GRANULAR RESOURCES AND BEDROCK CONSTRUCTION MATERIALS CAMSELL BEND (95J)

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INTRODUCTION

The Camsell Bend map-sheet is bounded by latitudes 62° and 63° N and longitudes 122° and 124°W. Published Geological Survey of Canada maps and reports, and unpublished oil and pipeline company shot hole and drilling records show that natural granular material and rippable bedrock are abundant. However, the distribution of these materials is such that shortages may occur at construction sites in the southern half of the map-area.

High quality, natural granular material suitable for coarse and fine aggregate, granular base, sub-base, and free-draining fill are found primarily in glacial deposits and, to a lesser extent, in eolian and alluvial deposits[1].

GEOLOGIC DESCRIPTION OF EXPLOITABLE MAP UNITS

Granular material occurs as sediments deposited by glaciers, rivers or winds. Bedrock granular materials come from rock that can be mechanically crushed or has been broken down by natural weathering.

Glacial Deposits

The best granular material, both coarse and fine, comes chiefly from the glaciofluvial outwash, but glaciolacustrine deposits are also a potential source of fine material. The glacial till is normally

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1 Definitions:
- a. Glaciofluvial deposits are composed of sediments left by streams flowing from glaciers.
- b. Glaciolacustrine deposits consist of sediment left in lakes fed by meltwater from glaciers.
- c. Morainal tills are deposited directly from glacier ice.
- d. Eolian deposits are sediments transported and deposited by the wind.
- e. Alluvial (fluvial) deposits are deposited by post-glacial rivers and streams.

composed of fine material but in some places has significant amount of gravel.

Glaciofluvial Deposits

(Gp, Gpc, Gpv, Gt, Gtc, Gh, Ghp, Ght, Gr, Gtr, tM Gp + Lp, Gt + Lp, Gp + Ap, esker)

Glaciofluvial gravel and sand deposits are concentrated in the north-central, southwestern, west-central, and northwestern parts of the map-area. Glaciolacustrine sand and silt deposits occur mainly in the south-central and southeastern sections (see Fig. 1a).

All glaciofluvial deposits in the Camsell Bend area consist of sand and gravel. On the surficial geology photomosaic map (95J) those deposits are in solid red, red with blue dots, red with green dots, or a red striped pattern (see Figs. 1 and 1b). The capital G in the unit mapped indicates a glaciofluvial origin for the deposit and a small letter prefix indicates the principal type(s) of material, e.g. silt (si), sand(s), gravel and/or sand (g), till (t). When two prefixes are used, the first refers to the most abundant constituent (see map legend, Fig. 1b).

Topographic expression of a unit is indicated by a suffix, e.g. plain (p), terrace (t), ridge (r), hummocky (h), veneer (pv). Certain symbols, such as (esker), also show surface features.

Glaciofluvial units range from flat and gently sloping (Gp, Gt, Gpv, Gp + Lp, Gpc) to hummocky and ridged [Gh, Ghp, Ght, Gr, Gtr, tM (eskers)] . Thickness ranges from 15 to 150 feet, the thicker deposits occupying mountain valleys. Where no information on thickness was available, an average value of 50 feet was used to estimate the volume of glaciofluvial deposits.

Esker ridges ( ) are sinuous, ridged gravel and sand deposits formed by rivers beneath glacial ice. This gravel and sand is clean, well washed, and well sorted. Eskers vary in height and width and, when exact dimensions were unknown, volumetric calculations were based on a 10 foot width and 10 foot thickness.

The exploitation of certain glaciofluvial deposits may be difficult due to the presence of ground ice (thermokarst -k) and organic deposits (pO, fO). Such deposits are described in the section on the geographic distribution of exploitable materials and in the Granular Resources Estimate sheets.

A conservative estimate of usable granular material recoverable from glaciofluvial units is in excess of 3280 million cubic yards.

Glaciolacustrine Deposits

$$(Lp, \underset{tM}{Lpv}, Lp + Gp, Lp + Ap)$$

Glaciolacustrine deposits consist of sand, silt, and clay. Occasionally they contain scattered pods and lenses of gravel, e.g., Lp + Gp, Lp + Ap units. On the surficial geology photomosaic map they are shown in solid light blue, light blue with red dots, or a light blue striped pattern (see Figs. 1 and 1b). These units are designated with a capital L, indicating the glaciolacustrine origin. The small lettered prefixes and suffixes give textural and morphologic information respectively.

Morainal deposits with significant amounts of coarse material are found in the central and north-central areas. A cluster of small morainal ridges in south-central and southeastern sections might also supply a limited amount of granular material. Till of the ground moraine cover, which mantles most bedrock (eastern

two-thirds of the map-area), has been used in construction of the Mackenzie highway south of Fort Simpson, but it does not contain much coarse granular material.

Glaciolacustrine deposits are generally flat or gently sloping. They sometimes have a discontinuous cover of organic deposits. Ground ice may be present, especially in units having much peat..

Glaciolacustrine deposits range in thickness from 5 feet ($\underset{tM}{Lpv}$ unit north of the Mackenzie River) to 240 feet (Lp units in the mountains) but are generally between 15 and 40 feet thick. An average figure of 23 feet was used in the computations when thicknesses were unknown. Glaciolacustrine deposits are extensive but are not the best source of granular material because they usually lack gravel and often contain ground ice in the top 15 feet. Deposits mapped as Lp + GP (e.g. south side of Mackenzie River) are probably best for exploitation because they contain gravel at depth. An estimate of total glaciolacustrine sand, silt, and gravel is 1145 million cubic yards.

Morainal Deposits

$$(Md,\ Mr,\ tMp + \underset{tM}{SGpv},\ \text{[illegible]},\ \text{[illegible]})$$

Morainal deposits have been labelled with a capital M and appropriate textural and morphologic modifiers. Only morainal deposits with enough gravel to be developed have been coloured yellow or yellow with red dots.

Moraine ridges (Mr), [illegible], [illegible], and two areas of ground moraine (g, tMd, tMp + $\underset{tM}{SGpv}$) probably contain enough gravel to be developed. Large moraine ridges ([illegible]) may be 60 feet in height while small ridges ([illegible]) in the south-central part of the map-area are only

6 feet high. However, even these ground moraine areas do not contain much usable material because of the high silt and clay content in these deposits.

Ice content and organic cover in morainal areas is variable and is controlled largely by topography. Ridged areas are the best drained and hence have less organic cover and ground ice.

The amount of usable granular material that can be recovered from the morainal units is approximately 40 million cubic yards.

Alluvial Deposits

(Ap, At, Af, Afx, $\underset{gGp}{Apv}$)

Alluvial (fluvial) deposits consist of silts, sands and gravels. They are shown in light green, green with red dots, and a green-striped pattern (see Figs. 1 and 1b). All alluvial deposits are labelled A with the appropriate textural and morphologic prefixes and suffixes. The alluvial deposits containing sufficient coarse granular material at the surface to be economic occur along braided streams and bedrock ridges in the western half of the map-area.

Mackenzie River alluvial deposits (plains and terraces) are composed mostly of silt and clay. Gravel bars do occur in the present channel.

Alluvial deposits form plains of low relief along present river and stream channels, terraces (flat surfaces) above present channels, and fans (sloping surfaces) at the base of mountain slopes.

Alluvial plain deposits are 3 to 15 feet thick, and an average of 8 feet was used in volume calculations. The terrace deposits are thicker and range from 3 to 85 feet. A figure of 40 feet was used for most calculations. The terrace deposits locally

contain gravel at depth, but they have a high ground ice content and in many places are covered by organic material.

Fan deposits vary in thickness from 15 to 150 feet. An average of 25 feet was used in volume estimates.

Gravel can be found at depth in alluvial terrace deposits, but its use would entail removal of the thick, fine-grained overlying deposits. The approximate volume of alluvial deposits is 3090.52 million cubic yards.

Eolian Deposits

(Er)

Eolian deposits are small and occur only in southeast and south-central sections of the map-area. They are a source of sand but contain little or no gravel.

A few eolian deposits have been designated as E with appropriate prefixes and suffixes. They are in pink on the surficial geology photomosaic map (see Figs. 1 and 1b). They consist of fine to medium sand and occur as dune ridges (Er) with intervening flat areas. The dune ridges are generally between 15 to 60 feet in height. The area between the ridges sometimes contains organic material, ground ice or ponds, but the sand in the ridges is dry and usable. Estimated volume of eolian deposits is 100 million cubic yards.

Bedrock[5]

Devonian limestone and dolomite from eight geologic formations can be used for construction materials[4]. These limestones and dolomites

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[4]A formation is a bed (of rocks) or an assemblage of beds with a well-marked upper and lower boundary that can be traced and mapped over a considerable distance.

[5]Bedrock information comes from Geological Survey of Canada Paper 61-13 and from discussion with D.K. Norris, Geological Survey of Canada.

occur in the McConnell Range and Willow Ridge in the north-central part of the map-sheet, to the west in the Camsell Range, and in the southwestern corner in the Ram Plateau and Nahanni Range. One poorly exposed limestone unit is found at several localities both east and west of the Mackenzie River. These formations have been coloured on the Geological Survey of Canada bedrock map (Fig. 2).

These competent limestones and dolomites form mountain ridges in the western third of the map-sheet.

The eastern two-thirds of the map-area is underlain by Devonian and Cretaceous shales, siltstones, and mudstones which are not suitable for construction purposes. These soft, incompetent rocks also outcrop in valleys between mountain ranges.

High Quality Bedrock for Construction Materials

The bedrock formations are described in order of their suitability for construction purposes.

The Nahanni Formation, unit 17, is a Middle Devonian limestone. This limitation is fairly competent, and weathers and breaks into blocks three feet square and larger. A few shaly, less competent beds are also present. The Nahanni Formation is approximately 300 feet thick in the northern part of the map-area and is fairly widespread in the mountain ranges.

The Arnica Formation, unit 11, is a Middle Devonian dolomite. It is thick (1,340 feet just north of the map-area) and consists of competent rock suitable for construction purposes. Outcrops are abundant in some mountain ranges, especially the Nahanni Range, the Camsell Range, and the Ram Plateau.

The Middle Devonian Manetoe Formation, unit 12, is stratigraphically above the Arnica and is generally about 175 feet thick. It consists of competent dolomite which is highly fractured and cut by calcite and dolomite veins and which break into slabs and blocks. The Manetoe, which is not widespread, is most abundant in the Camsell Range.

Unit 9, a Devonian dolomite, occurs almost exclusively in the Nahanni Range. It is a silty dolomite, with sandstone interbeds, that varies in thickness from 300 to 900 feet. When accessible, it is a good source of competent rock.

Unit 8, the Devonian dolomite which underlies unit 9, is a strong formation. The rocks of this formation can be porous and vuggy but the material is nevertheless suitable for many construction purposes.

The Devonian Mt. Kindle Formation, unit 7, is found only in the McConnell Range. It could supply good construction material because it is composed of strong, somewhat cherty dolomite. North of the Camsell Bend map-area the formation is 900 feet thick.

Bedrock of Poorer Construction Characteristics.

Two formations, units 14 and 22, can be used as sources of rippable bedrock. Their outcrop pattern and lithology, however, make them less desirable than the six units mentioned above.

The Middle Devonian, Bear Rock Formation, unit 14, is a limestone breccia. It is poorly exposed in the Camsell Bend map-area, where it occurs only in the McConnell Range and Willow Ridge. Parts of the formation break into blocks or even into smaller fragments. The formation is 1,100 feet thick in the Wrigley area, which lies to the south.

The Upper Devonian silty, sandy limestone of unit 22 forms poor construction material, but may be convenient to use where exposed. Throughout the Camsell Bend area, unit 22 is mantled by glacial deposits of variable thicknesses. It is probably nearest to the surface in the northwestern quarter of the map-area.

GEOGRAPHIC DISTRIBUTION OF EXPLOITABLE MATERIALS

All granular deposits have been assigned an identification number, e.g. J-1 (see Fig. 1). Roman numerals I to VIII and geographic names designate groups of natural granular deposits discussed in this report (see Fig. 1a). Geographic names and large letters A to E indicate potential sources of bedrock construction materials (see Fig. 2). Further details, such as volume estimates of groupings and their individual components, can be found in the Resources Estimate section of this report.

Natural Granular Materials

Willowlake River Complex

This area, in the north-central part of the map-sheet, north of the Willowlake River has good potential for finding granular material. The deposits are basically glaciofluvial outwash, but some moraine, lacustrine and alluvial material is present.

Glaciofluvial deposits cover 43.58 sq. miles, morainal plain deposits, with a high percentage of gravel, 20.31 sq. miles, sandy glaciolacustrine deposits 6.60 sq. miles and gravelly alluvial deposits 7.14 sq. miles. Fifteen miles of eskers are also present.

Camsell Bend Outwash

The second most important area for natural granular material lies west of the Mackenzie and North Nahanni Rivers in the west-central and southwestern sections of the map-sheet. This material is composed primarily of sand and gravel of glaciofluvial origin but the relative percentages of gravel and sand are unknown. Ground ice and organic cover may make their exploitation difficult.

Gravelly alluvial plain deposits along the west side of the North Nahanni and the southern part of the Root River have been included. Alluvial plain deposits cover 34.43 sq. miles.

Alluvial terrace deposits along the Mackenzie River are listed, but any gravel within them is found only at depth. They total 13.53 sq. miles.

South Shore Mackenzie River Complex

Although the south-central, southeastern, and southwestern sections of the map contain several coloured units, the area they represent nas little surface gravel. A few glaciofluvial deposits along the east side of the North Nahanni River cover 19.62 sq. miles.

Gravel is also found in till ridges (J-182) and as lenses within glaciolacustrine sands and silts (J-19, J-20). Exploitation of the latter may entail excavating the glaciolacustrine material from adjacent alluvial terraces. A gravel pit near Fort Simpson uses this method.

Sandy glaciolacustrine and alluvial deposits cover 162.31 sq. miles. It should be noted that organic cover and ground ice often affect the potential of the fine-grained sands of the glaciolacustrine and alluvial units in this area.

North Shore Mackenzie River Complex

This complex of deposits covers a wide area in the central, south-central, and southeastern sections of the area. Glaciolacustrine, eolian, and alluvial sand is the chief granular material, but three areas of glaciolacustrine sand (J-21, J-22, J-23) may contain gravel at depth. Glaciolacustrine units account for 201.59 sq. miles, alluvial units 55.71 sq. miles, and eolian units 14.77 sq. miles. Organic cover and ground ice are common in the alluvial terrace units.

Gravelly till (J-175, J-186) may supply coarse material by sieving, although the yield per cubic yard is low. Till units cover 15.16 sq. miles.

Root River Complex

This complex includes minor deposits of glaciofluvial sands and gravels (28.81 sq. miles), alluvial sands and gravels (40.64 sq. miles), and one glaciolacustrine sand area (2.95 sq. miles). These deposits are situated in the west-central and northwestern sections of the map-area, both east and west of the Camsell Range.

Southern Camsell Range Complex

This complex includes all deposits in the west-central and southwestern sections not in unit II. The extent of the deposits involved is fairly small (glaciofluvial 28.06 sq. miles, alluvial 54.83 sq. miles, glaciolacustrine 10.52 sq. miles). The topography, organic cover, and ground ice would hinder exploitation of these deposits.

Willowlake River East Complex

This is a small area of glaciolacustrine sands and glaciofluvial esker deposits in the east-central and northeastern sections of the area. The total area involved is approximately 6.06 sq. miles not including the eskers which are the only good source of coarse material.

Mackenzie River Deposits

This group includes 42.38 sq. miles of glaciofluvial, alluvial terrace, and alluvial plain deposits forming islands along the present channel of the Mackenzie River. Silt and clay are their chief constituents, but the glaciofluvial and alluvial terrace deposits do contain some gravel. Gravel bars are present on some of the islands designated as alluvial plain.

Quantity of Natural Granular Resources

The volumes of sand and gravel for all deposits within the Camsell Bend map-area are depicted in tabular form in the Granular Resources Estimate. The total volume for the entire map area is 7944 million cubic yards. For obvious reasons, no volume estimates are made of the bedrock but information on bedrock sources is presented below.

Willow Ridge and McConnell Range

Limestone of the Nahanni Formation, limestone breccia of the Bear Rock Formation, and dolomite of the Mt. Kindle Formation are well exposed in these two ridges. The Nahanni and Mt. Kindle are the best sources of construction materials, but the Bear Rock can also be used.

Camsell Range

Limestone of the Nahanni Formation and dolomites of the Manetoe and Arnica Formations and unit 9 are exposed and suitable for construction material.

Ram Plateau and adjacent area

Limestone of the Nahanni Formation is the principal source of construction material in this area. Dolomite of the Manetoe and Arnica formations is also present.

Nahanni Range

Dolomite of the Arnica Formation is the biggest potential source of bedrock construction material followed by limestone of the Nahanni Formation. Dolomites of unit 9 and 8 are also available.

Upper Devonian Limestone Unit 22

Unit 22 is limestone which occurs throughout the western half of the area and which is a fair source of construction material, when exposed. It is probably closest to, and in some places within 10 feet of, the surface between Camsell Range and the Mackenzie River in the northwestern quarter of the area. Outcrops are scattered in other areas coloured in green (see Fig. 2).

Granular Resources Estimate

	Description and Material	Thickness (ft.)	Area (sq. mi.)	Volume yds^3 x 10^6 Total	Volume yds^3 x 10^6 Available
Willowlake River Complex					
J- 58		20	10.46	227.01	181.60
J- 59		20	0.85	18.55	12.98
J- 60	mainly glaciofluvial plain, locally hummocky	15	7.39	114.55	74.45
J- 61	and channelled: Sand and gravel	15	9.53	147.70	118.16
J- 62		15	1.55	24.13	16.87
J- 63		15	4.86	75.38	60.28
J- 64		15	8.94	138.65	110.92
Eskers in J- 58 to 64	esker ridges: gravel and sand			(TOTALS) 0.36	0.29
J- 65 J- 66 J- 68 J- 69	esker ridges: sand and gravel			(TOTALS) 0.11	0.08
J-184	drumlinoid ground moraine: gravelly material	60	20.81	1290.00	25.80
J- 13	glaciolacustrine plain: sand, silt	20	1.86	40.53	8.10
J- 14		7	4.74	29.42	5.88
J-158	alluvial plain along Willowlake River channel: gravel and sand, some organic material	40	5.36	216.32	86.52
J-159		40	0.58	23.53	4.70
J-160		40	0.27	10.92	2.18
J-161		40	0.93	37.57	7.51
				I. TOTAL	716.32

	Description and Material	Thickness (ft.)	Area (sq. mi.)	Volume yds^3 x 10^6 Total	Available
	Camsell Bend Outwash				
J- 30		30	5.01	155.50	63.75
J- 46		30	1.82	56.70	14.17
J- 47	glaciofluvial plains and terraces: mostly	75	1.24	96.50	28.95
J- 48	sand; includes gravel deposits (some as	75	1.05	81.50	24.45
J- 49	channel fill); minor organic and glacio-	75	9.53	738.50	221.55
J- 50	lacustrine sands	75	2.21	171.50	51.52
J- 51		75	0.58	45.25	13.57
J- 52		75	0.46	36.25	5.43
J- 31	glaciofluvial plain (gravel and silt)	30	40.14	1244.20	311.05
J- 53	and glaciolacustrine plain (sand and silt): some organic material and ground ice	50	12.75	672.18	134.43
J-177	glaciofluvial plain: silt, sand and gravel; much organic material and ground ice	30	17.19	532.90	106.58
J-178	alluvial terrace, sand and silt possibly under-	40	7.04	283.66	28.37
J-181	lain by glaciofluvial gravels, much organic material and ground ice	3	6.49	20.13	0.20
J-142		80	24.15	2021.49	1455.46
J-149		40	1.47	59.54	8.93
J-150	alluvial plain formed by braided streams and	8	1.28	11.94	8.35
J-151	floodplains: gravel, minor silt	8	3.73	34.71	24.29
J-152		8	1.82	17.01	11.90
J-153		8	1.43	13.83	9.36
J-141	alluvial fans near bedrock ridges: silt, sand, gravel	25	0.54	13.52	6.76
				II. TOTAL	2530.00

	Description and Material	Thickness (ft.)	Area (sq. mi.)	Volume yds^3 x 10^6 Total	Available
	South Shore Mackenzie River Complex				
J- 24		15	3.81	59.05	14.76
J- 25	glaciofluvial and alluvial terraces: gravel	30	1.05	32.60	14.67
J- 26	and sand includes glaciolacustrine sand,	30	6.49	201.30	84.54
J- 27	little ground ice or organic cover	30	4.55	141.10	59.22
J- 28		30	1.59	49.40	20.74
J- 29		150	2.13	331.50	135.91
J- 1		15	6.57	101.50	20.37
J- 8	glaciolacustrine plain: medium to fine sand,	15	14.97	233.10	93.84
J- 9	may contain ground ice.	30	0.77	24.10	7.23
J- 19		12	18.82	233.40	74.68
J- 20		12	49.86	618.24	197.83
J-182	moraine ridges, 6' high: gravel and till			(TOTALS) 0.61	0.31
J- 75	sand and gravel buried beneath alluvial	40	7.78	313.43	62.68
J- 76	terrace along Mackenzie River	40	2.68	108.16	16.22
J- 86		50	3.77	198.73	39.74
J-166	sand, gravel and silt in alluvial terraces along	40	4.66	188.24	18.82
J-167	Mackenzie R.: high ground ice and organic content	40	7.42	299.30	29.94
J-140		8	2.41	22.41	15.68
J-145	N. Nahanni alluvial floodplain and braided	80	1.47	123.66	89.03
J-147	stream bed: gravel	25	0.89	22.16	11.08
J-174	alluvial plain along small steam: gravel	8	4.47	41.58	14.55
J-144	alluvial fans (fairly steep slope) from	25	1.05	26.08	13.04
J-146	N. Nahanni bedrock: mixed sand, gravel and silt	25	0.89	22.16	11.08
J-180	glaciolacustrine veneer, 5 feet deep: sand and	3	27.34	84.75	0.85
J-181	silt over till	3	6.49	20.13	0.20
				III. TOTAL	(1050.00)

	Description and Material	Thickness (ft.)	Area (sq. mi.)	Volume yds^3 x 10^6 Total	Available
	North Shore Mackenzie River Complex				
J- 21	glaciolacustrine material with tendency to slump: sand and silt with some glaciofluvial sands and gravels. Ground ice and some organic material	12	2.95	36.16	11.56
J- 22		35	6.02	224.28	89.71
J- 23		15	13.38	207.35	43.54
J-175A	morainal plain and ridge: probably gravel and boulders plus till	3	11.70	36.29	3.63
J-186		60	3.46	214.60	10.73
J- 2	glaciolacustrine plain; very fine sand and silt	55	1.55	86.76	19.08
J- 3		20	1.78	38.85	15.54
J- 4		15	3.22	50.35	20.14
J- 5		15	0.58	9.05	3.62
J- 6		15	0.27	4.20	1.68
J-10		15	4.43	68.70	-
J- 7	glaciolacustrine plain: very fine sand and silt; thickness varying from veneer to 15 feet.	15	54.14	839.10	335.64
J- 82	sandy, silty alluvial terrace: sand, silt, maybe buried gravel, some ground ice and organic material	40	16.02	645.71	109.76
J- 87		40	2.83	114.40	22.88
J- 90		50	4.43	233.58	35.03
J- 92		40	10.19	410.67	86.23
J-168		40	14.97	603.46	72.41
J-169		40	7.27	293.02	29.30
J-178A	5 foot veneer of glaciolacustrine sand and silt over till	3	25.94	80.41	-
J-179		3	87.33	270.65	27.07
J-163	eolian ridges: mostly fine to medium sand	33	13.34	454.85	90.97
J-164		33	1.01	34.43	8.60
J-165		33	0.42	14.63	3.65
				IV. TOTAL	1040.77

	Description and Material	Thickness (ft.)	Area (sq. mi.)	Volume yds^3 x 10^6 Total	Available
Root River Complex					
J- 32		30	4.34	43.40	17.79
J- 33		45	7.97	370.65	151.96
J- 34	glaciofluvial plain: sand and gravel, some	25	2.87	71.36	28.54
J- 56	colluvial material (silt, sand, and gravel)	80	5.25	439.56	219.78
J- 57	from bedrock ridges. Minor organic content	80	1.51	126.9	63.45
J-176	and ground ice.	8	4.59	42.69	4.27
J-179A		3	1.12	3.50	1.22
J-185		25	1.16	28.96	11.58
J- 12	glaciolacustrine plain: sand and silt	240	2.95	732.80	366.40
J-116	alluvial terrace: gravel and sand	40	2.21	89.31	17.86
J-105		8	2.21	20.61	2.06
J-106		8	6.69	62.22	43.55
J-108	gravelly alluvial plain of braided streams.	8	8.16	75.96	53.17
J-111		8	10.50	97.65	68.35
J-157		8	1.90	17.73	12.41
J-103*		-	-	-	-
J-104*	alluvial fans: gravel, silt, and sand	-	-	-	-
J-107	Slope may affect use	25	1.43	35.68	17.84
J-110	(*Note J-103 and J-104 mostly silt).	25	1.24	30.88	15.44
J-115		25	0.73	18.32	9.16
J- 74A		25	3.38	83.92	41.96
J-112		25	.31	76.80	38.40
J-113	alluvial fans (cont'd)	25	1.12	28.00	14.00
J-114*	(*Note J-114 may be mapped incorrectly,	8	.54	-	-
J-154	therefore volumes not calculated)	25	.11	2.88	1.44
J-155		25	.11	2.88	1.55
				V. TOTAL	1202.07

	Description and Material	Thickness (ft.)	Area (sq. mi.)	Volume $yds^3 \times 10^6$ Total	Available
	Southern Camsell Range Complex				
J- 36		40	4.62	186.55	46.63
J- 37		40	3.03	122.20	48.88
J- 38		40	1.08	43.94	21.97
J- 39	glaciofluvial terrace and plain:	175	2.17	391.50	195.75
J- 40	sand and gravel, minor ground ice	175	2.83	510.40	255.20
J- 41		175	.66	118.90	59.45
J- 42		175	.31	55.68	27.84
J- 43		80	1.28	107.46	53.73
J- 44		80	.54	45.63	22.81
J-170	glaciofluvial plain: sand and silt	40	8.59	346.32	69.26
J-171	thick organic cover	40	2.95	119.08	39.81
J- 16	glaciolacustrine plain, silt and sand,	15	5.60	86.80	17.36
J-173	some organic material and possible ground ice	8	13.92	129.48	45.31
J-117		25	0.11	2.88	1.44
J-118		25	0.46	11.60	5.80
J-119		25	1.59	31.52	15.76
J-120		25	0.38	9.68	4.84
J-122		25	0.35	8.72	4.36
J-123		25	0.31	7.68	3.84
J-124		25	0.84	22.16	11.08
J-125	alluvial fans adjacent to bedrock ridges:	25	1.06	27.04	13.52
J-126	gravel, sand, silt	25	1.43	35.68	17.84
J-128		25	0.70	17.36	8.68
J-129		25	0.23	5.76	2.88
J-130		25	0.42	10.64	5.32
J-133		25	1.01	25.04	12.52
J-133A		25	0.70	17.36	8.68
J-135		25	0.89	22.16	11.08
J-135A		25	0.54	13.52	6.76
J-137		25	1.05	26.08	13.04
J-138		25	0.73	18.32	9.16

	Description and Material	Thickness (ft.)	Area (sq. mi.)	Volume yds^3 x 10^6 Total	Available
J-131		8	5.95	55.35	38.74
J-132	gravelly alluvial plain of braided	8	6.49	60.39	42.27
J-134	streams	8	3.03	28.20	19.74
J-136		8	0.70	6.51	4.55
J-139		8	3.22	30.03	21.02
J-173		8	13.92	129.48	45.31
J-174	sandy alluvial plain: high	8	4.47	41.58	14.55
J-175	organic content	8	4.20	39.06	13.67
				VI. TOTAL	1260.45
	Willowlake River East Complex				
J- 66A				.040	.032
J- 70A	eskers: gravel and sand			.040	.032
J- 71				.080	.064
J- 72				.080	.064
J- 15	glaciolacustrine plain: sand	15	1.16	18.12	-
J- 18	and silt	20	4.90	106.33	23.38
				VII. TOTAL	23.56
	Mackenzie River Deposits				
J- 54	glaciofluvial deposits on	15	3.03	47.00	18.80
J- 55	islands in the Mackenzie River:	15	6.53	101.25	40.50
J-183	sand and gravel	3	0.97	3.01	0.03
J- 95	alluvial terraces on islands in	40	1.75	70.59	10.58
J- 96	the Mackenzie River: sand and silt	40	0.50	20.41	3.06
J- 97	some ground ice	40	4.08	164.58	24.68

	Description and Material	Thickness (ft.)	Area (sq. mi.)	Volume yds^3 x 10^6 Total	Available
J- 78		8	1.40	13.02	1.95
J- 79		8	0.35	3.27	0.34
J- 80		8	3.30	30.75	1.53
J- 81		8	1.12	10.50	0.52
J- 83	alluvial plain in the Mackenzie River	8	6.14	54.15	5.68
J- 84	channel: silt and sand	8	2.17	20.25	2.12
J- 85		8	1.43	13.38	1.40
J- 88		8	1.47	13.74	1.37
J- 89		8	3.30	30.75	3.08
J- 91	alluvial plain in the Mackenzie River	8	1.43	13.88	1.34
J- 93	channel: silty sand	8	2.83	26.40	2.64
J- 99		40	0.58	23.53	4.70
				VIII. TOTAL	124.32

Miscellaneous Deposits

J- 67				.020	.016
J- 70	scattered eskers: sand and gravel			.020	.016
J- 73				.040	.032
				TOTAL	.064

Total sand and gravel resources for the Camsell Bend map sheet = 7943.63 mi. cu. yds.
or 7950 mi. cu. yds.

Bedrock Resources

Formation	Rock Type	Sources of Construction Materials: Suitability	Availability*
A. Willowlake Ridge and McConnell Range			
Nahanni	limestone	good	1
Bear Rock	limestone breccia	fair	2
Mt. Kindle	dolomite	good	3
B. Camsell Range			
Nahanni	limestone	good	1
Arnica	dolomite	good	2
Manetoe	dolomite	good	3
Unit 9	dolomite	good	4
C. Ram Plateau and adjacent areas			
Nahanni	limestone	good	1
Arnica	dolomite	good	2
Manetoe	dolomite	good	3
D. Nahanni Range			
Arnica	dolomite	good	1
Nahanni	limestone	good	2
Manetoe	dolomite	good	3
Unit 9	dolomite	good	4
Unit 8	dolomite	good	5
E. Upper Devonian Limestone Unit 22			
Unit 22	limestone	fair	may be covered by thick or thin glacial deposits

* Most available unit in each area is designated by lowest number.

APPENDIX A

Sources of Information

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Holmes, A.H.
1965: Principles of physical geology; Thomas Nelson and Sons Ltd., London.

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Unpublished, Shot hole reports of oil companies.

Legend (Figure 1C)

	Pencil No.	Major General Symbol	Description
	744	G	glaciofluvial sands and gravel, some silts
	743	E	eolian sands
	740 1/2	L	lacustrine sands and silts, some gravels
	740	Lb	beach sands and gravels
	Any Striped Colour		at least 50% of the area is peat (pO) or fen (fO)
	751	A	alluvial sands and gravels
	735	Mh Mr	hummocky and ridged moraine composed of glacial till
	737	M	marine deposits of sands, silts and clays
	Red 744 Blue Stabilo 8741	G + L	glaciofluvial material with unknown percentage of lacustrine deposits
	Blue 740 1/2 Red Stabilo 8040	L + G	lacustrine material with unknown percentage of glaciofluvial deposits
	Green 751 Red Stabilo 8040	A + G	alluvial material with an unknown percentage of glaciofluvial deposits
	Red 744 Green Stabilo 8043	G + A	glaciofluvial material with an unknown percentage of alluvial deposits
	Yellow 735 Red Stabilo 8040	Mh + G	morainal material with an unknown percentage of glaciofluvial deposits
			eskers, moraine ridges: (sand, gravel)
N 38*		(example)	indicates river stops along Mackenzie and Liard Rivers
38*		(example)	indicates helicopter stops
J-38		(example)	indicate relevant areas where volumetric calculations are made first letter refers to map sheet (eg. 95J).