Quaternary Geology of Wisconsin

A map of sediment deposited by glaciers, streams, wind, and other processes during the Quaternary Period (2.58 million years ago to present).

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cartography by Caroline Rose

MAP 512 • 2025

Acknowledgments

The authors dedicate this map to Lee Clayton, Tom Hooyer, WGNHS staff, colleagues, and students who worked to develop the mapping strategy for Quaternary sediment and landforms in Wisconsin. Kacie C. Stolzman, G.E. Graham, and Elizabeth G. Ceperley helped prepare the map, and comments from three peer reviewers improved the final product. Funding was provided by the National Cooperative Geologic Mapping Program of the U.S. Geological Survey, under Cooperative Agreement G20AC00201, and the Wisconsin Geological and Natural History Survey. 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.

Scale 1:500,000

10 0 10 20 30 MILES

10 0 10 20 30 40 50 KILOMETERS

Wisconsin Transverse Mercator Projection, 1991 adjustment to the North American Datum of 1983 (NAD 83/91)

Symbols

- Geologic contacts*
- Subglacial meltwater flow direction indicated by eskers
- Ice flow direction indicated by drumlins and other streamlined landforms
- Meltwater flow direction indicated by general slope and relict channels
- Wind direction indicated by dunes
- Spillway flow direction from major proglacial lakes
- Ice Age National Scenic Trail
- North Country National Scenic Trail
- Selected highways
- County and tribal seats
- Tribal land areas (including reservations, communities, and trust lands)
- Ceded territory boundaries of 1837 and 1842
- County boundaries
- Selected rivers
- Selected waterbodies

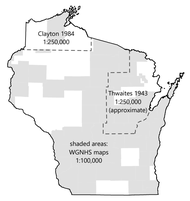
*uncertain contacts between units rb and ru are not shown as lines; a dot pattern differentiates these units.

Methods

Geologic mapping was based on the study of published and unpublished WGNHS map data (sources below), 1.5-m resolution lidar-derived elevation and shaded relief models (State Cartographer's Office, 2023), and Soil Survey Geographic database (Soil Survey Staff, 2018). Lithostratigraphic usage follows that of Syverson and others (2011). Map unit contacts were drawn in a GIS software and generalized to a scale of 1:500,000.

Basemap data sources

Ice Age National Scenic Trail data from the Ice Age Trail Alliance (accessed 2023). North Country National Science Trail data from the North Country Trail Association (accessed 2024). Hydrologic data adapted by WGNHS from National Hydrography Dataset (accessed 2023). Highways, county and tribal boundaries, and county seats from the U.S. Geological Survey's The National Map and the Wisconsin State Tribal Relations Initiative (accessed 2023). Tribal seats from Wisconsin First Nations (2018). Ho-Chunk Nation boundaries from written communication (2024). Ceded territory boundaries from Great Lakes Indian Fish and Wildlife Commission (version 2.1, accessed 2024).



Principal sources of map information (see list below) used to compile the map: grey shaded areas indicate WGNHS published and unpublished maps at 1:100,000 scale; outlined areas indicate published maps at 1:250,000 scale.

Primary author responsibility.

Principal sources of map information

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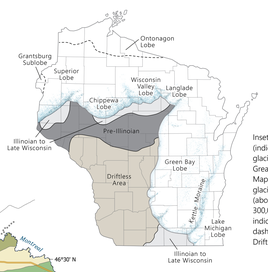
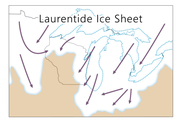
Glacial History





Inset (above) shows the general direction of ice flow (indicated with arrows) during the late Wisconsin glaciation (about 30,000–11,000 years ago) in the Great Lakes region of the United States and Canada. Map of glacial lobes (left) depicts the late Wisconsin glacial lobes in Wisconsin and areas where Illinoian (about 150,000 years ago) and pre-Illinoian (before about 300,000 years ago) sediment are found. Stippling indicates the edge of the late Wisconsin ice sheet and dashed lines indicate major late Wisconsin readvances. Driftless Area was not glaciated during the Quaternary.

Explanation

Glacial sediment of the Miller Creek Formation

Ep — Reddish-brown clay-rich till and similar sediment deposited by the Superior Lobe late in the Wisconsin Glaciation. **Unit Ep:** Wave-washed plains with localized offshore lake sediment over till, especially where adjacent to nearshore proglacial lake sediment (ln). Includes areas modified by nearshore processes in proglacial lakes (typically wave-cut benches) where there are minor amounts of sandy nearshore sediment.

Glacial sediment of the Trade River Formation

Tm, Th — Brown to yellowish-brown silty-clay till and similar sediment deposited by the Grantsburg Sublobe that advanced from the southwest late in the Wisconsin Glaciation. **Unit Tm:** Areas of rolling topography in moraines. **Unit Th:** Areas of hummocky topography with typically 10 m of relief.

Glacial sediment of the Kewaunee Formation

Km, Ks, Kr, Kp, Kb — Reddish-brown to brown silty-clay till and similar sediment deposited by the Green Bay and Lake Michigan lobes late in the Wisconsin Glaciation. **Unit Km:** Areas of hummocky topography with typically less than 10 m of relief in moraines. **Unit Kh:** Areas of hummocky topography with typically 7 m of relief not in moraines. Typically draped over older sediment. **Unit Ks:** Areas of drumlins and other streamlined landforms. Drumlins with older till or sand and sandy gravel in the core are common. **Unit Kr:** Areas of gently rolling topography. **Unit Kp:** Areas of wave-washed plains with localized lake sediment over till. **Unit Kb:** Areas where glacial sediment is thin and topography is controlled by underlying bedrock.

Glacial sediment of the Oak Creek Formation

Om, Oh, Os, Or, Op — Gray to yellowish-brown silty-clay till and similar sediment deposited by the Lake Michigan Lobe late in the Wisconsin Glaciation. **Unit Om:** Areas of hummocky topography with typically 3 m of relief in moraines. **Unit Oh:** Areas of hummocky topography with typically 5 m of relief not in moraines. **Unit Os:** Areas of drumlins and other streamlined landforms. **Unit Or:** Areas of gently rolling topography. **Unit Op:** Areas of wave-washed plain with localized thin lake sediment over till.

Glacial sediment of the Holy Hill Formation

Hm, Hs, Hr, Hb — Brown to yellowish-brown sandy till and similar sediment deposited by the Green Bay and Lake Michigan Lobes late in the Wisconsin Glaciation. **Unit Hm:** Areas of hummocky topography with typically 10 m of relief in moraines. Contains areas of sandy and gravelly outwash. Few isolated ice-walled lake plains. **Unit Hh:** Similar to Hm but not in moraines and meltwater-stream sediment is common (su and sc). **Unit Hl:** Hummocky topography with typically less than 3 m of relief. **Unit Hs:** Areas of drumlins and other streamlined landforms. **Unit Hr:** Areas of gently rolling topography. **Unit Hb:** Areas where glacial sediment is thin, and topography is controlled by underlying bedrock.

Glacial sediment of the Copper Falls Formation

Cl, Cm, Cs, Cr, Cb — Reddish-brown to brown sandy till and similar sediment deposited by the Langlade, Wisconsin Valley, Chippewa, Superior, and Ontonagon lobes late in the Wisconsin Glaciation. **Unit Ch:** Areas of hummocky topography with typically 30 m of relief. Contains areas of sandy and gravelly outwash and sandy and silty lake sediment. Ice-walled lake plains are common. **Unit Cl:** Similar to Ch but with typically 10 m of relief. **Unit Ci:** Poorly sorted sandy and gravelly sediment in the ice-proximal parts of outwash plains and fans. May contain some till. **Unit Cm:** Moraines or narrow zones of boulder ridges and ice-walled lake plains that mark former ice-margin positions. **Unit Cs:** Areas of drumlins and other streamlined landforms. **Unit Cr:** Areas of gently rolling topography. Southernmost extent includes areas that predates the late Wisconsin Glaciation. **Unit Cb:** Areas where glacial sediment is thin and topography is controlled by underlying bedrock.

Glacial sediment of the River Falls Formation

Rr — Reddish-brown sandy till deposited by glaciers that advanced into the area from the Superior basin during the Illinoian Glaciation. **Unit Rr:** Areas of gently rolling topography. Glacial landforms are absent, and most sediment is preserved on uplands. Some meltwater-stream sediment is present.

Glacial sediment of the Zenda Formation

Zh — Brown to pink silty-clay till and similar sediment deposited by glaciers that advanced into the area from the Lake Michigan basin during the Illinoian Glaciation. **Unit Zh:** Areas of hummocky topography with typically 6 m of relief.

Glacial sediment of the Walworth Formation

Ws, We — Brown silty-clay till and similar sediment deposited by glaciers that advanced into the area from the Lake Michigan basin during the Illinoian Glaciation. **Unit Ws:** Areas of drumlins and other streamlined landforms. **Unit We:** Eroded areas with a dendritic drainage network and no glacial landforms. Typically includes ru on slopes.

Glacial sediment of the Marathon Formation

Mr — Brown to gray silty till and similar sediment deposited by glaciers that advanced into the area from the northwest prior to the Illinoian Glaciation. **Unit Mr:** Areas of very gently rolling topography. Glacial landforms are absent. Was likely continuous further to the east and south before removal by erosion, as evidenced by small outliers.

Glacial sediment of the Pierce Formation

Pe — Dark gray to yellowish-brown loam till deposited by glaciers that advanced into the area from the northwest prior to the Illinoian Glaciation. **Unit Pe:** Eroded areas with a dendritic drainage network and no glacial landforms. Typically includes ru on slopes.

Correlation of mapped formations

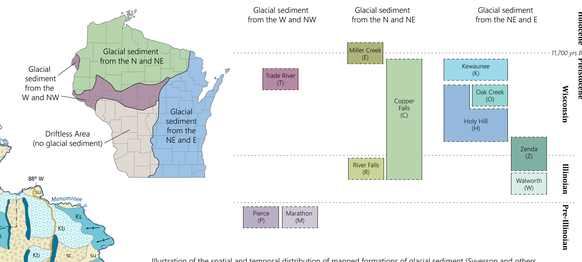


Illustration of the spatial and temporal distribution of mapped formations of glacial sediment (Syverson and others, 2011). Formations are represented in purple, green, and blue color groupings based on the sediment source area. The map on the left shows their distribution across Wisconsin. The schematic chart on the right shows their distribution through time, with oldest units at the bottom. In the chart, the horizontal dashed lines mark the boundaries between the Wisconsin, Illinoian, and Pre-Illinoian glacial periods of the Pleistocene epoch, and the onset of the current Holocene epoch approximately 11,700 years ago.

Explanation (continued)

Organic-rich sediment

o — **Unit o:** Organic-rich sediment in marshes and other wetlands. Flat to low-relief surfaces in wet areas. Typically overlies sediment found in adjacent map units and lake sediment.

Modern and premodern nonglacial stream sediment

sm, sn — Stratified sand and silt in modern floodplains and in terraces containing premodern nonglacial sediment. **Unit sm:** Adjacent to modern streams, deposited during the Holocene. **Unit sn:** Premodern, non-glacial, graded to alluvial terraces and streams, deposited during the Pleistocene.

Windblown sediment

wa, wi, wt — Stratified and well-sorted sand or massive silt deposited by wind. **Unit wa:** Sand deposited in low-relief sheets and dunes with up to 15 m of relief, typically cross bedded. Commonly associated with extensive outwash and lake plains. **Unit wi:** Massive silt deposited as loess, thickest adjacent to the Mississippi River and thinning eastward. **Unit wt:** Massive silt deposited as loess in the Wisconsin Glaciation over glacial sediment that was deposited prior to the Illinoian Glaciation.

Lake sediment

lp, ln — Stratified and well-sorted sandy gravel, sand, silt, and clay deposited in lakes. **Unit lp:** Lake plains formed in ice-marginal lakes, includes both laminated offshore and bedded nearshore sediment. Includes small hills that were islands within the lakes. **Unit ln:** Deposited along shorelines of the Great Lakes and ice-marginal lakes, includes dunes, wave-cut benches, sand bars, spits, and offshore plains.

Meltwater-stream sediment in outwash plains and fans

su, sc, sh, se — Stratified sandy gravel, gravelly sand, sand, and silt, typically cross bedded, deposited by glacial meltwater streams in low-relief outwash plains and fans. Abandoned anastomosing channels are identifiable in many places. Closed depressions located where buried ice melted out. **Unit su:** Original depositional surface is recognizable in most places and outwash stream channels are recognizable in many places. **Unit se:** Deposited on stagnant glacial ice, original depositional surface is pitted or not recognizable in most places as a result of subsequent collapse. Topographic relief is variable. **Unit sh:** Mixed with debris flows and till in areas of hummocky topography. **Unit se:** Occurs on dissected uplands and likely formed during the glaciation that deposited the River Falls Formation.

Meltwater-stream and related sediment in the Kettle Moraine

kmh, kmc, kmr — Stratified sandy gravel, gravelly sand, sand, and silt, typically cross bedded, deposited by glacial meltwater streams in the Kettle Moraine. Sediment deposited by the Lake Michigan and Green Bay Lobes during the glacial advance that deposited the Holy Hill Formation. **Unit kmh:** Areas with generally hummocky topography with typically 25 m of relief. **Unit kmc:** Areas with pitted surface surrounded by flat to gently rolling stream-bed surface. **Unit kmr:** Areas of gently rolling topography.

Meltwater-stream and related sediment in terraces

st, sb, ss, sr — Stratified sand and sandy gravel with laminated fine-grained sediment in places, deposited by streams and forming gently sloping terrace surfaces a few meters to a few tens of meters above modern floodplains. **Unit st:** Terraces of sand and sandy gravel along major tributaries to the lower Wisconsin River; laminated fine-grained slackwater sediment is small. Inset deposits graded to terrace surfaces on the adjacent mainstem stream; terraces of sand and sandy gravel along nonglacial streams. **Unit sb:** Sand and sandy gravel meltwater sediment deposited along the Mississippi River and subsequently scoured by latest Pleistocene floods; identified as the Bagley terrace. **Unit ss:** Laminated fine-grained slackwater sediment in tributary mouths adjacent to sb, surface is a few tens of meters higher than sb because of scouring of that unit; identified as the Savanna terrace. **Unit sr:** Deeply weathered sand and sandy gravel, with windblown sand and silt, and colluvial sediment deposited on a bedrock strath surface in the lower Wisconsin River valley prior to the Illinoian Glaciation; identified as the Bridgeport terrace.

Colluvial sediment

cf, cc — Poorly sorted sediment moved downslope by gravity, often associated with moderate to steep slopes. **Unit cf:** Predominantly fine-grained sediment derived from loess, may contain boulders of local bedrock. Bedrock outcrops are common. **Unit cc:** Coarse, blocky sediment predominantly composed of cobbles and boulders of local bedrock. Bedrock outcrops are common.

Residual sediment

ru, rb — Poorly sorted silty to clayey loam sediment derived from *in situ* weathering. Patchy and discontinuous and typically absent on steep slopes adjacent to modern streams. **Unit ru:** Derived from *in situ* weathering of rock and younger stream and glacial sediment. **Unit rb:** Derived from *in situ* weathering of igneous, metamorphic, and sedimentary rock.

Bedrock

b — **Unit b:** Igneous, metamorphic and sedimentary rock. Includes areas with thin sediment where topography is controlled by underlying rock.