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Natural
Resources
Conservation
Service
and
Forest Service

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

Soil Survey of Iron County, Michigan



How To Use This Soil Survey

General Soil Map

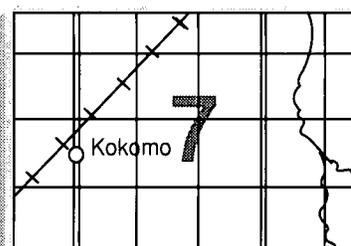
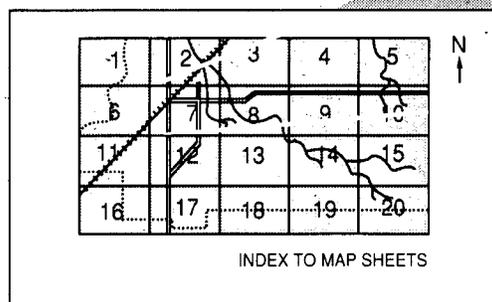
The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

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

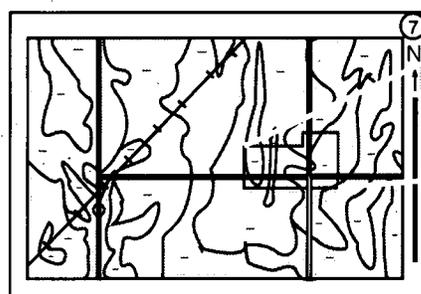
The detailed soil maps follow the general soil map. These maps can be useful in planning the use and management of small areas.

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.

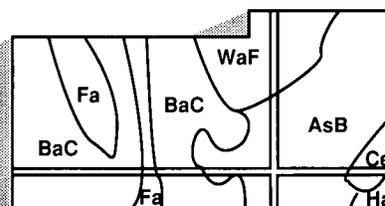


MAP SHEET

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 Natural Resources Conservation Service (formerly 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 1991. Soil names and descriptions were approved in 1992. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1991. This survey was made cooperatively by the Natural Resources Conservation Service, the Forest Service, the Michigan Department of Agriculture, the Michigan Agricultural Experiment Station, the Cooperative Extension Service, and the Michigan Technological University. It is part of the technical assistance furnished to the Iron Soil and Water Conservation District. The Iron County Board of Commissioners provided financial assistance.

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 Natural Resources Conservation Service are offered on a nondiscriminatory basis, without regard to race, color, national origin, religion, sex, age, marital status, or handicap.

Cover: Horseshoe Rapids on the Paint River.

Contents

Index to map units	v	Entic Haplorthods, sandy-skeletal	187
Summary of tables	ix	Escanaba series	187
Foreword	xi	Fence series	188
General nature of the county	1	Gaastra series	189
How this survey was made	4	Gogebic series	189
Map unit composition	5	Goodman series	190
Survey procedures	5	Greenwood series	191
General soil map units	9	Kalkaska series	191
Soil descriptions	9	Karlin series	192
Broad land use considerations	20	Keweenaw series	193
Detailed soil map units	23	Kinross series	193
Soil descriptions	23	Lode series	194
Prime farmland	155	Lupton series	194
Use and management of the soils	157	Manitowish series	195
Crops and pasture	157	Merwin series	195
Woodland management and productivity	161	Minocqua series	196
Forest habitat types	163	Monico series	196
Windbreaks and environmental plantings	165	Net series	197
Recreation	165	Oconto series	198
Wildlife habitat	166	Ocqueoc series	198
Engineering	168	Padus series	199
Soil properties	173	Peavy series	200
Engineering index properties	173	Pence series	200
Physical and chemical properties	174	Petticoat series	201
Soil and water features	175	Sagola series	201
Soil characterization data for selected soils	177	Sarona series	202
Classification of the soils	179	Solona series	203
Soil series and their morphology	179	Soperton series	203
Alfic Fragiorthods, coarse-loamy	179	Stambaugh series	204
Alstad series	180	Sundog series	205
Au Gres series	181	Trenary series	205
Beechwood series	181	Typic Dystrochrepts, coarse-loamy	206
Cathro series	182	Typic Fragiaquods, coarse-loamy	207
Champion series	182	Vilas series	207
Channing series	183	Wabeno series	208
Croswell series	184	Waucedah series	209
Ensley series	184	Witbeck series	209
Entic Fragiorthods, coarse-loamy	185	Formation of the soils	211
Entic Haplorthods, coarse-loamy	186	Factors of soil formation	211
Entic Haplorthods, sandy	186	Processes of soil formation	212

References	215	Tables	227
Glossary	217	Interpretive groups	417

Issued October 1997

Index to Map Units

50—Aquents and Histosols, ponded	23	71D—Karlin-Vilas-Rock outcrop complex, 1 to 18 percent slopes, stony	42
51—Lupton-Cathro-Humaquepts complex	24	72B—Karlin fine sandy loam, 1 to 6 percent slopes.	43
52—Greenwood and Merwin peats	25	72D—Karlin fine sandy loam, 6 to 18 percent slopes.	43
53—Waucedah-Cathro mucks, frequently flooded	25	72F—Karlin fine sandy loam, 18 to 35 percent slopes.	44
54—Pits, sand and gravel.	26	73A—Gaastra silt loam, 0 to 3 percent slopes, stony.	45
55A—Oconto very fine sandy loam, 1 to 2 percent slopes.	26	74A—Au Gres sand, 0 to 3 percent slopes	46
55B—Oconto very fine sandy loam, 2 to 6 percent slopes.	27	75—Kinross muck.	47
55D—Oconto very fine sandy loam, 6 to 18 percent slopes	29	76—Ensley fine sandy loam, stony.	47
56—Pits and dumps, mine	30	77B—Vilas loamy sand, 1 to 6 percent slopes	48
57A—Padus fine sandy loam, 1 to 2 percent slopes.	30	77D—Vilas loamy sand, 6 to 18 percent slopes	49
57B—Padus fine sandy loam, 2 to 6 percent slopes.	31	78B—Vilas-Karlin complex, 1 to 6 percent slopes.	49
57D—Padus fine sandy loam, 6 to 18 percent slopes, stony	31	78D—Vilas-Karlin complex, 6 to 18 percent slopes.	50
57F—Padus fine sandy loam, 18 to 35 percent slopes, stony	32	78F—Vilas-Karlin complex, 18 to 35 percent slopes.	51
58B—Trenary fine sandy loam, 1 to 6 percent slopes, stony	33	79A—Fence silt loam, 1 to 2 percent slopes	51
58D—Trenary fine sandy loam, 6 to 18 percent slopes, stony	34	79B—Fence silt loam, 2 to 6 percent slopes	52
59A—Solona very fine sandy loam, 0 to 3 percent slopes, stony	35	79D—Fence silt loam, 6 to 18 percent slopes	53
60D—Trenary-Rock outcrop complex, 1 to 18 percent slopes, very stony	36	80B—Pence fine sandy loam, 1 to 6 percent slopes.	54
64A—Channing very fine sandy loam, 0 to 3 percent slopes	37	80D—Pence fine sandy loam, 6 to 18 percent slopes.	55
65—Witbeck muck, very stony.	37	80F—Pence fine sandy loam, 18 to 35 percent slopes.	56
67B—Net very fine sandy loam, 0 to 4 percent slopes, very stony	38	82B—Keweenaw loamy fine sand, 1 to 6 percent slopes.	56
68B—Net-Witbeck complex, 0 to 4 percent slopes, very stony	39	82D—Keweenaw loamy fine sand, 6 to 18 percent slopes.	57
69A—Karlin, moderately wet-Croswell complex, 0 to 3 percent slopes	40	82F—Keweenaw loamy fine sand, 18 to 35 percent slopes	58
70B—Sundog-Channing very fine sandy loams, 0 to 6 percent slopes, rocky, stony.	41	100B—Keweenaw-Karlin complex, 1 to 6 percent slopes.	59

100D—Keweenaw-Karlin complex, 6 to 18 percent slopes.....	60	112F—Sundog cobbly fine sandy loam, 18 to 50 percent slopes, stony.....	79
101B—Trenary-Solona complex, 0 to 6 percent slopes, stony.....	61	113A—Sundog very fine sandy loam, moderately wet, 0 to 3 percent slopes.....	79
102B—Escanaba loamy fine sand, 1 to 6 percent slopes.....	62	114A—Minocqua-Channing complex, 0 to 3 percent slopes.....	80
103B—Wabeno-Sarona complex, 1 to 6 percent slopes, stony.....	63	115A—Manitowish fine sandy loam, 0 to 3 percent slopes.....	81
103D—Wabeno-Sarona complex, 6 to 18 percent slopes, stony.....	64	116B—Wabeno silt loam, 1 to 6 percent slopes, very stony.....	82
104A—Stambaugh silt loam, 1 to 2 percent slopes, stony.....	65	116D—Wabeno silt loam, 6 to 18 percent slopes, very stony.....	83
104B—Stambaugh silt loam, 2 to 6 percent slopes, stony.....	66	121B—Peavy silt loam, 1 to 6 percent slopes, stony.....	83
104D—Stambaugh silt loam, 6 to 18 percent slopes, stony.....	67	121D—Peavy silt loam, 6 to 18 percent slopes, stony.....	84
105D—Wabeno-Rock outcrop complex, 1 to 18 percent slopes, very stony.....	68	122B—Sarona-Karlin fine sandy loams, 1 to 6 percent slopes, stony.....	85
106D—Champion very fine sandy loam, 1 to 18 percent slopes, rocky, very stony.....	69	122D—Sarona-Karlin fine sandy loams, 6 to 18 percent slopes, stony.....	86
107B—Sarona fine sandy loam, 1 to 6 percent slopes, stony.....	70	123B—Ocqueoc loamy fine sand, 1 to 6 percent slopes.....	88
107D—Sarona fine sandy loam, 6 to 18 percent slopes, stony.....	71	123D—Ocqueoc loamy fine sand, 6 to 18 percent slopes.....	88
107F—Sarona fine sandy loam, 18 to 35 percent slopes, stony.....	72	124B—Wabeno-Net silt loams, 0 to 6 percent slopes, very stony.....	89
108D—Sarona-Rock outcrop complex, 1 to 18 percent slopes, very stony.....	72	125B—Wabeno-Net silt loams, 0 to 6 percent slopes, rocky, very stony.....	90
108F—Sarona-Rock outcrop complex, 18 to 35 percent slopes, very stony.....	73	126B—Champion very fine sandy loam, 1 to 6 percent slopes, very stony.....	91
109D—Udorthents, nearly level to rolling.....	74	126D—Champion very fine sandy loam, 6 to 18 percent slopes, very stony.....	91
110B—Petticoat-Wabeno silt loams, 1 to 6 percent slopes, very stony.....	74	126F—Champion very fine sandy loam, 18 to 35 percent slopes, very stony.....	92
110D—Petticoat-Wabeno silt loams, 6 to 18 percent slopes, very stony.....	75	127D—Goodman silt loam, 1 to 18 percent slopes, rocky, very stony.....	93
111B—Champion-Net very fine sandy loams, 0 to 6 percent slopes, very stony.....	76	128B—Goodman-Wabeno-Sundog, sandy substratum, complex, 1 to 6 percent slopes, stony.....	94
112B—Sundog very fine sandy loam, 1 to 6 percent slopes.....	77	128D—Goodman-Wabeno-Sundog, sandy substratum, complex, 6 to 18 percent slopes, stony.....	95
112D—Sundog very fine sandy loam, 6 to 18 percent slopes.....	78		

128F—Goodman-Sundog, sandy substratum, complex, 18 to 45 percent slopes, stony	96	511D—Typic Dystrochrepts, coarse-loamy, sandy substratum, rolling.	116
163B—Sagola fine sandy loam, 1 to 6 percent slopes, stony	97	511F—Typic Dystrochrepts, coarse-loamy, sandy substratum, hilly	116
163D—Sagola fine sandy loam, 6 to 18 percent slopes, stony	98	512—Borosaprists, acid	117
163F—Sagola fine sandy loam, 18 to 35 percent slopes, stony	99	513B—Entic Haplorthods, coarse-loamy, deep water table, nearly level and undulating	118
164B—Alstad loam, 0 to 6 percent slopes	99	514B—Stambaugh silt loam, moderately wet, nearly level and undulating, stony.	118
165B—Sundog-Channing very fine sandy loams, 0 to 6 percent slopes	100	515—Borosaprists, frequently flooded	119
166F—Soperton silt loam, 18 to 35 percent slopes, very stony	101	516B—Fragiorthods, nearly level and undulating	120
167A—Monico loam, 0 to 3 percent slopes	102	516D—Fragiorthods, rolling	120
168F—Soperton-Rock outcrop complex, 18 to 35 percent slopes, very stony	103	517B—Lode silt loam, nearly level and undulating.	121
500B—Wabeno silt loam, nearly level and undulating, very stony	104	517D—Lode silt loam, rolling.	121
500D—Wabeno silt loam, rolling, very stony	104	517F—Lode silt loam, hilly	122
501F—Soperton silt loam, hilly, very stony	105	518—Humaquepts, sandy substratum.	123
502B—Champion very fine sandy loam, moderately wet, nearly level and undulating, very stony	106	519A—Monico loam, sandy substratum, nearly level	124
502D—Champion very fine sandy loam, moderately wet, rolling, very stony	107	520B—Haplorthods, deep water table, nearly level and undulating	124
502F—Champion very fine sandy loam, hilly, very stony	107	521B—Pence sandy loam, very deep water table, nearly level and undulating	125
503A—Typic Fragiaquods, coarse-loamy, nearly level	108	522D—Entic Fragiorthods, coarse-loamy-Typic Dystrochrepts complex, nearly level to hilly, rocky, stony	126
504B—Pence fine sandy loam, nearly level and undulating	109	523B—Entic Haplorthods-Typic Haplaquepts complex, nearly level and undulating	126
504D—Pence fine sandy loam, rolling.	110	524D—Haplorthods, bedrock substratum, rolling, rocky	127
504F—Pence fine sandy loam, hilly.	111	524F—Haplorthods, bedrock substratum, hilly to very steep, rocky.	128
505—Humaquepts, acid, very stony.	111	525B—Entic Haplorthods, sandy-skeletal, nearly level and undulating	128
506—Humaquepts, nonacid, very stony	112	525D—Entic Haplorthods, sandy-skeletal, rolling and hilly	129
507A—Monico loam, nearly level	112	525F—Entic Haplorthods, sandy-skeletal, steep and very steep	129
508A—Beechwood silt loam, nearly level.	113	527—Borochemists-Borosaprists, acid, complex	130
509A—Typic Dystrochrepts, coarse-loamy, deep water table, nearly level.	114	528—Borochemists, acid	131
510—Borosaprists, nonacid	115	529—Borochemists, nonacid	131
511B—Typic Dystrochrepts, coarse-loamy, sandy substratum, nearly level and undulating	115	530—Borosaprists-Histic Humaquepts, nonacid, complex.	132

531C—Champion silt loam, nearly level to rolling, very stony	132	542F—Gogebic fine sandy loam, well drained, hilly	142
532F—Champion-Haplorthods complex, hilly, rocky, very stony	133	543A—Haplaquods, nearly level	142
533B—Entic Fragiorthods, coarse-loamy, nearly level and undulating	134	544C—Haplorthods, esker, rolling	143
534B—Entic Haplorthods, sandy, stratified substratum, nearly level and undulating	134	544D—Haplorthods, esker, hilly	143
534D—Entic Haplorthods, sandy, stratified substratum, rolling	135	544F—Haplorthods, esker, steep	144
535B—Vilas loamy sand, nearly level and undulating	135	545B—Haplorthods, nearly level and undulating	144
535D—Vilas loamy sand, rolling	136	545D—Haplorthods, rolling	145
536F—Entic Haplorthods, sandy-skeletal, esker, very steep	136	545F—Haplorthods, hilly	145
537B—Haplorthods, moderately deep water table, nearly level and undulating	137	546C—Entic Haplorthods, esker, rolling	146
538B—Entic Haplorthods, sandy substratum, nearly level and undulating	138	546D—Entic Haplorthods, esker, hilly and steep	146
538D—Entic Haplorthods, sandy substratum, rolling	138	546F—Entic Haplorthods, esker, very steep	147
539B—Karlin sandy loam, very deep water table, nearly level and undulating	139	547B—Haplorthods, very deep water table, nearly level and undulating	147
540B—Entic Fragiorthods-Typic Fragiaquods- Borosaprists, nonacid, complex, nearly level and undulating	139	548—Humaquepts-Terric Borosaprists, nonacid, complex, frequently flooded	148
541—Fluvaquents, frequently flooded	140	549B—Karlin-Pence complex, nearly level and undulating	148
542B—Gogebic fine sandy loam, nearly level and undulating	140	549D—Karlin-Pence complex, rolling	149
542D—Gogebic fine sandy loam, rolling	141	549F—Karlin-Pence complex, hilly	150
		550—Terric Borosaprists, nonacid, frequently flooded	151
		551A—Typic Fragiorthods, nearly level, stony	151
		552F—Kalkaska sand, banded substratum, hilly	152
		553D—Kalkaska loamy sand, rolling	153
		554B—Alfic Fragiorthods, coarse-loamy, nearly level and undulating	153
		555B—Entic Haplorthods, very deep water table, nearly level and undulating	154
		556—Haplaquods, wet	154

Summary of Tables

Temperature and precipitation (table 1)	228
Freeze dates in spring and fall (table 2).....	230
Growing season (table 3).....	232
Acreage and proportionate extent of the soils (table 4)	233
Prime farmland (table 5).....	236
Yields per acre of crops (table 6).....	237
Capability classes and subclasses (table 7)	240
Woodland management and productivity (table 8).....	241
Equipment limitations on woodland (table 9).....	262
Windbreaks and environmental plantings (table 10)	277
Recreational development (table 11).....	283
Wildlife habitat (table 12)	297
Building site development (table 13)	308
Sanitary facilities (table 14)	323
Construction materials (table 15)	338
Water management (table 16).....	351
Engineering index properties (table 17)	364
Physical and chemical properties of the soils (table 18).....	394
Soil and water features (table 19)	406
Classification of the soils (table 20).....	414

Foreword

This soil survey contains information that can be used in land-planning programs in Iron County, Michigan. 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 Natural Resources Conservation Service or the Cooperative Extension Service.

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Soil Survey of Iron County, Michigan

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United States Department of Agriculture, Natural Resources Conservation Service and Forest Service,
in cooperation with
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IRON COUNTY is in the southwestern part of the Upper Peninsula of Michigan (fig. 1). The county is bordered on the east by Dickinson and Marquette Counties, on the north by Baraga and Houghton Counties, on the west by Ontonagon and Gogebic Counties, and on the south by the State of Wisconsin. Iron County has a total area of 744,371 acres, or about 1,163 square miles. In 1990, it had a population of 13,175.

This survey updates an earlier survey of Iron County published in 1937 (USDA, 1937). It provides additional information and has larger maps, which show the soils in greater detail.

General Nature of the County

This section provides general information about the county. It describes climate, physiography, streams and lakes, history and development, farming, and transportation facilities and employment.

Climate

Prepared by the Michigan Department of Agriculture, Environmental Division, Climatology Section.

The climate in Iron County is highly varied because of topographical variations and the proximity of the

county to inland lakes. Table 1 gives data on temperature and precipitation for the survey area as recorded at Beechwood, Crystal Falls, and Stambaugh. 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 14.3 degrees F at Beechwood, 11.6 degrees at Crystal Falls, and 14.6 degrees at Stambaugh. The average daily minimum temperature is 4.5 degrees at Beechwood and 4.1 degrees at Stambaugh. The lowest temperature on record was -36 degrees at Beechwood on January 17, 1982, and -47 degrees at Stambaugh on February 10, 1899. In summer, the average temperature is 63.4 degrees at Beechwood, 62 degrees at Crystal Falls, and 63.2 degrees at Stambaugh. The highest recorded temperature was 96 degrees at Beechwood on June 19, 1988, and 103 degrees at Stambaugh on July 13, 1936.

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.

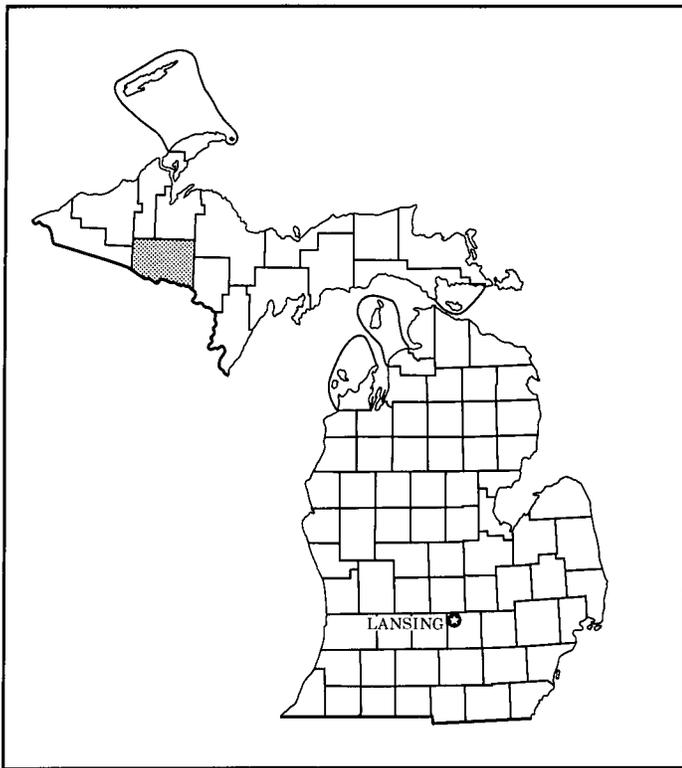


Figure 1.—Location of Iron County in Michigan.

The total annual precipitation is 33.63 inches at Beechwood, 29.92 inches at Crystal Falls, and 31.68 inches at Stambaugh. Of the total precipitation, 22.52 inches, or 67 percent, usually falls in April through September at Beechwood. About 20.30 inches, or 68 percent, falls during this period at Crystal Falls, and 21.87 inches, or 69 percent, falls during this period at Stambaugh. 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 17.99 inches at Beechwood, 16.73 inches at Crystal Falls, and 18.33 inches at Stambaugh. The heaviest 1-day rainfall during the period of record was 4.03 inches at Beechwood, 3.50 inches at Crystal Falls, and 4.44 inches at Stambaugh. Thunderstorms occur on about 33 days each year, and most occur in July.

The average seasonal snowfall is 106.3 inches at Beechwood, 70.8 inches at Crystal Falls, and 76.9 inches at Stambaugh. The greatest snow depth at any one time during the period of record was 39 inches at Beechwood, 47 inches at Crystal Falls, and 53 inches at Stambaugh. On the average, 150 days of the year at Beechwood, 143 days of the year at Crystal Falls, and 132 days of the year at Stambaugh 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 18.2 inches at Beechwood, 18.0 inches at Crystal Falls, and 16.2 inches at Stambaugh. The greatest monthly snowfall was 63.2 inches in December 1968 at Beechwood, 53.4 inches in March 1939 at Crystal Falls, and 39 inches in March 1917 at Stambaugh. The greatest seasonal snowfall was 139.6 inches in 1968-69 at Beechwood, 143.2 inches in 1942-43 at Crystal Falls, and 113.7 inches in 1959-60 at Stambaugh. The smallest seasonal snowfall was 62.9 inches in 1986-87 at Beechwood, 31.6 inches in 1963-64 at Crystal Falls, and 28.5 inches in 1902-03 at Stambaugh.

Based on data recorded at the National Weather Service Office at Green Bay Airport, the average relative humidity at 1 p.m. is about 63 percent. Humidity is higher at night, and the average at 7 a.m. is about 82 percent. The sun shines 65 percent of the time possible in summer and 47 percent in winter. The prevailing wind is from the southwest. Average windspeed is highest, 11.4 miles per hour, in April.

Physiography

Iron County is part of a high plateau region. Elevation ranges from about 1,285 to 1,875 feet above sea level. The physiography of the county is the result of continental glaciation, modified in some areas by bedrock. Glacial landforms include rolling ground moraines, end moraines, steep ice-contact features, and outwash plains.

The major bedrock types in the county are Middle Precambrian. They are dominantly the Michigamme slate and associated formations including graywacke, greenstone, and quartzite deposits. Extensive iron formations are near the area around Iron River and Crystal Falls. Lower Precambrian rocks, chiefly Algoman and Laurentian granite and granite gneiss, occur in the eastern part of Iron County.

Outcrops of bedrock are throughout the county, but most areas are covered with glacial drift as much as 200 feet thick. The surficial glacial deposits in Iron County are all of late Wisconsinan Age. They were deposited primarily by the Langlade, Ontonagon, Keweenaw Bay, Green Bay, and Michigamme lobes of the Woodfordian and Valdres advances (Peterson, 1985). Subsequent ablation of the glacier, glacial meltwater, and postglacial activity greatly modified these deposits.

The lineated topography characterized by drumlins and intervening grooves in southwestern Iron County is a ground moraine deposited by the Langlade lobe. The

drumlins are oriented northeast-southwest and are typically 0.5 to 1.0 mile long, 0.3 to 0.5 mile wide, and 50 to 150 feet high. The grooves at the lower altitudes tend to contain deposits of outwash and ice-contact stratified sand and gravelly sand. Swamps and lakes are in linear depressions adjacent to the drumlins.

The Winegar moraine is a major end moraine system in northwestern and north-central Iron County. It was deposited by the Keweenaw Bay lobe to the east and by the Ontonagon lobe to the west. The moraine consists of a hummocky topography of drumlins and bedrock knolls with many swampy enclosed depressions and a few lakes.

Two end moraines deposited by the Green Bay lobe occur in southeastern Iron County. The moraine south of Crystal Falls consists of bedrock hills with a thin veneer of drift. The Sagola moraine forms a narrow hummocky ridge along the Dickinson County line.

The ground moraine in northeastern Iron County was deposited by the Langlade, Keweenaw Bay, and Michigamme lobes. The topography consists of low ridges of thin drift over bedrock surrounded by poorly drained, flat topography.

Kettle-kame topography is common throughout the region, especially in eastern Iron County. The topography is characterized by steep ridges, kettle lakes, kame terraces, eskers, crevasse fillings, pitted outwash, and poorly drained depressions. The areas consist primarily of ice-contact stratified drift deposited as the glacial ice melted.

A large outwash plain is in eastern Iron County. The topography in this area consists of steep, pitted outwash and broad, flat sand plains. The pitted outwash is characterized by bogs and swamps as well as sand ridges. The Panola plain south of Crystal Falls is an example of a flat outwash plain.

The glacial deposits in Iron County have been modified by postglacial activity. The forces of water and wind erosion were most dramatic during the period after the glaciers were gone and before revegetation of the landscape. Alluvial and lacustrine deposits occur in areas that were flooded by the water of streams and lakes. Eolian deposits include sand dunes and the silty cap that covers most of the glacial deposits in the region. Organic deposits occur in bogs and swamps throughout the county.

Streams and Lakes

Iron County has more than 900 miles of streams and rivers and more than 1,000 lakes and ponds. The major rivers are the Paint, Net, Hemlock, Fence, Deer, Michigamme, Iron, Brule, and Menominee Rivers.

The Net, Hemlock, and Paint Rivers and their many

tributaries drain the central and western parts of Iron County. The Fence, Deer, and Michigamme Rivers drain the eastern part. The Iron and Brule Rivers drain the southwestern part. The Brule River, for nearly its entire length, forms the boundary between Michigan and Wisconsin. The Paint, Michigamme, and Brule Rivers converge in southeastern Iron County to form the Menominee River, which divides Michigan and Wisconsin and eventually flows into Green Bay. A few rivers in northwestern Iron County, including the Perch River and the East Branch of the Ontonagon River, flow northward to Lake Superior.

There are several hydroelectric dams on the Michigamme and Paint Rivers. The Michigamme Reservoir and Peavy Pond are two large impoundments on the Michigamme River.

Iron County has many natural lakes and ponds. The largest of these are Perch Lake in the northern part of the county and Smoky, Hagerman, Sunset, and Chicagon Lakes in the southern part.

History and Development

In 1846, a survey crew led by William Burt noted abnormal compass readings on the Paint River near the site that is now Crystal Falls. In 1851, a U.S. land surveyor noted an outcrop of iron ore 5 feet high near the site that is now Stambaugh. These findings became known as the western deposits of the Menominee Iron Range. By 1875, prospectors and developers were making numerous excursions into the wilderness of the western Menominee Range. By the time the Chicago and Northwestern Railway reached the eastern Menominee Range in 1882, active mines had mined more than 74,000 tons of iron ore (Reiman, 1951).

The influx of miners along the western Menominee Range sparked a movement to establish a new county from the area that made up the western townships of Marquette County. Despite the objections of the Marquette County Board of Supervisors, Iron County was established in September 1885. Crystal Falls was chosen as the county seat.

As iron mining continued to grow steadily, the lumber industry grew to become the county's second most important industry. During the winter of 1895-96, loggers in Amasa cut and floated more than 87 million board feet of pine to the sawmills at the mouth of the Menominee River. After the turn of the century, hardwoods dominated the lumber industry.

Mining in Iron County peaked in 1920, but its decline was gradual. In 1939, the county's 11 mines employed 1,000 people. In 1954, 15 iron mines, employing approximately 2,000 workers, shipped more than \$22 million in iron ore. In 1956, the county's 3 remaining

mines, the Bristol at Crystal Falls and the Homer-Wauseca and Sherwood at Iron River, produced a combined total of 2.4 million tons of iron ore and employed 700 people. The Sherwood, Iron County's last active mine, closed in 1978 (Reiman, 1951).

Farming

Agriculture plays a minor role in the economy of Iron County. Iron County ranked sixth in the state in total land area and fourth in individual farm size in 1989, but it ranked 72nd in agricultural production. Factors that limit the acreage used for crop production are the short growing season, the limited local markets, and the stony soil conditions in many of the upland areas.

Typically, farms in Iron County are about 40 percent woodland. They average about 300 acres in size. In 1989, the county had about 29,000 acres of farmland. Of this total, about 13,000 acres was cropland (Michigan Department of Agriculture, 1990). Oats were grown on about 1,200 acres, potatoes on 600 acres, wheat on 100 acres, and barley on 100 acres. The main soils in the county that are used for crops are Oconto, Stambaugh, Sundog, Padus, Saronia, and Wabeno soils. Dairy cattle, beef cattle, and potatoes are the main agricultural products in Iron County. In 1989, Iron County had about 2,200 cattle and calves, including 300 milk cows and 1,000 beef cattle (Michigan Department of Agriculture, 1990).

Iron County's most notable agricultural undertaking was the Triangle Ranch, which began operation in 1920 northwest of Amasa. The Triangle Ranch raised beef cattle in cutover areas of Sundog soils. The owners also operated a beaver farm, produced maple syrup, raised chickens and dairy cows, and opened a dude ranch. Today much of the ranch is used for pine and spruce plantations, and the remaining areas of open land are used as hayland (Michigan History Magazine, 1984).

Transportation Facilities and Employment

The main roads in the county are U.S. Highways 2 and 141 and State Highways 69, 73, and 189. Two small airports serve the county. The town of Amasa is served by a railroad that passes through northeastern Iron County.

The major sources of employment in Iron County are small manufacturing facilities; sawmills; local, State, and Federal government; two hospitals and a medical care facility; tourism; pulpwood and timber cutting and hauling; and farming.

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, landforms, relief, climate, and 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.

Some of the boundaries on the detailed soil maps of Iron 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, variations in the intensity of mapping, and variations in the extent of the soils in each survey area.

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 two or three 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.

The section "Survey Procedures" explains specific procedures used to make this survey.

Survey Procedures

The general procedures followed in making this survey are described in the National Soil Survey Handbook (USDA, 1983) of the Natural Resources Conservation Service. The U.S. Forest Service ecological classification system (Brenner and Jordan, 1991; Driscoll and others, 1984; Jordan, 1977 and 1982; Nelson and Jordan, 1987; Russell and Jordan, 1991) was used in conjunction with the handbook to prepare the soil survey on all private and public lands within the administrative boundary of the Ottawa National Forest. The map units on the Forest Service lands were designed differently from those in other parts of the survey area.

The ecological classification system is an integrated system that includes evaluation and classification of landscape areas. Ecological units are mapped on aerial photographs, and interpretations are made from inventory maps for use in managing forest land and resources. In this survey, map symbols 500B to 556 identify map units within the Ottawa National Forest.

Procedures for Map Units 50 to 168F

The soil survey maps made for conservation planning prior to the start of the project and the survey of Iron County published in 1937 (USDA, 1937) were among the references used in making this survey. Before the fieldwork began, preliminary boundaries of slopes and landforms were plotted stereoscopically on 1:20,000 leaf-off aerial photographs. U.S. Geologic Survey topographic maps, at a scale of 1:24,000, were used to relate land and image features.

A reconnaissance was made by pickup truck before the soil scientists traversed the surface on foot. In areas where the soil pattern is very complex, traverses were spaced as closely as 200 yards. In areas where the soil pattern is relatively simple, traverses were about one-fourth mile apart.

As they traversed the surface, the soil scientists divided the landscape into segments. For example, a hillside was separated from a swale and a gently sloping ridgetop from a very steep side slope.

Observations of such items as landforms, blown-down trees, vegetation, and roadbanks were made without regard to spacing. Soil boundaries were determined on the basis of soil examinations, observations, and photo interpretation. The soil material was examined with the aid of a hand auger or a spade to a depth of about 5 feet. The pedons described as typical were observed and studied in pits that were dug with shovels, mattocks, and digging bars.

Notes were taken on the composition of map units during each year of the project. These notes were supplemented by additional notes as mapping progressed and as the composition of individual map units was determined.

Samples for chemical and physical analyses were taken from representative sites of some soils in the survey area. The analyses were made by the Soil Research Laboratory, Michigan Technological University, Houghton, Michigan, and the Soil Survey Laboratory, Lincoln, Nebraska. The results of the studies can be obtained on request from the State office of the Natural Resources Conservation Service in East Lansing, Michigan.

After the completion of soil mapping on aerial photographs, map unit delineations were transferred by hand to another set of the same photographs. Cultural

features were recorded from observations of the maps and the landscape.

Procedures for Map Units 500B to 556

Before ecological units were mapped, information about the climate, geology, soils, hydrology, and vegetation in the survey area was collected. Research techniques were used in mid and late successional stands to collect information on vegetative and soil components in areas on uplands. Soils were tentatively classified to an appropriate taxonomic level (USDA, 1975). The results were used in developing ecological map units that are defined on the basis of both abiotic and biotic landscape characteristics.

The initial map unit legend was field tested for 2 years, and all minor units were identified and described. The range in characteristics for ecological types was analyzed and documented. All studies, map unit development, and map unit legend were by land type associations.

Following field testing, field sheets were thoroughly examined by scanning stereoscope to delineate possible map units, select traverse locations, study historical disturbance features, learn past management activities, identify local glacial landforms, and establish vegetation history. Also, information from past onsite investigations and local research was incorporated and several scales, types, and times of other aerial photography were reviewed.

Mapping personnel traversed the landscape, evaluated all site factors, and determined and plotted ecological unit boundaries in the field. Some important characteristics used by the field personnel included glacial landforms, water table levels and other moisture regime characteristics, soil texture and color, interpretation of groups of vegetative species, and disturbance factors.

Typically, mappers inventoried 300 to 400 acres per day. They performed detailed evaluations and documented each observation on field sheet overlays; completed numerous field note cards; established and completed full soil descriptions; and analyzed landforms, vegetation plots, and hydrologic features on numerous transects. Descriptions of soil pedons and vegetation plots were developed from subsequent laboratory analysis of soil samples. The samples were taken from locations that were strategically selected for the examination of landscape features and the collection of data on overstory, understory, ground flora, forest floor, soil, substratum, and ground water for documenting ecological units. Numerous monitoring stations recording air temperature, soil temperature, water table levels, precipitation, and soil moisture were installed for a period of 5 years to further document

these ecological units. Specific procedures used by the Ottawa National Forest to execute the U.S. Forest Service Ecological Classification System may be further reviewed in Ottawa National Forest Supplements 1 through 5.

Soil profiles were described to a depth of 6 feet in all loamy till and clayey lacustrine deposits and to a depth of 10 to 15 feet in all sandy till, sandy outwash, and

sandy lacustrine deposits. Soil properties and geological properties can affect ecological behavior at these depths (Hannah and Zahner, 1970).

Following field inventory, the final boundaries of the ecological units were drawn on the aerial photographs. The completed photography was checked for line closure and for matching of delineations across photographs.

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.

Soil Descriptions

Nearly Level, Very Poorly Drained, Mucky or Peaty Soils

These soils are used mainly as woodland. An equipment limitation and windthrow are the main management concerns.

1. Lupton-Cathro Association

Nearly level, very poorly drained, mucky soils on ground moraines, outwash plains, end moraines, and stream terraces

Areas of these soils are in depressions on ground moraines, outwash plains, end moraines, and stream terraces. Slopes range from 0 to 2 percent.

This association makes up about 0.8 percent of the county. It is about 40 percent Lupton and similar soils, 35 percent Cathro and similar soils, and 25 percent soils of minor extent.

Typically, the surface layer of the Lupton soils is black muck about 10 inches thick. The material below this to a depth of about 60 inches also is black muck.

Typically, the surface layer of the Cathro soils is

black muck about 7 inches thick. Below this is black muck about 19 inches thick. The substratum to a depth of about 60 inches is dark gray and brown very fine sandy loam and fine sandy loam.

Of minor extent in this association are moderately well drained to somewhat excessively drained, nearly level to steep, mineral soils on knolls and ridges. The poorly drained Waucedah soils are adjacent to streams and are subject to frequent flooding.

This association is used mainly as woodland. The major management concerns are an equipment limitation and windthrow.

2. Greenwood-Merwin Association

Nearly level, very poorly drained, peaty soils on ground moraines, outwash plains, and end moraines

Areas of these soils are in depressions on ground moraines, outwash plains, and end moraines. Slopes are 0 to 1 percent.

This association makes up about 1.4 percent of the county. It is about 40 percent Greenwood and similar soils, 35 percent Merwin and similar soils, and 25 percent soils of minor extent.

Typically, the surface layer of the Greenwood soils is reddish brown peat about 5 inches thick. Below this to a depth of about 60 inches are layers of dark reddish brown and dark brown peat and dark reddish brown mucky peat and muck.

Typically, the surface layer of the Merwin soils is yellowish brown peat about 8 inches thick. Below this is dark reddish brown mucky peat about 24 inches thick. The substratum to a depth of about 60 inches is black silt loam and very dark grayish brown and brown sandy loam.

Of minor extent in this association are moderately well drained to somewhat excessively drained, nearly level to steep, mineral soils on knolls and ridges. The poorly drained Waucedah soils are adjacent to streams and are subject to frequent flooding.

This association is used mainly as woodland. The major management concerns are an equipment limitation and windthrow.

Nearly Level to Rolling, Excessively Drained, Sandy Soils

These soils are used mainly as woodland. Seedling mortality and an equipment limitation are the major management concerns.

3. Vilas Association

Nearly level to rolling, excessively drained, sandy soils on outwash plains

Areas of these soils are on outwash plains. Slopes range from 1 to 18 percent.

This association makes up about 1 percent of the county. It is about 70 percent Vilas and similar soils and 30 percent soils of minor extent.

Typically, the surface layer of the Vilas soils is dark reddish brown loamy sand about 4 inches thick. The subsurface layer is dark reddish gray loamy sand about 1 inch thick. The subsoil is about 19 inches thick. The upper part is dark reddish brown and dark brown, very friable loamy sand. The lower part is dark brown, loose sand. The substratum to a depth of about 60 inches is brown and light brown sand.

Of minor extent in this association are the somewhat excessively drained Karlin soils, the well drained Pence soils, and the very poorly drained Lupton and Greenwood soils. Karlin and Pence soils are less droughty than the Vilas soils. They are in landscape positions similar to those of the Vilas soils. Lupton and Greenwood soils are in depressions on uplands and on lowlands.

This association is used mainly as woodland. The major management concerns are seedling mortality and an equipment limitation.

Nearly Level to Hilly, Excessively Drained to Well Drained, Loamy and Sandy Soils

These soils are used mainly as woodland. Seedling mortality and an equipment limitation are the major management concerns. Some of the soils are used as cropland. If cultivated crops are grown, water erosion and droughtiness are management concerns.

4. Karlin-Sarona-Vilas Association

Nearly level to hilly, excessively drained to well drained, loamy and sandy soils on ground moraines, end moraines, and outwash plains

Areas of these soils are on ground moraines, end moraines, and outwash plains. Slopes range from 1 to 35 percent.

This association makes up about 12.3 percent of the county. It is about 30 percent Karlin and similar soils, 20 percent Sarona and similar soils, 15 percent Vilas and similar soils, and 35 percent soils of minor extent (fig. 2).

The Karlin soils are somewhat excessively drained. Typically, the surface layer is black fine sandy loam about 2 inches thick. The subsurface layer is reddish gray fine sandy loam about 1 inch thick. The subsoil is about 32 inches thick. The upper part is brown, friable fine sandy loam. The lower part is brown and yellowish red, friable and very friable sandy loam and loamy sand. The substratum to a depth of about 60 inches is brown sand.

The Sarona soils are well drained. Typically, the surface layer is very dark gray fine sandy loam about 2 inches thick. The subsurface layer is brown fine sandy loam about 5 inches thick. The subsoil is about 30 inches thick. The upper part is dark brown and brown, friable fine sandy loam and loamy fine sand. The lower part is dark brown, friable loam. The substratum to a depth of about 60 inches is reddish brown gravelly sandy loam.

The Vilas soils are excessively drained. Typically, the surface layer is dark reddish brown loamy sand about 4 inches thick. The subsurface layer is dark reddish gray loamy sand about 1 inch thick. The subsoil is about 19 inches thick. The upper part is dark reddish brown and dark brown, very friable loamy sand. The lower part is dark brown, loose sand. The substratum to a depth of about 60 inches is brown and light brown sand.

Of minor extent in this association are the well drained Pence soils, the moderately well drained Wabeno soils, the somewhat poorly drained Au Gres and Channing soils, and the very poorly drained Lupton and Greenwood soils. Pence soils have a substratum of sand and gravelly sand. Wabeno soils have very firm layers in the subsoil that limit rooting depth. Pence and Wabeno soils are in landscape positions similar to those of the major soils. Au Gres and Channing soils are in drainageways and on low flats in the uplands. Lupton and Greenwood soils are in depressions on uplands and on lowlands.

This association is used mainly as woodland. The major management concerns are seedling mortality in areas of the Vilas soils and an equipment limitation in areas of all the major soils.

Some areas are used as cropland. The major management concerns are droughtiness in areas of the Karlin and Vilas soils and water erosion in areas of all the major soils.

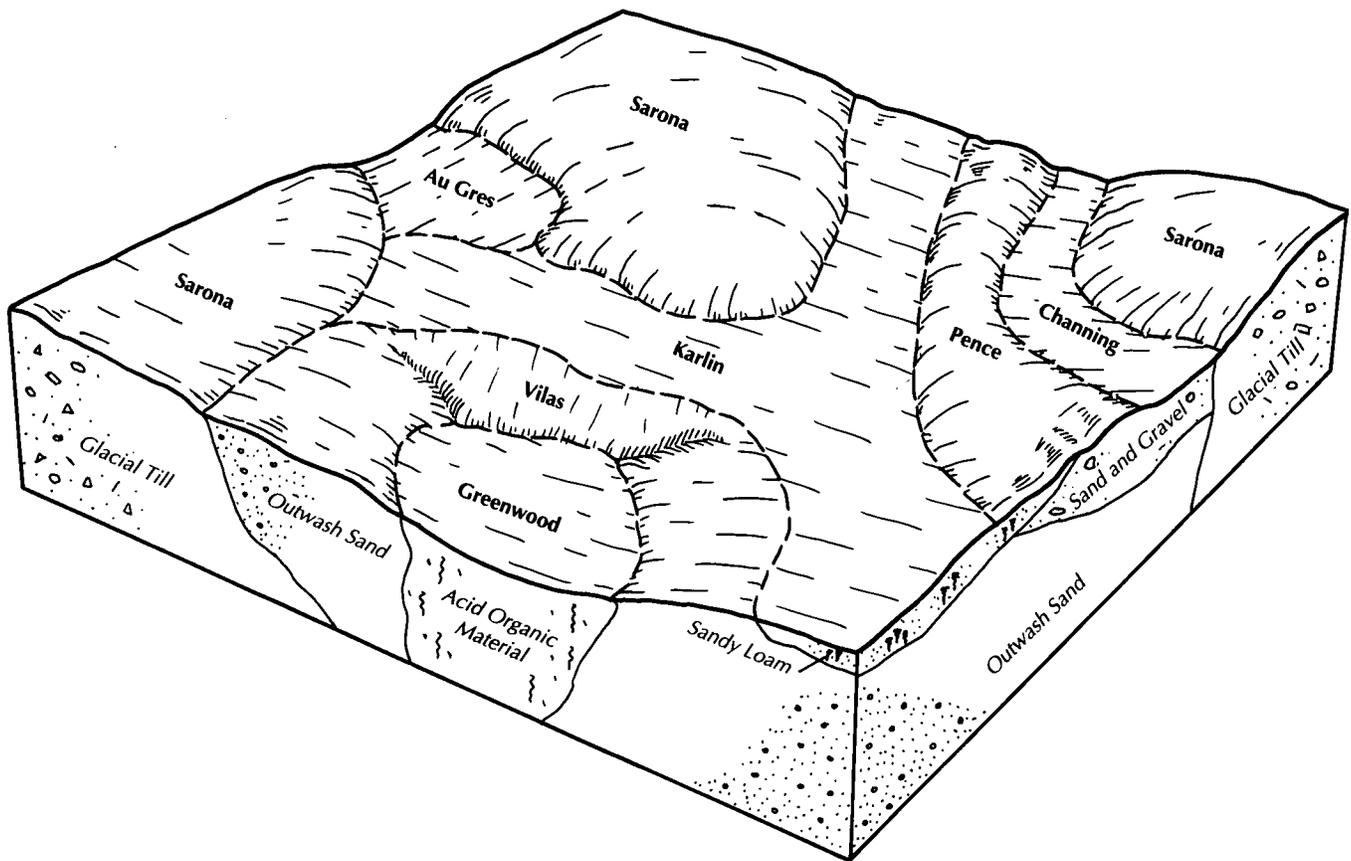


Figure 2.—Typical pattern of soils and parent material in the Karlin-Sarona-Vilas association.

5. Haplorthods Association

Nearly level to hilly, well drained, loamy and sandy soils on end moraines

Areas of these soils are on end moraines. Slopes range from 1 to 35 percent.

This association makes up about 9.1 percent of the county. It is about 65 percent Haplorthods and similar soils and 35 percent soils of minor extent.

Typically, the surface layer and subsoil of the Haplorthods are sandy, loamy, or sandy and loamy. The substratum is sand or sand and gravelly sand.

Of minor extent in this association are the somewhat excessively drained Karlin soils and Entic Haplorthods and areas of sandy soils; the well drained Pence soils and Entic Haplorthods and areas of sandy-skeletal soils; and the moderately well drained Gogebic soils. All of these minor soils are in positions on the landscape similar to those of the Haplorthods. Also of minor extent are the somewhat poorly drained Haplaquods and the poorly drained, nonacid Humaquepts in drainageways

and on low flats on uplands and the very poorly drained Borohemists-Borosaprists, acid, and Borosaprists-Histic Humaquepts, nonacid, complexes in depressions on uplands and on lowlands.

This association is used mainly as woodland. The major management concerns are an equipment limitation and erosion.

Nearly Level to Hilly, Well Drained and Very Poorly Drained, Loamy and Mucky Soils

These soils are used mainly as woodland. An equipment limitation and windthrow are the major management concerns. Some areas are used as cropland. If cultivated crops are grown, water erosion is a management concern.

6. Sagola-Trenary-Cathro Association

Nearly level to hilly, well drained and very poorly drained, loamy and mucky soils on ground moraines and end moraines

Areas of these soils are in depressions and on

ground moraines and end moraines. Slopes range from 0 to 35 percent.

This association makes up about 1 percent of the county. It is about 40 percent Sagola and similar soils, 15 percent Trenary and similar soils, 10 percent Cathro and similar soils, and 35 percent soils of minor extent.

The Sagola soils are in nearly level to hilly areas and are well drained. Typically, the surface layer is black fine sandy loam about 1 inch thick. The subsurface layer is reddish gray fine sandy loam about 6 inches thick. The subsoil is about 40 inches thick. The upper part is reddish brown, friable fine sandy loam. The next part is brown and dark brown, friable fine sandy loam. The lower part is dark reddish brown and reddish brown, firm fine sandy loam and loamy fine sand. The substratum to a depth of about 60 inches is reddish brown loamy fine sand.

The Trenary soils are in nearly level to rolling areas and are well drained. Typically, the surface layer is black fine sandy loam about 4 inches thick. The subsurface layer is brown fine sandy loam about 1 inch thick. The subsoil is about 31 inches thick. The upper part is dark brown, friable fine sandy loam. The next part is dark reddish brown and reddish brown, firm sandy loam and loamy sand. The lower part is dark reddish brown and reddish brown, friable loam and loamy sand. The substratum to a depth of about 60 inches is reddish brown sandy loam.

The Cathro soils are nearly level and are in depressions. They are very poorly drained. Typically, the surface layer is black muck about 7 inches thick. Below this is black muck about 19 inches thick. The substratum to a depth of about 60 inches is dark gray and brown very fine sandy loam and fine sandy loam.

Of minor extent in this association are the somewhat excessively drained Karlin soils, the well drained Pence and Keweenaw soils, the somewhat poorly drained Solona soils, and the poorly drained Ensley and Waucedah soils. Karlin, Pence, and Keweenaw soils are coarser textured and more droughty than the major soils. They are in landscape positions similar to those of the Sagola and Trenary soils. Solona and Ensley soils are in drainageways and depressions on uplands. They commonly are adjacent to and slightly higher than the Cathro soils. Waucedah soils are adjacent to streams and are subject to frequent flooding.

This association is used mainly as woodland. The major management concerns are an equipment limitation in areas of all the major soils and windthrow in areas of the Cathro soils.

Some areas of the Sagola and Trenary soils are used as cropland. The major management concern is water erosion.

Nearly Level to Very Steep, Somewhat Excessively Drained to Poorly Drained, Loamy Soils

These soils are used mainly as woodland. An equipment limitation, seedling mortality, and windthrow are the major management concerns. Some of the soils are used as cropland. If cultivated crops are grown, water erosion and seasonal wetness are management concerns.

7. Trenary-Solona-Karlin Association

Nearly level to rolling, somewhat excessively drained, well drained, and somewhat poorly drained, loamy soils on ground moraines and end moraines

Areas of these soils are on ground moraines and end moraines. Slopes range from 0 to 18 percent.

This association makes up about 1 percent of the county. It is about 40 percent Trenary and similar soils, 15 percent Solona and similar soils, 10 percent Karlin and similar soils, and 35 percent soils of minor extent.

The Trenary soils are in nearly level to rolling areas and are well drained. Typically, the surface layer is black fine sandy loam about 4 inches thick. The subsurface layer is brown fine sandy loam about 1 inch thick. The subsoil is about 31 inches thick. The upper part is dark brown, friable fine sandy loam. The next part is dark reddish brown and reddish brown, firm sandy loam and loamy sand. The lower part is dark reddish brown and reddish brown, friable loam and loamy sand. The substratum to a depth of about 60 inches is reddish brown sandy loam.

The nearly level Solona soils are in drainageways. They are somewhat poorly drained. Typically, the surface layer is black very fine sandy loam about 6 inches thick. The subsurface layer is brown, mottled very fine sandy loam about 6 inches thick. The subsoil is about 24 inches thick. The upper part is brown, mottled, friable very fine sandy loam. The lower part is yellowish red and brown, friable loam and loamy sand. The substratum to a depth of about 60 inches is yellowish red sandy loam.

The Karlin soils are nearly level to rolling and are on broad plains, knolls, and back slopes. They are somewhat excessively drained. Typically, the surface layer is black fine sandy loam about 2 inches thick. The subsurface layer is reddish gray fine sandy loam about 1 inch thick. The subsoil is about 32 inches thick. The upper part is brown, friable fine sandy loam. The lower part is brown and yellowish red, friable and very friable sandy loam and loamy sand. The substratum to a depth of about 60 inches is brown sand.

Of minor extent in this association are the well drained Oconto soils, the well drained or moderately well drained Wabeno soils, the somewhat poorly

drained Au Gres soils, the poorly drained Ensley and Witbeck soils, and the very poorly drained Lupton soils. Oconto soils have a substratum of very gravelly coarse sand. Wabeno soils have very firm layers in the subsoil that limit rooting depth. Oconto and Wabeno soils are in landscape positions similar to those of the Trenary and Karlin soils. Au Gres soils are coarser textured and more droughty than the major soils. Au Gres, Ensley, and Witbeck soils are in landscape positions similar to those of the Solona soils. Lupton soils are in depressions on uplands and on lowlands.

This association is used mainly as woodland. The major management concerns are an equipment limitation in areas of all the major soils and seedling mortality in areas of the Solona soils.

Some areas are used as cropland. The major management concerns are water erosion on the Trenary and Karlin soils and seasonal wetness on the Solona soils.

8. Champion-Net Association

Nearly level to hilly; well drained to somewhat poorly drained, loamy soils on ground moraines and end moraines

Areas of these soils are in drainageways and on ground moraines and end moraines. Slopes range from 0 to 35 percent.

This association makes up about 7 percent of the county. It is about 50 percent Champion and similar soils, 15 percent Net and similar soils, and 35 percent soils of minor extent.

The Champion soils are in nearly level to hilly areas and are moderately well drained and well drained. Typically, the surface layer is black, partially decomposed organic material about 1 inch thick. The subsurface layer is gray very fine sandy loam about 3 inches thick. The subsoil is about 45 inches thick. The upper part is dark reddish brown and dark brown, very friable and friable very fine sandy loam. The next part is dark brown and brown, friable very fine sandy loam. The lower part is dark grayish brown and dark brown, mottled, extremely firm gravelly fine sandy loam. The substratum to a depth of about 60 inches is grayish brown gravelly fine sandy loam.

The Net soils are nearly level and are in drainageways. They are somewhat poorly drained. Typically, the surface layer is dark brown very fine sandy loam about 3 inches thick. The subsurface layer is brown very fine sandy loam about 3 inches thick. The subsoil is about 43 inches thick. The upper part is dark brown, mottled, friable very fine sandy loam and fine sandy loam. The lower part is brown and dark brown, mottled, very firm gravelly loamy sand and gravelly

sandy loam. The substratum to a depth of about 60 inches is dark brown gravelly sandy loam.

Of minor extent in this association are the somewhat excessively drained or moderately well drained Karlin soils, the well drained or moderately well drained Sundog soils, the moderately well drained Croswell soils, the poorly drained Witbeck soils, and the very poorly drained Lupton and Greenwood soils. Karlin, Sundog, and Croswell soils are coarser textured and more droughty than the major soils. They are in landscape positions similar to those of the Champion soils. Witbeck soils are in landscape positions similar to those of the Net soils. Lupton and Greenwood soils are in depressions on uplands and on lowlands.

This association is used mainly as woodland. The major management concerns are an equipment limitation and windthrow in areas of the Champion and Net soils and seedling mortality in areas of the Net soils.

9. Sundog-Minocqua-Channing Association

Nearly level to very steep, well drained to poorly drained, loamy soils on stream terraces, outwash plains, eskers, and crevasse fillings

Areas of these soils are on stream terraces, outwash plains, and eskers and in depressions and drainageways. Slopes range from 0 to 50 percent.

This association makes up about 8.2 percent of the county. It is about 40 percent Sundog and similar soils, 15 percent Minocqua and similar soils, 10 percent Channing and similar soils, and 35 percent soils of minor extent (fig. 3).

The Sundog soils are in nearly level to steep areas and are well drained and moderately well drained. Typically, the surface layer is dark brown very fine sandy loam about 4 inches thick. The subsurface layer is gray very fine sandy loam about 2 inches thick. The subsoil is about 16 inches thick. The upper part is dark reddish brown and dark brown, friable very fine sandy loam. The lower part is brown, friable gravelly very fine sandy loam. The substratum to a depth of about 60 inches is brown sand and very gravelly coarse sand.

The Minocqua soils are nearly level and are in depressions. They are poorly drained. Slopes range from 0 to 2 percent. Typically, the surface layer is black muck about 4 inches thick. The subsurface layer is very dark gray silt loam about 2 inches thick. The subsoil is about 23 inches thick. The upper part is gray, mottled, friable loam. The lower part is grayish brown, loose loamy coarse sand. The substratum to a depth of about 60 inches is dark grayish brown, stratified coarse sand and gravelly coarse sand.

The Channing soils are nearly level and are in

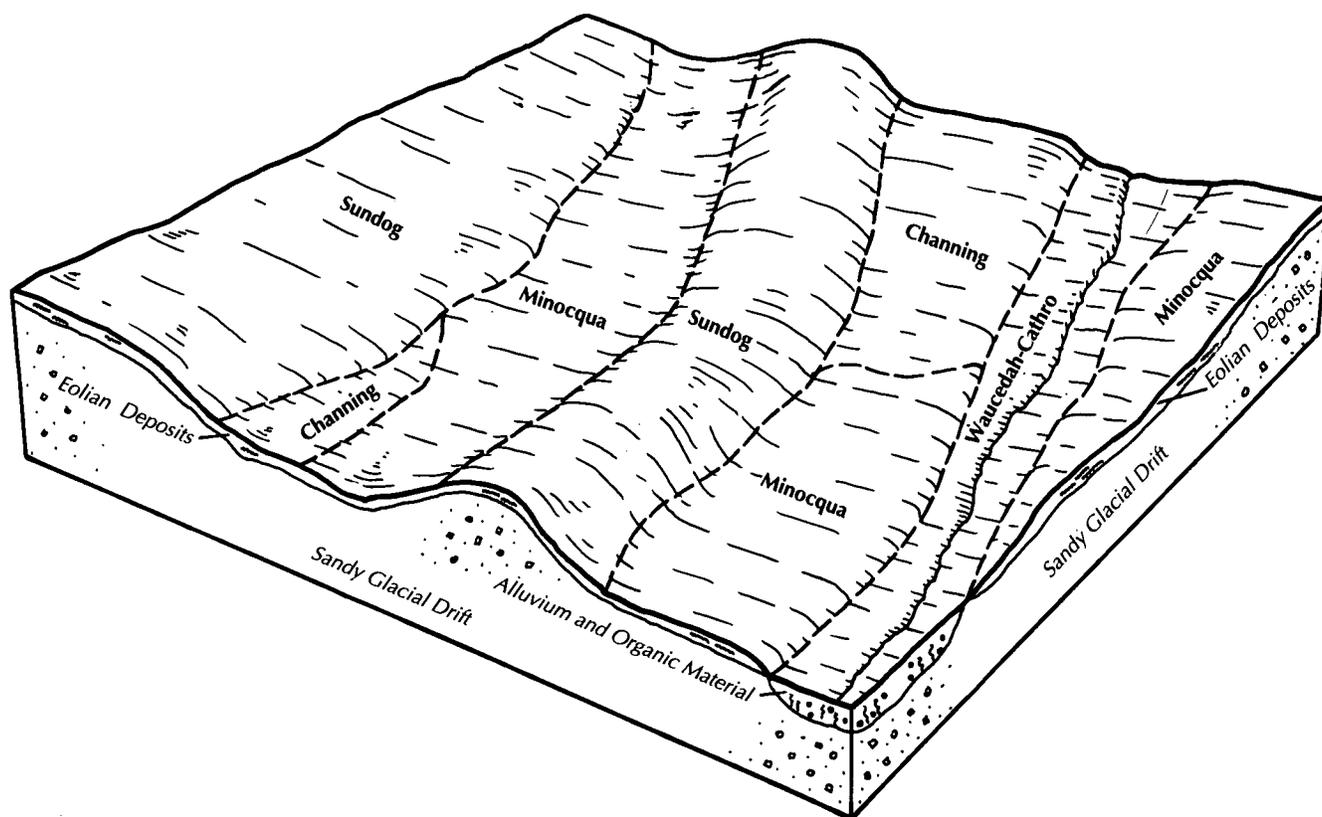


Figure 3.—Typical pattern of soils and parent material in the Sundog-Minocqua-Channing association.

drainageways. They are somewhat poorly drained. Typically, the surface layer is very dark grayish brown very fine sandy loam about 2 inches thick. The subsurface layer is grayish brown, mottled very fine sandy loam about 2 inches thick. The subsoil is dark yellowish brown, mottled, friable very fine sandy loam about 19 inches thick. The substratum extends to a depth of about 60 inches. It is strong brown and brown sand and loamy sand in the upper part and brown, stratified coarse sand and very gravelly sand in the lower part.

Of minor extent in this association are the excessively drained Vilas soils, the somewhat excessively drained or moderately well drained Karlin soils, the moderately well drained Croswell soils, the poorly drained Waucedah soils, and the very poorly drained Cathro and Merwin soils. Vilas, Karlin, and Croswell soils are coarser textured and more droughty than the Sundog soils. They are in landscape positions similar to those of the Sundog soils. Waucedah soils are adjacent to streams and are subject to frequent flooding. Cathro and Merwin soils have organic layers that are more than 16 inches thick. They are in

landscape positions similar to those of the Minocqua soils.

This association is used mainly as woodland. The major management concerns are an equipment limitation in areas of all the major soils and windthrow and seedling mortality in areas of the Minocqua and Channing soils.

Some areas of the Sundog soils are used as cropland. The major management concern is water erosion.

Nearly Level to Very Steep, Well Drained and Moderately Well Drained, Loamy Soils on Ground Moraines, End Moraines, and Drumlins

These soils are used mainly as woodland. An equipment limitation and windthrow are the major management concerns. Some of the soils are used as cropland. If cultivated crops are grown, water erosion is a concern.

10. Wabeno Association

Nearly level to rolling, moderately well drained, loamy

soils on ground moraines, end moraines, and drumlins

Areas of these soils are on ground moraines and drumlins. Slopes range from 1 to 18 percent.

This association makes up about 23.5 percent of the county. It is about 65 percent Wabeno and similar soils and 35 percent soils of minor extent (fig. 4).

The Wabeno soils are moderately well drained. Typically, the surface layer is black silt loam about 2 inches thick. The subsurface layer is brown silt loam about 2 inches thick. The subsoil is about 46 inches thick. The upper part is dark brown and brown, friable silt loam. The next part is dark brown and brown, mottled, friable and very firm silt loam and very fine sandy loam. The lower part is reddish brown, very firm sandy loam. The substratum to a depth of about 60 inches is brown sandy loam.

Of minor extent in this association are the well drained Stambaugh and Padus soils; the well drained or moderately well drained Champion and Fence soils; the somewhat poorly drained Gaastra, Monico, and Net soils; the poorly drained Witbeck soils; the very poorly drained, nonacid Borosapristis; and the very poorly drained Lupton soils. Stambaugh and Padus soils have a substratum of gravelly sand. Champion soils are coarser textured than the Wabeno soils and are less productive. Fence soils do not have very firm layers in the subsoil and thus have a greater rooting depth than the Wabeno soils. Stambaugh, Padus, Champion, and Fence soils are in landscape positions similar to those of the Wabeno soils. Gaastra, Monico, Net, and Witbeck soils are in drainageways and on low flats in the uplands. Lupton soils and the nonacid Borosapristis are in depressions on uplands and on lowlands.

This association is used mainly as woodland. The major management concerns are an equipment limitation and windthrow.

Some areas are used as cropland. The major management concerns are stoniness and water erosion.

11. Peavy Association

Nearly level to rolling, well drained and moderately well drained, loamy soils on ground moraines and end moraines

Areas of these soils are on ground moraines and end moraines. Slopes range from 1 to 18 percent.

This association makes up about 1.7 percent of the county. It is about 65 percent Peavy and similar soils and 35 percent soils of minor extent (fig. 5).

Typically, the surface layer of the Peavy soils is dark reddish brown silt loam about 6 inches thick. The subsoil is dark reddish brown, very firm channery loam

about 35 inches thick. The substratum to a depth of about 60 inches is dark reddish brown channery sandy loam.

Of minor extent in this association are the somewhat excessively drained Karlin soils, the well drained Padus and Sarena soils, the somewhat poorly drained Net soils, the poorly drained Witbeck soils, and the very poorly drained Lupton and Cathro soils. Karlin soils are coarser textured and more droughty than the major soils. Padus soils have a substratum of gravelly sand. Sarena soils have a friable subsoil. Karlin, Padus, and Sarena soils are in landscape positions similar to those of the Peavy soils. Net and Witbeck soils are in drainageways and on low flats in the uplands. Lupton and Cathro soils are in depressions on uplands and on lowlands.

This association is used mainly as woodland. The major management concerns are an equipment limitation and windthrow.

Some areas are used as cropland. The major management concern is water erosion.

12. Champion Association

Nearly level to hilly, well drained and moderately well drained, loamy soils on ground moraines and drumlins

Areas of these soils are on ground moraines and drumlins. Slopes range from 1 to 35 percent.

This association makes up about 8.4 percent of the county. It is about 65 percent Champion and similar soils and 35 percent soils of minor extent.

Typically, the surface layer of the Champion soils is black, partially decomposed organic material about 1 inch thick. The subsurface layer is gray very fine sandy loam about 3 inches thick. The subsoil is about 45 inches thick. The upper part is dark reddish brown and dark brown, very friable and friable very fine sandy loam. The next part is dark brown and brown, friable very fine sandy loam. The lower part is dark grayish brown and dark brown, mottled, extremely firm gravelly fine sandy loam. The substratum to a depth of about 60 inches is grayish brown gravelly fine sandy loam.

Of minor extent in this association are the well drained, coarse-loamy Typic Dystrachrepts that have a sandy substratum; the somewhat poorly drained, coarse-loamy Typic Fragiaquods; and the very poorly drained, nonacid and acid Borosapristis. Typic Dystrachrepts have a coarser textured substratum than the Champion soils and are less productive. They are in landscape positions similar to those of the Champion soils. Typic Fragiaquods are in drainageways and on low flats in the uplands. Borosapristis are in depressions on uplands and on lowlands.

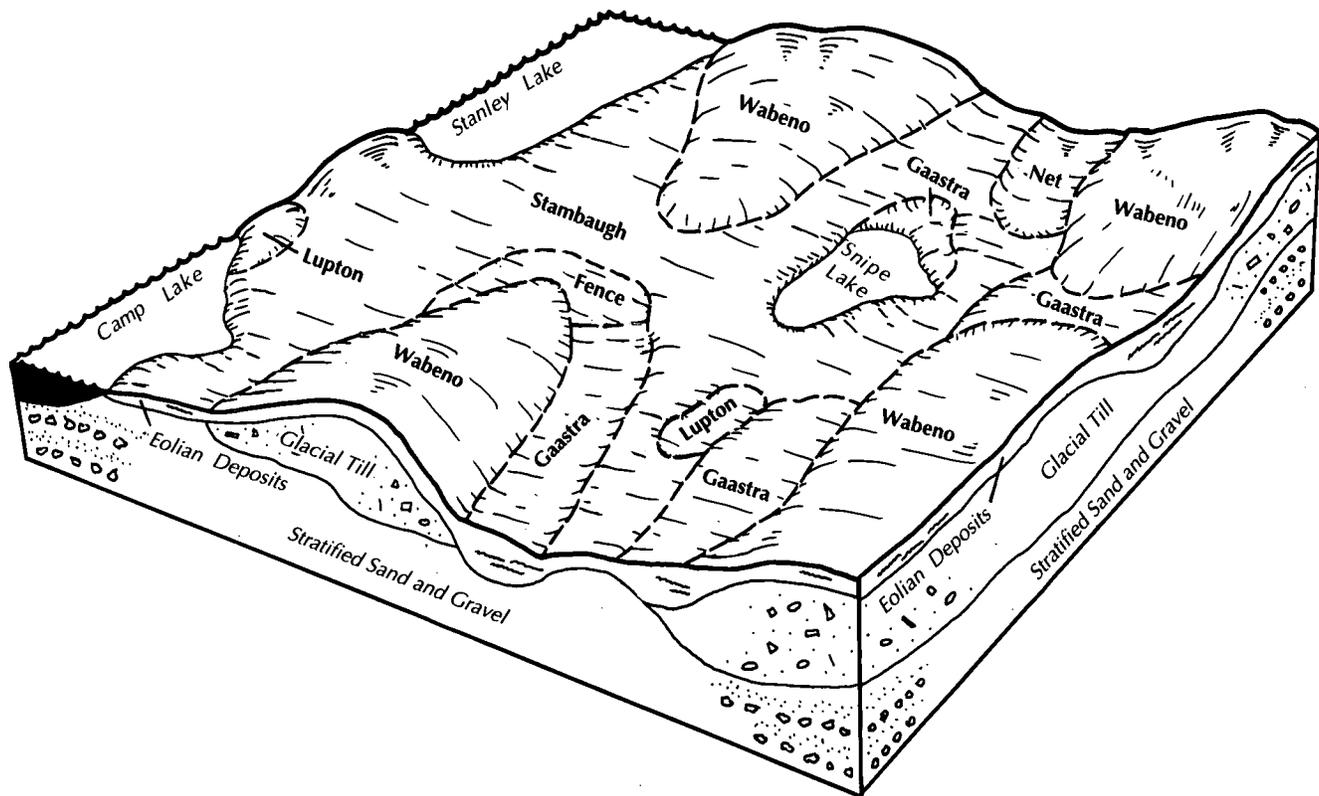


Figure 4.—Typical pattern of soils and parent material in the Wabeno association.

This association is used mainly as woodland. The major management concerns are an equipment limitation, seedling mortality, and windthrow.

Some areas are used as cropland. The major management concerns are water erosion and stoniness.

13. Sarona-Wabeno Association

Nearly level to hilly, well drained and moderately well drained, loamy soils on ground moraines and end moraines

Areas of these soils are on ground moraines and end moraines. Slopes range from 1 to 35 percent.

This association makes up about 0.6 percent of the county. It is about 35 percent Sarona and similar soils, 30 percent Wabeno and similar soils, and 35 percent soils of minor extent.

The Sarona soils are in nearly level to hilly areas and are well drained. Typically, the surface layer is very dark gray fine sandy loam about 2 inches thick. The subsurface layer is brown fine sandy loam about 5 inches thick. The subsoil is about 30 inches thick. The upper part is dark brown and brown, friable fine sandy

loam and loamy fine sand. The lower part is dark brown, friable loam. The substratum to a depth of about 60 inches is reddish brown gravelly sandy loam.

The Wabeno soils are in nearly level to rolling areas and are moderately well drained. Typically, the surface layer is black fine sandy loam about 2 inches thick. The subsurface layer is brown fine sandy loam about 2 inches thick. The subsoil is about 46 inches thick. The upper part is dark brown, friable fine sandy loam. The next part is dark brown and brown, mottled, friable and very firm silt loam and very fine sandy loam. The lower part is reddish brown, very firm sandy loam. The substratum to a depth of about 60 inches is brown sandy loam.

Of minor extent in this association are the somewhat excessively drained Karlin soils; the well drained Keweenaw, Ocqueoc, and Pence soils; the somewhat poorly drained Net soils; the poorly drained Witbeck soils; and the very poorly drained Cathro and Lupton soils. Karlin, Keweenaw, Ocqueoc, and Pence soils are coarser textured and more droughty than the major soils. They are in landscape positions similar to those of the major soils. Net and Witbeck soils are in

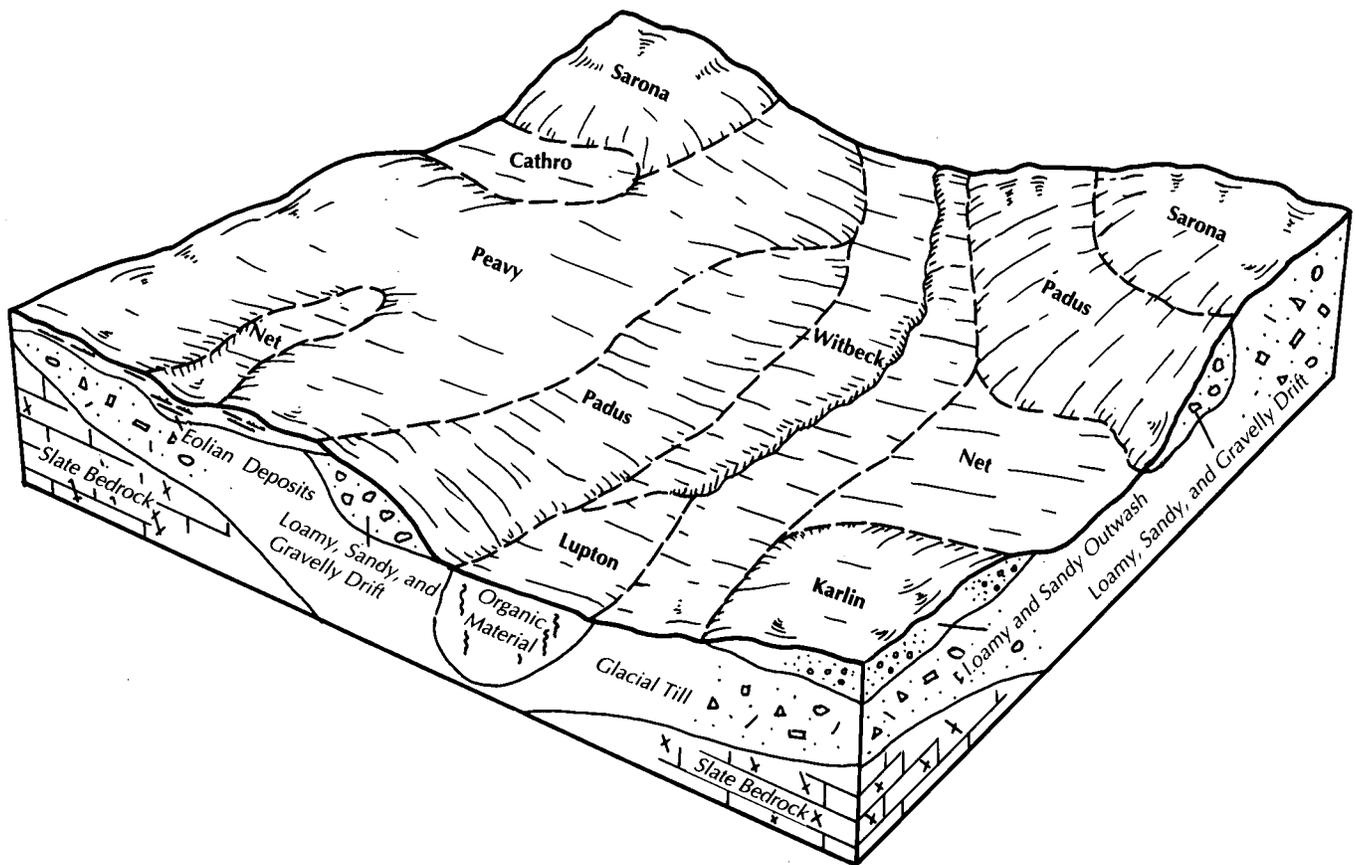


Figure 5.—Typical pattern of soils and parent material in the Peavy association.

drainageways and on low flats in the uplands. Cathro and Lupton soils are in depressions on uplands and on lowlands.

This association is used mainly as woodland. The major management concern is an equipment limitation in areas of the Sarona and Wabeno soils and windthrow in areas of the Wabeno soils.

Some areas are used as cropland. The major management concern is water erosion.

14. Petticoat-Wabeno Association

Nearly level to rolling, well drained and moderately well drained, loamy soils on ground moraines

Areas of these soils are on ground moraines. Slopes range from 1 to 18 percent.

This association makes up about 5.1 percent of the county. It is about 40 percent Petticoat and similar soils, 35 percent Wabeno and similar soils, and 25 percent soils of minor extent.

The Petticoat soils are well drained or moderately well drained. Typically, the surface layer is black silt

loam about 1 inch thick. The subsurface layer is reddish gray silt loam about 3 inches thick. The subsoil is about 34 inches thick. The upper part is dark reddish brown and dark brown, friable silt loam. The lower part is brown and dark brown, mottled, friable and firm silt loam and loam. The substratum to a depth of about 60 inches is brown gravelly loamy sand.

The Wabeno soils are moderately well drained. Typically, the surface layer is black silt loam about 2 inches thick. The subsurface layer is brown silt loam about 2 inches thick. The subsoil is about 46 inches thick. The upper part is dark brown, friable silt loam. The next part is dark brown and brown, mottled, friable and very firm silt loam and very fine sandy loam. The lower part is reddish brown, very firm sandy loam. The substratum to a depth of about 60 inches is brown sandy loam.

Of minor extent in this association are the well drained and moderately well drained Sundog soils, the well drained Pence soils, the moderately well drained Manitowish soils, the somewhat poorly drained Net soils, the poorly drained Witbeck soils, and the very

poorly drained Lupton and Greenwood soils. Sundog, Pence, and Manitowish soils are coarser textured and more droughty than the major soils. They are in landscape positions similar to those of the major soils. Net and Witbeck soils are in drainageways and on low flats in the uplands. Lupton and Greenwood soils are in depressions on uplands and on lowlands.

This association is used mainly as woodland. The major management concerns are an equipment limitation in areas of the Petticoat and Wabeno soils and windthrow in areas of the Wabeno soils.

15. Goodman-Wabeno-Sundog Association

Nearly level to very steep, well drained and moderately well drained, loamy soils on ground moraines and end moraines

Areas of these soils are on ground moraines and end moraines. Slopes range from 1 to 50 percent.

This association makes up about 1.8 percent of the county. It is about 30 percent Goodman and similar soils, 25 percent Wabeno and similar soils, 15 percent Sundog and similar soils, and 30 percent soils of minor extent.

The Goodman soils are in nearly level to steep areas and are moderately well drained or well drained. Typically, the surface layer is very dark gray silt loam about 3 inches thick. The subsurface layer is dark grayish brown silt loam about 2 inches thick. The subsoil is about 44 inches thick. The upper part is dark brown and brown, friable very fine sandy loam, and the lower part is dark reddish brown, friable fine sandy loam and brown, friable loamy sand. The substratum to a depth of about 60 inches is reddish brown fine sandy loam.

The Wabeno soils are in nearly level to rolling areas and are moderately well drained. Typically, the surface layer is black silt loam about 2 inches thick. The subsurface layer is brown silt loam about 2 inches thick. The subsoil is about 46 inches thick. The upper part is dark brown, friable silt loam. The next part is dark brown and brown, mottled, friable and very firm silt loam and very fine sandy loam. The lower part is reddish brown, very firm sandy loam. The substratum to a depth of about 60 inches is brown sandy loam.

The Sundog soils are in nearly level to steep areas and are well drained and moderately well drained. Typically, the surface layer is dark brown very fine sandy loam about 4 inches thick. The subsurface layer is gray very fine sandy loam about 2 inches thick. The subsoil is about 16 inches thick. The upper part is dark reddish brown and dark brown, friable very fine sandy loam. The lower part is brown, friable gravelly very fine sandy loam. The substratum to a depth of about 60

inches is brown sand and coarse sand.

Of minor extent in this association are the somewhat excessively drained Karlin soils, the well drained Pence soils, the somewhat poorly drained Net soils, the poorly drained Witbeck soils, and the very poorly drained Lupton and Greenwood soils. Karlin and Pence soils are coarser textured and more droughty than the major soils. They are in landscape positions similar to those of the major soils. Net and Witbeck soils are in drainageways and on low flats in the uplands. Lupton and Greenwood soils are in depressions on uplands and on lowlands.

This association is used mainly as woodland. The major management concerns are an equipment limitation in areas of all the major soils and windthrow in areas of the Wabeno soils.

Nearly Level to Hilly, Somewhat Excessively Drained to Moderately Well Drained, Loamy Soils on Outwash Plains, Stream Terraces, Deltas, and Eskers

These soils are used mainly as woodland. An equipment limitation and windthrow are the major management concerns. Some of the soils are used as cropland. If cultivated crops are grown, water erosion is a concern.

16. Entic Haplorthods, Sandy, Stratified Substratum, Association

Nearly level to rolling, somewhat excessively drained, loamy soils on outwash plains and deltas

Areas of these soils are on outwash plains and deltas. Slopes range from 1 to 18 percent.

This association makes up about 1.4 percent of the county. It is about 65 percent Entic Haplorthods and similar soils and 35 percent soils of minor extent.

Typically, the surface layer of the Entic Haplorthods is black sandy loam about 1 inch thick. The subsurface layer is reddish gray loamy sand about 2 inches thick. The subsoil is about 39 inches thick. The upper part is reddish brown, friable loamy sand. The next part is yellowish red, loose gravelly coarse sand. The lower part is light brown, loose sand. The substratum to a depth of about 60 inches is light brown sand that has strata of fine sand, loamy fine sand, and gravelly coarse sand.

Of minor extent in this association are the somewhat excessively drained Karlin soils; the well drained Pence soils and Haplorthods; and the very poorly drained, nonacid and acid Borochemists. Karlin and Pence soils and Haplorthods are finer textured than the Entic Haplorthods and are more productive. They are in landscape positions similar to those of the Entic Haplorthods. Borochemists are in depressions

on uplands and on lowlands.

This association is used mainly as woodland. The major management concern is an equipment limitation.

17. Pence-Lode Association

Nearly level to rolling, well drained, loamy soils on outwash plains and stream terraces

Areas of these soils are on outwash plains and stream terraces. Slopes range from 1 to 18 percent.

This association makes up about 6.4 percent of the county. It is about 45 percent Pence and similar soils, 20 percent Lode and similar soils, and 35 percent soils of minor extent.

Typically, the surface layer of the Pence soils is black, partially decomposed organic material. The subsurface layer is light brownish gray fine sandy loam about 3 inches thick. The subsoil is about 29 inches thick. The upper part is dark brown, friable fine sandy loam and sandy loam. The lower part is strong brown, loose gravelly sand. The substratum to a depth of about 60 inches is dark yellowish brown, stratified gravelly coarse sand and sand.

Typically, the surface layer of the Lode soils is dark brown silt loam about 7 inches thick. The subsoil is about 30 inches thick. The upper part is dark brown and reddish brown, mottled, friable loam and sandy loam. The lower part is strong brown, loose coarse sand. The substratum to a depth of about 70 inches is brown and dark yellowish brown sand.

Of minor extent in this association are the somewhat poorly drained Monico soils that have an apparent water table; the poorly drained Humaquepts that have a sandy substratum; the very poorly drained, nonacid Borosaprists; and the very poorly drained, occasionally flooded Fluvaquents. Monico soils and Humaquepts are in drainageways and on low flats in the uplands. Borosaprists are in depressions on uplands and on lowlands. Fluvaquents are adjacent to streams.

This association is used mainly as woodland. The major management concern is an equipment limitation.

Some areas are used as cropland. The major management concerns are droughtiness in areas of the Pence soils and water erosion in areas of the Pence and Lode soils.

18. Padus-Pence Association

Nearly level to hilly, well drained, loamy soils on outwash plains, stream terraces, and eskers

Areas of these soils are on outwash plains, stream terraces, and eskers. Slopes range from 1 to 35 percent.

This association makes up about 5.6 percent of the county. It is about 35 percent Padus and similar soils, 30 percent Pence and similar soils, and 35 percent soils of minor extent.

Typically, the surface layer of the Padus soils is very dark grayish brown fine sandy loam about 7 inches thick. The subsoil is about 32 inches thick. The upper part is dark brown and brown, friable fine sandy loam. The next part is reddish brown and brown, friable gravelly fine sandy loam and fine sandy loam. The lower part is dark reddish brown, friable gravelly fine sandy loam. The substratum to a depth of about 60 inches is brown gravelly coarse sand.

Typically, the surface layer of the Pence soils is black, partially decomposed organic material about 1 inch thick. The subsurface layer is light brownish gray fine sandy loam about 3 inches thick. The subsoil is about 29 inches thick. The upper part is dark brown, friable fine sandy loam and sandy loam. The lower part is strong brown, loose gravelly sand. The substratum to a depth of about 60 inches is dark yellowish brown, stratified coarse sand and sand.

Of minor extent in this association are the excessively drained Vilas soils, the moderately well drained Crowell and Karlin soils, the somewhat poorly drained Channing soils, and the very poorly drained Lupton, Cathro, and Merwin soils. Vilas soils are coarser textured and more droughty than the major soils. Vilas, Crowell, and Karlin soils are in landscape positions similar to those of the major soils. Channing soils are in drainageways and on low flats in the uplands. Lupton, Cathro, and Merwin soils are in depressions on uplands and on lowlands.

This association is used mainly as woodland. The major management concern is an equipment limitation.

Some areas are used as cropland. The major management concern is water erosion.

19. Oconto Association

Nearly level to rolling, well drained, loamy soils on outwash plains

Areas of these soils are on outwash plains. Slopes range from 1 to 18 percent.

This association makes up about 0.6 percent of the county. It is about 90 percent Oconto and similar soils and 10 percent soils of minor extent.

Typically, the surface layer of the Oconto soils is dark brown very fine sandy loam about 7 inches thick. The subsurface layer is brown very fine sandy loam about 4 inches thick. The subsoil is about 24 inches thick. The upper part is strong brown and dark brown, friable and firm very fine sandy loam. The lower part is

dark brown, friable gravelly loam. The substratum to a depth of about 60 inches is strong brown very gravelly coarse sand.

Of minor extent in this association are the somewhat excessively drained Karlin soils, the somewhat poorly drained Channing soils, the poorly drained Minocqua and Waucesah soils, and the very poorly drained Cathro and Lupton soils. Karlin soils are coarser textured and more droughty than the Oconto soils. They are in landscape positions similar to those of the Oconto soils. Channing and Minocqua soils are in drainageways and on low flats in the uplands.

Waucesah soils are adjacent to streams and are subject to frequent flooding. Cathro and Lupton soils are in depressions on uplands and on lowlands.

This association is used mainly as woodland. The major management concern is an equipment limitation.

Some areas are used as cropland. The major management concerns are water erosion and soil blowing.

20. Stambaugh-Padus Association

Nearly level to hilly, well drained and moderately well drained, loamy soils on outwash plains and stream terraces

Areas of these soils are on outwash plains and stream terraces. Slopes range from 1 to 35 percent.

This association makes up about 3.1 percent of the county. It is about 35 percent Stambaugh and similar soils, 25 percent Padus and similar soils, and 40 percent soils of minor extent.

The Stambaugh soils are in nearly level to rolling areas and are moderately well drained and well drained. Typically, the surface layer is very dark gray silt loam about 4 inches thick. The subsoil is about 35 inches thick. The upper part is dark brown, brown, and yellowish brown, friable silt loam and very fine sandy loam. The lower part is reddish brown and brown, mottled, firm silt loam. The substratum to a depth of about 60 inches is dark brown very gravelly sand and reddish brown gravelly sand.

The Padus soils are in nearly level to rolling areas and are well drained. Typically, the surface layer is very dark grayish brown fine sandy loam about 7 inches thick. The subsoil is about 32 inches thick. The upper part is dark brown and brown, friable fine sandy loam. The next part is reddish brown and brown, friable gravelly fine sandy loam and fine sandy loam. The lower part is dark reddish brown, friable gravelly fine sandy loam. The substratum to a depth of about 60 inches is brown gravelly coarse sand.

Of minor extent in this association are the excessively drained Vilas soils, the somewhat

excessively drained or moderately well drained Karlin soils, the moderately well drained Croswell and Wabeno soils, the somewhat poorly drained Gaastra soils, and the very poorly drained Cathro and Merwin soils. Vilas, Karlin, and Croswell soils are coarser textured and more droughty than the major soils. Wabeno soils have very firm layers in the subsoil that limit rooting depth. Vilas, Karlin, Croswell, and Wabeno soils are in landscape positions similar to those of the major soils. Gaastra soils are in drainageways and on low flats in the uplands. Cathro and Merwin soils are in depressions on uplands and on lowlands.

This association is used mainly as woodland. The major management concern is an equipment limitation.

Some areas are used as cropland. The major management concern is water erosion.

Broad Land Use Considerations

The general soil map is helpful in identifying broad areas than can be developed for residential, industrial, agricultural, and other uses. It cannot be used, however, in the selection of sites for specific structures or specific crops.

About 90 percent of the acreage in Iron County is forested. Sugar maple is the dominant type of forest cover in areas of the Sarona, Sagola, Trenary, Wabeno, Net, Champion, Peavy, Petticoat, Goodman, and Stambaugh soils and the Haplorthods in associations 4, 6, 7, 8, 10, 11, 12, 13, 14, 15, and 20. Aspen and paper birch are dominant in areas of the Karlin, Sundog, Channing, Lode, Pence, Padus, and Oconto soils in associations 4, 7, 9, 15, 17, 18, 19, and 20. Aspen, jack pine, and northern red oak are dominant in areas of the Vilas soils and the Entic Haplorthods in associations 3 and 16. Northern whitecedar, balsam fir, black spruce, and tamarack are the dominant cover types in areas of the Lupton, Cathro, and Minocqua soils in associations 1, 6, and 9.

Erosion and an equipment limitation are the major management concerns on the hilly and steep Sarona, Karlin, Sagola, Sundog, Pence, and Padus soils and the Haplorthods and Entic Haplorthods in associations 4, 5, 6, 7, 9, 13, 15, 16, 18, and 20. Erosion, the equipment limitation, and windthrow are the major management concerns on the hilly Champion soils in associations 8 and 12. Seedling mortality and the equipment limitation are the major management concerns on the Vilas soils in associations 3 and 4. Windthrow, seedling mortality, and the equipment limitation are the major management concerns on the Net, Solona, Minocqua, and Channing soils in associations 7, 8, and 9. Windthrow and the equipment limitation are the major management concerns on the nearly level to rolling Wabeno,

Champion, and Peavy soils in associations 8, 10, 11, 12, 13, 14, and 15. The equipment limitation is the major management concern on the rolling Karlin, Sagola, Trenary, Sundog, Petticoat, Goodman, Lode, Pence, Padus, Oconto, and Stambaugh soils and the Haplorthods and Entic Haplorthods in associations 4, 5, 6, 7, 9, 13, 14, 15, 16, 17, 18, 19, and 20. Windthrow and the equipment limitation are the major management concerns on the Lupton and Cathro soils in associations 1 and 6.

Cropland is concentrated in areas of associations 10, 11, 17, 19, and 20 in the southern and central parts of the county. The soils most commonly used for cultivated crops are the nearly level to rolling Wabeno, Peavy, Lode, Oconto, and Stambaugh soils. Some areas of Karlin, Sundog, Pence, and Padus soils in associations 4, 7, 9, 15, 18, and 20 also are used as cropland. The mucky soils in associations 1, 2, and 6 generally are not cultivated because of wetness and a short growing season. The Vilas soils in associations 3 and 4 generally are unsuited to cultivated crops because of droughtiness. Water erosion, soil blowing, droughtiness, low organic matter content, and tillth are the major management concerns affecting cropland in Iron County.

The nearly level and undulating Vilas, Karlin, Sagola, Trenary, Sundog, Lode, Pence, Padus, Oconto, and Stambaugh soils and Haplorthods and Entic Haplorthods in associations 3, 4, 5, 6, 7, 9, 13, 15, 16, 17, 18, 19, and 20 are suited to most intensive recreational uses, such as playgrounds, camp areas, picnic areas, and paths and trails. Small stones are a limitation in some areas. The Lupton, Cathro, Greenwood, Merwin, Net, Solona, Minocqua, and Channing soils in associations 1, 2, 6, 7, 8, and 9 generally are not suited to these uses because of wetness or ponding. The rolling soils in associations 4 through 20 generally are suited to camp areas, picnic areas, and paths and trails, but the slope and, in some

cases, wetness and stones are limitations. The nearly level and undulating Wabeno, Champion, and Peavy soils in associations 8, 10, 11, and 12 generally are suited to picnic areas and paths and trails, but wetness and, in some cases, stones are limitations.

The loamy and sandy soils throughout the county generally are suited to both openland and woodland wildlife habitat. The Lupton, Cathro, Greenwood, Merwin, Net, Solona, Minocqua, and Channing soils in associations 1, 2, 6, 7, 8, and 9 generally are suited to wetland wildlife habitat.

The rolling Goodman soils in association 15 and the nearly level to rolling Sagola and Trenary soils in associations 4, 6, 7, and 13 generally are suited to building site development. The nearly level to rolling Vilas, Karlin, Sundog, Lode, Pence, Padus, Oconto, and Stambaugh soils and Entic Haplorthods and the rolling Petticoat soils in associations 3, 4, 7, 9, 14, 15, 16, 17, 18, 19, and 20 generally are suited to building site development but are severely limited as sites for septic tank absorption fields because of a poor filtering capacity. The nearly level to rolling Wabeno soils and the nearly level and undulating Peavy, Petticoat, and Goodman soils in associations 10, 11, 13, 14, and 15 generally are suited to dwellings without basements but are severely limited as sites for septic tank absorption fields because of wetness. The rolling Peavy soils in association 11 generally are suited to building site development but are severely limited as sites for septic tank absorption fields because of slow percolation. The nearly level to rolling Net, Champion, Solona, and Channing soils in associations 7, 8, and 9 are generally unsuited to building site development and septic tank absorption fields because of wetness. The Lupton, Cathro, Greenwood, Merwin, and Minocqua soils in associations 1, 2, 6, and 9 are unsuited to building site development and septic tank absorption fields because of ponding.

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 the heading "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, Padus fine sandy loam, 2 to 6 percent slopes, is a phase of the Padus 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. Vilas-Karlin complex, 1 to 6 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. Greenwood and Merwin peats 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, sand and 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.

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.

The map symbols designate the location of the map units in Iron County. Map units 50 to 168F are outside the Ottawa National Forest. Map units 500B to 556 are in the Ottawa National Forest.

Soil Descriptions

50—Aquents and Histosols, ponded

Setting

Landform and position on the landform: Depressions on ground moraines, outwash plains, and flood plains

Slope: 0 to 2 percent

Shape of areas: Irregular

Size of areas: 5 to 100 acres

Soil Properties and Qualities

Texture: Aquepts—sandy or loamy material; Histosols—16 to more than 51 inches of organic material over loamy or sandy material

Depth class: Very deep

Permeability: Aquepts—variable; Histosols—moderately slow to moderately rapid in the organic material and variable in the mineral material

Available water capacity: Variable

Drainage class: Aquepts—poorly drained; Histosols—very poorly drained

Seasonal high water table: Near the surface to 1 foot above the surface for most of the year

Surface runoff: Ponded

Flooding: None

Composition

Aquepts and Histosols: 90 to 100 percent

Contrasting inclusions: 0 to 10 percent

Inclusions

Contrasting inclusions:

- Small areas of poorly drained soils at the edges of the unit

Use and Management

Land use: Wildlife habitat

- Onsite investigation is needed to determine the suitability for specific uses.

Interpretive Groups

Land capability classification: None assigned

Woodland ordination symbol: None assigned

Michigan soil management group: None assigned

51—Lupton-Cathro-Humaquepts complex

Setting

Landform and position on the landform: Depressions on ground moraines and outwash plains

Slope: 0 to 2 percent

Shape of areas: Irregular or long and narrow

Size of areas: 5 to 2,500 acres

Typical Profile

Lupton

Surface layer:

0 to 10 inches—black muck

Subsoil:

10 to 60 inches—black muck

Cathro

Surface layer:

0 to 7 inches—black muck

Subsoil:

7 to 26 inches—black muck

Substratum:

26 to 60 inches—dark gray and brown very fine sandy loam and fine sandy loam

Humaquepts

Texture: 1 to 15 inches of well decomposed or partially decomposed organic material over loamy or sandy material

Soil Properties and Qualities

Depth class: Very deep

Permeability: Lupton—moderately slow to moderately rapid; Cathro—moderately slow to moderately rapid in the upper part and moderate or moderately slow in the lower part; Humaquepts—variable

Available water capacity: Lupton—high; Cathro—high; Humaquepts—variable

Drainage class: Lupton and Cathro—very poorly drained; Humaquepts—poorly drained

Seasonal high water table: 1 foot above to 1 foot below the surface at some time from September through June

Surface runoff: Very slow or ponded

Flooding: None

Composition

Lupton soil and similar soils: 35 to 45 percent

Cathro soil and similar soils: 30 to 40 percent

Humaquepts and similar soils: 20 to 25 percent

Contrasting inclusions: 0 to 5 percent

Inclusions

Contrasting inclusions:

- The moderately well drained Wabeno soils in the higher landscape positions
- The excessively well drained or moderately well drained Karlin soils in the higher landscape positions
- The well drained Sarona soils in the higher landscape positions
- Greenwood and Merwin soils, which are more acid than the major soils; in landscape positions similar to those of the major soils

Similar inclusions:

- Areas that are subject to occasional flooding

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow hazard

Management measures:

- Because of wetness and low strength, special harvesting equipment is needed. The equipment can be

used only during periods in winter when skid roads and access roads are frozen.

- Because of wetness, seedling mortality, and plant competition, trees are generally not planted on these soils.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: VIw

Woodland ordination symbol: Lupton—2W; Cathro—5W

Michigan soil management group: Lupton—Mc; Cathro—M/3c

Primary habitat type: TTS

Secondary habitat type: None assigned

52—Greenwood and Merwin peats

Setting

Landform and position on the landform: Depressions on ground moraines and outwash plains

Slope: 0 to 2 percent

Shape of areas: Irregular or oval

Size of areas: 5 to 1,000 acres

Typical Profile

Greenwood

Surface layer:

0 to 5 inches—reddish brown peat

Subsoil:

5 to 18 inches—dark reddish brown and dark brown peat

18 to 60 inches—dark reddish brown mucky peat and muck

Merwin

Surface layer:

0 to 8 inches—yellowish brown peat

Subsoil:

8 to 36 inches—dark reddish brown mucky peat

Substratum:

36 to 60 inches—black silt loam and very dark grayish brown and brown sandy loam

Soil Properties and Qualities

Depth class: Very deep

Permeability: Greenwood—moderate or moderately rapid; Merwin—rapid in the upper part, moderately slow in the lower part

Available water capacity: High

Drainage class: Very poorly drained

Seasonal high water table: 1 foot above to 1 foot below

the surface at some time from September through June

Surface runoff: Very slow or ponded

Flooding: None

Composition

Greenwood soil and similar soils: 0 to 90 percent

Merwin soil and similar soils: 10 to 95 percent

Contrasting inclusions: 0 to 5 percent

Inclusions

Contrasting inclusions:

- The moderately well drained Croswell, Manitowish, and Karlin soils in the higher landscape positions
- The well drained Pence and Sarona soils in the higher landscape positions
- Lupton and Cathro soils, which are less acid than the major soils; in landscape positions similar to those of the major soils

Similar inclusions:

- Soils that have a substratum of sand

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow hazard

Management measures:

- Because of wetness and low strength, special harvesting equipment is needed. The equipment can be used only during periods in winter when skid roads and access roads are frozen.
- Because of wetness, seedling mortality, and plant competition, trees are generally not planted on these soils.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: VIIw

Woodland ordination symbol: 2W

Michigan soil management group: Mc-a

Primary habitat type: PCS

Secondary habitat type: None assigned

53—Waucedah-Cathro mucks, frequently flooded

Setting

Landform and position on the landform: First bottom on flood plains

Slope: 0 to 2 percent

Shape of areas: Long and narrow

Size of areas: 5 to 1,000 acres

Typical Profile

Waucedah

Surface layer:

0 to 10 inches—black muck

Substratum:

10 to 60 inches—grayish brown and dark grayish brown, mottled fine sandy loam

Cathro

Surface layer:

0 to 7 inches—black muck

Subsoil:

7 to 26 inches—black muck

Substratum:

26 to 60 inches—dark gray and brown very fine sandy loam and fine sandy loam

Soil Properties and Qualities

Depth class: Very deep

Permeability: Waucedah—moderate; Cathro—moderately slow to moderately rapid in the upper part and moderate or moderately slow in the lower part

Available water capacity: High

Drainage class: Waucedah—poorly drained; Cathro—very poorly drained

Seasonal high water table: Waucedah—2 feet above to 1 foot below the surface at some time from January through December; Cathro—1 foot above to 1 foot below the surface at some time from November through June

Surface runoff: Pondered

Flooding: Frequent

Composition

Waucedah soil and similar soils: 30 to 60 percent

Cathro soil and similar soils: 30 to 60 percent

Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

- The moderately well drained Wabeno soils in the higher landscape positions
- The excessively well drained or moderately well drained Karlin soils in the higher landscape positions
- The well drained Saronas soils in the higher landscape positions

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow hazard

Management measures:

- Because of wetness and low strength, special

harvesting equipment is needed. The equipment can be used only during periods in winter when skid roads and access roads are frozen.

- Because of wetness, seedling mortality, and plant competition, trees are generally not planted on these soils.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: Vw

Woodland ordination symbol: Waucedah—3W; Cathro—5W

Michigan soil management group: Waucedah—L-4c; Cathro—M/3c

Primary habitat type: FMC

Secondary habitat type: None assigned

54—Pits, sand and gravel

Setting

Landform: Ground moraines, outwash plains

Shape of areas: Irregular

Size of areas: 5 to 20 acres

Composition

Pits: 100 percent

Use and Management

Land use: Source of sand and gravel

Management measures:

- Onsite investigation is needed to determine the suitability for specific uses.

Interpretive Groups

Land capability classification: None assigned

Woodland ordination symbol: None assigned

Michigan soil management group: None assigned

55A—Oconto very fine sandy loam, 1 to 2 percent slopes

Setting

Landform and position on the landform: Nearly level areas on outwash plains

Shape of areas: Irregular

Size of areas: 5 to 800 acres

Typical Profile

Surface layer:

0 to 7 inches—dark brown very fine sandy loam

Subsurface layer:

7 to 11 inches—brown very fine sandy loam

Subsoil:

11 to 28 inches—strong brown and dark brown, friable and firm very fine sandy loam

28 to 35 inches—dark brown, friable gravelly loam

Substratum:

35 to 60 inches—strong brown very gravelly coarse sand

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderate in the upper part and rapid or very rapid in the lower part

Available water capacity: Moderate

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow

Flooding: None

Composition

Oconto soil and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

Inclusions*Contrasting inclusions:*

- Karlin soils, which are more droughty than the Oconto soil; in landscape positions similar to those of the Oconto soil
- Ternary soils, which have a substratum of sandy loam; in landscape positions similar to those of the Oconto soil
- The somewhat poorly drained Channing soils in depressions and drainageways

Similar inclusions:

- Soils that have less than 35 percent gravel in the substratum
- Soils that have slopes of 2 to 6 percent

Use and Management

Land use: Dominant uses—woodland, cropland

Woodland

Major management concerns: Equipment limitation

Management measures:

- The use of equipment is briefly restricted in spring and during other excessively wet periods. Access is easiest during periods in winter when access roads are frozen.

Cropland

Major management concerns: Soil blowing, low organic matter content, soil moisture content, tillage

Management measures:

- Conservation tillage, crop residue management,

stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.

- No-till farming, a cropping sequence that includes green manure crops, and crop residue management increase the organic matter content.
- Minimizing tillage and tilling at the proper soil moisture content help to maintain good tillth and prevent crusting.
- Irrigation water should be applied at a rate that ensures optimum production but does not increase the rate of deep percolation, the runoff rate, or the hazard of erosion (fig. 6).
- Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.

Interpretive Groups

Land capability classification: IIs

Woodland ordination symbol: 3L

Michigan soil management group: 4a

Primary habitat type: TM

Secondary habitat type: ATD

55B—Oconto very fine sandy loam, 2 to 6 percent slopes**Setting**

Landform and position on the landform: Nearly level and undulating areas on outwash plains

Shape of areas: Irregular

Size of areas: 5 to 600 acres

Typical Profile*Surface layer:*

0 to 7 inches—dark brown very fine sandy loam

Subsurface layer:

7 to 11 inches—brown very fine sandy loam

Subsoil:

11 to 28 inches—strong brown and dark brown, friable and firm very fine sandy loam

28 to 35 inches—dark brown, friable gravelly loam

Substratum:

35 to 60 inches—strong brown very gravelly coarse sand

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderate in the upper part and rapid or very rapid in the lower part

Available water capacity: Moderate

Drainage class: Well drained



Figure 6.—Irrigated potatoes in an area of Oconto very fine sandy loam, 1 to 2 percent slopes.

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow

Flooding: None

Composition

Oconto soil and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

- Karlin soils, which are more droughty than the Oconto soil; in landscape positions similar to those of the Oconto soil
- Ternary soils that have a substratum of sandy loam; in landscape positions similar to those of the Oconto soil
- The somewhat poorly drained Channing soils in the lower landscape positions

Similar inclusions:

- Soils in which the substratum has less than 35 percent gravel

Use and Management

Land use: Dominant uses—woodland, cropland

Woodland

Major management concerns: Equipment limitation

Management measures:

- The use of equipment is briefly restricted in spring and during other excessively wet periods. Access is easiest during periods in winter when access roads are frozen.

Cropland

Major management concerns: Soil blowing, water erosion, low organic matter content, soil moisture content, tillth

Management measures:

- Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
- Conservation tillage, grassed waterways, cover crops, and crop rotations that include grasses or legumes help to control water erosion.
- Contour farming and contour stripcropping reduce the runoff rate and the hazard of water erosion.
- No-till farming, crop residue management, and a cropping sequence that includes green manure crops increase the organic matter content.
- Minimizing tillage and tilling at the proper soil moisture content help to maintain good tillth and prevent crusting.
- Irrigation water should be applied at a rate that ensures optimum production but does not increase the

rate of deep percolation, the runoff rate, or the hazard of erosion.

- Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.

Interpretive Groups

Land capability classification: IIe

Woodland ordination symbol: 3L

Michigan soil management group: 4a

Primary habitat type: TM

Secondary habitat type: ATD

55D—Oconto very fine sandy loam, 6 to 18 percent slopes

Setting

Landform and position on the landform: Rolling areas on outwash plains

Shape of areas: Irregular

Size of areas: 5 to 100 acres

Typical Profile

Surface layer:

0 to 7 inches—dark brown very fine sandy loam

Subsurface layer:

7 to 11 inches—brown very fine sandy loam

Subsoil:

11 to 28 inches—strong brown and dark brown, friable and firm very fine sandy loam

28 to 35 inches—dark brown, friable gravelly loam

Stratum:

35 to 60 inches—strong brown very gravelly coarse sand

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderate in the upper part and rapid or very rapid in the lower part

Available water capacity: Moderate

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Medium

Flooding: None

Composition

Oconto soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Inclusions

Contrasting inclusions:

- Karlin soils, which are more droughty than the Oconto

soil; in landscape positions similar to those of the Oconto soil

- Ternary soils that have a substratum of sandy loam; in landscape positions similar to those of the Oconto soil
- The somewhat poorly drained Channing soils on foot slopes and in drainageways

Similar inclusions:

- Soils in which the substratum has less than 35 percent gravel

Use and Management

Land use: Dominant uses—woodland, cropland

Woodland

Major management concerns: Equipment limitation

Management measures:

- The use of equipment is briefly restricted in spring and during other excessively wet periods. Access is easiest during periods in winter when access roads are frozen.
- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.

Cropland

Major management concerns: Soil blowing, water erosion, low organic matter content, tilth

Management measures:

- Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
- Water erosion can be controlled by diversions, crop residue management, contour stripcropping, field stripcropping, cover crops, grassed waterways, conservation tillage, crop rotations, grade-stabilization structures, or a combination of these practices.
- No-till farming, crop residue management, and a cropping sequence that includes green manure crops increase the organic matter content.
- Minimizing tillage and tilling at the proper soil moisture content help to maintain good tilth and prevent crusting.
- Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.

Interpretive Groups

Land capability classification: IVe

Woodland ordination symbol: 3L

Michigan soil management group: 4a

Primary habitat type: TM

Secondary habitat type: ATD

56—Pits and dumps, mine**Setting**

Landform: Ground moraines

Shape of areas: Irregular

Size of areas: 5 to 80 acres

Composition

Pits: 60 percent

Dumps: 40 percent

Use and Management

Land use: Wildlife habitat

Management measures:

- Onsite investigation is needed to determine the suitability for specific uses.

Interpretive Groups

Land capability classification: None assigned

Woodland ordination symbol: None assigned

Michigan soil management group: None assigned

57A—Padus fine sandy loam, 1 to 2 percent slopes**Setting**

Landform and position on the landform: Nearly level areas on outwash plains, stream terraces, and eskers

Shape of areas: Irregular

Size of areas: 5 to 200 acres

Typical Profile

Surface layer:

0 to 7 inches—very dark gray fine sandy loam

Subsoil:

7 to 25 inches—dark brown and brown, friable fine sandy loam

25 to 35 inches—reddish brown and brown, friable gravelly fine sandy loam and fine sandy loam

35 to 39 inches—dark reddish brown, friable gravelly fine sandy loam

Substratum:

39 to 60 inches—brown gravelly coarse sand

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderate in the upper part and rapid or very rapid in the lower part

Available water capacity: Moderate

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow

Flooding: None

Composition

Padus soil and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

- Karlin and Pence soils, which are more droughty than the Padus soil; in landscape positions similar to those of the Padus soil
- The somewhat poorly drained Channing soils in the lower landscape positions
- Stambaugh soils that have a surface layer and subsoil of silt loam, which are less droughty than the Padus soil; in landscape positions similar to those of the Padus soil

Similar inclusions:

- Soils that have slopes of 2 to 6 percent
- Soils that have thin layers of sandy loam in the substratum

Use and Management

Land use: Dominant uses—woodland, cropland

Woodland

Major management concerns: Equipment limitation

Management measures:

- The use of equipment is briefly restricted in spring and during other excessively wet periods. Access is easiest during periods in winter when access roads are frozen.

Cropland

Major management concerns: Soil blowing, low organic matter content, tilth

Management measures:

- Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
- No-till farming, crop residue management, and a cropping sequence that includes green manure crops increase the organic matter content.
- Minimizing tillage and tilling at the proper soil moisture content help to maintain good tilth and prevent crusting.
- Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.

Interpretive Groups

Land capability classification: IIs

Woodland ordination symbol: 3L

Michigan soil management group: 3a-a

Primary habitat type: TM

Secondary habitat type: ATD

57B—Padus fine sandy loam, 2 to 6 percent slopes

Setting

Landform and position on the landform: Undulating areas on outwash plains, stream terraces, and eskers

Shape of areas: Irregular

Size of areas: 5 to 600 acres

Typical Profile

Surface layer:

0 to 7 inches—very dark gray fine sandy loam

Subsoil:

7 to 25 inches—dark brown and brown, friable fine sandy loam

25 to 35 inches—reddish brown and strong brown, friable gravelly fine sandy loam and fine sandy loam

35 to 39 inches—dark reddish brown, friable gravelly fine sandy loam

Substratum:

39 to 60 inches—brown gravelly coarse sand

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderate in the upper part and rapid or very rapid in the lower part

Available water capacity: Moderate

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow

Flooding: None

Composition

Padus soil and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

- Karlin and Pence soils, which are more droughty than the Padus soil; in landscape positions similar to those of the Padus soil

- The somewhat poorly drained Channing soils in the lower landscape positions

- Stambaugh soils that have a surface layer and subsoil of silt loam, which are less droughty than the Padus soil; in landscape positions similar to those of the Padus soil

Similar inclusions:

- Soils that have thin layers of sandy loam in the substratum

Use and Management

Land use: Dominant uses—woodland, cropland

Woodland

Major management concerns: Equipment limitation

Management measures:

- The use of equipment is briefly restricted in spring and during other excessively wet periods. Access is easiest during periods in winter when access roads are frozen.

Cropland

Major management concerns: Soil blowing, water erosion, low organic matter content, tilth

Management measures:

- Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.

- Conservation tillage, grassed waterways, cover crops, and crop rotations that include grasses or legumes help to control water erosion.

- Contour farming and contour stripcropping reduce the runoff rate and the hazard of water erosion.

- No-till farming, crop residue management, and a cropping sequence that includes green manure crops increase the organic matter content.

- Minimizing tillage and tilling at the proper soil moisture content help to maintain good tilth and prevent crusting.

- Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.

Interpretive Groups

Land capability classification: 11e

Woodland ordination symbol: 3L

Michigan soil management group: 3a-a

Primary habitat type: TM

Secondary habitat type: ATD

57D—Padus fine sandy loam, 6 to 18 percent slopes, stony

Setting

Landform and position on the landform: Rolling areas on outwash plains, stream terraces, and eskers

Shape of areas: Irregular

Size of areas: 5 to 400 acres

Typical Profile

Surface layer:

0 to 7 inches—very dark gray fine sandy loam

Subsoil:

7 to 25 inches—dark brown and brown, friable fine sandy loam

25 to 35 inches—reddish brown and strong brown,

friable gravelly fine sandy loam and fine sandy loam
35 to 39 inches—dark reddish brown, friable gravelly
fine sandy loam

Substratum:

39 to 60 inches—brown gravelly coarse sand

Soil Properties and Qualities

Depth class: Very deep

Rock fragments on the surface: Kind—stones and
cobbles; percentage of surface covered—0.01 to
0.1 percent

Permeability: Moderate in the upper part and rapid or
very rapid in the lower part

Available water capacity: Moderate

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6
feet

Surface runoff: Medium

Flooding: None

Composition

Padus soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Inclusions

Contrasting inclusions:

- Karlin and Pence soils, which are more droughty than the Padus soil; in landscape positions similar to those of the Padus soil
- The somewhat poorly drained Channing soils on foot slopes and in depressions
- Stambaugh soils that have a surface layer and subsoil of silt loam, which are less droughty than the Padus soil; in landscape positions similar to those of the Padus soil

Similar inclusions:

- Soils that have thin layers of sandy loam in the substratum

Use and Management

Land use: Dominant uses—woodland, cropland

Woodland

Major management concerns: Equipment limitation

Management measures:

- The use of equipment is briefly restricted in spring and during other excessively wet periods. Access is easiest during periods in winter when access roads are frozen.
- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.

Cropland

Major management concerns: Soil blowing, water erosion, low organic matter content, tith

Management measures:

- Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
- Water erosion can be controlled by diversions, crop rotations, grade-stabilization structures, or a combination of these practices.
- No-till farming, crop residue management, and a cropping sequence that includes green manure crops increase the organic matter content.
- Minimizing tillage and tilling at the proper soil moisture content help to maintain good tilth and prevent crusting.
- Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.
- Stones on the surface may interfere with the use of tillage and planting equipment and some harvesting equipment. Removing the stones minimizes wear on equipment.

Interpretive Groups

Land capability classification: V1e

Woodland ordination symbol: 3L

Michigan soil management group: 3a-a

Primary habitat type: TM

Secondary habitat type: ATD

57F—Padus fine sandy loam, 18 to 35 percent slopes, stony

Setting

Landform and position on the landform: Hilly areas on
outwash plains, stream terraces, and eskers

Shape of areas: Irregular or long and narrow

Size of areas: 5 to 100 acres

Typical Profile

Surface layer:

0 to 7 inches—very dark gray fine sandy loam

Subsoil:

7 to 25 inches—dark brown and brown, friable fine
sandy loam

25 to 35 inches—reddish brown and strong brown,
friable gravelly fine sandy loam and fine sandy loam

35 to 39 inches—dark reddish brown, friable gravelly
fine sandy loam

Substratum:

39 to 60 inches—brown gravelly coarse sand

Soil Properties and Qualities

Depth class: Very deep

Rock fragments on the surface: Kind—stones and

cobbles; percentage of surface covered—0.01 to 0.1

Permeability: Moderate in the upper part and rapid or very rapid in the lower part

Available water capacity: Moderate

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Rapid

Flooding: None

Composition

Padus soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Inclusions

Contrasting inclusions:

- Karlin and Pence soils, which are more droughty than the Padus soil; in landscape positions similar to those of the Padus soil
- The somewhat poorly drained Channing soils on foot slopes and in drainageways
- Stambaugh soils that have a surface layer and subsoil of silt loam, which are less droughty than the Padus soil; in landscape positions similar to those of the Padus soil

Similar inclusions:

- Soils that have thin layers of sandy loam in the substratum

Use and Management

Land use: Woodland

Major management concerns: Erosion hazard, equipment limitation

Management measures:

- Because of the erosion hazard, water should be removed from logging roads by water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures. Building logging roads on the contour or on the gentler slopes and seeding logging roads, skid roads, and landings after the trees are logged also help to prevent excessive soil loss.
- The use of equipment is briefly restricted in spring and during other excessively wet periods. Access is easiest during periods in winter when access roads are frozen.
- Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.

Interpretive Groups

Land capability classification: VIIe

Woodland ordination symbol: 3R

Michigan soil management group: 3a-a

Primary habitat type: TM

Secondary habitat type: ATD

58B—Trenary fine sandy loam, 1 to 6 percent slopes, stony

Setting

Landform and position on the landform: Nearly level and undulating areas on ground moraines and end moraines

Shape of areas: Irregular

Size of areas: 5 to 200 acres

Typical Profile

Surface layer:

0 to 4 inches—black fine sandy loam

Subsurface layer:

4 to 5 inches—brown fine sandy loam

Subsoil:

5 to 12 inches—dark brown, friable fine sandy loam

12 to 23 inches—dark reddish brown and reddish brown, firm sandy loam and loamy sand

23 to 36 inches—dark reddish brown and reddish brown, friable loam and loamy sand

Substratum:

36 to 60 inches—reddish brown sandy loam

Soil Properties and Qualities

Depth class: Very deep

Rock fragments on the surface: Kind—stones and cobbles; percentage of surface covered—0.01 to 0.1

Permeability: Moderate

Available water capacity: Moderate

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow

Flooding: None

Composition

Trenary soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Solona soils in the lower landscape positions
- Escanaba and Karlin soils, which are more droughty than the Trenary soil; in landscape positions similar to those of the Trenary soil

Similar inclusions:

- Soils that have gravelly sand at a depth of 40 to 60 inches

Use and Management

Land use: Dominant uses—woodland, cropland

Woodland

Major management concerns: Equipment limitation

Management measures:

- The use of equipment is briefly restricted in spring and during other excessively wet periods. Access is easiest during periods in winter when access roads are frozen.

Cropland

Major management concerns: Soil blowing, water erosion, low organic matter content, tilth

Management measures:

- Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
- Conservation tillage, grassed waterways, cover crops, and crop rotations that include grasses or legumes help to control water erosion.
- Contour farming and contour stripcropping reduce the runoff rate and the hazard of water erosion.
- No-till farming, crop residue management, and a cropping sequence that includes green manure crops increase the organic matter content.
- Minimizing tillage and tilling at the proper soil moisture content help to maintain good tilth and prevent crusting.
- Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.
- Stones on the surface may interfere with the use of tillage and planting equipment and some harvesting equipment. Removing the stones minimizes wear on equipment.

Interpretive Groups

Land capability classification: IIIs

Woodland ordination symbol: 3L

Michigan soil management group: 3a

Primary habitat type: AVO

Secondary habitat type: None assigned

58D—Trenary fine sandy loam, 6 to 18 percent slopes, stony

Setting

Landform and position on the landform: Rolling areas on knolls and back slopes on ground moraines and end moraines

Shape of areas: Irregular

Size of areas: 5 to 200 acres

Typical Profile

Surface layer:

0 to 4 inches—black fine sandy loam

Subsurface layer:

4 to 5 inches—brown fine sandy loam

Subsoil:

5 to 12 inches—dark brown, friable fine sandy loam

12 to 23 inches—dark reddish brown and reddish brown, firm sandy loam and loamy sand

23 to 36 inches—dark reddish brown and reddish brown, friable loam and loamy sand

Substratum:

36 to 60 inches—reddish brown sandy loam

Soil Properties and Qualities

Depth class: Very deep

Rock fragments on the surface: Kind—stones and cobbles; percentage of surface covered—0.01 to 0.1

Permeability: Moderate

Available water capacity: Moderate

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Medium

Flooding: None

Composition

Trenary soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Solona soils on foot slopes and in low fault areas
- Escanaba and Karlin soils, which are more droughty than the Trenary soil; in landscape positions similar to those of the Trenary soil

Similar inclusions:

- Soils that have gravelly sand at a depth of 40 to 60 inches

Use and Management

Land use: Dominant uses—woodland, cropland

Woodland

Major management concerns: Equipment limitation

Management measures:

- The use of equipment is briefly restricted in spring and during other excessively wet periods. Access is easiest during periods in winter when access roads are frozen.
- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.

Cropland

Major management concerns: Soil blowing, water erosion, low organic matter content, tilth

Management measures:

- Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
- Water erosion can be controlled by diversions, crop rotations, grade-stabilization structures, or a combination of these practices.
- No-till farming, crop residue management, and a cropping sequence that includes green manure crops increase the organic matter content.
- Minimizing tillage and tilling at the proper soil moisture content help to maintain good tilth and prevent crusting.
- Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.
- Stones on the surface may interfere with the use of tillage and planting equipment and some harvesting equipment. Removing the stones minimizes wear on equipment.

Interpretive Groups

Land capability classification: VIe

Woodland ordination symbol: 3L

Michigan soil management group: 3a

Primary habitat type: AVO

Secondary habitat type: None assigned

59A—Solona very fine sandy loam, 0 to 3 percent slopes, stony**Setting**

Landform and position on the landform: Drainageways on ground moraines

Shape of areas: Long and narrow or irregular

Size of areas: 5 to 30 acres

Typical Profile

Surface layer:

0 to 6 inches—black very fine sandy loam

Subsurface layer:

6 to 12 inches—brown, mottled very fine sandy loam

Subsoil:

12 to 30 inches—brown, mottled, friable very fine sandy loam

30 to 36 inches—yellowish red and brown, friable loam and loamy sand

Substratum:

36 to 60 inches—yellowish red sandy loam

Soil Properties and Qualities

Depth class: Very deep

Rock fragments on the surface: Kind—stones and cobbles; percentage of surface covered—0.01 to 0.1

Permeability: Moderate

Available water capacity: Moderate

Drainage class: Somewhat poorly drained

Seasonal high water table: 1 to 3 feet below the surface at some time from March through July

Surface runoff: Slow

Flooding: None

Composition

Solona soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Inclusions

Contrasting inclusions:

- The well drained Trenary soils in the higher landscape positions
- The poorly drained Witbeck soils in depressions
- The sandy Au Gres soils in landscape positions similar to those of the Solona soil

Similar inclusions:

- Soils that have gravelly sand at a depth of 40 to 60 inches
- Soils that are moderately well drained

Use and Management

Land use: Dominant uses—woodland, cropland

Woodland

Major management concerns: Equipment limitation, windthrow hazard

Management measures:

• Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.

• The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen or has an adequate snow cover.

• Areas of the better drained included Trenary soils are more suitable for landing sites.

• Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Cropland

Major management concerns: Soil blowing, seasonal wetness, tilth

Management measures:

• Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop

rotations that include small grain and hay help to control soil blowing.

- Tile drains can be used to reduce wetness if a suitable outlet is available.
- Crop residue management, cover crops, green manure crops, proper use of manure, and conservation tillage help to maintain and improve tilth, the moisture-holding capacity, and organic matter content.
- Minimizing tillage and tilling at the proper soil moisture content help to maintain good tilth and prevent crusting.
- Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.
- Stones on the surface may interfere with the use of tillage and planting equipment and some harvesting equipment. Removing the stones minimizes wear on equipment.

Interpretive Groups

Land capability classification: IIIs

Woodland ordination symbol: 3W

Michigan soil management group: 3b

Primary habitat type: AVO-CI

Secondary habitat type: TMC

60D—Trenary-Rock outcrop complex, 1 to 18 percent slopes, very stony

Setting

Landform and position on the landform: Nearly level to hilly areas on ground moraines

Shape of areas: Irregular

Size of areas: 5 to 200 acres

Typical Profile

Trenary

Surface layer:

0 to 4 inches—black fine sandy loam

Subsurface layer:

4 to 5 inches—brown fine sandy loam

Subsoil:

5 to 12 inches—dark brown, friable fine sandy loam

12 to 23 inches—dark reddish brown and reddish brown, firm sandy loam and loamy sand

23 to 36 inches—dark reddish brown and reddish brown, friable loam and loamy sand

Substratum:

36 to 60 inches—reddish brown sandy loam

Soil Properties and Qualities

Trenary

Depth class: Very deep

Rock fragments on the surface: Kind—stones and cobbles; percentage of surface covered—1 to 3

Permeability: Moderate

Available water capacity: Moderate

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow

Flooding: None

Composition

Trenary soil and similar soils: 75 to 80 percent

Rock outcrop: 10 to 20 percent

Contrasting inclusions: 10 to 15 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Solona soils on foot slopes and in depressions
- Escanaba and Karlin soils, which are more droughty than the Trenary soil; in landscape positions similar to those of the Trenary soil

Similar inclusions:

- Soils that have gravelly sand at a depth of 40 to 60 inches
- Soils that are less than 60 inches deep over bedrock
- Areas where 0.01 to 0.1 percent of the surface is covered with stones and cobbles

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation

Management measures:

- The use of equipment is briefly restricted in spring and during other excessively wet periods. Access is easiest during periods in winter when access roads are frozen.
- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.
- Because of stones on the surface, wheeled skidders with high clearance should be operated at a reduced speed over carefully chosen routes.
- The areas of Rock outcrop should be considered when road locations and landing sites are planned.

Interpretive Groups

Land capability classification: VIe

Woodland ordination symbol: 3L

Michigan soil management group: 3a

Primary habitat type: TM

Secondary habitat type: ATD

64A—Channing very fine sandy loam, 0 to 3 percent slopes

Setting

Landform and position on the landform: Drainageways on outwash plains and stream terraces

Shape of areas: Long and narrow or irregular

Size of areas: 5 to 80 acres

Typical Profile

Surface layer:

0 to 7 inches—dark brown very fine sandy loam

Subsurface layer:

7 to 9 inches—grayish brown very fine sandy loam

Subsoil:

9 to 24 inches—dark yellowish brown, mottled, friable very fine sandy loam

Substratum:

24 to 43 inches—strong brown and brown sand and loamy sand

43 to 60 inches—brown, stratified coarse sand and very gravelly sand

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderate in the upper part and very rapid in the lower part

Available water capacity: Low

Drainage class: Somewhat poorly drained

Seasonal high water table: 0.5 foot to 1.5 feet below the surface at some time from November through May

Surface runoff: Slow

Flooding: None

Composition

Channing soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Inclusions

Contrasting inclusions:

- The moderately well drained Manistowish and Sundog soils and the well drained Pence and Padus soils in the higher positions on the landscape
- The poorly drained Minocqua soils in depressions
- Au Gres soils that are sand throughout; in landscape positions similar to those of the Channing soil

Similar inclusions:

- Soils that have layers of silt loam in the substratum
- Areas where the surface is stony

Use and Management

Land use: Dominant uses—woodland, cropland

Woodland

Major management concerns: Equipment limitation,

seedling mortality, windthrow hazard

Management measures:

- Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
- The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen or has an adequate snow cover.
- Small areas of the better drained included soils are more suitable for landing areas.
- Special site preparation, such as bedding, can reduce the seedling mortality rate.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Cropland

Major management concerns: Soil blowing, low organic matter content, seasonal wetness, droughtiness, tillage

Management measures:

- Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
- No-till farming, crop residue management, and a cropping sequence that includes green manure crops increase the organic matter content.
- Tile drains can be used to reduce wetness if a suitable outlet is available.
- A system of conservation tillage that leaves crop residue on the surface is effective in conserving moisture.
- Minimizing tillage and tilling at the proper soil moisture content help to maintain good tillage.
- Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.

Interpretive Groups

Land capability classification: IIIw

Woodland ordination symbol: 2W

Michigan soil management group: 3/5b

Primary habitat type: TMC-Vac

Secondary habitat type: TMC

65—Witbeck muck, very stony

Setting

Landform and position on the landform: Depressions on ground moraines and end moraines

Slope: 0 to 2 percent

Shape of areas: Long and narrow or irregular

Size of areas: 5 to 100 acres

Typical Profile

Surface layer:

0 to 5 inches—black muck

Subsurface layer:

5 to 8 inches—black silt loam

Subsoil:

8 to 18 inches—dark brown, mottled, friable silt loam

Substratum:

18 to 60 inches—grayish brown and brown, mottled fine sandy loam and gravelly sandy loam

Soil Properties and Qualities

Depth class: Very deep

Rock fragments on the surface: Kind—stones and cobbles; percentage of surface covered—1 to 3

Permeability: Moderate or moderately slow

Available water capacity: Moderate

Drainage class: Poorly drained

Seasonal high water table: 0.5 foot above to 1.0 foot below the surface at some time from November through June

Surface runoff: Very slow or ponded

Flooding: None

Composition

Witbeck soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Net soils in the slightly higher positions on the landscape
- The very poorly drained, organic Cathro soils in landscape positions similar to those of the Witbeck soil
- Areas where stones cover more than 3 percent of the surface

Similar inclusions:

- Soils that have a surface layer of fine sandy loam

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow hazard

Management measures:

- Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
- The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen or has an adequate snow cover.

- Large stones on the surface can hinder harvesting operations and damage equipment.
- Because of wetness, seedling mortality, and plant competition, trees are generally not planted in areas of this soil.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: Vw

Woodland ordination symbol: 5W

Michigan soil management group: 3c

Primary habitat type: F1

Secondary habitat type: None assigned

67B—Net very fine sandy loam, 0 to 4 percent slopes, very stony

Setting

Landform and position on the landform: Drainageways on ground moraines and end moraines

Shape of areas: Long and narrow or irregular

Size of areas: 5 to 100 acres

Typical Profile

Surface layer:

0 to 3 inches—dark brown very fine sandy loam

Subsurface layer:

3 to 6 inches—brown, mottled very fine sandy loam

Subsoil:

6 to 28 inches—dark brown, mottled, friable very fine sandy loam and fine sandy loam

28 to 49 inches—a fragipan of dark brown and brown, mottled, very firm gravelly sandy loam and gravelly loamy sand

Substratum:

49 to 60 inches—dark brown gravelly sandy loam

Soil Properties and Qualities

Depth class: Very deep

Rock fragments on the surface: Kind—stones and cobbles; percentage of surface covered—1 to 3

Permeability: Moderate in the upper part, very slow in the fragipan, and moderate or moderately rapid in the lower part

Available water capacity: Low

Drainage class: Somewhat poorly drained

Seasonal high water table: Perched at a depth of 0.5 foot to 1.5 feet at some time from November through May

Surface runoff: Slow

Flooding: None

Composition

Net soil and similar soils: 85 to 90 percent
 Contrasting inclusions: 10 to 15 percent

Inclusions

Contrasting inclusions:

- The moderately well drained Wabeno, Champion, and Petticoat soils in the higher positions on the landscape
- The poorly drained Witbeck soils in depressions

Similar inclusions:

- Areas where stones cover less than 1 percent of the surface

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow hazard

Management measures:

- Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
- The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen or has an adequate snow cover.
- Large stones on the surface can hinder harvesting operations and damage equipment.
- Special site preparation, such as bedding, can reduce the seedling mortality rate.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: VIIIs

Woodland ordination symbol: 3W

Michigan soil management group: 3b-af

Primary habitat type: TMC

Secondary habitat type: None assigned

68B—Net-Witbeck complex, 0 to 4 percent slopes, very stony

Setting

Landform and position on the landform: Net—drainageways on ground moraines and end moraines; Witbeck—depressions on ground moraines and end moraines

Shape of areas: Irregular

Size of areas: 5 to 100 acres

Typical Profile

Net

Surface layer:

0 to 3 inches—dark brown silt loam

Subsurface layer:

3 to 6 inches—brown, mottled silt loam

Subsoil:

6 to 28 inches—dark brown, mottled, friable very fine sandy loam and fine sandy loam

28 to 49 inches—a fragipan of dark brown and brown, mottled, very firm gravelly sandy loam and gravelly loamy sand

Substratum:

49 to 60 inches—dark brown gravelly sandy loam

Witbeck

Surface layer:

0 to 5 inches—black muck

Subsurface layer:

5 to 8 inches—black silt loam

Subsoil:

8 to 18 inches—dark brown, mottled, friable silt loam

Substratum:

18 to 60 inches—grayish brown and brown, mottled fine sandy loam and gravelly sandy loam

Soil Properties and Qualities

Depth class: Very deep

Rock fragments on the surface: Kind—stones and cobbles; percentage of surface covered—1 to 3

Permeability: Net—moderate in the upper part, very slow in the fragipan, and moderate or moderately rapid in the lower part; Witbeck—moderate or moderately slow

Available water capacity: Net—low; Witbeck—moderate

Drainage class: Net—somewhat poorly drained; Witbeck—poorly drained

Seasonal high water table: Net—perched at a depth of 0.5 foot to 1.5 feet at some time from November through May; Witbeck—0.5 foot above to 1.0 foot below the surface at some time from November through June

Surface runoff: Net—slow; Witbeck—very slow or ponded

Flooding: None

Composition

Net soil and similar soils: 50 to 70 percent

Witbeck soil and similar soils: 25 to 45 percent

Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:

- The moderately well drained Wabeno, Champion, and

Petticoat soils in the higher positions on the landscape

- The very poorly drained, organic Cathro soils in landscape positions similar to those of the Witbeck soil
- Soils in areas where stones cover more than 3 percent of the surface; in landscape positions similar to those of the Witbeck soil

Similar inclusions:

- Soils that do not have muck in the surface layer
- Soils in areas where stones cover less than 3 percent of the surface; in landscape positions similar to those of the Net soil

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow hazard

Management measures:

- Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
- The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen or has an adequate snow cover.
- Large stones on the surface can hinder harvesting operations and damage equipment.
- Because of wetness, seedling mortality, and plant competition, trees are generally not planted in areas of the Witbeck soil.
- Special site preparation, such as bedding, can reduce the seedling mortality rate in areas of the Net soil.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: VIIIs

Woodland ordination symbol: Net—3W; Witbeck—5W

Michigan soil management group: Net—3b-af; Witbeck—3c

Primary habitat type: TMC

Secondary habitat type: FI

69A—Karlín, moderately wet-Croswell complex, 0 to 3 percent slopes

Setting

Landform and position on the landform: Nearly level areas on outwash plains and stream terraces

Shape of areas: Irregular

Size of areas: 5 to 150 acres

Typical Profile

Karlín

Surface layer:

0 to 2 inches—black fine sandy loam

Subsurface layer:

2 to 3 inches—reddish gray fine sandy loam

Subsoil:

3 to 10 inches—brown, friable fine sandy loam

10 to 35 inches—brown and yellowish red, friable and very friable sandy loam and loamy sand

Substratum:

35 to 60 inches—brown, mottled sand

Croswell

Surface layer:

0 to 1 inch—black sand

Subsurface layer:

1 to 5 inches—reddish gray sand

Subsoil:

5 to 20 inches—dark reddish brown and yellowish red, loose sand

Substratum:

20 to 60 inches—brown, mottled sand

Soil Properties and Qualities

Depth class: Very deep

Permeability: Karlín—moderately rapid in the upper part and rapid in the lower part; Croswell—rapid

Available water capacity: Low

Drainage class: Moderately well drained

Seasonal high water table: 2 to 5 feet below the surface at some time from November through May

Surface runoff: Slow

Flooding: None

Composition

Karlín soil and similar soils: 40 to 60 percent

Croswell soil and similar soils: 30 to 50 percent

Contrasting inclusions: 10 to 15 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Au Gres and Channing soils in the slightly lower positions on the landscape
- Sarona soils, which are less droughty than the major soils; in landscape positions similar to those of the major soils

Similar inclusions:

- Soils that are well drained, somewhat excessively drained, or excessively drained
- Soils that have a substratum of gravelly sand

Use and Management

Land use: Woodland

Major management concerns: Karlin—windthrow hazard;
 Croswell—equipment limitation, seedling mortality,
 windthrow hazard

Management measures:

- Because loose sand can interfere with the traction of wheeled equipment in areas of the Croswell soil, logging roads should be stabilized.
- Planting seedlings that can withstand droughty conditions in areas of the Croswell soil can lower the seedling mortality rate. Replanting is needed in some areas.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: IIIs

Woodland ordination symbol: Karlin—5A; Croswell—5S

Michigan soil management group: Karlin—4a;

Croswell—5a

Primary habitat type: TMV

Secondary habitat type: TMC

70B—Sundog-Channing very fine sandy loams, 0 to 6 percent slopes, rocky, stony

Setting

Landform and position on the landform: Sundog—undulating areas on outwash plains and stream terraces; Channing—drainageways on outwash plains and stream terraces

Shape of areas: Irregular

Size of areas: 5 to 100 acres

Typical Profile

Sundog

Surface layer:

0 to 4 inches—dark brown very fine sandy loam

Subsurface layer:

4 to 6 inches—gray very fine sandy loam

Subsoil:

6 to 15 inches—dark reddish brown and dark brown, friable very fine sandy loam

15 to 22 inches—brown, friable gravelly very fine sandy loam

Substratum:

22 to 43 inches—brown sand with bands of loamy sand
 43 to 60 inches—brown very gravelly sand with pockets of very fine sandy loam

Channing

Surface layer:

0 to 7 inches—dark brown very fine sandy loam

Subsurface layer:

7 to 9 inches—grayish brown very fine sandy loam

Subsoil:

9 to 24 inches—dark yellowish brown, mottled, friable very fine sandy loam

Substratum:

24 to 43 inches—strong brown and brown sand and loamy sand

43 to 60 inches—brown, stratified coarse sand and very gravelly sand

Soil Properties and Qualities

Depth class: Very deep

Rock fragments on the surface: Kind—stones and cobbles; percent of surface covered—0.01 to 0.1

Permeability: Sundog—moderate in the upper part and very rapid in the lower part; Channing—moderate in the upper part and very rapid in the lower part

Available water capacity: Low

Drainage class: Sundog—well drained; Channing—somewhat poorly drained

Seasonal high water table: Sundog—at a depth of more than 6 feet; Channing—0.5 foot to 1.5 feet below the surface at some time from November through May

Surface runoff: Slow

Flooding: None

Composition

Sundog soil and similar soils: 50 to 65 percent

Channing soil and similar soils: 20 to 35 percent

Rock outcrop: 1 to 10 percent

Contrasting inclusions: 10 to 15 percent

Inclusions

Contrasting inclusions:

- Karlin and Pence soils, which are more droughty than the major soils; in landscape positions similar to those of the Sundog soil
- The poorly drained Minocqua soils in depressions
- The somewhat poorly drained Au Gres soils, which are sand throughout; in landscape positions similar to those of the Channing soil

Similar inclusions:

- Soils that do not have a stony surface

Use and Management

Land use: Woodland

Major management concerns: Sundog—equipment limitation; Channing—equipment limitation, seedling mortality, windthrow hazard

Management measures:

- The use of equipment is briefly restricted in areas of the Sundog soil in spring and during other excessively

wet periods. Access is easiest during periods in winter when access roads are frozen.

- Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
- The seasonal high water table in areas of the Channing soil restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen or has an adequate snow cover.
- Areas of the better drained Sundog soil are more suitable sites for landings.
- Rock outcrops should be considered when planning road locations and landing sites.
- Special site preparation, such as bedding, can reduce the seedling mortality rate in areas of the Channing soil.
- Windthrow can be minimized in areas of the Channing soil by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: IIIs

Woodland ordination symbol: Sundog—2L; Channing—2W

Michigan soil management group: Sundog—3/5a; Channing—3/5b

Primary habitat type: TMV

Secondary habitat type: TMC-Vac

71D—Karlin-Vilas-Rock outcrop complex, 1 to 18 percent slopes, stony

Setting

Landform and position on the landform: Nearly level to rolling areas on outwash plains

Shape of areas: Irregular

Size of areas: 5 to 400 acres

Typical Profile

Karlin

Surface layer:

0 to 2 inches—black fine sandy loam

Subsurface layer:

2 to 3 inches—reddish gray fine sandy loam

Subsoil:

3 to 10 inches—brown, friable fine sandy loam

10 to 35 inches—brown and yellowish red, friable and very friable sandy loam and loamy sand

Substratum:

35 to 60 inches—brown sand

Vilas

Surface layer:

0 to 4 inches—dark reddish brown loamy sand

Subsurface layer:

4 to 5 inches—dark reddish gray loamy sand

Subsoil:

5 to 17 inches—dark reddish brown and dark brown, very friable loamy sand

17 to 24 inches—dark brown, loose sand

Substratum:

24 to 60 inches—brown and light brown sand

Soil Properties and Qualities

Depth class: Very deep

Rock fragments on the surface: Kind—stones and cobbles; percent of surface covered—0.01 to 0.1

Permeability: Karlin—moderately rapid in the upper part and rapid in the lower part; Vilas—rapid

Available water capacity: Low

Drainage class: Karlin—somewhat excessively drained; Vilas—excessively drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Karlin—medium; Vilas—slow

Flooding: None

Composition

Karlin soil and similar soils: 35 to 50 percent

Vilas soil and similar soils: 25 to 40 percent

Rock outcrop: 10 to 25 percent

Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Au Gres and moderately well drained Croswell and Karlin, moderately wet, soils in low, flat areas and on foot slopes
- Sarona soils, which are less droughty than the major soils; in landscape positions similar to those of the major soils

Similar inclusions:

- Soils that have a surface layer and subsoil of sand
- Soils that have a substratum of gravelly sand
- Areas that are not stony

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation on landings

Management measures:

- Although the equipment limitation is slight for most woodland operations, the nearly level and undulating

areas of the unit should be selected as sites for landings.

- The areas of Rock outcrop should be considered when road locations and landing sites are planned.

Interpretive Groups

Land capability classification: VIe

Woodland ordination symbol: Karlin—3A; Vilas—6A

Michigan soil management group: Karlin—4a; Vilas—5.3a

Primary habitat type: TM

Secondary habitat type: TMV

72B—Karlin fine sandy loam, 1 to 6 percent slopes

Setting

Landform and position on the landform: Nearly level and undulating areas on outwash plains, stream terraces, ground moraines, and end moraines

Shape of areas: Irregular or long and narrow

Size of areas: 5 to 400 acres

Typical Profile

Surface layer:

0 to 2 inches—black fine sandy loam

Subsurface layer:

2 to 3 inches—reddish gray fine sandy loam

Subsoil:

3 to 10 inches—brown, friable fine sandy loam

10 to 35 inches—brown and yellowish red, friable and very friable sandy loam and loamy sand

Substratum:

35 to 60 inches—brown sand

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderately rapid in the upper part, rapid in the lower part

Available water capacity: Low

Drainage class: Somewhat excessively drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow

Flooding: None

Composition

Karlin soil and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Au Gres and Channing soils in the lower landscape positions

- The well drained Sarona soils, which are less droughty than the Karlin soil; in landscape positions similar to those of the Karlin soil
- The excessively drained Vilas soils, which are more droughty than the Karlin soil; in landscape positions similar to those of the Karlin soil

Similar inclusions:

- Soils that have a substratum of gravelly sand

Use and Management

Land use: Dominant uses—woodland, cropland

Woodland

Major management concerns: None

Cropland

Major management concerns: Soil blowing, water erosion, low organic matter content, droughtiness

Management measures:

- Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
- Conservation tillage, grassed waterways, cover crops, and crop rotations that include grasses or legumes help to control water erosion.
- Contour farming and contour stripcropping reduce the runoff rate and the hazard of water erosion.
- No-till farming, crop residue management, and a cropping sequence that includes green manure crops increase the organic matter content.
- A system of conservation tillage that leaves crop residue on the surface is effective in conserving moisture.
- Irrigation water should be applied at a rate that ensures optimum production but does not increase deep percolation, the runoff rate, and the hazard of erosion.
- Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.

Interpretive Groups

Land capability classification: IIIs

Woodland ordination symbol: 3A

Michigan soil management group: 4a

Primary habitat type: TMV

Secondary habitat type: AQV

72D—Karlin fine sandy loam, 6 to 18 percent slopes

Setting

Landform and position on the landform: Rolling areas on

outwash plains, stream terraces, ground moraines, and end moraines

Shape of areas: Irregular

Size of areas: 5 to 1,000 acres

Typical Profile

Surface layer:

0 to 2 inches—black fine sandy loam

Subsurface layer:

2 to 3 inches—reddish gray fine sandy loam

Subsoil:

3 to 10 inches—brown, friable fine sandy loam

10 to 35 inches—brown and yellowish red, friable and very friable sandy loam and loamy sand

Substratum:

35 to 60 inches—brown sand

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderately rapid in the upper part, rapid in the lower part

Available water capacity: Low

Drainage class: Somewhat excessively drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Medium

Flooding: None

Composition

Karlin soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Au Gres and Channing soils on foot slopes and in drainageways
- The well drained Sarona soils, which are less droughty than the Karlin soil; in landscape positions similar to those of the Karlin soil
- The excessively drained Vilas soils, which are more droughty than the Karlin soil; in landscape positions similar to those of the Karlin soil

Similar inclusions:

- Soils that have a substratum of gravelly sand
- Soils that have bands of loamy sand in the substratum

Use and Management

Land use: Dominant uses—woodland, cropland

Woodland

Major management concerns: None

Management measures:

- Although the equipment limitation is slight for most woodland operations, the nearly level and undulating

areas of the unit should be selected as sites for landings.

Cropland

Major management concerns: Soil blowing, water erosion, low organic matter content, seasonal droughtiness

Management measures:

- Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
- Water erosion can be controlled by diversions, crop residue management, contour stripcropping, field stripcropping, cover crops, grassed waterways, conservation tillage, crop rotations, grade-stabilization structures, or a combination of these practices.
- No-till farming, crop residue management, and a cropping sequence that includes green manure crops increase the organic matter content.
- A system of conservation tillage that leaves crop residue on the surface is effective in conserving moisture.
- Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.

Interpretive Groups

Land capability classification: IVe

Woodland ordination symbol: 3A

Michigan soil management group: 4a

Primary habitat type: TMV

Secondary habitat type: AQV

72F—Karlin fine sandy loam, 18 to 35 percent slopes

Setting

Landform and position on the landform: Hilly areas on outwash plains, stream terraces, and end moraines

Shape of areas: Irregular

Size of areas: 5 to 60 acres

Typical Profile

Surface layer:

0 to 2 inches—black fine sandy loam

Subsurface layer:

2 to 3 inches—reddish gray fine sandy loam

Subsoil:

3 to 10 inches—brown, friable fine sandy loam

10 to 35 inches—brown and yellowish red, friable and very friable sandy loam and loamy sand

Substratum:

35 to 60 inches—brown sand

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderately rapid in the upper part, rapid in the lower part

Available water capacity: Low

Drainage class: Somewhat excessively drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Medium

Flooding: None

Composition

Karlin soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Inclusions*Contrasting inclusions:*

- The well drained Saronia soils, which are less droughty than the Karlin soil; in landscape positions similar to those of the Karlin soil
- The excessively drained Vilas soils, which are more droughty than the Karlin soil; in landscape positions similar to those of the Karlin soil
- Areas that have slopes of 35 to 50 percent

Similar inclusions:

- Soils that have a substratum of gravelly sand
- Soils that have bands of loamy sand in the substratum

Use and Management

Land use: Woodland

Major management concerns: Erosion hazard, equipment limitation

Management measures:

- Because of the erosion hazard, water should be removed from logging roads by water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures. Building logging roads on the contour or on the gentler slopes and seeding logging roads, skid roads, and landings after the trees are logged also help to prevent excessive soil loss.
- Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.
- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.

Interpretive Groups

Land capability classification: VIIe

Woodland ordination symbol: 3R

Michigan soil management group: 4a

Primary habitat type: TMV

Secondary habitat type: AQV

73A—Gaastra silt loam, 0 to 3 percent slopes, stony**Setting**

Landform and position on the landform: Nearly level areas on lake plains and ground moraines

Shape of areas: Long and narrow or irregular

Size of areas: 5 to 50 acres

Typical Profile*Organic mat:*

0 to 1 inch—black, well decomposed organic material

Surface layer:

1 to 4 inches—dark brown silt loam

Subsurface layer:

4 to 6 inches—brown, mottled silt loam

Subsoil:

6 to 51 inches—brown and dark yellowish brown, mottled, friable silt loam

Substratum:

51 to 60 inches—reddish brown silt loam

Soil Properties and Qualities

Depth class: Very deep

Rock fragments on the surface: Kind—stones and cobbles; percent of surface covered—0.01 to 0.1

Permeability: Moderately slow

Available water capacity: High

Drainage class: Somewhat poorly drained

Seasonal high water table: 1 to 2 feet below the surface at some time from November through May

Surface runoff: Slow

Flooding: None

Composition

Gaastra soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Inclusions*Contrasting inclusions:*

- The poorly drained Witbeck soils in depressions
- Channing soils, which are coarser textured and more droughty than the Gaastra soil; in landscape positions similar to those of the Gaastra soil
- Net soils, which have a shallower rooting depth than the Gaastra soil; in landscape positions similar to those of the Gaastra soil

Similar inclusions:

- Soils that are moderately well drained

Use and Management

Land use: Dominant uses—woodland, cropland

Woodland

Major management concerns: Equipment limitation, windthrow hazard

Management measures:

- Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
- The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen or has an adequate snow cover.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Cropland

Major management concerns: Soil blowing, seasonal wetness, tilth

Management measures:

- Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
- Tile drains can be used to reduce wetness if a suitable outlet is available.
- Fine sand and silt can plug tile lines. Tile drainage systems should be designed so that the rate of flowing water helps to keep the tile lines clean. Also, suitable filtering material may be needed to keep the silt and fine sand from flowing into the tile lines.
- Crop residue management, cover crops, green manure crops, proper use of manure, and conservation tillage help to maintain and improve tilth, the moisture-holding capacity, and organic matter content.
- Minimizing tillage and tilling at the proper soil moisture content help to maintain good tilth and prevent crusting.
- Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.
- Stones on the surface may interfere with the use of tillage and planting equipment and some harvesting equipment. Removing the stones minimizes wear on equipment.

Interpretive Groups

Land capability classification: IIIs

Woodland ordination symbol: 3W

Michigan soil management group: 2.5b

Primary habitat type: AVO-C1

Secondary habitat type: TMC

74A—Au Gres sand, 0 to 3 percent slopes

Setting

Landform and position on the landform: Drainageways on outwash plains and stream terraces

Shape of areas: Long and narrow or irregular

Size of areas: 5 to 50 acres

Typical Profile

Surface layer:

0 to 3 inches—very dark gray sand

Subsurface layer:

3 to 7 inches—brown sand

Subsoil:

7 to 32 inches—strong brown and brown, mottled, very friable sand

Substratum:

32 to 60 inches—dark yellowish brown sand with thin strata of coarse sand

Soil Properties and Qualities

Depth class: Very deep

Permeability: Rapid

Available water capacity: Low

Drainage class: Somewhat poorly drained

Seasonal high water table: 0.5 foot to 1.5 feet below the surface at some time from November through May

Surface runoff: Slow

Flooding: None

Composition

Au Gres soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:

- The poorly drained Kinross soils in depressions

Similar inclusions:

- Soils that are moderately well drained
- Soils that have a substratum of gravelly sand

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow hazard

Management measures:

- Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
- The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen or has an adequate snow cover.
- Special site preparation, such as bedding, can

reduce the seedling mortality rate.

- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: IVw

Woodland ordination symbol: 6W

Michigan soil management group: 5b

Primary habitat type: TMC-Vac

Secondary habitat type: TMC

75—Kinross muck

Setting

Landform and position on the landform: Depressions on outwash plains and stream terraces

Slope: 0 to 2 percent

Shape of areas: Long and narrow or irregular

Size of areas: 5 to 100 acres

Typical Profile

Surface layer:

0 to 5 inches—black muck

Subsurface layer:

5 to 20 inches—brown, mottled fine sand and loamy fine sand

Subsoil:

20 to 27 inches—dark brown, loose fine sand

27 to 40 inches—brown, loose fine sand

40 to 52 inches—brown, mottled, loose fine sand

Substratum:

52 to 60 inches—yellowish red fine sand

Soil Properties and Qualities

Depth class: Very deep

Permeability: Rapid

Available water capacity: Low

Drainage class: Very poorly drained

Seasonal high water table: 1 foot above to 1 foot below the surface at some time from September through June

Surface runoff: Slow or very slow

Flooding: None

Composition

Kinross soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Au Gres soils in the slightly higher positions on the landscape

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow hazard

Management measures:

- Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
- The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen or has an adequate snow cover.
- Site preparation, such as bedding, trenching, or mounding, can maximize growth and the seedling survival rate in new plantations.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: VIw

Woodland ordination symbol: 2W

Michigan soil management group: 5c-a

Primary habitat type: FMC

Secondary habitat type: None assigned

76—Ensley fine sandy loam, stony

Setting

Landform and position on the landform: Depressions on ground moraines and end moraines

Slope: 0 to 2 percent

Shape of areas: Irregular or long and narrow

Size of areas: 3 to 10 acres

Typical Profile

Surface layer:

0 to 3 inches—black fine sandy loam

Subsurface layer:

3 to 9 inches—dark grayish brown, mottled fine sandy loam

Subsoil:

9 to 20 inches—dark yellowish brown, mottled, friable fine sandy loam

Substratum:

20 to 30 inches—yellowish brown, mottled fine sandy loam

30 to 60 inches—brown and strong brown fine sandy loam

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderate in the upper part and moderately rapid in the lower part

Available water capacity: Moderate

Drainage class: Poorly drained

Seasonal high water table: Near the surface to 1 foot above the surface at some time from October through June

Surface runoff: Very slow or ponded

Flooding: None

Composition

Ensley soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Inclusions

Contrasting inclusions:

- The well drained Trenary and Sagola soils on low knolls
- The somewhat poorly drained Solona soils in the slightly higher landscape positions
- The very poorly drained Cathro soils in landscape positions similar to those of the Ensley soil

Similar inclusions:

- Soils that are loamy fine sand in the upper part of the subsoil

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow hazard

Management measures:

- Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
- The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen or has an adequate snow cover.
- Because of wetness, seedling mortality, and plant competition, trees are generally not planted in areas of this soil.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: Vw

Woodland ordination symbol: 2W

Michigan soil management group: 3c

Primary habitat type: FI

Secondary habitat type: TTS

77B—Vilas loamy sand, 1 to 6 percent slopes

Setting

Landform and position on the landform: Nearly level and undulating areas on outwash plains

Shape of areas: Irregular

Size of areas: 10 to 1,500 acres

Typical Profile

Surface layer:

0 to 4 inches—dark reddish brown loamy sand

Subsurface layer:

4 to 5 inches—dark reddish gray loamy sand

Subsoil:

5 to 17 inches—dark reddish brown and dark brown, very friable loamy sand

17 to 24 inches—dark brown, loose sand

Substratum:

24 to 60 inches—brown and light brown sand

Soil Properties and Qualities

Depth class: Very deep

Permeability: Rapid

Available water capacity: Low

Drainage class: Excessively drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow

Flooding: None

Composition

Vilas soil and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Au Gres and moderately well drained Croswell soils in low, flat areas
- Karlin and Pence soils, which are less droughty than the Vilas soil; in landscape positions similar to those of the Vilas soil

Similar inclusions:

- Soils that have a surface layer and subsoil of sand
- Soils that have a substratum of gravelly sand

Use and Management

Land use: Woodland

Major management concerns: None

Interpretive Groups

Land capability classification: IVs

Woodland ordination symbol: 6A

Michigan soil management group: 5.3a

Primary habitat type: AQV

Secondary habitat type: None assigned

77D—Vilas loamy sand, 6 to 18 percent slopes

Setting

Landform and position on the landform: Rolling areas on outwash plains

Shape of areas: Irregular

Size of areas: 5 to 500 acres

Typical Profile

Surface layer:

0 to 4 inches—dark reddish brown loamy sand

Subsurface layer:

4 to 5 inches—dark reddish gray loamy sand

Subsoil:

5 to 17 inches—dark reddish brown and dark brown, very friable loamy sand

17 to 24 inches—dark brown, loose sand

Substratum:

24 to 60 inches—brown and light brown sand

Soil Properties and Qualities

Depth class: Very deep

Permeability: Rapid

Available water capacity: Low

Drainage class: Excessively drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Medium

Flooding: None

Composition

Vilas soil and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Au Gres and moderately well drained Croswell soils in low, flat areas
- Karlin and Pence soils, which are less droughty than the Vilas soil; in landscape positions similar to those of the Vilas soil

Similar inclusions:

- Soils that have a surface layer and subsoil of sand
- Soils that have a substratum of gravelly sand

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation on landings

Management measures:

- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.

Interpretive Groups

Land capability classification: VIIs

Woodland ordination symbol: 6A

Michigan soil management group: 5.3a

Primary habitat type: AQV

Secondary habitat type: None assigned

78B—Vilas-Karlin complex, 1 to 6 percent slopes

Setting

Landform and position on the landform: Nearly level and undulating areas on outwash plains

Shape of areas: Irregular

Size of areas: 5 to 400 acres

Typical Profile

Vilas

Surface layer:

0 to 4 inches—dark reddish brown loamy sand

Subsurface layer:

4 to 5 inches—dark reddish gray loamy sand

Subsoil:

5 to 17 inches—dark reddish brown and dark brown, very friable loamy sand

17 to 24 inches—dark brown, loose sand

Substratum:

24 to 60 inches—brown and light brown sand

Karlin

Surface layer:

0 to 2 inches—black fine sandy loam

Subsurface layer:

2 to 3 inches—reddish gray fine sandy loam

Subsoil:

3 to 10 inches—brown, friable fine sandy loam

10 to 35 inches—brown and yellowish red, friable and very friable sandy loam and loamy sand

Substratum:

35 to 60 inches—brown sand

Soil Properties and Qualities

Depth class: Very deep

Permeability: Vilas—rapid; Karlin—moderately rapid in the upper part, rapid in the lower part

Available water capacity: Low

Drainage class: Vilas—excessively drained; Karlin—somewhat excessively drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow

Flooding: None

Composition

Vilas soil and similar soils: 40 to 60 percent

Karlin soil and similar soils: 35 to 50 percent

Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Au Gres soils and the moderately well drained Croswell and Karlin, moderately wet, soils in low, flat areas
- Sarona soils, which are less droughty than the major soils; in landscape positions similar to those of the major soils

Similar inclusions:

- Soils that have a surface layer and subsoil of sand
- Soils that have a substratum of gravelly sand

Use and Management

Land use: Woodland

Major management concerns: None

Interpretive Groups

Land capability classification: IVs

Woodland ordination symbol: Vilas—6A; Karlin—3A

Michigan soil management group: Vilas—5.3a; Karlin—4a

Primary habitat type: AQV

Secondary habitat type: TMV

78D—Vilas-Karlin complex, 6 to 18 percent slopes

Setting

Landform and position on the landform: Rolling areas on outwash plains

Shape of areas: Irregular

Size of areas: 5 to 1,000 acres

Typical Profile

Vilas

Surface layer:

0 to 4 inches—dark reddish brown loamy sand

Subsurface layer:

4 to 5 inches—dark reddish gray loamy sand

Subsoil:

5 to 17 inches—dark reddish brown and dark brown, very friable loamy sand

17 to 24 inches—dark brown, loose sand

Substratum:

24 to 60 inches—brown and light brown sand

Karlin

Surface layer:

0 to 2 inches—black fine sandy loam

Subsurface layer:

2 to 3 inches—reddish gray fine sandy loam

Subsoil:

3 to 10 inches—brown, friable fine sandy loam

10 to 35 inches—brown and yellowish red, friable and very friable sandy loam and loamy sand

Substratum:

35 to 60 inches—brown sand

Soil Properties and Qualities

Depth class: Very deep

Permeability: Vilas—rapid; Karlin—moderately rapid in the upper part, rapid in the lower part

Available water capacity: Low

Drainage class: Vilas—excessively drained; Karlin—somewhat excessively drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Medium

Flooding: None

Composition

Vilas soil and similar soils: 40 to 60 percent

Karlin soil and similar soils: 35 to 50 percent

Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Au Gres soils and the moderately well drained Croswell and Karlin, moderately wet, soils in low, flat areas
- Sarona soils, which are less droughty than the major soils; in landscape positions similar to those of the major soils

Similar inclusions:

- Soils that have a substratum of loamy sand
- Soils that have a substratum of gravelly sand

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation on landings

Management measures:

- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.

Interpretive Groups

Land capability classification: VIIs

Woodland ordination symbol: Vilas—6A; Karlin—3A
Michigan soil management group: Vilas—5.3a; Karlin—4a
Primary habitat type: AQV
Secondary habitat type: TMV

78F—Vilas-Karlin complex, 18 to 35 percent slopes

Setting

Landform and position on the landform: Hilly areas on outwash plains
Shape of areas: Irregular
Size of areas: 5 to 60 acres

Typical Profile

Vilas

Surface layer:
0 to 4 inches—dark reddish brown loamy sand
Subsurface layer:
4 to 5 inches—dark reddish gray loamy sand
Subsoil:
5 to 17 inches—dark reddish brown and dark brown, very friable loamy sand
17 to 24 inches—dark brown, loose sand
Substratum:
24 to 60 inches—brown and light brown sand

Karlin

Surface layer:
0 to 2 inches—black fine sandy loam
Subsurface layer:
2 to 3 inches—reddish gray fine sandy loam
Subsoil:
3 to 10 inches—brown, friable fine sandy loam
10 to 35 inches—brown and yellowish red, friable and very friable sandy loam and loamy sand
Substratum:
35 to 60 inches—brown sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Vilas—rapid; Karlin—moderately rapid in the upper part, rapid in the lower part
Available water capacity: Low
Drainage class: Vilas—excessively drained; Karlin—somewhat excessively drained
Seasonal high water table: At a depth of more than 6 feet
Surface runoff: Medium
Flooding: None

Composition

Vilas soil and similar soils: 45 to 60 percent
 Karlin soil and similar soils: 35 to 50 percent
 Contrasting inclusions: 5 percent

Inclusions

Contrasting inclusions:

- Sarona soils, which are less droughty than the major soils; in landscape positions similar to those of the major soils
- Soils that have slopes of 35 to 50 percent

Similar inclusions:

- Soils that have a substratum of loamy sand
- Soils that have a substratum of gravelly sand

Use and Management

Land use: Woodland

Major management concerns: Erosion hazard, equipment limitation

Management measures:

- Because of the erosion hazard, water should be removed from logging roads by water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures. Building logging roads on the contour or on the gentler slopes and seeding logging roads, skid roads, and landings after the trees are logged also help to prevent excessive soil loss.
- Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.

Interpretive Groups

Land capability classification: VIIIs
Woodland ordination symbol: Vilas—6R; Karlin—3R
Michigan soil management group: Vilas—5.3a; Karlin—4a
Primary habitat type: AQV
Secondary habitat type: TMV

79A—Fence silt loam, 1 to 2 percent slopes

Setting

Landform and position on the landform: Nearly level areas on outwash plains and ground moraines
Shape of areas: Irregular
Size of areas: 10 to 80 acres

Typical Profile

Surface layer:
0 to 2 inches—very dark gray silt loam
Subsurface layer:
2 to 5 inches—brown silt loam

Subsoil:

5 to 9 inches—dark brown, friable silt loam
 9 to 41 inches—brown and reddish brown, mottled, firm and friable silt loam

Substratum:

41 to 60 inches—reddish brown, mottled very fine sandy loam

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderately slow

Available water capacity: High

Drainage class: Moderately well drained

Seasonal high water table: 2 to 6 feet below the surface at some time from November through May

Surface runoff: Slow

Flooding: None

Composition

Fence soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Inclusions*Contrasting inclusions:*

- The somewhat poorly drained Gaastra soils in the lower landscape positions
- Stambaugh soils, which have a substratum of gravelly sand; in landscape positions similar to those of the Fence soil
- Wabeno soils, which have a shallower rooting depth than the Fence soil; in landscape positions similar to those of the Fence soil

Similar inclusions:

- Soils that are well drained
- Soils that have slopes of 2 to 6 percent

Use and Management

Land use: Dominant uses—woodland, cropland

Woodland

Major management concerns: Equipment limitation

Management measures:

- The use of equipment is briefly restricted in spring and during other excessively wet periods. Access is easiest during periods in winter when access roads are frozen.

Cropland

Major management concerns: Soil blowing, low organic matter content, seasonal wetness, tilth

Management measures:

- Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
- No-till farming, crop residue management, and a

cropping sequence that includes green manure crops increase the organic matter content.

- Generally, only low areas and drainageways need tile drainage, but some level areas may need a grid system of tile drainage.
- Subsurface drainage systems should be designed so that the rate of flowing water helps to keep fine sand and silt from plugging the tile lines. Also, suitable filtering material may be needed to keep the silt and fine sand from flowing into the tile lines.
- Minimizing tillage and tilling at the proper soil moisture content help to maintain good tilth and prevent crusting.
- Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.

Interpretive Groups

Land capability classification: I

Woodland ordination symbol: 3L

Michigan soil management group: 3a

Primary habitat type: AVO

Secondary habitat type: AOC

79B—Fence silt loam, 2 to 6 percent slopes**Setting**

Landform and position on the landform: Undulating areas on outwash plains and ground moraines

Shape of areas: Irregular

Size of areas: 5 to 80 acres

Typical Profile*Surface layer:*

0 to 2 inches—very dark gray silt loam

Subsurface layer:

2 to 5 inches—brown silt loam

Subsoil:

5 to 9 inches—dark brown, friable silt loam

9 to 41 inches—brown and reddish brown, mottled, firm and friable silt loam

Substratum:

41 to 60 inches—reddish brown, mottled very fine sandy loam

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderately slow

Available water capacity: High

Drainage class: Moderately well drained

Seasonal high water table: 2 to 6 feet below the surface at some time from November through May

Surface runoff: Slow

Flooding: None

Composition

Fence soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Gaastra soils in the lower landscape positions
- Stambaugh soils that have a substratum of gravelly sand; in landscape positions similar to those of the Fence soil
- Wabeno soils, which have a shallower rooting depth than the Fence soil; in landscape positions similar to those of the Fence soil

Similar inclusions:

- Soils that are well drained

Use and Management

Land use: Dominant uses—woodland, cropland

Woodland

Major management concerns: Equipment limitation

Management measures:

- The use of equipment is briefly restricted in spring and during other excessively wet periods. Access is easiest during periods in winter when access roads are frozen.

Cropland

Major management concerns: Soil blowing, water erosion, low organic matter content, seasonal wetness, tilth

Management measures:

- Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
- Conservation tillage, grassed waterways, cover crops, and crop rotations that include grasses or legumes help to control water erosion.
- Contour farming and contour stripcropping reduce the runoff rate and the hazard of water erosion.
- No-till farming, crop residue management, and a cropping sequence that includes green manure crops increase the organic matter content.
- Generally, only low areas and drainageways need tile drainage, but some level areas may need a grid system of tile drainage.
- Subsurface drainage systems should be designed so that the rate of flowing water helps to keep fine sand and silt from plugging the tile lines. Also, suitable filtering material may be needed to keep the silt and fine sand from flowing into the tile lines.
- Minimizing tillage and tilling at the proper soil moisture content help to maintain good tilth and prevent crusting.
- Returning crop residue to the soil, adding other

organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.

Interpretive Groups

Land capability classification: IIe

Woodland ordination symbol: 3L

Michigan soil management group: 3a

Primary habitat type: AVO

Secondary habitat type: AOC

79D—Fence silt loam, 6 to 18 percent slopes

Setting

Landform and position on the landform: Rolling areas on outwash plains and ground moraines

Shape of areas: Irregular

Size of areas: 5 to 20 acres

Typical Profile

Surface layer:

0 to 2 inches—very dark gray silt loam

Subsurface layer:

2 to 5 inches—brown silt loam

Subsoil:

5 to 9 inches—dark brown, friable silt loam

9 to 41 inches—brown and reddish brown, firm and friable silt loam

Substratum:

41 to 60 inches—reddish brown very fine sandy loam

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderately slow

Available water capacity: High

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Medium

Flooding: None

Composition

Fence soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Gaastra soils on foot slopes and in drainageways
- Stambaugh soils that have a substratum of gravelly sand; in landscape positions similar to those of the Fence soil
- Wabeno soils, which have a shallower rooting depth

than the Fence soil; in landscape positions similar to those of the Fence soil

- Soils that have slopes of 18 to 30 percent

Use and Management

Land use: Dominant uses—woodland, cropland

Woodland

Major management concerns: Equipment limitation

Management measures:

- The use of equipment is briefly restricted in spring and during other excessively wet periods. Access is easiest during periods in winter when access roads are frozen.
- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.

Cropland

Major management concerns: Soil blowing, water erosion, low organic matter content, tilth

Management measures:

- Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
- Water erosion can be controlled by diversions, crop residue management, contour stripcropping, field stripcropping, cover crops, grassed waterways, conservation tillage, crop rotations, grade-stabilization structures, or a combination of these practices.
- No-till farming, crop residue management, and a cropping sequence that includes green manure crops increase the organic matter content.
- Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.
- Minimizing tillage and tilling at the proper soil moisture content help to maintain good tilth and prevent crusting.

Interpretive Groups

Land capability classification: IIIe

Woodland ordination symbol: 3L

Michigan soil management group: 3a

Primary habitat type: AVO

Secondary habitat type: AOC

80B—Pence fine sandy loam, 1 to 6 percent slopes

Setting

Landform: Nearly level and undulating areas on outwash plains, stream terraces, and eskers

Shape of areas: Irregular

Size of areas: 5 to 1,200 acres

Typical Profile

Organic mat:

0 to 1 inch—black, partially decomposed forest litter

Subsurface layer:

1 to 4 inches—light brownish gray fine sandy loam

Subsoil:

4 to 20 inches—dark brown, friable fine sandy loam and sandy loam

20 to 33 inches—strong brown, loose gravelly sand

Substratum:

33 to 60 inches—dark yellowish brown, stratified gravelly coarse sand and sand

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderately rapid in the upper part and rapid or very rapid in the lower part

Available water capacity: Low

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow

Flooding: None

Composition

Pence soil and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Channing soils in the lower landscape positions
- Sundog and Padus soils, which are less droughty than the Pence soil; in landscape positions similar to those of the Pence soil
- Vilas soils, which are more droughty than the Pence soil; in landscape positions similar to those of the Pence soil

Similar inclusions:

- Soils that have a substratum of sand

Use and Management

Land use: Dominant uses—woodland, cropland

Woodland

Major management concerns: None

Cropland

Major management concerns: Soil blowing, water erosion, low organic matter content, seasonal droughtiness, tilth

Management measures:

- Conservation tillage, crop residue management,

strip cropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.

- Conservation tillage, grassed waterways, cover crops, and crop rotations that include grasses or legumes help to control water erosion.
- Contour farming and contour strip cropping reduce the runoff rate and the hazard of water erosion.
- No-till farming, crop residue management, and a cropping sequence that includes green manure crops increase the organic matter content.
- A system of conservation tillage that leaves crop residue on the surface is effective in conserving moisture.
- Irrigation water should be applied at a rate that ensures optimum production but does not increase deep percolation, the runoff rate, and the hazard of erosion.
- Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.
- Minimizing tillage and tilling at the proper soil moisture content help to maintain good tilth and prevent crusting.

Interpretive Groups

Land capability classification: IIIe

Woodland ordination symbol: 3A

Michigan soil management group: 4a-a

Primary habitat type: TMV

Secondary habitat type: AQV

80D—Pence fine sandy loam, 6 to 18 percent slopes

Setting

Landform and position on the landform: Rolling areas on outwash plains, stream terraces, and eskers

Shape of areas: Irregular or long and narrow

Size of areas: 5 to 400 acres

Typical Profile

Organic mat:

0 to 1 inch—black, partially decomposed forest litter

Subsurface layer:

1 to 4 inches—light brownish gray fine sandy loam

Subsoil:

4 to 20 inches—dark brown, friable fine sandy loam and sandy loam

20 to 33 inches—strong brown, loose gravelly sand

Substratum:

33 to 60 inches—dark yellowish brown, stratified gravelly coarse sand and sand

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderately rapid in the upper part and rapid or very rapid in the lower part

Available water capacity: Low

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Medium

Flooding: None

Composition

Pence soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Channing soils in drainageways and depressions
- Sundog, Sarona, and Padus soils, which are less droughty than the Pence soil; on foot slopes and in low, flat areas
- Vilas soils, which are more droughty than the Pence soil; in landscape positions similar to those of the Pence soil

Similar inclusions:

- Soils that have a substratum of sand

Use and Management

Land use: Dominant uses—woodland, cropland

Woodland

Major management concerns: Equipment limitation on landings

Management measures:

- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.

Cropland

Major management concerns: Soil blowing, water erosion, low organic matter content, droughtiness, tilth

Management measures:

- Conservation tillage, crop residue management, strip cropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
- Water erosion can be controlled by diversions, crop residue management, contour strip cropping, field strip cropping, cover crops, grassed waterways, conservation tillage, crop rotations, grade-stabilization structures, or a combination of these practices.
- No-till farming, crop residue management, and a cropping sequence that includes green manure crops

increase the organic matter content.

- A system of conservation tillage that leaves crop residue on the surface is effective in conserving moisture.
- Irrigation water should be applied at a rate that ensures optimum production but does not increase deep percolation, the runoff rate, and the hazard of erosion.
- Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.
- Minimizing tillage and tilling at the proper soil moisture content help to maintain good tilth and prevent crusting.

Interpretive Groups

Land capability classification: VIe

Woodland ordination symbol: 3A

Michigan soil management group: 4a-a

Primary habitat type: TMV

Secondary habitat type: AQV

80F—Pence fine sandy loam, 18 to 35 percent slopes

Setting

Landform and position on the landform: Hilly areas on outwash plains, stream terraces, and eskers

Shape of areas: Irregular or long and narrow

Size of areas: 5 to 40 acres

Typical Profile

Organic mat:

0 to 1 inch—black, partially decomposed forest litter

Subsurface layer:

1 to 4 inches—light brownish gray fine sandy loam

Subsoil:

4 to 20 inches—dark brown, friable fine sandy loam and sandy loam

20 to 33 inches—strong brown, loose gravelly sand

Substratum:

33 to 60 inches—dark yellowish brown, stratified gravelly coarse sand and sand

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderately rapid in the upper part and rapid or very rapid in the lower part

Available water capacity: Low

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Rapid

Flooding: None

Composition

Pence soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Channing soils in drainageways and depressions
- Sundog, Sarona, and Padus soils, which are less droughty than the Pence soil; on foot slopes and in low, flat areas
- Vilas soils, which are more droughty than the Pence soil; in landscape positions similar to those of the Pence soil

Similar inclusions:

- Soils that have a substratum of sand

Use and Management

Land use: Woodland

Major management concerns: Erosion hazard, equipment limitation

Management measures:

- Because of the erosion hazard, water should be removed from logging roads by water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures. Building logging roads on the contour or on the gentler slopes and seeding logging roads, skid roads, and landings after the trees are logged also help to prevent excessive soil loss.
- Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.
- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.

Interpretive Groups

Land capability classification: VIIe

Woodland ordination symbol: 3R

Michigan soil management group: 4a-a

Primary habitat type: TMV

Secondary habitat type: AQV

82B—Keweenaw loamy fine sand, 1 to 6 percent slopes

Setting

Landform and position on the landform: Nearly level and undulating areas on ground moraines and end moraines

Shape of areas: Irregular

Size of areas: 5 to 120 acres

Typical Profile

Surface layer:

0 to 1 inch—black loamy fine sand

Subsurface layer:

1 to 6 inches—brown loamy fine sand

Subsoil:

6 to 33 inches—yellowish red, very friable loamy fine sand and loamy sand

33 to 39 inches—brown and dark reddish brown, friable loamy sand and sandy loam

39 to 60 inches—strong brown, very friable loamy sand with bands of yellowish red sandy loam

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderate or moderately rapid

Available water capacity: Low

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow

Flooding: None

Composition

Keweenaw soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Channing and Au Gres soils in the lower landscape positions
- Sarona soils, which are less droughty than the Keweenaw soil; in landscape positions similar to those of the Keweenaw soil
- Pence and Karlin soils, which are more droughty than the Keweenaw soil; in landscape positions similar to those of the Keweenaw soil

Use and Management

Land use: Dominant uses—woodland, cropland

Woodland

Major management concerns: None

Cropland

Major management concerns: Soil blowing, water erosion, low organic matter content, seasonal droughtiness

Management measures:

- Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.

- Conservation tillage, grassed waterways, cover crops, and crop rotations that include grasses or legumes help to control water erosion.

- Contour farming and contour stripcropping reduce the runoff rate and the hazard of water erosion.

- No-till farming, crop residue management, and a cropping sequence that includes green manure crops increase the organic matter content.

- A system of conservation tillage that leaves crop residue on the surface is effective in conserving moisture.

- Irrigation water should be applied at a rate that ensures optimum production but does not increase deep percolation, the runoff rate, and the hazard of erosion.

Interpretive Groups

Land capability classification: IIIe

Woodland ordination symbol: 3A

Michigan soil management group: 4a-a.

Primary habitat type: TM

Secondary habitat type: None assigned

82D—Keweenaw loamy fine sand, 6 to 18 percent slopes

Setting

Landform and position on the landform: Rolling areas on ground moraines and end moraines

Shape of areas: Irregular

Size of areas: 5 to 600 acres

Typical Profile

Surface layer:

0 to 1 inch—black loamy fine sand

Subsurface layer:

1 to 6 inches—brown loamy fine sand

Subsoil:

6 to 33 inches—yellowish red, very friable loamy fine sand and loamy sand

33 to 39 inches—brown and dark reddish brown, friable loamy sand and sandy loam

39 to 60 inches—strong brown, very friable loamy sand with bands of yellowish red sandy loam

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderate or moderately rapid

Available water capacity: Low

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow

Flooding: None

Composition

Keweenaw soil and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Channing and Au Gres soils on foot slopes and in drainageways
- Saronas soils, which are less droughty than the Keweenaw soil; in landscape positions similar to those of the Keweenaw soil
- Pence and Karlin soils, which are more droughty than the Keweenaw soil; in landscape positions similar to those of the Keweenaw soil

Use and Management

Land use: Dominant uses—woodland, cropland

Woodland

Major management concerns: Equipment limitation on landings

Management measures:

- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.

Cropland

Major management concerns: Soil blowing, water erosion, low organic matter content, seasonal droughtiness

Management measures:

- Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
- Water erosion can be controlled by diversions, crop residue management, contour stripcropping, field stripcropping, cover crops, grassed waterways, conservation tillage, crop rotations, grade-stabilization structures, or a combination of these practices.
- No-till farming, crop residue management, and a cropping sequence that includes green manure crops increase the organic matter content.
- A system of conservation tillage that leaves crop residue on the surface is effective in conserving moisture.

Interpretive Groups

Land capability classification: IVE

Woodland ordination symbol: 3A

Michigan soil management group: 4a-a

Primary habitat type: TM

Secondary habitat type: None assigned

82F—Keweenaw loamy fine sand, 18 to 35 percent slopes

Setting

Landform and position on the landform: Hilly areas on ground moraines and end moraines

Shape of areas: Irregular

Size of areas: 5 to 40 acres

Typical Profile

Surface layer:

0 to 1 inch—black loamy fine sand

Subsurface layer:

1 to 6 inches—brown loamy fine sand

Subsoil:

6 to 33 inches—yellowish red, very friable loamy fine sand and loamy sand

33 to 39 inches—brown and dark reddish brown, friable loamy sand and sandy loam

39 to 60 inches—strong brown, very friable loamy sand with bands of yellowish red sandy loam

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderate or moderately rapid

Available water capacity: Low

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Medium

Flooding: None

Composition

Keweenaw soil and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Channing and Au Gres soils on foot slopes and in drainageways
- Areas that have slopes of 35 to 45 percent
- Saronas soils, which are less droughty than the Keweenaw soil; in landscape positions similar to those of the Keweenaw soil
- Pence and Karlin soils, which are more droughty than the Keweenaw soil; in landscape positions similar to those of the Keweenaw soil

Use and Management

Land use: Woodland

Major management concerns: Erosion hazard, equipment limitation

Management measures:

- Because of the erosion hazard, water should be removed from logging roads by water bars, out-sloping

or in-sloping road surfaces, culverts, and drop structures. Building logging roads on the contour or on the gentler slopes and seeding logging roads, skid roads, and landings after the trees are logged also help to prevent excessive soil loss.

- Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.
- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.

Interpretive Groups

Land capability classification: VIIe

Woodland ordination symbol: 3R

Michigan soil management group: 4a-a

Primary habitat type: TM

Secondary habitat type: None assigned

100B—Keweenaw-Karlin complex, 1 to 6 percent slopes

Setting

Landform and position on the landform: Nearly level and undulating areas on ground moraines and end moraines

Shape of areas: Irregular

Size of areas: 5 to 200 acres

Typical Profile

Keweenaw

Surface layer:

0 to 1 inch—black loamy fine sand

Subsurface layer:

1 to 6 inches—brown loamy fine sand

Subsoil:

6 to 33 inches—yellowish red, very friable loamy fine sand and loamy sand

33 to 39 inches—brown and dark reddish brown, friable loamy sand and sandy loam

39 to 60 inches—strong brown, very friable loamy sand with bands of yellowish red sandy loam

Karlin

Surface layer:

0 to 2 inches—black fine sandy loam

Subsurface layer:

2 to 3 inches—reddish gray fine sandy loam

Subsoil:

3 to 10 inches—brown, friable fine sandy loam

10 to 35 inches—brown and yellowish red, friable and very friable sandy loam and loamy sand

Substratum:

35 to 60 inches—brown sand

Soil Properties and Qualities

Depth class: Very deep

Permeability: Keweenaw—moderate or moderately rapid; Karlin—moderately rapid in the upper part, rapid in the lower part

Available water capacity: Low

Drainage class: Keweenaw—well drained; Karlin—somewhat excessively drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow

Flooding: None

Composition

Keweenaw soil and similar soils: 50 to 55 percent

Karlin soil and similar soils: 30 to 40 percent

Contrasting inclusions: 10 to 15 percent

Inclusions

Contrasting inclusions:

- Sarona soils, which are less droughty than the major soils; in landscape positions similar to those of the major soils
- The moderately well drained Croswell soils and the moderately well drained, moderately wet Karlin soils; in drainageways

Similar inclusions:

- Soils that have a substratum of gravelly sand

Use and Management

Land use: Dominant uses—woodland, cropland

Woodland

Major management concerns: None

Cropland

Major management concerns: Soil blowing, water erosion, low organic matter content, seasonal droughtiness

Management measures:

- Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
- Conservation tillage, grassed waterways, cover crops, and crop rotations that include grasses or legumes help to control water erosion.
- Contour farming and contour stripcropping reduce the runoff rate and the hazard of water erosion.
- No-till farming, crop residue management, and a cropping sequence that includes green manure crops increase the organic matter content.
- A system of conservation tillage that leaves crop

residue on the surface is effective in conserving moisture.

- Irrigation water should be applied at a rate that ensures optimum production but does not increase deep percolation, the runoff rate, and the hazard of erosion.
- Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability; and the rate of water infiltration.

Interpretive Groups

Land capability classification: IIIe

Woodland ordination symbol: Keweenaw—3A; Karlin—3A

Michigan soil management group: Keweenaw—4a-a; Karlin—4a

Primary habitat type: TM

Secondary habitat type: TMV

100D—Keweenaw-Karlin complex, 6 to 18 percent slopes

Setting

Landform and position on the landform: Rolling areas on ground moraines and end moraines

Shape of areas: Irregular

Size of areas: 5 to 700 acres

Typical Profile

Keweenaw

Surface layer:

0 to 1 inch—black loamy fine sand

Subsurface layer:

1 to 6 inches—brown loamy fine sand

Subsoil:

6 to 33 inches—yellowish red, very friable loamy fine sand and loamy sand

33 to 39 inches—brown and dark reddish brown, friable loamy sand and sandy loam

39 to 60 inches—strong brown, very friable loamy sand with bands of yellowish red sandy loam

Karlin

Surface layer:

0 to 2 inches—black fine sandy loam

Subsurface layer:

2 to 3 inches—reddish gray fine sandy loam

Subsoil:

3 to 10 inches—brown, friable fine sandy loam

10 to 35 inches—brown and yellowish red, friable and very friable sandy loam and loamy sand

Substratum:

35 to 60 inches—brown sand

Soil Properties and Qualities

Depth class: Very deep

Permeability: Keweenaw—moderate or moderately rapid; Karlin—moderately rapid in the upper part, rapid in the lower part

Available water capacity: Low

Drainage class: Keweenaw—well drained; Karlin—somewhat excessively drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow

Flooding: None

Composition

Keweenaw soil and similar soils: 50 to 60 percent

Karlin soil and similar soils: 30 to 40 percent

Contrasting inclusions: 10 percent

Inclusions

Contrasting inclusions:

- Sarona soils, which are less droughty than the major soils; in landscape positions similar to those of the major soils
- The somewhat poorly drained Channing and Au Gres soils on foot slopes and in drainageways
- Areas that have slopes of 18 to 30 percent

Similar inclusions:

- Soils that have a substratum of gravelly sand

Use and Management

Land use: Dominant uses—woodland, cropland

Woodland

Major management concerns: Equipment limitation on landings

Management measures:

- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.

Cropland

Major management concerns: Soil blowing, water erosion, low organic matter content, seasonal droughtiness

Management measures:

- Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
- Water erosion can be controlled by diversions, crop residue management, contour stripcropping, field stripcropping, cover crops, grassed waterways, conservation tillage, crop rotations, grade-stabilization

structures, or a combination of these practices.

- No-till farming, crop residue management, and a cropping sequence that includes green manure crops increase the organic matter content.
- A system of conservation tillage that leaves crop residue on the surface is effective in conserving moisture.
- Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.

Interpretive Groups

Land capability classification: IVE

Woodland ordination symbol: Keweenaw—3A; Karlin—3A

Michigan soil management group: Keweenaw—4a-a; Karlin—4a

Primary habitat type: TM

Secondary habitat type: TMV

101B—Trenary-Solona complex, 0 to 6 percent slopes, stony

Setting

Landform and position on the landform: Trenary—undulating areas on ground moraines; Solona—drainageways on ground moraines

Shape of areas: Irregular

Size of areas: 5 to 30 acres

Typical Profile

Trenary

Surface layer:

0 to 4 inches—black fine sandy loam

Subsurface layer:

4 to 5 inches—brown fine sandy loam

Subsoil:

5 to 12 inches—dark brown, friable fine sandy loam

12 to 23 inches—dark reddish brown and brown, firm sandy loam and loamy sand

23 to 36 inches—dark reddish brown and reddish brown, friable loam and loamy sand

Substratum:

36 to 60 inches—reddish brown sandy loam

Solona

Surface layer:

0 to 6 inches—black very fine sandy loam

Subsurface layer:

6 to 12 inches—brown, mottled very fine sandy loam

Subsoil:

12 to 30 inches—brown, mottled, friable very fine sandy loam

30 to 36 inches—yellowish red and brown, friable loam and loamy sand

Substratum:

36 to 60 inches—yellowish red sandy loam

Soil Properties and Qualities

Depth class: Very deep

Rock fragments on the surface: Kind—stones and cobbles; percent of surface covered—0.01 to 0.1

Permeability: Moderate

Available water capacity: Moderate

Drainage class: Trenary—well drained; Solona—somewhat poorly drained

Seasonal high water table: Trenary—at a depth of more than 6 feet; Solona—1 to 3 feet below the surface at some time from March through July

Surface runoff: Slow

Flooding: None

Composition

Trenary soil and similar soils: 50 to 65 percent

Solona soil and similar soils: 25 to 35 percent

Contrasting inclusions: 10 to 15 percent

Inclusions

Contrasting inclusions:

- Escanaba and Karlin soils, which are coarser textured than the major soils; in landscape positions similar to those of the major soils
- The poorly drained Witbeck and very poorly drained Cathro soils in depressions

Similar inclusions:

- Soils that have gravelly sand at a depth of 40 to 60 inches

Use and Management

Land use: Dominant uses—woodland, cropland

Woodland

Major management concerns: Trenary—equipment limitation; Solona—equipment limitation, windthrow hazard

Management measures:

- The use of equipment is briefly restricted in spring and during other excessively wet periods in areas of the Trenary soil. Access is easiest during periods in winter when access roads are frozen.
- The seasonal high water table in areas of the Solona soil restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen or has an adequate snow cover.
- Year-round logging roads require roadfill and gravel.

Culverts are needed to maintain the natural drainage system.

- Windthrow in areas of the Solona soil can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Cropland

Major management concerns: Trenary—soil blowing, water erosion, low organic matter content, and tith; Solona—soil blowing, seasonal wetness, and tith

Management measures:

- Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
- In areas of the Trenary soil, conservation tillage, grassed waterways, cover crops, and crop rotations that include grasses or legumes help to control water erosion.
- In areas of the Trenary soil, contour farming and contour stripcropping reduce the runoff rate and the hazard of water erosion.
- In areas of the Trenary soil, no-till farming, crop residue management, and a cropping sequence that includes green manure crops increase the organic matter content.
- Using tile drains in areas of the Solona soil can reduce wetness if a suitable outlet is available.
- Minimizing tillage and tilling at the proper soil moisture content help to maintain good tith and prevent crusting.
- Stones on the surface may interfere with the use of tillage and planting equipment and some harvesting equipment. Removing the stones minimizes wear on equipment.

Interpretive Groups

Land capability classification: IIIs

Woodland ordination symbol: Trenary—3L; Solona—3W

Michigan soil management group: Trenary—3a; Solona—3b

Primary habitat type: ATD

Secondary habitat type: TMC

102B—Escanaba loamy fine sand, 1 to 6 percent slopes

Setting

Landform and position on the landform: Nearly level and undulating areas on ground moraines and end moraines

Shape of areas: Irregular

Size of areas: 5 to 50 acres

Typical Profile

Surface layer:

0 to 1 inch—black loamy fine sand

Subsurface layer:

1 to 9 inches—reddish gray loamy fine sand

Subsoil:

9 to 28 inches—dark reddish brown and strong brown, very friable and friable loamy fine sand

28 to 36 inches—reddish brown and dark reddish gray, firm fine sandy loam and loamy fine sand

36 to 49 inches—dark reddish brown, friable fine sandy loam

Substratum:

49 to 60 inches—reddish brown fine sandy loam

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderately rapid in the upper part and moderate in the lower part

Available water capacity: Moderate

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow

Flooding: None

Composition

Escanaba soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Inclusions

Contrasting inclusions:

- Karlin soils, which are more droughty than the Escanaba soil; in landscape positions similar to those of the Escanaba soil
- Trenary soils, which are less droughty than the Escanaba soil; in landscape positions similar to those of the Escanaba soil
- The moderately well drained, moderately wet Karlin soils in low, flat areas

Similar inclusions:

- Soils that have slopes of 6 to 12 percent

Use and Management

Land use: Dominant uses—woodland, cropland

Woodland

Major management concerns: Equipment limitation, seedling mortality

Management measures:

- Because loose sand can interfere with the traction of wheeled equipment, logging roads should be stabilized.
- Planting seedlings that can withstand droughty conditions can lower the seedling mortality rate.

Replanting is needed in some areas.

Cropland

Major management concerns: Soil blowing, water erosion, low organic matter content

Management measures:

- Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
- Conservation tillage, grassed waterways, cover crops, and crop rotations that include grasses or legumes help to control water erosion.
- No-till farming, crop residue management, and a cropping sequence that includes green manure crops increase the organic matter content.
- Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.

Interpretive Groups

Land capability classification: IIIs

Woodland ordination symbol: 3S

Michigan soil management group: 4/2a

Primary habitat type: TM

Secondary habitat type: None assigned

103B—Wabeno-Sarona complex, 1 to 6 percent slopes, stony

Setting

Landform and position on the landform: Nearly level and undulating areas on ground moraines and end moraines

Shape of areas: Irregular

Size of areas: 5 to 1,000 acres

Typical Profile

Wabeno

Surface layer:

0 to 2 inches—black silt loam

Subsurface layer:

2 to 4 inches—brown silt loam

Subsoil:

4 to 23 inches—dark brown and brown, friable silt loam
23 to 32 inches—dark brown and brown, mottled, friable silt loam

32 to 42 inches—a fragipan of dark brown and brown, mottled, very firm very fine sandy loam

42 to 50 inches—a fragipan of reddish brown, very firm sandy loam

Substratum:

50 to 60 inches—brown sandy loam

Sarona

Surface layer:

0 to 2 inches—very dark gray fine sandy loam

Subsurface layer:

2 to 7 inches—brown fine sandy loam

Subsoil:

7 to 33 inches—dark brown and brown, friable fine sandy loam and loamy fine sand

33 to 37 inches—dark brown, friable loam

Substratum:

37 to 60 inches—reddish brown gravelly sandy loam

Soil Properties and Qualities

Depth class: Very deep

Rock fragments on the surface: Kind—stones and cobbles; percent of surface covered—0.01 to 0.1

Permeability: Wabeno—moderate in the upper part, moderately slow in the fragipan, and moderate in the lower part; Sarona—moderate

Available water capacity: Moderate

Drainage class: Wabeno—moderately well drained; Sarona—well drained

Seasonal high water table: Wabeno—perched at a depth of 1.5 to 3.5 feet at some time from October through June; Sarona—at a depth of more than 6 feet

Surface runoff: Slow

Flooding: None

Composition

Wabeno soil and similar soils: 40 to 55 percent

Sarona soil and similar soils: 40 to 50 percent

Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Net soils in drainageways and on foot slopes
- Keweenaw and Karlin soils, which are more droughty than the major soils; in landscape positions similar to those of the major soils
- Areas where 1 to 3 percent of the surface is covered with stones and cobbles

Similar inclusions:

- Soils that have gravelly sand at a depth of 40 to 60 inches

Use and Management

Land use: Dominant uses—woodland, cropland

Woodland

Major management concerns: Wabeno—equipment

limitation, windthrow hazard; Sarona—equipment limitation

Management measures:

- The use of equipment is briefly restricted in spring and during other excessively wet periods. Access is easiest during periods in winter when access roads are frozen.
- Windthrow in areas of the Wabeno soil can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Cropland

Major management concerns: Soil blowing, water erosion, low organic matter content, tilth

Management measures:

- Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
- Conservation tillage, grassed waterways, cover crops, and crop rotations that include grasses or legumes help to control water erosion.
- Contour farming and contour stripcropping reduce the runoff rate and the hazard of water erosion.
- No-till farming, crop residue management, and a cropping sequence that includes green manure crops increase the organic matter content.
- Minimizing tillage and tilling at the proper soil moisture content help to maintain good tilth and prevent crusting.
- Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.
- Stones on the surface may interfere with the use of tillage and planting equipment and some harvesting equipment. Removing the stones minimizes wear on equipment.

Interpretive Groups

Land capability classification: IIIs

Woodland ordination symbol: Wabeno—3L; Sarona—3L

Michigan soil management group: Wabeno—2a-af; Sarona—3a

Primary habitat type: AVO

Secondary habitat type: ATD

103D—Wabeno-Sarona complex, 6 to 18 percent slopes, stony

Setting

Landform and position on the landform: Rolling areas on ground moraines and end moraines

Shape of areas: Irregular

Size of areas: 5 to 600 acres

Typical Profile

Wabeno

Surface layer:

0 to 2 inches—black silt loam

Subsurface layer:

2 to 4 inches—brown silt loam

Subsoil:

4 to 23 inches—dark brown and brown, friable silt loam
23 to 32 inches—dark brown and brown, mottled, friable silt loam

32 to 42 inches—a fragipan of dark brown and brown, mottled, very firm very fine sandy loam

42 to 50 inches—a fragipan of reddish brown, very firm sandy loam

Substratum:

50 to 60 inches—brown sandy loam

Sarona

Surface layer:

0 to 2 inches—very dark gray fine sandy loam

Subsurface layer:

2 to 7 inches—brown fine sandy loam

Subsoil:

7 to 33 inches—dark brown and brown, friable fine sandy loam and loamy fine sand

33 to 37 inches—dark brown, friable loam

Substratum:

37 to 60 inches—reddish brown gravelly sandy loam

Soil Properties and Qualities

Depth class: Very deep

Rock fragments on the surface: Kind—stones and cobbles; percent of surface covered—0.01 to 0.1

Permeability: Wabeno—moderate in the upper part, moderately slow in the fragipan, and moderate in the lower part; Sarona—moderate

Available water capacity: Moderate

Drainage class: Wabeno—moderately well drained; Sarona—well drained

Seasonal high water table: Wabeno—perched at a depth of 1.5 to 3.5 feet at some time from October through June; Sarona—at a depth of more than 6 feet

Surface runoff: Medium

Flooding: None

Composition

Wabeno soil and similar soils: 40 to 55 percent

Sarona soil and similar soils: 40 to 50 percent

Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Net soils in drainageways
- Keweenaw and Karlin soils, which are more droughty than the major soils; in landscape positions similar to those of the major soils
- Areas where 1 to 3 percent of the surface is covered with stones and cobbles
- The poorly drained Witbeck soils in depressions
- Soils that have slopes of 18 to 30 percent

Similar inclusions:

- Soils that have gravelly sand at a depth of 40 to 60 inches

Use and Management

Land use: Dominant uses—woodland, cropland

Woodland

Major management concerns: Wabeno—equipment limitation, windthrow hazard; Sarona—equipment limitation

Management measures:

- The use of equipment is briefly restricted in spring and during other excessively wet periods. Access is easiest during periods in winter when access roads are frozen.
- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.
- Windthrow in areas of the Wabeno soil can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Cropland

Major management concerns: Soil blowing, water erosion, low organic matter content, tillth

Management measures:

- Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
- Water erosion can be controlled by diversions, crop rotations, grade-stabilization structures, or a combination of these practices.
- No-till farming, crop residue management, and a cropping sequence that includes green manure crops increase the organic matter content.
- Minimizing tillage and tilling at the proper soil moisture content help to maintain good tillth and prevent crusting.
- Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.
- Stones on the surface may interfere with the use of

tillage and planting equipment and some harvesting equipment. Removing the stones minimizes wear on equipment.

Interpretive Groups

Land capability classification: VIe

Woodland ordination symbol: Wabeno—3L; Sarona—3L

Michigan soil management group: Wabeno—2a-af; Sarona—3a

Primary habitat type: AVO

Secondary habitat type: ATD

104A—Stambaugh silt loam, 1 to 2 percent slopes, stony

Setting

Landform and position on the landform: Nearly level areas on outwash plains and stream terraces

Shape of areas: Irregular

Size of areas: 10 to 400 acres

Typical Profile

Surface layer:

0 to 4 inches—very dark gray silt loam

Subsoil:

4 to 22 inches—dark brown, brown, and yellowish brown, friable silt loam and very fine sandy loam
22 to 39 inches—reddish brown and brown, mottled, firm silt loam

Substratum:

39 to 60 inches—dark brown very gravelly sand and reddish brown gravelly sand

Soil Properties and Qualities

Depth class: Very deep

Rock fragments on the surface: Kind—stones and cobbles; percent of surface covered—0.01 to 0.1

Permeability: Moderately slow in the upper part and rapid in the lower part

Available water capacity: High

Drainage class: Moderately well drained

Seasonal high water table: 2.5 to 5.0 feet below the surface at some time from November through April

Surface runoff: Slow

Flooding: None

Composition

Stambaugh soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Inclusions

Contrasting inclusions:

- Wabeno soils, which have a shallower rooting depth

than the Stambaugh soil; in landscape positions similar to those of the Stambaugh soil

- Fence soils, which have a substratum of very fine sandy loam; in landscape positions similar to those of the Stambaugh soil
- The well drained Padus soils, which are more droughty than the Stambaugh soil; in landscape positions similar to those of the Stambaugh soil
- The somewhat poorly drained Gaastra soils in the slightly lower landscape positions

Similar inclusions:

- Soils that have slopes of 2 to 6 percent

Use and Management

Land use: Dominant uses—woodland, cropland

Woodland

Major management concerns: Equipment limitation

Management measures:

- The use of equipment is briefly restricted in spring and during other excessively wet periods. Access is easiest during periods in winter when access roads are frozen.

Cropland

Major management concerns: Soil blowing, low organic matter content, tilling

Management measures:

- Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
- No-till farming, crop residue management, and a cropping sequence that includes green manure crops increase the organic matter content.
- Minimizing tillage and tilling at the proper soil moisture content help to maintain good tilling and prevent crusting.
- Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.
- Stones on the surface may interfere with the use of tillage and planting equipment and some harvesting equipment. Removing the stones minimizes wear on equipment.

Interpretive Groups

Land capability classification: IIIs

Woodland ordination symbol: 3L

Michigan soil management group: 3/5a-a

Primary habitat type: AVO

Secondary habitat type: None assigned

104B—Stambaugh silt loam, 2 to 6 percent slopes, stony

Setting

Landform and position on the landform: Undulating areas on outwash plains and stream terraces

Shape of areas: Irregular

Size of areas: 10 to 400 acres

Typical Profile

Surface layer:

0 to 4 inches—very dark gray silt loam

Subsoil:

4 to 22 inches—dark brown, brown, and yellowish brown, friable silt loam and very fine sandy loam
22 to 39 inches—reddish brown and brown, firm silt loam

Substratum:

39 to 60 inches—dark brown very gravelly sand and reddish brown gravelly sand

Soil Properties and Qualities

Depth class: Very deep

Rock fragments on the surface: Kind—stones and cobbles; percent of surface covered—0.01 to 0.1

Permeability: Moderately slow in the upper part and rapid in the lower part

Available water capacity: High

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow

Flooding: None

Composition

Stambaugh soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Inclusions

Contrasting inclusions:

- Wabeno soils, which have a shallower rooting depth than the Stambaugh soil; in landscape positions similar to those of the Stambaugh soil
- Fence soils, which have a substratum of very fine sandy loam; in landscape positions similar to those of the Stambaugh soil
- The well drained Padus soils, which are more droughty than the Stambaugh soil; in landscape positions similar to those of the Stambaugh soil
- The somewhat poorly drained Gaastra soils in the slightly lower landscape positions

Use and Management

Land use: Dominant uses—woodland (fig. 7), cropland



Figure 7.—A mature stand of sugar maple in an area of Stambaugh silt loam, 2 to 6 percent slopes, stony.

Woodland

Major management concerns: Equipment limitation

Management measures:

- The use of equipment is briefly restricted in spring and during other excessively wet periods. Access is easiest during periods in winter when access roads are frozen.

Cropland

Major management concerns: Soil blowing, water erosion, low organic matter content, tilling

Management measures:

- Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
- Conservation tillage, grassed waterways, cover crops, and crop rotations that include grasses or legumes help to control water erosion.
- Contour farming and contour stripcropping reduce the runoff rate and the hazard of water erosion.
- No-till farming, crop residue management, and a cropping sequence that includes green manure crops increase the organic matter content.
- Minimizing tillage and tilling at the proper soil moisture content help to maintain good tilling and prevent crusting.
- Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.
- Stones on the surface may interfere with the use of tillage and planting equipment and some harvesting equipment. Removing the stones minimizes wear on equipment.

Interpretive Groups

Land capability classification: IIIs

Woodland ordination symbol: 3L

Michigan soil management group: 3/5a-a

Primary habitat type: AVO

Secondary habitat type: None assigned

104D—Stambaugh silt loam, 6 to 18 percent slopes, stony

Setting

Landform and position on the landform: Rolling areas on outwash plains and stream terraces

Shape of areas: Irregular

Size of areas: 5 to 300 acres

Typical Profile

Surface layer:

0 to 4 inches—very dark gray silt loam

Subsoil:

4 to 22 inches—dark brown, brown, and yellowish brown, friable silt loam and very fine sandy loam

22 to 39 inches—reddish brown and brown, firm silt loam

Substratum:

39 to 60 inches—dark brown very gravelly sand and reddish brown gravelly sand

Soil Properties and Qualities

Depth class: Very deep

Rock fragments on the surface: Kind—stones and cobbles; percent of surface covered—0.01 to 0.1

Permeability: Moderately slow in the upper part and rapid in the lower part

Available water capacity: High

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Medium

Flooding: None

Composition

Stambaugh soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Inclusions

Contrasting inclusions:

- The moderately well drained Wabeno soils, which have a shallower rooting depth than the Stambaugh soil; in landscape positions similar to those of the Stambaugh soil
- The moderately well drained Fence soils that have a substratum of very fine sandy loam; in landscape positions similar to those of the Stambaugh soil
- Padus soils, which are more droughty than the Stambaugh soil; in landscape positions similar to those of the Stambaugh soil
- The somewhat poorly drained Gaastra soils on foot slopes and in drainageways
- Areas that have slopes of 18 to 30 percent

Use and Management

Land use: Dominant uses—woodland, cropland

Woodland

Major management concerns: Equipment limitation

Management measures:

- The use of equipment is briefly restricted in spring and during other excessively wet periods. Access is easiest during periods in winter when access roads are frozen.
- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.

Cropland

Major management concerns: Soil blowing, water erosion, low organic matter content, tillage

Management measures:

- Conservation tillage, crop residue management, strip cropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
- Water erosion can be controlled by diversions, crop

rotations, grade-stabilization structures, or a combination of these practices.

- No-till farming, crop residue management, and a cropping sequence that includes green manure crops increase the organic matter content.
- Minimizing tillage and tilling at the proper soil moisture content help to maintain good tillage and prevent crusting.
- Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.
- Stones on the surface may interfere with the use of tillage and planting equipment and some harvesting equipment. Removing the stones minimizes wear on equipment.

Interpretive Groups

Land capability classification: VIe

Woodland ordination symbol: 3L

Michigan soil management group: 3/5a-a

Primary habitat type: AVO

Secondary habitat type: None assigned

105D—Wabeno-Rock outcrop complex, 1 to 18 percent slopes, very stony

Setting

Landform and position on the landform: Nearly level to rolling areas on ground moraines and end moraines

Shape of areas: Irregular

Size of areas: 5 to 400 acres

Typical Profile

Wabeno

Surface layer:

0 to 2 inches—black silt loam

Subsurface layer:

2 to 4 inches—brown silt loam

Subsoil:

4 to 23 inches—dark brown and brown, friable silt loam

23 to 32 inches—dark brown and brown, mottled, friable silt loam

32 to 42 inches—a fragipan of dark brown and brown, mottled, very firm very fine sandy loam

42 to 50 inches—a fragipan of reddish brown, very firm sandy loam

Substratum:

50 to 60 inches—brown sandy loam

Soil Properties and Qualities

Wabeno

Depth class: Very deep

Rock fragments on the surface: Kind—stones and

cobbles; percentage of surface covered—1 to 3
Permeability: Moderate in the upper part, moderately slow in the fragipan, and moderate in the lower part
Available water capacity: Moderate
Drainage class: Moderately well drained
Seasonal high water table: Perched at a depth of 1.5 to 3.5 feet at some time from October through June
Surface runoff: Slow
Flooding: None

Composition

Wabeno soil and similar soils: 65 to 80 percent
 Rock outcrop: 10 to 20 percent
 Contrasting inclusions: 10 to 15 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Net soils on foot slopes and in drainageways
- Sundog and Karlin soils, which are more droughty than the Wabeno soil; in landscape positions similar to those of the Wabeno soil

Similar inclusions:

- Soils that are less than 60 inches deep over bedrock
- Soils that do not have a firm layer in the subsoil

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, windthrow hazard

Management measures:

- The use of equipment is briefly restricted in spring and during other excessively wet periods. Access is easiest during periods in winter when access roads are frozen.
- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.
- Because of stones on the surface, wheeled skidders with high clearance should be operated at a reduced speed over carefully chosen routes.
- The areas of Rock outcrop should be considered when road locations and landing sites are planned.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: VIIe
Woodland ordination symbol: 3L
Michigan soil management group: 2a-af
Primary habitat type: TM
Secondary habitat type: ATD

106D—Champion very fine sandy loam, 1 to 18 percent slopes, rocky, very stony

Setting

Landform and position on the landform: Nearly level to rolling areas on ground moraines and end moraines
Shape of areas: Irregular
Size of areas: 5 to 300 acres

Typical Profile

Organic mat:

0 to 1 inch—black, partially decomposed forest litter

Subsurface layer:

1 to 4 inches—gray very fine sandy loam

Subsoil:

4 to 11 inches—dark brown and dark reddish brown, very friable and friable very fine sandy loam

11 to 20 inches—dark brown and brown, friable very fine sandy loam

20 to 49 inches—a fragipan of dark grayish brown and dark brown, mottled, extremely firm gravelly fine sandy loam

Substratum:

49 to 60 inches—grayish brown gravelly fine sandy loam

Soil Properties and Qualities

Depth class: Very deep

Rock fragments on the surface: Kind—stones and cobbles; percentage of surface covered—1 to 3

Permeability: Moderate in the upper part, very slow in the fragipan, and moderate or moderately rapid in the lower part

Available water capacity: Low

Drainage class: Moderately well drained

Seasonal high water table: Perched at a depth of 1 to 2 feet at some time from November through May

Surface runoff: Slow

Flooding: None

Composition

Champion soil and similar soils: 85 to 95 percent

Rock outcrop: 1 to 10 percent

Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:

- Karlin soils, which are more droughty than the Champion soil; in landscape positions similar to those of the Champion soil
- The somewhat poorly drained Net soils on foot slopes and in drainageways
- Areas where 3 to 15 percent of the surface is covered with stones and cobbles

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, windthrow hazard

Management measures:

- Equipment should be used only during periods when the soil is relatively dry or has an adequate snow cover.
- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.
- Because of stones on the surface, wheeled skidders with high clearance should be operated at a reduced speed over carefully chosen routes.
- Rock outcrops should be considered when road locations and landing sites are planned.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: VIIe

Woodland ordination symbol: 3W

Michigan soil management group: 3a-af

Primary habitat type: ATD

Secondary habitat type: None assigned

107B—Sarona fine sandy loam, 1 to 6 percent slopes, stony

Setting

Landform and position on the landform: Nearly level and undulating areas on ground moraines and end moraines

Shape of areas: Irregular

Size of areas: 5 to 200 acres

Typical Profile

Surface layer:

0 to 2 inches—very dark gray fine sandy loam

Subsurface layer:

2 to 7 inches—brown fine sandy loam

Subsoil:

7 to 33 inches—dark brown and brown, friable fine sandy loam and loamy fine sand

33 to 37 inches—dark brown, friable loam

Substratum:

37 to 60 inches—reddish brown gravelly sandy loam

Soil Properties and Qualities

Depth class: Very deep

Rock fragments on the surface: Kind—stones and cobbles; percent of surface covered—0.01 to 0.1

Permeability: Moderate

Available water capacity: Moderate

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow

Flooding: None

Composition

Sarona soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Net soils in the lower landscape positions
- Keweenaw and Karlin soils, which are more droughty than the Sarona soil; in landscape positions similar to those of the Sarona soil
- The moderately well drained Wabeno soils, which have a shallower rooting depth than the Sarona soil; in landscape positions similar to those of the Sarona soil

Similar inclusions:

- Soils that have gravelly sand at a depth of 40 to 60 inches

Use and Management

Land use: Dominant uses—woodland, cropland

Woodland

Major management concerns: Equipment limitation

Management measures:

- The use of equipment is briefly restricted in spring and during other excessively wet periods. Access is easiest during periods in winter when access roads are frozen.

Cropland

Major management concerns: Soil blowing, water erosion, low organic matter content, tilth

Management measures:

- Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
- Conservation tillage, grassed waterways, cover crops, and crop rotations that include grasses or legumes help to control water erosion.
- Contour farming and contour stripcropping reduce the runoff rate and the hazard of water erosion.
- No-till farming, crop residue management, and a cropping sequence that includes green manure crops increase the organic matter content.
- Minimizing tillage and tilling at the proper soil moisture content help to maintain good tilth and prevent crusting.
- Returning crop residue to the soil, adding other organic material, and including grasses and legumes in

the cropping sequence improve soil structure, permeability, and the rate of water infiltration.

- Stones on the surface may interfere with the use of tillage and planting equipment and some harvesting equipment. Removing the stones minimizes wear on equipment.

Interpretive Groups

Land capability classification: IIIs
Woodland ordination symbol: 3L
Michigan soil management group: 3a
Primary habitat type: ATD
Secondary habitat type: TM

107D—Sarona fine sandy loam, 6 to 18 percent slopes, stony

Setting

Landform and position on the landform: Rolling areas on ground moraines and end moraines
Shape of areas: Irregular
Size of areas: 5 to 300 acres

Typical Profile

Surface layer:
 0 to 2 inches—very dark gray fine sandy loam
Subsurface layer:
 2 to 7 inches—brown fine sandy loam
Subsoil:
 7 to 33 inches—dark brown and brown, friable fine sandy loam and loamy fine sand
 33 to 37 inches—dark brown, friable loam
Substratum:
 37 to 60 inches—reddish brown gravelly sandy loam

Soil Properties and Qualities

Depth class: Very deep
Rock fragments on the surface: Kind—stones and cobbles; percent of surface covered—0.01 to 0.1
Permeability: Moderate
Available water capacity: Moderate
Drainage class: Well drained
Seasonal high water table: At a depth of more than 6 feet
Surface runoff: Medium
Flooding: None

Composition

Sarona soil and similar soils: 85 to 90 percent
 Contrasting inclusions: 10 to 15 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Net soils on foot slopes and in drainageways
- Keweenaw and Karlin soils, which are more droughty than the Sarona soil; in landscape positions similar to those of the Sarona soil
- Wabeno soils, which have a shallower rooting depth than the Sarona soil; in landscape positions similar to those of the Sarona soil

Similar inclusions:

- Soils that have gravelly sand at a depth of 40 to 60 inches

Use and Management

Land use: Dominant uses—woodland, cropland

Woodland

Major management concerns: Equipment limitation, slope

Management measures:

- The use of equipment is briefly restricted in spring and during other excessively wet periods. Access is easiest during periods in winter when access roads are frozen.
- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.

Cropland

Major management concerns: Soil blowing, water erosion, low organic matter content, tilth

Management measures:

- Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
- Water erosion can be controlled by diversions, crop rotations, grade-stabilization structures, or a combination of these practices.
- No-till farming, crop residue management, and a cropping sequence that includes green manure crops increase the organic matter content.
- Minimizing tillage and tilling at the proper soil moisture content help to maintain good tilth and prevent crusting.
- Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.
- Stones on the surface may interfere with the use of tillage and planting equipment and some harvesting equipment. Removing the stones minimizes wear on equipment.

Interpretive Groups

Land capability classification: VIe

Woodland ordination symbol: 3L
 Michigan soil management group: 3a
 Primary habitat type: ATD
 Secondary habitat type: TM

107F—Sarona fine sandy loam, 18 to 35 percent slopes, stony

Setting

Landform and position on the landform: Hilly areas on end moraines
Shape of areas: Irregular
Size of areas: 5 to 30 acres

Typical Profile

Surface layer:
 0 to 2 inches—very dark gray fine sandy loam
Subsurface layer:
 2 to 7 inches—brown fine sandy loam
Subsoil:
 7 to 33 inches—dark brown and brown, friable fine sandy loam and loamy fine sand
 33 to 37 inches—dark brown, friable loam
Substratum:
 37 to 60 inches—reddish brown gravelly sandy loam

Soil Properties and Qualities

Depth class: Very deep
Rock fragments on the surface: Kind—stones and cobbles; percent of surface covered—0.01 to 0.1
Permeability: Moderate
Available water capacity: Moderate
Drainage class: Well drained
Seasonal high water table: At a depth of more than 6 feet
Surface runoff: Rapid
Flooding: None

Composition

Sarona soil and similar soils: 85 to 90 percent
 Contrasting inclusions: 10 to 15 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Net soils on foot slopes and in drainageways
- Keweenaw and Karlin soils, which are more droughty than the Sarona soil; in landscape positions similar to those of the Sarona soil
- Wabeno soils, which have a shallower rooting depth than the Sarona soil; in landscape positions similar to those of the Sarona soil

Similar inclusions:

- Soils that have gravelly sand at a depth of 40 to 60 inches

Use and Management

Land use: Woodland

Major management concerns: Erosion hazard, equipment limitation

Management measures:

- Because of the erosion hazard, water should be removed from logging roads by water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures. Building logging roads on the contour or on the gentler slopes and seeding logging roads, skid roads, and landings after the trees are logged also help to prevent excessive soil loss.
- Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.
- The use of equipment is briefly restricted in spring and during other excessively wet periods. Access is easiest during periods in winter when access roads are frozen.

Interpretive Groups

Land capability classification: Vllc
Woodland ordination symbol: 3R
Michigan soil management group: 3a
Primary habitat type: ATD
Secondary habitat type: TM

108D—Sarona-Rock outcrop complex, 1 to 18 percent slopes, very stony

Setting

Landform and position on the landform: Nearly level to rolling areas on ground moraines and end moraines
Shape of areas: Irregular
Size of areas: 5 to 100 acres

Typical Profile

Sarona

Surface layer:
 0 to 2 inches—very dark gray fine sandy loam
Subsurface layer:
 2 to 7 inches—brown fine sandy loam
Subsoil:
 7 to 33 inches—dark brown and brown, friable fine sandy loam and loamy fine sand
 33 to 37 inches—dark brown, friable loam
Substratum:
 37 to 60 inches—reddish brown gravelly sandy loam

Soil Properties and Qualities

Sarona

Depth class: Very deep

Rock fragments on the surface: Kind—stones and cobbles; percentage of surface covered—1 to 3

Permeability: Moderate

Available water capacity: Moderate

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow

Flooding: None

Composition

Sarona soil and similar soils: 65 to 80 percent

Rock outcrop: 10 to 20 percent

Contrasting inclusions: 10 to 15 percent

Inclusions

Contrasting inclusions:

- The moderately well drained Wabeno soils, which have a shallower rooting depth than the Sarona soil; in landscape positions similar to those of the Sarona soil
- The somewhat poorly drained Net soils on foot slopes and in drainageways
- Karlin and Keweenaw soils, which are more droughty than the Sarona soil; in landscape positions similar to those of the Sarona soil

Similar inclusions:

- Soils that are less than 60 inches deep over bedrock
- Soils that have gravelly sand at a depth of 40 to 60 inches

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation

Management measures:

- The use of equipment is briefly restricted in spring and during other excessively wet periods. Access is easiest during periods in winter when access roads are frozen.
- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.
- Because of stones on the surface, wheeled skidders with high clearance should be operated at a reduced speed over carefully chosen routes.
- The areas of Rock outcrop should be considered when road locations and landing sites are planned.

Interpretive Groups

Land capability classification: VIIIe

Woodland ordination symbol: 3L

Michigan soil management group: 3a

Primary habitat type: TM

Secondary habitat type: TMV

108F—Sarona-Rock outcrop complex, 18 to 35 percent slopes, very stony

Setting

Landform and position on the landform: Hilly areas on end moraines

Shape of areas: Irregular

Size of areas: 5 to 100 acres

Typical Profile

Sarona

Surface layer:

0 to 2 inches—very dark gray fine sandy loam

Subsurface layer:

2 to 7 inches—brown fine sandy loam

Subsoil:

7 to 33 inches—dark brown and brown, friable fine sandy loam and loamy fine sand

33 to 37 inches—dark brown, friable loam

Substratum:

37 to 60 inches—reddish brown gravelly sandy loam

Soil Properties and Qualities

Sarona

Depth class: Very deep

Rock fragments on the surface: Kind—stones and cobbles; percentage of surface covered—1 to 3

Permeability: Moderate

Available water capacity: Moderate

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Rapid

Flooding: None

Composition

Sarona soil and similar soils: 65 to 80 percent

Rock outcrop: 10 to 15 percent

Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

- The moderately well drained Wabeno soils, which have a shallower rooting depth than the Sarona soil; in landscape positions similar to those of the Sarona soil
- The somewhat poorly drained Net soils in drainageways and on foot slopes
- Karlin and Keweenaw soils, which are more droughty than the Sarona soil; in landscape positions similar to those of the Sarona soil

Similar inclusions:

- Soils that are less than 60 inches deep over bedrock
- Soils that have gravelly sand at a depth of 40 to 60 inches

Use and Management

Land use: Woodland

Major management concerns: Erosion hazard, equipment limitation

Management measures:

- Because of the erosion hazard, water should be removed from logging roads by water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures. Building logging roads on the contour or on the gentler slopes and seeding logging roads, skid roads, and landings after the trees are logged also help to prevent excessive soil loss.
- Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.
- The use of equipment is briefly restricted in spring and during other excessively wet periods. Access is easiest during periods in winter when access roads are frozen.
- The areas of Rock outcrop should be considered when road locations and landing sites are planned.
- Because of stones on the surface, wheeled skidders with high clearance should be operated at a reduced speed over carefully chosen routes.

Interpretive Groups

Land capability classification: VIIIIs

Woodland ordination symbol: 3R

Michigan soil management group: 3a

Primary habitat type: TM

Secondary habitat type: TMV

109D—Udorthents, nearly level to rolling**Setting**

Landform and position on the landform: Nearly level to rolling areas on moraines that formerly were excavated for borrow material and that have been filled

Slope: 0 to 18 percent

Shape of areas: Irregular

Size of areas: 5 to 20 acres

Soil Properties and Qualities

Texture: 10 inches of strong brown gravelly sandy loam over loamy and gravelly material

Depth class: Very deep

Permeability: Variable

Available water capacity: Variable

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow to rapid

Flooding: None

Composition

Udorthents and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

Inclusions*Contrasting inclusions:*

- Somewhat poorly drained and poorly drained soils in the lower positions on the landscape

Use and Management

Land use: Former use—woodland; current uses—none

Management measures:

- Onsite investigation is needed to determine the suitability for specific uses.

Interpretive Groups

Land capability classification: None assigned

Woodland ordination symbol: None assigned

Michigan soil management group: None assigned

Habitat type: None assigned

110B—Petticoat-Wabeno silt loams, 1 to 6 percent slopes, very stony**Setting**

Landform: Nearly level and undulating ground moraines

Shape of areas: Irregular

Size of areas: 5 to 2,000 acres

Typical Profile**Petticoat**

Surface layer:

0 to 1 inch—black silt loam

Subsurface layer:

1 to 4 inches—reddish gray silt loam

Subsoil:

4 to 20 inches—dark reddish brown and dark brown, friable silt loam

20 to 38 inches—brown and dark brown, mottled, friable and firm silt loam and loam

Substratum:

38 to 60 inches—brown gravelly loamy sand

Wabeno

Surface layer:

0 to 2 inches—black silt loam

Subsurface layer:

2 to 4 inches—brown silt loam

Subsoil:

- 4 to 23 inches—dark brown and brown, friable silt loam
 23 to 32 inches—dark brown and brown, mottled, friable silt loam
 32 to 42 inches—a fragipan of dark brown and brown, mottled, very firm very fine sandy loam
 42 to 50 inches—a fragipan of reddish brown, very firm sandy loam

Substratum:

50 to 60 inches—brown sandy loam

Soil Properties and Qualities

Depth class: Very deep

Rock fragments on the surface: Kind—stones and cobbles; percentage of surface covered—1 to 3

Permeability: Petticoat—moderate in the upper part and rapid in the lower part; Wabeno—moderate in the upper part, moderately slow in the fragipan, and moderate in the lower part

Available water capacity: Moderate

Drainage class: Moderately well drained

Seasonal high water table: Petticoat—1.5 to 4.0 feet below the surface at some time from November through May; Wabeno—perched at a depth of 1.5 to 3.5 feet at some time from November through June

Surface runoff: Slow

Flooding: None

Composition

Petticoat soil and similar soils: 40 to 55 percent

Wabeno soil and similar soils: 40 to 55 percent

Contrasting inclusions: 5 to 15 percent

Inclusions**Contrasting inclusions:**

- The somewhat poorly drained Net soils in drainageways and on foot slopes
- Sundog soils, which are more droughty than the major soils; in landscape positions similar to those of the major soils

Use and Management

Land use: Woodland

Major management concerns: Petticoat—equipment limitation; Wabeno—equipment limitation, windthrow hazard

Management measures:

- The use of equipment is briefly restricted in spring and during other excessively wet periods. Access is easiest during periods in winter when access roads are frozen.
- Because of stones on the surface, wheeled skidders with high clearance should be operated at a reduced speed over carefully chosen routes.
- Windthrow in areas of the Wabeno soil can be minimized by harvest methods that do not leave the

remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: Vls

Woodland ordination symbol: Petticoat—3L; Wabeno—3L

Michigan soil management group: Petticoat—3/5a; Wabeno—2a-af

Primary habitat type: AVO

Secondary habitat type: ATD

110D—Petticoat-Wabeno silt loams, 6 to 18 percent slopes, very stony**Setting**

Landform and position on the landform: Rolling areas on ground moraines

Shape of areas: Irregular

Size of areas: 5 to 200 acres

Typical Profile**Petticoat**

Surface layer:

0 to 1 inch—black silt loam

Subsurface layer:

1 to 4 inches—reddish gray silt loam

Subsoil:

4 to 20 inches—dark reddish brown and dark brown, friable silt loam

20 to 38 inches—brown and dark brown, friable and firm silt loam and loam

Substratum:

38 to 60 inches—brown gravelly loamy sand

Wabeno

Surface layer:

0 to 2 inches—black silt loam

Subsurface layer:

2 to 4 inches—brown silt loam

Subsoil:

4 to 23 inches—dark brown and brown, friable silt loam
 23 to 32 inches—dark brown and brown, mottled, friable silt loam

32 to 42 inches—a fragipan of dark brown and brown, mottled, very firm very fine sandy loam

42 to 50 inches—a fragipan of reddish brown, very firm sandy loam

Substratum:

50 to 60 inches—brown sandy loam

Soil Properties and Qualities

Depth class: Very deep

Rock fragments on the surface: Kind—stones and cobbles; percentage of surface covered—1 to 3
Permeability: Petticoat—moderate in the upper part and rapid in the lower part; Wabeno—moderate in the upper part, moderately slow in the fragipan, and moderate in the lower part
Available water capacity: Moderate
Drainage class: Petticoat—well drained; Wabeno—moderately well drained
Seasonal high water table: Petticoat—at a depth of more than 6 feet; Wabeno—perched at a depth of 1.5 to 3.5 feet at some time from November through June
Surface runoff: Medium
Flooding: None

Composition

Petticoat soil and similar soils: 45 to 55 percent
 Wabeno soil and similar soils: 35 to 50 percent
 Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Net soils on foot slopes and in depressions
- Sundog soils, which are more droughty than the major soils; in landscape positions similar to those of the major soils
- Areas that have slopes of 18 to 35 percent

Use and Management

Land use: Woodland

Major management concerns: Petticoat—equipment limitation; Wabeno—equipment limitation, windthrow hazard

Management measures:

- The use of equipment is briefly restricted in spring and during other excessively wet periods. Access is easiest during periods in winter when access roads are frozen.
- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.
- Large stones on the surface can hinder harvesting operations and damage equipment.
- Because of stones on the surface, wheeled skidders with high clearance should be operated at a reduced speed over carefully chosen routes.
- Windthrow in areas of the Wabeno soil can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: VIIe

Woodland ordination symbol: Petticoat—3L; Wabeno—3L

Michigan soil management group: Petticoat—3/5a; Wabeno—2a-af

Primary habitat type: AVO

Secondary habitat type: ATD

111B—Champion-Net very fine sandy loams, 0 to 6 percent slopes, very stony

Setting

Landform and position on the landform: Champion—nearly level and undulating areas on ground moraines and end moraines; Net—drainageways on ground moraines and end moraines

Shape of areas: Irregular

Size of areas: 5 to 300 acres

Typical Profile

Champion

Organic mat:

0 to 1 inch—black, partially decomposed forest litter

Subsurface layer:

1 to 4 inches—gray very fine sandy loam

Subsoil:

4 to 11 inches—dark reddish brown and dark brown, very friable and friable very fine sandy loam

11 to 20 inches—dark brown and brown, friable very fine sandy loam

20 to 49 inches—a fragipan of dark grayish brown and dark brown, mottled, extremely firm gravelly fine sandy loam

Substratum:

49 to 60 inches—grayish brown gravelly fine sandy loam

Net

Surface layer:

0 to 3 inches—dark brown very fine sandy loam

Subsurface layer:

3 to 6 inches—brown, mottled very fine sandy loam

Subsoil:

6 to 28 inches—dark brown, mottled, friable very fine sandy loam and fine sandy loam

28 to 49 inches—a fragipan of dark brown and brown, mottled, very firm gravelly sandy loam and gravelly loamy sand

Substratum:

49 to 60 inches—dark brown gravelly sandy loam

Soil Properties and Qualities

Depth class: Very deep

Rock fragments on the surface: Kind—stones and cobbles; percentage of surface covered—1 to 3

Permeability: Champion—moderate in the upper part,

very slow in the fragipan, and moderate or moderately rapid in the lower part; Net—moderate in the upper part, very slow in the fragipan, and moderate or moderately rapid in the lower part

Available water capacity: Low

Drainage class: Champion—moderately well drained; Net—somewhat poorly drained

Seasonal high water table: Champion—perched at a depth of 1 to 2 feet at some time from November through May; Net—perched at a depth of 0.5 foot to 1.5 feet at some time from November through May

Surface runoff: Slow

Flooding: None

Composition

Champion soil and similar soils: 50 to 65 percent

Net soil and similar soils: 25 to 35 percent

Contrasting inclusions: 10 to 15 percent

Inclusions

Contrasting inclusions:

- Karlin and Sundog soils, which are more droughty than the major soils; in landscape positions similar to those of the Champion soil
- The poorly drained Witbeck soils in depressions
- Areas where 3 to 15 percent of the surface is covered with stones and cobbles

Use and Management

Land use: Woodland

Major management concerns: Champion—equipment limitation and windthrow hazard; Net—equipment limitation, seedling mortality, and windthrow hazard

Management measures:

- The seasonal high water table in areas of the Net soil restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen or has an adequate snow cover.
- Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
- Because of stones on the surface, wheeled skidders with high clearance should be operated at a reduced speed over carefully chosen routes.
- Special site preparation, such as bedding, can reduce the seedling mortality rate in areas of the Net soil.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: IVs

Woodland ordination symbol: Champion—3W; Net—3W

Michigan soil management group: Champion—3a-af;

Net—3b-af

Primary habitat type: ATD

Secondary habitat type: TMC

112B—Sundog very fine sandy loam, 1 to 6 percent slopes

Setting

Landform and position on the landform: Nearly level and undulating areas on outwash plains, eskers, stream terraces, moraines, and crevasse fillings

Shape of areas: Irregular or long and narrow

Size of areas: 5 to 400 acres

Typical Profile

Surface layer:

0 to 4 inches—dark brown very fine sandy loam

Subsurface layer:

4 to 6 inches—gray very fine sandy loam

Subsoil:

6 to 15 inches—dark reddish brown and dark brown, friable very fine sandy loam

15 to 22 inches—brown, friable gravelly very fine sandy loam

Substratum:

22 to 43 inches—brown sand with bands of loamy sand

43 to 60 inches—brown very gravelly sand with pockets of very fine sandy loam

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderate in the upper part and very rapid in the lower part

Available water capacity: Low

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow

Flooding: None

Composition

Sundog soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Channing soils in the lower landscape positions
- Karlin and Pence soils, which are more droughty than the Sundog soil; in landscape positions similar to those of the Sundog soil

Use and Management

Land use: Dominant uses—woodland, cropland

Woodland

Major management concerns: Equipment limitation

Management measures:

- The use of equipment is briefly restricted in spring and during other excessively wet periods. Access is easiest during periods in winter when access roads are frozen.

Cropland

Major management concerns: Soil blowing, water erosion, low organic matter content, tillth

Management measures:

- Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
- Conservation tillage, grassed waterways, cover crops, and crop rotations that include grasses or legumes help to control water erosion.
- No-till farming, crop residue management, and a cropping sequence that includes green manure crops increase the organic matter content.
- Minimizing tillage and tilling at the proper soil moisture content help to maintain good tillth and prevent crusting.
- Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.

Interpretive Groups

Land capability classification: 1Ie

Woodland ordination symbol: 2L

Michigan soil management group: 3/5a

Primary habitat type: TMV

Secondary habitat type: TM

112D—Sundog very fine sandy loam, 6 to 18 percent slopes**Setting**

Landform and position on the landform: Rolling areas on outwash plains, eskers, stream terraces, moraines, and crevasse fillings

Shape of areas: Irregular

Size of areas: 5 to 200 acres

Typical Profile

Surface layer:

0 to 4 inches—dark brown very fine sandy loam

Subsurface layer:

4 to 6 inches—gray very fine sandy loam

Subsoil:

6 to 15 inches—dark reddish brown and dark brown, friable very fine sandy loam

15 to 22 inches—brown, friable gravelly very fine sandy loam

Substratum:

22 to 43 inches—brown sand with bands of loamy sand

43 to 60 inches—brown very gravelly coarse sand with pockets of very fine sandy loam

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderate in the upper part and very rapid in the lower part

Available water capacity: Low

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Medium

Flooding: None

Composition

Sundog soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:

- Karlin and Pence soils, which are more droughty than the Sundog soil; in landscape positions similar to those of the Sundog soil

Use and Management

Land use: Dominant uses—woodland, cropland

Woodland

Major management concerns: Equipment limitation

Management measures:

- The use of equipment is briefly restricted in spring and during other excessively wet periods. Access is easiest during periods in winter when access roads are frozen.
- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.

Cropland

Major management concerns: Soil blowing, water erosion, low organic matter content, tillth

Management measures:

- Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
- Water erosion can be controlled by diversions, crop residue management, contour stripcropping, field stripcropping, cover crops, grassed waterways, conservation tillage, crop rotations, grade-stabilization structures, or a combination of these practices.
- No-till farming, crop residue management, and a cropping sequence that includes green manure crops

increase the organic matter content.

- Minimizing tillage and tilling at the proper soil moisture content help to maintain good tilth and prevent crusting.
- Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.

Interpretive Groups

Land capability classification: IVe

Woodland ordination symbol: 2L

Michigan soil management group: 3/5a

Primary habitat type: TMV

Secondary habitat type: TM

112F—Sundog cobbly fine sandy loam, 18 to 50 percent slopes, stony

Setting

Landform and position on the landform: Hilly to very steep areas on outwash plains, eskers, stream terraces, moraines, and crevasse fillings

Shape of areas: Long and narrow or irregular

Size of areas: 5 to 100 acres

Typical Profile

Surface layer:

0 to 5 inches—very dark grayish brown cobbly fine sandy loam

Subsurface layer:

5 to 8 inches—reddish gray cobbly fine sandy loam

Subsoil:

8 to 16 inches—reddish brown and brown, friable gravelly fine sandy loam

16 to 24 inches—brown, firm very gravelly loamy sand

Substratum:

24 to 60 inches—brown very gravelly coarse sand and yellowish brown gravelly coarse sand

Soil Properties and Qualities

Depth class: Very deep

Rock fragments on the surface: Kind—cobbles and stones; percentage of surface covered—0.01 to 1.0

Permeability: Moderate in the upper part and very rapid in the lower part

Available water capacity: Low

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Rapid

Flooding: None

Hazard of water erosion: Severe

Composition

Sundog soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:

- Karlin and Pence soils, which are more droughty than the Sundog soil; in landscape positions similar to those of the Sundog soil

Use and Management

Land use: Woodland

Major management concerns: Erosion hazard, equipment limitation

Management measures:

- Because of the erosion hazard, water should be removed from logging roads by water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures. Building logging roads on the contour or on the gentler slopes and seeding logging roads, skid roads, and landings after the trees are logged also help to prevent excessive soil loss.
- Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.
- The use of equipment is briefly restricted in spring and during other excessively wet periods. Access is easiest during periods in winter when access roads are frozen.

Interpretive Groups

Land capability classification: VIIs

Woodland ordination symbol: 2R

Michigan soil management group: 3/5a

Primary habitat type: TMV

Secondary habitat type: TM

113A—Sundog very fine sandy loam, moderately wet, 0 to 3 percent slopes

Setting

Landform and position on the landform: Nearly level areas on outwash plains, stream terraces, moraines, and crevasse fillings

Shape of areas: Irregular

Size of areas: 5 to 250 acres

Typical Profile

Surface layer:

0 to 2 inches—dark reddish brown very fine sandy loam

Subsurface layer:

2 to 3 inches—reddish gray very fine sandy loam

Subsoil:

3 to 18 inches—dark reddish brown and dark brown, friable very fine sandy loam

18 to 25 inches—brown, mottled, friable very fine sandy loam

Substratum:

25 to 60 inches—brown very gravelly sand and gravelly sand

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderate in the upper part and very rapid in the lower part

Available water capacity: Low

Drainage class: Moderately well drained

Seasonal high water table: 2.5 to 6.0 feet below the surface at some time from November through May

Surface runoff: Slow

Flooding: None

Composition

Sundog soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Inclusions*Contrasting inclusions:*

- The somewhat poorly drained Channing soils in the lower positions on the landscape
- Karlin, Croswell, and Manitowish soils, which are more droughty than the Sundog soil; in landscape positions similar to those of the Sundog soil

Use and Management

Land use: Dominant uses—woodland, cropland

Woodland

Major management concerns: Equipment limitation

Management measures:

- The use of equipment is briefly restricted in spring and during other excessively wet periods. Access is easiest during periods in winter when access roads are frozen.

Cropland

Major management concerns: Soil blowing, low organic matter content, tilth

Management measures:

- Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
- No-till farming, crop residue management, and a cropping sequence that includes green manure crops increase the organic matter content.
- Minimizing tillage and tilling at the proper soil moisture content help to maintain good tilth and prevent crusting.
- Returning crop residue to the soil, adding other

organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.

Interpretive Groups

Land capability classification: IIIs

Woodland ordination symbol: 4L

Michigan soil management group: 3/5a

Primary habitat type: TMC-Vac

Secondary habitat type: TMV

114A—Minocqua-Channing complex, 0 to 3 percent slopes**Setting**

Landform and position on the landform: Minocqua—depressions on outwash plains and stream terraces; Channing—drainageways on outwash plains and stream terraces

Shape of areas: Long and narrow or irregular

Size of areas: 5 to 100 acres

Typical Profile**Minocqua**

Surface layer:

0 to 4 inches—black muck

Subsurface layer:

4 to 6 inches—very dark gray silt loam

Subsoil:

6 to 25 inches—gray, mottled, friable loam

25 to 29 inches—grayish brown, friable loamy coarse sand

Substratum:

29 to 60 inches—dark grayish brown, stratified coarse sand and gravelly coarse sand

Channing

Surface layer:

0 to 4 inches—dark brown very fine sandy loam

Subsurface layer:

4 to 6 inches—gray very fine sandy loam

Subsoil:

6 to 15 inches—dark reddish brown and dark brown, friable very fine sandy loam

15 to 22 inches—brown, friable gravelly very fine sandy loam

Substratum:

22 to 43 inches—brown sand with bands of loamy sand

43 to 60 inches—brown very gravelly sand with pockets of very fine sandy loam

Soil Properties and Qualities

Depth class: Very deep

Permeability: Minocqua—moderate in the upper part and rapid or very rapid in the lower part;
Channing—moderate in the upper part and rapid or very rapid in the lower part

Available water capacity: Minocqua—moderate;
Channing—low

Drainage class: Minocqua—poorly drained; Channing—somewhat poorly drained

Seasonal high water table: Minocqua—1 foot above to 1 foot below the surface at some time from November through May; Channing—0.5 foot to 1.5 feet below the surface at some time from November through May

Surface runoff: Minocqua—very slow or ponded;
Channing—slow

Flooding: None

Composition

Minocqua soil and similar soils: 50 to 65 percent

Channing soil and similar soils: 25 to 45 percent

Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

- The very poorly drained, organic Cathro soils in landscape positions similar to those of the major soils
- The moderately well drained Sundog soils on low ridges

Similar inclusions:

- Areas where 0.01 to 1.0 percent of the surface is covered with stones and cobbles

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow hazard

Management measures:

- Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
- The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen or has an adequate snow cover.
- Because of wetness, seedling mortality, and plant competition, trees are generally not planted in areas of the Minocqua soil.
- In areas of the Channing soil, special site preparation, such as bedding, can reduce the seedling mortality rate.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: VIw

Woodland ordination symbol: Minocqua—7W;
Channing—2W

Michigan soil management group: Minocqua—4c;
Channing—3/5b

Primary habitat type: TTS

Secondary habitat type: PCS

115A—Manitowish fine sandy loam, 0 to 3 percent slopes

Setting

Landform and position on the landform: Nearly level areas on outwash plains and stream terraces

Shape of areas: Irregular

Size of areas: 5 to 400 acres

Typical Profile

Surface layer:

0 to 1 inch—very dark gray fine sandy loam

Subsurface layer:

1 to 4 inches—brown fine sandy loam

Subsoil:

4 to 19 inches—dark brown and dark yellowish brown, friable fine sandy loam

19 to 26 inches—dark yellowish brown, very friable gravelly loamy sand

Substratum:

26 to 60 inches—yellowish brown, mottled, stratified gravelly sand and sand

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderately rapid in the upper part and rapid in the lower part

Available water capacity: Low

Drainage class: Moderately well drained

Seasonal high water table: 3 to 6 feet below the surface at some time from November through May

Surface runoff: Slow

Flooding: None

Composition

Manitowish soil and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Channing soils in the slightly lower positions on the landscape

Similar inclusions:

- Areas that are well drained
- Soils that have a substratum of sand

Use and Management

Land use: Dominant uses—woodland, cropland

Woodland

Major management concerns: Seedling mortality

Management measures:

- Planting seedlings that can withstand droughty conditions can lower the seedling mortality rate. Replanting is needed in some areas.

Cropland

Major management concerns: Soil blowing, low organic matter content, droughtiness

Management measures:

- Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
- No-till farming, crop residue management, and a cropping sequence that includes green manure crops increase the organic matter content.
- Minimizing tillage and tilling at the proper soil moisture content help to maintain good tilth and prevent crusting.
- A system of conservation tillage that leaves crop residue on the surface conserves moisture.
- Irrigation water should be applied at a rate that ensures optimum production but does not increase deep percolation, the runoff rate, and the hazard of erosion.
- Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.

Interpretive Groups

Land capability classification: IIIs

Woodland ordination symbol: 3S

Michigan soil management group: 4a

Primary habitat type: TMV

Secondary habitat type: TM

116B—Wabeno silt loam, 1 to 6 percent slopes, very stony

Setting

Landform and position on the landform: Nearly level and undulating areas on ground moraines and end moraines

Shape of areas: Irregular, oval, or long and narrow

Size of areas: 5 to 600 acres

Typical Profile

Surface layer:

0 to 2 inches—black silt loam

Subsurface layer:

2 to 4 inches—brown silt loam

Subsoil:

4 to 23 inches—dark brown and brown silt loam

23 to 32 inches—dark brown and brown, mottled, friable silt loam

32 to 42 inches—a fragipan of dark brown and brown, mottled, very firm very fine sandy loam

42 to 50 inches—a fragipan of reddish brown, very firm sandy loam

Substratum:

50 to 60 inches—brown sandy loam

Soil Properties and Qualities

Depth class: Very deep

Rock fragments on the surface: Kind—stones and cobbles; percentage of surface covered—1 to 3

Permeability: Moderate in the upper part, moderately slow in the fragipan, and moderate in the lower part

Available water capacity: Moderate

Drainage class: Moderately well drained

Seasonal high water table: Perched at a depth of 1.5 to 3.5 feet at some time from November through June

Surface runoff: Slow

Flooding: None

Composition

Wabeno soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Net soils in the lower landscape positions
- Sundog and Karlin soils, which are more droughty than the Wabeno soil; in landscape positions similar to those of the Wabeno soil
- The well drained Stambaugh soils, which have a substratum of gravelly sand; in landscape positions similar to those of the Wabeno soil

Similar inclusions:

- Soils that do not have a firm layer in the subsoil

Use and Management

Land use: Woodland

Woodland

Major management concerns: Equipment limitation, windthrow hazard

Management measures:

- The use of equipment is briefly restricted in spring and during other excessively wet periods. Access is easiest during periods in winter when access roads are frozen.
- Because of stones on the surface, wheeled skidders with high clearance should be operated at a reduced

speed over carefully chosen routes.

- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: IVs

Woodland ordination symbol: 3L

Michigan soil management group: 2a-af

Primary habitat type: AVO

Secondary habitat type: AOC

116D—Wabeno silt loam, 6 to 18 percent slopes, very stony

Setting

Landform and position on the landform: Rolling areas on ground moraines and end moraines

Shape of areas: Irregular or long and narrow

Size of areas: 5 to 800 acres

Typical Profile

Surface layer:

0 to 2 inches—black silt loam

Subsurface layer:

2 to 4 inches—brown silt loam

Subsoil:

4 to 23 inches—dark brown and brown silt loam

23 to 32 inches—dark brown and brown, mottled, friable silt loam

32 to 42 inches—a fragipan of dark brown and brown, mottled, very firm very fine sandy loam

42 to 50 inches—a fragipan of reddish brown, very firm sandy loam

Substratum:

50 to 60 inches—brown sandy loam

Soil Properties and Qualities

Depth class: Very deep

Rock fragments on the surface: Kind—stones and cobbles; percentage of surface covered—1 to 3

Permeability: Moderate in the upper part, moderately slow in the fragipan, and moderate in the lower part

Available water capacity: Moderate

Drainage class: Moderately well drained

Seasonal high water table: Perched at a depth of 1.5 to 3.5 feet at some time from November through June

Surface runoff: Medium

Flooding: None

Composition

Wabeno soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Net soils on foot slopes and in drainageways
- Sundog and Karlin soils, which are more droughty than the Wabeno soil; in landscape positions similar to those of the Wabeno soil
- The well drained Stambaugh soils, which have a substratum of gravelly sand; in landscape positions similar to those of the Wabeno soil

Similar inclusions:

- Soils that do not have a firm layer in the subsoil

Use and Management

Land use: Woodland

Woodland

Major management concerns: Equipment limitation, windthrow hazard

Management measures:

- The use of equipment is briefly restricted in spring and during other excessively wet periods. Access is easiest during periods in winter when access roads are frozen.
- Because of stones on the surface, wheeled skidders with high clearance should be operated at a reduced speed over carefully chosen routes.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: VIIe

Woodland ordination symbol: 3L

Michigan soil management group: 2a-af

Primary habitat type: AVO

Secondary habitat type: AOC

121B—Peavy silt loam, 1 to 6 percent slopes, stony

Setting

Landform and position on the landform: Nearly level and undulating areas on ground moraines

Shape of areas: Irregular

Size of areas: 5 to 200 acres

Typical Profile

Surface layer:

0 to 6 inches—dark reddish brown silt loam

Subsoil:

6 to 27 inches—dark reddish brown and reddish brown, mottled, friable very fine sandy loam and fine sandy loam

27 to 41 inches—dark reddish brown, very firm channery loam

Substratum:

41 to 70 inches—dark reddish brown channery sandy loam

Soil Properties and Qualities

Depth class: Moderately deep or deep to dense till

Rock fragments on the surface: Kind—stones and cobbles; percent of surface covered—0.01 to 0.1

Permeability: Moderate in the upper part and slow or very slow in the lower part

Available water capacity: Low

Drainage class: Moderately well drained

Seasonal high water table: Perched at a depth of 1.5 to 3.0 feet at some time from November through April

Surface runoff: Slow

Flooding: None

Composition

Peavy soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Net soils in the lower landscape positions
- Padus soils, which are more droughty than the Peavy soil; in landscape positions similar to those of the Peavy soil
- Areas that have rock outcrops

Similar inclusions:

- Soils that have a substratum of gravelly loamy sand
- Soils that do not have a firm layer in the subsoil or substratum

Use and Management

Land use: Dominant uses—woodland, cropland

Woodland

Major management concerns: Equipment limitation, windthrow hazard

Management measures:

- Equipment should be used only when the soil is relatively dry or has an adequate snow cover.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Cropland

Major management concerns: Soil blowing, water erosion, low organic matter content, tilth

Management measures:

- Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop

rotations that include small grain and hay help to control soil blowing.

- Conservation tillage, grassed waterways, cover crops, and crop rotations that include grasses or legumes help to control water erosion.
- Contour farming and contour stripcropping reduce the runoff rate and the hazard of water erosion.
- No-till farming, crop residue management, and a cropping sequence that includes green manure crops increase the organic matter content.
- Minimizing tillage and tilling at the proper soil moisture content help to maintain good tilth and prevent crusting.
- Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.
- Stones on the surface may interfere with the use of tillage and planting equipment and some harvesting equipment. Removing the stones minimizes wear on equipment.

Interpretive Groups

Land capability classification: IIIs

Woodland ordination symbol: 3W

Michigan soil management group: 3/2a-d

Primary habitat type: AVO

Secondary habitat type: ATD

121D—Peavy silt loam, 6 to 18 percent slopes, stony

Setting

Landform and position on the landform: Rolling areas on ground moraines

Shape of areas: Irregular

Size of areas: 5 to 100 acres

Typical Profile

Surface layer:

0 to 6 inches—dark reddish brown silt loam

Subsoil:

6 to 27 inches—dark reddish brown and reddish brown, friable very fine sandy loam and fine sandy loam

27 to 41 inches—dark reddish brown, very firm channery loam

Substratum:

41 to 70 inches—dark reddish brown channery sandy loam

Soil Properties and Qualities

Depth class: Moderately deep or deep to dense till

Rock fragments on the surface: Kind—stones and cobbles; percent of surface covered—0.01 to 0.1

Permeability: Moderate in the upper part and slow or

very slow in the lower part

Available water capacity: Low

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Medium

Flooding: None

Composition

Peavy soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Net soils on foot slopes and in drainageways
- Padus soils, which are more droughty than the Peavy soil; in landscape positions similar to those of the Peavy soil
- Areas that have rock outcrops

Similar inclusions:

- Soils that have a substratum of gravelly loamy sand
- Soils that do not have a firm layer in the subsoil or substratum

Use and Management

Land use: Dominant uses—woodland, cropland

Woodland

Major management concerns: Equipment limitation, windthrow hazard

Management measures:

- Equipment should be used only when the soil is relatively dry or has an adequate snow cover.
- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Cropland

Major management concerns: Soil blowing, water erosion, low organic matter content, tillth

Management measures:

- Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
- Water erosion can be controlled by diversions, crop rotations, grade-stabilization structures, or a combination of these practices.
- No-till farming, crop residue management, and a cropping sequence that includes green manure crops increase the organic matter content.

- Minimizing tillage and tilling at the proper soil moisture content help to maintain good tillth and prevent crusting.
- Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.
- Stones on the surface may interfere with the use of tillage and planting equipment and some harvesting equipment. Removing the stones minimizes wear on equipment.

Interpretive Groups

Land capability classification: VIe

Woodland ordination symbol: 3D

Michigan soil management group: 3/2a-d

Primary habitat type: AVO

Secondary habitat type: ATD

122B—Saronia-Karlin fine sandy loams, 1 to 6 percent slopes, stony

Setting

Landform and position on the landform: Nearly level and undulating areas on ground moraines and end moraines

Shape of areas: Irregular

Size of areas: 5 to 200 acres

Typical Profile

Saronia

Surface layer:

0 to 2 inches—very dark gray fine sandy loam

Subsurface layer:

2 to 7 inches—brown fine sandy loam

Subsoil:

7 to 33 inches—dark brown and brown, friable fine sandy loam and loamy fine sand

33 to 37 inches—dark brown, friable loam

Substratum:

37 to 60 inches—reddish brown gravelly sandy loam

Karlin

Surface layer:

0 to 2 inches—black fine sandy loam

Subsurface layer:

2 to 3 inches—reddish gray fine sandy loam

Subsoil:

3 to 10 inches—brown, friable fine sandy loam

10 to 35 inches—brown and yellowish red, friable and very friable sandy loam and loamy sand

Substratum:

35 to 60 inches—brown sand

Soil Properties and Qualities

Depth class: Very deep

Rock fragments on the surface: Kind—stones and cobbles; percent of surface covered—0.01 to 0.1

Permeability: Sarona—moderate; Karlin—moderately rapid in the upper part, rapid in the lower part

Available water capacity: Sarona—moderate; Karlin—low

Drainage class: Sarona—well drained; Karlin—somewhat excessively drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow

Flooding: None

Composition

Sarona soil and similar soils: 40 to 55 percent

Karlin soil and similar soils: 30 to 50 percent

Contrasting inclusions: 10 to 15 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Au Gres and Net soils in the lower landscape positions
- The excessively drained Vilas soils, which are more droughty than the major soils; in landscape positions similar to those of the major soils
- The moderately well drained Wabeno soils, which have a shallower rooting depth than the major soils; in landscape positions similar to those of the major soils
- The moderately well drained, moderately wet Karlin soils in the slightly lower landscape positions

Similar inclusions:

- Soils that have gravelly sand at a depth of 40 to 60 inches
- Soils that have bands of loamy sand in the substratum

Use and Management

Land use: Dominant uses—woodland, cropland

Woodland

Major management concerns: Equipment limitation in areas of the Sarona soil

Management measures:

- The use of equipment is briefly restricted in spring and during other excessively wet periods in areas of the Sarona soil. Access is easiest during periods in winter when access roads are frozen.

Cropland

Major management concerns: Soil blowing, water erosion, low organic matter content, tilth, and droughtiness in areas of the Karlin soil

Management measures:

- Conservation tillage, crop residue management,

strip cropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.

- Water erosion can be controlled by diversions, crop residue management, contour strip cropping, field strip cropping, cover crops, grassed waterways, conservation tillage, crop rotations, grade-stabilization structures, or a combination of these practices.
- No-till farming, crop residue management, and a cropping sequence that includes green manure crops increase the organic matter content.
- Minimizing tillage and tilling at the proper soil moisture content help to maintain good tilth and prevent crusting.
- Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.
- Stones on the surface may interfere with the use of tillage and planting equipment and some harvesting equipment. Removing the stones minimizes wear on equipment.
- In areas of the Karlin soil, a system of conservation tillage that leaves crop residue on the surface is effective in conserving moisture.
- In areas of the Karlin soil, irrigation water should be applied at a rate that ensures optimum production but does not increase deep percolation, the runoff rate, and the hazard of erosion.

Interpretive Groups

Land capability classification: IIIs

Woodland ordination symbol: Sarona—3L; Karlin—3A

Michigan soil management group: Sarona—3a; Karlin—4a

Primary habitat type: TM

Secondary habitat type: TMV

122D—Sarona-Karlin fine sandy loams, 6 to 18 percent slopes, stony

Setting

Landform and position on the landform: Rolling areas on ground moraines and end moraines

Shape of areas: Irregular

Size of areas: 5 to 300 acres

Typical Profile

Sarona

Surface layer:

0 to 2 inches—very dark gray fine sandy loam

Subsurface layer:

2 to 7 inches—brown fine sandy loam

Subsoil:

7 to 33 inches—dark brown and brown, friable fine sandy loam and loamy fine sand
33 to 37 inches—dark brown, friable loam

Substratum:

37 to 60 inches—reddish brown gravelly sandy loam

Karlin*Surface layer:*

0 to 2 inches—black fine sandy loam

Subsurface layer:

2 to 3 inches—reddish gray fine sandy loam

Subsoil:

3 to 10 inches—brown, friable fine sandy loam
10 to 35 inches—brown and yellowish red, friable and very friable sandy loam and loamy sand

Substratum:

35 to 60 inches—brown sand

Soil Properties and Qualities

Depth class: Very deep

Rock fragments on the surface: Kind—stones and cobbles; percent of surface covered—0.01 to 0.1

Permeability: Sarona—moderate; Karlin—moderately rapid in the upper part, rapid in the lower part

Available water capacity: Sarona—moderate; Karlin—low

Drainage class: Sarona—well drained; Karlin—somewhat excessively drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow

Flooding: None

Composition

Sarona soil and similar soils: 40 to 55 percent

Karlin soil and similar soils: 30 to 50 percent

Contrasting inclusions: 10 to 15 percent

Inclusions*Contrasting inclusions:*

- The somewhat poorly drained Channing and Net soils on foot slopes and in drainageways
- The excessively drained Vilas soils, which are more droughty than the major soils; in landscape positions similar to those of the major soils
- The moderately well drained Wabeno soils, which have a shallower rooting depth than the major soils; in landscape positions similar to those of the major soils
- Areas that have slopes of 18 to 25 percent

Similar inclusions:

- Soils that have gravelly sand at a depth of 40 to 60 inches

- Soils that have bands of loamy sand in the substratum

Use and Management

Land use: Dominant uses—woodland, cropland

Woodland

Major management concerns: Equipment limitation in areas of the Sarona soil

Management measures:

- The use of equipment is briefly restricted in spring and during other excessively wet periods in areas of the Sarona soil. Access is easiest during periods in winter when access roads are frozen.
- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.

Cropland

Major management concerns: Soil blowing, water erosion, low organic matter content, tilth, and droughtiness in areas of the Karlin soil

Management measures:

- Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
- Water erosion can be controlled by diversions, crop rotations, grade-stabilization structures, or a combination of these practices.
- No-till farming, crop residue management, and a cropping sequence that includes green manure crops increase the organic matter content.
- Minimizing tillage and tilling at the proper soil moisture content help to maintain good tilth and prevent crusting.
- Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.
- Stones on the surface may interfere with the use of tillage and planting equipment and some harvesting equipment. Removing the stones minimizes wear on equipment.
- In areas of the Karlin soil, a system of conservation tillage that leaves crop residue on the surface is effective in conserving moisture.

Interpretive Groups

Land capability classification: Vle

Woodland ordination symbol: Sarona—3L; Karlin—3A

Michigan soil management group: Sarona—3a; Karlin—4a

Primary habitat type: TM

Secondary habitat type: TMV

123B—Ocqueoc loamy fine sand, 1 to 6 percent slopes

Setting

Landform and position on the landform: Nearly level and undulating areas on outwash plains

Shape of areas: Irregular

Size of areas: 5 to 30 acres

Typical Profile

Surface layer:

0 to 3 inches—dark reddish brown loamy fine sand

Subsurface layer:

3 to 5 inches—dark reddish gray loamy fine sand

Subsoil:

5 to 17 inches—dark reddish brown, very friable loamy fine sand

17 to 23 inches—reddish brown, very friable loamy fine sand

Substratum:

23 to 60 inches—reddish brown very fine sand with bands of reddish brown very fine sandy loam

Soil Properties and Qualities

Depth class: Very deep

Permeability: Rapid in the upper part and moderately slow in the lower part

Available water capacity: Moderate

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow

Flooding: None

Composition

Ocqueoc soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Inclusions

Contrasting inclusions:

- Sarona soils, which are less droughty than the Ocqueoc soil; in landscape positions similar to those of the Ocqueoc soil
- The moderately well drained, moderately wet Karlin soils in the lower landscape positions

Similar inclusions:

- Soils that have a substratum of loamy fine sand

Use and Management

Land use: Woodland

Major management concerns: None

Interpretive Groups

Land capability classification: IIIs

Woodland ordination symbol: 3A

Michigan soil management group: 4/2a

Primary habitat type: TM

Secondary habitat type: TMV

123D—Ocqueoc loamy fine sand, 6 to 18 percent slopes

Setting

Landform and position on the landform: Rolling areas on outwash plains

Shape of areas: Irregular

Size of areas: 5 to 80 acres

Typical Profile

Surface layer:

0 to 3 inches—dark reddish brown loamy fine sand

Subsurface layer:

3 to 5 inches—dark reddish gray loamy fine sand

Subsoil:

5 to 17 inches—dark reddish brown, very friable loamy fine sand

17 to 23 inches—reddish brown, very friable loamy fine sand

Substratum:

23 to 60 inches—reddish brown very fine sand with bands of reddish brown very fine sandy loam

Soil Properties and Qualities

Depth class: Very deep

Permeability: Rapid in the upper part and moderately slow in the lower part

Available water capacity: Moderate

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Medium

Flooding: None

Composition

Ocqueoc soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Inclusions

Contrasting inclusions:

- Sarona soils, which are less droughty than the Ocqueoc soil; in landscape positions similar to those of the Ocqueoc soil
- The moderately well drained, moderately wet Karlin soils in the lower landscape positions
- The somewhat poorly drained Au Gres soils on foot slopes and in drainageways
- Areas that have slopes of 18 to 30 percent

Use and Management

Land use: Woodland

Major management concerns: None

Management measures:

- Although the equipment limitation is slight for most woodland operations, the adjacent nearly level and undulating areas, if available, should be selected as sites for landings.

Interpretive Groups

Land capability classification: IVe

Woodland ordination symbol: 3A

Michigan soil management group: 4/2a

Primary habitat type: TM

Secondary habitat type: TMV

124B—Wabeno-Net silt loams, 0 to 6 percent slopes, very stony

Setting

Landform and position on the landform: Wabeno—nearly level and undulating areas on ground moraines;

Net—drainageways on ground moraines

Shape of areas: Irregular

Size of areas: 5 to 250 acres

Typical Profile

Wabeno

Surface layer:

0 to 2 inches—black silt loam

Subsurface layer:

2 to 4 inches—brown silt loam

Subsoil:

4 to 23 inches—dark brown and brown silt loam

23 to 32 inches—dark brown and brown, mottled, friable silt loam

32 to 42 inches—a fragipan of dark brown and brown, mottled, very firm very fine sandy loam

42 to 50 inches—a fragipan of reddish brown, very firm sandy loam

Substratum:

50 to 60 inches—brown sandy loam

Net

Surface layer:

0 to 3 inches—dark brown silt loam

Subsurface layer:

3 to 6 inches—brown, mottled silt loam

Subsoil:

6 to 28 inches—dark brown, mottled, friable very fine sandy loam and fine sandy loam

28 to 49 inches—a fragipan of dark brown and brown,

mottled, very firm gravelly sandy loam and gravelly loamy sand

Substratum:

49 to 60 inches—dark brown gravelly sandy loam

Soil Properties and Qualities

Depth class: Very deep

Rock fragments on the surface: Kind—stones and cobbles; percentage of surface covered—1 to 3

Permeability: Wabeno—moderate in the upper part, moderately slow in the fragipan, and moderate in the lower part; Net—moderate in the upper part, very slow in the fragipan, and moderate or moderately rapid in the lower part

Available water capacity: Wabeno—moderate; Net—low

Drainage class: Wabeno—moderately well drained; Net—somewhat poorly drained

Seasonal high water table: Wabeno—perched at a depth of 1.5 to 3.5 feet at some time from October through June; Net—perched at a depth of 0.5 foot to 1.5 feet at some time from November through May

Surface runoff: Slow

Flooding: None

Composition

Wabeno soil and similar soils: 50 to 65 percent

Net soil and similar soils: 25 to 35 percent

Contrasting inclusions: 10 to 15 percent

Inclusions

Contrasting inclusions:

- The poorly drained Witbeck soils in depressions
- Sundog and Karlin soils, which are more droughty than the major soils; in landscape positions similar to those of the Wabeno soil

Similar inclusions:

- Soils that do not have a firm layer in the subsoil

Use and Management

Land use: Woodland

Major management concerns: Wabeno—equipment limitation, windthrow hazard; Net—equipment limitation, seedling mortality, windthrow hazard

Management measures:

- Equipment should be used only when the soils are relatively dry or have an adequate snow cover.
- Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
- The seasonal high water table in areas of the Net soil restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen or

has an adequate snow cover.

- Because of stones on the surface, wheeled skidders with high clearance should be operated at a reduced speed over carefully chosen routes.
- Special site preparation, such as bedding, can reduce the seedling mortality rate.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: IVs

Woodland ordination symbol: Wabeno—3L; Net—3W

Michigan soil management group: Wabeno—2a-af;
Net—3b-af

Primary habitat type: ATD

Secondary habitat type: TMC

125B—Wabeno-Net silt loams, 0 to 6 percent slopes, rocky, very stony

Setting

Landform and position on the landform: Wabeno—nearly level and undulating areas on ground moraines;

Net—drainageways on ground moraines

Shape of areas: Irregular

Size of areas: 10 to 350 acres

Typical Profile

Wabeno

Surface layer:

0 to 2 inches—black silt loam

Subsurface layer:

2 to 4 inches—brown silt loam

Subsoil:

4 to 23 inches—dark brown and brown silt loam

23 to 32 inches—dark brown and brown, mottled, friable silt loam

32 to 42 inches—a fragipan of dark brown and brown, mottled, very firm very fine sandy loam

42 to 50 inches—a fragipan of reddish brown, very firm sandy loam

Substratum:

50 to 60 inches—brown sandy loam

Net

Surface layer:

0 to 3 inches—dark brown silt loam

Subsurface layer:

3 to 6 inches—brown, mottled silt loam

Subsoil:

6 to 28 inches—dark brown, mottled, friable very fine sandy loam and fine sandy loam

28 to 49 inches—a fragipan of dark brown and brown, mottled, very firm gravelly sandy loam and gravelly loamy sand

Substratum:

49 to 60 inches—dark brown gravelly sandy loam

Soil Properties and Qualities

Depth class: Very deep

Rock fragments on the surface: Kind—stones and cobbles; percent of surface covered—1 to 3

Permeability: Wabeno—moderate in the upper part, moderately slow in the fragipan, and moderate in the lower part; Net—moderate in the upper part, very slow in the fragipan, and moderate or moderately rapid in the lower part

Available water capacity: Wabeno—moderate; Net—low

Drainage class: Wabeno—moderately well drained; Net—somewhat poorly drained

Seasonal high water table: Wabeno—perched at a depth of 1.5 to 3.5 feet at some time from October through June; Net—perched at a depth of 0.5 foot to 1.5 feet at some time from November through May

Surface runoff: Slow

Flooding: None

Composition

Wabeno soil and similar soils: 50 to 65 percent

Net soil and similar soils: 20 to 35 percent

Rock outcrop: 1 to 10 percent

Contrasting inclusions: 10 to 15 percent

Inclusions

Contrasting inclusions:

- The poorly drained Witbeck soils in depressions
- Sundog and Karlin soils, which are more droughty than the major soils; in landscape positions similar to those of the Wabeno soil

Similar inclusions:

- Areas that do not have a firm layer in the subsoil

Use and Management

Land use: Woodland

Major management concerns: Wabeno—equipment limitation, windthrow hazard; Net—equipment limitation, seedling mortality, windthrow hazard

Management measures:

- The seasonal high water table in areas of the Net soil restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen or has an adequate snow cover.
- Equipment should be used only when the soils are relatively dry or have an adequate snow cover.
- Year-round logging roads require roadfill and gravel.

Culverts are needed to maintain the natural drainage system.

- Because of stones on the surface, wheeled skidders with high clearance should be operated at a reduced speed over carefully chosen routes.
- Rock outcrops should be considered when road locations and landing sites are planned.
- In areas of the Net soil, special site preparation, such as bedding, can reduce the seedling mortality rate.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: IVs

Woodland ordination symbol: Wabeno—3L; Net—3W

Michigan soil management group: Wabeno—2a-af;
Net—3b-af

Primary habitat type: ATD

Secondary habitat type: TMC

126B—Champion very fine sandy loam, 1 to 6 percent slopes, very stony

Setting

Landform and position on the landform: Nearly level and undulating areas on ground moraines

Shape of areas: Irregular, oval

Size of areas: 5 to 500 acres

Typical Profile

Organic mat:

0 to 1 inch—black, partially decomposed forest litter

Subsurface layer:

1 to 4 inches—gray very fine sandy loam

Subsoil:

4 to 11 inches—dark reddish brown and dark brown, very friable and friable very fine sandy loam

11 to 20 inches—dark brown and brown, friable very fine sandy loam

20 to 49 inches—a fragipan of dark grayish brown and dark brown, mottled, extremely firm gravelly fine sandy loam

Substratum:

49 to 60 inches—grayish brown gravelly fine sandy loam

Soil Properties and Qualities

Depth class: Very deep

Rock fragments on the surface: Kind—stones and cobbles; percentage of surface covered—1 to 3

Permeability: Moderate in the upper part, very slow in the fragipan, and moderate or moderately rapid in the lower part

Available water capacity: Low

Drainage class: Moderately well drained

Seasonal high water table: Perched at a depth of 1 to 2 feet at some time from November through May

Surface runoff: Slow

Flooding: None

Composition

Champion soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:

- Sundog and Karlin soils, which are more droughty than the Champion soil; in landscape positions similar to those of the Champion soil
- The somewhat poorly drained Net soils in the lower landscape positions
- Areas where 3 to 15 percent of the surface is covered with stones and cobbles

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, windthrow hazard

Management measures:

- Equipment should be used only when the soil is relatively dry or has an adequate snow cover.
- Because of stones on the surface, wheeled skidders with high clearance should be operated at a reduced speed over carefully chosen routes.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: IVs

Woodland ordination symbol: 3W

Michigan soil management group: 3a-af

Primary habitat type: ATD

Secondary habitat type: None assigned

126D—Champion very fine sandy loam, 6 to 18 percent slopes, very stony

Setting

Landform and position on the landform: Rolling areas on ground moraines and end moraines

Shape of areas: Irregular

Size of areas: 5 to 300 acres

Typical Profile

Organic mat:

0 to 1 inch—black, partially decomposed forest litter

Subsurface layer:

1 to 4 inches—gray very fine sandy loam

Subsoil:

4 to 11 inches—dark reddish brown and dark brown, very friable and friable very fine sandy loam

11 to 20 inches—dark brown and brown, friable very fine sandy loam

20 to 49 inches—a fragipan of dark grayish brown and dark brown, mottled, extremely firm gravelly fine sandy loam

Substratum:

49 to 60 inches—grayish brown gravelly fine sandy loam

Soil Properties and Qualities

Depth class: Very deep

Rock fragments on the surface: Kind—stones and cobbles; percentage of surface covered—1 to 3

Permeability: Moderate in the upper part, very slow in the fragipan, and moderate or moderately rapid in the lower part

Available water capacity: Low

Drainage class: Moderately well drained

Seasonal high water table: Perched at a depth of 1 to 2 feet at some time from November through May

Surface runoff: Medium

Flooding: None

Composition

Champion soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:

- Sundog and Karlin soils, which are more droughty than the Champion soil; in landscape positions similar to those of the Champion soil
- The somewhat poorly drained Net soils on foot slopes and in drainageways
- Areas where 3 to 15 percent of the surface is covered with stones and cobbles

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, windthrow hazard

Management measures:

- Equipment should be used only when the soil is relatively dry or has an adequate snow cover.
- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas

should be selected as sites for landings.

- Because of stones on the surface, wheeled skidders with high clearance should be operated at a reduced speed over carefully chosen routes.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: VIIe

Woodland ordination symbol: 3W

Michigan soil management group: 3a-af

Primary habitat type: ATD

Secondary habitat type: None assigned

126F—Champion very fine sandy loam, 18 to 35 percent slopes, very stony

Setting

Landform and position on the landform: Hilly areas on end moraines

Shape of areas: Irregular or long and narrow

Size of areas: 5 to 100 acres

Typical Profile

Organic mat:

0 to 1 inch—black, partially decomposed forest litter

Subsurface layer:

1 to 4 inches—gray very fine sandy loam

Subsoil:

4 to 11 inches—dark reddish brown and dark brown, very friable and friable very fine sandy loam

11 to 20 inches—dark brown and brown, friable very fine sandy loam

20 to 49 inches—a fragipan of dark grayish brown and dark brown, mottled, extremely firm gravelly fine sandy loam

Substratum:

49 to 60 inches—grayish brown gravelly fine sandy loam

Soil Properties and Qualities

Depth class: Very deep

Rock fragments on the surface: Kind—stones and cobbles; percentage of surface covered—1 to 3

Permeability: Moderate in the upper part, very slow in the fragipan, and moderate or moderately rapid in the lower part

Available water capacity: Low

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Rapid

Flooding: None

Composition

Champion soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:

- Sundog and Karlin soils, which are more droughty than the Champion soil; in landscape positions similar to those of the Champion soil
- Areas where 3 to 15 percent of the surface is covered with stones and cobbles

Use and Management

Land use: Woodland

Major management concerns: Erosion hazard; equipment limitation, windthrow hazard

Management measures:

- Because of the erosion hazard, water should be removed from logging roads by water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures. Building logging roads on the contour or on the gentler slopes and seeding logging roads, skid roads, and landings after the trees are logged also help to prevent excessive soil loss.
- Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.
- Equipment should be used only when the soil is relatively dry or has an adequate snow cover.
- Because of stones on the surface, wheeled skidders with high clearance should be operated at a reduced speed over carefully chosen routes.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: VIIe

Woodland ordination symbol: 3R

Michigan soil management group: 3a-af

Primary habitat type: ATD

Secondary habitat type: None assigned

127D—Goodman silt loam, 1 to 18 percent slopes, rocky, very stony

Setting

Landform and position on the landform: Nearly level to rolling areas on ground moraines and end moraines

Shape of areas: Irregular

Size of areas: 5 to 300 acres

Typical Profile

Surface layer:

0 to 3 inches—very dark gray silt loam

Subsurface layer:

3 to 5 inches—dark grayish brown silt loam

Subsoil:

5 to 14 inches—dark brown, friable very fine sandy loam

14 to 33 inches—brown and dark brown, friable very fine sandy loam

33 to 49 inches—dark reddish brown, friable fine sandy loam and reddish brown, friable loamy sand

Substratum:

49 to 60 inches—reddish brown fine sandy loam

Soil Properties and Qualities

Depth class: Very deep

Rock fragments on the surface: Kind—cobbles and stones; percentage of surface covered—1 to 3

Permeability: Moderate

Available water capacity: High

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Medium

Flooding: None

Composition

Goodman soil and similar soils: 85 to 95 percent

Rock outcrop: 1 to 10 percent

Contrasting inclusions: 5 to 14 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Net soils on foot slopes and in drainageways
- Sundog soils, which are more droughty than the Goodman soil; in landscape positions similar to those of the Goodman soil
- The moderately well drained Wabeno soils, which have a shallower rooting depth than the Goodman soil; in landscape positions similar to those of the Goodman soil
- Areas where 3 to 15 percent of the surface is covered with stones and cobbles

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation

Management measures:

- The use of equipment is briefly restricted in spring and during other excessively wet periods. Access is easiest during periods in winter when access roads are frozen.
- Small areas of nearly level included soils, if any are

available, and suitable nearly level adjacent areas should be selected as sites for landings.

- Rock outcrops should be considered when road locations and landing sites are planned.
- Because of stones on the surface, wheeled skidders with high clearance should be operated at a reduced speed over carefully chosen routes.

Interpretive Groups

Land capability classification: VIIe

Woodland ordination symbol: 3L

Michigan soil management group: 2.5a

Primary habitat type: ATD

Secondary habitat type: AVO

128B—Goodman-Wabeno-Sundog, sandy substratum, complex, 1 to 6 percent slopes, stony

Setting

Landform and position on the landform: Nearly level and undulating areas on ground moraines

Shape of areas: Irregular

Size of areas: 5 to 400 acres

Typical Profile

Goodman

Surface layer:

0 to 3 inches—very dark gray silt loam

Subsurface layer:

3 to 5 inches—dark grayish brown silt loam

Subsoil:

5 to 14 inches—dark brown, friable very fine sandy loam

14 to 33 inches—brown and dark brown, friable very fine sandy loam

33 to 49 inches—dark reddish brown, friable fine sandy loam and reddish brown, friable loamy sand

Substratum:

49 to 60 inches—reddish brown fine sandy loam

Wabeno

Surface layer:

0 to 2 inches—black silt loam

Subsurface layer:

2 to 4 inches—brown silt loam

Subsoil:

4 to 23 inches—dark brown and brown silt loam

23 to 32 inches—dark brown and brown, mottled, friable silt loam

32 to 42 inches—a fragipan of dark brown and brown,

mottled, very firm very fine sandy loam
42 to 50 inches—a fragipan of reddish brown, very firm sandy loam

Substratum:

50 to 60 inches—brown sandy loam

Sundog, sandy substratum

Surface layer:

0 to 3 inches—dark brown very fine sandy loam

Subsurface layer:

3 to 6 inches—gray very fine sandy loam

Subsoil:

6 to 46 inches—dark reddish brown, dark brown, and brown, friable very fine sandy loam

Substratum:

46 to 60 inches—brown sand

Soil Properties and Qualities

Depth class: Very deep

Rock fragments on the surface: Kind—stones and cobbles; percentage of surface covered—0.01 to 1.0

Permeability: Goodman—moderate; Wabeno—moderate in the upper part, moderately slow in the fragipan, and moderate in the lower part; Sundog—moderate in the upper part and rapid in the lower part

Available water capacity: Goodman—high; Wabeno—moderate; Sundog—moderate

Drainage class: Goodman—well drained; Wabeno—moderately well drained; Sundog—well drained

Seasonal high water table: Goodman—at a depth of more than 6 feet; Wabeno—perched at a depth of 1.5 to 3.5 feet at some time from October through June; Sundog—at a depth of more than 6 feet

Surface runoff: Slow

Flooding: None

Composition

Goodman soil and similar soils: 30 to 40 percent

Wabeno soil and similar soils: 25 to 30 percent

Sundog soil and similar soils: 25 to 30 percent

Contrasting inclusions: 10 to 15 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Net and Channing soils in the lower landscape positions
- Karlin soils, which are more droughty than the major soils; in landscape positions similar to those of the major soils

Similar inclusions:

- Soils that have a substratum of gravelly sand

Use and Management

Land use: Woodland

Major management concerns: Goodman—equipment limitation; Wabeno—equipment limitation, windthrow hazard; Sundog—equipment limitation

Management measures:

- The use of equipment is briefly restricted in spring and during other excessively wet periods. Access is easiest during periods in winter when access roads are frozen.
- Windthrow in areas of the Wabeno soil can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: IIIs

Woodland ordination symbol: Goodman—3L; Wabeno—3L; Sundog—2L

Michigan soil management group: Goodman—2.5a; Wabeno—2a-af; Sundog—3/5a

Primary habitat type: AVO

Secondary habitat type: ATD

128D—Goodman-Wabeno-Sundog, sandy substratum, complex, 6 to 18 percent slopes, stony

Setting

Landform and position on the landform: Rolling areas on ground moraines and end moraines

Shape of areas: Irregular

Size of areas: 5 to 200 acres

Typical Profile

Goodman

Surface layer:

0 to 3 inches—very dark gray silt loam

Subsurface layer:

3 to 5 inches—dark grayish brown silt loam

Subsoil:

5 to 14 inches—dark brown, friable very fine sandy loam

14 to 33 inches—brown and dark brown, friable very fine sandy loam

33 to 49 inches—dark reddish brown, friable fine sandy loam and reddish brown, friable loamy sand

Substratum:

49 to 60 inches—reddish brown fine sandy loam

Wabeno

Surface layer:

0 to 2 inches—black silt loam

Subsurface layer:

2 to 4 inches—brown silt loam

Subsoil:

4 to 23 inches—dark brown and brown silt loam

23 to 32 inches—dark brown and brown, mottled, friable silt loam

32 to 42 inches—a fragipan of dark brown and brown, mottled, very firm very fine sandy loam

42 to 50 inches—a fragipan of reddish brown, very firm sandy loam

Substratum:

50 to 60 inches—brown sandy loam

Sundog, sandy substratum

Surface layer:

0 to 3 inches—dark brown very fine sandy loam

Subsurface layer:

3 to 6 inches—gray very fine sandy loam

Subsoil:

6 to 46 inches—dark reddish brown, dark brown, and brown, friable very fine sandy loam

Substratum:

46 to 60 inches—brown sand

Soil Properties and Qualities

Depth class: Very deep

Rock fragments on the surface: Kind—stones and cobbles; percentage of surface covered—0.01 to 1.0

Permeability: Goodman—moderate; Wabeno—moderate in the upper part, moderately slow in the fragipan, and moderate in the lower part; Sundog—moderate in the upper part and rapid in the lower part

Available water capacity: Goodman—high; Wabeno—moderate; Sundog—moderate

Drainage class: Goodman—well drained; Wabeno—moderately well drained; Sundog—well drained

Seasonal high water table: Goodman—at a depth of more than 6 feet; Wabeno—perched at a depth of 1.5 to 3.5 feet at some time from October through June; Sundog—at a depth of more than 6 feet

Surface runoff: Medium

Flooding: None

Composition

Goodman soil and similar soils: 30 to 40 percent

Wabeno soil and similar soils: 25 to 30 percent

Sundog soil and similar soils: 25 to 30 percent

Contrasting inclusions: 10 to 15 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Net and Channing soils in drainageways

- Karlin soils, which are more droughty than the major soils; in landscape positions similar to those of the major soils

Similar inclusions:

- Soils that have a substratum of gravelly sand

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, windthrow hazard in areas of the Wabeno soil

Management measures:

- The use of equipment is briefly restricted in spring and during other excessively wet periods. Access is easiest during periods in winter when access roads are frozen.
- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.
- Windthrow in areas of the Wabeno soil can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: VIe

Woodland ordination symbol: Goodman—3L; Wabeno—3L; Sundog—2L

Michigan soil management group: Goodman—2.5a; Wabeno—2a-af; Sundog—3/5a

Primary habitat type: AVO

Secondary habitat type: ATD

128F—Goodman-Sundog, sandy substratum, complex, 18 to 45 percent slopes, stony

Setting

Landform and position on the landform: Hilly and steep areas on end moraines

Shape of areas: Irregular or long and narrow

Size of areas: 5 to 100 acres

Typical Profile

Goodman

Surface layer:

0 to 3 inches—very dark gray silt loam

Subsurface layer:

3 to 5 inches—dark grayish brown silt loam

Subsoil:

5 to 14 inches—dark brown, friable very fine sandy loam

14 to 33 inches—brown and dark brown, friable very fine sandy loam

33 to 49 inches—dark reddish brown, friable fine sandy loam and reddish brown, friable loamy sand

Substratum:

49 to 60 inches—reddish brown fine sandy loam

Sundog, sandy substratum

Surface layer:

0 to 4 inches—dark brown very fine sandy loam

Subsurface layer:

4 to 6 inches—gray very fine sandy loam

Subsoil:

6 to 22 inches—dark reddish brown, dark brown, and brown, friable very fine sandy loam

Substratum:

22 to 60 inches—brown sand

Soil Properties and Qualities

Depth class: Very deep

Rock fragments on the surface: Kind—stones and cobbles; percentage of surface covered—0.01 to 0.1

Permeability: Goodman—moderate; Sundog—moderate in the upper part and rapid in the lower part

Available water capacity: Moderate

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Rapid

Flooding: None

Composition

Goodman soil and similar soils: 35 to 55 percent

Sundog soil and similar soils: 35 to 50 percent

Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:

- Karlin soils, which are more droughty than the major soils; in landscape positions similar to those of the major soils

Similar inclusions:

- Soils that have a substratum of gravelly sand

Use and Management

Land use: Woodland

Major management concerns: Erosion hazard, equipment limitation

Management measures:

- Because of the erosion hazard, water should be removed from logging roads by water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures. Building logging roads on the contour or on the gentler slopes and seeding logging roads, skid roads, and landings after the trees are logged also help

to prevent excessive soil loss.

- Equipment should be used only when the soils are relatively dry or have an adequate snow cover.
- Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.

Interpretive Groups

Land capability classification: VIIIe

Woodland ordination symbol: Goodman—3R; Sundog—2R

Michigan soil management group: Goodman—2.5a; Sundog—3/5a

Primary habitat type: ATD

Secondary habitat type: AVO

163B—Sagola fine sandy loam, 1 to 6 percent slopes, stony

Setting

Landform and position on the landform: Nearly level and undulating areas on ground moraines

Shape of areas: Irregular

Size of areas: 5 to 200 acres

Typical Profile

Surface layer:

0 to 1 inch—black fine sandy loam

Subsurface layer:

1 to 7 inches—reddish gray fine sandy loam

Subsoil:

7 to 18 inches—reddish brown, friable fine sandy loam

18 to 30 inches—brown and dark brown, friable fine sandy loam

30 to 47 inches—dark reddish brown, firm fine sandy loam and reddish brown, firm loamy fine sand

Substratum:

47 to 60 inches—reddish brown loamy fine sand

Soil Properties and Qualities

Depth class: Very deep

Rock fragments on the surface: Kind—stones and cobbles; percentage of surface covered—0.01 to 0.1

Permeability: Moderately rapid

Available water capacity: Moderate

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow

Flooding: None

Composition

Sagola soil and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

- The well drained Karlin soils, which are coarser textured than the Sagola soil; in landscape positions similar to those of the Sagola soil
- The somewhat poorly drained Solona soils in the lower landscape positions
- The poorly drained Ensley soils in depressions

Similar inclusions:

- Soils that are loamy fine sand in the upper part of the profile and fine sandy loam in the lower part
- Soils that are dominantly fine sandy loam and loam

Use and Management

Land use: Dominant uses—woodland, cropland

Woodland

Major management concerns: Equipment limitation

Management measures:

- The use of equipment is briefly restricted in spring and during other excessively wet periods. Access is easiest during periods in winter when access roads are frozen.

Cropland

Major management concerns: Soil blowing, water erosion, low organic matter content, droughtiness, tilth

Management measures:

- Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
- Conservation tillage, grassed waterways, cover crops, and crop rotations that include grasses or legumes help to control water erosion.
- Contour farming and contour stripcropping reduce the runoff rate and the hazard of water erosion.
- No-till farming, crop residue management, and a cropping sequence that includes green manure crops increase the organic matter content.
- Minimizing tillage and tilling at the proper soil moisture content help to maintain good tilth and prevent crusting.
- A system of conservation tillage that leaves crop residue on the surface is effective in conserving moisture.
- Irrigation water should be applied at a rate that ensures optimum production but does not increase deep percolation, the runoff rate, and the hazard of erosion.
- Returning crop residue to the soil, adding other organic material, and including grasses and legumes in

the cropping sequence improve soil structure, permeability, and the rate of water infiltration.

- Stones on the surface may interfere with the use of tillage and planting equipment and some harvesting equipment. Removing the stones minimizes wear on equipment.

Interpretive Groups

Land capability classification: IIIs

Woodland ordination symbol: 4L

Michigan soil management group: 3a

Primary habitat type: TMV

Secondary habitat type: ATD

163D—Sagola fine sandy loam, 6 to 18 percent slopes, stony

Setting

Landform and position on the landform: Rolling areas on ground moraines and end moraines

Shape of areas: Irregular

Size of areas: 5 to 100 acres

Typical Profile

Surface layer:

0 to 1 inch—black fine sandy loam

Subsurface layer:

1 to 7 inches—reddish gray fine sandy loam

Subsoil:

7 to 18 inches—reddish brown, friable fine sandy loam

18 to 30 inches—brown and dark brown, friable fine sandy loam

30 to 47 inches—dark reddish brown, firm fine sandy loam and reddish brown, firm loamy fine sand

Substratum:

47 to 60 inches—reddish brown loamy fine sand

Soil Properties and Qualities

Depth class: Very deep

Rock fragments on the surface: Kind—stones and cobbles; percentage of surface covered—0.10 to 0.1

Permeability: Moderately rapid

Available water capacity: Moderate

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Medium

Flooding: None

Composition

Sagola soil and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

- The well drained Karlin soils, which are coarser textured than the Sagola soil; in landscape positions similar to those of the Sagola soil
- The somewhat poorly drained Solona soils on foot slopes and in drainageways
- The poorly drained Ensley soils in depressions

Similar inclusions:

- Soils that are loamy fine sand in the upper part of the profile and fine sandy loam in the lower part
- Soils that are dominantly fine sandy loam or loam

Use and Management

Land use: Dominant uses—woodland, cropland

Woodland

Major management concerns: Equipment limitation

Management measures:

- The use of equipment is briefly restricted in spring and during other excessively wet periods. Access is easiest during periods in winter when access roads are frozen.
- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.

Cropland

Major management concerns: Soil blowing, water erosion, low organic matter content, droughtiness, tillth

Management measures:

- Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
- Water erosion can be controlled by diversions, crop rotations, grade-stabilization structures, or a combination of these practices.
- No-till farming, crop residue management, and a cropping sequence that includes green manure crops increase the organic matter content.
- Minimizing tillage and tilling at the proper soil moisture content help to maintain good tillth and prevent crusting.
- A system of conservation tillage that leaves crop residue on the surface is effective in conserving moisture.
- Stones on the surface may interfere with the use of tillage and planting equipment and some harvesting equipment. Removing the stones minimizes wear on equipment.

Interpretive Groups

Land capability classification: IVE

Woodland ordination symbol: 4L

Michigan soil management group: 3a

Primary habitat type: TMV
Secondary habitat type: ATD

163F—Sagola fine sandy loam, 18 to 35 percent slopes, stony

Setting

Landform and position on the landform: Hilly areas on end moraines

Shape of areas: Irregular

Size of areas: 5 to 100 acres

Typical Profile

Surface layer:

0 to 1 inch—black fine sandy loam

Subsurface layer:

1 to 7 inches—reddish gray fine sandy loam

Subsoil:

7 to 18 inches—reddish brown, friable fine sandy loam

18 to 30 inches—brown and dark brown, friable fine sandy loam

30 to 47 inches—dark reddish brown, firm fine sandy loam and reddish brown, firm loamy fine sand

Substratum:

47 to 60 inches—reddish brown loamy fine sand

Soil Properties and Qualities

Depth class: Very deep

Rock fragments on the surface: Kind—stones and cobbles; percentage of surface covered—0.01 to 0.1

Permeability: Moderately rapid

Available water capacity: Moderate

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Rapid

Flooding: None

Composition

Sagola soil and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

- The well drained Karlin soils, which are coarser textured than the Sagola soil; in landscape positions similar to those of the Sagola soil
- The somewhat poorly drained Solona soils on foot slopes and in drainageways
- The poorly drained Ensley soils in depressions

Similar inclusions:

- Soils that are loamy fine sand in the upper part of the

profile and fine sandy loam in the lower part

- Soils that are dominantly fine sandy loam or loam

Use and Management

Land use: Woodland

Woodland

Major management concerns: Erosion hazard, equipment limitation

Management measures:

- Because of the erosion hazard, water should be removed from logging roads by water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures.
- Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.
- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.

Interpretive Groups

Land capability classification: VIIe

Woodland ordination symbol: 4R

Michigan soil management group: 3a

Primary habitat type: TMV

Secondary habitat type: ATD

164B—Alstad loam, 0 to 6 percent slopes

Setting

Landform and position on the landform: Nearly level and undulating areas on ground moraines

Shape of areas: Irregular or long and narrow

Size of areas: 5 to 30 acres

Typical Profile

Surface layer:

0 to 4 inches—dark reddish brown loam

Subsoil:

4 to 16 inches—dark brown, mottled, friable loam

16 to 21 inches—grayish brown, mottled, firm fine sandy loam

21 to 26 inches—dark reddish brown, mottled, firm clay loam and grayish brown, mottled, firm fine sandy loam

26 to 42 inches—dark reddish brown, mottled, friable clay loam

Substratum:

42 to 60 inches—reddish brown clay loam

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderate in the upper part and moderately slow in the lower part

Available water capacity: High

Drainage class: Somewhat poorly drained

Seasonal high water table: Perched at a depth of 1 to 3 feet at some time from November through May

Surface runoff: Slow

Flooding: None

Composition

Alstad soil and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

- The well drained Trenary soils on low knolls
- The somewhat poorly drained Solona soils, which are coarser textured than the Alstad soil; in landscape positions similar to those of the Alstad soil

Similar inclusions:

- Soils that have a substratum of fine sand or loamy fine sand

Use and Management

Land use: Dominant uses—woodland, cropland

Woodland

Major management concerns: Equipment limitation, windthrow hazard

Management measures:

- Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
- The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen or has an adequate snow cover.
- Areas of the better drained included Trenary soils are more suitable as sites for landings.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Cropland

Major management concerns: Seasonal wetness, water erosion, tillth

Management measures:

- Tile drains can be used to reduce wetness if a suitable outlet is available.
- Conservation tillage, grassed waterways, cover crops, and crop rotations that include grasses or legumes help to control water erosion.
- Minimizing tillage and tilling at the proper soil moisture content help to maintain good tillth and prevent crusting.
- Crop residue management, cover crops, green

manure crops, proper use of manure, and conservation tillage help to maintain and improve tillth, the moisture-holding capacity, and the organic matter content.

- Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.

Interpretive Groups

Land capability classification: IIe

Woodland ordination symbol: 3W

Michigan soil management group: 1.5b

Primary habitat type: TMC

Secondary habitat type: None assigned

165B—Sundog-Channing very fine sandy loams, 0 to 6 percent slopes

Setting

Landform and position on the landform: Sundog—nearly level and undulating areas on outwash plains and stream terraces; Channing—drainageways on outwash plains and stream terraces

Shape of areas: Irregular

Size of areas: 5 to 100 acres

Typical Profile

Sundog

Surface layer:

0 to 4 inches—dark brown very fine sandy loam

Subsurface layer:

4 to 6 inches—gray very fine sandy loam

Subsoil:

6 to 15 inches—dark reddish brown and dark brown, friable very fine sandy loam

15 to 22 inches—brown gravelly very fine sandy loam

Substratum:

22 to 43 inches—brown sand with bands of loamy sand

43 to 60 inches—brown very gravelly coarse sand with pockets of very fine sandy loam

Channing

Surface layer:

0 to 7 inches—dark brown very fine sandy loam

Subsurface layer:

7 to 9 inches—grayish brown, mottled very fine sandy loam

Subsoil:

9 to 24 inches—dark yellowish brown, mottled, friable very fine sandy loam

Substratum:

24 to 43 inches—strong brown and brown sand and loamy sand

43 to 60 inches—brown, stratified coarse sand and very gravelly sand

Soil Properties and Qualities

Depth class: Very deep

Permeability: Sundog—moderate in the upper part and rapid or very rapid in the lower part; Channing—moderate in the upper part and very rapid in the lower part

Available water capacity: Low

Drainage class: Sundog—well drained; Channing—somewhat poorly drained

Seasonal high water table: Sundog—at a depth of more than 6 feet; Channing—at a depth of 0.5 foot to 1.5 feet at some time from November through May

Surface runoff: Slow

Flooding: None

Composition

Sundog soil and similar soils: 40 to 60 percent

Channing soil and similar soils: 30 to 50 percent

Contrasting inclusions: 10 to 15 percent

Inclusions

Contrasting inclusions:

- The poorly drained Ensley soils in depressions
- Karlin and Pence soils, which are more droughty than the major soils; in landscape positions similar to those of the major soils

Similar inclusions:

- Areas where the surface of both soils is cobbly or stony
- Soils that are similar to the Sundog soil but are darker in the upper part of the subsoil

Use and Management

Land use: Dominant uses—woodland, cropland

Woodland

Major management concerns: Sundog—equipment limitation; Channing—equipment limitation, seedling mortality, windthrow hazard

Management measures:

- Equipment should be used only when the soils are relatively dry or have an adequate snow cover.
- Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
- Special site preparation, such as bedding, can reduce the seedling mortality rate.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Cropland

Major management concerns: Sundog—soil blowing,

water erosion, low organic matter content, tilth; Channing—soil blowing, low organic matter content, seasonal wetness, droughtiness, tilth

Management measures:

- Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
- Crop residue management, cover crops, green manure crops, proper use of manure, and conservation tillage help to maintain and improve tilth, the moisture-holding capacity, and the organic matter content.
- Contour farming and contour stripcropping reduce the runoff rate and the hazard of water erosion.
- No-till farming, crop residue management, and a cropping sequence that includes green manure crops increase the organic matter content.
- Drains can be used to reduce wetness if a suitable outlet is available.
- Minimizing tillage and tilling at the proper soil moisture content help to maintain good tilth.

Interpretive Groups

Land capability classification: IIe

Woodland ordination symbol: Sundog—2L; Channing—2W

Michigan soil management group: Sundog—3/5a; Channing—3/5b

Primary habitat type: TMV

Secondary habitat type: TMC

166F—Soperton silt loam, 18 to 35 percent slopes, very stony

Setting

Landform and position on the landform: Hilly areas on end moraines

Shape of areas: Irregular

Size of areas: 4 to 200 acres

Typical Profile

Surface layer:

0 to 1 inch—very dark gray silt loam

Subsurface layer:

1 to 5 inches—brown silt loam

Subsoil:

5 to 25 inches—dark brown and brown, friable silt loam

25 to 32 inches—a fragipan of dark brown and brown, very firm loam

32 to 41 inches—a fragipan of dark brown, very firm sandy loam

Substratum:

41 to 60 inches—brown sandy loam

Soil Properties and Qualities

Depth class: Very deep

Rock fragments on the surface: Kind—stones and cobbles; percentage of surface covered—1 to 3

Permeability: Moderate in the upper part, moderately slow in the fragipan, and moderate in the lower part

Available water capacity: Moderate

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Medium

Flooding: None

Composition

Soperton soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Net soils on foot slopes and in drainageways
- Sundog and Karlin soils, which are more droughty than the Soperton soil; in landscape positions similar to those of the Soperton soil
- The well drained Stambaugh soils, which have a substratum of gravelly sand; in landscape positions similar to those of the Soperton soil

Similar inclusions:

- Soils that do not have a firm layer in the subsoil

Use and Management

Land use: Woodland

Major management concerns: Erosion, equipment limitation, windthrow hazard

Management measures:

- Because of the erosion hazard, water should be removed from logging roads by water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures. Building logging roads on the contour or on the gentler slopes and seeding logging roads, skid roads, and landings after the trees are logged also help to prevent excessive soil loss.
- Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.
- Because of stones on the surface, wheeled skidders with high clearance should be operated at a reduced speed over carefully chosen routes.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: VIIe

Woodland ordination symbol: 3R

Michigan soil management group: 2a-af

Primary habitat type: AVO

Secondary habitat type: AOC

167A—Monico loam, 0 to 3 percent slopes

Setting

Landform and position on the landform: Drainageways in interdrumlin areas

Shape of areas: Long and narrow

Size of areas: 5 to 10 acres

Typical Profile

Organic mat:

0 to 2 inches—partially decomposed organic material

Surface layer:

2 to 4 inches—very dark gray loam

Subsurface layer:

4 to 7 inches—dark grayish brown, mottled loam

Subsoil:

7 to 47 inches—dark brown, mottled, friable sandy loam

Substratum:

47 to 60 inches—dark brown gravelly sandy loam

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderate

Available water capacity: Moderate

Drainage class: Somewhat poorly drained

Seasonal high water table: Perched at a depth of 1 to 3 feet at some time from November through May

Surface runoff: Slow

Flooding: None

Composition

Monico soil and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

- The moderately well drained Wabeno soils on low knolls

Similar inclusions:

- Soils that have a substratum of gravelly sand

Use and Management

Land use: Woodland, cropland

Major management concerns: Equipment limitation, windthrow hazard

Management measures:

- Year-round logging roads require roadfill and gravel.

Culverts are needed to maintain the natural drainage system.

- The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen or has an adequate snow cover.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Cropland

Major management concerns: Seasonal wetness, tilth

Management measures:

- Working the soil when it is too wet results in cloddiness and in compaction, which inhibits root development. As the natural soil structure is altered by compaction, surface crusting becomes more severe. Crusting can prevent seedling emergence, increase the runoff rate, and increase the hazard of erosion.
- Tile drains can be used to reduce wetness if a suitable outlet is available.
- Crop residue management, cover crops, green manure crops, proper use of manure, and conservation tillage help to maintain and improve tilth, the moisture-holding capacity, and the organic matter content.

Interpretive Groups

Land capability classification: 1lw

Woodland ordination symbol: 3W

Michigan soil management group: 3b-a

Primary habitat type: ATD-CI

Secondary habitat type: None assigned

168F—Soperton-Rock outcrop complex, 18 to 35 percent slopes, very stony

Setting

Landform and position on the landform: Hilly areas on end moraines

Shape of areas: Irregular

Size of areas: 5 to 200 acres

Typical Profile

Soperton

Surface layer:

0 to 1 inch—very dark gray silt loam

Subsurface layer:

1 to 5 inches—brown silt loam

Subsoil:

5 to 25 inches—dark brown and brown, friable silt loam

25 to 32 inches—a fragipan of dark brown and brown, very firm loam

32 to 41 inches—a fragipan of dark brown, very firm sandy loam

Substratum:

41 to 60 inches—brown sandy loam

Soil Properties and Qualities

Soperton

Depth class: Very deep

Rock fragments on the surface: Kind—stones and cobbles; percentage of surface covered—1 to 3

Permeability: Moderate in the upper part, moderately slow in the fragipan, and moderate in the lower part

Available water capacity: Moderate

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Medium

Flooding: None

Composition

Soperton soil and similar soils: 70 to 80 percent

Rock outcrop: 10 to 15 percent

Contrasting inclusions: 10 to 15 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Net soils on foot slopes and in drainageways
- Sundog and Karlin soils, which are more droughty than the Soperton soil; in landscape positions similar to those of the Soperton soil
- The well drained Stambaugh soils, which have a substratum of gravelly sand; in landscape positions similar to those of the Soperton soil

Similar inclusions:

- Soils that do not have a firm layer in the subsoil

Use and Management

Land use: Woodland

Major management concerns: Erosion, equipment limitation, windthrow hazard

Management measures:

- Because of the erosion hazard, water should be removed from logging roads by water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures. Building logging roads on the contour or on the gentler slopes and seeding logging roads, skid roads, and landings after the trees are logged also help to prevent excessive soil loss.
- Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.
- Because of stones on the surface, wheeled skidders with high clearance should be operated at a reduced speed over carefully chosen routes.

- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.
- The areas of Rock outcrop should be considered when road locations and landing sites are planned.

Interpretive Groups

Land capability classification: VIIe
Woodland ordination symbol: 3R
Michigan soil management group: 2a-af
Primary habitat type: AVO
Secondary habitat type: AOC

500B—Wabeno silt loam, nearly level and undulating, very stony

Setting

Landform and position on the landform: Nearly level and undulating areas on ground moraines

Slope: 1 to 6 percent

Shape of areas: Long and narrow, oval, or irregular

Size of areas: 5 to 800 acres

Typical Profile

Organic mat:

0 to 1 inch—black, well decomposed organic material

Subsurface layer:

1 to 3 inches—brown silt loam

Subsoil:

3 to 19 inches—dark brown and brown, mottled, friable and firm silt loam

19 to 63 inches—a fragipan of brown and dark grayish brown, mottled, very firm and friable cobbly sandy loam and cobbly loamy sand

Substratum:

63 to 72 inches—dark grayish brown cobbly sandy loam

Soil Properties and Qualities

Depth class: Very deep

Rock fragments on the surface: Kind—stones and cobbles; percentage of surface covered—1 to 3

Permeability: Moderate in the upper part, moderately slow in the fragipan, and moderately rapid in the lower part

Available water capacity: Moderate

Drainage class: Moderately well drained

Seasonal high water table: Perched at a depth of 1.5 to 3.5 feet at some time from October through June

Surface runoff: Slow

Flooding: None

Composition

Wabeno soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Beechwood soils in the lower positions on the landscape
- Champion soils, which are coarser textured than the Wabeno soil; in landscape positions similar to those of the Wabeno soil

Similar inclusions:

- Soils that do not have mottles in the subsoil
- Soils that have a substratum of silt loam

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, windthrow hazard

Management measures:

- The use of equipment is briefly restricted in spring and during other excessively wet periods. Access is easiest during periods in winter when access roads are frozen.
- Because of stones on the surface, wheeled skidders with high clearance should be operated at a reduced speed over carefully chosen routes.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: IVs

Woodland ordination symbol: 3L

Michigan soil management group: 2a-af

Primary habitat type: AVO

Secondary habitat type: None assigned

500D—Wabeno silt loam, rolling, very stony

Setting

Landform and position on the landform: Rolling areas on ground moraines and end moraines

Slope: 6 to 18 percent

Shape of areas: Long and narrow, oval, and irregular

Size of areas: 5 to 800 acres

Typical Profile

Organic mat:

0 to 1 inch—black, well decomposed organic material

Subsurface layer:

1 to 3 inches—brown silt loam

Subsoil:

3 to 19 inches—dark brown and brown, mottled, friable and firm silt loam

19 to 63 inches—a fragipan of brown and dark grayish brown, mottled, very firm and friable cobbly sandy loam and cobbly loamy sand

Substratum:

63 to 72 inches—dark grayish brown cobbly sandy loam

Soil Properties and Qualities

Depth class: Very deep

Rock fragments on the surface: Kind—stones and cobbles; percentage of surface covered—1 to 3

Permeability: Moderate in the upper part, moderately slow in the fragipan, and moderately rapid in the lower part

Available water capacity: Moderate

Drainage class: Moderately well drained

Seasonal high water table: Perched at a depth of 1.5 to 3.5 feet at some time from October through June

Surface runoff: Medium

Flooding: None

Composition

Wabeno soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Inclusions*Contrasting inclusions:*

- The somewhat poorly drained Beechwood soils on foot slopes and in drainageways
- Champion soils, which are coarser textured than the Wabeno soil; in landscape positions similar to those of the Wabeno soil

Similar inclusions:

- Soils that do not have mottles in the subsoil
- Soils that have a substratum of silt loam

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, windthrow hazard

Management measures:

- The use of equipment is briefly restricted in spring and during other excessively wet periods. Access is easiest during periods in winter when access roads are frozen.
- Because of stones on the surface, wheeled skidders with high clearance should be operated at a reduced speed over carefully chosen routes.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: VIIIe

Woodland ordination symbol: 3L

Michigan soil management group: 2a-af

Primary habitat type: AVO

Secondary habitat type: None assigned

501F—Soperton silt loam, hilly, very stony**Setting**

Landform and position on the landform: Hilly areas on end moraines

Slope: 18 to 35 percent

Shape of areas: Long and narrow or irregular

Size of areas: 5 to 100 acres

Typical Profile*Surface layer:*

0 to 1 inch—very dark gray silt loam

Subsurface layer:

1 to 5 inches—brown silt loam

Subsoil:

5 to 25 inches—dark brown and brown, friable silt loam
25 to 32 inches—a fragipan of dark brown and brown, very firm loam

32 to 41 inches—a fragipan of dark brown, very firm sandy loam

Substratum:

41 to 60 inches—brown sandy loam

Soil Properties and Qualities

Depth class: Very deep

Rock fragments on the surface: Kind—stones and cobbles; percentage of surface covered—1 to 3

Permeability: Moderate in the upper part, moderately slow in the fragipan, and moderately rapid in the lower part

Available water capacity: Moderate

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Medium

Flooding: None

Composition

Soperton soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Inclusions*Contrasting inclusions:*

- The somewhat poorly drained Beechwood soils on foot slopes and in drainageways
- Champion soils, which are coarser textured than the Soperton soil; in landscape positions similar to those of the Soperton soil

Similar inclusions:

- Soils that have mottles in the subsoil
- Soils that have a substratum of silt loam

Use and Management

Land use: Woodland

Major management concerns: Erosion hazard,

equipment limitation, windthrow hazard

Management measures:

- Because of the erosion hazard, water should be removed from logging roads by water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures. Building logging roads on the contour or on the gentler slopes and seeding logging roads, skid roads, and landings after the trees are logged also help to prevent excessive soil loss.
- Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.
- Because of stones on the surface, wheeled skidders with high clearance should be operated at a reduced speed over carefully chosen routes.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: VIIe

Woodland ordination symbol: 3R

Michigan soil management group: 2a-af

Primary habitat type: AVO

Secondary habitat type: None assigned

502B—Champion very fine sandy loam, moderately wet, nearly level and undulating, very stony

Setting

Landform and position on the landform: Nearly level and undulating areas on ground moraines

Slope: 1 to 6 percent

Shape of areas: Irregular

Size of areas: 5 to 400 acres

Typical Profile

Organic mat:

0 to 1 inch—black, partially decomposed forest litter

Subsurface layer:

1 to 4 inches—gray very fine sandy loam

Subsoil:

4 to 11 inches—dark brown and dark reddish brown, very friable and friable very fine sandy loam

11 to 20 inches—dark brown and brown, friable very fine sandy loam

20 to 49 inches—a fragipan of dark grayish brown and dark brown, mottled, extremely firm gravelly fine sandy loam

Substratum:

49 to 60 inches—grayish brown gravelly fine sandy loam

Soil Properties and Qualities

Depth class: Very deep

Rock fragments on the surface: Kind—stones and cobbles; percentage of surface covered—1 to 3

Permeability: Moderate in the upper part, very slow in the next part, and moderate or moderately rapid in the lower part

Available water capacity: Low

Drainage class: Moderately well drained

Seasonal high water table: Perched at a depth of 1 to 2 feet at some time from November through May

Surface runoff: Slow

Flooding: None

Composition

Champion soil and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained, coarse-loamy Typic Fragiaquods in the slightly lower positions on the landscape

Similar inclusions:

- Areas of well drained soils that contain a higher percentage of silt in the subsoil

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, windthrow hazard

Management measures:

- Equipment should be used only when the soil is relatively dry or has an adequate snow cover.
- Because of stones on the surface, wheeled skidders with high clearance should be operated at a reduced speed over carefully chosen routes.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: IVs

Woodland ordination symbol: 3W

Michigan soil management group: 2a-af

Primary habitat type: ATD

Secondary habitat type: None assigned

502D—Champion very fine sandy loam, moderately wet, rolling, very stony**Setting**

Landform and position on the landform: Rolling areas on ground moraines

Slope: 6 to 18 percent

Shape of areas: Irregular

Size of areas: 5 to 300 acres

Typical Profile

Organic mat:

0 to 1 inch—black, partially decomposed forest litter

Subsurface layer:

1 to 4 inches—gray very fine sandy loam

Subsoil:

4 to 11 inches—dark brown and dark reddish brown, very friable and friable very fine sandy loam

11 to 20 inches—dark brown and brown, friable very fine sandy loam

20 to 49 inches—a fragipan of dark grayish brown and dark brown, mottled, extremely firm gravelly fine sandy loam

Substratum:

49 to 60 inches—grayish brown gravelly fine sandy loam

Soil Properties and Qualities

Depth class: Very deep

Rock fragments on the surface: Kind—stones and cobbles; percentage of surface covered—1 to 3 percent

Permeability: Moderate in the upper part, very slow in the next part, and moderately rapid in the lower part

Available water capacity: Low

Drainage class: Moderately well drained

Seasonal high water table: Perched at a depth of 1 to 2 feet at some time from November through May

Surface runoff: Medium

Flooding: None

Composition

Champion soil and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained, coarse-loamy Typic Fragiaquods in the slightly lower landscape positions

Similar inclusions:

- Areas of well drained soils that contain a higher percentage of silt in the subsoil

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, windthrow hazard

Management measures:

- Equipment should be used only when the soil is relatively dry or has an adequate snow cover.
- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.
- Because of stones on the surface, wheeled skidders with high clearance should be operated at a reduced speed over carefully chosen routes.

Interpretive Groups

Land capability classification: VIIe

Woodland ordination symbol: 3W

Michigan soil management group: 2a-af

Primary habitat type: ATD

Secondary habitat type: None assigned

502F—Champion very fine sandy loam, hilly, very stony**Setting**

Landform and position on the landform: Hilly areas on end moraines

Slope: 18 to 35 percent

Shape of areas: Irregular or long and narrow

Size of areas: 5 to 100 acres

Typical Profile

Organic mat:

0 to 1 inch—black, partially decomposed forest litter

Subsurface layer:

1 to 4 inches—gray very fine sandy loam

Subsoil:

4 to 11 inches—dark brown and dark reddish brown, very friable and friable very fine sandy loam

11 to 20 inches—dark brown and brown, friable very fine sandy loam

20 to 49 inches—a fragipan of dark grayish brown and dark brown, extremely firm gravelly fine sandy loam

Substratum:

49 to 60 inches—grayish brown gravelly fine sandy loam

Soil Properties and Qualities

Depth class: Very deep

Rock fragments on the surface: Kinds—stones and cobbles; percentage of surface covered—1 to 3

Permeability: Moderate in the upper part, very slow in

the next part, and moderate or moderately rapid in the lower part

Available water capacity: Low

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Rapid

Flooding: None

Composition

Champion soil and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

- Areas of the somewhat poorly drained, coarse-loamy Typic Fragiaquods on foot slopes and in drainageways

Similar inclusions:

- Areas of well drained soils that have a higher percentage of silt in the subsoil

Use and Management

Land use: Woodland

Major management concerns: Erosion hazard, equipment limitation, windthrow hazard

Management measures:

- Erosion results from the concentration of runoff on logging roads, in the tracks of wheeled equipment, and on landings.
- Because of the erosion hazard, water should be removed from logging roads by water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures.
- Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.
- Because of stones and boulders on the surface, wheeled skidders with high clearance should be operated at a reduced speed over carefully chosen routes.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: VIIe

Woodland ordination symbol: 3R

Michigan soil management group: 2a-af

Primary habitat type: ATD

Secondary habitat type: None assigned

503A—Typic Fragiaquods, coarse-loamy, nearly level

Setting

Landform and position on the landform: Drainageways on ground moraines

Slope: 0 to 3 percent

Shape of areas: Long and narrow or irregular

Size of areas: 5 to 30 acres

Reference Profile

Organic mat:

0 to 2 inches—black, well decomposed organic material

Surface layer:

2 to 7 inches—black loam

Subsurface layer:

7 to 9 inches—dark gray, mottled loam

Subsoil:

9 to 15 inches—brown, mottled, friable sandy loam

15 to 38 inches—a fragipan of grayish brown and reddish brown, mottled, firm and very firm sandy loam

Substratum:

38 to 60 inches—grayish brown, mottled cobbly sandy loam

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderate in the upper part, very slow in the fragipan, and moderate in the lower part

Available water capacity: Low

Drainage class: Somewhat poorly drained

Seasonal high water table: Perched at a depth of 0.5 foot to 1.5 feet at some time from October through June

Surface runoff: Slow

Flooding: None

Composition

Typic Fragiaquods, coarse-loamy, and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Inclusions

Contrasting inclusions:

- The moderately well drained Champion soils in the slightly higher positions on the landscape
- The poorly drained, nonacid, very stony Humaquepts in depressions

Use and Management

Land use: Woodland

Woodland

Major management concerns: Equipment limitation,

seedling mortality, windthrow hazard

Management measures:

- Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
- The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen or has an adequate snow cover.
- Small areas of the better drained included soils are more suitable as landing areas.
- Special site preparation, such as bedding, can reduce the seedling mortality rate.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: 1lw

Woodland ordination symbol: 2W

Michigan soil management group: None assigned

Primary habitat type: TMC

Secondary habitat type: None assigned

504B—Pence fine sandy loam, nearly level and undulating

Setting

Landform and position on the landform: Nearly level and undulating areas on outwash plains and stream terraces

Slope: 1 to 6 percent

Shape of areas: Irregular

Size of areas: 5 to 500 acres

Typical Profile

Organic mat:

0 to 1 inch—partially decomposed forest litter

Surface layer:

1 to 2 inches—dark brown fine sandy loam

Subsurface layer:

2 to 5 inches—pinkish gray fine sandy loam

Subsoil:

5 to 20 inches—dark brown, friable and very friable fine sandy loam and sandy loam

20 to 35 inches—strong brown, loose gravelly sand

Substratum:

35 to 60 inches—dark yellowish brown very gravelly sand

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderately rapid in the upper part and

rapid or very rapid in the lower part

Available water capacity: Low

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow

Flooding: None

Composition

Pence soil and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Monico soils that have a seasonal high water table; in the slightly lower landscape positions

Similar inclusions:

- Soils that have a finer textured subsoil

Use and Management

Land use: Dominant use—woodland; other uses—cropland

Woodland

Major management concerns: None

Cropland

Major management concerns: Soil blowing, water erosion, low organic matter content, seasonal droughtiness, tith

Management measures:

- Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
- Conservation tillage, grassed waterways, cover crops, and crop rotations that include grasses or legumes help to control water erosion.
- Contour farming and contour stripcropping reduce the runoff rate and the hazard of water erosion.
- No-till farming, crop residue management, and a cropping sequence that includes green manure crops increase the organic matter content.
- A system of conservation tillage that leaves crop residue on the surface is effective in conserving moisture.
- Irrigation water should be applied at a rate that ensures optimum production but does not increase deep percolation, the runoff rate, and the hazard of erosion.
- Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.
- Minimizing tillage and tilling at the proper soil moisture

content help to maintain good tilth and prevent crusting.

Interpretive Groups

Land capability classification: IIIe

Woodland ordination symbol: 3A

Michigan soil management group: 4a-a

Primary habitat type: TMV

Secondary habitat type: None assigned

504D—Pence fine sandy loam, rolling

Setting

Landform and position on the landform: Rolling areas on stream terraces and outwash plains

Slope: 6 to 18 percent

Shape of areas: Irregular or long and narrow

Size of areas: 5 to 300 acres

Typical Profile

Organic mat:

0 to 1 inch—partially decomposed forest litter

Surface layer:

1 to 2 inches—dark brown fine sandy loam

Subsurface layer:

2 to 5 inches—pinkish gray fine sandy loam

Subsoil:

5 to 20 inches—dark brown, friable and very friable fine sandy loam and sandy loam

20 to 35 inches—strong brown, loose gravelly sand

Substratum:

35 to 60 inches—dark yellowish brown very gravelly sand

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderately rapid in the upper part and rapid or very rapid in the lower part

Available water capacity: Low

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Medium

Flooding: None

Composition

Pence soil and similar soils: 95 to 100 percent

Contrasting inclusions: 0 to 5 percent

Inclusions

Contrasting inclusions:

- Small areas of the somewhat poorly drained Monico soils that have a seasonal high water table; in the

slightly lower positions on foot slopes and in drainageways

Similar inclusions:

- Soils that have a finer textured subsoil

Use and Management

Land use: Dominant use—woodland; other uses—cropland

Woodland

Major management concerns: Equipment limitation on landings

Management measures:

- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.

Cropland

Major management concerns: Soil blowing, water erosion, low organic matter content, droughtiness, tilth

Management measures:

- Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
- Water erosion can be controlled by diversions, crop residue management, contour stripcropping, field stripcropping, cover crops, grassed waterways, conservation tillage, crop rotations, grade-stabilization structures, or a combination of these practices.
- No-till farming, crop residue management, and a cropping sequence that includes green manure crops increase the organic matter content.
- A system of conservation tillage that leaves crop residue on the surface is effective in conserving moisture.
- Irrigation water should be applied at a rate that ensures optimum production but does not increase deep percolation, the runoff rate, and the hazard of erosion.
- Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.
- Minimizing tillage and tilling at the proper soil moisture content help to maintain good tilth and prevent crusting.

Interpretive Groups

Land capability classification: VIe

Woodland ordination symbol: 3A

Michigan soil management group: 4a-a

Primary habitat type: TMV

Secondary habitat type: None assigned

504F—Pence fine sandy loam, hilly**Setting**

Landform and position on the landform: Hilly areas on stream terraces and outwash plains

Slope: 18 to 35 percent

Shape of areas: Irregular or long and narrow

Size of areas: 3 to 100 acres

Typical Profile

Organic mat:

0 to 1 inch—partially decomposed forest litter

Surface layer:

1 to 2 inches—dark brown fine sandy loam

Subsurface layer:

2 to 5 inches—pinkish gray fine sandy loam

Subsoil:

5 to 20 inches—dark brown, friable and very friable fine sandy loam and sandy loam

20 to 35 inches—strong brown, loose gravelly sand

Substratum:

35 to 60 inches—dark yellowish brown very gravelly sand

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderately rapid in the upper part and rapid or very rapid in the lower part

Available water capacity: Low

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Rapid

Flooding: None

Composition

Pence soil and similar soils: 100 percent

Inclusions

Similar inclusions:

- Soils that are finer textured in the subsoil

Use and Management

Land use: Woodland

Major management concerns: Erosion hazard, equipment limitation

Management measures:

- Because of the erosion hazard, water should be removed from logging roads by water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures.
- Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that

they conform to the topography.

- Because of the slope, the number of suitable landing sites is minimal. The best sites are small, nearly level areas, if any are available, and the nearly level adjacent areas.

Interpretive Groups

Land capability classification: VIIe

Woodland ordination symbol: 3R

Michigan soil management group: 4a-a

Primary habitat type: TMV

Secondary habitat type: None assigned

505—Humaquepts, acid, very stony**Setting**

Landform and position on the landform: Depressions on outwash plains, moraines

Slope: 0 to 2 percent

Shape of areas: Irregular

Size of areas: 5 to 20 acres

Soil Properties and Qualities

Texture: 0 to 16 inches of partially decomposed or well decomposed organic material over loamy or sandy material

Depth class: Very deep

Rock fragments on the surface: Kind—stones and cobbles; percentage of surface covered—1 to 3

Permeability: Variable

Available water capacity: Variable

Drainage class: Poorly drained

Seasonal high water table: 1 foot above to 1 foot below the surface at some time from November through May

Surface runoff: Very slow or ponded

Flooding: None

Composition

Humaquepts and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained, coarse-loamy Typic Fragaquods in the slightly higher landscape positions

Similar inclusions:

- Soils that are more than 16 inches deep over mineral material

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow hazard

Management measures:

- Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
- Equipment can be used only during dry summer months and during periods in winter when the snow cover is adequate or the soil is frozen.
- Because of stones on the surface, wheeled skidders with high clearance should be operated at a reduced speed over carefully chosen routes.
- Because of wetness, severe seedling mortality, and plant competition, trees generally are not planted in areas of these soils.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: None assigned
Woodland ordination symbol: None assigned
Michigan soil management group: None assigned
Primary habitat type: TTS
Secondary habitat type: None assigned

506—Humaquepts, nonacid, very stony**Setting**

Landform and position on the landform: Depressions on outwash plains and moraines
Slope: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 5 to 15 acres

Soil Properties and Qualities

Texture: 0 to 16 inches of partially decomposed or well decomposed organic material over loamy or sandy material
Depth class: Very deep
Rock fragments on the surface: Kind—stones and cobbles; percentage of surface covered—1 to 3
Permeability: Variable
Available water capacity: Variable
Drainage class: Poorly drained
Seasonal high water table: 1 foot above to 1 foot below the surface at some time from November through May
Surface runoff: Very slow or ponded
Flooding: None

Composition

Humaquepts and similar soils: 85 to 95 percent
 Contrasting inclusions: 5 to 15 percent

Inclusions*Contrasting inclusions:*

- The somewhat poorly drained, coarse-loamy Typic Fragiaquods and Monico soils in the slightly higher landscape positions

Similar inclusions:

- Soils that are more than 16 inches deep over mineral material

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow hazard

Management measures:

- Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
- Equipment can be used only during dry summer months and during periods in winter when the snow cover is adequate or the soil is frozen.
- Because of stones and boulders on the surface, wheeled skidders with high clearance should be operated at a reduced speed over carefully chosen routes.
- Because of wetness, severe seedling mortality, and plant competition, trees generally are not planted in areas of these soils.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: None assigned
Woodland ordination symbol: None assigned
Michigan soil management group: None assigned
Primary habitat type: FMC
Secondary habitat type: FI

507A—Monico loam, nearly level**Setting**

Landform and position on the landform: Drainageways in interdumlin areas
Slope: 0 to 3 percent
Shape of areas: Long and narrow or irregular
Size of areas: 5 to 20 acres

Typical Profile

Organic mat:
 0 to 2 inches—partially decomposed organic material
Surface layer:
 2 to 4 inches—very dark gray loam

Subsurface layer:

4 to 7 inches—dark grayish brown, mottled loam

Subsoil:

7 to 47 inches—dark brown, mottled, friable sandy loam

Substratum:

47 to 60 inches—dark brown gravelly sandy loam

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderate

Available water capacity: Moderate

Drainage class: Somewhat poorly drained

Seasonal high water table: Perched at a depth of 1 to 3 feet at some time from November through May

Surface runoff: Slow

Flooding: None

Composition

Monico and similar soils: 80 to 85 percent

Contrasting inclusions: 15 to 20 percent

Inclusions*Contrasting inclusions:*

- Small areas of the moderately well drained Champion and Wabeno soils in the higher landscape positions
- Small areas of the poorly drained, nonacid, very stony Humaquepts in depressions

Use and Management

Land use: Dominant use—woodland; other uses—cropland

Woodland

Major management concerns: Equipment limitation, windthrow hazard

Management measures:

- Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
- The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen or has an adequate snow cover.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Cropland

Major management concerns: Seasonal wetness, tilth

Management measures:

- Working the soil when it is too wet results in cloddiness and in compaction, which inhibits root development. As the natural soil structure is altered by compaction, surface crusting becomes more severe. Crusting can prevent seedling emergence, increase the runoff rate, and increase the susceptibility to erosion.

- Tile drains can be used to reduce wetness if a suitable outlet is available.
- Crop residue management, cover crops, green manure crops, proper use of manure, and conservation tillage help to maintain and improve tilth, the moisture-holding capacity, and the organic matter content.

Interpretive Groups

Land capability classification: 11w

Woodland ordination symbol: 3W

Michigan soil management group: 3b-a

Primary habitat type: ATD-CI

Secondary habitat type: None assigned

508A—Beechwood silt loam, nearly level**Setting**

Landform and position on the landform: Drainageways on drumlinoid ground moraines

Slope: 0 to 2 percent

Shape of areas: Long and narrow or irregular

Size of areas: 5 to 100 acres

Typical Profile*Organic mat:*

0 to 2 inches—dark yellowish brown, well decomposed organic material

Subsurface layer:

2 to 4 inches—grayish brown silt loam

Subsoil:

4 to 34 inches—brown and yellowish brown, mottled, friable silt loam

34 to 49 inches—dark yellowish brown, mottled, friable sandy loam

Substratum:

49 to 71 inches—reddish yellow, mottled loamy sand

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderate

Available water capacity: High

Drainage class: Somewhat poorly drained

Seasonal high water table: 1 to 2 feet below the surface at some time from September through July

Surface runoff: Slow

Flooding: None

Composition

Beechwood soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Inclusions*Contrasting inclusions:*

- The moderately well drained Wabeno soils in the higher landscape positions

- The poorly drained, nonacid, very stony Humaquepts and the very poorly drained, nonacid Borosapristis; in depressions

Use and Management

Land use: Dominant use—woodland; other uses—cropland

Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow hazard

Management measures:

- Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
- The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen or has an adequate snow cover.
- Special site preparation, such as bedding, can reduce the seedling mortality rate.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Cropland

Major management concerns: Soil blowing, water erosion, low organic matter content, seasonal droughtiness, tilth

Management measures:

- Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
- Conservation tillage, grassed waterways, cover crops, and crop rotations that include grasses or legumes help to control water erosion.
- Contour farming and contour stripcropping reduce the runoff rate and the hazard of water erosion.
- No-till farming, crop residue management, and a cropping sequence that includes green manure crops increase the organic matter content.
- A system of conservation tillage that leaves crop residue on the surface is effective in conserving moisture.
- Irrigation water should be applied at a rate that ensures optimum production but does not increase deep percolation, the runoff rate, and the hazard of erosion.
- Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.
- Minimizing tillage and tilling at the proper soil moisture content help to maintain good tilth and prevent crusting.

Interpretive Groups

Land capability classification: 1lw

Woodland ordination symbol: 2W

Michigan soil management group: 3b

Primary habitat type: TMC

Secondary habitat type: None assigned

509A—Typic Dystrochrepts, coarse-loamy, deep water table, nearly level

Setting

Landform and position on the landform: Nearly level areas on ground moraines

Slope: 0 to 2 percent

Shape of areas: Long and narrow or irregular

Size of areas: 5 to 30 acres

Reference Profile

Organic mat:

0 to 1 inch—recent hardwood litter

1 to 3 inches—black, decomposed organic material

Surface layer:

3 to 5 inches—dark brown silt loam

Subsoil:

5 to 12 inches—dark yellowish brown, friable cobbly silt loam

12 to 51 inches—dark yellowish brown and dark brown, mottled, firm cobbly silt loam

51 to 63 inches—dark yellowish brown, mottled, firm silt loam

Substratum:

63 to 72 inches—dark brown, mottled silt loam

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderate

Available water capacity: High

Drainage class: Moderately well drained

Seasonal high water table: 4 to 6 feet below the surface at some time from November through May

Surface runoff: Slow

Flooding: None

Composition

Typic Dystrochrepts and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Monico soils in the slightly lower landscape positions

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation

Management measures:

- The use of equipment is briefly restricted in spring and during other excessively wet periods. Access is easiest during periods in winter when access roads are frozen.
- Using wheeled and tracked equipment when the soils are wet results in ruts and surface compaction and can damage tree roots.

Interpretive Groups

Land capability classification: IIs

Woodland ordination symbol: 3L

Michigan soil management group: None assigned

Primary habitat type: AVO-CI

Secondary habitat type: None assigned

510—Borosaprists, nonacid

Setting

Landform and position on the landform: Depressions on outwash plains and moraines

Slope: 0 to 2 percent

Shape of areas: Irregular

Size of areas: 5 to 200 acres

Soil Properties and Qualities

Texture: 16 to more than 51 inches of well decomposed organic material over loamy or sandy material

Depth class: Very deep

Permeability: Variable

Available water capacity: Variable

Drainage class: Very poorly drained

Seasonal high water table: 1 foot above to 1 foot below the surface at some time from September through June

Surface runoff: Very slow or ponded

Flooding: None

Composition

Borosaprists and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

- The poorly drained, nonacid, very stony Humaquepts in landscape positions similar to those of the Borosaprists
 - The poorly drained Humaquepts that have a sandy substratum; in landscape positions similar to those of the Borosaprists
 - The somewhat poorly drained, nearly level Haplaquods in the slightly higher landscape positions
- Similar inclusions:*
- Organic soils that are more acid

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, seeding mortality, windthrow hazard

Management measures:

- Because of wetness and low strength, special harvesting equipment is needed. The equipment can be used only during periods in winter when skid roads and access roads are frozen.
- Because of wetness, seedling mortality, and plant competition, trees are generally not planted in areas of these soils.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: None assigned

Woodland ordination symbol: None assigned

Michigan soil management group: None assigned

Primary habitat type: TTS

Secondary habitat type: None assigned

511B—Typic Dystrochrepts, coarse-loamy, sandy substratum, nearly level and undulating

Setting

Landform and position on the landform: Nearly level and undulating areas on outwash plains, stream terraces, and alluvial fans

Slope: 0 to 6 percent

Shape of areas: Irregular

Size of areas: 5 to 300 acres

Reference Profile

Organic mat:

0 to 1 inch—partially decomposed forest litter

Surface layer:

1 to 3 inches—very dark gray fine sandy loam

Subsurface layer:

3 to 7 inches—brown fine sandy loam

Subsoil:

7 to 41 inches—brown, friable fine sandy loam

Substratum:

41 to 60 inches—dark brown sand

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderate in the loamy part and rapid in the sandy part

Available water capacity: Moderate

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow

Flooding: None

Composition

Typic Dystrochrepts and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained, coarse-loamy Typic Fragiaquods in the slightly lower landscape positions

Similar inclusions:

- Soils that are less than 40 inches deep over sand

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation

Management measures:

- The use of equipment is briefly restricted in spring and during other excessively wet periods. Access is easiest during periods in winter when access roads are frozen.

Interpretive Groups

Land capability classification: IIe

Woodland ordination symbol: 9L

Michigan soil management group: None assigned

Primary habitat type: TM

Secondary habitat type: None assigned

511D—Typic Dystrochrepts, coarse-loamy, sandy substratum, rolling

Setting

Landform and position on the landform: Rolling areas on outwash plains, stream terraces, and alluvial fans

Slope: 6 to 18 percent

Shape of areas: Irregular

Size of areas: 5 to 300 acres

Reference Profile

Organic mat:

0 to 1 inch—partially decomposed forest litter

Surface layer:

1 to 3 inches—very dark gray fine sandy loam

Subsurface layer:

3 to 7 inches—brown fine sandy loam

Subsoil:

7 to 41 inches—brown, friable fine sandy loam

Substratum:

41 to 60 inches—dark brown sand

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderate in the loamy part and rapid in the sandy part

Available water capacity: Moderate

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow

Flooding: None

Composition

Typic Dystrochrepts and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained, coarse-loamy Typic Fragiaquods in the slightly lower landscape positions

Similar inclusions:

- Soils that are less than 40 inches deep over sand

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation

Management measures:

- The use of equipment is briefly restricted in spring and during other excessively wet periods. Access is easiest during periods in winter when access roads are frozen.
- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.

Interpretive Groups

Land capability classification: IVe

Woodland ordination symbol: 9L

Michigan soil management group: None assigned

Primary habitat type: TM

Secondary habitat type: None assigned

511F—Typic Dystrochrepts, coarse-loamy, sandy substratum, hilly

Setting

Landform and position on the landform: Hilly areas on outwash plains, stream terraces, and alluvial fans

Slope: 18 to 35 percent

Shape of areas: Irregular

Size of areas: 5 to 50 acres

Reference Profile

Organic mat:

0 to 1 inch—partially decomposed forest litter

Surface layer:

1 to 3 inches—very dark gray fine sandy loam

Subsurface layer:

3 to 7 inches—brown fine sandy loam

Subsoil:

7 to 41 inches—brown, friable fine sandy loam

Substratum:

41 to 60 inches—dark brown sand

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderate in the loamy part and rapid in the sandy part

Available water capacity: Moderate

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Medium

Flooding: None

Composition

Typic Dystrochrepts and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained, coarse-loamy Typic Fragiaquods on foot slopes and in drainageways

Similar inclusions:

- Soils that are less than 40 inches deep over sand

Use and Management

Land use: Woodland

Major management concerns: Erosion hazard, equipment limitation

Management measures:

- Because of the erosion hazard, water should be removed from logging roads by water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures.
- Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.
- Because of the slope, the number of suitable landing sites is minimal. The best sites are small, nearly level areas, if any are available, and the nearly level adjacent areas.
- The use of equipment is briefly restricted in spring and during other excessively wet periods. Access is easiest during periods in winter when access roads are frozen.

Interpretive Groups

Land capability classification: Vllc

Woodland ordination symbol: 9R

Michigan soil management group: None assigned

Primary habitat type: TM

Secondary habitat type: None assigned

512—Borosaprists, acid

Setting

Landform and position on the landform: Depressions on outwash plains and moraines

Shape of areas: Irregular

Size of areas: 5 to 200 acres

Soil Properties and Qualities

Texture: 16 to more than 51 inches of well decomposed organic material over loamy or sandy material

Depth class: Very deep

Permeability: Variable

Available water capacity: Variable

Drainage class: Very poorly drained

Seasonal high water table: 1 foot above to 1 foot below the surface at some time from September through June

Surface runoff: Very slow or ponded

Flooding: None

Composition

Borosaprists and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

- The poorly drained, acid, very stony Humaquepts in landscape positions similar to those of the Borosaprists
- The somewhat poorly drained, nearly level Haplaquods in the slightly higher landscape positions

Similar inclusions:

- Organic soils that are less acid

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, seeding mortality, windthrow hazard

Management measures:

- Because of wetness and low strength, special harvesting equipment is needed. The equipment can be used only during periods in winter when skid roads and access roads are frozen.
- Because of wetness, severe seedling mortality, and plant competition, trees generally are not planted in areas of these soils.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: None assigned
Woodland ordination symbol: None assigned
Michigan soil management group: None assigned
Primary habitat type: PCS
Secondary habitat type: None assigned

513B—Entic Haplorthods, coarse-loamy, deep water table, nearly level and undulating

Setting

Landform and position on the landform: Nearly level and undulating areas on deltas, alluvial fans, and stream terraces
Slope: 0 to 6 percent
Shape of areas: Irregular
Size of areas: 5 to 200 acres

Reference Profile

Organic mat:
 0 to 1 inch—black, partially decomposed hardwood and conifer litter
Surface layer:
 1 to 2 inches—black fine sandy loam
Subsurface layer:
 2 to 8 inches—reddish gray fine sandy loam
Subsoil:
 8 to 30 inches—dark reddish brown and reddish brown, friable and very friable fine sandy loam
 30 to 47 inches—yellowish red, loose sand
Substratum:
 47 to 60 inches—reddish brown, mottled sand with thin bands of sandy loam

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderate in the upper loamy part and rapid in the lower sandy part
Available water capacity: Low
Drainage class: Moderately well drained
Seasonal high water table: 4 to 6 feet below the surface at some time from November through May
Surface runoff: Slow
Flooding: None

Composition

Entic Haplorthods and similar soils: 90 to 95 percent
 Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:
 • The somewhat poorly drained, coarse-loamy Typic

Fragiaquods in the slightly lower landscape positions

Similar inclusions:

- Soils that are darker in the upper part of the subsoil

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation

Management measures:

- The use of equipment is briefly restricted in spring and during other excessively wet periods. Access is easiest during periods in winter when access roads are frozen.

Interpretive Groups

Land capability classification: IIe
Woodland ordination symbol: 3L
Michigan soil management group: None assigned
Primary habitat type: ATD
Secondary habitat type: None assigned

514B—Stambaugh silt loam, moderately wet, nearly level and undulating, stony

Setting

Landform and position on the landform: Undulating areas on stream terraces
Slope: 2 to 6 percent
Shape of areas: Irregular
Size of areas: 5 to 80 acres

Typical Profile

Organic mat:
 0 to 2 inches—partially decomposed forest litter
Surface layer:
 2 to 8 inches—dark brown silt loam
Subsoil:
 8 to 23 inches—brown, friable silt loam
 23 to 44 inches—brown and dark brown, mottled, firm sandy loam and silt loam
Substratum:
 44 to 60 inches—yellowish brown, mottled very gravelly sand

Soil Properties and Qualities

Depth class: Very deep
Rock fragments on the surface: Kind—stones and cobbles; percentage of surface covered—0.01 to 0.1
Permeability: Moderately slow in the upper part and rapid in the sandy part
Available water capacity: High
Drainage class: Moderately well drained
Seasonal high water table: 2.5 to 6.0 feet below the surface at some time from November through April

Surface runoff: Slow
Flooding: None

Composition

Stambaugh and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Beechwood soils in the slightly lower landscape positions

Similar inclusions:

- Soils that are less than 40 inches deep over the gravelly substratum

Use and Management

Land use: Dominant use—woodland; other uses—cropland

Woodland

Major management concerns: Equipment limitation

Management measures:

- The use of equipment is briefly restricted in spring and during other excessively wet periods. Access is easiest during periods in winter when access roads are frozen.

Cropland

Major management concerns: Soil blowing, water erosion, low organic matter content, tilth

Management measures:

- Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
- Conservation tillage, grassed waterways, cover crops, and crop rotations that include grasses or legumes help to control water erosion.
- Contour farming and contour stripcropping reduce the runoff rate and the hazard of water erosion.
- No-till farming, crop residue management, and a cropping sequence that includes green manure crops increase the organic matter content.
- Minimizing tillage and tilling at the proper soil moisture content help to maintain good tilth and prevent crusting.
- Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.
- Stones on the surface may interfere with the use of tillage and planting equipment and some harvesting equipment. Removing the stones minimizes wear on equipment.

Interpretive Groups

Land capability classification: IIIs
Woodland ordination symbol: 3L

Michigan soil management group: 3/5a
Primary habitat type: ATD
Secondary habitat type: None assigned

515—Borosapristis, frequently flooded

Setting

Landform and position on the landform: First bottom on flood plains

Slope: 0 to 2 percent

Shape of areas: Long and narrow

Size of areas: 5 to 300 acres

Soil Properties and Qualities

Texture: 16 to more than 51 inches of well decomposed organic material over loamy or sandy material

Depth class: Very deep

Permeability: Variable

Available water capacity: Variable

Drainage class: Very poorly drained

Seasonal high water table: Near the surface to 1 foot below the surface at some time from September through June

Surface runoff: Very slow or ponded

Flooding: Frequent

Composition

Borosapristis and similar soils: 100 percent

Inclusions

Similar inclusions:

- Soils that have thin layers of mineral material in the profile
- Soils underlain by mineral material at a depth of less than 16 inches

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, seeding mortality, windthrow hazard

Management measures:

- Because of wetness and low strength, special harvesting equipment is needed. The equipment can be used only during periods in winter when skid roads and access roads are frozen.
- Because of wetness, occasional flooding, and severe seedling mortality, trees are not planted in areas of these soils.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: None assigned

Woodland ordination symbol: None assigned
Michigan soil management group: None assigned
Primary habitat type: FMC
Secondary habitat type: None assigned

516B—Fragiorthods, nearly level and undulating

Setting

Landform and position on the landform: Nearly level and undulating areas on ground moraines and end moraines
Slope: 1 to 6 percent
Shape of areas: Irregular
Size of areas: 5 to 100 acres

Soil Properties and Qualities

Texture: 15 to 20 inches of loam over 10 to 15 inches of firm fine sandy loam and very fine sandy loam; underlain by loamy sand to gravelly sand
Depth class: Very deep
Permeability: Variable
Available water capacity: Variable
Drainage class: Moderately well drained
Seasonal high water table: Perched at a depth of 1 to 2 feet at some time from October through May
Surface runoff: Slow
Flooding: None

Composition

Fragiorthods and similar soils: 90 to 95 percent
 Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:
 • The somewhat poorly drained, coarse-loamy Typic Fragaquods in the slightly lower landscape positions

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow hazard

Management measures:

- Equipment should be used only during periods when the soils are relatively dry or have an adequate snow cover.
- Special site preparation, such as bedding, can reduce the seedling mortality rate.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: None assigned

Woodland ordination symbol: None assigned
Michigan soil management group: None assigned
Primary habitat type: TMV
Secondary habitat type: None assigned

516D—Fragiorthods, rolling

Setting

Landform and position on the landform: Rolling areas on ground moraines and end moraines
Slope: 6 to 18 percent
Shape of areas: Irregular
Size of areas: 5 to 100 acres

Soil Properties and Qualities

Depth class: Very deep
Texture: 15 to 20 inches of loam over 10 to 15 inches of firm fine sandy loam and very fine sandy loam; underlain by loamy sand to gravelly sand
Permeability: Variable
Available water capacity: Variable
Drainage class: Moderately well drained
Seasonal high water table: Perched at a depth of 1 to 2 feet at some time from October through May
Surface runoff: Medium
Flooding: None

Composition

Fragiorthods and similar soils: 95 percent
 Contrasting inclusions: 5 percent

Inclusions

Contrasting inclusions:
 • The somewhat poorly drained, coarse-loamy Typic Fragaquods in the slightly lower landscape positions

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow hazard

Management measures:

- Equipment should be used only when the soils are relatively dry or have an adequate snow cover.
- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.
- Special site preparation, such as bedding, can reduce the seedling mortality rate.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: None assigned

Woodland ordination symbol: None assigned
Michigan soil management group: None assigned
Primary habitat type: TMV
Secondary habitat type: None assigned

517B—Lode silt loam, nearly level and undulating

Setting

Landform and position on the landform: Nearly level and undulating areas on outwash plains and stream terraces

Slope: 1 to 6 percent

Shape of areas: Irregular

Size of areas: 5 to 800 acres

Typical Profile

Surface layer:

0 to 7 inches—dark brown silt loam

Subsoil:

7 to 31 inches—dark brown and reddish brown, friable and firm loam and sandy loam

31 to 37 inches—strong brown, loose coarse sand

Substratum:

37 to 70 inches—brown and dark yellowish brown sand

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderate in the upper part, very rapid in the lower part

Available water capacity: Low

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow

Flooding: None

Composition

Lode soil and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

- Pence soils, which are more droughty than the Lode soil; in landscape positions similar to those of the Lode soil
- The somewhat poorly drained Monico soils that have a seasonal high water table; in the slightly lower landscape positions

Use and Management

Land use: Dominant use—woodland; other uses—cropland

Woodland

Major management concerns: Equipment limitation

Management measures:

- The use of equipment is briefly restricted in spring and during other excessively wet periods. Access is easiest during periods in winter when access roads are frozen.

Cropland

Major management concerns: Soil blowing, water erosion, low organic matter content, seasonal droughtiness, tillth

Management measures:

- Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
- Conservation tillage, grassed waterways, cover crops, and crop rotations that include grasses or legumes help to control water erosion.
- Contour farming and contour stripcropping reduce the runoff rate and the hazard of water erosion.
- No-till farming, crop residue management, and a cropping sequence that includes green manure crops increase the organic matter content.
- A system of conservation tillage that leaves crop residue on the surface is effective in conserving moisture.
- Irrigation water should be applied at a rate that ensures optimum production but does not increase deep percolation, the runoff rate, and the hazard of erosion.
- Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.
- Minimizing tillage and tilling at the proper soil moisture content help to maintain good tillth and prevent crusting.

Interpretive Groups

Land capability classification: 11e

Woodland ordination symbol: 7L

Michigan soil management group: 3/5a-a

Primary habitat type: TM

Secondary habitat type: None assigned

517D—Lode silt loam, rolling

Setting

Landform and position on the landform: Rolling areas on outwash plains and stream terraces

Slope: 6 to 18 percent

Shape of areas: Irregular

Size of areas: 5 to 400 acres

Typical Profile

Surface layer:

0 to 7 inches—dark brown silt loam

Subsoil:

7 to 31 inches—dark brown and reddish brown, friable and firm loam and sandy loam

31 to 37 inches—strong brown, loose coarse sand

Substratum:

37 to 70 inches—brown and dark yellowish brown sand

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderate in the upper part, very rapid in the lower part

Available water capacity: Low

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Medium

Flooding: None

Composition

Lode soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:

- Pence soils, which are more droughty than the Lode soil; in landscape positions similar to those of the Lode soil
- The somewhat poorly drained Monico soils that have a seasonal high water table; in the slightly lower landscape positions

Use and Management

Land use: Dominant use—woodland; other uses—cropland

Woodland

Major management concerns: Equipment limitation

Management measures:

- The use of equipment is briefly restricted in spring and during other excessively wet periods. Access is easiest during periods in winter when access roads are frozen.
- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.

Cropland

Major management concerns: Soil blowing, water erosion, low organic matter content, droughtiness, tilth

Management measures:

- Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop

rotations that include small grain and hay help to control soil blowing.

- Water erosion can be controlled by diversions, crop residue management, contour stripcropping, field stripcropping, cover crops, grassed waterways, conservation tillage, crop rotations, grade-stabilization structures, or a combination of these practices.
- No-till farming, crop residue management, and a cropping sequence that includes green manure crops increase the organic matter content.
- A system of conservation tillage that leaves crop residue on the surface is effective in conserving moisture.
- Irrigation water should be applied at a rate that ensures optimum production but does not increase deep percolation, the runoff rate, and the hazard of erosion.
- Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.
- Minimizing tillage and tilling at the proper soil moisture content help to maintain good tilth and prevent crusting.

Interpretive Groups

Land capability classification: IVE

Woodland ordination symbol: 7L

Michigan soil management group: 3/5a-a

Primary habitat type: TM

Secondary habitat type: None assigned

517F—Lode silt loam, hilly

Setting

Landform and position on the landform: Hilly areas on outwash plains and stream terraces

Slope: 18 to 35 percent

Shape of areas: Irregular

Size of areas: 5 to 100 acres

Typical Profile

Surface layer:

0 to 7 inches—dark brown silt loam

Subsoil:

7 to 31 inches—dark brown and reddish brown, friable and firm loam and sandy loam

31 to 37 inches—strong brown, loose coarse sand

Substratum:

37 to 70 inches—brown and dark yellowish brown sand

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderate in the upper part, very rapid in the lower part

Available water capacity: Low
Drainage class: Well drained
Seasonal high water table: At a depth of more than 6 feet
Surface runoff: Medium
Flooding: None

Composition

Lode soil and similar soils: 85 to 95 percent
 Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:

- Pence soils, which are more droughty than the Lode soil; in landscape positions similar to those of the Lode soil
- The somewhat poorly drained Monico soils that have a seasonal high water table; on foot slopes and in drainageways
- Areas that have slopes of 35 to 45 percent

Use and Management

Land use: Woodland

Major management concerns: Erosion hazard, equipment limitation

Management measures:

- Because of the erosion hazard, water should be removed from logging roads by water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures.
- Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.
- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.

Interpretive Groups

Land capability classification: VIIe
Woodland ordination symbol: 7R
Michigan soil management group: 3/5a-a
Primary habitat type: TM
Secondary habitat type: None assigned

518—Humaquepts, sandy substratum

Setting

Landform and position on the landform: Depressions on outwash plains and moraines
Slope: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 5 to 200 acres

Soil Properties and Qualities

Texture: 0 to 16 inches of partially decomposed or well decomposed organic material over 25 to 35 inches of loamy material; underlain by sand and gravel
Depth class: Very deep
Permeability: Variable
Available water capacity: Variable
Drainage class: Poorly drained
Seasonal high water table: 1 foot above to 1 foot below the surface at some time from November through May
Surface runoff: Very slow or ponded
Flooding: None

Composition

Humaquepts and similar soils: 90 to 95 percent
 Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Monico soils that have a sandy substratum; in the slightly higher landscape positions

Similar inclusions:

- Soils that are more than 16 inches deep over mineral material
- Soils that are less than 40 inches deep over sandy material

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow hazard

Management measures:

- Equipment can be used only during dry summer months and during periods in winter when the snow cover is adequate or the soil is frozen.
- Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
- Because of wetness, severe seedling mortality, and plant competition, trees generally are not planted in areas of these soils.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: None assigned
Woodland ordination symbol: None assigned
Michigan soil management group: None assigned
Primary habitat type: TTS
Secondary habitat type: None assigned

519A—Monico loam, sandy substratum, nearly level

Setting

Landform and position on the landform: Drainageways on outwash plains and stream terraces

Slope: 0 to 2 percent

Shape of areas: Long and narrow or irregular

Size of areas: 5 to 200 acres

Typical Profile

Organic mat:

0 to 1 inch—black, decomposed forest litter

Surface layer:

1 to 7 inches—very dark gray loam

Subsurface layer:

7 to 19 inches—brown sandy loam

Subsoil:

19 to 46 inches—brown, mottled, friable fine sandy loam

Substratum:

46 to 60 inches—dark brown, mottled loamy sand

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderate

Available water capacity: Moderate

Drainage class: Somewhat poorly drained

Seasonal high water table: 1 to 2 feet below the surface at some time from November through May

Surface runoff: Slow

Flooding: None

Composition

Monico soil and similar soils: 80 to 85 percent

Contrasting inclusions: 15 to 20 percent

Inclusions

Contrasting inclusions:

- Small areas of the poorly drained Humaquepts that have a sandy substratum; in depressions
- Small areas of the very poorly drained, frequently flooded Fluvaquents in drainageways

Use and Management

Land use: Dominant use—woodland; other uses—cropland

Woodland

Major management concerns: Equipment limitation, windthrow hazard

Management measures:

- Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.

- The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen or has an adequate snow cover.
- Landing sites are generally available only during the driest time of the year.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Cropland

Major management concerns: Seasonal wetness, tilth

Management measures:

- Working the soil when it is too wet results in cloddiness and in compaction, which inhibits root development. As the natural soil structure is altered by compaction, surface crusting becomes more severe. Crusting can prevent seedling emergence, increase the runoff rate, and increase the susceptibility to erosion.
- Tile drains can be used to reduce wetness if a suitable outlet is available.
- Crop residue management, cover crops, green manure crops, proper use of manure, and conservation tillage help to maintain and improve tilth, the moisture-holding capacity, and the organic matter content.

Interpretive Groups

Land capability classification: IIw

Woodland ordination symbol: 5W

Michigan soil management group: 3b-a

Primary habitat type: TMC-Vac

Secondary habitat type: None assigned

520B—Haplorthods, deep water table, nearly level and undulating

Setting

Landform and position on the landform: Nearly level and undulating areas on outwash plains and moraines

Slope: 1 to 6 percent

Shape of areas: Irregular

Size of areas: 5 to 300 acres

Soil Properties and Qualities

Texture: Loamy and sandy material

Depth class: Very deep

Permeability: Variable

Available water capacity: Variable

Drainage class: Moderately well drained

Seasonal high water table: 4 to 6 feet below the surface at some time from November through May

Surface runoff: Slow

Flooding: None

Composition

Haplorthods and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:

- The well drained Pence and Lode soils in the slightly higher landscape positions
- The somewhat poorly drained Monico soils in the slightly lower landscape positions
- The very poorly drained, nonacid Borosaprists in depressions

Use and Management

Land use: Woodland

- Onsite investigation is needed to determine specific management concerns or to determine the suitability for other uses.

Interpretive Groups

Land capability classification: None assigned

Woodland ordination symbol: None assigned

Michigan soil management group: None assigned

Primary habitat type: TMC-Vac

Secondary habitat type: None assigned

521B—Pence sandy loam, very deep water table, nearly level and undulating

Setting

Landform and position on the landform: Nearly level and undulating areas on outwash plains and stream terraces

Slope: 1 to 6 percent

Shape of areas: Irregular

Size of areas: 5 to 100 acres

Typical Profile

Surface layer:

0 to 2 inches—very dark gray sandy loam

Subsurface layer:

2 to 4 inches—brown sandy loam

Subsoil:

4 to 12 inches—dark brown, friable sandy loam

12 to 22 inches—dark brown, friable gravelly loamy sand

22 to 51 inches—brown and dark yellowish brown, mottled, friable loamy sand, sand, and coarse sand

Substratum:

51 to 60 inches—dark brown very gravelly sand

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderately rapid in the upper part and very rapid in the lower part

Available water capacity: Low

Drainage class: Well drained

Seasonal high water table: 6 to 10 feet below the surface at some time from November through May

Surface runoff: Slow

Flooding: None

Composition

Pence soil and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

- The moderately well drained Lode soils, which are finer textured than the Pence soil; in landscape positions similar to those of the Pence soil

Use and Management

Land use: Dominant use—woodland; other uses—cropland

Woodland

Major management concerns: None

Cropland

Major management concerns: Soil blowing, water erosion, low organic matter content, seasonal droughtiness, tilth

Management measures:

- Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
- Conservation tillage, grassed waterways, cover crops, and crop rotations that include grasses or legumes help to control water erosion.
- Contour farming and contour stripcropping reduce the runoff rate and the hazard of water erosion.
- No-till farming, crop residue management, and a cropping sequence that includes green manure crops increase the organic matter content.
- A system of conservation tillage that leaves crop residue on the surface is effective in conserving moisture.
- Irrigation water should be applied at a rate that ensures optimum production but does not increase deep percolation, the runoff rate, and the hazard of erosion.
- Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.
- Minimizing tillage and tilling at the proper soil moisture content help to maintain good tilth and prevent crusting.

Interpretive Groups

Land capability classification: IIIe

Woodland ordination symbol: 9A
Michigan soil management group: 4a-a
Primary habitat type: TMV
Secondary habitat type: None assigned

522D—Entic Fragiorthods, coarse-loamy-Typic Dystrochrepts complex, nearly level to hilly, rocky, stony

Setting

Landform and position on the landform: Nearly level to hilly areas on ground moraines
Slope: 1 to 25 percent
Shape of areas: Irregular
Size of areas: 5 to 400 acres

Reference Profile

Entic Fragiorthods

Organic mat:
 0 to 2 inches—partially decomposed hardwood and conifer litter

Surface layer:
 2 to 7 inches—very dark gray loam

Subsurface layer:
 7 to 8 inches—brown loam

Subsoil:
 8 to 16 inches—dark brown, mottled, friable loam
 16 to 26 inches—a fragipan of brown and dark brown, mottled, very firm fine sandy loam
 26 to 45 inches—dark brown, mottled, friable sandy loam

Substratum:
 45 to 60 inches—dark grayish brown, mottled gravelly sandy loam

Typic Dystrochrepts

Texture: 10 to 24 inches of sandy loam to very cobbly loam over very gravelly or very cobbly sandy material

Soil Properties and Qualities

Depth class: Very deep

Rock fragments on the surface: Kind—stones and cobbles; percentage of surface covered—0.01 to 0.1

Permeability: Entic Fragiorthods—moderate in the upper part, very slow in the fragipan, and moderate in the substratum; Typic Dystrochrepts—variable

Available water capacity: Entic Fragiorthods—low; Typic Dystrochrepts—variable

Drainage class: Entic Fragiorthods—moderately well drained; Typic Dystrochrepts—well drained

Seasonal high water table: Entic Fragiorthods—perched

at a depth of 1 to 2 feet at some time from November through May; Typic Dystrochrepts—at a depth of more than 6 feet

Surface runoff: Medium

Flooding: None

Composition

Entic Fragiorthods and similar soils: 55 to 65 percent
 Typic Dystrochrepts and similar soils: 20 to 25 percent
 Rock outcrop: 5 percent
 Contrasting inclusions: 10 to 15 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained, nearly level Haplaquods on foot slopes and in drainageways
- The poorly drained, nonacid, very stony Humaquepts in depressions

Similar inclusions:

- Soils that are less than 40 inches deep over bedrock

Use and Management

Land use: Woodland

Major management concerns: Erosion hazard, equipment limitation, windthrow hazard

Management measures:

- Because of the erosion hazard, water should be removed from logging roads by water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures.
- Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: IIe

Woodland ordination symbol: Entic Fragiorthods—8W; Typic Dystrochrepts—none assigned

Michigan soil management group: None assigned

Primary habitat type: Entic Fragiorthods—ATD; Typic Dystrochrepts—TMV

Secondary habitat type: None assigned

523B—Entic Haplorthods-Typic Haplaquepts complex, nearly level and undulating

Setting

Landform and position on the landform: Entic Haplorthods—nearly level and undulating areas on outwash plains and moraines; Typic Haplaquepts—

depressions or swales on outwash plains and moraines

Slope: 0 to 4 percent

Shape of areas: Irregular

Size of areas: 5 to 100 acres

Soil Properties and Qualities

Texture: Loamy or sandy material

Depth class: Very deep

Permeability: Variable

Available water capacity: Variable

Drainage class: Entic Haplorthods—well drained; Typic Haplaquepts—poorly drained

Seasonal high water table: Entic Haplorthods—perched at a depth of 6 to 10 feet at some time from November through March; Typic Haplaquepts—1 foot above to 1 foot below the surface at some time from November through May

Surface runoff: Entic Haplorthods—slow; Typic Haplaquepts—very slow or ponded

Flooding: None

Composition

Entic Haplorthods and similar soils: 60 to 70 percent
Typic Haplaquepts and similar soils: 25 to 25 percent
Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:

- The moderately well drained Gogebic soils and the moderately well drained, coarse-loamy Alfic Fragiorthods that have a dense subsoil; in landscape positions similar to those of the Entic Haplorthods
- The very poorly drained, nonacid Borosaprists in closed depressions; in landscape positions similar to those of the Typic Haplaquepts

Similar inclusions:

- Soils that are similar to the Entic Haplorthods but have a water table at a depth of 4 to 6 feet
- Soils that are similar to the Entic Haplorthods but are darker in the upper part of the subsoil

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, windthrow hazard

Management measures:

- The seasonal high water table in areas of the Typic Haplaquepts restricts the use of equipment to midsummer, when the soils are dry, or midwinter, when the soils are frozen or have an adequate snow cover.
- Windthrow in areas of the Typic Haplaquepts can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

- Onsite investigation is needed to determine the suitability for other specific uses.

Interpretive Groups

Land capability classification: None assigned

Woodland ordination symbol: None assigned

Michigan soil management group: None assigned

Primary habitat type: Entic Haplorthods—ATD; Typic Haplaquepts—TMC

Secondary habitat type: None assigned

524D—Haplorthods, bedrock substratum, rolling, rocky

Setting

Landform and position on the landform: Rolling areas on ground moraines

Slope: 6 to 18 percent

Shape of areas: Irregular

Size of areas: 5 to 100 acres

Soil Properties and Qualities

Texture: Loamy, sandy, or gravelly material 40 to 90 inches thick; underlain by bedrock

Depth class: Deep or very deep

Permeability: Variable

Available water capacity: Variable

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow

Flooding: None

Composition

Haplorthods and similar soils: 95 to 98 percent
Rock outcrop: 2 to 5 percent

Inclusions

Similar inclusions:

- Soils that are less than 40 inches deep over bedrock

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation

Management measures:

- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.
- Because of the content of gravel on the surface in some areas, machine planting is difficult.
- Rock outcrops should be considered when road locations and landing sites are planned.
- Onsite investigation is needed to determine the suitability for other specific uses.

Interpretive Groups

Land capability classification: None assigned
Woodland ordination symbol: None assigned
Michigan soil management group: None assigned
Primary habitat type: ATD
Secondary habitat type: None assigned

524F—Haplorthods, bedrock substratum, hilly to very steep, rocky

Setting

Landform and position on the landform: Hilly to very steep areas on ground moraines and end moraines
Slope: 18 to 60 percent
Shape of areas: Irregular
Size of areas: 5 to 60 acres

Soil Properties and Qualities

Texture: Loamy, sandy, or gravelly material 40 to 90 inches thick; underlain by bedrock
Depth class: Deep or very deep
Permeability: Variable
Available water capacity: Variable
Drainage class: Well drained
Seasonal high water table: At a depth of more than 6 feet
Surface runoff: Medium
Flooding: None

Composition

Haplorthods and similar soils: 95 to 98 percent
 Rock outcrop: 2 to 5 percent

Inclusions

Similar inclusions:

- Soils that are less than 40 inches deep over bedrock

Use and Management

Land use: Woodland

Major management concerns: Erosion hazard, equipment limitation

Management measures:

- Cable yarding systems are generally safer than other logging methods and result in less surface disturbance.
- Because of the slope, ordinary crawler tractors and rubber-tired skidders cannot be operated safely in areas of these soils. As a result, special logging methods, such as yarding the logs with a cable, may be needed.
- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.
- Rock outcrops should be considered when road locations and landing sites are planned.
- Onsite investigation is needed to determine the

suitability for other specific uses.

Interpretive Groups

Land capability classification: None assigned
Woodland ordination symbol: None assigned
Michigan soil management group: None assigned
Primary habitat type: ATD
Secondary habitat type: None assigned

525B—Entic Haplorthods, sandy-skeletal, nearly level and undulating

Setting

Landform and position on the landform: Nearly level and undulating areas on end moraines and eskers
Slope: 1 to 6 percent
Shape of areas: Irregular
Size of areas: 5 to 400 acres

Reference Profile

Organic mat:

0 to 2 inches—partially decomposed conifer and hardwood litter

Subsurface layer:

2 to 5 inches—brown cobbly sandy loam

Subsoil:

5 to 18 inches—dark brown, friable gravelly sandy loam
 18 to 52 inches—dark yellowish brown, loose extremely cobbly coarse sand

Substratum:

52 to 65 inches—very dark grayish brown extremely cobbly coarse sand

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderate in the loamy part and rapid in the sandy part

Available water capacity: Low

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow

Flooding: None

Composition

Entic Haplorthods and similar soils: 85 to 95 percent
 Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained, nearly level Haplaquods in the lower landscape positions
- The moderately well drained Gogebic soils, which have a root-limiting subsoil; in landscape positions

similar to those of the Entic Haplorthods

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, windthrow hazard

Management measures:

- Because of the content of cobbles, machine planting may be difficult.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: VIs

Woodland ordination symbol: 3F

Michigan soil management group: None assigned

Primary habitat type: ATD

Secondary habitat type: None assigned

525D—Entic Haplorthods, sandy-skeletal, rolling and hilly

Setting

Landform and position on the landform: Rolling and hilly areas on end moraines and eskers

Slope: 6 to 35 percent

Shape of areas: Irregular

Size of areas: 5 to 600 acres

Reference Profile

Organic mat:

0 to 2 inches—partially decomposed conifer and hardwood litter

Subsurface layer:

2 to 5 inches—brown cobbly sandy loam

Subsoil:

5 to 18 inches—dark brown, friable gravelly sandy loam

18 to 52 inches—dark yellowish brown, loose extremely cobbly coarse sand

Substratum:

52 to 65 inches—very dark grayish brown extremely cobbly coarse sand

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderate in the loamy part and rapid in the sandy part

Available water capacity: Low

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow

Flooding: None

Composition

Entic Haplorthods and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

- The moderately well drained Gogebic soils, which have a root-limiting subsoil; in landscape positions similar to those of the Entic Haplorthods

Use and Management

Land use: Woodland

Major management concerns: Erosion hazard, equipment limitation, windthrow hazard

Management measures:

- Because of the erosion hazard, water should be removed from logging roads by water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures.
- Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.
- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.
- Because of the content of cobbles, machine planting may be difficult.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: VIs

Woodland ordination symbol: 3R

Michigan soil management group: None assigned

Primary habitat type: ATD

Secondary habitat type: None assigned

525F—Entic Haplorthods, sandy-skeletal, steep and very steep

Setting

Landform and position on the landform: Steep and very steep areas on end moraines and eskers

Slope: 35 to 55 percent

Shape of areas: Irregular

Size of areas: 5 to 400 acres

Typical Profile

Organic mat:

0 to 2 inches—partially decomposed conifer and hardwood litter

Subsurface layer:

2 to 5 inches—brown cobbly sandy loam

Subsoil:

5 to 18 inches—dark brown, friable gravelly sandy loam

18 to 52 inches—dark yellowish brown, loose extremely cobbly coarse sand

Substratum:

52 to 65 inches—very dark grayish brown extremely cobbly coarse sand

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderate in the loamy part and rapid in the sandy part

Available water capacity: Low

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Medium

Flooding: None

Composition

Entic Haplorthods and similar soils: 95 to 100 percent

Contrasting inclusions: 0 to 5 percent

Inclusions

Contrasting inclusions:

- The moderately well drained Gogebic soils, which have a root-limiting subsoil; in the slightly lower landscape positions

Use and Management

Land use: Woodland

Major management concerns: Erosion hazard, equipment limitation, windthrow hazard

Management measures:

- Because of the erosion hazard, water should be removed by water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures. Building logging roads on the contour or on the gentler slopes and seeding logging roads, skid roads, and landings after the trees are logged also help to prevent excessive soil loss.
- Because of the slope, ordinary crawler tractors and rubber-tired skidders cannot be operated safely in areas of these soils. As a result, special logging methods, such as yarding the logs with a cable, may be needed.
- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.

- Because of the content of cobbles, machine planting may be difficult.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: VIs

Woodland ordination symbol: 3R

Michigan soil management group: None assigned

Primary habitat type: ATD

Secondary habitat type: None assigned

527—Borochemists-Borosaprists, acid, complex

Setting

Landform: Depressions on outwash plains and moraines

Shape of areas: Irregular

Size of areas: 5 to 200 acres

Soil Properties and Qualities

Texture: Borochemists—decomposed and partially decomposed organic material; Borosaprists—decomposed organic material

Depth class: Very deep

Permeability: Variable

Available water capacity: Variable

Drainage class: Very poorly drained

Seasonal high water table: 1 foot above to 1 foot below the surface at some time from September through June

Surface runoff: Very slow or ponded

Flooding: None

Composition

Borochemists and similar soils: 40 to 50 percent

Borosaprists and similar soils: 40 to 50 percent

Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

- The poorly drained, nonacid, very stony, mineral Humaquepts in landscape positions similar to those of the major soils
- The somewhat poorly drained, nearly level Haplaquods in the slightly higher landscape positions

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow hazard

Management measures:

- Because of wetness and low strength, special

harvesting equipment is needed. The equipment can be used only during periods in winter when skid roads and access roads are frozen.

- Because of wetness, severe seedling mortality, and plant competition, trees are not planted in areas of these soils.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: None assigned
Woodland ordination symbol: None assigned
Michigan soil management group: None assigned
Primary habitat type: PCS
Secondary habitat type: None assigned

528—Borohemists, acid

Setting

Landform and position on the landform: Depressions on outwash plains
Slope: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 5 to 200 acres

Soil Properties and Qualities

Texture: Decomposed and partially decomposed organic material
Depth class: Very deep
Permeability: Variable
Available water capacity: Variable
Drainage class: Very poorly drained
Seasonal high water table: 1 foot above to 1 foot below the surface at some time from September through June
Surface runoff: Very slow or ponded
Flooding: None

Composition

Borohemists and similar soils: 100 percent

Inclusions

Similar inclusions:

- Organic soils composed only of well decomposed material

Use and Management

Land use: Woodland, open bogs
Major management concerns: Equipment limitation, seeding mortality, windthrow hazard
Management measures:

- Because of wetness and low strength, special harvesting equipment is needed. The equipment can be

used only during periods in winter when skid roads and access roads are frozen.

- Because of wetness, severe seedling mortality, and plant competition, trees are not planted in areas of these soils.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: None assigned
Woodland ordination symbol: None assigned
Michigan soil management group: None assigned
Primary habitat type: PCS
Secondary habitat type: None assigned

529—Borohemists, nonacid

Setting

Landform and position on the landform: Depressions on outwash plains and moraines
Shape of areas: Irregular
Size of areas: 5 to 200 acres

Soil Properties and Qualities

Texture: Decomposed and partially decomposed organic material
Depth class: Very deep
Permeability: Variable
Available water capacity: Variable
Drainage class: Very poorly drained
Seasonal high water table: 1 foot above to 1 foot below the surface at some time from September through June
Surface runoff: Very slow or ponded
Flooding: None

Composition

Borohemists and similar soils: 100 percent.

Use and Management

Land use: Woodland
Major management concerns: Equipment limitation, seeding mortality, windthrow hazard
Management measures:

- Because of wetness and low strength, special harvesting equipment is needed. The equipment can be used only during periods in winter when skid roads and access roads are frozen.
- Because of wetness, severe seedling mortality, and plant competition, trees are not planted in areas of these soils.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by

selective cutting and strip cutting.

Interpretive Groups

Land capability classification: None assigned
Woodland ordination symbol: None assigned
Michigan soil management group: None assigned
Primary habitat type: TTS
Secondary habitat type: None assigned

530—Borosapristis-Histic Humaquepts, nonacid, complex

Setting

Landform and position on the landform: Levees on flood plains
Slope: 0 to 2 percent
Shape of areas: Long and narrow or irregular
Size of areas: 5 to 20 acres

Soil Properties and Qualities

Texture: Borosapristis—decomposed organic material;
 Histic Humaquepts—less than 16 inches of decomposed organic material over loamy or sandy deposits
Depth class: Very deep
Permeability: Variable
Available water capacity: Variable
Drainage class: Very poorly drained
Seasonal high water table: 1 foot above the surface to 1 foot below the surface at some time from September through June
Surface runoff: Ponded
Flooding: Occasional

Composition

Borosapristis and similar soils: 45 to 55 percent
 Histic Humaquepts and similar soils: 35 to 50 percent
 Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

- Areas of the somewhat poorly drained Haplaquods in the slightly higher landscape positions

Similar inclusions:

- Very poorly drained soils that have a mineral surface layer

Use and Management

Land use: Woodland
Major management concerns: Equipment limitation, seedling mortality, windthrow hazard
Management measures:

- Because of wetness and low strength, special harvesting equipment is needed. The equipment can be

used only during periods in winter when skid roads and access roads are frozen.

- Because of wetness, severe seedling mortality, and plant competition, trees are not planted in areas of these soils.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: None assigned
Woodland ordination symbol: None assigned
Michigan soil management group: None assigned
Primary habitat type: TTS
Secondary habitat type: None assigned

531C—Champion silt loam, nearly level to rolling, very stony

Setting

Landform and position on the landform: Nearly level to rolling areas on ground moraines and end moraines
Slope: 1 to 12 percent
Shape of areas: Irregular
Size of areas: 5 to 400 acres

Typical Profile

Organic mat:
 0 to 2 inches—black, decomposed organic material
Subsurface layer:
 2 to 4 inches—brown silt loam
Subsoil:
 4 to 12 inches—dark reddish brown, friable silt loam
 12 to 29 inches—reddish brown and brown, friable cobbly fine sandy loam
 29 to 37 inches—a fragipan of dark grayish brown, very firm cobbly loamy sand
 37 to 60 inches—a fragipan of dark grayish brown, mottled, very firm cobbly sandy loam

Soil Properties and Qualities

Depth class: Very deep
Rock fragments on the surface: Kind—stones and cobbles; percentage of surface covered—1 to 3
Permeability: Moderate in the upper part and very slow in the fragipan
Available water capacity: Low
Drainage class: Moderately well drained
Seasonal high water table: Perched at a depth of 1 to 2 feet at some time from November through May
Surface runoff: Medium
Flooding: None

Composition

Champion soil and similar soils: 95 to 100 percent
 Contrasting inclusions: 0 to 5 percent

Inclusions

Contrasting inclusions:

- The poorly drained, nonacid, very stony Histic Humaquepts in small depressions

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, windthrow hazard

Management measures:

- Equipment should be used only when the soil is relatively dry or has an adequate snow cover.
- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: VI_s

Woodland ordination symbol: 3W

Michigan soil management group: 3a-af

Primary habitat type: ATD

Secondary habitat type: None assigned

532F—Champion-Haplorthods complex, hilly, rocky, very stony**Setting**

Landform and position on the landform: Hilly areas on end moraines

Slope: 18 to 35 percent

Shape of areas: Irregular

Size of areas: 5 to 150 acres

Typical Profile**Champion**

Organic mat:

0 to 2 inches—black, decomposed organic material

Subsurface layer:

2 to 4 inches—brown silt loam

Subsoil:

4 to 12 inches—dark reddish brown, friable silt loam

12 to 29 inches—reddish brown and brown, friable cobbly fine sandy loam

29 to 37 inches—a fragipan of dark grayish brown, very firm cobbly loamy sand

37 to 60 inches—a fragipan of dark grayish brown,

mottled, very firm cobbly sandy loam

Haplorthods, bedrock substratum

Texture: 20 to 60 inches of sandy loam to extremely cobbly silt loam over bedrock

Soil Properties and Qualities

Depth class: Champion—very deep; Haplorthods—moderately deep and deep

Rock fragments on the surface: Kind—stones and cobbles; percentage of surface covered—1 to 3

Permeability: Champion—moderate in the upper part and very slow in the fragipan; Haplorthods—variable

Available water capacity: Champion—low; Haplorthods—variable

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Medium

Flooding: None

Composition

Champion soil and similar soils: 55 to 60 percent

Haplorthods and similar soils: 35 to 40 percent

Rock outcrop: 5 percent

Inclusions

Similar inclusions:

- Soils that are less than 20 inches deep over bedrock

Use and Management

Land use: Woodland

Major management concerns: Erosion, equipment limitation, windthrow hazard

Management measures:

- Because of the erosion hazard, water should be removed from logging roads by water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures.
- Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.
- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.
- Rock outcrops and the shallow depth to bedrock in some areas should be considered when road locations and landing sites are planned.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: VII_e

Woodland ordination symbol: Champion—3R;

Haplorthods—none assigned
 Michigan soil management group: Champion—3a-af;
 Haplorthods—none assigned
 Primary habitat type: ATD
 Secondary habitat type: None assigned

533B—Entic Fragiorthods, coarse-loamy, nearly level and undulating

Setting

Landform and position on the landform: Nearly level and undulating areas on ground moraines
Slope: 1 to 6 percent
Shape of areas: Irregular
Size of areas: 5 to 150 acres

Reference Profile

Organic mat:
 0 to 2 inches—dark reddish brown, partially decomposed forest litter

Surface layer:
 2 to 4 inches—very dark gray very fine sandy loam

Subsurface layer:
 4 to 8 inches—reddish gray very fine sandy loam

Subsoil:
 8 to 21 inches—dark reddish brown and dark brown, friable very fine sandy loam
 21 to 35 inches—a fragipan of dark grayish brown and dark brown, very firm gravelly loamy sand and gravelly sandy loam

Substratum:
 35 to 60 inches—grayish brown, mottled gravelly loamy sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderate in the upper part, very slow in the fragipan, and moderate or moderately rapid in the substratum
Available water capacity: Low
Drainage class: Moderately well drained
Seasonal high water table: Perched at a depth of 1 to 2 feet at some time from November through May
Surface runoff: Slow
Flooding: None

Composition

Entic Fragiorthods and similar soils: 90 to 95 percent
 Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:
 • Areas of the very poorly drained, nonacid Borosaprists in closed depressions

Similar inclusions:
 • Soils in which the upper part of the subsoil is darker and thicker

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, windthrow hazard

Management measures:
 • Equipment can be used only during dry summer months and during periods in winter when the snow cover is adequate or the soil is frozen.
 • Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: IIe
Woodland ordination symbol: 8W
Michigan soil management group: None assigned
Primary habitat type: TMC-D
Secondary habitat type: None assigned

534B—Entic Haplorthods, sandy, stratified substratum, nearly level and undulating

Setting

Landform and position on the landform: Nearly level and undulating areas on outwash plains
Slope: 0 to 6 percent
Shape of areas: Irregular
Size of areas: 5 to 1,500 acres

Reference Profile

Surface layer:
 0 to 1 inch—black sandy loam

Subsurface layer:
 1 to 2 inches—reddish gray loamy sand

Subsoil:
 2 to 6 inches—reddish brown, friable loamy sand
 6 to 19 inches—yellowish red, loose gravelly coarse sand
 19 to 41 inches—light brown, loose sand

Substratum:
 41 to 60 inches—light brown sand that has strata of fine sand, loamy sand, and gravelly coarse sand

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderately rapid in the upper part and moderately rapid or rapid in the lower part
Available water capacity: Low
Drainage class: Somewhat excessively drained
Seasonal high water table: At a depth of more than 6 feet
Surface runoff: Slow
Flooding: None

Composition

Entic Haplorthods and similar soils: 95 percent
 Contrasting inclusions: 5 percent

Inclusions

Contrasting inclusions:

- The very poorly drained, nonacid Borohemists in depressions

Use and Management

Land use: Woodland

Major management concerns: None

Interpretive Groups

Land capability classification: IVs
Woodland ordination symbol: 6A
Michigan soil management group: None assigned
Primary habitat type: AQV
Secondary habitat type: None assigned

534D—Entic Haplorthods, sandy, stratified substratum, rolling

Setting

Landform and position on the landform: Rolling areas on outwash plains
Slope: 6 to 18 percent
Shape of areas: Irregular
Size of areas: 5 to 1,000 acres

Reference Profile

Surface layer:
 0 to 1 inch—black sandy loam
Subsurface layer:
 1 to 2 inches—reddish gray loamy sand
Subsoil:
 2 to 6 inches—reddish brown, friable loamy sand
 6 to 19 inches—yellowish red, loose gravelly coarse sand
 19 to 41 inches—light brown, loose sand
Substratum:
 41 to 60 inches—light brown sand that has strata of fine sand, loamy sand, and gravelly coarse sand

Soil Properties and Qualities

Depth class: Very deep
Permeability: Moderately rapid in the upper part and moderately rapid or rapid in the lower part
Available water capacity: Low
Drainage class: Somewhat excessively drained
Seasonal high water table: At a depth of more than 6 feet
Surface runoff: Slow
Flooding: None

Composition

Entic Haplorthods and similar soils: 95 percent
 Contrasting inclusions: 5 percent

Inclusions

Contrasting inclusions:

- The very poorly drained, nonacid Borohemists in depressions

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation on landings

- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.

Interpretive Groups

Land capability classification: VI_s
Woodland ordination symbol: 6A
Michigan soil management group: None assigned
Primary habitat type: AQV
Secondary habitat type: None assigned

535B—Vilas loamy sand, nearly level and undulating

Setting

Landform and position on the landform: Nearly level and undulating areas on outwash plains
Slope: 0 to 6 percent
Shape of areas: Irregular
Size of areas: 5 to 60 acres

Typical Profile

Organic mat:
 0 to 1 inch—black, partially decomposed forest litter
Subsurface layer:
 1 to 2 inches—brown loamy sand
Subsoil:
 2 to 30 inches—dark reddish brown, very friable loamy sand
 30 to 42 inches—brown, loose sand

Substratum:

42 to 95 inches—light brown sand

Soil Properties and Qualities*Depth class:* Very deep*Permeability:* Rapid*Available water capacity:* Low*Drainage class:* Excessively drained*Seasonal high water table:* At a depth of more than 6 feet*Surface runoff:* Slow*Flooding:* None**Composition**

Vilas soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Inclusions*Contrasting inclusions:*

- The somewhat poorly drained, nearly level Haplaquods in the slightly lower landscape positions
- The moderately well drained Entic Haplorthods that have a moderately deep water table; in the slightly lower landscape positions

Use and Management**Land use:** Woodland*Major management concerns:* None**Interpretive Groups***Land capability classification:* IVs*Woodland ordination symbol:* 6A*Michigan soil management group:* 5.3a*Primary habitat type:* AQV*Secondary habitat type:* None assigned**535D—Vilas loamy sand, rolling****Setting***Landform and position on the landform:* Rolling areas on outwash plains*Slope:* 6 to 18 percent*Shape of areas:* Irregular*Size of areas:* 5 to 60 acres**Typical Profile***Organic mat:*

0 to 1 inch—black, partially decomposed forest litter

Subsurface layer:

1 to 2 inches—brown loamy sand

Subsoil:

2 to 30 inches—dark reddish brown, very friable loamy sand

30 to 42 inches—brown, loose sand

Substratum:

42 to 95 inches—light brown sand

Soil Properties and Qualities*Depth class:* Very deep*Permeability:* Rapid*Available water capacity:* Low*Drainage class:* Excessively drained*Seasonal high water table:* At a depth of more than 6 feet*Surface runoff:* Slow*Flooding:* None**Composition**

Vilas soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Inclusions*Contrasting inclusions:*

- The somewhat poorly drained, nearly level Haplaquods in drainageways
- The moderately well drained Entic Haplorthods that have a moderately deep water table; on foot slopes and in drainageways

Use and Management**Land use:** Woodland*Major management concerns:* Equipment limitation on landings*Management measures:*

- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.

Interpretive Groups*Land capability classification:* VIIs*Woodland ordination symbol:* 6A*Michigan soil management group:* 5.3a*Primary habitat type:* AQV*Secondary habitat type:* None assigned**536F—Entic Haplorthods, sandy-skeletal, esker, very steep****Setting***Landform and position on the landform:* Steep and very steep areas on eskers*Slope:* 35 to 55 percent*Shape of areas:* Long and narrow*Size of areas:* 5 to 50 acres**Reference Profile***Organic mat:*

0 to 4 inches—partially decomposed forest litter

Surface layer:

4 to 6 inches—dark brown silt loam

Subsurface layer:

6 to 8 inches—brown silt loam

Subsoil:

8 to 18 inches—dark brown, friable gravelly sandy loam
18 to 29 inches—dark yellowish brown, loose very gravelly coarse sand

Substratum:

29 to 60 inches—dark yellowish brown extremely gravelly coarse sand

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderate in the upper loamy part and rapid in the lower sandy part

Available water capacity: Low

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Medium

Flooding: None

Composition

Entic Haplorthods and similar soils: 90 to 100 percent
Contrasting inclusions: 0 to 10 percent

Inclusions*Contrasting inclusions:*

- The moderately well drained Entic Haplorthods that have a moderately deep water table; in the slightly lower landscape positions

Use and Management

Land use: Woodland

Major management concerns: Erosion hazard, equipment limitation

Management measures:

- Because of the erosion hazard, water should be removed from logging roads by water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures.
- Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.
- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.

Interpretive Groups

Land capability classification: VIs

Woodland ordination symbol: 3R

Michigan soil management group: None assigned

Primary habitat type: ATD

Secondary habitat type: None assigned

537B—Haplorthods, moderately deep water table, nearly level and undulating**Setting**

Landform and position on the landform: Nearly level and undulating areas on outwash plains and deltas

Slope: 0 to 6 percent

Shape of areas: Irregular

Size of areas: 5 to 60 acres

Soil Properties and Qualities

Texture: Loamy sand to gravelly coarse sand throughout

Depth class: Very deep

Permeability: Variable

Available water capacity: Variable

Drainage class: Moderately well drained

Seasonal high water table: 2 to 3 feet below the surface at some time from November through May

Surface runoff: Slow

Flooding: None

Composition

Entic Haplorthods and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Inclusions*Contrasting inclusions:*

- The somewhat poorly drained, nearly level Haplaquods in the slightly lower landscape positions
- The excessively drained Vilas soils in the slightly higher landscape positions

Similar inclusions:

- Soils that are sandy loam in the upper part of the subsoil

Use and Management

Land use: Woodland

Major management concerns: Windthrow hazard

Management measures:

- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: None assigned

Woodland ordination symbol: None assigned

Michigan soil management group: None assigned

Primary habitat type: TMV

Secondary habitat type: None assigned

538B—Entic Haplorthods, sandy substratum, nearly level and undulating

Setting

Landform and position on the landform: Nearly level and undulating areas on outwash plains

Slope: 0 to 6 percent

Shape of areas: Irregular

Size of areas: 5 to 80 acres

Soil Properties and Qualities

Texture: Surface layer and subsoil—sand or very gravelly sand; substratum—sandy material

Depth class: Very deep

Permeability: Variable

Available water capacity: Variable

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow

Flooding: None

Composition

Entic Haplorthods and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:

- The moderately well drained Entic Haplorthods that have a moderately deep water table; in the slightly lower landscape positions
- The well drained, coarse-loamy Typic Dystrochrepts that have a sandy substratum; in landscape positions similar to those of the major soils
- The moderately well drained, coarse-loamy Entic Fragiorthods in the slightly lower landscape positions

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation

Management measures:

- Because loose sand can interfere with the traction of wheeled equipment, logging roads should be stabilized.

Interpretive Groups

Land capability classification: None assigned

Woodland ordination symbol: None assigned

Michigan soil management group: None assigned

Primary habitat type: TMV

Secondary habitat type: None assigned

538D—Entic Haplorthods, sandy substratum, rolling

Setting

Landform and position on the landform: Rolling areas on outwash plains

Slope: 6 to 18 percent

Shape of areas: Irregular

Size of areas: 5 to 80 acres

Soil Properties and Qualities

Texture: Surface layer and subsoil—sand or very gravelly sand; substratum—sandy material

Depth class: Very deep

Permeability: Variable

Available water capacity: Variable

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow

Flooding: None

Composition

Entic Haplorthods and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:

- The moderately well drained Entic Haplorthods that have a moderately deep water table; in the slightly lower landscape positions
- The well drained, coarse-loamy Typic Dystrochrepts that have a sandy substratum; in landscape positions similar to those of the major soils
- The moderately well drained, coarse-loamy Entic Fragiorthods in the slightly lower landscape positions

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation

Management measures:

- Because loose sand can interfere with the traction of wheeled equipment, logging roads should be stabilized.
- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.

Interpretive Groups

Land capability classification: None assigned

Woodland ordination symbol: None assigned

Michigan soil management group: None assigned

Primary habitat type: TMV

Secondary habitat type: None assigned

539B—Karlin sandy loam, very deep water table, nearly level and undulating**Setting**

Landform and position on the landform: Nearly level and undulating areas on outwash plains

Slope: 0 to 6 percent

Shape of areas: Irregular

Size of areas: 5 to 400 acres

Typical Profile

Surface layer:

0 to 1 inch—dark brown sandy loam

Subsurface layer:

1 to 3 inches—brown loamy sand

Subsoil:

3 to 8 inches—dark brown, friable sandy loam

8 to 36 inches—strong brown and brown, friable and very friable sand

36 to 61 inches—brown, mottled, loose sand

Substratum:

61 to 95 inches—light brown, mottled sand

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderately rapid in the upper part, rapid in the lower part

Available water capacity: Low

Drainage class: Somewhat excessively drained

Seasonal high water table: 6 to 10 feet below the surface at some time from November through May

Surface runoff: Slow

Flooding: None

Composition

Karlin soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained, nearly level Haplaquods in the lower landscape positions
- The moderately well drained Entic Haplorthods that have a moderately deep water table; in the slightly lower landscape positions

Similar inclusions:

- Soils that are sand or loamy sand in the upper part of the subsoil

Use and Management

Land use: Woodland

Major management concerns: None

Interpretive Groups

Land capability classification: IVs

Woodland ordination symbol: 3A

Michigan soil management group: 4a

Primary habitat type: AQV

Secondary habitat type: None assigned

540B—Entic Fragiorthods-Typic Fragiaquods-Borosapristis, nonacid, complex, nearly level and undulating**Setting**

Landform and position on the landform: Entic

Fragiorthods—nearly level and undulating areas on ground moraines; Typic Fragiaquods—drainageways on ground moraines; Borosapristis—depressions on ground moraines

Slope: 0 to 6 percent

Distinctive landscape features: Cradle-knoll landscape

Shape of areas: Irregular

Size of areas: 5 to 70 acres

Soil Properties and Qualities

Texture: Entic Fragiorthods—loamy or sandy; Typic Fragiaquods—loamy or sandy; Borosapristis—16 to more than 51 inches of well decomposed organic material over loamy or sandy material

Depth class: Very deep

Permeability: Variable

Available water capacity: Variable

Drainage class: Entic Fragiorthods—moderately well drained; Typic Fragiaquods—somewhat poorly drained; Borosapristis—very poorly drained

Seasonal high water table: Entic Fragiorthods—perched at a depth of 1 to 2 feet at some time from November through May; Typic Fragiaquods—perched at a depth of 0.5 foot to 1.5 feet at some time from September through May; Borosapristis—1 foot above to 1 foot below the surface at some time from November through May

Surface runoff: Entic Fragiorthods and Typic Fragiaquods—slow; Borosapristis—very slow or ponded

Flooding: None

Composition

Entic Fragiorthods and similar soils: 55 to 65 percent

Typic Fragiaquods and similar soils: 15 to 20 percent

Borosapristis and similar soils: 15 to 20 percent

Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

- The well drained Gogebic soils in the slightly higher landscape positions; associated with the Entic Fragiorthods

Similar inclusions:

- Soils that are darker in the upper part of the subsoil; associated with the Entic Fragiorthods
- Soils that have less than 16 inches of organic material; associated with the Borosaprists

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow hazard

Management measures:

- The seasonal high water table restricts the use of equipment to midsummer, when the soils are dry, or midwinter, when the soils are frozen or have an adequate snow cover.
- Because of wetness and low strength, special harvesting equipment is needed in areas of the Borosaprists. The equipment can be used only during periods in winter when skid roads and access roads are frozen.
- Special site preparation, such as bedding, can reduce the seedling mortality rate in areas of the Entic Fragiorthods and Typic Fragiaquods.
- Trees are not planted in areas of the Borosaprists because of wetness, severe seedling mortality, and plant competition.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: None assigned

Woodland ordination symbol: None assigned

Michigan soil management group: None assigned

Primary habitat type: Entic Fragiorthods—TMC-D; Typic Fragiaquods—TMC; Borosaprists—TTS

Secondary habitat type: None assigned

541—Fluvaquents, frequently flooded**Setting**

Landform and position on the landform: Levees on flood plains

Slope: 0 to 2 percent

Shape of areas: Long and narrow

Size of areas: 5 to 100 acres

Soil Properties and Qualities

Texture: 1 to 7 inches of organic material over silty clay loam to sand

Depth class: Very deep

Permeability: Variable

Available water capacity: Variable

Drainage class: Very poorly drained

Seasonal high water table: 1 foot above to 1 foot below the surface at some time from November through May

Surface runoff: Slow

Flooding: Frequent

Composition

Fluvaquents and similar soils: 100 percent

Inclusions*Similar inclusions:*

- Soils that have 8 to 16 inches of organic material on the surface

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow hazard

Management measures:

- The seasonal high water table restricts the use of equipment to midsummer, when the soils are dry, or midwinter, when the soils are frozen or have an adequate snow cover.
- Because of wetness, flooding, severe seedling mortality, and plant competition, trees are not planted in areas of these soils.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: None assigned

Woodland ordination symbol: None assigned

Michigan soil management group: None assigned

Primary habitat type: FMC

Secondary habitat type: None assigned

542B—Gogebic fine sandy loam, nearly level and undulating**Setting**

Landform and position on the landform: Nearly level and undulating areas on end moraines

Slope: 1 to 6 percent

Shape of areas: Irregular

Size of areas: 5 to 200 acres

Typical Profile*Organic mat:*

0 to 2 inches—dark reddish brown, decomposed organic material

Subsurface layer:

2 to 7 inches—reddish gray fine sandy loam

Subsoil:

7 to 21 inches—dark reddish brown and reddish brown, friable fine sandy loam

21 to 28 inches—a fragipan of reddish brown, mottled, very firm loamy fine sand and fine sandy loam

28 to 37 inches—reddish brown, firm fine sandy loam

Substratum:

37 to 60 inches—reddish brown sandy loam

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderate in the upper part, very slow in the fragipan, and moderate in the lower part

Available water capacity: Low

Drainage class: Moderately well drained

Seasonal high water table: Perched at a depth of 1 to 2 feet at some time from November through May

Surface runoff: Slow

Flooding: None

Composition

Gogebic soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained, nearly level Haplaquods in the lower landscape positions
- The poorly drained, nonacid, very stony Humaquepts in depressions

Similar inclusions:

- Soils that have more clay in the upper part of the subsoil

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow hazard

Management measures:

- Equipment can be used only during dry summer months and during periods in winter when the snow cover is adequate or the soil is frozen.
- Special site preparation, such as bedding, can reduce the seedling mortality rate.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: IIe

Woodland ordination symbol: 3W

Michigan soil management group: 3a-af

Primary habitat type: ATD

Secondary habitat type: None assigned

542D—Gogebic fine sandy loam, rolling**Setting**

Landform and position on the landform: Rolling areas on end moraines

Slope: 6 to 18 percent

Shape of areas: Irregular

Size of areas: 5 to 100 acres

Typical Profile

Organic mat:

0 to 2 inches—dark reddish brown, decomposed organic material

Subsurface layer:

2 to 7 inches—reddish gray fine sandy loam

Subsoil:

7 to 21 inches—dark reddish brown and reddish brown, friable fine sandy loam

21 to 28 inches—a fragipan of reddish brown, mottled, very firm loamy fine sand and fine sandy loam

28 to 37 inches—reddish brown, firm fine sandy loam

Substratum:

37 to 60 inches—reddish brown sandy loam

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderate in the upper part, very slow in the fragipan, and moderate in the lower part

Available water capacity: Low

Drainage class: Moderately well drained

Seasonal high water table: Perched at a depth of 1 to 2 feet at some time from November through May

Surface runoff: Slow

Flooding: None

Composition

Gogebic soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained, nearly level Haplaquods on foot slopes and in drainageways
- The poorly drained, nonacid, very stony Humaquepts in depressions

Similar inclusions:

- Soils that have more clay in the upper part of the subsoil

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow hazard

Management measures:

- Equipment can be used only during dry summer months and during periods in winter when the snow cover is adequate or the soil is frozen.
- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.
- Special site preparation, such as bedding, can reduce the seedling mortality rate.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups*Land capability classification:* IVe*Woodland ordination symbol:* 3W*Michigan soil management group:* 3a-af*Primary habitat type:* ATD*Secondary habitat type:* None assigned**542F—Gogebic fine sandy loam, well drained, hilly****Setting***Landform and position on the landform:* Hilly areas on end moraines*Slope:* 18 to 35 percent*Shape of areas:* Irregular*Size of areas:* 5 to 80 acres**Typical Profile***Organic mat:*

0 to 2 inches—dark reddish brown, decomposed organic material

Subsurface layer:

2 to 7 inches—reddish gray fine sandy loam

Subsoil:

7 to 21 inches—dark reddish brown and reddish brown, friable fine sandy loam

21 to 28 inches—a fragipan of reddish brown, mottled, very firm loamy fine sand and fine sandy loam

28 to 37 inches—reddish brown, firm fine sandy loam

Substratum:

37 to 60 inches—reddish brown sandy loam

Soil Properties and Qualities*Depth class:* Very deep*Permeability:* Moderate in the upper part, very slow in the fragipan, and moderate in the lower part*Available water capacity:* Low*Drainage class:* Well drained*Seasonal high water table:* At a depth of more than 6 feet*Surface runoff:* Medium*Flooding:* None**Composition**

Gogebic soil and similar soils: 100 percent

Inclusions*Similar inclusions:*

- Soils that have more clay in the upper part of the subsoil

Use and Management**Land use:** Woodland*Major management concerns:* Erosion hazard, equipment limitation, seedling mortality, windthrow hazard*Management measures:*

- Because of the erosion hazard, water should be removed from logging roads by water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures.
- Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.
- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.
- Equipment can be used only during dry summer months and during periods in winter when the snow cover is adequate or the soil is frozen.
- Special site preparation, such as bedding, can reduce the seedling mortality rate.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups*Land capability classification:* VIIe*Woodland ordination symbol:* 3R*Michigan soil management group:* 3a-af*Primary habitat type:* ATD*Secondary habitat type:* None assigned**543A—Haplaquods, nearly level****Setting***Landform and position on the landform:* Drainageways on ground moraines and outwash plains*Slope:* 0 to 3 percent*Shape of areas:* Long and narrow or irregular*Size of areas:* 5 to 30 acres

Soil Properties and Qualities

Texture: Sandy or loamy material
Depth class: Very deep
Permeability: Moderate to rapid
Available water capacity: Moderate
Drainage class: Somewhat poorly drained
Seasonal high water table: 1 to 2 feet below the surface at some time from November through May
Surface runoff: Slow
Flooding: None

Composition

Haplaquods and similar soils: 85 to 90 percent
 Contrasting inclusions: 10 to 15 percent

Inclusions*Contrasting inclusions:*

- The very poorly drained, nonacid Borohemists and Borosaprists in depressions
- The moderately well drained, coarse-loamy Entic Fragiorhods in the slightly higher landscape positions
- The moderately well drained Entic Haplorthods that have a moderately deep water table; in the slightly higher landscape positions

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, windthrow hazard

Management measures:

- Equipment can be used only during dry summer months and during periods in winter when the snow cover is adequate or the soil is frozen.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: None assigned
Woodland ordination symbol: None assigned
Michigan soil management group: None assigned
Primary habitat type: TMC
Secondary habitat type: TTS

544C—Haplorthods, esker, rolling**Setting**

Landform and position on the landform: Rolling areas on eskers
Slope: 6 to 12 percent
Shape of areas: Long and narrow
Size of areas: 4 to 40 acres

Soil Properties and Qualities

Texture: Loamy, sandy, or gravelly material
Depth class: Very deep
Permeability: Variable
Available water capacity: Variable
Drainage class: Well drained
Seasonal high water table: At a depth of more than 6 feet
Surface runoff: Slow
Flooding: None

Composition

Haplorthods and similar soils: 100 percent

Inclusions*Similar inclusions:*

- Well drained, loamy soils that have a dense layer in the upper part of the subsoil

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation

Management measures:

- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.

Interpretive Groups

Land capability classification: None assigned
Woodland ordination symbol: None assigned
Michigan soil management group: None assigned
Primary habitat type: ATD
Secondary habitat type: None assigned

544D—Haplorthods, esker, hilly**Setting**

Landform and position on the landform: Rolling and hilly areas on eskers
Slope: 12 to 25 percent
Shape of areas: Long and narrow
Size of areas: 5 to 50 acres

Soil Properties and Qualities

Texture: Loamy, sandy, or gravelly material
Depth class: Very deep
Permeability: Variable
Available water capacity: Variable
Drainage class: Well drained
Seasonal high water table: At a depth of more than 6 feet
Surface runoff: Medium
Flooding: None

Composition

Haplorthods and similar soils: 95 percent
 Contrasting inclusions: 5 percent

Inclusions*Contrasting inclusions:*

- The moderately well drained Gogebic soils in landscape positions similar to those of the Haplorthods

Use and Management

Land use: Woodland

Major management concerns: Erosion hazard, equipment limitation

Management measures:

- Because of the erosion hazard, water should be removed from logging roads by water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures.
- Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.
- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.

Interpretive Groups

Land capability classification: None assigned
Woodland ordination symbol: None assigned
Michigan soil management group: None assigned
Primary habitat type: ATD
Secondary habitat type: None assigned

544F—Haplorthods, esker, steep**Setting**

Landform and position on the landform: Steep and very steep areas on eskers
Slope: 35 to 60 percent
Shape of areas: Long and narrow
Size of areas: 5 to 80 acres

Soil Properties and Qualities

Texture: Loamy, sandy, or gravelly material
Depth class: Very deep
Permeability: Variable
Available water capacity: Variable
Drainage class: Well drained
Seasonal high water table: At a depth of more than 6 feet
Surface runoff: Rapid
Flooding: None

Composition

Haplorthods and similar soils: 95 percent
 Contrasting inclusions: 5 percent

Inclusions*Contrasting inclusions:*

- The moderately well drained Gogebic soils in the slightly lower landscape positions

Use and Management

Land use: Woodland

Major management concerns: Erosion hazard, equipment limitation

Management measures:

- Cable yarding systems are generally safer than other logging methods and result in less surface disturbance.
- Because of the slope, ordinary crawler tractors and rubber-tired skidders cannot be operated safely. As a result, special logging methods, such as yarding the logs with a cable, may be needed.

Interpretive Groups

Land capability classification: None assigned
Woodland ordination symbol: None assigned
Michigan soil management group: None assigned
Primary habitat type: ATD
Secondary habitat type: None assigned

545B—Haplorthods, nearly level and undulating**Setting**

Landform and position on the landform: Nearly level and undulating areas on end moraines
Slope: 0 to 6 percent
Shape of areas: Irregular
Size of areas: 5 to 400 acres

Soil Properties and Qualities

Texture: Sandy or loamy over sandy materials or mixtures of sand and gravel
Depth class: Very deep
Permeability: Variable
Available water capacity: Variable
Drainage class: Well drained
Seasonal high water table: At a depth of more than 6 feet
Surface runoff: Slow
Flooding: None

Composition

Haplorthods and similar soils: 90 to 95 percent
 Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

- The moderately well drained Gogebic soils and the moderately well drained, coarse-loamy Alfic Fragiorthods; in landscape positions similar to those of the Haplorthods
- The somewhat poorly drained Haplaquods in the lower landscape positions

Use and Management

Land use: Woodland

- Onsite investigation is needed to determine the suitability of these soils for woodland management and for other specific uses.

Interpretive Groups

Land capability classification: None assigned
Woodland ordination symbol: None assigned
Michigan soil management group: None assigned
Primary habitat type: ATD
Secondary habitat type: None assigned

545D—Haplorthods, rolling

Setting

Landform and position on the landform: Rolling areas on end moraines
Slope: 6 to 18 percent
Shape of areas: Irregular
Size of areas: 5 to 1,500 acres

Soil Properties and Qualities

Texture: Sandy or loamy over sandy materials or mixtures of sand and gravel
Depth class: Very deep
Permeability: Variable
Available water capacity: Variable
Drainage class: Well drained
Seasonal high water table: At a depth of more than 6 feet
Surface runoff: Slow or medium
Flooding: None

Composition

Haplorthods and similar soils: 90 to 95 percent
 Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

- The moderately well drained Gogebic soils in landscape positions similar to those of the Haplorthods
- The somewhat poorly drained, nearly level Haplaquods on foot slopes and in drainageways

Use and Management

Land use: Woodland

Management measures:

- Onsite investigation is needed to determine the suitability of these soils for woodland and for other specific uses.

Interpretive Groups

Land capability classification: None assigned
Woodland ordination symbol: None assigned
Michigan soil management group: None assigned
Primary habitat type: ATD
Secondary habitat type: None assigned

545F—Haplorthods, hilly

Setting

Landform and position on the landform: Hilly areas on end moraines
Slope: 18 to 35 percent
Shape of areas: Irregular
Size of areas: 5 to 80 acres

Soil Properties and Qualities

Texture: Sandy or loamy over sandy materials or mixtures of sand and gravel
Depth class: Very deep
Permeability: Variable
Available water capacity: Variable
Drainage class: Well drained
Seasonal high water table: At a depth of more than 6 feet
Surface runoff: Medium
Flooding: None

Composition

Haplorthods and similar soils: 95 percent
 Contrasting inclusions: 5 percent

Inclusions

Contrasting inclusions:

- The well drained Gogebic soils in landscape positions similar to those of the Haplorthods

Use and Management

Land use: Woodland

Major management concerns: Erosion hazard, equipment limitation

Management measures:

- Because of the erosion hazard, water should be removed from logging roads by water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures.
- Because of the slope, special care is needed in laying

out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.

- Onsite investigation is needed to determine the suitability of these soils for woodland and for other specific uses.

Interpretive Groups

Land capability classification: None assigned
Woodland ordination symbol: None assigned
Michigan soil management group: None assigned
Primary habitat type: ATD
Secondary habitat type: None assigned

546C—Entic Haplorthods, esker, rolling

Setting

Landform and position on the landform: Rolling areas on eskers
Slope: 6 to 12 percent
Shape of areas: Long and narrow
Size of areas: 5 to 60 acres

Soil Properties and Qualities

Texture: Gravelly sandy loam 20 to 40 inches thick over extremely gravelly sand or extremely cobbly coarse sand
Depth class: Very deep
Permeability: Variable
Available water capacity: Variable
Drainage class: Somewhat excessively drained
Seasonal high water table: At a depth of more than 6 feet
Surface runoff: Slow
Flooding: None

Composition

Entic Haplorthods and similar soils: 95 to 100 percent
 Contrasting inclusions: 5 percent

Inclusions

Contrasting inclusions:
 • Small areas of the somewhat poorly drained, nearly level Haplaquods in the lower landscape positions.

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation

Management measures:

- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.

Interpretive Groups

Land capability classification: None assigned

Woodland ordination symbol: None assigned
Michigan soil management group: None assigned
Primary habitat type: TM
Secondary habitat type: None assigned

546D—Entic Haplorthods, esker, hilly and steep

Setting

Landform and position on the landform: Hilly areas on eskers
Slope: 18 to 35 percent
Shape of areas: Long and narrow
Size of areas: 5 to 60 acres

Soil Properties and Qualities

Texture: Gravelly sandy loam 20 to 40 inches thick over extremely gravelly sand or extremely cobbly coarse sand
Depth class: Very deep
Permeability: Variable
Available water capacity: Variable
Drainage class: Somewhat excessively drained
Seasonal high water table: At a depth of more than 6 feet
Surface runoff: Slow
Flooding: None

Composition

Entic Haplorthods and similar soils: 95 to 100 percent
 Contrasting inclusions: 5 percent

Inclusions

Contrasting inclusions:
 • Small areas of the somewhat poorly drained, nearly level Haplaquods on foot slopes and in drainageways

Use and Management

Land use: Woodland

Major management concerns: Erosion hazard, equipment limitation

Management measures:

- Because of the erosion hazard, water should be removed from logging roads by water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures.
- Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.
- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.

Interpretive Groups

Land capability classification: None assigned
Woodland ordination symbol: None assigned
Michigan soil management group: None assigned
Primary habitat type: TM
Secondary habitat type: None assigned

546F—Entic Haplorthods, esker, very steep**Setting**

Landform and position on the landform: Steep and very steep areas on eskers
Slope: 35 to 60 percent
Shape of areas: Long and narrow
Size of areas: 5 to 40 acres

Soil Properties and Qualities

Texture: Gravelly sandy loam 20 to 40 inches thick over extremely gravelly coarse sand or extremely cobbly coarse sand
Depth class: Very deep
Permeability: Variable
Available water capacity: Variable
Drainage class: Somewhat excessively drained
Seasonal high water table: At a depth of more than 6 feet
Surface runoff: Medium or rapid
Flooding: None

Composition

Entic Haplorthods and similar soils: 100 percent

Use and Management

Land use: Woodland
Major management concerns: Erosion hazard, equipment limitation
Management measures:

- Cable yarding systems are generally safer than other logging methods and result in less surface disturbance.
- Because of the slope, ordinary crawler tractors and rubber-tired skidders cannot be operated safely. As a result, special logging methods, such as yarding the logs with a cable, may be needed.
- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.

Interpretive Groups

Land capability classification: None assigned
Woodland ordination symbol: None assigned
Michigan soil management group: None assigned
Primary habitat type: TM
Secondary habitat type: None assigned

547B—Haplorthods, very deep water table, nearly level and undulating**Setting**

Landform and position on the landform: Nearly level and undulating areas on ground moraines and outwash plains
Slope: 0 to 6 percent
Shape of areas: Irregular
Size of areas: 5 to 200 acres

Soil Properties and Qualities

Texture: 8 to 48 inches of loamy material over fine sand to coarse sand
Depth class: Very deep
Permeability: Variable
Available water capacity: Variable
Drainage class: Well drained
Seasonal high water table: 6 to 10 feet below the surface at some time from November through March
Surface runoff: Slow
Flooding: None

Composition

Haplorthods and similar soils: 85 to 95 percent
 Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:

- The moderately well drained, coarse-loamy Entic Fragiorthods that have a dense subsoil; in landscape positions similar to those of the Haplorthods

Similar inclusions:

- Well drained soils that are sandy throughout

Use and Management

Land use: Woodland
Management measures:

- Because of the variable nature of these soils, onsite investigation is needed to determine the suitability for woodland and for other specific uses.

Interpretive Groups

Land capability classification: None assigned
Woodland ordination symbol: None assigned
Michigan soil management group: None assigned
Primary habitat type: TM
Secondary habitat type: None assigned

548—Humaquepts-Terric Borosaprists, nonacid, complex, frequently flooded

Setting

Landform and position on the landform: Levees on flood plains

Slope: 0 to 2 percent

Shape of areas: Long and narrow

Size of areas: 5 to 200 acres

Soil Properties and Qualities

Texture: Humaquepts—0 to 16 inches of organic material over 25 to 35 inches of loamy material underlain by sand and gravel; Terric Borosaprists—16 to 40 inches of well decomposed organic material over sandy or loamy material

Depth class: Very deep

Permeability: Variable

Available water capacity: Variable

Drainage class: Humaquepts—poorly drained; Terric Borosaprists—very poorly drained

Seasonal high water table: Humaquepts—near the surface to 1 foot below the surface at some time from November through May

Surface runoff: Very slow or ponded

Flooding: Frequent

Composition

Humaquepts and similar soils: 45 to 55 percent

Terric Borosaprists and similar soils: 45 to 55 percent

Inclusions

Similar inclusions:

- Soils that have more than 40 inches of organic material

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow hazard

Management measures:

- Equipment can be used only during dry summer months and during periods in winter when the snow cover is adequate or the soil is frozen.
- Because of wetness and low strength, special harvesting equipment is needed in areas of the Terric Borosaprists. The equipment can be used only during periods when skid roads and access roads are frozen.
- Because of wetness, severe seedling mortality, and plant competition, trees are not planted on these soils.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: None assigned

Woodland ordination symbol: None assigned

Michigan soil management group: None assigned

Primary habitat type: FMC

Secondary habitat type: None assigned

549B—Karlin-Pence complex, nearly level and undulating

Setting

Landform and position on the landform: Nearly level and undulating areas on outwash plains

Slope: 1 to 6 percent

Shape of areas: Irregular

Size of areas: 5 to 400 acres

Typical Profile

Karlin

Surface layer:

0 to 2 inches—black fine sandy loam

Subsurface layer:

2 to 3 inches—reddish gray fine sandy loam

Subsoil:

3 to 24 inches—brown, friable fine sandy loam

24 to 35 inches—yellowish red, very friable loamy sand

Substratum:

35 to 60 inches—brown sand

Pence

Organic mat:

0 to 1 inch—black, partially decomposed forest litter

Subsurface layer:

1 to 4 inches—light brownish gray fine sandy loam

Subsoil:

4 to 20 inches—dark brown, friable fine sandy loam and sandy loam

20 to 33 inches—strong brown, loose gravelly sand

Substratum:

33 to 60 inches—dark yellowish brown, stratified gravelly coarse sand and sand

Soil Properties and Qualities

Depth class: Very deep

Permeability: Karlin—moderate in the upper part and rapid in the lower part; Pence—moderately rapid in the upper part and rapid or very rapid in the lower part

Available water capacity: Low

Drainage class: Karlin—somewhat excessively drained; Pence—well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow

Flooding: None

Composition

Karlin soil and similar soils: 40 to 55 percent
 Pence soil and similar soils: 40 to 50 percent
 Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained, nearly level Haplaquods in the slightly lower landscape positions
- The moderately well drained Gogebic soils that have a dense subsoil; in landscape positions similar to those of the major soils

Use and Management

Land use: Dominant use—woodland; other uses—cropland

Woodland

Major management concerns: None

Cropland

Major management concerns: Soil blowing, water erosion, low organic matter content, droughtiness

Management measures:

- Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
- Conservation tillage, grassed waterways, cover crops, and crop rotations that include grasses or legumes help to control water erosion.
- Contour farming and contour stripcropping reduce the runoff rate and the hazard of water erosion.
- No-till farming, crop residue management, and a cropping sequence that includes green manure crops increase the organic matter content.
- A system of conservation tillage that leaves crop residue on the surface is effective in conserving moisture.
- Irrigation water should be applied at a rate that ensures optimum production but does not increase deep percolation, the runoff rate, and the hazard of erosion.
- Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.

Interpretive Groups

Land capability classification: IIIs
Woodland ordination symbol: Karlin—3A; Pence—3A
Michigan soil management group: Karlin—4a; Pence—4a-a
Primary habitat type: TM

Secondary habitat type: None assigned

549D—Karlin-Pence complex, rolling

Setting

Landform and position on the landform: Rolling areas on outwash plains

Slope: 6 to 18 percent

Shape of areas: Irregular

Size of areas: 5 to 400 acres

Typical Profile

Karlin

Surface layer:

0 to 2 inches—black fine sandy loam

Subsurface layer:

2 to 3 inches—reddish gray fine sandy loam

Subsoil:

3 to 24 inches—brown, friable fine sandy loam

24 to 35 inches—yellowish red, very friable loamy sand

Substratum:

35 to 60 inches—brown sand

Pence

Organic mat:

0 to 1 inch—black, partially decomposed forest litter

Subsurface layer:

1 to 4 inches—light brownish gray fine sandy loam

Subsoil:

4 to 20 inches—dark brown, friable fine sandy loam and sandy loam

20 to 33 inches—strong brown, loose gravelly sand

Substratum:

33 to 60 inches—dark yellowish brown, stratified gravelly coarse sand and sand

Soil Properties and Qualities

Depth class: Very deep

Permeability: Karlin—moderate in the upper part and rapid in the lower part; Pence—moderately rapid in the upper part and rapid or very rapid in the lower part

Available water capacity: Low

Drainage class: Karlin—somewhat excessively drained; Pence—well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow

Flooding: None

Composition

Karlin soil and similar soils: 40 to 55 percent
 Pence soil and similar soils: 40 to 50 percent

Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

- The moderately well drained Gogebic soils that have a dense subsoil; in landscape positions similar to those of the major soils

Use and Management

Land use: Dominant use—woodland; other uses—cropland

Woodland

Major management concerns: Equipment limitation on landings

Management measures:

- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.

Cropland

Major management concerns: Soil blowing, water erosion, low organic matter content, seasonal droughtiness

Management measures:

- Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
- Water erosion can be controlled by diversions, crop residue management, contour stripcropping, field stripcropping, cover crops, grassed waterways, conservation tillage, crop rotations, grade-stabilization structures, or a combination of these practices.
- No-till farming, crop residue management, and a cropping sequence that includes green manure crops increase the organic matter content.
- A system of conservation tillage that leaves crop residue on the surface is effective in conserving moisture.
- Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.

Interpretive Groups

Land capability classification: IVe

Woodland ordination symbol: Karlin—3A; Pence—3A

Michigan soil management group: Karlin—4a; Pence—4a-a

Primary habitat type: TM

Secondary habitat type: None assigned

549F—Karlin-Pence complex, hilly

Setting

Landform and position on the landform: Hilly areas on outwash plains

Slope: 18 to 35 percent

Shape of areas: Irregular

Size of areas: 5 to 100 acres

Typical Profile

Karlin

Surface layer:

0 to 2 inches—black fine sandy loam

Subsurface layer:

2 to 3 inches—reddish gray fine sandy loam

Subsoil:

3 to 24 inches—brown, friable fine sandy loam

24 to 35 inches—yellowish red, very friable loamy sand

Substratum:

35 to 60 inches—brown sand

Pence

Organic mat:

0 to 1 inch—black, partially decomposed forest litter

Subsurface layer:

1 to 4 inches—light brownish gray fine sandy loam

Subsoil:

4 to 20 inches—dark brown, friable fine sandy loam and sandy loam

20 to 33 inches—strong brown, loose gravelly sand

Substratum:

33 to 60 inches—dark yellowish brown, stratified gravelly coarse sand and sand

Soil Properties and Qualities

Depth class: Very deep

Permeability: Karlin—moderate in the upper part and rapid in the lower part; Pence—moderately rapid in the upper part and rapid or very rapid in the lower part

Available water capacity: Low

Drainage class: Karlin—somewhat excessively drained; Pence—well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Medium

Flooding: None

Composition

Karlin soil and similar soils: 40 to 55 percent

Pence soil and similar soils: 40 to 50 percent

Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

- The moderately well drained Gogebic soils that have a dense subsoil; in landscape positions similar to those of the major soils

Use and Management

Land use: Woodland

Major management concerns: Erosion hazard, equipment limitation

Management measures:

- Because of the erosion hazard, water should be removed from logging roads by water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures.
- Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.
- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.

Interpretive Groups

Land capability classification: VIIe

Woodland ordination symbol: Karlin—3R; Pence—3R

Michigan soil management group: Karlin—4a; Pence—4a-a

Primary habitat type: TM

Secondary habitat type: None assigned

550—Terric Borosapristis, nonacid, frequently flooded

Setting

Landform and position on the landform: Levees on flood plains

Slope: 0 to 2 percent

Shape of areas: Long and narrow

Size of areas: 5 to 200 acres

Soil Properties and Qualities

Texture: 16 to 40 inches of well decomposed organic material over sandy or loamy material

Depth class: Very deep

Permeability: Variable

Available water capacity: Variable

Drainage class: Very poorly drained

Seasonal high water table: 1 foot above to 1 foot below the surface at some time from November through May

Surface runoff: Very slow or ponded

Flooding: Frequent

Composition

Terric Borosapristis and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

- The poorly drained, nonacid, very stony Humaquepts in landscape positions similar to those of the Terric Borosapristis

Similar inclusions:

- Soils that have more than 40 inches of organic material

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, windthrow hazard, seedling mortality

Management measures:

- Because of wetness and low strength, special harvesting equipment is needed. The equipment can be used only during periods in winter when skid roads and access roads are frozen.
- Because of wetness, severe seedling mortality, and plant competition, trees are not planted in areas of these soils.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

Interpretive Groups

Land capability classification: None assigned

Woodland ordination symbol: None assigned

Michigan soil management group: None assigned

Primary habitat type: FMC

Secondary habitat type: None assigned

551A—Typic Fragiorthods, nearly level, stony

Setting

Landform and position on the landform: Nearly level areas on end moraines

Slope: 0 to 2 percent

Shape of areas: Long and narrow or irregular

Size of areas: 5 to 80 acres

Soil Properties and Qualities

Texture: 30 to 50 inches of sandy loam to very gravelly or very cobbly silt loam over loamy sand to gravelly sandy loam

Depth class: Very deep

Rock fragments on the surface: Kind—rounded stones; percentage of surface covered—0.01 to 0.1

Permeability: Variable

Available water capacity: Variable
Drainage class: Moderately well drained
Seasonal high water table: Perched at a depth of 1 to 2 feet at some time from November through May
Surface runoff: Slow
Flooding: None

Composition

Typic Fragiorthods and similar soils: 90 to 95 percent
 Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Monico soils in the slightly lower landscape positions

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, windthrow hazard

Management measures:

- Equipment can be used only during dry summer months and during periods in winter when snow cover is adequate or the soil is frozen.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

Interpretive Groups

Land capability classification: None assigned
Woodland ordination symbol: None assigned
Michigan soil management group: None assigned
Primary habitat type: AVO
Secondary habitat type: None assigned

552F—Kalkaska sand, banded substratum, hilly

Setting

Landform and position on the landform: Hilly areas on outwash plains
Slope: 18 to 35 percent
Shape of areas: Irregular
Size of areas: 5 to 200 acres

Typical Profile

Surface layer:

0 to 1 inch—very dark gray sand

Subsurface layer:

1 to 5 inches—brown sand

Subsoil:

5 to 19 inches—dark brown, very friable sand

19 to 50 inches—strong brown, friable sand

50 to 58 inches—strong brown, mottled, friable sand

Substratum:

58 to 90 inches—light brown, mottled fine sand that has bands of strong brown loamy fine sand

Soil Properties and Qualities

Depth class: Very deep

Permeability: Rapid

Available water capacity: Low

Drainage class: Somewhat excessively drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow

Flooding: None

Composition

Kalkaska soil and similar soils: 90 to 95 percent
 Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained, nearly level Haplaquods in the lower landscape positions

Similar inclusions:

- Soils that are lighter colored in the upper part of the subsoil

Use and Management

Land use: Woodland

Major management concerns: Erosion hazard, equipment limitation, seedling mortality

Management measures:

- Because of the erosion hazard, water should be removed from logging roads by water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures.
- Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.
- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.
- Planting seedlings that can withstand droughty conditions can lower the seedling mortality rate. Replanting is needed in some areas.

Interpretive Groups

Land capability classification: VIIIs

Woodland ordination symbol: 3R

Michigan soil management group: 5a

Primary habitat type: AQV

Secondary habitat type: None assigned

553D—Kalkaska loamy sand, rolling**Setting**

Landform and position on the landform: Rolling areas on ground moraines, end moraines, and outwash plains

Slope: 6 to 18 percent

Shape of areas: Irregular

Size of areas: 5 to 40 acres

Typical Profile

Surface layer:

0 to 4 inches—dark reddish gray loamy sand

Subsoil:

4 to 16 inches—dark brown, very friable sand

16 to 32 inches—brown, very friable sand

32 to 58 inches—light brown, loose sand

Substratum:

58 to 95 inches—light brown sand

Soil Properties and Qualities

Depth class: Very deep

Permeability: Rapid

Available water capacity: Low

Drainage class: Somewhat excessively drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow

Flooding: None

Composition

Kalkaska soil and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained, nearly level Haplaquods on foot slopes and in drainageways

Similar inclusions:

- Soils that are sandy loam in the upper part of the subsoil
- Areas that are underlain by fine sand at a depth of more than 40 inches

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, seedling mortality

Management measures:

- Because loose sand can interfere with the traction of wheeled equipment, logging roads should be stabilized.
- Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.

- Planting seedlings that can withstand droughty conditions can lower the seedling mortality rate. Replanting is needed in some areas.

Interpretive Groups

Land capability classification: VIs

Woodland ordination symbol: 3A

Michigan soil management group: 5a

Primary habitat type: ATD

Secondary habitat type: None assigned

554B—Alfic Fragiorthods, coarse-loamy, nearly level and undulating**Setting**

Landform and position on the landform: Nearly level and undulating areas on ground moraines

Slope: 1 to 6 percent

Shape of areas: Irregular

Size of areas: 5 to 50 acres

Reference Profile

Organic mat:

0 to 2 inches—black, partially decomposed forest litter

Surface layer:

2 to 3 inches—black fine sandy loam

Subsurface layer:

3 to 7 inches—reddish gray fine sandy loam

Subsoil:

7 to 19 inches—reddish brown, friable very fine sandy loam

19 to 30 inches—a fragipan of reddish brown and dark reddish brown, mottled, very firm very fine sandy loam and loam

30 to 40 inches—dark reddish brown, firm loam

Substratum:

40 to 60 inches—reddish brown fine sandy loam

Soil Properties and Qualities

Depth class: Very deep

Permeability: Moderate in the upper part, very slow in the fragipan, and moderate or moderately rapid in the lower part

Available water capacity: Low

Drainage class: Moderately well drained

Seasonal high water table: Perched at a depth of 1 to 2 feet at some time from October through May

Surface runoff: Slow

Flooding: None

Composition

Alfic Fragiorthods and similar soils: 5 to 10 percent

Contrasting inclusions: 90 to 95 percent

Inclusions*Contrasting inclusions:*

- The somewhat poorly drained, nearly level Haplaquods in the slightly lower landscape positions
- The very poorly drained, nonacid Borosaprists in depressions

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow hazard

Management measures:

- Equipment can be used only during dry summer months and during periods in winter when the snow cover is adequate or the soil is frozen.
- Special site preparation, such as bedding, can reduce the seedling mortality rate.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: IIe

Woodland ordination symbol: 3W

Michigan soil management group: None assigned

Primary habitat type: AVO

Secondary habitat type: None assigned

555B—Entic Haplorthods, very deep water table, nearly level and undulating**Setting**

Landform and position on the landform: Nearly level and undulating areas on outwash plains and deltas

Slope: 0 to 6 percent

Shape of areas: Irregular

Size of areas: 5 to 40 acres

Soil Properties and Qualities

Texture: 28 to 48 inches of sandy or loamy material over sand or gravelly sand

Depth class: Very deep

Permeability: Variable

Available water capacity: Variable

Drainage class: Well drained

Seasonal high water table: 6 to 10 feet below the surface at some time from November through March

Surface runoff: Slow

Flooding: None

Composition

Entic Haplorthods and similar soils: 95 to 100 percent

Contrasting inclusions: 5 to 10 percent

Inclusions*Contrasting inclusions:*

- The somewhat poorly drained, nearly level Haplaquods in the lower landscape positions

Use and Management

Land use: Woodland

- Because of the variability of these soils, onsite investigation is needed to determine the suitability for woodland and for other specific uses.

Interpretive Groups

Land capability classification: None assigned

Woodland ordination symbol: None assigned

Michigan soil management group: None assigned

Primary habitat type: TMV

Secondary habitat type: None assigned

556—Haplaquods, wet**Setting**

Landform and position on the landform: Depressions on moraines and outwash plains

Shape of areas: Irregular

Size of areas: 5 to 10 acres

Soil Properties and Qualities

Texture: Sandy or loamy material

Depth class: Very deep

Permeability: Variable

Available water capacity: Variable

Drainage class: Poorly drained

Seasonal high water table: 1 foot above to 1 foot below the surface at some time from November through May

Surface runoff: Very slow or ponded

Flooding: None

Composition

Haplaquods and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

Inclusions*Contrasting inclusions:*

- Small areas of the somewhat poorly drained Haplaquods in the slightly higher landscape positions

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow hazard

Management measures:

- The seasonal high water table restricts the use of equipment to midsummer, when the soils are dry, or

midwinter, when the soils are frozen or have an adequate snow cover.

- Site preparation methods, such as bedding, trenching, or mounding, can maximize growth and increase the seedling survival rate in new plantations.
- Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced and by selective cutting and strip cutting.

Interpretive Groups

Land capability classification: None assigned

Woodland ordination symbol: None assigned

Michigan soil management group: None assigned

Primary habitat type: PCS

Secondary habitat type: None assigned

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 Natural Resources Conservation Service.

About 65,000 acres in the county, or about 8 percent of the total acreage, meets the soil requirements for prime farmland. The map units in Iron 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 as 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 to prevent soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, foresters, and others collect extensive field data about the nature and behavioral 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 recreational facilities; and for wildlife habitat. It can be used to identify the potentials and 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 all or part of 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.

The soils in the survey area are assigned to various interpretive groups at the end of each map unit description and in some of the tables. The groups for each map unit also are shown under the heading

“Interpretive Groups,” which follows the tables at the back of this survey.

Crops and Pasture

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 Natural Resources Conservation Service is explained; 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 the heading “Detailed Soil Map Units.” Specific information can be obtained from the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

Field crops commonly grown in the county are birdsfoot trefoil, red clover, alfalfa, bromegrass, oats, timothy, corn, and barley. Small acreages of strawberries, blueberries, raspberries, potatoes, and cabbage are also grown, and there are a few small apple orchards.

The annual number of frost-free days ranges from about 60 in the northwestern part of the county to about 110 in the southeast corner (Michigan Department of Agriculture, 1990). Crops that are adapted to short, cool growing seasons and the strongly acid soils should be selected. The crops that have potential for local and specialized markets include cabbage, buckwheat, apples, cranberries, raspberries, blackberries, blueberries, various herbs, canola, triticale, rape, kale, swedes, and turnips.

The production of crops can be improved if crop varieties are carefully selected and if the choice of growing sites includes consideration of soil conditions, such as water-holding capacity, drainage, maximum sun exposure, southern aspect, and cold air drainage.

The main management concerns affecting crop

production in the county include soil reaction, low fertility levels, the hazard of erosion, wetness, stoniness, droughtiness, the frost hazard, tilth, and the short, cool growing season.

Many of the soils in Iron County are acid and are low in natural fertility. Applications of lime and other fertilizers in a well managed program can correct both of these problems. On all soils, the amount of lime and fertilizer applied should be based on the results of laboratory soil tests. The Cooperative Extension Service can help to determine the amounts of fertilizer and lime that are needed by different crops for the desired yields.

Water erosion and *soil blowing* are hazards if the soils are not adequately protected. Vegetation and crop residue can provide a protective cover and thus reduce the hazard of erosion.

Erosion is damaging for several reasons. The surface layer is generally the most fertile part of the soil. As the surface layer is eroded away, productivity is reduced, plants become stunted, the seedling mortality rate increases, and the soil becomes more susceptible to further erosion. Erosion can also result in the sedimentation of culverts, drainage ditches, and streams. Sediments from cropland that enter streams and lakes commonly contain fertilizer and pesticides, which can further reduce water quality and alter the aquatic habitat.

The erodibility of a soil is dependent on surface texture, the length of slopes, and the slope gradient. Generally, as the slope increases the hazard of water erosion also increases. Soils that have clayey, silty, and loamy textures are more susceptible to water erosion than sandy soils. In Iron County, some of the soils that are susceptible to water erosion are Wabeno silt loam, Saronia fine sandy loam, Stambaugh silt loam, Padus fine sandy loam, and Sundog very fine sandy loam. Soils that have a sandy surface layer are susceptible to soil blowing. In Iron County, these include Vilas loamy sand, Au Gres sand, and Croswell sand.

Erosion-control practices provide protective cover, reduce the runoff rate, increase the rate of water infiltration, and reduce the amount of sediment that enters and clogs waterways.

Conservation tillage or minimum tillage systems leave crop residue on the surface. These tillage systems include crop rotations that maintain a sufficient amount of topsoil. Crop residue management maintains and enhances topsoil by incorporating species and varieties that produce high yields of residue. For example, grasses and grains produce more residue than legumes.

Green manure crops are grown explicitly for the purpose of improving fertility and maintaining the content of organic matter. They are incorporated into

the soil while still green. Red clover and rye grass are commonly used as green manure crops. Any crop that is easily established, grows rapidly, and is easily eradicated may be used as a green manure crop. Legumes that are planted as a green manure crop can add nitrogen to the soil, thus reducing the need for nitrogen fertilizer.

Cover crops are seeded during final cultivation of a crop. After the main crop is harvested, the cover crop provides winter cover for erosion control. The cover crop retains nutrients that otherwise might be leached downward into the soil. Plants used as cover crops should have a growth period that allows them to reach maturity after the cash crop is removed.

Applications of animal manure can enhance topsoil, organic matter content, and fertility. Excessive amounts of agricultural waste can result in contamination of surface water and thus should be avoided in areas where the land slopes toward streams. Injection of manure below the soil surface can be effective in preventing the contamination of streams. Excessive application rates can also result in the contamination of ground water.

Contour cross-slope stripcropping involves growing crops in strips established on the contour or across the slope and arranged so that strips exposed to sheet and rill erosion are alternated with strips having protective cover. Cross-wind stripcropping involves growing crops in strips established at right angles to the prevailing wind and arranged so that strips exposed to wind erosion are alternated with strips having protective cover.

Grassed waterways are used to prevent the formation of gullies in areas where water is transported downslope in a concentrated flow. Subsurface drainage tile can be installed beneath the waterway to remove excess water as long as wetland conservation laws are not violated. This internal drainage enhances vegetative growth in the waterway and provides drier conditions for equipment use during field activities. Rocked crossings can also be built across waterways to provide convenient access to various fields.

Soil blowing, or wind erosion, can be a hazard on all unprotected soils, especially soils that have a sandy surface layer, such as Vilas, Keweenaw, Au Gres, and Croswell soils. Drained and unprotected areas of organic soils are also highly susceptible to soil blowing. Maintaining vegetative cover, applying surface mulch, and establishing field windbreaks of adapted trees and shrubs planted at right angles to the prevailing wind can reduce the hazard of soil blowing.

Wetness is a major management concern in many areas used for crops and pasture. Some soils are excessively wet because of a high water table resulting

from snowmelt, rain, floodwater, or landscape position. These wet soils are generally in low-lying areas and in depressions. Seed germination, plant growth, and the use of equipment can be adversely affected unless the excess water is removed. Soils that have a high water table are often subject to low soil temperature and a frost hazard, which can also hinder production.

Very poorly drained and poorly drained soils have a water table near or above the surface for much of the year and are generally not suited to crop production. Very poorly drained soils in Iron County include Cathro, Greenwood, Merwin, and Lupton soils. These soils have thick accumulations of organic material, and in undrained areas they have obvious wetland characteristics. Poorly drained soils include Waucedah, Minocqua, Kinross, and Witbeck soils.

Somewhat poorly drained soils may have a water table at a depth of 6 to 12 inches during excessively wet periods. Au Gres, Solona, Net, Channing, Gaastra, and Beechwood soils are examples of somewhat poorly drained soils.

Moderately well drained soils may have a water table at a depth of 12 to 30 inches during excessively wet periods. Champion and Wabeno soils that have slopes of less than 18 percent are examples. These soils have restricted permeability at a depth of about 24 inches. Moderately well drained soils that do not have a layer with restricted permeability include Fence soils that have slopes of less than 6 percent and Crowell and Manitowish soils. Small areas of wetter soils are commonly included with moderately well drained soils.

The design of surface and subsurface drainage systems varies with the kind of soil. Because of the frost hazard in areas of poorly drained and very poorly drained soils, most drainage systems have been installed in areas of somewhat poorly drained and moderately well drained soils. Surface drainage systems are often the most cost effective. Improving natural waterways, removing drainage obstructions, and installing diversions to redirect surface runoff can greatly improve drainage. Deeper drainage ditches can function well if adequate outlets are available. Subsurface tile drainage systems can be used to lower the water table; however, some soils have a fragipan that can interfere with tile drainage. Information about the design of drainage systems and the laws that protect wetlands is available from local offices of the Natural Resources Conservation Service and from local conservation districts.

Droughtiness during dry periods is a management concern in areas of sandy soils that have a low available water capacity. Crops may wither during the summer unless irrigation water is applied or drought-resistant crops are selected for planting. Examples of

droughty soils in Iron County are Karlin, Vilas, Crowell, Keweenaw, Pence, and Manitowish soils. The moisture-holding capacity of these soils can be improved by increasing the organic matter content. No-till farming also conserves soil moisture.

The *frost hazard* can injure sensitive crops. Frost can occur in spring, in fall, and, occasionally, in summer. Freezing air from the higher altitudes falls because it is heavier than the lower warm air. The coldest air travels downslope to the lowest areas and accumulates, causing frost in lowlands and on flood plains.

The short, cool *growing season* limits the time during which crops can grow and mature. Cold soils inhibit seed germination. The aspect, or the direction in which a slope faces, has an important effect on soil temperature and crop growth. Soils on slopes that have a southern aspect warm up considerably more rapidly in the spring than those on slopes that face in other directions. Crops germinate and grow faster because of increased sunlight and soil temperatures. However, soils on south-facing slopes can lose soil moisture and become droughty earlier during the drier years. The effects of early germination and growth can be harmful to frost-sensitive plants.

Soil tilth affects the germination of seeds and the infiltration of water into the soils. It also influences the amount of water available to crops. Soils that have good tilth are granular and porous. In areas where tilth is poor, a crust may form on the surface after periods of intense rainfall. In soils that have a loamy surface layer, additions of organic material may be needed to maintain tilth. No-till methods of pasture and hayland seeding can maintain good soil tilth and conserve soil moisture.

Operating machinery or allowing grazing in areas of wet, loamy soils can result in compaction of the surface layer. Productivity is reduced on compacted soils because of increased soil density, which inhibits root penetration, and decreased pore space in the root zone, which reduces the amount of air and water available to plant roots.

Pasture management includes proper applications of fertilizer and lime. The applications should be based on the results of soil tests. Pasture rotation, deferred grazing, adequate water supplies for livestock, and the maintenance of the key forage species are other important aspects of pasture management. Many of the soils used for pasture are slowly permeable and dry slowly in the spring and after heavy rains. In areas of these soils, grazing during wet periods causes compaction and reduces yields. If possible, areas of better drained soils should be used during wet periods. Key forage species include birdsfoot trefoil and brome grass on medium textured, moderately well drained soils; alfalfa, red clover, brome grass, and

orchardgrass on coarse textured, well drained soils; and mixtures of birdsfoot trefoil and reed canarygrass on wet soils. For optimum production, alfalfa requires a nearly neutral soil. Alfalfa generally grows well in areas of Trenary and Oconto soils because of increased alkalinity at greater depths. In all pasture mixtures, legumes require proper applications of inoculant at planting time so that the nitrogen-forming bacteria can form root nodules.

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 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 Natural Resources Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops (USDA, 1961). 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 or 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, 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."

At the end of each map unit description under the heading "Detailed Soil Map Units," the Michigan soil management group is listed. The soils in each map unit are assigned to a group according to the dominant texture, the drainage class, and the main management concerns (Mokma and others, 1978). More detailed information about these groups is available from the local office of the Michigan State University Cooperative Extension Service.

Woodland Management and Productivity

Dennis Robinson, technical representative, Michigan Department of Agriculture, helped prepare this section.

The major concerns associated with use and management of woodland are discussed in this section. Also, the major forest habitat types are described and related to the different kinds of soils in the survey area.

Woodland makes up about 670,000 acres in Iron County, or about 90 percent of the total acreage. Approximately 62 percent of the forest land is privately owned. Federal, State, and local government agencies control more than 256,000 acres. A number of forest industry companies and other corporations own large acreages of woodland. Many small units that are owned by individuals also make up an important part of the forest resource of Iron County.

Woodland is the dominant land use on all but a few of the soils in the survey area. Many upland soils support northern hardwoods, such as sugar maple, red maple, basswood, and yellow birch. Black cherry, white ash, red oak, balsam fir, hemlock, white pine, white birch, and white spruce are also in some stands. Large areas support aspen or mixed northern hardwoods and aspen. Scattered areas support stands of jack pine, red pine, and white pine. Stands on the wetter soils are predominantly red maple, quaking aspen, balsam poplar, paper birch, and balsam fir.

Wooded areas in swamps are mostly balsam fir, black spruce, northern whitecedar, and tamarack. Red maple, quaking aspen, paper birch, and black ash are in some stands.

Erosion damage may occur as a result of site preparation and cutting operations where the soil is exposed along logging roads, skid roads, and fire lanes and in landing areas. Fire can also leave the soils susceptible to erosion. Erosion is generally a hazard on forest land if the slope is 18 percent or more. Establishing logging roads and skid roads on the contour helps to control erosion.

Soil wetness results from a high water table, flooding, or ponding. Excessive wetness increases the seedling mortality rate, limits the use of equipment, increases the invasion or growth of undesirable plants following harvest, and increases the likelihood of windthrow by restricting the rooting depth of some trees. Ruts form easily when wheeled skidders are used during wet periods. Deep ruts tend to restrict lateral drainage, damage tree roots, and alter soil structure and can result in a change in species composition and reduced yields. Wetness can be overcome by restricting woodland management activities to periods when the soils are dry or frozen or have adequate snow cover.

Droughtiness can also cause seedling mortality. Steep, south- and west-facing slopes may be especially droughty because of high temperatures and evaporation on these sites. Planting during moist soil conditions can reduce seedling losses. Seedling survival during dry seasons can be improved by planting large, vigorous nursery stock if natural regeneration is undesirable or insufficient. Special site preparation, such as furrowing, may also be needed. Using containerized planting stock may be necessary on very dry sites.

Slope, stoniness, and rock outcrops can limit the use of forestry equipment. Slope of 18 percent or more generally limits the use of equipment in logging areas and on skid roads and logging roads. Establishing logging roads and skid roads on the contour helps to overcome the slope. On the very steep slopes, track-type harvesting equipment cannot be operated safely and other systems must be used. Slope also influences the location of landings and log-handling areas. Level to undulating areas are the best locations for such sites. Stones, rock outcrops, and shallow bedrock can also be obstacles to the construction of logging roads. The location of logging roads should be carefully planned.

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 in the spring thaw period and during periods of high rainfall. 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, and fire lanes and in 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 and season of use are 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 volumes listed in the table are determined from standard yield tables as referenced in the Natural Resources Conservation Service National Forestry Manual (USDA).

The first species listed under *common trees* for a soil is the indicator species for that soil. It generally is the most common species on the soil and is 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 logging roads. Limitations are given for the most limiting season and for the preferred season. The *most limiting season* in this survey area 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 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 the logs are dragged or hauled from the stump to a log landing.

Landings are areas where logs are assembled for transportation (fig. 8). Wheeled equipment may be used more frequently in these areas than in any other areas affected by logging.

Logging roads are access roads leading from primary or surfaced roads to the logging areas. The logging roads serve as transportation routes for wheeled logging equipment and logging trucks. Generally, they are unpaved roads. Some are graveled.

Forest Habitat Types

The information in this section is derived from a field guide developed for the Upper Peninsula of Michigan and for northeastern Wisconsin by Cooperative Research on Forest Soils (CROFS) and partially funded by the McIntire Stennis Act and Champion International (Coffman and others, 1980). The system of habitat classification used in the guide is based on the concept that plants occur in predictable patterns or communities and that these plant communities reflect differences in site characteristics.

Besides identifying the various habitat types by means of vegetative keys, the guide also provides suggested forest management practices for most of the habitat types. The successional stages depend largely on the amount and kind of forest disturbance. They include the succession after logging in the original climax stands, the succession after logging in the second-growth stands, and the succession in stands that have been both logged and burned.

The guide provides the suggested forest management for each of the successional stages. This management includes methods of thinning, harvesting, and site preparation and measures that improve regeneration of the stands. The potential productivity, in terms of a site index and the mean annual volume in

cubic feet per acre per year, is given for most of the habitat types.

Habitat types have been determined for each map unit in the survey area. The primary habitat type is the one that is most common for the map unit. The secondary habitat type is less common. The following paragraphs describe the habitat types in the survey area. They provide information about the potential climax species, some of the common understory species, and the potential productivity, if known, of the habitat type.

AOC—Acer-Osmorhiza-Caulophyllum habitat type. This habitat type has a potential climax overstory dominated by sugar maple. Other species include eastern hemlock and American basswood. American elm, white ash, and eastern hophornbeam are in some areas. The dominant ground flora includes spinulose woodfern, blue cohosh, sweet cicely, common ladyfern, smooth yellow violet, Canada white violet, and downy yellow violet. The potential productivity for northern hardwoods is high.

AQV—Acer-Quercus-Vaccinium habitat type. This habitat type has a potential climax overstory dominated by red maple and northern red oak. Other species include eastern hemlock, eastern white pine, balsam fir, and white spruce. The dominant ground flora includes lowbush blueberry, Canada blueberry, brackenfern, wintergreen, bigleaf aster, and hazelnut. The potential productivity is moderately low for northern hardwoods, moderate for aspen, and moderately high for red pine and jack pine.

ATD—Acer-Tsuga-Dryopteris habitat type. This habitat type has a potential climax overstory dominated by sugar maple. Other species include eastern hemlock and American basswood. Yellow birch, red maple, and American elm are in some areas. The dominant ground flora includes spinulose woodfern, rosy twistedstalk, Solomons seal, scarlet elder, and Canada mayflower. The potential productivity is moderately high for northern hardwoods and high for aspen. The potential productivity for red pine plantations is high if plant competition is controlled.

ATD-CI—Acer-Tsuga-Dryopteris habitat type, Circaea-Impatiens phase. This habitat type has a potential climax overstory dominated by sugar maple. Other species include eastern hemlock and American basswood. Yellow birch, red maple, and American elm are in some areas. The dominant ground flora includes spinulose woodfern, rosy twistedstalk, Solomons seal, scarlet elder, Canada mayflower, jewelweed, and alpine circaea. The potential productivity is moderately high for northern hardwoods and high for aspen. The potential productivity for red pine plantations is high if plant competition is controlled.



Figure 8.—A large log landing in a forest clearing near a major all-season highway.

AVO—Acer-Viola-Osmorhiza habitat type. This habitat type has a potential climax overstory dominated by sugar maple. Other species include American basswood, white ash, yellow birch, eastern hophornbeam, eastern hemlock, and American elm. The dominant ground flora includes Canada white violet, sweet cicely, spinulose woodfern, ladyfern, Solomons seal, and rosy twistedstalk. The potential productivity is high for northern hardwoods and aspen. It also is high for red pine plantations if plant competition is controlled.

AVO-CI—Acer-Viola-Osmorhiza habitat type, Circaea-Impatiens phase. This habitat type has a potential climax overstory dominated by sugar maple. Other species include American basswood, white ash, yellow birch, eastern hophornbeam, eastern hemlock, and American elm. The dominant ground flora includes Canada white violet, sweet cicely, spinulose woodfern, ladyfern, Solomons seal, rosy twistedstalk, jewelweed, and alpine circaea. The potential productivity is high for northern hardwoods and aspen. It also is high for red pine plantations if plant competition is controlled.

FI—Fraxinus-Impatiens habitat type. This habitat type has a potential climax overstory dominated by white ash

and red maple. Other species include sugar maple, black ash, and balsam fir. The dominant ground flora includes jewelweed, sedge, alpine circaea, spinulose woodfern, ladyfern, scarlet elder, and field mint. The potential productivity for northern hardwoods is moderate.

FMC—Fraxinus-Mentha-Carex habitat type. This habitat type has a potential climax overstory dominated by black ash and American elm. Other species include red maple and balsam fir. The dominant ground flora includes sedge, field mint, speckled alder, and jewelweed.

PCS—Picea-Chamadaphne-Sphagnum habitat type. This habitat type has a potential climax overstory dominated by black spruce. Other species include tamarack and northern whitecedar. The dominant ground flora includes leatherleaf, bog rosemary, pale laurel, sphagnum, Labrador tea ledum, sedge, and Canada blueberry.

TM—Tsuga-Maianthemum habitat type. This habitat type has a potential climax overstory dominated by eastern hemlock, sugar maple, and red maple. Other species include yellow birch, white spruce, balsam fir,

eastern white pine, northern red oak, northern whitecedar, and American basswood. The dominant ground flora includes Canada mayflower, brackenfern, sedge, American starflower, and wild sarsaparilla. The potential productivity is moderate for northern hardwoods, moderately high for aspen, and high for red pine and jack pine.

TMC—Tsuga-Maianthemum-Coptis habitat type. This habitat type has a potential climax overstory dominated by eastern hemlock and red maple. Sugar maple and yellow birch are common. Other species include balsam fir, white spruce, and northern whitecedar. The dominant ground flora includes Canada mayflower, goldthread, yellow beadleily, bunchberry dogwood, American starflower, and spinulose woodfern. The potential productivity is moderate for northern hardwoods and aspen.

TMC-D—Tsuga-Maianthemum-Coptis habitat type, Dryopteris phase. This habitat type has a potential climax overstory dominated by eastern hemlock and red maple. Sugar maple and yellow birch are common. Other species include balsam fir, white spruce, and northern whitecedar. The dominant ground flora includes Canada mayflower, goldthread, yellow beadleily, bunchberry dogwood, American starflower, spinulose woodfern, long beechfern, oakfern, and Solomons seal. The potential productivity is moderate for northern hardwoods and aspen.

TMC-Vac—Tsuga-Maianthemum-Coptis habitat type, Vaccinium phase. This habitat type has a potential climax overstory dominated by eastern hemlock and red maple. Sugar maple and yellow birch are common. Other species include balsam fir, white spruce, and northern whitecedar. The dominant ground flora includes Canada mayflower, goldthread, yellow beadleily, bunchberry dogwood, American starflower, Canada blueberry, lowbush blueberry, and spinulose woodfern. The potential productivity is moderate for northern hardwoods and aspen.

TMV—Tsuga-Maianthemum-Vaccinium habitat type. This habitat type has a potential climax overstory dominated by eastern hemlock and red maple. Other species include sugar maple, eastern white pine, balsam fir, white spruce, and northern red oak. The dominant ground flora includes Canada blueberry, wild sarsaparilla, brackenfern, Canada mayflower, lowbush blueberry, yellow beadleily, and wood betony. The potential productivity is moderate for northern hardwoods, moderately high for aspen, and high for red pine and jack pine.

TTS—Tsuga-Thuja-Sphagnum habitat type. This habitat type has a potential climax overstory dominated by eastern hemlock and northern whitecedar. Other species include balsam fir, black spruce, and red

maple. The dominant ground flora includes sphagnum, goldthread, bunchberry dogwood, sedge, Canada mayflower, American starflower, and wood sorrel.

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 Natural Resources Conservation Service or the Cooperative Extension Service or from a commercial nursery.

Recreation

Recreation is a major land use in Iron County. Much of the land in the county is used for extensive recreational activities, such as fishing, hunting, sightseeing, and observation of wildlife and plants. Winter recreational activities include cross-country skiing and snowmobiling. Some areas are used for intensive recreational activities. These include campgrounds, picnic areas, playgrounds, hiking trails, downhill skiing areas, and golf courses. As population and costs of land ownership increase, changes in land use will be likely. These changes may include more land being used 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 recreational uses by the duration and intensity of flooding and the season when flooding occurs. In planning recreational 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 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.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

Wildlife Habitat

Lynn C. Sampson, biologist, Natural Resources Conservation Service, helped prepare this section.

The variety of wildlife species in an area depends upon complex relationships between soil, water, and vegetation. Wildlife populations are in balance with the essential elements of habitat, including food, cover, and water.

Habitat for wildlife in Iron County is diverse and ranges from heavily wooded areas to open farmland. Woodland habitats include lowland conifer (whitecedar, balsam fir, black spruce, tamarack), lowland hardwood (black ash, red maple), upland hardwood (sugar maple, American basswood, northern red oak), and aspen. Iron County has many streams and inland lakes and wetland areas that support diverse populations of fish and wildlife. Wetland habitat includes large areas of lowland shrub (speckled alder, sweet gale, dwarf birch) and acid bogs (leatherleaf, Labrador tea) and smaller areas of marsh.

Before European settlement, black bear, mountain lions, caribou, moose, and timber wolf roamed the survey area. The marten and fisher were abundant in the forests. Because of logging and agricultural development starting in the middle 1800's, species adapted to second-growth forest, brushy edges, and agricultural areas became abundant. Populations of white-tailed deer, red fox, and raccoons increased.

The heavily wooded areas in the county provide important habitat for white-tailed deer, ruffed grouse, and eastern wild turkey. These areas also provide food and cover for black bear, raccoons, skunks, tree squirrels, grosbeaks, warblers, and woodpeckers. The farmed areas and associated idle areas of grass and brush are inhabited by coyote, woodchuck, red fox, raccoon, hawks, owls, and numerous songbirds. The wooded streams and diverse wetlands provide habitat for blue herons, green herons, bald eagles, belted kingfishers, woodcock, marsh hawks, beaver, and mink.

The streams and lakes of Iron County support good populations of sunfish, perch, largemouth bass, smallmouth bass, walleye, northern pike, and bullheads. The rivers and streams provide an abundance of trout.

The plant and animal communities of Iron County include many species recognized by the State of Michigan as rare, threatened, or endangered. These species include the common loon, bald eagles, osprey, red-shouldered hawk, marten, and assiniboia sedge.

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 flooding. Soil temperature and soil moisture are also considerations. Examples of grain

and seed crops are buckwheat, corn, wheat, sorghum, millet, oats, and rye.

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, flooding, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are orchardgrass, timothy, brome grass, 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 flooding. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bunchberry dogwood, goldenrod, wild cicely, lambsquarters, and dandelion.

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, maple, apple, hawthorn, dogwood, raspberry, 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 swamp milkweed, spotted joe pyeweed, wild rice, marsh marigold, 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 sharp-tailed grouse, kestrel, 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, 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. Ratings are given for 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 should 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 evaluate the potential of areas for residential, commercial, industrial, and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and 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 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 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, shrinking and swelling, and organic layers can cause the movement of footings. A high water table, depth to bedrock, 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, 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, and the available water capacity in the upper 40 inches 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 landfill. 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, and flooding affect absorption of the effluent. Large stones and bedrock 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, flooding, large stones, and content of organic matter.

Excessive seepage resulting from rapid permeability in 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 and bedrock 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 should be considered.

The ratings in table 14 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock, 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 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 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 or the water table to permit revegetation. The soil material used as the 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 to 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 have a water table at a depth of less than 1 foot. They 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. They 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 high 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, terraces and diversions, 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, 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, permeability of the aquifer, and quality of the water as inferred from the salinity of the soil. 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 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 the potential for frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts,

sodium, and sulfur. Availability of drainage outlets is not considered in the ratings.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to control erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of soil blowing or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

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 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.

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