GRANULAR RESOURCE INVENTORY

SOUTHERN MACKENZIE VALLEY

SIBBESTON LAKE, 95 G

GEOLOGICAL SURVEY OF CANADA

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DEPARTMENT OF ENERGY, MINES AND RESOURCES

GRANULAR RESOURCE INVENTORY - SOUTHERN MACKENZIE VALLEY SIBBESTON LAKE (95G) 1:125,000

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SUMMARY

Many unconsolidated deposits in the Sibbeston Lake map-area contain only fine-grained material. Those with considerable sand and gravel are glaciofluvial in origin and are concentrated in the lowland area between the Nahanni Range and Ram Plateau.

Glaciolacustrine silts are plentiful but in many localities poor drainage and permafrost may make them difficult to exploit.

Till deposits are widespread and those which have the most sand and gravel are found in the northeastern corner of the map-area.

Alluvial deposits of the Tetcela and Nahanni Rivers contain gravel, sand, and silt while those along the Liard River consist mainly of silt and sand. Drilling in terrace deposits of the Liard River might show buried gravels.

Bedrock that can be crushed and used as granular material may be obtained from limestones, sandstones, and dolomites of eleven geologic formations. Most of the competent bedrock units outcrop throughout the Nahanni and Liard Ranges, in the Ram and Liard Plateaus, and in isolated localities along the Blackstone River.

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 granualr 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.

Information on bedrock that can supply granular material comes mainly from Geological Survey of Canada Paper 60-19. Map 23-1960, 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 Sibbeston Lake map-area lies within several physiographic regions. The eastern two-thirds of the area falls within the Great Slave Plain. The Nahanni Range of the Franklin Mountains which trends north-south separates the Great Slave Plain from the Mackenzie Plain to the west. South and west of the South Nahanni River both the Liard Range of the Mackenzie Mountains and the Liard Plateau are represented (see location map, Figure 1).

Bedrock geology was mapped by the Geological Survey on Operation Mackenzie in 1957 (Douglas and Norris, 1961). A reconnaissance surficial geology investigation was undertaken by B. G. Craig as part of this operation (Douglas and Norris, 1961; Craig, 1965). A detailed surficial

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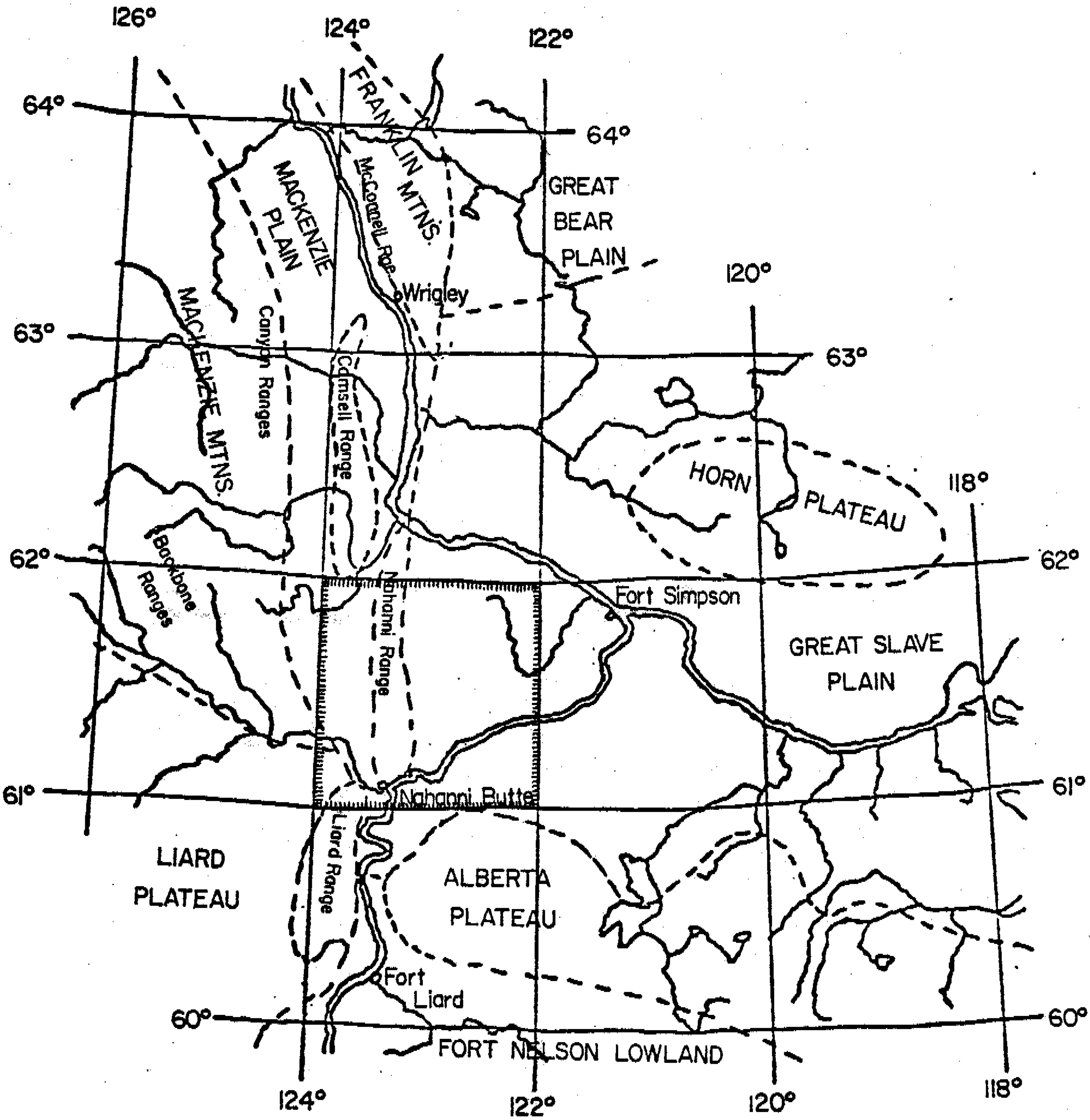
[2] The area of each deposit was measured on the surficial geology map with a planimeter. The average thickness of the deposit was multiplied by the area to get the total volume of the deposit. Variables, i.e. water table, type of deposit, were assessed to obtain the final percentage of the total volume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



PHYSIOGRAPHIC REGIONS – SIBBESTON LAKE, 95G

miles 50
Scale

Figure 1

after Bostock 1969

geology map based on airphoto interpretation and field investigations is being compiled by the Geological Survey during 1972-73 (Rutter and Boydell, in press).

Bedrock formations[3] are basically Paleozoic (Devonian and Carboniferous limestones, dolomites, shales and sandstones) and Mesozoic (Cretaceous shales, siltstones and sandstones).

The shales, sandstones and siltstones which generally occur in lowland areas both east and west of the Nahanni Range are poor sources of granular material.

Competent limestones are found at or near the surface along the western slopes of the Nahanni Range, throughout the Silent Hills, and in the Blackstone River region. Dolomites occur almost exclusively along the eastern slopes of the Nahanni Range.

Morainal deposits mantle the bedrock throughout the lowland areas. In addition to the ground moraine cover, glacier activity has produced glaciofluvial plain, terrace, hummocky, and ridged deposits west of the Nahanni Range and a few small eskers to the east. Lacustrine silts and clays were deposited in glacial lakes west of the Nahanni Range and along the south side of the Liard River. Rivers and creeks have reworked unconsolidated material into alluvial plain and terrace deposits and slope wash has formed alluvial fan deposits at the base of bedrock ridges.

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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 and mapped over a considerable tract of country (Holmes, 1965).

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 Figures 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, the deposits either consist almost entirely of material $< 1/16$ mm or have frozen ground or extensive swampy organic areas.

Figure 3 is a Geological Survey of Canada bedrock geology map. Bedrock at or near the surface is indicated by a solid unit boundary line, 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 sizes. Glaciolacustrine plain deposits consist of silt and sand. Morainal deposits are generally made up of fine material, but some plain, hummocky, and ridged deposits may contain sand and gravel.

Glaciofluvial Deposits
(Gt, Gp, Gpe, Gr, Gh, esker)

Glaciofluvial deposits are composed of good quality sand and gravel. These deposits are most abundant along the Ram, Tetcela, and South Nahanni Rivers. Esker ridges also occur at various localities in the lowland east of the Nahanni Range. Glaciofluvial deposits are indicated by several types of dot and circle patterns or by the 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 type(s) of material, e.g. silt (si), sand (s), and gravel and sand (g). If two prefixes are used the first refers to the most abundant constituent (see legend for surficial geology maps, Figure 2b). Topographic description of the unit is indicated by a suffix, e.g. plain (p), terrace (t), ridge (r), hummocky (h), and veneer (pv). Symbols such as esker (^) also show surface form.

Glaciofluvial units vary from flat and gently sloping (Gp, Gt, Gpe) to hummocky and ridged (Gh, Gr, eskers). An average figure of 50 feet was used in calculating volumes of these units.

Esker ridges (^) are sinuous, ridge deposits formed by rivers beneath glacial ice and are usually composed of clean and fairly well sorted sand and gravel. Eskers in this map-area vary from 30 to 45 feet in height and from 50 to 100 feet in width.

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
(Lp, Lt, Lph, Lrh, $\frac{\mathrm{Lpv}}{\mathrm{Gp}}$)

Glaciolacustrine deposits consist of silt and very fine sand. On the natural granular materials map they have been assigned a striped pattern (see Figure 2). The capital L in the glaciolacustrine map-unit indicates its origin and the lower case prefixes and suffixes give textural and morphologic information respectively.

Glaciolacustrine deposits are generally flat or gently sloping (Lp, Lt, $\frac{\mathrm{Lpv}}{\mathrm{Gp}}$). Many lacustrine deposits contain ground ice especially when much peat is present. Ground ice is also responsible for formation of hummocky (Lph) and ridged (Lrh) lacustrine deposits.

Glaciolacustrine deposits range in thickness from 5 feet[4] ($\frac{\mathrm{Lpv}}{\mathrm{Gp}}$ units) to 100 feet, but in most places the average thickness is 30 feet. Although they are widespread in the Sibbeston Lake area, glaciolacustrine deposits are not the best source of granular material since they lack gravel and usually contain ground ice in the upper 15 feet.

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[4]Glaciolacustrine veneer deposits ($\frac{\mathrm{Lpv}}{\mathrm{Gp}}$; $\frac{\mathrm{Lpv}}{\mathrm{tm}}$) are indicated by map-unit names. They have not been assigned a pattern designation nor included in the tabular summary because they are too thin to exploit economically.

Morainal Deposits
(Mhr, Mph,)

Several morainal deposits containing appreciable amounts of coarse granular material have been shown with a broken line pattern or moraine ridge symbol ( ) on the natural granular materials map (see Figure 2). Ground moraine deposits of varying quality and averaging 60 feet in thickness cover most of the map-area. Some of these deposits would provide good fill material if they are well drained and unfrozen.

Moraine ridges ( ) range from 8 to 45 feet in height and from 40 to 150 feet in width. Percentages of available granular material in these and other morainal deposits are low (5%) because of the high content of silt and clay.

Ice content and organic cover in morainal areas are variable and are controlled largely by topography. Well drained ridged and hummocky deposits with less organic cover and ground ice are generally best to exploit for coarse material or fill.

Alluvial Deposits
(Ap, At, Atc, Af, Afx)

Alluvial deposits consist of silt, sand, and gravel-sized material. Only those with sand or gravel 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 textured and morphologic modifiers. Alluvial deposits with abundant gravel-sized material generally occur in the mountainous western third of the map-area.

Alluvial deposits generally form plains with little 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 range from 10 feet thick in the lowland areas, e.g. along the Martin River, to 30 feet thick in the Nahanni Range. The terrace deposits are slightly thicker and an average thickness of 40 feet was used in volume calculations. Gravelly alluvial terrace deposits are most common in the Nahanni Range. Terrace deposits along the Liard River have sand and silt at the surface, but drilling might show glaciofluvial gravels at depth.

Alluvial fan deposits located adjacent to bedrock ridges are highly variable in composition and thicknesses. An average thickness of 25 feet was used in volume estimates when thickness data was unknown after field investigations.

Bedrock

Devonian limestone, dolomite, and sandstone, and Carboniferous limestone and sandstone from eleven geologic formations can be used to supply granular material. Outcrop area of these formations are indicated on Figure 3 with solid lines, dashed lines, or an x symbol. All of the formations, except for unit 26, occur at or near the surface in the Nahanni Range, Silent Hills, and Ram Plateau. Unit 26 is exposed only along the Blackstone River in the southeastern part of the map-sheet.

Two-thirds of the map-area (east of the Nahanni Range) is underlain mainly by soft Cretaceous and Devonian shales, sandstones, and siltstones which are mantled by glacial drift. A thick drift cover also overlies incompetent Devonian shales in lowland areas west of the Nahanni Range. Both rock type and drift cover in these low areas make them poor localities to find competent bedrock for construction materials.

High Quality Bedrock for Construction Materials

Bedrock formations are described in order of their suitability for construction materials. The Nahanni Formation, unit 22, is a Middle Devonian limestone that is well exposed along the western flank of the Nahanni Range and in the Ram Plateau. Rocks of this formation are fairly competent and weather and break into blocks with dimensions of three feet square and larger. A few shaly, less competent beds are present. The Nahanni Formation ranges from 410 feet thick at Little Doctor Lake to 650 feet thick on the Ram Plateau.

Unit 16 is a Middle Devonian dolomite that occurs in the Nahanni Range. The formation is 2,430 feet thick at Little Doctor Lake and consists of competent rock suitable for construction materials.

Unit 4 outcrops along the eastern side of the Nahanni Range. It is an Ordovician or Silurian formation. The lower part is a massive, reefy, somewhat porous dolomite and the upper part is an argillaceous, medium to thinly bedded dolomite. At Little Doctor Lake about 800 feet of the formation is present. The massive nature of the lower part of this formation might make crushing difficult, but generally the formation is a good source of construction material.

Unit 2 is exposed on the eastern flank of the Nahanni Range. It consists of dolomite interbedded with quartzose sandstone and is Ordovician or older. South of Little Doctor Lake about 500 feet of the formation is exposed. Both sandstone and dolomite members would be good bedrock sources for granular materials.

The upper and middle parts of the Carboniferous Mattson Formation, unit 33, would also provide good granular material. The middle part, unit 33b, is a medium to massive-bedded and thickly crossbedded sandstone. In the southwestern portion of the map-area, it is 800 feet thick at Mattson Gap and 750 feet at Jackfish Gap. Unit 33c, the upper part, is a fossiliferous limestone interbedded with calcareous sandstone, fissile shale, and sandy dolomite. It is 1,230 and 1,730 feet thick at Jackfish and Mattson Gaps respectively.

Unit 19 is Middle Devonian, medium to thickly bedded, massive limestone that is exposed throughout the Nahanni Range. When accessible it could be crushed for granular materials.

Unit 10 is a Devonian or older, silty dolomite that is interbedded with quartzose sandstone. At least 260 feet of the formation is exposed in the eastern slopes of the Nahanni Range.

Unit 18 is a competent Middle Devonian, massive recrystallized dolomite. It is a thin unit with beds seldom thicker than 300 feet and is exposed in the Sibbeston Lake map-area at the northern and southern ends of the Nahanni Range.

Unit 26 is an Upper Devonian sandy limestone. It occurs in the southeast corner of the map-area and is covered by thick drift except for exposures along Blackstone River. When rocks of this formation appear at the surface, they can be used for granular materials.

Secondary Bedrock Sources for Construction Materials

Two formations, units 32 and 30, can be used as sources of rippable bedrock. However, their outcrop patterns and lithologies make them less desirable than the nine units mentioned above.

Unit 32 is a Carboniferous limestone interbedded with argillaceous limestone, calcareous shale, and dolomite. This formation is 1,430 feet thick at Jackfish Gap. Exposures lacking the incompetent calcareous shale member would be best to exploit for granular material.

Unit 30 is a Carboniferous sandstone member interbedded with siltstone and shale. On the Yohin Ridge in southwestern Sibbeston Lake map-area it is 600 feet thick. When siltstone and shale are present this unit would not be good to crush for granular materials.

GEOGRAPHIC DISTRIBUTION OF EXPLOITABLE MATERIALS

All granular deposits have been assigned an identification number, e.g. G-1, for use in assembling data. Roman numerals I to V and geographic names designate groups of natural granular deposits discussed in this report. The lowest Roman numeral applies to the best area of natural granular deposits (see Figure 2). The same system of Roman numerals and geographic names has been used to assemble bedrock information for different localities on the map-sheet (see Figure 3).

Further details on volumetric estimate of natural granular material and types of bedrock available in each Roman numeral area are found in the tabular summary of this report.

I. Silent Hills

This area is located west of the Nahanni Range. Unconsolidated deposits are basically glaciolacustrine and alluvial sand and silt and glaciofluvial gravel and sand. Competent bedrock of five formations is available in the Liard Range, Liard Plateau, Silent Hills, and Ram Plateau.

Volumes of glaciofluvial plain, terrace, hummocky, and ridged deposits have been calculated using a 50 foot average thickness. These deposits were determined to contain 35 - 70% usable material in relation to their total estimated volumes.

Glaciolacustrine plain and ridged deposits are estimated to be approximately 30 feet thick and have 20% available granular material.

Two Lp units (G-6, G-7) on the northwest side of the Nahanni Range are 100 feet thick. Glaciolacustrine terrace deposits (found only in the north end of Area I) are about 100 feet and 40% usable. Glaciolacustrine plain, ridge, terrace, and hummocky units have considerable ground ice and would be difficult to exploit for granular material.

Alluvial plain, terrace, and fan deposits are abundant in Area I. Thicknesses used for volume calculations were 25, 30, and 40 feet for fan, plain, and terrace deposits respectively. Alluvial plains and terraces closer to bedrock highs contain more gravel-sized material and are estimated as 40% usable for granular material. Those with less gravel were calculated using a figure of 20%. Alluvial fan deposits which occur throughout the mountainous regions are estimated as 50% coarse material. Fans with moderate slopes would be easiest to exploit for granular material.

Limestone of the Nahanni Formation, unit 22, dolomite of unit 18, and sandstone and limestone of unit 33 are the best bedrock sources for granular material. Units 32 and 30 may also be crushed but incompetent members in the formations make them less attractive than the three formations mentioned above.

II. Liard River Complex

This area contain much fine-grained material (silt and fine sand) in alluvial and glaciolacustrine deposits. Good gravel-sized material is restricted to a single glaciofluvial plain deposit and two esker deposits. Alluvial deposits of the Liard River might also contain buried gravels. The sandy limestone of unit 26 is the only source of crushable bedrock.

Alluvial plain and terrace deposits are 10 to 40 feet thick and 20% available for granular material. The alluvial fan complex is 25 feet thick and 50% usable.

Glaciolacustrine plain deposits have been estimated as 20% available granular material, but permafrost which is suspected in these deposits might make exploitation of the material difficult.

The glaciofluvial deposit on the eastern edge of this area is about 50 feet thick and 40% coarse material. The two esker ridges are similar in size, 30 feet high and 50 feet wide, and are estimated to be 80% available material.

The sandy limestone of unit 26 which outcrops along the Blackstone River would be a good bedrock source for granular material where it is not covered by thick glacial drift.

III. Nahanni Range

Gravel-sized granular material is common in this area. It is the primary constituent of the glaciofluvial and alluvial deposits. Gravelly till and sandy glaciolacustrine deposits are also present.

Bedrock and bedrock colluvium from seven geologic formations which outcrop in the Nahanni Range can be used to supply good granular material.

Glaciofluvial plain, terrace, and ridge deposits have been observed to be about 50 feet thick and eskers about 30 feet high and 50 feet wide. These eskers and other ridged deposits may contribute from 70 - 80% coarse material. Glaciofluvial terraces and plains are 40% and 35% available granular material respectively.

Alluvial fans are common throughout the Nahanni Range. They consist of gravel and angular rock fragments and are usually about 25 feet thick and 50% available material if slope angles are low. Alluvial plain deposits are somewhat thicker (30 feet) but have a smaller percentage of exploitable granular material (40%).

Morainal deposits are composed of gravelly till and are 50 feet thick and 5% usable.

As in other areas, glaciolacustrine deposits are 30 feet thick and contain 20% granular material.

Limestone and dolomite from units 22, 16, 4, 2, 19, 10, and 18, in the Nahanni Range could supply colluvium and crushable rock.

IV. Martin Hills

Gravelly morainal material, gravelly alluvial material, and glaciolacustrine silt are present near the Martin Hills. Moraine plain and ridged deposits are composed of till, sand, and gravel and are the best sources of granular material. These deposits are generally about 50 feet thick and have a low yield (5%) of coarse granular material. One small alluvial plain deposit has gravel and silt, but is only 10 feet thick and 20% usable. The glaciolacustrine plain deposit consists of silt and fine sand. No competent bedrock is exposed in this area.

V. Sibbeston Lake Till Plain

Good granular material is scarce here and occurs only in scattered glaciofluvial and alluvial deposits. The alluvial plain deposits are only 10 feet thick and have 20% available coarse material and the glaciofluvial ridge deposit is 50 feet thick and 40% usable. Eskers in this area are 45 feet high and 100 feet wide with 80% coarse material. No bedrock source of granular material is present in this portion of the Sibbeston Lake map-area.

TABULAR SUMMARY

	Description & Material	Thickness (ft.)	Area (Sq. mi.)	Volumes Total	(Million yd.^{3}) Available
	I. Silent Hills				
G- 26	Glaciofluvial terrace deposits,	50	1.36	71.61	28.64
G- 27	gravel and sand	50	0.58	30.54	12.21
G- 28		50	1.36	71.61	28.64
G- 42		50	3.15	165.87	66.35
G- 43		50	0.66	34.75	13.90
G- 44		50	1.08	56.87	22.74
G- 29	Glaciofluvial plain deposits,	50	3.38	177.98	71.19
G- 30	gravel and sand	50	4.94	260.13	104.05
G- 33		50	0.77	40.54	16.21
G-100		50	1.05	55.25	22.10
G- 46	Glaciofluvial plain deposit, gravel and sand 5 - 15% organic material	50	5.01	263.82	92.33
G- 36	Glaciofluvial plain deposit, sand and silt	50	3.73	196.41	78.56
G- 31	Glaciofluvial hummocky deposits,	50	0.97	51.07	35.75
G- 32	gravel and sand	50	1.36	71.61	50.12
G- 35	Glaciofluvial hummocky deposit of sand; sandy, silty glaciolacustrine plain between hummocks	50	4.27	224.85	67.45

	Description & Material	Thickness (ft.)	Area (sq. mi.)	Volumes (Million yd.^{3}) Total	Available
G- 34	Glaciofluvial ridged deposit, gravel	50	0.46	24.22	16.95
G- 45	Glaciofluvial plain deposit, gravel; veneer of sandy, silty glaciolacustrine material	50	4.94	260.13	91.04
G- 1	Glaciolacustrine plain deposits, silt	30	5.25	162.60	35.52
G- 3		30	13.30	411.98	82.39
G- 6		100	10.69	1,092.74	218.54
G- 12		30	1.01	31.28	6.25
G- 19		30	14.19	439.55	87.90
G- 7	Glaciolacustrine plain deposits, sand and silt	100	25.28	2,584.14	516.82
G- 9		30	12.79	396.18	79.23
G- 14		30	5.13	158.90	31.78
G- 17		30	10.81	334.85	66.97
G- 16	Glaciolacustrine plain deposits, hummocky, sand and silt; frozen ground	30	14.51	449.15	89.83
G- 18		30	21.39	662.57	132.51
G- 8	Glaciolacustrine plain deposit, silt and sand; 5 - 15% bedrock	30	12.48	386.58	77.31
G- 2	Glaciolacustrine terrace deposits, silt	100	1.51	154.35	61.74
G- 4		100	1.40	143.10	57.24
G- 5		100	4.27	436.48	174.59
G- 10	Glaciolacustrine ridge deposits, hummocky, sand and silt; frozen ground	30	9.06	280.64	56.12
G- 11		30	3.89	120.49	24.09
G- 13		30	10.96	339.40	67.89
G- 15		30	18.08	560.00	112.00

	Description & Material	Thickness (ft.)	Area (sq. mi.)	Volumes Total	(Million yd.^{3}) Available
G- 73	Alluvial terrace deposits, gravel and sand	40	0.54	21.74	4.35
G- 96		40	2.84	114.27	45.71
G- 98		40	0.97	39.00	15.60
G- 99		40	11.75	437.07	189.23
G-104		40	0.70	28.08	11.23
G-110	Alluvial terrace deposit, gravel and sand; 50% bedrock	40	2.72	109.46	43.78
G-106	Alluvial terrace deposit, gravel, sand, and silt	40	4.71	189.54	75.82
G- 74	Alluvial terrace deposit, sand and silt	40	0.39	15.70	3.14
G- 76	Alluvial plain deposits, gravel and sand	30	24.90	771.30	154.26
G- 79		30	0.04	1.23	0.49
G- 81		30	0.89	27.50	11.00
G- 82		30	0.43	13.30	5.32
G- 97		30	17.93	555.30	222.12
G-105		30	13.23	409.80	163.92
G-114		30	9.37	290.20	116.08
G- 87	Alluvial plain deposit, gravel and sand; 5 - 15% bedrock	30	3.89	120.40	48.16
G- 88	Alluvial plain deposit, sand and silt	30	4.05	125.40	25.08
G-107	Alluvial plain deposit, silt and gravel; 5 - 15% bedrock	30	4.24	131.30	52.52

	Description & Material	Thickness (ft.)	Area (sq. mi.)	Volumes Total	(Million yd.^{3}) Available
G- 94	Alluvial fan deposits, rock and gravel	25	0.43	10.64	5.32
G- 95		25	0.93	23.04	11.32
G-103		25	0.39	9.60	4.80
G-108		25	0.39	9.60	4.80
G-111		25	0.89	22.00	11.00
G- 90	Alluvial fan deposits, gravel and sand	25	1.56	38.64	19.32
G- 93		25	1.98	49.04	24.52
G- 80		25	0.66	16.32	8.16
G- 92	Alluvial fan deposits, till and gravel	25	1.32	32.64	16.32
G-109		25	0.66	16.32	8.16
G- 89	Alluvial fan complex deposits, rock and gravel	25	0.58	14.32	7.16
G-112		25	1.98	49.04	25.52
G-113		25	2.76	68.32	34.16
G-124		25	0.78	19.29	9.64
G-125		25	0.58	14.32	7.16
G-126		25	0.19	4.64	2.32
G- 75	Alluvial fan complex deposit, gravel and sand	25	1.16	28.91	14.45

Bedrock - limestone of unit 22 (good)
sandstone and limestone of unit 33 (good)
dolomite of unit 18 (good)
limestone of unit 32 (fair)
sandstone of unit 30 (fair)

I. TOTAL 4,184.44

	Description & Material	Thickness (ft.)	Area (sq. mi.)	Volumes (Million yd.^{3}) Total	Available
	II. Liard River Complex				
G- 48	Glaciofluvial plain deposit eroded; gravel	50	5.01	263.82	105.52
G- 49	Esker deposits, gravel and sand			0.74	0.59
G- 49a				0.37	0.30
G- 22	Glaciolacustrine plain deposits,	30	8.28	256.48	51.29
G- 23	silt and fine sand	30	7.89	244.40	48.88
G- 24		30	85.73	2,655.50	531.11
G- 60	Alluvial terrace deposits,	40	0.97	39.00	7.80
G- 61	silt and sand	40	0.16	6.37	1.27
G- 63		40	1.63	65.63	13.12
G- 69		40	18.71	753.42	150.68
G- 62	Alluvial terrace deposit, channelled;	40	1.56	62.81	12.56
G- 64	silt and sand	40	9.22	371.27	74.25
G- 65	Alluvial plain deposits, silt and sand	30	3.46	107.10	21.42
G- 66		30	7.39	228.90	45.78
G- 67		30	0.89	27.50	5.50
G- 68		30	1.09	33.70	6.74
G- 70		30	0.70	21.60	4.32
G- 71		30	1.91	59.10	11.82

	Description & Material	Thickness (ft.)	Area (sq. mi.)	Volumes Total	(Million yd.^{3}) Available
G-127	Alluvial plain deposit, silt and gravel	10	6.03	56.07	11.22
G-123	Alluvial fan complex deposit, rock	25	0.39	9.60	4.80
	Bedrock - sandy limestone of unit 26 (good)				
				II. TOTAL	1,108.97
	III. Nahanni Range				
G- 39	Glaciofluvial terrace deposits, gravel and sand	50	0.62	32.64	13.05
G- 40		50	3.89	204.84	81.93
G- 37	Glaciofluvial ridge deposits, gravel and sand	50	0.62	32.64	22.85
G- 41		50	6.41	337.54	236.28
G- 38	Glaciofluvial plain deposit, gravel and sand; 5 - 15% organic material	50	2.68	141.12	49.39
G- 50	Esker deposit, gravel and sand			1.31	1.05
G- 20	Glaciolacustrine plain deposits, sand and silt	30	2.10	65.05	13.01
G- 21		30	1.40	43.36	8.67
G- 83	Alluvial plain deposit, gravel	30	1,09	33.76	13.50

	Description & Material	Thickness (ft.)	Area (sq. mi.)	Volumes Total	(Million yd.^{3}) Available
G- 84	Alluvial fan deposit , rock and gravel; associated with alluvial plain deposit, gravel and sand	25	3.23	80.00	40.00
G- 86	Alluvial fan complex, gravel; associated with alluvial plain deposit, gravel	25	0.78	19.28	9.64
G- 85	Alluvial fan complex, rock and gravel	25	7.97	197.44	98.72
G-115		25	0.39	9.60	4.80
G-116		25	0.39	9.60	4.80
G-117		25	0.39	9.60	4.80
G-118		25	0.19	4.64	2.32
G-119		25	0.19	4.64	2.32
G-120		25	0.19	4.64	2.32
G-121		25	0.39	9.60	4.80
G-122		25	0.39	9.60	4.80
G- 77	Alluvial fan complex	25	0.04	0.99	0.49
G- 78		25	0.04	0.99	0.49
G- 91	Alluvial fan deposits, rock and gravel	25	0.54	13.36	6.68
G-101		25	0.39	9.60	4.80
G-102		25	0.39	9.60	4.80

	Description & Material	Thickness (ft.)	Area (sq. mi.)	Volumes Total	(Million yd.^{3}) Available
G- 55	Moraine deposits, hummocks and ridges of	50	6.72	353.86	17.69
G- 56	till and gravel	50	4.94	260.13	13.00
	Bedrock - limestone of unit 22 (good) dolomite of unit 16 (good) dolomite of unit 4 (good) dolomite of unit 2 (good) limestone of unit 19 (good) dolomite of unit 10 (good) dolomite of unit 18 (good)				
				III. TOTAL	667.00

IV. Martin Hills

G- 25	Glaciolacustrine plain deposit, silt and sand	30	17.07	528.76	105.75
G- 57	Alluvial plain deposit, gravel and silt	10	1.28	9.29	1.86
G- 53	Morainal plain deposit, hummocky; till, sand, and gravel ridges included	50	25.32	1,333.33	66.66
G- 54	Morainal plain deposit, hummocky, till, sand, and gravel	50	4.66	245.39	12.26
	Bedrock - none				
				IV. TOTAL	186.53

	Description & Material	Thickness (ft.)	Area (sq. mi.)	Volumes Total	(Million yd.^{3}) Available
	V. Sibbeston Lake Till Plain				
G- 47	Glaciofluvial plain deposit, sand and gravel	50	1.24	65.29	26.11
G- 51	Esker deposits, sand and gravel			8.71	6.97
G- 52				0.73	0.59
G-128				0.37	0.30
G- 58	Alluvial plain deposit, gravel and silt	10	4.98	46.27	9.25
G- 59	Alluvial plain deposit, sand and gravel	10	7.51	69.78	13.96
G- 72	Alluvial plain deposit, sand and silt	10	5.84	54.28	10.85
	Bedrock - none				
				V. TOTAL	68.03

Total natural granular material resources for Sibbeston Lake map-sheet = 6,214.97 million cubic yards*

Appendix A

Sources of Information

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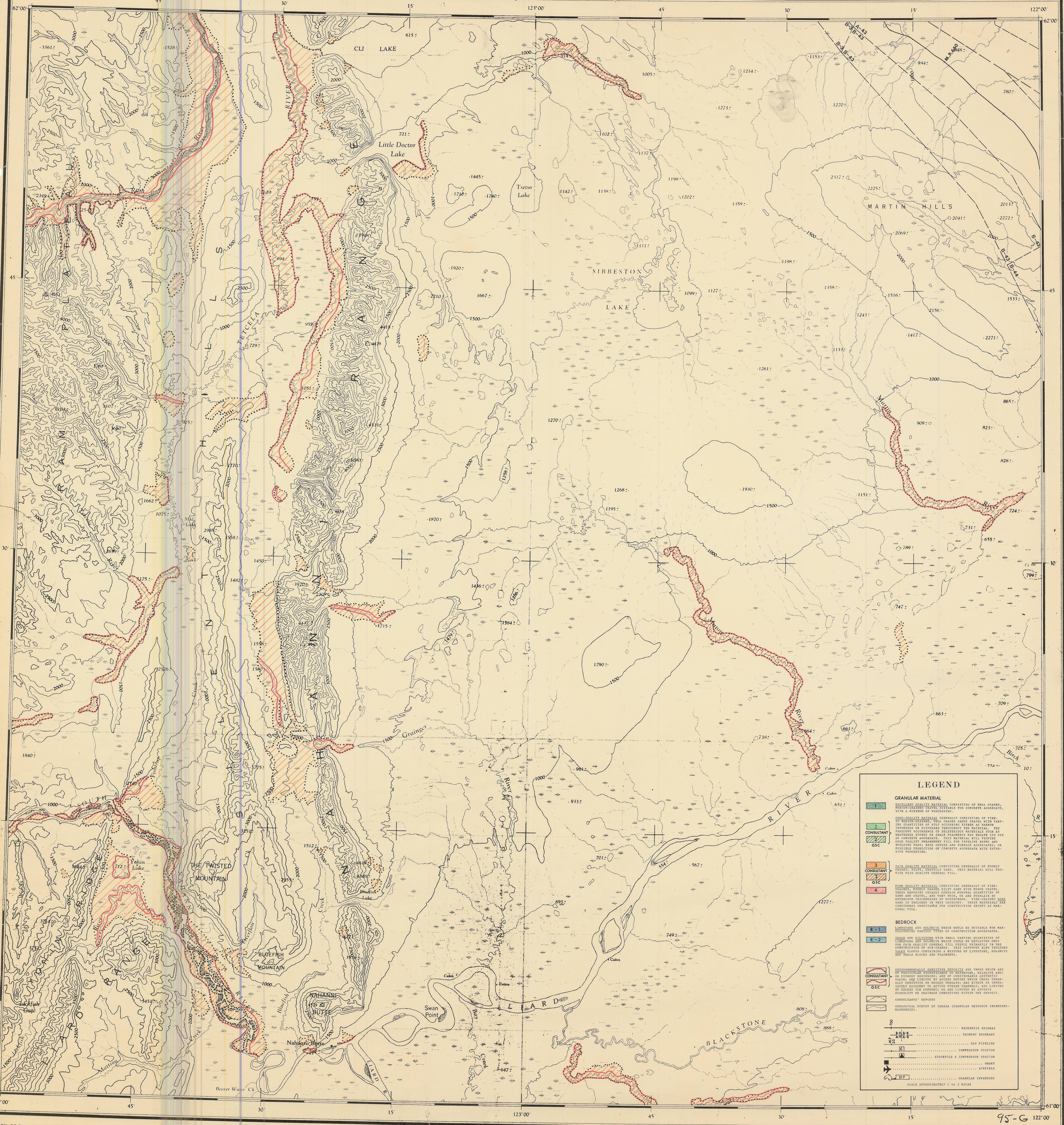


ATION OF THE COMPASS NEEDLE, 1960.

Produced by the ARMY SURVEY ESTABLISHMENT, R.C.E. 1952-60.
Aerial photography 1949.

SIBBESTON LAKE

DISTRICT OF MACKENZIE

NORTHWEST TERRITORIES

Scale 1 : 250,000

Contour Interval 500 Feet
Elevations in Feet above Mean Sea Level
Transverse Mercator Projection
North American Datum 1927
Preliminary 1952

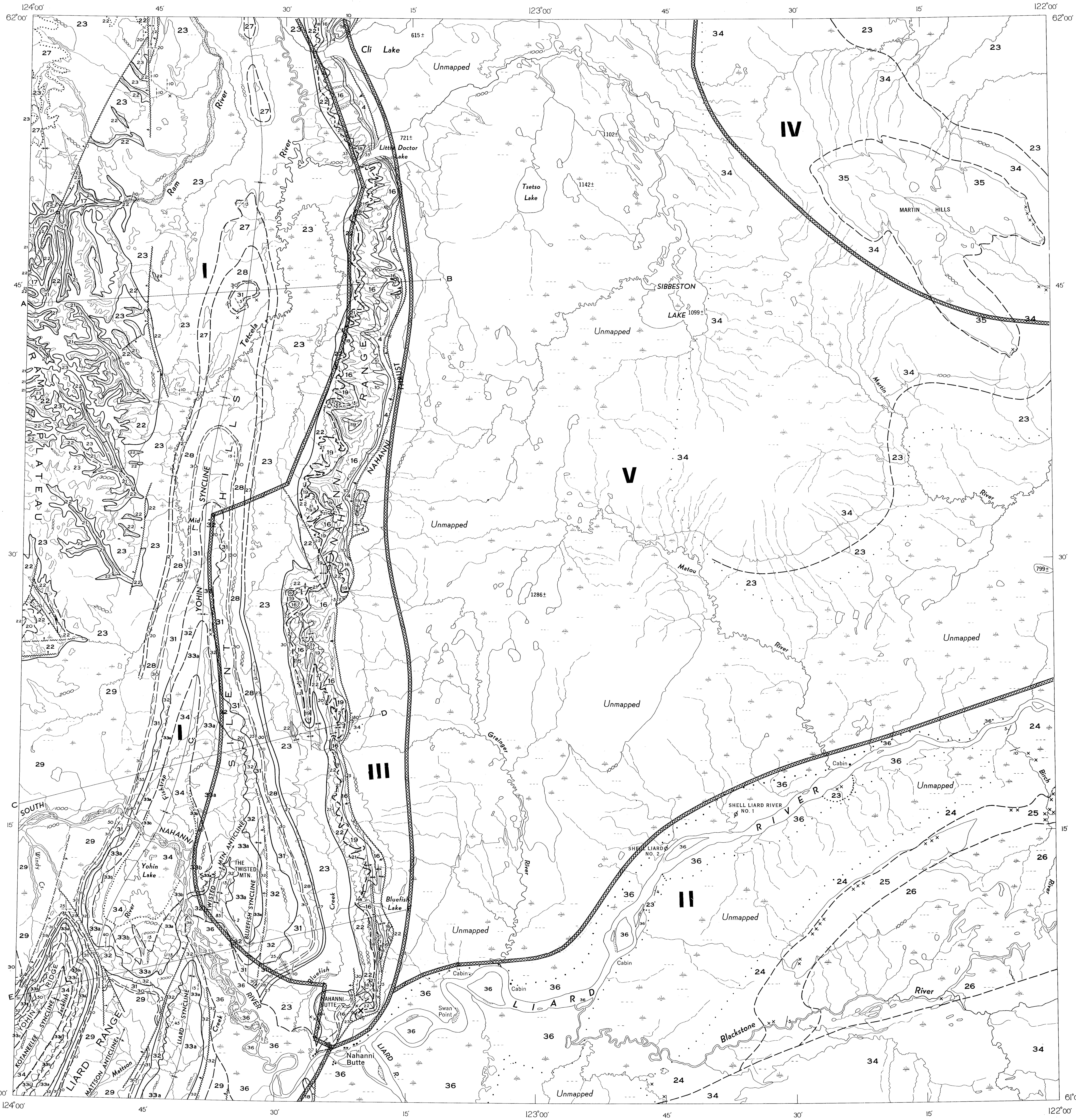
REFERENCE

Road, Hard Surface, All Weather — More than 2 Lanes Wide; 2 Lanes; Route No. 26; Less than 2
Loose Surface, All Weather — 2 Lanes Wide or More
Less than 2 Lanes — All Weather; Dry Weather

REFERENCE

Church, School		Horizontal Control Point	△
Settlement, Town	○ □	Spot Elevation, in feet	.124
Contours, Elevation	5500 5000	Forest, unclassified	
Depression	5000 4500	Swamp or Marsh	

ROOT RIVER · CAMSELL BEND · NORTHWEST TERRITORIES · VIRGINIA · 95 K · 95 J · 95 I · 95 F



0 miles 5
Scale 1:125,000

Figure 3

BEDROCK GEOLOGY, SIBBESTON LAKE, DISTRICT OF MACKENZIE, 95G

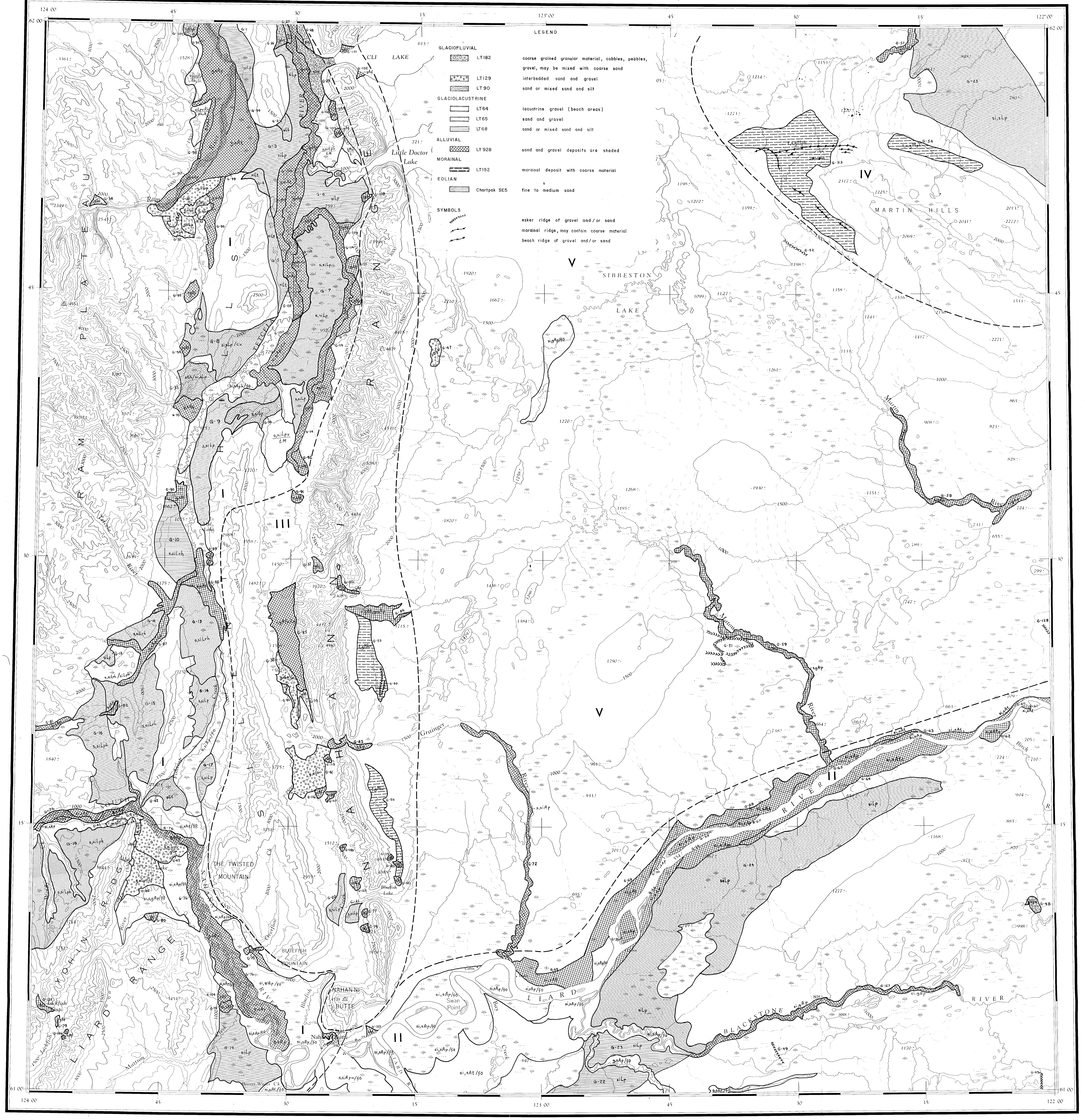
after Douglas 1960, G.S.C. Map 23-1960

NATIONAL TOPOGRAPHIC SYSTEM

CANADA

SECOND EDITION

SHEET 95 G



THE DECLINATION OF THE COMPASS NEEDLE, 1960.

Produced by the ARMY SURVEY ESTABLISHMENT, R.C.E. 1952-60.
Aerial photography 1949.

0 miles 5

REFERENCE

Figure 2

NATURAL GRANULAR MATERIALS

SIBBESTON LAKE

DISTRICT OF MACKENZIE

NORTHWEST TERRITORIES

1:125,000

Based on G.S.C. Open File (in press)

January 1972

Contour Interval 500 Feet
Elevations in Feet above Mean Sea Level
Transverse Mercator Projection
North American Datum 1927
Preliminary 1952

REFERENCE