	U		Canada warbler		R	R	
House wren		U	U		American redstart	C			
Winter wren		U	U		House sparrow		A	A	
Short-billed marsh wren		C	C		Bobolink		C	C	
Gray catbird		U	U		Western meadowlark				
Brown thrasher		C	C		Yellow-headed blackbird		R	R	
American robin		C	C		Red-winged blackbird		C	C	
Wood thrush		R	R		Northern oriole		R	R	
Hermit thrush		C	C		Brewer's blackbird		A	A	
Swainson's thrush		U	U		Rusty blackbird		R	R	
Gray-cheeked thrush		U	U		Common grackle		C	C	
Veery		A	A		Brown-headed cowbird		U	U	
Eastern bluebird		U	U		Scarlet tanager		U	U	
Golden-crowned kinglet		C	C		Rose-breasted grosbeak		C	C	
Ruby-crowned kinglet		U	U		Indigo bunting		R	R	C
Cedar waxwing		U	U		Evening grosbeak		U	U	
Northern shrike		U	U	U	Purple finch				C
Starling	A				Pine grosbeak				U
Yellow-throated vireo		R	R		Hoary redpoll				C
Solitary vireo		U	U		Common redpoll	V			
Red-eyed vireo		A	A		Pine siskin		R	R	
Philadelphia vireo		U	U		American goldfinch	V			
Warbling vireo		R	R		Red crossbill	V			
Black-and-white warbler		C	C		White-winged crossbill		U	U	
Golden-winged warbler		U	U		Rufous-sided Towhee		A	A	
Tennessee warbler		R	R		Savannah sparrow		A	A	
Orange-crowned warbler		R	R		LeConte's sparrow				
Nashville warbler		A	A		Sharp-tailed sparrow		R	R	
Northern parula		U	U		Dark-eyed junco		C	C	
Yellow warbler		C	C		Tree sparrow		C	C	
Magnolia warbler		U	U		Chipping sparrow		A	A	
Cape May warbler		R	R		Clay-colored sparrow				
Black-throated blue warbler		R	R		Harris' sparrow		C	C	
Yellow-rumped warbler		C	C		White-crowned sparrow		C	C	
Black-throated green warbler		C	C		White-throated sparrow		C	C	
Blackburnian warbler		C	C		Fox sparrow		U	U	
Chestnut-sided warbler		C	C		Lincoln's sparrow		C	C	
Bay-breasted warbler		R	R		Swamp sparrow		A	A	
Blackpoll warbler		R	R		Song sparrow		C	C	
					Snow bunting				C

* Species with Minnesota hunting seasons.

† Protected in Minnesota but hunted in other states.

A = abundant, C = common, U = uncommon, R = rare, VR = very rare, V = variable, may be locally common some years and absent in others.

Canada geese were introduced by the Division of Fish and Wildlife in an attempt to establish a resident flock and attract migrating geese. Goslings from the Carlos Avery Game Farm were received in two stages: 80 in 1970 and 71 in 1974. As the goslings reached fledging age, the 1970 group was released into an open-topped enclosure. The primary wing feathers on part of the group were clipped, but the majority was allowed to fly free. All remaining birds from the 1970 group were allowed to fly free in 1972. The 1974 group has been wing-clipped annually and kept in the enclosure. In 1978, four breeding pairs were released on the Brown's Lake area. Free flying geese concentrate on the enclosure area before migration.

Canada geese have apparently dispersed and begun to breed in the Red Lake WMA - Beltrami Island State Forest area. The total population has not been estimated, but up to 115 free-flying geese were present in the enclosure in the fall of 1978. No estimates of reproduction have been made; however, 18 goslings were fledged on Brown's Lake in 1978.

Four species of upland game birds occur on the management area. Ruffed, spruce, and sharp-tailed grouse are permanent residents, while the woodcock is a summer resident. The ruffed grouse is the most heavily hunted game bird. Each spring, ruffed grouse drumming is recorded along four established routes to provide an index to population levels (Table 9). Grouse numbers on the management area have generally been above the northwestern Minnesota average. Sharp-tailed grouse densities in the open bog were estimated to be over 4.7 calling males per 100 acres (Warner and Doehlert 1978). Singing male woodcock counts suggest that the population on the unit has remained relatively stable since 1969.

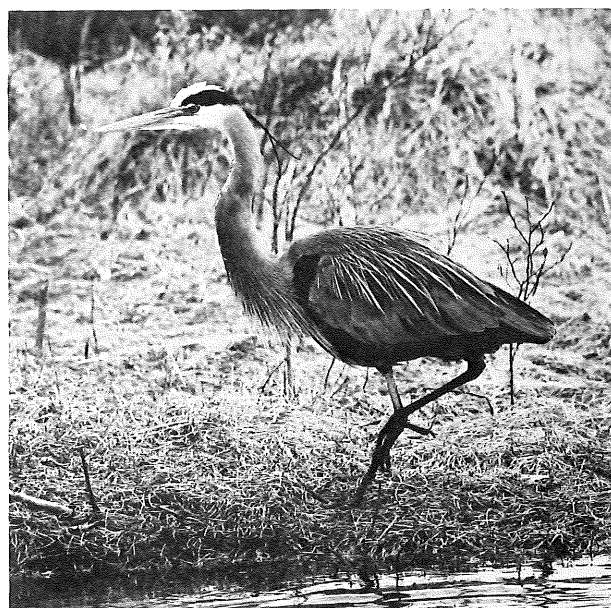
The diverse habitats on the management area attract a variety of nongame birds. Avian abundance, distribution, and species diversity in peatland and surrounding plant communities have been studied by the University of Minnesota in cooperation with the DNR, Division of Minerals' peatland studies. Of 13 different habitat types surveyed (Table 10), the swamp thicket

Table 9. Average number of ruffed grouse drums per stop for the Red Lake WMA, northcentral Minnesota, and northwestern Minnesota, 1968-1979.

Year	Red Lake WMA	Northwestern Minnesota ¹	Northcentral Minnesota
1968	5.24	—	2.60
1969	4.56	—	2.80
1970	2.08	—	3.10
1971	0.96	—	3.30
1972	2.28	—	3.40
1973	0.28	1.30	1.30
1974	1.05	0.80	1.10
1975	2.15	1.30	1.40
1976	1.10	0.80	1.50
1977	1.55	1.00	1.60
1978	2.98	1.90	2.40
1979	2.45	1.68	2.24

¹ Includes the Red Lake WMA.

Source: Minnesota DNR, Section of Wildlife.



The great blue heron is frequently observed in shallow marshes of the Red Lake WMA.

(lowland brush) and lowland cedar-spruce communities supported the highest species diversity and the greatest number of breeding bird species (Warner and Doehlert 1978). Nashville and chestnut-sided warblers, common yellowthroats, and swamp and white-throated sparrows were the most common breeding species observed in these two habitats. Other species commonly observed in lowland conifer communities included yellow-bellied flycatchers, dark-eyed juncos, chipping sparrows, and gray jays (Table 11). The open bog and muskeg communities had the lowest bird species diversity. Common species observed in these

habitats included palm warbler, and Savannah and Lincoln's sparrows. Mixed upland and bottomland forests attracted such species as the least flycatcher, redbellied vireo, ovenbird, and eastern wood pewee. Twenty species of migrant and resident raptors may occur on the area. The red-tailed hawk and the broad-winged hawk are the most common resident raptors. Two active bald eagle nests have been observed southeast and southwest of the management area; and although eagles are sometimes seen, no nests have been found on the unit. Nongame birds are most abundant during the fall and spring migrations.

Table 10. Bird species diversity in 13 plant communities in the Red Lake WMA vicinity.

Habitat Type	Number of species detected	Number of species breeding	Number of transects
Open fen	24	6	41
Shrub fen	12	6	40
Open bog	6	3	44
Muskeg ¹	8	3	40
Swamp conifer ²			
Spruce	15	5	62
Spruce-feathermoss	30	5	35
Tamarack	27	5	37
Cedar-spruce	41	10	66
Poor swamp forest ³	21	4	41
Swamp thicket (lowland brush)	44	10	40
Clear-cut conifer	24	3	18
Bottomland hardwood forest	31	2	14
Mixed coniferous-deciduous forest	38	3	39

¹ Bog with 5-25 percent stunted black spruce cover.

² Tree cover greater than 25 percent.

³ Tree cover greater than 25 percent, dominated by stunted black spruce.

Source: Warner and Doehlert 1978.

Table 11. Bird densities expressed as singing males per 100 acres in muskeg and swamp conifer-spruce habitats in the Red Lake WMA vicinity.

Species	Muskeg ¹	Swamp conifer-spruce ²
Palm warbler	3.90 ± 1.60 ³	3.33 ± 2.51
Savannah sparrow	11.11 ± 6.19	
Lincoln's sparrow	4.14 ± 3.14	
Nashville warbler		4.96 ± 3.35
Yellow-bellied flycatcher		4.34 ± 2.45
Yellow-rumped warbler		1.80 ± 2.43
Dark-eyed junco		6.27 ± 3.21
Chipping sparrow	0.05	4.91 ± 2.16
Connecticut warbler		1.44 ± 1.44
Hermit thrush		2.06 ± 1.23
Gray jay		3.17
Spruce grouse		2.11
Raven		0.82
Cedar waxwing		0.58
Blackburnian warbler		0.38
Olive-sided flycatcher		0.28
Robin		0.19
Blue jay		0.19
Brown-headed cowbird	0.19	0.14
Solitary vireo		0.05
Sharp-tailed grouse	4.71	
Brewer's blackbird	0.19	
Tree swallow	0.86	

¹ Bog with 5-25 percent stunted black spruce cover.

² Tree cover greater than 25 percent, 75 percent of which are black spruce.

³ Mean ± 95 percent confidence interval. Total breeding population assumed to be double the singing male densities.

Source: Warner and Doehlert 1978.

Mammals. Most mammal species on the area today were present during presettlement times. Settlement brought logging, drainage, fires, and unregulated hunting and trapping which decimated several large native mammal species from the area.

Woodland caribou were once abundant in northern Minnesota. As settlement expanded, the caribou population and range diminished, until by the 1930's only a small remnant herd remained in the Red Lake bog. In 1932, the Red Lake Game Refuge was established to protect the remaining caribou range. In 1938, nine animals were obtained from Saskatchewan and released in the game refuge in attempts to replenish the herd (Minnesota Conservation Dept. 1938). These efforts failed, and by the late 1940's the caribou had disappeared from the state.

Other species, however, adapted to and often benefited from changes brought about by settlement. White-tailed deer and moose probably increased as a result of early successional, second-growth forests created by extensive logging and recurrent fires. The network of drainage ditches and the aspen, willow, and balsam poplar which became established on the spoil banks provided favorable habitat for beaver.

Mammal species currently present on the management area were determined from information supplied by the University of Minnesota and Bemidji State University as well as Minnesota DNR, Section of Wildlife records and personnel (Table 12). Fifty mammal species occur on or near the management area. An additional four species possibly occur, but no positive evidence is available.

Seventeen mammal species are protected under Minnesota Statutes, Sec. 100.27, 1978, and may be taken only during authorized hunting or trapping seasons. The marten and gray wolf (eastern timber wolf) are afforded special protection by state or federal laws and have no open season in Minnesota. White-tailed deer, black bear, and snowshoe hare are commonly hunted on the management area. Beaver, red fox, mink, and fisher are commonly trapped on the



The white-tailed deer, the most sought after game animal on the WMA, will be a primary focus of forest management.

Table 12. Mammals occurring in the Red Lake WMA vicinity.¹

Masked shrew	Southern bog lemming
Water shrew	Northern bog lemming
Arctic shrew	Norway rat
Pygmy shrew	House mouse
Short-tailed shrew	Meadow jumping mouse
Star-nosed mole	Woodland jumping mouse
Little brown myotis	Porcupine
Keen's myotis ²	Coyote
Silver-haired bat ²	Gray wolf (eastern timber wolf)
Big brown bat	
Red bat	*Red fox
Hoary bat	*Black bear
*Eastern cottontail ²	*Raccoon
*Snowshoe hare	*Marten ³
Eastern chipmunk	*Fisher
	Ermine (short-tailed weasel)
Least chipmunk	Least weasel
Woodchuck	Long-tailed weasel
Thirteen-lined ground squirrel	*Mink
Franklin's ground squirrel	*Badger
	Striped skunk
*Gray squirrel	*River otter
*Fox squirrel ²	*Lynx
Red squirrel	*Bobcat
Northern flying squirrel	*White-tailed deer
*Beaver	
	*Moose
Deer mouse	
White-footed mouse	
Southern red-backed vole	
Meadow vole	
*Muskrat	

* Game species - may be taken only under DNR regulations.

¹ Names and sequence of mammal species follow Jones et al. 1975.

² Possible occurrence.

³ Special protection under state or federal laws.

unit; beaver and otter trapping is by permit only. The remaining 31 species are unprotected by Minnesota laws. Two of these, the coyote and striped skunk, may be trapped for their furs.

The Endangered Species Act of 1973 classified the gray wolf in Minnesota and the eastern U.S. as an "endangered species," or one likely to be eliminated from all or much of its range in the foreseeable future. Since their protection, wolves in northcentral Minnesota have increased. The Red Lake WMA and vicinity were classified as primary wolf range by the Eastern Timber Wolf Recovery Team (Bailey et al. 1978). During the winter of 1975-76, densities on the management area and vicinity were estimated at one wolf per 17 square miles (Fritts, 1979). Prey populations appear adequate to support even higher wolf densities (Bailey et al. 1978). In 1978, the U.S. Fish and Wildlife Service changed the wolf's classification in Minnesota from endangered to threatened. A "threatened species" is not

considered to be in present danger of elimination but is considered likely to become endangered in the foreseeable future.

Winter aerial moose surveys are conducted annually by the Division of Fish and Wildlife. Moose numbers have fluctuated but have generally remained stable in northwestern Minnesota since 1973-74 (Table 13). A 675 square mile area, including the northern half of the Red Lake WMA, had an estimated population of 66 and 89 moose during the winters of 1977-78 and 1978-79, respectively.

The white-tailed deer is the most heavily hunted game mammal on the management area. Spring pellet-group counts indicated densities in the Red Lake WMA vicinity of approximately 7.4 and 12.5 deer per square mile for the winters of 1977-78 and 1978-79, respectively. Similar trends in density were noted for eastern and western Koochiching County (Table 14).

Although generally inconspicuous, small mammals representative of coniferous-deciduous and peatland communities occur on the management area. Several species of voles, mice, shrews, bats, chipmunks, and squirrels are common.

Table 13. Moose population estimates for northwestern Minnesota based on winter aerial surveys, 1962-1980.

Census Period	Estimated Population
1962-63	1,450 ± 350 ¹
1963-64	1,450 ± 350
1964-65	ND ²
1965-66	1,840 ± 290
1966-67	1,900 ± 400
1967-68	1,835 ± 260
1968-69	1,620 ± 220
1969-70	ND
1970-71	2,040 ± 430
1971-72 ³	2,350 ⁴
1972-73 ⁵	3,144 ± 572
1973-74 ³	2,686 ± 544
1974-75	3,539 ± 1,070
1975-76 ^{3,5}	2,416 ± 522
1976-77	3,562 ± 1,331
1977-78 ³	2,518 ± 713
1978-79	2,156 ⁴ ± 473
1979-80	2,800 ± 600

¹ Mean number ± 2 standard errors.

² No data.

³ Post hunt census.

⁴ No standard error reported.

⁵ Area restratified for sampling.

Source: Minnesota DNR, Section of Wildlife.

Table 14. Estimates of deer per square mile based on spring pellet-group surveys for Lake of the Woods, northern Beltrami, and Koochiching Counties, 1975-1980

Year	Lake of the Woods and northern Beltrami Counties ¹	Western Koochiching County	Eastern Koochiching County	Total
1975	11.1 ± 3.0 ²	12.8 ± 4.4		
1976	10.9 ± 3.3	9.0 ± 3.0	9.3 ± 2.8	10.0 ± 1.9
1977	17.2 ± 4.5	10.4 ± 5.2	12.4 ± 5.4	13.2 ± 2.9
1978	7.4 ± 5.3	9.5 ± 5.2	10.6 ± 5.4	11.5 ± 3.1
1979	12.5 ± 3.6	11.2 ± 3.5	14.4 ± 7.4	—
1980	10.9 ± 3.7	8.2 ± 2.6	21.6 ± 6.9	—

¹ Includes the Red Lake WMA.

² Mean number of deer per square mile ± 2 standard errors.

Source: Minnesota DNR, Section of Wildlife.

Fish. Water bodies on the area are managed primarily for waterfowl and other wetland wildlife and not for fish production. Most wetlands are low in productivity and too shallow to support fish over winter. Trout were once stocked by the Section of Fisheries on the North Branch of the Rapid River and Brown's Creek north of the unit boundary, but stocking was discontinued due to the limited trout habitat and periodic low stream flows.

Seven game fish and 44 nongame fish species are known to occur in the vicinity of the management area (Table 15). The Upper Red Lake and its tributaries support 38 species of fish (Smith and Krefting 1953). Walleye, yellow perch, lake whitefish, northern pike, white sucker, goldeye, freshwater drum, and black bullhead are fished on both a commercial and recreational basis. The Tamarack River, which discharges into the lake at Waskish, is a major spawning area for walleyes and white suckers. Since 1935, the Section of Fisheries has maintained a field station at Waskish to collect walleye spawn for distribution to nearby hatcheries. Since 1949, the Waskish Station has been an operational walleye hatchery.

Table 15. Fish species occurring in the Red Lake WMA vicinity.¹

*Lake sturgeon	Longnose dace
Mooneye	Brassy minnow
Goldeye	Bluntnose minnow
Lake whitefish	Fathead minnow
Quillback	*Channel catfish
River carpsucker	Black bullhead
Golden redhorse	Tadpole madtom
Silver redhorse	Central mudminnow
Shorthead redhorse	*Northern pike
White sucker	Burbot
Creek chub	Trout-perch
Pearl dace	*Largemouth bass
Emerald shiner	*Smallmouth bass
Rosy face shiner	*Rock bass
Common shiner	*Black crapple
Weed shiner	*Walleye
Blackchin shiner	*Yellow perch
Spottail shiner	Blackside darter
Blgmouth shiner	River darter
Sand shiner	Logperch
Blacknose shiner	Johnny darter
Northern redbelly dace	Iowa darter
Finescale dace	Freshwater drum
Hornyhead chub	Silmy sculpin
Silver chub	Mottled sculpin
Brook stickleback	

* Games species - may be taken only under DNR regulations.

¹ Names and sequence of fish species follow American Fisheries Society 1970.

OPERATIONS

The operation of the Red Lake WMA depends on capital improvements, staff, equipment, and funding. The relationship of the area to other Minnesota DNR functions in Region I is important to understand administrative and funding procedures and problems. Knowledge of the present operation is necessary to formulate a comprehensive plan that will utilize existing development and equipment and can be implemented under anticipated budgetary and administrative constraints.

ADMINISTRATION AND FISCAL

The Red Lake WMA is one of 925 state wildlife management areas and is administered through the DNR Region I office in Bemidji. Region I consists of 21 counties and includes 323 wildlife management areas with approximately 644,000 managed acres. Ten area wildlife managers manage 319 of the wildlife areas, while four resident managers direct four additional units. The regional wildlife manager supervises wildlife management in Region I.

Wildlife and fish administration and management in Minnesota is financed primarily through appropriations from the Game and Fish Fund. Receipts from hunting, trapping, and fishing license sales, cash receipts from wildlife management areas, and federal-aid matching funds are deposited into the Game and Fish Fund. These monies are dedicated for state-wide fish and wildlife management and are appropriated to the Minnesota DNR.

Federal matching funds are derived from the Federal Aid in Wildlife Restoration Act (Pittman-

Robertson Act) and the Federal Aid in Sport Fish Restoration Act (Dingell-Johnson Act). These acts imposed excise taxes on sporting arms, ammunition, archery equipment, and fishing equipment. Funds from these taxes are used to match state funds on a 3:1 ratio for federally approved wildlife and fish projects.

All income received from the use of the Beltrami Island lease lands (L.U.P.) is paid into the state treasury and credited to the Beltrami Island Conservation Fund. These monies are appropriated for the administration and management of these lands in accordance with the terms of the Beltrami Island lease, and are disbursed between the Divisions of Fish and Wildlife and Forestry. Any portion of income not needed for the operation of these lands may be used for the acquisition by the state of additional lands to block in, round out, and enlarge its holdings (Minnesota Statutes, Sec. 84.155, Subd. 6, 1978). Income on L.U.P. lands, derived primarily from timber sales, totaled \$50,183 in 1978.

Expenditures for salaries, taxes, equipment, and other operating expenses on the Red Lake WMA, estimated from the resident manager's records, totaled \$123,719 in 1977 and \$137,563 in 1978 (Table 16). Income from timber sales, firewood permits, and property leases amounted to \$38,579 in fiscal year (FY) 1977 and \$38,981 in FY 1978.

Two parcels of land at Waskish, totaling about six acres, are leased to the Waskish Township Board by the state for \$7 per year. These lands are to be used for recreational, non-commercial, community, or local

Table 16. Expenditures and income in dollars on the Red Lake WMA in 1977 and 1978.

	Year	
	1977	1978
Regional Expenditures		
Salaries	54,774	89,315
Equipment and operating expenses	67,165	46,825
Land Bureau and Administrative Service Expenditures		
Payment in lieu of taxes	205	205
Real estate taxes	1,575	1,218
Total Expenditures	123,719	137,563
Income		
Timber and firewood permits sales	38,571 ¹	38,973 ²
Property leases	8	8
Total Income	38,579	38,981

¹ Figure for fiscal year 1977 (7/1/76-6/30/77).

² Figure for fiscal year 1978 (7/1/77-6/30/78).

resident uses. In addition, the state leases a church and surrounding property to the Bethlehem Lutheran Church for \$1 per year.

Equipment, major equipment repairs, and most capital improvements are budgeted in the DNR, Bureau of Field Services. These expenses vary yearly depending on equipment and management needs. Equipment needs and major capital improvements, such as buildings, dikes, and control structures, are funded on a region-wide priority basis. Supplemental appropriations such as Betterment of Wildlife Management Areas and the Waterfowl Habitat Improvement Program provide funding for some improvement projects.

All income received from the operation, development, management, and use of Consolidated Conservation lands is paid into the state treasury and credited to the Consolidated Conservation Fund. Counties are appropriated one-half of the income derived from Consolidated Conservation lands located within that county (Minnesota Statutes, Sec. 84A.51, 1978). Payments to Beltrami and Lake of the Woods Counties totaled \$61,383 and \$87,786 in FY 1978, respectively.

Payments in lieu of taxes are made to counties for all state lands acquired for public hunting grounds and game refuges, except state Trust Fund lands. Payments are disbursed from the Game and Fish Fund at a rate of \$0.50 per acre or 35 percent of the gross receipts, whichever is greater (Minnesota Statutes, Sec. 97.49, Subd. 3, 1978). A third alternative method of determining in lieu of tax payments will become effective July 1, 1981 (Laws Minn. 1979, ch. 301). This method would tax qualifying lands at the rate of $\frac{3}{4}$ of 1 percent of the appraised market value. Payments of \$0.50 per acre to Beltrami and Lake of the Woods Counties for the Red Lake WMA totaled \$205 in 1977 and 1978.

Effective July 1, 1979, additional in lieu of tax payments are made to counties in which certain natural

resource lands are located. Payments will be disbursed from general funds at the rate of: (1) \$3 per acre for state natural resource lands which were previously privately owned and were acquired by purchase, condemnation, or gift, (2) 75 cents per acre for state tax-forfeited lands administered by the county, and (3) 37.5 cents per acre for other state lands administered by the DNR, including tax-forfeited, Trust Fund, and Consolidated Conservation area lands (Laws Minn. 1979, ch. 303). Any payments to counties during the preceding year from the DNR under Minnesota Statutes, Sections 84A.51, 89.036, and 97.49 are deducted from the amounts levied under this provision. Payments to Beltrami and Lake of the Woods Counties for Red Lake WMA lands under this provision total about \$90,540 and \$42,180, respectively.

In addition, Minnesota Statutes, Section 272.011 (1978) requires the state to pay real estate taxes to the counties for all state-owned residences occupied by state employees. These taxes are paid from the Minnesota DNR, Field Services Budget, 27 percent of which is derived from the Game and Fish Fund. In 1977 and 1978, \$1,575 and \$1,218 in real estate taxes, respectively, were paid to Lake of the Woods County for the state-owned residences at Norris Camp.

CAPITAL IMPROVEMENTS

Capital improvements are permanent developments necessary for the management and public use of the area. While improved habitat and food plots may be forms of capital improvements, only constructed facilities are considered below.

The Red Lake WMA headquarters is located two miles north of the unit at Norris Camp (Figure 4). All but two of the 25 buildings presently at the headquarters were built between 1935 and 1940 and are in fair to good condition (Table 17). The manager's residence and a combination office/barracks/garage were constructed by the state in 1962 and 1969, respectively.

Table 17. Buildings maintained on the Red Lake WMA headquarters at Norris Camp.

Building	Area (Square Feet)	Construction Date	Condition
Mess hall	800	1930-35	Fair
Oil shed	80	1930-35	Fair-good
Well house	256	1930-35	Good
Storage bldg.	800	1930-35	Poor
Blacksmith shop	600	1930-35	Good
Barracks	800	1930-35	Good
Sanitation bldg.	800	1930-35	Good
Cabin	400	1930-35	Good
Cabin	400	1930-35	Good
Duplex	1400	1930-35	Fair-good
Garage	1600	1930-35	Fair-good
Garage	1000	1930-35	Good
Carpenter shop	1000	1930-35	Good
Granary	192	1930-35	Poor-fair
Storage bldg.	2100	1930-35	Poor
Machine shed	400	1930-35	Fair
Storage bldg.	2100	1930-35	Poor
Cabin	400	1930-35	Fair
Residence	1344	1962	Good
Utility bldg.	1680	1969	Good-excellent
Bunkhouse	2200	1930-35	Fair
Garage	1000	1920-30	Good
Hanger	1280	1930-35	Fair-Poor
Residence	768	1920-30	Good
Toolshed	1200	1930-35	Fair

Nineteen other buildings are maintained at Waskish by the Section of Fisheries and the Divisions of Enforcement and Forestry (Appendix E).

Excluding state highways, there are 116 miles of roads and access trails on the management unit (Figure 4). The Division of Forestry maintains and develops many of the roads and trails on the WMA for logging activities and fire control. The Division of Fish and Wildlife does supplementary maintenance on roads and trails needed for the management and public use of the unit. The amount of road maintenance depends on manpower and equipment availability; approximately 64 miles of roads and trails were maintained by the Division of Fish and Wildlife in 1978.

There are no hunting stations, campgrounds, recreational trails, or parking lots maintained by the Division of Fish and Wildlife on the management unit. Approximately 20 miles of snowmobile trails are maintained on the area by the Division of Parks and Recreation. A 30-acre public access in Waskish on Upper Red Lake is maintained by the Division of Enforcement. The Waskish Campground is managed by the Division of Forestry.

Three impoundments totaling 700 wetland acres have been constructed on the unit. In addition, WMA personnel manage nine other impoundments (2,100 acres) on Beltrami Island lease lands (L.U.P.) outside the unit. Only three of the 12 water control structures

on these impoundments are capable of regulating water levels.

EQUIPMENT

Thirty-four pieces of equipment are maintained on the area (Table 18). Heavy equipment is utilized on other Region I wildlife projects when needed. Agricultural equipment is used for planting food and cover plots and for vegetation management. Light and heavy-duty trucks are used for wildlife surveys, enforcement, and transporting personnel, equipment, and materials. Heavy machinery is used to construct and maintain roads and water control structures and to clear vegetation.

STAFF

Four full-time and various part-time employees are assigned to the Red Lake WMA. The resident manager, assistant manager, general equipment repairman, and technician are full-time. Three seasonal and four hourly laborers were employed during 1978. Salaries for the general equipment repairman and technician are disbursed from the Beltrami Island Conservation Fund. Temporary hourly laborers are employed as needed if funds are available. Additional personnel have been employed in the past through federal and state programs for youth and the unemployed.

Table 18. Equipment based on the Red Lake WMA.

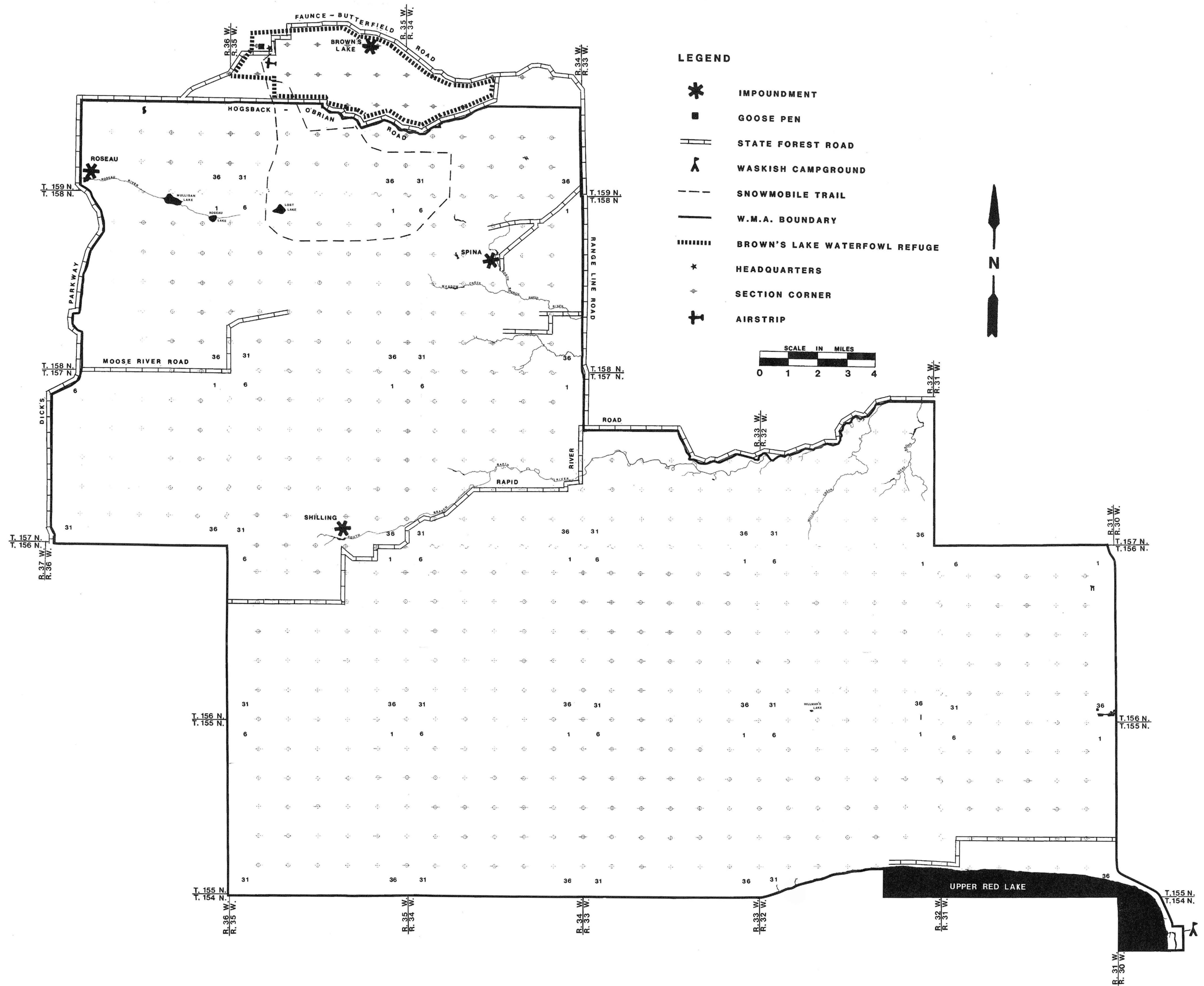
Equipment	Make/Model	Model Year	Percent WMA Use	Condition
Truck, flatbed	International/ ¾ ton	1964	100	Poor
Truck, dump	Chevrolet/ 2 ton	1967	95	Good
Truck, pickup	International Scout/ ½ ton	1967	100	Fair
Truck, pickup	International/ ½ ton 4 x 4	1973	100	Poor
Truck, flatbed	Loadstar/Schwartzbed	1975	85	Excellent
Truck, pickup	GMC/ ½ ton, 4 x 4	1976	100	Excellent
Truck, pickup	Dodge/ ¾ ton, 4 x 4	1954	100	Excellent
Truck, panel	Chevrolet/ 1 ton	1963	100	Poor
Crawler tractor	Caterpillar/D8	Unknown	100	Good
Crawler tractor	Caterpillar/D4	1964	95	Good
Dragline	P & H	Unknown	100	Good
Crawler loader	Allis Chalmers/crawler loader	1966	95	Fair
Tractor, farm, diesel	John Deere/3020	1966	100	Good
Tractor, farm	International/W4	1948	100	Fair
Bombardier ¹	Muskeg ATV	1968	80	Unknown
All-terrain-vehicle	Cushman/trackster ATV	1973	100	Good
Disc	John Deere	1977	100	Excellent
Gang plow	International/ 2 bottom	1948	100	Poor
Fertilizer	Unknown	Unknown	100	Poor
Grain binder	Minnesota	Unknown	100	Good
Cultivator	John Deere/ 10 ft.	Unknown	100	Good
Shearing blade	KG	Unknown	100	Fair
Grain drill	Farmall	Unknown	100	Fair
Snowmobile	Rupp	1973	100	Good
Snowmobile	Rupp	1975	100	Good
Lawnmower	Trustworthy/riding	1968	100	Poor
Lawnmower	Toro/800 riding	1969	100	Poor
Mower	John Deere/rotary	1963	100	Fair
Trailer	Spartan/snowmobile	1966	100	Good
Trailer	Plato/ 3 ton, tilt-top	1955	100	Fair
Boat	Aluminum 16 ft.	1952	100	Fair
Canoe	Grumman/Aluminum 17 ft.	1948	100	Poor
Canoe	Alumacraft/ 17 ft.	1975	100	Excellent
Outboard motor	Evinrude/ 3 h.p.	1960	100	Fair
Outboard motor	Johnson/ 4 h.p.	1976	100	Excellent

¹ On loan from U.S. Geological Survey.

FIGURE 4. PRESENT DEVELOPMENT

RED LAKE WILDLIFE MANAGEMENT AREA

PRESENT DEVELOPMENT



LAND OWNERSHIP

Land ownership and policies bear strongly on natural resource management. The management goals and acquisition status are affected by the project acquisition history, present land ownership patterns, and the sources of acquisition funds.

ACQUISITION STATUS

The management area encompasses 417,456 acres, 84 percent of which is in state ownership (Table 19). Scattered tracts of federal, Indian, and private lands account for the remaining 16 percent of the area. State lands were acquired through tax forfeiture, land exchanges, condemnation, and purchases (Table 20). In 1935, 19 parcels of land at Waskish, totaling 301.92 acres, were condemned by the state for fish conservation and propagation. Of this, 2.85 acres were acquired by the Division of Forestry, 9.99 acres were transferred to the Department of Transportation for State Highway

72, and 289.08 were placed under the administration of the Division of Fish and Wildlife. An additional 80,781 acres of Beltrami Island lease lands (L.U.P.) in Beltrami, Lake of the Woods, and Roseau Counties were leased to the State of Minnesota in 1940 for 50 years; 651 acres were added to the lease in 1948. Approximately 20,595 acres of L.U.P. lands are within the Red Lake WMA.

Land acquisition expenditures by the Division of Fish and Wildlife have totaled \$5,593 (Table 21). Game and Fish Fund monies, derived from license revenues and cash receipts from wildlife management areas, were used to purchase 309.38 acres. Federal Pittman-Robertson funds, derived from the excise tax on the sale of sporting arms, ammunition, and archery equipment, were matched with state funds on a 3:1 ratio to purchase an additional 120 acres.

Table 19. Present land ownership in the Red Lake WMA.

Ownership	County		Total (acres)	Percent
	Beltrami (acres)	Lake of the Woods (acres)		
Beltrami Island Lease (L.U.P.)	3,686	16,909	20,595 ²	5
Red Lake Indian Reservation	13,168	16,649	29,817	7
Other federal lands	320	40	360	< 1
Private ¹	9,468	5,755	15,223	4
State				
Consolidated Conservation	237,877	111,751	349,628	
Trust Fund	0	440	440	
Division of Fish & Wildlife	429	0	429	
Division of Forestry	4	0	4	
Volstead	670	280	950	
Department of Transportation	10	0	10	
Subtotal	238,990	112,471	351,461	84
Total area	265,632	151,824	417,456	100

¹ Includes 2,288 acres of tax-delinquent lands still in private ownership.

² An additional 60,837 acres are located outside the Red Lake WMA.

Source: Minnesota DNR, Bureau of Lands.

Table 20. Previous ownership and method of acquisition for state lands in the Red Lake WMA.

Previous Ownership	Method of Acquisition	County		Total (acres)	Percent
		Beltrami (acres)	Lake of the Woods (acres)		
Private	Purchase	141	0	141	< 0.1
	Condemnation	302	0	302	0.1
	Land exchange	160	1,640	1,800	0.5
	Tax-forfeiture	237,717	110,831	348,548	99.2
U.S. Government	Purchase	670	0	670	0.2
Total		238,990	112,471	351,461	100.0

Source: Minnesota DNR, Bureau of Lands.

Table 21. Sources of funds and acreage purchased by the Division of Fish and Wildlife in the Red Lake WMA.

Acquisition Method	Sources and Amounts of Funds		Acres
	Federal Aid in Wildlife Restoration ¹	Minnesota Game and Fish Fund	
Federal Aid Project	\$450	\$ 150	120.00
Section of Wildlife Project	0	4,558	289.08
	0	435	20.30
Totals	\$450	\$5,143	429.38

¹ Pittman-Robertson Act.

PUBLIC USE

Wildlife management areas in Minnesota are available for a variety of public uses. Outdoor recreation accounts for most of the public use on the Red Lake WMA, but the area is also utilized for non-recreational activities such as timber harvest, environmental education, and biological research. Knowledge of present use levels is necessary to predict the future demand for outdoor recreation and to develop management programs.

A survey was conducted on the management area from June to December, 1978, to estimate public use types and levels and to determine the attitudes and demographic characteristics of area users. Although survey results do not represent absolute use figures, they should provide reasonable estimates of use types and levels. Survey results were supplemented, when possible, with use estimates from car counts and hunter bag-checks conducted by the resident manager. A description of survey techniques, data analysis, and additional results is presented in Appendix F.

The units of public use are reported as visitor-days and use-days. A visitor-day is defined as one individual using the area on one day, regardless of the length of stay. A use-day is one individual using the area for one activity, such as hunting or fishing, on one day. One person may account for as many use-days as activities participated in on one day, but that person only accounts for one visitor-day.

A total of 314 questionnaires were distributed to area users; 122 were returned, a response rate of 39 percent. Results from the survey were expanded to cover the period from May 13 to December 31. Total use during this period was estimated at 13,333 visitor-days (Table 22). Fifty-one percent of the total use occurred during the nonhunting period (May 13-August 31) and 49 percent during the hunting period (September 1-December 31).

Visitor use was distributed among 13 different recreational activities (Table 23). Hunting, camping, and fishing constituted the major recreational uses.

Table 22. Distribution and percentage contribution of visitor use by season and type of day on the Red Lake WMA, May 13-December 31, 1978.

Season/Type of Day Category	Visitor-days	Percent Total
Nonhunting (May 13-August 31)		
Weekend	2701	20
Weekday	4139	31
Subtotal	6840	51
Hunting (September 1-December 31)		
Weekend	3429	26
Weekday	3064	23
Subtotal	6493	49
Total	13,333	100

Table 23. Percent of respondents participating in various recreational activities on the Red Lake WMA, May 13-December 31, 1978.

Activity	Period ¹		
	Nonhunting (May 13-August 31)	Hunting (Sept. 1-Dec. 31)	Combined (May 13-Dec. 31)
Hunting	0	86	64
Camping	40	38	39
Fishing	63	29	38
Observing nature	37	28	30
Firewood gathering	13	17	16
Picnicking	33	9	16
Boating/Canoeing	27	10	15
Photography	10	15	14
Hiking	17	10	12
Wild food gathering	0	7	5
Snowmobiling	0	6	4
Snowshoeing	0	2	2
Painting/Drawing	0	1	1

¹ The summation of percentages for each period exceeds 100 because respondents could participate in more than one activity during a visit.

HUNTING

Hunting was the dominant use during the hunting period, with 86 percent of the parties participating. An estimated 5,800 hunter use-days were spent on the management area during 1978. Most use was by deer and ruffed grouse hunters. An estimated 2,855 hunter use-days occurred during the 1978 firearms-deer season. For the same period, the resident manager estimated 1,750 hunter use-days based on car counts. Hunting pressure on bear and waterfowl was minimal.

Moose hunting seasons in Minnesota have been conducted in alternate years since 1971 on a permit-quota basis. In addition, a Red Lake Indian moose zone, which included the northern half of the WMA, was open to nonband members with special permits from the Red Lake Band in 1975 through 1977 and in 1979. Estimates of the number of DNR and Red Lake Band permit holders that hunted on the Red Lake WMA are not available.

Table 24. Estimated hunter use-days and temporal and spatial distribution of hunters on the Red Lake WMA in 1978.

	Firearms Deer ¹	Ruffed Grouse	Waterfowl
Temporal Distribution			
Hunter-use days	2,885	2,007	375
Open day	Sat. Nov. 4	Sat. Sept. 16	Sun. Oct. 1
% use	13	15	40
Opening weekend	Nov. 4,5	Sept. 16,17	—
% use	26	30	
First week	Nov. 4-10	Sept. 16-22	Oct. 1-6
% use	71	40	85
Remaining weekends	40 days	30 days	14 days
% use	18	10	5
Remaining weekdays	5 days	70 days	30 days
% use	11	50	10
Spatial Distribution			
% use by compartment (see Figure 5)			
1	19	10	17
2	12	7	0
3	21	19	17
4	5	15	17
5	12	30	17
6	9	10	22
7	2	0	0
8	2	3	11
9	19	7	0

¹ Nov. 4-19 bucks only, antlerless deer by permit Nov. 18-19, and special muzzleloader season Dec. 2-17.

Hunting pressure on deer, ruffed grouse, and waterfowl was estimated for different periods throughout their respective 1978 seasons by the resident manager (Table 24). Over 75 percent of the deer and waterfowl hunting on the management area occurred during the opening weekend. Hunting pressure on ruffed grouse was moderate during opening weekend. Hunting pressure on all game species for the remainder of the season was substantially lower and fairly uniform, but somewhat heavier on weekends.

Hunting pressure was not uniformly distributed over the management area because of habitat distribution, hunter preferences and habits, and accessibility. The unit was divided into nine compartments to examine hunter distribution (Figure 5). The greatest hunting concentrations occurred in compartments 1, 3, 5, and 9, generally within one mile or less of access roads. Compartments 7 and 8 are extremely inaccessible and received little hunter use (Table 24).

CAMPING

Camping is allowed on the management area by permit from the resident manager and in designated areas. An estimated 5,340 camper-use days were spent on the unit in 1978. The Waskish campground, located on the southeast corner of the unit, received approximately 45 percent of the camping use. Camping was generally in association with other activities, mostly hunting or fishing.

FISHING

Although fishing opportunities on the management area are limited, fishing was still the major recreational activity during the nonhunting period. Over 60 percent of the parties surveyed during this period engaged in fishing. An estimated 6,150 fisherman use-days were spent on the management area in 1978; over 80 percent of the fishing activity occurred on Upper Red Lake.

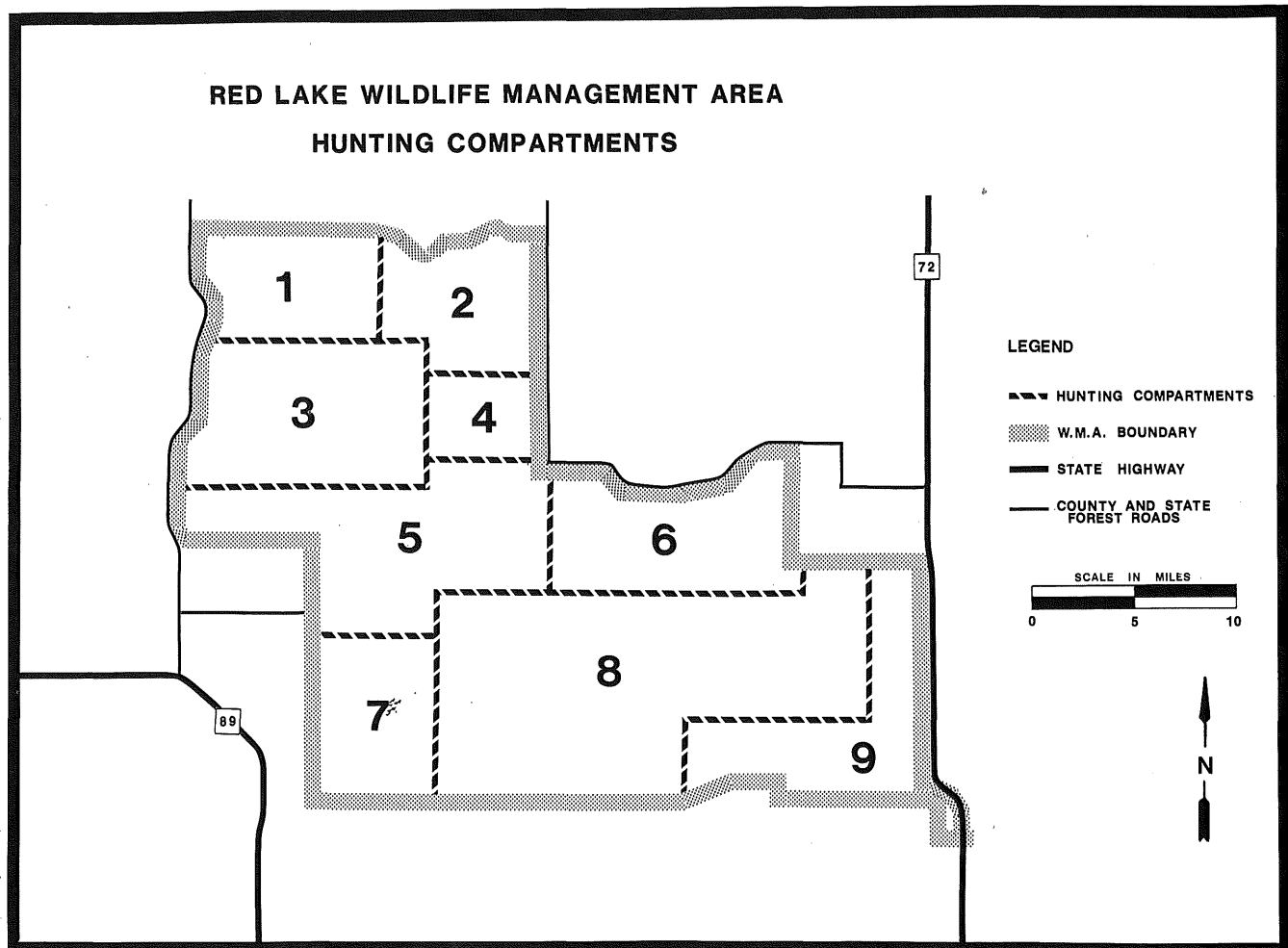
TRAPPING

Estimates of trapper numbers and harvest on the management area were not available. Except for beaver and otter, trapping permits are not required on the unit. In addition, trappers are not required to report their harvest to the resident manager. In 1977 and 1978, the resident manager issued seven beaver trapping permits.

OTHER ACTIVITIES

The Red Lake WMA is used for a variety of other outdoor recreational activities. Important activities include observing nature, firewood gathering, picnicking, boating/canoeing, photography, and hiking. Over 90 percent of the visitors surveyed participated in these activities in association with hunting and fishing.

Snowmobiles may be operated on the management area. All-terrain vehicles and horseback riding are prohibited except by permit from the resident manager.



VISITOR CHARACTERISTICS

Visitors to the management area averaged 37 years of age. Approximately one-half, 53 percent, were younger than 40 years. The majority, 73 percent, were males. Only 7 percent of the respondents were out-of-state residents.

Nearly all, 94 percent, of the visitors traveled more than 50 miles to the management area (Table 25). Over 88 percent of the respondents had visited the unit at least once previously within the last year, averaging 4.4 trips. Most respondents came in groups of two to four individuals; average party size was 2.7 people. Nearly one-half, 48 percent, of the visitors to the area stayed longer than 24 hours. Visitors spent an estimated \$148,000 in the management area vicinity, averaging \$19.75 per visit (Table 26).

The majority, 80 percent, of the respondents rated their visit to the management area as good to very good. Only 9 percent of the visits were rated as poor to very poor. Responses during the hunting season, however, may more closely reflect hunting success than the overall quality of the visit. Respondents considered area appearance (wilderness, scenic beauty), hunting and fishing opportunities, and camping and

water access facilities as the most important features of the area. (Appendix F, Table 4) Nineteen percent of the respondents felt that the management area did not need further improvements. Most respondents, 36 percent, stated that the campground and access facilities should be improved. Respondents also wanted to see habitat improvements (logging, burning, farming), more maintenance and development of access roads and trails, increased enforcement of hunting regulations, and wolf control (Appendix F, Table 5).

TIMBER HARVEST

Timber sales on the Red Lake WMA are conducted by district foresters at Clear River, Williams, Waskish, and Grygla. Forest products harvested on the management area include hard and softwood pulp, softwood poles and posts, softwood sawtimber, and fuelwood. The quantity of timber sold depends on the number and size of allowable cuts, current market prices, and the demand for wood. In fiscal year 1978, 39 timber leases totaling \$38,794 were sold and over 6,800 cords of wood were harvested.

Table 25. Traveling distance by respondents according to recreational activity on the Red Lake WMA.

Distance (miles)	Percent			Total
	Hunters	Fishermen	Other users	
0-50	6	6	7	6
51-100	27	30	19	27
101-200	21	20	33	22
201-300	18	9	0	13
> 300	5	6	15	6
Twin City Area ¹	21	16	15	19
Out of state	2	13	11	7

¹ Includes Ramsey, Hennepin, Washington, Dakota, Scott, Carver, and Anoka Counties.

Table 26. Average length of visit, party size, expenditures, and number of previous visits by season on the Red Lake WMA.

Attribute	Period		Total
	Nonhunting	Hunting	
Length of visit (hours)	18.6	62.2	55.4
Party Size	2.9	2.7	2.7
Local Expenditures/person/visit (dollars)	8.32	24.44	19.75
Number previous visits/person in the past year	4.2	4.5	4.4

LOCAL PERSPECTIVE

Fish and wildlife management is influenced by factors in the management area vicinity. Land use and ownership, demographic characteristics, and economic conditions must be examined before formulating a comprehensive plan. Development or the potential for development adjacent to the management area may affect future management decisions. Also, the availability of public lands for outdoor recreation in the vicinity will influence the demand for recreation on the Red Lake WMA.

GENERAL

The management area is located in one of the least populated regions of the state. Beltrami and Lake of the Woods Counties rank 74th and 86th among Minnesota's 87 counties in population density, with 12.0 and 3.2 persons per square mile (Minnesota State Planning Agency 1975a). A 14 percent population increase is expected in Beltrami County by 1990, while population levels in Lake of the Woods County should remain stable (Minnesota State Planning Agency 1975b, Headwaters Regional Development Commission 1978). Baudette (population 1,547) and Roseau (population 2,552), the largest cities near the WMA, are 37 and 44 highway miles from the WMA headquarters at Norris Camp. Bemidji (population 11,490) is 100 highway miles south of Norris Camp, and the Twin Cities lie about 340 miles to the southeast.

Land ownership patterns have a significant effect on natural resource management. In the two counties, approximately 50 percent of the land is publicly owned (Table 27). State lands, mostly state forests and wildlife management areas, comprise the majority of public lands. Red Lake Indian lands account for about 13 and 19 percent of the land area in Beltrami and Lake of the Woods Counties, respectively. Only about 30 percent of the land in each county is in private ownership, concentrated in the southern half of Beltrami County and the northern third of Lake of the Woods County.

Forestry is the principal land use (Table 28), with more than 48 percent of Beltrami and 42 percent of Lake of the Woods Counties in forests. The forests are mixed deciduous-coniferous and spruce-tamarack; aspen is the predominate deciduous type. Markets for spruce, pine, and tamarack in the region are good, but the demand for aspen and other hardwoods is generally low.

Land use patterns in the management area vicinity are visible in Figure 6. This infrared photo was taken in late August, 1976, by a LANDSAT satellite from an altitude of 570 miles. The large, undeveloped area between Lake of the Woods and Upper Red Lake comprises the Red Lake WMA and Beltrami Island State Forest. The vast, patterned peatlands are clearly visible. The regular patchwork pattern to the north and west is composed of agricultural fields.

Agriculture is important to the area's economy, even though farming is limited by a short growing season, poor soils, and large expanses of untillable land. Approximately 11 percent of both counties is cultivated or in pasture and open lands, mostly in northern Lake of the Woods and southern Beltrami Counties. Although the number of people living on farms has been decreasing slowly, the acres of land in production has remained relatively stable. Hay is the principal crop followed by oats, wheat, barley, and corn (Minnesota Department of Agriculture 1978). Livestock include beef and dairy cattle, hogs, poultry, and sheep.

Outdoor recreation is an important source of income for both counties. Lake of the Woods and Beltrami Counties rank 2nd and 9th out of Minnesota's 87 counties for tourist-generated expenditures as a percent of total sales (Minnesota Department of Economic Development 1975).

A variety of public and private outdoor recreational opportunities are available in the two-county area

Table 27. Land ownership in Lake of the Woods and Beltrami Counties.

	Lake of the Woods		Beltrami	
	Acres	Percent	Acres	Percent
Private ownership	224,577	27	511,634	32
Red Lake Indian Reservation	108,911	13	306,293	19
Federal lands	27,702	3	71,444	-
State lands	465,934	56	567,899	35
County lands	825	< 1	153,610	10
Total	827,949	100	1,610,880	100

Sources: Minnesota DNR, Bureau of Lands.
Headwaters Regional Development Commission 1978.

Table 28. General land use in Beltrami and Lake of the Woods Counties.

	Beltrami Percent	Lake of the Woods Percent
Forested	48	43
Cultivated	5	8
Pasture and open	6	5
Marsh	22	18
Water	18	27
Residential	< 1	< 1

Source: Minnesota State Planning Agency 1975a.

(Table 29). In addition to the Red Lake WMA, there are 5,485 acres in two state parks, 1,879 acres in 12 additional wildlife management areas, about 537,000 acres in six state forests, and 69,468 acres of the Chippewa National Forest. Other recreational facilities include 72 campgrounds with 1,222 campsites, 66 picnic areas, and over 390 miles of recreational trails.

The region contains some of the finest water resources in the state and provides opportunities for many different types of water-based recreation. Surface waters comprise 17 and 26 percent of the total area of Beltrami and Lake of the Woods Counties, respectively. Important lakes include Minnesota's largest, Red Lake, and a large portion of Lake of the Woods. Water-based facilities include 41 public accesses, 93 swimming beaches, plus 117 marinas.

Other important recreational facilities outside the two-county area may influence the demand for recreation on the Red Lake WMA. Hayes Lake State Park (2,700 acres) and the Roseau River WMA (61,333 acres) in Roseau County, the Thief Lake WMA (33,255 acres) and the Agassiz National Wildlife Refuge (61,487 acres) in Marshall County, and the Pine Island State Forest (641,136 acres) in Koochiching County are all within 50 miles of the unit (Figure 7).

ADJACENT DEVELOPMENT

Development adjacent to the management area is limited. The southern portion of the unit is surrounded by inaccessible and poorly drained peat bogs, generally unsuitable for commercial, agricultural, or other associated development. The Red Lake Indian Reservation and Upper Red Lake border the management area to the south. The Beltrami Island State Forest encompasses the northern half of the WMA (Figure 7).

Recently, the search for alternative sources of energy has intensified interest in Minnesota's peat resources. In 1975, the Minnesota Gas Company applied to the DNR for a 25-year lease to mine peat from approximately 200,000 acres of state-owned lands in Beltrami, Lake of the Woods, and Koochiching Counties. The proposed development area includes about 54 square miles of peatland in the southeastern portion of the Red Lake WMA (Figure 3). The lease is pending until the peat mining and reclamation techniques and resultant environmental impacts are fully assessed. The State of Minnesota is in the process of formulating a peatland management policy. The DNR, Division of Minerals has initiated a comprehensive program to delineate and inventory major peatlands and to study the feasibility and impact of peat utilization and reclamation on the area.

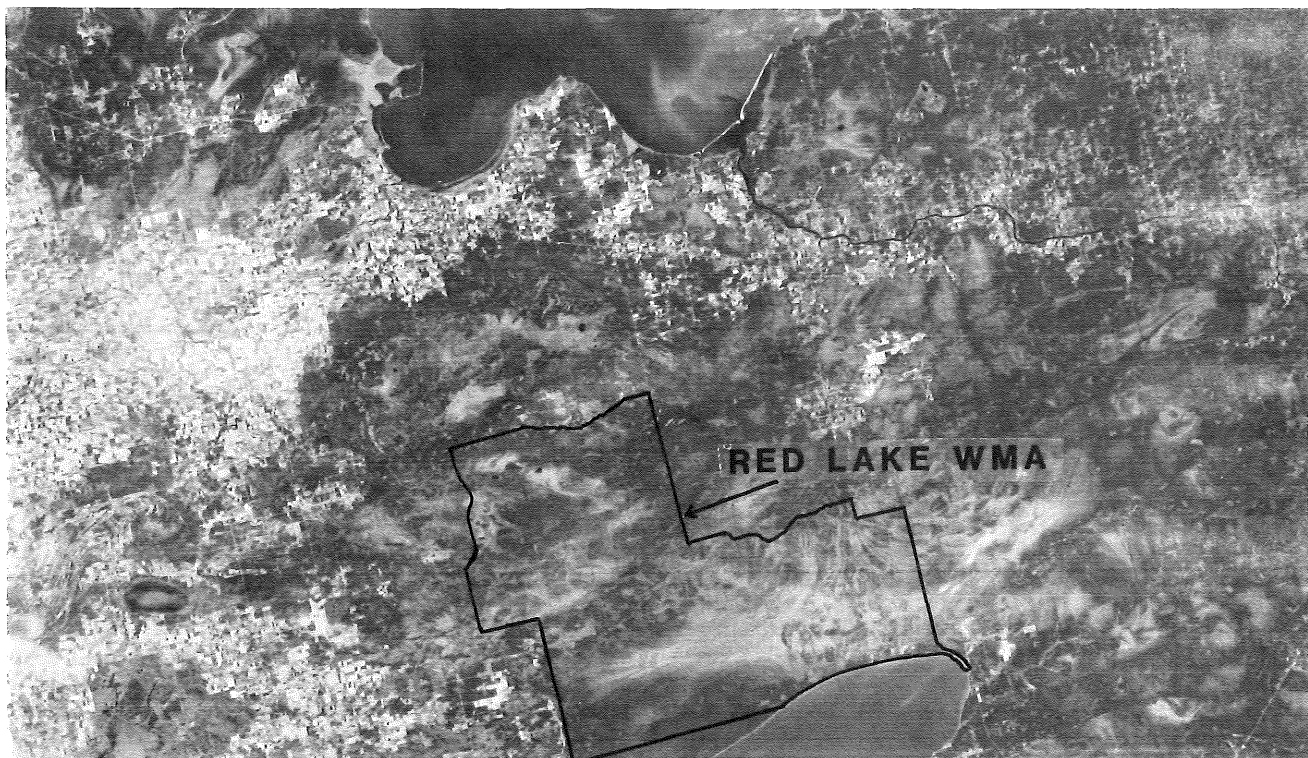


Figure 6

Table 29. Public recreation areas in Beltrami and Lake of the Woods Counties.

Area	Name	County	
		Beltrami	Lake of the Woods
State Parks (acres)	Zippel Bay		2,786
	Lake Bemidji	2,700	
Wildlife Management Areas (acres)	Red Lake	265,632	151,824
	Carmelle	160	
	Long	155	
	Morph Meadows	320	
	Northwood	160	
	Beltrami R.C.1	160	
	Beltrami R.C.2	160	
	Shooks	19	
	Shotley	30	
	Long Point		195
	North		120
	Rako		400
State Forests (acres)	Beltrami Island ¹	183,468	246,896
	Red Lake	59,257	
	Northwest Angle		14,399
	Blackduck	7,898	
	Buena Vista	18,488	
	Mississippi Headwaters	6,180	
National Forest (acres)	Chippewa ²	69,468	
Water Facilities	Swimming beaches	81	12
	Marinas	86	31
	Marina capacity (boats)	832	574
	Public water accesses	40	1
Trails (miles)	Nature	8	7
	Snowmobile	92	112
	Hiking	64	17
	Horse	18	4
	Bicycle	6	2
	Multi-use	51	8
Camping Areas	Areas	53	19
	Campsites	825	397
Picnic Areas	Areas	48	18
	Tables	328	62

¹ A portion (75,590 acres) of the state forest also lies in Roseau County.

² Portions also lie in Itasca and Cass Counties.

Sources: Minnesota DNR 1974, 1976, 1978b.

BELTRAMI ISLAND STATE FOREST

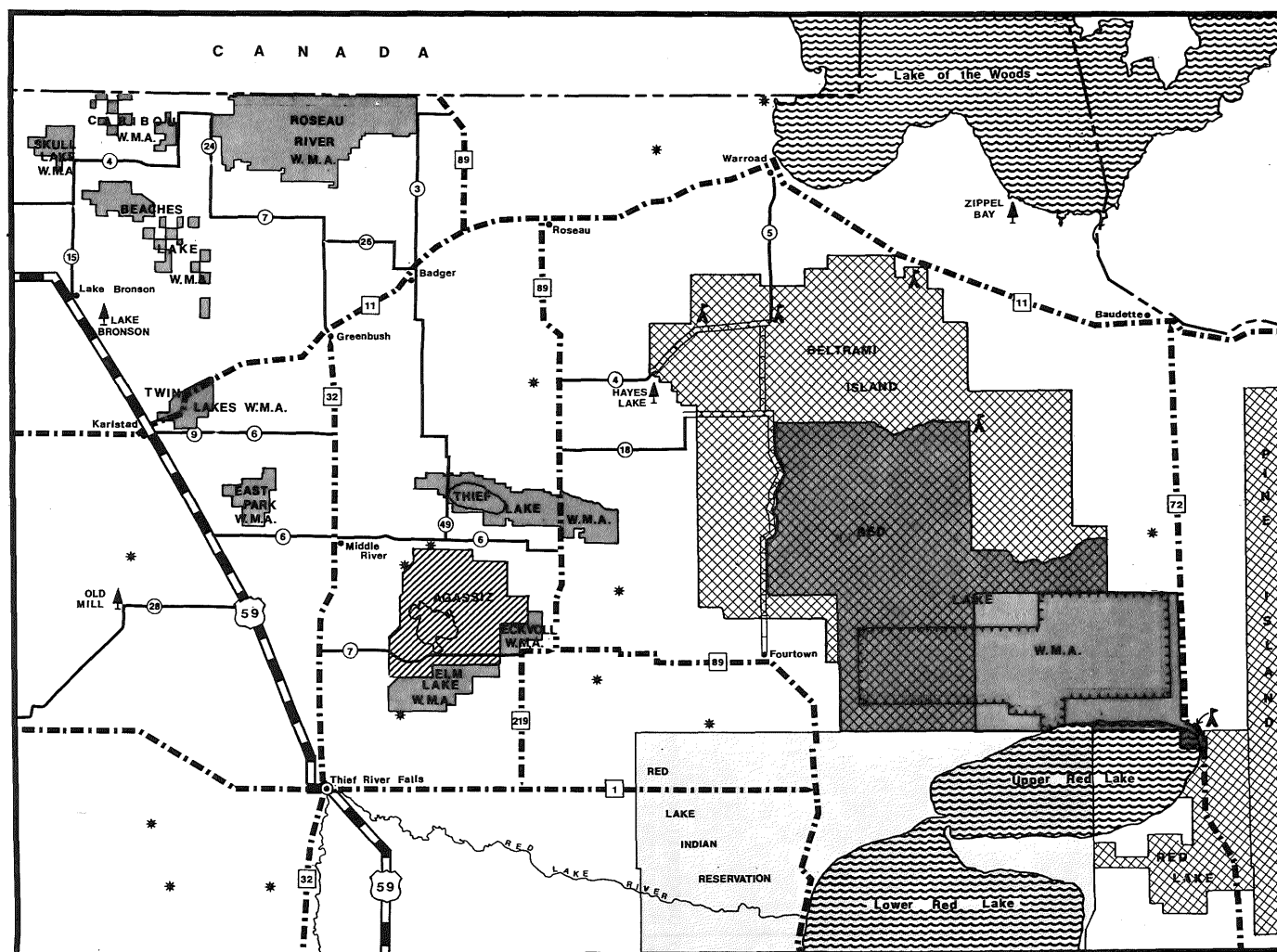
In 1933, the Minnesota Legislature established the Beltrami Island State Forest in Beltrami, Lake of the Woods, and Roseau Counties for growing, managing, and harvesting timber and other forest crops. The forest includes approximately 669,030 acres within the statutory boundaries, of which 505,954 are controlled by the Division of Forestry (Figure 7). The present boundaries include about 60 percent of the Red Lake WMA.

Recreational facilities managed by the Division of Forestry include three campgrounds with 14 campsites and 10 picnic sites, a ski and toboggan slope, nature trails, and 250 miles of snowmobile trails.

CONSOLIDATED CONSERVATION LANDS.

Legislation between 1929 and 1933 authorized the state to take title to all parcels of tax-forfeited land in Aitkin, Beltrami, Koochiching, Lake of the Woods, Mahnomen, Marshall, and Roseau Counties. A total of 1,917,705 acres of land in these seven counties were

SELECTED STATE AND FEDERAL AREAS IN NORTHWESTERN MINNESOTA



LEGEND

- LARGE WILDLIFE MANAGEMENT AREA
- SMALL WILDLIFE MANAGEMENT AREA
- STATE FOREST
- STATE PARK
- STATE FOREST CAMPGROUND
- PEATLAND NATIONAL LANDMARK BOUNDARY
- NATIONAL WILDLIFE REFUGE
- INDIAN RESERVATION
- INTERNATIONAL BOUNDARY
- U.S. HIGHWAY
- STATE HIGHWAY
- COUNTY ROAD
- STATE FOREST ROAD

Scale in Miles
0 5 10 20



Figure 7

acquired by the state, including 349,628 acres in the Red Lake WMA. These lands, called Consolidated Conservation lands, were placed under the administration of the DNR. The DNR was required to classify these lands with respect to their suitability for agriculture, forestry, and wildlife. Lands classified more suitable for agriculture were to be sold at public auctions. As of 1978, approximately 356,709 acres (19 percent) of the Consolidated Conservation lands had been sold. The remaining 1,559,996 acres are largely marginal for agriculture, but provide important habitat for a variety of wildlife species.

The Commissioner of Natural Resources has the authority to dedicate Consolidated Conservation lands for natural resource purposes (state forests, state parks, WMA's, etc.). Controversy has existed over whether these lands should be retained for natural resource use or reclassified and sold to the public.

RED LAKE PEATLANDS

The Red Lake peatlands north of Upper Red Lake in Beltrami County and parts of adjacent counties contain some of the best representative expanses of continuous, patterned peatlands in the contiguous United States.

In 1975, 137,920 acres of peatland in the southern half of the Red Lake WMA (Figure 7) were placed on the National Registry of Natural Landmarks by the U.S.

Department of the Interior. Designation as a natural landmark has not affected state management activities on the area, nor does it confer any restrictions on land use.

The DNR, Scientific and Natural Areas (SNA) Section is proposing that the Red Lake peatland be included under their registry system of areas with unique and rare resources of high significance to the natural diversity of Minnesota. Registration involves no legal or financial commitments by the managing agency, nor does it affect management activities on the area. The SNA Section and the Commissioner's Advisory Committee on SNA's is reviewing and evaluating information on the peatlands to determine if the area meets the criteria for registration.

RED LAKE INDIAN RESERVATION

The Red Lake Indian Reservation was established in 1889. The western one-third of the reservation was ceded to the federal government by the act of February 20, 1904 (Dana et al. 1960). The reservation borders the wildlife management area to the south (Figure 7) and includes approximately 637,000 acres in Beltrami and Clearwater Counties. In addition, about 157,000 acres of land in scattered tracts extending northward to the Canadian border have been ceded to the Red Lake Band since 1934.

RECREATION DEMAND AND CAPACITY

Anticipating the future demand for hunting, trapping, fishing and other compatible outdoor recreational uses is important for the development of an effective management plan. By relating future demand to the recreational capacity of the area, programs can be designed to both utilize and protect the area's resources.

DEMAND

Projecting the wildlife and fish-oriented use of the Red Lake WMA is difficult. Projections can be made for hunting, trapping, and fishing by examining statewide population trends, license sales, game abundance and harvest, and availability of private and public lands for these activities. The future demands for other types of compatible recreation can be estimated from participation surveys if the survey limitations are recognized (Minnesota DNR 1974).

Deer hunting license sales have increased since 1940 at a rate greater than the overall population growth. Sales are expected to fluctuate between 250,000 and 350,000 with an upward trend through the next 10 years. Archery-deer license sales increased from 12,500 in 1970 to 32,300 in 1978; an increase over twice as great as the increase in firearms license sales during the same period.

Small game license sales declined from a 1958 high of 379,667 to 221,154 in 1969. Much of the decrease

was probably due to the pheasant decline in southern Minnesota. However, sales of small game licenses have stabilized at about 280,000 to 300,000 since 1970 and are expected to remain near this level in the near future. Small game hunting pressure on the Red Lake WMA has probably not been affected by decreases in license sales related to pheasant declines.

Over one-half of the total small game license holders are waterfowl hunters. Federal migratory waterfowl stamp sales, which closely parallel waterfowl hunter numbers, have fluctuated between 122,000 and 180,000 since 1969. The number of waterfowl hunters should remain a relatively constant proportion of the state's population if waterfowl populations and hunting regulations do not change significantly (Minnesota DNR 1974). Future regulation restrictions, decreases in waterfowl populations, or increases in the price of the federal or state migratory bird stamps may depress the number of Minnesota waterfowl hunters. Liberalization of regulations would probably increase waterfowl hunters.

The demand for trapping will probably be related to the availability of places to trap, furbearer populations, and fur prices. The number of trapping licenses sold in Minnesota has varied widely from a high of 53,899 in 1964 to a low of 5,903 in 1971. License sales stabilized at about 11,000 to 14,000 between 1973 and 1978. Due to increasing fur prices and furbearer populations,

license sales increased to 18,121 in 1979 and over 30,000 in 1980. Trapper numbers are expected to remain near this level or decrease slightly in the near future.

The proportion of Minnesota residents that fish will probably remain at the present level or increase very slowly. Fishing opportunities on the management area are limited to Upper Red Lake. In the near future, fishing demand on the unit should about equal overall state increases.

Although the preceding discussions are only qualitative, these projections do suggest that total hunting, trapping, and fishing demand in Minnesota will not increase dramatically in the near future. The same trend is developing for other wildlife and fish-oriented recreation. Intensified agricultural practices, forest succession, increased posting of private lands, and more restrictive trespass laws will, however, increase the importance of state wildlife management areas to wildlife and sportsmen. Additionally, forest habitat improvement for white-tailed deer is concentrated on wildlife management areas or other public lands and will attract an increasing number of hunters. Wildlife management areas are important for a growing number of urban hunters who have difficulty obtaining access to private land. As Minnesota's population increases, so will the number of hunters, especially the urban hunters, who rely on wildlife management areas. Although Minnesota sportsmen and wildlife enthusiasts are mobile, most recreational pressure will occur on lands closest to densely populated regions.

The Red Lake WMA will probably experience an increased demand for deer and small game hunting and other wildlife-oriented recreation equal to the state average. However, if fuel shortages develop or transportation costs continue to increase, a decrease in use could occur, since the majority of users travel more than 100 miles to the area.

CAPACITY

In order to develop comprehensive plans insuring quality public recreational use while protecting a wildlife management area's resources, the capacity of the area for hunting, trapping, fishing, and other compatible uses must be examined. The capacity of the Red Lake WMA is related to many factors, such as fish and wildlife abundance, regulations, topography, vegetation, and access. Excessive user-densities result in interference or conflicts between sportsmen. The U.S. Fish and Wildlife Service and U.S. Bureau of Outdoor Recreation (now the Heritage Conservation and Recreation Service) have developed hunter density guidelines for quality hunting which may be a useful guide for wildlife management areas (Table 30). Concentrations of sensitive wildlife populations may require the exclusion of hunting, trapping, fishing, or trespass at specific times from sanctuaries and refuges established within a wildlife management area.

Futhermore, quality experiences also depend on the sportsmanship and sense of responsibility of hunters and fishermen. Thus, the same set of user-density standards cannot be applied uniformly to all wildlife management areas. The capacity of the Red Lake WMA to accommodate hunters should be examined in terms of hunting experiences which are rewarding to hunters and acceptable to the nonhunting public.

The Division of Fish and Wildlife encourages the use of wildlife management areas for activities related to fish and wildlife or their habitats. A management area's attractiveness for and capacity to support compatible outdoor recreation depend on many factors, such as access, the variety and sensitivity of the area's wildlife populations, plant communities, and topography. Although the Red Lake WMA is used primarily for hunting, trapping, and fishing, the area can also accommodate many people each year interested in nature observation, hiking, environmental education, the understanding of wildlife management techniques, and other compatible activities.

Table 30. Hunter density guidelines proposed by the U.S. Fish and Wildlife Service and the U.S. Bureau of Outdoor Recreation.

Game Species	Standard	Length of Stay (hours)
Geese	1 blind per 200 yards per 2 hunters	4
Ducks	1 blind per 10 acres of marsh per 2 hunters or 1 blind per 200 yards	4
Upland game birds	13 hunters per square mile	2
Small game	13 hunters per square mile	4
Pheasants	64 hunters per square mile	3
Deer	13 hunters per square mile	8

Sources: U.S. Department of the Interior 1967, 1972.

MANAGEMENT PROGRAMS

Plans for the Red Lake WMA should insure the sustained production and use of a variety of wildlife and fish and the protection of unique scientific, historic, and aesthetic resources. To develop plans, management objectives were identified, factors influencing management programs were considered, present management programs were described, and future programs were then developed from research knowledge and past experience. Current emphasis on the Red Lake WMA is on forest habitat management for wildlife, but wetland and non-forested upland habitat management as well as public use management will also receive high priority.

ADMINISTRATION, MANAGEMENT, AND LAND ACQUISITION

Objectives. The Red Lake WMA and overlapping Beltrami Island State Forest will be managed cooperatively by the Divisions of Fish and Wildlife and Forestry for wildlife, forest products, and outdoor recreation. The WMA boundaries will be adjusted to facilitate management and eliminate lands with low wildlife management potential. The Division of Fish and Wildlife will seek to acquire, exchange, consolidate, or cooperatively manage lands not under DNR administration within the WMA.

Considerations. Administration and land ownership are critical problems on the Red Lake WMA. Problems exist because of the state forest-WMA overlap, the varied and scattered nature of land ownership (state, private, Indian, federal leased land), and the large size and complex history of the area.

The overlap of the Beltrami Island State Forest and the Red Lake WMA has created much confusion over the administration of lands within the boundaries of both units. There is no formal document designating the Red Lake unit as a state wildlife management area, but the area has been referred to as a WMA in a series of DNR Commissioner's orders and in numerous DNR publications. Also, the legislature recognized the unit as a wildlife management area by including it under the provisions of the Outdoor Recreation Act of 1975. The potential for confusion over the unit's classification is increased by the posting of most of the unit only as a state game refuge. The area is still commonly called "The Refuge" locally.

The Outdoor Recreation Act of 1975 (Minnesota Statutes, Sec. 86A, 1978) specifies the purposes, requirements, and administration of all of the 11 components of the state outdoor recreational system, including state forests and WMA's. Secondary units may be authorized wholly or partially within the boundaries of another unit, provided that the administration of both units is consistent with the purposes and objectives of the respective units. State wildlife management areas may be authorized wholly or partially within a state forest. However, only state water access sites are permitted within a state wildlife management area.

Priority ratings have been established for wildlife land acquisition. Critical ratings were applied to lands

needed as soon as possible to protect or develop important wildlife habitat or solve serious management problems. Lands needed for future management, development, or habitat preservation were designated as desirable. Eventual ratings included lands needed to consolidate ownership and increase the manageability of the unit.

Land acquisition on the Red Lake WMA has been complicated by the many individual tracts and different landowners involved, the unfavorable attitudes toward state land acquisition, and the lack of acquisition funds. Also land acquisition in this area has been given a low priority. Statewide wildlife acquisition programs have concentrated on wildlife lands in better agricultural areas of the state where intensive agricultural practices have been rapidly eliminating wildlife habitat.

Land purchases or leases by the state for wildlife purposes must be approved by the county board of commissioners (Minnesota Statutes, Sec. 97.481, 1978). County boards have recently opposed further land acquisition by the state in the northwest until land-use classification procedures for Consolidated Conservation lands are agreed upon. Land classification negotiations between the DNR and the affected counties are in progress.

Although the unit has existed since the 1930's, over 16 percent of the project is not yet state-owned (Table 19). Over 29,800 acres of Red Lake Indian Reservation land are scattered throughout the WMA. Federally-owned Beltrami Island lease lands make up 5 percent of the unit, and scattered private tracts occupy 4 percent. These scattered parcels of land make management, use by the public, and game law enforcement very difficult. It is impossible to confine Indian use to Indian lands and general public use to public lands. Surveying and posting of these lands would be prohibitively expensive for either the Indians or the state. Consolidated Conservation lands, administered by the Division of Forestry, comprise about 83 percent of the management area.

The 12,160-acre Brown's Lake Waterfowl Refuge was established in 1971 to protect the resident goose flock. Since 1971, WMA personnel have invested considerable labor and funds developing the impoundment and surrounding area into one of the better wetland complexes in the management area vicinity. This area also contains valuable upland wildlife habitat and lowland conifer areas important as winter deer concentration areas. State lands account for about 90 percent of the refuge. The remainder consists of scattered tracts of private, unclassified federal, Red Lake Indian, and Beltrami Island lease lands. The WMA headquarters is located adjacent to the refuge, facilitating maintenance and development on the area.

The Red Lake peatland, encompassing approximately 285,000 acres in northern Beltrami and a portion of Koochiching County, is the largest and most distinctive, continuous area of patterned peatland in the contiguous United States (Gorham et al. 1979). A

unique complex of vegetational patterns and plant communities, including ribbed fens, raised bogs, and ovoid and teardrop-shaped islands, occur on the area. The majority of the Red Lake peatland is state-owned and lies within the Red Lake WMA and the Beltrami Island and Pine Island State Forests.

WMA's are managed primarily for wildlife production and public hunting and trapping. Although a variety of wildlife species utilize peatlands, these areas provide poor quality habitat for game species such as moose, white-tailed deer, and ruffed grouse. In addition, public hunting and trapping are extremely limited on these areas because of their inaccessibility, excessive wetness, and low game populations. For these reasons, wildlife management on peatlands has been given a low priority.

In 1935, the Division of Fish and Wildlife acquired 289 acres of land at Waskish with Game and Fish Fund monies. The wildlife values of this area now, however, are negligible, and the area is best suited for recreational uses such as camping, picnicking, and fishing. Waskish is located over 60 miles from the WMA headquarters, making any management expensive and time consuming. In addition, a large portion of the management area along the north shore of Upper Red Lake is in private ownership. (Appendix K, Figure 2).

The WMA headquarters is centrally located to the areas where most management activities occur, providing manpower and equipment for wildlife management, census and surveys, wildfire control, and enforcement. The headquarters is also important for public use management and public safety. WMA personnel provide information to area users and assist in search and rescue operations. Headquarter facilities are also used to house forestry crews, researchers, and other agency personnel.

Administration of the management area and adjacent state forest currently involves five district foresters, three area foresters, one regional forester, one WMA manager, one area wildlife manager, and one regional wildlife manager. Coordination of wildlife and forestry programs under this complex administrative system is difficult. Extensive review of forestry management will require additional wildlife personnel.

A DNR policy for coordination of wildlife and forestry management has been developed. (Appendix G). This policy sets forth specific procedures for the implementation of integrated management and establishes administrative procedures to resolve conflicts which arise. This policy will help implement cooperative management on the Red Lake WMA.

The large size and inaccessibility of the management area creates problems with communications. The lack of an adequate radio system hinders management operations and cooperative programs with other DNR divisions. Considerable time, money, and energy are expended in extra trips from work areas in the field to the WMA headquarters. Radio communications with the Division of Forestry field personnel would be extremely valuable, especially during severe fire danger periods or prescribed burning operations.

Present Programs. The Division of Fish and Wildlife's goal for the Red Lake WMA has been to eventually acquire or administratively control all lands within the project boundary. Because of a shortage of funds, land acquisition has not been completed. In re-

cent years, the state has acquired several tracts of tax-forfeited land on the area, but less than 5 percent of the project has been purchased or is under the administrative control of the Division of Fish and Wildlife.

There is minimal coordination of wildlife and forestry management on the unit. Wildlife management plans involving timber harvest on Division of Forestry-administered lands are submitted to forest managers since they must approve and manage timber sales. Recently, foresters have submitted some cutting proposals in white cedar stands for review by the resident wildlife manager. No required review process has been established.

Except under mutual written agreement, no management is conducted on Red Lake Indian lands. No wildlife management is conducted on peat lands on the WMA. Although the Waskish area is within the unit, WMA personnel do little management on this area except to periodically provide manpower and equipment for special or large projects. The Division of Forestry and Enforcement and the Section of Fisheries are responsible for managing their respective facilities at Waskish.

Communication equipment on the management area consists of 2 mobile radios (Division of Enforcement frequency) and a telephone system. The radios are mounted in pickup trucks, but are generally not used for routine operations. Larger trucks on the WMA do not have any communication equipment. A new underground telephone line was installed to the WMA headquarters in 1979.

Future Programs. A total of 133,350 acres, primarily peatlands in the southeastern portion of the unit and including the Waskish village area, will be deleted from the Red Lake WMA (Appendix K, Figure 2). The Division of Fish and Wildlife will request a DNR Commissioner's Order removing this area from the Red Lake Game Refuge. This deletion lies outside the Beltrami Island State Forest; however, the Division of Forestry will retain administrative control of Consolidated Conservation lands which comprise 88 percent of the deleted area (Table 31). Disposition of Division of Fish and Wildlife land (289 acres) in the Waskish area will be decided after consultation between the Commissioner of Natural Resources and the Divisions of Forestry, Fish and Wildlife, Enforcement, and Parks and Recreation. It is recommended that all or part of the deletion be designated as a state forest, state scientific and natural area, state wilderness area,

Table 31. Ownership and acreage of lands within the Red Lake WMA deletion.

Ownership	Acres	Percent
Private	4,857	3.6
Red Lake Indian Reservation	6,592	5.0
Beltrami Island Lease (L.U.P.)	2,565	2.0
Other Federal lands	320	0.3
State		
Consolidated Conservation	118,037	88.4
Volstead	670	0.5
Division of Fish and Wildlife	309	0.2
Total	133,450	100.0

or some combination of these to protect unique peatland features and plant communities occurring on the area.

The Red Lake WMA-Beltrami Island State Forest area will be managed cooperatively by the Divisions of Fish and Wildlife and Forestry as specified in a Memorandum of Agreement between the two divisions (Appendix H). In accordance with the DNR's Wildlife/Forestry Coordination Policy (Appendix G), Wildlife and Forestry personnel will develop management programs through cooperative planning to maximize wildlife and forestry benefits. Forest management plans will be reviewed and approved by the resident manager prior to implementation. Likewise, the area foresters will review and approve plans for wildlife management and development. The wildlife manager and area forester may mutually agree to waive the review and approval process for certain types of projects. If funds are available, an additional full-time wildlife manager will be hired to implement the cooperative management agreement with the Division of Forestry.

Conflicts between long-term wildlife and forestry objectives on specific tracts of land will be resolved, if possible, through the forestry/wildlife coordination process. If conflicts cannot be resolved at lower administrative levels, the Commissioner of Natural Resources will either recommend modification of forestry or wildlife objectives or transfer administrative control of specific tracts of land between the Divisions of Fish and Wildlife and Forestry by lease, purchase, or dedication.

Concurrent with the publication of this plan, the Division of Fish and Wildlife will request a DNR Commissioner's Order to vacate the Red Lake Game Refuge and formally designate the Red Lake unit as a state wildlife management area. The project boundary will then be posted with state wildlife management area signs.

Private and unclassified federal lands within the WMA are assigned an acquisition priority rating (Appendix I). Six tracts, totaling 880 acres, are rated as critical. Desirable lands include 31 tracts, totaling 1,990 acres. The remaining 45 tracts, totaling 7,483 acres, are rated for eventual acquisition (Appendix K, Figure 2).

Private land will be acquired as funds become available and owners are willing to sell. For this reason, a definite acquisition schedule is not possible. Land exchanges will be negotiated, if possible, when land-owners desire. Priority will be given to acquiring tracts of land rated as critical or desirable.

The Minnesota DNR will seek to develop cooperative agreements with the Red Lake Band for wildlife management on Indian lands in the Red Lake WMA. The DNR will negotiate agreements on census methods, harvest quotas, and seasons for all wildlife in the area of scattered Indian holdings. The possibility of an exchange or consolidation of the Indian lands on the management area will be investigated. The DNR will also seek approval from the U.S. Fish and Wildlife Service for eventual acquisition of the Beltrami Island lease lands (L.U.P.).

Current wildlife management activities will continue on the Brown's Lake Waterfowl Refuge. Norris Camp will remain as the WMA headquarters.

Communication systems on the management area will be improved. Additional radio equipment will be installed in all trucks in current use, and a base

transceiver will be obtained for the WMA headquarters. In addition, the well system at the assistant manager's residence is inadequate and will be replaced.

FOREST MANAGEMENT

Objectives. Forests will be managed cooperatively by the Divisions of Fish and Wildlife and Forestry for wildlife and forest products. Forest management for wildlife will be most concerned with game species, such as white-tailed deer, moose, and ruffed grouse, but a variety of nongame wildlife will also benefit.

Considerations. Current forest types and their distribution have an important effect on the species, density, and distribution of wildlife on the Red Lake WMA. Plant communities, however, are not static. Through natural plant succession and human influences, the structure and composition of the plant communities are continuously changing. Wildlife populations respond to these changes in the forest. To achieve the management objectives, forest manipulation will always be required.

Forests on the Red Lake WMA are extensive and can be managed most efficiently by commercial logging. Studies in Minnesota have demonstrated the effectiveness of commercial timber harvest as a wildlife management technique (Rutske 1969, Erickson et al. 1961, Stenlund 1971). The type, total acreage, and spatial distribution of timber harvest will depend on market prices, timber demands, and accessibility of logging sites to loggers. In recent years, the demand for softwood pulpwood and sawlogs has been stable. Due to poor market conditions in the past, abundant aspen exists in both the pulpwood and sawtimber size classes. The Division of Forestry, however, expects the demand for aspen and softwoods in this area to increase in the near future as several new wood-products plants are being developed in northcentral Minnesota.

Fire prevention and suppression, forest succession, and site conversions to plant types less favorable to wildlife all reduce the capability of the area to produce forest game species. Forest manipulation by logging, prescribed burning, and mechanical methods removes mature trees and promotes resprouting of tree species as well as understory shrubs and herbaceous plants. The result is an increased yield of available woody browse and other food for wildlife and increased habitat diversity through establishment of a multiple age class forest.

While some wildlife species are most clearly associated with climax plant communities, others such as white-tailed deer and ruffed grouse depend on plant communities of different successional ages at different times during the year. Studies in Minnesota and Wisconsin have shown that early successional forest types contain the greatest abundance of deer forage (McCaffery and Creed 1969, Rutske 1969, McCaffery et al. 1974, Kohn and Mooty 1971). As the forest matures, there is a reduction in the production of palatable deer forage due to increased shading (Wetzel et al. 1975). Optimum grouse habitat contains a mosaic of forest age classes within the restricted foraging range of grouse (Gullion and Svobada 1972).

Management for deer and ruffed grouse is generally beneficial to moose. However, non-forested habitats such as lowland brush and wetlands are also important to moose. Phillips et al. (1973) reported heavy use of willow and willow-aspen habitats by moose in northwestern Minnesota.

Deer in this region generally concentrate in mixed deciduous-coniferous or lowland conifer stands for protection from severe winter weather, often with little regard for the availability of food. White cedar and balsam fir provide the most important winter cover (Wetzel et al. 1975). These stands provide a favorable microclimate which reduces body heat loss and reduces travel restrictions caused by deep snow (Ozoga 1968). Wintering areas receive increased use with increases in snow depth and decreases in snow supporting qualities. Many stands provide little palatable deer forage. Wintering areas are often long-established and traditional, with the same deer often returning each winter (Hoskinson and Mech 1976, Verme 1973). Dense winter cover is also important to moose during severe weather and deep snow conditions (Phillips et al. 1973).

White cedar is a long-lived species, but is not a climax type and will require management in order for these stands to continue as an important component of winter deer habitat. White cedar regenerates by layering, suckering, and seeding and produces a good seed crop every three to five years (Johnston 1977). Regeneration, however, is suppressed in many stands by poor site conditions or heavy browsing pressure. On many sites, other trees, such as balsam fir and black spruce, gradually replace white cedar, particularly after disturbances. Timber management practices to regenerate white cedar have been proposed by Petraborg (1969), Verme (1972), and Johnston (1977). Attempts to regenerate white cedar must be carefully planned, however, as the success of various techniques varies, depending on such factors as site characteristics, site treatment, stand size, and associated tree species.

Jack pine is a shade-intolerant, short-lived species, often pioneering on burns or bare sandy soil. Fires favor the natural regeneration of jack pine by killing the shrub and tree competition, preparing seedbeds, and releasing seeds from the serotinous cones (Benzie 1977). Depending on the site characteristics and postlogging treatments, jack pine clear-cuts can often supply significant amounts of shrubby and herbaceous deer browse for a period of up to 10 years following cutting (McCaffery and Creed 1969). In addition, studies have shown that jack pine, especially young trees, are utilized by deer for winter forage (Mooty 1976, Rutske 1969). Wildlife use of lowland conifer types, however, is quite limited and clear-cuts on these types produce little wildlife forage.

Extensive mature conifer stands are of little benefit to ruffed grouse. Spruce and balsam fir may occasionally provide useful winter cover for grouse if they occur in small dense stands. Pines, up to 15 to 20 years of age, can provide valuable cover until self-pruning begins (Gullion 1967).

Studies have also shown the close relationship between aspen communities and deer and ruffed grouse populations and have emphasized the importance of proper management of this forest type on these wildlife species (Rutske 1969, McCaffery et al. 1974, Gullion and Svoboda 1972). Aspen and aspen-birch forest types, especially following disturbances, supply the greatest amounts of preferred deer forage. Aspen alone in the proper age class diversity can supply all the basic habitat requirements of ruffed grouse. Flower buds of mature male aspen trees are an important winter food resource (Gullion 1969).

Several factors affect aspen regeneration. Clear-

cutting of aspen stands is preferable, as shade cast by residual trees inhibits aspen regeneration. Suckering generally increases as the density of the parent aspen stand harvested increases (Perala 1972). Aspen approaching 60 to 80 years old does not resprout as vigorously following timber harvest as 40 or less year old aspen (Graham et al. 1963). In the absence of disturbances favoring regeneration, aspen stands begin to deteriorate without regeneration at an age of 60 to 80 years on most sites, and the clonal stock will be lost permanently (Gullion 1969). However, as long as a few live aspen trees per acre remain, such stands can generally be regenerated through clear-cutting (Fralish 1972).

Aspen clear-cuts resulting in 12,000 to 15,000 aspen suckers per acre that grow to five feet in height during the first growing season are desirable. With this level of regeneration, stem density will exceed 10,000 stems per acre by the fourth growing season and will provide optimal ruffed grouse activity centers (Gullion 1970, Gullion and Svoboda 1971).

Poorly stocked, low quality (off-site) aspen stands, due to their open canopy, generally support an abundance of herbaceous and woody deer forage. Cutting of these stands results in dense suckering, which shades out ground flora and quickly grows out of reach. For some off-site aspen, therefore, it may be more beneficial not to regenerate the stand and allow it to perpetuate the desirable understory flora (Verme 1972).

Clear-cuts are generally attractive to deer, but their characteristics may limit their use (Drolet 1978). Deer tend to avoid large, open expanses, especially during winter (Verme 1972). In cuts larger than 40 acres, deer use tends to be restricted to edges. As deer become increasingly restricted to dense cover by accumulating snow, deer use of larger clear-cuts and cuts located farther from cover is considerably reduced (Verme 1972, Drolet 1978).

Removal of logging debris (slash) following timber harvest encourages greater ruffed grouse and deer utilization (Gullion 1976, Stormer and Bauer 1980.) and improves hunter access. Slash also provides horizontal cover that provides more concealment for grouse predators than grouse (Dolgaard et al. 1976). Full-tree harvesting and limbing at central sites are beneficial since they concentrate slash. Prescribed burning has been used to remove slash on other areas (Sando 1972) and is beneficial to nutrient cycling. Slash can be removed by mechanical means, but removal is expensive and tree stumps prevent the effective use of heavy equipment.

Evaluations of wildlife habitat on an area are necessary to effectively direct management activities to ensure the greatest benefit to wildlife. One method of assessing the quality of an area to wildlife is to compare the existing conditions to criteria established for optimum wildlife habitat composition. Habitat evaluation, however, is only meaningful when criteria are applied to definite units of land. On forested areas, Minnesota DNR wildlife biologists have suggested a four square mile area as the basic unit for deer habitat evaluations. Based on accepted habitat requirements for deer in the Lake States, general forest composition guidelines for quality deer habitat on a four square mile block were determined. These guidelines were modified for the Red Lake WMA (Table 32). Using these guidelines, the wildlife manager should ideally be able to divide an area into four square mile blocks, and, after evaluation, state the relative quality and

management required to most effectively obtain the composition goals for each habitat block. These goals would obviously not be attainable or desirable on all blocks within an area. Some blocks may have management priorities for other wildlife species, while others may have restrictive factors, such as soil fertility and

moisture, preventing desired habitat manipulations. Blocks where habitat goals are unrealistic will receive the lowest wildlife management priorities. Forest management to improve deer habitat will also benefit moose, ruffed grouse, and a variety of other forest wildlife species.

Table 32. Forest composition goals and timber management guidelines for white-tailed deer on the Red Lake WMA.

Type	Percent of four square mile management block	Management Conditions
Aspen	40-60	Aspen stands should be clear-cut on a 40-year rotation in blocks of less than 40 acres, preferably 10-20 acres. Cuts should be narrow and irregular to create the maximum amount of edge. Cuts should be planned so that 25 percent of the aspen is in each of four age classes: 0-10, 11-20, 21-30, > 30.
Mixed deciduous-coniferous	10-15	Manage by forestry recommended guidelines. Cuttings should be less than 40 acres and narrow and irregular in shape. Mixed stands, especially within or adjacent to deer yards, should be evaluated for their importance as winter cover by the resident wildlife manager before being approved for cutting.
Other intolerant deciduous types (upland brush, birch, oak)	0-5	Manage by forestry recommended guidelines. In stands with oak, leave a number of mature trees for mast production and den sites.
Conifer		
Jack pine	10-15	Jack pine stands should be clear-cut according to forestry recommended rotation. Cuts should be planned to create a diversity of age classes. Prescribed burning followed by reseeding, if necessary, is the preferred method of site preparation for jack pine regeneration.
Lowland conifer (white cedar, black spruce, tamarack)	5-10	White cedar cuts must be approved by the resident wildlife manager and should be planned only on sites where cedar regeneration is possible or where loss of winter deer habitat is not significant. Lowland conifer stands should be rim-cut or clear-cut in narrow, alternate strips to encourage regeneration.
Other conifers (white spruce, red pine, white pine)	0-5	Manage by forestry recommended guidelines.
Other types (bottom-land hardwoods, low-land brush, wetlands)	0-5	Selectively cut bottomland hardwoods to maintain the stand and increase understory browse. Manage lowland brush areas by prescribed burning.
Openings	10 (half of which are brushy and half grassy or in food plots)	Maintain as necessary. Openings should be less than five acres in size and preferably narrower than 330 feet. Openings should be well distributed both within the deer summer range forest types (aspen, upland brush, jack pine, mixed deciduous-coniferous) and adjacent to deer wintering areas.
All types		Cuttings should be distributed to create the maximum age class diversity. Avoid large clear-cut areas created by placing a number of smaller cuts adjacent to one another. If smaller clear-cuts are not feasible or economical, large cuts may be allowed at the wildlife manager's discretion. On large cuts, alternate strips or blocks of sufficient size to prevent wind-throws and provide cover should be left uncut. The intervening timber should be left for a minimum of 5 years, preferably longer. When possible, cuttings should be planned for the fall and winter. Concentrate on cutting mature deciduous timber in or adjacent to deer yards. Burn or cut slash low (<12 inches) to the ground to increase access to the area. Avoid herbiciding regenerating sites.

Present Programs. District foresters at Clear River, Grygla, Waskish, and Williams are responsible for managing the timber resource and conducting commercial timber sales on the Red Lake WMA. Timber sales are conducted through informal sales or auctions to commercial loggers. The resident wildlife manager works in cooperation with the district foresters and makes recommendations when possible on timber management practices affecting wildlife.

District foresters develop annual cutting plans based on annual harvest recommendations, market conditions, accessibility of sites, and the maturity and condition of stands. Priority is generally given to damaged or diseased stands.

Timber is managed on a rotational basis. The interval between successive harvest on the same area varies between 50 and 110 years depending on the tree species. Trees are cut for pulpwood, bolts, poles, and sawtimber; a limited number of fuelwood permits are also issued. Aspen is generally clear-cut for pulpwood on a 40 to 50-year rotation, as market conditions permit. Better stands of aspen in accessible areas may be managed for sawlog production. Jack pine cuttings are concentrated in 60 to 70-year age classes. Some selective cutting of jack pine is done in 40 to 50-year stands to prevent tree losses due to natural thinning. Black spruce stands are generally rim-cut or clear-cut in strips to encourage reproduction. Tamarack is clear-cut where possible on a 100-year rotation.

Approximately 476 and 380 acres of timber were harvested on the management area in fiscal years 1977 and 1978, respectively (Table 33). Black spruce, jack pine, tamarack, and aspen were the most heavily harvested species. The majority of timber was used for pulpwood.

Timber sales usually range between two and 50 acres. Loggers are generally required to cut all merchantable timber and utilize timber to a six to eight inch top diameter for sawtimber, four inch top



Commercial logging is the most efficient method of forest habitat management on the Red Lake WMA.

diameter for pulpwood, and a two inch top diameter for poles. Trees less than six inches diameter at breast height (DBH) are merchantable only for poles. Some permits, especially in aspen stands, require loggers to cut all timber over two inches DBH. Stumps must be cut low to the ground.

Commercial loggers are not required to remove slash but must keep slash low to the ground. Slash-free areas, 30 to 50 feet wide, are generally required next to standing timber and roads or trails and serve as firebreaks. Some slash is sold as fuelwood to the public.

Tree planting on the management area in recent

Table 33. Annual timber harvest on the Red Lake WMA by tree species for fiscal years 1977 and 1978¹.

	FY 1977			FY 1978		
Number of permits and auction sales	48			39		
Permit sales (dollars)	38,571.35			38,793.75		
Acres cut	476			380		
Harvest by species	Cords	MBF ²	Pieces	Cords	MBF	Pieces
Black spruce	2005	—	500	1645	—	—
Jack pine	1901	20	400	1609	—	—
Tamarack	1828	—	—	1535	—	—
Aspen	1305	—	—	1624	—	—
White cedar	251	—	20	165	—	—
White spruce	76	55	—	121	32	—
Red pine	120	1	300	60	18	2200
Balsam fir	6	—	—	0.5	—	—
Paper birch	24	—	—	58	—	—

¹ Fiscal year runs from July 1 to June 30 of the following year.

² Thousand board feet.

years has been limited. Planting programs have emphasized red pine, jack pine, white spruce, and black spruce in the past.

Forest management is also conducted by the resident wildlife manager. A bulldozer and shearing blade are used to regenerate aspen or provide winter food for deer. WMA personnel also develop and maintain access trails and firebreaks. Under severe conditions, unit personnel and equipment also assist the Division of Forestry with wildfire control.

Future Programs. The resident wildlife manager will work in cooperation with the district foresters in developing annual forest management plans to maximize wildlife and forestry benefits on the Red Lake WMA. In conjunction with the timber management goals of the Division of Forestry, future forest management will be directed toward creating and maintaining an optimum distribution of preferred forest types and age classes for deer, moose, and ruffed grouse. When and where possible, forest management will follow the wildlife guidelines for forest composition and harvest techniques outlined in Table 32.

During the next four to five years, an updated forest inventory of the northwest region will be completed by the Division of Forestry. The distribution, age, composition, and condition of various timber types will be mapped. This inventory will provide a basis for developing annual forest management plans.

The wildlife manager will identify areas of critical wildlife habitat, such as bald eagle nest sites or sharp-tailed grouse dancing grounds, on the unit. Forestry management practices on these areas will be reviewed with the district forester and altered, if necessary, to ensure that these areas will be managed to best meet the wildlife objectives. Wildlife recommendations will be given priority consideration on these critical areas.

Forest management will rely heavily on commercial logging. Priority will be given to harvesting stands approaching over-maturity. The degree to which the above goals can be accomplished will depend on future market conditions for timber products. Increases in pulpwood demands are expected in the near future, and the annual timber harvest on the management area will increase accordingly. When possible, the Section of Wildlife will supply funds and/or equipment and manpower to maintain and construct logging roads to provide access for private loggers to areas where timber harvest is desirable.

As aspen is in high demand for commercial purposes and is valuable to wildlife, forest management will emphasize the improvement and expansion of the aspen resource wherever feasible. Priority will be given to regenerating over-mature aspen stands in the process of deterioration (Figure 8). Aspen stands will be managed on a 30 to 40-year rotation. Stands will be clear-cut to favor sucker regeneration and to preserve aspen clonal stock. When economically feasible, clear-cuts will be limited to 20 acres or less in size. Cuts will be placed to provide maximum age class diversity. Cuts will be in irregular shapes or strips where possible to produce more edge. Mature aspen stands adjacent to known or potential winter deer concentration areas will be given cutting priority.

Off-site aspen stands lacking adequate understory forage will be regenerated by mechanical manipulation. The amount of noncommercial management will depend on equipment availability and funding. Prescribed burning as a management technique for regenerating aspen, brush, and stagnant timber sites will be examined.

Winter deer concentration areas will require special management considerations. Known and potential wintering areas will be protected from logging and other disturbances until a survey of the number, distribution, cover type, and deer use-levels of wintering sites is conducted and a wildlife-forestry management plan for these areas is formulated. Information and techniques for regenerating white cedar will be investigated and experimental cutting operations to promote regeneration will be undertaken. When possible, deciduous stands in or adjacent to deer wintering areas will be clear-cut to provide felled browse and regenerating sprouts for deer. Cuts will be small (< 10 acres), narrow (< 330 feet wide), and in irregular shapes or strips (Rutske 1969, McCaffery and Creed 1969). Cutting will be done in fall and winter. Periodic retreatment of these areas will be needed in order to maintain the area in an early successional stage. The number and distribution of these clearings will depend on equipment, funding, and accessibility.

WETLAND MANAGEMENT

Objectives. Wetlands will be managed primarily for waterfowl and furbearer production and migratory waterfowl use. At the same time, marshes will provide areas for public hunting and trapping. Wetlands will be managed to provide stable water levels, an interspersed of emergent vegetation and open water, and waterfowl food plants.

Considerations. Wetlands are managed primarily for ducks and geese. Managed wetlands also provide habitat for a variety of other wildlife. Wetland management practices in forested areas, however, are not well developed, since waterfowl research has concentrated on the prime prairie breeding range. Therefore, management recommendations must be general, allowing the resident manager to experiment with various techniques.

Beaver ponds and abandoned drainage ditches are common on the management area. Beaver ponds may contribute significantly as waterfowl breeding habitat (Beard 1953, Renouf 1972). Mallards, wood ducks, and blue-winged teal breed on small woodland ponds in Minnesota (Cline 1965, Ball 1973). Waterfowl production and use of these sites on the management area, however, are not documented.

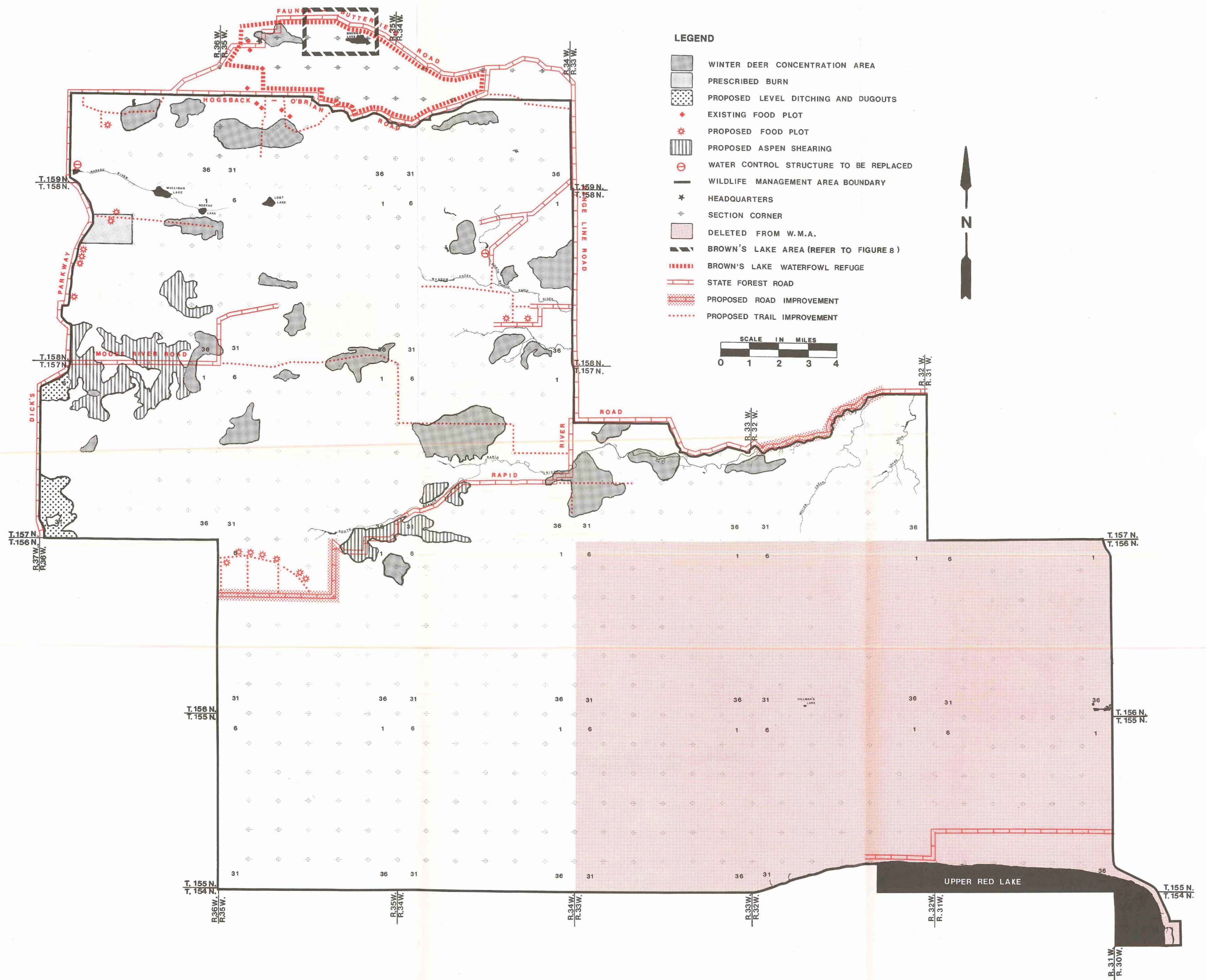
Marshes are dynamic systems requiring periodic water level manipulations to maintain plant and animal productivity and diversity (Weller and Fredrickson 1974). This fact applies to impounded marshes where water level regulation is important in maintaining open water and desirable aquatic vegetation. Emergent vegetation can eliminate much of the open water in shallow impoundments, discouraging waterfowl use by limiting the growth of submerged vegetation and restricting waterfowl movements. Temporary water level drawdowns favor soil nutrient release (Kadlec 1962) and the growth of moist soil plants beneficial as waterfowl food and cover (Linde 1969).

Dikes help retain water in marshes. They should be located where soils are relatively impermeable and where watersheds are adequate to maintain desired water levels. Water control structures are necessary for water level manipulation. On the management area, suitable sites for new impoundments exist on both the Rapid and Roseau Rivers. Proposed impoundments should be carefully examined, however, to assure that the expected benefits justify the projected costs.

Waterfowl breeding habitat can be created by constructing level ditches and dugouts, blasting potholes, or, in peat areas, by burning (Linde 1969). If natural

**FIGURE 8. PROPOSED MANAGEMENT
AND DEVELOPMENT**

RED LAKE WILDLIFE MANAGEMENT AREA PROPOSED MANAGEMENT AND DEVELOPMENT



waterfowl nesting sites are scarce, artificial nest structures and islands or large hay bales in impoundment openings provide suitable nesting sites. When cavities in trees are lacking, wood duck nesting boxes provide nesting substitutes.

Woody vegetation may invade wetland edges or shallows. Late summer or early fall burns are effective in destroying invading brush. However, some brush may provide useful cover for waterfowl broods (Linde 1969).

For waterfowl production, impoundments should be surrounded by grassy openings for nesting cover and goose grazing. Grain and/or green forage food plots for migratory waterfowl use should also be included. These developments increase the diversity of vegetation on the WMA and provide important habitat for deer, moose, furbearers, ground nesting birds, and small mammals. Impoundment complexes also provide excellent sites for hunting, trapping, and wildlife observation and photography.

Past and Present Programs. Dikes have been constructed on the management area to create three shallow impoundments (Figure 4). Water control structures on all three impoundments, however, were damaged by ice and floods, and function only as fixed-level spillways rather than variable water level controls. Funding constraints have prevented replacement of the damaged control structures. Six elevated goose nesting structures and 48 wood duck nesting boxes are maintained annually. Nesting islands constructed in the Brown's Lake impoundment are maintained in nesting cover.

Bulldozers and draglines are used to create dugouts and level ditches. Woody vegetation is periodically removed from wetlands by brush discing or prescribed burning.

Since 1970, a captive Canada goose flock has been managed to produce geese on the area. Between 30 and 50 wing-clipped birds are held year-round at the area headquarters in a 6-acre open-top enclosure. Breeding pens and nesting islands were constructed on a 1-acre pond developed within the enclosure. In 1978, four wing-clipped pairs were released on Brown's Lake and two of these pairs successfully raised broods. In the spring of 1979, nine of 14 nests in the enclosure were successful and 17 goslings were raised. The Brown's Lake Waterfowl Refuge (Figure 9) was established in 1971 to protect the resident goose flock.

Future Programs. Current wetland management and maintenance programs on the WMA and the Brown's Lake Waterfowl Refuge will continue (Figures 8 and 9). Wetland management activities will be directed at developing wetland complexes. Development of food plots, nesting habitat, dugouts, level ditching, and nest structures will be concentrated around impoundment areas.

The damaged water control structures on the Spina and Roseau impoundments will be replaced. Portions of the Shilling impoundment are in Red Lake Indian ownership. The DNR will seek an agreement with the Red Lake Band concerning the management and public access of this impoundment before repairs are undertaken. The cost feasibility and engineering requirements of constructing additional impoundments on the management area will be investigated.

When funds are available and conditions permit, heavy equipment will be used to develop open-water habitat for waterfowl (Figures 8 and 9). Dugouts will be

constructed in wetlands with bulldozers or draglines according to guidelines suggested by Linde (1969) and the Atlantic Waterfowl Council (1972). Level ditches will be constructed with draglines according to recommendations by Hammond and Lacy (1959) and Mathiak and Linde (1956). Woody vegetation in the marshes will be controlled by brush discing and prescribed burning. Additional nesting structures and islands will be constructed as labor and funds permit. Larger natural islands on the Brown's Lake impoundment will be cleared of brush.

Management of the resident goose flock will continue. WMA personnel will continue to release clipped, paired adult birds at Brown's Lake and other impoundments and water areas throughout the Red Lake WMA-Beltrami Island State Forest area. About 12 pairs of birds will continue to be held in the enclosure as breeding stock. As many birds as possible from the resident flock will be captured and banded annually. The number and size of nesting sites within the pen area will be increased, and a larger grazing area will be provided. Much of the Canada goose management on the area, however, is experimental. Continued efforts will be made to evaluate progress so management can be changed as needed. If management efforts in the future fail, Canada goose management will be discontinued.

NON-FORESTED UPLAND MANAGEMENT

Objectives. Non-forested uplands include forest openings, cropland, and upland nesting cover areas. Croplands will be managed as wildlife food plots. Forest openings will be maintained to provide edge and to increase habitat diversity. Upland nesting cover will be managed primarily to provide secure nesting habitat for waterfowl and nongame birds.

Considerations. Forest openings are an important component of forest wildlife habitat and provide a variety of herbaceous forage. Studies have documented the importance of openings to white-tailed deer (McCaffery and Creed 1969), ruffed grouse (Berner and Gysel 1969), and woodcock (Hale and Gregg 1976). Openings provide high quality deer forage in early spring and fall when the nutritional requirements of deer are greatest following winter stress and coinciding with rutting activities. Opening edges supply a variety of preferred ruffed grouse forage generally not found in the adjacent forest (McCaffery and Creed 1969).

Smaller, scattered openings are more valuable to forest wildlife. Openings less than five acres in size and narrower than 330 feet in width were used more intensively by deer in northern Wisconsin than larger openings (McCaffery and Creed 1969). Openings created by forest cuttings are more important to ruffed grouse than sodded openings (Moulton 1968).

Many of the small forest openings on the management area are remnants of old logging camps or homesteads. Many of these openings have developed a dense sod cover. New forest openings are created by logging operations, but are less permanent and require more frequent maintenance than sodded openings. With natural plant succession, woody vegetation will encroach and eventually dominate openings. The result is loss of these habitats and a corresponding decrease in habitat diversity.

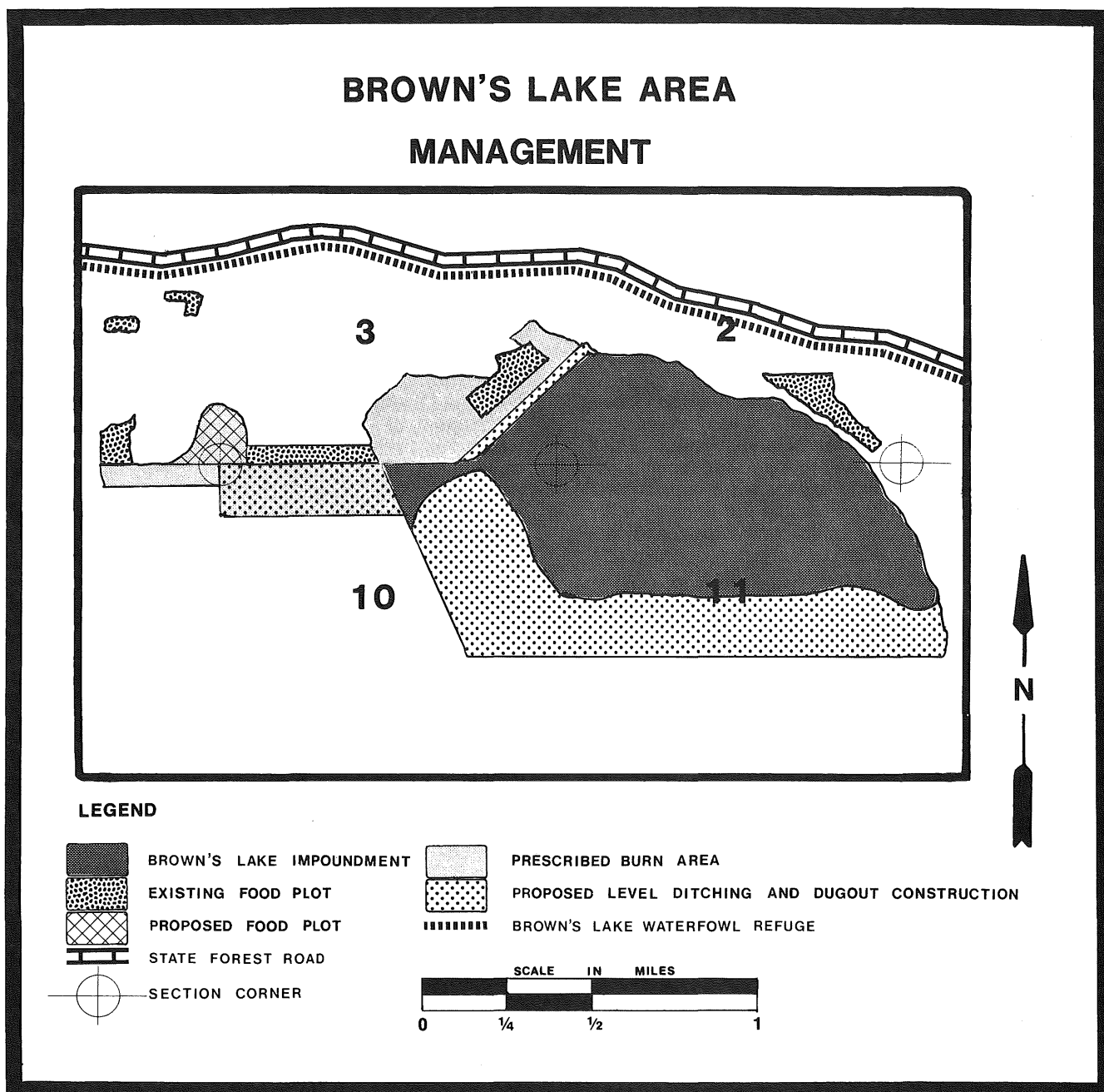
Larger non-forested areas, created by logging, fire, and farming, are an important component of sharp-tailed grouse habitat in the forested region of the state.

In northwestern Minnesota, Artmann and Beer (1970) reported extensive use of open brushland and old fields by sharp-tailed grouse during spring and summer. Agricultural crops appear to be an important food source for sharp-tailed grouse in many areas (Harris 1967).

Dense, undisturbed grasslands close to semi-permanent or permanent marshes are beneficial to upland nesting waterfowl and many nongame birds. These areas are also used by deer and a variety of small mammals. Upland nesting areas require active management to maintain the desired plant species and habitat structure. Prescribed burning improves the

density and height of cover, increases the nutritive content of the regenerating forage, and removes ground litter and matted vegetation.

Agricultural crops provide supplementary food for deer, migratory waterfowl, and other wildlife species. Small scattered food plots placed near heavy escape or winter cover are most beneficial to wildlife. Areas planted to legumes improve soil conditions and provide important "green-up" areas that are heavily used by deer in early spring. All agricultural land on the unit is farmed by WMA personnel. Private farming is uneconomical because of poor soil fertility, high costs of site preparation, and distance to and between the scattered agricultural fields.



Present Programs. Forest openings, trails, and firebreaks are created with bulldozers. Brush mowing, dozing, chemical vegetation control, and prescribed burning are used to prevent encroachment of woody vegetation on forest openings, old fields, and upland nesting areas. Treatment type and frequency depend on the characteristics of each site and seasonal weather conditions for controlled burning as well as available funding.

During 1978, 19 openings totaling 150 acres were developed by mechanical manipulation. Six sites totaling 473 acres and 180 forest openings totaling 573 acres were maintained by prescribed burning and chemical control during 1978, respectively. Prescribed burning has been used to convert unmerchantable aspen stands on a two square mile experimental area to open brushland for sharp-tailed grouse.

In 1979, four agricultural fields totaling 23 acres were planted on the management area. In addition, 111 acres were cultivated on the Brown's Lake Waterfowl Refuge and 99 acres on Beltrami Island lease lands (L.U.P.) outside the WMA. Crops include winter wheat, buckwheat, oats, barley, clovers, and some corn. Crops are left standing as wildlife food plots or are harvested and stacked for winter use by wildlife. Additional small grains may be hauled in during winter for supplementary feeding. Some fields are seeded to clover and left for three to four years, but may be periodically mowed, burned, and/or fertilized.

Future Programs. The present management on non-forested uplands will continue. Prescribed burning, mowing, shearing, and chemical control will be used to maintain and improve existing openings and upland nesting areas. New openings will be developed as funding permits. Three to 5 percent of the forest land will be maintained as openings beneficial to deer, ruffed grouse, and other wildlife. Existing openings will not be planted to trees, unless requested by the resident wildlife manager. Priority will be given to clearing areas adjacent to wetlands for agricultural crops and nesting habitat.

Food plots for deer, waterfowl, and other wildlife will be continued. As funding permits, additional food plots

will be developed as indicated in Figures 8 and 9. New food plots will be placed near heavy brush, marsh, or forest cover in relation to the distribution of deer and other wildlife.

Artificial winter feeding of wildlife will continue only during emergency situations and if specific funds are available. Emphasis will be on supplying natural browse rather than farm crops. Increased forest management will reduce the need for artificial feeding.

Sharp-tailed grouse use and production on the experimental burn area will be monitored. The area will be partitioned into management blocks and burned on a two to three year rotation, if conditions permit, to maintain an open brush habitat. Food plots will be developed within and adjacent to the burn to attract and help hold sharp-tailed grouse. The feasibility of converting off-site aspen stands to open brush habitats by controlled burns on the other parts of the management area will be examined (Figures 8 and 9).

PUBLIC USE MANAGEMENT

Objectives. The Red Lake WMA will be managed to provide quality hunting, trapping, fishing, and other compatible fish and wildlife-related recreation. Dispersed, unstructured recreation with a minimum of developed facilities will be provided as part of the outdoor recreation system in northwestern Minnesota.

Considerations. The Red Lake WMA, Beltrami Island State Forest, and Hayes Lake and Zippel Bay State Parks are public natural resource lands in northwestern Minnesota accommodating a variety of recreation (Figure 7). As components of the Minnesota outdoor recreation system, these units should be managed to maximize the types of recreational opportunities provided by the system, while avoiding unnecessary duplication. To best serve the widest range of Minnesota recreationists, opportunities should include organized activities, such as group camping and naturalist-directed interpretative programs; less structured or intensively developed activities, including the use of marked and developed trails and self-guiding interpretive programs; and unstructured activities with low participant densities, such as fishing, hunting, and



Forest openings may be improved for wildlife by seeding clover under a nurse crop of oats.

self-directed hiking and skiing. This approach will provide a variety of opportunities and will fill the needs of most individuals.

The northwestern Minnesota state parks provide a variety of outdoor activities. Depending on the classification of each park, the park resources, and theme, state park-oriented recreation will include organized and directed programs as well as less intensively structured activities with lower user densities. These parks, however, cannot provide for some dispersed types of recreation nor all the trail systems needed to accommodate hikers, skiers, and snowmobilers.

Hayes Lake is classified as a recreational state park, and will thus be managed for a relatively intensive recreation level. The park will be developed as a "gateway to the Beltrami Island State Forest," with multiple-use trails connecting the two units (Minnesota DNR 1979). The Zippel Bay unit is not classified and has not been fully developed; however, park management and development will probably be directed towards Lake of the Woods. Both units will provide modern campsites, including recreational vehicle facilities for potential users of the WMA. Increasing use of these parks will allow more people to become acquainted with the Red Lake WMA and Beltrami Island State Forest.

The Beltrami Island State Forest provides less structured recreation than the state parks. The area accommodates a variety of unstructured activities such as hunting, fishing, and primitive camping, as well as providing picnic and sanitary facilities and marked, improved trails. More intensively organized activities with higher participant densities, however, may conflict with sportsmen and recreationists seeking more solitude.

To round out this system, the Red Lake WMA should provide public hunting, trapping, and fishing, plus unstructured compatible forms of recreation such as nature observation, hiking, cross-country skiing, and photography at lower user densities. Management of the Red Lake WMA for dispersed, unstructured recreation can provide alternative opportunities for northwestern Minnesota recreationists and will minimize use conflicts on all areas.

To function as a recreational system, opportunities in these areas should be accessible. A system of lightly traveled rural and state forest roads provide access to the various recreational units (Figure 7).

Public use pressures on the Red Lake WMA are not as great as on many of the other state wildlife management areas. The unit is not located near major population centers and much of it is not easily accessible. If fuel shortages develop or transportation costs continue to increase, a decrease in public use is possible, since the majority of users travel more than 100 miles to the area.

The maintenance of high quality public hunting on the Red Lake WMA is a major concern. A quality hunting experience depends on many factors, one of which is the number of other hunters in the field. Except possibly for hunting pressure on the opening weekends of the ruffed grouse and deer-firearms seasons, the Red Lake WMA furnishes quality hunting recreation. The problem of temporal distribution of hunters is considered when hunting regulations are established. However, regulations can only be partially successful in equalizing weekend, weekday, and opening day hunting pressure.

Unequal hunter distribution on the area is the result

of hunter preference, access, and game distribution. Management for deer and ruffed grouse has been concentrated in compartments 1, 2, 3, and 4 (Figure 5), and, as a result, hunting pressure for these game species occurs primarily in these compartments. The intensity and distribution of hunter use can also be influenced by the location of access roads and parking lots.

The Red Lake Band of the Chippewa Indians may lawfully take protected animals on all tribal, trust, or allotted lands at any time and may transport protected animals elsewhere in the state according to the provisions of Commissioner's Order No. 1942. The Red Lake Band may also issue permits for non-band members to hunt on Indian lands. Non-band hunters, however, must meet all state regulations if game is possessed or transported on state lands. Problems arise because of the scattered nature of Indian lands across the northwestern portion of the state. The boundaries of these scattered tracts are difficult to locate, complicating law enforcement and resource management. To date, there has been very little coordination or agreement between the DNR and the Red Lake Band on wildlife management. Harvest records on Indian lands are needed by the DNR to assess regional wildlife population levels and harvests, as most of the scattered Indian tracts lie within or adjacent to state lands.

An adequate map indicating roads, trails, and vegetation types on the management area is not available for visitors. As a result, hunters unfamiliar with the area may be limited in their hunting opportunities.

Limited access on the management area restricts public use of the area and prevents the implementation of some management programs. Additional roads and trails could provide needed access and recreational opportunities and yet maintain the primitive character of the management area.

Since the unit is designated both as a wildlife management area and a game refuge, it is posted with a variety of signs, creating a confusing situation for the public. The unit is currently posted with three types of signs: 1) Red Lake Wildlife Management Area and Public Hunting Grounds (large routed signs entering-leaving unit), 2) Wildlife Management Area (smaller regulation signs entering-leaving unit), 3) State Game Refuge (around most of the perimeter of the unit). Adding to the confusion are overlapping state forest signs and state waterfowl refuge signs around the Brown's Lake Waterfowl Refuge.

Except at Waskish, other compatible fish and wildlife uses of the Red Lake WMA are not extensive for several reasons. Forest dwelling wildlife is often difficult to observe, and there are no spectacular concentrations of migrating waterfowl to attract users. Also, the abundance of mosquitoes and other biting insects can make travel during the summer unpleasant. Fishing opportunities other than Upper Red Lake are limited. Activities such as hiking, cross-country skiing, environmental education, and sightseeing are very minor uses compared to hunting, trapping, and fishing.

The Waskish Campground accommodates a variety of recreational activities, mainly fishing and camping, and receives heavy use from spring through early fall. The area provides facilities not available elsewhere on the management area including a developed campground, picnic tables, and water access facilities.

Snowmobiles, four-wheel drive vehicles, and motor-bikes have been shown to be detrimental to wildlife habitats (Newman and Merriam 1972, Wanek 1973). In addition, snowmobiling may be detrimental to wintering deer and other wildlife (Jarvinen and Schmid 1971, Kopischke 1974, Dorrence et al. 1975).

The Red Lake WMA contains both unique and diverse plant and animal communities. The area, therefore, presents an unique opportunity for environmental education. Hunter education and more information about the management of the area and the existing wildlife populations are needed. Staff and funding, however, are not adequate for the development of educational and informational programs.

Past and Present Programs. Other than law enforcement and public informational contact, public use management is limited. Roads and trails are maintained for public access and management purposes. Boundary signs are posted and maintained on the management area and the Brown's Lake Waterfowl Refuge. The Waskish Campground is managed by the Division of Forestry with limited assistance from WMA personnel.

Use of the management area is presently regulated by the resident manager in accordance with Minnesota DNR Commissioner's Order No. 1961, Regulations Relating to the Public Use of Wildlife Management Areas (Appendix J) and other annual Commissioner's Orders specifying hunting and fishing seasons and use of game refuges. Motor vehicles may be operated on the unit but only on established roads, and no vehicles may be driven beyond a sign prohibiting vehicular use or beyond any man-made vehicle barrier. Snowmobiling is permitted on the WMA. Camping on the area is prohibited except in designated areas or by permit from the resident manager.

Game and fish violations on the area are a constant problem. The resident manager is authorized to make arrests for violations of fish and game laws (Minnesota DNR Commissioner's Delegation Order No. 255, 1976), but does not have time for intensive enforcement duties. Conservation officers stationed at Waskish and Baudette are also responsible for law enforcement on the area. Waterfowl hunting is prohibited on the Brown's Lake Waterfowl Refuge, but deer and small game hunting are permitted. In addition, Red Lake Indian lands are not open to public hunting and trapping unless specially licensed by the Red Lake Band. A permit from the resident wildlife manager is required to trap beaver and otter on the management area.

Moose hunting seasons have been conducted in alternate years since 1971 on a quota-permit basis in 25 zones in northeastern and northwestern Minnesota. Zone 1 covers 1,314 square miles in northwestern Minnesota and includes the northern half of the Red Lake WMA (Figure 10). Hunters holding state permits to hunt moose in zone 1 were not permitted to hunt on Red Lake Indian lands within this zone.

Under agreement between the DNR and the Red Lake Band of the Chippewa Indians, a special Red Lake zone was opened to moose hunting in 1975, 1976, 1977, and 1979 to non-band members under special permit by the Red Lake Band (Commissioner's Order No. 1935, 1966, 1985 and 2028); no season was held in 1978. This 675 square mile zone encompasses the eastern half of DNR zone 1, portions of the Beltrami Island State Forest east of zone 1, and Red Lake Indian Reservation and state forest lands on the northwest

corner of Lake of the Woods (Figure 10). All state, federal, and Indian lands within this zone were open to Red Lake Band permit holders.

Winter population estimates and harvest records for zone 1 indicated that the moose population in this zone was over harvested. Based on these findings, the DNR reduced the 1979 state moose permit quota for zone 1 from 100 to 60 permits and reduced the season length by 50 percent. In addition, the Red Lake Band permit quota was reduced from 150 to 20 permits. During the 1979 season, regular DNR zone 1 hunters reported harvesting 19 moose and Red Lake Band permit holders reported taking four more. In past years, Red Lake Band permit holders have not always complied with DNR regulations requiring the registration of all moose harvested by non-band hunters.

Winter population estimates and harvest records for the Red Lake Band moose zone indicate that the moose population in this zone is probably over harvested. A 33 percent harvest rate was estimated for the Red Lake zone during the 1977 season. Harvest rates of moose exceeding 8 to 10 percent generally result in a population decline (Patrick Karns, Minnesota DNR, personal communication).

Future Programs. Most present regulations will remain in effect. Increased enforcement of game and fish laws will require additional assistance from the Division of Enforcement. To obtain estimates of trapper numbers and harvest on the area, all trappers will be required to obtain a permit from the resident manager and will be required to report their harvest at the end of the season.

The DNR will closely monitor the moose population in zone 1 and will adjust the harvest quota to prevent further population declines. State permits for non-Indian hunting on Indian land outside of authorized state seasons should be withheld unless strict compliance with harvest reporting and harvest quotas is obtained.

An improved, updated map of the unit will be developed and made available to the public to familiarize both hunters and nonhunters with the area. The maps will show access roads and trails, water impoundments, restricted use areas, and major vegetation types. An informational brochure, explaining the purpose, history, and recreational opportunities as well as describing the plant and wildlife communities of the area, will be prepared in conjunction with the map to benefit both the hunting and nonhunting visitor.

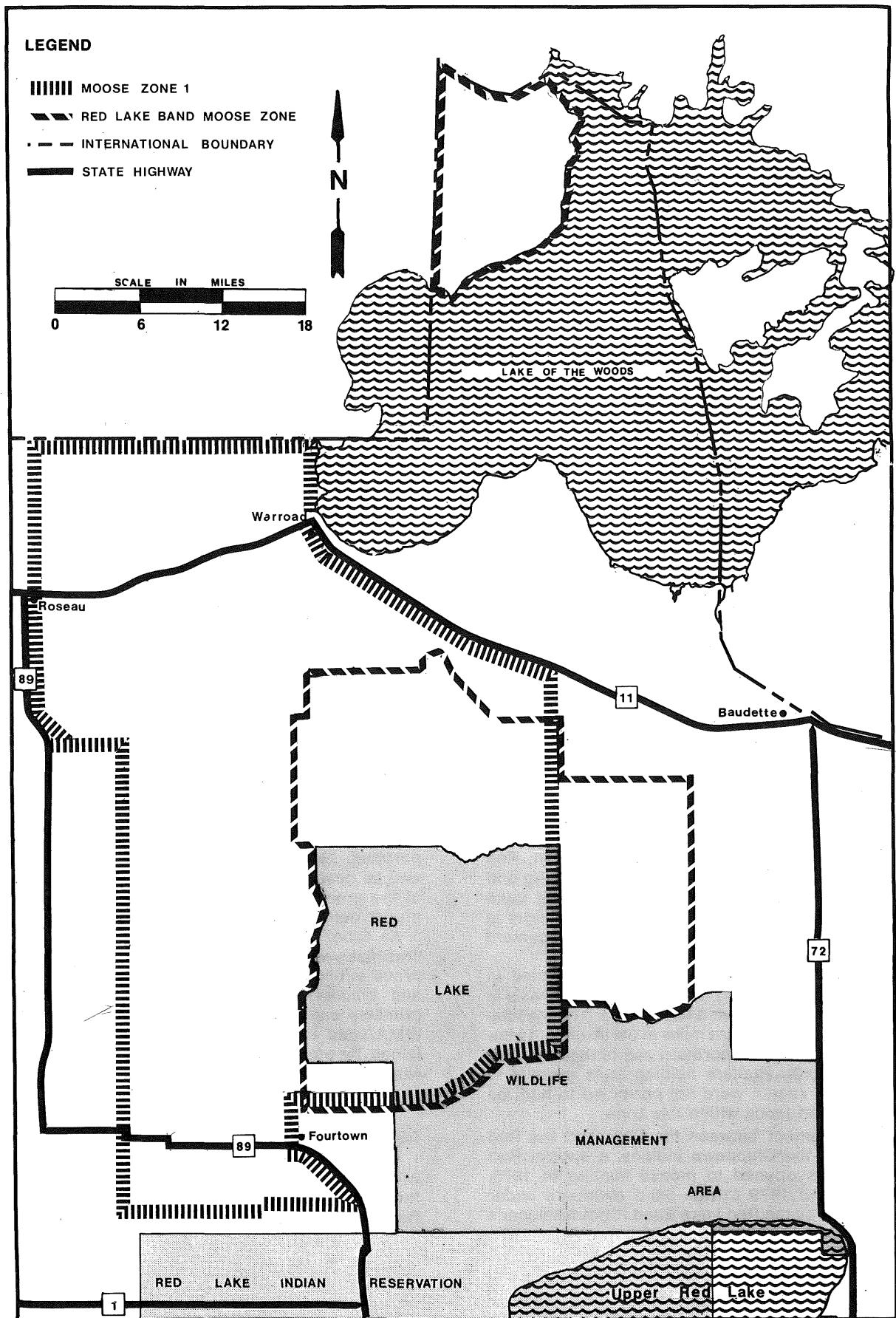
As labor and funding permit, roads, trails, and firebreaks will be developed and maintained to improve public access to the area. The Division of Fish and Wildlife will not oppose the establishment of primitive campgrounds or snowmobile trails on the WMA/state forest if they are developed and maintained by other DNR divisions and if they avoid sensitive and critical wildlife areas.

RESEARCH AND SURVEYS

Objectives. Surveys will be conducted to monitor wildlife abundance and harvest, public use, and the effects of management on the unit's resources. Research to gather information on wildlife and their habitats will be encouraged. Research and survey results will be used to evaluate present management programs and to develop new techniques.

Considerations. Information on wildlife abundance and distribution, hunting and trapping harvests, and

MOOSE HUNTING ZONES IN THE RED LAKE WILDLIFE MANAGEMENT AREA VICINITY



public use is needed to guide the development and management of the WMA.

Wildlife abundance is difficult to assess. Aerial surveys of deer, moose, and waterfowl are useful under certain conditions. In forested regions, deer pellet group surveys in spring provide an index to deer numbers. Annual surveys, such as ruffed grouse drumming counts and woodcock singing counts on established routes, can be used as indexes to small game abundance. All of these techniques, however, require extensive labor and funding. Surveys of deer and moose populations receive the highest priority, since their present management depends heavily on annual changes in harvest regulations based, in part, on these population estimates. Measuring changes in wildlife abundance in response to management on specific areas is complicated by changes in abundance in the surrounding area and by animal movements to and from the managed area. Additional surveys are limited by the available staff and funds, available techniques, and the size and inaccessibility of the area.

Wildlife productivity is even more difficult to assess. Deer reproduction can be assessed by examining car-killed does in spring. Waterfowl productivity can be estimated using breeding pair counts, nest searches, or brood counts. Measurement of the reproductive response of waterfowl to habitat manipulation may be complicated by other factors such as weather, predation, the harvest in the preceding year, or the phenology of the nesting season.

Wildlife harvest statistics are used, in part, to estimate wildlife abundance and the success of management programs and regulations. Harvest data is determined by hunter bag checks, game registration, carcass collections, and mail surveys. Harvest records also supply information on physical condition of the animals, population sex and age structures, and, in some cases, food habits.

Public use is difficult to assess because of the area's size, limited staff, and the numerous public entry points. Information on the number of users, temporal and spatial distribution of use, and other statistics on area visitors are used to document public use trends, problems, and needs. Input from individual users by interviews or questionnaires is useful in determining factors which increase or decrease the quality of a visit.

The effects of management on the resources of the area should be examined. Projects designed to benefit specific wildlife species may be detrimental to other animals, plants, soils, or waters. All projects should be examined for their impact on nontarget resources. Federal guidelines require these investigations when federal aid is involved.

Research information helps to develop effective management programs. The area has potential for research in many areas, including habitat use, food habits, and mortality factors of white-tailed deer; responses of plants and animals to habitat manipulation such as prescribed burning, clear-cutting, and wetland management; and the effects of specific wildlife species management on nontarget wildlife. The unit will become more important as a research area as natural areas in the state are fragmented or destroyed by development.

Past and Present Programs. The resident manager uses car counts and bag checks to estimate hunting pressure and harvest during the ruffed grouse and firearms-deer seasons. The proportions of small

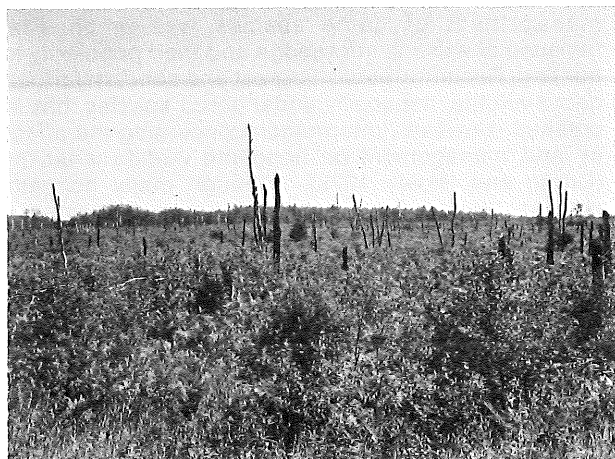
game, waterfowl, and bear hunters are estimated through informal observations and interviews. Data on trapper numbers and harvest are incomplete because trapping permits are required only for beaver and otter, and trappers are not required to report their harvest.

A public use survey involving mailback questionnaires was conducted on the management area in 1978 as part of the wildlife planning process (Appendix F). Survey results were used to estimate public use types and levels and to determine the attitudes and demographic characteristics of area users.

Annual wildlife surveys include: deer pellet group counts, ruffed grouse drumming counts, and woodcock singing counts in spring; aerial moose surveys in winter; and predator scent post surveys in summer. Approximately 90 man-days are spent each year conducting these surveys on the management area. No surveys are conducted to determine the abundance of other upland game species, waterfowl, and nongame wildlife.

The University of Minnesota and the Minnesota DNR have cooperated on several research projects in the management area and vicinity. From 1972 to 1977, timber wolf movements, population dynamics, and food habits were studied using radio-telemetry (Fritts 1979). In 1977, a series of investigations on peatland flora and wildlife were initiated as part of the DNR, Division of Minerals' peatland study. Researchers from the University of Minnesota examined ecological and floristic aspects of peatland vegetation (Gorham et al. 1978), importance of peatland habitats to small mammals (Birney and Nordquist 1978), and bird species diversity and seasonal habitat use of peatlands (Warner and Doehlert 1978).

A research study to evaluate prescribed burning as a management technique to convert low commercial value aspen stands to open brushland for sharp-tailed grouse has been conducted on the area since 1962. Four spring burns in 1968, 1971, 1973, and 1975 were conducted on a two square mile experimental area. A control area of the same size, with similar vegetation, was also established. A mile-wide buffer zone on which all forestry and wildlife management practices were prohibited was established around the burn and control sites. Sharp-tailed grouse, ruffed grouse, and deer activity on the burn site is being monitored and com-



Prescribed burning to create brushland habitat for sharp-tailed grouse is being evaluated on the Red Lake WMA.

pared with the control area.

Future Programs. Present wildlife surveys will be continued or expanded as funding becomes available. Management and research personnel of the DNR will cooperate on improving techniques to census wildlife populations. If staff and support funds permit, additional wildlife surveys will be initiated. A survey to determine the number, distribution, cover types, and deer use-levels of winter deer concentration areas will be given highest priority. Surveys of waterfowl production and response to wetland management should also be considered. Lower priority surveys include aerial counts of wolves and nesting sandhill cranes.

Car counts and bag checks to estimate hunting pressure and game harvest will be continued. Interviews with visitors or questionnaires placed on vehicles will occasionally be used to obtain visitor opinions and suggestions concerning management of the WMA. Comprehensive public use surveys will be conducted periodically if additional staff and funds become available.

The effects of proposed management projects on the area's resources, including plants, nontarget wildlife, and abiotic resources, will be assessed by the area personnel. The Division of Fish and Wildlife will submit significant development plans to the Minnesota Historical Society for review in order to avoid destroying or altering important prehistoric or historical cultural resources.

Research by the Minnesota DNR and other competent researchers will be encouraged. Area personnel will cooperate and provide any assistance which their other duties permit. The Divisions of Fish and Wildlife and Forestry will cooperatively experiment with various techniques to promote white cedar regeneration. WMA personnel will continue experimental Canada goose management efforts.

Area personnel will maintain the area by periodic burning and will continue to monitor sharp-tailed grouse use and production.

NONGAME MANAGEMENT

Objectives. An objective of wildlife management on the Red Lake WMA is an effectively balanced program for all native wildlife species. Nongame wildlife will be considered in managing the forest, wetlands, non-forested openings, and other habitats on the area.

Considerations. The Minnesota DNR has statutory responsibility for the protection, propagation, and wise use of the state's wildlife resources. In the past, the management of game species was emphasized because of existing knowledge and their popularity for hunting. Recently, public interest and concern for nongame wildlife, especially endangered species, has increased. However, information concerning the effects of land management on nongame wildlife is lacking (Curtis and Ripley 1975). Although many nongame species benefit from habitat programs directed at game species, planning for nongame should not be neglected.

It is not possible to manage all portions of an area for all species at the same time. Some species require mature forests, while others need open, nearly bare, areas. A variety of habitats are needed to provide for a variety of wildlife species. In managing habitats for wildlife, especially mobile species such as most birds, a manager should consider which habitats are rare or becoming less common in the area.

The nongame discussion emphasizes birds because there has been more public interest in this group, more



Great gray owls, rarely seen in most of Minnesota, nest in lowland conifer forests of the Red Lake WMA.

research has been conducted on birds, and birds constitute a large portion of the management area's nongame wildlife. Populations of many migratory species show dramatic fluctuations in density from year to year even when vegetation is not physically modified (Balda 1975). Winter or spring conditions on the wintering area will influence migrant and breeding bird densities on the management area. These factors complicate nongame management and the evaluation of different programs.

A management plan for nongame birds should consider three factors (Zeedyk and Evans 1975). First, structural characteristics of the vegetation influence avifauna composition. Birdlife diversity increases with increases in the horizontal and vertical diversity as well as the patchiness of the vegetation. Second, bird species are adapted to nearly every habitat type so management benefiting some species can be detrimental to others. Lastly, bird species differ in their ability to adapt to habitat variability since some species have specific requirements, while others are more general.

Logging increases the foliage height diversity and the bird species diversity often increases as a result (Webb et al. 1977). Clear-cutting has the effect of producing an edge or ecotone between two contrasting vegetation types. The avian diversity and density often increases in response to this increase in edge or horizontal diversity. The common flicker, Alder flycatcher, Nashville warbler, and several species of sparrows commonly use clear-cuts (Warner and Doehlert 1978). The gray catbird, common yellowthroat, and yellow warbler benefit from forest

edge and brush areas along the perimeter of clearcuts. As the forest begins to regenerate, species closely associated with early successional stages, such as the mourning and chestnut-sided warblers, rose-breasted grosbeak, and white-throated sparrow, will benefit (Curtis and Ripley 1975). Access trails and forest openings also provide greater vegetative diversity for birds.

Species attracted to clear-cuts and edges usually have broad ranges of tolerance, high reproductive rates, and good powers of dispersal. Other species with more narrow ranges of tolerance may be eliminated from certain portions of the management area should management be directed solely at species diversity and density (Balda 1975). Species that require mature forest include the goshawk, ovenbird, barred owl, pileated woodpecker, red-headed woodpecker, and wood thrush. Extensive cutting of mature forest areas may be detrimental to these species. At current harvest rates, however, suitable mature forest habitats will remain available. However, if harvest increases, care should be taken to maintain large blocks or interconnected smaller blocks, rather than isolated patches.

Other management on the area also influences nongame wildlife. Management of wetlands for an interspersed of open water and structurally diverse emergent vegetation will benefit migrant shorebirds and marsh birds. Grassy upland areas provide breeding habitat for such songbirds as the bobolink, meadowlark, and several sparrow species. Although breeding songbirds may not be affected by food plots, wintering songbirds may benefit from additional food sources (Burt 1976).

The greater sandhill crane nests on open bog/fen areas in the management area vicinity. Although once an abundant resident and migrant in Minnesota wetlands (Roberts 1936), a drastic decline in crane numbers occurred as settlement progressed in the late 1800's. During this period, large numbers of cranes were harvested and much of their wetland habitat was drained for agriculture. A gradual recovery has occurred in Minnesota in recent years, but the sandhill crane will continue to require special management considerations (Minnesota DNR 1975). Management information on the greater sandhill crane is not extensive and specific recommendations can not be made in this plan. However, cranes at the Red Lake WMA should benefit from the wetland management proposals. Surveys should be undertaken to determine the abundance, distribution, and habitat use of sandhill cranes on the management area.

The U.S. Fish and Wildlife Service has classified the bald eagle in Minnesota as a threatened species. Large amounts of open water supporting sizable fish populations are necessary for eagles. Large trees are also important for eagle nest sites. Active eagle nests have been observed south of the management area. Breeding habitat for bald eagles may exist on the WMA along the north shore of Upper Red Lake, although suitable nesting trees may be lacking. The potential for artificial nest structures may exist in this area.

The Red Lake WMA lies within the primary range of the eastern timber wolf in Minnesota (Bailey et al. 1978). Although the U.S. Fish and Wildlife Service has reclassified the eastern timber wolf from endangered to threatened, the Minnesota DNR does not consider the eastern timber wolf to be in danger of elimination in the state in the foreseeable future. The Eastern Timber

Wolf Recovery Team (1978) has recommended that the management area remain in a total protection zone in the future. The team also recommended that any development, settlement, and the destruction, disturbance, or modification of habitat that might reduce wolf populations or restrict their recovery be prohibited. At present, the DNR is negotiating with the U.S. Fish and Wildlife Service to develop a comprehensive, state-directed wolf management plan.

Up to the present, all funding for nongame management has come from hunting, fishing, and trapping license fees. In 1980, however, legislation was passed creating the Minnesota Nongame Wildlife Fund. This is a dedicated funding source for nongame management and research derived from voluntary checkoffs of state income tax refunds beginning in 1981. In addition, federal nongame funding legislation which would provide excise tax appropriations as matching funds for state nongame projects is under consideration. This legislation may provide substantial support for specific nongame management in the future.

Past and Present Programs. Current management on the WMA benefits nongame wildlife by promoting the maintenance of diverse habitats and preserving naturally occurring communities. Maintaining cover and food supplies and limiting human disturbance should help both game and nongame species. Nongame wildlife is considered in management plans, but thus far, lack of funds and information has limited management specifically for nongame species.

A nongame wildlife specialist employed by the Section of Wildlife beginning in 1977 has worked at evaluating the current status of many nongame species, especially uncommon ones, plus making suggestions for management. Breeding records and sightings of uncommon species are reported to and summarized by the nongame specialist.

Future Programs. Management programs on the Red Lake WMA will continue to consider all wildlife species, especially uncommon and threatened species. As funds become available for nongame work, additional surveys and habitat management will be done. Suggestions of the nongame wildlife specialist will be incorporated into the management of the WMA whenever possible.

MANAGEMENT OF BELTRAMI ISLAND LEASE LANDS (L.U.P.)

Objectives. Beltrami Island lease lands, including those located outside the Red Lake WMA, will be managed cooperatively by the Divisions of Fish and Wildlife and Forestry for wildlife and forest resources. The DNR will seek to acquire L.U.P. lands from the federal government.

Considerations. In 1940, 81,400 acres of scattered lands in Beltrami, Lake of the Woods, and Roseau Counties acquired by the federal government under the Resettlement Program (Land Utilization Project, L.U.P.) were leased to the state of Minnesota. These lands were placed under the jurisdiction of the Department of Conservation (DNR), Division of Game and Fish (Division of Fish and Wildlife), to be managed for wildlife, forest resources, and recreation. In 1942, Presidential Executive Order # 9091 designated the L.U.P. lands as the Beltrami Wildlife Management Area to serve as a refuge and breeding ground for native wildlife. Approximately 20,600 acres of the total 81,400 acres of L.U.P. lands are located within the Red Lake

WMA.

The provisions of the lease require that "wildlife management practices be of such character as to maintain the lands in a productive condition from the standpoint of wildlife; the lands shall be managed to effectuate a balanced wildlife population; and the forest management practices shall be so planned as to assure reproduction of desirable species . . ." In addition, the lease requires that any tree planting program be consistent with the wildlife and recreational purposes of the project.

The L.U.P. lands comprise some of the better wildlife habitat in the area. While some homesteading did take place on very poor, wet, and inaccessible tracts, the majority of the settlers selected the better drained, upland sites for homesteading. The abandonment of these wilderness farms left numerous openings in the forest, which are important to deer and other wildlife. The scattered nature of L.U.P. lands, however, makes management difficult.

Past and Present Programs. L.U.P. lands are currently managed by the Divisions of Fish and Wildlife and Forestry. Red Lake WMA personnel are responsible for wildlife management on these lands. Management includes the development and maintenance of forest openings, food plots, and impoundments plus enforcement of fish and wildlife regulations. Nine impoundments have been constructed on L.U.P. lands outside of the WMA, but only three of these currently have functional water control structures (Table 5). The three functional impoundments are maintained and operated to provide optimum water depths for waterfowl.

District foresters conduct timber management and sales on L.U.P. lands. In the past, timber sales and tree plantings have not always been coordinated with wildlife objectives. There is now an informal working agreement among the area and district foresters and the wildlife manager concerning timber management. However, due to staff limitations, the wildlife manager is unable to monitor a significant proportion of timber sales.

Future Programs. Current wildlife management work on these lands will continue. Administrative control of L.U.P. lands will be retained by the Division of Fish and Wildlife. District foresters will be responsible for timber management and sales on L.U.P. lands in cooperation with the resident wildlife manager. Increased commercial logging will be encouraged. The wildlife manager may give blanket approval to the district foresters for certain timber management practices or timber sales on specific areas.

As funds become available, damaged water control structures will be replaced on all impoundments. An exception may be the Manweiler impoundment (Table 5) that lies partially on Red Lake Indian lands. The DNR will seek an agreement with the Red Lake Tribe concerning management and public access before repairs are undertaken.

The DNR will seek approval from the U.S. Fish and Wildlife Service for the acquisition of the L.U.P. lands. The possibility of a land exchange will be investigated. Acquisition of these lands by the state would ensure the maintenance of past management investments and would encourage expenditures of wildlife and forestry funds for more intensified management.

SUMMARY OF MANAGEMENT PROGRAMS

MANAGEMENT AND LAND ACQUISITION.

The Red Lake WMA and overlapping Beltrami Island State Forest will be managed cooperatively by the Divisions of Fish and Wildlife and Forestry for wildlife, forest products, and compatible outdoor recreation. A total of 133,350 acres of peatland in the southeastern portion of the unit, including the Waskish Village area, will be deleted from the WMA and vacated from the Red Lake Game Refuge. Division of Forestry-administered land within the WMA will be acquired by the Division of Fish and Wildlife only upon mutual agreement between the divisions or upon recommendation of the Commissioner. A DNR Commissioner's Order will be requested to vacate the Red Lake Game Refuge and formally designate the unit as a state WMA. The boundary will then be posted with state wildlife management area signs. The DNR will seek to acquire, exchange, consolidate, or cooperatively manage lands not under DNR administration within the WMA. Private lands totaling 10,273 acres are proposed for acquisition from willing sellers. Current wildlife management activities on the Brown's Lake Waterfowl Refuge and the Beltrami Island lease lands (L.U.P.) will continue. Norris Camp will remain as the WMA headquarters.

FORESTS

Forests will be managed to provide productive habitats for wildlife while improving and expanding the timber resource. Wildlife recommendations will be given priority consideration on critical wildlife habitat, such as bald eagle nest sites and winter deer concen-

tration areas. Forest management will rely heavily on commercial logging. Priority will be given to regenerating overmature aspen stands. Small (< 20 acres), dispersed clear-cuts will be the preferred harvest technique. Unmarketable timber will be periodically cut, sheared, or burned to set back succession and maintain wildlife values.

WETLANDS

Wetlands will be managed primarily for waterfowl, furbearers, and public hunting. Impoundment water levels will be regulated to provide optimum water depths for waterfowl. Wetland management activities will concentrate on developing food plots, nesting habitat, dugouts, level ditches, and nesting structures around impoundment areas. Damaged water control structures will be replaced on two impoundments. Heavy equipment will be used to develop open-water habitat for waterfowl. Small islands and artificial structures will be constructed and maintained to provide waterfowl nesting sites. Management of the resident Canada goose flock will continue.

NON-FOREST UPLANDS

Non-forested uplands include forest openings, cropland, and upland nesting areas. Forest openings will be created and maintained to provide edge and to increase habitat diversity. Croplands will be managed as wildlife food plots. Upland nesting cover will be managed primarily to provide secure nesting habitat for waterfowl, sharp-tailed grouse, and nongame birds. Prescribed burning, logging, dozing, mowing,

shearing, and chemical control will be used to create and maintain forest openings and upland nesting cover.

PUBLIC USE

The management area will provide quality public hunting, trapping, and other activities compatible with its legal purpose and management objectives. Trappers will be required to obtain a permit from the wildlife manager to trap on the WMA and will be required to report their harvest at the end of the season. An improved, updated map of the unit will be developed and made available to the public. Other outdoor recreational activities, such as snowmobiling, cross-country skiing, and wildlife observation will be permitted on the area. The Division of Fish and Wildlife will permit primitive campgrounds and snowmobile trails on the WMA if they avoid sensitive and critical wildlife areas and are developed and maintained by other DNR divisions.

RESEARCH AND SURVEYS

Car counts and hunter bag-checks will be conducted to estimate hunting pressure and game harvest. Annual surveys of wildlife abundance, including aerial

censuses of moose, deer pellet group counts, and ruffed grouse drumming counts, will be continued. Area personnel will cooperate with DNR and university research projects which will aid in statewide or unit management.

NONGAME WILDLIFE

Nongame wildlife will be integrated with game habitat management. Special management considerations will be given to rare or unique species such as the gray wolf, greater sandhill crane, and bald eagle. More specific programs for nongame species will be implemented as needs are identified and funds are provided through the state nongame wildlife program.

BELTRAMI ISLAND LEASE LANDS (L.U.P.).

L.U.P. lands, including those located outside the Red Lake WMA, will be managed cooperatively by the Divisions of Fish and Wildlife and Forestry for wildlife and forest resources. The DNR will seek to acquire the L.U.P. lands from the federal government. Current wildlife management on these lands will continue. Damaged water control structures will be replaced on five impoundments located on L.U.P. lands.

IMPLEMENTATION AND COST ESTIMATES

Specific programs to manage fish and wildlife and provide quality fish and wildlife-related recreation were developed based on present conditions and future expectations. Implementation of these programs depends on land ownership, land and management costs, and the amount and sources of funding.

LAND COSTS

Land acquisition costs are not estimated for the management area because of the extreme variation in land types and values. Acquisition costs will continue to increase as land values increase. Funds for land purchases are not part of the management area operating budget.

Land acquisition has been funded historically by a surcharge on small game hunting licenses. This \$2 surcharge, which is authorized through 1984, currently generates about \$600,000 annually for wildlife land acquisition. Throughout the years, special appropriations for wildlife land acquisition have been made by the Legislative Commission on Minnesota Resources (LCMR). The LCMR's most recent appropriation was \$250,000 in 1975. LCMR appropriations remain a possible future funding source. In recent years, surcharge and LCMR funds have been supplemented by general revenue funds under a program called Resource 2000. This 6-year program has provided \$9.2 million for wildlife land acquisition since 1975. The amount of wildlife lands which can be acquired in future years will depend on the level of funding provided by these three sources.

MANAGEMENT PROGRAMS AND COSTS

Management programs on the Red Lake WMA will

be implemented through the Divisions of Fish and Wildlife and Forestry. Section of Wildlife costs are estimated in greatest detail.

Division of Fish and Wildlife. The Section of Wildlife, through the Region I office in Bemidji, will implement the wildlife proposals in this plan. The wildlife management proposals involve changes in funding and staffing for the management area.

Allocating funds for specific wildlife habitat projects is difficult because many activities are dependent to a large degree on uncontrollable conditions. Prescribed burning is only effective under exact conditions. The construction of dikes, level ditches, and potholes is dependent on seasonal weather trends. Proposed developments and management programs depend on weather conditions, land acquisition, and equipment and labor availability. The resident manager must have the flexibility to decide how funds will be spent through the year and to modify programs to suit changing conditions.

The wildlife management programs were placed in three alternative spending levels. (Table 34). All costs were estimated in 1980 dollars. Costs will increase with inflation.

Included in the first spending level are those programs having the highest priority and which can be implemented at the current spending level without management cutbacks. Present expenditures of about \$100,000 to \$140,000 per year represent current costs for salaries, routine equipment and facility maintenance and operation, and yearly habitat maintenance and development.

The two additional spending levels require increased funding for manpower and support expenses which will enable more intensive management (Table

Table 34. Annual spending alternatives for the Red Lake WMA.

Level I. Management at current spending level			
Forest management <ol style="list-style-type: none"> 1. Mechanical vegetation manipulation 2. Prescribed burning 3. Develop and maintain firebreaks Wetland management <ol style="list-style-type: none"> 1. Maintain dikes and water control structures 2. Manage impoundment water levels 3. Construct and maintain nesting structures 4. Construct level ditches and dugouts 5. Beaver control Public use management <ol style="list-style-type: none"> 1. Maintain roads and trails 2. Manage public hunting and trapping 3. Maintain boundary and other regulatory signs 4. Enforce regulations Research and surveys <ol style="list-style-type: none"> 1. Continue wildlife surveys and hunter bag-checks 2. Assist research projects Non-forested upland management <ol style="list-style-type: none"> 1. Plant food plots 2. Artificial feeding 3. Develop and maintain openings and upland nesting areas 			
Annual spending		Immediate capital needs for Implementation	
1978 Baseline	\$136,000	Replacement	
Added labor and support	- 0 -	Vehicle bridges (2)	\$1,500
Annual Total	\$136,000	Well pump system at assistant manager's residence	\$2,000
		Total	\$3,500
Level II. Additional management with increased spending			
Forest management <ol style="list-style-type: none"> 1. Additional mechanical clearing Wetland management <ol style="list-style-type: none"> 1. Construct additional level ditches and dugouts 2. Repair dikes and water control structures 3. Construct additional nesting structures Public use management <ol style="list-style-type: none"> 1. Develop additional roads and trails Research and surveys <ol style="list-style-type: none"> 1. Survey winter deer concentration areas 2. Survey public use Non-forested upland management <ol style="list-style-type: none"> 1. Develop additional food plots and openings 			
Annual Spending		Immediate capital needs for Implementation	
Level I annual total	\$136,000	Level I total	\$ 3,500
Added labor and support (1, 9-month laborer) (1, ½ time clerk-typist)	13,100	Replacement	
Annual Total	\$149,100	Water control structures (2)	
		Spina Impoundment	30,000
		Roseau Impoundment	95,000
		Equipment shed (50' x 100')	15,000
		New	
		Motor road grader	50,000
		Brush disc	7,500
		Interseeder	6,500
		Backhoe	29,000
		Bombardier muskeg tractor	38,000
		Compact sedan or wagon	4,500
		Total	\$278,600

Level III. Additional management with increased spending.

Forest management

1. Prescribed burning of upland forests and lowland brush
2. Investigate techniques to regenerate white cedar
3. Improve wildlife/forestry cooperative management

Public use management

1. Increase enforcement efforts
2. Develop an environmental education program

Other

1. Renovate headquarter's buildings

Annual spending	
Level II annual total	\$149,100
Added labor and support (2, 9-month laborers) (1, full time wildlife-forestry liaison)	32,200
Total	\$181,300

Immediate capital needs for implementation	
Level II total	\$278,600
Replacement	
Renovate headquarter's buildings	5,000
New	
Dump truck with snowplow and wing attachment	25,000
Total	\$308,600

34). The additional expenses for labor, supplies, maintenance, and minor equipment are listed for the two highest spending levels.

All spending levels require additional funds for the purchase of equipment or the construction of capital improvements. Many of these capital investments are required to immediately implement all programs. Although spending levels are presented on an annual basis, the costs for capital expenditures listed in Table 34 will only occur once during the 10-year planning period.

Equipment replacement needs are difficult to predict because of the uncertain demands on equipment. Also, major equipment replacement is dependent on funding, needs, and priorities within Region I. Because of these factors, the anticipated equipment replacement is scheduled in 5-year intervals (Table 35). Replacement costs were based on price estimates for new equipment. In many cases, however, used equipment, especially farm machinery, will be adequate and can be purchased at substantially lower costs.

Fisheries work at Waskish can be implemented with current funding. No additional fisheries management programs are planned on the WMA.

Division of Forestry. The Division of Forestry, through the Williams, Grygla, Waskish, and Clear River District Offices, will conduct forest management and timber sales. Most forestry programs can be conducted with current funding levels.

The proposed updated forest inventory is needed for further forestry planning. Approximately 18 man-years of effort at a cost of about \$600,000 will be needed to complete an intensive inventory of the Red Lake WMA-Beltrami Island State Forest area.

MANAGEMENT AREA FUNDING

Funding for completing acquisition within the Red Lake project will be primarily from the surcharge fund

and the Resource 200 program described under land costs.

Funds for the development and operation of the management area are appropriated from the dedicated Game and Fish Fund. Receipts into this fund are primarily from the sale of hunting, trapping, and fishing licenses and federal aid reimbursement through the Pittman-Robertson and Dingell-Johnson programs. Federal aid reimbursement is 75 percent on approved projects. For the most part, the Division of Fish and Wildlife operates within a budget that can only be increased through an increase in license fees or license sales.

A \$3 Minnesota migratory waterfowl stamp was initiated in 1977. The legislature appropriates an amount which approximates waterfowl stamp receipts. This appropriation is for the development of waterfowl habitat on public hunting grounds and designated lakes.

In addition, as part of the Resource 2000 program, the legislature appropriated \$1,000,000 for the betterment of wildlife management areas.

Except for the recent increase in revenue provided by the migratory waterfowl stamp and possible future general fund appropriations, management funds will probably not increase significantly by 1989. Accordingly, most proposals are planned within the present budgetary constraints. Wildlife management finances in Region I are somewhat flexible, and funds can be shifted from item to item. However, the restructuring of spending priorities could be detrimental to some regional wildlife management functions. To maintain the present wildlife programs throughout the region and to implement all of the planned management on the Red Lake WMA, increased funding in Region I will be needed.

Table 35. Equipment replacement schedule for the Red Lake WMA.

Period	Item	Current Model	Replacement Model	Estimated Cost
1980-1984	Crawler tractor	Caterpillar/D8	Caterpillar/D6	\$100,000
	Crawler tractor	Caterpillar/D4	Equivalent	70,000
	Crawler loader	Allis Chalmers/H3	Equivalent	18,000
	Tractor	International/W4	John Deere/4240	30,000
	Dragline	P & H	American/597	100,000
	Shearing blade	KG	Equivalent	7,000
	Cultivator	John Deere/10 ft.)	John Deere/16 ft	4,800
	Plow	International/2 bottom	Equivalent	6,500
	Grain binder	Minnesota	Hay baler/	1,500 ¹
			International 420	
			Swather/Versatile 102	1,500 ¹
	Fertilizer	Unknown	John Deere/602	2,500
	Mower	John Deere/rotary	Equivalent	7,000
	Grain drill	Farmall	John Deere/9350	4,240
	Flatbed truck	International 3/4 ton	Equivalent	6,200
	Truck	Chevrolet/1 ton panel	4 x 4 utility truck	8,000
	Pickup	International/1/2 ton 4 x 4	3/4 ton, 4 x 4	7,300
1985-1989	Flatbed truck	Loadstar/Schwartzbed	Equivalent	25,000
	Pickup	International/Scout 1/2 ton	Equivalent	8,000
	Pickup	GMC/1/2 ton, 4 x 4	Equivalent	6,500
	Pickup	Dodge/3/4 ton, 4 x 4	Equivalent	7,300
	Tractor	John Deere/3020	Equivalent	20,700
	Disc	John Deere/12 ft.	Equivalent	3,400
	Snowmobile (2)	Rupp	Equivalent (2)	3,200
	Lawnmower (2)	Toro/800 riding Trustworthy/riding	Equivalent (2)	2,600
	Trailer (2)	Spartan/snowmobile Plato/3 ton, tilt-top	Double snowmobile trailer (1)	450
	Canoe (2)	Alumacraft/17 ft. Grumman/Aluminum, 17 ft.	Equivalent (2)	700
	Outboard Motor (2)	Evinrude/3 h.p. Johnson/4 h.p.	Equivalent (2)	620

¹Cost estimate for used equipment.

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Appendix A. The Minnesota Outdoor Recreation System

Classification	Purpose	Administration
Natural State Park	A natural state park shall be established to protect and perpetuate extensive areas of the state possessing those resources which illustrate and exemplify Minnesota's natural phenomena and to provide for the use, enjoyment, and understanding of such resources without impairment for the enjoyment and recreation of future generations.	Commissioner of Natural Resources
Recreational State Park	A recreational state park shall be established to provide a broad selection of outdoor recreation opportunities in a natural setting which may be used by large numbers of people.	Commissioner of Natural Resources
State Trail	A state trail shall be established to provide a recreational travel route which connects units of the outdoor recreation system or the national trail system, provides access to or passage through other areas which have significant scenic, historic, scientific, or recreational qualities or reestablishes or permits travel along an historically prominent travel route or which provides commuter transportation.	Commissioners of Transportation and Natural Resources
State Scientific and Natural Area	A scientific and natural area shall be established to protect and perpetuate in an undisturbed natural state those natural features which possess exceptional scientific or educational value.	Commissioner of Natural Resources
State Wilderness Area	A state wilderness area shall be established to preserve, in a natural wild and undeveloped condition, areas which offer outstanding opportunities for solitude and primitive types of outdoor recreation.	Commissioner of Natural Resources
State Forests and State Forest Sub-Areas	A state forest, as established by Minnesota Statutes, Section 89.021, shall be administered to accomplish the purposes set forth in that section, and a state forest sub-area shall be established to permit development and management of specialized outdoor recreation at locations and in a manner consistent with the primary purpose of the forest.	Commissioner of Natural Resources
State Wildlife Management Area	A state wildlife management area shall be established to protect those lands and waters which have a high potential for wildlife production and to develop and manage these lands and waters for the production of wildlife, for public hunting, fishing, and trapping, and for other compatible outdoor recreational uses.	Commissioner of Natural Resources
State Water Access Site	A state water access site shall be established to provide public access to rivers and lakes which are suitable for outdoor water recreation and where the access is necessary to permit public use.	Commissioner of Natural Resources
State Wild, Scenic, and Recreational Rivers	State wild, scenic, and recreational rivers shall be established to protect and maintain the natural characteristics of all or a portion of a river or stream or its tributaries, or lake through which the river or stream flows which together with adjacent lands possesses outstanding scenic, scientific, historical, or recreational value, as provided by Sections 104.31 to 104.40.	Commissioner of Natural Resources
State Historic Site	A state historic site shall be established to preserve, restore, and interpret buildings and other structures, locales, sites, antiquities, and related lands which aptly illustrate significant events, personalities, and features of the history and archaeology of the state or nation.	Commissioner of Natural Resources, Minnesota Historical Society, Board of Regents of the University of Minnesota, Governmental subdivisions of the State and County Historical Societies.
State Rest Area	A state rest area shall be established to promote a safe, pleasurable, and informative travel experience along Minnesota highways by providing areas and facilities at reasonable intervals for information, emergencies, or the rest and comfort of travelers.	Commissioner of Transportation

Appendix B. History of the Red Lake Game Refuge and the Beltrami Island State Forest.

Date	Order/Law and Description	Purpose
1931	Laws Minn. 1931, Ch. 124 — An act specifying certain lands as state forests, including an area in the Red Lake Game Preserve.	Withdraw certain lands from sale and establish them as state forests.
1932	Commissioner's Game Refuge Order-Regulation prohibiting hunting and trapping in a certain area (266,520 acres) of the Red Lake Game Preserve (Figure 2).	Establish game refuge to protect and propagate caribou, moose, deer, grouse, migratory game birds, beaver, otter, muskrat, and other kinds of wildlife existing in the area.
1933	Laws Minn. 1933, Ch. 419 — An act relating to the establishment, management, and control of state forests, including a provision expanding the state forest lands in the Red Lake Game Preserve and designating these lands as the Beltrami Island State Forest.	Establish state forests to preserve, propagate, and breed wildlife of all suitable kinds; to develop forests and prevent forest fires; to preserve and develop the rare and distinctive species of flora native to the area; to protect the watershed area; and to establish and develop other recreational uses.
1934	Commissioner's Game Refuge Order — Amendment to regulations prohibiting hunting and trapping in certain areas (138,560 acres) of the Red Lake Game Preserve.	Enlarge game refuge.
1937	Commissioner's Game Refuge Order — Second addition to the Red Lake Game Preserve.	Enlarge game refuge.
1937	Commissioner's Game Refuge Orders # 17 and 18 — Orders establishing the U.S.F.S.A. Refuge "A" and "B" in Lake of the Woods County.	Establish game refuges.
1939	Commissioner's Game Refuge Order # 48 — Order vacating portion of the Red Lake Game Preserve.	Vacate portion of game refuge.
1940	Commissioner's Game Refuge Orders # 52 and 53 — Orders establishing additions to the Red Lake Game Refuge and denying petition for a further addition in Lake of the Woods County.	Enlarge game refuge.
1943	Laws Minn. 1943, Ch. 171 — An act amending laws Minn. 1933 Ch. 419 relating to the establishment, management, and control of state forests. This act enlarged the Beltrami Island State Forest.	Amend state forest boundaries and management policies.
1950	Commissioner's Game Refuge Order # 198 — Order establishing the Norris Camp State Game Refuge.	Establish game refuge around unit headquarters.
1951	Commissioner's Order # 1309-Regulations for the taking of deer in 1951.	Establish archery season in certain game refuges including Red Lake.
1952	Commissioner's Order # 1350-Regulations for hunting of deer in 1952.	Establish archery and firearm season in certain game refuges including Red Lake.
1953	Commissioner's Order # 1373-Regulations for the taking of ruffed grouse in certain game refuges for the year 1953.	Establish a ruffed grouse season in certain game refuges including Red Lake.
1954	Commissioner's Game Refuge Order # 247 — Order modifying the boundaries of the Red Lake Game Refuge (Figure 2).	Establish present game refuge boundaries.
1957	Commissioner's Order # 1485-Regulations for hunting and trapping in the state game refuges, public hunting grounds, federal refuges, and state parks during the 1957-1958 hunting and trapping season.	Allow all hunting and trapping except waterfowl in certain game refuges including Red Lake.

Appendix B (continued)

Date	Order/Law and Description	Purpose
1958	Commissioner's Order # 1509-Regulations for hunting and trapping in state game refuges, public hunting grounds, federal refuges, and state parks during the 1958-1959 hunting and trapping season. A similar order has been issued annually since 1958-1959.	Allow all hunting and trapping in certain game refuges including Red Lake.
1960	Commissioner's Game Refuge Orders # 304 and 305 — Orders vacating the U.S.F.S.A. Statutory Game Refuges "A" and "B" in Lake of the Woods County.	Vacate game refuges.
1963	Laws Minn. 1963, Ch. 332 — An act amending Laws Minn. 1943, Ch. 171 relating to the establishment, management, and control of state forests. This act established the present boundaries of the Beltrami Island State Forest (Figure 7).	Amend state forest boundaries.
1972	Commissioner's Game Refuge Order # 381 — Order vacating the Norris Camp State Game Refuge, Lake of the Woods County.	Vacate Norris Camp Game Refuge.

Appendix C. Common and scientific names of plants mentioned in the text.

Family	Common Name	Scientific Name
Apocynaceae	Dogbane	<i>Apocynum androsaemifolium</i>
Araliaceae	Wild sarsaparilla	<i>Aralia nudicaulis</i>
Betulaceae	Speckled alder Paper birch Bog birch Beaked hazel	<i>Alnus rugosa</i> <i>Betula papyrifera</i> <i>Betula pumila</i> <i>Corylus cornuta</i>
Caprifoliaceae	Bush honeysuckle	<i>Diervilla lonicera</i>
Caryophyllaceae	Chickweed	<i>Stellaria longifolia</i>
Ceratophyllaceae	Coontail	<i>Ceratophyllum demersum</i>
Compositae	Aster Large-leafed aster Joe-Pye weed Goldenrod	<i>Aster laevis</i> <i>Aster macrophyllus</i> <i>Eupatorium maculatum</i> <i>Solidago</i> sp.
Cornaceae	Round-leafed dogwood Red-osier dogwood	<i>Cornus rugosa</i> <i>Cornus stolonifera</i>
Cupressaceae	White cedar	<i>Thuja occidentalis</i>
Curcubitaceae	Wild cucumber	<i>Echinocystis lobata</i>

Appendix C (continued)

Family	Common Name	Scientific Name
Cyperaceae	Sedge	<i>Carex exilis</i>
	Sedge	<i>Carex lasiocarpa</i>
	Sedge	<i>Carex limosa</i>
	Sedge	<i>Carex livida</i>
	Cotton grass	<i>Eriophorum spissum</i>
	Cotton grass	<i>Eriophorum gracile</i>
	Twig-rush	<i>Cladium mariscoides</i>
	Bulrush	<i>Scirpus</i> sp.
	Wool grass	<i>Scirpus cyperinus</i>
	Beak-rush	<i>Rhynchospora alba</i>
	Beak-rush	<i>Rhynchospora fusca</i>
Droseraceae	Sundew	<i>Drosera anglica</i>
	Sundew	<i>Drosera intermedia</i>
	Sundew	<i>Drosera linearis</i>
Ericaceae	Bog-rosemary	<i>Andromeda glaucophylla</i>
	Leather-leaf	<i>Chamaedaphne calyculata</i>
	Bog-laurel	<i>Kalmia polifolia</i>
	Labrador tea	<i>Ledum groenlandicum</i>
	Cranberry	<i>Vaccinium Oxycoccus</i>
	Blueberry	<i>Vaccinium</i> sp.
Fabaceae	Hog peanut	<i>Amphicarpa bracteata</i>
	Wild pea	<i>Lathyrus venosus</i>
Gentianaceae	Gentian	<i>Gentiana rubricaulis</i>
	Buckbean	<i>Menyanthes trifoliata</i>
Gramineae	Quack grass	<i>Agropyron repens</i>
	Brome grass	<i>Bromus</i> sp.
	Bluejoint	<i>Calamagrostis canadensis</i>
	Common reed	<i>Phragmites communis</i>
	Wild rice	<i>Zizania aquatica</i>
Haloragaceae	Water milfoil	<i>Myriophyllum exalbescent</i>
Juncaceae	Rush	<i>Juncus stygius</i>
Juncaginaceae	Arrow-grass	<i>Scheuchzeria palustris</i>
Lentibulariaceae	Bladderwort	<i>Utricularia vulgaris</i>
Lilliacaeae	Carriionflower	<i>Smilax</i> sp.
Moraceae	Wild hops	<i>Humulus Lupulus</i>
Najadaceae	Pondweed	<i>Potamogeton</i> sp.
Nymphaeaceae	Yellow pond lily	<i>Nuphar variegatum</i>
Oleaceae	Black ash	<i>Fraxinus nigra</i>
	Green ash	<i>Fraxinus pennsylvanica</i>
Onagraceae	Fireweed	<i>Epilobium angustifolium</i>

Appendix C (continued)

Family	Common Name	Scientific Name
Orchidaceae	Dragon's mouth orchid	<i>Arethusa bulbosa</i>
	Moccasin flower	<i>Cypripedium acaule</i>
	Ragged fringed orchid	<i>Habenaria lacera</i>
	Yellow twayblade	<i>Liparis Loeselli</i>
	Heartleaf twayblade	<i>Listeria cordata</i>
	Adder's-mouth orchid	<i>Malaxis unifolia</i>
	Snake-mouth orchid	<i>Pogonia ophioglossoides</i>
	Snake-mouth orchid	<i>Pogonia ophioglossoides forma albitlora</i>
Pinaceae	Balsam fir	<i>Abies balsamea</i>
	Tamarack	<i>Larix laricina</i>
	White spruce	<i>Picea glauca</i>
	Black spruce	<i>Picea mariana</i>
	Jack pine	<i>Pinus banksiana</i>
	Red pine	<i>Pinus resinosa</i>
	White pine	<i>Pinus strobus</i>
Polygonaceae	Smartweed	<i>Polygonum</i> sp.
Polypodiaceae	Bracken fern	<i>Pteridium aquilinum</i>
Primulaceae	Loosestrife	<i>Lysimachia thyrsiflora</i>
Ranunculaceae	Meadow rue	<i>Thalictrum dioicum</i>
Rosaceae	Marsh cinquefoil	<i>Potentilla palustris</i>
	Chokecherry	<i>Prunus virginiana</i>
	Wild rose	<i>Rosa</i> sp.
	Red raspberry	<i>Rubus strigosus</i>
	Juneberry	<i>Amelanchier</i> sp.
Rubiaceae	Bedstraw	<i>Galium labradoricum</i>
Salicaceae	Balsam poplar	<i>Populus balsamifera</i>
	(Balm of Gilead)	
	Trembling aspen	<i>Populus tremuloides</i>
	Willow	<i>Salix</i> sp.
Sarraceniaceae	Pitcher plant	<i>Sarracenia purpurea</i>
Saxifragaceae	Gooseberry	<i>Ribes triste</i>
Sphagnaceae	Sphagnum moss	<i>Sphagnum</i> sp.
Tiliaceae	Basswood	<i>Tilia americana</i>
Typhaceae	Common cattail	<i>Typha latifolia</i>
Ulmaceae	American elm	<i>Ulmus americana</i>
Umbelliferae	Water-hemlock	<i>Cicuta bulbifera</i>
Urticaceae	Woodnettle	<i>Laportea canadensis</i>
Xyridaceae	Yellow-eyed grass	<i>Xyris montana</i>

Appendix D. Vegetative composition of the Red Lake WMA and proposed deletion.

Type	Present WMA Boundary				Proposed Deletion			
	State, Federal, and Private Lands		Red Lake Indian Lands		State, Federal, and Private Lands		Red Lake Indian Lands	
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
Upland Deciduous (aspen, birch)	35,338	9	2,885	10	2,765	2	90	1
Upland Conifer (jack pine, red pine, white pine, spruce/balsam)	8,188	2	1,310	4	57	< 1	0	0
Bottomland Hardwood	2,612	1	183	< 1	0	0	0	0
Lowland Deciduous (lowland brush, off- site aspen)	127,016	33	7,682	26	37,466	30	2,138	31
Lowland Conifer (black spruce, tamarack, white cedar)	132,132	34	10,107	34	35,528	28	2,586	37
Mixed Deciduous/ Coniferous	3,434	1	961	3	12	< 1	0	0
Fen/Bog	71,677	18	5,436	18	42,694	34	1,980	29
Agricultural Field (cropland and rice paddies)	835	<1	0	0	666	< 1	0	0
Old Field	926	< 1	287	1	126	< 1	0	0
Experimental Burn	587	< 1	48	< 1	0	0	0	0
Marsh	4,791	1	890	2	1,302	1	132	2
Open Water	103	< 1	118	< 1	5,926	5	0	0
Total	287,639	100	29,817	100	126,442	100	6,908	100

Appendix E. Inventory of DNR buildings on the Red Lake WMA at Waskish.

Controlling Discipline	Building Type	Inventory Number	Area (Square feet)	Construction Date	Condition
Enforcement	Garage	0193	299	1930-40	Poor
	Boathouse	0194	448	1950-60	Fair
	Cabin	1286	540	1930-40	Poor-Fair
	Residence	1282	2328	1930-40	Fair-Good
	Residence	0658	2080	1950-60	Good
	Warehouse/Storage	1291	168	1930-40	Fair
	Warehouse/Storage	1293	448	1930-40	Fair
	Warehouse/Storage	0466	960	1930-40	Fair
Fisheries	Garage	1285	624	1930-40	Fair
	Fish Hatchery	1281	1800	1930-40	Fair
	Ice House	1290	192	1930-40	Fair
	Guard Shack	1289	96	1930-40	Poor
	Warehouse/Garage	1288	2000	1930-40	Fair
Forestry	Fish Cleaning House	0756	192	1960-70	Fair
	Garage	0436	324	1950-60	Fair
	Garage	0467	640	1930-40	Fair
	Office/Warehouse	0744	1860	1960-70	Fair
	Oil House	0465	100	1930-40	Fair
	Well House	0464	70	1950-60	Fair

Appendix F. Red Lake WMA public use survey; methods, analysis, and results.

A public use survey was conducted to supply additional information on the types and amounts of recreational use occurring on the area. Information on the attitudes and demographic characteristics of area users was also obtained.

SURVEY PERIOD

The survey, conducted in 1978, was divided into two subperiods, June through August and September through December, because of differences in the intensity and types of use on the area. June through August are months of warm weather activities such as fishing, camping, and boating, while hunting predominates during September through December. Public use of the area from January through April is extremely low according to the resident manager. Since time and funding was not adequate to survey the entire year, this period was not sampled.

SAMPLING TECHNIQUES

Questionnaires were distributed to parked vehicles encountered along a predetermined route which included the major access points and roads of the management area (Figure 1). For each vehicle encountered, the vehicle type, license plate number, time of day, and approximate location were recorded on a tally sheet. A closed, road-blocking technique was not feasible because of the dispersed points of access along the roads bordering and bisecting the WMA.

Each subperiod was stratified by weekday units (Monday - Friday) and weekend units (Saturday - Sunday). One sample day was drawn from every other weekday unit and one from every other weekend unit, with a random start for selecting the first unit sampled. Within each unit selected, one sampling day was drawn at random.

Additional public use surveys were conducted on three other WMA's in northwestern Minnesota concurrent with the Red Lake WMA survey. Because of time and personnel constraints, only one area could be surveyed per day. When conflicts in surveys occurred on the same day between the four WMA's, the extra route(s) were reassigned to the nearest day within that sampling unit.

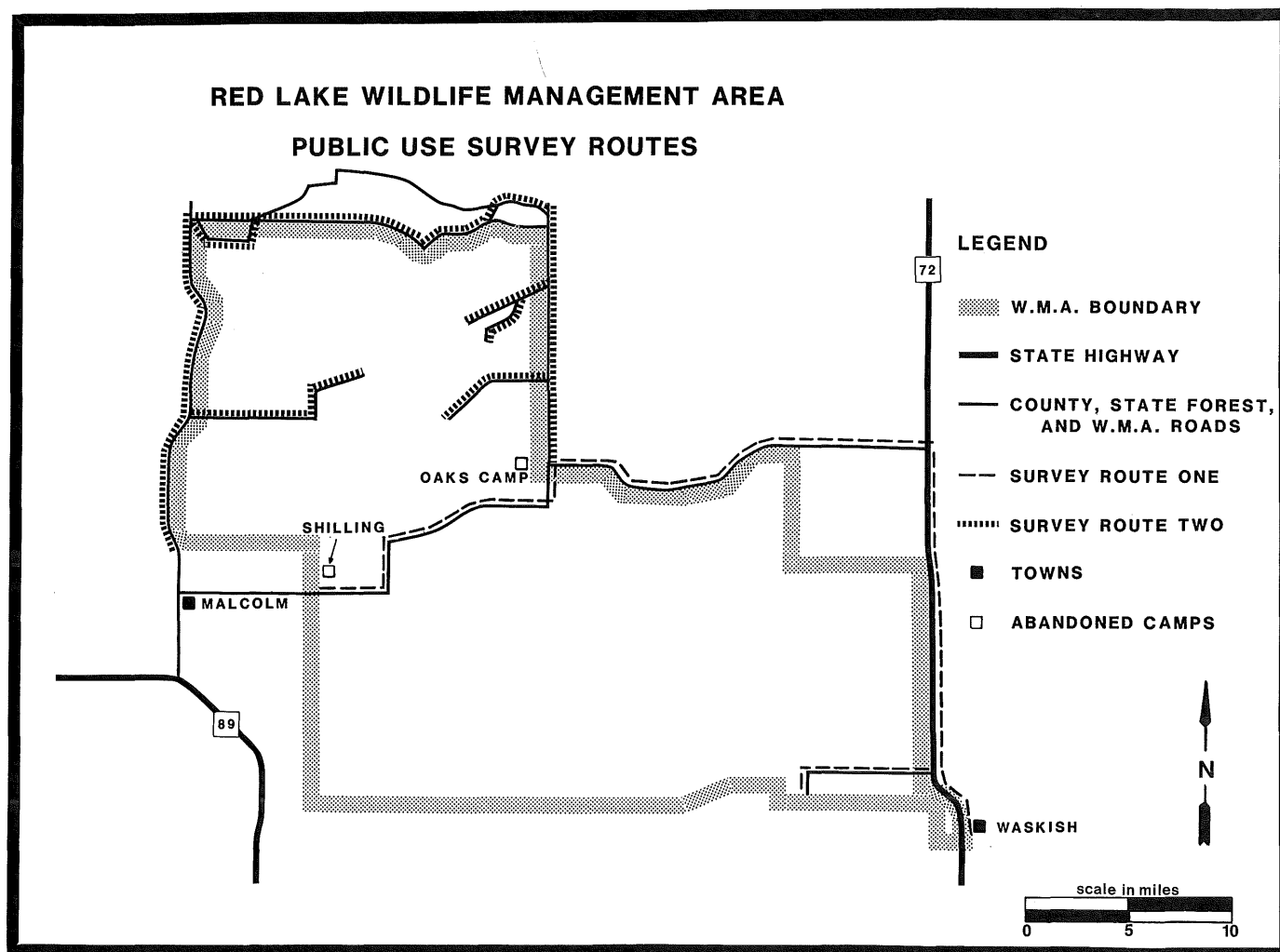
Because of the long traveling distance around the WMA, two independent routes of approximately equal distance were established. Route 1 covered the southern half of the WMA and ran from Waskish to Shilling; route 2 surveyed the northern half and ran from Oaks Camp to Malcom (Figure 1). Routes were alternated from one sample unit day to the next, but, in addition, each route was reversed on every like sample unit. For example, if route 1 was sampled from Waskish to Shilling on a weekend unit, it was sampled from Shilling to Waskish on the next weekend unit route 1 was surveyed.

Only vehicles parked along the portions of the route paralleling or entirely within the WMA boundary were tallied and given a questionnaire.

Starting times for each route during the June-August period alternated between 10 a.m. and 3 p.m. to better cover expected evening use of the area. For the September-December period, each route alternated between 8 a.m. and 1 p.m. to better comply with hunting hours. The enumerator recorded the starting and ending times of each survey route.

QUESTIONNAIRE

A questionnaire and stamped business reply envelope were clipped on the windshield of each vehicle encountered along the survey route. The questionnaire consisted of 13 questions which could all be answered by a simple check or short answer. (Figure 2). The questionnaire was designed to be completed on a visitor-



Appendix F, Figure 1

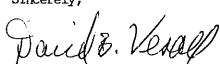
Appendix F (continued)

FIGURE 2. Public Use Survey Questionnaire.

Dear Visitor:

The Department of Natural Resources is preparing a long range management plan for the Red Lake Wildlife Management Area and we would like your help. After your visit today, please complete the following questionnaire, put it in the attached envelope, and drop it in a mail box. No postage is required. It is important that you complete this even if you have filled one out on a previous day.

Thank you.

Sincerely,

 David B. Vesall, Director
 Division of Fish and Wildlife
 Department of Natural Resources

THE QUESTIONS START ON THE BACK OF THIS PAGE

PLEASE NOTE: THE WASKISH CAMPGROUND IS WITHIN THE RED LAKE WILDLIFE MANAGEMENT AREA.

2

1. Did you, or any member of your party use the Red Lake Wildlife Management Area today? (Please refer to the attached map if you are unsure of the area's exact boundaries).

Yes - (go to question 2).

No - (thank you, do not answer any more questions, just mail the questionnaire to us in the envelope provided).

2. Please indicate the age, circle the sex, and write the hometown of each person in your vehicle that used the area today. Don't forget yourself.

Age	Sex	Hometown
1. _____	Male/Female	_____
2. _____	Male/Female	_____
3. _____	Male/Female	_____
4. _____	Male/Female	_____
5. _____	Male/Female	_____
6. _____	Male/Female	_____

3. Approximately how many times has each party member visited the Red Lake Wildlife Management Area in the last 12 months?

Party Member Number (from question 2.)	Number of Visits last 12 months
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____
5. _____	_____
6. _____	_____

4. Following is a list of activities. Find the activities your party participated in on the area today. In the space provided, write in the number of hours your party spent on each activity.

_____ duck hunting	_____ sharptailed grouse (Chickens) hunting
_____ goose hunting	_____ deer hunting
_____ controlled goose hunt	_____ trapping
_____ ruffed grouse (partridge) hunting	

The list is continued on the next page.

3

4. Continued -

_____ fishing	_____ firewood gathering
_____ snowshoe hare hunting	_____ bird watching
_____ Hungarian partridge hunting	_____ observing nature
_____ camping	_____ photography
_____ snowshoeing	_____ drawing/painting
_____ skiing	_____ berry picking
_____ boating	_____ picnicking
_____ canoeing	_____ gathering wild food other than berries
_____ hiking	_____ other, describe _____
_____ snowmobiling	

5. If any party members hunted or fished, please list the species you were after, the number your party took, and any hunting cripples that were lost.

Species	Take	Cripples Lost
(Example): Ruffed Grouse	0	1
1. _____	_____	_____
2. _____	_____	_____
3. _____	_____	_____
4. _____	_____	_____
5. _____	_____	_____
6. _____	_____	_____

6. Did you hunt with a dog?
 _____ Yes _____ No

7. What time did you arrive at the area? Hour _____ A.M. _____ P.M. _____ / _____ / _____
 (month/day/year)

8. What time did you leave? Hour _____ A.M. _____ P.M. _____ / _____ / _____
 (month/day/year)

Continued on the back of this page.

4

9. On the next page is a map of the Red Lake Wildlife Management Area. The unit is divided into numbered zones. Please check those zones your party used today. You may keep the map if you like.

Zones		
_____ 1	_____ 4	_____ 7
_____ 2	_____ 5	_____ 8
_____ 3	_____ 6	_____ 9

10. How would you describe the quality of your visit to the area?

_____ Very good
 _____ Good
 _____ Fair
 _____ Poor
 _____ Very poor

11. What do you like about the area?

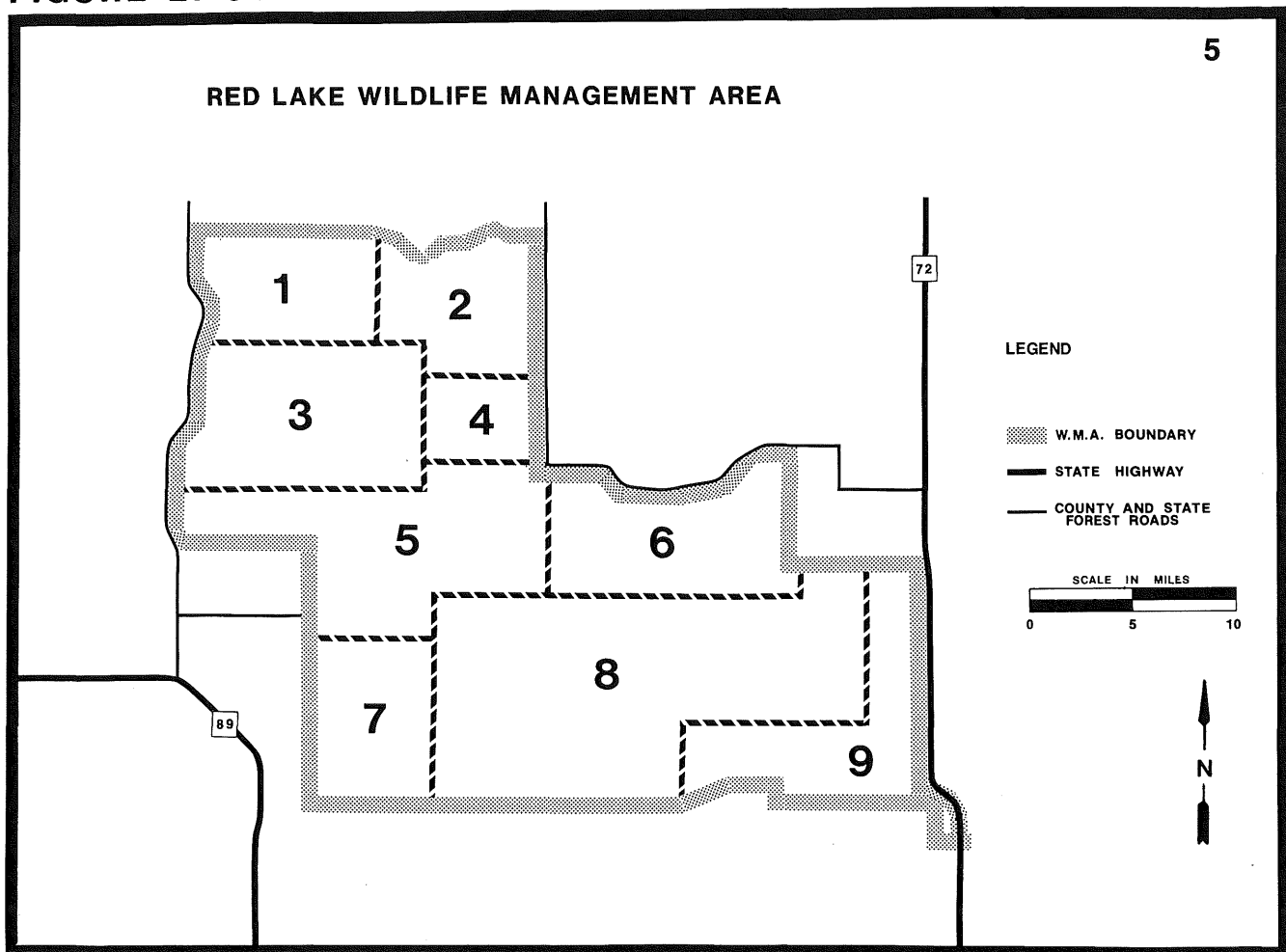
12. How could the area be improved?

13. What amount of money did your party spend on this trip for such things as lodging, transportation, beverages, tobacco, ammunition, etc., in:

A. Beltrami and Lake of the Woods Counties _____ (Dollars)

B. Other counties _____ (Dollars)

FIGURE 2. Continued.



party basis. Extra spaces were provided for questions requiring individual answers. A map of the WMA divided into nine compartments was attached to each questionnaire. An individual identification number was stamped on the upper right hand corner of each questionnaire to facilitate tabulating and checking questionnaire returns.

Visitors were requested to complete and return a questionnaire even if they had done so on a previous day. No attempt was made to contact non-respondents.

RESULTS AND ANALYSIS

Between June 14 and December 31, 1978, 44 survey routes were completed; 20 for route 1 and 24 for route 2. Seventeen of these 44 routes were run during the nonhunting period (June-August) and 27 during the hunting period (September-December). Routes were approximately equally divided between weekends and weekdays with 21 and 23, respectively. The average driving time per route was four hours and four hours, 16 minutes for the nonhunting and hunting periods, respectively. There was no significant difference between driving times for route 1 and route 2.

A total of 314 questionnaires was distributed to area users; 122, 39 per cent, were returned. Visitors were encountered more frequently during the hunting period, on weekends rather than weekdays, and on route 1 rather than route 2 (Table 1). Route 1 included the Waskish campground area which received heavy use from late spring through fall.

In 1978, the state fishing season opened on May 13; this survey did not begin until June 14. Since public use during the first month of the fishing season was expected to be important, the nonhunting period was extrapolated to cover these extra 32 days (May 13 — June 13). Public use during these 32 days was assumed to be comparable to use levels during the rest of the period (June 14 — August 31). Public use prior to May 13 was assumed to be insignificant.

Data was expanded assuming that use levels for similar sampled and non-sampled days during a sample period (hunting/nonhunting) would not differ significantly. The visitors length of stay and the amount of immigration and emigration by visitors during the driving time required to complete one survey route, however, will affect use estimates. If visitors stay less than the average driving time to complete one survey route, they may not be counted. To compensate for this, a correction factor was used when the data were expanded.

The correction factor was based on the distribution of the length of stay of parties responding to the questionnaire. For each sample period (hunting/nonhunting), the sample day was divided into two to three subperiods based on the average driving time (A.D.T.) for the survey route (see below). Depending on their length of stay, respondents were tallied into one of these categories. The percentage of respondents in each category was calculated. Each category was assigned a multiplication correction factor (M.C.F.) based on its proportion of the total sample day. For example, the < A.D.T. category was assigned a M.C.F. of 3 because it represented one-third of the sample day. In this manner, it was possible to expand use estimates and compensate for parties which may not have been sampled because their length of stay was short. An example of this distribution method follows:

Subperiod	Number of parties	Percentage	M.C.F.
< A.D.T.	x	$x/n = X_1$	$3 = M_1$
A.D.T. - 2x A.D.T.	y	$y/n = X_2$	$2 = M_2$
> 2x A.D.T.	z	$z/n = X_3$	$1 = M_3$
TOTAL	n		

Table 1. Average number of questionnaires distributed per route by period and type of day.

Period	Type of Day			
	Weekend		Weekday	
	Route 1	Route 2	Route 1	Route 2
Nonhunting	13	1	9.5	0.8
Hunting	15.5	9.7	6.5	2
Total	14.5	6.5	7.7	1.5

Estimates of party use were calculated separately by sample unit (weekend/weekday) and by route before combined to obtain estimates of total use for that sampling period. The units of public use are reported as party visitor-days, visitor-days, and use-days. A visitor-day is defined as one individual using the area on one day, regardless of the length of stay. A party visitor-day is one party or group of visitors using the area on one day, regardless of their length of stay or party size. A use-day is one person using the area for one activity, such as hunting or fishing, on one day. One person may account for as many use-days as activities participated in on one day, but that person only accounts for one visitor-day.

In addition, the hunting period was divided into three subperiods to better estimate variations in hunting pressure. Use estimates were calculated separately for each subperiod and then totaled. The subperiods and corresponding hunting types are as follows:

September 1 - November 3	Woodcock and grouse hunting
November 4 - November 19	Firearms-deer hunting
November 20 - December 31	Late grouse and snowshoe hare hunting

An expanded average party visitor-days/route figure was netculated by summing the average number of parties/routes times the percentage of parties in each A.D.T. subperiod times the appropriate M.C.F. The formula and its notations follow:

$$\bar{x} = \sum_{i=1}^3 \bar{p} (X_i) M_i$$

where \bar{x} = expanded average party visitor-days/route

\bar{p} = average number of parties/route

X_i = percentage of parties in the i^{th} A.D.T. subperiod

M_i = M.C.F. for the i^{th} A.D.T. subperiod.

The party visitor-days for each sampling period (hunting/nonhunting) were calculated by multiplying the expanded average party visitor-days/route by the number of weekdays or weekend days in the sampling period. An estimated 2,377 and 2,141 party visitor-days occurred during the nonhunting and hunting periods, respectively. Total visitor-days were estimated by multiplying party visitor-days by

average party size; 6,840 and 6,493 visitor-days occurred during the nonhunting and hunting periods, respectively.

Estimates of use-days by recreational activity for each sample period were calculated by multiplying the total estimated number of visitor-days in that period by the percentage of parties participating in each specific activity. For example, 63 percent of the parties responding during the non-hunting period engaged in fishing. A total of 6,840 visitor-days were estimated for this period; therefore, $0.63 \times 6,840 = 4,309$ estimated fisherman use-days for the non-hunting period. All members of a party were assumed to participate in all recreational activities checked on the questionnaire. Use-day estimates by recreational activity total more than the estimate of total visitor-days for each sampling period, as respondents may participate in more than one activity per day. Hunting, fishing, camping, and nature observation generated the most use-days (Table 2).

No attempt was made to correct for nonresponse bias. It was assumed that user characteristics for respondents and nonrespondents would not differ significantly.

Additional survey results concerning the distribution and percentage contribution of visitor use by season and type of day and the percent of respondents participating in various recreational activities are described in the Public Use section (pages 26-29).

SPATIAL DISTRIBUTION. Visitor distribution by activity was examined by requesting users to indicate which portions of the WMA they used during their visit. A map of the management area, divided into nine zones was attached to each questionnaire. Visitor use by activity and zone was tallied and percentages were calculated for the amount of each activity by zone and the contribution of each activity to the total use in each zone (Table 3.) For example, 19 percent of the ruffed grouse hunters responding hunted in zone 3, and grouse hunting accounted for 24 percent of the total use calculated for this zone (indicated as 19/24 on Table 3).

Among the 122 parties responding to the questionnaire, 34 percent of all activities occurred in zone 9, which includes the Waskish Campground. Zone 7, the southwestern part of the WMA, was the least used zone.

VISITOR CHARACTERISTICS. Attitudes and characteristics of area users were described in the Public Use section (pages 26-29). Demographic characteristics described include age, sex, and current place of residence. Attributes describing

Table 2. Estimated number of use-days for each of 13 major recreational activities on the Red Lake WMA, May - December 1978.

Activity	Period		
	Nonhunting (May-August)	Hunting (Sept.-Dec.)	Total (May-Dec.)
Total hunting	0	5,790	5,790
Ruffed grouse	0	2,007	2,007
Deer ¹	0	3,062	3,062
Sharp-tailed grouse	0	346	346
Waterfowl	0	375	375
Fishing	4,309	1,844	6,153
Camping	2,736	2,609	5,345
Observing nature	2,510	1,846	4,356
Picnicking	2,257	698	2,955
Boating/canoeing	1,826	708	2,534
Firewood gathering	910	1,119	2,029
Hiking	1,142	737	1,879
Berry picking	1,140	459	1,599
Photography	684	1,074	1,138

¹ Includes archery and special muzzleloader deer seasons.

Table 3. Spatial distribution of activities by percentage on the Red Lake WMA reported by 122 parties May — December, 1978.

Activity	Compartment								
	1	2	3	4	5	6	7	8	9
Hunting									
Ruffed grouse	10 ¹ /15 ²	7/17	19/24	15/29	30/30	10/16	0/0	3/8	7/3
Deer	19/25	12/22	21/20	5/4	12/8	9/11	2/50	2/4	19/6
Waterfowl	17/9	0/0	17/7	17/6	17/5	22/11	0/0	11/8	0/0
Sharp-tailed grouse	10/6	0/0	16/7	21/8	26/8	21/11	0/0	5/4	0/0
Fishing	0/0	2/4	2/2	4/4	2/2	0/0	0/0	7/12	82/25
Camping	4/6	4/9	11/13	13/15	13/13	2/11	0/0	6/12	40/15
Firewood gathering	11/9	0/0	11/7	18/10	15/6	3/3	0/0	7/8	33/6
Photography	10/9	3/4	10/7	11/10	21/9	10/8	0/0	7/8	21/4
Observing nature	4/6	8/17	8/9	12/12	14/11	10/14	2/50	4/8	38/13
Picnicking	4/3	10/9	0/0	10/4	4/2	10/5	0/0	10/8	53/8
Boating/canoeing	6/3	6/4	0/0	0/0	0/0	0/0	0/0	12/8	75/9
Hiking	4/3	0/0	4/2	9/4	9/3	9/5	0/0	13/12	52/8
Berry picking	10/3	20/9	10/2	10/2	0/0	10/3	0/0	10/4	30/2
Relative amount of total use within each compartment	8	6	11	12	15	9	0	6	34

¹ Percent across the row=relative amount of a single activity in each of nine compartments.

² Percent down the column=relative amount of each activity within each compartment.

the respondent's visit include party size, length of visit, distance traveled, number of previous visits, expenditures, and opinions on the quality of their visit and the management area.

The responses of users to questions asking what they like about the WMA and how the WMA could be improved are summarized in Tables 4 and 5. Characteristics of the unit which were most important were its wild and scenic qualities, the general quality of hunting, hunting and fishing opportunities, and campground and public access facilities. About 20 percent of the respondents felt that no improvements were needed on the unit. The most frequently cited needed improvements involved camping and water access sites. Respondents also felt that increased habitat management, more maintenance and development of access roads and trails, and better enforcement of regulations were needed.

Vehicles were encountered by the enumerator on the survey routes in the following proportions: standard pickup trucks, 48.5 percent; automobiles, 25.6 percent; motor homes, 10.1 percent; four-wheel drive vehicles, 9.8 percent; vans, 4.7 percent; and buses, 1.3 percent. Most trucks had bed covers or campers attached.

Table 4. Most important characteristics of the Red Lake WMA as reported by 107 respondents surveyed, June — December, 1978.

Characteristic	Number of Responses	Percent ¹
Area appearance (wildness, scenery, solitude)	72	67.3
Hunting quality and opportunities	20	18.7
Campground and public access facilities	20	18.7
Fishing opportunities	18	16.8
Abundance of wildlife	12	11.2
Access roads and trails	6	5.6
Friendly people	4	3.7
Upper Red Lake and beaches	2	1.9
Other	7	6.5

¹ The summation of percentages exceeds 100 because respondents could report more than one characteristic.

Table 5. Improvements needed on the Red Lake WMA as reported by 105 respondents surveyed, June — December, 1978.

Characteristic	Number of Responses	Percent ¹
Campground and access facilities (toilet, electricity, insect control, mow grass, wood supply)	38	36.2
No improvements needed	20	19.0
Habitat improvement	15	14.3
More access roads and trails/maintain existing roads	14	13.3
More enforcement of hunting and fishing regulations	11	10.5
Wolf control	10	9.5
Increased fisheries management	5	4.8
More wildlife research	3	2.9
Increase wildlife populations	3	2.9
Less commercial logging	3	2.9
More restrictive hunting regulations	3	2.9
Better posting of the area/Improved maps	3	2.9
Hunter ethics	2	1.9
Stop commercial fishing on Upper Red Lake	2	1.9
Other	4	3.8

¹ The summation of percentages exceeds 100 because respondents could report more than one characteristic.

Appendix G. Wildlife/Forestry Coordination Policy.

PREAMBLE

As state administered lands are to be managed for compatible multiple use benefits, unless otherwise dedicated by law, both the Divisions of Forestry and Fish and Wildlife are jointly charged with the responsibility of achieving the goal of integrating forest and wildlife management and recognizing other multiple use purposes. The following policies and procedures are meant to ensure that integration takes place.

GENERAL POLICY

1. All State Administered Lands (unless otherwise dedicated by laws)

The Department shall strive to implement the practices delineated in the Forestry/Wildlife Guidelines To Habitat Management on all state administered lands. Such implementation is important since manipulation of forest vegetation is the key to managing for wildlife as well as timber products. Successful management for these two purposes depends upon achieving the desired combination and distribution of age classes by forest types in conjunction with stated multiple-use policies and overall sustained forest and wildlife goals. Therefore, *both disciplines will follow* these guidelines when planning and implementing forestry and wildlife management practices recognizing that whenever possible wildlife management objectives should be met through forest management practices. These guidelines will be expanded and updated as new techniques are developed.

A. Forestry Administered Lands Outside of State Forests in Wildlife Management Areas.

1. To the extent possible on lands determined to have significant wildlife and significant forestry values, wildlife management objectives should be met through forestry management practices. However, where long term forest management objectives are in conflict with long term *wildlife objectives on specific tracts of land* transfer of custodial control, lease or acquisition shall be considered. However, this should be considered *only* where critical habitat conditions cannot be met through cooperative planning.

2. Lands determined to have primary value for wildlife with relatively low values for forestry should be acquired or custodial control transferred to the Division of Fish and Wildlife.

B. Wildlife Management Area Lands Within State Forests

Where overlap of unit boundaries occurs, i.e. state forest and state wildlife management areas, cooperative agreements relative to administration shall be established. These agreements shall become part of the forest management and wildlife management area plan. However, where long term forest management objectives are in conflict with long term wildlife objectives on specific tracts of land, transfer of custodial control, lease or acquisition shall be considered.

2. Other Non-DNR Lands

Wildlife and forestry personnel should seek to establish cooperative agreements with other public land management agencies, or private or industrial landowners for the purpose of meeting wildlife and forest management objectives. Private Forest Management assistance should consider the Forestry Wildlife Guidelines To Habitat Management.

SPECIFIC POLICY

1. Forestry/Wildlife Guidelines to Habitat Management

Forestry/Wildlife Guidelines To Habitat Management should be developed by the Division of Fish and Wildlife six months after this policy has been approved. Upon development, these guidelines shall be reviewed by the Forestry/Wildlife Task Force. Upon agreement of the Task Force, the guidelines shall be submitted to the Division Directors of Forestry and Fish and Wildlife for joint approval. Subsequent changes or additions shall be brought to the attention of the Division level of Forestry and Fish and Wildlife. Upon joint agreement at the division level, the guidelines or changes will be forwarded to the field for implementation. Until these guidelines are completed, it shall be the responsibility of the area wildlife manager to inform the area and districts of desired practices. In the interim the 1972 Forest Wildlife Habitat Management Plan Procedure shall be used as a guideline with special emphasis placed on the site disturbance map.

A. The following points need to be covered in the Forestry/Wildlife Guidelines To Habitat Management to be developed by the Section of Wildlife with input from the Division of Forestry.

1. Habitat composition goals: Habitat composition goals need to be developed so that any district in the state has something to work with. It should be recognized that these goals provide a general framework within which the area manager has leeway to develop more specific objectives.
2. Compartment analysis: The guidelines should define a procedure for getting a specific compartment analysis to the districts.
3. Forestry practices: The specific types of modifications (size, design, etc.,) to forestry practices, e.g. timber sales, site preparation, roads, for habitat enhancement need to be addressed.
4. Openings: The guidelines should develop a system for dealing with wildlife openings created from forestry practices, e.g. the Spoden method.
5. Special wildlife considerations: Those considerations needed for special wildlife species or wildlife concentrations, e.g., eagles, osprey, prairie chickens etc. need to be addressed.
6. Habitat development projects: The guidelines should develop a method for handling and keeping tract of habitat development projects, e.g. browse strips, impoundments, prescribed burns.

B. The task force which developed the wildlife/forestry coordination policy shall meet in one year following implementation of the above policy to determine how well the policies and procedures are working and to recommend any changes that may be necessary. This task force should be expanded, at that time, to include representatives from forestry and wildlife from the prairie transition and agricultural areas of the state.

C. The Department will develop an in-house policy for reviewing all proposals for land acquisition, land exchange, boundary revisions, land sales and easements.

D. To improve coordination and cooperation between the Divisions of Forestry and Fish and Wildlife, wildlife and forestry personnel, within the primary forested area of the state, shall have a common office, when the opportunity exists.

E. The Department should initiate forest and wildlife research projects on mutually important tree species such as white cedar, oak, and others to address wildlife and forestry values.

F. Management plans for all DNR management units will have input from all divisions prior to public release or public information meetings.

G. The Divisions of Fish and Wildlife and Forestry need to develop a joint policy on the use of prescribed fire.

H. A policy statement or cooperative agreement(s) should be developed to address problems between fish management and forest and wildlife management practices.

GENERAL PROCEDURAL POLICY

As a general rule, assigned Forestry and Wildlife staffs should attempt to review *all* management practices at *joint meetings* (see specific management practices) since such meetings foster better working relationships, promote understanding and favor mutual agreements. It is hoped that these meetings will encourage more frequent contact between staffs.

If upon notification of a specific practice a discipline opts to *not* review a specific practice then lack of review shall indicate there are no concerns. Any differences in judgement in interpreting this policy or procedure or in deciding any particular management project or program which cannot be resolved shall be immediately referred to the next higher level of the department organization. Under no circumstances is one level or division to delay a decision on a proposal of another

because of disagreement. It should be referred to the next level of supervision with recommendations as to why it should not be approved.

Disagreements that cannot be resolved at the division directors level will be immediately referred to the Planning and Environmental Review Team (PERT). PERT will review the problem and forward its recommendations for resolution to the Commissioner's office for making a decision.

SPECIFIC PROCEDURAL POLICY

Notification on each of the following specific management practices (1-13) shall be by "speed letter". A "speed letter" shall be initiated by that discipline level proposing an action. The speed letter shall be forwarded to the identified staff level and discipline for each activity below.

Upon receipt of notification the reviewer has two options:

1. No review needed — sign pink copy and return to initiator.
2. Request review meeting. Following this meeting, one of the following actions shall take place:
 - A. Review and approve — sign pink copy, state approval, and return to initiator.
 - B. Review and disapprove — sign pink copy and list non-approved project with an explanation and copy of memo sent to next higher level of review.

Time schedules for review are noted under specific activities to be reviewed. Mutually agreeable arrangements concerning waiver of review for certain categories of projects may be proposed by memo, at the regional level, for joint approval at the division director level, e.g. non-review by forestry of wetland acquisition in the farmland area of the state, when necessary to alleviate creating a cumbersome review and approval process.

To assure that integration of management will take place forestry and wildlife staffs shall adhere to the following procedural policies:

1. Site Preparation -
Planting/Seeding -
Timber Stand Improvements -

Area wildlife and district (or area) forestry personnel will review draft plans, ideally at a joint meeting(s), at the time such plans (down to the site) are proposed. Such review should take place within two weeks of notification unless some other time interval is arranged. Review shall include approval, modification, or suggestions of alternative projects. Any changes in the planned projects shall be reviewed within five working days of notification of change.

2. Vegetative Management;
Timber Sales and Non-Commercial
Stand Regeneration

Area wildlife and district forestry personnel shall review the "planned annual cut" and non-commercial stand regeneration proposals at a joint meeting at the time such management activities are planned. Such review should take place within two weeks of notification from Forestry or Wildlife unless some other time interval is arranged. Review shall include approval, modification, or suggestions of alternative projects. Any changes in the planned annual cuts or non-commercial stand regeneration proposals shall be reviewed within five working days of notification of change. Any work outside of the planned area is considered a change.

3. Roads and Trails -

Area wildlife and district forestry personnel will review all new road and trail project proposals, ideally at a joint meeting(s), as such roads and trails are planned. Such review should take place within two weeks of notification, unless some other time interval is arranged. Review shall include approval, modification, or suggestions of alternative projects. Any changes in planned projects shall be reviewed within five working days of notification of change.

4. Agricultural leases -

Area wildlife and district and area forestry personnel will review all agricultural leases as they are proposed. Such review should take place within two weeks of notification unless some other time interval is arranged. Review shall include approval, modification, or suggestions of alternative projects.

5. Forest Inventory -

Area wildlife, district and area forestry personnel, and the inventory project leader will review the inventory project before field work starts. Such review should take

place within one month of notification unless some other time interval is arranged. Review shall include approval, modification, or suggestions on the type of field information needing emphasis within the individual area.

6. Significant Wildlife Conditions —

Area wildlife and district forestry personnel will notify each other of significant wildlife conditions, e.g. bald eagle nest sites, heron rookeries, osprey nest sites, etc. (listed by the non-game program) and emergency situations i.e. deer starvation etc., as soon as they become aware of such conditions on any land. Review of forest management considerations relative to significant wildlife conditions shall take place as soon as possible following notification. Wildlife recommendations shall be given priority consideration if such conditions are confirmed as significant or of an emergency nature.

7. Significant Forestry Conditions

Area wildlife and district forestry personnel will notify each other of significant forest management opportunities e.g. unique soil conditions for a high value species, when they become aware of such opportunities on any land. Review of wildlife management considerations relative to significant forestry opportunities shall take place within one month of notification.

8. Boundary Changes, Acquisition, Land Exchanges, Land Sales, Easements, and Leases

Area wildlife and area forestry personnel will notify each other of all proposals for boundary changes, acquisition, land exchanges, land sales and easements. On wildlife management projects the wildlife management area land acquisition proposal (G.F. 300) shall constitute notification for all acquisition, easement, and boundary changes for that wildlife management area. These shall be reviewed internally within the two divisions at all levels prior to official public release and/or submittal for legislative consideration. Following approval of the respective directors, all levels shall be notified of the decision prior to official public release.

9. District or Forest Management Plan —

Development of district or forest management plans shall be the responsibility of forestry. The wildlife management recommendations for this plan are to be developed by wildlife personnel and will address browse management, cover management, openings, impoundments, significant wildlife conditions, access roads and other priorities needed during the life of the management plan. Review, by each discipline, shall be conducted according to a jointly agreed upon management plan schedule. Review shall include approval, modification, or suggestions of alternatives.

10. Wildlife Management Area Plan —

Development of Wildlife Management Area plans shall be the responsibility of wildlife. The forestry management recommendations for this plan are to be developed by forestry personnel to cover the life of the management plan. Review, by each discipline, shall be conducted according to a jointly agreed upon management plan schedule. Review shall include approval, modification, or suggestions of alternatives.

11. Wildlife Projects Initiated by Wildlife —

- a. **Forestry Administered Lands:** All proposed wildlife projects on forestry administered lands will be reviewed by district, area, and regional personnel prior to implementation. Such review will take place within one month of notification from wildlife unless some other time interval is arranged. Review shall include approval, modification, or suggestions of other alternatives.
- b. **Non-DNR Forestry Administered Lands:** Area wildlife personnel will inform appropriate forestry personnel of planned and desired wildlife projects and conditions on non-DNR forestry lands when they are proposed so as to foster greater opportunities for cooperation and achieving optimum forestry and wildlife benefits. Such projects and conditions include but are not limited to planned development and treatment of openings, browse management, cover management, impoundments, significant wildlife conditions, etc.

12. Forest Projects Initiated by Forestry —

Wildlife Administered Lands: All proposed forestry projects on wildlife administered lands will be reviewed by area and regional personnel prior to implementation. Such review will take place within one month of notification from forestry unless some other time interval is arranged. Review shall include approval, modification, or suggestions of other alternatives.

13. Wildlife Projects Initiated by Forestry on Forestry Administered Lands —

All proposed wildlife projects on forestry administered lands will be reviewed by area and regional wildlife personnel prior to implementation. Such review will take place within one month of notification from forestry unless some other time interval is arranged. Review shall include approval, modification, or suggestions of other alternatives.

Appendix H. Memorandum of agreement, November 7, 1980.

MEMORANDUM OF AGREEMENT

BETWEEN

The Division of Forestry, Minnesota Department of Natural Resources
and

The Division of Fish and Wildlife, Minnesota Department of Natural Resources
Relating to Management of the Red Lake Wildlife Management Area
Within the Statutory Boundaries of the Beltrami Island State Forest
in Beltrami and Lake of the Woods County

The intent of this memorandum of agreement is to ensure that cooperative management programs will be developed by the Divisions of Forestry and Fish and Wildlife (hereinafter the Divisions) on the Red Lake Wildlife Management Area (WMA) within the statutory boundary of the Beltrami Island State Forest.

WHEREAS, confusion over the administrative and management authority of the Divisions in the Red Lake WMA has hindered effective management of the area for many years, and

WHEREAS, state law authorizes the establishment of wildlife management areas wholly or partially within the boundaries of state forests only when such establishment is consistent with the purposes and objectives of the respective units (M.S. 86A.08, 1978), and

WHEREAS, the purposes and objectives of the Red Lake WMA and Beltrami Island State Forest are consistent and compatible, and

WHEREAS, cooperative management by the Divisions will contribute significantly toward the maximum development of the area's potential for wildlife production and management; forest production; and public hunting, trapping, and other outdoor recreation; and will contribute to the conservation of all natural resources on the area,

NOW, THEREFORE,

THE DIVISIONS AGREE:

1. To request that the Commissioner of Natural Resources designate lands in Beltrami and Lake of the Woods Counties, described in the Department of Natural Resources' Red Lake Wildlife Management Area Master Plan 1980-1989, as the Red Lake Wildlife Management Area.
2. To manage the area cooperatively, recognizing the statutory purposes and objectives of both State Forests and State Wildlife Management Areas, by

joint planning and/or review of site-specific management proposals by the Wildlife and Forestry Area Managers.

3. To refer all disagreements at the Area Manager level for resolution according to the guidelines established in the Department of Natural Resources' Forestry/Wildlife Coordination Policy.

4. To maintain current administrative control of state and leased federal lands within the Red Lake WMA and to cooperatively pursue the acquisition of private and federal lands within the area.

5. To legally post the common outer boundary and common public entrances to the Red Lake WMA and Beltrami Island State Forest with signs clearly indicating the joint administration of the area.

6. That this Memorandum of Agreement is contingent upon the approval of both the Department of Natural Resources' Forestry/Wildlife Coordination Policy and also the Department of Natural Resources' Red Lake Wildlife Management Area Master Plan, 1980-1989, by the Divisions of Forestry and Fish and Wildlife and by the Commissioner of Natural Resources.

7. That this Memorandum of Agreement shall become effective when signed by the parties hereto and shall continue in force until terminated by mutual consent of the Divisions or by direction of the Commissioner of Natural Resources.

APPROVED:

Date 11/4/80, CR Burrows, Director, Division of Fish and
Wildlife

Date 11/4/80, Raymond B. Olson, Director, Division of Forestry

Date 11-7-80, Joseph J. Munnich, Commissioner of Natural Resources

Appendix I. Ownership, legal description, acreage, and priority of private and unclassified federal tracts to be acquired on the Red Lake WMA.

County	Owner	Twp.	Rge.	Sec.	Legal Description	Acreage	Priority ¹
Beltrami	A. Cartigny and M. Koehler	155N	34W	9	NE $\frac{1}{4}$	160 ²	E
	St. Regis Paper Company	"	"	15	SW $\frac{1}{4}$	160 ²	E
	"	"	"	16	S $\frac{1}{2}$	320	E
	"	"	"	17	N $\frac{1}{2}$, SE $\frac{1}{4}$	480	E
	"	"	"	18	NE $\frac{1}{4}$	160	E
	"	"	"	20	NE $\frac{1}{4}$	160	E
	"	"	"	21	All	640	E
	"	"	"	22	W $\frac{1}{2}$	320	E
	Tulane Education Fund	"	"	23	NE $\frac{1}{4}$	160	E
	St. Regis Paper Company	"	"	25	NW $\frac{1}{4}$, W $\frac{1}{2}$ NE $\frac{1}{4}$	240	E
	F. Post	"	"	26	SW $\frac{1}{4}$	160	E
	St. Regis Paper Company	"	"	27	NW $\frac{1}{4}$	160	E
	L. Thielen	156N	34W	1	SE $\frac{1}{4}$	160 ²	E
	W. Russell	"	"	3	Lot 3&4	64.5 ²	E
	I. Russell	"	"	"	SW $\frac{1}{4}$, S $\frac{1}{2}$ NW $\frac{1}{4}$	224.58 ²	E
	E. Ewen	"	"	6	SW $\frac{1}{4}$	162.17 ²	D
	W. Russell	"	"	10	NW $\frac{1}{4}$	160 ²	E
	J. Achmoody	"	"	17	NE $\frac{1}{4}$ SE $\frac{1}{4}$	40	D
	F. Fritt	"	"	"	W 25 acres of SW $\frac{1}{4}$ SE $\frac{1}{4}$	25 ²	D
	G. Clevon	"	"	"	E 15 acres of SW $\frac{1}{4}$ SE $\frac{1}{2}$	15 ²	D
	T. Clevon	"	"	"	W 15 acres of SE $\frac{1}{4}$ SE $\frac{1}{4}$	15 ²	D
	V. Zilinski	"	"	"	E 25 acres of SE $\frac{1}{4}$ SE $\frac{1}{4}$	25 ²	D
	D. Dangler	156N	35W	3	W $\frac{1}{2}$ SW $\frac{1}{4}$	80 ²	D
	T. Mertz, et al.	"	"	19	NW $\frac{1}{4}$	164.29 ²	E
	H. Murray	157N	36W	35	NW $\frac{1}{4}$	160 ²	E
	A. Bryant	158N	36W	5	Lot 3	52.31 ^{2,4}	E
	J. Areiszewski	"	"	10	S $\frac{1}{2}$ NW $\frac{1}{4}$, N $\frac{1}{2}$ SW $\frac{1}{4}$	160 ²	D
Lake of the Woods	Watab & St. Regis Paper Company	157N	32W	11	S $\frac{1}{2}$ NW $\frac{1}{4}$	80	E
	"	"	"	14	W $\frac{1}{2}$ NW $\frac{1}{4}$	80	E
	K. Carey	"	"	17	S $\frac{1}{2}$ NE $\frac{1}{4}$, SE $\frac{1}{4}$ NW $\frac{1}{4}$	160 ³	D
	Watab & St. Regis Paper Company	"	"	21	N $\frac{1}{2}$ NW $\frac{1}{4}$	80	E
	Federal Government	"	"	22	SE $\frac{1}{4}$ NE $\frac{1}{4}$	40	D
	St. Regis Paper Company	157N	34W	2	Lot 1&2	158	E
	"	"	"	3	SE $\frac{1}{4}$ SW $\frac{1}{4}$, SW $\frac{1}{4}$ SE $\frac{1}{4}$	80	C
	Federal Government	"	"	6	NE $\frac{1}{4}$ NW $\frac{1}{4}$	40	E
	St. Regis Paper Company	"	"	8	NE $\frac{1}{4}$, SE $\frac{1}{4}$ NW $\frac{1}{4}$, NE $\frac{1}{4}$ SW $\frac{1}{4}$	240	C

Appendix I (continued)

County	Owner	Twp.	Rge.	Sec.	Legal Description	Acreage	Priority ¹
Lake of the Woods	L. McFadden	157N	34W	9	N $\frac{1}{2}$ NW $\frac{1}{4}$, SE $\frac{1}{4}$ NW $\frac{1}{4}$	120	C
	F. Patterson	"	"	"	SW $\frac{1}{4}$ NW $\frac{1}{4}$	40	C
	St. Regis Paper Company	"	"	"	NE $\frac{1}{4}$, W $\frac{1}{2}$ SE $\frac{1}{4}$	240	C
	"	"	"	10	NW $\frac{1}{4}$	160	C
	"	"	"	28	SE $\frac{1}{4}$ SE $\frac{1}{4}$	40	E
	G. Schertz and P. Russell	"	"	33	SW $\frac{1}{4}$, W 26.6 acres of NE $\frac{1}{4}$ NE $\frac{1}{4}$, E 26.6 acres of S $\frac{1}{2}$ NE $\frac{1}{4}$	213	E
	F. Russell	"	"	"	N 13.33 acres of NE $\frac{1}{4}$ NE $\frac{1}{4}$	13	D
	D. Russell	"	"	"	NW $\frac{1}{4}$, W 53.3 acres of S $\frac{1}{2}$ NE $\frac{1}{4}$	213	E
	F. Russell	"	"	34	SE $\frac{1}{4}$	160	E
	G. Gillie	158N	34W	14	W $\frac{1}{2}$ SE $\frac{1}{4}$, NE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$	160	E
	H. Evenson	"	"	24	SW $\frac{1}{4}$	160	E
	St. Regis Paper Company	"	"	35	SE $\frac{1}{4}$ SW $\frac{1}{4}$, N $\frac{1}{2}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$	160	D
	R. Gladen	157N	35W	1	Lot 3	41.26	D
	C. Robertson	"	"	"	Lot 4	41.68	D
	"	"	"	2	Lot 1	40.88	D
	R. Gladen	"	"	"	Lot 2	40.62	D
	St. Regis Paper Company	"	"	3	Lot 1&2	79.44	D
	"	"	"	19	NE $\frac{1}{4}$, E $\frac{1}{2}$ NW $\frac{1}{2}$, Lot 2	281.9	D
	"	158N	35W	3	Lot 2&3	89.5	E
	J. Lund	"	"	7	Lot 2	40	D
	J. Bratland	"	"	"	Lot 3	40.32	D
	St. Regis Paper Company	"	"	12	NE $\frac{1}{4}$	160	D
	H. Anderson	"	"	20	SE $\frac{1}{4}$ NE $\frac{1}{4}$	40	D
	"	"	"	21	SW $\frac{1}{4}$ NW $\frac{1}{4}$	40	D
	—	"	"	"	SE $\frac{1}{4}$ NW $\frac{1}{4}$	40	D
	St. Regis Paper Company	"	"	26	NW $\frac{1}{4}$ SW $\frac{1}{4}$	40	D
	"	"	"	27	N $\frac{1}{4}$ SE $\frac{1}{4}$	80	D
	"	"	"	34	SE $\frac{1}{4}$ SE $\frac{1}{4}$	40	D
	C. Robertson	"	"	36	SW $\frac{1}{4}$ SW $\frac{1}{4}$	40	D
	R. Gladen	"	"	"	SE $\frac{1}{4}$ SW $\frac{1}{4}$	40	D
	W. McFadden	"	"	"	NE $\frac{1}{4}$ SE $\frac{1}{4}$	40	D
	J. McGilvery	"	"	"	SE $\frac{1}{4}$ SE $\frac{1}{4}$	40	D
	St. Regis Paper Company	159N	35W	19	Lot 2, 3, & 4, E $\frac{1}{2}$ SW $\frac{1}{4}$	156.95	E
	C. Stine	"	"	"	W $\frac{1}{2}$ SE $\frac{1}{4}$, SE $\frac{1}{4}$ SE $\frac{1}{4}$	120	E
	"	"	"	20	SW $\frac{1}{4}$ SW $\frac{1}{4}$	40	E
	"	"	"	25	S $\frac{1}{2}$ SW $\frac{1}{4}$	80	E

Appendix I (continued)

County	Owner	Twp.	Rge.	Sec.	Legal Description	Acreage	Priority ¹
Lake of the Woods	St. Regis Paper Company	159N	25W	25	SE¼	160	E
	"	"	"	26	NE¼	160	E
	D. Curry	"	"	31	E½NW¼, Lot 1&2	133.36	E
	St. Regis Paper Company	"	"	32	E½SW¼, Lot 1&2	157	E
	—	"	"	"	SE¼NW¼	40 ²	D
	A. Lyle	"	"	34	S½NE¼	80	E
	St. Regis Paper Company	"	"	"	N½SW¼, Lot 2&3, NW¼SE¼	197.78	E
	"	"	"	36	NW¼, N½SW¼, Lot 1, 2, 3, & 4 N½SE¼	475.5	E
	W. Strandberg	159N	36W	20	NW¼SW¼	40	E
	N. Eglet	"	"	23	S½SW¼	80	E
	M. O'Link	"	"	24	NE¼NW¼	40	E
	P. Wallestad	"	"	27	N½NW¼	80	E

¹ C = critical, D = desirable, E = eventual.

² Tax-delinquent but still in private ownership.

³ 22.2 acres within the Red Lake WMA.

⁴ 35.16 acres within the Red Lake WMA.

Sources: Minnesota DNR 1975.
Beltrami and Lake of the Woods County Offices.

Appendix J. Regulations relating to the public use of wildlife management areas, Commissioner's Order No. 1961.

No use shall be made of any state-owned wildlife management area except in accordance with the following regulations:

Section 1. Entry and use.

- (a) Those parts of wildlife management areas posted "STATE GAME REFUGE — NO TRESPASSING" or "WILDLIFE SANCTUARY — NO TRESPASSING" shall not be entered except as authorized by an agent of the Commissioner.

- (b) No part of any wildlife management area may be entered or used during the hours 10:00 P.M. to 5:00 A.M. if so posted at the major access points.

Sec. 2. Hunting and trapping.

- (a) Protected wild animals may be taken on wildlife management areas by hunting or trapping during the established seasons therefore in the zones in which they are located unless the wildlife management area is specifically closed by Commissioner's Order. Upon request by an agent of the Commissioner, all persons shall report animals taken on wildlife management areas and submit them for inspection.
- (b) Unprotected wild animals may be taken on wildlife management areas from September 1 through the last day in February unless the wildlife management area is specifically closed by Commissioner's Order. Nuisance animals may be controlled under permit issued by a wildlife manager.

Sec. 3. Commercial fishing.

The taking of minnows and other live baits for commercial purposes may be allowed only under permit from the wildlife manager and only on wildlife management areas over 2,000 acres in size.

Sec. 4. Watercraft.

Use of motorized watercraft is permitted only on the following Wildlife Management Areas except where posted otherwise by agents of the Commissioner:

- (a) In the Gores Wildlife Management Area (Mississippi River Pool 3, Dakota and Goodhue Counties) motorized watercraft may be used without limitation on size.
- (b) In the Lac qui Parle Wildlife Management Area (Big Stone, Chippewa, Lac qui Parle, and Swift Counties) motorized watercraft may be used without limitation on size.
- (c) In the Mud-Goose Wildlife Management Area (Cass County) motorized watercraft powered by motors of 10 horsepower or less may be used *except during the waterfowl season*.
- (d) In the Orwell Wildlife Management Area (Ottertail County) motorized watercraft powered by motors of 10 horsepower or less may be used.

- (e) In the Roseau River Wildlife Management Area (Roseau County) motorized watercraft may be used in the main channel of the Roseau River. Motorized watercraft powered by motors of 10 horsepower or less may be used elsewhere on this management area during the waterfowl season only.
- (f) In the Talcot Lake Wildlife Management Area (Cottonwood and Murray Counties) motorized watercraft may be used on Talcot Lake *except during the waterfowl season*. Such watercraft are not permitted on the river and marshes.
- (g) In the Thief Lake Wildlife Management Area (Marshall County) motorized watercraft powered by motors of 10 horsepower or less may be used.
- (h) In the Walnut Lake Wildlife Management Area (Faribault County) motorized watercraft powered by motors of 10 horsepower or less may be used in that portion of the area known as South Walnut Lake.

Sec. 5. *Vehicles.*

- (a) Regulations in this Section do not pertain to Federal, State or County highways or Township roads.
- (b) No person shall operate an all-terrain vehicle, hang glider, air boat, or hover craft in a wildlife management area. No person shall operate a snowmobile in any wildlife management area without the written permission of the wildlife manager in charge thereof in that part of the state lying south and west of a line described as follows: U.S. Highway No. 2 from East Grand Forks easterly to Bemidji; thence southerly along U.S. Highway No. 71 to Wadena; thence easterly along U.S. Highway No. 10 to Staples and U.S. Highway No. 210 to Carlton; thence east in a straight line to the easterly boundary of the state.
- (c) Motor vehicles may be operated on the following wildlife management areas, but not in excess of 20 mph. They may be operated only on established roads, and no vehicle may be driven beyond a sign prohibiting vehicular use or beyond any man-made vehicle barrier.
 1. Carlos Avery Wildlife Management Area (Anoka and Chisago Counties)
 2. Hubbel Pond Wildlife Management Area (Becker County)
 3. Mille Lacs Wildlife Management Area (Kanabec and Mille Lacs Counties)
 4. Red Lake Wildlife Management Area (Beltrami County)
 5. Roseau River Wildlife Management Area (Roseau County)
 6. Thief Lake Wildlife Management Area (Marshall County)

- (d) Vehicles are prohibited on all other wildlife management areas except they may be operated, not in excess of 20 mph, on those routes designated by signs as being for travel purposes.

- (e) No vehicle shall be parked where it obstructs travel.

Sec. 6. *Aircraft.*

Unauthorized use of aircraft below 1000 feet AGL (above ground level) over a wildlife management area is prohibited except in emergencies.

Sec. 7. *Firearms and target shooting.*

Target, trap, skeet, or promiscuous shooting is prohibited.

Sec. 8. *Disorderly conduct.*

Obnoxious behavior or other disorderly conduct is prohibited.

Sec. 9. *Disposal of waste and abandonment of property.*

Disposal or abandonment of garbage, trash, spoil, sludge, rocks, vehicles, or other debris or personal property on any wildlife management area is prohibited. Boats, decoys, and other equipment must not be left unattended overnight except traps on those wildlife areas open to trapping.

Sec. 10. *Destruction or removal of property.*

Signs, posts, fences, buildings, trees, shrubs, vines, plants, or other property may not be destroyed or removed except that marsh vegetation may be used to build blinds on the area, and edible and decorative portions of plants (except wild rice) may be picked for personal use. Wild rice may not be harvested unless the area is specifically opened by commissioner's order.

Sec. 11. *Private property or structures.*

No person shall construct or maintain any building, dock, fence, billboard, sign, or other structure on any wildlife management area, except that duck blinds may be erected but shall not become private property or be used to preempt hunting rights. It is unlawful to construct, occupy or use any elevated scaffold or other elevated device for the purpose of hunting, watching for or killing big game, except that portable tree stands may be used for this purpose provided they are removed each day at the close of hunting hours and do no permanent damage to trees in which they are placed.

Sec. 12. *Private operations.*

Soliciting business, agricultural cropping, beekeeping or conducting other commercial enterprises on any wildlife management area is prohibited except by lease agreement.

Sec. 13. *Introduction of plants or animals.*

Plant and animal life taken elsewhere shall not be released, placed, or transplanted on any wildlife management area except as approved by the wildlife manager.

Sec. 14. *Animal trespass.*

Livestock, horses, and other domestic animals, except dogs being used for hunting purposes, shall not be permitted on wildlife management areas except under cooperative agreement or permit prepared by the wildlife manager.

Sec. 15. *Camping.*

No person shall camp on any wildlife management area except by permit or in designated areas during the hunting season.

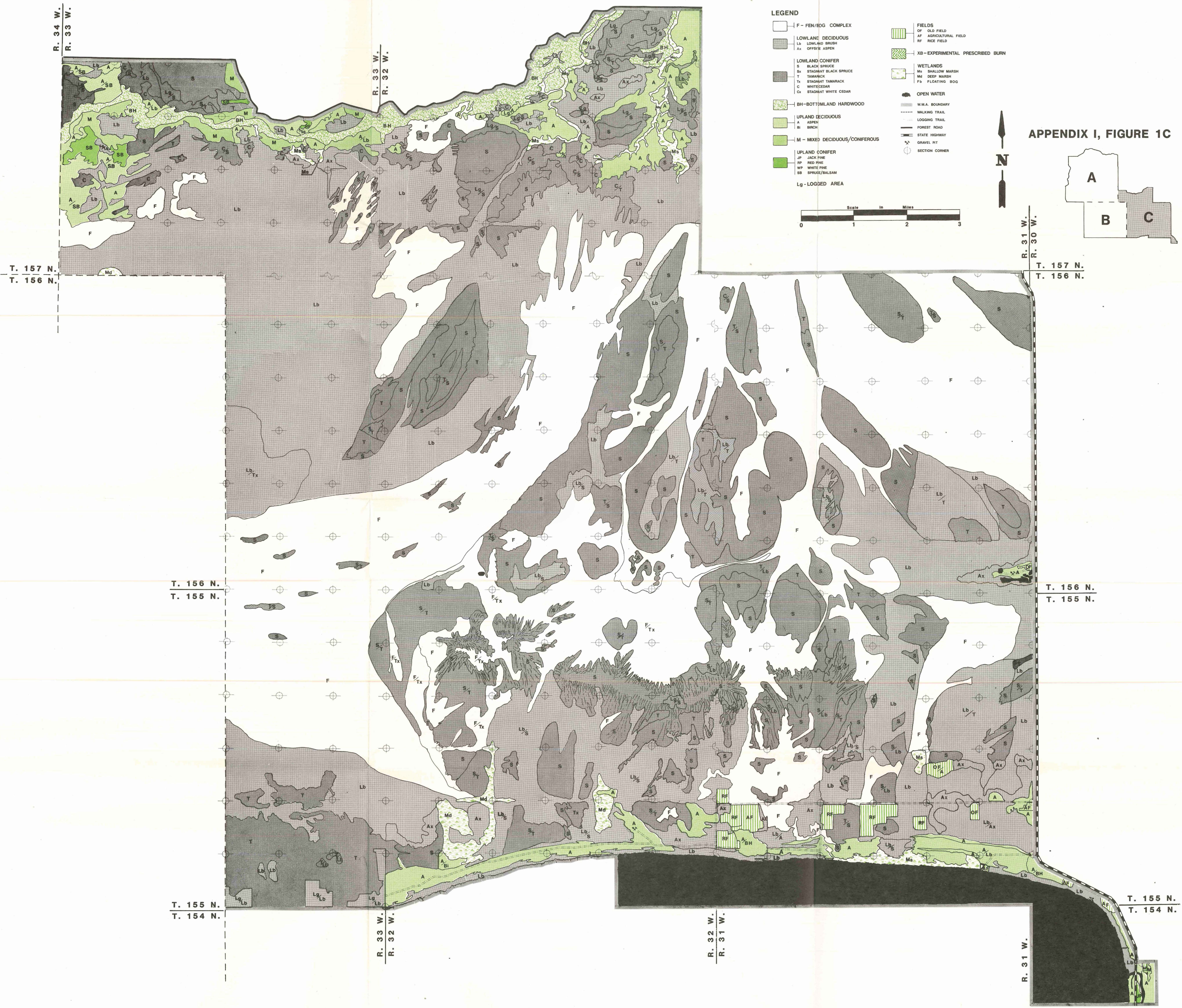
Sec. 16. *Other compatible uses.*

Wildlife management areas may be used for hiking, wildlife observation, sport fishing, and other wildlife-related uses provided such uses are not inconsistent with sections 1 through 15 of this order.

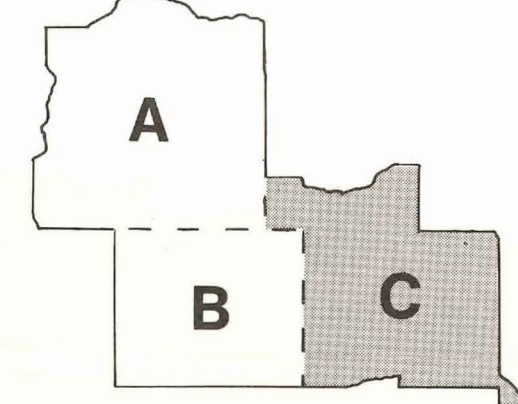
Sec. 17. These regulations do not apply to persons engaged in official Department of Natural Resources operations or research projects approved by the Department of Natural Resources.

Sec. 18. Commissioner's Order No. 1948 is hereby superseded.

RED LAKE WILDLIFE MANAGEMENT AREA VEGETATION

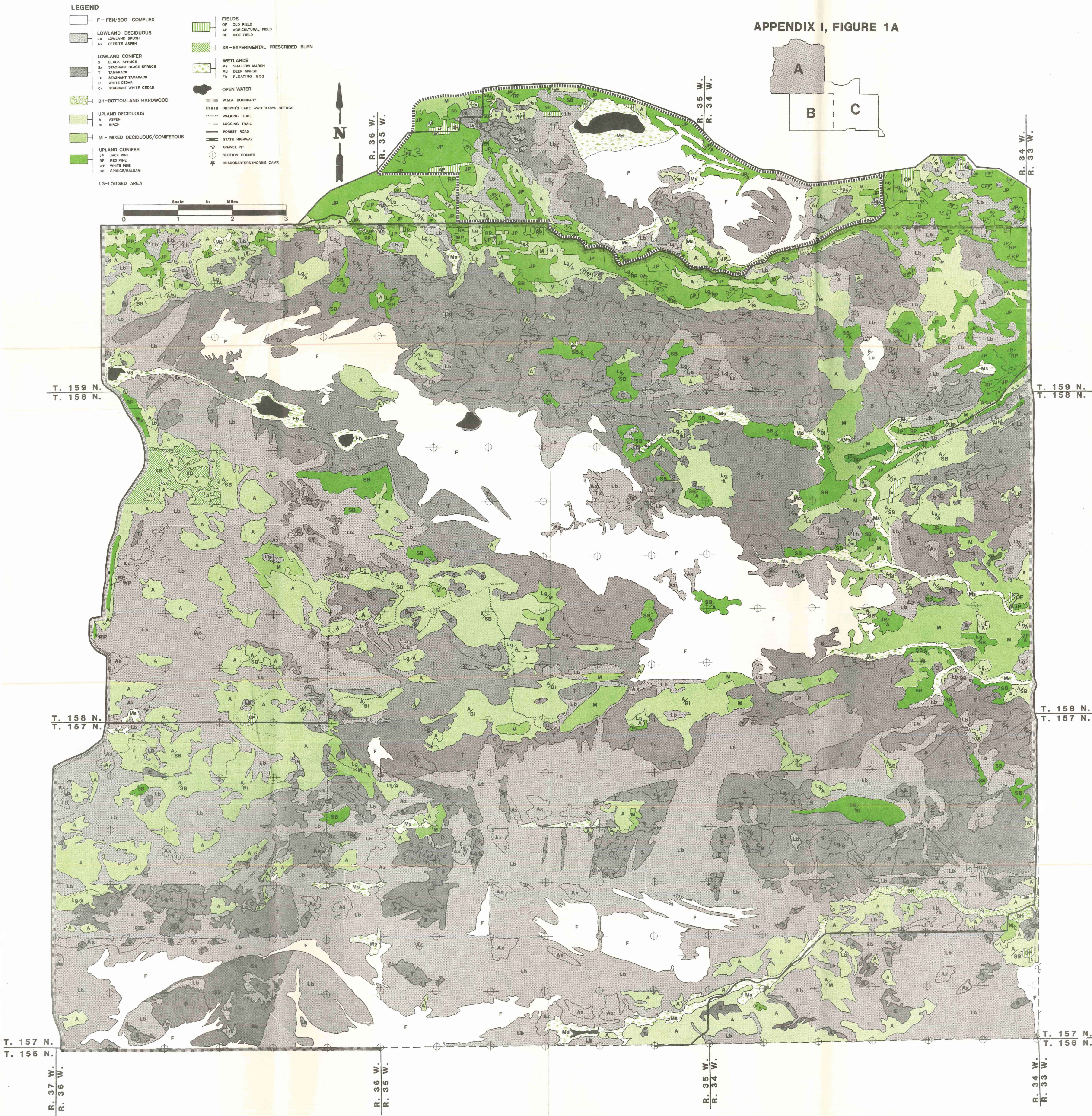


APPENDIX I, FIGURE 1C

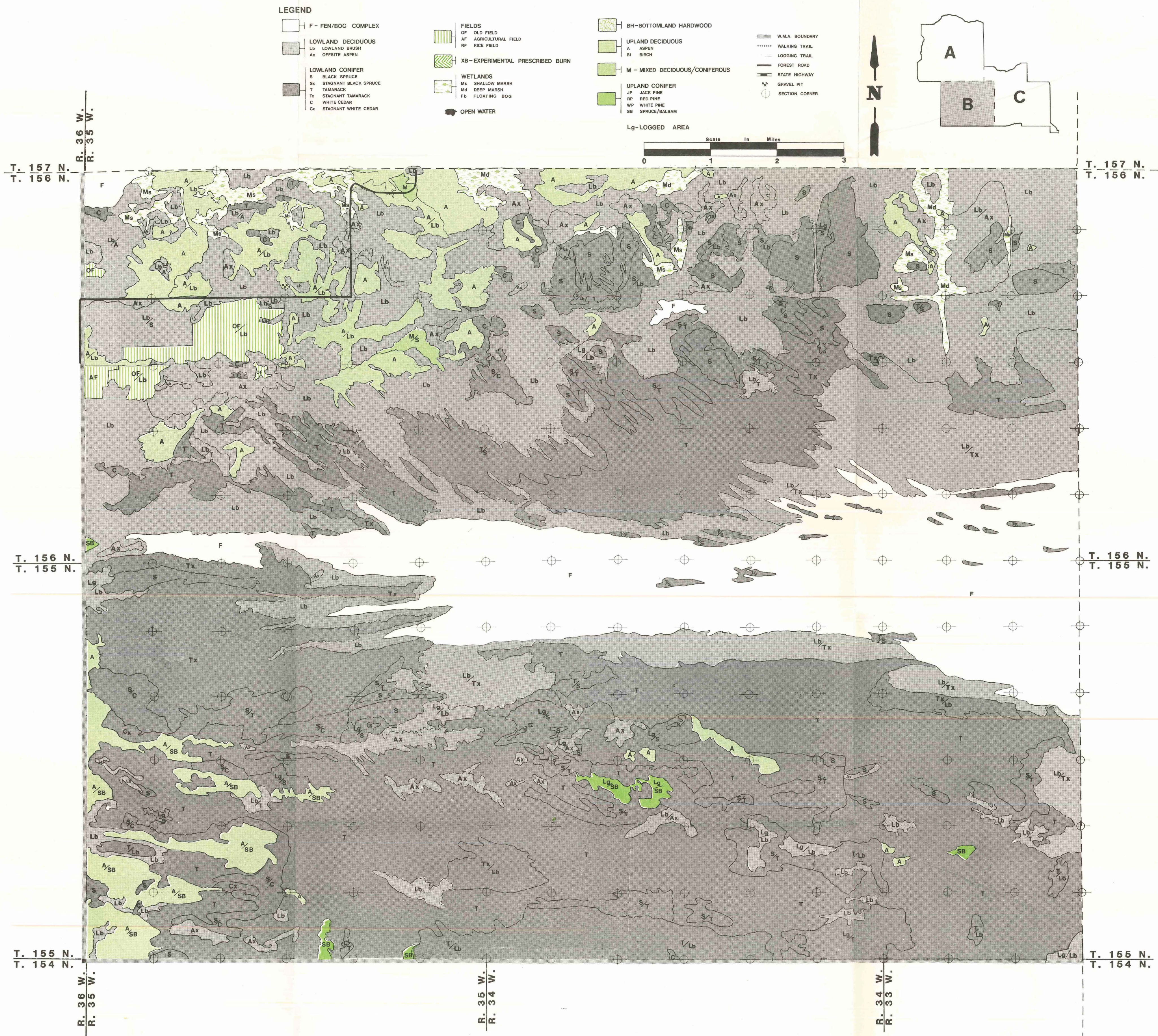


RED LAKE WILDLIFE MANAGEMENT AREA VEGETATION

APPENDIX I, FIGURE 1A



APPENDIX I, FIGURE 1B







RED LAKE WILDLIFE MANAGEMENT AREA

LAND OWNERSHIP AND ACQUISITION PRIORITIES

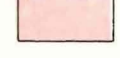







LEGEND

LAND OWNERSHIP

-  WILDLIFE
-  CONSOLIDATED CONSERVATION
-  LAND UTILIZATION PROJECT (L.U.P.)
-  RED LAKE INDIAN RESERVATION
-  FORESTRY
-  FEDERAL
-  TRUST FUND & VOLSTEAD
-  PRIVATE

ACQUISITION PRIORITY

- ACQUIRED
- NO ACQUISITION PLANNED
- EVENTUAL
- NO ACQUISITION PLANNED
- EVENTUAL
- NO ACQUISITION PLANNED
- CRITICAL
- DESIRABLE
- EVENTUAL

-  DELETED FROM W.M.A.
-  W.M.A. BOUNDARY
-  STATE FOREST BOUNDARY
-  STATE HIGHWAY
-  STATE FOREST ROAD
-  HEADQUARTERS (NORRIS CAMP)
-  SECTION CORNER
-  OPEN WATER

Scale in Miles
0 1 2 3

