Energy, Mines and Resources Canada / Énergie, Mines et Ressources Canada
Geological Survey of Canada / Commission géologique du Canada

DESCRIPTIVE NOTES

The Swan Lake, Manitoba-Saskatchewan map area is situated at the boundary between the Manitoba Escarpment and the Manitoba Plain. On a local scale, the map area can be divided into five physiographic areas: Porcupine Hills, Duck Mountain, Swan River valley, Red Deer River valley, and Westlake plain

Porcupine Hills, situated in the western part of the map area, and the northern edge of Duck Mountain, in the extreme south of the region, are part of the Manitoba Escarpment. These upland areas stand about 400 m above the adjacent Manitoba Plain, consisting primarily of Cretaceous rocks of the Riding Mountain Formation (Elson, 1967)

Swan River valley, wedged between the Porcupine Hills and Duck Mountain; and Red Deer River valley, between Pasquia Hills northwest of the map area and Porcupine Hills, drain the Saskatchewan Plain west of the study area to Lake Winnipegosis. Red Deer River valley lies in the preglacial Endeavour Valley (Moran, 1969) and it is likely that Swan River valley had a similar predecessor. Presently, the valleys of Swan and Red Deer rivers are broad and U-shaped, probably in part formed by intense erosion as continental glaciers advancing from the northeast were forced between the bedrock masses of Porcupine Hills and Duck Mountain, and between Pasquia Hills and Porcupine Hills (Moran, 1969). This glacial activity has also resulted in the deposition of a large thrust block in Swan River valley; known as Thunder Hill, it is an elongated, streamlined hill about 150 m high, 6 km long, 3 km wide at the northeast end, and 1.5 km wide at the southwest end. Its major axis is oriented parallel to the direction of regional ice flow at 250°. The hill is a composite mass of glacial till and slabs of Cretaceous rocks derived from the northeast. The slabs of till and bedrock were probably deposited as a succession of imbricate thrust blocks to form the hill which was then streamlined by ice movement (Moran, 1969)

The Westlake plain occupying the eastern half of the study area was a basin of glacial Lake Agassiz. It consists of generally flat topography interrupted by a series of raised Agassiz beaches documenting the regression of the glacial lake in this area

The study area is underlain by three types of bedrock (Manitoba Mineral Resources Division, 1979). The Porcupine Hills are underlain by Cretaceous shales of the Riding Mountain Formation with successive underlying beds of the Vermillion River Formation, Favel Formation, and Ashville Formation. Cretaceous sandstone of the Swan River Formation outcrops in a narrow belt at the base of the Porcupine Hills and is the dominant bedrock underlying Swan River valley. The Westlake plain is underlain by Devonian red shale, micrite, limestone, and dolomite of the Souris River and Dawson Bay formations. In addition to these three main groups of bedrock, a thin belt of dolomitized limestone biomicrite of Devonian age occurs in the extreme northeast corner of the map area. Outcrops are scarce and were noted only in the Dawson Bay area

Drift thickness varies from less than 1 m in the Westlake plain to hundreds of metres on the Porcupine Hills. Borehole data from the Duck Mountain uplands show drift thickness as great as 300 m (Klassen, 1979). Since the Porcupine Hills are part of the same Riding Mountain bedrock formation and are at a similar elevation as Duck Mountain, it is likely that drift thickness on the Porcupine Hills is comparable. The uppermost till on the Porcupine Hills is the dark brown to grey, silty clay till of the Zelena Formation (Klassen, 1979). Ice directional features are not apparent on the Porcupine Hills. The till of the Westlake plain and Swan River valley is lighter in colour than the upland till but has a similar grain size distribution. This till, part of the Arran Formation (Klassen, 1979), is light brown to olive, calcareous, dominated by clay and silt sized grains, and overlies the Zelena Formation on the Manitoba Plain. Ice directional features and one striation near Dawson Bay measured at 250° (Nielsen and Gale, 1985) indicate that Arran Till was deposited by an ice advance from the northeast which abutted the Manitoba Escarpment and continued through Red Deer and Swan river valleys

Outwash deposits are limited to two zones in the southwestern corner of the map area. These sediments were deposited by meltwater flowing from blocks of dead ice isolated in upland areas (Moran, 1969). Farther up Swan River valley, to the west of the study area, ice contact sand and gravel occur (Klassen, 1979); known as the Harvey Lake moraine, it is situated on the south side of the valley and represents the western limit of the Arran ice advance in this region

The absence of glaciofluvial sediments on the sides of Porcupine Hills and Duck Mountain is conspicuous. It would be expected that ice contact materials would have been deposited where the Late Wisconsinan ice responsible for the Arran Formation abutted stagnant ice that remained on the upland. No evidence of these sediments can be found, however, even though lithological differences have been identified in the two tills (Klassen, 1979)

Deep basinal silt and clay deposited in glacial Lake Agassiz is found principally in Swan and Red Deer river valleys. These deposits are seldom greater than 1 m thick. Similar deposits are found sporadically in topographic depressions in the Westlake plain. Most of the surface sediment on this plain is till, however, indicating that little sediment was supplied to this part of glacial Lake Agassiz

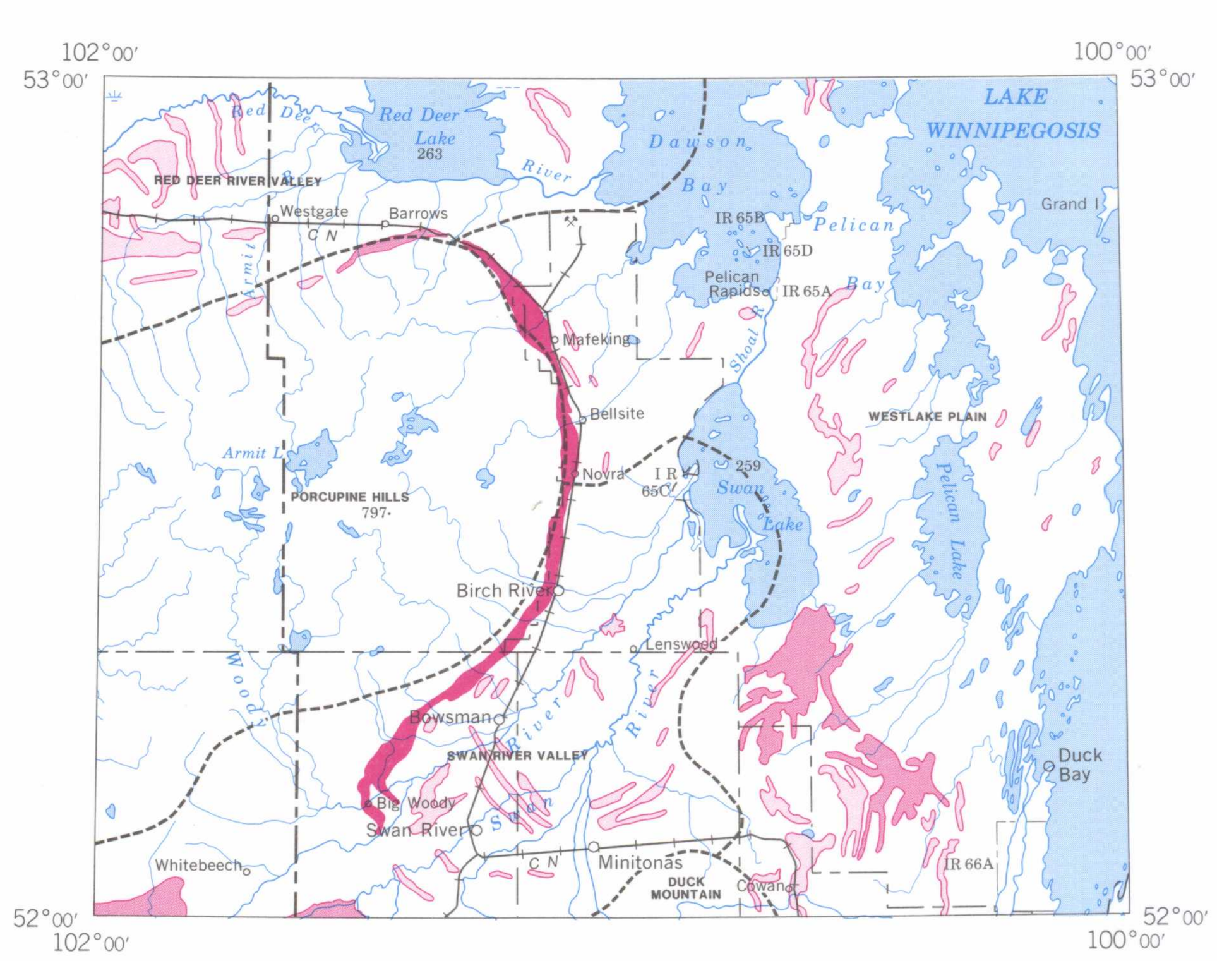
The western limit of glacial Lake Agassiz in the study area is found along the Manitoba Escarpment. Numerous deposits of nearshore lacustrine sediments occur near the base of the Porcupine Hills and Duck Mountain, throughout Swan River valley, and in the Westlake plain. Well developed strandlines representing the Upper and Lower Campbell levels of Lake Agassiz are found around Porcupine Hills, and particularly in Swan River valley where they have elevations of 357 and 349 m, respectively (Nielsen et al., 1984). Radiocarbon dates on bison remains from a spit situated between the two Campbell beaches in Swan River valley indicate that these nearshore sediments were deposited during the high water Emerson Phase of Lake Agassiz about 10 000 years ago (Nielsen et al, 1984). Following the development of the Campbell beaches, Lake Agassiz retreated as the land rebounded isostatically, leaving a series of raised beaches across the Westlake plain. Raised beach complexes continued to form here until Laurentide ice retreated far enough north to open up the eastern outlets of Lake Agassiz

Littoral deposits are found in Swan River valley and wrap around the eastern edge of the Porcupine Hills. Derived from the upland by stream and river transport, the sediments consist primarily of sand near the basin margin and grade basinward into a thin veneer of silt and clay overlying the till of the Westlake plain

Alluvial deposits occur as floodplains along several rivers and lakeshores, and as deltas at the base of the Porcupine Hills and Duck Mountain. The largest floodplains are those of Red Deer and Swan rivers; these rivers have constructed large deltas into Red Deer and Swan lakes, respectively. Most rivers originating in the Porcupine Hills and Duck Mountain have an associated delta radiating from the base of the escarpment (locations indicated by symbols). A number of these alluvial deltas have been documented by Elson (1967)

Extensive slumping and landslide activity has taken place in the Porcupine Hills. Many of the landslide zones are too small to map at this scale but they exist all along the escarpment, particularly on the eastern and northern sides of the Porcupine Hills. The largest landslide, situated between the towns of Mafeking and Bellsite, truncates the Lower Campbell beach level, indicating an age of less than 9500 years (Nielsen and Watson, 1985)

The abundance of nearshore lacustrine deposits in this area provides an ample source of aggregate. The location of Highway 10 along the base of the Porcupine Hills provides easy access to these sand and gravel resources and it is expected that they can serve the area for many years into the future



POTENTIAL AGGREGATE RESOURCES AND PHYSIOGRAPHIC REGIONS

SAND AND GRAVEL DEPOSITS

High potential for economic feasibility: large volume ice contact and esker deposits. Ideally, gravel content is greater than 35%, oversize gravel (>10 cm diameter) content is less than 20%, and lithological deficiencies (i.e., chert, shale, mica, etc.) are minimal

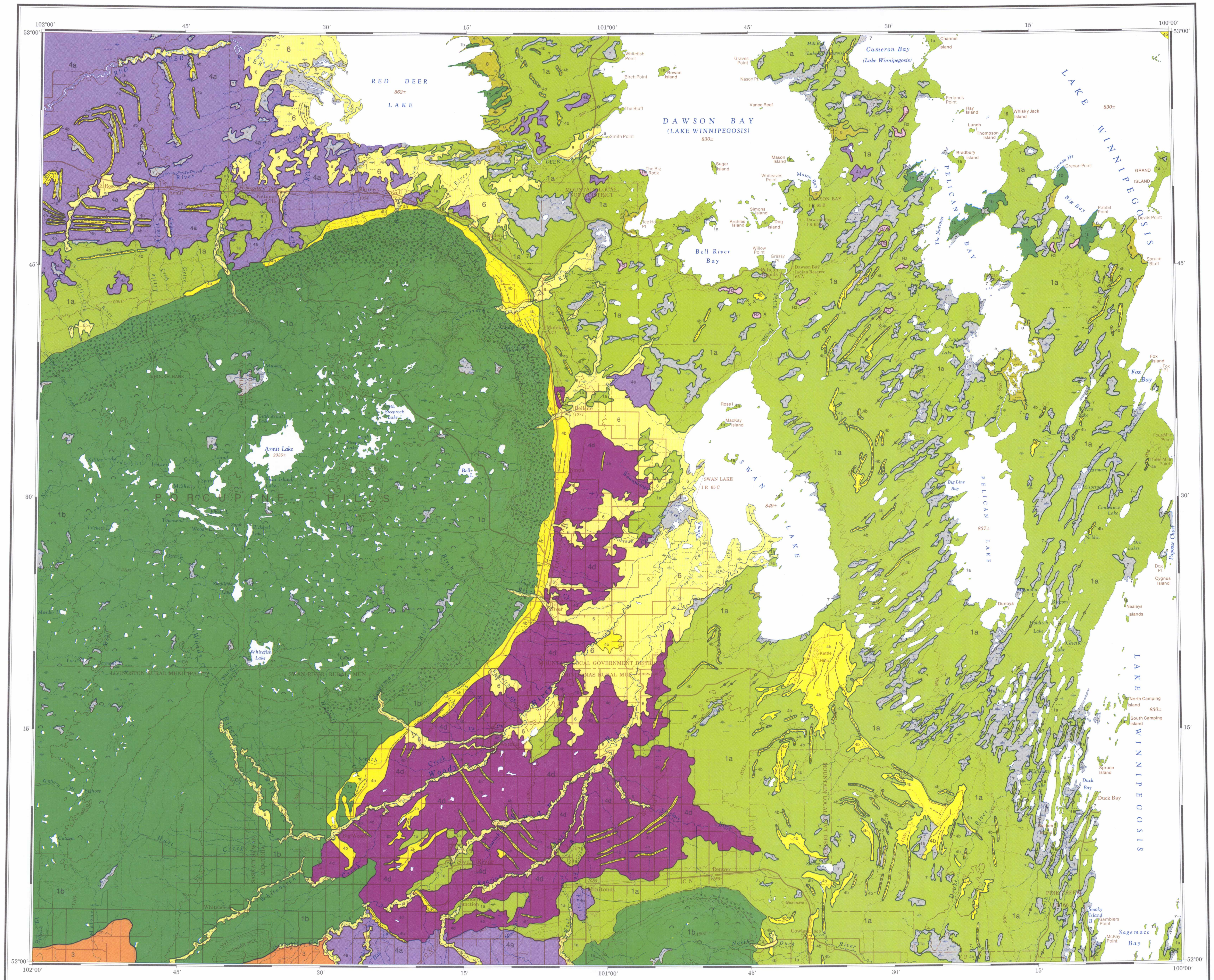
Medium potential for economic feasibility: small volume ice contact and esker deposits and large volume nearshore lacustrine and nearshore marine deposits. Deposit lacks either in volume or quality of aggregate to be considered of high potential

Low potential for economic feasibility: small volume nearshore lacustrine or nearshore marine deposits and small volume ice contact and esker deposits

Contribution to Canada-Manitoba Mineral Development Agreement 1984-89, a subsidiary agreement under the Economic and Regional Development Agreement. Project funded by the Geological Survey of Canada

Manitoba Energy and Mines

Canada



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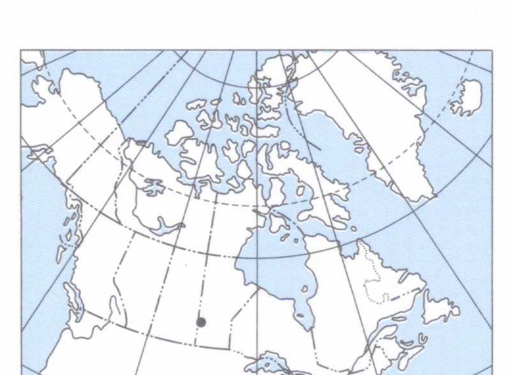

INDEX MAP

Geology by M.D. Clarke, 1987

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Any revisions or additional geological information known to the user would be welcomed by the Geological Survey of Canada

Base map at 1:250 000 published by the Surveys and Mapping Branch in 1978
Base map at 1:1 000 000 published by the Surveys and Mapping Branch in 1972

MAP 1697A

SURFICIAL GEOLOGY

SWAN LAKE

MANITOBA-SASKATCHEWAN

Scale 1:250 000 - Échelle 1/250 000

Kilometres 5 0 5 10 15 20 Kilomètres

Universal Transverse Mercator Projection
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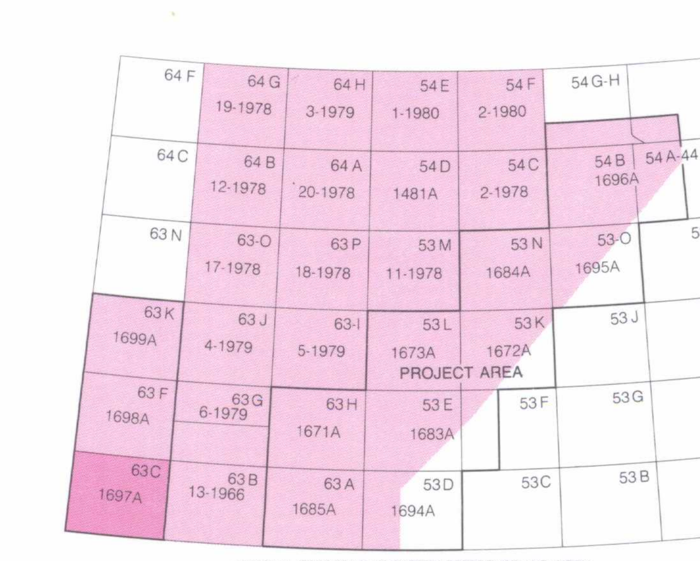
Mean magnetic declination 1989, 10°45′ East, decreasing 8.9′ annually. Readings vary from 09°40′E in the SE corner to 11°50′E in the NW corner of the map

Elevations in feet above mean sea level



NATIONAL TOPOGRAPHIC SYSTEM REFERENCE AND INDEX TO ADJOINING GEOLOGICAL SURVEY OF CANADA MAPS

LEGEND

Coloured legend blocks indicate map units that appear on this map

SURFICIAL DEPOSITS
QUATERNARY

HOLOCENE

NONGLACIAL ENVIRONMENT

8 — *LACUSTRINE DEPOSITS: sand, muddy sand and pebbly sand; up to 2 m thick; occurs as sloping or gently undulating plain; nearshore sediments associated with modern lakes*

7 — *ORGANIC DEPOSITS: lichen-moss, sedge, and woody peat; 1.5 to 3 m thick; may occur at or up to 3 m above the water table; includes both bog peat and fen peat; peat mantles most geological features*

6 — *ALLUVIAL DEPOSITS: silt, sand and rounded gravel, commonly terraced; thicknesses range from a thin veneer up to 30 m; deposited by streams within active drainage systems since the retreat of the sea, proglacial lakes, or glacial ice as floodplains, spits, point bars, and deltas*

NONGLACIAL AND GLACIAL ENVIRONMENT

MARINE/GLACIOMARINE DEPOSITS: well sorted, stratified sand to stony silt deposited in Tyrrell Sea, and glacial deposits modified by marine processes during offlap; commonly overlain by peat

5b — *Nearshore sediments: well sorted silt, sand, and gravel; up to 3 m thick; occurs as a series of ridges in the form of beaches, bars, spits, and ice-pushed ridges, or as a flat plain*

5a — *Offshore sediments: poorly sorted clayey silt, stony silt, and sand with pockets of nearshore sand and gravel and windblown sand; probably a till plain levelled by filling of depressions and planation by wave action; thicknesses of up to 2 m near marine limit and increasing towards Hudson Bay to a maximum of 7 m; may contain marine fossils; commonly overlain by organic materials*

LACUSTRINE/GLACIOLACUSTRINE DEPOSITS: massive to bedded silt-clay with granules, overlain by a veneer of sand. Deposited in glacial Lake Agassiz; where deposits are thin, they mirror the underlying glacial and bedrock structures, and where thick, they form a flat plain

4d — *Littoral sediments: blanket of sand grading basinward into undifferentiated silt and clay*

4c — *Nearshore sediment veneer: well sorted sand and gravel; occurs as a ridge or series of ridges with 1 to 4 m relief on wave washed glaciofluvial deposits predating glacial Lake Agassiz*

4b — *Nearshore sediments: well sorted sand and gravel; occurs as a ridge or series of ridges with 1 to 4 m relief; includes beaches, bars, spits, and ice-pushed ridges*

4a — *Offshore sediments: well sorted clay, silt, and sand; thickness ranges from a thin veneer up to 20 m; surface characterized by iceberg scours and extensive areas of peat*

LATE PLEISTOCENE

GLACIAL ENVIRONMENT

GLACIOFLUVIAL DEPOSITS: water sorted, stratified sand and gravelly sand deposited in, around, or near a glacier, largely as a result of meltwater flow

3 — *Outwash sediments: well rounded, cross-stratified sands and gravels, 3 to 20 m thick, characterized by braided channels and kettle depressions; occurs along the flanks of eskers or in the bottom of subglacial and proglacial meltwater channels; surfaces are commonly terraced and hummocky*

2 — *Ice contact stratified drift: well sorted, poorly stratified sand and gravel kame deposits, 10 to 30 m high, stratified sand and minor gravel esker deposits, 5 to 20 m high, and recessional, end, or interlobate moraines; kames occur as irregular mounds flanking eskers; eskers occur as elongate ridges generally parallel to the direction of ice movement*

GLACIAL DEPOSITS (TILL): poorly sorted debris deposited at the front of or beneath glaciers or under ice shelves. The tills in the western part of the province are sandy to silty sand and have a high percentage of clasts derived from granitic terrain; the tills in the eastern part are generally silty and highly calcareous

1b — *Till blanket: silty to sandy, 1 to 10 m thick; masks most bedrock features; surface features include drumlins, fluting, ribbed moraine, and hummocks*

1a — *Till veneer: sandy, usually less than 1 m thick, interspersed with areas of thicker till, bedrock, marine, or lacustrine sediments; surface reflects the underlying bedrock structure*

BEDROCK
PRE-QUATERNARY

R_2 — *Paleozoic rock: sedimentary carbonate rocks; dolomitic limestone and dolomite*

R_1 — *Precambrian rock: largely massive granitic and gneissic rock with isolated bands of volcanic rock*

Geological boundary
Small bedrock outcrop
Drumlin
Fluting
Hummocky moraine
Beach ridge
Undifferentiated slopewash sediments
Landslide scars
Delta

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