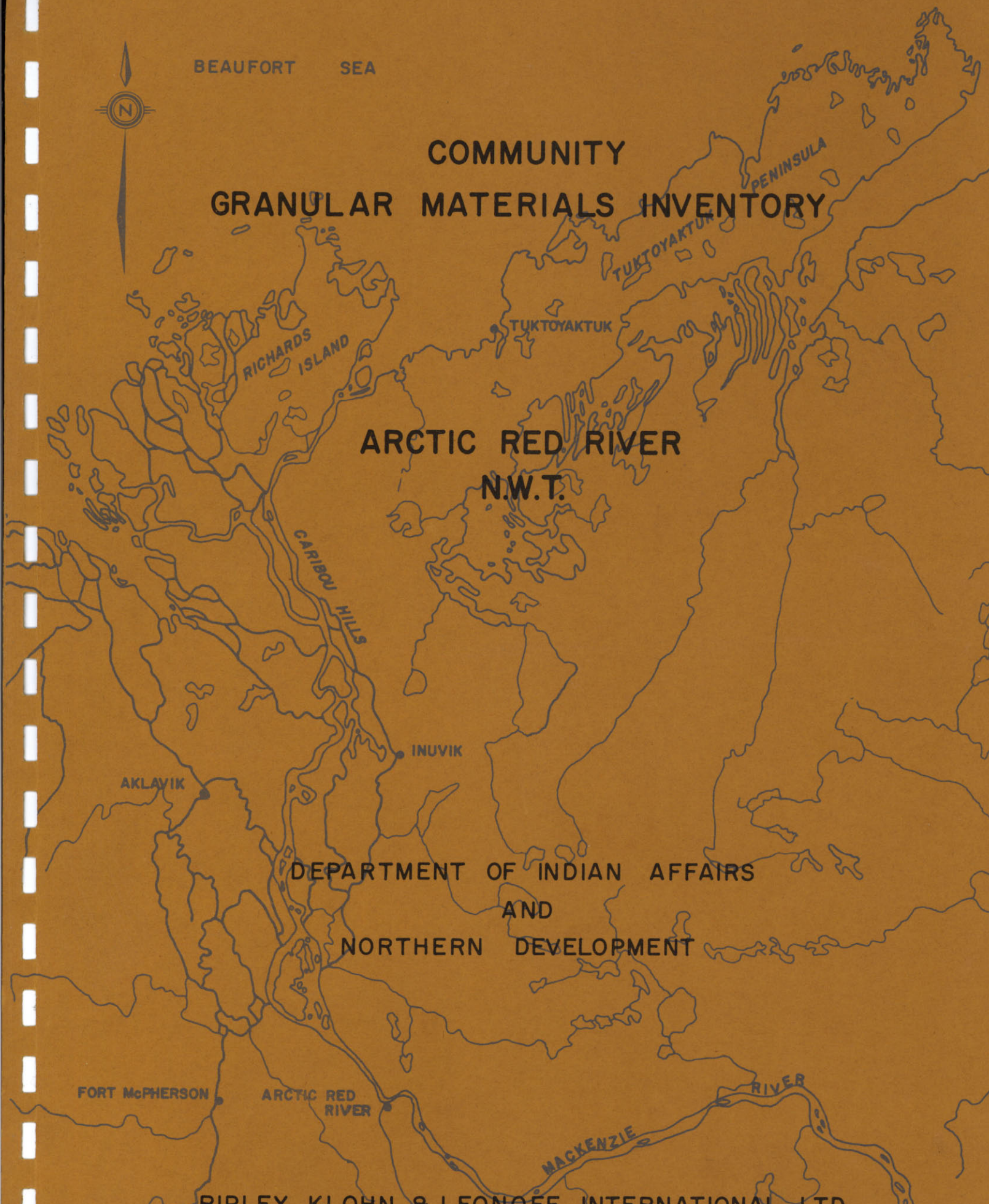

COMMUNITY GRANULAR MATERIALS INVENTORY

ARCTIC RED RIVER N.W.T.

DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

RIPLEY, KLOHN & LEONOFF INTERNATIONAL LTD.
Consulting Geotechnical Engineers

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1. INTRODUCTION

1.1 Assignment

The Department of Indian Affairs and Northern Development commissioned Ripley, Klohn & Leonoff International Ltd. to undertake Stage #2 of a granular material inventory which includes all unconsolidated material and bedrock suitable for engineering construction. The search area included the Tuktoyaktuk Peninsula, Richards Island, and the Mackenzie River Delta, south to Fort McPherson and Arctic Red River.

This report presents the results of the investigation and testing of granular materials adjacent to the community of Arctic Red River, N.W.T. The work was conducted in accordance with the requirements of the Stage #2 Terms of Reference provided by the Department which requested recommendations for usage, development and restoration of each source. The approximate quantities of granular materials required for the Arctic Red River community were as follows:

Fine grained aggregate (sand).....25,000 cu. yds.
Coarse grained aggregate (gravel).....35,000 cu. yds.
Material suitable for building
pads, roads, airstrips etc.....350,000 cu. yds.

Authorization to proceed with the work was received September 5, 1972 under Contract No. OTT-72-141 and Authority Reference T.B. No. 714562.

1.2 Procedure

The investigation procedure entailed a study and compilation of existing geological data from the work of the Geological Survey of Canada, pipeline route studies, and other previous work conducted within the designated area by Ripley, Klohn & Leonoff International Ltd. Airphoto interpretation was carried out prior to the field reconnaissance and drilling program. This work was done in co-operation with J.D. Mollard and Associates of Regina. The field reconnaissance to ground-

check potential sources was done by means of surface sampling and hand dug test pits. At the same time the field staff observed access roads, drainage conditions, biotic environmental concerns and source development considerations. The reconnaissance program indicated that 9 sources are within a 10 mile radius of the community, one is 11 miles east, and one is 11 miles west of the community, about 1½ miles south of the Dempster Highway.

1.3 Data Presented

Information for the granular material sources is presented in the following sections:

Section Entitled "Arctic Red River" - is the text of the report which provides a general appreciation of the surficial geology and environment in the area and recommendations with respect to use of materials, management, development and restoration of the source areas.

Section Entitled "Maps and Tables" - provides topographic maps showing the location of the community and the locations of the sources near the community. A summary table giving the pertinent information relative to each source is provided in this section together with an explanation of the symbols and terms used in this report.

Sections Entitled "Source No _____" - provide all details for each source including test pit and test hole logs, results of laboratory analyses and details of the development and restoration of each source.

2. ARCTIC RED RIVER COMMUNITY

2.1 Surficial Geology

The Arctic Red River study area consists of two main physiographic regions, the Peel Plain south of the Mackenzie River, and the Anderson Plain to the north. Over the area shale and sandstone bedrock is exposed primarily beside stream channels, and elsewhere is covered by surficial material of glacial origin. A widespread ground morainal till is overlain by a variety of glacial landforms, laid down during the last glacial retreat. Much of the area is covered by either glaciofluvial or glaciolacustrine plains.

In geologically recent times the rivers flowing east and north to the Mackenzie River have cut through the morainal till, building up deposits of silt and clay in the streambeds.

2.2 Environment

Arctic Red River lies at the confluence of the Arctic Red and Mackenzie Rivers, near the eastern limit of the Peel River Game Preserve. The area supports a population of small furbearing animals, such as beaver, mink, lynx, and marten, which are trapped by the men from the community. Certain areas within ten miles of the community are regarded as important wildlife areas, but none of the sources of granular material investigated for this report infringe on these areas.

The Arctic Red and Mackenzie Rivers are important fisheries. Fortunately, none of the sources of granular material investigated in this report lie within the valley bottoms. Although development of these sources is not likely to lead to problems in siltation, nevertheless the transportation of gravel could lead to problems of various kinds.

2.3 Sources and Materials

A total of eleven sources of granular material were investigated in the vicinity of this community. Three have been discarded, as being of no further interest, but are described in this report. AR - 603A and AR - 604A contain excessive amounts of silt and ice and AR - 608A contains very silty material in a shallow deposit, and is remote from present development.

Of the remainder, one source (AR - 607) is a bedrock pit, one (AR - 606) is a veneer of coarse gravel that has accumulated on a bedrock slope, five (AR - 600, 601, 602, 605 and 609) are kames or eskers, and one (650) is a glacial outwash deposit in a wide valley.

Of the sources readily available to the Community, two sources contain a natural blend of sand and gravel (AR - 609 and 650), one contains a natural gravel (AR - 602), and one contains a natural sand (AR - 605). The other sources contain materials that can be used for general fill. Other sources further from the Community (AR - 600 and 601) contain sand and gravel, but suitable only for general fill.

The petrographic analyses of different sources vary considerably. Quartzite is the main constituent in the glacial deposits, running from 21% to 68% of the gravel, with limestone, granite, and chert the other principal constituents. All contain a percentage of potentially deleterious materials, and pending further qualitative investigation, it is recommended that concrete produced with any of these aggregates should be made with cement containing less than 0.6% alkali.

It is considered at this time that Sources 650 and AR - 609 can be used for all classes of construction.

2.4 Management

Arctic Red River is fortunate in having several sources of granular material quite close to the Community. A second advantage derived from this is the reduced impact of development on the wildlife and fish of the area. In the immediate future, only the haulage of granular material from Source AR - 607 is considered a potentially serious hazard to the environment, because of drainage from the pit above the Arctic Red River and possible spillage of material in the stream. Eventually, of course, Source 650 will be developed, and some dislocation can be expected in the vicinity of this source.

Source 650 is the best deposit of specification material available to Arctic Red River, and can also be used as a source of general fill for construction projects within economic hauling distance. The source is very large and so it is expected to be used also by the Fort McPherson Community as well as by the Department of Public Works. Co-operation among all parties is essential to the satisfactory development of this resource. Since it is expected that the Department of Public Works will carry out the initial pit development to surface the Dempster Highway, they should ensure that the contractors leave the pit in a clean and tidy condition, for the Communities' future use.

Until the granular material from Source 650 is readily available in Arctic Red River, the small Source AR - 609 can be developed quite inexpensively for specification aggregates, such as may be required for concrete or asphalt.

For general fill the existing sources (AR - 606 and AR - 607) will probably be adequate for the near future. For large projects the location and cost of haulage will dictate which source

is developed, but ample material for general fill is available. Source AR - 601 deserves special consideration because of its location on the bank of the Mackenzie River, with the possibility of haulage on the river by scow in summer and by truck in winter.

The indiscriminate development of sources for small volumes must be discouraged, in order to avoid environmental problems, and in all cases restoration must follow close behind development.

2.5 Development

2.5.1 General

At the time of investigation two sources (AR - 606 and AR - 607) were in use by the Community, and one (AR - 602) was developed for the construction of a C.N.T. communications tower. The immediate needs of the Community will probably require the development of AR - 609, in addition to the continued use of the existing sources of general fill. Source 650 will probably become the main source of the area.

2.5.2 Access

All sources are accessible by truck during the winter. Eventually Source 650 will be connected to the Community by the Dempster Highway and a short service road, probably all-weather. Present plans call for the Highway crossing both Arctic Red and Mackenzie Rivers by ferry.

Source AR - 606 is on the outskirts of the Community, and is connected by an all-weather road. Source AR - 607 will require construction of a short haulage road for summer haulage, and the provision of a ferry crossing over the Arctic Red River.

Source AR - 609 will require construction of less than 2 miles of road to permit year-around operation.

Source AR - 601 is about 9 miles from the Community by the Mackenzie River, and would require the construction of about 1 mile of new road from the river-bank to the deposit on the plain above.

2.5.3 Material Use and Handling

Only Sources 650 and AR - 609 can supply specification materials for use in the Community. Other sources can be developed for the supply of general fill.

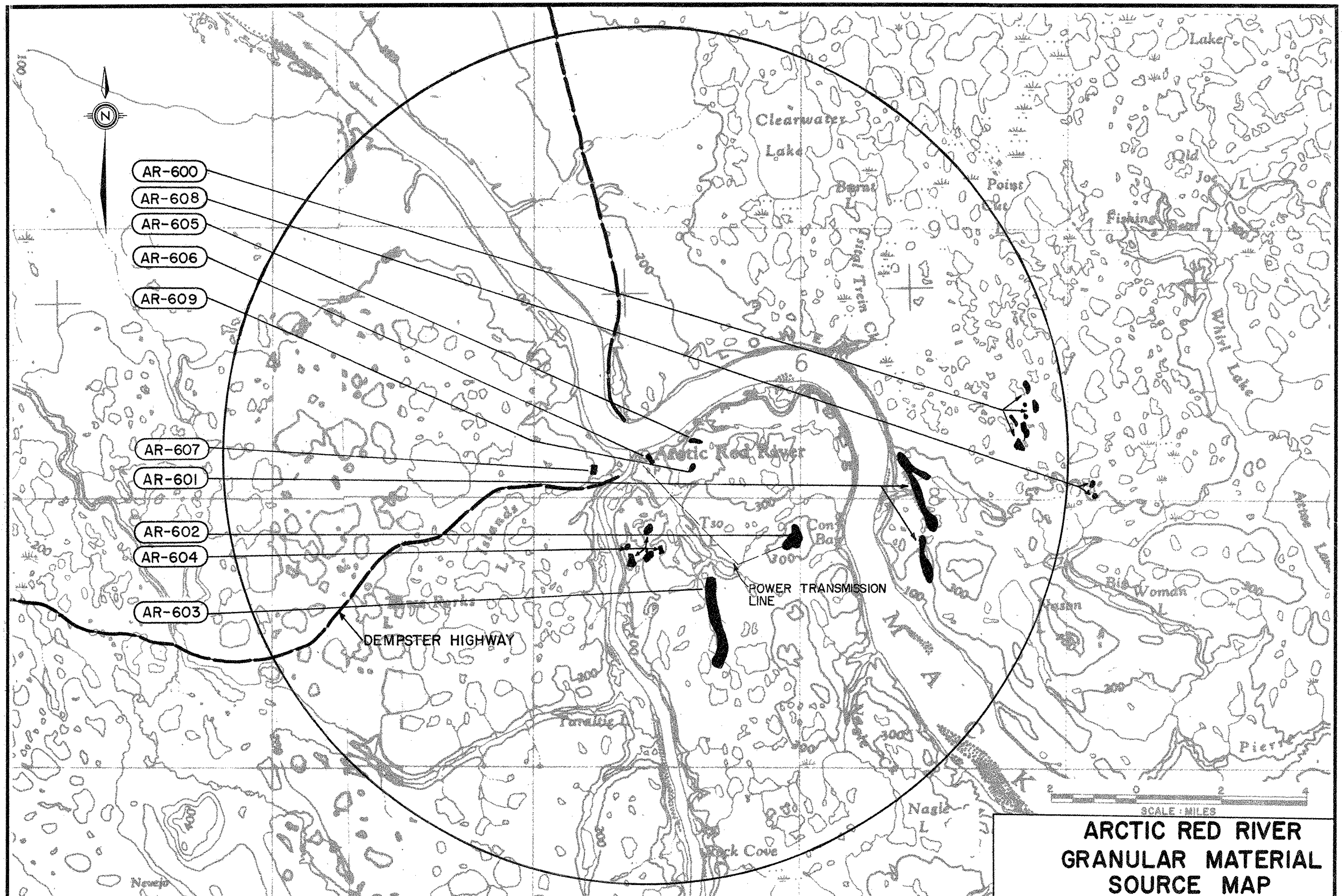
All sources will require the same assembly of equipment, dozers with ripper attachments, front-end loaders, and trucks. Preparation of aggregate for concrete will also require a screening plant, and perhaps a crusher.

2.5.4 Stripping and Restoration

All sources of granular material near Arctic Red River will require the removal of trees and the stripping of organic cover. In all cases it is recommended that trees and heavy roots be burned, and that organic cover and surficial soils be stockpiled for later restoration of the source. Banks of pits or other excavations must be graded to a stable slope before restoration. More specific recommendations are provided in the discussion of each source, in this report.

Sources AR - 606 and 607 are located on the banks of the Mackenzie and Arctic Red River. The drainage from both pits may carry silt and other waste to the rivers, and perhaps the construction of clarification ponds near the rivers may be necessary.

Detailed descriptions of vegetative cover to be employed in restoring disturbed areas are beyond the scope of this report, but can be provided by a botanist familiar with the Arctic region.



ARCTIC RED RIVER GRANULAR MATERIAL SOURCE MAP

MLNL
MKNR

DEMPSTER HIGHWAY

PROPOSED LOCATION

650

SCALE: MILES

GRANULAR MATERIAL SOURCE No. 650 MAP

EXPLANATION OF
SYMBOLS AND TERMS USED IN THIS REPORT

GENERAL CLASSIFICATION SYSTEM FOR SOILS

MAJOR DIVISION			Group SYMBOL	Graph SYMBOL	TYPICAL DESCRIPTION
COARSE-GRAINED SOILS (more than half by weight larger than 200 sieve)	BOULDERS		N/A		LARGER THAN 8 INCHES DIAMETER
	COBBLES		N/A		3 TO 8 INCHES DIAMETER
	GRAVELS more than half coarse grains larger than No. 4 sieve & 100% smaller than 3 inches diameter	CLEAN GRAVELS (little or no fines)	G W		WELL GRADED GRAVELS, LITTLE OR NO FINES
			G P		POORLY GRADED GRAVELS, AND GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		DIRTY GRAVELS (with some fines)	G M		SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
			G C		CLAYEY GRAVELS, GRAVEL-SAND CLAY MIXTURES
	SANDS more than half fine grains smaller than No. 4 sieve.	CLEAN SANDS (little or no fines)	S W		WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
			S P		POORLY GRADED SANDS, LITTLE OR NO FINES
		DIRTY SANDS (with some fines)	S M		SILTY SANDS, SAND-SILT MIXTURES
			S C		CLAYEY SANDS, SAND-CLAY MIXTURES
FINE-GRAINED SOILS (more than half by weight passes 200 sieve)	SILTS below "A" line negligible organic content	W_L 50%	M L		INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY SANDS OF SLIGHT PLASTICITY
		W_L 50%	M H		INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDY OR SILTY SOILS
	CLAYS above "A" line on plasticity chart negligible organic content	W_L 30%	C L		INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY, OR SILTY CLAYS, LEAN CLAYS
		30% W_L 50%	C I		INORGANIC CLAYS OF MEDIUM PLASTICITY, SILTY CLAYS
		W_L 50%	C H		INORGANIC CLAYS OR HIGH PLASTICITY, FAT CLAYS
	ORGANIC SILTS & CLAYS below "A" line on chart	W_L 50%	O L		ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
		W_L 50%	O H		ORGANIC CLAYS OF HIGH PLASTICITY
HIGHLY ORGANIC SOILS			P t		PEAT AND OTHER HIGHLY ORGANIC SOILS

SUPPLEMENTARY TERMS IDENTIFYING THE COMPOSITION OF GRANULAR SOILS

Component	Identification	Terms Identifying Proportions	Defining Range Percentage by Weight
Principal Component.....	GRAVEL	...	50 or more
	SAND	...	
	SILT	...	
Minor Component.....	Gravel	and	35 to 50
	Sand	some	20 to 35
	Silt	little	10 to 20
		trace	1 to 10

CLASSIFICATION SYSTEM FOR ICE

Non Visible Ice	Nf	Poorly bonded
	Nbn	Well bonded
	Nbe	Excess Ice
Visible Ice Less than 1 inch thick	Vx	Individual ice crystals or inclusions
	Vc	Ice coatings or particles
	Vr	Random or irregularly oriented ice formation
	Vs	Stratified or distinctly oriented ice formations
Visible Ice Greater Than 1 inch thick	ICE+	Ice with soil inclusions
	ICE	Ice without soil inclusions

GROUND ICE CONTENT - % BY VOLUME

Low -<10% Med - 10% to 20% High ->20%

DESCRIPTIVE SOIL TERMS

Well graded .... having wide range of grain sizes and substantial amounts of all intermediate sizes.

Poorly graded .. predominantly of one grain size.

Coarse Aggregate .. Gravel retained on $\frac{1}{4}$ inch screen.

Fine Aggregate . Sand passing $\frac{1}{4}$ inch screen.

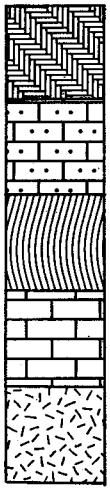
Interbedded .... composed of alternate layers of different soil or rock types.

Calcareous ..... containing appreciable quantities of calcium carbonate.

Organic ..... containing organic matter; may be decomposed or fibrous.

Peat ..... a fibrous mass of organic matter in various stages of decomposition. Generally dark brown to black in colour and of spongy consistency.

SUPPLEMENTARY SYMBOLS AND NOTATIONS



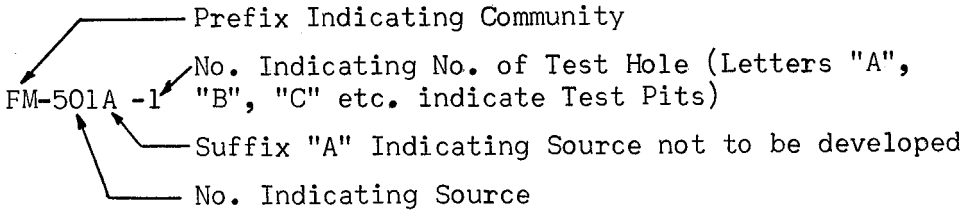
Bedrock

Sandstone

Shale

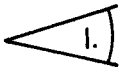
Limestone

Talus



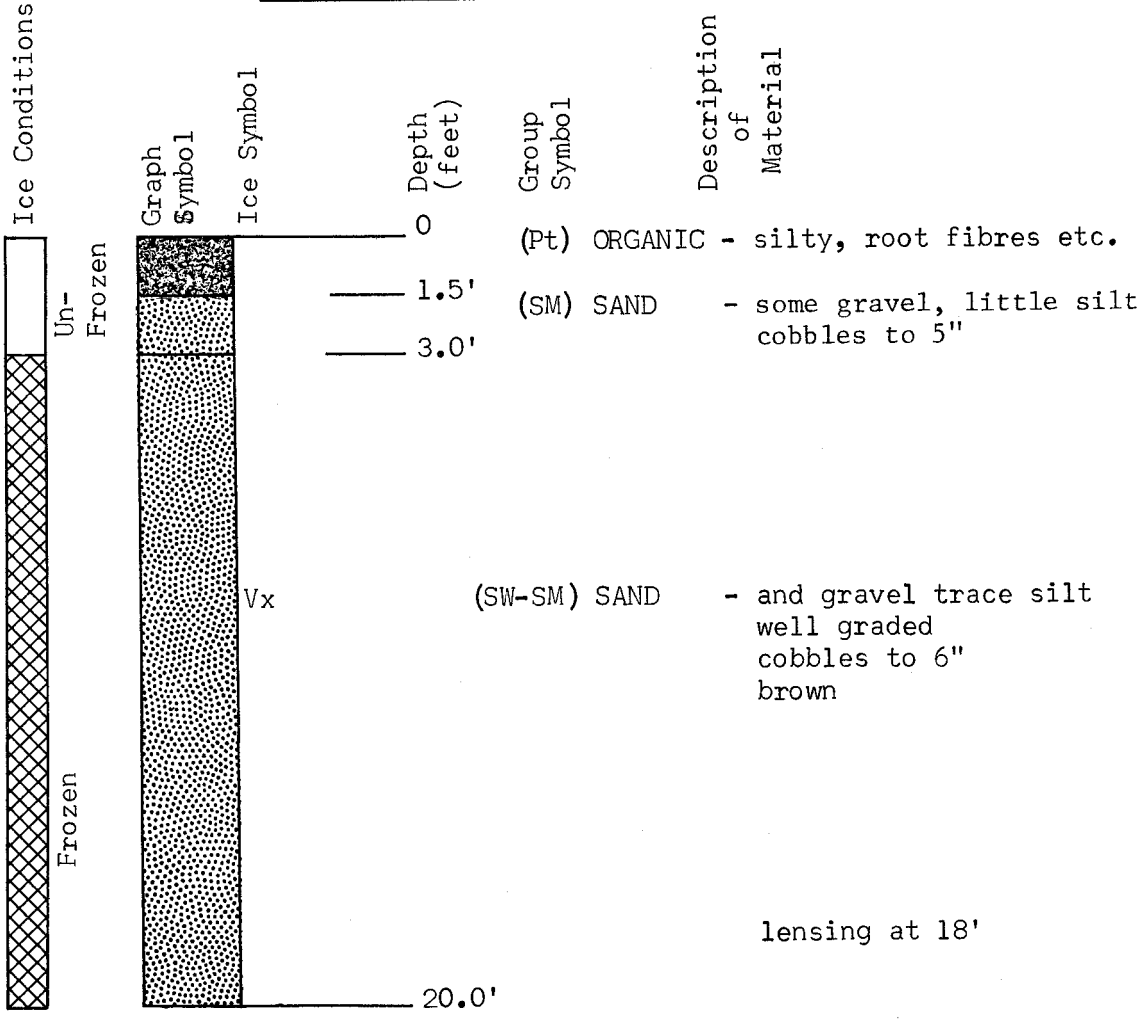
Indicates Test Hole Location

Indicates Test Pit Location



Indicates Direction of Ground Photograph and Field of View

EXAMPLE OF SOIL LOG



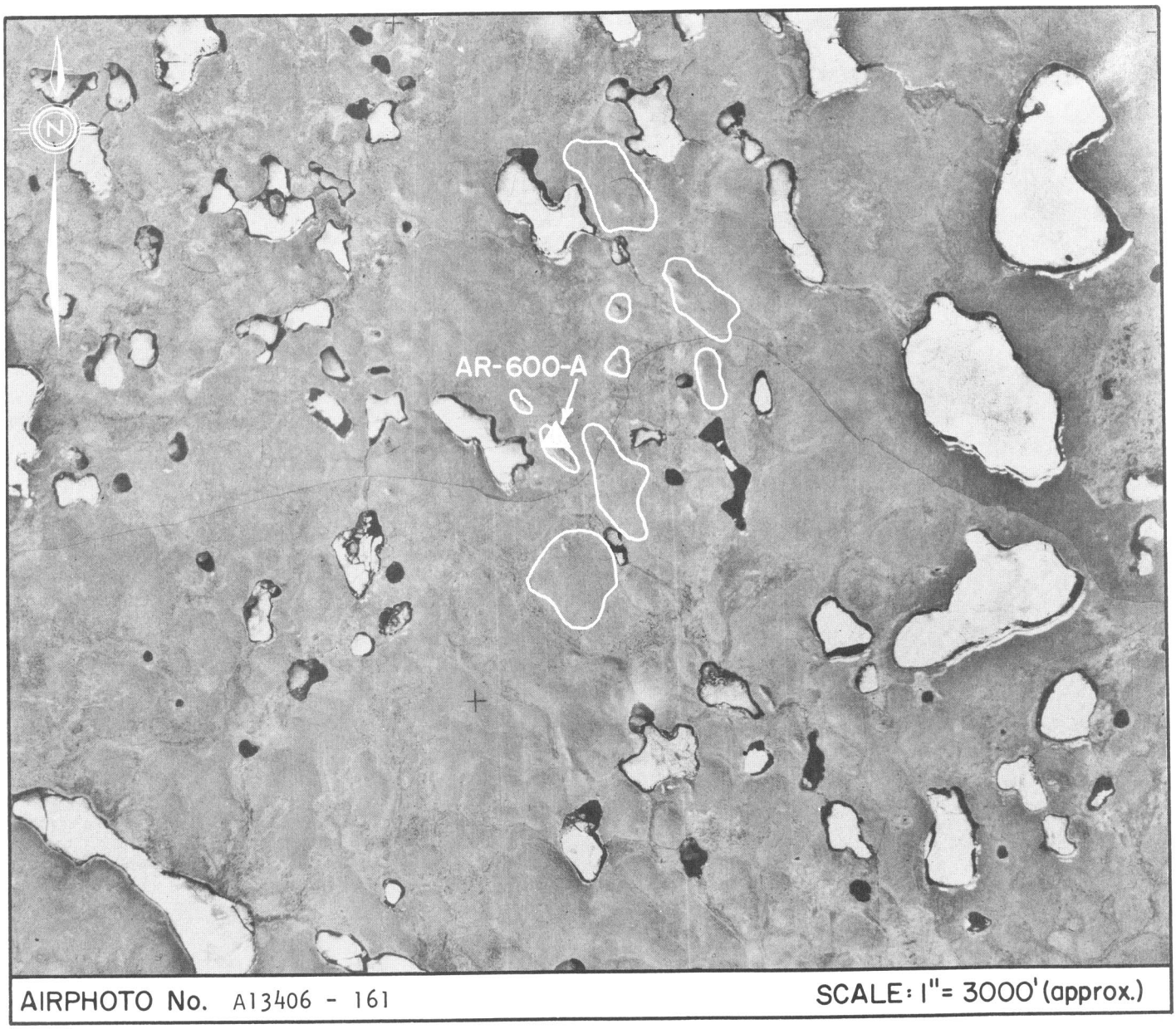
SOURCE No.	DISTANCE FROM COMMUNITY MILES	MATERIAL TYPE (UNIFIED GROUP SYMBOL)	VOLUME ESTIMATES CUBIC YARDS	ENVIRONMENTAL CONCERNS	CONCLUSIONS	SOURCE DEVELOPMENT DATA									
						DRAINAGE	STRIPPING			GRD. ICE	REC. DEPTH (FT.)	TYPE OF EXCAVATION	MATERIAL USEAGE	EQUIPMENT REQUIRED	STATE OF DEVELOPMENT OF SOURCE
							MATERIAL	DEPTH (FT)	DISPOSAL						
AR-600	15	SAND - and gravel (SW-SM)	200,000 from above permafrost zone	Disturbance of vegetation over large area and hence possible disturbance of wildlife	Low priority for development due to remoteness of source and variability of quality	Good	Peat and silt	0 to 3	Stockpile for later regrading	Med.	up to 3 from active zone	Doze into piles, drain, load in trucks	General fill	Dozer, Loader, Truck	Undeveloped
						SEE SECTION AR-600 FOR SOURCE DETAILS									
AR-601	15 by land route	GRAVEL - and sand (GM)	1,500,000 at least	No major environmental concern	Suitable for development dependant on economics of haul	Good	Topsoil and silt	1 to 6	Stockpile for later regrading	Low to Med.	15 to 25	Doze into piles, drain, load into trucks or onto barge	General fill Base course aggregate	Dozer, Loader, Trucks	Undeveloped
						SEE SECTION AR-601 FOR SOURCE DETAILS									
AR-602	6	GRAVEL - some sand (GW-GM)	150,000 from active permafrost zone	Disturbance of vegetation over large area	Low priority for development due to large area to be disturbed to obtain material	Good	Topsoil and silt	0 to 2	Stockpile for later regrading	Low in active zone, High below	4	Doze into piles, drain, load in trucks	General fill Coarse aggregate, some fine aggregate	Dozer, Loader, Trucks, maybe Crusher and Screener	Partially developed during C.N.T. Tower construction
						SEE SECTION AR-602 FOR SOURCE DETAILS									
AR-603A	4	SAND - with silt (SM)	500,000	No major environmental concern	Not suitable for development due to poor quality. Should only be used as a last resort.	Good	Topsoil and silt	1 to 4	Stockpile for later regrading	Low to Med.	4	Doze into piles, drain, load in trucks	Poor general fill	Dozer, Loader, Trucks	Undeveloped
						SEE SECTION AR-603A FOR SOURCE DETAILS									

SOURCE No.	DISTANCE FROM COMMUNITY MILES	MATERIAL TYPE (UNIFIED GROUP SYMBOL)	VOLUME ESTIMATES CUBIC YARDS	ENVIRONMENTAL CONCERNS	CONCLUSIONS	SOURCE DEVELOPMENT DATA									
						DRAINAGE	STRIPPING			GRD. ICE	REC. DEPTH (FT.)	TYPE OF EXCAVATION	MATERIAL USEAGE	EQUIPMENT REQUIRED	STATE OF DEVELOPMENT OF SOURCE
							MATERIAL	DEPTH (FT)	DISPOSAL						
AR-604A	4	SAND - and silt (SM)	1,000,000	No environmental concern except possible damage to physical environment if developed	Not recommended for development due to poor quality	Good	Organic and silt	1 to 3		Med. to High	Nil	SEE SECTION AR-604A FOR SOURCE DETAILS	Not suitable as fill or aggregate		Undeveloped
AR-605	1½	SAND - and silt (SM) SAND - some gravel (SM)	80,000 from active permafrost zone	No major environmental concern	Low priority development due to variability of deposit	Good	Topsoil and silt	1 to 3	Stockpile for later regrading	Low to High	10	Doze into piles, drain, load into trucks SEE SECTION AR-605 FOR SOURCE DETAILS	General fill	Dozer, Loader, Trucks	Undeveloped
AR-606	1/2	GRAVEL - with sand (GW-GM) SHALE - soft	10,000 gravel - sand 100,000 shale	No major environmental concern	Suitable for continued development	Good	Topsoil and silt	0 to 2	Stockpile away from river for later regrading into pit	Low	4 gravel 20 plus shale	Doze gravel into piles, drain, load into trucks Rip shale load into trucks SEE SECTION AR-606 FOR SOURCE DETAILS	General fill and coarse aggregate General fill	Dozer with Ripper, Loader, Truck	Partially developed by Community
AR-607	2	SHALE - soft some layers sandstone	200,000 at least	Drainage from the pit could cause siltation in Arctic Red River unless prevented as discussed in details of source	Suitable for continued development	Fair	Topsoil and silt	0 to 10	Stockpile for later regrading in pit	Low	30 plus	Rip, doze into piles, load into trucks SEE SECTION AR-607 FOR SOURCE DETAILS	General fill	Dozer with Ripper, Loader, Truck	Partially developed by Department of Public Works

SOURCE No.	DISTANCE FROM COMMUNITY MILES	MATERIAL TYPE (UNIFIED GROUP SYMBOL)	VOLUME ESTIMATES CUBIC YARDS	ENVIRONMENTAL CONCERNS	CONCLUSIONS	SOURCE DEVELOPMENT DATA									
						DRAINAGE	STRIPPING			GRD. ICE	REC. DEPTH (FT.)	TYPE OF EXCAVATION	MATERIAL USEAGE	EQUIPMENT REQUIRED	STATE OF DEVELOPMENT OF SOURCE
							MATERIAL	DEPTH (FT)	DISPOSAL						
AR-608A	18	SAND - and silt (SM)	20,000	No major environmental concern	Not suitable for development due to poor quality of material	Good	Topsoil and silt	1 to 3		Med. to high	Nil	SEE SECTION AR-608A FOR SOURCE DETAILS	Not suitable for fill or aggregate		Undeveloped
AR-609	1½	SAND - and gravel (SW-SM)	20,000	No major environmental concern	Suitable for immediate development	Good	Topsoil and silt	½ to 1	Stockpile for later regrading	Low	14	Rip, drain, push into piles, load in trucks SEE SECTION AR-609 FOR SOURCE DETAILS	Fine and coarse aggregate	Dozer, Loader, Trucks	Undeveloped
650	11	GRAVEL - and sand (GM) SAND - and gravel (SM)	2,500,000 at least	No major environmental concern	Suitable for development for Arctic Red River and Fort McPherson communities use as well as Dept. of Public Works	Poor	Moss and silt	0 to 3	Stockpile adjacent to pit for later regrading into depleted area	Low	25	Rip, stockpile thaw, load into trucks. Screen perhaps crush SEE SECTION 650 FOR SOURCE DETAILS	General fill, fine and coarse aggregate	Dozer, Loader, Trucks Screen and Crusher plant	Undeveloped

ARCTIC RED RIVER
SOURCE No. AR-600

LANDFORM AND LOCATION:	Kames and an esker 15 miles by road east of Arctic Red River.
MATERIAL:	SAND - with gravel, some silt.
VOLUME:	200,000 cu. yds. approximately, above permafrost.
CONCLUSION:	Not recommended for development at this time, because of remoteness to community and the probable variability in material quality.



AIRPHOTO No. A13406 - 161

SCALE: 1" = 3000' (approx.)

AR-600 ENVIRONMENT

Physical

The source consists of four large kames, three small kames, and an esker. The large kames range up to 1,000 feet in diameter and perhaps 100 feet high, whereas the smaller kames are about 500 feet in diameter and 50 feet high. The esker ridge is about 1,000 feet long and 25 to 50 feet high. Drainage of the features is good, although the surrounding drainage is very poor, containing many shallow thermal ponds. This source has not been developed.

The source is about 9 miles by air, and 15 miles by road, from the community, almost due east.

Biotic

Vegetation consists of tufts of grass and a relatively thin cover of black spruce up to 40 feet high. Canopy density is 20% to 40%. Low areas are covered by sphagnum bogs.

The area does not lie within any critical wildlife area.

AR-600 MATERIALS AND QUANTITIES

The material sampled is sand and gravel, with a trace silt. Although the source was tested at only one point, more detailed examination of similar landforms nearby disclosed a wide variation in material gradation and a high ice content.

The quantity of material available from the active permafrost zone of this source is about 200,000 cubic yards.

AR-600 DEVELOPMENT

General

The source had not been developed for use at the time of this investigation.

Access

Access to the source is possible only during winter, and is 15 miles by road. The route would follow the Dempster Highway north across

the Mackenzie River for about 2 miles, then along a seismic line for about 12 miles, then south for 1 mile on a new road to be constructed.

Material Use and Handling

Development of this source would involve a large amount of stripping for the volume of material to be removed. The surface layer of silt and organic material would have to be removed and stockpiled for re-grading. The dozer would then push the granular material to loading points, where a loader would fill the trucks for transport to the community. Probably the development of these landforms would require a great deal of selectivity, because of the variable nature of granular material, and in any case would need to follow an extensive program of test pitting. The material from this source would be primarily used as common fill.

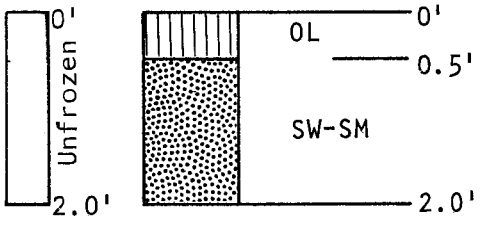
Stripping and Restoration

Trees and roots on the source should be removed and burned. The layer of surface soil would then be stripped and stockpiled for restoration, which should follow as soon as possible after the granular material had been removed.

TEST PIT LOGS

SOURCE No. AR-600

AR-600-A

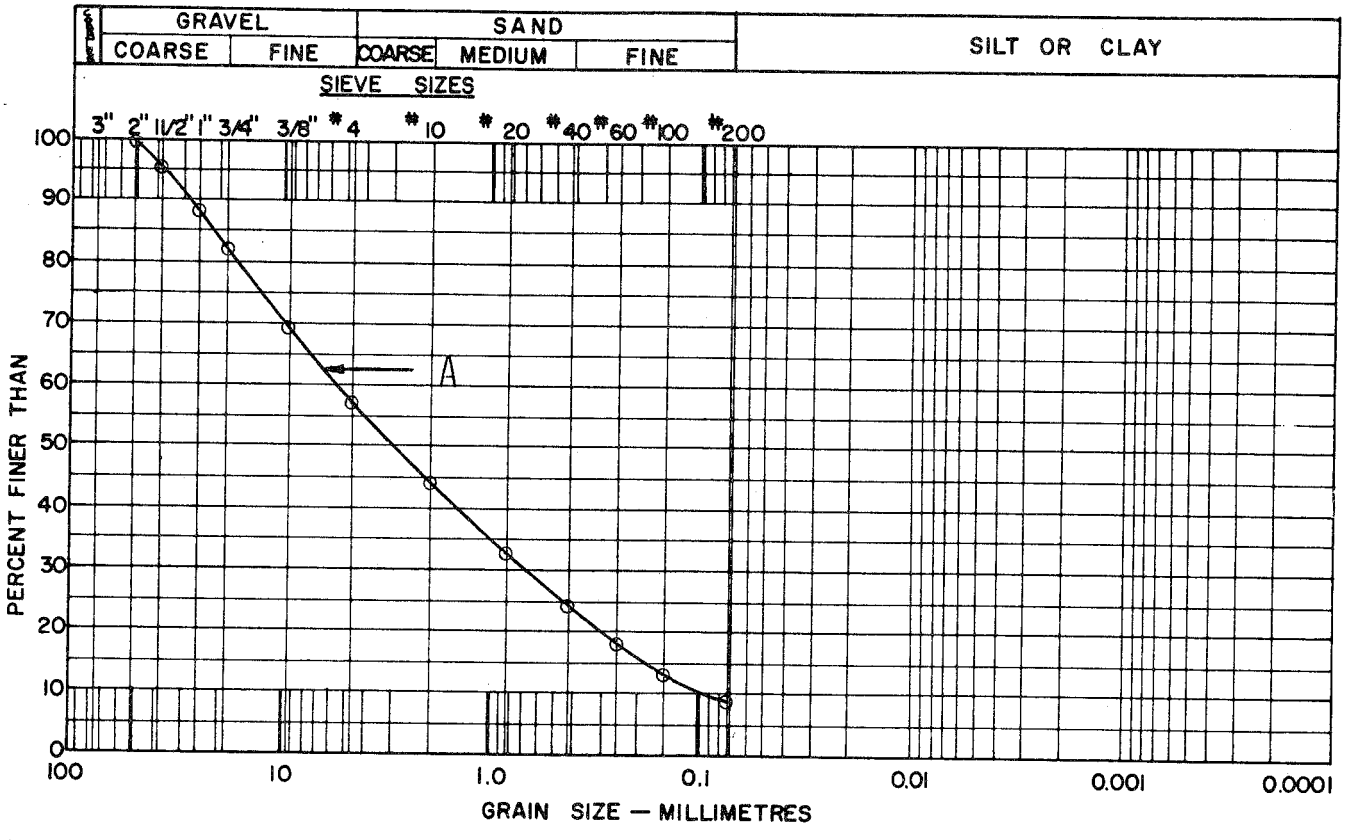


SILT - organic

SAND - and gravel, trace silt max. 4" angular to subangular

LABORATORY
TEST DATA
SOURCE No. AR-600

GRAIN SIZE DISTRIBUTION



MOISTURE CONTENT

A (0.5' - 2.0') M/C = 4.4%

ORGANIC CONTENT

HARDNESS TEST

PETROGRAPHIC ANALYSIS

Sandstone, fine	-32%
Quartzite	-23%
Limestone, hard	-28%
Limestone, porous	- 5%
Granitic	- 4%
Clay shale	- 2%
Ironstone	- 2%
Sandstone, coarse	- 2%
Quartz	- 1%
Sandstone, porous	- 1%
Total	100%

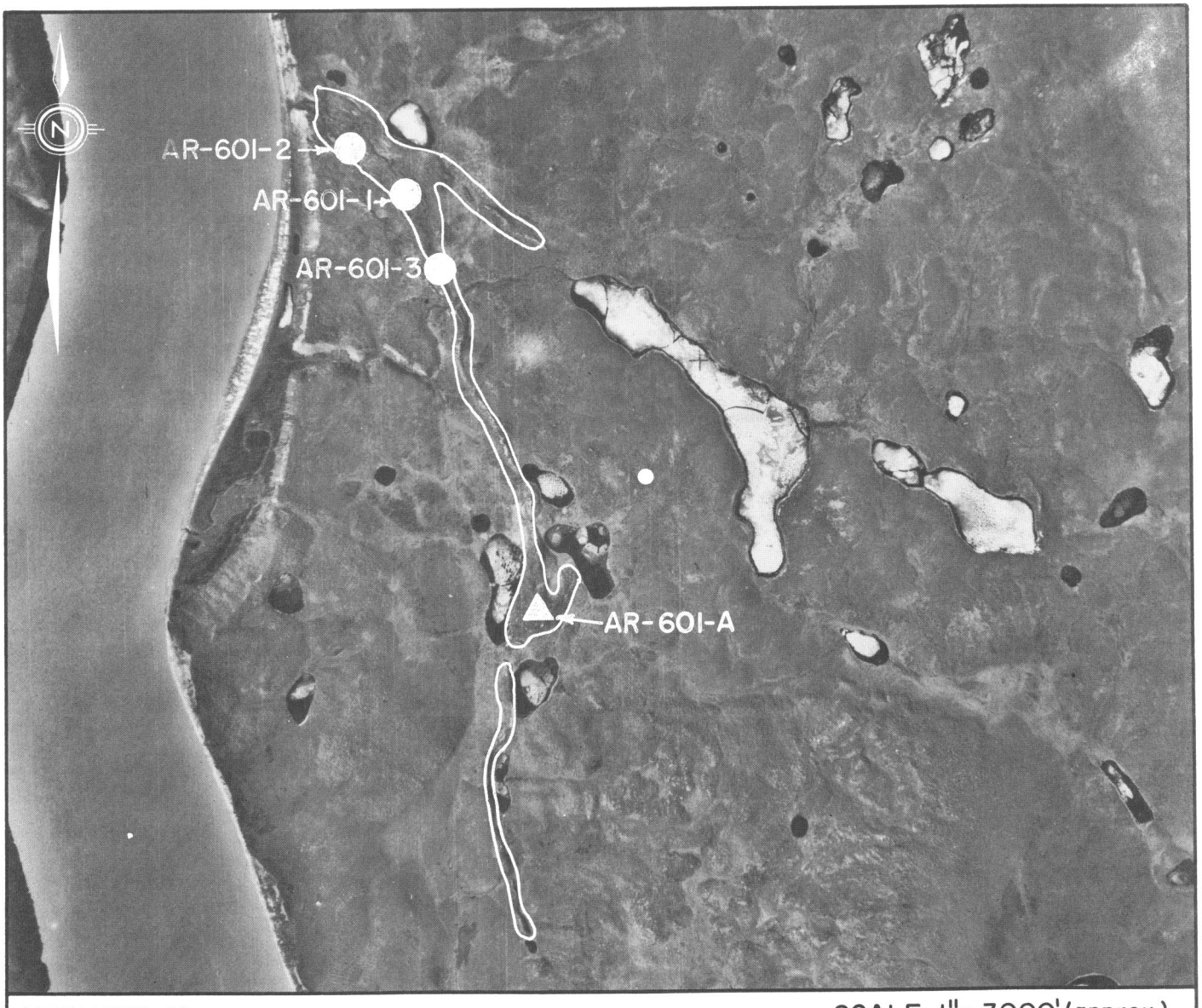
ARCTIC RED RIVER
SOURCE No. AR-601

LANDFORM AND LOCATION: Esker ridge approximately 3 miles long and 200 to 1,000 feet in width. Source is 6 miles due east of community.

MATERIAL: GRAVEL and sand, little silt. Approximately 25% of aggregate is unsound.

VOLUME: 1,500,000 cu. yds. at least.

CONCLUSION: Source is suitable for development primarily for general fill and base course materials. Production of aggregate for high quality concrete and asphalt will probably require special processing to remove the unsound material.



AIRPHOTO No. A13406 - 234

SCALE: 1" = 3000' (approx.)

AR-601 ENVIRONMENT

Physical

The source is an esker ridge approximately 3 miles long, from 200 to 1,000 feet wide, and from 20 to 100 feet high. This feature lies on rolling terrain directly east of the Mackenzie River and about 200 feet above the river level. Drainage of the esker is good, and was free of ground ice to at least 3 feet in depth. The source has not been developed.

The location of the source is 6 miles from the Community on a bearing slightly south of east.

Biotic

The vegetative cover is tufted grass and moss, with sparse stands of black spruce up to 40 feet in height.

The area does not form part of any critical or important wildlife area. It supports small fur-bearing animals such as marten, muskrat, and mink.

AR-601 MATERIALS AND QUANTITIES

The material is clean granular aggregate, with a silt content generally below 10%. The proportions of sand and gravel appear to vary, however. The material is well suited to use as general fill and road material, but the high proportion (about 25%) of unsound rock makes it unsuitable for use in concrete or asphalt.

The volume of material available in this source is very large, at least 1,500,000 cubic yards.

The petrographic analysis of one sample indicates quartzite (28%), granite (12%), chert (11%), quartz (20%) and hard sandstone (3%) as the sound component of the aggregate. The unsound materials are porous limestone, ironstone, soft sandstone, shalestone, and sandy clay shale, totalling 26%.

AR-601 DEVELOPMENT

General

This source must be compared with alternatives near the community for

cost of haulage and ease of development. Probably it can be loaded out only by barge in summer and by truck in winter, because of the long road to be built for summer truck-haul.

The source may be valuable to other developments near the Mackenzie River, because of the short distance to a loading point on the river bank. Material from this source cannot likely be used for concrete or for asphalt, without expensive processing to remove the unsound rock.

Access

Summer access to the site is by barge, loading at the river bank directly below the source. The haulage road from river bank to the source will be about 1 mile long, with a climb of about 200 feet up a tributary gully.

Winter trucking access may follow two routes. The shorter will follow the Mackenzie River for about 8 miles to the same loading point used by the barges in summer. The winter use of the road from this point to the source will require further study, but gravel could be stockpiled on the river bank for winter haulage in any case.

The longer winter road, about 15 miles in length, would follow the Dempster Highway north for about 2 miles, thence east along a seismic line for 8 miles, thence south for 5 miles on a road to be constructed. This haulage does not appear to be attractive when compared with the much easier haul from Source No. 650.

Material Use and Handling

Material from this source can be used as general fill and as base course in road construction.

Equipment required for development of the source is the usual assembly of ripper-dozer, front-end loader, and trucks. The same equipment could construct the haulage road to the river bank, if this is necessary.

The procedure for developing the source will be to clear and burn all trees, strip and stockpile the overburden material, rip and

push material into piles for thawing and drainage, and finally load out the material on trucks.

Stripping and Restoration

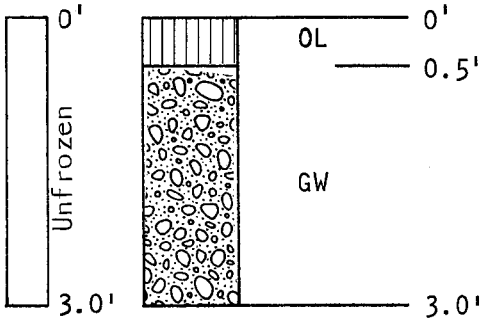
All trees and roots will have to be burned. Overburden soils should be re-graded over the worked-out areas as soon as possible, in order to minimize disturbance to the permafrost soils below. Probably it will not be necessary or advisable to excavate below the grade of the surrounding area, because this would lead to ponding.

After an area has been re-graded, it should be seeded for speedy re-vegetation. The choice of vegetative cover, and the method of preparation, should be provided by a scientist experienced in Arctic horticulture.

TEST PIT LOGS

SOURCE No. AR-601

AR-601-A

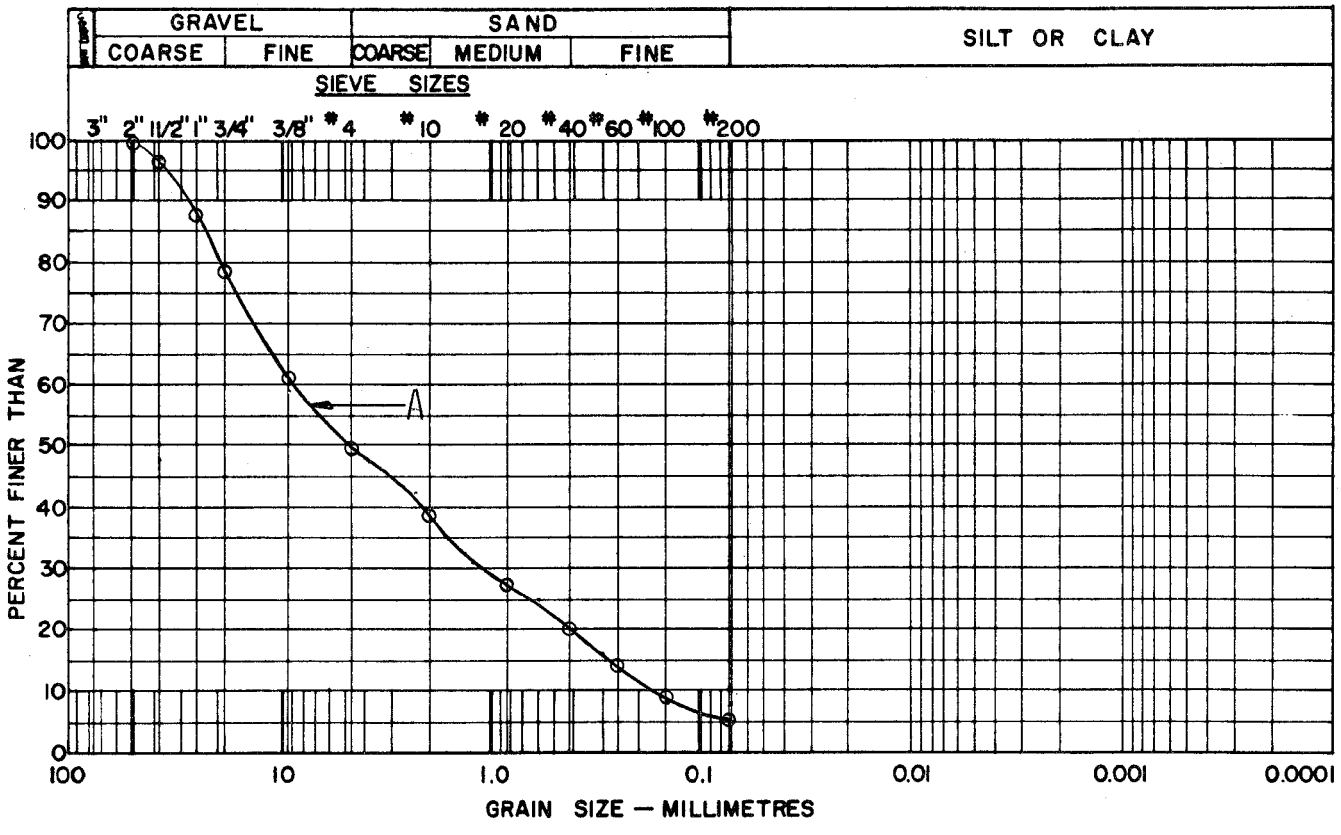


SILT - organic

GRAVEL - and sand, trace silt, max. 2"
rounded to subrounded
well graded

LABORATORY
TEST DATA
SOURCE No. AR-601

GRAIN SIZE DISTRIBUTION



MOISTURE CONTENT

A (0.5' - 3.0') M/C = 3.8%

ORGANIC CONTENT

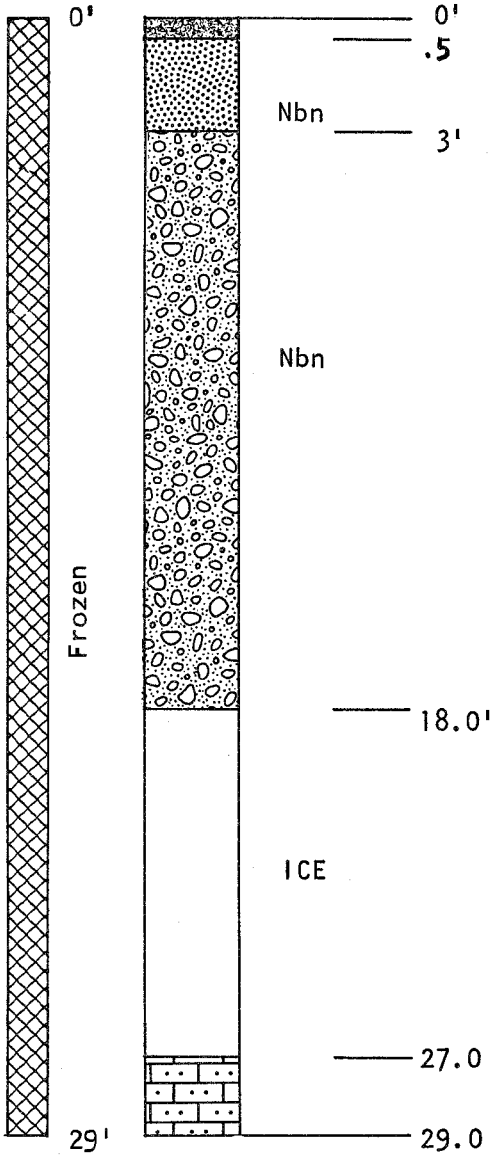
HARDNESS TEST

PETROGRAPHIC ANALYSIS

TEST HOLE LOGS

SOURCE No. AR-601

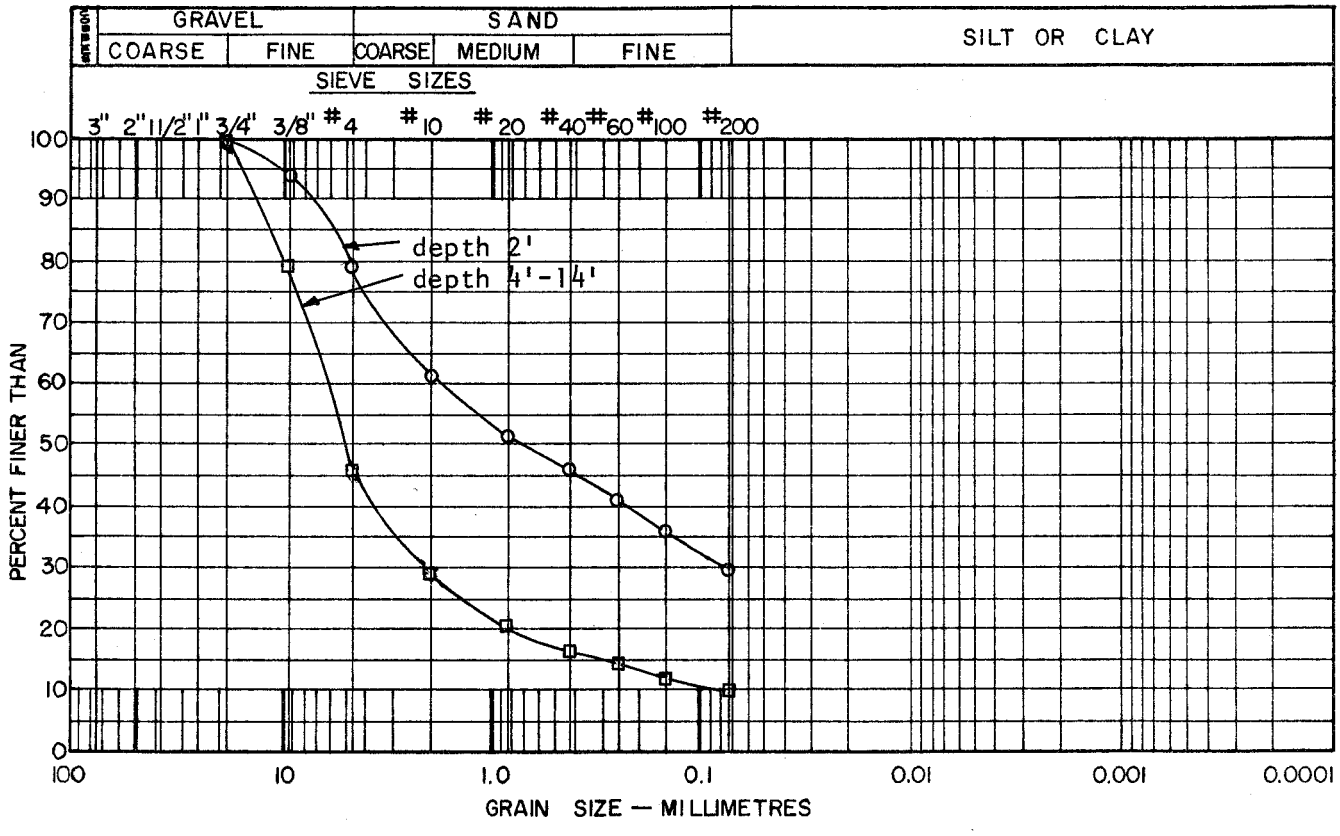
AR-601 -1



0' – .5	(Pt)	ORGANIC - silt, roots, moss etc.
Nbn 3'	(SM)	SAND - some gravel, some silt
Nbn 18.0'	(GM)	GRAVEL - and sand, little silt well graded, no visible ice
ICE 27.0		ICE - clear
27.0 – 29.0		SANDSTONE - bedrock

LABORATORY
TEST DATA
TEST HOLE-SOURCE No. AR-601-1

GRAIN SIZE DISTRIBUTION



MOISTURE CONTENT

Sample 1 depth	2'	11.9%
Sample 2 depth	4'	6.6%
Sample 3 depth	6'	6.5%
Sample 4 depth	8'	5.8%
Sample 5 depth	10'	5.8%
Sample 6 depth	14'	6.1%

ORGANIC CONTENT

HARDNESS TEST

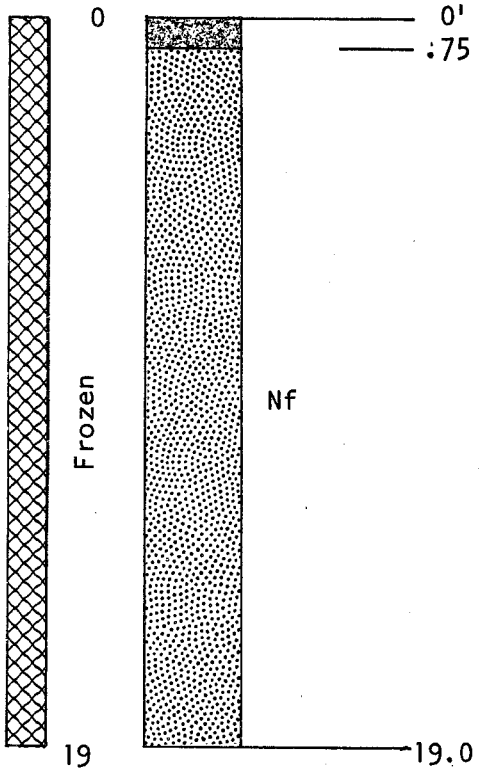
PETROGRAPHIC ANALYSIS

Quartzite	-28%	Ironstone	- 4%
Granitic	-12%	Sandstone, porous, soft	-18%
Chert	-11%	Shalestone	-neg.
Sandstone, hard	- 3%	Clay shale and sandy	- 1%
Limestone, porous	- 3%		
Quartz	-20%	Total	100%

TEST HOLE LOGS

SOURCE No. AR-601

AR-601-2



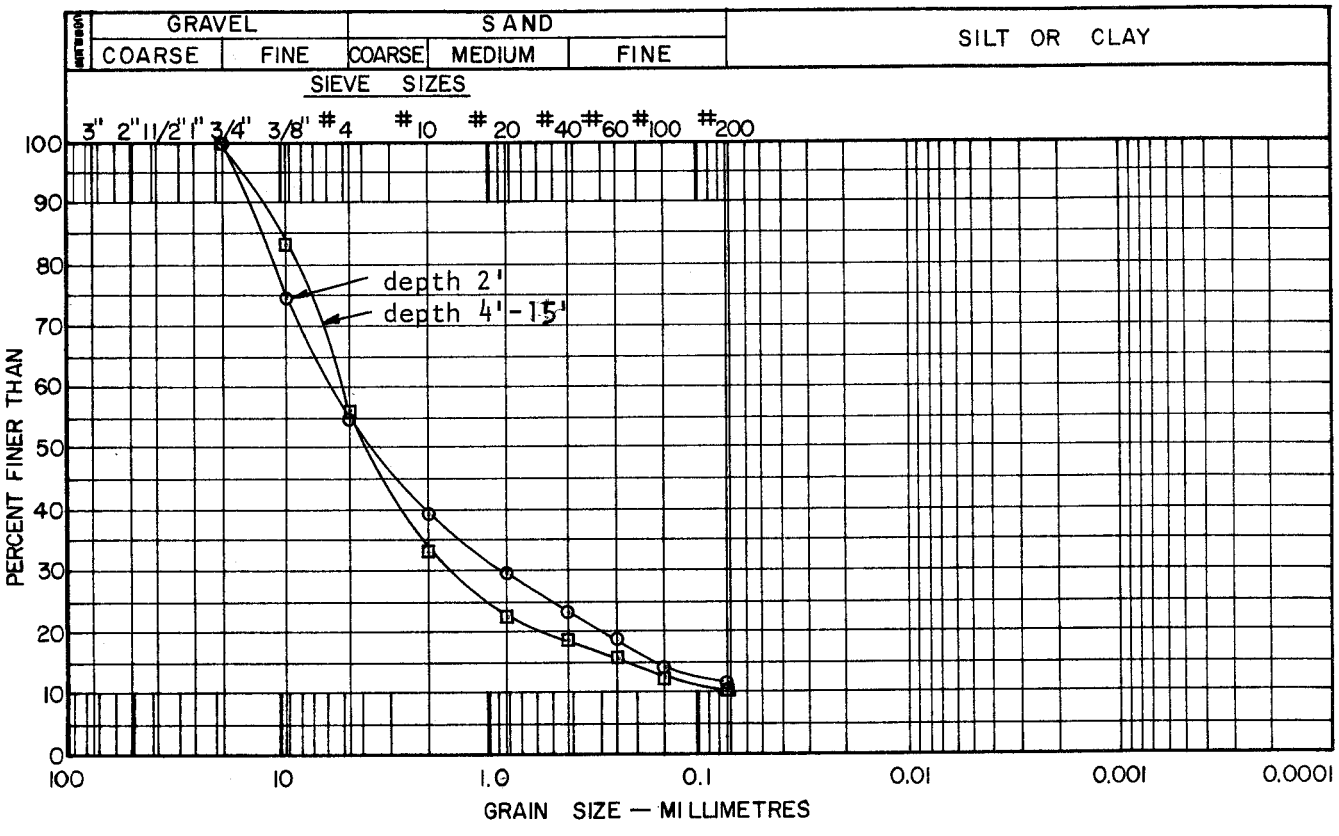
(Pt) ORGANIC - silt, roots, topsoil

(SW-SM) SAND - and gravel, little silt well graded. No visible ice. Trace cobbles.

BOULDER - at 19'

LABORATORY
TEST DATA
TEST HOLE-SOURCE No. AR-601-2

GRAIN SIZE DISTRIBUTION



MOISTURE CONTENT

Sample 1	depth 2'	7.6%
Sample 2	depth 4'	5.3%
Sample 3	depth 6'	7.6%
Sample 4	depth 8'	8.0%
Sample 5	depth 10'	5.8%
Sample 6	depth 15'	13.8%

ORGANIC CONTENT

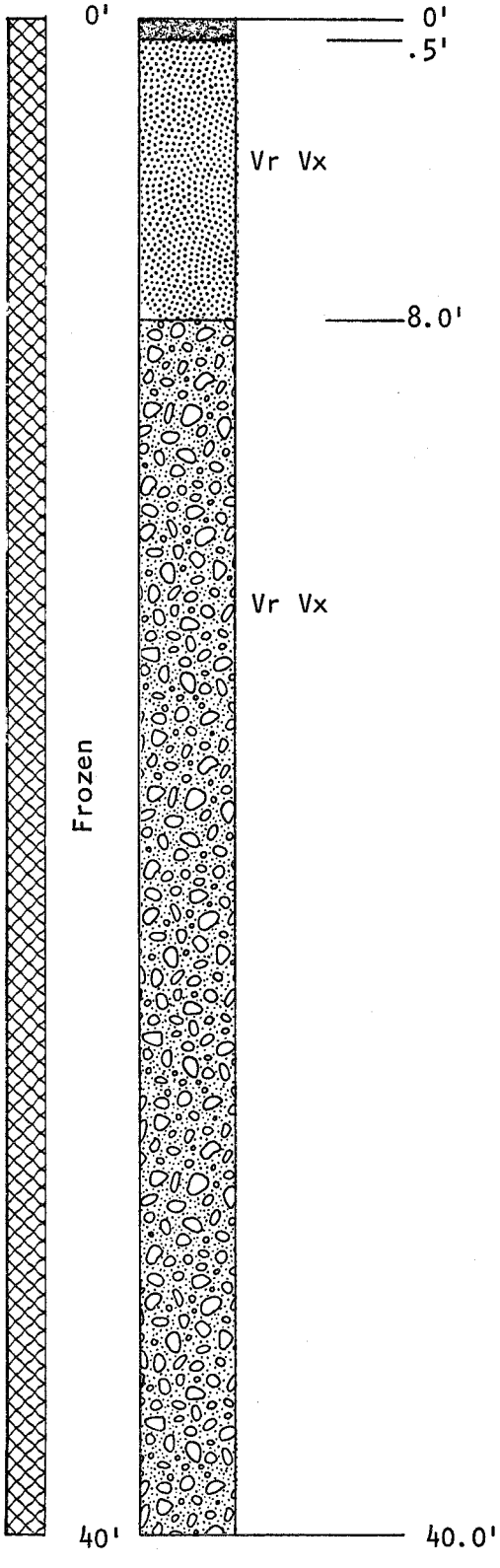
HARDNESS TEST

PETROGRAPHIC ANALYSIS

TEST HOLE LOGS

SOURCE No. AR-601

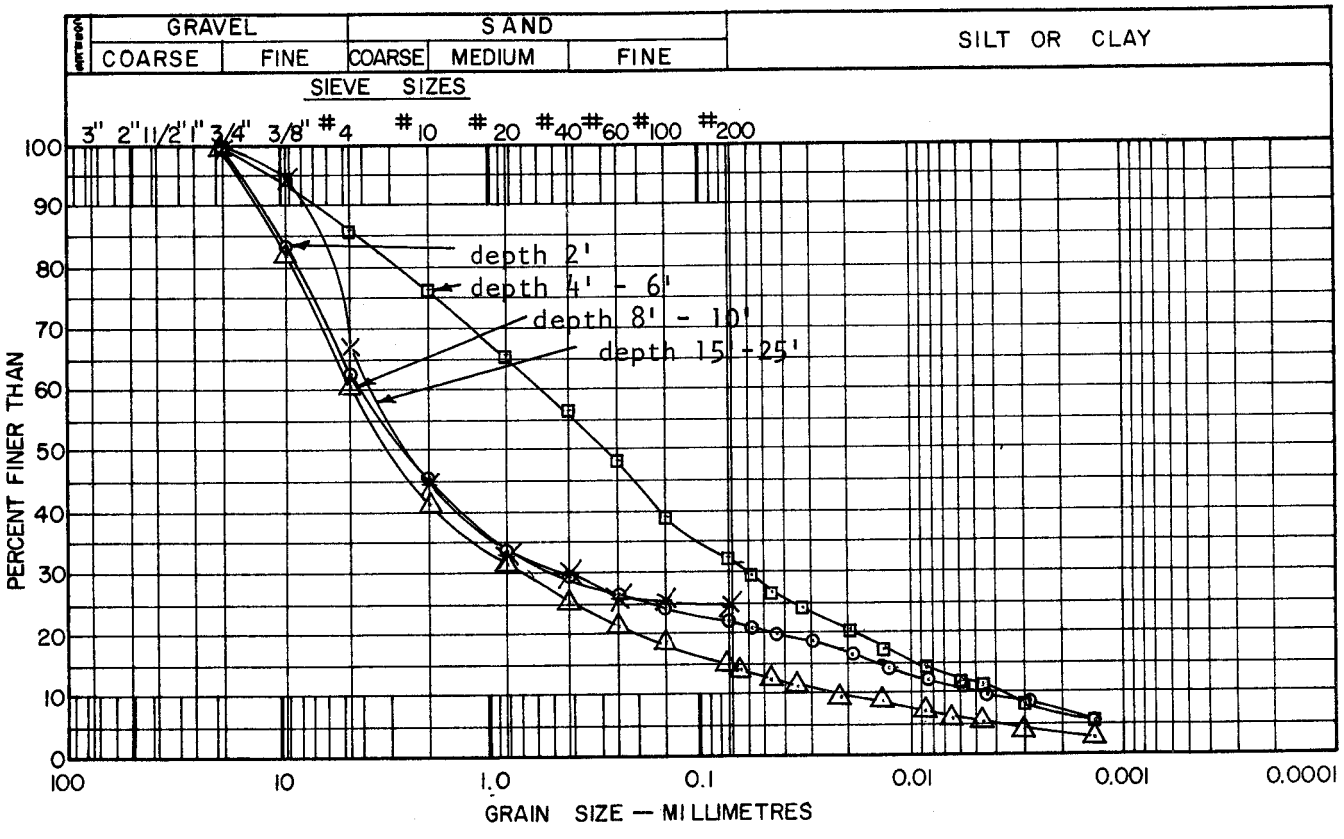
AR-601-3



0' – .5'	(Pt)	PEAT - roots, moss etc.
.5' – 8.0'	(SM)	SAND - some gravel, some silt well graded. Ice crystals and inclusions
8.0' – 40.0'	(GM)	GRAVEL - and sand, some silt well graded. Ice crystals and inclusions

LABORATORY
TEST DATA
TEST HOLE-SOURCE No. AR-601-3

GRAIN SIZE DISTRIBUTION



MOISTURE CONTENT

Sample 1	depth	2'	11.8%	Sample 5	depth	10'	13.3%
Sample 2	depth	4'	32.3%	Sample 6	depth	15'	8.0%
Sample 3	depth	6'	15.2%	Sample 7	depth	20'	8.4%
Sample 4	depth	8'	6.3%	Sample 8	depth	25'	7.6%

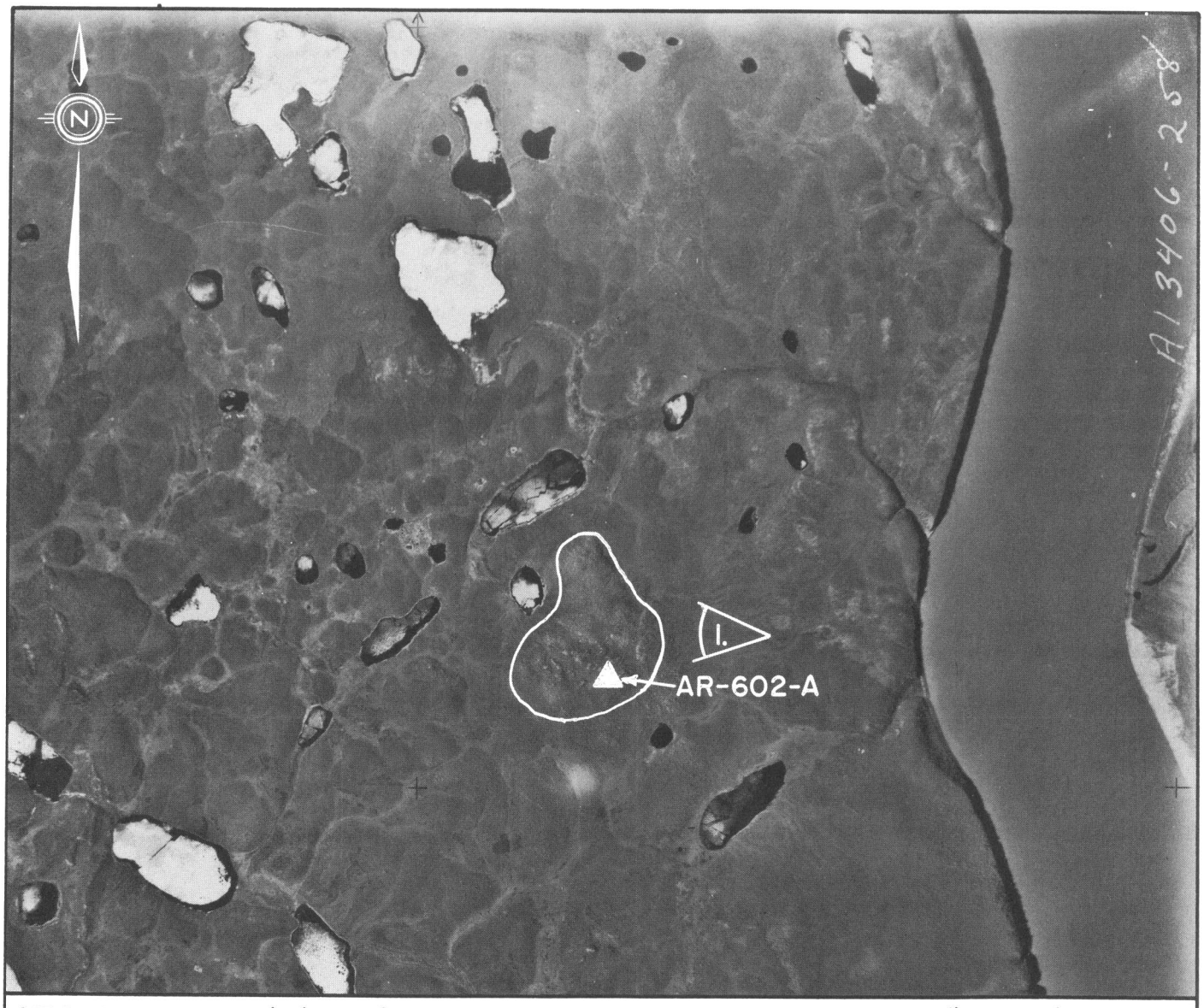
ORGANIC CONTENT

HARDNESS TEST

PETROGRAPHIC ANALYSIS

ARCTIC RED RIVER
SOURCE No. AR-602

LANDFORM AND LOCATION:	Large kame about 1,500 feet wide at the base and about 150 feet high. Four miles south east of the Community.
MATERIAL:	GRAVEL, some sand, trace silt.
VOLUME:	150,000 cu. yds, approximately
CONCLUSION:	Low priority for development due to large area to be disturbed in order to obtain suitable material.



AIRPHOTO No. A13406 - 258 SCALE: 1"= 3000' (approx.)

AR-602 ENVIRONMENT

Physical

The source is a large kame, about 1,500 feet across at the base and about 150 feet high, located 4 miles south east of the Community. The surface of the kame is well drained.

Photo No. 1 Source AR-602 looking west at kame

The kame supports two communication structures, and in connection with this work a shallow pit was opened at the base of the kame.

Biotic

A moderately dense stand of white spruce, white birch, and aspen covers the kame, with a canopy density of 40% to 60%. The trees are from 20 to 40 feet high.

The area supports a normal population of small fur bearing animals such as marten, mink, lynx and beaver, which are hunted and trapped from time to time. This is not a critical or important wildlife area.

AR-602 MATERIALS AND QUANTITIES

A sample of material taken from the side of the existing pit indicates a material containing 60% gravel, 30% sand, and 10% silt. In connection with their search for highway material the Department of Public Works drilled the kame recently, and found high ice content silts below the permafrost level (about 4 feet depth).

The active permafrost layer, to a depth of about 4 feet is expected to yield a volume of 150,000 cubic yards.

The individual rock particles are generally sound, although coated with a calcareous precipitate. The main constituents are quartzite (68%), limestone (10%), and chert (9%), with sandstone, granite, ironstone, opal, and quartz making up the remainding 13%. The deleterious content is about 8%.

AR-602 DEVELOPMENT

General

The material from this source is suitable for use as common fill, but too coarse for concrete aggregate without crushing and screening. The available material is only about 4 feet in thickness, so a large area must be disturbed to remove any volume of granular material. Other sources of common fill are more readily available and it is recommended that this source should not be developed at this time.

Material Use and Handling

The gravel in this source is suitable for the production of coarse and fine aggregates for concrete or asphalt as well as for general fill.

The sand and gravel materials can be removed with conventional equipment, bulldozers, loaders, and trucks etc., but screening equipment would be required for the production of coarse and fine aggregates. On the basis of the pit exposure, the gradation of the natural material is too coarse for the most economical production of coarse and fine aggregates. Surplus coarse aggregate would be produced during the screening operation, which could be used for drains or as general fill.

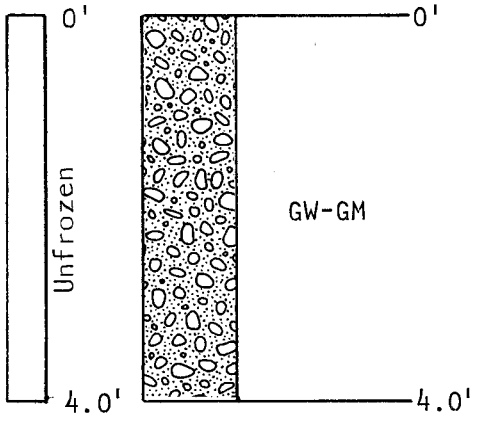
Stripping and Restoration

The development of this source requires the clearing of all trees and the removal of from 0 to 2 feet of organic topsoil to expose the granular materials. All trees should be burned and the stripped soil should be piled adjacent to the borrow area.

After the granular material is removed the area should be restored by spreading the stripped materials over the exposed borrow area.

TEST PIT LOGS
SOURCE No. AR-602

AR-602-A

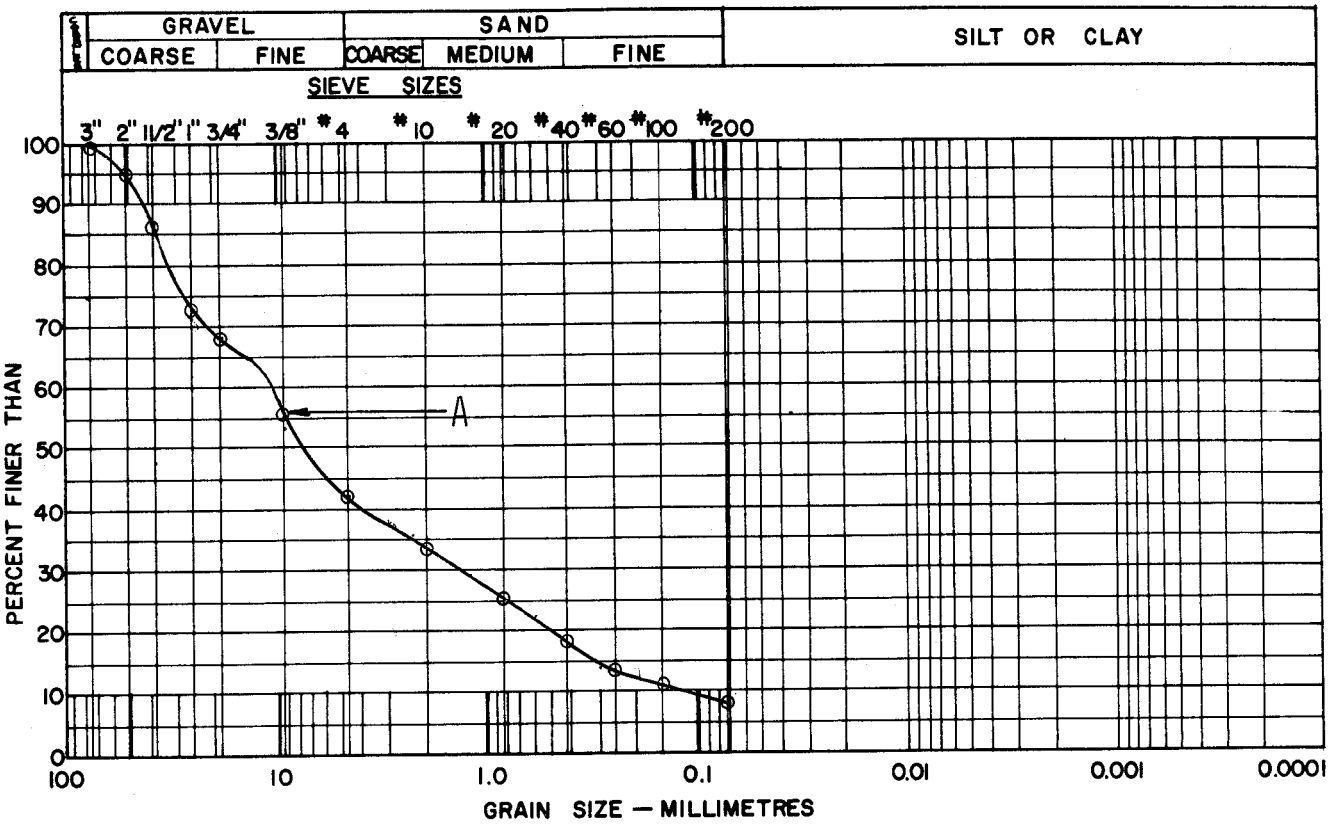


GRAVEL - some sand, trace silt
angular to subangular
max. 3", well graded

Profile from existing pit exposure.

LABORATORY
TEST DATA
SOURCE No. AR-602

GRAIN SIZE DISTRIBUTION



MOISTURE CONTENT

A (Pit Face) M/C = 6.5%

ORGANIC CONTENT

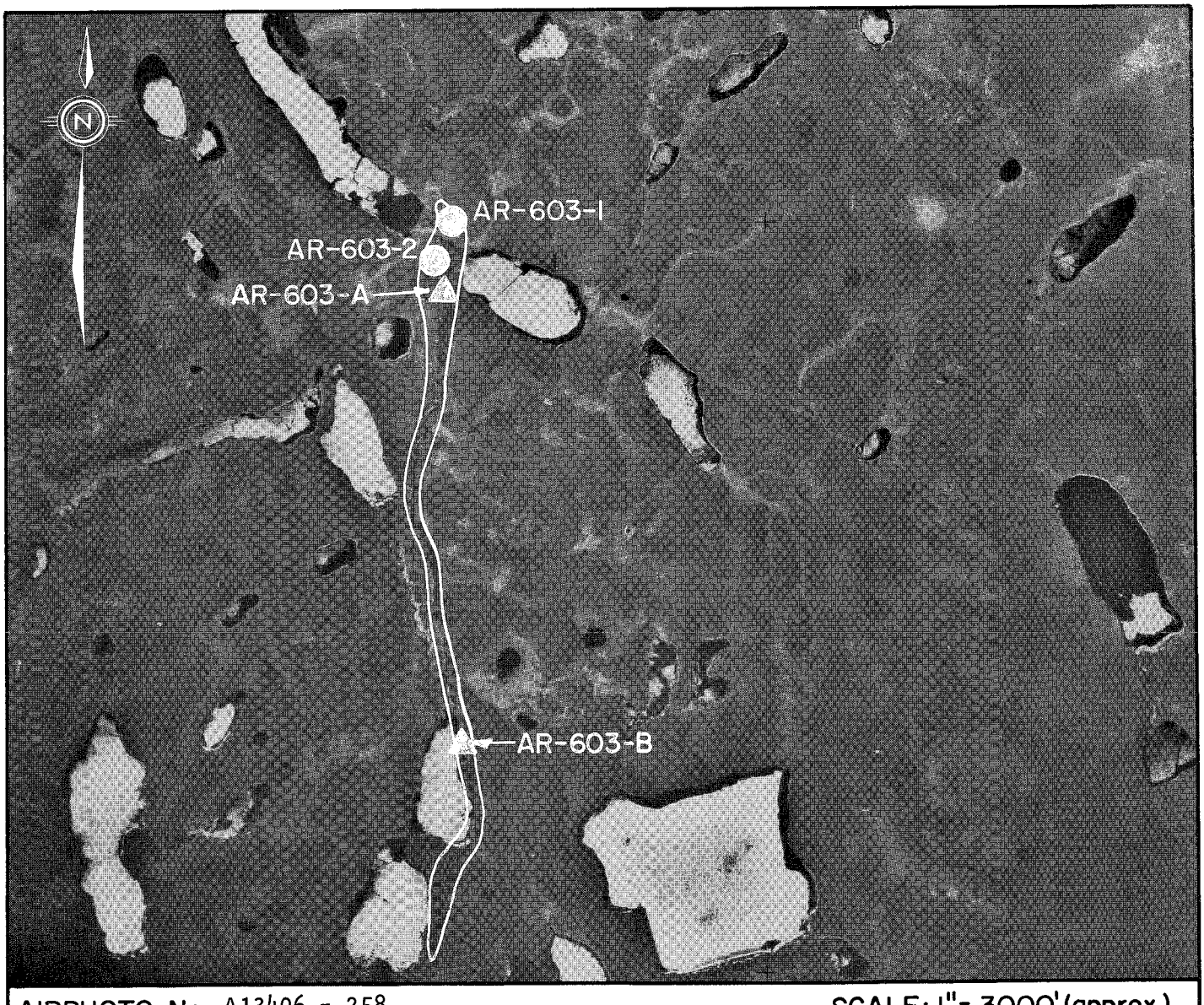
HARDNESS TEST

PETROGRAPHIC ANALYSIS

Quartzite	- 68%	Sandstone, porous	- 1%
Limestone, hard	- 10%	Opal	- 1%
Chert	- 9%	Limestone, porous	- 1%
Sandstone, fine	- 5%	Total	100%
Granitic	- 1%		
Ironstone	- 4%		

ARCTIC RED RIVER
SOURCE No. AR-603A

LANDFORM AND LOCATION:	Esker, about 2½ miles long, lying 4 miles south of the Community.
MATERIAL:	SAND - with silt.
VOLUME:	500,000 cu. yds.
CONCLUSION:	Source not recommended for development because of a high silt and medium ice content and the shallow depth of material above permafrost.



AIRPHOTO No. A13406 - 258

SCALE: 1" = 3000' (approx.)

AR-603A ENVIRONMENT

Physical

The source is an esker about 2½ miles long, 300 to 800 feet wide, and 20 to 50 feet high. The esker is well drained, although the surrounding area is very poorly drained. The source has not been developed.

The north end of the north-south-trending esker is 4 miles south of the community, directly adjacent to a cleared power-telephone line leading to the community.

Biotic

The area is covered with black spruce and some aspen, about 20 to 40 feet in height with a canopy density of 20% to 40%. Low areas near the esker contain black spruce and sphagnum moss. The source does not lie within any critical or important wildlife area, but supports a normal population of small fur-bearing animals and rodents.

AR-603A MATERIALS AND QUANTITIES

The material in this source is a silty sand, with less than 5% coarser than #4 mesh and about 35% finer than 200 mesh. The body of the esker contains a low to medium percentage of ice in the form of ice crystals and inclusions, with the water content increasing from about 10% in the top 4 feet to about 20% at 12 feet.

The volume available in the active layer is about 500,000 cubic yards.

The material in this source could be used only for general fill, and is not especially good for that.

AR-603A DEVELOPMENT

General

The source is not recommended for development because of the inferior quality of the material and because the available material above the active permafrost layer is quite shallow. A large area would have to be disturbed to obtain any volume.

Access

Winter access to this source is very good, being only 4 miles along

a cleared power-telephone line. Summer access would require the construction of an all weather road, and is probably not feasible.

Material Use and Handling

The material in this source is a poor quality general fill, not recommended for use under most conditions. It would be highly frost susceptible with large heave potential and loss of strength in spring thaw.

Handling of this material would require the usual assembly of equipment, including ripper-dozer, front-end loader, and trucks.

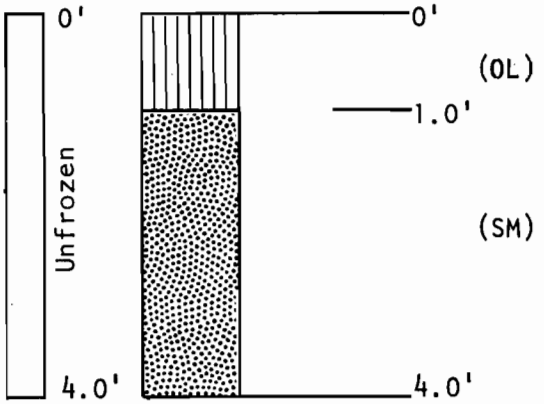
Stripping and Restoration

Because the depth of available material is small, a large area of the source would have to be disturbed in order to develop any volume of material. The process of stripping and restoration would be the same as for similar landforms in the area.

TEST PIT LOGS

SOURCE No. AR-603A

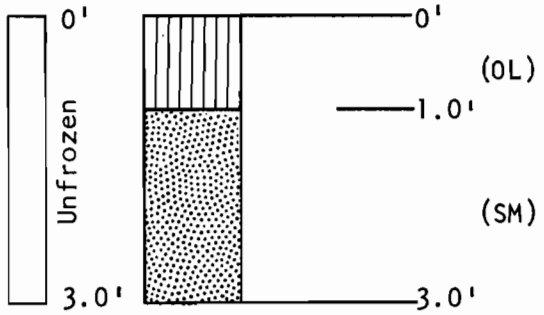
AR-603A-A



SILT - organic, trace gravel trace sand

SAND - and silt, very fine, uniform brown

AR-603A-B

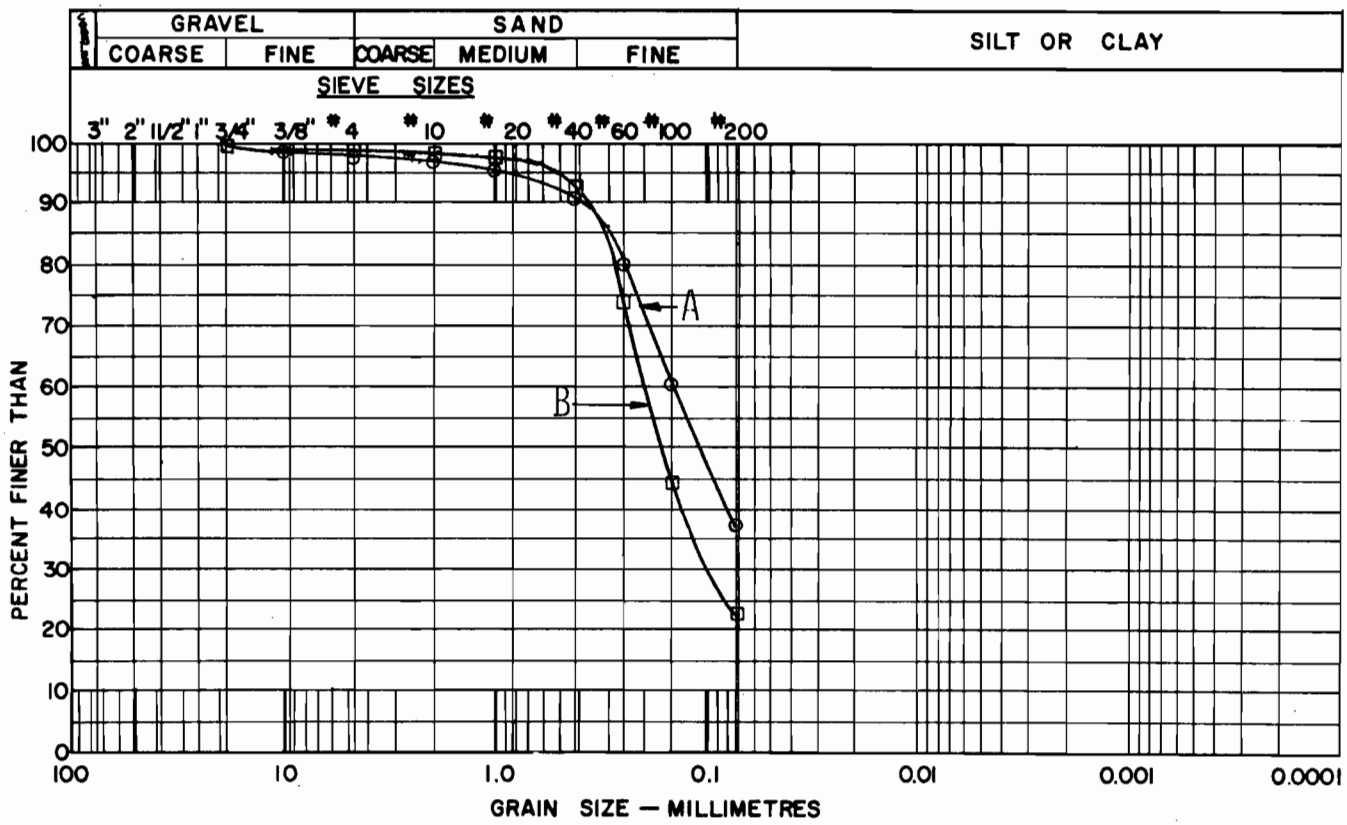


SILT - organic, trace fine sand

SAND - some silt, fine, uniform, brown

LABORATORY
TEST DATA
SOURCE No. AR-603A

GRAIN SIZE DISTRIBUTION



MOISTURE CONTENT

A (1.0' - 4.0') M/C = 12.2%

B (1.0' - 3.0') M/C = 8.5%

ORGANIC CONTENT

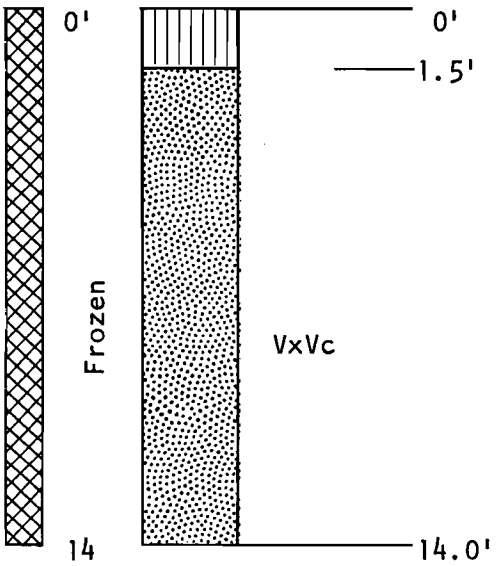
HARDNESS TEST

PETROGRAPHIC ANALYSIS

TEST HOLE LOGS

SOURCE No. AR-603A

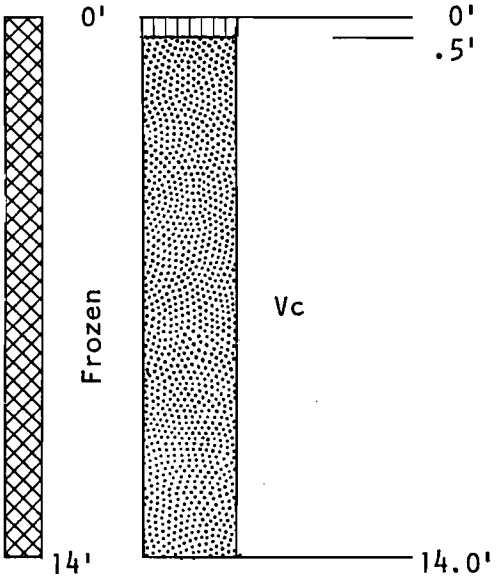
AR-603A-1



(Pt) SILT - Organic roots etc.

(SM) SAND - some silt, fine uniform gradation. Nonplastic, ice crystals and inclusions.

AR-603A-2

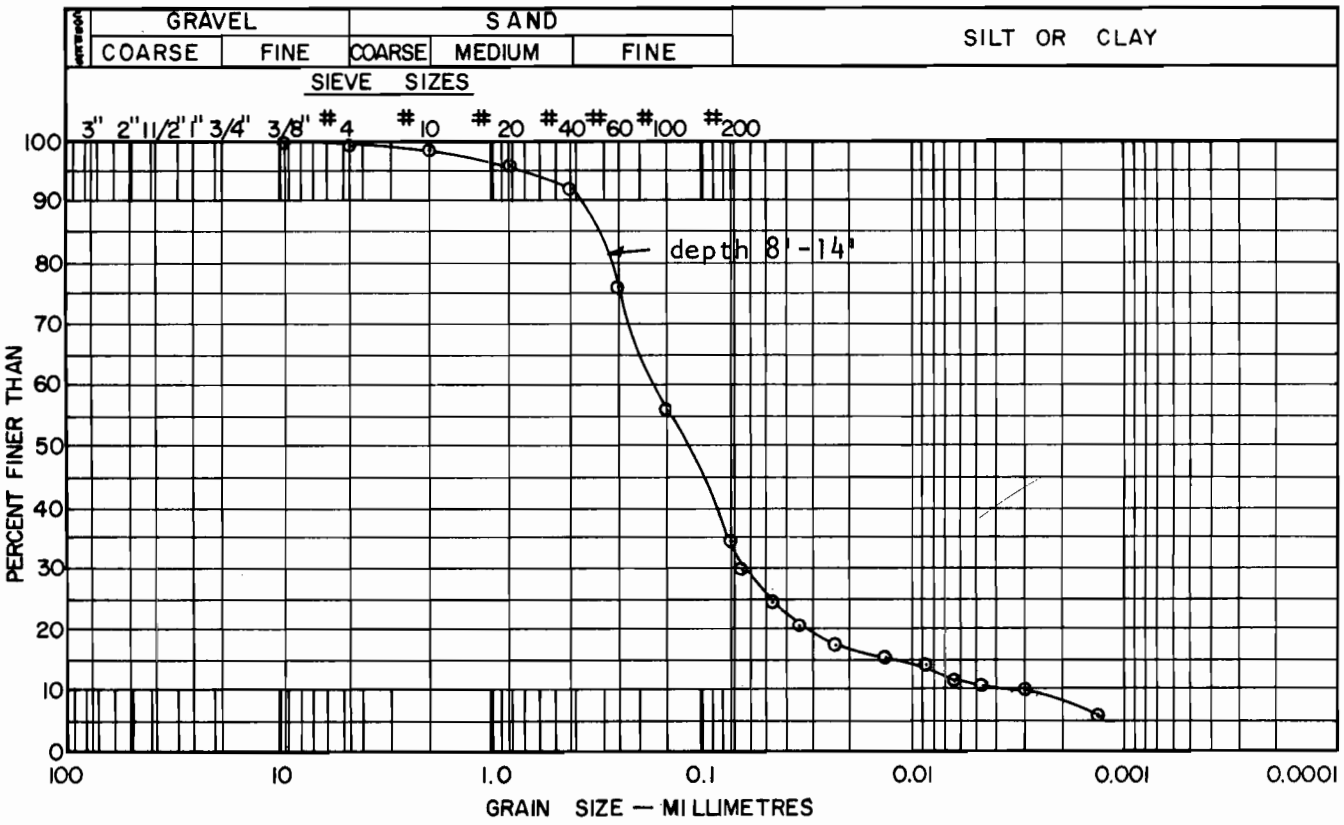


SILT - and organics

(SM) SAND - Some silt, fine uniform gradation, nonplastic. Trace of ice crystals and coatings.

LABORATORY
TEST DATA
TEST HOLE-SOURCE No. AR-603A-1

GRAIN SIZE DISTRIBUTION



MOISTURE CONTENT

Sample 1 depth 8' 19.9%
Sample 2 depth 14' 23.8%

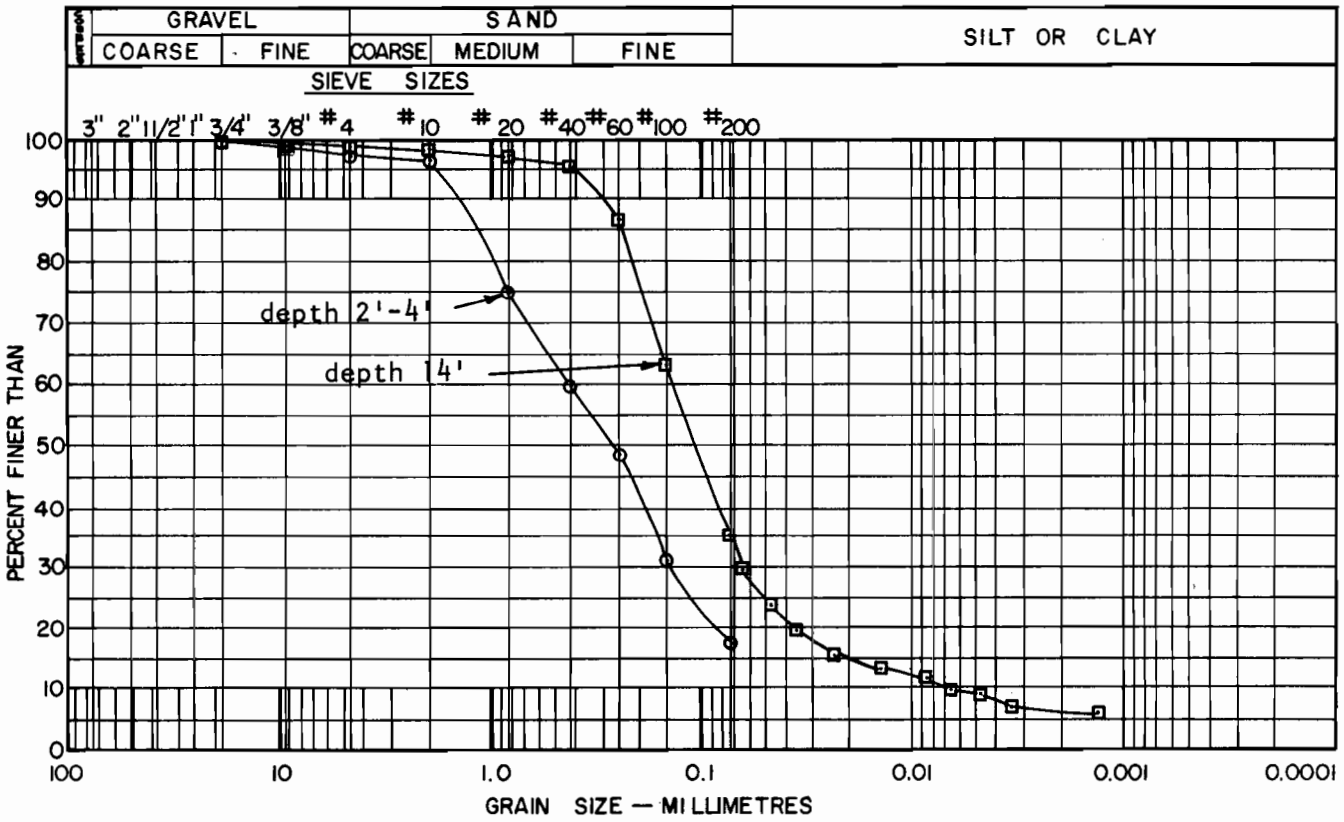
ORGANIC CONTENT

HARDNESS TEST

PETROGRAPHIC ANALYSIS

LABORATORY
TEST DATA
TEST HOLE-SOURCE No. AR-603A-2

GRAIN SIZE DISTRIBUTION



MOISTURE CONTENT

Sample 1	depth	2'	9.7%
Sample 2	depth	4'	14.5%
Sample 3	depth	6'	23.3%
Sample 4	depth	14'	21.5%

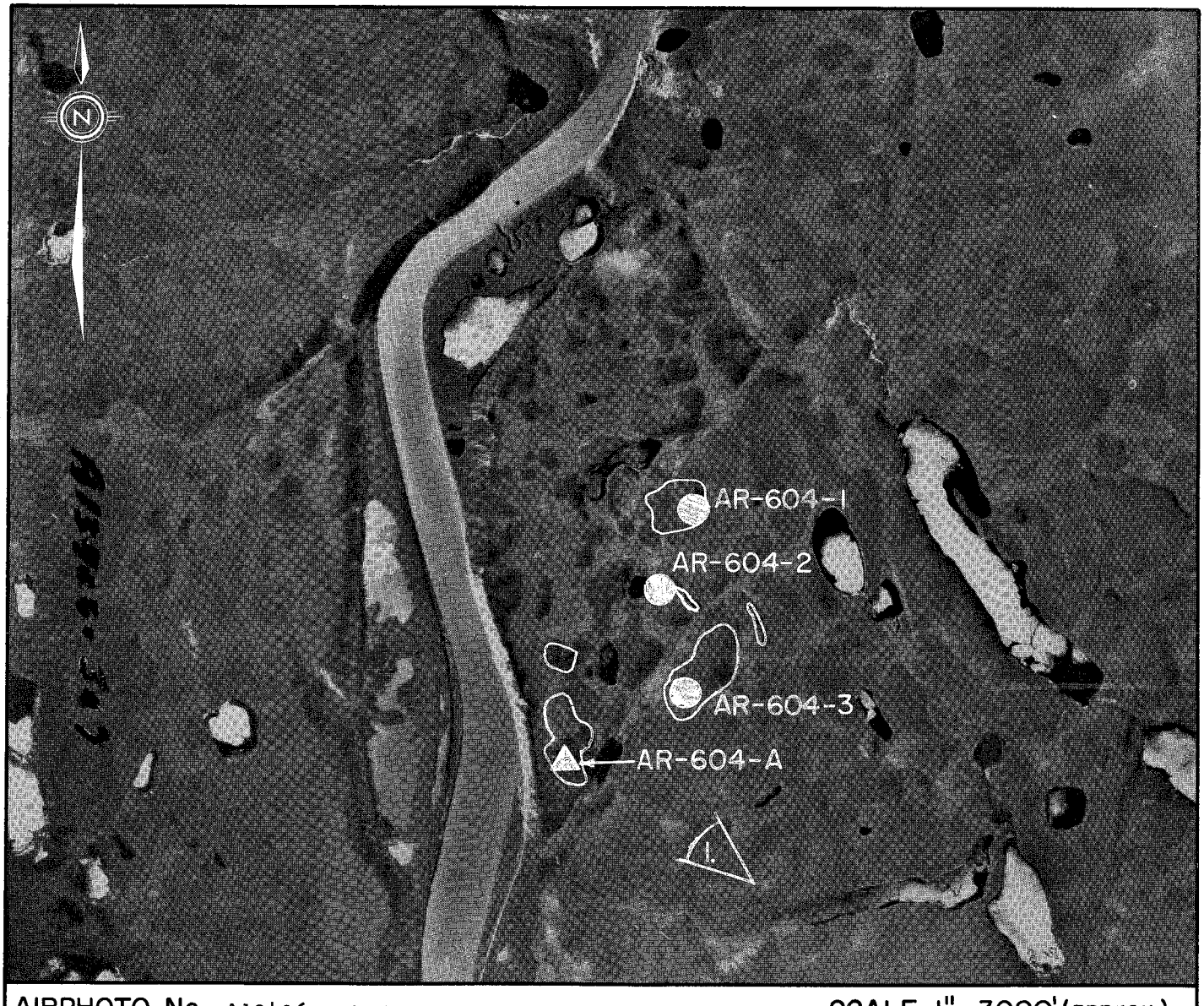
ORGANIC CONTENT

HARDNESS TEST

PETROGRAPHIC ANALYSIS

ARCTIC RED RIVER
SOURCE No. AR-604A

LANDFORM AND LOCATION:	Four large kames and two short eskers, located in a group two miles south of the community.
MATERIAL:	SAND and SILT in approximately equal volumes, little gravel.
VOLUME:	1,000,000 cu. yds., approximately.
CONCLUSION:	The source is not worth further consideration because of the poor quality of the material.



AIRPHOTO No. A13406 - 307 SCALE: 1"= 3000' (approx.)

AR-604A ENVIRONMENT

Physical

The source consists of four large kames and two small esker remnants, all grouped within a circle 1½ miles in diameter. The kames are 1000 to 3000 feet in diameter, and 50 to 150 feet high. The eskers are 300 to 400 feet long, and up to 20 feet high. The group is adjacent to the east bank of Arctic Red River, two miles by air south of the community.

The features are well drained, and have not been developed.

Biotic

Forest cover over the area is primarily white spruce, white birch, and larch, generally ranging from 20 to 40 feet high. The canopy density over the features is 40% to 60%, and somewhat less over the surrounding area.

The area supports the normal population of small fur-bearing animals, and is not part of any important wildlife area.

AR-604A MATERIALS AND QUANTITIES

The material, as sampled at three points is uniformly poor, a mixture of sand and silt in approximately equal volumes with 15% fine gravel retained on the #4 screen. The ice content is medium to high, mainly as ice coatings on particles.

The volume of material available from this source is about 1,000,000 cubic yards.

AR-604A DEVELOPMENT

General

This source is not recommended for development because of the inferior quality of material.

Access

The source is about 4 miles by road from the community, including 2 miles on the existing cleared telephone line and two miles of new construction. Access is possible only during winter months.

Material Use and Handling

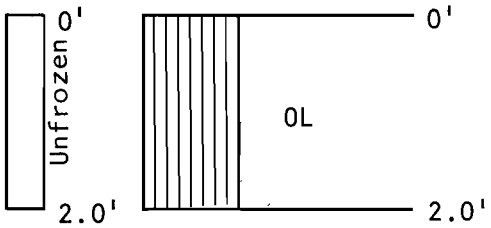
The material in this source contains too much silt and too little gravel to be useful for general fill or for specification use.

Stripping and Restoration

Development of this source would lead to severe thermal erosion because of the high ice and silt contents. If development is attempted restoration would be very difficult and costly.

TEST PIT LOGS
SOURCE No. AR-604A

AR-604A-A

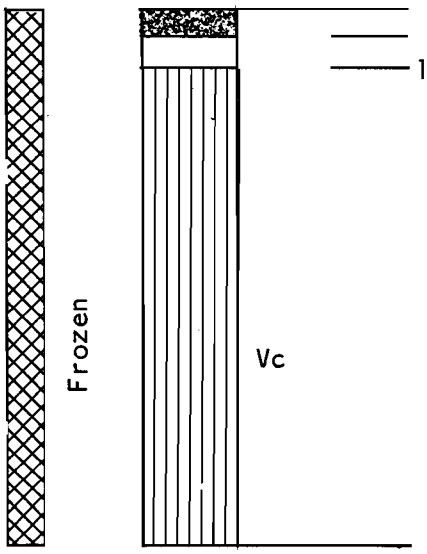


SILT - organic, trace sand
trace gravel, low plastic

TEST HOLE LOGS

SOURCE No. AR-604A

AR-604A-1



PEAT - silt, moss, roots etc.

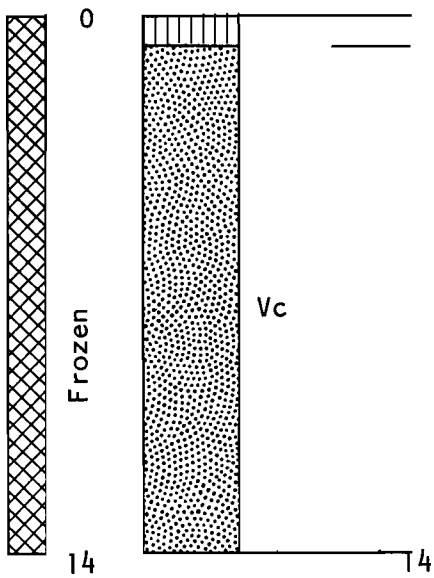
ICE - with silt inclusions

(ML) SILT - little sand, little gravel, dark grey low plastic, ice crystals and coatings

Moisture content

Sample 1	depth 4'	18.3%
Sample 2	depth 6'	14.7%
Sample 3	depth 14'	17.0%

AR-604A-2

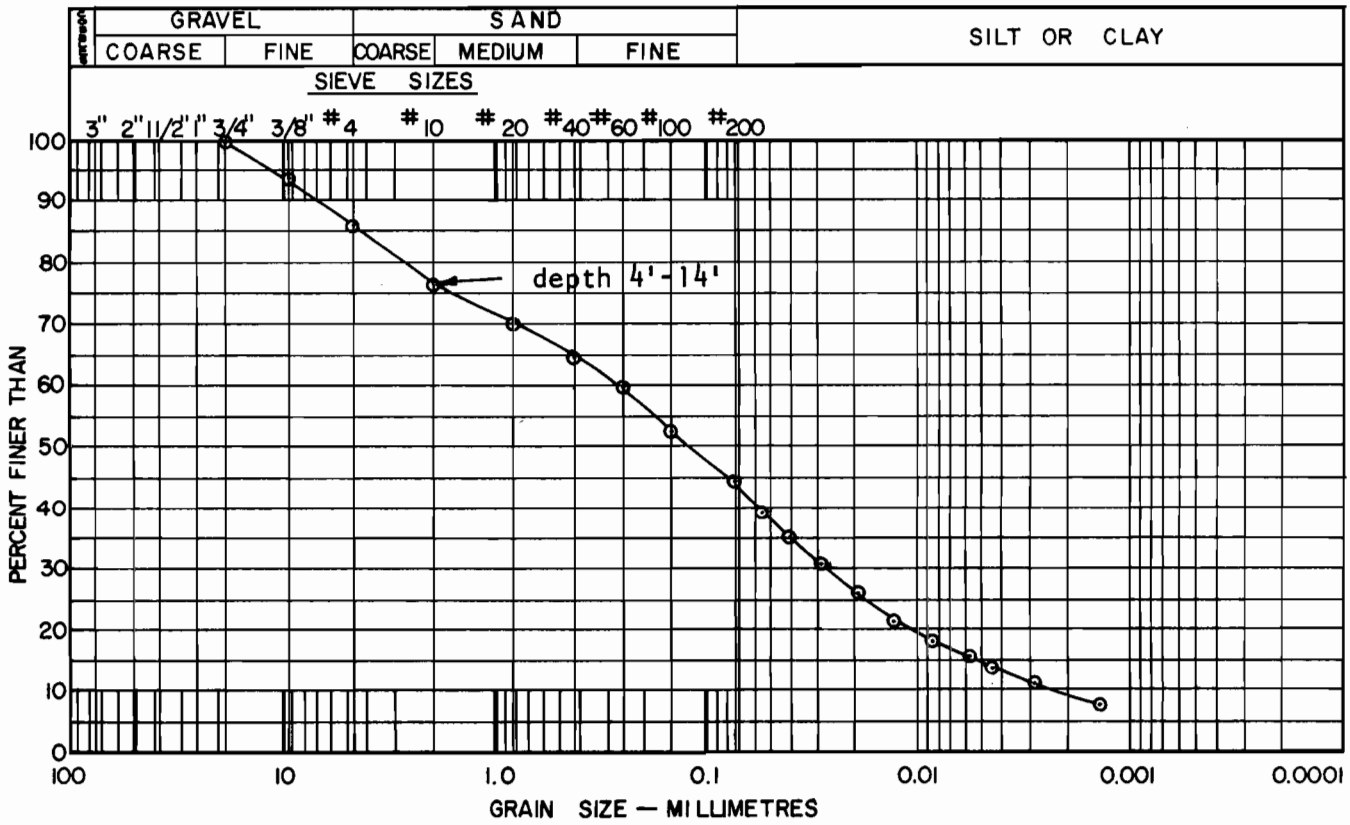


SILT - organic, roots etc.

(SM) SAND - and silt, little gravel, dark grey, low plastic, ice crystals and coatings

LABORATORY
TEST DATA
TEST HOLE-SOURCE No. AR-604A-2

GRAIN SIZE DISTRIBUTION



MOISTURE CONTENT

Sample 1	depth	2'	12.2%
Sample 2	depth	4'	13.0%
Sample 3	depth	6'	18.4%
Sample 4	depth	14'	15.0%

ORGANIC CONTENT

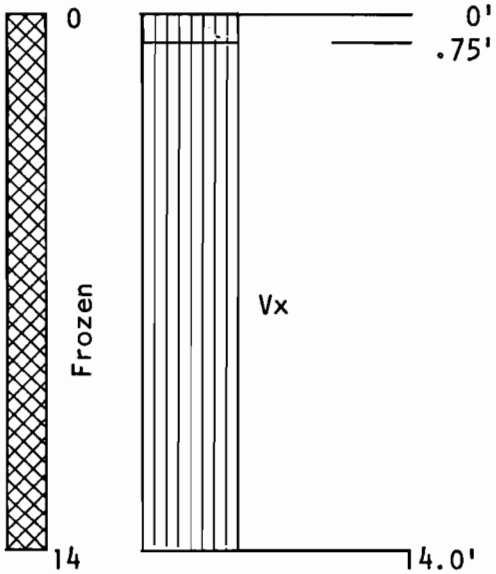
HARDNESS TEST

PETROGRAPHIC ANALYSIS

TEST HOLE LOGS

SOURCE No. AR-604A

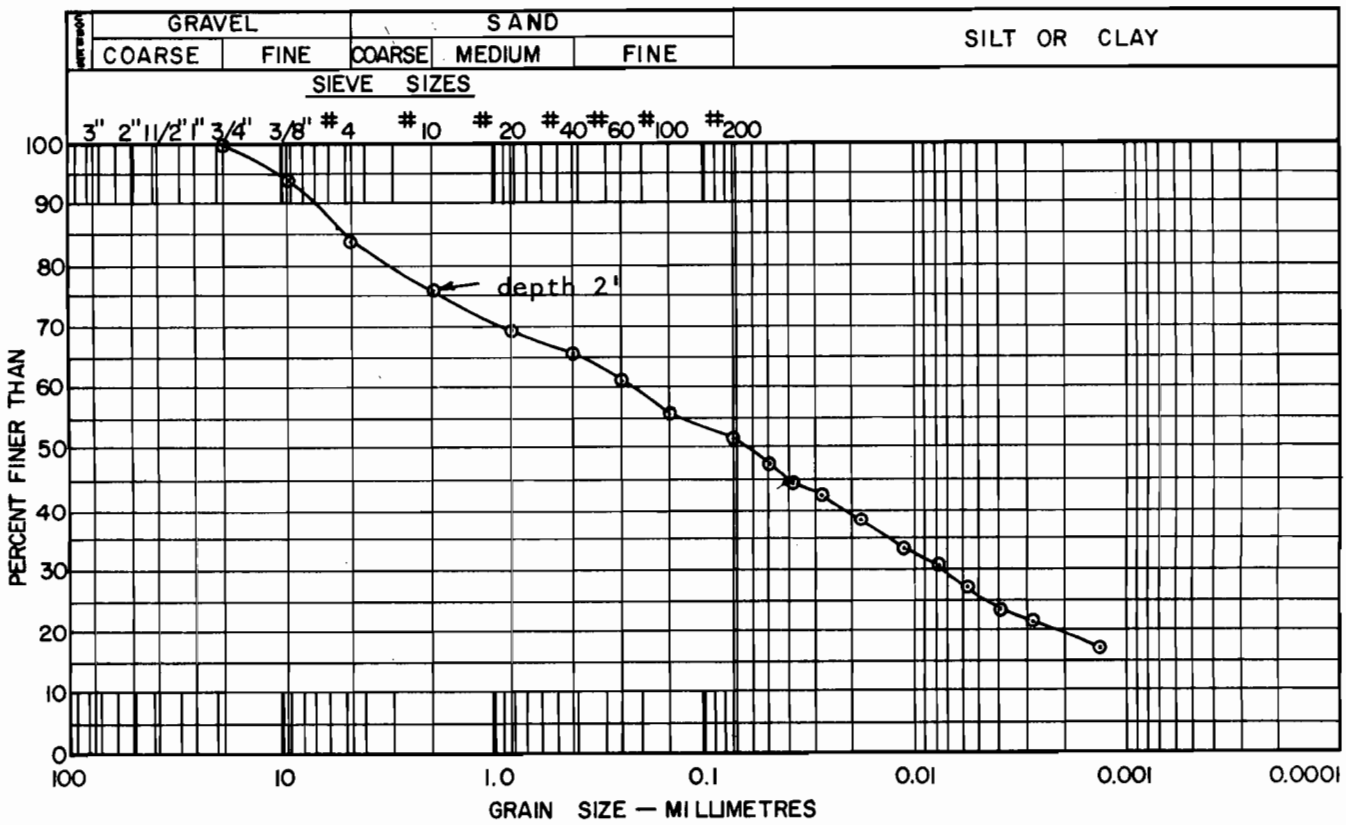
AR-604A-3



0'	(Pt)	SILT - Organic, roots, peat, moss etc.
.75'		
Vx	(ML)	SILT - and sand, little gravel, little clay. Low to nonplastic, trace ice crystals & inclusions.
14.0'		

LABORATORY
TEST DATA
TEST HOLE-SOURCE No. AR-604A-3

GRAIN SIZE DISTRIBUTION



MOISTURE CONTENT

Sample 1 depth 2' 15.0%
Sample 2 depth 4' 13.9%

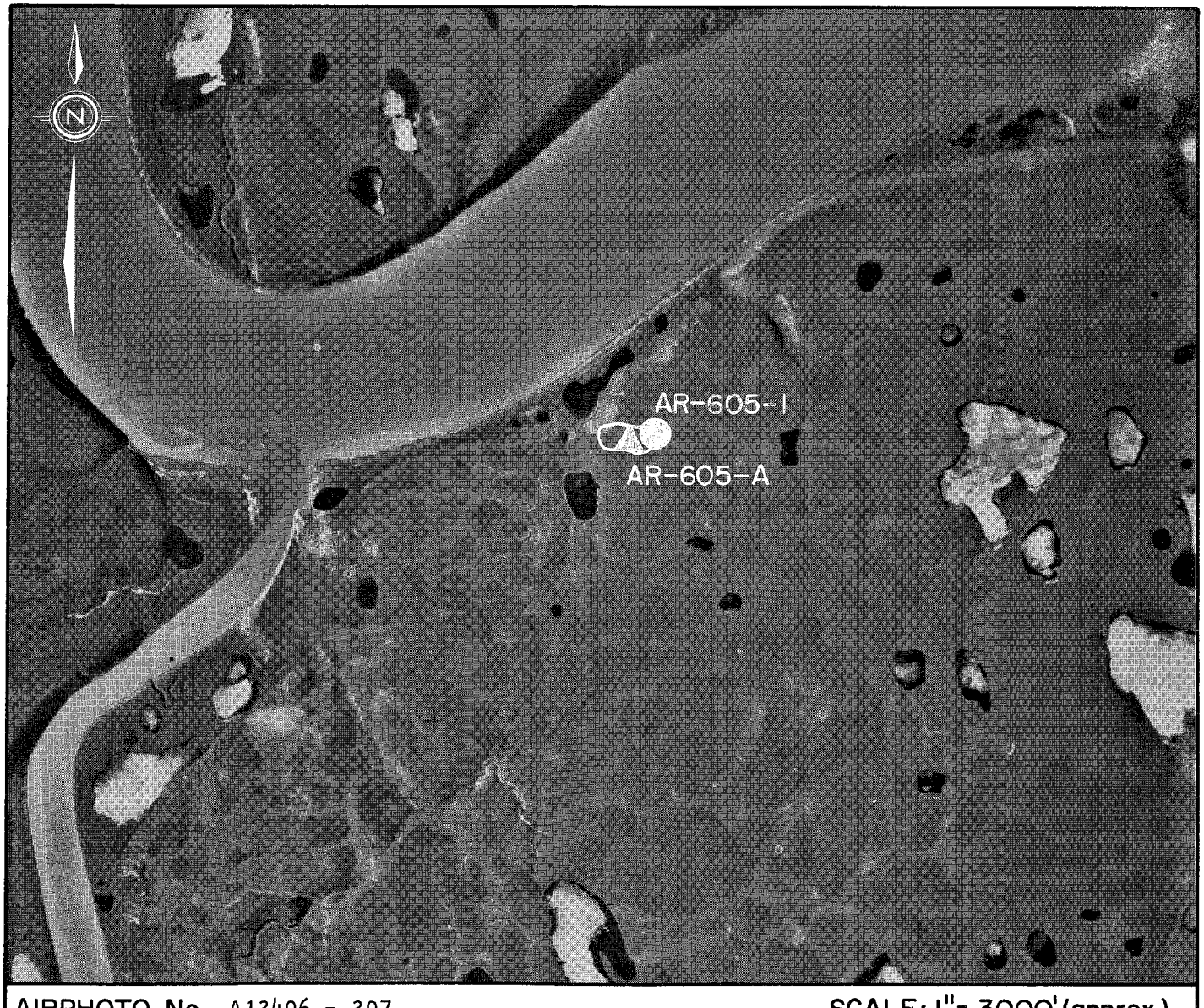
ORGANIC CONTENT

HARDNESS TEST

PETROGRAPHIC ANALYSIS

ARCTIC RED RIVER
SOURCE No. AR-605

LANDFORM AND LOCATION:	This source is an esker remnant, about 1000 feet long, located about 1½ miles east of the community.
MATERIAL:	Variable, mostly SAND.
VOLUME:	80,000 cu. yds., approximately.
CONCLUSION:	Not recommended for development at this time. The material is useful only as general fill, and other sources are closer to the community.



AIRPHOTO No. A13406 - 307 SCALE: 1"= 3000' (approx.)

AR-605 ENVIRONMENT

Physical

The source is an esker remnant about 1,000 feet long, 200 feet wide, and 50 feet high. The esker terminates at the top of the steep bank falling to the Mackenzie River, about 1½ miles east of the community. Drainage of the source and of the area is good. The source has not been developed.

Biotic

The tree cover is primarily spruce and aspen up to 40 feet high, with a canopy density of 40% to 60%. The area is not an important or critical wildlife area, although small fur-bearing animals such as beaver, mink, marten and lynx are trapped from time to time.

AR-605 MATERIALS AND QUANTITIES

The material in this source is highly variable, grading from silty sand to a relatively clean sandy gravel. Unfortunately, at the point tested the cleaner material underlies the silty material.

Water content of the frozen material at AR-605-1 varies from 30% at 3 feet to 12% at 8 feet, and back to 28% plus at 14 feet.

The source is estimated to contain 80,000 cubic yards in the active permafrost zone.

AR-605 DEVELOPMENT

General

The source is not recommended for development at this time because the material is evidently variable in quality and in ice content and other sources of general fill are closer to the community.

Development would require the disturbance of a large area in order to produce any volume of material.

Access

The source is a little over a mile by a direct route from the community along the top of the river bank, but at present no part of this route has been cleared. Winter access would be quite easy after the road had been cleared.

Materials Use and Handling

The material in this source appears to be extremely variable. For limited use it may be possible to locate areas of high quality material by a program of test pitting, but at this time the source is considered to contain nothing more than general fill.

Material from this source would be removed by the usual assemby of equipment, ripper-dozer, frontend loader, and trucks. The source would require selectivity in development, but would present no particular processing problems.

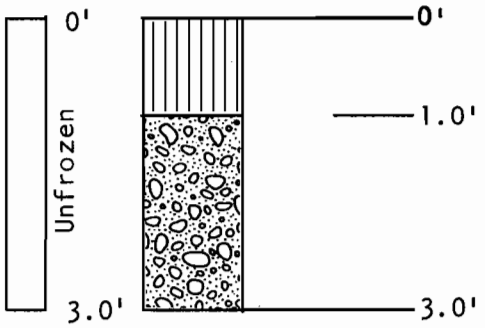
Stripping and Restoration

All trees and roots would have to be removed and burned adjacent to the source. The surface layer of silt would then be stripped and stockpiled for replacement after the granular material had been removed. Re-grading should follow as soon as possible after extraction of gravel, following which the area should be seeded for speedy re-vegetation. The selection of vegetative cover and the method of preparation should be provided by a scientist experienced in Arctic horticulture.

TEST PIT LOGS

SOURCE No. AR-605

AR-605-A

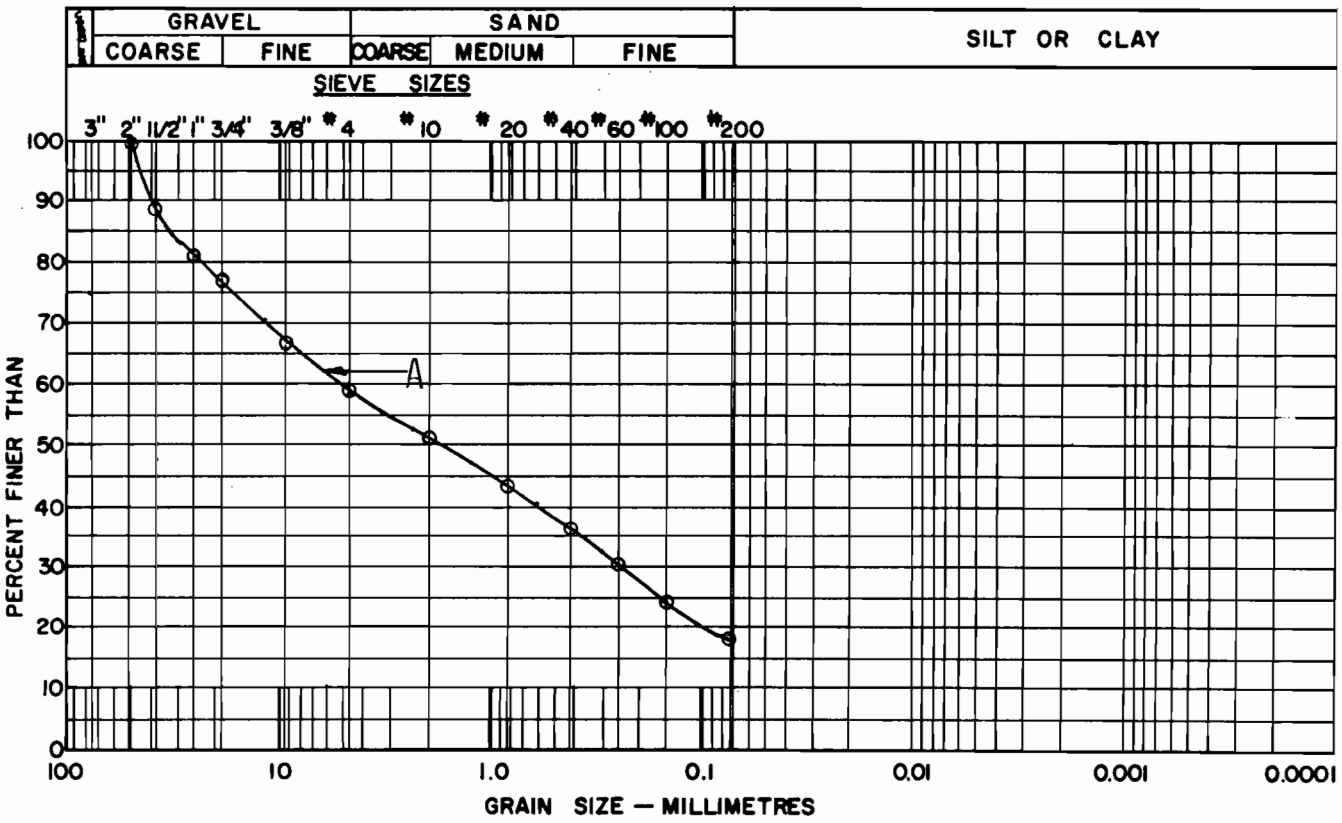


(OL) SILT - organic, some sand

(GM) GRAVEL - and sand, little silt
max. 2", angular

LABORATORY
TEST DATA
SOURCE No. AR-605

GRAIN SIZE DISTRIBUTION



MOISTURE CONTENT

A (1.0' - 3.0') M/C = 7.1%

ORGANIC CONTENT

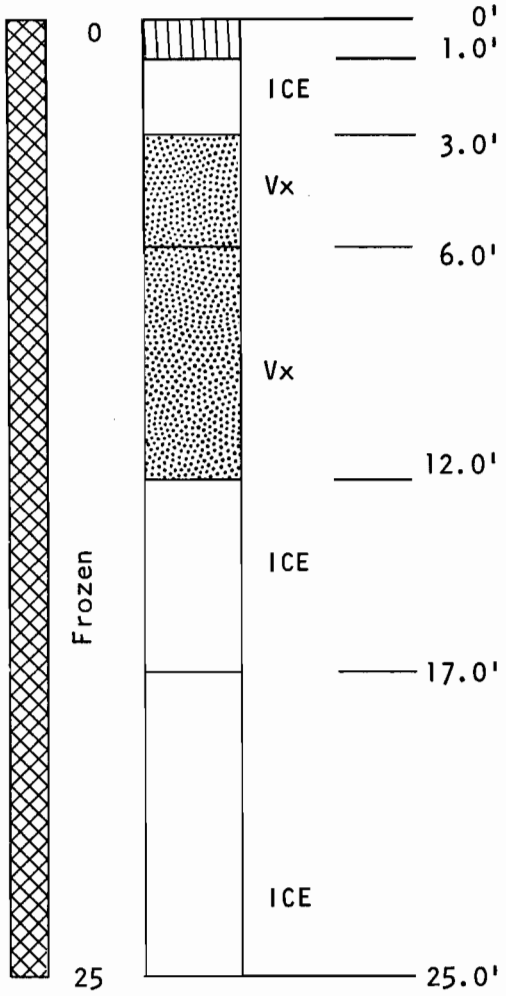
HARDNESS TEST

PETROGRAPHIC ANALYSIS

TEST HOLE LOGS

SOURCE No. AR-605

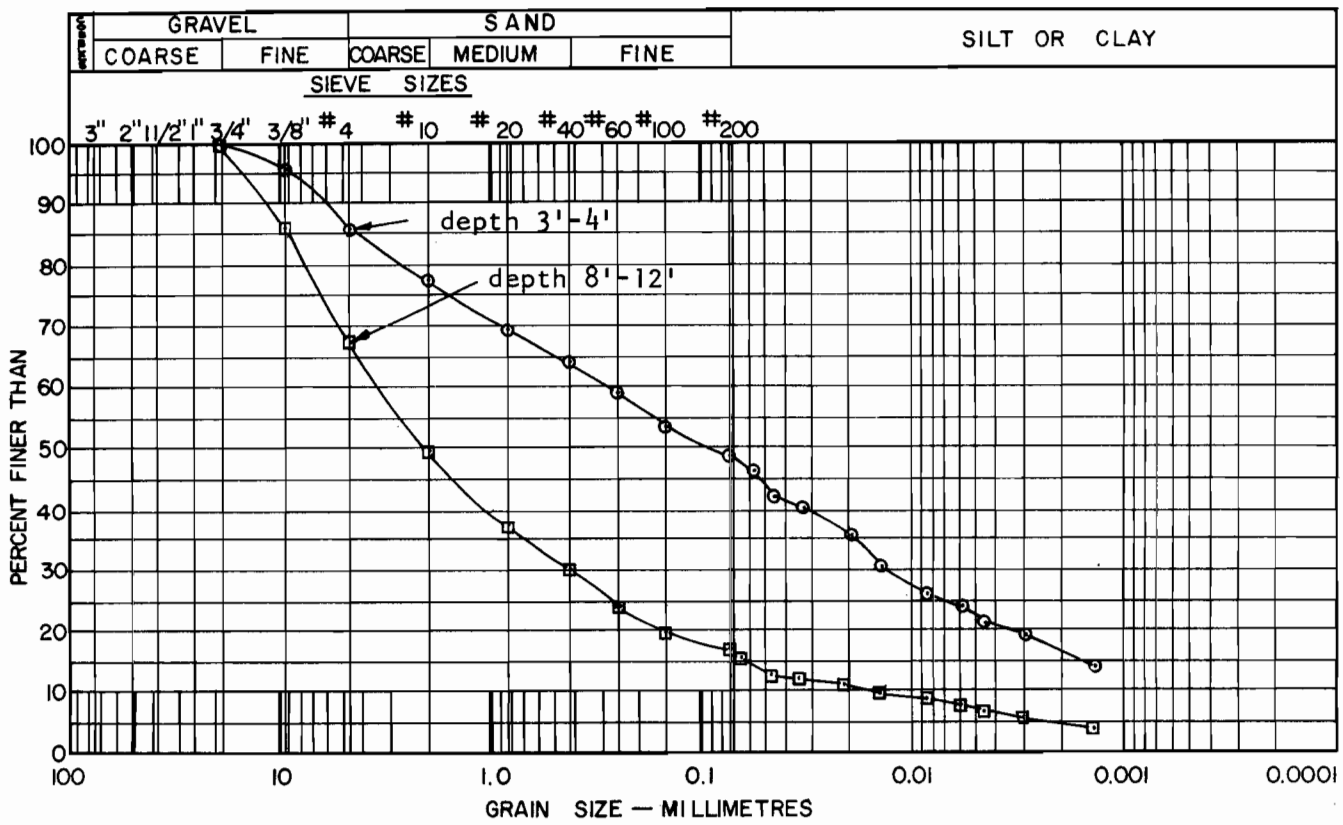
AR-605-1



0'	(Pt)	SILT - and organic roots moss etc.
1.0'		ICE - with silt layers
3.0'	(SM)	SAND - and silt, trace gravel ice crystals and inclusions.
6.0'		
	(SM)	SAND - some gravel little silt, brown. Ice crystals and inclusions.
12.0'		ICE - with silt lensing and inclusions
17.0'		
		ICE - clear
25.0'		

LABORATORY
TEST DATA
TEST HOLE-SOURCE No. AR-605-1

GRAIN SIZE DISTRIBUTION



MOISTURE CONTENT

Sample 1 depth	3'-4'	30.0%	
Sample 2 depth	6'	15.4%	
Sample 3 depth	8'	11.6%	
Sample 4 depth	10'	13.1%	
Sample 5 depth	14'	28.0%	(silt inclusion)

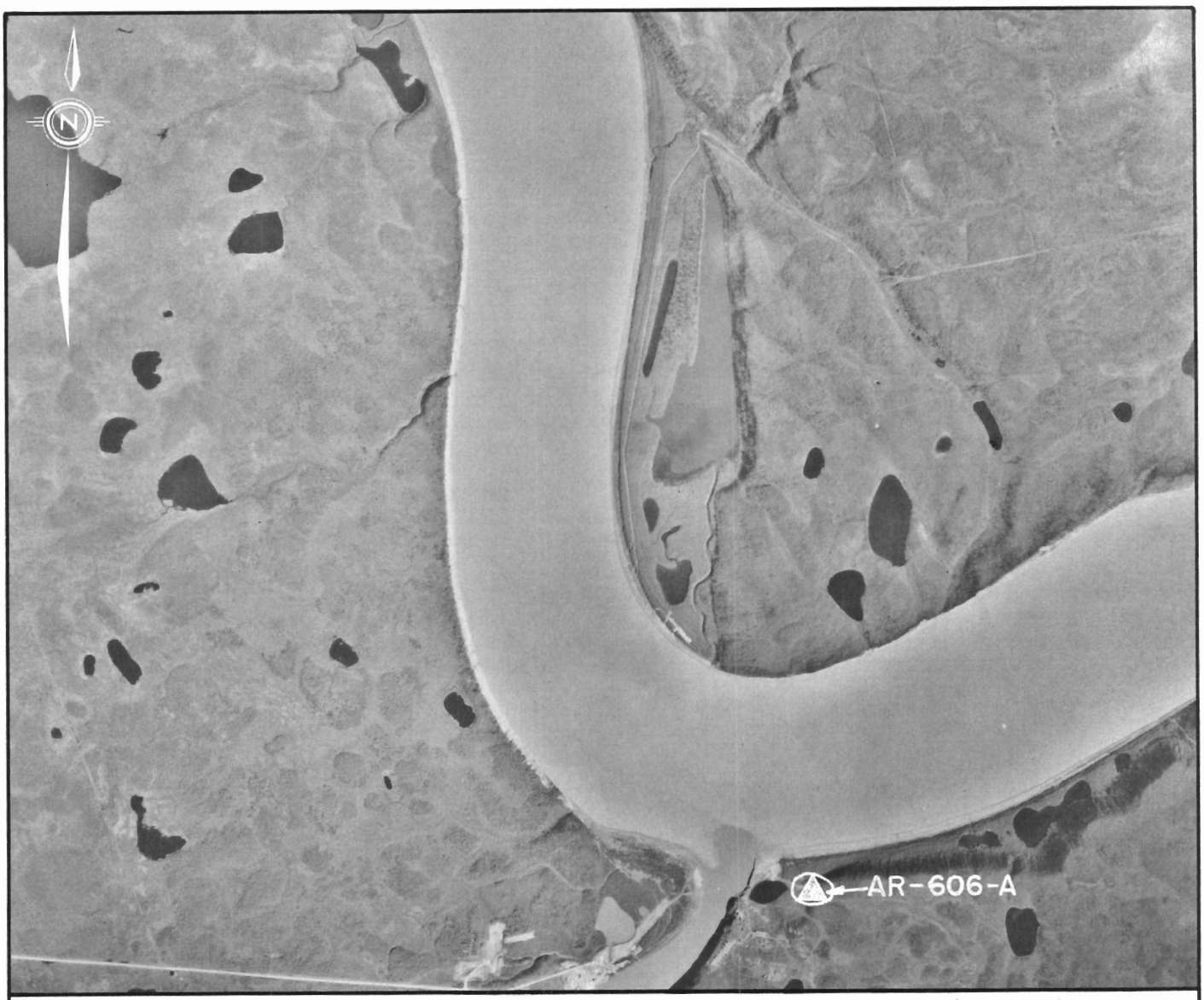
ORGANIC CONTENT

HARDNESS TEST

PETROGRAPHIC ANALYSIS

ARCTIC RED RIVER
SOURCE No. AR-606

LANDFORM AND LOCATION:	A veneer of granular material over bedrock on slope of south bank of Mackenzie River, 1/2 mile east of Community.
MATERIALS:	GRAVEL, and sand, little silt, boulders SHALE, soft below
VOLUME:	10,000 cu. yds., Gravel and Sand approximately 100,000 cu. yds., Shale approximately
CONCLUSION:	Suitable for continued use by the Community for general fill.



AIRPHOTO No. A22890-150 SCALE: 1"= 3000' (approx.)

AR-606 ENVIRONMENT

Physical

The source is an existing trench about 300 feet long and 25 to 50 feet wide, cut into the sloping bank of the Mackenzie River to excavate granular material that overlies the bedrock in a veneer of variable thickness. The pit lies within one-half mile east of the community. Drainage of this pit is good.

Biotic

The slope is heavily treed with white spruce, white birch, and larch to 40 feet in height and with a canopy density of 40% to 60%.

The source is so close to the community that wildlife are not a major consideration.

AR-606 MATERIALS AND QUANTITIES

The overlying material is a coarse gravel, well graded, and containing about 10% silt. A petrographic analysis indicates the material is primarily shale (54%) with quartzite and granities (20%), limestone and sandstone (17%) and siltstone, chert and ironstone (9%). The volume of additional available gravel is estimated at 10,000 cubic yards. Underlying the gravel is soft shale-sandstone with an estimated volume of 100,000 cubic yards of available material. The shale is suitable for general fill only.

AR-606 DEVELOPMENT

General

The deposit will undoubtedly continue to service the community as a convenient source of granular materials.

Access

All-weather access is now provided to the source, within 1/2 mile of the community.

Material Use and Handling

Because of the high shale content the gravel is only suitable for general fill and coarse aggregate. It may be necessary to rake out the

coarser material at the surface of the fill. The material will provide a stable fill, regardless of exposure or moisture. Further development of the source will require a dozer for clearing and stripping, and a front-end loader to load trucks.

The shale will be only suitable for general fill. Development will require a dozer with ripper attachment, front end loader and trucks. Because of the nature of some of the shale to decompose to a clay silt when subjected to water and wear, the fill surfaces should be graded to allow easy drainage and protected with a wearing layer of gravel.

Stripping and Restoration

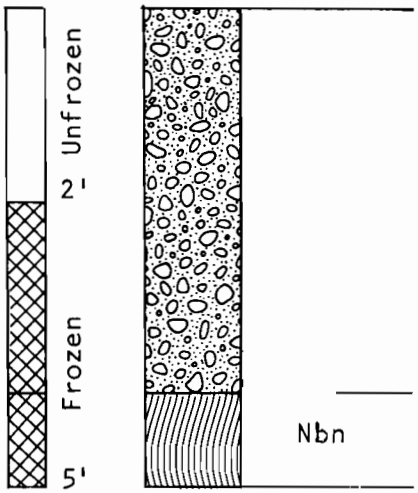
Stripping should be stockpiled for later re-grading. After a section of the pit is worked out the banks should be graded to a stable slope and the banks and floor covered with stripped soil, after which the area should be seeded for speedy revegetation. The selection of vegetative cover and the method of preparation should be provided by a scientist experienced in Arctic horticulture.

Drainage of the pit will be towards the Mackenzie River. We do not anticipate a large volume of water, but should it be noted, siltation in the river may occur. If observed then it will be necessary to create a clarification pond on the inactive flood plain at the base of slope.

TEST PIT LOGS

SOURCE No. AR-606

AR-606-A



0'

(GW-GM) GRAVEL - and sand, little silt angular to subrounded, well graded

4.0'

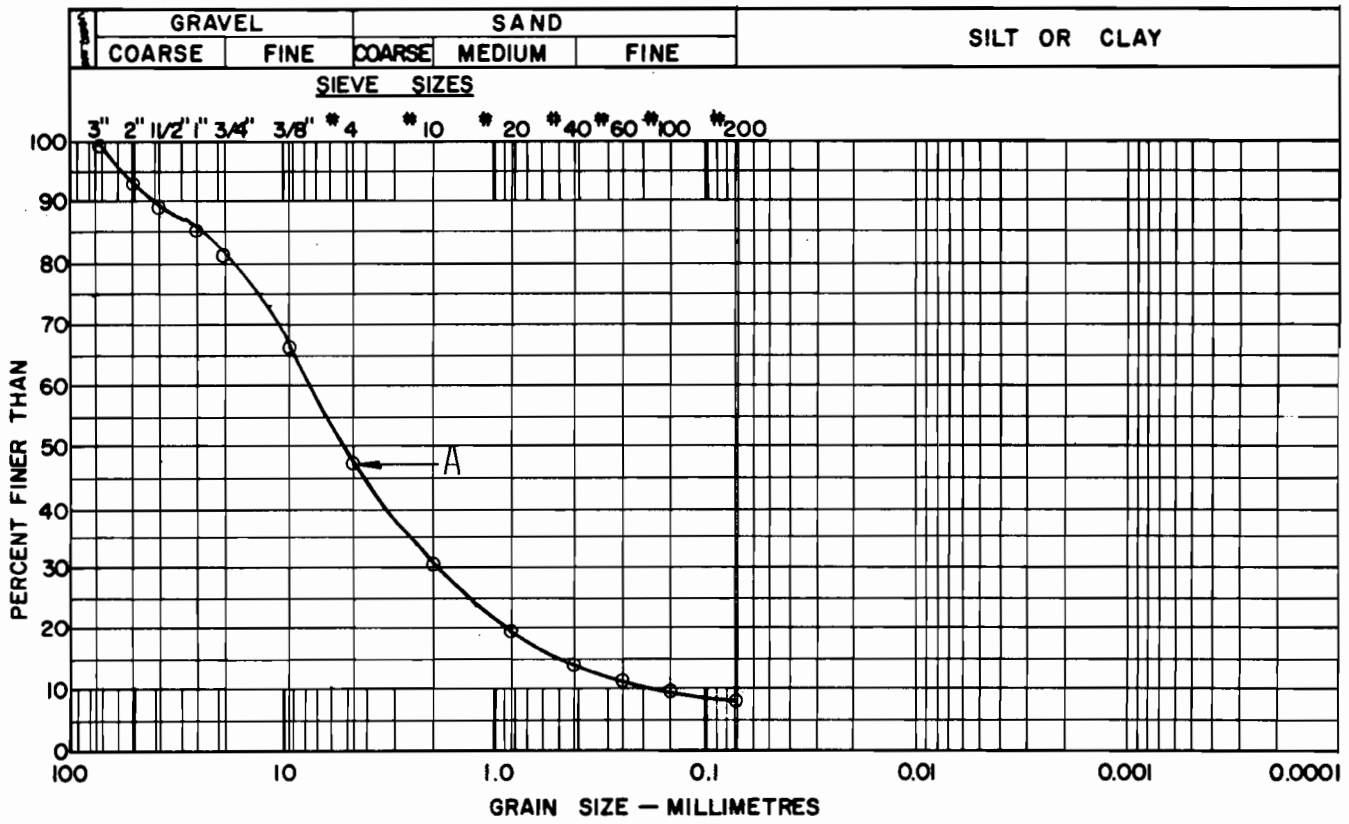
SHALE - thin bedrock, soft, grey brown

5.0'

Soil profile as logged from pit wall.

LABORATORY
TEST DATA
SOURCE No. AR-606

GRAIN SIZE DISTRIBUTION



MOISTURE CONTENT

A (0.0' - 4.0') M/C = 4.1%

ORGANIC CONTENT

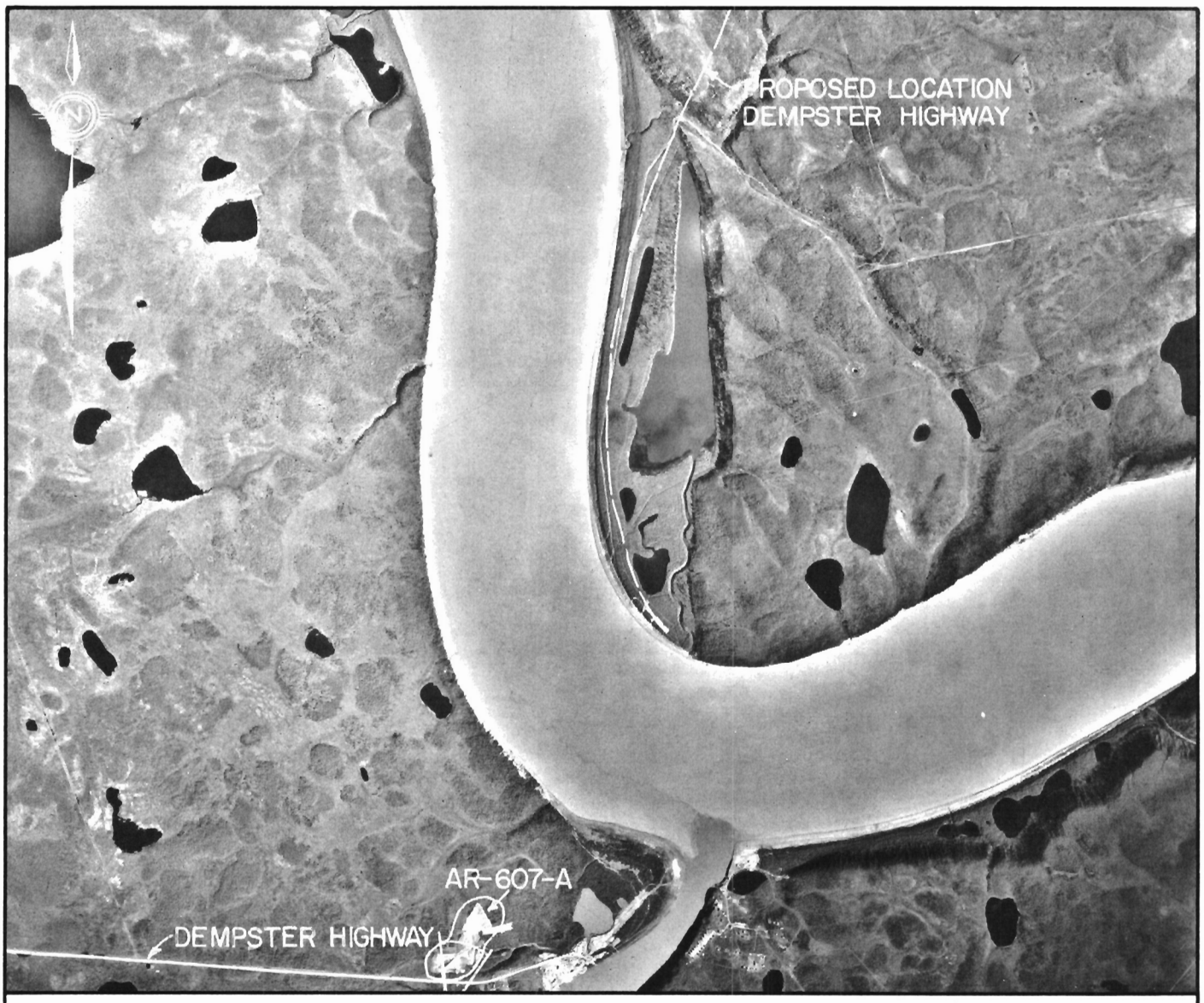
HARDNESS TEST

PETROGRAPHIC ANALYSIS

Shale, silt	- 24%	Limestone	- 8%
Quartzite	- 15%	Shale, micaceous	- 6%
Shale, clay	- 13%	Siltstone, micaceous	- 3%
Shale, calcitic	- 11%	Granite	- 5%
Sandstone, hard	- 9%	Chert	- 4%
		Ironstone	- 2%
		Total	100%

ARCTIC RED RIVER
SOURCE No. AR-607

LANDFORM AND LOCATION:	Source is an existing bedrock pit on a morainal plain, west of Arctic Red River, and within two miles of the Community.
MATERIAL:	SHALE, soft, some sandstone layers
VOLUME:	200,000 cu. yds. at least.
CONCLUSION:	This source contains material suitable only for general fill, and for this purpose may require a surface layer of sound granular material.



AIRPHOTO No. A22890 - 150 SCALE: 1"= 3000' (approx.)

AR-607 ENVIRONMENT

Physical

The source is an existing bedrock pit excavated into the top of the west bank of the Arctic Red River, just upstream from the junction with the Mackenzie River. The bedrock is covered by as much as 10 feet of ice-rich silt.

Photo No. 1 Source AR-607 showing existing pit face

The developed area is about 800 feet long and 200 to 300 feet wide, with a maximum cut of 25 to 30 feet. Drainage is good, with a small stream flowing from the pit to the Arctic Red River.

Biotic

Tree cover is primarily spruce and aspen from 20 to 40 feet high, and with a canopy density of 20% to 40%.

The source lies at the border of the Peel River Game Preserve, in an area that supports beaver and other small fur bearing animals. Because of the short distance from the community and from the highway, the wildlife population near this source is not considered an important factor.

AR-607 MATERIALS AND QUANTITIES

The source consists of bedrock, composed of soft shale with layers of soft sandstone. The material can be excavated by dozers with ripper

attachments. The material degrades to a soft sandy clay when exposed to air and water, and can become unstable if re-worked, for example by traffic.

The existing pit can be extended westward to provide at least another 200,000 cubic yards.

A large volume of this material has been used for the Dempster Highway construction to the west. Evidently it has proved to be a satisfactory fill material.

AR-607 DEVELOPMENT

General

The source is recommended for further development as a source of common fill.

Access

At the time of investigation the source could be operated only during winter months. It lies about one-half mile north of the Dempster Highway, and may be further used by the Department of Public Works during the coming summer, which would require on all weather access road to be constructed. The new highway will then provide ready access to the community when extended across Arctic Red River, but until then summer access is limited. Winter access is satisfactory.

Material Use and Handling

Material from this source can be used as general fill, especially in deep fills, where the surface of the fill can be protected from traffic or other types of disturbance. The surface should be graded to allow positive drainage and a layer of gravel placed on top to provide a wearing surface.

The excavation of the source will require dozers with ripping attachments. The material can then be pushed into piles for loading into trucks by means of front end loaders.

Stripping and Restoration

Because of the depth of cut in this pit, the ratio of area disturbed

to volume removed is small, so the environmental effects of the development will not be severe.

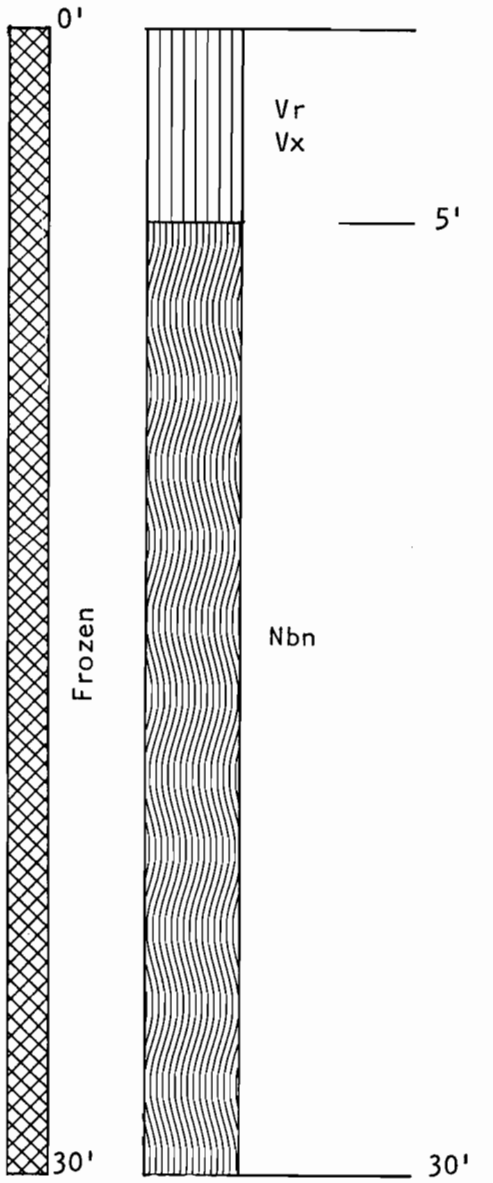
The extension of the source will require the clearing and burning of trees and roots, then the stripping of the frozen silt overlying the bedrock. Probably the pit is now large enough so that stripping can be stockpiled in the abandoned portions for re-grading later on.

Drainage from the thawed overburden may carry some silt to the small stream draining the pit. If so a small pond should be formed in the lower reaches of the stream to permit clarification.

After a section of the pit is exhausted it should be re-graded with overburden and seeded to restore the vegetative cover. The selection of cover, and the preparation for seeding, should be determined by a scientist experienced in Arctic horticulture.

TEST PIT LOGS

SOURCE No. AR-607



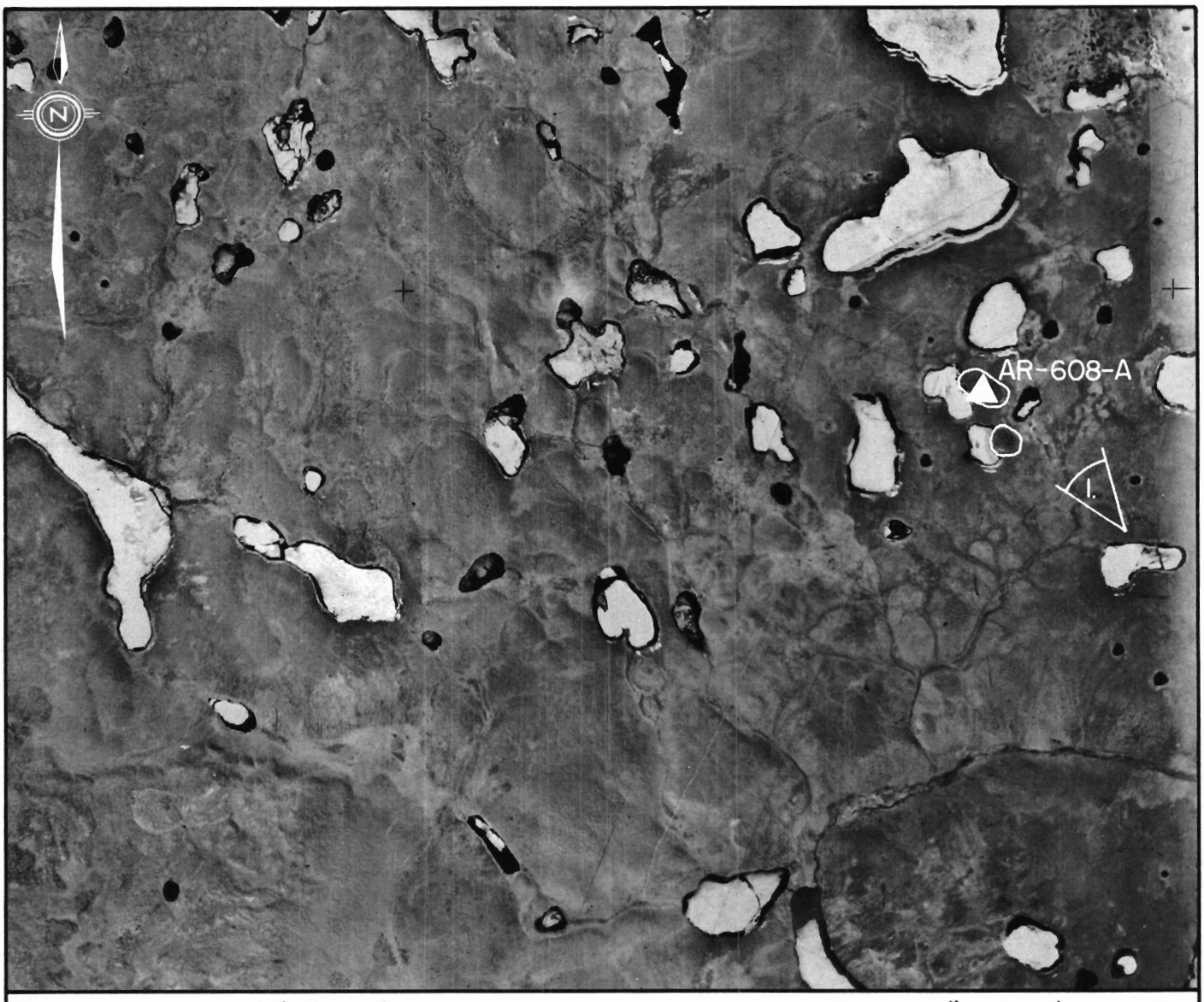
(ML) SILT - little sand, trace of clay, brown

SHALE - thin bedded, soft, grey brown

Soil profile as logged from pit wall.

ARCTIC RED RIVER
SOURCE No. AR-608A

LANDFORM AND LOCATION:	Two small kames located 10 miles east of the Community.
MATERIAL:	SAND and silt, little gravel
VOLUME:	20,000 cu. yds. approximately
CONCLUSION:	Not recommended for development due to high silt content.



AIRPHOTO No. A13406 - 161 SCALE: 1"= 3000' (approx.)

AR-608A ENVIRONMENT

Physical

The source consists of two small kames located in the hummocky morainal plain 10 miles east of the community. The kames are, at most, 300 feet across the base and 50 feet high.

The features appear to be well drained, although the surrounding area contains some thermal ponds and sphagnum bogs. In September the unfrozen zone on the kame was 2.5 feet deep.

Biotic

The tree cover in the area consists of black spruce from 20 to 40 feet high, with a canopy density of from 20% to 40%. The area has been burned. The lower areas surrounding the kames contain sphagnum bogs.

The area supports a population of small fur-bearing animals such as mink, beaver, and muskrat, but is not part of an important wildlife area.

AR-608A MATERIALS AND QUANTITIES

The surface of the kame tested consisted of one foot of organic silt, then 1.5 feet of sand and silt containing a trace of gravel. The testing did not penetrate the permafrost zone, but similar landforms in the area have all contained silts in a matrix of ice.

The sample from this source contained 12% gravel, 40% sand, and 48% silt.

The estimated volume of material is 20,000 cubic yards contained in the active zone above permafrost.

AR-608A DEVELOPMENT

General

This source is not recommended for development. The material is poor in quality and small in volume. Source No. 600 is larger, contains better material on the whole and is closer to the community and to the highway. The source has not been developed to date.

Access

The source can be reached by winter road from the community, following the Dempster Highway north for about 2 miles, thence east along a seismic line for about 12 miles, thence south along a road to be construced for 4 miles.

Material Use and Handling

The material in this source contains too much silt and too little gravel to be useful for general fill or for specification use.

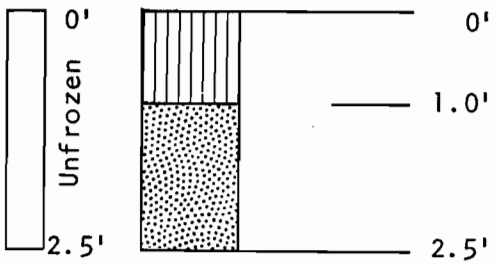
Stripping and Restoration

Development of this source could lead to severe thermal erosion because of the high ice and silt contents. If development is attempted restoration would be very difficult and costly.

TEST PIT LOGS

SOURCE No. AR-608A

AR-608A-A



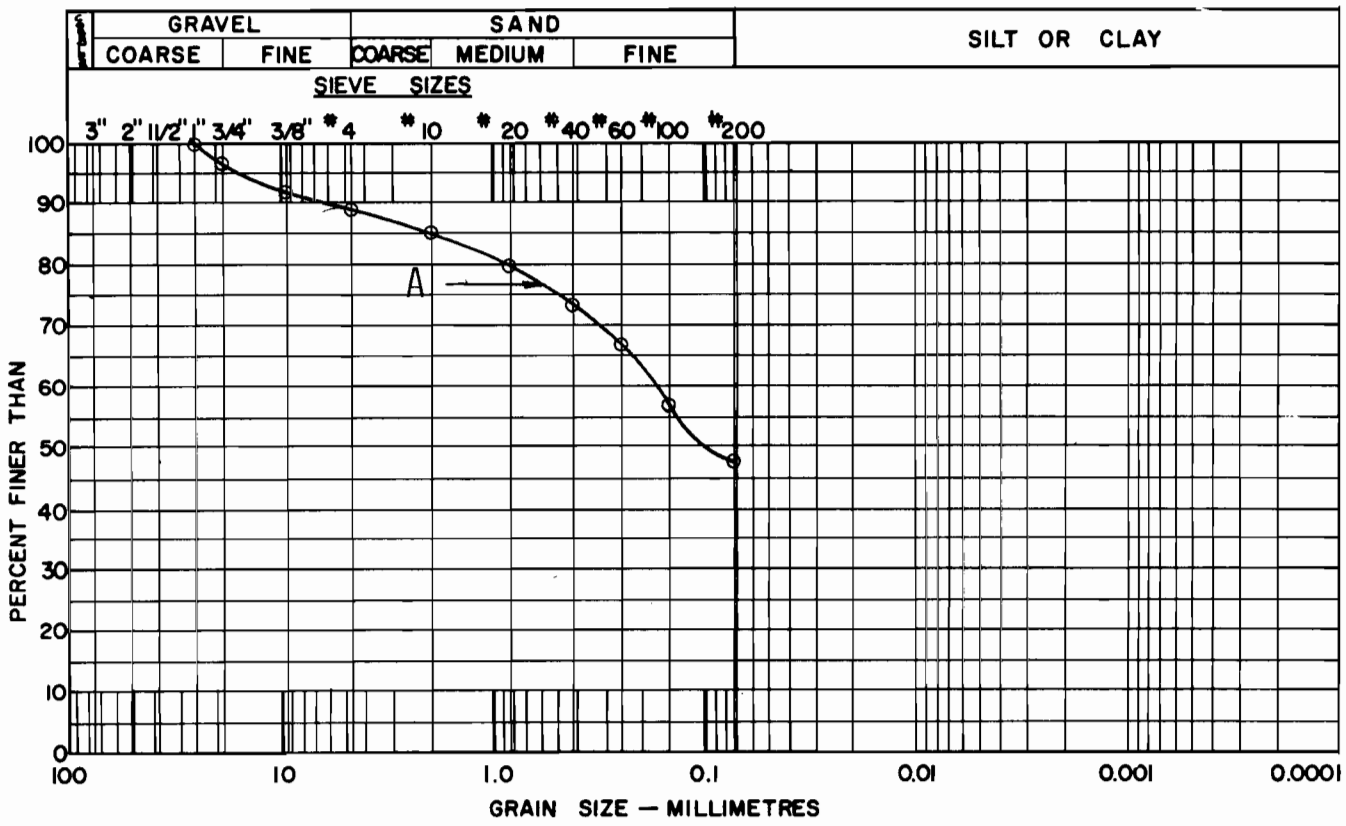
(OL) SILT - organic

(SM) SAND - and silt, little gravel, max. 1" angular, brown

LABORATORY
TEST DATA

SOURCE No. AR-608A

GRAIN SIZE DISTRIBUTION



MOISTURE CONTENT

A (1.0' - 2.5') M/C = 8.6%

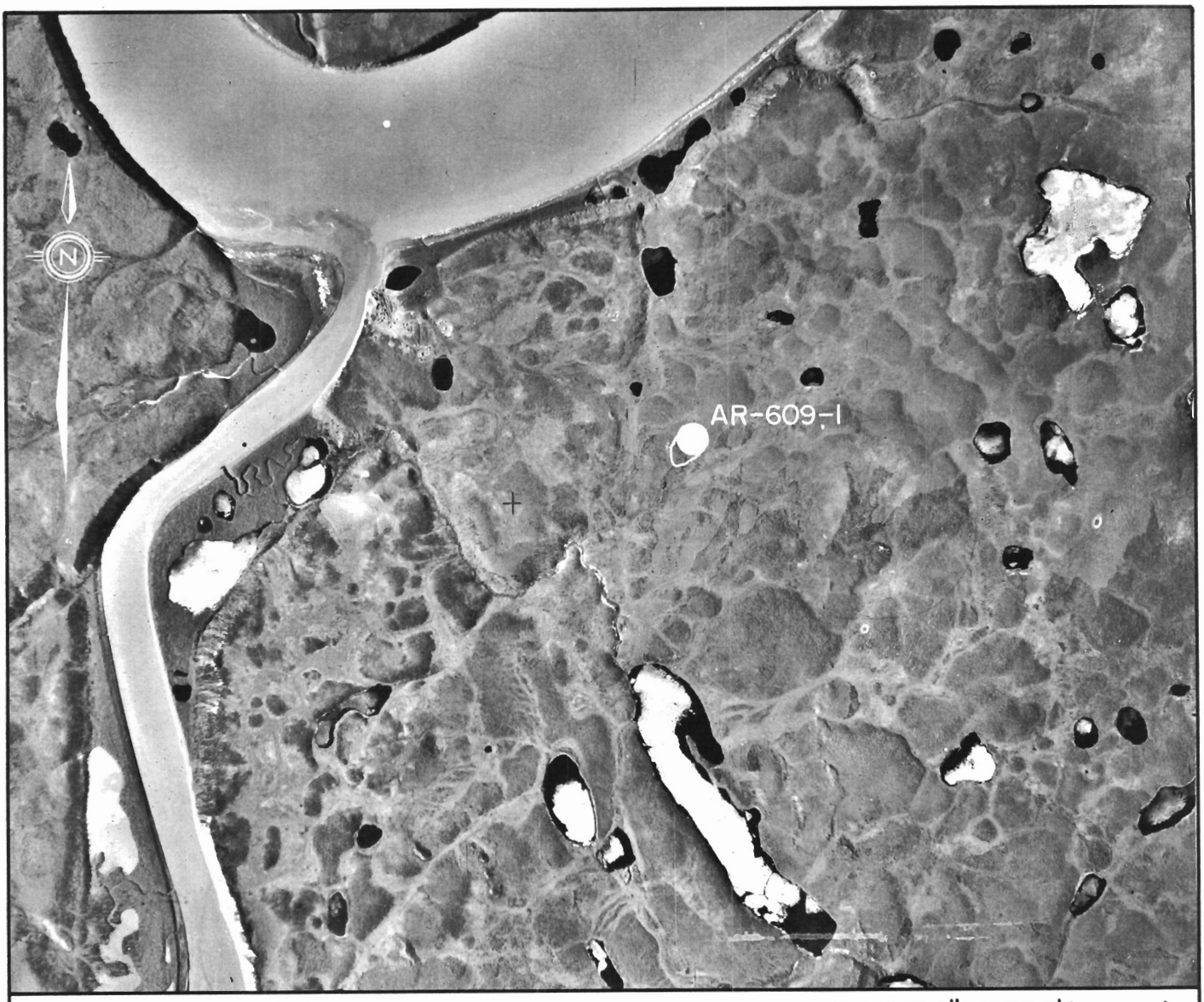
ORGANIC CONTENT

HARDNESS TEST

PETROGRAPHIC ANALYSIS

ARCTIC RED RIVER
SOURCE No. AR-609

LANDFORM AND LOCATION:	Small kame located 1½ miles southeast of the community.
MATERIAL:	SAND and gravel, little silt.
VOLUME:	20,000 cu. yds. approximately
CONCLUSION:	This source can be developed for the immediate needs of the community. The aggregate is suitable for medium quality concrete and asphalt, and should be reserved for uses of this type.



AIRPHOTO No. A13406 - 307 SCALE: 1" = 3000' (approx.)

AR-609 ENVIRONMENT

Physical

The source is an isolated small kame located in the rolling plain about 1½ miles southeast of the community. The kame is about 300 feet in diameter, and 25 feet high. Drainage of the kame is good, although the surrounding area is poorly drained. The source has not been developed.

Biotic

Tree cover is primarily white spruce, aspen and larch, from 20 to 40 feet high and with a canopy density of 20% to 40%. The area is not an important or critical wildlife area, although small fur-bearing animals such as beaver, mink, marten, and lynx are trapped from time to time.

AR-609 MATERIALS AND QUANTITIES

The material from this source is relatively clean sand and gravel, containing 43% gravel (to3/4" size), 47% sand, and 10% silt.

The ice content is low, with water contents ranging from 5% at 2 foot depth to 10% at 12 foot depth.

A petrographic analysis of the gravel of this source indicates that the material is primarily quartzite (21%), hard limestone (26%), granite (11%) and chert (10%) with quartz, porous sandstone and limestone, ironstone, siltstone and shale making up the remaining 32%.

The volume of material available at this source is about 20, 000 cubic yards.

AR-609 DEVELOPMENT

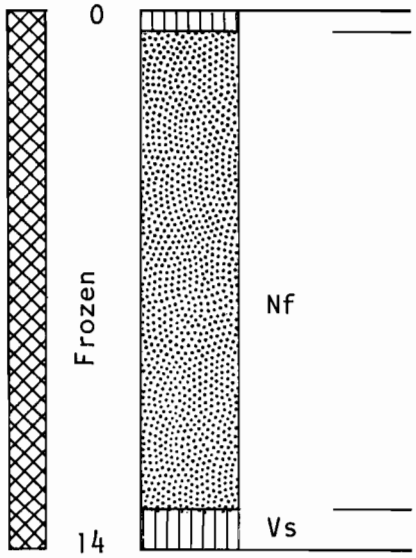
General

The favourable location and satisfactory quality of this source recommend it for development for the immediate needs of the community, for concrete and other specification uses.

TEST HOLE LOGS

SOURCE No. AR-609

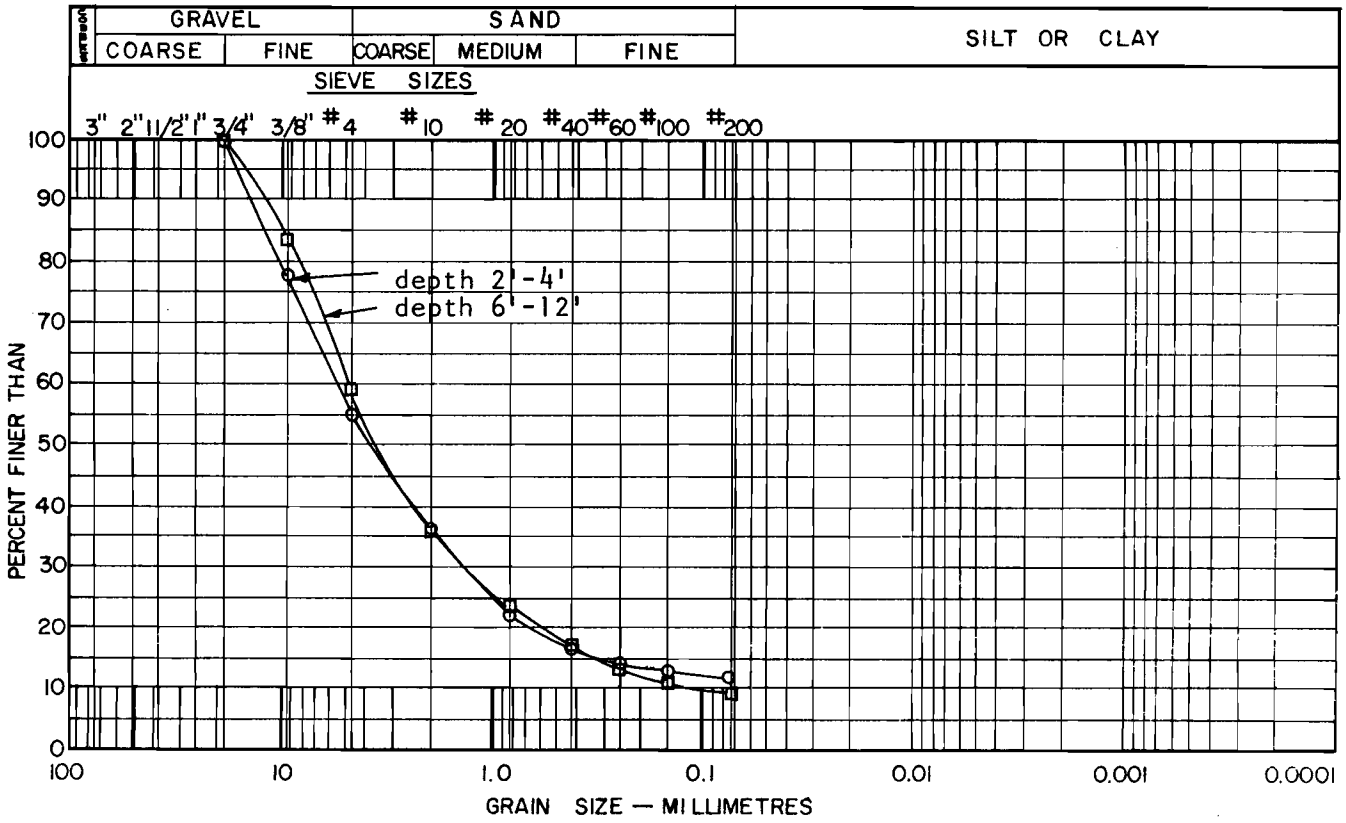
AR-609-1



0'	(Pt)	SILT - and organic peat, roots etc.
.5		
	(SW-SM)	SAND - and gravel trace silt well graded to med gravel size trace ice at 12'-13'.
13.0'	(ML)	SILT - and ice lenses.
14.0'		

LABORATORY
TEST DATA
TEST HOLE-SOURCE No. AR-609-1

GRAIN SIZE DISTRIBUTION



MOISTURE CONTENT

Sample 1 depth	2'	4.9%	Sample 5 depth	10'	8.0%
Sample 2 depth	4'	4.9%	Sample 6 depth	12'	10.4%
Sample 3 depth	6'	7.7%	Sample 7 depth	14'	31.8%
Sample 4 depth	8'	7.7%			

ORGANIC CONTENT

HARDNESS TEST

PETROGRAPHIC ANALYSIS

Quartzite	-21%	Sandstone, porous	-9%
Limestone	-26%	Limestone, soft	-5%
Granite	-11%	Ironstone	-4%
Chert	-10%	Siltstone, hard	-2%
Quartz	- 9%	Shale & siltstone, soft	-3%
		Total	100%

Access

The source lies within ½ mile of the telephone and power transmission line running southeast from the community, and within ¼ mile of a seismic line that crosses the transmission line. The distance to the source will not exceed 2 miles by road.

Access to the source is now feasible only during winter months, and perhaps two miles of road must be built to provide all weather access.

Material Use and Handling

The material from this source can be used for any purpose. Probably a simple screening operation will be sufficient to produce a satisfactory concrete aggregate. For other uses the material can be used with no processing.

Perhaps it should be pointed out that the source has been tested at one point. Although kames have proved to be consistently variable in grain size distribution, the one test in the small kame indicated uniform quality to a depth of 13 feet.

The development of this source will require clearing and burning all trees and roots, stripping and stockpiling the organic topsoil, ripping and pushing the granular material into piles for thawing and draining, and finally loading out the material on trucks.

Equipment required for this development is the usual assembly of ripper, dozer, front end loader, and trucks.

Stripping and Restoration

All trees and roots have to be burned adjacent to the area to be developed. After an area has been worked out the overburden that has been stockpiled nearby should be regraded over the area as soon as possible, in order to minimize the disturbance of the high ice content soil beneath the gravel. The area should then be re-seeded for speedy re-vegetation, using vegetative cover and methods of preparation provided by a scientist experienced in Arctic horticulture.

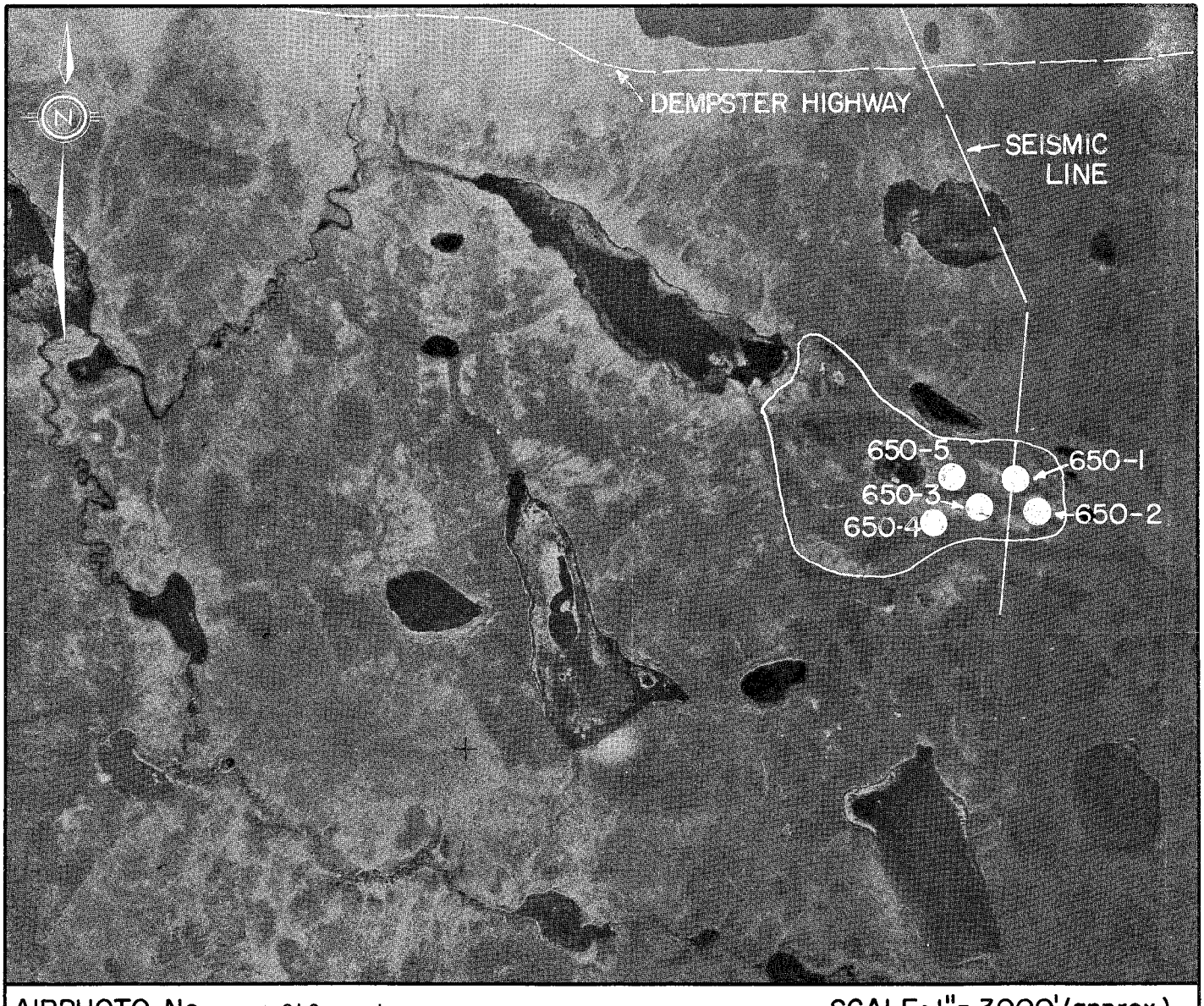
ARCTIC RED RIVER
SOURCE No. 650

LANDFORM AND LOCATION: A glacio-fluvial outwash plain located 11 miles west of Arctic Red River.

MATERIAL: GRAVEL and SAND.

VOLUME: 2,500,000 cu. yds at least.

CONCLUSION: Because this source contains the best granular material that has been located in the area it is recommended that the source be reserved for controlled development. The first investigation indicates that this source is large enough to supply all the granular materials required in the nearby communities and in the general area.



AIRPHOTO No. A12848 - 54 SCALE: 1"= 3000' (approx.)

650 ENVIRONMENTAL

Physical

This source is located in a glacio-fluvial outwash plain south of the Dempster Highway between the communities of Fort McPherson and Arctic Red River. It is 4 miles north of Nevejo Lake.

The outwash plain covers a wide valley bottom and is approximately 5000 feet long and between 1000 and 2000 feet in width. It is adjacent to a small stream which flows in a northwesterly direction into a small lake which drains into Frog Creek. Several small lakes are present in the source area.

Biotic

Tree cover in the source consists of black spruce and upland spruce varying between 20 and 40 feet in height. Some low alder are also present in the area. An old burn covers about 10% of the source area. The canopy density is approximately 20%.

The source lies within the Peel River Game Reserve, and is in a large area known to be an important habitat of beaver. Productivity is low and the populations are easily disturbed by man. Harvesting in the past has resulted in decreased population, but the present population densities are probably between 0.5 and 1.0 beaver colonies per square mile.

Mink, lynx and marten are trapped in the surrounding areas during the winter months.

650 MATERIALS AND QUANTITIES

The source contains clean, well graded gravel and sand with a trace of silt. The maximum size of cobbles encountered in the deposit is 8 inches in diameter.

The volume of material in this source is estimated to be more than 2,500,000 cu. yds., based on the test-hole information obtained during the winter drilling program. The approximate quantities of coarse and fine aggregates in the area investigated are estimated at 1,000,000 and 1,500,000 cu. yds. respectively. Additional

drilling is required to obtain more qualitative information about the material in different parts of this large source, and to establish limits for development.

Petrographic analysis of two typical samples indicates that the material is primarily quartzite (62%) and chert (20%), with granite, limestone, ironstone, quartz, shalestone, and sandstone making up the remaining 18%.

Organic tests on selected samples indicate an average color code between 3 and 4. Loss of ignition tests on two typical samples gave an average value of 3.25%.

The potentially deleterious rocks are chert (18%), ironstone (2%), siliceous limestone (3%), and shalestone (2%). The conventional test for refractive index, however, indicates that the chert and limestone are not likely to be reactive. Pending further qualitative studies, it is recommended that concrete made with this aggregate should use cement that contains less than 0.6% alkali.

650 DEVELOPMENT

General

This source has not been developed up to the present time. It is the only major source of granular materials between Fort McPherson and Arctic Red River. Sufficient granular materials are available for the needs of the communities and for surfacing of the Dempster Highway. The source covers a large area and development must be strictly controlled to prevent wasteful use of the material.

Access

The source is located about 1½ miles south of the Dempster Highway along a seismic line that intersects the highway about 11 miles by road from the community. The total distance by road from Arctic Red River to the source will be 13 miles.

Winter access to the intersection with the seismic line will be readily available from the community along the Dempster Highway, but summer access will have to await the provision of ferry service over the Arctic Red River, probably in 1975. For winter operation a winter

road can be used along the seismic line. For summer operation, a road will have to be constructed along the seismic line, if in fact one has not already been built by the Department of Public Works.

Materials Use and Handling

The materials in this source would be suitable for concrete, asphalt, and for base course aggregates as well as for general fill.

The materials can be processed into coarse and fine aggregate by screening, perhaps by crushing as well. Screening of the materials to produce coarse and fine aggregates is feasible for small quantities, however, an estimated 15 to 20 per cent of the material will be wasted. For large quantities, crushing will be more economical and substantially all of the gravel and sand can be used to produce coarse and fine aggregates.

The materials are frozen and the ice content is generally low. For processing, the materials will have to be ripped, bulldozed into piles and allowed to thaw and drain before screening or crushing begins. In addition to the screening and crushing plant, other equipment that will be required for the complete operation is conventional--bulldozers, loaders, and trucks.

Stripping and Restoration

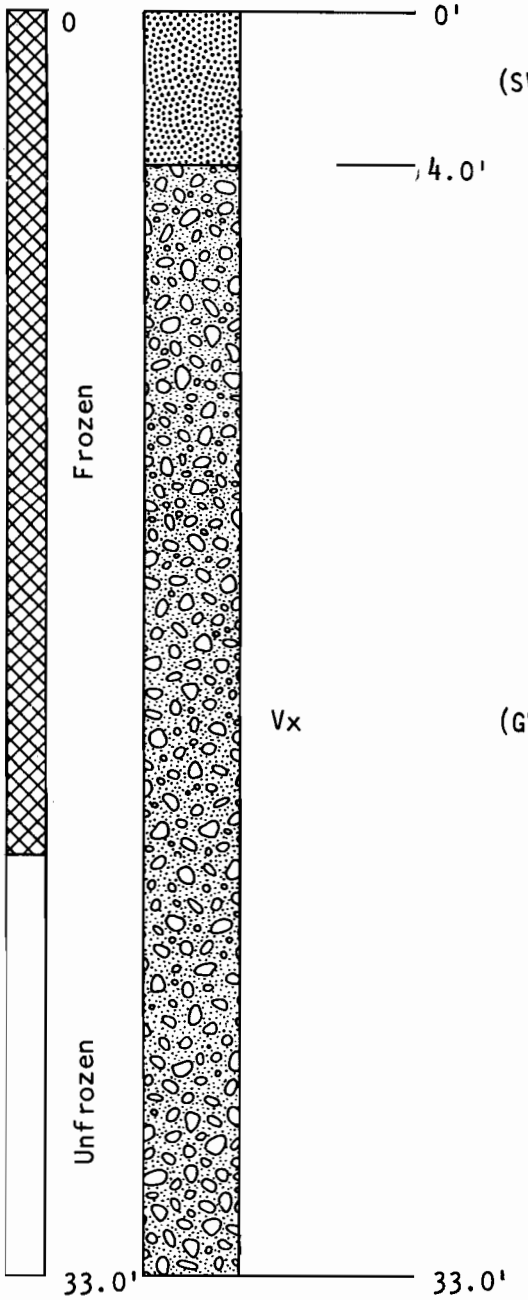
All trees will have to be cut and disposed of by burning. The depth of stripping in the area investigated varies between 0 and 6 feet. These materials can be stored adjacent to that area of the source being developed. After depletion of the gravels, the stripped materials can be used to cover slopes and the bottom of the pit area.

In early stages of development, water which accumulates in the pit can be drained by ditches to the natural drainage system passing through the source. When the pit area becomes too low to permit natural drainage, the water will have to periodically pumped from the pit area. In all cases the water may need to be clarified in ponds before it is introduced into the natural stream.

TEST HOLE LOGS

SOURCE No. 650

650-1

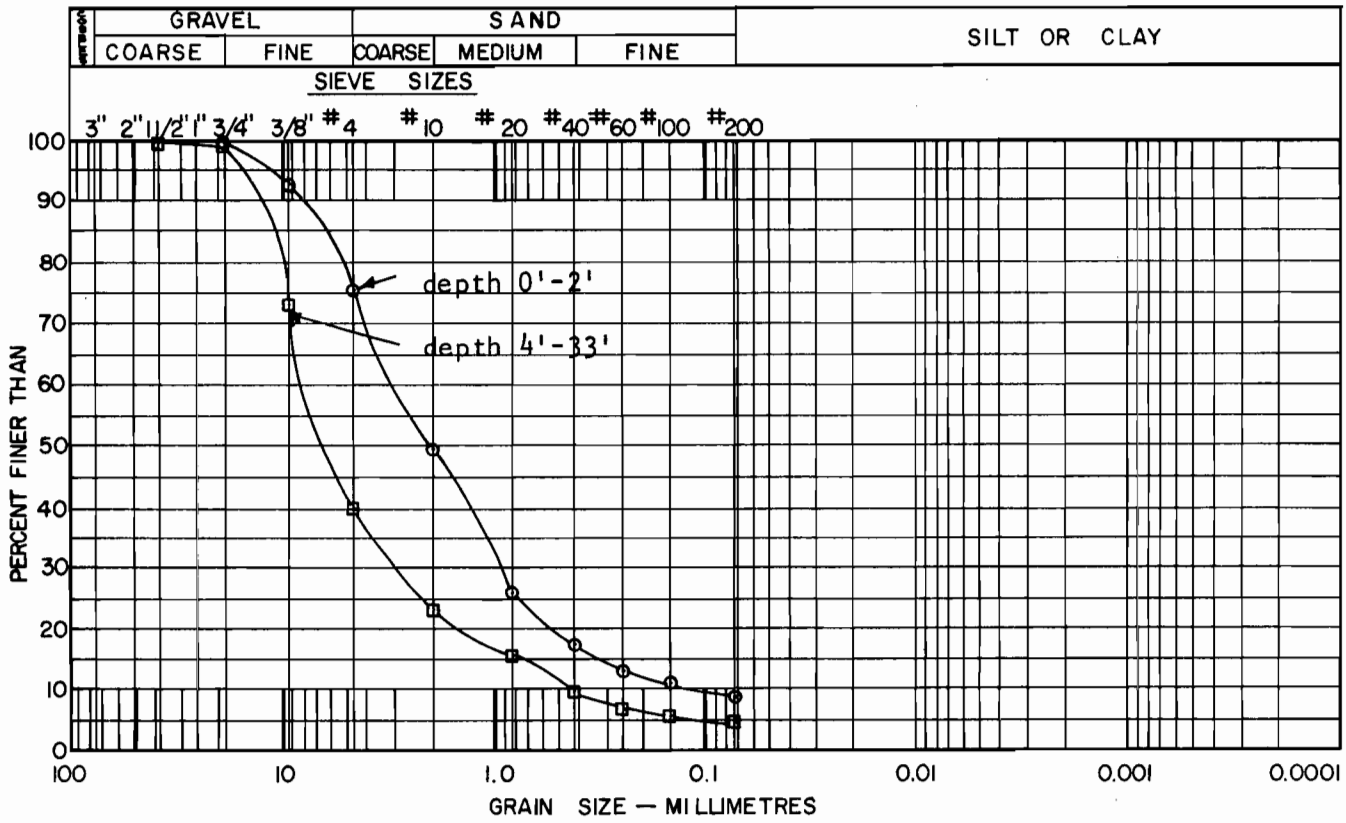


(SW) SAND - Some gravel, trace silt well graded, cobbles to 5", brown.

(GW) GRAVEL- and sand, trace silt well graded, cobbles to 5"

LABORATORY
TEST DATA
TEST HOLE-SOURCE No. 650-1

GRAIN SIZE DISTRIBUTION



MOISTURE CONTENT

Sample 1	depth	0'-2'	7.7%	Sample 5	depth	12'-14'	10.9%
Sample 2	depth	4'-6'	4.8%	Sample 6	depth	18'	6.1%
Sample 3	depth	6'-7'	4.0%	Sample 7	depth	25'	8.6%
Sample 4	depth	8'-10'	4.8%	Sample 8	depth	32'-33'	3.1%

ORGANIC CONTENT

Loss of ignition test
Sample 2 to 8 depth 4'-33' - 3.67%
Color test - sample 2 to 8 depth 4'-33' - Rdg 3

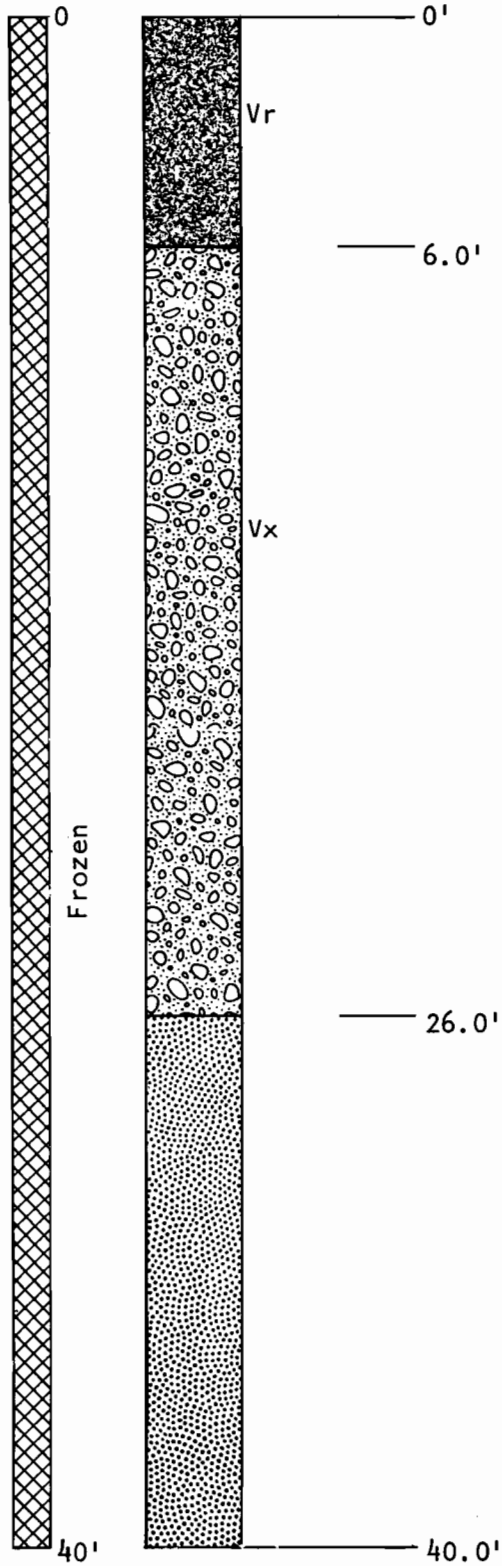
PETROGRAPHIC ANALYSIS

Quartzite	- 59%
Granitic	- 7%
Limestone	- 3%
Cherts	- 18%
Quartz	- 5%
Ironstone	- 2%
Porous Sandstone	- 4%
Shalestone	- 2%
Total	100%

TEST HOLE LOGS

SOURCE No. 650

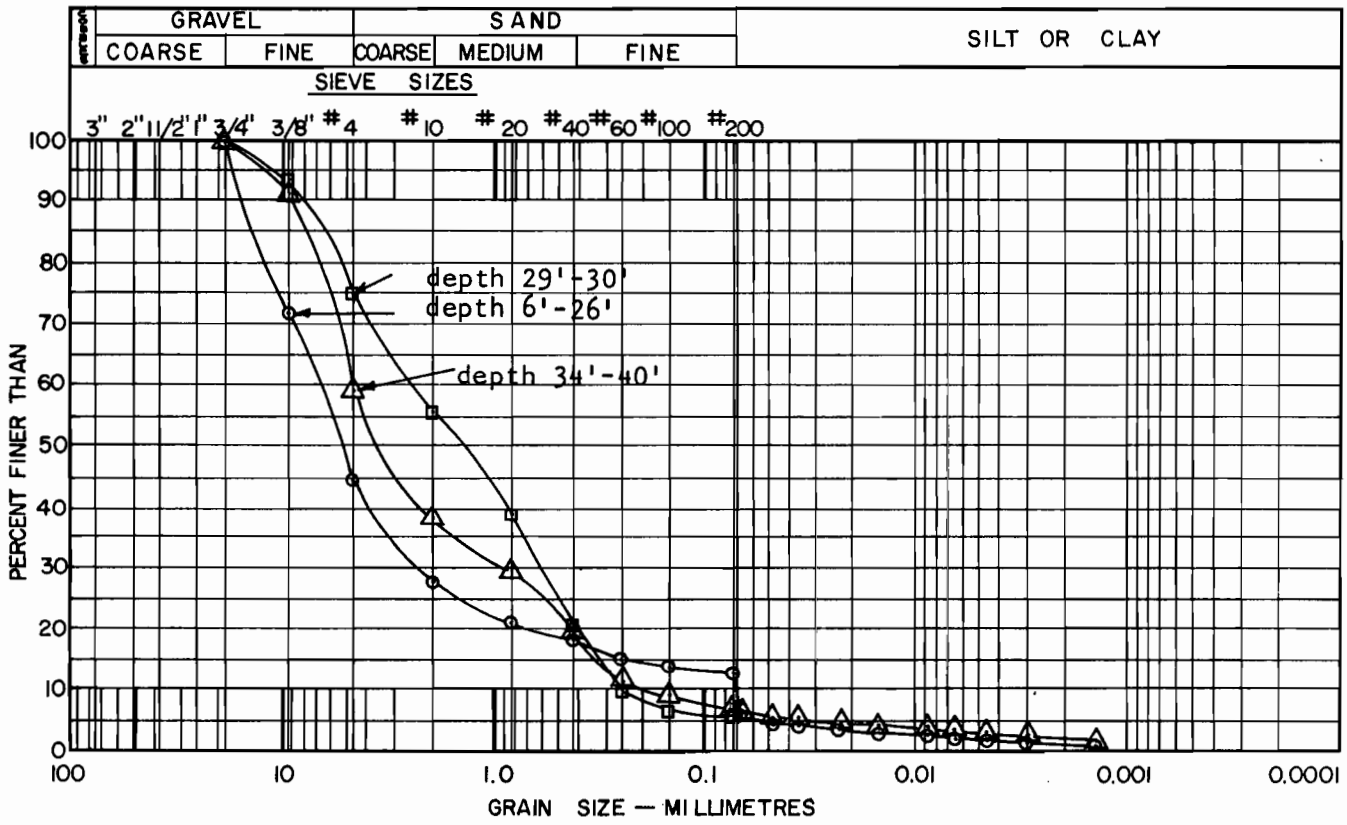
650-2



	(Pt)	PEAT - organic silt, roots etc.
	(GW)	GRAVEL - and sand trace silt well graded, cobbles to 6".
		ICE - lensing @ 15' - 16'
	(SW)	SAND - and gravel, trace silt well graded cobbles to 5", brown.

LABORATORY
TEST DATA
TEST HOLE-SOURCE No. 650-2

GRAIN SIZE DISTRIBUTION



MOISTURE CONTENT

Sample 1	depth 3'-4'	*130.8%	
Sample 2	depth 6'-8'	9.0%	
Sample 3	depth 8'-10'	11.9%	
Sample 4	depth 10'-12'	8.9%	
Sample 5	depth 12'-14'	9.2%	
Sample 6	depth 19'-20'	6.4%	
Sample 7	depth 24'-26'	5.5%	
Sample 8	depth 29'-30'	12.3%	
Sample 9	depth 34'-35'	10.1%	
Sample 10	depth 39'-40'	9.6%	

*Bag leaked

ORGANIC CONTENT

Color Test

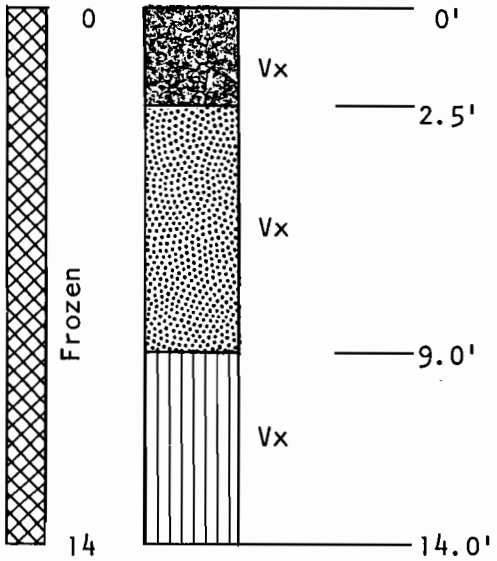
Sample 2 to 7 Depth 6'-26' - Rdg. 4 & 5

PETROGRAPHIC ANALYSIS

TEST HOLE LOGS

SOURCE No. 650

650-3

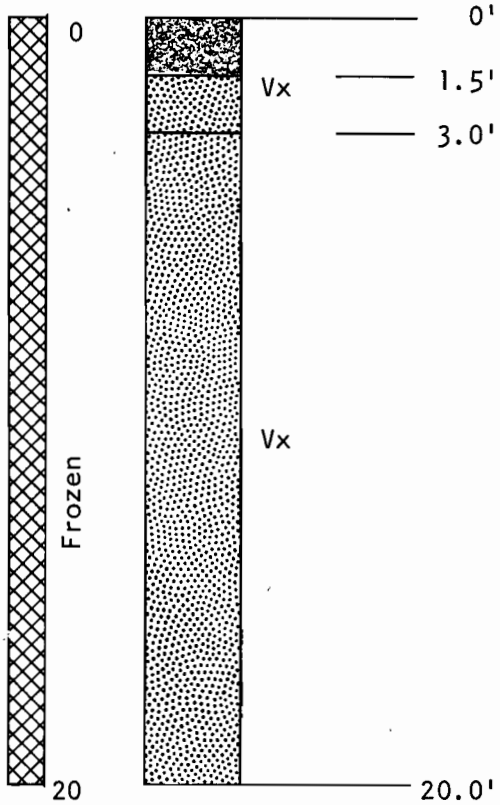


(Pt) ORGANIC - silty topsoil, root fibres

(SM) SAND - some gravel, some silt

(ML) SILT - little gravel, little sand, low plastic, (till)

650-4



(Pt) ORGANIC - silty, root fibres etc.

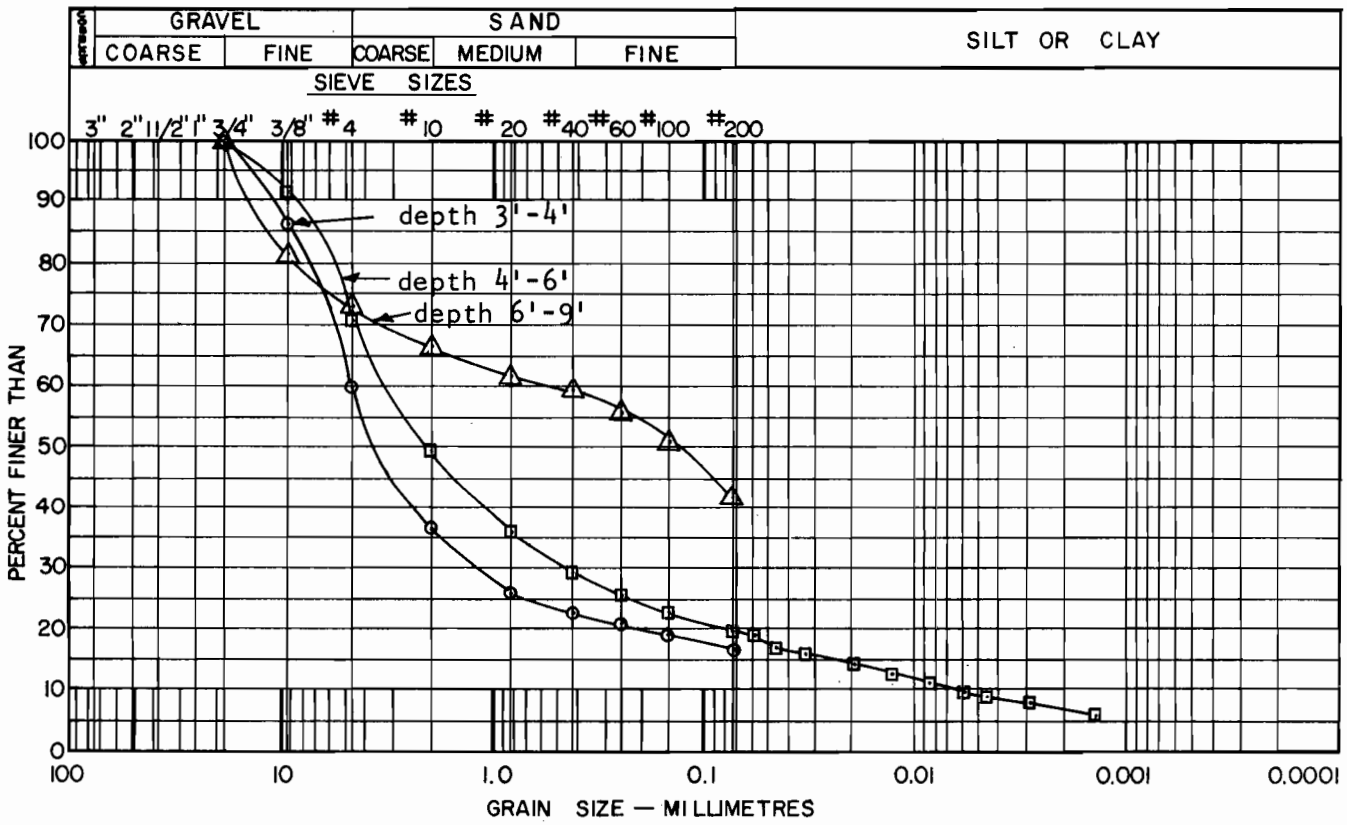
(SM) SAND - some gravel, little silt cobbles to 5".

(SW-SM) SAND - and gravel trace silt, well graded, cobbles to 6", brown

ICE - lensing @ 18'

LABORATORY
TEST DATA
TEST HOLE-SOURCE No. 650-3

GRAIN SIZE DISTRIBUTION



MOISTURE CONTENT

Sample 1	depth 3'-4'	21.2%	
Sample 2	depth 4'-6'	25.1%	
Sample 3	depth 6'-8'	17.0%	
Sample 4	depth 8'-9'	16.4%	
Sample 5	depth 9'-10'	18.4%	
Sample 6	depth 10'-12'	14.0%	
Sample 7	depth 12'-14'	15.1%	

ORGANIC CONTENT

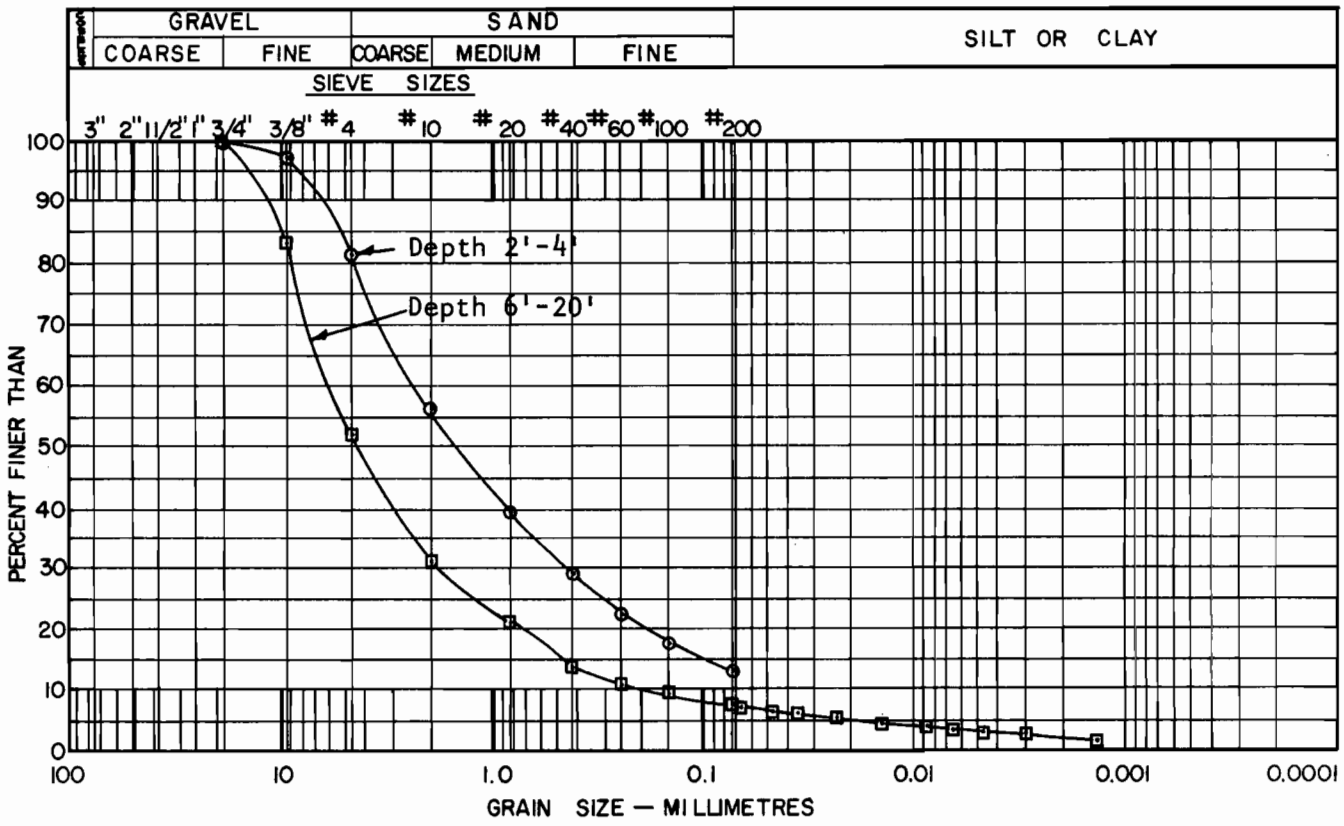
Color Test

Sample 3 depth 4'-6' - Rdg 3 to 4

PETROGRAPHIC ANALYSIS

LABORATORY
TEST DATA
TEST HOLE-SOURCE No. 650-4

GRAIN SIZE DISTRIBUTION



MOISTURE CONTENT

Sample	1	depth	2'-4'	7.5%	Sample 5	depth	10'-12'	7.2%
Sample	2	depth	4'-6'	8.5%	Sample 6	depth	12'-14'	7.9%
Sample	3	depth	6'-8'	8.9%	Sample 7	depth	19'-20'	5.6%
Sample	4	depth	8'-10'	8.3%				

ORGANIC CONTENT

Loss of Ignition test
Sample 2 to 7 depth 6'-20' - 2.84%
Color Test
Sample 2 to 7 depth 6'-20' Rdg 3 to 4

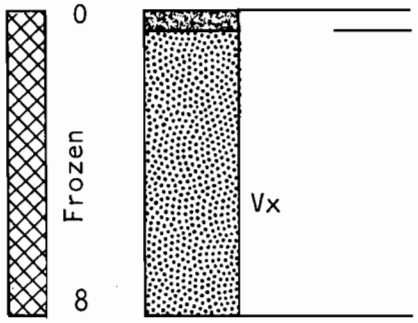
PETROGRAPHIC ANALYSIS

Quartzite	- 67%
Granitic	- 4%
Limestone	- 3%
Cherts	- 21%
Soft Limestone	- 1%
Ironstone	- 3%
Quartz	- 1%
Porous Sandstone	- neg.
Total	100%

TEST HOLE LOGS

SOURCE No. 650

650-5

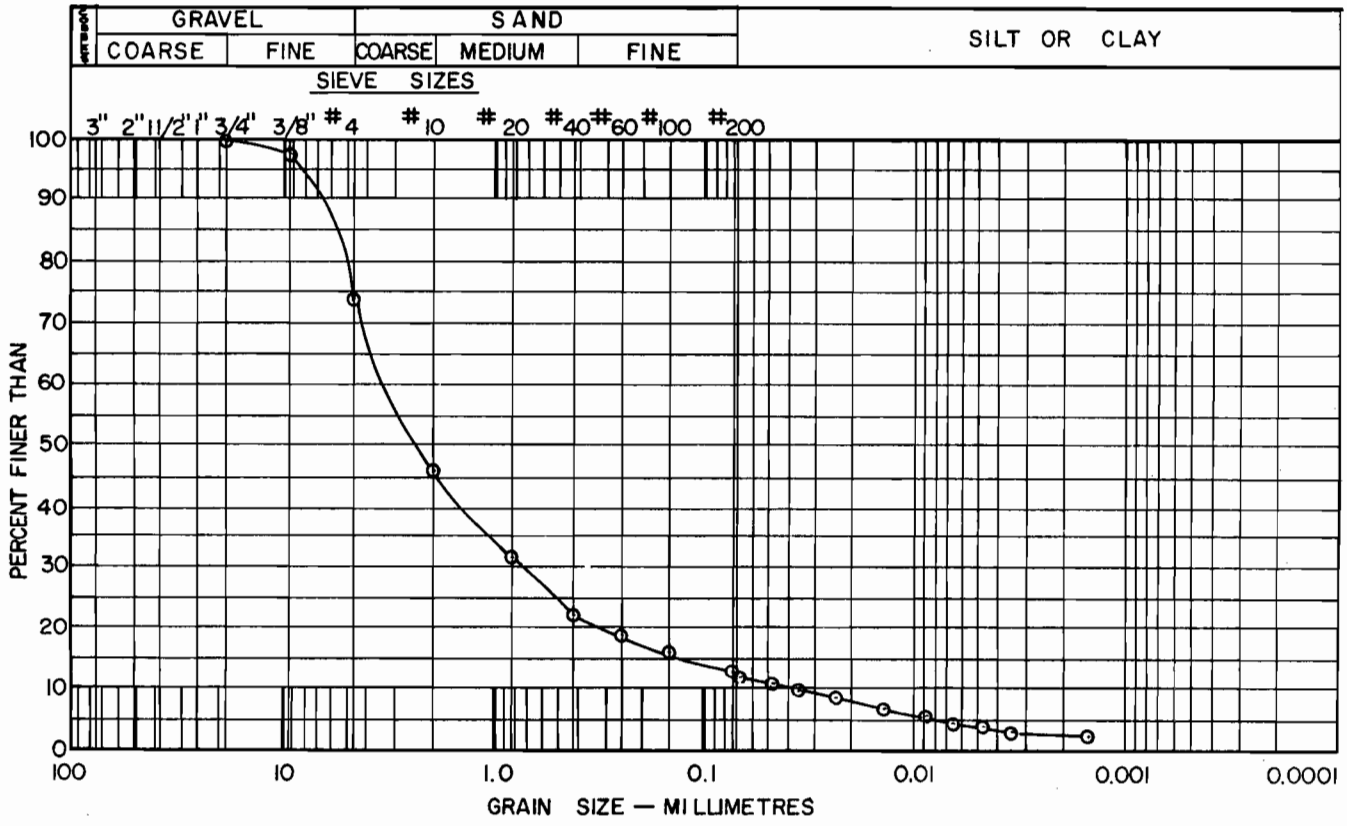


(Pt) PEAT - Organic silt, roots etc.

(GW) SAND - some gravel, little silt, cobbles and boulders, refusal on boulder.

LABORATORY
TEST DATA
TEST HOLE-SOURCE No.650-5

GRAIN SIZE DISTRIBUTION



MOISTURE CONTENT

Sample 1 depth 4'-5' 11.0%

Sample 2 depth 7'-8' 5.7%

ORGANIC CONTENT

HARDNESS TEST

Color Test

Samples 1 and 2 depth 4'-8' Rdg 3 to 4

PETROGRAPHIC ANALYSIS