Ground Truth Findings (Jan. 19 2010)

Site 1: Sod Farm

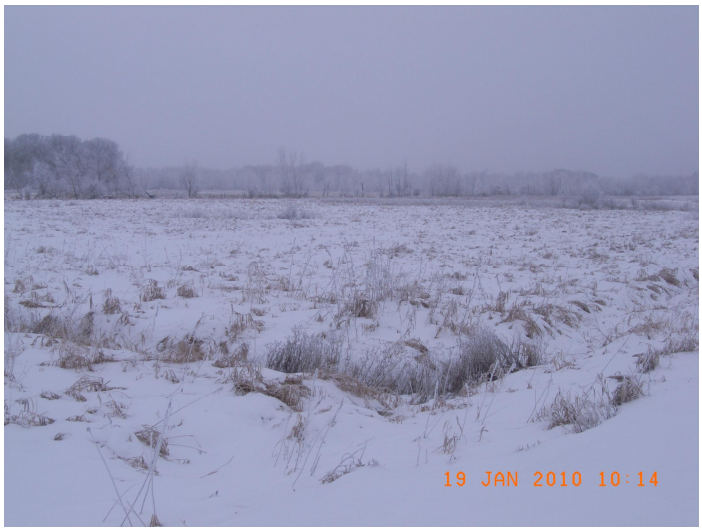
Intersection of 360th and Sunrise Prairie Trail (UTM Coordinates: 501341 5035211)

Visible Vegetation:

Kentucky Blue Grass - FAC
Stinging nettle - FAC
Reed Canary Grass - FACW
Smooth Brome - NI
Switch grass - FAC
Canada Goldenrod - FAC

The site was as described: There is RCG and various forbs sticking up through the snow with Alders and Cottonwoods growing in the ditch.

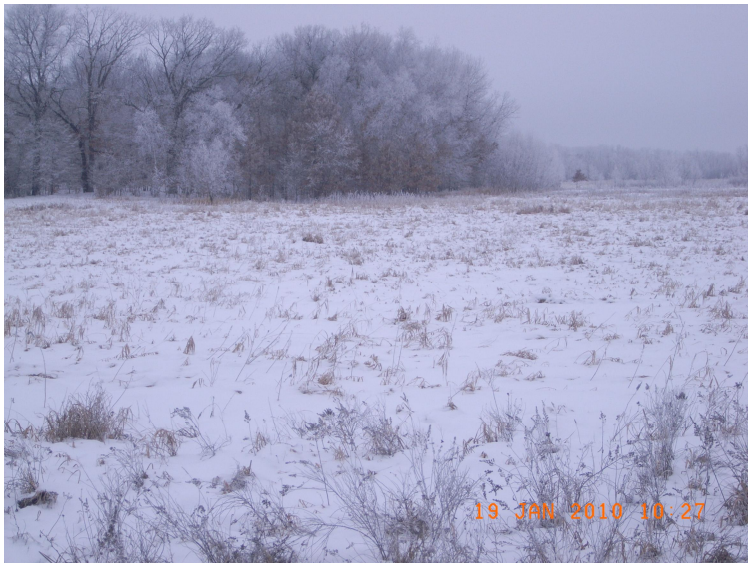
Photo(s): Both facing South West

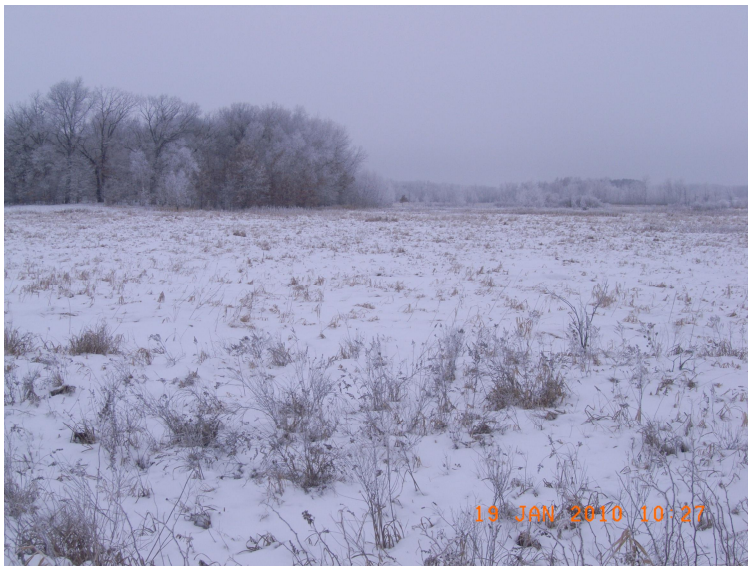


Fallow Sod Field (UTM Coordinates: 501320 5034969)

Vegetation was the same as Intersection of 360th and Sunrise Prairie Trail on all accounts

Photo(s): Both facing West from Sunrise Prairie Trail





Active Sod Field (UTM Coordinates: 501287 5034455)

Vegetation on site was not visible (as you described)

Photo – Facing South West

Abandoned Sod Field
Sunrise Watershed Ground Truthing

Site 2: Forested Site

Sample point A (UTM Coordinates 501564 5024633)

This point was located in a visibly forested/shrub swamp wetland area

Vegetation:

Paper Birch - FACU
Speckled Alder - OBL
Red Osier Dogwood - FACW
Reed Canary Grass - FACW
Cottonwood - FAC

Photo(s):

Sample point B (UTM Coordinates: 501596 5024574)

This sample point was located at a seemingly Upland area. The sample point was a short distance up slope of where the wetland area seemed to be. The slope was dominated by red oaks.

Vegetation:

Red Oak - FACU
Paper Birch - FACU
Speckled Alder - OBL
Red Osier Dogwood - FACW
Reed Canary Grass - FACW
Cottonwood - FAC

The photo we took was down slope of the provided sample coordinates

Photo:

Sample Point C: (UTM Coordinates 501666 5024503)

This site was located in a visibly forested/shrub swamp wetland area.

Vegetation:

Paper Birch - FACU
Speckled Alder - OBL
Red Osier Dogwood - FACW
Reed Canary Grass - FACW
Cottonwood - FAC
Braken Fern: FACU

Photo: Facing East. Sample point is located 15-20 feet East.

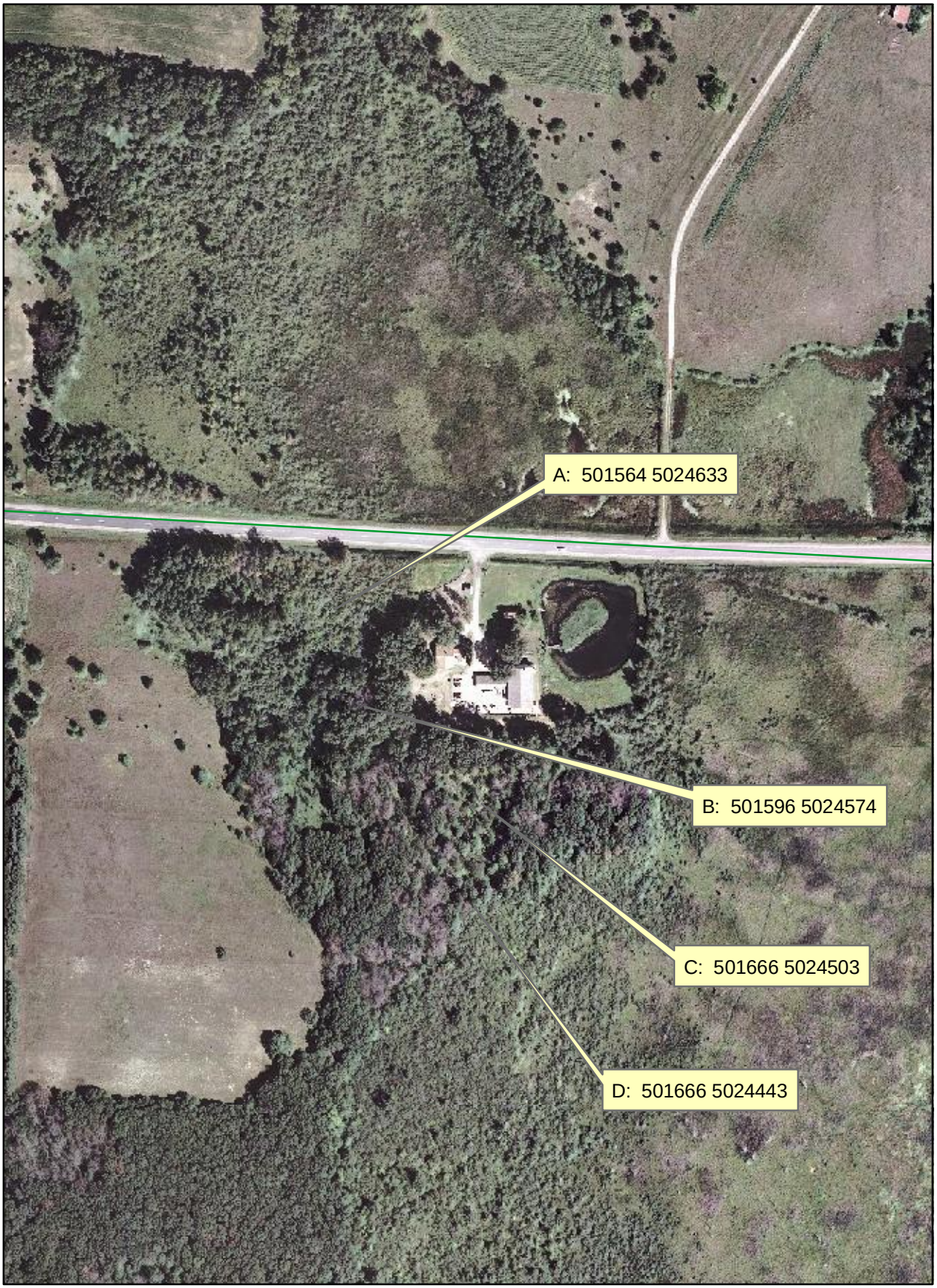
Figure 1

Sample Point D: (UTM Coordinates 501666 5024443)

Vegetation:

Paper Birch - FACU
Speckled Alder - OBL
Red Osier Dogwood - FACW
Reed Canary Grass - FACW
Cottonwood - FAC
Braken Fern: FACU

No photos



Carlos Aveny Forested Site
Sunrise Watershed Ground Truthing

LOCATION AMES IA+MN

Established Series
Rev. JRC-RJK-TWN
08/2006

AMES SERIES

The Ames series consists of very deep, poorly or very poorly drained soils that formed in glacial till, reworked glacial till, or till-derived sediments. These soils occur on flat to slightly depressed areas of small size on dissected landscapes that border stream valleys. Slope ranges from 0 to 2 percent. Mean annual air temperature is about 9 degrees C. Mean annual precipitation is about 815 millimeters.

TAXONOMIC CLASS: Fine, smectitic, mesic Typic Albaqualfs

TYPICAL PEDON: Ames silt loam, in a depression, in a wooded pasture. (Colors are for moist soil unless otherwise stated)

A--0 to 8 centimeters; very dark brown (10YR 2/2) silt loam, gray (10YR 5/1) dry; many black (10YR 2/1) coats on faces of peds; weak fine subangular blocky structure; friable; neutral; abrupt smooth boundary. (5 to 13 centimeters thick)

E1--8 to 15 centimeters; dark gray (10YR 4/1) silt loam, gray (10YR 6/1) dry; many very dark gray (10YR 3/1) coats on faces of peds; weak medium platy structure parting to weak very fine subangular blocky; friable; strongly acid; clear smooth boundary.

E2--15 to 28 centimeters; dark gray (10YR 4/1) silt loam, gray (10YR 6/1) dry; moderate medium platy structure parting to weak fine subangular blocky; friable; common medium dark concretions (Fe and Mn oxides); strongly acid; gradual smooth boundary.

E3--28 to 43 centimeters; light brownish gray (10YR 6/2) silt loam, light gray (10YR 7/1) dry; weak very coarse platy structure parting to moderate fine subangular blocky; friable; common medium dark concretions (Fe and Mn oxides); strongly acid; abrupt smooth boundary. (Combined thickness of the E horizon is 15 to 38 centimeters.)

Btg1--43 to 53 centimeters; gray (10YR 5/1) and grayish brown (10YR 5/2) clay loam; strong fine angular blocky structure; firm; common distinct dark grayish brown (10YR 4/2) clay films on faces of peds; common medium dark concretions (Fe and Mn oxides); few fine distinct yellowish brown (10YR 5/4) redoximorphic concentrations; strongly acid; gradual smooth boundary.

Btg2--53 to 74 centimeters; gray (10YR 5/1) and grayish brown (2.5Y 5/2) clay; strong medium angular blocky structure; firm; common distinct dark gray (10YR 4/1) clay films on faces of peds; common medium dark concretions (Fe and Mn oxides); few fine distinct yellowish brown (10YR 5/4) redoximorphic concentrations; strongly acid; gradual smooth boundary.

Btg3--74 to 94 centimeters; grayish brown (2.5Y 5/2) and gray (10YR 5/1) clay loam; moderate fine prismatic structure parting to strong fine angular blocky; firm; many distinct very dark gray (10YR 3/1) and dark gray (10YR 4/1) clay films on faces of peds; common medium dark concretions (Fe and Mn oxides); few medium prominent strong brown (7.5YR 5/6) redoximorphic concentrations; moderately acid; gradual smooth boundary.

Btg4--94 to 112 centimeters; gray (10YR 5/1) clay loam; moderate very fine prismatic structure parting to strong fine angular blocky; very firm; common distinct dark gray (10YR 4/1) clay films on faces of peds and along surfaces of pores; common black (N 2/0) coats along surfaces of pores; many fine dark concretions (Fe and Mn oxides); many fine prominent strong brown (7.5YR 5/6) redoximorphic concentrations; slightly acid; gradual smooth boundary.

Btg5--112 to 135 centimeters; gray (5Y 5/1) and grayish brown (2.5Y 5/2) clay loam; strong fine angular blocky structure; very firm; common distinct dark gray (10YR 4/1) clay films on faces of peds and on surfaces along pores; common distinct black (N 2/0) coats along surfaces of pores; many medium prominent strong brown (7.5YR 5/6) redoximorphic concentrations; many fine dark concretions (Fe and Mn oxides); neutral; clear smooth boundary. (Combined thickness of the Btg horizon is 71 to 102 centimeters.)

Cg--135 to 152 centimeters; olive gray (5Y 5/2) loam; massive; firm; common distinct black (N 2/0) coats on faces of peds and along surfaces of pores; many fine dark concretions (Fe and Mn oxides); many medium prominent strong brown (7.5YR 5/6) and red (2.5YR 4/8) redoximorphic concentrations; neutral.

TYPE LOCATION: Major Land Resource Area (MLRA) 103-Central Iowa and Minnesota Till Prairies; Boone County, Iowa subset; about 4 miles northwest of Boone; located about 600 feet west and 30 feet south of the northeast corner of section 36, T. 85 N., R. 27 W; USGS Fraser topographic quadrangle; lat. 42 degrees 08 minutes 15 seconds N. and long. 93 degrees 56 minutes 02 seconds W., NAD 83.

RANGE IN CHARACTERISTICS:
Depth to carbonates--91 to 152 centimeters
Clay content of the particle-size control section (weighted average)--35 to 40 percent
Sand content of the particle-size control section (weighted average)--20 to 40 percent

A horizon:
Hue--10YR
Value--2 to 4
Chroma--1 or 2
Texture--silt loam or loam
Clay content--15 to 25 percent
Sand content--20 to 40 percent
Reaction--slightly acid or neutral

In cultivated areas, the Ap horizon has value of 4 and chroma of 1 or 2

E horizon:
Hue--10YR
Value--4 to 6
Chroma--1 or 2
Texture--silt loam or loam
Clay content--12 to 20 percent
Sand content--20 to 40 percent
Reaction--very strongly acid to moderately acid

Btg horizon:
Hue--10YR, 2.5Y, or 5Y
Value--4 or 5
Chroma--1 or 2
Texture--clay loam or clay
Clay content--32 to 42 percent
Sand content--20 to 50 percent
Reaction--strongly acid to neutral

Cg horizon:
Hue--10YR, 2.5Y, or 5Y
Value--5 or 6
Chroma--1 to 3
Texture--loam or clay loam
Clay content--20 to 30 percent
Sand content--35 to 50 percent

Reaction--slightly acid to moderately alkaline

COMPETING SERIES:
These are the Leaksville, Pierron, Rushville, Watchung, Wynoose, and Zwingle series.
Leaksville--have a lithic contact of shale at a depth of 150 centimeters
Pierron--have an average sand content of less than 7 percent in the particle-size control section
Rushville--have an average sand content of less than 5 percent in the particle-size control section
Watchung--have gabbro rock fragments throughout the series control section
Wynoose--have an average sand content of less than 15 percent in the particle-size control section
Zwingle--have an average clay content of 50 to 60 percent in the particle-size control section

GEOGRAPHIC SETTING:
Parent material--glacial till, reworked glacial till, or till-derived sediments
Landform--flat to slightly depressed areas of small size on dissected landscapes that border stream valleys
Slope--0 to 2 percent
Elevation--244 to 427 meters above sea level
Mean annual air temperature--7 to 11 degrees C
Mean annual precipitation--760 to 870 millimeters
Frost free period--140 to 165 days

GEOGRAPHICALLY ASSOCIATED SOILS: Members of the typical catena include Hayden, Lester, Le Sueur, and Luther soils.
Hayden and Lester--are at lower landscape positions on convex side slopes and do not have frequently saturated zones within a depth of 1.8 meters in normal years
Luther--are at slightly higher landscape positions on slight convex rises and have a frequently saturated zone at a depth of 0.3 meter during the wettest periods of normal years
Le Sueur--are at slightly higher landscape positions on slight convex rises and have a frequently saturated zone at a depth of 0.45 meter during the wettest periods of normal years

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY:
Drainage class--poorly or very poorly drained--in undrained conditions, these soils are frequently saturated at the soil surface during April to June in normal years and both perched and apparent saturation can occur on this soil based on the season and intensity of rainfall during a given period of time
Saturated hydraulic conductivity--0.10 to 1.00 micrometers per second (moderately low)
Surface runoff potential--negligible to medium
Ponding--frequently or occasionally ponded up to 0.3 meter in depth for long duration in normal years from precipitation events and snowmelt

USE AND VEGETATION:
Some areas are used for cultivated crops if artificially drained. The principal crops are corn, soybeans, small grains, and legume hay. Many areas are in pasture or trees. Native vegetation is trees and grasses tolerant to wetness.

DISTRIBUTION AND EXTENT:
Physiographic Division--Interior Plains
Physiographic Province--Central Lowland
Physiographic section--Western lake section
MLRAs--Central Iowa and Minnesota Till Prairie (103) and Wisconsin and Minnesota Sandy Outwash (91)
LRR M; north central Iowa and south central Minnesota
Extent--small

MLRA OFFICE RESPONSIBLE: St. Paul, Minnesota

SERIES ESTABLISHED: Story County, Iowa, 1936.

REMARKS:

Particle-size control section--the zone from a depth of 43 to 93 centimeters;
series control section--the zone from the surface to a depth of 150 centimeters.

Diagnostic horizons and features recognized in this pedon include:
ochric epipedon--the zone from the surface to a depth of 43 centimeters(A, E1, E2, and E3 horizons);
albic horizon--the zone from 8 to 43 centimeters (E1, E2, and E3 horizons);
argillic horizon--the zone from 43 to 135 centimeters (Btg1, Btg2, Btg3, Btg4, and Btg5);
udic moisture regime.

Taxonomy version--Keys to Soil Taxonomy, tenth edition, 2006.

National Cooperative Soil Survey
U.S.A.

LOCATION AUBURNDALE WI+MN

Established Series
Rev. DTS-TAM-TWN
07/2009

AUBURNDALE SERIES

The Auburndale series consists of very deep, poorly drained soils formed in 90 to 150 centimeters of loess or silty alluvium, or both, and in the underlying loamy till. These soils are in depressions and drainageways on ground moraines. Slope ranges from 0 to 3 percent. Mean annual precipitation is about 750 millimeters. Mean annual air temperature is about 5 degrees C.

TAXONOMIC CLASS: Fine-silty, mixed, superactive, frigid Mollic Epiaqualfs

TYPICAL PEDON: Auburndale silt loam, on a slope of less than 1 percent, in an abandoned field reverting to marsh vegetation, at an elevation of about 363 meters above sea level. (Colors are for moist soil unless otherwise stated.)

Ap--0 to 18 centimeters; very dark grayish brown (10YR 3/2) silt loam, light grayish brown (10YR 5/2) dry; moderate fine and medium granular structure; friable; common very fine and fine roots; very strongly acid; clear smooth boundary.

Eg--18 to 36 centimeters; grayish brown (10YR 5/2) silt loam, light gray (10YR 7/2) dry; weak medium platy structure; friable; common very fine and fine roots; many medium prominent strong brown (7.5YR 5/8) masses of iron accumulation; very strongly acid; clear wavy boundary.

Btg1--36 to 51 centimeters; light brownish gray (10YR 6/2) silt loam; moderate fine subangular blocky structure; friable; common very fine and fine roots: few faint grayish brown (10YR 5/2) clay films on faces of some peds; many medium distinct brownish yellow (10YR 6/6) masses of iron accumulation; very strongly acid; clear wavy boundary.

Btg2--51 to 74 centimeters; light brownish gray (10YR 6/2) silt loam; moderate fine subangular blocky structure; friable; few fine roots: few faint grayish brown (10YR 5/2) clay films on faces of peds; many medium distinct brownish yellow (10YR 6/6) masses of iron accumulation; strongly acid; clear wavy boundary.

Btg3--74 to 104 centimeters; grayish brown (10YR 5/2) silt loam; moderate fine subangular blocky structure; friable; few fine roots; few faint dark grayish brown (10YR 4/2) clay films on faces of peds; many medium prominent strong brown (7.5YR 5/8) and common fine prominent yellowish brown (10YR 5/8) masses of iron accumulation; moderately acid; clear wavy boundary.

2Btg4--104 to 135 centimeters; grayish brown (10YR 5/2) loam; weak medium and coarse subangular blocky structure; friable; few fine roots; few faint dark grayish brown (10YR 4/2) clay films on faces of some peds; many coarse prominent reddish yellow (7.5YR 6/8) and common medium prominent yellowish red (5YR 5/6) masses of iron accumulation; about 5 percent gravel; moderately acid; gradual wavy boundary.

2C--135 to 152 centimeters; dark brown (7.5YR 3/4) sandy loam; massive; friable; few medium distinct strong brown (7.5YR 5/8) masses of iron accumulation; about 8 percent gravel; slightly acid.

TYPE LOCATION: Major Land resource Area (MLRA) 90A-Wisconsin and Minnesota Thin Loess and Till, Northern Part, Clark County, Wisconsin subset; about 2.5 miles north and 2.5 miles west of Thorpe; located about 100 feet south and 100 feet east of the northwest corner of section 15, T. 29 N., R. 4 W.; USGS Bellinger topographic quadrangle; lat. 45 degrees 00 minutes 08 seconds N. and long. 90 degrees 51 minutes 40 seconds W., NAD 83.

RANGE IN CHARACTERISTICS:

Depth to loamy till--90 to 150 centimeters
Clay content of the particle-size control section (weighted average)--18 to 27 percent
Sand content of the particle-size control section (weighted average)--less than 15 percent, fine sand and sand coarser than fine sand
Ratio of coarse silt to fine silt in the silty mantle--1.25 to 2.50

Ap horizon:
Hue--7.5YR or 10YR
Value--2 or 3
Chroma--1 to 3
Texture--silt loam
Clay content--6 to 25 percent
Sand content--less than 15 percent
Rock fragment content--0 to 10 percent, gravel; 0 to 3 percent, cobbles
Reaction--pH 4.5 to 7.3
Thickness--15 to 23 centimeters

A horizon (when present):
Hue--7.5YR or 10YR
Value--2 or 3
Chroma--1 or 2
Texture--silt loam
Clay content--6 to 25 percent
Sand content--less than 15 percent
Rock fragment content--0 to 10 percent, gravel; 0 to 3 percent, cobbles
Reaction--pH 4.5 to 7.3
Thickness--0 to 15 centimeters

Eg horizon:
Hue--10YR or 2.5Y
Value--4 to 6
Chroma--1 or 2
Texture--silt loam or silt
Clay content--6 to 20
Sand content--less than 15 percent
Rock fragment content--0 to 10 percent, gravel; 0 to 3 percent, cobbles
Reaction--pH 4.5 to 6.0
Thickness--0 to 30 centimeters

Btg horizon and Cg horizon (when present):
Hue--7.5YR, 10YR, or 2.5Y
Value--4 to 6
Chroma--1 or 2
Texture--silt loam
Clay content--18 to 27 percent
Sand content--less than 15 percent
Rock fragment content--0 to 10 percent, gravel; 0 to 3 percent, cobbles
Reaction--pH 4.5 to 6.0
Thickness of the Btg horizon--50 to 100 centimeters

2Btg, 2Bt horizon (when present), 2BCg horizon (when present), or 2BC horizon (when present):
Hue--2.5YR, 5YR, 7.5YR, or 10YR
Value--3 to 6
Chroma--2 to 6 (value of 3 and chroma of 2 or 3 do not occur together)
Texture--sandy loam, fine sandy loam, loam, or the gravelly analogs of these textures
Clay content--8 to 20 percent

Sand content--40 to 70 percent
Rock fragment content--3 to 35 percent, gravel; 0 to 5 percent, cobbles
Reaction--pH 4.5 to 6.0
Moist bulk density--1.5 to 1.80 g/cc
Thickness of the 2Btg horizon--0 to 40 centimeters

2C horizon:
Hue--2.5YR, 5YR, 7.5YR, or 10YR
Value--3 to 6
Chroma--3 to 6 (value of 3 and chroma of 2 or 3 do not occur together)
Texture--sandy loam, fine sandy loam, loam, or the gravelly analogs of these textures
Clay content--5 to 15 percent
Sand content--40 to 70 percent
Rock fragment content--3 to 35 percent, gravel; 0 to 5 percent, cobbles
Reaction--pH 4.5 to 6.5
Moist bulk density--1.70 to 1.85 g/cc

Some pedons have a dominant moist chroma of 2 in the upper part of the 2Cg horizon

2Cd horizon (when present, below a depth of 150 centimeters):
Hue--2.5YR, 5YR, 7.5YR, or 10YR
Value--3 to 6
Chroma--3 to 6 (value of 3 and chroma of 2 or 3 do not occur together)
Texture--sandy loam, fine sandy loam, loam, or the gravelly analogs of these textures
Clay content--7 to 17 percent
Sand content--45 to 75 percent
Rock fragment content--3 to 35 percent, gravel; 0 to 5 percent, cobbles
Reaction--pH 5.1 to 6.5
Moist bulk density--1.85 to 2.00 g/cc

Some pedons have small pockets or thin strata of loamy sand or gravelly loamy sand

COMPETING SERIES: This is the Barronett series.
Barronett--have a sand content of less than 15 percent in the lower third of the series control section

GEOGRAPHIC SETTING:
Parent material--90 to 150 centimeters of loess or other silty deposits and in the underlying loamy till of Late or Early Wisconsinan Age
Landform--depressions and drainageways on ground moraines
Slope--0 to 3 percent
Elevation--205 to 595 meters above sea level
Mean annual air temperature--3 to 8 degrees C
Mean annual precipitation--635 to 865 millimeters
Frost-free period--90 to 180 days

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Adolph, Almena, Capitola, Freeon, Loyal, Magnor, Otterholt, Spencer, and Withee soils.
Adolph--are on landscape positions similar to those of the Auburndale soils and have a clay content that averages less than 18 percent in the particle-size control section
Almena--are on higher landscape positions and have a frequently saturated zone occurs between depths of 0.15 and 0.75 meter during the wettest periods of years when precipitation is within one standard deviation of 30 year mean of annual precipitation
Capitola--are on landscape positions similar to those of the Auburndale soils and have a clay content that averages less than 18 percent in the particle-size control section
Freeon--are on higher landscape positions and have a frequently saturated zone between depths of 0.6 to 1 meter during the wettest periods of years when precipitation is within one standard deviation of 30 year mean of annual precipitation

Loyal--are on higher landscape positions and have a sand content that averages 15 to 65 percent in the particle-size control section
Magnor--are on higher landscape positions and have a densic contact within a depth of 150 centimeters with a moist bulk density range of 1.8 to 2.0 g/cc
Otterholt--are on higher landscape positions and do not have a frequently saturated zone within a depth of 1.8 meter during the wettest periods of years when precipitation is within one standard deviation of 30 year mean of annual precipitation
Spencer--are on higher landscape positions and have a frequently saturated zone between depths of 0.75 to 1 meter during the wettest periods of years when precipitation is within one standard deviation of 30 year mean of annual precipitation
Withee--are on higher landscape positions and have a sand content that averages 15 to 65 percent in the particle-size control section

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY:
Drainage class--poorly drained--these soils are frequently saturated from the surface of the soil to a depth of 0.3 meters during the wettest periods of years when precipitation is within one standard deviation of 30 year mean of annual precipitation, this saturation is considered perched
Saturated hydraulic conductivity--4.00 to 14.00 micrometers per second in the silty mantle, 1.00 to 14.00 micrometers per second in the till, and 0.01 to 1.00 in the dense till, when present
Ponding--frequently ponded to a depth of 0.15 meters for long duration during the wettest periods of years when precipitation is within one standard deviation of 30 year mean of annual precipitation

USE AND VEGETATION:
Most areas are in native vegetation of wetland grasses, alder shrubs, and trees such as black ash, quaking aspen, and bog willow. Some areas are pastured. Marsh hay is harvested from some areas in dry years. Some areas are drained and cultivated.

DISTRIBUTION AND EXTENT:
Physiographic division--Interior Plains
Physiographic Province--Central Lowland
Physiographic section--Western Lake section
MLRAs--Wisconsin and Minnesota Thin Loess and Till, Northern Part (90A), Wisconsin and Minnesota Thin Loess and Till, Southern Part (90B), and Wisconsin and Minnesota Sandy Outwash (91B)
LRR K; north-central and northwestern Wisconsin and east-central Minnesota
Extent--moderate

MLRA OFFICE RESPONSIBLE: St. Paul, Minnesota; MLRA SSO 10-9 (Rhinelander, Wisconsin).

SERIES ESTABLISHED: Langlade County, Wisconsin, 1947.

REMARKS:
Particle-size control section--the zone from a depth of 36 to 86 centimeters; series control section--the zone from the surface to a depth of 150 centimeters.

Diagnostic horizons and features recognized in this pedon are:
ochric epipedon--the zone from the surface of the soil to a depth of 36 centimeters (Ap and Eg horizons);
albic horizon--the zone from a depth of 18 to 36 centimeters (Eg horizon);
argillic horizon--the zone from a depth of 36 to 135 centimeters (Btg1, Btg2, Btg3, and 2Btg4 horizons);
lithologic discontinuity--the contact with till at a depth of 135 centimeters;
udic moisture regime.

Cation-exchange activity class is supported by laboratory data (NSSL).

Taxonomy version--Keys to Soil Taxonomy, tenth edition, 2006.

ADDITIONAL DATA:
Laboratory data--National Soil Survey Laboratory, Lincoln, Nebraska-user pedonid 74MN163002 (http://ssldata.sc.egov.usda.gov/).

National Cooperative Soil Survey
U.S.A.

LOCATION BARRONETT WI+MN

Established Series
Rev. AJK-TAM-TWN
08/2009

BARRONETT SERIES

The Barronett series consists of very deep, poorly drained soils formed in silty lacustrine deposits. These soils are on stream terraces and glacial lake plains. Slope ranges from 0 to 2 percent. Mean annual precipitation is about 760 millimeters. Mean annual air temperature is about 5 degrees C.

TAXONOMIC CLASS: Fine-silty, mixed, superactive, frigid Mollic Epiaqualfs

TYPICAL PEDON: Barronett silt loam, on a nearly level slope of 1 percent, in a cultivated field, at an elevation of about 379 meters above sea level. (Colors are for moist soil unless otherwise stated.)

Ap--0 to 23 centimeters; black (10YR 2/1) silt loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; friable; common fine roots; neutral; abrupt smooth boundary.

Eg--23 to 41 centimeters; gray (10YR 6/1) silt loam; weak thick platy structure parting to weak medium and fine subangular blocky; few fine roots; few fine prominent reddish yellow (7.5YR 6/8) masses of iron accumulation; few earthworm casts; moderately acid; clear wavy boundary.

Btg1--41 to 58 centimeters; gray (10YR 6/1) silt loam; weak fine subangular blocky structure; friable; few fine roots; common clay films on faces of peds and in pores; common fine prominent reddish yellow (7.5YR 6/8) and few fine prominent red (2.5YR 4/6) masses of iron accumulation; moderately acid; clear wavy boundary.

Btg2--58 to 86 centimeters; gray (10YR 6/1) silt loam; weak coarse subangular blocky structure; friable; few fine roots; few clay films on faces of peds and in pores; few fine prominent yellowish red (5YR 4/6) and yellowish brown (10YR 5/6) masses of iron accumulation; moderately acid; clear wavy boundary.

Cg--86 to 152 centimeters; light brownish gray (10YR 6/2) stratified silt and very fine sand; massive breaking to weak thick plates along depositional strata; very friable; few fine prominent yellowish red (5YR 4/6) and distinct yellowish brown (10YR 5/6) masses of iron accumulation; slightly acid.

TYPE LOCATION: Major Land Resource Area (MLRA) 90A-Wisconsin and Minnesota Thin Loess and Till, Northern Part, Polk County, Wisconsin subset; about 7 1/2 miles northwest of Turtle Lake; located about 2,060 feet east and 1,460 feet north of the southwest corner of section 22, T. 35 N., R. 15 W.; USGS McKinley topographic quadrangle; lat. 45 degrees 30 minutes 01 seconds N. and long. 92 degrees 12 minutes 37 seconds W., NAD 83.

RANGE IN CHARACTERISTICS:
Depth to stratification--60 to 100 centimeters
Depth to carbonates--more than 150 centimeters
Clay content in the particle-size control section (weighted average)--18 to 27 percent
Sand content in the particle-size control section (weighted average)--less than 15 percent

A or Ap horizon:
Hue--10YR, 2.5Y, or is neutral
Value--2 or 3
Chroma--0 or 2
Texture--silt loam or mucky silt loam
Clay content--5 to 22 percent

Sand content--less than 15 percent
Rock fragment content--0 to 5 percent
Reaction--pH 4.5 to 7.3
Thickness--15 to 25 centimeters

Some pedons have a thin loess mantle

Eg horizon:
Hue--10YR or 2.5Y
Value--4 to 6
Chroma--1 or 2
Texture--silt loam or silt
Clay content--4 to 20 percent
Sand content--less than 15 percent
Rock fragment content--0 to 5 percent
Reaction--pH 4.5 to 6.5
Thickness--10 to 25 centimeters

Btg horizon:
Hue--10YR, 2.5Y, 5Y, or 5G
Value--4 to 6
Chroma--1 or 2
Texture--silt loam, silty clay loam, or is stratified silt, very fine sand, or fine sand
Clay content--18 to 27 percent
Sand content--less than 15 percent
Rock fragment content--0 to 5 percent
Reaction--pH 4.5 to 6.5
Thickness--35 to 60 centimeters

Ratio of clay content of the illuvial horizon to that of the eluvial horizon--1.2 or larger

C horizon:
Hue--5YR, 7.5YR, 10YR, 2.5Y, and 5Y
Value--4 to 6
Chroma--1 to 3
Texture--stratified silt loam, loam, very fine sandy loam, and very fine sand
Clay content--8 to 20 percent
Sand content--15 to 90 percent
Rock fragment content--0 to 5 percent
Reaction--pH 4.5 to 7.8

Some pedons have thin strata of silty clay loam, silt, and fine sand

Some pedons have a sandy substratum

COMPETING SERIES: This is the Auburndale series.
Auburndale--have a sand content of 40 to 70 percent in the lower third of the series control section

GEOGRAPHIC SETTING:
Parent material--silty lacustrine deposits
Landform--glacial lake basins and stream terraces
Slope--0 to 2 percent
Elevation--205 to 595 meters above sea level
Mean annual air temperature--3 to 8 degrees C
Mean annual precipitation--660 to 865 millimeters

Frost-free period--110 to 180 days

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Campia, Comstock, and Crystal Lake soils.
Campia--are on higher landscape positions and do not have a frequently saturated zone within a depth of 1.8 meters during the wettest periods of years when precipitation is within one standard deviation of 30 year mean of annual precipitation
Comstock--are on slightly higher landscape positions and have a frequently saturated zone between depths of 0.3 and 0.75 meter during the wettest periods of years when precipitation is within one standard deviation of 30 year mean of annual precipitation
Crystal Lake--are on higher landscape positions and have a frequently saturated zone between depths of 0.75 and 1.0 meter during the wettest periods of years when precipitation is within one standard deviation of 30 year mean of annual precipitation

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY:
Drainage class--poorly drained--these soils are frequently saturated from the surface of the soil to a depth of 0.3 meter during the wettest periods of years when precipitation is within one standard deviation of 30 year mean of annual precipitation, this saturation is considered both perched and apparent
Saturated hydraulic conductivity--4.00 to 42.00 micrometers per second in the upper sediments and 1.00 to 4.00 micrometers per second in the underlying stratified sediments
Flooding--not flooded to rarely flooded for brief duration
Ponding--frequently ponded to a depth of 0.15 meter for long duration during the wettest periods of years when precipitation is within one standard deviation of 30 year mean of annual precipitation

USE AND VEGETATION:
Most areas are pastured or managed for hay production. Drained areas are cultivated. The principal crops are corn, small grain, and hay. The native vegetation is sedges and grasses with scattered American elm, black ash, aspen, and willows.

DISTRIBUTION AND EXTENT:
Physiographic division--Interior Plains
Physiographic Province--Central Lowland
Physiographic section--Western Lake section
MLRAs--Wisconsin and Minnesota Thin Loess and Till, Northern Part (90A) and Wisconsin and Minnesota Thin Loess and Till, Southern Part (90B)
LRR K; north-central Wisconsin and east-central Minnesota
Extent--moderate

MLRA OFFICE RESPONSIBLE: St. Paul, Minnesota; MLRA SSO 10-9 (Rhinelander, Wisconsin).

SERIES ESTABLISHED: Barron County, Wisconsin, 1950

REMARKS:
Particle-size control section--the zone from a depth of 41 to 86 centimeters; series control section--the zone from the surface of the soil to a depth of 150 centimeters.

Diagnostic horizons and features recognized in this pedon are:
ochric epipedon--the zone from the surface of the soil to a depth of 41 centimeters (Ap and Eg horizons);
albic horizon--the zone from a depth of 23 to 41 centimeters (E horizon);
argillic horizon--the zone from a depth of 41 to 86 centimeters (Btg1 and Btg2 horizons);
aquic moisture regime.

Cation-exchange activity class is supported by laboratory data (NSSL).

Taxonomy version--Keys to Soil Taxonomy, tenth edition, 2006.

ADDITIONAL DATA:
Laboratory data--National Soil Survey Laboratory, Lincoln, Nebraska-user pedonid 75WI095004 (http://ssldata.sc.egov.usda.gov/).

National Cooperative Soil Survey
U.S.A.

LOCATION BLOMFORD MN+WI

Established Series
Rev. LMC-AGG
02/2003

BLOMFORD SERIES

The Blomford series consists of very deep, poorly drained soils that formed a sandy glacial outwash or eolian mantle and underlying calcareous, loamy till. These soils are on moraines, lake washed till plains and glacial beach ridges. They have rapid permeability in the upper mantle and moderate to moderately slow permeability in the underlying till. Slopes range from 0 to 2 percent. Mean annual air temperature is about 42 degrees F. Mean annual precipitation is about 25.

TAXONOMIC CLASS: Loamy, mixed, superactive, frigid Arenic Endoaqualfs

TYPICAL PEDON: Blomford loamy fine sand with a slightly concave slope of 1 percent on a sandy mantled ground moraine. (Colors are for moist soil unless otherwise stated.)

A--0 to 5 inches; black (10YR 2/1) loamy fine sand, light brownish gray (10YR 6/2) dry; moderate fine granular structure; very friable; many fine to coarse roots throughout; 2 percent gravel; slightly acid; gradual wavy boundary. (3 to 9 inches thick)

Eg--5 to 23 inches; brown (10YR 4/3) loamy fine sand, pale brown (10YR 6/3) dry; weak fine granular structure; very friable; many fine and medium roots throughout; many fine and medium distinct grayish brown (10YR 5/2) iron depletions and many fine and medium distinct dark yellowish brown (10YR 3/6) iron concentrations; 2 percent gravel; slightly acid; abrupt wavy boundary. (12 to 36 inches thick)

2Btg1--23 to 40 inches; dark grayish brown (2.5Y 4/2) clay loam; strong coarse subangular blocky structure; firm; many very fine to medium roots throughout; common continuous distinct very dark grayish brown (2.5Y 3/2) clay films on faces of peds; few coarse masses of iron accumulation; many medium and coarse distinct dark gray (5Y 4/1) iron depletions and many medium and coarse distinct olive brown (2.5Y 4/4) iron concentrations; 12 percent gravel; slightly acid; gradual wavy boundary.

2Btg2--40 to 55 inches; olive gray (5Y 4/2)clay loam; strong coarse subangular blocky structure; firm; common very fine and fine roots throughout; many continuous distinct dark olive gray (5Y 3/2) clay films on faces of peds; few coarse masses of iron accumulation; many coarse faint dark gray (5Y 4/1) iron depletions and many coarse prominent olive brown (2.5Y 4/4) iron concentrations; 12 percent gravel; slightly acid; gradual wavy boundary. (Combined thickness of the 2Bt horizons is 12 to 40 inches)

2BCg--55 to 65 inches; light olive brown (2.5Y 5/3) clay loam; strong coarse subangular blocky structure; very firm; few very fine roots; few discontinuous distinct dark grayish brown (2.5Y 4/2) clay films on faces of peds; few fine masses of iron accumulation; few fine carbonate threads; many fine and medium distinct olive gray (5Y 5/2) iron depletions and many fine and medium distinct light olive brown (2.5Y 5/6) iron concentrations; 10 percent gravel; neutral; gradual wavy boundary. (0 to 18 inches thick)

2Cg--65 to 80 inches; mixed grayish brown (2.5Y 5/2) and light olive brown (2.5Y 5/4) clay loam and sandy clay loam; massive; very friable; few very fine roots; few fine masses of iron accumulation; few fine carbonate threads; many fine and medium prominent yellowish brown (10YR 5/8) iron concentrations; 8 percent gravel; slightly effervescent; slightly alkaline.

TYPE LOCATION: Cass County, Minnesota; 2,300 feet south and 150 feet west of the northeast corner of sec. 19, T. 145 N., R. 31 W., Cass County; USGS Steamboat Lake quadrangle; lat. 47 degrees 21 minutes 37 seconds N. and long.

94 degrees 40 minutes 10 seconds W., NAD27:

RANGE IN CHARACTERISTICS: Depth to free carbonates ranges from 30 to over 60 inches. The upper mantle is 20 to less than 40 inches thick. Rock fragments, by volume, range from 0 to 10 percent gravel in the upper part and 2 to 10 percent gravel and 0 to 5 percent cobbles in the underlying till. A gravelly lag line up to 5 inches thick may occur at the contact of the upper mantle and the till. Rock fragments range to 35 percent, by volume, in this horizon.

The A or Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 1 through 3. It is loamy sand, loamy fine sand, or loamy coarse. The reaction is strongly acid to slightly acid.

The Eg or E horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 3. It is loamy sand, loamy fine sand, sand or coarse sand. The reaction is strongly acid to slightly acid. Thin lamellae may occur in this horizon.

Some pedons have a thin B/E, 2B/E, E & Bt, or 2E/B horizon.

The 2Btg horizon has hue of 10YR to 5Y; value of 4 to 6; and chroma of 1 or 2. It is loam, clay loam, or sandy clay loam. The reaction is moderately acid to neutral. It has 18 to 30 percent clay and less than 45 percent total sand.

Some pedons have a 2Bkg horizon that has hue of 2.5Y or 5Y, value of 4 to 7; and chroma of 1 or 2. It is loam or clay loam. Carbonate threads or masses are common to many. Reaction is slightly alkaline or moderately alkaline

Properties of the 2BCg are similar to the B and C horizons respectively. The reaction is slightly acid to slightly alkaline.

The 2Cg horizon has hue of 2.5Y or 5Y, value of 5 or 6; and chroma of 2 to 4. It is loam or clay loam. Reaction is slightly alkaline or moderately alkaline. The moist bulk density is 1.4 to 1.6 g/cc. Redox features with chroma of 1 to 4 are present.

COMPETING SERIES: There are no competing series.

GEOGRAPHIC SETTING: These soils have plane or concave slopes on glacial moraines and till plains. Slopes are 0 to 2 percent. These soils formed in a sandy glacial outwash or eolian mantle and underlying calcareous, loamy till. Mean annual precipitation ranges from 22 to 30 inches. Mean annual air temperature ranges from 36 to 45 degrees F. Frost-free days range from 88 to 145. Elevation above sea level ranges from 670 to 1,500 feet.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the well Braham, moderately well drained Cutaway, and somewhat poorly drained Ricelake soils that are members of a hydrosequence. The poorly drained Talmoon and Effie soils and somewhat poorly drained Beltrami soils are associated in places.

DRAINAGE AND PERMEABILITY: Poorly drained. Surface runoff is low. Permeability is rapid in the upper part and moderate to moderately slow in the lower part. The depth to season high saturation is as high as .5 foot during April to June in normal years.

USE AND VEGETATION: Blomford soils are mostly cropped to corn, soybeans, and hay in the southern part of their range and are mostly in forest in the northern part of their range. Native vegetation is mixed water tolerant deciduous, spruce and pine trees.

DISTRIBUTION AND EXTENT: : North-central, east-central and west-central Minnesota. MLRA-57, 88, 91 and possibly MLRA-93. Moderately extensive.

MLRA OFFICE RESPONSIBLE: St. Paul, Minnesota

SERIES ESTABLISHED: Isanti County, Minnesota, l953.

REMARKS: Diagnostic horizons and features recognized in this pedon are: ochric epipedon - the zone from the

surface to 23 inches (A and Eg horizons); argillic horizon - the zone from about 23 to 55 inches (2Btg horizon); arenic subgroup - the layers in the upper 23 inches have textures of loamy fine sand or coarser; aquic moisture regime - low chroma of argillic horizon.

National Cooperative Soil Survey
U.S.A.

LOCATION BLUFFTON MN+WI

Established Series
Rev. KRV-HRF-ROP
11/2004

BLUFFTON SERIES

The Bluffton series consists of very deep, very poorly drained, soils that formed in a mantle of loamy alluvium from glacial till and in underlying loamy glacial till on glacial moraines. These soils have moderately rapid or moderate permeability in the upper part and moderate or moderately slow permeability in the lower part. Slopes range from 0 to 2 percent. Mean annual precipitation is about 28 inches. Mean annual air temperature is about 44 degrees F.

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, frigid Typic Endoaquolls

TYPICAL PEDON: Bluffton loam with a slightly concave slope of 1 percent in a depression on a ground moraine in a cultivated field. (Colors are for moist soil unless otherwise stated.)

Ap--0 to 8 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; common roots; slightly acid; abrupt smooth boundary.

A1--8 to 15 inches; black (N 2/0) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; few roots; slightly acid; clear smooth boundary.

A2--15 to 19 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak medium prismatic structure parting to weak medium subangular and angular blocky; friable; few roots; few faint clay films or shiny coatings on faces of peds; slightly acid; abrupt smooth boundary. (Combined thickness of A horizons is 7 to 24 inches.)

Bg--19 to 22 inches; dark gray (5Y 4/1) fine sandy loam; few medium prominent yellowish brown (10YR 5/6) Fe concentrations; weak medium prismatic structure parting to weak medium angular and subangular blocky; friable; few roots; few distinct black coatings on vertical faces of prisms; about 6 percent gravel; few limestone pebbles; neutral; clear smooth boundary. (3 to 30 inches thick)

Cg1--22 to 26 inches; light olive gray (5Y 6/2) fine sandy loam; few medium distinct greenish gray (5BG 6/1) Fe depletions and pale olive (5Y 6/4) Fe concentrations; massive; friable; few roots; olive gray (5Y 4/2) and dark olive gray (5Y 3/2) fillings in old root channels; about 5 percent gravel; slight effervescence; slightly alkaline; clear wavy boundary.

Cg2--26 to 38 inches; gray (5Y 6/1) loam; few medium distinct greenish gray (5BG 6/1) Fe depletions and prominent olive yellow (5Y 6/6) Fe concentrations; massive; friable; few roots; about 4 percent gravel; slight effervescence; slightly alkaline; clear wavy boundary.

Cg3--38 to 60 inches; light olive gray (5Y 6/2) sandy clay loam; many coarse prominent greenish gray (5BG 6/1) Fe depletions and strong brown (7.5YR 5/8) Fe concentrations; massive; friable; few roots; about 4 percent gravel; strong effervescence; moderately alkaline.

TYPE LOCATION: Washington County, Minnesota; about 2 miles north of Mahtomedi; 2,200 feet east and 900 feet south of the northwest corner of sec. 6, T. 30 N., R. 21 W.

RANGE IN CHARACTERISTICS: Solum thickness and depth to free carbonates commonly are 15 to 44 inches, but ranges to greater than 60 inches in some pedons. The mollic epipedon is 7 to 24 inches thick. The series control section has 18 to 30 percent clay, 45 to 65 percent sand, and 10 to 15 percent very fine sand. Content of rock fragments of mixed lithology ranges from 0 to 10 percent in the upper part to a few pebbles to 10 percent in the lower part. Textural

change with depth in these soils commonly is erratic. Some pedons have an O horizon as much as 6 inches in thickness. The soil moisture control section is saturated for 20 to 60 days in most years following the summer solstice unless artificially drained.

The A horizon has hue of 10YR to 5Y, value of 2 or 3, and chroma of 1 or 2 or is N 2/ or N 3/. It has mottles in some pedons. It is loam, silt loam, sandy loam or sandy clay loam. The A horizon is neutral to moderately acid.

The B horizon has hue of 5Y or 2.5Y, value of 4 to 6 and chroma of 1 or 2. It is fine sandy loam, loam, clay loam or sandy clay loam. It is moderately acid to neutral.

The Bk horizons are present in some pedons. They have properties similar to the C horizons.

The C horizon has hue of 5Y or 2.5Y, value of 5 or 6, and chroma of 1 or 2. It mostly is loam, fine sandy loam, or sandy clay loam, but subhorizons with coarser texture are in some pedons. It is slightly alkaline or moderately alkaline.

COMPETING SERIES: These are the Flom series. However, when formerly classified as Typic Haplaquolls, the competing series were Larry, Mahtowa, Mann, and Wyard. Flom soils have less than 45 percent sand in the series control section. Larry and Wyard soils are substantially drier in the moisture control section during the 120 days following the summer solstice. Also, Larry soils have more than 10 percent rock fragments in the control section. Mahtowa soils have hue 5YR or redder in the lower part of the control section. The Mann soils have more than 45 percent silt and less than 20 percent fine sand or coarser in the upper part of the control section and high density soil materials in the lower part.

GEOGRAPHIC SETTING: These soils have concave slopes with gradients less than 2 percent in depressions, swales, and drainageways on glacial moraines. At least the upper part of the solum formed in loamy local alluvium from glacial till. The lower part of the solum or the C horizon is loamy till of the Des Moines Lobe including the St. Louis and Grantsburg sublobes of the Late Wisconsin glaciation. Mean air annual temperature ranges from 37 to 45 degrees F. Mean annual precipitation ranges from 26 to 30 inches. Frost-free days range from 90 to 145. The elevation above sea level ranges from 1000 to 1500 feet.

GEOGRAPHICALLY ASSOCIATED SOILS: The main ones are the Alstad, Beltrami, Cushing, Nebish, Shooker, and Talmoon soils. The Bluffton soils are members of both the Nebish-Beltrami-Shooker hydrosequence and the Cushing-Alstad hydrosequence. The well drained Nebish and Cushing soils have convex slopes and are on higher lying more sloping terrain. The moderately well drained Beltrami soils have nearly level to gently undulating plane or slightly convex slopes. The somewhat poorly drained Alstad and poorly drained Shooker and Talmoon soils have nearly level slightly convex to slightly concave slopes. Organic soils such as Cathro and Seelyeville are common associates in some places.

DRAINAGE AND PERMEABILITY: Very poorly drained. Surface runoff is very slow or ponded. Permeability is moderately rapid or moderate in the upper part and moderate or moderately slow in the lower part. Apparent water table ranges from plus 2 feet to 1 foot at some time from January to December.

USE AND VEGETATION: Some of these soils are in native vegetation; some are used for pasture; and some are drained and used for small grain, corn and soybeans. Native vegetation is mixture of water-tolerant grasses, deciduous trees and coniferous trees. Principal species are alder, black ash, black spruce, willow, and sedges.

DISTRIBUTION AND EXTENT: Central and northern Minnesota, and northwestern Wisconsin. Moderately extensive.

MLRA OFFICE RESPONSIBLE: St. Paul, Minnesota

SERIES ESTABLISHED: Wadena County, Minnesota, 1926.

REMARKS: Diagnostic horizons and features in this pedon: mollic epipedon - the zone from the surface to 19 inches (A horizons); cambic horizon - the zone from 19 to 22 inches; aquic moisture regime - low chroma matrix on horizon

below mollic epipedon. Series formerly classified as Typic Haplaquolls, fine-loamy, mixed, frigid.

ADDITIONAL DATA: Refer to Minnesota Agricultural Experiment Station Central File Code No. 1563 for results of some laboratory analyses of the typical pedon.

National Cooperative Soil Survey
U.S.A.

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 substratums 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 levl 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 neglible 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.)

National Cooperative Soil Survey
U.S.A.

LOCATION DUNDAS MN+IA

Established Series
Rev. HRF-AGG
08/2005

DUNDAS SERIES

The Dundas series consists of very deep, poorly drained soils that formed in loamy calcareous till on moraines. These soils have moderately slow saturated hydraulic conductivity. Slopes range from 0 to 2 percent. Mean annual precipitation is about 29 inches and mean air annual temperature is about 48 degrees F.

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, mesic Mollic Endoaqualfs

TYPICAL PEDON: Dundas silt loam with a slightly convex slope of 1 percent on a ground moraine in a cultivated field. (Colors are for moist soil unless otherwise noted.)

Ap--0 to 7 inches; very dark gray (10YR 3/1) silt loam, gray (N 5/0) dry; weak fine and medium subangular blocky structure; friable; about 2 percent coarse fragments; neutral; abrupt smooth boundary. (6 to 10 inches thick)

A1--7 to 9 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; weak fine granular structure; friable; about 2 percent coarse fragments; slightly acid; abrupt wavy boundary. (0 to 3 inches thick)

E--9 to 15 inches; dark gray (10YR 4/1) loam, dark grayish brown (10YR 4/2) faces of peds, gray (10YR 6/1) dry and rubbed; moderate fine and medium subangular blocky structure with a tendency toward platy; friable; about 5 percent coarse fragments; strongly acid; clear wavy boundary. (2 to 8 inches thick)

Btg1--15 to 20 inches; dark grayish brown (2.5Y 4/2) heavy loam; common fine and medium distinct light olive brown (2.5Y 5/4) mottles; moderate fine and medium subangular blocky structure; friable; common medium and thick gray (10YR 6/1) coats of clean silt grains on faces of peds; few thin clay films on faces of peds; about 5 percent coarse fragments; strongly acid; clear wavy boundary. (0 to 8 inches thick)

Btg2--20 to 26 inches; grayish brown (2.5Y 5/2) clay loam; common fine distinct light olive brown (2.5Y 5/4) mottles; moderate fine and medium subangular blocky structure; firm; few thin gray (10YR 6/1) coats of clean silt grains on faces of peds; few thin grayish brown (2.5Y 5/2) clay films on faces of peds; about 5 percent coarse fragments; strongly acid; clear wavy boundary. (4 to 10 inches thick)

Btg3--26 to 31 inches; olive (5Y 5/3) clay loam; many medium faint olive gray (5Y 5/2) and many fine distinct yellowish brown (10YR 5/8) mottles; strong medium and coarse prismatic structure parting to moderate medium and coarse angular blocky structure; firm; thin to thick continuous very dark gray (10YR 3/1) and dark gray (10YR 4/1) clay films on faces of peds; common black (10YR 2/1) clayey fillings in old root channels; few thin coats of clean silt grains on faces of peds; few dark oxide stains and concretions; about 5 percent coarse fragments; moderately acid; clear wavy boundary. (4 to 12 inches thick)

Btg4--31 to 40 inches; olive (5Y 5/3) clay loam; many medium faint olive gray (5Y 5/2) and many medium distinct yellowish brown (10YR 5/8) mottles; moderate coarse prismatic structure; firm; medium and thick continuous very dark gray (10YR 3/1) and dark gray (10YR 4/1) clay films on faces of peds; common black (10YR 2/1) clayey fillings in old root channels; few dark oxide stains and concretions; about 5 percent coarse fragments; moderately acid; clear wavy boundary. (4 to 12 inches thick)

Cg--40 to 60 inches; grayish brown (2.5Y 5/2) loam; many medium faint light olive brown (2.5Y 5/4) and common fine distinct olive yellow (2.5Y 6/8) mottles; massive; friable; few black (10YR 2/1) clayey fillings in old root channels in the upper part; few soft grayish limy segregations; few dark oxide stains; about 5 percent coarse fragments; stronlyly

effervescent; slightly alkaline.

TYPE LOCATION: Rice County, Minnesota; about 9 miles north of Faribault; 200 feet south and 1,700 feet west of the northeast corner of sec. 7, T. 111 N., R. 20 W.

RANGE IN CHARACTERISTICS: Solum thickness and depth to free carbonates range from 30 to 48 inches. Coarse fragments of mixed lithology typically occupy 1 to 8 percent by volume of the solum, but are lacking in the A horizon in some pedons.

The Ap or A1 horizon has hue of 10YR, value of 2 or 3, and chroma of 1. It is fine sandy loam, sandy clay loam, loam, silt loam, light clay loam or light silty clay loam.. Reaction is moderately acid or slightly acid.

The E horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. It is fine sandy loam, sandy clay loam, loam, or silt loam, Reaction is stronly acid to slightly acid. slightly acid or medium acid.

The Btg horizon has hue of 2.5Y or 5Y, value of 4 or 5, and chroma of 1 through 3. Distinct or prominent mottles are in most of the B horizon. The upper part of the B horizon typically is heavy loam or clay loam, but sandy clay loam high in silt, silty clay loam high in sand and light clay are within the range. The lower part of the B horizon is sandy clay loam high in silt, clay loam or loam. The upper 20 inches of the argillic horizon averages between 30 and 35 percent clay and typically 20 to 35 percent fine sand and coarser. Reaction is strongly acid to slightly acid

The C horizon has hue of 2.5Y or 5Y. It is typically loam or clay loam but includes sandy loam. It is slightly alkaline or moderately alkaline.

COMPETING SERIES: There are no competing series.

GEOGRAPHIC SETTING: Dundas soils are on level or nearly level, plane to slightly convex slopes on end or ground moraines. They formed mostly in friable calcareous, glacial till of Late Wisconsin Age. In some pedons the upper part of the solum apparently formed in somewhat modified glacial till. The climate is humid continental with warm summers and cold winters. Mean annual temperature is about 45 to 50 degrees F., and mean annual precipitation is about 28 to 32 inches.

GEOGRAPHICALLY ASSOCIATED SOILS: These are Hayden, Luther, Nessel, and Hamel soils which are members of a hydro sequence with the Dundas soils. Well drained Hayden soils are on the more sloping areas. Moderately well drained Nessel soils are on slightly elevated flats and gentle slopes. Somewhat poorly drained Luther soils on on slight rises. Poorly drained Hamel soils are on toe slopes.

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY: Poorly drained. Surface runoff is low. Saturated hydraulic conductivity is moderately slow. Seasonal high saturation occurs at or near the surface in the months of March to July and October to December in years of normal precipitation.

USE AND VEGETATION: Mostly cropped to corn, soybeans, small grains, and hay. Significant areas are in pasture or forested pasture. Native vegetation was mixed deciduous forest and prairie grass.

DISTRIBUTION AND EXTENT: MLRA-103. Southern and central Minnesota and north central Iowa. Moderately extensive.

MLRA OFFICE RESPONSIBLE: St. Paul, Minnesota

SERIES ESTABLISHED: Scott County, Minnesota, 1957.

REMARKS: The Dundas series was classified as a Planosol Gray Brown Podzolic intergrade in the former system.

ADDITIONAL DATA: Refer to MAES Central File Code No. 994 for some results of laboratory analysis of the typical pedon, and to Nos. 743, 829, and 830 for some data on a pedon from Wright County and two pedons from

Hennepin County.

National Cooperative Soil Survey
U.S.A.

LOCATION FORDUM WI+MN

Established Series
AJO-JJJ-HFG
12/2006

FORDUM SERIES

The Fordum series consists of very deep, poorly drained soils which are moderately deep to sand. They formed in recent alluvium on flood plains. Permeability is moderate or moderately rapid in the loamy alluvium and rapid or very rapid in the sandy alluvium. Slopes range from 0 to 2 percent. Mean annual precipitation is about 30 inches. Mean annual air temperature is about 42 degrees F.

TAXONOMIC CLASS: Coarse-loamy, mixed, superactive, nonacid, frigid Mollic Fluvaquents

TYPICAL PEDON: Fordum silt loam on a plane level slope on a flood plain at an elevation of about 1,160 feet. (Colors are for moist soil unless otherwise stated.)

A--0 to 6 inches; very dark brown (10YR 2/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine subangular blocky structure; friable; many fine and medium roots; neutral; abrupt wavy boundary. (6 to 9 inches thick)

Cg1--6 to 18 inches; dark gray (5Y 4/1) silt loam; weak coarse subangular blocky structure; friable; few fine roots; common medium prominent yellowish brown (10YR 5/6) masses of iron accumulation in the matrix; many thin strata of fine sandy loam; moderately acid; clear wavy boundary.

Cg2--18 to 30 inches; dark gray (10YR 4/1) fine sandy loam; massive; friable; common fine prominent strong brown (7.5YR 5/6) masses of iron accumulation in the matrix; many thin strata of silt loam and fine sand; moderately acid; clear wavy boundary. (Combined thickness of the Cg1 and Cg2 horizons is 18 to 34 inches.)

2Cg3--30 to 60 inches; gray (10YR 5/1) sand; single grain; loose; few thin strata of silt loam; slightly acid.

TYPE LOCATION: Marathon County, Wisconsin; about 2 miles west of Wausau; 2140 feet north and 2515 feet eastof the SW corner of sec. 33, T. 29 N., R. 7 E. USGS Wausau West, Wis. Quad. Latitude 44 degrees 57 minutes 1 second N. Longitude 89 degrees 40 minutes 53 seconds N. NAD 27.

RANGE IN CHARACTERISTICS: Thickness of the loamy alluvium and depth to sandy alluvium ranges from 24 to 40 inches. The particle-size control section averages from 7 to 17 percent clay. The coarse-loamy mantle has 50 percent or more fine or coarser sand. Volume of gravel ranges from 0 to 35 percent in the loamy mantle, but is typically less than 15 percent. Volume of gravel ranges from 0 to 60 percent in the sandy lower part. Volume of cobbles ranges from 0 to 10 percent throughout. Total volume of rock fragments is less than 35 percent as a weighted average in the particle-size control section. Reaction ranges from very strongly acid to moderately alkaline in the loamy alluvium and from moderately acid to moderately alkaline in the sandy alluvium. Carbonates are absent to 60 inches or more. Redox accumulations are typically throughout the loamy mantle below the A horizon. Aquic conditions occur at same time in most years and redox depletions are 50 percent or more of the matrix at a depth of 16 to 20 inches.

The A horizon has hue of 7.5YR, 10YR, 2.5Y, or 5Y or the hue is neutral. It has value of 2 or 3 and chroma of 0 to 3. Color value is 5 or less dry. Texture of the A horizon is silt loam, very fine sandy loam, loam, fine sandy loam, sandy loam, or the mucky analogs.

The upper loamy part of the Cg horizon has hue of 7.5YR, 10YR, 2.5Y, or 5Y, or the hue is neutral. It has value of 2 to 6 and chroma of 0 to 2. Some pedons have thin strata with higher value or chroma. Texture is commonly stratified layers of silt loam, loam, sandy loam, or fine sandy loam, or the gravelly, very gravelly, or mucky analogs but includes thin strata of very fine sandy loam, loamy very fine sand, loamy fine sand, loamy sand, very fine sand, fine sand, sand

or the gravelly, very gravelly or mucky analogs. Strata of organic materials less than 8 inches thick are also included.

The sandy lower part of the Cg or C horizon has hue of 5YR, 7.5YR, 10YR, 2.5Y, or 5Y or the hue is neutral. It has value of 4 to 6 and chroma of 0 to 4 and has redox concentrations in some pedons. Texture is sand, coarse sand, fine sand, loamy sand, loamy coarse sand, loamy fine sand, or the gravelly or very gravelly analogs of these textures, or stratified sand and gravel. Thin strata of materials containing more clay and silt are also included.

COMPETING SERIES: There are no competing series.

GEOGRAPHIC SETTING: Fordum soils are on the lowest part of the flood plain adjacent to stream or river channels. Numerous abandoned meander, small overflow channels, and scours produce an irregular microrelief. Slopes range from 0 to 2 percent. These soils formed in recent alluvium. Mean annual precipitation ranges from 22 to 33 inches. Mean annual temperature ranges from about 36 to 45 degrees F. The frost free period ranges from about 70 to 135 days. Elevation ranges from 680 to 1700 feet.

GEOGRAPHICALLY ASSOCIATED SOILS: These are Bowstring, Cathro, Markey, Minocqua, Moquah, and Roscommon soils. The very poorly drained Bowstring soils are in abandoned meander channels where there is more than 51 inches of organic material which contains thin strata of mineral material. The very poorly drained Cathro and Markey soils are in abandoned meander channels where there is 16 to 51 inches of organic material. Minocqua and Roscommon soils are nearby on terraces off the floodplain. The moderately well drained Moquah soils are in higher positions on the flood plain.

DRAINAGE AND PERMEABILITY: Poorly drained. The potential for surface runoff ranges from negligible to low. Permeability is moderate or moderately rapid in the upper loamy alluvium and rapid or very rapid in the lower sandy alluvium. Flooding is rare to frequent and of brief to long duration, but in some areas of lower rainfall in Western Minnesota, it is very brief duration. The main period of flooding is March to June, but flooding can occur following any period of high runoff. Fordum soils have an apparent seasonal high water table from 1 foot above to 1 foot below the surface at some time during the period January to December in most years.

USE AND VEGETATION: Most areas are used for in woodland. Common trees are silver maple, red maple, quaking aspen, big tooth aspen, paper birch, American elm, white spruce, and yellow birch. Tag alder is common in many places. Some areas are in marsh vegetation of grasses, seeds, sedges and shrubs. Some areas are used for pastureland and some small areas are used for harvesting marsh hay.

DISTRIBUTION AND EXTENT: Northern Wisconsin and northern Minnesota. The soil is of moderate extent.

MLRA OFFICE RESPONSIBLE: St. Paul, Minnesota

SERIES ESTABLISHED: Shawano County, Wisconsin, 1981.

REMARKS: Diagnostic horizons recognized in this pedon are:
ochric epipedon (darker than typic) - 0 to 6 inches (A);
mixing to depth of 7 inches meets requirement for mollic subgroup;
Aquepts - chroma of 1 or less and value of 4 or more dominant in the matrix at a depth of 16 to 20 inches and saturation there.

National Cooperative Soil Survey
U.S.A.

LOCATION ISANTI MN

Established Series
Rev. LMC-JFC-ROP-KDS
6/97

ISANTI SERIES

The Isanti series consists of very deep, poorly and very poorly drained soils that formed in sandy glacial outwash or eolian sediments on outwash plains and valley trains. These soils have moderately rapid or rapid permeability in the upper part and rapid permeability in the lower part. Slopes range from 0 to 2 percent. Mean annual precipitation is about 26 inches. Mean annual air temperature is about 44 degrees F.

TAXONOMIC CLASS: Sandy, mixed, frigid Typic Endoaquolls

TYPICAL PEDON: Isanti fine sandy loam on a slightly concave slope of less than 1 percent in native vegetation. (Colors described are for moist conditions unless otherwise stated.)

A1--0 to 4 inches; black (10YR 2/1) fine sandy loam; weak medium platy structure; very friable; common roots; strongly acid; abrupt smooth boundary.

A2--4 to 10 inches; black (N 2/0) fine sandy loam; weak thin platy structure; very friable; common roots; strongly acid; abrupt wavy boundary. (Combined thickness of A horizons is 7 to 18 inches.)

Bg1--10 to 14 inches; gray (N 5/0) fine sand; single grain; loose; few roots; common very dark gray (10YR 3/1) 1 to 3 cm thick discontinuous horizontal streaks and a few small black inclusions; moderately acid; clear wavy boundary.

Bg2--14 to 26 inches; gray (10YR 5/1) fine sand; single grain; loose; few roots; strongly acid; abrupt smooth boundary.

Bg3--26 to 31 inches; dark gray (10YR 4/1) fine sand; single grain; loose; moderately acid; abrupt wavy boundary. (Combined thickness of Bg horizons is 13 to 36 inches.)

Cg--31 to 60 inches; light brownish gray (10YR 6/2) fine sand; single grain; loose; moderately acid; gradual smooth boundary.

TYPE LOCATION: Anoka County, Minnesota; about 7 miles east of Anoka; 1,345 feet east and 960 feet north of the southwest corner of sec. 5, T. 31 N., R. 23 W.; USGS Circle Pines quadrangle; lat. 45 degrees 12 minutes 0 seconds N. and long. 93 degrees 14 minutes 20 seconds W., NAD27.

RANGE IN CHARACTERISTICS: The series control section is dominated by fine sand and has 85 percent or more passing the No. 40 sieve. It also has no rock fragments. Some pedons have an O horizon as much as 6 inches thick. The mollic epipedon ranges from 10 to 18 inches in thickness where texture is loamy fine sand or coarser and 7 to 18 inches in thickness for those soils with finer textures.

The A horizon has hue of 10YR, 2.5Y, 5Y or is neutral. Some pedons have an AB or BA horizon as much as 6 inches thick. The A horizon is loamy fine sand, fine sand, sand, loamy sand, fine sandy loam, or sandy loam. It ranges from slightly acid to strongly acid.

The Bg horizons have hue of 10YR, 2.5Y or 5Y, value of 4 or 5, and chroma of 1 or 2, or is neutral with value of 4 or 5. In some pedons it has discontinuous nearly horizontal remnants as well as involutions of the A horizon 0.5 to 10 cm thick that presumably resulted from frost action. It is fine sand, sand, loamy fine sand or loamy sand. It ranges from slightly acid to strongly acid.

Some pedons have a BC horizon.

The Cg horizon has hue of 10YR to 5Y, value of 5 or 6, and chroma of 1 or 2. It is sand, fine sand, loamy sand, or loamy fine sand. Reaction is moderately acid to mildly alkaline.

COMPETING SERIES: These are the Hamar, Hangaard, Isan, Medano, and Venlo soils. Hamar, Hangaard, Medano, and Venlo soils have neutral or higher pH in the series control section. Isan soils have less than 85 percent sand passing the No. 40 sieve.

GEOGRAPHIC SETTING: These soils have plane or concave slopes in depressions, drainageways, and low flats on outwash plains and valley trains. Slopes range from 0 to 2 percent. The Isanti soils formed in gravel free, noncalcareous sandy glacial outwash or eolian sediments of Late Wisconsinan Age. Mean annual air temperature ranges from about 37 to 45 degrees F. Mean annual precipitation ranges from about 22 to 33 inches. Frost-free days range from 90 to 150. Elevation above sea level ranges from 700 to 1600 feet.

GEOGRAPHICALLY ASSOCIATED SOILS: These are principally the Anoka, Lino, Sartell, and Zimmerman soils. The Lino soils are on slightly higher elevations and are somewhat poorly drained. The Anoka, Sartell, and Zimmerman soils are better drained.

DRAINAGE AND PERMEABILITY: Poorly and very poorly drained. Surface runoff is very low to ponded. Permeability is moderately rapid in the upper part and rapid in the lower part. An apparent water table is at plus 1 foot to 0.5 feet for the very poorly drained, depressional phase, and 0.5 to 1.5 feet for poorly drained phase at some time Oct-June in most years.

USE AND VEGETATION: Mostly idle or in pasture, but some areas are drained and cropped to corn, soybeans, potatoes, or sod. Native vegetation was primarily grasses, sedges, and willow.

DISTRIBUTION AND EXTENT: East central Minnesota and possibly northwestern Wisconsin. Moderately extensive.

MLRA OFFICE RESPONSIBLE: St. Paul, Minnesota

SERIES ESTABLISHED: Mille Lacs County, Minnesota, 1927.

REMARKS: Diagnostic horizons and feature recognized in this pedon are: mollic epipedon - the zone from the surface to 10 inches (A horizon); aquic subgroup - low chroma matrix immediately below the mollic epipedon (Bg1 horizon).

Classification only was changed 5/94. Competing series and other updates will be made later.

ADDITIONAL DATA: Refer Minnesota Agricultural Experiment Station Central File Code No. 1071 for results of some laboratory analyses of the typical pedon. SIR # MN0196; MN0651, depressional phase.

National Cooperative Soil Survey
U.S.A.

LOCATION KRATKA MN+ND SD WI

Established Series
Rev. MNJ-RBH-AGG
03/2009

KRATKA SERIES

The Kratka series consists of very deep poorly and very poorly drained soils that formed in a mantle of sandy glacial lacustrine or outwash sediments over lacustrine sediments or loamy glacial till on glacial lake plains, glacial deltas of former glacial lakes, stream terraces, and moraines. These soils have moderately rapid or rapid permeability in the upper part and moderately rapid to moderately slow permeability in the lower part. Slopes range from 0 to 2 percent. Mean annual precipitation is about 22 inches. Mean annual air temperature is about 40 degrees F.

TAXONOMIC CLASS: Sandy over loamy, mixed, superactive, frigid Typic Endoaquolls

TYPICAL PEDON: Kratka fine sandy loam, in a slightly concave area, on a glacial lake plain, in a cultivated field, at an elevation of about 1,072 feet above sea level. (Colors are for moist soil unless otherwise stated.)

Ap--0 to 6 inches; black (10YR 2/1) fine sandy loam, very dark gray (10YR 3/1) dry; weak fine and medium subangular blocky structure parting to weak fine granular; friable; few medium and common very fine and fine roots; about 5 percent gravel; slightly alkaline; abrupt smooth boundary.

A--6 to 11 inches; black (10YR 2/1) fine sandy loam, very dark gray (10YR 3/1) dry; weak moderate subangular blocky structure parting to weak fine granular; friable; few fine and common very fine roots; about 5 percent gravel; slightly alkaline; clear smooth boundary. (Combined thickness of the A horizon is 6 to 18 inches.)

Bg1--11 to 14 inches; dark grayish brown (2.5Y 4/2) fine sandy loam; weak medium subangular blocky structure; very friable; few very fine and fine roots; about 5 percent gravel; common medium distinct light olive brown (2.5Y 5/4) Fe concentrations; slightly alkaline; clear smooth boundary.

Bg2--14 to 18 inches; dark grayish brown (2.5Y 4/2) loamy fine sand; weak fine and medium subangular blocky structure; very friable; about 8 percent gravel; common medium distinct light olive brown (2.5Y 5/4) and yellowish brown (10YR 5/6) Fe concentrations; slightly alkaline; clear wavy boundary. (Combined thickness of the Bg horizon is 0 to 32 inches.)

Cg1--18 to 25 inches; grayish brown (2.5Y 5/2) fine sand; single grain; loose; about 10 percent gravel; many coarse distinct light olive brown (2.5Y 5/6) Fe concentrations and common medium faint light brownish gray (2.5Y 6/2) Fe depletions and few medium prominent yellowish brown (10YR 5/6) Fe concentrations; slightly alkaline; abrupt wavy boundary. (0 to 12 inches thick)

2Cg2--25 to 31 inches; olive gray (5Y 5/2) loam; massive; friable; about 5 percent gravel; common medium prominent light olive brown (2.5Y 5/4) Fe concentrations; slightly effervescent; slightly alkaline; clear wavy boundary.

2Cg3--31 to 39 inches; olive gray (5Y 5/2) loam; massive; friable; about 5 percent gravel; common medium prominent light olive brown (2.5Y 5/4) and few fine prominent yellowish brown (10YR 5/6) Fe concentrations; strongly effervescent; slightly alkaline; clear smooth boundary.

2Cg4--39 to 80 inches; olive gray (5Y 5/2) clay loam; massive; friable; about 5 percent gravel; few medium prominent yellowish brown (10YR 5/6) and common medium prominent light olive brown (2.5Y 5/6) Fe concentrations; strongly effervescent; slightly alkaline.

TYPE LOCATION: Pennington County, Minnesota; about 11 miles northwest of Thief River Falls; located about

1,420 feet north and 250 feet east of the southwest corner of section 12, T. 154 N., R. 45 W.; USGS Viking topographic quadrangle; lat. 48 degrees 10 minutes 16 seconds N. and 96 degrees 23 minutes 23 seconds W., NAD 83.

RANGE IN CHARACTERISTICS: The thickness of the mollic epipedon typically is 6 to 18 inches. The depth to loamy glacial till or lacustrine sediments ranges from 20 to 40 inches. Some pedons have stratified sediments below 40 inches. The depth to carbonates typically ranges from 16 to 45 inches but ranges to more than 60 inches in some pedons. The upper sediments have 0 to 5 percent gravel and the 2C horizon contains 0 to 8 percent by volume of gravel of mixed lithology. In pedons that have lacustrine sediments in the 2C horizons, rock fragments may not be present. A thin lag line ranging to as much as 6 inches in thickness and containing as much as 35 percent by volume of gravel is at the contact between the upper and lower material. The reaction ranges from moderately acid to slightly alkaline in the A and Bg horizons, slightly acid to slightly alkaline in the Cg horizons and slightly acid to moderately alkaline in the 2Cg horizons.

The A or Ap horizon has hue of 10YR or 2.5Y, value of 2 or 3, chroma of 1 or 2 or is neutral. It is loamy sand, loamy fine sand, sandy loam, or fine sandy loam.

Some pedons have an ABg horizon.

The Bg or Bw horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 or 2 in the upper part, and includes chroma of 3 or 4 in the lower part. It is loamy fine sand, fine sand, loamy sand, sand or fine sandy loam.

Some pedons have Bkg or 2Bkg horizons with 2.5Y or 5Y hue. They are slightly alkaline or moderately alkaline.

Some pedons have 2Bg horizons with hue of 2.5Y or 5Y, value of 4 to 6 and chroma of 1 to 3. Textures include loam or clay loam.

The Cg horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 4. Texture is sand, fine sand, loamy fine sand or loamy sand.

Some pedons have thin Ab horizons.

The 2Cg horizon has hue of 10YR to 5Y; value of 4 to 6; and chroma of 1 to 3. It is loam, clay loam, sandy loam, or fine sandy loam in the glacial till and silt loam, silty clay loam, or very fine sandy loam, with thin strata of loamy fine sand or fine sand in the lacustrine material.

COMPETING SERIES: There are no competing series.

GEOGRAPHIC SETTING: These soils have plane or slightly concave slopes on flats or in shallow depressions on stream terraces, glacial lake plains, glacial deltas of former glacial lakes, and glacial moraines. Slopes range from 0 to 2 percent. Kratka soils formed in a sandy mantle of lacustrine glacial outwash over loamy glacial till or lacustrine sediments of Late Wisconsinan Age. Mean annual air temperature ranges from 37 to 45 degrees F. Mean annual precipitation ranges from 19 to 33 inches. Frost-free period ranges from 88 to 150 days. Elevation ranges from 700 to 1,500 feet above sea level.

GEOGRAPHICALLY ASSOCIATED SOILS: These typically include the Foldahl, Grimstad, Rockwell, Strathcona and Towner soils which formed in similar materials. The Foldahl and Grimstad soils are moderately well drained to somewhat poorly drained. Rockwell and Strathcona soils have a calcic horizon and the Towner soils are moderately well drained. They are also associated with Blomford and Braham soils in a few places. Blomford are poorly drained soils on plane slopes and Braham are well drained and moderately well drained soils on plane and convex slopes.

DRAINAGE AND PERMEABILITY: Poorly and very poorly drained. Permeability is moderately rapid or rapid in upper part and moderately rapid to moderately slow in the lower part. Surface runoff is negligible. Depth to an apparent seasonal high water table is 0.5 to 1.5 feet at some time from April to July in normal years for the poorly drained phases and at plus 1 to 0.5 feet at some time from March to August in normal years for the very poorly drained phase.

USE AND VEGETATION: Most areas of the Kratka series are used for hay and pasture or are cropped with small grains. Native vegetation is wet tall grass prairie and sedges with some scattered shrubs.

DISTRIBUTION AND EXTENT: Primarily northwestern Minnesota in the Glacial Lake Agassiz Plain and in eastern North Dakota, but is also recognized in other parts of northern Minnesota and Wisconsin. Moderately extensive.

MLRA OFFICE RESPONSIBLE: Bismarck, North Dakota

SERIES ESTABLISHED: Norman County, Minnesota, 1970.

REMARKS: Diagnostic horizons and features recognized in this pedon include: mollic epipedon - from the surface to 11 inches (A horizons); aquic features per low chroma below mollic epipedon. Typical pedon was revisited 9/97 and described to 80 inches.

ADDITIONAL DATA: Refer to Minnesota Agricultural Experiment Station Central File Code number 3006 for laboratory data of the typical pedon. See also MAES CFC numbers 802 and 883 and NSSL S92MN-113-3 for laboratory data of representative pedons and Minnesota Department of Transportation data for SS81369-370 for engineering test data.

SIR #MN0072; MN0419, Depressional phase; MN0640, Stratified substratum phase; MN0641, Stratified substratum, depressional phase; MN0618, thick solum phase.

National Cooperative Soil Survey
U.S.A.

LOCATION LUPTON MI+MA ME MN NY VT WI

Established Series
Rev. WEM-WEF-LMC
06/2004

LUPTON SERIES

The Lupton series consists of very deep, very poorly drained soils formed in organic deposits more than 51 inches thick within depressions on lake plains, moraines and outwash plains. Permeability of these soils is moderately slow to moderately rapid. Slopes typically are from 0 to 2 percent, but may range to 15 percent. Mean annual precipitation is about 29 inches. Mean annual temperature is about 44 degrees F.

TAXONOMIC CLASS: Euic, frigid Typic Haplosaprists

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

Oa1--0 to 10 inches; black (5YR 2/1) broken face and rubbed muck; about 15 percent fiber, 5 percent rubbed; weak coarse granular structure parting to weak fine granular; very friable; about 5 percent woody fibers; about 20 percent mineral; slightly alkaline (pH 7.5 in water); clear smooth boundary.

Oa2--10 to 20 inches; dark reddish brown (5YR 2/2) broken face, black (5YR 2/1) rubbed muck; about 30 percent fiber, less than 10 percent rubbed; weak fine granular structure; very friable; primarily woody fibers; some are up to 8 to 10 cm. long and 2 to 3 cm. wide; slightly alkaline (pH 7.5 in water); gradual smooth boundary.

Oa3--20 to 27 inches; dark reddish brown (5YR 2/2) broken face and rubbed muck; about 30 percent fiber, less than 10 percent rubbed; weak fine granular structure; very friable; primarily woody fibers; a few fibers are up to 10 to 20 cm. long and 2 to 4 cm. wide all breaking down on rubbing; slightly alkaline (pH 7.5 in water); clear smooth boundary.

Oa4--27 to 42 inches; dark reddish brown (5YR 2/2) broken face and rubbed muck; about 40 percent fibers, less than 10 percent rubbed; massive; primarily herbaceous fibers; few woody fibers; slightly alkaline (pH 7.5 in water); clear smooth boundary.

Oa5--42 to 65 inches; very dark brown (10YR 2/2) broken face, black (10YR 2/1) rubbed muck; about 30 percent fibers, less than 10 percent rubbed; massive; primarily herbaceous fibers; slightly alkaline (pH 7.5 in water).

TYPE LOCATION: Charlevoix County, Michigan; about 5 miles west and 1 mile north of Boyne City; 1,860 feet south and 620 feet east of northwest corner, sec. 25, T. 33 N., R. 7 W.

RANGE IN CHARACTERISTICS: The organic layers are greater than 51 inches thick. Woody fragments comprising up to 30 percent of the volume in some pedons are mixed throughout the control section in the form of twigs, branches, logs, or stumps. The control section typically has pH of 6.6 to 7.8 in 0.01M calcium chloride but ranges from 4.5 to 7.8. The surface tier has hue of 10YR, 7.5YR, or 5YR, value of 2 or 3, and chroma of 0 to 3 or are neutral. Surface tier commonly is sapric material, but some pedons are hemic or consist of various proportions of hemic and sapric material. This tier has a weak to medium, coarse to very fine granular structure. Some pedons have up to 4 inches of fibric material on the surface.

The subsurface and lower tier has hue of 5YR, 7.5YR, or 10YR, value of 2 or 3, and chroma of 0 to 3 or are neutral. Chroma or value or both may change 0.5 to 1 unit when rubbed or pressed. The subsurface tier primarily is sapric material. Some pedons contain layers of hemic material within the subsurface and bottom tiers but their combined thickness is less than 10 inches. A few thin layers of fibric material are also in the bottom two tiers of some pedons but their combined thickness is less than 5 inches. The upper part of the subsurface tier typically has a weak to moderate,

fine to coarse granular structure; however, some pedons are massive or coarse blocky that parts to a granular or fine to medium subangular blocky structure. The lower portion of the subsurface tier commonly is either massive or has thick platy structure consisting primarily of herbaceous fibers. In some pedons, where the lower part of the tier is comprised of woody materials, the structure is similar to that in the upper part. The aggregated material in the subsurface tier breaks abruptly under pressure between the fingers. The unrubbed, well decomposed sapric material resembles woody tissue. The bottom tier has variable amounts of woody and herbaceous fiber. The structure is commonly massive or thick platy.

COMPETING SERIES: These are the Bucksport, Pywell, Seelyeville, and Tendoy series. Bucksport soils typically do not have genetically developed structure in the profile and are in areas receiving more than 34 inches of annual precipitation. Pywell soils have layers of volcanic ash in the profile. Tendoy and Seelyeville soils do not have woody fibers and/or fragments throughout the control section. In addition, the Tendoy soils have free carbonates in the upper part of the surface tier

GEOGRAPHIC SETTING: Lupton soils are in depressions within lake plains, till plains, outwash plains, and moraines. These depressions vary from small enclosed ones to those of several thousand acres in extent. Lupton soils have normally been influenced by ground water passing through surrounding mineral soil materials that are high in minerals. Slopes typically range from 0 to 2 percent, but range to 15 percent. Minor deposits above 2 percent are on foot slopes as the upland soils break sharply into depressional or flood plain areas. These minor deposits are typically associated with groundwater discharge or seep areas. The mean annual precipitation ranges from 22 to 34 inches; and the mean annual temperature ranges from 36 to 45 degrees F. Frost free days range from 88 to 150. Elevation above sea level ranges from 670 to 1,600 feet.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Cathro and Tawas soils, which occur in similar landscape positions. Poorly drained or very poorly drained mineral soils are at the margin of the Lupton soils as they grade into the upland.

DRAINAGE AND PERMEABILITY: Very poorly drained. The representative depth to wet soil moisture status is at the surface to 1 foot below the surface at some time throughout the year. The representative depth of ponding is from .2 to 1.0 foot at some time throughout the year. Surface runoff is negligible to high, dependent on slope. Permeability is moderately slow to moderately rapid.

USE AND VEGETATION: A large part of these soils is in woodland, cut-over woodland, or brush. Some areas are cleared and used for permanent pasture or hay production. Major forest vegetation includes alder, balsam fir, black ash, black spruce, American elm, red maple, tamarack, white birch, white cedar, willow, and yellow birch.

DISTRIBUTION AND EXTENT: Upper Peninsula of Michigan, Northern lower peninusula of Michigan, Minnesota, Wisconsin, Vermont, and probably New York. The series is of large extent.

MLRA OFFICE RESPONSIBLE: St. Paul, Minnesota

SERIES ESTABLISHED: Antrim County, Michigan, 1923.

REMARKS: Diagnostic horizons and features recognized in this pedon are:
Sapric and typic features; well decomposed organic material from the surface to a depth of 65 inches;
Euic feature; reaction greater than 4.5 in 0.01M $CaCl_2$ throughout.

National Cooperative Soil Survey
U.S.A.

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.

LOCATION MILLERVILLE MN

Established Series
Rev. DDM-HRF
12/98

MILLERVILLE SERIES

These soils have dark brown and dark reddish brown moderately decomposed organic soil materials derived mostly from herbaceous plants underlain by very dark grayish brown limnic sediments of coprogenous earth at depths of about 24 inches. The organic soil materials are neutral or slightly acid.

TAXONOMIC CLASS: Coprogenous, euic, frigid Limnic Haplohemists

TYPICAL PEDON: Millerville mucky peat - on a plane level slope in a 40 acre bog inset between bluffs of ice-walled lake and terminal moraine in a cultivated field. (Colors are for the moist soil, and fiber content for unrubbed fiber unless otherwise stated.)

Oep--0 to 9 inches; dark brown (7.5YR 3/2) broken face and rubbed hemic material; about 75 percent fibers, 35 percent rubbed; massive; nonsticky; common inclusions of black sapric material with weak fine granular structure; herbaceous fibers; about 35 percent mineral material; slightly acid (pH 6.5 in 0.01 M calcium chloride); abrupt smooth boundary.

Oe2--9 to 19 inches; dark reddish brown (5YR 3/2) broken face and rubbed hemic material; about 60 percent fibers, 25 percent rubbed; weak thick platy structure; nonsticky; herbaceous fibers; about 15 percent mineral material; slightly acid (pH 6.2 in 0.01 M calcium chloride); clear smooth boundary.

Oe3--19 to 24 inches; dark brown (7.5YR 3/2) fibers and very dark brown (10YR 2/2) matrix, very dark brown (10YR 2/2) rubbed hemic material; about 35 percent fibers, 10 percent rubbed; weak medium platy structure; nonsticky; herbaceous fibers; about 15 percent mineral material; slightly acid (pH 6.1 in O.01 M calcium chloride); abrupt smooth boundary.

Lco1--24 to 42 inches; very dark grayish brown (10YR 3/2), very dark gray (10YR 3/1, rubbed) coprogenous earth; massive nonsticky; about 15 percent plant detritus; about 20 percent mineral material; slightly acid (pH 6.0 in 0.01 M calcium chloride); gradual smooth boundary.

Lco2--42 to 78 inches; very dark gray (10YR 3/1) broken face and rubbed coprogenous earth; massive; nonsticky; about 5 percent plant detritus; about 70 percent mineral material; about 10 percent snail shells; strongly effervescent; neutral.

TYPE LOCATION: Douglas County, Minnesota; 72 feet west and 73 feet north of the southeast corner of SE1/4NW1/4SE1/4, sec. 3, T. 129 N., R. 39 W.

RANGE IN CHARACTERISTICS: The depth to coprogenous earth ranges from 16 to 51 inches. The organic soil material primarily is derived from herbaceous plants but some pedons contain layers of Hypnum moss fibers. Woddy fibers and fragments typically are lacking, but a small amount of these are in the surface tier of some pedons. The organic soil material typically contains 10 to 20 percent mineral material but ranges from 10 to 40 percent. It typically ranges from neutral to slightly acid in 0.01 M calcium chloride, but medium acid is in the range. Mean annual soil temperature is estimated to range from 38 to 47 degrees F. These soils commonly are saturated with water during most of the year unless artificially drained. If the coprogenous earth has its upper boundary below a depth of 35 inches, hemic soil materials are dominant in at least the subsurface tier and if the coprogenous earth has its upper boundary above a depth of 35 inches, hemic soil materials are dominant in the organic portion of the control section. Some pedons have layers totaling less than 10 inches of sapric soil materials.

The hemic soil material has on the broken face hue of 5YR, 7.5YR, or 10YR; value of 3 or 4; and chroma of 2 or 3. The rubbed material is similar in color or is 1 unit lower in value or chroma or both. Content of fiber ranges from 35 to 80 percent in the unrubbed condition to 15 to 40 after rubbing. This material is massive or has weak platy structure.

The Lco horizon has hue of 10YR, 2.5Y, or 5Y; value of 3 or 4 but value of 2 is included in the range; and chroma of 1 or 2. Content of mineral material ranges from 15 to 80 percent with the higher values in the lower part. It typically lacks free carbonates in the upper part but the calcium carbonates equivalent ranges up to 50 percent in the lower part. It ranges from meduim acid to mildly alkaline in 0.01 M calcium chloride. Bulk density range from 0.3 to 0.6 gm/cm. Snail shells comprise up to 20 percent by volume of this material in some pedons.

COMPETING SERIES: This is the only series in this family. Closely related series are the Brophy, Carlos, and Rifle series. Brophy soils have fibric organic soil materials consisting mostly of Hypnum mosses in the subsurface tier. Carlos soils have layers of marl in the control section. Rifle soils lack limnic layers in the control section.

GEOGRAPHIC SETTING: These soils are in bogs within glacial moraines, outwash plains, and lacustrine plains. The bogs formerly were post-glacial lakes. These soils formed in 16 to less than 51 inches of organic materials derived from herbaceous plants and coprogenous earth. The climate is humid continental with warm summers and cold winters. Mean annual temperature is about 36 to 45 degrees F, and mean annaul precipitation is about 20 to 35 inches or more.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the competing Rifle soils and the Cathro, Markey, and Urness soils. All of these series are very poorly drained. The Cathro and Markey soils have a IIC horizon of loam and sand materials beginning at depths ranging from 16 to 51 inches. They commonly are on the fringe between bodies of Millerville soils and the border of the bog. Urness soils formed entirely in limnic sediments, (coprogenous earth).

DRAINAGE AND PERMEABILITY: Very poorly drained. Surface runoff is ponded. Permeability is moderately slow.

USE AND VEGETATION: Most of this soil is undrained. Some areas are used for pasture and hay. A few areas are drained and cropped to small grains. Native vegetation consisted mostly in grasses and sedges with scattered willow and alder.

DISTRIBUTION AND EXTENT: Central and northern Minnesota and possibly the northern parts of MIchigan and Wisconsin. Moderately extensive.

MLRA OFFICE RESPONSIBLE: St. Paul, Minnesota

SERIES ESTABLISHED: Douglas County, Minnesota, in December 1970.

REMARKS: This series was classified as a Bog or Half-Bog Soil in the former system.

ADDITIONAL DATA: Refer to MAES No. 69-21-8-4 for results of some laboratory analysis of the typifying pedon.

National Cooperative Soil Survey
U.S.A.

LOCATION NEWSON WI+MN

Established Series
Rev. HFG-JJJ
12/2006

NEWSON SERIES

The Newson series consists of very deep, poorly drained and very poorly drained soils formed in sandy outwash, sandy alluvium, or sandy lacustrine deposits on outwash plains, lake terraces, stream terraces, and valley trains. Permeability is rapid or very rapid. Slopes range from 0 to 2 percent. Mean annual precipitation is about 30 inches. Mean annual air temperature is about 42 degrees F.

TAXONOMIC CLASS: Mixed, frigid Humaqueptic Psammaquents

TYPICAL PEDON: Newson mucky loamy sand, from an area of Meehan-Newson complex - on a plane 1 percent slope in a sparse stand of aspen at an elevation of about 955 feet. (Colors are for moist soil unless otherwise stated.)

A1--0 to 3 inches; black (10YR 2/1) mucky loamy sand; very dark gray (10YR 3/1) dry; weak very fine and fine subangular blocky structure; very friable; common very fine, fine, medium, and coarse roots; very strongly acid; clear smooth boundary.

A2--3 to 8 inches; black (10YR 2/1) loamy sand, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; very friable; many very fine, fine medium, and coarse roots; extremely acid; abrupt irregular boundary. (Combined thickness of the A horizons is 6 to 9 inches.)

Bg--8 to 16 inches; dark grayish brown (10YR 4/2) sand; weak medium subangular blocky structure; very friable; few very fine and fine roots; few fine prominent strong brown (7.5YR 5/6) masses of iron accumulation; black (10YR 2/1) soil in some root channels; extremely acid; gradual smooth boundary. (8 to 30 inches thick)

BCg--16 to 22 inches; grayish brown (10YR 5/2) sand; single grain; loose; few fine roots; few fine prominent strong brown (7.5YR 5/6) masses of iron accumulation; few medium faint dark grayish brown (10YR 4/2) masses of iron depletion; extremely acid; gradual smooth boundary. (0 to 11 inches thick)

C--22 to 60 inches; yellowish brown (10YR 5/4) sand; single grain; loose; many medium prominent strong brown (7.5YR 5/6) masses of iron accumulation; very strongly acid.

TYPE LOCATION: Juneau County, Wisconsin; about 4 miles east and 2.4 miles north of Finley; 1050 feet south and 700 feet east of the northwest corner of sec. 5, T. 20 N., R. 4 E. USGS New Miner, Wis. Quad. Latitude 44 degrees 14 minutes 46 seconds N. Longitude 90 degrees 3 minutes 14 seconds W. NAD 27.

RANGE IN CHARACTERISTICS: (Unless otherwise stated, thickness in the following paragraph is measured from the top of the mineral soil.) depth to the base of soil development typically ranges from 20 to 30 inches, but it ranges to 50 inches in some pedons. The particle-size control section averages less than 50 percent fine sand and typically averages less than 25 percent coarse and very coarse sand. Coarse fragments are absent in most pedons but in some pedons, volume of gravel ranges up to 35 percent in individual subhorizons. Reaction naturally ranges from extremely acid to moderately acid in the solum but ranges to neutral in the upper part, where the soil is limed. Reaction ranges from very strongly acid to slightly acid in the substratum. Redox accumulations are in the A horizon in some pedons. Redox accumulations are typically throughout the solum below the A horizon and are in the substratum in some pedons. Redox depletions with chroma of 2 or less commonly dominate the matrix below the A horizon, but the C horizon in many pedons is the color of the uncoated sand grains.

Some pedons have an O horizon of muck or mucky peat as much as 7 inches thick. It has hue of 7.5YR, 10YR, 2.5Y or

is neutral in hue. Value is 2 or 3 and chroma is 0 to 2. Some pedons that have O horizons do not have A horizons.

The A or Ap horizon has hue of 7.5YR, 10YR, 2.5Y, or 5Y; value of 2 or 3; and chroma of 1 to 3. Some pedons with a mucky surface have hue of 5YR or 7.5YR. Texture of the A or Ap horizon is loamy sand, mucky loamy sand, or loamy fine sand. When the upper 6 inches are mixed, the color value moist is 3 or less and color value dry is 5 or less (crushed and smoothed).

The Bg horizon has hue of 7.5YR, 10YR, 2.5Y, or 5Y; value of 4 to 7; and chroma of 1 or 2. Texture is loamy sand, loamy coarse sand, sand, or coarse sand or the gravelly analogs.

The BCg horizon has hue of 7.5YR, 10YR, 2.5Y, or 5Y; value of 5 or 6; and chroma of 1 or 2. Texture is loamy sand, loamy coarse sand, sand or coarse sand

The Cg or C horizon typically has hue of 7.5YR, 10YR or 2.5Y, value of 4 to 8, and chroma of 1 to 6, but some pedons have hue of 7.5YR or 5YR in the C horizon above a depth of 40 inches. In many pedons the color of the C horizon is that of the uncoated sand grains. Texture of the Cg or C horizon is loamy sand, loamy coarse sand, sand, or coarse sand or the gravelly analogs.

COMPETING SERIES: There are no competing series.

GEOGRAPHIC SETTING: These soils occupy flats, depressions and drainageways on outwash plains, lake terraces, stream terraces and valley trains. Slopes range from 0 to 2 percent. Newson soils formed in very deep sandy outwash, sandy alluvium, or sandy lacustrine deposits. Mean annual precipitation ranges from 26 to 33 inches. Mean annual air temperature ranges from 36 to 45 degrees F. The frost free period ranges from about 90 to 135 days. Elevation ranges from 600 to 1950 feet.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Dawson, Friendship, Markey, Meehan, Menahga, Nemadji, Omega, and Sartell. The excessively drained Menahga, Omega, and Sartell soils; the moderately well drained Friendship soils; and the somewhat poorly drained Meehan and Nemadji soils form a drainage sequence with the Newson soils. Dawson and Markey soils are in nearby areas where there is 16 to 51 inches of organic soil over sand.

DRAINAGE AND PERMEABILITY: Poorly drained and very poorly drained. The potential for surface runoff is negligible or very low. Permeability is rapid or very rapid. These soils have an apparent seasonal high water table from 1 foot above to 1 foot below the surface for long periods from September to June in 6 or more out of 10 years.

USE AND VEGETATION: Many areas are in wetland vegetation consisting of grasses, sedges, reeds, and shrubs. Some areas are in woodland. Trees are of poor quality. Common trees are quaking aspen, paper birch, jack pine and eastern white pine. Some areas are used for pastureland and some areas have been drained and are used for cropland. Common crops are corn, small grains, and hay.

DISTRIBUTION AND EXTENT: Central and northwestern Wisconsin and northeastern Minnesota. The series is extensive.

MLRA OFFICE RESPONSIBLE: St. Paul, Minnesota

SERIES ESTABLISHED: Wood County, Wisconsin, 1971.

REMARKS: Diagnostic features recognized in this pedon are: humaqueptic feature - has an A horizon 6 to 9 inches thick with value moist lower than 3.5 and value dry lower than 5.5 (or the upper soil, after mixing to a depth of 6 inches, has these colors) and has base saturation (by NH4OAc) less than 50 percent at 40 inches.

National Cooperative Soil Survey
U.S.A.

LOCATION PREBISH MN

Established Series
Rev. CKS-KRV-ROP
12/2001

PREBISH SERIES

The Prebish series consists of very poorly drained and poorly drained soils that formed in dense loamy glacial till on drumlins and glacial moraines. These soils are deep to dense till (paralithic contact). These soils have moderately slow to moderately rapid permeability in the upper part and very slow permeability in the dense till. Slopes range from 0 to 1 percent. Mean annual precipitation is about 27 inches. Mean annual air temperature is about 44 degrees F.

TAXONOMIC CLASS: Coarse-loamy, mixed, superactive, frigid Typic Epiaquolls

TYPICAL PEDON: Prebish fine sandy loam with a slightly concave slope of less than 1 percent in a shallow depression on a till plain in a cultivated field. (Colors are for moist soil unless otherwise stated.)

Ap--0 to 6 inches; black (5YR 2/1) fine sandy loam high in content of organic matter; weak medium granular structure; very friable; about 5 percent gravel; neutral; abrupt wavy boundary.

A1--6 to 11 inches; black (N 2/0) fine sandy loam; weak medium and coarse subangular blocky structure; friable; about 5 percent gravel; neutral; clear irregular boundary.

A2--11 to 16 inches; black (2.5Y 2/1) fine sandy loam; few fine distinct dark reddish brown (5YR 3/3) Fe concentrations; weak medium subangular blocky structure; friable; about 5 percent gravel; neutral; clear wavy boundary. (Combined thickness of the A horizon is 10 to 24 inches.)

Bg1--16 to 19 inches; grayish brown (2.5Y 5/2) and dark grayish brown (2.5Y 4/2) fine sandy loam; few fine prominent dark red (2.5YR 3/6) Fe concentrations; weak medium and thick platy structure; friable; about 5 percent gravel; neutral; clear irregular boundary. (2 to 4 inches thick)

Bg2--19 to 46 inches; gray (5YR 5/1) fine sandy loam; common medium distinct reddish brown (5YR 4/4) Fe concentrations; weak medium and thick platy structure; friable; about 5 percent gravel; neutral; clear wavy boundary. (15 to 36 inches thick)

Cd--46 to 60 inches; reddish brown (5YR 4/3) sandy loam; many medium distinct yellowish red (5YR 4/6) Fe concentrations; massive, medium platy-like soil fragments; very firm; about 10 percent gravel; neutral.

TYPE LOCATION: Benton County, Minnesota; about 4 miles north of Gilman; 2,330 feet east and 1,085 feet south of the northwest corner of sec. 16, T. 38 N., R. 29 W.

RANGE IN CHARACTERISTICS: Depth to a paralithic contact over the dense till ranges from 40 to 60 inches. Free calcium carbonate typically is absent to depths of 60 inches or more inches, but in a few pedons very small amounts are in the lower part of the C horizon. Rock fragments of mixed lithology, but mostly of igneous type, comprise 2 to 15 percent volume in the upper part and 5 to 20 percent of the lower part of the control section(Cd horizon). Some pedons have O horizons as much as 8 inches in thickness. The mollic epipedon ranges from 10 to 24 inches in thickness. Reaction in the upper part of the control section ranges from moderately acid to neutral and moderately acid to moderately alkaline in the lower part (Cd horizon). The 10- to 40-inch particle size control section averages between 12 and 18 percent clay and 40 and 65 percent fine sand and coarser. Stony phases are recognized in some pedons.

The A horizon typically has hue of 10YR to 5Y; value of 2 or 3; and chroma of 1 or is N 2/0 or N 3/0. However, in some pedons the O horizon and those A horizons that are very high in content of organic matter have hue of 5YR or

7.5YR. They are loam, sandy loam, or fine sandy loam.

The upper part of the Bg horizon has hue of 10YR, value of 4 to 6, and chroma of 1, or hue of 2.5Y or 5Y and chroma of 1 or 2. The lower part of the B horizon has hue of 5YR to 2.5Y, value of 4 or 5 and chroma of 1 to 3. It typically is coarse sandy loam, fine sandy loam, or sandy loam, or loam, but it has subhorizons of silt loam in some pedons. It has a bulk density ranging from 1.5 to 1.7 gm/cc.

The Cd horizon and BC horizons, where present, have hue of 5YR or 7.5YR, value of 3 to 5, and chroma of 3 to 6. They are coarse sandy loam, sandy loam, or fine sandy loam or their gravelly analogues. Some pedons have 2B and 2C horizons. It has bulk density ranging from 1.8 to 2.0 gm/cc.

COMPETING SERIES: These are the Adolph, Nokasippi and Parent series. However, when formerly classified as Typic Haplaquolls, the competing series were Forada, Runeberg, and Tiffany series. Adolph soils have greater than 80 percent passing the 200 sieve in the upper part of the control section. Forada soils have sand and gravel at depths of 20 to 40 inches. Nokasippi soils have sandy textures in the upper part of the particle-size control section. Parent soils have bulk densities greater than 1.7 gm/cc in the lower part of the control section. Runeberg soils have hue yellower than 7.5YR in the C horizon. Tiffany soils have free carbonates at depths of 20 to 40 inches and hue yellower than 7.5YR in the lower part of the series control section.

GEOGRAPHIC SETTING: Prebish soils have plane or concave slopes on upland flats in shallow depressions and swales. They are on glacial moraines and in depressions between drumlins. Slope gradients range from 0 to 1 percent. The Prebish soils formed in modified till or local wash over reddish brown or brown dense loamy glacial till of late Wisconsin age. Mean annual air temperature ranges from 37 to 45 degrees F. Mean annual precipitation ranges from 24 to 30 inches. Frost-free days range from 90 to 150. Elevation above sea level ranges from 670 to 1450 feet.

GEOGRAPHICALLY ASSOCIATED SOILS: The Milaca, Mora, Ronneby, and Parent soils form a drainage sequence with the Prebish soils. They are on higher or more sloping positions on the landscape and are better drained. The Milaca soils are well drained; the Mora soils are moderately well drained; the Ronneby soils are somewhat poorly drained; and the Parent soils are poorly drained. The Flak, Brainerd, and Nokay soils are also associated with Prebish soils in some places.

DRAINAGE AND PERMEABILITY: Very poorly drained and poorly drained. Surface runoff is very slow or ponded. Permeability is moderately slow to moderately rapid in the upper part and very slow in the dense till. The perched water table ranges from .5 to 2 feet for the poorly drained phase and plus 1 to 1 foot for the very poorly drained phase.

USE AND VEGETATION: Most of this soil is used for pasture. Small areas are planted to cultivated crops. Native vegetation is mostly grasses and sedges with scattered alder and willow.

DISTRIBUTION AND EXTENT: Central Minnesota. Moderately extensive.

MLRA OFFICE RESPONSIBLE: St. Paul, Minnesota

SERIES ESTABLISHED: Benton County, Minnesota, 1970.

ADDITIONAL DATA: Refer to MAES Central File No. 811 for some results of laboratory analysis of the typical pedon.

REMARKS: Diagnostic horizons and features recognized in this pedon are: mollic epipedon - the zone from the surface to 16 inches (A horizons); cambic horizons - the zone from 16 to 46 inches (Bg horizons); aquic conditions- low chroma immediately below the mollic epipedon; Paralithic contact- the zone at about46 inches where soil meets dense glacial till. These soils were formerly classified as Typic Haplaquolls.

U.S.A.

LOCATION RIFLE MI+ME MN ND NY VT WI

Established Series
Rev. RWJ-WEF
12/98

RIFLE SERIES

The Rifle series consists of very deep, very poorly drained soils formed in organic deposits more than 51 inches thick in bogs and depressional areas within ground moraines, end moraines, outwash plains, and lake plains. These soils have moderately rapid permeability. Slopes range from 0 to 2 percent. Mean annual precipitation is about 30 inches and the mean annual temperature is about 42 degrees F.

TAXONOMIC CLASS: Euic, frigid Typic Haplohemists

TYPICAL PEDON: Rifle mucky peat - undisturbed. (Colors are for moist soils.)

Oi1--0 to 2 inches; yellowish brown (10YR 5/4) broken face and rubbed peat, light yellowish brown (10YR 6/4) pressed; 90 to 100 percent sphagnum moss rubbed; massive; neutral; clear smooth boundary.

Oi2--2 to 4 inches black (5YR 2/1) broken face, rubbed and pressed peat; about 90 percent fiber, 60 percent rubbed; massive; primarily sphagnum moss and some woody fragments; neutral; abrupt smooth boundary.

Oe1--4 to 8 inches; black (5YR 2/1) broken face and rubbed mucky peat, dark reddish brown (5YR 2/2) pressed; about 30 percent fiber and 10 percent rubbed; weak fine granular structure; woody and herbaceous fibers; neutral; abrupt smooth boundary.

Oe2--8 to 20 inches; dark reddish brown (5YR 2/2) broken face, rubbed and pressed mucky peat; about 65 percent fiber and 20 percent rubbed; weak thick platy structure; primarily herbaceous fibers few woody fragments; neutral; clear smooth boundary.

Oe3--20 to 39 inches; dark reddish brown (5YR 2/2) broken face and rubbed mucky peat, dark reddish brown (5YR 3/3) pressed; about 80 percent fiber and 20 percent rubbed; weak thick platy structure; primarily herbaceous fibers; neutral; gradual smooth boundary.

Oe4--39 to 60 inches; dark reddish brown (5YR 2/2) broken face, rubbed and pressed mucky peat; about 70 percent fiber, and 15 percent rubbed; weak thick platy structure; primarily herbaceous fibers; neutral.

TYPICAL LOCATION: Delta County, Michigan; about 4 miles northeast of the town of Bark River 1700 feet south and 350 feet west of the northeast corner, sec. 13, T. 39 N., R. 24 W.

RANGE OF CHARACTERISTICS: The thickness of the organic soil layers exceeds 51 inches. The organic material is estimated to be primarily herbaceous fibers, however, some pedons contain less than 15 percent by volume of woody fragments that cannot be crushed between the fingers. The layers in the subsurface tier typically have pH of 4.5 to 6.5 in O.01M CaCl2, but range from pH 5.6 to 7.3. The organic soil materials lack free carbonates in all parts of the control section.

Some pedons contain surface layers composed of hemic or sapric material. The layers in the surface tier are quite variable in color depending upon the stage of decomposition. Hue ranges from 10YR to 5YR, value from 2 to 6, and chroma from 1 to 4. The fibers in these layers are primarily coarse granular or weak thick platy structure or the layers in the subsurface and bottom tier have hue of 10YR, 7.5YR or 5YR, values of 2 to 5 and chroma of 1 to 5. Colors become darker upon brief exposure to air. Rubbed colors have about the same range in the colors of broken faces, but in some pedons they differ by 0.5 to 1 unit in chroma or value or both. The lighter colors are generally those of

materials that contain more fiber. The layers in the subsurface and bottom tier are commonly massive, but in some pedons they have weak thick platy structure. The materials are dominantly of hemic material. In some pedons, layers of fibric or sapric materials are within the subsurface and bottom tier but total thickness of either material is less than 10 inches. Some pedons have limnic materials at depths of 51 inches or greater.

COMPETING SERIES: These are the Mooselake soils in the same family and the closely related Carbondale, Carlisle, Greenwood and Houghton series. Mooselake soils have hemic material with mostly woody fiber. Carbondale soils have sapric material dominant in the subsurface tier, and more than 10 inches of hemic material dominant in the subsurface and bottom tiers. Carlisle and Houghton soils have sapric material dominant in the subsurface tier and are mesic. Greenwood soils are dysic.

GEOGRAPHIC SETTING: Rifle soils are in bogs and depressional areas within ground moraines, end moraines, outwash plains, and lake plains. Slope gradients are less than 2 percent. The mean annual precipitation ranges from 19 to 35 inches and the mean annual temperature is about 40 to 46 degrees F. The frost-free period is 90 to 150 days and the elevation ranges from 600 to 1,950 feet.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Cathro, Lupton, Markey soils and Carbondale soils. Cathro and Markey soils have loamy or sandy materials at depths of less than 51 inches. Lupton soils formed in woody materials. The soils on nearby uplands are commonly acid and have coarse and moderately coarse texture.

DRAINAGE AND PERMEABILITY: Very poorly drained. The seasonal high water table ranges from 1 foot above the surface to 1 foot below the surface from November to June. Surface runoff and internal drainage is very slow; permeability is moderately rapid.

USE AND VEGETATION: These soils are primarily in woodland. A few areas are used for pasture. Principal vegetation is tamarack, black spruce, paper birch, balsam fir, black ash, and northern white-cedar. Ground cover is sphagnum moss, leather leaf, blueberry, and labrador tea.

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

MLRA OFFICE RESPONSIBLE: St. Paul, Minnesota

SERIES ESTABLISHED: Ogemaw County, Michigan, 1923.

REMARKS: Diagnostic horizons and other features recognized in this pedon are: fibric material from the surface to 4 inches (Oi1 and Oi2 horizons); hemic material from 8 to 60 inches (Oe1, Oe2, Oe3 and Oe4 horizons); aquic soil moisture regime.

National Cooperative Soil Survey
U.S.A.

LOCATION SEELYEVILLE MN+ND WI

Established Series
Rev. AGG-TCJ
05/2001

SEELYEVILLE SERIES

The Seelyeville series consists of very deep, very poorly drained soils that formed in organic materials more than 51 inches thick. These soils are on glacial outwash plains, valley trains, flood plains, glacial lake plains and glacial moraines. They have moderately rapid to moderately slow permeability. Slopes are 0 to 15 percent. Mean annual precipitation is about 28 inches. Mean annual air temperature is about 42 degrees F.

TAXONOMIC CLASS: Euic, frigid Typic Haplosaprists

TYPICAL PEDON: Seelyeville muck with less than a 1 percent plane slope in a pastured field. (Colors are for moist soil unless otherwise stated)

Oa1--0 to 10 inches; black (10YR 2/1) broken face and rubbed muck (sapric material); about 20 percent fiber unrubbed, 5 percent rubbed; weak fine and medium subangular structure; very friable; mostly herbaceous fiber; slightly acid; gradual smooth boundary.

Oa2--10 to 19 inches; dark brown (7.5YR 3/2) broken face muck (sapric material), black (10YR 2/1) rubbed; about 30 percent fiber unrubbed, 2 percent rubbed; weak medium subangular blocky structure; very friable; mostly herbaceous fiber; slightly acid; gradual wavy boundary.

Oa3--19 to 35 inches; very dark brown (10YR 2/2) broken face muck (sapric material), black (10YR 2/1) rubbed; about 50 percent fiber unrubbed, 15 percent rubbed; massive; very friable; mostly herbaceous fiber; slightly acid; gradual wavy boundary.

Oa4--35 to 42 inches; black (10YR 2/1) broken face and rubbed muck (sapric material); about 6 percent fiber unrubbed, 1 percent rubbed; massive; friable; slightly acid; clear smooth boundary.

Oa5--42 to 80 inches; dark brown (7.5YR 3/2) broken face muck (sapric material), black (10YR 2/1) rubbed; about 15 percent fiber unrubbed, 2 percent rubbed; massive; friable; mostly herbaceous fiber; slightly acid.

TYPE LOCATION: Sherburne County. Minnesota: 1300 feet south and 800 feet east of the northwest corner of sec. 34, T. 33 N., R. 26 W.; USGS Elk River quadrangle; lat. 45 degrees 18 minutes 37 seconds N and long. 93 degrees 34 minutes 08 seconds W., NAD27

RANGE IN CHARACTERISTICS: Seelyeville soils have organic soil materials extending to depths of 51 to 100 inches or more. Mineral or limnic materials are below these depths. The fibers are derived mostly from herbaceous plants, but some layers contain moss fibers. Woody fibers and fragments typically do not occur in all parts of the control section, but a small amount of these materials are in the surface tier of some pedons. The organic material has from 10 to 40 percent of mineral material in the control section. All partcs of the control section typically range from strongly acid to neutral (in 0.01 M calcium chloride), but very strongly acid to moderately alkaline layers are within the range. Free carbonates are typically absent in the organic soil material, but some phases have free carbonates throughout. The surface tier typically consists entirely of muck (sapric material), but in some, mucky peat (hemic material) comprise part to all of the tier. The subsurface and bottom tiers typically are muck. However, in some pedons, mucky peat totaling to as much as 10 inches in thickness is in these tiers. These hemic layers primarily are in the upper part of the subsurface tier.

The Oa horizons have hue of 10YR or 7.5YR or neutral, value of 2 or 3, and chroma of 0 to 2, both for the broken face

and rubbed. The content of fiber typically is less than 50 percent in the undisturbed condition and less than 15 percent after rubbing.

The Oe horizons, when present, have hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 2 or 3 on the broken face.

COMPETING SERIES: These are the Bucksport, Lupton, Pywell and Tendoy series. The Bucksport and Lupton soils have typically redder hue and woody fibers and/or fragments throughout the control section. The Pywell soils have layers of volcanic ash in the control section. The Tendoy soils have discontinuous, thin layers of mineral soil material in the 3 tiers.

GEOGRAPHIC SETTING: The Seelyeville soils are in depressions and large basins on nearly level slopes on outwash plains, flood plains, valley trains, glacial lake plains, and glacial moraines. Slope gradients typically are less than 0.5 percent but range to 15 percent in areas with hillside seeps. These soils are formed in highly decomposed organic soil materials that are more than 51 inches thick and that primarily are derived from herbaceous plants. Mean annual air temperature ranges from 36 to 45 degrees F. Mean annual precipitation ranges from 16 to 33 inches. About sixty percent occurs during May through September. Frost-free days range from 88 to 150. The elevation ranges from 600 to 2000 feet. These soils are frozen from December to mid-April.

GEOGRAPHICALLY ASSOCIATED SOILS: The main ones are the Carbondale, Cathro, Markey, and Rondeau soils. Carbondale soils have hemic soil materials totaling more than 10 inches in thickness within 51 inches. Cathro and Markey soils have mineral soil materials within 51 inches. Rondeau soils have marl within 51 inches. In some places the Rifle soils which are dominated by mucky peat are associates. Also, poorly drained or very poorly drained mineral soils are at the margins of the bogs.

DRAINAGE AND PERMEABILITY: Very poorly drained. Surface runoff is negligible. Permeability is moderately slow to moderately rapid. Depth to an apparent water table is as high as plus 1 to .5 feet at some time from October through June for the Seelyeville, Seelyeville flooded, and Seelyeville calcareous phases, 0 to 2 feet for Seelyeville sloping, and plus 3 to 0 feet at some time from October through June for Seelyeville ponded.

USE AND VEGETATION: Most of these soils are in native vegetation. Some areas are used for pasture or for hay. A few areas are drained and cropped to specialty crops. Native vegetation primarily is sedges and grasses. Some areas have scattered alders, willow, tamarack, and bog birch.

DISTRIBUTION AND EXTENT: Mostly northern and western Minnesota and northern Wisconsin possibly in the northern part of Michigan. Extensive.

MLRA OFFICE RESPONSIBLE: St. Paul, Minnesota

SERIES ESTABLISHED: Norman County, Minnesota, 1970.

REMARKS: Diagnostic horizons and features recognized in this pedon are: sapric soil materials (muck) dominate the surface, subsurface and bottom tiers in the 51-inch control section. Type location moved from Anoka County, Mn. to Sherburne County, Mn., 11/96 to better characterize the series concept in the MLRA.

ADDITIONAL DATA: SIR # MN0128; MN0353, sloping phase; MN0647, calcareous phase; MN0733, frequently flooded phase; MN0646, ponded phase.

National Cooperative Soil Survey
U.S.A.

LOCATION TALMOON MN

Established Series
Rev. PRCN-DMH-ROP
3/98

TALMOON SERIES

The Talmoon series consists of very deep, very poorly drained and poorly drained soils formed in loamy glaciofluvial materials and the underlying loamy till. They are in shallow depressions, swales and nearly level areas on till-floored lake plains and moraines. These soils have moderate permeability in the upper part and moderately slow permeability in the lower part. Slopes range from 0 to 2 percent. Mean annual precipitation is about 24 inches. Mean annual air temperature is about 40 degrees F.

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, frigid Mollic Endoaqualfs

TYPICAL PEDON: Talmoon silt loam in a nearly level area under lowland hardwood forest. (Colors are for moist soil unless otherwise stated.)

A--0 to 6 inches; very dark gray (10YR 3/1) silt loam; gray (10YR 5/1) dry; weak and moderate very fine and fine subangular blocky structure; very friable; many medium and fine roots; moderately acid; abrupt wavy boundary. (3 to 10 inches thick)

Eg1--6 to 9 inches; gray (10YR 5/1) and dark gray (10YR 4/1) silt loam; weak thick platy structure parting to weak fine subangular blocky; very friable; many medium and fine roots; few medium prominent light olive brown (2.5Y 5/4) Fe concentrations; slightly acid; abrupt wavy boundary.

Eg2--9 to 16 inches; grayish brown (2.5Y 5/2) and light brownish gray (2.5Y 6/2) very fine sandy loam; weak medium platy structure parting to weak fine subangular blocky; very friable; many fine and very fine roots; common medium distinct light yellowish brown (2.5Y 6/4) and few fine distinct light olive brown (2.5Y 5/4) Fe concentrations; slightly acid; clear wavy boundary. (Combined thickness of E horizons is 4 to 12 inches.)

Btg1--16 to 33 inches; olive gray (5Y 5/2) sandy clay loam; moderate medium and coarse subangular blocky structure; firm; common fine and very fine roots; many faint olive gray (5Y 4/2) clay films on faces of peds; many medium prominent yellowish brown (10YR 5/6) Fe concentrations; about 5 percent gravel, about 2 percent soft shale fragments; slightly acid; clear wavy boundary.

2Btg2--33 to 42 inches; olive gray (5Y 5/2) loam; weak coarse subangular blocky structure; firm; few very fine roots; few distinct olive gray (5Y 4/2) clay films on faces of peds; common medium prominent yellowish brown (10YR 5/6) and few medium prominent light olive brown (2.5Y 5/4) Fe concentrations; about 5 percent gravel, about 2 percent soft gray shale fragments; neutral; clear smooth boundary. (Combined thickness of the Btg horizons is 6 to 30 inches)

2Cg--42 to 60 inches; light olive gray (5Y 6/2) and olive gray (5Y 5/2) loam; massive; friable; common medium prominent light yellowish brown (2.5Y 6/4) Fe concentrations; about 5 percent gravel, about 2 percent soft gray shale fragments; slightly effervescent; slightly alkaline.

TYPE LOCATION: Itasca County, Minnesota; about 7 miles north and 2 miles west of Deer River; about 2500 feet north and 250 feet west of the southeast corner of sec. 21, T. 146 N., R. 25 W.; USGS Quadrangle Deer River NE quadrangle; lat. 47 degrees 26 minutes 52 seconds N. and long. 93 degrees 50 minutes 20 seconds W., NAD27.

RANGE IN CHARACTERISTICS: The depth to free calcium carbonate typically ranges from 18 to 44 inches, but it is greater than 60 inches in some pedons. Rock fragments are 1 to 10 percent by volume in the 2B and 2C horizons.

Some pedons have an Oa horizon up to 7 inches thick. It has hue of 10YR or 2.5Y, value of 2, chroma of 1 or is neutral.

The A horizon has hue of 10YR or 2.5Y, value of 2 or 3, and chroma of 1 or 2, or is neutral with value of 2. It is silt loam, loam, very fine sandy loam, fine sandy loam, sandy loam, or their mucky modifiers. Reaction is strongly acid to neutral. Some pedons have an Ap horizon that has hue of 10YR or 2.5Y, value of 2 or 3 (5.5 or less dry), and chroma of 1 or 2. Pedons with the thinner A horizons typically have an O horizon that is muck.

The Eg horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or 2. It is fine sandy loam, sandy loam, very fine sandy loam, loam, or silt loam. It is neutral to strongly acid.

Some pedons have a thin BE horizon.

The Btg and 2Btg horizons have hue of 2.5Y or 5Y, value of 4 to 6, and chroma of 1 or 2. It is clay loam, sandy clay loam, or loam. It is moderately acid to moderately alkaline. Clay content is 18 to 35 percent and sand content is 25 to 55 percent.

The 2Cg or 2Bkg (where present) horizons have hue of 2.5Y or 5Y, value of 5 to 7, and chroma of 1 or 2. Texture typically is loam, sandy clay loam, or clay loam, but subhorizons of sandy loam, silt loam, or silty clay loam are common. It is slightly alkaline or moderately alkaline. Clay content ranges from 15 to 30 percent and sand content from 25 to 55 percent.

COMPETING SERIES: These are the Egglake, Jevne, and Willosippi Series. The Egglake soils have rock fragments in the upper part of the control secttion. The Willosippi soils do not have gravel in the argillic horizon. Jevne soils have stratified textures in the lower one-third of the series control section.

GEOGRAPHIC SETTING: These soils are in shallow depressions and swales and nearly level areas on till-floored lake plains and moraines of Late Wisconsinan Age. Slopes are 0 to 2 percent. These soils formed in loamy glaciofluvial material and underlying loamy till. Mean annual air temperature ranges from 36 to 45 degrees F. Mean annual precipitation ranges from 22 to 30 inches. Frost-free days range from 88 to 150. Elevation above sea level ranges from 800 to 1600 feet.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Alstad, Beltrami, Bluffton, Cathro, Nebish, Shooker, Stuntz, and Warba soils. Alstad, Beltrami, Nebish, and Warba soils are all on higher, better drained landscape positions. The somewhat poorly drained Stuntz soils are on slightly higher landscape positions. Very poorly drained Bluffton soils are in depressions. Cathro soils formed in organic materials in depressions. The poorly drained Shooker soils are on nearly level flats adjacent to Talmoon soils.

DRAINAGE AND PERMEABILITY: Very poorly drained and poorly drained. Surface runoff is low or very low. Permeability is moderate in the upper part and moderately slow in the lower part. The apparent seasonal water table is at +1 to 0.5 foot in the very poorly drained phase and 0.5 to 1.5 feet in the poorly drained phase at some time during November to June in most years.

USE AND VEGETATION: Most areas grow native vegetation of lowland hardwoods or aspen or a cover of sedges and willows. Some areas are pastured. Significant areas of Talmoon, poorly drained are used to grow cultivated crops.

DISTRIBUTION AND EXTENT: North-central and east-central Minnesota. These soils are of moderate extent.

MLRA OFFICE RESPONSIBLE: St. Paul, Minnesota

SERIES ESTABLISHED: Itasca County, Minnesota, 1982.

REMARKS: Diagnostic horizons and features recognized in this pedon are: ochric epipedon - the zone from the surface to 16 inches (A and Eg horizon); albic horizon - the zone from 6 to 16 inches (Eg horizon); argillic horizon - the zone from 16 to 33 inches (Btg horizons); aquic conditions- low chroma in argillic horizon; mollic subgroup - the A

horizon qualifies for mollic epipedon except for thickness. This series was formerly classified as a Mollic Ochraqualfs.

ADDITIONAL DATA: Soil Interpretation Record numbers: MN0592 and MN0380, depressional.

National Cooperative Soil Survey
U.S.A.

LOCATION WARMAN MN+WI

Established Series
Rev. TAF-ROP
02/2003

WARMAN SERIES

The Warman series consists of very deep, very poorly drained and poorly drained soils formed in glacial outwash sediments consisting of a loamy mantle over sand or gravel deposits. These soils are on glacial outwash plains and valley trains. Slopes range from 0 to 2 percent. Permeability is moderately rapid or moderate in the loamy mantle and rapid or very rapid in the substratum. Mean annual temperature is 40 degrees F. Mean annual precipitation is 28 inches.

TAXONOMIC CLASS: Coarse-loamy over sandy or sandy-skeletal, mixed, superactive, frigid Typic Endoaquolls

TYPICAL PEDON: Warman loam with a 1 percent concave slope on an outwash plain in a cultivated field. (Colors are for moist soil unless otherwise noted.)

A--0 to 9 inches; very dark gray (10YR 3/1) loam, grayish brown (10YR 5/2) dry; moderate medium subangular blocky structure; friable; common medium roots; about 2 percent gravel; moderately acid; abrupt smooth boundary. (7 to 13 inches thick)

AB--9 to 12 inches; very dark grayish brown (10YR 3/2) very fine sandy loam, grayish brown (10YR 5/2) dry; common medium distinct dark yellowish brown (10YR 4/4) mottles; moderate medium subangular blocky structure; friable; common medium roots; about 2 percent gravel; moderately acid; clear wavy boundary. (0 to 6 inches thick)

Bg1--12 to 20 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; common medium distinct dark yellowish brown (10YR 4/4) mottles; moderate medium subangular blocky structure; friable; common medium roots; about 3 percent gravel; moderately acid; clear wavy boundary.

Bg2--20 to 26 inches; grayish brown (10YR 5/2) fine sandy loam; common medium distinct dark yellowish brown (10YR 4/4) mottles; moderate medium subangular blocky structure; friable; common fine roots; about 5 percent gravel; slightly acid; clear wavy boundary.

Bg3--26 to 33 inches; grayish brown (10YR 5/2) loam; common medium distinct dark yellowish brown (10YR 4/4) and common medium faint light brownish gray (10YR 6/2) mottles; moderate medium subangular blocky structure; friable; few fine roots; about 3 percent gravel; slightly acid; clear wavy boundary. (Combined thick of Bg horizons is 10 to 26 inches.)

2C--33 to 60 inches; dark yellowish brown (10YR 4/4) sand; single grain; loose; few very fine roots; about 10 percent gravel; slightly acid.

TYPE LOCATION: Morrison County, Minnesota; about 4 miles southeast of Hillman; 1600 feet west and 300 feet north the southeast corner, sec. 8, T. 40 N., R. 28 W.

RANGE IN CHARACTERISTICS: Depth to the contrasting particle size (2C horizon) ranges from 20 to 40 inches. The depth to free carbonates exceeds 70 inches. The mollic epipedon is 7 to 24 inches thick. The volume of rock fragments ranges from 0 to 10 percent by volume in the upper part and 5 to 50 percent in the 2C horizon.

Some pedons have an 0 horizon as much as 3 inches thick. The Ap or A horizons have value of 2 or 3 and chroma of 1 or 2, or is neutral with value of 2 or 3. Mottles are present in the lower part of some pedons. It is loam, silt loam, very fine sandy loam, loamy fine sand, or fine sandy loam, and commonly has a mucky modifier. It is very strongly acid to moderately acid. Some pedons have a BA horizon.

The upper part of the Bg horizon has hue of 7.5YR to 2.5Y, value of 3 to 6, and chroma of 1 or 2. The lower part of the Bg horizon has hue of 5YR to 2.5Y, value of 4 to 6, and chroma of 1 to 4. The Bg horizon has distinct or prominent mottles in all parts. It is loam, silt loam, very fine sandy loam or fine sandy loam. Some pedons have sandy loam subhorizons. The Bg horizon averages less than 50 percent fine and coarser sand. It ranges from strongly acid to slightly acid in the upper part and moderately acid to neutral in the lower part.

The 2C horizon has hue of 5YR to 2.5Y, value of 3 to 6, and chroma of 2 to 4. It is coarse sand, sand, gravelly sand, or gravelly coarse sand. It has 0 to 10 percent cobbles. Thin strata of finer textured material are in some pedons. Reaction is slightly acid or neutral.

COMPETING SERIES: This is the Bruneel series. The Bruneel soils have a pH of 7.4 or higher in the upper part of the series control section and are neutral to moderately alkaline throughout the soil.

GEOGRAPHIC SETTING: These soils have plane or concave slopes with gradients of 0 to 2 percent in depressions on glacial outwash plains and valley trains and in drainageways. They formed in a 20 to 40 inch loamy mantle over glacial outwash derived from Late Wisconsinan glaciation. Mean annual temperature ranges from 36 to 45 degrees F. Mean annual precipitation ranges from 25 to 30 inches. Frost-free days range from 90 to 150. Elevation above sea level ranges from 670 to 1600 feet.

GEOGRAPHICALLY ASSOCIATED SOILS: The main ones are the Chetek, Cloquet, Oesterle, and Rosholt series. The Chetek and Cloquet soils are somewhat excessively drained and are in higher lying positions. Oesterle and Rosholt are better drained and are slightly higher in the landscape. Organic soils are common associates toward the center of depressions.

DRAINAGE AND PERMEABILITY: Very poorly drained and poorly drained. Surface runoff is very slow or ponded. Permeability is moderate or moderately rapid in the upper part and rapid or very rapid in the 2C horizon. The apparent water table is at plus 2 to 1 foot during January to December in most years for the very poorly drained phase and at 1.0 to 2.0 feet for the poorly drained phase.

USE AND VEGETATION: Some areas have been cleared and pastured or cropped. Native vegetation is water tolerant grasses and sedges and mixed deciduous-coniferous forest.

DISTRIBUTION AND EXTENT: Northeastern Minnesota and northwestern Wisconsin. Moderately extensive.

MLRA OFFICE RESPONSIBLE: St. Paul, Minnesota

SERIES ESTABLISHED: Pine County, Minnesota, 1935.

REMARKS: Diagnostic horizons and features recognized in this pedon are: mollic epipedon - a zone from the surface to 20 inches (Ap, AB, and Bg1 horizons); cambic horizon - the zone from about 20 to 33 inches (Bg2 and Bg3 horizons).

Classification only was changed 5/94. Competing series and other updates will be made later.

ADDITIONAL DATA: Refer to MAES Central File Code Number 1203 for results of some laboratory analyses of a representative pedon.

National Cooperative Soil Survey
U.S.A.

LOCATION WEBSTER IA+MN

Established Series
Rev. CSF-ROD-RJW-AGG
12/97

WEBSTER SERIES

The Webster series consists of very deep, poorly drained, moderately permeable soils formed in glacial till or local alluvium derived from till on uplands. Slope ranges from 0 to 3 percent. Mean annual air temperature is about 48 degrees F, and mean annual precipitation is about 30 inches.

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

TYPICAL PEDON: Webster silty clay loam on a concave slope of about 1 percent gradient in a cultivated field. (Colors are for moist soil unless otherwise stated.)

Ap--0 to 8 inches; black (N 2/0) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.

A--8 to 16 inches; black (N 2/0) silty clay loam, very dark gray (10YR 3/1) dry; few fine faint very dark grayish brown (2.5Y 3/2) redox depletions; weak medium subangular blocky structure; friable; about 3 percent gravel; few worm casts; neutral; clear smooth boundary. (Combined thickness of the A horizons is 14 to 24 inches.)

BAg--16 to 21 inches; dark gray (5Y 4/1) clay loam; few fine distinct dark grayish brown (2.5Y 4/2) redox depletions; weak fine subangular blocky structure; friable; continuous very dark gray (5Y 3/1) coatings on faces of peds; many roots; many pores; neutral; gradual smooth boundary. (0 to 6 inches thick)

Bg1--21 to 26 inches; olive gray (5Y 5/2) clay loam; common fine faint dark gray (5Y 4/1) redox depletions; weak fine subangular blocky structure; friable; discontinuous very dark gray (10YR 3/1) coatings on faces of peds; many roots; many fine pores and worm holes; few fine dark concretions (iron and manganese oxides); neutral; clear smooth boundary.

Bg2--26 to 32 inches; light olive gray (5Y 6/2) clay loam; weak fine subangular blocky structure; friable; discontinuous dark gray (5Y 4/1) coatings on faces of peds; few roots; many fine and medium pores; few dark concretions (iron and manganese oxides); few very dark gray (10YR 3/1) organic coatings along root channels and cleavage planes; neutral; gradual smooth boundary. (Combined thickness of the Bg horizons is 7 to 26 inches.)

BCg--32 to 40 inches; light olive gray (5Y 6/2) loam; few fine prominent yellowish brown (10YR 5/4 and 5/8) redox concentrations; weak fine subangular blocky structure; friable; few roots; few white masses and streaks of calcium carbonate in the lower part; slightly alkaline; clear smooth boundary. (0 to 9 inches thick)

Cg--40 to 60 inches; light olive gray (5Y 6/2) loam; common medium prominent yellowish brown (10YR 5/4 and 5/8) redox concentrations; massive; friable; about 3 percent gravel; strongly effervescent; slightly alkaline.

TYPE LOCATION: Hamilton County, Iowa; about 1 mile south of Webster City; 700 feet west and 1,480 feet north of the southeast corner of sec. 12, T. 88 N., R. 26 W.; USGS Webster City, Iowa quadrangle, latitude 42 degrees 26 minutes 45 seconds N., longitude 93 degrees 49 minutes 06 seconds W.

RANGE IN CHARACTERISTICS: Solum thickness generally ranges from 24 to 42 inches, but it is as much as 50 inches in some pedons. The depth to free carbonates has about the same range as solum thickness, although in some pedons the BCg horizon lacks free carbonates. The mollic epipedon ranges from 14 to 24 inches in thickness. Rock fragments make up 1 to 10 percent, by volume, of those horizons formed in glacial till.

The Ap and A horizons have hue of 10YR, 2.5Y or is neutral, value of 2 or 3, and chroma of 0 or 1. They are clay loam, loam, or silty clay loam with 15 to 20 percent sand.

The Bg and BCg horizons have hue of 5Y or 2.5Y, value of 4 or 5, and chroma of 1 or 2. Redox concentrations or oxide concretions of high and low chroma are typically present. They are typically clay loam or loam, with silty clay loam with a moderate sand content in the range. Clay content typically averages from 25 to 35 percent and sand content between about 18 and 45 percent. Clay films and a slight clay increase occur in some pedons but do not meet the criteria for an argillic.

The Cg horizon has hue of 2.5Y or 5Y, value of 4 through 6 and chroma of 1 or 2. The texture of the moderately coarse substratum phase is loam, fine sandy loam or sandy loam. It has 12 to 22 percent clay with a total sand content more than 40 percent. The texture of the moderately fine substratum phase is loam or clay loam. The clay content is 20 to 30 percent with total sand content of less than 45 percent. Thin strata of silty or sandy material are in the lower part of the soil in some pedons. Where the soils contain such strata, loam till is generally at depths of 3 to 6 feet.

COMPETING SERIES: These are the Clyde, Colwood, Faxon, free, Kossuth, Letri, Reddick, Selma, Tripoli, and Wolcott series in the same family and the Biscay, Canisteo, and Drummer series. Clyde soils are commonly leached to greater depths, contain more yellowish brown and strong brown mottles in the lower part of the sola, contain more glacial boulders, and generally are more stratified in the subsoil and substrata. Colwood soils commonly have less clay in the 10- to 40-inch control section, and they are more stratified. Faxon soils have lithic contacts at depths of less than 40 inches. Free soils have more than 15 percent rock fragments at depths of 20 to 40 inches and less than 20 percent clay in the upper 20 inches of the argillic horizon. Kossuth soils average more clay in the upper part of the solum and have a distinct break in parent materials. Letri soils typically have thinner sola and are shallower to free carbonates and have firm consistence at depths of less than 40 inches. Reddick soils have finer textures in the lower part of the B horizon. Selma soils typically have thicker sola and coarse textured C horizons beginning at depths between 40 and 60 inches. Tripoli soils have higher chroma in the B horizon, firm consistence at depths of less than 40 inches, and a stone line at the top of loam till at depths of 18 to 30 inches. Wolcott soils have firm glacial till C horizons and are very poorly drained. Biscay soils have sand and gravel within depths of 40 inches. Canisteo soils are calcareous throughout. Drummer soils are fine-silty.

GEOGRAPHIC SETTING: Webster soils are on relatively undissected till plains of Wisconsin age. Slopes are nearly plane to slightly concave and range in gradient from 0 to 3 percent. Webster soils formed in loamy glacial till of mixed mineralogy and from local alluvium from such till. Mean annual air temperature is about 45 to 49 degrees F, and mean annual precipitation is about 28 to 32 inches. Frost free days range from 120 to 180. Elevation above sea level ranges from 700 to 1400 feet.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the competing Canisteo soils and the Clarion, Glencoe, Harps, Nicollet, Okoboji, and Wacousta soils. Canisteo soils are on similar landscape positions. Clarion and Nicollet soils are the most common associates and form a drainage sequence with Webster soils. Clarion and Nicollet soils lack gleyed B horizons and are on slightly higher elevations. Glencoe soils have mollic epipedons over 24 inches thick. Harps soils are highly calcareous and are on rims of depressions. Okoboji soils have thicker A horizons and typically contain less sand in the sola. Wacousta soils have thinner A horizons and clear or abrupt boundary to the B horizon. Okoboji, Glencoe and Wacousta soils are in depressions.

DRAINAGE AND PERMEABILITY: Webster soils are poorly drained, and most areas are artificially drained with tile and open ditches. Runoff is slow. Permeability is moderate. The seasonal high water table is a depths of 0 to 1 foot from November to July in most years where undrained.

USE AND VEGETATION: Largely cultivated and cropped intensively to corn and soybeans. Small grain and hay are other major crops. Native vegetation is predominantly wet-site tall prairie grasses.

DISTRIBUTION AND EXTENT: North-central and central Iowa and south-central Minnesota. Extensive in MLRA-103.

MLRA OFFICE RESPONSIBLE: St. Paul, Minnesota

SERIES ESTABLISHED: Clay County, Iowa, 1916.

REMARKS: Diagnostic horizons and features recognized in this pedon are: Mollic epipedon - the zone from the surface of the soil to a depth of 16 inches (Ap and A horizon); Cambic horizon - the zone from a depth of 16 to 40 inches (BAg, Bg1, Bg2 and BCg horizons); aquic moisture regime based on low chroma colors below the mollic epipedon.

The concepts of moderately coarse and moderately fine substratum phases were established by the mlra-103 steering committee. The Des Moines Lobe till gets sandier and contains less clay as one progresses south along the path of the Des Moines advance.

Competing series not updated as of this edit.

National Cooperative Soil Survey
U.S.A.

Historical Inventory Codes

Anoka, Chisago, Washington

MUSYM	MUName (Anoka, Chisago, Washington)	Parent	Wetland_Type_Primary	Wetland_Type_Secondary	Soil_Order
1055	Aquolls and histosols, ponded		5		Histosol
189	Auburndale silt loam	Mineral	7	2	Alfisol
456	Barronett silt loam	Mineral	2	7	Alfisol
1847	Barronett silt loam, sandy substratum	Mineral	2	7	Alfisol
170	Blomford loamy fine sand	Mineral	7		Alfisol
722	Blomford loamy fine sand, lacustrine substratum	Mineral	7		Alfisol
75	Bluffton loam	Mineral	2	7	Mollisol
544	Cathro muck	Organic	7	2	Histosol
123	Dundas fine sandy loam	Mineral	7	2	Alfisol
792	Fordum sandy loam, frequently flooded	Mineral	7	2	Entisol
Iw	Isanti fine sandy loam	Mineral	2		Mollisol
161	Isanti loamy find sand, depressional	Mineral	2		Mollisol
161	Isanti loamy fine sand	Mineral	2		Mollisol
481	Kratka find sandy loam	Mineral	2	6	Mollisol
726	Kratka loamy fine sand, thick solum	Mineral	2	6	Mollisol
Lw	Loamy wet land	Mineral	3		
Lx	Lupton muck	Organic	7		Histosol
543	Markey muck	Organic	7	3	Histosol
Ma	Markey muck	Organic	7	3	Histosol
Mc	Marsh	Mineral	3		
Mk	Millerville mucky peat	Organic	2	6	Histosol
274	Newson mucky loamy sand	Mineral	2	7	Entisol
325	Prebish loam	Mineral	2	6	Mollisol
325	Prebish sandy loam	Mineral	2	6	Mollisol
541	Rifle muck	Organic	7		Histosol
Rf	Rifle mucky peat	Organic	7		Histosol
Rh	Rifle soils, ponded	Organic	7		Histosol
Se	Seelyeville muck	Organic	2	6	Histosol
540	Seelyeville muck	Organic	2	6	Histosol
346	Talmoon loam	Mineral	7	6	Alfisol
337	Warman loam	Mineral	2	7	Mollisol
W	Water		12	5	
M-W	Water, miscellaneous		12	5	
1356	Water, miscellaneous		12	5	
113	Webster loam	Mineral	2		Mollisol

Isanti

MUSYM_1	desc_ (Isanti)	Parent	Wetland_Type_Primary	Wetland_Type_Secondary	Soil_Order
4868	Ames fine sandy loam	Mineral	7	2	Alfisol
3637	Ames silt loam	Mineral	7	2	Alfisol
1524	Blomford loamy fine sand	Mineral	7		Alfisol
10729	Bluffton loamy and silty clay loam	Mineral	2	7	Mollisol
4133	Cathro muck	Organic	7	2	Histosol
9695	Isanti mucky loamy fine sand	Mineral	2		Mollisol
3092	Markey muck	Organic	7	3	Histosol
53642	Rifle and Seelyeville soils	Organic	2	7	Histosol
10158	Water		12	5	

Existing Inventory Codes

URS_code	wetlnd
1	Seasonally Flooded Basin
2	Wet Meadow / Sedge Meadow / Wet Prairie
3	Shallow Marsh
4	Deep Marsh
5	Shallow Open Water Community
6	Shrub Carr / Alder Thicket
7	Forested Wetland
12	Lake
13	Excavated Pond / Stormwater Pond
14	Ditch
15	Riverine (Riparian)