

QUATERNARY

Nonglacial environments

- ALLUVIAL DEPOSITS:** Sorted sand, silt and clay with minor gravel and organic detritus; commonly stratified; deposited along and/or within all modern rivers and streams.
- Floodplain deposits:** sorted sand, silt, clay, minor gravel and organic detritus less than 1 m thick; forming active floodplains close to river and stream level.
 - Floodplain deposits:** sorted sand, silt, clay, minor gravel and organic detritus greater than 1 m thick; forming active floodplains close to river and stream level; includes terraces too small to show at this map scale.
 - Floodplain deposits:** sorted sand, silt, clay, minor gravel and organic detritus greater than 2 m thick; consisting of gravel, sand, and overbank silt and organic detritus.

- ORGANIC DEPOSITS:** undifferentiated peat and muck; 0.3 to greater than 3 m thick; formed by the accumulation of plant material in various stages of decomposition; generally occurs as flat, wet terrain (swamps and bogs) over poorly drained substrates. Peat bogs are present along some water channels. Permafrost is commonly present underlying/within organic deposits. Small, unmappped deposits commonly occur in most terrain units. Peat marries most geological units.
- Veneer:** the accumulations of peat; 0.3 to less than 1 m thick; which drapes the existing topography.
 - Blanket:** continuous peat between 1 and 2 m thick; which drapes the existing topography. Some polygons include hummocky mounds and ridges underlying by discontinuous permafrost.
 - Plain:** fat to gently undulating plain of peat, greater than 2 m thick; that contains numerous small thermokarst ponds and depressions.
 - Wetland - bog:** fat to gently undulating plain of peat, greater than 2 m thick; that contains hummocky mounds and plateaus overlain by discontinuous permafrost. It includes thermokarst terrain related to melting ground ice.
 - Wetland - fen:** fat to gently undulating plain of fibric vegetation, often floating; that makes the underlying topography.

LACUSTRINE DEPOSITS

- Undifferentiated deposits:** massive to stratified, sorted sand, silt, clay and minor organic detritus deposited adjacent to and/or within modern ponds and lakes. This unit is common along the shores of Partridge Breast Lake and the Churchill River, where drainage was directed away from the Partridge Breast Lake and the Churchill River.
- Lacustrine veneer:** thin accumulations of lacustrine sediments, 0.3 to less than 1 m thick; which drape the existing topography.

Proglacial and glacial environments

- GLACIOLACUSTRINE DEPOSITS:** massive to laminated (rhythmically bedded) silt, clay and sand, with areas of ice-rafted clastic material; deposited into linear and deep-water environments of glacial Lake Agassiz. These deposits are of variable thickness (0.2 to 3 m), and drape both till deposits and bedrock. Around some of the larger lakes, the glaciolacustrine sediments have been removed from the shoreline by Holocene wave-washing, and thickness increases inland.
- GLACIOLACUSTRINE ICE CONTACT:** weakly to nonconsolidated, massive to weakly stratified fine sand, silt and minor clay, commonly contains ice-rafted stones and distinct beds (masses) with 1-5% granules to small pebbles of calcareous and crystalline rock. Disrupted and/or reworked by ice near the margin of the retreating glacier and the Lake Agassiz. Includes areas of scour and De Geer moraines.
- Veneer:** 0.2 to 1 m thick, imperfect to moderately drained, underlying topography is discernible.
 - Blanket:** 1 to 3 m thick, imperfect to moderately drained, continuous cover forming fat undulating topography that locally obscures underlying geomorphology.
 - Undulating:** 0.2 to 3 m thick, imperfect to well drained, forms undulations and hummocks that rise up out of the surrounding terrain. Can be overlain by a thin veneer of sandy diamicton with 20 to 30% clasts. Includes De Geer moraine - minor moraines formed due to subsequent sedimentation and/or by ice margin temporary melt in proglacial line setting.
 - Streamlined:** greater than 2 m thick, glaciolacustrine lateral sand and silt draped by a thin veneer of clast-rich sandy diamicton; moulded beneath the glacier into linear ridges and/or furrows parallel to ice flow (quadrant) ridges.

- GLACIOLACUSTRINE LITTORAL:** glacial sediments reworked by wave action; forms moderately well sorted isolated or a series of ridges, 1 to 3 m in height, including beaches, bars and spits, banks of east grading basinward into silt and clay, commonly less than 1 m thick.
- Ridged sediments:** 0.5 to 2 m thick, moderate to well-drained sandy beach ridge.
 - Veneer:** 0.2 to 1 m thick, moderate to imperfectly drained blankets of fine sand and silt sand; underlying topography is discernible.
 - Blanket:** 0.2 to 1 m thick, imperfect to poorly drained, underlying topography is discernible.

- GLACIOLACUSTRINE DEEP WATER:** calcareous to noncalcareous, massive to rhythmically bedded, well sorted, moderately dense, milk-chocolate brown clay and silt with glaciolacustrine clay was observed underlying a veneer of till north of Cedar Lake and just east of Mairy Lake (NTS 64H2N).
- Veneer:** 0.2 to 1 m thick, imperfect to poorly drained, underlying topography is discernible.
 - Blanket:** 1 to 3 m thick, imperfect to very poorly drained, continuous cover forming fat undulating topography that locally obscures underlying geomorphology. Typically mantled by peat of variable thickness.

- GLACIOLACUSTRINE DEPOSITS:** orange to tan, moderately to poorly-sorted, silt, sand, gravel and diamicton deposited behind, at or in front of the ice margin by flowing glacial meltwater. Where the suffix 'x' has been added to the terrain-unit label (i.e., GFVx), it indicates the sediments have had significant surface reworking by glacial Lake Agassiz.
- Veneer:** discontinuous sand and gravel cover, less than 1-2 m thick, underlying topography is discernible.
 - Blanket:** continuous sand cover greater than 2 m thick, forming fat to undulating topography that locally obscures underlying units and associated geomorphic patterns; typically formed by redistribution of glaciolacustrine sands in a shallow water environment.

- Ice contact:** massive to stratified, sorted sand, silt and gravel with minor diamicton, deposited by glacial meltwater in direct contact with the glacier; 1 to greater than 10 m thick, forming gently undulating to hummocky topography related to melting of retreating ice. Features include terraces, kames and ridges.
- Eskers, esker systems and crevasse fills:** massive to stratified sand, silt and minor gravel, deposited by meltwater flow tunnels beneath or within the glacier; present as 1 to 20 m high ridges, some esker ridges are below the glaciolacustrine till and exhibit isolated hogbacks with some wave-washed re-distribution and plateaus to the ridges. Crevasse fills occur as 3 to 5 m high sand, gravel and diamicton ridges that form a reticulate pattern; deposited near the ice margin in fractures within a thinning ice sheet.
 - Ice contact esker:** well to moderately stratified sand and gravel (silt); deposit, formed where a meltwater channel entered a glacial lake during regression and lowering of lake levels; surface is levelled and landform has a steep front.

- GLACIAL DEPOSITS:** unsorted to poorly sorted diamictons (D) deposited in subglacial environments. There is a wide range in the composition of the till, with significant variable proportions of eastern- and/or northwestern-sourced (Palaeozoic and Proterozoic), locally-sourced (granite, gneiss, greenstone, and mafic) and northern-sourced (Dulabert Supergroup) clast concentrations.
- T:** The dominant till is a Keweenaw-Hudsonian calcareous to highly calcareous hybrid till, with silt sand to clayey silt matrix, which contains 5-20% of, on average 20% of, Paleozoic carbonate-bearing clasts mixed with Proterozoic Precambrian and Archaean clasts (granite, gneiss and greenstone rocks). The matrix is calcareous (11-42% CaO, total carbonate and 1.7-7.8 wt. % CaCO₃); this till was deposited by ice flowing west from the Quebec-Labrador ice sector of the Laurentide Ice Sheet, and later variably reworked by ice flowing southward and south from the Keweenaw sector, or an ice saddle overlying southeastern Hudson Bay, where the suffix 'x' has been added to the terrain label (e.g., Tvx, Tbx, Tcx, Tdx, Tfx, Tlx). It indicates that the sediments have had significant surface reworking by lacustrine or fluvial waters.
 - Tx:** means glaciolacustrine veneer overlies streamlined till.
 - Tv:** Blanket: continuous till cover greater than 1 m thick; forming fat to undulating topography that locally obscures underlying units and associated geomorphic patterns; occasional thinner patches of till may occur.
 - Tt:** Hummocky till: till greater than 2 m thick with hummocky topography (2-5 m waves), either moulded beneath the glacier or as a result of subsequent meltwater channel till deposited by melting of subglacial ice; coarse, naturally variable sandy to gravelly matrix, some sorting; angular to subangular clasts.
 - Tu:** Undulating till: till greater than 2 m thick, moulded beneath the glacier into undulating topography (0.1-2 m waves).
 - Ts:** Streamlined till: greater than 2 m thick, subglacial till moulded beneath the glacier into linear ridges and/or furrows parallel to ice flow, drumlins, drumlinoid ridges, buttes. Ridges are typically 0.1-0.5 km long and 0.5-10 m high.

- PRE-QUATERNARY**
- P:** Precambrian rocks; metamorphic, metavolcanic rocks and associated intrusive rocks, may be overlain by a thin, discontinuous veneer of till and/or glaciolacustrine clay-silt upland areas.

- SYMBOLS**
- Kettle:** Kettle
 - Mass movement:** Mass movement
 - Outcrop:** Outcrop
 - Field site with till sample:** Field site with till sample
 - Field site without till sample:** Field site without till sample
 - Roche moutonnée:** Roche moutonnée
 - Straie, direction known, poorly preserved:** Straie, direction known, poorly preserved
 - Straie, direction known, well preserved:** Straie, direction known, well preserved
 - Straie, direction unknown, poorly preserved:** Straie, direction unknown, poorly preserved
 - Straie, direction unknown, well preserved:** Straie, direction unknown, well preserved
 - Beach ridge:** Beach ridge
 - Crag-and-tail landform:** Crag-and-tail landform
 - Crevasse ridge:** Crevasse ridge
 - De Geer moraine:** De Geer moraine
 - Drumlin:** Drumlin
 - Drumlinoid ridge or fluting:** Drumlinoid ridge or fluting
 - Dune:** Dune
 - Esker, direction known, poorly preserved:** Esker, direction known, poorly preserved
 - Esker, direction known, well preserved:** Esker, direction known, well preserved
 - Esker, direction unknown, poorly preserved:** Esker, direction unknown, poorly preserved
 - Esker, direction unknown, well preserved:** Esker, direction unknown, well preserved
 - Esker, washed, direction unknown:** Esker, washed, direction unknown
 - Iceberg scour:** Iceberg scour
 - Major moraine:** Major moraine
 - Meltwater channel:** Meltwater channel
 - Meltwater corridor:** Meltwater corridor
 - Minor moraine, undifferentiated:** Minor moraine, undifferentiated
 - Minor moraine (pristine):** Minor moraine (pristine)
 - Scarp:** Scarp
 - Streamlined bedrock:** Streamlined bedrock
 - Trimline (Scarp):** Trimline (Scarp)

- Scale 1:50 000**
- 0 5000 10000 metres

- Location Map**
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- National Topographic System and index to adjoining maps**
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- Geology by M.S. Trommelen (2013)**
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DESCRIPTIVE NOTES

Surficial geology of the Gauer Lake-Wishart Lake area (NTS 64H4, 5, 12, 13)

The surficial geology of the Gauer Lake-Wishart Lake area was interpreted from 1:60 000 scale black and white airphotos obtained from Natural Resources Canada. Aspects of the regional surficial geology were also gleaned from Shuttle Radar Topography Mission imagery (30 and 90 m resolution; United States Geological Survey, 2002) and SRTM1 orthorectified (2012). Field studies were conducted by helicopter in July 2013. This project includes data from 244 field sites, from which 155 till samples were analyzed for geochemical and clast composition (Trommelen, 2013). This new mapping builds on previous 1:250 000 scale surficial mapping completed in the 1960s (Klassen and Nettleville, 1980, 1985).

The study area is mantled by glacial and postglacial sediments. Elevation varies mainly from 240 to 360 m above sea level (asl) and relief up to 30 m. The drift cover is generally thin, though bedrock outcrops along the shores of most major lakes in the region. The area is a part of the extensive discontinuous permafrost zone (Sladen, 2011), and permafrost was encountered beneath organic deposits at most sites. In 1977, Manitoba Hydro completed construction of a diversion that saw water from the Churchill River system enter the Burnwood and Nelson river systems. As a result, water levels were lowered along the Churchill River and within Partridge Breast and Messing lakes.

Quaternary history

The study area was repeatedly glaciated by the Laurentide Ice Sheet (LIS) during the Quaternary. In the Lake Wisconsin, the region was affected by ice flowing southward from the Keweenaw ice divide (Klassen, 1986; Dredge and Cowan, 1989) and westward from the Quebec-Labrador sector (Hudsonian ice, Dredge and Nixon, 1992; Dredge et al., 2007). The nature of interaction between ice from Keweenaw and from Hudson Bay is uncertain, but a thick ice ridge (ice saddle) was likely present over southern Hudson Bay in deglaciation (Dyke and Prest, 1987; Thorleifson et al., 1993; Trommelen et al., 2012). Circa 8.2 °C ka, the study area was inundated by glacial Lake Agassiz (Klassen, 1983; Thorleifson, 1996). Radiocarbon dates are rare in northern Manitoba, but it is thought that this inundation was short-lived and absent by ca. 7.7 °C ka (Thorleifson, 1996; Teller and Leventsov, 2004). The northern half of the study area is dominated by a lobate streamlined-landform fan (Quinn Lake ice stream; Dredge et al., 1986; Dredge and Nixon, 1992), which was thought to have been formed during a surge or readvance into glacial Lake Agassiz. These streamlined landforms also outline the deglaciation-type Quinn Lake glacial terrain zone (Figure 1; Trommelen et al., 2012).

Ice-flow history

The study area contains evidence of at least six different ice-flow phases (Figure 2). Early, well-preserved southward-phase I, between 120 and 107, westward (phase II, between 260 and 207) and southward-trending (phase III, between 230 and 247) ice-flow indicators are present. These ice-flow phases are rare but regionally extensive (Dredge et al., 1986; Dredge and Nixon, 1992; Kaszycki et al., 2008), and consist of the pre-Lake Wisconsin transport of calcareous detritus to the area (Dredge, 1988). Rare but widespread striations and several notches/multinotchies then document southward ice flow (phase IV, between 150 and 194). This was followed by strong, early erosive, south-southwestward ice flow (phase V, between 203 and 212). During deglaciation, ice flowed to the southwest (phase VI, between 220 and 230) and south and southeast (phase VI; ~160°, 160°, 120°) during the Quinn Lake readvance. Drumlinoid ridge formation in the northern half of the area occurred during the Quinn Lake phase VI, whereas streamlined landforms in the southern half of the area are presumed to correlate with phase V.

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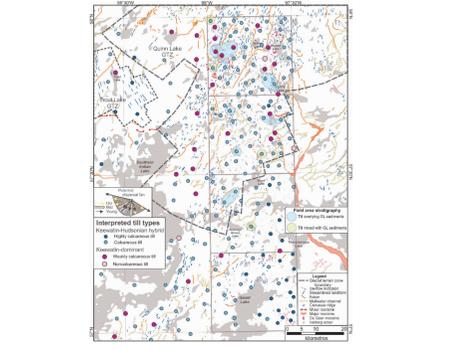


Figure 1: The study area contains a portion of the Quinn Lake glacial terrain zone (GTZ) and just to the west of study area is the Trout Lake GTZ. The Quinn Lake GTZ is classified as a deglaciation-type GTZ, formed during a late deglaciation surge of an ice stream glacial Lake Agassiz. The Trout Lake GTZ was investigated during fieldwork completed by Kaszycki (1989). The boundaries are closely tied to the edges of a row of south-southwest-trending, downlateral, streamlined landforms. Unlike the Quinn Lake GTZ, the eskers and meltwater channels within the Trout Lake GTZ clearly crosscut the streamlined-landform flowset, meaning that it is a palimpsest- or relic-type GTZ (Trommelen et al., 2012).

Interpreted till types in the study area are based on the proportion of calcareous clasts in the till matrix. Keweenaw-dominant till refers to till with <5% of % calcareous clasts that were mainly emplaced by a younger south-southwest-flowing ice-flow phase with near-complete dilution/overprinting of calcareous detritus. Keweenaw-Hudsonian hybrid till contains 5-50% of % calcareous clasts, and a spatially variable mixture of far-travelled calcareous detritus, which has been diluted by comminution, combined with incorporation of Precambrian silt clasts sourced from the east, northeast and north. Abbreviation: GL, glaciolacustrine.

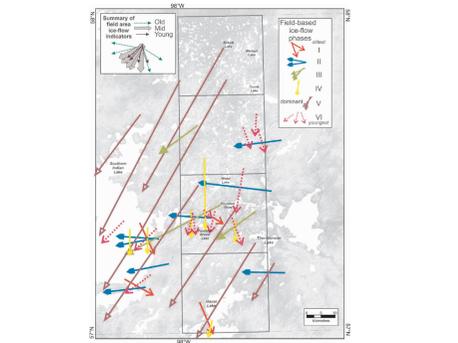


Figure 2: Compiled and interpreted ice-flow phases in the study area. The summary of ice-flow indicators (inset, upper left) provides a description of possible dispersal fan orientations for the area that may be encountered during till exploration. Background image was generated using a Shuttle Radar Topography Mission digital elevation model (United States Geological Survey, 2002).



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