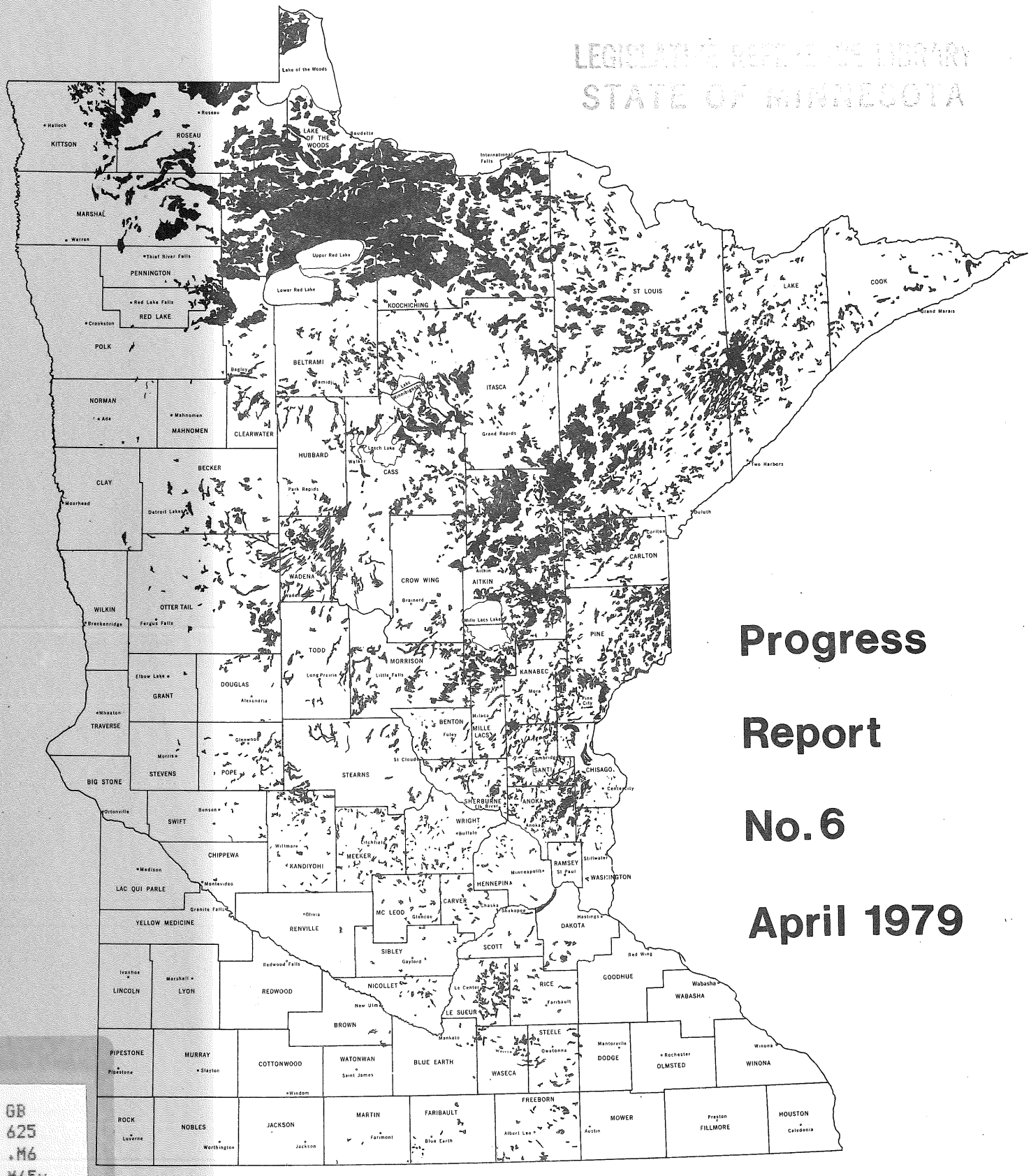
PEAT PROGRAM

1978-1979 BIENNIUM LEGISLATIVE APPROPRIATION



Progress Report No. 6

April 1979

MINNESOTA DEPARTMENT OF NATURAL RESOURCES

MINNESOTA PEAT PROGRAM PROGRESS REPORT

April 1979

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 Great Lakes Regional Commission in the Phase II -- Peat Program.

These studies cover such areas as water resources of peatlands, the plants and animals of Minnesota peatlands, forest and agriculture reclamation of peatlands, and the analysis of Minnesota peat for possible industrial chemical uses. 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)

During the past three months field activities have been minimal since the outlets from the study areas have been frozen. However, the 20 ground water benchmarks in the Toivola bog were surveyed and elevations are known. Also, a snow survey was run at Toivola and Corona to determine the maximum snow accumulation that will runoff this spring. The average snow water equivalent at Toivola was found to be 7.35 inches while the Corona bog contained 5.94 inches.

Other major activities during this period included planning for the initial water quality survey of 51 peatlands in Minnesota. Potential sampling points have been located on county highway maps for 47 peatlands and the additional water quality equipment has been obtained. At present, we are planning to make the spring run of the survey in late April.

Preliminary ground water flow maps have been developed for the Toivola bog based upon the piezometer and ground water data collected to date. Although these graphs are not available in a copy ready form the general trend has been a flow-through condition with ground water movement generally flowing through the peatland from the upper parts of the watershed to the lower parts. In many cases, however, vertical gradients exceed horizontal gradients between sampling stations indicating variability in flow direction.

The water budget information has been coded on computer sheets and analysis of monthly water budgets for each study area has begun.

The literature review now includes 117 water quality and water quantity publications.

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

Intensive Study Fieldwork:

The twelve sites representing the major peatland habitats of the Big Falls area have been monitored through the past three months. Deep snow and lack of personnel have slowed trapping during this period; however, all sites have been sampled at least once for small mammals.

Monitoring of the twelve sites will be continued. Supplemental sites, similar to the twelve habitats currently being sampled, will be trapped after most of the snow has melted. Habitat analysis also will be intensified at that time.

Laboratory Work:

Autopsies of the small mammals captured during the two state-wide surveys and those collected from the intensive study site have been conducted. Autopsy work will continue until all specimens have been analyzed.

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

During the winter work continued on data processing and evaluation of the 1978 field season data. The earlier conclusion, that the first year's data indicate intensive short term use by birds of some bog habitats and that some bird species (e.g. Palm Warbler) breed in substantial numbers in specific, dominant habitat types, is further substantiated by the data.

The appearance in mid-summer of both adults and young of species not found breeding in the habitats under intensive study suggests that there are types of plant associations in the peatlands that we did not have under study last season. This question is of special interest. On the basis of the several classifications of wetland-bog vegetation types we believed that our inventory last season included all bird habitats, but there seems to be at least one type, perhaps only a slight variant in size and/or density of black spruce forest, that we did not survey. In early April search for that habitat type will be made; and if one is discovered, it will be censused for birds and the vegetation measured.

One winter survey of Sharp-tailed grouse populations was made. Numbers were comparable to counts made a year before.

Plans for the spring and early summer field season (through June 30) are under way. Two of last year's field crew will return and, along with four new biologists who have been hired, will begin field work out of Waskish on April 1.

The principal investigator, D. W. Warner, presented a paper on birds and bird habitats on peatlands at the symposium, Avian Ecology and Habitat Management in Minnesota, March 9-11.

Special population inventories and ecological studies of the Palm Warbler and Sharp-tailed grouse will be expanded this season.

It is my recommendation that this project be extended through this season and next so that the data supporting the conclusions after one season may be substantiated further by repeating a second and third year.

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

In the five-month period between 1 November, 1978 and 1 April, 1979 field work continued as usual at the Lake Alice study site. Radio-locations were made 15 or more times per month on each radio-tagged ruffed grouse, spruce grouse, and snowshoe hare, and 20 or more times per month on each radio-tagged white-tailed deer. Trapping efforts included 12 deer trap nights with the result of two more radio-collared does, and 36 hare trap nights resulting in the recollaring of a formerly monitered hare. A major effort was made to attract grouse to bait sites for the purpose of "lily-pad" trapping, unfortunately, consistently cold temperatures precluded the use of these traps. Roughly 40 hours were spent in attempts to "noose" spruce grouse with the result of 2 newly radioed birds and one mortality.

As a result of these tagging efforts and the loss of radioed animals due to predation and transmitter failure, numbers of deer monitered varied from 2 to 4, hare from 8 to 5, spruce grouse from 5 to 3 and ruffed grouse from 4 to 0. Trapping efforts for both species of grouse will continue through April.

Snow-track surveys were conducted in twelve habitat types on eleven occasions following fresh snows. Records were made of tracks, droppings, and resting sites of all species encountered.

In February a survey of snowshoe hare browse was conducted in six habitat types. At least 50 hours were devoted to evaluating potential and

utilized browse using techniques developed by Moody (1977) and Grigal (in press).

Sightings of unmarked animals in the study area were recorded as usual. These included 2 sightings of deer, 8 of hare, 15 of ruffed grouse, and 29 of spruce grouse.

Fieldwork will continue into late May with the hope of collecting as much information as possible on breeding spruce grouse and ruffed grouse. Aside from radio-tracking and tagging efforts, we intend to locate drumming logs, and will attempt to conduct a modified King census in a number of habitats.

A deer and hare pellet survey will be conducted in May or June if water levels recede sufficiently. Monitoring of deer tracks on the study site road will be reinitiated when road surface conditions allow it.

Because one radio-tagged deer has consistently ranged outside the study area, vegetational mapping of that section of land will be done after the snow cover disappears. If time permits, some shrub layer evaluation may be made over parts of the study area to aid in the interpretation of hare movements.

In addition to field work, considerable effort has begun on some phases of data analysis. A number of non-parametric statistical techniques are being explored to determine their usefulness for the various types of data that have been collected.

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

The 15 December, 1978-15 March, 1979 period of the amphibians and reptiles peatland research program has been spent in preparation for the 1979 field season. This has consisted of planning, ordering needed supplies and construction of various pieces of field equipment. As noted in the December, 1978 request for extension of funding the 1979 season will focus on a detailed study of a particular site, the Porter Ridge Road bog/fen complex located seven miles south of Big Falls, Koochiching County. All logistical arrangements have been made, permits secured, etc. Field headquarters for the project will again be the Big Falls Forestry Station. Daryl Karns is again in charge of field work. Preparations have gone smoothly as a result of the experience gained from the 1978 field season.

In addition to field season preparations time was spent in the laboratory of Dr. Robert McKinnel of the Department of Genetics and Cell Biology. Dr. McKinnel's lab uses frogs on a large scale in a variety of research programs. From Dr. McKinnel and his staff techniques were learned for the handling and processing of large numbers of amphibian eggs for experimental purposes. These techniques will prove invaluable in the studies planned on bog water toxicity.

Several sets of experiments were run using eggs of the Northern Leopard Frog (Rana pipiens). Bog water secured last fall and kept in cold storage was utilized for these tests. The effects of bog water on fertilization, egg hatching success and tadpole survival were investigated. These results have not yet been statistically analyzed and will be presented in a subsequent report.

The December 1978 request for extension of funding to cover salary and transportation for the second half of the 1979 field

season was approved. The project is now funded through 31 October 1979 at which time it will terminate.

The following is a calender for the first part of the 1979 field season:

15-20 March:	Leased truck received
21-31 March:	Initial trip to Big Falls with equipment load. Initial reconnaissance of Porter Ridge Road. Probable return trip to Twin Cities for another load.
1-15 April:	Preparation Porter Ridge Road Site. Lab set up.
~15 April:	Amphibian breeding begins. Field season commences.

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

This progress report includes a discussion of research in the following three areas:

I. Soils Laboratory Research
II. Soils Greenhouse Research
III. Wilderness Valley Farms - Field Research

These three activities will be correlated in the final section of this report (section IV).

I) Soils Laboratory Research

This laboratory serves both as a reference library and a sample preparation-analysis facility. Selected equipment to enable procedures such as Kjeldahl digestion-distillation-nitrogen determination by titration; a complete array of physical properties including bulk density, fiber content, water content, ash content and pH; freezer storage of samples; thorough mix and subsampling of samples; and sample preparation for analysis other than our capabilities are included in this facility. The reference library, including a comprehensive county-by-county peat inventory allows us to catalog each sample, not only by mapped location, but also by designating specific properties. An oxygen bomb calorimeter is also at our disposal to determine the combustion values of select, fuel-potential samples.

The equipment we have received include an upright, frostless freezer. As peat samples are collected, the freezer will enable us to "hold" microbial activity, stabilizing biological activity and chemical processes. Samples collected at different dates throughout the season will exhibit differing nutrient analysis as they are thawed, prepared and analyzed. Preparation of samples will be in two modes, one for our lab and the other for emmision spectroscopy by ICP (inductively coupled plasma source). In-lab preparation includes physical analysis of undisturbed samples, mixing and subsampling using a RIFFLE sampler, digestion-distillation-titration for Kjeldahl N. We are presently equipped with all micro-Kjeldahl apparatus necessary: two; six-burner digestion racks, Labconco distilla-

tion unit, automatic Machlet burets for titration. The ICP preparation entails sample drying with a forced air oven, sample milling with a Wiley mill, ashing in a muffle furnace, dissolution of ash in ammonium acetate or concentration hydrochloric acid, batch filtration of ash solutions (either HCl dissolved or NH_4OA_c extractable-exchange filtrate) and finally multiple mineral analysis by ICP. Certain equipment, glassware and apparatus have yet to be received to complete the basic equipment. The oxygen-bomb calorimeter is accessible in another lab of the Soils department.

II) Greenhouse Project (note Figures 1 and 2)

One half of a bay in the Soils Greenhouse is designated to peat research. Our research presently deals with nutrient applications on four peat soils using two varieties of greenhouse tomatoes and one green pepper variety. The four soils were selected from Wilderness Valley Farms (surface and excavated), from Anoka County and from the Floodwood area in St. Louis County. The latter being a Sphagnum moss peat designated as Arlberg. Tomatoes and green peppers were selected as indicator plants due to their response to nutrient status of the medium. Each soil will have three standard nutrient applications as replicated treatments (i.e. WVF Surface Soil: Low, High, High + Frit (minor elements) Applications; three replications of each tomato and green pepper variety per nutrient application). Each of the organic soil treatments are located within one sand bed. The low-profile fiberglass tubs were molded to our specifications, fitted with sealed plexiglass dividers, filled to one foot with uniform sand and equipped with isolated watering systems. The sand beds will eliminate watering providing a constant, capillary water flow from the saturated sand up to the treated organic medium in the pots. Each divided chamber represents a specific nutrient treatment applied to three

replications of each indicator plant (i.e. nine potted plants per chamber, three chambers per tub, twenty-seven indicator plants per tub). (See Figure 2).

The automatic watering system utilizes porous ceramic candles with float valves identical to furnace humidifier attachments. Continuous-flow tubing connects the stationary float reservoirs to a plexiglass column filled with water designating the level of water in the saturated sand. The level of water in the column and in the reservoir are equalized by the flow from the reservoir to the column and the reservoir is replenished as the float valve opens. The sealed chambers do not allow contamination of water from one nutrient treatment to another in the event of leaching through the potted soil downward into the sand bed. Thus, overhead watering and treatment contamination are eliminated.

The remaining areas are utilized for germination of seeds of both indicator plants and crops to be transplanted. These areas consist of sand beds which can be equipped with automatic watering systems or simply wetted to provide a humid environment to insure germination and development of seedlings. Seeds of indicated transplant varieties will be planted in one inch depth of sphagnum-sand mix, sphagnum alone or in Jiffy pots of sphagnum alone. The less-dense medium enables separation of seedlings without extensive root damage. Germination in some cases is enhanced by covering seeding flats with plastic, however if the seeds are untreated the conditions created are prone to damping off and related fungi. The moss medium used is Heco brand Sphagnum which is uniformly milled and starter-fertilized. Using these methods, expecially concerning lesser numbers of transplants started in peat pots, we have approximately 90% germination and vigorous plant specimens. These units are easily situated in the larger, free-draining plastic pots containing peat soils under investigation.

III) Wilderness Valley Farms Research

During the fourth week of March seed orders began arriving. The bulk of the vegetable crops are from upper New York state seed suppliers and growers, Herbst Brothers Seedsmen and Stokes Seeds Incorporated. The bean and pea seeds were ordered from Vermont Bean-Pea Company. Preference was given to the shorter season All American Selections and to those varieties trial grown or especially adaptable to organic soils (peatlands). Many potential seed sources were eliminated due to location, quality of seed and price listings. We sought commercial growers or wholesale prices, as the mark-up to retail can be as high as 300%. See Table 1 for a list of vegetable crops and varieties selected. Also, it may be noted that a number of common herbs, two flower varieties and several vegetable crops of possibly lesser adaptability were selected. The former two groups were indicated in a British seed source (Thompson and Morgan) and in Stokes Seeds as aromatic pest deterents. The adaptability trials will include such crops as tomatoes, cantaloupe, watermelon, cucumbers, beets and possibly some berries. Each variety will be allocated one thirty foot row and in most cases transplants will be used. From the six varieties of the commercial plots and hopefully from the adaptability trials the most successful varieties may be selected as potential crops for coming seasons of experimentation.

Referring to vegetable growers guides and suggestions, often submitted by the seed sources, seeding and direct sowing timetables were established. We have begun seeding of onion and celery transplants in the Sphagnum moss flats, expecting ten week old transplants for field planting early June. Most other transplanted crops require plants four to eight weeks old, or five to six inch heights. These crops include the Brassicae family of cabbage, cauliflower and broccoli. Considering limitations imposed by season length, most of the crops which require a growing season of about

ninety days or those crops commonly transplanted (as those mentioned) must be transplanted. Presently, seeding flats (9" x 20") should yield 200 propagules considering germination percentages of 75-90% overall. Noting total row length and spacing specifications, we can approximate plant numbers required and seed accordingly. We have been allocated additional greenhouse space in the bay adjoining the one diagrammed, in which to germinate and raise the transplants.

Figures 3 and 4 indicate the layout of Field 7W at Wilderness Valley Farms which is designated for vegetable crops. Figure 3 illustrates the planting plan of the varietal trials including the adaptability trials. This area is located in the enclosed site of the 1978 trial garden. The east and west aisle along the fence will be used as planting areas for aromatic companion plants. Each of these plots has an 8' by 12' area of five rows totalling 40' of row length of one variety of one vegetable crop. Figure 4 indicates the commercial plots. These plots include three divisions of 42 plots each, totalling 126 plots. Three nutrient treatments (low, high and high plus micronutrients) will be applied in three replications per variety of vegetable crop. In some instances, two varieties may be selected, doubling the plot number for that vegetable crop. These plots will be randomly located in each of the divisions and each division will indicate a nutrient application. Each plot covers an area of 12' by 36' of five rows totalling 180' row length. In all cases row spacing is three foot on center to facilitate cultivation with tractor. The five row method is used to improve statistical application and to eliminate fringe affects by harvesting a standard length of the interior three rows for yield and other analysis.

In conjunction with the Iron Range Resources and Rehabilitation Board efforts, possibly thirty acres of grains and grasses may also be

planted. These will include sixteen acres of Lodi oats, four acres of Era spring wheat, four acres of Morek barley and one acre parcels of sod grasses. The grasses will include straight Kentucky bluegrass seedings, an elite bluegrass mix and a durable, intensive-use, perennial rye-grass and bluegrass mix.

Selected varieties of vegetable crops, sod grasses and possibly grains will be planted in the excavated area. These plots can not be as extensive as the surface due to limited area but will nevertheless be applicable in contrasting growth habits using similar experimental and cultural procedures.

A steel building serving as the office, dormitory facility (accomodating eight persons) and laboratory will be constructed this season. The aforementioned IRR and R Board have collaborated with us in the planning and funding (note Figure 5). A greenhouse may be a later addition, which is essential to the future vegetable growing efforts. A high profile tractor with attachments will be bid upon shortly to accomodate maintenance in the commercial plots. Also a number of tools and devices will be ordered to organize our efforts more efficiently.

IV) Correlation of Research Efforts

These efforts will delineate commercially potential vegetable and sod-grass crops, describe nutrient applications optimizing yields and contrast surface experimentation to replicated excavation ones. Many of the varieties selected are unique to the area and only recently bred for shorter-season climates. Using proper cultural techniques, efficacious nutrient applications and select current varieties forthcoming results will indicate the economic feasibility of commercial establishments in this area, on surface and excavated peat.

Table 1. Vegetable Crops for Field Variety Trials - 1979.

Crop	Variety	Seed Source	Commercial Plot Selection	Number Plots	Total Row Length(feet)	In-Row Spacing (Inches)	Days to Mature (✓Transplant)
Beans (Green)	Blue Crop	Vermont		1	40	18	64
	Bush Blue Lake	Vermont	✓	10	1660	18	68
	Green Crop	Vermont		1	40	18	61
	Improved Tender-green	Vermont		1	40	18	63
	Tendercrop	Vermont		1	40	18	56
	Top Crop	Vermont		1	40	18	53
Beans (Dried)	Great Northern White	Vermont	✓	9	1620	18	85
Beets	Early Wonder	Herbst		1	30	2	55
	Detroit Dark Red Short Top	Herbst		1	30	2	60
Broccoli	Bravo	Stokes	✓	10	1660	18	✓76
	Cleopatra	Stokes		1	40	18	✓75
	Green Hornet	Stokes	✓	10	1660	18	✓70
	Green Comet	Herbst		1	40	18	✓78
	Premium Crop	Stokes		1	40	18	✓82
	Regal F-1	Herbst		1	40	18	✓76

Crop	Variety	Seed Source	Commercial Plot Selection	Number Plots	Total Row Length(feet)	In-Row Spacing (inches)	Days to Mature (✓Transplant)
Cabbage	China King(#14)	Herbst		1	40	18	✓ 70
	Danish Ballhead	Herbst		1	40	18	✓ 100
	Early Jersen Wake-field	Herbst	✓	10	1660	18	✓ 63
	Golden Acre	Herbst		1	40	18	✓ 64
	King Cole	Stokes		1	40	18	✓ 72
	Savoy Ace	Herbst		1	40	18	✓ 68
Cantaloupe	Earlisweet	Herbst		1	30	4	✓ 70
	Burpee Hybrid	Stokes		1	30	4	✓ 68
Carrots	Canuck	Stokes	✓	10	1660	2	64
	Danvers Half Long	Herbst		1	40	2	62
	Early Pak	Herbst		1	40	2	60
	Gold Pak Elite	Stokes		1	40	2	63
	Long Marketer F-1	Herbst		1	40	2	63
	Spartan Bonus	Stokes	✓	10	1660	2	66

Crop	Variety	Seed Source	Commercial Plot Selection	Number Plots	Total Row Length(feet)	In-Row Spacing (inches)	Days to Mature (✓Transplant)
Cauliflower	Early Abundance	Stokes		1	40	18	✓ 60
	Early Purple	Stokes		1	40	18	✓ 65
	Early Snowball	Herbst		1	40	18	✓65
	Extra Early Snowball	Stokes	✓	10	1660	18	✓55
	Self Blanche	Herbst		1	40	18	✓70
	Snow Crown	Stokes	✓	10	1660	18	✓53
Celery	Cornell 619	Stokes		1	40	6	✓100
	Florida 683	Herbst		1	40	6	✓100
	Golden Self Blanching	Herbst		1	40	6	✓ 90
	Improved Utah 52-70	Stokes		1	40	6	✓105
	Surepak	Stokes	✓	10	1660	6	✓100
	Tendercrisp	Stokes		1	40	6	✓110
Cucumbers	Burpless	Herbst		1	30	3	65
	Victory	Herbst		1	30	3	60
Companion Flowers	Marigolds(Brassicae Cucumbers)	Herbst		Border			
	Nastortiums (Brassicae)	Herbst		Border			

Crop	Variety	Seed Source	Commercial Plot Selection	Number Plots	Total Row Length(feet)	In-Row Spacing (inches)	Days to Mature (✓Transplant)
Herbs	Chives(Brassicae)	Herbst		Border			
	Dill(Cucumbers)	Herbst		Border			
	Garlic(Brassicae beans)	Herbst		Border			
	Hyssop(Brassicae)	Herbst		Border			
	Peppermint (Brassicae)	Herbst		Border			
	Sage(Carrots)	Herbst		Border			
	Spearmint(Peas)	Herbst		Border			
	Summer Savory(beans)	Herbst		Border			
Lettuce	Buttercrunch	Stokes		1	40	12	66
	Butterking	Stokes		1	40	12	64
	Minetto	Herbst		1	40	12	✓84
	Minilake	Stokes	✓	10	1660	12	✓80
	Premier Great Lakes	Stokes		1	40	12	✓90
	Stokes Evergreen	Stokes		1	40	12	✓94

Crop	Variety	Seed Source	Commercial Plot Selection	Number Plots	Total Row Length(feet)	In-Row Spacing (inches)	Days to Mature (✓Transplant)
Onions	Early Yellow Globe	Stokes		1	40	3	✓ 98
	Southport Red Globe	Herbst		1	40	3	✓110
	Spartan Banner	Stokes		1	40	3	✓108
	Storage King	Stokes	✓	10	1660	3	✓ 96
	White Sweet Spanish	Herbst		1	40	3	✓115
	Yellow Sweet Spanish	Herbst		1	40	3	✓115
Peas	Alaska	Vermont		1	40	3	55
	Freezonian	Vermont		1	40	3	63
	Little Marvel	Vermont		1	40	3	59
	Laxton Progress #9	Vermont		1	40	3	60
	Sugar Snap	Vermont		1	40	3	70
	Wando	Vermont		1	40	3	68
Potatoes	Anoka	Hort.		1	40	12	early
	Kennabec	Hort.		1	40	12	mid season
	Norgold	Hort.		1	40	12	medium early
	Norland	Hort.	✓	10	1660	12	early
	Red Pontiac	Hort.	✓	10	1660	12	mid season
	Superior	Hort.		1	40	12	medium early

Crop	Variety	Seed Source	Commercial Plot Selection	Number Plots	Total Row Length(feet)	In-Row Spacing (inches)	Days to Mature (✓Transplant)
Raspberries	Latham Fall Red	Farmer		1 plot	25 plants in 30'		bearing throughout season
Spinach	America	Herbst		1	40	4	50
	Bloomsdale Long Standing	Herbst		1	40	4	46
	Hybrid No. 7	Herbst		1	40	4	42
	Melody	Herbst		1	40	4	44
	New Zealand Everlasting	Herbst		1	40	4	70
	Popeye F-1	Herbst		1	40	4	45
Tomatoes	Floramerica	Herbst		1	30	36	✓ 70
	Spring Giant	Stokes		1	30	36	✓ 68
	Spring Set	Herbst		1	30	36	✓ 65
	Ultra Boy	Stokes		1	30	36	✓ 75
Watermelon	Yellow Baby	Herbst		1	30	72	✓ 75
	Sweet Favorite	Stokes		1	30	72	✓ 80

Figure 1

SOILS GREENHOUSE EXPERIMENTS

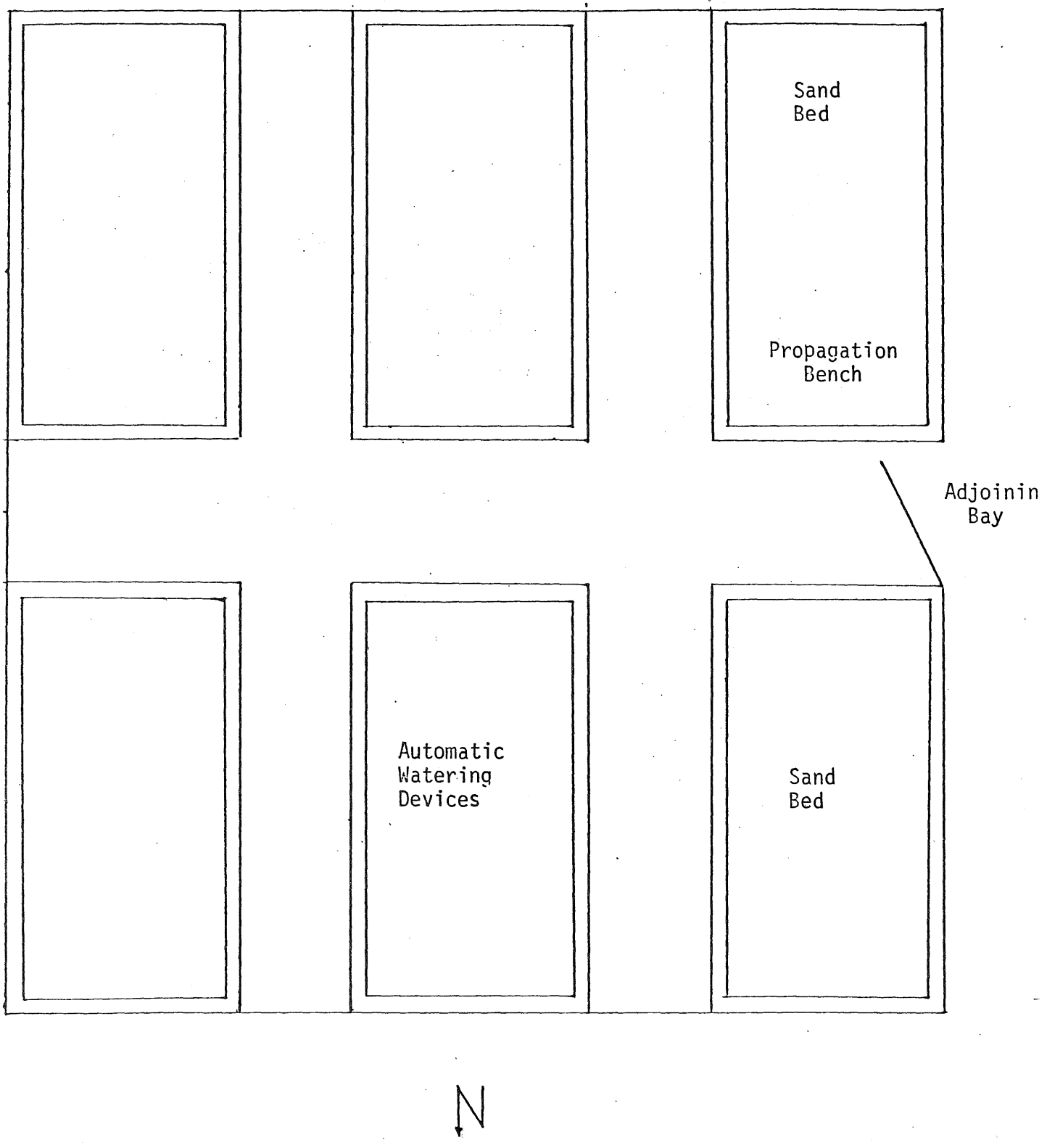
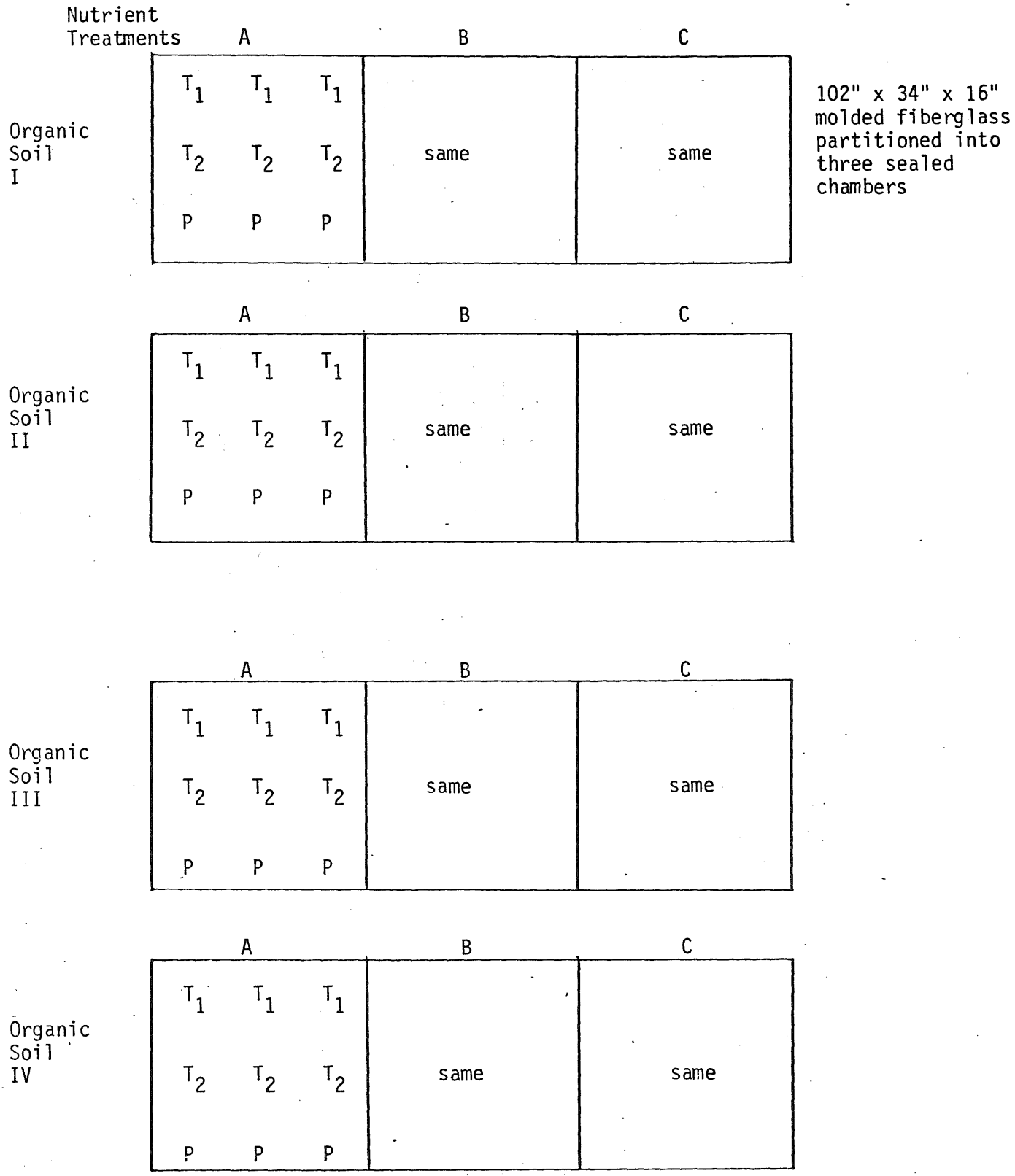


Figure 2

AUTOMATIC WATERING DEVICES & PLANT BEDS (GREENHOUSE)



T_1 = Tropic tomato
T_2 = Vendor tomato
P = Emerald Giant pepper

A = low nutrient
B = high nutrient
C = high + micronutrients

Figure 3

FIELD 7W VARIETAL TRIALS (VEGETABLES)

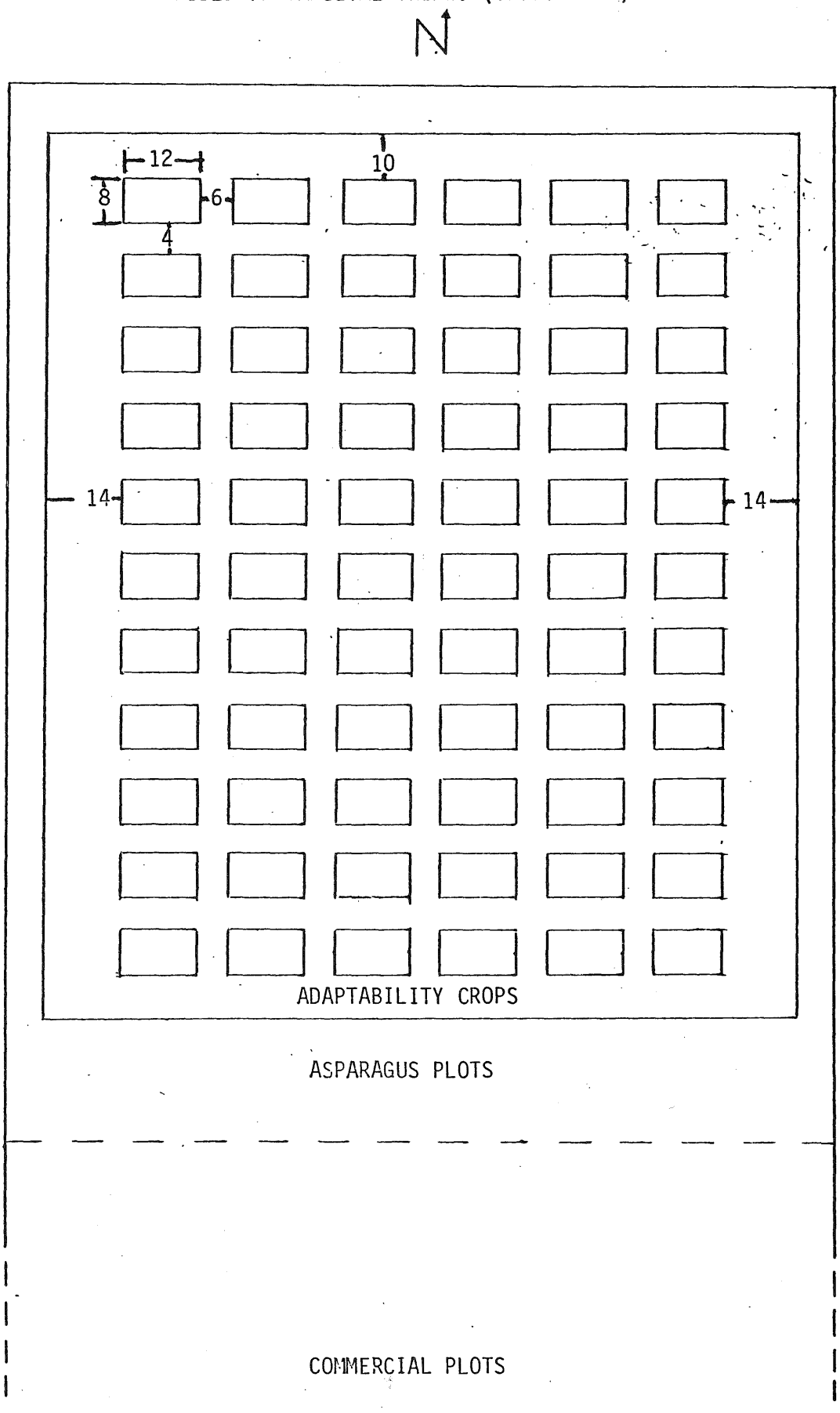
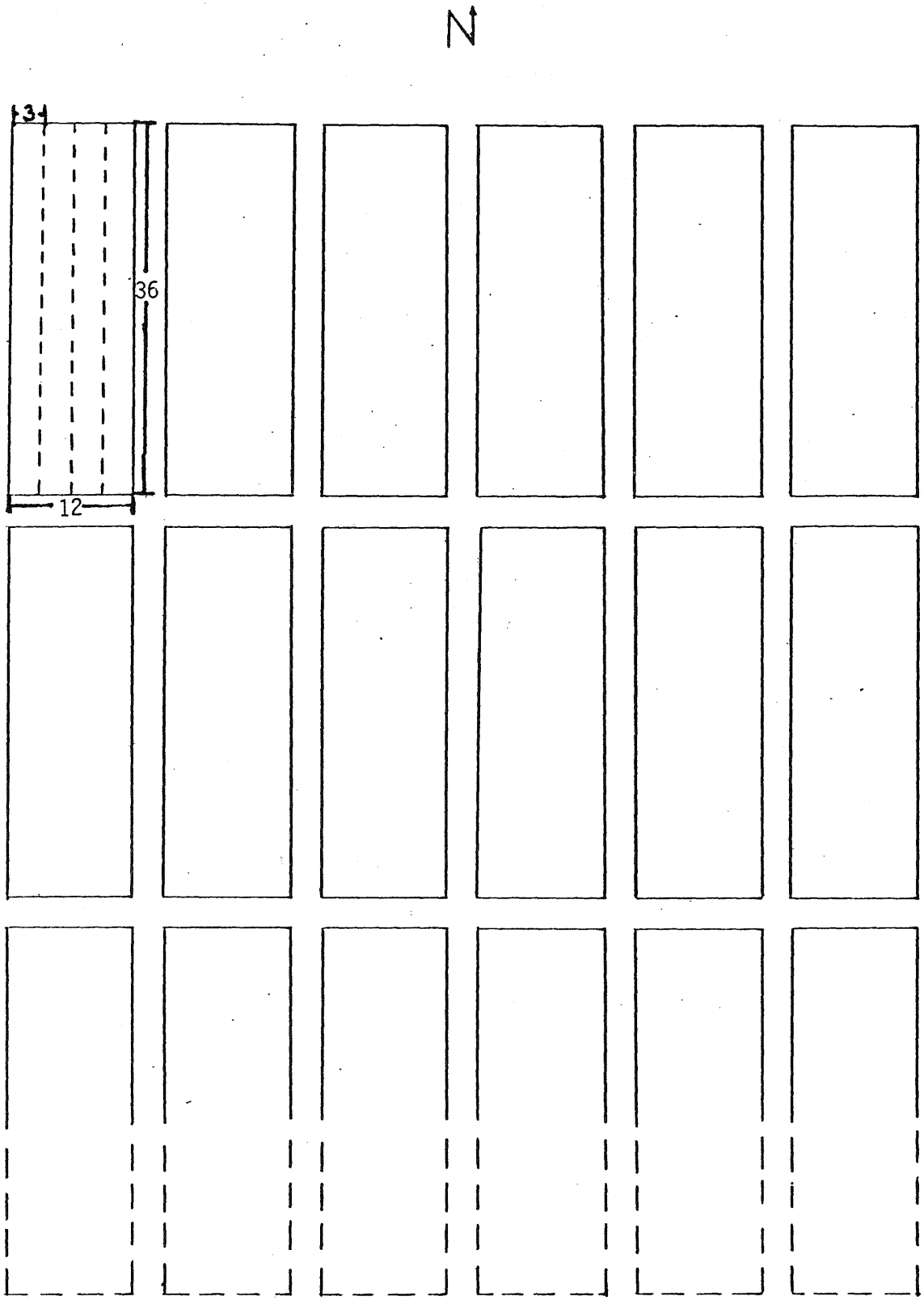


Figure 4

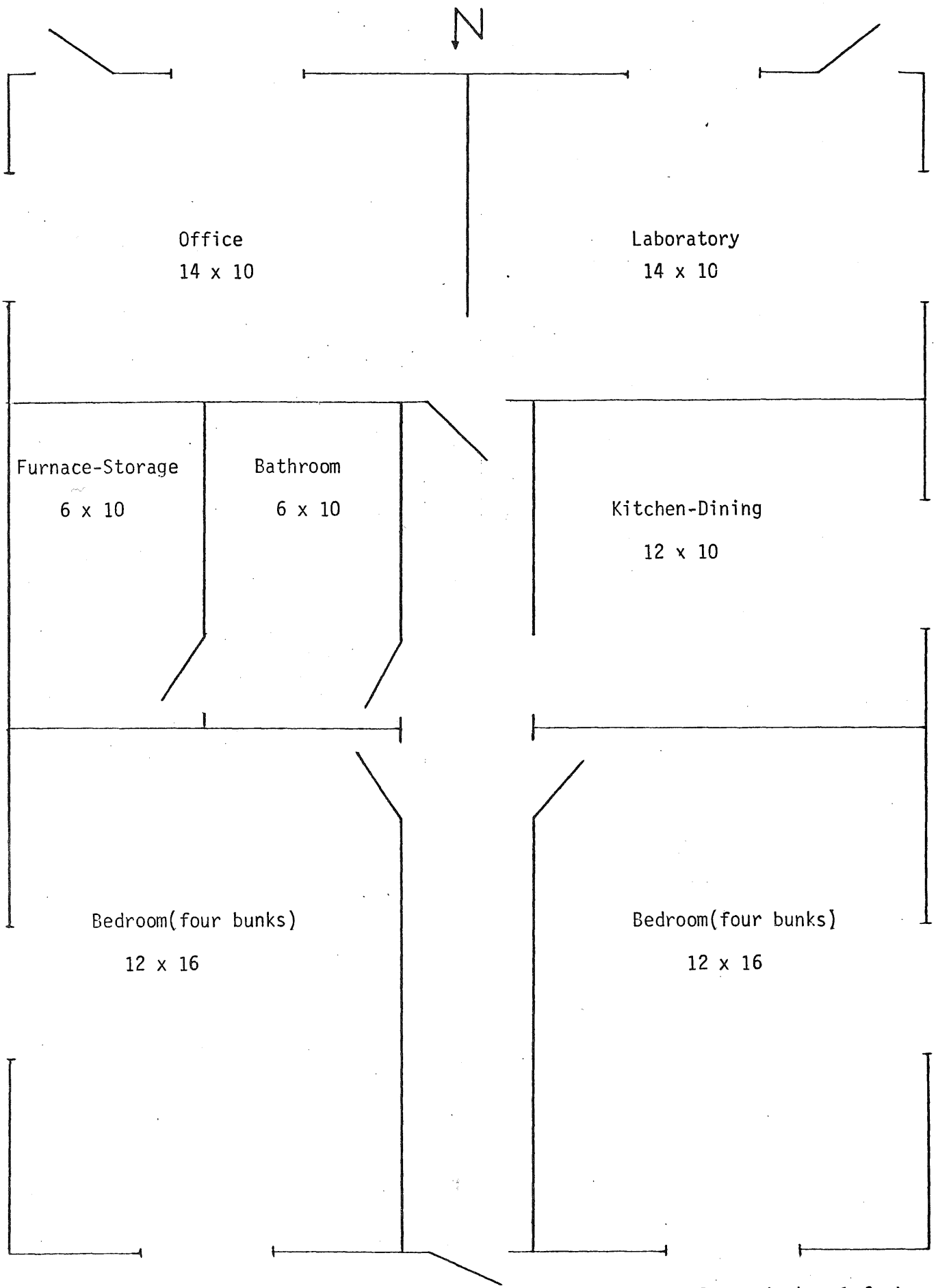
COMMERCIAL PLOTS (VEGETABLES)



Each nutrient treatment division is a 42 plot block (Treatments I, II, III)
(i.e. 6 plots E to W
7 plots N to S)

Figure 5

DORMITORY-OFFICE BUILDING - I.R.R.R.B. WILDERNESS VALLEY FARMS



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

Unmined Peatlands

No field work is expected during the winter.

Mined Peatlands

Plans have been arranged to test several combinations of fertilizers and tree species on "excavated" peat areas at Zim, Minnesota. Containerized seedlings are being grown by Chippewa Farms, Brandon, Minnesota for planting in late June or early July. Species being tested are white spruce, black spruce, Siberian larch, Scots pine, and Norway spruce. The Siberian larch seed represent seven genetically superior sources and have been supplied by Dr. Richard W. Tinus, Principal Plant Physiologist, U.S. Forest Service, Rocky Mountain Forest and Range Experiment Station, Bottineau, North Dakota. Seed of the other species has been supplied by the Minnesota Division of Forestry, Department of Natural Resources. Plantings will be installed if the planting areas are ready in 1979.

Secondary Succession on Disturbed Peatlands

Laboratory and office analysis continues on data collected during the 1978 field season.

Ecological and Floristic Studies of the Peatland Vegetation of Northern Minnesota (Dr. Eville Gorham & Dr. Herbert Wright, Jr., University of Minnesota)

Activities since the progress report of December:

1. Dr. Paul Glaser is preparing a detailed report on the plant communities, land forms and water chemistry of the Red Lake peatland, which has necessitated an extensive review of some hundreds of papers in the peatland literature. The report is being prepared in a form suitable for publication in a scientific journal, so that it may be useful to peatland scientists beyond the borders of Minnesota. It will also compare the Red Lake peatland with peatlands elsewhere.

2. Mr. Gerald Wheeler has completed the identification, labelling and mapping of all specimens of higher plants collected during field work in 1978. The specimens have been fully prepared for mounting, which is going on at the present time. After mounting, all specimens will be filed permanently in the Herbarium of the University of Minnesota in St. Paul. Mr. Wheeler has also revised a report on notable vascular plants of the Red Lake peatland. He is now working on two reports, one on the total vascular flora of the Red Lake peatland, and the other on the sedges (genus Carex) of the peatland and their relationship to water chemistry, especially pH. All three reports are being prepared for scientific publication. A species list for the Red Lake peatland is also in preparation, with every species being related to the specific habitat(s) in which it is found.

3. Professor Frank M. Bowers (University of Wisconsin, Stevens Point) and Professor Clifford M. Wetmore (University of Minnesota) have completed identifications of the bryophytes and lichens of the Red Lake peatland respectively, and have submitted lists to us. Specimens are being mounted for eventual deposit in the Herbarium of the University of Minnesota.

4. Professor Eville Gorham and Professor Herbert E. Wright have consulted frequently with Dr. Glaser and Mr. Wheeler on their reports in preparation. Professor Gorham has also reviewed a great deal of peatland literature, with a view to submitting a proposal for further scientific studies to the National Science Foundation. A preliminary outline of the proposal has been discussed with several possible collaborators, and with officials of the National Science Foundation. The studies are intended to focus on (1) rates of peat accumulation, (2) biogeochemical cycling, and (3) the environmental factors controlling these processes.

Vegetation Analysis of Selected Beltrami, Koochiching, and St. Louis County Peatlands by Remote Sensing Methods (Dr. Merle Meyer, University of Minnesota)

1.0 Introduction

The present one-year study is divided into two phases, each with the following objectives:

Phase 1 - Preparation of 100% site-specific vegetation cover type maps of portions of 9 7½-minute USGS quadrangles in the Upper Red Lake Bog and portions of 6 7½-minute quadrangles in St. Louis County (circa 315 square miles total). Classification to be accomplished from the most recent existing 1:15,840 summer B&W infrared aerial photography.

Phase II - A two-camera 35mm aerial photography camera system will provide color infrared coverage of up to 35 miles of representative transects selected by the investigators. Continuous coverage of the transects will be flown at circa 1:84,000 and photo plots at circa 1:12,000 will be flown at selected intervals along the transects.

2.0 Methods

The methods were described in the previous quarterly report and are not repeated here.

3.0 Results to Date

The Chase Brook SW Quadrangle has been completed in full (except for acreage measurements) and was turned over to the DNR Peat Project on March 21. The final product consists of a 72x32-inch three-panel folding display. On the center panel is mounted the orthophotoquad with its vegetation map overlay and the classification scheme. The right-hand panel displays the color infrared transects that fall within the quadrangle as well as samples of the large scale photo plots. On the left-hand panel is mounted an orthotopomap with an overlay on which is indexed transect locations, aerial obliques and ground photographs and the Ecological and Floristics Study Group's vegetation relevé sample points, core sample points, peat depths, and water sample points. Water chemistry is given in an adjoining table.

Work remaining will be largely a continuation of what was done for the Chase Brook SW Quadrangle. Similar displays will be completed for both the Red Lake and Toivola study areas on a quadrangle by quadrangle basis. Partial quadrangles may be combined in one display.

Photo interpretation of the Red Lake Study Area is about three-fifths complete. Detail transfer, final drafting of overlays and display layout proceeds as the interpretation is completed for each quadrangle.

Acreage measurements have been held up pending a decision as to how the cover types should be grouped. This problem has just been resolved and planimetering of the Chase Brook SW quadrangle will begin soon.

4.0 Discussion

As work has progressed, it has become increasingly clear that the plant communities and the vegetation patterns of the Red Lake Peatlands reflect to an amazing degree the hydrology of the peatlands. Watershed divides and patterns of water flow within watersheds are discernible in considerable detail on aerial photographs, particularly on color infrared photography. Where natural runoff patterns have been altered by ditches or roads, these disturbances are reflected by the vegetation.

Analysis of Minnesota Peat for Possible Industrial Chemical Use (Dr. Charles Fuchsman, Bemidji State University)

Authorization: The work done on this project is performed under contract 328062 between Minnesota Department of Natural Resources and Bemidji State University. The analytical work on peat bitumens was conducted by Dr. K. A. Dreyer; the work on phosphorus and ash was conducted by Dr. K. R. Lundberg.

1. Activities since December 15, 1978.

   a) Samples of peat were received from Tom Malterer's field crew from three additional areas: Wilderness Farms - Wild Bog; Wilderness Farms - Sod Farm; and Brookston. Samples had previously been received from bogs at Pine Island, Norman Lake, Baudette, Salol, and Meadowlands. Because of other commitments by the field crew, weather conditions, and time limitations for the study of peat samples, chemical analysis was limited to these eight deposits, instead of the twelve initially contemplated. A double complement of samples was obtained from Brookston bog as a result of deep sampling. The actual number of peat samples submitted was 180 instead of the 240 expected. The total number of analyses run, however exceeds the number originally planned because virtually all of the samples received from the later field tests were analyzed, instead of the previously scheduled analysis of only 60% of the samples. A more detailed analytical profile was obtained by sampling at 1-ft intervals, instead of compositing 2-ft segments.

   b) The accumulation and translation of selections of peat analytical methods mainly from Russian and German language sources, has been essentially completed. A description of these methods will be included in the final report for the project.

   c) The basic analyses for phosphorus, ash, and bitumens have been completed. Re-runs of some individual samples, recalibration checks of phosphorus analyses, and a few non-routine analyses remain to be done.

2. Evaluation of results.

a) Bitumens. Benzene-ethanol extractable bitumens are evaluated on the assumption that one-half of the bitumens represent recoverable peat waxes, and that at least 5% yield of peat wax is required to warrant further study of the commercial feasibility of producing wax from peat. This criterion is somewhat more conservative than that made in the Dec. 15 progress report, but does not substantially alter the general evaluation of the peat deposits analyzed in this study.

Fractions of samples containing $\geq$8%, $\geq$10%, and $\geq$12% bitumens respectively are given in the following tabulation.

Bog	$\geq$ 8%	$\geq$ 10%	$\geq$ 12%
Pine Island	.42	.25	.08
Brookston	.23	.05	.00
Norman Lake	.12	.00	.00
Meadowlands	.07	.00	.00
Salol	.00	.00	.00
Baudette	.00	.00	.00
Wilderness Farms:			
Wild Bog	.00	.00	.00
Sod Farm	.00	.00	.00

b) Phosphorus. Recent information received from Finland indicates that Finnish coke, averaging 0.19% P and ranging from 0.06 to 0.15% P is being marketed to the Norwegian ferrosilicon industry. This phosphorus level is considerably above the level of 0.06% P, reportedly typical of the German peat coke product. Since the concentration of phosphorus in coke is about three times that in the raw dry peat, the Finnish data implies that 0.05% P rather than 0.02% P may be the maximum acceptable in uncoked peat. The fractions of peat coke samples corresponding to various phosphorus levels is tabulated below.

Bog	< 0.05% P	< 0.04% P	< 0.03% P
Pine Island	.89	.89	.33
Brookston	.87	.53	.21
Baudette	.67	.11	.00
Salol	.33	.11	.11
Norman Lake	.20	.00	.00
Meadowlands	.05	.00	.00
Wilderness Farms:			
Wild Bog	.00	.00	.00
Sod Farm	.00	.00	.00

All analyses are, however, subject to possible revision following final recalibration. No samples so far analyzed had less than 0.02% P.

c) Ash. There are no known rigidly fixed maxima for ash content of peat intended for either coke or activated carbon applications. However low ash is usually desired, and available grades of coke commonly contain less than 10% ash. Activated carbon may contain up to 15% ash. These values correspond to 3% and 5% respectively in uncarbonized peat. The fractions of samples containing $< 5\%$, $< 4\%$, and $< 3\%$ ash, respectively, are given below.

Bog	$< 5\%$ ash	$< 4\%$ ash	$< 3\%$ ash
Pine Island	.60	.35	.25
Brookston	.41	.36	.15

The ash contents of the samples from other bogs all exceeded 5%.

3. Tentative conclusions.

Samples from the Pine Island and Brookston bogs have sufficiently high bitumen content and sufficiently low phosphorus and ash content to warrant more detailed study of their potential value as raw materials for the production of peat waxes, peat coke, and activated carbon.

Samples from Norman Lake, Baudette, Salol, Meadowlands, and Wilderness Farms do not appear suitable for the production of waxes, coke, or carbon.