



**BUREAU OF WATERSHED MANAGEMENT
INTERIM GUIDANCE**

**NUTRIENT MANAGEMENT - CAFO APPLICATIONS ON SHALLOW
GROUNDWATER SOILS**

March 2009

Description: Ch. NR 243, Wis. Adm. Code, restrictions CAFO manure and process wastewater applications to fields that have less than 24 inches of soil over groundwater or bedrock.

This guidance describes how permittees and their consultants can identify and determine whether to use these fields as well as how Department staff can review fields for compliance with this requirement.

This document is intended solely as guidance, and does not contain any mandatory requirements except where requirements found in statute or administrative rule are referenced. This guidance does not establish or affect legal rights or obligations, and is not finally determinative of any of the issues addressed. This guidance does not create any rights enforceable by any party in litigation with the State of Wisconsin or the Department of Natural Resources. Any regulatory decisions made by the Department of Natural Resources in any matter addressed by this guidance will be made by applying the governing statutes and administrative rules to the relevant facts.

INTERIM GUIDANCE

Background

NR 243.14(2)(b)(7) requires CAFO manure or process wastewater applications may not be applied on areas of a field with a depth to groundwater or bedrock of less than 24 inches.

This restriction applies only to those portions of field that have less than 24 inches of separation to groundwater. If portions of a field have at least 24" of soil, these portions of the field are not subject to the prohibition (i.e., there is no de minimus amount of field that falls into/out of a prohibition area that would allow the entire field to be determined to not meet/meet the restriction).

NRCS Conservation Planning Technical Note WI-1

This document (Appendix 1) identifies soils with high potential for groundwater contamination. It places restrictions on 'w' type soils. The 'w' symbol indicates the soil is very poorly and poorly drained has an apparent water table that is less than 12 inches from the surface for any duration at any time of the year. Accordingly, 'w' soils indicate, by definition, where the depth to groundwater may also be within 24 inches of the field surface for any duration at any time of the year.

Tech Note WI-1 link (Sept 2007): <http://www.wi.nrcs.usda.gov/technical/technotes.html>

NRCS Soil Description for 'w' soils

NRCS soil descriptions provide more detailed information for individual soils, including 'w' soils. Each description contains a category entitled DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY. This category describes the depth to water table (groundwater) for specific time periods. Here are two examples:

Example 1 - Poorly drained. An apparent seasonal high water table is at 15 cm (0.5 foot) above the surface to 31 cm (1.0 foot) below the surface at some time during spring in most years.

Example 2 - Very poorly drained. Depth to the seasonal high water table ranges from 2 foot above the surface in ponded phases to 1 foot below the surface from September to June.

For specific NRCS soil descriptions, use NRCS Soil Description Search link (click on soil series name search): <http://soils.usda.gov/technical/classification/osd/index.html>

NRCS soil description, groundwater depth factors and NR 243 compliance

The NRCS soil descriptions, however, are not regulatory. They are general guidance provided by NRCS for general nutrient management purposes. *The actual depth to groundwater on a specific day or under specific conditions may vary from the NRCS narrative soil descriptions.*

The following factors influence groundwater depth:

- Soil type(s) and moisture content.
- Field topography.
- Weather patterns (wet or dry seasons).
- Drainage systems (ditches and drain tiles).
- Crop and Tillage types.

NR 243.14 requires manure applications to fields meet the depth to groundwater requirement **on a field by field basis at the time of application.** The steps described below provide permitted CAFO farms some methods to demonstrate compliance with the NR243 depth to groundwater requirement. Please note, this guidance does not preclude a CAFO farm from submitting or implementing alternative methods to this guidance*.

* = Alternative methods do not become effective until the department has reviewed and approved the method.

Interim guidance for shallow groundwater soils

- (1) For each field listed in farm's Nutrient Management Plan (NMP), identify and map all 'w' soil units using tools below. Keep with NMP.**

Web Soil Survey - <http://websoilsurvey.nrcs.usda.gov/app/>

Tech Note WI-1 (Appx 1)- <http://www.wi.nrcs.usda.gov/technical/technotes.html>

- (2) For each field, document the NRCS Soil Series description for all 'w' soil units using link below. Keep with NMP. Use DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY description to determine depth to water table time period(s).**

NRCS Soil Description - <http://ortho.ftw.nrcs.usda.gov/cgi-bin/osd/osdname.cgi>

- (3) If possible, avoid applying manure or process wastewater to areas of fields with 'w' soils during shallow groundwater time periods listed in NRCS soil description(s). If avoidance is not possible, follow steps 4-6 below.**

- (4) Before any application, inspect the 'w' soil section(s) of the field and answer the following question: Are 'w' soil sections of field 'idle' - Y or N?**

For purposes of this guidance, "idle" means: the 'w' soil section(s) of field show evidence of hydric soils and exhibit: (1) Wetland vegetation (woody vegetation, shrubs, grasses) or (2) Abandoned condition (e.g., no crops or evidence of recent crops for at least two years).

- i. If Y – no application; locate alternative acreage.**
- ii. If N – go to Step 4.**

- (5) Before any application, demonstrate 'w' soil sections of field do not have a groundwater depth of less than 24 inches.**

- i. If Y– apply manure and follow all other NR243.14 manure spreading requirements.**
- ii. If N– no application; locate alternative acreage; or apply at time when groundwater depth is greater than 24 inches.**

For purposes of this guidance, 'demonstrate' means one of the following options:

- (1) Locate drain tile(s) on the field with 'w' soils units. Determine drain tile(s) are functioning and tile depth is 24 inches or greater from the surface of the field. If drain tile(s) meet criteria above, complete application and follow all other NR243 spreading requirements (e.g., preventing drain tile discharges to surface waters).
- (2) Excavate at least two "representative" soil pits within at least one 'w' soil area on the field that is five acres or less in size* (using mechanical soil auger or manual hand tools) to a depth of at least 30 inches. After at least one hour, observe if the water table is below 24 inches of surface. If both pits (for each five acre area) meet the criteria above, refill each pit, complete application and follow all other NR243 spreading requirements.

*– When 'w' soil area on field is greater than five acres in size, excavate additional soil pits so a ratio of two pits for each 5 acre sized 'w' soil unit is met.

For purposes of this guidance, "representative" means choosing locations within a 'w' soil area of field that reflects the overall structure and characteristics of the 'w' soil unit.

- (6) Document steps taken at each field with 'w' soil units in WPDES permit daily and annual spreading reports.**

AdA

LOCATION ALLENDALE

MI+MN WI

Established Series

Rev. RWJ-WEF-LMC

08/2012

ALLENDALE SERIES

The Allendale series consists of very deep, somewhat poorly drained soils that formed in sandy sediments and in the underlying clayey lacustrine deposits or till on lake basins, lake terraces, lake plains, outwash plains, and ground moraines. Slope ranges from 0 to 12 percent. Mean annual precipitation is about 787 mm (31 inches), and mean annual temperature is about 6.1 degrees C (43 degrees F).

TAXONOMIC CLASS: Sandy over clayey, mixed, semiactive, frigid Alfic Epiaquods

TYPICAL PEDON: Allendale loamy sand, on a west-facing, 2 percent slope in a forested area. (Colors are for moist soil unless otherwise stated.)

A--0 to 8 cm (3 inches); very dark gray (10YR 3/1) loamy sand, gray (10YR 5/1) dry; very weak medium granular structure; very friable; slightly acid; abrupt smooth boundary. [2.5 to 13 cm (1 to 5 inches) thick]

E--8 to 25 cm (3 to 10 inches); gray (10YR 6/1) sand, light brownish gray (10YR 6/2) dry; single grain; loose; moderately acid; abrupt irregular boundary. [0 to 25 cm (10 inches) thick]

Bhs--25 to 33 cm (10 to 13 inches): dark brown (7.5YR 3/2) sand; weak coarse subangular blocky structure; very friable; few fine prominent strong brown (7.5YR 5/6) masses of oxidized iron throughout; moderately acid; gradual wavy boundary. [0 to 13 cm (5 inches) thick]

Bs1--33 to 41 cm (13 to 16 inches): brown (7.5YR 4/4) sand; single grain; loose; common medium distinct grayish brown (10YR 5/2) iron depletions throughout; moderately acid; gradual wavy boundary.

Bs2--41 to 66 cm (16 to 26 inches): yellowish brown (10YR 5/6) sand; single grain; loose; common medium distinct brown (10YR 5/3) masses of oxidized iron throughout; common medium prominent grayish brown (10YR 5/2) iron depletions throughout; slightly acid; abrupt wavy boundary. [Combined thickness of the Bs horizon is 0 to 64 cm (25 inches).]

E'--66 to 71 cm (26 to 28 inches); pale brown (10YR 6/3) sand; single grain; loose; slightly acid; abrupt irregular boundary. [0 to 20 cm (8 inches) thick]

2Bt--71 to 86 cm (28 to 34 inches); brown (7.5YR 5/4) clay; ped coatings and crack fillings of pale brown (10YR 6/3) sand in upper 5 to 10 cm (2 to 4 inches); moderate fine angular blocky structure; very firm; common medium prominent yellowish brown (10YR 5/8) masses of oxidized iron throughout; common medium faint pale brown (10YR 6/3) iron depletions throughout; slightly acid; abrupt wavy boundary. [10 to 82 cm (4 to 32 inches) thick]

2C--86 to 152 cm (34 to 60 inches); brown (7.5YR 5/4) clay; weak fine angular blocky fragments; very firm; common medium distinct pinkish gray (7.5YR 6/2) and prominent gray (N 6/) iron depletions; strongly effervescent; moderately alkaline.

TYPE LOCATION: Arenac County, Michigan; about 2 1/2 miles north of Standish; 2220 feet north and 2340 feet west of the southeast corner of sec. 26, T. 19 N., R. 4 E.; USGS Omer SW, MI topographic quadrangle; lat. 44 degrees 01 minute 03 seconds N. and long. 83 degrees 57 minutes 21 seconds W., NAD 27.

RANGE IN CHARACTERISTICS:

Depth to the argillic horizon: 51 to 102 cm (20 to 40 inches)

Depth to carbonates: 51 cm (20 inches) to greater than 152 cm (60 inches)

A horizon:

Hue: 7.5YR or 10YR, or is neutral

Value: 2, 2.5, or 3

Chroma: 0 to 2, or is neutral

Texture: sand, loamy sand, fine sand, loamy fine sand, sandy loam, or fine sandy loam

Rock fragment content: 0 to 8 percent gravel

Reaction: extremely acid to neutral

Ap horizon, where present:

Hue: 7.5YR or 10YR

Value: 2 to 4

Chroma: 1 to 3

Texture: sand, loamy sand, fine sand, loamy fine sand, sandy loam, or fine sandy loam

Rock fragment content: 0 to 8 percent gravel

Reaction: extremely acid to neutral

E horizon:

Hue: 7.5YR or 10YR

Value: 5 to 7

Chroma: 1 to 4

Texture: sand, loamy sand, fine sand, loamy fine sand, sandy loam, or fine sandy loam

Rock fragment content: 0 to 8 percent gravel

Reaction: very strongly acid to neutral

Bhs horizon:

Hue: 5YR or 7.5YR, or less commonly 10YR

Value: 2, 2.5, or 3; 10YR hue has value of 3 only
Chroma: 2 or 3; 10YR hue has chroma of 1 only
Texture: fine sand, sand, loamy fine sand, or loamy sand
Rock fragment content: 0 to 8 percent gravel
Reaction: very strongly acid to moderately acid

Bs1 horizon in pedons with no Bhs horizons:
Hue: 5YR or 7.5YR
Value: 3 or 4
Chroma of 4
Texture: fine sand, sand, loamy fine sand, or loamy sand
Rock fragment content: 0 to 8 percent gravel
Reaction: very strongly acid to moderately acid

Bs1 horizon in pedons with a Bhs horizon:
Hue: 5YR to 10YR
Value: 3 to 5
Chroma: 4 to 6
Texture: fine sand, sand, loamy fine sand, or loamy sand
Rock fragment content: 0 to 8 percent gravel
Reaction: very strongly acid to moderately acid

Bs2 horizon:
Hue: 7.5YR or 10YR
Value: 4 to 6
Chroma: 4 to 8
Texture: fine sand, sand, loamy fine sand, or loamy sand
Rock fragment content: 0 to 8 percent gravel
Reaction: very strongly acid to slightly acid

A few weakly to strongly cemented pieces of ortstein are in the Bhs and Bs horizons in some pedons. The colors of ortstein normally correspond to the colors of both the Bhs and Bs horizons.

E' horizon:
Hue: 2.5YR to 10YR
Value: 4 to 7
Chroma: 2 to 4
Texture: fine sand, sand, loamy sand, or loamy fine sand
Rock fragment content: 0 to 8 percent gravel
Reaction: very strongly acid to neutral

Some pedons do not have an E' horizon. Some pedons have a glossic horizon (E/Bt or Bt/E horizon). Some pedons have thick coatings of E material on faces of ped in the upper part of the 2Bt horizon. Some pedons have a thin layer that is sandy loam, silty clay loam, or clay loam, which is just above the 2Bt horizon.

2Bt horizon:
Hue: 2.5YR to 10YR
Value: 4 to 6
Chroma: 2 to 4
Texture: silty clay or clay
Clay content: averages 40 to 60 percent
Rock fragment content: 0 or 1 percent
Reaction: slightly acid to moderately alkaline

2C horizon:
Hue: 2.5YR to 10YR
Value: 4 to 6
Chroma: 2 to 4
Texture: silty clay or clay; thin strata of silty clay loam and silt loam are in some pedons
Rock fragment content: 0 or 1 percent
Reaction: slightly acid to moderately alkaline

Sandy substratums below 152 cm (60 inches) are recognized.

COMPETING SERIES: This is the [Fibre](#) series. The Fibre soils are saturated for longer periods and at a shallower depth in the upper part of the series control section.

GEOGRAPHIC SETTING: Allendale soils are on lake basins, lake terraces, lake plains, outwash plains, and ground moraines. Slope ranges from 0 to 12 percent. Mean annual precipitation ranges from 686 to 864 mm (27 to 34 inches). Mean annual temperature ranges from 5.0 to 8.3 degrees C (41 to 47 degrees F).

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Au Gres, [Bergland](#), [Croswell](#), [Kalkaska](#), [Kellogg](#), [Manistee](#), [Melita](#), [Pickford](#), [Pinconning](#), [Rubicon](#), [Rudyard](#), and [Selkirk](#) soils. The well drained Manistee, the moderately well drained Kellogg, and the poorly drained or very poorly drained [Fibre](#) and Pinconning soils form a drainage sequence with Allendale. The somewhat excessively drained Kalkaska and Melita, the excessively drained Rubicon, the moderately well drained Croswell, and the somewhat poorly drained Au Gres are sandy soils associated with the Allendale soils. The somewhat poorly drained Selkirk and Rudyard soils and the poorly drained Pickford and Bergland soils are clayey soils that are in association with Allendale soils in some areas.

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY: Somewhat poorly drained. Depth to the top of a perched seasonal high water table ranges from 15 to 61 cm (0.5 to 2 feet) during October, November, March, April, May, and June in normal years. The water tends to perch at the interface between the sandy and clayey materials. Potential for surface runoff is negligible to very low, dependent on slope. Saturated hydraulic conductivity is high or very high in the sandy part and moderately low or low in the clayey part. Permeability is rapid in the sandy upper part and slow or very slow in the clayey lower part.

USE AND VEGETATION: Cleared areas are used for the production of small grains, alfalfa-

grass hay, and corn with some soybeans and field beans. Some areas are in permanent pasture or in woodland. Natural forest vegetation consists of quaking aspen, balsam fir, paper birch, red maple, eastern white pine, white ash, and white spruce.

DISTRIBUTION AND EXTENT: MLRAs 90A, 92, 93A, 93B, 94A, 94B, 94C, 95A, 96, 98, and 99 in the northern half of the Lower Peninsula and the Upper Peninsula of Michigan, northwestern Wisconsin, and northern Minnesota. This series is of moderate extent.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: AMHERST, MASSACHUSETTS

SERIES ESTABLISHED: Ottawa County, Michigan, 1922.

REMARKS: Diagnostic horizons and features recognized in this pedon are:
Ochric epipedon: from the surface to a depth of 25 cm (10 inches) (A and E horizons).
Albic horizon: from a depth of 8 to 25 cm (3 to 10 inches) and from 66 to 71 cm (26 to 28 inches) (E and E' horizons).
Spodic horizon: from a depth of 25 to 41 cm (10 to 16 inches) (Bhs and Bs1 horizons).
Argillic horizon: from a depth of 71 to 84 cm (28 to 34 inches) (2Bt horizon).
Aquic conditions: redoximorphic features in the Bhs horizon.

National Cooperative Soil Survey
U.S.A.

Ax

LOCATION ANGELICA

MI+WI

Established Series

Rev. LWB-WEF-LLD

08/2006

ANGELICA SERIES

The Angelica series consists of very deep, poorly drained and very poorly drained soils formed in loamy glacial till deposits on ground moraines. Saturated hydraulic conductivity is moderately high. Slopes range from 0 to 2 percent. Mean annual precipitation is about 760 millimeters, and mean annual temperature is about 6 degrees C.

TAXONOMIC CLASS: Fine-loamy, mixed, active, nonacid, frigid Aeric Endoaquepts

TYPICAL PEDON: Angelica loam - on a 1 percent northeast-facing slope in a forested area. (Colors refer to moist soil unless otherwise stated.)

Oa--0 to 5 centimeters; black (10YR 2/1) muck, very dark gray (10YR 3/1) dry; weak medium granular structure; very friable; slightly acid; abrupt smooth boundary. (0 to 18 centimeters thick)

A--5 to 15 centimeters; very dark gray (10YR 3/1) loam; grayish brown (10YR 5/2) dry; weak medium subangular blocky structure; friable; slightly acid; abrupt wavy boundary. (5 to 13 centimeters thick)

Bg--15 to 25 centimeters; grayish brown (2.5Y 5/2) sandy loam; weak medium subangular blocky structure; friable; many medium distinct dark gray (5Y 4/1) iron depletions throughout; about 2 percent gravel; neutral; abrupt wavy boundary. (8 to 23 centimeters thick)

Bw1--25 to 36 centimeters; brown (7.5YR 4/4) loam; weak fine subangular blocky structure; friable; common fine distinct yellowish red (5YR 5/6) iron accumulations throughout; about 2 percent gravel; neutral; clear wavy boundary.

Bw2--36 to 43 centimeters; reddish brown (5YR 5/4) sandy clay loam; weak medium subangular blocky structure; firm; common fine faint yellowish red (5YR 5/6) iron accumulations throughout; about 2 percent gravel; neutral; clear wavy boundary. (Combined thickness of the Bw horizon is 18 to 41 centimeters.)

C--43 to 152 centimeters; light brown (7.5YR 6/4) loam; massive; friable; many medium distinct pale red(2.5YR 6/2) iron depletions, and few medium faint brownish yellow (10YR 6/6) iron accumulations throughout; about 2 percent gravel; slightly effervescent; moderately alkaline.

TYPE LOCATION: Delta County, Michigan; about 4 miles southeast of Ensign; 200 feet southeast of northwest corner, sec. 29, T. 40 N., R. 20 W.

RANGE IN CHARACTERISTICS: The thickness of the solum and depth to free carbonates typically averages 38 to 64 centimeters, but ranges from 30 to 76 centimeters. Gravel content ranges from 0 to 10 percent in the solum and from 1 to 25 percent in the C horizon. Cobble content ranges from 0 to 5 percent throughout. Some pedons have free carbonates in the solum.

The A horizon has hue of 10YR or is neutral, value of 2 or 3, and chroma of 0 to 2. Where present the Ap horizon has hue of 10YR or 7.5YR, value of 3 or 4, and chroma of 2 or 3. The A horizon is loam, silt loam, sandy loam, or mucky analogues of these textures. The A or Ap horizon ranges from slightly acid to neutral.

The Bg horizon has hue of 7.5YR, to 5Y; value of 4 to 6; and chroma of 1 or 2. Redoximorphic features range from faint to prominent where matrix colors have chroma of 2. It is sandy loam, loam, or silt loam. Reaction ranges from slightly acid to neutral.

The Bw1 horizon has hue of 10YR, to 5YR; value of 4 to 7; and chroma of 2 to 4. It is sandy loam, loam, sandy clay loam, or clay loam. The Bw2 horizon has hue of 5.YR, 7.5YR, or 10YR; value of 4 to 6; and chroma of 2 to 6. It is sandy loam, loam, sandy clay loam, or clay loam. The matrix colors in the Bw1 and Bw2 horizons reflect the color of the parent materials. Reaction of the Bw horizons ranges from slightly acid to neutral.

The C horizon has hue of 5YR, to 2.5Y; value of 5 to 7; and chroma of 2 to 4. It is typically loam, but gravelly loam, silt loam, sandy loam, or clay loam with less than 35 percent clay is included. Reaction is slightly or moderately alkaline.

COMPETING SERIES: There are no other series in the family. The [Easton](#) series may be a competitor when the classification of this series is reviewed. Easton soils do not contain free carbonates within 152 centimeters.

GEOGRAPHIC SETTING: Angelica soils are on nearly level or in depressions on ground moraines. Slope gradients range from 0 to 2 percent. Mean annual precipitation ranges from 690 to 840 millimeters and mean annual temperature ranges from 6 to 8 degrees C.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the [Cathro](#), [Mackinac](#), [Onaway](#), [Tacoosh](#), and [Trenary](#) soils. Cathro and Tacoosh soils are shallow organic soils that are common associates on lower topographic positions. Mackinac, Onaway, and Trenary soils are on higher landform positions and form a drainage sequence with Angelica.

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY: Poorly drained and very poorly drained. This soil has representative wet soil moisture status that ranges from the surface to 61 centimeters below the surface at times throughout the year. This soil has representative ponding depth at 7 to 15 centimeters at times during the period from October to June. Surface runoff is slow or ponded. Saturated hydraulic conductivity is moderately high.

USE AND VEGETATION: Mostly in woodland. A small acreage is used for pasture. Where drained these soils are used for corn, small grain, and hay. Natural forest vegetation consists of aspen, balsam fir, northern white-cedar, paper birch, yellow birch, black spruce, black ash, and alder.

DISTRIBUTION AND EXTENT: Northern part of lower peninsula and eastern part of the upper peninsula of Michigan and northeastern Wisconsin. The series is moderate in extent.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: St. Paul, Minnesota

SERIES ESTABLISHED: Presque Isle County, Michigan, 1950.

REMARKS: Diagnostic horizons and other features recognized in this pedon are: ochric epipedon - the zone from 5 to 15 centimeters (A horizons); cambic horizon - the zone from 15 to 43 centimeters (Bs, Bw1, and Bw2 horizons); aquic conditions between 40 and 50 centimeters.

ADDITIONAL DATA: Soil Interpretation Record No.: MI0065

National Cooperative Soil Survey
U.S.A.

Ba

LOCATION BACH
Established Series
Rev. NWS-WEF
02/2004

MI+WI

BACH SERIES

These soils consist of poorly drained and very poorly drained soils formed in calcareous silty lacustrine sediments. These lake plain soils have slopes of less than 2 percent. They have moderately slow or moderate permeability. Mean annual precipitation is about 33 inches, and mean annual temperature is about 47 degrees F.

TAXONOMIC CLASS: Coarse-silty, mixed, semiactive, calcareous, mesic Mollic Endoaquepts

TYPICAL PEDON: Bach very fine sandy loam - on a 1 percent slope in an idle cultivated field. (Colors are for moist soil unless otherwise stated.)

Ap--0 to 8 inches; black (10YR 2/1) very fine sandy loam, grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; slight effervescence; moderately alkaline; abrupt smooth boundary. (8 to 10 inches thick)

Bg1--8 to 13 inches; gray (5Y 5/1) very fine sandy loam; common medium prominent strong brown (7.5YR 5/6) mottles; very weak fine subangular blocky structure; very friable; strong effervescence; moderately alkaline; clear wavy boundary.

Bg2--13 to 21 inches; light gray (5Y 6/1) very fine sandy loam; many medium prominent olive yellow (2.5Y 6/8) mottles; very weak medium subangular blocky structure; very friable; strong effervescence; moderately alkaline; clear wavy boundary.

Bg3--21 to 36 inches; light gray (5Y 6/1) very fine sandy loam; many medium and coarse prominent olive yellow (2.5Y 6/8) mottles; very weak coarse subangular blocky structure; very friable; strong effervescence; moderately alkaline; clear wavy boundary. (Combined thickness of the Bg horizon is 3 to 58 inches.)

C1--36 to 48 inches; light brownish gray (2.5Y 6/2) very fine sandy loam; common fine prominent yellowish brown (10YR 5/6) mottles; massive; very friable; strong effervescence; moderately alkaline; clear wavy boundary.

C2--48 to 62 inches; light brownish gray (2.5Y 6/2) loamy very fine sand; common medium distinct light olive brown (2.5Y 5/4) mottles; single grained; loose; strong effervescence; moderately alkaline.

TYPE LOCATION: St. Clair County, Michigan; on Harsens Island in ditch bank next to cultivated field, 200 feet east of junction of Voakes and Columbine roads on south side of Voakes Road, T. 2 N., R. 16 E.

RANGE IN CHARACTERISTICS: Solum thickness typically is 25 to 35 inches and ranges from 20 to 40 inches. Some pedons are calcareous at the surface, and all are calcareous within a depth of 10 inches.

The Ap horizon has hue of 10YR to 5Y, value of 2 or 3, and chroma of 1 or 2. It is silt loam, loam, very fine sandy loam, fine sandy loam, or loamy very fine sand. It ranges from neutral to moderately alkaline.

The Bg horizons have hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or 2. Texture is typically very fine sandy loam but often there are strata of loam, silt loam, loamy very fine sand, fine sandy loam, very fine sand, clay loam, or silty clay loam. The 10 to 40 inch control section has less than 18 percent clay and less than 15 percent of the particles are fine sand or coarser.

The C horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 to 3. Textures are similar to those of the B horizon, but in some pedons there are strata of fine sand, fine gravel, or silty clay loam. In some pedons loam or clay loam till is below 40 inches.

COMPETING SERIES: There are no competing series. Closely related series are the [Colwood](#), [Keowns](#), [Lamson](#), and [McBeth](#) soils. Colwood soils are fine-loamy and have more acid sola. Keowns soils are coarse-loamy and are nonacid. Lamson soils are coarse-loamy, are more acid, and have thicker sola. McBeth soils are Mollisols.

GEOGRAPHIC SETTING: The Bach soils are on lake plains. Slope gradients are less than 2 percent. These soils formed in calcareous stratified silts and very fine sands. The average annual precipitation ranges from 28 to 36 inches, and the average annual temperature ranges from 44 to 48 degrees F.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the [Blount](#), [Eastport](#), [Gagetown](#), [Lamson](#), [Linwood](#), [Londo](#), [Minoa](#), [Oakville](#), [Parkhill](#), [Pipestone](#), [Sanilac](#), [Sims](#), [Tappan](#), and [Tobico](#) soils. The Bach soils are in a drainage sequence with the Sanilac and Gagetown soils. Sanilac soils are somewhat poorly drained, nearly level to gently sloping, and occur on slightly rounded swells and drainage divides. Gagetown soils are moderately well drained and occupy the more sloping areas in the landscape. Linwood, Tobico, and Lamson are closely associated poorly drained soils. Linwood and Tobico soils have organic surface layers. Lamson soils have noncalcareous surface horizons. Londo, Blount, Sims, Tappan, and Parkhill soils are formed in glacial till and

border Bach soils in some areas. Oakville, Minoa, Eastport, and Pipestone soils are better drained sandy soils directly associated with areas of Bach soils.

DRAINAGE AND PERMEABILITY: Poorly and very poorly drained. Runoff is very slow or ponded. Permeability is moderately slow or moderate depending on the texture and sequence of the layers.

USE AND VEGETATION: Most areas of Bach soils are used to grow corn, small grains, white beans, and sugar beets. Bluegrass is grown for sod purposes in some areas. A few partially drained areas are used for permanent pasture. Undrained areas grow sedges, reeds, and wetland shrubs, or a second growth of elm, red maple, ash, and tag alder. Native vegetation was mixed northern hardwoods or reeds, sedges and water tolerant shrubs in flooded areas.

DISTRIBUTION AND EXTENT: Thumb area and central parts of the lower peninsula of Michigan. The series is of moderate extent.

MLRA OFFICE RESPONSIBLE: Indianapolis, Indiana

SERIES ESTABLISHED: Sanilac County, Michigan, 1955.

ADDITIONAL DATA: The Bach pedon was sampled and characterized as S75MI- 63-3, Sample Nos. 75L111-75L115.

REMARKS: Classification was adjusted to agree with ST Issue #17 on 7 Sept 94 by CLG. Diagnostic horizons and features recognized in this pedon are: ochric epipedon - the zone from the surface to 8 inches (Ap horizon); cambic horizon - the zone from 8 to 36 inches (Bg1, Bg2 and Bg3 horizons); aquic soil moisture regime.

Bn

LOCATION BONDUUEL

WI+MI

Established Series
Rev. DCR-HFG-AAC
11/2011

BONDUEL SERIES

The Bonduel series consists of somewhat poorly drained soils that are moderately deep to a lithic contact with dolomite bedrock. These soils formed in loamy till underlain by dolomite on ground moraines. Slope ranges from 0 to 3 percent. Mean annual precipitation is about 762 mm (30 inches). Mean annual air temperature is about 6.1 degrees C (43 degrees F).

TAXONOMIC CLASS: Fine-loamy, mixed, active, frigid Aquollic Hapludalfs

TYPICAL PEDON: Bonduel loam - on a 1 percent slope in a cultivated field at an elevation of about 236 meters (774 feet) above mean sea level. (Colors are for moist soil unless otherwise stated.)

Ap--0 to 20 cm (0 to 8 inches); very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; moderate medium granular structure; friable; many roots; neutral; abrupt smooth boundary. [15 to 23 cm (6 to 9 inches) thick]

BE--20 to 36 cm (8 to 14 inches); brown (7.5YR 4/4) loam; weak medium subangular blocky structure; friable; many roots; common medium prominent strong brown (7.5YR 5/8) masses of oxidized iron in the matrix; few fine distinct pinkish gray (7.5YR 6/2) iron depletions in the matrix; slightly alkaline; gradual wavy boundary. [0 to 23 cm (0 to 9 inches) thick]

Bt1--36 to 51 cm (14 to 20 inches); brown (7.5YR 5/4) loam; moderate medium subangular blocky structure; friable; many roots; few distinct clay films on faces of peds; common medium prominent strong brown (7.5YR 5/8) masses of oxidized iron in the matrix; common medium distinct pinkish gray (7.5YR 6/2) iron depletions in the matrix; about 2 percent gravel; slightly alkaline; gradual wavy boundary.

Bt2--51 to 64 cm (20 to 25 inches); brown (7.5YR 5/4) loam; weak medium subangular blocky structure; friable; few faint clay films on faces of peds; common medium prominent strong brown (7.5YR 5/8) masses of iron accumulation in the matrix; common medium distinct pinkish gray (7.5YR 6/2) iron depletions in the matrix; about 5 percent dolomitic gravel; slightly alkaline; clear irregular boundary. [Combined thickness of the Bt horizons ranges from 15 to 53 cm (6 to 21 inches).]

C--64 to 94 cm (25 to 37 inches); light brown (7.5YR 6/4) loam; massive; friable; common

medium prominent strong brown (7.5YR 5/8) masses of oxidized iron in the matrix; few medium distinct pinkish gray (7.5YR 6/2) iron depletions in the matrix; about 5 percent dolomitic gravel; violently effervescent; slightly alkaline; abrupt wavy boundary. [0 to 38 cm (0 to 15 inches) thick]

2R--94 to 152 cm (37 to 60 inches); gray (10YR 6/1) dolomite bedrock; moderately alkaline.

TYPE LOCATION: Oconto County, Wisconsin; about 3 1/2 miles northeast of Pulaski; 1000 feet south and 700 feet east of the northwest corner of sec. 16, T. 26 N., R. 19 E. USGS Pulaski, Wisconsin topographic quadrangle; lat. 44 degrees 43 minutes 39 seconds N., and long. 88 degrees 12 minutes 32 seconds W., NAD 27.

RANGE IN CHARACTERISTICS:

Depth to the base of the argillic horizon: 51 to 102 cm (20 to 40 inches)

Depth to a lithic contact with dolomite bedrock: 51 to 102 cm (20 to 40 inches) coincides with depth to argillic horizon in some pedons

Particle-size control section (weighted average): 18 to 35 percent clay

Volume of rock fragments: 0 to 5 percent in the upper part of the solum, 5 to 20 percent in the lower part and in the substratum

Reaction: typically neutral or slightly alkaline in the solum, moderately alkaline in the lower part in some pedons; slightly or moderately alkaline in the C horizon

Redox depletions and saturation: chroma of 2 or less within the upper 25 cm (10 inches) of the argillic horizon

Ap or A horizon:

Hue: 5YR, 7.5YR or 10YR

Value: 2 or 3

Chroma: 1 to 3

Texture: loam, silt loam or loamy very fine sand

E horizon (where present):

Hue: 7.5YR or 10YR

Value: 4 to 6

Chroma: 2 or 3

Texture: loam or silt loam

BE horizon:

Hue: 5YR, 7.5YR or 10YR

Value: 4 or 5

Chroma: 3 or 4

Texture: loam or silt loam

Bt horizon:

Hue: 5YR, 7.5YR or 10YR

Value: 4 or 5

Chroma: 3 or 4

Texture: loam, sandy clay loam, or clay loam

BC and/or C horizon:

Hue: 5YR, 7.5YR or 10YR

Value: 4 to 6

Chroma: 3 or 4

Texture: loam, fine sandy loam, sandy loam or sandy clay loam

R horizon:

Hue: 10YR or 2.5Y

Value: 6 or 7

Chroma: 1 to 6

Other features:

It is dolomite bedrock that is massive or that has thin, widely spaced, clay-filled joints that extend to depths varying from a few inches to several feet.

COMPETING SERIES: There are no competing series.

GEOGRAPHIC SETTING: Bonduel soils are on concave or plane slopes and depressions on ground moraines underlain by dolomite. Slope ranges from 0 to 3 percent. Bonduel soils formed in loamy till over dolomite. Mean annual precipitation ranges from 710 to 840 mm (28 to 33 inches). Mean annual air temperature ranges from 4.4 to 7.2 degrees C (40 to 45 degrees F).

GEOGRAPHICALLY ASSOCIATED SOILS: These are the [Kolberg](#), [Longrie](#), and [Namur](#) soils. The Kolberg soils are nearby in better drained positions where the argillic horizon averages more than 35 percent clay. The Longrie soils are also nearby in better drained positions, but are coarse-loamy. The Namur soils are nearby where the depth to bedrock is less than 31 cm (12 inches).

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY: Somewhat poorly drained. The potential for surface runoff ranges from negligible to moderate. Saturated hydraulic conductivity is moderately high to high (4.23 to 14.11 micrometers per second) in the till and ranges from moderately low to high (0.42 to 14.11 micrometers per second) in the bedrock. Permeability is moderate in the till and ranges from moderate to slow in the bedrock. These soils have a perched seasonal high water table at a depth of 31 to 61 cm (1 to 2 feet) for some time in most years

USE AND VEGETATION: Many areas of this soil have been cleared and are used for cropland. Common crops are corn, small grains and hay. Some areas are used for pastureland or woodland. Native vegetation is commonly mixed deciduous and coniferous forest. Common trees are quacking aspen, paper birch, red maple, and some northern white-cedar.

DISTRIBUTION AND EXTENT: MLRAs 94A, 94B, and 95A in northeastern Wisconsin and northern lower Michigan. These soils are of moderate extent.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Indianapolis, Indiana

SERIES ESTABLISHED: Brown County, Wisconsin, 1970.

REMARKS: Diagnostic horizons and features recognized in this pedon are: ochric epipedon - 0 to 36 cm (0 to 14 inches) (Ap BE); argillic horizon - 36 to 64 cm (14 to 25 inches) (Bt); aquic feature - redox depletions with chroma of 2 or less and saturation in upper 10 inches of argillic horizon; Aquollic subgroup Ap horizon with color value and chroma, moist, of less than 4 and color value, dry, less than 6

National Cooperative Soil Survey

U.S.A.

Ca

LOCATION CARBONDALE

MI+MN NY VT WI

Established Series

Rev. RWJ-WEF

11/2000

CARBONDALE SERIES

The Carbondale series consists of very deep, very poorly drained soils formed in organic deposits more than 51 inches thick on ground moraines, outwash plains and lake plains. These soils have moderately slow to moderately rapid permeability. Slopes range from 0 to 2 percent. Mean annual precipitation is about 30 inches, and mean annual temperature is about 43 degrees F.

TAXONOMIC CLASS: Euic, frigid Hemic Haplosaprists

TYPICAL PEDON: Carbondale muck - on a slope less than 1 percent in a forested area. (Colors are for moist soil unless otherwise stated.)

Oa1--0 to 5 inches; very dark gray (10YR 3/1) broken face muck, very dark brown (10YR 2/2) rubbed; about 35 percent fiber, less than 10 percent rubbed; weak medium granular structure; primarily herbaceous fibers; slightly acid (pH 6.3 in water); clear smooth boundary.

Oa2--5 to 28 inches; very dark brown (10YR 2/2) broken face and rubbed muck; about 25 percent fiber, less than 5 percent rubbed; weak medium granular structure; primarily herbaceous fibers, few woody fibers; slightly acid (pH 6.4 in water); abrupt smooth boundary.

Oa3--28 to 39 inches; black (10YR 2/1) broken face and rubbed muck; about 10 percent fiber, less than 5 percent rubbed; massive; primarily herbaceous fibers and a few woody fragments; slightly acid (pH 6.4 in water); abrupt smooth boundary.

0e--39 to 60 inches; dark brown (7.5YR 3/2) broken face mucky peat, very dark brown (10YR 2/2) rubbed; about 70 percent fiber, about 35 percent rubbed; massive; primarily herbaceous fibers; few woody fibers; slightly acid (pH 6.4 in water).

TYPE LOCATION: Emmet County, Michigan; about 6 miles north of Pleasant View; 2,660 feet east and 400 feet north of the southwest corner of sec. 16, T. 37 N., R. 5 W.

RANGE IN CHARACTERISTICS: The organic layers are more than 51 inches thick. Organic material has hue of 10YR to 5YR, or is neutral; value of 2 or 3; and chroma of 0 to 2. Wood fragments, from 1 to several inches in diameter, are throughout some pedons.

Some pedons have a thin 1 to 3 inch layer of peat on the surface. The surface tier contains either muck (sapric material) or mucky peat (hemic material) or both. It generally has granular structure, but in some pedons, the primary structure is weak or moderate coarse blocky or prismatic. It commonly is derived from herbaceous plants, but in some pedons a moderate amount of the material is woody. Below depths of 12 inches woody materials typically comprise minor amounts of the recognizable fiber. More than one-half the volume of the middle tier is muck (sapric material). Where this layer contains muck, mucky peat, and peat, muck is the largest component. The subsurface tier has mainly pH of 6.5 to 7.5 in calcium chloride and 5.1 to 7.0 in water, and the full range is from 5.5 to less than 7.8 in calcium chloride. Below depths of 12 inches the soil is commonly massive, but some of it breaks into thick to thin plates which appear to be related to the mode of deposition. The bottom tier commonly is dominated by mucky peat (hemic material), and in some pedons the entire layer is mucky peat. More than 10 inches of the subsurface and bottom tiers are mucky peat.

COMPETING SERIES: There are no competing series. Closely related series are the [Cathro](#), [Greenwood](#), [Markey](#), [Rifle](#), and [Tawas](#) series. Cathro, Markey, and Tawas soils have mineral soil material at depths of less than 51 inches. Greenwood soils are dysic. In addition, the middle tier is dominated by mucky peat. Rifle soils have mucky peat dominant in the middle tier and have less than 10 inches of muck or peat in the middle and lower tiers.

GEOGRAPHIC SETTING: Carbondale soils are in depressions on ground moraines, outwash plains, and lake plains. Small areas of these soils are common between drumlins or eskers. The mean annual precipitation is ranges from about 27 to 44 inches, and the mean annual temperature ranges from 40 to 45 degrees F.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the [Cathro](#), [Markey](#), and [Tawas](#) soils which are near the edges of the Carbondale soils. The [Angelica](#), [Ensley](#), and [Roscommon](#) are mineral soils commonly on the margins of the Carbondale soils.

DRAINAGE AND PERMEABILITY: Very poorly drained. Depth to the seasonal high water table ranges from 1 foot above to 1 foot below the surface at times during the period from November to May.. Surface runoff is ponded. Permeability is moderately slow to moderately rapid.

USE AND VEGETATION: Most of these soils are in forest of northern whitecedar, balsam fir, black spruce, and white birch. Small areas are cleared and used for pasture.

DISTRIBUTION AND EXTENT: Michigan, New York, Vermont, and Wisconsin. The series is of large extent.

MLRA OFFICE RESPONSIBLE: St. Paul, Minnesota

SERIES ESTABLISHED: Chippewa County, Michigan, 1927.

REMARKS: Diagnostic horizons and features recognized in this pedon are: organic material greater than 51 inches thick; hemic material greater than 25 cm thick in the subsurface of bottom tiers - Hemic subgroup.

ADDITIONAL DATA: Soil Interpretation Record No.: MI0089

National Cooperative Soil Survey
U.S.A.

Cm

LOCATION CATHRO

MI+ME MN ND NY VT WI

Established Series

Rev. WEM-WEF-LMC-AGG

06/2006

CATHRO SERIES

The Cathro series consists of very deep, very poorly drained organic soils moderately deep to loamy materials. They formed in organic material 16 to 51 inches thick overlying loamy glacial deposits on ground moraines, end moraines, outwash plains, lake plains, stream terraces, and flood plains. Permeability is moderately slow to moderately rapid in the organic material and moderately slow or moderate in the loamy material. Slopes range from 0 to 2 percent. Mean annual precipitation is about 32 inches. Mean annual air temperature is about 43 degrees F.

TAXONOMIC CLASS: Loamy, mixed, euic, frigid Terric Haplosaprists

TYPICAL PEDON: Cathro muck - on a slope of 1 percent in a forested area (Colors are for moist conditions unless otherwise stated.)

0a1--0 to 6 inches; black (5YR 2/1) rubbed and pressed muck (sapric material); about 40 percent fiber, about 15 percent rubbed; weak fine granular structure; nonsticky; primarily herbaceous fibers; neutral (pH 6.8 in water); clear wavy boundary.

0a2--6 to 11 inches; black (5YR 2/1) broken face and rubbed muck (sapric material), dark reddish brown (5YR 2/2) pressed; about 35 percent fiber, about 10 percent rubbed; weak medium granular structure; nonsticky; primarily herbaceous fibers; neutral (pH 6.8 in water); clear smooth boundary.

0a3--11 to 23 inches; black (5YR 2/1) on broken face and rubbed muck (sapric material); about 40 percent fibers, less than 10 percent rubbed; massive; nonsticky; primarily herbaceous fibers; neutral (pH 6.8 in water); abrupt smooth boundary. (Combined thickness of Oa horizons is 15 to 51 inches.)

Cg--23 to 60 inches; grayish brown (2.5Y 5/2) sandy loam; massive; slightly sticky; common coarse prominent reddish brown (5YR 5/3) and common coarse distinct brown (10YR 5/3) Fe concentrations; strongly effervescent; moderately alkaline.

TYPE LOCATION: Delta County, Michigan; about 4 miles south of Ensign; 1,620 feet north and 200 feet east of the southwest corner of sec. 23, T. 40 N., R. 21 W.

RANGE IN CHARACTERISTICS: The depth to the loamy C horizon ranges from 16 to 51 inches. Woody fragments over 2cm in size comprise less than 15 percent of the organic material. The organic portion of the control section has hue of 10YR, 7.5YR, or 5YR; value of 2 or 3; and chroma of 0 to 3 or are neutral. In some pedons the value or chroma or both increases 1 or 2 units when exposed to the air. The organic portion of the control section ranges from pH 4.5 to less than pH 7.8 in calcium chloride and does not have free carbonates.

The surface tier exclusive of loose surface litter or mosses, is comprised of mucky peat (hemic material) or muck (sapric material) material with an unrubbed fiber content that ranges from about 20 percent to 50 percent; rubbed is less than 20 percent. Up to 4 inches of peat is on the surface in some pedons. The surface tier is weak or moderate fine granular structure. Typically the structure grade becomes stronger as the amount of recognizable woody material increases.

The subsurface tier is muck (sapric material). The unrubbed fiber content ranges from 50 to less than 10 percent and is less than 16 percent after rubbing. Some pedons have thin layers of mucky peat (hemic material) in the control section. Ash content of the organic layer just above the loamy substratum is as much as 40 percent in some pedons.

A thin A horizon is present in some pedons. It has hue of 10YR, 2.5Y, 5Y or is neutral, value of 2 or 3 and chroma of 0 to 2. It is sandy loam, fine sandy loam, sandy clay loam, loam, silt loam or their mucky analogs. It ranges from moderately acid to slightly alkaline.

The C horizon has hue of 5YR, 7.5YR, 10YR, 2.5Y, 5GY, 5GB, or 5Y; value of 4 to 6; and chroma of 1 to 3. It is sandy loam, fine sandy loam, very fine sandy loam, sandy clay loam, loam, silt loam, clay loam or silty clay loam. Stratified substratum phases containing thin strata of fine sand or sand, less than 3 inches thick are recognized. It ranges from moderately acid to moderately alkaline. Coarse fragments range from 0 to 25 percent by volume. Some pedons do not contain free carbonates.

COMPETING SERIES: These are the [Berner](#), [Bullwinkle](#), [Dingle](#), [Nidaros](#), and [Wonsqueak](#) series. Berner soils have a sandy layer above the loamy sediment. Bullwinkle soils have greater than 15 percent woody fragments in the organic material. Dingle soils occur in areas with 14 to 16 inches of annual precipitation and in elevations from 5900 to 6000 feet. Nidaros soils have sandy underlying materials. Wonsqueak soils are substantially drier in the moisture control section during the 120 days following the summer solstice.

GEOGRAPHIC SETTING: Cathro soils commonly are in relatively small depressions mainly within ground moraines, end moraines, lake plains and outwash plains. A few areas are on narrow flood plains. Individual bodies range in size from about 10 to 100 acres. Slopes are 0 to 2 percent. The ground water carrying minerals from the surrounding upland, influences the composition of the organic deposit. Mean annual precipitation ranges from about 19 to 43 inches. Mean annual air temperature ranges from

36 to 45 degrees F. Frost-free days range from 70 to 145. Elevation above sea level ranges from 600 to 2,000 feet.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the [Carbondale](#) and [Rifle](#) soils that occupy similar landscape positions and the [Angelica](#) and [Ensley](#) soils. Angelica and Ensley soils are poorly drained mineral soils commonly located adjacent to the edges of Cathro soils. The Carbondale soils have hemic soil materials within 51 inches. Rifle soils formed in hemic materials 51 inches or greater.

DRAINAGE AND PERMEABILITY: Very poorly drained. Depth to the seasonal high saturation ranges from 1 foot above the surface to 0.5 foot below the surface at some time from October to June in most years. Ponded phases have a seasonal high saturation from 4 foot above the surface to 0.5 foot below the surface throughout the year. Surface runoff is negligible to low. Permeability is moderately rapid to moderately slow in the organic portion and moderately slow or moderate in the mineral substratum. Stratified substratum phases have saturated hydraulic conductivity ranging up to moderately rapid or rapid in the individual sand strata.

USE AND VEGETATION: Most of these soils are in woodland, however some are in sedge and cattails. Vegetation includes white cedar, alder, and balsam fir. A few areas are cleared and are used for pasture.

DISTRIBUTION AND EXTENT: Northern Lower Peninsula and Upper Peninsula of Michigan, northern Minnesota, northern Wisconsin and upper New England.

MLRA OFFICE RESPONSIBLE: St. Paul, Minnesota.

SERIES ESTABLISHED: Delta County, Michigan, 1969.

REMARKS: Diagnostic horizons and features recognized in this pedon are: sapric material from the surface to 23 inches (Oa1, Oa2, and Oa3 horizons); terric feature at 23 inches (Cg horizon); aquic moisture regime (low chroma in the soil moisture control section.)

FaA

LOCATION FABIUS

MI+WI

Established Series

Rev. RWJ-EPW-WEF

06/2011

FABIUS SERIES

The Fabius series consist of very deep somewhat poorly drained soils formed in loamy and sandy drift on lake plains, outwash plains, valley trains, and beach ridges. Slope ranges from 0 to 6 percent. Mean annual precipitation is about 813 mm (32 inches), and mean annual temperature is about 8.9 degrees C (48 degrees F).

TAXONOMIC CLASS: Fine-loamy over sandy or sandy-skeletal, mixed, semiactive, mesic Aquic Argiudolls

TYPICAL PEDON: Fabius sandy loam, in a cultivated field. (Colors are for moist soil unless otherwise noted.)

Ap--0 to 18 cm (7 inches); very dark grayish brown (10YR 3/2) sandy loam, grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; many medium and fine roots; slightly acid; abrupt smooth boundary. [18 to 30 cm (7 to 12 inches) thick]

E--18 to 25 cm (7 to 10 inches); brown (10YR 5/3) sandy loam; weak coarse granular structure; very friable; many roots; slightly acid; clear smooth boundary. [0 to 10 cm (4 inches) thick]

Bt1--25 to 30 cm (10 to 12 inches); brown (10YR 5/3) sandy loam; weak coarse granular structure; firm; common fine roots; few distinct dark grayish brown (10YR 4/2) clay films on faces of peds; common medium faint dark yellowish brown (10YR 4/4) masses of iron accumulation; about 2 percent gravel; slightly acid; clear wavy boundary. [0 to 10 cm (4 inches) thick]

Bt2--30 to 46 cm (12 to 18 inches); yellowish brown (10YR 5/6) sandy clay loam; weak medium subangular blocky structure; firm; few roots; common distinct dark grayish brown (10YR 4/2) clay films on faces of peds; common medium prominent grayish brown (10YR 5/2) iron depletions; common medium distinct dark yellowish brown (10YR 4/4) masses of oxidized iron; about 5 percent gravel; slightly acid; abrupt wavy boundary. [10 to 20 cm (4 to 8 inches) thick]

2C--46 to 152 cm (18 to 60 inches); pale brown (10YR 6/3) stratified gravel and coarse sand; single grain; loose; strongly effervescent; moderately alkaline.

TYPE LOCATION: Lapeer County, Michigan; about 2 miles east and 2 miles north of Dryden; 550 feet south and 420 feet east of the northwest corner of the NE1/4 of sec. 6, T. 6 N., R. 12 E.

RANGE IN CHARACTERISTICS:

Thickness of the solum: 30 to 76 cm (12 to 30 inches)
Depth to sand and gravel: 46 to 76 cm (18 to 30 inches)
Reaction: moderately acid to slightly alkaline in the solum

Ap horizon:

Hue: 10YR
Value 3
Chroma: 1 or 2
Texture: sandy loam or loam
Rock fragment content: 0 to 10 percent gravel

E horizon:

Hue: 10YR
Value: 5 or 6
Chroma: 1 to 6
Texture: sandy loam or loam
Rock fragment content: 0 to 10 percent gravel

Bt horizon:

Hue: 7.5YR or 10YR
Value: 4 or 5
Chroma: 3 to 6
Texture: dominantly sandy clay loam, loam, clay loam, or the gravelly analogs of these textures; sandy loam or gravelly sandy loam subhorizons are allowed
Clay content: 18 to 30 percent
Sand content: 45 to 70 percent fine sand or coarser
Rock fragment content: 0 to 30 percent

2C horizon:

Hue: 10YR
Value: 5 or 6
Chroma: 1 to 6
Texture: stratified sand and gravel, dominantly coarse sand, or coarse gravel
Rock fragment content 0 to 30 percent

COMPETING SERIES: There are no other series in the same family.

GEOGRAPHIC SETTING: Fabius soils are on outwash plains, valley trains, beach ridges, and lake plains of Wisconsinan Age. Slopes are dominantly between 0 to 2 percent, but they range up to 6 percent. The Fabius soils formed in sandy and loamy drift. Mean annual precipitation ranges from 737 to 940 mm (29 to 37 inches). Mean annual temperature ranges from 8.3 to 12.2 degrees C (47 to 54 degrees F).

GEOGRAPHICALLY ASSOCIATED SOILS: These are the [Casco](#), [Matherton](#), [Mussey](#), and

[Sebewa](#) soils. Fabius soils are in a drainage sequence with the somewhat excessively drained Casco and the poorly drained or very poorly drained Mussey soils. Matherton soils and the poorly drained or very poorly drained Sebewa soils are associated in many places.

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY: Somewhat poorly drained. Depth to the top of a seasonal high water table ranges from 30 to 61 cm (1 to 2 feet) from November to May in normal years. Potential for surface runoff is negligible to medium. Saturated hydraulic conductivity is moderately high in the upper part and high or very high in the lower part. Permeability is moderate or moderately rapid in the upper part and rapid or very rapid in the lower part.

USE AND VEGETATION: Most areas are cultivated. Small grain, beans, corn, and legume-grass hay are the principal crops, especially where artificial drainage is adequate. A part is in permanent pasture or forest. Native vegetation is lowland hardwoods, chiefly American elm, white ash, and swamp white oak.

DISTRIBUTION AND EXTENT: MLRAs 95A, 95B, 98, and 99 in central Michigan and eastern Wisconsin. This series is of moderate extent.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Indianapolis, Indiana.

SERIES ESTABLISHED: Lapeer County, Michigan, 1967.

REMARKS: Diagnostic horizons and features recognized in this pedon are:
Mollic epipedon: from the surface to a depth of 18 cm (7 inches) (Ap horizon).
Argillic horizon: from a depth of 25 to 46 cm (10 to 18 inches) (Bt1 and Bt2 horizons).
Aquic conditions: redoximorphic features present from a depth of 25 to 46 cm (10 to 18 inches) (Bt1 and Bt2 horizons).

HsB

LOCATION HORTONVILLE WI
Established Series
Rev. HFG-AAC
11/2004

HORTONVILLE SERIES

The Hortonville series consists of very deep, well drained soils formed primarily in calcareous loamy till on drumlins and ground moraines. Permeability is moderately slow. Slope ranges from 1 to 35 percent. Mean annual precipitation is about 30 inches. Mean annual temperature is about 48 degrees F.

TAXONOMIC CLASS: Fine-loamy, mixed, active, mesic Haplic Glossudalfs

TYPICAL PEDON: Hortonville fine sandy loam - on a west-facing 2 percent slope in an alfalfa-red clover field at an elevation of about 880 feet above mean sea level. (Colors are for moist soil unless otherwise stated.)

Ap--0 to 9 inches; dark grayish brown (10YR 4/2) fine sandy loam, light brownish gray (10YR 6/2) dry; weak fine subangular blocky structure; friable; common fine roots; about 6 percent gravel; slightly acid; abrupt smooth boundary. (6 to 9 inches thick)

B/E--9 to 12 inches; about 75 percent brown (7.5YR 4/4) sandy clay loam (Bt); strong fine and medium subangular blocky structure; firm; common faint dark brown (7.5YR 3/4) clay films on faces of peds; penetrated by tongues of brown (10YR 5/3) fine sandy loam (E), light gray (10YR 7/2) dry; weak medium platy structure; friable; common fine roots; few worm holes and casts in upper 1 to 2 inches; about 1 percent gravel; slightly acid; clear wavy boundary. (Glossic horizon - 2 to 19 inches thick)

Bt1--12 to 16 inches; reddish brown (5YR 4/4) clay loam; weak coarse prismatic structure parting to strong fine angular blocky; firm; common fine roots; many faint reddish brown (5YR 4/3) clay films on faces of peds; few light gray (10YR 7/2) dry, coatings on vertical faces of prisms; about 1 percent gravel; neutral; clear wavy boundary.

Bt2--16 to 22 inches; reddish brown (5YR 4/4) clay loam; weak coarse prismatic structure parting to strong fine angular blocky; firm; common fine roots; many faint reddish brown (5YR 4/3) clay films on faces of peds; about 5 percent gravel; slightly alkaline; clear wavy boundary.

Bt3--22 to 28 inches; reddish brown (5YR 4/4) loam; moderate medium subangular blocky structure; firm; common fine roots; few faint reddish brown (5YR 4/3) clay films

mainly on vertical faces of peds; about 12 percent gravel and 2 percent cobbles; slightly alkaline; clear wavy boundary. (Combined thickness of the Bt horizons ranges from 8 to 30 inches.)

C--28 to 60 inches; reddish brown (5YR 4/4) fine sandy loam; massive; firm; few fine roots; about 10 percent gravel and 2 percent cobbles; slightly effervescent; moderately alkaline.

TYPE LOCATION: Waupaca County, Wisconsin; about 1.5 miles south and 2 miles west of Weyauwega; 2580 feet south and 1080 feet west of the northeast corner of sec. 18, T. 21 N., R. 13 E.; USGS Weyauwega, Wisconsin topographic quadrangle; I lat. 44 degrees 17 minutes 37 seconds N., and long. 88 degrees 57 minutes 56 seconds W., NAD 27

RANGE IN CHARACTERISTICS: Depth to the base of the argillic horizon and to carbonates ranges from 20 to 40 inches. Some pedons have a silt loam mantle less than 12 inches thick. Clay content averages from 27 to 35 percent in the particle-size control section but ranges from 20 to 40 percent in individual subhorizons of the argillic. Volume of gravel ranges from 1 to 15 percent throughout. Volume of cobbles ranges from 0 to 5 percent throughout. Reaction naturally is moderately acid or slightly acid in the surface layer and upper subsoil but ranges to slightly alkaline, where the soil is limed. Reaction ranges from moderately acid to slightly alkaline in the lower part of the subsoil and is slightly alkaline or moderately alkaline in the substratum. Carbonates are in the substratum and, in some pedons, are in the lower part of the subsoil. The calcium carbonate equivalent ranges from 15 to 40 percent in the substratum.

The Ap horizon has hue of 7.5YR or 10YR, value of 3 or 4, and chroma of 2 or 3. Dry value exceeds 5.5. Uncultivated pedons have an A horizon, 1 to 5 inches thick, with hue of 7.5YR or 10YR, value of 2 or 3, and chroma of 1 or 2. Texture of the Ap or A horizon is silt loam, loam, or fine sandy loam.

Some pedons have an E horizon with hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 2 or 3. Colors of 4/3 and 5/3 have dry value of 7 or more. Texture is fine sandy loam, loam, or silt loam.

Hortonville soils have a glossic horizon (E/B or B/E horizon, or both) (2E/B or 2B/E in pedons with a thin silty mantle). The E part has color like the E horizon described above. Texture is fine sandy loam or loam. The Bt part has hue of 5YR, or 7.5YR, value of 3 to 6; and chroma of 4 to 6. Texture is typically silty clay loam with more than 15 percent sand or clay loam but is sandy clay loam in some pedons.

The Bt horizon (2Bt in pedons with a thin silt loam mantle) has dominant hue of 5YR or 7.5YR but some pedons have subhorizons with hue of 2.5 YR or 7.5YR. Hue of 5YR occurs in some part of the Bt horizon. Value is 3 to 6 and chroma is 4 to 6. Texture is mostly clay loam or silty clay loam with more than 15 percent sand but grades to loam or fine sandy loam in the lower part in most pedons.

The C horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. Texture is fine sandy loam or loam. The calcium carbonate equivalent ranges from 15 to 40 percent.

COMPETING SERIES: These are the [Guelph](#), and [Waymor](#) series. Guelph soils have hues yellower than 5YR throughout the argillic horizon. Waymor soils average 18 to 27 percent clay in the particle size control section.

GEOGRAPHIC SETTING: Hortonville soils are on drumlins and ground moraines. Slope ranges from 1 to 35 percent. Hortonville soils formed mostly in calcareous loamy till of late Wisconsinan Age. Mean annual precipitation ranges from 28 to 33 inches. Mean annual air temperature ranges from 46 to 50 degrees F. The frost free period ranges from about 135 to 155 days. Elevation ranges from 700 feet to 1000 feet.

GEOGRAPHICALLY ASSOCIATED SOILS: These are mainly the [Symco](#) and [Kewaunee](#) soils. The somewhat poorly drained Symco soils form a drainage sequence with the Hortonville soils. Kewaunee soils are nearby on landscape positions similar to those of Hortonville soils where there is more clay in the soil.

DRAINAGE AND PERMEABILITY: Well drained. The potential for surface runoff ranges from medium to very high. Permeability is moderately.

USE AND VEGETATION: Most areas are used for cropland. Common crops are corn, small grain, and hay. A few areas are used for pastureland or woodland. Native vegetation is mixed hardwood forest. Common trees are American basswood, sugar maple, northern red oak, and yellow birch.

DISTRIBUTION AND EXTENT: East-central Wisconsin. Hortonville soils are of large extent.

MLRA OFFICE RESPONSIBLE: Indianapolis, Indiana

SERIES ESTABLISHED: Outagamie County, Wisconsin, 1975.

REMARKS: The Hortonville soils were formerly included with the Kewaunee series.

A new series is needed for 1,755 acres correlated as Hortonville, limestone substratum in Outagamie County (limestone at 40 to 60 inches).

In Winnebago County, there are 28,568 ac. correlated as a Taxadjunct to the Hortonville series because they do not have a glossic horizon. It appears they classify as fine-loamy, mixed, active, mesic Typic Hapludalfs. They do not fit any existing series. A new series is needed.

10/04 The difference in concept between Hortonville and Waymor is unclear. It appears that, at the time of mapping, the concept was that Hortonville had more clay than Waymor in the lower subsoil and in the substratum. However, numerous field

descriptions and limited lab data do not show a significant mutually exclusive difference. This revision differentiates the two soils based on the weighted average clay content in the particle-size control section (18-27% for Waymor and 27-35% for Hortonville). The limited lab data available supports this. However, field descriptions do not entirely support this separation. For example, the typical pedon for Waymor in Kewaunee County has textures of silty clay loam and clay loam in the argillic horizon. If the textures are correct, this pedon would average more than 27 percent clay in the argillic. Additional study of these two soils is needed to determine if they can be separated and on what criteria.

Diagnostic horizons and features recognized in this pedon are: ochric epipedon - 0 to 9 inches (Ap); glossic horizon - 9 to 12 inches (B/E); argillic horizon - 9 to 28 inches (B/E, Bt1, Bt2, Bt3); haplic feature - glossic horizon less than 20 inches thick.

ADDITIONAL DATA: Refer to soil survey sample number S78WI-135-003 for NSSL data on the typical pedon.

National Cooperative Soil Survey
U.S.A.

KuA

LOCATION KIBBIE

MI+OH WI

Established Series

Rev. NWS-LWB-RAR

06/2011

KIBBIE SERIES

The Kibbie series consists of very deep, somewhat poorly drained soils on lake plains, ground moraines, outwash plains, and deltas. They formed in stratified loamy and silty glaciofluvial or glaciolacustrine deposits. Slope ranges from 0 to 6 percent. Mean annual precipitation is about 813 mm (32 inches), and mean annual temperature is about 9.4 degrees C (49 degrees F).

TAXONOMIC CLASS: Fine-loamy, mixed, active, mesic Aquollic Hapludalfs

TYPICAL PEDON: Kibbie loam, on a 2 percent slope in a cultivated field. (Colors are for moist soil unless otherwise stated.)

Ap--0 to 18 cm (7 inches); very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; many fine roots; slightly acid; abrupt smooth boundary. [15 to 23 cm (6 to 9 inches) thick]

E--18 to 28 cm (7 to 11 inches); grayish brown (10YR 5/2) loam; moderate medium granular structure; friable; many fine roots; many medium distinct yellowish brown (10YR 5/4) masses of oxidized iron in the matrix; slightly acid; clear smooth boundary. [0 to 15 cm (6 inches) thick]

Bt1--28 to 48 cm (11 to 19 inches); brown (10YR 5/3) silt loam; moderate medium subangular blocky structure; firm; many fine roots; few lenses of very fine sand 3 to 25.4 mm (1/8- to 1-inch) thick; thin clay films on faces of peds and in root channels; common medium faint brown (10YR 4/3) iron depletions in the matrix; slightly acid; gradual wavy boundary.

Bt2--48 to 86 cm (19 to 34 inches); brown (10YR 5/3) silty clay loam; moderate medium subangular blocky structure; firm; few fine roots; thin lenses of very fine sand and silt loam; thin clay films on faces of peds and in some root channels; many medium distinct yellowish brown (10YR 5/6) masses of oxidized iron in the matrix; common medium faint light brownish gray (10YR 6/2) iron depletions in the matrix; neutral; abrupt wavy boundary. (Combined thickness of the Bt horizon is 20 to 86 cm (8 to 34 inches).)

C--86 to 152 cm (34 to 60 inches); brown (10YR 5/3) stratified silt loam, fine sand and very fine sand; massive; friable; common medium prominent yellowish brown (10YR 5/8) masses of oxidized iron in the matrix; many medium faint light brownish gray (10YR 6/2) iron depletions in the matrix; strongly effervescent; slightly alkaline.

TYPE LOCATION: Lapeer County, Michigan; about 9 miles east and 2 1/2 miles north of North Branch; 760 feet east and 420 feet north of the southwest corner of southeast quarter of sec. 23, T. 10 N., R. 12 E.

RANGE IN CHARACTERISTICS:

Thickness of the solum: typically 71 to 107 cm (28 to 42 inches) but ranges from 61 to 122 cm (24 to 48 inches)

Depth to carbonates: typically 71 to 107 cm (28 to 42 inches) but ranges from 61 to 122 cm (24 to 48 inches)

Particle-size control section: averages 18 to 35 percent clay

Rock fragment content: 0 to 1 percent

Ap horizon:

Hue: 10YR

Value: 2 or 3, 5 or less dry

Chroma: 1 to 3

Texture: loam, silt loam, very fine sandy loam, fine sandy loam, or loamy fine sand

Rock fragment content: 0 to 1 percent

Reaction: moderately acid to neutral

E horizon:

Hue: 10YR

Value: 5 or 6

Chroma: 2 or 3

Texture: loam, silt loam, very fine sandy loam, fine sandy loam, or loamy fine sand

Rock fragment content: 0 to 1 percent

Reaction: moderately acid to neutral

Bt horizon:

Hue: 10YR or 2.5Y

Value: 4 to 6

Chroma: 3 to 6

Texture: loam, clay loam, sandy clay loam, silty clay loam, or silt loam; thickness and sequence of strata of silt loam, fine sandy loam, fine sand, and very fine sand are variable within short horizontal distances

Rock fragment content: 0 to 1 percent

Reaction: moderately acid to neutral, and includes slightly alkaline in the lower part

Some pedons have a BC or BCg horizon. Some pedons have Bk horizons with colors and textures similar to that of the C horizon.

C or Cg horizon:

Hue: 10YR or 2.5Y

Value: 5 or 6

Chroma: 2 to 4

Texture: thickness and sequence of layers of different textures vary within short horizontal

distances; strata are dominantly silt loam to fine sand and range in thickness from 6 mm to more than 38 cm (1/4 to more than 15 inches); in some pedons strata 6 mm to 8 cm (1/4 to 3 inches) thick ranging from clay to loamy sand or fine sand are in the lower part of the B horizon and in the C horizon

Rock fragment content: 0 to 1 percent

Reaction: slightly alkaline or moderately alkaline

Silty clay loam and clay loam till is below 102 cm (40 inches) in some pedons. Sandy substratum phases that have sand or fine sand below 102 cm (40 inches) are presently. These sandy substratum phases may have stratified silt loam to sand between the solum and sandy substratum. See REMARKS.

COMPETING SERIES: These are the [Alida](#), [Ashippun](#), [Lourdes](#), [Marker](#), [Montmorenci](#), and [Symco](#) series. Alida, Ashippun, Lourdes, Marker, Montmorenci, and Symco soils contain more than 1 percent rock fragments in some part of the series control section.

GEOGRAPHIC SETTING: Kibbie soils are on lake plains, ground moraines, outwash plains, and deltas of Wisconsin age. Slope ranges from 0 to 6 percent. Kibbie soils formed in stratified loamy and silty glaciofluvial or glaciolacustrine deposits. Mean annual precipitation ranges from 711 to 914 mm (28 to 36 inches). Mean annual temperature ranges from 8.3 to 10.0 degrees C (47 to 50 degrees F).

GEOGRAPHICALLY ASSOCIATED SOILS: The poorly drained or very poorly drained [Colwood](#), the well drained [Sisson](#), and the moderately well drained [Tuscola](#) soils are in a drainage sequence with Kibbie soils. [Conover](#) and [Metamora](#) soils are associated where deltas and outwash plains grade into till plains. The Del Rey and the poorly drained or very poorly drained [Lenawee](#) soils are associated on lake plains.

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY: Somewhat poorly drained. Depth to the seasonal high water table ranges from 30 to 61 cm (1 to 2 feet) below the surface from November to May in normal years. Potential for surface runoff is negligible to medium. Saturated hydraulic conductivity is moderately high. Permeability is moderate.

USE AND VEGETATION: Most areas are cultivated. Corn, small grains, beans, and hay are the principal crops. A small part is in permanent pasture or in woodland. Native vegetation is forests of American elm, American beech, red maple, and American basswood.

DISTRIBUTION AND EXTENT: MLRAs 95A, 95B, 96, 97, 98, 99, and 111B in southern Michigan, southeastern Wisconsin, and northwestern Ohio. The series is of large extent.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Indianapolis, Indiana.

SERIES ESTABLISHED: Newton County, Indiana; 1943.

REMARKS: The till substratum and sandy substratum phases will become new series when their area of use is updated.

Diagnostic horizons and features recognized in this pedon are:

Ochric epipedon: from the surface to a depth of 28 cm (11 inches) (Ap and E horizons).

Albic horizon: from a depth of 18 to 28 cm (7 to 11 inches) (E horizon).

Argillic horizon: from a depth of 28 to 86 cm (11 to 34 inches) (Bt1 and Bt2 horizons).

Aquic conditions: iron depletions with chroma of 2 or less in horizons below a depth of 48 cm (19 inches) (Bt2 and C horizons).

National Cooperative Soil Survey

U.S.A.

LmA

LOCATION LAMARTINE

WI+IL

Established Series

Rev. GWH-AAC

01/2011

LAMARTINE SERIES

The Lamartine series consists of very deep, somewhat poorly drained soils formed in loess and in the underlying loamy till on ground moraines and interdrumlin areas. Slope ranges from 0 to 6 percent. Mean annual precipitation is about 737 mm (29 inches). Mean annual air temperature is about 8.3 degrees C (47 degrees F).

TAXONOMIC CLASS: Fine-silty, mixed, superactive, mesic Aquollic Hapludalfs

TYPICAL PEDON: Lamartine silt loam - on a 4 percent slope in a cultivated field at an elevation of about 271 meters (890 feet) above mean sea level. (Colors are for moist soil unless otherwise stated.)

Ap--0 to 20 cm (0 to 8 inches); very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate medium and fine granular structure; friable; neutral; abrupt smooth boundary. [15 to 23 cm (6 to 9 inches) thick]

E--20 to 28 cm (8 to 11 inches); dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) silt loam; weak medium platy structure parting to weak very fine subangular blocky; friable; many worm casts; few fine prominent yellowish brown (10YR 5/6) masses of oxidized iron in the matrix; neutral; clear wavy boundary. [0 to 13 cm (0 to 5 inches) thick]

Bt1--28 to 43 cm (11 to 17 inches); brown (10YR 4/3) silt loam; weak and moderate fine subangular blocky structure; friable; few distinct very dark grayish brown (10YR 3/2) organo-clay films on faces of peds; common medium distinct yellowish brown (10YR 5/6) masses of oxidized iron in the matrix; common medium faint grayish brown (10YR 5/2) iron depletions in the matrix; slightly acid; clear irregular boundary. [10 to 15 cm (4 to 6 inches) thick]

Bt2--43 to 71 cm (17 to 28 inches); brown (10YR 4/3) silty clay loam; moderate medium subangular and angular blocky structure parting to moderate fine subangular and angular blocky; firm; many distinct dark brown (7.5YR 3/2) clay films on faces of peds; many fine distinct yellowish brown (10YR 5/6) masses of oxidized iron in the matrix; many fine faint grayish brown (10YR 5/2) iron depletions in the matrix; neutral; clear irregular boundary. [20 to 31 cm (8 to 12 inches) thick]

2Bt3--71 to 89 cm (28 to 35 inches); brown (10YR 4/3) and brown (10YR 5/3) clay loam; moderate medium subangular and angular blocky structure; firm; many distinct dark brown

(7.5YR 3/3) clay films on faces of peds; many medium prominent yellowish brown (10YR 5/8) masses of oxidized iron in the matrix; many medium faint light brownish gray (10YR 6/2) iron depletions in the matrix; slightly alkaline; clear irregular boundary. [5 to 20 cm (2 to 8 inches) thick]

2C--89 to 152 cm (35 to 60 inches); yellowish brown (10YR 5/4) loam; massive; friable; many medium prominent yellowish brown (10YR 5/8) masses of iron accumulation in the matrix; many medium distinct grayish brown (10YR 5/2) iron depletions in the matrix; about 8 percent gravel; strongly effervescent; moderately alkaline.

TYPE LOCATION: Fond du Lac County, Wisconsin; about 2 1/2 miles north of Eldorado; 875 feet east and 2590 feet south from the northwest corner of sec. 17, T. 16 N., R. 16 E. USGS Eldorado, Wisconsin topographic quadrangle; lat. 43 degrees 51 minutes 31 seconds N., and long. 88 degrees 37 minutes 17 seconds W., NAD 27.

RANGE IN CHARACTERISTICS:

Depth to the base of the argillic horizon: 61 to 102 cm (24 to 40 inches)

Thickness of the loess mantle: 51 to 91 cm (20 to 36 inches)

Particle-size control section: averages 25 to 35 percent clay

Volume of gravel: 0 to 15 percent in 2Bt horizon and ranges from 5 to 50 percent in the 2C horizon

Volume of cobbles: 0 to 3 percent in the 2Bt and 2C horizons

Reaction ranges from moderately acid to slightly alkaline in the upper part of the solum and ranges from slightly acid to slightly alkaline in the lower part, and is slightly or moderately alkaline in the substratum.

Redox features and saturation: typically throughout the soil below the Ap horizon; redox depletions with chroma of 2 or less in the upper 25 cm (10 inches) of the argillic horizon

Ap or A horizon:

Hue: 10YR

Value: 2 or 3

Chroma: 1 or 2

Texture: silt loam.

The E horizon (where present):

Hue: 10YR

Value: 4 or 5

Chroma: 2 or 3

Texture: silt loam.

Bt horizon:

Hue: 10YR or 2.5Y

Value: 4 or 5

Chroma: 3 to 6

Texture: silty clay loam and, less commonly, silt loam.

2Bt horizon:

Hue: 7.5YR, 10YR, 2.5Y, or N

Value: 4 to 6

Chroma: 0 to 6

Texture: clay loam or loam.

Other features:

Carbonates are in the lower part of the 2Bt horizon in some pedons.

2C horizon:

Hue: 7.5YR or 10YR

Value: 4 to 6

Chroma: 2 to 4

Texture: loam, but the range includes sandy loam, fine sandy loam, or the gravelly analogs.

Sand content: 40 to 70 percent

Calcium carbonate equivalent; 20 to 90 percent

COMPETING SERIES: This is the [Millstream](#) series. Millstream soils have more than 75 percent sand in the lower part of the series control section.

GEOGRAPHIC SETTING: Lamartine soils typically are on nearly level to sloping ridgetops and foot slopes of ground moraines and interdrumlin areas. Slopes range from 0 to 6 percent. These soils formed in loess and in the underlying loamy till. Mean annual precipitation ranges from 686 to 890 mm (27 to 35 inches). Mean annual air temperature ranges from 7.2 to 11.7 degrees C (45 to 53 degrees F).

GEOGRAPHICALLY ASSOCIATED SOILS: These are the [Conover](#), [Dodge](#), [Kendall](#), and [Mayville](#) soils. The well drained Dodge and the moderately well drained Mayville are common associates on the somewhat steeper gradients. Kendall soils are on nearby areas of similar slopes where loess thickens beyond 91 cm (36 inches), and Conover soils are on nearby areas of similar slopes where loess thins out to less than 51 cm (20 inches).

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY: Somewhat poorly drained. Potential for surface runoff is negligible to medium. Saturated hydraulic conductivity is moderately high to high (4.23 to 14.11 micrometers per second). Permeability is moderate. These soils have an apparent seasonal high water table at a depth of 31 to 76 cm (1 to 2.5 feet) for some time in most years.

USE AND VEGETATION: Most of the soil is used for cropland. Common crops are corn, small grain, and hay. Native vegetation is primarily deciduous forest with maple-basswood and oak-hickory predominating.

DISTRIBUTION AND EXTENT: MLRAs 95A, and 95B in southeastern Wisconsin. The Lamartine soils are of moderate extent.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Indianapolis, Indiana

SERIES ESTABLISHED: Green County, Wisconsin, 1969.

REMARKS:

Diagnostic horizons and features recognized in this pedon are: ochric epipedon - 0 to 28 cm (0 to 11 inches) (Ap, E); argillic horizon - 28 to 89 cm (11 to 35 inches) (Bt1, Bt2, 2Bt3); mollic feature have an Ap horizon with color value, moist, of less than 4 and color value, dry, of less than 6; aquic feature redox depletions with chroma of 2 or less and saturation in the upper 25 cm of the argillic horizon.

National Cooperative Soil Survey

U.S.A.

Mk

LOCATION MARKEY

MI+ME MN ND NY VT WI

Established Series

Rev. RWJ-WEF-JJJ-JFH

06/2007

MARKEY SERIES

The Markey series consists of very deep, very poorly drained organic soils. They formed in herbaceous organic material 40 to 130 centimeters thick overlying sandy deposits in depressions on outwash plains, lake plains, flood plains, river terraces, valley trains, and moraines. Saturated hydraulic conductivity is moderately slow to moderately rapid in the organic layers and rapid or very rapid in the sandy material. Slopes range from 0 to 2 percent. Mean annual precipitation is about 760 millimeters. Mean annual air temperature is about 6 degrees C.

TAXONOMIC CLASS: Sandy or sandy-skeletal, mixed, euic, frigid Terric Haplosaprists

TYPICAL PEDON: Markey muck - on a slope of 1 percent in a bog with marsh vegetation. (Colors are for moist soil unless otherwise stated.)

Oa1--0 to 23 centimeters; very dark brown (10YR 2/2), black (10YR 2/1) rubbed muck (sapric material); about 10 percent fibers, less than 5 percent rubbed; weak thin platy structure; fibers are primarily herbaceous; slightly alkaline (pH 7.5 in water); clear smooth boundary.

Oa2--23 to 30 centimeters; very dark grayish brown (10YR 3/2), very dark brown (10YR 2/2) rubbed muck (sapric material) about 20 percent fiber, less than 5 percent rubbed; weak thin platy structure; fibers are primarily herbaceous; slightly alkaline (pH 7.5 in water); clear smooth boundary.

Oa3--30 to 61 centimeters; very dark brown (10YR 2/2) on broken face and rubbed muck (sapric material); about 10 percent fiber, less than 5 percent rubbed; moderate thick platy structure; fibers are primarily herbaceous; about 20 percent mineral soil material; slightly alkaline (pH 7.5 in water); gradual wavy boundary.

Oa4--61 to 81 centimeters; very dark brown (10YR 2/2), black (10YR 2/1) rubbed muck (sapric material); about 5 percent fiber, less than 5 percent rubbed; weak coarse subangular blocky structure; primarily herbaceous fibers; less than 10 percent mineral soil material; slightly alkaline (pH 7.5 in water); abrupt smooth boundary. (Combined thickness of Oa horizons is 40 to 130 centimeters.)

Cg--81 to 152 centimeters; gray (N 5/0) sand; single grain; loose; slightly alkaline.

TYPE LOCATION: Major Land Resource Area 94A Northern Michigan and Wisconsin Sandy Drift, Clare County Michigan Subset; about 2 miles north of Clare; 660 feet east and 891 feet north of the southwest corner, sec. 13, T. 17 N., R. 4 W. USGS Loomis Quadrangle; 43 degrees 51 minutes 39 seconds north latitude, 89 degrees 44 minutes 44 seconds west longitude; NAD 83.

RANGE IN CHARACTERISTICS: The depth to the sandy C horizon is commonly 61 to 107 centimeters and ranges from 40 to 130 centimeters. The organic material is primarily derived from herbaceous plants. There are no free carbonates in the organic material. Some pedons contain as much as 15 percent by volume of fragments of twigs, branches, or logs that range from about 0.3 to 15 centimeters in diameter.

Oi horizon (when present on the surface):

Thickness 2 to 10 centimeters

Organic material sphagnum moss

Oa horizons:

Hue 2.5YR to 10YR, or neutral

Value - 2 to 4

Chroma - 0 to 3

Reaction - pH 4.5 to 7.8 in 0.01M calcium chloride

--Broken face, rubbed, and pressed soil material may vary by one unit in color value or chroma or both.

The organic layer immediately above C horizons commonly contains more mineral soil material than overlying organic layers.

A horizon (when present):

Hue 10YR to 2.5Y, or neutral

Value 2 or 3

Chroma 0 or 1

Texture fine sandy loam, sandy loam, loamy fine sand, or loamy sand

Reaction pH 5.6 to 7.3

Thickness 0 to 10 centimeters

C horizon:

Hue - 7.5YR to 5Y, or neutral

Value - 4 to 6

Chroma - 0 to 4

Texture - sand, fine sand, coarse sand, loamy sand, and the gravelly analogs of loamy sand, sand, and coarse sand

Gravel content - 0 to 35 percent by volume

Reaction - very strongly acid to moderately alkaline

- Thin layers of loamy materials overlying the sand are included.
- Some pedons in floodplains have thin layers of organic materials.

Surface tier (0 to 30 centimeters):

Organic material - mainly sapric material, but some pedons have either sapric or hemic material or both in varying proportions.

Structure - weak platy or granular, but in some pedons is massive.

Subsurface tier (30 to 90 centimeters):

Organic material dominantly sapric material, but some pedons have as much as 25 centimeters of hemic material or 13 centimeters of fibric material.

Structure, organic material - weak, thick to thin platy, weak coarse granular, or blocky subangular blocky

Structure, mineral material - structureless (massive or single grain)

Bottom tier (90 to 130 centimeters):

Structure, organic material - weak, thick to thin platy, weak coarse granular, or blocky subangular blocky

Structure, mineral material - structureless (massive or single grain)

COMPETING SERIES: These are the [Pondicherry](#) and [Tawas](#) series. Pondicherry soils have higher mean annual precipitation. Tawas soils are formed primarily from woody plant materials.

GEOGRAPHIC SETTING: Markey soils are in depressions within outwash plains, lake plains, flood plains, river terraces, valley trains, and moraines. Soils on nearby uplands are predominantly sandy.

Slope - 0 to 2 percent

Mean annual precipitation - 380 to 1120 millimeters.

Mean annual air temperature - 2 to 8 degrees C.

Frost free period - 70 to 145 days

Elevation - 180 to 855 meters above sea level

GEOGRAPHICALLY ASSOCIATED SOILS: These are the [Carbondale](#), [Greenwood](#), and [Rifle](#) soils; and the [Deford](#), [Kinross](#), and [Roscommon](#) soils.

Carbondale - formed in herbaceous organic material greater than 130 centimeters thick and are in the Hemic Haplosaprists Subgroup.

Greenwood - formed in mostly hemic soil material greater than 130 centimeters thick, are in the dysic reaction class, and in the Typic Haplohemists Subgroup.

Rifle soils formed in mostly hemic soil material greater than 130 centimeters thick and are in the Typic Haplohemists Subgroup.

Deford, Kinross, and Roscommon - are poorly drained sandy soils near the edge of the bogs.

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY:

Drainage class - Depth to the seasonal high water table ranges from 30 centimeters above

the surface to 15 centimeters below the surface during November to June in most years (very poorly drained).

Flooding frequency - occasional and frequent

Surface runoff potential negligible

Saturated hydraulic conductivity - moderately slow to moderately rapid in the organic material and rapid or very rapid in the sandy material

USE AND VEGETATION: Most of this soil is in native vegetation. Most areas are forested with black ash, quaking aspen, balsam fir, black spruce, tamarack, northern white-cedar, and paper birch. Some areas are in cattails, marsh grasses, reeds, and sedges. A small part is used for permanent pasture.

DISTRIBUTION AND EXTENT:

Physiographic Divisions

--Interior Plains

--Laurentian Upland

--Appalachian Highlands

Physiographic Provinces

--Central Lowland

--Superior Upland

--St. Lawrence Valley

--Adirondack

--New England

Physiographic Sections

--Western Lake

--Eastern Lake

--Champlain

--New England Upland

--Green Mountain

Land Resource Regions

--Northern Great Plains Spring Wheat Region (LRR F)

--Northern Lake States Forest and Forage Region (LRR K)

--Lake States Fruit, Truck Crop, and Dairy Region (LRR L)

--Northeastern Forage and Forest Region (LRR R)

Major Land Resource Areas

--Central Black Glaciated Plains (MLRA 55B)

--Red River Valley of the North (MLRA 56)

--Northern Minnesota Gray Drift (MLRA 57)

--Northern Minnesota Glacial Lake Basins (MLRA 88)

--Wisconsin and Minnesota Thin Loess and Till, Northern Part (MLRA 90A)

--Central Minnesota Sandy Outwash (MLRA 91A)

--Wisconsin and Minnesota Sandy Outwash (MLRA 91B)

--Superior Stony and Rocky Loamy Plains and Hills, Eastern Part (MLRA 93B)

--Northern Michigan and Wisconsin Sandy Drift (MLRA 94A)

--Michigan Eastern Upper Peninsula Sandy Drift (MLRA 94B)

--Northeastern Wisconsin Drift Plain (MLRA 95A)

- Western Michigan and Northeastern Wisconsin Fruit Belt (MLRA 96)
- Southern Michigan and Northern Indiana Drift Plain (MLRA 98)
- St. Lawrence-Champlain Plain (MLRA 142)
- Northeastern Mountains (MLRA 143)
- New England and Eastern New York Upland, Northern Part (MLRA 144B)

The series is extensive.

MLRA OFFICE RESPONSIBLE: St. Paul, Minnesota

SERIES ESTABLISHED: Grand Traverse County, Michigan, 1963.

REMARKS: Diagnostic horizons and features recognized in the typical pedon are: Well decomposed organic soil materials (sapric) 0 to 81 centimeters (Oa1, Oa2, Oa3, and Oa4 horizons)

Terric subgroup - a mineral layer 30 centimeters or more thick between 30 and 130 centimeters

National Cooperative Soil Survey
U.S.A.

MmA

LOCATION MATHERTON

MI+IN WI

Established Series

Rev. NWS-LWB-WEF-TJE

04/2009

MATHERTON SERIES

The Matherton series consists of very deep, somewhat poorly drained soils formed in loamy glaciofluvial material and gravelly or sandy outwash on outwash plains, valley trains, and stream terraces on terrace landscapes. Permeability is moderate in the loamy material and rapid or very rapid in the underlying material. Slope ranges from 0 to 6 percent. Mean annual precipitation is about 32 inches, and mean annual temperature is about 48 degrees F.

TAXONOMIC CLASS: Fine-loamy over sandy or sandy-skeletal, mixed, superactive, mesic Udollic Endoaqualfs

TYPICAL PEDON: Matherton sandy loam, on a concave, 2 percent slope in a cultivated field at an elevation of 727 feet. (Colors are for moist soil unless otherwise stated.)

Ap--0 to 8 inches; very dark grayish brown (10YR 3/2) sandy loam, grayish brown (10YR 5/2) dry, weak medium granular structure; slightly acid; abrupt smooth boundary. (6 to 10 inches thick)

Eg--8 to 11 inches; grayish brown (10YR 5/2) sandy loam; weak coarse granular structure; friable; few fine distinct yellowish brown (10YR 5/6) masses of iron oxide accumulation; slightly acid; clear wavy boundary. (0 to 7 inches thick)

Bt--11 to 19 inches; brown (10YR 5/3) sandy clay loam; moderate medium subangular blocky structure; firm; common thin grayish brown (10YR 5/2) clay films on faces of peds; common medium faint olive brown (2.5Y 4/4) masses of iron oxide accumulation; slightly acid; clear wavy boundary.

Btg--19 to 35 inches; grayish brown (10YR 5/2) gravelly clay loam; weak medium subangular blocky structure; firm; common thin clay films on faces of peds; about 20 percent gravel; neutral; abrupt irregular boundary. (Combined thickness of the Bt horizon is 8 to 28 inches.)

2Cg--35 to 60 inches; light gray (10YR 7/1) very gravelly sand; single grain; loose; about 50 percent gravel; strongly effervescent; moderately alkaline.

TYPE LOCATION: Shiawassee County, Michigan; about 2 miles northwest of Carland; 1,630 feet west and 400 feet north of the southeast corner of sec. 21, T. 8 N., R. 1 E.; U.S.G.S. Ovid East, MI topographic quadrangle; lat. 43 degrees 4 minutes 18.3 seconds N. and long. 84 degrees 20 minutes 59.7 seconds W., NAD 27; UTM Zone 16, 715761 easting and 4772193 northing, NAD 83.

RANGE IN CHARACTERISTICS: The thickness of the solum ranges from 24 to 40 inches. Reaction in the solum ranges from moderately acid to neutral, but the E horizon and Bt1 horizon are strongly acid in some pedons. Rock fragment content, mostly gravel, ranges from 0 to 15 percent in the A and E horizons, 2 to 30 percent in the Bt or 2Bt horizon, and 1 to 59 percent in the 2C horizon.

The Ap horizon has hue of 10YR, value 2 or 3, and chroma of 1 to 3. Some pedons have A horizons, 1 to 4 inches thick. The E horizon has hue of 10YR, value of 5 or 6, and chroma of 2. The A and E horizons are sandy loam, loam, or silt loam, or the gravelly analogues of these textures.

The Bt horizon has hue of 7.5YR to 2.5Y, value of 4 to 6, and chroma of 2 to 4. It is sandy clay loam, clay loam, or loam, or the gravelly analogues of these textures. Some pedons have thin subhorizons of fine sandy loam or sandy loam. Some pedons have 2Bt horizons of loamy sand, loamy coarse sand, or sandy loam with hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 4.

The 2C horizon has hue of 7.5YR to 2.5Y, value of 4 to 7, and chroma of 1 to 4. It is commonly gravelly sand, gravelly coarse sand, very gravelly sand, or stratified sand and gravelly sand, but the range includes fine sand or sand. Silty clay loam, clay loam, silty clay, or clay lacustrine material is below 40 inches in some pedons.

COMPETING SERIES: There are no other series in this family. Similar soils are the [Brady](#), [Homer](#), [Ionia](#), and [Wasepi](#) series. Brady and Wasepi soils have a coarse-loamy particle-size class. Homer soils have moist color value of more than 3 in the A horizon. Ionia soils do not have low chroma redox depletions within the upper 10 inches of the argillic horizon.

GEOGRAPHIC SETTING: Matherton soils formed in loamy glaciofluvial material and gravelly or sandy outwash on outwash plains, valley trains, and stream terraces on terrace landscapes. Slope gradients range from 0 to 6 percent. Mean annual precipitation ranges from 28 to 36 inches, mean annual temperature ranges from 47 to 50 degrees F., frost-free period ranges from 120 to 180 days, and elevation ranges from 580 to 1,300 feet above sea level.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the [Brady](#), [Fox](#), [Gilford](#), [Homer](#), [Ionia](#), [Sebewa](#) and [Wasepi](#) soils. The well drained Fox soils, the moderately well drained Ionia soils, and the very poorly drained or poorly drained Sebewa soils are in a drainage sequence with the Matherton soils. The very poorly drained or poorly drained Gilford soils have a mollic epipedon.

DRAINAGE AND PERMEABILITY: Somewhat poorly drained. The potential for surface runoff is negligible to medium. Permeability is moderate in the loamy material and rapid or very rapid in the underlying material. The depth to the seasonal high water table ranges from 1 to 2 feet below the surface for some time in normal years.

USE AND VEGETATION: The greater part is cropped to corn, beans, small grains, and hay. A small part is in permanent pasture or forest. The native vegetation is forest of red maple, American elm, white ash, swamp white oak, American basswood, and hickory.

DISTRIBUTION AND EXTENT: MLRAs 95A, 95B, 97, 98, 110, and 111 is southern Michigan, northern Indiana, eastern Wisconsin, and northeastern Illinois. The series is of moderate extent.

MLRA OFFICE RESPONSIBLE: Indianapolis, Indiana.

SERIES ESTABLISHED: McHenry County, Illinois, 1960.

REMARKS: Diagnostic horizons and features recognized in this pedon are: ochric epipedon - from the surface to 8 inches (Ap horizon); albic horizon - from 8 to 11 inches (Eg horizon); argillic horizon - from 11 to 35 inches (Bt and Btg horizons); aquic conditions - redoximorphic features present in all horizons between 8 and 60 inches.

ADDITIONAL DATA: Lab characterization data is available from the National Soil Survey Laboratory, Lincoln, NE.

My

LOCATION MUSSEY

MI+IN WI

Established Series

Rev. NWS

03/2011

MUSSEY SERIES

The Mussey series consists of very deep, poorly drained and very poorly drained that are shallow to sand and gravel. The Mussey soils formed in loamy outwash and are on outwash plains and valley trains. Slope ranges from 0 to 2 percent. Mean annual precipitation is about 813 mm (32 inches), and mean annual temperature is about 9.4 degrees C (49 degrees F).

TAXONOMIC CLASS: Fine-loamy over sandy or sandy-skeletal, mixed, semiactive, mesic Typic Argiaquolls

TYPICAL PEDON: Mussey loam, on a 1 percent slope in a cultivated field. (Colors are for moist soil unless otherwise stated.)

Ap--0 to 23 cm (9 inches); very dark brown (10YR 2/2) loam; moderate fine granular structure; friable; many fine roots; neutral; abrupt smooth boundary. [18 to 25 cm (7 to 10 inches) thick]

Btg1--23 to 30 cm (9 to 12 inches); dark gray (10YR 4/1) loam; weak fine subangular blocky structure; firm; many fine roots; few thin very dark gray (10YR 3/1) clay films; few fine distinct dark yellowish brown (10YR 4/4) and prominent yellowish brown (10YR 5/6) masses of oxidized iron; 2 percent gravel; neutral; clear wavy boundary. [0 to 10 cm (4 inches) thick]

Btg2--30 to 46 cm (12 to 18 inches); grayish brown (10YR 5/2) clay loam; moderate medium subangular blocky structure; firm; many fine roots; few thin clay films; common medium distinct dark yellowish brown (10YR 4/4) and prominent yellowish brown (10YR 5/6) masses of oxidized iron; 5 percent gravel; neutral; abrupt wavy boundary. [13 to 25 cm (5 to 10 inches) thick]

2C--46 to 152 cm (18 to 60 inches); grayish brown (10YR 5/2) gravelly sand; single grain; loose; many medium faint brown (10YR 5/3) masses of oxidized iron; many medium faint gray (10YR 6/1) iron depletions; 40 percent gravel; strongly effervescent; moderately alkaline.

TYPE LOCATION: Lapeer County, Michigan; about 2 miles east and 2 miles north of Dryden; 720 feet west and 320 feet south of the northeast corner of sec. 6, T. 6 N., R. 12 E.

RANGE IN CHARACTERISTICS:

Thickness of the solum: 30 to 51 cm (12 to 20 inches)

Reaction: slightly acid to slight alkaline in the solum

Mean annual soil temperature: 8.3 to 11.1 degrees C (47 to 52 degrees F)

A horizon:

Hue: 10YR

Value: 2 or 3

Chroma: 1 or 2

Texture: loam or sandy loam, or the gravelly analogues of these textures

Rock fragment content: 0 to 25 percent gravel and 0 to 5 percent cobbles

Btg horizon:

Hue: 10YR to 5Y

Value: 4 or 5

Chroma: 1 or 2

Texture: loam, sandy clay loam, or clay loam, or the gravelly analogues of these textures

Rock fragment content: 0 to 25 percent gravel and 0 to 5 percent cobbles

2C horizon:

Hue: 10YR to 5Y

Value: 5 or 6

Chroma: 1 or 2

Texture: gravelly sand, sand, or stratified sand and gravel

Rock fragment content: 0 to 40 percent gravel and 0 to 5 percent cobbles

COMPETING SERIES: There are no other series in the same family.

GEOGRAPHIC SETTING: Mussey soils are on outwash plains and valley trains. They formed in loamy outwash underlain by sand and gravel at depths of less than 20 inches. Slope ranges from 0 to 2 percent. Mean annual precipitation ranges from 711 to 864 mm (28 to 34 inches). Mean annual temperature ranges from 7.2 to 10.0 degrees C (45 to 50 degrees F).

GEOGRAPHICALLY ASSOCIATED SOILS: Mussey soils are in a drainage sequence with the somewhat excessively drained [Casco](#) soils and the somewhat poorly drained [Fabius](#) soils. [Gilford](#), [Sebewa](#) and the somewhat poorly drained [Wasepi](#) soils are associated on some outwash plains. All of these have thicker sola. In addition, Gilford and Wasepi soils are coarse-loamy.

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY: Poorly drained or very poorly drained. Potential for surface runoff is negligible. Saturated hydraulic conductivity is moderately high in the solum and high or very high in the substratum. Permeability is moderate in the solum and rapid in the substratum.

USE AND VEGETATION: About 90 percent of this soil is cultivated or in pasture. The remainder is in woodland. Corn, small grains, soybeans, and legume-grass hay are the principal crops. Native vegetation is mixed hardwoods, predominantly elm, ash, hickory, pin oak, and aspen.

DISTRIBUTION AND EXTENT: MLRAs 95A, 95B, and 98 in southern Michigan,

southeastern Wisconsin, and northern Indiana. The series is of moderate extent.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Indianapolis, Indiana.

SERIES ESTABLISHED: Lapeer County, Michigan, 1966.

REMARKS: Diagnostic horizons and features recognized in this pedon are:

Mollic epipedon: from the surface to a depth of 23 cm (9 inches) (Ap horizon).

Argillic horizon: from a depth of 23 to 46 cm (9 to 18 cm) (Btg horizon).

Strongly contrasting particle-sizes: clay loam to gravelly sand at 46 cm (18 inches).

Aquic conditions: redoximorphic features present in all horizons below the mollic epipedon.

National Cooperative Soil Survey

U.S.A.

Pe

LOCATION PELLA
Established Series
Rev. JCD-SLE
01/2009

IL+IN MI WI

PELLA SERIES

The Pella series consists of very deep, poorly drained soils formed in loamy sediments and the underlying stratified loamy glacial sediments on outwash plains and till plains. Slope ranges from 0 to 3 percent. Mean annual precipitation is about 838 mm (33 inches), and mean annual air temperature is about 11 degrees C (52 degrees F).

TAXONOMIC CLASS: Fine-silty, mixed, superactive, mesic Typic Endoaquolls

TYPICAL PEDON: Pella clay loam - nearly level in a cultivated field at an elevation of 204 meters (670 feet) above mean sea level. (Colors are for moist soil unless otherwise stated.)

Ap--0 to 15 cm (0 to 6 inches); black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; moderate medium angular blocky structure; friable; common fine roots; neutral; abrupt smooth boundary.

A--15 to 33 cm (6 to 13 inches); black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; moderate and strong medium granular structure; friable; common fine roots; few fine dark reddish brown (5YR 3/2) iron-manganese nodules and concretions throughout; neutral; clear smooth boundary.[Combined thickness of the A horizon is 25 to 51 cm (10 to 20 inches).]

BA--33 to 43 cm (13 to 17 inches); very dark gray (10YR 3/1) clay loam; moderate and strong medium and coarse granular structure; firm; common fine roots; few fine dark reddish brown (5YR 3/2) iron-manganese nodules and concretions throughout; common black krotovina; neutral; clear smooth boundary. [0 to 28 cm (0 to 11 inches) thick]

Btg1--43 to 64 cm (17 to 25 inches); olive gray (5Y 4/2) clay loam; moderate medium prismatic structure parting to moderate medium angular and subangular blocky; firm; common fine roots; common faint olive gray (5Y 5/2) clay films on faces of prisms; few fine dark reddish brown (5YR 3/2) iron-manganese nodules and concretions throughout; common black krotovina; few fine prominent yellowish brown (10YR 5/8) masses of oxidized iron in the matrix; slightly alkaline; clear smooth boundary.

Btg2--64 to 79 cm (25 to 31 inches); olive gray (5Y 5/2) silty clay loam; moderate and strong medium prismatic structure parting to strong medium angular blocky; firm;

common fine roots; common faint gray (5Y 5/1) clay films on faces of peds; few fine dark reddish brown (5YR 3/2) iron-manganese nodules and concretions throughout; common black krotovina; common fine prominent yellowish brown (10YR 5/8) masses of oxidized iron in the matrix; slightly alkaline; clear smooth boundary.

2Btg3--79 to 97 cm (31 to 38 inches); gray (5Y 5/1) stratified loam and silt loam; weak medium prismatic structure parting to weak medium angular and subangular blocky; firm; few fine roots; common faint gray (5Y 5/1) clay films on faces of prisms; few fine dark reddish brown (5YR 3/2) iron-manganese nodules and concretions throughout; common black krotovina; many medium prominent yellowish brown (10YR 5/6 and 5/8) masses of oxidized iron in the matrix; moderately alkaline; gradual wavy boundary. [Combined thickness of the Btg and 2Btg horizons is 23 to 64 cm (9 to 25 inches).]

2Cg1--97 to 130 cm (38 to 51 inches); gray (5Y 5/1) stratified sandy loam, silt loam, and clay loam; massive; friable and firm; very few fine roots; few fine dark reddish brown (5YR 3/2) iron-manganese nodules and concretions throughout; common black krotovina; many coarse prominent yellowish brown (10YR 5/6 and 5/8) masses of oxidized iron in the matrix; slightly effervescent (12 percent calcium carbonate); moderately alkaline; clear wavy boundary.

2Cg2--130 to 152 cm (51 to 60 inches); olive gray (5Y 5/2) stratified sandy loam, silt loam, and clay loam; massive; firm; few fine dark reddish brown (5YR 3/2) iron-manganese nodules and concretions throughout; few black krotovina; many medium prominent strong brown (7.5YR 5/6) and yellowish brown (10YR 5/8) masses of oxidized iron in the matrix; strongly effervescent (24 percent calcium carbonate); moderately alkaline.

TYPE LOCATION: Iroquois County, Illinois; about 4.8 kilometers (3 miles) west and 1.6 kilometers (1 mile) north of Onarga; 187.5 meters (615 feet) east and 30.5 meters (100 feet) south of the center of sec. 16, T. 26 N., R. 10 E.; USGS Onarga West topographic quadrangle; lat. 40 degrees 43 minutes 40 seconds N. and long. 88 degrees 04 minutes 28 seconds W., NAD 27; UTM Zone 16, 409262 easting and 4509098 northing, NAD 83.

RANGE IN CHARACTERISTICS: The depth to the base of the cambic horizon ranges from 76 to 127 cm (30 to 50 inches). The depth to carbonates ranges from 41 to 102 cm (16 to 40 inches). The mollic epipedon ranges from 25 to 61 cm (10 to 24 inches) in thickness. The particle-size control section averages less than 15 percent fine and coarser sand and averages between 27 and 35 percent clay.

The Ap, A, and/or AB horizon has hue of 10YR or is neutral, value of 2 to 3, and chroma of 0 to 2. It is silty clay loam, silt loam, or clay loam. Reaction ranges from slightly acid to slightly alkaline. Some pedons contain redoximorphic features in the lower part, and some have organic coatings on faces of peds.

The Btg and/or Bg horizon has hue of 5Y, 2.5Y, or 10YR; value of 4 to 6; chroma of 1 or 2; and has redoximorphic features. In addition to the colors stated, redoximorphic features have chroma that ranges to 8. The Btg or Bg horizon has individual subhorizons that are silty clay loam, clay loam, or silty clay. Reaction is neutral or slightly alkaline and contains carbonates in some pedons.

The 2Btg, 2BCg, and/or 2Bg horizon has hue of 5Y, 2.5Y, or 10YR; value of 5 or 6; and chroma of 1 to 8; and has redoximorphic features. The 2Btg or 2Bg horizon is stratified. It is dominantly silty clay loam, clay loam, silt loam, or loam, and contains strata of sandy loam, loamy sand, or sand in some pedons. Sand content averages more than 10 percent and is not dominated by fine or very fine sand. Some pedons contain as much as 10 percent rock fragments. Reaction is slightly alkaline or moderately alkaline and contains carbonates in most pedons.

The 2Cg horizon has hue of 5Y, 2.5Y, or 10YR; value of 5 or 6; and chroma of 1 to 8. In addition to the colors stated, some redoximorphic features have hue of 7.5YR. Typically some part of the matrix has chroma of 1 or 2 and redoximorphic features of higher chroma. This part is stratified silt loam, loam, silty clay loam, clay loam, or sandy loam, and some pedons contain thin lenses of sand or loamy sand. Sand content averages more than 10 percent and is not dominated by fine or very fine sand. Some pedons contain as much as 20 percent rock fragments. Reaction is moderately alkaline, or less commonly, slightly alkaline and contains carbonates.

COMPETING SERIES: These are the [Chalmers](#), [Chetomba](#), [Dolbee](#), [Drummer](#), [Dunham](#), [Elpaso](#), [Elvira](#), [Garwin](#), [Gillett Grove](#), [Hartsburg](#), [Madelia](#), [Marcus](#), [Mascoutah](#), [Maxcreek](#), [Maxfield](#), [Maxmore](#), [Ossian](#), [Patton](#), [Rushmore](#), [Sable](#), and [Wacousta](#) soils. Chalmers, Chetomba, Dolbee, Drummer, Elpaso, Garwin, Maxfield, Maxmore, Ossian, Patton, and Sable soils do not have carbonates above a depth of 102 cm (40 inches). Dunham soils average more than 15 percent gravel in the lower part of the series control section. Elvira soils have iron and manganese oxides in the B horizon and iron and manganese accumulations in the A horizon. Gillett Grove soils formed in 102 to 152 cm (40 to 60 inches) of loess and in the underlying glacial till. Hartsburg, Mascoutah, and Sable soils average less than 10 percent sand in the lower half of the series control section. Madelia soils have in the lower half of the series control section a sand fraction dominated by very fine sand or fine sand. Marcus soils average less than 10 percent sand in the lower part of the B horizon, and the C horizon is not stratified in the series control section. Maxcreek and Rushmore soils have well graded sand fractions lower two parts of the series control section. Wacousta soils have the base of the cambic horizon within a depth of 76 cm (30 inches).

GEOGRAPHIC SETTING: Pella soils are on nearly level or depressional areas on outwash plains and till plains thought to be of Wisconsin Age. They have plane or convex slopes with gradients typically less than 1 percent, but ranging from 0 to 3 percent. They formed in 51 to 102 cm (20 to 40 inches) of silty material with less than 15 percent sand coarser than very fine sand and the underlying stratified loamy sediments. Mean annual air temperature ranges from 7 to 12 degrees C (45 to 54 degrees F), mean annual

precipitation ranges from 71 to 102 cm (28 to 40 inches), frost-free period ranges from 140 to 180 days, and elevation ranges from 152 to 311 meters (500 to 1020 feet) above mean sea level.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the competing [Drummer](#) soils and the [Barrington](#), [Brenton](#), [Elburn](#), [Harpster](#), [Mundelein](#), [Peotone](#), and [Wauconda](#) soils. Drummer soils are slightly higher on the landform and commonly are adjacent to or surround areas of Pella. The moderately well drained Barrington soils and somewhat poorly drained Mundelein soils are on higher parts of the landform and form a drainage sequence with Pella. The somewhat poorly drained Brenton and Elburn soils have argillic horizons, lack carbonates within a depth of 102 cm (40 inches), and are on higher part of the landform. Harpster soils are on similar or slightly lower parts of the landform and are calcareous throughout. Peotone soils are on similar or slightly lower positions, have mollic epipedons more than 61 cm (24 inches) thick, and lack carbonates within a depth of 102 cm (40 inches). Wauconda soils lack mollic epipedons and are on slightly higher parts of the landscape.

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY: Poorly drained. An apparent seasonal high water table is at 15 cm (0.5 foot) above the surface to 31 cm (1.0 foot) below the surface at some time during spring in most years. The potential for surface runoff is negligible to low. Saturated hydraulic conductivity is moderately high or high (4.23 to 14.11 micrometers per second). Permeability is moderate.

USE AND VEGETATION: Most areas of these soils are used for cultivated crops. Corn and soybeans are the principal crops. Native vegetation is probably marsh grasses and sedges.

DISTRIBUTION AND EXTENT: Illinois, Indiana, Michigan, and Wisconsin in MLRA 95A, 95B, 98, 99, 108A, 108B, 110, 111A, 111B, 111C, 111D, and 115C. These soils are of large extent with more than 80,000 hectares (200,000 acres) mapped.

MLRA OFFICE RESPONSIBLE: Indianapolis, Indiana.

SERIES ESTABLISHED: Ford County, Illinois, 1929.

REMARKS: This pedon in Iroquois County is pedon number 84 in appendix IV of Soil Taxonomy. A till substratum, stratified sandy substratum, and occasionally flooded phases are recognized. These phases will be evaluated during MLRA update activities to determine if new series are needed.

Diagnostic horizons and features recognized in this pedon are: mollic epipedon - the zone from the surface to a depth of 0 to 43 cm (0 to 17 inches) (Ap, A, and BA horizons); cambic horizon - the zone from approximately 33 to 97 cm (13 to 38 inches) (BA, Btg1, Btg2 and 2Btg3).

National Cooperative Soil Survey
U.S.A.

Rs

LOCATION ROSCOMMON
Established Series
Rev. EPW-WEF-AGG
02/2005

MI+MN WI

ROSCOMMON SERIES

The Roscommon series consists of very deep, poorly drained and very poorly drained soils formed in sandy deposits on lake plains, outwash plains, lake basins and glacial drainageways. The saturated hydraulic conductivity is rapid. Slopes range from 0 to 2 percent. Mean annual precipitation is about 30 inches and mean air annual temperature is about 43 degrees F.

TAXONOMIC CLASS: Mixed, frigid Mollic Psammaquents

TYPICAL PEDON: Roscommon mucky sand - on a 1 percent slope in a forested area. (Colors are for moist soil unless otherwise stated.)

A--0 to 9 inches; very dark gray (10YR 3/1) mucky sand, gray (10YR 5/1) dry; weak coarse subangular blocky structure; very friable; many fine roots; slightly acid; clear smooth boundary. (6 to 10 inches thick)

Cg--9 to 14 inches; light brownish gray (10YR 6/2) sand; single grain; loose; common fine roots; slightly acid; gradual smooth boundary.

C--14 to 60 inches; brown (10YR 5/3) sand; single grain; loose; few fine roots; slightly acid.

TYPE LOCATION: Lake County, Michigan; about 10 miles northeast of the village of Luther; 2,580 feet north and 75 feet west of the southeast corner of sec. 12, T. 20 N., R. 11 W., NAD27.

RANGE IN CHARACTERISTICS: The 10 to 40 inch control section typically ranges from moderately acid to slightly alkaline, but the lower part in some pedons is moderately alkaline. Gravel ranges from 0 to 10 percent throughout the pedon.

The A horizon has hue of 10YR or 7.5YR and has value of 2 or 3, and chroma of 1 or 2, or is neutral with value of 2 or 3. Ap horizon, where present, has colors like the A horizon. The A horizon is sand, loamy fine sand, fine sand, loamy sand or the mucky analogues of these textures. Some undisturbed areas have thin layers of muck, 1 to 3 inches thick, on the surface. The A horizon is moderately acid to slightly alkaline.

The C horizons have hue of 10YR to 5Y; value of 4 to 6; and chroma of 1 to 3. Some subhorizons have chroma of 4. They typically are sand, coarse sand, loamy sand, or loamy coarse sand, but some pedons have thin subhorizons of fine sand. The C horizon ranges from moderately acid to moderately alkaline.

COMPETING SERIES: These are the [Cormant](#) and [Wheatley](#) series in the same family and the [Deford](#), [Edmore](#), [Epoufette](#), [Granby](#), [Kinross](#), [Maumee](#), [Newton](#), [Scarboro](#), and [Tobico](#) series. Cormant soils have a sand fraction dominated by fine sand. Wheatley and Epoufette soils have stratified calcareous sand and gravel within the 10 to 40 inch control section. Deford soils have fine sand, loamy fine sand, or very fine sand textures. Edmore soils have more than 15 percent clay in the control section and are mesic. Granby, Maumee, and Newton have mollic epipedons and are mesic. Kinross soils are strongly acid and have spodic horizons. Scarboro soil have thicker dark surface layers, are more acid, and are mesic. Tobico soils are mesic and have calcareous sand and gravel within a depth of 15 inches.

GEOGRAPHIC SETTING: The Roscommon soils are on nearly level areas and depressions of outwash and lake plains and in glacial drainageways. Slope gradients range from 0 to 2 percent. Mean annual precipitation ranges from 22 to 34 inches, and mean annual air temperature ranges from 38 to 47 degrees F.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the [Au Gres](#), [Croswell](#), [Graycalm](#), [Kalkaska](#), [Meehan](#), [Menahga](#), and [Rubicon](#) soils. They are on the higher better drained parts of the landscape. Various organic soils on the wetter parts are the common associates.

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY: Poorly drained and very poorly drained. Surface runoff is negligible or ponded. Saturated hydraulic conductivity is rapid. This soil is ponded or has saturation within 1 foot of the surface, at some time during the months of September through June in years with normal precipitation.

USE AND VEGETATION: More than 90 percent is in forest. A small percentage is in permanent pasture, or in hay and small grains. Forests are chiefly balsam fir, black spruce, jack pine, northern whitecedar, quaking aspen, red maple, and yellow birch.

DISTRIBUTION AND EXTENT: Northern Michigan, Minnesota, and northeastern Wisconsin. The series is of large extent.

MLRA OFFICE RESPONSIBLE: St. Paul, Minnesota

SERIES ESTABLISHED: Sanilac County, Michigan, 1955.

REMARKS: Diagnostic horizons and features recognized in this pedon are: ochric epipedon - the zone from the surface to 9 inches; aquic soil moisture regime; mollic

feature - the zone from the surface to 9 inches with color value moist of 3 or less, and color value dry of 5 or less.

The requirement for chroma of 1 or less in Cg horizon is waived due to uncoated sand grains.

National Cooperative Soil Survey
U.S.A.

Ru

LOCATION RUSE
Established Series
Rev. GDW-WEF
02/2003

MI+NY WI

RUSE SERIES

The Ruse series consists of shallow, poorly drained and very poorly drained soils formed in loamy glacial till material underlain by limestone bedrock. Permeability is moderate or moderately rapid. Slopes range from 0 to 2 percent. Mean annual precipitation is about 30 inches, and mean annual temperature is about 43 degrees F.

TAXONOMIC CLASS: Loamy, mixed, active, frigid Lithic Endoaquolls

TYPICAL PEDON: Ruse mucky loam - on a one percent slope in a forested area. (Colors are for moist soil unless otherwise stated.)

A--0 to 7 inches; black (10YR 2/1) mucky loam, dark gray (10YR 4/1) dry; moderate medium granular structure; friable; many fine to coarse roots; neutral; abrupt smooth boundary (2 to 8 inches thick)

Bg--7 to 11 inches; grayish brown (10YR 5/2) sandy loam; weak medium subangular blocky structure; friable; many fine faint gray (10YR 6/1) iron depletions; common fine to coarse roots; slightly alkaline; abrupt smooth boundary. (2 to 5 inches thick)

Bw--11 to 15 inches; pale brown (10YR 6/3) sandy loam; weak coarse platy structure; friable; common fine prominent yellowish brown (7.5YR 5/6) iron accumulations and common fine distinct light brownish gray (2.5Y 6/2) iron depletions throughout; few fine roots; slightly alkaline; abrupt smooth boundary. (2 to 12 inches thick)

2R--15 inches; fractured limestone bedrock.

TYPE LOCATION: Mackinac County, Michigan, about 2 miles west of the village of Engadine, 2,000 feet east and 1,500 feet south of the the northwest corner of sec. 19, T. 43 N., R. 10 W.

RANGE IN CHARACTERISTICS: The depth to bedrock ranges from 10 to 20 inches. Cobble or flagstone content ranges from 0 to 20 percent throughout. Gravel content ranges from 0 to 30 percent in the A horizon and from 0 to 15 percent in the remainder of the pedon. Rock fragments are primarily limestone.

Some pedons have a thin muck surface, less than 4 inches thick over the mineral soil material.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is sandy loam, fine sandy loam, silt loam, loam or the mucky, gravelly or cobbly analogues of textures. Reaction ranges from slightly acid to slightly alkaline.

The Bg horizon has hue of 5YR to 2.5Y, value of 4 to 6 and chroma of 1 or 2. It is sandy loam, fine sandy loam, silt loam or the gravelly or flaggy analogues of these textures. Reaction ranges from slightly acid to moderately alkaline.

The Bw horizon has hue of 5YR to 2.5Y, value of 4 to 6, and chroma of 3 or 4. It is sandy loam, fine sandy loam, silt loam or the gravelly or flaggy analogues of these textures. Reaction ranges from slightly acid to moderately alkaline.

A thin calcareous C horizon is in some pedons. The upper 1 to 4 inches of the bedrock is weathered in some pedons.

COMPETING SERIES: There are no other series in the family. Closely related is the [Ensign](#) series. Ensign soils do not have aquic soil moisture regimes.

GEOGRAPHIC SETTING: Ruse soils are on nearly level areas and in depressions of lake benches and ground moraines. Slopes range from 0 to 2 percent. They formed in glacial till of Wisconsinan Age, over Ordovician, Devonian, or Silurian limestone. Mean annual precipitation ranges from 28 to 33 inches, and the mean annual temperature ranges from 41 to 45 degrees F.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the [Angelica](#), [Chippeny](#), [Ensign](#), [Longrie](#), [Nahma](#), [Summerville](#), and [Sundell](#) soils. The Longrie, Summerville, and Sundell soils are well drained and in higher landscape positions. Ensign soils are somewhat poorly drained and are in slightly higher landscape positions. Angelica, Chippeny, and Nahma soils are poorly drained associates found on similar landscape positions. Angelica soils are very deep to bedrock, Chippeny soils are organic soils and Nahma soils are moderately deep to bedrock.

DRAINAGE AND PERMEABILITY: Poorly drained and very poorly drained. The depth to the seasonal high water table ranges from one foot above the surface to one foot below the surface at some during the period from October to May. Surface runoff is very slow or ponded. Permeability is moderate or moderately rapid.

USE AND VEGETATION: Nearly all is in woodland. A small part is used for pasture. Forests are primarily of alder, ash, aspen, balsam fir, black spruce, elm, white birch, and northern whitecedar.

DISTRIBUTION AND EXTENT: Northern part of the Lower Peninsula and eastern part of the Upper Peninsula of Michigan, northeastern Wisconsin and the northeastern part of the Erie-Ontario Lowlands in New York.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: St. Paul, Minnesota

SERIES ESTABLISHED: Schoolcraft County, Michigan, 1933.

REMARKS: Diagnostic horizons and features recognized in this pedon are: mollic epipedon - the zone from the surface to 7 inches (A horizon); aquic soil moisture regime - the zone from 7 to 11 inches (Bg horizon); cambic horizon - the zone from 7 to 15 inches (Bg and Bw horizons); lithic subgroup - lithic contact at 11 inches.

ADDITIONAL DATA: Soil Interpretation Record No.: MI0072; MI0510 - MUCKY SURFACE

National Cooperative Soil Survey
U.S.A.

ShA

LOCATION SHIOCTON

WI

Established Series

Rev. HFG

10/2006

SHIOCTON SERIES

The Shiocton series consists of very deep, somewhat poorly drained soils formed in mostly loamy lacustrine deposits on glacial lake basins. Permeability is moderate. Slopes range from 0 to 3 percent. Mean annual precipitation is about 30 inches. Mean annual air temperature is about 47 degrees F.

TAXONOMIC CLASS: Coarse-silty, mixed, superactive, frigid Aquic Hapludolls

TYPICAL PEDON: Shiocton silt loam - on a nearly level slope of less than 1 percent on a glacial lake basin in an idle field at an elevation of about 795 feet. (Colors are for moist soil unless otherwise stated.)

Ap--0 to 10 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; moderate fine granular structure; friable; many fine roots; slightly alkaline; abrupt smooth boundary. (8 to 10 inches thick)

Bw1--10 to 15 inches; brown (10YR 5/3) silt loam; weak fine subangular blocky structure; friable; few fine prominent yellowish brown (10YR 5/6) masses of iron accumulation in the matrix; many coarse distinct very dark grayish brown (10YR 3/2) worm casts; slightly alkaline; clear smooth boundary. (5 to 15 inches thick)

Bw2--15 to 26 inches; brown (10YR 5/3) very fine sandy loam; weak thick platy structure parting to weak fine subangular blocky; very friable; many coarse prominent strong brown (7.5YR 5/6) masses of iron accumulation in the matrix; few fine distinct gray (5Y 6/1) iron depletions in the matrix; violently effervescent; slightly alkaline; clear smooth boundary. (0 to 15 inches thick)

C1--26 to 30 inches; brown (10YR 5/3) very fine sandy loam; massive but breaks along horizontal planes; very friable; many coarse prominent strong brown (7.5YR 5/6) masses of iron accumulation in the matrix; few fine distinct gray (5Y 6/1) iron depletions in the matrix; violently effervescent; slightly alkaline; clear smooth boundary.

C2--30 to 60 inches; variegated light brown (7.5YR 6/4), strong brown (7.5YR 5/8), brown (10YR 5/3), and gray (5Y 6/1) stratified silt loam and very fine sand; massive but breaks along horizontal planes; very friable; strongly effervescent; slightly alkaline.

TYPE LOCATION: Shawano County, Wisconsin; about 10 miles south of Bonduel; 1,056 feet east and 65 feet north of the southwest corner of sec. 32, T. 25 N., R. 17 E.; USGS Nichols, Wis. Quad. Latitude 44 degrees 35 minutes 23 seconds N. Longitude 88 degrees 27 minutes 46 seconds W. NAD 83.

RANGE IN CHARACTERISTICS: Depth to the base of soil development ranges from 20 to 40 inches. Thickness of the mollic epipedon ranges from 8 to 15 inches. Depth to carbonates typically ranges from 15 to 30 inches but in some pedons carbonates are at the surface. The weighted average clay content of the particle-size control section ranges from 5 to 18 percent. Rock fragments are typically absent throughout the soil but volume of gravel ranges up to 3 percent in the C horizon in some pedons. Reaction ranges from slightly acid to slightly alkaline in the upper part of the solum and from neutral to moderately alkaline in the lower part. Saturation and redoximorphic features occur within 16 inches of the soil surface or saturation occurs within 30 inches in one or more horizons with a total thickness of 6 inches or more with redox depletions.

The Ap or A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 to 3. Texture is silt loam or very fine sandy loam.

The Bw horizon has hue of 7.5YR or 10YR, and less commonly 5YR; value of 4 to 6; and chroma of 3 to 6. Texture is very fine sandy loam or silt loam with thin strata of coarser finer texture in the lower part in some pedons.

The C horizon has hue of 7.5YR or 10YR, and less commonly 5YR; value of 5 or 6; and chroma of 1 to 6. Texture commonly is stratified silt or silt loam and very fine sand with thin strata of coarser or finer texture in many pedons.

COMPETING SERIES: This is the [Hantho](#) series. Closely related is the [Corwith](#) series. Other related series are the Nichols, [Salter](#), and [Yahara](#). Hantho soils have hue yellower than 10YR in the lower part of the series control section. Corwith soils have a mesic temperature regime. Nichols and Salter soils formed in similar deposits but do not have mollic epipedons and mottles with chroma of 2 or less. In addition, Salter soils are coarse-loamy. Yahara soils formed in similar materials but are coarse-loamy.

GEOGRAPHIC SETTING: The Shiocton soils are on glacial lake basins. Slopes range from 0 to 3 percent. These soils formed in calcareous, mostly loamy lacustrine deposits. Mean annual precipitation ranges from 25 to 35 inches. Mean annual temperature ranges from 46 to 48 degrees F.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Nichols, [Rousseau](#), [Shawano](#), and [Keowns](#) soils. The moderately well drained and well drained Nichols soils form a drainage sequence with the Shiocton soils. Rousseau and Shawano soils are in similar landscape positions, but formed in fine sand. In some places near the 47 degree temperature line, the poorly drained mesic Keowns soils are associated with the Shiocton soils.

DRAINAGE AND PERMEABILITY: Somewhat poorly drained. The potential for surface runoff is negligible or low. Permeability is moderate. These soils have an apparent seasonal high water table at a depth of 1 to 2.5 feet for some time in most years.

USE AND VEGETATION: Many areas of this soil are drained and used for cropland. Common crops are corn, small grains and hay. Specialty crops, such as beans, cabbage, peas, and sweet corn, are also commonly grown. Some areas are used for pastureland. Native vegetation is prairie grasses and scattered wetland tree species.

DISTRIBUTION AND EXTENT: East-central part of Wisconsin. These soils are of moderate extent.

MLRA OFFICE RESPONSIBLE: Indianapolis, Indiana.

SERIES ESTABLISHED: Outagamie County, Wisconsin, 1975.

REMARKS: Diagnostic horizons and features recognized in this pedon are: mollic epipedon - 0 to 10 inches (Ap); cambic horizon 10 to 26 inches (Bw1, Bw2); Aquic feature redox depletions with chroma of 2 or less and saturation within 30 inches of the surface.

Additional field and lab study is needed to verify placement in coarse-silty family and presence or absence of an argillic horizon.

About 70% of the correlated acres of Shiocton are in the mesic soil temperature zone including the series type location in southern Shawano County. I was going to change the classification from frigid to mesic but there is an existing series (Corwith) which competes and which I could not adequately differentiate from Shiocton. If the classification of Shiocton remains the same after further study, perhaps the Corwith series could be used for the mesic acres. Another possibility is to correlate the mesic acres as slightly warmer temperature taxadjuncts of Shiocton as was done in the Calumet-Manitowoc soil survey. Also, if Shiocton remains frigid, a new typical pedon should be used since the current one is in the mesic zone just south of the mesic/frigid line in Shawano County.

Some of the acres in Shawano County and all of the 9280 ac. correlated in Oconto County are in the frigid temperature zone.

A new series is needed for the 2900 ac. correlated as a clayey substratum phase in Outagamie County

SoA

LOCATION SOLONA
Established Series
Rev. HFG-JJJ
05/2005

WI+MI

SOLONA SERIES

The Solona series consists of very deep, somewhat poorly drained soils formed in loamy glacial till on ground moraines. These soils have moderate permeability. Slopes range from 0 to 3 percent. Mean annual precipitation is about 30 inches. Mean annual air temperature is about 44 degrees F.

TAXONOMIC CLASS: Coarse-loamy, mixed, superactive, frigid Aquic Argiudolls

TYPICAL PEDON: Solona loam - on a 1 percent slope in an alfalfa field at an elevation of about 928 feet. (Colors are for moist soil unless otherwise stated.)

Ap--0 to 9 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; moderate medium granular structure; friable; many fine and medium roots; about 3 percent gravel; neutral; abrupt smooth boundary. (6 to 10 inches thick)

Bt1--9 to 19 inches; reddish brown (5YR 4/4) fine sandy loam; moderate medium and fine subangular blocky structure; friable; common fine roots; faint clay films on faces of peds and in pores and channels; common medium prominent yellowish red (5YR 5/8) and few fine prominent strong brown (7.5YR 5/8) masses of iron accumulation; few fine prominent pinkish gray (7.5YR 6/2) iron depletions; about 8 percent gravel; slightly alkaline; clear wavy boundary.

Bt2--19 to 27 inches; reddish brown (5YR 4/4) fine sandy loam; moderate medium subangular blocky structure; friable; few fine roots; faint clay films on faces of peds and in pores and channels; common medium prominent yellowish red (5YR 5/8) masses of iron accumulation; few fine distinct pinkish gray (7.5YR 6/2) iron depletions; about 7 percent gravel; slightly alkaline; gradual wavy boundary. (Combined thickness of the Bt horizons ranges from 14 to 30 inches.)

C--27 to 60 inches; reddish brown (5YR 5/4) loam; massive; friable; common medium distinct strong brown (7.5YR 5/6) masses of iron accumulation; few fine distinct brown (7.5YR 5/2) iron depletions; about 12 percent gravel; violently effervescent; moderately alkaline.

TYPE LOCATION: Shawano County, Wisconsin; about 2 miles east and 3 miles north of Briarton; 140 feet west and 660 feet north of the southeast corner, sec. 11, T. 25 N., R. 17 E. USGS Bonduel, Wis. Quad.; Latitude 44 degrees 38 minutes 54 seconds N., Longitude 88 degrees 23 minutes 02 seconds W. NAD 27.

RANGE IN CHARACTERISTICS: Depth to the base of soil development and to carbonates typically ranges from 24 to 30 inches, but the full range is 20 to 40 inches. The particle-size control section averages between 12 and 18 percent clay. Volume of gravel ranges from 2 to 15 percent in the solum and 2 to 25 percent in the substratum. Volume of cobbles ranges from 0 to 8 percent in the solum and substratum. Reaction is neutral or mildly alkaline in the surface layer and subsoil but ranges to moderately alkaline in the lower subsoil in some pedons. Reaction is slightly alkaline or moderately alkaline in the substratum. Carbonates are in the substratum and, in some pedons, are in the lower part of the subsoil.

The Ap horizon has hue of 5YR, 7.5YR, or 10YR ; value of 2 to 4; and chroma of 1 to 3. Uncultivated pedons have an A horizon with similar hue, but value of 2 or 3, and chroma of 1 or 2. Texture of the Ap or A horizon is loam, silt loam, sandy loam, fine sandy loam or very fine sandy loam.

Some pedons have an E horizon with hue of 5YR, 7.5YR, or 10YR; value of 4 to 6; and chroma of 2 to 4. Texture is dominantly sandy loam, fine sandy loam, loam, or silt loam; but ranges to loamy sand in some pedons.

The Bt horizon has hue of 5YR, 7.5YR, or 10YR; value of 4 or 5; and chroma of 3 to 6. Texture is sandy loam, fine sandy loam, or loam, but some pedons have thin subhorizons with more than 20 percent clay.

The C horizon has hue of 5YR or 7.5YR , value of 4 to 6, and chroma of 3 to 6. Texture is sandy loam, fine sandy loam, or loam or the gravelly analogs.

COMPETING SERIES: This is the [Nereson](#) series. Nereson soils have a 10 to 36 inch thick mantle of loamy outwash over the till.

GEOGRAPHIC SETTING: Solona soils are in depressions and drainageways of ground moraines. Slopes are concave or plane and gradients range from 0 to 3 percent. These soils formed in calcareous sandy loam or loam till. Mean annual precipitation ranges from 27 to 33 inches. Mean annual air temperature ranges from 42 to 45 degrees F.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the [Angelica](#), [Menominee](#), [Onaway](#), and [Tilleda](#) soils. The well drained Onaway and the poorly drained Angelica soils are in a drainage sequence with Solona soils and are the most closely associated soils. In some areas, where 20 to 40 inches of sand overlies the till, Menominee soils are associated with the Solona soils. Tilleda soils are on nearby well drained sites.

DRAINAGE AND PERMEABILITY: Somewhat poorly drained. The potential for surface runoff is negligible or low. Permeability is moderate. These soils have an apparent seasonal high water table at a depth of 1 to 2 feet for some time in most years.

USE AND VEGETATION: Most areas of this soil are used for cropland. Common crops are corn, small grain, and hay. Native vegetation is mostly mixed deciduous forest. Common trees are white ash, sugar maple, northern red oak, and American basswood.

DISTRIBUTION AND EXTENT: Northeastern Wisconsin and the Upper Peninsula of Michigan. Solona soils are of large extent.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: St. Paul, Minnesota.

SERIES ESTABLISHED: Brown County, Wisconsin, 1970.

REMARKS: Diagnostic horizons and features recognized in this pedon are:
mollic epipedon - 0 to 9 inches (Ap);
argillic horizon - 9 to 27 inches (Bt1, Bt2);
aquic feature - redox depletions with chroma of 2 or less and saturation in upper 25 cm of the argillic horizon.

ADDITIONAL DATA: Refer to soil survey sample numbers 78WI115001 and 79WI115015 for NSSL data on 2 Solona pedons.

National Cooperative Soil Survey
U.S.A.

SyA

LOCATION SYMCO
Established Series
Rev. HFG-AAC
11/2004

WI

SYMCO SERIES

The Symco series consists of very deep, somewhat poorly drained soils formed primarily in calcareous loamy till on ground moraines. Permeability is slow or moderately slow. Slope ranges from 0 to 3 percent. Mean annual precipitation is about 30 inches. Mean annual air temperature is about 45 degrees F.

TAXONOMIC CLASS: Fine-loamy, mixed, active, mesic Aquollic Hapludalfs

TYPICAL PEDON: Symco loam on a 1 percent slope in a corn field at an elevation of 840 feet above mean sea level. (Colors are for moist soil unless otherwise stated.)

Ap--0 to 8 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; moderate fine granular structure; friable; common roots; neutral; abrupt smooth boundary. (6 to 9 inches thick)

Bt1--8 to 12 inches; brown (7.5YR 4/4) clay loam; moderate fine angular blocky structure; firm; few roots; many faint brown (7.5YR 4/4) clay films on faces of peds; common medium distinct strong brown (7.5YR 5/6) masses of iron accumulation in the matrix; common fine distinct dark grayish brown (10YR 4/2) iron depletions in the matrix; about 2 percent gravel; neutral; clear wavy boundary.

Bt2--12 to 21 inches; reddish brown (5YR 4/4) clay loam; moderate fine angular blocky structure; firm; few roots; many faint reddish brown (5YR 4/3) clay films on faces of peds; common medium distinct strong brown (7.5YR 5/6) masses of iron accumulation in the matrix; many medium prominent dark grayish brown (10YR 4/2) iron depletions in the matrix; about 4 percent gravel; neutral; clear wavy boundary.

Bt3--21 to 26 inches; reddish brown (5YR 4/4) clay loam; moderate medium subangular blocky structure; firm; few roots; few faint reddish brown (5YR 4/3) clay films in pores; common medium distinct strong brown (7.5YR 5/6) masses of iron accumulation in the matrix; few fine prominent dark grayish brown (10YR 4/2) iron depletions in the matrix; about 3 percent gravel and 1 percent cobbles by volume; slightly alkaline; clear wavy boundary. (Combined thickness of the Bt horizons ranges from 10 to 24 inches.)

C--26 to 60 inches; reddish brown (5YR 4/4) clay loam; massive; friable; few fine light gray (10YR 7/2) soft accumulations of lime; common medium distinct strong brown

(7.5YR 5/6) masses of iron accumulation in the matrix; about 4 percent gravel and 1 percent cobbles; slightly effervescent; moderately alkaline.

TYPE LOCATION: Waupaca County, Wisconsin; about 1 mile northeast of Manawa; 90 feet south and 1,300 feet west of the northeast corner of sec. 14, T. 23 N., R. 13 E. USGS Manawa, Wisconsin topographic quadrangle; lat. 44 degrees 28 minutes 35 seconds N., and long. 88 degrees 53 minutes 04 seconds W., NAD 27.

RANGE IN CHARACTERISTICS: Depth to the base of the argillic horizon and to carbonates ranges from 20 to 40 inches. Some pedons have a loess or other silty mantle up to 10 inches thick. The particle-size control section averages 27 to 35 percent clay but the content of clay ranges from 20 to 40 percent in individual subhorizons of the argillic horizon. Rock fragments are of mixed lithology but include no shale fragments. Volume of gravel ranges from 0 to 10 percent in the surface layer and from 2 to 15 percent in the subsoil and substratum. Volume of cobbles ranges from 0 to 5 percent throughout the pedon. Reaction ranges from slightly acid to neutral in the upper part of the solum and from neutral to moderately alkaline in the lower part. Reaction is slightly alkaline or moderately alkaline in the substratum. The calcium carbonate equivalent ranges from 15 to 40 percent in the substratum. Redox features and saturation typically occur throughout the soil below the Ap horizon and redox depletions with choma of 2 or less are in the upper 10 inches of the argillic horizon.

The Ap horizon has hue of 7.5YR or 10YR, value of 2 or 3, and chroma of 2 or 3. Uncultivated pedons have an A horizon with hue of 7.5YR or 10Yr, value of 2 or 3, and chroma of 1 or 2. Texture of the Ap or A horizon typically is loam or silt loam, but in some pedons it is loamy fine sand.

Some pedons have an E horizon with hue of 7.5Yr or 10YR, value of 4 or 5, and chroma of 2 or 3. Texture is silt loam or loam.

The Bt horizon has hue of 5YR or 7.5YR, value of 4 to 6, and chroma of 3 or 4. Texture is typically loam or clay loam, and atypically silty clay loam.

The C horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. Texture is typically loam or clay loam, and atypically silty clay loam. The calcium carbonate equivalent ranges from 15 to 40 percent.

COMPETING SERIES: These are the [Alida](#), [Ashippun](#), [Kibbie](#), [Lourdes](#), [Marker](#), and [Montmorenci](#) series. Alida soils do not have carbonates within the series control section. Ashippun soils have shale fragments in the lower part of the series control section. Kibbie soil are stratified in the lower part of the series contro section. Lourdes soils have a calcium carbonate equivalent of less than 15 percent in the till substratum. Marker soils have a densic contact at a depth of 20 to 40 inches. Montmorenci soils have hues yellower than 7.5YR in the subsoil and substratum.

GEOGRAPHIC SETTING: Symco soils are on ground moraines. Slope ranges from 0 to 3 percent. These soils formed primarily in calcareous loamy till. Mean annual

precipitation ranges from 27 to 34 inches. Mean annual air temperature ranges from 45 to 49 degrees F.

GEOGRAPHICALLY ASSOCIATED SOILS: These are primarily the [Hortonville](#) soils and the [Angelica](#), [Bonduel](#), and [Tilleda](#) soils. The well drained Hortonville soils form a drainage sequence with the Symco soils. In nearby low-lying areas are the poorly drained Angelica soils. Bonduel soils are nearby where there is limestone bedrock at a depth of 20 to 40 inches. In similar landscapes positions, where the till contains more sand, the Tilleda soils are associates.

DRAINAGE AND PERMEABILITY: Somewhat poorly drained. The potential for surface runoff is low or medium. Permeability is slow or moderately slow. These soils have an apparent seasonal high water table at a depth of 1 to 2 feet for some time in most years.

USE AND VEGETATION: Most areas of this soil are used for cropland. Common crops are corn, small grain, or hay. Some areas are used for pastureland or woodland. Native vegetation is mixed deciduous forest. Common trees are American basswood, white ash, red maple, and northern red oak.

DISTRIBUTION AND EXTENT: East-central Wisconsin. Symco soils are of moderate extent.

MLRA OFFICE RESPONSIBLE: Indianapolis, Indiana

SERIES ESTABLISHED: Outagamie County, Wisconsin, 1975.

REMARKS: Symco soils appear to straddle Aquic Argiudolls and Aquollic Hapludalfs depending upon thickness of the mollic surface, dry color of the mollic surface, and depth to the bottom of the argillic horizon. More pedons can be placed with Aquollic Hapludalfs and this will be the concept.

Diagnostic horizons and features recognized in this pedon are: ochric epipedon - 0 to 8 inches (Ap); argillic horizon - 8 to 21 inches (Bt1, Bt2, Bt3); Mollic subgroup Ap horizon with color value and chroma moist of less than 4 and color value, dry, less than 6; Aquic feature redox depletions with chroma of 2 or less and saturation in the upper 10 inches of the argillic horizon.

ADDITIONAL DATA; Refer to soil survey sample number S79WI-135-005 for NSSL data on the typical pedon.

WaA

LOCATION WAINOLA
Established Series
Rev. LWB-WEF-LLD
09/2006

MI+WI

WAINOLA SERIES

The Wainola series consists of deep, somewhat poorly drained soils formed in fine sandy glaciofluvial deposits on outwash plains, lake plains, and glacial lake deltas. Saturated hydraulic conductivity is high or very high. Slopes range from 0 to 4 percent. Mean annual precipitation is about 760 millimeters, and mean annual temperature is about 6 degrees C.

TAXONOMIC CLASS: Sandy, mixed, frigid Typic Endoaquods

TYPICAL PEDON: Wainola fine sand - forested. (Colors are for moist soil unless otherwise stated.)

Oa--0 to 5 centimeters; black (N 2/0) well decomposed litter; weak fine granular structure; very friable; many fine and medium roots; strongly acid; abrupt wavy boundary. (0 to 10 centimeters thick)

E--5 to 30 centimeters; pinkish gray (7.5YR 6/2) fine sand; single grain; loose; common fine and coarse roots; strongly acid; abrupt wavy boundary. (8 to 30 centimeters thick)

Bs1--30 to 46 centimeters; reddish brown (5YR 4/4) fine sand; weak fine subangular blocky structure; very friable; common fine and medium roots; common dark reddish brown (5YR 3/4) weakly cemented ortstein fragments; common fine distinct strong brown (7.5YR 5/6) masses of iron accumulations throughout; very strongly acid; gradual wavy boundary.

Bs2--46 to 69 centimeters; strong brown (7.5YR 4/6) fine sand; weak fine subangular blocky structure; very friable; few fine and medium roots; common dark brown (7.5YR 3/4) very weakly cemented ortstein fragments; common fine faint strong brown (7.5YR 5/6) masses of iron accumulations throughout; very strongly acid; gradual wavy boundary. (The combined thickness of the Bs horizons is 20 to 61 centimeters.)

BC--69 to 104 centimeters; brown (7.5YR 5/4) fine sand; single grain; loose; few fine roots; common fine distinct reddish yellow (7.5YR 6/6) and brown (7.5YR 5/2) masses of iron accumulations throughout; strongly acid; clear wavy boundary. (0 to 51 centimeters thick)

C--104 to 152 centimeters; brown (7.5YR 5/2) very fine sand; single grain; loose; strongly acid.

TYPE LOCATION: Menominee County, Michigan; about 8 miles southeast of Stephenson; 2,200 feet north and 200 feet west of the southeast corner, sec. 6, T. 34 N., R. 25 W.

RANGE IN CHARACTERISTICS: Solum thickness ranges from 46 to 107 centimeters. Coarse fragments are less than 5 percent by volume throughout. The particle-size control section averages more than 50 percent fine sand.

Some pedons have an A horizon, 2 to 13 centimeters thick, that has a hue of 5YR to 10YR, or is neutral; value of 2 or 3; and chroma of 0 to 2. Some pedons have an Ap horizon 15 to 23 centimeters thick, which has value of 3 or 4 and chroma of 1 or 2

The E horizon has hue of 5YR to 10YR, value of 5 to 7, and chroma of 2 or 3. The A and E horizons are fine sand or loamy fine sand. Reaction of the A, E and Ap horizons ranges from very strongly acid to slightly acid.

The Bs1 horizon has hue of 5YR or 7.5YR; value of 3 or 4; and chroma of 2 to 4. The Bs2 horizon has hue of 5YR, 7.5YR, and 10YR; value of 4 or 5; and chroma of 4 to 6. The B horizons are stratified fine sand, very fine sand or loamy fine sand with some thin strata of silt. Reaction of the Bs horizon ranges from very strongly acid to moderately acid. In some places the reaction of the Bs2 horizon may range to slightly acid.

The BC horizon has hue of 7.5YR or 10YR, value of 5 and chroma of 4 to 6. It is fine sand. Reaction ranges from strongly acid to neutral.

The C horizon has hue of 5YR, 7.5YR, and 10YR; value of 4 to 7; and chroma of 2 to 4. The C horizon has textures like that of the B horizon. Reaction ranges from strongly acid to neutral.

COMPETING SERIES: These are the [Au Gres](#) and [Battlefield](#) series. Au Gres soils have more than 50 percent fine sand throughout the particle-size control section (are dominantly medium sand). Battlefield soils are underlain by gravelly sand within 51 to 102 centimeters of the surface.

GEOGRAPHIC SETTING: These soils are on outwash plains, lake plains, and glacial lake deltas. Slope gradients range from 0 to 4 percent. These soils formed in fine sand and loamy fine sand deposits. Mean annual temperature is estimated to range from 5 to 8 degrees C, and mean annual precipitation ranges from 710 to 860 millimeters.

GEOGRAPHICALLY ASSOCIATED SOILS: The well drained [Rousseau](#) and the poorly drained [Deford](#) soils are in the same drainage sequence. The somewhat poorly drained [Brimley](#) and [Richter](#) soils are other associated soils. These soils are loamy textured.

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY: Somewhat poorly drained. The soil has representative wet soil moisture status from 15 to 76 centimeters below the surface during the period from October to May. Surface runoff is slow. Saturated hydraulic conductivity is high or very high.

USE AND VEGETATION: A large proportion is in forest, permanent pasture, or is idle cropland. A small acreage is under cultivation and used for small grain and hay. The present forest vegetation is chiefly quaking aspen, white ash, red maple, northern red oak with shrubs and grasses.

DISTRIBUTION AND EXTENT: Northern Michigan, New York and northern Wisconsin. The series is of moderate extent.

MLRA OFFICE RESPONSIBLE: Indianapolis, Indiana

SERIES ESTABLISHED: Arenac County, Michigan, 1964.

REMARKS: Laboratory data is available for this pedon S80MI-109-4. Diagnostic horizons and features recognized in this pedon are: ochric epipedon - the zone from 5 to 30 centimeters (E horizon); albic horizon - the zone from 5 to 30 centimeters (E horizon); spodic horizon - the zone from 30 to 46 centimeters (Bs1 horizon); aquic conditions within 50 centimeters of the surface.

ADDITIONAL DATA: Soil Interpretation Record: MI0212

National Cooperative Soil Survey
U.S.A.

Water Features

Kewaunee County, Wisconsin

Map symbol and soil name	Hydrologic group	Surface runoff	Month	Water table		Ponding			Flooding	
				Upper limit	Lower limit	Surface depth	Duration	Frequency	Duration	Frequency
				<i>Ft</i>	<i>Ft</i>	<i>Ft</i>				
AdA:										
Allendale	C	---	January	0.3-2.0	>6.0	---	---	None	---	None
			February	0.3-2.0	>6.0	---	---	None	---	None
			March	0.0-1.5	>6.0	0.0-0.5	Brief	Occasional	---	None
			April	0.0-1.5	>6.0	---	---	Rare	---	None
			May	0.0-1.5	>6.0	---	---	Rare	---	None
			June	1.0-3.0	>6.0	---	---	None	---	None
			July	1.0-3.0	>6.0	---	---	None	---	None
			August	1.0-3.0	>6.0	---	---	None	---	None
			September	1.0-3.0	>6.0	---	---	None	---	None
			October	1.0-3.0	>6.0	---	---	None	---	None
			November	1.0-3.0	>6.0	---	---	None	---	None
			December	1.0-3.0	>6.0	---	---	None	---	None
Wainola loamy fine sand	---	---	Jan-Dec			---	---	None	---	None
Wauseon fine sandy loam	---	---	Jan-Dec			---	---	None	---	None

Water Features

Kewaunee County, Wisconsin

Map symbol and soil name	Hydrologic group	Surface runoff	Month	Water table		Ponding			Flooding	
				Upper limit	Lower limit	Surface depth	Duration	Frequency	Duration	Frequency
				<i>Ft</i>	<i>Ft</i>	<i>Ft</i>				
Ax:										
Angelica	B/D	---	January	0.0-1.0	>6.0	0.0-0.5	Brief	Occasional	---	None
			February	0.0	>6.0	0.0-1.0	Long	Occasional	---	Rare
			March	0.0	>6.0	0.0-2.0	Very long	Frequent	Long	Frequent
			April	0.0-0.5	>6.0	0.0-1.0	Long	Frequent	Brief	Occasional
			May	0.0-1.0	>6.0	0.0-0.5	Long	Occasional	---	Rare
			June	0.0-1.0	>6.0	0.0-0.5	Brief	Occasional	---	None
			July	0.0-2.0	>6.0	---	---	Rare	---	None
			August	0.0-2.0	>6.0	---	---	Rare	---	None
			September	0.0-2.0	>6.0	---	---	Rare	---	None
			October	0.0-1.0	>6.0	---	---	Rare	---	None
			November	0.0-1.0	>6.0	---	---	Rare	---	None
			December	0.0-1.0	>6.0	0.0-0.5	Brief	Occasional	---	None
Cathro muck	---	---	Jan-Dec			---	---	None	---	None
Solona silt loam	---	---	Jan-Dec			---	---	None	---	None
Substratum is gravel	---	---	Jan-Dec			---	---	None	---	None
Substratum is gravelly loam	---	---	Jan-Dec			---	---	None	---	None

Water Features

Kewaunee County, Wisconsin

Map symbol and soil name	Hydrologic group	Surface runoff	Month	Water table		Ponding			Flooding	
				Upper limit	Lower limit	Surface depth	Duration	Frequency	Duration	Frequency
				<i>Ft</i>	<i>Ft</i>	<i>Ft</i>				
Ba:										
Bach	B/D	---	January	0.0-1.0	>6.0	0.0-0.5	Brief	Occasional	---	None
			February	0.0	>6.0	0.0-1.0	Long	Occasional	---	Rare
			March	0.0	>6.0	0.0-2.0	Very long	Frequent	Long	Frequent
			April	0.0-0.5	>6.0	0.0-1.0	Long	Frequent	Brief	Occasional
			May	0.0-1.0	>6.0	0.0-0.5	Long	Occasional	---	Rare
			June	0.0-1.0	>6.0	0.0-0.5	Brief	Occasional	---	None
			July	0.0-2.0	>6.0	---	---	Rare	---	None
			August	0.0-2.0	>6.0	---	---	Rare	---	None
			September	0.0-2.0	>6.0	---	---	Rare	---	None
			October	0.0-1.0	>6.0	---	---	Rare	---	None
			November	0.0-1.0	>6.0	---	---	Rare	---	None
			December	0.0-1.0	>6.0	0.0-0.5	Brief	Occasional	---	None
Kibbie silt loam	---	---	Jan-Dec			---	---	None	---	None
Shiocton silt loam	---	---	Jan-Dec			---	---	None	---	None
Subsoil is silt loam	---	---	Jan-Dec			---	---	None	---	None
Subsoil is silty clay loam	---	---	Jan-Dec			---	---	None	---	None
Substratum is silty clay loam	---	---	Jan-Dec			---	---	None	---	None

Water Features

Kewaunee County, Wisconsin

Map symbol and soil name	Hydrologic group	Surface runoff	Month	Water table		Ponding			Flooding	
				Upper limit	Lower limit	Surface depth	Duration	Frequency	Duration	Frequency
				<i>Ft</i>	<i>Ft</i>	<i>Ft</i>				
Bn:										
Bonduel	C	---	January	0.5-3.0	1.7-3.3	---	---	None	---	None
			February	0.0-2.0	1.7-3.3	---	---	None	---	Very rare
			March	0.0	0.0-1.0	---	---	Rare	---	Rare
				1.0-3.3	1.7-3.3					
			April	0.0	0.0-1.0	---	---	Rare	---	Rare
				1.0-3.3	1.7-3.3					
			May	0.0-2.0	1.7-3.3	---	---	Rare	---	Very rare
			June	1.0-3.0	1.7-3.3	---	---	None	---	None
			November	1.0-3.0	1.7-3.3	---	---	None	---	None
			December	1.0-3.0	1.7-3.3	---	---	None	---	None
Bedrock outcrops	---	---	Jan-Dec			---	---	None	---	None
Depth to bedrock is <20	---	---	Jan-Dec			---	---	None	---	None
Kolberg silt loam	---	---	Jan-Dec			---	---	None	---	None
Longrie loam	---	---	Jan-Dec			---	---	None	---	None
Ruse loam	---	---	Jan-Dec			---	---	None	---	None
Solona silt loam	---	---	Jan-Dec			---	---	None	---	None

Water Features

Kewaunee County, Wisconsin

Map symbol and soil name	Hydrologic group	Surface runoff	Month	Water table		Ponding			Flooding	
				Upper limit	Lower limit	Surface depth	Duration	Frequency	Duration	Frequency
				<i>Ft</i>	<i>Ft</i>	<i>Ft</i>				
Ca:										
Carbondale	A/D	---	January	0.0-1.0	>6.0	0.0-0.5	Brief	Occasional	---	None
			February	0.0	>6.0	0.0-1.0	Long	Occasional	---	Rare
			March	0.0	>6.0	0.0-2.0	Very long	Frequent	Long	Frequent
			April	0.0-0.5	>6.0	0.0-1.0	Long	Frequent	Brief	Occasional
			May	0.0-1.0	>6.0	0.0-0.5	Long	Occasional	---	Rare
			June	0.0-1.0	>6.0	0.0-0.5	Brief	Occasional	---	None
			July	0.0-2.0	>6.0	---	---	Rare	---	None
			August	0.0-2.0	>6.0	---	---	Rare	---	None
			September	0.0-2.0	>6.0	---	---	Rare	---	None
			October	0.0-1.0	>6.0	---	---	Rare	---	None
			November	0.0-1.0	>6.0	---	---	Rare	---	None
			December	0.0-1.0	>6.0	0.0-0.5	Brief	Occasional	---	None
Angelica silt loam	---	---	Jan-Dec			---	---	None	---	None
Cathro muck	---	---	Jan-Dec			---	---	None	---	None
Markey muck	---	---	Jan-Dec			---	---	None	---	None
Pella silt loam	---	---	Jan-Dec			---	---	None	---	None
Roscommon mucky loamy sand	---	---	Jan-Dec			---	---	None	---	None
Slope is greater than 2%	---	---	Jan-Dec			---	---	None	---	None

Water Features

Kewaunee County, Wisconsin

Map symbol and soil name	Hydrologic group	Surface runoff	Month	Water table		Ponding			Flooding	
				Upper limit	Lower limit	Surface depth	Duration	Frequency	Duration	Frequency
				<i>Ft</i>	<i>Ft</i>	<i>Ft</i>				
Cm:										
Cathro	A/D	---	January	0.0-1.0	>6.0	0.0-0.5	Brief	Occasional	---	None
			February	0.0	>6.0	0.0-1.0	Long	Occasional	---	Rare
			March	0.0	>6.0	0.0-2.0	Very long	Frequent	Long	Frequent
			April	0.0-0.5	>6.0	0.0-1.0	Long	Frequent	Brief	Occasional
			May	0.0-1.0	>6.0	0.0-0.5	Long	Occasional	---	Rare
			June	0.0-1.0	>6.0	0.0-0.5	Brief	Occasional	---	None
			July	0.0-2.0	>6.0	---	---	Rare	---	None
			August	0.0-2.0	>6.0	---	---	Rare	---	None
			September	0.0-2.0	>6.0	---	---	Rare	---	None
			October	0.0-1.0	>6.0	---	---	Rare	---	None
			November	0.0-1.0	>6.0	---	---	Rare	---	None
			December	0.0-1.0	>6.0	0.0-0.5	Brief	Occasional	---	None
Angelica silt loam	---	---	Jan-Dec			---	---	None	---	None
Bach silt loam	---	---	Jan-Dec			---	---	None	---	None
Carbondale muck	---	---	Jan-Dec			---	---	None	---	None
Markey muck	---	---	Jan-Dec			---	---	None	---	None
Pella silt loam	---	---	Jan-Dec			---	---	None	---	None
Soil that contains marl	---	---	Jan-Dec			---	---	None	---	None

Water Features

Kewaunee County, Wisconsin

Map symbol and soil name	Hydrologic group	Surface runoff	Month	Water table		Ponding			Flooding	
				Upper limit	Lower limit	Surface depth	Duration	Frequency	Duration	Frequency
				<i>Ft</i>	<i>Ft</i>	<i>Ft</i>				
FaA:										
Fabius	B	---	January	0.5-3.0	>6.0	---	---	None	---	None
			February	0.0-2.0	>6.0	---	---	None	---	Very rare
			March	0.0	0.0-1.0	---	---	Rare	Brief	Rare
				1.0->6.0	>6.0					
			April	0.0-1.0	>6.0	---	---	Rare	Brief	Rare
			May	0.0-2.0	>6.0	---	---	Rare	---	Very rare
			June	1.7-4.0	>6.0	---	---	None	---	None
			July	2.0-5.0	>6.0	---	---	None	---	None
			August	2.0-5.0	>6.0	---	---	None	---	None
			September	2.0-4.0	>6.0	---	---	None	---	None
			October	2.0-4.0	>6.0	---	---	None	---	None
			November	2.0-4.0	>6.0	---	---	None	---	None
			December	1.0-3.0	>6.0	---	---	None	---	None
Casco sandy loam	---	---	Jan-Dec			---	---	None	---	None
Dresden silt loam	---	---	Jan-Dec			---	---	None	---	None
Matherton silt loam	---	---	Jan-Dec			---	---	None	---	None
Mussey loam	---	---	Jan-Dec			---	---	None	---	None

Water Features

Kewaunee County, Wisconsin

Map symbol and soil name	Hydrologic group	Surface runoff	Month	Water table		Ponding			Flooding	
				Upper limit	Lower limit	Surface depth	Duration	Frequency	Duration	Frequency
				<i>Ft</i>	<i>Ft</i>	<i>Ft</i>				
HsB:										
Hortonville	C	---	January	5.0->6.0	>6.0	---	---	None	---	None
			February	5.0->6.0	>6.0	---	---	None	---	None
			March	5.0->6.0	>6.0	---	---	None	---	None
			April	5.0->6.0	>6.0	---	---	None	---	None
			May	5.0->6.0	>6.0	---	---	None	---	None
			June	5.0->6.0	>6.0	---	---	None	---	None
			July	5.0->6.0	>6.0	---	---	None	---	None
			August	5.0->6.0	>6.0	---	---	None	---	None
			September	5.0->6.0	>6.0	---	---	None	---	None
			October	5.0->6.0	>6.0	---	---	None	---	None
			November	5.0->6.0	>6.0	---	---	None	---	None
			December	5.0->6.0	>6.0	---	---	None	---	None
Symco	C	---	January	0.0-1.0	>6.0	---	---	Rare	Brief	Rare
			February	0.0-1.0	>6.0	---	---	Rare	Brief	Occasional
			March	---	---	0.0-1.0	Long	Frequent	Long	Occasional
			April	---	---	0.0-1.0	Long	Occasional	Long	Occasional
			May	0.0-1.0	>6.0	0.0-1.0	Brief	Occasional	Brief	Occasional
			June	0.0-2.0	>6.0	---	---	Rare	---	Rare
			July	0.5-2.0	>6.0	---	---	Rare	---	Rare
			August	0.5-2.0	>6.0	---	---	Rare	---	Rare
			September	0.0-2.0	>6.0	---	---	Rare	---	Rare
			October	0.0-1.0	>6.0	---	---	Rare	---	Rare
			November	0.0-1.0	>6.0	---	---	Rare	---	Rare
			December	0.0-1.0	>6.0	---	---	Rare	---	Rare
Angelica silt loam	---	---	Jan-Dec	---	---	---	---	None	---	None
Kewaunee silt loam	---	---	Jan-Dec	---	---	---	---	None	---	None

Water Features

Kewaunee County, Wisconsin

Map symbol and soil name	Hydrologic group	Surface runoff	Month	Water table		Ponding			Flooding	
				Upper limit	Lower limit	Surface depth	Duration	Frequency	Duration	Frequency
				<i>Ft</i>	<i>Ft</i>	<i>Ft</i>				
HsB:										
Manawa silt loam	---	---	Jan-Dec			---	---	None	---	None
Pella silt loam	---	---	Jan-Dec			---	---	None	---	None
Poygan silty clay loam	---	---	Jan-Dec			---	---	None	---	None
KuA:										
Kibbie	B	---	January	0.3-2.0	>6.0	---	---	None	---	None
			February	0.3-2.0	>6.0	---	---	None	---	None
			March	0.0-1.0	>6.0	0.0-0.5	Brief	Occasional	---	None
			April	0.0-1.0	>6.0	---	---	Rare	---	None
			May	0.0-2.0	>6.0	---	---	Rare	---	None
			June	1.0-3.0	>6.0	---	---	None	---	None
			July	1.0-3.0	>6.0	---	---	None	---	None
			August	1.0-3.0	>6.0	---	---	None	---	None
			September	0.5-2.0	>6.0	---	---	None	---	None
			October	0.5-2.0	>6.0	---	---	None	---	None
			November	0.3-2.0	>6.0	---	---	None	---	None
			December	0.3-2.0	>6.0	---	---	None	---	None
Bach silt loam	---	---	Jan-Dec			---	---	None	---	None
Kibbie Variant silt loam	---	---	Jan-Dec			---	---	None	---	None
Matherton silt loam	---	---	Jan-Dec			---	---	None	---	None
Shiocton silt loam	---	---	Jan-Dec			---	---	None	---	None
Substratum has layers of clay	---	---	Jan-Dec			---	---	None	---	None

Water Features

Kewaunee County, Wisconsin

Map symbol and soil name	Hydrologic group	Surface runoff	Month	Water table		Ponding			Flooding	
				Upper limit	Lower limit	Surface depth	Duration	Frequency	Duration	Frequency
				<i>Ft</i>	<i>Ft</i>	<i>Ft</i>				
KuA:										
Zurich silt loam	---	---	Jan-Dec			---	---	None	---	None
KvA:										
Kibbie variant	C	---	January	0.3-3.0	>6.0	---	---	None	---	None
			February	0.3-3.0	>6.0	---	---	None	---	None
			March	0.0-2.0	>6.0	0.0-0.5	Brief	Occasional	Brief	Occasional
			April	0.0-2.0	>6.0	---	---	Rare	---	Rare
			May	0.0-2.0	>6.0	---	---	Rare	---	None
			June	1.0-3.0	>6.0	---	---	None	---	None
			July	1.0-3.0	>6.0	---	---	None	---	None
			August	1.0-3.0	>6.0	---	---	None	---	None
			September	1.0-3.0	>6.0	---	---	None	---	None
			October	1.0-3.0	>6.0	---	---	None	---	None
			November	1.0-3.0	>6.0	---	---	None	---	None
			December	1.0-3.0	>6.0	---	---	None	---	None
Bach silt loam	---	---	Jan-Dec			---	---	None	---	None
Kibbie silt loam	---	---	Jan-Dec			---	---	None	---	None
Lamartine silt loam	---	---	Jan-Dec			---	---	None	---	None
Matherton silt loam	---	---	Jan-Dec			---	---	None	---	None
Zurich silt loam	---	---	Jan-Dec			---	---	None	---	None

Water Features

Kewaunee County, Wisconsin

Map symbol and soil name	Hydrologic group	Surface runoff	Month	Water table		Ponding			Flooding	
				Upper limit	Lower limit	Surface depth	Duration	Frequency	Duration	Frequency
				<i>Ft</i>	<i>Ft</i>	<i>Ft</i>				
LmA:										
Lamartine	C	---	January	0.3-2.5	>6.0	---	---	None	---	None
			February	0.3-2.5	>6.0	---	---	None	---	None
			March	0.0-2.0	>6.0	0.0-0.5	Brief	Occasional	Brief	Occasional
			April	0.0-2.0	>6.0	---	---	Rare	---	Rare
			May	0.0-2.0	>6.0	---	---	Rare	---	None
			June	1.0-3.0	>6.0	---	---	None	---	None
			July	1.0-3.0	>6.0	---	---	None	---	None
			August	1.0-3.0	>6.0	---	---	None	---	None
			September	1.0-3.0	>6.0	---	---	None	---	None
			October	1.0-3.0	>6.0	---	---	None	---	None
			November	1.0-3.0	>6.0	---	---	None	---	None
			December	1.0-3.0	>6.0	---	---	None	---	None
Pella silt loam	---	---	Jan-Dec			---	---	None	---	None
Waymor silt loam	---	---	Jan-Dec			---	---	None	---	None

Water Features

Kewaunee County, Wisconsin

Map symbol and soil name	Hydrologic group	Surface runoff	Month	Water table		Ponding			Flooding	
				Upper limit	Lower limit	Surface depth	Duration	Frequency	Duration	Frequency
				<i>Ft</i>	<i>Ft</i>	<i>Ft</i>				
Mk:										
Markey	A/D	---	January	0.0	>6.0	0.0-1.0	Very long	Frequent	---	None
			February	0.0	>6.0	0.0-1.0	Very long	Frequent	---	Rare
			March	0.0	>6.0	0.0-1.0	Very long	Frequent	Long	Frequent
			April	0.0	>6.0	0.0-1.0	Very long	Frequent	Long	Occasional
			May	0.0	>6.0	0.0-0.5	Very long	Frequent	---	Rare
			June	0.0-1.3	>6.0	0.0-0.5	Long	Occasional	---	None
			July	0.0-2.0	>6.0	---	---	Rare	---	None
			August	0.0-2.0	>6.0	---	---	Rare	---	None
			September	0.0-1.3	>6.0	0.0-0.5	Long	Occasional	---	None
			October	0.0-1.3	>6.0	0.0-0.5	Long	Occasional	---	None
			November	0.0	>6.0	0.0-0.5	Very long	Frequent	---	None
			December	0.0	>6.0	0.0-1.0	Very long	Frequent	---	None
Carbondale muck	---	---	Jan-Dec			---	---	None	---	None
Cathro muck	---	---	Jan-Dec			---	---	None	---	None
Mussey loam	---	---	Jan-Dec			---	---	None	---	None
Roscommon mucky loamy sand	---	---	Jan-Dec			---	---	None	---	None

Water Features

Kewaunee County, Wisconsin

Map symbol and soil name	Hydrologic group	Surface runoff	Month	Water table		Ponding			Flooding	
				Upper limit	Lower limit	Surface depth	Duration	Frequency	Duration	Frequency
				<i>Ft</i>	<i>Ft</i>	<i>Ft</i>				
MmA:										
Matherton	B	---	January	0.3-3.0	>6.0	---	---	None	---	None
			February	0.3-3.0	>6.0	---	---	None	---	None
			March	0.0-2.0	>6.0	0.0-0.5	Brief	Occasional	---	None
			April	0.0-2.0	>6.0	---	---	Rare	---	None
			May	0.0-2.0	>6.0	---	---	Rare	---	None
			June	1.0-3.0	>6.0	---	---	None	---	None
			July	1.0-3.0	>6.0	---	---	None	---	None
			August	1.0-3.0	>6.0	---	---	None	---	None
			September	1.0-3.0	>6.0	---	---	None	---	None
			October	1.0-3.0	>6.0	---	---	None	---	None
			November	1.0-3.0	>6.0	---	---	None	---	None
			December	1.0-3.0	>6.0	---	---	None	---	None
Casco sandy loam	---	---	Jan-Dec			---	---	None	---	None
Depth to substratum is >40	---	---	Jan-Dec			---	---	None	---	None
Dresden silt loam	---	---	Jan-Dec			---	---	None	---	None
Fabius loam	---	---	Jan-Dec			---	---	None	---	None
Mussey loam	---	---	Jan-Dec			---	---	None	---	None

Water Features

Kewaunee County, Wisconsin

Map symbol and soil name	Hydrologic group	Surface runoff	Month	Water table		Ponding			Flooding	
				Upper limit	Lower limit	Surface depth	Duration	Frequency	Duration	Frequency
				<i>Ft</i>	<i>Ft</i>	<i>Ft</i>				
My:										
Mussey	B/D	---	January	0.0-1.0	>6.0	0.0-0.5	Long	Occasional	---	None
			February	0.0-1.0	>6.0	0.0-0.5	Long	Occasional	---	Rare
			March	0.0-0.5	>6.0	0.0-1.0	Very long	Frequent	Long	Frequent
			April	0.0	>6.0	0.0-0.5	Long	Frequent	Brief	Occasional
			May	0.0-1.0	>6.0	0.0-0.5	Brief	Occasional	---	Rare
			June	0.0-1.0	>6.0	---	---	Rare	---	None
			July	0.0-2.0	>6.0	---	---	Rare	---	None
			August	0.0-2.0	>6.0	---	---	Rare	---	None
			September	0.0-1.0	>6.0	---	---	Rare	---	None
			October	0.0-1.0	>6.0	---	---	Rare	---	None
			November	0.0-1.0	>6.0	---	---	Rare	---	None
			December	0.0-1.0	>6.0	0.0-0.5	Long	Occasional	---	None
Depth to substratum > 20	---	---	Jan-Dec			---	---	None	---	None
Fabius loam	---	---	Jan-Dec			---	---	None	---	None
Markey muck	---	---	Jan-Dec			---	---	None	---	None
Matherton silt loam	---	---	Jan-Dec			---	---	None	---	None

Water Features

Kewaunee County, Wisconsin

Map symbol and soil name	Hydrologic group	Surface runoff	Month	Water table		Ponding			Flooding	
				Upper limit	Lower limit	Surface depth	Duration	Frequency	Duration	Frequency
				<i>Ft</i>	<i>Ft</i>	<i>Ft</i>				
Pe:										
Pella	B/D	---	January	0.0-1.0	>6.0	0.0-0.5	Long	Occasional	---	None
			February	0.0-0.5	>6.0	0.0-0.5	Long	Occasional	---	None
			March	0.0	>6.0	0.0-1.0	Long	Frequent	---	None
			April	0.0	>6.0	0.0-1.0	Long	Frequent	---	None
			May	0.0-1.0	>6.0	0.0-0.5	Brief	Occasional	---	None
			June	0.0-1.0	>6.0	---	---	Rare	---	None
			July	0.0-2.0	>6.0	---	---	Rare	---	None
			August	0.0-2.0	>6.0	---	---	Rare	---	None
			September	0.0-2.0	>6.0	---	---	Rare	---	None
			October	0.0-2.0	>6.0	---	---	Rare	---	None
			November	0.0-1.0	>6.0	---	---	Rare	---	None
			December	0.0-1.0	>6.0	---	---	Rare	---	None
Cathro muck	---	---	Jan-Dec			---	---	None	---	None
Lamartine silt loam	---	---	Jan-Dec			---	---	None	---	None
Surface is muck	---	---	Jan-Dec			---	---	None	---	None
Symco silt loam	---	---	Jan-Dec			---	---	None	---	None

Water Features

Kewaunee County, Wisconsin

Map symbol and soil name	Hydrologic group	Surface runoff	Month	Water table		Ponding			Flooding	
				Upper limit	Lower limit	Surface depth	Duration	Frequency	Duration	Frequency
				<i>Ft</i>	<i>Ft</i>	<i>Ft</i>				
Rs:										
Roscommon	A/D	---	January	0.0-1.0	>6.0	0.0-0.5	Brief	Occasional	---	None
			February	0.0	>6.0	0.0-1.0	Long	Occasional	---	Rare
			March	0.0	>6.0	0.0-2.0	Very long	Frequent	Brief	Frequent
			April	0.0-0.5	>6.0	0.0-1.0	Long	Frequent	Brief	Occasional
			May	0.0-1.0	>6.0	0.0-0.5	Long	Occasional	---	Rare
			June	0.0-1.0	>6.0	0.0-0.5	Brief	Occasional	---	None
			July	0.0-2.0	>6.0	---	---	Rare	---	None
			August	0.0-2.0	>6.0	---	---	Rare	---	None
			September	0.0-2.0	>6.0	---	---	Rare	---	None
			October	0.0-1.0	>6.0	---	---	Rare	---	None
			November	0.0-1.0	>6.0	---	---	Rare	---	None
			December	0.0-1.0	>6.0	0.0-0.5	Brief	Occasional	---	None
Markey muck	---	---	Jan-Dec			---	---	None	---	None
Mussey loam	---	---	Jan-Dec			---	---	None	---	None
Substratum is silt & fine sand	---	---	Jan-Dec			---	---	None	---	None
Surface is sand	---	---	Jan-Dec			---	---	None	---	None
Surface layer is sandy loam	---	---	Jan-Dec			---	---	None	---	None
Wainola loamy fine sand	---	---	Jan-Dec			---	---	None	---	None

Water Features

Kewaunee County, Wisconsin

Map symbol and soil name	Hydrologic group	Surface runoff	Month	Water table		Ponding			Flooding	
				Upper limit	Lower limit	Surface depth	Duration	Frequency	Duration	Frequency
				<i>Ft</i>	<i>Ft</i>	<i>Ft</i>				
Ru:										
Ruse	D	---	January	0.0-1.0	0.8-1.7	---	---	Rare	---	None
			February	0.0-1.0	0.8-1.7	---	---	Rare	---	None
			March	0.0	0.8-1.7	0.0-1.0	Long	Frequent	---	None
			April	0.0-0.5	0.8-1.7	0.0-1.0	Long	Occasional	---	None
			May	0.0-1.0	0.8-1.7	0.0-1.0	Long	Occasional	---	None
			June	0.0-1.0	0.8-1.7	---	---	Rare	---	None
			July	0.0-1.7	0.8-1.7	---	---	Rare	---	None
			August	0.0-1.7	0.8-1.7	---	---	Rare	---	None
			September	0.0-1.7	0.8-1.7	---	---	Rare	---	None
			October	0.0-1.0	0.8-1.7	---	---	Rare	---	None
			November	0.0-1.0	0.8-1.7	---	---	Rare	---	None
			December	0.0-1.0	0.8-1.7	---	---	Rare	---	None
Bonduel loam	---	---	Jan-Dec			---	---	None	---	None
ShA:										
Shiocton	C	---	January	0.0-1.0	>6.0	---	---	Rare	---	Rare
			February	0.0-1.0	>6.0	---	---	Rare	---	Rare
			March	0.0-0.5	>6.0	0.0-1.0	Long	Frequent	Long	Occasional
			April	0.0-0.5	>6.0	0.0-1.0	Long	Frequent	Brief	Occasional
			May	0.0-1.0	>6.0	0.0-1.0	Brief	Occasional	---	Rare
			June	0.0-1.0	>6.0	---	---	Rare	---	Rare
			July	0.0-1.0	>6.0	---	---	None	---	None
			August	0.0-1.0	>6.0	---	---	None	---	None
			September	0.0-1.0	>6.0	---	---	None	---	Rare
			October	0.0-1.0	>6.0	---	---	Rare	---	Rare
			November	0.0-1.0	>6.0	---	---	Rare	---	Rare
			December	0.0-1.0	>6.0	---	---	Rare	---	Rare

Water Features

Kewaunee County, Wisconsin

Map symbol and soil name	Hydrologic group	Surface runoff	Month	Water table		Ponding			Flooding	
				Upper limit	Lower limit	Surface depth	Duration	Frequency	Duration	Frequency
				<i>Ft</i>	<i>Ft</i>	<i>Ft</i>				
ShA:										
Bach silt loam	---	---	Jan-Dec			---	---	None	---	None
Kibbie silt loam	---	---	Jan-Dec			---	---	None	---	None
Lamartine silt loam	---	---	Jan-Dec			---	---	None	---	None
Nichols fine sandy loam	---	---	Jan-Dec			---	---	None	---	None
Wainola loamy fine sand	---	---	Jan-Dec			---	---	None	---	None
SoA:										
Solona	C	---	January	0.0-1.0	>6.0	---	---	Rare	---	Rare
			February	0.0-1.0	>6.0	---	---	Rare	---	Rare
			March	0.0-0.5	>6.0	0.0-1.0	Long	Frequent	Brief	Occasional
			April	0.0-0.5	>6.0	0.0-1.0	Brief	Occasional	Brief	Occasional
			May	0.0-2.0	>6.0	---	---	Rare	---	Rare
			June	0.0-2.0	>6.0	---	---	Rare	---	Rare
			July	0.5-2.0	>6.0	---	---	None	---	None
			August	0.5-2.0	>6.0	---	---	None	---	None
			September	0.5-2.0	>6.0	---	---	None	---	Rare
			October	0.0-2.0	>6.0	---	---	Rare	---	Rare
			November	0.0-2.0	>6.0	---	---	Rare	---	Rare
			December	0.0-1.0	>6.0	---	---	Rare	---	Rare
Angelica silt loam	---	---	Jan-Dec			---	---	None	---	None
Bonduel loam	---	---	Jan-Dec			---	---	None	---	None
Onaway loam	---	---	Jan-Dec			---	---	None	---	None

Water Features

Kewaunee County, Wisconsin

Map symbol and soil name	Hydrologic group	Surface runoff	Month	Water table		Ponding			Flooding	
				Upper limit	Lower limit	Surface depth	Duration	Frequency	Duration	Frequency
				<i>Ft</i>	<i>Ft</i>	<i>Ft</i>				
SyA:										
Symco	C	---	January	0.0-1.0	>6.0	---	---	Rare	Brief	Rare
			February	0.0-1.0	>6.0	---	---	Rare	Brief	Occasional
			March	---	---	0.0-1.0	Long	Frequent	Long	Occasional
			April	---	---	0.0-1.0	Long	Occasional	Long	Occasional
			May	0.0-1.0	>6.0	0.0-1.0	Brief	Occasional	Brief	Occasional
			June	0.0-2.0	>6.0	---	---	Rare	---	Rare
			July	0.5-2.0	>6.0	---	---	Rare	---	Rare
			August	0.5-2.0	>6.0	---	---	Rare	---	Rare
			September	0.0-2.0	>6.0	---	---	Rare	---	Rare
			October	0.0-1.0	>6.0	---	---	Rare	---	Rare
			November	0.0-1.0	>6.0	---	---	Rare	---	Rare
			December	0.0-1.0	>6.0	---	---	Rare	---	Rare
Angelica silt loam	---	---	Jan-Dec			---	---	None	---	None
Hortonville silt loam	---	---	Jan-Dec			---	---	None	---	None
Manawa silt loam	---	---	Jan-Dec			---	---	None	---	None
Subsoil is silty clay or clay	---	---	Jan-Dec			---	---	None	---	None
Substratum is silty clay	---	---	Jan-Dec			---	---	None	---	None

Water Features

Kewaunee County, Wisconsin

Map symbol and soil name	Hydrologic group	Surface runoff	Month	Water table		Ponding			Flooding	
				Upper limit	Lower limit	Surface depth	Duration	Frequency	Duration	Frequency
				<i>Ft</i>	<i>Ft</i>	<i>Ft</i>				
WaA:										
Wainola	B	---	January	0.5-2.0	>6.0	---	---	None	---	None
			February	0.5-2.0	>6.0	---	---	None	---	None
			March	0.0-2.0	>6.0	0.0-0.5	Brief	Occasional	---	None
			April	0.0-2.0	>6.0	---	---	Rare	---	None
			May	0.0-2.0	>6.0	---	---	Rare	---	None
			June	0.5-2.0	>6.0	---	---	None	---	None
			July	1.0-3.0	>6.0	---	---	None	---	None
			August	1.0-3.0	>6.0	---	---	None	---	None
			September	1.0-3.0	>6.0	---	---	None	---	None
			October	1.0-3.0	>6.0	---	---	None	---	None
			November	1.0-3.0	>6.0	---	---	None	---	None
			December	1.0-3.0	>6.0	---	---	None	---	None
Oakville loamy fine sand	---	---	Jan-Dec			---	---	None	---	None
Roscommon mucky loamy sand	---	---	Jan-Dec			---	---	None	---	None
Substratum is sand and gravel	---	---	Jan-Dec			---	---	None	---	None