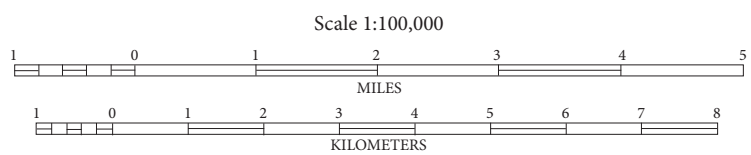


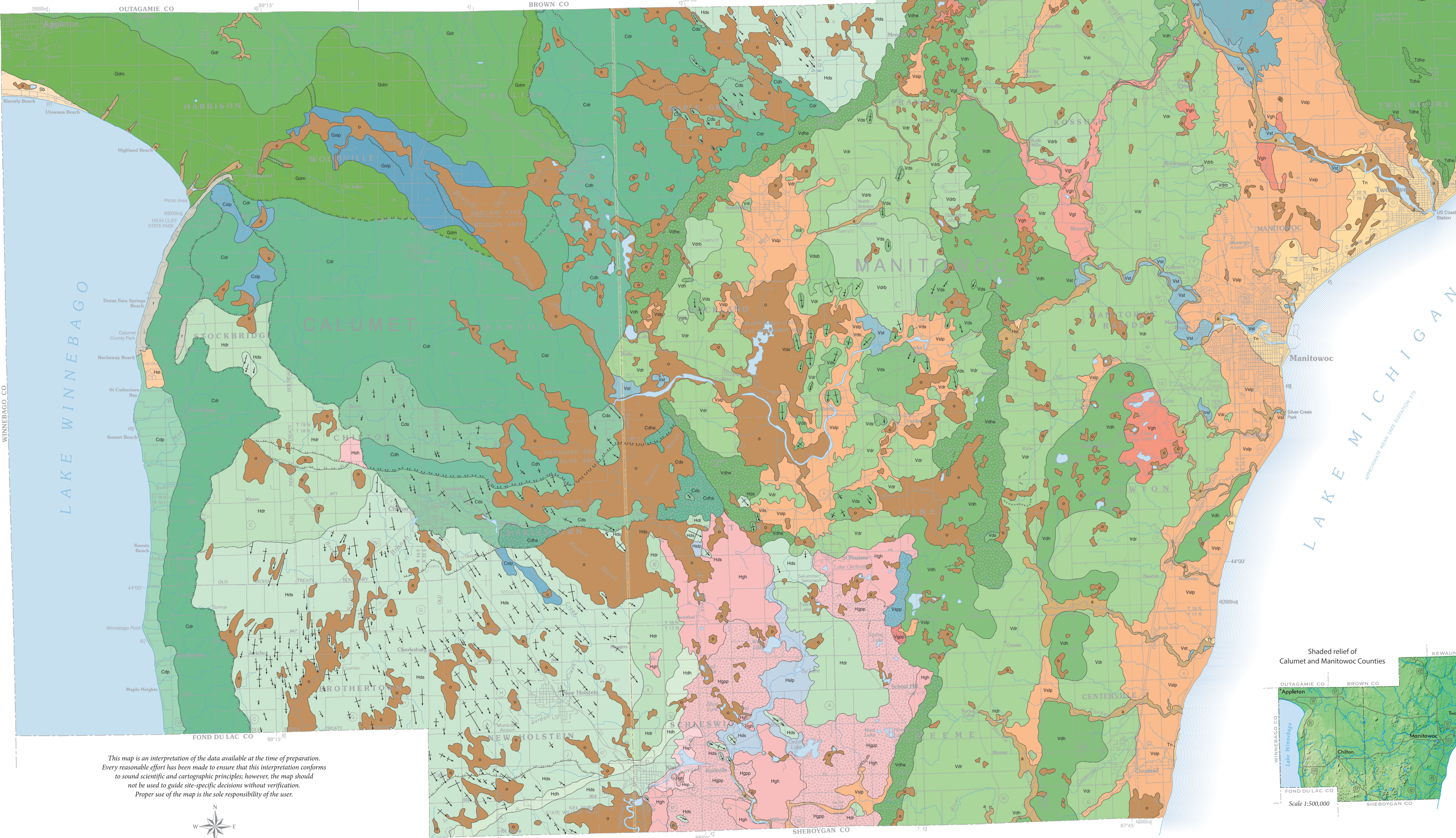
Quaternary Geology of Calumet and Manitowoc Counties, Wisconsin

D.M. Mickelson and B.J. Socha

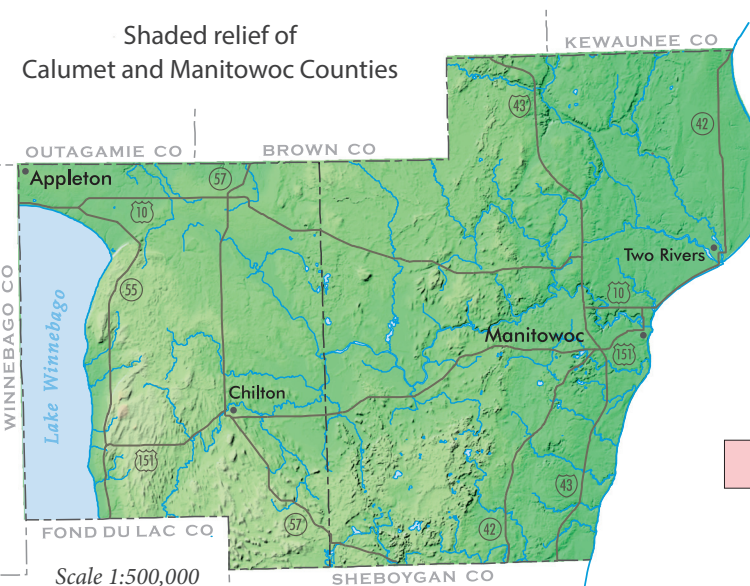
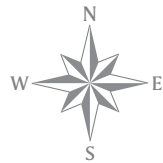
Bulletin 108
Plate 1
2017



Wisconsin Transverse Mercator Projection 1991 adjustment to the North American Datum of 1983 (NAD 83/91).
The base map was constructed from U.S. Geological Survey digital line graph files (1990, scale 1:100,000) and modified by the Wisconsin Department of Natural Resources (1992) and the Wisconsin Geological and Natural History Survey (2004).



This map is an interpretation of the data available at the time of preparation. Every reasonable effort has been made to ensure that this interpretation conforms to sound scientific and cartographic principles; however, the map should not be used to guide site-specific decisions without verification. Proper use of the map is the sole responsibility of the user.



Symbols

- Geologic contact.** Position shown on map is judged to be generally within 0.2 km of actual position.
- Ice-margin position.** Interpreted position of maximum extent of readvance of ice or position of ice-margin stability where ice-contact face or end moraine is missing.
- Palimpsest ice-margin position.** Interpreted position of ice margin stability, landform is inherited from deposits of older glacial advances.
- Stream cutbank.** Hachures point toward stream channel center line.
- Esker.** V points in direction of water flow.
- Drumlin.** Length of arrow on symbol proportional to length of drumlin axes; arrow points in the direction of ice flow; cross-line on symbol proportional to drumlin width.

Logic of unit descriptors

Stratigraphic unit/material/landform

V = Valders Member (Keweenaw Fm.)
d = diamicton
r = rolling land surface

Note: Postglacial deposits and bedrock use 1- to 2-letter descriptors.

Stratigraphic units (first letter)

Keweenaw Formation
T Two Rivers Member
G Glenmore Member
C Chilton Member
V Valders Member
B Branch River Member
Holy Hill Formation
H Entire formation

Materials (second letter)

d diamicton
g gravel and sandy gravel
s silty sand to sand

Landforms (third and fourth letters)

b rock generally less than 3 m below the surface
f alluvial fan
h hummocky landscape, uneven terrain with many closed depressions (kettles) and small hills
he hummocky end moraine
lp lacustrine plain, nearly flat to gently sloping former lake bottom
m moraine
p plain, generally flat to gently sloping plain with less than 20 percent surface interrupted by collapse depressions
pp pitted plain with between 20 and 80 percent of surface interrupted by collapse depressions
r rolling land surface
s streamlined landscape
t outwash terrace

Explanation

Postglacial deposits

- S** Postglacial organic sediment. Peat and muck; thickness ranges from less than 1 m to about 5 m; underlain by deposits of streams, glaciers, or lakes; generally found in low parts of the landscape on flat to gently sloping surfaces.
- A** Postglacial sand and silt. Commonly a mixture of sand, silt, and clay containing varying amounts of organic matter; found mostly along the edges of modern streams and at the base of extensive slopes. Contacts between this unit and postglacial organic sediment have been drawn arbitrarily in many places.
- SB** Modern beaches. Well-sorted sand, underlying low beaches, along present lake shorelines.
- Tn** Modern and abandoned beaches along Lake Michigan. Nipissing and post-Nipissing phase (5000 BP) beaches, dunes, beach ridges and intervening swales along Lake Michigan. Beaches too narrow to map are included in the adjoining unit.

Keweenaw Formation

Two Rivers Member

Diamicton in areas of hummocky topography. Unit **Tdh**: Mostly basal till, commonly with a 1- to 3-m thick layer of mudflow deposits; reddish-brown, indistinctly stratified or unstratified, clayey silt; generally compact and uniform, except in upper few meters, where sand lenses and other discontinuities are found; upper 3 m contains fractures; surface has low relief (less than 5 m), hummocky topography. Unit **Tdh**: Hummocky end moraine.

Gravel and sand in outwash plains. Unit **Tgh**: Moderately well-sorted, well-stratified gravel and sand deposited by glacial streams. Unit **Tgpp**: More than 20 percent of original floodplain interrupted by depressions formed by melting ice blocks. Unit **Tgt**: Terrace above modern stream. All units deposited by braided streams in front of end moraines or in valleys running parallel to glacier margin.

Glenmore Member

Diamicton in terminal or recessional moraines. Generally compact and uniform basal till, reddish-brown, indistinctly stratified or unstratified, clayey silt; may contain dispersed organic material including spruce wood and mosses; upper few meters contains fractures; moraine relief due to subglacial and marginal accumulation of till (generally 10 to 20 m thick).

Diamicton in areas of rolling topography. Mostly basal till, reddish-brown, indistinctly stratified or unstratified, clayey silt; may contain dispersed organic material including spruce wood and mosses; generally compact and uniform, with few discontinuous silt and sand lenses or layers; upper few meters contains fractures; surface has low relief (generally less than 5 m).

Gravel and sand in outwash terraces. Moderately well-sorted, well-stratified gravel and sand deposited by glacial streams. Now in terrace above modern stream. Deposited by braided streams in front of end moraines or in valleys running parallel to glacier margin.

Clay, silt, and sand in lacustrine plains. Moderately well-sorted silt, sand, and clay underlying generally flat plains. Occupies low places in the landscape where lakes were dammed by retreating ice margin.

Chilton Member

Diamicton in areas of rolling topography. Mostly basal till, reddish-brown, indistinctly stratified or unstratified, clayey silt; generally compact and uniform, with few discontinuous silt and sand lenses or layers; upper few meters contains fractures; surface has low relief (generally less than 5 m).

Diamicton in areas of hummocky topography. Unit **Cdh**: Mostly basal till, commonly with a 1- to 3-m thick layer of mudflow deposits; reddish-brown, crudely stratified or unstratified, clayey silt; generally compact and uniform, except in upper few meters, where sand lenses and other discontinuities are found; upper 3 m contains fractures; surface has low relief (less than 5 m), hummocky topography. Hummocks may be in part inherited from surface form of older glacial deposits. Unit **Cdh**: Hummocky end moraine.

Diamicton in areas of streamlined topography. Generally compact and uniform basal till; reddish-brown, indistinctly stratified or unstratified, clayey silt; upper few meters contains fractures; streamlined forms inherited from surface form of older glacial deposits.

Clay, silt, and sand in lacustrine plains. Moderately well-sorted silt, sand, and clay underlying generally flat plains. Occupies low places in the landscape where lakes were dammed by retreating ice margin.

Diamicton in wave-washed plain along the shore of glacial Lake Oshkosh. Mostly basal till with some laminated silty and clayey lacustrine sediment. Includes minor areas of sand and gravel underlying low beaches along abandoned shoreline of proglacial Lake Oshkosh.

Valders Member

Diamicton in areas of hummocky topography. Unit **Vdh**: Mostly basal till, commonly with a 1- to 3-m thick layer of mudflow deposits; reddish-brown, crudely stratified or unstratified, clayey silt; generally compact and uniform, except in upper few meters, where sand lenses and other discontinuities are found; upper 3 m contains fractures; surface has low relief (less than 5 m), hummocky topography. Hummocks may be in part inherited from surface form of older glacial deposits. Unit **Vdh**: Hummocky end moraine.

Diamicton in areas of palimpsest streamlined topography. Unit **Vds**: Generally compact, uniform basal till; reddish-brown, crudely stratified or unstratified, clayey silt; upper 3 m contains fractures; streamlined forms inherited from an earlier ice advance. Unit **Vds**: Shallow bedrock, mostly less than 3 m.

Diamicton in palimpsest rolling topography. Unit **Vdr**: Generally compact, uniform basal till; reddish-brown, crudely stratified or unstratified, clayey silt; upper 3 m contains fractures. Unit **Vdr**: Shallow bedrock, mostly less than 3 m.

Gravel and sand in outwash plains. Moderately well-sorted, well-stratified gravel and sand deposited by glacial streams. Unit **Vgp**: Less than 20 percent of original floodplain interrupted by depressions formed by melting ice blocks. Unit **Vgh**: More than 20 percent of original floodplain surface interrupted by depressions formed by melting ice blocks. Unit **Vgt**: Former floodplain surface preserved above modern floodplain. All units deposited by braided streams in front of end moraines or in valleys running parallel to glacier margin.

Postglacial lake bottom sediment and wave-cut terraces along the shore of Lake Michigan. Sand and silt 2- to 20-m thick in former ice-marginal lake basins often peat covered. Sand and gravel less than several meters thick over older diamicton; generally well sorted; in many places contains interbedded pebbles; sand is water-deposited beach and offshore sediment. Represents Glenwood and Calumet phases of Lake Michigan. Higher in elevation than unit **Tn**, which represents a mid-Holocene (Nipissing) shoreline at an elevation of about 189 m.

Sand and some gravel in outwash and lacustrine plains. Moderately well-sorted, well-stratified sand and sandy gravel deposited by glacial streams or waves and currents. Unit **Vgp**: Between 20 and 80 percent of original floodplain interrupted by depressions formed by melting ice blocks. Unit **Vsf**: Fan or delta surface sloping gently away from former ice margin. Unit **Vst**: Terrace above modern stream. All units deposited by braided streams in front of end moraines or in valleys running parallel to glacier margin.

Branch River Member

Diamicton in areas of hummocky topography. Unit **Bdh**: Mostly basal till, commonly with a 1- to 3-m thick layer of mudflow deposits; reddish-brown, crudely stratified or unstratified, clayey silt; generally compact and uniform, except in upper few meters, where sand lenses and other discontinuities are found; upper 3 m contains fractures; surface has low relief (less than 5 m), hummocky topography. Unit **Bdh**: Hummocky end moraine.

Diamicton in rolling topography. Generally compact, uniform basal till; reddish-brown, crudely stratified or unstratified, clayey silt; upper 3 m contains fractures.

Gravel and sand in outwash plains. Moderately well-sorted, well-stratified gravel and sand deposited by glacial streams. Fan surface sloping gently away from former ice margin. Deposited by braided streams in front of end moraines or in valleys running parallel to glacier margin.

Silt and sand in lacustrine plains. Moderately well-sorted silt, sand, and clay underlying flat plains. Occupies low places in the landscape where lakes were dammed by retreating ice margin.

Holy Hill Formation

Undifferentiated

Diamicton in areas of streamlined or rolling topography. Light yellowish-brown, crudely stratified or unstratified, gravelly, clayey, silty sand; generally compact, uniform basal till. Unit **Hdr**: Rolling topography with moderate relief. Unit **Hds**: Streamlined forms produced by sliding at the glacier bed; surface has high relief (generally greater than 15 m).

Diamicton in areas of hummocky topography. Brown to light yellowish-brown, crudely stratified or unstratified gravelly, clayey, silty sand; generally compact, uniform basal till, except in upper 5 m, where sand lenses and other discontinuities may be found in mudflow sediments; surface has moderate relief (less than 15 m), hummocky topography.

Gravel and sand in areas of hummocky topography. Poorly to moderately well-sorted sand and gravel; surface has moderate to high relief (greater than 10 m), hummocky topography; deposited on and beneath glacial ice by meltwater stream near ice margin; sediment later collapsed to produce hummocky topography as underlying ice melted.

Gravel and sand in outwash plains. Moderately well-sorted, well-stratified gravel and sand. More than 20 percent collapsed surface, yet exhibits some of the uncollapsed former stream bed. Deposited by braided streams in front of glacier margin.

Bedrock

r Rock outcrop. Silurian dolomite, undivided; and Maquoketa Formation shale, dolomitic shale, and dolomite, exposed in steep scarp.

Research supported by the U.S. Geological Survey, National Cooperative Geologic Mapping Program, under StateMap awards: 1434HQ6A021537, 1434HQ7AG1815 (Manitowoc County) and USGS E08map awards: 1434HQ6A021555 and 1434HQ7AG1733 (Calumet County). The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government.

Cartography by D.L. Patterson.

Wisconsin Geological and Natural History Survey

3817 Mineral Point Road • Madison, Wisconsin 53705-5100 • 608/263.7389

Kenneth R. Bradbury, Director and State Geologist

WisconsinGeologicalSurvey.org

UW Extension

UW-Extension provides equal opportunities in employment and programming, including Title IX, Title IX, and ADA.