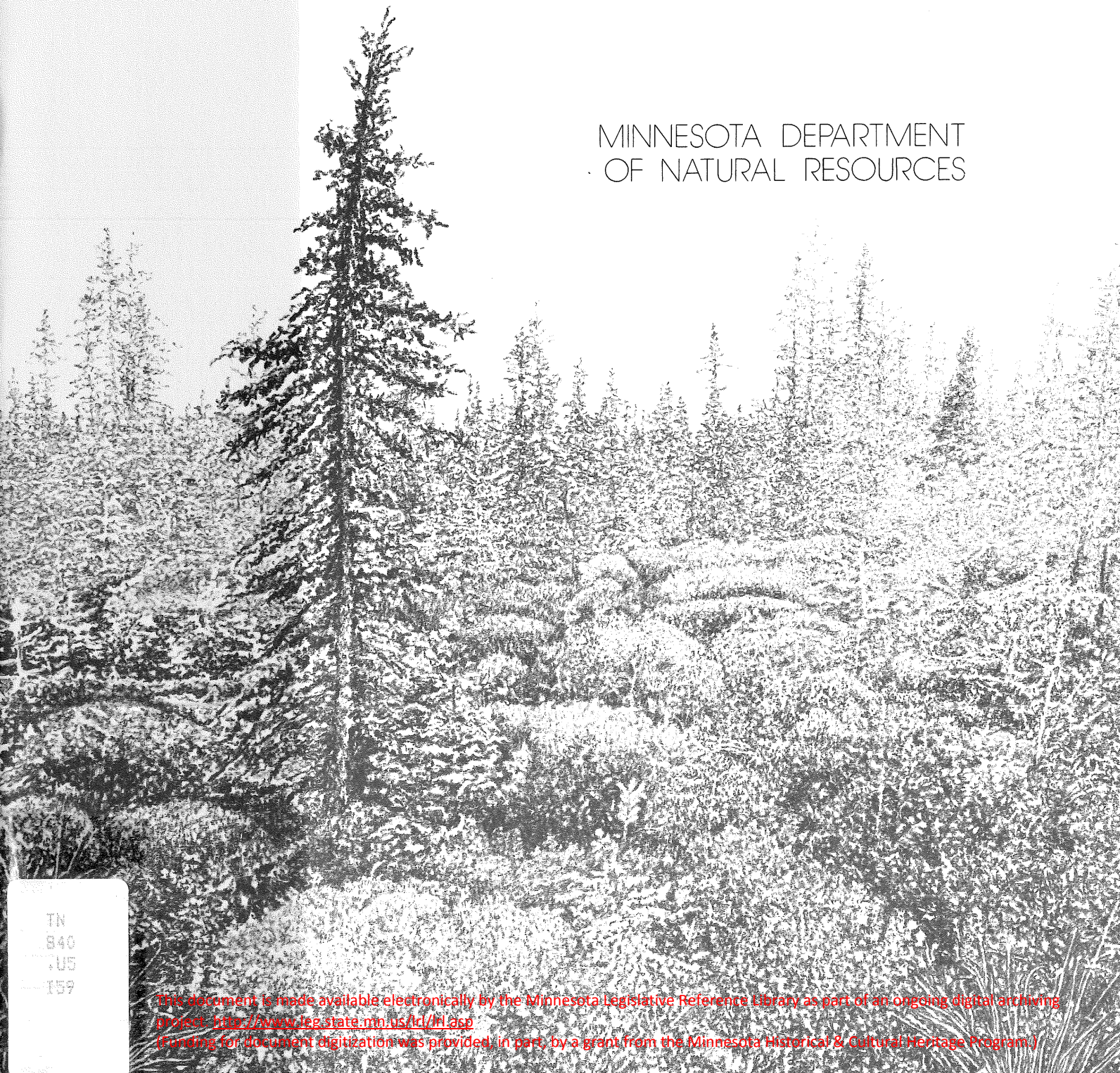




INVENTORY OF PEAT RESOURCES

AN AREA OF
BELTRAMI AND LAKE OF THE WOODS COUNTIES,
MINNESOTA

MINNESOTA DEPARTMENT
OF NATURAL RESOURCES



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INVENTORY OF PEAT RESOURCES

AN AREA OF BELTRAMI AND LAKE OF THE WOODS COUNTIES MINNESOTA

prepared by the

**Minnesota Department of Natural Resources
Division of Minerals**

**Peat Inventory Project
Hibbing, Minnesota
1984**

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INTRODUCTION

This report presents the findings of the Minnesota Peat Inventory Project's (MPIP) reconnaissance-level survey of an area of Beltrami and Lake of the Woods counties (fig. 1). Peatlands cover about 314,000 hectares (775,000 acres) of this area and constitute about 12 percent of the state's total peat resource.

The survey identifies the location and amount of fuel-grade and horticultural peat in the two county area. Funding for this project was provided by the State Legislature and by a grant from the U.S. Department of Energy and the Gas Research Institute. This report is the fourth in a series of publications that assess the peat resources in Minnesota.

The report consists of (1) a text that provides a general discussion of peatlands and describes the field and laboratory procedures of this peatland survey and (2) a map of the peat resources in the surveyed area.

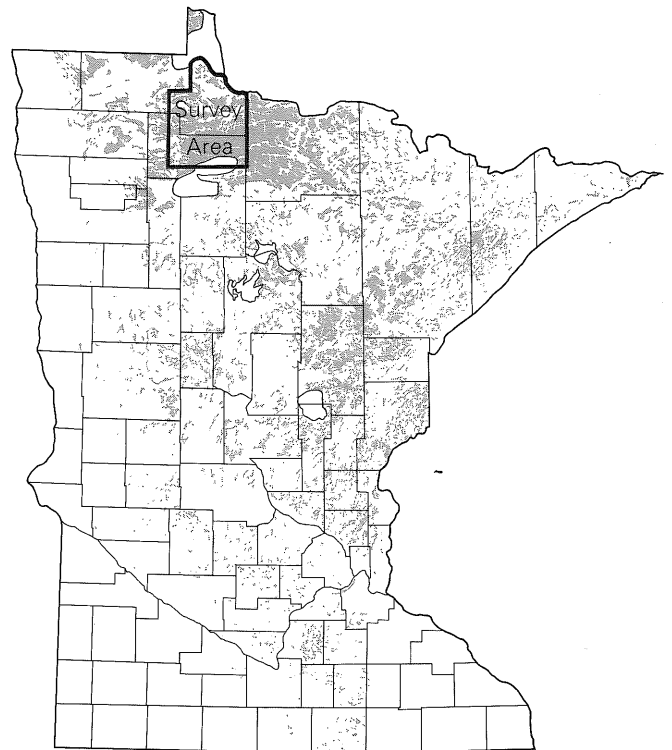


Fig. 1. Location of the Beltrami and Lake of the Woods Counties Survey Area

INTRODUCTION TO PEATLANDS

PEATLAND FORMATION

Requirements for Peat Formation

Peat is organic matter, in varying stages of decomposition, that accumulates over time under water-saturated conditions. Peat deposits contain plant remains from trees, shrubs, sedges, grasses, forbs, and mosses. Peat formation is dependent upon the interrelationship of geologic, topographic, climatic, and biotic factors (Heinselman 1963) and only occurs when the rate of production of organic material exceeds the rate of decomposition.

Peatlands are found throughout the world wherever the combination of environmental factors allows for peat accumulation. The most typical areas for peatland formation are the boreal and arctic regions of the northern hemisphere, but peatlands also can be found in the tropics and the subtropics (Moore and Bellamy 1974). The optimum areas for peatland formation have cool, humid climates and are poorly drained. Peat accumulates in these areas because the saturated conditions limit the amount of oxygen present, which in turn restricts the number of aerobic microorganisms that are available to digest the plant remains.

Peatland Formation Processes

There are two major processes of peatland formation: lakefill and paludification. Lakefill is the filling in of lakes and ponds by vegetation (fig. 2). Following the creation of a lake, limnic sediments, composed of aquatic plant and animal debris, begin to accumulate on the bottom. Plants, such as sedges, mosses, and ericaceous shrubs, become established along the lake margins and eventually die. These plant remains accumulate as peat because of the anaerobic conditions and form a medium on which other plants can grow (fig. 2, INITIAL STAGE). The accumulating peat and the living

plants form a floating mat that slowly extends into the center of the lake (fig. 2, INTERMEDIATE STAGE). The water space between the floating mat and the limnic sediments is slowly replaced by peat as plants die and the plant debris accumulates (Tarnocai 1978) (fig. 2, COMPLETELY-FILLED STAGE).

Paludification, also called swamping, is the process of peatland formation and expansion caused by a gradual raising of the water table due to peat accumulation (Heinselman 1963) (fig. 3). It occurs on level or gently sloping terrain where the water table is close to the surface, creating conditions favorable to the growth of plants adapted to a wet environment. Plant debris gradually accumulates as peat, which further impedes drainage. The water table rises, and the peatland expands as the plants migrate from the original site of peat accumulation (fig. 3, INITIAL STAGE). Under constant climatic conditions, this cyclical process continues and makes peatland expansion upslope possible. Paludification can ultimately result in a continuous blanket of peat over the regional landscape, regardless of the underlying topography (fig. 3, EXPANSION STAGE).

The invasion of sphagnum moss species occurs as the peat build-up continues and the surface vegetation becomes increasingly isolated from the influence of the ground water. A cap of sphagnum moss peat may eventually accumulate on the previous peat deposition.

CLASSIFICATION

Peat Classification

Numerous peat classification systems exist, each designed for specific purposes. The systems range from classification of the resource for soil scientists to classification for the horticultural peat industry. Most peat scientists adopt a combination of classification systems

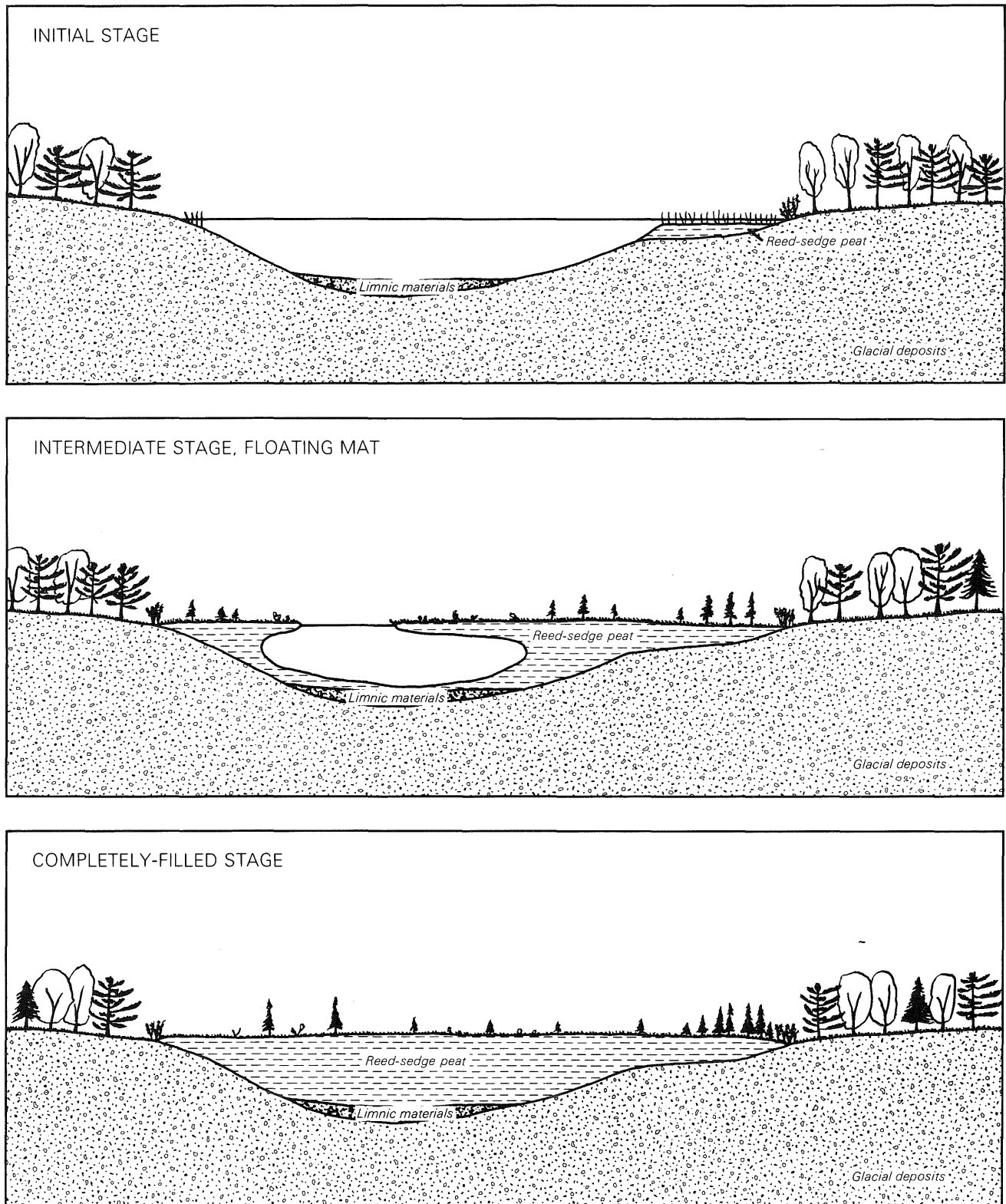


Fig. 2. Lakefill Process of Peatland Formation

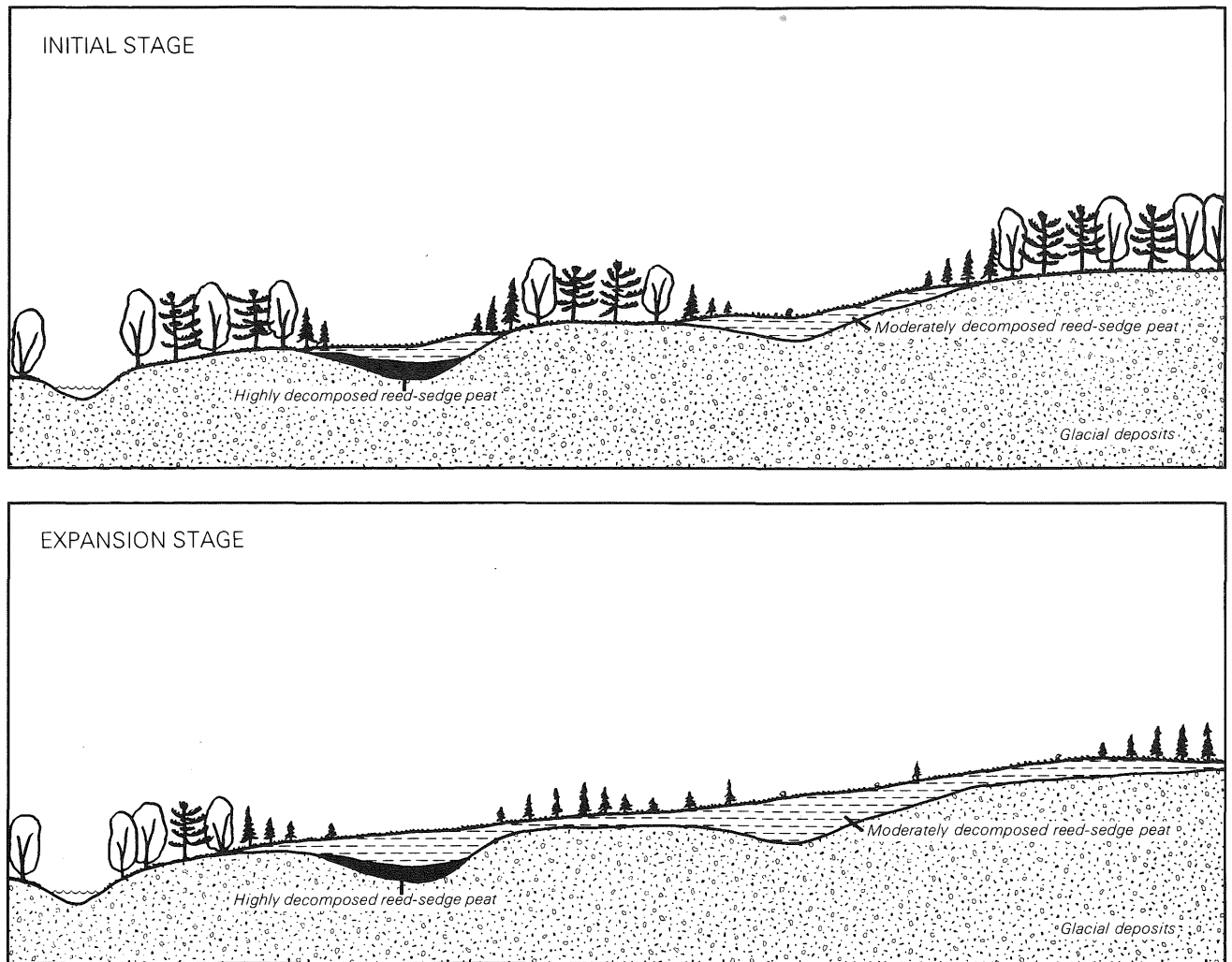


Fig. 3. Paludification Process of Peatland Formation

that incorporates criteria that pertain both to the degree of decomposition and to the botanical origin of the organic materials.

In the United States, systems developed by the Swedish scientist von Post, the U.S.D.A. Soil Conservation Service (SCS), and the International Peat Society (IPS) are widely used. In the 1920s, von Post developed a classification scheme to assess the degree of decomposition of undisturbed peat (Puustjarvi and Robertson 1975). It is a ten-point scale based on a visual examination of the physical properties of a peat sample. The peat is classified by squeezing a small sample in a clenched fist and observing (1) the amount and the turbidity of the water that is released, (2) the amount of peat that is extruded between the fingers, and (3) the nature of the plant residues. The scale ranges from H1 for undecomposed peat to H10 for completely decomposed peat (Table 1).

The Soil Conservation Service (1975) classifies organic soil (peat) by the degree of decomposition and by the botanical origin of the peat material. Two parameters, rubbed fiber content and the solubility of the organic soil materials in chemical solution, determine the degree of decomposition, which is used to classify peat into three types. Fibric soil materials are the least decomposed of the three types. The botanical origin of the relatively undecomposed plant fiber can be readily identified. Sapric soil materials are the most decomposed of the three types, and the origin of the plant material generally cannot be identified by a visual inspection. Hemic soil materials are intermediate in the degree of decomposition; usually, the botanical origin of the fibers can be identified.

In 1976, the International Peat Society, in an effort to standardize peat classification systems worldwide, published its classification proposal (Table 2). It collapsed

TABLE 1

MODIFIED VERSION OF THE VON POST SCALE FOR ASSESSING THE DEGREE OF DECOMPOSITION OF FRESH PEAT

Degree of decomposition	Nature of water expressed on squeezing	Proportion of peat extruded between fingers	Nature of plant residues	Description
H1	Clear, colourless	None	Unaltered, fibrous, elastic	Undecomposed
H2	Almost clear, yellow-brown	None	Almost unaltered	Almost undecomposed
H3	Slight turbid, brown	None	Most remains easily identifiable	Very slightly decomposed
H4	Turbid, brown	None	Most remains identifiable	Slightly decomposed
H5	Strongly turbid, contains a little peat in suspension	Very little	Bulk of remains difficult to identify	Moderately well decomposed
H6	Muddy, much peat in suspension	One third	Bulk of remains unidentifiable	Well decomposed
H7	Strongly muddy	One half	Relatively few remains identifiable	Strongly decomposed
H8	Thick mud, little free water	Two thirds	Only resistant roots, fibres and bark, etc., identifiable	Very strongly decomposed
H9	No free water	Almost all	Practically no identifiable remains	Almost completely decomposed
H10	No free water	All	Completely amorphous	Completely decomposed

SOURCE: Puustjarvi and Robertson, Peat in Horticulture.

the ten-point von Post system into three categories: R1 includes H1-H3, R2 includes H4-H6, and R3 includes H7-H10. The proposal also classified peat by its botanical origin. The groups include (1) moss peat, composed mainly of plant remains derived from sphagnum and other mosses; (2) herbaceous peat, composed mainly of plant remains derived from sedges, reeds, grasses, and related species; (3) wood peat, composed of plant remains from trees and shrubs; and (4) mixed groups.

Peatland Classification

Scientists classify peatlands by a number of criteria, including water chemistry, vegetation, and landforms. A brief explanation of three classifications follows.

Peatlands can be divided into two types, ombrotrophic and minerotrophic, based on the source of their water and nutrients (Sjors 1963). Ombrotrophic peatlands receive water and nutrients solely from precipitation. Their waters are acidic and nutrient poor. Minerotrophic peatlands also receive water and nutrients from precipitation, but in addition they are influenced by

water that has percolated through mineral soils. Their waters are usually slightly acidic or circumneutral and are rich in nutrients.

Bogs, fens, and swamps are the general vegetation types associated with these two peatland types. Bogs are ombrotrophic peatlands that support a low diversity of species because of the extremely acidic and nutrient-poor conditions (pH less than 4.2 and Ca^{2+} concentration between 0.5 and 2.1 mg/l [Glaser, et al. 1979, Sjors 1963]). Bogs have a nearly continuous sphagnum moss carpet (Glaser, et al. 1979; Heinselman 1970), which increases the acidic conditions and further limits the species diversity on these peatlands. Bogs are often dominated by stunted black spruce in stands of varying densities, but they may also be unforested (open bog). The understory is composed of ericaceous shrubs, such as leatherleaf and Labrador tea; sedges; and cotton grass.

Fens and swamps are the two vegetation types that occur on minerotrophic peatlands. Because of the nutrient-rich conditions (pH 4 to pH 7 and Ca^{2+} of 2 mg/l [Glaser, et al. 1979, Sjors 1963]), both fens and swamps support a high species diversity. Although the species found in fens and swamps can include any of the species

TABLE 2
IPS THREE-GRADE SCALE OF PEAT DECOMPOSITION

Scale grade	Percent of fibers	Structure and look of the peat bulk	Presence and look of humus	Amount and look of water
R1 Weakly decomposed peats	>70%	Spongy or fibrous, built of plant residues tied with one another. For separation tearing off the plant residues is required. Easily recognizable plant residues (well preserved). Elastic, compact.	Not visible or occurs in little amounts as a dispersed dark mass, saturating and coloring plant residues.	Great amount of water, which can be easily pressed out and pours as a streamlet. Almost totally pure or slightly brownish. May contain dark humus spots.
R2 Medium decomposed peats	70-40%	Amorphous-fibrous, grass and moss peats contain numerous plant residues of various size; woody peats are more friable due to the presence of wood residues in amorphous humus. When pressed in fingers, transforms into an amorphous, plastic mass.	Distinctly discernible against which plant residues are visible. Humus can be pressed out between fingers of the clenched fist but not more than 1/3 of the taken sample.	Can be pressed out or flows by few drops; usually thick and of dark color/humus. In drained peat slightly colored with humus coagulated in consequence of partly drying.
R3 Strongly decomposed peats	<40%	Lumpy-amorphous, consisting in main part of humus. In lumpy-amorphous peat greater fragments of plant residue/wood, rhizomes, greater rootlets/occur. Friable, disintegrates under pressure. Amorphous peat strongly plastic, with sporadic greater plant residues.	Uniform mass, can be pressed out between fingers of the clenched fist in the amount of a half or the whole of the taken sample.	Cannot be pressed out, instead the humus mass is squeezed.

found in bogs, the bog species do not constitute the dominant vegetation cover. Fens are often open and meadowlike in appearance, and the cover is dominated by sedges, with occasional grasses and forbs. Occasionally, small shrubs (such as bog birch) and scattered, stunted trees (such as tamarack, northern white cedar, and black spruce) occur. Swamps, in contrast to fens, are dominated by either trees (such as northern white cedar, black ash, black spruce, and tamarack) or by tall shrubs (such as alder and willow). Herbaceous vegetation forms the understory.

Some peatlands contain landforms that can be classified by their physical characteristics. These landforms result from the interaction of water flow, water chemistry, and vegetation. Several examples from Minnesota follow.

Water tracks are areas in which mineral-rich water is channeled across a peatland expanse (fig. 4). Because of

the nutrient-rich conditions, fen vegetation occurs. Within water tracks, one can find several types of vegetation patterns, including patterned fens and peat islands of various sizes and shapes (Wright and Glaser 1982). Patterned fens, also called ribbed fens, consist of a series of alternating, sinuous ridges (strings) of vegetation and parallel, water-filled troughs (flarks) oriented perpendicular to the surface flow of the water (fig. 4). Teardrop-shaped islands are an example of the small peat islands found in the water tracks. These islands are oriented parallel to the water movement and have heads of small tamarack and black spruce and tails of brush extending downslope (fig. 4).

Raised bogs are a type of bog characterized by a dome-shaped accumulation of fibric sphagnum moss peat, usually overlying hemic herbaceous peat (fig. 5). They begin to form on local watershed divides within peatlands where isolation from mineral-rich water favors



Fig. 4. Aerial Photograph Showing Peatland Landforms. Landform features include (1) water track with ribbed fen, (2) teardrop-shaped island, and (3) ovoid islands. (Red Lake Peatland, Beltrami County, Minnesota)

sphagnum moss growth (Heinselman 1970). Because of the acidic and saturated conditions, there is a low rate of decomposition of the organic matter. Peat accumulates more rapidly on these sites, and the deposit becomes convex in shape, when viewed in cross-section, and increasingly dependent on precipitation as the major source of water and nutrients (Heinselman 1975, Boelter and Verry 1977, Walker 1970). Typical raised bog vegetation patterns can be interpreted on aerial photographs as lines of black spruce radiating outward from a central point or axis (fig. 6). Unforested openings between these lines of spruce are bog drains, where runoff is channeled away from the bog crest (Glaser, et al. 1981). Further downslope the drains coalesce to form open and broad sphagnum lawns.

Ovoid islands are a type of bog whose shapes are delimited by water flow (fig. 4). These islands are believed to be formed by the headward expansion of bog drains, which can lead to fragmentation of bog forest into clusters with water flow directed around their margins (Wright and Glaser 1982).

Generally, the distinguishing features of the various landform types can be readily identified on aerial photographs. In some peatlands, however, the features, particularly the radiating pattern of black spruce on raised bogs, have been obscured by fire scars, making an interpretation of the features more difficult.

PEAT STRATIGRAPHY

The stratigraphy of a peat deposit refers to the layering of peat within a deposit. The material in each peat layer originates from peatland vegetation; thus, the analysis of plant remains of successive peat layers can be used to reconstruct the succession of peatland plant communities. An analysis of the decomposition of peat material in each layer can be used to reconstruct the hydrological conditions during the existence of the peatland.

A typical, simplified cross-section, described using

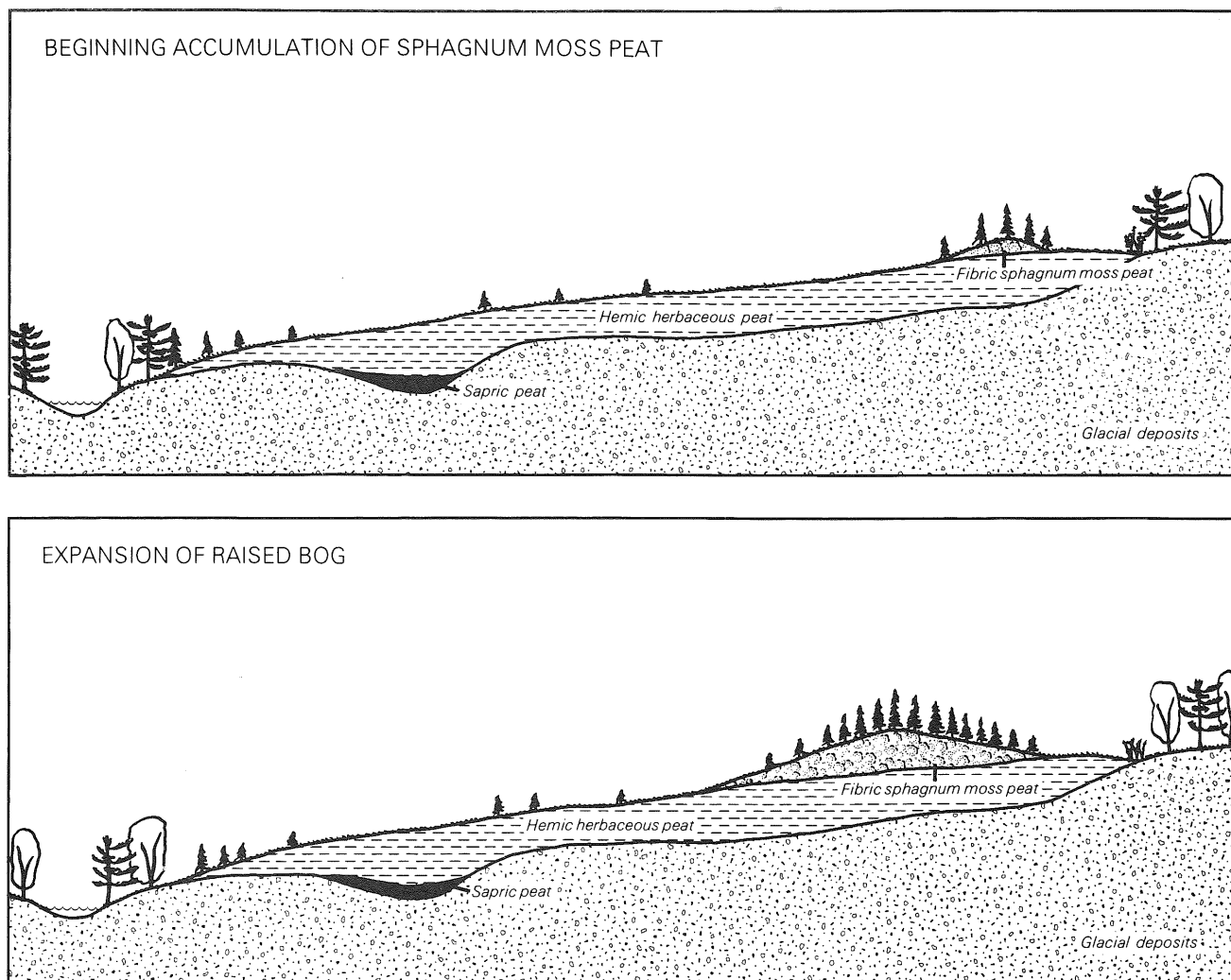


Fig. 5. Raised Bog Formation

the SCS nomenclature for organic soil materials, consists of a very thin basal layer of sapric peat, covered by a relatively thick layer of hemic peat, and overlain locally by fibric peat. Basal peat accumulations are usually composed of fen or swamp vegetation and are generally strongly decomposed because the aerobic conditions during initial peat accumulation favor a rapid rate of decomposition. As the peat continues to accumulate, the resultant rise in the water table produces saturated, anaerobic conditions that slow the rate of decomposition and result in hemic peat accumulation. In Minnesota, most of the hemic peat accumulation is decomposed fen vegetation. The local accumulations of weakly decomposed fibric peat are composed primarily of sphagnum moss remains.

Variations in this typical profile occur. For example, sapric and fibric peat formed from similar plant communities may be interlayered with hemic peat. This layer-

ing may reflect short-term climatic changes, such as drought or excessive precipitation. Recent man-related activities, such as ditching, often result in sapric surface layers adjacent to the ditches.

USES OF PEAT

The depth, type, areal extent, and location of a peat deposit are factors that may determine its use. For example, peat energy projects require extensive areas of hemic or sapric peat because these types of peat have a high heating value per pound dry weight. In horticultural operations, fibric sphagnum moss peat has the highest value as a soil amendment because of its high water-holding and cation exchange capacities.

Another use of peat is as a chemical raw material for



Fig. 6. Aerial Photograph Showing a Raised Bog. Features include (1) a radiating pattern of black spruce, (2) bog drains, and (3) sphagnum lawn.
(Pine Island Peatland, Koochiching County, Minnesota)

the production of industrial commodities such as peat coke, waxes, and yeasts. The botanical origin and decomposition of the peat determines the amount of these products that can be obtained. For example, greater quantities of carbohydrates, used in the production of yeasts, can be extracted from sphagnum moss peat than from other peat types (Fuchsman 1978).

In addition to these extractive uses of peat, there are several nonextractive uses of peatland. These include agriculture, forestry, wildlife management, sewage treatment, preservation, recreation, and the production of energy crops. For a detailed discussion of peat uses, see *Minnesota Peat Program Final Report* (MDNR 1981).

PEATLANDS IN BELTRAMI AND LAKE OF THE WOODS COUNTIES

AREA SELECTED FOR SURVEY

The MPIP survey of Beltrami and Lake of the Woods counties focused on the areas of greatest peat accumulation, as measured by both the areal extent and depth of the deposits. The inventoried area contains numerous large peatlands, including the Red Lake Peatland, one of the largest contiguous peatlands in the conterminous United States (Glaser, et al. 1979). In contrast, southern Beltrami County contains only small, scattered peatlands and therefore, was not included in the survey. The westernmost portion of Beltrami County contains shallow peatlands and was excluded to conform with the purpose of the MPIP survey to identify peatlands greater

than 150 cm deep.

DEVELOPMENT OF THE PRESENT LANDSCAPE

The distribution of peatlands in this area is a result of the depositional and erosional processes of glacial and post-glacial times. During the last glaciation of North America, the Wisconsin Stage, the ice advanced several times across the area. The last glacier to affect these counties was the St. Louis sublobe of the Des Moines lobe, which advanced from the northwest and deposited ground moraine across the study area (fig. 7).

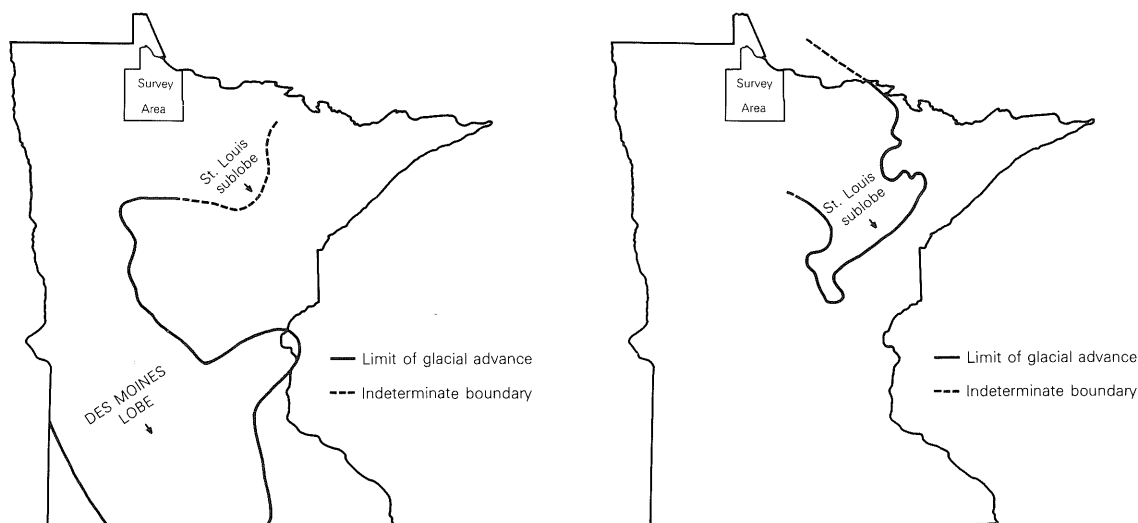


Fig. 7. The Advance of the St. Louis Sublobe Across the Beltrami and Lake of the Woods Counties Survey Area (based on Wright 1972)

As the ice sheet wasted, the meltwater was ponded between the ice front and terminal moraines and higher ground on the south and east, creating Glacial Lake Agassiz (fig. 8). The lake covered at least a part of the study area from about 12,000 to 9,900 years ago (Griffin 1977, Wright 1972, Clayton and Moran 1982). Wave action reworked the glacial till and deposited beachlines, off-shore sand, and lake bottom sediments (Eng 1979 and unpublished). As the lake drained, a broad, flat, gently undulating plain remained.

Peat accumulation did not begin immediately after the lake drained. Pollen analysis indicates that the climate became warmer and drier for a time and the vegetation changed from boreal forest to prairie. The climate then changed again, becoming cooler and wetter and conducive to peat formation. A peat core obtained from a site in the Red Lake Peatland (located in T.155N., R.33W., Sec. 11) records about 3,000 years of peat accumulation (Griffin 1977). Earlier peat accumulation may have occurred, but any layers were probably burned away in fires. Initial peat accumulation consisted primarily of sedges. Sphagnum moss peat accumulation in this area did not begin until about 2,000 years ago, although sphagnum mosses may have been present earlier (Griffin 1977).

SURVEY

The MPIP inventoried the peatlands in the area to identify (1) the areal extent, depth, and type of peat, and (2) those peatlands containing fuel-grade peat. Fuel-grade peat as defined by the U.S. Department of Energy (DOE) (1) has a heating value of 8,000 Btu/pound or more in an oven-dried state, (2) contains less than 25% ash, (3) occurs in deposits that are at least 150 cm (~5 ft) deep, and (4) covers a cumulative area of more than 30 ha (80 ac) per 2.6 km² (1 mi²).

The inventory was a reconnaissance-level survey, which is useful for resource management and for identifying areas that require more detailed mapping. In this type of survey, the boundaries between mapping units are based on field observations, aerial photograph interpretation, and the general appearance of the landscape (Soil Survey Staff 1951).

This report and the accompanying map, *Peat Resources, An Area of Beltrami and Lake of the Woods Counties, Minnesota* (in back flap), present the results of this inventory work.

Field Procedures

The survey began with the interpretation of 1:24,000 United States Geological Survey (USGS) quadrangle and orthophotoquadrangle maps and 1:80,000 aerial photographs. MPIP staff used these maps and aerial photos to identify the peatlands to survey. Peatland landforms were used as indicators of the botanical origin and the amount of decomposition of the surface layers of the peat.

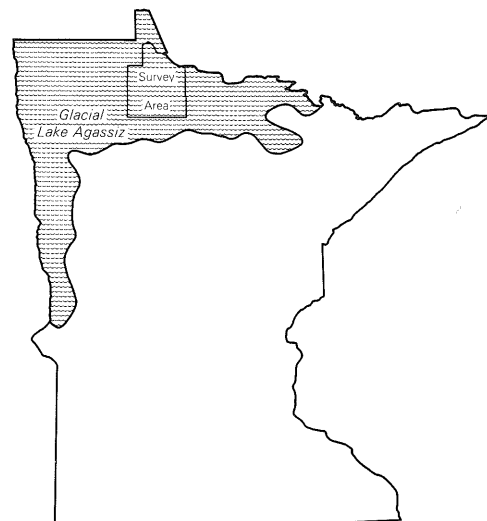


Fig. 8. The Area Covered by Sediments of Glacial Lake Agassiz (based on Wright 1972)

Observation Sites

MPIP staff members selected field observation sites to provide data on the stratigraphy and depth of the peatlands. The data were collected along traverses and at random locations within the peatlands. Because of the vastness of the peatlands in these counties, field crews reached the majority of the sites by helicopter when clearings permitted landing. Other sites were reached either by all-terrain vehicle when located near trails or on unforested, unditched peatlands, or by foot when located within walking distance of roads. Access by all-terrain vehicle or by foot increased the density of the observation sites.

At over 650 sites, the field crews described the peat profile, vegetation, and microrelief. A Davis sampler was used to bring up a small sample at regular intervals (about every 30 cm) in the profile. These samples were examined to determine the degree of decomposition according to the von Post scale, the botanical origin of the layers according to the IPS classification, and the texture of the underlying mineral material. These data are available at the Department of Natural Resources, Minerals Division, Hibbing or St. Paul, Minnesota.

Sample Sites

Inventory staff sampled 133 representative peatland sites for laboratory analysis. Several factors were considered in the selection of these sites, including the peatland landform type and the depth and layering of the peat accumulation.

Staff members used a Macaulay sampler to collect undisturbed peat samples of known volume within specific layers of the deposit. At 121 sites, the field crews collected samples from a core for analysis at the

MPIP laboratory in Hibbing. At the 12 remaining sites, two cores in close proximity to each other were sampled within layers of the same peat type. Samples from one core were analyzed at Hibbing, and samples from the second core were sent to the DOE Coal Analysis Laboratory at the Grand Forks Energy Technological Center, Grand Forks, North Dakota, for energy value analysis.

Additional Information

To supplement the field data, the MPIP staff examined three additional sources of information. These data were obtained from the SCS, the Iron Range Resources and Rehabilitation Board (IRRRB), and an unpublished doctoral dissertation by Finney.

In Beltrami County, SCS soil scientists are currently gathering and compiling information to publish a detailed Soil Survey of the county (to be completed by 1989). The MPIP used the SCS profile descriptions where applicable.

MPIP staff also examined the IRRRB (1966) report entitled, *Peat Resources of Minnesota, Red Lake Bog*. The IRRRB inventoried the major raised bog complex in the Red Lake Peatland, primarily to assess the quality and the quantity of the sphagnum moss peat resource. Their report contains 80 site descriptions that include the total depth of peat and the type, pH, ash content, and water holding capacity of the top seven feet of the peat at one foot intervals.

Finney's (1966) thesis focused on the structure of raised bogs, as revealed by the configuration of the deposits and the stratigraphy of the peat layers in four raised bogs in northern Minnesota. One of the raised bogs studied was the raised bog complex in the Red Lake Peatland. Finney made three transects of the raised bog and recorded the thickness of the peat strata and the depth to the underlying mineral material.

Mapping Procedures

Compilation of the *Peat Resources* map began with an examination of field data to determine which mapping units were appropriate for a peatland. The mapping units, which were developed during earlier MPIP surveys, differentiate the depth, the degree of decomposition, and the botanical origin of the peat. Staff members converted the field descriptions from the ten-point von Post scale to three categories for the mapping units. SCS terminology for organic soil materials was used to identify these classes, which are related to the von Post scale in the following manner: fibric (H1-H3), hemic (H4-H6), and sapric (H7-H10).

The peat mapping units were delineated through the use of two sets of contour lines. One set differentiates the total depth of peat in increments of 150 cm (~5 ft). The other set identifies the depth of the fibric sphagnum moss peat accumulations of raised bogs. The class intervals for this set of delineations are 20-60, 61-150, and 151-300 cm (~1-2, 2-5, and 5-10 ft).

MPIP staff drew each set of contour lines on 1:24,000 USGS quadrangle maps. The locations of the lines are based primarily on (1) the site descriptions, which were

plotted on the quadrangles and served as the control points for drawing the contours, and (2) aerial photograph interpretation, which was particularly important for delineating the areal extent of the raised bogs. Where appropriate, the MPIP staff used the SCS, IRRRB, and Finney data to verify delineations.

Once the contour lines were drawn, the quadrangles were reduced to a scale of 1:126,720 (1/2 inch : 1 mile). The peat delineations were then transferred to an overlay registered to the 1981 highway maps of Beltrami and Lake of the Woods counties on which the peat/mineral boundaries were drawn (based on Eng 1979 and unpublished).

Minor inclusions may occur within these mapping units due to the effects of generalization during map compilation and production. Two types of generalization that affect the map are (1) the map scale, which restricted the size of the mapping unit that could be delineated and labeled to approximately 30 ha (80 ac); and (2) the number and location of the observation and sample sites that served as the control points.

Laboratory Analyses

Laboratory analyses provide data to characterize the peat and determine its suitability for various uses. In addition to collecting field data, physical and chemical parameters were measured to help classify the peat soils.

MPIP Analyses

The MPIP performed analyses for ash content, moisture content, bulk density, and pH on 378 samples from 133 sample sites. The laboratory methods appear in Appendix A, and the data appear in Appendix B.

Ash is the residue left after a sample is heated to a sufficient temperature to drive off all combustible material. The residue comes from the original peat-forming vegetation as well as from sediment brought into the peatland by runoff from mineral soil and as atmospheric dust. As a result of mineralization during decomposition, ash content increases as the degree of decomposition increases (Walmsley 1977).

Moisture content is a measure of the amount of water that peat absorbs and retains. The amount of water that can be retained depends largely on the degree of decomposition and the botanical origin of the peat. Less decomposed peats have a greater water-holding capacity than those that are more decomposed. The moisture content of sphagnum moss peat is greater than for other peat types. The cellular structure of the moss leaves and stems and the large surface area of the plant, which results from the many small, overlapping leaves and the dense, interwoven growth pattern, increase the water-holding capacity of the plant and, thus, the peat.

Bulk density is a measure of the weight of a given volume of soil. The volume of a sample is usually measured wet because soil volume changes with water content (Walmsley 1977). The bulk density depends upon the organic, mineral, and moisture contents of the peat. As the mineral content increases, bulk density

increases; as the moisture content increases, bulk density decreases. Because bulk density increases with increasing decomposition of the peat, bulk density values can be used as an indirect measure of the degree of decomposition.

pH values describe the hydrogen ion concentration of a solution. The pH values range from 1 to 14, with values less than 7 indicating acidity and values greater than 7 indicating alkalinity. The pH of peat is primarily dependent on the water chemistry, botanical origin, and the decomposition of the peat. Most peat types are acidic (pH values of about 4 to 7) or circumneutral (about pH 7).

DOE Analyses

The DOE laboratory conducted energy value analysis on 26 peat samples from 12 sample sites. The analysis consisted of a determination of the heating value, proximate analysis, and ultimate analysis. The data appear in Appendix C.

Heating Value

Heating value is a measure of the energy released by a fuel when it is completely burned. It is expressed in Btu/pound of material, but for energy estimates that are regional or national in scope, Btu values are converted to quads of energy ($1 \text{ quad} = 1 \times 10^{15} \text{ Btu}$).

Proximate Analysis

Proximate analysis provides data on the characteristics of a peat fuel when it is burned. It is expressed in percentages of moisture, volatile matter, fixed carbon, and ash.

Volatile matter is the gaseous fraction of the fuel, composed mainly of hydrogen and hydrogen-carbon compounds, that is removed by heating the fuel.

Fixed carbon is that portion of the fuel that remains after the volatile matter is driven off before combustion. It is burned in a solid state, such as on a stoker, or as particles in a suspension boiler.

Ash is the inorganic fraction of the fuel that remains after combustion and must be removed from the combustion facility.

Ultimate Analysis

Ultimate analysis identifies the constituents of peat in percentages of carbon, hydrogen, oxygen, sulfur, and hydrogen. The components are used in combustion calculations and for determining plant efficiencies and potential pollutants.

RESULTS

Peatlands in Beltrami and Lake of the Woods Counties

Peatlands in the surveyed area contain peat derived from sedges, reeds, sphagnum and other mosses, and wood fragments. The peat ranges from slightly to strongly decomposed. The fibric peat is generally com-

posed of sphagnum mosses, but fibric peat composed of reeds and sedges or a combination of mosses, reeds, and sedges can be found. The hemic peat is predominantly herbaceous peat and occasionally moss peat. Wood peat layers also occur. The origin of the sapric peat is probably herbaceous or wood, but the high degree of decomposition prevents fiber identification in the field. The absence of limnic materials underlying the peat accumulation at the survey sites indicates that these peatlands formed by the paludification process.

Three diagrams follow to illustrate the peatland types found in the surveyed area. Each diagram consists of a map view and a cross-section drawn along a selected transect. The map views are based on Eng (1979 and unpublished), and the cross-sections are based on the MPIP field data. Surface elevations are from 1:24,000 USGS quadrangle maps.

Figure 9 is an example of a peatland that formed by paludification on the bed of former Glacial Lake Agassiz. The peatland is located in the northeast corner of Lake of the Woods County in an area covered by lakewashed ground moraine, beach deposits, and lake bottom sediments. Most of the peatland has fen vegetation, but an indistinct raised bog pattern is apparent on the eastern edge of the peatland near the Rapid River. The transect passes through a patterned fen in which water flow is to the northeast. The entire peat profile is composed of hemic herbaceous peat that is as deep as seven feet (2.1 m) at the sample sites.

Two ovoid islands occur in a peatland located in the south-central part of Lake of the Woods County (fig. 10). The southern ovoid island exhibits a radiating pattern of black spruce from a central crest; however, in the western half of the island some of the patterning has been obscured by a fire scar. The island has bog vegetation that includes a continuous carpet of sphagnum moss, black spruce, and ericaceous species. The cross-section of this island shows a dome-shaped accumulation of fibric sphagnum moss peat overlying hemic peat. The peat depths reach ten feet (3 m) and include a fibric sphagnum moss cap of three feet (0.9 m).

Within the water track that divides and sharply defines the ovoid islands, minerotrophic species such as tamarack, bog birch, and ferns exist. Hemic and sapric peat comprise the profile.

The northern ovoid island is divided by internal water tracks that have an east-west orientation. The radiating pattern of black spruce is absent or indistinct on portions of the island. Minerotrophic indicator species are found in the internal water tracks. The peat accumulation along this part of the transect is shallow, less than five feet (1.5 m) deep, and consists of 1-2 feet (0.3-0.6 m) of fibric sphagnum moss peat overlying hemic peat.

The third map view and cross-section (fig. 11) is from Minnesota's largest raised bog complex, located north of Upper Red Lake in Beltrami County. This raised bog has a strongly developed pattern of black spruce radiating outward from a linear crest. Approximately one mile (1.6 km) south of the bog crest, the vegetation type changes from forested bog to open bog. The peat accumulation along this transect reaches 14 feet (4.3 m), of which the upper 7-10 feet (2.1-3.0 m) is fibric sphagnum moss peat near the crest.

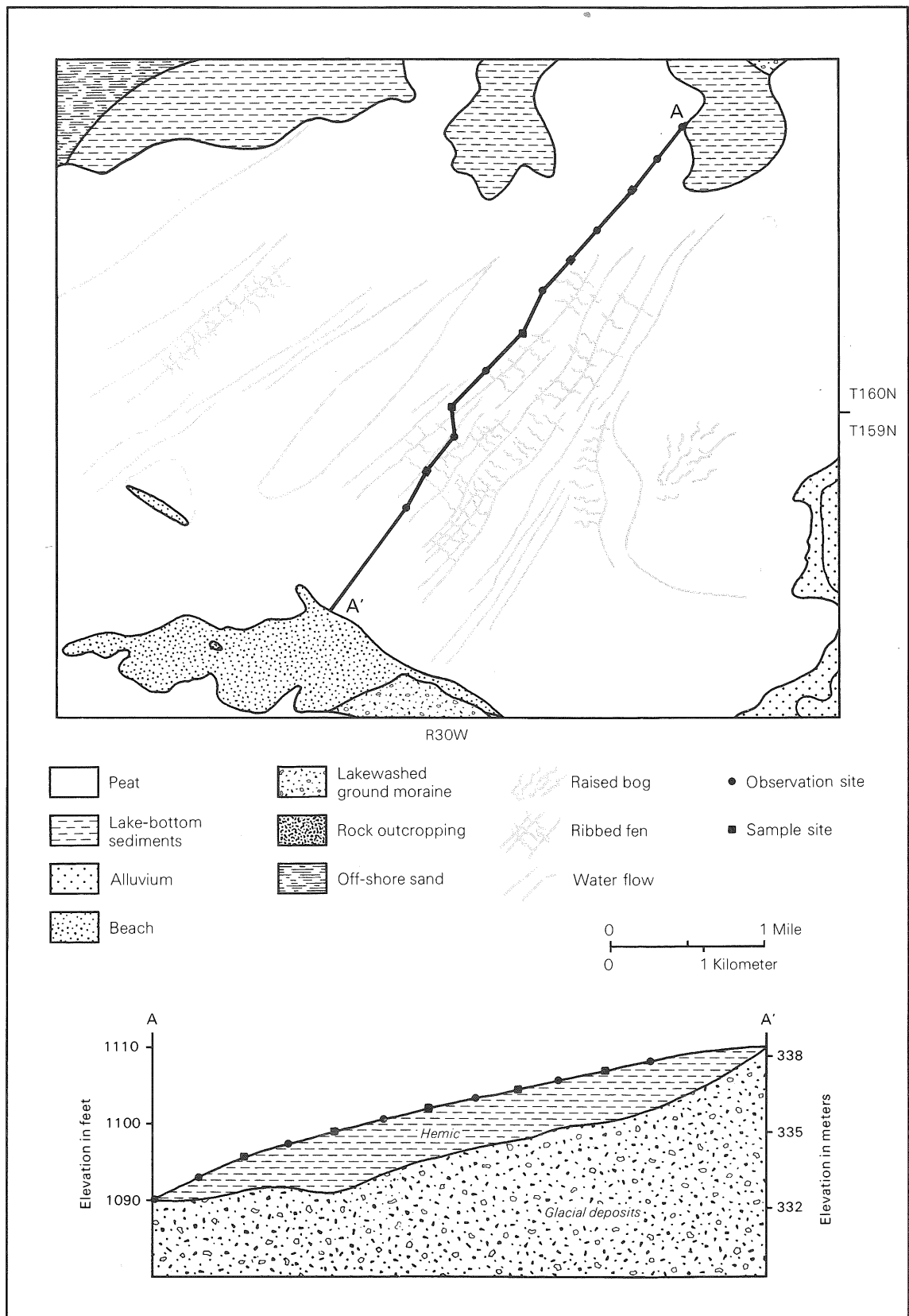


Fig. 9. Peatland Formed by Paludification in Lake of the Woods County

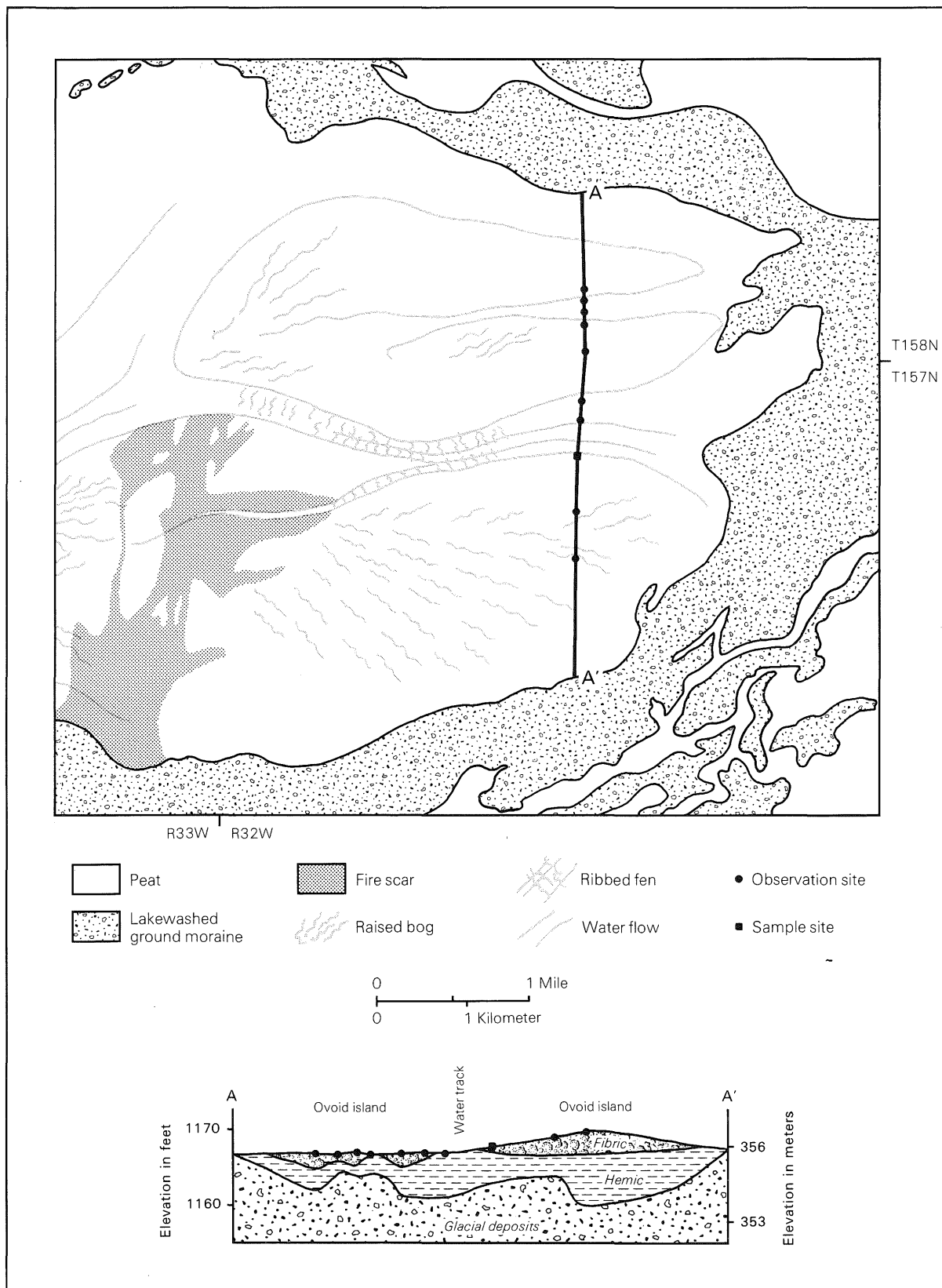


Fig. 10. Peatland Landforms in a Peatland in Lake of the Woods County

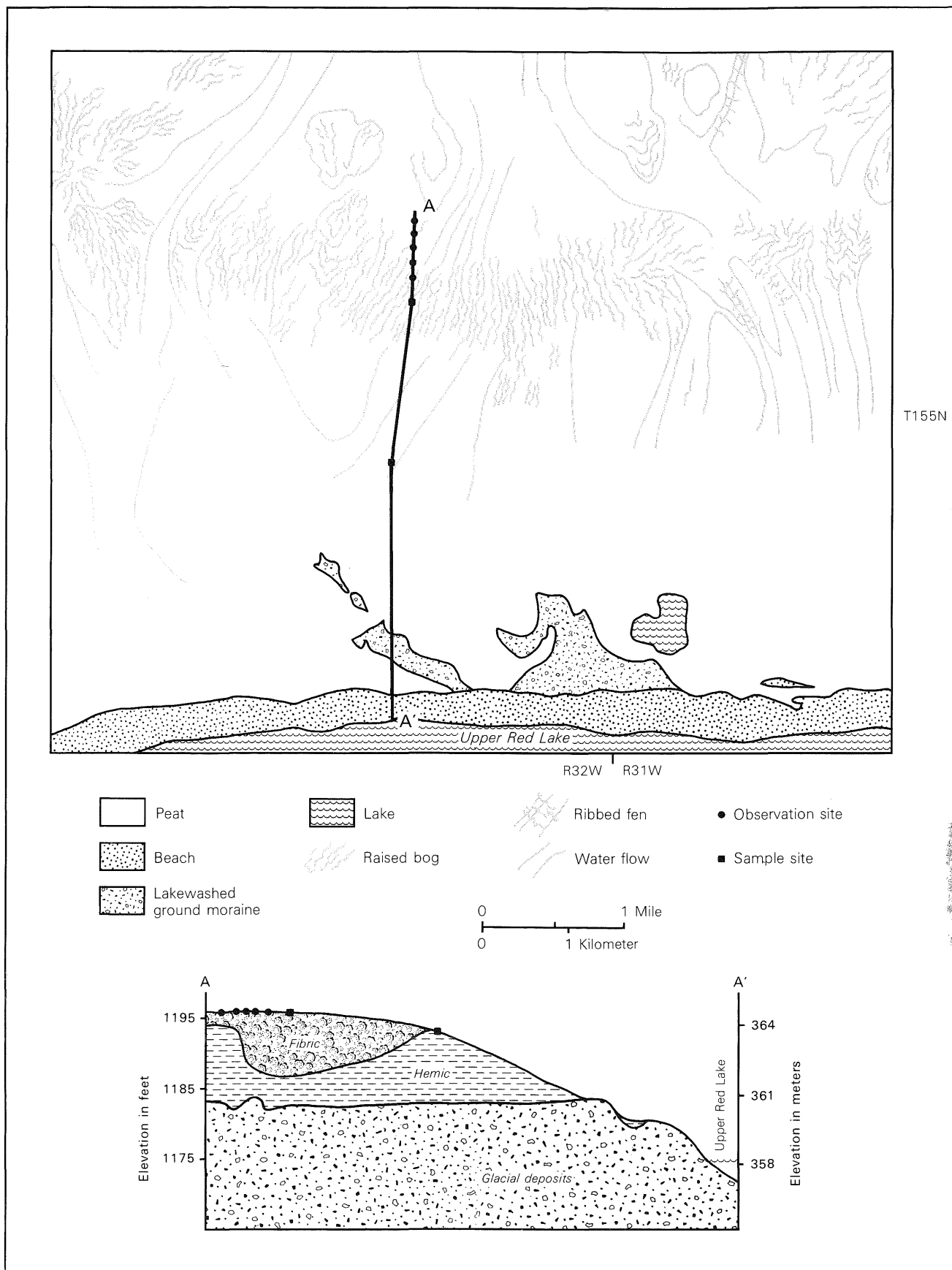


Fig. 11. A Raised Bog in Beltrami County

Laboratory Data

The results of both the MPIP and the DOE analyses of the peat samples are presented in summary form in Tables 3-9.

MPIP Data

The summary data for ash content, moisture content, bulk density, and pH for 378 samples are presented in Tables 3-6. The sample data are presented by site, depth, and type in Appendix B.

The summary data indicate relationships between the parameters and decomposition (fig. 12). These correlations follow results found elsewhere (e.g., Walmsley 1977); that is, the ash content, bulk density, and pH increase with increasing decomposition, while moisture content decreases with increasing decomposition.

DOE Data

The summary data for heating value, proximate analysis, and ultimate analysis for 26 samples are presented in Tables 7-9. Only one sample of sapric peat was analyzed at the DOE laboratory; therefore, the values from this sample are not included in tabular form. Moisture content is measured as received; other values are based on moisture-free samples. Appendix C contains the DOE data.

Twenty-four of the 26 samples met the DOE criteria for fuel-grade peat based on heating value and ash content (i.e., a heating value greater than 8,000 Btu/pound and an ash content less than 25%). The relationship between the decomposition of the peat and the heating value for each peat type is shown in figure 12. Two samples have a heating value less than 8,000 Btu/pound and are therefore not included in the summary analysis. One sample was taken from near the bottom of a shallow deposit (depth about 90 cm), while the other sample was taken from nearer the surface of a deeper deposit.

Resource Estimation

The design of the map, *Peat Resources, An Area of Beltrami and Lake of the Woods Counties, Minnesota*, uses color and patterns to emphasize those peatlands meeting the DOE criteria for fuel-grade peat. Four types of areas are depicted on the map: peat greater than 150 cm deep, peat less than 150 cm deep, areas with sphagnum moss peat accumulation, and mineral soil. Since samples of all three peat types, fibric, hemic, and sapric, generally have heating values greater than 8,000 Btu/pound with an ash content less than 25%, the depth and areal extent of the peatlands became the factors for determining fuel-grade peat.

Fuel-grade peatlands, shown in dark orange on the map, are greater than 150 cm deep and cover at least 30 ha (80 ac). Shallow peatlands, peatlands that are less than 150 cm deep and therefore do not meet the DOE fuel-grade peat criterion for depth, are shown in light orange. The black stipple pattern on peatlands design-

ates peatlands covered by an accumulation of fibric sphagnum moss peat (raised bogs). Through the use of labels and contour lines, the areas of peat greater than 150 cm deep and the areas covered by sphagnum moss peat are further subdivided by depth. Mineral soil areas are displayed in gray.

On the map, the mapping units for total depth of peat are indicated by the following designations:

A	0-150 cm (~ 0- 5 ft)
B	151-300 cm (~ 5-10 ft)
C	301-450 cm (~10-15 ft)
D	451-600 cm (~15-20 ft)

When used alone, the total depth labels (e.g., A) denote a profile composed entirely of hemic peat. A total depth designation used in conjunction with a lower-case letter suffix indicates a hemic peat profile with a fibric moss peat cap or a profile composed of sapric peat.

The mapping units that indicate the fibric sphagnum moss peat accumulation of a raised bog have a total peat depth designation accompanied by one of the following labels, which indicate the amount of relatively unde-composed moss peat accumulation:

a	20- 60 cm (~1- 2 ft)
b	61-150 cm (~2- 5 ft)
c	151-300 cm (~5-10 ft)

An example of one of the mapping unit labels for an area of a raised bog is Aa. The peat unit has a total depth indicated by the first letter (e.g., A 0-150 cm) and has a fibric sphagnum moss peat cap of the depth indicated by the lower-case letter (e.g., a 20-60 cm). Hemic peat composes the remainder of the profile.

The symbol Ax designates sapric peat areas on the map. The profile is predominantly sapric peat and has a depth of A (0-150 cm).

Staff members used the areal extent, depth, bulk density, and Btu values to estimate the energy potential of the peat in this area. To calculate the areal extent of the peatlands, the mapped information was entered into the computer system at the Land Management Information Center of the Minnesota State Planning Agency to obtain acreage counts for each mapping unit. Next, staff members determined the value of the mid-point for each mapping unit so that volumes of peat could be calculated. For example, the mid-point of the B unit, which is 151-300 cm deep, is 225 cm. Laboratory analysis provided values for the bulk density and the heating value of the sampled peat. From these values, the average bulk density and heating value for each peat type were calculated.

The quantity of peat, expressed in peat tonnage, was estimated for each mapping unit by multiplying the areal extent and average depth of each mapping unit by the average bulk density value for the appropriate peat type or types.

Multiplying the quantity of peat by the average heating value for each peat type provided an estimate of the peat energy potential.

Peatland Area

Peatlands cover 314,000 ha (775,000 ac) of a total area

TABLE 3
SUMMARY OF MPIP ANALYSES

	Average	Range	Standard Deviation	Coefficient of Variation
Ash Content (%)	9.1	3.0-24.6	3.08	33.8
Bulk Density (g/cc)	0.13	0.04-0.24	0.04	30.8
Moisture Content (total wt) (%)	87.7	78.5-95.3	3.05	3.5
Moisture Content (dry wt) (%)	765	366-2013	243	31.8
pH (H ₂ O)	5.2	3.4-6.6	0.63	12.1
pH (CaCl ₂)	4.8	2.8-6.0	0.68	14.2

NOTE: Data from 378 samples containing less than 25% ash.

TABLE 4
MPIP ANALYSIS—FIBRIC SAMPLES

	Average	Range	Standard Deviation	Coefficient of Variation
Ash Content (%)	5.7	3.0-11.6	3.00	52.6
Bulk Density (g/cc)	0.07	0.04-0.10	0.02	28.6
Moisture Content (total wt) (%)	92.5	89.2-95.2	2.27	2.5
Moisture Content (dry wt) (%)	1353	828-1981	439	32.4
pH (H ₂ O)	4.4	3.7-5.6	0.61	13.9
pH (CaCl ₂)	3.5	2.8-5.4	0.75	21.4

TABLE 5
MPIP ANALYSIS—HEMIC SAMPLES

	Average	Range	Standard Deviation	Coefficient of Variation
Ash Content (%)	8.9	3.2-22.5	2.75	30.9
Bulk Density (g/cc)	0.12	0.04-0.23	0.03	25.0
Moisture Content (total wt) (%)	87.8	79.7-95.3	2.80	3.2
Moisture Content (dry wt) (%)	767	394-2013	217	28.3
pH (H ₂ O)	5.3	3.4-6.6	0.62	11.7
pH (CaCl ₂)	4.8	2.8-6.0	0.64	13.3

TABLE 6
MPIP ANALYSIS—SAPRIC SAMPLES

	Average	Range	Standard Deviation	Coefficient of Variation
Ash Content (%)	13.6	7.4-24.6	4.32	31.8
Bulk Density (g/cc)	0.18	0.10-0.24	0.04	22.2
Moisture Content (total wt) (%)	83.2	78.5-87.4	2.36	2.8
Moisture Content (dry wt) (%)	505	366-695	82.0	16.2
pH (H ₂ O)	5.4	4.5-6.2	0.37	6.9
pH (CaCl ₂)	5.1	4.4-5.6	0.30	5.9

TABLE 7
SUMMARY OF DOE ANALYSES

	Average	Range	Standard Deviation	Coefficient of Variation
Btu/lb	8714	7460-9411	507.06	5.8
Ash Content (%)	7.7	3.7-15.7	3.44	44.7
Moisture Content (total wt) (%)	91.3	79.1-97.8	3.62	4.0
Volatile Matter (%)	65.3	57.8-70.5	3.59	5.5
Fixed Carbon (%)	27.0	20.1-30.2	2.08	7.7
Hydrogen (%)	4.81	3.57-5.33	0.41	8.5
Carbon (%)	52.17	46.26-55.26	2.34	4.5
Nitrogen (%)	1.99	0.72-3.07	0.80	40.2
Sulfur (%)	0.62	0.14-2.6	0.75	121
Oxygen (%)	32.7	24.7-38.5	3.72	11.4
Bulk Density (g/cc)*	0.10	0.05-0.18	0.04	40.0
pH (H ₂ O)*	5.0	3.7-6.0	0.68	13.6
pH (CaCl ₂)*	4.3	2.8-5.5	0.84	19.5

NOTE: Data from 24 samples containing less than 25% ash.

* Analysis performed in MPIP laboratory (samples from DOE site, but from a second profile).

TABLE 8
DOE ANALYSIS—FIBRIC SAMPLES

	Average	Range	Standard Deviation	Coefficient of Variation
Btu/lb	8354	7460-8781	440.6	5.3
Ash Content (%)	6.0	3.7-9.4	2.16	36.0
Moisture Content (total wt) (%)	93.4	90.9-97.8	2.46	2.6
Volatile Matter (%)	68.4	65.5-70.5	1.76	2.6
Fixed Carbon (%)	25.6	20.1-29.0	2.84	11.1
Hydrogen (%)	4.98	4.71-5.24	0.19	3.8
Carbon (%)	50.93	46.26-53.71	2.54	5.0
Nitrogen (%)	1.10	0.90-1.67	0.27	24.5
Sulfur (%)	0.17	0.15-0.20	0.02	11.8
Oxygen (%)	36.8	34.2-38.5	1.52	4.1
Bulk Density (g/cc)*	0.07	0.05-0.09	0.02	28.6
pH (H ₂ O)*	4.1	3.7-4.5	0.32	7.8
pH (CaCl ₂)*	3.2	2.8-3.6	0.36	11.3

* Analysis performed in MPIP laboratory.

TABLE 9
DOE ANALYSIS—HEMIC SAMPLES

	Average	Range	Standard Deviation	Coefficient of Variation
Btu/lb	8863	7504-9411	481.23	5.4
Ash Content (%)	8.0	4.8-15.7	3.48	43.5
Moisture Content (total wt) (%)	90.7	79.1-94.5	3.74	4.1
Volatile Matter (%)	64.4	57.8-70.4	3.26	5.1
Fixed Carbon (%)	27.6	24.8-30.2	1.53	5.5
Hydrogen (%)	4.77	3.57-5.33	0.44	9.2
Carbon (%)	52.70	48.05-55.26	2.19	4.2
Nitrogen (%)	2.28	0.72-3.07	0.67	29.4
Sulfur (%)	0.69	0.14-2.6	0.71	102.9
Oxygen (%)	31.5	26.4-38.1	2.71	8.6
Bulk Density (g/cc)*	0.10	0.05-0.18	0.03	30.0
pH (H ₂ O)*	5.3	4.5-6.0	0.45	8.5
pH (CaCl ₂)*	4.8	3.6-5.5	0.50	10.4

* Analysis performed in MPIP laboratory.

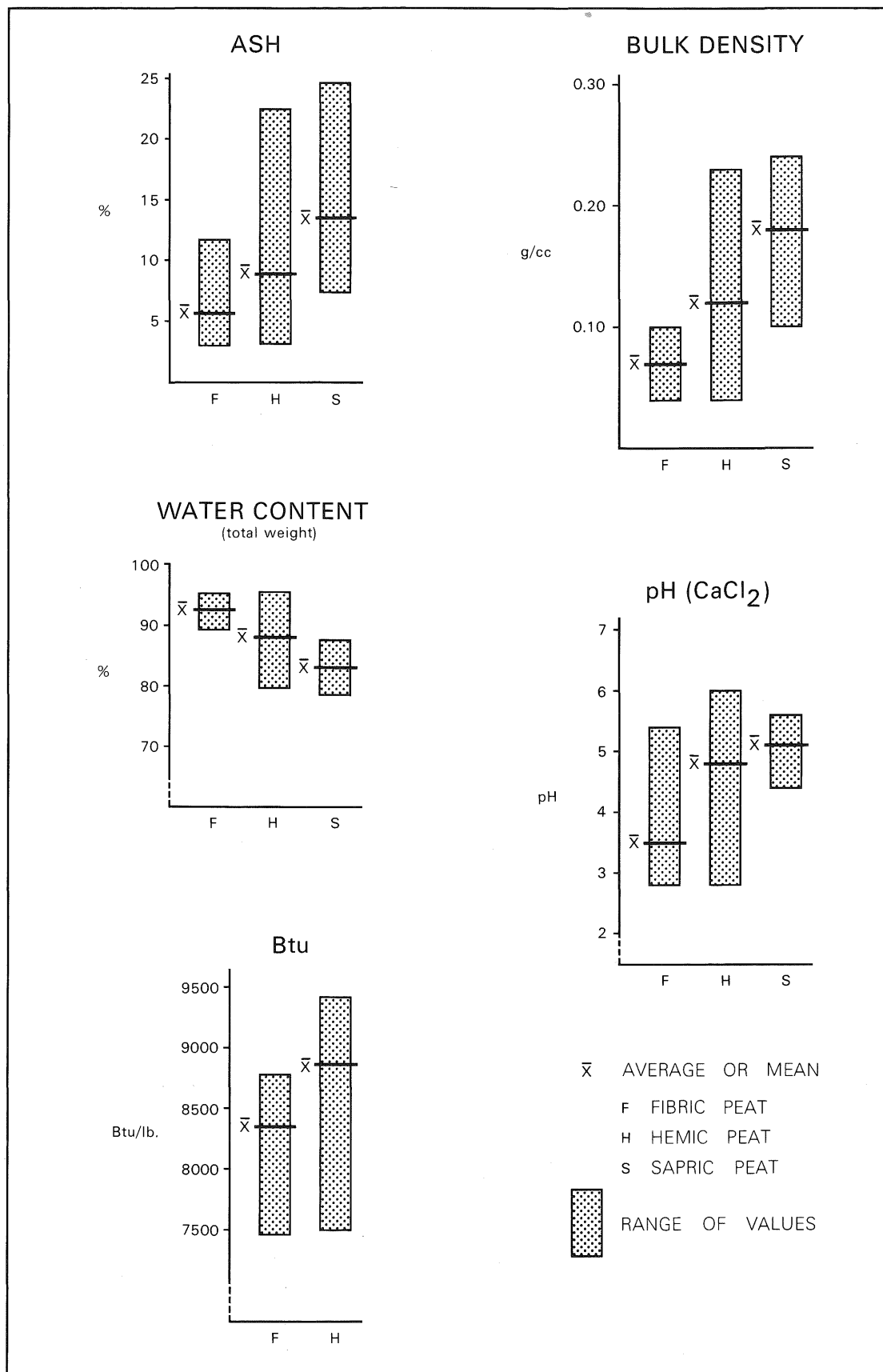


Fig. 12. Degree of Decomposition Versus MPIP Analyses and DOE Heating Value (Btu) Analysis

TABLE 10

AREAL EXTENT AND VOLUMES OF MAPPING UNITS IN THE BELTRAMI AND LAKE OF THE WOODS COUNTIES SURVEY AREA

Map Unit	Peat Type	Percent Peat Area	Area		Average Thickness		Volume	
			ha	ac	cm	ft	ha-cm	ac-ft
A	Hemic	72.5	227,490	562,100	75	2.5	17,061,750	1,405,250
B	Hemic	17.5	55,030	136,000	225	7.5	12,381,750	1,020,000
C	Hemic	1.7	5,240	13,000	375	12.5	1,965,000	162,500
D	Hemic	0.03	100	300	525	17.5	52,500	5,250
Aa	Fibric				40	1.3	13,000	10,400
	Hemic				35	1.2	113,750	9,600
	Total	1.0	3,250	8,000	75	2.5	243,750	20,000
Ba	Fibric				40	1.3	370,800	29,770
	Hemic				185	6.2	1,714,950	141,980
	Total	2.9	9,270	22,900	225	7.5	2,085,750	171,750
Ca	Fibric				40	1.3	128,000	10,400
	Hemic				335	11.2	1,078,700	89,600
	Total	1.0	3,220	8,000	375	12.5	1,207,500	100,000
Bb	Fibric				105	3.5	145,950	11,900
	Hemic				120	4.0	166,800	13,600
	Total	0.4	1,390	3,400	225	7.5	312,750	25,500
Cb	Fibric				105	3.5	602,700	49,700
	Hemic				270	9.0	1,549,800	127,800
	Total	1.8	5,740	14,200	375	12.5	2,152,500	177,500
Bc	Fibric	0.1	440	1,100	225	7.5	99,000	8,250
Cc	Fibric				225	7.5	420,750	34,500
	Hemic				150	5.0	280,500	23,000
	Total	0.6	1,870	4,600	375	12.5	701,250	57,500
Ax	Sapric	0.2	710	1,800	75	2.5	53,250	4,500
TOTAL			313,750	775,400			38,316,750	3,158,000
TOTAL AREA COVERED BY PEAT RESOURCES MAP			482,270	1,191,800				

of 482,000 ha (1,192,000 ac) in the surveyed area. Hemic peat covers 289,000 ha (711,000 ac), 91.8% of the peatland area; sapric peat covers 700 ha (1,800 ac), 0.2% of the peatland area; and areas of hemic peat overlain by a fibric sphagnum moss cap cover 25,000 ha (62,000 ac), 8% of the peatland area.

Areas with peat accumulations greater than 150 cm cover 82,000 ha (204,000 ac), or approximately 26% of the total peatland area. The areal extent for each mapping unit is shown on Table 10.

Peat Tonnages

The total quantity of oven-dried peat in the area is 450,600,000 metric tons (504,600,000 U.S. short tons). Hemic peat comprises 436,400,000 metric tons (488,800,000 U.S. short tons), sapric peat 1,000,000 metric tons (1,100,000 U.S. short tons), and fibric peat

13,200,000 metric tons (14,700,000 U.S. short tons).

The quantity of peat found in accumulations greater than 150 cm deep is 242,600,000 metric tons (271,800,000 U.S. short tons). Peat tonnages for each mapping unit are presented on Table 11.

Peat Energy Potential

The estimated energy potential for the peat deposits in the inventoried area is 8.94 quads. The estimated energy potential for those deposits meeting the DOE fuel-grade criteria is 4.81 quads.

The estimated energy potential for peat deposits meeting the DOE fuel-grade criteria, but excluding fibric moss peat, which has horticultural value, is 4.61 quads. Table 12 is a summary of the quantity and energy potential of peat resources in the surveyed area.

TABLE 11

PEAT TONNAGE (OVEN-DRIED) PER MAPPING UNIT IN THE BELTRAMI AND LAKE OF THE WOODS COUNTIES
SURVEY AREA

Map Unit	Peat Type	Metric Tons ($\times 1,000$)	U.S. Tons (Short) ($\times 1,000$)
A	Hemic	204,700	229,100
B	Hemic	148,600	166,300
C	Hemic	23,600	26,500
D	Hemic	600	900
Aa	Fibric	900	1,000
	Hemic	1,400	1,600
	Total	2,300	2,600
Ba	Fibric	2,600	2,800
	Hemic	20,600	23,100
	Total	23,200	25,900
Ca	Fibric	900	1,000
	Hemic	12,900	14,600
	Total	13,800	15,600
Bb	Fibric	1,000	1,100
	Hemic	2,000	2,200
	Total	3,000	3,300
Cb	Fibric	4,200	4,700
	Hemic	18,600	20,800
	Total	22,800	25,500
Bc	Fibric	700	800
Cc	Fibric	2,900	3,300
	Hemic	3,400	3,700
	Total	6,300	7,000
Ax	Sapric	1,000	1,100
TOTAL		450,600	504,600

NOTE: Computed using fibric peat at 7 metric tons/ha-cm (95 U.S. short tons/ac-ft), hemic peat at 12 metric tons/ha-cm (163 U.S. short tons/ac-ft), and sapric peat at 18 metric tons/ha-cm (245 U.S. short tons/ac-ft).

TABLE 12

QUANTITY AND ENERGY POTENTIAL OF THE PEAT RESOURCES
IN THE BELTRAMI AND LAKE OF THE WOODS COUNTIES SURVEY AREA
(By Peat Type, in Mapping Units >150 cm Deep and ≤ 150 cm Deep)

Peat Type	Areal Extent ¹		Tons-Dry Metric ($\times 1000$)	Tons-Dry U.S. Short ($\times 1000$)	Btu's ²	Quads ³
	ha	ac				
Fibric						
>150cm	21,930	54,200	12,300	13,700	0.23×10^{15}	0.23
≤ 150 cm	3,250	8,000	900	1,000	0.02×10^{15}	0.02
					0.25×10^{15}	0.25
Hemic						
>150cm	82,300	203,500	203,300	258,100	4.58×10^{15}	4.58
≤ 150 cm	230,740	570,100	206,100	230,700	4.09×10^{15}	4.09
					8.67×10^{15}	8.67
Sapric						
≤ 150 cm	710	1,800	1,000	1,100	0.02×10^{15}	0.02
TOTAL			450,600	504,600	8.94×10^{15}	8.94

¹The areal extent of peatlands is not summed because fibric peat overlies hemic peat and the areal extent of these units would therefore be added twice.

²The Btu values per pound dry weight used in these calculations are Fibric peat - 8354, Hemic peat - 8863, Sapric peat - 8561

³One quad = 1×10^{15} Btu

SUMMARY

The MPIP staff described the peat profiles at approximately 850 sites. Samples were obtained from 133 representative sites selected for MPIP laboratory analysis. Samples from 12 of these sites were also sent to the DOE laboratory for energy-related analysis.

Peatlands cover 314,000 ha (775,000 ac), or 65% of the total area surveyed in Beltrami and Lake of the Woods counties. The total amount of oven-dried peat is about 450,600,000 metric tons (504,600,000 U.S. short tons).

The peatlands meeting the DOE criteria for fuel-grade peat cover 82,000 ha (204,000 ac), or 26% of the total peatland area. The quantity of peat in these peatlands is about 242,600,000 oven-dried metric tons (271,800,000 oven-dried U.S. short tons). These peatlands cover at least 80 contiguous acres (30 ha) and are composed of peat that (1) has an average energy value of 8,714 Btu/pound (moisture-free), (2) has an average ash content of 7.7%, and (3) is at least 150 cm (~5 ft) deep.

The estimated potential energy of these peatlands is 4.81 quads for those deposits greater than 150 cm deep.

APPENDIX A

LABORATORY METHODS

Moisture Content

To determine moisture content, a wet sample was weighed, oven-dried to a constant weight (105°C for ~24 hours), cooled, and reweighed. Moisture content is expressed as (1) a percentage of total weight and as (2) a percentage of dry weight. Moisture content was calculated as follows:

$$\begin{aligned}\text{Total weight, percent} &= [(A - B) \times 100]/A \\ \text{Dry weight, percent} &= [(A - B) \times 100]/B\end{aligned}$$

where:

A = grams of wet sample and
B = grams of oven-dried sample.

Bulk Density

To determine bulk density, a wet sample of known volume was oven-dried to a constant weight (105°C for ~24 hours), cooled, and weighed. Bulk density was calculated as follows:

$$\text{Bulk density, g/cm}^3 = B/C$$

where:

B = grams of oven-dried sample, and
C = volume in cm³ of as-received sample.

Ash Content

To determine ash content, an oven-dried sample was thoroughly mixed in a blender. A one-gram portion was placed in a crucible, ignited in a muffle furnace (500°C for 1 hour), cooled, and reweighed. Ash content was

calculated as follows:

$$\text{Ash, percent} = (D \times 100)/E$$

where:

D = grams of ash, and

E = one-gram of oven-dried and mixed sample.

pH

The pH of peat was measured in (1) a suspension of deionized H₂O and (2) in a suspension of 0.01M CaCl₂ solution. The procedure for both measurements involved lightly packing 15 cc of an as-received peat sample into a 100 cc container, adding 15 cc of solution, and mixing. Each suspension was set aside for an hour to equilibrate before measuring with a pH meter.

pH was measured both in water and in a calcium chloride solution because the pH readings in water can be modified by salts, whereas, the observed pH in calcium chloride solution is virtually independent of the initial amount of salts present in the soil (ASTM 1971). Calcium chloride suspensions are almost independent of dilution because of the release of hydrogen ions through cation exchange, whereas, water suspensions have a greater dilution effect, resulting in a slightly higher pH value (Canada Soil Survey Committee 1976).

Proximate and Ultimate Analyses

Proximate and ultimate analyses were performed at the DOE Coal Analysis Laboratory using standard ASTM laboratory procedures.

APPENDIX B

SITE DESCRIPTIONS WITH MPIP LABORATORY DATA

Reference Number: 1

Location: 172m (565ft)N and 617m (2025ft)W of the SE corner of Sec. 1, T.155N., R.30W.

Vegetation: Sparse black spruce. Understory includes many sedges; few ericaceous shrubs and cotton grass. Continuous sphagnum carpet.

Microrelief: 30cm

Depth To Water Table: At surface

Described And Sampled By: D. Olson, D. Mellem, and D. Haverkost on July 26, 1979.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content Total Wt. (%)	Dry Wt. (%)	pH H ₂ O	CaCl ₂	Ash Content (%)
Fibric	0- 35	50- 65	0.09	90.8	989	3.4	3.0	8.5
Hemic	35-149	85-100	0.11	88.3	756	3.8	3.6	4.8
Sandy clay loam	149+	130-145	0.17	84.1	528	4.6	4.2	9.7

Reference Number: 2

Location: 776m (2545ft)S and 472m (1550ft)W of the NE corner of Sec. 15, T.155N., R.30W.

Vegetation: Cover dominated by cotton grass; few shrubs (willow) and forbs (cattail).

Microrelief: 10cm

Depth To Water Table: At surface

Described And Sampled By: D. Mellem and D. Olson on August 2, 1979.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content Total Wt. (%)	Dry Wt. (%)	pH H ₂ O	CaCl ₂	Ash Content (%)
Hemic	0-175	60-110	0.11	88.3	754	5.5	4.9	6.2
Silt loam	175+	110-160	0.14	87.2	679	5.4	4.8	9.0

Reference Number: 3

Location: 76m (250ft)N and 23m (75ft)W of the SE corner of Sec. 6, T.158N., R.30W.

Vegetation: Not recorded

Microrelief: Not recorded

Depth To Water Table: Not recorded

Described And Sampled by: H. Hobbs, C. Cameron, and D. Mellem on September 6, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content Total Wt. (%)	Dry Wt. (%)	pH H ₂ O	CaCl ₂	Ash Content (%)
Hemic	0-110	35-50	0.16	85.8	603	5.4	5.1	10.6
Clay loam	110+	80-95	0.18	83.5	507	5.3	5.0	10.1

Reference Number: 4

Location: 236m (775ft)N and 69m (225ft)E of the SW corner of Sec. 7, T.158N., R.30W.

Vegetation: Cover includes many shrubs (bog birch) and grasses; some forbs (goldenrod, aster). Few mosses.

Microrelief: Not recorded

Depth To Water Table: Not recorded

Described And Sampled by: B. Leuelling, D. Olson, T. Malterer, H. Hobbs, and C. Cameron on September 6, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content Total Wt. (%)	Dry Wt. (%)	pH H ₂ O	CaCl ₂	Ash Content (%)
Hemic	0-191	35- 50	0.13	87.1	677	4.4	4.1	6.4
Silt	191-200	85-100	0.11	88.3	755	4.6	4.4	6.7
Fine sand	200+	135-150	0.14	86.9	663	5.0	5.0	8.4
		172-187	0.17	84.0	526	4.8	4.8	10.8

Reference Number: 5**Location:** 792m (2600ft)S and 15m (50ft)W of the NE corner of Sec. 7, T.158N., R.30W.**Vegetation:** Sparse aspen. Understory dominated by grasses; some shrubs (bog birch); few forbs and ericaceous shrubs.**Microrelief:** 15cm**Depth To Water Table:** At surface**Described And Sampled By:** D. Olson, B. Leuelling, and B. Balen on September 6, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content Total Wt. (%)	Moisture Content Dry Wt. (%)	pH H ₂ O	pH CaCl ₂	Ash Content (%)
Hemic	0-315	35- 50	0.04	92.9	1305	5.4	5.2	6.8
Sapric	315-328	85-100	0.09	91.1	1022	5.3	4.8	5.3
with		135-150	0.09	91.2	1035	5.4	5.0	5.1
sand		185-200	0.09	90.9	997	5.5	4.2	6.3
grains		235-250	0.10	90.1	907	5.6	5.3	7.4
Medium sand	328+	285-300	0.13	86.3	629	5.1	5.0	14.5

Reference Number: 6**Location:** 229m (750ft)N and 658m (2160ft)W of the SE corner of Sec. 7, T.158N., R.30W.**Vegetation:** Cover dominated by grasses; many shrubs (bog birch); few ericaceous shrubs, forbs (goldenrod), and cotton grass. Few mosses.**Microrelief:** Not recorded**Depth To Water Table:** At surface**Described And Sampled By:** B. Leuelling, D. Olson, and B. Balen on September 6, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content Total Wt. (%)	Moisture Content Dry Wt. (%)	pH H ₂ O	pH CaCl ₂	Ash Content (%)
Hemic	0-264	35- 50	0.07	91.9	1129	5.4	5.0	8.6
Clay	264 +	85-100	0.09	90.5	948	5.3	5.0	7.0
loam		135-150	0.11	89.1	815	5.5	5.0	6.4
		185-200	0.09	90.4	939	5.5	5.2	7.5
		235-250	0.12	88.5	772	5.6	5.3	8.5

Reference Number: 7**Location:** 232m (760ft)N and 488m (1600ft)E of the SW corner of Sec. 8, T.158N., R.30W.**Vegetation:** Cover includes many cotton grass; some shrubs (bog birch); few forbs (goldenrod, aster). Few mosses.**Microrelief:** Not recorded**Depth To Water Table:** At surface**Described And Sampled By:** B. Leuelling, D. Olson, and B. Balen on September 6, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content Total Wt. (%)	Moisture Content Dry Wt. (%)	pH H ₂ O	pH CaCl ₂	Ash Content (%)
Hemic	0-234	35- 50	0.11	89.2	825	5.2	5.0	9.1
Clay	234 +	85-100	0.08	90.9	1001	5.4	5.2	8.5
loam		135-150	0.11	88.7	782	5.8	5.6	8.0
		185-200	0.14	85.9	612	5.4	5.4	11.8

Reference Number: 8**Location:** 221m (725ft)N and 8m (25ft)W of the SE corner of Sec. 8, T.158N., R.30W.**Vegetation:** Cover dominated by cotton grass; some shrubs (bog birch*, willow); few forbs (goldenrod). Few mosses.**Microrelief:** Not recorded**Depth To Water Table:** At surface**Described And Sampled by:** B. Leuelling, D. Olson, and B. Balen on September 6, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content Total Wt. (%)	Moisture Content Dry Wt. (%)	pH H ₂ O	pH CaCl ₂	Ash Content (%)
Hemic	0-206	35- 50	0.09	90.1	908	5.8	5.4	8.8
Silty	206 +	85-100	0.13	86.5	641	5.4	5.3	8.2
clay		135-150	0.13	87.2	684	5.4	5.2	6.7
loam		185-200	0.14	85.5	589	5.1	5.0	11.2

* following a species denotes that it is a dominant species. Generally, it is used for shrubs and ericaceous shrubs.

Reference Number: 9**Location:** 206m (675ft)N and 649m (2130ft)W of the SE corner of Sec. 9, T.158N., R.30W.**Vegetation:** Cover dominated by grasses; some shrubs (bog birch*, willow) and cotton grass; few forbs (cattail).**Microrelief:** Not recorded**Depth To Water Table:** At surface**Described And Sampled By:** B. Leuelling, D. Olson, and B. Balen on September 6, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-187	40- 55	0.11	89.2	830	5.4	5.2	12.3
Silty	187 +	85-100	0.09	90.9	1003	5.2	5.0	9.3
clay		135-150	0.13	88.2	746	5.3	5.0	8.8

Reference Number: 10**Location:** 251m (825ft)S and 15m (50ft)W of the NE corner of Sec. 18, T.158N., R.30W.**Vegetation:** Not recorded**Microrelief:** Not recorded**Depth To Water Table:** Not recorded**Described And Sampled By:** H. Hobbs, C. Cameron, and D. Mellem on September 6, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-180	35- 50	0.11	88.6	778	5.1	4.9	9.6
Clay	180 +	85-100	0.09	90.6	961	5.2	5.0	7.6
loam		135-150	0.12	88.8	789	5.2	5.0	9.8
		165-180	0.26	78.3	360	5.4	5.2	52.3

Reference Number: 11**Location:** 236m (775ft)S and 361m (1185ft)E of the NW corner of Sec. 18, T.158N., R.30W.**Vegetation:** Not recorded**Microrelief:** Not recorded**Depth To Water Table:** Not recorded**Described And Sampled By:** H. Hobbs, D. Mellem, and C. Cameron on September 6, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-191	35- 50	0.08	90.8	986	5.6	5.4	8.7
Medium	191 +	85-100	0.08	91.9	1136	5.7	5.6	9.2
sand		135-150	0.12	89.4	842	5.8	5.7	8.7

Reference Number: 12**Location:** 663m (2175ft)S and 114m (375ft)E of the NW corner of Sec. 1, T.159N., R.30W.**Vegetation:** Scattered black spruce. Understory includes some ericaceous shrubs (leather-leaf*) and cotton grass. Discontinuous sphagnum carpet; some other mosses.**Microrelief:** 35cm**Depth To Water Table:** At surface**Described And Sampled By:** B. Leuelling and B. Balen on October 3, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-248	35- 50	0.07	91.9	1139	3.9	3.4	7.9
Sapric	248-253	85-100	0.09	90.4	944	5.2	5.0	7.6
Fine	253 +	135-150	0.09	90.9	1004	5.6	5.3	6.1
sandy		185-200	0.11	89.1	813	5.9	5.7	6.8
loam		225-240	0.16	86.5	639	5.7	5.6	7.6

Reference Number: 13**Location:** 693m (2275ft)S and 258m (845ft)E of the NW corner of Sec. 2, T.159N., R.30W.**Vegetation:** Scattered black spruce; sparse tamarack. Understory dominated by ericaceous shrubs (swamp laurel*); some grasses. Discontinuous moss carpet; some sphagnum mosses.**Microrelief:** 34cm**Depth To Water Table:** At surface**Described And Sampled By:** B. Leuelling and B. Balen on October 3, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-250	35- 50	0.08	91.5	1078	5.6	4.8	10.4
Sapric	250-254	85-100	0.06	93.2	1371	5.8	5.1	9.0
Silt loam	254 +	135-150	0.10	90.4	943	6.0	5.4	8.2
		185-200	0.11	89.2	825	6.2	5.5	9.6
		235-250	0.17	84.4	540	6.2	5.8	12.8

Reference Number: 14**Location:** 707m (2320ft)S and 267m (875ft)E of the NW corner of Sec. 3, T.159N., R.30W.**Vegetation:** Sparse black spruce. Understory dominated by cotton grass; many shrubs (bog birch); some sedges and ericaceous shrubs; few forbs. Discontinuous sphagnum carpet; some other mosses.**Microrelief:** 30cm**Depth To Water Table:** At surface**Described And Sampled By:** H. Hobbs, D. Olson, and C. Cameron on August 31, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-192	50- 65	0.10	90.7	978	5.4	5.2	8.4
Clay	192 +	85-100	0.08	90.7	976	5.5	5.2	9.1
		135-150	0.11	89.5	854	5.5	5.2	9.8
		175-190	0.18	83.5	506	5.4	5.2	14.9

Reference Number: 15**Location:** 122m (400ft)N and 149m (490ft)E of the SW corner of Sec. 5, T.159N., R.30W.**Vegetation:** Stunted black spruce with 30% cover; sparse aspen. Understory dominated by ericaceous shrubs (leatherleaf*, cranberry*) and shrubs (bog birch). Some sphagnum and other mosses.**Microrelief:** 20cm**Depth To Water Table:** 10cm**Described And Sampled By:** B. Leuelling and K. Hayner on October 17, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0- 97	35-50	0.15	85.9	609	5.5	5.2	11.3
Sapric	97-100	80-95	0.23	80.9	424	5.4	5.3	16.2
Clay	100 +							

Reference Number: 16**Location:** 556m (1825ft)N and 449m (1475ft)E of the SW corner of Sec. 6, T.159N., R.30W.**Vegetation:** Cover includes many sedges and grasses (*Phragmites communis*); some cotton grass; few shrubs (bog birch). Discontinuous sphagnum carpet; some other mosses.**Microrelief:** 20cm**Depth To Water Table:** 10cm**Described And Sampled By:** B. Leuelling and K. Hayner on October 17, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-109	35- 50	0.15	84.8	557	5.5	5.3	12.5
Sapric	109-111	85-100	0.20	81.8	448	5.4	5.3	11.6
Silt loam	111 +							

Reference Number: 17**Location:** 568m (1865ft)S and 434m (1425ft)E of the NW corner of Sec. 10, T.159N., R.30W.**Vegetation:** Stunted black spruce with 30% cover. Understory dominated by ericaceous shrubs (cranberry*); some other shrubs (willow*, bog birch) and cotton grass. Discontinuous sphagnum carpet; few other mosses.**Microrelief:** 35cm**Depth To Water Table:** Not recorded**Described And Sampled By:** B. Leuelling and B. Balen on October 3, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-200	35- 50	0.10	90.4	938	5.2	4.9	10.6
Sapric	200-220	85-100	0.10	90.2	922	5.4	5.2	10.3
Clay	220 +	135-150	0.06	93.2	1380	5.4	5.2	9.7
loam		185-200	0.15	85.6	593	5.5	5.4	13.8
		205-220	0.28	77.2	338	5.6	5.6	40.7

Reference Number: 18**Location:** 549m (1800ft)S and 267m (875ft)E of the NW corner of Sec. 11, T.159N., R.30W.**Vegetation:** Stunted black spruce with 30% cover. Understory dominated by ericaceous shrubs (Labrador tea*); some other shrubs (willow*, bog birch) and cotton grass. Discontinuous sphagnum carpet; some other mosses.**Microrelief:** 24cm**Depth To Water Table:** 12cm**Described And Sampled By:** B. Leuelling and B. Balen on October 3, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-75	20-35	0.12	88.4	764	4.8	4.2	8.6
Sapric	75-83	60-75	0.14	86.1	619	5.1	4.6	8.8
Loam	83 +							

Reference Number: 19**Location:** 549m (1800ft)S and 114m (375ft)E of the NW corner of Sec. 12, T.159N., R.30W.**Vegetation:** Stunted black spruce with 45% cover. Understory includes many ericaceous shrubs (Labrador tea*, lingen berry); few other shrubs (speckled alder). Discontinuous sphagnum carpet; few other mosses.**Microrelief:** 38cm**Depth To Water Table:** 12cm**Described And Sampled By:** B. Leuelling and B. Balen on October 3, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-105	35- 50	0.16	84.9	561	4.6	4.2	9.2
Sapric	105-118	85-100	0.21	82.8	481	5.4	5.2	9.2
Clay	118 +							
loam								

Reference Number: 20**Location:** 198m (650ft)S and 759m (2490ft)E of the NW corner of Sec. 14, T.159N., R.30W.**Vegetation:** Cover includes many shrubs (willow) and sedges; some grasses. Discontinuous moss carpet; few sphagnum mosses.**Microrelief:** 15cm**Depth To Water Table:** 13cm**Described And Sampled By:** B. Leuelling and K. Hayner on November 1, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-74	35-50	0.16	85.8	606	5.6	5.3	15.1
Sapric	74-80							
Clay	80 +							
loam								

Reference Number: 21

Location: 8m (25ft)N and 564m (1850ft)W of the SE corner of Sec. 15, T.159N., R.30W.
Vegetation: Cover dominated by grasses; some shrubs (willow). Discontinuous sphagnum carpet.

Microrelief: 12cm

Depth To Water Table: At surface

Described And Sampled By: B. Leuelling and K. Hayner on November 1, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Total Wt. (%)	Content Dry Wt. (%)	pH		Ash Content (%)
						H ₂ O	CaCl ₂	
Hemic	0-56	35-50	0.16	85.9	611	5.5	5.3	12.5
Sapric	56-61							
Clay	61+							

Reference Number: 22

Location: 442m (1450ft)S and 782m (2565ft)W of the NE corner of Sec. 18, T.159N., R.30W.
Vegetation: Stunted black spruce with 60% cover. Understory includes many ericaceous shrubs; few cotton grass. Discontinuous sphagnum carpet; few other mosses.

Microrelief: 40cm

Depth To Water Table: 20cm

Described And Sampled By: B. Leuelling and K. Hayner on October 19, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Total Wt. (%)	Content Dry Wt. (%)	pH		Ash Content (%)
						H ₂ O	CaCl ₂	
Hemic	0-206	45- 60	0.10	89.5	850	3.5	3.1	6.6
Sapric	206-215	85-100	0.10	89.4	844	4.6	4.4	6.8
Silt	215+	135-150	0.10	90.1	906	5.2	5.0	8.1
loam		185-200	0.12	87.7	710	5.6	5.4	8.7

Reference Number: 23

Location: 442m (1450ft)S and 328m (1075ft)W of the NE corner of Sec. 18, T.159N., R.30W.
Vegetation: Sparse aspen. Understory dominated by shrubs (speckled alder*, bog birch, dogwood); few ericaceous shrubs and grasses (*Phragmites communis*). Some sphagnum and other mosses.

Microrelief: 10cm

Depth To Water Table: 5cm

Described And Sampled By: B. Leuelling and K. Hayner on October 19, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Total Wt. (%)	Content Dry Wt. (%)	pH		Ash Content (%)
						H ₂ O	CaCl ₂	
Sapric	0-160	35- 50	0.11	87.4	695	5.6	5.2	10.2
Silt	160+	85-100	0.16	84.0	526	5.4	5.1	13.2
loam		135-150	0.20	81.6	444	5.4	5.3	15.1

Reference Number: 24

Location: 442m (1450ft)S and 655m (2150ft)E of the NW corner of Sec. 18, T.159N., R.30W.

Vegetation: Stunted black spruce with 60% cover. Understory includes many ericaceous shrubs (lingen berry*, leatherleaf*); few cotton grass. Discontinuous sphagnum carpet; few other mosses.

Microrelief: 40cm

Depth To Water Table: 10cm

Described And Sampled By: B. Leuelling and K. Hayner on October 19, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Total Wt. (%)	Content Dry Wt. (%)	pH		Ash Content (%)
						H ₂ O	CaCl ₂	
Fibric	0- 38	35- 50	0.10	88.8	790	3.4	2.8	7.0
Hemic	38-245	85-100	0.08	91.6	1087	3.6	3.2	3.5
Sapric	245-260	135-150	0.09	90.7	978	4.4	4.2	5.4
Fine	260+	185-200	0.11	89.0	805	5.0	4.8	8.6
sand		235-250	0.17	84.4	541	5.2	5.1	12.2

Reference Number: 25

Location: 587m (1925ft)N and 582m (1910ft)E of the SW corner of Sec. 20, T.159N., R.30W.
Vegetation: Aspen forest with 50% cover. Understory includes many shrubs (speckled alder*, willow); some sedges. Discontinuous moss carpet.

Microrelief: Not recorded

Depth To Water Table: Not recorded

Described And Sampled By: B. Leuelling and D. Mellem on August 29, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content Total Wt. (%)	Moisture Content Dry Wt. (%)	pH H ₂ O	pH CaCl ₂	Ash Content (%)
Hemic	0- 78	35-50	0.11	87.4	696	6.4	5.8	13.6
Sapric	78-105	75-90	0.17	82.9	484	6.2	5.6	14.0
Sandy loam	105 +							

Reference Number: 26

Location: 343m (1125ft)N and 572m (1875ft)E of the SW corner of Sec. 20, T.159N., R.30W.
Vegetation: Sparse paper birch. Understory includes many shrubs (bog birch*, dogwood); few ericaceous shrubs and sedges. Few sphagnum and other mosses.

Microrelief: Not recorded

Depth To Water Table: Not recorded

Described And Sampled By: B. Leuelling and D. Mellem on August 29, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content Total Wt. (%)	Moisture Content Dry Wt. (%)	pH H ₂ O	pH CaCl ₂	Ash Content (%)
Hemic	0-112	35-50	0.13	87.0	668	6.0	5.5	11.5
Fine sand	112 +	84-99	0.18	82.6	475	6.0	5.4	10.8

Reference Number: 27

Location: 73m (240ft)N and 544m (1785ft)E of the SW corner of Sec. 20, T.159N., R.30W.
Vegetation: Sparse paper birch. Understory dominated by shrubs (bog birch*, dogwood); few forbs (goldenrod, aster).

Microrelief: Not recorded

Depth To Water Table: Not recorded

Described And Sampled By: B. Leuelling and D. Mellem on August 29, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content Total Wt. (%)	Moisture Content Dry Wt. (%)	pH H ₂ O	pH CaCl ₂	Ash Content (%)
Hemic	0- 95	35-50	0.13	88.0	733	5.4	4.9	9.2
Sapric	95-100	65-80	0.18	82.3	466	5.4	4.8	9.1
Silt	100-110							
Silty clay	110 +							

Reference Number: 28

Location: 594m (1950ft)N and 8m (25ft)W of the SE corner of Sec. 20, T.159N., R.30W.
Vegetation: Cover dominated by shrubs (willow*, dogwood); few forbs (aster, iris). Discontinuous moss carpet.

Microrelief: Not recorded

Depth To Water Table: At surface

Described And Sampled By: B. Leuelling and D. Mellem on August 29, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content Total Wt. (%)	Moisture Content Dry Wt. (%)	pH H ₂ O	pH CaCl ₂	Ash Content (%)
Hemic	0-50	34-49	0.18	81.8	450	6.6	6.0	17.5
Silty clay	50 +							

Reference Number: 29**Location:** 518m (1700ft)S and 442m (1450ft)W of the NE corner of Sec. 25, T.159N., R.30W.**Vegetation:** Stunted black spruce with 50% cover; sparse tamarack. Understory includes many ericaceous shrubs (leatherleaf*, lingen berry); few cotton grass. Discontinuous sphagnum carpet; some other mosses.**Microrelief:** 38cm**Depth To Water Table:** Not recorded**Described And Sampled By:** B. Leuelling and K. Hayner on October 5, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0- 85	35- 50	0.13	87.5	697	4.2	3.8	7.8
Sapric	85-111	85-100	0.22	78.8	371	5.2	5.0	15.8
Clay loam	111+							

Reference Number: 30**Location:** 732m (2400ft)N and 482m (1580ft)E of the SW corner of Sec. 26, T.159N., R.30W.**Vegetation:** Stunted black spruce with 60% cover. Understory includes many ericaceous shrubs (leatherleaf*, lingen berry); some cotton grass. Discontinuous moss carpet; some sphagnum mosses.**Microrelief:** 35cm**Depth To Water Table:** At surface**Described And Sampled By:** B. Leuelling and B. Balen on October 4, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-155	45- 60	0.04	95.2	1981	3.7	3.0	3.7
Sapric	155-171	85-100	0.11	88.5	767	4.0	3.6	9.7
Silt loam	171+	135-150	0.15	85.8	603	5.2	5.0	5.3

Reference Number: 31**Location:** 739m (2425ft)N and 152m (500ft)W of the SE corner of Sec. 26, T.159N., R.30W.**Vegetation:** Scattered tamarack; sparse black spruce. Understory includes many ericaceous shrubs (leatherleaf*, lingen berry); some cotton grass. Discontinuous moss carpet; some sphagnum mosses.**Microrelief:** 40cm**Depth To Water Table:** At surface**Described And Sampled By:** B. Leuelling and B. Balen on October 4, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-120	35- 50	0.12	85.3	581	3.7	3.2	5.1
Loamy fine sand	120+	85-100	0.14	86.3	628	4.2	4.0	11.9

Reference Number: 32**Location:** 152m (500ft)S and 137m (450ft)W of the NE corner of Sec. 34, T.159N., R.30W.**Vegetation:** Stunted black spruce with 60% cover. Understory dominated by cotton grass; some ericaceous shrubs (leatherleaf*). Continuous sphagnum carpet.**Microrelief:** 40cm**Depth To Water Table:** At surface**Described And Sampled By:** B. Leuelling and B. Balen on October 4, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-133	35- 50	0.10	89.6	857	4.0	3.5	9.2
Sapric	133-153	85-100	0.10	89.8	885	5.2	4.7	6.3
Clay loam	153+	130-145	0.15	83.4	503	5.4	5.0	12.5

Reference Number: 33**Location:** 572m (1875ft)S and 602m (1975ft)W of the NE corner of Sec. 34, T.159N., R.30W.**Vegetation:** Stunted black spruce with 50% cover; sparse tamarack. Understory includes many ericaceous shrubs (leatherleaf*); some cotton grass. Discontinuous sphagnum carpet.**Microrelief:** 45cm**Depth To Water Table:** At surface**Described And Sampled By:** B. Leuelling and B. Balen on October 4, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-148	40- 55	0.10	89.6	861	3.8	3.2	8.0
Sapric	148-167	85-100	0.08	90.9	1004	4.6	4.3	6.3
Clay	167+	135-150	0.14	88.3	752	5.0	4.6	7.1

Reference Number: 34**Location:** 655m (2150ft)S and 22m (75ft)E of the NW corner of Sec. 17, T.160N., R.30W.**Vegetation:** Aspen forest with 35% cover. Understory includes many grasses; some forbs (goldenrod).**Microrelief:** Negligible**Depth To Water Table:** Below 30cm**Described And Sampled By:** B. Leuelling and K. Hayner on November 2, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic Clay	0-79 79+	35-50	0.12	86.9	662	4.9	4.7	9.7

Reference Number: 35**Location:** 338m (1275ft)N and 118m (390ft)E of the SW corner of Sec. 25, T.160N., R.30W.**Vegetation:** Scattered tamarack; sparse black spruce and aspen. Understory includes many ericaceous shrubs; few other shrubs (bog birch), cotton grass, and wooded bog forbs. Continuous sphagnum carpet.**Microrelief:** 30cm**Depth To Water Table:** At surface**Described And Sampled By:** H. Hobbs, D. Olson, and C. Cameron on August 30, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Fibric	0- 23	35- 50	0.10	88.6	775	6.4	6.0	18.9
Hemic	23-165	85-100	0.16	84.5	544	6.2	5.6	9.3
Clay loam	165+	135-150	0.15	86.2	624	6.2	5.8	9.6

Reference Number: 36**Location:** 798m (2620ft)S and 734m (2410ft)W of the NE corner of Sec. 26, T.160N., R.30W.**Vegetation:** Cover includes many shrubs (bog birch) and sedges; some forbs (ferns*, iris).**Microrelief:** 40cm**Depth To Water Table:** At surface**Described And Sampled By:** H. Hobbs, T. Malterer, and C. Cameron on August 29, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-140	35- 50	0.14	87.2	683	5.7	5.2	11.2
Clay	140+	85-100	0.16	84.8	558	5.9	5.4	12.1
loam		124-139	0.17	83.7	515	5.9	5.5	13.6

Reference Number: 37**Location:** 4m (15ft)N and 277m (910ft)E of the SW corner of Sec. 26, T.160N., R.30W.**Vegetation:** Cover dominated by shrubs (bog birch*, willow); some ericaceous shrubs (leatherleaf) and sedges; few forbs (iris).**Microrelief:** 30cm**Depth To Water Table:** At surface**Described And Sampled By:** H. Hobbs, T. Malterer, and C. Cameron on August 29, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content Total Wt. (%)	Dry Wt. (%)	pH H ₂ O	CaCl ₂	Ash Content (%)
Hemic	0-240	35- 50	0.13	87.5	701	5.9	5.1	8.6
Sapric	240-243	85-100	0.09	90.7	980	6.0	5.4	7.1
Silt loam	243 +	135-150	0.13	88.1	743	6.0	5.5	11.8
		185-200	0.15	86.1	618	5.4	5.3	13.9
		225-240	0.18	83.6	511	5.5	5.4	15.5

Reference Number: 38**Location:** 274m (900ft)N and 134m (440ft)W of the SE corner of Sec. 27, T.160N., R.30W.**Vegetation:** Cover dominated by shrubs (bog birch); some ericaceous shrubs (leatherleaf*) and cotton grass; few forbs (ferns). Discontinuous sphagnum carpet.**Microrelief:** 10cm**Depth To Water Table:** At surface**Described And Sampled By:** H. Hobbs, D. Olson, and C. Cameron on August 30, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content Total Wt. (%)	Dry Wt. (%)	pH H ₂ O	CaCl ₂	Ash Content (%)
Hemic	0-120	35- 50	0.14	87.0	670	5.7	5.1	9.8
Sapric	120-202	85-100	0.15	85.9	610	6.0	5.3	9.3
Silt	202 +	135-150	0.16	85.5	587	5.6	5.3	11.9
		180-195	0.20	81.0	426	5.6	5.3	13.4

Reference Number: 39**Location:** 7m (25ft)N and 525m (1725ft)E of the SW corner of Sec. 28, T.160N., R.30W.**Vegetation:** Scattered black spruce. Understory dominated by shrubs (bog birch); many ericaceous shrubs (leatherleaf*) and cotton grass; few forbs (goldenrod). Discontinuous sphagnum carpet.**Microrelief:** 25cm**Depth To Water Table:** At surface**Described And Sampled By:** B. Leuelling and B. Balen on September 7, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content Total Wt. (%)	Dry Wt. (%)	pH H ₂ O	CaCl ₂	Ash Content (%)
Hemic	0-175	35- 50	0.12	88.4	761	4.9	4.7	8.3
Sapric	175-195	85-100	0.12	86.3	629	5.2	5.0	9.8
Silt	195 +	135-150	0.15	86.1	617	5.2	5.0	9.6

Reference Number: 40**Location:** 762m (2500ft)N and 381m (1250ft)E of the SW corner of Sec. 30, T.160N., R.30W.**Vegetation:** Cover dominated by grasses; many shrubs (willow) and forbs (asters*). Few mosses.**Microrelief:** 18cm**Depth To Water Table:** 61cm**Described And Sampled By:** B. Leuelling and B. Balen on September 7, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content Total Wt. (%)	Dry Wt. (%)	pH H ₂ O	CaCl ₂	Ash Content (%)
Sapric	0-132	35- 50	0.10	83.6	509	5.2	4.7	8.1
Loamy fine sand	132 +	85-100	0.16	84.3	538	5.1	4.8	7.4

Reference Number: 41**Location:** 152m (500ft)S and 429m (1410ft)W of the NE corner of Sec. 31, T.160N., R.30W.**Vegetation:** Cover dominated by shrubs (bog birch) and grasses; few forbs (goldenrod).
Some mosses.**Microrelief:** 25cm**Depth To Water Table:** 5cm**Described And Sampled By:** B. Leuelling and B. Balen on September 7, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content Total Wt. (%)	Moisture Content Dry Wt. (%)	pH H ₂ O	pH CaCl ₂	Ash Content (%)
Hemic	0-156	35- 50	0.11	88.9	797	5.0	4.4	7.5
Sapric	156-190	85-100	0.14	85.7	600	5.2	4.8	10.0
Silt loam	190 +	135-150	0.15	85.3	583	5.2	5.0	10.2

Reference Number: 42**Location:** 338m (1110ft)S and 601m (1975ft)E of the NW corner of Sec. 31, T.160N., R.30W.**Vegetation:** Cover includes many shrubs (bog birch) and grasses; some forbs (goldenrod).
Some mosses.**Microrelief:** 20cm**Depth To Water Table:** Not recorded**Described And Sampled By:** B. Leuelling and B. Balen on September 7, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content Total Wt. (%)	Moisture Content Dry Wt. (%)	pH H ₂ O	pH CaCl ₂	Ash Content (%)
Hemic	0-192	35- 50	0.12	89.0	810	5.2	5.0	7.3
Sapric	192-219	85-100	0.14	86.2	626	5.5	5.2	9.9
Silt loam	219-228	135-150	0.14	86.2	623	5.6	5.4	10.0
Silt loam with pebbles	228 +	185-200	0.19	82.3	466	4.7	4.6	27.7

Reference Number: 43**Location:** 51m (170ft)N and 65m (215ft)E of the SW corner of Sec. 31, T.160N., R.30W.**Vegetation:** Cover includes many grasses; some shrubs (willow) and forbs (asters*).**Microrelief:** 20cm**Depth To Water Table:** At surface**Described And Sampled By:** B. Leuelling and B. Balen on September 7, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content Total Wt. (%)	Moisture Content Dry Wt. (%)	pH H ₂ O	pH CaCl ₂	Ash Content (%)
Hemic	0-197	35- 50	0.10	89.5	854	4.7	4.4	4.8
Sapric	197-225	85-100	0.10	88.7	785	5.2	5.0	6.4
Silt loam	225 +	135-150	0.10	89.5	854	5.2	5.0	7.3
		182-197	0.16	84.3	537	4.6	4.5	27.0

Reference Number: 44**Location:** 25m (85ft)N and 644m (2115ft)W of the SE corner of Sec. 31, T.160N., R.30W.**Vegetation:** Cover dominated by shrubs (willow*, bog birch); few forbs (aster, goldenrod).
Discontinuous moss carpet.**Microrelief:** 20cm**Depth To Water Table:** Not recorded**Described And Sampled By:** B. Leuelling and B. Balen on September 7, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content Total Wt. (%)	Moisture Content Dry Wt. (%)	pH H ₂ O	pH CaCl ₂	Ash Content (%)
Hemic	0-138	35- 50	0.14	85.9	611	4.6	4.2	7.0
Clay loam	138 +	85-100	0.17	83.2	494	5.4	5.1	9.8
		115-130	0.15	85.5	591	5.5	5.3	11.4

Reference Number: 45

Location: 640m (2100ft)N and 576m (1890ft)E of the SW corner of Sec. 32, T.160N., R.30W.
Vegetation: Sparse black spruce and tamarack. Understory dominated by shrubs (bog birch) and ericaceous shrubs (Labrador tea*). Discontinuous sphagnum carpet; some other mosses.

Microrelief: 30cm

Depth To Water Table: 12cm

Described And Sampled By: B. Leuelling and B. Balen on September 7, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-154	35- 50	0.09	89.2	830	4.4	4.0	8.7
Sapric	154-174	85-100	0.13	87.4	694	4.7	4.5	7.2
Sand	174-180	135-150	0.11	88.2	744	4.8	4.6	9.4
and silt loam with pebbles	180 +							

Reference Number: 46

Location: 647m (2125ft)N and 53m (175ft)W of the SE corner of Sec. 32, T.160N., R.30W.
Vegetation: Stunted black spruce with 30% cover. Understory includes many ericaceous shrubs (leatherleaf*); few other shrubs (willow, bog birch). Discontinuous moss carpet; few sphagnum mosses.

Microrelief: 30cm

Depth To Water Table: Not recorded

Described And Sampled By: B. Leuelling and B. Balen on September 7, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-175	35- 50	0.12	88.3	756	4.6	4.4	9.1
Sapric	175-189	85-100	0.13	86.7	649	5.2	5.1	10.0
Clay loam	189 +	135-150	0.15	86.1	621	5.2	5.2	10.2

Reference Number: 47

Location: 798m (2620ft)S and 304m (1000ft)W of the NE corner of Sec. 34, T.160N., R.30W.
Vegetation: Sparse black spruce and northern white cedar. Understory includes many ericaceous shrubs (bog rosemary*) and other shrubs (bog birch*, willow); few forbs (iris). Discontinuous sphagnum carpet.

Microrelief: 30cm

Depth To Water Table: At surface

Described And Sampled By: H. Hobbs, T. Malterer, and C. Cameron on August 29, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-201	35- 50	0.11	87.9	723	5.6	4.9	8.1
Silty	201 +	85-100	0.12	88.1	741	6.0	5.2	11.6
clay		135-150	0.11	90.1	910	6.1	5.4	8.6
loam		185-200	0.14	86.8	655	5.2	5.0	12.8

Reference Number: 48

Location: 25m (85ft)N and 723m (2375ft)E of the SW corner of Sec. 34, T.160N., R.30W.
Vegetation: Not recorded

Microrelief: 30cm

Depth To Water Table: At surface

Described And Sampled By: H. Hobbs, T. Malterer, and C. Cameron on August 29, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic Clay loam	0-195 195 +	35- 50	0.13	88.1	739	5.7	4.8	10.4
		85-100	0.12	88.6	778	5.9	5.0	7.5
		135-150	0.11	89.9	888	5.9	5.2	8.5
		176-191	0.13	87.6	710	5.7	5.3	12.5

Reference Number: 49**Location:** 716m (2350ft)S and 757m (2485ft)W of the NE corner of Sec. 35, T.160N., R.30W.**Vegetation:** Cover includes many ericaceous shrubs (swamp laurel*); some grasses; few cotton grass. Few sphagnum mosses.**Microrelief:** 35cm**Depth To Water Table:** At surface**Described And Sampled By:** T. Malterer, H. Hobbs, and C. Cameron on August 29, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content Total Wt. (%)	Content Dry Wt. (%)	pH H ₂ O	CaCl ₂	Ash Content (%)
Hemic	0-174	35- 50	0.13	88.0	733	5.6	4.9	10.1
Sapric	174-180	85-100	0.12	88.2	746	6.0	5.3	10.4
Clay	180+	135-150	0.15	86.3	633	6.0	5.4	9.1
loam		162-177	0.17	84.3	537	6.0	5.6	10.6

Reference Number: 50**Location:** 39m (130ft)N and 652m (2140ft)W of the SE corner of Sec. 35, T.160N., R.30W.**Vegetation:** Stunted black spruce with 30% cover. Understory includes some ericaceous shrubs, few sedges and cotton grass.**Microrelief:** Not recorded**Depth To Water Table:** Not recorded**Described And Sampled By:** T. Malterer, H. Hobbs, and C. Cameron on August 29, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content Total Wt. (%)	Content Dry Wt. (%)	pH H ₂ O	CaCl ₂	Ash Content (%)
Fibric	0- 30	35- 50	0.12	88.8	790	4.9	4.0	7.4
Hemic	30-194	85-100	0.11	88.9	805	6.0	5.2	10.1
Sapric	194-196	135-150	0.11	89.2	823	6.0	5.4	5.5
Silt	196+	179-194	0.13	87.1	676	5.4	5.2	9.0
loam								

Reference Number: 51**Location:** 621m (2040ft)S and 121m (400ft)E of the NW corner of Sec. 36, T.160N., R.30W.**Vegetation:** Stunted black spruce with 35% cover. Understory includes some ericaceous shrubs and cotton grass; few wooded bog forbs. Continuous sphagnum carpet.**Microrelief:** 50cm**Depth To Water Table:** 10cm**Described And Sampled By:** H. Hobbs, D. Olson, and C. Cameron on August 30, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content Total Wt. (%)	Content Dry Wt. (%)	pH H ₂ O	CaCl ₂	Ash Content (%)
Fibric	0- 34	35- 50	0.06	93.6	1461	4.3	3.3	9.5
Hemic	34-223	85-100	0.08	91.0	1015	4.8	4.0	7.6
Clay	223+	135-150	0.14	87.3	685	5.8	5.2	8.6
loam		185-200	0.14	86.9	663	5.8	5.4	9.2
with pebbles								

Reference Number: 52**Location:** 68m (225ft)N and 144m (475ft)E of the SW corner of Sec. 36, T.160N., R.30W.**Vegetation:** Stunted black spruce with 30% cover. Understory includes many ericaceous shrubs (leatherleaf*). Continuous sphagnum carpet.**Microrelief:** 35cm**Depth To Water Table:** At surface**Described And Sampled By:** H. Hobbs, D. Olson, and C. Cameron on August 30, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content Total Wt. (%)	Content Dry Wt. (%)	pH H ₂ O	CaCl ₂	Ash Content (%)
Hemic	0-235	35- 50	0.08	92.5	1236	4.4	3.4	7.0
Clay	235+	85-100	0.10	89.7	873	5.4	4.6	7.4
		135-150	0.10	90.1	910	5.7	5.0	5.7
		185-200	0.11	89.3	834	5.6	5.2	8.1

Reference Number: 53**Location:** 91m (300ft)N and 60m (200ft)W of the SE corner of Sec. 16, T.155N., R.31W.**Vegetation:** Sparse black spruce and tamarack. Understory dominated by sedges (*Carex oligosperma*); some ericaceous shrubs (Labrador tea*). Continuous sphagnum carpet.**Microrelief:** 45cm**Depth To Water Table:** At surface**Described And Sampled By:** L. Severson and H. Mooers on November 20, 1980.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Fibric	0- 10	50-100	0.08	90.9	1000	4.9	3.9	5.3
Hemic	10-270	130-180	0.12	88.9	800	5.8	5.0	7.7
Medium sand	270+	200-250	0.13	88.1	741	5.3	5.0	12.7

Reference Number: 54**Location:** 796m (2610ft)S and 777m (2550ft)E of the NW corner of Sec. 12, T.158N., R.31W.**Vegetation:** Cover dominated by shrubs (willow*, bog birch, speckled alder); many grasses; few forbs. Discontinuous moss carpet.**Microrelief:** Not recorded**Depth To Water Table:** Not recorded**Described And Sampled By:** B. Leuelling and D. Mellem on September 1, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-159	35- 50	0.10	88.6	781	5.2	4.6	6.9
Sapric	159-176	85-100	0.14	86.0	614	5.2	4.7	9.1
Fine sandy loam	176+	135-150	0.18	83.8	519	5.3	5.0	9.5

Reference Number: 55**Location:** 243m (800ft)N and 386m (1265ft)E of the SW corner of Sec. 12, T.158N., R.31W.**Vegetation:** Cover includes many shrubs (bog birch*, willow) and grasses; few forbs (goldenrod, aster). Discontinuous moss carpet.**Microrelief:** Not recorded**Depth To Water Table:** Not recorded**Described And Sampled By:** B. Leuelling, D. Mellem, and B. Balen on September 5, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-164	35- 50	0.12	87.9	725	4.8	4.1	7.5
Silty clay	164-168	85-100	0.13	87.1	674	4.9	4.4	7.6
Fine sand	168-178	135-150	0.19	83.7	514	5.1	4.8	11.0
Silty clay with pebbles	178+							

Reference Number: 56**Location:** 239m (785ft)N and 11m (35ft)E of the SW corner of Sec. 12, T.158N., R.31W.**Vegetation:** Cover dominated by shrubs (bog birch*, willow); some grasses; few forbs (goldenrod) and ericaceous shrubs. Some mosses.**Microrelief:** Not recorded**Depth To Water Table:** Not recorded**Described And Sampled By:** B. Leuelling, D. Mellem, and B. Balen on September 5, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-156	35- 50	0.13	86.8	656	5.2	4.7	6.5
Silty clay	156+	85-100	0.14	86.3	632	5.3	4.8	9.9
		135-150	0.17	83.8	516	5.5	5.0	8.6

Reference Number: 57

Location: 396m (1300ft)N and 785m (2575ft)E of the SW corner of Sec. 12, T.158N., R.31W.
Vegetation: Cover dominated by shrubs (bog birch*, willow); some forbs (goldenrod); few cotton grass. Some mosses; few sphagnum mosses.

Microrelief: Not recorded

Depth To Water Table: Not recorded

Described And Sampled By: B. Leuelling and D. Mellem on September 1, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content Total Wt. (%)	Content Dry Wt. (%)	pH H ₂ O	CaCl ₂	Ash Content (%)
Hemic	0- 90	35- 50	0.14	84.9	561	5.3	4.8	7.2
Sapric	90-133	110-125	0.16	84.3	536	5.6	5.1	10.8
Fine sand	133-141							
Silty clay with pebbles	141+							

Reference Number: 58

Location: 248m (815ft)N and 381m (1250ft)W of the SE corner of Sec. 12, T.158N., R.31W.
Vegetation: Cover includes many grasses; some shrubs (bog birch*, willow); few forbs (goldenrod, aster) and ericaceous shrubs. Discontinuous moss carpet.

Microrelief: Not recorded

Depth To Water Table: 15cm

Described And Sampled By: B. Leuelling, D. Mellem, and B. Balen on September 5, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content Total Wt. (%)	Content Dry Wt. (%)	pH H ₂ O	CaCl ₂	Ash Content (%)
Hemic	0-193	35- 50	0.11	87.8	718	4.8	4.4	7.2
Sapric	193-195	85-100	0.10	88.4	764	5.0	4.7	9.3
Fine sand	195+	135-150	0.13	87.8	717	5.0	4.8	10.6
sand with pebbles		180-195	0.19	81.5	441	4.7	4.6	14.6

Reference Number: 59

Location: 190m (625ft)S and 786m (2580ft)W of the NE corner of Sec. 13, T.158N., R.31W.
Vegetation: Cover includes some shrubs (bog birch*, speckled alder); few forbs (goldenrod) and ericaceous shrubs. Some mosses; few sphagnum mosses.

Microrelief: Not recorded

Depth To Water Table: 20cm

Described And Sampled By: B. Leuelling and D. Mellem on September 1, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content Total Wt. (%)	Content Dry Wt. (%)	pH H ₂ O	CaCl ₂	Ash Content (%)
Hemic	0-160	35- 50	0.15	84.9	564	5.5	4.8	8.1
Sapric	160-175	85-100	0.14	86.3	629	5.9	5.2	8.4
Sandy clay	175+	135-150	0.16	84.6	551	6.0	5.4	10.0

Reference Number: 60

Location: 579m (1900ft)S and 655m (2150ft)W of the NE corner of Sec. 1, T.159N., R.31W.
Vegetation: Cover dominated by grasses (*Phragmites communis*); some cotton grass and forbs (goldenrod); few shrubs (bog birch). Continuous sphagnum carpet.

Microrelief: 10cm

Depth To Water Table: At surface

Described And Sampled By: B. Leuelling and K. Hayner on October 5, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content Total Wt. (%)	Content Dry Wt. (%)	pH H ₂ O	CaCl ₂	Ash Content (%)
Hemic	0-175	50- 65	0.11	88.6	776	5.3	4.9	6.7
Sapric	175-178	85-100	0.09	92.2	1175	5.0	4.7	6.2
Clay loam	178+	135-150	0.10	89.9	892	5.0	4.8	6.4

Reference Number: 61**Location:** 442m (1450ft)S and 610m (2000ft)W of the NE corner of Sec. 2, T.159N., R.31W.**Vegetation:** Cover dominated by shrubs (bog birch) and sedges; some grasses and forbs; few ericaceous shrubs. Few mosses.**Microrelief:** 15cm**Depth To Water Table:** At surface**Described And Sampled By:** D. Mellem and K. Hayner on October 4, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-190	35- 50	0.12	88.4	763	5.0	4.7	12.6
Fine	190+	85-100	0.12	87.8	719	5.2	5.0	7.5
sandy		125-140	0.13	87.7	715	5.4	5.1	7.6
clay		175-190	0.16	84.3	537	5.0	4.9	14.9

Reference Number: 62**Location:** 643m (2110ft)N and 20m (65ft)E of the SW corner of Sec. 2, T.159N., R.31W.**Vegetation:** Cover dominated by grasses; many shrubs (willow); few forbs. Some mosses.**Microrelief:** 20cm**Depth To Water Table:** At surface**Described And Sampled By:** D. Mellem and K. Hayner on October 4, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-145	35- 50	0.11	89.1	821	5.6	5.4	9.1
Silty	145-148	85-100	0.13	86.9	661	5.4	5.2	7.9
clay		128-143	0.19	82.3	465	5.5	5.4	17.8
Clay	148+							

Reference Number: 63**Location:** 311m (1020ft)N and 549m (1800ft)W of the SE corner of Sec. 10, T.159N., R.31W.**Vegetation:** Cover dominated by grasses; many forbs (goldenrod); few shrubs (willow).**Microrelief:** 15cm**Depth To Water Table:** At surface**Described And Sampled By:** D. Mellem and K. Hayner on October 11, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-141	35- 50	0.12	87.7	712	5.3	5.0	7.2
Medium	141-151	85-100	0.16	84.9	560	5.2	5.0	7.7
sand								
Clay	151+							

Reference Number: 64**Location:** 770m (2525ft)N and 30m (100ft)E of the SW corner of Sec. 11, T.159N., R.31W.**Vegetation:** Cover dominated by grasses; some shrubs (willow*, bog birch). Discontinuous moss carpet.**Microrelief:** 25cm**Depth To Water Table:** At surface**Described And Sampled By:** D. Mellem and K. Hayner on October 4, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-102	35- 50	0.09	89.4	843	5.7	5.2	12.7
Silty	102+	85-100	0.18	82.7	479	5.2	5.0	16.9
clay								

Reference Number: 65**Location:** 503m (1650ft)S and 762m (2500ft)W of the NE corner of Sec. 12, T.159N., R.31W.**Vegetation:** Black spruce forest with 50% cover. Understory dominated by ericaceous shrubs (Labrador tea*, cranberry*, lingon berry); many cotton grass. Continuous sphagnum carpet.**Microrelief:** 20cm**Depth To Water Table:** 10cm**Described And Sampled By:** B. Leuelling and K. Hayner on October 5, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-124	35- 50	0.09	90.9	1001	4.4	3.8	5.1
Fine sand	124-140	85-100	0.14	86.6	645	5.4	5.2	10.4
Sandy loam	140 +							

Reference Number: 66**Location:** 465m (1525ft)S and 556m (1825ft)E of the NW corner of Sec. 13, T.159N., R.31W.**Vegetation:** Sparse spruce. Understory dominated by ericaceous shrubs (Labrador tea, leatherleaf); few shrubs (bog birch) and sedges. Continuous sphagnum carpet.**Microrelief:** 20cm**Depth To Water Table:** At surface**Described And Sampled By:** D. Mellem and T. Malterer on October 31, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-120	35- 50	0.16	85.1	572	4.0	3.4	6.1
Sapric	120-135	85-100	0.18	83.4	502	4.8	4.6	11.8
Clay loam	135 +	117-132	0.22	82.2	462	5.0	4.8	17.9

Reference Number: 67**Location:** 632m (2075ft)N and 40m (130ft)W of the SE corner of Sec. 13, T.159N., R.31W.**Vegetation:** Scattered aspen; sparse spruce. Understory includes many shrubs (bog birch); some ericaceous shrubs. Continuous sphagnum carpet.**Microrelief:** 20cm**Depth To Water Table:** 30cm**Described And Sampled By:** D. Mellem and T. Malterer on October 31, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-150	35- 50	0.12	88.7	785	3.7	3.0	4.9
Clay	150 +	85-100	0.12	88.9	801	4.6	4.1	9.0
loam		135-150	0.15	86.7	653	5.0	4.6	10.0

Reference Number: 68**Location:** 500m (1640ft)S and 35m (115ft)E of the NW corner of Sec. 15, T.159N., R.31W.**Vegetation:** Cover dominated by grasses; many shrubs (bog birch); some ericaceous shrubs (leatherleaf); few forbs (goldenrod). Few mosses.**Microrelief:** 15cm**Depth To Water Table:** At surface**Described And Sampled By:** D. Mellem and K. Hayner on October 11, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-172	35- 50	0.12	89.0	808	5.0	4.8	7.6
Silty	172 +	85-100	0.14	86.2	626	5.0	4.9	8.0
clay with calcareous pebbles		135-150	0.15	86.5	640	5.4	5.3	8.6

Reference Number: 69**Location:** 23m (75ft)N and 632m (2075ft)W of the SE corner of Sec. 15, T.159N., R.31W.**Vegetation:** Cover dominated by grasses. Some shrubs (willow, bog birch); few forbs (goldenrod).**Microrelief:** 15cm**Depth To Water Table:** At surface**Described And Sampled By:** D. Mellem and K. Hayner on October 11, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0- 90	35-50	0.15	86.9	665	4.9	4.6	9.9
Sandy	90-110	68-83	0.19	84.2	534	4.7	4.4	8.2
clay								
Silty	110+							
clay								

Reference Number: 70**Location:** 619m (2030ft)N and 757m (2485ft)E of the SW corner of Sec. 16, T.159N., R.31W.**Vegetation:** Cover dominated by grasses; some ericaceous shrubs (leatherleaf) and forbs (goldenrod); few shrubs (bog birch). Few mosses.**Microrelief:** 20cm**Depth To Water Table:** At surface**Described And Sampled By:** D. Mellem and K. Hayner on October 11, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-223	35- 50	0.11	88.3	757	5.2	4.9	6.6
Sapric	223-226	85-100	0.13	87.7	711	5.5	5.2	12.3
Silty	226+	135-150	0.13	87.9	727	5.6	5.3	9.5
clay		185-200	0.14	87.2	679	5.6	5.3	9.0

Reference Number: 71**Location:** 15m (50ft)N and 183m (600ft)E of the SW corner of Sec. 16, T.159N., R.31W.**Vegetation:** Cover includes many grasses; some ericaceous shrubs (leatherleaf); few forbs (goldenrod). Few sphagnum and other mosses.**Microrelief:** 15cm**Depth To Water Table:** 23cm**Described And Sampled By:** B. Leuelling and K. Hayner on November 2, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-192	35- 50	0.14	87.1	677	5.0	4.4	5.3
Silt	192+	85-100	0.13	87.8	718	5.4	4.9	7.9
loam		135-150	0.12	88.4	760	5.5	5.1	10.4

Reference Number: 72**Location:** 18m (60ft)N and 450m (1475ft)W of the SE corner of Sec. 16, T.159N., R.31W.**Vegetation:** Cover dominated by grasses; some forbs (goldenrod); few shrubs (bog birch) and ericaceous shrubs. Few mosses.**Microrelief:** 20cm**Depth To Water Table:** At surface**Described And Sampled By:** D. Mellem and K. Hayner on October 11, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-207	35- 50	0.13	87.7	711	5.1	4.7	5.8
Sapric	207-210	85-100	0.11	89.6	866	5.2	4.8	7.4
Very	210+	135-150	0.14	87.2	682	5.2	4.9	8.1
fine		185-200	0.12	87.9	725	5.3	4.9	7.0
sandy								
clay								

Reference Number: 73

Location: 568m (1865ft)S and 445m (1460ft)E of the NW corner of Sec. 17, T.159N., R.31W.

Vegetation: Sparse black spruce and aspen. Understory includes some ericaceous shrubs (Labrador tea*) and other shrubs (bog birch); few forbs. Continuous sphagnum carpet.

Microrelief: 35cm

Depth To Water Table: 7cm

Described And Sampled By: B. Leuelling and K. Hayner on October 18, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-237	35- 50	0.13	87.3	687	4.2	3.8	7.2
Sapric	237-250	85-100	0.18	83.4	501	5.1	4.8	9.7
Fine	250 +	135-150	0.17	84.4	542	5.2	5.0	9.6
sand		185-200	0.17	84.2	534	5.2	5.0	9.6
		225-240	0.24	79.2	380	5.2	5.1	24.6

Reference Number: 74

Location: 38m (125ft)N and 360m (1180ft)W of the SE corner of Sec. 17, T.159N., R.31W.

Vegetation: Sparse aspen. Understory dominated by shrubs (bog birch); many grasses; some ericaceous shrubs (leatherleaf*).

Microrelief: 20cm

Depth To Water Table: At surface

Described And Sampled By: B. Leuelling and K. Hayner on October 18, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-164	35- 50	0.11	89.1	816	4.6	4.5	8.4
Clay	164 +	85-100	0.09	91.1	1025	5.2	4.7	7.5
loam		135-150	0.11	89.9	887	5.4	5.1	9.9

Reference Number: 75

Location: 632m (2075ft)S and 40m (130ft)W of the NE corner of Sec. 21, T.159N., R.31W.

Vegetation: Cover dominated by grasses; few ericaceous shrubs, cotton grass, and shrubs (bog birch). Discontinuous moss carpet.

Microrelief: 20cm

Depth To Water Table: 10cm

Described And Sampled By: B. Leuelling and K. Hayner on October 12, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-193	35- 50	0.10	89.7	870	5.3	5.0	9.2
Sapric	193-203	85-100	0.11	88.8	792	5.3	5.1	9.8
Sandy	203 +	135-150	0.12	88.9	797	5.4	5.2	9.6
clay		180-195	0.18	84.8	560	5.4	5.2	10.7

Reference Number: 76

Location: 622m (2040ft)S and 96m (315ft)E of the NW corner of Sec. 21, T.159N., R.31W.

Vegetation: Cover dominated by grasses; many shrubs (dogwood*, willow, speckled alder).

Microrelief: 15cm

Depth To Water Table: Not visible

Described And Sampled By: D. Mellem and K. Hayner on October 11, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-115	35- 50	0.15	82.4	467	5.4	5.3	8.4
Silty	115 +	85-100	0.17	83.0	489	5.3	5.2	8.5
clay								

Reference Number: 77**Location:** 709m (2325ft)S and 747m (2450ft)W of the NE corner of Sec. 22, T.159N., R.31W.**Vegetation:** Cover includes many ericaceous shrubs (leatherleaf*) and other shrubs (bog birch); few forbs (goldenrod).**Microrelief:** 10cm**Depth To Water Table:** At surface**Described And Sampled By:** B. Leuelling and K. Hayner on October 5, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-106	35-50	0.12	87.5	702	5.0	4.6	7.2
Clay loam	106+	80-95	0.12	88.3	752	5.1	4.8	7.3

Reference Number: 78**Location:** 709m (2325ft)S and 251m (825ft)W of the NE corner of Sec. 22, T.159N., R.31W.**Vegetation:** Cover dominated by cotton grass; some ericaceous shrubs (leatherleaf); few shrubs (willow, bog birch). Discontinuous moss carpet.**Microrelief:** 20cm**Depth To Water Table:** At surface**Described And Sampled By:** B. Leuelling and K. Hayner on October 12, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-155	35- 50	0.15	86.2	623	5.4	4.2	6.4
Sapric	155-158	85-100	0.11	89.0	807	5.4	4.6	7.2
Clay loam	158+	135-150	0.17	84.6	551	5.7	5.0	9.2

Reference Number: 79**Location:** 549m (1800ft)N and 756m (2480ft)E of the SW corner of Sec. 23, T.159N., R.31W.**Vegetation:** Sparse tamarack. Understory dominated by ericaceous shrubs (Labrador tea*); few cotton grass. Continuous sphagnum carpet.**Microrelief:** 35cm**Depth To Water Table:** Not recorded**Described And Sampled By:** B. Leuelling and K. Hayner on October 12, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-153	35- 50	0.12	88.5	767	3.5	2.9	4.0
Sapric	153-168	85-100	0.13	87.9	729	3.8	3.2	5.4
Hemic	168-266	135-150	0.15	86.4	637	4.6	4.1	6.4
Sapric	266-280	185-200	0.17	84.6	548	5.2	4.8	9.0
Sandy clay loam	280+	235-250	0.20	81.2	432	5.5	5.1	9.4

Reference Number: 80**Location:** 579m (1900ft)N and 523m (1715ft)E of the SW corner of Sec. 24, T.159N., R.31W.**Vegetation:** Scattered black spruce; sparse tamarack. Understory dominated by ericaceous shrubs (lingen berry*); few cotton grass. Discontinuous moss carpet; some sphagnum mosses.**Microrelief:** 35cm**Depth To Water Table:** 10cm**Described And Sampled By:** B. Leuelling and K. Hayner on October 12, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-268	35- 50	0.10	90.6	965	3.8	3.0	3.3
Sapric	268-274	85-100	0.07	91.8	1116	4.4	3.6	4.6
Clay	274+	135-150	0.10	90.2	919	5.0	4.6	6.7
loam		185-200	0.11	89.2	827	5.6	5.2	9.2
		235-250	0.16	86.1	618	5.8	5.4	8.3

Reference Number: 81**Location:** 579m (1900ft)N and 40m (130ft)W of the SE corner of Sec. 24, T.159N., R.31W.**Vegetation:** Sparse tamarack. Understory dominated by cotton grass; some ericaceous shrubs (leatherleaf*, cranberry*). Discontinuous moss carpet; some sphagnum mosses.**Microrelief:** 30cm**Depth To Water Table:** At surface**Described And Sampled By:** B. Leuelling and K. Hayner on October 12, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0- 96	35- 50	0.15	87.0	670	4.8	4.3	8.5
Sapric	96-106	85-100	0.17	84.6	549	5.4	5.2	11.9
Loam	106 +							

Reference Number: 82**Location:** 411m (1350ft)S and 796m (2610ft)E of the NW corner of Sec. 25, T.159N., R.31W.**Vegetation:** Sparse tamarack and aspen. Understory includes many ericaceous shrubs (Labrador tea*); some cotton grass. Discontinuous sphagnum carpet; some other mosses.**Microrelief:** 35cm**Depth To Water Table:** 12cm**Described And Sampled By:** B. Leuelling and K. Hayner on October 18, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-190	35- 50	0.13	88.3	755	3.6	3.2	5.2
Sapric	190-192	85-100	0.16	85.7	600	4.6	4.4	7.5
Loamy	192 +	135-150	0.17	85.1	573	5.3	5.0	12.6
fine sand		175-190	0.22	80.9	423	5.6	5.4	12.4

Reference Number: 83**Location:** 61m (200ft)S and 244m (800ft)W of the NE corner of Sec. 26, T.159N., R.31W.**Vegetation:** Sparse tamarack and black spruce. Understory includes many ericaceous shrubs (leatherleaf*) and cotton grass; few shrubs (bog birch). Discontinuous moss carpet; few sphagnum mosses.**Microrelief:** 20cm**Depth To Water Table:** 10cm**Described And Sampled By:** B. Leuelling and K. Hayner on October 18, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-150	35- 50	0.14	87.2	680	4.4	4.2	7.2
Fine	150 +	85-100	0.12	88.3	758	5.2	4.8	9.2
sand with pebbles		120-135	0.15	86.4	634	5.2	5.0	10.6

Reference Number: 84**Location:** 450m (1475ft)S and 488m (1600ft)E of the NW corner of Sec. 26, T.159N., R.31W.**Vegetation:** Cover dominated by grasses; many forbs (goldenrod); few shrubs (willow). Some mosses.**Microrelief:** 10cm**Depth To Water Table:** 10cm**Described And Sampled By:** B. Leuelling and K. Hayner on October 18, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-76	35-50	0.18	84.5	547	5.0	4.8	11.0
Sapric	76-81							
Loamy	81 +							
fine sand								

Reference Number: 85**Location:** 709m (2325ft)N and 259m (850ft)W of the SE corner of Sec. 26, T.159N., R.31W.**Vegetation:** Cover dominated by grasses; many shrubs (willow); few ericaceous shrubs and forbs (goldenrod). Some sphagnum mosses.**Microrelief:** 10cm**Depth To Water Table:** 20cm**Described And Sampled By:** B. Leuelling and K. Hayner on October 18, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-74	35-50	0.18	84.4	542	4.9	4.6	10.6
Sapric	74-77							
Loamy	77+							
fine sand								

Reference Number: 86**Location:** 635m (2085ft)N and 152m (500ft)W of the SE corner of Sec. 34, T.159N., R.31W.**Vegetation:** Cover dominated by grasses; many shrubs (willow); some forbs (goldenrod). Few mosses.**Microrelief:** 15cm**Depth To Water Table:** Not visible**Described And Sampled By:** D. Mellem and T. Malterer on October 31, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-130	35- 50	0.19	82.4	470	4.9	4.8	12.1
Sapric	130-170	85-100	0.21	79.8	394	5.2	5.0	11.0
Clay loam	170+	135-150	0.50	65.2	187	5.6	5.5	72.0

Reference Number: 87**Location:** 343m (1125ft)N and 23m (75ft)E of the SW corner of Sec. 13, T.160N., R.31W.**Vegetation:** Cover dominated by shrubs (bog birch*, dogwood, sumac); many grasses.**Microrelief:** Negligible**Depth To Water Table:** 10cm**Described And Sampled By:** D. Olson and B. Balen on August 26, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-81	35-50	0.08	88.0	733	6.4	6.0	12.3
Medium sand	81+							

Reference Number: 88**Location:** 724m (2375ft)N and 61m (200ft)W of the SE corner of Sec. 13, T.160N., R.31W.**Vegetation:** Cover dominated by shrubs (speckled alder*) and grasses.**Microrelief:** Negligible**Depth To Water Table:** 10cm**Described And Sampled By:** D. Olson and B. Balen on August 29, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-93	35-50	0.10	86.1	618	5.4	5.0	11.0
Fine sand	93+	75-90	0.14	82.1	459	5.4	5.1	17.3

Reference Number: 89**Location:** 549m (1800ft)N and 640m (2100ft)W of the SE corner of Sec. 13, T.160N., R.31W.**Vegetation:** Not recorded**Microrelief:** Not recorded**Depth To Water Table:** Not recorded**Described And Sampled By:** H. Hobbs, D. Mellem, and C. Cameron on September 11, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0- 86	35- 50	0.14	86.8	655	5.4	5.1	10.6
Fibric	86-104	85-100	0.10	90.1	910	5.6	5.4	11.6
Hemic Clay loam	104-144 144 +	125-140	0.19	83.8	516	5.6	5.5	13.0

Reference Number: 90**Location:** 526m (1725ft)N and 23m (75ft)E of the SW corner of Sec. 16, T.160N., R.31W.**Vegetation:** Aspen forest with 80% cover. Understory dominated by forbs; few shrubs (speckled alder).**Microrelief:** 5cm**Depth To Water Table:** 20cm**Described And Sampled By:** D. Olson and B. Balen on August 29, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-133	35- 50	0.09	84.8	556	5.0	4.6	7.3
Clay loam	133 +	90-100				5.5	5.3	

Reference Number: 91**Location:** 119m (390ft)S and 38m (125ft)W of the NE corner of Sec. 17, T.160N., R.31W.**Vegetation:** Aspen forest with 80% cover. Understory includes some ericaceous shrubs (leatherleaf) and forbs.**Microrelief:** Negligible**Depth To Water Table:** 20cm**Described And Sampled By:** D. Olson and B. Balen on August 29, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic Sand	0-111 111 +	35- 50 90-100	0.11	83.2	497	4.6 5.4	4.1 4.8	9.2

Reference Number: 92**Location:** 571m (1875ft)S and 27m (90ft)W of the NE corner of Sec. 17, T.160N., R.31W.**Vegetation:** Aspen forest with 35% cover; sparse black spruce and tamarack. Understory dominated by ericaceous shrubs (Labrador tea*, leatherleaf*); few shrubs (bog birch, speckled alder). Continuous sphagnum carpet.**Microrelief:** 35cm**Depth To Water Table:** 20cm**Described And Sampled By:** D. Olson and B. Balen on August 29, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-140	35- 50	0.11	85.4	584	5.3	4.8	6.7
Clay loam	140 +	85-100	0.09	85.3	581	5.6	5.0	9.6

Reference Number: 93**Location:** 617m (2025ft)N and 655m (2150ft)W of the SE corner of Sec. 23, T.160N., R.31W.**Vegetation:** Sparse black spruce and tamarack. Understory includes many sedges; few ericaceous shrubs and bog forbs. Discontinuous sphagnum carpet; some other mosses.**Microrelief:** 30cm**Depth To Water Table:** At surface**Described And Sampled By:** D. Mellem and K. Hayner on October 4, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-210	35- 50	0.12	88.3	758	3.8	3.1	6.8
Sapric	210-225	85-100	0.09	90.5	956	4.3	3.8	4.8
Clay	225 +	135-150	0.10	90.2	925	5.4	5.0	7.8
loam		185-200	0.10	88.9	799	5.7	5.4	8.5
		210-225	0.18	83.3	497	5.6	5.3	19.2

Reference Number: 94**Location:** 527m (1730ft)S and 8m (25ft)E of the NW corner of Sec. 24, T.160N., R.31W.**Vegetation:** Sparse black spruce and tamarack. Understory includes many ericaceous shrubs; some sedges. Continuous sphagnum carpet.**Microrelief:** 50cm**Depth To Water Table:** At surface**Described And Sampled By:** D. Mellem and K. Hayner on October 3, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-194	35- 50	0.12	88.2	750	3.7	3.2	7.9
Sapric	194-230	85-100	0.11	88.5	772	5.0	4.6	7.6
Silty	230-235	135-150	0.08	90.1	905	5.3	5.0	9.2
clay		185-200	0.15	85.4	587	5.4	5.2	13.6
Fine sandy clay	235 +	215-230	0.24	78.5	366	5.5	5.4	20.6

Reference Number: 95**Location:** 126m (415ft)N and 378m (1240ft)E of the SW corner of Sec. 24, T.160N., R.31W.**Vegetation:** Sparse black spruce. Understory dominated by sedges; some ericaceous shrubs (leatherleaf*); few cotton grass. Continuous sphagnum carpet.**Microrelief:** 40cm**Depth To Water Table:** At surface**Described And Sampled By:** D. Mellem and K. Hayner on October 3, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-310	35- 50	0.07	93.2	1369	4.4	3.5	7.5
Clay	310-350	85-100	0.08	90.7	970	5.7	5.4	6.7
with pebbles		135-150	0.09	90.5	950	6.0	5.0	8.3
Banded	350 +	185-200	0.10	89.6	865	6.2	5.6	8.2
clay		235-250	0.10	89.7	875	6.2	5.5	9.7
		285-300	0.13	87.0	668	6.2	5.7	9.4

Reference Number: 96**Location:** 579m (1900ft)N and 564m (1850ft)E of the SW corner of Sec. 25, T.160N., R.31W.**Vegetation:** Stunted black spruce with 30% cover; scattered tamarack. Understory includes some ericaceous shrubs. Continuous sphagnum carpet.**Microrelief:** 25cm**Depth To Water Table:** At surface**Described And Sampled By:** D. Mellem and K. Hayner on October 3, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-230	35- 50	0.10	89.7	874	4.2	3.4	5.0
Clay	230 +	85-100	0.08	91.8	1119	5.6	4.8	5.9
		135-150	0.13	86.4	633	6.0	5.2	7.5
		185-200	0.09	90.8	991	6.2	5.6	7.7
		215-230	0.17	82.2	463	5.5	5.4	22.5

Reference Number: 97**Location:** 165m (540ft)N and 492m (1615ft)W of the SE corner of Sec. 25, T.160N., R.31W.**Vegetation:** Cover dominated by sedges; some shrubs (bog birch). Some sphagnum mosses.**Microrelief:** 10cm**Depth To Water Table:** At surface**Described And Sampled By:** D. Mellem and K. Hayner on October 3, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content Total Wt. (%)	Dry Wt. (%)	pH H ₂ O	CaCl ₂	Ash Content (%)
Hemic Clay	0-205 205 +	35- 50	0.09	90.5	948	5.3	4.8	7.7
		85-100	0.13	87.6	705	5.6	5.3	9.0
		135-150	0.11	89.0	808	5.7	5.4	9.2
		185-200	0.14	86.9	661	6.0	5.6	13.2

Reference Number: 98**Location:** 799m (2620ft)S and 587m (1925ft)W of the NE corner of Sec. 26, T.160N., R.31W.**Vegetation:** Stunted black spruce with 60% cover. Understory includes few ericaceous shrubs, sedges, and bog forbs. Continuous sphagnum carpet.**Microrelief:** 45cm**Depth To Water Table:** At surface**Described And Sampled By:** D. Mellem and K. Hayner on October 4, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content Total Wt. (%)	Dry Wt. (%)	pH H ₂ O	CaCl ₂	Ash Content (%)
Hemic Silty clay	0-225 225 +	35- 50	0.09	91.3	1056	3.5	3.0	6.3
		85-100	0.09	90.8	992	3.7	3.2	4.2
		135-150	0.10	89.3	832	4.2	3.9	5.9
		185-200	0.12	87.8	721	5.0	4.8	7.7
		210-225	0.20	81.7	446	5.4	5.2	19.6

Reference Number: 99**Location:** 564m (1850ft)S and 155m (510ft)E of the NW corner of Sec. 26, T.160N., R.31W.**Vegetation:** Sparse black spruce and tamarack. Understory includes many sedges; some ericaceous shrubs (Labrador tea*). Discontinuous sphagnum carpet; some other mosses.**Microrelief:** 20cm**Depth To Water Table:** At surface**Described And Sampled By:** D. Mellem and K. Hayner on October 4, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content Total Wt. (%)	Dry Wt. (%)	pH H ₂ O	CaCl ₂	Ash Content (%)
Hemic Clay	0-170 170 +	35- 50		95.3	2013	3.7	3.2	5.9
		85-100	0.08	89.5	856	3.8	3.4	5.6
		135-150	0.11	89.5	849	4.8	4.5	7.2

Reference Number: 100**Location:** 686m (2250ft)S and 678m (2225ft)W of the NE corner of Sec. 35, T.160N., R.31W.**Vegetation:** Cover dominated by ericaceous shrubs (bog rosemary) and other shrubs (bog birch*, willow); few forbs (cattail). Few sphagnum and other mosses.**Microrelief:** 15cm**Depth To Water Table:** At surface**Described And Sampled By:** D. Mellem and K. Hayner on October 4, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content Total Wt. (%)	Dry Wt. (%)	pH H ₂ O	CaCl ₂	Ash Content (%)
Hemic Sapric Silty clay	0-185 185-193 193 +	35- 50	0.07	90.1	908	5.8	5.0	9.5
		85-100	0.12	88.5	769	6.0	5.2	7.0
		135-150	0.09	87.2	680	6.1	5.4	5.5
		175-190	0.18	83.7	515	5.8	5.4	9.7

Reference Number: 101**Location:** 625m (2050ft)N and 271m (890ft)E of the SW corner of Sec. 36, T.160N., R.31W.**Vegetation:** Cover dominated by sedges; many shrubs (bog birch*, willow). Few sphagnum and other mosses.**Microrelief:** 10cm**Depth To Water Table:** At surface**Described And Sampled By:** D. Mellem and K. Hayner on October 4, 1978.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content Total Wt. (%)	Dry Wt. (%)	pH H ₂ O	CaCl ₂	Ash Content (%)
Hemic	0-130	35- 50	0.06	91.7	1101	5.6	4.8	7.2
Silty clay	130+	85-100	0.10	89.1	818	5.9	5.2	7.3

Reference Number: 102**Location:** 267m (875ft)S and 361m (1185ft)W of the NE corner of Sec. 7, T.155N., R.32W.**Vegetation:** Sparse black spruce and tamarack. Understory dominated by sedges (*Carex oligosperma*); few ericaceous shrubs and bog forbs. Discontinuous sphagnum carpet.**Microrelief:** 35cm**Depth To Water Table:** At surface**Described And Sampled By:** D. Riihiluoma and H. Mooers on November 24, 1980.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content Total Wt. (%)	Dry Wt. (%)	pH H ₂ O	CaCl ₂	Ash Content (%)
Fibric	0-210	50-100	0.09	89.2	828	4.2	3.2	8.8
Hemic	210-450	100-200	0.05	94.4	1677	4.2	3.5	3.0
Loam	450+	210-270	0.07	93.3	1382	5.5	4.6	5.5
		300-400				5.2	4.8	

Reference Number: 103**Location:** 130m (425ft)S and 675m (2215ft)W of the NE corner of Sec. 23, T.155N., R.32W.**Vegetation:** Sparse black spruce and tamarack. Understory dominated by sedges (*Carex oligosperma*); some ericaceous shrubs (cranberry*). Some sphagnum mosses.**Microrelief:** 25cm**Depth To Water Table:** Not visible**Described And Sampled By:** H. Mooers and D. Riihiluoma on November 24, 1980.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content Total Wt. (%)	Dry Wt. (%)	pH H ₂ O	CaCl ₂	Ash Content (%)
Hemic	0-300	50-150	0.10	89.5	850	5.0	4.1	4.6
Coarse sand and gravel	300+	200-300	0.14	87.4	693	5.9	5.3	13.3

Reference Number: 104**Location:** 107m (350ft)S and 122m (400ft)W of the NE corner of Sec. 12, T.156N., R.32W.**Vegetation:** Sparse tamarack. Understory includes many ericaceous shrubs (leatherleaf*); some other shrubs (bog birch), grasses (*Phragmites communis*), and sedges. Continuous sphagnum carpet.**Microrelief:** 20cm**Depth To Water Table:** At surface**Described And Sampled By:** L. Severson and H. Mooers on November 20, 1980.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content Total Wt. (%)	Dry Wt. (%)	pH H ₂ O	CaCl ₂	Ash Content (%)
Fibric	0- 30	50- 90	0.09	91.1	1025	5.4	4.8	5.9
Hemic	30-180	100-180	0.11	89.5	855	5.9	5.3	7.3
Clay loam	180+							

Reference Number: 105

Location: 46m (150ft)S and 792m (2600ft)W of the NE corner of Sec. 26, T.156N., R.32W.
Vegetation: Cover dominated by sedges (*Carex lasiocarpa*); few shrubs (bog birch),
ericaceous shrubs, and forbs.

Microrelief: 10cm

Depth To Water Table: 15cm

Described And Sampled By: S. Nelson and N. Aaseng on November 20, 1980.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content Total Wt. (%)	Dry Wt. (%)	pH H ₂ O	CaCl ₂	Ash Content (%)
Fibric	0- 60	45- 60				5.5	4.5	
Hemic	60-285	100-180	0.07	92.8	1285	5.6	4.7	5.9
Sapric	285-310	210-270	0.10	89.8	881	5.2	4.9	11.0
Limnic	310-320							
Silt with gravel	320 +							

Reference Number: 106

Location: 671m (2200ft)N and 792m (2600ft)W of the SE corner of Sec. 4, T.157N., R.32W.
Vegetation: Scattered black spruce and tamarack. Understory includes many ericaceous shrubs (leatherleaf*); some sedges (*Carex paupercula**, *C. aquatilis*); few wooded bog forbs. Continuous sphagnum carpet.

Microrelief: 40cm

Depth To Water Table: 5cm

Described And Sampled By: H. Mooers, S. Nelson, L. Severson, and N. Aaseng on November 18, 1980.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content Total Wt. (%)	Dry Wt. (%)	pH H ₂ O	CaCl ₂	Ash Content (%)
Fibric	0- 45	60-100	0.13	87.4	691	5.8	5.3	10.6
Hemic	45-150							
Loam	150 +							

Reference Number: 107

Location: 15m (50ft)N and 152m (500ft)W of the SE corner of Sec. 32, T.157N., R.32W.
Vegetation: Scattered tamarack; sparse black spruce. Understory dominated by ericaceous shrubs (bog rosemary*, leatherleaf*); some sedges (*Carex lasiocarpa*) and shrubs (bog birch); few grasses (*Phragmites communis*) and bog forbs. Continuous sphagnum carpet.

Microrelief: 60cm

Depth To Water Table: At surface

Described And Sampled By: H. Mooers and S. Nelson on November 21, 1980.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content Total Wt. (%)	Dry Wt. (%)	pH H ₂ O	CaCl ₂	Ash Content (%)
Hemic	0-195	50-150	0.10	89.7	871	5.2	4.8	7.6
Medium sand	195 +							

Reference Number: 108

Location: 106m (350ft)S and 3m (10ft)E of the NW corner of Sec. 12, T.157N., R.33W.*
Vegetation: Sparse tamarack and black spruce. Understory dominated by sedges (*Carex oligosperma**, *C. aquatilis*); some ericaceous shrubs. Continuous sphagnum carpet.

Microrelief: Not recorded

Depth To Water Table: At surface

Described And Sampled By: L. Severson and H. Mooers on December 3, 1980.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content Total Wt. (%)	Dry Wt. (%)	pH H ₂ O	CaCl ₂	Ash Content (%)
Fibric	0- 95	75- 95				4.8	4.1	
Hemic	95-210	100-200	0.09	91.5	1080	5.5	4.9	6.7
Medium sand	210 +							

Reference Number: 109**Location:** 340m (1115ft)S and 110m (360ft)W of the NE corner of Sec. 2, T.155N., R.34W.**Vegetation:** Cover dominated by sedges (*Carex lasiocarpa*); few bog forbs and grasses (*Phragmites communis*). Few mosses.**Microrelief:** Negligible**Depth To Water Table:** 15cm above surface**Described And Sampled By:** H. Mooers and D. Riihiluoma on March 17, 1981.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic Medium sand	0-190	0-110				6.0	5.1	
	190+	110-175	0.09	90.7	971	6.0	5.2	6.1
		175-190	0.13	87.5	699	6.0	5.5	9.7

Reference Number: 111**Location:** 186m (610ft)N and 125m (410ft)E of the SW corner of Sec. 6, T.157N., R.34W.**Vegetation:** Cover includes many sedges (*Carex lasiocarpa**, *C. aquatilis*); some shrubs (bog birch); few forbs (cattails).**Microrelief:** Negligible**Depth To Water Table:** At surface**Described And Sampled By:** H. Mooers and L. Severson on December 4, 1980.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic Sandy loam	0-165 165+	100-150	0.20	81.8	451	5.7	5.2	12.2

Reference Number: 110**Location:** 518m (1700ft)N and 488m (1600ft)E of the SW corner of Sec. 11, T.156N., R.34W.**Vegetation:** Stunted black spruce with 35% cover; sparse tamarack. Understory dominated by ericaceous shrubs (Labrador tea*, leatherleaf*, lingen berry); few shrubs (willow) and sedges (*Carex paupercula*). Continuous sphagnum carpet.**Microrelief:** 45cm**Depth To Water Table:** Not visible**Described And Sampled By:** D. Riihiluoma and S. Nelson on November 26, 1980.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic Loam	0-90 90+	40-90	0.16	83.7	513	5.0	4.5	9.9

Reference Number: 112**Location:** 527m (1730ft)N and 343m (1125ft)W of the SE corner of Sec. 18, T.159N., R.34W.**Vegetation:** Sparse black spruce and tamarack. Understory includes many ericaceous shrubs; some cotton grass and sedges (*Carex oligosperma*). Discontinuous sphagnum carpet.**Microrelief:** 45cm**Depth To Water Table:** Not visible**Described And Sampled By:** H. Mooers and S. Nelson on December 10, 1980.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic Sapric Sand	0-180 180-225 225+	35- 50 100-150	0.16	84.5	546	4.0 5.5	3.1 4.6	12.8

Reference Number: 113**Location:** 299m (980ft)S and 427m (1400ft)E of the NW corner of Sec. 18, T.160N., R.34W.**Vegetation:** Cover dominated by sedges (*Carex lasiocarpa**); many shrubs (willow); some forbs (iris*) and grasses (*Phragmites communis*).**Microrelief:** Negligible**Depth To Water Table:** At surface**Described And Sampled By:** H. Mooers and S. Nelson on December 8, 1980.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-150	50- 90	0.10	89.5	857	6.1	5.5	7.7
Fine sand	150 +	100-140	0.11	89.3	836	6.6	5.8	9.3

Reference Number: 114**Location:** 739m (2425ft)S and 76m (250ft)E of the NW corner of Sec. 30, T.160N., R.34W.**Vegetation:** Stunted black spruce with 35% cover. Understory dominated by sedges; some shrubs (bog birch); few forbs (cattail).**Microrelief:** Negligible**Depth To Water Table:** At surface**Described And Sampled By:** S. Nelson and H. Mooers on December 10, 1980.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-90	60-90	0.17	82.8	483	6.3	5.7	13.3
Mineral soil	90 +							

Reference Number: 115**Location:** 24m (80ft)N and 587m (1925ft)E of the SW corner of Sec. 25, T.155N., R.35W.**Vegetation:** Scattered tamarack. Understory includes many sedges; some ericaceous shrubs, other shrubs (bog birch*, willow), and forbs (iris, cattail). Continuous sphagnum carpet.**Microrelief:** 30cm**Depth To Water Table:** At surface**Described And Sampled By:** D. Riihiluoma and S. Nelson on November 25, 1980.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-150	60-130	0.13	88.2	745	5.7	5.2	8.3
Medium to coarse sand	150 +							

Reference Number: 116**Location:** 411m (1350ft)N and 546m (1790ft)W of the SE corner of Sec. 18, T.156N., R.35W.**Vegetation:** Cover dominated by grasses; few shrubs (willow) and forbs.**Microrelief:** Negligible**Depth To Water Table:** At surface**Described And Sampled By:** L. Severson and H. Mooers on December 4, 1980.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-105	0-100	0.17	81.5	440	5.9	5.5	10.1
Mineral soil	105 +							

Reference Number: 117**Location:** 30m (100ft)S and 43m (140ft)W of the NE corner of Sec. 25, T.157N., R.35W.**Vegetation:** Cover dominated by grasses (*Phragmites communis**); many shrubs (willow); few sedges (*Carex aquatilis*).**Microrelief:** Negligible**Depth To Water Table:** 10cm**Described And Sampled By:** H. Mooers and L. Severson on December 4, 1980.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content Total Wt. (%)	Dry Wt. (%)	pH H ₂ O	CaCl ₂	Ash Content (%)
Hemic Clay loam	0-210 210+	0-100	0.15	86.0	614	5.9	5.4	7.7

Reference Number: 118**Location:** 588m (1930ft)N and 271m (890ft)E of the SW corner of Sec. 9, T.158N., R.35W.**Vegetation:** Sparse tamarack. Understory dominated by sedges (*Carex lasiocarpa*); some bog forbs (pitcher plant); few shrubs (bog birch) and ericaceous shrubs (bog rosemary).**Microrelief:** Negligible**Depth To Water Table:** 10cm above surface**Described And Sampled By:** H. Mooers and S. Nelson on December 9, 1980.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content Total Wt. (%)	Dry Wt. (%)	pH H ₂ O	CaCl ₂	Ash Content (%)
Fibric Hemic Loamy sand	0-30 30-210 210+	75-125	0.11	89.1	818	6.4	5.7	9.8

Reference Number: 119**Location:** 571m (1875ft)N and 465m (1525ft)E of the SW corner of Sec. 5, T.160N., R.35W.**Vegetation:** Scattered tamarack. Understory dominated by shrubs (bog birch*); many grasses (*Phragmites communis**); some sedges (*Carex lasiocarpa*) and forbs (ferns*).**Microrelief:** Negligible**Depth To Water Table:** 5cm above surface**Described And Sampled By:** S. Nelson and H. Mooers on December 8, 1980.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content Total Wt. (%)	Dry Wt. (%)	pH H ₂ O	CaCl ₂	Ash Content (%)
Hemic Silt loam	0-270 270+	50-150 150-250	0.12 0.13	89.1 88.1	817 739	6.5 6.1	5.7 5.6	10.0 8.9

Reference Number: 120**Location:** 76m (250ft)N and 168m (550ft)W of the SE corner of Sec. 25, T.157N., R.36W.**Vegetation:** Cover dominated by sedges (*Carex lasiocarpa*); some shrubs (bog birch); few ericaceous shrubs. Discontinuous feathermoss carpet.**Microrelief:** Negligible**Depth To Water Table:** At surface**Described And Sampled By:** H. Mooers and L. Severson on December 4, 1980.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content Total Wt. (%)	Dry Wt. (%)	pH H ₂ O	CaCl ₂	Ash Content (%)
Hemic Sandy loam	0-240 240+	75-125 175-225	0.10 0.14	90.5 87.5	952 702	5.6 5.5	5.0 5.0	6.2 9.5

Reference Number: 121

Location: 23m (75ft)N and 40m (130ft)E of the SW corner of Sec. 29, T.157N., R.36W.

Vegetation: Cover dominated by sedges (*Carex lasiocarpa*); some shrubs (bog birch); few forbs (cattail, aster). Discontinuous feathermoss carpet.

Microrelief: Negligible

Depth To Water Table: At surface

Described And Sampled By: L. Severson and H. Mooers on December 4, 1980.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic	0-120	0- 90	0.10	89.9	894	5.6	5.0	6.0
Gravel	120+	90-120	0.14	86.0	616	5.7	5.2	8.3

APPENDIX C

SITE DESCRIPTIONS WITH DOE ENERGY VALUE DATA

Reference Number: 122

Location: 805m (2640ft)S and 91m (300ft)E of the NW corner of Sec. 18, T.156N., R.30W.

Vegetation: Cover dominated by sedges (*Carex lasiocarpa*); few shrubs (bog birch) and grasses (*Phragmites communis*).

Microrelief: Negligible

Depth To Water Table: At surface

Described And Sampled By: H. Mooers and D. Riihiluoma on March 18, 1981.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content Total Wt. (%)	Dry Wt. (%)	pH H ₂ O	CaCl ₂	Ash Content (%)
Hemic Mineral soil	0-150	75-100	0.10	89.7	876	5.2	4.8	7.0
	150 +	110-150	0.11	89.1	820	5.2	4.9	9.6
Ultimate Analysis								
		Sample Depth (cm)	Total C (%)	H (%)	N (%)	S (%)	O (%)	
		75-100	53.76	4.82	2.36	0.27	32.4	
		110-150	53.28	4.27	2.32	0.78	29.9	
Proximate Analysis								
		Sample Depth (cm)	Btu/lb.	Moisture Content (%)	Ash Content (%)	Volatiles (%)	Fixed Carbon (%)	
		75-100	9054	90.3	6.4	65.0	28.6	
		110-150	8753	89.7	9.5	61.9	28.6	

Reference Number: 123

Location: 457m (1500ft)N and 23m (75ft)E of the SW corner of Sec. 1, T.155N., R.32W.

Vegetation: Sparse tamarack. Understory dominated by sedges (*Carex oligosperma*); some ericaceous shrubs; few other shrubs (bog birch). Continuous sphagnum carpet.

Microrelief: 30cm

Depth To Water Table: At surface

Described And Sampled By: L. Severson and N. Aaseng on November 21, 1980.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content Total Wt. (%)	Dry Wt. (%)	pH H ₂ O	CaCl ₂	Ash Content (%)
Fibric	0-120	50-120				4.4	3.6	
Hemic	120-315	150-315	0.07	92.3	1205	5.6	4.8	7.1
Silt loam	315 +							
Ultimate Analysis								
		Sample Depth (cm)	Total C (%)	H (%)	N (%)	S (%)	O (%)	
		50-120	46.26	4.71	0.94	0.20	38.5	
		150-315	54.20	5.15	1.44	0.16	33.1	
Proximate Analysis								
		Sample Depth (cm)	Btu/lb.	Moisture Content (%)	Ash Content (%)	Volatiles (%)	Fixed Carbon (%)	
		50-120	7460	97.8	9.4	70.5	20.1	
		150-315	8997	93.4	6.0	67.0	27.0	

Reference Number: 124**Location:** 23m (75ft)S and 305m (1000ft)W of the NE corner of Sec. 13, T.155N., R.32W.**Vegetation:** Black spruce forest with 80% cover. Understory dominated by ericaceous shrubs (Labrador tea*, lingon berry). Continuous sphagnum carpet.**Microrelief:** 30cm**Depth To Water Table:** At surface**Described And Sampled By:** H. Mooers and D. Riihiluoma on March 16, 1981.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Fibric Bottom unknown	0-250	50-100	0.09	91.3	1055	3.8	2.8	5.8
	250+	150-200	0.05	94.8	1824	4.5	3.6	3.8
Ultimate Analysis								
		Sample Depth (cm)	Total C (%)	H (%)	N (%)	S (%)	O (%)	
		50-100	52.98	5.04	0.90	0.15	36.4	
		150-200	53.71	5.03	1.04	0.15	35.9	
Proximate Analysis								
		Sample Depth (cm)	Btu/lb.	Moisture Content (%)	Ash Content (%)	Volatiles (%)	Fixed Carbon (%)	
		50-100	8648	92.0	4.5	68.0	27.5	
		150-200	8781	93.6	4.2	66.8	29.0	

* following a species denotes that it is a dominant species. Generally, it is used for shrubs and ericaceous shrubs.

Reference Number: 125**Location:** 30m (100ft)S and 457m (1500ft)W of the NE corner of Sec. 14, T.155N., R.32W.**Vegetation:** Cut over area. Stunted black spruce with 60% cover. Understory dominated by ericaceous shrubs (Labrador tea*, lingon berry, snowberry); few cotton grass. Continuous sphagnum carpet.**Microrelief:** 30cm**Depth To Water Table:** 10cm**Described And Sampled By:** H. Mooers and L. Severson on November 20, 1980.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Fibric Hemic Loam	0-270	50-100	0.08	91.7	1104	3.7	2.8	4.2
	270-405	100-270	0.06	93.5	1441	4.0	3.0	4.5
		270-360	0.05	94.1	1602	4.5	3.6	3.2
	405+	360-400	0.10	90.1	909	5.5	5.1	11.2
Ultimate Analysis								
		Sample Depth (cm)	Total C (%)	H (%)	N (%)	S (%)	O (%)	
		50-100	51.52	5.24	1.08	0.18	36.6	
		100-270	52.14	5.08	0.92	0.15	38.0	
		270-360	51.36	4.90	0.72	0.14	38.1	
		360-400	48.29	4.41	2.64	1.10	27.9	
Proximate Analysis								
		Sample Depth (cm)	Btu/lb.	Moisture Content (%)	Ash Content (%)	Volatiles (%)	Fixed Carbon (%)	
		50-100	8502	91.0	5.4	68.9	25.7	
		100-270	8479	93.4	3.7	69.9	26.4	
		270-360	8265	94.3	4.8	70.4	24.8	
		360-400	8220	90.1	15.7	58.7	25.6	

Reference Number: 126

Location: 61m (200ft)S and 91m (300ft)E of the NW corner of Sec. 25, T.156N., R.32W.

Vegetation: Sparse black spruce and tamarack. Understory includes many sedges (*Carex oligosperma*); few ericaceous shrubs. Continuous sphagnum carpet.

Microrelief: 25cm

Depth To Water Table: 15cm

Described And Sampled By: N. Aaseng and S. Nelson on November 21, 1980.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content Total Wt. (%)	Content Dry Wt. (%)	pH H ₂ O	CaCl ₂	Ash Content (%)
Fibric	0- 90	60- 90				4.4	3.4	
Hemic	90-360	100-270	0.06	93.4	1419	5.5	4.5	5.3
Sapric	360-390	360-390	0.16	86.0	613	4.5	4.4	14.2
Loam	390 +							

Ultimate Analysis

Sample Depth (cm)	Total C (%)	H (%)	N (%)	S (%)	O (%)
60- 90	50.73	5.06	1.67	0.18	34.2
100-270	54.92	5.11	1.24	0.17	33.3
360-390	51.41	4.23	3.02	2.59	24.7

Proximate Analysis

Sample Depth (cm)	Btu/lb.	Moisture Content (%)	Ash Content (%)	Volatiles (%)	Fixed Carbon (%)
60- 90	8470	90.9	8.2	65.5	26.3
100-270	9065	92.9	5.3	65.0	29.7
360-390	8561	87.3	14.1	58.9	27.0

Reference Number: 127

Location: 584m (1915ft)N and 739m (2425ft)E of the SW corner of Sec. 33, T.156N., R.32W.

Vegetation: Sparse black spruce. Understory dominated by cotton grass; many ericaceous shrubs; few sedges (*Carex oligosperma*). Continuous sphagnum carpet.

Microrelief: 20cm

Depth To Water Table: Not visible

Described And Sampled By: S. Nelson and D. Riihiluoma on November 24, 1980.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content Total Wt. (%)	Content Dry Wt. (%)	pH H ₂ O	CaCl ₂	Ash Content (%)
Fibric	0- 60	0- 60				4.1	3.0	
Hemic	60-345	100-200	0.07	92.0	1157	5.0	3.7	4.9
Sapric	345-360	210-300	0.07	92.1	1161	5.9	5.1	6.1
Loam	360 +	300-345	0.11	89.8	883	5.4	5.1	9.0

Ultimate Analysis

Sample Depth (cm)	Total C (%)	H (%)	N (%)	S (%)	O (%)
0- 60	49.17	4.73	1.16	0.19	38.1
100-200	52.87	5.08	1.47	0.17	35.6
210-300	54.62	5.08	1.98	0.41	32.3
300-345	53.08	4.89	2.63	1.53	30.2

Proximate Analysis

Sample Depth (cm)	Btu/lb.	Moisture Content (%)	Ash Content (%)	Volatiles (%)	Fixed Carbon (%)
0- 60	8140	95.1	6.7	69.1	24.2
100-200	8871	92.7	4.8	69.1	26.1
210-300	9140	92.7	5.6	65.0	29.4
300-345	9039	91.2	7.7	65.4	26.9

Reference Number: 128

Location: 541m (1775ft)S and 152m (500ft)W of the NE corner of Sec. 4, T.155N., R.33W.

Vegetation: Cover dominated by sedges (*Carex lasiocarpa*); some grasses (*Phragmites communis*).

Microrelief: Not visible

Depth To Water Table: 20cm above surface

Described And Sampled By: D. Riihiluoma and H. Mooers on March 17, 1981.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic Loam	0-265	0-140	0.06	93.9	1535	5.9	5.2	4.9
	265 +	140-230	0.09	90.4	942	4.8	4.6	7.1
Ultimate Analysis								
		Sample Depth (cm)	Total C (%)	H (%)	N (%)	S (%)	O (%)	
		0-140	53.37	4.84	2.52	0.40	33.0	
		140-230	53.38	5.01	2.93	1.92	29.2	
Proximate Analysis								
		Sample Depth (cm)	Btu/lb.	Moisture Content (%)	Ash Content (%)	Volatiles (%)	Fixed Carbon (%)	
		0-140	9086	94.5	5.9	65.5	28.6	
		140-230	9143	92.6	7.6	65.6	26.8	

Reference Number: 129

Location: 30m (100ft)N and 76m (250ft)W of the SE corner of Sec. 24, T.155N., R.33W.

Vegetation: Sparse tamarack and aspen. Understory dominated by sedges (*Carex lasiocarpa*); many ericaceous shrubs (leatherleaf*) and other shrubs (bog birch). Some feathermosses.

Microrelief: 30cm

Depth To Water Table: At surface

Described And Sampled By: D. Riihiluoma and H. Mooers on November 24, 1980.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic Loam	0-90 90 +	50-90	0.16	84.2	532	4.9	4.6	10.5
Ultimate Analysis								
		Sample Depth (cm)	Total C (%)	H (%)	N (%)	S (%)	O (%)	
		50-90	51.21	4.48	2.52	0.47	29.9	
Proximate Analysis								
		Sample Depth (cm)	Btu/lb.	Moisture Content (%)	Ash Content (%)	Volatiles (%)	Fixed Carbon (%)	
		50-90	8412	85.3	11.4	61.5	27.1	

Reference Number: 130**Location:** 53m (175ft)N and 41m (135ft)W of the SE corner of Sec. 24, T.156N., R.33W.**Vegetation:** Sparse tamarack. Understory dominated by ericaceous shrubs (leatherleaf*); many other shrubs (bog birch*, willow); some grasses; few forbs.**Microrelief:** 20cm**Depth To Water Table:** Not recorded**Described And Sampled By:** H. Mooers and D. Riihiluoma on March 17, 1981.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash Content (%)
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	
Hemic Mineral soil	0-225	70-120	0.09	90.8	989	5.1	4.7	6.6
	225 +	125-175	0.08	91.6	1094	5.3	5.0	5.8
		210-225	0.11	89.6	857	4.7	4.5	11.7
	Ultimate Analysis							
		Sample Depth (cm)	Total C (%)	H (%)	N (%)	S (%)	O (%)	
		70-120	54.82	5.06	2.66	0.28	32.0	
		125-175	55.26	5.33	2.97	1.17	29.8	
		210-225	51.66	4.80	3.07	2.60	26.4	
Proximate Analysis								
		Sample Depth (cm)	Btu/lb.	Moisture Content (%)	Ash Content (%)	Volatiles (%)	Fixed Carbon (%)	
		70-120	9129	92.7	5.2	64.6	30.2	
		125-175	9411	93.2	5.5	66.7	27.8	
		210-225	8818	90.3	11.5	62.9	25.6	

Reference Number: 131**Location:** 53m (175ft)N and 152m (500ft)E of the SW corner of Sec. 4, T.159N., R.33W.**Vegetation:** Sparse tamarack. Understory dominated by sedges (*Carex* spp.); many shrubs (bog birch); few ericaceous shrubs. Some feathermosses.**Microrelief:** 25cm**Depth To Water Table:** At surface**Described And Sampled By:** D. Riihiluoma and H. Mooers on March 12, 1981.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content Total Wt. (%)	Dry Wt. (%)	pH H ₂ O	CaCl ₂	Ash Content (%)
Hemic Gravel	0-170 +	75-125	0.13	87.7	714	6.0	5.4	12.3
Ultimate Analysis								
		Sample Depth (cm)	Total C (%)	H (%)	N (%)	S (%)	O (%)	
		75-125	49.92	4.13	2.68	0.15	30.9	
Proximate Analysis								
		Sample Depth (cm)	Btu/lb.	Moisture Content (%)	Ash Content (%)	Volatiles (%)	Fixed Carbon (%)	
		75-125	9336	87.4	12.2	61.1	26.7	

Reference Number: 132**Location:** 695m (2280ft)N and 523m (1715ft)W of the SE corner of Sec. 3, T.162N., R.34W.**Vegetation:** Cut over area. Stunted black spruce with 35% cover; sparse tamarack.

Understory dominated by ericaceous shrubs (leatherleaf*); some other shrubs (bog birch). Discontinuous sphagnum carpet; some other mosses.

Microrelief: 30cm**Depth To Water Table:** 5cm**Described And Sampled By:** S. Nelson and H. Mooers on December 8, 1980.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content		pH		Ash
				Total Wt. (%)	Dry Wt. (%)	H ₂ O	CaCl ₂	Content (%)
Hemic Sandy loam	0-90	60-90	0.18	79.7	394	5.9	5.5	13.0
	90 +							
	Ultimate Analysis							
	Sample Depth (cm)	Total C (%)	H (%)	N (%)	S (%)	O (%)		
	60-90	48.05	3.57	1.92	0.16	32.2		
Proximate Analysis								
Sample Depth (cm)	Btu/lb.	Moisture Content (%)	Ash Content (%)	Volatiles (%)	Fixed Carbon (%)			
60-90	7504	79.1	14.1	57.8	28.1			

Reference Number: 133**Location:** 632m (2075ft)S and 201m (660ft)E of the NW corner of Sec. 1, T.155N., R.35W.**Vegetation:** Sparse tamarack. Understory dominated by sedges (*Carex lasiocarpa*); many

ericaceous shrubs (bog rosemary); some other shrubs (bog birch*, willow); few forbs.

Discontinuous sphagnum carpet.

Microrelief: Negligible**Depth To Water Table:** At surface**Described And Sampled By:** H. Mooers and D. Riihiluoma on March 17, 1981.

Layer	Depth (cm)	Sample Depth (cm)	Bulk Density (g/cc)	Moisture Content Total Wt. (%)	Content Dry Wt. (%)	pH H ₂ O	CaCl ₂	Ash Content (%)
Fibric Hemic Sandy loam	0- 90 90-150 150 +	90-140	0.11	90.0	896	5.6	4.7	5.7
Ultimate Analysis								
		Sample Depth (cm)	Total C (%)	H (%)	N (%)	S (%)	O (%)	
		90-140	54.49	4.98	2.90	0.54	31.6	
Proximate Analysis								
		Sample Depth (cm)	Btu/lb.	Moisture Content (%)	Ash Content (%)	Volatiles (%)	Fixed Carbon (%)	
		90-140	9282	90.1	5.5	65.8	28.7	
		90-140	9282	90.1	5.5	65.8	28.7	

GLOSSARY

This glossary was adapted from the following sources:
American Geological Institute. 1972. *Glossary of Geology*. Washington, D.C.

Soil Science Society of America. 1979. *Glossary of Soil Science Terms*. Madison, WI.

Soil Survey Staff. 1975. *Soil Taxonomy, Agricultural Handbook No. 436*. U.S. Department of Agriculture. Washington, D.C.: U.S. Government Printing Office.

Btu. British thermal unit, the quantity of heat required to raise the temperature of one pound of water one degree Fahrenheit.

Clay. A soil separate that consists of mineral particles less than .002 mm in diameter. A soil textural class in which the soil material is 40% or more clay, less than 45% sand, and less than 40% silt.

Crown cover. The amount of plant surface that covers the ground when viewed from above, which is expressed as a percentage of the total possible cover (100%), e.g., a black spruce crown cover of about 50%.

Ericaceous. Plants of the heath family, including bog rosemary, leatherleaf, Labrador tea, and swamp laurel.

Fiber. A fragment or piece of plant tissue, excluding live roots, that is large enough to be retained on a 100-mesh sieve (openings 0.15 mm in diameter) and that retains recognizable cellular structure of the plant from which it came.

Fibric peat. Organic soil that has a high content of undecomposed plant fibers and a bulk density less than about 0.1 g/cm³.

Ground cover. Low growing plants, such as mosses and sedges, that form a layer on the ground surface.

Ground moraine. The debris that is deposited as a glacier melts. The accumulation of this material forms an extensive, fairly even, thin layer of till with a gently rolling surface.

Hemic peat. Organic soil that has an intermediate degree of plant fiber decomposition and a bulk density between about 0.1 and 0.2 g/cm³.

Humus. The relatively resistant, usually dark-brown to black, fraction of soil, organic matter, peats, or compost, which is formed during the biological decomposition of organic residues.

Loam. A soil textural class in which the soil material contains a moderate amount of sand, silt, and clay. Loams contain less than 52% sand, 28 to 50% silt, and 7 to 27% clay.

Lobe, glacial. A large, rounded, tongue-like projection that extends from the margin of the main mass of an ice sheet.

Microrelief. Small-scale differences in topography. In this report, microrelief is the distance from the top of a hummock to the bottom of a hollow in a peatland.

Mineralization. The conversion of an element from an organic form to an inorganic state as a result of microbial decomposition.

Moraine. A mound, ridge, or other distinct accumulation of unsorted, unstratified material, predominantly till, that is deposited by glacial ice.

Profile, soil. A vertical section of the soil through all its horizons.

Sand. A soil separate that consists of mineral particles between 0.05 and 2.0 mm in diameter. A soil textural class in which the soil material contains 85% or more sand and the percentage of silt plus 1.5 times the percentage of clay does not exceed 15%.

Sapric peat. Organic soil that has a high content of plant material so decomposed that the original plant structure cannot be determined and that has a bulk density of about 0.2 g/cm³ or more.

Silt. A soil separate that consists of mineral particles that range in diameter from 0.002 to 0.05 mm. A soil textural class in which the soil material is 80% or more silt and less than 15% clay.

Soil. Both the organic and inorganic matter that comprises the unconsolidated surface material of the earth. This material is made up of organic matter, inorganic matter, water, and air, and results from the interaction, over time, of climate, micro- and macro-organisms, and topography on the parent material.

Terminal moraine. A moraine that has been deposited at or near a more-or-less stationary edge or at a place marking the cessation of a glacial advance.

Texture, soil. The relative proportions of the various soil separates in a soil.

Till. Unstratified and unsorted glacial material deposited directly by the ice and consisting of clay, silt, sand, gravel, and boulders intermingled in any proportions.

Understory. A layer of foliage in a forest that is beneath the crown cover and above the ground cover.

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PEAT RESOURCES

An Area of
Beltrami and Lake of the Woods Counties,
Minnesota
1982

PEAT AND MINERAL UNITS

- Peat greater than 150 cm deep
- Peat less than 150 cm deep
- Raised bog (fibric sphagnum moss cap)
- Mineral soil
- Indistinct peat/mineral boundary

LABELS FOR DEPTH AND TYPE OF PEAT

TOTAL DEPTH OF PEAT

- A 0-150 cm (~ 0-5 ft)
- B 151-300 cm (~ 5-10 ft)
- C 301-450 cm (~ 10-15 ft)
- D 451-600 cm (~ 15-20 ft)

Total depth is hemic peat when label is an upper-case letter only.

DEPTH OF FIBRIC SPHAGNUM MOSS LAYER

- a 20-60 cm (~ 1-2 ft)
- b 61-150 cm (~ 2-5 ft)
- c 151-300 cm (~ 5-10 ft)

DEPTH OF SAPRIC PEAT

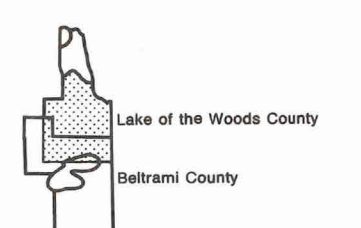
- x Total depth is sapric peat

FORMS USED FOR PEAT LABELS

- The "A" unit is indicated by color only; total depth (0-150 cm) is hemic peat.
- Units labeled with an upper-case letter only (e.g., B, C, or D) indicate that the total depth is hemic peat.
- The total depth A (0-150 cm) consists of sapric peat.
- The total depth of peat (e.g., A 0-150 cm) includes a layer of fibric sphagnum moss peat (e.g., a 20-60 cm deep) overlying hemic peat.

PEAT OBSERVATION SITES

- Observation site.
- Sample site with laboratory data.
- Sample site with additional DOE laboratory data.



0 1 2 3 4 5 Miles
0 1 2 3 4 5 Kilometers



Minnesota Peat Inventory Project
Minnesota Department of Natural Resources
Division of Minerals