United States Department of Agriculture

Soil Conservation Service

In cooperation with Michigan Department of Agriculture, Michigan Agricultural Experiment Station, and Michigan Technological University

Soil Survey of Cheboygan County, Michigan

How To Use This Soil Survey

General Soil Map

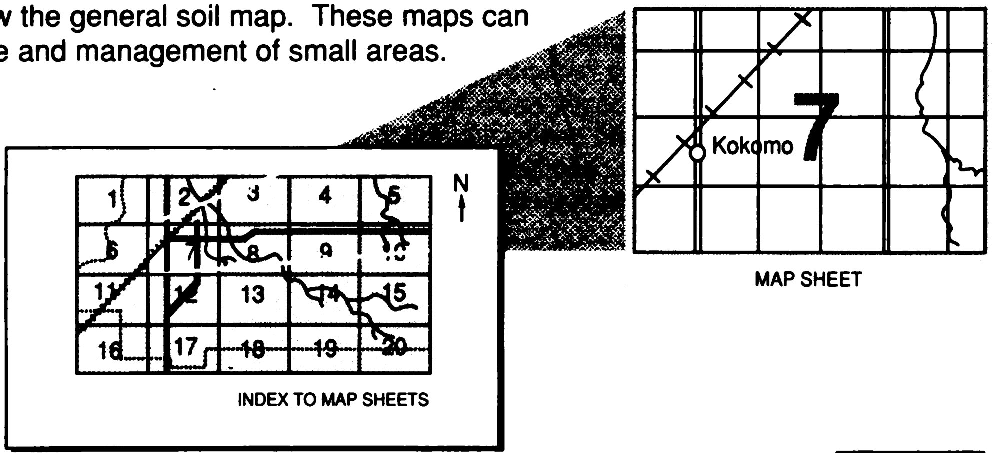
The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

Detailed Soil Maps

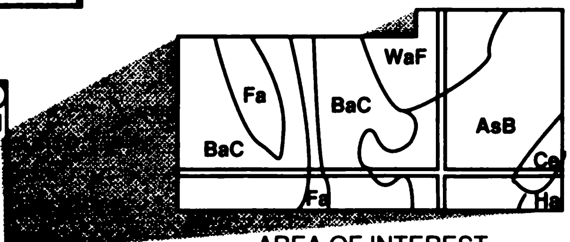
The detailed soil maps follow the general soil map. These maps can be useful in planning the use and management of small areas.

To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet, and turn to that sheet.



Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Index to Map Units** (see Contents), which lists the map units by symbol and name and shows the page where each map unit is described.

MAP SHEET



AREA OF INTEREST

NOTE: Map unit symbols in a soil survey may consist only of numbers or letters, or they may be a combination of numbers and letters.

The **Summary of Tables** shows which table has data on a specific land use for each detailed soil map unit. See **Contents** for sections of this publication that may address your specific needs.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1987. Soil names and descriptions were approved in 1988. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1987. This survey was made cooperatively by the Soil Conservation Service, the Michigan Department of Agriculture, the Michigan Agricultural Experiment Station, and Michigan Technological University. It is part of the technical assistance furnished to the Cheboygan County Soil Conservation District. Financial assistance was provided by the Cheboygan County Board of Commissioners.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

All programs and services of the Soil Conservation Service are offered on a nondiscriminatory basis, without regard to race, color, national origin, religion, sex, age, marital status, or handicap.

Cover: A northern hardwood forest and the adjacent farmland in an area of the Cheboygan-Blue Lake association.

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Issued September 1991

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Foreword

This soil survey contains information that can be used in land-planning programs in Cheboygan County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

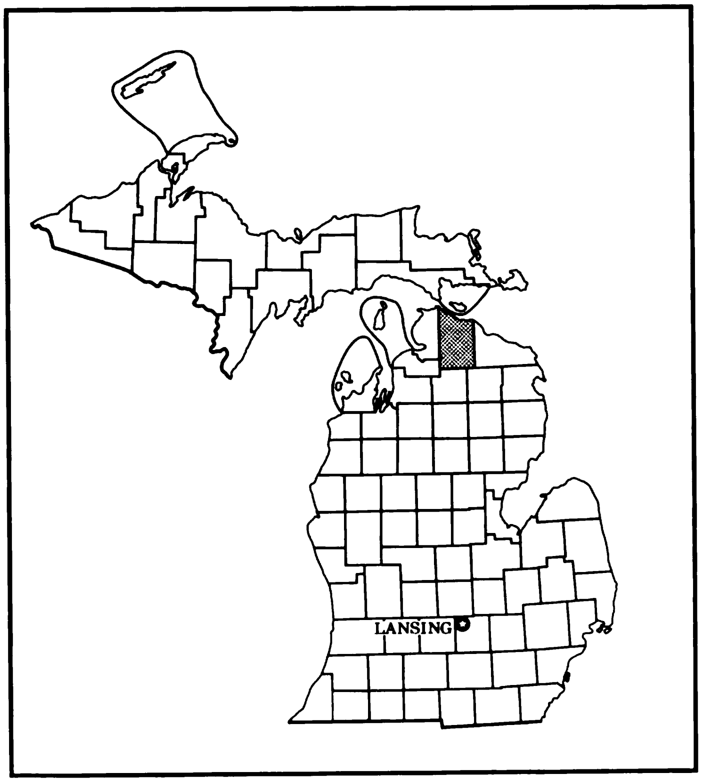
This soil survey is designed for many different users. Farmers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

Homer R. Hilner

Homer R. Hilner
State Conservationist
Soil Conservation Service



Location of Cheboygan County in Michigan.

Soil Survey of Cheboygan County, Michigan

By Stephen W. Tardy, Soil Conservation Service

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United States Department of Agriculture, Soil Conservation Service, in cooperation with
Michigan Department of Agriculture, Michigan Agricultural Experiment Station, and Michigan Technological University

CHEBOYGAN COUNTY is at the northern end of Michigan's lower peninsula and has a total land area of 720 square miles, or 460,922 acres. It is bordered by Charlevoix and Emmet Counties on the west, Presque Isle County on the east, and Montmorency and Otsego Counties on the south. Cheboygan, the county seat, is at the northern edge of the county at the mouth of the Cheboygan River. In 1980, the population of Cheboygan County was 20,649.

Most of Cheboygan County consists of gently rolling to steep moraines and bedrock, steep and very steep pitted outwash plains, channeled uplands, ancient shorelines, and nearly level lake terraces and deltas.

Farming is an important economic enterprise in the county. The major crops are corn, hay, and small grains. Most jobs in the county are in the manufacturing, government service, forest products, recreation, tourism, and retail trade industries.

This survey updates the soil survey of Cheboygan County published in 1939 *(3)*. It provides additional information and larger maps, which show the soils in greater detail.

General Nature of the County

This section gives general information concerning Cheboygan County. It discusses climate, history and development, physiography and relief, lakes and streams, and farming.

Climate

Prepared by the Michigan Department of Agriculture, Climatology Division, East Lansing, Michigan.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Cheboygan and Vanderbilt, Michigan, in the period 1951 to 1980. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter, the average temperature is 21.0 degrees F at Cheboygan and 17.8 degrees at Vanderbilt and the average daily minimum temperature is 13.1 degrees at Cheboygan and 7.5 degrees at Vanderbilt. The lowest temperature on record was -38 degrees at Cheboygan and -51 degrees at Vanderbilt. In summer, the average temperature is 65.6 degrees at Cheboygan and 63.2 degrees at Vanderbilt and the average daily maximum temperature is 76.5 degrees at Cheboygan and 78.4 degrees at Vanderbilt. The highest recorded temperature is 104 degrees at Cheboygan and 108 degrees at Vanderbilt.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is 27.99 inches at Cheboygan and 30.48 inches at Vanderbilt. Of these totals, 17.35 inches at Cheboygan, or 62 percent, and 18.20 inches at Vanderbilt, or 59.7 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 13.0 inches at Cheboygan and 15.6 inches at Vanderbilt. The heaviest 1-day rainfall during the period of record was 6.34 inches at Cheboygan on July 8, 1890, and 4.57 inches at Vanderbilt on September 3, 1937. Thunderstorms occur on about 24 days each year at Cheboygan and 25 days each year at Vanderbilt.

The average seasonal snowfall is 77.8 inches at Cheboygan and 114.6 inches at Vanderbilt. The greatest snow depth at any one time during the period of record was 53 inches at Cheboygan and 54 inches at Vanderbilt. On the average, 115 days of the year at Cheboygan and 130 days at Vanderbilt have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

The heaviest 1-day snowfall on record was more than 18 inches at Cheboygan and 20 inches at Vanderbilt. The greatest monthly snowfall was 49.0 inches at Cheboygan in December 1983 and 63.5 inches at Vanderbilt in January 1971. The greatest total seasonal snowfall was 119.9 inches at Cheboygan during the 1942-43 season and 199.1 inches at Vanderbilt during the 1970-71 season. The lowest total seasonal snowfall was 23.0 inches at Cheboygan during the 1901-02 season and 26.3 inches at Vanderbilt during the 1936-37 season.

Based on data recorded at Alpena, Michigan, the average relative humidity in midafternoon is about 63 percent. Humidity is higher at night, and the average at dawn is about 83 percent. The sun shines 63 percent of the time possible in summer and 36 percent in winter. The prevailing wind is from the southwest. Average windspeed is highest, 9.1 miles per hour, in April.

History and Development

Records indicate that Jacob Sammons was the first settler in Cheboygan County. In 1844, Mr. Sammons left Chicago and arrived on Mackinac Island. He left his family there and proceeded on to Cheboygan, where he built a home. His family joined him the following spring.

Indian legend indicates, however, that Jacob Sammons was not the first to settle in Cheboygan County. Around 1676, the Ottawa Indians from Mackinac Island ambushed the Ausequmug Indians, who lived near present-day Mackinaw City. The battle took place on the banks of the Cheboygan River. The Ottawa Indians were the victors; not a single Ausequmug Indian survived.

Cheboygan County was organized by the state legislature in 1853. The village of Cheboygan was formed in 1871. County records indicate the population of Cheboygan County was 483 in 1864 and 3,174 in 1874.

Many people came to the straits area in the 1870's for health reasons. According to local physicians of the time, many visitors found cures for hay fever, allergies, asthma, and other illnesses. A large number of the visitors decided to stay in the area.

Early settlers included lumbermen, who harvested the enormous white pine forests of Northern Michigan, fishermen, farmers, trappers, and some tourists. Industries developed around these occupations; the forest products industry became the largest. Today, the largest employer in the county is the community hospital.

In 1944, the U.S. Coast Guard stationed the ice-breaker "Mackinaw" in the Cheboygan River at Cheboygan. At the time of its commissioning, the "Mackinaw" was the largest ice-breaker in the world. Today it is largely responsible for keeping shipping and travel in the Great Lakes open well into the winter months *(15)*.

Physiography and Relief

Five distinct kinds of surface features occur in Cheboygan County. These features are moraines, till plains, outwash plains, lake plains, and deltas, all of which formed as a result of the complex action of glaciers and postglacial lakes.

The morainic areas are characterized by rolling to steep, uneven, knoblike hills and pothole depressions. The largest morainic area extends toward the southeast through Mentor Township to South Forest Township.

The till plains, which occur in the form of drumlin fields, are characterized by elongated hills and ridges with a southeast orientation. These till plains occur on ancient islands in Munro and Inverness Townships and in Aloha Township and the western part of Waverly Township.

Outwash plains are scattered with the morainic areas and till plains. They are characterized by nearly level to sloping, sometimes pitted areas. The largest outwash plain is west of Wolverine.

The lake plains are associated with the former Great Lakes Algonquin, Nipissing, and Algoma. They are mainly north of the northern border of Mentor, Ellis, Walker, and Forest Townships. Another lake plain is in the western part of southern Forest Township. The lake plains are characterized by nearly level to undulating areas separated by steep scarps, which indicate changes in lake elevation. Wave action has exposed boulders and stones in areas where glacial till is near the water surface. Limestone bedrock is exposed on the lake plain in the eastern part of Waverly Township, in the southeastern part of Koehler Township, and in the western part of Mackinaw Township.

The deltas are characterized by broad, nearly level plains dissected at widely spaced intervals by deeply incised stream and river channels. Deltas formed at the outlets of the Sturgeon, Little Sturgeon, Pigeon, and Black Rivers when these rivers flowed into Lake Algonquin. The largest delta in the county is south of the Indian River.

The highest elevation in the county, about 1,300 feet above mean sea level, is in Wilmot Township. The lowest elevation, 577 feet above mean sea level, is at the shoreline of Lake Huron, which forms the northern boundary of Cheboygan County. Other significant elevations are the ancient shorelines of Great Lakes Algonquin, Nipissing, and Algoma, which are about 755 feet, 620 feet, and 600 feet above mean sea level, respectively.

Lakes and Streams

About 334 lakes and 7 major rivers are scattered throughout Cheboygan County. These water areas differ in size and shape and in shoreline characteristics.

Cheboygan County has over 51,000 acres of lakes. The lakes range from less than 5 acres to more than 17,000 acres in size. Some are in marshes and exhibit all stages of filling by vegetation. The larger lakes are in the center of the county. Among them are Mullet Lake, which covers about 17,360 acres; Burt Lake, which covers about 17,120 acres; Black Lake, which covers about 10,130 acres; Douglas Lake, which covers about 3,395 acres; Carp Lake, which covers about 1,900 acres; Munro Lake, which covers about 694 acres; and Long Lake, which covers about 400 acres.

Major rivers in the Cheboygan River Basin are the Cheboygan River, the Black River, the Pigeon River, the Sturgeon River, and the Indian River.

The Cheboygan River is a deep-water port of Lake Huron. It also is the beginning of a 40-mile inland waterway that includes Mullet Lake, Burt Lake, and the Crooked River.

Farming

Although farming is not the most important industry in Cheboygan County, it does have a significant impact on the economy and the land uses of the county.

About 11 percent of the total land area of Cheboygan County, or 46,000 acres, is active or inactive farmland *(14)*. The average farm size is 230 acres. The rest of the land area consists mainly of state-owned land, privately owned woodland, abandoned farmland, recreational areas, and resort property.

Only 30 years after the survey area was first settled, 200 farms covered 72,000 acres. Currently there are 221 farms in the county. Of this total, 34 range from 1 to 49 acres in size; 89, from 50 to 170 acres; 75, from 180 to 499 acres; 18, from 500 to 999 acres; 4, from 1,000 to 1,999 acres; and 1 is more than 2,000 acres.

The first wheat crops in the county were planted November 2, 1851, on 1.25 acres of land from which potatoes had been harvested and which still had tree stumps on it. The yield was good, 51.1 bushels (41 bushels per acre). Crops harvested in the late 1800's include corn, hay, potatoes, wheat, oats, barley, and other small grains.

Similar crops are grown today in addition to Christmas trees. In 1985, 9,000 acres was used for hay, 2,200 acres for corn, 1,400 acres for wheat and oats, and 600 acres for barley *(5)*. About 12,400 acres is currently used for pasture. Cheboygan County farmers harvest as many as 450,000 Christmas trees every year. The trees are distributed throughout Michigan and the United States and even as far away as Germany.

On June 1, 1948, local farmers formed the Cheboygan County Soil Conservation District in order to assist landowners with soil erosion and pollution control practices.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, the landforms, relief, climate, and the natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by several kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soil on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

Survey Procedures

The general procedures followed in making this survey are described in the National Soils Handbook and the *Soil Survey Manual (9)* of the Soil Conservation Service.

Before going into the field, each map sheet was compared to the U.S. Geological Survey topographic map for the area. Preliminary boundaries of slopes and landforms were plotted stereoscopically on leaf-off aerial photographs.

Traverses were made by truck or trail bike on the existing network of roads and trails. Most traverses, however, were made on foot at intervals of about 1/10 mile. Traverses of selected observations were made at closer intervals in areas of high variability.

Soil examinations along the traverses were made wherever obvious soil boundaries were crossed. Observations of such items as landforms, blowndown trees, vegetation, roadbanks, and rock outcrops were made without regard to spacing. Soil boundaries were determined on the basis of soil examinations, landscape and vegetation observations, and photo interpretation. The soil material to a depth of about 5 feet was examined with the aid of a hand auger or a spade. The pedons described as typical were observed and studied in small excavations of about 3 feet by 4 feet in area and about 5 feet in depth.

Samples for chemical and physical analyses were taken from sites of the typical pedon for some of the major soils in the survey area. The analyses were made by Michigan Technological University, Soil Laboratory, and Soil Conservation Service, National Soils Laboratory, Lincoln, Nebraska. The results of the analyses are stored in a computerized data file at the laboratories. The results and the laboratory procedures can be obtained on request from the laboratory.

General Soil Map Units

The general soil map at the back of this publication shows the soil associations in this survey area. Each association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

Descriptions, names, and delineations of soils in this soil survey do not fully agree with those on the soil maps of adjacent counties. Differences are the result of improvements in the classification of the soils, particularly modifications or refinements in soil series concepts, and variations in the intensity of mapping or in the extent of the soils within the survey area.

Soil Descriptions

Nearly Level, Deep Soils That Are Very Poorly Drained to Somewhat Poorly Drained

Most areas of these soils are used as woodland. Some are used for building site development. The soils are suited to trees and wetland wildlife habitat. They are poorly suited or unsuited to crops. The major concerns in managing woodland are the equipment limitation and the windthrow hazard. If cultivated crops are grown, removing excess water, preventing ponding, and providing drainage outlets are management concerns. The soils are poorly suited or unsuited to building site development and to septic tank absorption fields.

1. Roscommon-Charity-Au Gres Association

Deep, nearly level, very poorly drained to somewhat poorly drained, mucky, loamy, and sandy soils that formed in sandy and lacustrine deposits; on lake plains

The Roscommon and Charity soils in this association are in broad, low areas and in swales. They are subject to ponding. The Au Gres soils are on low, narrow ridges. Slopes range from 0 to 3 percent.

This association makes up about 5 percent of the county. It is about 33 percent Roscommon and similar soils, 15 percent Charity and similar soils, 15 percent Au Gres and similar soils, and 37 percent soils of minor extent.

Roscommon soils are very poorly drained. Typically, the surface layer is black muck about 6 inches thick. The substratum to a depth of about 60 inches is light brownish gray, brown, and dark brown, mottled sand.

Charity soils are poorly drained. Typically, the surface layer is very dark gray, calcareous fine sandy loam about 8 inches thick. The subsoil extends to a depth of about 26 inches. It is mottled. It is friable, grayish brown gravelly sandy loam in the upper part and firm, reddish brown silty clay loam in the lower part. The substratum to a depth of about 60 inches is reddish brown, mottled silty clay loam.

Au Gres soils are somewhat poorly drained. Typically, the surface layer is mixed very dark gray and light brownish gray sand about 1 inch thick. The subsurface layer is light brownish gray, mottled sand about 10 inches thick. The subsoil is mottled sand about 26 inches thick. The upper part is dark brown and is loose and very friable, and the lower part is strong brown and loose. The substratum to a depth of about 60 inches is light yellowish brown, mottled sand.

Minor in this association are the very poorly drained Tawas soils, the somewhat poorly drained Allendale soils, and the well drained Eastport soils. Tawas soils are in swales between beach ridges. Allendale soils are on sandbars within areas of the Charity soils. Eastport soils are on beach ridges adjacent to Lake Huron.

The soils in this association are used mainly as woodland. Some areas of the Au Gres, Allendale, and Eastport soils are used for building site development. Many areas of the Charity soils were farmed but have been abandoned because of inadequate drainage.

The major soils are suited to woodland and to wetland wildlife habitat. They are poorly suited or unsuited to farming and to building site development. Wetness is the major limitation. Locating drainage outlets is difficult because the soils are at elevations similar to those of large bodies of water. The soils are poorly suited or unsuited to septic tank absorption fields because of a high water table and slow or rapid permeability. The rapidly permeable soils cannot adequately filter the effluent. The soils adjacent to Lake Huron are susceptible to shoreline erosion and have a fluctuating water table.

2. Tawas-Lupton Association

Deep, nearly level, very poorly drained, mucky soils that formed in organic material or in organic material and sandy material; in depressions on lake plains and till plains

The soils in this association are in broad, low areas, in depressions on lake plains, and along the major drainageways on till plains. They are frequently ponded. Slopes are 0 to 2 percent.

This association makes up about 8 percent of the county. It is about 48 percent Tawas soils, 44 percent Lupton soils, and 8 percent soils of minor extent.

Tawas soils are very poorly drained. Typically, the surface layer is dark brown peat about 2 inches thick. The next 44 inches is black and very dark brown muck, very dark grayish brown mucky peat, and dark brown muck. The substratum to a depth of about 60 inches is gray sand.

Lupton soils are very poorly drained. Typically, the surface layer is black muck about 12 inches thick. The next layer is black muck about 17 inches thick. The next 5 inches is black mucky peat. Below this to a depth of about 60 inches is black muck.

Minor in this association are the very poorly drained Roscommon and somewhat poorly drained Au Gres soils on sandbars and sandspits.

The soils in this association are used mainly as woodland or as wetland wildlife habitat. Swamp conifers, such as northern whitecedar, tamarack, and black spruce, are the dominant trees. The soils are unsuited to crops, pasture, recreational development, building site development, and septic tank absorption fields because of excessive wetness and the instability of the organic material. Woodland harvesting activities are severely limited by wetness and low strength.

Nearly Level to Rolling, Deep Soils That Are Excessively Drained to Very Poorly Drained

Most areas of these soils are used as woodland. Some are used as cropland or for building site development. The soils are suited to woodland. The equipment limitation, seedling mortality, and the windthrow hazard are management concerns in wooded areas. The soils are poorly suited or unsuited to building site development and to septic tank absorption fields.

3. Rudyard-Bruce-Ontonagon Association

Deep, nearly level to rolling, well drained to poorly drained, loamy, silty, and clayey soils that formed in lacustrine deposits, stratified material, or clayey material; on lake plains

The Rudyard and Bruce soils in this association are on broad, nearly level plains. The Ontonagon soils are on low knolls and the sides of drainageways. Slopes range from 0 to 18 percent.

This association makes up about 5 percent of the county. It is about 53 percent Rudyard soils, 28 percent Bruce soils, 17 percent Ontonagon soils, and 2 percent soils of minor extent.

Rudyard soils are somewhat poorly drained and nearly level. Typically, the surface layer is dark reddish brown loam about 10 inches thick. The subsoil is about 7 inches thick. It is mottled. The upper part is mixed reddish brown and grayish brown, firm clay and silt loam, and the lower part is reddish brown, firm clay. The substratum to a depth of about 60 inches is light reddish brown, mottled, calcareous silty clay.

Bruce soils are poorly drained and nearly level. Typically, the surface layer is very dark gray fine sandy loam about 5 inches thick. The subsoil is about 19 inches thick. It is mottled and friable. The upper part is light brownish gray loamy sand, the next part is yellowish brown loam, and the lower part is light brown, calcareous silt loam. The substratum to a depth of about 60 inches is light brown, mottled, calcareous silt loam.

Ontonagon soils are well drained and moderately well drained and are nearly level to rolling. Typically, the surface layer is dark brown silty clay loam, silt loam, or silty clay about 7 inches thick. The subsoil is reddish brown silty clay about 15 inches thick. It is mottled in the lower part. The substratum to a depth of about 60 inches is reddish brown, mottled, calcareous silty clay loam.

Minor in this association are the poorly drained Charity and somewhat poorly drained Allendale soils.

Charity soils are in depressions, and Allendale soils are on low sandbars.

The soils in this association are used mainly as cropland or pasture. Some areas are used as woodland. Hay and silage are the most common crops. Northern hardwoods and swamp conifers are the most common trees. Wetness is the main limitation affecting most uses.

The major soils are well suited, moderately well suited, poorly suited, or unsuited to crops and are suited to woodland. They are poorly suited or unsuited to building site development and septic tank absorption fields because of wetness and restricted permeability.

4. Detour-Brevort Association

Nearly level, somewhat poorly drained and very poorly drained, loamy and sandy soils that either are moderately deep to dense till or are deep and that formed in loamy glacial till or in sandy material over loamy glacial till; on lake plains and till plains

The Brevort soils in this association are slightly lower on the landscape than the Detour soils and are subject to ponding. Slopes range from 0 to 3 percent.

This association makes up about 11 percent of the county. It is about 49 percent Detour soils, 33 percent Brevort soils, and 18 percent soils of minor extent.

Detour soils are moderately deep to dense till and are somewhat poorly drained. Typically, the surface layer is very dark brown cobbly loam about 5 inches thick. The subsurface layer is pale brown, mottled loamy sand about 5 inches thick. The next layer is pale brown and brown, mottled, friable loamy sand and sandy clay loam about 2 inches thick. The subsoil is about 11 inches thick. It is mottled and friable. It is brown sandy clay loam in the upper part and brown loam in the lower part. The substratum to a depth of about 60 inches is light brown, mottled, calcareous gravelly loam.

Brevort soils are deep and very poorly drained. Typically, the surface layer is black mucky loamy sand about 5 inches thick. The substratum is mottled and calcareous. The upper part is light yellowish brown loamy sand, the next part is pale brown gravelly sand, and the lower part to a depth of about 60 inches is light brown loam.

Minor in this association are the very poorly drained Hessel and Burleigh and somewhat poorly drained Riggsville soils. Hessel and Burleigh soils are in depressions and swales, and Riggsville soils are on low ridges.

The soils in this association are used mainly as woodland. Some areas have been cleared and are used as pasture. Wetness and stoniness limit the suitability of this association for crops and most other uses. The Detour and Brevort soils are poorly suited or unsuited to building site development and to septic tank absorption fields because of the wetness and restricted permeability.

5. Au Gres-Rubicon-Roscommon Association

Deep, nearly level and undulating, somewhat poorly drained, excessively drained, and very poorly drained, sandy and mucky soils that formed in sandy material; on lake plains and outwash plains

The Rubicon soils in this association are on the upper parts of the landscape. The Au Gres soils are in the slightly lower landscape positions. The Roscommon soils are in depressions and swales. They are subject to ponding. Slopes range from 0 to 6 percent.

This association makes up about 9 percent of the county. It is about 34 percent Au Gres soils, 31 percent Rubicon soils, 26 percent Roscommon soils, and 9 percent soils of minor extent.

Au Gres soils are somewhat poorly drained and nearly level. Typically, the surface layer is mixed very dark gray and light brownish gray sand about 1 inch thick. The subsurface layer is light brownish gray, mottled sand about 10 inches thick. The subsoil is mottled sand about 26 inches thick. The upper part is dark brown and is loose and very friable, and the lower part is strong brown and loose. The substratum to a depth of about 60 inches is yellowish brown, mottled sand.

Rubicon soils are excessively drained and are nearly level and undulating. Typically, the surface layer is mixed black and light brownish gray sand about 1 inch thick. The subsurface layer is light brownish gray sand about 5 inches thick. The subsoil is very friable sand about 30 inches thick. The upper part is dark brown, the next part is dark yellowish brown, and the lower part is yellowish brown. The substratum to a depth of about 60 inches is light yellowish brown sand.

Roscommon soils are very poorly drained and nearly level. Typically, the surface layer is black muck about 6 inches thick. The substratum to a depth of about 60 inches is light brownish gray, brown, and dark brown, mottled sand.

Of minor extent are the very poorly drained Tawas soils in depressions near the Roscommon soils.

The soils in this association are used mainly as woodland. Some areas are used for building site development. Quaking aspen, red maple, birch, balsam fir, and red pine are common in areas of the Rubicon and Au Gres soils. Northern whitecedar and black spruce are common in areas of the Roscommon soils. The soils are suited to woodland. Seedling mortality in areas of the Rubicon and Au Gres soils and wetness and the equipment limitation in areas of the Roscommon soils are the major management concerns.

The Rubicon soils are moderately well suited to building site development and are poorly suited to septic tank absorption fields. The wetness limits building site development in areas of the Au Gres and Roscommon soils. A poor filtering capacity in these soils is a limitation on sites for septic tank absorption fields. The soils in this association are generally not suited to crops because of droughtiness, the wetness, and the hazard of soil blowing.

6. Rubicon-East Lake Association

Deep, nearly level and undulating, excessively drained and somewhat excessively drained, sandy soils that formed in sandy deposits or in sandy material over gravelly deposits; on lake plains, outwash plains, deltas, beach ridges, and eskers

The soils in this association are on uplands. Slopes range from 0 to 6 percent.

This association makes up about 17 percent of the county. It is about 60 percent Rubicon soils, 23 percent East Lake soils, and 17 percent soils of minor extent.

Rubicon soils are excessively drained. Typically, the surface layer is mixed black and light brownish gray sand about 1 inch thick. The subsurface layer is light brownish gray sand about 5 inches thick. The subsoil is very friable sand about 30 inches thick. The upper part is dark brown, the next part is dark yellowish brown, and the lower part is yellowish brown. The substratum to a depth of about 60 inches is light yellowish brown sand.

East Lake soils are somewhat excessively drained. Typically, the surface layer is mixed black and light gray sand about 1 inch thick. The subsurface layer is light brownish gray coarse sand about 1 inch thick. The subsoil is about 20 inches thick. The upper part is reddish brown, yellowish red, and strong brown, loose coarse sand, and the lower part is yellowish brown, loose gravelly coarse sand. The substratum to a depth of about 60 inches is light yellowish brown, calcareous gravelly coarse sand.

Minor in this association are the well drained Cheboygan and very poorly drained Roscommon soils. Cheboygan soils are on slightly higher rises than the East Lake soils. Roscommon soils are in depressions and swales.

The soils in this association are used mainly as woodland. Some areas are used for building site development. Quaking aspen, red pine, and red maple are the most common trees. The soils are suited to woodland and are well suited or moderately well suited to building site development. Seedling mortality is the major management concern in wooded areas. The soils are generally not suited to crops and pasture, mainly because of droughtiness and the hazard of soil blowing.

7. Grayling-Rubicon Association

Deep, nearly level to gently rolling, excessively drained, sandy soils that formed in sandy deposits; on outwash plains, deltas, and lake plains

The soils in this association are on uplands. They are deeply dissected at widely spaced intervals by currently active drainageways.

This association makes up about 6 percent of the county. It is about 45 percent Grayling soils, 39 percent Rubicon soils, and 16 percent soils of minor extent (fig. 1).

Grayling soils are excessively drained. Typically, the surface layer is mixed black and very light gray sand about 2 inches thick. The subsurface layer is light brownish gray sand about 2 inches thick. The subsoil is dark yellowish brown, loose sand about 14 inches thick. The substratum to a depth of about 60 inches is brownish yellow and light yellowish brown sand.

Rubicon soils are excessively drained. Typically, the surface layer is mixed black and light brownish gray sand about 1 inch thick. The subsurface layer is light brownish gray sand about 5 inches thick. The subsoil is very friable sand about 30 inches thick. The upper part is dark brown, the next part is dark yellowish brown, and the lower part is yellowish brown. The substratum to a depth of about 60 inches is light yellowish brown sand.

Minor in this association are the very poorly drained Bowstring soils on the first bottom of rivers and streams. Steep and very steep areas are between the Bowstring soils and soils on terraces.

The soils in this association are used mainly as woodland. Jack pine, northern pin oak, red pine, and quaking aspen are the most common trees. The soils are suited to woodland. Seedling mortality is the major management concern. The soils are well suited or moderately well suited to building site development and are poorly suited to septic tank absorption fields. A poor filtering capacity is a limitation on sites for septic tank absorption fields. The soils are generally not suited to crops and pasture, mainly because of droughtiness and the hazard of soil blowing.

Nearly Level to Very Steep, Moderately Deep and Deep Soils That Are Excessively Drained, Well Drained, and Moderately Well Drained

Most areas of these soils are used as woodland. Some areas have been cleared and are used as

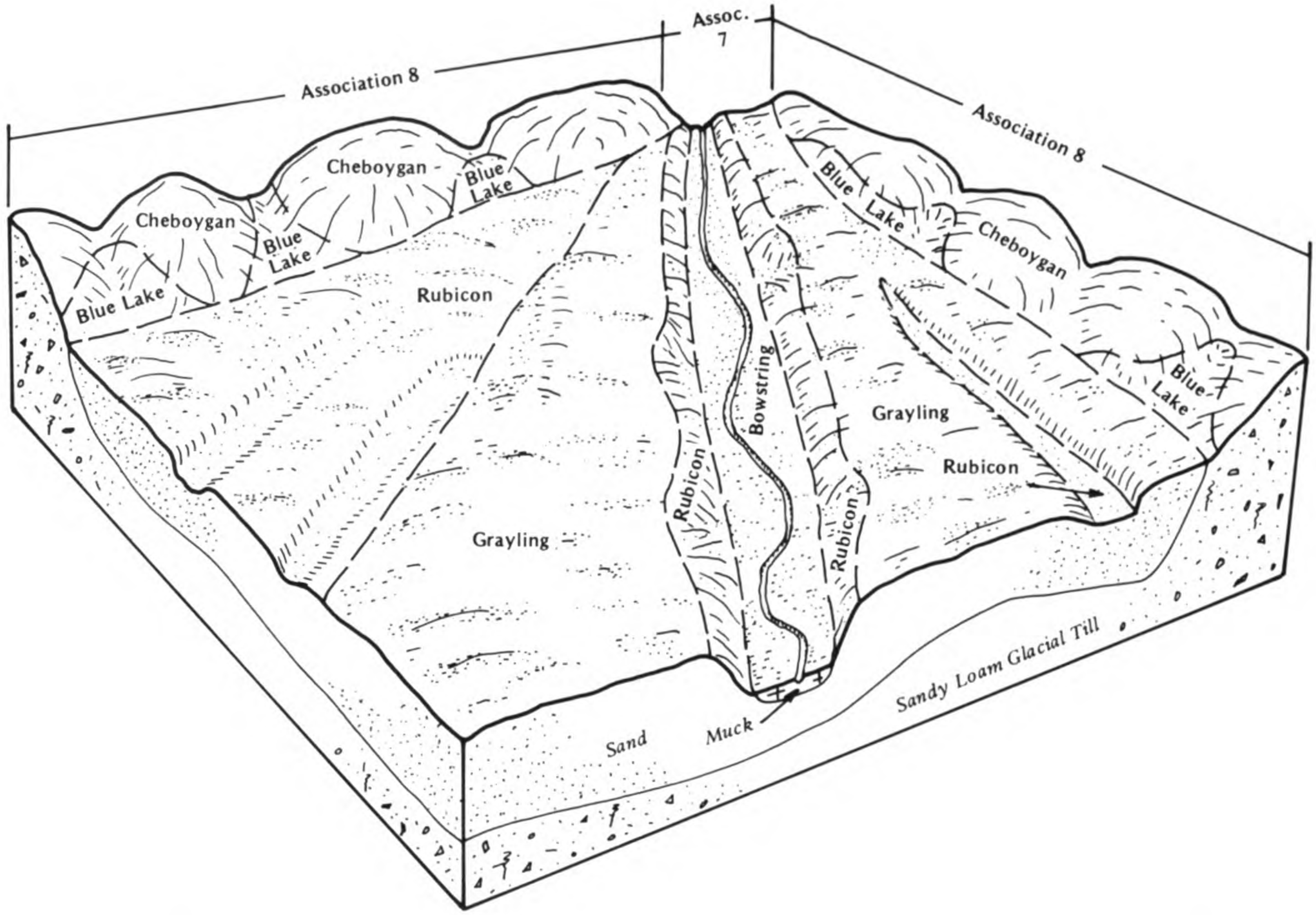

Figure 1.—Typical pattern of soils and parent material in the Grayling-Rubicon and Cheboygan-Blue Lake associations.

pasture or cropland. The soils are suited to woodland. Because of the slope, the equipment limitation is the major management concern. Water erosion and soil blowing are hazards in areas used as cropland.

These soils are suited to building site development, but slope and aspect should be considered when building sites are designed.

8. Cheboygan-Blue Lake Association

Nearly level to very steep, well drained and moderately well drained, sandy soils that either are moderately deep to dense till or are deep and that formed in loamy and sandy deposits; on till plains and moraines

The soils in this association are on uplands. Slopes range from 0 to 50 percent.

This association makes up about 28 percent of the county. It is about 54 percent Cheboygan soils, 30 percent Blue Lake soils, and 16 percent soils of minor extent (fig. 2).

Cheboygan soils are moderately deep to dense till and are well drained and moderately well drained. Typically, the surface layer is mixed black and light gray loamy sand about 2 inches thick. The subsurface layer is pinkish gray sand about 4 inches thick. The subsoil is about 22 inches thick. The upper part is dark brown and strong brown, friable loamy sand; the next part is pale brown and pinkish gray, friable and firm loamy sand; and the lower part is mixed dark brown and pinkish gray, firm sandy clay loam and sandy loam. The substratum to a depth of about 60 inches is brown, calcareous loam.

Blue Lake soils are well drained. Typically, the surface layer is mixed black and light brownish gray loamy sand about 2 inches thick. The subsurface layer is light brownish gray loamy sand about 6 inches thick. The upper part of the subsoil is dark brown, reddish brown, and strong brown, friable and very friable loamy sand. The next part is pale brown and dark brown, very friable loamy sand. The lower part to a depth of about

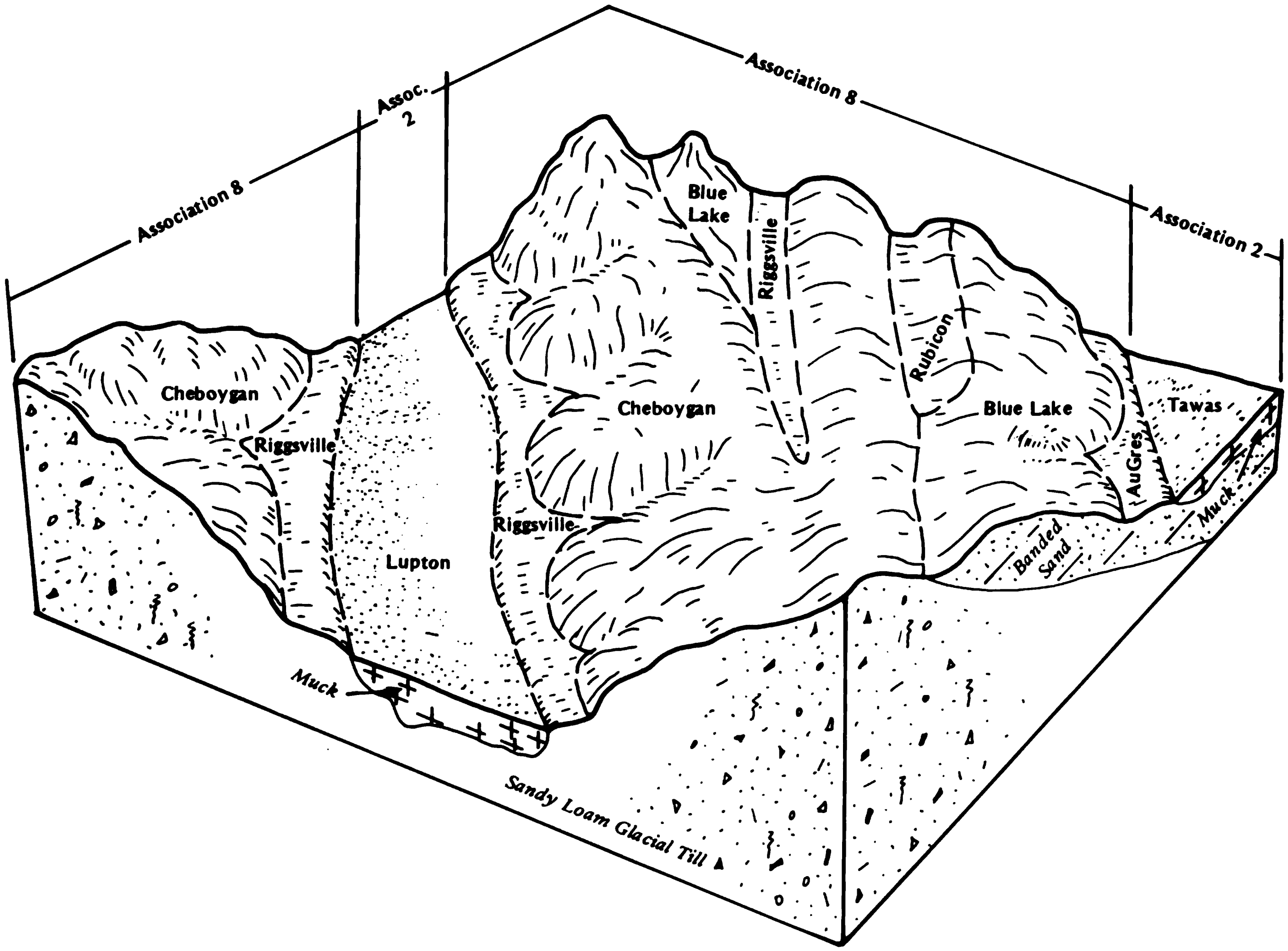

Figure 2.—Typical pattern of soils and parent material in the Cheboygan-Blue Lake and Tawas-Lupton associations.

80 inches is banded light yellowish brown, very friable sand and reddish brown loamy sand. The total thickness of the bands of loamy sand is more than 8 inches.

Minor in this association are the somewhat poorly drained Riggsville and excessively drained Rubicon soils. Riggsville soils are on nearly level ridgetops, in swales, and in drainageways. Rubicon soils are on side slopes.

The soils in this association are used mainly as woodland. Sugar maple, American beech, and American basswood are the most common trees. The use of equipment is limited by the slope. Some undulating to rolling areas have been cleared and are used as cropland or pasture. Corn, small grain, and hay are the most common crops. Water erosion and soil blowing are hazards in areas used as cropland.

In most areas the soils in this association are well suited or moderately well suited to building site development and are poorly suited to septic tank absorption fields. Moderately slow permeability is a limitation in areas of the Cheboygan soils, and a poor filtering capacity is a limitation in areas of the Blue Lake soils. The slope is a limitation on about 45 percent of the acreage in the association.

9. Rubicon-Blue Lake Association

Deep, gently rolling to very steep, excessively drained and well drained, sandy soils that formed in sandy deposits; on lake plains, outwash plains, and moraines

The soils in this association are on dissected hills in the uplands. Slopes range from 6 to 50 percent.

This association makes up about 8 percent of the county. It is about 53 percent Rubicon soils, 36 percent Blue Lake soils, and 11 percent soils of minor extent.

Rubicon soils are excessively drained. Typically, the surface layer is mixed black and light brownish gray sand about 1 inch thick. The subsurface layer is light brownish gray sand about 5 inches thick. The subsoil is very friable sand about 30 inches thick. The upper part is dark brown, the next part is dark yellowish brown, and the lower part is yellowish brown. The substratum to a depth of about 60 inches is light yellowish brown sand.

Blue Lake soils are well drained. Typically, the surface layer is mixed black and light brownish gray loamy sand about 2 inches thick. The subsurface layer is light brownish gray loamy sand about 6 inches thick. The subsoil extends to a depth of about 80 inches. The upper part is dark brown, reddish brown, and strong brown, friable and very friable loamy sand. The next part is pale brown and dark brown, very friable loamy sand. The lower part is banded light yellowish brown, very friable sand and reddish brown loamy sand. The total thickness of the bands of loamy sand is more than 8 inches.

Minor in this association are the well drained Cheboygan soils. These soils are lower on the landscape than the Rubicon soils.

The soils in this association are used as woodland. Quaking aspen, red oak, white oak, eastern white pine, and red pine are the most common trees. The equipment limitation and seedling mortality are the major management concerns. The soils are generally unsuited to crops and pasture. Water erosion, droughtiness, and soil blowing are management concerns. The soils are poorly suited or unsuited to building site development because of the slope. The use of off-road vehicles has damaged many areas.

10. Fairport-Onaway Association

Moderately deep and deep, nearly level to hilly, well drained, loamy soils that formed in loamy glacial till or in loamy glacial till over limestone bedrock; on glacial lake benches, till plains, and moraines

The Fairport soils in this association are on ridges and knolls. The Onaway soils are on long ridges. Slopes range from 1 to 25 percent.

This association makes up about 3 percent of the county. It is about 55 percent Fairport soils, 15 percent Onaway soils, and 30 percent soils of minor extent.

Fairport soils are moderately deep over bedrock and are well drained. Typically, the surface layer is very dark grayish brown fine sandy loam about 10 inches thick. The subsoil is about 20 inches thick. The upper part is dark yellowish brown, very friable sandy loam; the next part is dark brown, friable loam; and the lower part is yellowish brown, calcareous gravelly sandy loam. The substratum is yellowish brown, calcareous cobbly sandy loam about 6 inches thick. Unweathered limestone bedrock is at a depth of about 36 inches.

Onaway soils are well drained. Typically, the surface layer is black loam about 4 inches thick. The subsurface layer is brown sandy loam about 4 inches thick. The subsoil is about 24 inches thick. The upper part is dark brown, friable sandy loam; the next part is brown, pale brown, and dark brown, friable loam and sandy loam; and the lower part is dark brown and dark yellowish brown, friable loam. The substratum to a depth of about 60 inches is yellowish brown, calcareous loam.

Minor in this association are the somewhat poorly drained Bonduel and very poorly drained Tawas soils. Bonduel soils are in swales and depressions. Tawas soils are in low depressions.

The soils in this association are used mainly as woodland. Some areas have been cleared and are used as cropland or pasture. The slope and the depth to bedrock are limitations in areas used as cropland. The soils are well suited or moderately well suited to crops in areas that have slopes of less than 12 percent. In many areas they are poorly suited to urban uses because of restricted permeability and the depth to bedrock.

Broad Land Use Considerations

The soils in Cheboygan County vary widely in their suitability for major land uses.

About 3 percent of the land in the county is used for cultivated crops. Most of this cropland is in the northern half of the county and is concentrated in associations 3, 8, and 10. The soils in these associations are generally suited to crops. In association 3, crops are grown on well drained to somewhat poorly drained soils. Removing excess water during wet periods and maintaining soil tilth are management concerns in cultivated areas.

The nearly level to gently rolling soils in associations 8 and 10 are used for crops. Water erosion and soil blowing are management concerns. Crops are generally not grown in associations 1, 2, 4, 5, 6, 7, and 9. The soils in association 1 are difficult to drain because they are at elevations similar to those of large bodies of water. The organic soils in association 2 are unstable and wet. The soils in association 4 are wet and stony. The soils in associations 5, 6, and 7 are droughty. The soils in association 9 are droughty and are gently rolling to very steep.

About 4 percent of the land in Cheboygan County is permanent pasture, and about 2 percent is used for hay in a tillage rotation. The poorly drained soils in association 3 and the nearly level to rolling soils in association 8 are suited to pasture and hay. Some of the steeper areas in association 8 are used as pasture.

About 72 percent of the county is woodland. The cover type is northern whitecedar in associations 1 and 2. It is dominantly red maple, white birch, white spruce, and balsam fir in associations 3, 4, and 5. It is oak and red maple in associations 6 and 9; jack pine in association 7; and sugar maple, American beech, and yellow birch in associations 8 and 10. Seedling mortality and the equipment limitation are the major management concerns. Erosion and the windthrow hazard are additional management concerns in some areas.

Some of the soils in Cheboygan County are well suited to recreational development, and others range from moderately well suited to unsuited. Most of the soils in associations 1 and 2 are not suited to recreational uses, such as playgrounds, picnic areas, camp areas, and paths, because of wetness. Many areas of the soils in association 1 are used for recreational purposes because they are bounded by about 100 miles of shoreline. The soils in associations 3 and 4 generally are used for recreational purposes only in areas that overlook water. Wetness and the sandy surface layer are limitations. Many areas of the soils in associations 5, 6, and 7 are used for paths and trails. The sandy surface layer is a severe limitation affecting most recreational uses.

The nearly level to rolling soils in association 8 are suited to most recreational uses if measures that control soil blowing are applied. The soils in association 9 are not suited to recreational uses because of the slope and the sandy surface layer. The nearly level to rolling soils in association 10 are suited to most recreational uses.

The soils in associations 1 and 2 are suited to wetland wildlife habitat. The soils in associations 3, 4, and 5 are suited to woodland wildlife habitat and to wetland wildlife habitat. The soils in associations 6, 7, and 9 are poorly suited to wildlife habitat because they are droughty. The soils in associations 8 and 10 are suited to woodland wildlife habitat.

Generally, the nearly level to gently rolling soils in associations 6 and 7 are well suited or moderately well suited to building site development. A poor filtering capacity is a limitation on sites for septic tank absorption fields. The nearly level to gently rolling soils in association 8 are suited to building site development, but slope and aspect should be considered when building sites are designed. The soils in associations 1, 3, 4, and 5 generally are poorly suited to building site development and septic tank absorption fields because of wetness. The very poorly drained soils in association 2 are not suited to urban uses because of low strength, wetness, and ponding. The rolling to very steep soils in association 9 are not suited to building site development because of the slope. Most of the soils in association 10 are not suited to building site development because of restricted permeability and the depth to bedrock.

Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the substratum. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Cheboygan loamy sand, 0 to 6 percent slopes, is a phase of the Cheboygan series.

Some map units are made up of two or more major soils. These map units are called soil complexes or undifferentiated groups.

A *soil complex* consists of two or more soils, or one or more soils and a miscellaneous area, in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Au Gres-Roscommon complex, 1 to 4 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils in the mapped areas are not uniform. An area can be made up of only one of the major soils, or it can be made up of all of them. Histosols and Aquents, ponded, is an undifferentiated group in this survey area.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits, gravel, is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

Some of the boundaries on the detailed soil maps of Cheboygan County do not match those on the soil maps of adjacent counties, and some of the soil names and descriptions do not fully agree. Differences are the result of modifications or refinements in soil series concepts or variations in the intensity of mapping or in the extent of the soils within the survey area.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

Soil Descriptions

2—Lupton muck. This deep, nearly level, very poorly drained soil is in depressions in drainageways. It is subject to ponding. Individual areas are irregularly shaped and range from 4 to more than 800 acres in size.

Typically, the surface layer is black muck about 12 inches thick. The next 17 inches also is black muck. The next 5 inches is black mucky peat. Below this to a depth of about 60 inches is black muck. In places the soil is underlain by sandy or loamy material.

Included with this soil in mapping are small areas of Histosols and Aquents, ponded. These soils are in landscape positions similar to those of the Lupton soil. They make up 5 to 10 percent of the unit.

Permeability is moderately slow to moderately rapid in the Lupton soil. The available water capacity is high. Surface runoff is very slow or ponded. A seasonal high water table is about 1 foot above to 1 foot below the surface from autumn to late spring.

Most areas are used as woodland. Windthrow is a hazard, and the equipment limitation, seedling mortality, and plant competition are management concerns. Because of the wetness, the trees are shallow rooted. Some may be blown down during periods of high wind. Windthrow losses can be minimized by cutting systems that do not isolate the remaining trees or allow them to funnel the wind. Ordinary crawler tractors or rubber-tired skidders generally cannot be used on this soil. Special harvesting equipment may be needed. The equipment can be used during periods in winter when access roads are frozen. Ruts form easily when wheeled skidders are used during excessively wet periods. Deep ruts tend to restrict lateral drainage, expose tree roots, and alter soil structure. Such damage can be avoided if the use of equipment is restricted to periods when the soil is frozen. Because of the wetness, the soil is severely limited as a site for log landings. Seedling losses may be high because of the wetness. Trees generally are not planted on this soil because of the high seedling mortality rate, plant competition, and low productivity.

This soil generally is unsuited to recreational development because of the seasonal high water table and the instability of the organic material.

This soil generally is unsuited to building site development and septic tank absorption fields because of the hazard of ponding, the high water table, low soil strength, and a high potential for frost action. Overcoming these limitations is difficult and costly.

The land capability subclass is VIw. The woodland ordination symbol is 2W. The Michigan soil management group is Mc.

5—Loxley peat. This deep, nearly level, very poorly drained soil is in bogs or depressions in upland areas and swales (fig. 3). It is subject to ponding. Individual areas are irregularly shaped and range from 6 to more than 700 acres in size.

Typically, the surface layer is very dusky red peat about 2 inches thick. The subsurface layer is dark reddish brown mucky peat about 7 inches thick. The underlying layers to a depth of about 60 inches are black and dark reddish brown mucky peat and muck. In some places the soil is less acid. In other places the subsurface layer is mucky peat.

Included with this soil in mapping are small areas of Histosols and Aquents, ponded. These soils are in landscape positions similar to those of the Loxley soil. They make up about 5 to 10 percent of the unit.

Permeability is moderately slow to moderately rapid in the Loxley soil. The available water capacity is high. Surface runoff is very slow or ponded. A seasonal high water table is about 1 foot above to 1 foot below the surface from early autumn to late spring.

This soil is unsuited to woodland. Windthrow is a hazard, and the equipment limitation, seedling mortality, plant competition, and very low natural fertility are management concerns. Overcoming these limitations is not practical.

This soil generally is unsuited to recreational development because of the seasonal high water table and instability of the organic material.

This soil generally is unsuited to building site development and septic tank absorption fields because of the hazard of ponding, the high water table, low soil strength, and the high potential for frost action. Overcoming these limitations is difficult and costly.

The land capability subclass is VIIw. The woodland ordination symbol is 2W. The Michigan soil management group is Mc-a.

7—Grousehaven Variant muck. This deep, nearly level, very poorly drained soil is in bogs and other depressional areas on flood plains. It is subject to ponding and to flooding of long duration in the spring. Individual areas are irregularly shaped and range from 7 to more than 400 acres in size.

Typically, the organic material is black and dark reddish brown muck about 7 inches thick. The next layer is greenish gray, mottled marl about 12 inches thick. Below this to a depth of about 60 inches is grayish brown, mottled, calcareous sand. In some areas the marl extends to a depth of 60 inches or more. In other areas the organic material is less than 16 inches thick.

Included with this soil in mapping are small areas of the very poorly drained Lupton and Tawas soils. These soils are in landscape positions similar to those of the Grousehaven Variant soil. Lupton soils formed in organic material that is more than 51 inches thick. Tawas soils are underlain by sand or gravelly sand at a depth of 16 to 51 inches. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately slow to moderately rapid

Figure 3.—An area of Loxley peat. The vegetation consists mainly of sphagnum, leatherleaf, and Canada blueberry.

in the upper part of the Grousehaven Variant soil and slow in the lower part. The available water capacity is high. Surface runoff is very slow or ponded. A seasonal high water table is about 1 foot above to 1 foot below the surface throughout the year.

This soil is poorly suited to woodland. Windthrow is a hazard, and the equipment limitation, seedling mortality, and plant competition are management concerns. Because of the wetness, the trees are shallow rooted. Some may be blown down during periods of high wind. Windthrow losses can be minimized by cutting systems that do not isolate the remaining trees or allow them to funnel the wind. Ordinary crawler tractors or rubber-tired skidders generally cannot be used on this soil. Special harvesting equipment is needed. The equipment can be used during periods in winter when access roads are frozen. Ruts form easily when wheeled skidders are used during excessively wet periods. Deep ruts tend to restrict lateral drainage, expose tree roots, and alter soil structure. Such damage can be avoided if the use of equipment is restricted to periods when the soil is frozen. Because of the wetness, the soil is severely limited as a site for log landings. Seedling losses may be high because of the wetness. Special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. Trees generally are not planted on this soil because of the high seedling mortality rate, plant competition, and low productivity.

This soil generally is unsuited to recreational development because of the seasonal high water table and instability of the organic material.

This soil generally is unsuited to building site development and septic tank absorption fields because of the hazard of ponding, the high water table, low soil strength, and a high potential for frost action. Overcoming these limitations is difficult and costly.

The land capability subclass is VIIw. The woodland ordination symbol is 3W. The Michigan soil management group is 5c.

8—Tawas peat. This deep, nearly level, very poorly drained soil is in drainageways and depressions on plains. It is subject to ponding. Individual areas are irregularly shaped and are 3 to more than 900 acres in size.

Typically, the surface layer is dark brown peat about 2 inches thick. The lower organic layers extend to a depth of about 44 inches. In sequence downward, they are black and very dark brown muck; very dark grayish brown mucky peat; and dark brown muck. The substratum to a depth of about 60 inches is gray sand. In some places the muck is more than 51 inches thick. In other places the organic material is acid. In some areas the substratum is loamy.

Included with this soil in mapping are small areas of the very poorly drained Roscommon soils. These soils are in landscape positions similar to those of the Tawas soil. They have less than 16 inches of muck. They make up 10 to 15 percent of the unit.

Permeability is moderately slow to moderately rapid in the upper part of the Tawas soil and rapid in the lower part. The available water capacity is high. Surface runoff is very slow or ponded. A seasonal high water table is about 1 foot above to 1 foot below the surface from late autumn to late spring.

This soil is poorly suited to woodland. Windthrow is a hazard, and the equipment limitation, seedling mortality, and plant competition are management concerns. Because of the wetness, the trees are shallow rooted. Some may be blown down during periods of high wind. Windthrow losses can be minimized by cutting systems that do not isolate the remaining trees or allow them to funnel the wind. Ordinary crawler tractors or rubber-tired skidders generally cannot be used on these soils. Special harvesting equipment may be needed. The equipment can be used during periods in winter when access roads are frozen. Ruts form easily when wheeled skidders are used during excessively wet periods. Deep ruts tend to restrict lateral drainage, expose tree roots, and alter soil structure. Such damage can be avoided if the use of equipment is restricted to periods when the soil is frozen. Because of the wetness, the soil is severely limited as a site for log landings. Seedling losses may be high because of the wetness. Trees generally are not planted on this soil because of the high seedling mortality rate, plant competition, and low productivity.

This soil generally is unsuited to recreational development because of the seasonal high water table and instability of the organic material.

This soil generally is unsuited to building site development and septic tank absorption fields because of the hazard of ponding, the high water table, low soil strength, and a high potential for frost action. Overcoming these limitations is difficult and costly.

The land capability subclass is VIw. The woodland ordination symbol is 5W. The Michigan soil management group is M/4c.

9—Greenwood peat. This deep, nearly level, very poorly drained soil is in bogs, depressions, and swales in the uplands. It is subject to ponding. Individual areas are circular or long and narrow and range from 10 to more than 1,200 acres in size.

Typically, the surface layer is yellowish red peat about 4 inches thick. The underlying layers to a depth of about 60 inches are reddish brown and dark reddish brown mucky peat. In some places the soil is underlain by sandy or loamy material. In other places it is less acid.

Included with this soil in mapping are small areas of the very poorly drained Loxley and Tawas soils. These soils do not have layers of peat or mucky peat below a thin peaty surface layer. They are in landscape positions similar to those of the Greenwood soil. Also included are small areas of floating bogs around Nolton Lake in Hebron Township and around Mud Lake in South Grant Township. Included areas make up 5 to 8 percent of the unit.

Permeability is moderately slow to moderately rapid in the Greenwood soil. The available water capacity is high. Surface runoff is very slow or ponded. A seasonal high water table is about 1 foot above to 1 foot below the surface from autumn to early summer.

In most areas this soil is used as wildlife habitat. It supports native vegetation, such as blueberry, leatherleaf, Labrador tea, cranberry, sedge, tamarack, and black spruce.

This soil is poorly suited to woodland. Windthrow is a hazard, and the equipment limitation, seedling mortality, plant competition, and very low natural fertility are management concerns. Overcoming these limitations is not practical.

This soil generally is unsuited to recreational development because of the seasonal high water table and the instability of the organic material.

This soil generally is unsuited to building site development and septic tank absorption fields because of the hazard of ponding, the high water table, low soil strength, and a high potential for frost action. Overcoming these limitations is difficult and costly.

The land capability subclass is VIIw. The woodland ordination symbol is 2W. The Michigan soil management group is Mc-a.

10—Dawson peat. This deep, nearly level, very poorly drained soil is in depressions, bogs, and swales in the uplands. It is subject to ponding. Individual areas are irregularly shaped and range from 3 to more than 200 acres in size.

Typically, the surface layer is dark yellowish brown peat about 5 inches thick. The subsurface layer is reddish brown peat about 3 inches thick. The lower organic layers extend to a depth of about 17 inches. They are dark reddish brown mucky peat and very dark grayish brown muck. The substratum to a depth of about 60 inches is grayish brown sand. In places the soil is less acid.

Included with this soil in mapping are small areas of Histosols and Aquents, ponded, and the very poorly drained Loxley soils. Histosols and Aquents, ponded, are ponded throughout the year. Loxley soils have organic material more than 51 inches thick. All of the included soils are in landscape positions similar to those of the Dawson soil. They make up about 5 to 8 percent of the unit.

Permeability is moderately slow to moderately rapid in the upper part of the Dawson soil and rapid in the lower part. The available water capacity is high. Surface runoff is very slow or ponded. A seasonal high water table is about 1 foot above to 1 foot below the surface from autumn to early summer.

This soil is unsuited to woodland. Windthrow is a hazard, and the equipment limitation, seedling mortality, plant competition, and very low natural fertility are management concerns. Overcoming these limitations is not practical.

This soil generally is unsuited to recreational development because of the seasonal high water table and the instability of the organic material.

This soil generally is unsuited to building site development and septic tank absorption fields because of the hazard of ponding, the high water table, low soil strength, and a high potential for frost action. Overcoming these limitations is difficult and costly.

The land capability subclass is VIIw. The woodland ordination symbol is 2W. The Michigan soil management group is M/4c-a.

11B—Kalkaska sand, 0 to 6 percent slopes. This deep, nearly level and undulating, somewhat excessively drained soil is on knolls, ridges, and broad plains in the uplands. Individual areas are irregularly shaped and range from 3 to more than 400 acres in size.

Typically, the surface layer is mixed very dark gray and light gray sand about 2 inches thick. The subsurface layer is pinkish gray sand about 10 inches thick. The subsoil is sand about 23 inches thick. The upper part is dark reddish brown and friable, the next part is strong brown and loose, and the lower part is brownish yellow and loose. The substratum to a depth of about 60 inches is light yellowish brown sand. In some places the upper part of the subsoil is thinner. In other places the subsoil has many thin bands of loamy sand.

Included with this soil in mapping are small areas of the moderately well drained Cheboygan and excessively drained Rubicon soils. Cheboygan soils have a loamy substratum. Rubicon soils are characterized by less subsoil development than the Kalkaska soil and are more droughty. Both of the included soils are in landscape positions similar to those of the Kalkaska soil. They make up about 5 percent of the unit.

Permeability is rapid in the Kalkaska soil. The available water capacity is low. Surface runoff is very slow.

Such crops as corn, oats, alfalfa, and mixed grasses and legumes can be grown on this soil. Conserving moisture during dry periods, controlling soil blowing, and maintaining or increasing the organic matter content are management concerns. A system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface and additions of organic material to the soil increase the available water capacity. If water of sufficient quantity and quality is available, irrigation can help to overcome the low available water capacity. Cover crops, buffer strips, field windbreaks, and conservation tillage help to control soil blowing.

The main concern in managing pastured areas is conserving moisture during dry periods. Maintaining an adequate ground cover by rotation grazing or strip grazing reduces the susceptibility to erosion and helps to keep the pasture in good condition.

Most areas are used as woodland. The equipment limitation, seedling mortality, and plant competition are management concerns. In heavily traveled areas, loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. Because of dry weather conditions, the loss of planted or natural tree seedlings can be as high as 25 to 50 percent. Special planting stock, such as containerized seedlings, and special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. Furrowing before planting also reduces the seedling mortality rate. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

If this soil is used for recreational development, the sandy surface layer is a limitation. Adding a layer of loamy material to the surface and seeding deep-rooted grasses and legumes can help to overcome this limitation. Some land shaping and leveling may be needed on sites for playgrounds.

This soil is well suited to building site development but is poorly suited to septic tank absorption fields. The sides of shallow excavations can cave in unless they are reinforced. The soil readily absorbs the effluent in septic tank absorption fields, but it does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability subclass is IVs. The woodland ordination symbol is 3S. The Michigan soil management group is 5a.

11C—Kalkaska sand, 6 to 12 percent slopes. This deep, gently rolling, somewhat excessively drained soil is on knolls, ridges, and broad plains in the uplands. Individual areas are irregularly shaped and range from 3 to more than 300 acres in size.

Typically, the surface layer is mixed very dark gray and light gray sand about 2 inches thick. The subsurface layer is pinkish gray sand about 10 inches thick. The subsoil is sand about 23 inches thick. The upper part is dark reddish brown and friable, the next part is strong brown and loose, and the lower part is brownish yellow and loose. The substratum to a depth of about 60 inches is light yellowish brown sand. In some places the upper part of the subsoil is thinner. In other places the subsoil has many thin bands of loamy sand.

Included with this soil in mapping are small areas of the well drained Cheboygan and excessively drained Rubicon soils. Cheboygan soils have a loamy substratum. Rubicon soils are characterized by less subsoil development than the Kalkaska soil and are more droughty. Both of the included soils are in landscape positions similar to those of the Kalkaska soil. They make up 7 to 10 percent of the unit.

Permeability is rapid in the Kalkaska soil. The available water capacity is low. Surface runoff is slow.

The main concerns in managing pastured areas are conserving moisture during dry periods and controlling soil blowing. Maintaining an adequate ground cover by rotation grazing or strip grazing and restricted use during dry periods reduce the susceptibility to erosion and help to keep the pasture in good condition.

Most areas are used as woodland. The equipment limitation, seedling mortality, and plant competition are management concerns. In heavily traveled areas, loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. Landings can be established in the small, nearly level included areas, if available, or in the nearly level adjacent areas.

Because of dry weather conditions, the loss of planted or natural tree seedlings can be as high as 25 to 50 percent. Special planting stock, such as containerized seedlings, and special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. Furrowing before planting also reduces the seedling mortality rate. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

If this soil is used for recreational purposes, the sandy surface layer and the slope are limitations. A layer of loamy material is needed on playgrounds and in camping areas, and a cover of wood chips or bark is needed on paths and trails. Some land shaping and leveling may be needed to overcome the slope on campsites, in picnic areas, and on playgrounds.

This soil is moderately well suited to building site development but is poorly suited to septic tank absorption fields. The slope and the instability of cutbanks are limitations on building sites. Buildings should be designed so that they conform to the natural slope of the land. The sides of shallow excavations should be reinforced. The slope and a poor filtering capacity are limitations on sites for septic tank absorption fields. Land shaping and installing the distribution lines across the slope help to ensure the proper functioning of the absorption fields. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability subclass is VIs. The woodland ordination symbol is 3S. The Michigan soil management group is 5a.

11D—Kalkaska sand, 12 to 30 percent slopes. This deep, rolling to steep, somewhat excessively drained soil is on high knolls, ridges, and hills in the uplands. Individual areas are irregularly shaped and range from 3 to more than 300 acres in size.

Typically, the surface layer is mixed very dark gray and light gray sand about 2 inches thick. The subsurface layer is pinkish gray sand about 10 inches thick. The subsoil is sand about 23 inches thick. The upper part is dark reddish brown and friable, the next part is strong brown and loose, and the lower part is brownish yellow and loose. The substratum to a depth of about 60 inches is light yellowish brown sand. In some places the upper part of the subsoil is thinner. In other places the subsoil has many thin bands of loamy sand.

Included with this soil in mapping are small areas of the well drained Cheboygan and excessively drained Rubicon soils. Cheboygan soils have a loamy substratum. Rubicon soils are characterized by less subsoil development than the Kalkaska soil and are more droughty. Both of the included soils are in landscape positions similar to those of the Kalkaska soil. They make up 8 to 12 percent of the unit.

Permeability is rapid in the Kalkaska soil. The available water capacity is low. Surface runoff is medium.

Most areas are used as woodland. Erosion is a hazard, and the equipment limitation, seedling mortality, and plant competition are management concerns. Because of the erosion hazard, logging roads, skid trails, and landings should be established on gentle grades. Cross-drainage methods of water removal that are matched to specific sites are necessary. Out-sloping road surfaces, open-top drains, and culverts are needed. The use of equipment is restricted by the slope. Special care is needed in laying out roads and landings and in operating the equipment. The roads can be designed so that they conform to the natural slope of the land. The grade should be kept as low as possible. In heavily traveled areas, loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. Rubber-tired and crawler tractors can be operated safely on these slopes, but caution is needed and the steeper slopes should be avoided.

Because of dry weather conditions, the loss of planted or natural tree seedlings can be as high as 25 to 50 percent. Special planting stock, such as containerized seedlings, and special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. Furrowing before planting also reduces the seedling mortality rate. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

If this soil is used for recreational purposes, the sandy surface layer and the slope are limitations. The slope can prohibit the construction of campsites and playgrounds or can significantly increase construction costs. A layer of loamy material is needed on playgrounds and in camping areas, and a cover of wood chips or bark is needed on paths and trails.

This soil is poorly suited to building site development and septic tank absorption fields. The slope and the instability of cutbanks are limitations on building sites. Buildings should be designed so that they conform to the natural slope of the land. The sides of shallow excavations should be reinforced. The slope and a poor filtering capacity are limitations on sites for septic tank absorption fields. Land shaping and installing the distribution lines across the slope help to ensure the proper functioning of the absorption fields. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability subclass is VIIs. The woodland ordination symbol is 3R. The Michigan soil management group is 5a.

11F—Kalkaska sand, 30 to 50 percent slopes. This deep, very steep, somewhat excessively drained soil is on hills, ridges, and side slopes in the uplands. Individual areas are irregularly shaped and range from 3 to more than 300 acres in size.

Typically, the surface layer is mixed very dark gray and light gray sand about 2 inches thick. The subsurface layer is pinkish gray sand about 10 inches thick. The subsoil is sand about 23 inches thick. The upper part is dark reddish brown and friable, the next part is strong brown and loose, and the lower part is brownish yellow and loose. The substratum to a depth of about 60 inches is light yellowish brown sand. In some places the upper part of the subsoil is thinner. In other places the subsoil has many thin bands of loamy sand.

Included with this soil in mapping are small areas of the excessively drained Rubicon soils. These soils are in landscape positions similar to those of the Kalkaska soil. They are characterized by less subsoil development than the Kalkaska soil and are more droughty. They make up about 8 to 15 percent of the unit.

Permeability is rapid in the Kalkaska soil. The available water capacity is low. Surface runoff is medium.

Most areas are used as woodland. Erosion is a hazard, and the equipment limitation, seedling mortality, and plant competition are management concerns. Because of the erosion hazard, logging roads, skid trails, and landings should be established on gentle grades. Cross-drainage methods of water removal that are matched to specific sites are necessary. Out-sloping road surfaces, open-top drains, and culverts are needed. The use of equipment is restricted by the slope. Ordinary crawler tractors and rubber-tired skidders cannot be operated safely on the very steep side slopes. Special logging methods, such as cable yarding, may be needed. In heavily traveled areas, loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized.

Because of dry weather conditions, the loss of planted or natural tree seedlings can be as high as 25 to 50 percent. Special planting stock, such as containerized seedlings, and special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. Furrowing before planting also reduces the seedling mortality rate. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is poorly suited to recreational development. The sandy surface layer and the slope are limitations. The slope can prohibit the construction of campsites and playgrounds or can significantly increase construction costs. A layer of loamy material is needed on playgrounds and in camping areas, and a cover of wood chips or bark is needed on paths and trails.

This soil is unsuited to building site development and septic tank absorption fields. The instability of cutbanks and the slope are limitations on building sites. Also, a poor filtering capacity is a limitation on sites for septic tank absorption fields. Soils that are better suited to these uses generally are nearby.

The land capability subclass is VIIs. The woodland ordination symbol is 3R. The Michigan soil management group is 5a.

12B—Grayling sand, 0 to 8 percent slopes. This deep, nearly level to gently rolling, excessively drained soil is in the uplands. Individual areas are long and narrow or irregular in shape and range from 10 to more than 1,000 acres in size.

Typically, the surface layer is mixed black and very light gray sand about 2 inches thick. The subsurface layer is light brownish gray sand about 2 inches thick. The subsoil is dark yellowish brown, loose sand about 14 inches thick. The substratum to a depth of about 60 inches is brownish yellow and light yellowish brown sand. In some places the subsoil and substratum are fine sand and have a few thin bands of loamy sand. In other places the subsoil is darker colored.

Permeability is rapid. The available water capacity is low. Surface runoff is very slow.

Most areas are used as woodland. The equipment limitation and seedling mortality are management concerns. The best sites for landings are the nearly level parts of the landscape. In heavily traveled areas, loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. Because of dry weather conditions, the loss of planted or natural tree seedlings can be as high as 25 to 50 percent. Special planting stock, such as containerized seedlings, and special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. Furrowing before planting also reduces the seedling mortality rate.

This soil is poorly suited to recreational development. The sandy surface layer is a limitation. Adding a layer of loamy material to the surface and seeding deep-rooted grasses and legumes can help to overcome this limitation. Some land shaping and leveling may be needed on sites for playgrounds.

This soil is well suited to building site development but is poorly suited to septic tank absorption fields. The instability of cutbanks is a management concern. The sides of shallow excavations should be reinforced. The soil readily absorbs the effluent in septic tank absorption fields, but it does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability subclass is VIs. The woodland ordination symbol is 4S. The Michigan soil management group is 5.7a.

13B—Rubicon sand, 0 to 6 percent slopes. This deep, nearly level and undulating, excessively drained soil is on ridges, knolls, plains, and side slopes in the uplands. Individual areas are irregularly shaped and range from 10 to more than 1,000 acres in size.

Typically, the surface layer is mixed black and light brownish gray sand about 1 inch thick. The subsurface layer is light brownish gray sand about 5 inches thick. The subsoil is very friable sand about 30 inches thick. The upper part is dark brown, the next part is dark yellowish brown, and the lower part is yellowish brown. The substratum to a depth of about 60 inches is light yellowish brown sand. In some areas the subsoil is darker. In other areas the substratum has thin bands of loamy sand. In places the water table is within a depth of 60 inches for short periods.

Included with this soil in mapping are small areas of the somewhat poorly drained Au Gres and somewhat excessively drained East Lake soils. Au Gres soils are in depressions. East Lake soils have calcareous gravel in the substratum. They are in landscape positions similar to those of the Rubicon soil. Included soils make up 8 to 15 percent of the unit.

Permeability is rapid in the Rubicon soil. The available water capacity is low. Surface runoff is very slow.

Most areas are used as woodland (fig. 4). The equipment limitation and seedling mortality are management concerns. In heavily traveled areas, loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. Because of dry weather conditions, the loss of planted or natural tree seedlings

Figure 4.—A log landing in a wooded area of Rubicon sand, 0 to 6 percent slopes.

can be as high as 25 to 50 percent. Special planting stock, such as containerized seedlings, and special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. Furrowing before planting also reduces the seedling mortality rate.

This soil is poorly suited to recreational development. The sandy surface layer is a limitation. Adding a layer of loamy material to the surface and seeding deep-rooted grasses and legumes can help to overcome this limitation. Some land shaping and leveling may be needed on sites for playgrounds.

This soil is well suited to building site development but is poorly suited to septic tank absorption fields. The instability of cutbanks is a management concern. The sides of shallow excavations should be reinforced. The soil readily absorbs the effluent in septic tank absorption fields, but it does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability subclass is VIs. The woodland ordination symbol is 4S. The Michigan soil management group is 5.3a.

13C—Rubicon sand, 6 to 12 percent slopes. This deep, gently rolling, excessively drained soil is on ridges, knolls, and side slopes in the uplands. Individual areas are irregularly shaped and range from 5 to more than 500 acres in size.

Typically, the surface layer is mixed black and light brownish gray sand about 1 inch thick. The subsurface layer is light brownish gray sand about 5 inches thick. The subsoil is very friable sand about 30 inches thick. The upper part is dark brown, the next part is dark yellowish brown, and the lower part is yellowish brown. The substratum to a depth of about 60 inches is light yellowish brown sand. In some places the subsoil is darker. In other places the substratum has thin bands of loamy sand.

Included with this soil in mapping are small areas of the somewhat excessively drained East Lake soils. These soils have calcareous gravel in the substratum. They are in landscape positions similar to those of the Rubicon soil. They make up 8 to 15 percent of the unit.

Permeability is rapid in the Rubicon soil. The available water capacity is low. Surface runoff is slow.

Most areas are used as woodland. The equipment limitation and seedling mortality are management concerns. In heavily traveled areas, loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. Landings can be established in the small, nearly level included areas, if available, or in the nearly level adjacent areas. Because of dry weather conditions, the loss of planted or natural tree seedlings can be as high as 25 to 50 percent. Special planting stock, such as containerized seedlings, and special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. Furrowing before planting also reduces the seedling mortality rate.

This soil is poorly suited to recreational development. The sandy surface layer and the slope are limitations. A layer of loamy material is needed on playgrounds and in camping areas, and a cover of wood chips or bark is needed on paths and trails. Some land shaping and leveling may be needed to overcome the slope on campsites, in picnic areas, and on playgrounds.

This soil is moderately well suited to building site development but is poorly suited to septic tank absorption fields. The slope and the instability of cutbanks are limitations on building sites. Buildings should be designed so that they conform to the natural slope of the land. The sides of shallow excavations should be reinforced. The slope and a poor filtering capacity are limitations on sites for septic tank absorption fields. Land shaping and installing the distribution lines across the slope help to ensure the proper functioning of the absorption fields. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability subclass is VIs. The woodland ordination symbol is 4S. The Michigan soil management group is 5.3a.

13D—Rubicon sand, 18 to 30 percent slopes. This deep, hilly and steep, excessively drained soil is on ridges, hills, and high knolls in the uplands. Individual areas are irregularly shaped and range from 3 to more than 300 acres in size.

Typically, the surface layer is mixed black and light brownish gray sand about 1 inch thick. The subsurface layer is light brownish gray sand about 5 inches thick. The subsoil is very friable sand about 30 inches thick. The upper part is dark brown, the next part is dark yellowish brown, and the lower part is yellowish brown. The substratum to a depth of about 60 inches is light yellowish brown sand. In some places the subsoil is darker. In other places the substratum has thin bands of loamy sand.

Included with this soil in mapping are small areas of the somewhat excessively drained East Lake soils. These soils have calcareous gravel in the substratum. They are in landscape positions similar to those of the Rubicon soil. They make up 8 to 15 percent of the unit.

Permeability is rapid in the Rubicon soil. The available water capacity is low. Surface runoff is medium.

Most areas are used as woodland. Erosion is a hazard, and the equipment limitation and seedling mortality are management concerns. Because of the erosion hazard, logging roads, skid trails, and landings should be established on gentle grades. Cross-drainage methods of water removal that are matched to specific sites are necessary. Out-sloping road surfaces, open-top drains, and culverts are needed. The use of equipment is restricted by the slope. Special care is needed in laying out roads and landings and in operating the equipment. The roads can be designed so that they conform to the natural slope of the land. The grade should be kept as low as possible. In heavily traveled areas, loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. Rubber-tired and crawler tractors can be operated safely on these slopes, but caution is needed and the steeper slopes should be avoided.

Because of dry weather conditions, the loss of planted or natural tree seedlings can be as high as 25 to 50 percent. Special planting stock, such as containerized seedlings, and special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. Furrowing before planting also reduces the seedling mortality rate.

If this soil is used for recreational purposes, the sandy surface layer and the slope are limitations. The slope can prohibit the construction of campsites and playgrounds or can significantly increase construction costs. A layer of loamy material is needed on playgrounds and in camping areas, and a cover of wood chips or bark is needed on paths and trails.

This soil is poorly suited to building site development and septic tank absorption fields. The slope and the instability of cutbanks are limitations on building sites. Buildings should be designed so that they conform to the natural slope of the land. The sides of shallow excavations should be reinforced. The slope and a poor filtering capacity are limitations on sites for septic tank absorption fields. Land shaping and installing the distribution lines across the slope help to ensure the proper functioning of the absorption fields. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability subclass is VIIs. The woodland ordination symbol is 4R. The Michigan soil management group is 5.3a.

13F—Rubicon sand, 30 to 60 percent slopes. This deep, very steep, excessively drained soil is on ridges, hills, and side slopes in the uplands. Individual areas are irregularly shaped and range from 3 to more than 200 acres in size.

Typically, the surface layer is mixed black and light brownish gray sand about 1 inch thick. The subsurface layer is light brownish gray sand about 5 inches thick. The subsoil is very friable sand about 30 inches thick. The upper part is dark brown, the next part is dark yellowish brown, and the lower part is yellowish brown. The substratum to a depth of about 60 inches is light yellowish brown sand. In some places the subsoil is darker. In other places the substratum has thin bands of loamy sand.

Included with this soil in mapping are small areas of the somewhat excessively drained East Lake soils. These soils have calcareous gravel in the substratum. They are in landscape positions similar to those of the Rubicon soil. They make up 10 to 15 percent of the unit.

Permeability is rapid in the Rubicon soil. The available water capacity is low. Surface runoff is medium.

Most areas are used as woodland. Erosion is a hazard, and the equipment limitation and seedling mortality are management concerns. Because of the erosion hazard, logging roads, skid trails, and landings should be established on gentle grades. Cross-drainage methods of water removal that are matched to specific sites are necessary. Out-sloping road surfaces, open-top drains, and culverts are needed. The use of equipment is restricted by the slope. Ordinary crawler tractors and rubber-tired skidders cannot be operated safely on the very steep side slopes. Special logging methods, such as cable yarding, may be needed. In heavily traveled areas, loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized.

Because of dry weather conditions, the loss of planted or natural tree seedlings can be as high as 25 to 50 percent. Special planting stock, such as containerized seedlings, and special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. Furrowing before planting also reduces the seedling mortality rate.

This soil is poorly suited to recreational development. The sandy surface layer and the slope are limitations. The slope can prohibit the construction of campsites and playgrounds or can significantly increase construction costs. A layer of loamy material is needed on playgrounds and in camping areas, and a cover of wood chips or bark is needed on paths and trails.

This soil generally is unsuited to building site development and septic tank absorption fields. The slope and the instability of cutbanks are limitations on building sites. Also, a poor filtering capacity is a limitation on sites for septic tank absorption fields. Soils that are better suited to these uses generally are nearby.

The land capability subclass is VIIs. The woodland ordination symbol is 4R. The Michigan soil management group is 5.3a.

16B—East Lake sand, 0 to 6 percent slopes. This deep, nearly level and undulating, somewhat excessively drained soil is on broad plains, low ridges, and knolls in the uplands. Individual areas are irregularly shaped and range from 3 to more than 100 acres in size.

Typically, the surface layer is mixed black and light gray sand about 1 inch thick. The subsurface layer is light brownish gray coarse sand about 1 inch thick. The subsoil is about 26 inches thick. It is loose. The upper part is reddish brown, yellowish red, and strong brown coarse sand, and the lower part is yellowish brown gravelly coarse sand. The substratum to a depth of about 60 inches is light yellowish brown, calcareous gravelly coarse sand. In places the soil is dominantly sand.

Included with this soil in mapping are small areas of the somewhat excessively drained Mancelona and somewhat poorly drained Battlefield soils. Mancelona soils are in landscape positions similar to those of the East Lake soil. Also, they have more clay in the subsoil. Battlefield soils are in depressions. Included soils make up 5 to 10 percent of the unit.

Permeability is very rapid in the East Lake soil. The available water capacity is very low. Surface runoff is very slow.

Most areas are used as woodland. The equipment limitation and seedling mortality are management concerns. In heavily traveled areas, loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. Because of dry weather conditions, the loss of planted or natural tree seedlings can be as high as 25 to 50 percent. Special planting stock, such as containerized seedlings, and special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. Furrowing before planting also reduces the seedling mortality rate.

This soil is poorly suited to recreational development. The sandy surface layer is a limitation. Adding a layer of loamy material to the surface and seeding deep-rooted grasses and legúmes can help to overcome this limitation. Some land shaping and leveling may be needed on sites for playgrounds.

This soil is well suited to building site development but is poorly suited to septic tank absorption fields. The instability of cutbanks is a limitation on building sites. The sides of shallow excavations should be reinforced. The soil readily absorbs the effluent in septic tank absorption fields, but it does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability subclass is IVs. The woodland ordination symbol is 2S. The Michigan soil management group is 5a.

16C—East Lake sand, 6 to 12 percent slopes. This deep, gently rolling, somewhat excessively drained soil is on ridges and knolls in the uplands. Individual areas are irregularly shaped and range from 3 to more than 100 acres in size.

Typically, the surface layer is mixed black and light gray sand about 1 inch thick. The subsurface layer is light brownish gray coarse sand about 1 inch thick. The subsoil is about 26 inches thick. It is loose. The upper part is reddish brown, yellowish red, and strong brown coarse sand, and the lower part is yellowish brown gravelly coarse sand. The substratum to a depth of about 60 inches is light yellowish brown, calcareous gravelly coarse sand. In places the soil is dominantly sand.

Included with this soil in mapping are small areas of the somewhat excessively drained Mancelona soils. These soils are in landscape positions similar to those of the East Lake soil. Also, they have more clay in the subsoil. They make up about 8 to 10 percent of the unit.

Permeability is very rapid in the East Lake soil. The available water capacity is very low. Surface runoff is slow.

Most areas are used as woodland. The equipment limitation and seedling mortality are management concerns. In heavily traveled areas, loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. Landings can be established in the small, nearly level included areas, if available, or in the nearly level adjacent areas. Because of dry weather conditions, the loss of planted or natural tree seedlings can be as high as 25 to 50 percent. Special planting stock, such as containerized seedlings, and special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. Furrowing before planting also reduces the seedling mortality rate.

This soil is poorly suited to recreational development. The sandy surface layer and the slope are limitations. Adding a layer of loamy material to the surface and seeding deep-rooted grasses and legumes can help to overcome this limitation. Some land shaping and leveling may be needed on campsites, in picnic areas, and on playgrounds.

This soil is moderately well suited to building site development but is poorly suited to septic tank absorption fields. The slope and the instability of cutbanks are limitations on building sites. Buildings should be designed so that they conform to the natural slope of the land. The sides of shallow excavations should be reinforced. The slope and a poor filtering capacity are limitations on sites for septic tank absorption fields. Land shaping and installing the distribution lines across the slope help to ensure the proper functioning of the absorption fields. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability subclass is VIs. The woodland ordination symbol is 2S. The Michigan soil management group is 5a.

16D—East Lake sand, 12 to 30 percent slopes. This deep, rolling to steep, somewhat excessively drained soil is on ridges, knolls, and side slopes in the uplands. Individual areas are irregularly shaped and range from 3 to 100 acres in size.

Typically, the surface layer is mixed black and light gray sand about 1 inch thick. The subsurface layer is light brownish gray coarse sand about 1 inch thick. The subsoil is about 26 inches thick. It is loose. The upper part is reddish brown, yellowish red, and strong brown coarse sand, and the lower part is yellowish brown gravelly coarse sand. The substratum to a depth of about 60 inches is light yellowish brown, calcareous gravelly coarse sand. In places the soil is dominantly sand.

Included with this soil in mapping are small areas of the somewhat excessively drained Mancelona soils. These soils are in landscape positions similar to those of the East Lake soil. Also, they have more clay in the subsoil. They make up 5 to 15 percent of the unit.

Permeability is very rapid in the East Lake soil. The available water capacity is very low. Surface runoff is medium.

Most areas are used as woodland. Erosion is a hazard, and the equipment limitation and seedling mortality are management concerns. Because of the erosion hazard, logging roads, skid trails, and landings should be established on gentle grades. Cross-drainage methods of water removal that are matched to specific sites are necessary. Out-sloping road surfaces, open-top drains, and culverts are needed. The use of equipment is restricted by the slope. Special care is needed in laying out roads and landings and in operating the equipment. The roads can be designed so that they conform to the natural slope of the land. The grade should be kept as low as possible. In heavily traveled areas, loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. Rubber-tired and crawler tractors can be operated safely on these slopes, but caution is needed and the steeper slopes should be avoided.

Because of dry weather conditions, the loss of planted or natural tree seedlings can be as high as 25 to 50 percent. Special planting stock, such as containerized seedlings, and special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. Furrowing before planting also reduces the seedling mortality rate.

If this soil is used for recreational purposes, the sandy surface layer and the slope are limitations. The slope can prohibit the construction of campsites and playgrounds or can significantly increase construction costs. A layer of loamy material is needed on playgrounds and in camping areas, and a cover of wood chips or bark is needed on paths and trails.

This soil is poorly suited to building site development and septic tank absorption fields The slope and the instability of cutbanks are limitations on building sites. Buildings should be designed so that they conform to the natural slope of the land. The sides of shallow excavations should be reinforced. The slope and a poor filtering capacity are limitations on sites for septic tank absorption fields. Land shaping and installing the distribution lines across the slope help to ensure the proper functioning of the absorption fields. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability subclass is VIIs. The woodland ordination symbol is 2R. The Michigan soil management group is 5a.

16F—East Lake sand, 30 to 50 percent slopes. This deep, very steep, somewhat excessively drained soil is on ridges and side slopes, on hills, and in deeply incised drainageways in the uplands. Individual areas are irregularly shaped and range from 3 to more than 100 acres in size.

Typically, the surface layer is mixed black and light gray sand about 1 inch thick. The subsurface layer is light brownish gray coarse sand about 1 inch thick. The subsoil is about 26 inches thick. It is loose. The upper part is reddish brown, yellowish red, and strong brown coarse sand, and the lower part is yellowish brown gravelly coarse sand. The substratum to a depth of about 60 inches is light yellowish brown, calcareous gravelly coarse sand. In places the soil is dominantly sand.

Included with this soil in mapping are small areas of the somewhat excessively drained Mancelona soils. These soils are in landscape positions similar to those of the East Lake soil. Also, they have more clay in the subsoil. They make up 8 to 15 percent of the unit.

Permeability is very rapid in the East Lake soil. The available water capacity is very low. Surface runoff is medium.

Most areas are used as woodland. Erosion is a hazard, and the equipment limitation and seedling mortality are management concerns. Because of the erosion hazard, logging roads, skid trails, and landings should be established on gentle grades. Cross-drainage methods of water removal that are matched to specific sites are necessary. Out-sloping road surfaces, open-top drains, and culverts are needed. The use of equipment is restricted by the slope. Ordinary crawler tractors and rubber-tired skidders cannot be operated safely on the very steep side slopes. Special logging methods, such as cable yarding, may be needed. In heavily traveled areas, loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized.

Because of dry weather conditions, the loss of planted or natural tree seedlings can be as high as 25 to 50 percent. Special planting stock, such as containerized seedlings, and special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. Furrowing before planting also reduces the seedling mortality rate.

This soil is poorly suited to recreational development. The slope and the sandy surface layer are limitations. The slope can prohibit the construction of campsites and playgrounds or can significantly increase construction costs. A layer of loamy material is needed on playgrounds and in camping areas, and a cover of wood chips or bark is needed on paths and trails.

This soil is unsuited to building site development and septic tank absorption fields. The slope and the instability of cutbanks are limitations on building sites. The slope and a poor filtering capacity are limitations on sites for septic tank absorption fields. Soils that are better suited to these uses generally are nearby.

The land capability subclass is VIIs. The woodland ordination symbol is 2R. The Michigan soil management group is 5a.

17B—Wallace sand, 0 to 6 percent slopes. This deep, nearly level and undulating, well drained soil is on knolls and ridges and in swales on uplands. Individual areas are irregularly shaped and range from 3 to more than 70 acres in size.

Typically, the surface layer is mixed black and pinkish gray sand about 2 inches thick. The subsurface layer is pinkish gray sand about 9 inches thick. The subsoil is sand about 22 inches thick. The upper part is dark brown and black and is firm and extremely firm, and the lower part is yellowish brown and very pale brown and is friable. The substratum to a depth of about 60 inches is brownish yellow sand. In places the subsoil is friable.

Included with this soil in mapping are small areas of the well drained Rousseau and excessively drained Rubicon soils. These soils do not have a firm subsoil. Rousseau soils are dominantly fine sand. Both of the included soils are in landscape positions similar to those of the Wallace soil. They make up 10 to 15 percent of the unit.

Permeability is moderately slow in the upper part of the Wallace soil and rapid in the lower part. The available water capacity is low. Surface runoff is very slow.

Most areas are used as woodland. Windthrow is a hazard, and the equipment limitation and seedling mortality are management concerns. Because of a cemented pan in the subsoil, the trees are shallow rooted. Some may be blown down during periods of high wind. Windthrow losses can be minimized by cutting systems that do not isolate the remaining trees or allow them to funnel the wind. In heavily traveled areas, loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized.

Because of dry weather conditions, the loss of planted or natural tree seedlings may be as high as 25 to 50 percent. Special planting stock, such as containerized seedlings, and special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. Furrowing before planting also reduces the seedling mortality rate.

This soil is poorly suited to most recreational development. The sandy surface layer is a limitation. Adding a layer of loamy material to the surface and seeding deep-rooted grasses and legumes can help to overcome this limitation. Some land shaping and leveling may be needed on sites for playgrounds.

This soil is moderately well suited to building site development but is poorly suited to septic tank absorption fields. The instability of cutbanks and the cemented pan are limitations. The sides of shallow excavations should be reinforced. The soil readily absorbs the effluent in septic tank absorption fields, but it does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability subclass is VIs. The woodland ordination symbol is 6D. The Michigan soil management group is 5a-h.

17D—Wallace sand, 6 to 18 percent slopes. This deep, gently rolling and rolling, well drained soil is on knolls, ridges, and side slopes in the uplands. Individual areas are irregularly shaped and range from 3 to more than 100 acres in size.

Typically, the surface layer is mixed black and pinkish gray sand about 2 inches thick. The subsurface layer is pinkish gray sand about 9 inches thick. The subsoil is sand about 22 inches thick. The upper part is dark brown and black and is firm and extremely firm, and the lower part is yellowish brown and very pale brown and is friable. The substratum to a depth of about 60 inches is brownish yellow sand. In places the subsoil is friable.

Included with this soil in mapping are small areas of the well drained Rousseau and excessively drained Rubicon soils. These soils do not have a firm subsoil. Rousseau soils are dominantly fine sand. Both of the included soils are in landscape positions similar to those of the Wallace soil. They make up 10 to 20 percent of the unit.

Permeability is moderately slow in the upper part of the Wallace soil and rapid in the lower part. The available water capacity is low. Surface runoff is medium.

Most areas are used as woodland. Windthrow is a hazard, and the equipment limitation and seedling mortality are management concerns. Because of a cemented pan in the subsoil, the trees are shallow rooted. Some may be blown down during periods of high wind. Windthrow losses can be minimized by cutting systems that do not isolate the remaining trees or allow them to funnel the wind. In heavily traveled areas, loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. Because of the slope, the number of suitable landing sites is limited. The best sites are the small, nearly level included areas, if available, or the nearly level adjacent areas.

Because of dry weather conditions, the loss of planted or natural tree seedlings may be as high as 25 to 50 percent. Special planting stock, such as containerized seedlings, and special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. Furrowing before planting also reduces the seedling mortality rate.

This soil is poorly suited to recreational development. The sandy surface layer, the slope, and the cemented pan are limitations. A layer of loamy material is needed on playgrounds and in camping areas, and a cover of wood chips or bark is needed on paths and trails. Some leveling and land shaping may be needed on campsites, in picnic areas, and on playgrounds.

This soil is moderately well suited to building site development but is poorly suited to septic tank absorption fields. The slope, the cemented pan, and the instability of cutbanks are limitations on building sites. Buildings should be designed so that they conform to the natural slope of the land. The sides of shallow excavations should be reinforced. The slope and a poor filtering capacity are limitations on sites for septic tank absorption fields. Land shaping and installing the distribution lines across the slope help to ensure the proper functioning of the absorption fields. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability subclass is VIIs. The woodland ordination symbol is 6D. The Michigan soil management group is 5a-h.

17E—Wallace sand, 18 to 30 percent slopes. This deep, hilly and steep, well drained soil is on hills, ridges, and side slopes in the uplands. Individual areas are irregularly shaped and range from 3 to more than 40 acres in size.

Typically, the surface layer is mixed black and pinkish gray sand about 2 inches thick. The subsurface layer is pinkish gray sand about 9 inches thick. The subsoil is sand about 22 inches thick. The upper part is dark brown and black and is firm and extremely firm, and the lower part is yellowish brown and very pale brown and is friable. The substratum to a depth of about 60 inches is brownish yellow sand. In places the subsoil is friable.

Included with this soil in mapping are small areas of the well drained Rousseau and excessively drained Rubicon soils. These soils do not have a firm subsoil. Rousseau soils are dominantly fine sand. Both of the included soils are in landscape positions similar to those of the Wallace soil. They make up 15 to 20 percent of the unit.

Permeability is moderately slow in the upper part of the Wallace soil and rapid in the lower part. The available water capacity is low. Surface runoff is medium.

Most areas are used as woodland. Erosion and windthrow are hazards, and the equipment limitation and seedling mortality are management concerns. Because of the erosion hazard, logging roads, skid trails, and landings should be established on gentle grades. Cross-drainage methods of water removal that are matched to specific sites are necessary. Out-sloping road surfaces, open-top drains, and culverts are needed. Because of a cemented pan in the subsoil, the trees are shallow rooted. Some may be blown down during periods of high wind.

Windthrow losses can be minimized by cutting systems that do not isolate the remaining trees or allow them to funnel the wind. In heavily traveled areas, loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. The use of equipment is restricted by the slope. Special care is needed in laying out roads and landings and in operating the equipment. The roads can be designed so that they conform to the natural slope of the land. The grade should be kept as low as possible. Rubber-tired and crawler tractors can be operated safely on these slopes, but caution is needed and the steeper slopes should be avoided. Because of dry weather conditions, the loss of planted or natural tree seedlings may be as high as 25 to 50 percent. Special planting stock, such as containerized seedlings, and special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. Furrowing before planting also reduces the seedling mortality rate.

This soil is poorly suited to recreational development. The sandy surface layer, the slope, and the cemented pan are limitations. The slope can prohibit the construction of campsites and playgrounds or can significantly increase construction costs. A layer of loamy material is needed on playgrounds and in camping areas, and a cover of wood chips or bark is needed on paths and trails.

This soil is poorly suited to building site development and septic tank absorption fields. The slope, the cemented pan, and the instability of cutbanks are limitations on building sites. Buildings should be designed so that they conform to the natural slope of the land. The sides of shallow excavations should be reinforced. The slope and a poor filtering capacity are limitations on sites for septic tank absorption fields. Land shaping and installing the distribution lines across the slope help to ensure the proper functioning of the absorption fields. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability subclass is VIIs. The woodland ordination symbol is 6R. The Michigan soil management group is 5a-h.

18B—Blue Lake loamy sand, 0 to 6 percent slopes. This deep, nearly level and undulating, well drained soil is on knolls, ridges, and broad plains in the uplands. Individual areas are irregularly shaped and range from 3 to more than 300 acres in size.

Typically, the surface layer is mixed black and light brownish gray loamy sand about 2 inches thick. The subsurface layer is brownish gray loamy sand about 6 inches thick. The subsoil extends to a depth of about 80 inches. The upper part is dark brown, reddish brown, and strong brown, friable and very friable loamy sand. The next part is pale brown and dark brown, friable loamy sand. The lower part is banded light yellowish brown, very friable sand and reddish brown loamy sand. The total thickness of the bands of loamy sand is more than 8 inches. In some places the soil has a substratum of sand or loamy sand. In other places the total thickness of the bands of loamy sand is less than 6 inches. In some areas the upper part of the subsoil is less red.

Included with this soil in mapping are small areas of the well drained Cheboygan and excessively drained Rubicon soils. Cheboygan soils have more clay in the subsoil and substratum than the Blue Lake soil, and Rubicon soils have less clay. Both of the included soils are in landscape positions similar to those of the Blue Lake soil. They make up 5 to 10 percent of the unit.

Permeability is rapid in the Blue Lake soil. The available water capacity is low. Surface runoff is very slow.

Such crops as small grains, grasses, and legumes can be grown on this soil. Conserving moisture during dry periods, controlling soil blowing, and maintaining or increasing the organic matter content are management concerns. A system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface and additions of organic material to the soil increase the available water capacity. If water of sufficient quantity and quality is available, irrigation can help to overcome the low available water capacity. Cover crops, buffer strips, field windbreaks, and conservation tillage help to control soil blowing.

The main concern in managing pastured areas is conserving moisture during dry periods. Maintaining an adequate ground cover by rotation grazing or strip grazing reduces the susceptibility to erosion and helps to keep the pasture in good condition.

Most areas are used as woodland. Plant competition is the major management concern. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is suited to most recreational development. The sandy surface layer is a limitation. Adding a layer of loamy material to the surface and seeding deep-rooted grasses and legumes can help to overcome this limitation.

This soil is moderately well suited to building site development but is poorly suited to septic tank absorption fields. The instability of cutbanks is a limitation on building sites. The sides of shallow excavations should be reinforced. A poor filtering capacity is a limitation on sites for septic tank absorption fields. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability subclass is IIIs. The woodland ordination symbol is 3A. The Michigan soil management group is 4a.

18C—Blue Lake loamy sand, 6 to 12 percent slopes. This deep, gently rolling, well drained soil is on knolls, ridges, and side slopes in the uplands. Individual areas are irregularly shaped and range from 3 to more than 100 acres in size.

Typically, the surface layer is mixed black and light brownish gray loamy sand about 2 inches thick. The subsurface layer is brownish gray loamy sand about 6 inches thick. The subsoil extends to a depth of about 80 inches. The upper part is dark brown, reddish brown, and strong brown, friable and very friable loamy sand. The next part is pale brown and dark brown, friable loamy sand. The lower part is banded light yellowish brown, very friable sand and reddish brown loamy sand. The total thickness of the bands of loamy sand is more than 8 inches. In some places the soil has a substratum of sand or loamy sand. In other places the total thickness of the bands of loamy sand is less than 6 inches. In some areas the upper part of the subsoil is less red.

Included with this soil in mapping are small areas of the well drained Cheboygan and excessively drained Rubicon soils. Cheboygan soils have more clay in the subsoil and substratum than the Blue Lake soil, and Rubicon soils have less clay. Both of the included soils are in landscape positions similar to those of the Blue Lake soil. They make up 8 to 15 percent of the unit.

Permeability is rapid in the Blue Lake soil. The available water capacity is low. Surface runoff is slow.

This soil is suited to such crops as corn, oats, alfalfa, and mixed grasses and legumes. Water erosion and soil blowing are hazards, and maintaining the organic matter content and conserving moisture during dry periods are management concerns. A cropping system that includes close-growing crops and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface reduce the hazard of water erosion by increasing the rate of water infiltration. Growing grasses and legumes for pasture or hay also is effective in controlling erosion. Grassed waterways, diversions, and drop structures help to prevent gullying. Conservation tillage, cover crops, buffer strips, field windbreaks, and rough tillage and ridging at an angle to the prevailing wind help to control soil blowing, maintain the content of organic matter, and increase the available water capacity. If water of sufficient quantity and quality is available, irrigation can help to overcome the low available water capacity.

Most areas are used as woodland. The equipment limitation on sites for landings and plant competition are management concerns. Landings can be established in small, nearly level included or adjacent areas. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

If this soil is used for recreational purposes, the sandy surface layer and the slope are limitations. A layer of loamy material is needed on playgrounds and in camping areas, and a cover of wood chips or bark is needed on paths and trails. Some land shaping and leveling may be needed on campsites, in picnic areas, and on playgrounds.

This soil is moderately well suited to building site development but is poorly suited to septic tank absorption fields. The slope and the instability of cutbanks are limitations on building sites. Buildings should be designed so that they conform to the natural slope of the land. The sides of shallow excavations should be reinforced. The slope and a poor filtering capacity are limitations on sites for septic tank absorption fields. Land shaping and installing the distribution lines across the slope help to ensure the proper functioning of the absorption fields. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability subclass is IIIe. The woodland ordination symbol is 3A. The Michigan soil management group is 4a.

18D—Blue Lake loamy sand, 12 to 30 percent slopes. This deep, rolling to steep, well drained soil is on hills, ridges, and side slopes in the uplands. Individual areas are irregularly shaped and range from 3 to more than 100 acres in size.

Typically, the surface layer is mixed black and light brownish gray loamy sand about 2 inches thick. The subsurface layer is brownish gray loamy sand about 6 inches thick. The subsoil extends to a depth of about 80 inches. The upper part is dark brown, reddish brown, and strong brown, friable and very friable loamy sand. The next part is pale brown and dark brown, friable loamy sand. The lower part is banded light yellowish brown, very friable sand and reddish brown loamy sand. The total thickness of the bands of loamy sand is more than 8 inches. In some places the soil has a substratum of sand or loamy sand. In other places the total thickness of the bands of loamy sand is less than 6 inches. In some areas the upper part of the subsoil is less red.

Included with this soil in mapping are small areas of the well drained Cheboygan soils. These soils are in landscape positions similar to those of the Blue Lake soil. Also, they have more clay in the subsoil and substratum. They make up 10 to 15 percent of the unit.

Permeability is rapid in the Blue Lake soil. The available water capacity is low. Surface runoff is medium.

Most areas are used as woodland. Erosion is a hazard, and the equipment limitation and plant competition are management concerns. Because of the erosion hazard, logging roads, skid trails, and landings should be established on gentle grades. Cross-drainage methods of water removal that are matched to specific sites are necessary. Out-sloping road surfaces, open-top drains, and culverts are needed. The use of equipment is restricted by the slope. Special care is needed in laying out roads and landings and in operating the equipment. The roads can be designed so that they conform to the natural slope of the land. The grade should be kept as low as possible. In heavily traveled areas, loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. Rubber-tired and crawler tractors can be operated safely on these slopes, but caution is needed and the steeper slopes should be avoided. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is poorly suited to recreational development. The sandy surface layer and the slope are limitations. The slope can prohibit the construction of campsites and playgrounds or can significantly increase construction costs. A layer of loamy material is needed on playgrounds and in camping areas, and a cover of wood chips or bark is needed on paths and trails.

This soil is poorly suited to building site development and septic tank absorption fields. The slope and the instability of cutbanks are limitations on building sites. Buildings should be designed so that they conform to the natural slope of the land. The sides of shallow excavations should be reinforced. The slope and a poor filtering capacity are limitations on sites for septic tank absorption fields. Land shaping and installing the distribution lines across the slope help to ensure the proper functioning of the absorption fields. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability subclass is VIe. The woodland ordination symbol is 3R. The Michigan soil management group is 4a.

18F—Blue Lake loamy sand, 30 to 50 percent slopes. This deep, steep and very steep, well drained soil is on hills and ridges and in deeply incised drainageways in the uplands. Individual areas are irregularly shaped and range from 3 to more than 100 acres in size.

Typically, the surface layer is mixed black and light brownish gray loamy sand about 2 inches thick. The subsurface layer is brownish gray loamy sand about 6 inches thick. The subsoil extends to a depth of about 80 inches. The upper part is dark brown, reddish brown, and strong brown, friable and very friable loamy sand. The next part is pale brown and dark brown, friable loamy sand. The lower part is banded light yellowish brown, very friable sand and reddish brown loamy sand. The total thickness of the bands of loamy sand is more than 8 inches. In some places the soil has a substratum of sand or loamy sand. In other places the total thickness of the bands of loamy sand is less than 6 inches. In some areas the upper part of the subsoil is less red.

Included with this soil in mapping are small areas of the well drained Cheboygan soils. These soils are in landscape positions similar to those of the Blue Lake soil. Also, they have more clay in the subsoil and substratum. They make up 10 to 15 percent of the unit.

Permeability is rapid in the Blue Lake soil. The available water capacity is low. Surface runoff is medium.

Most areas are used as woodland. Erosion is a hazard, and the equipment limitation and plant competition are management concerns. Because of the erosion hazard, logging roads, skid trails, and landings should be established on gentle grades. Cross-drainage methods of water removal that are matched to specific sites are necessary. Out-sloping road surfaces, open-top drains, and culverts are needed. The use of equipment is restricted by the slope. Ordinary crawler tractors and rubber-tired skidders cannot be operated safely on the very steep side slopes. Special logging methods, such as cable yarding, may be needed. In heavily traveled areas, loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is poorly suited to recreational development. The sandy surface layer and the slope are limitations. The slope can prohibit the construction of campsites and playgrounds or can significantly increase construction costs. A layer of loamy material is needed on playgrounds and in camping areas, and a cover of wood chips or bark is needed on paths and trails.

This soil is unsuited to building site development and septic tank absorption fields. The slope and the instability of cutbanks are limitations on building sites. The slope and a poor filtering capacity are limitations on sites for septic tank absorption fields.

The land capability subclass is VIIe. The woodland ordination symbol is 3R. The Michigan soil management group is 4a.

20B—Mancelona sand, 0 to 6 percent slopes. This deep, nearly level and undulating, somewhat excessively drained soil is on knolls, ridges, and broad plains in the uplands. Individual areas are irregularly shaped and range from 3 to more than 200 acres in size.

Typically, about 1 inch of black, well decomposed forest litter is at the surface. The subsurface layer is dark brown sand about 7 inches thick. The subsoil is about 24 inches thick. It is dark brown, very friable and friable loamy sand in the upper part and dark brown, friable sandy loam in the lower part. The substratum to a depth of about 60 inches is light yellowish brown, calcareous very gravelly coarse sand. In places the subsoil is redder.

Included with this soil in mapping are small areas of the well drained Nadeau and excessively drained Rubicon soils. Nadeau soils are on gravel beaches and water-reworked eskers. They have more gravel in the surface layer and subsoil than the Mancelona soil. Rubicon soils are in landscape positions similar to those of the Mancelona soil. Also, they have less gravel in the substratum. Included soils make up 5 to 8 percent of the unit.

Permeability is moderately rapid in the upper part of the Mancelona soil and very rapid in the lower part. The available water capacity is low. Surface runoff is slow.

Such crops as corn, oats, alfalfa, and mixed grasses and legumes can be grown on this soil. Conserving moisture during dry periods, controlling soil blowing, and maintaining or increasing the organic matter content are management concerns. A system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface and additions of organic material to the soil increase the available water capacity. If water of sufficient quantity and quality is available, irrigation can help to overcome the low available water capacity. Cover crops, buffer strips, field windbreaks, and conservation tillage help to control soil blowing.

The main concern in managing pastured areas is conserving moisture during dry periods. Maintaining an adequate ground cover by rotation grazing or strip grazing reduces the susceptibility to erosion and helps to keep the pasture in good condition.

Most areas are used as woodland. The equipment limitation, seedling mortality, and plant competition are management concerns. In heavily traveled areas, loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. Because of dry weather conditions, the loss of planted or natural tree seedlings can be as high as 25 to 50 percent. Special planting stock, such as containerized seedlings, and special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. Furrowing before planting also reduces the seedling mortality rate. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is unsuited to most recreational development. The sandy surface layer is a limitation. Adding a layer of loamy material to the surface and seeding deep-rooted grasses and legumes can help to overcome this limitation. Some land shaping and leveling may be needed on sites for playgrounds.

This soil is well suited to building site development but is poorly suited to septic tank absorption fields. The instability of cutbanks is a limitation on building sites. The sides of shallow excavations should be reinforced. A poor filtering capacity is a limitation on sites for septic tank absorption fields. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability subclass is IIIs. The woodland ordination symbol is 3S. The Michigan soil management group is 4a.

20C—Mancelona sand, 6 to 12 percent slopes. This deep, gently rolling, somewhat excessively drained soil is on knolls, ridges, and side slopes in the uplands. Individual areas are irregularly shaped and range from 3 to more than 100 acres in size.

Typically, about 1 inch of black, well decomposed forest litter is at the surface. The subsurface layer is dark brown sand about 7 inches thick. The subsoil is about 24 inches thick. It is dark brown, very friable and friable loamy sand in the upper part and dark brown, friable sandy loam in the lower part. The substratum to a depth of about 60 inches is light yellowish brown, calcareous very gravelly coarse sand. In places the subsoil is redder.

Included with this soil in mapping are small areas of the well drained Nadeau and excessively drained Rubicon soils. Nadeau soils are on gravel beaches and water-reworked eskers. They have more gravel in the surface and subsoil than the Mancelona soil. Rubicon soils are in landscape positions similar to those of the Mancelona soil. Also, they have less gravel in the substratum. Included soils make up 8 to 10 percent of the unit.

Permeability is moderately rapid in the upper part of the Mancelona soil and very rapid in the lower part. The available water capacity is low. Surface runoff is slow.

This soil is fairly suited to such crops as small grains and grasses and legumes. Water erosion and soil blowing are hazards, and maintaining the organic matter content and conserving moisture during dry periods are management concerns. A cropping system that includes close-growing crops and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface reduce the hazard of water erosion by increasing the rate of water infiltration. Growing grasses and legumes for pasture or hay also is effective in controlling erosion. Grassed waterways, diversions, and drop structures help to prevent gullying. Conservation tillage, cover crops, buffer strips, field windbreaks, and rough tillage and ridging at an angle to the prevailing wind help to control soil blowing, maintain the organic matter content, and increase the available water capacity. If water of sufficient quantity and quality is available, irrigation can help to overcome the low available water capacity.

The main concern in managing pastured areas is conserving moisture during dry periods. Maintaining an adequate ground cover by rotation grazing or strip grazing reduces the susceptibility to erosion and helps to keep the pasture in good condition.

Most areas are used as woodland. The equipment limitation, seedling mortality, and plant competition are management concerns. In heavily traveled areas, loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. Landings can be established in the small, nearly level included areas, if available, or in the nearly level adjacent areas. Because of dry weather conditions, the loss of planted or natural tree seedlings can be as high as 25 to 50 percent. Special planting stock, such as containerized seedlings, and special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. Furrowing before planting also reduces the seedling mortality rate. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is poorly suited to recreational development. The sandy surface layer and the slope are limitations. A layer of loamy material is needed on playgrounds and in camping areas, and a cover of wood chips or bark is needed on paths and trails. Some land shaping and leveling may be needed to overcome the slope on campsites, in picnic areas, and on playgrounds.

This soil is moderately well suited to building site development but is poorly suited to septic tank absorption fields. The slope and the instability of cutbanks are limitations on building sites. Buildings should be designed so that they conform to the natural slope of the land. The sides of shallow excavations should be reinforced. The slope and a poor filtering capacity are limitations on sites for septic tank absorption fields. Land shaping and installing the distribution lines across the slope help to ensure the proper functioning of the absorption fields. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability subclass is IIIe. The woodland ordination symbol is 3S. The Michigan soil management group is 4a.

20D—Mancelona sand, 12 to 30 percent slopes. This deep, rolling to steep, excessively drained soil is on high knolls, hills, ridges, and side slopes in the uplands. Individual areas are irregularly shaped and range from 3 to more than 80 acres in size.

Typically, about 1 inch of black, well decomposed forest litter is at the surface. The subsurface layer is dark brown sand about 7 inches thick. The subsoil is about 24 inches thick. It is dark brown, very friable and friable loamy sand in the upper part and dark brown, friable sandy loam in the lower part. The substratum to a depth of about 60 inches is light yellowish brown, calcareous very gravelly coarse sand. In places the subsoil is redder.

Included with this soil in mapping are small areas of the excessively drained Rubicon soils. These soils are in landscape positions similar to those of the Mancelona soil. Also, they have less gravel in the substratum. They make up 8 to 15 percent of the unit.

Permeability is moderately rapid in the upper part of the Mancelona soil and very rapid in the lower part. The available water capacity is low. Surface runoff is medium.

Most areas are used as woodland. Erosion is a hazard, and the equipment limitation, seedling mortality, and plant competition are management concerns. Because of the erosion hazard, logging roads, skid trails, and landings should be established on gentle grades. Cross-drainage methods of water removal that are matched to specific sites are necessary. Out-sloping road surfaces, open-top drains, and culverts are needed. The use of equipment is restricted by the slope. Special care is needed in laying out roads and landings and in operating the equipment. The roads can be designed so that they conform to the natural slope of the land. The grade should be kept as low as possible. In heavily traveled areas, loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. Rubber-tired and crawler tractors can be operated safely on these slopes, but caution is needed and the steeper slopes should be avoided.

Because of dry weather conditions, the loss of planted or natural tree seedlings can be as high as 25 to 50 percent. Special planting stock, such as containerized seedlings, and special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. Furrowing before planting also reduces the seedling mortality rate. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is poorly suited to recreational development. The slope and the sandy surface layer are limitations.

The slope can prohibit the construction of campsites and playgrounds or can significantly increase construction costs. A layer of loamy material is needed on playgrounds and in camping areas, and a cover of wood chips or bark is needed on paths and trails.

This soil is poorly suited to building site development and septic tank absorption fields. The slope and the instability of cutbanks are limitations on building sites. Buildings should be designed so that they conform to the natural slope of the land. The sides of shallow excavations should be reinforced. The slope and a poor filtering capacity are limitations on sites for septic tank absorption fields. Land shaping and installing the distribution lines across the slope help to ensure the proper functioning of the absorption fields. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability subclass is VIe. The woodland ordination symbol is 3R. The Michigan soil management group is 4a.

20F—Mancelona sand, 30 to 50 percent slopes. This deep, very steep, excessively drained soil is on hills, ridges, and side slopes in the uplands. Individual areas are irregularly shaped and range from 3 to more than 100 acres in size.

Typically, about 1 inch of black, well decomposed forest litter is at the surface. The subsurface layer is dark brown sand about 7 inches thick. The subsoil is about 24 inches thick. It is dark brown, very friable and friable loamy sand in the upper part and dark brown, friable sandy loam in the lower part. The substratum to a depth of about 60 inches is light yellowish brown, calcareous very gravelly coarse sand. In places the subsoil is redder.

Included with this soil in mapping are small areas of the excessively drained Rubicon soils. These soils are in landscape positions similar to those of the Mancelona soil. Also, they have less gravel in the substratum. They make up 10 to 15 percent of the unit.

Permeability is moderately rapid in the upper part of the Mancelona soil and very rapid in the lower part. The available water capacity is low. Surface runoff is rapid.

Most areas are used as woodland. Erosion is a hazard, and the equipment limitation, seedling mortality, and plant competition are management concerns. Because of the erosion hazard, logging roads, skid trails, and landings should be established on gentle grades. Cross-drainage methods of water removal that are matched to specific sites are necessary. Out-sloping road surfaces, open-top drains, and culverts are needed. The use of equipment is restricted by the slope. Ordinary crawler tractors and rubber-tired skidders cannot be operated safely on the very steep side slopes. Special logging methods, such as cable yarding, may be needed. In heavily traveled areas, loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized.

Because of dry weather conditions, the loss of planted or natural tree seedlings can be as high as 25 to 50 percent. Special planting stock, such as containerized seedlings, and special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. Furrowing before planting also reduces the seedling mortality rate. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is poorly suited to recreational development. The slope and the sandy surface layer are limitations. The slope can prohibit the construction of campsites and playgrounds or can significantly increase construction costs. A layer of loamy material is needed on playgrounds and in camping areas, and a cover of wood chips or bark is needed on paths and trails.

This soil is unsuited to building site development and septic tank absorption fields. The slope and the instability of cutbanks are limitations on building sites. The slope and a poor filtering capacity are limitations on sites for septic tank absorption fields.

The land capability subclass is VIIe. The woodland ordination symbol is 3R. The Michigan soil management group is 4a.

21B—Zimmerman fine sand, 0 to 8 percent slopes. This deep, nearly level and undulating, excessively drained soil is on broad plains and low knolls in the uplands. Individual areas are irregularly shaped and range from 3 to more than 1,200 acres in size.

Typically, the surface layer is mixed black and grayish brown loamy fine sand about 2 inches thick. The subsurface layer is grayish brown fine sand about 2 inches thick. The subsoil to a depth of about 60 inches is friable. The upper part is dark yellowish brown and brownish yellow fine sand, and the lower part is very pale brown fine sand that has textural bands of dark brown loamy fine sand and fine sandy loam 1/16 to 1/4 inch thick. In places the surface layer is sand.

Included with this soil in mapping are small areas of the excessively drained Grayling and Rubicon, banded substratum, soils. Grayling soils are dominantly sand without textural bands in the subsoil. Rubicon, banded substratum, soils have a redder subsoil than the Zimmerman soil and are dominantly sand. Both of the included soils are in landscape positions similar to those of the Zimmerman soil. They make up 8 to 15 percent of the unit.

Permeability is rapid in the Zimmerman soil. The available water capacity is moderate. Surface runoff is very slow.

Most areas are used as woodland. The equipment limitation and seedling mortality are management concerns. In heavily traveled areas, loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. Because of dry weather conditions, the loss of planted or natural tree seedlings can be as high as 25 to 50 percent. Special planting stock, such as containerized seedlings, and special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. Furrowing before planting also reduces the seedling mortality rate.

This soil is poorly suited to most recreational development. The sandy surface layer is a limitation. Adding a layer of loamy material to the surface and seeding deep-rooted grasses and legumes can help to overcome this limitation. Some land shaping and leveling may be needed on sites for playgrounds.

This soil is well suited to building site development but is poorly suited to septic tank absorption fields. The instability of cutbanks is a limitation on building sites. The sides of shallow excavations should be reinforced. A poor filtering capacity is a limitation on sites for septic tank absorption fields. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability subclass is IVs. The woodland ordination symbol is 8S. The Michigan soil management group is 5a.

22B—Leelanau loamy sand, 0 to 6 percent slopes. This deep, nearly level and undulating, well drained soil is on knolls, ridges, and broad plains in the uplands. Individual areas are irregularly shaped and range from 5 to more than 100 acres in size.

Typically, the surface layer is mixed black and light gray loamy sand about 3 inches thick. The subsurface layer is grayish brown loamy sand about 3 inches thick. The subsoil is about 36 inches thick. The upper part is dark brown, friable loamy sand; the next part is pale brown and strong brown, friable loamy sand and sandy loam; and the lower part is strong brown, friable sandy loam. The substratum to a depth of about 60 inches is light brown, calcareous loamy sand. In places the subsoil is not so dark.

Included with this soil in mapping are small areas of the somewhat excessively drained Kalkaska soils. These soils have less clay in the subsoil than the Leelanau soil and do not have a calcareous substratum. Also, they are in similar landscape positions. They make up 8 to 15 percent of the unit.

Permeability is rapid in the Leelanau soil. The available water capacity is moderate. Surface runoff is very slow.

This soil is fairly well suited to such crops as small grains and grasses and legumes. Conserving moisture during dry periods, controlling soil blowing, and maintaining or increasing the organic matter content are management concerns. A system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface and additions of organic material to the soil increase the available water capacity. If water of sufficient quantity and quality is available, irrigation can help to overcome the low available water capacity. Cover crops, buffer strips, field windbreaks, and conservation tillage help to control soil blowing.

The main concern in managing pastured areas is conserving moisture during dry periods. Maintaining an adequate ground cover by rotation grazing or strip grazing reduces the susceptibility to erosion and helps to keep the pasture in good condition.

Most areas are used as woodland. Plant competition is the major management concern. After the overstory has been removed, plant competition can be controlled by specially designed cutting systems and proper site preparation.

This soil is poorly suited to most recreational development. The sandy surface layer is a limitation. Adding a layer of loamy material to the surface and seeding deep-rooted grasses and legumes can help to overcome this limitation. Some land shaping and leveling may be needed on sites for playgrounds.

This soil is moderately well suited to building site development but is poorly suited to septic tank absorption fields. The instability of cutbanks is a limitation on building sites. The sides of shallow excavations should be reinforced. A poor filtering capacity is a limitation on sites for septic tank absorption fields. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability subclass is IIIs. The woodland ordination symbol is 3A. The Michigan soil management group is 4a.

22C—Leelanau loamy sand, 6 to 12 percent slopes. This deep, gently rolling, well drained soil is on knolls and ridges in the uplands. Individual areas are irregularly shaped and range from 5 to more than 100 acres in size.

Typically, the surface layer is mixed black and light gray loamy sand about 3 inches thick. The subsurface layer is grayish brown loamy sand about 3 inches thick. The subsoil is about 36 inches thick. The upper part is dark brown, friable loamy sand; the next part is pale brown and strong brown, friable loamy sand and sandy loam; and the lower part is strong brown, friable sandy loam. The substratum to a depth of about 60 inches is light brown, calcareous loamy sand. In places the subsoil is not so dark.

Included with this soil in mapping are small areas of the somewhat excessively drained Kalkaska soils. These soils have less clay in the subsoil than the Leelanau soil and do not have a calcareous substratum. Also, they are in similar landscape positions. They make up 10 to 15 percent of the unit.

Permeability is rapid in the Leelanau soil. The available water capacity is moderate. Surface runoff is slow.

This soil is fairly well suited to such crops as small grains and grasses and legumes. Water erosion and soil blowing are hazards, and maintaining the organic matter content and conserving moisture during dry periods are management concerns. A cropping system that includes close-growing crops and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface reduce the hazard of water erosion by increasing the rate of water infiltration. Growing grasses and legumes for hay or pasture also is effective in controlling erosion. Grassed waterways, diversions, and drop structures help to prevent gullying. Conservation tillage, cover crops, buffer strips, field windbreaks, and rough tillage and ridging at an angle to the prevailing wind help to control soil blowing and maintain the content of organic matter. These practices also increase the available water capacity. If water of sufficient quantity and quality is available, irrigation can help to overcome the low available water capacity.

Most areas are used as woodland. The equipment limitation on sites for landings and plant competition are management concerns. Landings can be established in the small, nearly level included areas, if available, or in the level adjacent areas. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is poorly suited to most recreational development. The sandy surface layer and the slope are limitations. Adding a layer of loamy material to the surface and seeding deep-rooted grasses and legumes can help to compensate for the sandy surface layer. Some land shaping and leveling may be needed to overcome the slope on campsites, in picnic areas, and on playgrounds.

This soil is moderately well suited to building site development but is poorly suited to septic tank absorption fields. The slope and the instability of cutbanks are limitations on building sites. Buildings should be designed so that they conform to the natural slope of the land. The sides of shallow excavations should be reinforced. The slope and a poor filtering capacity are limitations on sites for septic tank absorption fields. Land shaping and installing the distribution lines across the slope help to ensure the proper functioning of the absorption fields. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability subclass is IIIe. The woodland ordination symbol is 3A. The Michigan soil management group is 4a.

22D—Leelanau loamy sand, 12 to 30 percent slopes. This deep, rolling to steep, well drained soil is on knolls, ridges, and side slopes in the uplands. Individual areas are irregularly shaped and range from 5 to more than 100 acres in size.

Typically, the surface layer is mixed black and light gray loamy sand about 3 inches thick. The subsurface layer is grayish brown loamy sand about 3 inches thick. The subsoil is about 36 inches thick. The upper part is dark brown, friable loamy sand; the next part is pale brown and strong brown, friable loamy sand and sandy loam; and the lower part is strong brown, friable sandy loam. The substratum to a depth of about 60 inches is light brown, calcareous loamy sand. In places the subsoil is not so dark.

Included with this soil in mapping are small areas of the somewhat excessively drained Kalkaska soils. These soils have less clay in the subsoil than the Leelanau soil and do not have a calcareous substratum. Also, they are in similar landscape positions. They make up 10 to 15 percent of the unit.

Permeability is rapid in the Leelanau soil. The available water capacity is moderate. Surface runoff is medium.

Most areas are used as woodland. Erosion is a hazard, and the equipment limitation and plant competition are management concerns. Because of the erosion hazard, logging roads, skid trails, and landings should be established on gentle grades. Cross-drainage methods of water removal that are matched to specific sites are necessary. Out-sloping road surfaces, open-top drains, and culverts are needed. The use of equipment is restricted by the slope. Special care is needed in laying out roads and landings and in operating the equipment. The roads can be designed so that they conform to the natural slope of the land. The grade should be kept as low as possible. In heavily traveled areas, loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. Rubber-tired and crawler tractors can be operated safely on these slopes, but caution is needed and the steeper slopes should be avoided. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is poorly suited to recreational development. The slope and the sandy surface layer are limitations. The slope can prohibit the construction of campsites and playgrounds or can significantly increase construction costs. A layer of loamy material is needed on playgrounds and in camping areas, and a cover of wood chips or bark is needed on paths and trails.

This soil is poorly suited to building site development and septic tank absorption fields. The slope and the instability of cutbanks are limitations on building sites. Buildings should be designed so that they conform to the natural slope of the land. The sides of shallow excavations should be reinforced. The slope and a poor filtering capacity are limitations on sites for septic tank absorption fields. Land shaping and installing the distribution lines across the slope help to ensure the proper functioning of the absorption fields. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability subclass is VIe. The woodland ordination symbol is 3R. The Michigan soil management group is 4a.

24B—Ocqueoc fine sand, 0 to 6 percent slopes. This deep, nearly level and undulating, well drained soil is on low knolls and ridges in the uplands and on broad plains. Individual areas are irregularly shaped and range from 3 to more than 100 acres in size.

Typically, the surface layer is dark brown fine sand about 8 inches thick. The subsoil is about 18 inches thick. It is dark reddish brown, very friable fine sand in the upper part; strong brown and yellowish brown, very friable fine sand in the next part; and light yellowish brown, very friable very fine sand in the lower part. The substratum to a depth of about 60 inches is stratified. It is pink very fine sand and silt in the upper part and light brown very fine sand, silt, very fine sandy loam, and loamy very fine sand in the lower part. In places depth to the substratum is less than 20 inches.

Included with this soil in mapping are small areas of the well drained Alcona and Rousseau soils. Alcona soils have more clay in the subsoil than the Ocqueoc soil. Rousseau soils do not have very fine sand and silt in the subsoil and substratum. Both of the included soils are in landscape positions similar to those of the Ocqueoc soil. They make up 8 to 15 percent of the unit.

Permeability is rapid in the sandy upper part of the Ocqueoc soil and moderately slow in the stratified lower part. The available water capacity is moderate. Surface runoff is very slow. The shrink-swell potential is moderate.

This soil is fairly well suited to such crops as small grains and grasses and legumes. Maintaining the organic matter content and controlling soil blowing are management concerns. A system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface, cover crops, additions of organic material, buffer strips, field windbreaks, and rough tillage and ridging at an angle to the prevailing wind help to control soil blowing and maintain the organic matter content.

The main concern in managing pastured areas is conserving moisture during dry periods. Maintaining an adequate ground cover by rotation grazing or strip grazing reduces the susceptibility to erosion and helps to keep the pasture in good condition.

Most areas are used as woodland. The equipment limitation, seedling mortality, and plant competition are management concerns. In heavily traveled areas, loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. Because of dry weather conditions, the loss of planted or natural tree seedlings can be as high as 25 to 50 percent. Special planting stock, such as containerized seedlings, and special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. Furrowing before planting also reduces the seedling mortality rate. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is suited to recreational development. The sandy surface layer is a limitation. Adding a layer of loamy material to the surface and seeding deep-rooted grasses and legumes can help to overcome this limitation. Some land shaping and leveling may be needed on sites for playgrounds.

This soil is moderately well suited to building site development but is poorly suited to septic tank absorption fields. The moderate shrink-swell potential and the instability of cutbanks are limitations on building sites. Widening the foundation trench and backfilling the trench with suitable coarse material can help to overcome the shrink-swell potential. The sides of shallow excavations should be reinforced. The moderately slow permeability is a limitation on sites for septic tank absorption fields. Enlarged absorption fields or alternating drain fields may be needed because of the restricted permeability.

The land capability subclass is IIIs. The woodland ordination symbol is 3S. The Michigan soil management group is 4/2a.

24C—Ocqueoc fine sand, 6 to 12 percent slopes. This deep, gently rolling, well drained soil is on knolls, ridges, and side slopes in the uplands. Individual areas are irregularly shaped and range from 3 to more than 80 acres in size.

Typically, the surface layer is dark brown fine sand about 8 inches thick. The subsoil is about 18 inches thick. It is dark reddish brown, very friable fine sand in the upper part; strong brown and yellowish brown, very friable fine sand in the next part; and light yellowish brown, very friable very fine sand in the lower part. The substratum to a depth of about 60 inches is stratified. It is pink very fine sand and silt in the upper part and light brown very fine sand, silt, very fine sandy loam, and loamy very fine sand in the lower part. In places depth to the substratum is less than 20 inches.

Included with this soil in mapping are small areas of the well drained Alcona and Rousseau soils. Alcona soils have more clay in the subsoil than the Ocqueoc soil. Rousseau soils do not have very fine sand and silt in the subsoil and substratum. Both of the included soils are in landscape positions similar to those of the Ocqueoc soil. They make up 8 to 15 percent of the unit.

Permeability is rapid in the sandy upper part of the Ocqueoc soil and moderately slow in the stratified lower part. The available water capacity is moderate. Surface runoff is slow. The shrink-swell potential is moderate.

This soil is fairly well suited to such crops as small grains and grasses and legumes. Water erosion is a hazard, and a low content of organic matter is a management concern. A cropping system that includes close-growing crops and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface reduce the hazard of water erosion by increasing the rate of water infiltration. Growing grasses and legumes for pasture or hay also is effective in controlling erosion. Grassed waterways, diversions, and drop structures help to prevent gullying. Conservation tillage and additions of organic material to the soil increase the content of organic matter.

The main concern in managing pastured areas is conserving moisture during dry periods. Maintaining an adequate ground cover by rotation grazing or strip grazing reduces the susceptibility to erosion and helps to keep the pasture in good condition.

Most areas are used as woodland. The equipment limitation, seedling mortality, and plant competition are management concerns. In heavily traveled areas, loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. Landings can be established in the small, nearly level included areas, if available, or in the nearly level adjacent areas. Because of dry weather conditions, the loss of planted or natural tree seedlings can be as high as 25 to 50 percent. Special planting stock, such as containerized seedlings, and special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. Furrowing before planting also reduces the seedling mortality rate. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is poorly suited to recreational development. The sandy surface layer and the slope are limitations. A layer of loamy material is needed on playgrounds and in camping areas, and a cover of wood chips or bark is needed on paths and trails. Some land shaping and leveling may be needed to overcome the slope on campsites, in picnic areas, and on playgrounds.

This soil is moderately well suited to building site development but is poorly suited to septic tank absorption fields. The slope and the instability of cutbanks are limitations on building sites. Widening the foundation trench and backfilling the trench with suitable coarse material can help to overcome the shrink-swell potential. The sides of shallow excavations should be reinforced. The slope and the moderately slow permeability are limitations on sites for septic tank absorption fields. Land shaping and installing the distribution lines across the slope help to ensure the proper functioning of the absorption fields. Enlarged absorption fields or alternating drain fields may be needed because of the restricted permeability.

The land capability subclass is IIIe. The woodland ordination symbol is 3S. The Michigan soil management group is 4/2a.

24D—Ocqueoc fine sand, 12 to 30 percent slopes. This deep, rolling to steep, well drained soil is on hills and ridges and in deeply incised drainageways in the uplands. Individual areas are irregularly shaped and range from 3 to more than 80 acres in size.

Typically, the surface layer is dark brown fine sand about 8 inches thick. The subsoil is about 18 inches thick. It is dark reddish brown, very friable fine sand in the upper part; strong brown and yellowish brown, very friable fine sand in the next part; and light yellowish brown, very friable very fine sand in the lower part. The substratum to a depth of about 60 inches is stratified. It is pink very fine sand and silt in the upper part and light brown very fine sand, silt, very fine sandy loam, and loamy very fine sand in the lower part. In places depth to the substratum is less than 20 inches.

Included with this soil in mapping are small areas of the well drained Alcona and Rousseau soils. Alcona soils have more clay in the subsoil than the Ocqueoc soil. Rousseau soils do not have very fine sand and silt in the subsoil and substratum. Both of the included soils are in landscape positions similar to those of the Ocqueoc soil. They make up 10 to 15 percent of the unit.

Permeability is rapid in the sandy upper part of the Ocqueoc soil and moderately slow in the stratified lower part. The available water capacity is moderate. Surface runoff is medium. The shrink-swell potential is moderate.

Most areas are used as woodland. Erosion is a hazard, and the equipment limitation, seedling mortality, and plant competition are management concerns. Because of the erosion hazard, logging roads, skid trails, and landings should be established on gentle grades. Cross-drainage methods of water removal that are matched to specific sites are necessary. Out-sloping road surfaces, open-top drains, and culverts are needed. The use of equipment is restricted by the slope. Special care is needed in laying out roads and landings and in operating the equipment. The roads can be designed so that they conform to the natural slope of the land. The grade should be kept as low as possible. In heavily traveled areas, loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. Rubber-tired and crawler tractors can be operated safely on these slopes, but caution is needed and the steeper slopes should be avoided.

Because of dry weather conditions, the loss of planted or natural tree seedlings can be as high as 25 to 50 percent. Special planting stock, such as containerized seedlings, and special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. Furrowing before planting also reduces the seedling mortality rate. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is poorly suited to recreational development. The slope and the sandy surface layer are limitations. The slope can prohibit the construction of campsites and playgrounds or can significantly increase construction costs. A layer of loamy material is needed on playgrounds and in camping areas, and a cover of wood chips or bark is needed on paths and trails.

This soil is poorly suited to building site development and septic tank absorption fields. The slope and the instability of cutbanks are limitations on building sites. Buildings should be designed so that they conform to the natural slope of the land. Land shaping may be necessary in some areas. The sides of shallow excavations should be reinforced. The slope and the moderately slow permeability are limitations on sites for septic tank absorption fields. Land shaping and installing the distribution lines across the slope help to ensure the proper functioning of the absorption fields. Enlarged absorption fields or alternating drain fields may be needed because of the restricted permeability.

The land capability subclass is VIe. The woodland ordination symbol is 3R. The Michigan soil management group is 4/2a.

25B—Eastport sand, 0 to 6 percent slopes. This deep, nearly level and undulating, excessively drained soil is on ridges and in swales adjacent to Lake Huron. Individual areas are irregularly shaped and range from 3 to more than 300 acres in size.

Typically, the surface layer is mixed black and light gray sand about 1 inch thick. The subsurface layer is sand about 13 inches thick. The upper part is pale brown, and the lower part is yellowish brown. The subsoil is strong brown, very friable sand about 14 inches thick. The substratum to a depth of about 60 inches is light yellowish brown, calcareous sand. In places the substratum is gravelly sand or very gravelly sand.

Included with this soil in mapping are small areas of the moderately well drained Croswell and somewhat poorly drained Au Gres soils. Croswell soils are on side slopes, and Au Gres soils are in depressions. Included soils make up 5 to 8 percent of the unit.

Permeability is very rapid in the Eastport soil. The available water capacity is very low. Surface runoff is very slow.

Most areas are used as woodland. The equipment limitation and seedling mortality are management concerns. In heavily traveled areas, loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. Because of dry weather conditions, the loss of planted or natural tree seedlings can be as high as 25 to 50 percent. Special planting stock, such as containerized seedlings, and special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. Furrowing before planting also reduces the seedling mortality rate.

This soil is suited to recreational development. The sandy surface layer is a limitation. Adding a layer of loamy material to the surface and seeding deep-rooted grasses and legumes can help to overcome this limitation. Some land shaping and leveling may be needed on sites for playgrounds.

This soil is well suited to building site development but is poorly suited to septic tank absorption fields. The instability of cutbanks is a limitation on building sites. The sides of shallow excavations should be reinforced. A poor filtering capacity is a limitation on sites for septic tank absorption fields. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability subclass is VIs. The woodland ordination symbol is 2S. The Michigan soil management group is 5.3a.

25D—Eastport sand, 12 to 25 percent slopes. This deep, rolling and hilly, excessively drained soil is on ridges and in swales adjacent to Lake Huron. Individual areas are irregularly shaped and range from 3 to more than 100 acres in size.

Typically, the surface layer is mixed black and light gray sand about 1 inch thick. The subsurface layer is sand about 13 inches thick. The upper part is pale brown, and the lower part is yellowish brown. The subsoil is strong brown, very friable sand about 14 inches thick. The substratum to a depth of about 60 inches is light yellowish brown, calcareous sand. In places the substratum is gravelly sand or very gravelly sand.

Included with this soil in mapping are small areas of the moderately well drained Croswell soils on side slopes. Included soils make up 8 to 15 percent of the unit.

Permeability is very rapid in the Eastport soil. The available water capacity is very low. Surface runoff is medium.

Most areas are used as woodland. Erosion is a hazard, and the equipment limitation and seedling mortality are management concerns. Because of the erosion hazard, logging roads, skid trails, and landings should be established on gentle grades. Cross-drainage methods of water removal that are matched to specific sites are necessary. Out-sloping road surfaces, open-top drains, and culverts are needed. The use of equipment is restricted by the slope. Special care is needed in laying out roads and landings and in operating the equipment. The roads can be designed so that they conform to the natural slope of the land. The grade should be kept as low as possible. In heavily traveled areas, loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. Rubber-tired and crawler tractors can be operated safely on these slopes, but caution is needed and the steeper slopes should be avoided.

Because of dry weather conditions, the loss of planted or natural tree seedlings can be as high as 25 to 50 percent. Special planting stock, such as containerized seedlings, and special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. Furrowing before planting also reduces the seedling mortality rate.

This soil is poorly suited to recreational development. The sandy surface layer and the slope are limitations. The slope can prohibit the construction of campsites and playgrounds or can significantly increase construction costs. A layer of loamy material is needed on playgrounds and in camping areas.

This soil is poorly suited to building site development and septic tank absorption fields. The slope and the instability of cutbanks are limitations on building sites. Buildings should be designed so that they conform to the natural slope of the land. The sides of shallow excavations should be reinforced. The slope and a poor filtering capacity are limitations on sites for septic tank absorption fields. Land shaping and installing the distribution lines across the slope help to ensure the proper functioning of the absorption fields. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability subclass is VIIs. The woodland ordination symbol is 2R. The Michigan soil management group is 5.3a.

26B—Rubicon sand, dark subsoil, 0 to 6 percent slopes. This deep, nearly level and undulating, somewhat excessively drained soil is on broad plains and low knolls in the uplands. Individual areas are irregularly shaped and range from 10 to more than 500 acres in size.

Typically, the surface is covered with a mat of decomposed leaf litter about 2 inches thick. The subsurface layer is brown sand about 8 inches thick. The subsoil is sand about 18 inches thick. The upper part is dark brown and friable, and the lower part is dark yellowish brown and loose. The substratum to a depth of about 60 inches is brownish yellow sand. In places the subsoil is not so dark.

Included with this soil in mapping are small areas of the well drained Blue Lake and moderately well drained Croswell soils. Blue Lake soils have loamy strata in the subsoil and substratum. They are in landscape positions similar to those of the Rubicon soil. Croswell soils are lower on the landscape than the Rubicon soil. Included soils make up 5 to 10 percent of the unit.

Permeability is rapid in the Rubicon soil. The available water capacity is low. Surface runoff is very slow.

Most areas are used as woodland. The equipment limitation and seedling mortality are management concerns. In heavily traveled areas, loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. Because of dry weather conditions, the loss of planted or natural tree seedlings can be as high as 25 to 50 percent. Special planting stock, such as containerized seedlings, and special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. Furrowing before planting also reduces the seedling mortality rate.

This soil is suited to recreational development. The sandy surface layer is a limitation. Adding a layer of loamy material to the surface and seeding deep-rooted grasses and legumes can help to overcome this limitation. Some land shaping and leveling may be needed on sites for playgrounds.

This soil is well suited to building site development but is poorly suited to septic tank absorption fields. The instability of cutbanks is a limitation on building sites. The sides of shallow excavations should be reinforced. A poor filtering capacity is a limitation on sites for septic tank absorption fields. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability subclass is VIs. The woodland ordination symbol is 3S. The Michigan soil management group is 5a.

26C—Rubicon sand, dark subsoil, 6 to 12 percent slopes. This deep, gently rolling, somewhat excessively drained soil is on knolls, ridges, and side slopes in the uplands. Individual areas are irregularly shaped and range from 3 to more than 100 acres in size.

Typically, the surface is covered with a mat of decomposed leaf litter about 2 inches thick. The subsurface layer is brown sand about 8 inches thick. The subsoil is sand about 18 inches thick. The upper part is dark brown and friable, and the lower part is dark yellowish brown and loose. The substratum to a depth of about 60 inches is brownish yellow sand. In places the subsoil is not so dark.

Included with this soil in mapping are small areas of the well drained Blue Lake and moderately well drained Croswell soils. Blue Lake soils have loamy strata in the subsoil and substratum. They are in landscape positions similar to those of the Rubicon soil. Croswell soils are lower on the landscape than the Rubicon soil. Included soils make up 8 to 15 percent of the unit.

Permeability is rapid in the Rubicon soil. The available water capacity is low. Surface runoff is slow.

Most areas are used as woodland. The equipment limitation and seedling mortality are management concerns. In heavily traveled areas, loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. Landings can be established in the small, nearly level included areas, if available, or in the nearly level adjacent areas. Because of dry weather conditions, the loss of planted or natural tree seedlings can be as high as 25 to 50 percent. Special planting stock, such as containerized seedlings, and special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. Furrowing before planting also reduces the seedling mortality rate.

This soil is poorly suited to recreational development. The sandy surface layer and the slope are limitations. A layer of loamy material is needed on playgrounds and in camping areas, and a cover of wood chips or bark is needed on paths and trails. Some land shaping and leveling may be needed to overcome the slope on campsites, in picnic areas, and on playgrounds.

This soil is moderately well suited to building site development but is poorly suited to septic tank absorption fields. The slope and the instability of cutbanks are limitations on building sites. Buildings should be designed so that they conform to the natural slope of the land. The sides of shallow excavations should be reinforced. The slope and a poor filtering capacity are limitations on sites for septic tank absorption fields. Land shaping and installing the distribution lines across the slope help to ensure the proper functioning of the absorption fields. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability subclass is VIs. The woodland ordination symbol is 3S. The Michigan soil management group is 5a.

26D—Rubicon sand, dark subsoil, 12 to 30 percent slopes. This deep, rolling to steep, somewhat excessively drained soil is on high knolls and ridges in the uplands. Individual areas are irregularly shaped and range from 3 to more than 100 acres in size.

Typically, the surface is covered with a mat of decomposed leaf litter about 2 inches thick. The subsurface layer is brown sand about 8 inches thick. The subsoil is sand about 18 inches thick. The upper part is dark brown and friable, and the lower part is dark yellowish brown and loose. The substratum to a depth of about 60 inches is brownish yellow sand. In places the subsoil is not so dark.

Included with this soil in mapping are small areas of the well drained Blue Lake and moderately well drained Croswell soils. Blue Lake soils have loamy strata in the subsoil and substratum. They are in landscape positions similar to those of the Rubicon soil. Croswell soils are lower on the landscape than the Rubicon soil. Included soils make up 10 to 15 percent of the unit.

Permeability is rapid in the Rubicon soil. The available water capacity is low. Surface runoff is medium.

Most areas are used as woodland. Erosion is a hazard, and the equipment limitation and seedling mortality are management concerns. Because of the erosion hazard, logging roads, skid trails, and landings should be established on gentle grades. Cross-drainage methods of water removal that are matched to specific sites are necessary. Out-sloping road surfaces, open-top drains, and culverts are needed. The use of equipment is restricted by the slope. Special care is needed in laying out roads and landings and in operating the equipment. The roads can be designed so that they conform to the natural slope of the land. The grade should be kept as low as possible. In heavily traveled areas, loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. Rubber-tired and crawler tractors can be operated safely on these slopes, but caution is needed and the steeper slopes should be avoided.

Because of dry weather conditions, the loss of planted or natural tree seedlings can be as high as 25 to 50 percent. Special planting stock, such as containerized seedlings, and special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. Furrowing before planting also reduces the seedling mortality rate.

This soil is poorly suited to recreational development. The sandy surface layer and the slope are limitations. The slope can prohibit the construction of campsites and playgrounds or can significantly increase construction costs. A layer of loamy material is needed on playgrounds and in camping areas, and a cover of wood chips or bark is needed on paths and trails.

This soil is poorly suited to building site development and septic tank absorption fields. The slope and the instability of cutbanks are limitations on building sites. Buildings should be designed so that they conform to the natural slope of the land. The sides of shallow excavations should be reinforced. The slope and a poor filtering capacity are limitations on sites for septic tank absorption fields. Land shaping and installing the distribution lines across the slope help to ensure the proper functioning of the absorption fields. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability subclass is VIIs. The woodland ordination symbol is 3R. The Michigan soil management group is 5a.

27B—Cheboygan loamy sand, 0 to 6 percent slopes. This nearly level and undulating, well drained soil is on broad plains and low knolls in the uplands. It is moderately deep to dense till. Individual areas are irregularly shaped and range from 3 to more than 1,000 acres in size.

Typically, the surface layer is mixed black and light gray loamy sand about 2 inches thick. The subsurface layer is pinkish gray loamy sand about 4 inches thick. The subsoil is about 22 inches thick. The upper part is dark brown and strong brown, friable loamy sand; the next part is pale brown and pinkish gray, friable and firm loamy sand; and the lower part is mixed dark brown and pinkish gray, mottled, firm sandy clay loam and sandy loam. The substratum to a depth of about 60 inches is brown, calcareous loam. In some places the soil is more than 48 inches deep to a substratum of sandy loam. In other places the upper part of the subsoil is redder.

Included with this soil in mapping are small areas of the well drained Blue Lake and Emmet soils. These soils are in landscape positions similar to those of the Cheboygan soil. Blue Lake soils have less clay in the subsoil and substratum than the Cheboygan soil, and Emmet soils have more clay in the surface layer and subsurface layer. Also included are small areas of the somewhat poorly drained Riggsville soils in the lower positions on the landscape. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the upper part of the Cheboygan soil and very slow in the lower part. The available water capacity is low. Surface runoff is slow. A perched seasonal high water table is at a depth of 2 to 3 feet during the spring.

This soil is suited to such crops as corn, oats, alfalfa, and mixed grasses and legumes. Water erosion and soil blowing are hazards, and maintaining the organic matter content and conserving moisture during dry periods are management concerns. A cropping system that includes close-growing crops and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface reduce the hazard of water erosion by increasing the rate of water infiltration. Growing grasses and legumes for pasture or hay also is effective in controlling erosion. Grassed waterways, diversions, and drop structures help to prevent gullying. Conservation tillage, cover crops, buffer strips, field windbreaks, and rough tillage and ridging at an angle to the prevailing wind can help to control soil blowing and maintain the content of organic matter. These practices also increase the

Figure 5.—An aspen stand in an area of Cheboygan loamy sand, 0 to 6 percent slopes.

available water capacity. If water of sufficient quantity and quality is available, irrigation can help to overcome the low available water capacity.

The main concern in managing pastured areas is conserving moisture during dry periods. Maintaining an adequate ground cover by rotation grazing or strip grazing reduces the susceptibility to erosion and helps to keep the pasture in good condition.

Most areas are used as woodland (fig. 5). The windthrow hazard and plant competition are management concerns. Because of the seasonal high water table, the trees are shallow rooted. Some may be blown down during periods of high wind. Windthrow losses can be minimized by cutting systems that do not isolate the remaining trees or allow them to funnel the wind. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is poorly suited to recreational development. The very slow permeability and the sandy surface layer are limitations. Because of the very slow permeability, the recreational areas should not be used during wet periods. Adding a layer of loamy material to the surface and seeding deep-rooted grasses and legumes can help to compensate for the sandy surface layer. Some land shaping and leveling may be needed on sites for playgrounds.

This soil is moderately well suited to building site development but is poorly suited to septic tank absorption fields. The instability of cutbanks is a limitation on building sites. The sides of shallow excavations should be reinforced. The seasonal high water table and the very slow permeability are limitations on sites for septic tank absorption fields. Surface and subsurface drainage systems can lower the water table. Enlarged absorption fields or alternating drain fields may be needed because of the restricted permeability.

The land capability subclass is IIIs. The woodland ordination symbol is 3A. The Michigan soil management group is 3a.

27C—Cheboygan loamy sand, 6 to 12 percent slopes. This gently rolling, well drained soil is on ridges, plains, and side slopes in the uplands. It is moderately deep to dense till. Individual areas are irregularly shaped and range from 3 to more than 600 acres in size.

Typically, the surface layer is mixed black and light gray loamy sand about 2 inches thick. The subsurface layer is pinkish gray loamy sand about 4 inches thick. The subsoil is about 22 inches thick. The upper part is dark brown and strong brown, friable loamy sand; the next part is pale brown and pinkish gray, friable and firm loamy sand; and the lower part is mixed dark brown and pinkish gray, mottled, firm sandy clay loam and sandy loam. The substratum to a depth of about 60 inches is brown, calcareous loam. In some places the soil is more than 48 inches deep to a substratum of sandy loam. In other places the upper part of the subsoil is redder.

Included with this soil in mapping are small areas of the well drained Blue Lake and Emmet soils. These soils are in landscape positions similar to those of the Cheboygan soil. Blue Lake soils have less clay in the subsoil and substratum than the Cheboygan soil, and

Emmet soils have more clay in the surface layer and subsurface layer. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the upper part of the Cheboygan soil and very slow in the lower part. The available water capacity is low. Surface runoff is slow.

This soil is fairly well suited to such crops as corn, oats, alfalfa, and mixed grasses and legumes. Water erosion and soil blowing are hazards, and maintaining the organic matter content and conserving moisture during dry periods are management concerns. A cropping system that includes close-growing crops and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface reduce the hazard of water erosion by increasing the rate of water infiltration. Growing grasses and legumes for pasture or hay also is effective in controlling erosion. Grassed waterways, diversions, and drop structures help to prevent gullying. Conservation tillage, cover crops, buffer strips, field windbreaks, and rough tillage and ridging at an angle to the prevailing wind can help to control soil blowing, maintain the organic matter content, and increase the available water capacity. If water of sufficient quantity and quality is available, irrigation can help to overcome the low available water capacity.

The main concern in managing pastured areas is conserving moisture during dry periods. Maintaining an adequate ground cover by rotation grazing or strip grazing reduces the susceptibility to erosion and helps to keep the pasture in good condition.

Most areas are used as woodland. The equipment limitation on sites for landings and plant competition are management concerns. The use of equipment is restricted in spring and in other excessively wet periods. The upper part of the subsoil is saturated during these periods. The degree of saturation generally is higher on the lower part of the slopes than on the upper part. When the soil is wet, unsurfaced roads tend to be slippery and ruts form easily. Landings can be established in the small, nearly level included areas, if available, or on the level adjacent areas. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is poorly suited to recreational development. The very slow permeability, the sandy surface layer, and the slope are limitations. Because of the very slow permeability, the recreational areas should not be used during wet periods. Adding a layer of loamy material to the surface and seeding deep-rooted grasses and legumes can help to compensate for the sandy surface layer. Some land shaping and leveling may be needed to overcome the slope on campsites, in picnic areas, and on playgrounds.

This soil is moderately well suited to building site development but is poorly suited to septic tank absorption fields. The slope and the instability of cutbanks are limitations on building sites. Buildings should be designed so that they conform to the natural slope of the land. The sides of shallow excavations should be reinforced. The slope and the very slow permeability are limitations on sites for septic tank absorption fields. Land shaping and installing the distribution lines across the slope help to ensure the proper functioning of the absorption fields. Enlarged absorption fields or alternating drain fields may be needed because of the restricted permeability.

The land capability subclass is IIIe. The woodland ordination symbol is 3A. The Michigan soil management group is 3a.

27D—Cheboygan loamy sand, 12 to 30 percent slopes. This rolling to steep, well drained soil is on ridges and side slopes in the uplands. It is moderately deep to dense till. Individual areas are irregularly shaped and range from 3 to more than 500 acres in size.

Typically, the surface layer is mixed black and light gray loamy sand about 2 inches thick. The subsurface layer is pinkish gray loamy sand about 4 inches thick. The subsoil is about 22 inches thick. The upper part is dark brown and strong brown, friable loamy sand; the next part is pale brown and pinkish gray, friable and firm loamy sand; and the lower part is mixed dark brown and pinkish gray, mottled, firm sandy clay loam and sandy loam. The substratum to a depth of about 60 inches is brown, calcareous loam. In some places the soil is more than 48 inches deep to a substratum of sandy loam. In other places the upper part of the subsoil is redder.

Included with this soil in mapping are small areas of the well drained Blue Lake and Emmet soils. These soils are in landscape positions similar to those of the Cheboygan soil. Blue Lake soils have less clay in the subsoil and substratum than the Cheboygan soil, and Emmet soils have more clay in the surface layer and subsurface layer. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the upper part of the Cheboygan soil and very slow in the lower part. The available water capacity is low. Surface runoff is medium.

Most areas are used as woodland. Erosion is a hazard, and the equipment limitation and plant competition are management concerns. Because of the erosion hazard, logging roads, skid trails, and landings should be established on gentle grades. The use of equipment is briefly restricted in spring and in other excessively wet periods. When the soil is wet, unsurfaced roads tend to be slippery and ruts form easily. Cross-drainage methods of water removal that are matched to specific sites are necessary. Out-sloping road surfaces, open-top drains, and culverts are needed. The use of equipment is restricted by the slope. Special care is needed in laying out roads and landings and in operating the equipment. The roads can be designed so that they conform to the natural slope of the land. The grade should be kept as low as possible. Rubber-tired and crawler tractors can be operated safely on these slopes, but caution is needed and the steeper slopes should be avoided. Landings can be established in the small, nearly level included areas, if available, or in the nearly level adjacent areas. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is poorly suited to recreational development. The slope, the sandy surface layer, and the very slow permeability are limitations. The slope can prohibit the construction of campsites and playgrounds or can significantly increase construction costs. A layer of loamy material is needed on playgrounds and in camping areas, and a cover of wood chips or bark is needed on paths and trails. Because of the very slow permeability, the recreational areas should not be used during wet periods.

This soil is poorly suited to building site development and septic tank absorption fields. The slope and the instability of cutbanks are limitations on building sites. The sides of shallow excavations should be reinforced. Buildings should be designed so that they conform to the natural slope of the land. Land shaping may be necessary in some areas. The very slow permeability and the slope are limitations on sites for septic tank absorption fields. Land shaping and installing the distribution lines across the slope can help to ensure the proper functioning of the absorption fields. Enlarged absorption fields or alternating drain fields may be needed because of the restricted permeability.

The land capability subclass is VIe. The woodland ordination symbol is 3R. The Michigan soil management group is 3a.

27F—Cheboygan loamy sand, 30 to 50 percent slopes. This steep and very steep, well drained soil is on ridges and side slopes and in deeply incised drainageways in the uplands. It is moderately deep to dense till. Individual areas are irregularly shaped and range from 3 to more than 400 acres in size.

Typically, the surface layer is mixed black and light gray loamy sand about 2 inches thick. The subsurface layer is pinkish gray loamy sand about 4 inches thick. The subsoil is about 22 inches thick. The upper part is dark brown and strong brown, friable loamy sand; the next part is pale brown and pinkish gray, friable and firm loamy sand; and the lower part is mixed dark brown and pinkish gray, mottled, firm sandy clay loam and sandy loam. The substratum to a depth of about 60 inches is brown, calcareous loam. In some places the soil is more than 48 inches deep to a substratum of sandy loam. In other places the upper part of the subsoil is redder.

Included with this soil in mapping are small areas of the well drained Blue Lake and Emmet soils. These soils are in landscape positions similar to those of the Cheboygan soil. Blue Lake soils have less clay in the subsoil and substratum than the Cheboygan soil, and Emmet soils have more clay in the surface layer and subsurface layer. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the upper part of the Cheboygan soil and very slow in the lower part. The available water capacity is low. Surface runoff is rapid.

Most areas are used as woodland. Erosion is a hazard, and the equipment limitation and plant competition are management concerns. Because of the erosion hazard, logging roads, skid trails, and landings should be established on gentle grades. Cross-drainage methods of water removal that are matched to specific sites are necessary. Out-sloping road surfaces, open-top drains, and culverts are needed. The use of equipment is restricted by the slope. Ordinary crawler tractors and rubber-tired skidders cannot be operated safely on the very steep side slopes. Special logging methods, such as cable yarding, may be needed. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is poorly suited to recreational development. The slope, the sandy surface layer, and the very slow permeability are limitations. The slope can prohibit the construction of campsites and playgrounds or can significantly increase construction costs. A layer of loamy material is needed on playgrounds and in camping areas, and a cover of wood chips or bark is needed on paths and trails. Because of the very slow permeability, the recreational areas should not be used during wet periods.

This soil is unsuited to building site development and septic tank absorption fields. The slope and the instability of cutbanks are limitations on building sites. The slope and the very slow permeability are limitations on sites for septic tank absorption fields. Soils that are better suited to these uses generally are nearby.

The land capability subclass is VIIe. The woodland ordination symbol is 3R. The Michigan soil management group is 3a.

29B—Fairport fine sandy loam, 1 to 8 percent slopes. This moderately deep, nearly level to gently rolling, well drained soil is on broad plains, low knolls, and low ridges in the uplands. Individual areas are irregularly shaped and range from 5 to more than 200 acres in size.

Typically, the surface layer is very dark grayish brown fine sandy loam about 10 inches thick. The subsoil is about 20 inches thick. The upper part is dark yellowish brown, very friable sandy loam; the next part is dark brown, friable loam; and the lower part is yellowish brown, calcareous gravelly sandy loam. The substratum is yellowish brown, calcareous cobbly sandy loam about 6 inches thick. Unweathered limestone bedrock is at a depth of about 36 inches. In some places depth to the unweathered limestone bedrock is less than 20 inches. In other places the subsoil is coarser textured.

Included with this soil in mapping are small areas of the deep, well drained Onaway soils and the somewhat poorly drained Bonduel soils. Onaway soils are in landscape positions similar to those of the Fairport soil, and Bonduel soils are lower on the landscape. Included soils make up 5 to 10 percent of the unit.

Permeability is moderate in the Fairport soil. The available water capacity is low. Surface runoff is medium. The shrink-swell potential is moderate.

This soil is fairly well suited to such crops as corn, small grains, and grasses and legumes. Water erosion and soil blowing are hazards, and maintaining the organic matter content and conserving moisture during dry periods are management concerns. A cropping system that includes close-growing crops and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface reduce the hazard of water erosion by increasing the rate of water infiltration. Growing grasses and legumes for pasture or hay also is effective in controlling erosion. Grassed waterways, diversions, and drop structures help to prevent gullying. Conservation tillage, cover crops, buffer strips, field windbreaks, and rough tillage and ridging at an angle to the prevailing wind can help to control soil blowing, maintain the organic matter content, and increase the available water capacity. If water of sufficient quantity and quality is available, irrigation can help to overcome the low available water capacity.

The main concern in managing pastured areas is conserving moisture during dry periods. Maintaining an adequate ground cover by rotation grazing or strip grazing reduces the susceptibility to erosion and helps to keep the pasture in good condition.

Most areas are used as woodland. The equipment limitation, the windthrow hazard, and plant competition are management concerns. The use of equipment is restricted in spring and in other excessively wet periods. The upper part of the subsoil is saturated during these periods. The degree of saturation generally is higher on the lower part of the slopes than on the upper part. The best sites for landings are the nearly level parts of the landscape. In a few places the bedrock hinders road construction. Because of the moderate depth to bedrock, the trees are subject to windthrow during periods of high wind. Windthrow losses can be minimized by cutting systems that do not isolate the remaining trees or allow them to funnel the wind. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is suited to recreational development. The moderate depth to bedrock is a limitation on sites for playgrounds. Adding suitable fill to the site can help to overcome this limitation.

This soil is poorly suited to building site development and unsuited to septic tank absorption fields. The moderate depth to bedrock and the moderate shrink-swell potential are limitations on building sites and on sites for septic tank absorption fields. If buildings are constructed, backfilling the foundation trench with suitable material can help to overcome the depth to bedrock and the shrink-swell potential.

The land capability subclass is IIIe. The woodland ordination symbol is 3D. The Michigan soil management group is 2/Ra.

29C—Fairport fine sandy loam, 8 to 25 percent slopes. This moderately deep, gently rolling to hilly, well drained soil is on broad plains, low knolls, and low ridges in the uplands. Individual areas are irregularly shaped and range from 5 to more than 200 acres in size.

Typically, the surface layer is very dark grayish brown fine sandy loam about 10 inches thick. The subsoil is about 20 inches thick. The upper part is dark yellowish brown, very friable sandy loam; the next part is dark brown, friable loam; and the lower part is yellowish brown, calcareous gravelly sandy loam. The substratum is yellowish brown, calcareous cobbly sandy loam about 6 inches thick. Unweathered limestone bedrock is at a depth of about 36 inches. In some places depth to the unweathered limestone bedrock is less than 20 inches. In other places the subsoil is coarser textured.

Included with this soil in mapping are small areas of the deep, well drained Onaway soils. These soils are in landscape positions similar to those of the Fairport soil. They make up 8 to 15 percent of the unit.

Permeability is moderate in the Fairport soil. The available water capacity is low. Surface runoff is medium or rapid. The shrink-swell potential is moderate.

This soil is poorly suited to such crops as corn, small grains, and grasses and legumes. Water erosion is a hazard, and the slope is a limitation. Maintaining good tilth and conserving moisture during dry periods are additional management concerns. A cropping system that includes close-growing crops and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface reduce the hazard of water erosion by minimizing surface crusting and increasing the rate of water infiltration. Growing grasses and legumes for pasture or hay also is effective in controlling erosion. Grassed waterways, diversions, and drop structures help to prevent gullying. Farming on the contour can minimize the equipment limitation caused by the slope and help to control erosion. Conservation tillage and additions of organic material to the soil increase the available water capacity. If water of sufficient quantity and quality is available, irrigation can help to overcome the low available water capacity.

The main concern in managing pastured areas is conserving moisture during dry periods. Maintaining an adequate ground cover by rotation grazing or strip grazing reduces the susceptibility to erosion and helps to keep the pasture in good condition.

Most areas are used as woodland. The equipment limitation, the windthrow hazard, and plant competition are management concerns. The use of equipment is restricted in spring and in other excessively wet periods. The upper part of the subsoil is saturated during these periods. The degree of saturation generally is higher on the lower part of the slopes than on the upper part. The best sites for landings are the nearly level parts of the landscape. In a few places the bedrock hinders road construction. Because of the moderate depth to bedrock, the trees are subject to windthrow during periods of high wind. Windthrow losses can be minimized by cutting systems that do not isolate the remaining trees or allow them to funnel the wind. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is poorly suited to recreational development. The slope and the moderate depth to bedrock are limitations. The slope can prohibit the construction of campsites and playgrounds or can significantly increase construction costs. Adding suitable fill to the site can help to overcome the limited depth to bedrock.

This soil generally is poorly suited to building site development and unsuited to septic tank absorption fields. The moderate depth to bedrock, the slope, and the moderate shrink-swell potential are limitations on building sites. The moderate depth to bedrock, the slope, and seepage are limitations on sites for septic tank absorption fields. If buildings are constructed, backfilling the foundation trench with suitable material and widening the trench can help to overcome the shrink-swell potential. Adding suitable fill material can increase the depth to bedrock. Buildings should be designed so that they conform to the natural slope of the land.

The land capability subclass is IVe. The woodland ordination symbol is 3R. The Michigan soil management group is 2/Ra.

30B—Rousseau fine sand, 0 to 6 percent slopes. This deep, nearly level and undulating, well drained soil is on broad plains and low knolls in the uplands. Individual areas are irregularly shaped and range from 5 to more than 100 acres in size.

Typically, the surface layer is mixed black and pinkish gray fine sand about 1 inch thick. The subsurface layer is pinkish gray fine sand about 5 inches thick. The subsoil is fine sand about 23 inches thick. It is dark reddish brown and friable in the upper part, dark brown and loose in the next part, and yellowish brown and loose in the lower part. The substratum to a depth of about 60 inches is light yellowish brown fine sand. In some places the soil is moderately well drained. In other places it is sand.

Included with this soil in mapping are small areas of the somewhat poorly drained Au Gres and well drained Wallace soils. Au Gres soils are in shallow depressions. Wallace soils have a subsoil that is very firm and that is redder than that of the Rousseau soil. They are in landscape positions similar to those of the Rousseau soil. Included soils make up 5 to 8 percent of the unit.

Permeability is rapid in the Rousseau soil. The available water capacity is low. Surface runoff is very slow.

Most areas are used as woodland. The equipment limitation and seedling mortality are management concerns. In heavily traveled areas, loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. Because of dry weather conditions, the loss of planted or natural tree seedlings can be as high as 25 to 50 percent. Special planting stock, such as containerized seedlings, and special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. Furrowing before planting also reduces the seedling mortality rate.

This soil is poorly suited to most recreational development. The sandy surface layer is a limitation. Adding a layer of loamy material to the surface and seeding deep-rooted grasses and legumes can help to overcome this limitation. Some land shaping and leveling may be needed on sites for playgrounds.

This soil is well suited to building site development but is poorly suited to septic tank absorption fields. The instability of cutbanks is a limitation on building sites. The sides of shallow excavations should be reinforced. A poor filtering capacity is a limitation on sites for septic tank absorption fields. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability subclass is IIIs. The woodland ordination symbol is 5S. The Michigan soil management group is 4a.

30C—Rousseau fine sand, 6 to 12 percent slopes. This deep, gently rolling, well drained soil is on knolls, ridges, and side slopes in the uplands. Individual areas are irregularly shaped and range from 3 to more than 80 acres in size.

Typically, the surface layer is mixed black and pinkish gray fine sand about 1 inch thick. The subsurface layer is pinkish gray fine sand about 5 inches thick. The subsoil is fine sand about 23 inches thick. It is dark reddish brown and friable in the upper part, dark brown and loose in the next part, and yellowish brown and loose in the lower part. The substratum to a depth of about 60 inches is light yellowish brown fine sand. In some places the soil is moderately well drained. In other places it is sand.

Included with this soil in mapping are small areas of the well drained Wallace soils. These soils are in landscape positions similar to those of the Rousseau soil. Also, they have a subsoil that is redder and that is very firm. They make up 5 to 10 percent of the unit.

Permeability is rapid in the Rousseau soil. The available water capacity is low. Surface runoff is slow.

Most areas are used as woodland. The equipment limitation and seedling mortality are management concerns. In heavily traveled areas, loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. Landings can be established in the small, nearly level included areas, if available, or in the nearly level adjacent areas. Because of dry weather conditions, the loss of planted or natural tree seedlings can be as high as 25 to 50 percent. Special planting stock, such as containerized seedlings, and special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. Furrowing before planting also reduces the seedling mortality rate.

This soil is poorly suited to recreational development. The sandy surface layer and the slope are limitations. A layer of loamy material is needed on playgrounds and in camping areas, and a cover of wood chips or bark is needed on paths and trails. Some land shaping and leveling may be needed to overcome the slope on campsites, in picnic areas, and on playgrounds.

This soil is moderately well suited to building site development but is poorly suited to septic tank absorption fields. The slope and the instability of cutbanks are limitations on building sites. Buildings should be designed so that they conform to the natural slope of the land. Land shaping may be necessary in some areas. The sides of shallow excavations should be reinforced. Slopes should be stabilized to prevent excessive erosion. The slope and a poor filtering capacity are limitations on sites for septic tank absorption fields. Land shaping and installing the distribution lines across the slope help to ensure the proper functioning of the absorption fields. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability subclass is IIIe. The woodland ordination symbol is 5S. The Michigan soil management group is 4a.

30D—Rousseau fine sand, 12 to 30 percent slopes. This deep, rolling to steep, well drained soil is on high knolls, ridges, and side slopes in the uplands. Individual areas are irregularly shaped and range from 3 to more than 80 acres in size.

Typically, the surface layer is mixed black and pinkish gray fine sand about 1 inch thick. The subsurface layer is pinkish gray fine sand about 5 inches thick. The subsoil is fine sand about 23 inches thick. It is dark reddish brown and friable in the upper part, dark brown and loose in the next part, and yellowish brown and loose in the lower part. The substratum to a depth of about 60 inches is light yellowish brown fine sand. In some places the soil is moderately well drained. In other places it is sand.

Included with this soil in mapping are small areas of the well drained Wallace soils. These soils are in landscape positions similar to those of the Rousseau soil. Also, they have a subsoil that is redder and that is very firm. They make up 8 to 10 percent of the unit.

Permeability is rapid in the Rousseau soil. The available water capacity is low. Surface runoff is medium.

Most areas are used as woodland. Erosion is a hazard, and the equipment limitation and seedling mortality are management concerns. Because of the erosion hazard, logging roads, skid trails, and landings should be established on gentle grades. Cross-drainage methods of water removal that are matched to specific sites are necessary. Out-sloping road surfaces, open-top drains, and culverts are needed. The use of equipment is restricted by the slope. Special care is needed in laying out roads and landings and in operating the equipment. The roads can be designed so that they conform to the natural slope of the land. The grade should be kept as low as possible. In heavily traveled areas, loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. Rubber-tired and crawler tractors can be operated safely on these slopes, but caution is needed and the steeper slopes should be avoided.

Because of dry weather conditions, the loss of planted or natural tree seedlings can be as high as 25 to 50 percent. Special planting stock, such as containerized seedlings, and special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. Furrowing before planting also reduces the seedling mortality rate.

This soil is poorly suited to recreational development. The sandy surface layer and the slope are limitations. The slope can prohibit the construction of campsites and playgrounds or can significantly increase construction costs. A layer of loamy material is needed on playgrounds and in camping areas, and a cover of wood chips or bark is needed on paths and trails.

This soil is poorly suited to building site development and septic tank absorption fields. The slope and the instability of cutbanks are limitations on building sites. Buildings should be designed so that they conform to the natural slope of the land. Land shaping may be necessary in some areas. Slopes should be stabilized to prevent excessive erosion. The sides of shallow excavations should be reinforced. The slope and a poor filtering capacity are limitations on sites for septic tank absorption fields. Land shaping and installing the distribution lines across the slope help to ensure the proper functioning of the absorption fields. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability subclass is VIe. The woodland ordination symbol is 5R. The Michigan soil management group is 4a.

31B—Nadeau extremely gravelly loamy sand, 1 to 9 percent slopes. This deep, nearly level to gently rolling, well drained soil is on ridges in the uplands. Individual areas are long and narrow or irregular in shape and range from 3 to more than 100 acres in size.

Typically, the surface layer is mixed black and pinkish gray extremely gravelly loamy sand about 1 inch thick. The subsurface layer is pinkish gray extremely gravelly loamy sand about 5 inches thick. The subsoil is about 17 inches thick. The upper part is brown, very friable extremely gravelly sandy loam; the next part is strong brown, friable extremely gravelly sandy clay loam; and the lower part is dark brown, loose extremely gravelly loamy sand. The substratum to a depth of about 60 inches is light yellowish brown, calcareous extremely gravelly sand.

Included with this soil in mapping are small areas of the somewhat excessively drained Mancelona soils. These soils are in landscape positions similar to those of the Nadeau soil. Also, they have a subsoil that is darker in the upper part and that is more sandy. They make up about 5 to 8 percent of the unit.

Permeability is very rapid in the Nadeau soil. The available water capacity is very low. Surface runoff is slow.

Most areas are used as woodland. The equipment limitation and plant competition are management concerns. The best sites for landings are the nearly level parts of the landscape. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is poorly suited to recreational development. The slope and small stones are limitations. Some land shaping and leveling may be needed on campsites, in picnic areas, and on playgrounds.

This soil is well suited to building site development but is poorly suited to septic tank absorption fields. The instability of cutbanks is a limitation on building sites. The sides of shallow excavations should be reinforced. A poor filtering capacity is a limitation on sites for septic tank absorption fields. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability subclass is IIIs. The woodland ordination symbol is 2L. The Michigan soil management group is Ga.

32B—Rubicon sand, banded substratum, 0 to 6 percent slopes. This deep, nearly level and undulating, excessively drained soil is on broad plains and ridges in the uplands. Individual areas are irregularly shaped and range from 5 to more than 800 acres in size.

Typically, about 2 inches of black, well decomposed forest litter is at the surface. The subsurface layer is light gray sand about 6 inches thick. The subsoil is loose sand about 31 inches thick. It is strong brown in the upper part and brownish yellow in the lower part.

The substratum to a depth of about 80 inches is light gray sand that has strong brown bands of loamy sand 1/16 to 1/4 inch thick. In some places the substratum does not have bands of loamy sand. In other places the subsoil has less iron and organic matter.

Included with this soil in mapping are small areas of the well drained Blue Lake and somewhat excessively drained East Lake soils. Blue Lake soils have more clay in the subsoil than the Rubicon soil, and East Lake soils have more gravel in the substratum. Both of these included soils are in landscape positions similar to those of the Rubicon soil. Also included are small areas of the moderately well drained Croswell soils in the slightly lower landscape positions. Included soils make up 5 to 10 percent of the unit.

Permeability is rapid in the Rubicon soil. The available water capacity is low. Surface runoff is very slow.

Most areas are used as woodland. The equipment limitation and seedling mortality are management concerns. In heavily traveled areas, loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. Because of dry weather conditions, the loss of planted or natural tree seedlings can be as high as 25 to 50 percent. Special planting stock, such as containerized seedlings, and special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. Furrowing before planting also reduces the seedling mortality rate.

This soil is suited to most recreational development. The sandy surface layer is a limitation. Adding a layer of loamy material to the surface and seeding deep-rooted grasses and legumes can help to overcome this limitation. Some land shaping and leveling may be needed on sites for playgrounds.

This soil is well suited to building site development but is poorly suited to septic tank absorption fields. The instability of cutbanks is a limitation on building sites. The sides of shallow excavations should be reinforced. A poor filtering capacity is a limitation on sites for septic tank absorption fields. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability subclass is VIs. The woodland ordination symbol is 6S. The Michigan soil management group is 5.3a.

32C—Rubicon sand, banded substratum, 6 to 12 percent slopes. This deep, gently rolling, excessively drained soil is on ridges, knolls, and side slopes in the uplands. Individual areas are irregularly shaped and range from 3 to more than 300 acres in size.

Typically, about 2 inches of black, well decomposed forest litter is at the surface. The subsurface layer is light gray sand about 6 inches thick. The subsoil is loose sand about 31 inches thick. It is strong brown in the upper part and brownish yellow in the lower part. The substratum to a depth of about 80 inches is light gray sand with strong brown bands of loamy sand 1/16 to 1/4 inch thick. In some places the substratum does not have bands of loamy sand. In other places the subsoil has less iron and organic matter.

Included with this soil in mapping are small areas of the well drained Blue Lake and somewhat excessively drained East Lake soils. Blue Lake soils have more clay in the subsoil than the Rubicon soil, and East Lake soils have more gravel in the substratum. Both of these included soils are in landscape positions similar to those of the Rubicon soil. Also included are small areas of the moderately well drained Croswell soils in the slightly lower landscape positions. Included soils make up 8 to 15 percent of the unit.

Permeability is rapid in the Rubicon soil. The available water capacity is low. Surface runoff is slow.

Most areas are used as woodland. The equipment limitation and seedling mortality are management concerns. In heavily traveled areas, loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. Landings can be established in the small, nearly level included areas, if available, or in the nearly level adjacent areas. Because of dry weather conditions, the loss of planted or natural tree seedlings can be as high as 25 to 50 percent. Special planting stock, such as containerized seedlings, and special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. Furrowing before planting also reduces the seedling mortality rate.

This soil is poorly suited to recreational development. The sandy surface layer and the slope are limitations. A layer of loamy material is needed on playgrounds and in camping areas, and a cover of wood chips or bark is needed on paths and trails. Some land shaping and leveling may be needed to overcome the slope on campsites, in picnic areas, and on playgrounds.

This soil is moderately well suited to building site development but is poorly suited to septic tank absorption fields. The slope and the instability of cutbanks are limitations on building sites. Buildings should be designed so that they conform to the natural slope of the land. Land shaping may be necessary in some areas. Slopes should be stabilized to prevent excessive erosion. The sides of shallow excavations should be reinforced. The slope and a poor filtering capacity are limitations on sites for septic tank absorption fields. Land shaping and installing the distribution lines across the slope help to ensure the proper functioning of the absorption fields. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability subclass is VIs. The woodland ordination symbol is 6S. The Michigan soil management group is 5.3a.

32D—Rubicon sand, banded substratum, 12 to 30 percent slopes. This deep, rolling to steep, excessively drained soil is on ridges, hills, and high knolls in the uplands. Individual areas are irregularly shaped and range from 3 to more than 200 acres in size.

Typically, about 2 inches of black, well decomposed forest litter is at the surface. The subsurface layer is light gray sand about 6 inches thick. The subsoil is loose sand about 31 inches thick. It is strong brown in the upper part and brownish yellow in the lower part. The substratum to a depth of about 80 inches is light gray sand with strong brown bands of loamy sand 1/16 to 1/4 inch thick. In some places the substratum does not have bands of loamy sand. In other places the subsoil has less iron and organic matter.

Included with this soil in mapping are small areas of the well drained Blue Lake and somewhat excessively drained East Lake soils. Blue Lake soils have more clay in the subsoil than the Rubicon soil, and East Lake soils have more gravel in the substratum. Both of the included soils are in landscape positions similar to those of the Rubicon soil. They make up 10 to 20 percent of the unit.

Permeability is rapid in the Rubicon soil. The available water capacity is low. Surface runoff is medium.

Most areas are used as woodland. Erosion is a hazard, and the equipment limitation and seedling mortality are management concerns. Because of the erosion hazard, logging roads, skid trails, and landings should be established on gentle grades. Cross-drainage methods of water removal that are matched to specific sites are necessary. Out-sloping road surfaces, open-top drains, and culverts are needed. The use of equipment is restricted by the slope. Special care is needed in laying out roads and landings and in operating the equipment. The roads can be designed so that they conform to the natural slope of the land. The grade should be kept as low as possible. In heavily traveled areas, loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. Rubber-tired and crawler tractors can be operated safely on these slopes, but caution is needed and the steeper slopes should be avoided.

Because of dry weather conditions, the loss of planted or natural tree seedlings can be as high as 25 to 50 percent. Special planting stock, such as containerized seedlings, and special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. Furrowing before planting also reduces the seedling mortality rate.

This soil is poorly suited to recreational development. The sandy surface layer and the slope are limitations. The slope can prohibit the construction of campsites and playgrounds or can significantly increase construction costs. A layer of loamy material is needed on playgrounds and in camping areas, and a cover of wood chips or bark is needed on paths and trails.

This soil is poorly suited to building site development and septic tank absorption fields. The slope and the instability of cutbanks are limitations on building sites. Buildings should be designed so that they conform to the natural slope of the land. The sides of shallow excavations should be reinforced. The slope and a poor filtering capacity are limitations on sites for septic tank absorption fields. Land shaping and installing the distribution lines across the slope help to ensure the proper functioning of the absorption fields. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability subclass is VIIs. The woodland ordination symbol is 6R. The Michigan soil management group is 5.3a.

33B—Ontonagon silty clay loam, 2 to 6 percent slopes. This deep, nearly level and undulating, moderately well drained soil is on knolls and in broad areas in the uplands. Individual areas are irregularly shaped and range from 3 to more than 100 acres in size.

Typically, the surface layer is dark brown silty clay loam about 7 inches thick. The subsoil extends to a depth of about 22 inches. It is reddish brown, firm silty clay. It is mottled in the lower part. The substratum to a depth of about 60 inches is light reddish brown, mottled, calcareous silty clay loam. In some places the surface layer is clay loam. In other places it is thinner.

Included with this soil in mapping are small areas of the well drained Alcona and somewhat poorly drained Rudyard soils. Alcona soils are in landscape positions similar to those of the Ontonagon soil. Also, they have less clay throughout. Rudyard soils are in shallow depressions. Included soils make up 10 to 15 percent of the unit.

Permeability is very slow in the Ontonagon soil. The available water capacity is high. Surface runoff is medium. A seasonal high water table is at a depth of

2.5 to 6.0 feet during the spring. The shrink-swell potential is high.

This soil is well suited to such crops as corn, small grains, and grasses and legumes. Erosion is a hazard, and maintaining good tilth is a management concern. A cropping system that includes close-growing crops and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface reduce the hazard of water erosion by minimizing surface crusting and increasing the rate of water infiltration. Growing grasses and legumes for pasture or hay also is effective in controlling erosion. Grassed waterways, diversions, and drop structures help to prevent gullying. Working the soil when it is too wet results in cloddiness and surface compaction. Applying a system of conservation tillage, adding organic material to the soil, and tilling within the proper range in moisture content help to maintain good tilth.

This soil is well suited to pasture. Overgrazing causes surface compaction, excessive runoff, and erosion. Proper stocking rates, rotation grazing or strip grazing, and restricted use during wet periods help to keep the pasture in good condition.

Most areas are used as woodland. The equipment limitation, the windthrow hazard, and plant competition are management concerns. The very slow permeability and sticky and plastic qualities of the subsoil limit the use of equipment in spring and in other excessively wet periods. Ruts form easily if skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage, expose tree roots, and alter soil structure. When the soil is wet, unsurfaced roads and landings tend to be slippery and ruts form easily. On year-round roads, a gravel base is needed. Culverts are needed to maintain the natural drainage system. Because of the firm subsoil, the trees are shallow rooted. Some may be blown down during periods of high wind and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is suited to recreational development. Because of the very slow permeability, however, the recreational areas should not be used during wet periods.

This soil is moderately well suited to building site development but is poorly suited to septic tank absorption fields. The high clay content and the high shrink-swell potential are limitations on building sites. Widening the foundation trench and backfilling the trench with suitable coarse material can help to overcome the shrink-swell potential. The seasonal high water table and the very slow permeability are limitations on sites for septic tank absorption fields. Enlarging the absorption fields or raising the site by filling or mounding with suitable soil material helps to overcome these limitations. Surface and subsurface drainage systems can lower the water table.

The land capability subclass is IIIe. The woodland ordination symbol is 2C. The Michigan soil management group is Oa.

33B2—Ontonagon silty clay loam, 2 to 6 percent slopes, eroded. This deep, nearly level and undulating, moderately well drained soil is on knolls and in broad areas in the uplands. Individual areas are irregularly shaped and range from 3 to more than 80 acres in size.

Typically, the surface layer is dark brown silty clay loam about 7 inches thick. The subsoil extends to a depth of about 22 inches. It is reddish brown, firm silty clay. It is mottled in the lower part. The substratum to a depth of about 60 inches is light reddish brown, mottled, calcareous silty clay loam. In some places, the subsoil is thinner and the calcareous silty clay loam is at a shallower depth. In other places the surface layer is material from the subsoil.

Included with this soil in mapping are small areas of the well drained Alcona soils. These soils are in landscape positions similar to those of the Ontonagon soil. Also, they have less clay throughout. They make up about 10 to 15 percent of the unit.

Permeability is very slow in the Ontonagon soil. The available water capacity is high. Surface runoff is medium. A seasonal high water table is at a depth of 2.5 to 6.0 feet during the spring. The shrink-swell potential is high.

This soil is moderately well suited to such crops as corn, small grains, and grasses and legumes. Erosion is a hazard, and maintaining good tilth is a management concern. A cropping system that includes close-growing crops and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface reduce the hazard of water erosion by minimizing surface crusting and increasing the rate of water infiltration. Growing grasses and legumes for pasture or hay also is effective in controlling erosion. Grassed waterways, diversions, and drop structures help to prevent gullying. Working the soil when it is too wet results in cloddiness and surface compaction. Applying a system of conservation tillage, adding organic material to the soil, and tilling within the proper range in moisture content help to maintain good tilth.

This soil is well suited to pasture. Overgrazing causes surface compaction, excessive runoff, and erosion. Proper stocking rates, rotation grazing or strip grazing, and restricted use during wet periods help to keep the pasture in good condition.

Using this soil as woodland helps to prevent further erosion. If the soil is used for woodland, however, the equipment limitation, the windthrow hazard, and plant competition are management concerns. The very slow permeability and sticky and plastic qualities of the subsoil limit the use of equipment in spring and in other excessively wet periods. Ruts form easily if skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage, expose tree roots, and alter soil structure. When the soil is wet, unsurfaced roads and landings tend to be slippery and ruts form easily. On year-round roads, a gravel base is needed. Culverts are needed to maintain the natural drainage system. Because of the firm subsoil, the trees are shallow rooted. Some may be blown down during periods of high wind and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is suited to recreational development. Because of the very slow permeability, however, the recreational areas should not be used during wet periods.

This soil is moderately well suited to building site development but is poorly suited to septic tank absorption fields. The high clay content and the high shrink-swell potential are limitations on building sites. Widening the foundation trench and backfilling the trench with suitable coarse material can help to overcome the shrink-swell potential. The seasonal high water table and the very slow permeability are limitations on sites for septic tank absorption fields. Enlarging the absorption fields or raising the site by filling or mounding with suitable soil material helps to overcome these limitations. Surface and subsurface drainage systems can lower the water table.

The land capability subclass is IIIe. The woodland ordination symbol is 2C. The Michigan soil management group is Oa.

33C2—Ontonagon silty clay loam, 6 to 18 percent slopes, eroded. This deep, gently rolling and rolling, well drained soil is on knolls and side slopes and in broad areas in the uplands. Individual areas are irregularly shaped and range from 3 to more than 60 acres in size.

Typically, the surface layer is dark brown silty clay loam about 7 inches thick. The subsoil extends to a depth of about 22 inches. It is reddish brown, firm silty clay. It is mottled in the lower part. The substratum to a depth of about 60 inches is light reddish brown, mottled, calcareous silty clay loam. In some places, the subsoil is thinner and the calcareous silty clay loam is at a shallower depth. In other places the surface layer is mainly material from the subsoil.

Included with this soil in mapping are small areas of the well drained Alcona soils. These soils are in landscape positions similar to those of the Ontonagon soil. Also, they have less clay. They make up 8 to 15 percent of the unit.

Permeability is very slow in the Ontonagon soil. The available water capacity is high. Surface runoff is medium. The shrink-swell potential is moderate.

This soil is moderately well suited to such crops as corn, small grains, and grasses and legumes. Erosion is a hazard, and maintaining good tilth is a management concern. A cropping system that includes close-growing crops and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface reduce the hazard of water erosion by minimizing surface crusting and increasing the rate of water infiltration. Growing grasses and legumes for pasture or hay also is effective in controlling erosion. Grassed waterways, diversions, and drop structures help to prevent gullying. Working the soil when it is too wet results in a cloddiness and surface compaction. Applying a system of conservation tillage, adding organic material to the soil, and tilling within the proper range in moisture content help to maintain good tilth.

Using this soil as woodland helps to prevent further erosion. If the soil is used for woodland, however, the equipment limitation, the windthrow hazard, and plant competition are management concerns. The very slow permeability and sticky and plastic qualities of the subsoil limit the use of equipment in spring and in other excessively wet periods. Ruts form easily if skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage, expose tree roots, and alter soil structure. When the soil is wet, unsurfaced roads and landings tend to be slippery and ruts form easily. On year-round roads, a gravel base is needed. Culverts are needed to maintain the natural drainage system. Because of the firm subsoil, the trees are shallow rooted. Some may be blown down during periods of high wind and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is poorly suited to recreational development. The very slow permeability and the slope are limitations. The slope can prohibit the construction of campsites and playgrounds or can significantly increase construction costs. Restricting use during wet periods can help to overcome the restricted permeability.

This soil is moderately well suited to building site development but is poorly suited to septic tank absorption fields. The slope is a limitation on building sites. Buildings should be designed so that they conform to the natural slope of the land. Land shaping may be necessary in some areas. Slopes should be stabilized to prevent excessive erosion. The very slow permeability and the slope are limitations on sites for septic tank absorption fields. Enlarged absorption fields or alternating drain fields may be needed because of the restricted permeability. Land shaping and installing the distribution lines across the slope help to ensure the proper functioning of the absorption fields.

The land capability subclass is IVe. The woodland ordination symbol is 2C. The Michigan soil management group is Oa.

34B—Alcona very fine sandy loam, 0 to 6 percent slopes. This deep, nearly level and undulating, well drained soil is on plains and low knolls in the uplands. Individual areas are irregularly shaped and range from 3 to more than 80 acres in size.

Typically, the surface layer is dark brown very fine sandy loam about 2 inches thick. The subsurface layer is dark grayish brown very fine sandy loam about 5 inches thick. The subsoil is about 12 inches thick. The upper part is dark brown and yellowish brown, very friable very fine sandy loam; the next part is very pale brown, loose very fine sandy loam; and the lower part is reddish brown, friable loam. The substratum to a depth of about 60 inches is very pale brown, calcareous, stratified loamy very fine sand and silt. In some places the subsoil is darker and redder. In other places the subsoil has more clay.

Included with this soil in mapping are small areas of the somewhat poorly drained Brimley soils. These soils are in the lower landscape positions. They make up about 5 to 10 percent of the unit.

Permeability is moderate in the Alcona soil. The available water capacity is high. Surface runoff is very slow.

This soil is well suited to such crops as corn, small grains, and grasses and legumes. Water erosion and soil blowing are hazards. A cropping system that includes close-growing crops and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface reduce the hazard of water erosion by increasing the rate of water infiltration. Growing grasses and legumes for pasture or hay also is effective in controlling erosion. Grassed waterways, diversions, and drop structures help to prevent gullying. Conservation tillage, cover crops, buffer strips, field windbreaks, and rough tillage and ridging at an angle to the prevailing wind can help to control soil blowing.

This soil is well suited to pasture. Overgrazing causes surface compaction, excessive runoff, and erosion. Proper stocking rates, rotation grazing or strip grazing, and restricted use during wet periods help to keep the pasture in good condition.

Most areas are used as woodland. The equipment limitation and plant competition are management concerns. The use of equipment is briefly restricted in spring and in other excessively wet periods. When the soil is wet, unsurfaced roads tend to be slippery and ruts form easily. Operating equipment during wet periods can result in surface compaction and can expose tree roots. The best sites for landings are the nearly level parts of landscape. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is well suited to recreational development. No major limitations affect this use.

This soil is well suited to building site development but is poorly suited to septic tank absorption fields. The instability of cutbanks is a limitation on building sites. The sides of shallow excavations should be reinforced. The moderately slow permeability is a limitation on sites for septic tank absorption fields. Enlarged absorption fields or alternating drain fields may be needed because of the restricted permeability.

The land capability subclass is IIe. The woodland ordination symbol is 3L. The Michigan soil management group is 2.5a-s.

34C—Alcona very fine sandy loam, 6 to 15 percent slopes. This deep, gently rolling, well drained soil is on knolls, ridges, and side slopes in the uplands. Individual areas are irregularly shaped and range from 3 to more than 50 acres in size.

Typically, the surface layer is dark brown very fine sandy loam about 2 inches thick. The subsurface layer is dark grayish brown very fine sandy loam about 5 inches thick. The subsoil is about 12 inches thick. The upper part is dark brown and yellowish brown, very friable very fine sandy loam; the next part is very pale brown, loose very fine sandy loam; and the lower part is reddish brown, friable loam. The substratum to a depth of about 60 inches is very pale brown, calcareous, stratified loamy very fine sand and silt. In places the subsoil is darker and redder.

Included with this soil in mapping are small areas of the well drained Ontonagon soils. These soils are in landscape positions similar to those of the Alcona soil.

Also, they have more clay throughout. They make up 5 to 10 percent of the unit.

Permeability is moderate in the Alcona soil. The available water capacity is high. Surface runoff is slow.

This soil is moderately well suited to such crops as corn, small grains, and grasses and legumes. Water erosion and soil blowing are hazards. A cropping system that includes close-growing crops and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface reduce the hazard of water erosion by increasing the rate of water infiltration. Growing grasses and legumes for pasture or hay also is effective in controlling erosion. Grassed waterways, diversions, and drop structures help to prevent gullying. Conservation tillage, cover crops, buffer strips, field windbreaks, and rough tillage and ridging at an angle to the prevailing wind can help to control soil blowing.

This soil is well suited to pasture. Overgrazing causes surface compaction, excessive runoff, and erosion. Proper stocking rates, rotation grazing or strip grazing, and restricted use during wet periods help to keep the pasture in good condition.

Most areas are used as woodland. The equipment limitation and plant competition are management concerns. The use of equipment is briefly restricted in spring and in other excessively wet periods. When the soil is wet, unsurfaced roads tend to be slippery and ruts form easily. Operating equipment during wet periods can result in surface compaction and can expose tree roots. Landings can be established in the small, nearly level areas, if available, or in the nearly level adjacent areas. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is well suited to recreational development. The slope is a limitation. Some land shaping and leveling may be needed on campsites, in picnic areas, and on playgrounds.

This soil is moderately well suited to building site development but is poorly suited to septic tank absorption fields. The slope is a limitation on building sites. Buildings should be designed so that they conform to the natural slope of the land. Land shaping may be necessary in some areas. The moderately slow permeability is a limitation on sites for septic tank absorption fields. Land shaping and installing the distribution lines across the slope can help to ensure the proper functioning of the absorption fields. Enlarged absorption fields or alternating drain fields may be needed because of the restricted permeability.

The land capability subclass is IIIe. The woodland ordination symbol is 3L. The Michigan soil management group is 2.5a-s.

34E—Alcona very fine sandy loam, 20 to 50 percent slopes. This deep, hilly to very steep, well drained soil is on hills and escarpments and in thickly incised drainageways in the uplands. Individual areas are irregularly shaped and range from 3 to more than 50 acres in size.

Typically, the surface layer is dark brown very fine sandy loam about 2 inches thick. The subsurface layer is dark grayish brown very fine sandy loam about 5 inches thick. The subsoil is about 12 inches thick. The upper part is dark brown and yellowish brown, very friable very fine sandy loam; the next part is very pale brown, loose very fine sandy loam; and the lower part is reddish brown, friable loam. The substratum to a depth of about 60 inches is very pale brown, calcareous, stratified loamy very fine sand and silt. In places the subsoil is darker and redder.

Included with this soil in mapping are small areas of the well drained Ontonagon soils. These soils are in landscape positions similar to those of the Alcona soil. Also, they contain more clay throughout. They make up 10 to 20 percent of the unit.

Permeability is moderate in the Alcona soil. The available water capacity is high. Surface runoff is very rapid.

Most areas are used as woodland. Erosion is a hazard, and the equipment limitation and plant competition are management concerns. Because of the erosion hazard, logging roads, skid trails, and landings should be established on gentle grades. Cross-drainage methods of water removal that are matched to specific sites are necessary. Out-sloping road surfaces, open-top drains, and culverts are needed. Rubber-tired or crawler tractors cannot be operated safely on slopes of more than 30 percent. Special logging methods, such as cable yarding, may be needed. The use of equipment is briefly restricted in spring and in other excessively wet periods. During wet periods, unsurfaced roads tend to be slippery and ruts form easily. Because of the slope, the number of suitable landing sites is limited. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is poorly suited to recreational development. The slope is a limitation. It can prohibit the construction of campsites and playgrounds or can significantly increase construction costs.

This soil is unsuited to building site development and septic tank absorption fields. The slope and the moderately slow permeability are limitations.

The land capability subclass is VIIe. The woodland ordination symbol is 3R. The Michigan soil management group is 2.5a-s.

37B—Emmet sandy loam, 1 to 6 percent slopes. This deep, nearly level and undulating, well drained soil is on broad plains, knolls, and ridges in the uplands. Individual areas are irregularly shaped and range from 5 to more than 400 acres in size.

Typically, the surface layer is dark grayish brown sandy loam about 8 inches thick. The subsurface layer is mixed dark grayish brown sandy loam and pale brown loamy sand about 4 inches thick. The subsoil extends to a depth of about 27 inches. It is reddish brown and pale brown, firm sandy loam in the upper part and reddish brown, very firm sandy clay loam in the lower part. The substratum to a depth of about 60 inches is brown, calcareous sandy loam. In places the surface layer is loamy sand more than 20 inches thick.

Included with this soil in mapping are small areas of the well drained Blue Lake and Cheboygan and somewhat poorly drained Riggsville soils. Blue Lake soils have more sand throughout than the Emmet soil, and Cheboygan soils have more sand in the surface layer and upper part of the subsoil. Blue Lake and Cheboygan soils are in landscape positions similar to those of the Emmet soil, and Riggsville soils are lower on the landscape. Included soils make up 5 to 10 percent of the unit.

Permeability is moderately slow in the Emmet soil. The available water capacity is low. Surface runoff is medium.

This soil is suited to such crops as corn, oats, alfalfa, and mixed grasses and legumes. Water erosion and soil blowing are hazards, and maintaining the organic matter content and conserving moisture during dry periods are management concerns. A cropping system that includes close-growing crops and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface reduce the hazard of water erosion by increasing the rate of water infiltration. Growing grasses and legumes for pasture or hay also is effective in controlling erosion. Grassed waterways, diversions, and drop structures help to prevent gullying. Conservation tillage, cover crops, buffer strips, field windbreaks, and rough tillage and ridging at an angle to the prevailing wind can help to control soil blowing, maintain the organic matter content, and increase the available water capacity.

The main concern in managing pastured areas is conserving moisture during dry periods. Maintaining an adequate ground cover by rotation grazing or strip grazing reduces the susceptibility to erosion and helps to keep the pasture in good condition.

Many areas are used as woodland. The equipment limitation and plant competition are management concerns. The use of equipment is briefly restricted in spring and in other excessively wet periods. When the soil is wet, unsurfaced roads tend to be slippery and ruts form easily. Operating equipment during wet periods can result in surface compaction and can expose tree roots. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is suited to recreational development. Because of the moderately slow permeability, however, the recreational areas should not be used during wet periods.

This soil is well suited to building site development but is poorly suited to septic tank absorption fields. The instability of cutbanks is a limitation on building sites. The sides of shallow excavations should be reinforced. The moderately slow permeability is a limitation on sites for septic tank absorption fields. Enlarged absorption fields or alternating drain fields may be needed because of the restricted permeability.

The land capability subclass is IIe. The woodland ordination symbol is 3L. The Michigan soil management group is 3a.

37C—Emmet sandy loam, 6 to 12 percent slopes. This deep, gently rolling, well drained soil is on knolls and ridges in the uplands. Individual areas are irregularly shaped and range from 3 to more than 400 acres in size.

Typically, the surface layer is dark grayish brown sandy loam about 8 inches thick. The subsurface layer is mixed dark grayish brown sandy loam and pale brown loamy sand about 4 inches thick. The subsoil extends to a depth of about 27 inches. It is reddish brown and pale brown, firm sandy loam in the upper part and reddish brown, very firm sandy clay loam in the lower part. The substratum to a depth of about 60 inches is brown, calcareous sandy loam. In places the surface layer is loamy sand more than 20 inches thick.

Included with this soil in mapping are small areas of the well drained Blue Lake and Cheboygan soils. Blue Lake soils have more sand throughout than the Emmet soil, and Cheboygan soils have more sand in the surface layer and the upper part of the subsoil. Both of the included soils are in landscape positions similar to those of the Emmet soil. They make up 8 to 10 percent of the unit.

Permeability is moderately slow in the Emmet soil.

The available water capacity is low. Surface runoff is medium.

This soil is suited to such crops as corn, oats, alfalfa, and mixed grasses and legumes. Water erosion and soil blowing are hazards, and maintaining the organic matter content and conserving moisture during dry periods are management concerns. A cropping system that includes close-growing crops and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface reduce the hazard of water erosion by increasing the rate of water infiltration. Growing grasses and legumes for pasture or hay also is effective in controlling erosion. Grassed waterways, diversions, and drop structures help to prevent gullying. Conservation tillage, cover crops, buffer strips, field windbreaks, and rough tillage and ridging at an angle to the prevailing wind can help to control soil blowing, maintain the organic matter content, and increase the available water capacity.

The main concern in managing pastured areas is conserving moisture during dry periods. Maintaining an adequate ground cover by rotation grazing or strip grazing reduces the susceptibility to erosion and helps to keep the pasture in good condition.

Many areas are used as woodland. The equipment limitation and plant competition are management concerns. The use of equipment is briefly restricted in spring and in other excessively wet periods. When the soil is wet, unsurfaced roads tend to be slippery and ruts form easily. Operating equipment during wet periods can result in surface compaction and can expose tree roots. Landings can be established in the small, nearly level included areas, if available, or in the nearly level adjacent areas. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is suited to recreational development. The slope and the moderately slow permeability are limitations. Some land shaping and leveling may be needed on campsites, in picnic areas, and on playgrounds. Because of the moderately slow permeability, the recreational areas should not be used during wet periods.

This soil is moderately well suited to building site development but is poorly suited to septic tank absorption fields. The slope and the instability of cutbanks are limitations on building sites. Buildings should be designed so that they conform to the natural slope of the land. The sides of shallow excavations should be reinforced. The moderately slow permeability and the slope are limitations on sites for septic tank absorption fields. Land shaping and installing the distribution lines across the slope help to ensure the proper functioning of the absorption fields. Enlarged absorption fields or alternating drain fields may be needed because of the restricted permeability.

The land capability subclass is IIIe. The woodland ordination symbol is 3L. The Michigan soil management group is 3a.

37D—Emmet sandy loam, 12 to 18 percent slopes. This deep, rolling, well drained soil is on high knolls and ridges in the uplands. Individual areas are irregularly shaped and range from 3 to more than 300 acres in size.

Typically, the surface layer is dark grayish brown sandy loam about 8 inches thick. The subsurface layer is mixed dark grayish brown sandy loam and pale brown loamy sand about 4 inches thick. The subsoil extends to a depth of about 27 inches. It is reddish brown and pale brown, firm sandy loam in the upper part and reddish brown, very firm sandy clay loam in the lower part. The substratum to a depth of about 60 inches is brown, calcareous sandy loam. In places the surface layer is loamy sand more than 20 inches thick.

Included with this soil in mapping are small areas of the well drained Blue Lake and Cheboygan soils. Blue Lake soils have more sand throughout than the Emmet soil, and Cheboygan soils have more sand in the surface layer and the upper part of the subsoil. Both of the included soils are in landscape positions similar to those of the Emmet soil. They make up 8 to 15 percent of the unit.

Permeability is moderately slow in the Emmet soil. The available water capacity is low. Surface runoff is rapid.

Most areas are used as woodland. The equipment limitation and plant competition are management concerns. The use of equipment is briefly restricted in spring and in other excessively wet periods. When the soil is wet, unsurfaced roads tend to be slippery and ruts form easily. Because of the slope, the number of suitable landing sites is limited. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is poorly suited to recreational development. The slope can prohibit the construction of campsites and playgrounds or can significantly increase construction costs.

This soil is poorly suited to building site development and septic tank absorption fields. The slope and the instability of cutbanks are limitations. Buildings should be designed so that they conform to the natural slope of the land. Land shaping may be necessary in some areas. The slope and the moderately slow permeability are limitations on sites for septic tank absorption fields.

Land shaping and installing the distribution lines across the slope can help to ensure the proper functioning of the absorption fields. Enlarged absorption fields or alternating drain fields may be needed because of the restricted permeability.

The land capability subclass is IVe. The woodland ordination symbol is 3L. The Michigan soil management group is 3a.

38B—Onaway loam, 1 to 6 percent slopes. This deep, nearly level and undulating, well drained soil is on knolls, ridges, and broad plains in the uplands. Individual areas are irregularly shaped and range from 3 to more than 300 acres in size.

Typically, the surface layer is black loam about 4 inches thick. The subsurface layer is brown sandy loam about 4 inches thick. The subsoil is about 24 inches thick. The upper part is dark brown, friable sandy loam; the next part is brown, pale brown, and dark brown, friable loam and sandy loam; and the lower part is dark brown and dark yellowish brown, friable loam. The substratum to a depth of about 60 inches is yellowish brown, calcareous loam. In some places the soil has less clay throughout. In other places depth to the substratum is more than 35 inches.

Included with this soil in mapping are small areas of the somewhat poorly drained Alstad and well drained Fairport and Emmet soils. Fairport and Emmet soils are in landscape positions similar to those of the Onaway soil, and Alstad soils are lower on the landscape. Fairport soils have limestone bedrock within a depth of 40 inches. Emmet soils have less clay in the subsoil and substratum than the Onaway soil. Included soils make up 5 to 10 percent of the unit.

Permeability is moderately slow in the Onaway soil. The available water capacity is high. Surface runoff is medium.

This soil is well suited to such crops as corn, small grains, and grasses and legumes. Water erosion is a hazard, and maintaining tilth is a management concern. A cropping system that includes close-growing crops and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface reduce the hazard of water erosion by minimizing surface crusting and increasing the rate of water infiltration. Growing grasses and legumes for pasture or hay also is effective in controlling erosion. Grassed waterways, diversions, and drop structures help to prevent gullying. Working the soil when it is too wet results in cloddiness and surface compaction. Applying a system of conservation tillage, adding organic material to the soil, and tilling within the proper range in moisture content help to maintain good tilth.

This soil is well suited to pasture. The main concerns are conserving moisture during dry periods, maintaining tilth, and controlling erosion. Maintaining an adequate ground cover by rotation grazing or strip grazing reduces the susceptibility to erosion and helps to keep the pasture in good condition.

Most areas are used as woodland. The equipment limitation and plant competition are management concerns. The use of equipment is restricted in spring and in other excessively wet periods. The upper part of the subsoil is saturated during these periods. When the soil is wet, unsurfaced roads tend to be slippery and ruts form easily. Operating equipment during wet periods can result in surface compaction and can expose tree roots. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is suited to recreational development. Because of the moderately slow permeability, however, the recreational areas should not be used during wet periods.

This soil is well suited to building site development but is poorly suited to septic tank absorption fields. No major concerns affect the use of the soil for building site development. The moderately slow permeability is a limitation on sites for septic tank absorption fields. Enlarged absorption fields or alternating drain fields may be needed because of the restricted permeability.

The land capability subclass is IIe. The woodland ordination symbol is 3L. The Michigan soil management group is 2.5a.

38C—Onaway loam, 6 to 12 percent slopes. This deep, gently rolling, well drained soil is on knolls, ridges, and broad plains in the uplands. Individual areas are irregularly shaped and range from 3 to more than 200 acres in size.

Typically, the surface layer is black loam about 4 inches thick. The subsurface layer is brown sandy loam about 4 inches thick. The subsoil is about 24 inches thick. The upper part is dark brown, friable sandy loam; the next part is brown, pale brown, and dark brown, friable loam and sandy loam; and the lower part is dark brown and dark yellowish brown, friable loam. The substratum to a depth of about 60 inches is yellowish brown, calcareous loam. In some places the soil has less clay throughout. In other places depth to the substratum is more than 35 inches.

Included with this soil in mapping are small areas of the well drained Fairport and Emmet soils. Fairport soils have limestone bedrock within a depth of 40 inches. Emmet soils have less clay in the subsoil and substratum than the Onaway soil. Both of the included soils are in landscape positions similar to those of the

Onaway soil. They make up 8 to 15 percent of the unit.

Permeability is moderately slow in the Onaway soil. The available water capacity is high. Surface runoff is medium.

This soil is moderately well suited to such crops as corn, small grains, and grasses and legumes. Water erosion is a hazard, and maintaining good tilth is a management concern. A cropping system that includes close-growing crops and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface reduce the hazard of water erosion by minimizing surface crusting and increasing the rate of water infiltration. Growing grasses and legumes for pasture or hay also is effective in controlling erosion. Grassed waterways, diversions, and drop structures help to prevent gullying. Working the soil when it is too wet results in cloddiness and surface compaction. Applying a system of conservation tillage, adding organic material to the soil, and tilling within the proper range in moisture content help to maintain good tilth.

This soil is fairly well suited to pasture. The main concerns are conserving moisture during dry periods, maintaining tilth, and controlling erosion. Maintaining an adequate ground cover by rotation grazing or strip grazing reduces the susceptibility to erosion and helps to keep the pasture in good condition.

Most areas are used as woodland. The equipment limitation and plant competition are management concerns. The use of equipment is briefly restricted in spring and in other excessively wet periods. When the soil is wet, unsurfaced roads tend to be slippery and ruts form easily. Landings can be established in the small, nearly level included areas, if available, or in the nearly level adjacent areas. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is suited to recreational development. The slope and the moderately slow permeability are limitations. Some land shaping and leveling may be needed on campsites, in picnic areas, and on playgrounds. Because of the moderately slow permeability, the recreational areas should not be used during wet periods.

This soil is moderately well suited to building site development but is poorly suited to septic tank absorption fields. The slope is a limitation on building sites. Buildings should be designed so that they conform to the natural slope of the land. Land shaping may be necessary in some areas. Slopes should be stabilized to prevent excessive erosion. The moderately slow permeability and the slope are limitations on sites for septic tank absorption fields. Enlarged absorption fields or alternating drain fields may be needed because of the restricted permeability. Land shaping and installing the distribution lines across the slope can help to ensure the proper functioning of the absorption fields.

The land capability subclass is IIIe. The woodland ordination symbol is 3L. The Michigan soil management group is 2.5a.

38E—Onaway loam, 18 to 25 percent slopes. This deep, steep, well drained soil is on hills and ridges in the uplands. Individual areas are irregularly shaped and range from 3 to more than 40 acres in size.

Typically, the surface layer is black loam about 4 inches thick. The subsurface layer is brown sandy loam about 4 inches thick. The subsoil is about 24 inches thick. The upper part is dark brown, friable sandy loam; the next part is brown, pale brown, and dark brown, friable loam and sandy loam; and the lower part is dark brown and dark yellowish brown, friable loam. The substratum to a depth of about 60 inches is yellowish brown, calcareous loam. In some places the soil has less clay throughout. In other places depth to the substratum is more than 35 inches.

Included with this soil in mapping are small areas of the well drained Fairport and Emmet soils. Fairport soils have limestone bedrock within a depth of 40 inches. Emmet soils have less clay in the subsoil and substratum than the Onaway soil. Both of the included soils are in landscape positions similar to those of the Onaway soil. They make up 8 to 15 percent of the unit.

Permeability is moderately slow in the Onaway soil. The available water capacity is high. Surface runoff is rapid.

Most areas are used as woodland. Erosion is a hazard, and the equipment limitation and plant competition are management concerns. Because of the erosion hazard, logging roads, skid trails, and landings should be established on gentle grades. Cross-drainage methods of water removal that are matched to specific sites are necessary. Out-sloping road surfaces, open-top drains, and culverts are needed. Rubber-tired and crawler tractors can be operated safely on these slopes, but caution is needed and the steeper slopes should be avoided. The use of equipment is briefly restricted in spring and in other excessively wet periods. When the soil is wet, unsurfaced roads tend to be slippery and ruts form easily. Because of the slope, the number of suitable landing sites is limited. The best sites are the small, nearly level included areas, if available, and the nearly level adjacent areas. Landings should be stabilized. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is poorly suited to recreational development. The slope and the moderately slow permeability are limitations. The slope can prohibit the construction of campsites and playgrounds or can significantly increase construction costs. Because of the moderately slow permeability, the recreational areas should not be used during wet periods.

This soil is poorly suited to building site development and unsuited to septic tank absorption fields. The slope is a limitation on building sites. Buildings should be designed so that they conform to the natural slope of the land. Land shaping may be necessary in some areas. Slopes should be stabilized to prevent excessive erosion. The moderately slow permeability and the slope are limitations on sites for septic tank absorption fields. Enlarged absorption fields or alternating drain fields may be needed because of the restricted permeability. Land shaping and installing the distribution lines across the slope can help to ensure the proper functioning of the absorption fields.

The land capability subclass is VIe. The woodland ordination symbol is 3R. The Michigan soil management group is 2.5a.

39B—Nester loam, 2 to 6 percent slopes. This deep, undulating, well drained soil is on knolls and ridges in the uplands. Individual areas are irregularly shaped and range from 8 to more than 100 acres in size.

Typically, the surface layer is very dark grayish brown loam about 9 inches thick. The subsoil extends to a depth of about 19 inches. It is mixed, friable, light brownish gray sandy loam and reddish brown clay loam in the upper part and reddish brown, firm clay loam in the lower part. The substratum to a depth of about 60 inches is reddish brown, calcareous clay loam. In places the surface layer is clay loam.

Included with this soil in mapping are small areas of the well drained Onaway soils. These soils are in landscape positions similar to those of the Nester soil. Also, they have less clay in the subsoil and substratum. They make up 5 to 10 percent of the unit.

Permeability is slow in the Nester soil. The available water capacity is high. Surface runoff is medium. The shrink-swell potential is moderate.

This soil is well suited to such crops as corn, small grains, and grasses and legumes. Water erosion is a hazard, and maintaining good tilth is a management concern. A cropping system that includes close-growing crops and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface reduce the hazard of water erosion by minimizing surface crusting and increasing the rate of water infiltration. Growing grasses and legumes for pasture or hay also is effective in controlling erosion. Grassed waterways, diversions, and drop structures help to prevent gullying. Working the soil when it is too wet results in cloddiness and surface compaction. Applying a system of conservation tillage, adding organic material to the soil, and tilling within the proper range in moisture content help to maintain good tilth.

This soil is well suited to pasture. Overgrazing causes surface compaction, excessive runoff, and erosion. Proper stocking rates, rotation grazing or strip grazing, and restricted use during wet periods help to keep the pasture in good condition.

Most areas are used as woodland. The equipment limitation and plant competition are management concerns. The use of equipment is briefly restricted in spring and in other excessively wet periods. When the soil is wet, unsurfaced roads tend to be slippery and ruts form easily. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is suited to recreational development. Because of the slow permeability, however, the recreational areas should not be used during wet periods.

This soil is moderately well suited to building site development but is poorly suited to septic tank absorption fields. The high shrink-swell potential is a limitation on building sites. Widening the foundation trench and backfilling the trench with suitable coarse material can help to overcome this limitation. The slow permeability is a limitation on sites for septic tank absorption fields. Enlarged absorption fields or alternating drain fields may be needed.

The land capability subclass is IIe. The woodland ordination symbol is 3L. The Michigan soil management group is 1.5a.

39C—Nester loam, 6 to 15 percent slopes. This deep, gently rolling and rolling, well drained soil is on side slopes in the uplands. Individual areas are irregularly shaped and range from 3 to more than 20 acres in size.

Typically, the surface layer is very dark grayish brown loam about 9 inches thick. The subsoil extends to a depth of about 19 inches. It is mixed, friable, light brownish gray sandy loam and reddish brown clay loam in the upper part and reddish brown, firm clay loam in the lower part. The substratum to a depth of about 60 inches is reddish brown, calcareous clay loam. In places the surface layer is clay loam.

Included with this soil in mapping are small areas of the well drained Onaway soils. These soils are in landscape positions similar to those of the Nester soil. Also, they have less clay in the subsoil and substratum. They make up 5 to 10 percent of the unit.

Permeability is slow in the Nester soil. The available water capacity is high. Surface runoff is medium. The shrink-swell potential is moderate.

This soil is fairly well suited to such crops as corn, small grains, and grasses and legumes. Water erosion is a hazard, and maintaining good tilth is a management concern. A cropping system that includes close-growing crops and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface reduce the hazard of water erosion by minimizing surface crusting and increasing the rate of water infiltration. Growing grasses and legumes for pasture or hay also is effective in controlling erosion. Grassed waterways, diversions, and drop structures help to prevent gullying. Working the soil when it is too wet results in cloddiness and surface compaction. Applying a system of conservation tillage, adding organic material to the soil, and tilling within the proper range in moisture content help to maintain good tilth.

This soil is well suited to pasture. Overgrazing causes surface compaction, excessive runoff, and erosion. Proper stocking rates, rotation grazing or strip grazing, and restricted use during wet periods help to keep the pasture in good condition.

Most areas are used as woodland. The equipment limitation and plant competition are management concerns. The use of equipment is briefly restricted in spring and in other excessively wet periods. When the soil is wet, unsurfaced roads tend to be slippery and ruts form easily. Landings can be established in the small, nearly level included areas, if available, or in the nearly level adjacent areas. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is suited to recreational development. The slope and the slow permeability are limitations. Some land shaping or leveling may be needed on campsites, in picnic areas, and on playgrounds. Because of the slow permeability, the recreational areas should not be used during wet periods.

This soil is moderately well suited to building site development but is poorly suited to septic tank absorption fields. The slope and the high shrink-swell potential are limitations on building sites. Buildings should be designed so that they conform to the natural slope of the land. Widening the foundation trench and backfilling the trench with suitable coarse material can help to overcome the shrink-swell potential. The slow permeability and the slope are limitations on sites for septic tank absorption fields. Land shaping and installing the distribution lines across the slope can help to ensure the proper functioning of the absorption fields. Enlarged absorption fields or alternating drain fields may be needed because of the restricted permeability.

The land capability subclass is IIIe. The woodland ordination symbol is 3L. The Michigan soil management group is 1.5a.

40B—Ontonagon silt loam, 0 to 4 percent slopes. This deep, nearly level and undulating, moderately well drained soil is on narrow flats and knolls in the uplands. Escarpments are common along the sides of streams. Individual areas are irregularly shaped and range from 3 to more than 20 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 11 inches thick. The subsoil is about 15 inches thick. It is mottled. The upper part is mixed, friable, reddish brown clay and pale brown silt loam; the next part is reddish brown, friable clay; and the lower part is reddish brown, firm clay. The substratum to a depth of about 60 inches is light reddish brown, mottled, calcareous silty clay. In places the subsoil has less clay and more silt.

Included with this soil in mapping are small areas of the somewhat poorly drained Rudyard soils. These soils are in small depressions and drainageways. They make up 5 to 10 percent of the unit.

Permeability is very slow in the Ontonagon soil. The available water capacity is high. Surface runoff is medium. A seasonal high water table is at a depth of about 2.5 to 6.0 feet from autumn to spring. The shrink-swell potential is high.

This soil is well suited to such crops as small grains and grasses and legumes. Erosion is a hazard, and maintaining good tilth is a management concern. A cropping system that includes close-growing crops and a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface reduce the hazard of water erosion by minimizing surface crusting and increasing the rate of water infiltration. Growing grasses and legumes for pasture or hay also is effective in controlling erosion. Grassed waterways, diversions, and drop structures help to prevent gullying. Working the soil when it is too wet results in cloddiness and surface compaction. Applying a system of conservation tillage, adding organic material to the soil, and tilling within the proper range in moisture content help to maintain good tilth.

This soil is well suited to pasture. Overgrazing causes surface compaction, excessive runoff, and erosion. Proper stocking rates, rotation grazing or strip grazing, and restricted use during wet periods help to keep the pasture in good condition.

If this soil is used as woodland, windthrow is a hazard and the equipment limitation, seedling mortality, and plant competition are management concerns. Because of the wetness, the trees are shallow rooted. Some may be blown down during periods of high wind. Windthrow losses can be minimized by cutting systems that do not isolate the remaining trees or allow them to funnel the wind. The use of equipment is briefly restricted in spring and in other excessively wet periods. When the soil is wet, unsurfaced roads tend to be slippery and ruts form easily. Special planting stock, such as containerized seedlings, and special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. Furrowing before planting also reduces the seedling mortality rate. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is suited to recreational development. Because of the very slow permeability, however, the recreational areas should not be used during wet periods.

This soil is moderately suited to building site development but is poorly suited to septic tank absorption fields. The high content of clay and the high shrink-swell potential are limitations on building sites. Widening the foundation trench and backfilling the trench with suitable coarse material can help to overcome the shrink-swell potential. The seasonal high water table and the very slow permeability are limitations on sites for septic tank absorption fields. Enlarging the absorption fields and filling or mounding with suitable soil material help to overcome these limitations. Surface and subsurface drainage systems can lower the water table.

The land capability subclass is IIIe. The woodland ordination symbol is 2C. The Michigan soil management group is Oa.

40D2—Ontonagon silty clay, 12 to 25 percent slopes, eroded. This deep, rolling and hilly, well drained soil is adjacent to streams and on the sides of ridges in the uplands. Escarpments are common along the sides of streams. Individual areas are irregularly shaped and range from 3 to more than 100 acres in size.

Typically, the surface layer is dark brown silty clay about 6 inches thick. The subsoil is reddish brown, firm, calcareous clay about 3 inches thick. The substratum to a depth of about 60 inches is reddish brown, calcareous silty clay. In some places the subsoil has less clay and more silt. In other places the surface layer is mainly material from the subsoil.

Included with this soil in mapping are small areas of the well drained Alcona soils. These soils have less clay in the subsoil and substratum than the Ontonagon soil. They are on ridgetops and side slopes. They make up 5 to 10 percent of the unit.

Permeability is very slow in the Ontonagon soil. The available water capacity is high. Surface runoff is very rapid. The shrink-swell potential is high.

Most areas are used as woodland. The erosion hazard, the equipment limitation, the windthrow hazard, seedling mortality, and plant competition are management concerns. Because of the erosion hazard, logging roads, skid trails, and landings should be established on gentle grades. Cross-drainage methods of water removal that are matched to specific sites are necessary. Out-sloping road surfaces, open-top drains, and culverts are needed. Because of the wetness, the trees are shallow rooted. Some may be blown down during periods of high wind. Windthrow losses can be minimized by cutting systems that do not isolate the remaining trees or allow them to funnel the wind. The use of equipment is briefly restricted in spring and in other excessively wet periods. When the soil is wet, unsurfaced roads tend to be slippery and ruts form easily. Rubber-tired and crawler tractors can be operated safely on these slopes, but caution is needed and the steeper slopes should be avoided. Landings can be established in the nearly level adjacent areas. Special planting stock, such as containerized seedlings, and special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. Furrowing before planting also reduces the seedling mortality rate. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is poorly suited to recreational development. The very slow permeability and the slope are limitations. The slope can prohibit the construction of campsites and playgrounds or can significantly increase construction costs.

This soil is poorly suited to building site development and unsuited to septic tank absorption fields. The slope, the high clay content, and the high shrink-swell potential are limitations on building sites. Buildings should be designed so that they conform to the natural slope of the land. Land shaping may be necessary in some areas. Widening the foundation trench and backfilling the trench with suitable coarse material can help to overcome the shrink-swell potential. The slope and the very slow permeability are limitations on sites for septic tank absorption fields. Soils that are better suited to this use generally are nearby.

The land capability subclass is VIe. The woodland ordination symbol is 2R. The Michigan soil management group is Oa.

41A—Au Gres sand, 0 to 3 percent slopes. This deep, nearly level, somewhat poorly drained soil is on low knolls and ridges and broad plains in the uplands. Individual areas are irregularly shaped and range from 3 to more than 500 acres in size.

Typically, the surface layer is mixed very dark gray and light brownish gray sand about 1 inch thick. The subsurface layer is light brownish gray, mottled sand about 10 inches thick. The subsoil is sand about 26 inches thick. It is mottled. The upper part is dark brown and is loose and very friable, and the lower part is strong brown and loose. The substratum to a depth of about 60 inches is yellowish brown, mottled sand. In some places the subsoil is darker red. In other places the soil has a loamy substratum below a depth of 40 inches. In some areas sand and gravel are below a depth of 40 inches.

Included with this soil in mapping are small areas of the moderately well drained Croswell and very poorly drained Roscommon soils. Croswell soils are on ridgetops and the tops of knolls. Roscommon soils are in drainageways and depressions. Included soils make up 10 to 15 percent of the unit.

Permeability is rapid in the Au Gres soil. The available water capacity is low. Surface runoff is very slow. A seasonal high water table is at a depth of 0.5 foot to 1.5 feet from late autumn to early summer.

Most areas are used as woodland. Windthrow is a hazard, and the equipment limitation, seedling mortality, and plant competition are management concerns. Because of the seasonal high water table, the trees are shallow rooted. Some may be blown down during periods of high wind. Windthrow losses can be minimized by cutting systems that do not isolate the remaining trees or allow them to funnel the wind. Ruts form easily if wheeled skidders are used when the soil is wet (fig. 6). Deep ruts tend to restrict lateral drainage, expose tree roots, and alter soil structure. Such damage can be avoided if the use of equipment is restricted to periods when the soil is relatively dry or frozen. The best sites for landings are in areas of the included Croswell soils.

Seedling losses may be high during wet spring months and dry summer months. Special planting stock, such as containerized seedlings, and special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. Furrowing before planting also reduces the seedling mortality rate. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is poorly suited to recreational development. The seasonal high water table and the sandy surface layer are limitations. Adding a layer of loamy material to the surface and seeding deep-rooted grasses and legumes can help to overcome these limitations.

This soil is poorly suited to building site development and septic tank absorption fields. The wetness and the instability of cutbanks are limitations on building sites. Buildings can be constructed on well compacted fill material, which raises the level of the site. The sides of shallow excavations should be reinforced. The wetness and a poor filtering capacity are limitations on sites for septic tank absorption fields. Enlarging the absorption fields and filling or mounding with suitable soil material help to overcome these limitations. Also, surface and subsurface drainage systems help to lower the water table. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability subclass is IVw. The woodland ordination symbol is 6W. The Michigan soil management group is 5b.

43A—Battlefield sand, 0 to 3 percent slopes. This deep, somewhat poorly drained soil is on low knolls, ridges, and broad plains in the uplands. Individual areas are irregularly shaped and range from 3 to more than 150 acres in size.

Typically, the surface layer is mixed very dark gray and gray sand about 1 inch thick. The subsurface layer is light brownish gray sand about 4 inches thick. The subsoil is about 27 inches thick. It is mottled. The upper part is dark brown and strong brown, very friable sand; the next part is strong brown, very friable gravelly sand; and the lower part is yellowish brown, loose sand. The substratum to a depth of about 60 inches is pale brown, mottled, calcareous gravelly sand. In some places the soil is moderately well drained. In other places the lower part of the subsoil has more clay.

Included with this soil in mapping are small areas of the somewhat poorly drained Au Gres and somewhat excessively drained East Lake soils. Au Gres soils do not have gravel in the substratum. They are in landscape positions similar to those of the Battlefield soil. East Lake soils are on high knolls and ridges. Included soils make up 8 to 15 percent of the unit.

Permeability is very rapid in the Battlefield soil. The available water capacity is low. Surface runoff is very slow. A seasonal high water table is at a depth of about 0.5 foot to 1.5 feet from late autumn to spring.

Most areas are used as woodland. Windthrow is a

Figure 6.—Ruts in an area of Au Gres sand, 0 to 3 percent slopes. Restricting the use of equipment to periods when the ground is dry or frozen helps to prevent the formation of ruts.

hazard, and the equipment limitation, seedling mortality, and plant competition are management concerns. Because of the seasonal high water table, the trees are shallow rooted. Some may be blown down during periods of high wind. Windthrow losses can be minimized by cutting systems that do not isolate the remaining trees or allow them to funnel the wind. Ruts form easily if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage, expose tree roots, and alter soil structure. Such damage can be avoided if the use of equipment is restricted to periods when the soil is relatively dry or frozen.

Seedling losses may be high during wet spring months and dry summer months. Special planting stock, such as containerized seedlings, and special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. Furrowing before planting also reduces the seedling mortality rate. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is poorly suited to recreational development. The seasonal high water table and the sandy surface layer are limitations. Because of the sandy surface layer, a layer of loamy material should be added to the surface and deep-rooted grasses and legumes should be seeded.

This soil is poorly suited to building site development and septic tank absorption fields. The wetness and the instability of cutbanks are limitations on building sites. Buildings can be constructed on well compacted fill material, which raises the level of the site. The sides of shallow excavations should be reinforced. Surface and subsurface drainage systems can lower the water table. The wetness and a poor filtering capacity are limitations on sites for septic tank absorption fields. Enlarging the absorption fields and filling or mounding with suitable soil material help to overcome these limitations. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability subclass is IIIw. The woodland ordination symbol is 5W. The Michigan soil management group is 5b.

45B—Croswell sand, 1 to 4 percent slopes. This deep, nearly level and undulating, moderately well drained soil is on ridges, knolls, and broad plains in the uplands. Individual areas are irregularly shaped and range from 3 to more than 100 acres in size.

Typically, the surface layer is black sand about 1 inch thick. The subsurface layer is pinkish gray sand about 6 inches thick. The subsoil is sand about 32 inches thick. The upper part is strong brown and friable, and the lower part is brownish yellow, mottled, and loose. The substratum to a depth of about 60 inches is light yellowish brown, mottled sand. In places the water table is below a depth of 60 inches.

Included with this soil in mapping are areas that have slopes of more than 4 percent. Also included are small areas of the somewhat poorly drained Au Gres and somewhat excessively drained East Lake soils. Au Gres soils are in shallow depressions and drainageways. East Lake soils have calcareous gravel in the substratum. They are in the slightly higher positions on the landscape. Included soils make up 5 to 8 percent of the unit.

Permeability is rapid in the Croswell soil. The available water capacity is low. Surface runoff is very slow. A seasonal high water table is at a depth of 2 to 4 feet from late autumn to spring.

Most areas are used as woodland. Windthrow is a hazard, and the equipment limitation, seedling mortality, and plant competition are management concerns. Because of the seasonal high water table, the trees are shallow rooted. Some may be blown down during periods of high wind. Windthrow losses can be minimized by cutting systems that do not isolate the remaining trees or allow them to funnel the wind. In heavily traveled areas, loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. Because of dry weather conditions, the loss of planted or natural seedlings may be as high as 25 to 50 percent. Special planting stock, such as containerized seedlings, and special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. Furrowing before planting also reduces the seedling mortality rate. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is poorly suited to recreational development. The sandy surface layer and the seasonal high water table are limitations. Adding a layer of loamy material to the surface and seeding with thick-rooted grasses and legumes can help to overcome these limitations.

This soil is poorly suited to building site development and septic tank absorption fields. The wetness and the instability of cutbanks are limitations on building sites. Buildings can be constructed on well compacted fill material, which raises the level of the site. The sides of shallow excavations should be reinforced. The wetness and a poor filtering capacity are limitations on sites for septic tank absorption fields. Enlarging the absorption fields and filling or mounding with suitable soil material help to overcome these limitations. Also, surface and subsurface drainage systems help to lower the water table. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability subclass is IVs. The woodland ordination symbol is 5S. The Michigan soil management group is 5a.

47A—Ingalls loamy sand, 0 to 3 percent slopes. This deep, nearly level, somewhat poorly drained soil is on low plains and in swales on uplands. Individual areas are irregularly shaped and range from 3 to more than 150 acres in size.

Typically, the surface layer is dark grayish brown loamy sand about 8 inches thick. The subsurface layer is light gray, mottled sand about 3 inches thick. The subsoil is mottled loamy sand about 11 inches thick. The upper part is dark reddish brown and friable, the next part is strong brown and very friable, and the lower part is yellowish brown and friable. The substratum to a depth of about 60 inches is light brown, mottled, calcareous, stratified loamy very fine sand and silt.

Included with this soil in mapping are small areas of the very poorly drained Burleigh and well drained Ocqueoc soils. Burleigh soils are in depressions.

Ocqueoc soils are in the higher landscape positions. Included soils make up 5 to 10 percent of the unit.

Permeability is rapid in the upper part of the Ingalls soil and moderately slow in the lower part. The available water capacity is moderate. Surface runoff is very slow. A seasonal high water table is at a depth of 0.5 foot to 1.5 feet from late autumn to spring.

This soil is fairly well suited to such crops as corn, small grains, and grasses and legumes if a drainage system is installed. Soil blowing is a hazard, and removing excess water during wet periods and maintaining good tilth are management concerns. A system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface, cover crops, buffer strips, and field windbreaks help to control soil blowing.

A combination of surface and subsurface drains can reduce the wetness in the cropped areas. Shallow surface ditches are effective in removing surface water if adequate drainage outlets are available. Erosion-control structures may be needed where the surface ditches enter other drainageways. If adequate drainage outlets are available, a subsurface drainage system can help to lower the high water table. The tile lines can become clogged with fine sand unless they are protected with suitable material. Applying a system of conservation tillage, adding organic material to the soil, and tilling within the proper range in moisture content help to maintain good tilth.

The main concern in managing pastured areas is conserving moisture during dry periods. Maintaining an adequate ground cover by rotation grazing or strip grazing reduces the susceptibility to erosion and helps to keep the pasture in good condition.

Most areas are used as woodland. Windthrow is a hazard, and the equipment limitation, seedling mortality, and plant competition are management concerns. Because of the seasonal high water table, the trees are shallow rooted. Some may be blown down during periods of high wind. Windthrow losses can be minimized by cutting systems that do not isolate the remaining trees or allow them to funnel the wind. Ruts form easily if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage, expose tree roots, and alter soil structure. Such damage can be avoided if the use of equipment is restricted to periods when the soil is relatively dry or frozen.

Seedling losses may be high during wet spring months and dry summer months. Special planting stock, such as containerized seedlings, and special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. Furrowing before planting also reduces the seedling mortality rate. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is poorly suited to recreational development. The seasonal high water table, the sandy surface layer, and the moderately slow permeability are limitations. Because of the sandy surface layer, a layer of loamy material should be added and deep-rooted grasses and legumes should be seeded.

This soil is poorly suited to building site development and septic tank absorption fields. The seasonal high water table and the instability of cutbanks are limitations on building sites. Buildings can be constructed on well compacted fill material, which raises the level of the site. The sides of shallow excavations should be reinforced. The wetness and the moderately slow permeability are limitations on sites for septic tank absorption fields. Enlarging the absorption field and filling or mounding with suitable soil material help to overcome these limitations. Also, surface and subsurface drainage systems help to lower the water table.

The land capability subclass is IIIw. The woodland ordination symbol is 4W. The Michigan soil management group is 4/2b.

48A—Allendale sand, 0 to 3 percent slopes. This deep, nearly level, somewhat poorly drained soil is on low ridges in the uplands. Individual areas are long and narrow and range from 7 to more than 50 acres in size.

Typically, the surface layer is very dark brown sand about 9 inches thick. The subsoil extends to a depth of about 25 inches. It is mottled and loose. The upper part is light yellowish brown sand, and the lower part is grayish brown gravelly loamy sand. The substratum to a depth of about 60 inches is reddish brown, mottled, calcareous silty clay. In places the subsoil is darker red.

Included with this soil in mapping are small areas of the very poorly drained Pinconning and poorly drained Charity soils. Pinconning soils are in depressions. Charity soils have more clay in the subsurface layer and subsoil than the Allendale soil. They are in swales. Included soils make up 5 to 10 percent of the unit.

Permeability is rapid in the upper part of the Allendale soil and very slow in the lower part. The available water capacity is moderate. Surface runoff is very slow. A seasonal high water table is at a depth of about 1 to 2 feet from late autumn to early summer. The shrink-swell potential is moderate.

This soil is fairly well suited to such crops as small grains and grasses and legumes. Soil blowing is a hazard, and removing excess water during wet periods and maintaining good tilth are management concerns. A system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface, cover crops, buffer strips, and field windbreaks help to control soil blowing.

A combination of surface and subsurface drains can reduce the wetness in the cropped areas. Shallow surface ditches are effective in removing surface water if adequate drainage outlets are available. Erosion-control structures may be needed where the surface ditches enter other drainageways. If adequate drainage outlets are available, a subsurface drainage system can help to lower the high water table. The tile lines can become clogged with fine sand unless they are protected with suitable material. Applying a system of conservation tillage, adding organic material to the soil, and tilling within the proper range in moisture content help to maintain good tilth.

This soil is well suited to pasture. The main concerns are conserving moisture during dry periods and maintaining good tilth. Maintaining an adequate ground cover by rotation grazing or strip grazing helps to keep the pasture in good condition.

Most areas are used as woodland. Windthrow is a hazard, and the equipment limitation and plant competition are management concerns. Because of the seasonal high water table, the trees are shallow rooted. Some may be blown down during periods of high wind. Windthrow losses can be minimized by cutting systems that do not isolate the remaining trees or allow them to funnel the wind. Ruts form easily if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage, expose tree roots, and alter soil structure. Such damage can be avoided if the use of equipment is restricted to periods when the soil is relatively dry or frozen. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is poorly suited to recreational development. The seasonal high water table, the sandy surface layer, and the very slow permeability are limitations. Because of the sandy surface layer, a layer of loamy material should be added to the surface and deep-rooted grasses and legumes should be seeded.

This soil is poorly suited to building site development and septic tank absorption fields. The seasonal high water table is a limitation on building sites. Buildings can be constructed on well compacted fill material, which raises the level of the site. The wetness, a poor filtering capacity, and the very slow permeability are limitations on sites for septic tank absorption fields. Enlarging the absorption fields and filling or mounding with suitable soil material help to overcome these limitations. Also, surface and subsurface drainage systems can lower the water table.

The land capability subclass is IIIw. The woodland ordination symbol is 4W. The Michigan soil management group is 4/1b.

49A—Finch sand, 0 to 3 percent slopes. This deep, nearly level and undulating, somewhat poorly drained soil is on low plains and in depressions in the uplands. Individual areas are irregularly shaped and range from 3 to more than 150 acres in size.

Typically, about 3 inches of dark reddish brown and black organic material is at the surface. The subsurface layer is light gray, mottled sand about 9 inches thick. The subsoil is sand about 26 inches thick. It is mottled. The upper part is dark reddish brown and extremely firm, the next part is dark yellowish brown and very firm, and the lower part is brown and light yellowish brown and loose. The substratum to a depth of about 60 inches is light yellowish brown sand.

Included with this soil in mapping are small areas of the somewhat poorly drained Au Gres soils. These soils have a subsoil that is loose in consistence. They are in landscape positions similar to those of the Finch soil. Also included are areas of soils that are subject to ponding. Included soils make up 8 to 20 percent of the unit.

Permeability is slow in the upper part of the Finch soil and moderately rapid in the lower part. The available water capacity is low. Surface runoff is very slow. A seasonal high water table is at a depth of about 0.5 foot to 1.5 feet from winter to early summer.

Most areas are used as woodland. Windthrow is a hazard, and the equipment limitation, seedling mortality, and plant competition are management concerns. Because of the seasonal high water table, the trees are shallow rooted. Some may be blown down during periods of high wind. Windthrow losses can be minimized by cutting systems that do not isolate the remaining trees or allow them to funnel the wind. Ruts form easily if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage, expose tree roots, and alter soil structure. Such damage can be avoided if the use of equipment is restricted to periods when the soil is relatively dry or frozen.

Seedling losses may be high during wet spring months and dry summer months. Special planting stock, such as containerized seedlings, and special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. Furrowing before planting also reduces the seedling mortality rate. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is poorly suited to recreational development. The seasonal high water table, the sandy surface layer, and a cemented pan in the subsoil are limitations. Because of the sandy surface layer, a layer of loamy material should be added to the surface and deep-rooted grasses and legumes should be seeded.

This soil is poorly suited to building site development and septic tank absorption fields. The seasonal high water table, the instability of cutbanks, and the cemented pan are limitations on building sites. Buildings can be constructed on well compacted fill material, which raises the level of the site. The sides of shallow excavations should be reinforced. Surface and subsurface drainage systems can lower the water table. The cemented pan, the wetness, and the moderately slow permeability are limitations on sites for septic tank absorption fields. Enlarging the absorption fields and filling or mounding with suitable soil material help to overcome these limitations.

The land capability subclass is IVw. The woodland ordination symbol is 4W. The Michigan soil management group is 5b-h.

50A—Bonduel loamy very fine sand, 0 to 3 percent slopes. This moderately deep, nearly level, somewhat poorly drained soil is in swales and on low knolls in the uplands. Individual areas are irregularly shaped and range from 3 to more than 80 acres in size.

Typically, about 3 inches of black, partially decomposed forest litter is at the surface. The subsurface layer is light brownish gray, mottled loamy very fine sand about 4 inches thick. The subsoil is about 10 inches thick. It is mottled. The upper part is dark yellowish brown, friable fine sandy loam, and the lower part is brown, friable, calcareous silty clay. Limestone bedrock is at a depth of about 17 inches. In places the subsoil has less clay.

Included with this soil in mapping are small areas of the well drained Fairport soils. These soils are higher on the landscape than the Bonduel soil. They make up 5 to 10 percent of the unit.

Permeability is moderately slow in the Bonduel soil. The available water capacity is low. Surface runoff is slow. A seasonal high water table is at a depth of about 1.0 to 1.5 feet from late autumn to late spring. The shrink-swell potential is moderate.

This soil is well suited to such crops as corn, small grains, and grasses and legumes if a drainage system is installed. Soil blowing is a hazard, and removing excess water during wet periods, maintaining the organic matter content, and conserving moisture during dry periods are management concerns. A system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface, cover crops, buffer strips, and field windbreaks help to control soil blowing.

A combination of surface and subsurface drains can reduce the wetness in the cropped areas. Shallow surface ditches are effective in removing surface water if adequate drainage outlets are available. Erosion-control structures may be needed where the surface ditches enter other drainageways. If adequate drainage outlets are available, a subsurface drainage system can help to lower the high water table. The tile lines can become clogged with fine sand unless they are protected with suitable material. Applying a system of conservation tillage and adding organic material to the soil help to maintain or increase the organic matter content and increase the available water capacity. If water of sufficient quantity and quality is available, irrigation can help to overcome the low available water capacity.

The main concern in managing pastured areas is conserving moisture during dry periods. Maintaining an adequate ground cover by rotation grazing or strip grazing reduces the susceptibility to erosion and helps to keep the pasture in good condition.

Most areas are used as woodland. Windthrow is a hazard, and the equipment limitation and plant competition are management concerns. Because of the seasonal high water table, the trees are shallow rooted. Some may be blown down during periods of high wind. Windthrow losses can be minimized by cutting systems that do not isolate the remaining trees or allow them to funnel the wind. Ruts form easily if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage, expose tree roots, and alter soil structure. Such damage can be avoided if the use of equipment is restricted to periods when the soil is relatively dry or frozen. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is poorly suited to recreational development. The seasonal high water table, the moderately slow permeability, and the limited depth to bedrock are limitations.

This soil generally is unsuited to building site development and septic tank absorption fields because of the seasonal high water table and the underlying bedrock.

The land capability subclass is IIw. The woodland ordination symbol is 4W. The Michigan soil management group is 2R/bc.

51A—Otisco sand, 0 to 3 percent slopes. This deep, nearly level and undulating, somewhat poorly drained soil is on low plains and low knolls in the uplands. Individual areas are irregularly shaped and range from 3 to more than 80 acres in size.

Typically, the surface layer is mixed black and brown sand about 1 inch thick. The subsurface layer is pinkish gray sand about 6 inches thick. The subsoil to a depth of about 60 inches is mottled. The upper part is dark reddish brown and strong brown, friable sand; the next part is yellowish brown, firm sand; and the lower part is yellowish brown, friable loamy sand that has light reddish brown bands of friable sandy loam ¼ to 1 inch thick. In places the subsoil does not have bands of sandy loam.

Included with this soil in mapping are small areas of the moderately well drained Croswell and excessively drained Rubicon soils. These soils do not have bands of sandy loam. Croswell soils are on low knolls. Rubicon soils are on knolls and ridges. Included soils make up 5 to 8 percent of the unit.

Permeability is rapid in the Otisco soil. The available water capacity is low. Surface runoff is very slow. A seasonal high water table is at a depth of about 0.5 foot to 1.5 feet from late autumn to mid spring.

Most areas are used as woodland. Windthrow is a hazard, and the equipment limitation, seedling mortality, and plant competition are management concerns. Because of the seasonal high water table, the trees are shallow rooted. Some may be blown down during periods of high wind. Windthrow losses can be minimized by cutting systems that do not isolate the remaining trees or allow them to funnel the wind. Ruts form easily if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage, expose tree roots, and alter soil structure. Such damage can be avoided if the use of equipment is restricted to periods when the soil is relatively dry or frozen.

Seedling losses may be high during wet spring months and dry summer months. Special planting stock, such as containerized seedlings, and special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. Furrowing before planting also reduces the seedling mortality rate. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is poorly suited to recreational development. The seasonal high water table and the sandy surface layer are limitations. Because of the sandy surface layer, a layer of loamy material should be added to the surface and deep-rooted grasses and legumes should be seeded.

This soil is poorly suited to building site development and septic tank absorption fields. The wetness and the instability of cutbanks are limitations on building sites. Buildings can be constructed on well compacted fill material, which raises the level of the site. Surface and subsurface drainage systems can lower the water table. The sides of shallow excavations should be reinforced. The wetness and a poor filtering capacity are limitations on sites for septic tank absorption fields. Enlarging the absorption fields and filling or mounding with suitable soil material help to overcome these limitations. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability subclass is IIIw. The woodland ordination symbol is 4W. The Michigan soil management group is 4b.

52A—Ogemaw sand, 0 to 3 percent slopes. This deep, nearly level, somewhat poorly drained soil is on low plains in the uplands. Individual areas are irregularly shaped and range from 3 to more than 80 acres in size.

Typically, the surface layer is mixed black and pinkish gray sand about 4 inches thick. The subsurface layer is pinkish gray sand about 9 inches thick. The subsoil is about 32 inches thick. It is mottled. The upper part is dark reddish brown, firm sand; the next part is dark brown and strong brown, extremely firm and very firm sand; and the lower part is mixed pale brown and brown, friable sandy loam and loam. The substratum to a depth of about 60 inches is light brown, calcareous sandy loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Au Gres and Otisco soils. These soils have a subsoil that is more friable than that of the Ogemaw soil. Also, they have less clay in the subsoil and substratum. They are in landscape positions similar to those of the Ogemaw soil. They make up 8 to 15 percent of the unit.

Permeability is slow in the Ogemaw soil. The available water capacity is very low. Surface runoff is very slow. A seasonal high water table is at a depth of about 0.5 foot to 1.5 feet from late autumn to mid spring. The shrink-swell potential is moderate.

This soil is poorly suited to such crops as corn, small grains, and grasses and legumes unless a drainage system is installed. Soil blowing is a hazard, and removing excess water during wet periods, maintaining the organic matter content, and conserving moisture during dry periods are management concerns. A system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface, cover crops, buffer strips, and field windbreaks help to control soil blowing.

A combination of surface and subsurface drains can reduce the wetness in the cropped areas. Shallow surface ditches are effective in removing surface water if adequate drainage outlets are available. Erosion-control structures may be needed where the surface ditches enter other drainageways. If adequate drainage outlets are available, subsurface drainage can help to lower the high water table. The tile lines can become clogged with fine sand unless they are protected with suitable material. Applying a system of conservation tillage and adding organic material to the soil help to maintain or increase the organic matter content and increase the available water capacity. If water of sufficient quantity and quality is available, irrigation can help to overcome the low available water capacity.

The main concern in managing pastured areas is conserving moisture during dry periods. Maintaining an adequate ground cover by rotation grazing or strip grazing reduces the susceptibility to erosion and helps to keep the pasture in good condition.

Most areas are used as woodland. Windthrow is a hazard, and the equipment limitation, seedling mortality, and plant competition are management concerns. Because of the seasonal high water table, the trees are shallow rooted. Some may be blown down during periods of high wind. Windthrow losses can be minimized by cutting systems that do not isolate the remaining trees or allow them to funnel the wind. Ruts form easily if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage, expose tree roots, and alter soil structure. Such damage can be avoided if the use of equipment is restricted to periods when the soil is relatively dry or frozen.

Seedling losses may be high during wet spring months and dry summer months. Special planting stock, such as containerized seedlings, and special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. Furrowing before planting also reduces the seedling mortality rate. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is poorly suited to recreational development. The seasonal high water table, the sandy surface layer, and a cemented pan in the subsoil are limitations. Because of the sandy surface layer, a layer of loamy material should be added to the surface and deep-rooted grasses and legumes should be seeded.

This soil is poorly suited to building site development and septic tank absorption fields. The cemented pan, the instability of cutbanks, and the wetness are limitations on building sites. Buildings can be constructed on well compacted fill material, which raises the level of the site. Surface and subsurface drainage systems can lower the water table. The cemented pan, the wetness, and the slow permeability are limitations on sites for septic tank absorption fields. Enlarging the absorption fields and filling or mounding with suitable soil material help to overcome these limitations.

The land capability subclass is IVw. The woodland ordination symbol is 4W. The Michigan soil management group is 5b-h.

55A—Solona sandy loam, 0 to 3 percent slopes. This deep, nearly level and undulating, somewhat poorly drained soil is on low plains and low knolls in the uplands. Individual areas are irregularly shaped and range from 3 to more than 300 acres in size.

Typically, the surface layer is dark brown sandy loam about 7 inches thick. The subsurface layer is pale brown, mottled sandy loam about 5 inches thick. The subsoil is brown, mottled, friable sandy loam about 11 inches thick. The substratum to a depth of about 60 inches is light reddish brown, mottled, calcareous sandy loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Riggsville soils. These soils have a loamy sand surface layer that is more than 20 inches thick. They are in landscape positions similar to those of the Solona soil. They make up 10 to 20 percent of the unit.

Permeability is moderately slow in the Solona soil. The available water capacity is low. Surface runoff is slow. A seasonal high water table is at a depth of about 1 to 3 feet from late autumn to spring.

This soil is well suited to such crops as corn, small grains, and grasses and legumes if a drainage system is installed. Soil blowing is a hazard, and removing excess water during wet periods, conserving moisture during dry periods, and maintaining the organic matter content are management concerns. A system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface, cover crops, buffer strips, and field windbreaks help to control soil blowing.

A combination of surface and subsurface drains can reduce the wetness in the cropped areas. Shallow surface ditches are effective in removing surface water if adequate drainage outlets are available. Erosion-control structures may be needed where the surface ditches enter other drainageways. If adequate drainage outlets are available, subsurface drainage can help to lower the high water table. The tile lines can become clogged with fine sand unless they are protected with suitable material. Applying a system of conservation tillage and adding organic material to the soil help to maintain or increase the organic matter content. If water of sufficient quantity and quality is available, irrigation can help to overcome the low available water capacity.

This soil is well suited to pasture. Conserving moisture during dry periods and maintaining tilth are management concerns. Maintaining an adequate ground cover by rotation grazing or strip grazing helps to keep the pasture in good condition.

Most areas are used as woodland. Windthrow is a hazard, and the equipment limitation and plant competition are management concerns. Because of the seasonal high water table, the trees are shallow rooted. Some may be blown down during periods of high wind. Windthrow losses can be minimized by cutting systems that do not isolate the remaining trees or allow them to funnel the wind. Ruts form easily if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage, expose tree roots, and alter soil structure. Such damage can be avoided if the use of equipment is restricted to periods when the soil is relatively dry or frozen. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is poorly suited to recreational development. The seasonal high water table and the moderately slow permeability are limitations.

This soil is poorly suited to building site development and septic tank absorption fields. The seasonal high water table is a limitation on building sites. Buildings can be constructed on well compacted fill material, which raises the level of the site. Surface and subsurface drainage systems can lower the water table. The wetness and the moderately slow permeability are limitations on sites for septic tank absorption fields. Enlarging the absorption fields and filling or mounding with suitable soil material help to overcome these limitations.

The land capability subclass is IIw. The woodland ordination symbol is 3W. The Michigan soil management group is 3b.

56A—Riggsville loamy sand, 0 to 3 percent slopes. This nearly level, somewhat poorly drained soil is on low plains and toe slopes in the uplands. It is moderately deep to dense till. Individual areas are irregularly shaped and range in size from 3 to more than 300 acres in size.

Typically, the surface layer is mixed black and light gray loamy sand about 2 inches thick. The subsurface layer is pinkish gray, mottled loamy sand about 7 inches thick. The subsoil is about 21 inches thick. It is mottled. The upper part is strong brown and dark brown, very friable loamy sand; the next part is light brown and reddish brown, friable, mixed loamy sand and sandy loam; and the lower part is reddish brown, friable sandy loam. The substratum to a depth of about 60 inches is brown, mottled, calcareous sandy loam. In some places the upper part of the subsoil is cemented. In other places the lower part of the subsoil and the substratum have more clay.

Included with this soil in mapping are small areas of the well drained Cheboygan and Emmet soils. These soils are on low knolls and ridges. They make up 5 to 10 percent of the unit.

Permeability is moderately rapid in the upper part of the Riggsville soil and very slow in the lower part. The available water capacity is low. Surface runoff is very slow. A seasonal high water table is at a depth of 1 to 2 feet from late autumn to spring.

This soil is well suited to such crops as corn, small grains, and grasses and legumes if a drainage system is installed. Soil blowing is a hazard, and removing excess water during wet periods, conserving moisture during dry periods, and maintaining the organic matter content are management concerns. A system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface, cover crops, buffer strips, and field windbreaks help to control soil blowing.

A combination of surface and subsurface drains can reduce the wetness in the cropped areas. Shallow surface ditches are effective in removing surface water if adequate drainage outlets are available. Erosion-control structures may be needed where the surface ditches enter other drainageways. If adequate drainage outlets are available, subsurface drainage can help to lower the high water table. The tile lines can become clogged with fine sand unless they are protected with suitable material. Applying a system of conservation tillage and adding organic material to the soil help to maintain or increase the organic matter content. If water of sufficient quantity and quality is available, irrigation can help to overcome the low available water capacity.

The main concern in managing pastured areas is conserving moisture during dry periods. Maintaining an adequate ground cover by rotation grazing or strip grazing reduces the susceptibility to erosion and helps to keep the pasture in good condition.

Most areas are used as woodland. Windthrow is a hazard, and the equipment limitation and plant competition are management concerns. Because of the seasonal high water table, the trees are shallow rooted. Some may be blown down during periods of high wind.

Windthrow losses can be minimized by cutting systems that do not isolate the remaining trees or allow them to funnel the wind. Ruts form easily if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage, expose tree roots, and alter soil structure. Such damage can be avoided if the use of equipment is restricted to periods when the soil is relatively dry or frozen. The best sites for landings are in areas of the included Cheboygan and Emmet soils. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is poorly suited to recreational development. The seasonal high water table and the sandy surface layer are limitations. Because of the sandy surface layer, a layer of loamy material should be added to the surface and deep-rooted grasses and legumes should be seeded.

This soil is poorly suited to building site development and septic tank absorption fields. The seasonal high water table is a limitation on building sites. Buildings can be constructed on well compacted fill material, which raises the level of the site. Surface and subsurface drainage systems can lower the water table. The seasonal high water table and the very slow permeability are limitations on sites for septic tank absorption fields. Enlarging the absorption fields and filling or mounding with suitable soil material help to overcome these limitations.

The land capability subclass is IIw. The woodland ordination symbol is 5W. The Michigan soil management group is 3b.

57A—Brimley very fine sandy loam, 0 to 3 percent slopes. This deep, nearly level and undulating, somewhat poorly drained soil is on low plains and low knolls in the uplands. Individual areas are irregularly shaped and range from 3 to more than 300 acres in size.

Typically, the surface layer is very dark grayish brown very fine sandy loam about 9 inches thick. The subsurface layer is pale brown, mottled very fine sandy loam about 2 inches thick. The subsoil is about 14 inches thick. It is mottled. The upper part is brown, friable fine sandy loam, and the lower part is brown, friable silt loam. The substratum to a depth of about 60 inches is pale brown, light brownish gray, and yellowish brown, mottled, calcareous, stratified silt and very fine sand. In some places the surface layer is coarser textured. In other places the subsoil is darker red.

Included with this soil in mapping are small areas of the somewhat poorly drained Ingalls soils. These soils are in landscape positions similar to those of the Brimley soil. Also, they have less silt and clay in the subsoil. They make up about 10 to 15 percent of the unit.

Permeability is moderately slow in the Brimley soil. The available water capacity is high. Surface runoff is slow. A seasonal high water table is at a depth of about 1 to 2 feet from late autumn to spring.

This soil is well suited to such crops as corn, small grains, and grasses and legumes if a drainage system is installed. Soil blowing is a hazard, and removing excess water during wet periods is a management concern. A system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface, cover crops, buffer strips, and field windbreaks help to control soil blowing.

A combination of surface and subsurface drains can reduce the wetness in the cropped areas. Shallow surface ditches are effective in removing surface water if adequate drainage outlets are available. Erosion-control structures may be needed where the surface ditches enter other drainageways. If adequate drainage outlets are available, subsurface drainage can help to lower the high water table. The tile lines can become clogged with fine sand unless they are protected with suitable material.

This soil is well suited to pasture. The main concerns are conserving moisture during dry periods and maintaining tilth. Maintaining an adequate ground cover by rotation grazing or strip grazing helps to keep the pasture in good condition.

Most areas are used as woodland. Windthrow is a hazard, and the equipment limitation and plant competition are management concerns. Because of the seasonal high water table, the trees are shallow rooted. Some may be blown down during periods of high wind. Windthrow losses can be minimized by cutting systems that do not isolate the remaining trees or allow them to funnel the wind. Ruts form easily if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage, expose tree roots, and alter soil structure. Such damage can be avoided if the use of equipment is restricted to periods when the soil is relatively dry or frozen. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is poorly suited to recreational development. The seasonal high water table and the moderately slow permeability are limitations.

This soil is poorly suited to building site development and septic tank absorption fields. The seasonal high water table and the instability of cutbanks are limitations on building sites. Buildings can be constructed on well compacted fill material, which raises the level of the site. Surface and subsurface drainage systems can lower the water table. The sides of shallow excavations should be reinforced. The moderately slow permeability and the seasonal high water table are limitations on sites for septic tank absorption fields. Enlarging the absorption fields and filling or mounding with suitable soil material help to overcome these limitations.

The land capability subclass is IIw. The woodland ordination symbol is 3W. The Michigan soil management group is 2.5b-s.

58A—Alstad loam, 0 to 3 percent slopes. This deep, nearly level and undulating, somewhat poorly drained soil is on low plains and low knolls in the uplands. Individual areas are irregularly shaped and range from 3 to more than 150 acres in size.

Typically, the surface layer is very dark gray loam about 6 inches thick. The subsurface layer is yellowish brown, mottled sandy loam about 3 inches thick. The subsoil is about 12 inches thick. It is mottled. The upper part is mixed yellowish red and yellowish brown, friable sandy clay loam and sandy loam; the next part is yellowish red, firm, calcareous sandy clay loam; and the lower part is strong brown, firm, calcareous loam. The substratum to a depth of about 60 inches is light brown, mottled, calcareous loam.

Included with this soil in mapping are small areas of the very poorly drained Angelica and well drained Onaway soils. Angelica soils are in shallow depressions and drainageways. Onaway soils are on knolls and ridges. Included soils make up about 8 to 15 percent of the unit.

Permeability is moderately slow in the Alstad soil. The available water capacity is high. Surface runoff is slow. A seasonal high water table is perched at a depth of about 1 to 3 feet from late autumn to spring.

This soil is well suited to such crops as corn, small grains, and grasses and legumes if a drainage system is installed. Removing excess water during wet periods and maintaining good tilth are management concerns. A combination of surface and subsurface drains can reduce the wetness in the cropped areas. Shallow surface ditches are effective in removing surface water if adequate drainage outlets are available. Erosion-control structures may be needed where the surface ditches enter other drainageways. If adequate drainage outlets are available, subsurface drainage can help to lower the high water table. Working the soil when it is too wet results in cloddiness and surface compaction. Applying a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface, adding organic material to the soil, and tilling within the proper range in moisture content help to maintain good tilth.

This soil is well suited to pasture. Overgrazing causes surface compaction, excessive runoff, and erosion. Proper stocking rates, rotation grazing or strip grazing, and restricted use during wet periods help to keep the pasture in good condition.

Most areas are used as woodland. Windthrow is a hazard, and the equipment limitation and plant competition are management concerns. Because of the seasonal high water table, the trees are shallow rooted. Some may be blown down during periods of high wind. Windthrow losses can be minimized by cutting systems that do not isolate the remaining trees or allow them to funnel the wind. Ruts form easily if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage, expose tree roots, and alter soil structure. Such damage can be avoided if the use of equipment is restricted to periods when the soil is relatively dry or frozen. The best sites for landings are in areas of the included Onaway soils. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is poorly suited to recreational development. The seasonal high water table and the moderately slow permeability are limitations.

This soil is poorly suited to building site development and septic tank absorption fields because of the wetness. Buildings can be constructed on well compacted fill material, which raises the level of the site. Surface and subsurface drainage systems can lower the water table. The moderately slow permeability is a limitation on sites for septic tank absorption fields. Enlarging the absorption fields and filling or mounding with suitable soil material help to overcome these limitations.

The land capability subclass is IIw. The woodland ordination symbol is 3W. The Michigan soil management group is 2.5b.

60A—Rudyard loam, 0 to 3 percent slopes. This deep, nearly level, somewhat poorly drained soil is on low knolls and low broad plains in the uplands. Individual areas are irregularly shaped and range from 3 to more than 1,200 acres in size.

Typically, the surface layer is dark reddish brown loam about 10 inches thick. The subsoil is about 17 inches thick. It is mottled. The upper part is mixed reddish brown and grayish brown, firm clay and silt loam, and the lower part is reddish brown, firm clay. The substratum to a depth of about 60 inches is light reddish brown, mottled silty clay.

Included with this soil in mapping are small areas of the somewhat poorly drained Allendale and moderately well drained Ontonagon soils. Allendale soils have a sandy surface layer and are sandy in the upper part of the subsoil. They are in landscape positions similar to those of the Rudyard soil. Ontonagon soils are on the steeper knolls and in areas adjacent to drainageways. Included soils make up 8 to 15 percent of the unit.

Permeability is very slow in the Rudyard soil. The available water capacity is moderate. Surface runoff is slow. A seasonal high water table is perched at a depth of 0.5 foot to 1.5 feet from late autumn to late spring. The shrink-swell potential is high.

This soil is moderately well suited to such crops as grasses and legumes if a drainage system is installed. Removing excess water during wet periods and maintaining good tilth are management concerns. A combination of surface and subsurface drains can reduce the wetness in the cropped areas. Shallow surface ditches are effective in removing surface water if adequate drainage outlets are available. Erosion-control structures may be needed where the surface ditches enter other drainageways. If adequate drainage outlets are available, subsurface drainage can help to lower the high water table. Working the soil when it is too wet results in cloddiness and surface compaction. Applying a system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface, adding organic material to the soil, and tilling within the proper ranges in moisture content help to maintain good tilth.

This soil is well suited to pasture. Overgrazing causes surface compaction, excessive runoff, and erosion. Proper stocking rates, rotation grazing or strip grazing, and restricted use during wet periods help to keep the pasture in good condition.

Most areas are used as woodland. Windthrow is a hazard, and the equipment limitation, seedling mortality, and plant competition are management concerns. Because of the seasonal high water table, the trees are shallow rooted. Some may be blown down during periods of high wind. Windthrow losses can be minimized by cutting systems that do not isolate the remaining trees or allow them to funnel the wind. Ruts form easily if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage, expose tree roots, and alter soil structure. Such damage can be avoided if the use of equipment is restricted to periods when the soil is relatively dry or frozen. The best landing sites are in areas of the included Ontonagon soils. Special planting stock, such as containerized seedlings, and special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. Furrowing before planting also reduces the seedling mortality rate. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is poorly suited to recreational development. The seasonal high water table and the very slow permeability are limitations.

This soil is poorly suited to building site development and septic tank absorption fields. The seasonal high water table and the high shrink-swell potential are limitations on building sites. Buildings can be constructed on well compacted fill material, which raises the level of the site. Surface and subsurface drainage systems can lower the water table. The very slow permeability and the seasonal high water table are limitations on sites for septic tank absorption fields. Enlarging the absorption fields and filling or mounding with suitable soil material help to overcome these limitations.

The land capability subclass is IIIw. The woodland ordination symbol is 6W. The Michigan soil management group is Ob.

61—Roscommon muck. This deep, nearly level, very poorly drained soil is on low plains, in depressional areas, and in broad drainageways. It is subject to ponding. Individual areas are irregularly shaped and range from 5 to more than 1,000 acres in size.

Typically, the surface layer is black muck about 6 inches thick. The substratum to a depth of about 60 inches is light brownish gray, brown, and dark brown, mottled sand. In some places the substratum is cemented and is dark brown. In other places it is gravelly sand.

Included with this soil in mapping are areas of the somewhat poorly drained Au Gres and very poorly drained Tawas soils. Au Gres soils are in the slightly higher positions on the landscape. Tawas soils have organic material to a depth of 16 to 50 inches. They are in landscape positions similar to those of the Roscommon soil. Included soils make up 5 to 10 percent of the unit.

Permeability is rapid in the Roscommon soil. The available water capacity is low. Surface runoff is very slow or ponded. A seasonal high water table is 1 foot above to 1 foot below the surface from autumn to late spring.

Most areas are used as woodland. Windthrow is a hazard, and the equipment limitation, seedling mortality, and plant competition are management concerns. Because of the seasonal high water table, the trees are shallow rooted. Some may be blown down during periods of high wind. Windthrow losses can be minimized by cutting systems that do not isolate the remaining trees or allow them to funnel the wind. Ruts form easily if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage, expose tree roots, and alter soil structure. Such damage can be avoided if the use of equipment is restricted to periods when the soil is relatively dry or frozen. Sites for log landings generally are available only during the driest periods. Seedling losses may be high because of the wetness. Special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation. Trees generally are not planted on this soil because of the high seedling mortality rate, plant competition, and low productivity.

This soil is unsuited to recreational development because of the seasonal high water table and the ponding.

This soil is unsuited to building site development and septic tank absorption fields. The ponding and the instability of cutbanks are limitations on building sites. The ponding and a poor filtering capacity are limitations on sites for septic tank absorption fields.

The land capability subclass is VIw. The woodland ordination symbol is 6W. The Michigan soil management group is 5c.

62—Wheatley loamy sand. This deep, nearly level, poorly drained soil is on low plains. It is subject to ponding. Individual areas are irregularly shaped and range from 10 to more than 300 acres in size.

Typically, the surface layer is loamy sand about 5 inches thick. It is black in the upper part and dark brown in the lower part. The upper part of the substratum is yellowish brown and brown sand. The lower part to a depth of about 60 inches is brown, calcareous gravelly sand. In some places the substratum has less gravel. In other places the subsoil has more clay.

Included with this soil in mapping are small areas of the somewhat poorly drained Battlefield and very poorly drained Roscommon soils. Battlefield soils are on low ridges. Roscommon soils do not have gravelly sand in the substratum. They are in landscape positions similar to those of the Wheatley soil. Included soils make up 8 to 15 percent of the unit.

Permeability is rapid in the Wheatley soil. The available water capacity is very low. Surface runoff is very slow or ponded. A seasonal high water table is about 1 foot above to 1 foot below the surface from autumn to late spring.

Most areas are used as woodland. Windthrow is a hazard, and the equipment limitation, seedling mortality, and plant competition are management concerns. Because of the seasonal high water table, the trees are shallow rooted. Some may be blown down during periods of high wind. Windthrow losses can be minimized by cutting systems that do not isolate the remaining trees or allow them to funnel the wind. Ruts form easily if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage, expose tree roots, and alter soil structure. Such damage can be avoided if the use of equipment is restricted to periods when the soil is relatively dry or frozen. Sites for log landings generally are available only during the driest periods. Seedling losses may be high because of the wetness. Special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation. Trees generally are not planted on this soil because of the high seedling mortality rate, plant competition, and low productivity.

This soil is unsuited to recreational development because of the sandy surface layer, the seasonal high water table, and the ponding.

This soil is unsuited to building site development and septic tank absorption fields. The ponding and the instability of cutbanks are limitations on building sites. The ponding and a poor filtering capacity are limitations on sites for septic tank absorption fields.

The land capability subclass is Vw. The woodland ordination symbol is 2W. The Michigan soil management group is 5c.

63—Brevort mucky loamy sand. This deep, nearly level, very poorly drained soil is on broad, low plains. It is subject to ponding. Individual areas are irregularly shaped and range from 5 to more than 300 acres in size.

Typically, the surface layer is black mucky loamy sand about 5 inches thick. The substratum is calcareous and mottled. The upper part is light yellowish brown loamy sand, the next part is pale brown gravelly sand, and the lower part to a depth of about 60 inches is light brown loam. In places depth to the loamy substratum is less than 20 inches.

Included with this soil in mapping are small areas of the somewhat poorly drained Detour and very poorly drained Roscommon soils. Detour soils are in the higher positions on the landscape. Roscommon soils are in landscape positions similar to those of the Brevort soil. Also, they have less clay in the substratum. Included soils make up about 5 to 10 percent of the unit.

Permeability is rapid to moderately rapid in the upper part of the Brevort soil and moderately slow in the lower part. The available water capacity is high. Surface runoff is very slow or ponded. A seasonal high water table is about 1 foot above to 1 foot below the surface from late autumn to late spring.

Most areas are used as woodland. Windthrow is a hazard, and the equipment limitation, seedling mortality, and plant competition are management concerns. Because of the seasonal high water table, the trees are shallow rooted. Some may be blown down during periods of high wind. Windthrow losses can be minimized by cutting systems that do not isolate the remaining trees or allow them to funnel the wind. Ruts form easily if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage, expose tree roots, and alter soil structure. Such damage can be avoided if the use of equipment is restricted to periods when the soil is relatively dry or frozen. Sites for log landings generally are available only during the driest periods. Seedling losses may be high because of the wetness. Special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation. Trees generally are not planted on this soil because of the high seedling mortality rate, plant competition, and low productivity.

This soil is unsuited to recreational development because of the seasonal high water table and the ponding.

This soil is unsuited to building site development and septic tank absorption fields. The instability of cutbanks and the ponding are limitations on building sites. A poor filtering capacity, the moderately slow permeability, and the ponding are limitations on sites for septic tank absorption fields.

The land capability subclass is Vw. The woodland ordination symbol is 2W. The Michigan soil management group is 4/2c.

64—Burleigh mucky sand. This deep, nearly level, very poorly drained soil is on low plains and in swales. It is subject to ponding. Individual areas are irregularly shaped and range from 3 to more than 200 acres in size.

Typically, the surface layer is black mucky sand about 8 inches thick. The substratum is calcareous and mottled. The upper part is grayish brown sand, the next part is light gray sand, and the lower part to a depth of about 60 inches is light brownish gray and brown, stratified silt loam and loamy very fine sand. In places the surface layer is sand.

Included with this soil in mapping are small areas of the poorly drained Charity and very poorly drained Roscommon soils. Charity soils have more clay throughout than the Burleigh soil, and Roscommon soils have less silt and very fine sand in the substratum. Both of the included soils are in landscape positions similar to those of the Burleigh soil. They make up 8 to 20 percent of the unit.

Permeability is rapid in the upper part of the Burleigh soil and moderately slow in the lower part. The available water capacity is moderate. Surface runoff is very slow or ponded. A seasonal high water table is about 1 foot above to 1 foot below the surface from late autumn to late spring.

Most areas are used as woodland. Windthrow is a hazard, and the equipment limitation, seedling mortality, and plant competition are management concerns. Because of the seasonal high water table, the trees are shallow rooted. Some may be blown down during periods of high wind. Windthrow losses can be minimized by cutting systems that do not isolate the remaining trees or allow them to funnel the wind. Ruts form easily if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage, expose tree roots, and alter soil structure. Such damage can be avoided if the use of equipment is restricted to periods when the soil is relatively dry or frozen. Sites for log landings generally are available only during the driest periods. Seedling losses may be high because of the wetness. Special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation. Trees generally are not planted on this soil because of the high seedling mortality rate, plant competition, and low productivity.

This soil generally is unsuited to recreational development because of the seasonal high water table and the ponding.

This soil is unsuited to building site development and septic tank absorption fields. The instability of cutbanks and the ponding are limitations on building sites. The moderately slow permeability and a poor filtering capacity are limitations on sites for septic tank absorption fields.

The land capability subclass is Vw. The woodland ordination symbol is 2W. The Michigan soil management group is 4/2c.

66—Pinconning mucky loamy sand. This deep, nearly level, very poorly drained soil is on lake plains. It is subject to ponding. Individual areas are irregularly shaped and range from 5 to more than 200 acres in size.

Typically, the surface layer is black mucky loamy sand about 9 inches thick. The substratum is mottled. The upper part is grayish brown sand, and the lower part to a depth of about 60 inches is reddish brown, calcareous silty clay. In some places the surface layer is sandy. In other places it is cobbly. In some areas depth to the clay substratum is more than 20 inches.

Included with this soil in mapping are small areas of the somewhat poorly drained Allendale soils on low knolls. Included soils make up about 5 to 15 percent of the unit.

Permeability is rapid in the upper part of the Pinconning soil and slow or very slow in the lower part. The available water capacity is moderate. Surface runoff is very slow or ponded. A seasonal high water table is about 1 foot above to 1 foot below the surface from autumn to late spring. The shrink-swell potential is high.

Most areas are used as woodland. Windthrow is a hazard, and the equipment limitation, seedling mortality, and plant competition are management concerns. Because of the seasonal high water table, the trees are shallow rooted. Some may be blown down during periods of high wind. Windthrow losses can be minimized by cutting systems that do not isolate the remaining trees or allow them to funnel the wind. Ruts form easily if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage, expose tree roots, and alter soil structure. Such damage can be avoided if the use of equipment is restricted to periods when the soil is relatively dry or frozen. Sites for log landings generally are available only during the driest periods. Seedling losses may be high because of the wetness. Special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation. Trees generally are not planted on this soil because of the high seedling mortality rate, plant competition, and low productivity.

This soil is unsuited to recreational development because of the slow or very slow permeability, the seasonal high water table, and the ponding.

This soil is unsuited to building site development and septic tank absorption fields. The instability of cutbanks and the ponding are limitations on building sites. The slow or very slow permeability and the ponding are limitations on sites for septic tank absorption fields.

The land capability subclass is Vw. The woodland ordination symbol is 3W. The Michigan soil management group is 4/1c.

67—Kinross mucky sand. This deep, nearly level, very poorly drained soil is on lake plains and outwash plains. It is subject to ponding. Individual areas are irregularly shaped and range from 3 to more than 200 acres in size.

Typically, the surface layer is black mucky sand about 5 inches thick. The subsurface layer is mottled sand about 7 inches thick. It is light gray in the upper part and pale brown in the lower part. The subsoil is loose sand about 27 inches thick. The upper part is dark reddish brown, the next part is dark brown and mottled, and the lower part is light yellowish brown and mottled. The substratum to a depth of about 60 inches is brownish yellow, mottled sand. In some places the subsoil is less red. In other places it is firm or very firm.

Included with this soil in mapping are small areas of the somewhat poorly drained Au Gres soils on low knolls. Included soils make up 5 to 10 percent of the unit.

Permeability is rapid in the Kinross soil. The available water capacity is low. Surface runoff is very slow or ponded. A seasonal high water table is about 1 foot above to 1 foot below the surface from autumn to early summer.

Most areas are used as woodland. Windthrow is a hazard, and the equipment limitation, seedling mortality, and plant competition are management concerns. Because of the seasonal high water table, the trees are shallow rooted. Some may be blown down during periods of high wind. Windthrow losses can be minimized by cutting systems that do not isolate the remaining trees or allow them to funnel the wind. Ruts form easily if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage, expose tree roots, and alter soil structure. Such damage can be avoided if the use of equipment is restricted to periods when the soil is relatively dry or frozen. Sites for log landings generally are available only during the driest periods. Seedling losses may be high because of the wetness. Special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation. Trees generally are not planted on this soil because of the high seedling mortality rate, plant competition, and low productivity.

This soil is unsuited to recreational development because of the seasonal high water table and the ponding.

This soil is unsuited to building site development and septic tank absorption fields. The instability of cutbanks and the ponding are limitations on building sites. A poor filtering capacity and the ponding are limitations on sites for septic tank absorption fields.

The land capability subclass is VIw. The woodland ordination symbol is 2W. The Michigan soil management group is 5c-a.

70—Au Gres-Roscommon complex, 1 to 4 percent slopes. This map unit consists of nearly level and undulating soils in depressions and swales and on low knolls and low ridges in the uplands. The Au Gres soil is somewhat poorly drained, and the Roscommon soil is very poorly drained. The Roscommon soil is subject to ponding. Individual areas are long and narrow or irregular in shape and range from about 10 to 200 acres in size. They are 55 to 65 percent Au Gres soil and 35 to 40 percent Roscommon soil. The two soils occur as areas so intricately mixed or so small that mapping them separately was not practical.

Typically, the surface layer of the Au Gres soil is mixed very dark gray and light brownish gray sand about 1 inch thick. The subsurface layer is light brownish gray, mottled sand about 10 inches thick. The subsoil is about 26 inches thick. It is mottled. The upper part is dark brown and is loose and very friable, and the lower part is strong brown and loose. The substratum to a depth of about 60 inches is light yellowish brown, mottled sand. In some places the subsoil is darker red. In other places the soil has a loamy substratum below a depth of 40 inches. In some areas sand and gravel are below a depth of 40 inches.

Typically, the surface layer of the Roscommon soil is black muck about 6 inches thick. The substratum to a depth of about 60 inches is light brownish gray, brown, and dark brown, mottled sand. In some places the substratum is cemented. In other places it is gravelly sand.

Included with these soils in mapping are small areas of the moderately well drained Croswell and very poorly drained Tawas soils. Croswell soils are in the slightly higher positions on the landscape. Tawas soils are in landscape positions similar to those of the Roscommon soil. They have organic material between depths of 16 and 50 inches. Included soils make up 5 to 10 percent of the unit.

Permeability is rapid in the Au Gres and Roscommon soils. The available water capacity is low. Surface runoff is very slow on the Au Gres soil and very slow or ponded on the Roscommon soil. The Au Gres soil has a seasonal high water table at a depth of 1 to 2 feet from autumn to spring, and the Roscommon soil has one about 1 foot above to 1 foot below the surface from autumn to spring.

Most areas are used as woodland. Windthrow is a hazard, and the equipment limitation, seedling mortality, and plant competition are management concerns. Because of the seasonal high water table, the trees are shallow rooted. Some may be blown down during periods of high wind. Windthrow losses can be minimized by cutting systems that do not isolate the remaining trees or allow them to funnel the wind. Ruts form easily if wheeled skidders are used when the soils are wet. Deep ruts tend to restrict lateral drainage, expose tree roots, and alter soil structure. Such damage can be avoided if the use of equipment is restricted to periods when the soils are relatively dry or frozen. The best sites for log landings are in areas of the included Croswell soils.

Seedling losses may be high because of the wetness. Special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

These soils are unsuited to recreational development because of the seasonal high water table, the sandy surface layer, and the ponding in areas of the Roscommon soil.

These soils are unsuited to building site development and septic tank absorption fields. The instability of cutbanks and the ponding are limitations on building sites. A poor filtering capacity and the ponding are limitations on sites for septic tank absorption fields.

The land capability subclass is VIw. The woodland ordination symbol is 6W. The Michigan soil management groups are 5b and 5c.

71—Bowstring muck, frequently flooded. This deep, nearly level, very poorly drained soil is on flood plains. It is frequently flooded for long periods in the spring. Individual areas are irregularly shaped and range from 10 to more than 500 acres in size.

Typically, the surface layer is black and very dark gray, well decomposed muck about 12 inches thick. The next 5 inches is brown sand. Below this to a depth of about 60 inches is very dark grayish brown, well decomposed muck. In some places the depth to a mineral layer more than 12 inches thick is less than 51 inches. In other places the soil has no mineral layers.

Included with this soil in mapping are small areas of Histosols and Aquents. These soils are in landscape positions similar to those of the Bowstring soil. They make up 10 to 20 percent of the unit.

Permeability is moderately rapid to moderately slow in the Bowstring soil. The available water capacity is high. Surface runoff is very slow. A seasonal high water table is within 2 feet of the surface from autumn to early summer.

This soil is poorly suited to woodland. Windthrow is a hazard, and the equipment limitation, seedling mortality, and plant competition are management concerns. Because of the high water table, the trees are shallow rooted. Some may be blown down during periods of high wind. Windthrow losses can be minimized by cutting systems that do not isolate the remaining trees or allow them to funnel the wind. Ordinary crawler tractors or rubber-tired skidders generally cannot be used on this soil. Special harvesting equipment may be needed. The equipment can be used during periods in winter when access roads are frozen. Seedling losses may be high because of the wetness. Trees generally are not planted on this soil because of the high seedling mortality rate, plant competition, and low productivity.

This soil is unsuited to recreational development because of the frequent flooding and the instability of the organic material.

This soil is unsuited to building site development and septic tank absorption fields. The flooding, the high water table, low soil strength, and a high potential for frost action are limitations. They can be difficult and costly to overcome.

The land capability subclass is VIw. The woodland ordination symbol is 3W. The Michigan soil management group is L-Mc.

77—Bruce fine sandy loam. This deep, nearly level, poorly drained soil is in low areas. It is subject to ponding. Individual areas are irregularly shaped and range from 5 to more than 300 acres in size.

Typically, the surface layer is very dark gray fine sandy loam about 5 inches thick. The subsoil is about 19 inches thick. It is mottled. The upper part is light brownish gray loamy sand, the next part is yellowish brown loam, and the lower part is light brown, calcareous silt loam. The substratum to a depth of about 60 inches is light brown, mottled, calcareous silt loam. In places the surface layer is mucky loamy sand.

Included with this soil in mapping are small areas of the somewhat poorly drained Brimley and very poorly drained Burleigh and Roscommon soils. Brimley soils are on slight rises. Burleigh soils have 20 to 40 inches of sand over stratified material. Roscommon soils have less fine sand than the Bruce soil and do not have textures of loam or silt loam in the subsoil or substratum. Burleigh and Roscommon soils are in landscape positions similar to those of the Bruce soil. Included soils make up 8 to 15 percent of the unit.

Permeability is moderately slow in the Bruce soil. The available water capacity is high. Surface runoff is very slow or ponded. A seasonal high water table is about 1 foot above to 1 foot below the surface from late autumn to late spring.

Most areas are used as woodland. Windthrow is a hazard, and the equipment limitation, seedling mortality, and plant competition are management concerns. Because of the seasonal high water table, the trees are shallow rooted. Some may be blown down during periods of high wind. Windthrow losses can be minimized by cutting systems that do not isolate the remaining trees or allow them to funnel the wind. Ruts form easily if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage, expose tree roots, and alter soil structure. Such damage can be avoided if the use of equipment is restricted to periods when the soil is relatively dry or frozen. Sites for log landings generally are available only during the driest periods. Seedling losses may be high because of the wetness. Special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation. Trees generally are not planted on this soil because of the high seedling mortality rate, plant competition, and low productivity.

This soil is unsuited to recreational development because of the seasonal high water table, the moderately slow permeability, and the ponding.

This soil is unsuited to building site development and septic tank absorption fields. The instability of cutbanks and the ponding are limitations on building sites. The moderately slow permeability and the ponding are limitations on sites for septic tank absorption fields.

The land capability subclass is Vw. The woodland ordination symbol is 7W. The Michigan soil management group is 2.5c-s.

78—Angelica mucky sandy loam. This deep, nearly level, very poorly drained soil is in low areas and narrow drainageways in the uplands. It is subject to ponding. Individual areas are irregularly shaped and range from 3 to more than 100 acres in size.

Typically, the surface layer is black mucky sandy loam about 3 inches thick. The subsoil is mottled, friable, calcareous loam about 7 inches thick. The upper part is dark grayish brown, and the lower part is grayish brown. The substratum to a depth of about 60 inches is light brownish gray and pinkish gray, mottled, calcareous loam. In some places the substratum is clay loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Alstad soils on low knolls. Included soils make up 8 to 15 percent of the unit.

Permeability is moderately slow in the Angelica soil. The available water capacity is high. Surface runoff is very slow or ponded. A seasonal high water table is about 1 foot above to 1 foot below the surface from autumn to early summer.

Most areas are used as woodland. Windthrow is a hazard, and the equipment limitation, seedling mortality, and plant competition are management concerns. Because of the seasonal high water table, the trees are shallow rooted. Some may be blown down during periods of high wind. Windthrow losses can be minimized by cutting systems that do not isolate the remaining trees or allow them to funnel the wind. Ruts form easily if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage, expose tree roots, and alter soil structure. Such damage can be avoided if the use of equipment is restricted to periods when the soil is relatively dry or frozen. Sites for log landings generally are available only during the driest periods. Seedling losses may be high because of the wetness. Special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation. Trees generally are not planted on this soil because of the high seedling mortality rate, plant competition, and low productivity.

This soil is unsuited to recreational development because of the seasonal high water table, the moderately slow permeability, and the ponding.

This soil is unsuited to building site development and septic tank absorption fields. Ponding is a limitation on building sites. The moderately slow permeability and the ponding are limitations on sites for septic tank absorption fields.

The land capability subclass is Vw. The woodland ordination symbol is 7W. The Michigan soil management group is 2.5c.

79—Charity fine sandy loam. This deep, nearly level, poorly drained soil is on low plains. It is subject to ponding. Individual areas are irregularly shaped and range from 3 to more than 1,200 acres in size.

Typically, the surface layer is very dark gray, calcareous fine sandy loam about 8 inches thick. The subsoil extends to a depth of about 26 inches. It is mottled. It is friable, grayish brown gravelly sandy loam in the upper part and firm, reddish brown silty clay loam in the lower part. The substratum to a depth of about 60 inches is reddish brown silty clay loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Allendale and very poorly drained Pinconning soils. Allendale soils are on low ridges. Pinconning soils have a sandy surface layer. They are on low sand ridges. Included soils make up 8 to 15 percent of the unit.

Permeability is very slow in the Charity soil. The available water capacity is high. Surface runoff is very slow or ponded. A seasonal high water table is about 1 foot above to 1 foot below the surface from late autumn to early summer. The shrink-swell potential is moderate.

Most areas are used as woodland. Windthrow is a hazard, and the equipment limitation, seedling mortality, and plant competition are management concerns. Because of the seasonal high water table, the trees are shallow rooted. Some may be blown down during periods of high wind. Windthrow losses can be minimized by cutting systems that do not isolate the remaining trees or allow them to funnel the wind. Ruts form easily if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage, expose tree roots, and alter soil structure. Such damage can be avoided if the use of equipment is restricted to periods when the soil is relatively dry or frozen. Sites for log landings generally are available only during the driest periods. Seedling losses may be high because of the wetness. Special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation. Trees generally are not planted on this soil because of the high seedling mortality rate, plant competition, and low productivity.

This soil is unsuited to recreational development because of the very slow permeability and the ponding.

This soil is unsuited to building site development and septic tank absorption fields. The ponding and the high shrink-swell potential are limitations on building sites (fig. 7). The very slow permeability and the ponding are limitations on sites for septic tank absorption fields.

The land capability subclass is Vw. The woodland ordination symbol is 5W. The Michigan soil management group is 1c-c.

81—Udipsamments, nearly level to steep. This map unit consists of nearly level, excessively drained to somewhat poorly drained soils that have been disturbed. In some places the original surface layer and part of the substratum have been removed and sandy material exposed. In other places the original soil has been covered by sandy fill material. Individual areas vary considerably in shape, and many are bordered by escarpments. The areas range in size from 3 to more than 70 acres. Texture and color vary widely.

Included with these soils in mapping are small areas of poorly drained soils. Included soils make up 0 to 20 percent of the mapped areas.

Most areas are idle or are used as building sites. Onsite investigation is necessary to determine the suitability of the soils for specific uses.

No interpretive groups are assigned.

82—Udorthents, loamy, nearly level to steep. This map unit consists of nearly level to steep, well drained to somewhat poorly drained soils that have been

Figure 7.—Ponding in an area of Charity fine sandy loam used as a building site.

disturbed. In some places the original surface layer and part of the substratum have been removed and loamy material exposed. In other places the original soil has been covered by loamy fill material. Individual areas vary considerably in shape, and many are bordered by escarpments. The areas range in size from 3 to more than 100 acres. Texture and color vary widely.

Included with these soils in mapping are small areas of poorly drained soils. Included soils make up 5 to 20 percent of the mapped areas.

Most areas are idle or are used as building sites. Onsite investigation is necessary to determine the suitability of the soils for specific uses.

No interpretive groups are assigned.

83—Pits, gravel. This map unit consists of open excavations from which sand and gravel have been removed for use as fill or aggregate. The bottom of the pits may be dry or seasonally flooded or may be flooded year-round in areas where the excavation is below the water table. Individual areas vary considerably in shape and range from 3 to 20 acres in size.

Most areas are used as wildlife habitat or are still being mined. A few areas are used for recreational purposes. Onsite investigation is necessary to determine the suitability for specific uses.

No interpretive groups are assigned.

84—Pits, quarry. This map unit consists of open excavations from which limestone has been removed. The exposed rock supports few or no plants. In areas where the excavation is below the water table, the bottom of the pits may be flooded seasonally or year-round. Areas range from 40 to more than 60 acres in size.

Most areas are still being mined. Onsite investigation is necessary to determine the suitability for specific uses.

No interpretive groups are assigned.

85—Histosols and Aquents, ponded. These nearly level, very poorly drained soils are in marsh areas, most of which are always ponded (fig. 8). The Histosols are organic, and the Aquents are sandy or loamy. Individual areas are irregularly shaped and range from 5 to more than 200 acres in size. Some do not include Histosols. The two soils are used and managed so similarly that separating them in mapping was not practical.

Included with these soils in mapping are small areas of open water. These areas make up 5 to 20 percent of the unit.

Most of the acreage supports marsh vegetation or wetland tree species. These soils are well suited to wetland wildlife habitat. They are unsuited to recreational development and woodland. The hazard of ponding and the instability of the organic material are limitations.

These soils are unsuited to building site development and septic tank absorption fields. The ponding, the high water table, low soil strength, and a high potential for frost action are limitations. They can be difficult and costly to overcome.

No interpretive groups are assigned.

87—Beaches. This map unit consists of nearly level and gently sloping areas of recently deposited sandy material along the shore of Lake Huron. The sandy deposits have been washed and rewashed by waves and are covered with water during storms. Ice builds up in areas of this unit during winter storms.

Typically, the sandy material is mixed with fine sand and silt. This unit supports little or no vegetation. It is used mainly for recreational purposes.

No interpretive groups are assigned.

141A—Finch cobbly sand, 0 to 3 percent slopes. This deep, nearly level, somewhat poorly drained soil is on low plains in the uplands. Individual areas are irregularly shaped and range from 5 to more than 200 acres in size.

Typically, the surface layer is mixed black and gray cobbly sand about 2 inches thick. The subsurface layer

Figure 8.—An area of Histosols and Aquents, ponded.

is about 7 inches thick. It is gray cobbly sand in the upper part and pinkish gray cobbly loamy sand in the lower part. The subsoil is about 30 inches thick. It is mottled. The upper part is dark brown, loose sand; the next part is strong brown and yellowish brown, extremely firm and firm sand; and the lower part is banded, yellowish brown and brown, extremely firm and firm sand and loamy sand. The substratum to a depth of about 60 inches is yellowish brown sand. In places the subsoil is less than 50 percent ortstein.

Included with this soil in mapping are small areas of the very poorly drained Roscommon and somewhat poorly drained Au Gres soils. Roscommon soils are in depressions and swales. Au Gres soils do not have a firm subsoil. They are higher on the landscape than the Finch soil. Included soils make up 10 to 20 percent of the unit.

Permeability is slow in the upper part of the Finch soil and moderately rapid in the lower part. The available water capacity is low. Surface runoff is slow. A seasonal high water table is perched at a depth of about 0.5 foot to 1.5 feet from early winter to early summer.

Most areas are used as woodland. Windthrow is a hazard, and the equipment limitation, seedling mortality, and plant competition are management concerns. Because of the seasonal high water table, the trees are shallow rooted. Some may be blown down during periods of high wind. Windthrow losses can be minimized by cutting systems that do not isolate the remaining trees or allow them to funnel the wind. Ruts form easily if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage, expose tree roots, and alter soil structure. Such damage can be avoided if the use of equipment is restricted to periods when the soil is relatively dry or frozen. Because of the wetness, the soil is severely limited as a site for log landings.

Seedling losses may be high during wet spring months and dry summer months. Special planting stock, such as containerized seedlings, and special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. Furrowing before planting also reduces the seedling mortality rate. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is unsuited to recreational development. Small stones, the seasonal high water table, the sandy surface layer, and a cemented pan in the subsoil are limitations.

This soil is poorly suited to building site development and septic tank absorption fields. The seasonal high water table, the instability of cutbanks, and the cemented pan are limitations on building sites. Buildings can be constructed on well compacted fill material, which raises the level of the site. The sides of shallow excavations should be reinforced. Surface and subsurface drainage systems can lower the water table. The cemented pan, the seasonal high water table, and the moderately slow permeability are limitations on sites for septic tank absorption fields. Enlarging the absorption fields and filling or mounding with suitable soil material help to overcome these limitations.

The land capability subclass is VIs. The woodland ordination symbol is 4W. The Michigan soil management group is 5b-h.

158A—Detour cobbly loam, 0 to 3 percent slopes. This nearly level, somewhat poorly drained soil is on low, broad plains in the uplands. It is moderately deep to dense till. Stones on the surface are typically 10 to 36 inches in diameter and are 3 to 10 feet apart. They are rounded or semi-rounded. Individual areas of this soil are irregularly shaped and range from 3 to more than 300 acres in size.

Typically, the surface layer is very dark brown cobbly loam about 5 inches thick. The subsurface layer is pale brown, mottled loamy sand about 5 inches thick. The next 2 inches is pale brown and brown, mottled, friable loamy sand and sandy clay loam. The subsoil is 11 inches thick. It is friable and mottled. The upper part is brown sandy clay loam, and the lower part is brown loam. The substratum to a depth of about 60 inches is light brown, mottled, calcareous gravelly loam. In some places the surface layer does not have stones.

Included with this soil in mapping are small areas of the very poorly drained Brevort soils. These soils have more sand in the upper part of the profile than the Detour soil. They are in the lower positions on the landscape. They make up 5 to 10 percent of the unit.

Permeability is slow in the Detour soil. The available water capacity is low. Surface runoff is slow. A seasonal high water table is at a depth of about 0.5 foot to 2.0 feet from late autumn through spring.

Most areas are used as woodland. Windthrow is a hazard, and the equipment limitation and plant competition are management concerns. Because of the high water table, the trees are shallow rooted. Some may be blown down during periods of high wind. Windthrow losses can be minimized by cutting systems that do not isolate the remaining trees or allow them to funnel the wind. Ruts form easily if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage, expose tree roots, and alter soil structure. Such damage can be avoided if the use of equipment is restricted to periods when the soil is relatively dry or frozen. Sites for log landings generally are available only during the driest periods. Large stones on the surface can reduce the operating speed of skidders and can damage equipment. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation.

This soil is unsuited to recreational development. Small stones, the seasonal high water table, and the slow permeability are limitations.

This soil is poorly suited to building site development and septic tank absorption fields. The seasonal high water table is a limitation on building sites. Buildings can be constructed on well compacted fill material, which raises the level of the site. Surface and subsurface drainage systems can lower the water table. The slow permeability and the seasonal high water table are limitations on sites for septic tank absorption fields. Enlarging the absorption fields and filling or mounding with suitable soil material help to overcome these limitations.

The land capability subclass is VIw. The woodland ordination symbol is 7W. The Michigan soil management group is 2.5b.

179—Hessel mucky gravelly loam. This deep, nearly level, very poorly drained soil is on low, broad plains and in drainageways in the uplands. It is subject to ponding. Individual areas are irregularly shaped and range from 3 to more than 400 acres in size.

Typically, the surface layer is black mucky gravelly loam about 9 inches thick. The subsoil extends to a depth of about 10 inches. It is gray, mottled, friable, calcareous sandy loam. The substratum to a depth of about 60 inches is very pale brown, mottled, calcareous loam. In some places the surface layer is loam or cobbly loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Solona soils on low ridges. These soils make up 5 to 8 percent of the unit.

Permeability is moderately slow in the Hessel soil. The available water capacity is high. Surface runoff is very slow or ponded. A seasonal high water table is about 1 foot above to 1 foot below the surface from autumn to late spring.

Most areas are used as woodland. Windthrow is a hazard, and the equipment limitation, seedling mortality, and plant competition are management concerns. Because of the seasonal high water table, the trees are shallow rooted. Some may be blown down during periods of high wind. Windthrow losses can be minimized by cutting systems that do not isolate the remaining trees or allow them to funnel the wind. Ruts form easily if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage, expose tree roots, and alter soil structure. Such damage can be avoided if the use of equipment is restricted to periods when the soil is relatively dry or frozen. Sites for log landings generally are available only during the driest periods. Seedling losses may be high because of the wetness. Special site preparation that leaves thin layers of loose slash on the surface can reduce the seedling mortality rate. After the overstory has been removed, plant competition from unwanted species can be controlled by specially designed cutting systems and proper site preparation. Trees generally are not planted on this soil because of the high seedling mortality rate, plant competition, and low productivity.

This soil is unsuited to recreational development because of small stones, the seasonal high water table, the moderately slow permeability, and the ponding.

This soil is unsuited to building site development and septic tank absorption fields. The ponding is a hazard.

The land capability subclass is Vw. The woodland ordination symbol is 6W. The Michigan soil management group is 3c.

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban or built-up land or water areas. It either is used for food or fiber crops or is available for those crops. The soil qualities, growing season, and moisture supply are those needed for a well managed soil to produce a sustained high yield of crops in an economic manner. Prime farmland produces the highest yields with minimal expenditure of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Soil Conservation Service.

About 57,000 acres in the survey area, or more than 12 percent of the total acreage, meets the requirements for prime farmland. Scattered areas of this land are throughout the county, but most are in associations 3, 8, and 10, which are described under the heading "General Soil Map Units."

A recent trend in land use in some parts of the county has been the loss of some prime farmland to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and less productive and cannot be easily cultivated.

The map units in Cheboygan County that are considered prime farmland are listed in table 5. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

Some soils that have a seasonal high water table qualify for prime farmland only in areas where this limitation has been overcome by drainage measures. The need for these measures is indicated after the map unit name in table 5. Onsite evaluation is needed to determine whether or not this limitation has been overcome by corrective measures.

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, agronomists, conservationists, engineers, foresters, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and Pasture

Dwight L. Quisenberry, agronomist, Soil Conservation Service, helped prepare this section.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained *(10)*; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

In 1978, 46,000 acres in Cheboygan County was used as cropland or pasture and hayland and 366,600 acres was used as woodland *(14)*.

The potential of the soils in Cheboygan County for increased crop production is fair. Production can be increased by using the latest crop production technology on all cropland in the county. In the townships of Benton, Ellis, Forest, Grant, Hebron, Nunda, and Walker, however, the acreage of land used for agriculture production has decreased rapidly.

Wetness is the major management concern on much of the cropland in the county. In some areas the somewhat poorly drained Rudyard soils have been drained for use as cropland. Most of the poorly drained and very poorly drained soils cannot be drained in an economic manner. These soils are on low plains and in depressions, where ponding is frequent and suitable drainage outlets are not readily available. They also are subject to extended periods of frost and to low soil temperatures, which hinder seed germination. On the somewhat poorly drained soils, such as Brimley, Riggsville, and Solona soils, artificial drainage is needed. If excess water is not removed, tillage, seed germination, and growth are adversely affected.

Subsurface tile drainage systems generally are used to remove excess water. The tile drains must be spaced properly to allow for the differences in permeability of the soils. In some areas open ditches are needed as outlets for the drains. Deep open ditches are needed to provide outlets for both surface and subsurface drains. Cheboygan, Emmet, and Ocqueoc soils are well drained, but droughtiness is a hazard during long dry periods. Small areas of wet soils along drainageways and in swales commonly are used in combination with larger areas of well drained soils. Artificial drainage may be needed in some of the wet areas to prevent delays in fieldwork.

Water erosion is a hazard on some of the soils used for crops and pasture in the county. Productivity is reduced if the surface soil is lost and the subsoil is mixed into the plow layer. For example, the subsoil of the eroded Ontonagon soils has a higher content of clay and a lower organic matter content than the original surface soil. The higher content of clay causes the plow layer to remain wet longer after rains, and thus delays fieldwork. The surface layer also tends to be cloddy and makes a poor seedbed. Surface crusting, which restricts plant growth, is common. More energy is required to till eroded soils than noneroded soils. In places the subsoil of the Cheboygan, Emmet, and Onaway soils has a lower content of organic matter, a higher content of sand, a lower available water capacity, or poorer tilth than the original surface soil.

Exposure of the subsoil increases the hazard of soil blowing. In eroded areas sediment, which may contain fertilizer and pesticides, enters tile drains, creeks, and streams. The sedimentation reduces the quality of the water for public and private use.

Conservation tillage, which leaves crop residue on the surface, increases the rate of water infiltration and reduces the hazards of runoff and erosion. Planting no-till corn also effectively reduces the hazard of erosion. No-till cropping requires high levels of management and relies on herbicides and insecticides for weed and pest control. No-till practices are especially effective in minimizing erosion on the sloping soils in the county.

Tilling on the contour and stripcropping help to control erosion. Because of the complexity of the slopes, contour tilling is not common in Cheboygan County. It is most practical on deep, well drained soils that are highly susceptible to erosion.

Grassed waterways are used on both undulating and nearly level soils and on sloping soils to reduce channel erosion. Grassed waterways can be used to stabilize previously eroded areas that have been reshaped and seeded. They are installed on nearly level soils if a large watershed drains across the land. Subsurface drains generally are installed below the waterways to remove excess water. Proper drainage improves plant growth. It also results in dryer soil conditions, which facilitates the use of machinery.

Grade-stabilization structures help to control erosion in areas where surface water drains into channels. These structures generally are used in conjunction with grassed waterways and are installed at both ends of the waterway. They convey the water to a lower elevation and prevent excessive erosion on the sides and bottom of the channel.

Soil blowing is a hazard on many of the soils in Cheboygan County, especially on the unprotected, drained organic soils and on soils that have a sand, loamy sand, or sandy loam surface layer. Using surface mulch to maintain the plant cover, planting buffer strips of small grains, leaving crop residue on the surface, and maintaining a rough surface minimize the hazard of soil blowing. Vegetative barriers also help to control soil blowing. Field windbreaks of adapted trees and shrubs planted at right angles to the prevailing wind provide long-term protection against erosion.

Soil fertility is naturally low in the sandy soils in the county and medium in most of the loamy soils. The soils that formed on till plains and moraines, such as Cheboygan, Emmet, Onaway, Riggsville, and Solona soils, are moderately high in natural fertility. Soil fertility is quite variable as a result of differences in past land use and management. Most of the soils in the county are medium acid to neutral in the surface layer. Applications of lime and fertilizer should be based on the results of soil tests, the needs of the crop, and the expected level of yields. The Cooperative Extension Service can help in determining the kind and amount of fertilizer and lime *(6)*.

Soil tilth is an important factor affecting seed germination and the workability of the soil. Soils that have good tilth require a minimum of working for seed germination and plant growth. Many of the soils in the county that are used for crops have a surface layer of sandy loam, loam, or loamy sand. Soils that have good tilth have granular structure and a moderate or high content of organic matter. The use of machinery during wet periods results in compaction and surface crusting, which reduce the rate of water infiltration and increase the runoff rate. Compaction and the loss of granular soil structure can result in the formation of small individual soil particles. These small particles are carried away by wind and water. Preparing a good seedbed on severely eroded soils is difficult, mainly because of a susceptibility to further erosion. Adequate surface and subsurface drainage, timely field activities, and adequate levels of organic matter improve soil structure and tilth, reduce soil compaction, and help to control erosion.

Barley, corn, oats, and wheat are the main field crops that are suited to the soils in Cheboygan County. Commonly grown legumes include alfalfa, birdsfoot trefoil, and clover. Grasses grown for hay and pasture are mainly bromegrass, orchardgrass, and timothy. Rye, buckwheat, and sorghum-sudangrass are not commonly grown. A number of Christmas tree plantations are in the county.

Specialty crops, such as strawberries and potatoes, are grown only on a limited acreage in the county. The well drained loamy sands, sandy loams, and loams are suited to these crops. The latest information concerning specialty crops is available at local offices of the Cooperative Extension Service and the Soil Conservation Service.

Much of the permanent pasture in the county is on soils that are susceptible to erosion. Some pasture is on wet soils. Erosion control is particularly important during seeding operations. If lime and fertilizer are applied, the kind and amount should be determined by soil tests. Soil compaction, which can be caused by grazing when the soils are wet, inhibits the growth of pasture plants. Proper harvesting methods, such as those used for hay or silage, increase plant growth and reduce compaction.

The productivity of a pasture and its ability to protect the surface of the soil are influenced by the number of livestock the pasture supports, the length of time the livestock graze, and the distribution of rainfall. Good pasture management includes proper stocking rates, rotation grazing, deferred grazing, grazing at the proper season, and properly locating livestock watering facilities.

Yields Per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification of each map unit also is shown in the table.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capebility Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for woodland and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main hazard is the risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c,* used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The acreage of soils in each capability class and subclass is shown in table 7. The capability classification of each map unit is given in the section "Detailed Soil Map Units" and in the yields table. Also given at the end of each map unit description is a Michigan soil management group *(7)*. The soils are assigned to a group according to the dominant profile texture, the natural drainage class, and the major management concerns. For soils making up a complex, the management groups are listed in the same order as the series named in the complex.

Woodland Management and Productivity

The major concerns associated with woodland use and management are discussed in this section. Information is provided about the major kinds of vegetative cover and the relationship of plants to different kinds of soils. Present and potential woodland products are discussed. The woodland suitability groups of soils and the growth and management associated with each group also are discussed.

At one time a dense forest covered all the land in Cheboygan County, except for a few bogs and marshes. Most areas were logged and the slash burned. Many areas were cleared. Most of the cleared areas have either reverted to natural forest or have been planted to pines.

About 366,600 acres, or about 80 percent of the county, is wooded *(14)*. Approximately 186,000 acres is in the Mackinaw State Forest. Private forest industry operates on more than 11,000 acres in the county.

The county has 5 major kinds of natural forest cover types *(8)*. Each type is distinctly different and has different value and potential for forest use and for the production of woodland products. Generally, the soils in each forest cover type are quite different.

Jack Pine Forest Cover Type makes up about 21,000 acres in the county *(12)*. Jack pine and northern pin oak predominate. Other common associated trees include eastern white pine, red pine, and aspen. This cover type is mainly on Grayling and Zimmerman soils. These soils are deep and sandy and have weak profile development. The more droughty and less fertile soils support only northern pin oak and jack pine. Growth is slow, and reestablishing tree cover in cutover areas is difficult.

Oak-Red Maple Forest Cover Type makes up about 63,000 acres. Northern red oak and red maple predominate. Other common associated trees include bigtooth aspen, red pine, eastern white pine, and paper birch. This cover type is mainly on Rubicon and East Lake soils. These soils are deep and sandy. East Lake soils have limy sand and gravel in the substratum. Growth is good on these soils. Young plantations of red pine and eastern white pine are common in areas of this cover type.

Sugar Maple-Beech-Yellow Birch Forest Cover Type makes up about 146,000 acres. Sugar maple is the most common tree and is almost always dominant; however, American beech, yellow birch, and red maple also are very common. Other common associated trees include black cherry, northern red oak, and aspen. The number of American basswood, eastern hemlock, eastern white pine, red pine, and white ash varies. This cover type is mainly on Kalkaska, Cheboygan, Onaway, Emmet, and Blue Lake soils. These soils are well drained and are sandy and loamy and are the most productive soils in the survey area. Growth is good or excellent, and the potential for the production of wood products is high. Christmas tree farms are common in areas of this cover type.

Red Maple-Paper Birch-White Spruce-Balsam Fir Forest Cover Type makes up about 81,000 acres. Most stands are a mixture of wetland hardwoods and conifers and include a wide range of tree species. Red maple, paper birch, quaking aspen, white spruce, balsam fir, and eastern hemlock predominate. Other common associated trees include eastern white pine, northern whitecedar, black ash, and balsam poplar. The number of sugar maple, northern red oak, and American elm varies. Most American elm trees have died from Dutch Elm disease. This cover type is mainly on Au Gres, Croswell, Otisco, Riggsville, and Solona soils. These soils are sandy and loamy and have a seasonal high water table. Growth is fair to good on these soils.

Northern Whitecedar Forest Cover Type makes up about 50,000 acres. Northern whitecedar predominates. Other common associated trees include black spruce, black ash, red maple, eastern hemlock, balsam poplar, and tamarack. This cover type is mainly on Lupton, Tawas, Grousehaven Variant, Bowstring, and Roscommon soils. These are very poorly drained organic and sandy mineral soils. The water table is at or near the surface during most periods. Growth is slow, and reestablishing stands of desirable trees in cutover areas is difficult. Windthrow is a serious hazard in areas that are opened up by cutting.

Management for wood crops on the different kinds of soil in the survey area varies but is usually governed by the species present. One management alternative would be to favor northern hardwood species with uneven-aged harvesting methods. Another management alternative could favor aspen and white birch using even-aged harvesting methods. Woodland management should include erosion-control measures, supplemental planting where natural regeneration is undesirable or insufficient, measures that control vegetation that competes with natural or planted regeneration, practices that increase the seedling survival rate and minimize windthrow on the wetter sites, timely harvesting, control of the damage caused by insects and diseases, removal of cull trees and undesirable species, and maintenance of the optimum basal area.

Erosion damage may occur as a result of site preparation for planting or as a result of cutting operations that expose the soil along logging roads, fire lanes, and landing areas. Areas burned in forest fires may also be subject to erosion. Soil erosion is generally a hazard in areas of forest land with slopes of 18 percent or more. Locating logging roads and skid roads on the contour minimizes erosion.

Soil wetness is the result of a high water table, flooding, or ponding. The wetness or excess water increases seedling mortality, limits the use of equipment, and increases the invasion or growth of undesirable plants following harvest and the hazard of windthrow by restricting the rooting depth of some trees. Ruts form easily on some soils when wheeled skidders are used during wet periods. Deep ruts tend to restrict lateral drainage, expose tree roots, and alter soil structure and can result in a change in the dominant species and reduced yields. The wetness is best overcome by timing woodland activities to the drier periods or periods when the ground is frozen or has adequate snow cover.

Droughtiness may also increase seedling mortality. Steep south- and west-facing slopes may be especially droughty because of high insolation and evaporation. Planting when the soil is moist reduces seedling losses. If natural regeneration is undesirable or insufficient, the seedling survival rate during dry seasons can be improved by planting large, vigorous nursery stock or containerized seedlings. Special site preparation, such as furrowing, which conserves moisture, may also be needed. Using containerized planting stock may be necessary on very dry sites.

Slope and stoniness may limit the use of forestry equipment. Slopes of 18 percent or more generally limit the use of equipment in logging areas and on skid trails and logging roads. Establishing logging roads and skid trails on the contour helps to overcome the slope. The slope also affects the location of landings and log handling areas. Nearly level and undulating areas provide the best locations for such sites. In addition to restricting equipment use, surface and subsurface stones and shallowness to bedrock also can restrict the construction of logging roads.

Table 8 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination symbol for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for an indicator tree species. The number indicates the volume, in cubic meters per hectare per year, which the indicator species can produce. The number 1 indicates low potential productivity; 2 and 3, moderate; 4 and 5, moderately high; 6 to 8, high; 9 to 11, very high; and 12 to 39, extremely high. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *R* indicates steep slopes; *X*, stoniness or rockiness; *W*, excess water in or on the soil; *T*, toxic substances in the soil; *D*, restricted rooting depth; *C*, clay in the upper part of the soil; *S*, sandy texture; *F*, a high content of rock fragments in the soil; and *L*, low strength. The letter *A* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: R, X, W, T, D, C, S, F, and L.

In table 8, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

Erosion hazard is the probability that damage will occur as a result of site preparation and cutting where the soil is exposed along roads, skid trails, fire lanes, and log-handling areas. Forests that have been burned or overgrazed are also subject to erosion. Ratings of the erosion hazard are based on the percent of the slope. A rating of *slight* indicates that no particular prevention measures are needed under ordinary conditions. A rating of *moderate* indicates that erosion-control measures are needed in certain silvicultural activities. A rating of *severe* indicates that special precautions are needed to control erosion in most silvicultural activities.

Equipment limitation reflects the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. The chief characteristics and conditions considered in the ratings are slope, stones on the surface, rock outcrops, soil wetness, and texture of the surface layer. A rating of *slight* indicates that under normal conditions the kind of equipment or season of use is not significantly restricted by soil factors. Soil wetness can restrict equipment use, but the wet period does not exceed 1 month. A rating of *moderate* indicates that equipment use is moderately restricted because of one or more soil factors. If the soil is wet, the wetness restricts equipment use for a period of 1 to 3 months. A rating of *severe* indicates that equipment use is severely restricted either as to the kind of equipment that can be used or the season of use. If the soil is wet, the wetness restricts equipment use for more than 3 months.

Seedling mortality refers to the death of naturally occurring or planted tree seedlings, as influenced by the kinds of soil, soil wetness, or topographic conditions. The factors used in rating the soils for seedling mortality are texture of the surface layer, depth to a seasonal high water table and the length of the period when the water table is high, rock fragments in the surface layer, effective rooting depth, and slope aspect. A rating of *slight* indicates that seedling mortality is not likely to be a problem under normal conditions. Expected mortality is less than 25 percent. A rating of *moderate* indicates that some problems from seedling mortality can be expected. Extra precautions are advisable. Expected mortality is 25 to 50 percent. A rating of *severe* indicates that seedling mortality is a serious problem. Extra precautions are important. Replanting may be necessary. Expected mortality is more than 50 percent.

Windthrow hazard is the likelihood that trees will be uprooted by the wind because the soil is not deep enough for adequate root anchorage. The main restrictions that affect rooting are a seasonal high water table and the depth to bedrock, a fragipan, or other limiting layers. A rating of *slight* indicates that under normal conditions no trees are blown down by the wind. Strong winds may damage trees, but they do not uproot them. A rating of *moderate* indicates that some trees can be blown down during periods when the soil is wet and winds are moderate or strong. A rating of *severe* indicates that many trees can be blown down during these periods.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index* and as a *volume* number. The site index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

The *volume*, a number, is the yield likely to be produced by the most important trees. This number, expressed as cubic feet per acre per year, indicates the amount of fiber produced in a fully stocked, even-aged, unmanaged stand. The volume was determined using standard yield tables *(13)*.

The first species listed under *common trees* for a soil is the indicator species for that soil. It is the dominant species on the soil and the one that determines the ordination class.

Trees to plant are those that are suitable for commercial wood production.

Table 9 gives information about operating harvesting or thinning equipment in logging areas and on skid trails, log landings, and haul roads. Limitations are given for the most limiting season and for the preferred season. The *most limiting season* in Cheboygan County generally is spring or late fall. In some areas, however, it is during dry periods in summer, when loose sand can limit trafficability on deep, well drained, sandy soils.

The *preferred operating season* is the period when harvesting or thinning causes the least amount of soil damage. This period generally is when the soil is not too wet or when the ground is frozen or partly frozen or has an adequate snow cover.

In table 9 a rating of *slight* indicates that the use of conventional logging equipment is not restricted if normal logging methods are used. A rating of *moderate* indicates that the use of equipment is restricted because of one or more soil factors. If wetness is a limitation, high flotation equipment or special procedures may be needed to prevent the formation of ruts. A rating of *severe* indicates that the kind of equipment that can be used is seriously restricted.

Logging areas and skid trails include areas where some or all of the trees are being cut. Generally, equipment traffic is least intensive in the logging areas. Skid trails, which generally are within the logging area, are roads or trails over which logs are dragged or hauled from the stump to a log landing.

Log landings are areas where logs are assembled for transportation. Wheeled equipment may be used more frequently in these areas than in any other areas affected by logging.

Haul roads are access roads leading from primary or surfaced roads to the logging areas. The haul roads serve as transportation routes for wheeled logging equipment and logging trucks. Generally, they are unpaved roads. Some are graveled.

Windbreaks and Environmental Plantings

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 10 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 10 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a commercial nursery.

Recreation

Recreation is a major land use in Cheboygan County. Many areas are used for extensive recreational activities, such as fishing, hunting, sightseeing, and wildlife and plant observation. Winter recreational activities include cross-country skiing and snowmobiling. Some areas are dedicated to intensive recreational use. These include campgrounds, picnic areas, playgrounds, hiking trails, cross-country skiing areas, and golf courses. As the population and land prices increase, land uses will likely undergo changes in the future. These changes may include the use of more land for various types of recreation.

The soils of the survey area are rated in table 11 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewer lines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 11, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 11 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 14 and interpretations for dwellings without basements and for local roads and streets in table 13.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have gentle slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Wildlife Habitat

Cheboygan County has a large population of diverse wildlife species. White-tailed deer are abundant and are a popular game species. Snowshoe hare, raccoon, gray squirrel, black squirrel, and fox squirrel are abundant. Coyote, porcupine, badger, skunk, red squirrel, and woodchuck also are found in the area. Beaver, fox, muskrat, mink, and otter are important fur resources for trappers. The population of black bear and bobcat are significant for hunting. The wild turkey has been reintroduced and has become reestablished in the east-central part of the county. Other game species include ruffed grouse, woodcock, and waterfowl, such as mallards and golden eye ducks.

Cheboygan County also provides habitat for some rare species. The largest elk population east of the Rocky Mountains is located in the Pigeon River Country State Forest area. The area supports approximately 1,000 animals. The endangered pine marten has been reintroduced in the southern part of the county. In addition some rare bird species are found in the county. Bald eagles, osprey, and sandhill cranes have small nesting populations that will continue to increase if special care is taken to protect the habitat.

The nearly 51,000 acres of lakes and streams provide abundant habitat for the many game fish species in the county. Species such as sturgeon, muskellunge, northern pike, largemouth bass, walleye, trout, and perch as well as other game fish can be found in the waters of Cheboygan County.

The habitat for wildlife in Cheboygan County ranges from areas of farmland to northern hardwood climax forests. Much of the habitat can be improved by increasing available food and cover. Planting woodland openings to grasses, small grains, and food-producing shrubs helps to provide a diversity of habitats. Locating these openings near a wetland area or near a source of water further enhances the value of the area for a variety of wildlife species.

Examples of this type of wildlife improvement can be seen in several areas of Cheboygan County. Dingman Marsh, Stoney Creek Flooding, and Cornwall Creek Flooding are all areas of wildlife habitat improvement.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 12, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, winter wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, lovegrass, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bunchberry, sweetfern, brackenfern, wild strawberry, and sweet cicely.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are oak, aspen, cherry, sugar maple, beech, dogwood, blackberry, and blueberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian olive, autumn olive, and crabapple.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, cedar, and juniper.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are water horsetail, leatherleaf, wildrice, cattail, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. Wildlife attracted to these areas include sharptail grouse, goldfinch, meadowlark, field sparrow, cottontail, and red fox.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, ruffed grouse, woodcock, thrushes, woodpeckers, squirrels, red fox, porcupine, raccoon, deer, and bear.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kinds of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 13 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and *small commercial buildings* are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a dense layer or cemented pan, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a dense layer or cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic-supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a dense layer or cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 14 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 14 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a dense layer or cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 14 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a dense layer or cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage resulting from rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground-water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 14 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a dense layer or cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a dense layer, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 15 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, a low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have a moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. These soils may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 15, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, and bedrock.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel or stones, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel or stones, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 16 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed excavated ponds. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders or organic matter. A high water table affects the amount of usable material. It also affects trafficability.

Aquifer-fed excavated ponds are pits or dugouts that extend to a ground-water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table and the permeability of the aquifer. Depth to bedrock and the content of large stones affect the ease of excavation.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a dense layer or cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a dense layer or cemented pan, large stones, slope, and the hazard of cutbanks caving. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a dense layer or cemented pan affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classification, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

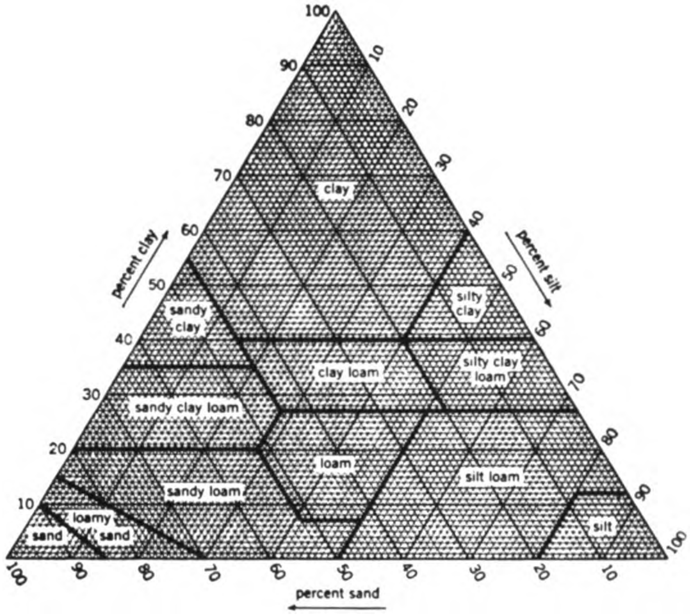

Figure 9.—Percentages of sand, silt, and clay in the basic USDA soil textural classes.

Engineering Index Properties

Table 17 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter (fig. 9). "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system *(2)* and the system adopted by the American Association of State Highway and Transportation Officials *(1)*.

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 18 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at ⅓ bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing. Soils are grouped according to the following distinctions:

1. Coarse sands, sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, and sapric soil material. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loams, silt loams, clay loams, and silty clay loams. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control soil blowing are used.

5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.

6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay. These soils are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.

7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material. These soils are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.

8. Soils that are not subject to wind erosion because of coarse fragments on the surface or because of surface wetness.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 18, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter in a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Tables 19 and 20 give estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used in table 19 to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the infiltration of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to two hydrologic groups in table 19, the first letter is for drained areas and the second is for undrained areas.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by lake levels. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 19 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs, on the average, once or less in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 19 are the depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 19.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given in table 20 if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Cemented pans are cemented or indurated subsurface layers within a depth of 5 feet. Such pans cause difficulty in excavation. Pans are classified as thin or thick. A thin pan is less than 3 inches thick if continuously indurated or less than 18 inches thick if discontinuous or fractured. Excavations can be made by trenching machines, backhoes, or small rippers. A thick pan is more than 3 inches thick if continuously indurated or more than 18 inches thick if discontinuous or fractured. Such a pan is so thick or massive that blasting or special equipment is needed in excavation.

Subsidence is the settlement of organic soils or of saturated mineral soils of very low density. Subsidence results from either desiccation and shrinkage or oxidation of organic material, or both, following drainage. Subsidence takes place gradually, usually over a period of several years. Table 20 shows the expected total subsidence, which usually is a result of oxidation.

Not shown in the table is subsidence caused by an imposed surface load or by the withdrawal of ground water throughout an extensive area as a result of lowering the water table.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Characterization Data for Selected Soils

Some of the soils in Cheboygan County were sampled and laboratory data were determined by the Soil Research Laboratory, Michigan Technological University, Houghton, Michigan, and the Soil Survey Investigations Staff, Soil Conservation Service, Lincoln, Nebraska. The laboratory data obtained from the soil samples include analyses of particle-size distribution, coarse fragments, bulk density, and moisture retention. Complete chemical analyses were also performed on each sample, and spodic horizon criteria were determined on the appropriate samples. Standard National Cooperative Soil Survey procedures were used for all analyses. Forest sites also were sampled for an estimate of the productivity of many of the sampled soils for wood products.

These data were used in classifying and correlating the soils and in evaluating their behavior, especially under forestry uses. A total of 16 profiles were selected as representative of their respective series. These series and their laboratory identification numbers are as follows: Blue Lake (S84MI-031-006), Alcona (S86MI-031-005), Bruce (S86MI-031-009), Charity (S86MI-031-006), Cheboygan (S84MI-031-007), Cheboygan (S85MI-031-004), Eastport (S86MI-031-001), Finch (S84MI-031-002), Battlefield (S86MI-031-002), Grayling (S84MI-031-004), Kalkaska (S86MI-031-003), Nadeau (S84MI-031-001), Ontonagon (S86MI-031-008), Rubicon (S84MI-031-003), Rudyard (S86MI-031-007), and Zimmerman (S84MI-031-005).

These data are available from the Soil Research Laboratory, Michigan Technological University, Houghton, Michigan; the Soil Survey Investigations Staff, Soil Conservation Service, Lincoln, Nebraska; the Soil and Water Conservation Division, Michigan Department of Agriculture, Lansing, Michigan; and the Soil Conservation Service, State Office, East Lansing, Michigan.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories *(11)*. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 21 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Eleven soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Spodosol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Aquod (*Aqu*, meaning water, plus *od*, from Spodosol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Haplaquods (*Hapl*, meaning minimal horizonation, plus *aquod*, the suborder of the Spodosols that has a horizon with an accumulation of aluminum, iron, and organic carbon in which not one of the elements dominates).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Haplaquods.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is sandy, mixed, frigid Typic Haplaquods.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual (9)*. Many of the technical terms used in the descriptions are defined in *Soil Taxonomy (11)*. Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Alcona Series

The Alcona series consists of deep, well drained, moderately permeable soils on lake plains. These soils formed in stratified, sandy and silty material. Slopes range from 0 to 50 percent.

The Alcona soils in this county have a higher content of silt in the subsoil and substratum than is defined as the range for the series. This difference, however, does not alter the use or management of the soils.

Typical pedon of Alcona very fine sandy loam, 0 to 6 percent slopes, 2,300 feet north and 800 feet west of the southeast corner of sec. 1, T. 36 N., R. 1 E., Grant Township:

A—0 to 2 inches; dark brown (10YR 3/3) very fine sandy loam, pale brown (10YR 6/3) dry; weak medium subangular blocky structure; very friable; many fine roots; strongly acid; abrupt smooth boundary.

E—2 to 7 inches; dark grayish brown (10YR 4/2) very fine sandy loam; weak medium subangular blocky structure; very friable; many fine roots; strongly acid; clear wavy boundary.

Bs1—7 to 9 inches; dark brown (7.5YR 4/4) very fine sandy loam; weak medium subangular blocky structure; very friable; common distinct cracked coatings on sand grains; common fine roots; strongly acid; clear wavy boundary.

Bs2—9 to 11 inches; yellowish brown (10YR 5/6) very fine sandy loam; weak medium subangular blocky structure; very friable; common medium and many fine roots; strongly acid; clear irregular boundary.

E′—11 to 15 inches; very pale brown (10YR 7/3) very fine sandy loam; single grain; loose; common medium and many fine roots; neutral; abrupt irregular boundary.

2Bt—15 to 19 inches; reddish brown (5YR 4/4) loam; weak fine angular blocky structure; friable; common patchy distinct thin reddish brown (5YR 4/4) clay films on vertical and horizontal faces of peds; common medium and many fine roots; neutral; abrupt irregular boundary.

2C—19 to 60 inches; very pale brown (10YR 7/3), stratified loamy very fine sand and silt; weak thick platy structure; very friable; few fine roots; strongly effervescent; mildly alkaline.

The thickness of the solum and the depth to carbonates range from 19 to 30 inches.

Some pedons have an Ap horizon, which is 6 to 9 inches thick. The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 to 3. It is dominantly very fine sandy loam, but the range includes loamy very fine sand. The E horizon has hue of 5YR to 10YR and value of 4 to 6. It is dominantly very fine sandy loam, but the range includes loamy fine sand.

The Bs horizon has value of 3 to 5. It is dominantly very fine sandy loam, but the range includes loamy fine sand. The E′ horizon has hue of 7.5YR or 10YR, value of 4 to 7, and chroma of 2 or 3. The 2Bt horizon has hue of 5YR or 7.5YR and value of 4 or 5. It is very fine sand to silt loam. The 2C horizon has value of 6 or 7 and chroma of 3 or 4. It is loamy very fine sand to silt loam.

Allendale Series

The Allendale series consists of deep, somewhat poorly drained soils on lake plains. These soils formed in sandy deposits underlain by clayey lacustrine deposits. Permeability is rapid in the sandy upper layers and very slow in the clayey underlying layers. Slopes are 0 to 3 percent.

The Allendale soils in this county have a more weakly developed subsoil than is definitive for the series. This difference, however, does not alter the use or management of the soils.

Typical pedon of Allendale sand, 0 to 3 percent slopes, 1,040 feet south and 400 feet east of the northwest corner of sec. 25, T. 38 N., R. 2 W., Beaugrand Township:

Ap—0 to 9 inches; very dark brown (10YR 2/2) sand, dark grayish brown (10YR 4/2) dry; weak medium granular structure; very friable; many very fine and many fine roots; neutral; abrupt smooth boundary.

Bw—9 to 21 inches; light yellowish brown (10YR 6/4) sand; common medium prominent strong brown (7.5YR 5/6) and common medium distinct yellowish brown (10YR 5/6) mottles; single grain; loose; common discontinuous faint thin dark brown (10YR 3/3) organic coatings bridging sand grains; common fine and few medium roots; neutral; abrupt smooth boundary.

Bg—21 to 25 inches; grayish brown (10YR 5/2) gravelly loamy sand; common fine distinct yellowish brown (10YR 5/6) mottles; weak medium platy structure; very friable; few fine roots; about 20 percent gravel; slightly effervescent; mildly alkaline; abrupt smooth boundary.

2C1—25 to 31 inches; reddish brown (5YR 5/3) silty clay; common fine prominent strong brown (7.5YR 5/6) and many fine prominent greenish gray (5GY 6/1) mottles; moderate fine angular blocky structure; firm; few very fine roots; common very fine tubular pores; common discontinuous prominent thin grayish brown (10YR 5/2) clay films on both horizontal and vertical faces of peds; slightly effervescent; moderately alkaline; abrupt smooth boundary.

2C2—31 to 60 inches; reddish brown (5YR 5/3) silty clay; common coarse prominent strong brown (7.5YR 5/6) and common medium prominent greenish gray (5GY 6/1) mottles; massive; firm; violently effervescent; moderately alkaline.

Depth to the 2C horizon ranges from 17 to 25 inches. The Ap horizon has value of 2 or 3. Pedons in undisturbed areas have an A horizon. This horizon has hue of 7.5YR, value of 2 or 3, and chroma of 1 or 2. The A and E horizons are dominantly sand, but the range includes loamy sand. The Bw horizon has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 2 to 4. It is sand, loamy sand, or gravelly loamy sand. The 2C horizon has hue of 5YR to 10YR and chroma of 2 to 4.

Alstad Series

The Alstad series consists of deep, somewhat poorly drained soils that formed in loamy glacial till on till plains. Permeability is moderately slow. Slopes are 0 to 3 percent.

Typical pedon of Alstad loam, 0 to 3 percent slopes, 2,520 feet east and 1,300 feet south of the northwest corner of sec. 18, T. 34 N., R. 1 W., Walker Township:

A—0 to 6 inches; very dark gray (10YR 3/1) loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; many fine and common medium roots; neutral; abrupt wavy boundary.

E—6 to 9 inches; yellowish brown (10YR 5/4) sandy loam, very pale brown (10YR 7/4) dry; many medium distinct yellowish brown (10YR 5/6) and few fine distinct grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; friable; common medium roots; neutral; abrupt irregular boundary.

Bt/E—9 to 11 inches; yellowish red (5YR 4/6) sandy clay loam (Bt) and yellowish brown (10YR 5/4) sandy loam (E) occurring as thin coatings surrounding peds of Bt material; common fine prominent yellowish brown (10YR 5/6), common medium prominent grayish brown (10YR 5/2), and common fine prominent gray (10YR 6/1) mottles; moderate medium subangular blocky and weak medium subangular blocky structure; friable; common medium roots; neutral; abrupt wavy boundary.

Bt—11 to 15 inches; yellowish red (5YR 4/6) sandy clay loam; few fine prominent yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; common distinct dark brown (7.5YR 4/4) clay films on vertical faces of peds; few fine roots; mildly alkaline; clear wavy boundary.

BC—15 to 21 inches; strong brown (7.5YR 4/6) loam; common medium faint strong brown (7.5YR 5/6) mottles; moderate medium platy and weak medium subangular blocky structure; firm; few fine roots; slightly effervescent; mildly alkaline; clear wavy boundary.

C—21 to 60 inches; light brown (7.5YR 6/4) loam; common medium distinct strong brown (7.5YR 5/6) and common medium prominent light greenish gray (5GY 7/1) mottles; moderate medium platy structure; firm; few fine roots; strongly effervescent; strongly alkaline.

The thickness of the solum ranges from 20 to 40 inches. The A horizon has value of 2 or 3. The Bt horizon is loam, sandy clay loam, or clay loam. The C horizon is loam or clay loam.

Angelica Series

The Angelica series consists of deep, very poorly drained, moderately slowly permeable soils on till plains. These soils formed in loamy material. Slopes are 0 to 2 percent.

The Angelica soils in this county have a grayer subsoil, are shallower to a calcareous substratum, and are more alkaline than is definitive for the series. These differences, however, do not alter the use or management of the soils.

Typical pedon of Angelica mucky sandy loam, 2,620 feet east and 40 feet south of the northwest corner of sec. 18, T. 34 N., R. 1 W., Walker Township:

A—0 to 3 inches; black (7.5YR 2/1) mucky sandy loam, very dark gray (7.5YR 3/1) dry; weak fine granular structure; very friable; common fine and few medium roots; slightly effervescent; mildly alkaline; abrupt wavy boundary.

Bg—3 to 6 inches; dark grayish brown (10YR 4/2) loam; common medium prominent dark yellowish brown (10YR 4/6) mottles; weak medium subangular blocky structure; friable; few fine roots; slightly effervescent; mildly alkaline; clear wavy boundary.

BC—6 to 10 inches; grayish brown (2.5Y 5/2) loam; common medium prominent brownish yellow (10YR 6/6), common medium prominent light gray or gray (5Y 6/1), and common medium prominent yellowish red (5YR 5/8) mottles; weak medium subangular blocky structure parting to moderate thin platy; friable; few fine roots; strongly effervescent; moderately alkaline; clear wavy boundary.

Cg1—10 to 16 inches; light brownish gray (2.5Y 6/2) loam; common coarse prominent olive yellow (2.5Y 6/6) and common coarse prominent yellowish brown (10YR 5/8) mottles; moderate thin platy structure parting to weak very fine subangular blocky; friable; strongly effervescent; moderately alkaline; clear wavy boundary.

Cg2—16 to 60 inches; pinkish gray (7.5YR 6/2) loam; common coarse prominent strong brown (7.5YR 5/8) and common fine prominent grayish brown (10YR 5/2) mottles; moderate thin platy structure; friable; strongly effervescent; moderately alkaline.

The thickness of the solum ranges from 10 to 20 inches. Some pedons have an Ap horizon, which is 6 to 9 inches thick. The A horizon has hue of 7.5YR or 10YR and value of 2 or 3. It is dominantly mucky sandy loam, but the range includes sandy loam and loam. The Bg horizon has hue of 10YR to 2.5Y, value of 4 or 5, and chroma of 1 or 2. It is dominantly loam, but the range includes sandy loam and clay loam. The C horizon has hue of 2.5Y, 7.5YR, or 10YR and value of 5 or 6.

Au Gres Series

The Au Gres series consists of deep, somewhat poorly drained, rapidly permeable soils on lake plains, outwash plains, and valley trains. These soils formed in sandy material. Slopes are 0 to 3 percent.

Typical pedon of Au Gres sand, 0 to 3 percent slopes, 1,100 feet south and 1,500 feet east of the northwest corner of sec. 5, T. 35 N., R. 1 E., Waverly Township:

A—0 to 1 inch; very dark gray (10YR 3/1) sand that has flecks of light brownish gray (10YR 6/2) sand (E material); dark gray (10YR 4/1) dry; weak fine granular structure; very friable; many fine and many medium roots; very strongly acid; clear wavy boundary.

E—1 to 11 inches; light brownish gray (10YR 6/2) sand; common fine distinct pinkish gray (7.5YR 6/2) mottles; weak fine subangular blocky structure; very friable; many fine and many medium roots; strongly acid; clear wavy boundary.

Bs1—11 to 14 inches; dark brown (7.5YR 3/4) sand; common medium distinct dark reddish brown (5YR 3/4) mottles; weak fine subangular blocky structure; very friable; about 10 percent strongly cemented ortstein; common distinct and few prominent cracked coatings on sand grains; many fine and common coarse roots; strongly acid; clear wavy boundary.

Bs2—14 to 25 inches; dark brown (7.5YR 4/4) sand; many coarse prominent red (2.5YR 4/6) and many coarse distinct strong brown (7.5YR 5/6) mottles; single grain; loose; about 12 percent strongly cemented ortstein; common distinct cracked coatings on sand grains; common fine roots; strongly acid; clear irregular boundary.

Bs3—25 to 37 inches; strong brown (7.5YR 5/6) sand; common coarse prominent yellowish brown (10YR 5/8) and common coarse faint dark yellowish brown (10YR 4/6) mottles; single grain; loose; about 12 percent strongly cemented ortstein; few prominent cracked coatings on sand grains; few fine roots; medium acid; gradual irregular boundary.

C—37 to 60 inches; yellowish brown (10YR 5/6) sand; common fine prominent strong brown (7.5YR 5/8) mottles; single grain; loose; few fine roots; slightly acid.

The thickness of the solum ranges from 22 to 40 inches. The content of gravel ranges from 0 to 10 percent in the solum.

The A horizon has hue of 5YR to 10YR, value of 2 or 3, and chroma of 1 or 2. The E horizon has hue of 7.5YR or 10YR, value of 5 to 7, and chroma of 1 or 2. The A and E horizons are dominantly sand, but the range includes loamy sand. The Bs horizon has hue of 5YR to 10YR, value of 3 to 6, and chroma of 4 to 6. It is sand or loamy sand. Some pedons have a BC horizon, which has hue of 7.5YR or 10YR and value and chroma of 4 to 6. The C horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 2 to 6.

Battlefield Series

The Battlefield series consists of deep, somewhat poorly drained, rapidly permeable soils on lake terraces and outwash plains. These soils formed in sandy and gravelly material. Slopes are 0 to 3 percent.

Typical pedon of Battlefield sand, 0 to 3 percent slopes, 900 feet south and 700 feet east of the northwest corner of sec. 29, T. 37 N., R. 1 E., Grant Township:

A—0 to 1 inch; very dark gray (10YR 3/1) sand that has flecks of gray (10YR 6/1) sand (E material); dark grayish brown (10YR 4/2) dry; weak fine granular structure; very friable; many fine and common medium roots; very strongly acid; abrupt smooth boundary.

E—1 to 5 inches; light brownish gray (10YR 6/2) sand; single grain; loose; many fine and common medium roots; about 6 percent gravel; very strongly acid; abrupt wavy boundary.

Bs1—5 to 10 inches; dark brown (7.5YR 4/4) sand; common medium prominent strong brown (7.5YR 5/8) mottles; weak medium subangular blocky structure; very friable; about 10 percent strongly cemented ortstein; many fine and common medium roots; common faint cracked coatings on sand grains; about 13 percent gravel; medium acid; clear wavy boundary.

Bs2—10 to 18 inches; strong brown (7.5YR 4/6) gravelly sand; common fine distinct strong brown (7.5YR 5/8) mottles; weak medium subangular blocky structure; very friable; few fine and common medium roots; about 16 percent gravel; medium acid; gradual wavy boundary.

BC—18 to 32 inches; yellowish brown (10YR 5/6) sand; many coarse prominent strong brown (7.5YR 5/8) and many coarse distinct yellowish brown (10YR 5/4) mottles; single grain; loose; few fine roots; about 9 percent gravel; medium acid; clear smooth boundary.

2C—32 to 60 inches; pale brown (10YR 6/3) gravelly sand; common fine distinct dark brown (10YR 4/3) mottles; single grain; loose; few fine roots; about 20 percent gravel and 7 percent cobbles; slightly effervescent; mildly alkaline.

The thickness of the solum ranges from 20 to 40 inches. The content of gravel ranges from 0 to 20 percent in the solum and from 18 to 45 percent in the substratum. The content of cobbles ranges from 0 to 10 percent in the substratum.

The A horizon has hue of 7.5YR or 10YR, value of 2 or 3, and chroma of 1 or 2. The E horizon has hue of 7.5YR or 10YR, value of 6 or 7, and chroma of 2 or 3.

Some pedons have a Bhs horizon, which has textures similar to those of the Bs horizon. The Bs horizon has value of 3 to 5. It is sand, coarse sand, loamy sand, or the gravelly analogs of those textures. The BC horizon has value of 5 or 6 and chroma of 4 to 6. It is coarse sand, sand, or gravelly sand. The 2C horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 2 to 4. It is gravelly or very gravelly sand.

Blue Lake Series

The Blue Lake series consists of deep, well drained, rapidly permeable soils on lake plains, till plains, and moraines. These soils formed in stratified, sandy material. Slopes range from 0 to 50 percent.

Typical pedon of Blue Lake loamy sand, 0 to 6 percent slopes, 1,140 feet south and 300 feet east of the northwest corner of sec. 35, T. 33 N., R. 1 W., Nunda Township:

A—0 to 2 inches; black (5YR 2/1) loamy sand that has flecks of light brownish gray (10YR 6/2) loamy sand (E material); very dark gray (N 3/0) dry; weak fine granular structure; friable; about 1 percent gravel; slightly acid; clear smooth boundary.

E—2 to 8 inches; light brownish gray (10YR 6/2) loamy sand; weak medium granular structure; very friable; about 1 percent gravel; slightly acid; clear wavy boundary.

Bhs—8 to 9 inches; dark brown (7.5YR 3/2) loamy sand; weak medium subangular blocky structure; very friable; common prominent cracked coatings on sand grains; about 1 percent gravel; slightly acid; clear wavy boundary.

Bs1—9 to 13 inches; reddish brown (5YR 4/4) loamy sand; weak medium subangular blocky structure; very friable; common distinct cracked coatings on sand grains; about 1 percent gravel; medium acid; clear wavy boundary.

Bs2—13 to 16 inches; strong brown (7.5YR 4/6) loamy sand; weak medium subangular blocky structure; friable; about 5 percent weakly cemented ortstein; few fine roots; about 1 percent gravel; slightly acid; clear irregular boundary.

E′—16 to 23 inches; pale brown (10YR 6/4) loamy sand; weak medium subangular blocky structure; very friable; common fine and few medium roots; about 1 percent gravel; slightly acid; clear wavy boundary.

Bt—23 to 26 inches; dark brown (7.5YR 4/4) loamy sand; weak medium subangular blocky structure; very friable; common fine and few medium roots; about 1 percent gravel; very strongly acid; clear broken boundary.

E&Bt—26 to 80 inches; light yellowish brown (10YR 6/4) and reddish brown (5YR 4/4) sand and loamy fine sand; weak medium subangular blocky structure; very friable; bands of Bt material ⅛ inch to 1½ inches thick, totaling 10 inches thick; few very fine roots; about 1 percent gravel; neutral.

The thickness of the solum ranges from 40 to more than 60 inches.

The A horizon has hue of 7.5YR or 10YR, value of 2 or 3, and chroma of 2. The E horizon has hue of 7.5YR or 10YR, value of 5 to 7, and chroma of 2. The A and E horizons are sand or loamy sand.

The Bhs horizon has hue of 5YR or 7.5YR and value and chroma of 2 or 3. The Bs horizon has hue of 5YR, 7.5YR, or 10YR, value of 4 or 5, and chroma of 4 to 6. It is sand or loamy sand. A few chunks of ortstein are within the Bh or Bs horizon in some pedons. Some pedons have a BC horizon.

Depth to the E&Bt horizon ranges from 24 to 36 inches. The E part has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 2 to 4. The individual bands range from 2 to 12 inches in thickness. The Bt part has hue of 7.5YR or 10YR, value of 3 to 5, and chroma of 3 to 6. It is loamy sand, loamy fine sand, or sandy loam. The individual bands range from about ⅛ inch to 6 inches in thickness. The combined thickness of the Bt bands is more than 6 inches. Some pedons have a C horizon. This horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 2 or 3. It is sand.

Bonduel Series

The Bonduel series consists of shallow, somewhat poorly drained, moderately permeable soils on till plains. These soils formed in sandy and loamy lacustrine material and in the underlying clayey glacial till over limestone bedrock. Slopes are 0 to 3 percent.

The Bonduel soils in this county have more clay in the argillic horizon, a browner subsoil, and a thinner solum than is definitive for the series. These differences, however, do not alter the use or management of the soils.

Typical pedon of Bonduel loamy very fine sand, 0 to 3 percent slopes, 250 feet west and 1,500 feet north of the southeast corner of sec. 27, T. 35 N., R. 1 E., Waverly Township:

Oe—3 inches to 0; black (10YR 2/1) hemic material; many medium and few fine roots; neutral; abrupt wavy boundary.

E—0 to 4 inches; light brownish gray (10YR 6/2) loamy very fine sand, white (10YR 8/1) dry; common medium faint dark brown (10YR 4/3) mottles; weak fine subangular blocky structure; very friable; many medium and few fine roots; about 2 percent gravel; neutral; abrupt wavy boundary.

Bw—4 to 9 inches; dark yellowish brown (10YR 4/6) fine sandy loam; common fine distinct yellowish brown (10YR 5/8) mottles; weak medium subangular blocky structure; friable; many medium and few fine roots; about 2 percent gravel; mildly alkaline; abrupt irregular boundary.

Bt—9 to 17 inches; dark brown (7.5YR 4/4) silty clay; few fine distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; friable; few medium roots; common discontinuous faint dark brown (7.5YR 4/4) clay films on faces of peds; about 5 percent gravel; strongly effervescent; moderately alkaline; abrupt wavy boundary.

2R—17 to 60 inches; pale brown (10YR 6/3), weathered limestone bedrock; violently effervescent.

The thickness of the solum and the depth to limestone bedrock range from 15 to 20 inches.

Some pedons have an Ap horizon, which is 6 to 9 inches thick. The E horizon is loamy sand, loamy fine sand, or loamy very fine sand. The Bw horizon has value of 4 to 6. The Bt horizon has hue of 5YR or 7.5YR and chroma of 3 or 4. The texture is loam, silty clay loam, or silty clay.

Bowstring Series

The Bowstring series consists of deep, very poorly drained, moderately rapidly permeable to moderately slowly permeable soils on flood plains. These soils formed in organic material stratified with sandy or loamy material. Slopes are 0 to 2 percent.

Typical pedon of Bowstring muck, frequently flooded, 2,200 feet north and 940 feet east of the southwest corner of sec. 28, T. 36 N., R. 1 E., Grant Township:

Oa—0 to 12 inches; sapric material, black (N 2/0) and very dark gray (10YR 3/1) rubbed; very dark brown (10YR 2/2) dry; strong medium granular structure; friable; many coarse and many medium roots; neutral; abrupt wavy boundary.

C—12 to 17 inches; brown (10YR 5/3) sand; common medium distinct gray (10YR 5/1), common medium prominent yellowish brown (10YR 5/8), and common coarse distinct very dark gray (10YR 3/1) mottles; single grain; loose; common coarse and few fine roots; mildly alkaline; abrupt wavy boundary.

Oa′—17 to 60 inches; sapric material, very dark grayish brown (10YR 3/2) and dark brown (7.5YR 3/2) rubbed; brown (10YR 5/3) dry; strong medium granular structure; friable; few wavy, continuous bands of brown (10YR 5/3) sand ¼ inch to 2 inches thick; neutral.

The organic material extends to a depth of more than 51 inches. Herbaceous material is dominant, but woody material is common. The content of woody coarse fragments ranges from 0 to 10 percent. Depth to the C horizon ranges from 10 to 28 inches. The sapric material has hue of 5YR, 7.5YR, or 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 2. The C horizon has hue of 7.5YR, 10YR, or 5Y, value of 2 to 6, and chroma of 1 to 3. It typically is sand or loamy sand, but the range includes silt and silt loam.

Brevort Series

The Brevort series consists of deep, very poorly drained soils on till plains and water-worked till plains. These soils formed in sandy glaciofluvial material underlain by loamy glacial or lacustrine sediments. Permeability is rapid or moderately rapid in the sandy upper layers and moderately slow in the loamy lower layers. Slopes are 0 to 2 percent.

The Brevort soils in this county have brighter colors than is definitive for the series. This difference, however, does not alter the use or management of the soils.

Typical pedon of Brevort mucky loamy sand, 2,600 feet south and 40 feet east of the northwest corner of sec. 2, T. 38 N., R. 3 W., Hebron Township:

A—0 to 5 inches; black (10YR 2/1) mucky loamy sand, very dark gray (10YR 3/1) dry; moderate medium granular structure; loose; about 10 percent gravel; mildly alkaline; abrupt wavy boundary.

C1—5 to 14 inches; light yellowish brown (10YR 6/4) loamy sand; common medium distinct grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; very friable; mildly alkaline; gradual wavy boundary.

C2—14 to 22 inches; pale brown (10YR 6/3) gravelly sand; single grain; loose; about 20 percent gravel; strongly effervescent; mildly alkaline; abrupt wavy boundary.

2C3—22 to 60 inches; light brown (7.5YR 6/4) loam; common medium prominent yellowish brown (10YR 5/6) and common medium prominent gray (5Y 6/1) mottles; moderate very thick platy structure; firm; about 10 percent gravel; violently effervescent; mildly alkaline.

Depth to the 2C horizon ranges from 20 to 40 inches. The content of gravel ranges from 0 to 20 percent throughout the pedon, and the content of cobbles ranges from 0 to 8 percent.

The A horizon has value of 2 or 3. It is dominantly mucky loamy sand, but the range includes sand, loamy sand, mucky sand, or mucky loamy sand. The C horizon has hue of 7.5YR, 10YR, or 2.5Y, value of 4 to 6, and chroma of 1 to 6. It is sand, loamy sand, or gravelly sand. The 2C horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 1 to 4. It is loam, clay loam, or silty clay loam.

Brimley Series

The Brimley series consists of deep, somewhat poorly drained, moderately slowly permeable soils on lake plains and outwash plains. These soils formed in stratified loamy deposits. Slopes are 0 to 3 percent.

The Brimley soils in this county have a darker surface layer, a more weakly developed subsoil, and more silt and less clay in the subsoil and substratum than is definitive for the series. These differences, however, do not alter the use or management of the soils.

Typical pedon of Brimley very fine sandy loam, 0 to 3 percent slopes, 925 feet north and 1,300 feet east of the southwest corner of sec. 17, T. 37 N., R. 1 W., Benton Township:

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) very fine sandy loam, dark grayish brown (10YR 4/2) dry; moderate medium granular structure; friable; slightly acid; abrupt smooth boundary.

E—9 to 11 inches; pale brown (10YR 6/3) very fine sandy loam; few medium distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; slightly acid; abrupt wavy boundary.

Bw—11 to 19 inches; brown (7.5YR 5/4) fine sandy loam; common medium prominent yellowish brown (10YR 5/6) and common medium distinct strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; friable; slightly acid; clear wavy boundary.

Bt—19 to 25 inches; brown (7.5YR 5/4) silt loam; common medium prominent yellowish brown (10YR 5/6) and common medium prominent light brownish gray (10YR 6/2) mottles; moderate medium subangular blocky structure; friable; common discontinuous distinct thin dark brown (7.5YR 4/2) clay films on faces of peds; slightly acid; abrupt wavy boundary.

C—25 to 60 inches; pale brown (10YR 6/3), light brownish gray (10YR 6/2), and yellowish brown (10YR 5/6), stratified very fine sand, very fine sandy loam, and silt; massive; friable; slightly effervescent; mildly alkaline.

The thickness of the solum and the depth to free carbonates range from 20 to 36 inches.

The Ap horizon has value of 3 or 4 and chroma of 1 or 2. The E horizon has value of 5 or 6 and chroma of 2 or 3. The A and E horizons are silt loam or very fine sandy loam. The Bw horizon has hue of 5YR, 7.5YR, or 10YR and chroma of 3 to 5. It is loam, silt loam, fine sandy loam, very fine sandy loam, or silty clay loam. Some pedons have an E′ horizon between the Bw and Bt horizons. This horizon is 1 to 4 inches thick. The Bt horizon has value of 4 or 5 and chroma of 4 to 6. The C horizon has hue of 5YR, 7.5YR, or 10YR, value of 5 or 6, and chroma of 2 to 6. It is mainly stratified very fine sand, very fine sandy loam, and silt. Some pedons have thin strata ranging from sand to silty clay.

Bruce Series

The Bruce series consists of deep, poorly drained, moderately slowly permeable soils that formed in loamy, stratified deposits on lake plains and outwash plains. Slopes are 0 to 2 percent.

The Bruce soils in this county have brighter colors in the subsoil and have more silt and less clay in the subsoil and substratum than is definitive for the series.

These differences, however, do not alter the use or management of the soils.

Typical pedon of Bruce fine sandy loam, 2,700 feet east and 100 feet south of the northwest corner of sec. 15, T. 36 N., R. 1 E., Grant Township:

A—0 to 5 inches; very dark gray (N 3/0) fine sandy loam, dark gray (N 4/0) dry; common fine distinct gray (10YR 5/1) mottles; weak medium granular structure; friable; common medium and many fine roots; neutral; abrupt smooth boundary.

Bg—5 to 8 inches; light brownish gray (10YR 6/2) loamy sand; common coarse prominent yellowish brown (10YR 5/8) and common medium faint grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; friable; common discontinuous very dark gray (N 3/0) organic coatings in root channels; neutral; abrupt wavy boundary.

2Bw1—8 to 15 inches; yellowish brown (10YR 5/4) loam; common medium prominent yellowish brown (10YR 5/8) and common medium prominent greenish gray (5GY 6/1) mottles; moderate thick platy structure; friable; mildly alkaline; clear wavy boundary.

2Bw2—15 to 24 inches; light brown (7.5YR 6/4) silt loam; common medium prominent reddish yellow (7.5YR 6/8) and many medium prominent greenish gray (5GY 6/1) mottles; moderate thick platy structure; friable; slightly effervescent; moderately alkaline; gradual wavy boundary.

2C—24 to 60 inches; light brown (7.5YR 6/4) silt loam; many medium prominent reddish yellow (7.5YR 6/8) and many medium prominent greenish gray (5GY 6/1) mottles; weak thick platy structure; friable; strongly effervescent; moderately alkaline.

The thickness of the solum ranges from 10 to 24 inches.

The Ap horizon has hue of 10YR and chroma of 1 or 2, or it is neutral in hue and has value of 2. The Bg horizon has value of 5 or 6 and chroma of 1 or 2. It is fine sandy loam, sandy loam, or loamy sand. The 2Bw horizon has hue of 5YR to 10YR, value of 5 or 6, and chroma of 2 to 4. It is silt loam or loam. The 2C horizon has value of 6 or 7. It is stratified very fine sand, loamy very fine sand, silt loam, silt, or silty clay loam.

Burleigh Series

The Burleigh series consists of deep, very poorly drained soils on lake plains. These soils formed in sandy material over stratified, sandy and silty material. Permeability is rapid in the upper part of the profile and moderately slow in the lower part. Slopes are 0 to 2 percent.

The Burleigh soils in this county have free carbonates higher in the profile than is definitive for the series and have browner colors in the substratum. These differences, however, do not alter the use or management of the soils.

Typical pedon of Burleigh mucky sand, 100 feet north and 2,300 feet west of the southeast corner of sec. 19, T. 37 N., R. 1 W., Grant Township:

A—0 to 8 inches; black (N 2/0) mucky sand, very dark grayish brown (10YR 3/2) dry; single grain; many white (10YR 8/1) shells; loose; slightly effervescent; mildly alkaline; abrupt smooth boundary.

Cg1—8 to 15 inches; grayish brown (10YR 5/2) sand; few fine prominent brownish yellow (10YR 6/6) mottles; single grain; loose; many white (10YR 8/1) shells; violently effervescent; moderately alkaline; abrupt smooth boundary.

Cg2—15 to 20 inches; light gray (5Y 7/1) fine sand; single grain; loose; many white (10YR 8/1) shells; violently effervescent; moderately alkaline; abrupt smooth boundary.

C—20 to 34 inches; very pale brown (10YR 7/4) sand; common medium faint pale brown (10YR 6/3) and common medium and coarse distinct brownish yellow (10YR 6/6) mottles; single grain; loose; many white (10YR 8/1) shells; violently effervescent; moderately alkaline; abrupt smooth boundary.

2Cg—34 to 60 inches; light brownish gray (10YR 6/2) and brown (7.5YR 5/4), stratified silt loam and loamy very fine sand; few fine distinct brownish yellow (10YR 6/6), common medium distinct yellowish brown (10YR 5/6), and common medium prominent light gray (5Y 7/1) mottles; weak thick platy structure; friable; strongly effervescent; moderately alkaline.

Depth to the 2C horizon ranges from 22 to 36 inches. The A horizon has hue of 10YR and chroma of 1, or it is neutral in hue. It is dominantly mucky sand, but the range includes loamy sand. The C horizon has hue of 10YR to 5Y, value of 5 to 7, and chroma of 1 to 4. It is sand or fine sand. The 2C horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 2 to 6. It is stratified silt loam to very fine sand.

Charity Series

The Charity series consists of deep, poorly drained soils that formed in clayey lacustrine material on lake plains. Permeability is very slow. Slopes are 0 to 2 percent.

Typical pedon of Charity fine sandy loam, 1,400 feet north and 150 feet east of the southwest corner of sec. 30, T. 38 N., R. 2 W., Beaugrand Township:

Ap—0 to 8 inches; very dark gray (10YR 3/1) fine sandy loam, dark gray (10YR 4/1) dry; common fine faint dark gray (10YR 4/1) mottles; moderate medium granular structure; friable; common fine and common medium roots; slight effervescence; mildly alkaline; abrupt smooth boundary.

Bg—8 to 9 inches; grayish brown (2.5Y 5/2) gravelly sandy loam; few fine prominent dark yellowish brown (10YR 4/6) mottles; moderate medium granular structure; friable; common medium roots; about 15 percent gravel; slight effervescence; moderately alkaline; abrupt broken boundary.

2Bw—9 to 26 inches; reddish brown (5YR 5/3) silty clay loam; common fine prominent greenish gray (5GY 6/1) mottles on faces of peds and few medium prominent yellowish brown (10YR 5/6) mottles in ped interiors; strong medium angular structure; firm; common fine roots; strong effervescence; moderately alkaline; diffuse wavy boundary.

2C—26 to 60 inches; reddish brown (5YR 5/4) silty clay; common fine prominent greenish gray (5YR 6/1) mottles along root channels and few medium prominent strong brown (7.5YR 5/8) mottles in ped interiors; massive; firm; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 20 to 30 inches. The content of gravel ranges from 0 to 10 percent in the A horizon, from 0 to 20 percent in the Bg horizon, and from 0 to 10 percent in the 2Bw and 2C horizons.

The Ap horizon has hue of 10YR and chroma of 1 or 2, or it is neutral in hue and has value of 2. It is dominantly fine sandy loam, but the range includes loam, silt loam, or silty clay loam. The Bg horizon has hue of 2.5Y or 10YR, value of 5 to 7, and chroma of 1 or 2. It is loam, sandy loam, gravelly sandy loam, clay loam, or silty clay. The 2Bw and 2C horizons have hue of 5YR, 7.5YR, 10YR, or 2.5Y, value of 5 or 6, and chroma of 2 to 4. They are silty clay, clay, or silty clay loam.

Cheboygan Series

The Cheboygan series consists of well drained and moderately well drained soils on till plains. These soils are moderately deep to dense till. They formed in sandy and loamy glaciofluvial deposits. Permeability is moderately rapid in the sandy material and very slow in the loamy material. Slopes range from 0 to 50 percent.

Typical pedon of Cheboygan loamy sand, 0 to 6 percent slopes, 1,040 feet east and 2,640 feet north of the southwest corner of sec. 10, T. 33 N., R. 1 E., South Forest Township:

A—0 to 2 inches; black (5YR 2/1) loamy sand that has flecks of light gray (N 6/0) loamy sand (E material); dark gray (5YR 4/1) dry; weak fine granular structure; very friable; common fine roots; about 2 percent gravel; strongly acid; clear smooth boundary.

E—2 to 6 inches; pinkish gray (7.5YR 6/2) loamy sand; single grain; loose; common fine and very fine roots; about 4 percent gravel; medium acid; clear wavy boundary.

Bs1—6 to 13 inches; dark brown (7.5YR 4/4) loamy sand; weak medium subangular blocky structure; friable; about 10 percent weakly cemented ortstein; common distinct cracked coatings on sand grains; common fine and very fine roots; about 2 percent gravel; slightly acid; gradual wavy boundary.

Bs2—13 to 17 inches; strong brown (7.5YR 4/6) loamy sand; moderate medium subangular blocky structure; friable; common medium roots; common faint cracked coatings on sand grains; about 3 percent gravel; slightly acid; clear wavy boundary.

E′1—17 to 19 inches; pale brown (10YR 6/3) loamy sand; strong medium subangular blocky structure; firm; few fine roots; common fine tubular pores; about 3 percent cobbles and 3 percent gravel; slightly acid; gradual wavy boundary.

E′2—19 to 22 inches; pinkish gray (7.5YR 6/2) loamy sand; moderate thick platy structure; friable; few fine roots; about 3 percent cobbles and 3 percent gravel; slightly acid; abrupt irregular boundary.

2Bt/E—22 to 28 inches; dark brown (7.5YR 4/4) sandy clay loam (Bt) and pinkish gray (7.5YR 6/2) sandy loam (E); few fine distinct strong brown (7.5YR 5/6) mottles; moderate very thick platy structure parting to moderate medium subangular blocky; firm; many continuous distinct thin reddish brown (5YR 4/4) clay films on faces of peds; few fine roots; about 3 percent cobbles and 3 percent gravel; neutral; clear irregular boundary.

2Cd—28 to 60 inches; brown (7.5YR 5/4) sandy loam; moderate very thick platy structure; firm; few fine roots; about 3 percent cobbles and 8 percent gravel; strongly effervescent; moderately alkaline.

The thickness of the solum ranges from 20 to more than 50 inches. The content of gravel ranges from 2 to 10 percent throughout the profile, and the content of cobbles ranges from 0 to 5 percent.

Pedons in cultivated areas have an Ap horizon 6 to 9 inches thick. Pedons in uncultivated areas have an A horizon 1 to 5 inches thick above an E horizon. The A horizon has hue of 5YR to 10YR, value of 2 to 5, and chroma of 1 to 3, or it is neutral in hue and has value of 2 or 3. The E horizon has hue of 5YR to 10YR, value of 5 or 6, and chroma of 1 to 3, or it is neutral in hue and has value of 5 or 6. The A and E horizons are loamy sand or sand.

Some pedons have a Bhs horizon. The Bs horizon has hue of 5YR or 7.5YR and value and chroma of 4 to 6. It is sand or loamy sand. The E′ horizon has colors and textures similar to those of the E part of the 2Bt/E horizon. The E part of the 2Bt/E horizon has hue of 7.5YR or 10YR, value of 5 to 7, and chroma of 2 or 3. It is sand or loamy sand. The Bt part has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. It is sandy loam, sandy clay loam, or loam. Some pedons have a 2Bt or BC horizon. The 2C horizon has hue of 5YR or 7.5YR, value of 4 to 6, and chroma of 3 or 4.

Croswell Series

The Croswell series consists of deep, moderately well drained, rapidly permeable soils on outwash plains, lake plains, and ground moraines. These soils formed in sandy lacustrine and glaciofluvial deposits. Slopes are 1 to 4 percent.

Typical pedon of Croswell sand, 1 to 4 percent slopes, 1,240 feet south and 700 feet west of the northeast corner of sec. 13, T. 37 N., R. 1 W., Benton Township:

A—0 to 1 inch; black (10YR 2/1) sand, dark grayish brown (10YR 4/2) dry; weak fine granular structure; very friable; strongly acid; clear smooth boundary.

E—1 to 7 inches; pinkish gray (7.5YR 6/2) sand; weak medium granular structure; very friable; strongly acid; clear irregular boundary.

Bs1—7 to 9 inches; strong brown (7.5YR 4/6) sand; weak medium subangular blocky structure; friable; common distinct cracked coatings on sand grains; strongly acid; clear irregular boundary.

Bs2—9 to 16 inches; strong brown (7.5YR 5/6) sand; weak medium subangular blocky structure; friable; common distinct cracked coatings on sand grains; slightly acid; clear irregular boundary.

BC—16 to 39 inches; brownish yellow (10YR 6/6) sand; common medium distinct strong brown (7.5YR 5/8) mottles; single grain; loose; slightly acid; gradual wavy boundary.

C—39 to 60 inches; light yellowish brown (10YR 6/4) sand; single grain; loose; slightly acid.

The thickness of the solum ranges from 15 to 36 inches. The content of gravel ranges from 0 to 5 percent throughout the profile.

The A horizon has hue of 5YR to 10YR, value of 2 or 3, and chroma of 1 or 2, or it is neutral in hue and has value of 2 or 3. The E horizon has hue of 7.5YR or 10YR and value of 5 to 7. The Bs horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 to 6. Some pedons have a thin Bhs horizon. The BC horizon has value of 5 or 6 and chroma of 4 to 8. The C horizon has hue of 7.5YR or 10YR, value of 5 to 7, and chroma of 4 to 8.

Dawson Series

The Dawson series consists of deep, very poorly drained soils on lake plains and in depressions on outwash plains. These soils formed in well decomposed, acidic organic material over sandy material. Permeability is moderately slow to moderately rapid in the upper part of the profile and rapid in the lower part. Slopes are 0 to 2 percent.

Typical pedon of Dawson peat, 2,400 feet south and 2,300 feet east of the northwest corner of sec. 9, T. 37 N., R. 1 E., Benton Township:

Oi1—0 to 5 inches; fibric material, dark yellowish brown (10YR 4/6) broken face; weak very thick platy structure; friable; very strongly acid; clear smooth boundary.

Oi2—5 to 8 inches; fibric material, reddish brown (5YR 4/4) and dark reddish brown (5YR 3/4) broken face; weak very thick platy structure; friable; very strongly acid; abrupt smooth boundary.

Oe—8 to 13 inches; hemic material, dark reddish brown (5YR 3/2) rubbed; moderate very thick platy structure; friable; extremely acid; abrupt smooth boundary.

Oa—13 to 17 inches; sapric material, black (10YR 2/1) and very dark grayish brown (10YR 3/2) broken face; moderate very coarse subangular blocky structure; friable; extremely acid; abrupt wavy boundary.

Cg—17 to 60 inches; grayish brown (10YR 5/2) and pale brown (10YR 6/3) sand; single grain; loose; slightly acid.

The thickness of the organic layers and the depth to sandy material are 17 to 50 inches. The surface tier has hue of 5YR to 10YR, value of 2 to 4, and chroma of 1 to 6. It is typically fibric material, but the range includes hemic material. The subsurface tier is predominantly sapric material, but in some pedons as much as 10 inches of this tier is hemic material. The subsurface tier has value of 5 or 6 and chroma of 2 or 3. The C horizon is sand, fine sand, or gravelly sand.

Detour Series

The Detour series consists of somewhat poorly drained, slowly permeable soils on water-worked till plains. These soils are moderately deep to dense till. They formed in loamy glacial till. Slopes are 0 to 3 percent.

The Detour soils in this county have more clay in the subsoil and have brighter colors in the substratum than is definitive for the series. These differences, however, do not alter the use or management of the soils.

Typical pedon of Detour cobbly loam, 0 to 3 percent slopes, 2,260 feet south and 4,000 feet east of the northwest corner of sec. 28, T. 39 N., R. 3 W., Mackinaw Township:

A—0 to 5 inches; very dark brown (10YR 2/2) cobbly loam, brown (10YR 5/3) dry; moderate medium granular structure; friable; many fine and common medium roots; common discontinuous distinct dark grayish brown (10YR 4/2) coatings; about 10 percent cobbles, 1 percent stones, and 8 percent gravel; neutral; abrupt wavy boundary.

E—5 to 10 inches; pale brown (10YR 6/3) loamy sand; few fine faint brown (10YR 5/3) mottles; weak very thick platy structure; friable; few fine and few medium roots; about 4 percent cobbles and 8 percent gravel; neutral; clear wavy boundary.

E/Bt—10 to 12 inches; pale brown (10YR 6/3) and brown (7.5YR 5/4) loamy sand and sandy clay loam; common fine prominent strong brown (7.5YR 5/8) and few fine faint brown (10YR 5/3) mottles; weak thick platy structure; friable; common fine and common very fine roots; about 5 percent gravel; neutral; abrupt wavy boundary.

Bt—12 to 19 inches; brown (7.5YR 5/4) sandy clay loam; common coarse distinct yellowish brown (10YR 5/4), common fine distinct yellowish brown (10YR 5/6), and few medium distinct grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; friable; common fine and very fine roots; few very fine discontinuous tubular pores; common discontinuous faint yellowish brown (10YR 5/4) clay films on faces of peds; about 5 percent gravel; neutral; clear wavy boundary.

BC—19 to 23 inches; brown (7.5YR 5/4) loam; common medium prominent dark grayish brown (10YR 4/2) and common medium prominent yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; friable; common discontinuous faint brown (7.5YR 5/4) clay films on faces of peds; about 5 percent gravel; slightly effervescent; mildly alkaline; clear wavy boundary.

Cd—23 to 60 inches; light brown (7.5YR 6/4) gravelly loam; common medium distinct brown (7.5YR 5/2) and common fine prominent strong brown (7.5YR 5/8) mottles; moderate very thick platy structure; firm; about 12 percent gravel and 5 percent cobbles; strongly effervescent; moderately alkaline.

The thickness of the solum ranges from 15 to 24 inches. The solum has 1 to 10 percent gravel and 1 to 15 percent cobbles and stones. The substratum has 5 to 10 percent gravel and 1 to 15 percent cobbles.

The A horizon has value of 2 or 3. The E horizon has value of 5 or 6 and chroma of 2 to 4. It is gravelly loamy sand or loamy sand. The Bt part of the E/Bt horizon has colors and textures similar to those of the Bt horizon. The E part has colors and textures similar to those of the E horizon. The Bt horizon has hue of 7.5YR or 10YR. It is sandy clay loam or clay loam. The Cd horizon is gravelly loam or loam.

East Lake Series

The East Lake series consists of deep, somewhat excessively drained, rapidly permeable soils on outwash plains, deltas, beach ridges, and eskers. These soils formed in sandy and gravelly glaciofluvial sediments. Slopes range from 0 to 50 percent.

Typical pedon of East Lake sand, 0 to 6 percent slopes, 1,600 feet north and 2,700 feet east of the southwest corner of sec. 14, T. 37 N., R. 1 W., Benton Township:

A—0 to 1 inch; black (10YR 2/1) sand that has flecks of light gray (10YR 7/2) sand (E material); dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; many fine and medium roots; about 10 percent cobbles; medium acid; abrupt smooth boundary.

E—1 to 2 inches; light brownish gray (10YR 6/2) coarse sand; single grain; loose; many fine and medium roots; about 10 percent cobbles; strongly acid; abrupt smooth boundary.

Bs1—2 to 6 inches; reddish brown (5YR 4/4) coarse sand; single grain; loose; many fine and medium roots; common prominent cracked coatings on sand grains; strongly acid; clear wavy boundary.

Bs2—6 to 11 inches; yellowish red (5YR 5/6) coarse sand; single grain; loose; many fine and medium roots; common distinct cracked coatings on sand grains; strongly acid; gradual wavy boundary.

Bs3—11 to 22 inches; strong brown (7.5YR 4/6) coarse sand; single grain; loose; about 5 percent gravel; common fine and medium roots; common faint cracked coatings on sand grains; strongly acid; clear wavy boundary.

2BC—22 to 28 inches; yellowish brown (10YR 5/6) gravelly coarse sand; single grain; loose; few fine roots; about 20 percent gravel; slightly acid; clear wavy boundary.

2C—28 to 60 inches; light yellowish brown (10YR 6/4) gravelly coarse sand; single grain; loose; few fine roots; about 20 percent gravel; slightly effervescent; mildly alkaline.

The thickness of the solum ranges from 20 to 31 inches. The content of gravel ranges from 0 to 20 percent in the solum and from 20 to 50 percent in the substratum.

The A horizon has hue of 5YR, 7.5YR, or 10YR, value of 2 or 3, and chroma of 1 or 2, or it is neutral in hue and has value of 2 or 3. The E horizon has hue of 5YR, 7.5YR, or 10YR, value of 5 to 7, and chroma of 2 or 3. The A and E horizons are sand, coarse sand, or loamy sand. The Bs horizon has hue of 5YR, 7.5YR, or 10YR, value of 4 or 5, and chroma of 4 to 8. It is sand, coarse sand, or gravelly sand. Some pedons have a thin Bhs horizon. The 2BC horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 3 to 8. It is coarse sand or gravelly sand. The 2C horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 3 or 4. It is gravelly sand, gravelly coarse sand, or very gravelly sand.

Eastport Series

The Eastport series consists of deep, excessively drained, rapidly permeable soils on beach ridges adjacent to Lake Huron. These soils formed in sandy material. Slopes range from 0 to 25 percent.

Typical pedon of Eastport sand, 0 to 6 percent slopes, 2,600 feet west and 1,100 feet north of the southeast corner of sec. 23, T. 38 N., R. 1 W., Benton Township:

A—0 to 1 inch; black (N 2/0) sand that has flecks of light gray (10YR 7/1) sand (E material); pale brown (10YR 6/2) dry; weak fine granular structure; very friable; many medium and fine roots; very strongly acid; abrupt wavy boundary.

E1—1 to 8 inches; pale brown (10YR 6/3) sand; single grain; loose; many fine roots; strongly acid; clear wavy boundary.

E2—8 to 14 inches; light yellowish brown (10YR 6/4) sand; single grain; loose; many fine roots; strongly acid; clear irregular boundary.

Bs—14 to 28 inches; strong brown (7.5YR 5/6) sand; weak medium subangular blocky structure; very friable; common fine and few medium roots; strongly acid; clear irregular boundary.

C—28 to 60 inches; light yellowish brown (10YR 6/4) sand; single grain; loose; very slightly effervescent; moderately alkaline.

The thickness of the solum ranges from 18 to 40 inches. The content of gravel ranges from 0 to 15 percent throughout the profile.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2, or it is neutral in hue and has value of 2 or 3. The E horizon has value of 5 to 7 and chroma of 2 to 4. The Bs horizon has hue of 7.5YR or 10YR and value and chroma of 4 to 6. The C horizon has hue of 7.5YR or 10YR and chroma of 3 or 4.

Emmet Series

The Emmet series consists of deep, well drained, moderately slowly permeable soils on till plains and moraines. These soils formed in loamy material. Slopes range from 1 to 18 percent.

Typical pedon of Emmet sandy loam, 6 to 12 percent slopes, 1,150 feet north and 150 feet west of the southeast corner of sec. 10, T. 37 N., R. 3 W., Munro Township:

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) sandy loam, light brownish gray (10YR 6/2) dry; weak medium subangular blocky structure parting to weak medium granular; friable; many fine and many medium roots; about 2 percent gravel; neutral; clear wavy boundary.

A/E—8 to 12 inches; dark grayish brown (10YR 4/2) sandy loam (A) and pale brown (10YR 6/3) loamy sand (E); weak medium subangular blocky structure parting to weak fine subangular blocky; friable; many fine and common medium roots; about 2 percent gravel; neutral; abrupt wavy boundary.

B/E—12 to 19 inches; reddish brown (5YR 4/4) (Bw) and pale brown (10YR 6/3) (E) sandy loam; weak coarse and weak very thick platy structure parting to moderate very fine subangular blocky; firm; few medium and common fine roots; about 2 percent gravel; slightly acid; clear wavy boundary.

Bt—19 to 27 inches; reddish brown (5YR 4/4) sandy clay loam; weak very thick platy structure parting to moderate medium subangular blocky; very firm; common discontinuous prominent thin dark reddish brown (5YR 3/3) clay films in root channels or pores; few fine and medium roots; about 5 percent gravel; slightly acid; gradual wavy boundary.

C—27 to 60 inches; brown (7.5YR 5/4) sandy loam; weak very thick platy structure parting to weak thick platy; extremely firm; few fine roots; about 5 percent gravel; slightly effervescent; mildly alkaline.

The thickness of the solum and the depth to carbonates range from 24 to 47 inches. The content of gravel ranges from 2 to 5 percent throughout the profile.

The Ap horizon has value of 3 or 4. It is dominantly sandy loam, but the range includes loamy sand. The E part of the A/E horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 2 or 3. In some cultivated pedons all of the E horizon has been mixed with the Ap horizon. Some pedons have a Bw horizon. This horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 to 6. It is sandy loam or loamy sand. The E part of the B/E horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 2 or 3. It is sandy loam or loamy sand. It is hard and brittle, especially during dry periods. Some pedons have an E/B horizon. The Bt horizon and the B part of the B/E horizon have hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. They are sandy loam, loam, or sandy clay loam. The C horizon has hue of 5YR or 7.5YR, value of 5 or 6, and chroma of 4 to 6.

Fairport Series

The Fairport series consists of moderately deep, well drained, moderately slowly permeable soils on glacial lake benches. These soils formed in loamy material over limestone bedrock. Slopes range from 1 to 25 percent.

The Fairport soils in this county have a darker and thicker surface layer and have a substratum with a higher content of coarse fragments than is definitive for the series. These differences, however, do not alter the use or management of the soils.

Typical pedon of Fairport fine sandy loam, 1 to 8 percent slopes, 250 feet north and 40 feet east of the southwest corner of sec. 30, T. 35 N., R. 1 W., Koehler Township:

Ap—0 to 10 inches; very dark grayish brown (10YR 3/2) fine sandy loam, grayish brown (2.5Y 5/2) dry; moderate medium granular structure parting to moderate fine granular; friable; about 3 percent gravel; slightly acid; abrupt smooth boundary.

Bw—10 to 14 inches; dark yellowish brown (10YR 4/4) sandy loam; moderate medium subangular blocky structure; very friable; many medium continuous tubular pores, less than 50 percent casts by volume; about 3 percent gravel; slightly acid; clear wavy boundary.

Bt—14 to 21 inches; dark brown (7.5YR 4/4) loam; few medium distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure parting to moderate fine subangular blocky; friable; many medium continuous tubular pores; few discontinuous distinct pale brown (10YR 6/3) silt skeletons on vertical faces of peds; common continuous distinct dark brown (7.5YR 4/4) clay films on vertical and horizontal faces of peds; about 12 percent gravel; strongly effervescent; mildly alkaline; clear wavy boundary.

BC—21 to 30 inches; yellowish brown (10YR 5/4) gravelly sandy loam; weak medium subangular blocky structure; friable; about 6 percent limestone cobbles and 18 percent gravel; violently effervescent; moderately alkaline; gradual wavy boundary.

2C—30 to 36 inches; yellowish brown (10YR 5/4) cobbly sandy loam; weak coarse subangular blocky structure parting to weak medium subangular blocky; firm; about 10 percent gravel and 20 percent limestone cobbles; violently effervescent; moderately alkaline; abrupt irregular boundary.

R—36 to 60 inches; unweathered limestone bedrock.

The thickness of the solum and the depth to carbonates range from 14 to 37 inches. The depth to limestone bedrock ranges from 20 to 37 inches. The content of gravel ranges from 3 to 18 percent in the solum. The content of cobbles and flagstones ranges from 5 to 20 percent in the 2C horizon.

Pedons in undisturbed areas have A and E horizons. The Ap horizon has value of 3 or 4 and chroma of 1 to 3. It is dominantly fine sandy loam, but the range includes sandy loam and loam. The B horizon has value of 4 to 6 and chroma of 3 to 5. It is dominantly sandy loam, but the range includes fine sandy loam, loam, and clay loam. The 2C horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 3 or 4. It is sandy loam or gravelly or flaggy sandy loam.

Finch Series

The Finch series consists of deep, somewhat poorly drained soils that formed in sandy material on lake plains and till plains. These soils have a strongly cemented subsoil. Permeability is slow in the cemented layer and rapid throughout the rest of the profile. Slopes are 0 to 3 percent.

Typical pedon of Finch sand, 0 to 3 percent slopes, 600 feet north and 1,800 feet west of the southeast corner of sec. 7, T. 37 N., R. 1 E., Benton Township:

Oe—2 inches to 1 inch; dark reddish brown (5YR 2/2) hemic material; very strongly acid; abrupt wavy boundary.

Oa—1 inch to 0; black (N 2/0) sapric material; very strongly acid; abrupt wavy boundary.

E—0 to 9 inches; light gray (10YR 7/2) sand; few fine distinct strong brown (7.5YR 5/6) mottles; single grain; loose; very strongly acid; abrupt irregular boundary.

Bhsm—9 to 14 inches; dark reddish brown (5YR 3/3) sand; few fine prominent strong brown (7.5YR 5/6) mottles; strong coarse subangular blocky structure; extremely firm; about 80 percent strongly cemented ortstein; common prominent cracked coatings on sand grains; strongly acid; clear irregular boundary.

Bsm—14 to 20 inches; dark yellowish brown (10YR 4/4) sand; common medium distinct dark brown (7.5YR 3/4) and strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; very firm; about 80 percent weakly cemented ortstein; common distinct cracked coatings on sand grains; strongly acid; clear wavy boundary.

Bs—20 to 30 inches; brown (10YR 5/3) sand; common medium distinct strong brown (7.5YR 5/6) mottles; single grain; loose; common distinct cracked coatings on sand grains; medium acid; clear wavy boundary.

BC—30 to 35 inches; light yellowish brown (10YR 6/4) sand; common medium distinct strong brown (7.5YR 5/6) mottles; single grain; loose; strongly acid; gradual wavy boundary.

C—35 to 60 inches; light yellowish brown (10YR 6/4) sand; single grain; loose; medium acid.

The thickness of the solum ranges from 30 to 40 inches.

Some pedons have an A horizon. This horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2, or it is neutral in hue and has value of 2 or 3. The E horizon has hue of 7.5YR or 10YR and value of 6 or 7.

The Bsm horizon has hue of 5YR or 7.5YR and value and chroma of 2 to 4. The Bs horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 or 4. Some pedons do not have a Bs horizon. The BC horizon has value and chroma of 4 to 6. The C horizon has value of 4 to 6.

Grayling Series

The Grayling series consists of deep, excessively drained, rapidly permeable soils on outwash plains and deltas. These soils formed in sandy glaciofluvial sediments. Slopes range from 0 to 8 percent.

Typical pedon of Grayling sand, 0 to 8 percent slopes, 2,700 feet north and 2,900 feet east of the southwest corner of sec. 16, T. 35 N., R. 1 E., Waverly Township:

A—0 to 2 inches; black (N 2/0) sand that has flecks of very light gray (N 7/0) sand (E material); dark grayish brown (10YR 4/2) dry; single grain; loose; very strongly acid; abrupt smooth boundary.

E—2 to 4 inches; light brownish gray (10YR 6/2) sand; single grain; loose; very strongly acid; abrupt broken boundary.

Bw—4 to 18 inches; dark yellowish brown (10YR 4/6) sand; single grain; loose; strongly acid; diffuse smooth boundary.

C1—18 to 27 inches; brownish yellow (10YR 6/6) sand; single grain; loose; medium acid; diffuse smooth boundary.

C2—27 to 60 inches; light yellowish brown (10YR 6/4) sand; single grain; loose; medium acid.

The thickness of the solum ranges from 16 to 22 inches. The content of gravel ranges from 0 to 5 percent throughout the profile.

The A horizon has hue of 5YR to 10YR, value of 2 or 3, and chroma of 1 or 2, or it is neutral in hue and has value of 2. The E horizon has hue of 7.5YR or 10YR, value of 5 to 7, and chroma of 2. The Bw horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 6 to 8. The C horizon has hue of 7.5YR or 10YR, value of 5 to 7, and chroma of 3 to 6. Bands and layers of loamy sand and loamy fine sand are below a depth of 60 inches in some pedons.

Greenwood Series

The Greenwood series consists of deep, very poorly drained, moderately permeable or moderately rapidly permeable soils on lake plains and in depressions on outwash plains. These soils formed in partly decomposed, acidic organic material. Slopes are 0 to 2 percent.

Typical pedon of Greenwood peat, 800 feet north and 400 feet west of the southeast corner of sec. 21, T. 37 N., R. 1 E., Benton Township:

Oi—0 to 4 inches; fibric material, reddish brown (5YR 5/4 and 5/6) rubbed; weak thick platy structure; very friable; extremely acid; clear wavy boundary.

Oe1—4 to 8 inches; hemic material, reddish brown (5YR 4/4) and dark brown (7.5YR 4/4) rubbed; moderate very thick platy structure; very friable; extremely acid; clear wavy boundary.

Oe2—8 to 16 inches; hemic material, dark reddish brown (5YR 3/2) broken face and rubbed; moderate thick platy structure; very friable; extremely acid; gradual wavy boundary.

Oe3—16 to 24 inches; hemic material, dark reddish brown (5YR 3/3) and dark brown (7.5YR 3/2) rubbed; moderate thick platy structure; very friable; extremely acid; gradual wavy boundary.

Oe4—24 to 36 inches; hemic material, dark reddish brown (5YR 3/2) broken face and rubbed; moderate thick platy structure; very friable; extremely acid; gradual wavy boundary.

Oe5—36 to 60 inches; hemic material, dark reddish brown (5YR 3/2 and 3/3) rubbed; moderate thick platy structure; very friable; very strongly acid.

The organic layers are 51 or more inches thick. Woody fragments make up as much as 10 percent of the volume in some pedons.

The surface horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 5 or 6. The surface tier is predominantly fibric, but in some pedons it has as much as 10 inches of hemic material. The subsurface and bottom tiers have hue of 5YR or 7.5YR, value of 2 to 6, and chroma of 2 or 3. These tiers are predominantly hemic, but in some pedons they have as much as 10 inches of sapric material.

Grousehaven Variant

The Grousehaven Variant consists of deep, very poorly drained organic soils in bogs and other depressional areas on lake plains and flood plains. These soils formed in decomposed herbaceous material over marl deposits. Permeability is moderately slow to moderately rapid in the organic material and slow in the marl. Slopes are 0 to 2 percent.

Typical pedon of Grousehaven Variant muck, 2,300 feet north and 300 feet east of the southwest corner of sec. 18, T. 35 N., R. 2 W., Tuscarora Township:

Oa1—0 to 3 inches; sapric material, black (5YR 2/1) broken face and rubbed; weak fine granular structure; friable; neutral; clear wavy boundary.

Oa2—3 to 5 inches; sapric material, dark reddish brown (5YR 3/3) broken face and rubbed; weak medium granular structure parting to weak fine granular; friable; neutral; clear wavy boundary.

Oa3—5 to 7 inches; sapric material, dark reddish brown (5YR 3/3) and black (5R 2/1) broken face and rubbed; weak very thick platy structure; friable; neutral; abrupt wavy boundary.

2Cg1—7 to 19 inches; greenish gray (5GY 6/1) marl; many medium prominent light gray (2.5Y 7/2) mottles; massive; friable; strongly effervescent; moderately alkaline; abrupt wavy boundary.

3Cg2—19 to 60 inches; grayish brown (2.5Y 5/2) sand; many medium distinct gray (5Y 5/1) mottles; single grain; loose; violently effervescent; moderately alkaline.

The depth to marl ranges from 5 to 16 inches.

The Oa horizon has value of 2 or 3 and chroma of 1 or 2. The 2Cg horizon has hue of 10YR, 2.5Y, 5GY, or 5Y, value of 2 to 6, and chroma of 1 or 2. The 3Cg horizon has hue of 5Y or 2.5Y, value of 5 to 8, and chroma of 1 or 2.

Hessel Series

The Hessel series consists of deep, very poorly drained, moderately slowly permeable soils on till plains and water-worked till plains. These soils formed in loamy glacial till. Slopes are 0 to 2 percent.

Typical pedon of Hessel mucky gravelly loam, 1,360 feet north and 80 feet west of the southeast corner of sec. 11, T. 38 N., R. 3 W., Hebron Township:

A—0 to 9 inches; black (N 2/0) mucky gravelly loam, very dark grayish brown (10YR 3/2) dry; moderate fine and moderate medium granular structure; friable; common coarse and medium roots; about 3 percent stones and 12 percent gravel; mildly alkaline; abrupt wavy boundary.

Bg—9 to 10 inches; gray (10YR 5/1) sandy loam; common fine prominent light olive brown (2.5Y 5/6) and common medium faint very dark gray (10YR 3/1) mottles; weak fine subangular blocky structure; friable; common medium and many fine roots; about 5 percent gravel; slightly effervescent; mildly alkaline; abrupt wavy boundary.

C—10 to 60 inches; very pale brown (10YR 7/3) loam; few fine prominent yellowish brown (10YR 5/6) and common fine distinct light brownish gray (10YR 6/2) mottles; weak fine subangular blocky structure; friable; few fine roots; about 5 percent gravel; strongly effervescent; moderately alkaline.

The thickness of the solum and the depth to carbonates range from 10 to 15 inches. The content of coarse fragments ranges from 5 to 15 percent throughout the profile. The content of stones ranges from 2 to 5 percent in the surface layer.

The A horizon has value of 2 or 3 and chroma of 0 to 2. It is dominantly mucky gravelly loam, but the range includes mucky loam. The Bg horizon has value of 4 to 6. It is sandy loam, loam, or clay loam. The C horizon has value of 6 or 7 and chroma of 2 to 4. It is sandy loam or loam.

Ingalls Series

The Ingalls series consists of deep, somewhat poorly drained soils on lake plains and outwash plains. These soils formed in sandy deposits over lacustrine sandy, loamy, and silty sediments. Permeability is rapid in the solum and moderately slow in the substratum. Slopes are 0 to 3 percent.

Typical pedon of Ingalls loamy sand, 0 to 3 percent slopes, 1,000 feet east and 1,100 feet south of the northwest corner of sec. 11, T. 37 N., R. 2 W., Inverness Township:

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) loamy sand, pale brown (10YR 6/3) dry; weak medium granular structure; friable; common fine roots; strongly acid; abrupt irregular boundary.

E—8 to 11 inches; light gray (10YR 7/2) sand; common coarse prominent yellowish brown (10YR 5/8) and common medium distinct gray (10YR 5/1) mottles; single grain; loose; common very fine roots; medium acid; abrupt broken boundary.

Bhs—11 to 12 inches; dark reddish brown (5YR 3/3) loamy sand; common medium prominent strong brown (7.5YR 5/8) mottles; weak fine subangular blocky structure; friable; about 10 percent weakly cemented ortstein; common prominent cracked coatings on sand grains; common very fine roots; medium acid; clear broken boundary.

Bs1—12 to 16 inches; strong brown (7.5YR 4/6) loamy sand; common fine distinct yellowish brown (10YR 5/8) mottles; weak medium subangular blocky structure; very friable; common faint cracked coatings on sand grains; medium acid; clear wavy boundary.

Bs2—16 to 22 inches; yellowish brown (10YR 5/6) loamy sand; common fine distinct yellowish brown (10YR 5/8) mottles; weak medium subangular blocky structure; friable; neutral; abrupt wavy boundary.

2C—22 to 60 inches; light brown (7.5YR 6/4), stratified loamy very fine sand and silt; many fine prominent greenish gray (5GY 6/1) and many fine prominent brownish yellow (10YR 6/8) mottles; weak medium platy structure; firm; strongly effervescent; moderately alkaline.

The thickness of the solum ranges from 18 to 50 inches. The content of gravel ranges from 2 to 10 percent throughout the profile.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. Some pedons have an A horizon. This horizon has hue of 10YR, value of 2 or 3, and chroma of 1 to 3, or it is neutral in hue and has value of 2 or 3. The E horizon has hue of 7.5YR or 10YR, value of 5 to 7, and chroma of 1 to 3. The A and E horizons are sand, fine sand, or loamy fine sand. The Bhs horizon has hue of 5YR or 7.5YR and chroma of 2 or 3. The Bs horizon has hue of 5YR to 10YR, value of 4 to 6, and chroma of 3 to 6. It is sand, fine sand, or loamy sand. The 2C horizon is stratified very fine sand, loamy fine sand, or silt loam.

Kalkaska Series

The Kalkaska series consists of deep, somewhat excessively drained, rapidly permeable soils that formed in sandy deposits on outwash plains, lake plains, valley trains, and ground moraines. Slopes range from 0 to 50 percent.

Typical pedon of Kalkaska sand, 0 to 6 percent slopes, 2,680 feet north and 100 feet west of the southeast corner of sec. 20, T. 33 N., R. 3 W., Wilmot Township:

A—0 to 2 inches; very dark gray (N 3/0) sand that has flecks of light gray (N 7/0) sand (E material); dark grayish brown (10YR 3/2) dry; moderate fine granular structure; very friable; many fine and common medium roots; extremely acid; clear wavy boundary.

E—2 to 12 inches; pinkish gray (7.5YR 6/2) sand; single grain; loose; common medium and fine roots; very strongly acid; abrupt irregular boundary.

Bhs—12 to 20 inches; dark reddish brown (5YR 3/3) sand; weak medium subangular blocky structure; friable; common fine roots; about 3 percent gravel; common prominent cracked coatings on sand grains; common silt-sized pellets; medium acid; clear irregular boundary.

Bs—20 to 27 inches; strong brown (7.5YR 5/6) sand; single grain; loose; common fine roots; common distinct cracked coatings on sand grains; medium acid; gradual wavy boundary.

BC—27 to 35 inches; brownish yellow (10YR 6/6) sand; single grain; loose; few fine and few medium roots; about 2 percent gravel; slightly acid; gradual wavy boundary.

C—35 to 60 inches; light yellowish brown (10YR 6/4) sand; single grain; loose; few fine and medium roots; medium acid.

The thickness of the solum ranges from 32 to 48 inches. The content of gravel ranges from 0 to 4 percent throughout the profile.

The A horizon has chroma of 0 or 1. The E horizon has hue of 7.5YR, value of 6 or 7, and chroma of 3, or it is neutral in hue and has value of 6 or 7. The A and E horizons are dominantly sand, but the range includes loamy sand. The Bhs horizon has value of 2 or 3 and chroma of 1 to 3. It is dominantly sand, but the range includes loamy sand. The C horizon has value of 5 or 6 and chroma of 3 to 6.

Kinross Series

The Kinross series consists of deep, very poorly drained, rapidly permeable soils on lake plains and outwash plains. These soils formed in sandy material. Slopes are 0 to 2 percent.

Typical pedon of Kinross mucky sand, 800 feet north and 1,500 feet east of the southwest corner of sec. 33, T. 35 N., R. 3 W., Tuscarora Township:

A—0 to 5 inches; black (5YR 2/1) mucky sand, dark reddish brown (5YR 3/2) dry; weak fine granular structure; very friable; many medium roots; very strongly acid; abrupt wavy boundary.

E1—5 to 9 inches; light gray (10YR 7/1) sand; common fine prominent yellowish brown (10YR 5/8) and common coarse distinct grayish brown (10YR 5/2) mottles; single grain; loose; common medium and few fine roots; very strongly acid; clear wavy boundary.

E2—9 to 12 inches; pale brown (10YR 6/3) sand; common coarse distinct brownish yellow (10YR 6/6) and dark brown (10YR 4/3) mottles; single grain; loose; few fine roots; strongly acid; clear wavy boundary.

Bhs—12 to 17 inches; dark reddish brown (5YR 2/2) sand; single grain; loose; common prominent cracked coatings on sand grains; common coarse silt-sized dark pellets; strongly acid; clear wavy boundary.

Bs—17 to 27 inches; dark brown (7.5YR 3/4) sand; common medium distinct strong brown (7.5YR 5/6) mottles; single grain; loose; common prominent cracked coatings on sand grains; strongly acid; gradual wavy boundary.

BC—27 to 39 inches; light yellowish brown (10YR 6/4) sand; common coarse distinct yellowish brown (10YR 5/6) mottles; single grain; loose; strongly acid; clear wavy boundary.

C—39 to 60 inches; brownish yellow (10YR 6/6) sand; single grain; loose; medium acid.

The thickness of the solum ranges from 20 to 40 inches.

The E horizon has value of 6 or 7 and chroma of 1 to 3. It is loamy sand or sand. The Bhs horizon has hue of 5YR or 7.5YR and value and chroma of 2 or 3. Some pedons do not have a BC horizon. The C horizon has value of 5 or 6 and chroma of 3 to 6.

Leelanau Series

The Leelanau series consists of deep, well drained, moderately rapidly permeable soils on till plains and moraines. These soils formed in sandy and loamy material. Slopes range from 0 to 30 percent.

Typical pedon of Leelanau loamy sand, 6 to 12 percent slopes, 1,100 feet south and 30 feet east of the northwest corner of sec. 19, T. 34 N., R. 3 W., Mentor Township:

A—0 to 3 inches; black (10YR 2/1) loamy sand that has flecks of light gray (10YR 7/1) loamy sand (E material); dark grayish brown (10YR 4/2) dry; weak fine granular structure; very friable; common medium and many fine roots; about 2 percent gravel; medium acid; abrupt wavy boundary.

E—3 to 6 inches; grayish brown (10YR 5/2) loamy sand; weak medium subangular blocky structure parting to weak fine subangular blocky; friable; common medium and many fine roots; about 2 percent gravel; medium acid; clear wavy boundary.

Bs1—6 to 14 inches; dark brown (7.5YR 3/4) loamy sand; weak medium subangular blocky structure parting to weak fine subangular blocky; friable; common fine and few coarse roots; common distinct cracked coatings on sand grains; about 2 percent gravel; slightly acid; clear wavy boundary.

Bs2—14 to 21 inches; dark brown (7.5YR 4/4) loamy sand; weak medium granular structure parting to weak fine granular; friable; common fine and few coarse roots; about 2 percent gravel; slightly acid; clear wavy boundary.

E&Bt—21 to 29 inches; pale brown (10YR 6/3) loamy sand (E) and strong brown (7.5YR 4/6) sandy loam (Bt); weak thin platy and weak medium platy structure; friable; few fine roots; about 4 percent gravel; neutral; gradual irregular boundary.

E/Bt—29 to 34 inches; pale brown (10YR 6/3) loamy sand (E) and strong brown (7.5YR 4/6) sandy loam (Bt); weak thin platy and weak medium platy structure; friable; few fine roots; about 4 percent gravel; neutral; clear irregular boundary.

Bt—34 to 42 inches; strong brown (7.5YR 4/6) sandy loam; moderate thick platy structure; friable; few very fine roots; about 3 percent gravel; neutral; abrupt broken boundary.

C—42 to 60 inches; light brown (7.5YR 6/4) loamy sand; single grain; loose; about 3 percent gravel; slightly effervescent; mildly alkaline.

The thickness of the solum ranges from 30 to 48 inches. The content of gravel ranges from 1 to 5 percent throughout the profile.

The E horizon has hue of 5YR to 10YR, value of 4 or 5, and chroma of 1 or 2. The A and E horizons are dominantly loamy sand, but the range includes sand. Some pedons have a thin Bhs horizon. The Bs horizon has hue of 7.5YR or 10YR and value of 3 to 5. It is sand or loamy sand. The E part of the E&Bt horizon has hue of 7.5YR or 10YR. It is sand or loamy sand. The B part has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. The C horizon has value of 5 or 6 and chroma of 3 or 4.

Loxley Series

The Loxley series consists of deep, very poorly drained, moderately slowly permeable to moderately rapidly permeable soils on lake plains and in depressions on outwash plains. These soils formed in well decomposed, acidic organic material. Slopes are 0 to 2 percent.

The Loxley soils in this county have more hemic material than is definitive for the series. This difference, however, does not alter the use or management of the soils.

Typical pedon of Loxley peat, 2,500 feet north and 450 feet west of the southeast corner of sec. 16, T. 38 N., R. 3 W., Hebron Township:

Oi—0 to 2 inches; fibric material, very dusky red (2.5YR 2/2) rubbed; weak thick platy structure; friable; extremely acid; gradual wavy boundary.

Oe1—2 to 9 inches; hemic material, dark reddish brown (5YR 2/2) rubbed; weak thick platy structure; friable; extremely acid; gradual wavy boundary.

Oe2—9 to 25 inches; hemic material, black (10YR 2/1) rubbed; moderate thick platy structure; friable; extremely acid; gradual wavy boundary.

Oa1—25 to 42 inches; sapric material, dark reddish brown (5YR 2/2) rubbed; moderate thick platy structure; friable; extremely acid; gradual wavy boundary.

0a2—42 to 60 inches; sapric material, dark reddish brown (5YR 2/2) rubbed; moderate thick platy structure; friable; extremely acid.

The organic layers are 51 or more inches thick. In some pedons woody fragments are mixed with the organic layers. The surface tier is typically fibric or hemic material, but the range includes sapric material.

Lupton Series

The Lupton series consists of deep, very poorly drained, moderately slowly permeable to moderately rapidly permeable soils on lake plains and in depressions on outwash plains and till plains. These soils formed in well decomposed organic material. Slopes are 0 to 2 percent.

Typical pedon of Lupton muck, 2,480 feet south and 400 feet east of the northwest corner of sec. 6, T. 37 N., R. 2 W., Inverness Township:

Oa1—0 to 12 inches; black (10YR 2/1) sapric material; moderate medium granular structure; friable; neutral; gradual wavy boundary.

Oa2—12 to 29 inches; black (5YR 2/1) sapric material; moderate very coarse granular structure; friable; neutral; gradual wavy boundary.

Oe—29 to 34 inches; black (5YR 2/1) hemic material; moderate coarse granular structure; friable; neutral; gradual wavy boundary.

Oa—34 to 60 inches; black (5YR 2/1) sapric material; moderate coarse granular structure; friable; mildly alkaline.

The organic layers are more than 51 inches thick. The organic material has hue of 5YR to 10YR, value of 2 or 3, and chroma of 1 to 3, or it is neutral in hue and has value of 2 or 3. The surface tier commonly is sapric, but some pedons are hemic or consist of various proportions of hemic and sapric material. Some pedons have as much as 3 inches of fibric material on the surface. The subsurface and bottom tiers have 10 to 30 percent woody fibers. Less than 10 inches of hemic material is in these tiers.

Mancelona Series

The Mancelona series consists of deep, somewhat excessively drained soils that formed in sandy and gravelly deposits on outwash plains, lake plains, stream terraces, and old beach ridges. Permeability is moderately rapid in the solum and very rapid in the substratum. Slopes range from 0 to 50 percent.

Typical pedon of Mancelona sand, 0 to 6 percent slopes, 1,360 feet north and 1,980 feet west of the southeast corner of sec. 8, T. 37 N., R. 2 W., Inverness Township:

Oa—1 inch to 0; black (N 2/0), well decomposed leaf litter; moderate medium subangular blocky structure; friable; many fine roots; about 1 percent gravel; slightly acid; abrupt wavy boundary.

E—0 to 7 inches; dark brown (7.5YR 4/2) sand; single grain; loose; many fine and medium roots; about 5 percent gravel; medium acid; clear irregular boundary.

Bs1—7 to 9 inches; dark brown (7.5YR 3/4) loamy sand; weak medium granular structure; very friable;

common distinct cracked coatings on sand grains; common fine and medium roots; about 7 percent gravel; slightly acid; clear irregular boundary.

Bs2—9 to 27 inches; dark brown (7.5YR 4/4) loamy sand; weak medium subangular blocky structure; friable; common distinct cracked coatings on sand grains; few fine and medium roots; about 10 percent gravel; medium acid; clear wavy boundary.

Bt—27 to 31 inches; dark brown (7.5YR 3/4) sandy loam; weak medium subangular blocky structure; friable; many fine roots; about 10 percent gravel; slightly acid; abrupt irregular boundary.

2C—31 to 60 inches; light yellowish brown (10YR 6/4) very gravelly coarse sand; single grain; loose; few fine roots; about 55 percent gravel; strongly effervescent; mildly alkaline.

The thickness of the solum ranges from 20 to 40 inches. The content of gravel ranges from 3 to 25 percent in the solum and from 15 to 55 percent in the substratum.

Some pedons have an A or Ap horizon. The A horizon has hue of 5YR or 10YR, value of 2 or 3, and chroma of 1 or 2, or it is neutral in hue and has value of 2 or 3. The Ap horizon has hue of 10YR, value of 3, and chroma of 2. The E horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 1 to 3. The A and E horizons are sand or loamy sand.

The Bs horizon has value of 3 to 5 and chroma of 3 to 6. It is loamy sand, sand, or the gravelly analogs of those textures. The Bt horizon has hue of 5YR to 10YR, value of 3 to 5, and chroma of 3 or 4. It is sandy loam, gravelly sandy loam, or gravelly loamy sand. The 2C horizon has value of 5 or 6 and chroma of 3 or 4. It is gravelly sand, very gravelly sand, or very gravelly coarse sand.

Nadeau Series

The Nadeau series consists of deep, well drained soils on spits and bars on lake plains. These soils formed in gravelly material. Permeability is moderate in the solum and very rapid in the substratum. Slopes range from 1 to 9 percent.

The Nadeau soils in this county have a lower base saturation, have less sand in the argillic horizon, and have more gravel than is definitive for the series. These differences, however, do not alter the use or management of the soils.

Typical pedon of Nadeau extremely gravelly loamy sand, 1 to 9 percent slopes, 2,060 feet west and 910 feet south of the northeast corner of sec. 10, T. 38 N., R. 3 W., Hebron Township:

A—0 to 1 inch; black (5YR 2/1) extremely gravelly loamy sand that has flecks of pinkish gray (10YR 6/2) extremely gravelly loamy sand (E material); very dark gray (7.5YR 3/1) dry; weak fine granular structure; very friable; many fine and very fine roots; about 68 percent gravel; very strongly acid; abrupt smooth boundary.

E—1 to 6 inches; pinkish gray (5YR 6/2) extremely gravelly loamy sand; single grain; loose; many very fine and fine roots in cracks; about 75 percent gravel; strongly acid; abrupt smooth boundary.

Bt1—6 to 10 inches; brown (7.5YR 5/4) extremely gravelly sandy loam; weak very fine granular structure; very friable; common discontinuous faint thin brown (7.5YR 5/4) clay films on horizontal faces of peds; many fine roots; about 80 percent gravel; medium acid; gradual smooth boundary.

Bt2—10 to 18 inches; strong brown (7.5YR 4/6) extremely gravelly sandy clay loam; weak fine subangular blocky structure; friable; common discontinuous faint thin strong brown (7.5YR 4/6) clay films on horizontal faces of peds; many fine and common medium roots; about 75 percent gravel; medium acid; gradual smooth boundary.

2BC—18 to 23 inches; dark brown (7.5YR 4/4) extremely gravelly loamy sand; single grain; loose; common fine roots; about 63 percent gravel; neutral; gradual wavy boundary.

2C—23 to 60 inches; light yellowish brown (10YR 6/4) extremely gravelly sand; single grain; loose; few fine roots; about 7 percent cobbles and 82 percent gravel; strongly effervescent; moderately alkaline.

The thickness of the solum generally is 15 to 20 inches, but it ranges from 12 to 24 inches. The content of gravel ranges from 35 to 85 percent throughout the profile.

The A horizon has hue of 5YR to 10YR, value of 2 or 3, and chroma of 1 or 2. The E horizon has hue of 7.5YR or 5YR, value of 5 or 6, and chroma of 2 or 3. The A and E horizons are dominantly extremely gravelly loamy sand, but the range includes very gravelly loamy sand. The Bt horizon has value of 4 or 5 and chroma of 4 to 6. It is the very gravelly or extremely gravelly analogs of loamy sand, sandy loam, or sandy clay loam. The 2C horizon has chroma of 3 or 4. It is dominantly extremely gravelly sand, but the range includes very gravelly sand and very gravelly coarse sand.

Nester Series

The Nester series consists of deep, well drained, slowly permeable soils on till plains and on the terminal moraine. These soils formed in loamy and clayey material. Slopes range from 2 to 15 percent.

The Nester soils in this county have more E horizon material tonguing into the Bt horizon than is definitive for the series. This difference, however, does not alter the use or management of the soils.

Typical pedon of Nester loam, 2 to 6 percent slopes, 2,000 feet south and 560 feet east of the northwest corner of sec. 3, T. 37 N., R. 3 W., Munro Township:

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) loam, light brownish gray (10YR 6/2) dry; moderate medium granular structure parting to moderate very fine subangular blocky; friable; about 2 percent gravel; slightly acid; abrupt smooth boundary.

E/Bt—9 to 12 inches; light brownish gray (10YR 6/2) sandy loam (E) and reddish brown (5YR 4/4) clay loam (Bt); few fine distinct strong brown (7.5YR 4/6) mottles; moderate medium subangular blocky structure parting to moderate fine subangular blocky; friable; about 2 percent gravel; slightly acid; abrupt irregular boundary.

Bt—12 to 19 inches; reddish brown (5YR 4/4) clay loam; strong medium subangular blocky structure; firm; few discontinuous distinct light brownish gray (10YR 6/2) silt skeletons on vertical faces of peds; many continuous faint reddish brown (5YR 4/4) clay films on vertical and horizontal faces of peds; about 4 percent gravel; slightly acid; clear irregular boundary.

BC—19 to 37 inches; reddish brown (5YR 4/4) clay loam; moderate medium subangular blocky structure parting to moderate fine subangular blocky; firm; about 6 percent gravel; very slightly effervescent; neutral; gradual wavy boundary.

C—37 to 60 inches; reddish brown (5YR 5/4) clay loam; weak thick platy structure parting to weak very fine subangular blocky; firm; about 6 percent gravel; slightly effervescent; mildly alkaline.

The thickness of the solum ranges from 24 to 40 inches. The content of gravel ranges from 2 to 10 percent throughout the profile.

The Ap horizon is loam or silt loam. Some pedons have an E horizon, which has hue of 10YR, value of 6, and chroma of 2. The E part of the E/Bt horizon has colors and textures similar to those of the E horizon. The Bt horizon has value of 4 or 5 and chroma of 4 to 6. It is dominantly clay loam, but the range includes sandy clay loam. The Bt part of the E/Bt horizon has colors and textures similar to those of the Bt horizon. The C horizon has value of 3 to 5.

Ocqueoc Series

The Ocqueoc series consists of deep, well drained soils on lake plains. These soils formed in sandy deposits and in the underlying stratified, silty and sandy material. Permeability is rapid in the upper part of the profile and moderately slow in the lower part. Slopes range from 0 to 18 percent.

Typical pedon of Ocqueoc fine sand, 0 to 6 percent slopes, 1,100 feet west and 2,200 feet south of the northeast corner of sec. 1, T. 36 N., R. 1 E., Grant Township:

Ap—0 to 8 inches; dark brown (10YR 3/3) fine sand; weak medium subangular blocky structure; very friable; common fine roots; extremely acid; abrupt smooth boundary.

Bhs—8 to 10 inches; dark reddish brown (5YR 3/2) fine sand; weak medium subangular blocky structure; friable; about 5 percent weakly cemented ortstein; common prominent cracked coatings on sand grains; common fine roots; extremely acid; clear broken boundary.

Bs1—10 to 13 inches; strong brown (7.5YR 5/6) fine sand; weak medium subangular blocky structure; very friable; about 3 percent weakly cemented ortstein; common faint cracked coatings on sand grains; common fine roots; extremely acid; clear wavy boundary.

Bs2—13 to 16 inches; yellowish brown (10YR 5/6) fine sand; weak medium subangular blocky structure; very friable; common faint cracked coatings on sand grains; common fine roots; extremely acid; clear wavy boundary.

BC—16 to 26 inches; light yellowish brown (10YR 6/4) very fine sand; weak medium subangular blocky structure; friable; common fine roots; extremely acid; clear wavy boundary.

2C1—26 to 47 inches; brown (7.5YR 5/4), stratified very fine sand and silt; weak coarse angular blocky structure; friable; few medium and common fine roots; mildly alkaline; abrupt wavy boundary.

2C2—47 to 60 inches; light brown (7.5YR 6/4), stratified very fine sand, silt, very fine sandy loam, and loamy very fine sand; moderate thick platy structure; friable; few medium and common fine roots; strongly effervescent; moderately alkaline.

The thickness of the solum ranges from 15 to 30 inches. Depth to the 2C horizon ranges from 30 to 50 inches.

The Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 1 to 3. Pedons in undisturbed areas have A and E horizons. These horizons are dominantly fine sand, but the range includes sand and loamy sand. The Bhs horizon has hue of 5YR or 7.5YR and value and chroma of 2 or 3. It is sand or fine sand. The Bs horizon has value of 3 to 5 and chroma of 4 to 6. It is fine sand or very fine sand. The 2C horizon has hue of 7.5YR or 10YR and value of 5 or 6. The texture of the stratified material ranges from fine sand to silt loam.

Ogemaw Series

The Ogemaw series consists of deep, somewhat poorly drained soils on lake plains. These soils formed in sandy lacustrine material and in the underlying loamy glacial till. Permeability is rapid in the upper part of the solum and slow in the lower part and is moderately slow in the substratum. Slopes are 0 to 3 percent.

The Ogemaw soils in this county have mottles higher in the profile than is definitive for the series and have more clay in the control section and less clay in the substratum. These differences, however, do not alter the use or management of the soils.

Typical pedon of Ogemaw sand, 0 to 3 percent slopes, 50 feet north and 800 feet east of the southwest corner of sec. 13, T. 36 N., R. 1 W., Aloha Township:

A—0 to 4 inches; black (N 2/0) sand that has flecks of pinkish gray (7.5YR 6/2) sand (E material); dark gray (10YR 4/1) dry; weak fine granular structure; very friable; many fine and many medium roots; medium acid; abrupt wavy boundary.

E—4 to 13 inches; pinkish gray (7.5YR 6/2) sand; single grain; loose; few fine roots; medium acid; clear wavy boundary.

Bhsm—13 to 15 inches; dark reddish brown (5YR 3/2) sand; common fine prominent strong brown (7.5YR 5/6) mottles; massive; firm; about 60 percent strongly cemented ortstein; common fine and medium roots; common prominent cracked coatings on sand grains; medium acid; clear broken boundary.

Bsm1—15 to 21 inches; dark brown (7.5YR 3/4) sand; common medium distinct strong brown (7.5YR 5/6) mottles; massive; extremely firm; about 70 percent strongly cemented ortstein; common distinct cracked coatings on sand grains; medium acid; clear wavy boundary.

Bsm2—21 to 33 inches; strong brown (7.5YR 5/6) sand; many medium faint reddish yellow (7.5YR 6/6) mottles; massive; very firm; about 70 percent strongly cemented ortstein; few distinct cracked coatings on sand grains; strongly acid; abrupt smooth boundary.

2E/Bt—33 to 40 inches; pale brown (10YR 6/3) and brown (7.5YR 5/4) sandy loam and loam; common medium distinct strong brown (7.5YR 5/6) and common fine prominent gray (5Y 6/1) mottles; moderate medium subangular blocky structure; friable; few medium roots in mat at top of horizon; about 5 percent cobbles; strongly acid; clear wavy boundary.

2Bt—40 to 45 inches; brown (7.5YR 5/4) loam; many fine prominent greenish gray (5GY 6/1), many medium prominent greenish gray (5GY 6/1), and common medium distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; friable; common continuous distinct greenish gray (5GY 6/1) clay films on vertical faces of peds; medium acid; gradual wavy boundary.

2C—45 to 60 inches; light brown (7.5YR 6/4) sandy loam; strong thick platy structure; firm; many fine rounded iron-manganese concretions; strongly effervescent; moderately alkaline.

The thickness of the solum and the depth to carbonates range from 20 to 50 inches. The content of gravel ranges from 0 to 15 percent throughout the profile.

The A horizon has hue of 7.5YR or 10YR, value of 2 or 3, and chroma of 1 or 2, or it is neutral in hue and has value of 2 or 3. Some pedons have an Ap horizon, which is 6 to 8 inches thick. The E horizon has hue of 7.5YR or 10YR, value of 5 to 7, and chroma of 1 or 2, or it is neutral in hue and has value of 5 to 7. The A and E horizons are dominantly sand, but the range includes loamy sand.

The Bhsm horizon has value and chroma of 2 or 3. The Bsm horizon has hue of 5YR, 7.5YR, or 10YR, value of 3 to 5, and chroma of 4 to 8. The content of ortstein ranges from 60 to 80 percent. The ortstein is weakly cemented to strongly cemented. This horizon is sand or loamy sand.

The E part of the 2E/Bt horizon has value of 5 or 6 and chroma of 3 or 4. The Bt part has colors and textures similar to those of the Bt horizon. The 2Bt horizon has hue of 5YR or 7.5YR and chroma of 4 to 6. It is dominantly sandy loam, but the range includes sandy clay loam. The 2C horizon has hue of 5YR or 7.5YR and value of 4 to 6.

Onaway Series

The Onaway series consists of deep, well drained soils on till plains and moraines. These soils formed in loamy glacial till. Permeability is moderately slow. Slopes range from 1 to 25 percent.

Typical pedon of Onaway loam, 1 to 6 percent slopes, 1,340 feet north and 2,000 feet west of the southeast corner of sec. 32, T. 35 N., R. 1 W., Koehler Township:

A—0 to 4 inches; black (N 2/0) loam, dark grayish brown (10YR 4/2) dry; moderate coarse subangular blocky structure parting to weak medium granular; friable; few coarse and common fine roots; about 1 percent cobbles; neutral; abrupt wavy boundary.

E—4 to 8 inches; brown (10YR 5/3) sandy loam; weak thick platy structure; friable; few coarse and common fine roots; about 1 percent cobbles and 2 percent gravel; neutral; clear wavy boundary.

Bw—8 to 11 inches; dark brown (10YR 4/3) sandy loam; weak thick platy structure; friable; few coarse and common fine roots; about 1 percent cobbles; neutral; clear wavy boundary.

E′—11 to 18 inches; brown (10YR 5/3) sandy loam; weak medium platy and weak fine subangular blocky structure; friable; common fine and medium roots; about 2 percent gravel; neutral; clear irregular boundary.

B/E—18 to 21 inches; dark brown (7.5YR 4/4) loam (Bt) and pale brown (10YR 6/3) sandy loam (E) occurring as thin coatings surrounding peds of Bt material; few fine distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; friable; common fine roots; about 2 percent gravel; neutral; abrupt irregular boundary.

Bt—21 to 28 inches; dark brown (7.5YR 4/4) loam; moderate medium subangular blocky structure parting to weak fine subangular blocky; friable; common continuous distinct thin dark brown (7.5YR 3/4) clay films throughout; common fine roots; about 2 percent gravel; neutral; gradual smooth boundary.

BC—28 to 32 inches; dark yellowish brown (10YR 4/4) loam; moderate coarse subangular blocky structure; friable; common fine roots; about 2 percent gravel; neutral; clear smooth boundary.

C—32 to 60 inches; yellowish brown (10YR 5/4) loam; massive; friable; common fine roots; about 2 percent gravel; violently effervescent; moderately alkaline.

The thickness of the solum and the depth to carbonates range from 20 to 35 inches. The content of gravel ranges from 2 to 15 percent throughout the profile.

The A or Ap horizon has hue of 7.5YR or 10YR, value of 2 or 3, and chroma of 1 or 2, or it is neutral in hue and has value of 2 or 3. It is dominantly loam, but the range includes sandy loam. The E horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 2 to 4. The Bw horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 3 to 6. The Bt part of the B/E horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. It is loam, sandy clay loam, or clay loam. The E part has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 2 or 3. The Bt horizon has hue, colors, and textures similar to those of the Bt part of the B/E horizon. The C horizon has hue of 5YR to 10YR and chroma of 3 or 4.

Ontonagon Series

The Ontonagon series consists of deep, moderately well drained and well drained, very slowly permeable soils on lake plains. These soils formed in clayey material. Slopes range from 0 to 25 percent.

Typical pedon of Ontonagon silt loam, 0 to 4 percent slopes, 1,160 feet south and 200 feet east of the northwest corner of sec. 26, T. 38 N., R. 2 W., Beaugrand Township:

Ap—0 to 11 inches; very dark grayish brown (10YR 3/2) silt loam, light brownish gray (10YR 6/2) dry; moderate medium subangular blocky structure; friable; neutral; abrupt wavy boundary.

Bt/E—11 to 14 inches; reddish brown (5YR 5/4) clay (Bt); tongues of pale brown (10YR 6/3) silt loam (E); common medium faint yellowish red (5YR 5/6) mottles; moderate medium subangular blocky structure parting to moderate fine subangular blocky; very friable; neutral; gradual wavy boundary.

Bt—14 to 19 inches; reddish brown (5YR 4/4) clay; common medium distinct yellowish red (5YR 5/6) and few fine prominent gray (5Y 5/1) mottles; moderate medium angular blocky structure; friable; neutral; gradual irregular boundary.

BC—19 to 26 inches; reddish brown (5YR 4/4) clay; strong fine angular blocky structure parting to strong very fine angular blocky; firm; common discontinuous thin dark brown (7.5YR 4/2) clay films on faces of peds; slightly effervescent; neutral; gradual irregular boundary.

C—26 to 60 inches; light reddish brown (5YR 6/4) silty clay; few fine prominent gray (5Y 5/1) and few medium faint pink (5YR 7/4) mottles; strong fine angular blocky structure parting to strong very fine angular blocky; firm; common discontinuous thin dark brown (7.5YR 4/2) clay films on faces of peds; strongly effervescent; mildly alkaline.

The thickness of the solum is 13 to 30 inches and commonly is the same as the depth to carbonates.

The Ap horizon has chroma of 2 or 3. In some pedons it is thinner and is intricately mixed with the Bt horizon. The A and E horizons are silt loam or silty clay.

The Bt horizon has hue of 5YR or 7.5YR, value of 3 to 5, and chroma of 4 to 6. It is silty clay or clay. The BC horizon has value of 4 or 5. It is clay or silty clay. The C horizon has value of 5 or 6. It is silty clay or clay.

In some pedons the surface layer is darker and the subsoil contains slightly less clay than is defined as the range for the series. These differences, however, do not alter the use or management of the soils.

Otisco Series

The Otisco series consists of deep, somewhat poorly drained, moderately rapidly permeable soils on outwash plains, lake plains, and lake beds on till plains. These soils formed in stratified, sandy material. Slopes are 0 to 3 percent.

Typical pedon of Otisco sand, 0 to 3 percent slopes, 2,300 feet south and 900 feet east of the northwest corner of sec. 1, T. 34 N., R. 1 W., Walker Township:

A—0 to 1 inch; black (10YR 2/1) sand that has flecks of brown (10YR 5/2) sand (E material); dark gray (10YR 4/1) dry; weak fine granular structure; very friable; strongly acid; abrupt smooth boundary.

E—1 to 7 inches; pinkish gray (7.5YR 6/2) sand; single grain; loose; very strongly acid; abrupt irregular boundary.

Bs1—7 to 9 inches; dark reddish brown (5YR 3/4) sand; common fine prominent yellowish red (5YR 5/8) mottles; weak coarse granular structure; friable; many prominent cracked coatings on sand grains; strongly acid; clear irregular boundary.

Bs2—9 to 15 inches; strong brown (7.5YR 4/6) sand; many medium distinct strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; friable; many prominent cracked coatings on sand grains; about 10 percent weakly cemented ortstein; strongly acid; clear wavy boundary.

E′—15 to 29 inches; yellowish brown (10YR 5/4) sand; common medium prominent red (2.5YR 4/8) and many coarse distinct yellowish red (5YR 5/6) mottles; weak thick platy structure; firm; strongly acid; abrupt wavy boundary.

E&Bt—29 to 60 inches; yellowish brown (10YR 5/4) loamy sand (E); bands of light reddish brown (5YR 6/4) sandy loam (Bt), totaling more than 6 inches thick; many coarse prominent yellowish red (5YR 5/8) mottles; weak medium subangular blocky structure; friable; strongly acid.

The solum is more than 60 inches thick.

The A horizon has hue of 10YR or is neutral in hue. The E horizon has hue of 7.5YR or 10YR and value of 5 or 6. The Bs horizon has hue of 5YR to 10YR, value of 3 to 5, and chroma of 4 to 6. The E′ horizon has value of 5 or 6. It is sand or loamy sand. The E part of the E&Bt horizon has colors and textures similar to those of the E′ horizon. The Bt part has hue of 5YR to 10YR and value and chroma of 4 to 6. It is sandy loam or loamy sand. Some pedons have a C horizon.

Pinconning Series

The Pinconning series consists of deep, very poorly drained soils that formed in sandy material over clayey material on lake plains. Permeability is rapid in the sandy layers and slow or very slow in the clayey underlying material. Slopes are 0 to 2 percent.

The Pinconning soils in this county have a redder subsoil and a thinner veneer of sandy material than is definitive for the series. These differences, however, do not alter the use or management of the soils.

Typical pedon of Pinconning mucky loamy sand, 1,000 feet south and 450 feet east of the northwest corner of sec. 3, T. 37 N., R. 1 W., Benton Township:

Ap—0 to 9 inches; black (N 2/0) mucky loamy sand, very dark gray (10YR 3/1) dry; weak medium granular structure; friable; common medium and many fine roots; about 4 percent gravel; mildly alkaline; abrupt wavy boundary.

Cg1—9 to 15 inches; grayish brown (10YR 5/2) sand; common medium faint brown (10YR 5/3) mottles; single grain; loose; common medium roots; about 12 percent gravel; mildly alkaline; clear wavy boundary.

Cg2—15 to 16 inches; grayish brown (2.5Y 5/2) sand; single grain; loose; common medium roots; about 5 percent gravel; mildly alkaline; abrupt smooth boundary.

2C1—16 to 19 inches; reddish brown (5YR 4/3) silty clay; common medium prominent strong brown (7.5YR 5/6) and common fine prominent greenish gray (5GY 6/1) mottles; moderate medium angular blocky structure; firm; common fine roots; slightly effervescent; moderately alkaline; clear smooth boundary.

2C2—19 to 60 inches; reddish brown (5YR 4/3) silty clay; common medium prominent greenish gray (5GY 6/1) mottles; massive; firm; slightly effervescent; moderately alkaline.

Depth to the 2C horizon typically is 15 to 24 inches, but it ranges from 12 to 40 inches. The content of gravel ranges from 2 to 14 percent in the sandy material.

The A horizon has hue of 7.5YR or 10YR or is neutral in hue. It is dominantly mucky loamy sand, but the range includes mucky sand and loamy sand. Pedons in undisturbed areas have A and E horizons. The Cg horizon has hue of 2.5YR or 10YR and value of 5 or 6. It is sand or loamy sand. The 2C horizon has value of 4 to 6 and chroma of 3 or 4. It is silty clay or clay.

Riggsville Series

The Riggsville series consists of somewhat poorly drained soils on moraines, drumlins, lake terraces, and till plains. These soils are moderately deep to dense till. They formed in sandy deposits and in the underlying loamy glacial till. Permeability is moderately rapid in the sandy upper part of the profile and very slow in the loamy lower part. Slopes are 0 to 3 percent.

Typical pedon of Riggsville loamy sand, 0 to 3 percent slopes, 600 feet north and 1,500 feet west of the southeast corner of sec. 26, T. 34 N., R. 1 W., Walker Township:

A—0 to 2 inches; black (N 2/0) loamy sand that has flecks of light gray (N 7/0) loamy sand (E material); very dark gray (10YR 3/1) dry; weak fine granular structure; very friable; many fine and common medium roots; about 2 percent cobbles and 1 percent gravel; strongly acid; abrupt wavy boundary.

E—2 to 9 inches; pinkish gray (7.5YR 7/2) loamy sand; few fine prominent strong brown (7.5YR 5/6) mottles; weak fine granular structure; very friable; many fine and common coarse roots; few discontinuous prominent gray (N 5/0) organic coatings throughout; about 2 percent cobbles and 1 percent gravel; strongly acid; abrupt wavy boundary.

Bs1—9 to 12 inches; strong brown (7.5YR 4/6) loamy sand; common medium distinct strong brown (7.5YR 5/8) mottles; weak medium subangular blocky structure; very friable; common prominent cracked coatings on sand grains; many fine and common medium roots; about 2 percent cobbles and 1 percent gravel; medium acid; clear wavy boundary.

Bs2—12 to 16 inches; dark brown (7.5YR 3/4) loamy sand; common medium distinct strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; very friable; many fine and common medium roots; few distinct cracked coatings on sand grains; about 2 percent cobbles and 1 percent gravel; neutral; abrupt wavy boundary.

E/Bt—16 to 23 inches; light brown (7.5YR 6/4) loamy sand (E) and reddish brown (5YR 4/4) sandy loam (Bt); common fine prominent strong brown (7.5YR 5/8) mottles; moderate medium subangular blocky structure; friable; common fine and many very fine roots; about 2 percent gravel; medium acid; clear wavy boundary.

2Bt—23 to 30 inches; reddish brown (5YR 4/4) sandy loam; common fine prominent brown (10YR 5/3) and common medium prominent strong brown (7.5YR 5/6) mottles; moderate medium angular blocky structure; friable; common fine and many very fine roots; few discontinuous faint reddish brown (5YR 4/4) clay films on vertical and horizontal faces of peds; about 2 percent gravel; neutral; clear wavy boundary.

2Cd—30 to 60 inches; brown (7.5YR 5/4) sandy loam; common medium prominent strong brown (7.5YR 5/8) mottles; moderate very thick platy structure; very firm; common discontinuous prominent light gray (5Y 7/1) lime or carbonate coatings throughout; about 4 percent gravel; violently effervescent; moderately alkaline.

The thickness of the solum and the depth to carbonates are typically 24 to 40 inches, but they range from 24 to 50 inches. The depth to noncalcareous till ranges from 17 to 27 inches. Reaction ranges from very strongly acid to neutral in the solum. The content of gravel ranges from 2 to 10 percent throughout the profile, and the content of coarse fragments larger than 3 inches ranges from 0 to 5 percent.

The A horizon has hue of 5YR to 10YR, value of 2 or 3, and chroma of 1 or 2, or it is neutral in hue and has value of 2 or 3. It is loamy sand or loamy fine sand. The E horizon has hue of 7.5YR or 10YR, value of 6 or 7, and chroma of 1 or 2, or it is neutral in hue and has value of 6 or 7. It is sand, loamy sand, or loamy fine sand.

The Bs horizon has value of 3 to 5 and chroma of 3 to 6. It is sand, loamy sand, or loamy fine sand. Some pedons have a Bhs horizon. The E part of the E/Bt horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 2 to 4. In some pedons the E horizon occurs as thick coatings on peds and as fillings in cracks in the upper part of the Bt horizon.

The Bt part of the E/Bt horizon has colors similar to those of the Bt horizon. The Bt horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. It is sandy loam or sandy clay loam. The 2C horizon has hue of 5YR to 10YR and value of 5 or 6.

Roscommon Series

The Roscommon series consists of deep, very poorly drained, rapidly permeable soils on outwash plains and lake plains and in glacial drainageways. These soils formed in sandy glaciofluvial material. Slopes are 0 to 2 percent.

The Roscommon soils in this county have more organic matter in the surface layer than is definitive for the series. This difference, however, does not alter the use or management of the soils.

Typical pedon of Roscommon muck, 2,900 feet north and 1,300 feet east of the southwest corner of sec. 5, T. 35 N., R. 1 E., Waverly Township:

Oa—0 to 6 inches; black (N 2/0) sapric material; moderate medium granular structure; friable; many fine and medium roots; slightly acid; abrupt smooth boundary.

Cg—6 to 10 inches; light brownish gray (10YR 6/2) sand; common coarse faint gray (10YR 6/1) and few fine prominent yellowish brown (10YR 5/6) mottles; single grain; loose; neutral; clear wavy boundary.

C1—10 to 22 inches; brown (10YR 5/3) sand; single grain; loose; neutral; clear wavy boundary.

C2—22 to 60 inches; dark brown (10YR 4/3) sand; single grain; loose; neutral.

Some pedons have an A horizon. This horizon has value of 2 and chroma of 1. It is mucky sand or sand. The C horizon has value of 4 to 6 and chroma of 2 to 4. It is sand, loamy sand, or coarse sand.

Rousseau Series

The Rousseau series consists of deep, well drained, rapidly permeable soils on old sand dunes. These soils formed in sandy, wind-worked glaciofluvial sediments. Slopes range from 0 to 30 percent.

Typical pedon of Rousseau fine sand, 0 to 6 percent slopes, 100 feet north and 550 feet east of the southwest corner of sec. 34, T. 37 N., R. 2 W., Inverness Township:

A—0 to 1 inch; black (5YR 2/1) fine sand that has flecks of pinkish gray (7.5YR 6/2) fine sand (E material); very dark gray (10YR 3/1) dry; moderate fine granular structure parting to weak fine granular; very friable; many fine and common medium roots; strongly acid; abrupt wavy boundary.

E—1 to 6 inches; pinkish gray (7.5YR 6/2) fine sand; single grain; loose; many fine roots; very strongly acid; abrupt wavy boundary.

Bs1—6 to 7 inches; dark reddish brown (5YR 3/4) fine sand; weak medium subangular blocky structure; friable; about 2 percent weakly cemented ortstein; common distinct cracked coatings on sand grains; common fine roots; strongly acid; abrupt broken boundary.

Bs2—7 to 10 inches; dark brown (7.5YR 4/4) fine sand; single grain; loose; common distinct cracked coatings on sand grains; few fine roots; strongly acid; clear wavy boundary.

Bs3—10 to 23 inches; yellowish brown (10YR 5/6) fine sand; single grain; loose; about 15 percent strongly cemented ortstein; common faint cracked coatings on sand grains; few fine roots; strongly acid; gradual irregular boundary.

C—23 to 60 inches; light yellowish brown (10YR 6/4) fine sand; single grain; loose; medium acid.

The thickness of the solum ranges from 20 to 32 inches.

The A horizon has hue of 5YR to 10YR and value of 2 or 3. Some pedons have an Ap horizon, which has hue of 10YR, value of 4, and chroma of 2. The E horizon has hue of 7.5YR or 10YR. The Bs horizon has hue of 7.5YR or 10YR, value of 3 to 5, and chroma of 4 to 8. The C horizon has hue of 7.5YR or 10YR.

Rubicon Series

The Rubicon series consists of deep, excessively drained, rapidly permeable soils on lake plains, outwash plains, and moraines. These soils formed in sandy deposits. Slopes range from 0 to 60 percent.

Typical pedon of Rubicon sand, 0 to 6 percent slopes, 300 feet north and 2,440 feet east of the southwest corner of sec. 5, T. 35 N., R. 1 W., Koehler Township:

A—0 to 1 inch; black (10YR 2/1) sand that has flecks of light brownish gray (10YR 6/2) sand (E material); dark gray (10YR 4/1) dry; weak fine granular structure; very friable; common roots; very strongly acid; abrupt smooth boundary.

E—1 to 6 inches; light brownish gray (10YR 6/2) sand; very weak medium granular structure; very friable; common roots; very strongly acid; clear smooth boundary.

Bs1—6 to 10 inches; dark brown (7.5YR 4/4) sand; weak medium granular structure; very friable; many roots; common distinct cracked coatings on sand grains; medium acid; clear wavy boundary.

Bs2—10 to 18 inches; dark yellowish brown (10YR 4/4) sand; weak coarse granular structure; very friable; common roots; common faint cracked coatings on sand grains; medium acid; clear irregular boundary.

BC—18 to 36 inches; yellowish brown (10YR 5/6) sand; very weak coarse subangular blocky structure; very friable; medium acid; chunks of yellowish brown

(10YR 5/6), dark reddish brown (5YR 3/4), and pale brown (10YR 6/3), weakly cemented to strongly cemented ortstein, 4 to 6 inches in diameter, between depths of 18 and 24 inches; massive; few roots; medium acid; clear irregular boundary.

C—36 to 60 inches; light yellowish brown (10YR 6/4) sand that has some coarse sand in the upper part; single grain; loose; slightly acid.

The thickness of the solum ranges from 20 to 40 inches. The content of gravel ranges from 0 to 5 percent throughout the profile.

The A horizon has hue of 5YR, 7.5YR, or 10YR, value of 2 or 3, and chroma of 1 to 3, or it is neutral in hue and has value of 2 or 3. The E horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 1 or 2. The A and E horizons are dominantly sand, but the range includes loamy sand.

The Bs horizon has value of 3 or 4 and chroma of 2 to 6. Some pedons have a thin Bhs horizon. The BC horizon has hue of 10YR or 7.5YR, value of 5 to 8, and chroma of 4 to 6. The content of ortstein ranges from 0 to 20 percent in the Bs and BC horizons. The C horizon has value of 5 to 7 and chroma of 3 to 6. It is sand or coarse sand. Some pedons have thin lamellae of loamy sand below a depth of 40 inches.

Rudyard Series

The Rudyard series consists of deep, somewhat poorly drained, very slowly permeable soils on lake plains. These soils formed in clayey lacustrine sediments. Slopes are 0 to 3 percent.

The Rudyard soils in this county have a thicker surface layer and have less clay throughout than is definitive for the series. These differences, however, do not alter the use or management of the soils.

Typical pedon of Rudyard loam, 0 to 3 percent slopes, 2,280 feet south and 250 feet east of the northwest corner of sec. 18, T. 37 N., R. 1 W., Inverness Township:

Ap—0 to 10 inches; dark reddish brown (5YR 2/2) loam, gray (5YR 5/1) dry; moderate fine granular structure; friable; neutral; abrupt smooth boundary.

Bt/E—10 to 12 inches; reddish brown (5YR 4/3) clay (Bt) and grayish brown (10YR 5/2) silt loam (E); common medium prominent olive (5Y 5/3) and gray (5Y 5/1) mottles; moderate very fine angular blocky structure; firm; many continuous clay films on vertical and horizontal faces of peds; neutral; clear wavy boundary.

Bt—12 to 17 inches; reddish brown (5YR 4/4) clay; few fine prominent dark gray (10YR 4/1) mottles; moderate very fine angular blocky structure; firm; neutral; clear wavy boundary.

C—17 to 60 inches; light reddish brown (5YR 6/4) silty clay; common fine prominent greenish gray (5GY 6/1) mottles; weak fine subangular blocky structure; firm; strongly effervescent; moderately alkaline.

The thickness of the solum and the depth to free carbonates range from 16 to 24 inches.

The Ap horizon has hue of 5YR or 10YR, value of 2 or 3, and chroma of 1 or 2. It is loam or silt loam. Pedons in uncultivated areas have an A horizon, which has hue of 5YR to 10YR, value of 2 or 3, and chroma of 2 to 4. The E horizon has chroma of 2 to 4. It is loam, silt loam, or silty clay. The Bt horizon has value of 4 to 6 and chroma of 3 or 4. It is clay or silty clay. The C horizon has value of 5 or 6 and chroma of 3 or 4. It is clay or silty clay.

Solona Series

The Solona series consists of deep, somewhat poorly drained, moderately slowly permeable soils on water-worked till plains. These soils formed in loamy glacial till. Slopes are 0 to 3 percent.

Typical pedon of Solona sandy loam, 0 to 3 percent slopes, 1,960 feet west and 840 feet south of the northeast corner of sec. 16, T. 38 N., R. 2 W., Beaugrand Township:

A—0 to 7 inches; dark brown (7.5YR 3/2) sandy loam, brown (7.5YR 5/2) dry; weak medium granular structure; friable; many fine and common medium roots; about 2 percent gravel; neutral; abrupt wavy boundary.

E—7 to 12 inches; pale brown (10YR 6/3) loamy sand; few fine distinct dark brown (10YR 4/3) and common medium prominent strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; very friable; common fine and medium roots; few discontinuous prominent very dark grayish brown (10YR 3/2) organic coatings throughout; about 2 percent gravel; neutral; abrupt wavy boundary.

Bt—12 to 19 inches; brown (7.5YR 5/4) sandy loam; few fine prominent gray (5Y 6/1) and common coarse distinct strong brown (7.5YR 5/8) mottles; moderate medium subangular blocky structure; friable; few fine and medium roots; few very fine discontinuous tubular pores; very few discontinuous faint light brown (7.5YR 6/4) clay films on vertical faces of peds; about 4 percent gravel; mildly alkaline; clear wavy boundary.

BC—19 to 23 inches; brown (7.5YR 5/4) sandy loam;

common coarse prominent grayish brown (10YR 5/2) and common medium distinct strong brown (7.5YR 5/6) mottles; weak thick platy structure; friable; few fine roots between peds; few very fine discontinuous tubular pores; about 3 percent gravel; slightly effervescent; mildly alkaline; clear wavy boundary.

C—23 to 60 inches; light reddish brown (5YR 6/4) sandy loam; common coarse prominent brown (7.5YR 5/2) and common fine distinct strong brown (7.5YR 5/6) mottles; moderate very thick platy structure; firm; few very fine discontinuous tubular pores; common discontinuous distinct pressure faces on horizontal faces of peds; about 3 percent gravel; strongly effervescent; moderately alkaline.

The thickness of the solum and the depth to carbonates range from 20 to 25 inches. The content of cobbles ranges from 2 to 8 percent throughout the profile.

The Ap horizon has value of 2 or 3 and chroma of 1 to 3. It is sandy loam or fine sandy loam. The Bt horizon is sandy loam or loam. The C horizon has value of 5 or 6 and chroma of 3 or 4.

Tawas Series

The Tawas series consists of deep, very poorly drained soils on lake plains and in depressions on outwash plains and till plains. These soils formed in well decomposed organic material over sandy material. Permeability is moderately slow to moderately rapid in the upper part of the profile and rapid in the lower part. Slopes are 0 to 2 percent.

Typical pedon of Tawas peat, 2,200 feet north and 1,300 feet west of the southeast corner of sec. 23, T. 35 N., R. 2 W., Koehler Township:

Oi—0 to 2 inches; fibric material, dark brown (10YR 3/3) and brown (10YR 5/3) rubbed; weak thick platy structure; very friable; neutral; abrupt wavy boundary.

Oa1—2 to 14 inches; sapric material, black (N 2/0 and 10YR 2/1) rubbed; weak thick platy structure; very friable; neutral; abrupt wavy boundary.

Oa2—14 to 26 inches; sapric material, very dark brown (10YR 2/2) and black (10YR 2/1) rubbed; weak thick platy structure; very friable; neutral; abrupt wavy boundary.

Oe—26 to 31 inches; hemic material, very dark grayish brown (10YR 3/2) broken face and rubbed; moderate thick platy structure; very friable; neutral; abrupt wavy boundary.

Oa—31 to 44 inches; sapric material, dark brown (7.5YR 3/2) broken face and rubbed; weak thick platy structure; very friable; neutral; abrupt wavy boundary.

2Cg—44 to 60 inches; light gray (10YR 6/1) sand; single grain; loose; neutral.

Depth to the sandy substratum ranges from 18 to 44 inches. The surface tier is dominantly hemic material, but the range includes sapric material. The organic tiers have hue of 5YR to 10YR, value of 2 or 3, and chroma of 1 or 2, or they are neutral in hue and have value of 2. The content of woody and herbaceous fibers varies widely among tiers and among pedons. Some pedons have as much as 2 inches of limnic material above the 2C horizon. The 2C horizon has hue of 7.5YR to 2.5Y or is neutral in hue. It has value of 3 to 6 and chroma of 0 to 2. It is sand or loamy sand.

Wallace Series

The Wallace series consists of deep, well drained soils on sand dunes. These soils formed in sandy material. Permeability is moderately slow in the upper part of the profile and rapid in the lower part. Slopes range from 0 to 30 percent.

Typical pedon of Wallace sand, 18 to 30 percent slopes, 300 feet south and 80 feet east of the northwest corner of sec. 7, T. 35 N., R. 3 W., Tuscarora Township:

A—0 to 2 inches; black (5YR 2/1) sand that has flecks of pinkish gray (7.5YR 6/2) sand (E material); black (N 2/0) dry; weak fine granular structure; very friable; very strongly acid; abrupt wavy boundary.

E—2 to 11 inches; pinkish gray (7.5YR 6/2) sand; single grain; loose; very strongly acid; abrupt irregular boundary.

Bsm—11 to 19 inches; dark brown (7.5YR 3/4) sand; weak coarse subangular blocky structure; firm; about 30 percent strongly cemented ortstein; common prominent cracked coatings on sand grains; strongly acid; abrupt broken boundary.

Bhsm—19 to 21 inches; black (5YR 2/1) sand; massive; extremely firm; about 90 percent indurated ortstein; many prominent cracked coatings on sand grains; common coarse silt-sized pellets; strongly acid; abrupt broken boundary.

BC—21 to 33 inches; yellowish brown (10YR 5/6) and very pale brown (10YR 7/4) sand; massive; friable; about 60 percent weakly cemented ortstein; medium acid; gradual irregular boundary.

C—33 to 60 inches; brownish yellow (10YR 6/6) sand; single grain; slightly acid.

The thickness of the solum ranges from 30 to 52 inches.

The A horizon has hue of 5YR, 7.5YR, or 10YR, value of 2 or 3, and chroma of 1 or 2. The E horizon has hue of 5YR to 10YR, value of 5 to 7, and chroma of 1 or 2. The A and E horizons are dominantly sand, but the range includes fine sand. The Bhsm horizon has hue of 5YR or 7.5YR and chroma of 1 or 2. The Bsm horizon has hue of 5YR or 7.5YR and chroma of 3 or 4. The BC horizon has hue of 5YR to 10YR, value of 5 or 6, and chroma of 4 to 6. The C horizon has hue of 5YR to 10YR, value of 5 or 6, and chroma of 4 to 6.

Wheatley Series

The Wheatley series consists of deep, poorly drained, rapidly permeable soils on lake plains. These soils formed in sandy glaciofluvial material. Slopes are 0 to 2 percent.

Typical pedon of Wheatley loamy sand, 50 feet north and 400 feet east of the southwest corner of sec. 2, T. 38 N., R. 3 W., Hebron Township:

A1—0 to 5 inches; black (N 2/0) loamy sand, very dark gray (10YR 3/1) dry; weak medium granular structure; very friable; many fine and common coarse roots; about 2 percent gravel; neutral; abrupt wavy boundary.

A2— 5 to 7 inches; dark brown (7.5YR 4/2) loamy sand; weak medium subangular blocky structure; friable; many fine roots; common discontinuous prominent black (N 2/0) organic coatings throughout; about 2 percent gravel; neutral; abrupt wavy boundary.

C1—7 to 11 inches; yellowish brown (10YR 5/4) sand; few fine distinct yellowish brown (10YR 5/6), few medium distinct dark brown (7.5YR 3/2), and common medium faint brown (10YR 5/3) mottles; single grain; loose; few fine roots; about 2 percent gravel; neutral; clear wavy boundary.

C2—11 to 26 inches; brown (10YR 5/3) sand; single grain; loose; about 4 percent gravel; moderately alkaline; abrupt smooth boundary.

C3—26 to 60 inches; brown (10YR 5/3) gravelly sand; single grain; loose; about 20 percent gravel; strongly effervescent; moderately alkaline.

The depth to free carbonates is more than 15 inches. The content of gravel ranges from 2 to 30 percent throughout the profile.

The A horizon has hue of 7.5YR or 10YR, value of 2 to 4, and chroma of 1 or 2, or it is neutral in hue and has value of 2 to 4. It is loamy sand or mucky loamy sand. The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 4. It is loamy sand, sand, or the gravelly analogs of those textures.

Zimmerman Series

The Zimmerman series consists of deep, excessively drained, rapidly permeable soils on deltas and outwash plains. These soils formed in sandy deposits. Slopes range from 0 to 8 percent.

Typical pedon of Zimmerman fine sand, 0 to 8 percent slopes, 500 feet north and 2,600 feet west of the southeast corner of sec. 16, T. 35 N., R. 1 E., Waverly Township:

A—0 to 2 inches; black (10YR 2/1) fine sand that has flecks of grayish brown (10YR 5/2) fine sand (E material); dark gray (10YR 4/1) dry; weak medium granular structure; friable; common fine and medium roots; very strongly acid; clear smooth boundary.

E—2 to 4 inches; grayish brown (10YR 5/2) fine sand; single grain; loose; common fine and medium roots; very strongly acid; abrupt broken boundary.

Bw1—4 to 14 inches; dark yellowish brown (10YR 4/6) fine sand; weak medium subangular blocky structure; friable; common fine roots; strongly acid; gradual wavy boundary.

Bw2—14 to 22 inches; brownish yellow (10YR 6/6) fine sand; weak medium subangular blocky structure; friable; common fine roots; medium acid; gradual wavy boundary.

E′—22 to 30 inches; very pale brown (10YR 7/4) fine sand; weak medium subangular blocky structure; friable; slightly acid; abrupt broken boundary.

E&Bt1—30 to 47 inches; very pale brown (10YR 7/4) fine sand (E); weak medium subangular blocky structure; friable; few dark brown (7.5YR 4/4), irregular and discontinuous bands of loamy fine sand (Bt) 1/16 to 1/4 inch thick; friable; slightly acid; abrupt wavy boundary.

E&Bt2—47 to 60 inches; very pale brown (10YR 7/4) fine sand (E); weak medium subangular blocky structure; friable; few dark brown (7.5YR 4/4), irregular and discontinuous bands of fine sandy loam (Bt) 1/16 to 1/4 inch thick; friable; medium acid.

The solum is more than 60 inches thick. The content of gravel ranges from 0 to 5 percent throughout the profile.

The A horizon has hue of 7.5YR or 10YR, value of 2 or 3, and chroma of 1 or 2, or it is neutral in hue and has value of 2 or 3. The E horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 1 to 5, or it is neutral in hue and has value of 4 to 6. The A and E horizons are dominantly fine sand, but the range includes loamy fine sand. The Bw horizon has hue of 7.5YR or 10YR, value of 4 to 7, and chroma of 4 to 8. The E′ horizon has value of 6 or 7 and chroma of 3 to

5. It is dominantly fine sand, but the range includes loamy fine sand. The E part of the E&Bt horizon has colors and textures similar to those of the E′ horizon. The Bt part has hue of 5YR to 10YR, value of 4 or 5, and chroma of 4 to 7. It is fine sandy loam, loamy fine sand, or loamy very fine sand. Some pedons have a C horizon.

Formation of the Soils

This section relates the five major factors of soil formation to the soils in the survey area. It also explains the processes of soil formation.

Factors of Soil Formation

Soil forms through the interaction of five major factors—the physical, chemical, and mineral composition of the parent material; the climate under which the soil material has accumulated and existed since accumulation; the plant and animal life on and in the soil; the relief, or lay of the land; and the length of time that the processes of soil formation have acted on the parent material *(4)*.

Climate and plant and animal life are the active forces in soil formation. They slowly change the parent material into a natural body of soil that has genetically related layers, called horizons. The effects of climate and plant and animal life are conditioned by relief. The nature of the parent material affects the kind of soil profile that forms and, in extreme cases, determines it almost entirely. Finally, time is needed for the differentiation of soil horizons.

The factors of soil formation are so closely interrelated in their effects on the soils that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four.

Parent Material

Parent material is the unconsolidated mass in which a soil forms. It affects the chemical and mineralogical composition of the soil. In Cheboygan County the parent materials were deposited by glaciers or glacial meltwater. The subsequent actions of water and wind reworked and redeposited the materials. Although most of the parent materials are of common glacial origin, their properties vary greatly, sometimes within small areas, depending on how the materials were deposited. The dominant parent materials in the county were deposited as glacial till, outwash material, lake sediment, wind-deposited sediment, alluvium, and organic material.

Glacial till was deposited directly by glaciers with minimal water action. It is a mixture of particles of different sizes. The small pebbles in glacial till have sharp corners, indicating that they have not been worn by water. The glacial till in Cheboygan County generally is calcareous sandy loam. Cheboygan soils are an example of soils that formed in glacial till. Typically, they are loamy and have moderately developed structure.

Outwash material was deposited by running water from melting glaciers. The size of the particles depends on the speed of the stream that carried the material. The water deposited the coarser particles as it slowed down. Slowly moving water carried the finer particles, such as very fine sand, silt, and clay. Outwash deposits generally occur as layers of particles of similar size, such as sand, coarse sand, and gravel. East Lake soils are an example of soils that formed in outwash material.

Lake sediment was deposited from still or slowly moving, deep lake water and from shallow, high-energy water near shorelines. Lake sediments are well sorted. The size of the particles depends on the speed of the stream that carried the material. Au Gres soils are an example of sandy soils that formed in material deposited as sandbars on a shallow lake bottom. Charity soils are an example of fine textured soils that formed in material deposited on a deep lake bottom.

Wind-deposited sediment was moved from the land surface and deposited as the wind speed decreased. The particles are fine sand or sand. The sediments form dunes along shorelines and across broad, sandy plains and accumulate on the lee side of ridges and hills. Wallace soils are an example of soils that formed in wind-deposited sediment.

Alluvium is material recently deposited by floodwater from streams. This material varies in texture, depending on the speed of the water from which it was deposited. Bowstring soils are an example of soils that formed in alluvium.

Organic material occurs as deposits of plant residue. After the glaciers withdrew from the area, water remained standing in depressions on outwash plains, flood plains, moraines, and till plains. Grasses and sedges grew around the edges of these lakes. When these plants died, their residue did not decompose because the areas were wet. Later, water-tolerant trees grew in the areas. After these trees died, their residue became part of the organic accumulation. Eventually, the lakes were filled with organic material and developed into areas of muck. Lupton soils are an example of soils that formed in organic material.

Climate

Climate determines the kind of plant and animal life on and in the soil and the amount of water available for the weathering of minerals and the translocation of soil material. Through its influence on soil temperature, climate also determines the rate of chemical reaction in the soil.

The climate in Cheboygan County is cool and humid. Presumably, it is similar to that under which the soils formed. The soils in the county differ from soils that formed under a dry, warm climate and from those that formed under a moist, hot climate. The climate generally is uniform in all areas, but its effect is modified locally by the proximity of the area to large lakes. Only minor differences among the soils in the county are the result of differences in climate.

Plant and Animal Life

Green plants are the principal organisms affecting the soils in Cheboygan County. Bacteria, fungi, earthworms, and humans also have been important. The chief contribution of plant and animal life is the addition of organic matter and nitrogen to the soil. The kind of organic matter depends on the kinds of plants that grew on the soil. Plant roots provide channels for the downward movement of water through the soil and add organic matter as they decay. Bacteria in the soil help to break down the organic matter into elements that can be used by plants.

The native vegetation in Cheboygan County was a mixture of coniferous and deciduous forest. Differences in natural soil drainage and changes in parent material affect the composition of forests. In general, the well drained upland soils, such as Cheboygan and Blue Lake soils, supported vast stands of sugar maple and white pine. Rubicon soils supported red pine, aspen, and red maple. The very poorly drained soils supported cedar, black spruce, and aspen. Kinross and Brevort soils, which formed under wet conditions, have a considerable amount of organic matter.

Relief

Relief influences soil formation through its effect on drainage, runoff, erosion, plant cover, and soil temperature. In Cheboygan County slopes range from 0 to 60 percent. Natural drainage varies considerably in the county. Soils on hilltops are typically excessively drained, and soils in depressions are very poorly drained.

Through its effect on soil aeration, drainage determines the color of the soil. Water and air move freely through well drained soils and slowly through very poorly drained soils. In well aerated soils, the iron and aluminum compounds that give most soils their color are brightly colored and oxidized. Poorly aerated soils are dull gray and mottled. Cheboygan soils are an example of well drained, well aerated soils, and Brevort soils are an example of poorly drained, poorly aerated soils. Both of these soils formed in similar parent material.

Time

Generally, a long time is needed for the development of distinct horizons. The degree of profile development commonly reflects the length of time that the parent material has been in place. Some soils form rapidly. Others form slowly.

The soils in Cheboygan County range from young to mature. Most of the soils that formed in glacial deposits have been exposed to the soil-forming factors long enough for the development of distinct horizons. Bowstring soils, which formed in alluvium, are young soils. Cheboygan soils reflect characteristics of long-term leaching of lime from the soil.

Processes of Soil Formation

The processes responsible for the development of the soil horizons in the unconsolidated parent material are referred to as soil genesis. Several processes were involved in the development of horizons in the soils of Cheboygan County. These are the accumulation of organic matter, the leaching of lime (calcium carbonate) and other bases, the reduction and transfer of iron, and the formation and translocation of silicate clay minerals. More than one of these processes have helped to differentiate horizons in most of the soils.

As organic matter accumulates at the surface, an A horizon forms. The A and E horizons are mixed into a plow layer, or Ap horizon, if the soil is plowed. The surface layer of the soils in Cheboygan County ranges from high to low in organic matter content. The content is high, for example, in Kinross soils and low in Grayling soils.

Carbonates and other bases have been leached from most of the soils. The leaching of bases generally precedes the translocation of silicate clay minerals. Many of the soils are moderately leached or strongly leached. Cheboygan soils, for example, are leached of carbonates to a depth of 20 to 40 inches, and Rubicon soils are leached to a depth of more than 60 inches.

Gleying, or the reduction and transfer of iron, is evident in somewhat poorly drained, poorly drained, and very poorly drained soils. A gray color in the subsoil indicates the reduction and loss of iron. An example is Brevort soils.

The translocation of clay minerals has contributed to horizon development in some soils. An eluviated, or leached, E horizon typically is lower in content of clay and lighter in color than the illuviated B horizon. The B horizon typically has an accumulation of clay, or clay films, in pores and on the faces of peds. These soils were probably leached of carbonates and soluble salts to a considerable extent before the translocation of silicate clay minerals. Ontonagon soils are an example of soils in which translocated silicate clay minerals in the form of clay films have accumulated in the B horizon.

In some of the soils in Cheboygan County, iron, aluminum, and humus have been transferred from the surface layer to the B horizon. The B horizon in such soils commonly is dark brown or dark reddish brown. Au Gres and Kalkaska soils are examples.

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Glossary

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation-exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Channery soil. A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a channer.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Dense layer. A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Drumlin. A low, smooth, elongated oval hill, mound, or ridge of compact glacial till. The longer axis is parallel to the path of the glacier and commonly has a blunt nose pointing in the direction from which the ice approached.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Esker (geology). A narrow, winding ridge of stratified gravelly and sandy drift deposited by a stream flowing in a tunnel beneath a glacier.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, and clay.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Glacial drift (geology). Pulverized and other rock material transported by glacial ice and then deposited. Also, the sorted and unsorted material deposited by streams flowing from glaciers.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by glacial meltwater.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Glaciofluvial deposits (geology). Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

Glaciolacustrine deposits. Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial meltwater. Many deposits are interbedded or laminated.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.6 centimeters) in diameter.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Kame (geology). An irregular, short ridge or hill of stratified glacial drift.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Limestone. Sedimentary rock consisting chiefly of calcium carbonate. Usually an accumulation of organic remains, such as shells.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Some types are terminal, lateral, medial, and ground.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Muck. Dark colored, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Organic soil. Generally, a soil in which more than half of the upper 32 inches of the profile is organic or in which organic soil material of any thickness rests on bedrock.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percs slowly (in tables). The slow movement of water through the soil, adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are—

Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Rippable. Bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 draw bar horsepower rating.

Rock outcrop. Bedrock that is exposed at the surface, often on the sides and crests of hills and ridges.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Sinkhole. A depression in the landscape where limestone has been dissolved.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stone line. A concentration of coarse fragments in a soil. Generally, it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to soil blowing and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. It includes all subdivisions of these horizons.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terminal moraine. A belt of thick glacial drift that generally marks the termination of important glacial advances.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Till plain. An extensive flat to undulating area underlain by glacial till.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

(Recorded in the period 1951-80 at Cheboygan and Vanderbilt, Michigan)

Month	Temperature: Average daily maximum	Temperature: Average daily minimum	Temperature: Average	Temperature: 2 years in 10 will have-- Maximum temperature higher than--	Temperature: 2 years in 10 will have-- Minimum temperature lower than--	Temperature: Average number of growing degree days*	Precipitation: Average	Precipitation: 2 years in 10 will have-- Less than--	Precipitation: 2 years in 10 will have-- More than--	Precipitation: Average number of days with 0.10 inch or more	Precipitation: Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
CHEBOYGAN:											
January----	26.7	11.3	19.0	46	-15	0	1.42	0.8	1.9	5	19.5
February---	28.4	9.6	19.0	47	-18	0	1.20	.6	1.8	3	13.3
March------	37.0	18.2	27.6	61	-11	**	1.68	.7	2.5	4	13.5
April------	50.5	30.8	40.7	77	11	19	2.44	1.4	3.4	6	3.9
May--------	63.6	40.8	52.2	85	26	136	2.54	1.5	3.5	6	.1
June-------	73.3	50.5	61.9	91	35	366	2.68	1.6	3.7	6	.0
July-------	79.0	57.0	68.0	93	43	565	2.99	1.5	4.3	5	.0
August-----	77.3	56.3	66.8	92	42	528	2.90	1.4	4.2	6	.0
September--	68.9	49.4	59.1	89	32	291	3.80	1.8	5.5	8	***
October----	58.3	40.3	49.3	81	23	100	2.09	1.0	3.1	5	.4
November---	43.5	30.0	36.8	67	9	7	2.38	1.4	3.3	6	7.3
December---	31.4	18.3	24.9	55	-7	0	1.87	1.0	2.6	5	19.8
Yearly:											
Average---	53.2	34.4	43.8	---	---	---	---	---	---	---	---
Extreme---	---	---	---	94	-20	---	---	---	---	---	---
Total-----	---	---	---	---	---	2,012	27.99	22.9	32.8	65	77.8
VANDERBILT:											
January----	25.7	6.1	15.9	46	-30	0	1.90	1.2	2.5	7	29.6
February---	28.1	3.7	16.0	49	-33	0	1.41	.8	2.0	4	19.3
March------	38.0	13.4	25.7	63	-22	1	1.88	1.1	2.6	5	17.1
April------	53.9	27.1	40.5	83	-1	34	2.51	1.6	3.3	7	5.8
May--------	68.1	36.2	52.2	90	15	162	2.84	1.8	3.8	7	.4
June-------	76.6	45.8	61.2	94	26	351	2.89	1.7	4.0	7	.0
July-------	80.7	49.6	65.2	95	32	478	3.23	1.8	4.5	6	.0
August-----	77.9	48.6	63.3	93	28	421	3.15	2.0	4.2	6	.0
September--	68.6	42.2	55.4	90	22	209	3.59	1.8	5.2	8	.0
October----	57.6	33.8	45.7	80	14	68	2.44	1.4	3.4	6	.9
November---	41.9	25.3	33.6	67	-4	4	2.55	1.7	3.3	8	14.3
December---	29.9	12.8	21.4	54	-22	0	2.09	1.4	2.7	7	27.2
Yearly:											
Average---	53.9	28.7	41.3	---	---	---	---	---	---	---	---
Extreme---	---	---	---	96	-35	---	---	---	---	---	---
Total-----	---	---	---	---	---	1,728	30.48	27.4	33.4	78	114.6

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50 degrees F).

** Less than .5.

*** Less than .05.

TABLE 2.--FREEZE DATES IN SPRING AND FALL

(Recorded in the period 1930-79 at Cheboygan and Vanderbilt, Michigan)

Probability	Temperature		
	24 °F or lower	28 °F or lower	32 °F or lower
CHEBOYGAN:			
Last freezing temperature in spring:			
1 year in 10 later than--	May 5	May 17	June 1
2 years in 10 later than--	Apr. 29	May 11	May 27
5 years in 10 later than--	Apr. 18	May 2	May 18
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 24	Oct. 1	Sept. 18
2 years in 10 earlier than--	Oct. 29	Oct. 8	Sept. 24
5 years in 10 earlier than--	Nov. 9	Oct. 22	Oct. 7
VANDERBILT:			
Last freezing temperature in spring:			
1 year in 10 later than--	May 31	June 20	July 9
2 years in 10 later than--	May 27	June 13	July 3
5 years in 10 later than--	May 19	June 3	June 20
First freezing temperature in fall:			
1 year in 10 earlier than--	Sept. 12	Aug. 28	Aug. 6
2 years in 10 earlier than--	Sept. 19	Sept. 3	Aug. 11
5 years in 10 earlier than--	Oct. 2	Sept. 13	Aug. 22

TABLE 3.--GROWING SEASON

(Recorded in the period 1930-79 at Cheboygan and Vanderbilt, Michigan)

Probability	Daily minimum temperature during growing season		
	Higher than 24 °F	Higher than 28 °F	Higher than 32 °F
	Days	Days	Days
CHEBOYGAN:			
9 years in 10	179	145	113
8 years in 10	188	155	123
5 years in 10	204	173	142
2 years in 10	220	191	161
1 year in 10	228	200	170
VANDERBILT:			
9 years in 10	111	80	39
8 years in 10	119	87	47
5 years in 10	135	101	63
2 years in 10	151	115	79
1 year in 10	158	122	87

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
2	Lupton muck	16,178	3.5
5	Loxley peat	1,683	0.4
7	Grousehaven Variant muck	1,924	0.4
8	Tawas peat	28,076	6.1
9	Greenwood peat	949	0.2
10	Dawson peat	1,960	0.4
11B	Kalkaska sand, 0 to 6 percent slopes	7,036	1.5
11C	Kalkaska sand, 6 to 12 percent slopes	2,831	0.6
11D	Kalkaska sand, 12 to 30 percent slopes	4,225	0.9
11F	Kalkaska sand, 30 to 50 percent slopes	1,971	0.4
12B	Grayling sand, 0 to 8 percent slopes	9,708	2.1
13B	Rubicon sand, 0 to 6 percent slopes	29,822	6.5
13C	Rubicon sand, 6 to 12 percent slopes	9,888	2.1
13D	Rubicon sand, 18 to 30 percent slopes	8,320	1.8
13F	Rubicon sand, 30 to 60 percent slopes	3,327	0.7
16B	East Lake sand, 0 to 6 percent slopes	9,629	2.1
16C	East Lake sand, 6 to 12 percent slopes	1,675	0.4
16D	East Lake sand, 12 to 30 percent slopes	951	0.2
16F	East Lake sand, 30 to 50 percent slopes	456	0.1
17B	Wallace sand, 0 to 6 percent slopes	391	0.1
17D	Wallace sand, 6 to 18 percent slopes	856	0.2
17E	Wallace sand, 18 to 30 percent slopes	284	0.1
18B	Blue Lake loamy sand, 0 to 6 percent slopes	14,924	3.2
18C	Blue Lake loamy sand, 6 to 12 percent slopes	9,556	2.1
18D	Blue Lake loamy sand, 12 to 30 percent slopes	8,395	1.8
18F	Blue Lake loamy sand, 30 to 50 percent slopes	2,036	0.4
20B	Mancelona sand, 0 to 6 percent slopes	3,436	0.7
20C	Mancelona sand, 6 to 12 percent slopes	1,454	0.3
20D	Mancelona sand, 12 to 30 percent slopes	1,185	0.2
20F	Mancelona sand, 30 to 50 percent slopes	627	0.1
21B	Zimmerman fine sand, 0 to 8 percent slopes	4,051	0.9
22B	Leelanau loamy sand, 0 to 6 percent slopes	866	0.2
22C	Leelanau loamy sand, 6 to 12 percent slopes	676	0.1
22D	Leelanau loamy sand, 12 to 30 percent slopes	669	0.1
24B	Ocqueoc fine sand, 0 to 6 percent slopes	1,768	0.4
24C	Ocqueoc fine sand, 6 to 12 percent slopes	636	0.1
24D	Ocqueoc fine sand, 12 to 30 percent slopes	691	0.1
25B	Eastport sand, 0 to 6 percent slopes	1,202	0.3
25D	Eastport sand, 12 to 25 percent slopes	232	0.1
26B	Rubicon sand, dark subsoil, 0 to 6 percent slopes	9,433	2.0
26C	Rubicon sand, dark subsoil, 6 to 12 percent slopes	2,350	0.5
26D	Rubicon sand, dark subsoil, 12 to 30 percent slopes	2,336	0.5
27B	Cheboygan loamy sand, 0 to 6 percent slopes	25,081	5.5
27C	Cheboygan loamy sand, 6 to 12 percent slopes	16,083	3.5
27D	Cheboygan loamy sand, 12 to 30 percent slopes	10,658	2.3
27F	Cheboygan loamy sand, 30 to 50 percent slopes	2,898	0.6
29B	Fairport fine sandy loam, 1 to 8 percent slopes	4,207	0.9
29C	Fairport fine sandy loam, 8 to 25 percent slopes	1,799	0.4
30B	Rousseau fine sand, 0 to 6 percent slopes	291	0.1
30C	Rousseau fine sand, 6 to 12 percent slopes	303	0.1
30D	Rousseau fine sand, 12 to 30 percent slopes	270	0.1
31B	Nadeau extremely gravelly loamy sand, 1 to 9 percent slopes	1,989	0.4
32B	Rubicon sand, banded substratum, 0 to 6 percent slopes	8,322	1.8
32C	Rubicon sand, banded substratum, 6 to 12 percent slopes	2,969	0.6
32D	Rubicon sand, banded substratum, 12 to 30 percent slopes	1,901	0.4
33B	Ontonagon silty clay loam, 2 to 6 percent slopes	1,206	0.3
33B2	Ontonagon silty clay loam, 2 to 6 percent slopes, eroded	859	0.2
33C2	Ontonagon silty clay loam, 6 to 18 percent slopes, eroded	1,311	0.3
34B	Alcona very fine sandy loam, 0 to 6 percent slopes	1,189	0.3
34C	Alcona very fine sandy loam, 6 to 15 percent slopes	523	0.1
34E	Alcona very fine sandy loam, 20 to 50 percent slopes	652	0.1
37B	Emmet sandy loam, 1 to 6 percent slopes	4,012	0.9

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
37C	Emmet sandy loam, 6 to 12 percent slopes	2,104	0.5
37D	Emmet sandy loam, 12 to 18 percent slopes	1,626	0.4
38B	Onaway loam, 1 to 6 percent slopes	3,525	0.8
38C	Onaway loam, 6 to 12 percent slopes	1,524	0.3
38E	Onaway loam, 18 to 25 percent slopes	931	0.2
39B	Nester loam, 2 to 6 percent slopes	465	0.1
39C	Nester loam, 6 to 15 percent slopes	660	0.1
40B	Ontonagon silt loam, 0 to 4 percent slopes	397	0.1
40D2	Ontonagon silty clay, 12 to 25 percent slopes, eroded	897	0.2
41A	Au Gres sand, 0 to 3 percent slopes	14,887	3.2
43A	Battlefield sand, 0 to 3 percent slopes	2,927	0.6
45B	Croswell sand, 1 to 4 percent slopes	11,913	2.6
47A	Ingalls loamy sand, 0 to 3 percent slopes	4,450	1.0
48A	Allendale sand, 0 to 3 percent slopes	2,263	0.5
49A	Finch sand, 0 to 3 percent slopes	2,227	0.5
50A	Bonduel loamy very fine sand, 0 to 3 percent slopes	1,230	0.3
51A	Otisco sand, 0 to 3 percent slopes	1,808	0.4
52A	Ogemaw sand, 0 to 3 percent slopes	787	0.2
55A	Solona sandy loam, 0 to 3 percent slopes	3,804	0.8
56A	Riggsville loamy sand, 0 to 3 percent slopes	16,561	3.6
57A	Brimley very fine sandy loam, 0 to 3 percent slopes	5,917	1.3
58A	Alstad loam, 0 to 3 percent slopes	1,950	0.4
60A	Rudyard loam, 0 to 3 percent slopes	6,382	1.4
61	Roscommon muck	17,770	3.9
62	Wheatley loamy sand	2,203	0.5
63	Brevort mucky loamy sand	6,369	1.4
64	Burleigh mucky sand	4,606	1.0
66	Pinconning mucky loamy sand	1,704	0.4
67	Kinross mucky sand	1,809	0.4
70	Au Gres-Roscommon complex, 1 to 4 percent slopes	4,189	0.9
71	Bowstring muck, frequently flooded	8,801	1.9
77	Bruce fine sandy loam	4,316	0.9
78	Angelica mucky sandy loam	1,873	0.4
79	Charity fine sandy loam	5,263	1.1
81	Udipsamments, nearly level to steep	1,156	0.3
82	Udorthents, loamy, nearly level to steep	763	0.2
83	Pits, gravel	429	0.1
84	Pits, quarry	84	*
85	Histosols and Aquents, ponded	5,983	1.3
87	Beaches	124	*
141A	Finch cobbly sand, 0 to 3 percent slopes	1,216	0.3
158A	Detour cobbly loam, 0 to 3 percent slopes	2,968	0.6
179	Hessel mucky gravelly loam	3,155	0.7
	Water areas less than 40 acres in size	1,720	0.4
	Total	460,922	100.0

* Less than 0.1 percent.

TABLE 5.--PRIME FARMLAND

(Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name)

Map symbol	Soil name
27B	Cheboygan loamy sand, 0 to 6 percent slopes
34B	Alcona very fine sandy loam, 0 to 6 percent slopes
37B	Emmet sandy loam, 1 to 6 percent slopes
38B	Onaway loam, 1 to 6 percent slopes
39B	Nester loam, 2 to 6 percent slopes
47A	Ingalls loamy sand, 0 to 3 percent slopes (where drained)
55A	Solona sandy loam, 0 to 3 percent slopes (where drained)
57A	Brimley very fine sandy loam, 0 to 3 percent slopes (where drained)
58A	Alstad loam, 0 to 3 percent slopes (where drained)
77	Bruce fine sandy loam (where drained)
78	Angelica mucky sandy loam (where drained)

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS

(Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil)

Soil name and map symbol	Land capability	Corn	Corn silage	Winter wheat	Oats	Alfalfa hay	Bromegrass-alfalfa hay
		Bu	Tons	Bu	Bu	Tons	Tons
2----------------- Lupton	VIw	---	---	---	---	---	---
5----------------- Loxley	VIIw	---	---	---	---	---	---
7----------------- Grousehaven Variant	VIIw	---	---	---	---	---	---
8----------------- Tawas	VIw	---	---	---	---	---	---
9----------------- Greenwood	VIIw	---	---	---	---	---	---
10---------------- Dawson	VIIw	---	---	---	---	---	---
11B--------------- Kalkaska	IVs	50	9	25	40	2.5	1.8
11C--------------- Kalkaska	VIs	---	---	---	---	2.0	1.6
11D, 11F---------- Kalkaska	VIIs	---	---	---	---	---	---
12B--------------- Grayling	VIs	---	---	---	---	---	---
13B, 13C---------- Rubicon	VIs	---	---	---	---	2.0	---
13D, 13F---------- Rubicon	VIIs	---	---	---	---	---	---
16B--------------- East Lake	IVs	50	9	---	40	2.5	1.8
16C--------------- East Lake	VIs	---	---	---	---	2.3	1.6
16D, 16F---------- East Lake	VIIs	---	---	---	---	---	---
17B--------------- Wallace	VIs	---	---	---	---	2.3	---
17D, 17E---------- Wallace	VIIs	---	---	---	---	---	---
18B--------------- Blue Lake	IIIs	70	11	28	60	3.0	2.1
18C--------------- Blue Lake	IIIe	65	10	25	55	2.8	2.0

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Land capability	Corn	Corn silage	Winter wheat	Oats	Alfalfa hay	Bromegrass-alfalfa hay
		Bu	Tons	Bu	Bu	Tons	Tons
18D------------- Blue Lake	VIe	---	---	---	---	2.0	1.8
18F------------- Blue Lake	VIIe	---	---	---	---	---	---
20B------------- Mancelona	IIIs	65	12	24	55	3.0	2.1
20C------------- Mancelona	IIIe	50	9	22	45	2.8	1.9
20D------------- Mancelona	VIe	---	---	---	---	---	---
20F------------- Mancelona	VIIe	---	---	---	---	---	---
21B------------- Zimmerman	IVs	---	---	---	---	---	---
22B------------- Leelanau	IIIs	70	11	30	60	3.0	2.1
22C------------- Leelanau	IIIe	55	8	25	50	3.0	2.1
22D------------- Leelanau	VIe	---	---	---	---	2.0	---
24B------------- Ocqueoc	IIIs	70	11	---	70	3.0	2.1
24C------------- Ocqueoc	IIIe	---	9	---	55	3.0	2.1
24D------------- Ocqueoc	VIe	---	---	---	---	---	---
25B------------- Eastport	VIs	---	---	---	---	---	---
25D------------- Eastport	VIIs	---	---	---	---	---	---
26B------------- Rubicon	VIs	---	---	---	---	---	---
26C------------- Rubicon	VIs	---	---	---	---	---	---
26D------------- Rubicon	VIIs	---	---	---	---	---	---
27B------------- Cheboygan	IIIs	75	12	35	70	3.8	3.5
27C------------- Cheboygan	IIIe	65	11	30	65	3.8	3.5

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Land capability	Corn	Corn silage	Winter wheat	Oats	Alfalfa hay	Bromegrass-alfalfa hay
		Bu	Tons	Bu	Bu	Tons	Tons
27D: Cheboygan	VIe	---	---	---	---	---	---
27F: Cheboygan	VIIe	---	---	---	---	---	---
29B: Fairport	IIIe	85	14	---	75	4.0	2.8
29C: Fairport	IVe	20	10	---	65	3.5	2.4
30B: Rousseau	IIIs	---	---	---	---	---	---
30C: Rousseau	IIIe	---	---	---	---	---	---
30D: Rousseau	VIe	---	---	---	---	2.3	---
31B: Nadeau	IIIs	---	---	---	---	---	---
32B: Rubicon	VIs	---	---	---	---	---	---
32C: Rubicon	VIs	---	---	---	---	---	---
32D: Rubicon	VIIs	---	---	---	---	---	---
33B: Ontonagon	IIIe	80	15	40	75	3.7	2.5
33B2: Ontonagon	IIIe	75	14	37	70	3.5	2.4
33C2: Ontonagon	IVe	70	13	34	60	3.3	2.3
34B: Alcona	IIe	85	13	35	75	3.5	2.5
34C: Alcona	IIIe	75	11	30	65	3.2	2.4
34E: Alcona	VIIe	---	---	---	---	---	---
37B: Emmet	IIe	75	12	35	75	3.8	2.6
37C: Emmet	IIIe	65	11	30	60	3.6	2.5
37D: Emmet	IVe	---	---	---	---	---	---

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Land capability	Corn	Corn silage	Winter wheat	Oats	Alfalfa hay	Bromegrass-alfalfa hay
		Bu	Tons	Bu	Bu	Tons	Tons
38B------------- Onaway	IIe	95	16	45	80	4.0	3.0
38C------------- Onaway	IIIe	85	14	40	70	3.8	2.8
38E------------- Onaway	VIe	---	---	---	---	---	---
39B------------- Nester	IIe	80	13	40	75	3.7	2.6
39C------------- Nester	IIIe	70	12	36	70	3.5	2.5
40B------------- Ontonagon	IIIe	---	---	---	75	4.0	2.8
40D2------------ Ontonagon	VIe	---	---	---	---	---	---
41A------------- Au Gres	IVw	---	---	---	---	---	---
43A------------- Battlefield	IIIw	---	---	---	---	---	---
45B------------- Croswell	IVs	---	---	---	---	---	---
47A------------- Ingalls	IIIw	85	14	40	75	3.5	2.5
48A------------- Allendale	IIIw	80	14	40	75	3.5	2.5
49A------------- Finch	IVw	---	---	---	---	---	---
50A------------- Bonduel	IIw	80	12	---	75	---	4.0
51A------------- Otisco	IIIw	---	---	---	---	---	---
52A------------- Ogemaw	IVw	55	11	25	45	---	---
55A------------- Solona	IIw	80	13	35	75	4.0	2.8
56A------------- Riggsville	IIw	80	18	---	85	3.5	2.5
57A------------- Brimley	IIw	95	16	48	85	4.0	2.8
58A------------- Alstad	IIw	85	14	48	75	4.0	2.8
60A------------- Rudyard	IIIw	---	---	---	80	---	---

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Land capability	Corn	Corn silage	Winter wheat	Oats	Alfalfa hay	Bromegrass-alfalfa hay
		Bu	Tons	Bu	Bu	Tons	Tons
61-------------- Roscommon	VIw	---	---	---	---	---	---
62-------------- Wheatley	Vw	---	---	---	---	---	---
63-------------- Brevort	Vw	---	---	---	---	---	---
64-------------- Burleigh	Vw	---	---	---	---	---	---
66-------------- Pinconning	Vw	---	---	---	---	---	---
67-------------- Kinross	VIw	---	---	---	---	---	---
70-------------- Au Gres-Roscommon	VIw	---	---	---	---	---	---
71-------------- Bowstring	VIw	---	---	---	---	---	---
77-------------- Bruce	Vw	---	---	---	---	---	---
78-------------- Angelica	Vw	---	---	---	---	---	---
79-------------- Charity	Vw	---	---	---	---	---	---
81. Udipsamments							
82. Udorthents							
83*, 84*. Pits							
85. Histosols and Aquents							
87*. Beaches							
141A------------ Finch	VIs	---	---	---	---	---	---
158A------------ Detour	VIw	---	---	---	---	---	---
179------------- Hessel	Vw	---	---	---	---	---	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--CAPABILITY CLASSES AND SUBCLASSES

(Miscellaneous areas are excluded. Absence of an entry indicates no acreage)

Class	Total acreage	Major management concerns (subclass)		
		Erosion (e)	Wetness (w)	Soil problem (s)
		Acres	Acres	Acres
I	---	---	---	---
II	38,653	9,191	29,462	---
III	106,373	40,188	17,830	48,355
IV	65,455	2,937	20,456	42,062
V	29,489	---	29,489	---
VI	174,855	25,495	77,085	72,275
VII	36,843	6,213	6,516	24,114
VIII	---	---	---	---

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY

(Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available)

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Potential productivity: Common trees	Site index	Volume*	Trees to plant
2 Lupton	2W	Slight	Severe	Severe	Severe	Black spruce	20	29	
						Balsam fir	46	86	
						Black ash	---	---	
						Northern whitecedar	---	---	
						Paper birch	---	---	
						Tamarack	---	---	
						Red maple	---	---	
						Quaking aspen	---	---	
						White spruce	---	---	
5 Loxley	2W	Slight	Severe	Severe	Severe	Black spruce	15	23	
						Tamarack	---	---	
						Balsam fir	---	---	
7 Grousehaven Variant	3W	Slight	Severe	Severe	Severe	Northern whitecedar	15	30	
						Black ash	---	---	
						Balsam fir	---	---	
8 Tawas	5W	Slight	Severe	Severe	Severe	Balsam fir	40	71	
						Northern whitecedar	---	---	
						Quaking aspen	---	---	
						Black ash	---	---	
						Red maple	---	---	
9 Greenwood	2W	Slight	Severe	Severe	Severe	Black spruce	15	23	
						Balsam fir	39	69	
						Tamarack	---	---	
10 Dawson	2W	Slight	Severe	Severe	Severe	Black spruce	15	23	
						Tamarack	---	---	
11B, 11C Kalkaska	3S	Slight	Moderate	Moderate	Slight	Sugar maple	64	40	Red pine, jack pine, eastern white pine.
						Quaking aspen	---	---	
						Red pine	---	---	
						Eastern white pine	---	---	
						American beech	---	---	
						Paper birch	---	---	
						Northern red oak	---	---	
						Red maple	63	39	
						Bigtooth aspen	80	7	
11D Kalkaska	3R	Moderate	Moderate	Moderate	Slight	Sugar maple	64	40	Red pine, jack pine, eastern white pine.
						Quaking aspen	---	---	
						Red pine	---	---	
						Eastern white pine	---	---	
						American beech	---	---	
						Paper birch	---	---	
						Northern red oak	---	---	
						Red maple	63	39	
						Bigtooth aspen	80	94	

See footnotes at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Potential productivity: Common trees	Potential productivity: Site index	Potential productivity: Volume*	Trees to plant
11F------------- Kalkaska	3R	Severe	Severe	Moderate	Slight	Sugar maple--------- Quaking aspen------- Red pine------------ Eastern white pine-- American beech------ Paper birch--------- Northern red oak---- Red maple----------- Bigtooth aspen------	64 --- --- --- --- --- --- 63 80	40 --- --- --- --- --- --- 39 94	Red pine, jack pine, eastern white pine.
12B------------- Grayling	4S	Slight	Moderate	Moderate	Slight	Jack pine----------- Northern pin oak---- White oak----------- Red pine------------ Quaking aspen-------	48 43 --- --- ---	63 28 --- --- ---	Jack pine, red pine.
13B, 13C-------- Rubicon	4S	Slight	Moderate	Moderate	Slight	Quaking aspen------- Jack pine----------- Red pine------------ Bigtooth aspen------ Northern red oak---- Red maple----------- Paper birch---------	60 53 53 66 --- 57 ---	64 73 82 75 --- 36 ---	Red pine, jack pine.
13D------------- Rubicon	4R	Moderate	Moderate	Moderate	Slight	Quaking aspen------- Jack pine----------- Red pine------------ Bigtooth aspen------ Northern red oak---- Red maple----------- Paper birch---------	60 53 53 66 --- 57 ---	64 73 82 75 --- 36 ---	Red pine, jack pine.
13F------------- Rubicon	4R	Severe	Severe	Moderate	Slight	Quaking aspen------- Jack pine----------- Red pine------------ Bigtooth aspen------ Northern red oak---- Red maple----------- Paper birch---------	60 53 53 66 --- 57 ---	64 73 82 75 --- 36 ---	Red pine, jack pine.
16B, 16C-------- East Lake	2S	Slight	Moderate	Moderate	Slight	Red maple----------- Northern red oak---- Quaking aspen------- Red pine------------ Jack pine----------- Paper birch---------	53 --- --- 55 --- ---	34 --- --- 77 --- ---	Red pine, jack pine, eastern white pine.
16D------------- East Lake	2R	Moderate	Moderate	Moderate	Slight	Red maple----------- Northern red oak---- Quaking aspen------- Red pine------------ Jack pine----------- Paper birch---------	53 --- --- 55 --- ---	34 --- --- 77 --- ---	Red pine, jack pine, eastern white pine.

See footnotes at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Potential productivity: Common trees	Site index	Volume*	Trees to plant
16F------------- East Lake	2R	Severe	Severe	Moderate	Slight	Red maple-----------	53	---	Red pine, jack pine, eastern white pine.
						Northern red oak----	---	---	
						Quaking aspen-------	---	---	
						Red pine------------	55	88	
						Jack pine-----------	---	---	
						Paper birch---------	---	---	
17B, 17D-------- Wallace	6D	Slight	Moderate	Moderate	Severe	Red pine------------	55	88	Red pine, white spruce, eastern white pine.
						Red maple-----------	---	---	
						Black spruce--------	---	---	
						Eastern hemlock-----	---	---	
						Balsam fir----------	---	---	
						Paper birch---------	63	70	
						Quaking aspen-------	75	87	
						Sugar maple---------	---	---	
17E------------- Wallace	6R	Moderate	Moderate	Moderate	Severe	Red pine------------	55	88	Red pine, white spruce, eastern white pine.
						Red maple-----------	---	---	
						Black spruce--------	---	---	
						Eastern hemlock-----	---	---	
						Balsam fir----------	---	---	
						Paper birch---------	63	70	
						Quaking aspen-------	75	87	
						Sugar maple---------	---	---	
18B, 18C-------- Blue Lake	3A	Slight	Slight	Slight	Slight	Sugar maple---------	61	38	Red pine, eastern white pine, white spruce.
						Yellow birch--------	---	---	
						Quaking aspen-------	---	---	
						Eastern white pine--	---	---	
						Eastern hemlock-----	---	---	
						American beech------	---	---	
						Black ash-----------	---	---	
18D------------- Blue Lake	3R	Moderate	Moderate	Slight	Slight	Sugar maple---------	61	38	Red pine, eastern white pine, white spruce.
						Yellow birch--------	---	---	
						Quaking aspen-------	---	---	
						Eastern white pine--	---	---	
						Eastern hemlock-----	---	---	
						American beech------	---	---	
						Black ash-----------	---	---	
18F------------- Blue Lake	3R	Severe	Severe	Slight	Slight	Sugar maple---------	61	38	Red pine, eastern white pine, white spruce.
						Yellow birch--------	---	---	
						Quaking aspen-------	---	---	
						Eastern white pine--	---	---	
						Eastern hemlock-----	---	---	
						American beech------	---	---	
						Black ash-----------	---	---	
20B, 20C-------- Mancelona	3S	Slight	Moderate	Moderate	Slight	Sugar maple---------	58	37	Red pine, eastern white pine.
						Northern red oak----	---	---	
						Red pine------------	---	---	
						Jack pine-----------	---	---	
						Eastern white pine--	---	---	
						Yellow birch--------	---	---	

See footnotes at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Potential productivity: Common trees	Potential productivity: Site index	Potential productivity: Volume*	Trees to plant
20D------------- Mancelona	3R	Moderate	Moderate	Moderate	Slight	Sugar maple---------	58	37	Red pine, eastern white pine.
						Northern red oak----	---	---	
						Red pine------------	---	---	
						Jack pine-----------	---	---	
						Eastern white pine--	---	---	
						Yellow birch--------	---	---	
20F------------- Mancelona	3R	Severe	Severe	Moderate	Slight	Sugar maple---------	58	37	Red pine, eastern white pine.
						Northern red oak----	---	---	
						Red pine------------	---	---	
						Jack pine-----------	---	---	
						Eastern white pine--	---	---	
						Yellow birch--------	---	---	
21B------------- Zimmerman	8S	Slight	Moderate	Moderate	Slight	Red pine------------	62	107	Red pine, eastern white pine, jack pine.
						Jack pine-----------	66	96	
						Paper birch---------	65	73	
						Quaking aspen-------	75	87	
						Balsam fir----------	65	129	
						Northern red oak----	53	39	
22B, 22C-------- Leelanau	3A	Slight	Slight	Slight	Slight	Sugar maple---------	61	38	White spruce, red pine, eastern white pine.
						Yellow birch--------	---	---	
						Eastern white pine--	---	---	
						American beech------	---	---	
						American basswood---	---	---	
						Quaking aspen-------	---	---	
						Red pine------------	---	---	
						Northern red oak----	---	---	
						Bigtooth aspen------	70	81	
22D------------- Leelanau	3R	Moderate	Moderate	Slight	Slight	Sugar maple---------	61	38	White spruce, red pine, eastern white pine.
						Yellow birch--------	---	---	
						Eastern white pine--	---	---	
						American beech------	---	---	
						American basswood---	---	---	
						Quaking aspen-------	---	---	
						Red pine------------	---	---	
						Northern red oak----	---	---	
						Bigtooth aspen------	70	81	
24B, 24C-------- Ocqueoc	3S	Slight	Moderate	Moderate	Slight	Sugar maple---------	63	38	Red pine, white spruce, eastern white pine.
						American beech------	---	---	
						Yellow birch--------	---	---	
						Quaking aspen-------	---	---	
						Eastern white pine--	---	---	
						Red pine------------	---	---	
						Jack pine-----------	---	---	
						Paper birch---------	---	---	
						Red maple-----------	---	---	
24D------------- Ocqueoc	3R	Moderate	Moderate	Moderate	Slight	Sugar maple---------	63	39	Red pine, white spruce, eastern white pine.
						American beech------	---	---	
						Yellow birch--------	---	---	
						Quaking aspen-------	---	---	
						Eastern white pine--	---	---	
						Red pine------------	---	---	
						Jack pine-----------	---	---	
						Paper birch---------	---	---	
						Red maple-----------	---	---	

See footnotes at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Potential productivity: Common trees	Site index	Volume*	Trees to plant
25B: Eastport	2S	Slight	Moderate	Moderate	Slight	Sugar maple	52	33	Red pine, jack pine, eastern white pine.
						American beech	---	---	
						Eastern hemlock	---	---	
						Yellow birch	---	---	
						Balsam fir	---	---	
						Northern red oak	---	---	
						Eastern white pine	---	---	
25D: Eastport	2R	Moderate	Moderate	Moderate	Slight	Sugar maple	52	33	Red pine, jack pine, eastern white pine.
						American beech	---	---	
						Eastern hemlock	---	---	
						Yellow birch	---	---	
						Balsam fir	---	---	
						Northern red oak	---	---	
						Eastern white pine	---	---	
26B, 26C: Rubicon	3S	Slight	Moderate	Moderate	Slight	Sugar maple	60	38	Red pine, jack pine.
						Red maple	60	38	
						Bigtooth aspen	88	105	
						American beech	---	---	
						Eastern white pine	---	---	
						Yellow birch	---	---	
						Red pine	---	---	
26D: Rubicon	3R	Moderate	Moderate	Moderate	Slight	Sugar maple	60	38	Red pine, jack pine.
						Red maple	60	38	
						Bigtooth aspen	88	105	
						American beech	---	---	
						Eastern white pine	---	---	
						Yellow birch	---	---	
						Red pine	---	---	
27B: Cheboygan	3A	Slight	Slight	Slight	Moderate	Sugar maple	64	40	Red pine, white spruce, eastern white pine.
						Quaking aspen	---	---	
						American basswood	---	---	
						American beech	---	---	
						Red maple	---	---	
						White ash	---	---	
						Red maple	---	---	
						Eastern white pine	---	---	
27C: Cheboygan	3A	Slight	Slight	Slight	Slight	Sugar maple	64	40	Red pine, white spruce, eastern white pine.
						Quaking aspen	---	---	
						White ash	---	---	
						American basswood	---	---	
						American beech	---	---	
						Red maple	---	---	
						Eastern white pine	---	---	
27D: Cheboygan	3R	Moderate	Moderate	Slight	Slight	Sugar maple	64	40	Red pine, white spruce, eastern white pine.
						Quaking aspen	---	---	
						White ash	---	---	
						American basswood	---	---	
						American beech	---	---	
						Red maple	---	---	
						Eastern white pine	---	---	

See footnotes at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Potential productivity: Common trees	Site index	Volume*	Trees to plant
27F------------- Cheboygan	3R	Severe	Severe	Slight	Slight	Sugar maple---------	64	40	Red pine, white spruce, eastern white pine.
						Quaking aspen-------	---	---	
						White ash-----------	---	---	
						American basswood---	---	---	
						American beech------	---	---	
						Red maple-----------	---	---	
						Eastern white pine--	---	---	
29B------------- Fairport	3D	Slight	Moderate	Slight	Moderate	Sugar maple---------	65	40	White spruce, eastern white pine.
						American beech------	---	---	
						Northern whitecedar-	---	---	
29C------------- Fairport	3R	Moderate	Moderate	Slight	Moderate	Sugar maple---------	65	40	White spruce, eastern white pine.
						American beech------	---	---	
						Northern whitecedar-	---	---	
30B, 30C-------- Rousseau	5S	Slight	Moderate	Moderate	Slight	Quaking aspen-------	65	73	Red pine, jack pine, eastern white pine.
						Sugar maple---------	60	38	
						Red maple-----------	---	---	
						Balsam fir----------	---	---	
						Northern red oak----	---	---	
						Eastern hemlock-----	---	---	
						Red pine------------	---	---	
						Jack pine-----------	62	89	
						Paper birch---------	65	73	
						Yellow birch--------	---	---	
						Bigtooth aspen------	---	---	
30D------------- Rousseau	5R	Moderate	Moderate	Moderate	Slight	Quaking aspen-------	65	73	Red pine, jack pine, eastern white pine.
						Sugar maple---------	60	38	
						Red maple-----------	---	---	
						Balsam fir----------	---	---	
						Northern red oak----	---	---	
						Eastern hemlock-----	---	---	
						Red pine------------	---	---	
						Jack pine-----------	62	89	
						Paper birch---------	65	73	
						Yellow birch--------	---	---	
						Bigtooth aspen------	---	---	
31B------------- Nadeau	2L	Slight	Moderate	Slight	Slight	Sugar maple---------	55	35	Red pine, eastern white pine.
						Quaking aspen-------	---	---	
						Bigtooth aspen------	63	70	
						Northern red oak----	65	59	
						Eastern white pine--	---	---	
						White ash-----------	---	---	
32B, 32C-------- Rubicon	6S	Slight	Moderate	Moderate	Slight	Bigtooth aspen------	75	87	Red pine, jack pine.
						Red pine------------	---	---	
32D------------- Rubicon	6R	Moderate	Moderate	Moderate	Slight	Bigtooth aspen------	75	87	Red pine, jack pine.
						Red pine------------	---	---	
33B, 33B2------- Ontonagon	2C	Slight	Severe	Slight	Moderate	Red maple-----------	55	35	White spruce, eastern white pine, northern whitecedar.
						Eastern white pine--	44	75	
						Yellow birch--------	---	---	
						Northern whitecedar-	---	---	
						Eastern hemlock-----	---	---	
						White spruce--------	---	---	
						Balsam fir----------	---	---	
						Red pine------------	46	4	

See footnotes at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Potential productivity: Common trees	Site index	Volume*	Trees to plant
33C2------------ Ontonagon	2C	Slight	Severe	Slight	Moderate	Red maple-----------	55	35	White spruce, eastern white pine, northern whitecedar.
						Eastern white pine--	44	75	
						Yellow birch--------	---	---	
						Northern whitecedar-	---	---	
						Eastern hemlock-----	---	---	
						White spruce--------	---	---	
						Balsam fir----------	---	---	
34B, 34C-------- Alcona	3L	Slight	Moderate	Slight	Slight	Sugar maple---------	61	38	White spruce, red pine, eastern white pine.
						Red maple-----------	---	---	
						Yellow birch--------	---	---	
						American basswood---	---	---	
						American beech------	---	---	
						Northern red oak----	---	---	
						Eastern white pine--	---	---	
						White ash-----------	---	---	
						Red pine------------	---	---	
34E------------- Alcona	3R	Severe	Severe	Slight	Slight	Sugar maple---------	61	38	White spruce, red pine, eastern white pine.
						Red maple-----------	---	---	
						Yellow birch--------	---	---	
						American basswood---	---	---	
						American beech------	---	---	
						Northern red oak----	---	---	
						Eastern white pine--	---	---	
						White ash-----------	---	---	
						Red pine------------	---	---	
37B, 37C, 37D--- Emmet	3L	Slight	Moderate	Slight	Slight	Sugar maple---------	66	41	White spruce, red pine, eastern white pine.
						Quaking aspen-------	---	---	
						Yellow birch--------	---	---	
						Red pine------------	---	---	
						American basswood---	---	---	
						American beech------	---	---	
						Northern red oak----	74	72	
						Eastern hemlock-----	---	---	
38B, 38C-------- Onaway	3L	Slight	Moderate	Slight	Slight	Sugar maple---------	65	41	White spruce, red pine, eastern white pine.
						Quaking aspen-------	---	---	
						Balsam fir----------	---	---	
						Yellow birch--------	---	---	
						Northern red oak----	---	---	
						Red pine------------	---	---	
						American basswood---	65	59	
						White ash-----------	---	---	
38E------------- Onaway	3R	Moderate	Moderate	Slight	Slight	Sugar maple---------	65	41	White spruce, red pine, eastern white pine.
						Quaking aspen-------	---	---	
						Balsam fir----------	---	---	
						Yellow birch--------	---	---	
						Northern red oak----	---	---	
						Red pine------------	---	---	
						American basswood---	65	59	
						White ash-----------	---	---	

See footnotes at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordi- nation symbol	Management concerns: Erosion hazard	Management concerns: Equip- ment limita- tion	Management concerns: Seedling mortal- ity	Management concerns: Wind- throw hazard	Potential productivity: Common trees	Potential productivity: Site index	Potential productivity: Volume*	Trees to plant
39B, 39C-------- Nester	3L	Slight	Moderate	Slight	Slight	Sugar maple---------	61	38	White spruce, red pine, eastern white pine.
						Quaking aspen-------	---	---	
						White ash-----------	---	---	
						American basswood---	---	---	
						Northern red oak----	---	---	
						White oak-----------	---	---	
						Black cherry--------	---	---	
						American beech------	---	---	
40B------------- Ontonagon	2C	Slight	Moderate	Slight	Moderate	Red maple-----------	55	35	White spruce, eastern white pine, northern whitecedar.
						Eastern white pine--	44	75	
						Yellow birch--------	---	---	
						Northern whitecedar-	---	---	
						Eastern hemlock-----	---	---	
						White spruce--------	---	---	
						Balsam fir----------	---	---	
						Red pine------------	46	67	
40D2------------ Ontonagon	2R	Moderate	Moderate	Slight	Moderate	Red maple-----------	55	35	White spruce, eastern white pine, northern whitecedar.
						Eastern white pine--	44	75	
						Yellow birch--------	---	---	
						Northern whitecedar-	---	---	
						Eastern hemlock-----	---	---	
						White spruce--------	---	---	
						Balsam fir----------	---	---	
41A------------- Au Gres	6W	Slight	Severe	Moderate	Severe	Quaking aspen-------	70	81	White spruce, red pine, eastern white pine, Norway spruce.
						Bigtooth aspen------	---	---	
						Balsam fir----------	---	---	
						Paper birch---------	---	---	
						Yellow birch--------	---	---	
						Red maple-----------	---	---	
						Eastern hemlock-----	---	---	
						Eastern white pine--	---	---	
						Northern whitecedar-	---	---	
43A------------- Battlefield	5W	Slight	Severe	Moderate	Severe	Quaking aspen-------	68	78	White spruce, black spruce, eastern white pine.
						Balsam fir----------	---	---	
						Paper birch---------	---	---	
						Red maple-----------	---	---	
45B------------- Croswell	5S	Slight	Moderate	Moderate	Moderate	Quaking aspen-------	68	78	Red pine, eastern white pine, white spruce.
						Red pine------------	55	88	
						Jack pine-----------	53	73	
						Northern red oak----	---	---	
						Black cherry--------	---	---	
						Eastern white pine--	---	---	
						Bigtooth aspen------	---	---	
						Red maple-----------	---	---	

See footnotes at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Potential productivity: Common trees	Site index	Volume*	Trees to plant
47A------------- Ingalls	4W	Slight	Severe	Moderate	Severe	Quaking aspen-------	60	64	Eastern white pine, white spruce.
						White ash-----------	---	---	
						Red maple-----------	---	---	
						Sugar maple---------	---	---	
						Jack pine-----------	---	---	
						Northern pin oak----	---	---	
						Northern whitecedar-	---	---	
						Balsam fir----------	---	---	
						Paper birch---------	---	---	
						Red maple-----------	---	---	
						Bigtooth aspen------	---	---	
						Eastern hemlock-----	---	---	
						Yellow birch--------	---	---	
48A------------- Allendale	4W	Slight	Severe	Moderate	Moderate	Quaking aspen-------	60	64	White spruce, eastern white pine.
						White ash-----------	---	---	
						Eastern white pine--	---	---	
						White spruce--------	---	---	
						Paper birch---------	---	---	
						Balsam fir----------	---	---	
						Red maple-----------	---	---	
49A------------- Finch	4W	Slight	Severe	Moderate	Severe	Quaking aspen-------	56	56	Eastern white pine, white spruce, red pine.
						Northern red oak----	56	44	
						Paper birch---------	54	55	
						Red maple-----------	56	36	
						Eastern white pine--	53	99	
						Sugar maple---------	53	34	
50A------------- Bonduel	4W	Slight	Severe	Slight	Moderate	Northern whitecedar-	35	51	White spruce, white ash.
						Quaking aspen-------	---	---	
						Paper birch---------	---	---	
						Red maple-----------	---	---	
51A------------- Otisco	4W	Slight	Severe	Moderate	Severe	Quaking aspen-------	60	64	White spruce, northern whitecedar, eastern white pine.
						Yellow birch--------	---	---	
						Balsam fir----------	---	---	
						White spruce--------	---	---	
						Red maple-----------	---	---	
						American elm--------	---	---	
52A------------- Ogemaw	4W	Slight	Severe	Moderate	Severe	Quaking aspen-------	60	64	White spruce, northern whitecedar, eastern white pine.
						Jack pine-----------	55	77	
						Northern whitecedar-	33	48	
						Red maple-----------	---	---	
						White spruce--------	---	---	
						Balsam fir----------	---	---	
55A------------- Solona	3W	Slight	Severe	Slight	Moderate	Sugar maple---------	64	40	Eastern white pine, white ash, white spruce.
						Northern red oak----	---	---	
						White ash-----------	---	---	
						American basswood---	---	---	
56A------------- Riggsville	5W	Slight	Moderate	Slight	Moderate	Bigtooth aspen------	63	70	White spruce, eastern white pine.
						Red maple-----------	---	---	
						Balsam fir----------	---	---	

See footnotes at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Potential productivity: Common trees	Potential productivity: Site index	Potential productivity: Volume*	Trees to plant
57A------------- Brimley	3W	Slight	Severe	Slight	Moderate	Sugar maple---------	60	38	White spruce, eastern white pine, northern whitecedar.
						Northern red oak----	---	---	
						Black ash-----------	---	---	
						Yellow birch--------	---	---	
						Eastern white pine--	---	---	
						Red maple-----------	---	---	
						Balsam fir----------	---	---	
						Northern whitecedar-	---	---	
						Eastern hemlock-----	---	---	
58A------------- Alstad	3W	Slight	Severe	Slight	Moderate	Red maple-----------	65	40	Eastern white pine, white spruce, black spruce.
						American basswood---	---	---	
						American elm--------	---	---	
						Quaking aspen-------	---	---	
						Northern red oak----	64	57	
						Sugar maple---------	---	---	
						Bigtooth aspen------	---	---	
60A------------- Rudyard	6W	Slight	Severe	Moderate	Severe	White spruce--------	45	84	White spruce, eastern white pine.
						Balsam fir----------	45	83	
						Quaking aspen-------	---	---	
						Northern whitecedar-	---	---	
						Eastern hemlock-----	---	---	
						Black ash-----------	---	---	
						Red maple-----------	---	---	
						American basswood---	---	---	
61-------------- Roscommon	6W	Slight	Severe	Severe	Severe	Quaking aspen-------	74	86	
						Black spruce--------	---	---	
						Northern whitecedar-	---	---	
						Jack pine-----------	---	---	
						Balsam fir----------	---	---	
						Red maple-----------	---	---	
						Yellow birch--------	---	---	
62-------------- Wheatley	2W	Slight	Severe	Severe	Severe	Quaking aspen-------	45	32	
						Balsam fir----------	40	71	
						Northern whitecedar-	15	30	
						Black spruce--------	15	23	
						Red maple-----------	40	2	
						Eastern hemlock-----	---	---	
63-------------- Brevort	2W	Slight	Severe	Severe	Severe	Quaking aspen-------	40	22	
						Balsam fir----------	---	---	
						Northern whitecedar-	---	---	
						American basswood---	---	---	
						Red maple-----------	---	---	
						Black spruce--------	15	23	
64-------------- Burleigh	2W	Slight	Severe	Severe	Severe	Quaking aspen-------	40	22	
						Bigtooth aspen------	---	---	
						Black ash-----------	---	---	
						Red maple-----------	---	---	
						Swamp white oak-----	---	---	
66-------------- Pinconning	3W	Slight	Severe	Severe	Severe	Quaking aspen-------	50	43	
						Black ash-----------	---	---	
						Black spruce--------	---	---	
						Northern whitecedar-	---	---	

See footnotes at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Potential productivity: Common trees	Potential productivity: Site index	Potential productivity: Volume*	Trees to plant
67-------------- Kinross	2W	Slight	Severe	Severe	Severe	Quaking aspen-------	45	32	
						Black spruce--------	---	---	
						Tamarack------------	---	---	
						Northern whitecedar-	---	---	
						Balsam fir----------	---	---	
						Red maple-----------	---	---	
70**:									
Au Gres--------	6W	Slight	Severe	Moderate	Severe	Quaking aspen-------	70	81	White spruce, red pine, eastern white pine.
						Bigtooth aspen------	---	---	
						Balsam fir----------	---	---	
						Paper birch---------	---	---	
						Yellow birch--------	---	---	
						Red maple-----------	---	---	
						Eastern hemlock-----	---	---	
						Eastern white pine--	---	---	
						Northern whitecedar-	---	---	
Roscommon------	6W	Slight	Severe	Severe	Severe	Quaking aspen-------	74	86	
						Black spruce--------	---	---	
						Northern whitecedar-	---	---	
						Jack pine-----------	---	---	
						Balsam fir----------	---	---	
						Red maple-----------	---	---	
						Yellow birch--------	---	---	
71-------------- Bowstring	3W	Slight	Severe	Severe	Severe	Northern whitecedar-	15	30	
						Black ash-----------	---	---	
						Red maple-----------	---	---	
						American basswood---	---	---	
						Balsam fir----------	---	---	
						Tamarack------------	---	---	
77-------------- Bruce	7W	Slight	Severe	Severe	Severe	White spruce--------	50	96	White spruce, eastern white pine, northern whitecedar.
						Balsam fir----------	---	---	
						Quaking aspen-------	---	---	
						Yellow birch--------	---	---	
						Northern whitecedar-	---	---	
						Red maple-----------	---	---	
						Black ash-----------	---	---	
78-------------- Angelica	7W	Slight	Severe	Severe	Severe	Balsam fir----------	54	105	White spruce, black spruce.
						Quaking aspen-------	60	64	
						Paper birch---------	---	---	
						Yellow birch--------	---	---	
						Northern whitecedar-	---	---	
						Black ash-----------	---	---	
79-------------- Charity	5W	Slight	Severe	Severe	Severe	White spruce--------	40	72	White spruce, eastern white pine.
						Balsam fir----------	---	---	
						Black ash-----------	---	---	
						Northern whitecedar-	---	---	
141A------------ Finch	4W	Slight	Severe	Moderate	Severe	Quaking aspen-------	56	56	White spruce, red pine.
						Northern red oak----	---	---	
						Paper birch---------	---	---	
						Red maple-----------	---	---	
						Eastern white pine--	---	---	
						Sugar maple---------	---	---	
						Jack pine-----------	52	71	

See footnotes at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Potential productivity: Common trees	Potential productivity: Site index	Potential productivity: Volume*	Trees to plant
158A------------ Detour	7W	Slight	Severe	Slight	Severe	Balsam fir----------	50	96	White spruce, eastern white pine.
						White spruce--------	50	96	
						Northern whitecedar-	---	---	
						Quaking aspen-------	---	---	
						Black spruce--------	---	---	
						Paper birch---------	---	---	
						Yellow birch--------	---	---	
179------------- Hessel	6W	Slight	Severe	Severe	Severe	Balsam fir----------	45	83	
						White spruce--------	---	---	
						Black ash-----------	---	---	
						Eastern white pine--	---	---	
						Eastern hemlock-----	---	---	
						Northern whitecedar-	---	---	
						Black spruce--------	---	---	
						Quaking aspen-------	---	---	

* Volume is the yield in cubic feet per acre per year calculated at the age of culmination of mean annual increment for fully stocked natural stands.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--EQUIPMENT LIMITATIONS ON WOODLAND

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Ratings for most limiting season(s)				Ratings for preferred operating season(s)		
	Logging areas and skid trails	Log landings	Haul roads	Preferred operating season(s)	Logging areas and skid trails	Log landings	Haul roads
2 Lupton	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter	Moderate: low strength.	Severe: low strength.	Moderate: low strength.
5 Loxley	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter	Moderate: low strength.	Severe: low strength.	Moderate: low strength.
7 Grousehaven Variant	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter	Moderate: low strength.	Severe: low strength.	Moderate: low strength.
8 Tawas	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter	Moderate: low strength.	Severe: low strength.	Moderate: low strength.
10 Dawson	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter	Moderate: low strength.	Severe: low strength.	Moderate: low strength.
11B Kalkaska	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight	Slight	Slight.
11C Kalkaska	Moderate: too sandy.	Moderate: too sandy, slope.	Moderate: too sandy.	Spring, fall, winter.	Slight	Moderate: slope.	Slight.
11D Kalkaska	Moderate: too sandy, slope.	Severe: slope.	Moderate: too sandy, slope.	Spring, fall, winter.	Moderate: slope.	Severe: slope.	Moderate: slope.
11F Kalkaska	Severe: slope.	Severe: slope.	Severe: slope.	Spring, fall, winter.	Severe: slope.	Severe: slope.	Severe: slope.
12B Grayling	Moderate: too sandy.	Moderate: too sandy, slope.	Moderate: too sandy.	Spring, fall, winter.	Slight	Moderate: slope.	Slight.
13B Rubicon	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight	Slight	Slight.

TABLE 9.--EQUIPMENT LIMITATIONS ON WOODLAND--Continued

Soil name and map symbol	Ratings for most limiting season(s)			Preferred operating season(s)	Ratings for preferred operating season(s)		
	Logging areas and skid trails	Log landings	Haul roads		Logging areas and skid trails	Log landings	Haul roads
13C: Rubicon	Moderate: too sandy.	Moderate: too sandy, slope.	Moderate: too sandy.	Spring, fall, winter.	Slight	Moderate: slope.	Slight.
13D: Rubicon	Moderate: too sandy, slope.	Severe: slope.	Moderate: too sandy, slope.	Spring, fall, winter.	Moderate: slope.	Severe: slope.	Moderate: slope.
13F: Rubicon	Severe: slope.	Severe: slope.	Severe: slope.	Spring, fall, winter.	Severe: slope.	Severe: slope.	Severe: slope.
16B: East Lake	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight	Slight	Slight.
16C: East Lake	Moderate: too sandy.	Moderate: too sandy, slope.	Moderate: too sandy.	Spring, fall, winter.	Slight	Moderate: slope.	Slight.
16D: East Lake	Moderate: too sandy, slope.	Severe: slope.	Moderate: too sandy, slope.	Spring, fall, winter.	Moderate: slope.	Severe: slope.	Moderate: slope.
16F: East Lake	Severe: slope.	Severe: slope.	Severe: slope.	Spring, fall, winter.	Severe: slope.	Severe: slope.	Severe: slope.
17B: Wallace	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight	Slight	Slight.
17D: Wallace	Moderate: too sandy.	Severe: slope.	Moderate: too sandy.	Spring, fall, winter.	Slight	Severe: slope.	Slight.
17E: Wallace	Moderate: too sandy, slope.	Severe: slope.	Moderate: too sandy, slope.	Spring, fall, winter.	Moderate: slope.	Severe: slope.	Moderate: slope.
18B: Blue Lake	Slight	Slight	Slight	Year round.	Slight	Slight	Slight.
18C: Blue Lake	Slight	Moderate: slope.	Slight	Year round.	Slight	Moderate: slope.	Slight.

TABLE 9.--EQUIPMENT LIMITATIONS ON WOODLAND--Continued

Soil name and map symbol	Ratings for most limiting season(s): Logging areas and skid trails	Ratings for most limiting season(s): Log landings	Ratings for most limiting season(s): Haul roads	Preferred operating season(s)	Ratings for preferred operating season(s): Logging areas and skid trails	Ratings for preferred operating season(s): Log landings	Ratings for preferred operating season(s): Haul roads
18D: Blue Lake	Moderate: slope.	Severe: slope.	Moderate: slope.	Year round.	Moderate: slope.	Severe: slope.	Moderate: slope.
18F: Blue Lake	Severe: slope.	Severe: slope.	Severe: slope.	Year round.	Severe: slope.	Severe: slope.	Severe: slope.
20B: Mancelona	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight	Slight	Slight.
20C: Mancelona	Moderate: too sandy.	Moderate: too sandy, slope.	Moderate: too sandy.	Spring, fall, winter.	Slight	Moderate: slope.	Slight.
20D: Mancelona	Moderate: too sandy, slope.	Severe: slope.	Moderate: too sandy, slope.	Spring, fall, winter.	Moderate: slope.	Severe: slope.	Moderate: slope.
20F: Mancelona	Severe: slope.	Severe: slope.	Severe: slope.	Spring, fall, winter.	Severe: slope.	Severe: slope.	Severe: slope.
21B: Zimmerman	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight	Slight	Slight.
22B: Leelanau	Slight	Moderate: slope.	Slight	Year round.	Slight	Moderate: slope.	Slight.
22C: Leelanau	Slight	Moderate: slope.	Slight	Year round.	Slight	Moderate: slope.	Slight.
22D: Leelanau	Moderate: slope.	Severe: slope.	Moderate: slope.	Year round.	Moderate: slope.	Severe: slope.	Moderate: slope.
24B: Ocqueoc	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight	Slight	Slight.
24C: Ocqueoc	Moderate: too sandy.	Moderate: too sandy, slope.	Moderate: too sandy.	Spring, fall, winter.	Slight	Moderate: slope.	Slight.
24D: Ocqueoc	Moderate: too sandy, slope.	Severe: slope.	Moderate: too sandy, slope.	Spring, fall, winter.	Moderate: slope.	Severe: slope.	Moderate: slope.

TABLE 9.--EQUIPMENT LIMITATIONS ON WOODLAND--Continued

Soil name and map symbol	Ratings for most limiting season(s): Logging areas and skid trails	Ratings for most limiting season(s): Log landings	Ratings for most limiting season(s): Haul roads	Preferred operating season(s)	Ratings for preferred operating season(s): Logging areas and skid trails	Ratings for preferred operating season(s): Log landings	Ratings for preferred operating season(s): Haul roads
25B: Eastport	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight	Slight	Slight.
25D: Eastport	Moderate: too sandy, slope.	Severe: slope.	Moderate: too sandy, slope.	Spring, fall, winter.	Moderate: slope.	Severe: slope.	Moderate: slope.
26B: Rubicon	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight	Slight	Slight.
26C: Rubicon	Moderate: too sandy.	Moderate: too sandy, slope.	Moderate: too sandy.	Spring, fall, winter.	Slight	Moderate: slope.	Slight.
26D: Rubicon	Moderate: too sandy, slope.	Severe: slope.	Moderate: too sandy, slope.	Spring, fall, winter.	Moderate: slope.	Severe: slope.	Moderate: slope.
27B: Cheboygan	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Summer, fall, winter.	Slight	Slight	Slight.
27C: Cheboygan	Moderate: low strength.	Moderate: low strength, slope.	Moderate: low strength.	Summer, fall, winter.	Slight	Moderate: slope.	Slight.
27D: Cheboygan	Moderate: low strength, slope.	Severe: slope.	Moderate: low strength, slope.	Summer, fall, winter.	Moderate: slope.	Severe: slope.	Moderate: slope.
27F: Cheboygan	Severe: slope.	Severe: slope.	Severe: slope.	Summer, fall.	Severe: slope.	Severe: slope.	Severe: slope.
29B: Fairport	Moderate: low strength.	Moderate: low strength, depth to rock, slope.	Moderate: low strength, depth to rock.	Summer, fall, winter.	Slight	Moderate: depth to rock, slope.	Moderate: depth to rock.
29C: Fairport	Moderate: low strength, slope.	Severe: slope.	Moderate: low strength, slope.	Summer, fall, winter.	Moderate: slope.	Severe: slope.	Moderate: slope.
30B: Rousseau	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight	Slight	Slight.

TABLE 9.--EQUIPMENT LIMITATIONS ON WOODLAND--Continued

Soil name and map symbol	Ratings for most limiting season(s)			Preferred operating season(s)	Ratings for preferred operating season(s)		
	Logging areas and skid trails	Log landings	Haul roads		Logging areas and skid trails	Log landings	Haul roads
30C Rousseau	Moderate: too sandy.	Moderate: too sandy, slope.	Moderate: too sandy.	Spring, fall, winter.	Slight	Moderate: slope.	Slight.
30D Rousseau	Moderate: too sandy, slope.	Severe: slope.	Moderate: too sandy, slope.	Spring, fall, winter.	Moderate: slope.	Severe: slope.	Moderate: slope.
31B Nadeau	Slight	Moderate: slope.	Slight	Year round.	Slight	Moderate: slope.	Slight.
32B Rubicon	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight	Slight	Slight.
32C Rubicon	Moderate: too sandy.	Moderate: too sandy, slope.	Moderate: too sandy.	Spring, fall, winter.	Slight	Moderate: slope.	Slight.
32D Rubicon	Moderate: too sandy, slope.	Severe: slope.	Moderate: too sandy, slope.	Spring, fall, winter.	Moderate: slope.	Severe: slope.	Moderate: slope.
33B, 33B2 Ontonagon	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Summer, fall, winter.	Slight	Slight	Slight.
33C2 Ontonagon	Moderate: low strength.	Severe: slope.	Moderate: low strength.	Summer, fall, winter.	Slight	Severe: slope.	Slight.
34B Alcona	Severe: low strength.	Severe: low strength.	Severe: low strength.	Summer, fall, winter.	Slight	Slight	Slight.
34C Alcona	Severe: low strength.	Severe: low strength.	Severe: low strength.	Summer, fall, winter.	Slight	Moderate: slope.	Slight.
34E Alcona	Severe: slope.	Severe: slope.	Severe: slope.	Summer, fall, winter.	Severe: slope.	Severe: slope.	Severe: slope.
37B Emmet	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Summer, fall, winter.	Slight	Slight	Slight.

TABLE 9.--EQUIPMENT LIMITATIONS ON WOODLAND--Continued

Soil name and map symbol	Ratings for most limiting season(s)			Preferred operating season(s)	Ratings for preferred operating season(s)		
	Logging areas and skid trails	Log landings	Haul roads		Logging areas and skid trails	Log landings	Haul roads
37C: Emmet	Moderate: low strength.	Moderate: low strength, slope.	Moderate: low strength.	Summer, fall, winter.	Slight	Moderate: slope.	Slight.
37D: Emmet	Moderate: low strength.	Severe: slope.	Moderate: low strength.	Summer, fall, winter.	Slight	Severe: slope.	Slight.
38B: Onaway	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Summer, fall, winter.	Slight	Slight	Slight.
38C: Onaway	Moderate: low strength.	Moderate: low strength, slope.	Moderate: low strength.	Summer, fall, winter.	Slight	Moderate: slope.	Slight.
38E: Onaway	Moderate: low strength, slope.	Severe: slope.	Moderate: low strength, slope.	Summer, fall, winter.	Moderate: slope.	Severe: slope.	Moderate: slope.
39B: Nester	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Summer, fall, winter.	Slight	Slight	Slight.
39C: Nester	Moderate: low strength.	Moderate: low strength, slope.	Moderate: low strength.	Summer, fall, winter.	Slight	Moderate: slope.	Slight.
40B: Ontonagon	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Summer, fall, winter.	Slight	Slight	Slight.
40D2: Ontonagon	Moderate: low strength, slope.	Severe: slope.	Moderate: low strength, slope.	Summer, fall, winter.	Moderate: slope.	Severe: slope.	Moderate: slope.
41A: Au Gres	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, fall, winter.	Slight	Slight	Slight.
43A: Battlefield	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, fall, winter.	Slight	Slight	Slight.

TABLE 9.--EQUIPMENT LIMITATIONS ON WOODLAND--Continued

Soil name and map symbol	Ratings for most limiting season(s)			Preferred operating season(s)	Ratings for preferred operating season(s)		
	Logging areas and skid trails	Log landings	Haul roads		Logging areas and skid trails	Log landings	Haul roads
45B---------------- Croswell	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight----------	Slight----------	Slight.
47A---------------- Ingalls	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, fall, winter.	Slight----------	Slight----------	Slight.
48A---------------- Allendale	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, fall, winter.	Slight----------	Slight----------	Slight.
49A---------------- Finch	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter.	Slight----------	Slight----------	Slight.
50A---------------- Bonduel	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, fall, winter.	Slight----------	Slight----------	Slight.
51A---------------- Otisco	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, fall, winter.	Slight----------	Slight----------	Slight.
52A---------------- Ogemaw	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, fall, winter.	Slight----------	Slight----------	Slight.
56A---------------- Riggsville	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, fall, winter.	Slight----------	Slight----------	Slight.
57A---------------- Brimley	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Summer, fall, winter.	Slight----------	Slight----------	Slight.
58A---------------- Alstad	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Summer, fall, winter.	Slight----------	Slight----------	Slight.
60A---------------- Rudyard	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, fall, winter.	Slight----------	Slight----------	Slight.
61------------------ Roscommon	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter.	Slight----------	Slight----------	Slight.

TABLE 9.--EQUIPMENT LIMITATIONS ON WOODLAND--Continued

Soil name and map symbol	Ratings for most limiting season(s)			Preferred operating season(s)	Ratings for preferred operating season(s)		
	Logging areas and skid trails	Log landings	Haul roads		Logging areas and skid trails	Log landings	Haul roads
62: Wheatley	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter.	Slight	Slight	Slight.
63: Brevort	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter.	Slight	Slight	Slight.
64: Burleigh	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter.	Slight	Slight	Slight.
66: Pinconning	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter.	Slight	Slight	Slight.
67: Kinross	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter.	Slight	Slight	Slight.
70B*:							
Au Gres	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, fall, winter.	Slight	Slight	Slight.
Roscommon	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter.	Slight	Slight	Slight.
71: Bowstring	Severe: flooding, wetness, low strength.	Severe: flooding, wetness, low strength.	Severe: flooding, wetness, low strength.	Winter	Moderate: low strength.	Severe: low strength.	Moderate: low strength.
77: Bruce	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Summer, winter.	Slight	Slight	Slight.
78: Angelica	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Summer, winter.	Slight	Slight	Slight.
79: Charity	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter.	Slight	Slight	Slight.
141A: Finch	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter.	Slight	Slight	Slight.
158A: Detour	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Summer, fall, winter.	Slight	Moderate: too cobbly.	Slight.

See footnote at end of table.

TABLE 9.--EQUIPMENT LIMITATIONS ON WOODLAND--Continued

Soil name and map symbol	Ratings for most limiting season(s)			Preferred operating season(s)	Ratings for preferred operating season(s)		
	Logging areas and skid trails	Log landings	Haul roads		Logging areas and skid trails	Log landings	Haul roads
179---------------- Hessel	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Summer, winter.	Slight---------	Slight--------	Slight.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

(The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil. Only the soils suited to windbreaks and environmental plantings are listed)

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- 8-15	16-25	26-35	>35
5. Loxley	Common ninebark, nannyberry viburnum, silky dogwood.	Northern whitecedar, whitecedar.	Siberian crabapple, eastern white pine, green ash, Norway spruce.	Imperial Carolina poplar.
8. Tawas	Silky dogwood, Amur privet, lilac, Roselow sargent crabapple.	Northern whitecedar, eastern white pine, Manchurian crabapple, white spruce.	Green ash, Norway spruce.	Imperial Carolina poplar.
11B, 11C, 11D, 11F. Kalkaska	Lilac, Amur maple, Amur privet, eastern redcedar, Siberian peashrub.	Siberian crabapple	Red pine, jack pine, eastern white pine.	Imperial Carolina poplar.
12B. Grayling	Lilac, Siberian peashrub, Amur privet, eastern redcedar, Amur maple.	Jack pine	Eastern white pine, red pine.	---
13B, 13C, 13D, 13F. Rubicon	Eastern redcedar, Siberian peashrub, Amur privet, lilac, Amur maple.	Siberian crabapple	Red pine, eastern white pine, jack pine.	Imperial Carolina poplar.
16B, 16C, 16D, 16F. East Lake	Siberian peashrub, Amur maple, lilac, Amur privet, eastern redcedar.	Siberian crabapple	Red pine, eastern white pine, jack pine.	Imperial Carolina poplar.
17B, 17D, 17E. Wallace	Siberian peashrub, northern whitecedar, Amur privet, lilac, silky dogwood, nannyberry viburnum, common ninebark.	Red pine, Siberian crabapple, white spruce.	Eastern white pine, green ash, Norway spruce.	---
18B, 18C, 18D, 18F. Blue Lake	Lilac, Amur privet, common ninebark, Siberian peashrub, Amur maple.	Eastern redcedar, Siberian crabapple.	Red pine, jack pine, eastern white pine, Norway spruce.	Imperial Carolina poplar.
20B, 20C, 20D, 20F. Mancelona	Amur maple, lilac, eastern redcedar, Siberian peashrub.	White spruce, Siberian crabapple, northern whitecedar.	Red pine, jack pine, eastern white pine, Norway spruce.	Imperial Carolina poplar.

TABLE 10.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- 8-15	16-25	26-35	>35
21B---------------- Zimmerman	Gray dogwood, silky dogwood, Siberian peashrub, American cranberrybush, Amur maple, lilac.	Norway spruce, eastern redcedar.	Jack pine, red pine, eastern white pine.	Imperial Carolina poplar.
22B, 22C, 22D----- Leelanau	Arrowwood, lilac, common ninebark, Amur privet.	White spruce, eastern redcedar, Siberian crabapple.	Red pine, green ash, Norway spruce, eastern white pine.	Imperial Carolina poplar.
24B, 24C, 24D----- Ocqueoc	Amur maple, lilac, arrowwood, Siberian peashrub, common ninebark.	White spruce, Siberian crabapple.	Eastern white pine, jack pine, green ash, red pine, Norway spruce.	Imperial Carolina poplar.
26B, 26C, 26D----- Rubicon	Siberian peashrub, lilac, eastern redcedar, Manchurian crabapple.	Jack pine-------------	Red pine, eastern white pine.	Imperial Carolina poplar.
27B, 27C, 27D, 27F--------------- Cheboygan	Common ninebark, lilac, nannyberry viburnum, Amur privet.	White spruce, Siberian crabapple, eastern redcedar.	Red pine, eastern white pine, Norway spruce, jack pine, red maple.	---
29B, 29C---------- Fairport	Lilac, silky dogwood	White spruce, northern whitecedar, eastern redcedar, Manchurian crabapple.	Eastern white pine, red pine, Norway spruce, jack pine.	Imperial Carolina poplar.
30B, 30C, 30D----- Rousseau	Siberian crabapple, silky dogwood, Amur privet.	White spruce, eastern redcedar.	Red pine, eastern white pine, jack pine, Norway spruce.	Imperial Carolina poplar.
31B---------------- Nadeau	Lilac, nannyberry viburnum, silky dogwood, common ninebark.	Northern whitecedar, white spruce.	Norway spruce, eastern white pine, red pine, green ash.	Imperial Carolina poplar.
32B, 32C, 32D----- Rubicon	Siberian peashrub, lilac, eastern redcedar, Manchurian crabapple.	Jack pine-------------	Red pine, eastern white pine.	---
33B, 33B2, 33C2--- Ontonagon	American cranberrybush, Amur maple, lilac, nannyberry viburnum, Siberian crabapple, redosier dogwood, silky dogwood, common ninebark, northern whitecedar.	White spruce, Norway spruce.	Eastern white pine----	---

TABLE 10.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- 8-15	16-25	26-35	>35
34B, 34C, 34E----- Alcona	Siberian crabapple, Amur privet, silky dogwood, arrowwood, American cranberrybush, nannyberry viburnum, lilac.	White spruce----------	Eastern white pine, Norway spruce, red pine.	Imperial Carolina poplar.
37B, 37C, 37D----- Emmet	Arrowwood, lilac, nannyberry viburnum, Amur privet, Siberian peashrub.	Siberian crabapple, eastern redcedar, northern whitecedar.	White spruce, red pine, Norway spruce, eastern white pine.	Imperial Carolina poplar.
38B, 38C, 38E----- Onaway	American cranberrybush, silky dogwood, Siberian crabapple, arrowwood, nannyberry viburnum, Amur privet, lilac.	White spruce, northern whitecedar.	Red pine, eastern white pine, Norway spruce.	Imperial Carolina poplar.
39B, 39C---------- Nester	Arrowwood, lilac, nannyberry viburnum, common ninebark, Amur privet, silky dogwood.	Siberian crabapple, white spruce, northern whitecedar.	Red pine, green ash, eastern white pine.	---
40B--------------- Ontonagon	Amur privet, nannyberry viburnum, silky dogwood, common ninebark.	White spruce, northern whitecedar, Manchurian crabapple.	Norway spruce, eastern white pine, green ash.	---
40D2-------------- Ontonagon	American cranberrybush, lilac, Siberian crabapple, silky dogwood, Amur maple, nannyberry viburnum, redosier dogwood, common ninebark.	White spruce, Norway spruce, northern whitecedar.	Eastern white pine, Norway spruce.	---
41A--------------- Au Gres	Silky dogwood, American cranberrybush, Amur maple, common ninebark, nannyberry viburnum.	White spruce, Manchurian crabapple.	Norway spruce, jack pine, green ash, eastern white pine.	Imperial Carolina poplar.
43A--------------- Battlefield	Silky dogwood, American cranberrybush, common ninebark, nannyberry viburnum, Amur maple, lilac.	White spruce, Norway spruce, northern whitecedar, Siberian crabapple.	Eastern white pine, green ash.	Imperial Carolina poplar.
45B--------------- Croswell	Lilac, silky dogwood, Amur maple, Amur privet.	Eastern redcedar, Siberian crabapple.	Red pine, Norway spruce, eastern white pine, white spruce.	Imperial Carolina poplar.

TABLE 10.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- 8-15	16-25	26-35	>35
47A---------------- Ingalls	American cranberrybush, lilac, silky dogwood, Amur privet, common ninebark, Roselow sargent crabapple.	White spruce, northern whitecedar, Manchurian crabapple.	Norway spruce, eastern white pine, green ash.	---
48A---------------- Allendale	American cranberrybush, silky dogwood, Amur privet, lilac, nannyberry viburnum, Roselow sargent crabapple.	White spruce, northern whitecedar, Manchurian crabapple.	Eastern white pine, red maple, Norway spruce.	---
49A---------------- Finch	Silky dogwood, American cranberrybush, common ninebark, nannyberry viburnum, Amur maple.	White spruce, northern whitecedar, eastern white pine, jack pine, Siberian crabapple.	Green ash, Norway spruce.	---
50A---------------- Bonduel	Common ninebark, redosier dogwood, nannyberry viburnum, lilac, American cranberrybush, silky dogwood.	White spruce, northern whitecedar.	Eastern white pine, white ash, silver maple, red maple.	---
51A---------------- Otisco	American cranberrybush, Roselow sargent crabapple, silky dogwood, common ninebark, white spruce, Amur privet, nannyberry viburnum.	Northern whitecedar, Manchurian crabapple.	Green ash, Norway spruce, eastern white pine.	---
52A---------------- Ogemaw	Silky dogwood, American cranberrybush, common ninebark, nannyberry viburnum, late lilac.	Northern whitecedar, Manchurian crabapple, white spruce.	Norway spruce, eastern white pine, red maple, green ash.	---
55A---------------- Solona	Common ninebark, lilac, silky dogwood, American cranberrybush, redosier dogwood, nannyberry viburnum.	White spruce, northern whitecedar.	Eastern white pine, white ash, silver maple, red maple.	---
56A---------------- Riggsville	American cranberrybush, silky dogwood, nannyberry viburnum, Amur privet.	Manchurian crabapple, northern whitecedar.	White spruce, red maple, Norway spruce, eastern white pine, green ash.	Imperial Carolina poplar.

TABLE 10.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- 8-15	16-25	26-35	>35
57A---------------- Brimley	American cranberrybush, silky dogwood, common ninebark, nannyberry viburnum, Amur privet.	Northern whitecedar, white spruce, Manchurian crabapple.	Norway spruce, eastern white pine, green ash.	Imperial Carolina poplar.
58A---------------- Alstad	Northern whitecedar, lilac, American cranberrybush, nannyberry viburnum, silky dogwood, redosier dogwood.	White spruce----------	Eastern white pine, green ash, white ash, red maple, silver maple.	---
70*:				
Au Gres-----------	Silky dogwood, American cranberrybush, Amur maple, common ninebark, nannyberry viburnum.	White spruce, Manchurian crabapple.	Norway spruce, jack pine, green ash, eastern white pine.	Imperial Carolina poplar.
Roscommon.				
78---------------- Angelica	Silky dogwood, American cranberrybush, nannyberry viburnum, lilac, redosier dogwood.	White spruce, northern whitecedar, eastern redcedar.	Red maple, eastern white pine, green ash.	---
79---------------- Charity	Common ninebark, lilac, redosier dogwood.	Blue spruce, white spruce, northern whitecedar.	Golden willow, eastern white pine, green ash, Norway spruce.	---
141A--------------- Finch	Silky dogwood, American cranberrybush, common ninebark, nannyberry viburnum, Amur maple.	White spruce, northern whitecedar, jack pine, Siberian crabapple.	Green ash, Norway spruce, eastern white pine.	---
179---------------- Hessel	Silky dogwood, Amur privet, lilac.	Northern whitecedar, white spruce, Manchurian crabapple, green ash.	Norway spruce, eastern white pine, red maple.	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--RECREATIONAL DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
2: Lupton	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.
5: Loxley	Severe: ponding, excess humus, too acid.	Severe: ponding, excess humus, too acid.	Severe: excess humus, ponding, too acid.	Severe: ponding, excess humus.
7: Grousehaven Variant	Severe: flooding, ponding, percs slowly.	Severe: ponding, excess humus, percs slowly.	Severe: excess humus, ponding, percs slowly.	Severe: ponding, excess humus.
8: Tawas	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.
9: Greenwood	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.
10: Dawson	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.
11B: Kalkaska	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
11C: Kalkaska	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
11D: Kalkaska	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy.
11F: Kalkaska	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy, slope.
12B: Grayling	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
13B: Rubicon	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
13C: Rubicon	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
13D: Rubicon	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy.
13F: Rubicon	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy, slope.

TABLE 11.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
16B: East Lake	Severe: too sandy.	Severe: too sandy.	Moderate: slope, small stones.	Severe: too sandy.
16C: East Lake	Severe: too sandy.	Severe: too sandy.	Severe: slope.	Severe: too sandy.
16D: East Lake	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope.	Severe: too sandy.
16F: East Lake	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope.	Severe: too sandy, slope.
17B: Wallace	Severe: too sandy, cemented pan.	Severe: too sandy, cemented pan.	Severe: too sandy, cemented pan.	Severe: too sandy.
17D: Wallace	Severe: too sandy, cemented pan.	Severe: too sandy, cemented pan.	Severe: slope, too sandy, cemented pan.	Severe: too sandy.
17E: Wallace	Severe: slope, too sandy, cemented pan.	Severe: slope, too sandy, cemented pan.	Severe: slope, too sandy, cemented pan.	Severe: too sandy.
18B: Blue Lake	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.
18C: Blue Lake	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.
18D: Blue Lake	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope, too sandy.
18F: Blue Lake	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
20B: Mancelona	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
20C: Mancelona	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
20D: Mancelona	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy.
20F: Mancelona	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.
21B: Zimmerman	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.

TABLE 11.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
22B Leelanau	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, small stones, too sandy.	Moderate: too sandy.
22C Leelanau	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.
22D Leelanau	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: too sandy, slope.
24B Ocqueoc	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
24C Ocqueoc	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
24D Ocqueoc	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy.
25B Eastport	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
25D Eastport	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy.
26B Rubicon	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
26C Rubicon	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
26D Rubicon	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy.
27B Cheboygan	Severe: percs slowly.	Severe: percs slowly.	Severe: percs slowly.	Moderate: too sandy.
27C Cheboygan	Severe: percs slowly.	Severe: percs slowly.	Severe: slope, percs slowly.	Moderate: too sandy.
27D Cheboygan	Severe: slope, percs slowly.	Severe: slope, percs slowly.	Severe: slope, percs slowly.	Moderate: too sandy, slope.
27F Cheboygan	Severe: slope, percs slowly.	Severe: slope, percs slowly.	Severe: slope, percs slowly.	Severe: slope.
29B Fairport	Slight	Slight	Moderate: slope, small stones, thin layer.	Slight.

TABLE 11.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
29C Fairport	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
30B Rousseau	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
30C Rousseau	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
30D Rousseau	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy.
31B Nadeau	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Slight.
32B Rubicon	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
32C Rubicon	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
32D Rubicon	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
33B, 33B2 Ontonagon	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight.
33C2 Ontonagon	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.
34B Alcona	Slight	Slight	Moderate: slope.	Slight.
34C Alcona	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
34E Alcona	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
37B Emmet	Slight	Slight	Moderate: slope, small stones.	Slight.
37C Emmet	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
37D Emmet	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
38B Onaway	Slight	Slight	Moderate: slope, small stones.	Slight.
38C Onaway	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
38E Onaway	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.

TABLE 11.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
39B Nester	Slight	Slight	Moderate: slope, small stones.	Slight.
39C Nester	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
40B Ontonagon	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight.
40D2 Ontonagon	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: too clayey, slope.
41A Au Gres	Severe: wetness, too sandy.	Severe: wetness, too sandy.	Severe: too sandy, wetness.	Severe: wetness, too sandy.
43A Battlefield	Severe: wetness, too sandy.	Severe: wetness, too sandy.	Severe: too sandy, wetness.	Severe: wetness, too sandy.
45B Croswell	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
47A Ingalls	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
48A Allendale	Severe: wetness, percs slowly, too sandy.	Severe: too sandy, percs slowly.	Severe: too sandy, wetness, percs slowly.	Severe: too sandy.
49A Finch	Severe: wetness, too sandy, cemented pan.	Severe: wetness, too sandy, cemented pan.	Severe: too sandy, wetness, cemented pan.	Severe: wetness, too sandy.
50A Bonduel	Severe: wetness, depth to rock.	Severe: thin layer, area reclaim.	Severe: wetness, thin layer, area reclaim.	Moderate: wetness.
51A Otisco	Severe: wetness, too sandy.	Severe: wetness, too sandy.	Severe: too sandy, wetness.	Severe: wetness, too sandy.
52A Ogemaw	Severe: wetness, too sandy, cemented pan.	Severe: wetness, too sandy, cemented pan.	Severe: too sandy, wetness, cemented pan.	Severe: wetness, too sandy.
55A Solona	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.
56A Riggsville	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: wetness, percs slowly.	Moderate: wetness.
57A Brimley	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.

TABLE 11.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
58A-------------------- Alstad	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.
60A-------------------- Rudyard	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
61--------------------- Roscommon	Severe: ponding, excess humus.	Severe: ponding.	Severe: ponding.	Severe: ponding.
62--------------------- Wheatley	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
63--------------------- Brevort	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
64--------------------- Burleigh	Severe: ponding, too sandy.	Severe: ponding, too sandy.	Severe: ponding, too sandy.	Severe: ponding, too sandy.
66--------------------- Pinconning	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding.
67--------------------- Kinross	Severe: ponding, too sandy.	Severe: ponding, too sandy.	Severe: too sandy, ponding.	Severe: ponding, too sandy.
70*:				
Au Gres---------------	Severe: wetness, too sandy.	Severe: wetness, too sandy.	Severe: too sandy, wetness.	Severe: wetness, too sandy.
Roscommon-------------	Severe: ponding, excess humus.	Severe: ponding.	Severe: ponding.	Severe: ponding.
71--------------------- Bowstring	Severe: flooding, wetness, excess humus.	Severe: wetness, excess humus.	Severe: excess humus, wetness, flooding.	Severe: wetness, excess humus.
77--------------------- Bruce	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
78--------------------- Angelica	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
79--------------------- Charity	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding.
81--------------------- Udipsamments	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
82--------------------- Udorthents	Variable-------------	Variable-------------	Variable-------------	Variable.
83*, 84*. Pits				

See footnote at end of table.

TABLE 11.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
85*:				
Histosols	Variable	Variable	Variable	Variable.
Aquents	Variable	Variable	Variable	Variable.
87*. Beaches				
141A Finch	Severe: wetness, too sandy, cemented pan.	Severe: wetness, too sandy, cemented pan.	Severe: large stones, too sandy, wetness.	Severe: wetness, too sandy.
158A Detour	Severe: wetness.	Severe: wetness.	Severe: large stones, small stones, wetness.	Severe: wetness.
179 Hessel	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--WILDLIFE HABITAT

(See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
2------------------ Lupton	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
5------------------ Loxley	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
7------------------ Grousehaven Variant	Very poor.	Very poor.	Poor	Poor	Poor	Fair	Good	Very poor.	Very poor.	Fair.
8------------------ Tawas	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
9------------------ Greenwood	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
10----------------- Dawson	Very poor.	Poor	Poor	Poor	Poor	Poor	Good	Poor	Poor	Fair.
11B---------------- Kalkaska	Fair	Fair	Fair	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
11C---------------- Kalkaska	Poor	Fair	Fair	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
11D---------------- Kalkaska	Very poor.	Poor	Fair	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
11F. Kalkaska										
12B---------------- Grayling	Poor	Poor	Fair	Poor	Poor	Poor	Very poor.	Poor	Poor	Very poor.
13B---------------- Rubicon	Poor	Poor	Fair	Fair	Fair	Poor	Very poor.	Poor	Fair	Very poor.
13C, 13D----------- Rubicon	Poor	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
13F---------------- Rubicon	Very poor.	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
16B---------------- East Lake	Poor	Poor	Fair	Fair	Fair	Poor	Very poor.	Poor	Fair	Very poor.
16C---------------- East Lake	Poor	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
16D, 16F----------- East Lake	Poor	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
17B---------------- Wallace	Poor	Poor	Fair	Fair	Fair	Poor	Very poor.	Poor	Fair	Very poor.
17D, 17E----------- Wallace	Poor	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.

TABLE 12.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
18B, 18C-----------Blue Lake	Fair	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
18D, 18F-----------Blue Lake	Very poor.	Poor	Good	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
20B, 20C-----------Mancelona	Fair	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
20D----------------Mancelona	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
20F----------------Mancelona	Very poor.	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
21B----------------Zimmerman	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
22B, 22C, 22D------Leelanau	Fair	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
24B----------------Ocqueoc	Fair	Fair	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.
24C----------------Ocqueoc	Fair	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
24D----------------Ocqueoc	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
25B----------------Eastport	Poor	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
25D----------------Eastport	Very poor.	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
26B----------------Rubicon	Poor	Poor	Fair	Good	Good	Poor	Very poor.	Poor	Fair	Very poor.
26C, 26D-----------Rubicon	Poor	Poor	Fair	Good	Good	Very poor.	Very poor.	Poor	Fair	Very poor.
27B, 27C, 27D------Cheboygan	Fair	Fair	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.
27F----------------Cheboygan	Very poor.	Poor	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
29B----------------Fairport	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
29C----------------Fairport	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
30B----------------Rousseau	Fair	Fair	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.
30C----------------Rousseau	Fair	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.

TABLE 12.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
30D: Rousseau	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
31B: Nadeau	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
32B: Rubicon	Poor	Poor	Fair	Fair	Fair	Poor	Very poor.	Poor	Fair	Very poor.
32C: Rubicon	Poor	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
32D: Rubicon	Poor	Poor	Fair	Fair	Fair	Poor	Very poor.	Poor	Fair	Very poor.
33B, 33B2: Ontonagon	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
33C2: Ontonagon	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
34B: Alcona	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
34C: Alcona	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
34E: Alcona	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
37B: Emmet	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
37C: Emmet	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
37D: Emmet	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
38B: Onaway	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
38C: Onaway	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
38E: Onaway	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
39B: Nester	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
39C: Nester	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
40B: Ontonagon	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
40D2: Ontonagon	Poor	Fair	Fair	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.

TABLE 12.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife
41A----------------- Au Gres	Poor	Fair	Good	Good	Good	Poor	Poor	Fair	Good	Poor.
43A----------------- Battlefield	Fair	Fair	Good	Fair	Fair	Poor	Very poor.	Fair	Fair	Very poor.
45B----------------- Croswell	Poor	Poor	Fair	Fair	Fair	Poor	Very poor.	Poor	Fair	Very poor.
47A----------------- Ingalls	Fair	Fair	Good	Fair	Fair	Fair	Fair	Fair	Fair	Fair.
48A----------------- Allendale	Fair	Fair	Good	Good	Good	Poor	Fair	Fair	Good	Poor.
49A----------------- Finch	Poor	Poor	Fair	Fair	Fair	Poor	Poor	Poor	Fair	Poor.
50A----------------- Bonduel	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
51A----------------- Otisco	Poor	Fair	Good	Fair	Good	Poor	Very poor.	Fair	Fair	Very poor.
52A----------------- Ogemaw	Poor	Fair	Fair	Fair	Fair	Fair	Poor	Fair	Fair	Poor.
55A----------------- Solona	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
56A----------------- Riggsville	Fair	Fair	Good	Fair	Good	Fair	Fair	Fair	Fair	Fair.
57A----------------- Brimley	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
58A----------------- Alstad	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
60A----------------- Rudyard	Fair	Good	Good	Good	Good	Good	Fair	Good	Good	Fair.
61------------------ Roscommon	Poor	Poor	Poor	Fair	Fair	Good	Good	Poor	Fair	Good.
62------------------ Wheatley	Poor	Poor	Fair	Fair	Fair	Fair	Good	Poor	Fair	Fair.
63------------------ Brevort	Poor	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
64------------------ Burleigh	Very poor.	Very poor.	Fair	Fair	Fair	Good	Good	Very poor.	Fair	Good.
66------------------ Pinconning	Poor	Poor	Fair	Fair	Fair	Good	Good	Poor	Fair	Good.
67------------------ Kinross	Very poor.	Poor	Poor	Fair	Fair	Good	Good	Very poor.	Fair	Good.

TABLE 12.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife
70*:										
Au Gres	Poor	Fair	Good	Good	Good	Poor	Poor	Fair	Good	Poor.
Roscommon	Poor	Poor	Poor	Fair	Fair	Good	Good	Poor	Fair	Good.
71 Bowstring	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
77 Bruce	Fair	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
78 Angelica	Good	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
79 Charity	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Very poor.	Very poor.	Good.
81. Udipsamments										
82. Udorthents										
83*, 84*. Pits										
85*:										
Histosols.										
Aquents.										
87*. Beaches										
141A Finch	Poor	Poor	Fair	Fair	Fair	Poor	Poor	Poor	Fair	Poor.
158A Detour	Poor	Fair	Fair	Fair	Fair	Fair	Fair	Poor	Fair	Fair.
179 Hessel	Poor	Poor	Fair	Fair	Fair	Good	Good	Poor	Fair	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--BUILDING SITE DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
2 Lupton	Severe: excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: ponding, frost action, subsides.	Severe: ponding, excess humus.
5 Loxley	Severe: excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: too acid, ponding, excess humus.
7 Grousehaven Variant	Severe: cutbanks cave, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: ponding, flooding, frost action.	Severe: ponding, excess humus.
8 Tawas	Severe: cutbanks cave, excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
9 Greenwood	Severe: excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: ponding, frost action, subsides.	Severe: ponding, excess humus.
10 Dawson	Severe: cutbanks cave, excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
11B Kalkaska	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Severe: droughty.
11C Kalkaska	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: droughty.
11D, 11F Kalkaska	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: droughty, slope.
12B Grayling	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Severe: droughty.
13B Rubicon	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Severe: droughty.
13C Rubicon	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: droughty.
13D, 13F Rubicon	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: droughty, slope.
16B East Lake	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.

TABLE 13.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
16C: East Lake	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
16D, 16F: East Lake	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
17B: Wallace	Severe: cemented pan, cutbanks cave.	Moderate: cemented pan.	Severe: cemented pan.	Moderate: cemented pan.	Moderate: cemented pan.	Severe: droughty, cemented pan.
17D: Wallace	Severe: cemented pan, cutbanks cave.	Moderate: slope, cemented pan.	Severe: cemented pan.	Severe: slope.	Moderate: cemented pan, slope.	Severe: droughty, cemented pan.
17E: Wallace	Severe: cemented pan, cutbanks cave, slope.	Severe: slope.	Severe: cemented pan, slope.	Severe: slope.	Severe: slope.	Severe: droughty, slope, cemented pan.
18B: Blue Lake	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
18C: Blue Lake	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
18D, 18F: Blue Lake	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
20B: Mancelona	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: small stones, droughty.
20C: Mancelona	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: small stones, droughty, slope.
20D, 20F: Mancelona	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
21B: Zimmerman	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
22B: Leelanau	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: large stones, droughty.
22C: Leelanau	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: large stones, droughty, slope.
22D: Leelanau	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
24B: Ocqueoc	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.

TABLE 13.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
24C: Ocqueoc	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
24D: Ocqueoc	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
25B: Eastport	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty, too sandy.
25D: Eastport	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
26B: Rubicon	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty, too sandy.
26C: Rubicon	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope, too sandy.
26D: Rubicon	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
27B: Cheboygan	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, frost action.	Moderate: large stones, droughty.
27C: Cheboygan	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: large stones, droughty, slope.
27D, 27F: Cheboygan	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
29B: Fairport	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Severe: low strength.	Moderate: area reclaim, thin layer.
29C: Fairport	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
30B: Rousseau	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
30C: Rousseau	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
30D: Rousseau	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

TABLE 13.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
31B--------------- Nadeau	Severe: cutbanks cave.	Moderate: large stones.	Moderate: large stones.	Moderate: slope, large stones.	Moderate: frost action, large stones.	Moderate: small stones, droughty.
32B--------------- Rubicon	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Severe: droughty.
32C--------------- Rubicon	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: droughty.
32D--------------- Rubicon	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Severe: droughty.
33B, 33B2--------- Ontonagon	Moderate: too clayey, wetness.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.
33C2-------------- Ontonagon	Moderate: too clayey, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, shrink-swell.	Moderate: slope.
34B--------------- Alcona	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Moderate: frost action.	Moderate: large stones, droughty.
34C--------------- Alcona	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: large stones, droughty, slope.
34E--------------- Alcona	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
37B--------------- Emmet	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Moderate: frost action.	Slight.
37C--------------- Emmet	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
37D--------------- Emmet	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
38B--------------- Onaway	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: frost action.	Moderate: large stones.
38C--------------- Onaway	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: large stones, slope.
38E--------------- Onaway	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
39B--------------- Nester	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
39C--------------- Nester	Moderate: too clayey, slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.

TABLE 13.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
40B---------------- Ontonagon	Moderate: too clayey, wetness.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.
40D2--------------- Ontonagon	Severe: slope.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.	Severe: slope, too clayey.
41A---------------- Au Gres	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
43A---------------- Battlefield	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
45B---------------- Croswell	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: droughty, too sandy.
47A---------------- Ingalls	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
48A---------------- Allendale	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Moderate: wetness, frost action.	Moderate: wetness, droughty, too sandy.
49A---------------- Finch	Severe: cemented pan, cutbanks cave, wetness.	Severe: wetness.	Severe: wetness, cemented pan.	Severe: wetness.	Severe: wetness.	Severe: wetness, droughty, cemented pan.
50A---------------- Bonduel	Severe: depth to rock, wetness.	Severe: wetness, depth to rock.	Severe: wetness, depth to rock.	Severe: wetness, depth to rock.	Severe: frost action, depth to rock.	Severe: thin layer, area reclaim.
51A---------------- Otisco	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
52A---------------- Ogemaw	Severe: cemented pan, cutbanks cave, wetness.	Severe: wetness.	Severe: wetness, cemented pan.	Severe: wetness.	Severe: low strength, wetness.	Severe: wetness, droughty, cemented pan.
55A---------------- Solona	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness, droughty.
56A---------------- Riggsville	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Moderate: wetness, frost action.	Moderate: large stones, wetness, droughty.
57A---------------- Brimley	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.

TABLE 13.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
58A: Alstad	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
60A: Rudyard	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, shrink-swell, wetness.	Severe: wetness.
61: Roscommon	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, excess humus.
62: Wheatley	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, droughty.
63: Brevort	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
64: Burleigh	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
66: Pinconning	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding.	Severe: ponding.	Severe: ponding.
67: Kinross	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
70*:						
Au Gres	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Roscommon	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, excess humus.
71: Bowstring	Severe: cutbanks cave, excess humus, wetness.	Severe: subsides, flooding, wetness.	Severe: subsides, flooding, wetness.	Severe: subsides, flooding, wetness.	Severe: subsides, wetness, flooding.	Severe: wetness, flooding, excess humus.
77: Bruce	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding.
78: Angelica	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding.
79: Charity	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding, frost action.	Severe: ponding.

See footnote at end of table.

TABLE 13.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
81----------------- Udipsamments	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
82----------------- Udorthents	Variable-------	Variable-------	Variable-------	Variable-------	Variable-------	Variable.
83*, 84*. Pits						
85*:						
Histosols---------	Variable-------	Variable-------	Variable-------	Variable-------	Variable-------	Variable.
Aquents-----------	Variable-------	Variable-------	Variable-------	Variable-------	Variable-------	Variable.
87*. Beaches						
141A--------------- Finch	Severe: cemented pan, cutbanks cave, wetness.	Severe: wetness.	Severe: wetness, cemented pan.	Severe: wetness.	Severe: wetness.	Severe: large stones, wetness, cemented pan.
158A--------------- Detour	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness, droughty.
179---------------- Hessel	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "poor," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
2: Lupton	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus.
5: Loxley	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus, too acid.
7: Grousehaven Variant	Severe: flooding, ponding, poor filter.	Severe: seepage, flooding, excess humus.	Severe: flooding, seepage, ponding.	Severe: flooding, seepage, ponding.	Poor: seepage, too sandy, ponding.
8: Tawas	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
9: Greenwood	Severe: subsides, ponding.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus.
10: Dawson	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus.
11B: Kalkaska	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
11C: Kalkaska	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
11D, 11F: Kalkaska	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
12B: Grayling	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
13B: Rubicon	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
13C: Rubicon	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.

TABLE 14.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
13D, 13F: Rubicon	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
16B: East Lake	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
16C: East Lake	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
16D, 16F: East Lake	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
17B: Wallace	Severe: cemented pan, percs slowly, poor filter.	Severe: seepage, cemented pan.	Severe: seepage, too sandy.	Severe: cemented pan, seepage.	Poor: cemented pan, seepage, too sandy.
17D: Wallace	Severe: cemented pan, percs slowly, poor filter.	Severe: seepage, cemented pan, slope.	Severe: seepage, too sandy.	Severe: cemented pan, seepage.	Poor: cemented pan, seepage, too sandy.
17E: Wallace	Severe: cemented pan, percs slowly, poor filter.	Severe: seepage, cemented pan, slope.	Severe: seepage, slope, too sandy.	Severe: cemented pan, seepage, slope.	Poor: cemented pan, seepage, too sandy.
18B: Blue Lake	Slight	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
18C: Blue Lake	Moderate: slope.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
18D, 18F: Blue Lake	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
20B: Mancelona	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
20C: Mancelona	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
20D, 20F: Mancelona	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.

TABLE 14.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
21B: Zimmerman	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
22B: Leelanau	Severe: poor filter.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: seepage.
22C: Leelanau	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Poor: seepage.
22D: Leelanau	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: seepage, slope.
24B: Ocqueoc	Severe: percs slowly, poor filter.	Severe: seepage.	Severe: too sandy.	Severe: seepage.	Poor: too sandy.
24C: Ocqueoc	Severe: percs slowly, poor filter.	Severe: seepage, slope.	Severe: too sandy.	Severe: seepage.	Poor: too sandy.
24D: Ocqueoc	Severe: percs slowly, poor filter, slope.	Severe: seepage, slope.	Severe: slope, too sandy.	Severe: seepage, slope.	Poor: too sandy, slope.
25B: Eastport	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
25D: Eastport	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
26B: Rubicon	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
26C: Rubicon	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
26D: Rubicon	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
27B: Cheboygan	Severe: wetness, percs slowly.	Severe: seepage.	Moderate: wetness.	Severe: seepage.	Fair: small stones, wetness.
27C: Cheboygan	Severe: percs slowly.	Severe: seepage, slope.	Moderate: slope.	Severe: seepage.	Fair: small stones, slope.
27D, 27F: Cheboygan	Severe: percs slowly, slope.	Severe: seepage, slope.	Severe: slope.	Severe: seepage, slope.	Poor: slope.

TABLE 14.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
29B: Fairport	Severe: thin layer, seepage, percs slowly.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Moderate: seepage.	Poor: area reclaim, thin layer.
29C: Fairport	Severe: thin layer, seepage, percs slowly.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage, slope.	Severe: slope.	Poor: area reclaim, slope, thin layer.
30B: Rousseau	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
30C: Rousseau	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
30D: Rousseau	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
31B: Nadeau	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
32B: Rubicon	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
32C: Rubicon	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
32D: Rubicon	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
33B, 33B2: Ontonagon	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
33C2: Ontonagon	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Moderate: slope.	Poor: too clayey, hard to pack.
34B: Alcona	Moderate: percs slowly.	Severe: seepage.	Severe: too sandy.	Slight	Poor: too sandy.
34C: Alcona	Moderate: percs slowly, slope.	Severe: seepage, slope.	Severe: too sandy.	Moderate: slope.	Poor: too sandy.
34E: Alcona	Severe: slope.	Severe: seepage, slope.	Severe: slope, too sandy.	Severe: slope.	Poor: too sandy, slope.
37B: Emmet	Severe: percs slowly.	Severe: seepage.	Slight	Severe: seepage.	Fair: small stones.

TABLE 14.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
37C: Emmet	Severe: percs slowly.	Severe: seepage, slope.	Moderate: slope.	Severe: seepage.	Fair: small stones, slope.
37D: Emmet	Severe: percs slowly, slope.	Severe: seepage, slope.	Severe: slope.	Severe: seepage, slope.	Poor: slope.
38B: Onaway	Severe: percs slowly.	Moderate: slope.	Slight	Slight	Poor: small stones.
38C: Onaway	Severe: percs slowly.	Severe: slope.	Moderate: slope.	Moderate: slope.	Poor: small stones.
38E: Onaway	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: small stones, slope.
39B: Nester	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight	Fair: too clayey, small stones.
39C: Nester	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, small stones, slope.
40B: Ontonagon	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
40D2: Ontonagon	Severe: percs slowly, slope.	Severe: slope.	Severe: slope, too clayey.	Severe: slope.	Poor: too clayey, hard to pack, slope.
41A: Au Gres	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
43A: Battlefield	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.
45B: Croswell	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
47A: Ingalls	Severe: wetness, percs slowly, poor filter.	Severe: seepage, wetness.	Severe: wetness.	Severe: seepage, wetness.	Poor: wetness.
48A: Allendale	Severe: wetness, percs slowly, poor filter.	Severe: seepage.	Severe: wetness, too clayey.	Severe: seepage, wetness.	Poor: too clayey, hard to pack, wetness.

TABLE 14.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
49A----------------- Finch	Severe: cemented pan, wetness, percs slowly.	Severe: seepage, cemented pan, wetness.	Severe: seepage, wetness, too sandy.	Severe: cemented pan, seepage, wetness.	Poor: cemented pan, seepage, too sandy.
50A----------------- Bonduel	Severe: depth to rock, seepage, wetness.	Severe: depth to rock, seepage, wetness.	Severe: depth to rock, seepage, wetness.	Severe: wetness, seepage.	Poor: area reclaim, wetness, thin layer.
51A----------------- Otisco	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
52A----------------- Ogemaw	Severe: cemented pan, wetness, percs slowly.	Severe: seepage, cemented pan, wetness.	Severe: wetness, too clayey.	Severe: cemented pan, seepage, wetness.	Poor: cemented pan, too clayey, wetness.
55A----------------- Solona	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
56A----------------- Riggsville	Severe: wetness, percs slowly.	Severe: seepage.	Severe: wetness.	Severe: wetness.	Poor: wetness.
57A----------------- Brimley	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, too sandy.	Severe: wetness.	Poor: wetness.
58A----------------- Alstad	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
60A----------------- Rudyard	Severe: wetness, percs slowly.	Slight-----------	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
61------------------ Roscommon	Severe: ponding, poor filter.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
62------------------ Wheatley	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, small stones.
63------------------ Brevort	Severe: ponding, percs slowly, poor filter.	Severe: seepage, ponding.	Severe: ponding.	Severe: seepage, ponding.	Poor: ponding.
64------------------ Burleigh	Severe: ponding, percs slowly, poor filter.	Severe: seepage, ponding.	Severe: ponding, too sandy.	Severe: seepage, ponding.	Poor: ponding.

TABLE 14.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
66------------------ Pinconning	Severe: ponding, percs slowly, poor filter.	Severe: seepage, ponding.	Severe: ponding, too clayey.	Severe: seepage, ponding.	Poor: too clayey, hard to pack, ponding.
67------------------ Kinross	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
70*:					
Au Gres------------	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
Roscommon----------	Severe: ponding, poor filter.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
71------------------ Bowstring	Severe: flooding, wetness, percs slowly.	Severe: seepage, flooding, excèss humus.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: wetness, excess humus.
77------------------ Bruce	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too sandy.	Severe: ponding.	Poor: too sandy, ponding.
78------------------ Angelica	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
79------------------ Charity	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, ponding.
81------------------ Udipsamments	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
82------------------ Udorthents	Variable---------	Variable---------	Variable---------	Variable---------	Variable.
83*, 84*. Pits					
85*:					
Histosols----------	Variable---------	Variable---------	Variable---------	Variable---------	Variable.
Aquents------------	Variable---------	Variable---------	Variable---------	Variable---------	Variable.
87*. Beaches					
141A---------------- Finch	Severe: cemented pan, wetness, percs slowly.	Severe: seepage, cemented pan.	Severe: seepage, wetness, too sandy.	Severe: cemented pan, seepage, wetness.	Poor: cemented pan, seepage, too sandy.

See footnote at end of table.

TABLE 14.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
158A----------------- Detour	Severe: wetness, percs slowly.	Moderate: seepage, large stones.	Severe: wetness.	Severe: wetness.	Poor: small stones, wetness.
179------------------ Hessel	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: small stones, ponding.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--CONSTRUCTION MATERIALS

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
2-------------------- Lupton	Poor: wetness, low strength.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
5-------------------- Loxley	Poor: wetness, low strength.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness, too acid.
7-------------------- Grousehaven Variant	Poor: wetness.	Probable-------------	Improbable: too sandy.	Poor: too sandy, wetness.
8-------------------- Tawas	Poor: wetness.	Probable-------------	Improbable: too sandy.	Poor: excess humus, wetness.
9-------------------- Greenwood	Poor: wetness, low strength.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
10------------------- Dawson	Poor: wetness.	Probable-------------	Probable-------------	Poor: excess humus, wetness.
11B, 11C------------- Kalkaska	Good-----------------	Probable-------------	Improbable: too sandy.	Poor: too sandy.
11D------------------ Kalkaska	Fair: slope.	Probable-------------	Improbable: too sandy.	Poor: too sandy, slope.
11F------------------ Kalkaska	Poor: slope.	Probable-------------	Improbable: too sandy.	Poor: too sandy, slope.
12B------------------ Grayling	Good-----------------	Probable-------------	Improbable: too sandy.	Poor: too sandy.
13B, 13C------------- Rubicon	Good-----------------	Probable-------------	Improbable: too sandy.	Poor: too sandy.
13D------------------ Rubicon	Fair: slope.	Probable-------------	Improbable: too sandy.	Poor: too sandy, slope.
13F------------------ Rubicon	Poor: slope.	Probable-------------	Improbable: too sandy.	Poor: too sandy, slope.
16B, 16C------------- East Lake	Good-----------------	Probable-------------	Probable-------------	Poor: too sandy, small stones, area reclaim.

TABLE 15.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
16D: East Lake	Fair: slope.	Probable	Probable	Poor: too sandy, small stones, area reclaim.
16F: East Lake	Poor: slope.	Probable	Probable	Poor: too sandy, small stones, area reclaim.
17B, 17D: Wallace	Good	Probable	Improbable: too sandy.	Poor: cemented pan, area reclaim, too sandy.
17E: Wallace	Fair: slope.	Probable	Improbable: too sandy.	Poor: cemented pan, area reclaim, too sandy.
18B: Blue Lake	Good	Probable	Improbable: too sandy.	Fair: too sandy.
18C: Blue Lake	Good	Probable	Improbable: too sandy.	Fair: too sandy, slope.
18D: Blue Lake	Fair: slope.	Probable	Improbable: too sandy.	Poor: slope.
18F: Blue Lake	Poor: slope.	Probable	Improbable: too sandy.	Poor: slope.
20B, 20C: Mancelona	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.
20D: Mancelona	Fair: slope.	Probable	Probable	Poor: too sandy, small stones, area reclaim.
20F: Mancelona	Poor: slope.	Probable	Probable	Poor: too sandy, small stones, area reclaim.
21B: Zimmerman	Good	Probable	Improbable: too sandy.	Poor: too sandy.
22B, 22C: Leelanau	Good	Probable	Improbable: too sandy.	Poor: too sandy, small stones.
22D: Leelanau	Fair: slope.	Probable	Improbable: too sandy.	Poor: too sandy, small stones, slope.
24B, 24C: Ocqueoc	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.

TABLE 15.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
24D: Ocqueoc	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, slope.
25B: Eastport	Good	Probable	Improbable: too sandy.	Poor: too sandy.
25D: Eastport	Fair: slope.	Probable	Improbable: too sandy.	Poor: too sandy, slope.
26B, 26C: Rubicon	Good	Probable	Improbable: too sandy.	Poor: too sandy.
26D: Rubicon	Fair: slope.	Probable	Improbable: too sandy.	Poor: too sandy, slope.
27B: Cheboygan	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
27C: Cheboygan	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
27D: Cheboygan	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, slope.
27F: Cheboygan	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, slope.
29B: Fairport	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
29C: Fairport	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
30B, 30C: Rousseau	Good	Probable	Improbable: too sandy.	Poor: too sandy.
30D: Rousseau	Fair: slope.	Probable	Improbable: too sandy.	Poor: too sandy, slope.
31B: Nadeau	Fair: large stones.	Probable	Probable	Poor: too sandy, small stones, area reclaim.
32B, 32C, 32D: Rubicon	Good	Probable	Improbable: too sandy.	Poor: too sandy.
33B, 33B2, 33C2: Ontonagon	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
34B, 34C: Alcona	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.

TABLE 15.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
34E: Alcona	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, slope.
37B, 37C: Emmet	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
37D: Emmet	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
38B, 38C: Onaway	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
38E: Onaway	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
39B, 39C: Nester	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, small stones.
40B: Ontonagon	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
40D2: Ontonagon	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, slope.
41A: Au Gres	Poor: wetness.	Probable	Improbable: too sandy.	Poor: too sandy, wetness.
43A: Battlefield	Poor: wetness.	Probable	Probable	Poor: too sandy, area reclaim, wetness.
45B: Croswell	Fair: wetness.	Probable	Improbable: too sandy.	Poor: too sandy.
47A: Ingalls	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
48A: Allendale	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
49A: Finch	Poor: wetness.	Probable	Improbable: too sandy.	Poor: cemented pan, area reclaim, too sandy.
50A: Bonduel	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones, thin layer.

TABLE 15.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
51A: Otisco	Poor: wetness.	Probable	Improbable: too sandy.	Poor: too sandy, wetness, area reclaim.
52A: Ogemaw	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: cemented pan, area reclaim, too clayey.
55A: Solona	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
56A: Riggsville	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
57A: Brimley	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
58A: Alstad	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, area reclaim.
60A: Rudyard	Poor: low strength, shrink-swell, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, too clayey.
61: Roscommon	Poor: wetness.	Probable	Improbable: too sandy.	Poor: wetness.
62: Wheatley	Poor: wetness.	Probable	Probable	Poor: too sandy, small stones, area reclaim.
63: Brevort	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, small stones, wetness.
64: Burleigh	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, wetness.
66: Pinconning	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, wetness.
67: Kinross	Poor: wetness.	Probable	Improbable: too sandy.	Poor: too sandy, wetness.
70*:				
Au Gres	Poor: wetness.	Probable	Improbable: too sandy.	Poor: too sandy, wetness.
Roscommon	Poor: wetness.	Probable	Improbable: too sandy.	Poor: wetness.

See footnote at end of table.

TABLE 15.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
71-------------------- Bowstring	Poor: wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
77-------------------- Bruce	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, wetness.
78-------------------- Angelica	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, wetness.
79-------------------- Charity	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
81-------------------- Udipsamments	Good------------------	Probable-------------	Improbable: too sandy.	Poor: too sandy.
82-------------------- Udorthents	Variable-------------	Variable-------------	Variable-------------	Variable.
83*, 84*. Pits				
85*:				
Histosols------------	Variable-------------	Variable-------------	Variable-------------	Variable.
Aquents--------------	Variable-------------	Variable-------------	Variable-------------	Variable.
87*. Beaches				
141A------------------ Finch	Poor: wetness.	Probable-------------	Improbable: too sandy.	Poor: cemented pan, area reclaim, too sandy.
158A------------------ Detour	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, wetness.
179------------------- Hessel	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--WATER MANAGEMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Grassed waterways
2 Lupton	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill.	Ponding, subsides, frost action.	Ponding, soil blowing.	Wetness.
5 Loxley	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill.	Ponding, subsides, frost action.	Ponding, too acid.	Wetness.
7 Grousehaven Variant	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: slow refill, cutbanks cave.	Ponding, percs slowly, flooding.	Ponding, droughty, percs slowly.	Wetness, droughty, percs slowly.
8 Tawas	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: slow refill, cutbanks cave.	Ponding, subsides, frost action.	Ponding	Wetness.
9 Greenwood	Severe: seepage.	Severe: excess humus, ponding.	Moderate: slow refill.	Ponding, frost action.	Ponding	Wetness.
10 Dawson	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill, cutbanks cave.	Ponding, subsides, frost action.	Ponding, rooting depth.	Wetness, rooting depth.
11B Kalkaska	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
11C, 11D, 11F Kalkaska	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty.
12B Grayling	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
13B Rubicon	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
13C, 13D, 13F Rubicon	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty.
16B East Lake	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
16C, 16D, 16F East Lake	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty.

TABLE 16.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Irrigation	Grassed waterways
17B---------------- Wallace	Severe: seepage, cemented pan.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty, cemented pan.
17D, 17E---------- Wallace	Severe: seepage, cemented pan, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty, cemented pan.
18B---------------- Blue Lake	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
18C, 18D, 18F----- Blue Lake	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty.
20B---------------- Mancelona	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
20C, 20D, 20F----- Mancelona	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty.
21B---------------- Zimmerman	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
22B---------------- Leelanau	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Large stones, droughty.
22C, 22D---------- Leelanau	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Large stones, slope, droughty.
24B---------------- Ocqueoc	Severe: seepage.	Severe: piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Erodes easily, droughty.
24C, 24D---------- Ocqueoc	Severe: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, erodes easily, droughty.
25B---------------- Eastport	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
25D---------------- Eastport	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty.
26B---------------- Rubicon	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
26C, 26D---------- Rubicon	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty.

TABLE 16.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Irrigation	Grassed waterways
27B: Cheboygan	Severe: seepage.	Severe: piping.	Severe: no water.	Percs slowly, slope.	Slope, wetness, droughty.	Droughty, rooting depth, percs slowly.
27C, 27D, 27F: Cheboygan	Severe: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty, rooting depth.
29B: Fairport	Moderate: seepage, depth to rock, slope.	Severe: thin layer.	Severe: no water.	Deep to water	Slope, soil blowing, thin layer.	Erodes easily, depth to rock.
29C: Fairport	Severe: slope.	Severe: thin layer.	Severe: no water.	Deep to water	Slope, soil blowing, thin layer.	Slope, erodes easily, depth to rock.
30B: Rousseau	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
30C, 30D: Rousseau	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty.
31B: Nadeau	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Slope, large stones, droughty.	Large stones, droughty.
32B: Rubicon	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
32C: Rubicon	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty.
32D: Rubicon	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
33B, 33B2: Ontonagon	Moderate: slope.	Severe: hard to pack.	Severe: slow refill.	Percs slowly, slope.	Slope, wetness, percs slowly.	Erodes easily, percs slowly.
33C2: Ontonagon	Severe: slope.	Severe: hard to pack.	Severe: no water.	Deep to water	Percs slowly, slope, erodes easily.	Slope, erodes easily, percs slowly.
34B: Alcona	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, droughty.	Droughty.
34C, 34E: Alcona	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, droughty.	Slope, droughty.
37B: Emmet	Severe: seepage.	Severe: piping.	Severe: no water.	Deep to water	Slope, soil blowing.	Rooting depth.
37C, 37D: Emmet	Severe: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, soil blowing.	Slope, rooting depth.

TABLE 16.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Irrigation	Grassed waterways
38B: Onaway	Moderate: slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope	Large stones.
38C, 38E: Onaway	Severe: slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope	Large stones, slope.
39B: Nester	Moderate: slope.	Slight	Severe: no water.	Deep to water	Slope, percs slowly.	Rooting depth, percs slowly.
39C: Nester	Severe: slope.	Slight	Severe: no water.	Deep to water	Slope, percs slowly.	Slope, rooting depth, percs slowly.
40B: Ontonagon	Slight	Severe: hard to pack.	Severe: slow refill.	Percs slowly	Wetness, percs slowly.	Erodes easily, percs slowly.
40D2: Ontonagon	Severe: slope.	Severe: hard to pack.	Severe: no water.	Deep to water	Slow intake, percs slowly, slope.	Slope, percs slowly.
41A: Au Gres	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Cutbanks cave	Wetness, droughty.	Wetness, droughty.
43A: Battlefield	Severe: seepage.	Severe: seepage, wetness.	Severe: cutbanks cave.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, droughty.
45B: Croswell	Severe: seepage.	Severe: seepage, piping.	Severe: cutbanks cave.	Cutbanks cave	Wetness, droughty.	Droughty.
47A: Ingalls	Severe: seepage.	Severe: piping, wetness.	Severe: slow refill, cutbanks cave.	Cutbanks cave	Wetness, droughty.	Wetness, erodes easily, droughty.
48A: Allendale	Severe: seepage.	Severe: hard to pack, wetness.	Severe: slow refill, cutbanks cave.	Percs slowly	Wetness, droughty.	Wetness, droughty, percs slowly.
49A: Finch	Severe: seepage, cemented pan.	Severe: seepage, piping, wetness.	Severe: no water.	Percs slowly, cemented pan.	Wetness, droughty.	Wetness, droughty, cemented pan.
50A: Bonduel	Severe: seepage, depth to rock.	Severe: thin layer, wetness.	Severe: depth to rock.	Thin layer, frost action.	Wetness, thin layer.	Wetness, depth to rock, area reclaim.
51A: Otisco	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Cutbanks cave	Wetness, droughty.	Wetness, droughty.
52A: Ogemaw	Severe: seepage, cemented pan.	Severe: wetness.	Severe: no water.	Percs slowly, cemented pan.	Wetness, droughty.	Wetness, droughty, cemented pan.

TABLE 16.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Irrigation	Grassed waterways
55A: Solona	Moderate: seepage.	Severe: piping, wetness.	Moderate: slow refill.	Frost action	Wetness, droughty, soil blowing.	Wetness, erodes easily, droughty.
56A: Riggsville	Moderate: seepage.	Severe: piping, wetness.	Severe: slow refill, cutbanks cave.	Percs slowly	Wetness, droughty, fast intake.	Wetness, droughty, rooting depth.
57A: Brimley	Slight	Severe: piping, wetness.	Severe: slow refill, cutbanks cave.	Frost action, cutbanks cave.	Wetness, soil blowing.	Wetness, erodes easily.
58A: Alstad	Moderate: seepage.	Severe: thin layer.	Severe: no water.	Frost action	Wetness, erodes easily.	Wetness, erodes easily.
60A: Rudyard	Slight	Severe: wetness, hard to pack.	Severe: no water.	Percs slowly	Wetness, percs slowly.	Wetness, erodes easily, percs slowly.
61: Roscommon	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: cutbanks cave.	Ponding, cutbanks cave.	Ponding, droughty.	Wetness, droughty.
62: Wheatley	Severe: seepage.	Severe: seepage, ponding.	Severe: cutbanks cave.	Ponding, cutbanks cave.	Ponding, droughty, fast intake.	Wetness, droughty.
63: Brevort	Severe: seepage.	Severe: piping, ponding.	Severe: slow refill, cutbanks cave.	Ponding	Ponding, droughty, fast intake.	Wetness, erodes easily, droughty.
64: Burleigh	Severe: seepage.	Severe: piping, ponding.	Severe: slow refill, cutbanks cave.	Ponding, cutbanks cave.	Ponding, droughty, fast intake.	Wetness, erodes easily, droughty.
66: Pinconning	Severe: seepage.	Severe: ponding.	Severe: slow refill, cutbanks cave.	Ponding, percs slowly.	Ponding, droughty, fast intake.	Wetness, droughty, percs slowly.
67: Kinross	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: cutbanks cave.	Ponding, cutbanks cave.	Ponding, droughty, fast intake.	Wetness, droughty.
70*:						
Au Gres	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Cutbanks cave	Wetness, droughty.	Wetness, droughty.
Roscommon	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: cutbanks cave.	Ponding, cutbanks cave.	Ponding, droughty.	Wetness, droughty.
71: Bowstring	Severe: seepage.	Severe: excess humus, wetness.	Severe: slow refill, cutbanks cave.	Flooding, subsides, frost action.	Wetness, flooding.	Wetness.

See footnote at end of table.

TABLE 16.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Irrigation	Grassed waterways
77 Bruce	Slight	Severe: ponding.	Severe: slow refill, cutbanks cave.	Ponding, frost action, cutbanks cave.	Ponding, soil blowing.	Wetness, erodes easily.
78 Angelica	Slight	Severe: piping, ponding.	Severe: slow refill.	Ponding, frost action.	Ponding, soil blowing, rooting depth.	Wetness, rooting depth.
79 Charity	Slight	Severe: ponding.	Severe: slow refill.	Ponding, percs slowly, frost action.	Ponding, soil blowing, percs slowly.	Wetness, erodes easily, percs slowly.
81 Udipsamments	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Droughty, fast intake, soil blowing.	Slope, droughty.
82 Udorthents	Variable	Variable	Variable	Variable	Variable	Variable.
83*, 84*. Pits						
85*:						
Histosols	Variable	Variable	Variable	Variable	Variable	Variable.
Aquents	Variable	Variable	Variable	Variable	Variable	Variable.
87*. Beaches						
141A Finch	Severe: seepage, cemented pan.	Severe: seepage, piping, wetness.	Severe: no water.	Percs slowly, cemented pan.	Wetness, droughty.	Wetness, droughty, cemented pan.
158A Detour	Slight	Severe: wetness.	Severe: slow refill.	Percs slowly, large stones, frost action.	Large stones, wetness.	Large stones, wetness, droughty.
179 Hessel	Slight	Severe: piping, ponding.	Severe: slow refill.	Ponding, frost action.	Ponding, droughty.	Large stones, wetness, droughty.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--ENGINEERING INDEX PROPERTIES

(The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated)

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
2-----------------Lupton	0-29	Sapric material	PT	A-8	0	---	---	---	---	---	---
	29-34	Hemic material---	PT	A-8	0	---	---	---	---	---	---
	34-60	Sapric material	PT	A-8	0	---	---	---	---	---	
5-----------------Loxley	0-2	Fibric material	PT	A-8	0	---	---	---	---	---	---
	2-9	Hemic material---	PT	A-8	0	---	---	---	---	---	---
	9-60	Sapric material	PT	A-8	0	---	---	---	---	---	---
7-----------------Grousehaven Variant	0-7	Sapric material	PT	A-8	0	---	---	---	---	---	---
	7-19	Marl--------------	OH, MH	A-8, A-5, A-7	0	100	95-100	80-90	60-80	50-90	NP-20
	19-60	Sand--------------	SP, SP-SM	A-3	0	100	95-100	80-95	0-10	<20	NP
8-----------------Tawas	0-2	Fibric material	PT	A-8	0	---	---	---	---	---	---
	2-44	Sapric material	PT	A-8	0	---	---	---	---	---	---
	44-60	Sand, loamy fine sand, gravelly sand.	SP, SM, SP-SM	A-3, A-2-4, A-4, A-1-b	0	80-100	60-100	30-80	0-40	---	NP
9-----------------Greenwood	0-4	Fibric material	PT	A-8	0	---	---	---	---	---	---
	4-60	Hemic material---	PT	A-8	0	---	---	---	---	---	---
10----------------Dawson	0-8	Fibric material	PT	A-8	0	---	---	---	---	---	---
	8-17	Sapric material	PT	A-8	0	---	---	---	---	---	---
	17-60	Sand, gravelly sand, fine sand.	SM-SC, SM, SC, SP-SM	A-2, A-3, A-1, A-4	0	45-100	35-100	15-90	0-45	<20	NP-10
11B, 11C, 11D, 11F-------------Kalkaska	0-12	Sand--------------	SM, SP-SM	A-1, A-2, A-3	0	95-100	90-100	45-70	5-15	---	NP
	12-20	Sand, loamy sand	SM, SP-SM	A-1, A-2, A-3	0	95-100	90-100	45-75	5-30	---	NP
	20-27	Sand--------------	SM, SP-SM	A-1, A-2, A-3	0	95-100	90-100	45-70	5-15	---	NP
	27-60	Sand--------------	SP, SP-SM, SM	A-1, A-2, A-3	0	100	95-100	45-70	0-15	---	NP
12B---------------Grayling	0-2	Sand--------------	SM, SP-SM, SP	A-1, A-2, A-3	0	95-100	90-100	45-70	3-15	---	NP
	2-18	Sand--------------	SP, SP-SM, SM	A-1, A-2, A-3	0	95-100	90-100	45-70	3-15	---	NP
	18-60	Sand--------------	SP, SP-SM, SM	A-1, A-2, A-3	0	95-100	90-100	40-70	0-15	---	NP
13B, 13C, 13D, 13F-------------Rubicon	0-6	Sand--------------	SM, SP-SM, SP	A-2, A-3, A-1	0	95-100	75-100	35-70	0-15	---	NP
	6-18	Sand--------------	SM, SP-SM, SP	A-2, A-3, A-1	0	95-100	75-100	35-70	0-15	---	NP
	18-60	Sand, coarse sand	SP, SP-SM, SM	A-1, A-2, A-3	0	95-100	75-100	30-70	0-15	---	NP

TABLE 17.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
16B, 16C, 16D, 16F East Lake	0-1	Sand	SM, SP-SM, SP	A-1, A-2-4, A-3	0-15	95-100	85-100	40-70	0-15	---	NP
	1-22	Sand, coarse sand, gravelly coarse sand.	SM, SP-SM, SP	A-1, A-2-4, A-3	0-5	85-100	70-100	35-75	0-30	---	NP
	22-60	Stratified very gravelly sand to sand.	GP, SP-SM, SP, GP-GM	A-1, A-3, A-2-4	0-5	40-90	25-80	20-55	0-10	---	NP
17B, 17D, 17E Wallace	0-11	Sand	SP, SP-SM	A-2, A-3, A-1-b	0	95-100	95-100	45-70	0-10	---	NP
	11-21	Sand	SM, SP-SM	A-2, A-3, A-1-b	0	95-100	90-100	45-75	5-15	---	NP
	21-60	Sand	SP, SP-SM	A-2, A-3, A-1-b	0	95-100	90-100	45-65	0-10	---	NP
18B, 18C, 18D, 18F Blue Lake	0-8	Loamy sand	SM, SP-SM	A-2-4, A-1-b	0-5	95-100	85-100	40-75	10-30	---	NP
	8-16	Loamy sand, sand	SP-SM, SM	A-2-4, A-3, A-1-b	0-5	95-100	85-100	40-75	5-30	---	NP
	16-80	Stratified sand to sandy loam.	SP-SM, SM	A-2-4, A-4, A-3, A-1-b	0-5	95-100	85-100	40-75	5-40	---	NP
20B, 20C, 20D, 20F Mancelona	0-7	Sand	SP, SP-SM, SM	A-2, A-3, A-1-b	0-8	90-100	75-95	35-70	0-15	---	NP
	7-27	Loamy sand, sand, gravelly loamy sand.	SM, SP-SM	A-2, A-1-b, A-3	0-8	80-100	55-95	30-75	5-30	---	NP
	27-31	Gravelly loamy sand, sandy loam, gravelly sandy loam.	SM-SC, SC, SP-SC	A-2, A-4, A-6, A-1	0-8	85-100	55-95	35-70	10-40	20-35	4-15
	31-60	Very gravelly sand, gravelly sand.	GP, SP, GW, SW	A-1, A-2, A-3	0-8	40-90	30-85	20-60	0-15	---	NP
21B Zimmerman	0-4	Fine sand	SM, SP-SM	A-2	0	100	100	95-100	10-20	<20	NP
	4-60	Fine sand, loamy fine sand.	SM, SP-SM	A-2, A-3	0	100	100	95-100	5-20	<20	NP
22B, 22C, 22D Leelanau	0-6	Loamy sand	SP-SM, SM, SM-SC	A-2, A-1	0-15	85-100	75-100	35-75	10-30	<25	NP-7
	6-21	Loamy sand, sand	SP-SM, SM, SW-SM, SM-SC	A-2, A-3, A-1	0-15	85-100	75-100	35-75	5-30	<25	NP-7
	21-42	Sandy loam, loamy sand.	SC, SM, SM-SC	A-2, A-4, A-1	0-20	80-100	75-100	45-70	10-40	20-30	NP-10
	42-60	Loamy sand	SW-SM, SM, SP-SM, SM-SC	A-2, A-1	0-20	80-100	75-100	35-75	10-30	<25	NP-7

TABLE 17.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag-ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas-ticity index
	In				Pct					Pct	
24B, 24C, 24D---- Ocqueoc	0-8	Fine sand--------	SM, SP-SM	A-3, A-2	0	100	100	50-80	5-15	<20	NP-4
	8-26	Sand, loamy sand, very fine sand.	SP-SM, SM, SM-SC	A-2, A-3	0	100	100	50-80	5-30	<20	NP-7
	26-60	Stratified fine sand to silt loam.	SM-SC, CL-ML, CL, SC	A-2, A-4, A-6	0	100	100	65-95	20-85	20-40	4-20
25B, 25D--------- Eastport	0-1	Sand-------------	SP, SM, SP-SM	A-3, A-2-4, A-1-b	0	90-100	75-100	35-70	0-15	---	NP
	1-28	Sand-------------	SP, SM, SP-SM	A-3, A-2-4, A-1-b	0	90-100	75-100	35-70	0-15	---	NP
	28-60	Sand-------------	SP, SM, SP-SM	A-3, A-2-4, A-1-b	0	90-100	75-100	35-70	0-15	---	NP
26B, 26C, 26D---- Rubicon	0-8	Sand-------------	SP, SP-SM, SM	A-2, A-3, A-1	0	95-100	90-100	45-70	3-15	---	NP
	8-26	Sand-------------	SP, SP-SM, SM	A-2, A-3, A-1	0	95-100	90-100	45-70	3-15	---	NP
	26-60	Sand-------------	SP, SP-SM	A-2, A-3, A-1	0	95-100	90-100	45-70	0-10	---	NP
27B, 27C, 27D, 27F------------- Cheboygan	0-6	Loamy sand-------	SM, SM-SC	A-2-4	0-8	90-100	90-100	55-70	15-30	<25	NP-5
	6-22	Loamy sand, sand	SM, SM-SC	A-2-4	0-8	90-100	90-100	55-70	15-30	<25	NP-5
	22-28	Sandy clay loam, sandy loam, loam.	SM, ML, SC, CL	A-2, A-4, A-6	0-8	95-100	90-100	55-85	25-55	<35	NP-15
	28-60	Sandy loam-------	SM, SM-SC, SC	A-2-4	0-8	85-95	80-95	50-80	20-35	<25	NP-10
29B, 29C--------- Fairport	0-14	Fine sandy loam	SM, SM-SC, SC	A-4, A-2	0-2	85-95	75-95	45-85	25-50	<20	NP-10
	14-36	Fine sandy loam, clay loam, gravelly sandy clay loam.	CL	A-6	0-5	85-95	65-95	45-95	15-80	25-40	10-25
	36	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
30B, 30C, 30D---- Rousseau	0-6	Fine sand--------	SM	A-2-4	0	100	100	65-80	20-35	---	NP
	6-23	Fine sand--------	SM	A-2-4	0	100	100	65-100	20-35	---	NP
	23-60	Fine sand--------	SP-SM, SM	A-2-4, A-3	0	100	100	50-100	5-35	---	NP
31B-------------- Nadeau	0-6	Extremely gravelly loamy sand.	GM, GC	A-1-b, A-2	0-15	55-85	15-25	5-25	0-15	<30	NP-10
	6-18	Extremely gravelly sandy loam, very gravelly loam, very gravelly sandy loam.	GM, GC, GP-GM, GM-GC	A-1, A-2	5-15	35-65	25-55	15-50	5-50	20-30	3-10
	18-60	Extremely gravelly coarse sand, very gravelly sand.	GW, SW, SW-SM, GP	A-1	5-15	35-75	25-60	5-35	0-15	---	NP

TABLE 17.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
32B, 32C, 32D----- Rubicon	0-6	Sand-------------	SP, SP-SM, SM	A-2, A-3, A-1	0	95-100	90-100	40-70	3-15	---	NP
	6-37	Sand-------------	SP, SP-SM, SM	A-2, A-3, A-1	0	95-100	90-100	45-70	3-15	---	NP
	37-60	Sand-------------	SP, SP-SM	A-2, A-3, A-1	0	95-100	90-100	45-70	0-10	---	NP
33B-------------- Ontonagon	0-7	Silty clay loam	CL	A-7	0	100	100	95-100	85-95	40-50	20-30
	7-22	Clay, silty clay	CH	A-7	0	100	100	90-100	75-95	65-90	40-55
	22-60	Silty clay loam	CL, CH, MH, CL-ML	A-4, A-6, A-7	0	100	100	90-100	75-95	40-50	20-30
33B2------------- Ontonagon	0-6	Silty clay loam	CL	A-7, A-6	0	100	100	95-100	85-95	40-50	20-30
	6-20	Silty clay, clay	CH	A-7	0	100	100	90-100	75-95	65-90	40-55
	20-60	Silty clay loam	CL, CH, MH, CL-ML	A-4, A-7, A-6	0	100	100	90-100	70-95	40-50	20-30
33C2------------- Ontonagon	0-5	Silty clay loam	CL	A-7	0	100	100	95-100	85-95	40-50	20-30
	5-14	Clay, silty clay	CH	A-7	0	100	100	90-100	75-95	65-90	40-55
	14-60	Silty clay loam	CL, CH, MH, CL-ML	A-4, A-6, A-7	0	100	100	90-100	80-100	40-50	20-30
34B, 34C, 34E---- Alcona	0-7	Very fine sandy loam.	SM, SM-SC, ML, CL-ML	A-4, A-2-4	0-8	95-100	90-100	55-95	25-65	<25	NP-7
	7-15	Loamy fine sand, very fine sandy loam.	SM, ML, SC, CL	A-4, A-2-4	0-8	100	100	85-95	40-65	<30	NP-10
	15-19	Silt loam, loam	CL, CL-ML	A-6, A-4	0	95-100	90-100	85-100	65-95	20-30	4-10
	19-60	Stratified fine sand to silt loam.	SM, ML, SM-SC, CL-ML	A-2-4, A-4	0	95-100	90-100	90-100	25-85	<30	NP-7
37B, 37C, 37D---- Emmet	0-12	Sandy loam-------	SM, SC, ML, CL	A-2, A-4, A-1-b	0-5	90-100	75-100	45-80	20-55	<25	NP-10
	12-19	Sandy loam, loamy sand, fine sandy loam.	SM, SC, ML, CL	A-2, A-1-b, A-4	0-5	95-100	75-100	35-85	10-55	<25	NP-10
	19-27	Loam, sandy loam, sandy clay loam.	SM-SC, CL, CL-ML, SC	A-2, A-4, A-6, A-1-b	0-5	95-100	75-100	45-95	20-75	20-40	5-20
	27-60	Sandy loam-------	SM, SM-SC, SC	A-2, A-4, A-1-b	0-5	95-100	75-100	45-80	20-50	<25	NP-10
38B, 38C, 38E---- Onaway	0-4	Loam-------------	CL-ML, CL, SM-SC, SC	A-4, A-6	0-10	90-100	75-95	65-90	45-70	20-35	4-15
	4-18	Sandy loam-------	SM-SC, SC	A-2, A-4, A-6, A-1	0-10	90-100	75-95	45-80	20-50	20-30	4-11
	18-32	Loam, clay loam, sandy clay loam.	CL, SC	A-4, A-6, A-2, A-7	0-20	85-100	65-95	50-95	20-70	25-45	9-22
	32-60	Loam-------------	ML, SC, CL, SM	A-4, A-6, A-2, A-1	0-20	90-100	75-100	65-100	50-90	15-35	NP-15

TABLE 17.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
39B, 39C--------- Nester	0-9	Loam-------------	ML, CL, CL-ML	A-4, A-6	0-5	90-100	75-100	65-100	50-90	15-35	2-15
	9-12	Clay loam, loam, sandy loam.	ML, SM	A-4, A-2-4, A-1-b	0-5	90-100	75-100	45-100	20-90	<35	NP-7
	12-37	Clay loam, silty clay loam, clay.	CL, CH	A-7	0-5	90-100	75-100	75-100	55-95	40-55	20-30
	37-60	Clay loam--------	CL	A-7	0-5	90-100	75-100	70-100	50-95	40-50	15-25
40B-------------- Ontonagon	0-11	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	95-100	85-95	25-35	5-15
	11-19	Clay-------------	CH	A-7	0	100	100	90-100	75-95	65-90	40-55
	19-60	Silty clay-------	CH	A-7	0	100	100	90-100	75-95	65-90	40-55
40D2------------- Ontonagon	0-6	Silty clay-------	CH	A-7	0	100	100	95-100	90-95	50-60	25-35
	6-9	Clay-------------	CH	A-7	0	100	100	90-100	75-95	65-90	40-55
	9-60	Silty clay-------	CH	A-7	0	100	100	90-100	75-95	65-90	40-55
41A-------------- Au Gres	0-11	Sand-------------	SM, SP-SM	A-2-4, A-3, A-1-b	0	95-100	85-100	40-65	5-15	---	NP
	11-37	Sand, loamy sand	SP-SM, SM, SM-SC	A-2-4, A-3, A-1-b	0	95-100	85-100	40-75	5-30	<25	NP-7
	37-60	Sand-------------	SP-SM, SM	A-3, A-2-4, A-1-b	0	95-100	85-100	40-60	5-15	---	NP
43A-------------- Battlefield	0-5	Sand-------------	SP-SM, SM	A-2-4, A-3, A-1-b	0	95-100	90-100	45-70	5-15	---	NP
	5-32	Sand, loamy sand, gravelly sand.	SP-SM, SM	A-3, A-2-4, A-1-b	0	80-100	70-100	35-75	5-30	---	NP
	32-60	Stratified very gravelly sand to gravelly sand.	GP, GP-GM, SW-SM, SP	A-1-b, A-2-4, A-3	0-10	50-80	50-75	20-55	0-10	---	NP
45B-------------- Croswell	0-7	Sand-------------	SP-SM, SM	A-3, A-2-4, A-1-b	0	90-100	85-100	40-70	5-15	---	NP
	7-16	Sand-------------	SP-SM, SM, SP	A-3, A-2-4, A-1-b	0	90-100	85-100	40-75	3-30	---	NP
	16-60	Sand-------------	SP-SM, SM, SP	A-3, A-2-4, A-1-b	0	90-100	85-100	40-70	3-15	---	NP
47A-------------- Ingalls	0-8	Loamy sand-------	SM, SP-SM	A-2, A-1	0-8	90-100	85-100	40-80	10-35	---	NP
	8-22	Loamy sand, sand, fine sand.	SM, SP-SM	A-2, A-3, A-1	0-8	90-100	85-100	40-80	5-35	---	NP
	22-60	Stratified silt to loamy fine sand.	CL, CL-ML, SC, SM-SC	A-6, A-4	0	95-100	90-100	65-100	45-95	20-35	4-15

TABLE 17.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
48A-------------- Allendale	0-9	Sand-------------	SM, SW-SM, SP-SM	A-2-4, A-3, A-1-b	0	95-100	90-100	45-80	5-35	---	NP
	9-25	Sand, gravelly loamy sand.	SM, SP-SM	A-2-4, A-3, A-4, A-1-b	0	95-100	70-100	35-75	5-30	---	NP
	25-60	Silty clay-------	CH, MH	A-7	0	100	90-100	90-100	75-95	50-70	20-40
49A-------------- Finch	0-9	Sand-------------	SP-SM, SM	A-3, A-2-4	0	100	100	50-70	5-15	---	NP
	9-30	Sand-------------	SP-SM, SM	A-3, A-2-4	0	100	100	50-70	5-15	---	NP
	30-60	Sand-------------	SP-SM, SM	A-3, A-2-4	0	100	100	50-70	5-15	---	NP
50A-------------- Bonduel	0-4	Loamy very fine sand.	ML, CL, CL-ML	A-4	0	90-100	90-100	90-95	40-60	<21	NP-4
	4-9	Fine sandy loam	ML, CL-ML	A-4	0-2	90-100	90-100	70-95	40-65	20-30	5-12
	9-17	Silty clay, silty clay loam, loam.	CL, CH	A-7	0	100	100	90-100	75-95	45-55	20-30
	17	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
51A-------------- Otisco	0-7	Sand-------------	SP-SM, SM, SM-SC	A-2, A-3, A-1-b	0	95-100	90-100	45-70	5-15	<20	NP-5
	7-29	Loamy sand, sand	SM, SP-SM, SM-SC	A-2, A-3, A-1-b	0	95-100	90-100	45-75	5-30	<20	NP-5
	29-60	Stratified sand to sandy clay loam.	SM, SP-SM, CL, SC	A-2, A-4, A-3, A-6	0	95-100	90-100	45-90	5-55	<30	NP-15
52A-------------- Ogemaw	0-13	Sand-------------	SM, SP-SM	A-1, A-2, A-3	0-5	90-100	85-100	40-70	5-15	<20	NP-4
	13-33	Sand-------------	SP-SM, SM, SM-SC	A-1, A-2	0-5	90-100	85-100	40-75	5-15	<20	NP-5
	33-60	Sandy clay loam, silty clay, clay loam.	CL, SC	A-6	0-5	90-100	85-100	70-100	35-95	30-40	15-25
55A-------------- Solona	0-7	Sandy loam-------	SM, SM-SC	A-4, A-2	0-3	80-100	75-100	45-85	25-50	<20	2-7
	7-19	Loamy sand, sandy loam, loam.	CL, ML, SC, SM	A-2, A-1-b	0-3	80-100	75-100	45-100	25-80	20-30	3-10
	19-60	Sandy loam-------	ML, SM-SC, SM, SC	A-2, A-4	0-3	95-100	85-100	50-70	20-40	<25	NP-10
56A-------------- Riggsville	0-9	Loamy sand-------	SM, SM-SC, SP-SM	A-2, A-1	0-8	90-100	85-100	40-70	10-30	<25	NP-5
	9-16	Loamy sand, sand, loamy fine sand.	SM, SM-SC, SP-SM	A-2, A-4, A-1, A-3	0-8	90-100	85-100	40-75	5-40	<25	NP-5
	16-30	Loamy sand, sandy loam, sandy clay loam.	SM, SM-SC, SC, CL	A-2, A-4, A-6	0-8	95-100	85-100	40-85	25-55	<35	NP-15
	30-60	Sandy loam-------	SM, SM-SC, SC	A-2, A-4	0-8	95-100	85-100	50-70	20-40	<25	NP-10

TABLE 17.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag-ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas-ticity index
	In				Pct					Pct	
57A-------------- Brimley	0-11	Very fine sandy loam.	SM, ML, SM-SC, CL-ML	A-4, A-6	0	100	100	70-95	40-65	20-30	3-11
	11-25	Fine sandy loam, silt loam, loam.	SM-SC, SM, CL-ML, ML	A-4, A-6	0	100	100	70-95	40-90	20-30	3-11
	25-60	Stratified very fine sand to silt loam.	ML, SM, SC, CL	A-4, A-6	0	100	100	70-95	40-90	20-40	3-18
58A-------------- Alstad	0-6	Loam-------------	CL, CL-ML, ML	A-4	0	95-100	95-100	80-100	55-100	<28	3-9
	6-9	Sandy loam-------	ML, CL, SM, SC	A-2, A-4	0	95-100	95-100	55-100	25-100	<26	2-8
	9-15	Sandy clay loam, clay loam, loam.	CL, SC	A-6, A-4, A-2, A-7	0	80-100	75-100	60-100	25-80	20-45	9-28
	15-60	Loam, clay loam	SC, CL, SM, ML	A-6, A-4, A-2, A-1	0-3	80-100	75-100	45-95	20-75	<35	2-20
60A-------------- Rudyard	0-10	Loam-------------	CL, CL-ML	A-4, A-6	0	100	100	85-100	60-90	25-40	5-15
	10-17	Clay-------------	CH	A-7	0	100	100	90-100	75-95	65-90	40-55
	17-60	Silty clay-------	CH	A-7	0	100	100	90-100	75-95	65-90	40-55
61--------------- Roscommon	0-6	Muck-------------	PT	A-8	0	---	---	---	---	---	---
	6-60	Sand, loamy sand, coarse sand.	SP, SP-SM, SM	A-1, A-2, A-3	0	95-100	85-100	40-75	0-30	<20	NP-4
62--------------- Wheatley	0-7	Loamy sand-------	SM, SP-SM, SM-SC	A-2-4, A-1-b	0-5	90-100	75-100	35-75	10-30	<25	NP-7
	7-26	Gravelly sand, gravelly loamy sand.	SM, SP-SM	A-2-4, A-1-b, A-3	0-5	80-95	65-90	30-75	5-30	<20	NP-4
	26-60	Gravelly sand, gravelly loamy sand.	SM, SP-SM	A-1-b, A-2-4, A-3	5-10	80-95	65-90	30-75	5-30	<20	NP-4
63--------------- Brevort	0-5	Mucky loamy sand	SP-SM, SM, SM-SC	A-1-b, A-2-4	0-8	85-100	75-100	35-75	10-30	<25	NP-7
	5-22	Sand, loamy sand, gravelly sand.	SM, SP-SM, SM-SC	A-2-4, A-3, A-1-b	0-8	85-100	70-100	35-85	5-35	<20	NP-7
	22-60	Clay loam, loam, silty clay loam.	CL, CL-ML, SC, SM-SC	A-4, A-6, A-7, A-2	0-8	85-100	75-100	50-100	30-95	20-45	5-25
64--------------- Burleigh	0-8	Mucky sand-------	SP-SM	A-2-4, A-3	0	100	95-100	50-75	5-10	---	NP
	8-34	Sand, coarse sand, fine sand.	SP-SM, SM	A-3, A-2-4	0	100	100	50-70	5-35	---	NP
	34-60	Stratified very fine sand to silt loam.	ML, SM	A-4	0	100	100	75-100	35-90	20-40	NP-10
66--------------- Pinconning	0-9	Mucky loamy sand	SM	A-2-4	0	100	95-100	50-75	15-30	---	NP
	9-16	Sand, loamy sand	SP-SM, SM	A-3, A-2-4	0	100	95-100	50-80	5-35	---	NP
	16-60	Clay, silty clay	CH, CL	A-7	0	100	95-100	90-100	75-95	40-60	25-35
67--------------- Kinross	0-5	Mucky sand-------	SP-SM, SM	A-3, A-2-4	0	100	100	50-80	5-35	---	NP
	5-12	Sand, loamy sand	SP-SM, SM	A-3, A-2-4	0	100	100	50-80	5-30	---	NP
	12-60	Sand-------------	SP-SM, SM	A-3, A-2-4	0	100	100	50-80	5-30	---	NP

TABLE 17.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
70*:											
Au Gres----------	0-11	Sand-------------	SM, SP-SM	A-2-4, A-3, A-1-b	0	95-100	85-100	40-65	5-15	---	NP
	11-37	Sand, loamy sand	SP-SM, SM, SM-SC	A-2-4, A-3, A-1-b	0	95-100	85-100	40-75	5-30	<25	NP-7
	37-60	Sand-------------	SP-SM, SM	A-3, A-2-4, A-1-b	0	95-100	85-100	40-60	5-15	---	NP
Roscommon--------	0-6	Sapric material	PT	A-8	0	---	---	---	---	---	---
	6-60	Sand, loamy sand, coarse sand.	SP, SP-SM, SM	A-1, A-2, A-3	0	95-100	85-100	40-75	0-30	<20	NP-4
71---------------- Bowstring	0-12	Sapric material	PT	A-8	0	---	---	---	---	---	---
	12-17	Sand, fine sand, fine sandy loam.	SP-SM, SM, SM-SC	A-2	0	100	100	50-85	10-35	<20	NP-5
	17-60	Sapric material	PT	A-8	0	---	---	---	---	---	---
77---------------- Bruce	0-5	Fine sandy loam	ML, CL-ML, SM, SM-SC	A-4	0	100	100	70-95	40-65	<30	2-10
	5-15	Silt loam, loam, very fine sandy loam.	CL-ML, ML, CL	A-4	0	100	100	85-100	50-80	20-35	2-10
	15-24	Silty clay loam, silt loam, loam.	CL	A-6, A-4	0	100	100	90-100	70-80	25-40	8-16
	24-60	Stratified silt to fine sand.	CL, SC	A-4, A-6	0	100	100	70-95	40-85	25-40	8-16
78---------------- Angelica	0-3	Mucky sandy loam	SM, ML	A-4, A-2-4	0-10	90-100	85-100	50-70	30-55	<25	NP-4
	3-6	Loam, sandy loam, clay loam.	SM, ML, SC, CL	A-4, A-6	0-10	90-100	85-100	50-90	36-90	12-40	2-20
	6-10	Sandy clay loam, loam, clay loam.	SC, CL, SM-SC, CL-ML	A-2-4, A-6, A-4, A-2-6	0-10	90-100	85-100	70-100	25-90	15-40	5-23
	10-60	Loam-------------	CL, SC, CL-ML	A-4, A-6	0-15	95-100	95-100	85-100	60-90	20-40	5-16
79---------------- Charity	0-8	Fine sandy loam	SM, SC, ML, CL	A-4	0	90-100	85-95	60-80	35-55	<30	NP-10
	8-9	Gravelly sandy loam, clay loam, loam.	CL, SC	A-2, A-6	0	95-100	75-95	50-85	30-75	20-40	10-20
	9-60	Silty clay loam, silty clay, clay.	CL, CH	A-7	0	100	100	90-100	75-95	45-55	20-30
81---------------- Udipsamments	0-60	Sand-------------	SP, SP-SM, SM	A-1, A-2, A-3	0	85-100	80-100	30-75	0-25	---	NP
82---------------- Udorthents	0-60	Variable---------	---	---	---	---	---	---	---	---	---
83*, 84*. Pits											

See footnote at end of table.

TABLE 17.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
85*:											
Histosols	0-51	Sapric material	PT	A-8	---	---	---	---	---	---	---
	51-60	Variable	---	---	---	---	---	---	---	---	---
Aquents	0-60	Variable	---	---	---	---	---	---	---	---	---
87*. Beaches											
141A Finch	0-10	Cobbly sand	SP-SM, SM	A-2-4, A-3	15-35	100	95-100	50-70	5-15	---	NP
	10-39	Sand, loamy sand	SP-SM, SM	A-2-4, A-3	0-3	100	100	80-95	5-15	---	NP
	39-60	Sand, loamy sand	SP, SP-SM	A-3	0-3	100	100	80-95	0-10	---	NP
158A Detour	0-5	Cobbly loam	ML, SM, SC, CL	A-4, A-2, A-1-b	15-20	90-95	85-95	70-90	50-70	<30	2-9
	5-19	Loamy sand, sandy clay loam, gravelly loam.	SC, CL, SM	A-2, A-6	15-20	70-90	60-75	45-75	20-60	30-40	10-20
	19-60	Gravelly loam, loam.	SC, CL	A-2, A-6	5-20	70-90	60-75	35-75	15-60	30-35	10-15
179 Hessel	0-9	Mucky loam	ML, CL, CL-ML	A-4	5-10	90-95	75-90	65-90	50-70	<25	NP-10
	9-10	Clay loam, sandy loam, loam.	CL, SC, CL-ML, SM-SC	A-4, A-6	0-5	95-100	85-100	75-100	55-80	20-40	4-20
	10-60	Loam, sandy loam	SM-SC, SC, CL, CL-ML	A-4, A-2, A-1	0-5	95-100	85-100	50-90	35-65	20-30	4-10

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 18.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

(The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH					Pct
2----------------- Lupton	0-29	---	0.10-0.35	0.2-6.0	0.35-0.45	5.6-7.8	---	---	5	2	70-90
	29-34	---	0.10-0.25	0.6-6.0	0.45-0.55	5.6-7.8	---	---			
	34-60	---	0.10-0.35	0.2-6.0	0.35-0.45	5.6-7.8	---	---			
5----------------- Loxley	0-2	---	0.30-0.40	>6.0	0.35-0.65	<4.5	---	---	5	7	70-90
	2-9	---	0.10-0.25	0.6-6.0	0.45-0.55	<4.5	---	---			
	9-60	---	0.10-0.35	0.2-6.0	0.35-0.45	<4.5	---	---			
7----------------- Grousehaven Variant	0-7	---	0.10-0.25	0.2-6.0	0.35-0.45	5.1-7.8	Low	---	1	8	>25
	7-19	---	---	<0.2	---	7.4-8.4	Low	---			
	19-60	0-10	1.40-1.55	6.0-20	0.05-0.10	7.4-8.4	Low	0.15			
8----------------- Tawas	0-2	---	0.20-0.40	>6.0	0.55-0.65	4.5-7.8	---	---	4	7	40-60
	2-44	---	0.20-0.40	>6.0	0.45-0.65	4.5-7.8	---	---			
	44-60	0-10	1.40-1.65	6.0-20	0.03-0.10	5.6-8.4	Low	0.15			
9----------------- Greenwood	0-4	---	0.30-0.40	>6.0	0.55-0.65	3.6-4.4	---	---	5	7	55-75
	4-60	---	0.10-0.25	0.6-6.0	0.45-0.55	3.6-4.4	---	---			
10---------------- Dawson	0-8	---	0.15-0.30	>6.0	0.55-0.65	3.6-4.4	---	---	4	7	65-85
	8-17	---	0.15-0.40	0.2-6.0	0.35-0.45	3.6-4.4	---	---			
	17-60	0-10	1.55-1.75	6.0-20	0.03-0.10	4.5-6.5	Low	---			
11B, 11C, 11D, 11F------------- Kalkaska	0-12	0-10	1.25-1.45	6.0-20	0.05-0.09	3.6-6.0	Low	0.15	5	1	1-4
	12-20	0-15	1.35-1.45	6.0-20	0.06-0.08	3.6-6.0	Low	0.15			
	20-27	0-10	1.35-1.45	6.0-20	0.06-0.08	4.5-6.0	Low	0.15			
	27-60	0-10	1.35-1.50	6.0-20	0.04-0.06	4.5-6.5	Low	0.15			
12B--------------- Grayling	0-2	0-10	1.30-1.65	6.0-20	0.07-0.09	3.6-5.5	Low	0.15	5	1	---
	2-18	0-10	1.30-1.65	6.0-20	0.06-0.08	3.6-5.5	Low	0.15			
	18-60	0-10	1.45-1.65	6.0-20	0.04-0.06	4.5-6.5	Low	0.15			
13B, 13C, 13D, 13F------------- Rubicon	0-6	0-5	1.35-1.55	6.0-20	0.05-0.09	4.5-6.0	Low	0.15	5	1	.5-1
	6-18	0-10	1.30-1.60	6.0-20	0.04-0.08	4.5-6.0	Low	0.15			
	18-60	0-5	1.40-1.65	6.0-20	0.04-0.06	4.5-6.5	Low	0.15			
16B, 16C, 16D, 16F------------- East Lake	0-1	0-8	1.30-1.60	6.0-20	0.05-0.09	5.1-7.3	Low	0.15	4	1	.5-2
	1-22	0-10	1.30-1.60	6.0-20	0.07-0.10	5.1-7.3	Low	0.15			
	22-60	0-10	1.50-1.65	>20	0.02-0.06	7.4-8.4	Low	0.10			
17B, 17D, 17E---- Wallace	0-11	0-8	1.35-1.45	6.0-20	0.05-0.12	4.5-5.5	Low	0.15	1	1	---
	11-21	2-10	1.75-2.05	0.2-0.6	0.02-0.04	4.5-6.0	Low	0.15			
	21-60	0-8	1.45-1.60	6.0-20	0.04-0.05	5.1-6.5	Low	0.15			
18B, 18C, 18D, 18F------------- Blue Lake	0-8	3-12	1.35-1.60	6.0-20	0.10-0.12	5.1-6.5	Low	0.17	5	2	.5-2
	8-16	5-12	1.30-1.60	6.0-20	0.06-0.11	5.1-6.5	Low	0.17			
	16-80	8-15	1.30-1.60	2.0-6.0	0.06-0.12	4.5-7.3	Low	0.17			
20B, 20C, 20D, 20F------------- Mancelona	0-7	0-5	1.35-1.65	6.0-20	0.06-0.09	5.1-7.3	Low	0.15	4	1	.5-2
	7-27	2-15	1.30-1.65	6.0-20	0.06-0.12	5.6-7.8	Low	0.17			
	27-31	10-25	1.30-1.65	2.0-6.0	0.06-0.16	6.1-7.8	Low	0.17			
	31-60	0-10	1.45-1.65	>20	0.02-0.04	7.4-8.4	Low	0.10			

TABLE 18.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH					Pct
21B-------------- Zimmerman	0-4	2-5	1.45-1.65	6.0-20	0.07-0.09	5.1-6.5	Low----------	0.17	5	1	.5-1
	4-60	2-10	1.50-1.70	6.0-20	0.06-0.10	5.1-7.3	Low----------	0.17			
22B, 22C, 22D---- Leelanau	0-6	2-15	1.35-1.60	6.0-20	0.07-0.10	5.6-7.3	Low----------	0.17	5	2	1-2
	6-21	2-15	1.30-1.60	6.0-20	0.05-0.10	5.6-7.3	Low----------	0.17			
	21-42	10-20	1.30-1.70	2.0-6.0	0.06-0.14	6.1-7.3	Low----------	0.24			
	42-60	2-15	1.50-1.70	6.0-20	0.05-0.10	7.4-8.4	Low----------	0.17			
24B, 24C, 24D---- Ocqueoc	0-8	0-10	1.30-1.55	6.0-20	0.07-0.09	4.0-6.5	Low----------	0.15	4	1	1-3
	8-26	0-10	1.15-1.60	6.0-20	0.06-0.12	4.0-6.5	Low----------	0.15			
	26-60	10-27	1.50-1.90	0.2-0.6	0.05-0.21	5.6-8.4	Low----------	0.37			
25B, 25D--------- Eastport	0-1	0-10	1.40-1.60	6.0-20	0.07-0.09	4.5-7.3	Low----------	0.15	5	1	1-2
	1-28	0-10	1.40-1.60	6.0-20	0.06-0.08	5.1-7.8	Low----------	0.15			
	28-60	0-4	1.40-1.55	6.0-20	0.03-0.06	6.6-8.4	Low----------	0.15			
26B, 26C, 26D---- Rubicon	0-8	0-5	1.20-1.45	6.0-20	0.05-0.09	3.6-6.0	Low----------	0.15	5	1	.5-1
	8-26	0-10	1.40-1.65	6.0-20	0.06-0.08	3.6-6.0	Low----------	0.15			
	26-60	0-5	1.55-1.65	6.0-20	0.04-0.06	5.1-6.5	Low----------	0.15			
27B, 27C, 27D, 27F------------- Cheboygan	0-6	5-15	1.20-1.65	6.0-20	0.10-0.12	5.1-7.3	Low----------	0.17	4	2	1-3
	6-22	0-15	1.60-1.75	2.0-6.0	0.06-0.11	5.6-6.5	Low----------	0.15			
	22-28	5-25	1.60-1.75	0.2-0.6	0.12-0.19	5.6-7.3	Low----------	0.28			
	28-60	8-18	1.80-1.95	<0.06	0.02-0.03	7.4-8.4	Low----------	0.28			
29B, 29C--------- Fairport	0-14	10-20	1.35-1.50	0.6-2.0	0.13-0.18	5.1-7.8	Low----------	0.24	4	3	1-3
	14-36	18-35	1.45-1.70	0.2-0.6	0.12-0.20	5.1-8.4	Moderate-----	0.37			
	36	---	---	---	---	---	-------------	----			
30B, 30C, 30D---- Rousseau	0-6	0-10	1.30-1.55	6.0-20	0.07-0.09	4.5-6.0	Low----------	0.15	5	1	1-2
	6-23	0-10	1.30-1.60	6.0-20	0.06-0.08	4.5-6.5	Low----------	0.15			
	23-60	0-10	1.50-1.65	6.0-20	0.05-0.07	5.1-6.5	Low----------	0.15			
31B-------------- Nadeau	0-6	2-15	1.30-1.60	0.6-2.0	0.06-0.15	5.1-7.3	Low----------	0.10	3	8	1-3
	6-18	8-18	1.35-1.60	0.6-2.0	0.04-0.09	5.6-7.8	Low----------	0.17			
	18-60	0-10	1.45-1.65	>20	0.01-0.04	6.6-8.4	Low----------	0.10			
32B, 32C, 32D---- Rubicon	0-6	0-5	1.20-1.45	6.0-20	0.05-0.09	4.5-6.0	Low----------	0.15	5	1	.5-1
	6-37	0-10	1.30-1.45	6.0-20	0.06-0.08	4.5-6.0	Low----------	0.15			
	37-60	0-10	1.40-1.55	6.0-20	0.04-0.06	5.1-6.5	Low----------	0.15			
33B-------------- Ontonagon	0-7	35-40	1.00-1.30	0.2-0.6	0.21-0.23	5.1-7.3	High---------	0.43	3	4	1-3
	7-22	44-60	1.35-1.55	<0.06	0.11-0.13	5.1-7.3	High---------	0.28			
	22-60	15-60	1.30-1.65	<0.06	0.10-0.20	7.9-8.4	High---------	0.43			
33B2------------- Ontonagon	0-6	35-40	1.00-1.30	0.2-0.6	0.21-0.23	5.1-7.3	High---------	0.43	3	4	1-3
	6-20	44-60	1.35-1.55	<0.06	0.11-0.13	5.1-7.3	High---------	0.28			
	20-60	15-60	1.30-1.65	<0.06	0.10-0.20	7.9-8.4	High---------	0.43			
33C2------------- Ontonagon	0-5	35-40	1.00-1.30	0.2-0.6	0.21-0.23	4.5-6.5	High---------	0.43	3	4	1-3
	5-14	60-85	1.35-1.45	<0.06	0.11-0.13	4.5-7.3	High---------	0.28			
	14-60	15-60	1.30-1.65	<0.06	0.10-0.20	7.9-8.4	High---------	0.43			
34B, 34C, 34E---- Alcona	0-7	5-15	1.30-1.60	0.6-6.0	0.12-0.18	5.1-6.5	Low----------	0.24	5	3	1-3
	7-15	5-20	1.35-1.70	0.6-6.0	0.10-0.17	5.1-7.3	Low----------	0.17			
	15-19	10-20	1.35-1.70	0.6-2.0	0.13-0.20	6.6-7.3	Low----------	0.24			
	19-60	5-18	1.35-1.70	0.6-2.0	0.08-0.20	6.6-7.8	Low----------	0.24			

TABLE 18.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH					Pct
37B, 37C, 37D: Emmet	0-12	5-15	1.30-1.65	2.0-6.0	0.12-0.15	6.1-7.3	Low	0.24	5	3	1-3
	12-19	10-18	1.40-1.70	2.0-6.0	0.11-0.14	6.1-6.5	Low	0.24			
	19-27	15-25	1.80-2.00	0.2-0.6	0.11-0.18	6.1-7.8	Moderate	0.32			
	27-60	8-18	1.80-2.00	0.2-0.6	0.11-0.14	7.4-8.4	Low	0.28			
38B, 38C, 38E: Onaway	0-4	10-22	1.30-1.55	0.6-2.0	0.14-0.20	5.1-7.8	Low	0.32	4	5	1-3
	4-18	10-20	1.40-1.70	2.0-6.0	0.12-0.14	5.1-7.8	Low	0.24			
	18-32	18-35	1.40-1.70	0.2-0.6	0.12-0.18	5.6-7.8	Low	0.32			
	32-60	5-25	1.45-1.70	0.2-0.6	0.17-0.19	7.4-8.4	Low	0.32			
39B, 39C: Nester	0-9	7-27	1.25-1.60	0.6-2.0	0.20-0.24	5.1-7.3	Low	0.32	3	5	1-3
	9-12	5-30	1.40-1.60	0.6-2.0	0.15-0.22	5.1-7.3	Low	0.32			
	12-37	35-45	1.40-1.65	0.06-0.2	0.08-0.17	5.1-7.3	Moderate	0.32			
	37-60	30-40	1.55-1.70	0.06-0.2	0.10-0.17	7.9-8.4	Moderate	0.32			
40B: Ontonagon	0-11	20-27	1.00-1.30	0.6-2.0	0.21-0.23	4.5-7.3	Low	0.43	3	6	1-3
	11-19	60-85	1.35-1.45	<0.06	0.11-0.13	4.5-7.3	High	0.28			
	19-60	50-60	1.35-1.45	<0.06	0.11-0.13	7.4-8.4	High	0.28			
40D2: Ontonagon	0-6	40-60	1.00-1.30	0.06-0.2	0.12-0.14	4.5-6.5	High	0.28	3	4	1-3
	6-9	60-85	1.35-1.45	<0.06	0.11-0.13	4.5-7.3	High	0.28			
	9-60	50-60	1.35-1.45	<0.06	0.11-0.13	7.4-8.4	High	0.28			
41A: Au Gres	0-11	0-8	1.30-1.55	6.0-20	0.07-0.10	3.6-7.3	Low	0.15	5	1	.5-8
	11-37	1-15	1.50-1.70	6.0-20	0.06-0.09	4.5-7.3	Low	0.15			
	37-60	0-8	1.50-1.70	6.0-20	0.05-0.07	5.1-7.3	Low	0.15			
43A: Battlefield	0-5	0-10	1.25-1.45	6.0-20	0.06-0.09	4.5-6.0	Low	0.15	5	1	1-3
	5-32	0-8	1.40-1.60	6.0-20	0.06-0.11	4.5-6.0	Low	0.15			
	32-60	0-5	1.25-1.50	>20	0.03-0.04	6.6-7.8	Low	0.10			
45B: Croswell	0-7	0-10	1.30-1.55	6.0-20	0.06-0.09	3.6-6.5	Low	0.15	5	1	.5-2
	7-16	0-10	1.40-1.60	6.0-20	0.06-0.10	4.5-7.3	Low	0.15			
	16-60	0-10	1.50-1.65	6.0-20	0.05-0.07	5.1-8.4	Low	0.15			
47A: Ingalls	0-8	2-10	1.25-1.40	6.0-20	0.07-0.10	5.1-7.3	Low	0.17	5	2	.5-3
	8-22	3-15	1.35-1.45	6.0-20	0.05-0.10	5.1-7.3	Low	0.17			
	22-60	2-25	1.45-1.80	0.2-0.6	0.09-0.22	5.6-8.4	Low	0.43			
48A: Allendale	0-9	0-10	1.25-1.40	6.0-20	0.07-0.09	4.5-7.3	Low	0.15	4	1	1-3
	9-25	0-15	1.35-1.45	6.0-20	0.06-0.10	4.5-7.8	Low	0.17			
	25-60	40-60	1.45-1.70	<0.06	0.08-0.12	6.1-8.4	Moderate	0.32			
49A: Finch	0-9	0-8	0.40-1.40	6.0-20	0.07-0.09	4.5-7.3	Low	0.15	2	1	2-7
	9-30	5-10	1.75-2.05	0.06-0.2	0.02-0.04	4.5-7.3	Low	0.15			
	30-60	0-10	1.40-1.55	6.0-20	0.02-0.04	5.6-7.8	Low	0.15			
50A: Bonduel	0-4	5-15	1.35-1.55	0.6-2.0	0.10-0.12	6.6-7.8	Low	0.24	4	5	2-3
	4-9	5-18	1.45-1.55	0.6-2.0	0.16-0.22	6.6-7.8	Low	0.32			
	9-17	20-40	1.55-1.65	0.6-2.0	0.15-0.22	6.6-8.4	Moderate	0.32			
	17	---	---	---	---	---	---	----			
51A: Otisco	0-7	0-10	1.25-1.40	6.0-20	0.07-0.09	4.5-6.5	Low	0.15	5	1	2-4
	7-29	2-12	1.25-1.40	2.0-20	0.06-0.11	5.1-6.5	Low	0.17			
	29-60	5-22	1.35-1.45	2.0-6.0	0.05-0.17	5.1-7.8	Low	0.17			
52A: Ogemaw	0-13	2-10	1.10-1.50	6.0-20	0.06-0.09	4.5-6.5	Low	0.15	2	1	2-8
	13-33	8-18	1.75-2.05	0.06-0.2	0.02-0.04	4.5-6.5	Low	0.17			
	33-60	18-35	1.50-1.70	0.06-0.6	0.04-0.06	6.1-8.4	Moderate	0.32			

TABLE 18.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH					Pct
55A------------- Solona	0-7	5-20	1.35-1.70	0.6-2.0	0.10-0.18	6.6-7.8	Low----------	0.24	5	3	1-3
	7-19	12-18	1.45-1.65	0.6-2.0	0.09-0.19	6.6-7.8	Low----------	0.24			
	19-60	5-20	1.45-1.70	0.2-0.6	0.11-0.13	7.4-8.4	Low----------	0.37			
56A------------- Riggsville	0-9	5-15	1.30-1.65	6.0-20	0.10-0.12	4.5-7.3	Low----------	0.17	4	2	1-3
	9-16	5-15	1.30-1.65	2.0-6.0	0.07-0.11	4.5-6.5	Low----------	0.17			
	16-30	5-25	1.60-1.70	0.6-2.0	0.11-0.17	5.6-7.3	Low----------	0.28			
	30-60	8-18	1.80-1.95	<0.06	0.02-0.03	6.6-8.4	Low----------	0.28			
57A------------- Brimley	0-11	10-20	1.35-1.50	0.6-2.0	0.16-0.22	5.6-7.3	Low----------	0.32	5	3	1-3
	11-25	10-20	1.45-1.70	0.6-2.0	0.16-0.24	5.6-7.3	Low----------	0.32			
	25-60	10-27	1.45-1.70	0.2-0.6	0.10-0.22	7.4-8.4	Low----------	0.43			
58A------------- Alstad	0-6	7-18	1.35-1.60	0.6-2.0	0.20-0.24	5.1-7.3	Low----------	0.37	5	5	2-4
	6-9	6-16	1.55-1.65	0.6-2.0	0.12-0.24	5.1-7.3	Low----------	0.32			
	9-15	18-35	1.55-1.70	0.6-2.0	0.13-0.19	5.1-7.8	Low----------	0.32			
	15-60	8-23	1.60-1.80	0.2-0.6	0.09-0.19	5.6-9.0	Low----------	0.32			
60A------------- Rudyard	0-10	15-27	1.00-1.60	0.6-2.0	0.20-0.24	5.1-7.3	Moderate-----	0.37	3	5	3-4
	10-17	60-85	1.10-1.40	<0.06	0.11-0.13	5.1-7.3	High---------	0.28			
	17-60	50-60	1.35-1.45	<0.06	0.10-0.12	7.4-8.4	High---------	0.28			
61--------------- Roscommon	0-6	---	0.30-0.40	0.2-6.0	0.35-0.45	5.6-7.8	--------------	----	5	2	40-60
	6-60	0-10	1.45-1.70	6.0-20	0.05-0.09	5.6-8.4	Low----------	0.17			
62--------------- Wheatley	0-7	5-15	1.20-1.60	2.0-6.0	0.10-0.12	6.1-7.8	Low----------	0.17	3	2	4-8
	7-26	2-10	1.45-1.70	6.0-20	0.06-0.08	6.1-8.4	Low----------	0.15			
	26-60	0-10	1.55-1.70	>20	0.02-0.04	7.4-8.4	Low----------	0.10			
63--------------- Brevort	0-5	2-15	0.90-1.30	2.0-6.0	0.12-0.17	6.1-7.8	Low----------	0.17	5	2	10-15
	5-22	2-15	1.40-1.55	2.0-20	0.05-0.11	6.1-7.8	Low----------	0.17			
	22-60	10-35	1.45-1.80	0.2-0.6	0.14-0.22	7.4-8.4	Moderate-----	0.43			
64--------------- Burleigh	0-8	0-8	0.90-1.20	6.0-20	0.20-0.30	6.1-7.8	Low----------	0.15	5	1	8-12
	8-34	2-10	1.40-1.55	6.0-20	0.06-0.09	6.1-8.4	Low----------	0.17			
	34-60	10-28	1.45-1.80	0.2-0.6	0.05-0.20	7.4-8.4	Low----------	0.43			
66--------------- Pinconning	0-9	2-12	1.00-1.20	6.0-20	0.12-0.14	5.6-7.8	Low----------	0.17	4	2	10-15
	9-16	2-12	1.40-1.55	6.0-20	0.06-0.11	6.1-7.8	Low----------	0.17			
	16-60	35-60	1.50-1.70	<0.2	0.08-0.12	7.4-8.4	High---------	0.32			
67--------------- Kinross	0-5	0-10	1.10-1.20	6.0-20	0.12-0.17	3.6-5.0	Low----------	0.15	5	1	10-15
	5-12	0-10	1.40-1.70	6.0-20	0.04-0.09	3.6-6.0	Low----------	0.15			
	12-60	0-10	1.40-1.70	6.0-20	0.04-0.06	4.5-6.5	Low----------	0.15			
70*:											
Au Gres---------	0-11	0-8	1.30-1.55	6.0-20	0.07-0.10	3.6-7.3	Low----------	0.15	5	1	.5-8
	11-37	1-15	1.50-1.70	6.0-20	0.06-0.09	4.5-7.3	Low----------	0.15			
	37-60	0-8	1.50-1.70	6.0-20	0.05-0.07	5.1-7.3	Low----------	0.15			
Roscommon-------	0-6	---	0.30-0.40	0.2-6.0	0.35-0.45	5.6-7.8	--------------	----	5	2	40-60
	6-60	0-10	1.45-1.70	6.0-20	0.05-0.09	5.6-8.4	Low----------	0.17			
71--------------- Bowstring	0-12	0-5	0.15-0.30	0.2-6.0	0.35-0.45	5.6-8.4	--------------	----	4	8	40-90
	12-17	1-12	1.40-1.60	0.6-20	0.08-0.14	5.6-8.4	Low----------	----			
	17-60	0-5	0.15-0.30	0.2-6.0	0.35-0.45	5.6-8.4	--------------	----			
77--------------- Bruce	0-5	5-18	1.15-1.50	0.6-2.0	0.16-0.22	6.1-7.8	Low----------	0.28	5	3	2-6
	5-15	8-22	1.30-1.60	0.6-2.0	0.16-0.24	6.1-7.8	Low----------	0.28			
	15-24	18-27	1.35-1.70	0.2-0.6	0.20-0.24	6.6-8.4	Low----------	0.28			
	24-60	8-27	1.35-1.70	0.2-0.6	0.10-0.18	7.4-8.4	Low----------	0.43			

See footnote at end of table.

TABLE 18.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH					Pct
78----------------- Angelica	0-3	5-20	1.15-1.60	0.6-2.0	0.12-0.15	6.1-7.8	Low-----------	0.24	5	3	2-4
	3-6	18-35	1.50-1.80	0.6-2.0	0.10-0.18	6.1-7.8	Low-----------	0.32			
	6-10	18-35	1.50-1.80	0.2-0.6	0.10-0.20	7.9-8.4	Moderate------	0.32			
	10-60	5-20	1.45-1.95	0.2-0.6	0.17-0.20	7.9-8.4	Low-----------	0.32			
79----------------- Charity	0-8	8-20	1.00-1.25	0.6-2.0	0.10-0.18	6.6-8.4	Low-----------	0.24	3	3	3-6
	8-9	15-30	1.10-1.35	0.6-2.0	0.14-0.19	7.9-8.4	Moderate------	0.24			
	9-60	35-45	1.30-1.55	<0.06	0.11-0.21	7.9-8.4	Moderate------	0.37			
81----------------- Udipsamments	0-60	0-10	1.35-1.65	>6.0	0.05-0.09	5.1-6.5	Low-----------	0.15	5	1	<1
82----------------- Udorthents	0-60	---	---	---	---	---	--------------	----	---	---	---
83*, 84*. Pits											
85*:											
Histosols--------	0-51	---	---	---	---	---	--------------	----	2	2	---
	51-60	---	---	---	---	---	--------------	----			
Aquents----------	0-60	---	---	---	---	---	--------------	----	---	---	---
87*. Beaches											
141A--------------- Finch	0-10	0-8	1.15-1.40	6.0-20	0.07-0.09	4.5-6.5	Low-----------	0.10	2	8	2-4
	10-39	5-10	1.75-2.05	0.06-0.2	0.05-0.10	4.5-6.5	Low-----------	0.15			
	39-60	0-10	1.40-1.55	6.0-20	0.05-0.10	5.6-6.5	Low-----------	0.15			
158A--------------- Detour	0-5	10-20	1.30-1.65	2.0-6.0	0.05-0.16	5.6-7.3	Low-----------	0.17	3	8	2-3
	5-19	18-30	1.40-1.80	0.6-2.0	0.10-0.14	6.6-7.8	Low-----------	0.24			
	19-60	18-25	1.80-2.00	0.06-0.2	0.01-0.03	7.4-8.4	Low-----------	0.24			
179---------------- Hessel	0-9	8-15	1.15-1.50	2.0-6.0	0.16-0.20	6.1-7.8	Low-----------	0.32	3	5	3-12
	9-10	10-30	1.75-1.80	0.6-2.0	0.07-0.17	7.4-8.4	Low-----------	0.24			
	10-60	12-18	1.75-1.95	0.2-0.6	0.04-0.16	7.9-8.4	Low-----------	0.24			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 19.--WATER FEATURES

("Flooding" and "water table" and terms such as "frequent," "long," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydrologic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months
					Ft		
2. Lupton	A/D	None	---	---	+1-1.0	Apparent	Sep-May
5. Loxley	A/D	None	---	---	+1-1.0	Apparent	Nov-May
7. Grousehaven Variant	D	Occasional	Long	Mar-May	+1-1.0	Apparent	Jan-Dec
8. Tawas	A/D	None	---	---	+1-1.0	Apparent	Nov-May
9. Greenwood	A/D	None	---	---	+1-1.0	Apparent	Sep-Jun
10. Dawson	A/D	None	---	---	+1-1.0	Apparent	Sep-Jun
11B, 11C, 11D, 11F. Kalkaska	A	None	---	---	>6.0	---	---
12B. Grayling	A	None	---	---	>6.0	---	---
13B, 13C, 13D, 13F. Rubicon	A	None	---	---	>6.0	---	---
16B, 16C, 16D, 16F. East Lake	A	None	---	---	>6.0	---	---
17B, 17D, 17E. Wallace	B	None	---	---	>6.0	---	---
18B, 18C, 18D, 18F. Blue Lake	A	None	---	---	>6.0	---	---
20B, 20C, 20D, 20F. Mancelona	A	None	---	---	>6.0	---	---
21B. Zimmerman	A	None	---	---	>6.0	---	---
22B, 22C, 22D. Leelanau	A	None	---	---	>6.0	---	---
24B, 24C, 24D. Ocqueoc	A	None	---	---	>6.0	---	---
25B, 25D. Eastport	A	None	---	---	>6.0	---	---
26B, 26C, 26D. Rubicon	A	None	---	---	>6.0	---	---
27B. Cheboygan	B	None	---	---	2.0-3.0	Perched	Apr-Jul

TABLE 19.--WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months
					Ft		
27C, 27D, 27F: Cheboygan	B	None	---	---	>6.0	---	---
29B, 29C: Fairport	C	None	---	---	>6.0	---	---
30B, 30C, 30D: Rousseau	A	None	---	---	>6.0	---	---
31B: Nadeau	B	None	---	---	>6.0	---	---
32B, 32C, 32D: Rubicon	A	None	---	---	>6.0	---	---
33B, 33B2: Ontonagon	D	None	---	---	2.5-6.0	Apparent	Mar-May
33C2: Ontonagon	D	None	---	---	>6.0	---	---
34B, 34C, 34E: Alcona	B	None	---	---	>6.0	---	---
37B, 37C, 37D: Emmet	B	None	---	---	>6.0	---	---
38B, 38C, 38E: Onaway	B	None	---	---	>6.0	---	---
39B, 39C: Nester	C	None	---	---	>6.0	---	---
40B: Ontonagon	D	None	---	---	2.5-6.0	Apparent	Mar-May
40D2: Ontonagon	D	None	---	---	>6.0	---	---
41A: Au Gres	B	None	---	---	0.5-1.5	Apparent	Nov-May
43A: Battlefield	A/D	None	---	---	0.5-1.5	Apparent	Dec-May
45B: Croswell	A	None	---	---	2.0-4.0	Apparent	Nov-May
47A: Ingalls	B	None	---	---	0.5-1.5	Apparent	Nov-May
48A: Allendale	B	None	---	---	1.0-2.0	Apparent	Nov-May
49A: Finch	C	None	---	---	0.5-1.5	Perched	Dec-Jun
50A: Bonduel	C	None	---	---	1.0-1.5	Apparent	Sep-Jun
51A: Otisco	A	None	---	---	0.5-1.5	Apparent	Nov-May

TABLE 19.--WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months
					Ft		
52A: Ogemaw	C/D	None	---	---	0.5-1.5	Perched	Nov-May
55A: Solona	C	None	---	---	1.0-3.0	Apparent	Mar-Jul
56A: Riggsville	C	None	---	---	1.0-2.0	Apparent	Nov-May
57A: Brimley	B	None	---	---	1.0-2.0	Apparent	Nov-May
58A: Alstad	C	None	---	---	1.0-3.0	Perched	Nov-May
60A: Rudyard	D	None	---	---	0.5-1.5	Perched	Nov-May
61: Roscommon	A/D	None	---	---	+1-1.0	Apparent	Sep-Jun
62: Wheatley	A/D	None	---	---	+1-1.0	Apparent	Oct-May
63: Brevort	B/D	None	---	---	+1-1.0	Apparent	Nov-May
64: Burleigh	A/D	None	---	---	+1-1.0	Apparent	Oct-May
66: Pinconning	B/D	None	---	---	+1-1.0	Apparent	Oct-May
67: Kinross	A/D	None	---	---	+1-1.0	Apparent	Sep-Jun
70*:							
Au Gres	B	None	---	---	0.5-1.5	Apparent	Nov-May
Roscommon	A/D	None	---	---	+1-1.0	Apparent	Sep-Jun
71: Bowstring	A/D	Frequent	Long	Mar-Jun	0-2.0	Apparent	Oct-Jun
77: Bruce	B/D	None	---	---	+1-1.0	Apparent	Nov-May
78: Angelica	B/D	None	---	---	+1-1.0	Apparent	Oct-Jun
79: Charity	D	None	---	---	+1-1.0	Apparent	Sep-Jun
81: Udipsamments	A	None	---	---	>6.0	---	---
82: Udorthents	---	None	---	---	>6.0	---	---
83*, 84*. Pits							

See footnote at end of table.

TABLE 19.--WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table		
		Frequency	Duration	Months	Depth	Kind	Months
					Ft		
85*:							
Histosols	B/D	Frequent	Long	Jan-Dec	+1-1.0	Apparent	Sep-Jun
Aquents	---	None	---	---	+1-1.0	Apparent	Oct-May
87*. Beaches							
141A Finch	C	None	---	---	0.5-1.5	Perched	Dec-Jun
158A Detour	B	None	---	---	0.5-2.0	Apparent	Nov-May
179 Hessel	B/D	None	---	---	+1-1.0	Apparent	Nov-Jun

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 20.--SOIL FEATURES

(The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Bedrock		Cemented pan		Total subsidence	Potential frost action	Risk of corrosion	
	Depth	Hardness	Depth	Hardness			Uncoated steel	Concrete
	In		In		In			
2----------------------- Lupton	>60	---	---	---	50-55	High-----	High-----	Low.
5----------------------- Loxley	>60	---	---	---	50-55	High-----	High-----	High.
7----------------------- Grousehaven Variant	>60	---	---	---	---	High-----	High-----	Low.
8----------------------- Tawas	>60	---	---	---	25-30	High-----	High-----	Moderate.
9----------------------- Greenwood	>60	---	---	---	---	High-----	High-----	High.
10---------------------- Dawson	>60	---	---	---	30-36	High-----	High-----	High.
11B, 11C, 11D, 11F------ Kalkaska	>60	---	---	---	---	Low------	Low------	High.
12B--------------------- Grayling	>60	---	---	---	---	Low------	Low------	Moderate.
13B, 13C, 13D, 13F------ Rubicon	>60	---	---	---	---	Low------	Low------	High.
16B, 16C, 16D, 16F------ East Lake	>60	---	---	---	---	Low------	Low------	Moderate.
17B, 17D, 17E----------- Wallace	>60	---	6-15	Thin	---	Low------	Low------	High.
18B, 18C, 18D, 18F------ Blue Lake	>60	---	---	---	---	Low------	Low------	Moderate.
20B, 20C, 20D, 20F------ Mancelona	>60	---	---	---	---	Low------	Low------	Low.
21B--------------------- Zimmerman	>60	---	---	---	---	Low------	Low------	High.
22B, 22C, 22D----------- Leelanau	>60	---	---	---	---	Low------	Low------	Low.
24B, 24C, 24D----------- Ocqueoc	>60	---	---	---	---	Low------	Low------	Moderate.
25B, 25D---------------- Eastport	>60	---	---	---	---	Low------	Low------	Moderate.
26B, 26C, 26D----------- Rubicon	>60	---	---	---	---	Low------	Low------	High.
27B, 27C, 27D, 27F------ Cheboygan	>60	---	---	---	---	Moderate	Moderate	Moderate.

TABLE 20.--SOIL FEATURES--Continued

Soil name and map symbol	Bedrock		Cemented pan		Total subsidence	Potential frost action	Risk of corrosion	
	Depth	Hardness	Depth	Hardness			Uncoated steel	Concrete
	In		In		In			
29B, 29C----------------- Fairport	20-40	Hard	---	---	---	Moderate	Moderate	Low.
30B, 30C, 30D------------ Rousseau	>60	---	---	---	---	Low------	Low------	Moderate.
31B---------------------- Nadeau	>60	---	---	---	---	Moderate	Low------	Low.
32B, 32C, 32D------------ Rubicon	>60	---	---	---	---	Low------	Low------	High.
33B, 33B2, 33C2---------- Ontonagon	>60	---	---	---	---	Moderate	High-----	Low.
34B, 34C, 34E------------ Alcona	>60	---	---	---	---	Moderate	Low------	Low.
37B, 37C, 37D------------ Emmet	>60	---	---	---	---	Moderate	Low------	Moderate.
38B, 38C, 38E------------ Onaway	>60	---	---	---	---	Moderate	Low------	Moderate.
39B, 39C----------------- Nester	>60	---	---	---	---	Moderate	High-----	Low.
40B---------------------- Ontonagon	>60	---	---	---	---	Moderate	High-----	Low.
40D2--------------------- Ontonagon	>60	---	---	---	---	Moderate	High-----	Moderate.
41A---------------------- Au Gres	>60	---	---	---	---	Moderate	Low------	Moderate.
43A---------------------- Battlefield	>60	---	---	---	---	Moderate	Low------	Low.
45B---------------------- Croswell	>60	---	---	---	---	Low------	Low------	Moderate.
47A---------------------- Ingalls	>60	---	---	---	---	Moderate	Moderate	Moderate.
48A---------------------- Allendale	>60	---	---	---	---	Moderate	High-----	Moderate.
49A---------------------- Finch	>60	---	9-16	Thin	---	Moderate	High-----	Moderate.
50A---------------------- Bonduel	15-20	Hard	---	---	---	High-----	Moderate	Low.
51A---------------------- Otisco	>60	---	---	---	---	Moderate	Low------	Moderate.
52A---------------------- Ogemaw	>60	---	10-15	Thin	---	Moderate	High-----	Moderate.
55A---------------------- Solona	>60	---	---	---	---	High-----	High-----	Low.

TABLE 20.--SOIL FEATURES--Continued

Soil name and map symbol	Bedrock		Cemented pan		Total subsidence	Potential frost action	Risk of corrosion	
	Depth	Hardness	Depth	Hardness			Uncoated steel	Concrete
	In		In		In			
56A------ Riggsville	>60	---	---	---	---	Moderate	Low------	Moderate.
57A------ Brimley	>60	---	---	---	---	High-----	High-----	Low.
58A------ Alstad	>60	---	---	---	---	High-----	Moderate	Moderate.
60A------ Rudyard	>60	---	---	---	---	Moderate	High-----	Low.
61------ Roscommon	>60	---	---	---	---	Moderate	High-----	Low.
62------ Wheatley	>60	---	---	---	---	Moderate	High-----	Low.
63------ Brevort	>60	---	---	---	---	Moderate	High-----	Moderate.
64------ Burleigh	>60	---	---	---	---	Moderate	High-----	Low.
66------ Pinconning	>60	---	---	---	---	Moderate	High-----	Moderate.
67------ Kinross	>60	---	---	---	---	Moderate	High-----	Moderate.
70*:								
Au Gres------	>60	---	---	---	---	Moderate	Low------	Moderate.
Roscommon------	>60	---	---	---	---	Moderate	High-----	Low.
71------ Bowstring	>60	---	---	---	20-30	High-----	High-----	Low.
77------ Bruce	>60	---	---	---	---	High-----	High-----	Low.
78------ Angelica	>60	---	---	---	---	High-----	High-----	Low.
79------ Charity	>60	---	---	---	---	High-----	Moderate	Low.
81------ Udipsamments	>60	---	---	---	---	Low------	Low------	Moderate.
82------ Udorthents	>60	---	---	---	---	---	---	---
83*, 84*. Pits								
85*:								
Histosols------	>60	---	---	---	---	High-----	---	---
Aquents------	>60	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 20.--SOIL FEATURES--Continued

Soil name and map symbol	Bedrock		Cemented pan		Total subsidence	Potential frost action	Risk of corrosion	
	Depth	Hardness	Depth	Hardness			Uncoated steel	Concrete
	In		In		In			
87*. Beaches								
141A---------------------- Finch	>60	---	9-16	Thin	---	Moderate	High-----	High.
158A---------------------- Detour	>60	---	---	---	---	High-----	High-----	Low.
179----------------------- Hessel	>60	---	---	---	---	High-----	High-----	Low.

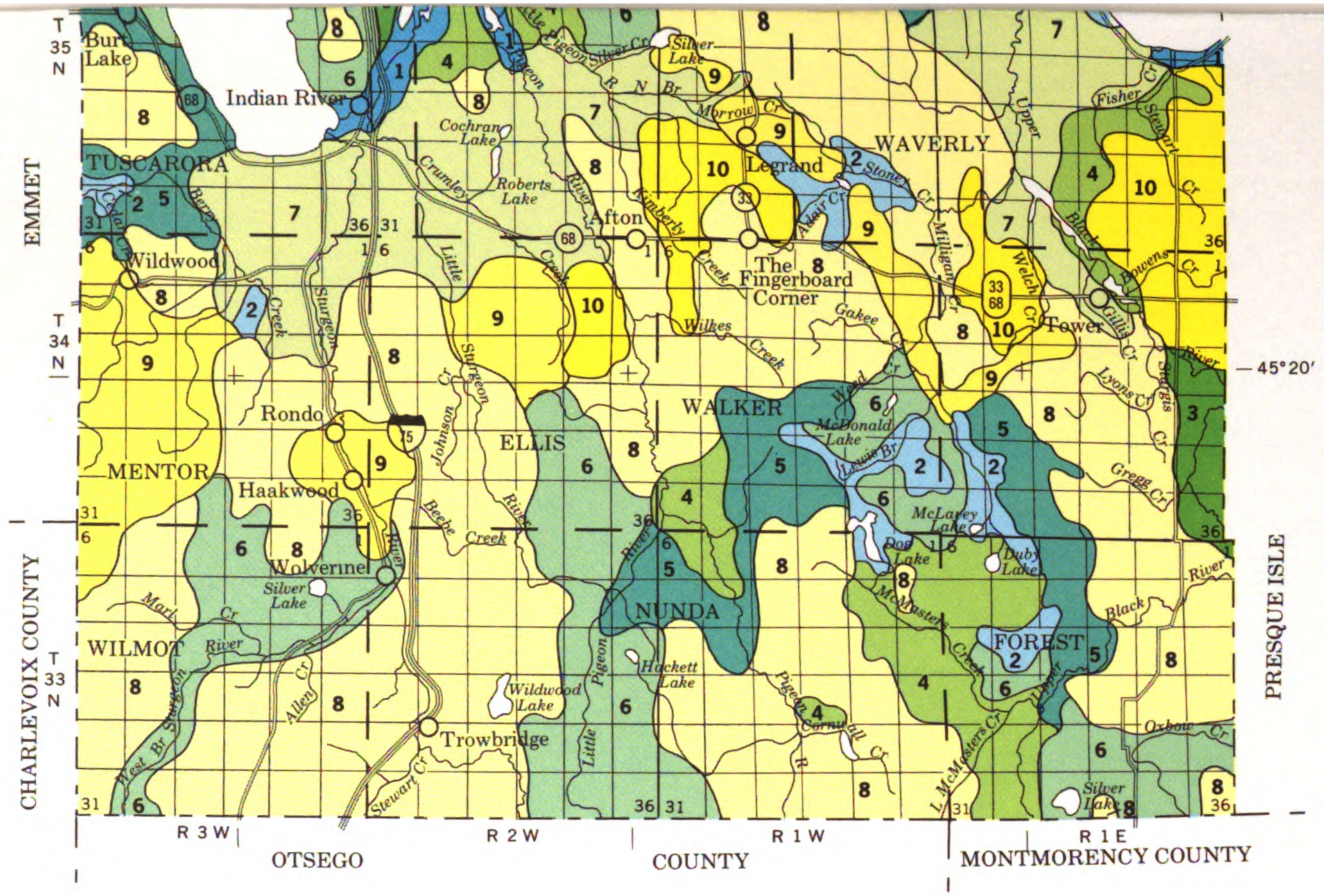
* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 21.--CLASSIFICATION OF THE SOILS

(An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series)

Soil name	Family or higher taxonomic class
*Alcona	Coarse-loamy, mixed, frigid Alfic Haplorthods
*Allendale	Sandy over clayey, mixed, frigid Alfic Haplaquods
Alstad	Fine-loamy, mixed Aquic Eutroboralfs
*Angelica	Fine-loamy, mixed, nonacid, frigid Aeric Haplaquepts
Aquents	Mixed, nonacid, frigid Aquents
Au Gres	Sandy, mixed, frigid Entic Haplaquods
Battlefield	Sandy, mixed, frigid Entic Sideraquods
Blue Lake	Sandy, mixed, frigid Alfic Haplorthods
*Bonduel	Fine-loamy, mixed Aquic Eutroboralfs
Bowstring	Euic Fluvaquentic Borosaprists
*Brevort	Sandy over loamy, mixed, nonacid, frigid Mollic Haplaquents
*Brimley	Fine-loamy, mixed, frigid Alfic Haplaquods
*Bruce	Fine-loamy, mixed, nonacid, frigid Mollic Haplaquepts
*Burleigh	Sandy over loamy, mixed, nonacid, frigid Mollic Haplaquents
Charity	Fine-silty, mixed (calcareous), frigid Typic Haplaquolls
Cheboygan	Coarse-loamy, mixed, frigid Alfic Haplorthods
Croswell	Sandy, mixed, frigid Entic Haplorthods
Dawson	Sandy or sandy-skeletal, mixed, dysic Terric Borosaprists
*Detour	Fine-loamy, mixed, frigid Aquic Eutrochrepts
East Lake	Sandy, mixed, frigid Entic Haplorthods
Eastport	Mixed, frigid Spodic Udipsamments
Emmet	Coarse-loamy, mixed Typic Eutroboralfs
*Fairport	Fine-loamy, mixed Typic Eutroboralfs
Finch	Sandy, mixed, frigid, ortstein Aeric Haplaquods
Grayling	Mixed, frigid Typic Udipsamments
Greenwood	Mixed, dysic Typic Borohemists
Grousehaven Variant	Fine-silty over sandy or sandy-skeletal, carbonatic, frigid Histic Humaquepts
Hessel	Coarse-loamy, mixed (calcareous), frigid Typic Haplaquolls
Histosols	Euic, frigid Histosols
Ingalls	Sandy over loamy, mixed, frigid Entic Haplaquods
Kalkaska	Sandy, mixed, frigid Typic Haplorthods
Kinross	Sandy, mixed, frigid Typic Haplaquods
Leelanau	Sandy, mixed, frigid Alfic Haplorthods
*Loxley	Dysic Typic Borosaprists
Lupton	Mixed, euic Typic Borosaprists
Mancelona	Sandy, mixed, frigid Alfic Haplorthods
*Nadeau	Coarse-loamy, mixed Typic Eutroboralfs
*Nester	Fine, mixed Typic Eutroboralfs
Ocqueoc	Sandy over loamy, mixed, frigid Entic Haplorthods
*Ogemaw	Sandy over loamy, mixed, frigid, ortstein Aquic Haplorthods
Onaway	Fine-loamy, mixed Typic Eutroboralfs
Ontonagon	Very fine, mixed Glossic Eutroboralfs
Otisco	Sandy, mixed, frigid Alfic Haplaquods
*Pinconning	Sandy over clayey, mixed, nonacid, frigid Mollic Haplaquents
Riggsville	Coarse-loamy, mixed, frigid Alfic Haplaquods
*Roscommon	Mixed, frigid Mollic Psammaquents
Rousseau	Sandy, mixed, frigid Entic Haplorthods
Rubicon	Sandy, mixed, frigid Entic Haplorthods
*Rudyard	Very fine, illitic Aquic Eutroboralfs
Solona	Coarse-loamy, mixed Aquic Eutroboralfs
Tawas	Sandy or sandy-skeletal, mixed, euic Terric Borosaprists
Udipsamments	Mixed, frigid Udipsamments
Udorthents	Loamy, mixed, frigid Udorthents
Wallace	Sandy, mixed, frigid, ortstein Typic Haplorthods
Wheatley	Mixed, frigid Mollic Psammaquents
Zimmerman	Mixed, frigid Alfic Udipsamments

* U.S. GOVERNMENT PRINTING OFFICE: 1991-281-364/40025



SECTIONALIZED TOWNSHIP

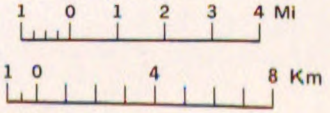
6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
MICHIGAN DEPARTMENT OF AGRICULTURE
MICHIGAN AGRICULTURAL EXPERIMENT STATION
MICHIGAN TECHNOLOGICAL UNIVERSITY

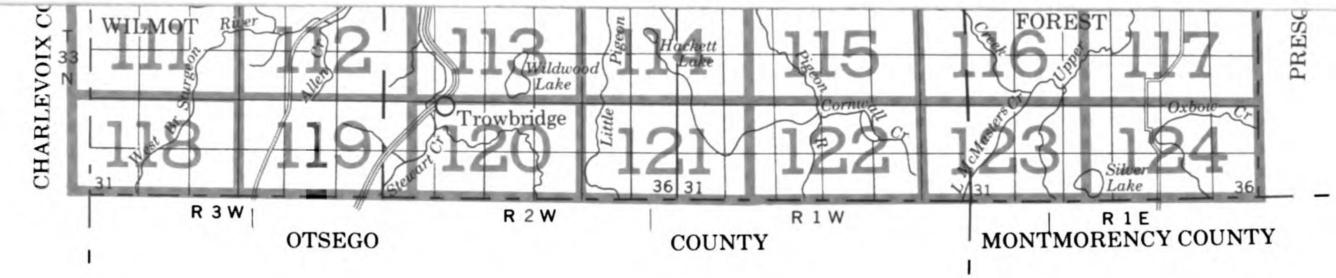
GENERAL SOIL MAP

CHEBOYGAN COUNTY, MICHIGAN

Scale 1:253,440



Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.



INDEX TO MAP SHEETS

CHEBOYGAN COUNTY, MICHIGAN

Scale 1:253,440

MICHIGAN DEPARTMENT OF AGRICULTURE
MICHIGAN AGRICULTURAL EXPERIMENT STATION
MICHIGAN TECHNOLOGICAL UNIVERSITY

ONVENTIONAL AND SPECIAL SYMBOLS LEGEND

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label) — Indian Mound
- Located object (label) — Tower
- Tank (label) — Gas
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double-line (label) — CANAL
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial — water, w
- Intermittent — int, i

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS — 16F 17B

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

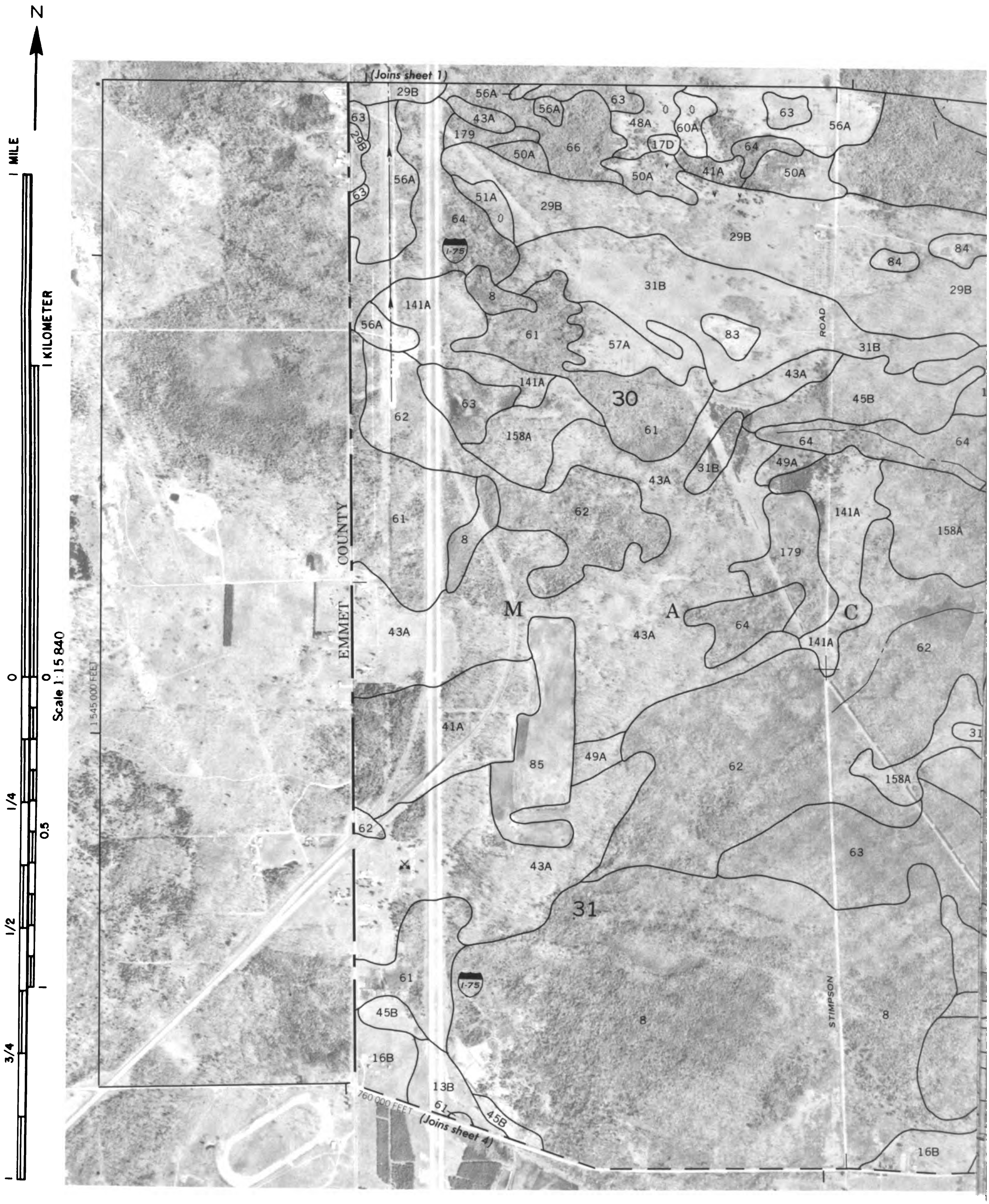
GULLY

DEPRESSION OR SINK

SOIL SAMPLE (normally not shown) — S

MISCELLANEOUS

- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot
- Marl (< 3 ac.)
- Wet depression or sink
- Loamy spot (< 3 ac.)
- Organic spot (< 3 ac.)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1 MILE
1 KILOMETER
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1 545 000 FEET
EMMET COUNTY
M A C
ROAD
STIMPSON
I-75
30
31
29B
56A
63
43A
179
48A
60A
17D
50A
66
64
41A
51A
84
141A
8
61
57A
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31B
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158A
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45B
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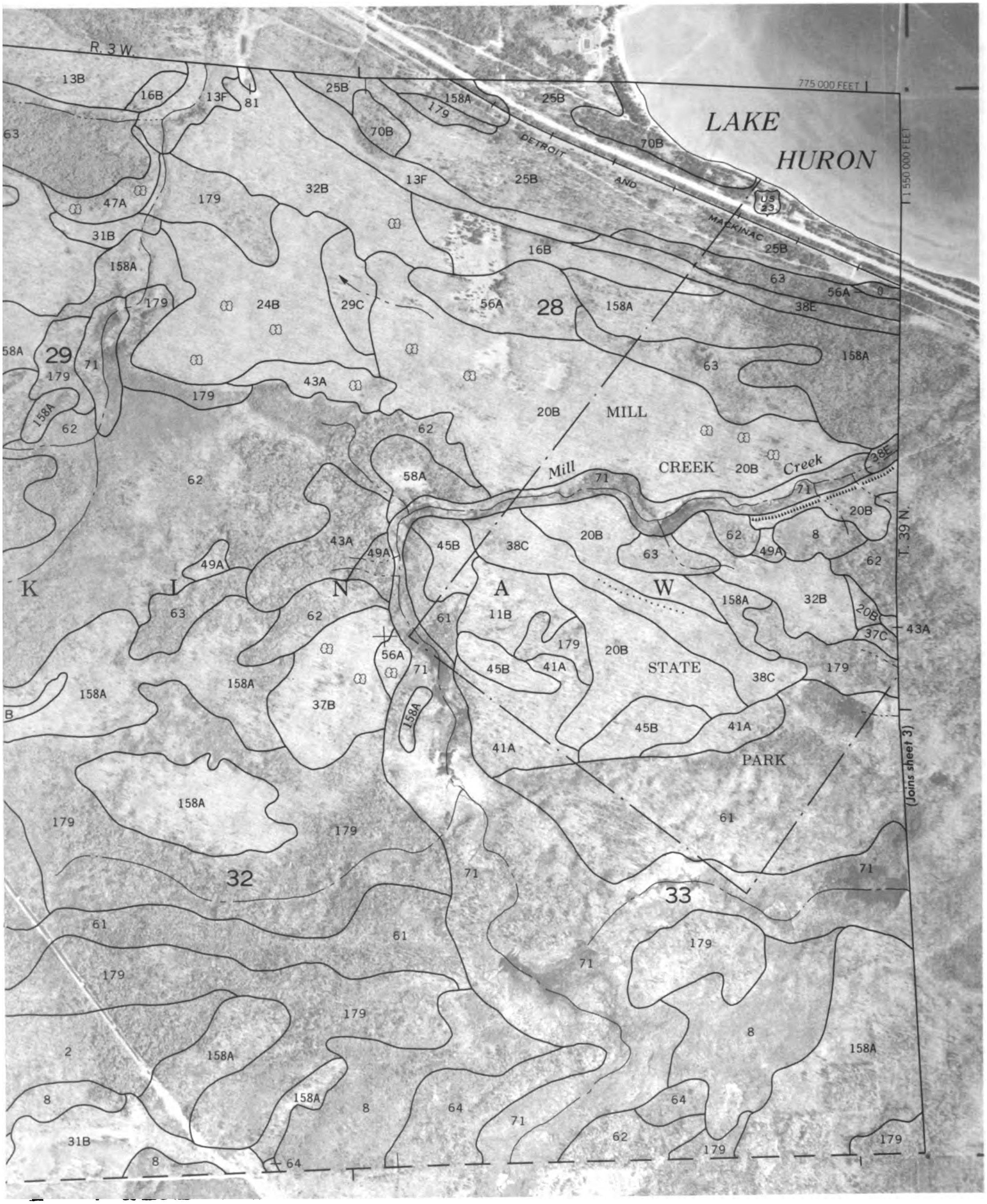
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DETROIT AND MACKINAC
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29
32
33
MILL
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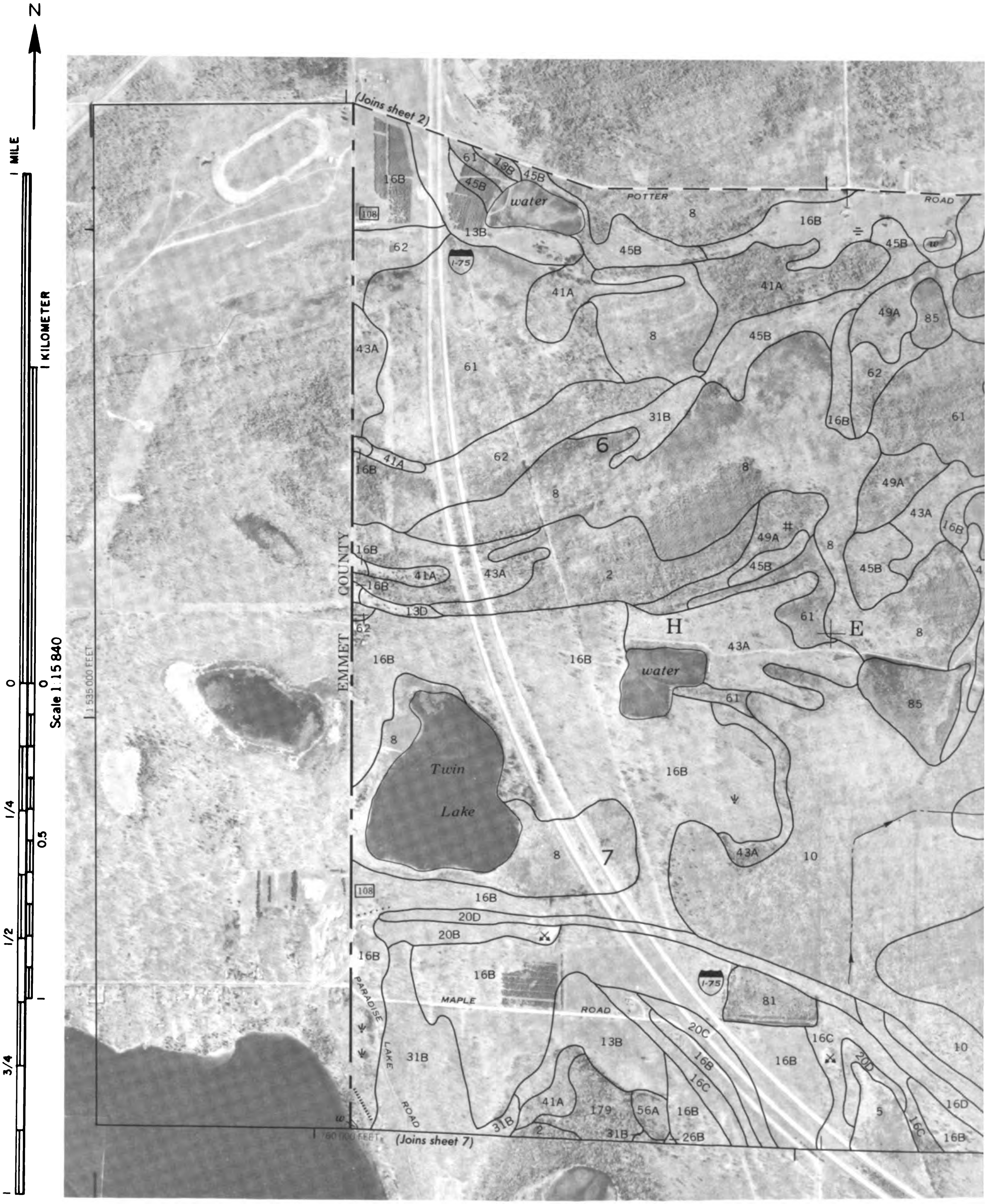
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Twin
Lake
EMMET COUNTY
MAPLE
ROAD
PARADISE
LAKE
ROAD
I-75
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601 000 FEET
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16B
61
13B
45B
62
41A
8
43A
31B
6
49A
85
2
13D
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E
7
10
20D
20B
81
20C
16C
56A
179
26B
5
16D


R. 3 W.
775 000 FEET
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T. 38 N.
(Joins sheet 5)
Mill Creek
POTTER ROAD
DINGMAN MARSH
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water
FLOODING
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5
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9
31B
43A
62
49A
61
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71
67
62
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179
158A
64
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31B
43A
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60A
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5
5
5
16C
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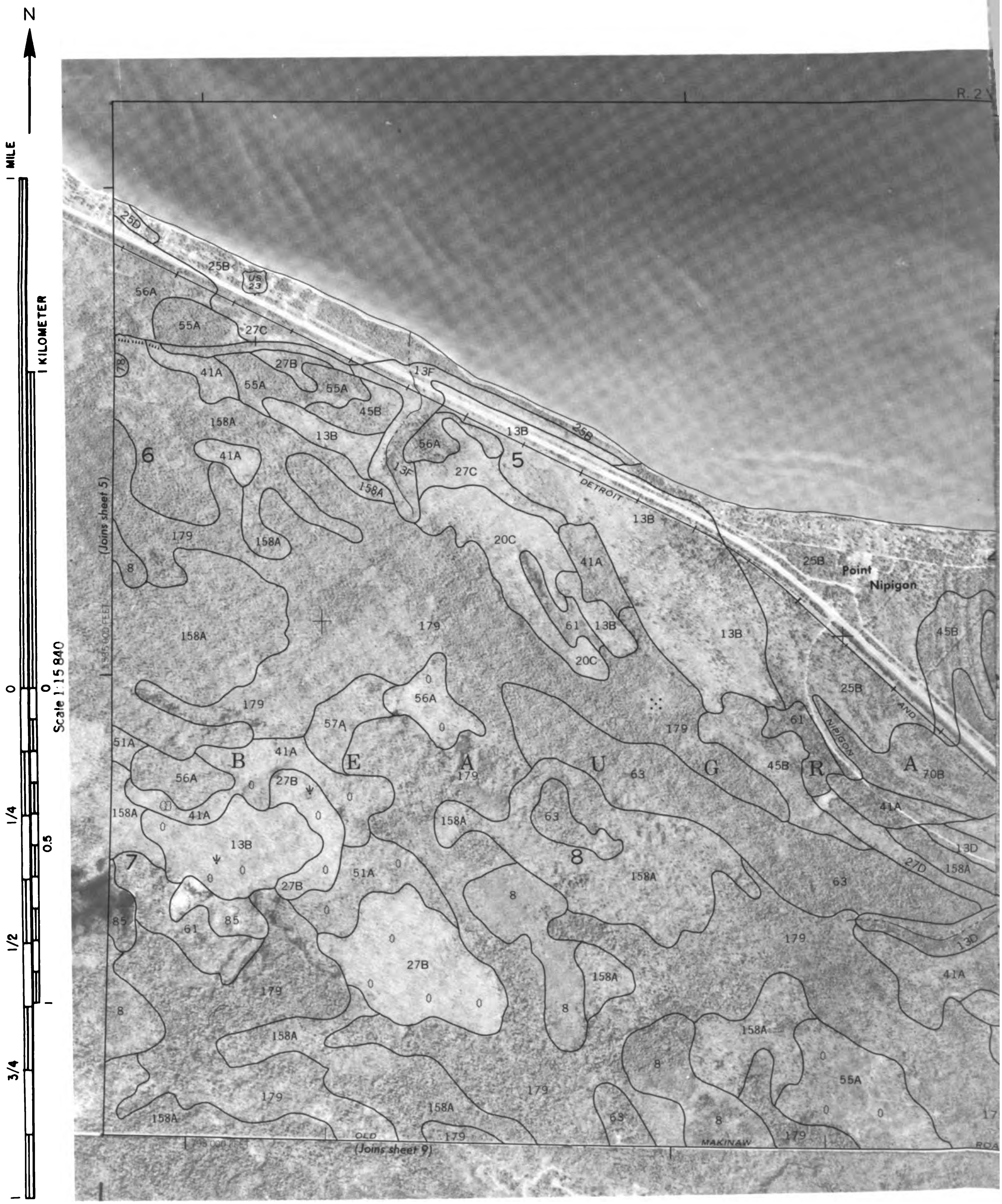
8
67
64
41A
45B
8
43A
67
8
10

6


N
1 MILE
1 KILOMETER
Scale 1:15 840
0
1/4
1/2
3/4
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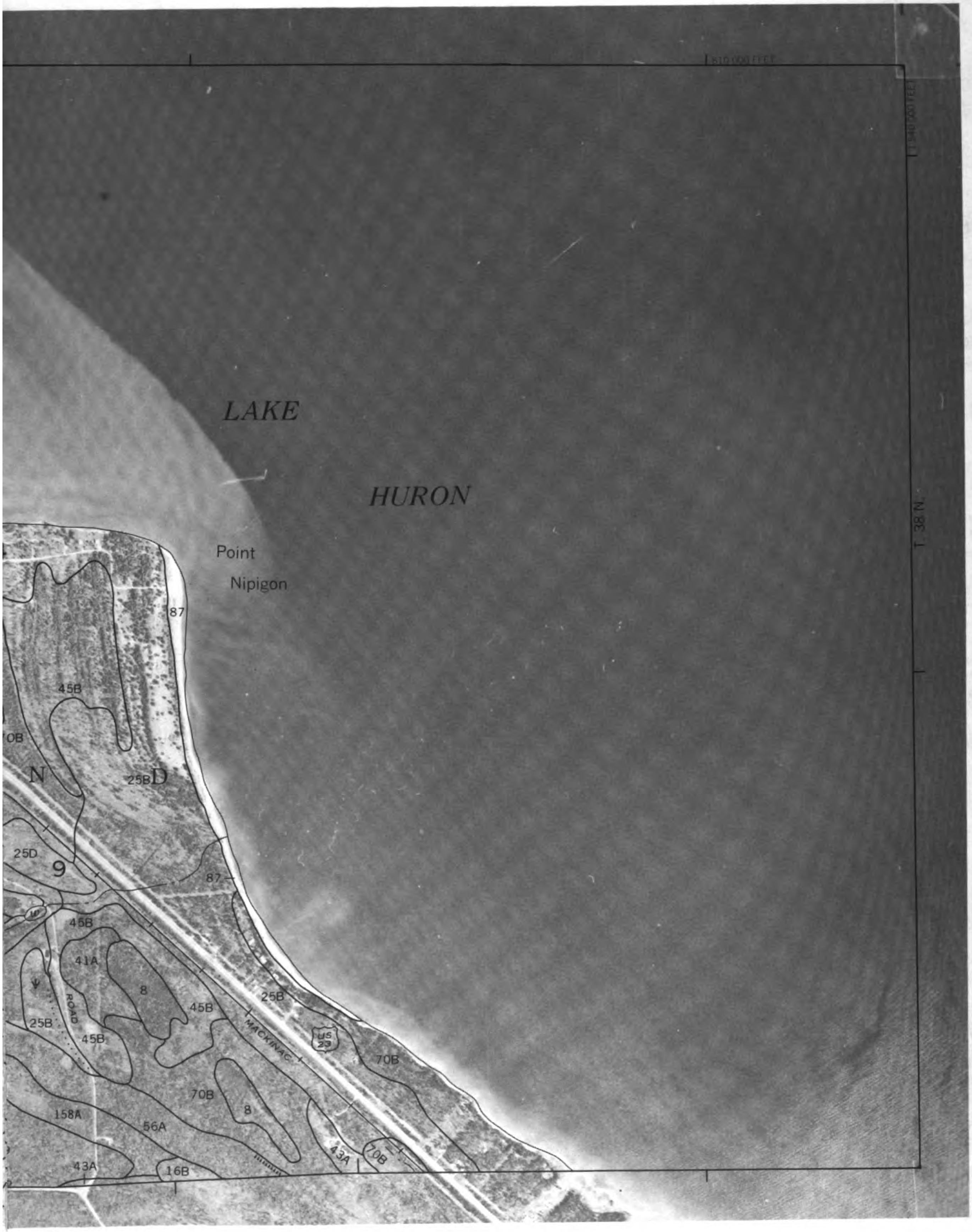
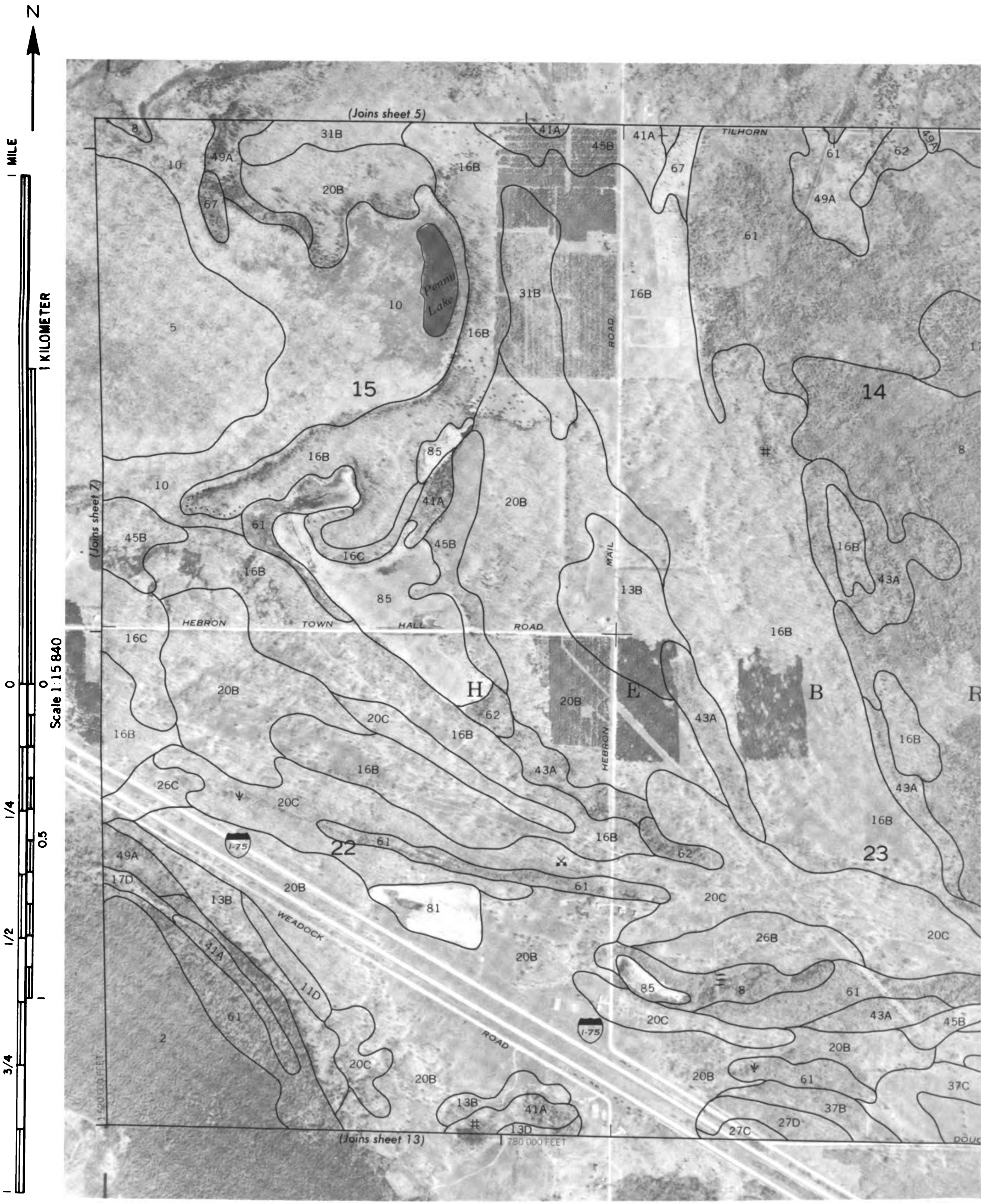
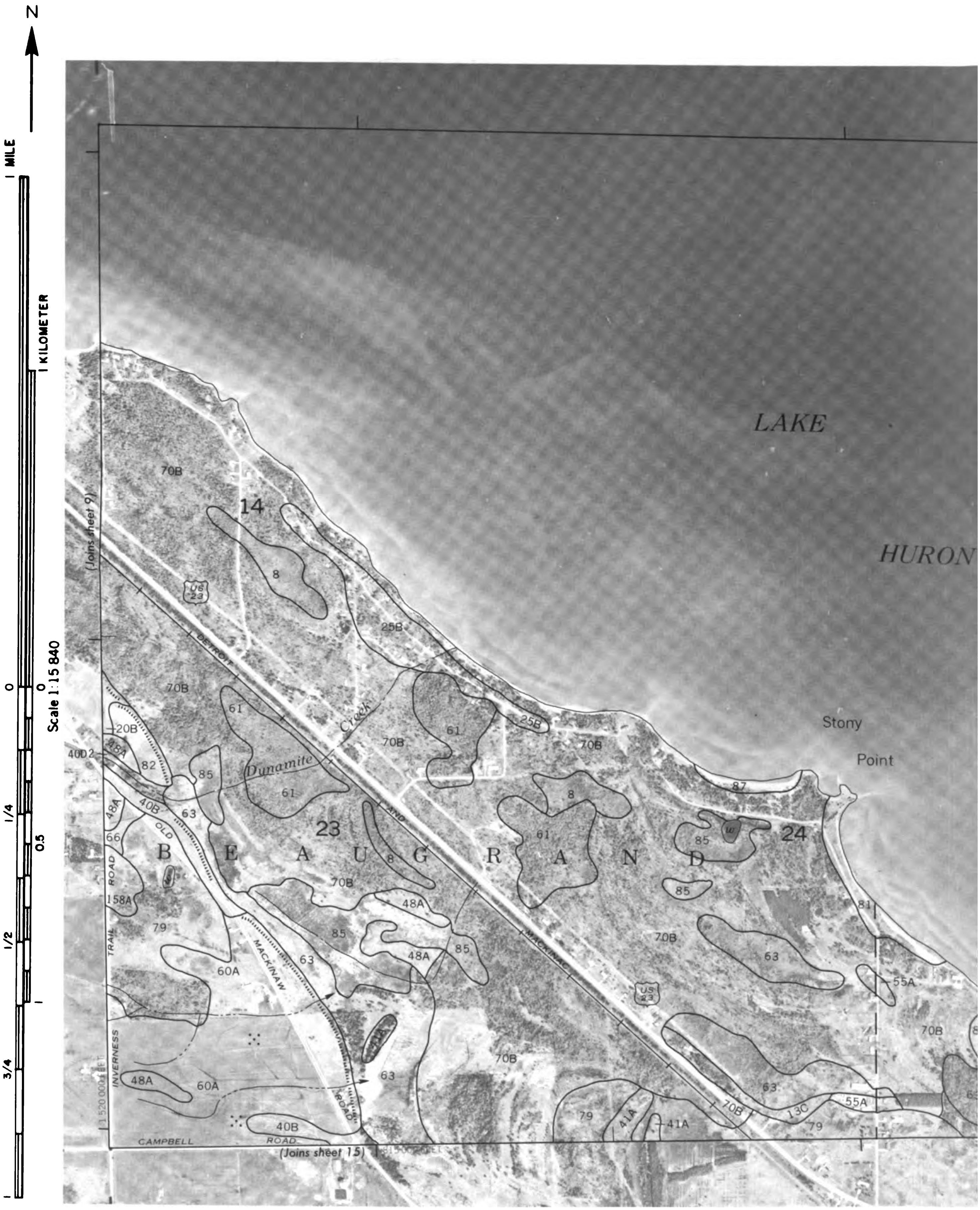
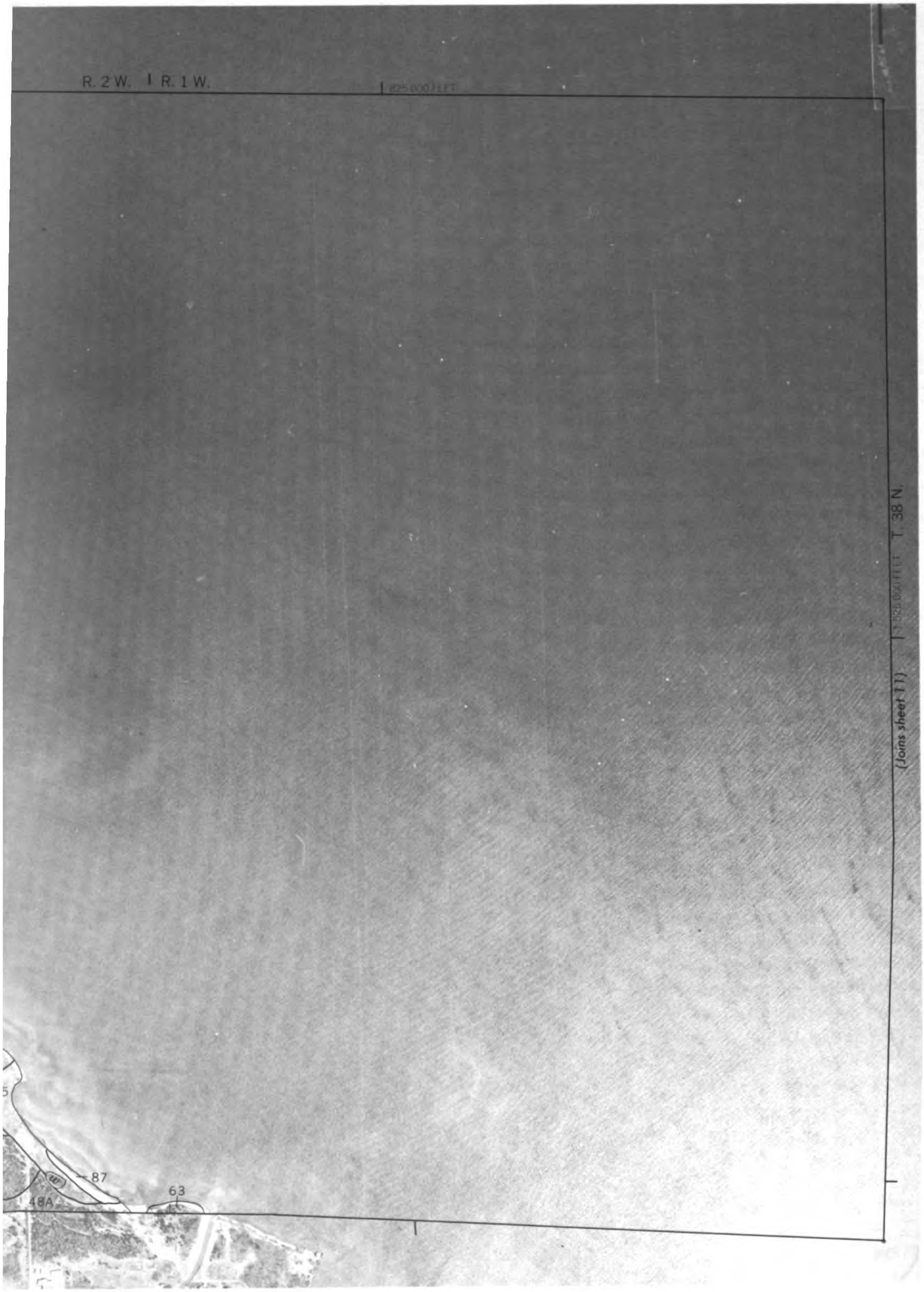
0
0.5
1
R. 2
(Joins sheet 5)
(Joins sheet 9)
US 23
DETROIT
AND
NIPIGON
OLD
MAKINAW
ROA
Point
Nipigon
B
E
A
U
G
R
A
5
6
7
8
25D
25B
56A
55A
27C
27B
41A
55A
55A
45B
13F
13B
13B
158A
41A
56A
27C
158A
158A
179
8
158A
20C
41A
61
13B
20C
179
13B
13B
25B
45B
25B
56A
57A
179
51A
56A
41A
27B
158A
41A
13B
27B
85
61
85
51A
179
63
63
158A
45B
61
70B
41A
13D
27D
158A
63
158A
8
158A
8
179
27B
179
8
158A
179
158A
179
158A
179
63
8
8
158A
55A
179
41A
13D
17

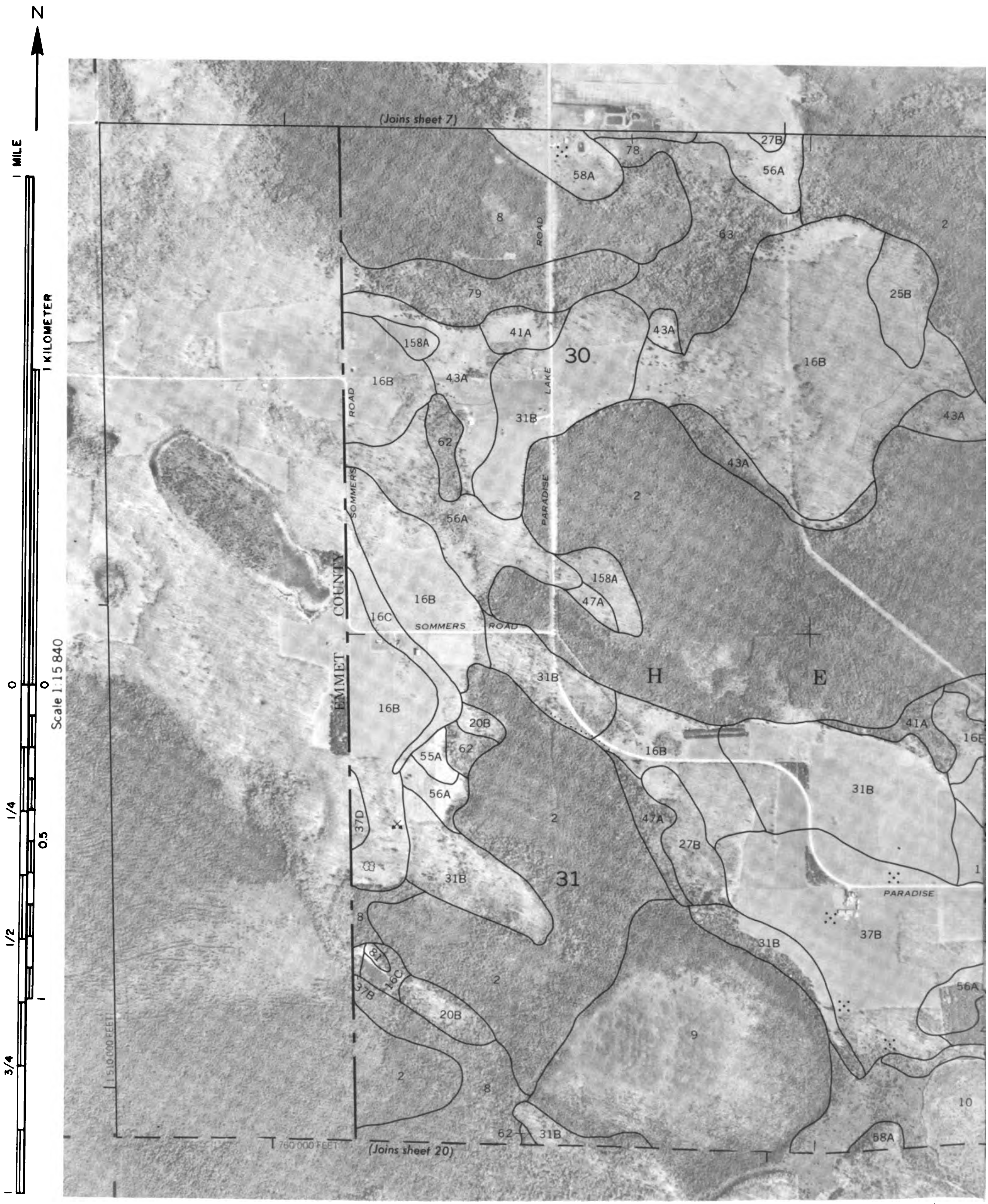

LAKE
HURON
Point
Nipigon
T. 38 N.
87
45B
70B
N
25B
D
25D
9
87
45B
41A
8
45B
25B
25B
ROAD
45B
MACKINAC
US 23
70B
70B
8
158A
56A
43A
70B
43A
16B


N
1 MILE
1 KILOMETER
Scale 1:15 840
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 5)
(Joins sheet 7)
(Joins sheet 13)
TILHORN
HEBRON TOWN HALL ROAD
MAIL ROAD
HEBRON
WEADOCK ROAD
Penny Lake
I-75
780 000 FEET
H E B R
15
14
22
23
8 31B 41A 45B 41A 67 61 62 49A 10 49A 67 20B 16B 61 49A
5 10 31B 16B 16B 15 14 8
16B 85 10 20B 41A 61 45B 16B 43A 16C 45B 16B 85 13B
16C 20B 16B 20B 62 20B 43A 16B 20C 16B 16B 43A
26C 20C 16B 43A 16B 62 16B 23 49A 61 61 17D 13B 20B 81 20C 20C
41A 11D 26B 20B 85 8 61 43A 45B 61 20C 20B
2 20C 20B 13B 41A 13D 20B 61 37C 37B 27C 27D


R. 3 W.
R. 2 W.
T. 38 N.
790 000 FEET
1 530 000 FEET
OLD
MACKINAW
ROAD
(Joins sheet 9)
13
18
24
19
O
N
B
E
A
U
G
R
A
N
D
62
63
41A
31B
158A
8
16B
43A
45B
179
31B
63
85
61
56A
27B
0
43A
16B
31B
85
61
27B
63
8
2
37D
37B
27F
56A
41A
13B
20B
158A


N
1 MILE
1 KILOMETER
Scale 1:15 840
LAKE
HURON
Stony
Point
B E A U G R A N D
14
23
24
Dynamite Creek
DETROIT AND MACKINAC
US 23
OLD MACKINAW ROAD
INVERNESS TRAIL ROAD
CAMPBELL ROAD
(Joins sheet 9)
(Joins sheet 15)


R. 2 W.
R. 1 W.
T. 38 N.
(Joins sheet 11)
87
63
48A


N
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
0.5
Scale 1:15 840
(Joins sheet 7)
(Joins sheet 20)
1 510 000 FEET
760 000 FEET
EMMET
COUNTY
SOMMERS ROAD
SOMMERS ROAD
PARADISE LAKE ROAD
PARADISE
30
31
H
E
58A
78
27B
56A
8
63
2
25B
79
41A
43A
158A
16B
43A
62
31B
56A
158A
47A
16C
20B
55A
56A
37D
47A
27B
31B
37B
9
81
16C
37B
20B
62
58A
10
41A


R. 3 W.
Mud
Lake
water
Mud
Creek
29
28
32
33
B
R
O
N
T. 38 N
(Joins sheet 13)
LAKE
ROAD
LEVERING
ROAD
179
56A
62
16B
43A
85
2
61
38B
58A
47A
55A
41A
37B
45B
27B
13B
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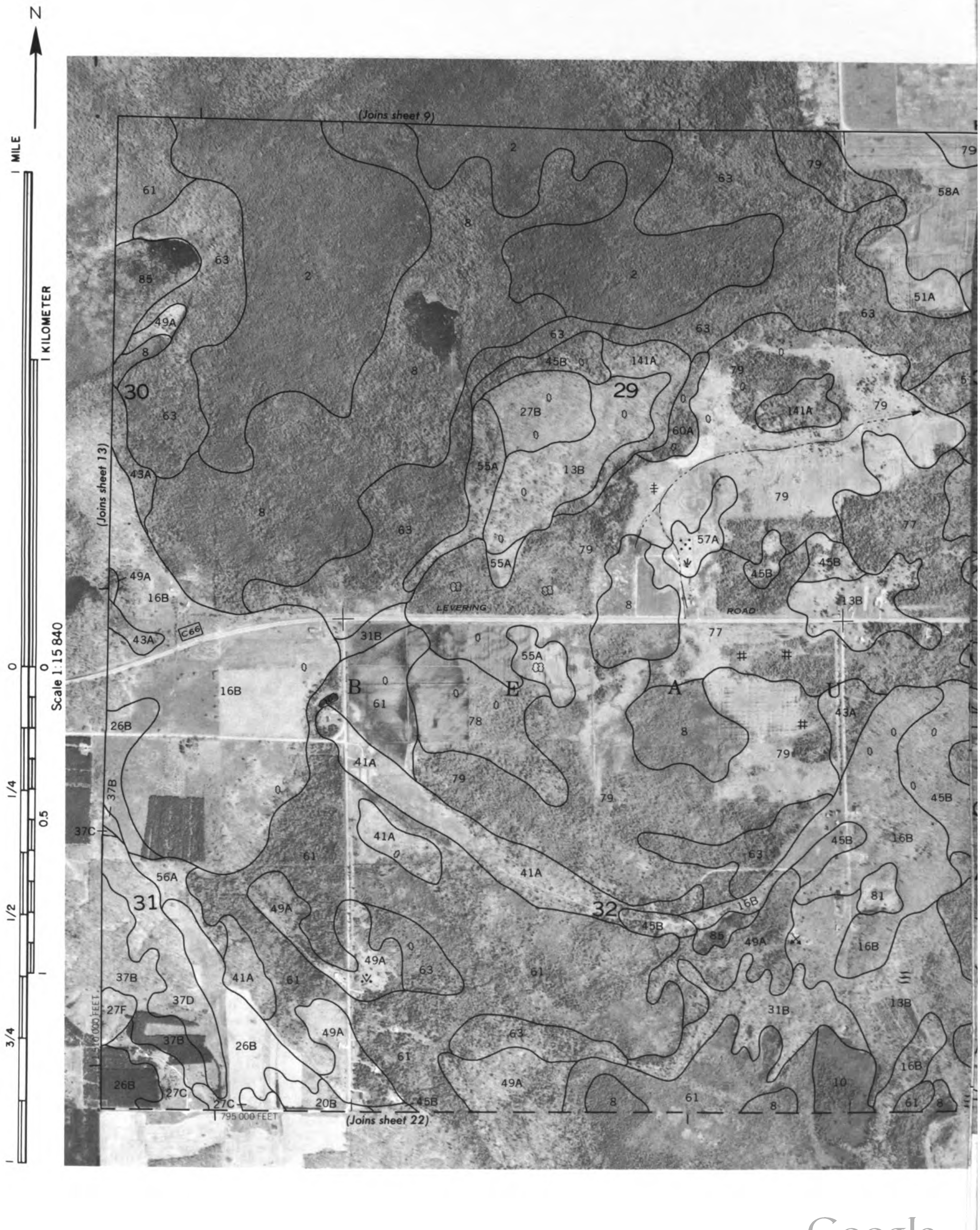
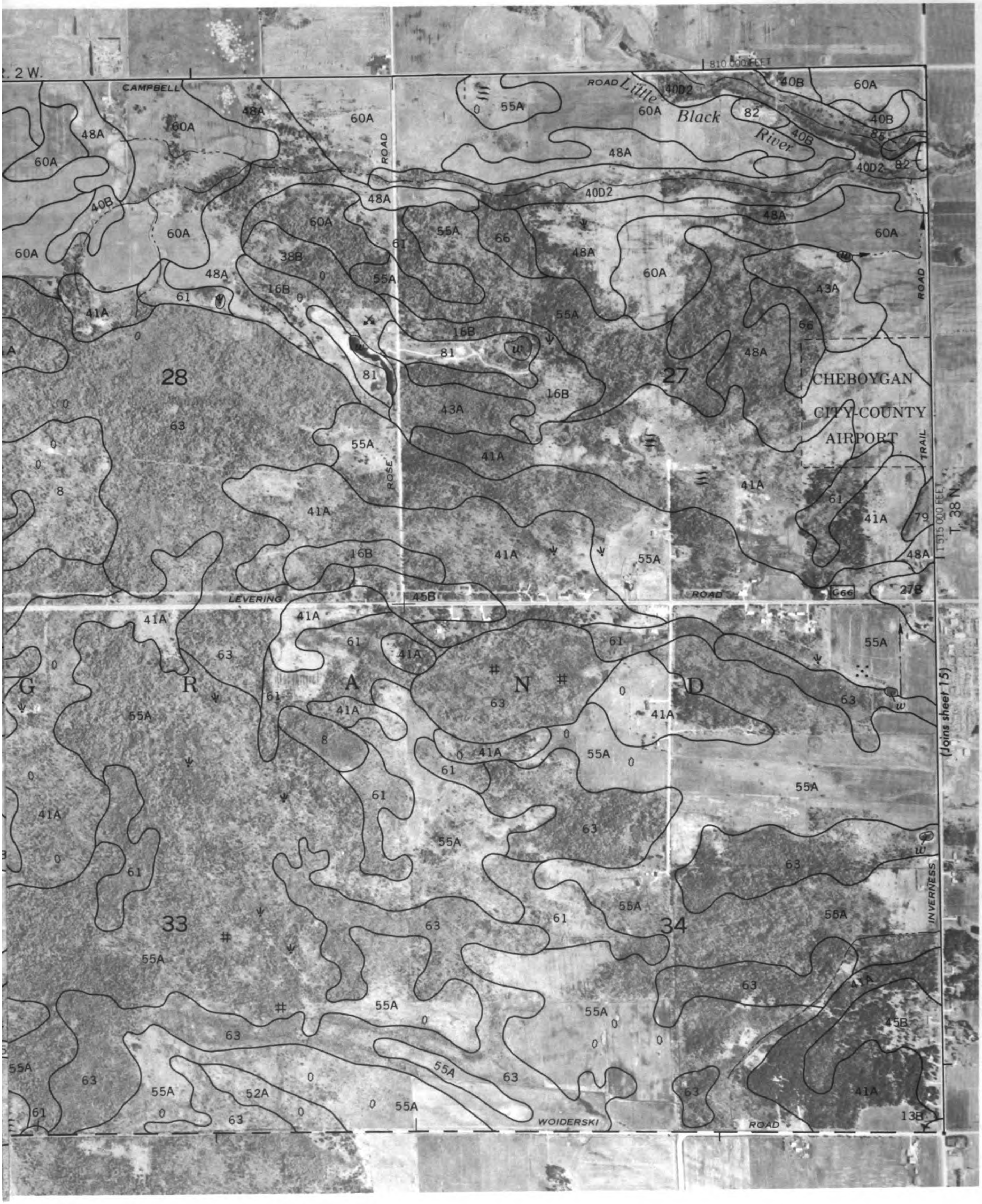
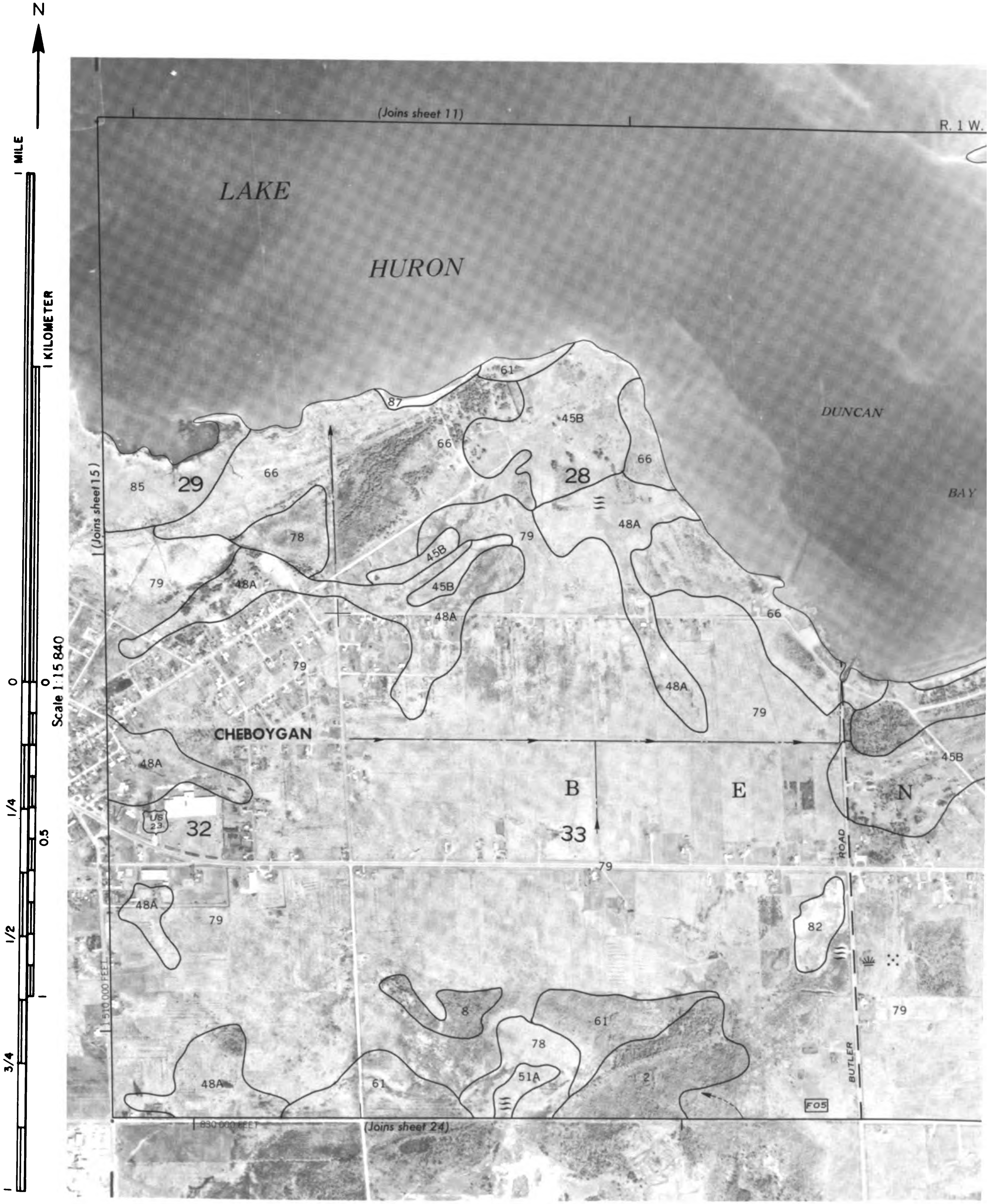
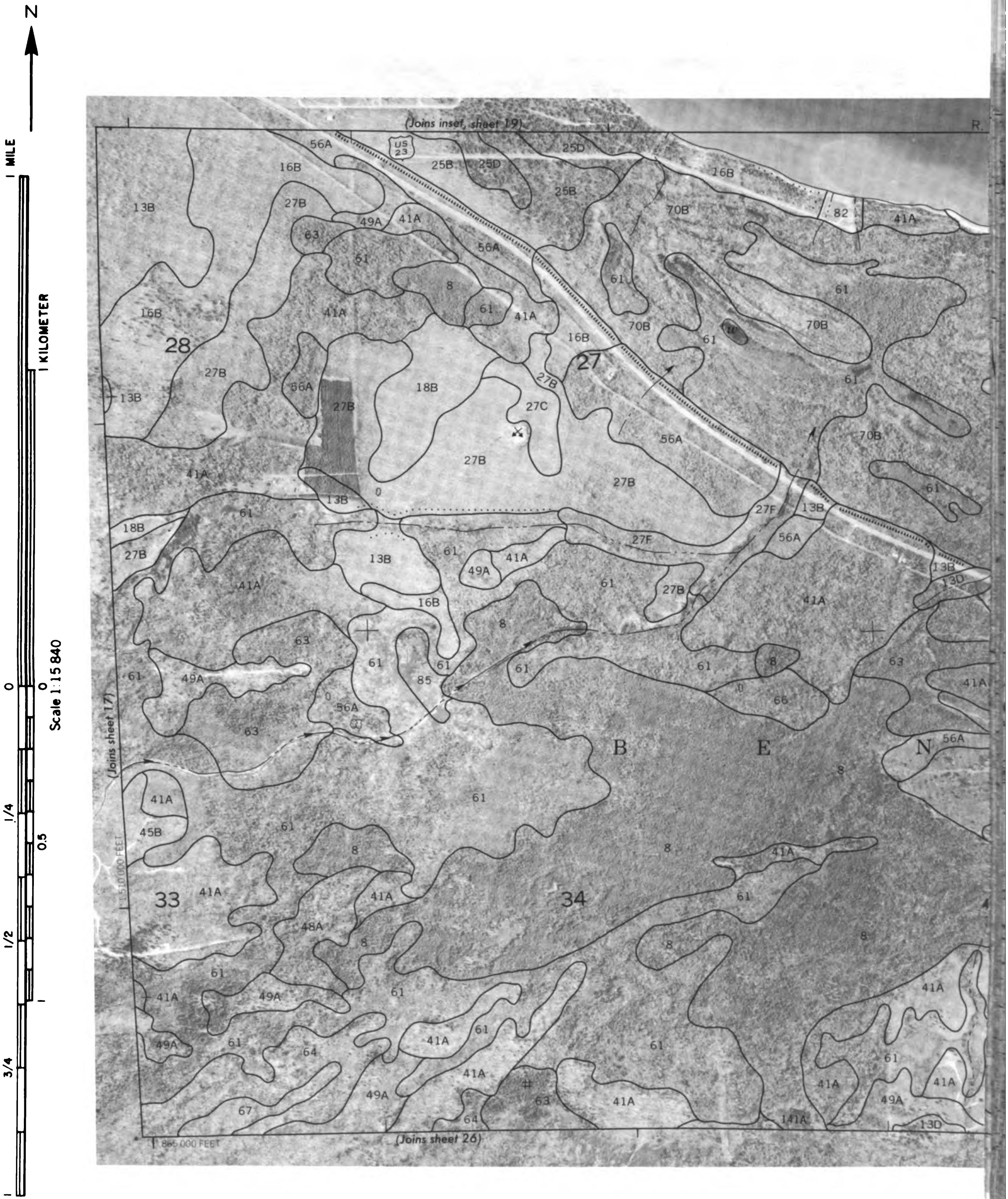
39C
78
52A
64
C66
0

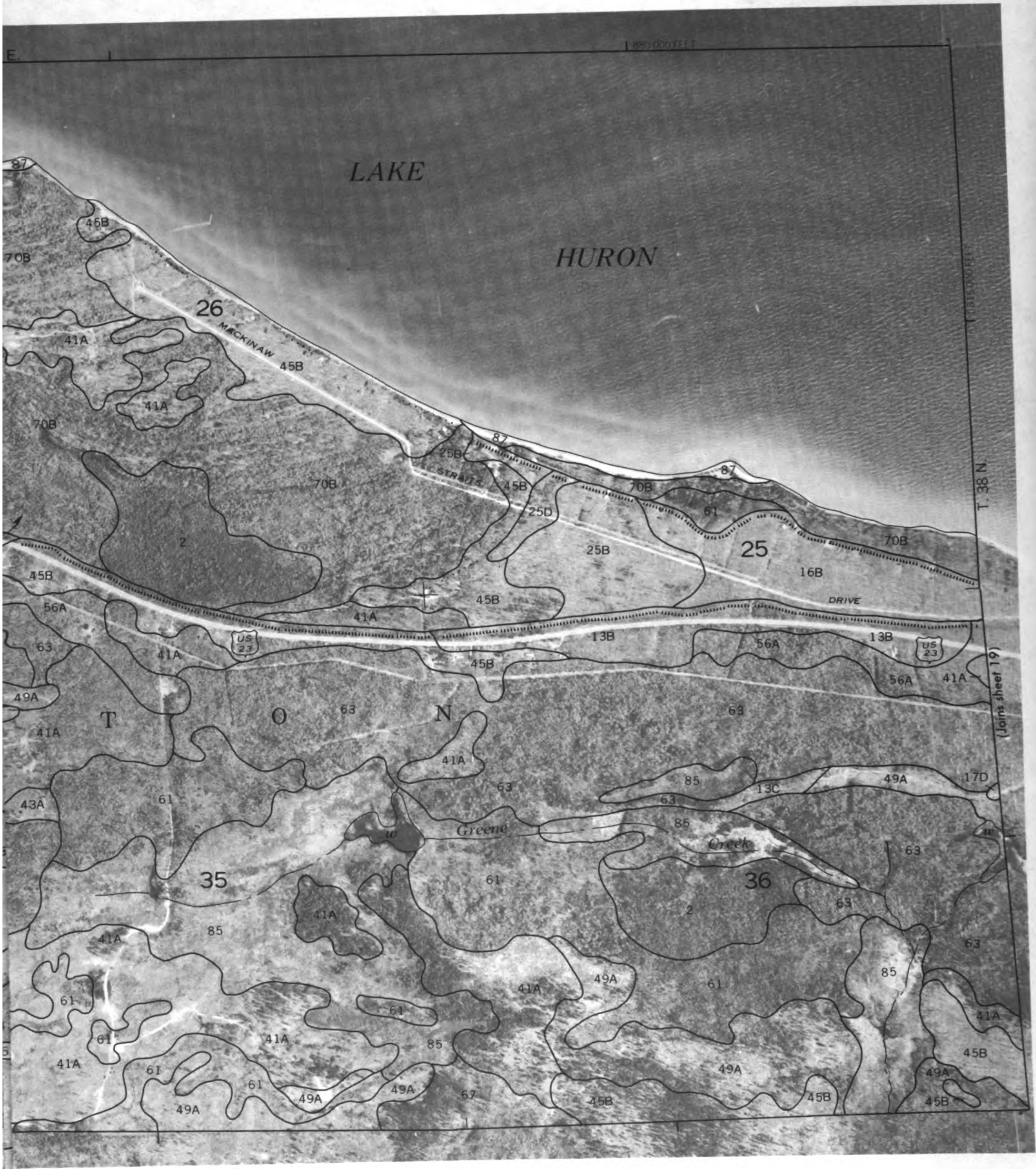

N
1 MILE
1 KILOMETER
Scale 1:15 840
0
1/4
1/2
3/4
0
0.5
1
(Joins sheet 9)
(Joins sheet 13)
(Joins sheet 22)
LEVERING
ROAD
C66
795 000 FEET
29
30
31
32
B
E
A
U

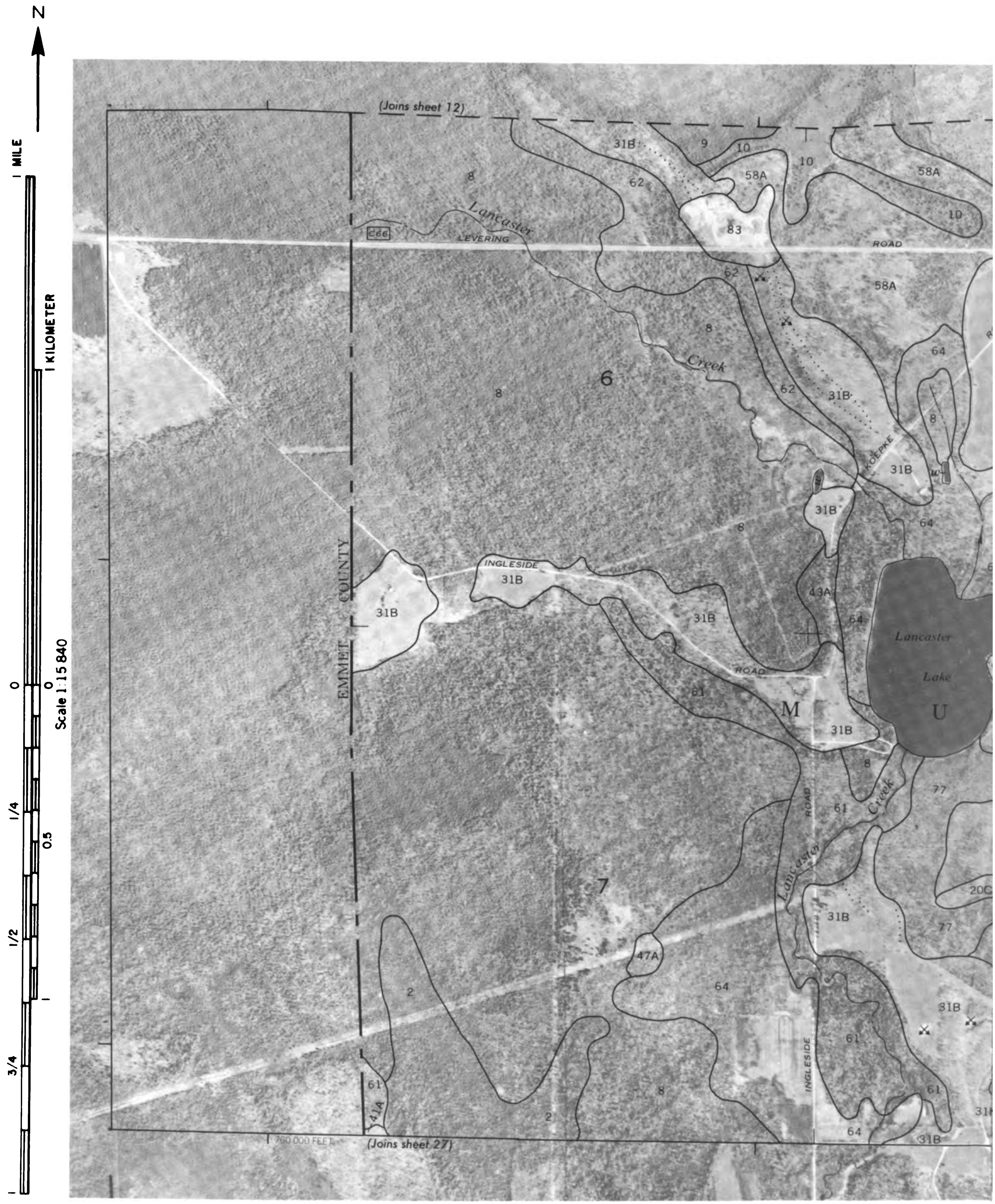

R. 2 W.
810 000 FEET
CAMPBELL
ROAD
Little Black River
ROSE
ROAD
LEVERING
ROAD
CHEBOYGAN
CITY-COUNTY
AIRPORT
TRAIL
ROAD
1 515 000 FEET
T. 38 N.
(Joins sheet 15)
INVERNESS
WOIDERSKI
ROAD
C66
28
27
33
34
G R A N D
60A
48A
40B
40D2
82
55A
38B
16B
61
41A
81
43A
63
66
8
45B
27B
79
52A
13B
0


N
1 MILE
1 KILOMETER
Scale 1:15 840
0
1/4
0.5
1/2
3/4
1
(Joins sheet 11)
R. 1 W.
LAKE
HURON
DUNCAN
BAY
(Joins sheet 15)
85
29
66
61
87
45B
28
78
79
48A
45B
45B
48A
79
CHEBOYGAN
B
E
N
32
33
US 23
ROAD
BUTLER
82
8
61
78
51A
2
F05
(Joins sheet 24)
510 000 FEET
830 000 FEET

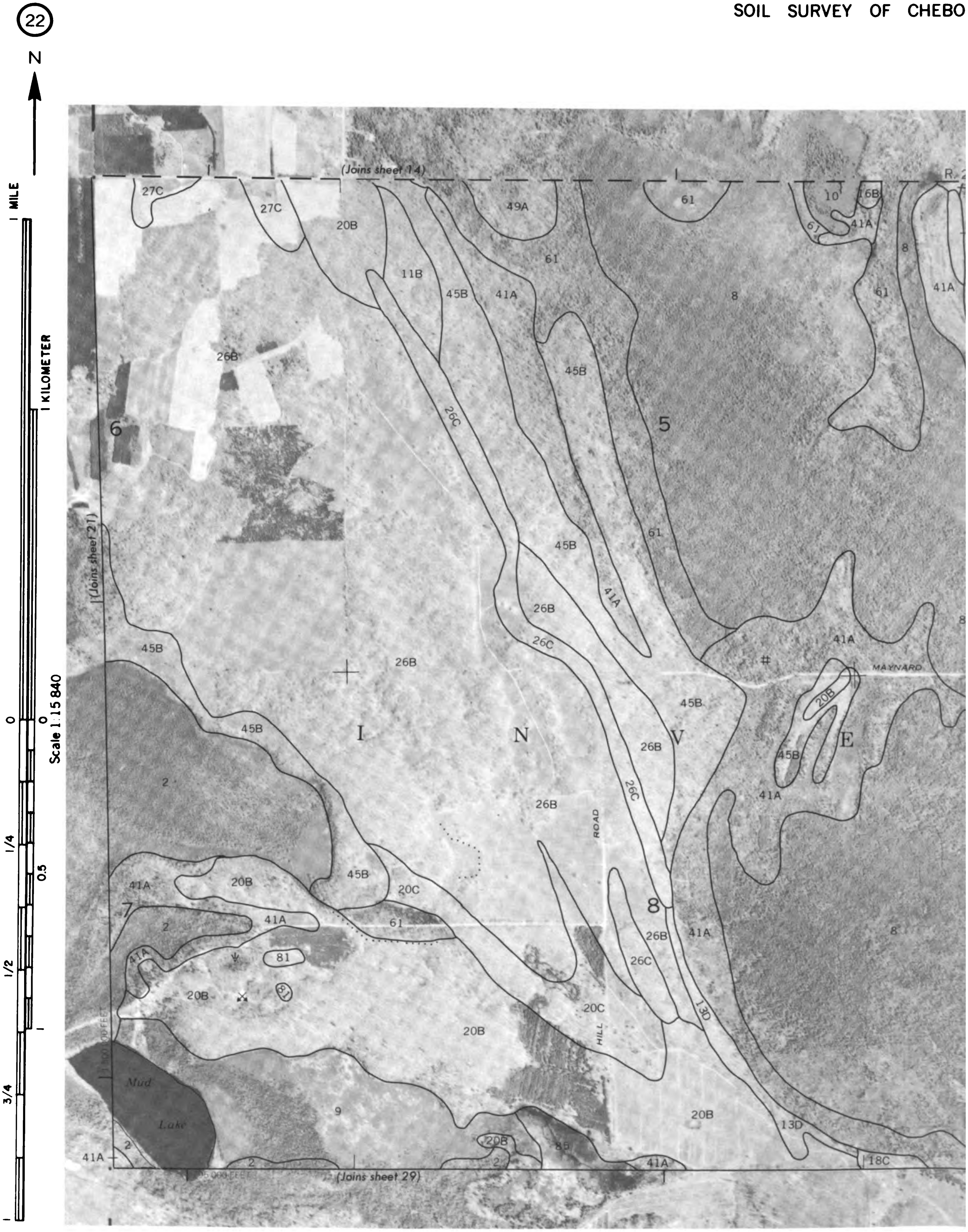

CHEBOYGAN
STATE
PARK
Elliot
Creek
Elliot
Creek
SEFFERN
ROAD
ALPENA
STATE
ROAD
US 23
T
O
N
27
26
34
35
85
61
8
70B
45B
49A
47A
48A
43A
25D
87
13B
51A
64
13D
71
81
13C
79
63
66
2
17D
(Joins sheet 17)
T. 38 N.


N
1 MILE
1 KILOMETER
0
0
Scale 1:15 840
1/4
0.5
1/2
1
3/4
1
(Joins inset, sheet 19)
(Joins sheet 17)
(Joins sheet 26)
R.
US 23
28
27
33
34
B
E
N
1 510 000 FEET
865 000 FEET
56A
16B
13B
27B
25B
25D
70B
82
41A
63
49A
61
8
18B
27C
56A
27F
13D
66
85
45B
48A
64
67

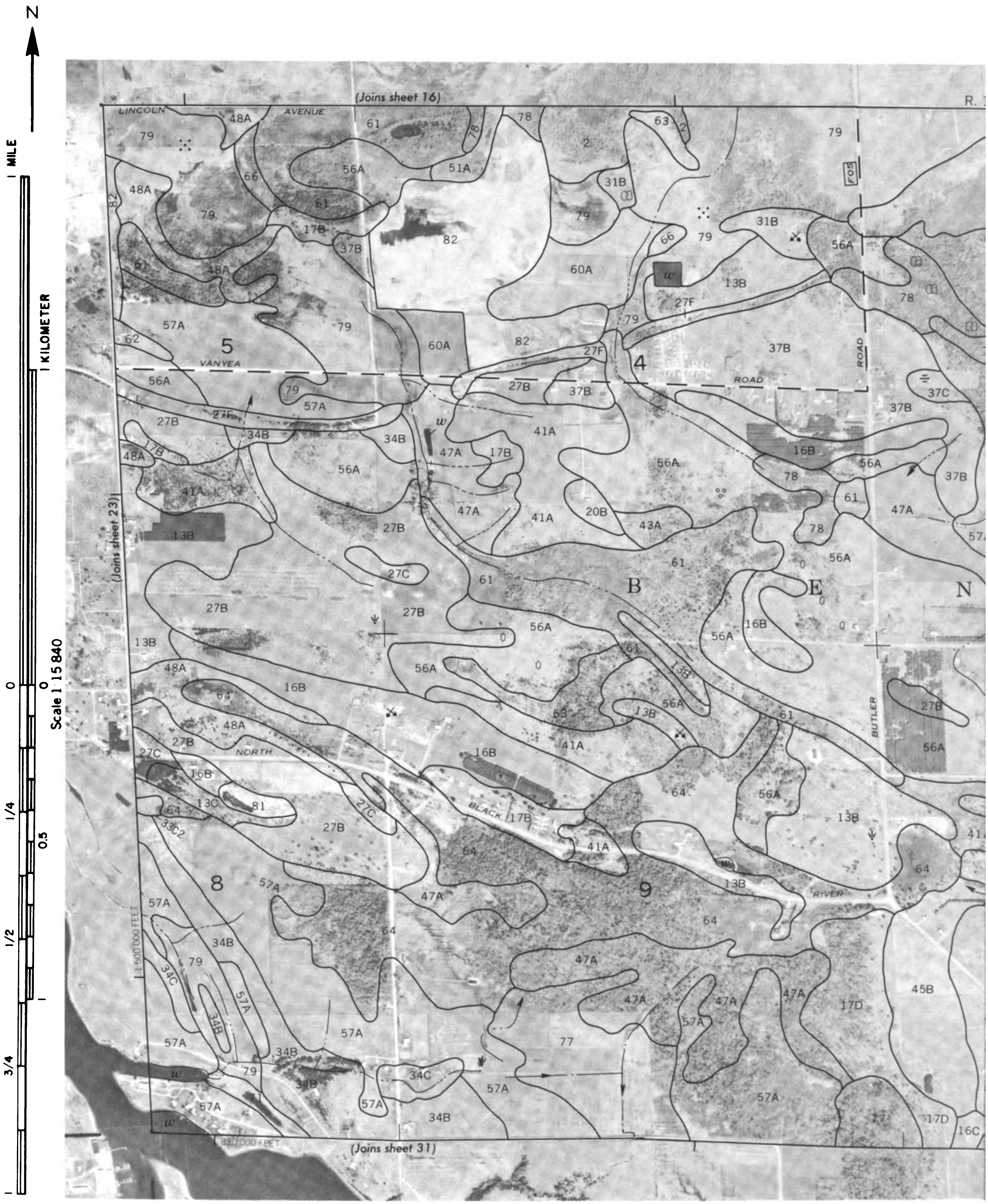

LAKE
HURON
26
25
35
36
MACKINAW
STRAITS
DRIVE
Greene
Creek
T
O
N
T. 38 N.
(Joins sheet 19)
US 23
87
45B
70B
41A
25B
25D
16B
61
2
45B
56A
63
13B
13C
17D
49A
43A
85
67
w


N
1 MILE
1 KILOMETER
Scale 1:15 840
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 12)
(Joins sheet 27)
760 000 FEET
EMMET COUNTY
Lancaster Creek
LEVERING ROAD
INGLESIDE ROAD
KOEPKE
INGLESIDE
ROAD
Lancaster Lake
6
7
M
U
31B
9
10
58A
62
83
8
64
43A
61
77
20C
47A
2
41A
C66

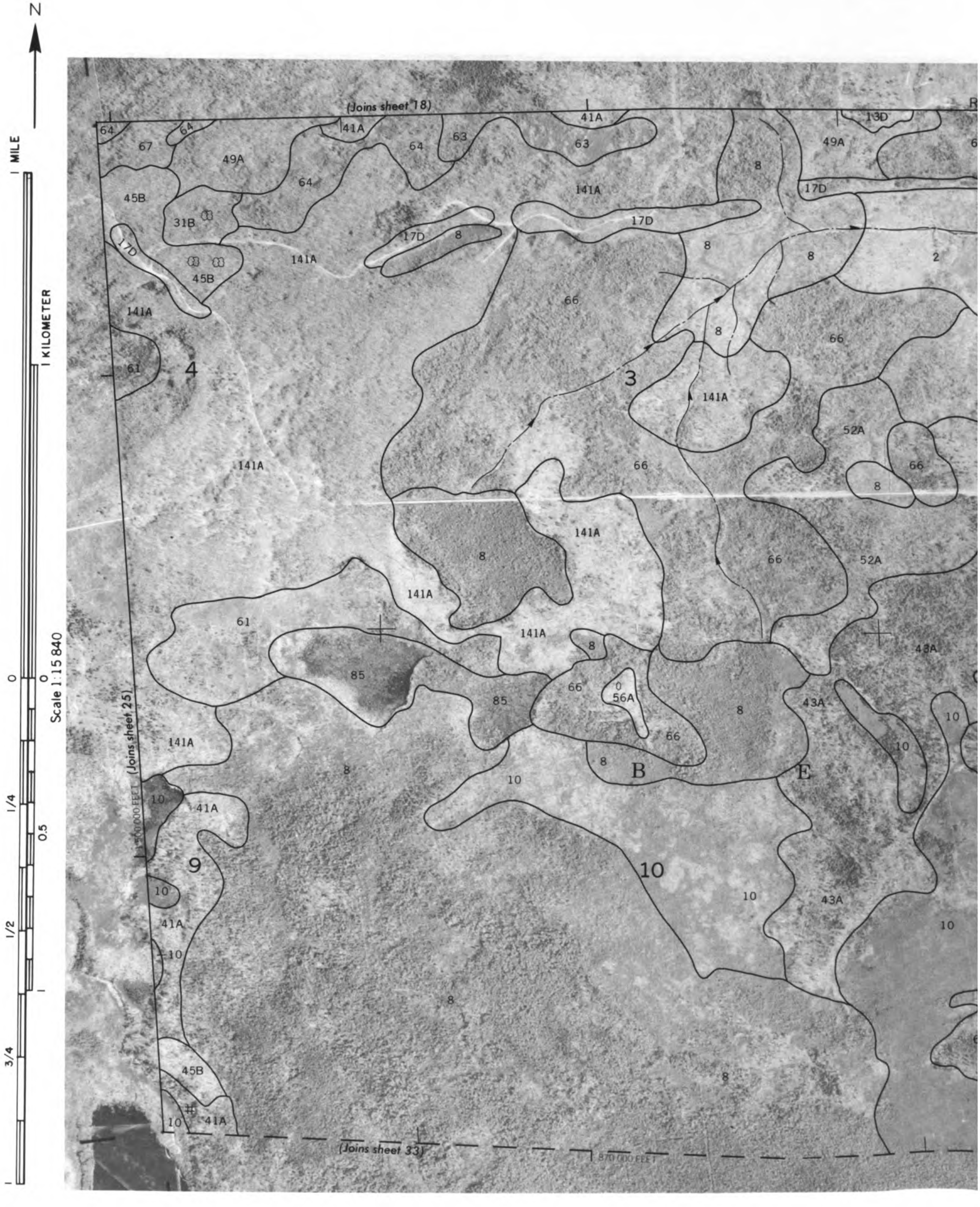

R. 3 W.
775 000 FEET
ROAD
LEVERING
ROAD
MCARTHUR
ROAD
HEILMAN
1 505 000 FEET
T. 37 N.
(Joins sheet 21)
C66
5
4
8
9
N
R
O
Munro
Lake
58A
10
52A
56A
58A
64
38B
78
52A
38C
39C
39B
18B
38C
78
38B
20B
58A
20C
38C
38B
24B
2
8
58A
58A
38B
27C
24B
38B
20C
27C
78
64
38C
38B
60A
78
2
8
27B
47A
18B
33B
79
56A
56A
27B
27C
11B
20D
27D
27B
31B
56A
62
27C
18B
27B
27C
27B
27D
11B
20D
27C
8
27C
16B
11B
11B
47A
31B
27F
27D
11C
27C
27B
13B
11B
18B
20D
11D
52A
27D
27B
11D
13B
20B
20C
64
20C
27C
11C
20F
27F
61
83
18B
27C
41A
20B
43A
20B
56A
31B
20D
61
85
61
20F
13D
18C
20F
27B
27D


22
N
1 MILE
1 KILOMETER
Scale 1:15 840
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 14)
(Joins sheet 21)
(Joins sheet 29)
27C
27C
20B
49A
61
10
16B
41A
61
61
11B
45B
41A
8
61
41A
26B
45B
26C
6
5
61
45B
41A
26B
26C
45B
26B
41A
MAYNARD
20B
45B
I
N
V
E
45B
2
26B
26C
26B
41A
ROAD
41A
20B
45B
20C
7
2
41A
61
8
26B
41A
8
81
41A
20B
81
26C
20B
20C
13D
HILL
Mud
Lake
9
20B
13D
2
20B
85
41A
41A
2
2
41A
18C
R. 2

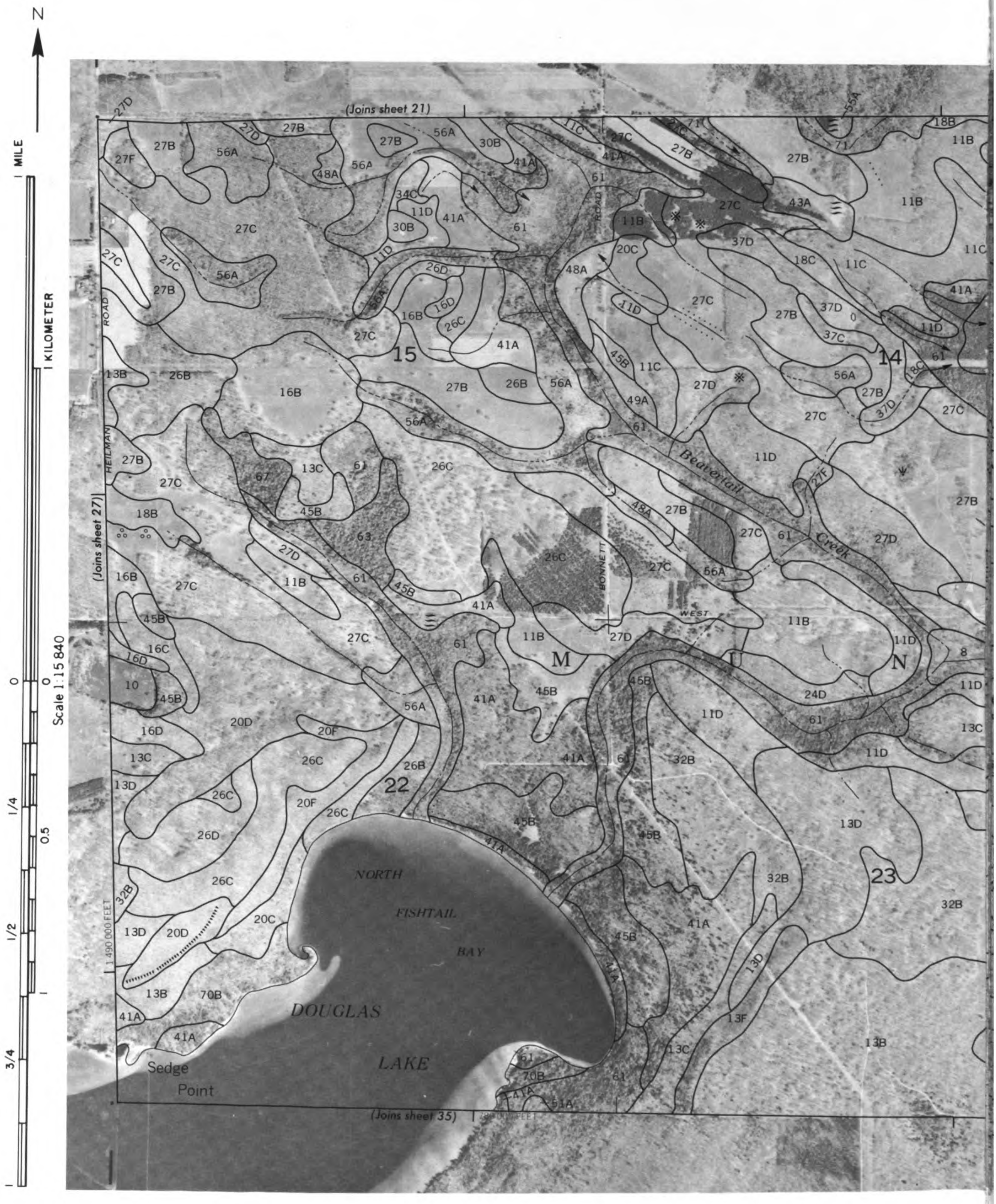
WOIDERSKI ROAD
810 000 FEET
MEYERS ROAD
SCHMIDT ROAD
ROAD
INVERNESS TRAIL ROAD
505 000 FEET
T. 37 N.
(Joins sheet 23)
R N E S S
3
4
9
10
55A
63
52A
47A
61
41A
13B
79
64
78
45B
8
85
48A
60A
57A
w

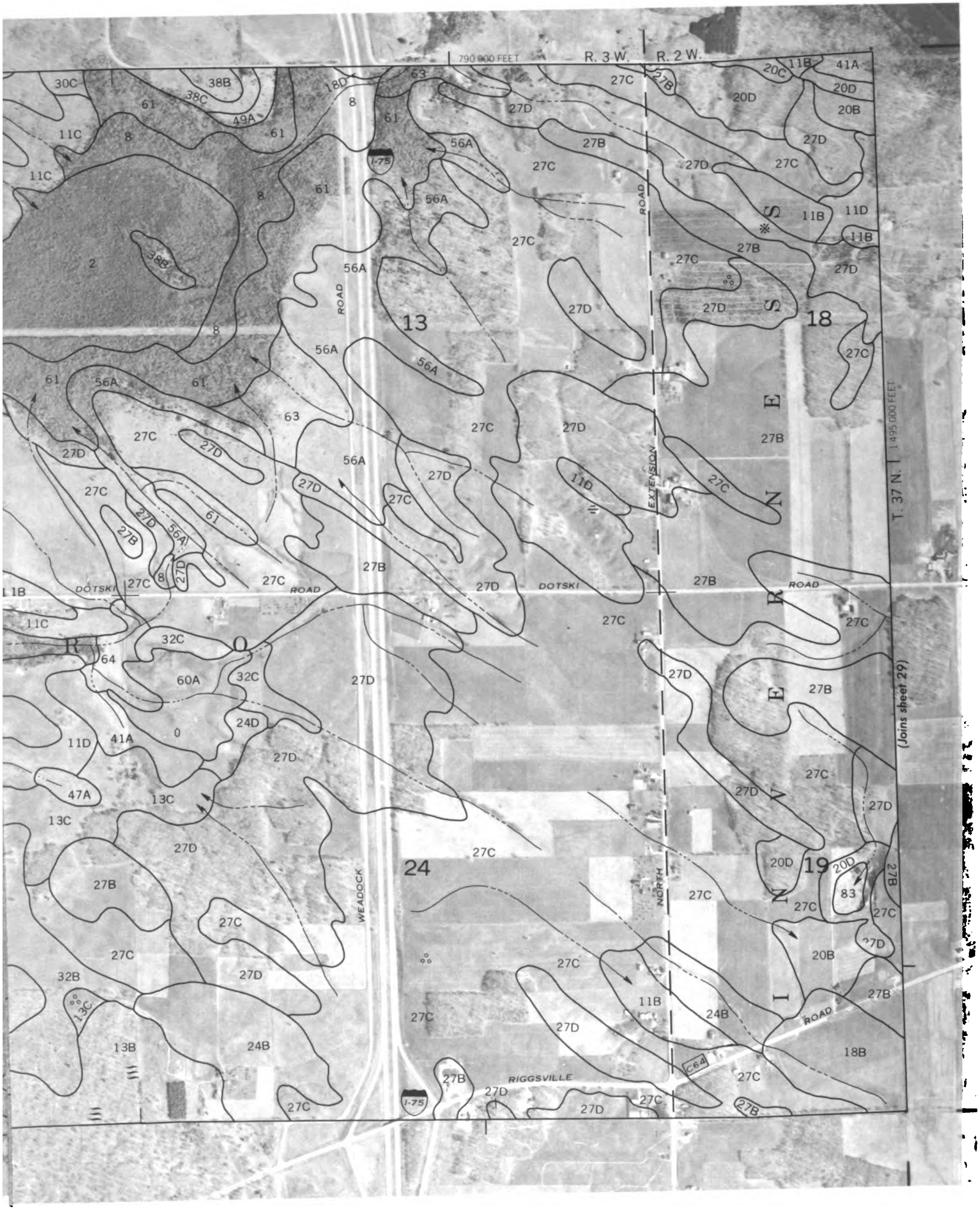

N
1 MILE
1 KILOMETER
Scale 1:15 840
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 16)
LINCOLN
AVENUE
R. 1
FOS
VANYEA
ROAD
ROAD
BUTLER
NORTH
BLACK
RIVER
(Joins sheet 23)
(Joins sheet 31)
1 500 000 FEET
830 000 FEET
B
E
N
5
4
8
9

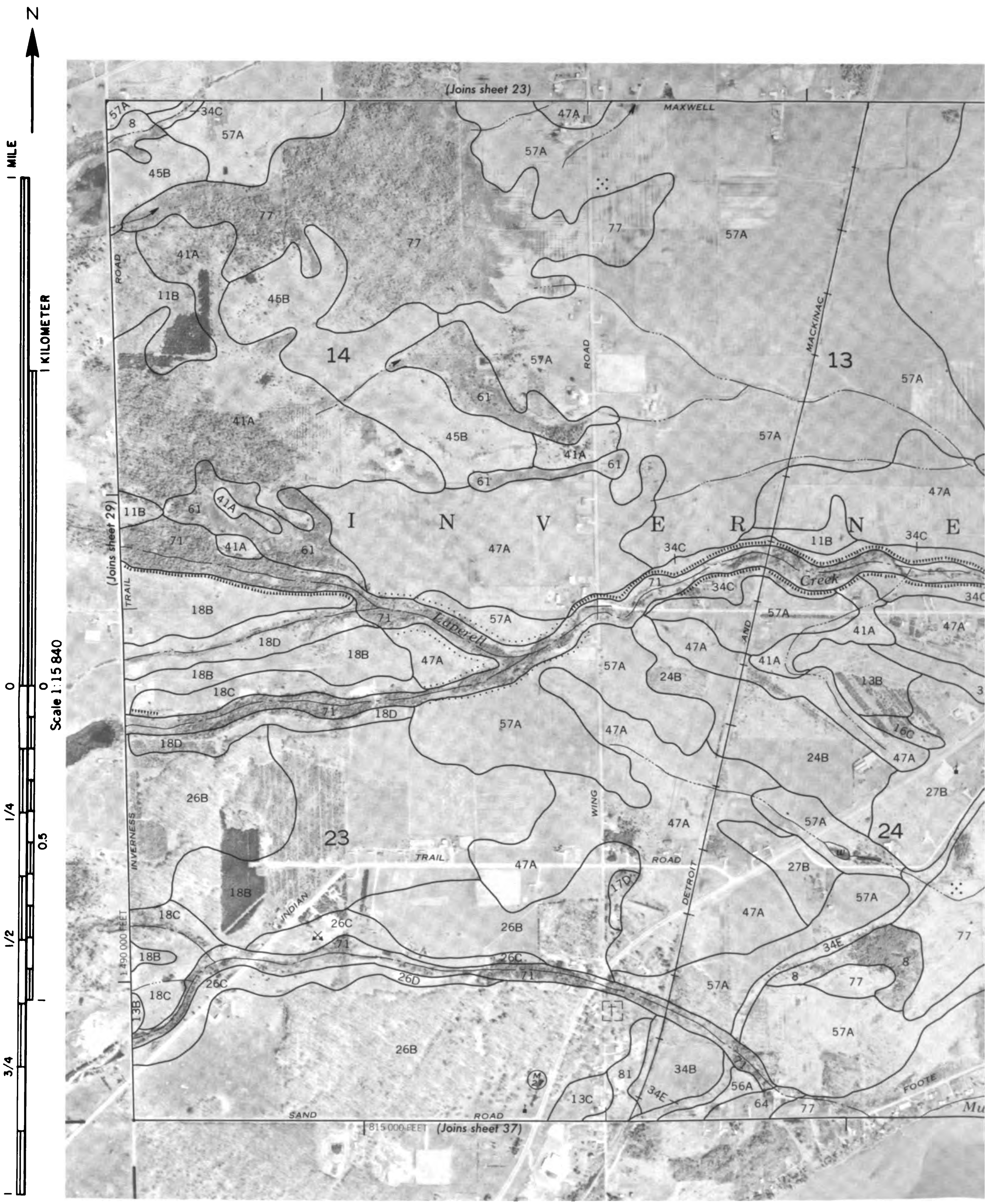

W.
66
70B
2
13C
45B
17D
13D
71
41A
13F
70B
41A
17D
13B
2
17D
13F
57A
13B
45B
24B
17D
16C
16B
16C
64
13B
O
N
16D
47A
45B
16C
13C
17B
17D
56A
81
13B
13C
16B
63
41A
17D
61
16B
16B
41A
61
13B
13B
13D
17D
16C
10
11
13B
13B
16B
16B
16B
16B
16C
13B
13B
13C
13B
T. 37 N.


N
1 MILE
1 KILOMETER
Scale 1:15 840
0
1/4
1/2
3/4
0.5
(Joins sheet 18)
(Joins sheet 25)
(Joins sheet 33)
870 000 FEET
64
67
49A
45B
31B
17D
141A
61
41A
63
64
8
66
13D
49A
2
52A
43A
85
56A
10
4
3
9
10
B
E


1 E.
850 000 FEET
49A
67
45B
8
49A
2
61
17D
49A
17D
85
85
w
2
2
2
45B
41A
67
49A
49A
49A
49A
45B
2
49A
1
26C
52A
26B
8
26B
66
141A
T. 37 N.
COUNTY
16B
141A
141A
ISLE
85
0
0
26B
0
N
T
O
N
PRESQUE
26B
141A
0
16B
141A
12
85
11
85
26B
141A
61
141A
10
61
10
141A
67
61
63
63
63
10
56A
10
61
8


N
MILE
KILOMETER
Scale 1:15 840
0
1/4
1/2
3/4
1
0.5
(Joins sheet 21)
(Joins sheet 27)
(Joins sheet 35)
HEILMAN ROAD
BONNETT ROAD
WEST
Beavertail Creek
NORTH FISHTAIL BAY
DOUGLAS LAKE
Sedge Point
1 490 000 FEET
15
14
22
23
M
U
N


790 000 FEET
R. 3 W.
R. 2 W.
1 495 000 FEET
T. 37 N.
(Joins sheet 29)
13
18
24
19
DOTSKI ROAD
RIGGSVILLE ROAD
WEADOCK ROAD
NORTH EXTENSION ROAD
I-75
C64

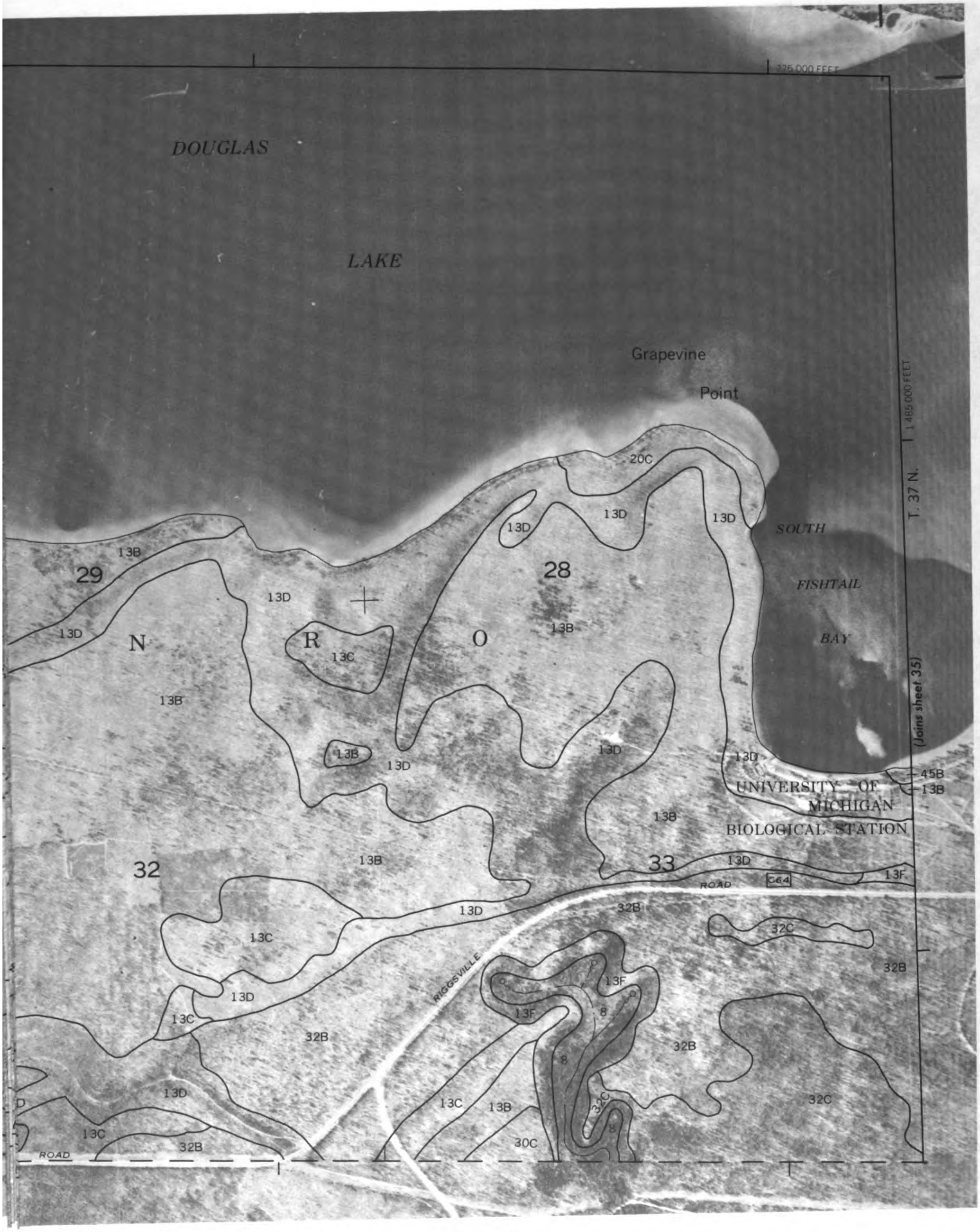

N
1 MILE
1 KILOMETER
Scale 1:15 840
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 23)
MAXWELL
57A
8
34C
57A
47A
57A
45B
77
77
77
57A
41A
ROAD
11B
45B
14
57A
ROAD
MACKINAC
13
57A
41A
61
45B
57A
41A
61
61
47A
11B
61
41A
(Joins sheet 29)
71
41A
61
47A
I N V E R N E
34C
11B
34C
71
34C
Creek
34C
TRAIL
18B
71
Laperell
57A
57A
41A
47A
18D
18B
47A
47A
57A
AND
41A
24B
13B
18B
18C
71
18D
57A
47A
16C
18D
24B
47A
27B
26B
INVERNESS
WING
47A
57A
24
23
TRAIL
ROAD
47A
27B
DETROIT
18B
17D
57A
18C
INDIAN
26C
47A
1 490 000 FEET
26B
77
71
34E
18B
26C
71
8
77
8
26C
26D
18C
57A
13B
57A
26B
81
34B
13C
34E
56A
64
77
FOOTE
SAND
ROAD
815 000 FEET
(Joins sheet 37)

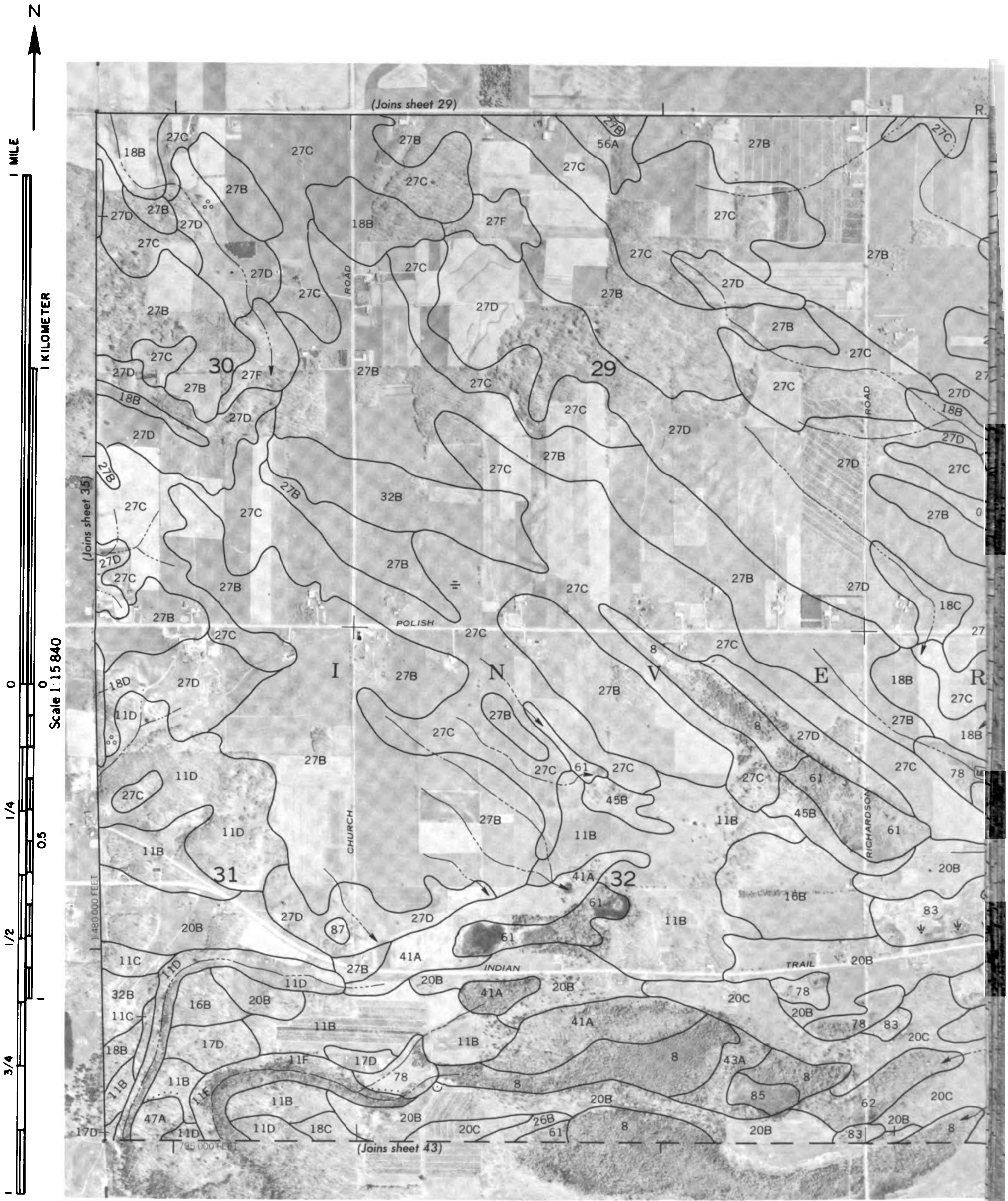

R. 2 W.
R. 1 W.
825 000 FEET
ROAD
CHEBOYGAN
RIVER
SOUTH
RIVER
ROAD
LINE
ROAD
TOWN
ROAD
CARTER
ROAD
HACKMATACK
ROAD
llett
Lake
T. 37 N.
(Joins sheet 31)
18
17
19
20
S
S
N
O
T
N
E
B
60A
40D2
40B
40D2
82
57A
40B
60A
79
40D2
57A
33C2
60A
40D2
71
57A
34E
47A
34C
34E
57A
34B
34B
57A
77
71
57A
34E
34B
60A
60A
33C2
57A
33C2
47A
13B
57A
34C
40D2
47A
77
57A
60A
47A
13B
57A
24B
34E
61
77
77
27B
34C
57A
37C
77
57A
64
57A
27C
41A
47A
34E
34C
45B
47A
37C
27B
64
57A
77
64
60A
77
77
47A


N
1 MILE
1 KILOMETER
Scale 1:15 840
0
1/4
1/2
3/4
0
0.5
1
(Joins sheet 25)
(Joins sheet 31)
(Joins sheet 39)
R. 1 W.
R. 1 E.
13
18
24
19
B E N T O N
G
16B
45B
61
41A
13B
49A
16B
41A
45B
13B
2
17D
85
8
67
26C
26B
43A
45B
41A
49A
8
67
48A
60A
66
30D

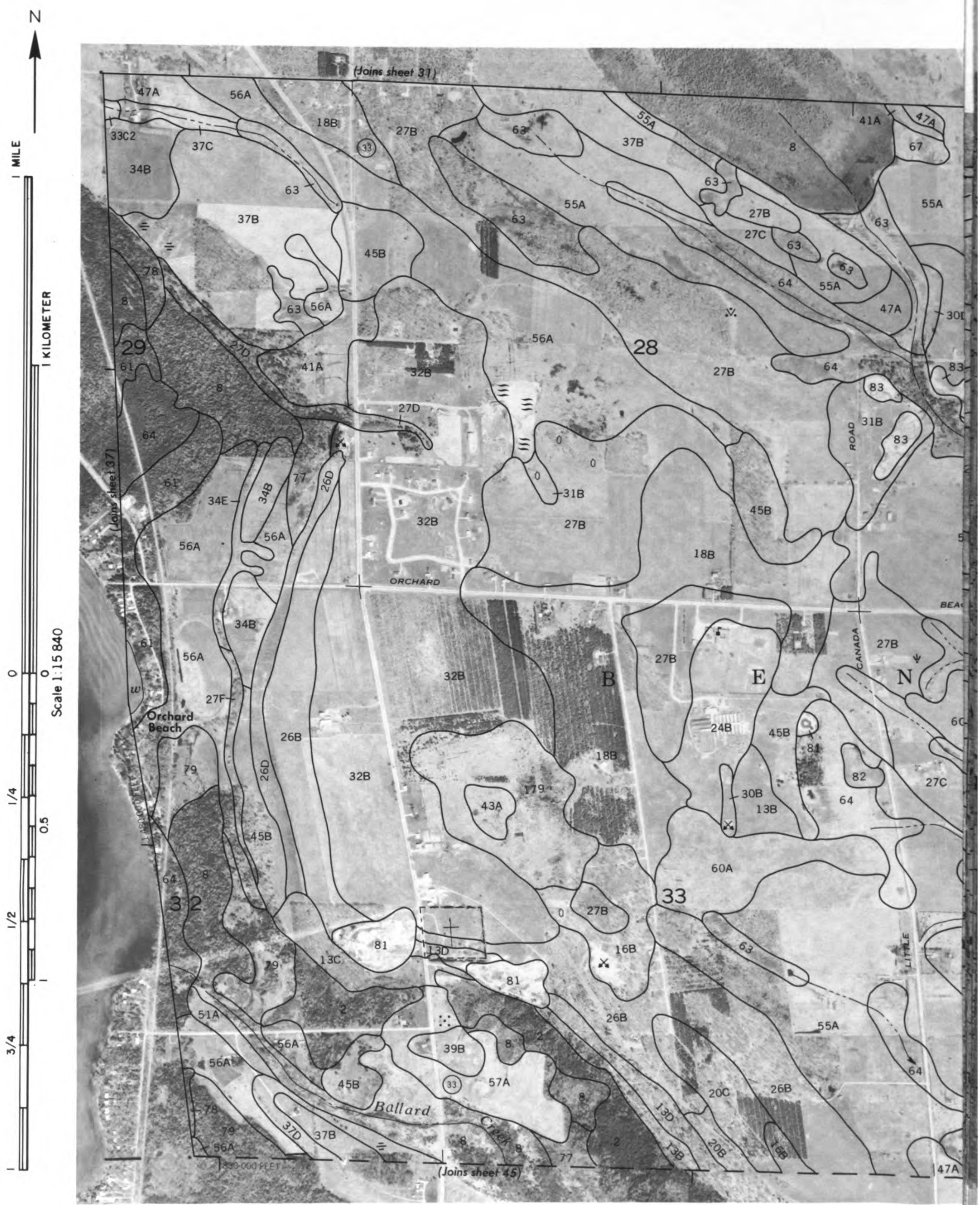

865 000 FEET
1 495 000 FEET
Lake
Sixteen
ALPENA
STATE
ROAD
17
16
20
21
R
A
N
T
T. 37 N.
(Joins sheet 33)
85
10
45B
13B
41A
9
16B
61
67
49A
8
41A
16C
43A
20B
49A


N
1 MILE
1 KILOMETER
Scale 1:15 840
0
1/4
1/2
3/4
0.5
(Joins sheet 27)
Maple Point
Pells
Islan
EMMET
COUNTY
30
31
M
U
BRYANT
ROAD
RIGGSVILLE
C64
1 480 000 FEET
760 000 FEET
(Joins sheet 41)
8
71
20B
67
47A
27B
56A
18C
13F
18D
13B
13D
45B
32B
85
41A
13C
18B
27C
27D


DOUGLAS
LAKE
Grapevine
Point
SOUTH
FISHTAIL
BAY
T. 37 N.
(Joins sheet 35)
UNIVERSITY OF MICHIGAN BIOLOGICAL STATION
RIGGSVILLE
ROAD
N
R
O
29
28
32
33
20C
13D
13B
13C
13F
45B
32B
32C
30C
8
C64


N
1 MILE
1 KILOMETER
Scale 1:15 840
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 29)
(Joins sheet 35)
(Joins sheet 43)
1 480 000 FEET
795 000 FEET
ROAD
POLISH
CHURCH
RICHARDSON
INDIAN
TRAIL
I N V E R
29
30
31
32
27B
27C
27D
27F
18B
18C
18D
32B
56A
11B
11C
11D
11F
16B
17D
20B
20C
41A
43A
45B
47A
61
62
78
83
85
87
8

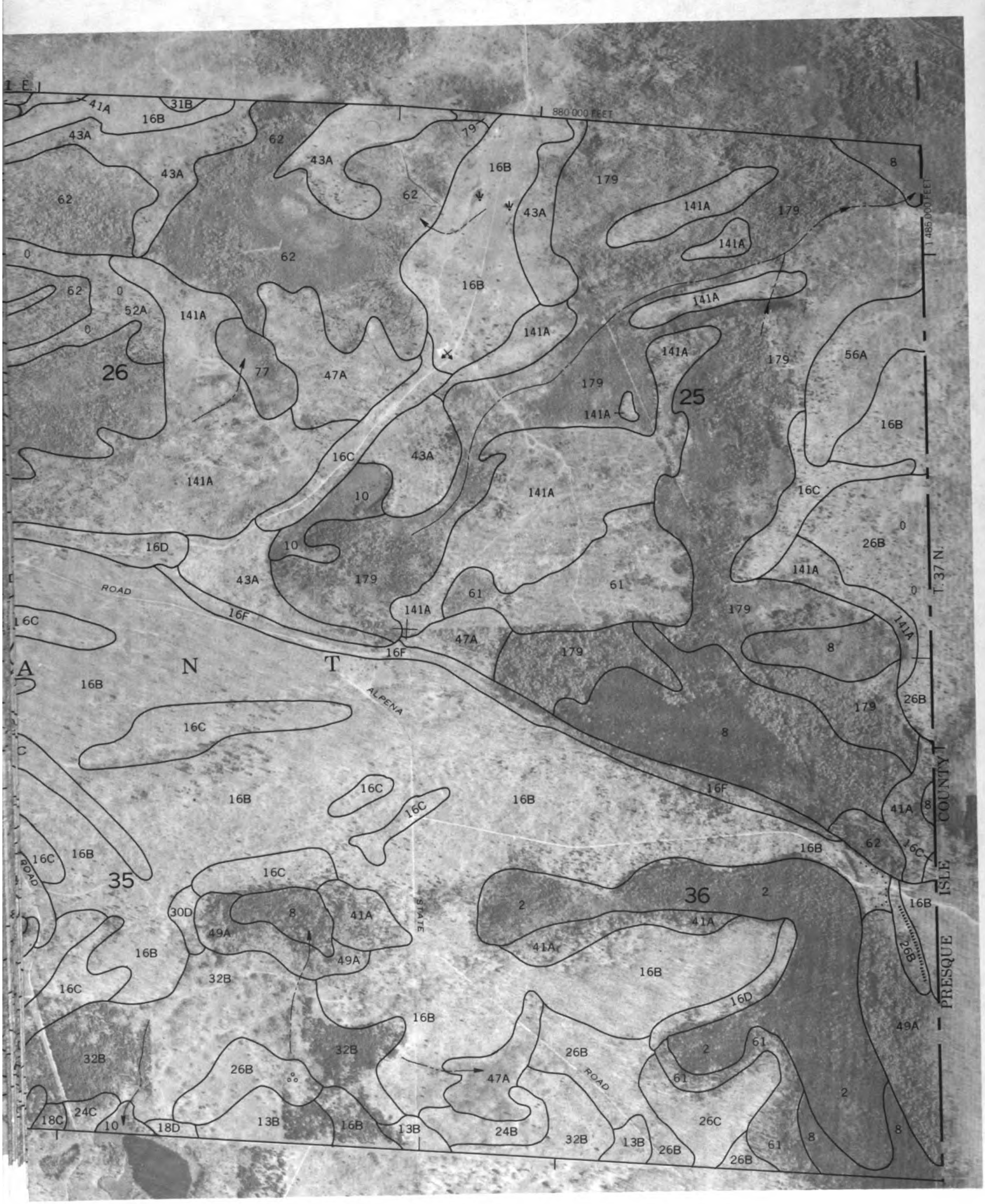

2 W.
810 000 FEET
1 485 000 FEET
T. 37 N.
(Joins sheet 37)
28
27
33
34
HANSON ROAD
KATE ROAD
INDIAN TRAIL ROAD
LINE ROAD
ROAD
Mullett Lake Creek
DETROIT AND MACKINAC
Mullett Lake
N E S S

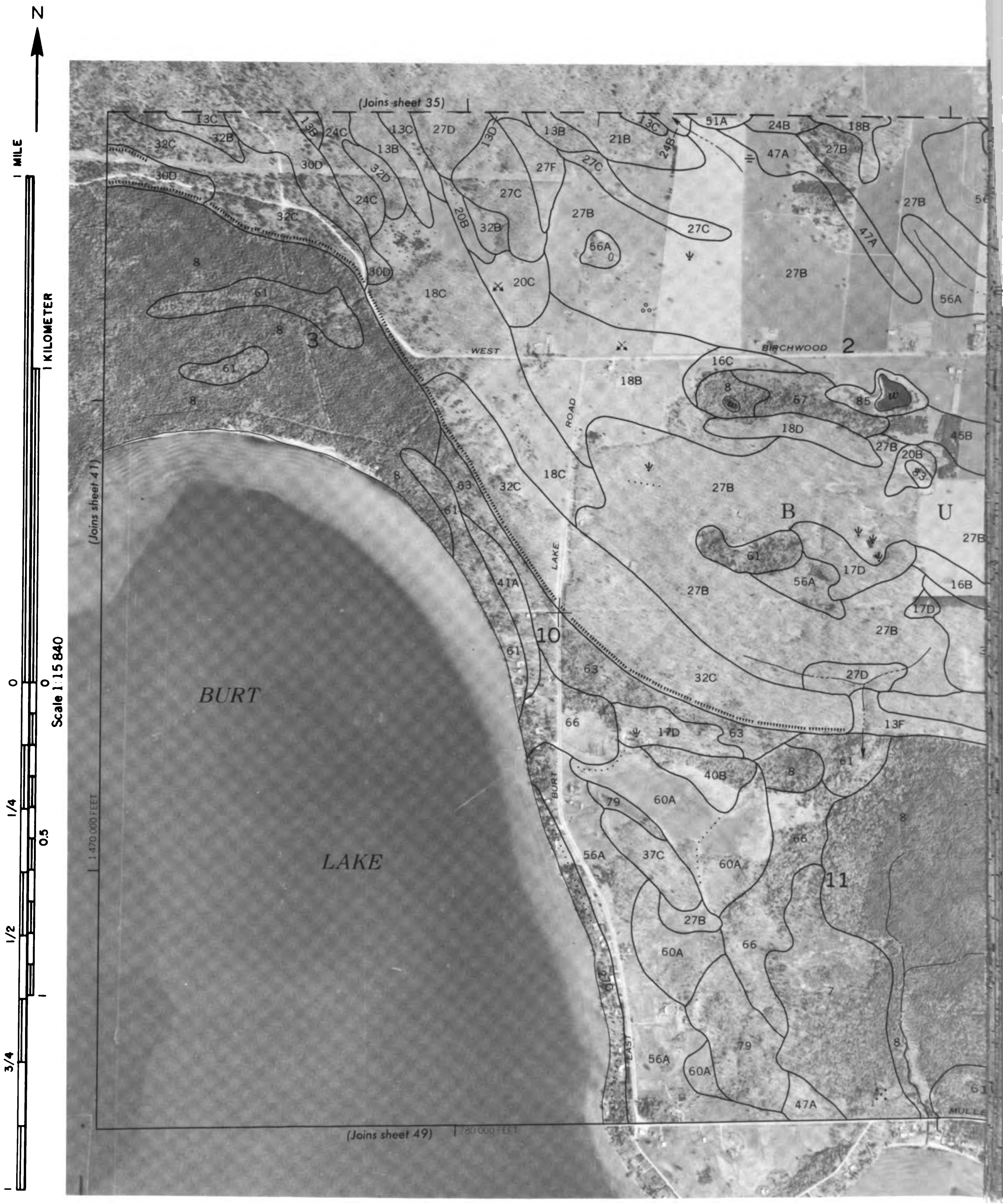

N
1 MILE
1 KILOMETER
Scale 1:15 840
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 31)
(Joins sheet 37)
(Joins sheet 45)
ORCHARD
Orchard Beach
CANADA
ROAD
LITTLE
Ballard
Creek
28
29
32
33
B
E
N


R. 1 W.
845 000 FEET
1 485 000 FEET
T. 37 N.
(Joins sheet 39)
27
26
34
35
BLACK
RIVER
SOUTH RIVER ROAD
MOGRAIN ROAD
ORCHARD BEACH ROAD
Alverno ROAD
LOWER
BLACK RIVER
NORTH RIVER ROAD
MANNING ROAD
T O N
FOS

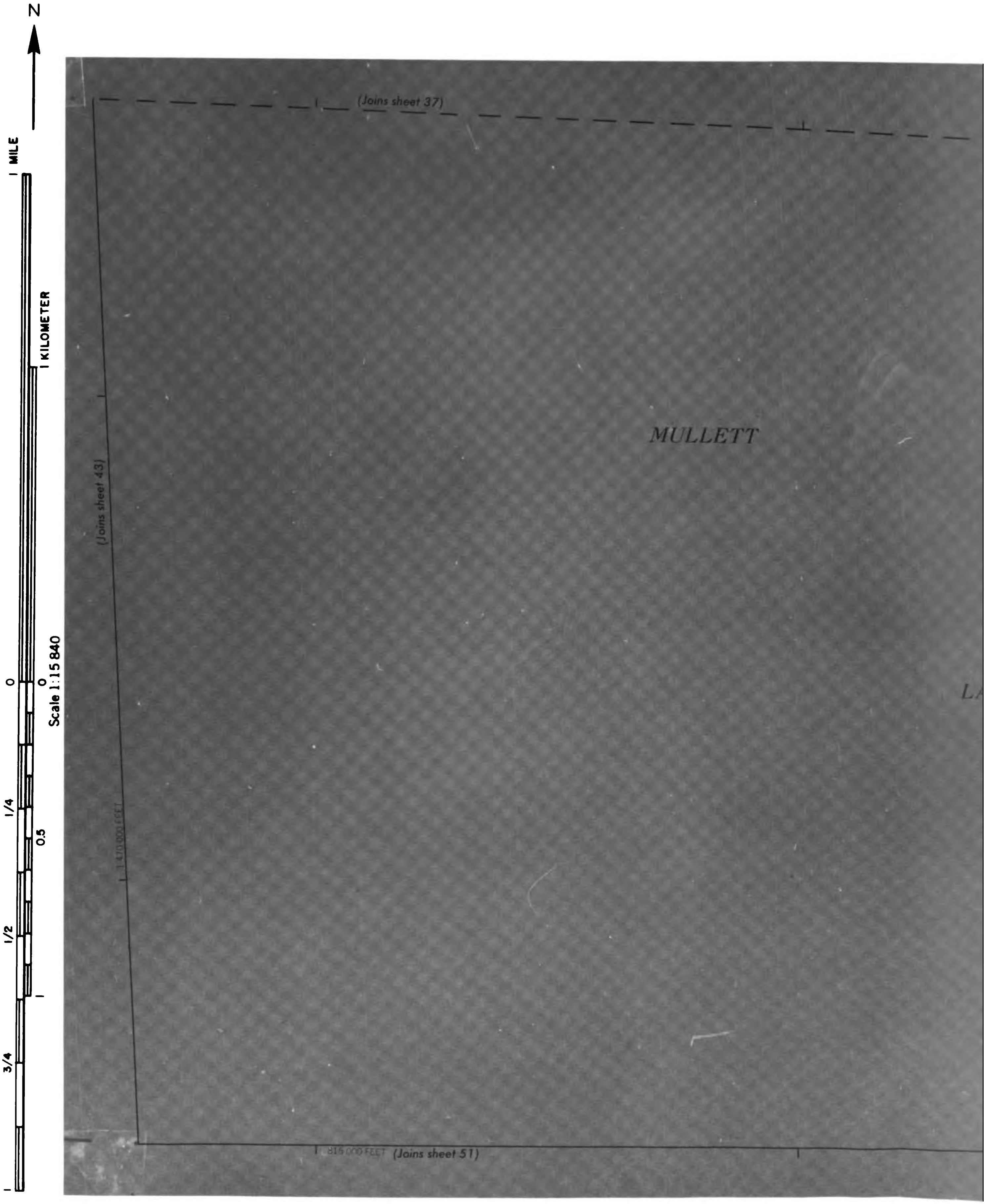
(39)


N
1 KILOMETER
Scale 1:15 840
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 33)
(Joins sheet 47)
(Joins sheet 39)
ALPENA STATE ROAD
BEACH
ORCHARD
KRAUSE
PAGE ROAD
Twin Lakes
G R
28
27
33
34
1 480 000 FEET
870 000 FEET

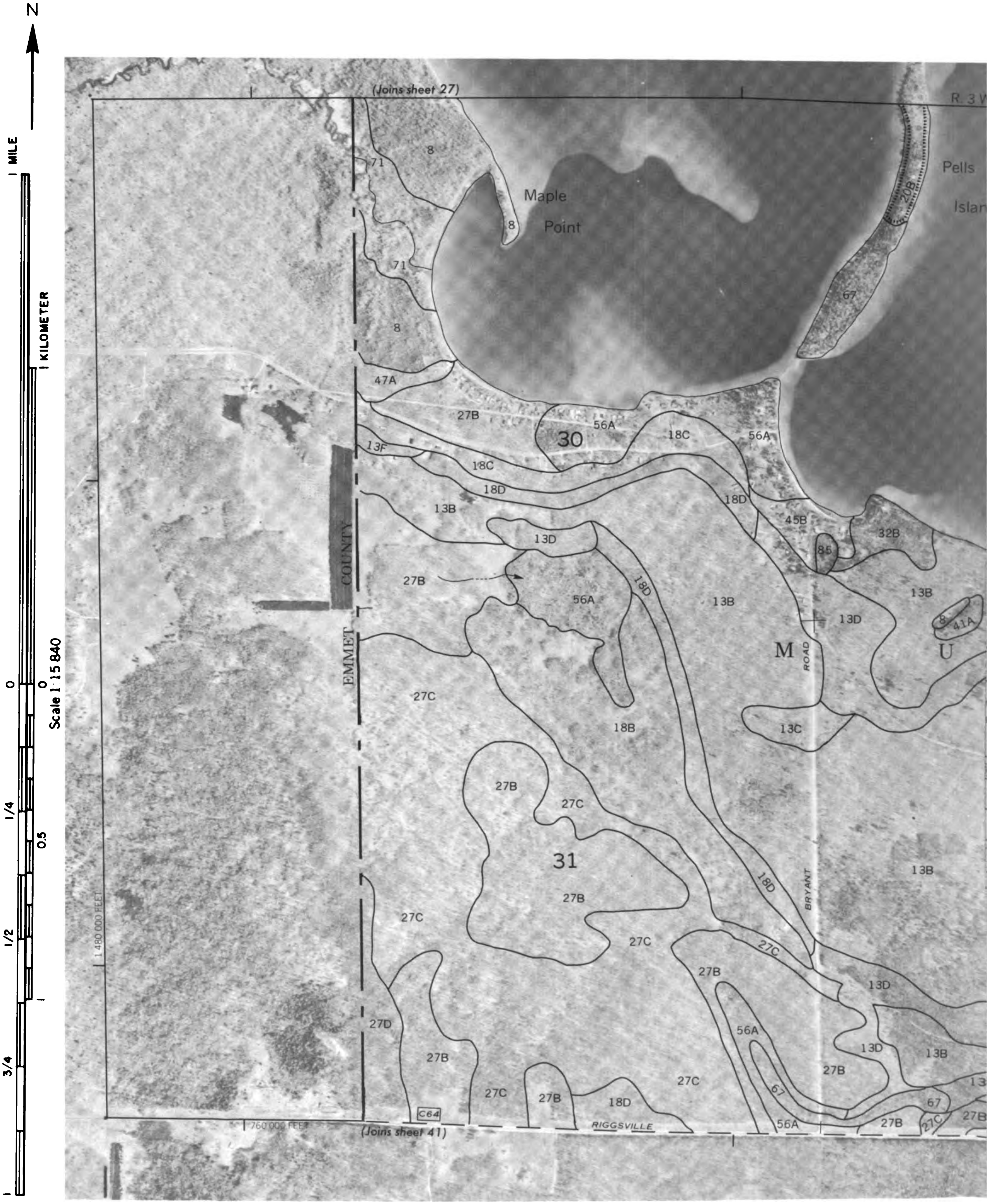

880 000 FEET
1 485 000 FEET
T. 37 N.
PRESQUE ISLE COUNTY
26
25
35
36
A N T
ROAD
ALPENA
STATE
ROAD
ROAD
16B
43A
62
179
141A
47A
16C
10
16D
16F
8
61
2
41A
49A
26B
32B
16B
47A
24B
13B
18D
18C
24C
26C
56A
77
52A
31B
41A
79
30D

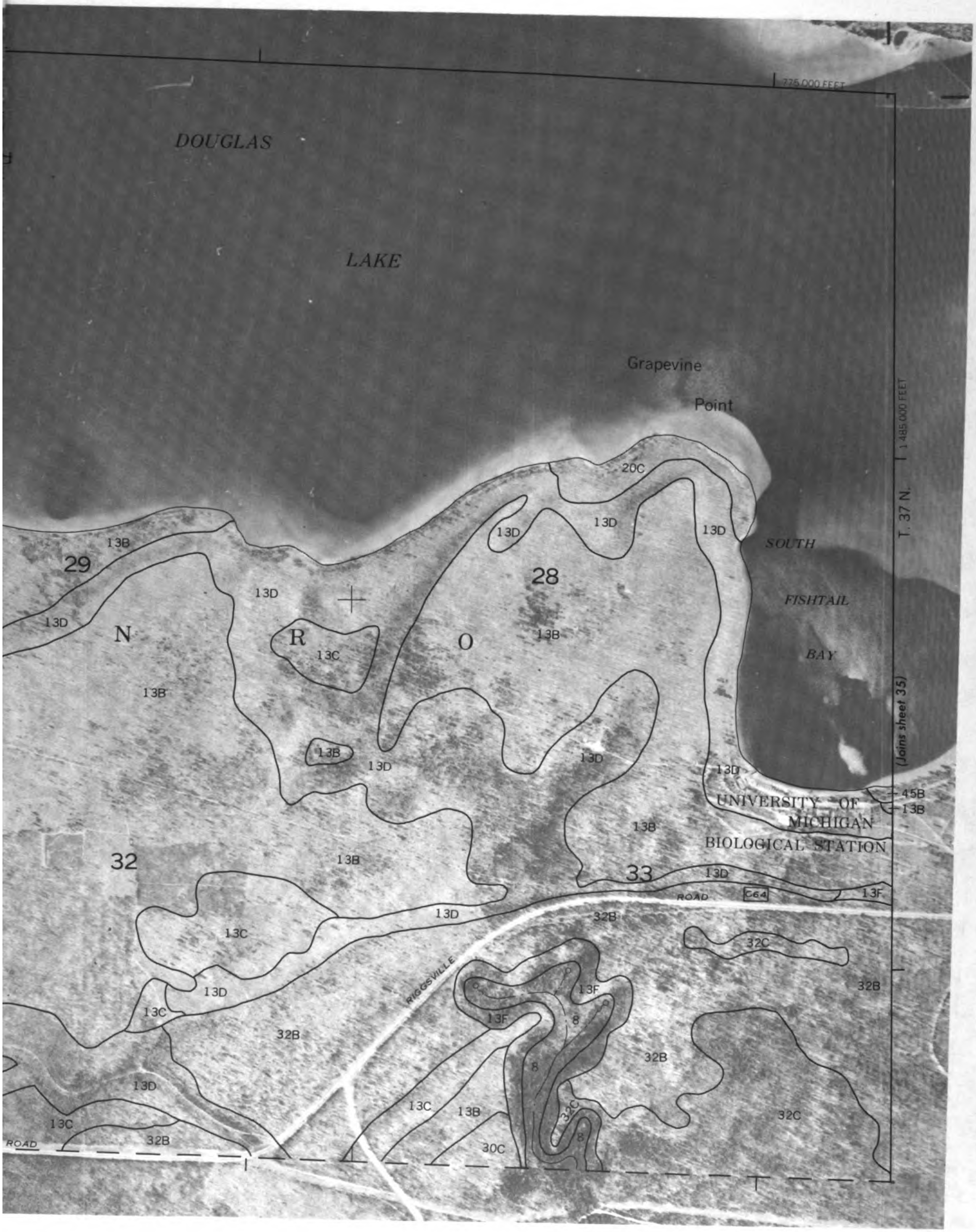

N
1 MILE
1 KILOMETER
Scale 1:15 840
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 35)
(Joins sheet 41)
(Joins sheet 49)
1 470 000 FEET
780 000 FEET
BURT
LAKE
WEST
BIRCHWOOD
ROAD
LAKE
BURT
LAKE
EAST
B
U
2
3
10
11
13C
32B
32C
30D
13B
24C
13C
27D
13B
32D
24C
13D
27F
27C
20B
32B
13B
27C
21B
13C
24B
51A
24B
47A
18B
27B
27B
27C
56A
27B
47A
56A
30D
18C
20C
8
61
8
61
8
16C
8
67
85
18D
18B
27B
20B
83
45B
18C
32C
27B
8
63
61
27B
61
56A
17D
16B
17D
41A
27B
61
63
32C
27D
13F
66
17D
63
40B
8
61
8
79
60A
56A
37C
60A
66
27B
66
60A
7
79
56A
60A
47A
8
61


R. 3 W.
R. 2 W.
290 000 FEET
1 475 000 FEET
T. 36 N.
(Joins sheet 43)
Mullett
Creek
BIRCHWOOD
ROAD
CRUMP
ROAD
SOUTH
EXTENSION
I-75
1
6
7
12
R
T
E
L
U
M
13C
27B
17D
60A
45B
61
8
64
17B
55A
32B
63
47A
57A
41A
56A
40D2
81
33C2
40B
57A
33B
27D
34C
77
49A
48A
26C
18C
27C
18B
41A
79
2
20D
20B
32C
32D
45B
13B
13F
30D
13D
11C
11B
85
51A
30C
48A
27C
ROAD

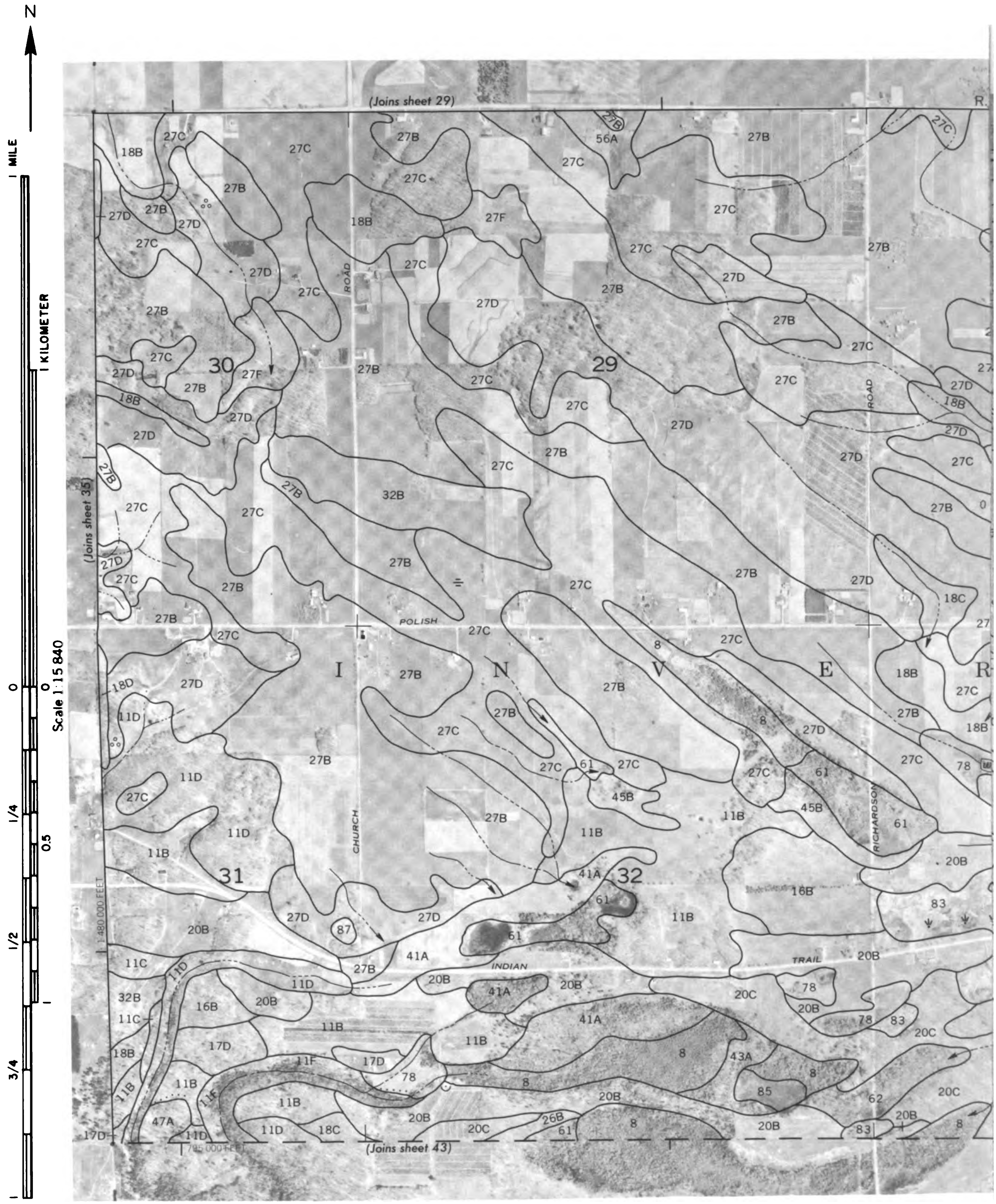

N
1 MILE
1 KILOMETER
Scale 1:15 840
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 37)
(Joins sheet 43)
MULLETT
1 470 000 FEET
815 000 FEET
(Joins sheet 51)


865 000 FEET
1 495 000 FEET
Lake
Sixteen
ALPENA
STATE
ROAD
17
16
20
21
R
A
N
T
T. 37 N.
(Joins sheet 33)
85
10
45B
13B
41A
16B
9
61
67
49A
8
16C
43A
20B
6B
45B
41A

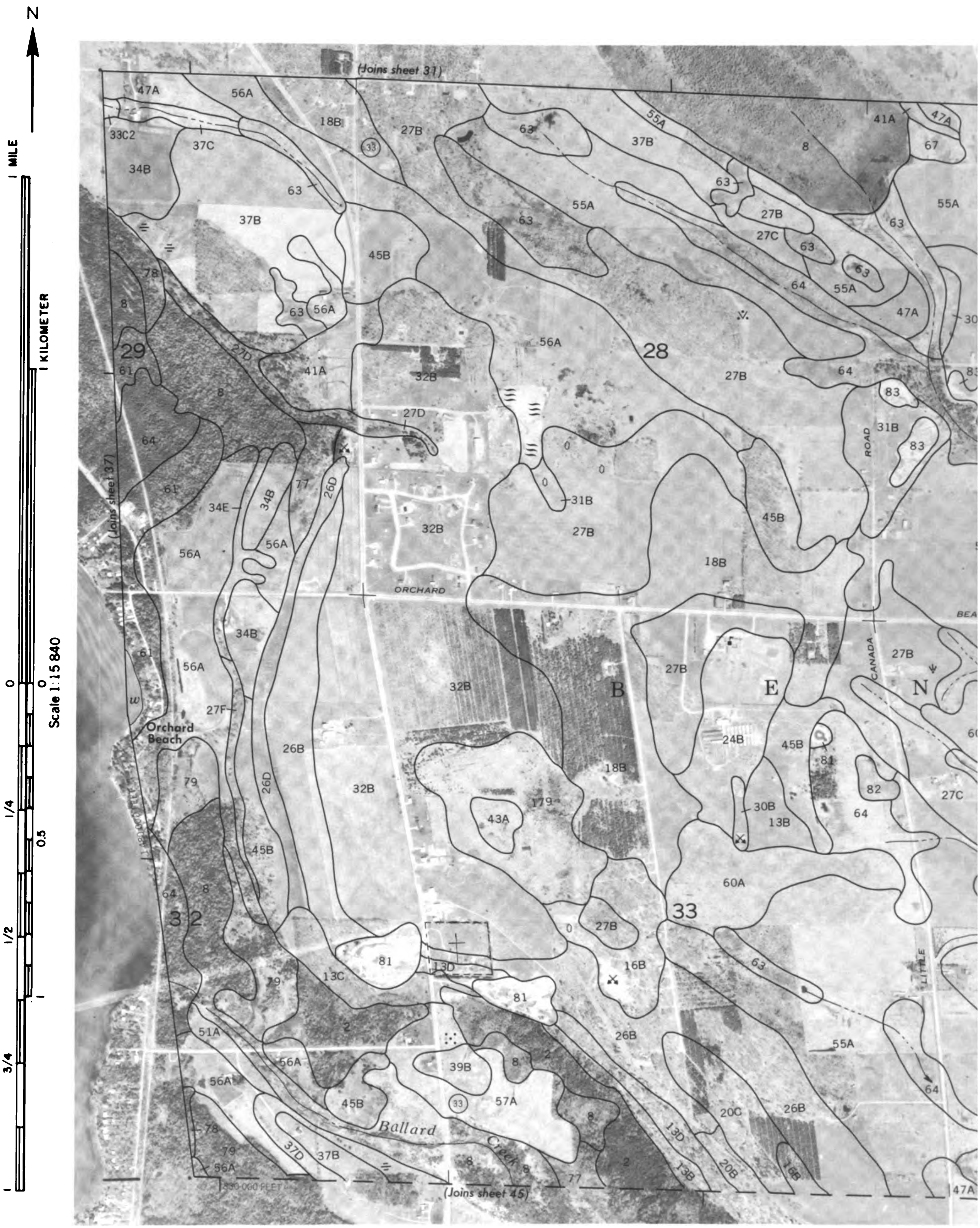

N
1 MILE
1 KILOMETER
0
0
1/4
0.5
1/2
1
3/4
1
Scale 1:15 840
(Joins sheet 27)
R. 3 W.
Maple
Point
Pells
Islan
EMMET
COUNTY
BRYANT
ROAD
M
U
30
31
1 480 000 FEET
760 000 FEET
C64
RIGGSVILLE
(Joins sheet 41)
8
71
47A
27B
13F
18C
18D
13B
13D
56A
20B
67
45B
85
32B
41A
13C
27C
18B
27D



775 000 FEET
DOUGLAS
LAKE
Grapevine
Point
1 485 000 FEET
T. 37 N.
SOUTH
FISHTAIL
BAY
(Joins sheet 35)
29
28
N
R
O
32
33
UNIVERSITY OF
MICHIGAN
BIOLOGICAL STATION
ROAD
C64
RIGGSVILLE
ROAD
20C
13D
13B
13C
13F
45B
32B
32C
30C
8


N
1 MILE
1 KILOMETER
Scale 1:15 840
0
1/4
1/2
3/4
1
0.5
(Joins sheet 29)
(Joins sheet 35)
(Joins sheet 43)
1 480 000 FEET
795 000 FEET
ROAD
CHURCH
POLISH
INDIAN
TRAIL
RICHARDSON
ROAD
I N V E R
29
30
31
32

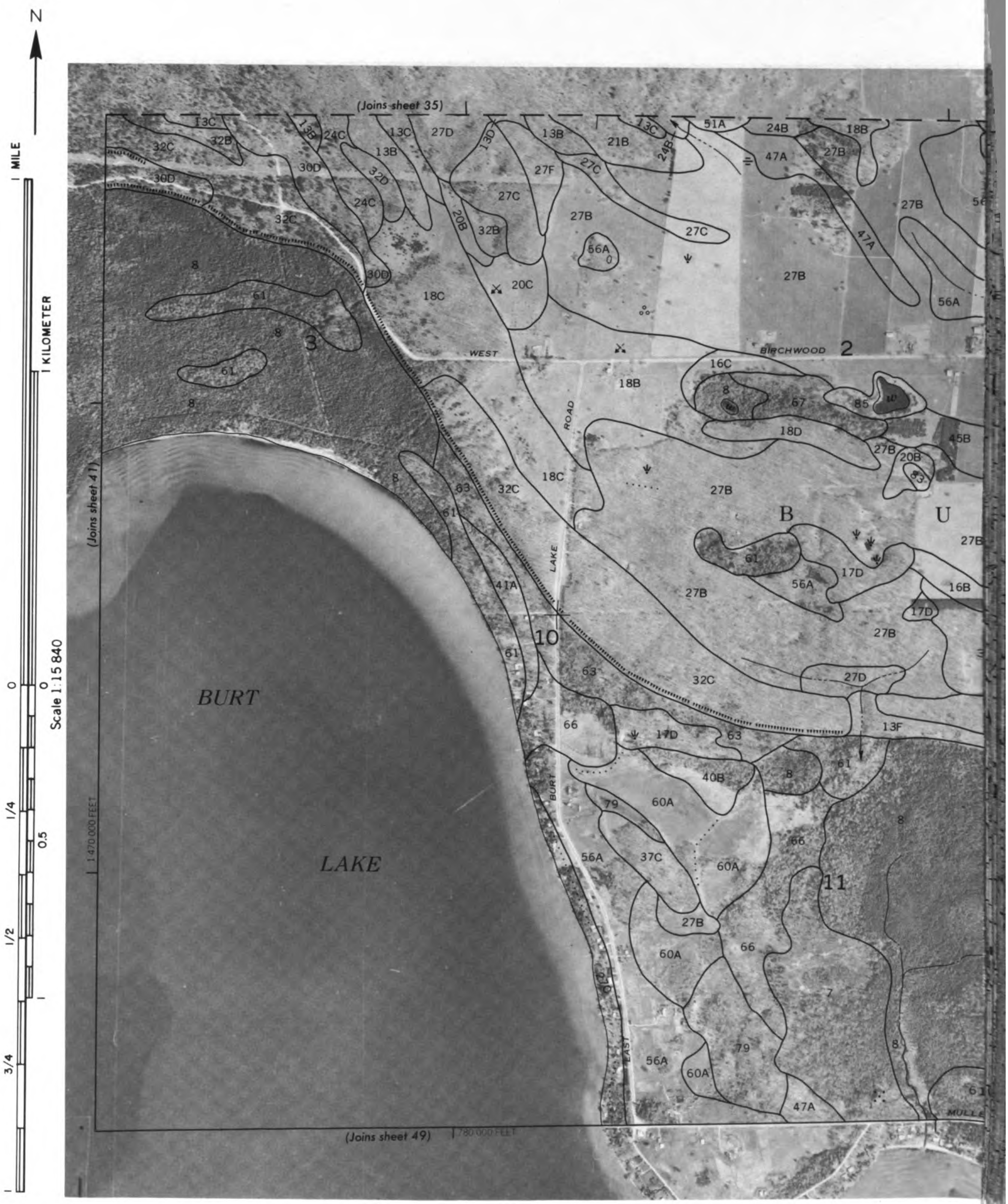

2 W.
810 000 FEET
1 485 000 FEET
T. 37 N.
(Joins sheet 37)
28
27
33
34
HANSON ROAD
KATE
INDIAN TRAIL ROAD
LINE ROAD
ROAD
Mullett Lake Creek
DETROIT AND MACKINAC
Mullett Lake
N E S S

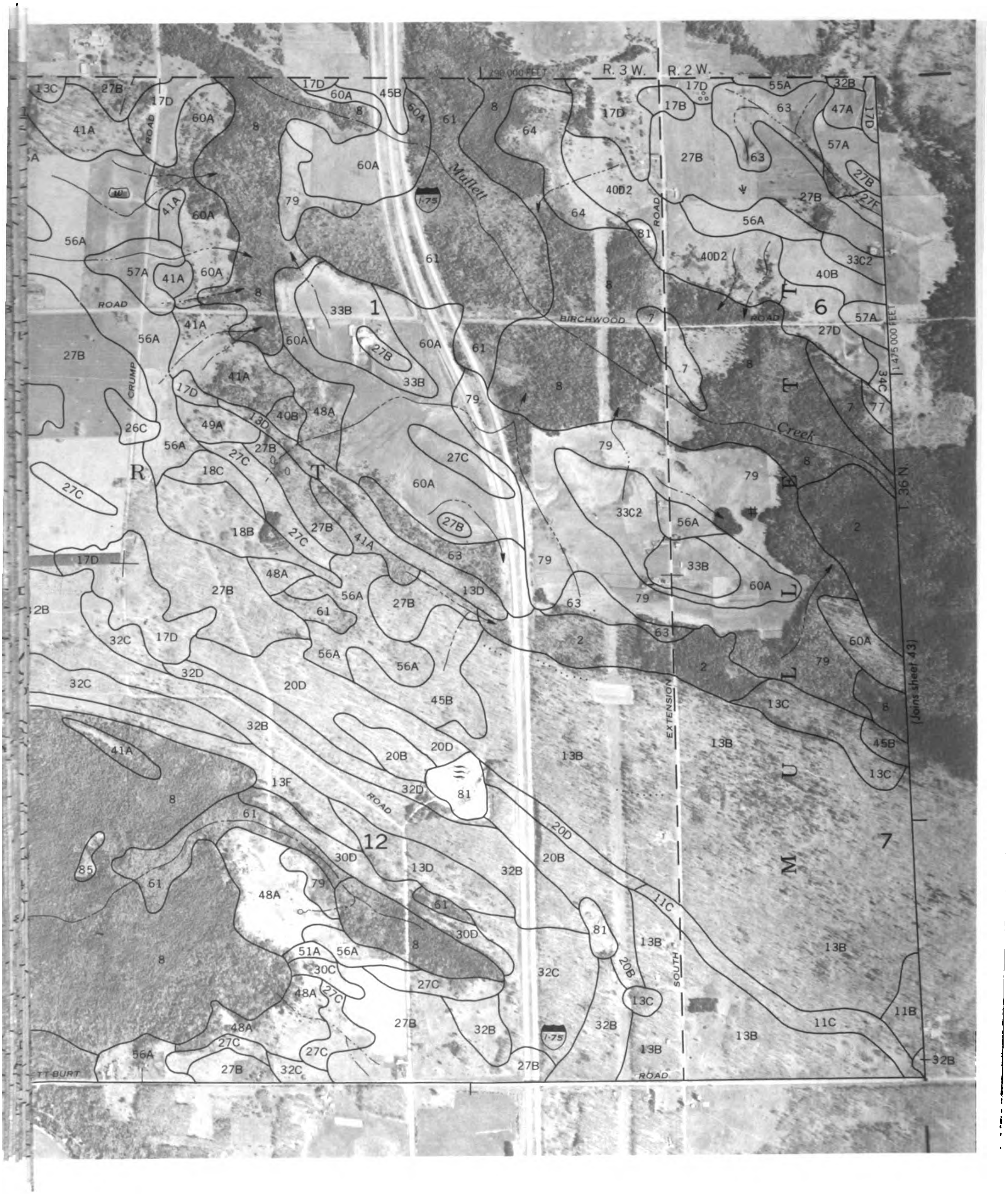

N
1 MILE
1 KILOMETER
Scale 1:15 840
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 31)
(Joins sheet 37)
(Joins sheet 45)
ORCHARD
Orchard Beach
Ballard Creek
ROAD
CANADA
LITTLE
BEA
28
29
32
33
B
E
N
47A
56A
18B
27B
33C2
37C
34B
63
37B
45B
55A
41A
67
27C
64
47A
78
8
27D
41A
32B
61
31B
83
34E
77
26D
56A
0
31B
18B
27F
w
79
26B
24B
81
82
30B
13B
43A
179
60A
27B
16B
13C
13D
51A
39B
57A
45B
37D
20C
20B
13B
16B
2
77
47A

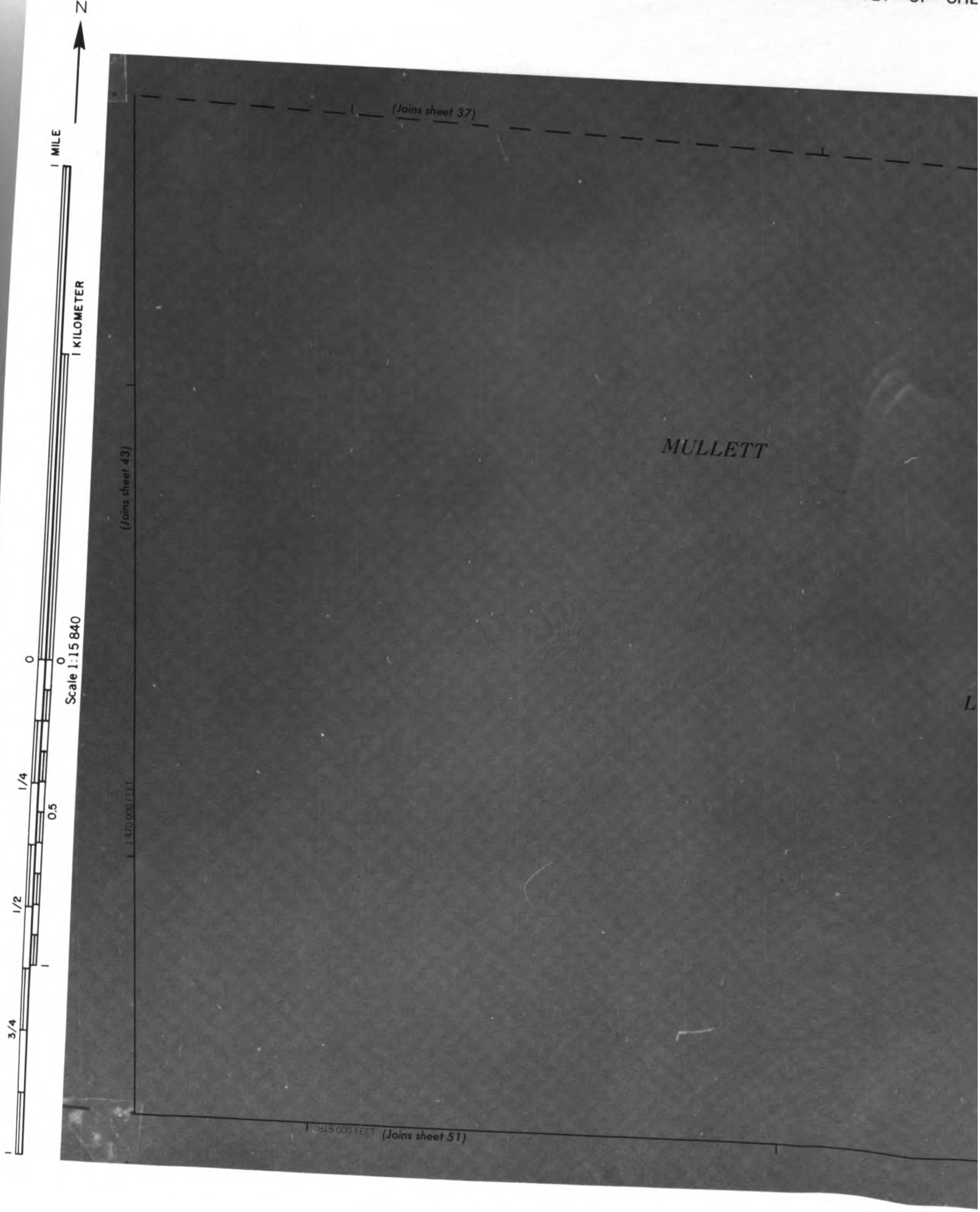

R. 1 W.
845 000 FEET
485 000 FEET
T. 37 N.
(Joins sheet 39)
BLACK RIVER
SOUTH BLACK RIVER ROAD
NORTH BLACK RIVER
ORCHARD BEACH ROAD
LOWER ROAD
MOGRAIN ROAD
MANNING ROAD
Alverno
27
26
34
35
T O N


N
1 MILE
1 KILOMETER
Scale 1:15 840
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 33)
(Joins sheet 39)
(Joins sheet 47)
ALPENA
STATE
ROAD
BEACH
ORCHARD
KRAUSE
PAGE
ROAD
G
R
28
27
33
34
Twin
Lakes
1 480 000 FEET
870 000 FEET

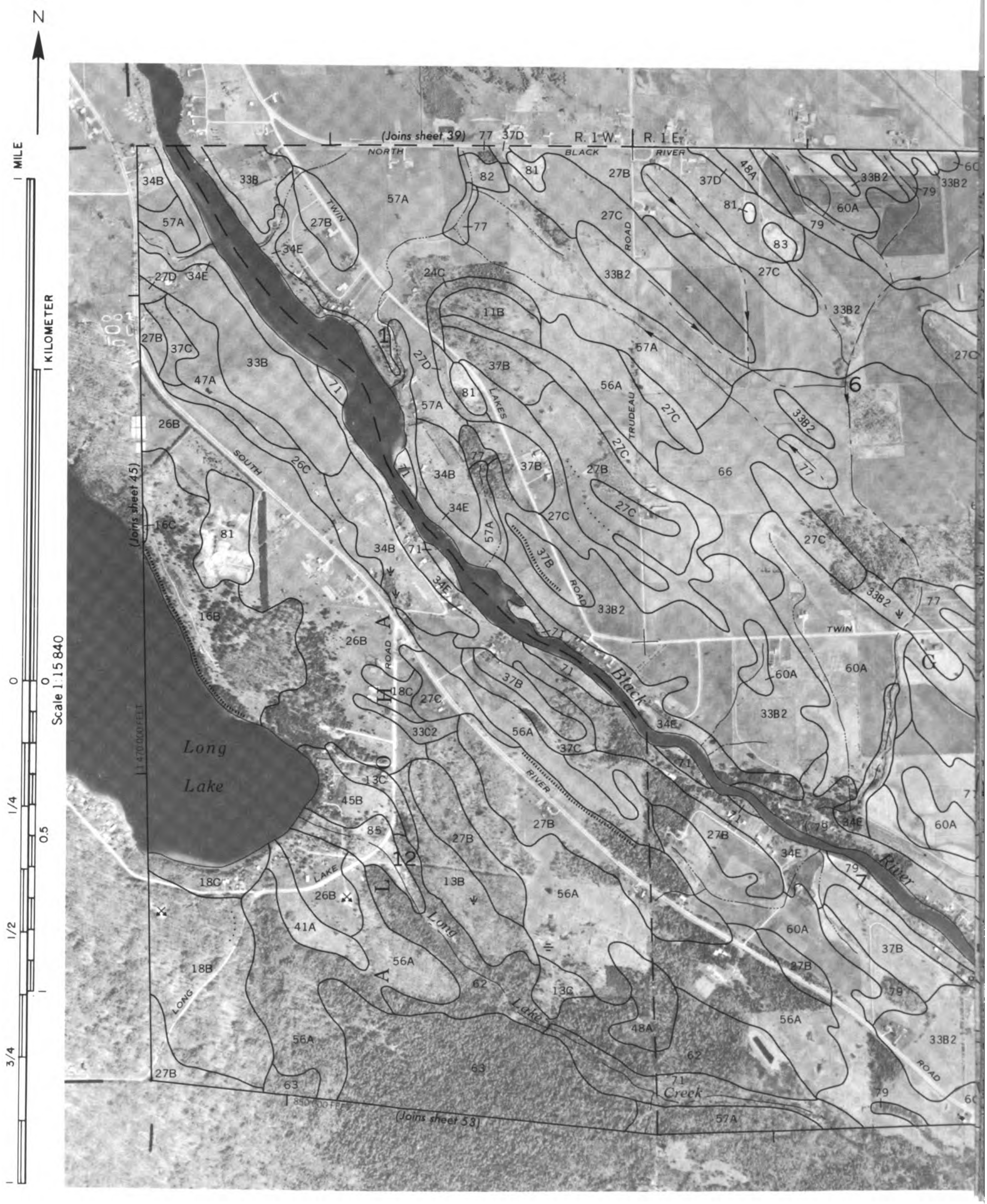

880 000 FEET
1 485 000 FEET
26
25
35
36
A N T
ROAD
ALPENA STATE ROAD
ROAD
T. 37 N.
PRESQUE ISLE COUNTY
41A
31B
16B
43A
62
43A
62
79
16B
43A
179
141A
179
8
141A
62
52A
141A
77
47A
16B
141A
141A
141A
179
56A
179
141A
16C
43A
10
141A
16B
141A
10
16C
16D
43A
179
61
61
26B
141A
16C
16F
141A
47A
179
179
141A
16F
16B
8
16C
179
26B
8
16B
16C
16C
16B
16F
16B
41A
62
16C
16C
16B
16C
2
2
30D
49A
8
41A
41A
41A
16B
16B
49A
32B
16C
16D
28B
16B
49A
32B
32B
26B
47A
26B
2
61
61
18C
24C
10
18D
13B
16B
13B
24B
32B
13B
26B
26C
61
8
8
2
26B


N
1 MILE
1 KILOMETER
Scale 1:15 840
0
1/4
0.5
1/2
3/4
1
(Joins sheet 35)
(Joins sheet 41)
(Joins sheet 49)
1 470 000 FEET
780 000 FEET
BURT
LAKE
WEST
BIRCHWOOD
ROAD
LAKE
BURT
OLD
EAST
MULLE
B
U
2
3
10
11

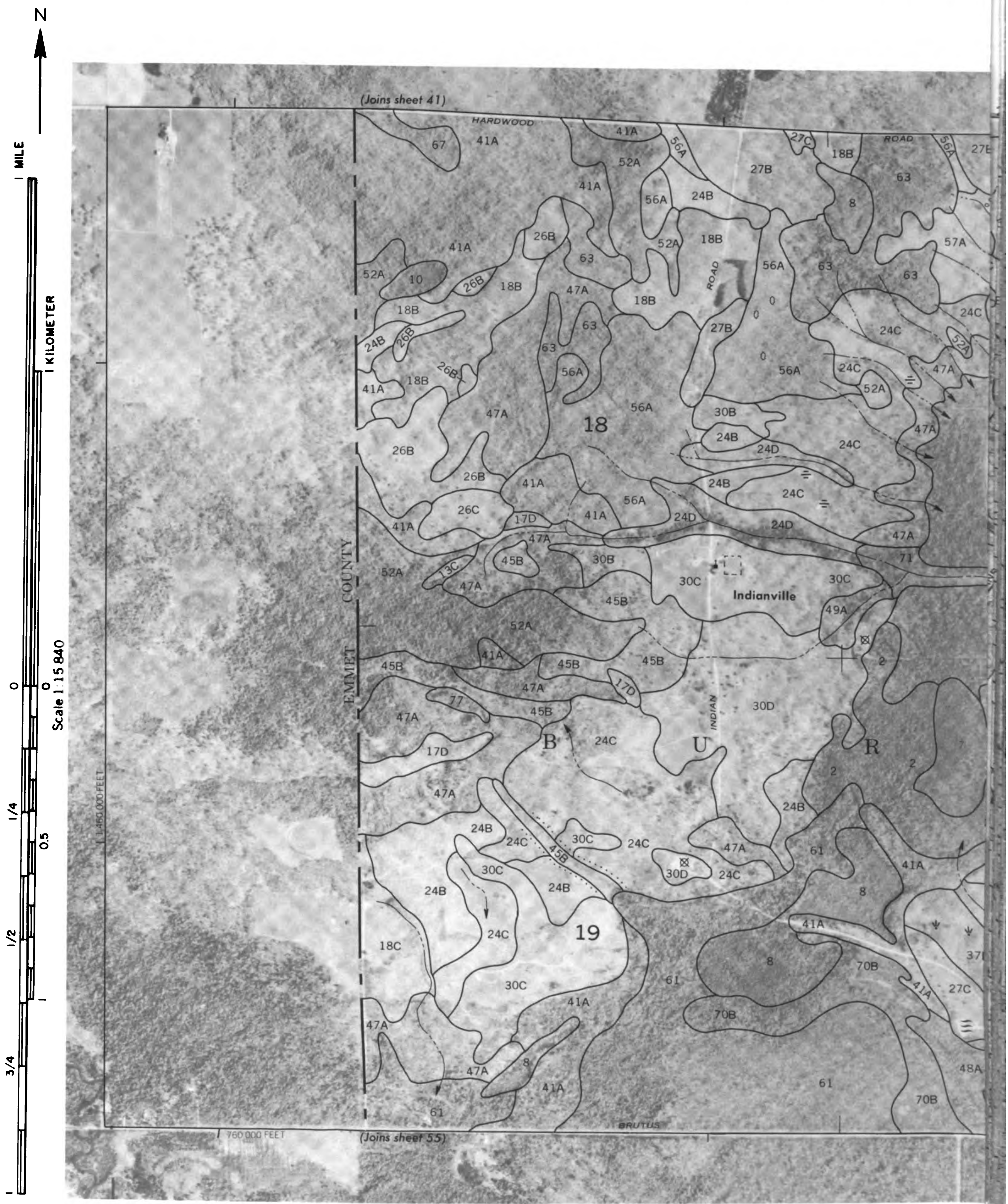

R. 3 W.
R. 2 W.
290 000 FEET
1 475 000 FEET
T. 36 N.
(Joins sheet 43)
Mullett
Creek
BIRCHWOOD
ROAD
CRUMP
SOUTH
EXTENSION
1
6
7
12

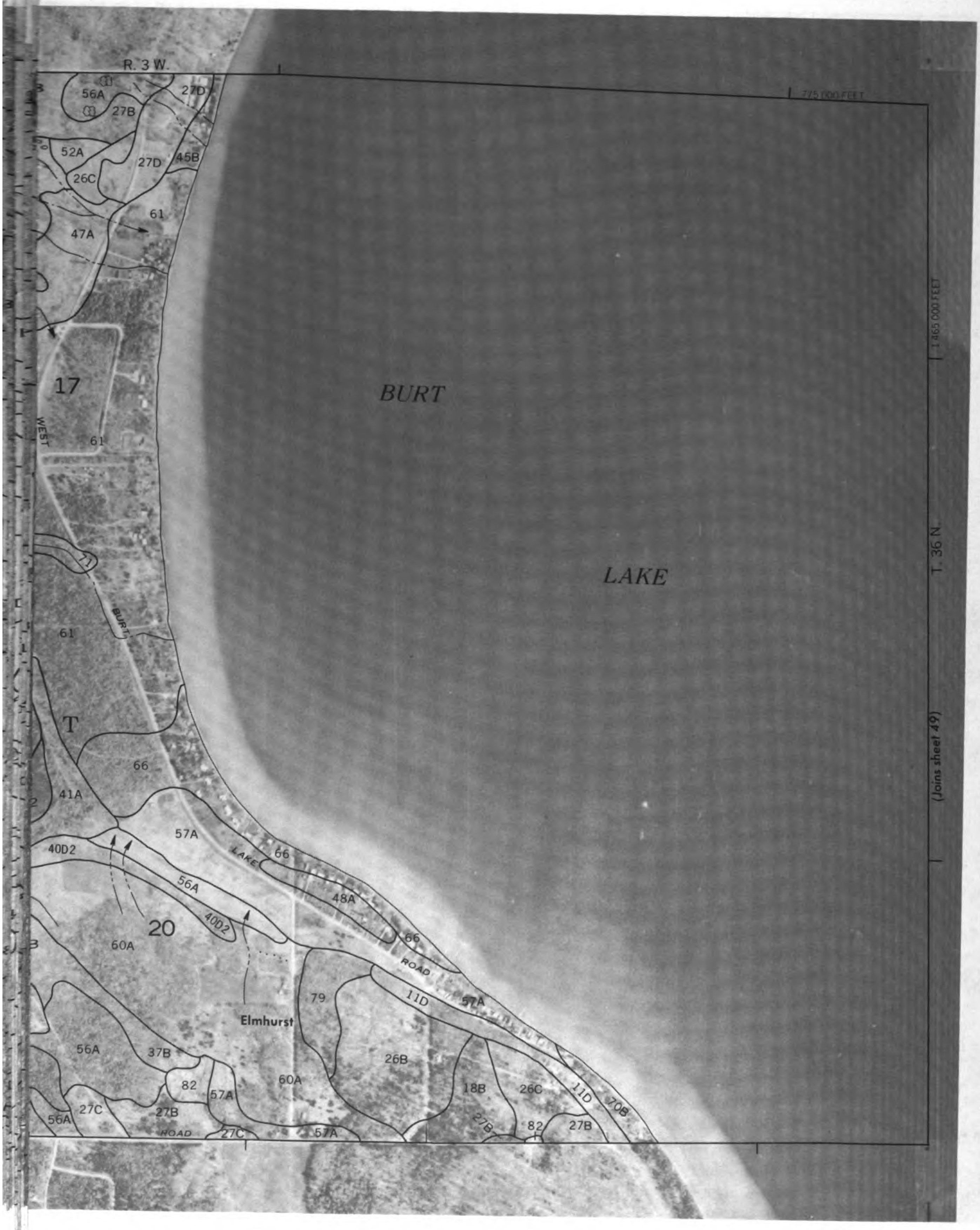

N
1 MILE
1 KILOMETER
0
0
Scale 1:15 840
1/4
0.5
1/2
1
3/4
1
(Joins sheet 37)
(Joins sheet 43)
MULLETT
1 470 000 FEET
815 000 FEET
(Joins sheet 51)


R. 2 W.
R. 1 W.
KE
56A
70B
25B
70B
65
5
70B
63
H
25B
56A
T. 36 N.
16B
63
11B
O
38B
33B
(Joins sheet 45)
Aloha
212
27B
L
33B
81
8
27B
82
A
ALOHA
STATE
PARK
w
82


N
1 MILE
1 KILOMETER
Scale 1:15 840
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 39)
(Joins sheet 45)
(Joins sheet 53)
R. 1 W.
R. 1 E.
NORTH BLACK RIVER
ROAD
TWIN
LAKES
TRUDEAU ROAD
SOUTH
RIVER
Black
River
Long Lake
LONG LAKE ROAD
Long Lake Creek
CHEBOYGAN
COUNTY
1 470 000 FEET
850 000 FEET
1
6
7
12
34B
33B
57A
27B
34E
27D
37C
47A
26B
26C
16C
81
16B
26B
18C
27C
33C2
13C
45B
85
18C
26B
41A
18B
27B
63
56A
62
13B
56A
37B
34B
34E
57A
37B
27C
33B2
71
11B
24C
82
77
37D
48A
60A
79
83
66
56A
27C
60A
33B2
37B
48A
62
57A


865 000 FEET
1 475 000 FEET
PAGE ROAD
LAKES ROAD
RIVER ROAD
BLACK
OWENS ROAD
CRONIN ROAD
HANSON ROAD
ROSS ROAD
Owens Creek
5
4
8
9
R A N T
T. 36 N.
(Joins sheet 47)

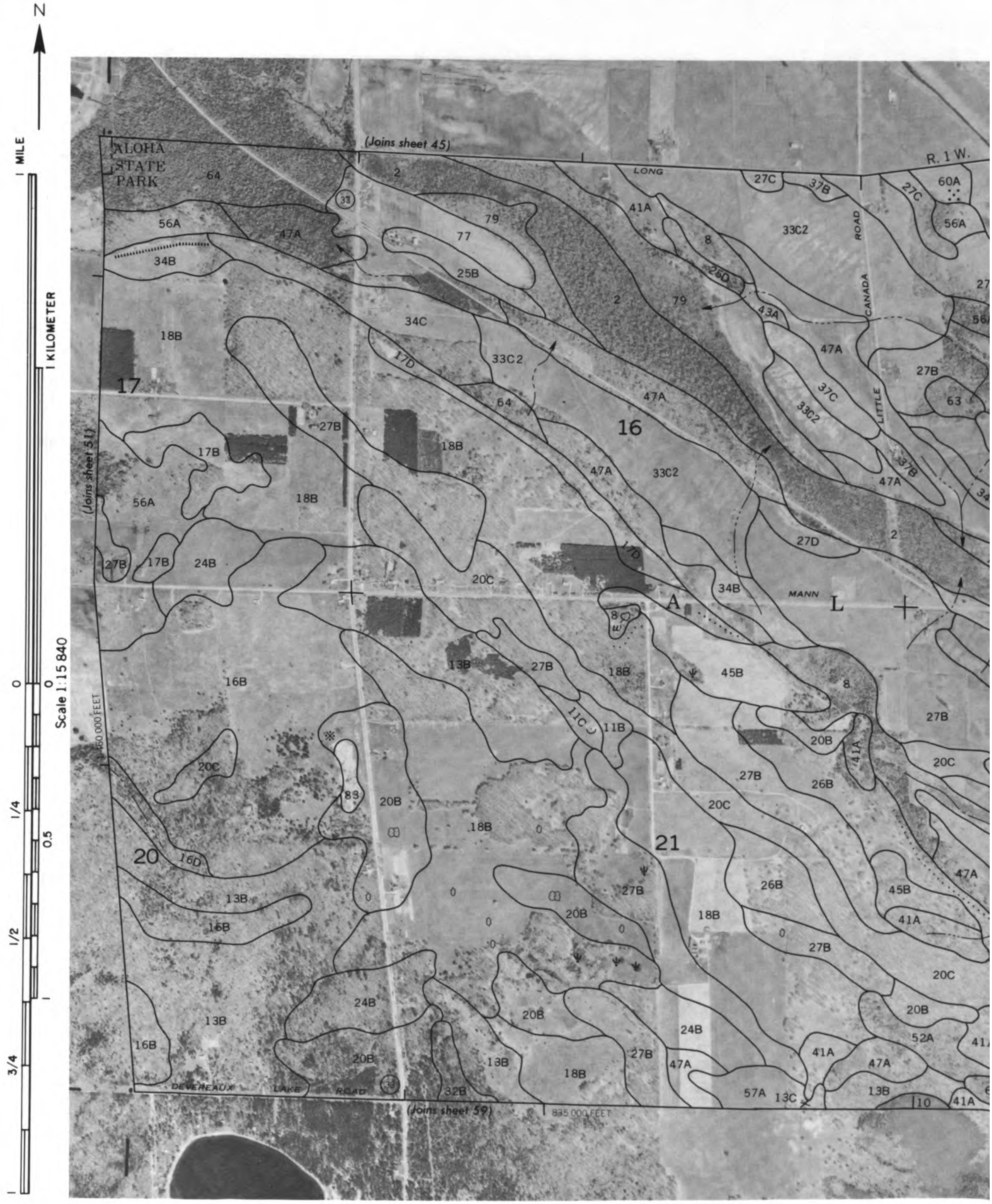

N
1 MILE
1 KILOMETER
Scale 1:15 840
0
1/4
0.5
1/2
3/4
1
(Joins sheet 41)
(Joins sheet 55)
HARDWOOD
ROAD
INDIAN
BRUTUS
EMMET COUNTY
Indianville
18
19
B
U
R
1 460 000 FEET
760 000 FEET

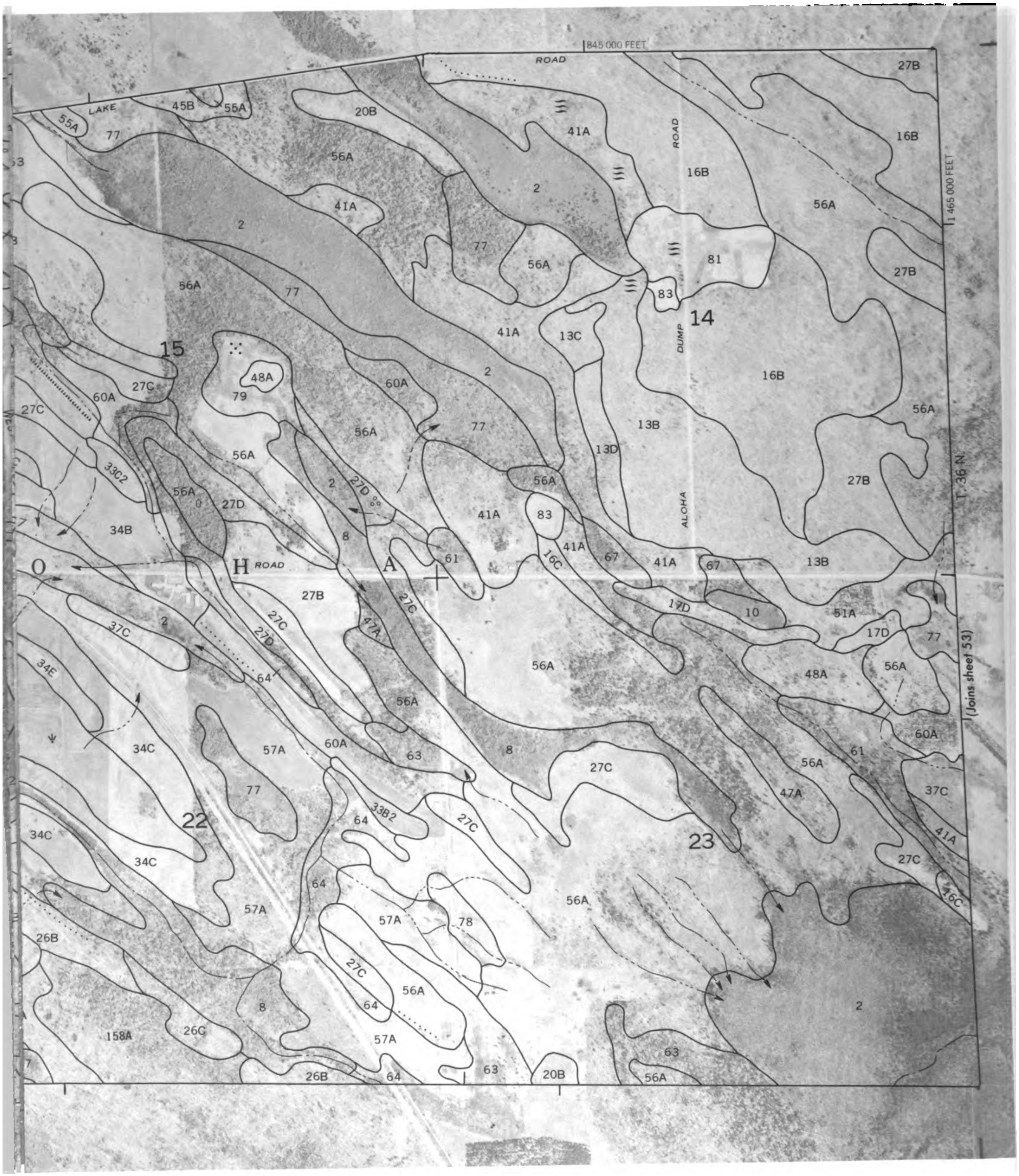

R. 3 W.
775 000 FEET
1 465 000 FEET
T. 36 N.
(Joins sheet 49)
BURT
LAKE
17
20
T
56A
27D
27B
52A
27D
45B
26C
61
47A
61
WEST
71
BURT
61
66
41A
57A
40D2
LAKE
66
56A
48A
40D2
66
60A
ROAD
79
11D
57A
Elmhurst
56A
37B
26B
82
60A
57A
18B
26C
11D
70B
27C
27B
56A
27B
82
27B
ROAD
27C
57A

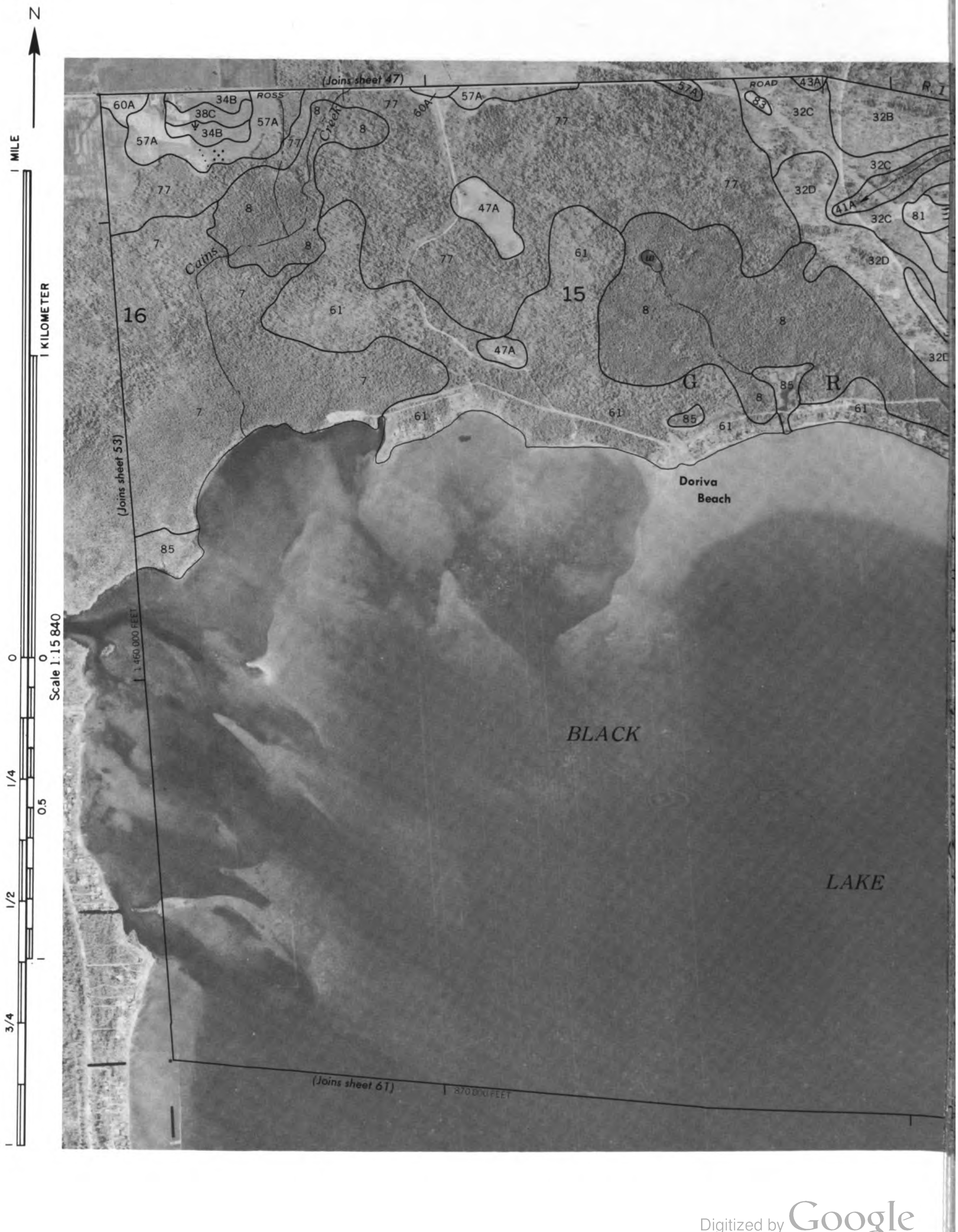
(49)


(Joins sheet 43)
MULLETT-BURT ROAD
ROAD
WOODMANSEE ROAD
BENNETT ROAD
DETROIT
Mullett Creek
MULLETT
(Joins sheet 49)
(Joins sheet 57)
1 460 000 FEET
795 000 FEET
17
18
19
20
21
Scale 1:15 840
1 KILOMETER
0
1/4
1/2
3/4
0.5


47A
Miami
Beach
41A
MACKINAC
158A
16
25B
70B
Veery
Point
MULLETT
LAKE
oyal
Oak
Beach
T. 36 N.
(Joins sheet 51)

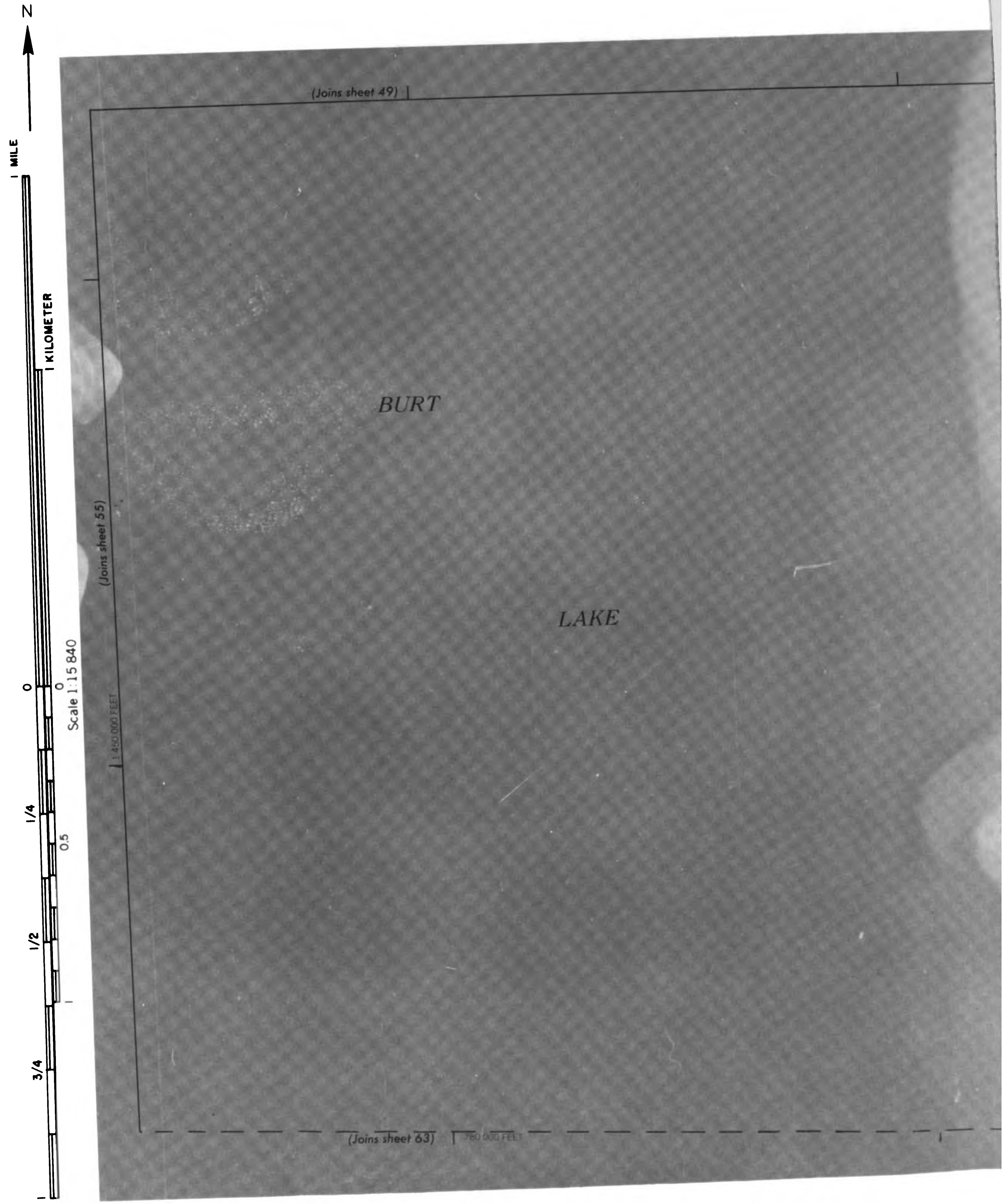

N
1 MILE
1 KILOMETER
Scale 1:15 840
0
1/4
1/2
3/4
0
0.5
1
(Joins sheet 45)
ALOHA
STATE
PARK
LONG
R. 1 W.
ROAD
CANADA
LITTLE
(Joins sheet 51)
17
16
MANN
20
21
DEVEREAUX
LAKE
ROAD
(Joins sheet 59)
835 000 FEET

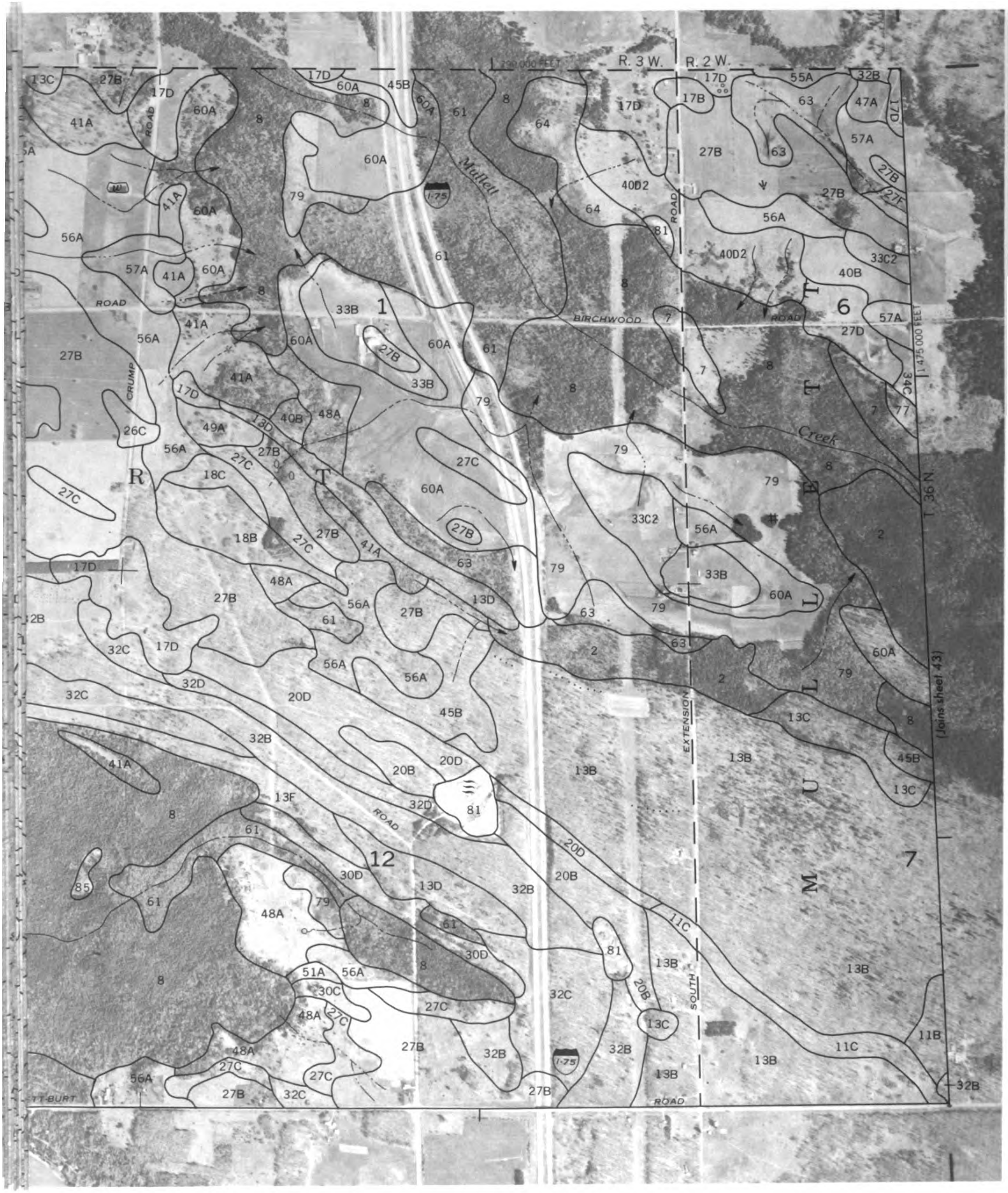

845 000 FEET
ROAD
LAKE
DUMP ROAD
ALOHA
ROAD
O H A
1 465 000 FEET
T. 36 N.
(Joins sheet 53)
14
15
22
23

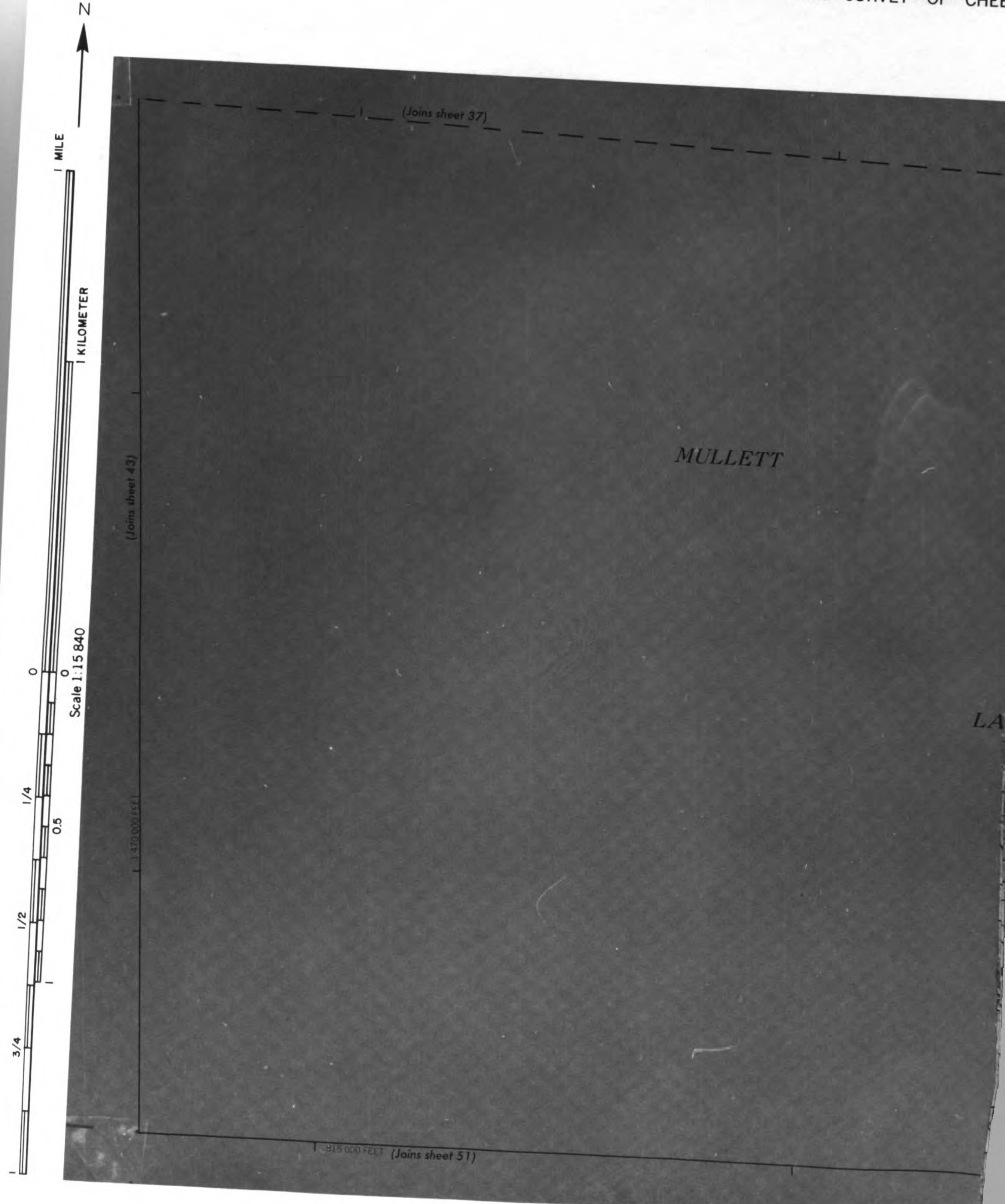

N
1 MILE
1 KILOMETER
0
0
Scale 1:15 840
1/4
0.5
1/2
1
3/4
1
(Joins sheet 47)
(Joins sheet 53)
(Joins sheet 61)
1 460 000 FEET
870 000 FEET
ROSS
ROAD
Cains
Creek
16
15
G
R
Doriva
Beach
BLACK
LAKE
60A
34B
38C
57A
77
8
7
61
47A
85
83
43A
32C
32B
32D
41A
81
60A


880 000 FEET
14 N
T
13
23
24
DORIVA
BEACH
ROAD
T. 36 N
PRESQUE ISLE COUNTY
13B
16D
13D
13C
32B
32D
32C
16B
16C
27C
27D
41A
67
27B
16C
81
13F
61
8
24B
24D
47A
33B
18B
18C

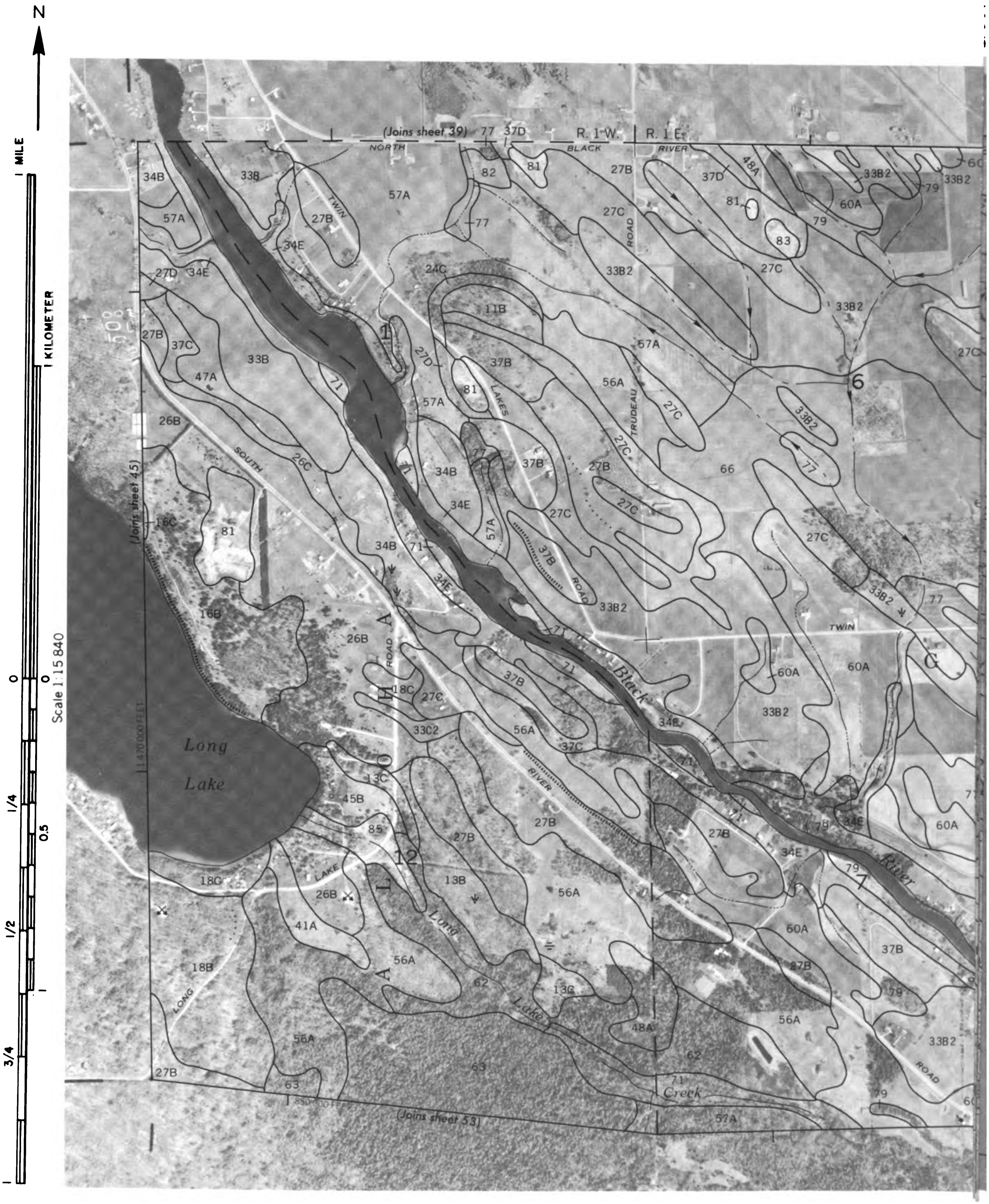
56


N
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
1
0
0.5
1
Scale 1:15 840
(Joins sheet 49)
(Joins sheet 55)
(Joins sheet 63)
BURT
LAKE
1 450 000 FEET

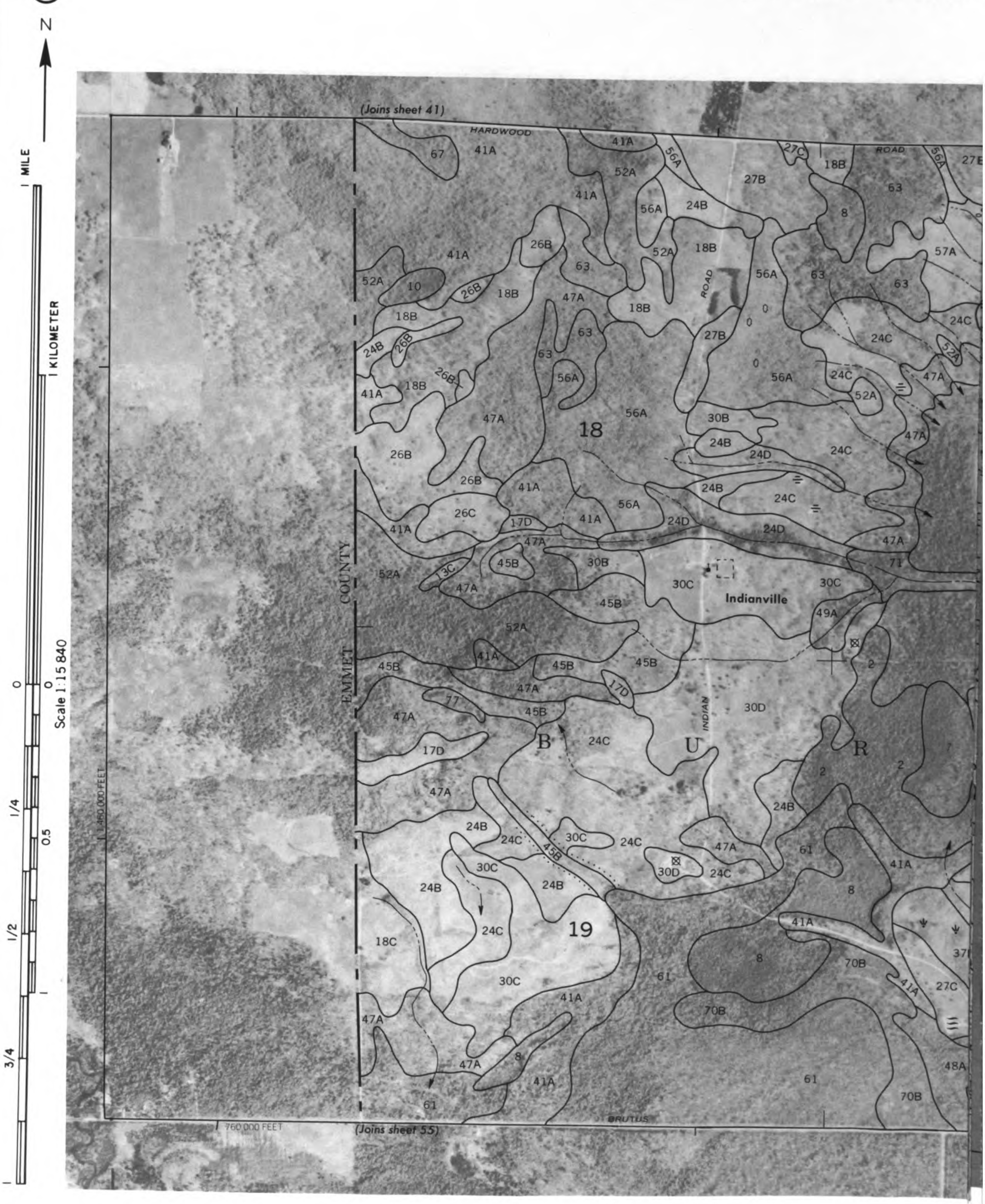

R. 3 W.
R. 2 W.
T. 36 N.
Mullett
Creek
BIRCHWOOD
ROAD
CRUMP
ROAD
SOUTH
EXTENSION
ROAD
I-75
1 475 000 FEET
(Joins sheet 43)
1
6
7
12
R T
M U L L E T T

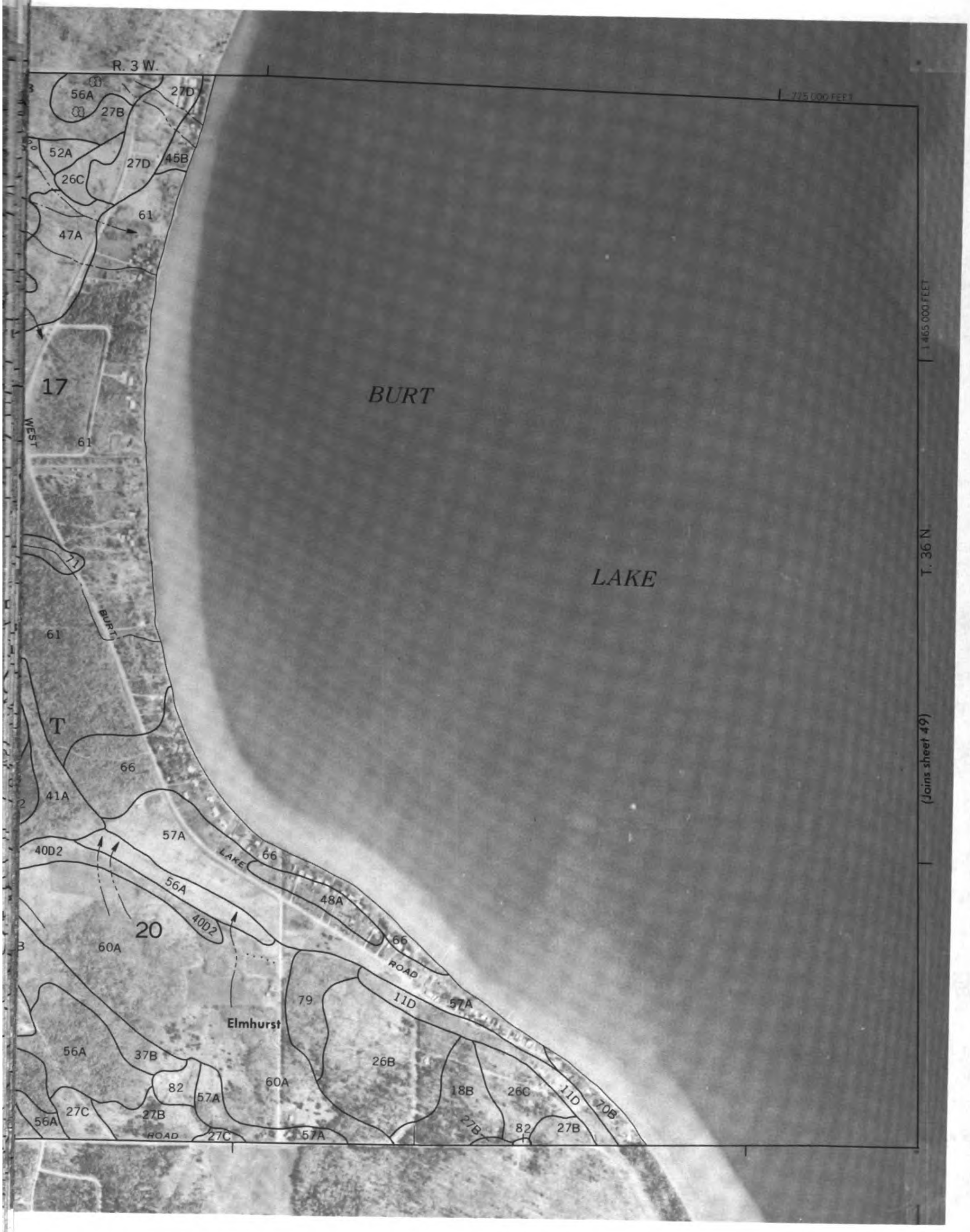

N
1 MILE
1 KILOMETER
Scale 1:15 840
(Joins sheet 37)
(Joins sheet 43)
MULLETT
(Joins sheet 51)


R. 2 W.
R. 1 W.
825 000 FEET
KE
70B
56A
25B
70B
63
5
70B
63
H
A
25B
56A
16B
63
11B
O
T. 36 N.
38B
33B
(Joins sheet 45)
Aloha
212
27B
L
33B
81
8
27B
82
8
A
8
ALOHA
STATE
PARK
w
82


N
1 MILE
1 KILOMETER
Scale 1:15 840
0
1/4
1/2
3/4
1
0.5
(Joins sheet 39)
(Joins sheet 45)
(Joins sheet 53)
R. 1 W.
R. 1 E.
NORTH BLACK RIVER
TWIN LAKES ROAD
TRUDEAU ROAD
SOUTH RIVER ROAD
TWIN ROAD
LONG LAKE ROAD
ROAD
Long Lake
Black River
Long Lake Creek
1 470 000 FEET


865 000 FEET
1 475 000 FEET
PAGE ROAD
ROAD
LAKES ROAD
RIVER ROAD
BLACK RIVER
OWENS ROAD
CRONIN ROAD
HANSON ROAD
ROSS ROAD
Owens Creek
T. 36 N.
(Joins sheet 47)
R A N T
5
4
8
9
F05

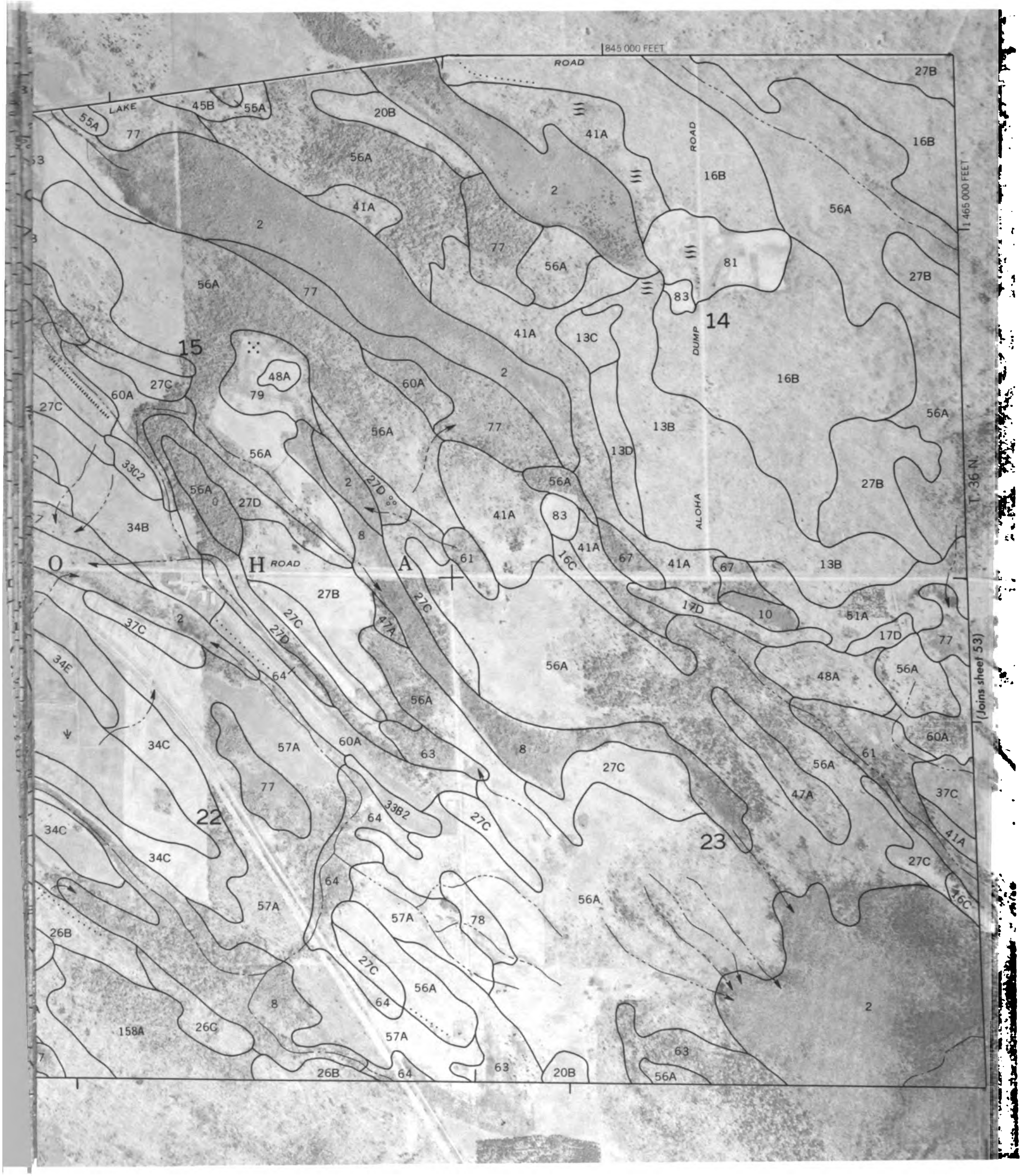

N
1 MILE
1 KILOMETER
Scale 1:15 840
0
1/4
1/2
3/4
0.5
(Joins sheet 41)
(Joins sheet 55)
HARDWOOD
ROAD
INDIAN
BRUTUS
EMMET COUNTY
Indianville
18
19
B U R
760 000 FEET
1 450 000 FEET


R. 3 W.
725 000 FEET
1 465 000 FEET
BURT
LAKE
T. 36 N.
(Joins sheet 49)
17
20
T
WEST
BURT
LAKE
ROAD
Elmhurst
56A
27B
27D
52A
26C
45B
61
47A
71
41A
66
57A
40D2
56A
48A
60A
79
11D
26B
37B
82
57A
18B
26C
27C
27B
70B

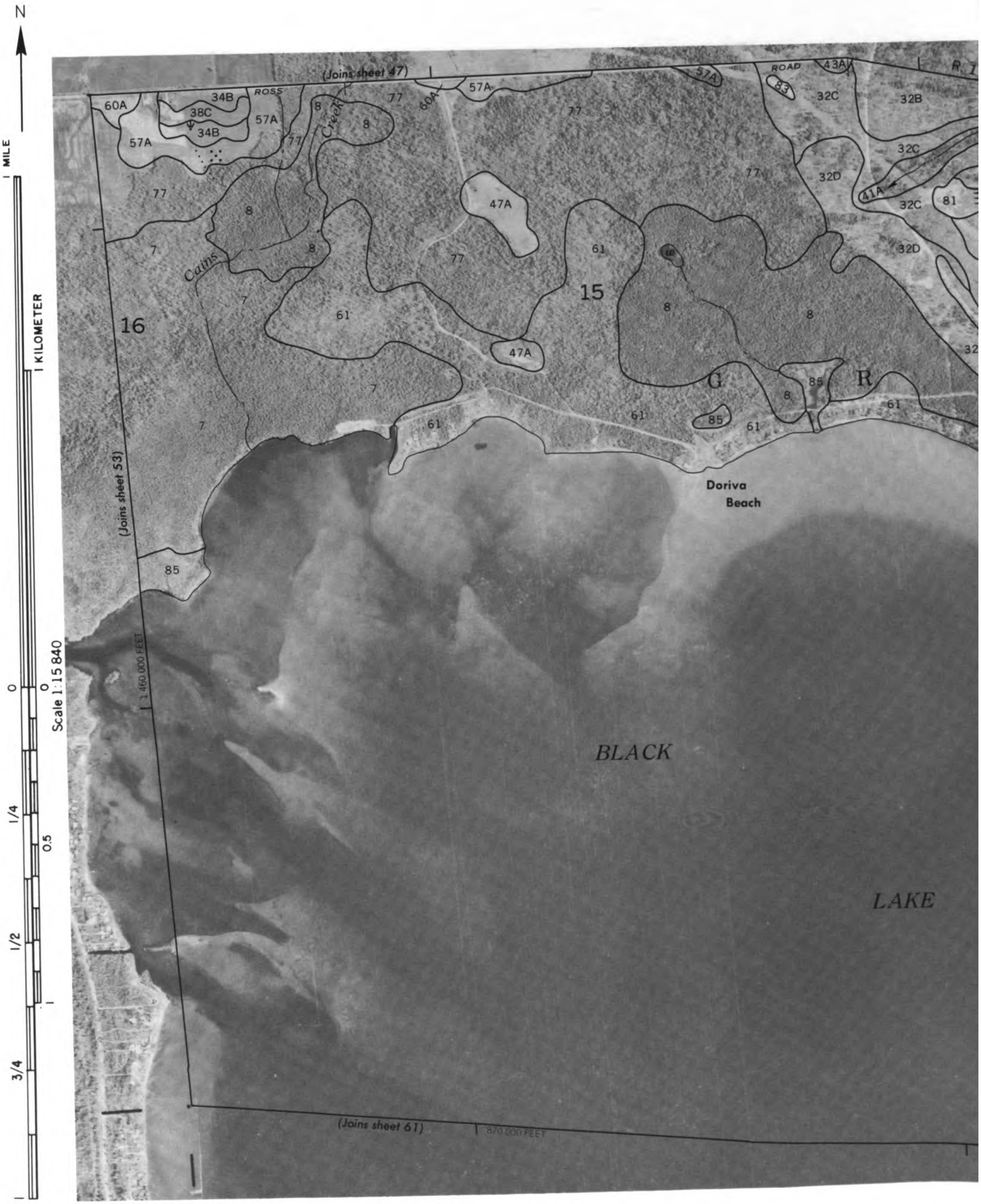

N
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
1
0
0.5
1
Scale 1:15 840
(Joins sheet 43)
(Joins sheet 49)
(Joins sheet 57)
MULLETT-BURT
WOODMANSEE
ROAD
BENNETT
MULLETT
Mullett
Creek
DETROIT
1 460 000 FEET
795 000 FEET
18
17
19
20
21
27


47A
Miami
Beach
41A
158A
MACKINAC
41A
158A
16
158A
Veery
Point
70B
MULLETT
LAKE
T. 36 N.
(Joins sheet 51)
Oak
Beach


52
N
1 MILE
1 KILOMETER
Scale 1:15 840
0
1/4
1/2
3/4
1
0.5
(Joins sheet 45)
(Joins sheet 51)
(Joins sheet 59)
ALOHA STATE PARK
R. 1 W.
LONG
CANADA ROAD
LITTLE
MANN
DEVEREAUX LAKE ROAD
835 000 FEET
17
16
20
21

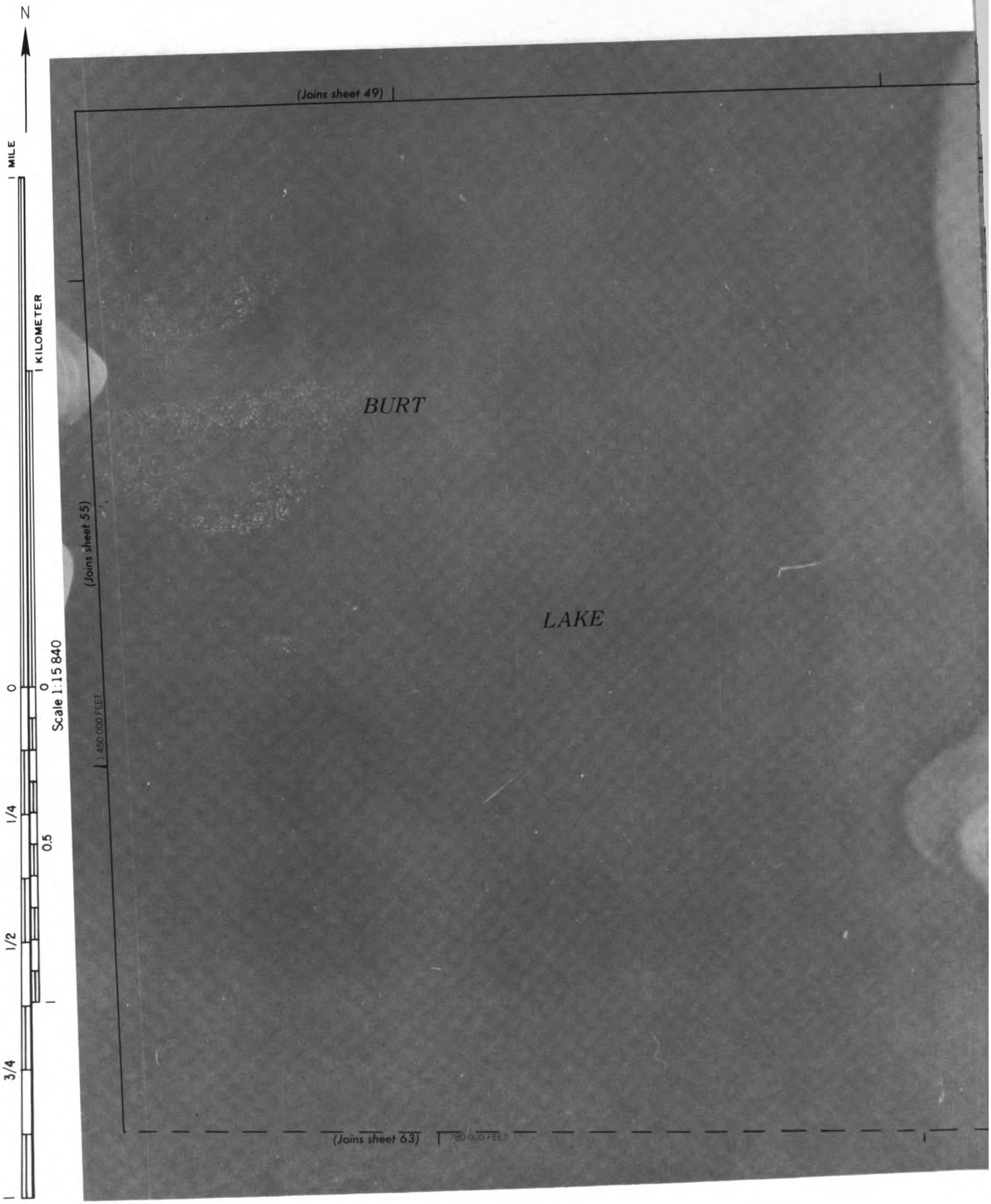

845 000 FEET
1 465 000 FEET
ROAD
LAKE
DUMP
ALOHA
ROAD
H ROAD A
O
T. 36 N.
(Joins sheet 53)
14
15
22
23
27B
16B
56A
41A
2
20B
56A
45B
55A
55A
77
81
83
13C
16B
27B
13B
13D
56A
41A
77
60A
48A
79
27C
60A
27C
33C2
56A
27D
34B
27D
83
41A
67
41A
67
13B
61
16C
27B
27C
27D
47A
27C
10
17D
51A
17D
77
37C
34E
2
64
56A
48A
56A
34C
57A
60A
63
8
27C
56A
61
60A
77
33B2
64
27C
47A
56A
37C
34C
34C
57A
64
57A
78
56A
27C
41A
16C
26B
27C
56A
64
8
158A
26C
57A
63
63
20B
26B
64
56A
2

54

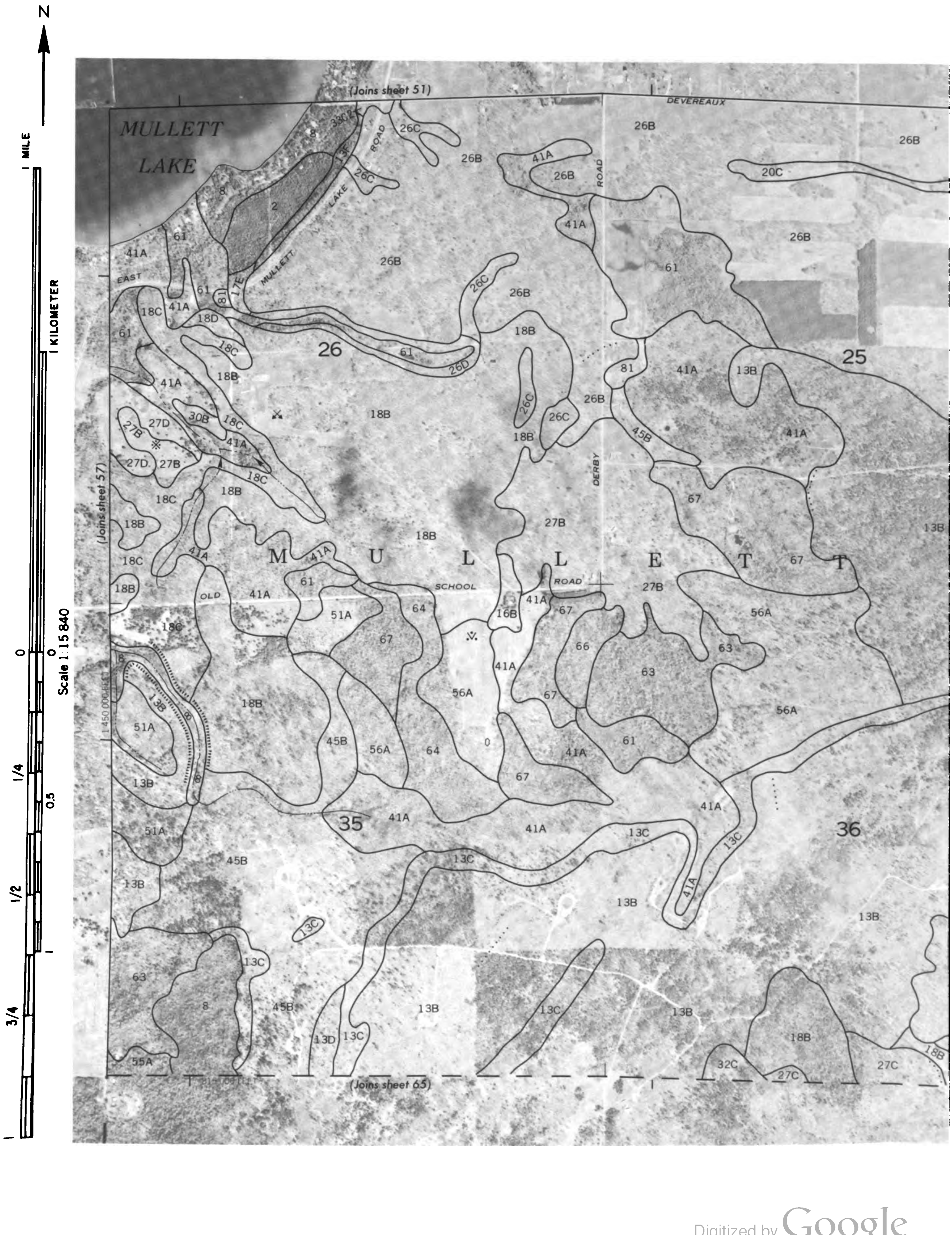

N
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
1
0
0.5
1
Scale 1:15 840
(Joins sheet 47)
(Joins sheet 53)
(Joins sheet 61)
1 460 000 FEET
870 000 FEET
ROSS
ROAD
Cains
Creek
16
15
G
R
Doriva
Beach
BLACK
LAKE
60A
34B
38C
57A
77
8
60A
57A
57A
43A
83
32C
32B
32D
41A
81
47A
7
61
85


880 000 FEET
1 465 000 FEET
14 N
T
36 N
13
23
24
DORIVA
BEACH
ROAD
PRESQUE ISLE COUNTY
13B
13C
13D
13F
16B
16C
16D
18B
18C
24B
24D
27B
27C
27D
32B
32C
32D
33B
41A
47A
61
67
8
81

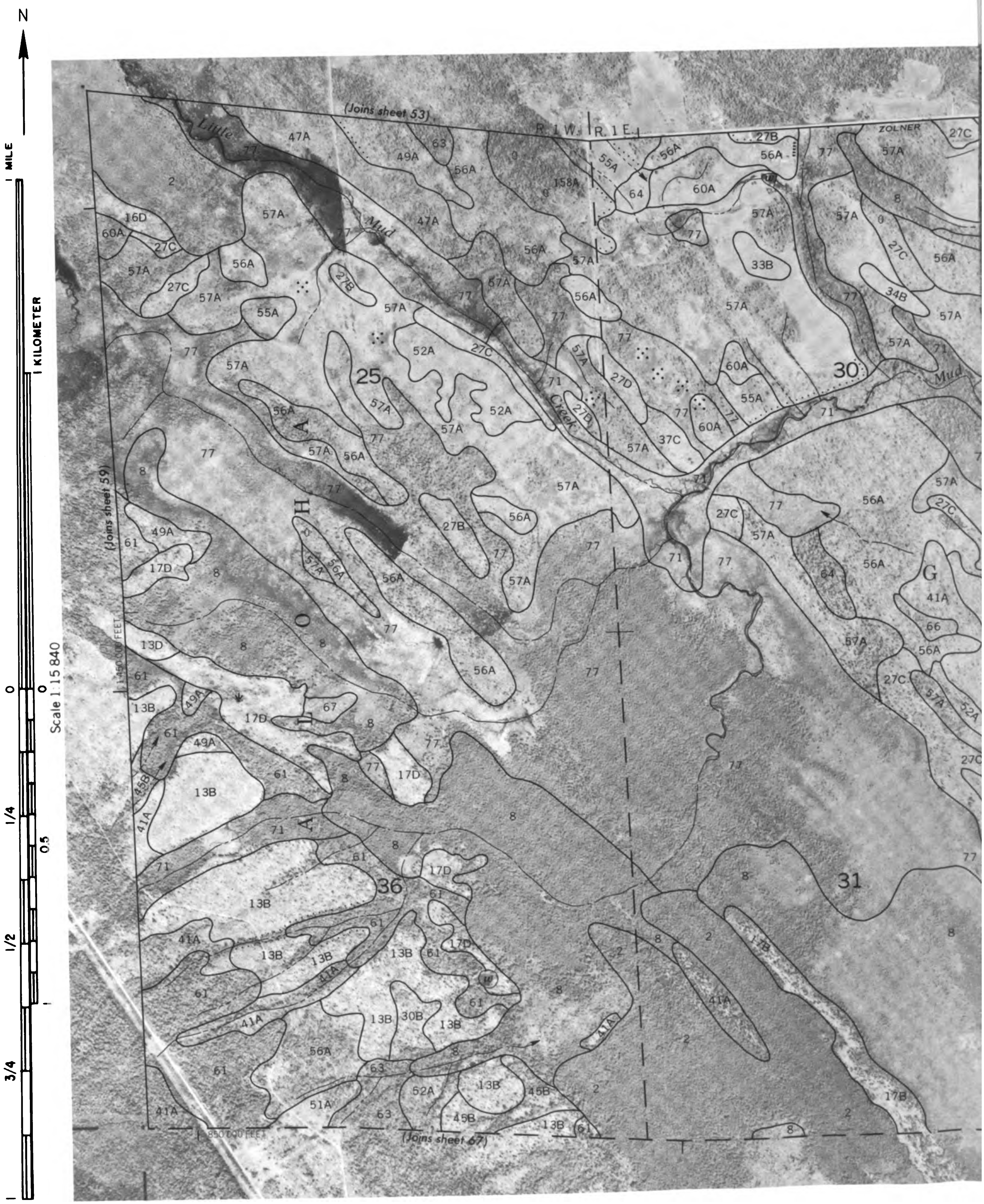
56


N
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
1
0
0.5
1
Scale 1:15 840
(Joins sheet 49)
(Joins sheet 55)
(Joins sheet 63)
1 450 000 FEET
280 000 FEET
BURT
LAKE

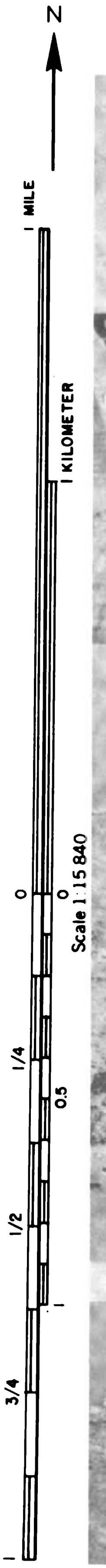

790 000 FEET
R. 3 W.
R. 2 W.
1 495 000 FEET
T. 36 N.
(Joins sheet 57)
I-75
I-75
25
30
35
36
31
B
U
R
T
T
T
E
L
L
U
M
EAGLES
NEST
ROAD
32C
32C
24B
32B
8
8
45B
41A
20B
13C
20B
32B
27B
27C
13C
18B
27D
13C
63
32C
13F
32B
16B
32B
30D
27C
27B
16B
13B
27F
27B
10
13D
56A
32B
45B
16B
16C
32B
27C
13C
18B
67
45B
32B
16C
32B
16B
24B
27B
24B
45B
41A
16C
18C
56A
30C
13C
24D
47A
24B
32B
16C
16B
32D
47A
16C
70B
24B
32B
32B
25B
41A
82
16B
16B
18B
61
25D
16D
16B
8
24B
47A
32B
70B
47A
8
25D
82
18B
32B
31
61
58A
61
8
13D
32B
81
32D
13B
4002
82
32B
32B
85
41A
41A
8
85
8
13B
13B
32D
41A
82
13C
8
61
13D
16C
27
27

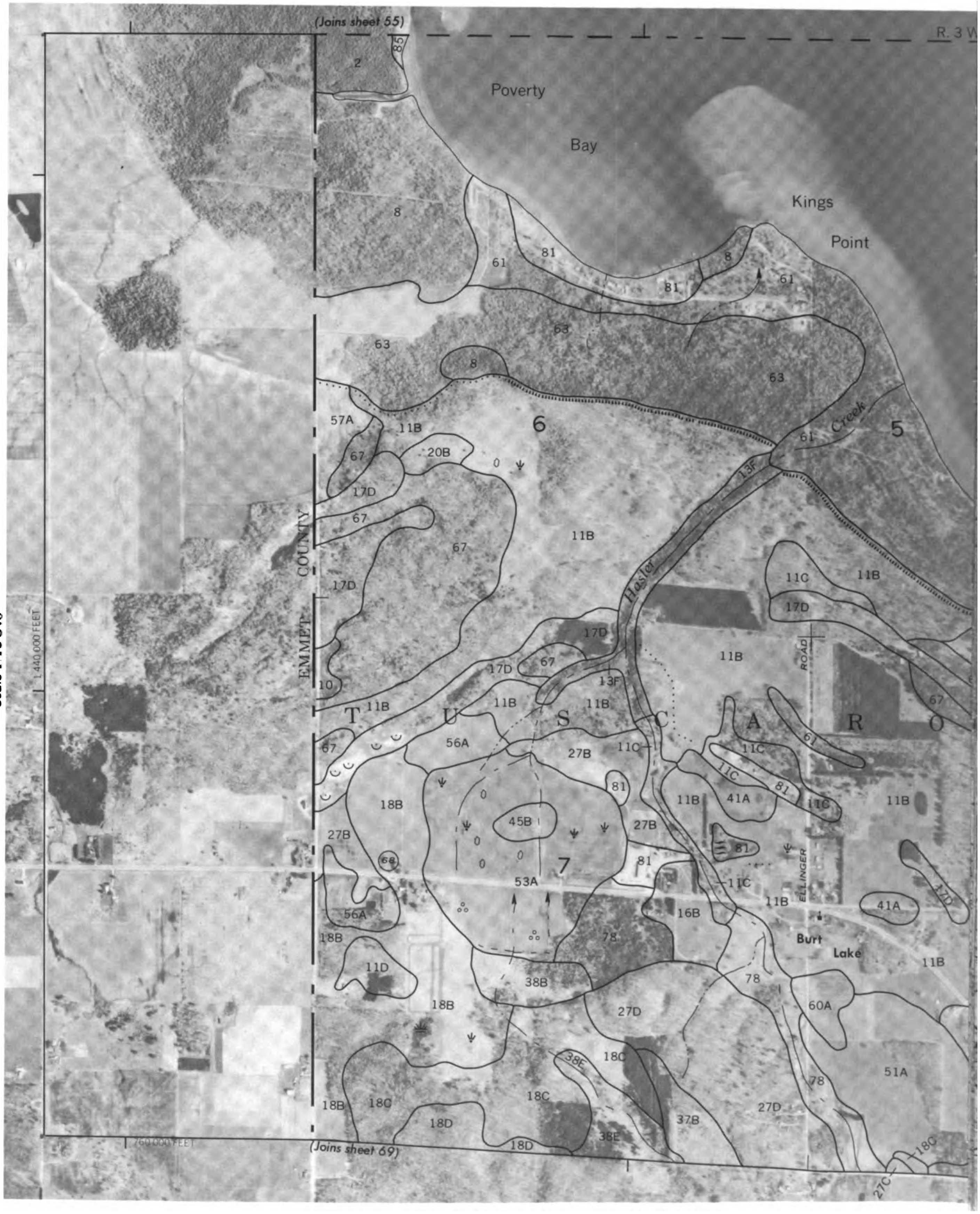

N
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
0.5
Scale 1:15 840
(Joins sheet 51)
(Joins sheet 57)
(Joins sheet 65)
MULLETT
LAKE
DEVEREAUX
ROAD
MULLETT LAKE ROAD
EAST
DERBY
ROAD
SCHOOL
OLD
M U L L E T T
26
25
35
36
1 450 000 FEET

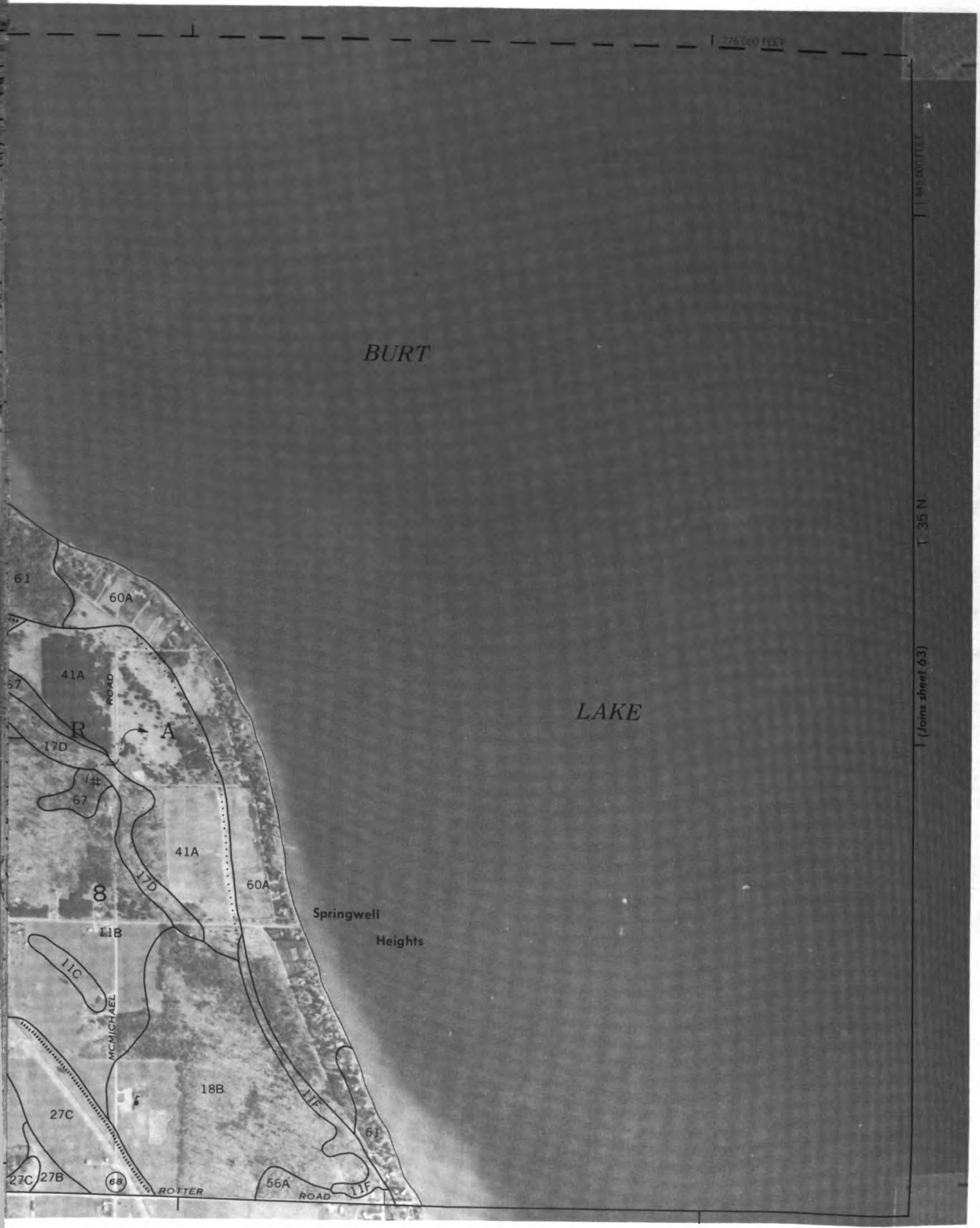

R. 2 W.
R. 1 W.
LAKE
ROAD
530 000 FEET
1 455 000 FEET
56A
18B
27B
13B
20C
26B
41A
16B
16D
83
13C
18B
61
26B
49A
30
16B
49A
61
41A
41A
29
13C
26B
41A
61
61
8
41A
67
67
13C
13B
41A
67
8
41A
45B
13C
67
T. 36 N.
A L O H A
45B
13B
13D
45B
13C
13B
13B
13C
13C
13B
13B
13D
(Joins sheet 59)
13B
67
45B
67
32B
32C
18B
31
13B
32
56A
13C
27C
32B
32C
56A
13B
32C
27C
32B
27D
56A
27B
56A
27B
32C
32C
18D
27C
32C
32B
32C
27C
47A
27D
27B
27B
18C
27C
13C


N
1 MILE
1 KILOMETER
Scale 1:15 840
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 53)
(Joins sheet 59)
(Joins sheet 67)
R 1 W.
R 1 E.
ZOLNER
Little
Mud
Creek
Mud
25
30
31
36
H
O
L
A
G
1 450 000 FEET
850 000 FEET

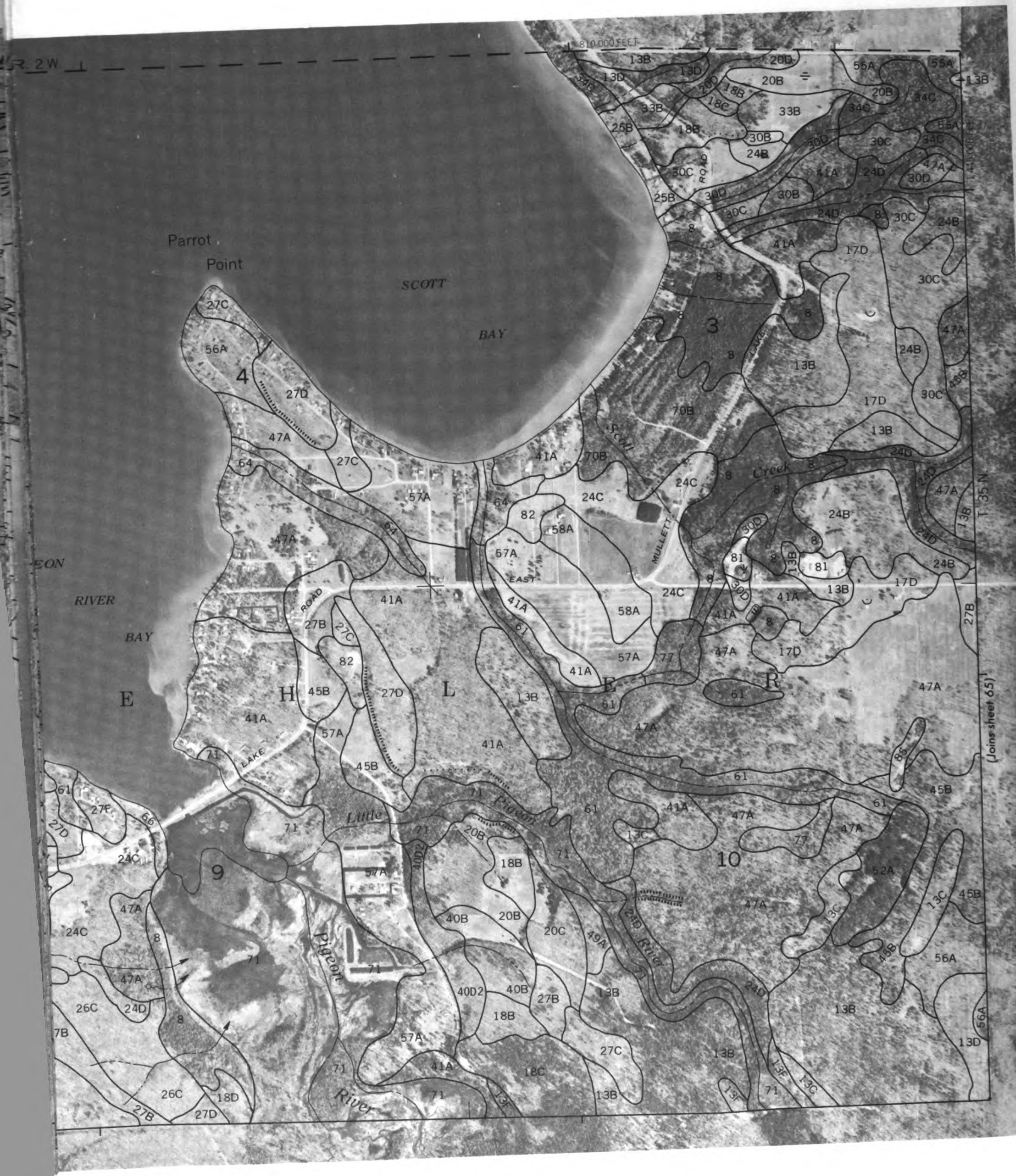

855 000 FEET
1 455 000 FEET
ROAD
FOS
BLACK
RIVER
Lake
Black
Creek
ROAD
29
28
32
33
R
A
N
T
T. 36 N.
(Joins sheet 61)
Black
River

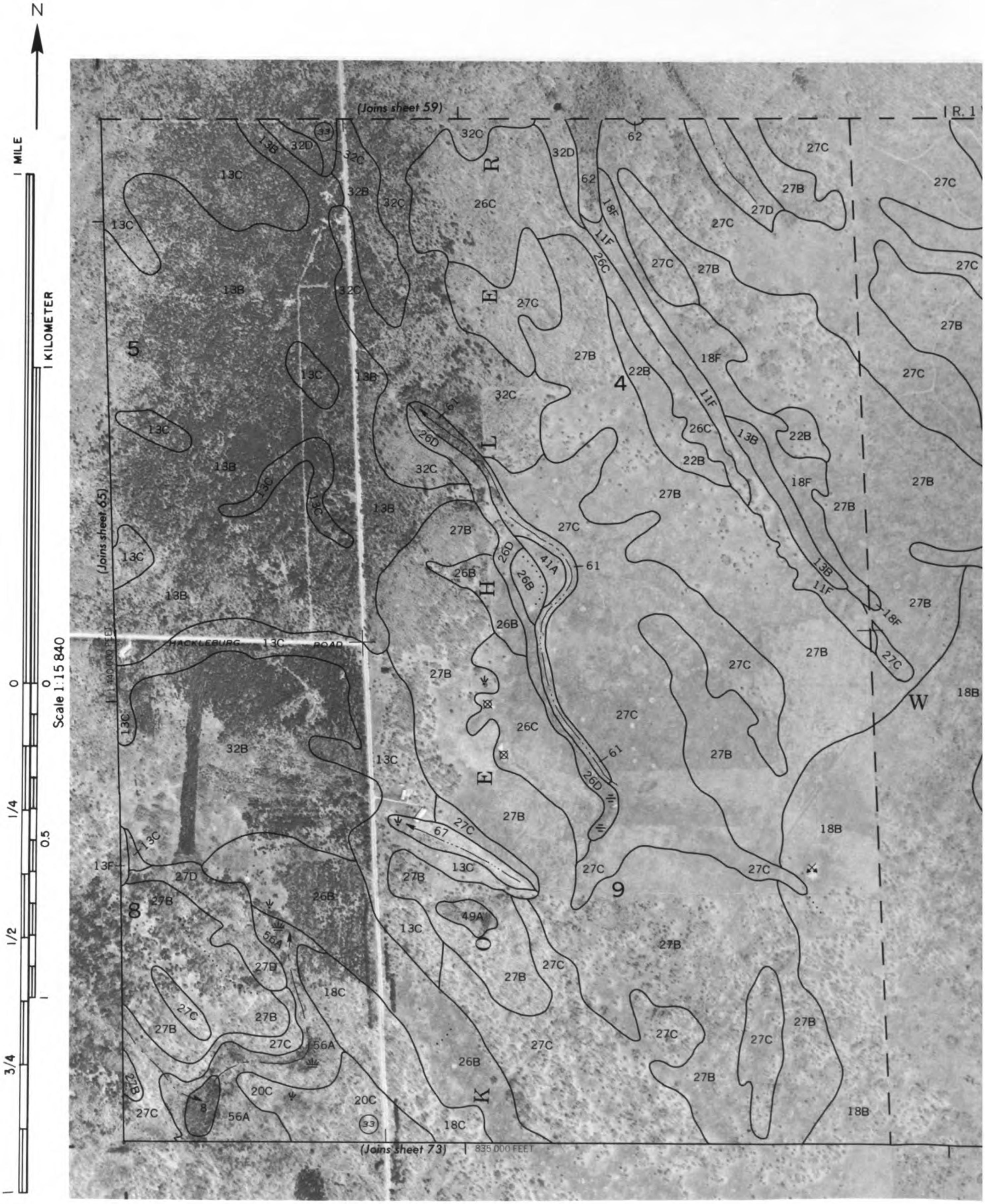

N
1 MILE
1 KILOMETER
Scale 1:15 840
0
0
1/4
0.5
1/2
1
3/4
1


(Joins sheet 55)
R. 3 W
Poverty
Bay
Kings
Point
Hasler
Creek
EMMET
COUNTY
T U S C A R O
ELLINGER
ROAD
Burt
Lake
1 440 000 FEET
760 000 FEET
(Joins sheet 69)
6
5
7


BURT
LAKE
Springwell
Heights
T. 35 N.
(Joins sheet 63)
61
60A
41A
ROAD
R
A
17D
67
41A
17D
60A
8
11B
11C
MCMICHAEL
18B
27C
27B
27C
68
ROTTER
56A
ROAD
11F
61
11F


N
1 MILE
1 KILOMETER
Scale 1:15 840
0
1/4
1/2
3/4
0
0.5
(Joins sheet 57)
(Joins sheet 63)
(Joins sheet 71)
MULLETT
LAKE
Grand
View
Beach
Indian
River
MACKINAC
AND
DETROIT
MULLETT
EAST
T U S C A R O R A
K O
6
5
8
13B
13C
27C
27B
41A
56A
79
16B
16C
85
47A
34B
7
77
64
57A
60A
70B
55A
27F
2
34C
24C
30C
30B
63
61
27D
66
81
86

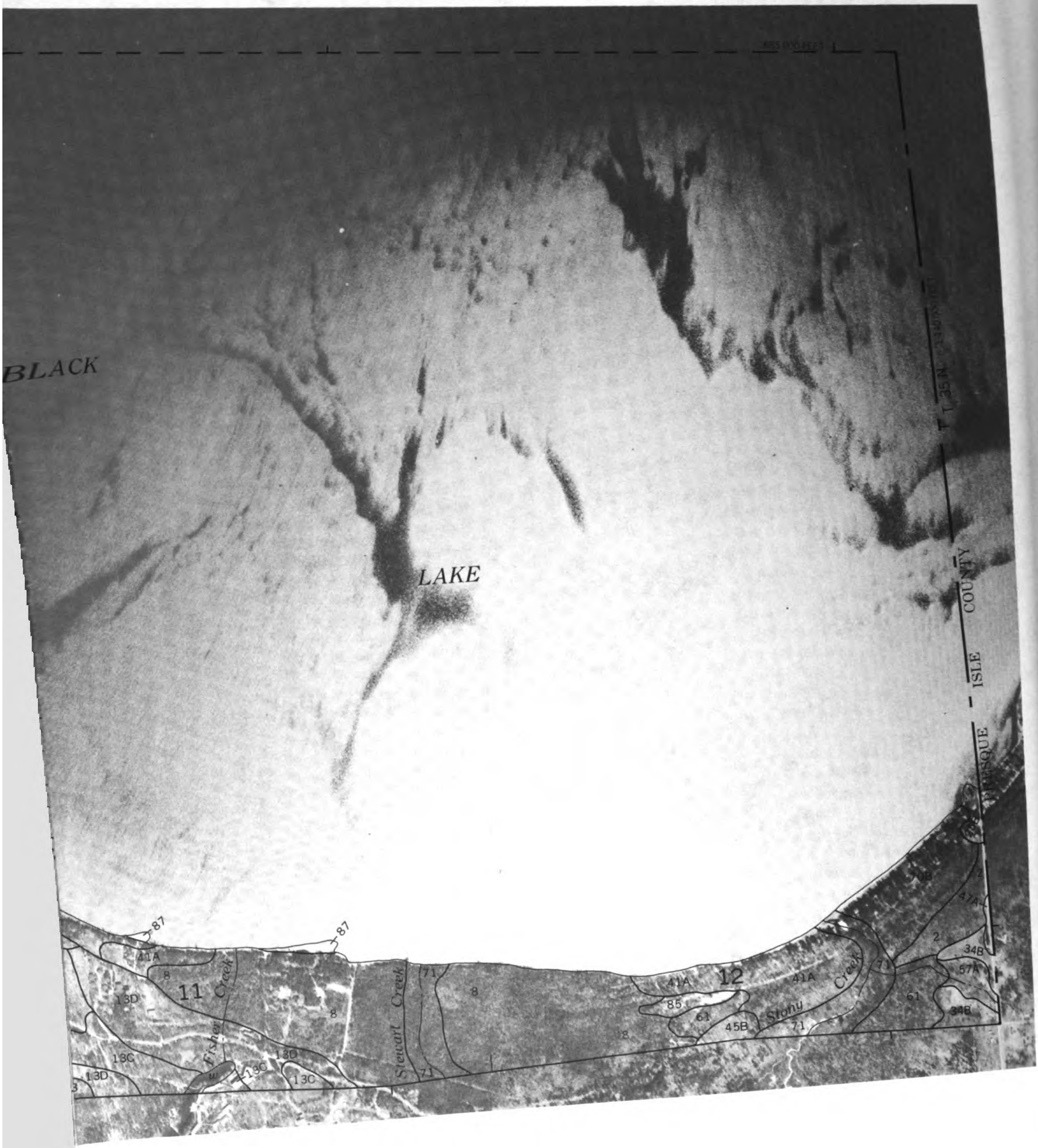

R. 2 W.
810 000 FEET
Parrot Point
SCOTT BAY
RIVER BAY
Little Pigeon
Pigeon River
Scott Creek
MULLETT LAKE ROAD
EAST
E H L E R
3
4
9
10
T 35 N
(Joins sheet 65)


N
MILE
KILOMETER
Scale 1:15 840
0
1/4
1/2
3/4
1
0.5
(Joins sheet 59)
(Joins sheet 65)
(Joins sheet 73)
835 000 FEET
R. 1
HACKLEBURG
ROAD
R
E
L
H
E
O
K
W
5
4
8
9


845 000 FEET
1 445 000 FEET
T. 35 N.
(Joins sheet 67)
A V E R L Y
2
3
10
11

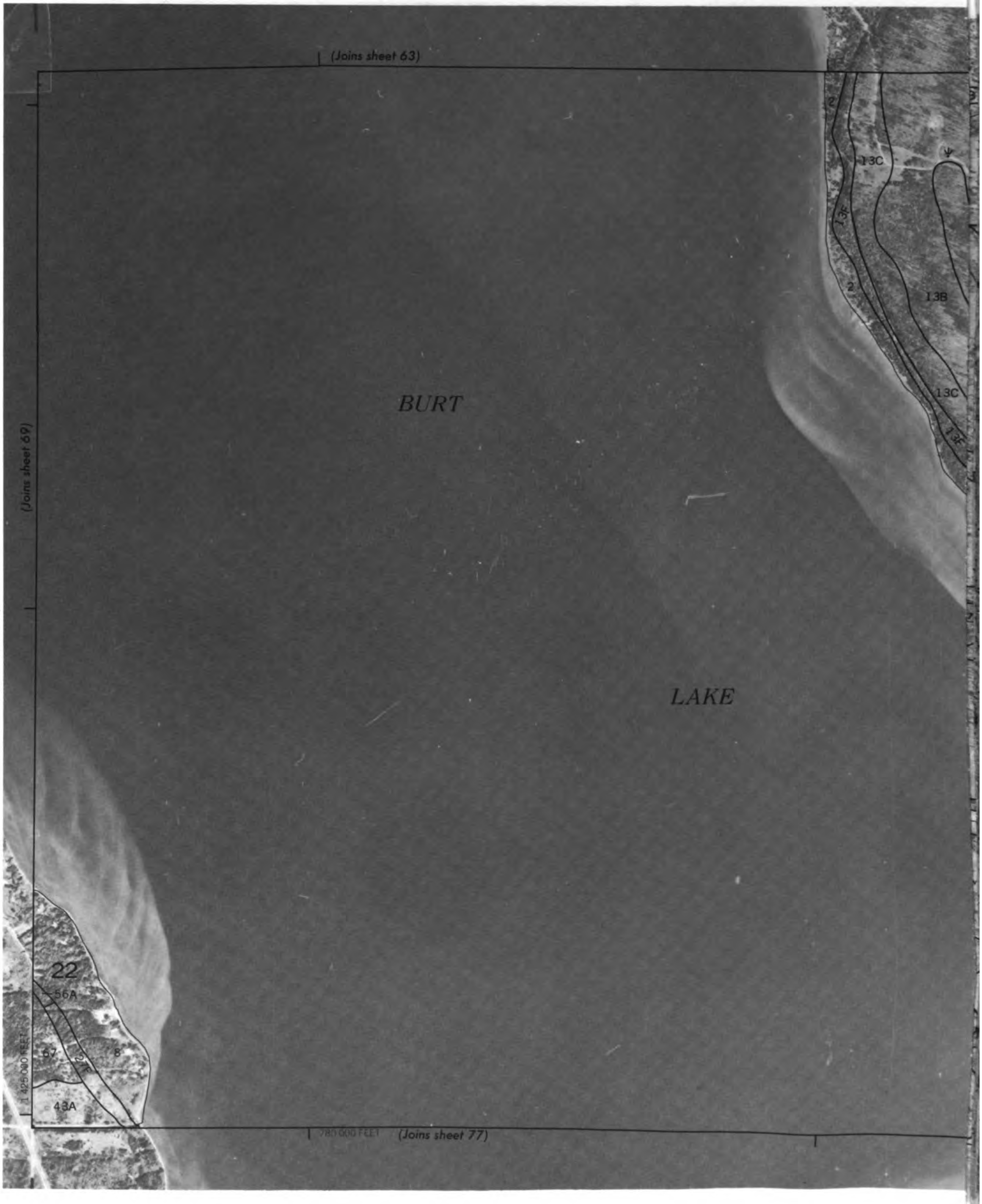
67

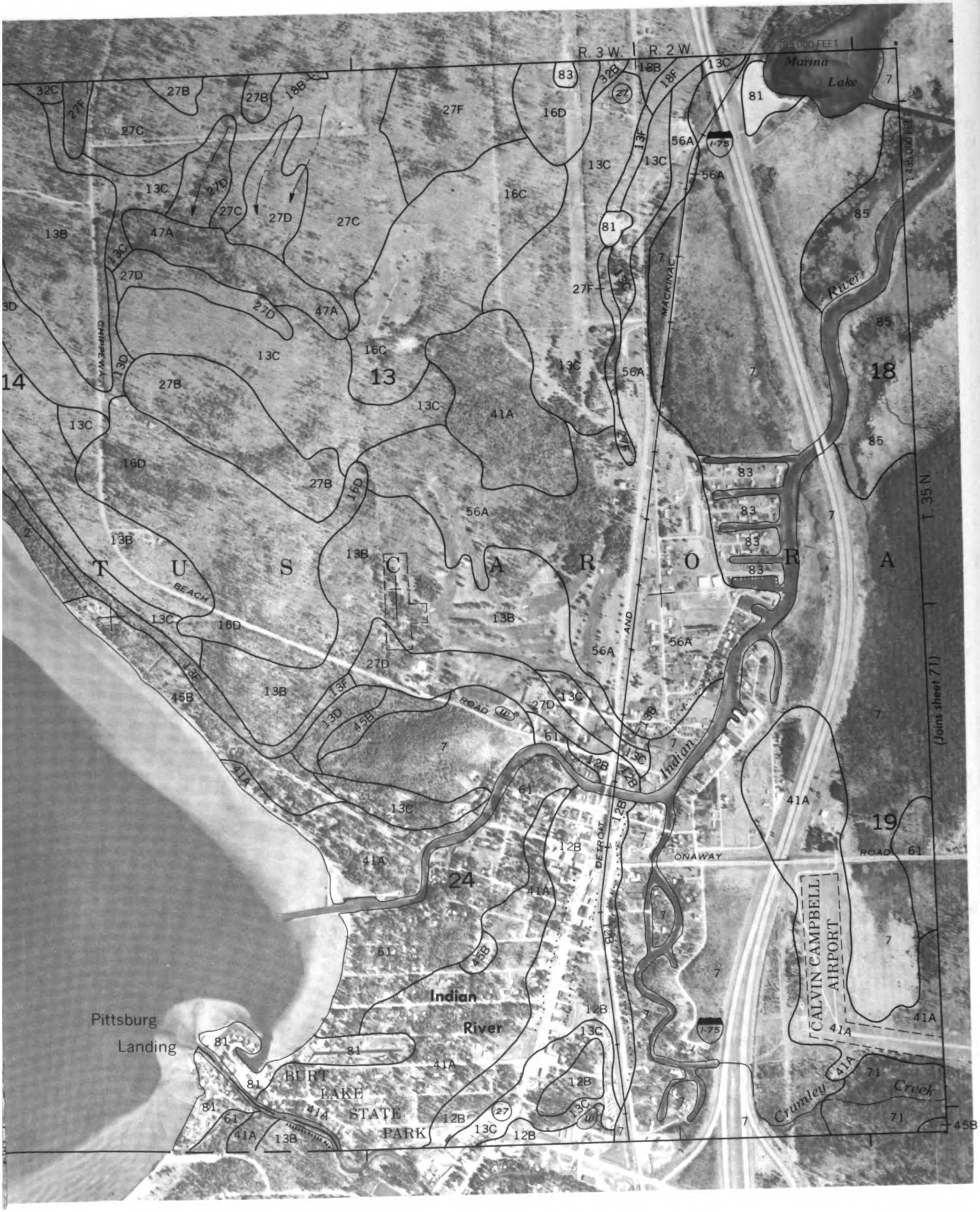

N
1 KILOMETER
0
0.5
1
0
1/4
1/2
3/4
1
Scale 1:15 840
(Joins sheet 61)
(Joins sheet 67)
(Joins sheet 75)
Pine
Grove
Beach
Mud
Lake
W E V A R L Y
RED BRIDGE ROAD
BLACK RIVER ROAD
FOS
4
3
9
10
71
81
8
61
41A
45B
13D
12B
13C
13B
13F
21B
1 435 000 FEET
870 000 FEET

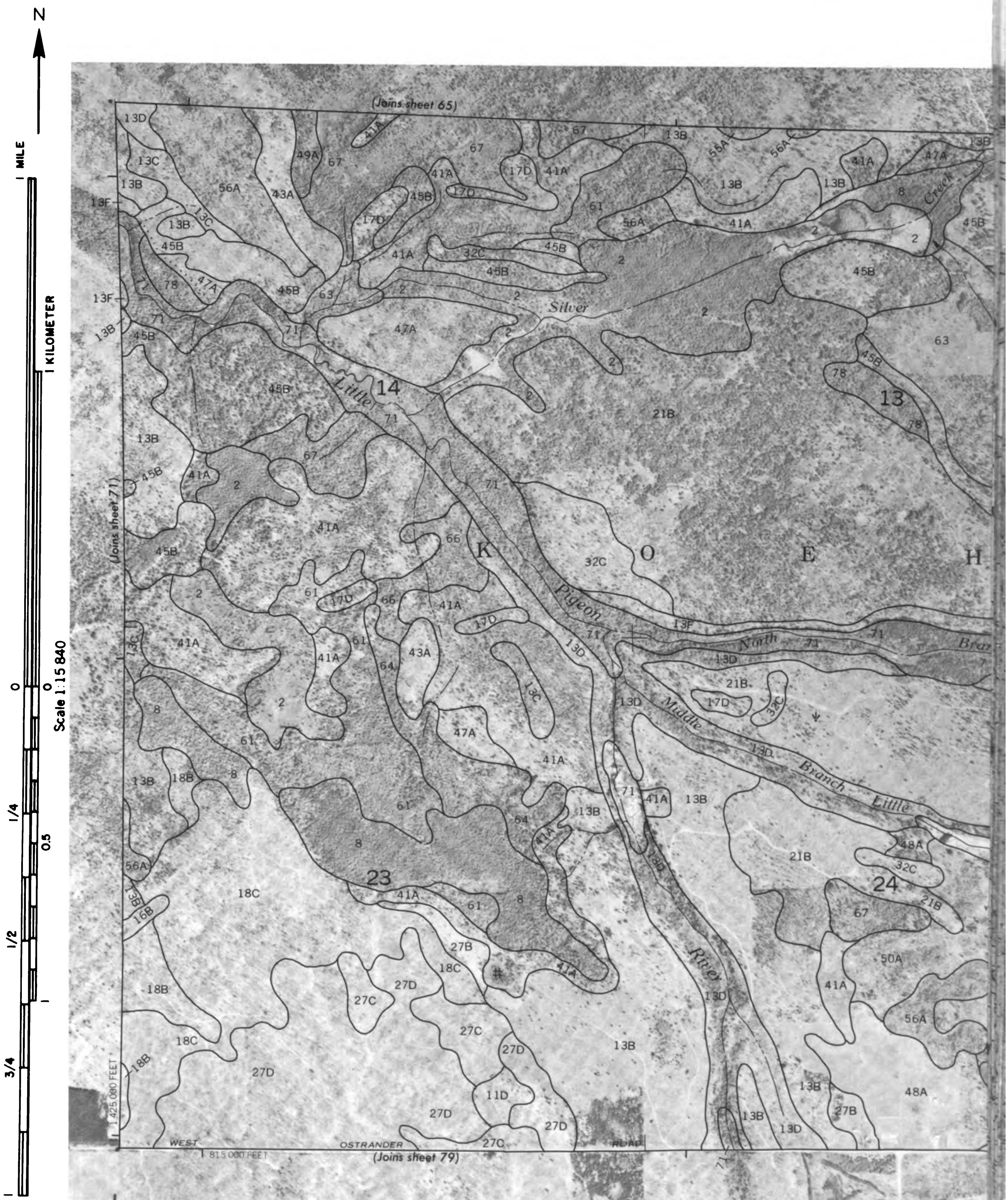

BLACK
LAKE
PRESQUE ISLE COUNTY
T. 35 N.
11
12
Fisher Creek
Stewart Creek
Stony Creek
87
41A
8
13D
13C
71
85
61
45B
2
34B
57A
47A
70B

N

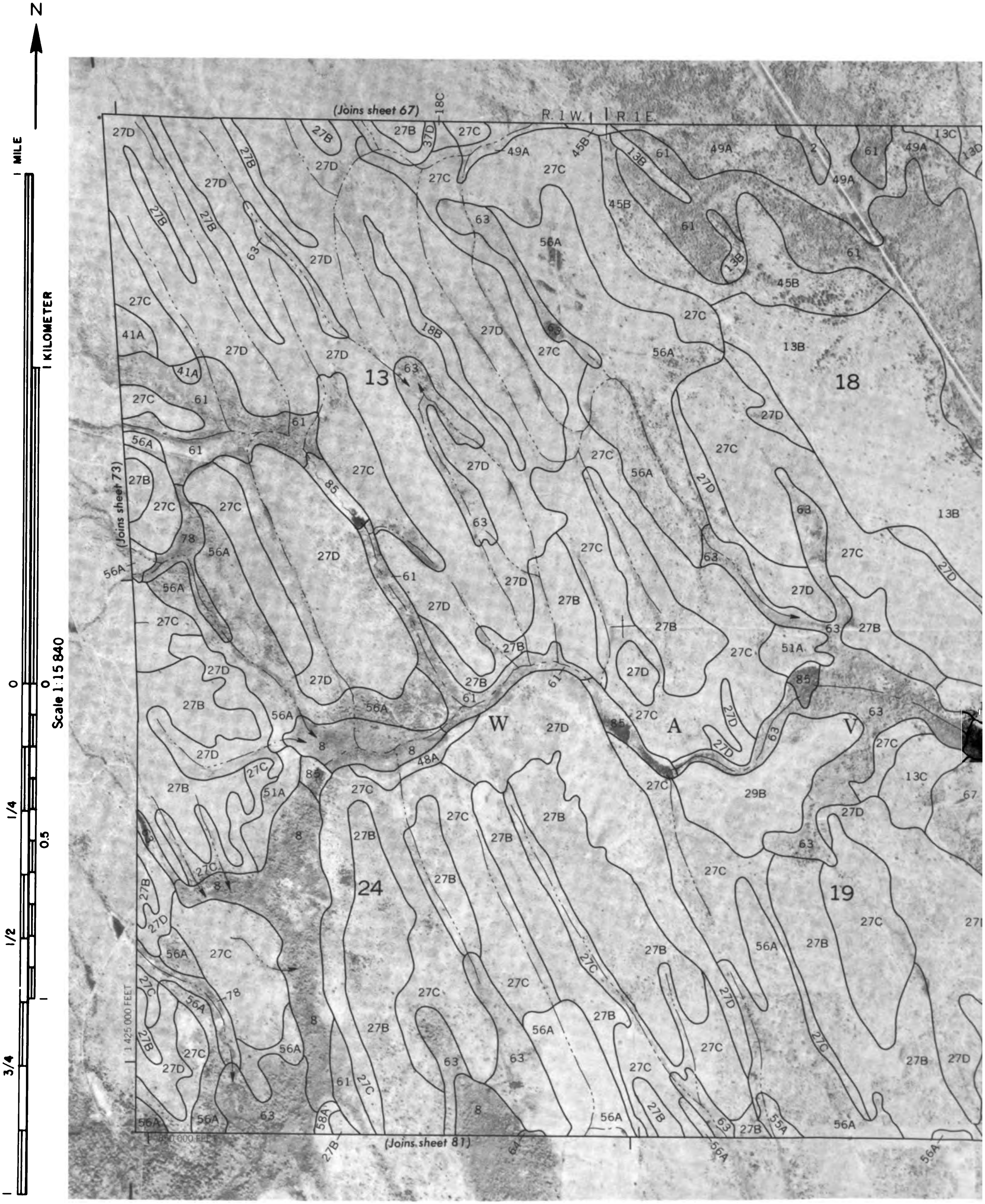
1 MILE
1 KILOMETER
Scale 1:15 840
0 1/4 1/2 3/4 1
0 0.5 1



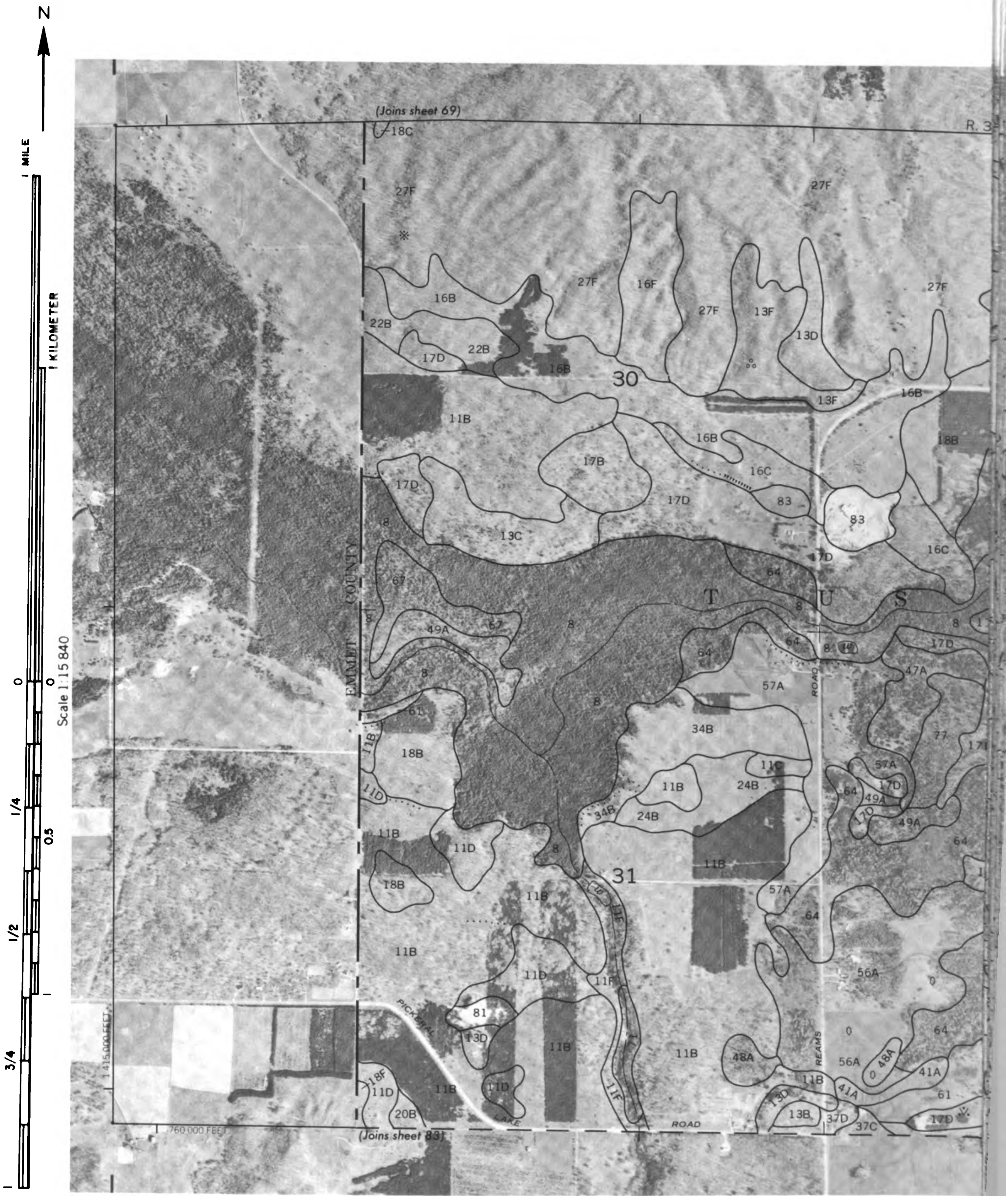

R. 3 W.
R. 2 W.
Marina Lake
I-75
CHIPPEWA
BEACH
ROAD
MACKINAC
AND
DETROIT
T U S C A R O R A
13
14
18
19
24
River
Indian
Indian River
ONAWAY ROAD
CALVIN CAMPBELL AIRPORT
Crumley Creek
Pittsburg Landing
BURT LAKE STATE PARK
T. 35 N.
(Joins sheet 71)


N
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
1
0
0.5
1
Scale 1:15 840
(Joins sheet 65)
(Joins sheet 71)
(Joins sheet 79)
Silver
Creek
Little
Pigeon
North Bran
Middle
Branch
Little
River
K
O
E
H
14
13
23
24
WEST
OSTRANDER
ROAD
815 000 FEET
1 425 000 FEET

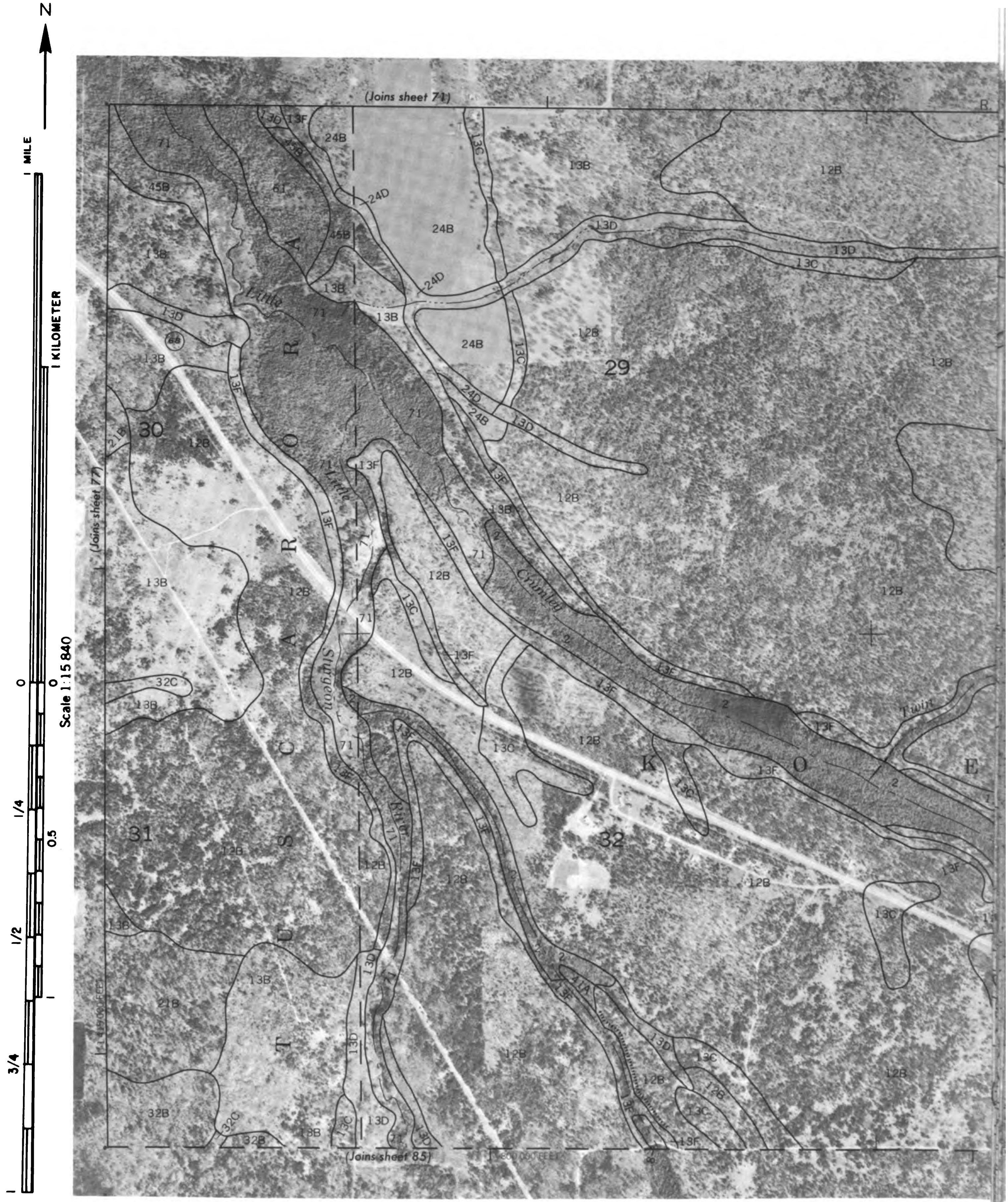

R. 2 W. | R. 1 W.
830 000 FEET
1 435 000 FEET
T. 35 N.
(Joins sheet 73)
17
18
19
20
Little
Pigeon
River
Pigeon River
Morrow
Creek
CARTER
ROAD
SOUTH
OSTRANDER
ROAD
EAST
L
E
R


N
1 MILE
1 KILOMETER
Scale 1:15 840
0
1/4
1/2
3/4
0
0.5
(Joins sheet 67)
R. 1 W.
R. 1 E.
(Joins sheet 73)
(Joins sheet 81)
13
18
24
19
W
A
V
1 425 000 FEET

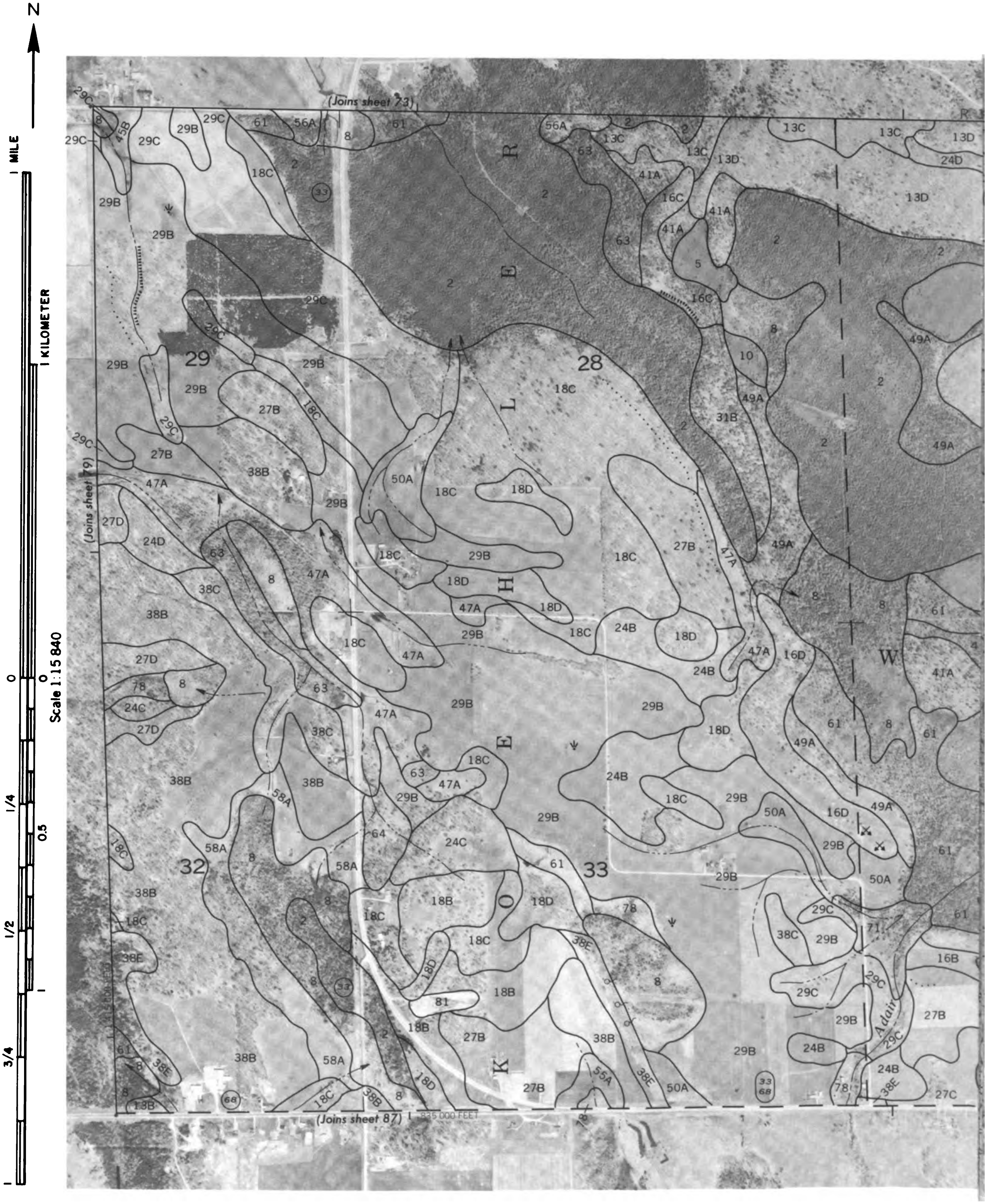

865 000 FEET
1 480 000 FEET
T. 35 N.
(Joins sheet 75)
17
16
20
21
E
R
L
Y
Upper
Black
River
ROAD
WAVELAND
45B
13F
13D
2
71
w
13B
12B
13C
16F
16B
49A
61
21B
27C
8
63
20B
45B
67
41A
56A
27B
51A
3C
16B
41A
27F
61

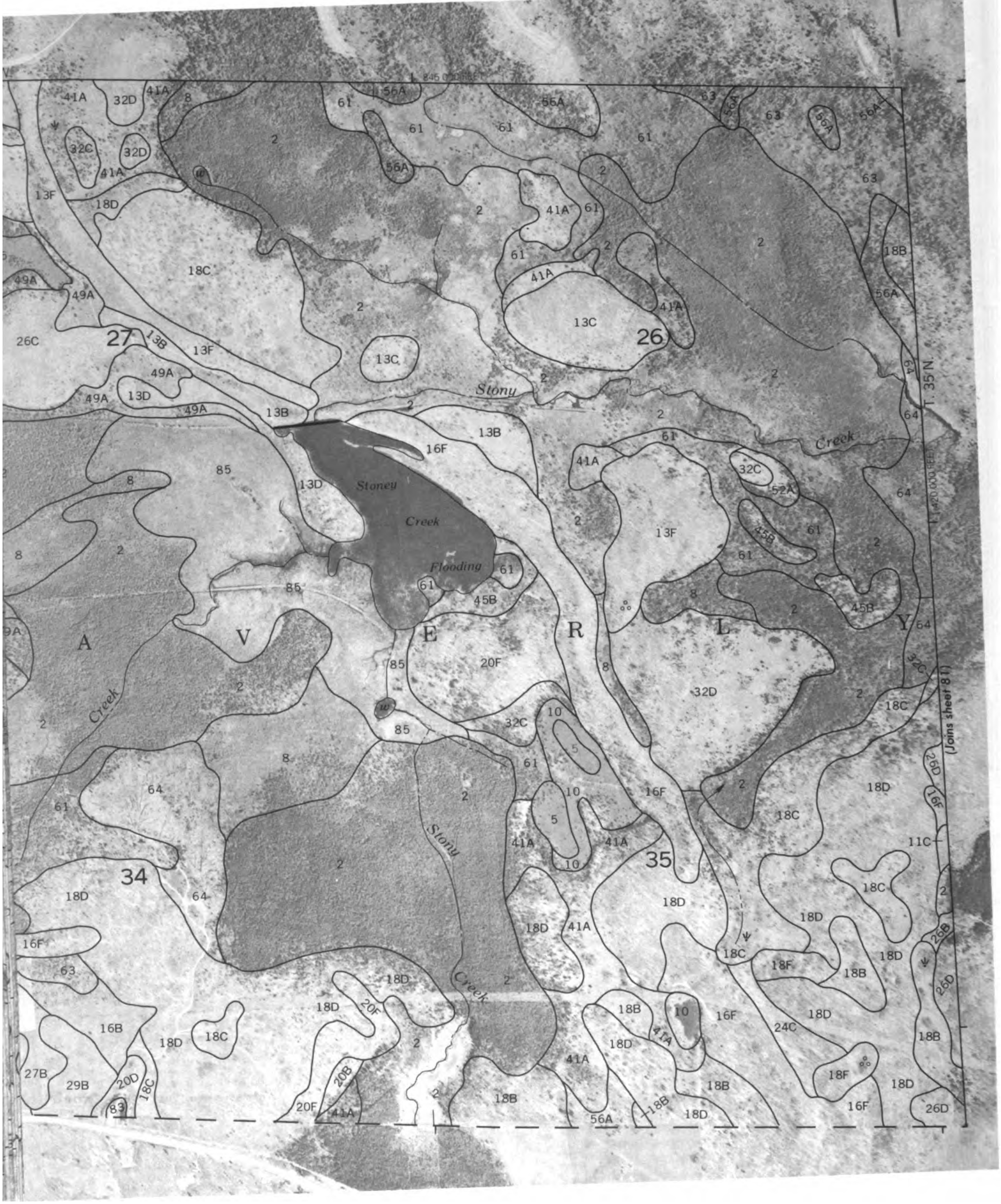

N
1 MILE
1 KILOMETER
0
1/4
0.5
1/2
3/4
1
Scale 1:15 840
(Joins sheet 69)
(Joins sheet 83)
R. 3
EMMET COUNTY
PICKEREL LAKE
ROAD
REAMS
ROAD
1 415 000 FEET
760 000 FEET
30
31
T
U
S
18C
27F
16B
22B
17D
16F
13F
13D
11B
17B
16C
83
13C
18B
8
67
64
49A
61
57A
47A
34B
11C
24B
11D
57A
77
49A
56A
11F
81
48A
41A
13B
37D
37C
20B
18F
0

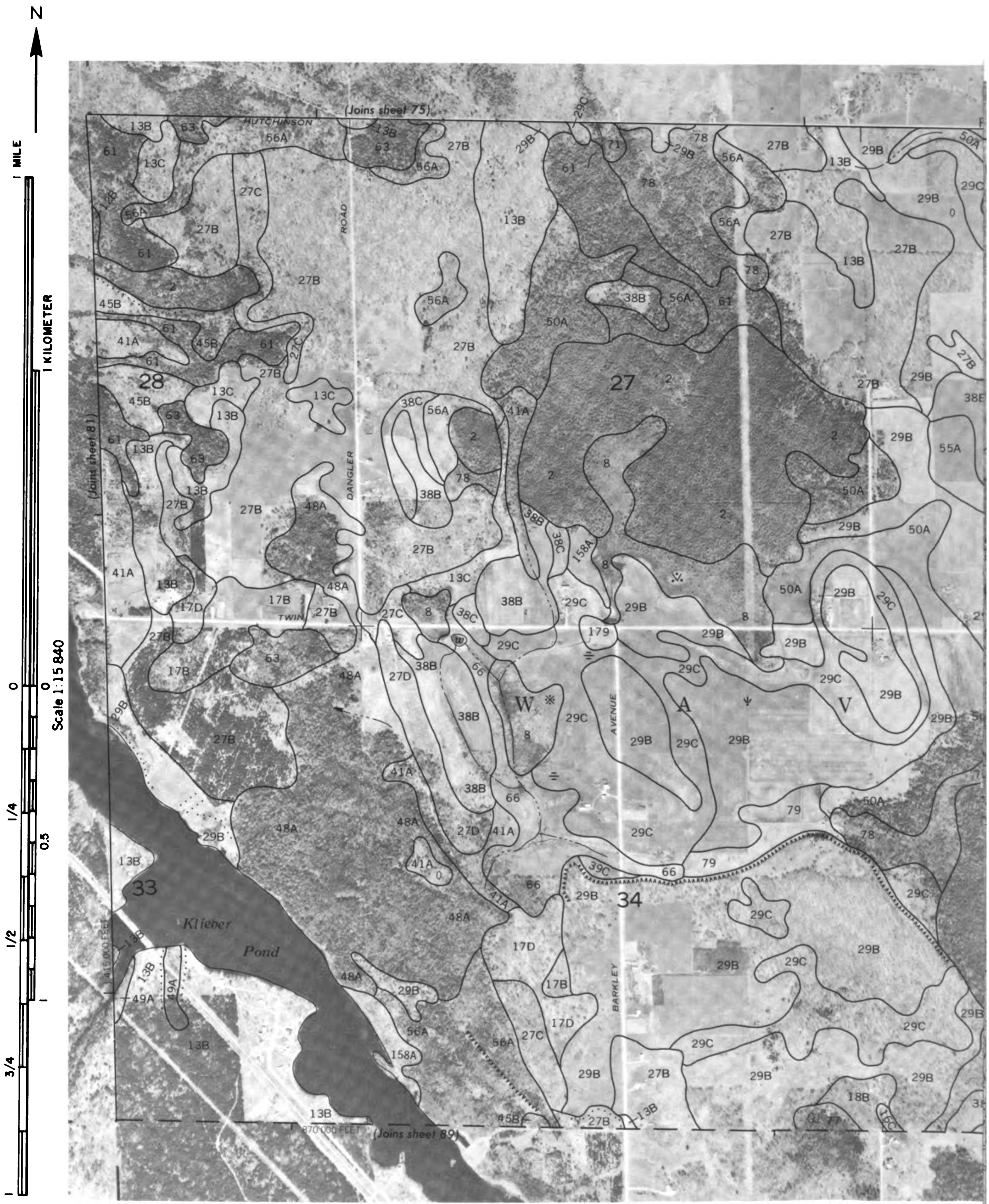

KING ROAD
PARKE ROAD
29
28
32
33
A R O R A
T. 35 N.
(Joins sheet 77)


N
1 MILE
1 KILOMETER
Scale 1:15 840
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 71)
(Joins sheet 77)
(Joins sheet 85)
29
30
31
32
Little
Little
Sturgeon
River
Crumley
Twin
R. A. R. O. A. C. S. U. T.
K O E
13B
12B
13C
13D
13F
24B
24D
45B
61
71
2
21B
32B
32C
41A

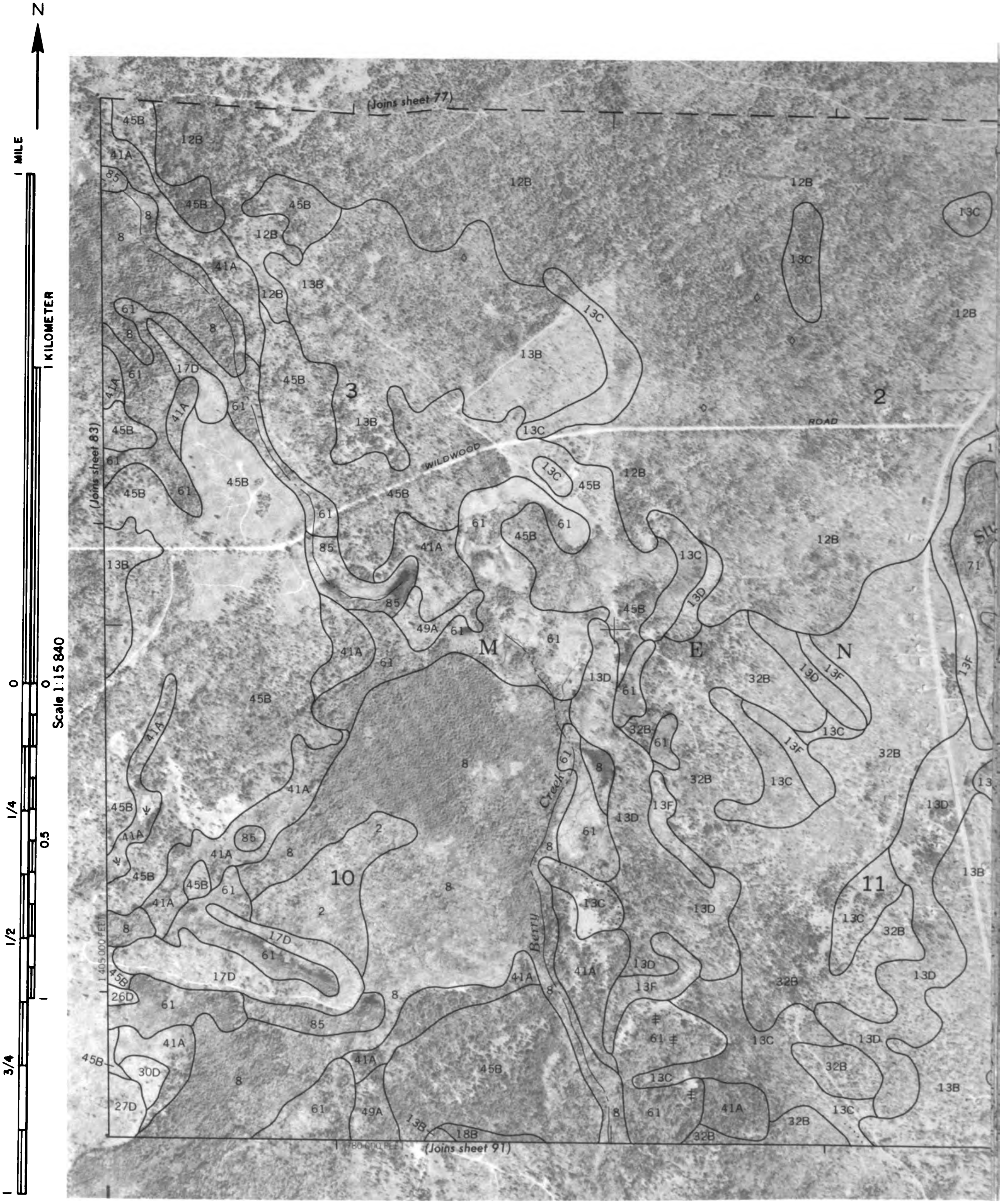

Roberts
Lake
Creek
Lakes
Creek
Pigeon
River
ONAWAY
ROAD
H
L
E
R
28
27
33
34
T. 35 N.
(Joins sheet 79)
12B
13B
13C
13F
18B
18C
18F
24B
27B
27C
27D
41A
43A
45B
61
71
16D
16B
20B
2
21B
68


N
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
0
0.5
Scale 1:15 840
(Joins sheet 73)
(Joins sheet 79)
(Joins sheet 87)
835 000 FEET
29
28
32
33
R
E
L
H
E
O
K
W
Adair

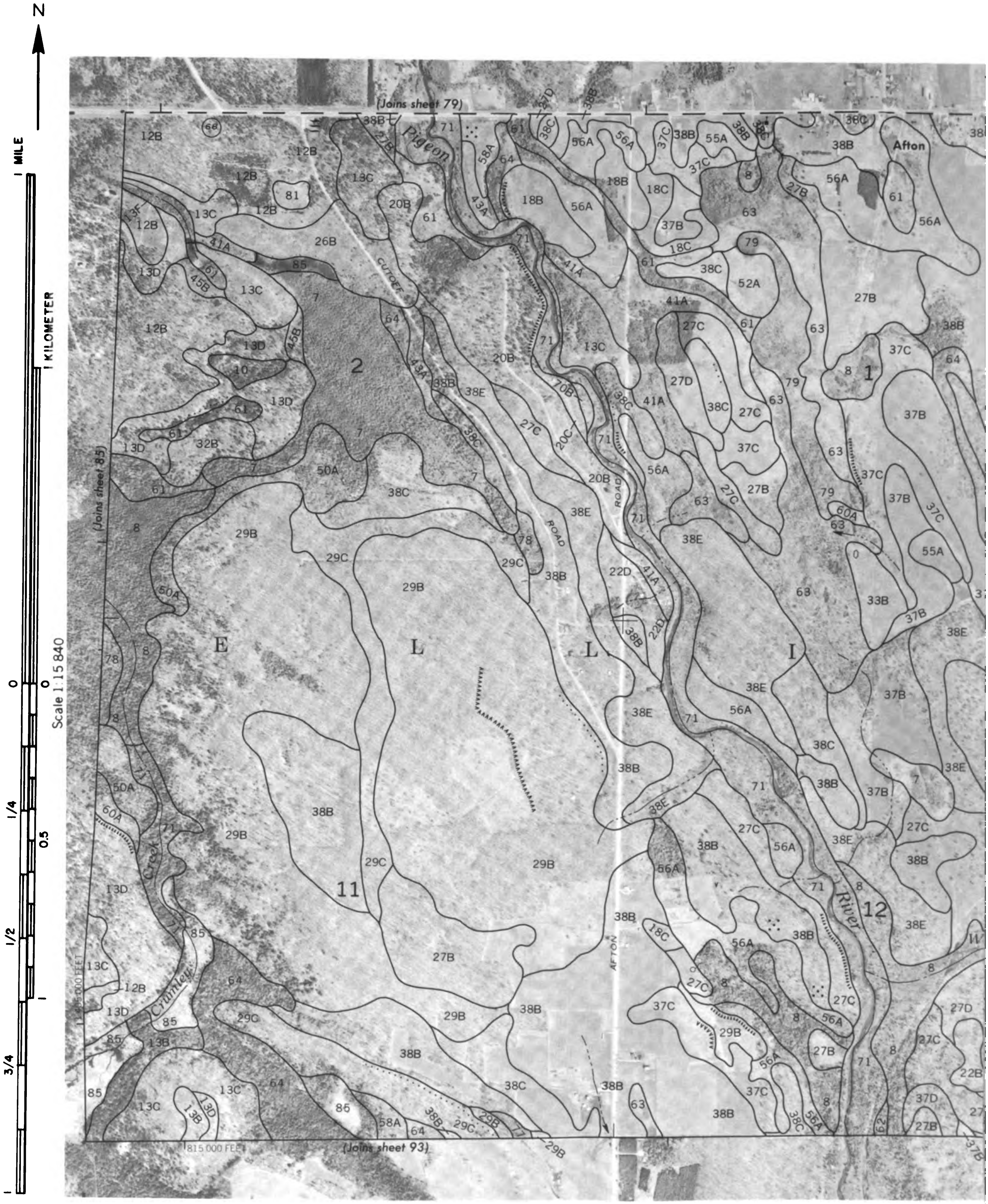

Stoney
Creek
Flooding
Stony
Creek
Stony
Creek
Creek
A V E R L Y
27
26
34
35
T. 35 N.
(Joins sheet 81)
845 000 FEET
420 000 FEET

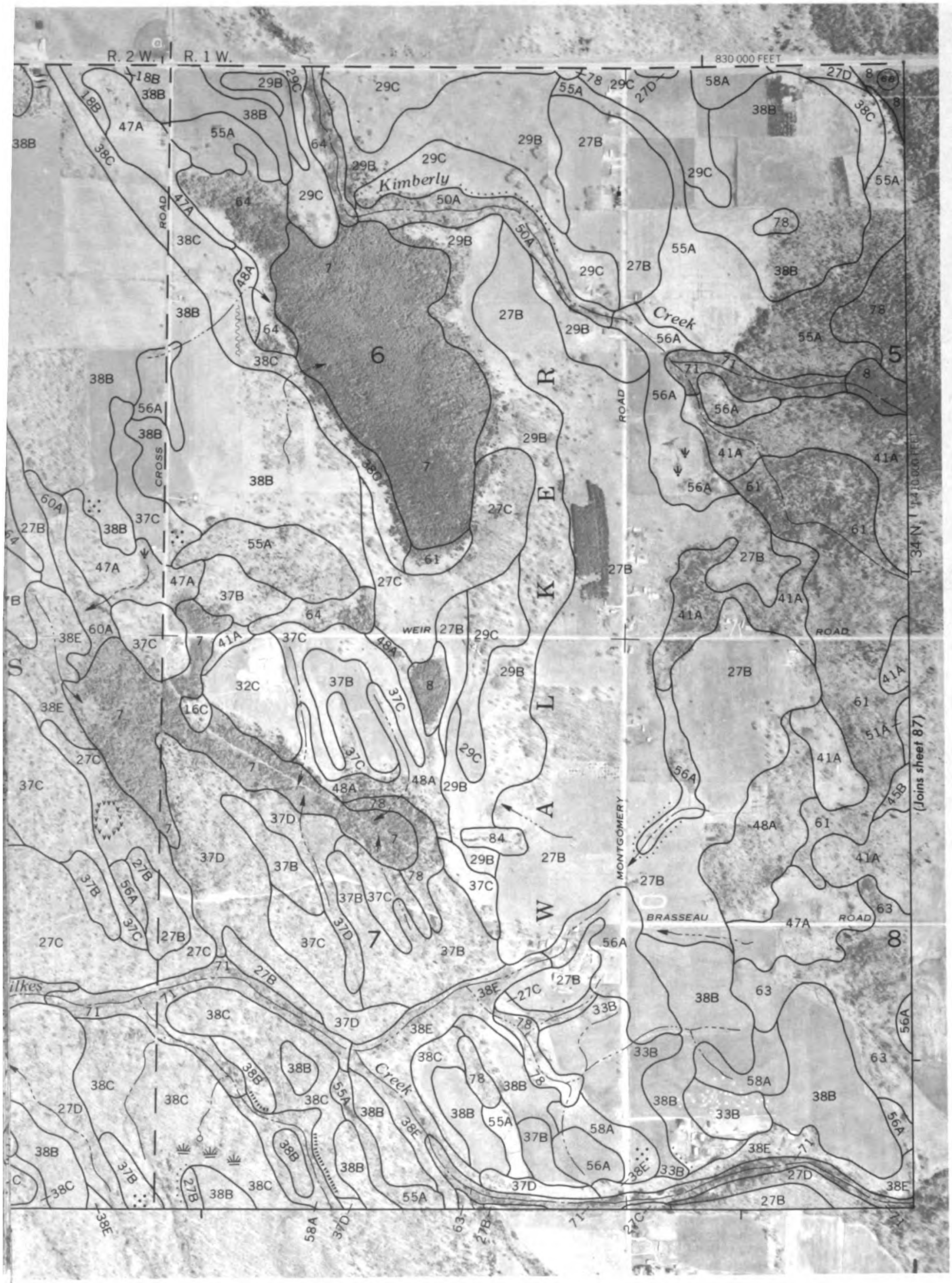

N
1 MILE
1 KILOMETER
Scale 1:15 840
0
1/4
0.5
1/2
3/4
1
(Joins sheet 75)
HUTCHINSON
ROAD
DANGLER
TWIN
AVENUE
BARKLEY
(Joins sheet 81)
(Joins sheet 89)
Klieber
Pond
28
27
33
34
870 000 FEET
415 000 FEET

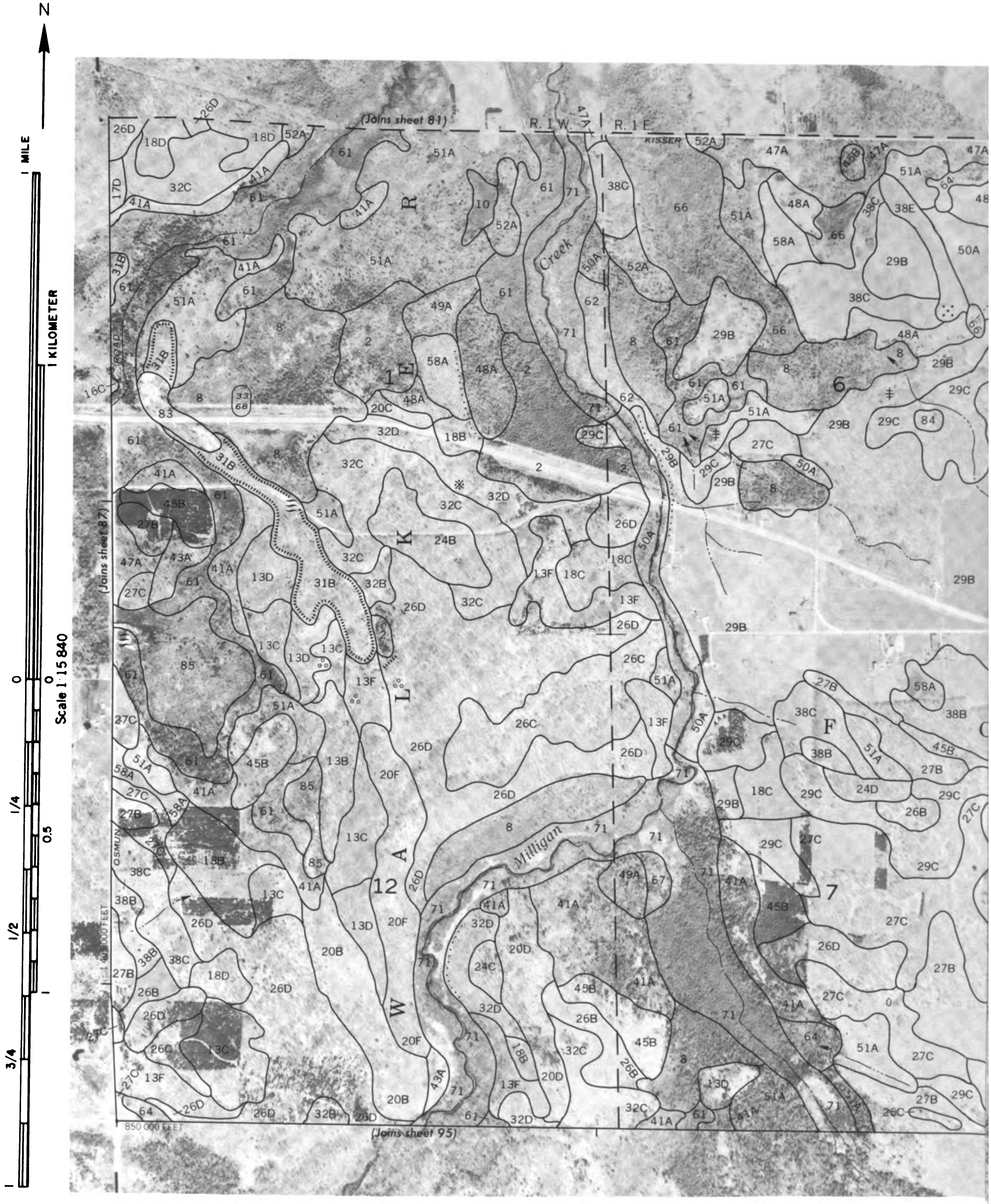
HIGHWAY
PURDY ROAD
SCHOOL ROAD
BLACK RIVER ROAD
LINE ROAD
26
25
35
36
T. 35 N.
PRESQUE ISLE COUNTY
F05
885 000 FEET
320 000 FEET

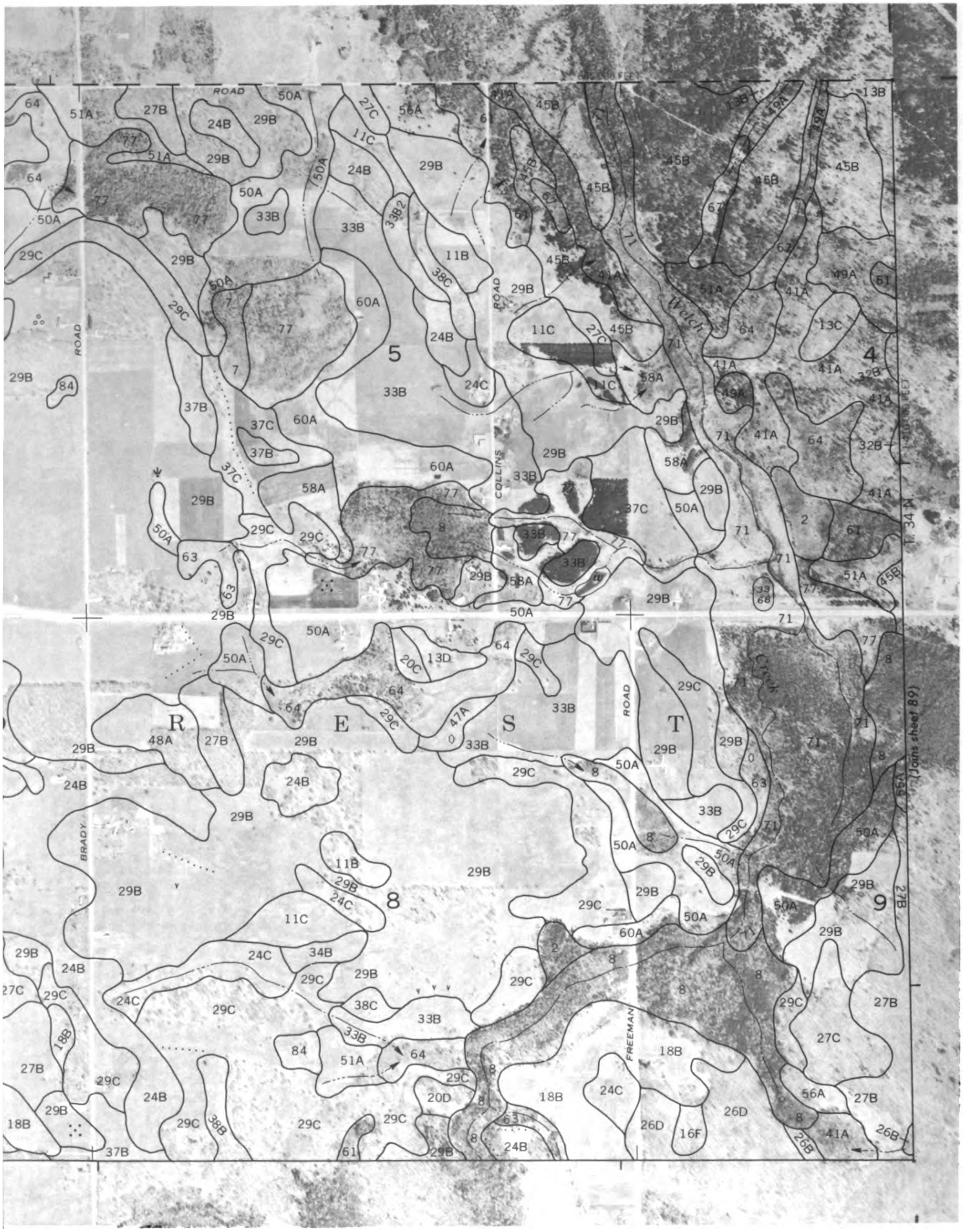

N
1 MILE
1 KILOMETER
0
0
Scale 1:15 840
1/4
0.5
1/2
1
3/4
1
(Joins sheet 77)
(Joins sheet 83)
(Joins sheet 91)
WILDWOOD
ROAD
Berry Creek
M
E
N
2
3
10
11

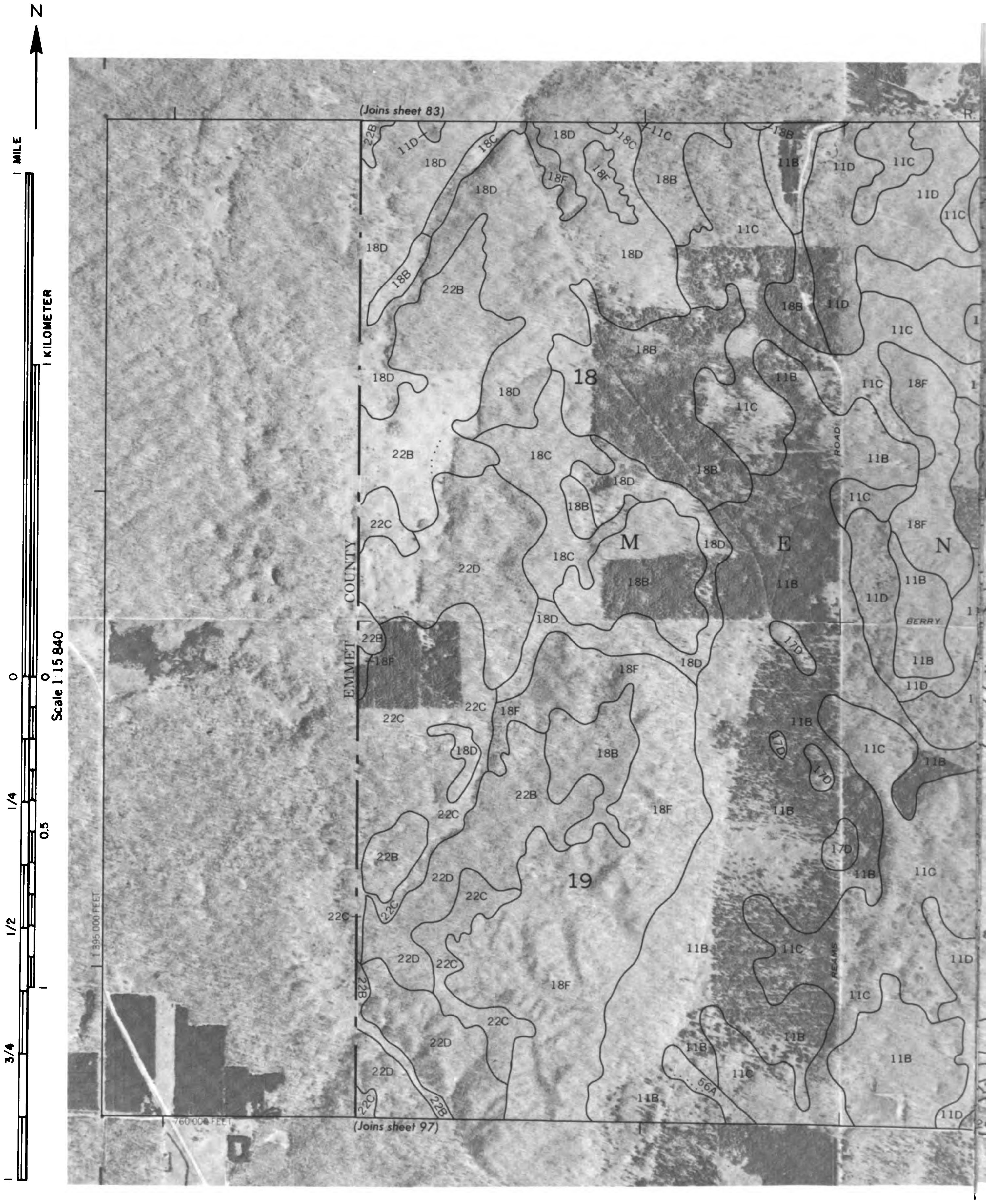

R. 3 W.
R. 2 W.
River
WHITE
ROAD
MACKINAC
DETROIT
AND
BRUDY
I-75
(Joins sheet 85)
T. 34 N.
1
6
7
12


N
1 MILE
1 KILOMETER
Scale 1:15 840
0
1/4
0.5
1/2
3/4
1
(Joins sheet 79)
(Joins sheet 85)
(Joins sheet 93)
815 000 FEET
Afton
Pigeon
River
Crumley
Creek
CUTOFF
ROAD
AFTON
E
L
L
I
1
2
11
12


R. 2 W.
R. 1 W.
830 000 FEET
Kimberly
Creek
CROSS
ROAD
WEIR
ROAD
MONTGOMERY
BRASSEAU
ROAD
W A L K E R
T. 34 N.
(Joins sheet 87)
5
6
7
8
Wilkes
Creek


N
1 MILE
1 KILOMETER
Scale 1:15 840
0
1/4
0.5
1/2
3/4
1
(Joins sheet 81)
R. 1 W.
R. 1 E.
KISSER
(Joins sheet 87)
ROAD
OSMUN
Creek
Milligan
BLACK
WALK
(Joins sheet 95)
850 000 FEET

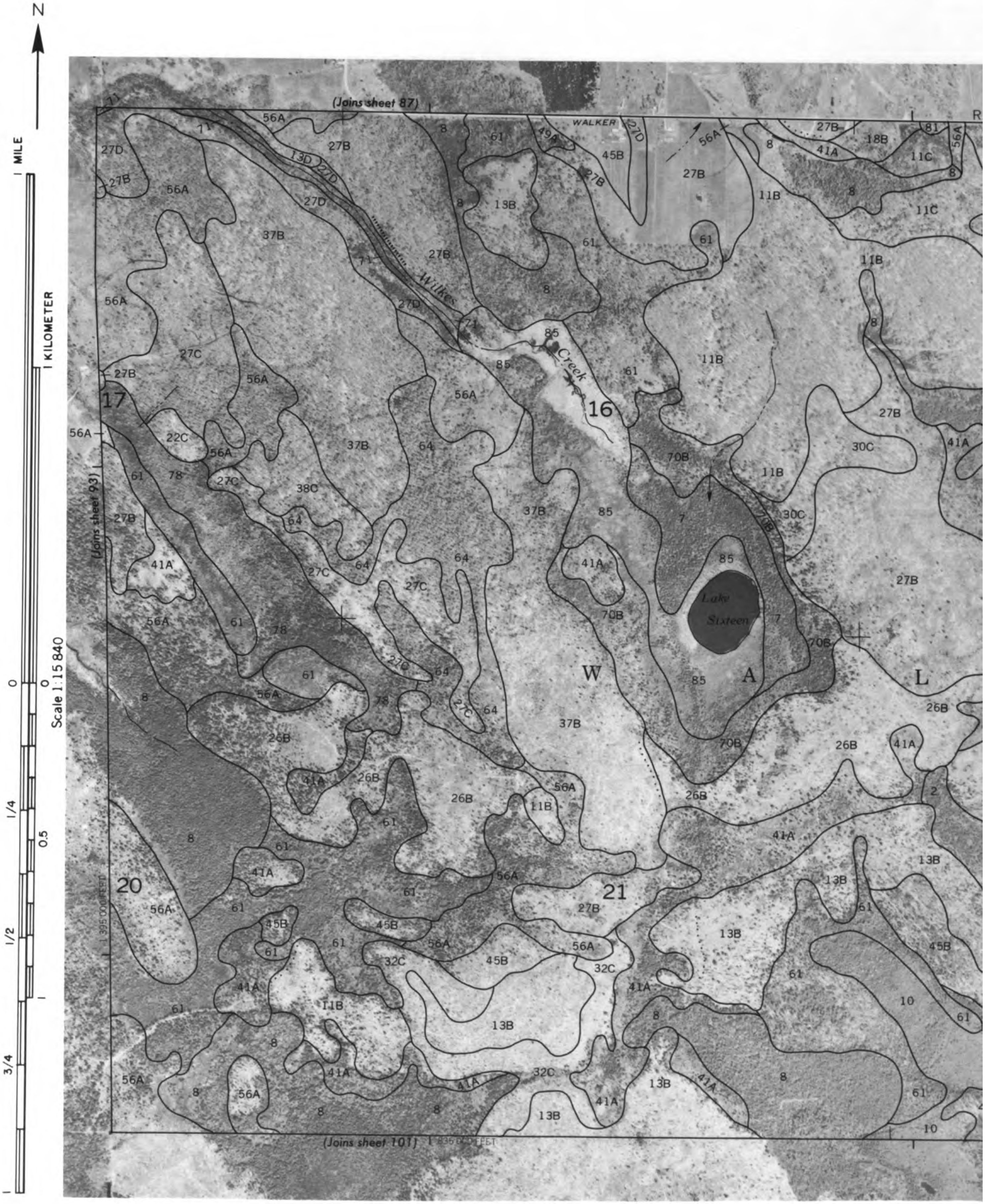

ROAD
ROAD
COLLINS
ROAD
BRADY
ROAD
FREEMAN
Welch
Creek
5
4
8
9
R
E
S
T
(Joins sheet 89)


N
1 MILE
1 KILOMETER
Scale 1:15 840
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 83)
(Joins sheet 97)
EMMET COUNTY
1 395 000 FEET
760 000 FEET
18
19
M
E
N
ROAD
BERRY
REAMS
22B
11D
18C
18D
18F
11C
18B
11B
22C
22D
17D
56A

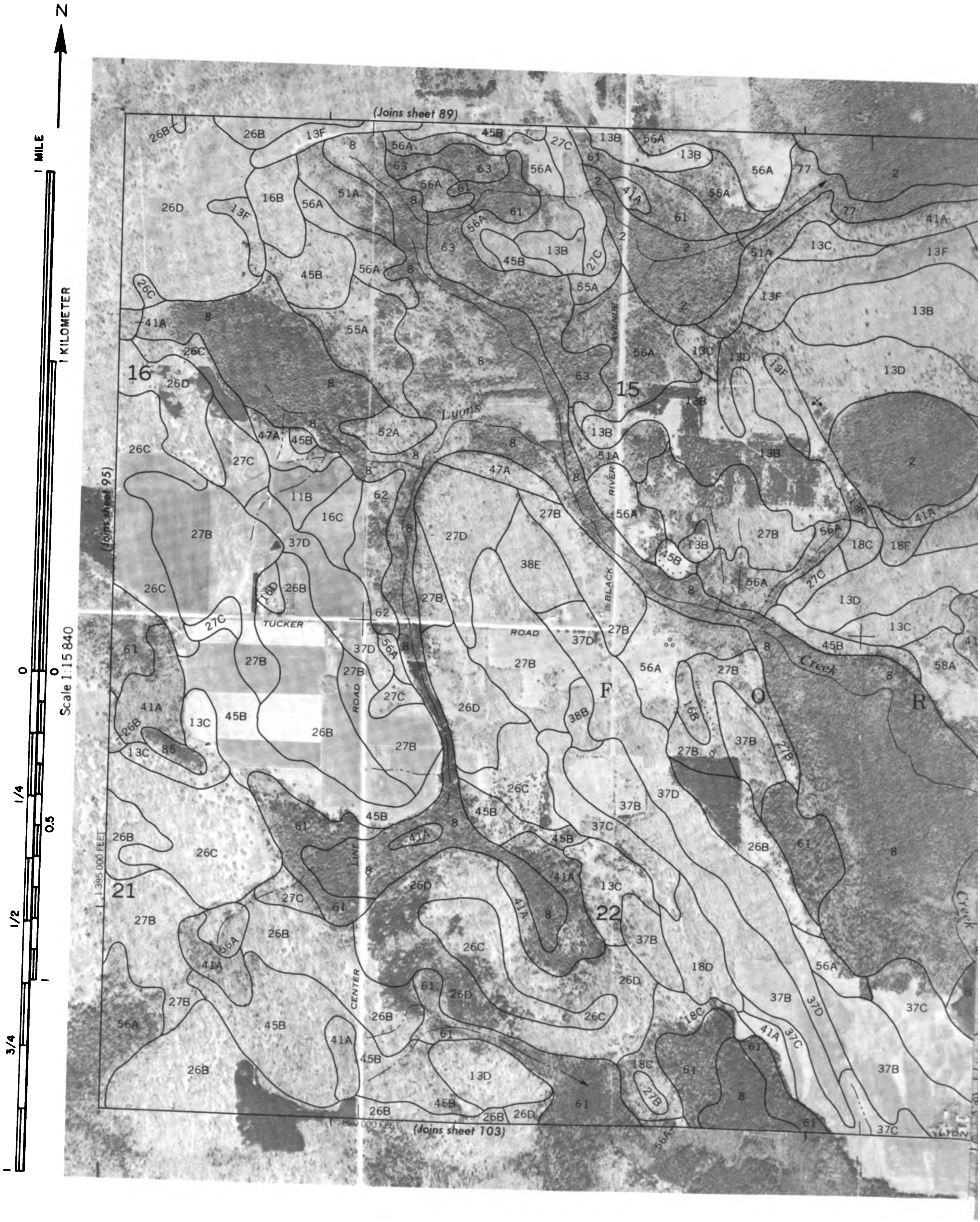

775 000 FEET
1 400 000 FEET
T. 34 N.
(Joins sheet 91)
17
16
20
21
T
O
R
A
CREEK
ROAD


N
1 MILE
1 KILOMETER
Scale 1:15 840
0
1/4
1/2
3/4
0.5
(Joins sheet 85)
(Joins sheet 91)
(Joins sheet 99)
BRUDY ROAD
RONDO
ROAD
AFTON ROAD
Sturgeon
Johnson
Creek
75
17
18
19
20
E
L
L


2 W.
16
15
21
22
I
S
AFTON
ROAD
Goose Lake
(Joins sheet 93)
13B
13C
13D
12B
41A
24C
56A
8
32B
32C
47A
49A
85
45B
27B
24D
32D
24B
67
13F
20D
20B
2
26D
41A
1A
61
71
18D
27C
27F
11C
16F
16D
16B
27D
11D
18C
18B
21B
52A
26B
26D


N
MILE
KILOMETER
Scale 1:15 840
0
1/4
0.5
1/2
1
3/4
1
(Joins sheet 87)
(Joins sheet 93)
(Joins sheet 101)
WALKER
R
Wilkes
Creek
Lake Sixteen
16
17
20
21
W
A
L
1 395 000 FEET
1 835 000 FEET


850 000 FEET
480 000 FEET
T. 34 N.
(Joins sheet 95)
ROAD
OSMUN
Weed
Creek
Osmun
Lake
K
E
R
14
15
22
23

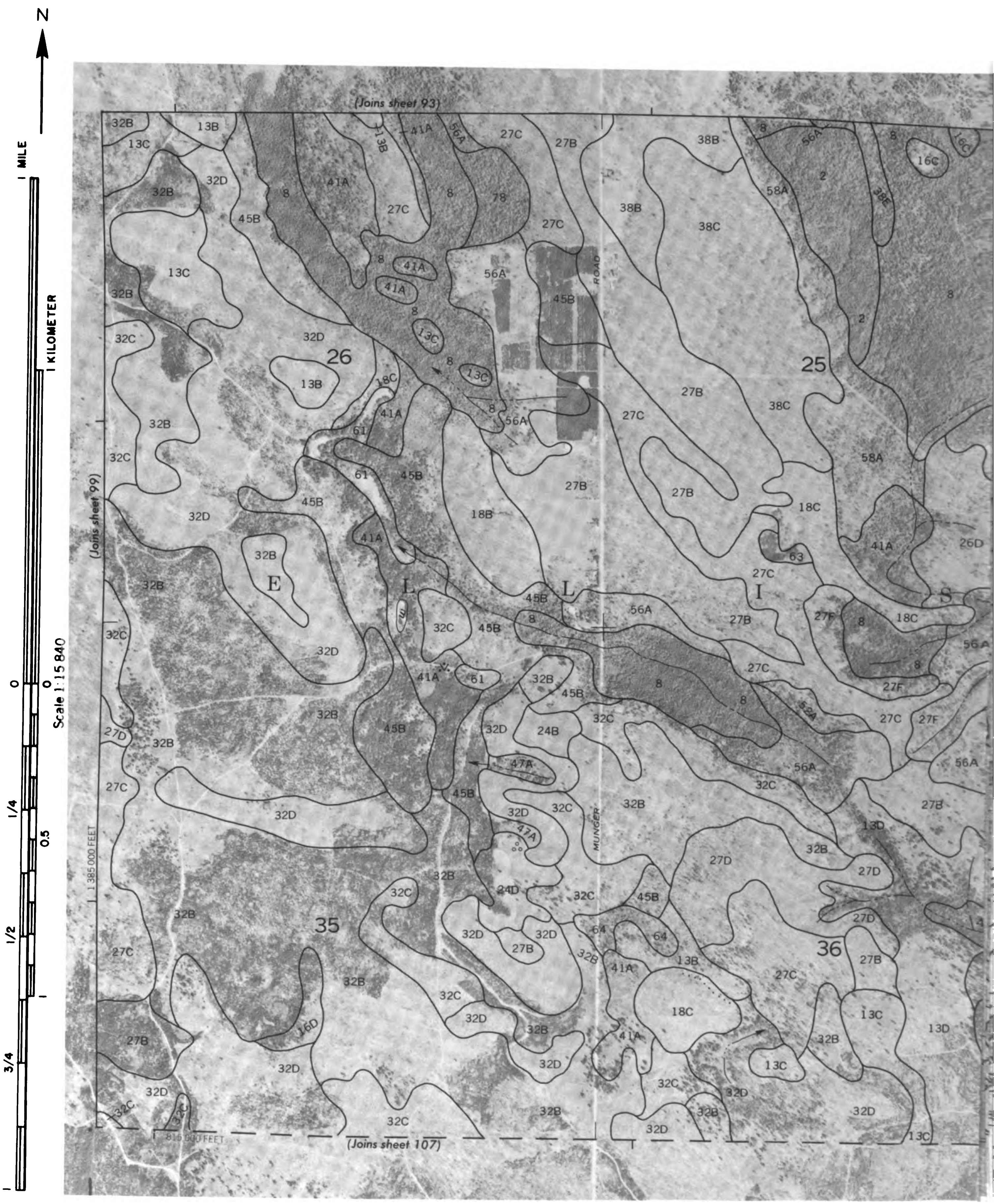

N
1 MILE
1 KILOMETER
0
0
1/4
0.5
1/2
3/4
1
1
Scale 1:15 840
(Joins sheet 89)
(Joins sheet 95)
(Joins sheet 103)
1 395 000 FEET
16
15
21
22
TUCKER
ROAD
CENTER
LINE
ROAD
BLACK
RIVER
AVENUE
Lyons
Creek
F
O
R
LYON


885 000 FEET
1 400 000 FEET
Black River
Sturgis
ROAD
WEST
HIGHWAY
COUNTY LINE
PRESQUE ISLE COUNTY
BLACK RIVER ROAD
13
14
23
24
E
S
T

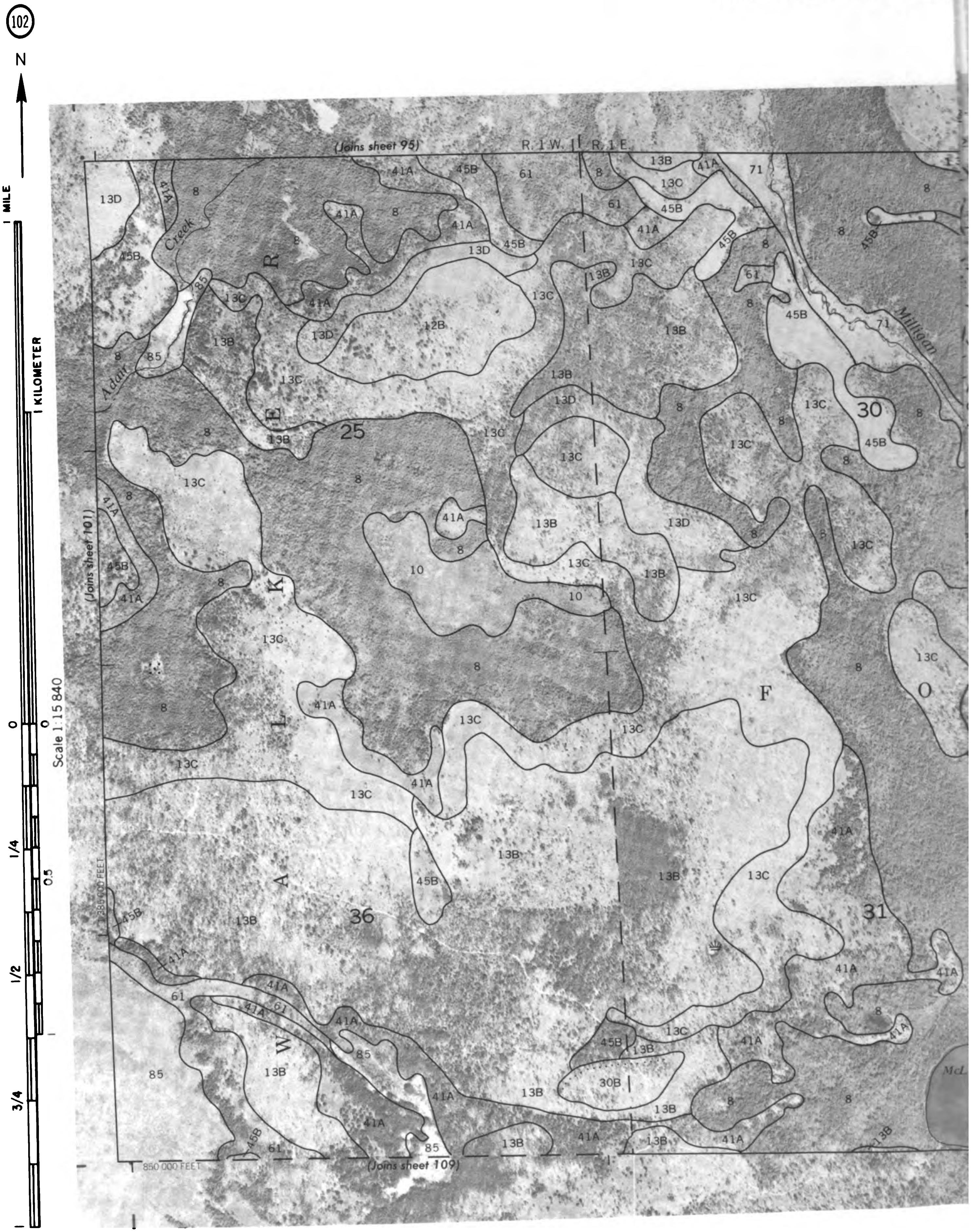

N
1 MILE
1 KILOMETER
Scale 1:15 840
0
0
1/4
0.5
1/2
3/4
1
1


(Joins sheet 91)
(Joins sheet 97)
(Joins sheet 105)
WATSON
ROAD
MENTOR
ROAD
MENTOR TOWNHALL
ROAD
1 885 000 FEET
780 000 FEET
27
34
35
26
M
E
N
T

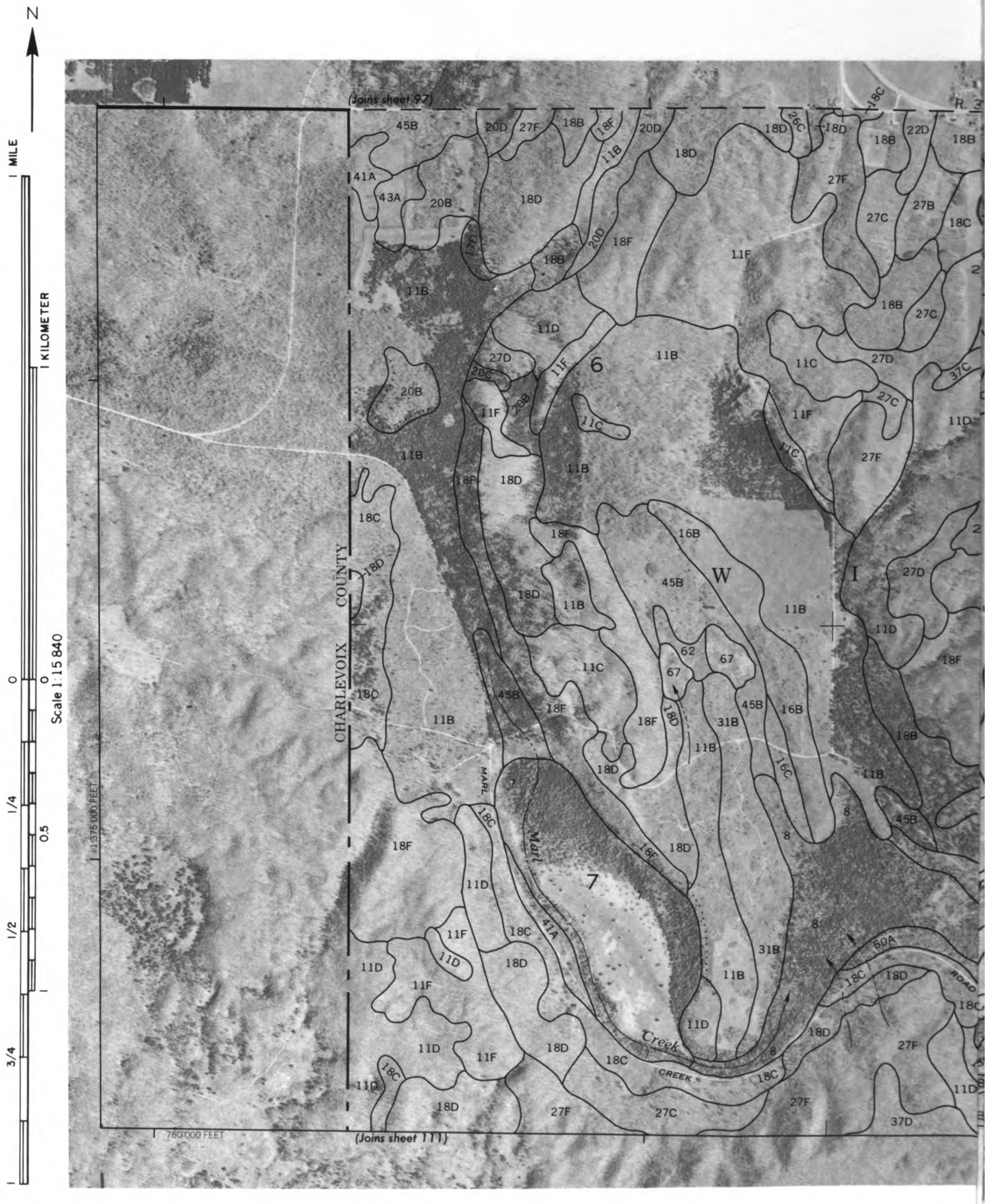

R. 3 W.
R. 2 W.
795 000 FEET
1 390 000 FEET
T. 34 N.
(Joins sheet 99)
Rondo
RONDO ROAD
ROAD
DETROIT AND MACKINAC
HAAKWOOD ROAD
Haak-Wood
SOUTH BILDER ROAD
SCOTT ROAD
Sturgeon River
Beebe Creek
FORREST
ELLIS
25
30
36
31
0
1/4
1/2
3/4
1


N
1 MILE
1 KILOMETER
Scale 1:15 840
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 93)
(Joins sheet 99)
(Joins sheet 107)
1 385 000 FEET
816 000 FEET
ROAD
MUNGER
26
25
35
36
E
L
L
I
S


R. 2 W.
R. 1 W.
830 000 FEET
1 390 000 FEET
T. 34 N.
(Joins sheet 101)
Pigeon
River
McIntosh
Creek
ROAD
MONTGOMERY
30
29
31
32
W A L K E R


102
N
1 MILE
1 KILOMETER
0
1/4
0.5
1/2
3/4
1
Scale 1:15 840
(Joins sheet 95)
R. 1 W.
R. 1 E.
(Joins sheet 101)
(Joins sheet 109)
Adair Creek
Milligan
850 000 FEET
25
30
36
31
R
E
K
L
A
W
F
O


865 000 FEET
1 350 000 FEET
Grass
Lake
Creek
29
28
32
33
R
E
S
T
T. 34 N.
(Joins sheet 103)
13B
45B
41A
13C
13D
12B
32C
8
56A
37C
61
71
67
48A
21B
37D
37B
51A
26B
47A
27B
85
18D
18C
64


N
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
1
0
0.5
1
Scale 1:15 840
(Joins sheet 97)
(Joins sheet 111)
CHARLEVOIX COUNTY
1 375 000 FEET
760 000 FEET
R. 3
6
7
W
I
Marl
MARL
Creek
CREEK
ROAD
45B
41A
43A
20B
20D
27F
18B
18F
11B
20D
18D
26C
18D
18B
22D
18B
18C
27F
27C
27B
18C
17D
18B
20D
18F
11F
11B
11D
27D
20C
11F
20B
6
11B
11C
27D
27C
37C
11F
11D
11C
27F
20B
11F
11C
11B
18D
18F
18C
18D
18F
16B
45B
11B
27D
18D
11B
11D
18F
62
67
67
11C
18C
45B
18F
18F
18D
45B
31B
16B
11B
11B
16C
18B
11B
18D
18F
18C
11D
18C
18D
8
8
8
45B
41A
18C
11F
11D
18D
31B
11B
60A
18C
18D
18C
11D
11F
11D
11D
11F
18D
18C
8
18C
18D
27F
11D
18C
18D
27F
27C
18C
27F
11D
37D

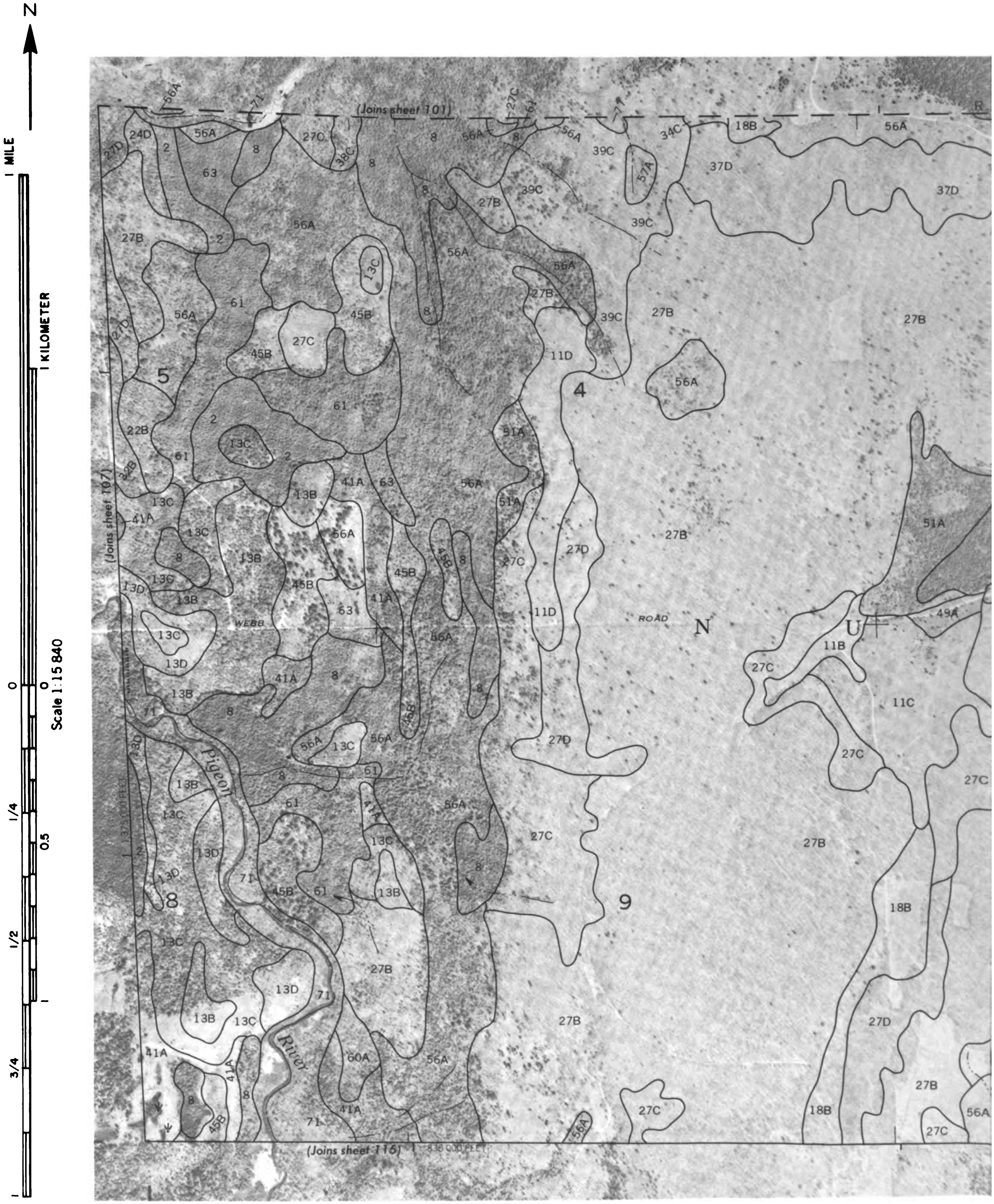
105

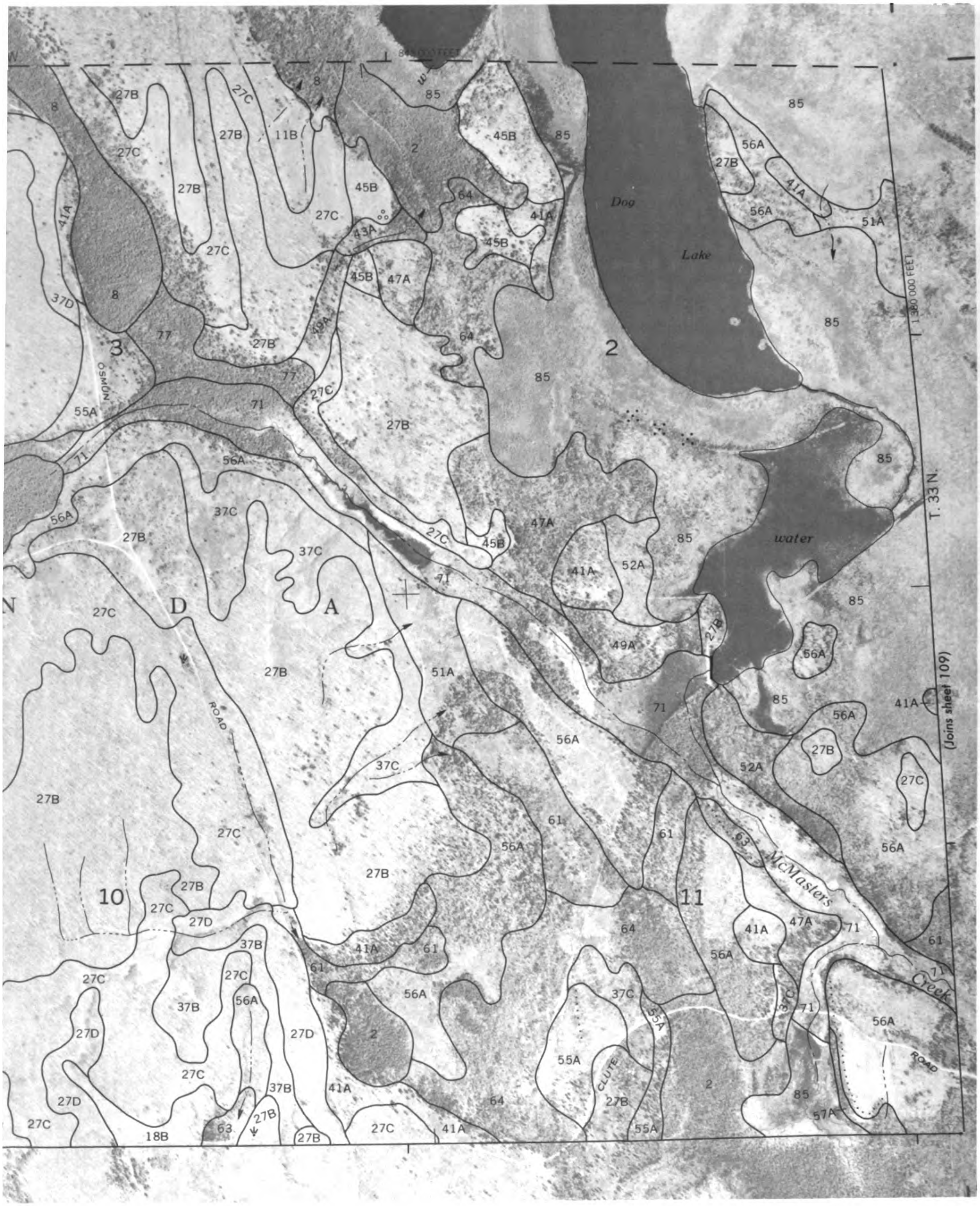

W.
WOLVERINE
MENTOR
ROAD
ROAD
PEET
ROAD
ROAD
CREEK
MARL
(Joins sheet 105)
T. 33 N.
1 350 000 FEET
5
4
8
9
L
M
O
T
20C
27B
37B
27C
27D
18B
20C
27B
34E
24C
20B
27C
20D
26B
26C
11C
11B
18D
18B
34E
27C
27D
18D
27B
27D
20B
18B
11B
13B
C58
26D
27C
27C
11D
18B
20C
27C
11C
24C
27F
11F
16D
18D
18B
11B
26D
18B
26C
26D
26D
18B
27F
11D
11F
11D
24D
27C
11D
11F
18F
24D
11D
27F
11F
18F
18B
18D
18C
18D
18B
26B
27D
18D
27C
18C
20D
26D
26B
20F
18F
18B
18C
18D
18F
18D
18B
51A
18D
27D
27F
27D
18D
32B
26D
8
27F
18D
18D
60A
85
18D
27D
11B
26C
18B
20D
18B
27F
18B
51A
11D
8
11B
85
61
41A
37B
18C
37D
18C
11B

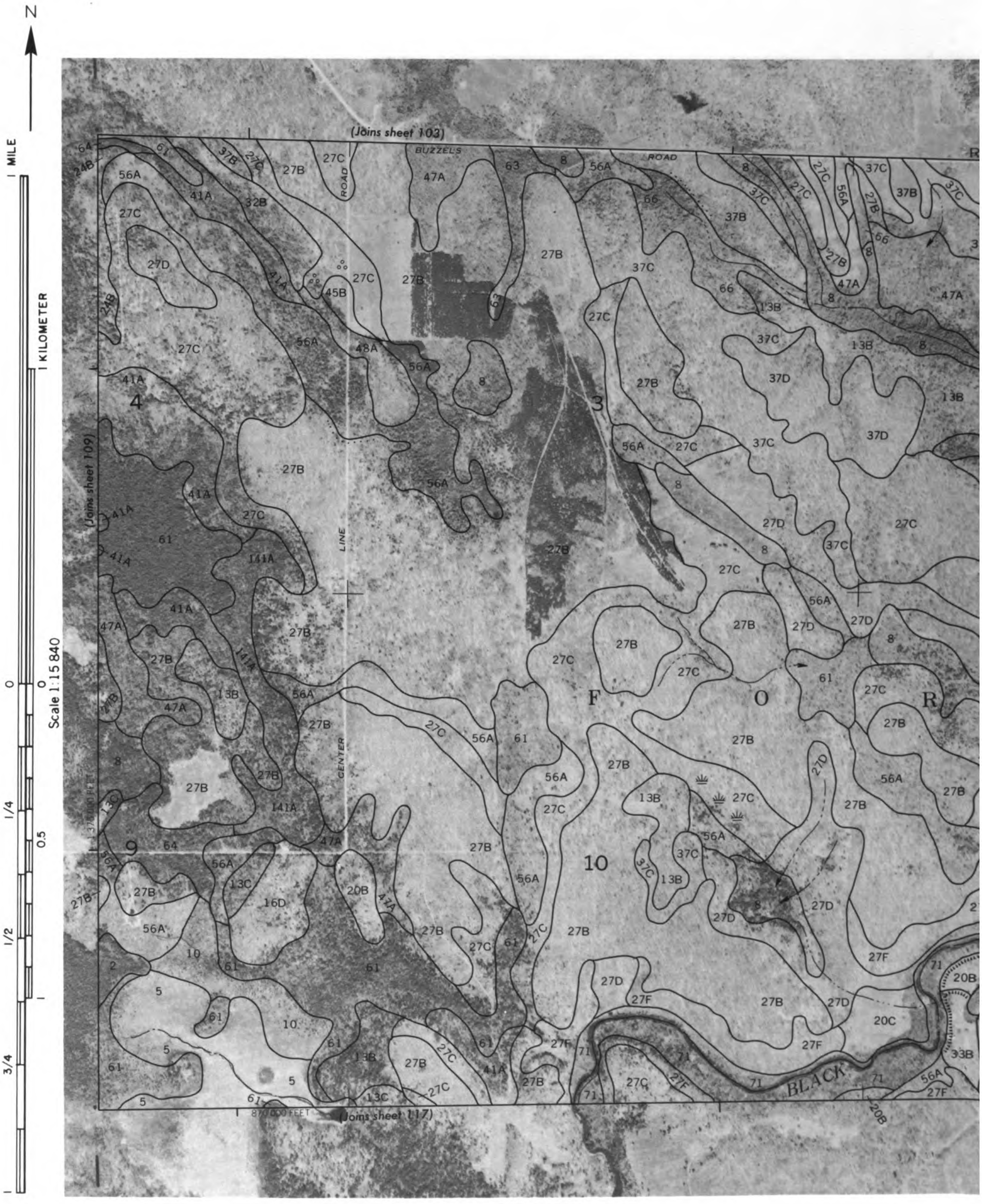

105
N
1 KILOMETER
Scale 1:15 840
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 99)
(Joins sheet 105)
(Joins sheet 113)
R. 2 W.
I-75
ROAD
SHANN
WOLVERINE
Beebe
Creek
Sturgeon
River
DETROIT
AND
MACKINAC
MOLINEAUX
1 375 000 FEET
800 000 FEET
6
5
7
8
N
U


Corey Lake
ROAD
WEBB
(Joins sheet 107)
T. 33 N.
4
3
9
10
N
D
A
27C
27B
27D
22C
22D
18F
18C
18D
18B
26D
45B
41A
32C
32D
20D
27D
2
8
67
w
85
38B
38C
24B
37D
26B
22B
41A
20C
51A
11B
11D
61
20F
2

1 MILE


N
1 MILE
1 KILOMETER
Scale 1:15 840
0
1/4
1/2
3/4
0.5
(Joins sheet 101)
(Joins sheet 107)
(Joins sheet 115)
Pigeon
River
WEBB
ROAD
5
4
8
9
N
U

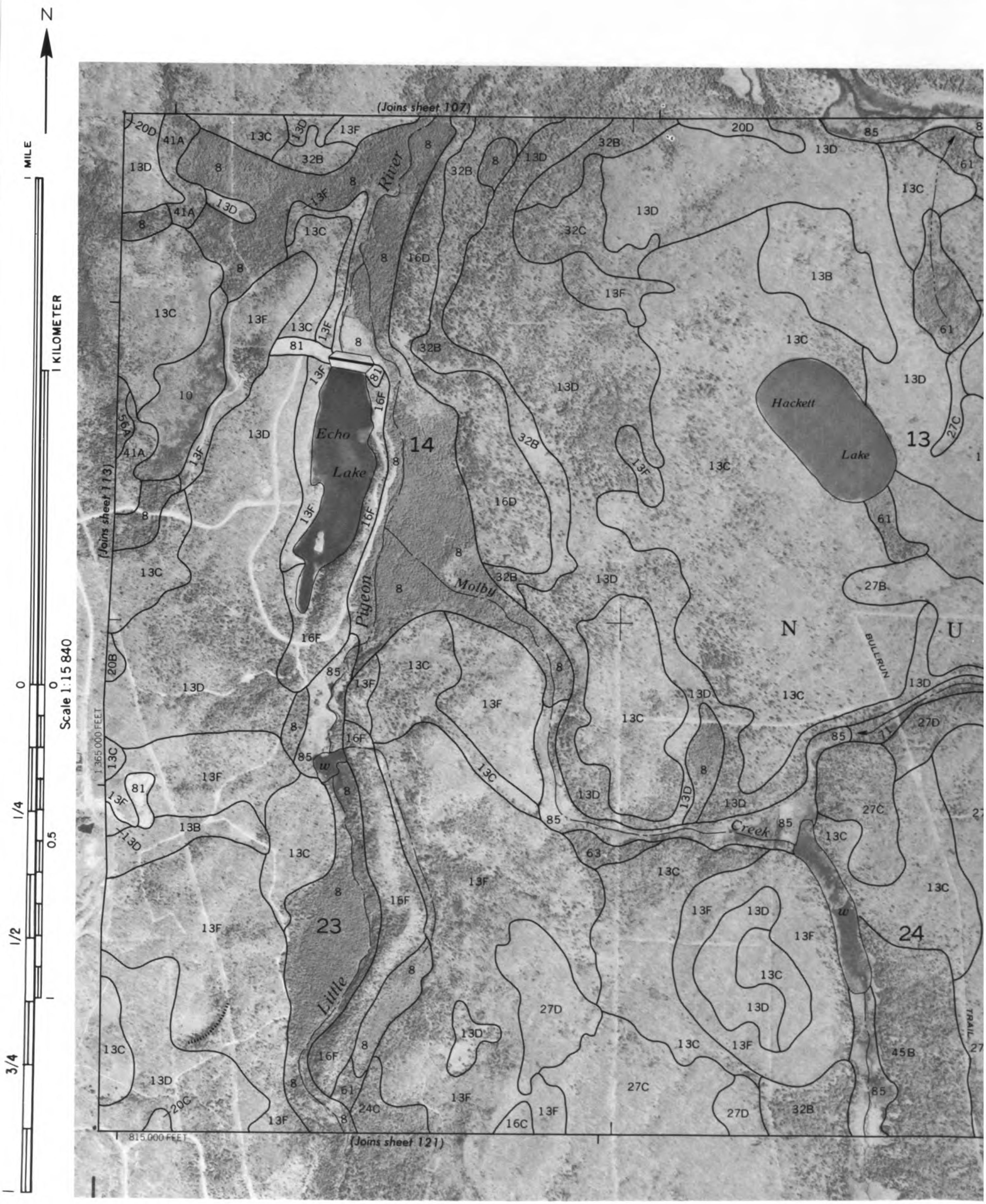

Dog
Lake
water
McMasters
Creek
OSMON
ROAD
CLUTE
ROAD
T. 33 N.
(Joins sheet 109)
1 380 000 FEET
3
2
10
11
N
D
A
27B
27C
8
11B
45B
85
56A
41A
51A
2
64
43A
47A
49A
37D
77
71
55A
37C
52A
51A
61
63
37B
27D
18B
57A


N
1 MILE
1 KILOMETER
Scale 1:15 840
0
1/4
0.5
1/2
1
3/4
(Joins sheet 103)
(Joins sheet 109)
(Joins sheet 117)
BUZZEL'S
ROAD
CENTER
LINE
BLACK
870 000 FEET
4
3
9
10
F
O
R

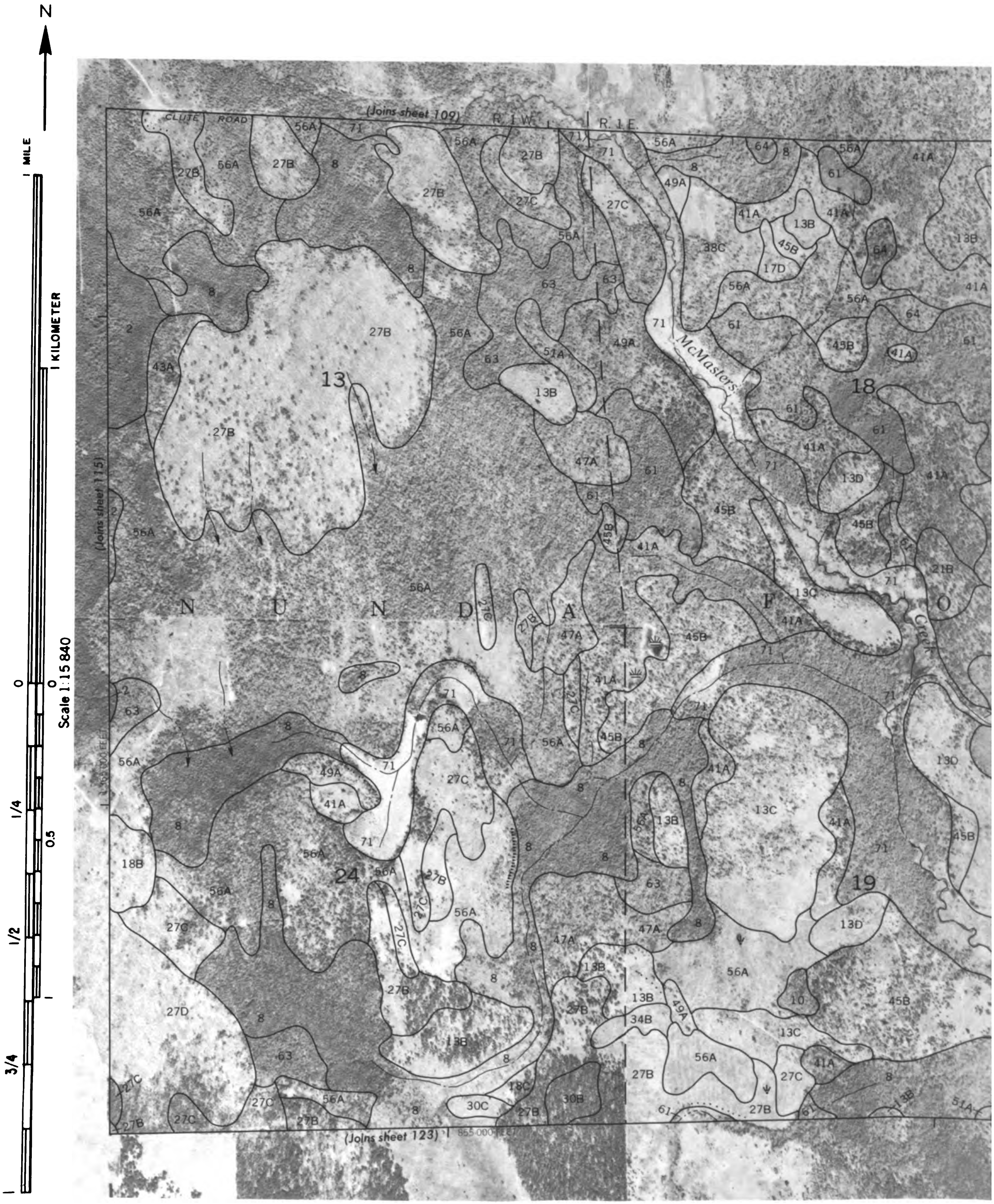

1 E.
885 000 FEET
MILLIGAN
HIGHWAY
ROAD
BLACK
RIVER
BLACK
RIVER
RIVER
BLACK
E
S
T
1
2
11
12
PRESQUE ISLE COUNTY


N
1 MILE
1 KILOMETER
Scale 1:15 840
0
1/4
1/2
3/4
0.5
(Joins sheet 105)
(Joins sheet 111)
(Joins sheet 119)
780 000 FEET
1 365 000 FEET
Marl Creek
West Branch
Sturgeon
WILM
PERRY ROAD
15
14
22
23

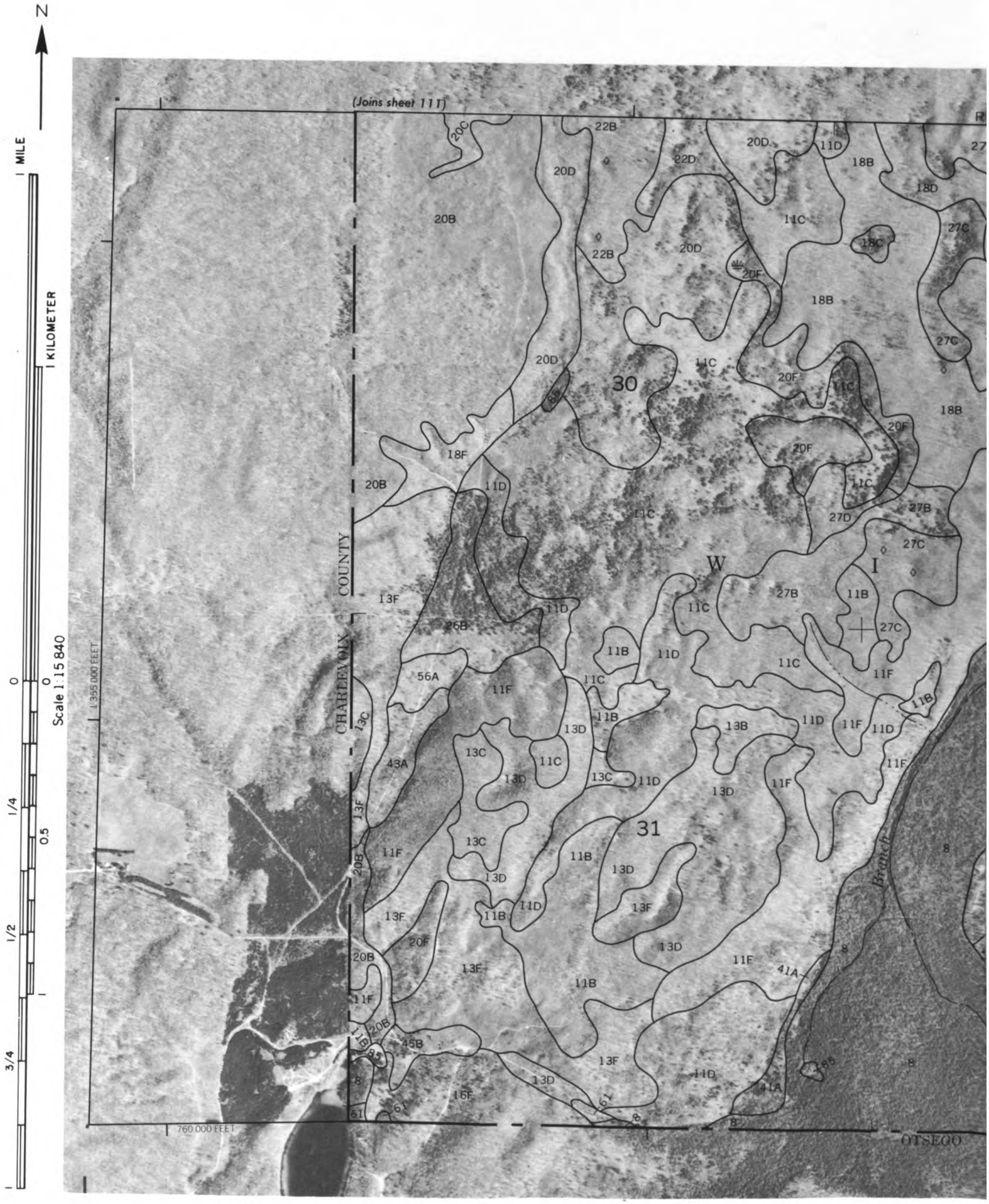

R. 3 W.
R. 2 W.
795 000 FEET
River
Creek
Allen
ROAD
SHIRE
13
18
24
19
Mud
Lake
T. 33 N.
(Joins sheet 113)


N
MILE
KILOMETER
Scale 1:15 840
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 107)
(Joins sheet 113)
(Joins sheet 121)
1 365 000 FEET
815 000 FEET
Echo
Lake
Hackett
Lake
Pigeon
River
Molby
Creek
Little
BULLRUN
TRAIL
14
13
23
24
N
U

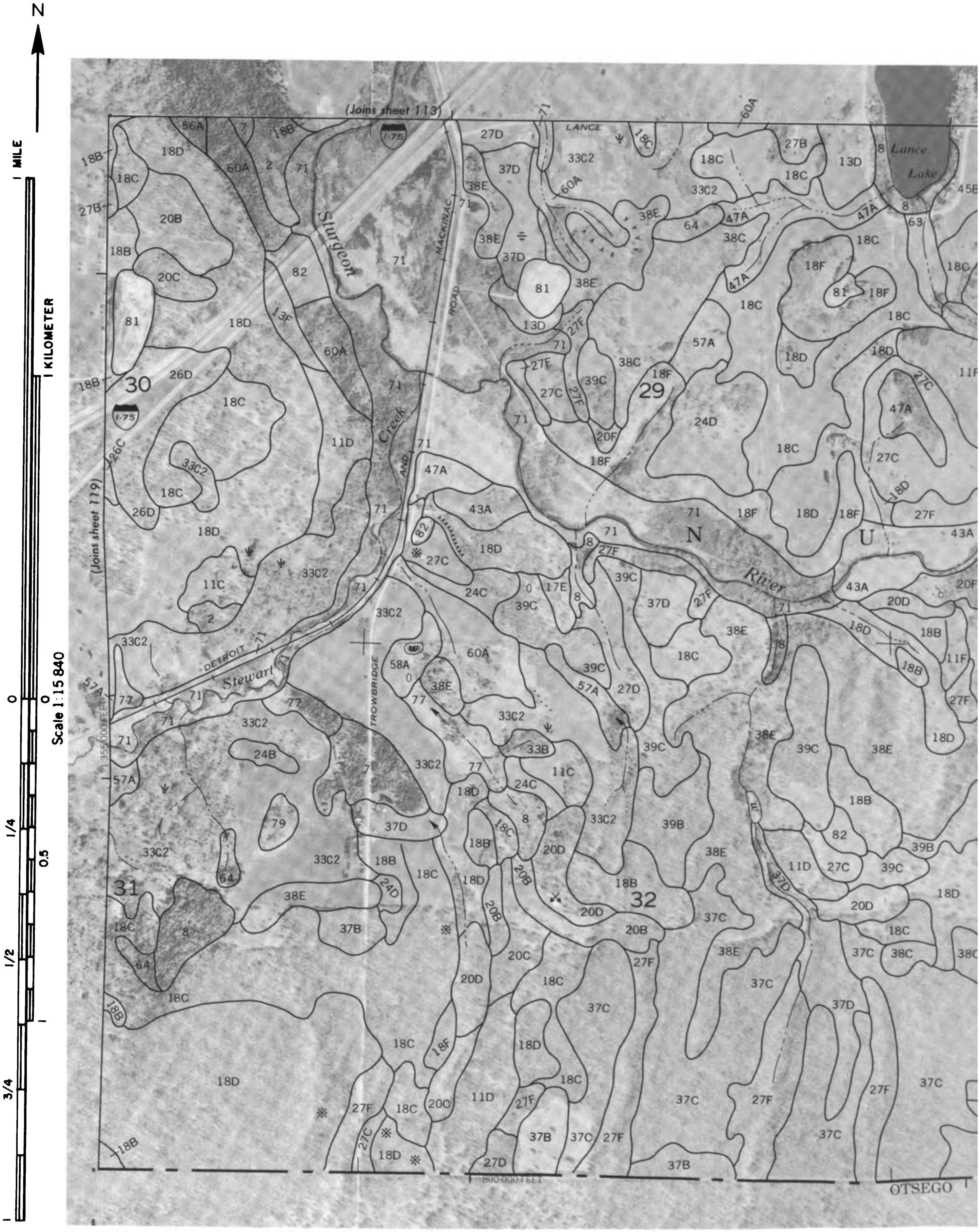

R. 2 W.
R. 1 W.
880 000 FEET
T. 33 N.
(Joins sheet 115)
N
D
A
18
17
19
20
61
8
85
11B
56A
27C
27D
27B
41A
45B
13C
13B
63
70B
45B
56A
32B
18C
18B
13D
37B
37C
2
71
18B
38E
26D
11D
11C
37C
27B
27C


N
1 MILE
1 KILOMETER
Scale 1:15 840
0
1/4
1/2
3/4
0
0.5
1
1
(Joins sheet 109)
CLUTE ROAD
R. 1 W.
R. 1 E.
(Joins sheet 115)
(Joins sheet 123)
N U N D A
F O
McMasters
Creek
13
18
24
19

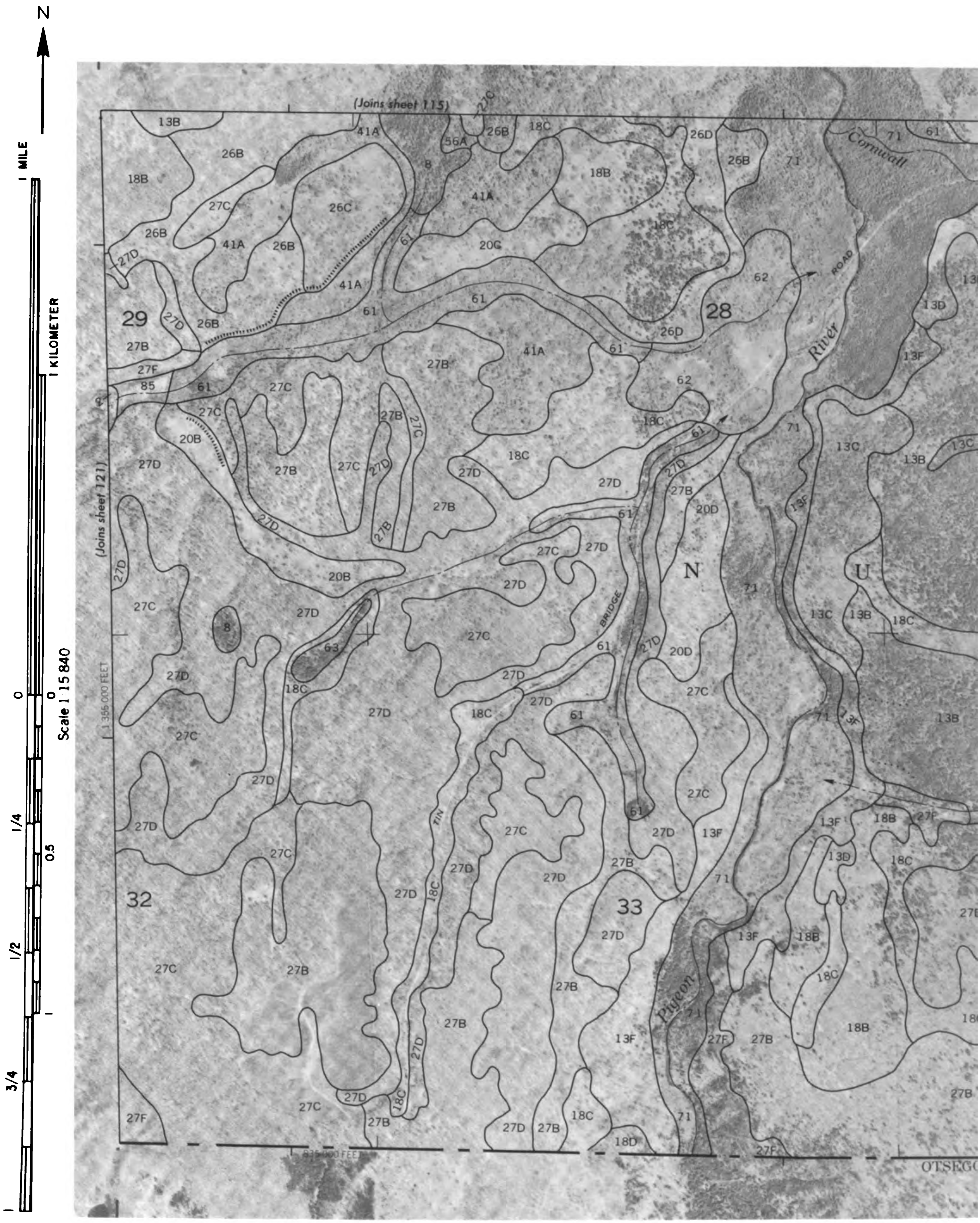

865 000 FEET
17
16
20
21
R
E
S
T
T. 33 N.
(Joins sheet 117)
BLACK
RIVER
McMasters
Creek


N
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
0.5
Scale 1:15 840
(Joins sheet 111)
CHARLEVOIX COUNTY
OTSEGO
1 355 000 FEET
760 000 FEET
30
31
W
I
Branch

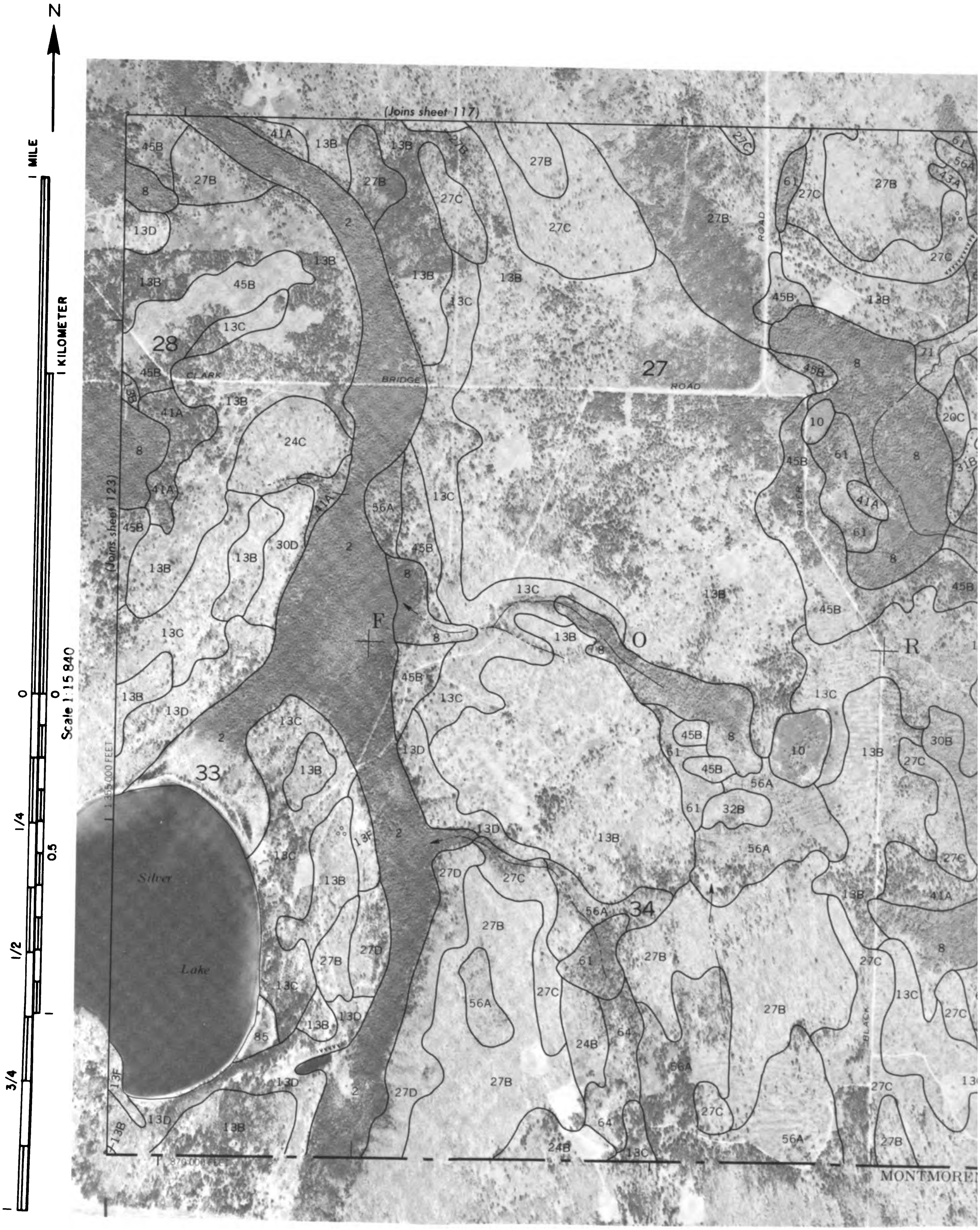

775 000 FEET
1 360 000 FEET
28
29
32
33
L
M
O
T
T. 33 N.
Sturgeon
River
PERRY ROAD
WEST
DUNHAM
ROAD
(Joins sheet 119)
COUNTY
11F
11C
11D
11B
8
18C
18D
18B
22B
22C
13F
27B
26B
20B
81


N
1 MILE
1 KILOMETER
Scale 1:15 840
0
1/4
1/2
3/4
0.5
(Joins sheet 113)
(Joins sheet 119)
LANCE
Lance Lake
Sturgeon Creek
MACKINAC ROAD
DETROIT AND
Stewart
TROWBRIDGE
N U River
I-75
29
30
31
32
355 000 FEET
800 000 FEET
OTSEGO

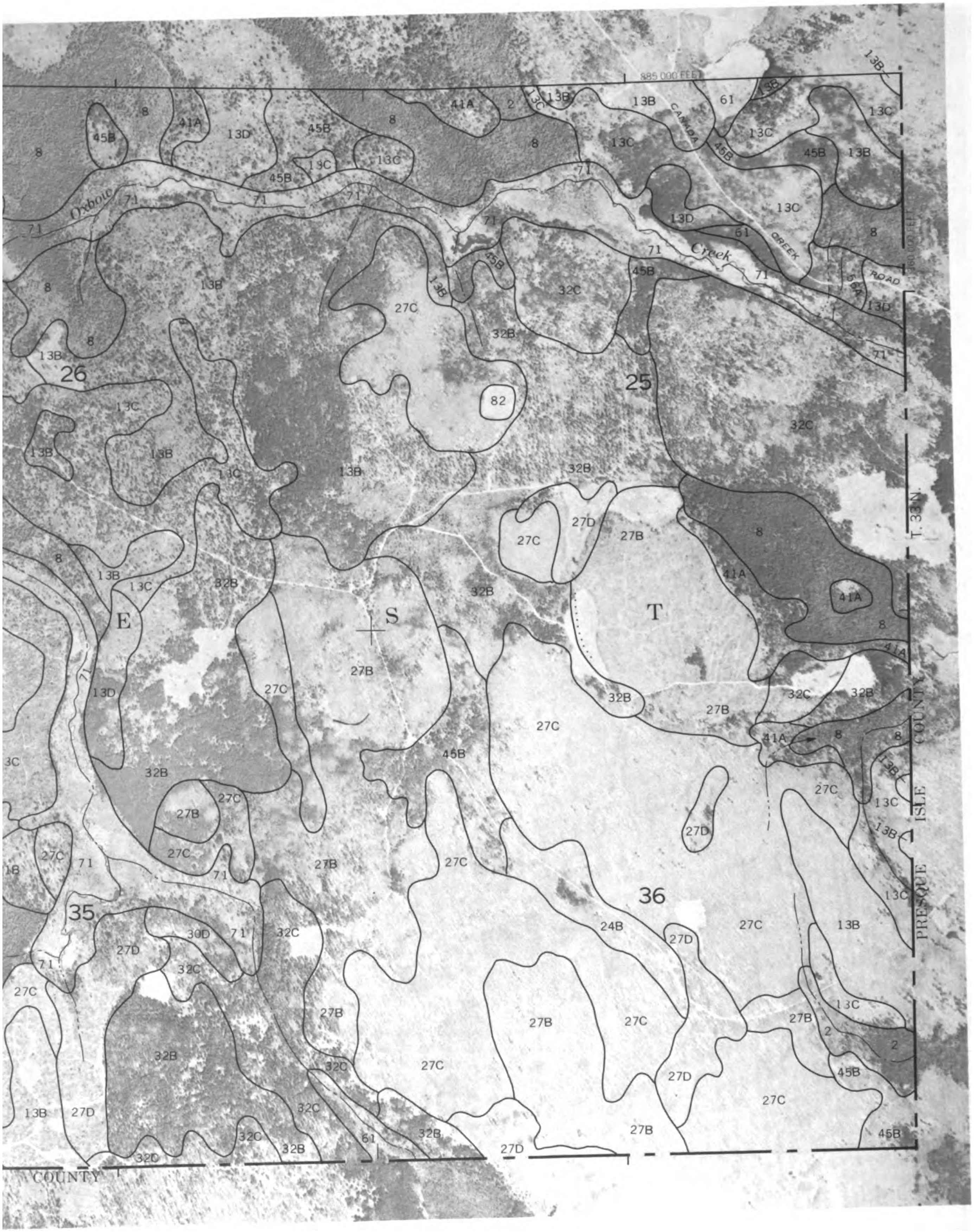
LAKE
ROAD
28
Sturgeon
27
33
34
River
T. 33 N.
(Joins sheet 121)
NTY


N
1 MILE
1 KILOMETER
0
0
Scale 1:15 840
1/4
0.5
1/2
1
3/4
1
(Joins sheet 115)
(Joins sheet 121)
1 356 000 FEET
835 000 FEET
29
28
32
33
N
U
Cornwall
ROAD
River
BRIDGE
Pigeon
OTSEGO
13B
26B
18B
27C
26C
41A
26B
27D
56A
8
18C
26D
71
61
20C
62
27B
27F
85
20B
63
13D
13F
13C
20D
18D
27D

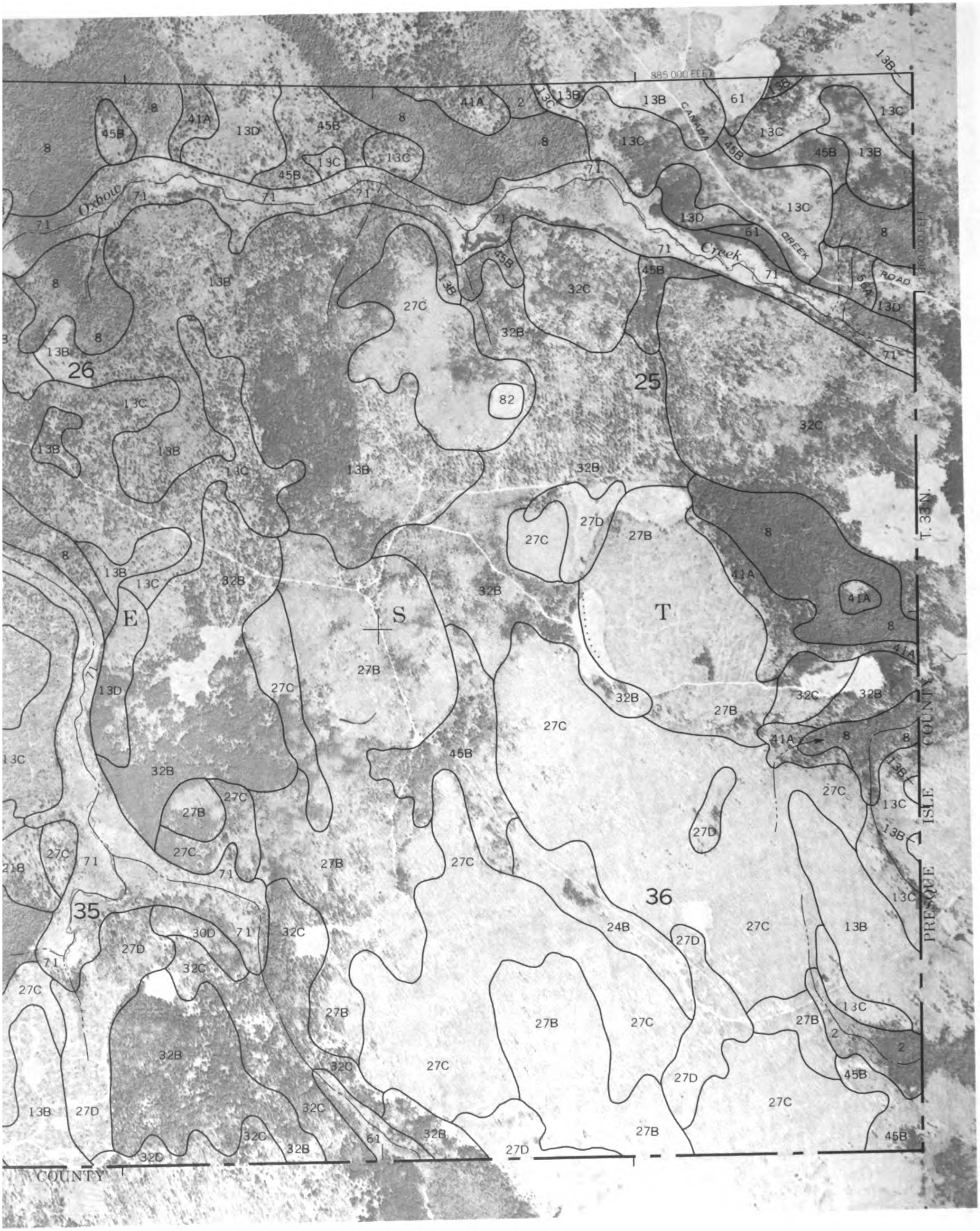

850 000 FEET
TIN
BRIDGE
ROAD
CORNWALL
Creek
CREEK
FLOODING
27
26
34
35
D
A
OSMUN
ROAD
Hemlock Lake
T. 33 N.
(Joins sheet 123)
COUNTY


N
1 MILE
1 KILOMETER
Scale 1:15 840
0
1/4
1/2
3/4
1
0.5
(Joins sheet 117)
(Joins sheet 123)
CLARK
BRIDGE
ROAD
RIVER
BLACK
Silver
Lake
28
27
33
34
F
O
R

COUNTY, MICHIGAN — SHEET NUMBER 124



This soil survey map is compiled on [illegible] aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.
CHEBOYGAN COUNTY, MICHIGAN NO. 124



CHEBOYGAN COUNTY, MICHIGAN NO. 124