Aggregate Report AR89-1

Aggregate Resource Inventory of the Rural Municipality of Louise

By R.V. Young

Manitoba
Energy and Mines
Mines Branch

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ABSTRACT

An aggregate resource inventory was carried out in the Rural Municipality of Louise. Airphoto interpretation followed by field investigation was used to identify and define sand and gravel deposits. A total of 21 aggregate deposits have been identified and an additional 17 potential aggregate deposits recognized. These deposits are characterized as being fine grained and having a high shale content. Estimated reserves are 31.6 million cubic metres, but the high shale content limits potential end uses and requires importing of some shale free gravel into the municipality. In addition to sand and gravel deposits, bedrock quarries supply aggregate for some local road maintenance.

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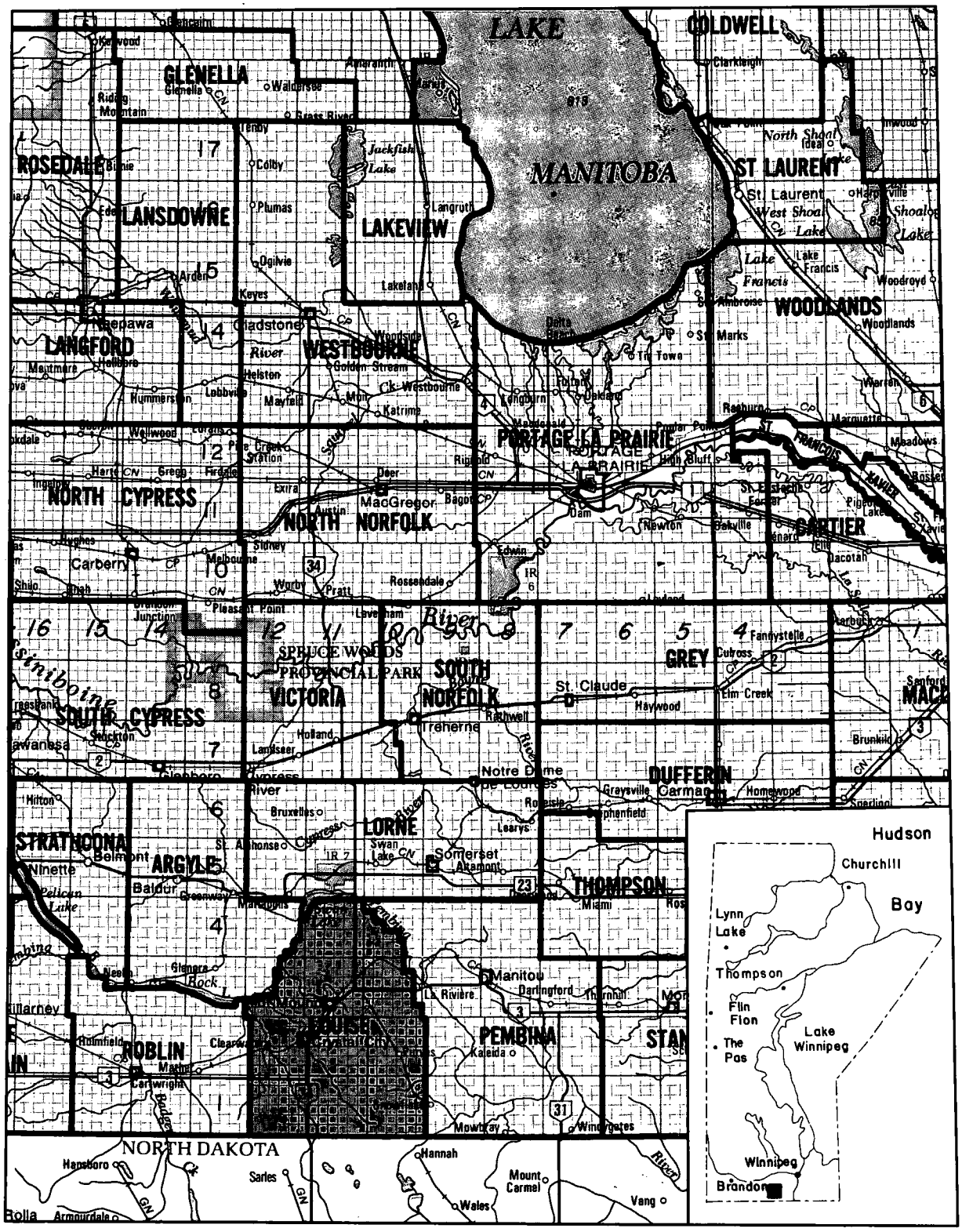

Figure 1: Location of the Rural Municipality of Louise

INTRODUCTION

Objectives

An aggregate resource inventory was carried out in the Rural Municipality of Louise with the objective of determining location and reserves of aggregate resources. The information contained within this report may be used to provide information for mineral land-use planning and for consumers of sand and gravel. Aggregate deposits are shown on Map AR89-1 accompanying this report.

Location and access

The study area (Fig. 1) covers 890 km^2 and is located 125 km southwest of Winnipeg. The municipality includes Townships 1-4 and Ranges 10-12 west of Principal Meridian. The largest settlements are the towns of Crystal City and Pilot Mound. The main access is by Provincial Highway 3 and 34, and by Provincial Roads 242, 253 and 440.

Topography and drainage

The municipality is at elevations between 408 and 522 m above sea level, with the lowest elevations along the Pembina River and the highest at Star Mound. The southern portion of the municipality is a flat to gently rolling till plain (Fig. 2). In the northern portion of the municipality the topography changes to a series of hills rising 60 m above the surrounding till plain. These hills form part of the Darlingford end moraine. Other abrupt topographical changes are along the Pembina River Spillway that has eroded into bedrock to a depth of up to 63 metres.

Main drainage is via the Pembina River, which occupies the Pembina Spillway. A series of creeks drain the municipality northwards towards the Pembina River.

Previous work

Early studies by Upham (1890) describe several land forms in the municipality, including Star Mound, Pilot Mound and the Pembina Valley. Elson (1955) mapped the surficial geology and interpreted the Pleistocene history of southwestern Manitoba. These topics and the groundwater resources are discussed by Halstead (1959). The thickness of fine grained sediment, and the geology and topography of buried bedrock surfaces are shown on a series of maps by Teller et al. (1976). Notes on the Quaternary geology and surficial geology are shown on Mineral Resources Division Geological Map AR80-7 (1980) at 1:250 000 scale. Mihychuk and Berk (1988) mapped the aggregate deposits and surficial geology in the adjoining Municipality of Roblin. Conley (1980) mapped the surficial geology and described the stratigraphy of a portion of southwestern Manitoba adjoining the study area. Soils within the municipality are shown by Ellis and Shafer (1943).

Methodology

Geological field investigations were conducted during the summer of 1987. Airphotos at scales of 1:50 000 and 1:15 840 were used to identify potential aggregate deposits. An EM31 resistivity meter was used to help define some deposit boundaries. Samples were sieved to determine grain size between 0.074 and 76.2 mm and pebble lithologies were determined from the 19.1 to 76.2 mm size fraction. Sizes less than 0.074 mm were recorded as the combined silt/clay fraction. Material larger than 76.2 mm was not sampled but was recorded in the field as crushable material. The grain size classification used in this study is shown in Appendix A. Deposit reserve estimates were calculated using the Aggregate Resources Section computer system. Estimated annual demand for sand and gravel was also calculated for the municipality.

Aggregate deposits were divided into two types, 1) aggregate resources; and 2) potential aggregate environments. Deposits are defined as aggregate resources that have been sampled or tested to confirm the presence of sand and gravel. Reserve estimates were calculated for each deposit. Potential aggregate environments consist of untested landforms having the potential to contain sand and gravel. No reserve estimates were calculated for potential deposits.

Acknowledgements

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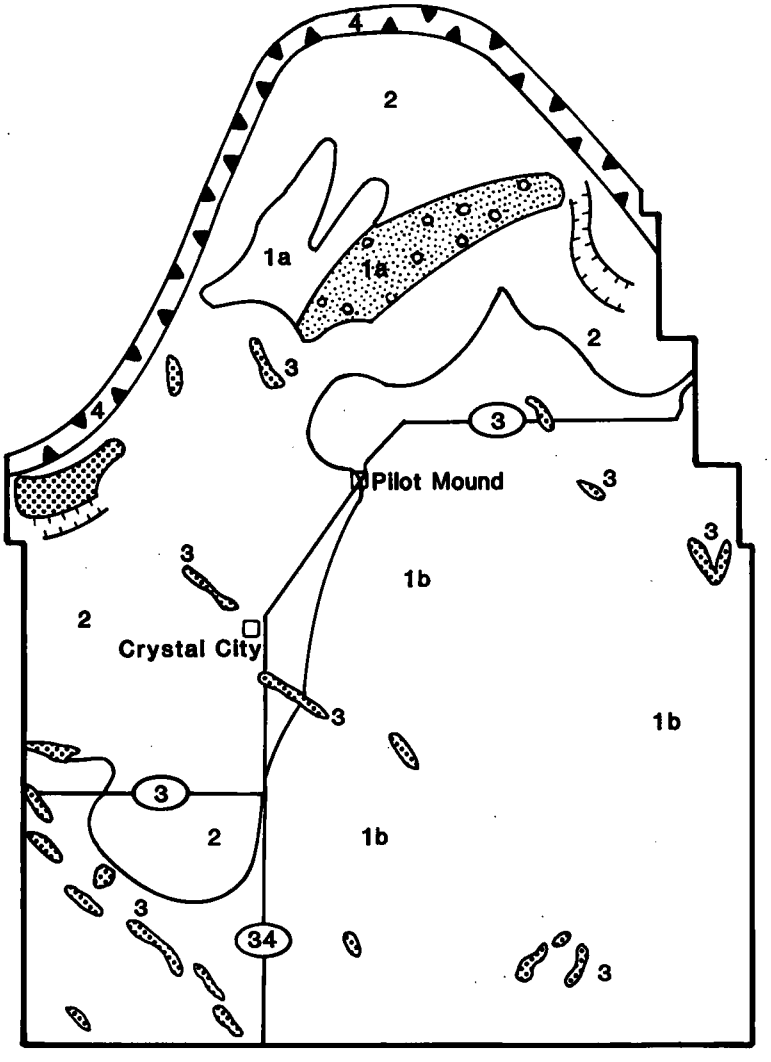
GEOLOGY

Bedrock geology

The municipality is underlain by the Odanah Member shale of the Riding Mountain Formation. The shale is a light, hard, siliceous rock ranging in color from grey or slightly greenish grey when dry to dark greenish grey when moist (Bannatyne, 1970). Outcrops are abundant along the Pembina Spillway, meltwater channels and several creeks. Several outcrops are located adjacent to Balfours and Barbours lakes, evidence that a series of hills south of the lakes may be ice thrust bedrock. Two distinctive bedrock ridges in the vicinity of the Town of Pilot Mound that trend northwest to southeast for a distance of 8 kilometres are interpreted as ice scoured bedrock ridges.

Surficial geology

The generalized surficial geology is shown on Figure 2. Surficial units consist of till, sand and gravel, outwash and alluvium. Till is common throughout the municipality and consists of two types, a brown clay till that covers the municipality south of the Darlingford Moraine, and a grey silty till found within the Darlingford Moraine (Mineral Resources Division Map AR80-7). Sand and gravel deposits consist of glaciofluvial eskers and kames. The eskers consist of a series of discontinuous ridges that trend northwest to southeast and the kames are isolated knolls. Outwash is located in the northern and western portions of the municipality. It is generally less than one metre thick and consists of sand, gravel and silt deposited by proglacial streams. A large outwash plain is located along the Pembina spillway. Minor outwash deposits occur along smaller meltwater channels as terraces and outwash plains. Alluvial deposits consist of silt, clay and organic deposits and are located along the Pembina River spillway.



4 Pembina River Spillway :
alluvium

3 Glaciofluvial :
eskers and kames

2 Outwash :
less than 1m thick, includes
sand, gravel, silt and clay

1 Till :
1b- clayey till
1a- silty till

Moraine, includes till
and ice thrust bedrock

Sand and gravel

Spillway

Meltwater channel

Geological contact

Figure 2: Generalized surficial geology of the study area (modified from Mineral Resources Division Geological Map AR80-7).

AGGREGATE RESOURCES

Introduction

Twenty-one aggregate deposits and 17 potential aggregate deposits were identified, 24 pits were recorded and 11 samples analyzed. In addition, 14 bedrock quarries were identified. The grain size distribution of each sand and gravel sample is shown in Appendix B, and the deposit characteristics are shown in Appendices C and D. Deposit and exposure locations are shown on Map AR89-1 accompanying this report. Additional information concerning sample sites is available upon request from the Mines Branch.

Aggregate resources

Aggregate resources consist of outwash, glaciofluvial deposits and shale bedrock quarries. A major outwash deposit is located along the Pembina River spillway with minor outwash deposits along secondary meltwater channels. The largest outwash deposit is deposit 7420; it contains the largest active pit in the study area at RY325 and a smaller active pit at RY326. This deposit consists of up to 6 m of bedded sand and gravel with a shale content of 52-88 per cent. The remaining outwash deposits are smaller, finer grained and have a higher shale content (92-100 per cent, shale). Deposit 7420 has the best potential for continued use and future development as it is coarser and has a lower shale content than other sand and gravel deposits in the area.

Remaining aggregate reserves are found within glaciofluvial eskers and kames that are concentrated in the southwest portion of the study area and consist primarily of sand and pebbly sand with high shale content. The eskers are ridges up to 3 km long, greater than 6 m high and up to 20 m wide (Fig. 3). The kames are isolated hummocks up to 5 m high consisting of interbedded sand and gravel (Fig. 4).

The third source of aggregate is derived from shale bedrock quarries. The bedrock is exposed along the flanks of meltwater channels and creeks that have eroded into the bedrock and within ice thrust bedrock in the Barbours-Balfours lakes areas. The friable shale bedrock is mined using front end loaders and the shale is applied directly to the road surface without processing. The quarries are small, used intermittently and serve as a local source of aggregate for municipal road resurfacing.

Supply and demand

The demand for sand and gravel was calculated from personal communications with the municipality and Department of Highways. The private sector demand was estimated. Estimated annual demand is shown on Table 1. Total estimated demand is 41 000 cubic metres annually. The demand by the Department of Highways of 19 000 cubic metres annually will fluctuate depending upon specific road improvements.

TABLE 1

Estimated Annual Demand for Sand and Gravel ('000 cubic metres)

R.M. of Louise	20.0
Department of Highways	19.0
Private	2.0
Total	41.0

The supply of sand and gravel, excluding processed shale and untested potential aggregate deposits, is shown on Table 2. Total reserves are estimated at 31.6 million cubic metres. Reserve estimates for each deposit are shown in Appendix C.

TABLE 2

Estimated Supply of Sand and Gravel ('000 cubic metres)

Outwash	19 276
Glaciofluvial	12 379
Total	31 655

There are sufficient reserves within the municipality to meet existing road maintenance requirements such as surfacing gravel municipal roads. The Department of Highways and local concrete manufacturers annually import 8 000 cubic metres of shale free aggregate to meet specialized end uses such as concrete and asphalt. because of the high shale content of all deposits.

Conclusions

A total of 21 sand and gravel deposits have been identified within the study area with estimated aggregate reserves of 31.6 million cubic metres. The high shale content of these resources limits potential end uses. Sufficient reserves are available to meet municipal road resurfacing but specialized end uses require the importation of shale free aggregate. Deposit 7420 shows the highest potential for continued development.

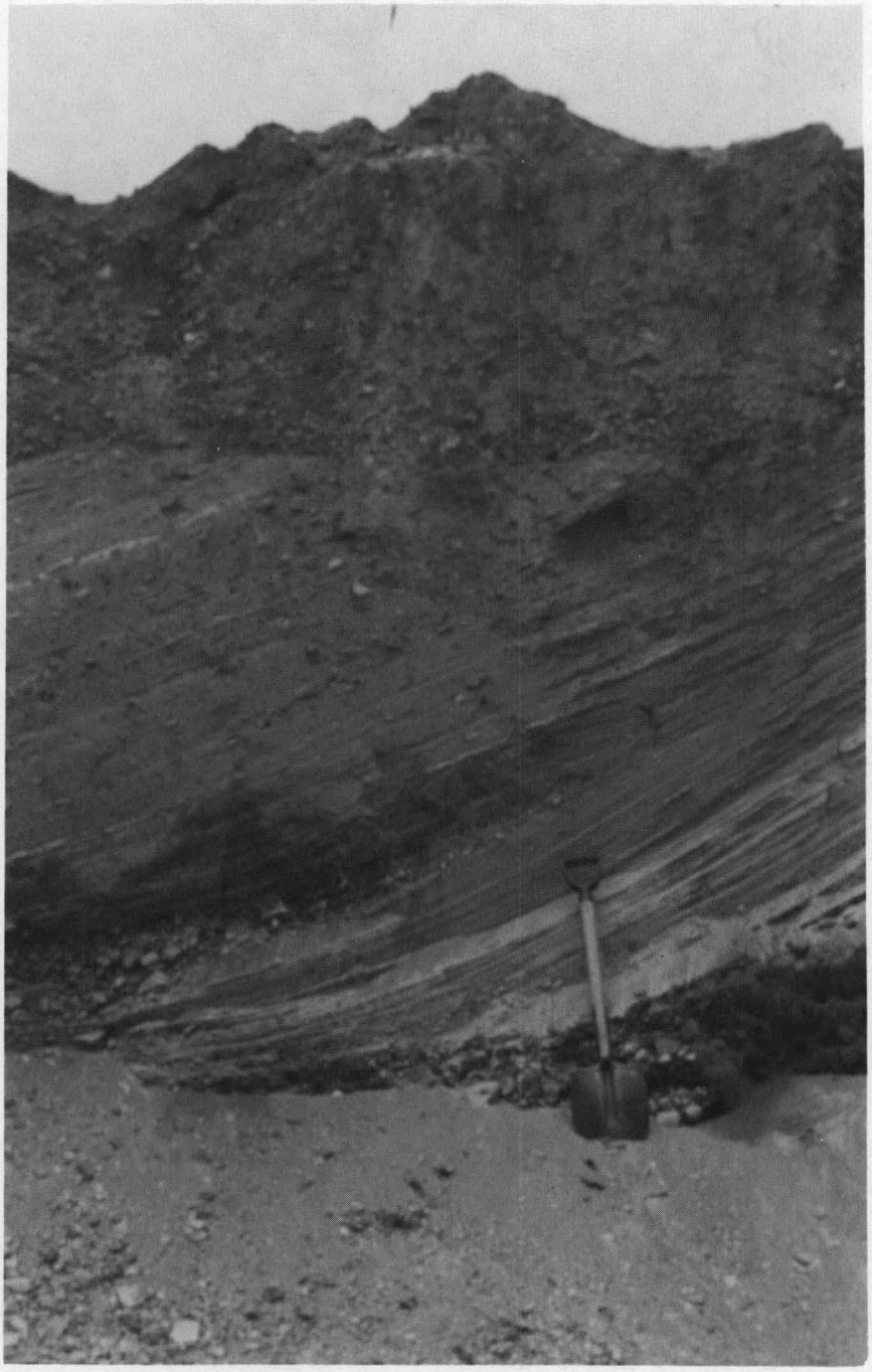


Figure 3: Massive sand and gravel underlain by crossbedded pebbly sand at RY334, esker deposit 7408.

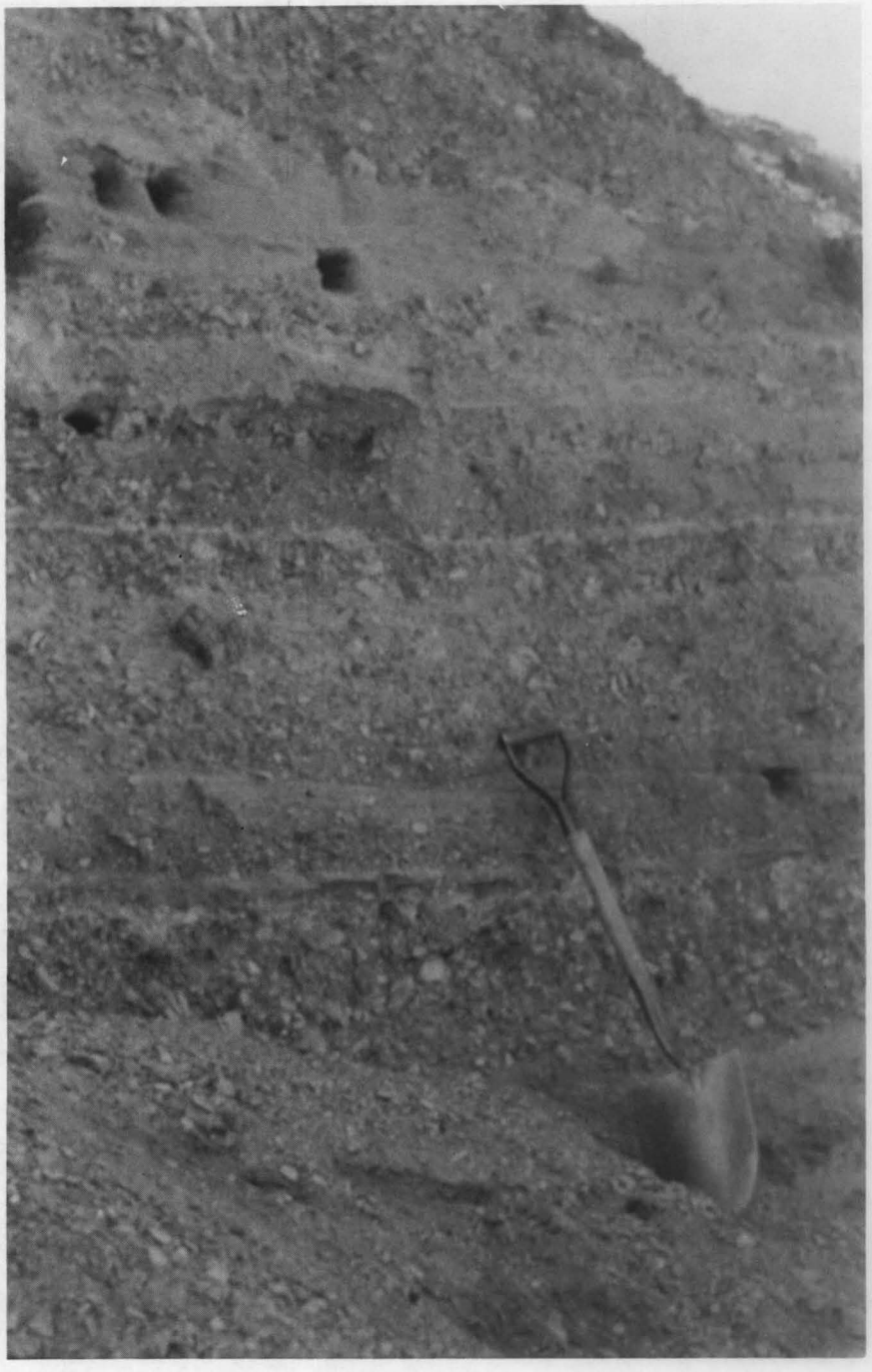


Figure 4: Kame deposit 7415 at RY318 consisting of interbedded sand and gravel. Shovel for scale.

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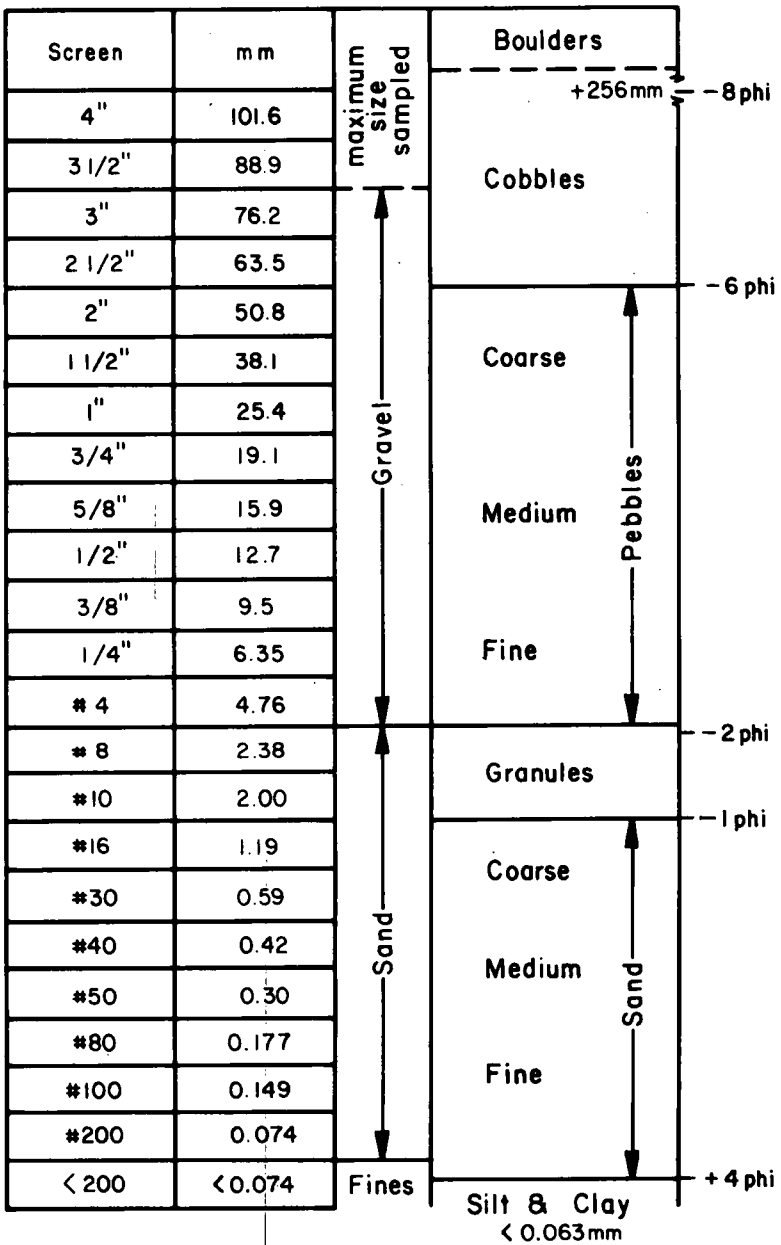
APPENDIX A

Grain Size Classification



APPENDIX B

Grain Size Distribution of Aggregate Samples

Deposit Number	Sample Number	% Stone > 4.76 mm	% Sand 4.76-0.074 mm	% Silt/Clay < 0.074 mm
7407	RY310	27	65	8
7408	RY334	26	69	5
7410	RY309	23	59	18
7411	RY335	31	57	12
7414	RY321	19	71	10
7415	RY318	20	64	16
7418	RY316	25	68	7
7419	RY323	29	46	25
7420	RY325	47	50	3
	RY327	43	48	9
7421	RY328	44	35	21

APPENDIX C

Description of Aggregate Deposits

Deposit Number	Site Number Sampled(s)	Genetic Type	Per Cent Stone > 4.76 mm	Estimated Reserves ('000 m^3)	Comments
7401	RY330	glaciofluvial		465	coarse sand, 7 m deep
7402	RY301	outwash		156	terrace deposit, high shale
7403	RY331	glaciofluvial		341	6 m fine sand
7404	RY312,311	glaciofluvial		1863	3 m pebbly sand
7405	RY329	glaciofluvial		452	4 m pebbly sand, one pit
7406	RY324	glaciofluvial		704	mapped by EM31
7407	RY310S	glaciofluvial	27	2874	6 m pebbly sand
7408	RY334S	glaciofluvial	26	205	4 m bedded sand and gravel
7409	RY319	glaciofluvial		157	3 m massive sand
7410	RY309S	outwash	23	207	4 m interbedded sand, silt, gravel
7411	RY335S	glaciofluvial	31	218	2 m pebbly sand
7412		glaciofluvial		203	pebbly sand
7413	RY322	glaciofluvial		312	fine sand
7414	RY321S	glaciofluvial	19	686	5 m pebbly sand
7415	RY318S	glaciofluvial	20	529	5 m interbedded sand and gravel
7416	RY317	glaciofluvial		238	5 m interbedded sand and gravel
7417	RY315	glaciofluvial		1188	3 m sand and gravel
7418	RY316S	glaciofluvial	25	1104	5 m pebbly sand
7419	RY323S	glaciofluvial	29	840	4 m pebbly sand
7420	RY325S	outwash	47	17739	6 m deep highways pit
	RY327S	outwash	43		2 m pebbly sand
7421	RY328S	outwash	44	1174	6 m bedded sand and gravel
			Total	31 655	

APPENDIX D

Sample Lithology Data
19.1 to 38.1 mm

Deposit Number	Sample Number	Shale %	Precambrian %	Carbonate %	Pebbles Counted
7408	RY310	100			167
7408	RY334	100			100
7410	RY309	99	1		100
7411	RY335	68	22	10	115
7414	RY321	91	6	3	74
7415	RY318	100			123
7418	RY316	100			100
7419	RY323	93	4	3	237
7420	RY325	52	21	27	176
	RY327	88	6	5	111
7421	RY328	92	8		161

APPENDIX E

Glossary

AGGREGATE

Any inert, construction material (sand, gravel, slag, crushed stone or other mineral material).

AGGREGATE RESERVES

Aggregate in a deposit which is proven and is economically signficiant.

ALLUVIUM

Alluvium is a general term for clay, silt, sand, gravel, or similar unconsolidated material deposited during postglacial time by a stream.

BEACH DEPOSITS

These are relatively narrow, linear features formed at the shores of glacial lakes that existed during deglaciation. Well developed beaches are usually less than 20 feet (6 m) thick. The aggregate is well sorted and stratified and sand-sized material commonly predominates.

BEDROCK

In-place pre-Quaternary material exposed at the surface or underlying the surficial material.

BINDER

Material that produces or promotes consolidation in loosely aggregated sediments. Usually mud or clay, sometimes till is used for binder.

CARBONATE ROCKS

A broad term referring to those sedimentary rocks consisting chiefly of carbonate minerals, mainly limestone and dolostone.

CLAST

An individual constituent, grain, or fragment of a sediment or rock, produced by the mechanical weathering of a large rock mass. Synonyms include particle and fragment.

CROWN LAND

Land reserved and administered by the Crown. Sand and gravel usually administered by the Crown.

CROWN SAND AND GRAVEL

Sand and gravel reserved and administered by the Crown.

DELETERIOUS LITHOLOGY

A general term used to designate those rock types which are chemically or physically unsuited for use as construction or road-building aggregates. Such lithologies as chert, shale, siltstone, and sandstone may deteriorate rapidly.

DEPOSIT

An accumulation of sediments left in a new location by a natural transportative agent such as water, wind, ice, or gravity.

An aggregate deposit is a deposit of sand and gravel considered to be of economic significance.

DIRT

See fines.

DOLOMITE (DOLOSTONE)

A carbonate sedimentary rock consisting chiefly of the mineral dolomite and containing relatively little calcite (dolomite is also known as dolostone).

DRIFT

A general term for all unconsolidated rock debris transported from one place and deposited in another; distinguished from underlying bedrock. In North America, glacial activity has been the dominant mode of transport and deposition of drift. Synonyms include overburden and surficial deposit.

DURABLE ROCK

A rock fragment which is hard and inert and can be used as aggregate without breaking, crumbling or reacting with the cementing material.

EOLIAN

Pertaining to wind action.

EPOCH

A geological-time unit longer than an age and a subdivision of a period.

ESKERS

Eskers are narrow, sinuous ridges of sand and gravel. They vary greatly in size. Many eskers consist of a central core of poorly sorted and stratified gravel. The core material is often draped by better sorted and stratified sand and gravel.

FINES

A general term used to describe the size fraction of an aggregate which passes (is finer than) the No. 200 mesh screen (0.074 mm). Also described informally as "dirt", these particles are in the silt- and clay-size range.

FLUVIAL

Pertaining to rivers or streams.

GLACIOFLUVIAL DEPOSITS

Material deposited by streams flowing from, on, or within melting glacier ice, generally composed of sorted, stratified sand and gravel; includes outwash, kame, esker, etc.

GLACIOLACUSTRINE DELTAS

These features were formed where streams or rivers of glacial meltwater flowed into lakes and deposited their suspended sediment. Such deposits tend to consist mainly of sand and abundant silt. However, in near-ice or ice-contact positions, coarse material may be present.

GLACIOLACUSTRINE DEPOSITS

Material deposited in lakes affected by glacier ice or by meltwater flowing directly from glaciers; composed of well-sorted clay, silt, or sand.

GRANULAR BASE COURSE

Components of a road placed on subgrade and designed to provide strength, stability, and drainage, as well as support for surfacing materials. Several types have been defined: Granular Base Course A consists of crushed and processed aggregate and has relatively stringent quality standards in comparison to Granular Base Course B and C which are usually pit-run or other unprocessed aggregate.

GROUND MORAINE

A deposit of till with a flat or undulating surface.

HOLOCENE

An epoch of the Quaternary period covering the time period from the retreat of the continental glaciers to the present, about 10 000 years.

HUMMOCKY

An irregular or knob and kettle surface.

HUMMOCKY MORAINE

A landscape composed primarily of till with a hummocky surface.

ICE-CONTACT DEPOSIT

Material deposited in contact with glacier ice by meltwater; includes kames, eskers, kame terraces, etc.

ICE-CONTACT TERRACES

These are glaciofluvial features deposited between the glacial margin and a confining topographic high, such as the side of a valley. The structure may be similar to outwash deposits.

KAMES

Kames are mounds of poorly sorted sand and gravel deposited by meltwater in depressions or fissures on the ice surface or at its margin. The deposits consist mainly of irregularly bedded and cross-bedded, poorly sorted sand and gravel. Deposits include single mounds, linear ridges (crevasse fillings) or complex groups of landforms.

LACUSTRINE DEPOSIT

Material deposited in a lake.

LITHOLOGY

The description of rocks on the basis of such characteristics as color, structure, mineralogic composition, and grain size. Generally, the description of the physical character of a rock.

MELTWATER CHANNEL

A drainage way produced by water flowing away from a melting glacier margin.

MORAINE

A distinct accumulation of glacial drift. Could represent an ice marginal position.

OUTWASH

Outwash deposits consist of sand and gravel laid down by meltwaters beyond the margin of the ice lobes. They occur as sheets or as terraced valley fills (valley trains) and may be very large in extent and thickness. Well developed outwash deposits have good horizontal bedding and are uniform in grain-size distribution. Outwash deposited near the glacier's margin is much more variable in texture and structure.

PIT RUN

Unprocessed aggregate removed from pit. Generally consists of fine pebble gravel with minor amounts of material coarser than 38 mm (1 1/2"). It is used for road maintenance, upgrading and resurfacing.

PLEISTOCENE

An epoch of the recent geological past including the time from approximately 1.8 million years ago to 10 000 years ago. Much of the Pleistocene was characterized by extensive glacial activity.

QUATERNARY

The second period of the Cenozoic era, thought to cover the last 2-3 million years. It consists of two epochs: The Pleistocene and the Holocene.

RESOURCE

An aggregate deposit or environment which may or may not be proven and is presently not economically significant.

SHALE

A fine-grained, sedimentary rock formed by the consolidation of clay, silt, or mud and characterized by well developed bedding planes, along which the rock breaks readily into thin layers. The term shale is also commonly used for fissile claystone, siltstone, and mudstone.

SPILLWAY

Large drainage valley formed by meltwater flowing from a glacial lake. Spillways often have gravel terraces.

STONE

That component of aggregate coarser than 4.76 mm or the #4 sieve, includes pebbles, cobbles and boulders.

SURFICIAL GEOLOGY

A form of geological mapping dealing with all materials occurring at surface in an area: unlithified or lithified (sediments or bedrock).

TERRACE

A relatively flat, stair-stepped, depositional or erosional surface bounded by an ascending slope on one side and a descending slope on the other.

TILL

Unsorted and unstratified rock debris, deposited directly by glaciers, and ranging in size from clay to large boulders.

WISCONSINAN

Pertaining to the last glacial stage of the Pleistocene Epoch in North America. It began approximately 100 000 years ago and ended approximately 10 000 years ago. The glacial deposits and landforms of southern Manitoba are predominantly the result of glacial activity during the Winsconsinan Stage.