GRANULAR RESOURCE INVENTORY
- MACKENZIE -
MACKENZIE DELTA NTS 107C E/2 W/2
(1:125,000)
Produced for Indian and Northern Affairs
by Dept. of Energy, Mines and Resources

GRANULAR RESOURCE INVENTORY - MACKENZIE

MACKENZIE DELTA NTS 107/C

(1:125,000)

D.E. Lawrence

F.G. Shnay

D.F. VanDine

for - Department of Indian Affairs and
Northern Development

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SUMMARY

The Mackenzie Delta map area contains vast glaciofluvial and marine deposits but the majority of these are fine and medium-grained sands. These deposits are therefore not acceptable as sources of coarse granular material. There are limited amounts of coarse material (gravel) in the southern portion of the area and in the immediate vicinity of Tuktoyaktuk. Sand and gravel deposits are restricted to several areas; adjacent to the East Channel of the Mackenzie River, south west of Eskimo Lakes and east of the Tuktoyaktuk settlement. Exploration for additional material should be directed toward locating lenses and channels of coarse material within the glaciofluvial sand deposits.

The amount of ground ice, the height of material above the water table, and the amount of swamp and muskeg are important considerations in evaluating the availability of material in this area. These factors are highly variable, even within a single deposit, so that, each potential source of material must be studied in detail.

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INTRODUCTION

This report attempts to assess the quantity of granular material available for construction. Only unconsolidated deposits have been considered because bedrock is not exposed within the Mackenzie Delta map area. Glaciofluvial and fluvial materials are usually considered first rate sources of sand and gravel; lacustrine and marine deposits vary in quality; whereas eolian material is of limited use because of its fine texture. Generally, moraines have only been considered where they are known to be hummocky and to contain some coarse material. Terminal moraines are usually considered as a source of granular material whereas ground moraines are not.

The information in this report and on the accompanying map has been compiled largely from published and unpublished manuscripts and personal communication with officers of the Geological Survey of Canada. Supplementary data, especially that concerning depths, thicknesses and, in some cases, the texture of deposits, has been obtained from confidential reports of government departments and industry. See appendix for details on sources of information.

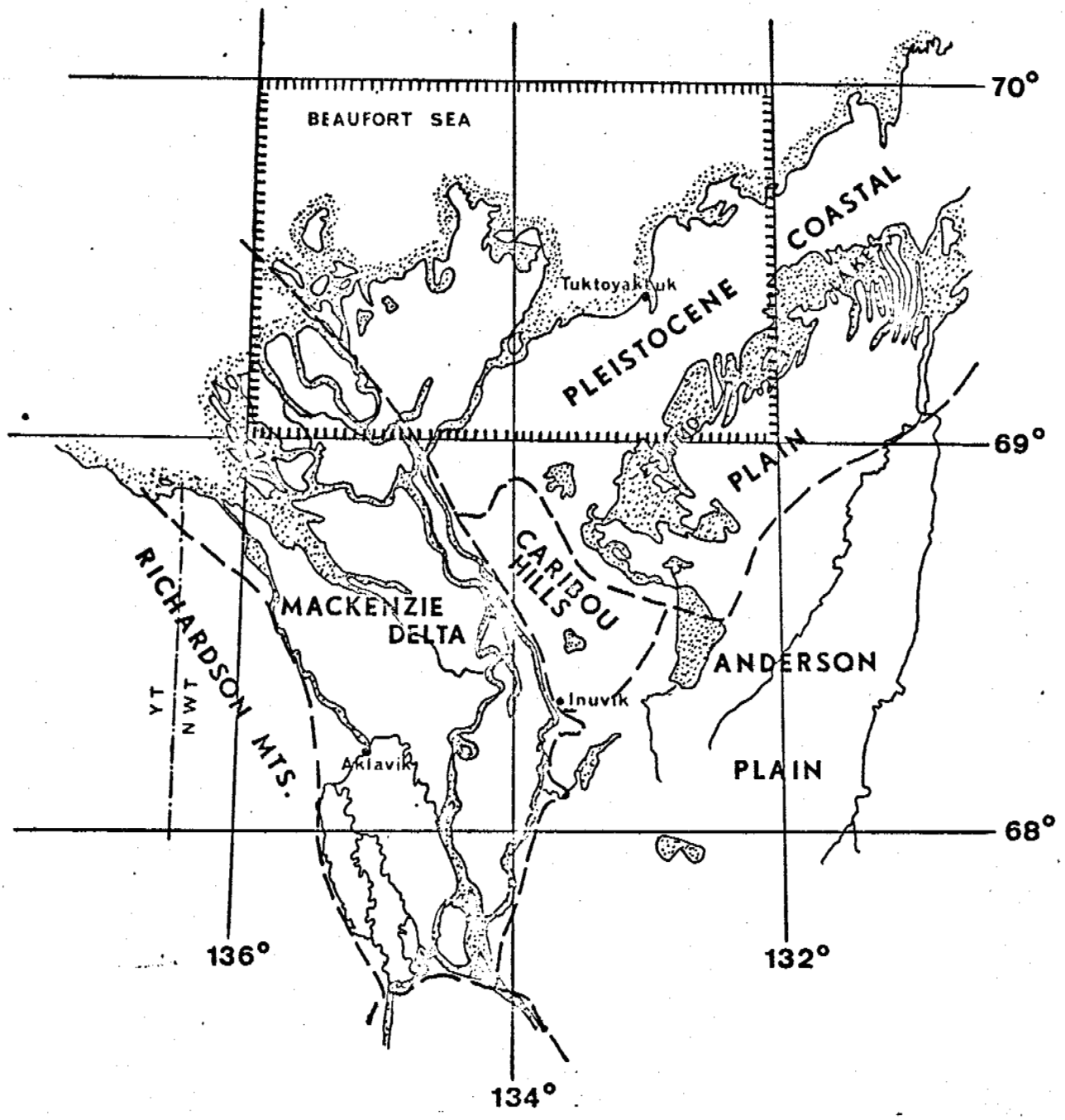
The basic document used as a data source for this compilation is a surficial geology map at a scale of 1:125,000 (Rampton, 1972). It is indexed as GSC Open File number 96 and may be viewed at Geological Survey of Canada offices in Ottawa, Calgary and Vancouver; ozalid copies may be obtained at nominal cost. All areal data are derived from this source; all major, and most minor, unconsolidated deposits of granular material are represented at this scale.

A derivative map for granular material has been produced from the basic surficial geology map in close association with the field geologist. His field observations provide additional data on thickness, texture, ice content, drainage, and the variability of the map units.

To supplement thickness and textural data, additional information was gathered from seismic shot hole records and samples, and from other drill hole logs.

Areal extent of deposits was estimated from the map by planimetric means. Average thickness for each deposit was estimated from the data mentioned above and adjusted using several other variables such as drainage, height above water table, amount of ground ice, etc. From this, the volume of granular material was estimated. All estimated volumes of material appear in a tabular summary in section IV.

For purposes of description, areas of granular material are outlined on a transparent overlay and are numbered to correspond to a tabular summary of materials. Areas which appear to have little material with respect to anticipated demand, or which require more research, are discussed in the report.



MACKENZIE DELTA

PHYSIOGRAPHIC REGIONS

0 miles 50 Scale

after Fyles 1971

GENERAL GEOLOGY AND PHYSIOGRAPHY

Two major physiographic regions are represented on the Mackenzie Delta map sheet (Fig. 1): the Mackenzie Delta to the west and the Pleistocene Coastal Plain to the east (Fyles, 1971). Bedrock is not exposed in the map-area and it is believed that Quaternary and Recent unconsolidated deposits exceed 200 feet (60 m). The majority of the coarse granular material has been deposited or reworked during the two major periods of glaciation.

Thick deposits of deltaic marine sands underlie all other deposits. Above these sands lie glaciofluvial sands and gravels. These deposits are covered in the east by post-glacial lacustrine silts, sands and gravels, and in the west by recent Mackenzie Delta fluvial silts. Marine sand and gravel beach deposits are continually being formed on the Arctic Coast. Small lakes and a hummocky terrain caused by thermokarst activity are prominent features on the Coastal Plain and flood plain lakes cover the Mackenzie Delta. Wind has reworked some areas on the older marine delta forming sand dunes.

Unconsolidated Deposits

Deltaic Marine Deposits, sand $s^{\circ GK}$

Layered deltaic marine sands are exposed primarily at the mouth of the East Channel of the Mackenzie River. Since deposition, glaciers have modified the deposit, thermokarst activity has produced small lakes, and wind erosion has formed sand dunes. The elevation of this area is less than 100 feet.

Fine granular material of this map area averages 20 feet in depth and contains approximately 5 to 10 percent available granular material. Coarser material is found in abandoned stream channels.

Glaciofluvial Deposits F^{G}

These deposits were formed as glacial outwash plains and consist almost exclusively of sand and gravel. In the Mackenzie Delta map-area the glaciofluvial

deposits generally occur immediately north of the Eskimo Lakes and on the southern shore of Richards Island. Gravels were deposited close to the melting ice margin in the southern portion of the map-area; further north from the ice margin, finer materials were deposited. Thermokarst activity has created a hummocky terrain as well as many small lakes.

The sand and gravel has an average thickness of 50 feet. Eighty percent of the gravel deposits are considered usable for construction purposes. Sandy deposits are a much poorer source of material because of texture, ground ice and drainage.

Lacustrine Deposits, sand and gravel L^G

Lacustrine deposits were formed in glacial lakes as the glacier receded. Although they contain silts, sands and gravels, only those areas which have an abundance of sand (s) and gravel (g) are of interest as a source of granular material. These deposits occur north of the Eskimo Lakes and north of the glaciofluvial deposit on Richards Island. Except for the hummocky thermokarst topograhy, these areas have little relief.

The lacustrine deposits of sand and gravel are a good source of granular material. The average thickness is 20 feet of which about 40 percent is available for granular material.

Active Marine Deposits, sand and gravel M^A

Beach sands and gravels are constantly being deposited and eroded by coastal wave and current action. Their average height above sea level is 8 feet and approximately 1 percent of the material is available as a granular resource.

MATERIALS

There are vast areas of glaciofluvial material distributed unevenly throughout the map-area. Most of this material, however, is fine and medium-grained sand. Glaciolacustrine deposits of sand and gravel varying in thickness from 10 to 20 feet are associated with the above units in the Eskimo Lakes basin and west of the East Channel of the Mackenzie River. The material in these units is similar to that of the adjacent glaciofluvial units. Generally, it may be expected that the lacustrine sands and gravels are from 5 to 20 feet thick while the glaciofluvial units are from 10 to 50 feet thick. Additional coarse material may be found as channels or lenses within the glaciofluvial sand units. In many areas ground ice and muskeg will hamper exploitation.

The glaciated marine sands which underlie most of the glaciofluvial units are exposed extensively at Kittigazuit Bay and to the west and northwest along the coast to Mackenzie Bay. These sands are mainly fine grained, coarser and finer material not being found in abundance. The deposits are generally fifty feet or more in thickness. Clayey units are up to 10 feet thick and gravel lenses are up to 2 feet thick.

Recent marine forms are spits, bay head bars, beaches and some near-shore islands. They are composed of sand and gravel, medium and fine sand being the most abundant material. These units are actively forming at present and average between 2 and 8 feet above sea level.

Bedrock is not exposed within this map-area (no bedrock overlay is included).

Sand and gravel is available from glaciofluvial units in the vicinity of Tuktoyaktuk and to the southwest of Pikiolik Lake. Marine gravel units to the southwest of Tuktoyaktuk could provide granular material. The above units are the

only known sources of coarse granular material within a radius of approximately 17 miles from Tuktoyaktuk. Suitable "sand cushion" material could be taken from most glaciofluvial units and would be suitable for road fill or for pipe bedding material. Very little coarse surface material for roads or coarse aggregate for concrete is available from these units.

TABULAR SUMMARY

Description and Material	Area (sq. mi.)	Estimated Average Thickness (ft.)	Estimated Volume of Granular Material ($yds^3 \times 10^6$)	
			total	available
Area I TUKTOYAKTUK				
a) $\underline{sgF^{G}pk}$ glaciofluvial hummocky thermokarst outwash plain; sand and gravel.	3.07	7.5	23.80	14.28
b) $\underline{sgFp^{G} - gF^{G}p}$ glaciofluvial outwash; sand and gravel; local veneer of silt.	0.03	7.5	6.41	3.84
c) $\underline{g\wr r^{A}, gs\wr r^{A}}$ marine spits, bars and beaches; sand and gravel.				
Area II NORTHERN ESKIMO LAKES				
a) $\underline{gFk^{G}}$ glaciofluvial hummocky outwash plain; sand and gravel.	.43	35	15.66	1.09
b) $\underline{sgFk^{G}}$ glaciofluvial hummocky outwash plain; sand and gravel.	1.56	55	89.50	71.60
c) $\underline{sgL^{G}}$ glaciolacustrine plain; sand and gravel.	2.75	20	56.94	22.78

Description and Material	Area (sq. mi.)	Estimated Average Thickness (ft.)	Estimated Volume of Granular Material ($yds^3 \times 10^6$)	
			total	available
Area III LOWER ESKIMO LAKES				
a) $\underline{gF^G_{pk}}$ glaciofluvial thermokarst outwash plain; gravel.	8.47	25	301.15	214.31
b) $\underline{gFr^G}$ glaciofluvial thermokarst outwash plain; gravel.	1.26	80	104.15	83.32
c) $\underline{gFp^G}$ glaciofluvial thermokarst outwash plain; gravel.	.77	35	28.36	19.83
Area IV WESTERN ESKIMO LAKES				
a) $\underline{gFk^G}$ glaciofluvial thermokarst hummocky outwash plain; gravel.	8.15	55	412.05	327.40
b) $\underline{sgL^G}$ glaciolacustrine deposits; sand and gravel.	6.07	20	125.31	50.12
c) $\underline{sgFk^G}$ glaciofluvial thermokarst hummocky outwash plain; sand and gravel.	14.73	55	836.88	669.46
Area V LOWER EAST CHANNEL (EAST)				
a) $\underline{sgFk^G}$ and $\underline{sgFp^G}$ glaciofluvial thermokarst hummocky outwash plain; sand and gravel.	31.71	50	245.64	122.82
b) $\underline{gFk^G}$ glaciofluvial thermokarst hummocky outwash plain; gravel.	.27	30	8.54	6.83

Description and Material	Area (sq. mi.)	Estimated Average Thickness (ft.)	Estimated Volume of Granular Material ($yds^3 \times 10^6$)	
			total	available
Area VI UPPER EAST CHANNEL				
a) $\underline{gFr}^G$ esker; gravel.	.97	20	30.50	24.40
b) $\underline{gsFk}^G$ glaciofluvial thermokarst gravel and sand.	41.03	50	658.67	392.32
Area VII LOWER EAST CHANNEL (WEST)				
a) $\underline{sgFp}^G$ glaciofluvial outwash plain; sand and gravel.	13.89	50	723.84	359.91
b) $\underline{gF}^G$ glaciofluvial outwash plain; gravel.	2.55	30	97.64	63.45
c) $\underline{gsL}$ glaciolacustrine deposit; sand and gravel.	5.44	30	169.53	135.62
Area VIII				
a) $\underline{sgFp}^G$ glaciofluvial outwash plain; sand and gravel; active ice slumps occur on recently steepened slopes.	0.19	50	10.16	5.08
Area IX				
a) $\underline{sgF}^G\underline{pk}$ glaciofluvial thermokarst hummocky outwash plain; sand and gravel.	0.58	50	30.48	15.24

Description and Material	Area (sq. mi.)	Estimated Average Thickness (ft.)	Estimated Volume of Granular Material ($yds^3 \times 10^6$)	
			total	available
Area X MACKENZIE BAY				
a) $\underline{sgFp^G}$ glaciofluvial outwash plain; sand and gravel.	2.73	50	152.42	71.13
b) gsL lacustrine thermokarst basins; gravel and sand.	0.07	30	2.40	1.92
Area XI HOOPER ISLAND				
a) $\underline{sg^A r}$ marine spits, bars and ridges; sands and gravel.	.47	8	3.91	3.12
Area XII PULLEN ISLAND				
a) g Gk marine thermokarst; gravel.	.39	8	3.25	2.60

SOURCES OF INFORMATION

Gulf Oil Canada Limited
1969, 1970: Seismic shot hole data (unpublished).

Imperial Oil Limited
1969, 1970: Seismic shot hole data (unpublished).

Mackay, J.R.
1963: The Mackenzie Delta Area; N.W.T.; Can. Dept. Mines Tech. Survey Geog. Br., Mem. 8.

Rampton, V.N.
1970, 1971: field notes Mackenzie Delta (unpublished); Geol. Surv. Can.

1971: Manuscript Surficial Geology Map of Mackenzie Delta, Geol. Surv. Can., Open File #96.

1971: Surficial deposits of portion of Mackenzie Delta, Stanton, Cape Dalhousie and Malloch Hill map sheets, Geol. Surv. Can. (in preparation).

Prest, V.K., Grant, D.R. and Rampton, V.N.
1967: Glacial Map of Canada; Geol. Surv. Can., map 1253A.

APPENDIX I, Part I

Unconsolidated Granular Materials

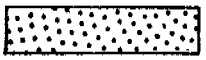
Each map sheet has a surficial geology legend (see appendix I, part IV). The following legend only indicates granular material, classified by genetic characteristics. In some cases, only part of a map unit has been patterned, indicating that only that portion is considered a suitable source for granular material.

Legend

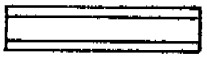
GLACIOFLUVIAL

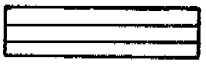

coarse grained granular material, cobbles, pebbles, gravel; may be mixed with some coarse sand.


mixed or interbedded sand and gravel


predominantly sand or sand with undesireable fines

GLACIOLACUSTRINE


gravel, lacustrine

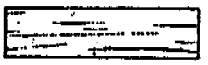

sand and gravel


sand

FLUVIAL

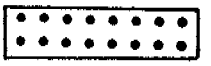

fluvial (only sand and gravel deposits are patterned)

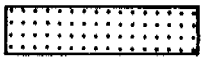
MORAINAL


morainal deposit

MARINE


coarse-grained material, cobbles, pebbles, gravel, may be mixed with coarse sand


mixed or interbedded sand and gravel


predominantly sand or sand with undesireable fines

EOLIAN

usually fine and medium-grained sandy material

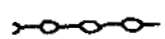
COLLUVIUM

primarily coarse grained material

Symbols

<<<<<<< eskers

* * * * gravel mounds

 morainal ridge found within moraine

APPENDIX I, Part II

Bedrock Geology

(black line overlay)

The rock units which appear on the accompanying overlay are an engineering geological grouping according to gross lithology and age.

These units were derived from a more detailed geological map (whose units were subdivided largely on the basis of airphoto and stratigraphic interpretation (Cook 1972). The units are identified by a two letter identification code. The first character is an upper case letter designating age which is followed by a mnemonic designating gross lithology e.g. Dls - Devonian limestone.

Legend

I - AGE

T - Tertiary

K - Cretaceous

M - Mississippian

D - Devonian

S - Silurian

O - Ordovician

C - Cambrian

P - Precambrian

OS- Ordovician/Silurian

P - Precambrian/Cambrian

II - LITHOLOGY

car - carbonates
limestone and/or dolomite

ss - sandstone

sh - shale

no lower case mnemonic modifier - rocks are undifferentiated

Symbols

Boundary of bedrock unit (approximate)

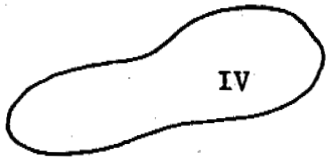
Boundary of bedrock unit inferred in areas of surficial cover

limit of mapping

APPENDIX I, Part III

GRANULAR RESOURCE UNITS

I GRANULAR RESOURCE AREAS (black)



granular resource area

(see text corresponding description)

APPENDIX I, Part IV

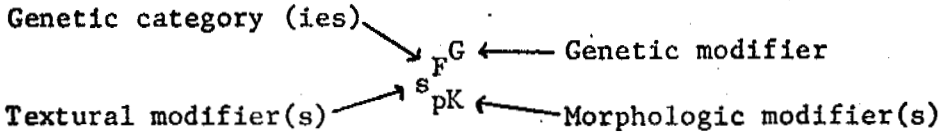
SURFICIAL GEOLOGY AND LANDFORMS

Malloch Hill (97F), Mackenzie Delta (107C), Stanton (107D),

and Cape Dalhousie (107E) map-areas

V.N. Rampton

Landform unit notation



$_{F}^{G}$ $^{s}_{pK}$

$\frac{M}{F}$ Stratigraphic relationship (M overlies F): used when upper unit is thin and irregular and underlying unit is known.

Genetic Categories

C - colluvial
E - eolian
F - fluvial
L - lacustrine
M - morainal
  - marine
O - organic (see symbol for organic)
R - bedrock
U - undifferentiated or unknown, commonly M or L

Genetic Modifiers[1]

G - glacial
A - responsible genetic process still actively affecting area

Textural Modifers

c - clay, clayey
ǵ - silt or interbedded clay silt and fine sand
s - sand, sandy
g - gravel, gravelly
sh - shale

Morphologic Modifiers

e - eroded, gullied
f - fan
h - hummocky
m - rolling
p - plain
r - ridged, beach
t - terrace
v - veneer[2]
G - glaciated[3]
K - thermokarst[5]

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1. Mainly used to separate glaciofluvial deposits (F^{G}) from nonglacial fluvial deposits (F); to separate late Pleistocene glaciolacustrine deposits (L^{G}) from lacustrine deposits of thermokarst origin (L); to indicate areas where the responsible genetic process is still active (A).

2. Veneer indicates known thickness of category is less than 15 feet, commonly only 3 feet or less. Surface is flat or gently rolling.

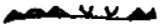
3. Glaciated indicates that map-unit has been topographically modified by glaciation even though till is not always easily identified on surface of map-unit.

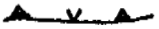
Thermokarst indicates that a hummocky topography has developed as a result of subsidence and erosion where frozen sediments or ground ice have melted.

Symbols


- beach ridge or spit (sand or gravel)

- former beach ridge or spit (sand or gravel; gravel)


- sea cliff or escarpment, ≥ 25 ft., constantly or periodically undercut (v indicates escarpment partly cut in bedrock)


- former sea cliff (partly cut in bedrock)


- abandoned glaciolacustrine shoreline, marked by cliffs beaches, etc.

- stream-cut escarpment, constantly or periodically undercut (v indicates escarpment partly cut in bedrock)


- former stream-cut escarpment (v indicates escarpment partly cut in bedrock)


- standing water covering ≥ 30 percent of area


- organic deposit, 5 to 15 ft. thick


- active, or recently active, blow-out


- ground observation point


- area of aerial observation

- boundaries (defined, approximate, assumed)