STATE LANDS

Their Agricultural and Forest Possibilities

REPORT TO THE MINNESOTA STATE LEGISLATURE
ON THE RESULTS OF CLASSIFICATION OF
STATE LANDS AS OF SEPTEMBER, 1928

STATE OF MINNESOTA
DEPARTMENT OF STATE
FILED
FEB - 1 1929
Secretary of State

By

G. M. CONZET

Commissioner of Forestry and Fire Prevention

Under Direction of

The Conservation Commission
G. M. Conzet, Chairman
George W. McCullough, Commissioner of Game and Fish
Ray P. Chase, State Auditor and Commissioner of Lands and Timber

4197

Reforestation

STATE OF MINNESOTA

DEPARTMENT OF CONSERVATION

OFFICE OF

COMMISSIONER OF FORESTRY AND FIRE PREVENTION

OLD STATE CAPITOL

ST. PAUL

G. M. CONZET
COMMISSIONER

January 31, 1929.

To The Senate and House of Representatives:

Gentlemen:

Pursuant to Chapter 248, Laws of 1927, I am submitting herewith to your honorable bodies, the printed report on the classification of State Lands, - "State Lands - Their Agricultural and Forest Possibilities".

This report contains a list or tabulation of part of the state owned lands that are suitable for afforestation or reforestation purposes, with recommendations that certain lands be set aside as permanent state forests; others as temporary state forests. It also contains a preliminary management plan for certain tracts within the areas examined.

An endeavor has been made to be brief and the report has been condensed as far as possible. There has been considerable detail left out, which, however, is all on record in the office of the Commissioner of Forestry and Fire Prevention. The information and findings that have been collected are valuable in formulating plans for the future management of our state forests.

Yours very truly,

Reforestation

G M Conzet

Commissioner

C EB

Mr. Bessette, from the Committee

on Reforestration, to which was referred

~~XXXX~~ ~~XXXXXXXXXX~~

Report of Commissioner of Forestry on "STATE LANDS- THEIR AGRICULTURAL AND FOREST POSSIBILITIES"

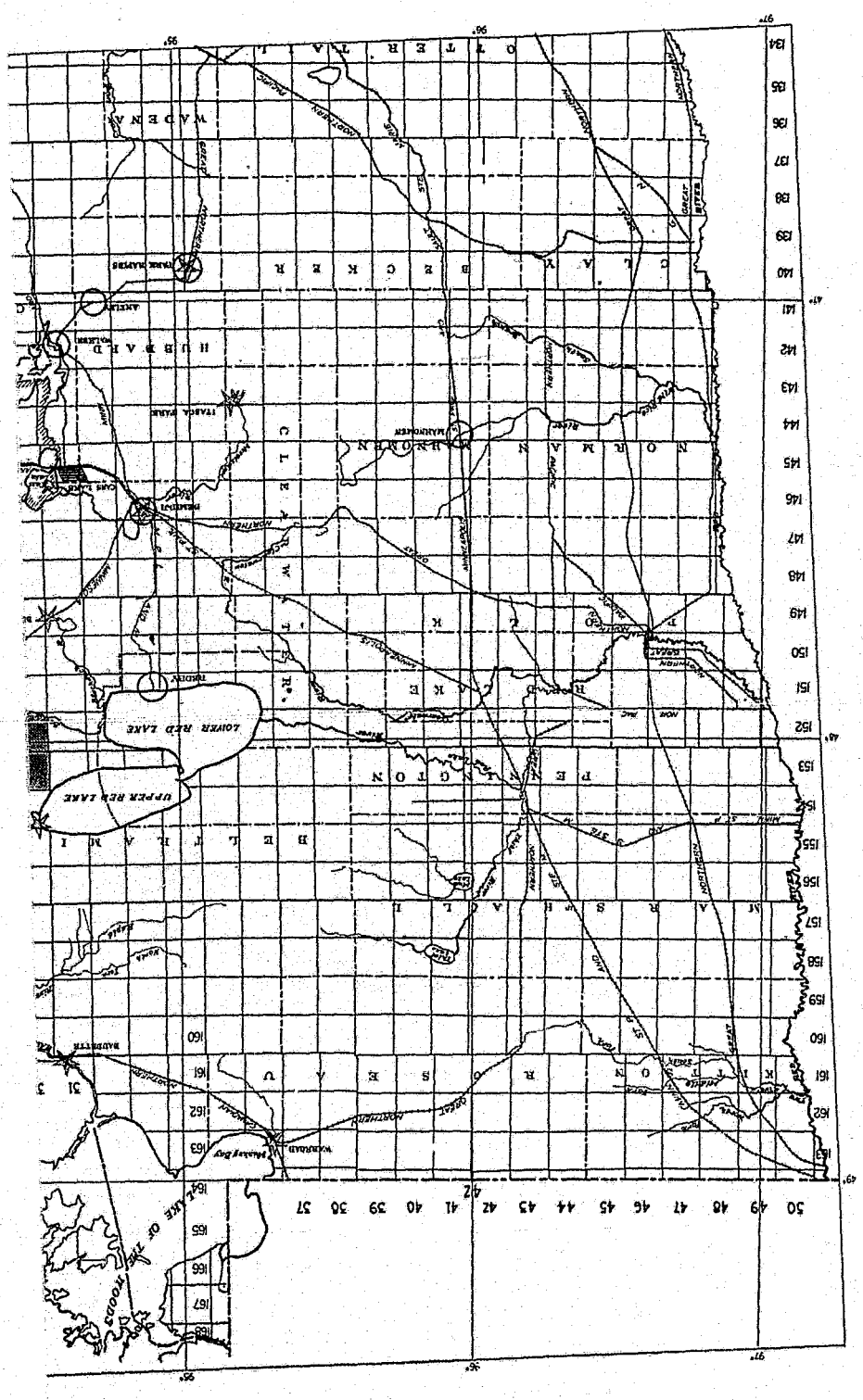
Adopted by the Senate.
FEB 1 - 1929
Secretary of the Senate.

Reports the same back with the recommendation that the report be filed with the Secretary of the State and made a permanent record of the State.

Report adopted.

STATE OF MINNESOTA
DEPARTMENT OF STATE
FILED
FEB - 1 1929

Secretary of State

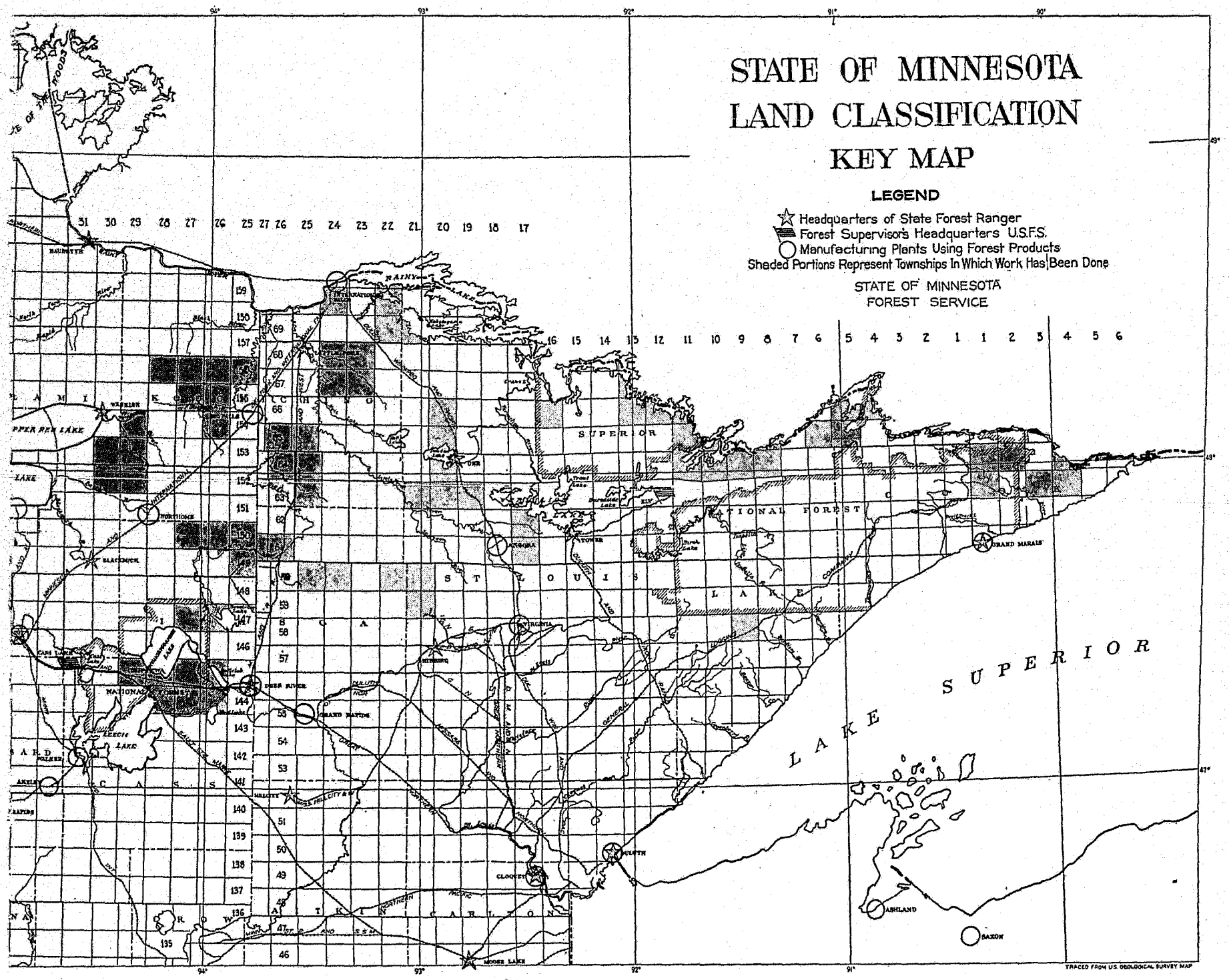

LOWER RED LAKE
UPPER RED LAKE
WADENA
CLAY
BECKER
MORRISON
CLEARWATER
HUBBARD
BELTRAMI
PENNINGTON
MARSHALL
POLK
KITTSON
ROSEAU
LAKE OF THE WOODS
96°
97°
47°
48°

STATE OF MINNESOTA
LAND CLASSIFICATION
KEY MAP

LEGEND

☆ Headquarters of State Forest Ranger
Forest Supervisor's Headquarters U.S.F.S.
○ Manufacturing Plants Using Forest Products
Shaded Portions Represent Townships In Which Work Has Been Done

STATE OF MINNESOTA
FOREST SERVICE



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Minnesota Forest Service

G. M. Conzet, St. Paul.....Commissioner of Forestry and Fire Prevention
A. F. Oppel, St. Paul.....Deputy Commissioner
A. E. Pimley, St. Paul.....Assistant in General Fire Prevention
Wm. M. Byrne, St. Paul.....Assistant in Railway Fire Prevention
Phil H. Hanson, St. Paul.....Executive Assistant
O. R. Levin, North Hibbing.....Supervisor of Public Relations
C. M. Roberts, Minneapolis.....Extension Agent
J. A. Kent, St. Paul.....Field Agent
Harold Ostergaard, Duluth.....Ranger, District 19
Roy B. Thomson, Minneapolis.....Assistant in Land Classification
Raymond Stevens, Bemidji.....Assistant in Forest Management
J. C. Prout, North Hibbing.....Assistant in Land Classification
P. W. Swedberg, Moose Lake.....Ranger, District 2
Percy Vibert, Cloquet.....Ranger, District 3
E. H. Rhodes, Brainerd.....Ranger, District 4
M. A. Rhodes, North Hibbing.....Ranger, District 5
Mike Guthrie, Deer River.....Ranger, District 6
H. I. Johnson, Hill City.....Ranger, District 7
John H. Nelson, Bemidji.....Ranger, District 8
A. W. Stone, Park Rapids.....Ranger, District 9
E. A. Linder, Arago.....Superintendent, Itasca State Park
Frank Pugh, Arago.....Ranger, District 10
L. J. Noyes, Waskish.....Ranger, District 11
Dick Willems, Warroad.....Ranger, District 12
J. C. Gannaway, Baudette.....Ranger, District 13
Roy Balsiger, Blackduck.....Ranger, District 14
V. B. Lofgren, Littlefork.....Ranger, District 15
L. R. Beatty, Orr.....Ranger, District 16
E. V. Gafvert, Tower.....Ranger, District 18
John E. Fritzen, Duluth.....Ranger, District 19
P. J. Bayle, Grand Marais.....Ranger, District 20

Letter of Transmittal

To the Members of the Legislature of Minnesota:

Pursuant to Chapter 248, Session Laws of 1927, I have the honor of submitting, herewith, the report on state land classification, as required by said law, which in brief is as follows:

> "An act authorizing and directing the Conservation Commission, through the Commissioner of Forestry and Fire Prevention, to examine, classify and make a list of all state owned lands suitable for afforestation or reforestation; and to make report thereof in detail to the legislature next hereafter convening in regular session; also, empowering said Commissioner to employ experts, clerical help and other assistance; and to do all things necessary for the purposes aforesaid; and appropriating $35,000 for the use of said Commissioner in carrying out the purposes of this act."

Respectfully submitted,

G. M. CONZET,
Commissioner of Forestry and Fire Prevention.

Acknowledgments

Acknowledgement is hereby made to Dr. George A. Pond, Associate Professor of Farm Management, University of Minnesota, for his field examination and discussion of the agricultural possibilities of the land covered in this report; to Dr. F. J. Alway and Professor P. R. McMiller of the Soil's Division, University of Minnesota, who checked the soil classification; to Dr. Raphael Zon, Director of the Lake States Forest Experiment Station, for his valuable criticism and suggestions; to Honorable Ray P. Chase, State Auditor and Commissioner of Land and Timber, for certain timber estimates and his suggestions; to Honorable George W. McCullough, Commissioner of Game and Fish, for cooperation and suggestions. Acknowledgement is, also, made of the help of the following members of the Minnesota State Forest Service, Arthur F. Oppel, Deputy Commissioner who directed the work. To Raymond E. Stevens, Assistant in Forest Management, Roy B. Thomson, Assistant in Land Classification, Clarence Prout, Assistant in Land Classification, Harold Ostergaard, District Ranger and Arthur Anderson, Patrolman-at-Large, who had charge of field crews and assisted in collecting and compiling field data, making recommendations and writing the report.

G. M. CONZET, Commissioner,
Forestry and Fire Prevention.

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General Summary of Findings

Of the 1,943,235 acres of state land,* the land classification has covered 311,408 acres in the areas shown on the map facing this page. This represents about 16% of the state's public domain.

Of the 311,408 acres examined, 212,499 acres, or 68%, are forest productive and 98,909 acres, or 32%, are for all practical purposes waste lands made up of open meadows, barrens and other unproductive lands.

Of the area examined, only 13,200 acres, or 4%, may be considered as potentially agricultural land.

Of the 212,499 acres of timber producing land, 129,240 acres, or 61%, are swamp and 83,259, or 39%, are highland.

Of the 212,499 acres of timber producing land, 90,655 acres, or 43%, are virgin and 121,844 acres, or 57%, are cutover. There is merchantable timber on some of these cutover lands. This includes trees that were reserved by the state when the area was logged and second growth timber now attaining merchantable size.

On most of the cutover area, however, the reproduction that is replacing the old stand is not of the most desirable species, neither are areas generally fully stocked. Over large areas there may be a sufficient number of trees to make a fully stocked stand, but locally the stands are either too open or too dense to give the largest return in timber products.

In general, little of the state lands examined have been burned over. The fact that so many of these lands are swamp and that most of the highland is made up of islands within and surrounded by swamp, makes the fire risk on these state lands very low.

Of the 401,763 acres of privately owned lands within the Bigfork, Red Lake, and Orr groups, which are outside of the present state forests, 140,463 acres, or 35%, are tax delinquent.

*From report of State Auditor, June 30, 1926.

Of the 311,408 acres covered, 211,010 acres, or 68%, are in fairly solid blocks and require little consolidation. The remainder, or 32%, is very scattered and should be consolidated.

The estimates by species, on the areas examined, are as follows:

Species	Board Feet
White Pine	18,595,000
Norway Pine	4,458,000
Jack Pine	11,591,000
Aspen	29,284,000
Balsam	40,693,000
Birch	12,460,000
Spruce	60,149,000
Cedar	13,927,000
Tamarack	40,673,000
Miscellaneous	448,000
Total	232,278,000

One of the outstanding conclusions brought out in the entire survey is that the state is the possessor of a good deal of very poor land; land not only too poor for agriculture, but also very unsuited to forest production. The estimates of the timber, though incomplete, disclose a very much lighter stand than any previous estimate of the stand on state land has ever given. On the 252,000 acres in Big Fork, Red Lake, Chippewa Forest, Cook County and Boundary groups on which detailed timber estimates were made, there is a total of 232,278,000 board feet, or 924 board feet per acre. Assuming that 924 board feet is an average stand per acre, there would be 1,795,549,000 board feet on the 1,943,235 acres of state land. This taken all in all is a poor stand, and shows the need of the state's acquiring good forest land to offset the poor forest land.

In selecting these areas, the primary consideration was to get average conditions which would apply to the state lands as a whole, but actually the conditions are better than average; in fact, these areas support the cream of the state timber.

Another striking conclusion is that although the state timber is scattered and in a large measure slow-growing, it is generally in good condition, that is, it is not deteriorating and except where there is special damage by fire, insects, wind or disease, there is no reason for disposing of the timber until such methods of cutting are determined which will safeguard the establishment of a new timber crop.

More detailed figures as to the agricultural and forest possibilities of the areas examined are given in Tables 1 and 2.

TABLE No. 1

CLASSIFICATION BY SURFACE SOIL CONDITIONS

Area in Acres, Groups.	Peat.	Highland		Total.
		Heavy Soil.	Light Soil.	
Big Fork	62,006	10,932	7,272	80,210
Red Lake	86,038	1,725	6,815	94,578
Chippewa Forest	32,126	77	8,879	41,082
Cook County	7,938	7,859	9,560	25,357
Orr	27,840	16,280	600	44,720
Miscellaneous	7,134	5,899	1,653	14,686
Canadian Boundary	621	.....	10,154	10,775
Total	223,703	42,772	44,933	311,408
Total Highland		87,705		

TABLE No. II

CLASSIFICATION BY FOREST PRODUCTIVITY

Area in Acres.

Groups.	Non-Producing			Producing	
	*Stagnant.	Open Meadow.	**Barren.	Highland.	Swamp.
Big Fork	11,322	250	100	18,204	50,334
Red Lake	44,860	.....	1,999	6,541	41,378
Chippewa Forest	21,784	3,712	5,024	8,956	1,606
Cook County	.....	.....	.....	17,419	7,938
Orr	6,961	.....	.....	16,880	†20,879
Miscellaneous	650	.....	600	6,952	6,484
Canadian Boundary	.....	.....	1,847	8,307	621
Total	85,377	3,962	9,570	83,259	129,240
Total Non-Producing		98,909	Total Producing		212,499

Summary of Agricultural Possibilities by Groups

The peat swamps, which constitute a large part of the state land, have only a low value for forest production, except where the peat is shallow. For farming purposes, the value is as small or even smaller, at the present time. In determining the amount of land potentially valuable for agriculture, the peat is, therefore, eliminated.

THE BIG FORK GROUP. There are 18,204 acres of highland in this group. Of this, 15,004 acres are suited only to forest production. This is because it is either in small isolated tracts, or the soil is light or stony, or the topography too rough. The remaining 3,200 acres are potentially agricultural as the soil is mostly clay and comparatively free from stones. The area is almost inaccessible at the present time and is considered as only potentially agricultural. (For brief conclusions and recommendations, see page 29.)

RED LAKE GROUP. The 8,540 acres of highland is all considered more valuable for forest production than for agriculture. The soil, for the most part, is very light. The highland areas are in small scattered, inaccessible tracts. (For brief conclusions and recommendations, see page 36.)

CHIPPEWA FOREST GROUP. Some of this land is fairly accessible but the soil, with very few exceptions, is light. The 8,956 acres of highland are in small scattered tracts and for the above reasons, are considered as forest lands. (For brief conclusions and recommendations, see page 42.)

COOK COUNTY GROUP. In this group there are 17,419 acres of highland and all of it is more suited to forest production than to agriculture. This is due primarily to the rough topography and extremely stony nature of the soil. (For brief conclusions and recommendations, see page 45.)

ORR GROUP. This group contains the best agricultural possibilities of any examined. Only an extensive examination was made of the area but it showed 16,880 acres of highland, about 10,000 acres of which is potentially valuable for agriculture. There is, however, much undeveloped private land in the same localities and the state land should remain in forest until there is a real need of it for agriculture. (For brief conclusions and recommendations, see page 48.)

MISCELLANEOUS AREAS. The 7,550 acres of highland in this group is scattered in 17 different townships. Of this, only a few forties have any potential value for agriculture. They are, therefore, all classed as forest land.

BOUNDARY SURVEY. The state land along the boundary is nearly all rock outcrop and almost inaccessible. The 10,154 acres of highland are, therefore, classed as permanent forest land. (For brief summary, see page 50.)

*The word "stagnant" is used to indicate the area on which the trees will not grow one inch in diameter in 30 years.

**"Barren" includes areas within highland or swamp where there is no commercial species or trees.

†Approximate.

Recommendations

1. State Lands Suitable for State Forests*

The state lands in townships where there are large blocks of forest land or those which are not readily accessible to market, not improved agriculturally, do not contain a sufficient amount of agricultural soil, or are located within areas rapidly becoming tax delinquent, should be definitely set aside as state forests. The following townships as far as this classification has extended, fall under this category:

ST. LOUIS COUNTY

Twps. (61N)
(62N) R. 17W of 4th Principal Meridian
Twp. 63N R. 19W of 4th Principal Meridian
Twps. (63N) R. 20W of 4th Principal Meridian
(64N)
Twps. (63N) R. 21W of 4th Principal Meridian
(64N)

Total Area 44,720 acres.

ITASCA COUNTY

Twp. 60N R. 24W of 4th Principal Meridian
Twps. (60N) R. 25W of 4th Principal Meridian
(61N)
Twps. (60N)
(61N) R. 26W of 4th Principal Meridian
(62N)
Twps. (60N) R. 27W of 4th Principal Meridian
(61N)
(62N)
Twps. (149N) R. 25W of 5th Principal Meridian
(150N)
Twp. 150N R. 26W of 5th Principal Meridian
Twp. 150N R. 27W of 5th Principal Meridian

Total Area 67,018 Acres

KOOCHICHING COUNTY

Twps. (63N) R. 25W of 4th Principal Meridian
(64N)
(65N)
Twps. (63N) R. 26W of 4th Principal Meridian
(64N)
(65N)
Twps. (63N) R. 27W of 4th Principal Meridian
(64N)
(65N)
Twps. (151N) R. 25W of 5th Principal Meridian
(152N)
(155N)
(156N)
(157N)
Twps. (151N) R. 26W of 5th Principal Meridian
(154N)
(155N)
(156N)
(157N)
Twps. (153N) R. 27W of 5th Principal Meridian
(154N)
(155N)
(156N)
(157N)
Twps. (153N) R. 28W of 5th Principal Meridian
(154N)
(155N)
(156N)
Twps. (152N) R. 29W of 5th Principal Meridian
(153N)
(154N)

Total Area 417,630 Acres

BELTRAMI COUNTY

Twps. (152N) R. 30W of 5th Principal Meridian
(153N)

Total Area 11,680 Acres

Grand Total 541,048 Acres

The total area of state lands in these townships is 541,048 acres, of which 173,886 acres, were examined intensively and 44,720 acres were examined less intensively. On the remainder enough work was done in the form of an extensive survey to determine that it was of a character similar to that which was intensively examined and to warrant designation as state forests.

This does not mean that all of the state land within these townships is classed as permanent forest land. Certain areas (small as they are) are potentially agricultural lands. However, there is considerable good private land in these areas that has not yet been developed for agricultural uses and it is therefore recommended that the state lands be left in forest until they are more urgently needed for agriculture. At such time, they can be eliminated from the state forests and used for farming.

Even if the potentially agricultural lands are not considered, the remaining state lands cannot all be classed as forest land. Of the total area of 311,408 acres which were examined in all groups, 98,909 acres are classed as submarginal for timber production. These include areas supporting a dwarfed stagnant growth of trees, natural grass meadows, open muskeg, and barren highland. These must all be thrown out as blanks when speaking of true forest land. Most of these non-producing areas, however, have a value to the public as habitats for game or as natural water reservoirs and should, therefore, be included in state forests.

Forestry and game and fish, should go hand in hand and on its own lands particularly, the state should take special precautions to care for its game. It is, therefore, recommended that large areas for game refuges and smaller areas for public shooting grounds be established within the state forests.

Certain areas within the lake regions should be managed from a recreational standpoint and timber cutting be more or less secondary. Trees around lakes and along public thoroughfares contribute a far greater benefit to our citizens if kept in a natural, but healthy state, than if cut for timber products.

*These lands are included in the Big Fork, Red Lake and Orr groups. Most of the state lands in the remaining groups have already been set aside as State Forests.

2. Consolidation of State Forests

Provided that the above areas are made state forests, the state will have nearly a million acres so designated. These will include much of the state lands, which are in relatively large blocks and some that are very scattered. For the most efficient and economical management the scattered areas must be consolidated either by acquisition or exchange. The state should remove all legal obstacles to such consolidation and make this possible

To facilitate further consolidation, the state should gain title to such tax delinquent lands as are best adapted to timber growing. These will in many cases help to fill out large blocks as can be seen on the economic maps of this report. The private timber lands which are being cutover and which are becoming delinquent as soon as the timber is cut, should be taken over by the state as soon as possible.

3. Fire Protection

The forest lands of the state particularly those designated as state forests, game refuges and public shooting grounds, must be given more intensive fire protection. An increased force is needed and this should be in the main, a year around force to be supplemented by an increased number during fire seasons. Within the state forests there should be more lookout towers, administrative centers, trails, telephone lines and firebreaks. A larger year around personnel would not only be more effective in fire protection, but it would also greatly assist in reducing trespass and assist in timber sales administration and management.

4. Establishment of State Forest Nursery

According to the Progress Report of the Forest Taxation Inquiry now being carried on by the United States Forest Service, 42 per cent of the state owned land in Minnesota, have been cutover, 24 per cent are barren of tree growth, and 34 per cent are timbered. Minnesota is more fortunate in having timbered land than its sister states of Michigan and Wisconsin. Where there is virgin timber, it should be cut with a view to reproducing it naturally to the more valuable kinds of trees. But on large areas of state lands which are cutover, and on the virgin areas where it is not possible to reforest naturally, planting must be done to insure the establishment of the more valuable kinds.

On most of the cutover areas, the trees that come back are of inferior quality such as aspen, birch and balsam. In most instances, these species will have to be left until they are merchantable and then cut clean and planted to the more valuable species, such as pine and spruce. For this reason, a planting program, should be started as soon as possible and in order to supply trees, a state nursery should be established in the northern part of the state.

5. Inventory of State Forests

After state forests have been set aside and while they are being consolidated, a detailed inventory of all the lands must be taken. This will include an estimate of the volume of timber, its age, condition and growth, as well as the amount and kinds of reproduction. Such an inventory should include complete information necessary to make up management and work plans for the forest.

On the total of 388,000 acres now in state forests, 78,000 acres have been covered in this way. This work should be continued on a much larger scale and finished as soon as possible.

6. Division of State Forests

The next step is to divide the state forest areas into separate forests or districts and further into working circles, working groups, blocks, compartments and logging units to facilitate administration and forest management.

7. Research

While the above are progresing, forest research must be carried on by specially trained men. The research will include investigations of improved methods of fire protection, the constructing of volume and normal yield tables for all tree species in this region, studies of the possibilities of drainage as an aid to forest productiveness, a study of slash disposal and silvicultural methods. This work should be carried on by the State Forest Service but some of it should be done in cooperation with the Lake States Forest Experiment Station and the University of Minnesota Forestry School.

8. Management Plans

These studies are essential in preparing Management Plans as a basis for a rational system of cutting on state forests. A Management Plan is a working plan for the regulation and allocation of the cut. The "Preliminary Management Plans" formulated in this report are not true Management Plans, but in reality they are only limitations of the cut based on observations and approximate growth data. That the formulation of Management Plans is a long process is proven by the fact that after many years of investigative work on the Chippewa National Forest, the first Management Plans are only now being made.

The Preliminary Management Plans are, however, similar in character and their publication is justifiable since Management Plans must be changed from time to time as economic conditions change.

The Management Plans should include: the object of management; whether the forest is to be managed for recreation, watershed protection or for the production of saw timber, pulpwood, posts, poles, or ties; a recommended system of silviculture, which includes the basis and application of timber marking, method of slash disposal and method of securing seedling reproduction and the regulation of the yield. To arrive at the latter, the rotation and cutting cycle must be fixed from a study of the growth of each species, and for each working group (the basis of this division is the timber type) the cut is limited on the basis of growth, surplus of old timber, market

demand and transportation requirements. The result or application is that a definite annual cut is fixed which will insure a sustained yield. This is the final object and goal of forest management.

9. Sale of Timber

After the annual cut has been determined, timber sale areas must be determined and a definite cutting budget made up. The timber to be cut each year shall be appraised by experienced men according to the method used by the United States Forest Service and as described in "Instructions for Appraising Stumpage on National Forests," a U. S. D. A. Forest Service publication. The sale should be advertised, the timber sold at public auction, a very rigid contract drawn up, and a bond of sufficient size to cover the condition of the contract put up by the buyer. State officers should enforce the terms of the contract to the letter.

10. Economic Survey and Land Classification

The data collected and published in this report on state lands alone give only partial information. An economic survey of all lands in the forest area of the state, whether privately or state owned, should be made and on this basis the land classified as to its best use. With this information the state can formulate definite land policies with regard to agriculture, forestry, recreation, colonization, etc.

11. Payment by the State of a Tax on Lands Set Aside as State Forests

Since the whole state benefits from trust funds derived from the state forests which are located in a few northern counties, it is only fair that the state should pay a tax on the productive lands in the "State Forests."

In the establishment of National Forests, the federal government recognizes this principle and pays to the local government 25 per cent of the gross receipts from the forests in lieu of taxes and spends an additional 10 per cent on roads within the forests.

The Economic Utilization of Certain State Lands

Geo. A. Pond, Associate Professor of Farm Management, University of Minnesota

A Study of Their Agricultural Possibilities

General Considerations

In appraising the agricultural value of the state lands included in this study attention was given to both physical and economic factors. Soil, topography and climatic conditions are of basic importance but can only be considered in the light of the existing economic environment. In this study major attention was given to these basic factors. At the same time the markets, roads, settlements, schools and community development were observed. Privately owned land as well as state land was observed in order to determine community possibilities. Settlers in the area observed were questioned as to their experience, their sources of income and their progress toward developing a self-supporting farm business. The possibilities of developing communities capable of affording sufficient local tax support to build and maintain local roads, schools and other needed township utilities were considered.

Comparisons were made between the areas observed and settled farming areas in other localities of similar soil type and timber cover. Data from the Northeast Agricultural Experiment Station at Duluth, and from the Pine County Farm Accounting Route at Askov were used in evaluating the agricultural possibilities of the land studied.

Agricultural Possibilities of Localities Studied

1. Orr Group

Most of the land in the general area including the townships studied in this group is definitely and permanently unfit for agricultural use. Sand, gravel, stone and rock outcrop as well as rough topography and large areas of swamp land make this distinctly submarginal agricultural land. The only important exception is the Little Fork valley which crosses this area from east to west. This valley is fairly level and free from gravel, stone and rock outcrop and the soil is a clay or clay loam. Agriculture may well be encouraged in this valley but elsewhere in the area the amount of the land suitable for farming is so limited in area and so scattered that settlement should be discouraged. In townships 61-17 and 63-19 there is practically no farming land. There was a small amount of farming land in 62-17 along the Little Fork Valley, in 63-20 along the northern edge, in 64-20 in northwest corner along Pelican Lake, and in the southwest corner of 64-21. The state land in these townships was all swamp or otherwise unfit for agriculture. Township 63-21 had the most land suitable for farming of any of these seven townships. The state land here, however, included much swamp land. It would appear advisable to set aside all state land in the first six townships as permanent state forest land. There is some state land in 63-21 that might eventually be needed for agricultural use. The privately owned land, however, is developing slowly and few, if any, of the present settlers are making their living from this land. Until such time as this privately owned land, which is the best farming land of the township, be developed, the state land should be retained as forest land.

2. The Pine Island Group (Red Lake Group)

The townships observed in this group were 154-26, 155-26, 156-26, 155-27, 156-27, and 156-28. Most of this area is part of a huge peat bog that is not only unfit for agriculture but isolates the occasional islands of high land in it from agricultural land outside the bog. These islands in addition to being small and isolated are usually too sandy to be considered agricultural land. With the large area of unused peat now available for agriculture in settled areas nearer market it is obvious that this land is distinctly non-agricultural and likely to remain so for a long time to come.

3. The Rock Cut Group (Big Fork Group)

(a) Koochiching County

The townships observed in this group were 63, 64, and 65 in ranges 25 and 26. Most of this area was a peat bog similar to the Pine Island area except that the islands, though small, were more frequent. These islands were too sandy for farming and in one case included some rock outcrop. There was some land along the Big Fork river in Townships 65-25 and 65-26 fairly well suited to farming but the area was small. The state land was almost exclusively swamp and as far as observed was wholly unfit for agriculture.

(b) Itasca County

The townships observed in this area are 60-24, 60-25, 60-27, 61-25, 61-26, 61-27 and 150-25 and 149-25. The only extensive areas of potential farming land in this section lay along the Big Fork and Bowstring, Rivers, largely in townships 61-26 and 61-27. This land was fairly level. The soil was mostly clay and apparently contained little stone. The state land in these townships was largely swamp and did not include the level clay soil of the river valleys. Township 150-25 was similar in soil type and topography to these other townships just mentioned, but unlike them was covered with standing timber. Since this timber was mature it would have to be cut before the land could be sold at a price a farmer could consider. Even then expensive clearing would make the land high priced to the farmer and he would have no timber products to offset the cost of clearing. The present price of farm products hardly justifies the expense of clearing this land. For the present, at least, this township had better remain as state forest land. The remaining townships

of this area are distinctly non-agricultural. The topography is rolling too rough. The soil is decidedly heterogeneous. The highland is mostly sand or gravel with some stone. There is some clay soil but most of this contains enough rock to unfit the land for farming. There are peat swamps in the low lands and the entire area is dotted with lakes so numerous as to cut the land up too much to permit of economical cultivation. This land is so well fitted naturally for forest and recreation purposes that it should be set aside definitely for such purposes. Any attempts at an agricultural utilization of state lands in this section interfers with the logical use of this land, and yield, too meager returns to justify any attempt at cultivation.

General Conclusions and Recommendations

Most of the state land observed in this study on account of physical features such as texture, drainage, presence of stone, or topography is at present definitely submarginal for agricultural use. Considerable areas of it are permanently so. A large portion of this land is covered with peat swamps. With the present development of the technic of handling peat soils and the present and prospective prices of farm products there is no way in which any appreciable proportion of this peat land can profitably be used for farming. There are already vast areas of idle peat land farther south in the state equally or better suited to crop production and far better located as to markets and other economic factors that are already in private hands. Since some of these state swamp lands, especially the shallower peats, now have some timber cover and may be bringing in some income it would seem a wise public policy to retain them as state forest. Some return could be obtained from these whereas as farming lands they can produce no revenue.

In many of the townships studied there were scattered settlers so thinly distributed that the burden of maintaining roads, schools and other public services were unduly large. To open up scattered tracts of state land would add to this problem. There is at present more privately owned land as well or better adapted to agriculture than the state land. Until this is brought under cultivation to open up new state land for settlement would only serve to complicate the already serious problem of the high cost of public services to the isolated settler. It would seem to be a wise public policy to retain as state forests practically all the state lands included in this study. This would serve several purposes. It would prevent settlers from getting onto lands for which present economic conditions, as well as the physical characteristics of the land, do not justify cultivation. It would make possible a more systematic settlement by forcing the use of present privately owned land before new and at present isolated tracts of state land are available. In this way public services and utilities could be withheld from unsettled areas until adjoining areas are settled and the problem of the isolated settler or the thinly scattered settlers be eliminated as a burden on tax resources. Then, too, such a policy would keep the state lands producing some revenue. The privately owned lands located adjacent to state lands are yielding little or no revenue. In some cases they furnish the owner a place to reside but little more. Little attempt is made to develop the timber producing ability of the land or to harvest to advantage existing growth. The maintenance of these state lands as state forest would make possible a management plan insuring future revenue for these lands. At the same time their recreational values could be protected and a full use of a valuable natural resource maintained.

The Worst-First Theory

By P. S. Lovejoy Michigan Department of Conservation

This article is a collection of exerpts from Mr. Lovejoy's paper that was published in the "Journal of Forestry," Vol. XXIV, No. 4, April, 1926. The article was written on forest conditions in Michigan, but it is equally applicable to Minnesota.

"Our present policies and practice in connection with the acquisition and development of lands for public forests—state and national—were derived out of stark necessities and fixed expediencies. A crust was better than no bread. Anything to get started.

"—our Michigan National Forest was created out of lands so lean that they never grew first-class pine, and so poor that they were not worth stealing while the stealing was good.

"Accepting these cull lands thankfully, foresters and their allies have labored faithfully and well with the junk intrusted to them. They have now demonstrated that new and bona-fide forests can be started and maintained on even the worst of the cull. They have found out how to grow and handle suitable planting stock, how to keep out the fires, and about what such operations must cost.

"Some 20 years have gone into these experiments and demonstrations and now we are ready for almost any expansions of program.

"While the farm-it-all-tomorrow illusion was dominant, it was highly expedient to accept even utter cull, and to labor it into productivity even though that might involve the planting of jack pine in the frost pockets, and jack pine fillers in the sodded sand plains.

"Anything to get started. Anything to scotch those crazy lumberjack notions that 'pine won't follow pine' and 'this country has raised its crop.' Anything to demonstrate that foresters were reasonable people and not minded to trespass upon the 'needs of agriculture'. Anything to get a chance to develop technic in nursery practice, planting and fire control. Anything to get started!

"So, for 20 years that has been going on and now the original objectives have been accomplished. The occasions for new forests and the practicability of generating them, are well established. Now we can exhibit a township or so of hand-made pine woods where there was nothing save stumps and ragged brush.

"Meanwhile the farm-it-all-tomorrow illusion has almost wholly faded out and it has become quite evident that for enormous and steadily increasing acreages, if they are to have a future, it must come through forests, wild-life and recreation resources. Otherwise there will be wholesale bankruptcies, indefinite years of idleness and increasing liabilities.

"Washington now announces that it is about to complete a purchase of 50,000 acres at $1.00 an acre—two more townships of AuSable sugarsand where the original Norway made a scant three logs in 150 years.

"The state authorities authorize the State Forester to proceed more rapidly with the planting of his bare pine plains. He may double the capacity of his pine nursery.

"Progress, certainly, but upon an old and outworn theory. That seems to run thus:

" 'Private owners must be encouraged to do all they can or will. What private owners can't or won't do, must be done through public agencies or won't be done at all.

" 'Private owners, will, of course, insist on taking their pick of the most favorable opportunities and for a long time will be chiefly interested in short-rotation specialities.

" 'Public activities, therefore, should be directed so as to offer a minimum of competition or interference with private activities—should be concentrated in and upon the less favorable combinations of soil, location and cover, and so as to provide for long-rotation products and management.

" 'With private activities working from the best toward the worst and public activities working from the worst toward the best, some time the two will absorb all of the timberlands which need intensive handling; some time the last of the idle lands will be pinched out, and the big job will be really in hand'.

"The worst-first or pinch-out theory was legitimately derived out of early expediencies but that it is now sound seems very doubtful.

"The current and coming expediencies are not those of ten or 20 years ago.

"Today the forester's prophesy has become the declaration of Congress and the Senate committee's conclusion is definite enough; 'The fundamental need is to increase the volume of timber grown (and growing) in the United States as rapidly as that may be accomplished'.

"Now we are talking of federal acquisitions in terms of millions of acres, and state bond issues of tens of millions of dollars are no longer considered merely bizarre concepts. Presently we shall be asking for unprecedented authorities and funds for the acquisition and development of timber lands for public forests, game refuges and so forth.

"But upon what fundamental theory shall we attempt to justify such authorities and appropriations? A worst-first and everybody-else-help-himself-and-we'll-take-what's-left theory? Or upon the theory that there is an emergency, with urgency and time-limits built in, and that increased volume of growing timber must be provided as rapidly as that may be accomplished?

"1. Adequate programs must involve early and very great development of public forests, and

"2. Public forests, to be most effective, must be so located and so managed as to insure the most certain, earliest and most generous returns.

"If that logic is sound, then the foundations disappear from under the old worst-first policy and to continue it in effect will be professional and economic malpractice.

"The fundamental rule of land economics is that when new development is to be justified at all, such development should be directed toward or into the best-available soils, sites and locations.

"The results of misdirected agricultural development, in over twenty states, have become plain enough. Tens of thousands of farms have been abandoned. Those lands proved submarginal for farming. They could be farmed—but not profitably in comparison with better lands.

"In precisely the same way we have millions of acres of timberlands at present submarginal for intensive forestry.

"There may yet be an element of expediency about it, but to permit the steady wrecking and devastation of good, thrifty, self-renewing forests, while at the same time laboriously building up new forests on cull lands, surely partakes of economic idiocy rather than of expediency.

"If public authorities are to be invoked and if public funds are to be appropriated so as to increase as rapidly as possible the volume of timber being grown, then the place to start is with the very best available.

"The remaining Lake State forests are chiefly hardwoods. The most critical deficits will be in connection with softwoods. The good pines, for the most part, are so far gone that planting must be resorted to.

"As the new policies and plans are framed, shall they continue the old worst-first-and-thank-you kindly system we now have, or shall they be directed so as to insure the most certain, earliest, and most generous volumes of good timber? Shall we continue the pretense that presently, before long, soon, most private timberland owners will adopt and apply some method of continuous production? On that account shall we defer to the

hypothetical eventuation and keep on laboring scrub timber on to cull land?

"In Michigan are some millions of acres which once carried 3 and 4-foot white pine, today carrying only a little popple and june-grass.

"Other millions of acres until recently carried 3-foot sugar maple and basswood, 4-foot hemlock and, occasionally where it got the chance, a 5-foot white pine. Broken hill land, today a sorry wilderness of blackberry tangles, pin-cherry and popple, making only fuel for the next fire.

"The thing of dominating importance, as it seems to me, is that the sum of all the private and all the pulic forest works so far proposed, or reasonably to be anticipated during the rest of this generation, is preposterously less than the minimum required to make a pinch-out of the idle timberlands.

"Enormous acreages, evidently, must drag on indefinitely, quite idle, or loafing under chance-caught scrub, untended save for enough fire protection to make game cover.

"For many decades if not generations, millions upon millions of acres of our timberlands must evidently go untended.

"Are we going to duplicate the vague optimisms, fallacies and foolishness of the pro-farm contingent which, for so many years, was 'going to farm it all, tomorrw,' but this time, with a vague optimism which assumes that, somehow, before long, soon, tomorrow, all the unfarmed humid lands will not only be 'needed' but actually will be used for commercial forests?

"Obfuscated with such illusions, shall we continue indefinitely content to daddle with cull timberlands while excellent stands of self-renewing wild timber go into barrens, and while splendid timber soils and sites accumulate in idleness?

Or shall we drench our silviculture and our acquisition policies with a dose of land economics, and, presently, proceed directly and boldly upon a best-first basis?"

The Need for Land Classification

With the steadily increasing development of any section of a country, it becomes necessary to determine the best use of the lands within it. In the pioneer days this was not necessary because there was an abundance of land for everybody for all uses. The best lands only, were exploited agriculturally. As settlement increased, however, and the best lands became scarce, agriculture was attempted on the very poorest of soils. This was encouraged in Minnesota by misleading land development schemes which sought to "push" all the land possible onto one great industry, namely, agriculture.

Much of the land in the northern part of this state is marginal or submarginal. This may be due to soil conditions, it may be due to both soil and climate or the area being so isolated that the distance to markets and the lack of marketing facilities, places the land in the marginal class.

At the present time there are many thousands of acres of land in the northern part of the state that are not now producing anything of commercial value. Due to natural causes such as deep peat, where tree growth is dwarfed or absent; rock outcrop which at the the best produces a scrubby tree growth; or to periodic flooding, which prevents a growth of merchantable trees, some of the land is classed as non-productive.

The remaining lands are capable of producing crops either agricultural or forest, but due to careless logging and numerous fires, many of them are either bare, or covered with worthless brush.

To determine the extent of these lands and their best uses, requires an inventory and classification of the land. A complete inventory will show the amount of land which is permanently non-productive, the amount of true forest land, the amount of agricultural land and the amount of marginal or potentially agricultural land which should be kept growing trees until it is needed for agriculture.

The counties of Cook, Lake, St. Louis, Koochiching, Beltrami, Itasca, Cass, Lake of the Woods, Aitkin, Crow Wing, Carlton, Clearwater, Hubbard, Pine, Kanabec and Mille Lacs are very seriously handicapped by the large portions of their areas that are not paying taxes. According to Professor H. H. Chapman of Yale University—"of the total area of 16,000,000 acres in these counties, fully one-half of the area is not paying taxes." This amount includes federal and state-owned lands, Indian lands, lands which have not been proved up as yet and lands on which taxes are delinquent.

The state owns nearly 2,000,000 acres of land, most of which is within the forested area and a large amount of which is cutover. This is made up largely of swamp lands obtained under the swamp land grant. Little was known up to the present time of the nature of the state lands as a whole, or of their relative values for forestry or agricultural purposes, yet the state has been disposing of its lands by sale to individuals, mostly for agricultural use, regardless of location or adaptability to that use. Therefore, the state must assume the blame for the delinquent tax situation along with the private land development enterprises.

The Federal Government is paying, to the counties within which the National Forests are situated, 25 per cent of the gross receipts from the sale of timber in lieu of taxes, and an additional 10 per cent goes to building roads in the forest; but the state is doing nothing to help these counties. Two measures are immediately possible, namely: the payment by the state of taxes on its own state forest lands, which will bring instant relief; and a classification of the lands within the state as to the best uses, and then limiting their uses according to inherent and economic factors.

Recognizing the need for excluding unsuitable land from agricultural development in the future, the state legislature enacted Chapter 248, Session Laws 1927, which authorized a classification of state lands. Under the provisions of this act, the Commissioner of Forestry and Fire Prevention under the direction of the Conservation Commission, was authorized to make this classification and to make a list of the lands owned by the state which are suitable for reforestation or afforestation purposes. "There is no better asset to the state than a good farm, but a good forest is a better asset than a poor farm." (Lieutenant-Governor W. I. Nolan, Hoo Hoo Club luncheon, American Forest Week).

METHOD OF PROCEDURE

Under the provisions of this act, it was necessary to make a detailed inventory or reconnaissance of much of the state-owned land in the northern part of the state. It not only became necessary to list the state-owned lands as to whether or not they were suitable for forestry or agriculture, but it was deemed advisable to present a preliminary plan for management.

In order to make such a management plan and to formulate a forest policy, considerable data is required as to the tree growth, soils and the accessibility of these lands. A complete inventory must be made of the assets of the land which includes not only the merchantable timber, but also the young growth—the reproduction—for in the young growth is our future timber.

In order to separate the agricultural lands from those strictly suitable for forestry, a number of factors must be considered, namely: soil, stoniness, topography and accessibility. A tract may have a good agricultural soil, but if there is a large amount of stone and rock in it, it is not practical to farm it; if the slopes are too steep, farming is difficult. On the other hand, the topography may be level and the soil free from stone, but too light to grow good farm crops.

Finally, the accessibility of the same tract of land must be considered. If it is isolated, surrounded by forest and not near a store, postoffice, school, road or shipping point, it should not be classed as agricultural land at present. There may be better located tracts of land that will yield a settler bigger returns in more settled areas and it should not be the policy of the state to sell such lands or encourage settlement in out-of-the-way places.

A small crew was organized in the summer of 1927 to make a preliminary survey; to make up field forms and to work out field methods. Considerable revising was necessary before satisfactory field sheets were adopted. These were designed so that all the necessary information could be noted easily and quickly.

STATE OF MINNESOTA—FOREST SERVICE
Land Classification

.....Sec..... Twp.....N R..... .....P. M.

District..... Compass..... Date.....

Mag. Decl.....Estimator.....

Acres; Plat Multiplier.....
Meadow.....
Barren.....
Water.....

TOPOGRAPHY

1. Level.....a.
2. Gentle Slope.....a.
3. Steep Slope.....a.
4. Mountainous.....a.

SOIL

1. Sand.....a.
2. Sandy Loam.....a.
3. Clay Loam.....a.
4. Peat.....a.

STONE

1. Free from..... .a.
2. Stony.....a.
3. Very Stony.....a.
4. Rock Outcrop.....a.

ACCESSIBILITY

Miles to:
Common Carrier..... School..... P. O.....
Shipping Point..... Passable Road..... Store.....
Highway..... SPECIAL USE.....

(Over)

TIMBER

SPECIES	VOLUME	LOG RUN	LOG HT.	C. L.	3 YR.	10 YR.	20 YR.	AGE
White Pine								
Norway Pine								
Jack Pine								
Tamarack								
Spruce								
Birch								
Balsam								
Poplar								
Cedar								
.....								
Dead								

Condition of Timber: Thrifty..... Mature..... Stagnant..... Decadent.....

DAMAGE..... Insect.....% Name.....
Disease.....% Name.....
Fire.....% Date.....

Other Damage: Cause..... Amt.....

WINDFALL

Light..... Medium..... Dense..... Location.....

LOGGING FACTORS

Location of Merchantable Timber.....
How Timber Will Go Out.....
Proposed Cutting System.....

REPRODUCTION

SPECIES	NO. PER FORTY II.	IV.	VI.	TOTAL	% BY SPECIES	HT.	% INJURED

REMARKS.....
.....
.....
Attach another sheet if necessary

In the fall of 1927 three large crews were organized. One crew worked in the vicinity of Bena, another at Rock Cut Ranger Station, located 27 miles south of Littlefork on the Minnesota-Dakota and Western Railroad, and the third crew was located approximately 16 miles west of Big Falls in what is known as the Pine Island country. These crews worked until the middle of March, 1928. After the spring fire season, 1928, the work was again resumed and continued until September, 1928. This summer work was done along the Minnesota-Canadian border from Gunflint Lake, Cook County, to Crane Lake, St. Louis County, near Kelliher, in Koochiching and Beltrami Counties; and in the vicinity of Bigfork, Itasca County.

The larger crews had the following personnel:

Chief of Party,
Cook,
Locator,
Draftsman,
4 to 8 "Two-Men" Crews.

The duties of the Chief of Party were to lay out the work, supervise the gathering of the data and to check the field work, office work, and the drafting.

The Locator was a man experienced in land surveying, who located the section corners and blazed out the section lines. He worked ahead of the field crews and thus could give

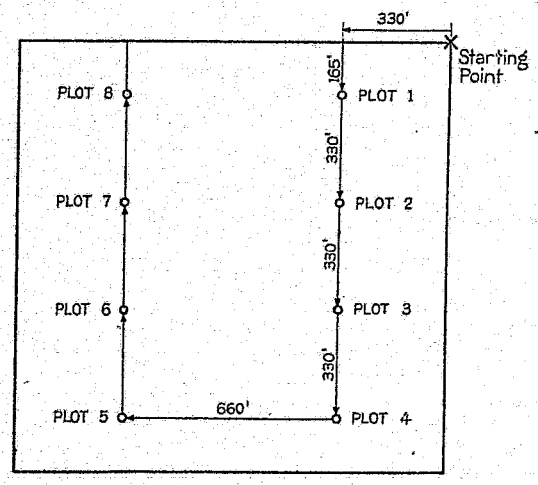
the Chief of Party valuable information as to the country to be worked.

The Draftsman took the field notes and plotted them on a special form by sections. He copied all data relating to each section on this special form and colored the map to differentiate the forest types.

The men gathering the field data worked in parties of two: One man acted as compass man, made the map and took notes on soil and general character of the country; the other man, estimated the timber and the reproduction, took notes on the character of the timber and any defects, diseases or insect damage.

The men went twice through each forty-acre tract, except in open country, where only one trip was deemed necessary. Starting at a corner of a forty, the men traversed the forty as shown in the diagram below:

Arrows indicate line of travel.



Each plot was a circular quarter-acre. On this plot the species were counted separately and tallied by diameters on the tally sheet. Measurements as to diameter were taken at 4½ feet from the ground and tallied as D. B. H.* The tree growth is divided into two classes: Merchantable timber and unmerchantable timber or reproduction. Trees 6 inches D. B. H. and over are classed and estimated as merchantable; those under 6 inches, as unmerchantable. This classification is used regardless of the age or the rate of growth. The reproduction was counted and tabulated by species. Sizes up to 2 inches D. B. H. were designated as Class II, from 2 and up to 4 inches D. B. H. as Class IV and from 4 inches to 6 inches D. B. H. as Class VI. These tabulations by species and diameter classes give a reliable set of figures to use in determining what the future stand will be.

Volumes were computed by using volume tables contained in the University of Minnesota, Technical Bulletin, No. 39, use being made of tables that applied to the area in which the data were gathered.

To get ages and rate of growth, the annual rings were counted and measured. Diameters were taken with a diameter tape.

Any special use for a forty such as lake shore lots, lookout sites, cabin sites, fur farms and game cover, were noted.

In **Remarks**, any special notes not contained in any other section of the sheet, were covered.

Special studies were carried on in regard to growth of the more important species. From these studies, local volume and yield tables were made and used in formulating a preliminary management plan. These investigations showed need for more forest research on growth, soils and sites.

TIMBER TYPES

Timber types were determined from the merchantable timber except where there was little or none of it. In this case, the unmerchantable timber determined the type.

Following is a definition of the types:

SWAMP CONIFERS—Consist of \black spruce (Picea mariana), tamarack (Larix larcina), cedar (Thuja occidentalis), and balsam fir (Abies balsamea) growing in a swamp. These species may grow either in mixture or in pure stands.

HIGHLAND CONIFERS—A stand of timber growing on highland containing more than 60 per cent conifers. The species found in this type are white pine (Pinus strobus), Norway pine (Pinus resinosa), jack pine (Pinus banksiana), white spruce (Picea Glauca), balsam fir and cedar, existing in pure stands or in mixtures.

HIGHLAND HARDWOODS—A stand of timber growing on highland which contains 70 per cent or more of hardwoods. The species found in this type are aspen (Populus tremuloides), birch (Betula papyrifera), balm of Gilead (Populus balsamifera) and other species such as elm (Ulmus sp.), ash (Froxinus sp.), maple (Acer sp.) and oak (Quercus sp.).

HIGHLAND MIXED CONIFERS AND HARDWOODS—A stand of timber growing on highland which contain from 40 to 70 per cent hardwoods.

Besides the timber types two other types of cover were recognized; namely: the brush and the non-timbered types. The brush type is one on which there is little or no timber, but which supports a growth of the brush species, such as alder (Alnus incana), hazel (Corylus sp.) and willow (Salix sp.) The non-timbered type supports nothing but a growth of grass and mosses and includes natural grass meadows, open muskeg and barren lands. These two types are taken out as blank areas when timber estimates are made.

SILVICULTURE

B. E. Fernow, known as the Dean of American Forestry, said, "Silviculture, the production of wood crops, is the pivot of the whole forestry business."

*Diameter Breast High.

Silviculture is the art of producing and tending a forest. It is directly concerned with the life, the growing characteristics and the response to cutting of the tree species making up the stand.

The following silvicultural descriptions bring out the outstanding characteristics of the forest tree species that are encountered in northern Minnesota.

White and Norway Pine

These two pines generally grow more or less together. It is comparatively seldom that they are to be found in pure stands at the present time. They are usually found growing with aspen, balsam, white spruce, and with jack pine on the more sandy soils. As a general thing, white pine prefers well-drained clay loam soil, and the Norway pine does very well in sandy loam to sandy soils. It is noticeable that where these two species predominate on ridges, the Norway pine outnumbers the white pine on the east slopes, whereas the white pine predominates on the west slopes.

White pine is the better wood of the two, but the Norway runs it a close second and the two species are thrown together in state timber sales.

As a general thing the Norway pine has a better form than the white pine, it has fewer natural enemies, and it recovers better from injury.

These two species should be grown to saw log sizes or for piling, but at the present time they are cut for saw logs, piling, pulpwood, and ties.

There are places in Township 150-25, where the old, partly decayed stumps, show that white pine has made excellent growth. There are comparatively few of these trees left and they are overmature. They are to be found on the highground and around the edges of the swamps. They seem to have made their best growth on sandy to sandy loam soils, due probably to the high water table.

Jack Pine

This is a scrubby tree that grows over a wide range of soils. However, it is found mostly on dry sandy or gravelly soils and on the thin soils of the rock outcrop region. It probably does not grow there through choice, but because it can survive more adverse living conditions than can its competitors.

Jack pine usually grows in pure stands but it is frequently found in mixture with Norway pine, white pine, scrub oak and aspen. In the rock outcrop region, it is found with black spruce, balsam, and paper birch.

Jack pine often replaces white and Norway pine after logging, especially if a fire has gone through the slash.

Where it grows in mixture with Norway pine, the stand can be converted to Norway by reserving enough trees to form a 30 per cent shade and leaving Norway pine seed trees. The jack pine is very intolerant of shade, and this gives the Norway a chance to reproduce but keeps the jack in check.

Jack pine is cut for saw timber, pulpwood, and ties.

White Spruce

White spruce does not grow in pure stands; it seldom makes up over a half. It is found in association with trembling aspen, balm of Gilead, balsam fir, and white pine. It occasionally grows with tamarack, black spruce, cedar, birch, basswood, and black ash around the borders of swamps.

This species is usually found growing on rich moist drift soils, where it makes its best growth.

White spruce is probably the most suitable species for the 150-25 region. There are a few scattered trees there and they have made good growth, some of them having made exceptional growth. It has made good growth on the highlands and around the edges of the ash swales; it is an all-around tree for that locality.

With the exception of white and Norway pine, white spruce demands a stumpage price that is second to none as saw timber, and as a pluping wood, it is the best that we have in the state, and as such it demands the topmost prices on the pulpwood market.

Aspen or Poplar

This is probably the most common species in northern Minnesota. This tree is nature's first attempt to reclaim the land that has been cutover or burned over, and so is usually even aged in pure stands. It reproduces both from suckers and from the seeds, the seeds being able to travel great distances. The dense thickets of suckers, that come in after logging, may choke out and for many years prevent the seeding-in of other species.

Although the gross periodic growth for the tree culminates at 60 to 70 years, because of decay, the growth of the stand culminates at 40 to 50 years, and this, therefore, would be the pathological rotation for the species.*

Aspen is an undesirable species as it is so susceptible to serious injury by fire, fungi, wind, and insects, and competition for light and growing space kills over 99 per cent of the trees before they attain the age of 80 years.

This species is generally found on well-drained upland soils, though it is frequently found about the borders of swamps.

Probably its greatest value is as a nurse crop for the more desirable species. White pine and white spruce and also balsam fir come in well under it. If the stand is protected from fire, the under story of conifers will gradually replace the aspens.

Its market value is low; the larger trees are very defective and the operators take the more available trees only. It is quite unusual to find this species sound in saw log sizes, as the trees may be sound at the butt cut, but totally cull at the first and second cuts above.

Growth and yield studies made on aspen by Mr. Stott of the United States Forest Service at Cass Lake shows the mean annual incre-

*From the "Heartrot of Aspens," Technical Bulletin 50, University of Minn.

ment, per acre, in both board feet and cubic foot content, to be greatest at 41 years. A yield of 5,000 board feet per acre, is predicted on a 50-year rotation and a 50-year cutting cycle.

Balm of Gilead

Balm of Gilead has little if any value in this region at the present time, the operators refusing to cut it. However, if this region is not logged before 1933, this species may have then acquired a value, provided it is sound.

Balsam Fir

Balsam fir is tolerant of considerable shade. It is found in mixture with white pine, white spruce, and aspen on well-drained soils. In the swamps it is frequently found with black spruce, when the peat is not too deep.

Balsam is undesirable in pure stands. It is liable to both wind breakage and to uprooting; its resistance to fire is very low, and it is very susceptible to budworm infestation. Although there are no serious signs of an attack in the Big Fork group, a pure stand of any size would most certainly invite such an attack.

The chief use for this species is for pulpwood, but some of the larger trees are cut for saw timber.

Paper Birch

This species is commonly found growing in mixture with aspen. They both follow fires on white pine and hardwood lands, the birch sometimes predominating over small areas. The birch and aspen form a temporary type that is gradually replaced by the white pine, balsam fir, and white spruce that comes in under it. It matures and decays earlier in pure stands than it does in mixture with other hardwoods and with conifers.

After cutting, birch will succeed itself by seeding from the remaining trees and from stump sprouts.

At the present time it is seldom that trees of this species are found that will cut out lumber. The most common use is for ties and many trees are so deformed as to be fit for little more than fuelwood.

Black Ash

This species is of no commercial importance in this region. It grows densely in swales, and out of them it competes with aspen, balsam, and white spruce. Although the trees may become 8-10 inches D. B. H., they are probably a hundred years old and so are making poor use of the site.

Swamp Species

There is very little data available on the growth or yield of any of the swamp species. The growth and yield of black spruce, cedar, tamarack, and balsam in these sites, varies inversely as the amount of excess moisture. The low soil temperature of about 55 degrees F. during the growing season, is not far above the temperature at which roots become active. These soils thaw out later in the spring and freeze earlier in the fall than highland soils, making the growing season sometimes six weeks shorter. It is quite common to find frost a foot below the surface of the swamp during the first part of July. Besides the low temperature, these swamp trees suffer from lack of aeration.

Black Spruce

Black spruce predominates in the peat swamps of northern Minnesota and around their borders. Tamarack, balsam fir, cedar, white spruce, and occasionally white pine and black ash are found with it. Black spruce is commonly found in mixture with jack pine on the thin soils of the rock outcrop region of the northeastern part of the state.

As a general thing it grows in even-aged stands. These trees may all be the same age in the stand whether they are five or fifty feet high. The trees that are big are the ones, that for some reason or other, made better use of the growing conditions when they were small, and dwarfed the less fortunate ones.

As black spruce rarely attains a diameter of over ten inches, its use is limited to pulpwood.

Tamarack

The future of the tamarack in this region is uncertain. It is being defoliated by the sawfly on both the highland and in the swamps. Therefore, it would be unwise to plan on a crop of this species, at least, until some method of control has been worked out.

The merchantable tamarack is practically all dead and well seasoned. It is used mostly for pulpwood and ties.

Cedar

This species is able to grow at a relatively fast rate if the site conditions are favorable. The cedar, growing in the swamps, however, is making very poor growth. It is a common thing to find that cedar trees of such a size as to make a 20-foot pole with a five-inch top to be a 100 years old and they are often defective. It would, therefore, be better economics to raise spruce. Even if spruce should not grow any faster, it has a higher stumpage value. This together with the fact that our white cedar cannot compete with western red cedar for poles, in either size or form, on the open market, makes it unwise to try to raise it on sites that will grow the more profitable species.

Miscellaneous Species

Oak, hard maple, elm, basswood and yellow birch, are occasionally found on the better clay soils. These trees are outside of their commercial ranges. They are scattered, usually poorly formed, and of no commercial importance.

SOIL CLASSIFICATION

The soil examination carried on as part of the classification of state lands, is of surface conditions only, although it was partially checked by the Soils Department. It was not made by soil experts and, therefore, cannot be considered as a true soil classification, but only as a general indication of whether the land is more suited to tree growth than it is to agricultural crops. The soil examinations were made by taking borings, and by examin-

ing the soils on uprooted trees and in road cuts and ditches.

In making notes in the field, four main classes of surface soils were used, namely: peat, clay loam, sandy loam and sand. All the timbered upland forties were traversed twice, the lines or strips being approximately 660 feet apart. The peat areas were traversed in the same manner except where they were open or it was known that there was no highland or merchantable timber. In the latter case only one line was run through each forty. The field crew made notations of the soil at 330-foot intervals on these strips.

In making the office tabulations, the highland soils were grouped under two main heads; **Heavy Soil** and **Light Soil.** The former includes what in the field was called clay loam and the latter the sand and sandy loam.

Maps are included in the writeup of each group and one of these maps shows the location of the soils by forties or fractional forties. Usually not more than two soil types are indicated on one forty-acre tract.

SELECTION OF AREAS

With the completion of the summer work in September, the classification had covered areas in all parts of northern Minnesota and the land so covered was representative of state lands in those regions.

Because of the many subjects covered and for the sake of brevity, it was found adviseable to group certain townships where conditions were more or less uniform, and to give each of these groups a name that identified it with the locality in which it was situated. To make the data gathered available in the most convenient form, a set of maps and tables were prepared for each of these groups.

1. BIG FORK GROUP—Embraces land in northern Itasca County and southern Koochiching. The six northern townships are characterized by large peat areas with scattered sand ridges while the southern townships have less swamp and the highland runs more to a clay soil. A large portion of the state land in this group is cutover.
2. RED LAKE GROUP—Embraces land in southwestern Koochiching and northeastern Beltrami Counties. This group contains an excessive amount of peat and the highland is practically all sand. Most of this peat has never produced merchantable timber and the timber on about half of the remaining state land has been cut. The area along the Tamarack River has been entirely cutover.
3. CHIPPEWA FOREST GROUP—Embraces state land in northeastern Cass County and northwestern Itasca County situated within the Chippewa National Forest. In this group, there is, also, a preponderance of peat which has never produced merchantable timber. The highland is nearly all sand. It has all been cutover.
4. COOK COUNTY GROUP — Embraces state land in northeastern Cook County. The soil in this group is largely clay to sandy loam with a prevalence of rock outcrop and large boulders. On much of this land the timber is still uncut.
5. ORR GROUP—Embraces state land in the west central part of St. Louis County. Much of the soil in this group is peat. On the highland, clay predominates. A large portion of the land has been cutover, but there is still considerable aspen that is uncut.
6. MISCELLANEOUS AREAS — Embraces small tracts of widely scattered state land which are not near enough to any of the above mentioned groups to be included in them. A map of these areas is not included in this report.
7. BOUNDARY SURVEY—Embraces state land along the Canadian boundary. The purpose of this survey was to classify the land but, also, to get an estimate of the damage that would result to the state, from raising the lake levels along the boundary. The entire area is in rock outcrop country. There is still considerable uncut timber. On account of the scattered nature of the state land along the boundary, a map of this area is not included in the report.

These groups represent sample plots of the entire northern part of the state. The data gathered on the different peat areas will be found true for similar areas in other parts of the northern half of the state and the same is true of all the other soils and forest growth.

The field data collected were recorded on maps with a scale of 8 inches to the mile and this permitted of a great deal more detail than could be shown on the maps in this report due to the smaller scale. This information is exceedingly valuable in formulating management plans and is always available for future work on these lands.

Big Fork Group

Location

The land in this group is located in Koochiching and Itasca counties, in the following townships:

Koochiching County

Twp. 63 N R. 25-W 4th P. M.
Twp. 64 N R. 25-W 4th P. M.
Twp. 65 N R. 25-W 4th P. M.
Twp. 63 N R. 26-W 4th P. M.
Twp. 64 N R. 26-W 4th P. M.
Twp. 65 N R. 26-W 4th P. M.

Itasca County

Twp. 60 N R. 24-W 4th P. M.
Twp. 60 N R. 25-W 4th P. M.
Twp. 61 N R. 25-W 4th P. M.
Twp. 61 N R. 26-W 4th P. M.
Twp. 61 N R. 27-W 4th P. M.
Twp. 149 N R. 25-W 5th P. M.
Twp. 150 N R. 25-W 5th P. M.
Twp. 150 N R. 26-W 5th P. M.
Twp. 150 N R. 27-W 5th P. M.

Climate

According to the U. S. Weather Bureau at Pokegama Falls, located near Grand Rapids, the range of temperatures are as follows:

The mean temperature for January is 3.4° Fahrenheit and for July 65.8°, while the mean annual temperature is 37.2°.

The average date of the last killing frost for the same station is June 2nd and the first killing frost is September 8th. The average length of the growing season is 98 days. The latest killing frost on record ocurred June 30th and the first on August 2nd.

The mean annual precipitation is 26.38 inches.

As can be seen from the above figures, the growing season is short. Frost can be expected any month in the year except July, but settlers have reported frost even in this month.

The winters are quite severe. The U. S. Weather Bureau states that all of the northern stations except three have recorded at one time or another, a temperature of —41°. The prevailing winds are from the northwest.

Topography

The area for the most part is level with some local areas classified as rolling with the exception of Township 150-27, where there are numerous steep slopes. The state-owned lands in the territory covered by reconnaissance are in fairly solid blocks.

Accessibility

The Minneapolis and Rainy River Railroad serves this area. The terminals of the railroad are Deer River, Craig and Wirt. Trains run from Deer River daily. On one day the trip is made to Craig and on the next day to Wirt. Shipments are made from Deer River over the Great Northern Railroad.

The Minneapolis and Rainy River Railroad runs along the western boundaries of Twps. 61, 62 and 63, R. 26. The Wirt branch runs northwest from the center of Twps. 60, R. 27, to Twp. 149, R. 26, in which Wirt is located.

The Minnesota, Dakota and Western Railroad runs along the western boundary of Twps. 63, 64, and 65, R. 25, to Littlefork where it connects with the Minnesota and International Railroad. The Minnesota, Dakota and Western is not a common carrier.

State Highway No. 61, is completed north from Deer River to Section 36, Twp. 150, R. 25. The right-of-way is cut out and grading done from there to the northeast corner of Section 25, Twp. 151, R. 25.

The township roads are poor. They are narrow, gravelled only in spots, and have no regular maintenance. In the country around Bigfork, which is primarily a clay country, most of these township roads are impassable for several days after a heavy rain. Due to the small number of settlers and tax delinquency, it is impossible to build better township roads.

Itasca County Road, known as "The Scenic Highway" runs from Bovey north and west to Bigfork. This is a fairly good all-weather road and is being widened and gravelled.

The Big Fork River runs through this group. It has been one of the chief means of transporting woods products, but lately very little use has been made of it in that respect. There are numerous lakes within the boundaries of this group and these act as water reservoirs and have an important influence on the water levels of the area. Their shore lines should be protected and the pollution of their waters prevented.

Population and Industries

The chief center of population within the area is at Bigfork, which has a population of 167, according to the United States Census report of 1920. The remainder of the population is scattered throughout the various townships. Some of the towns have no settlers as in the case of Township 64-25.

The settlers are, for the most part, of foreign extraction with the Scandinavian countries well represented. There is, also, a scattering of people from southern European countries. Most of the settlers depend for a livlihood on winter work on the roads or in the woods. Some make extra money as guides during hunting season and some supplement their farm income by trapping.

The towns within or immediately adjacent to this group, are very small. Bigfork is the largest within the group. Deer River and Grand Rapids are the largest towns to which this group is tributary.

The larger towns have good schools. Bigfork is just completing a very fine building. Rural schools are scattered throughout the area. These range in size from a small one room log building, to those of frame construction with two or more rooms. The schools located on the town roads are often difficult to reach, especially in the spring when the snow is melting and, also, after heavy snowstorms.

Postoffices are located at Wirt, Marcell, Bigfork, Effie, Mack and Craig. These are usually in conjunction with a country store. The mail leaves Bigfork every other day on the train and daily by auto.

Country stores are quite numerous. These are the usual crossroad stores carrying a diversified line of groceries, hardware, clothing and tourist supplies. A considerable portion of the income is derived from tourists.

Taxes and Delinquency

Tax delinquency is rapidly increasing. Of the towns worked in, a large portion of each is delinquent with the exception of Twp. 150, R. 25, which is practically all timbered. The lands in this town which have been cutover, are for the most part, delinquent.

TABLE No. III

BIG FORK GROUP

Ownership and Tax Delinquent Lands

Twp.	R.	P. M.	Total Area Acres.	State Land Acres.	% State Lands.	Total Private Land Acres.	% Private Land.	Private Land Paying Taxes Acres.	% of Private Land Paying Taxes.	Tax Delinquent Lands Acres.	% of Taxable Land Delinquent.	Total Land Not Paying Taxes Acres.	% of Total Not Paying Taxes.
60-N	24-W	4	20,997	6,000	29	14,997	71	9,797	65	5,200	35	11,200	53
60-N	25-W	4	23,960	6,440	27	17,520	73	12,600	72	4,920	28	11,360	47
61-N	25-W	4	23,040	11,400	49	11,640	51	9,080	78	2,560	22	13,960	61
63-N	25-W	4	23,040	5,560	24	17,480	76	13,000	74	4,480	26	10,040	44
64-N	25-W	4	22,280	19,040	85	3,240	15	2,720	84	520	16	19,560	88
65-N	25-W	4	23,040	17,680	77	5,360	23	4,080	76	1,280	24	18,960	82
61-N	26-W	4	23,040	3,080	13	19,960	87	15,640	78	4,320	22	7,400	32
63-N	26-W	4	23,040	12,280	53	10,760	47	6,600	61	4,160	39	16,440	71
64-N	26-W	4	23,040	12,240	53	10,800	47	4,880	45	5,920	55	18,160	79
65-N	26-W	4	23,040	14,200	62	8,840	38	5,360	61	3,480	39	17,680	77
60-N	27-W	4	10,651	436	4	10,215	96	4,815	47	5,400	53	5,836	55
61-N	27-W	4	8,640	3,400	39	5,240	61	3,800	73	1,440	27	4,840	56
149-N	25-W	5	23,040	3,800	16	19,240	84	11,560	60	7,680	40	11,480	50
150-N	25-W	5	23,040	8,960	39	14,080	61	12,440	88	1,640	12	10,600	46
150-N	26-W	5	23,040	9,080	39	13,960	61	10,080	72	3,880	28	12,460	54
150-N	27-W	5	22,164	8,902	40	13,262	60	11,880	90	1,382	10	10,284	46
Totals.....			339,092	142,498	42	196,594	58	138,332	70	58,262	30	200,260	59

The Property

This group consists of 26 townships of which 15 have been covered partly or wholly by a detailed reconnaissance. In these 15 townships with a total of 142,498 acres of state land, 80,210 acres have been mapped.

Soil Classification

The better agricultural land is found along the river valleys and it is here that the farmers are located in greatest numbers.

Of the entire area examined approximately 100 acres are barren; 250 acres, meadow; 61,656 acres, timbered swamp and 18,204 acres timbered highland.

The rock content was noted on the highland and a total of 1,969 acres are stony; 277 acres are very stony and 389 acres are rock outcrop. The remainder has little or no stone. Of the 18,204 acres of highland, 10,932 acres have a heavy soil and 7,272 acres have a light soil.

BIG FORK GROUP

TABLE No. IV

Soil Areas

Township	Range	P. M.	Heavy Soils Acres	Light Soils Acres	Peat Acres
60-N	24-W	4	312	2,167	2,745
60-N	25-W	4	404	261	806
61-N	25-W	4	61	545	2,274
63-N	25-W	4	300	400	1,085
64-N	25-W	4	1,200	.....	18,325
65-N	25-W	4	400	1,025	9,840
61-N	26-W	4	125	134	741
63-N	26-W	4	.....	1,106	6,092
64-N	26-W	4	400	700	7,097
65-N	26-W	4	.....	585	2,785
61-N	27-W	4	663	166	2,482
149-N	25-W	5	299	.....	381
150-N	25-W	5	4,507	183	2,840
150-N	26-W	5	1,868	.....	1,396
150-N	27-W	5	393	.....	3,117
Totals			10,932	7,272	62,006

The peat in Itasca County is mostly of lake filled origin. "The peat deposits in Koochiching County are in general of the built-up or 'high Moor type,'" according to bulletin No. 16, "The Peat Deposits of Minnesota, University of Minnesota." This type did not form under water, but by plant life deposited on top of the soil.

SEE

OVERSIZED

DOCUMENT(S)

BIG FORK GROUP

SURFACE INDICATIONS OF SOIL CONDITIONS

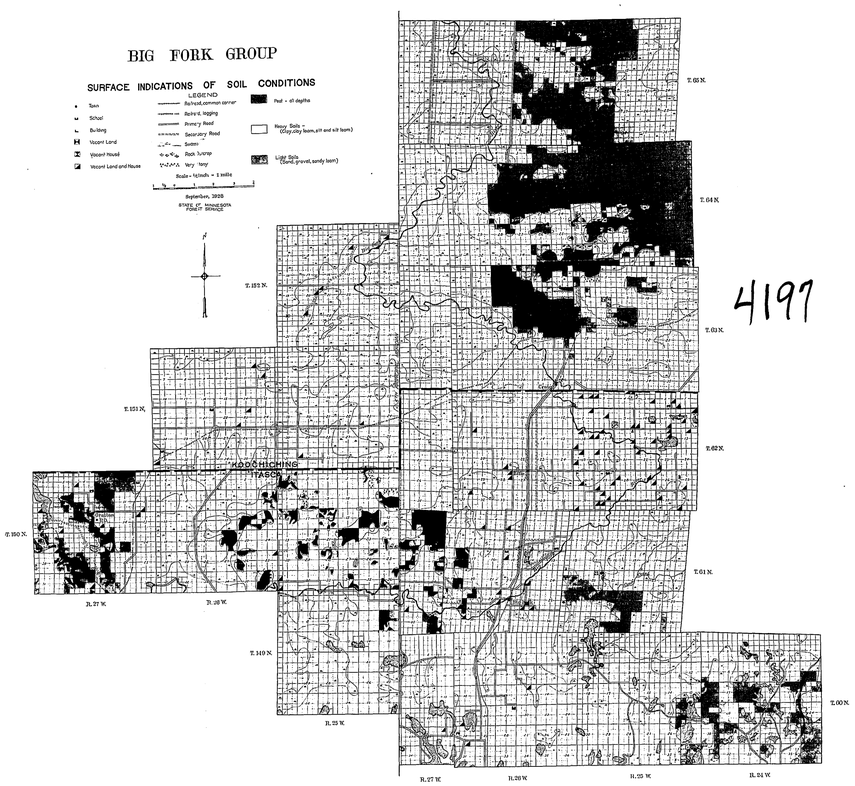
LEGEND

- Town
- School
- Building
- Vacant Land
- Vacant House
- Vacant Land and House
- Railroad, common carrier
- Road & logging
- Primary Road
- Secondary Road
- Swamp
- Rock Outcrop
- Very Stony
- Peat - all depths
- Heavy Soils - (Clays, clay loam, silt and silt loam)
- Light Soils (Sand, gravel, sandy loam)

Scale = 16 inch = 2 miles

September, 1935

STATE OF MINNESOTA
FOREST SERVICE



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BIG FORK GROUP

ECONOMIC MAP

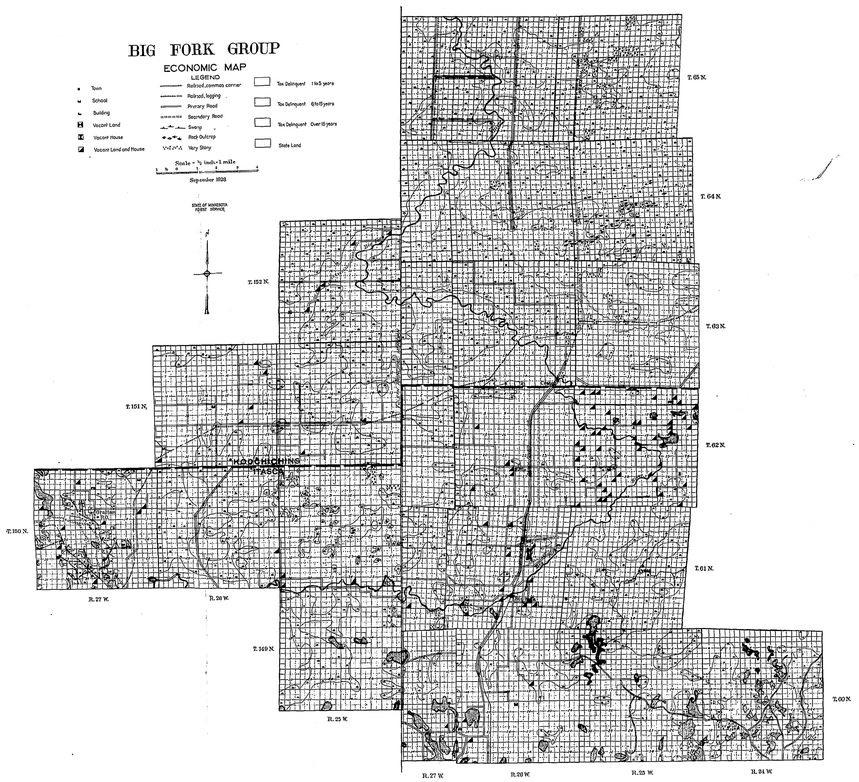
LEGEND

- Town
- School
- Building
- Vacant Land
- Vacant House
- Vacant Land and House
- Railroad, common carrier
- Railroad, logging
- Primary Road
- Secondary Road
- Swamp
- Rock Outcrop
- Very Stony
- Tax Delinquent 1 to 3 years
- Tax Delinquent 4 to 5 years
- Tax Delinquent Over 15 years
- State Land

Scale = ½ inch = 1 mile

September 1928

STATE OF WASHINGTON FOREST SERVICE



BIG FORK GROUP

TIMBER TYPE MAP

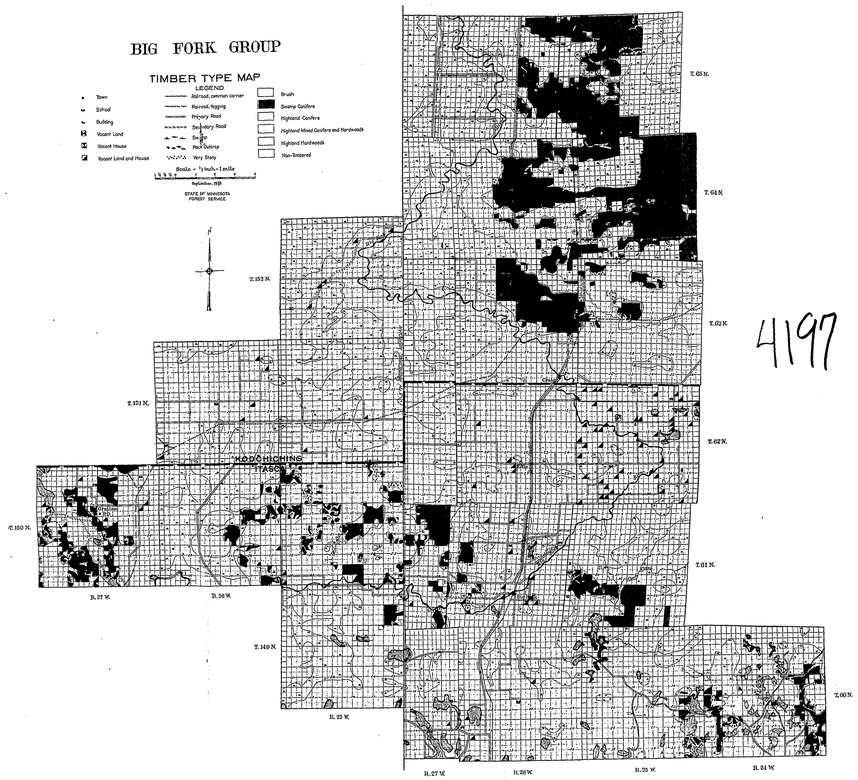
LEGEND

- Town
- School
- Building
- Vacant Land
- Vacant House
- Vacant Land and House
- Railroad, common carrier
- Railroad, logging
- Primary Road
- Secondary Road
- Single
- Rural Primary
- Very Stony
- Brush
- Swamp Conifers
- Highland Conifers
- Highland Mixed Conifers and Hardwoods
- Highland Hardwoods
- Non-Timbered

Scale = ½ inch = 1 mile

Reference: 159

STATE OF MINNESOTA
FOREST SERVICE



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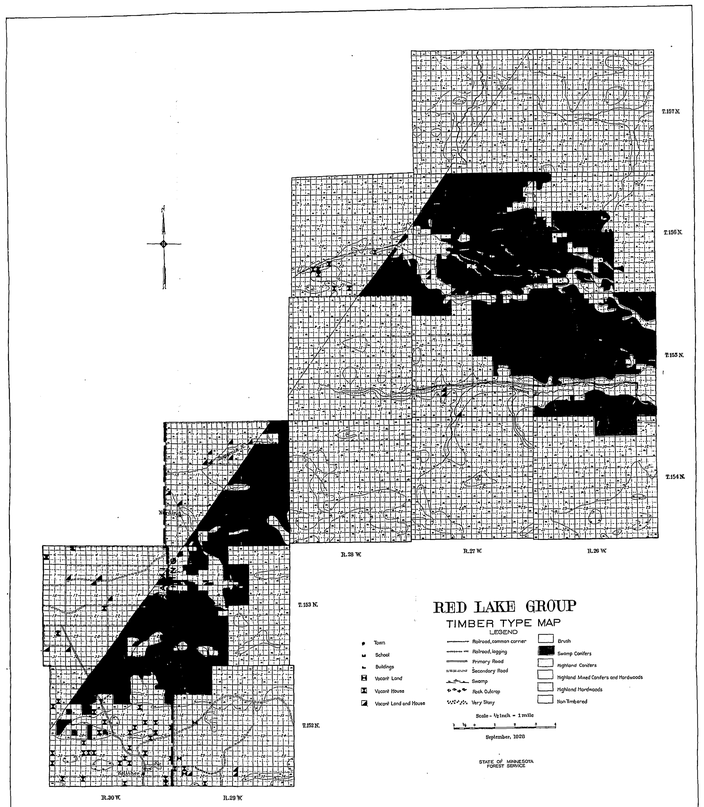
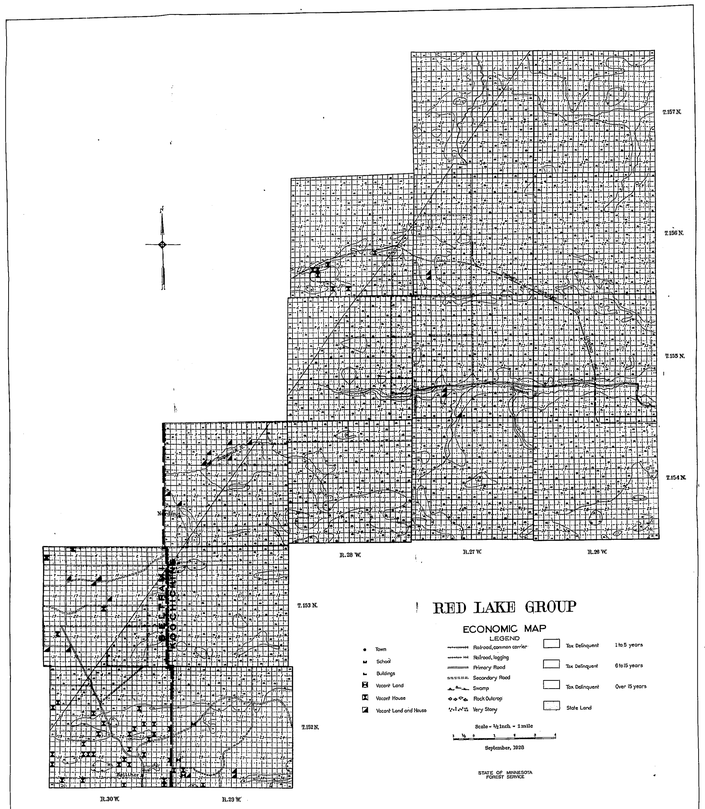
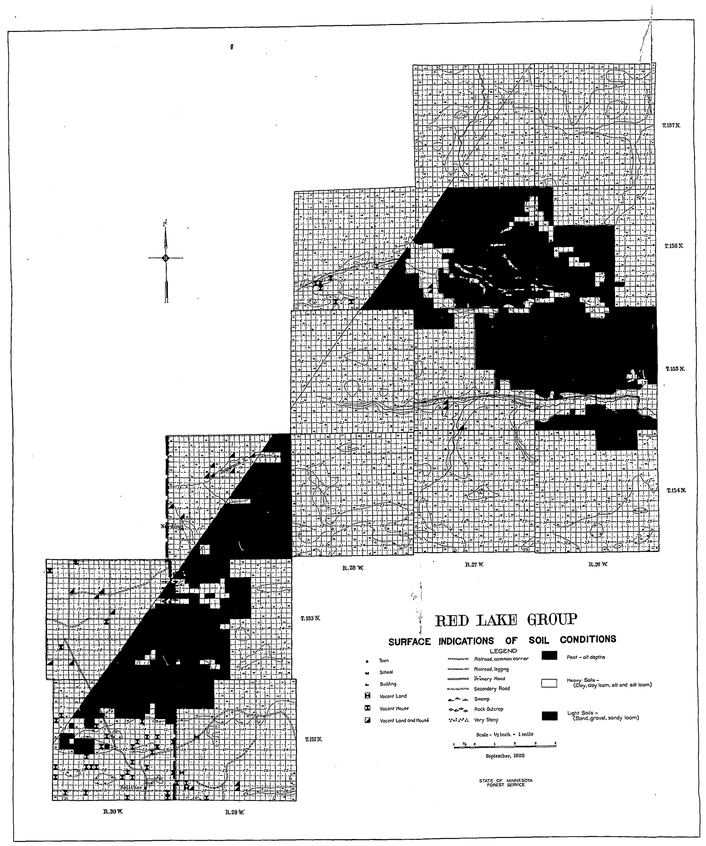
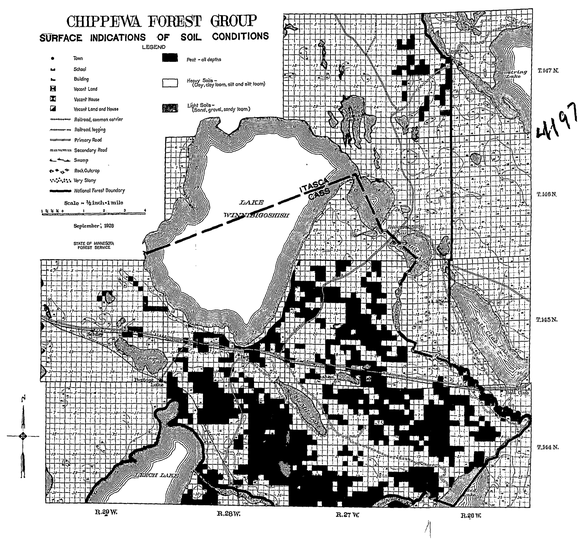
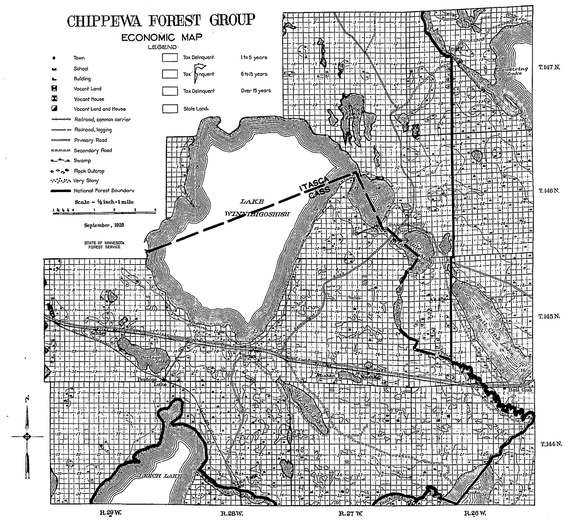

T.157 N.
T.156 N.
T.155 N.
T.154 N.
T.153 N.
T.152 N.
R.30 W.
R.29 W.
R.28 W.
R.27 W.
R.26 W.
RED LAKE GROUP
TIMBER TYPE MAP
LEGEND
Town
School
Buildings
Vacant Land
Vacant House
Vacant Land and House
Railroad, common carrier
Railroad, logging
Primary Road
Secondary Road
Swamp
Bush Swamp
Very Stony
Brush
Swamp Conifers
Highland Conifers
Highland Mixed Conifers and Hardwoods
Highland Hardwoods
Non-Timbered
Scale - ½ inch = 1 mile
September, 1920
STATE OF MINNESOTA
FOREST SERVICE

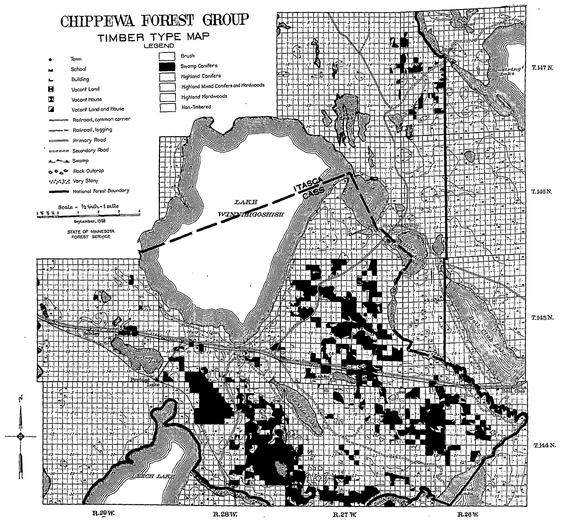

T.157 N.
T.156 N.
T.155 N.
T.154 N.
R. 28 W.
R. 27 W.
R. 26 W.
T.153 N.
T.152 N.
R. 30 W.
R. 29 W.
RED LAKE GROUP
ECONOMIC MAP
LEGEND
Town
School
Buildings
Vacant Land
Vacant House
Vacant Land and House
Railroad,common carrier
Railroad, logging
Primary Road
Secondary Road
Swamp
Rock Outcrop
Very Stony
Tax Delinquent 1 to 5 years
Tax Delinquent 6 to 15 years
Tax Delinquent Over 15 years
State Land
Scale - ½ inch. = 1 mile
September, 1935
STATE OF MINNESOTA
FOREST SERVICE

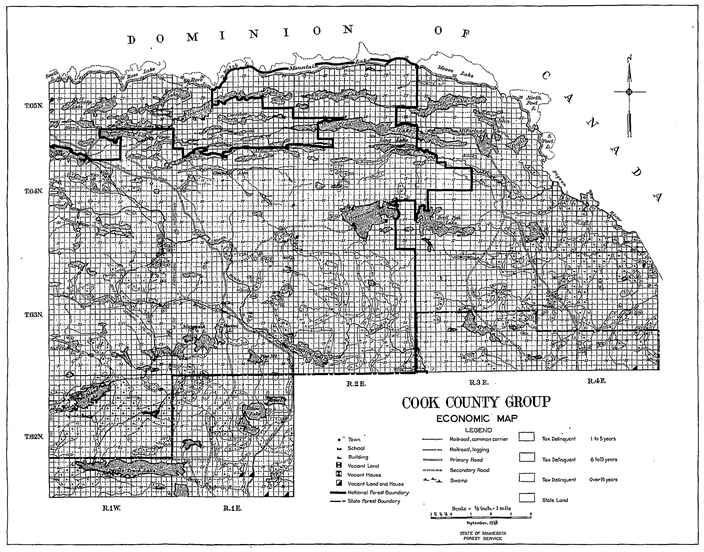

T.157 N.
T.156 N.
T.155 N.
T.154 N.
T.153 N.
T.152 N.
R.30 W.
R.29 W.
R.28 W.
R.27 W.
R.26 W.
Red Lake
Clearwater
Beltrami
RED LAKE GROUP
SURFACE INDICATIONS OF SOIL CONDITIONS
LEGEND
Town
School
Building
Vacant Land
Vacant House
Vacant Land and House
Railroad, common carrier
Railroad, logging
Primary Road
Secondary Road
Swamp
Rock Outcrop
Very Stony
Peat – all depths
Heavy Soils – (Clay, clay loam, silt and silt loam)
Light Soils – (Sand, gravel, sandy loam)
Scale – ½ inch = 1 mile
½ 0 1 2 3
September, 1928
STATE OF MINNESOTA
FOREST SURVEY


CHIPPEWA FOREST GROUP
SURFACE INDICATIONS OF SOIL CONDITIONS
LEGEND
Town
School
Building
Vacant Land
Vacant House
Vacant Land and House
Railroad, common carrier
Railroad, logging
Primary Road
Secondary Road
Swamp
Rock Outcrop
Very Stony
National Forest Boundary
Peat - all depths
Heavy Soils - (Clay, clay loam, silt and silt loam)
Light Soils - (Sand, gravel, sandy loam)
Scale = ½ inch = 1 mile
September, 1928
STATE OF MINNESOTA FOREST SERVICE
LAKE WINNIBIGOSHISH
TASH CASS
T.147 N.
T.146 N.
T.145 N.
T.144 N.
R.29 W.
R.28 W.
R.27 W.
R.26 W.
N.

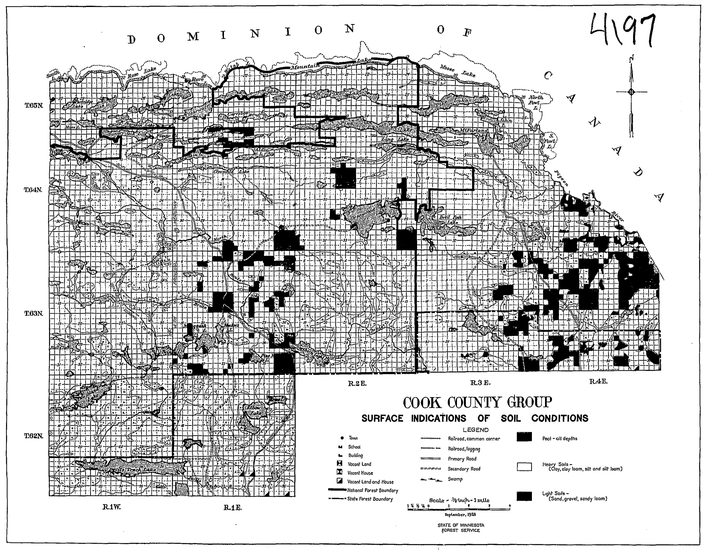
4197

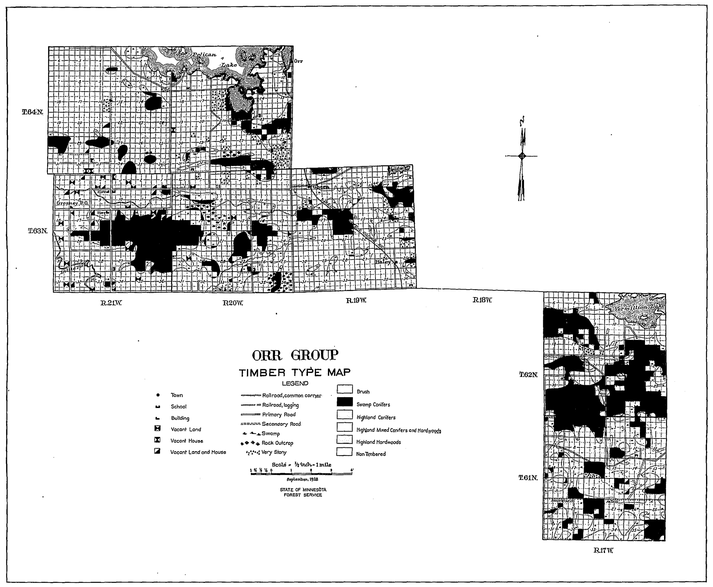

CHIPPEWA FOREST GROUP
ECONOMIC MAP
LEGEND
Town
School
Building
Vacant Land
Vacant House
Vacant Land and House
Railroad, common carrier
Railroad, logging
Primary Road
Secondary Road
Swamp
Rock Outcrop
Very Stony
National Forest Boundary
Tax Delinquent 1 to 5 years
Tax Delinquent 6 to 15 years
Tax Delinquent Over 15 years
State Lands
Scale - ½ inch = 1 mile
September, 1928
STATE OF MINNESOTA FOREST SERVICE
LAKE WINNIBIGOSHISH
TASCA CASS
T.147 N.
T.146 N.
T.145 N.
T.144 N.
R.29 W.
R.28 W.
R.27 W.
R.26 W.


CHIPPEWA FOREST GROUP
TIMBER TYPE MAP
LEGEND
Town
School
Building
Vacant Land
Vacant House
Vacant Land and House
Railroad, common carrier
Railroad, logging
Primary Road
Secondary Road
Swamp
Rock Outcrop
Very Stony
National Forest Boundary
Brush
Swamp Conifers
Highland Conifers
Highland Mixed Conifers and Hardwoods
Highland Hardwoods
Non-Timbered
Scale - ½ Inch = 1 Mile
September, 1938
STATE OF MINNESOTA
FOREST SERVICE
LAKE WINNIBIGOSHISH
TASCA CAKES
T.147 N.
T.146 N.
T.145 N.
T.144 N.
R.29 W.
R.28 W.
R.27 W.
R.26 W.

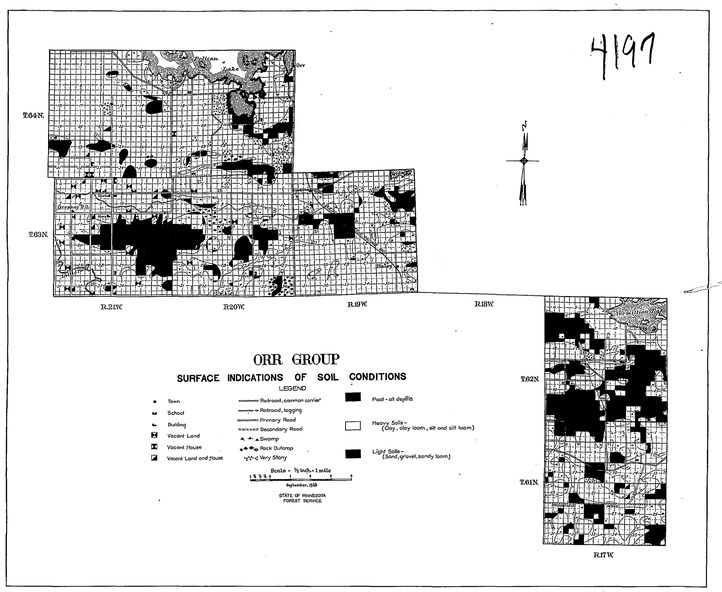

DOMINION OF
T63N
T62N
T61N
R.1W.
R.1E.
R.2E.
R.3E.
R.4E.
COOK COUNTY GROUP
ECONOMIC MAP
LEGEND
Town
School
Building
Vacant Land
Vacant House
Vacant Land and House
National Forest Boundary
State Forest Boundary
Railroad, common carrier
Railroad, logging
Primary Road
Secondary Road
Swamp
Tax Delinquent 1 to 5 years
Tax Delinquent 6 to 15 years
Tax Delinquent Over 15 years
State Land
Scale - ½ inch = 1 mile
September, 1918
STATE OF MINNESOTA
FOREST SERVICE

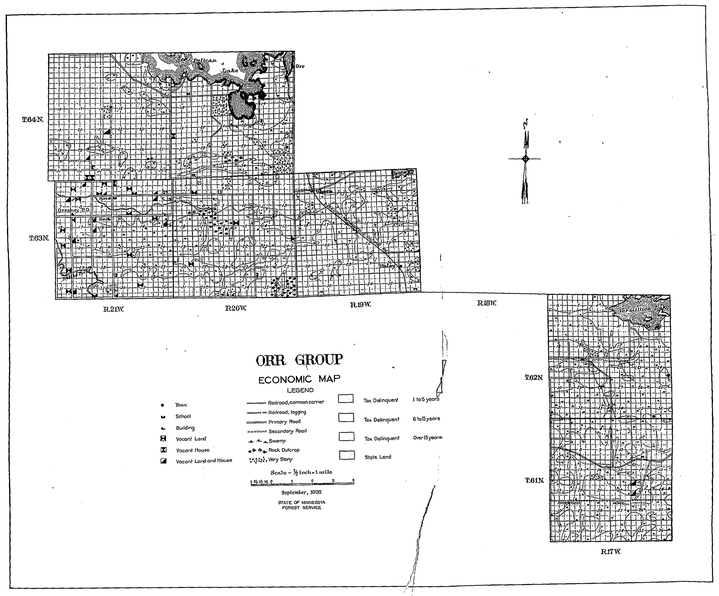
4197


D O M I N I O N O F
T.63N.
T.64N.
T.65N.
T.62N.
R.1W.
R.1E.
R.2E.
R.3E.
R.4E.
COOK COUNTY GROUP
SURFACE INDICATIONS OF SOIL CONDITIONS
LEGEND
Town
School
Building
Wood Land
Wood House
Wood Land and House
National Forest Boundary
State Forest Boundary
Railroad, common carrier
Railroad, logging
Primary Road
Secondary Road
Swamp
Peat - all depths
Heavy Soils - (Clay, clay loam, silt and silt loam)
Light Soils - (Sand, gravel, sandy loam)
Scale - 79.04 = 1 mile
Reference, 1933
STATE OF MINNESOTA
FOREST SERVICE


T64N
T63N
T62N
T61N
R.21W
R.20W
R.19W
R.18W
R.17W
ORR GROUP
TIMBER TYPE MAP
LEGEND
Town
School
Building
Vacant Land
Vacant House
Vacant Land and House
Railroad,common carrier
Railroad,logging
Primary Road
Secondary Road
Streams
Rock Outcrop
Very Stony
Brush
Swamp Conifers
Highland Conifers
Highland Mixed Conifers and Hardwoods
Highland Hardwoods
Non-Timbered
Scale - ½ inch = 1 mile
September, 1938
STATE OF MINNESOTA
FOREST SERVICE

4197


T64N
T63N
R.21W
R20W
R.19W
R.18W
T62N
T61N
R.17W
ORR GROUP
SURFACE INDICATIONS OF SOIL CONDITIONS
LEGEND
Town
School
Building
Vacant Land
Vacant House
Vacant Land and House
Railroad, common carrier
Railroad, logging
Primary Road
Secondary Road
Swamp
Rock Outcrop
Very Stony
Peat - all depths
Heavy Soils - (Clay, clay loam, silt and silt loam)
Light Soils - (Sand, gravel, sandy loam)
Scale - ½ inch = 1 mile
September, 1938
STATE OF MINNESOTA
FOREST SERVICE


T64N
T63N
R.21W
R.20W
R.19W
R.18W
R.17W
T62N
T61N
ORR GROUP
ECONOMIC MAP
LEGEND
Town
School
Building
Vacant Land
Vacant House
Vacant Land and House
Railroad, common carrier
Railroad, logging
Primary Road
Secondary Road
Swamp
Rock Outcrop
Very Stony
Tax Delinquent 1 to 5 years
Tax Delinquent 6 to 15 years
Tax Delinquent Over 15 years
State Land
Scale - 1/2 inch = 1 miles
September, 1928
STATE OF MINNESOTA
FOREST SERVICE

Dr. F. J. Alway said in his address on Land Classification, before the Tri-State Development Congress of 1921, "The peats are the poorest soils in the state for forestry purposes." He, also, said, "All of our peat land is to be regarded as potentially agricultural, but inexperienced settlers should be warned against locating on tracts wholly or largely covered with peat. Such lands belonging to the State or Federal Government, should not be allowed to pass to anyone without his first being fully warned of their disadvantages. It would probably be better for the state, as well as the settlers if these lands were entirely withdrawn from settlement for a time."

THE FOREST

Swamp Type

The tree growth on the swamp areas is made up principally of the following species: black spruce, white cedar and tamarack. There are extensive areas of this swamp timber land that support only a stunted growth of spruce. This may be due to several factors, some of which are deep peat, poor drainage, lack of some essential mineral element or a combination of the above factors. The total acreage of swamp land supporting this stagnant growth is 11,322 acres or 18% of the swamp area in this group. Whether or not this stagnant growth will ever reach merchantable size, is problematical. It may, however, serve as a steadying factor on water content and as a factor in maintaining water levels.

The remainder of the swamp area or 50,334 acres, supports some sort of merchantable growth varying from a few cords to 500 or more cords of pulpwood, per 40 acres.

TABLE No. V

BIG FORK GROUP

Merchantable Timber Swamp Type

Township.	Range.	P. M.	Area Acres.	Black Spruce Cords.	Tamarack Ties.	Tamarack Cords.	Cedar Poles.	Cedar Posts.	Cedar Ties.
60-N	24-W	4	2,745	177	12	.....	1,330	1,200	35
60-N	25-W	4	806	238	.....	.....	417	1,976	210
61-N	25-W	4	2,274	2,658	.....	.....	4,356	.....	525
63-N	25-W	4	1,085	331	.....	.....	.....	.....	.....
64-N	25-W	4	18,325	9,479	34,242	153	25,827	20,339	.....
65-N	25-W	4	9,840	9,039	15,599	4,877	6,180	340	200
61-N	26-W	4	741	206	.....	155	.....	.....	.....
63-N	26-W	4	6,092	316	.....	7	8	.....	.....
64-N	26-W	4	7,097	7,412	17,270	1,669	3,707	6,372	48
65-N	26-W	4	2,785	5,669	10,330	.....	800	.....	.....
61-N	27-W	4	2,462	844	825	.....	3,915	3,084	3,900
149-N	25-W	5	381	197	.....	.....	417	1,976	210
150-N	25-W	5	2,840	6,224	4,487	.....	72,407	122,107	24,306
150-N	26-W	5	1,396	1,052	.....	15	1,338	284	468
Totals			58,889	43,842	82,765	6,876	120,702	163,678	29,902

Average amount per acre: .9 cords, 1.9 ties, 2 poles, 2.8 posts.

Highland Type

The highland species usually consist of a mixture of balsam fir, aspen, white spruce, birch, and balm of Gilead. Scattered mature white pines are occasionally found throughout the region and also small stands of Norway pine.

Although the stands as a whole are of uneven age, a large part of the merchantable timber is either mature or over mature. This is especially true of the aspen, balm of Gilead, and balsam fir. These species are not as desirable, commercially, as pine and white spruce. The aspen and balm of Gilead are very susceptible to attack from fungi, and the balsam fir is readily attacked by the budworm.

Much of the unmerchantable timber, or reproduction, is old enough to be out of that class but it is not large enough to be called merchantable. The trees on some of the area are from 75 to 100 years old and have a diameter of only one inch at 4½ feet above the ground.

On the 62,006 acres of swamp there is an average per acre, for all species of 417 trees. This does not mean that each acre carries that number because actual conditions show that some areas are too crowded and others are far below the average.

Unmerchantable Timber—Highland Type

The highland reproduction consists chiefly of balsam, aspen, birch and jack pine with a scattering of Norway and white pine on the more favorable upland sites.

The balsam has come up not only on the cutover areas, but also, under dense stands of mature timber. No trouble will be found in securing a new growth of this species, but rather the problem will be to keep it from spreading to areas where it is not desired. Where it occurs in large quantities over large areas it is especially subject to budworm attack.

On the burnt and cutover areas, a large part of the aspen and birch reproduction is of sprout origin, springing from the stump or roots of the trees destroyed.

On the 18,204 acres of highland there is an average for all species of 580 unmerchantable trees, per acre.

Damage

The principal danger is from fire, and to this agency, is traced a large percentage of the damage done to timber and reproduction. These fires covered for the most part cutover areas following cutting operations.

Some of the townships have been repeatedly burned. This is true of Twp. 60 N, R. 24-W, 4 P. M. A total of 4,143 acres of State-owned

TABLE NO. VI

BIG FORK GROUP

MERCHANTABLE TIMBER—HIGHLAND TYPE

Twp.	Range	P. M.	Area in Acres	W. Pine	N. Pine	J. Pine		Balsam		Aspen		Birch			Balm of Gilead		White Spruce
				Bd. Ft.	Bd. Ft.	Bd. Ft.	Cords	Bd. Ft.	Cords	Bd. Ft.	Cords	Bd. Ft.	Ties	Cords	Bd. Ft.	Cords	Bd. Ft.
60–N	24–W	4	2,479	27,132	49,561	03,470	180	.....	110	10	48	.....	9	.....	.....	.....	.....
60–N	25–W	4	665	1,446	4,122	.....	.....	.....	80	.....	821	.....	.....	73	.....	.....	.....
61–N	25–W	4	606	141,222	34,310	7,515	.....	.....	2,094	.....	618	.....	1,570	.....	.....	.....	.....
63–N	25–W	4	700	.....	.....	.....	.....	.....	.....	.....	124	20,250	1,355	243	.....	.....	.....
64–N	25–W	4	1,200	200,125	7,500	1,170	.....	.....	2,420	.....	1,469	.....	.....	.....	.....	.....	.....
65–N	25–W	4	1,425	65,302	32,090	257,168	.....	.....	783	.....	1,454	.....	.....	5	.....	.....	.....
61–N	26–W	4	259	1,500	.....	.....	.....	.....	153	.....	231	.....	.....	85	.....	.....	4,000
63–N	26–W	4	1,106	5,310	.....	.....	1	.....	24	.....	2,350	.....	1,256	160	.....	.....	.....
64–N	26–W	4	1,100	10,810	350	19,716	.....	7,840	784	6,000	934	.....	340	114	.....	.....	.....
65–N	26–W	4	585	5,120	20,390	26,270	.....	.....	476	.....	153	.....	.....	.....	.....	.....	.....
61–N	27–W	4	829	189,928	200	.....	.....	36,000	1,214	158,500	802	.....	1,090	246	.....	.....	86,000
149–N	25–W	5	299	.....	.....	.....	.....	.....	80	.....	743	.....	.....	73	.....	.....	.....
150–N	25–W	5	4,690	5,654,786	26,061	1,000	.....	525,800	14,368	2,767,567	7,172	.....	27,263	3,176	99,160	165	2,468,931
150–N	26–W	5	1,808	14,835	.....	.....	.....	227,440	4,428	28,000	1,374	.....	5,173	680	12,000	.....	136,000
150–N	27–W	5	393	388,368	141,453	520	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	8,185
Totals.....			18,204	6,714,084	316,037	381,820	181	797,080	27,034	2,960,077	18,343	20,250	38,656	4,855	111,160	165	2,703,116

Average Amount, per Acre { 770 Bd. Ft.
2.8 Cords
2.1 Ties

The estimates all converted to board feet give a total of 71,800,000 Board Feet, or 930 Board Feet per acre

land was found to be burned over and of this area, 2,389 acres are re-stocking to some merchantable species and 1,754 acres are not. When such repeated burnings occur, the valuable humus is destroyed and a scraggy growth of brush springs up, composed chiefly of willows, alders and fire cherry. This type if given protection may be replaced after a long period of years by merchantable species.

The budworm has not invaded this area in epidemic form as yet. The larch sawfly has killed most of the mature tamarack and bids fair to kill what reproduction is now left in the area.

The aspen and balm of Gilead is heavily infected with Fomes igniarius, a shelf fungus. The nature balm of Gilead is especially susceptible to attack and when the fungus attack is in the advanced stage, the trees infected are usually broken off by the wind. About 90% of the aspen has been injured by this disease.

The wind is a factor of less importance. It usually destroys only scattered trees although in some parts of this area the damage done by wind has been considerable. This is especially true in Twp. 63, R. 25. During the summer of 1928, a windstorm occurred which was of sufficient force to break the tops and, also, uproot numerous large trees. This was especially damaging to the white spruce.

The animal damage is small. Porcupines are the worst offenders and especially damaging to the remaining trees on the cutover areas. Rabbits have not been so numerous the past two years and their damage to reproduction has not been severe.

Special Uses

The townships centering around Twp. 60, R. 25, offer a wide choice of recreational activities, of which hunting and fishing are the major attractions. The country is dotted with lakes all containing a variety of game fish. Many of these lakes are easily accessible and offer good camping sites. Deer and bear signs are numerous especially in Twps. 150, R. 25 and 26. Wolves appeared in small packs in many of the townships during the winter of 1927-28 and several carcasses of deer killed by them were seen.

There are a number of summer resorts in this area varying in size from a few cabins to large, modern and comfortable lodges with bathing beaches and golf links.

Scenic State Park, located in Twps. 60 and 61, R. 25, with an approximate area of 835 acres of state owned lands and 796 acres of private lands is also included in this region. This recreational center is well known for its fishing, boating, bathing, and beautiful scenery. The stand of Norway pine in the park is especially attractive and is an excellent example of what can be expected on similar areas within the group, under a system of forest management.

Portions of Twps. 60 and 61, R. 25, are included in a game refuge. There are a number of good sites for game farms, one fox farm now being in operation near Scenic State Park.

Conclusions and Recommendations

This group offers an excellent opportunity for the practice of forestry. It contains 142,498 acres of state owned lands and 58,262 acres of tax delinquent lands to which the state should secure title. A primary consideration is to consolidate the state holdings which are designated as state forests. After this consolidation a complete management plan can be made and the cost of administration and protection reduced to a minimum.

All swamps are included as forest land areas. They are not suited for agriculture nor are they attractive when considered from a timber producing standpoint. Timber production, however, combined with game cover and watershed protection is the better use.

Farming in this area is a precarious operation as markets are limited and quite distant. Ninety per cent of the state lands covered in this group are unsuited to agriculture. For the time being at least no state lands in this vicinity should be sold for agricultural purposes, as there is a great deal of privately owned land now lying idle.

Township 150, Range 25, is for the most part covered with virgin timber. The cutting on state lands in this town, should be carefully regulated and the slash disposal should be such as to favor a new stand of desirable species and to insure against slash fires. There is considerable fairly good agricultural land along the Big Fork River, but this is not being developed, and the state lands should be kept in forest until needed for agriculture.

Summing up the data for this group, the following recommendations are made:

The following townships should be set aside as forest towns and the state lands designated as state forests:

Koochiching County

Twp. 63 N R. 25-W 4 P. M.
Twp. 64 N R. 25-W 4 P. M.
Twp. 65 N R. 25-W 4 P. M.
Twp. 63 N R. 26-W 4 P. M.
Twp. 64 N R. 26-W 4 P. M.
Twp. 65 N R. 26-W 4 P. M.

Itasca County

Twp. 60 N R. 24-W 4 P. M.
Twp. 60 N R. 25-W 4 P. M.
Twp. 61 N R. 25-W 4 P. M.
Twp. 61 N R. 26-W 4 P. M.
Twp. 61 N R. 27-W 4 P. M.
Twp. 149 N R. 25-W 5 P. M.
Twp. 150 N R. 25-W 5 P. M.
Twp. 150 N R. 26-W 5 P. M.
Twp. 150 N R. 27-W 5 P. M.

The following townships in which no detailed reconnaissance has been made but which are very similar to the preceding townships, should be set aside as forest towns and the state lands within them designated as state forests:

Koochiching County

Twp. 63 N R. 27-W 4 P. M.
Twp. 64 N R. 27-W 4 P. M.
Twp. 65 N R. 27-W 4 P. M.
Twp. 151 N R. 25-W 5 P. M.
Twp. 152 N R. 25-W 5 P. M.
Twp. 151 N R. 26-W 5 P. M.

Itasca County

Twp. 60 N R. 26-W 4 P. M.
Twp. 62 N R. 26-W 4 P. M.
Twp. 60 N R. 27-W 4 P. M.
Twp. 62 N R. 27-W 4 P. M.

In the towns last mentioned a detailed inventory should be made, and if the survey shows the state lands to be of agricultural value, they can be withdrawn from the forest if the need for agricultural lands demands it. Until this need arises, they should be kept in forest and developed as forest lands.

Certain areas such as those surrounding Scenic State Park and around the larger more accessible lakes should be managed as recreational areas.

Much of the cutover and burned over areas are coming back to brush or species of inferior value. It has been found that planting under these conditions has not been successful and therefore, little of this area can be planted at the present time with the assurance of a good survival of the stock planted. All new burns and areas cutover in the future should be promptly replanted, wherever necessary, to the more valuable species.

This area has an abundance of big game. It also offers a retreat and nesting grounds for many of our game birds. Considering the large amount of state land, it would be well to set aside Twps. 63, 64 and 65, R. 25, and Twps. 63, 64 and 65, R. 26, as a public shooting ground and game refuge.

PRELIMINARY MANAGEMENT PLAN FOR TOWNSHIP 150 N, RANGE 25-W 5 P. M.

Introduction

The reason that Township 150-25 in the Big Fork Group was selected for a management plan was that it presented most of the difficulties that would be encountered in such a task. The land ownership here is divided, the State of Minnesota owning 39%, and the remaining 61% being privately owned. The sections of State land and private land are staggered or alternated in the northeast half of the township and in the southwest half the state lands are scattered and in small areas.

The timber here is virgin, much of it is overmature, some is stagnant, and some of it is decadent.

Some of the species growing here have a small market value, as only the better trees are taken, and some species are not cut at all.

There have been small areas cutover in the vicinity of this township, and with few exceptions they are coming back to species of little commercial value.

Parts of this township may be considered as potentially agricultural if no time limit is placed upon it. It is in reality a forest region, but it is beset with all of the difficulties that a forest working unit can be, in northern Minnesota.

Under the present status quo, wherein management, sale and supervision of the cutting of state timber comes under the jurisdiction of the State Auditor; the measurement of State Forest products under the Surveyor General; and the protection against fires, under the Commissioner of Forestry and Fire Prevention, it will be practically impossible to get and unified action. The practice of Forestry calls for a centralized control, a control that will make possible the application of lessons learned through research, both in this state and in other places where similar conditions prevail.

Forestry is a science, and the forest is the laboratory in which the forester studies and carries on his investigations. If the results of his study are doubtful, instead of giving up, the forester will start over again, attacking the problem from a different angle. Then when he has worked out the solution, common sense demands that he proceed in the forest proper, the same as he did on his sample plots.

Forest research is a slow task as the sample plots must be studied periodically, and the tree or the stand studied requires more time to mature than the span of a human life.

Economic Situation

This township contains 576 forty-acre subdivisions. Of these 576 forties, 41, or 7.1% are tax delinquent. This relatively very small tax delinquency in this region can be accounted for by the fact that little of the township has been logged.

A large lumber company at one time owned four forties, but they have been logged and they are now tax delinquent. This is a good illustration of the common practice of the region. It would not be unreasonable to expect the 36.5% of the land in this township that are owned by the same interests to go delinquent as soon as they are cutover.

The State of Minnesota owns 227 forties, or 39.4%. Big owners having holdings of more than four forties, the common area for a farm, own 242 forties or 42.0%, of the township, and 107 forties, or 18.6%, of the whole township are in the name of small holders.

Objects of Management

In Minnesota as in most of the United States, the problem of Forest Management is to take wild forest land and convert it into a forest which shall produce as much timber and of as good a quality as the site will permit, and have it of such an age that it can be cut annually or periodically.

Timber growing along lake shores or streams, or along highways is excepted, as in cases of this kind, the timber may be managed from an aesthetic viewpoint. Another exception is the timber that is grown for watershed protection, or to protect the banks of streams or hillsides from erosion. There will probably be little cutting in the scenic and

protection forests. The cutting there will be of dead and dying timber only, as the intrinsic value of the timber itself is of minor consideration.

In making a Management Plan, there are many things to be considered. Some of them are: the species making up the stand at the time, the species that can make the best use of that site, the species most in demand by the local market, the products for which the species will be cut, the volume available, the size and grade of the timber, the cost of logging, the cost of transportation to the point of manufacture, and to some extent the labor market.

Silviculture

The accepted methods of logging in this region as practiced by the operators is to cut clear everything that has a market value. Reproduction and immature trees of the desirable species are shown no consideration; the only criterion is "will it bring anything on the landing"? The promiscuous cutting of young growth is one of the causes of the prevalence of incoming aspens and birches on the cutover areas of this state. Upwards of 25% of the volume of timber cut in logging operations is immature.

In the past some of the logged-off highlands in this vicinity, have been burned over in the spring following the logging. On these lands as on the lands, that were not burned over, the reproduction has been mostly balsam fir and trembling aspen, and black spruce and cedar in the swamps. The balsam is especially prolific. It is found growing under the other species in the stand, before logging takes place, and it predominates after the merchantable material has been removed. Although it is true that balsam is increasing in value as pulpwood, it occupies a site that could be used by the white spruce which is a much superior wood both for paper pulp and lumber. The tendency of the balsam is to grow in dense thickets of small trees rather than into pulpwood sizes.

Method of Cutting

The method of cutting in Twp. 150-25 will probably be that of clear cutting, with seed trees. No white spruce should be cut that does not contain, at least, four 8-ft. sticks of pulp with a minimum top diameter of three inches. The pine is old and defective and it is doubtful if it would be advisable to reserve any of it. This could be determined at the time of advertising the sale.

Method of Brush Disposal

All upland coniferous slash shall be piled and burned. If the logging is a winter operation, the slash shall be burned by "progressive" or "forced burning," and shall precede skidding. The burning is to be carried on in such a manner that no injury shall be done to the reproduction, immature trees, or the seed trees left.

If the logging operations are carried on when there is no snow on the ground, the slash shall be piled in small compact piles whose height is, at least, equal to their diameter. These piles are not to be more than five feet in height, and they shall be so located that when burned there will be no injury done to the reproduction of remaining trees. The burning is to be done at a time when it is safe, and the piles are to be lighted on the leeward side of the pile, and also, on the leeward side of the area and permitted to burn up into the wind. No piles are to be built against trees, snags or stumps, except in the case of the burning or charring of insect infected material. No windrow burning shall be permitted.

In disposing of the slash, pieces up to three inches in diameter shall be cut into chunks four feet long and piled on top of the smaller slash and brush in the piles. In no case shall it be permissable to build a brush pile over a large top. All tops shall be well lopped and the debris placed upon the piles. In building the piles, all the butts shall be thrown towards the center; this will give a cleaner burn as well as making the pile more water resistant.

All debris resulting from the logging of upland hardwoods shall be well lopped so the pieces come in close contact with the ground. Crooked tops and crotches shall, also, be cut so as to come in direct contact with the ground.

An efficient slash disposal program would cause a closer utilization in tops and eliminate the leaving of cut products in the woods because of their being covered by logging debris.

Failure to dispose of slash or permitting slash disposal to lag behind the other logging operations shall be considered a sufficient cause for stopping logging operations on that State permit until the brush disposal is brought up to date.

Method of Logging

All logging operations shall be carried on with the welfare of the future stand in mind.

Trees shall be felled in such directions as to do the least possible injury to reproduction, seed trees, or other trees to be left.

The cutting of seed trees or undersized trees shall be considered as a "wilful trespass" against the State of Minnesota. A schedule should be included in the contract specifying the values of various sizes of immature trees.

Where trees are broken in felling, through inefficient or careless work, the volume of said broken tree shall be scaled up as being full, except for such defects as rot, fire scars, lightning damage, etc., and shall be so paid for.

Stumps exceeding one foot in height shall be scaled up and paid for by the operator at the regular stumpage prices.

All trees shall be cut into logs of such lengths as to fully utilize their full merchantable lengths. Logs shall be of such lengths that the loss through "crook" shall be the minimum.

Skidding trails shall be no wider than is necessary, and no needless swinging or rolling of logs through reproduction shall be tolerated.

Single horses only, and not teams shall be used for draying pulp and ties out to the road or landing.

All wood cut on state lands that is cut for camp use shall be scaled up and paid for at the regular stumpage prices.

No bearing tree or witness tree shall be cut so as to leave a stump height of less than five feet.

No section post, quarter post, established sixteenth post, meander post, or closing corner shall be destroyed or removed.

Failure of the operator to comply with the terms of the timber sale or the instructions of the supervising state officer shall be deemed sufficient cause for stopping logging operations on that sale until the necessary requirements have been met.

Rotation and Cutting Cycle

We have not enough data to decide on any fixed rotation or cutting cycle. As has been said before, the area is not stocked to the degree which is probably possible, nor is it stocked with the more desirable species. And at the present time there has been so very little work done in the region in the correlation of soils and tree growth that the Forester's judgment based upon local observations must be relied upon entirely, without specific investigative data.

The cutting of the present crop may be clear cutting, leaving for seed trees such trees as are deemed suitable.

For the next crop, which should be white pine and white spruce with a miscellaneous mixture, the rotation age could arbitrarily be be placed at 100 years with a 50-year cutting cycle.

Timber Sales Policy

A complete stem analysis was made of 25 white spruce trees growing on clay soils in Township 150-25, and its immediate vicinity.

The trees studied were all dominant, but had made very erratic growth; their ages ranged from 56 to 118 years.

Twenty per cent of the trees studied were not over 63 years old when they were cut. Two of these five trees had made better cubic foot volume growth than any of the others, even though some of the other trees were nearly twice as old. Two of these five trees were large enough to make merchantable pulpwood when they were 21-30 years old and two more became merchantable when they were 31-40 years old. The other trees did not become merchantable until they had attained an age of 41 years or more. From this one can see that the white spruce trees in this region that made the best growth when they were young, were the ones that produced the best yields.

If these five trees are disregarded in computing the mean annual growth; that is, their merchantable volumes divided by their ages, then these spruce trees made their maximum mean annual growth and, also, their maximum periodic growth at 101-110 years. If there had been more of the older trees, these maximum growths may have been found to occur even later in the trees' lives. However, there is no reason why these five trees should be disregarded. Considering these fast growing trees alone, their mean annual growth culminated at 61-70 years, and their maximum periodic growth at 51-60 years.

It is very probable that if white spruce were planted in this region, and if fires and other of its enemies were kept out, that the cubic foot rotation would be nearer 50 or 60 years than 100 or 110.

The data from these same trees were similarly worked up using the board foot as the unit of measure. When the fast growing trees were left out of the computations the trees made their maximum mean annual growth and, also, their maximum growth in the 101-110 year period, but it is possible that it may have occurred later if older trees had been included. When the young trees alone were considered, their mean annual growth and their ten year periodic growth was found to be greatest at 61-70 years.

The above figures are based on the tree as a unit. In determining a rotation, a similar process should be gone through using the stand, which is made up of trees, as a unit. The reason for this is that as the stand increases in age, it becomes crowded. When the trees commence to crowd each other some fall behind in their growth and eventually die. Therefore, the hundred year old stand does not contain as many trees as it did when it was fifty or sixty years old. This is the reason that the stand must be the unit of study in determining rotation, and not the tree.

As has been said before, the stand in 150-25, is a mixture of species, many of them undesirable. For this reason, it was not possible to study the stand as a unit. The study using the trees as a unit was merely to indicate the possibilities of the site quality.

It is a commonly known fact, that over extensive areas, in an untended mature stand, the decay and casualties offset the growth.

In the stands of timber, tended by man, the growth greatly exceeds that of natural stands. However, even in man grown forests, cutting should not exceed growth except in emergencies as in salvaging dead or dying timber or in warding off epidemics.

In order to improve the present stand in this area, it may be necessary to cut clear and replant. The determining factor in limiting the area to be cut under such a condition, will be the available planting stock.

Unless it is reasonably certain that the state lands will come back well stocked with the more desirable species by seed tree or selective cutting methods, the state stumpage sold should be held down to what the state can replace by planting the spring following logging.

This township in itself is a relatively small area, and for the present stand, the volume of the area to be cut will be determined primarily by the amount of available planting stock. As it is not likely that the State of Minnesota will have a forest nursery with available planting stock before the year 1933,

no timber should be sold in this area before, except for emergencies.

It would be well to hold the size of a sale permit down to four forties or less, for the time being, and the maximum stumpage area sold in one block, to (16) sixteen contiguous forties. Then if an operator buys more than four forties, compel him to finish his operations on each permit, and finish his slash disposal before permitting him to proceed on another permit. However, if the operator has several permits and is operating several camps, consider each camp as a separate operation and compel the camps to clean up their operations and slash on each permit before proceeding to other timber sale units.

Logging operators cutting on state lands or adjacent to state lands shall run and cut out a true line between the section corners and quarter corners involved. Interior forties shall be located by the method used in legally subdividing a section. These lines and subdivision are to be checked by a competent state officer using a staff compass and a steel tape or chain.

State timber shall be cruised and appraised by competent state officers before being offered or advertised for sale. Management plans should be completed, reservations made, and seed trees marked before the timber is offered for sale.

The timber shall be scaled and stamped on the land where cut.

In cases where there are several tiers or ricks of timber on a landing, there shall be a space of, at least, three feet between each tier or rick so it will be possible for the scaler to go between them and have a good chance to see the size and condition of the timber being measured.

The operator shall furnish suitable quarters separate from his own men and for the exclusive use of such state officers as may be necessary for the proper supervision of his operations. These quarters shall contain a table of such a size as to permit the state men to complete their office work in a reasonable length of time and with reasonable convenience. These quarters are to be well lighted, and equipped.

All brush and debris resulting from timber sale operations shall be disposed of as specified under Slash Disposal.

The state officer in charge should have discretionary powers as to the location and size of logging roads, skidways, and other areas cut clean of trees.

All rulings of the State Sanitary Board shall be complied with, both as to camp buildings and as to the camp site. State officers in charge of the operation should be empowered to enforce these regulations.

Cutting Budget

Considering a quarter section of state land as a timber sale unit, it is practically impossible to give the order in which the units should be offered for sale. As the conditions are at the present time, Section 36 should be offered first. If, but a quarter of this section is offered, it should be the southeast one. This has the best transportation facilities at the present time. It is possible to drive the timber down the Big Fork River, and it is possible to truck it to the town of Bigfork, seven miles to the east, on the Minneapolis & Rainy River Railroad, or to Deer River, thirty miles, south. In the winter time the products could be hauled to Bigfork on sleighs.

After thirty-six is cut, Section thirty-four would probably be the next logical area, as there are settlers living in that vicinity. In this way the timber could be offered for sale in the order of its accessibility. This is the order in which it should be handled if the logging were all done by small operators.

A large lumber company has a logging railroad running eastwards just two miles north of this township. When this company gets "cleaned up" in adjoining territory, it will make a strong bid for state stumpage in 150-25, provided there is competition. In another five or six years, or whenever the "cleanup" is made, the logging operations will in all probability be on a large scale.

As this company owns 36.5% of the land in this township, it will build railroad spurs into its holdings. When that is done, the northern part of the township will be more accessible than the southern part. In that case, the stumpage in the northern part would command a better market price than the southern. Then if for any reason the company would not wait for the timber in the southern part or if it did not want it because of the light stand, this timber would still be salable to small loggers.

Revision of Plan

General revisions of management plans are usually made every ten years, and sometimes every five years, as well as at the end of each cutting cycle.

This is but a preliminary report, and it is based on insufficient field data. When conditions become such that timber in this township should be offered for sale, a more intensive study should be made of the part concerned.

The next examination should consider the condition of the stand, and the economic conditions as well as the stand's volume.

There may be a change in economic conditions which will raise the price of stumpage and make a demand for such material as is now left in the woods. In such a case, it would be well to sell the stumpage on tracts having the inferior species, first, and hold back on the better ones.

Red Lake Group

Location

The area covered in this group includes the following townships lying east of Red Lake:

Koochiching County

Twp. 154 N R. 26-W 5 P. M.
Twp. 155 N R. 26-W 5 P. M.
Twp. 156 N R. 26-W 5 P. M.
Twp. 155 N R. 27-W 5 P. M.
Twp. 156 N R. 27-W 5 P. M.
Twp. 156 N R. 28-W 5 P. M.
Twp. 152 N R. 29-W 5 P. M.
Twp. 153 N R. 29-W 5 P. M.
Twp. 154 N R. 29-W 5 P. M.

Beltrami County

Twp. 152 N R. 30-W 5 P. M.
Twp. 153 N R. 30-W 5 P. M.

Climate

The climatological data was taken from the U. S. Weather Bureau report for Littlefork, Koochiching County, which is the weather station nearest to the area. The mean annual precipitation is 20.96 inches. The mean annual temperature is 36.2° Fahrenheit. The highest recorded temperature is 99° and the lowest is —52°. The prevailing wind direction is northwest. The average date of the first killing frost in the fall is September 8th and the average date of the last killing frost in the spring is June 14th. The latest date of a killing frost in the spring is June 30th and the earliest date of a killing frost in the fall is August 2nd. The average length of the growing season is 70 days, but actually there is only the month of July in which there is no danger from a killing frost.

Topography

The major portion of this area is swamp and, therefore, level. The highland consists of strips along the water courses and numerous small islands scattered throughout the swamps. The topography of these uplands is gently rolling. The soil is free from stone. Most of the area is made up of very wet peat and this supports only a dwarfed growth of tamarack and spruce. In parts of the swamp where the peat is less deep and not so wet there is a fair amount of merchantable timber. There are no lakes within the area and the few streams on state land are small. The two main rivers are the Sturgeon River which flows east into the Big Fork River and the Tamarack River which flows northwest into Red Lake.

Accessibility

This area lies adjacent to the Minnesota and International Railroad with principal shipping points at Big Falls and Kelliher. It lies from five to thirty miles distant from the railroad. The Twomey-Williams Company's temporary logging railroad running west and north from Big Falls, has made a large part of this territory readily accessible for the present time.

State Highway No. 4 parallels the main line of the Minnesota and International Railroad. A well-maintained highway leaves Highway No. 4 at Blackduck and runs north through Kelliher, Waskish and to Baudette. In addition to these highways, there are some county and township roads, chief of which are the Big Falls-Pine Island road along the Sturgeon River, the Waskish-Nordin road and the Kelliher-Nordin road. These roads are impassable in wet weather. There are, also, a number of ditch bank roads and old logging roads which are passable during the dry season. While these secondary roads are not passable in the summer, they are suitable for hauling logs by sleigh or truck in the winter.

The Sturgeon and Tamarack Rivers run through the area and both are suited to driving logs. The logs taken down the Tamarack River have been rafted across Red Lake to Redby and those taken down the Sturgeon River have gone to the Big Fork and then to the Rainy River. Immediately north is the Black River, a driveable stream which is tributary to the Rainy River.

Population and Industries

The population in this area is scant and very scattered. A large part of the area is not settled at all and has no roads or schools. Kelliher with a population of some 500 people, is the only town within the area. It is an old logging town whose business has greatly declined in recent years. It has stores, churches, a postoffice, a school, and a hotel. Nordin Postoffice in Township 154-29, is a small settlement and trading center.

Immediately adjacent to this area is the village of Big Falls and also the settlement of Waskish. Big Falls is one of the main shipping points and it has stores, hotels, a postoffice, a school and a church. At present Big Falls is fairly prosperous on account of its being headquarters for the Twomey-Williams Logging Company. Waskish is on upper Red Lake and it has a postoffice, two stores, and a hotel. Its business in the past has been logging and commercial fishing.

There are a few settlers along the Sturgeon River and quite a number north of Kelliher along the Kelliher-Washkish and Kelliher-Nordin roads. The nationality of the settlers is heterogenous in nature, with the Scandinavian predominating. Many of them live on farms but subsist chiefly on outside work such as road work, timber cutting or commercial fishing on Red Lake. There are a sufficient number of schools within the area to take care of the settlers.

Much of the land in this territory was acquired as homesteads and settled with the evident intention of developing it agriculturally. This land, at best is marginal even when developed and very expensive to develop for agricultural purposes. While the timber lasted, the settler was able to make a living by selling his timber and working in the woods. About the time most of the timber had been cut, an extensive system of drainage took place, which resulted in high taxes, tax delinquency and widespread abandonment.

TABLE No. VII

RED LAKE GROUP

Ownership and Tax Delinquent Lands

Twp.	R.	P. M.	Total Area Acres.	State Land Acres.	% State Lands.	Total Private Land Acres.	% Private Land.	Private Land Paying Taxes Acres.	% of Private Land Paying Taxes.	Tax Delinquent Lands Acres.	% of Taxable Land Delinquent.	Total Land Not Paying Taxes Acres.	% of Total Not Paying Taxes.
154-N	26-W	5	23,040	16,800	73	6,240	27	2,400	38	3,840	62	20,640	90
155-N	26-W	5	23,040	19,320	84	3,720	16	3,120	84	600	16	19,920	86
156-N	26-W	5	23,040	20,680	90	2,360	10	2,360	100	.....	..	20,680	90
155-N	27-W	5	23,040	18,040	78	5,000	22	2,800	56	2,200	44	20,240	88
156-N	27-W	5	23,040	18,700	81	4,340	19	1,440	33	2,900	67	21,600	94
156-N	28-W	5	23,040	2,551	11	20,489	89	10,409	51	10,080	49	12,631	54
152-N	29-W	5	23,040	6,640	29	16,400	71	8,280	50	8,120	50	14,761	64
153-N	29-W	5	23,040	20,080	87	2,960	13	680	23	2,280	77	22,360	98
154-N	29-W	5	23,040	11,019	48	12,021	52	4,240	35	7,781	65	18,800	82
152-N	30-W	5	23,040	6,441	28	16,599	72	7,760	47	8,839	53	15,280	66
153-N	30-W	5	23,040	5,239	23	17,801	77	4,480	25	13,321	75	18,560	81
Totals			253,440	145,510	57	107,930	43	47,969	44	59,961	56	205,472	81

Of the 253,440 acres which is the gross area of this group, 145,510 acres, or 57%, are state-owned and 107,930 acres, or 43%, are privately owned. Of the privately owned land, 59,961 acres, or 56%, are tax delinquent. Only 19% of the total area in this group is paying taxes. One township, 156-26, has no tax delinquencies; this is, no doubt, due to the fact that 90% of the land is owned by the state, and the timber on the private lands has not yet been cut. It will be noted, that there is only a small tax delinquency in Township 155-26, where 84% of the lands are state-owned. The land paying taxes in this township is located along the Sturgeon River and in the northern part of the town where there are a few timbered forties. The remaining townships all have a large percentage of their lands tax delinquent, due, no doubt, to the fact that the timber has been cut.

Area of the Property

An intensive examination was made of 94,578 acres of state land within the above named townships. Of this amount, 85,111 acres are swamp and 8,540 acres are highland, both of which support tree growth; 927 acres are non-timbered and include open meadows, open muskeg, and barren lands.

TABLE No. VIII

RED LAKE GROUP

Soil Areas

Township.	Range.	P. M.	Heavy Soil Acres.	Light Soil Acres.	Peat Acres.
154-N	26-W	5	.....	.....	1,267
155-N	26-W	5	668	1,118	17,527
156-N	26-W	5	316	1,289	8,293
155-N	27-W	5	6	122	7,561
156-N	27-W	5	735	383	17,419
156-N	28-W	5	.....	258	2,264
152-N	29-W	5	.....	.....	1,920
153-N	29-W	5	.....	998	9,740
154-N	29-W	5	.....	665	10,354
152-N	30-W	5	.....	1,539	4,902
153-N	30-W	5	.....	448	4,791
Totals			1,725	6,815	86,038

The Forest

The tree growth is classed as two main types, namely: the swamp type and the highland type. These again are divided into merchantable timber and unmerchantable timber. The timber, on the area tributary to the Tamarack River and south of the Sturgeon River, has been cut over, and the area north of the Sturgeon River has some merchantable timber which is in the process of being logged. On a large part of the area the tree growth will never reach merchantable size on account of present soil conditions.

The merchantable timber in this group is found on scattered tracts of highland and in parts of the swamp where the peat is somewhat shallow and drainage more favorable.

The swamp supports a stand of spruce, cedar and tamarack with the spruce predominating. The highland supports a mixture of white pine, Norway pine and jack pine with white pine predominating. Intermingled with these are aspen, birch, balsam, cedar and spruce in varying amounts. It has been noted on the area that when the original stand has been cut, aspen and balsam reproduction come in abundantly. Very little of the highland area is coming back to the more valuable species.

On the state lands covered in six townships, namely: Twps. 152, 153 and 154, R. 29, Twps. 152 and 153, R. 30 and Twp. 156, R. 28, there are only forty cords of spruce pulpwood, thirty cords of balsam pulpwood and three cords of birch which are of merchantable size at the present time. This has been considered a negligible quantity and left as an item of conservatism in the calculations.

TABLE No. IX

RED LAKE GROUP

Merchantable Timber—Swamp Type

Township.	Range.	P. M.	Area Covered Acres.	Spruce Bd. Ft.	Spruce Cords.	*Tamarack Bd. Ft.	*Tamarack Cords.	*Tamarack Ties.	Cedar Poles.	Cedar Posts.	Cedar Ties.
154-N	26-W	5	1,267	.....	511	.....	1,025	535	.....	.....	.....
155-N	26-W	5	17,525	525,500	11,352	.....	38,071	25,695	12,683	19,186	.....
156-N	26-W	5	8,275	437,600	3,168	53,800	20,835	14,225	88,524	372,832	1,335
155-N	27-W	5	7,561	.....	150	.....	308	620	92	.....	80
156-N	27-W	5	17,419	21,400	1,770	245,000	3,958	3,305	8,229	38,580	2,746
Totals			52,047	984,500	16,951	298,800	64,197	44,380	109,528	430,598	4,161

Average amount, per acre: 25 bd. ft., 1.6 cords, .9 ties, 2.1 poles, 8.3 posts.
*Most of the Tamarack shown in the above estimate, is dead.

TABLE No. X

RED LAKE GROUP

Merchantable Timber—Highland Type

Township	Area Covered Acres	W. Pine Bd. Ft.	N. Pine Bd. Ft.	J. Pine Bd. Ft.	Balsam Bd. Ft.	Balsam Cords	Birch Bd. Ft.	Birch Cords	Birch Ties	Aspen Bd. Ft.	Aspen Cords	Miscellaneous Bd. Ft.	Miscellaneous Cords
155-26	1,781	456,095	145,050	240,000	.....	1,457	8,000	370	2,185	406,420	587	900	12
156-26	1,605	2,837,920	1,457,540	310,300	5,406	185	2,400	277	15	8,510	34	30,550	..
156-27	1,118	110,600	54,350	2,500	.....	1,206	.....	182	75	160,645	62	.....	..
Totals	4,504	3,404,615	1,657,440	552,800	5,406	2,848	10,400	829	2,275	575,575	683	31,450	12

Average amount, per acre: 1,380 bd. ft., 1 cord, .5 ties.

This makes a total of all species both swamp and highland of 7½ million board feet, 86,000 cords, 49,000 ties, 110,000 poles and 431,000 posts. On a per acre basis, this is 132 board feet, 1.5 cords, 0.9 ties, 1.9 poles and 7.6 posts.

On the 85,111 acres of swamp type in the entire group, there is an average number of 914 unmerchantable trees, per acre.

On the 8,540 acres of highland type in the entire group there is an average number of 868 unmerchantable trees per acre.

DAMAGE

There have been only a few fires on the area and these are mostly old burns on cut-over land. The other injury is light. The swamp species, tamarack and spruce, are, for the most part, worthless and will never reach merchantable size. This is because they grow in wet swamps where the peat is very deep. About 50 per cent of the tamarack has been attacked by the larch sawfly in varying degrees of severity. The white pine is about 15 per cent defective, the Norway pine from 5 to 10 per cent and the cedar about 40 per cent. Most of the damage on the last three is due to heart rot.

SPECIAL USES

There is a fair amount of game on the area of which deer and moose are the most numerous. Since the state owns such a large proportion of this area, it would be well to set part of it aside as a game refuge and devote some of it to public shooting grounds. This use will in no way conflict with its use for the production of timber.

There are a great many ditches in the swamp areas and along these there is usually a growth of aspen. On account of the site, however, the aspen becomes defective at a very early age and will not make a good grade of merchantable timber. It is valuable, however, as beaver food. There are areas similar to this in Minnesota on which the beaver thrives and it would be well to investigate further the possibilities of raising beaver in the ditches throughout this region.

CONCLUSIONS AND RECOMMENDATIONS

The areas examined within this group are primarily forest lands and agriculture should not be encouraged. Of the 94,578 acres examined, 1,725 acres, or approximately 2 per cent, is classed as heavy soil. However, being of small sizes, scattered and remote from market, these areas can be considered as no better than marginal land. The few settlers within this area are not subsisting on agriculture alone, but derive a major part of their incomes from outside work. A study of the tax records has brought out the fact that most of the land, after the timber is cut, becomes tax delinquent, and shows that the number of settlers is decreasing rather than increasing, thus discouraging the development of improvements which are necessary in an agricultural community.

As rapidly as possible, the state should acquire all privately-owned forest lands within the areas set aside as state forests. Many of these lands are already tax delinquent.

The highland which is mostly of a very sandy character is ideal for forest production. It consists mostly of small islands surrounded by large bodies of deep wet peat. This re-

duce the fire hazard to a minimum, and with the proper forest management almost insures a continuous yield of forest products.

The area as a whole is most suited to forest production. The swamp areas where the peat is shallow produces a fair crop of timber. Where the peat is deep, there is only a scrubby growth of trees. On the shallow peat areas, it would be advisable to study soil conditions after logging has taken place to determine if moisture conditions change enough to permit a more rapid tree growth.

On the areas which produce very slow-growing swamp species, the production of game should be the predominating use. Deer, moose, caribou, beaver, grouse and ducks are found in the area and these should be protected sufficiently to permit of their maximum production. Until some means is found of accelerating the growth of the swamp tree species, they should be protected and preserved as game cover.

Therefore, it is recommended that the following townships be declared "Forest Townships," and the state lands therein be made permanent state forests, game refuge and public shooting grounds.

Beltrami County

Twp. 152 N R. 30-W 5 P. M.
Twp. 153 N R. 30-W 5 P. M.

Koochiching County

Twp. 152 N R. 29-W 5 P. M.
Twp. 153 N R. 29-W 5 P. M.
Twp. 154 N R. 29-W 5 P. M.
Twp. 153 N R. 28-W 5 P. M.
Twp. 154 N R. 28-W 5 P. M.
Twp. 155 N R. 28-W 5 P. M.
Twp. 156 N R. 28-W 5 P. M.
Twp. 153 N R. 27-W 5 P. M.
Twp. 154 N R. 27-W 5 P. M.
Twp. 155 N R. 27-W 5 P. M.
Twp. 156 N R. 27-W 5 P. M.
Twp. 157 N R. 27-W 5 P. M.
Twp. 154 N R. 26-W 5 P. M.
Twp. 155 N R. 26-W 5 P. M.
Twp. 156 N R. 26-W 5 P. M.
Twp. 157 N R. 26-W 5 P. M.
Twp. 155 N R. 25 W 5 P. M.
Twp. 156 N R. 25-W 5 P. M.
Twp. 157 N R. 25-W 5 P. M.

An inventory of the timber and lands has been carried on in the first eleven townships listed and a preliminary management plan made.

The last ten townships are very similar in character to the first eleven and contain a large amount of state lands. An inventory of these townships should be made as soon as possible so that they can be included in the management plan for the whole area.

PRELIMINARY MANAGEMENT PLAN

Tamarack River Area

In addition to the Land Classification, it was deemed advisable to present in this report the essential features of a management plan for state-owned forest lands so classified. Neither time nor funds permitted of the formulation of a detailed management plan for the total area covered, so areas were selected on which could be demonstrated the possibilities of growth.

One area is tributary to the Tamarack River and is, therefore, given that name. It includes 35,357 acres in Townships 152, 153 and 154, Range 29, and Townships 152 and 153, Range 30, a description of which was given in the Red Lake Group. Here it suffices to say that the entire area has been cut over and that much of the remaining timber is of a scrubby and dwarfed character which will never grow to merchantable size.

The area was, therefore, divided roughly into non-producing and producing. Under the first category are the areas that produce trees which do not make a one inch diameter growth in thirty years. This division is the one used by the Federal Government on the Chippewa National Forest for the same purpose. The following table shows the classification:

TABLE No. XI

TAMARACK RIVER AREA

Land Classification—Area in Acres*

Township.	Total Area.	TIMBERED				Barren.
		Swamp		Highland		
		Producing.	Non-Producing.	Producing.	Non-Producing.	
152-29	1,920	760	1,160	.....	.....	.....
153-29	10,738	7,977	1,617	1,078	.....	66
154-29	11,019	5,682	4,451	615	50	221
152-30	6,441	4,650	202	1,514	25	50
153-30	5,239	4,102	199	448	.....	490
Total	35,357	23,171	7,629	3,655	75	827

*Data taken directly from field sheets.

Growth studies were made of the most important species which were present in sufficient numbers to consider. These were made for the purpose of getting a mean annual growth figure for these species so that the growth could be predicted. To get this, quarter acre plots were laid out; the average tree calculated and measured. The computations are based on a 12-inch stump height and a 3-inch top diameter.

TABLE No. XII

TAMARACK RIVER AREA

Summary of Average Yields

Species.	Average Age Years.	Average D. B. H. Inches.	Average Total Height Feet.	Average Merch. Length Feet.	Average Volume Cu. Feet.	Mean Annual Growth Per Tree Cu. Feet.	Number Trees Per Acre.	Volume Per Acre Cu. Feet.	Mean Annual Growth Per Acre Cu. Feet.
Spruce	114	4.5	35.5	21	1.32	.012	472	620	5.4
Cedar	129	6.1	35.2	23	2.72	.023	462	1,260	9.8
Balsam	70	4.5	36.8	19	1.20	.018	660	790	11.3
Aspen	32	4.6	41.5	20	1.54	.048	328	510	15.9
Jack Pine	28	4.9	37.2	24	1.61	.057	544	880	31.4

In this area there is a negligible amount of merchantable timber, as stated above, so only the possibilities of growth in the unmerchantable timber had to be considered. Therefore, the stand was tabulated by sections, and by means of the mean annual growth per tree, the increment was calculated for 20 years on the highland and for 40 years for the swamp. On the species for which there were no growth studies made the mean annual growth was estimated on the basis of general knowledge of the species and a comparison with the other mean annual growth figures.

TABLE No. XIII

TAMARACK RIVER AREA

Probable Net Increment After Deduction for Loss in Numbers for the Rotation

	Cu. Ft.	
Swamp		
Tamarack	896,000 or	9,950 cords
Cedar	889,000 or	163,000 poles
Spruce	1,222,000 or	13,590 cords
	3,007,000	
Highland		
Aspen	1,049,000 or	11,640 cords
Balm of Gilead.....	5,000 or	60 cords
Birch	138,000 or	1,530 cords
Balsam	154,000 or	1,710 cords
Norway Pine	2,000 or	20 cords
Jack Pine	35,000 or	390 cords
Ash	90,000 or	1,000 cords
	1,473,000	

TABLE No. XIV

Converting Factors

1 Cord	90 cu. ft.
1 Cord	500 bd. ft.
33 Poles	1000 bd. ft.
250 Posts	1000 bd. ft.

RECOMMENDATIONS

Highland Type

There was a good original stand on this type, composed mostly of white, Norway and some jack pine. After logging, however, a stand made up mostly of inferior species has come in.

Growth studies could not be made on a sufficient number of trees to fix the rotation; that is, the age at which the stand should be cut, so it had to be estimated. It was estimated that in 20 years more, if will again be ready to cut for pulpwood or cordwood. Therefore, the increment was calculated for 20 years. At the end of that time a total of 16,350 cords of all species, or on the 3,655 productive acres, a yield of 4.49 cords per acre can be expected. This is a good stand and will warrant a logging operation, even though the tracts are small and scattered, and the species inferior to the original stand.

It is, therefore, recommended that nothing be cut in this type for 20 years and at the end of that time, logging shall be started and the stand cut clean and planted immediately after cutting, mainly to Norway pine. This species is best suited to this type of land, but white pine can be planted on some of the better sites and jack pine on the poorer.

Swamp Type

This type is much more difficult to handle. The increment was calculated for 40 years, not because the timber will be ready to cut at that time, but so that the expected volume could be determined. The stand will be very mediocre; yielding only 23,540 cords and 163,000 poles, or on the 23,171 productive acres, only 1.02 cords and 7 poles per acre forty years hence. Needless to say no timber should be cut for at least 40 years and during that time more intensive growth studies should be made, preparatory to formulating a more detailed management plan.

PRELIMINARY MANAGEMENT PLAN

Pine Island Territory

The area examined consists of 56,551 acres in Twps. 154, 155 and 156, R. 26, and Twps. 155 and 156, R. 27. The timber in this region is for the most part mature and the cutting should be continued. However, it should be regulated and limited. Therefore, on the basis of growth data collected, and with the estimates of merchantable timber as taken in the field, the cut can be limited, subject, of course, to change when a detailed management plan is made.

Swamp Type

The rotation in this type is fixed at 150 years, until such data is collected which will definitely determine it. This was approximated from general observation in the area, as the age at which the species in this type are merchantable.

Due to the lack of accurate growth data it is necessary to make another assumption and that is that the growth or increment in mature stands will just balance the decadence. This is not true exactly but it is true enough for all practical purposes at the present time. On this basis, then, the following table was constructed from Table XVI.

TABLE NO. XV

*MERCHANTABLE TIMBER—SWAMP TYPE

PINE ISLAND TERRITORY

Twp.	Total Area Covered Acres	Area Producing Merchantable Timber Acres	SPRUCE				TAMARACK						CEDAR					
			Bd. Ft.		Cords		Bd. Ft.		Cords		Ties		Poles		Posts		Ties	
			Total	Per Acre	Total	Per Acre	Total	Per Acre	Total	Per Acre	Total	Per Acre	Total	Per Acre	Total	Per Acre	Total	Per Acre
154-26	1,267	600	.....	....	511	1	.....	....	1,025	1	535	1	.....	....	.....	....	.....	....
155-26	17,525	9,598	525,500	55	11,352	1	.....	....	38,071	4	25,695	3	12,683	1	19,186	2	.....	....
156-26	8,275	5,631	437,600	78	3,168	1	53,800	10	20,835	4	14,225	3	88,524	16	372,835	66	1,335	....
155-27	7,561	440	.....	....	150	....	.....	....	308	1	620	1	92	....	.....	....	80	....
156-27	17,419	1,938	21,400	11	1,770	1	245,000	127	3,958	2	3,305	2	8,229	4	38,580	20	2,746	1
Totals...	52,047	18,207	984,500	53	16,951	1	298,800	16	64,197	4	44,380	2	109,528	6	430,598	24	41,611	1

*Timber over 6 inches D. B. H. considered merchantable.

TABLE NO. XVI

*MERCHANTABLE TIMBER—HIGHLAND TYPE

PINE ISLAND TERRITORY

Township	Total Area Covered Acres	Area Producing Merchantable Timber Acres	WHITE PINE		NORWAY PINE		JACK PINE		BALSAM				BIRCH						ASPEN				MISCELLANEOUS			
			Bd. Ft.		Bd. Ft.		Bd. Ft.		Bd. Ft.		Cords		Bd. Ft.		Cords		Ties		Bd. Ft.		Cords		Bd. Ft.		Cords	
			Total	Per Acre	Total	Per Acre	Total	Per Acre	Total	Per Acre	Total	Per Acre	Total	Per Acre	Total	Per Acre	Total	Per Acre	Total	Per Acre	Total	Per Acre	Total	Per Acre	Total	Per Acre
155-26	1,781	1,300	456,095	351	145,050	112	240,000	185	.....	....	1,457	1	8,000	6	370	....	2,185	2	406420	312	587	....	900	1	12	....
156-26	1,605	1,368	2,837,920	2,065	1,457,540	1063	310,300	227	5,406	4	185	....	2,400	2	277	....	15	....	8,510	6	34	....	30,550	22	.....	....
156-27	1,118	218	110,600	99	54,850	49	2,500	2	.....	....	1,206	1	.....	....	182	....	75	....	160645	144	62	....	.....	....	.....	....
Total...	4,504	2,886	3,404,615	1,180	1,657,440	573	552,800	191	5,406	2	2,848	1	10,400	4	829	....	2,275	1	575,575	199	683	....	31,450	11	12	....

*Two Townships with no highlands, 154, 26 and 155, 27.

TABLE No. XVII

LIMITATION OF THE CUT

Pine Island Territory

On 18,207 Producing Acres. Swamp Type.	Present Stand					Rotation 150 Years. Allowable Annual Cut				
Species.	Bd. Ft.	Cords.	Posts.	Poles.	Ties.	Bd. Ft.	Cords.	Posts.	Poles.	Ties.
Spruce	984,500	16,951	.....	.....	.....	6,600	113	.....	.....	.....
Tamarack	298,800	64,197	.....	.....	44,380	2,000	428	.....	.....	296
Cedar	.....	.....	430,598	109,528	4,161	.....	.....	2,875	730	28
Totals	1,283,300	81,148	430,598	109,528	48,541	8,600	541	2,875	730	324

From Table XVII it will be seen that on this area there should be cut each year only 8,600 board feet, 541 cords, 2,875 posts, 730 poles and 324 ties of all species, or its equivalent of 320,800 board feet. This is a very small amount indeed, but it shows conditions as they actually are and it proves that if the state intends to keep its forests in a productive condition and provide a continuous cut it cannot sell as much timber as has been the policy in the past. It is true that this will not be a job for a large logging concern but there are a great many small operators who would bid on this small amount. By selling only this amount of timber it will give the state a much better opportunity to supervise the cuttings with a limited force.

This timber should be cut in such a manner as to insure a future crop. The best method, no doubt, will be a clear cutting in strips, though a great deal of research work along this line is necessary before this can be stated definitely. There is comparatively little known about the silvical characteristics of the swamp species, and since these species form a large proportion of state-owned timber, the trained personnel of the forestry department should concentrate upon a study of them.

Highland Type

The highland in this area is a good pine site with an average stand of 1,944 board feet of pine per acre. See Table XVI. Of the pines, Norway pine seems to be the species to favor because it is more easily handled silviculturally than white pine and it is more valuable than Jack pine. The area occupied by pine should by all means be reproduced to pine; Norway pine on the major portion of the area, white pine on the best sites, and Jack pine on the poorest.

The cut of the white and Norway pine must necessarily be limited so as to insure reforestation. Therefore, a diameter limit of 14 inches D. B. H. has been set for these species to insure advanced reproduction. Besides this, a minimum of two Norway pine seed trees should be left to the acre to insure seedling reproduction. On this area, then, there are only 1,753 board feet of white and Norway pine to the acre and this amount is less than should be left on an acre to insure a future crop. Therefore, it is recommended that no white or Norway pine shall be cut, except the dead, down, and insect and fungus infested trees.

The remaining stand, including Jack pine, balsam, birch, aspen and miscellaneous species, shall be cut clean; no clear cutting to be done however, until the state has a forest tree nursery and is producing a sufficient number of trees to plant bare areas.

The exception to this is on areas where there is sufficient Norway pine to seed in the area, where the other species should be cut clean in a good Norway pine seed year. After the state is producing nursery stock, these species may be cut clean and planted as expeditiously as the production of nursery stock permits. On inaccessible areas where the stumpage value of seed trees exceeds the cost of artificial replanting, they should be cut clear and planted.

Chippewa Forest Group

Location

This group is wholly within the Chippewa National Forest and lies between and east of Lake Winnibigoshish and Leech Lake.

The area covered includes the following townships:

Itasca County

Twp. 147 N R. 26
Twp. 147 N R. 27

Cass County

Twp. 144 N R. 26
Twp. 145 N R. 26
Twp. 144 N R. 27
Twp. 145 N R. 27
Twp. 144 N R. 28
Twp. 145 N R. 28
Twp. 145 N R. 29

All west of the 5th Principal Meridian.

Climate

As can be expected, as far north as this rea lies, the winter are long and rather severe d the summers short. The United States Weather Bureau gives the following data for the station at Winnibigoshish Dam. The mean July temperature as 68.2° Fahrenheit, the mean January temperature as 5.0° and the mean annual temperature as 39.0°. The highest temperature on record is 103° and the lowest —46°. The same station gives the average date of the last killing frost as May 16th, and the average date of the first killing frost as September 22nd, while killing frosts may occur as late as June 11th and as early in the fall as August 17th. The average annual precipitation is 25.73 inches. The prevailing wind is northwest.

Topography

As a whole, the area is level to slightly rolling with occasionally a small area that is hilly. The main drainage is southeast to the Mississippi River.

Accessibility

The Great Northern Railroad passes through the area from east to west and is paralleled by State Highway No. 8. Roads are fairly numerous and radiate in all directions from Bena, a town on the Great Northern. The Soo Line (M. St. P. & S. S. M.) Railroad, runs through the southwest portion of the area, but it is too far to one side to be an important factor. None of the area is over five miles from a passable road and most of it is within eight miles of a shipping point, although a small portion is nearer twenty miles.

Bena, Federal Dam and Ball Club, are good trading centers, and have schools, post offices and stores. In addition, there are sidings at Portage Lake and Schley, all valuable as shipping points for forest products.

Population and Industries

There is a fairly large Indian settlement, in and immediately adjacent to Bena. A few of the Indians live on their allotments part of the year, but do little or no farming. On the whole, the agricultural activities are limited to cutting a little wild hay and tilling a few small garden tracts.

Most of the land belongs to the Federal Government or to the State, although there are some privately owned lands and Indian allotments. The state land is part of "The State Swamp Land Grant," of March 12, 1860, and as can be expected, most of it is swamp. In the nine townships under consideration, there are only 9,000 acres tax delinquent, but this, no doubt, is accounted for by the fact that there is very little privately owned land within these townships.

The Property

The state land examined in this group amounts to 41,082 acres and the survey shows that 32,126 acres, or 78%, are swamp, and 8,956 acres, or 22%, are highland. The 8,956 acres of highland are mostly pure sand, in places verging on a sandy loam. A total of 8,879 acres are classed as light soil and 77 acres as heavy soil. Nearly all of the highland is made up of islands within the swamp. They vary in size from a fraction of an acre to forty or fifty acres, but only a very few come near the forty acre size.

The swamp land is nearly all peat, varying in depth from a few inches to many feet. The swamps are very wet and 8,736 acres are entirely without tree growth. Of this 3,712 acres are natural meadows and the remainder or 5,024 acres are either too wet to grow trees of any kind or the tree growth has been destroyed by fire, insects or fungi.

TABLE No. XVIII
CHIPPEWA FOREST GROUP

Soil—Areas

Twp.	R.	P. M.	Highland—Heavy Soil Acres.	Highland—Light Soil Acres.	Peat Acres.
144-N	26-W	5	..	1,382	5,039
145-N	26-W	5	..	48	143
147-N	26-W	5	..	554	997
144-N	27-W	5	27	2,552	7,547
145-N	27-W	5	50	1,697	7,152
147-N	27-W	5	..	203	134
144-N	28-W	5	..	1,492	8,162
145-N	28-W	5	..	684	2,467
145-N	29-W	5	..	267	485
Total			77	8,879	32,126

The Forest

The swamps have never produced any merchantable timber and it is doubtful if they will under the present soil conditions. The exception to this is an occasional strip of swamp along the highland where the peat is shallow and the tree growth is fairly good.

Most of the swamp area is covered with tamarack and spruce less than six inches in diameter and due to their size they are classed as reproduction although, the average age is 50 years. The range of ages for most of these trees is from 15 to 110 years.

Except for a few isolated areas, the highland has all been cutover. Pine seed trees

were left when the area was first logged but most of these have since been sold and cut. On the whole there is very little merchantable timber left on the area.

Timber sales and management wherever possible should be in cooperation with the Federal Forest Service.

On the 32,344 acres which contain tree growth of merchantable species, there is an average, per acre, of: 118 board feet, .18 cords, .33 ties, .21 poles and .42 posts. Converting all the timber to board feet, it gives an average, per acre, of 224 board feet.

Of the immature trees or reproduction on the same area, there is an average per acre, of 509 trees. From the last figure it might be inferred that the area is fairly well stocked with reproduction. This, however, is not entirely true, as some of the area is overstocked and some understocked.

Damage

The merchantable timber runs fairly sound, not over 10% of the volume being defective, except the aspen which on the average will run at least 50% defective.

The immature highland species are, also, uniformly sound except white pine and aspen. About 40% of the white pine is slightly damaged by the pine weevil and 15% of the aspen is damaged by fungi, (Fomes igniarius). In both species it is the older trees that are damaged most.

In the immature swamp species, tamarack and spruce, the damage runs heavier. About 70% of the tamarack has been attacked by the larch saw fly and in some small areas the infestation is so severe that most of the trees are dead or dying. About 15% of the spruce is damaged by insects and fungi, but the attack is not serious enough at present to kill the trees.

Special Uses

There are numerous lakes, large and small, that in places have good possibilities for recreational purposes and are being used for such in a limited way.

There is very little game within about two miles of the main highways, but the remainder of the highland is well-stocked with deer. The swamps have practically no game at present, but are well adapted to moose and caribou. The lakes, within and adjoining the area, are natural resting and feeding grounds for all waterfowl.

The whole area, if kept tree clad, is valuable for the protection it affords part of the watershed, near the head of the Mississippi River. The swamps are great natural water retaining areas for regulating stream flow.

Conclusion and Recommendations

The highland, except on small local areas, has a sandy soil and is of no value for agriculture. It has produced, at least, one good crop of pine, and judging by the amount of reproduction coming in, it is capable of producing valuable timber crops indefinitely. The kind, quality and volume, of timber produced will depend almost entirely on the intensity of the forest management applied to the area.

Planting on the area at this time is not feasible because most of it was logged ten or more years ago and there are only a few small tracts where the ground is not fairly well covered, either by small trees or by brush. For these areas already cutover and restocking, the most practical thing to do, is give intensive fire protection and when the timber nears a merchantable size, work out a cutting program. If a fire occurs and most of the timber is killed, this burned area should be planted at once.

Nearly all of the remaining merchantable timber is aspen and birch. This is deteriorating rapidly and should be cut as soon as possible. It is, for the most part, of such poor quality that it should be sold as soon as a purchaser can be found, but not until provision has been made to plant pine and spruce, on the area, as soon as the aspen and birch are removed.

The area should be kept permanently in forest and none of the state lands sold for agricultural purposes.

The scattered state lands should be consolidated through exchange and purchase, as solid blocks are necessary for the best management and protection.

The Federal Government should own all the swamp lands tributary to Leech and Winnibigoshish Lakes so they could be used as reservoirs for power development and in flood control measures.

Studies on the cost and effect of drainage which are now being carried on to determine if the swamps can be made to produce merchantable timber should be continued.

An effort should be made to market the slow growing spruce in the swamps as Christmas trees.

Cook County Group

Location

The land area considered in this report lies in the east half of Cook County. It includes state land in Twp. 64, R. 1, 2 and 4 E; and Twp. 63, R. 1, 3 and 4 E. of the 4th Principal Meridian.

Climate

The U. S. Weather Bureau Station nearest this group is located at Grand Marais, but this is not an all year station so the data is taken from the station at Winton, located west of the area and at a lower elevation. The Winton station gives the mean annual temperature as 38° Fahrenheit, the mean January temperature as 4.6° F. and the mean July temperature as 68.6° F. The lowest for January is minus 48° F. and the highest for July is 98° F.

The average annual precipitation is 25.58 inches. The average date for the last killing frost in the spring is May 27th and the average date for the first killing frost in the fall is September 22nd. Killing frosts have been known to occur as late in the spring as June 17th, and as early in the fall as September 3rd.

The altitude at Winton is 1,325 ft. and for the region under discussion the mean altitude has been estimated as being 1,550 feet above sea level.

The prevailing wind direction for the year is northwest, but for the summer months it is more west.

Topography

The chief characteristic of the country is its mountainous topography. While the elevations of the hills are not high, if mountain country is considered, the hills with their steep rugged appearance are very noticeable, perhaps because there are no outstanding elevations with which to compare them.

Going north from Lake Superior, which has an altitude of 602 feet, the increase in elevation is very apparent, as is evidenced not only by the climb necessary to get there, but by the late appearance of spring, and the early frosts in the fall.

In this territory, lakes as a whole are large and numerous, and almost invariably lie in an easterly and westerly direction.

The region is entirely within the Lake Superior watershed.

Accessibility

There are no common carrier railroads with in the county, but the General Logging Company Railroad runs north and east from Hornby and passes north through the east side of Twp. 63, and 64, R. 1 west. This places the railroad immediately west of the area under consideration.

State Highway No. 1 follows the shore of Lake Superior, and is from two to twenty miles distant from the different parts of the area considered. There are several good roads extending back from the shore a few miles, and one that runs north from Grand Marais through R. 1 E., and another that runs north from Hovland to McFarland Lake. In addition there are some old tote roads that can be opened and used for sleigh and truck hauling in the winter.

The main outlet for timber will be the General Logging Company Railroad, although from most of the area, it is entirely feasible to haul the logs to some landing on Lake Superior.

There is a good harbor at Grand Marais, which is the largest town adjacent to the area. It has good stores, a post office and a school. Hovland, on Chicago Bay, has a postoffice and store and is about twenty miles northeast of Grand Marais, on the State Highway.

Population and Industries

There are a number of settlers along the shore and inland a few miles, who carry on dairying to some extent. Along the shore the principal industry is fishing.

The value of local agriculture is very small and, within the territory covered by this report, there are no settlers.

Lumbering was carried on quite extensively at one time, mostly near the shore and along the Pigeon River, but for a number of years this industry has been almost at a standstill. Now that the General Logging Company has almost completed its railroad, logging operations in the county will soon be on a large scale again.

In checking over the tax delinquent land in these townships, it is found that a total of 6,720 acres are delinquent, and that nearly all of it went delinquent soon after the timber was cut. Practically no land is tax delinquent where the timber is still uncut.

The Property

In this group of townships, there are approximately 119,680 acres. Of this, 31,040 acres belong to the state (25,357 acres of which have been examined). Seven thousand two hundred forty acres are in lakes, 6,720 acres are tax delinquent, and the remaining 74,680 acres are owned either by private people or by the United States Government.

Of the state land under consideration, 17,419 acres, or 68%, are highland and 7,938 acres, or 32%, are lowland or swamp.

Nearly all of the state land has been set aside as a permanent state forest, and some of it is within the boundary of the Superior National Forest.

Most of the 7,938 acres of lowland consists of peat swamps. Usually the peat is not very deep, but underlaid with solid rock. In a few instances a lowland area is found where the soil is a clay loam or sandy clay, but invariably full of rocks.

The 17,419 acres of highland is rolling to mountainous. Areas free from rocks are very few, and most of the land grades from stony to rock outcrop. Seven thousand eight hundred fifty nine acres are classed as heavy soil, and 9,560 acres as light soil.

TABLE NO. XX

COOK COUNTY GROUP

MERCHANTABLE TIMBER

Twp.	R.	P. M.	Acres	WHITE PINE Bd. Ft.	NORWAY PINE Bd. Ft.	JACK PINE Bd. Ft.	JACK PINE Cords	SPRUCE Bd. Ft.	SPRUCE Cords	TAMARACK Cords	TAMARACK Ties	CEDAR Bd. Ft.	CEDAR Poles	CEDAR Posts	CEDAR Ties	BALSAM Cords	BIRCH Bd. Ft.	BIRCH Cords	BIRCH Ties	ASPEN Cords	Miscellaneous Bd. Ft.	Miscellaneous Cords
64N	4-E	4	4,695	1,892,000	34,000	23,000	.....	700,000	11,669	1,432	10,818	.....	5,842	34,608	10,121	13,453	.....	5,180	2,679	13,092	.....	.....
63N	4-E	4	10,300	1,805,940	8,430	.....	.....	829,320	16,692	457	4,816	.....	30,488	121,077	21,966	28,952	3,000	8,237	14,319	3,551	17,940	122
63N	3-E	4	2,878	1,651,000	.....	.....	3	29,000	5,508	8	3,460	.....	3,460	28,136	22,728	5,604	22,000	4,094	13,737	505	.....	218
64N	2-E	4	1,356	145,000	400	9,000	.....	.....	1,221	.....	214	.....	45	110	130	269	.....	233	150	444	.....	7
64N	1-E	4	4,134	2,405,000	374,000	177,000	.....	.....	3,389	.....	73	.....	1,005	35	546	211	.....	120	104	.....	.....	.....
63N	1-E	4	1,498	93,960	4,960	601,500	5	.....	3,317	2	801	5,150	292	287	1,124	179	.....	172	40	799	.....	.....
Total.....			25,361	7,992,900	421,790	801,500	8	1,558,320	41,796	1,899	20,172	5,150	40,772	184,253	56,615	48,668	25,000	14,036	31,029	18,391	17,940	347

In this region the swamp species are often found on highland as well as in the swamp. All the species are, therefore, included in one table.
On the 25,361 acres there is a total of all species of: 10,824,900 board feet, 125,145 cords, 107,816 ties, 40,772 poles, and 184,253 posts.
On a per acre basis this is: 428 board feet, 4.9 cords, 4.3 ties, 1.6 poles, and 7.3 posts.
Converting all the products to board feet it gives 3,048 per acre.

The area contains numerous large and small lakes, and also many streams, but only few of the lakes are within or adjoining state lands.

TABLE No. XIX
COOK COUNTY GROUP
Area of Soil Types

Twp.	R.	P. M.	Highland Heavy Soils Acres.	Highland Light Soils Acres.	Peat Acres.
64-N	4 E.	4	3,393	.....	1,302
63-N	4 E.	4	3,756	2,739	3,805
63-N	3 E.	4	710	1,289	879
64-N	2 E.	4	.....	1,404	452
63-N	1 E.	4	.....	3,044	1,090
64-N	1 E.	4	.....	1,084	414
Total	.....		7,859	9,560	7,942
Grand Total	.....				25,361 Acres

Most of the land in this group is either rock outcrop or underlaid with rock. Because the outcrop is so prevalent, it is not shown on the map for the group.

The Forest

The original stand of timber in this country was mostly white pine and Norway pine, but a fire burned over large areas about sixty years ago and on these areas aspen, birch and Jack Pine has taken the place of much of the pine.

In the more inaccessible areas where the fire did no damage and where there has been no logging, there are still some very good stands of pine. There is a scattering of good white spruce throughout the highland. The swamps, for the most part, have a fair stand of black spruce mixed with cedar.

Unmerchantable Timber

On the total area of 25,361 acres in this group there are the following amounts of unmerchantable timber: 1,666,000 balsam, 1,065,000 spruce, 762,000 aspen, 515,000 birch, 262,000 cedar, 250,000 jack pine, 33,000 white pine, 8,000 tamarack, 1,000 Norway pine, and 14,000 miscellaneous species or a total average number per acre of 181 trees.

Damage

Balsam, of which there is considerable, is badly infested with the spruce bud worm. There is hardly a large tree within the area that is not affected to some extent and it is not unusual to see acre after acre where every balsam is dead or dying. Undoubtedly within a few years nearly every large balsam will be dead.

The spruce so far is fairly sound, but the bud worm is also working on it.

The white pine is only about 15% defective, aspen about the same, and birch about 25%. Defect has been deducted on all species, but on balsam the loss is constantly increasing.

Special Uses

The northern part of this area contains some of the most beautiful scenery in Minnesota and this scenic beauty can be preserved if the proper logging methods are used.

The summers in the region are cool. The lakes are deep and clear, some of the shores are ideal for summer homes or hotels, and a rapidly increasing tourist trade is being developed.

Game is abundant in the woods. It is not at all unusual to see moose and deer near the main highways. Bear, beaver and wolves are also quite numerous but not so often seen. The many lakes and streams are well stocked with fish.

Conclusion and Recommendations

None of the land within the area has any real value for agriculture. The tillable areas are very small, the growing season is too short, and there are too many rocks to make farming profitable. Roads are few and the land is too far from markets.

Most of the land, both highland and lowland, is producing valuable timber, and with the proper management can be made to produce a greater volume per acre.

It is fairly inaccessible and for that reason has been more free from fire than most parts of the state. The rocky and hilly nature of the soil and country makes it unsuited for agriculture, but it is suited to forest production.

The area covered by this report is only a small part of the state land in Cook County. A complete inventory of the remaining state land and timber should be taken before a cutting plan showing the annual cut can be made.

Where there are pine and spruce the selective method of cutting should be used, removing all other species first and giving the pine and spruce an opportunity to reseed the area.

When cutting is being done, care should be used to leave the scenic beauty as nearly intact as possible. Only dead and dying trees should be cut near lakes and roads.

The State should consolidate its holdings by exchange and purchase. No State land within this group should be sold for agricultural purposes.

The State should cooperate in every way with private owners to get them to cut on a selective basis.

Orr Group

Extensive Survey

The state land in this report lies within:

Twp. 61 N and 62 N R. 17-W 4 P. M.
Twp. 63 N R. 19-W 4 P. M.
Twp. 63 N and 64 N R. 20-W 4 P. M.
Twp. 63 N and 64 N R. 21-W 4 P. M.

All are in the northwest part of St. Louis County and are contiguous to the present State Forest.

Climate

The data on climate is used as given by the United States Weather Bureau Station at Virginia, located about 50 miles south of Orr.

The mean temperature for January is 5.4° Fahrenheit, for July 65.8° F. and for the year 37.6° F. The highest temperature on record is 101° F. and the lowest is —45° F. The average date of the last killing frost in the spring is May 30th and the average date of the first killing frost in the fall is September 12th. Killing frosts in the spring have occurred as late an June 23rd and as early in the fall as August 18th.

The prevailing wind is northwest and the average annual precipitation is 28.92 inches.

As the above figures show, the growing season is very short and the summers cool. This condition is a serious handicap for the growing of farm crops.

Topography

The topography is level to hilly, but there are numerous steep hills throughout the entire area. Nearly all the land under cultivation is level to rolling.

The drainage is mostly to the northwest by way of the Littlefork River and its tributaries, but a small part of the country drains into Pelican and Vermilion Lakes.

Accessibility

The Duluth, Winnipeg and Pacific Railroad runs through Twp. 63, R. 19, from southeast to northwest. State Highway No. 11 runs north and south close to the line between Range 19 and 20. Good county roads are numerous in all parts of the area except where the largest blocks of state land are found and in the south half of Twp. 61, R. 17.

The General Logging Company is building a winter logging railroad from Gheen west and north into the Bois Fort (Nett Lake) Indian Reservation.

The Littlefork River runs through part of the area and has been used for driving logs for many years.

The towns, Orr, Gheen, Cook, Leander and Angora are within or close to the area and in addition there are inland stores and one post office in the largest settlement. Each of the towns has a school, post office and stores. There are consolidated schools, one in the north central part of Twp. 63, R. 21 and one on the north side of Twp. 62, R. 20. There are several smaller schools, and where there is no school nearby, arrangements have been made to take the children by bus to the nearest one.

Population and Industries

There are settlers in all these townships but only a few in some of them. Twp. 63, R. 21, has by far the most, and Twp. 64, R. 20, comes next in population. Some of the farms have fairly large clearings and good looking buildings, but when it comes to crops raised the outlook is not so bright, as hay and garden truck are the only crops of real value. Some small fields of grain are found in places, but whatever the cause, ancient methods of harvesting are still used on most of the farms. In going through this part of the country, it is a common sight to see men and children harvesting grain with small hand sickles and tying it by hand. On over half of the farms looked over, the hay was cut with a hand scythe and raked into windrows by hand. In one instance, on a ten acre field less than a mile from Gheen, it was noted that three men with large wooden rakes were patiently raking the hay into windrows.

On inquiry it was found that practically every settler made part of his living by working in the woods, on the roads, or some other way not directly connected with the farms.

The state lands in four townships of this group, namely: Twp. 61 and 62, R. 17; Twp. 63, R. 19; and Twp. 64, R. 20, are for the most part not suited to agriculture. They have a large proportion of swamp and most of the highland is sandy, stony, or with rock outcrop. These have also fewer settlers than the others. The other three, Twp. 63, R. 20 and 21, and Twp. 64, R. 21, have a fair clay soil, good settlements, roads, and other improvements. Twp. 64, R. 21, is partly within the Bois Fort (Nett Lake) Indian Reservation,

TABLE No. XXI
ORR GROUP
Ownership and Tax Delinquent Lands

Twp.	R.	Total Area Acres.	State Land Acres.	% State Lands.	Total Private Land Acres.	% Private Land.	Private Land Paying Taxes.	% of Private Land Paying Taxes.	Tax Delinquent Land Acres.	% of Taxable Land Delinquent.	Total Land Not Paying Taxes.	% of Total Not Paying Taxes.
61	17	23,040	4,840	21	18,200	79	11,120	62	7,080	38	11,920	51
62	17	20,800	10,800	52	10,000	48	7,320	73	2,680	27	13,480	65
63	19	22,880	3,960	17	18,920	83	15,520	82	3,400	18	7,360	32
63	20	23,040	8,680	38	14,360	62	11,200	78	3,160	22	11,840	51
64	20	17,360	4,120	23	13,240	77	10,400	79	2,840	21	6,960	40
63	21	21,240	5,840	27	15,400	73	13,800	90	1,600	10	7,440	35
64	21	13,600	6,480	47	7,120	53	5,640	80	1,480	20	7,960	58
Total		141,960	44,720	31	97,240	69	75,000	77	22,240	23	66,960	47

but only the land outside the reservation is considered.

The Property

In this area there are about 44,720 acres of state land. Of this 27,840 acres, or 65%, are swamp. Of the 16,880 acres of highland about 10,000 acres are potentially agricultural.

The soil in all this territory is primarily glacial drift and varies from pure sand or pure clay loam to a mixture of the two, with or without rocks. Twp. 63, R. 20, and Twp. 64, R. 21, contain nearly all of the good soil on state land. It is a clay loam and much of it is free from stones. The remaining highland in these townships and in the others is either too stony or too sandy to have any present or future value for farming.

Most of the highland timber still uncut is aspen. In places this is mixed with balsam, white spruce, jack pine, balm of Gilead, and some scattered Norway and white pine. The aspen on nearly all the area is about sixty years old and will run about 2,000 board feet per acre. The other species are about the same age, except some Norway and white pine. Apparently a fire swept over nearly all of the highland 60 to 70 years ago and all that survived were a few old pines, and most of the swamps. The aspen and balm of Gilead are mature and deteriorating, but the other species are all thrifty.

On a small part of the swamps there is still some very good spruce that has not been cut, but for the most part the swamps are stocked with black spruce too small to be merchantable. Some of this spruce is thrifty and growing fast, but some is old and will never attain merchantable size unless the environmental conditions are changed.

Damage

Some years ago the aspen in this group was badly infested with leaf eating insects. As a result, much of the aspen has dead tops and the boles of the trees are so decayed that they are worthless for anything except cordwood. On the whole area about 50% is defective.

The other species are fairly sound except some of the black spruce, which is over mature. The white spruce on the whole area does exceptionally well. It is sound and grows rapidly.

Special Uses

Parts of Pelican and Vermilion Lakes touch this area. Some of the shore line on these lakes is suited to summer home sites, and is being developed as such, but very little of the state land within this group has any such value.

Deer are fairly numerous in the most unsettled areas and there are a few beaver in some of the streams. Pelican Lake affords good duck shooting.

Township 61, Range 17

In the whole township there are only 9 settlers and four of these are in the extreme northwest corner.

Most of the state owned highland has been cut over and burned repeatedly, so instead of the original stand of pine, this area is now partially covered with a young growth of aspen, birch, pin cherry and hazel. The soil is sandy with numerous rocks and rock outcrop.

Most of the swamps are shallow and have produced a good stand of spruce mixed with cedar. Practically all that was merchantable has been cut, but a fair stand of spruce, balsam and tamarack is coming in since the cutting.

The state land is unsuited to agriculture and is recommended as a permanent state forest.

Township, 62, Range 17

Most of the settlers are in the west central part of the township and some of the farms have good buildings. The topography, on the whole, is rolling and there are some steep hills in the northeast corner near Lake Vermilion.

About 90% of the state land is swamp. Sections 7 and 8 have a good stand of uncut black spruce on a large part of the land. The spruce is from 75 to 200 years old and in the best stands will run 15 cords to the acre. The oldest should be cut in the near future.

Sections 19 and 20 are mostly swamp, but the peat is shallow and there are some islands of higher land. The timber is spruce, balsam and aspen mostly about 70 years old. It is thrifty except the aspen, which should be cut soon and the area planted to white spruce.

Sections 28, 29, 30, 31, 32 and 34 are mostly swamp. All the merchantable timber has been cut and the area is coming back to spruce and tamarack. The southeast corner of the township is all swamp and carries a good stand of young spruce about 60 years old.

The soil on the highland is mostly clay loam, but very stony or with rock outcrop. In Section 16 there are about 200 acres which are comparatively free from rocks.

On the whole, the state land is more valuable for timber production than for farming and is recommended as a permanent state forest.

Township 63, Range 19

All the settlers in this township are near Gheen or Haley. There are a few well developed farms, but the farmers make a large part of their living at other work.

The state land is very rough and for the most part stony. The soil is mostly sand and gravel mixed with clay, in fact, it is typical glacial drift. The swamps have produced some good spruce, except in sections 11, 12, 16 and 17 where it is too wet and the peat too deep to produce anything but a dwarfed growth.

The highland has produced a very good crop of pine and some pine reproduction on the higher hills and on the sand ridges is growing fast and promises a partial crop in the future. Most of the highland, however, has a good stand of aspen, birch and balsam reproduction about 20 years old.

All the state land is more valuable for forest production than for agriculture, and is recommended as a permanent state forest.

Township 64, Range 20

The state land in this township is about half highland and half swamp. In some of the

swamps the peat is so deep and wet that only a scattered stand of dwarf spruce is found. From this it grades up to land with very shallow peat and a good stand of spruce.

Sections 16 and 36 have most of the highland. In 36 the soil is a clay loam except the southeast corner, where it is very gravelly. Most of the section is stony. Section 16 is rolling, with very stony clay loam soil. It has been cut over three times but still carries a good stand of unmerchantable aspen and birch.

There is not much mature timber left in the township. Section 36 has some mixed hardwoods and conifers but they are scattered and of very poor grade. Section 35 has a little mature spruce left. Sections 33 and 34 have some spruce and aspen that has not been cut.

The state land is better suited to timber production than to farming and is recommended as a permanent state forest.

Township 63, Range 20

Parts of this township are well settled, but most of the land is still unoccupied. There are some good roads and nearly all the settlers are close to them. The land is mostly clay loam and comparatively free from rocks, except Sections 16 and 36.

Of the state land, Sections 16, 36, and the south half of 33 are the poorest from the standpoint of agriculture on account of the extensive rock outcrop. The swamps in sections 14, 22 and 23 are rather wet and the spruce is not of merchantable size.

Only a very small part of the merchantable timber has been cut. Aspen predominates as on all the highland but is usually mixed with birch, balsam, and balm of Gilead. Section 16 has poor aspen, but white pine seems to be growing well. Section 36 has been cut over and is restocking to pine, birch and aspen. Data gathered indicate that white spruce, aspen and jack pine can be grown on a 50-60 year rotation. Due to the rapid tree growth possible and the large amount of private land still undeveloped, it is recommended that all the state land be set aside as a temporary state forest, to be managed as a state forest until such time as all the private land is developed.

Township 63, Range 21

This township has good roads and is fairly well settled, except the southeast corner which is largely state swamp land.

Nearly all the state land except Section 36 is swamp. Much of the swamp has a good stand of tamarack and spruce reproduction about 20 years old. It is showing good growth but there are no indications that the swamp has ever produced merchantable timber. Section 36 is nearly all highland. In the southeast corner there is a sand ridge with good merchantable jack pine. The remainder of the section has a poor stand of mature aspen that is deteriorating fast. A few Norway pine and white spruce show very good growth. It is recommended that the state land be set aside as a temporary state forest and so managed.

Township 64, Range 21

In this township only 13,840 acres are considered, as the remainder is in the Bois Fort (Nett Lake) Indian Reservation. There are comparatively few roads and only eight settlers. There are five more sets of farm buildings in which no one is living.

Although most of the soil is a clay loam and comparatively free from rocks, the local agriculture is of little value. One settler was asked if he had very much land in crop. He laughed and asked, "What would I do with any crop? I have not been able to get away from the place with a team since last spring before the frost went out. All the crop that I have is about half an acre of barley for chicken feed." Further conversation disclosed the fact that he has nine children, and drives the school bus taking his own children to school.

The 6,480 acres of state land is mostly highland, with a fair stand of aspen still uncut. The soil is a clay loam and much of it is free from stones. Some white spruce on the area reached pulpwood size at 30 years and now at the age of 60 years it is good for saw timber. Although the aspen is deteriorating to some extent, nothing should be cut until provision is made to replant the area as soon as it is cut over, because if it is left a few years after cutting, aspen and alder will take over the ground and planting be made impossible.

The soil is suited to agriculture but is especially well adapted to tree growth. The township is practically undeveloped and far from town and markets. The state land is in a fairly large block and there is much unoccupied private land in this and adjoining townships. It is, therefore, recommended that this state land be set aside as a state forest until such a time as the land is needed for agriculture more than it is needed for forest.

Conclusion and Recommendations

It is recommended:

That the state land in Twps. 61 and 62, R. 17; Twp. 63, R. 19; and Twp. 64, R. 20, being for the most part very stony and unsuited to agriculture, be set aside as permanent State Forests.

That the state land in Twps. 63 and 64, R. 21; and Twp. 63, R. 20, being for the most part suited to agriculture, be set aside as temporary state forests and be managed as state forests until such a time as the privately owned land is utilized to its best advantage.

That no timber be cut on state land until provision is made to replant the areas cut wherever planting is found to be advisable.

That white spruce and Norway pine be used for planting in the three townships set aside as temporary state forests.

Since the timber on most of the state land in the four townships, recommended as permanent state forests has already been cut and is restocking, planting is not believed practical until after the present stand becomes merchantable and the timber is cut.

Miscellaneous Areas

In gathering the data for land classification, only part of the state land in some townships was worked and the area covered was so small that it was inadvisable to make maps showing them. In order to include them in the report, they are assembled under the heading "Miscellaneous Areas," and only a very brief description given.

The following table shows in which townships work was done and the areas of highland and swamp in each.

TABLE XXII

Twp.	Range	P. M.	Highland	Peat
58 N	9-W	4	490	1,670
66 N	16-W	4	50	30
65 N	20-W	4	930	400
66 N	20-W	4	430	210
59 N	21-W	4	15	425
60 N	21-W	4	176	3
69 N	21-W	4	365	85
60 N	22-W	4	1,376	798
69 N	22-W	4	15	40
70 N	22-W	4	184	641
67 N	23-W	4	1,419	1,481
68 N	23-W	4	630	570
67 N	24-W	4	40	
68 N	24-W	4	768	562
70 N	24-W	4	552	88
156 N	25-W	5	30	130
154 N	26-W	5	80	
Total			7,550	7,134

These scattered areas lie in the center of Lake County, the northern part of St. Louis County, the extreme eastern part of Itasca County and in various parts of Koochiching County. The total area is 14,740 acres, of which 7,134 acres is peat swamp, 5,897 acres clay to sandy loam, 1,653 acres sand.

Much of this land has been cutover and burned at least once, and as there are many stones and considerable areas of rock outcrop, the reproduction coming in is nearly all aspen, birch and balsam. On some of the more recent cuttings where pine seed trees were left and the fires have been kept out, there is a good stand of pine seedlings showing up. On the sand areas the same species are coming in as on the other highland, but on the whole there is more pine reproduction on the sand than on the clay. The swamps are coming back to tamarack and spruce where the alder and bog birch is not crowding them out.

On the average, the cutover areas have enough trees to be half stocked, but it is not uniform. In some places the stand is too dense and in other places there are no young trees.

Section 16, Twp. 70, R. 24 is the only area of any size where the soil is suited to agriculture. The soil is a clay loam almost entirely free from stones. It is rolling and well drained, except the SE¼ SE¼, which is nearly all swamp.

The fact that it is on State Highway No. 4 and only about 3 miles from International Falls gives it the additional value of a good road and a nearby market.

Part of Section 36, Twp. 68, R. 24, and parts of sections 15, and 16, Twp. 67, R. 23, have soil that could be used for farming, but the areas are small and there are no summer roads, so for the present, at least, it should be all considered forest land.

In Twp. 68, R. 23 the soil is a clay loam grading to sandy loam. In most places it is very stony and there is some rock outcrop. The land is also badly cut up by swamps so the agricultural value is almost negligible.

Boundary Survey Report

During the summer of 1928 a survey was made of the state land along the Canadian boundary starting at Gunflint Lake in Cook County and continuing west through Gneiss, Maraboeuf, Sea Gull, Saganaga, Knife, Ensign, Newfound, Basswood, Crooked, and Iron Lakes, and to the east end of Lac LaCroix in St. Louis County.

The oject was to classify this land and to get an estimate of the timber and reproduction on the land bordering on the boundary's waters and to ascertain the damage that would be done to said timber and to summer homesites if the water in these lakes were to be raised. All computations for damages in the report are based on a fifteen-foot raise of water level on each lake.

In this territory there is only one road extending to the border waters. This is Gunflint Trail from Grand Marais to Gunflint Lake. The boundary waters can also be reached by canoe or boat from Winton on Fall Lake and from Crane Lake Post Office on Crane Lake. A road is being completed that will end at Sea Gull Lake. This is an extension of the Gunflint Trail.

Winton is on the Duluth and Iron Range Railroad and has good stores, post office, school and good roads. There is a store at Crane Lake Post Office on Crane Lake. The nearest town is Orr, on the Duluth, Winnipeg & Pacific Railway, about 32 miles distant.

There are numerous portages between the lakes on the boundary and on some of them, boats can be taken across on tramways. On most of the lakes, canoes must be used and carried across the portages.

The topography is rough and mountainous. The soil is almost 100% rock outcrop with a thin layer of sandy loam and humus on the rocks where it has not been destroyed by fire and subsequent rains.

Game is very abundant in most of the area and the fishing is some of the best in the state. Some of the sections around Newfound, Sea Gull, Knife and Ensign Lakes have been burned so hard that all the cover has been destroyed and here the game is more scarce. The entire area is within the Superior Game Refuge.

The following townships still have considerable merchantable timber: Twp. 66, R. 4 and 5; Twp. 65, R. 5; Twp. 66, R. 11 and 12; Twp. 66 and 67, R. 13. There has been little or no timber cut on the state land bordering the lakes in these townships. The remaining townships (Twp. 65, R. 6; Twp. 64, R. 8; Twp. 65, R. 8; Twp. 64, R. 9; Twp. 64, R. 10; Twp. 65, R. 10; Twp. 64, R. 11; Twp. 65, R. 11) have all been cut over and severely burned. This area is tributary to Winton and was logged from 10 to 20 years ago by the Swallow-Hopkins and St. Croix Lumber Companies, that had mills at Winton.

None of the lands examined have any value for agriculture either now or in the future. Their greatest value is for forest production and recreation in its various forms. The lands that have not been burned over have a good stand of timber and much of the lake shore is valuable for public camp grounds and summer homesites.

Summary

The following tables give a total for the whole area examined along the boundary with estimates of the total damage to timber, reproduction and cabin sites that would be caused by a 15-ft. raise of water levels in the lakes on which the land borders.

Merchantable Timber on Whole Area

	Bd. Ft.		Cords.	Ties.	Poles.	Posts.
White Pine	342,930	Aspen	9,183	...	...	...
Norway Pine	1,326,890	Jack Pine	13,387	...	...	...
Jack Pine	1,065,860	Spruce	6,232	...	...	...
Aspen	7,000	Balsam	501	...	...	...
Spruce	15,000	Birch	192	121	...	...
		Cedar	.....	95	670	360
		Tamarack	35	180	...	...
Total	2,757,680		29,530	396	670	360

Merchantable Timber Subject to Damage

White Pine	79,850 Bd. Ft.	Jack Pine	2,082 Cords	80 Birch Ties
Norway Pine	356,890 Bd. Ft.	Spruce	513 Cords	100 Cedar Posts
		Balsam	34 Cords	
		Aspen	1,348 Cords	
Total	436,740		3,977 Cords	

If the merchantable timber is given an assumed value of $4.00 per thousand and $1.00 per cord, the total damage that would be done should the water level in these lakes be raised 15 feet, is as follows:

Cabin Sites	$83,250.00*
Reproduction	17,038.75†
Timber	5,723.96
Total	$106,012.71

*The lakeshore, wherever it is suited to summer homesites, has been divided into lots with 100-foot frontage on the lake and each lot valued at $250. (Lakeshore lots rent at from $10 to $15 per lot, and $10 capitalized at 4 per cent interest gives a value of $250.)

†The schedule used in determining the value of the reproduction that would be damaged is the one used in determining fire damage. (Given in State Forest Service "Manual of Instructions.")

Statement of Expenditure

Appropriation		$35,000.00
Salaries and Wages.....	$23,829.98	
Travel and Subsistence..	6,706.95	
Equipment	1,895.79	
Stat'y, Office Supplies....	298.73	
Freight, Express and Drayage	121.45	
Team and Truck Hire...	56.20	
Printing Report, Engraving Maps, etc., (Estimated)	1,900.00	
Balance	190.90	
Total	$35,000.00	$35,000.00

A total of 311,408 acres of state land are covered in this report. Of this amount 25,357 acres were examined in Cook County in the winters of 1924-25-26 and 27, and it was paid for out of the appropriation "Experiments New State Forest." These examinations cost from $.158 to $.21 per acre, and includes the field work only. The reason that this cost is high is the rough character of the country worked and the scattered location of the state lands.

The examination of the 286,051 acres under Chapter 248, of the Session Laws of 1927, was done at a cost of $.12 per acre. This includes all of the field work; the compilation of the same; the making of the maps; and the printing of the report. In this cost, equipment is charged in full. The equipment is available for future work and only 20% should be charged to this work.

The crews on this work with the exception of four temporarily employed men, consisted of regular forest service employees who worked on land classification during periods of low fire danger and during the fall and winter months. By transferring regular personnel to the land classification budget it provided employment for more year around men, and saved on the regular fire prevention budget.

The State of Michigan has conducted an economic land survey at a total cost of 2¼ cents per acre for field work only. This does not include contributed work. The work in Michigan included all lands whether privately or publicly owned. The Minnesota Land Classification covered only state lands which were scattered and naturally increased the costs.

P. S. Lovejoy—"Theory and Practice in Land Classification," reprint from—"The Journal of Land and Public Utility Economics," April 1925, Page 170. "Total costs of the field work, not including contributed work for which the Survey does not pay, are running about 2½ cents per acre."

H. J. Andrews—"Land Economics Survey" in "Biennial Report," 1923-1924, Department of Conservation, Michigan, Pages 92 and 93. "Cost per acre for field work, 2.49 cents to 6.5 cents. This does not include salaries of workers furnished by cooperating organizations. These figures do not include the cost of winter office work on the maps and reports."

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