GRANULAR RESOURCE INVENTORY

SOUTHERN MACKENZIE VALLEY

KAKISA RIVER, 85 D

GEOLOGICAL SURVEY OF CANADA

98

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DEPARTMENT OF ENERGY, MINES AND RESOURCES

GRANULAR RESOURCE INVENTORY - SOUTHERN MACKENZIE VALLEY KAKISA RIVER (85D) 1:125,000

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Table of Contents

SUMMARY

Coarse natural granular material and competent, crushable bedrock are abundant at certain localities in the Kakisa River map-area. Unconsolidated deposits of glaciofluvial, alluvial, and glaciolacustrine origin contain sand and gravel. Morainal deposits also contain some coarse material along with fine grained till.

Glaciofluvial outwash plain, hummocky, ridged, and esker deposits and a glaciolacustrine beach complex are the best sources of sand and gravel. These deposits are generally well drained, lack organic cover, and are unfrozen.

Alluvial deposits of the Kakisa River and one of its tributaries contain significant amounts of sand and gravel. At certain localities these deposits are well drained and unfrozen.

Morainal deposits with coarse material usually are ridged. Shot hole records show two moraine plain deposits that also contain high percentages of sand and gravel.

Bedrock is at the surface only in the northeastern corner of the map-area near Foetus Lake. At this locality competent bedrock of three formations could be crushed to obtain granular material.

INTRODUCTION

Granular material for construction purposes can be obtained from unconsolidated deposits or competent bedrock. This report will discuss the distribution and physical characteristics of these sources of granular material and will also present an estimate of the quantity of material available in unconsolidated deposits.

Unconsolidated deposits resulting from various geologic processes, i.e. glacier activity, river deposition, wind action, and mass wasting, are a source of natural granular material of gravel (> 2 mm), sand (1/16-2 mm), silt (1/16-1/256 mm), and clay (< 1/256 mm) sizes.

Good natural granular material for construction uses is generally larger than silt size (1/16 mm)[1]. In the southern Mackenzie Valley good granular material comes primarily from deposits of glaciofluvial and glaciolacustrine origin, and secondarily from morainal, eolian, alluvial, and colluvial deposits.

Bedrock that can be crushed by mechanical means can also supply granular material. Competent bedrock suitable for crushing includes limestone, dolomite, sandstone, and certain igneous and metamorphic rock types. Other less resistant rock types, i.e. shale, can be used for fill material but will not be included here as a bedrock source of granular material. In the southern Mackenzie

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[1] Silt and clay size material < 1/16 mm can be used for fill. This material is unlimited in the unconsolidated deposits of this map-sheet and will not be included in the numerical estimate of the quantity of granular material available.

Valley limestone and dolomite are the best sources of rippable bedrock.

Published and unpublished Geological Survey of Canada maps and reports, personal communication with officers of the Geological Survey, and field investigation have provided the basic data for this report. Supplementary information on distribution, thicknesses, and textures of unconsolidated deposits was obtained from unpublished oil and pipeline company shot hole and drilling records (see sources of information, Appendix A).

A Geological Survey surficial geology map at a scale of 1:125,000 (Rutter, N. W., and Boydell, A. N., in press) provided data on location and areal extent of unconsolidated deposits containing good granular material. This map will be indexed as GSC Open File and when published it may be viewed at the Geological Survey of Canada offices in Ottawa, Calgary and Vancouver. Copies will be obtainable at a nominal cost from Riley's DataShare International, 631 - 8 Avenue South West, Calgary, Alberta.

Quantities of natural granular material in unconsolidated deposits have been computed using data on areal extent and thicknesses obtained from the surficial geology map, drilling results, and field observations. Variables such as ground ice and height of water table were considered when deriving final volumes of material available in each deposit[2]. The tabular summary at the end of this report contains detailed volumetric data.

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[2] The area of each deposit was measured on the surficial geology map with a planimeter. The average thickness of the deposit was multiplied by the area to get the total volume of the deposit. Variables, i.e. water table, type of deposit, were assessed to obtain the final percentage of the total volume that is listed in the table as material available for exploitation.

Information on bedrock that can supply granular material comes mainly from Geological Survey of Canada Paper 58-11. Map 28-1958, which accompanies this paper, has been used as a base for indicating competent bedrock that is available at or near the surface.

GENERAL GEOLOGY AND PHYSIOGRAPHY

The northern half of the Kakisa River map-area falls within the Great Slave Plain physiographic region and the southern half is part of the Alberta Plateau (see location map, Figure 1).

Bedrock geology was mapped by the Geological Survey on Operation Mackenzie in 1957 (Douglas, 1959). A reconnaissance surficial geology investigation was undertaken by B. G. Craig as part of this operation (Douglas, 1959; Craig, 1965). A detailed surficial geology map based on airphoto interpretation and field investigations is being compiled by the Geological Survey (Rutter, N. W., and Boydell, A. N., in press).

Bedrock formations[3] are mostly Cretaceous shales and Upper Devonian limestones with minor sandstones.

The Cretaceous shales underlie most of the area and are poor sources of granular material.

The Upper Devonian limestones near Foetus and Two Islands Lakes are competent formations suitable for crushing.

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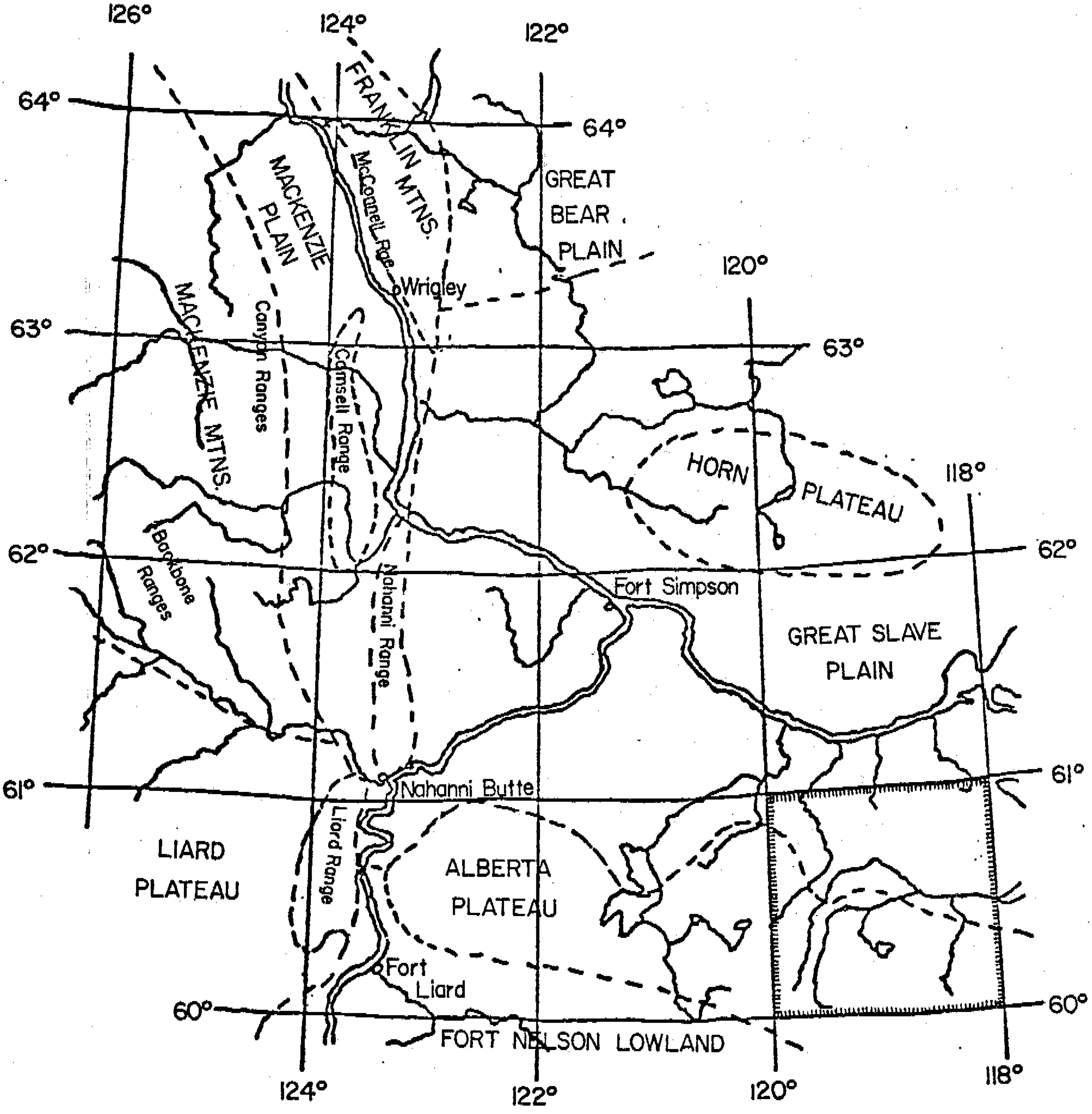
[3] A formation is a bed (of rocks) or assemblage of beds with well-marked upper and lower boundaries that can be traced over a considerable tract of country (Holmes, 1965).



PHYSIOGRAPHIC REGIONS — KAKISA RIVER, 85D

miles 50 Scale

Figure 1

after Bostock 1969

Morainal deposits cover bedrock throughout the area. Shot hole records show them to be at least 50 feet thick in most places[4]. Where this ground moraine covers the nearly flat lying Cretaceous shales there is often poor drainage and thick organic deposits. In addition to the ground moraine cover, glacier activity has produced minor glaciofluvial outwash deposits and glaciolacustrine beach deposits. Rivers and creeks have reworked unconsolidated material into alluvial plain and terrace deposits.

GEOLOGIC DESCRIPTION OF EXPLOITABLE MAP UNITS

Unconsolidated deposits and bedrock that can supply granular material appear on Figures 2 and 3 respectively.

Figure 2 is adapted from a Geological Survey of Canada surficial geology map. Unconsolidated deposits with good natural granular material are labelled with the appropriate map-unit name and assigned a pattern designation (see Figure 2, 2b). Pattern designations are based on geologic origin and texture of material in the deposit. Where map-unit names are used without pattern designations, e.g. some of the Kakisa River alluvial deposits, the deposits either consist almost entirely of material less than 1/16 mm or have frozen ground or extensive swampy organic areas.

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[4]There might be > 50 feet of till over bedrock, but shot holes end at 50 feet if bedrock is not encountered.

Figure 3 is a Geological Survey of Canada bedrock geology map. Bedrock at or near the surface is indicated by heavy dashed lines or an x. Bedrock formations preceded by an asterisk (*) could be crushed to obtain granular material (see legend, Figure 3).

Unconsolidated Deposits

Glacial Deposits

Glaciofluvial deposits contain high quality granular material of gravel and sand size. Glaciolacustrine beach deposits consist mainly of coarse sand and gravel. Morainal deposits are generally fine material, although several moraine plain and ridged deposits contain sand and gravel.

Glaciofluvial Deposits
(Gp, Gpc, Gt, Gh, Gr, Ghr, Gphr, Gr + tMp, $\frac{Gr}{sh}$, esker)

Glaciofluvial deposits scattered throughout the area consist of sand and gravel. They have been indicated by several dot and circle patterns or an esker symbol on the natural granular materials map (see Figure 2).

The capital G in the unit mapped indicates the glaciofluvial origin of the deposit and the lower case prefix denotes the principal types of material, e.g. silt (si), sand (s), and gravel and sand (g). It should be noted that if two prefixes are used, the first refers to the most abundant constituent (see legend for surficial geology maps, Figure 2b).

Topographic expression of the unit is indicated by the suffix attached, e.g. terrace (t), ridge (r), hummocky (h), plain (p). Symbols like esker ( ) also show surface form. Glaciofluvial units vary from flat and gently sloping (Gp, Gt) to hummocky and ridged (Gh, Gr, Ghr, eskers). Thicknesses of glaciofluvial deposits vary from 5 to 50 feet. Eskers are fairly small and a height of 20 feet and width of 30 feet was used in calculating volumes.

Glaciofluvial deposits are generally well drained and have little ground ice or organic cover. Deposits affected by these factors are described in the tabular summary.

Glaciolacustrine Deposits
(Lpbx,)

Only one glaciolacustrine beach deposit is present. The capital L in the unit name indicates its glaciolacustrine origin and the lower case prefixes and suffixes give textural and morphologic information respectively.

The beach deposit (Lpbx) consists of ridges of sand and gravel which rise above the surrounding plain. An average thickness of 27 feet was used in calculating the volume of material. This deposit is well drained, has little organic cover, and is probably unfrozen.

Morainal Deposits
(Mp, Mr, Mpr,)

Morainal deposits have been mapped as M with appropriate textural and morphologic modifiers. Well drained deposits with 3 - 5% coarse material have been assigned a broken line pattern or end moraine symbol () on the natural granular materials map[5]. Also some morainal deposits (Mpr) without pattern designation consist of well drained, fine grained till with occasional ridges of gravel. These deposits could provide good fill material for construction projects even though they are not coarse enough to classify as a granular resource. When thicknesses were unknown a figure of 60 feet was used in volume calculations for material in morainal deposits.

<u>Alluvial Deposits</u>
(Ap, At)

Alluvial deposits consist of silt, sand, and gravel-sized material. Only those with significant coarse material have been assigned a cross-hatched pattern on the accompanying natural granular materials map (see Figure 2). All alluvial deposits are mapped as A with textural and morphologic modifiers.

Alluvial deposits form plains (Ap) with little relief along present river and stream channels and terraces (At) above present channels. Alluvial plain and terrace deposits have varying dimensions. When thickness data was unavailable, an average figure of 8 feet was used for calculating volumes of alluvial plain deposits and 40 feet was used for terrace deposits.

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[5] Two gravelly moraine plain units D-72, D-73 were detected by shot hole records. Only more drilling will outline their exact dimensions.

Alluvial terrace deposits with a pattern designation on the granular materials map generally contain coarse material and are fairly well drained with only minor ground ice and organic cover. Alluvial plain deposits have more fine material and often contain permafrost, e.g. Ap deposits along Kakisa River.

Bedrock

Upper Devonian limestone of three geologic formations can be used to supply granular material. Outcrop areas of these formations are indicated on Figure 3 with heavy dashed lines or an x symbol.

All but the northeastern portion of the map-sheet is underlain by soft Cretaceous shales which are poor sources of construction material. In the northeast near Rabbit, Foetus, and Two Islands Lakes the three competent Devonian limestone units are at or near the surface.

High Quality Bedrock for Construction Materials

Bedrock formations are described in order of their suitability for construction materials.

Unit 21 is an Upper Devonian sandy, silty limestone. It is a tough, well jointed formation and is a good source of crushable rock.

Unit 22, an Upper Devonian sandy limestone, varies in quality with locality and stratigraphic horizon. In the vicinity of Rabbit and Foetus Lakes, the limestone is fine to coarse grained, fossiliferous, and a good source of construction materials.

Unit 20, an Upper Devonian sandy limestone, is a competent formation except for exposures with siltstone and mudstone members.

GEOGRAPHIC DISTRIBUTION OF EXPLOITABLE MATERIALS

All natural granular deposits have been assigned an identification number, e.g. D-1, for use in assembling data (Figure 2). Bedrock formations are shown on Figure 3.

Further details on volume estimates of natural granular material and bedrock resources are found in the tabular summary.

Kakisa River Area

Alluvial and glaciofluvial terrace deposits along Kakisa River and its tributaries contain considerable coarse granular material. Shot hole information indicates at least 40 feet of material in alluvial terraces. It is estimated that these deposits contain 20% usable granular material.

Field observations and shot hole records show 50 feet of sediment in glaciofluvial terraces along the western portion of the river. Forty per cent of the material in these deposits would probably be sand and gravel.

North Central Moraine Area

Moraine plain and ridge deposits in the north central part of the map-sheet contain sand and gravel. Shot holes show coarse material to be 50 feet thick at some localities. Volume calculations were based on the assumption that only 5% of the material in these deposits is coarse with the remainder being fine grained till.

Cameron Hills Glaciofluvial Deposits

Scattered hummocky and ridged glaciofluvial deposits approximately 50 feet thick and 70% usable are found in the southeastern corner of the map-area near the Cameron Hills.

Miscellaneous Deposits

Glaciofluvial plain, ridge, and esker deposits are found at various locations not previously mentioned. Most of the plain and ridge deposits are 50 feet thick and 40 - 70% usable for granular materials. Eskers are 20 feet high, 30 feet wide, and 80% sand and gravel.

A glaciolacustrine beach deposit (27 feet thick and 70% usable material) and competent bedrock for crushing purposes are located in the northeastern corner of the map-area.

TABULAR SUMMARY

	Description & Material	Thickness (ft.)	Area (sq. mi.)	Volumes (Million yd.^{3}) Total	Available
D- 1	Glaciofluvial outwash plain, gravel and sand	50	1.63	85.86	34.27
D-13		50	1.82	95.71	38.28
D-14		50	2.68	141.10	56.44
D-22		50	0.89	46.75	18.70
D-25		50	0.35	18.36	7.34
D-30		50	2.87	151.13	60.45
D-32		50	2.37	124.78	49.91
D- 3	Glaciofluvial outwash plain, channelled, gravel and sand	50	1.20	63.07	25.22
D-19	Glaciofluvial outwash plain, gravel and sand, some ridges	50	9.49	499.63	199.85
D-11	Glaciofluvial outwash plain, gravel and sand, 5 - 15% organic material, possible ground ice	50	4.74	249.56	87.34
D- 4	Glaciofluvial plain deposit, some hommocky and ridged areas, gravel and sand, 5 - 15% organic material, possible ground ice	50	3.96	208.42	72.94
D- 2	Glaciofluvial terrace deposits, gravel and sand	50	6.69	352.24	140.89
D-26		50	0.19	9.86	3.94
D-27		50	0.19	9.86	3.94

	Description & Material	Thickness (ft.)	Area (sq. mi.)	Volumes Total	(Million yd.^{3}) Available
D- 6	Glaciofluvial ridges of gravel and sand	50	0.70	36.72	25.70
D- 7		50	0.50	26.18	18.32
D-12		50	1.05	55.25	38.67
D-31		50	1.40	75.61	51.52
D-60		50	0.89	46.75	32.72
D-71		50	0.97	51.00	20.40
D- 5	Glaciofluvial deposits, hummocky, ridged,	50	9.01	153.17	107.21
D-24	gravel and sand	50	0.97	51.00	35.70
D-23	Veneer of glaciofluvial gravel over shale	5	1.28	7.92	3.16
D-15	Areas of glaciofluvial gravel ridges and	50	3.30	173.74	69.49
D-17	till plain deposits	50	4.39	231.08	92.41
D-18		50	1.24	65.28	42.43
D-20	Glaciofluvial ridges of gravel and sand, some till plain	50	2.99	157.42	102.32
D- 8	Glaciofluvial deposits, hummocky,	50	2.10	110.50	77.35
D-21	gravel and sand	50	1.16	61.03	42.72
D-28		50	0.19	9.86	6.88
D- 9	Glaciofluvial gravel and sand deposits,	50	2.99	157.42	102.32
D-10	hummocky, 5 - 15% organic material,	50	5.09	267.92	174.14
D-29	possible ground ice	50	0.46	24.14	15.69
D-33		50	0.70	36.72	23.86
D-34		50	0.89	46.75	30.38

	Description & Material	Thickness (ft.)	Area (sq. mi.)	Volumes (Million yd.^{3}) Total	Available
D-16	Glaciofluvial gravel deposit, channelled	50	1.24	65.28	26.11
D-57	Esker ridges, sand and gravel	20		0.092	0.07
D-58		20		0.18	0.15
D-59		20		0.092	0.07
D-61		20		0.43	0.34
D-62		20		0.30	0.24
D-63		20		0.09	0.07
D-64		20		0.20	0.16
D-65		20		0.23	0.18
D-66		20		0.17	0.13
D-67		20		0.30	0.24
D-68		20		0.12	0.09
D-35	Alluvial plain deposit, sand and silt	8	1.28	11.88	2.37
D-36	Alluvial plain deposits, sand and gravel	8	0.19	1.74	0.34
D-37		8	0.73	6.78	1.35
D-40	Alluvial plain deposit, very thick, silt, sand and gravel	40	3.15	126.75	25.34
D-38	Alluvial terrace deposit, sand and gravel	40	1.75	70.46	14.09
D-39	Alluvial terrace deposit, silt and gravel	40	0.58	23.27	4.65
D-41	Glaciolacustrine gravel, sand, and silt beach deposit	27	10.61	295.74	207.01

	Description & Material	Thickness (ft.)	Area (sq. mi.)	Volumes Total	(Million $yd.^3$) Available
D-69	Moraine ridge, gravelly or sandy till	20		0.86	0.04
D-72	Morainal plain, till with gravel and	60	5.52	341.80	17.09
D-73	sand lenses	60	32.91	2,038.00	101.92
D-70	Morainal plain of till, gravel ridges, 5 - 15% organic material, possible ground ice	60	2.10	130.00	3.90
D-51	Morainal ridges of till, gravel, and sand,		3.15	29.25	5.85
D-52	5 - 15% organic material, possible ground ice		3.73	34.65	6.93
D-53			0.85	7.89	1.57
D-54			1.71	15.87	3.27
D-55			1.40	12.99	2.59
D-56			0.66	6.12	1.22

Bedrock - limestone of Unit 21 (good)
limestone of Unit 22 (good)
limestone of Unit 20 (good-fair)

Total available volume of natural granular materials - 2340.28 million cubic yards

Appendix A

Sources of Information

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