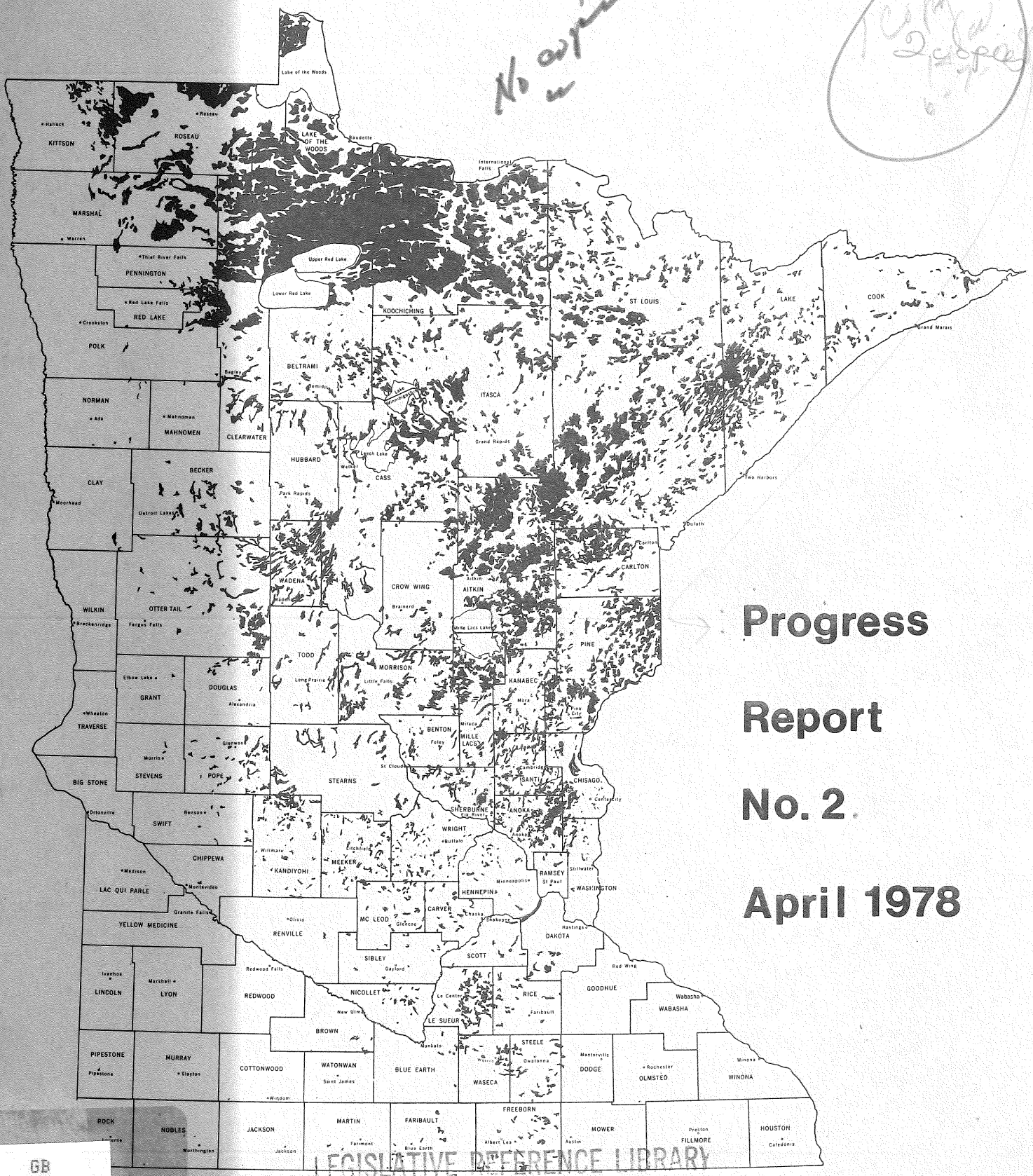
PEAT PROGRAM

1978-1979 BIENNIUM LEGISLATIVE APPROPRIATION



Progress Report No. 2.

April 1978

DEPARTMENT OF NATURAL RESOURCES

MINNESOTA PEAT PROGRAM PROGRESS REPORT
APRIL 1978

Submitted by the
Minnesota Department of Natural Resources

Funded by the
Minnesota State Legislature
(1978 - 1979 Biennium)

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PEAT PROGRAM PROGRESS REPORT

1978 - 1979 Biennium Legislative Appropriation

FOREWORD

The studies in this part of the Peat Program are complementary, as well as supplementary, to those funded by the Upper Lakes Regional Commission in the Phase II -- Peat Program.

These studies cover such areas as water resources of peatlands, the importance of peatland habitat to wildlife, forest and agriculture reclamation of peatlands, and the potential impact of peat development or non-development on, or adjacent to, the Red Lake Indian Reservation. The results of these studies will provide information necessary for the formulation of a policy governing the management of state peatlands.

Water Resources of Peatlands (Dr. Ken Brooks, University of Minnesota)

TASK 1: SELECT STUDY AREAS

Enclosed are copies of maps showing the three study areas previously selected:

Corona Bog - Harvesting Operation
Fens Bog - Reclamation
Toivola Bog - Natural Bog

In addition, it has been decided to study a natural bog in the Red Lake area to determine differences in hydrology and water quality between northwest and northeast Minnesota and also to obtain baseline water quality data. The Tamarac River was selected as a stream representative of peatland watersheds in the Red Lake area. This watershed drains a portion of the Minnegasco lease application area into Upper Red Lake. Based upon a reconnaissance of this area, the Tamarac River will be gauged at the intersection of section 8, 9, 16, and 17, T154N, R29W located about nine miles upsteam from Upper Red Lake.

TASKS 2 and 3: FIELD INSTRUMENTATION

The following instrumentation has been installed at each respective study area:

Toivola Bog

20 - water table wells
60 - piezometers
outlet gauging station
recording well
weather shelter
recording precipitation
11 - non-recording precipitation
recording temperature (ambient air and peat)

Corona Bog

10 - water table wells
1 - recording well
recording precipitation
3 - non-recording precipitation
2 - ditch outlet gauging station
weather shelter
recording temperature (ambient air and peat)

Fens Bog

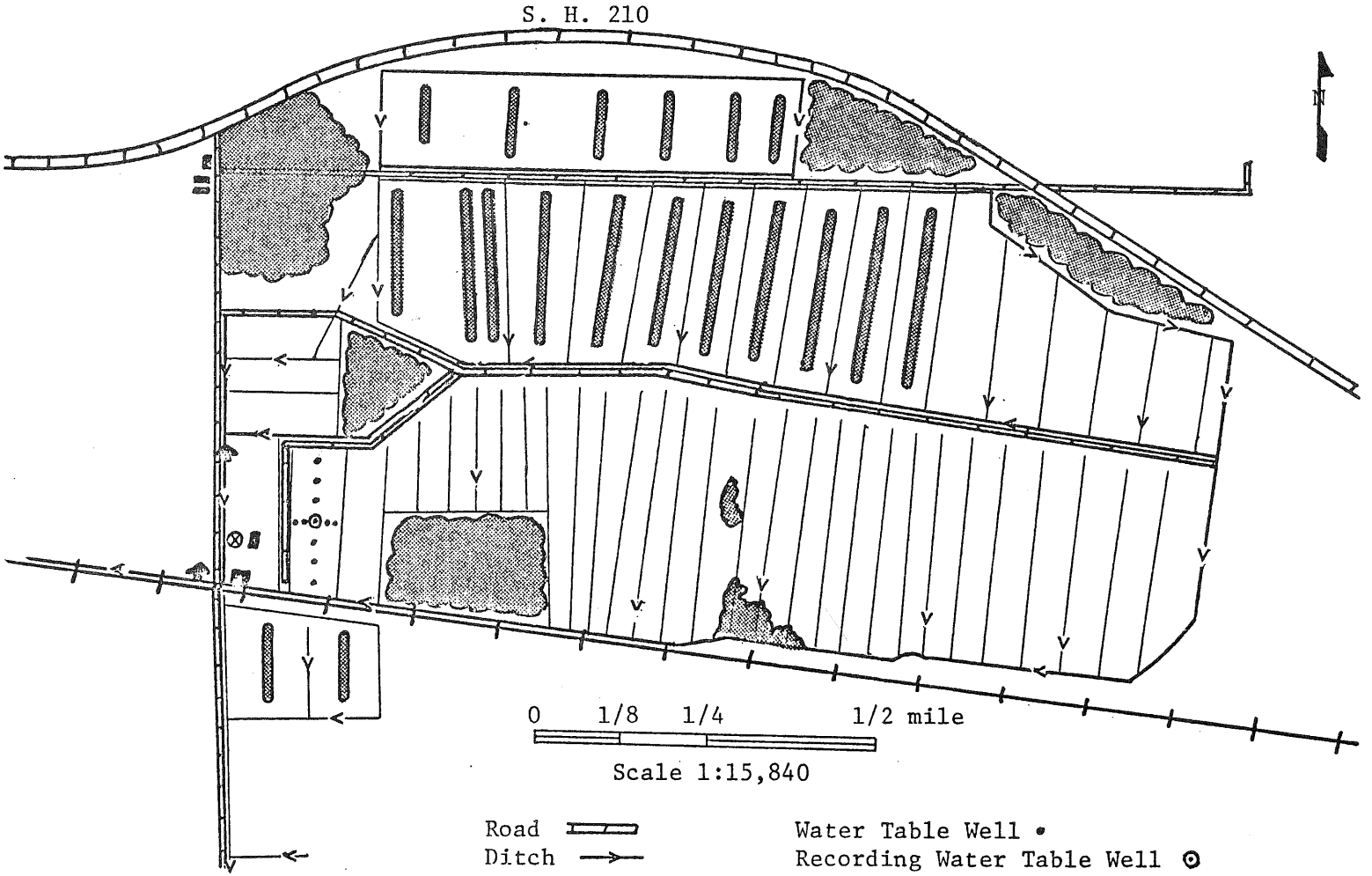
1 - ditch outlet gauging station

Tamarac River

None

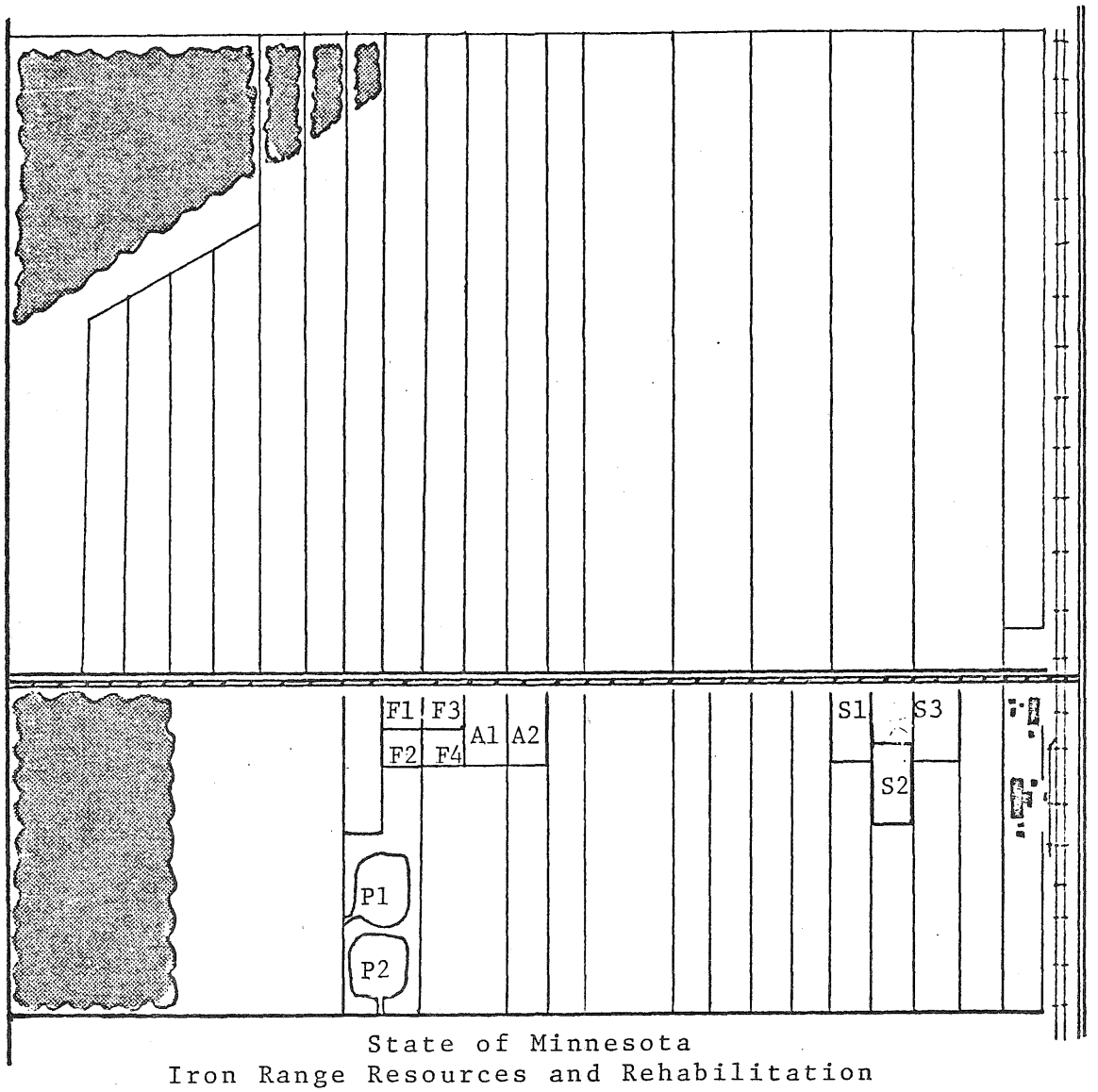
TASK 4: REVIEW LITERATURE

The project team is continuing to accumulate and review the literature pertaining to peatland hydrology and water quality. Presently, efforts are being directed toward literature reviews of humic acids and certain heavy metals.



CORONA BOG HARVESTING OPERATION
MICHIGAN PEAT COMPANY

CROMWELL, MINNESOTA
T48N, R19W



State of Minnesota
Iron Range Resources and Rehabilitation

AGRICULTURE EXPERIMENT STATION AT FENS

TWP 55 N RGE 18 W St. Louis County

Miles

0 1/8 1/4 1/2

N

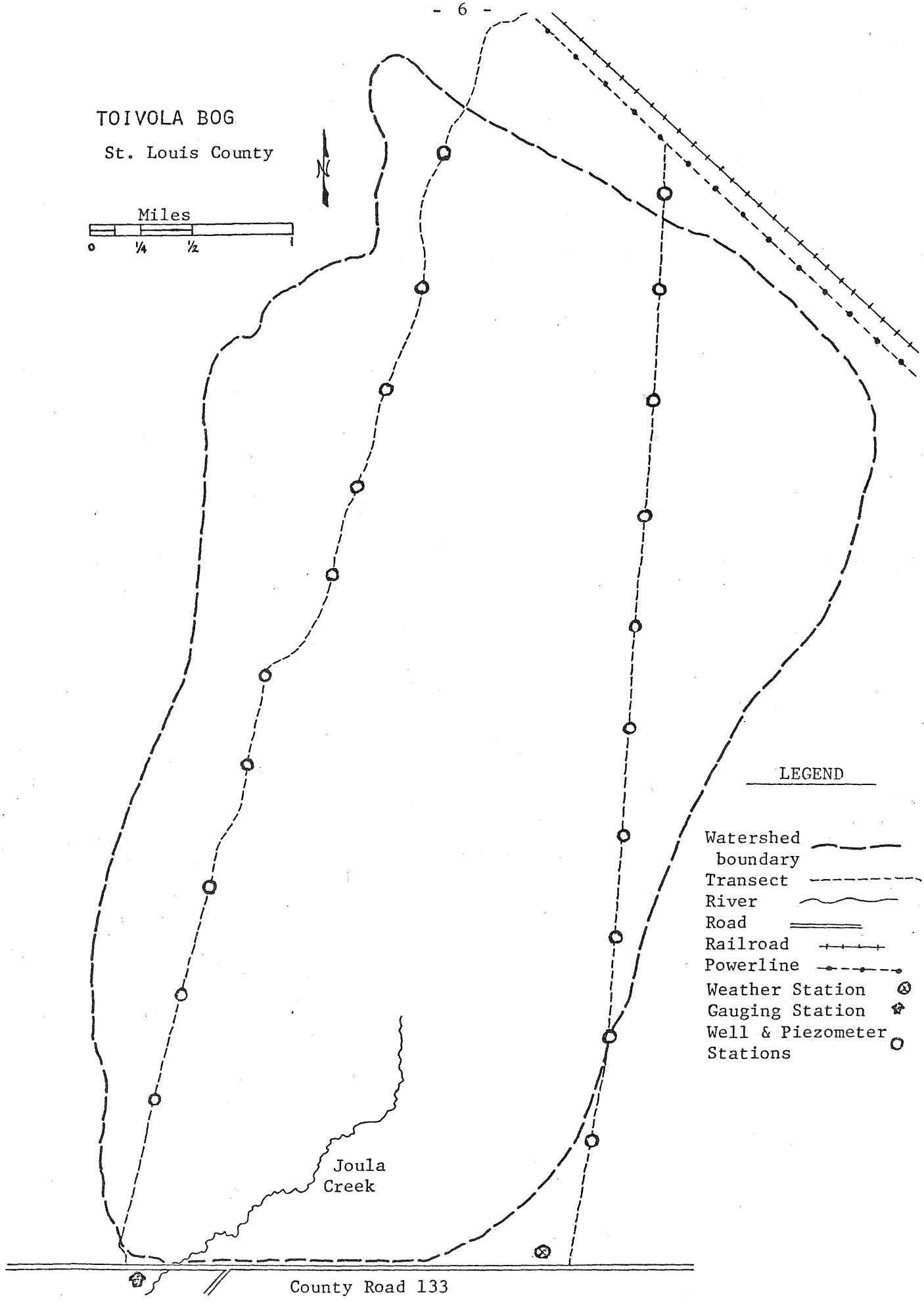
Drainage Ditch
Undeveloped Forest Area
Railroad
Building
Road

C= Control Plot
P= Pond
1. Mined to Mineral Soil
2. Mined to 1 Foot Peat

F= Forestry Plots
1. Unmined, unfertilized
2. Unmined, fertilized
3. Mined, unfertilized
4. Mined, fertilized

A= Agriculture Plots
1. Mined
2. Unmined

S= Sewage Application Plots
1. Finnish
2. Peat-Sand
3. Sludge


TOIVOLA BOG
St. Louis County
N
Miles
0
¼
½
1
LEGEND
Watershed boundary
Transect
River
Road
Railroad
Powerline
Weather Station
Gauging Station
Well & Piezometer Stations
Joula Creek
County Road 133

TASK 5: COLLECT FIELD DATA

Water quantity and water quality measurements began at Corona and Toivola bogs on January 13, 1978. Continuous readings of precipitation, air temperature, and peat temperature have been taken since that time. Weekly measurements of discharge were made until March 3, 1978, when gauging stations were converted to continuous recording. Weekly measurements of 30 water quality parameters have been made since January 31, 1978. Included in the list of water quality parameters being measured are:

temperature	zinc
pH	copper
specific conductance	boron
dissolved oxygen	molybdenum
color	lead
acidity	nickel
alkalinity	chromium
suspended sediments	cadmium
potassium	cobalt
calcium	strontium
magnesium	selenium
iron	mercury
sodium	total - nitrogen
manganese	total - phosphorus

Results of this sampling will be reported in the next quarterly report.

Three snow surveys were taken at each of the three study areas. Measurements were taken both directly on the study areas and on adjacent forested natural peatlands to evaluate the effects of clearing and harvesting peatlands on snow accumulation and melt. The snow measurements are presently being statistically analyzed.

As part of the overall effort to evaluate the effects of harvesting peatlands on water quality, the project team investigated the VARI-NIP press demonstration of "slurry peat" harvesting in the Red Lake bog and obtained water quality samples. The complete results of that investigation are given in the enclosed Table. Parameters that increased in concentration after pressing (i.e. discharge) are noted by an asterisk. Although these results must be considered as preliminary, the potential of increasing concentrations, especially nutrients, does exist and should be further evaluated.

TASK 6 - 9:

These tasks have not been initiated at this time. They include development, testing, and refining the hydrologic model and preparing the final report.

VARI-NIP PRESS DEMONSTRATION

Conducted 10/14/77

Water Quality Analysis

Parameter	Pond	Upstream Ditch	Discharge
Temp (^{o}C)	8	6	8
*pH	5.7	6.7	7.2
*Spec. Cond. µMhon/cm	41	76	107
*Ca mg/l	7.99	19.18	30.64
Al mg/l	0.23	0.12	0.25
*Na mg/l	1.79	2.22	2.40
Zn mg/l	1.22	0.29	0.20
*B mg/l	0.22	0.02	0.07
Ni mg/l	N.D.	N.D.	N.D.
Cd mg/l	0.02	0.01	0.02
*K mg/l	2.87	2.89	3.87
*Mg mg/l	5.71	9.25	10.05
*Fe mg/l	0.15	0.21	0.48
*Mn mg/l	N.D.	N.D.	0.13
Cu mg/l	0.08	0.02	0.08
Pb mg/l	0.12	0.15	0.15
Cr mg/l	N.D.	N.D.	N.D.
Co mg/l	0.05	0.02	0.04
*Total P mg/l	0.03	0.06	0.47
*Total N mg/l	0.8	0.8	16.4

Note: Perco 721 was used
N.D. = not detectable
* = parameters increasing by pressing

John Clausen
Peat Research Hydrologist
Minnesota DNR

The Importance of Peatland Habitats to Small Mammals in Minnesota (Dr. Elmer Birney, University of Minnesota)

PROGRESS OF STUDY:

Work on the peatland small mammal study during the past quarter (January - March, 1978) has been concentrated in two areas: 1) laboratory analysis of data from the 1977 field season; and 2) preparatory work for 1978 field work.

The previous field work (August - November, 1977) involved a state-wide survey of the distribution, density, and habitat selection on small mammals found on and near peatlands.

Information currently being gathered from each specimen collected during the survey includes standard external measurements, age, sex, condition of pelage, condition of the reproductive tract, and stomach contents. The majority of animals are injected with formalin and held in liquid preservative. Skins and skeltons of some specimens are prepared for permanent preservation and availability in the Bell Museum of Natural History, University of Minnesota. These include representative specimens of adult males and females of every species collected in a given region, as well as all specimens of the pigmy shrew (Microsorex hoyi), bog lemming (Synaptomys spp.), meadow jumping mouse (Zapus hudsonius), and short-tailed weasel (Mustela erminea).

Except for the sedges, most plants found in the peatland habitats surveyed have been identified to species. Dr. Thomas Morley, Department of Botany, University of Minnesota, assisted by confirming identifications. Peat samples collected from the survey have been analysed for pH and water content. Final classification of the peat will be made with the help of Dr. Rouse S. Farnham, Soil Science, University of Minnesota.

Field work in 1978 will involve both a second state-wide survey and an intensive study of small mammal populations at a single location. Work on this aspect of the project has concentrated on preparations for the intensive study, involving review and selection of a study site with living accomodations, and logistics (eg. field vehicles, traps, field gear, etc.).

The emphasis of the intensive study will be to provide information concerning the stability or instability of small mammals with regards to: 1) habitat utilization and local distribution; 2) population structure of each species; and 3) structure and composition of the small mammal communities in various peatland habitats. Data will be gathered by means of live and kill trapping for one year. The study area for the intensive study must include readily accessible, representative examples of most major peatland vegetational habitats and peat types within a relatively small area. From the previous survey of the northern peatlands and from discussions with Drs. M. L. Heinselman and H. E. Wright, Jr. of the University of Minnesota, the Lake Agassiz Peatlands Natural Area, Koochiching County, has been chosen tentatively for the intensive study site.

Because the research will involve field and laboratory work, living accomodations suitable for year-round occupation, including laboratory work space, water, and electricity, are being sought. Negotiations for the use of a building at the Dentaybow DNR station are in progress.

FUTHER WORK:

Further autopsies of specimens and preparation for the intensive study and the second survey will be continued into the next quarter. Field work will begin late spring for the intensive study and mid-summer for the second survey.

Bird Population Structure and Seasonal Habitat Use as Indicators of Environmental Quality of Peatlands
(Dr. Dwain Warner, University of Minnesota)

PROJECT NATURE AND OBJECTIVES:

This study is designed to obtain quantitative data on the population structure of bird species that utilize resources of the several vegetation types growing on major peat deposits in Minnesota. All types of population are included: migrating birds, non-breeding season (migrant) residents, permanent residents and breeding season (migrant) residents.

Both plot transects and line transect census techniques are in the planning stage and equipment for them has been ordered, including banding and color marking supplies and radios. Methods for determining resources use applicable to birds in bog habitats are nearly finalized for the intensive, large scale, study period from April 1 through October, 1978 and 1979.

Extensive survey of literature pertaining to birds in peatlands reveals that almost nothing is known about the subject. The literature review on all aspects of peatland structure and ecology is continuing.

PERSONNEL:

As of this date the field crew initiating the intensive phase of bird studies on April 1 will consist of 10 people. Five of these are doctoral students. Bruce Fall will be obtaining data for his doctoral dissertation; and three others anticipate developing their thesis research projects on peatland bird studies during this summer.

The fifth graduate student, Douglas Wells, will be arriving from Arizona State University to direct the project in the field (see below).

Four of the five other field assistants are experienced beyond the B .S. degree; one will receive the B.S. degree this summer.

LITERATURE SEARCH AND REVIEW:

Pertinent literature has been reviewed; but the search continues for sources of other relevant information. Copies of important literature are sent to the field station.

STUDY SITE SELECTION:

During this quarter site selection surveys for the spring-summer-fall period were intensified. With assistance from DNR personnel and bog experts at the University of Minnesota the bog areas most accessible from Waskish were chosen.

At Waskish arrangements have been made with the DNR for living and laboratory facilities. The project team is especially indebted to Merlyn Wesloh and his staff at Region Headquarters of the DNR and to Howard Latvala and Roger Lueth for their generous assistance. Roger Anderson, Area Forester at Waskish, has also been very helpful.

From air photos and maps numerous potential study sites have been selected. Some of these have been investigated on foot; the rest will be surveyed on foot and from the air in early April. The sites will include four areas of differing forest types for intensive study and approximately 15 strip census transect sites in all types of vegetation on peatland and adjacent mineral soils.

STATUS OF DATA GATHERING AND PROCESSING PROCEDURES:

1. From mid-November to March 15 two people, working out of Norris Camp, made winter bird censuses by two methods: a) driving a series of road transects at regular intervals and b) walking (on snowshoes) four 400 m. transects in relatively uniform vegetation:

   semi-open bog (bog birch, willow, tamarack; ht. 0-1.5 m.)
   mature tamarack (ht. 10-15 m.)
   open bog (bog birch; ht. 1 m.)
   mature black spruce (ht. 10 m.)

   Other activities included: integrating weather data with field observations; establishing carrion feeding stations and observing bird use of them; detailed mapping and photographing transect sites; and specimen preparation.

2. The spring-summer-fall study period will begin Arpil 1. Equipment has been ordered and much of it delivered.

   In January the principal investigator conferred with Drs. Robert Ohmart and Bertin Anderson at Arizona State University and investigated their field methods and data processing system used on their Colorado River studies. Their systems would fit our bog studies nearly perfectly; and they have offered to process our data, using their thoroughly tested computer programs. They will also keypunch the computer cards from our field data sheets -- all without charge.

   In addition the head of their field crew, Douglas Wells, has been accepted into our graduate program; and he will head the field phases of the bog project beginning April 1.

Their techniques and data applicability have been published in the symposium, "Importance, Preservation and Management of Riparian Habitat", USDA Forest Service, General Technical Report RM-43, 1977, pp. 146-155. The system obtains quantitative data on plants, vegetation structure, bird ecology and numbers, food resources, etc.

The principal investigator will coordinate the data processing procedures with Ohmart and Anderson in Phoenix during the North American Wildlife Conference.

Utilization of Minnesota Peatland Habitats by Large Mammals and Birds (Dr. John Tester, University of Minnesota)

Field work in the Hubbard County study area began on 28 November 1977 with the erection of five 25-foot radio towers. After determining the precise locations of these towers, their accuracy was tested with reference transmitters. Inconsistent test results led to the further testing of six different antenna systems, none of which provided the desired accuracy. As a result, hand-held antennas are now being used to determine the specific locations of radio-tagged animals. Towers are still used to ascertain general locations; after which hand-held equipment is used to gain a sighting of the animal or to provide a close-range triangulation. Day and/or night locations are determined for each animal at least once in every 48-hour period, except in the case of animals ranging far outside the study area.

Trapping and baiting operations began on 15 December 1977. Thus far the trapping effort includes 182 trap nights for hares, 113 for deer, and 90 for grouse. A total of 11 hares, eight spruce grouse, and two white-tailed deer have been radio-tagged. All live, marked animals are being monitored. Two spruce grouse died and five hares have shed their collars.

Dear trapping continues with the goal of radio-tagging two more does. Since only females can be collared, the three bucks that have been trapped were ear tagged and released.

Attempts have been made to capture ruffed grouse, coyotes, and bobcats; but thus far the efforts have been unsuccessful. Trapping efforts will resume for ruffed grouse when drumming activity allows the use of mirror traps. Further attempts to catch coyotes will also be made, and a seasonal scent-post survey of canids is planned.

Additional information regarding activity of radio-tagged animals is gathered using a multi-channel receiver attached to a rustrak recorder. This device can provide data on activity patterns 24 hours a day on as many as 16 animals. The recorder was put into operation on 22 March 1978 and, thus far, has been used to monitor up to five animals at a time.

During times of adequate snow cover, quadrat sampling was used to help relate habitat type to animal activity. Ten vegetational categories were defined, and each was sampled for numbers of tracks, droppings, and resting sites of all species. The first sampling effort was made on 27 February 1978. Subsequent recordings were made following fresh snow cover on 3 March and 15 March 1978.

Plans are in progress for the gathering of similar types of data in snowless months. Pellet counts, drumming counts, and browse sampling are among the techniques that will be employed. The same sampling procedures will be used periodically in comparable habitat types in the large peatlands of Koochiching County. Data from these sites can then be compared to those of the Hubbard County study area.

Another source of information on animal activity in the Hubbard County study area comes from incidental sighting and sign records. Data on numerous unmarked mammals and birds have been gathered from sightings and from tracks, droppings, kills, and other signs of activity. To date, unmarked animal sightings include 18 of hares, 26 of ruffed grouse, 122 of spruce grouse, and 20 of deer. Data have also been obtained on coyotes, porcupines, a red fox, a striped skunk, and a variety of small mammals. Bird records include turkey vultures, a goshawk, a bald eagle, and numerous smaller species.

In addition to information on animals, records of weather data and snow conditions have been kept since 1 January 1978. Snow depths, crustal strengths, and snow profiles have been measured weekly in each of six vegetation types. Temperatures, wind conditions, and precipitation are recorded daily.

Considerable effort has also gone into the preparation of a vegetation map for the study area, and of a plotting board used in locating animals. Aerial photographs were taken in March 1978 with the intention of improving and correcting the vegetation map now in use.

The Relationship of Amphibians and Reptiles to Peatland Habitats in Minnesota (Dr. Philip Regal, University of Minnesota)

INTRODUCTION:

The purpose of this report is to summarize information currently available on the herpetofauna (amphibians and reptiles) of the Minnesotan peatlands. This information was collected in preparation for a DNR sponsored research project to investigate these animals. The field phase will commence this spring. This assessment has drawn on a wide range of information sources both in the literature and through contact with institutions and individuals who have had experience in these areas.

SUMMARY OF CURRENT INFORMATION:

Before summarizing the available information it is necessary to define the extent of the geographic region under discussion. Peatlands of some type or size cover a vast and diffuse area of Minnesota. For the purposes of this report, it has been decided to limit the summary to the extensive peatland areas found in the north central region (Koochiching, Beltrami, and Lake of the Woods Counties) and in the northeast region (St. Louis and Aitkin Counties). This is justified since these are the areas of greatest interest to the current DNR projects. Also the smaller southern peatlands would be somewhat difficult to interpret in terms of the herpetofauna since the probability of contamination from nearby different habitats is to be expected. Only in the extensive northern peatlands will a true picture of the Minnesotan peatland-herpetofaunal relationship be discerned.

The task of summarizing current information on these areas is relatively simple. The fact is that virtually nothing is known concerning the herpetofauna. The standard reference is still Breckenridge (1944). Although this valuable work is in its 3rd edition (1970) it has never been revised except for a few additional literature references. As revealed in the book and the collections of the Bell Museum of Natural History, upon which the book is based, Breckenridge covered the central, southwestern and southeastern areas of the state in some detail. However, the northern wetlands were virtually ignored. Information on Minnesotan amphibians and reptiles gathered since that time is scattered in short notes and papers (see Bibliography) and again the work has concentrated in southern Minnesota.

There are several reasons for this lack of information. The first is logistical. The Minnesotan northern peatlands are far removed from the areas where people interested in the subject have generally worked. Also the area once reached is difficult to collect in due to the well known problems such as insects, transportation,

etc. The area is unfortunately the most difficult to work in during the spring, which for the herpetologist is the season of greatest interest. Another reason is that Minnestoa, in general, is not well known herpetologically. Due to its northern latitude and resultant climate it has a rather limited herpetofauna. For this reason it has not attracted much attention by herpetologists. If one wishes to deal with amphibians and reptiles then the southern U.S. and tropics offer much greater potential. Also amphibians' and reptiles' position on the "human value" scale is low. Of all the vertebrates in Minnesota (fish, amphibians, reptiles, birds and mammals) the herpetofauna is clearly the least important from an economic point of view. This plus their relative scarcity has meant little interest on the part of funding agencies which are responsible for basic research and management of natural resources. By this it is not meant to imply a total lack of interest and effort on the part of state institutions (mainly DNR and the university system). There is, of course, a non-game DNR division which has developed procedures for collecting information on the herpetofauna. Small research efforts have occurred under several investigators in various parts of the state. However, none of these efforts has dealt with the northern peatlands. One final point is that amphibians and reptiles, relative to other vertebrates, are difficult to study. As Voght and Hine (1977) note, "They are often unavailable even to the most ardent herpetologist. Unlike birds and mammals, herps will remain inactive for weeks (even during their normally active period of the year) if weather conditions are not within their activity range".

Hence for all of the above reasons there is a paucity of information on the Minnesotan herpetofauna and it is aggravated for the peatlands. Note that lack of information does not imply the absence of a peatlands herpetofauna. Herpetofaunas have been investigated in a number of peatland situations (northern Wisconsin, Voght and Hine, 1978; Southern Canada, Logier and Tonier, 1961; and Sweden, Gislen and Kauri, 1959). Unfortunately this

information consists mainly of annotated taxonomic listings with no substantial ecological information.

The one bright spot in the study of the Minnesotan herpetofauna which bears on the peatlands is the extensive work done at the University of Minnesota Lake Itasca Biological Station over the years. Although this is not an extensive peatlands area, it does contain bog areas and is the only place where the northern Minnesotan wetlands herpetofauna has been studied. In fact virtually all of what is known about the northern Minnesota herpetofauna has come from this station. It is particularly valuable for the present study since the work has been ecological rather than taxonomic in orientation (Marshall and Buell, 1955; Bellis, 1959; Bellis, 1965; Hedeen, 1972; Schmid, 1965; and references therein). These will be discussed later.

In order to determine what is known about the Minnesota herpetofauna and to prepare for the forthcoming research program, many possible sources of information were investigated. This consisted of correspondence and phone conversations with a number of state schools and various individuals known to be connected with or have worked in the areas of interest. This included the northern schools of the University of Minnesota (UM) system and biologists at these institutions as well as the considerable number of scientists and their students at the UM-Twin Cities who have worked there. The response was uniformly negative; most of the time these individuals had other areas of interest and/or expertise. They simply didn't notice the herpetofauna or were there at the wrong time of the year.

The two exceptions were Dr. R. G. McKinnel who, in a National Science Foundation funded program looking at the demise of Rana pipiens in the state, found R. pipiens young of the year near Little Falls, Koochiching County. Gerda Nordquist, who is involved in the small mammals DNR sponsored project, captured several toads (Bufo americanus) in her traps in Koochiching County and one salamander (believed to be Ambystoma tigrinum) in St. Louis

County. Again this should not be taken as evidence of the scarcity of amphibians and reptiles in peatland habitats since this work was done in the autumn when herpetofaunal activity is low.

Information was also sought from outside the state at institutions known to have specimens from Minnesota (University of Wisconsin-Madison, Milwaukee and several other smaller Wisconsin State schools, U.S. National Museum, Washington, D.C., and the Field Museum, Chicago were contacted). No specimens or information were available from these institutions. This search was by no means exhaustive but certainly indicated the lack of available information from the most likely sources.

Hence what one is left with is largely guess work based on the scanty evidence available and from large scale distribution maps and standard general herpetological references for the eastern United States (Conant, 1975; Dowling, 1975; and Wright and Wright, 1949). Predictions as to what will be found in the extensive northern peatlands have been summarized in Table 1. This will surely prove to be inaccurate. Species which could be in habitats neighboring the peatlands have been included. Table 2. includes a breakdown of peatland habitats as suggested by Heinselman (1963, 1970). As can be seen "peatlands" are a very heterogeneous set of habitat types. This fact will undoubtedly increase the number of species found in the general peatlands area by providing more habitat possibilities.

It is expected that reptiles will be scarce. The lowlying wetland areas of the peatlands afford much better ecological opportunity for amphibians. This list represents the current state of knowledge regarding the Minnesotan herpetofauna and northern peatlands. the information available is woefully inadequate for the purpose of making intelligent decisions concerning the future of these areas.

Some ecological information is available from the northern wetlands. Marshall and Buell's (1955) study of the occurrence of amphibians in relation to a bog succession at Twin Lakes Bog D at the Itasca Biological Station give an idea of what may be found in bog areas where fairly permanent bodies of open water are to be found. His results show leopard frogs (Rana pipiens) found in the tamarack, spruce and fir-ash zones; spring peepers (Hyla crucifer) and tree frogs (Hyla versicolor) are found in the spruce and ash-fir zones. The mink frog (Rana septentrioralis) and the american toad (Bufo americanus) were common. The study also contains a diet analysis for the amphibians found there.

Gosner and Black (1957) studied amphibians in the New Jersey Pine Barrens Bog. Bog water typically has a low pH. They were interested in the effect of this on anuran egg mass development and its impact on the local amphibian community. Eleven species of amphibians were common in the area but only three were abundant in the true bog. This distribution correlated with the exceptional tolerance of these three species to acidity relative to the other species as determined in laboratory experiments.

Gosner and Black's study suggests what may be found in Minnesotan peatlands. Peatland habitats place unique constraints on amphibians, especially as relates to water chemistry. Bog/peatland waters are low in pH and ionic content and high in tannins and other phenolics (giving the water its characteristic tea color) in addition to other plant secondary compounds. This will certainly have an effect on amphibain populations as suggested by evidence from other areas with similar conditions (Janzen, 1974 and Pough, 1976). In addition peatland habitats are nutrient stressed (Heinselman, 1970; Janzen, 1974). These facts suggest that the herpetofauna-peatlands relationship will pose many interesting ecological questions. Hence there is great scientific as well as practical value in the study to be undertaken.

RECOMMENDATIONS:

Clearly little is known concerning the herpetofauna of the Minnesotan peatlands. The study to commence this spring will add greatly to the available information on these habitats. As mentioned previously due to their lack of economic value non-game species like amphibians and reptiles are often ignored. This is changing due to environmental impact laws which make it mandatory for this sort of information to be collected for non-game as well as game species. The difficulty in research methodology for amphibians and reptiles has also held back their study in conjunction with state resource management. As opposed to fish, birds and mammals the herpetofauna have had no well developed field methodology to aid in accurate assessment of wild populations. Realization of this need has spurred several workers (Voght and Hine, 1977; Bury, 1977; and Campbell and Christman, 1977), to develop standarized collecting techniques to be used with amphibians and reptiles. The typical method of herpetofaunal assessment has involved labor intensive searching by a skilled observer(s). This can be amazingly unproductive unless one has a "trained eye". Since amphibians and reptiles represent a specialized group such trained observers are usually rare, especially when dealing with institutions whose main concern is game species.

The techniques developed by these workers all involve drift fences lined with an assortment of pit fall and funnel traps set in a particular array to maximize trapping efficiency. The techniques developed by Voght and Hines for the Wisconsin DNR are of particular interest since their goal was to "develop a usable technique for sampling terrestial vertebrates quantitatively and qualitatively by a non specialized biologist." Also, Wisconsin with habitats silimar to Minnesota was their test ground. They did not, however, trap extensively in wetland areas.

The principal investigator wishes to bring these techniques to the attention of the Minnesota DNR. In view of the future importance of environmental impact laws a standard technique will certainly be of value. Its assessment in Minnesota peatlands by our research program will be of great interest in the establishment of this technique as a standard tool for this often ignored group of animals. It must be stressed however that labor intensive collecting by a skilled observer will always prove invaluable.

In conclusion, this preliminary report on the relationship of amphibians and reptiles to Minnesotan peatland habitats has been, of necessity, rather brief and speculative. There has simply not been enough work done in the areas of interest to allow a more detailed assessment at this time. At the end of this field season a great deal more will be known and precise information as to the Minnesotan peatlands-herpetofaunal relationship as well as recommendations concerning the management of amphibians and reptiles in Minnesota in general will be possible.

Table 1. Preliminary List of the Amphibians and Reptiles Expected to Be Associated with the Minnesotan Peatlands* (Breckenridge, 1944; Conant; 1975; Ernst, 1973; Vogt, personal communication; and references in Dowling (ed.), 1963, et seq.)

Key:
X - species expected to be found in peatlands or in general vicinity of peatland habitats

? - possible peatland utilizers

O - not yet recorded from the state but predicted to be found in peatlands habitat

AMPHIBIANS

Salamanders

?	Necturus maculosus	Mudpuppy
X	Notophthalmus v. viridescens	Red Spotted Newt
X	Ambystoma laterale	Blue Spotted Salamander
X	Ambystoma t. tigrinum	Eastern Tiger Salamander
X	Plethodon c. cinereus	Red-Backed Salamander
O	Ambystoma maculatum	Spotted Salamander
O	Hemidactylium scutatum	Four-Toed Salamander

Frogs and Toads

X	Bufo americanus	American Toad
?	Bufo hemiophrys hemiophrys	Canadian Toad
X	Pseudacris triseriata maculata	Boreal Chorus Frog
X	Pseudacris t. triseriata	Western Chorus Frog
X	Hyla crucifer	Spring Peeper
X	Hyla versicolor	Gray Tree Frog
X	Hyla chrysoscelis	Gray Tree Frog

* This refers to the extensive peatlands of the northern part of the state where the proposed research program will be done. Additional species may be found in the smaller scattered peatlands of the southern part of the state.

?	Rana clamitans melanota	Green Frog
X	Rana pipiens	Northern Leopard Frog
X	Rana septentrionalis	Mink Frog
X	Rana sylvatica	Wood Frog

REPTILES

Lizards

?	Eumeces s. septentrionalis	Northern Prairie Skink

Snakes

?	Diadophis punctatus edwardsi	Northern Ring-Necked Snake
?	Heterodon platyrhinos	Eastern Hognose Snake
?	Opheodrys vernalis blanchardi	Western Smooth Green Snake
X	Opheodrys v. vernalis	Eastern Smooth Green Snake
X	Storeria o. occipitomaculata	Red-Bellied Snake
X	Thamnophis s. sirtalis	Eastern Garter Snake
?	Thamnophis radix haydeni	Western Plains Garter Snake

Turtles

X	Chelydra serpentina	Snapping Turtle
X	Chrysemys picta belli	Western Painted Turtle
?	Emydoidea blandingi	Blanding's Turtle

Table 2. Peatland Habitats and Associated Habitat Types Planned to be Sampled

Peatland Habitat Type		Heinselman (1970)	
Heinselman (1970)	Fox et al (1977)	Vegetational association	Water chemistry (pH)
Minerotrophic swamp	Minerotrophic swamp	Rich swamp forest	6.2-6.5
Weakly minerotrophic swamp	-	Poor swamp forest	3.9-6.1
String bog and patterned fen	String bog, forest island and fen complex	Cedar or larch string bog & fen complex	5.3-6.4
Forest island and fen complex		Poor swamp forest	5.3-6.4
Transitional forested bog	Oligotrophic tamarack swamp	Black spruce-feathermoss forest	3.2-3.5
Semi-ombrotrophic bog	Semi-ombrotrophic swamp	Sphagnum-black spruce-leatherleaf bog forest	3.1-3.8
Ombrotrophil bog	Raised bog	Combination of above and sphagnum-leatherleaf-Kalmia-spruceheath	3.2-3.5
Raised bog drains	Drains	Poor swamp forest	3.8-4.1
Disturbed peatland (drainage ditches, horticultural areas, etc.)		-	-
Adjacent non-peatland areas		-	-

Agricultural Reclamation of Peatlands (Dr. Rouse Farnham, University of Minnesota)

OBJECTIVES:

1. To determine suitability of several vegetable, forage and grain crops grown on mined (bottom) and unmined (surface) peatlands both in greenhouse and field trials.

2. To determine the best management practices for selected crops including cultural practices, fertilization and minor elements on mined and unmined peatlands.

3. To establish demonstration plots of commonly grown crops (vegetable, grain and forage) that are suitable and convenient for field tours by interested parties.

4. To establish and maintain peat wastewater and sludge demonstration plots suitable for field tours.

5. To evaluate by soil tests and analyses the physical and chemical properties of the peat soils at the Wilderness Valley Research facility of the I.R.R.R.B.

6. Cooperate with other researchers conducting hydrology studies, forestry research, evaluation of peat for energy and chemicals and on site preparation.

STUDY AREA:

Most of the research will be conducted at the Iron Range Resources Wilderness Valley Farms facility located on state land near Zim, St. Louis County.

TYPES OF RESEARCH:

1. Crop Production Evaluations

   Field Trials

   a) Evaluate crop adaptability on mined and unmined peatlands using 2 acre plot areas.

   b) Determine crop potential on mineral substrate and mixed peat-mineral (bottom sediments).

   Greenhouse Trials (to be done at Soil Science greenhouses at University in St. Paul, during winter)

   a) Collect surface peat, bottom peat, and mineral substrate soils and conduct pot tests in greenhouse during winter. Tomatoes to be used as bioassay crop. Relative crop productivity index to be developed from these studies to evaluate mined and unmined peat and soil-peat mixes.

2. Demonstration Plots - 4 acre plots

   Crops to be grown include wheat, barley, oats, bluegrass, quackgrass and several vegetable crops using standard management and cultural practices.

3. Management and Cultural Practices

   a) Evaluate proper grading and seed preparation methods.

   b) Compare open with closed drainage systems.

   c) Evaluate fertilization and cultural practices.

4. Physical and Chemical Properties of Peat

   Evaluate physical and chemical parameters of peat related to hydrologic characteristics, drainage feasibility, crop production, etc.

Peat urged as source of chemicals

United Press International

Minnesota's peat should be considered as source for industrial chemicals, according to a Department of Natural Resources study.

Charles Fuchsman of Bemidji State University, who prepared the report, said peat, which generally has been viewed as an alternate energy source, can be used to produce important chemical components for fertilizer, medicine and livestock feed.

"In Europe," he said, "peat has long been used as a raw material for the production of a variety of chemical products."

Fuchsman suggested peat might be considered for a small-scale chemical industry that would yield relatively high-priced products for long periods at locally owned, labor-intensive operations.

He said such development would be suited to the economic and social patterns of Minnesota and would be environmentally less damaging than large-scale industry.

Fuchsman's report was part of a $1.25-million department study evaluating potential peatland development.

5. Peat Pollution Abatement

Establish demonstration plots to determine the use of peat in wastewater treatment (peat over land systems), Finnish peat sewage treatment system (ditched bog) and application of sludge on peatlands (mined and unmined).

REPORT OF PROGRESS:

Samples of peat from the Iron Range Resources Wilderness Valley Farms facility in St. Louis County were collected last fall. These samples included surface, subsurface (bottom) and mineral substrate material from field 8 of the experiment station. Additional peat samples representing the major Minnesota peat types were collected in other locations for comparison purposes in the greenhouse growth trials.

The final plans for reclamation plots on "mined" and unmined (present surface) were completed in February in consultation with Don Grubich of the I.R.R.R.B. in Eveleth.

Waste treatment plot designs were also finalized in February as to location and construction at the research facility.

Plans and specifications were finalized for removal of peat in the greenhouse growth trials. This included shredding and storage in waterproof containers.

Soil samples for soil tests of major elements and for physical and chemical analyses were collected for each peat type for characterization purposes and these tests are presently being made.

GREENHOUSE TRIALS

A. Materials - Peat Types

1. WVF Field 8 Surface Peat
2. WVF Field 8 Bottom Peat
3. WVF Field 8 Mineral Substrate
4. Arlberg Sphagnum Peat (V. Acid)
5. Aitkin Co. Surface Hemic Peat (Acid)
6. St. Louis Co. Sapric (decomposed) Peat
7. Roseau Fibric-Hemic Surface Peat, non-acid

B. Treatments - two treatments

1. Fertilized - 5.0 gram, 10-10-10 fertilizer plus all purpose minor element mix per pot
2. Unfertilized - no additions

C. Assay Plants

1. Tomatoes - hybrid patio variety
2. Mums - cuttings, Neptune variety

D. Replications

3 replicates (3 plants for each treatment)

DISCUSSION:

Tomato and mum plants which were used for these greenhouse trials were purchased from a local greenhouse. They were carefully selected for uniformity of size and quality.

Peat materials and substrate soil were shredded and mixed thoroughly for uniformity. Fertilizer and minor element mix were carefully weighed and mixed with soil materials. Plants were potted about March 20, 1978 in 1/2 gallon plastic pots containing small holes at bottom to facilitate drainage.

The plants are presently about 6 to 8 inches in height and evaluation of their relative productivity is being made. Plants will be allowed to grow 2 to 3 months at which time an evaluation of their relative productivity index will be made. The productivity index will be made on the basis of quality, vigor and maximum increase in weight over time.

Data obtained in these greenhouse evaluations should be useful in predicting the comparisons to be made in the summer field trials at the research center.

Forestry Reclamation of Peatlands (Dr. Edwin White, University of Minnesota)

ABSTRACT:

Two graduate students have been employed on the project beginning April 1, 1978. Correspondence surveys have been completed to locate suitable quantity and quality of seedlings for use in the reforestation studies to be established at Zim, Minnesota.

Experimental design fertilization rates and species have been decided on in consultation with statisticians, literature and individuals familiar with forest tree growth on organic soils.

Correspondence surveys have been initiated to find peat areas that have been mined and abandoned over the past 50 or so years. These areas will be statistically surveyed to determine the degree of natural succession as a means of reclamation.

SPECIES AND FERTILIZATION TRIALS:

Initial planning work for the 1978 field season has essentially been completed.

By means of correspondence and personal contact with many individuals several species to be tested for reclamation use on mined peatlands have been selected. The tremendous acreage of organic soils in northern Minnesota offer a unique opportunity for research designed to utilize these peat soils for increasing the softwood fiber supply that many reports indicate is currently in short supply.

Species selected for inclusion in the current study include Scots pine, white spruce, black spruce, Norway spruce and a hybrid poplar, Rhinelander clone 5332. The Scots pine seedlings are being supplied by Potlatch Corporation from their Cloquet nursery; Norway spruce seedlings are coming from the DNR General Andrews nursery as well as from the Division of Forestry, State of Ohio; and the hybrid poplar clone is being furnished by the U.S. Forest Service Intensive Cultural Project, Institute of Forest Genetics, Rhinelander, Wisconsin.

It would be highly desirable to include eastern tamarack in the species test, however a supply of seed and/or seedlings could not be located. All state and many private nurseries from the Dakotas to Maine were contacted for a source of eastern tamarack seedlings.

In consultation with several statisticians, a rather sensitive experimental design was arrived at for testing the effects of peat excavation and fertilization on the suitability of Scots pine, white and black spruce for reclaiming mined peat lands. The plot layouts and experimental design are included in the appendix.

NATURAL SUCCESSION ON MINED PEAT LANDS:

Preliminary work has begun by means of a letter sent to many individuals across the state attempting to locate mined and then abandoned peat operations. The response to this correspondence is encouraging.

PERSONNEL:

Two graduate students have been employed to assist with the two phases of this project. Mr. Bruce Harding will be joining the project from Texas A&M University on March 24, 1978. Mr. Harding is completing a M.S. degree at Texas and will be beginning a Ph.D degree program utilizing the species-fertilization-nutrition aspects of the project.

Mr. John Saxhaug will join the project as of April 1, 1978. Mr. Saxhaug is a recent graduate of the College of Forestry at St. Paul and will be utilizing the natural succession phase of the project as a basis for an M.S. program at the College.

1978 FIELD SEASON:

A major effort will be to install the species-fertilizer trials at the Agricultural Experiment Station at Fens. Mr. Harding will be encouraged and given the leeway to develop supplemental laboratory studies designed at elucidating the nutritional relationships relating the species success in reclaiming mined peatlands.

A second phase will involve the quantitative field survey of natural succession on the mined and abandoned peatlands. These lands will be stratified based on age since mining, peat type and physical-chemical analysis of the peat.

APPENDIX

EXPERIMENTAL DESIGN, SPECIES X FERTILIZATION:

The experimental design will be a randomized complete block with three replications of three species and eight fertilizer treatments. Tree species to be tested are white spruce, black spruce and Scots pine. These treatments will be installed within the fertilized forestry and fertilized mined forestry areas.

Fertilizer treatments are:

1.	=	0.	=	Control, no fertilizer
1a.	=	0	=	Control, no fertilizer
2.	=	N	=	Nitrogen at 300 lbs/a
3.	=	P	=	Phosphorus at 150 lbs/a
4.	=	K	=	Potassium at 150 lbs/a
5.	=	NP	=	Nitrogen at 300 lbs/a plus phosphorus at 150 lbs/a
6.	=	NK	=	Nitrogen at 300 lbs/a plus potassium at 150 lbs/a
7.	=	PK	=	Phosphorus at 150 lbs/a plus potassium at 150 lbs/a
8.	=	NPK	=	Nitrogen at 300 lbs/a plus phosphorus at 150 lbs/a plus potassium at 150 lbs/a

Nitrogen will be from NH_4NO_3; phosphorus from triple superphosphate; potassium from KCl.

Individual treatment plots will consist of 12 trees planted at a 4 foot by 3 foot spacing. Wire plastic flags will be used to mark each planting spot. Trees will be planted during the middle two weeks of May, 1978 or as soon as the ground is unfrozen and ready for planting. The trees must be planted before June 1, 1978.

Immediately after planting, fertilizer will be evenly broadcast by hand across each appropriate treatment plot.

Amount of fertilizer per plot:

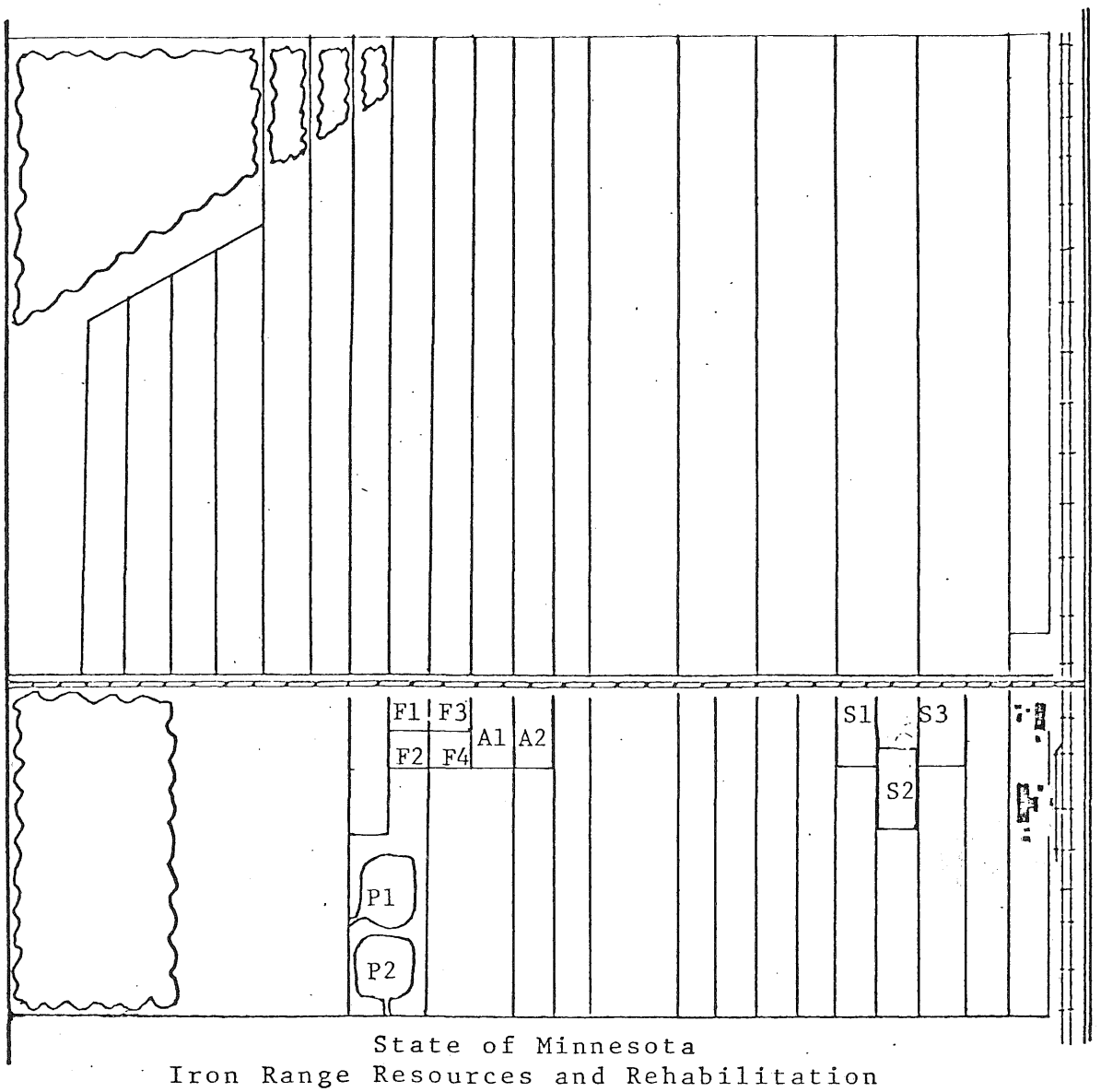
Nitrogen	=	each nitrogen plot will receive 9 pounds of NH_4NO_3 per plot.
Phosphorus	=	each phosphorus plot will receive 7.5 pounds of triple superphosphate per plot.
Potassium	=	each potassium plot will receive 3 pounds of KCl per plot.

Fertilizer	3	8	5	1a	7	6	4	2	1
	W.S.	SP	BS	WS	BS	SP	WS	BS	SP
R2	S.P.	WS	SP	BS	WS	BS	SP	WS	BS
	B.S.	BS	WS	SP	SP	WS	BS	SP	WS
Fertilizer	2	1a	3	6	5	4	1	8	7
	SP	WS	WS	BS	SP	BS	SP	WS	BS
R1	WS	BS	SP	SP	WS	SP	WS	BS	SP
	BS	SP	BS	WS	BS	WS	BS	SP	WS
Fertilizer	5	3	1a	6	4	1	8	7	2
	BS	SP	WS	SP	BS	SP	BS	WS	WS
R3	SP	WS	BS	BS	WS	WS	SP	BS	SP
	WS	BS	SP	WS	SP	BS	WS	SP	BS

N

Experimental design - Species X fertilization - Wilderness Farms, Zim, Minn.

N
4'
3'
Individual tree plot - 12 seedlings at 4 X 3 foot spacing.



State of Minnesota
Iron Range Resources and Rehabilitation

AGRICULTURE EXPERIMENT STATION AT FENS

TWP 55 N RGE 18 W St. Louis County

Miles

0 1/8 1/4 1/2

N

Drainage Ditch
Undeveloped Forest Area
Railroad
Building
Road

C= Control Plot
P= Pond
1. Mined to Mineral Soil
2. Mined to 1 Foot Peat

F= Forestry Plots
1. Unmined, unfertilized
2. Unmined, fertilized
3. Mined, unfertilized
4. Mined, fertilized

A= Agriculture Plots
1. Mined
2. Unmined

S= Sewage Application Plots
1. Finnish
2. Peat-Sand
3. Sludge