QUATERNARY GEOLOGY AND SAND AND GRAVEL RESOURCES OF THE RURAL MUNICIPALITY OF SPRINGFIELD

MANITOBA
DEPARTMENT OF ENERGY AND MINES
MINERAL RESOURCES DIVISION

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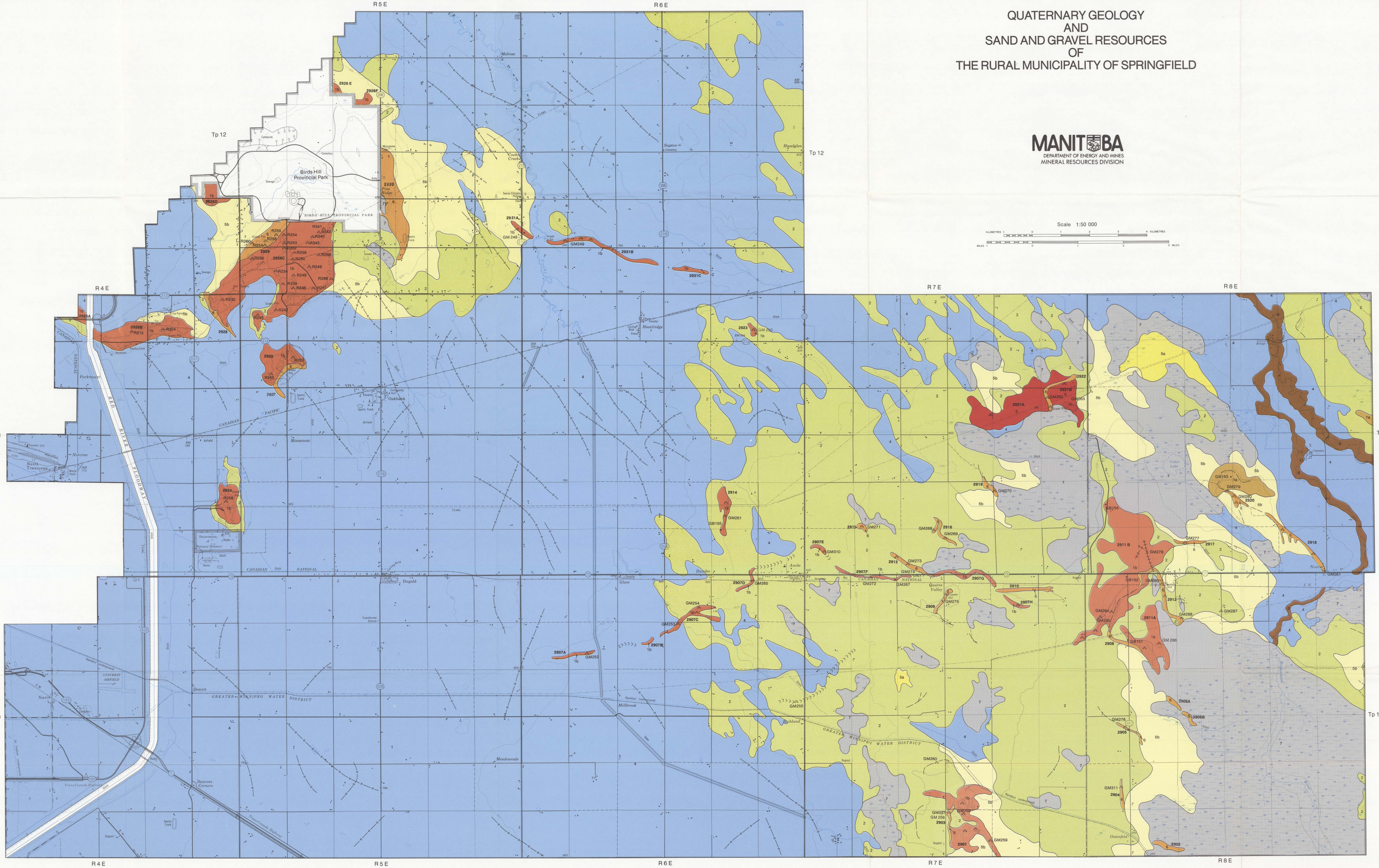


LEGEND

POST GLACIAL

- 8 — Alluvium: present day flood plain and/or valley fill material composed mainly of silt and clay and minor seasonally submerged organic deposits.
- 7 — Swamp: seasonally submerged organic deposits.

LATE GLACIAL

- 6 — Beach Ridges: representing major stillstands of Lake Agassiz, includes spits and offshore bars.

Littoral Sand and Gravel:

- 5a — Wave washed till overlain by a regressive sequence consisting of silt and clay grading upwards into sand and fine pebble gravel. Generally less than 2 metres thick and restricted to flat lying, poorly drained areas.
- 5b — Massive medium to fine grained sand with minor gravel generally overlying clay. Generally greater than 2 metres thick.
- 4 — Lacustrine clay: silt and clay deposited in the deep waters of Lake Agassiz.

GLACIAL

- 3 — Deltaic sand and gravel: deposited at or near the ice front during the final retreat of Keewatin ice from the area.
- 2 — Calcareous till: generally silt-rich and severely jointed calcareous till of northwest provenance commonly modified by wave action. Includes minor areas of sandy till of northeast provenance.

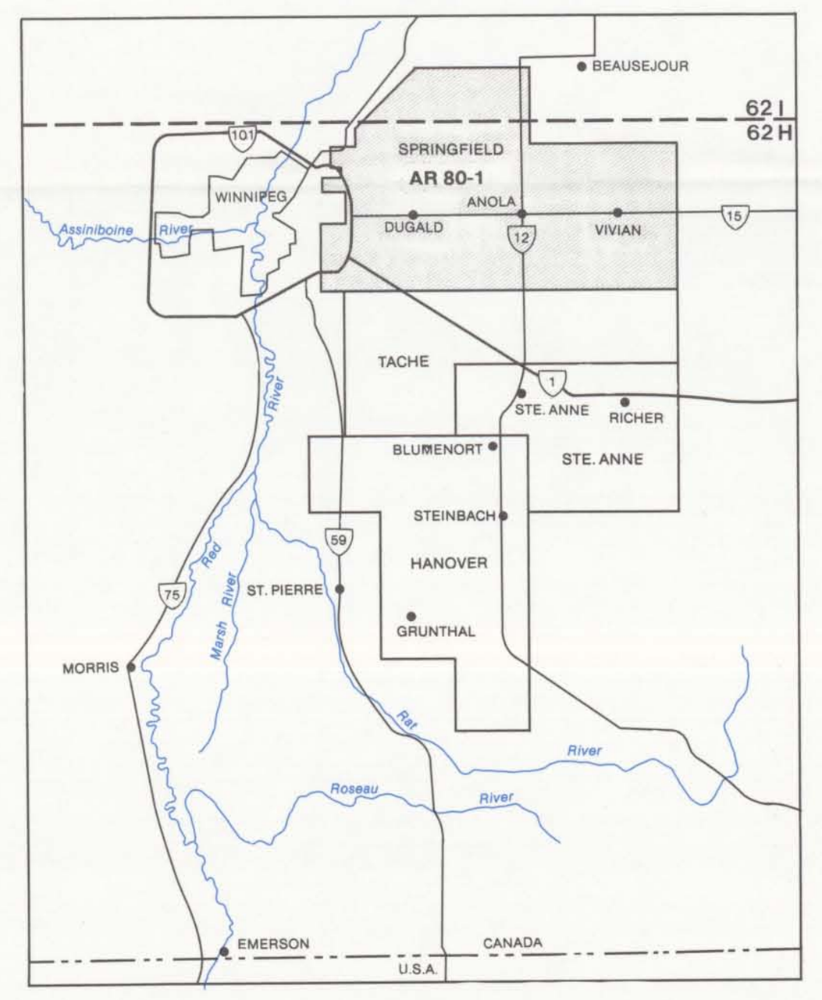
Glaciofluvial sand and gravel: glacially overridden glaciofluvial deposits consisting:

- 1a — Primarily of sand with minor gravel.
- 1b — Primarily of sand and gravel.

SYMBOLS

2308	deposit number
(symbol)	gravel pit
GM201	gravel pit w/station stop
• GM206	station stop
• GB101	backhoe test pit
(symbol)	sand dune (approximate orientation of individual dunes)
(symbol)	iceberg scour
(symbol)	raised shoreline
> > > > > > >	esker
(symbol)	transverse bar
(symbol)	spillway (partially infilled)
(symbol)	moraine

MAP INDEX



INTRODUCTION

Physiographic regions represented in the area are the Red River Lowlands and the Lake Terrace Plain. The Red River Lowlands is a flat area comprising thick accumulations of pro-glacial lake sediments, mainly clay. This area is interrupted by the Bird's Hill complex in the northwest corner of the area. The Red River Lowlands area is flanked on the south and east by the Lake Terrace Plain. The Lake Terrace Plain is a gently undulating area made up essentially of glacial till which is overlain by organic deposits and discontinuous proglacial lake sediments.

The thickness of Quaternary sediments overlying the bedrock is from 3-90 metres: generally 10-30 metres on the Red River Lowlands and 30-80 metres on the Lake Terrace Plain.

LATE WISCONSIN GLACIATION

Late Wisconsin continental ice has overridden the entire area four times. Initially, Labradoran ice from the northeast deposited a sandy till which occasionally crops out in the area. Three subsequent invasions of Keewatin ice from the northwest deposited finer textured tills which cover a large part of the area.

The Labradoran ice deposited the sandy Senkiw Formation (Fenton, 1974). The Senkiw till has a low stone content and an average of 60% sand, 29% silt and 11% clay (Teller and Fenton, 1980). The Senkiw till forms the uppermost till in sections 4-7-7E, 20-7-8E and 35-8-8E, in each of which it is overlain by minor lacustrine sand and gravel.

In section 4-7-7E, the Senkiw Formation and associated glaciofluvial sediments make up the core of a topographical high which was formed along the ice margin during the retreat of Labradoran ice. These sediments form a typically faulted and folded sequence of silt, sand and gravel in association with the Senkiw till. The sand and gravel layers are commonly cross-bedded with a highly variable paleocurrent direction.

During the period between 21,000 and 11,000 years before present, the Keewatin ice advanced from the northwest and retreated through the area several times, depositing three discontinuous till sheets: the Roseau, the Whitemouth Lake, and the Marchand Formations (Teller and Fenton, 1980). They are generally silt-rich carbonate tills with variable stone content and are commonly well jointed with dark brown magnesium stains on the jointed surface. The colour in outcrop is generally pale to medium brown. Only two of the three tills of north-western provenance have been identified in outcrop.

Glaciofluvial deposition occurred during the retreat of the three consecutive Keewatin sheets. These deposits are divided into two groups: 1) those formed at or near the ice front, mainly kame deltas, and 2) eskers, formed in a channel, on or in the ice.

The eskers are long narrow ridges with paleocurrent directions east-southeast. They were formed by glacial meltwaters carrying sediment to the ice front.

Glaciofluvial deposits associated with the ice front form topographical highs. The gravel fraction contains 60-70% carbonate due to their association with the carbonate rich Keewatin ice. The glaciofluvial deposits comprise well to moderately well sorted sand and gravel with lesser amounts of silt and silt-rich till. They are generally overlain by a discontinuous till sheet of northwest provenance.

The first Keewatin recession took place as far north as Bird's Hill where it formed an esker-delta complex. Bird's Hill formed as a result of glacial meltwater discharging through crevasses probably created by differential ice push at the margin of the ice sheet. The meltwater flowed into a shallow proglacial lake during an early stage of Lake Agassiz (Ringrose, 1979).

During the recession of the penultimate Keewatin ice sheet, glaciofluvial deposits in the Vivian, Grunthal and Ross areas were formed (Fenton, 1974). The deposits south and west of Ross are eskers which have been modified by wave erosion. The deposits in the Vivian and Grunthal areas are kame deltas formed at or near the ice front by glacial meltwater discharging into a proglacial lake. The resulting deltas were partially ice walled and thus prone to deformation upon ice melt.

During the retreat of the last Keewatin ice, the Marchand ice sheet, the glacier halted temporarily to form the "Blumenort Moraine" which extends from Blumenort east and north to Monominto. The northern section of this feature is very complex with highly variable paleocurrent directions. Glaciofluvial deposits in the southern part, the Blumenort area, form kame terraces as they: infill a depression, unlike the other glaciofluvial deposits; paleocurrent directions are consistently east-northeast parallel to the moraine; and the presence of cut and fill structures within the granular material tends to indicate deposition within an open channel. These deposits are partially overlain by till due to minor fluctuations of the Marchand ice front.

The deltaic sand and gravel (sections 23 and 24, 11-7E) is correlated with the recession of the Marchand ice. The southeast part of the deposit was probably not overridden by glacial ice as it shows no signs of deformation. The deposit displays large scale tabular cross-bedding with a paleocurrent direction generally southward.

LAKE AGASSIZ SEDIMENTATION

During ice front recession, the area was repeatedly inundated by pro-glacial lakes which subjected the area to several periods of erosion and deposition. The most prominent of these inundations was Lake Agassiz which rose to its highest level, the Herman, during the retreat of the Marchand ice. The lake gradually drained, first to the south through the Red River valley and then to the east into northwestern Ontario. During this time the lake level dropped to the Ojata strandline, approximately 290 metres, and parts of townships 5-5E, 7-8E and 8-8E emerged. About 10,000 years ago an ice advance in northwestern Ontario blocked the eastern outlet and the lake level rose to the Lower Campbell strandline and the area once again was completely under water. By approximately 8,000 years ago, Lake Agassiz had completely drained from the area (Elson, 1967).

Beach ridges marking stationary lake levels of the last regression are found throughout the Lake Terrace Plain. Lake levels represented in the area are the Ojata through to the Stonewall strandlines. The beaches are generally 1.5-3.0 metres high and made up of well sorted, horizontally bedded sand and gravel.

The regressive sand and gravel (Unit 5a) was also deposited along the shoreline of Lake Agassiz. This reversed graded sequence of clay, sand and gravel resulted as the lake level gradually lowered over a gently sloping ground surface.

The sand (Unit 5b) and the clay (Unit 4) form extensive flat plains. The sand is generally restricted to an area above 250 metres above sea level, where it overlies clay. This is also a regressive sequence, however, it is different from Unit 5a as it was deposited offshore, in a lower energy environment and therefore lacks the gravel clasts.

Iceberg scours form subtle ridges which criss-cross the clay plain. They are composed of contorted silt and clay laminae, and are believed to be the result of wind driven icebergs grounding on the clay in the bottom of Lake Agassiz. These features are unlikely to be related to the bedrock or to glaciation because there is often 30 metres of drift overlying the bedrock, the top 10 metres of which is generally clay. There are two possible sources for the icebergs:
1) the calving of frontal ice during recession, and
2) the breaking up of Lake Agassiz winter ice during spring thaw (Clayton, et. al., 1965).

ECONOMIC GEOLOGY

Diminishing gravel reserves in the Bird's Hill complex are encouraging increasing exploration and exploitation of resources in the Lake Terrace Plain area. Because of the haulage distance to Winnipeg markets, only the larger deposits are economically viable for Winnipeg consumption. A few Winnipeg based gravel suppliers are active in the Lake Terrace Plain area of the Rural Municipality of Springfield. Sand and gravel sources comprise beach ridges (Unit 6), deltaic sand and gravel (Unit 3) and glaciofluvial sand and gravel (Unit 1b).

Beach ridges are scattered throughout the Lake Terrace Plain. Economically, they have the advantage of being uniform in composition and easily defined, however they generally contain relatively small quantities of gravel in long, narrow ridges, making acquisition of a sufficiently large source difficult. Their value tends to be limited to local consumption. Deposits 2913 and 2915 are essentially depleted while the remaining beach ridges have yet to be extensively exploited. Deposit 2930, the largest beach ridge in the area, is composed of sand and is insignificant for gravel extraction.

The glaciofluvial deposits are highly variable in composition and more difficult to define on aerial photographs. They tend to contain larger quantities and better quality gravel than the beach ridges. Resistivity surveys and a limited number of backhoe pits have enabled delineation of the larger deposits.

The Bird's Hill complex is partially depleted above the water table and operators are beginning to mine remaining reserves below the water table. Bird's Hill has been the major source of sand and gravel for the Winnipeg market since the turn of the century.

The Monominto deposit (deposit 2901) has been mined extensively due to its proximity to the Greater Winnipeg Water District railway which is used to transport gravel to Winnipeg. The gravel pit at GM258 is from 7 to 12 metres deep. The water table was at approximately 12 metres at the present pit floor. A thin discontinuous layer of silt till overlies much of the gravel, which is of medium high quality.

The southern part of deposit 291 B is severely depleted due to extensive mining above the water table and is presently being mined below the water table to depths in excess of 10 metres. The water table is about 5 metres in the southern portion of the deposit. The northern portion of the deposit, particularly north of P.T.H. 15, is largely sand, however a backhoe pit, GB154 indicated high quality gravel below 2 metres of pebbly sand and silt. The water table at this point is 2 metres below the surface.

Deposit 2907 is largely depleted west of Anola. The gravel which was extracted below water level is of medium quality and is overlain on the flanks by clay and minor till. East of Anola the deposit is less extensive with only minor pits.

Deposit 2921 is the only deltaic sand and gravel deposit in the area, with an active gravel pit at GM263. It exposes 4 metres of medium high quality tabular cross-bedded sand and gravel. The water table is 4.5 metres deep. The granular material is approximately 40 per cent gravel with the coarsest grain size being 76 millimetres (3 inches). North and west of this pit the material decreases in quality.

Further information on the sand and gravel deposits may be obtained from the Aggregate Resources Section of the Mineral Resources Division.

REFERENCES

Clayton, L., Laird, W., Klassen, R.W., and Kupsch, W.O. 1965: Intersecting minor lineations on Lake Agassiz Plain. *Journal of Geology,* 73, pp. 652-656.

Elson, J.A., 1967: Geology of glacial Lake Agassiz. *In Life, Land, and Water* (Edited by W. Mayer-Oakes). University of Manitoba Press, Winnipeg, Manitoba, pp. 36-95.

Fenton, M.M., 1974: The Quaternary stratigraphy of a portion of southeastern Manitoba, Canada. Ph.D. thesis, *University of Western Ontario,* London, Ontario, 286 p.

Ringrose, S., 1979: The sedimentology of esker deposits in Manitoba, with particular reference to coarse sediment deposition and implications for the late glacial history of Manitoba. Ph.D. thesis, *University of London,* London, England, 395 p.

Teller, J.T., Fenton, M.M. 1980: Late Wisconsin glacial stratigraphy and history of southeastern Manitoba. *Canadian Journal of Earth Sciences,* 17, pp. 19-35.

Base map information compiled from 1:50,000 N.T.S. sheets.

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