

BEAUFORT SEA



# COMMUNITY GRANULAR MATERIALS INVENTORY

**FORT McPHERSON  
N.W.T.**

RICHARDS ISLAND

TUKTOYAKTUK PENINSULA  
TUKTOYAKTUK

CARIBOU HILLS

INUVIK

AKLAVIK

DEPARTMENT OF INDIAN AFFAIRS  
AND  
NORTHERN DEVELOPMENT

FORT McPHERSON

ARCTIC RED RIVER

MACKENZIE RIVER

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 Fort McPherson, 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 Fort McPherson community were as follows:

Fine grained aggregate (sand).....60,000 cu. yds.  
Coarse grained aggregate (gravel).....90,000 cu. yds.  
Material suitable for building  
pads, roads, airstrips etc.....1,000,000 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 6 sources for the community are within a 10 mile radius of the community and 1 source is 22 miles east 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 "Ft. McPherson" - 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 location of the sources for 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. FORT McPHERSON COMMUNITY

### 2.1 Surficial Geology

The Fort McPherson Community study area covers three physiographic regions: the Peel Plain in the centre and east, the Peel Plateau to the west, and the Mackenzie Delta to the north.

A silty ground moraine covers most of the area except for the Mackenzie Delta, which consists of recent alluvial silts and clays. The surficial deposit is reportedly up to 50 feet thick overlying shale and sandstone bedrock, and is associated with sparsely scattered glaciofluvial sand and gravel deposits in ridges, terraces and eskers, laid down during the retreat of the last glacial ice.

In geologically recent time, rivers and streams flowing east from the Richardson Mountains over the Peel Plateau have deposited granular materials in their channels.

### 2.2 Environment

Fort McPherson Community area is bisected by the Peel River which leads to the Mackenzie Delta in the north.

The Mackenzie Delta region is part of a critical wildlife zone supporting muskrat, mink, beaver and water fowl as well as being the habitat of large numbers of fish. West of the Peel River at the base of the Peel Plateau escarpment is a lynx trapping area. The Peel River valley itself is a noted moose hunting area during the fall, and the river is fished during periods of open water. Most of the area west of the Peel River is used for spring beaver hunting, and winter trapping of mink, beaver, lynx and marten. Muskrat are also found in significant numbers in the extreme south of the Community area.

Some of the lakes in the east half of the Community area support fishing, principally in the winter months.

Development of gravel sources must be compatible with other uses of streams and lakes, especially for fishing and for beaver habitat. A survey of granular material sources must take into account the necessity of avoiding siltation and other disruption of natural drainage systems.

### 2.3 Sources and Materials

A total of seven sources of granular materials were investigated. Two sources are kames and eskers in the Plain, two are pits excavated in the bedrock of the Plain, one is a talus deposit, one an inactive flood plain, and one is a glacial outwash deposit in a wide valley.

Three sources contain natural gravel, (FM-502, FM-503, 650) but only one (650) contains a natural sand in good volume. Two sources (FM-500, FM-505) contain shale that can be used as general fill and source FM-504 contains sandstone that can be used for general fill as well as coarse aggregate.

Petrographic analysis of a sample of gravel taken from Source FM-501 indicates that the granular material is primarily soft limestone (38½%), quartzite (21½%), and chert (13%), with granite, ironstone, sandstone, and clay shale making up the remaining 27%.

The potentially deleterious rocks in Source 650 are chert (18%), ironstone (2%), siliceous limestone (3%), and shalestone (2%). The chert and limestone have been checked for refractive index, however, and are not considered to be reactive.

It is considered at this time that Source 650 can be used for all classes of construction.

### 2.4 Management

With the exception of the pit on the outskirts of the town, (FM-505) granular deposits near Fort McPherson lie in areas now occupied by wildlife, and two are adjacent to major streams. In order to minimize the dislocation of valuable wildlife and fisheries in the area, as well as for economic reasons, the sources selected for development must be chosen carefully.

Source 650 is the best source of specification material available to Fort McPherson, 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 also used by the Arctic Red River community as well as the Department of Public Works. Co-operation between 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 the contractors leave the pit in a clean and tidy condition, for the communities future use.

For the general fill required within Fort McPherson, it may be advisable to develop one or more of the sources of coarse material (FM-500,502,504) that are nearby. Two sources are not recommended for development at this time; FM-505 is poor quality material and is almost depleted, and FM-503 will be economically feasible only after other sources have been depleted. Source FM 501A is not recommended for development due to poor quality, high costs and disruption of the environment.

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 only two sources (FM-500 and FM-505) had been developed and FM-505, is almost depleted. The immediate future needs of the community will require that at least one new source be developed for coarse and fine aggregates.

### 2.5.2 Access

The four sources that are recommended for development are all accessible by truck. FM-500 is now served by an all-weather road, and probably the Department of Public Works will build an all-weather road to Source 650 when highway construction goes ahead this year. Sources FM-502 and FM-504 can be reached by winter road, and Source FM-504 can also be loaded out by barge.

### 2.5.3 Material Use and Handling

Source 650 can be developed to supply materials for all construction needs, from common fill to concrete aggregate. It is recommended that a complete aggregate plant be assembled as the need for the full range of materials develops.

The development of source 650 will require a dozer with ripper attachment, a loader, trucks and eventually a crushing and screening plant.

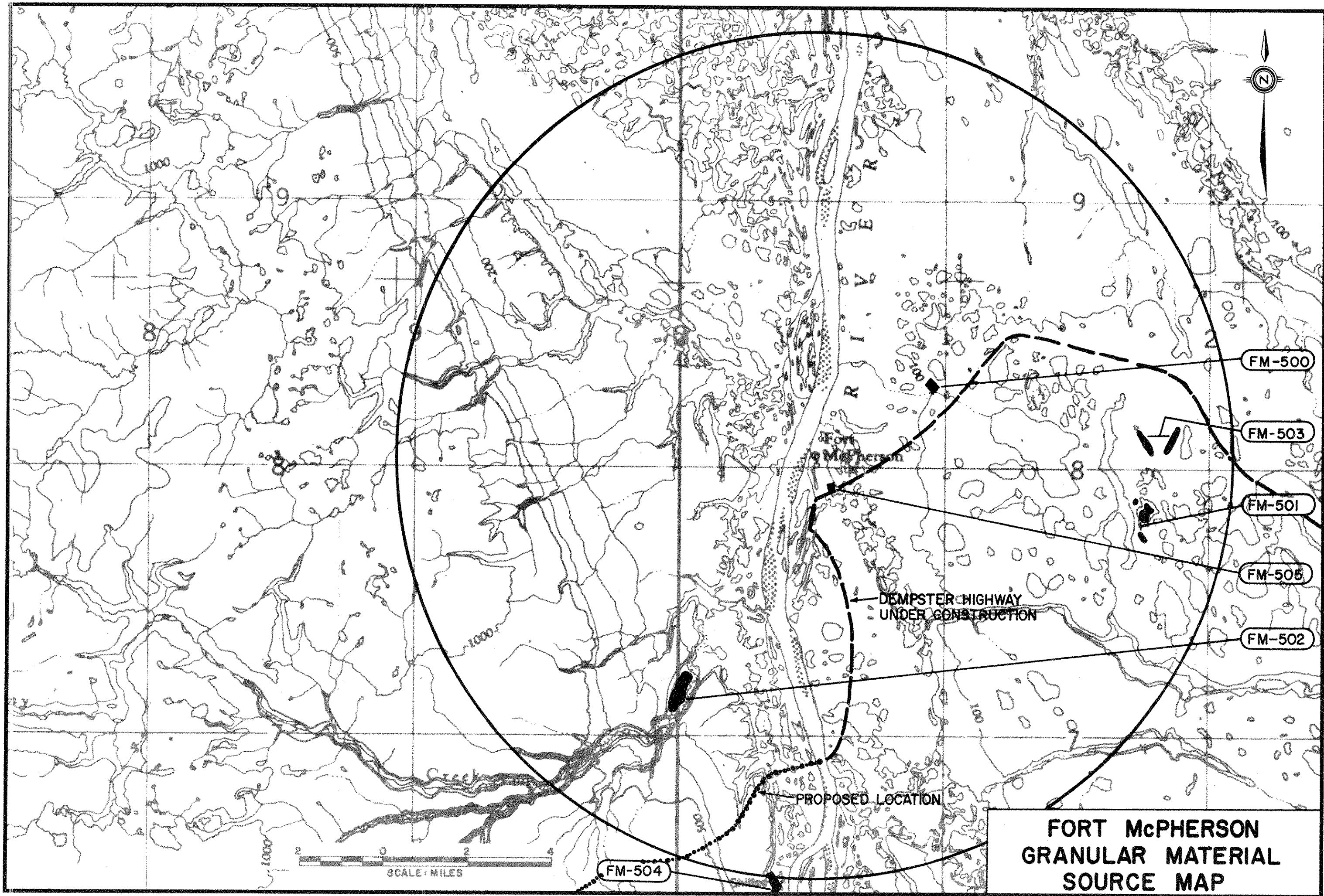
If developed for the supply of general fill to Fort McPherson, Sources FM-500, 502 and 504 will require dozers, loaders and trucks. Because the material at FM-500 is bedrock, the dozer operating there will require a ripper attachment, and possibly auxiliary drilling and blasting equipment as well.

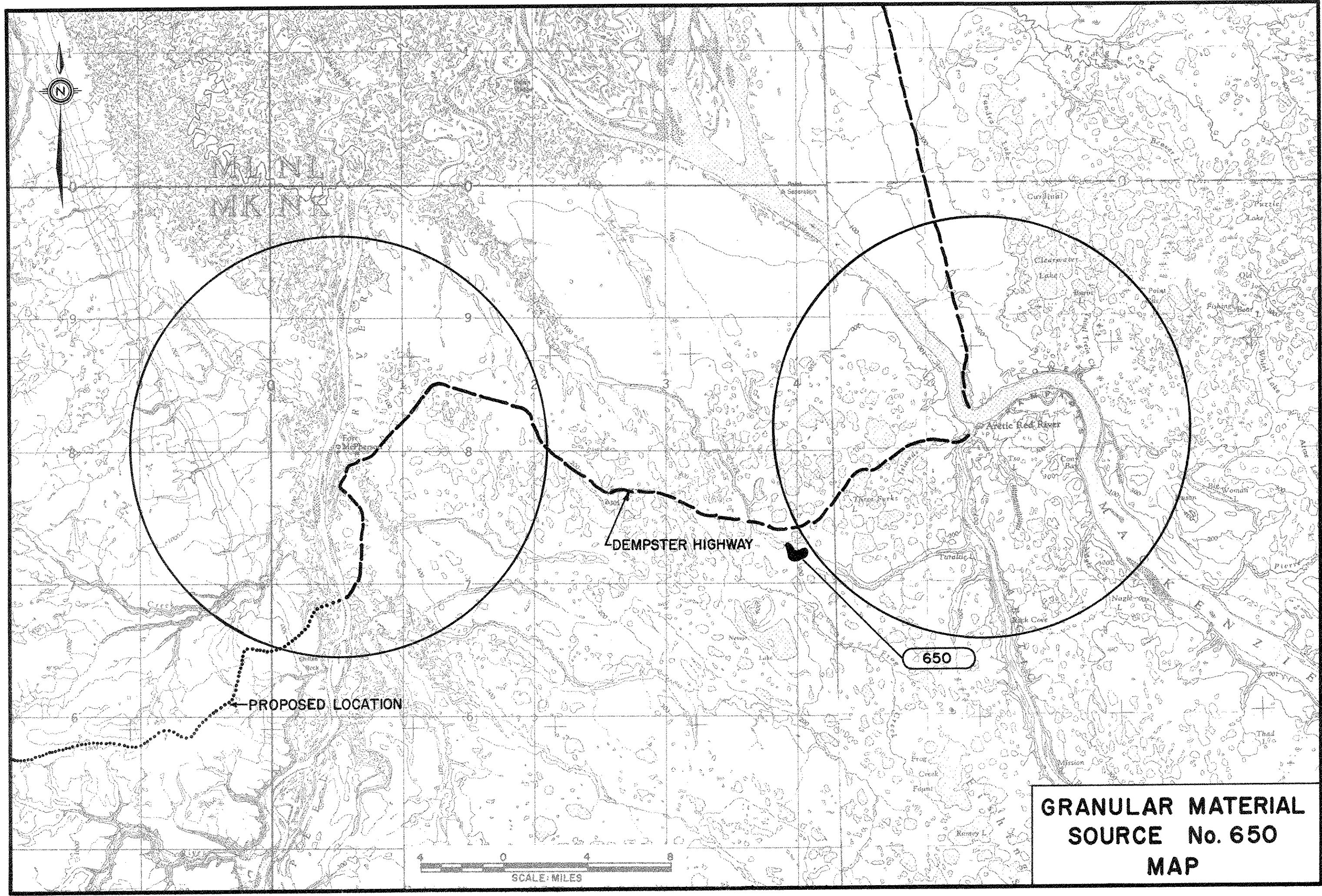
### 2.5.4 Stripping and Restoration

All sources of granular material near Fort McPherson 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.

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.







WAINIK  
WAINIK

RIVER

AGASSIZ RIVER

DEMPSTER HIGHWAY



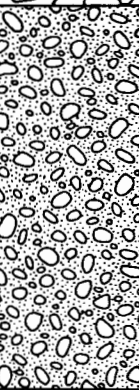

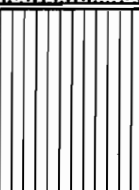
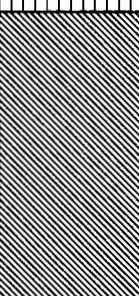
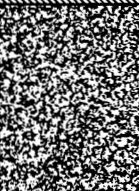

PROPOSED LOCATION

650

**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		
<b>COARSE-GRAINED SOILS</b> (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		
	<b>GRAVELS</b> 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	
		POORLY GRADED GRAVELS, AND GRAVEL-SAND MIXTURES, 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	
		CLAYEY GRAVELS, GRAVEL-SAND CLAY MIXTURES	G C		CLAYEY GRAVELS, GRAVEL-SAND CLAY MIXTURES	
	<b>SANDS</b> 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	
		POORLY GRADED 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	
		CLAYEY SANDS, SAND-CLAY MIXTURES	S C		CLAYEY SANDS, SAND-CLAY MIXTURES	
	<b>FINE-GRAINED SOILS</b> (more than half by weight passes 200 sieve)	<b>SILTS</b> 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
<b>CLAYS</b> 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	
<b>ORGANIC SILTS &amp; CLAYS</b> 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 SAND SILT	... ... ...	50 or more
Minor Component..... (	Gravel Sand Silt	and some little trace	35 to 50 20 to 35 10 to 20 1 to 10

### CLASSIFICATION SYSTEM FOR ICE

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

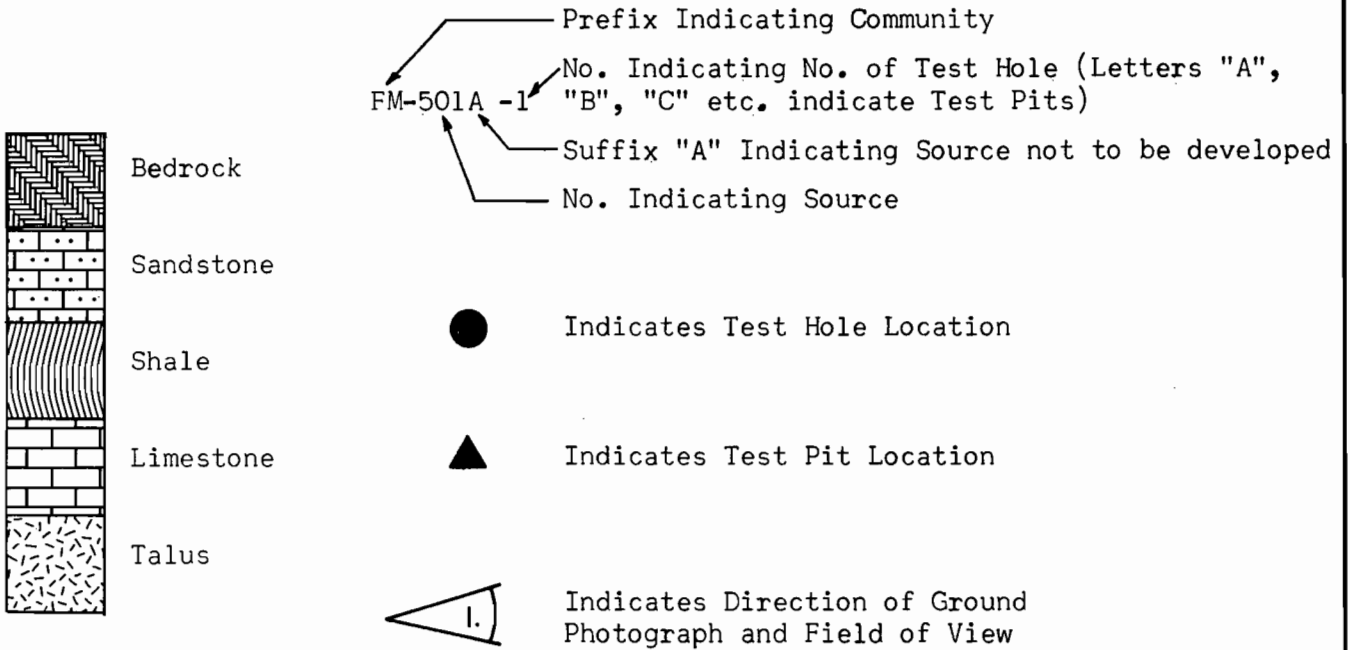
#### GROUND ICE CONTENT - % BY VOLUME

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

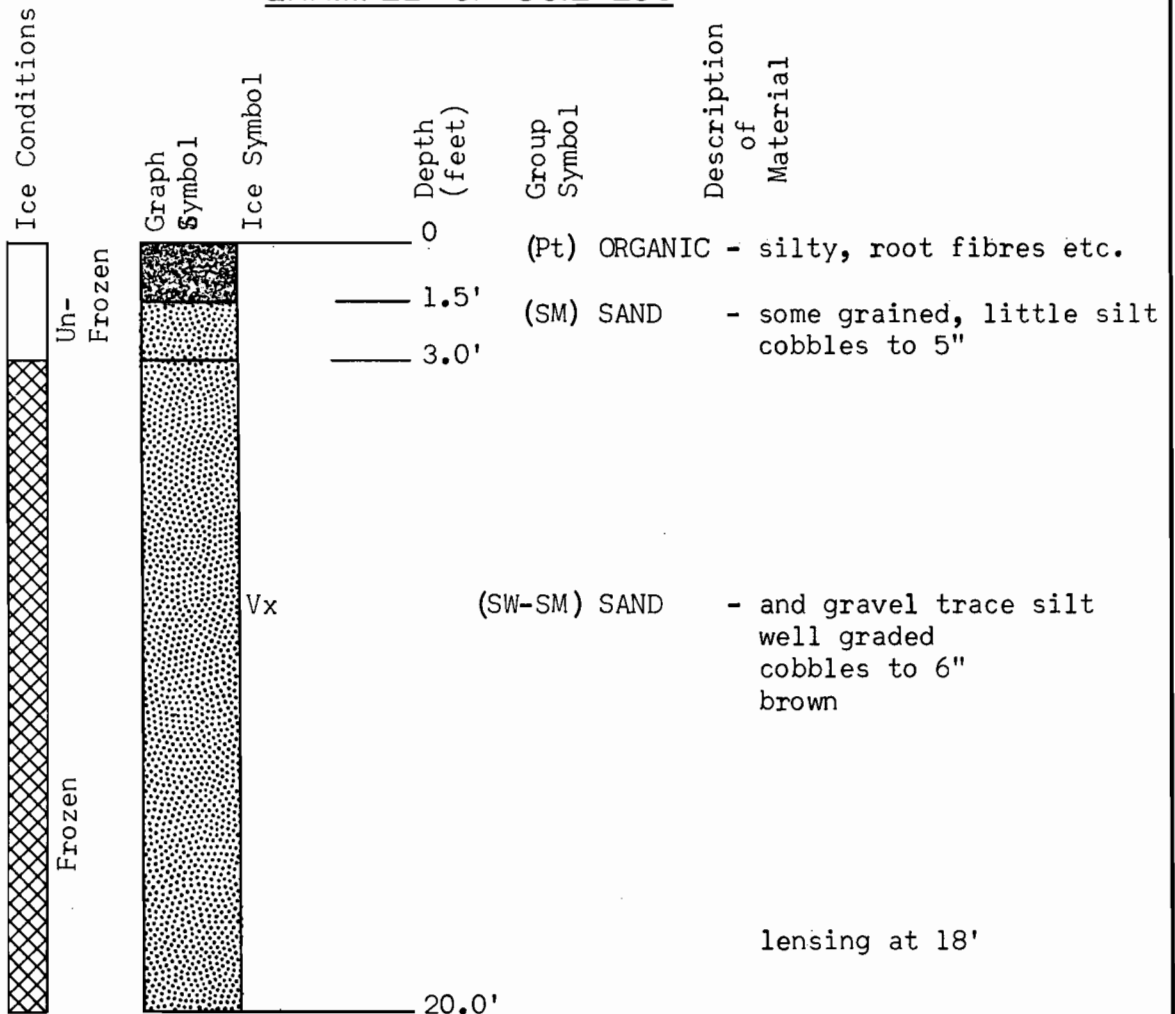
### DESCRIPTIVE SOIL TERMS

- 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



### 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						
FM-500	4	SHALE-SANDSTONE -stratified -hard and soft	Approx. 1,000,000	No major environmental concern	Suitable for development	Poor	Peat and Silt	2 to 4	Stockpile adjacent to pit for later re-grading in depression	Low to Nil	25 to 30	Rip and doze into piles; load into trucks	General fill	Dozer, Loader, Trucks May use shovel and blasting	Developed and in use by Dept of Public Works for Dempster Highway.
												SEE SECTION	FM-500 FOR SOURCE DETAILS		
FM-501A	14	SAND AND SILT -trace of gravel  (S W)	25,000 from active permafrost zone	Disturbance of vegetation over a large area. Potential loss of beaver.	Not recommended for development due to large area to be disturbed for minimum material, poor access, small size of source.	Good	Topsoil and Peat	0.5 to 2	Stockpile adjacent to pit for later re-grading	Med. to High	up to 3 from active zone	Doze into piles, drain, load into trucks	General fill	Dozer, Loader, Trucks	Undeveloped
												SEE SECTION	FM-501 FOR SOURCE DETAILS		
FM-502	13	GRAVEL-little sand  (G P)	200,000	No major environmental concern	Suitable for development	Excellent	Moss and Silt	0 to 3	Stockpile adjacent to steep slope away from active flood plain	Nil	3 to 5	Doze into piles and load into trucks	Coarse-aggregate or general fill	Dozer, Loader, Trucks May require Crusher and Screening plant	Undeveloped
												SEE SECTION	FM-502 FOR SOURCE DETAILS		
FM-503	12	GRAVEL-and sand  (G M)	50,000	Possible disturbance of vegetation and burrowing animals over large area	Development of this source should be of low priority.  Additional drilling required to delineate boundary of gravel	Good	Topsoil and Silt	0 to 3	Stockpile adjacent to pit for later regrading	Low to Med.	up to 20	Doze into piles-drain, load into trucks	Coarse and fine aggregate, general fill	Dozer, Loader, Trucks	Undeveloped
												SEE SECTION	FM-503 FOR SOURCE DETAILS		



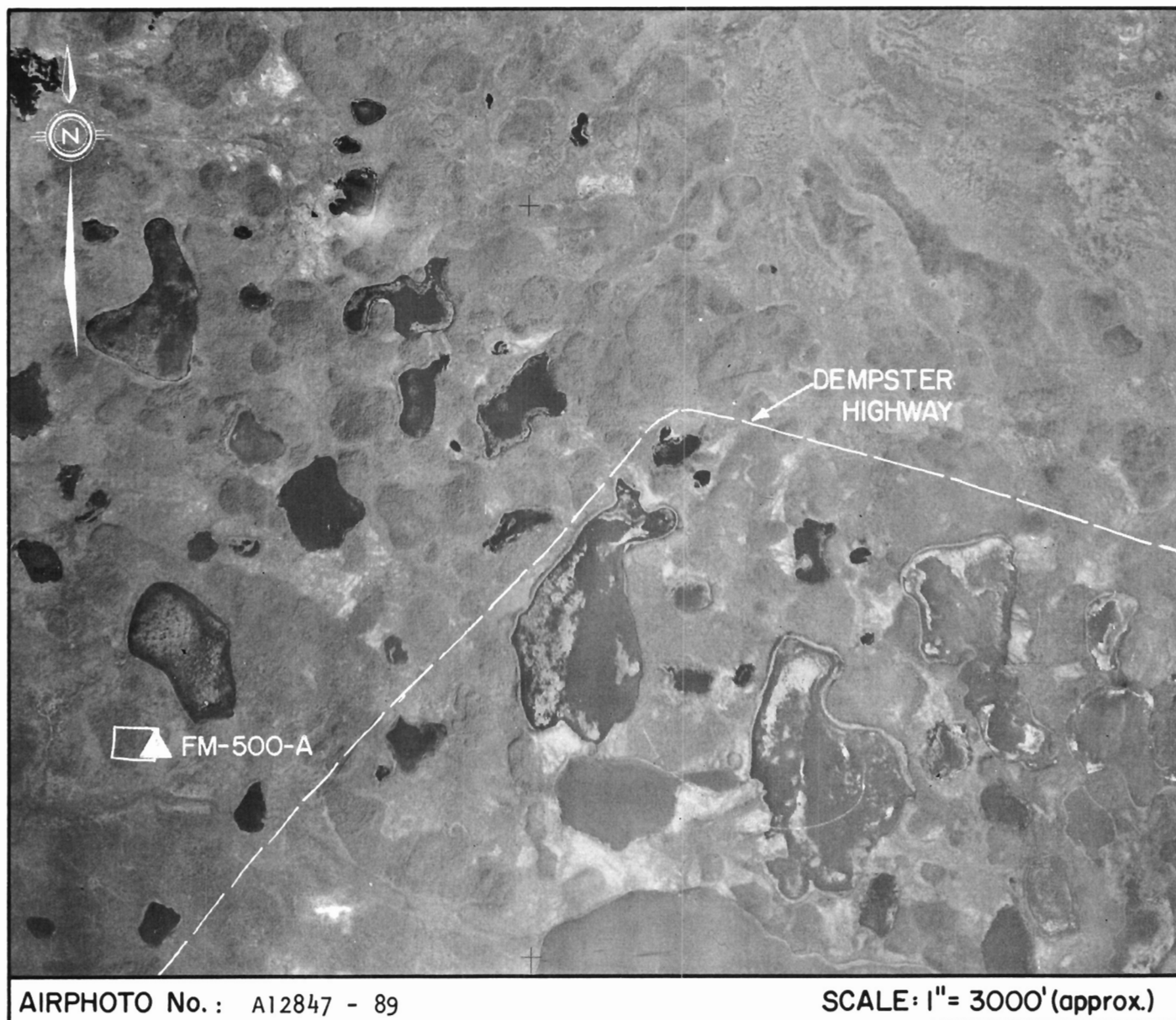
FORT McPHERSON  
SOURCE No. FM-500

LANDFORM AND LOCATION: On Peel Plain, about 4 miles northeast of Fort McPherson.

MATERIAL: Interbedded soft and hard layers of shale and sandstone bedrock. Probably rippable.

VOLUME: 1,000,000 cu. yds. approximately.

CONCLUSION: Source is suitable for development for common fill. Good access. Common equipment required for development.





Physical

This source is located in ground moraine of the Peel Plain approximately 4 miles northeast of the community of Fort McPherson. Shale and sandstone bedrock of the Devonian Age underlies a thin veneer of fine grained soils.



Photo No. 1 Source 500 showing existing pit wall exposure.

A borrow pit has been developed to provide shale and sandstone fill for the construction of the Dempster Highway. The present approximate dimensions of the borrow pit are 1000 x 300 feet.

Biotic

The vegetation is generally black spruce with some poplar and birch, all about 20 feet in height. The canopy density of the forest cover is approximately 30%.

The source is not located within any critical wildlife zone. Animal life in the regions around the pit is chiefly that of fur-bearing animals such as lynx, mink, marten and beaver. The region is particularly important for its beaver population--approximately one half to one colony per square mile--but productivity is low and the beaver population could easily be disturbed by man.

## FM 500 MATERIALS AND QUANTITY

The source is comprised of interbedded soft and hard layers of shale and sandstone bedrock, underlying 2 to 4 feet of high-ice-content fine-grained silt. In general the bedrock contained in this source is harder and more durable than the soft shale encountered in source number FM-505.

The source can be further developed to provide additional materials as required. The existing borrow pit can be widened to provide an estimated 1,000,000 cu. yds. of shale and sandstone materials.

## FM 500 DEVELOPMENT

### Access

After completion of the Dempster Highway through the area, this source will be readily accessible to the Fort McPherson community on a year-round basis. It is presently connected to the Dempster Highway by an access road one-half mile long, 4 miles northeast of the junction leading to the community.

### Material Use and Handling

The shale and sandstone materials are suitable for use as general fill only. Part of the shale fraction of the bedrock is quite soft and rapidly disintegrates into plastic clay and silt when exposed to air and water. Because of this characteristic its use as a base course on roads or as fill in those areas which are subjected to traffic is not recommended unless the shale is covered with a material such as gravel which is not affected by air and water.

The existing borrow pit has been developed to approximately 25 or 30 feet below the original ground surface. Further material can be obtained by extending the sides of the borrow area. Since the pit is developed below adjacent ground levels, periodic pumping will be required to dewater the pit while it is in use. Some blasting may be required to loosen the shale and sandstone bedrock unless large ripping equipment is available. After loosening, the material can be loaded into trucks and transported to the fill site.

FM 500 STRIPPING AND RESTORATION

The vegetation and stripping materials from this source have been piled adjacent to the borrow areas. The pit slopes should be flattened, covered by stripped material, and seeded to promote future growth.

## FM 501A ENVIRONMENT

### Physical

This source is located in hummocky morainal terrain of the Peel Plain, approximately 7 miles directly east of Fort McPherson. It is on the east side of an unnamed lake.



Photo No. 1 Source 501A looking southeast at kames

The source is comprised of hillocks or kames rising to 150 feet above the surrounding plain with widths ranging from 200 to 1000 feet across the base. The sides of the hillocks are well sloped and hence promote good drainage.

### Biotic

Within the source area the forest cover consists of spruce up to approximately 20 feet in height with a canopy density of approximately 30%. The source is located within the natural habitat for beaver, lynx, mink, and marten. The source is not located within any critical wildlife area, however the area is very important for its beaver population which are easily disturbed by man's activities.

## FM 501A MATERIALS AND QUANTITIES

The hillocks or kames within the source area contain materials consisting of sand and silt with a trace of gravel.

Soils containing high ice content were not encountered in the shallow test pits excavated during the early field investigation. During the winter, however, drilling to 20 and 30 foot depths revealed high ice content silts and sands below the active zone.

Only the 25,000 cu. yds. of material in the active permafrost zone can be easily excavated from this source and it is expected to be erratic in grain size distribution. Below the active permafrost zone, the material available is estimated at 1,000,000 cu. yds. Because of the high ice content which exists in the predominantly silt and sand soils, however, the removal of these materials is not recommended.

#### FM-501A DEVELOPMENT

##### General

At the time of the investigation no previous development of the source had taken place. Development of this source is not recommended at this time for the following reasons:

- (a) Access - lengthy, and if required throughout the year, expensive to build.
- (b) Size - the source contains only 25,000 cu. yds. above the permafrost zone.
- (c) Clearing and restoration costs are excessive.

##### Access

The best access to this source is southward from the Dempster Highway along a cleared seismic line which passes through the centre of the source. The total distance from the community following the Dempster Highway and the seismic line is 14 miles.

During the winter months access to the source would be along a winter road constructed along the seismic line. During the summer months a graded roadway would be required for access to the source.

##### Material Use and Handling

The material in this source would be suitable for general fill only.

The thin veneer of usable material occurring in the active permafrost zone can be removed with conventional equipment--bulldozers, loaders, and trucks. The high ice content material below the active zone would

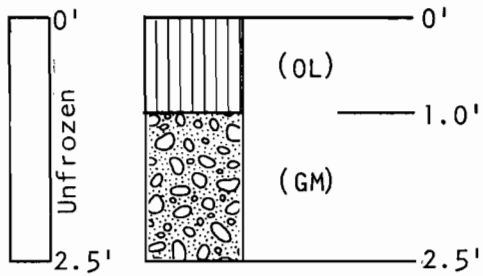
require ripping or blasting, stockpiling, thawing and drying before it was suitable for use as general fill.

#### Stripping and Restoration

Development of this source requires clearing of the trees and the stripping of 0.5 to 2 feet of organic topsoil and peat to expose the fill materials. Additional space would also be required for storing the stripping during removal of the material. After the source is depleted the stripped materials would be spread over the source to assist in promoting future growth. A large area must be cleared, stripped, and restored, compared with the volume of granular material available at this source.

TEST PIT LOGS  
SOURCE No. FM-501A

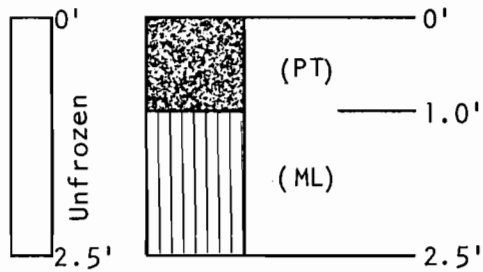
TP-FM501A-A



SILT - organic

GRAVEL - and sand, little silt, max. 2" rounded to subangular

TP-FM501A-B

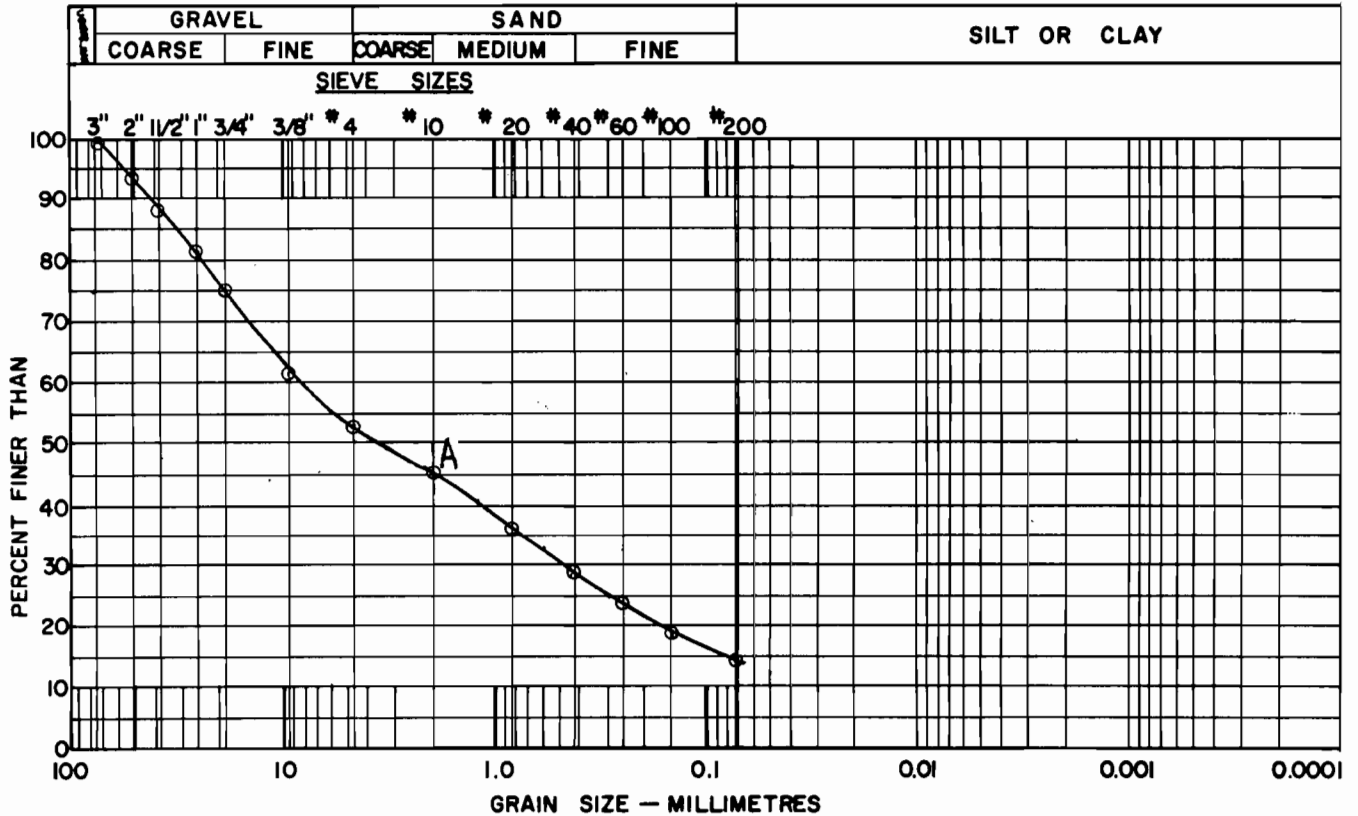


PEAT - trace silt

SILT - trace sand, low to non plastic

**LABORATORY  
TEST DATA  
SOURCE No. FM-501A**

**GRAIN SIZE DISTRIBUTION**



**MOISTURE CONTENT**

A-(1.0' - 2.5') M/C = 6.8%

**ORGANIC CONTENT**

**HARDNESS TEST**

**PETROGRAPHIC ANALYSIS**

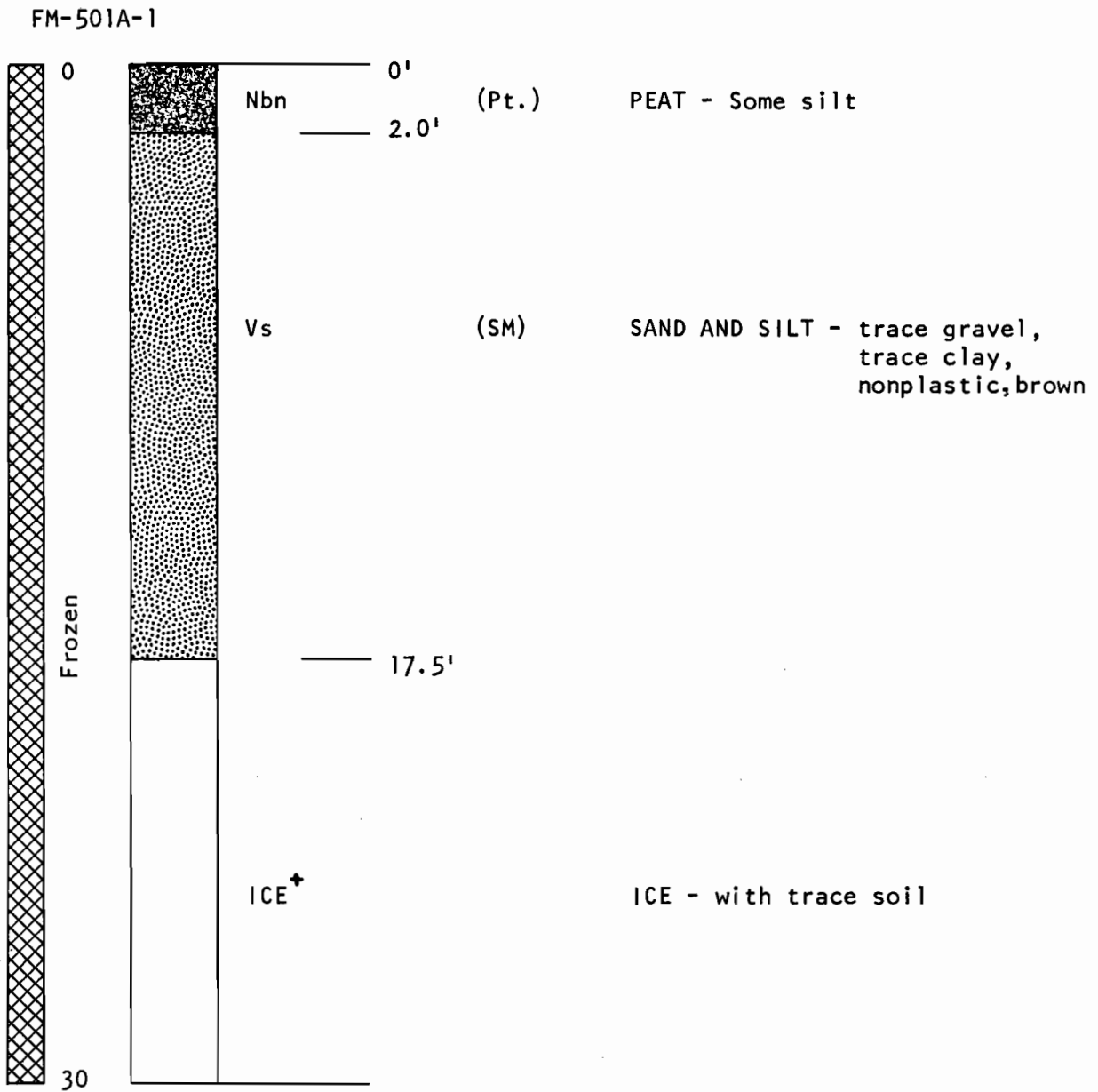
A-(1' - 2.5')

Soft Porous Limestone	- 38%	Fine Grain Sandstone	- 2%
Quartzite	- 21%	Clay Shale	- 1%
Chert	- 13%		
Soft Porous Sandstone	- 13%	Total	100%
Granitic	- 10%		
Ironstone	- 2%		



# TEST HOLE LOGS

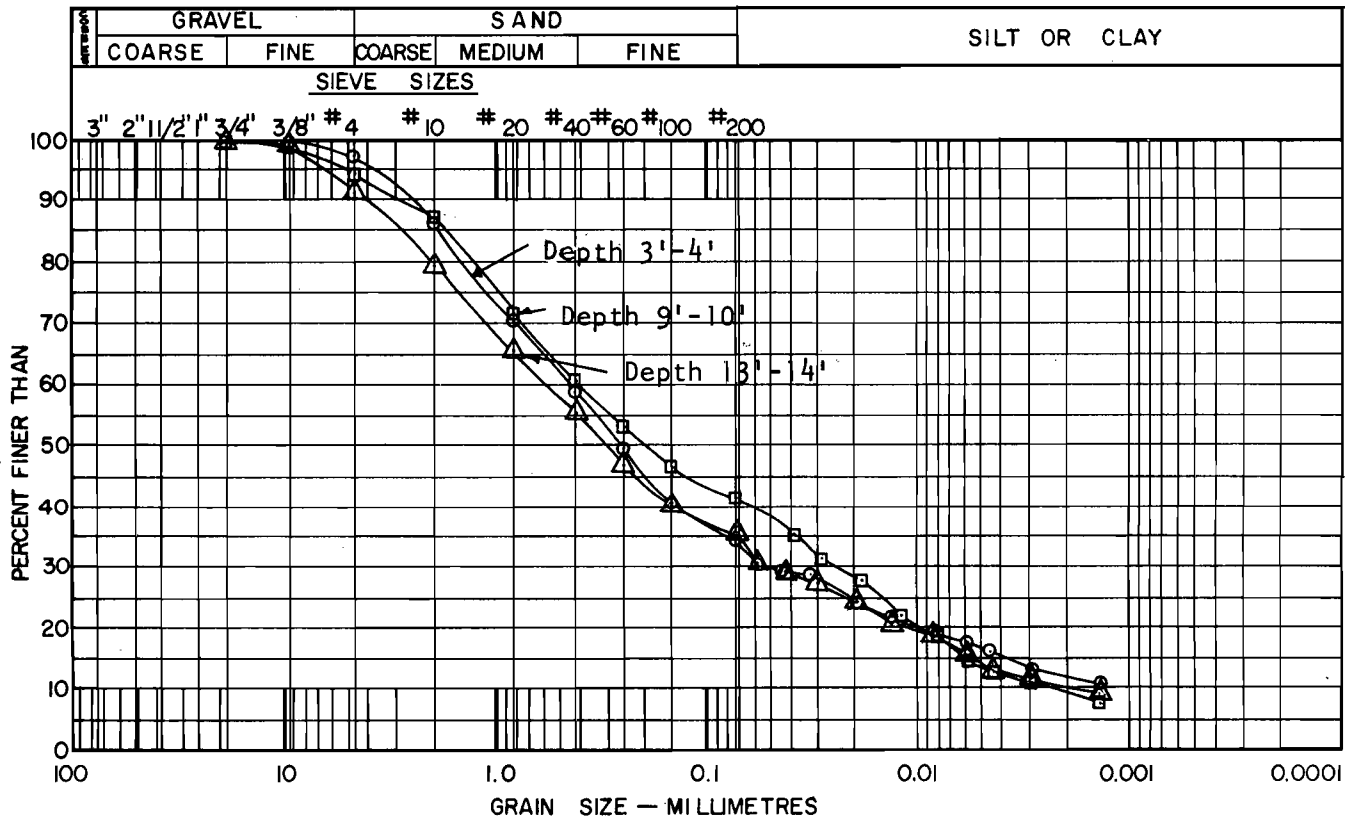
## SOURCE No. FM-501A-1



# LABORATORY TEST DATA

## TEST HOLE-SOURCE No.FM-501A-1

### GRAIN SIZE DISTRIBUTION



### MOISTURE CONTENT

Sample 1	depth 4'	18.3%
Sample 2	depth 6'	19.3%
Sample 3	depth 8'	25.1%
Sample 4	depth 10'	22.7%
Sample 5	depth 12'	25.1%
Sample 6	depth 14'	17.0%

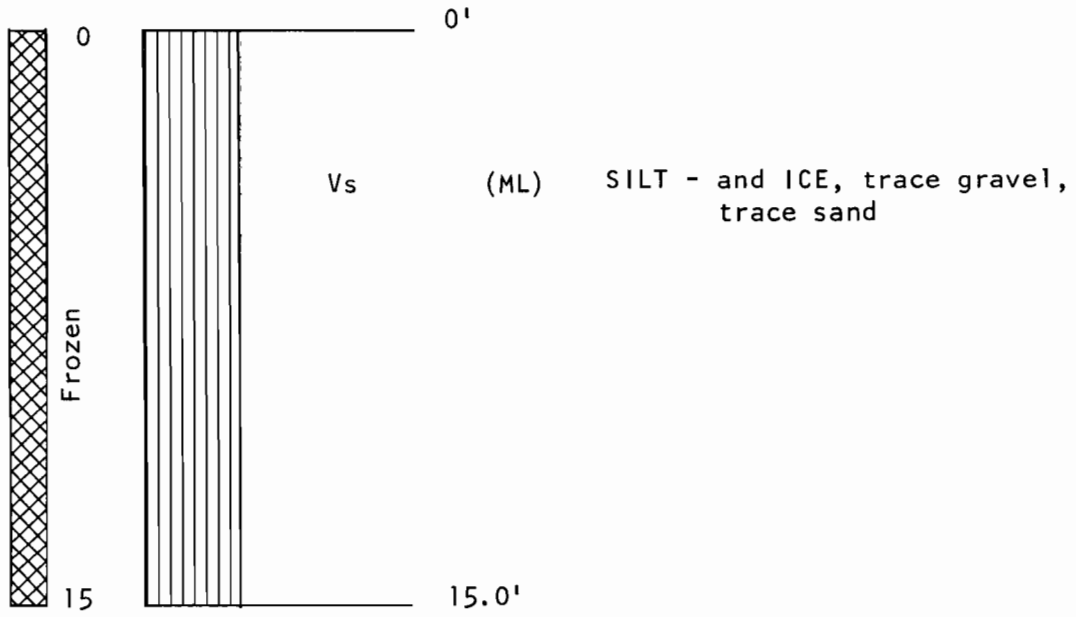
### ORGANIC CONTENT

### HARDNESS TEST

### PETROGRAPHIC ANALYSIS

TEST HOLE LOGS  
SOURCE No. FM-501A

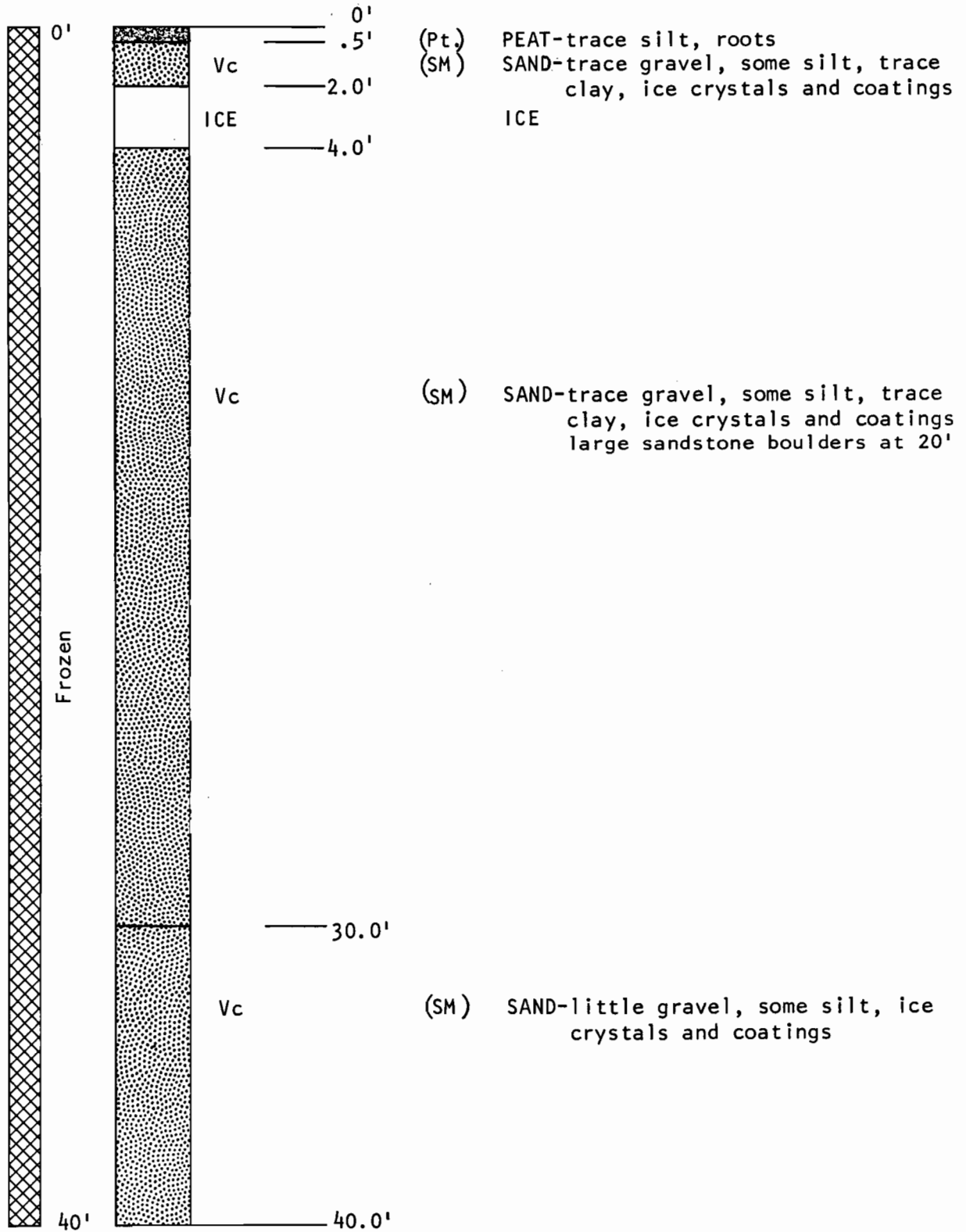
FM-501A-2



# TEST HOLE LOGS

## SOURCE No. FM-501A

FM-501A-3



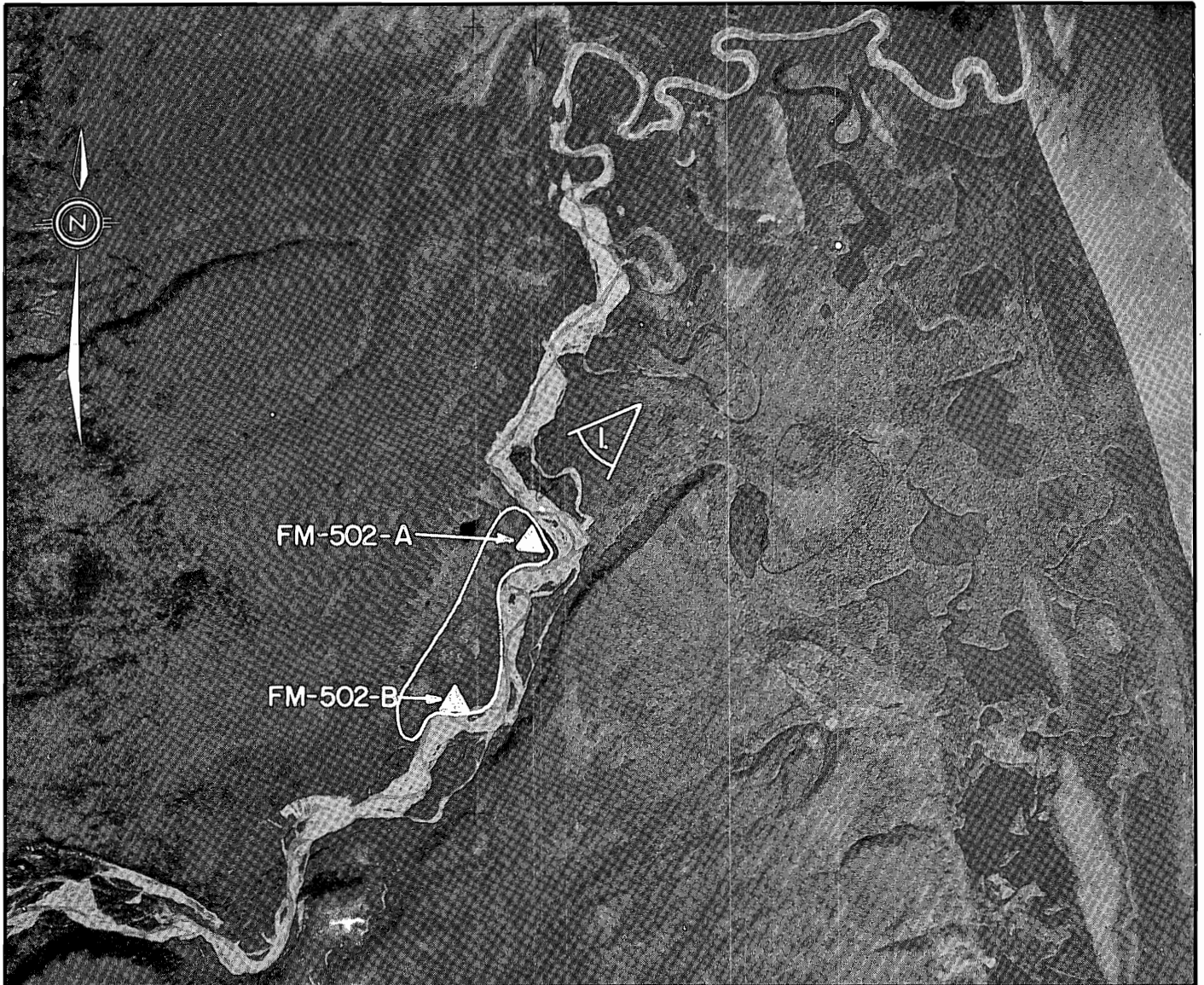
FORT McPHERSON  
SOURCE No. FM-502

LANDFORM AND LOCATION: Inactive flood plain adjacent to Stony Creek, about 4 miles above its junction with Peel River.

MATERIAL: GRAVEL - coarse (to 12") with little sand, part of which is unsound.

VOLUME: 200,000 cu. yds.

CONCLUSION: This source is recommended for winter operation, using material for common fill or for coarse aggregate.



AIRPHOTO No. : A12847 - 223

SCALE: 1" = 3000' (approx.)

## FM 502 ENVIRONMENT

### Physical

The source lies in the inactive flood plain of Stony Creek, approximately 4 miles up-stream from the confluence with the Peel River. The river has eroded a broad flat valley 200 feet below the Peel Plateau at this point, and the source area is enclosed by a river meander and the north valley wall of the stream. The source rises 3 to 5 feet above the level of the present river channel.



Photo No. 1 Source 502 looking southwest along Stony Creek.  
Note inactive flood plain on right.

The ground water level in the test pits coincides with the water level in Stony Creek.

### Biotic

The elevated areas of the flood plain have a growth of spruce, some aspen, and low alder. The lower areas of the flood plain contain dwarf shrubs and some sphagnum bogs.

The source area does not form any important or central wildlife area.

The river gravels are not recorded as being used for fish spawning.

## FM 502 MATERIALS AND QUANTITIES

The material in the source area consists of coarse gravels to 12 inches in diameter with little sand. Approximately 70% of the material is

Stripping and Restoration

The natural vegetative cover and surface soils within the source area must be removed to develop this source.

All trees should be burned, and stripped material stockpiled away from the river where it cannot be carried into the stream during high water.

As sections of the source are depleted, the river can be allowed to flow through the source area, providing the area is free of all debris and piles of stripped material.

greater than 3/4 inch in size. The coarse gravel fraction contains sandstone, limestone, shale and chert pieces. The sand fraction contains soft shale and sandstone particles.

No permafrost was encountered in the test pits within the depth excavated.

The volume of material that can be recovered from the source area is estimated at 200,000 cu. yds., of which 170,000 cu. yds. is coarse gravel and 30,000 cu. yds., is sand. The 170,000 cu. yds. is more than sufficient to supply the coarse aggregate requirement for the community. The 30,000 cu. yds. of sand contains a high percentage of material passing the no. 200 sieve (up to 20%) and is therefore unsuitable for use as a fine aggregate.

#### FM 502 DEVELOPMENT

##### Access

During the winter months access to Fort McPherson would be by winter road constructed along Stony Creek and the Peel River. Operation during the summer months would require construction of an access road as far as the Peel River where the material would be stockpiled for subsequent barging to the community of Fort McPherson. However, this operation would be very expensive and we recommend that the source be considered only for winter development.

##### Material Use and Handling

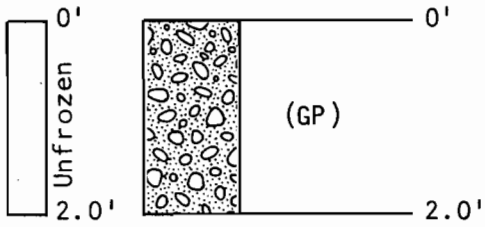
The natural gravel materials in the flood plain are very coarse, gap graded, and contain a small percentage of sand sizes, therefore the material would require extensive processing to provide materials which could be used for concrete or asphalt. For coarse aggregates, crushing would be required. For fine aggregates extensive washing would be required to produce a small volume of suitable sand.

The development of this source should therefore be considered firstly as a general source of fill material and secondly as a source of coarse aggregate for concrete or asphalt.



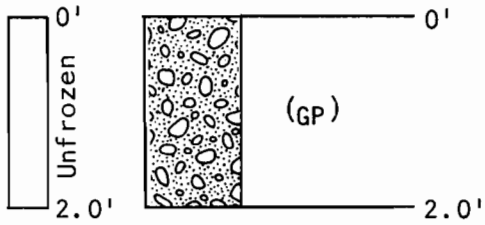
TEST PIT LOGS  
SOURCE No. FM-502

TP-FM502-A



GRAVEL - little sand, coarse,  
rounded to subangular

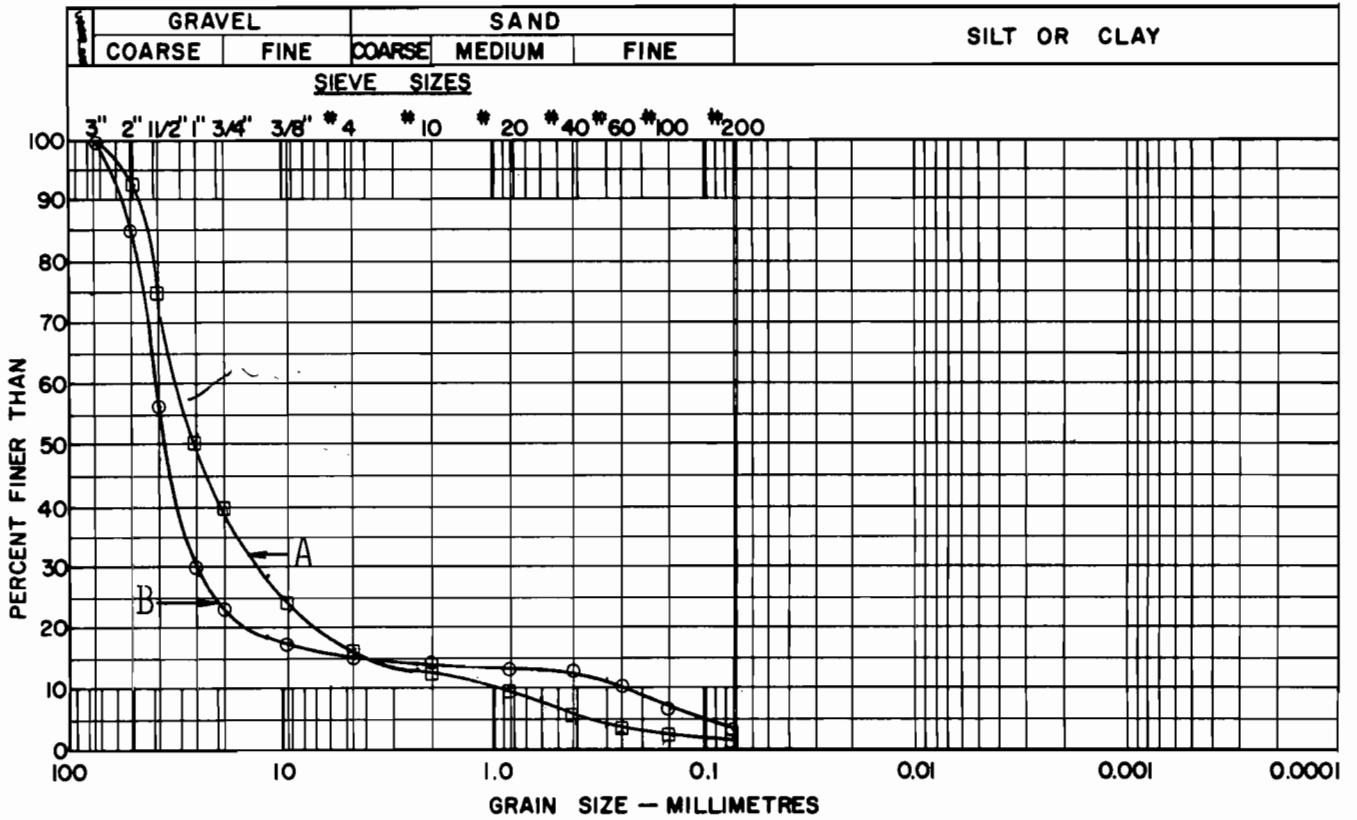
TP-FM502-B



GRAVEL - little sand, coarse  
rounded to subangular

**LABORATORY  
TEST DATA  
SOURCE No. FM-502**

**GRAIN SIZE DISTRIBUTION**



**MOISTURE CONTENT**

A (0' - 2.0') M/C = 1.5%

B (0' - 2.0') M/C = 0.8%

**ORGANIC CONTENT**

**HARDNESS TEST**

**PETROGRAPHIC ANALYSIS**

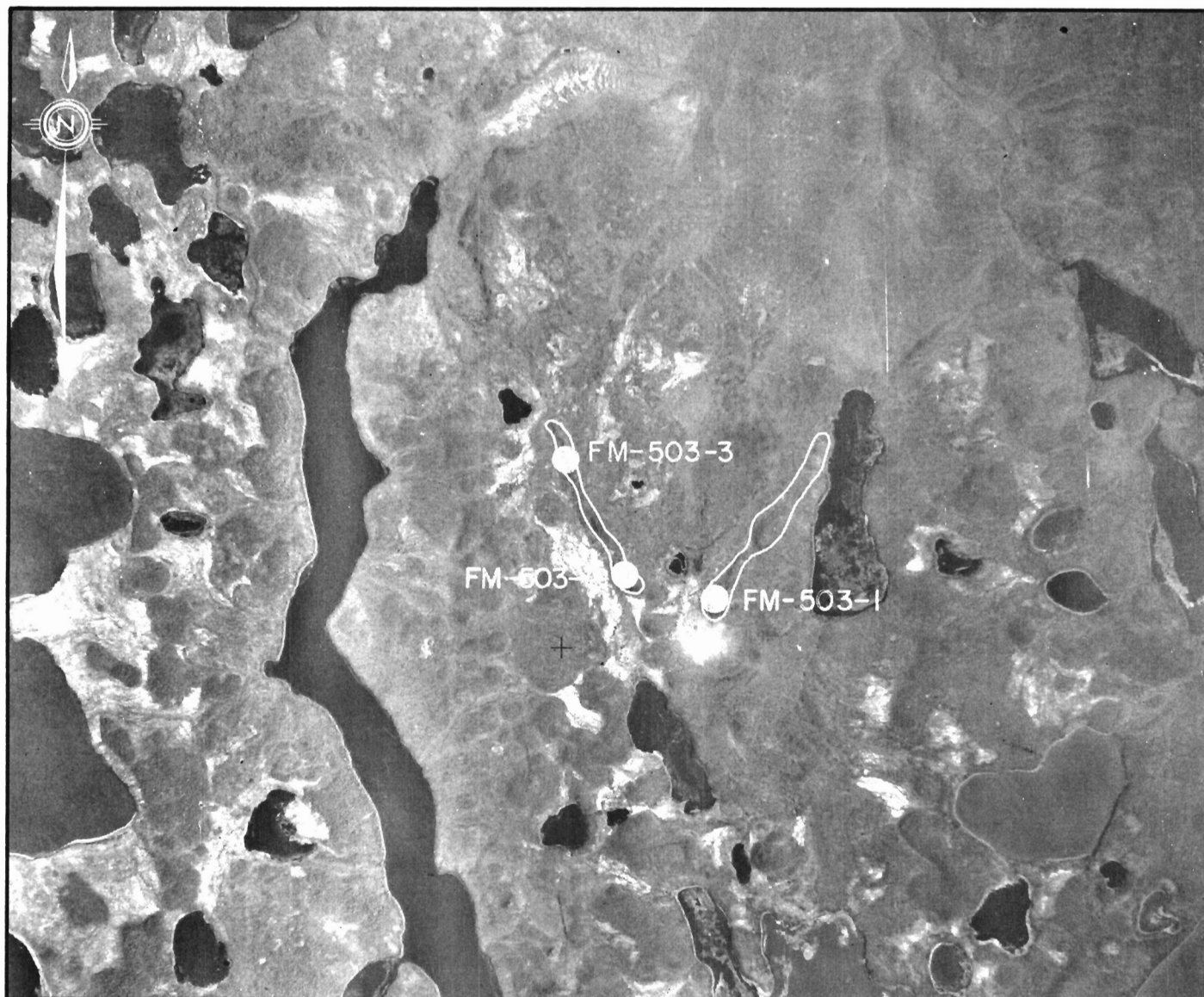
FORT McPHERSON  
SOURCE No. FM-503

LANDFORM AND LOCATION: Two small eskers, about 9 miles east of Fort McPherson.

MATERIAL: GRAVEL - well-graded, to silts.

VOLUME: 50,000 cu. yds.

CONCLUSION: Low priority for development.



AIRPHOTO No.: A12847 - 51

SCALE: 1" = 3000' (approx.)

## FM 503 ENVIRONMENT

### Physical

The source is comprised of two small eskers which are approximately one and a half miles south of the Dempster Highway and approximately  $\frac{1}{2}$  mile east of a cleared seismic line. The eskers are approximately three thousand feet in length and up to twenty feet in height above the surrounding morainal plain. The eskers are well drained, however drainage within the surrounding plain is poor.

### Biotic

The eskers are tree covered, with spruce and an occasional aspen. The trees range to thirty feet in height with a canopy density of approximately 30%.

The main animal life in the area is the small fur-bearing animals which can burrow into the esker. The source is not located in any critical wild-life zone, but it is in an area important for its deer population. Trapping takes place in the area during the winter and spring months.

## FM 503 MATERIALS AND QUANTITIES

The materials in the eskers are variable, ranging from well-graded gravels to silts. Extensive drilling will be required to locate the limits of gravel in this source. The silts encountered in 2 of the 3 holes drilled contain a high percentage of ice. Elsewhere, as indicated in the test hole log, ice in the gravels occurred as a coating or small crystals.

The depth of recoverable material will vary between zero and twenty feet over a width up to 150 feet.

The recoverable volume of well-graded gravel and sand is estimated at 50,000 yards of which 30,000 yards could be coarse aggregate and 20,000 yards fine aggregate.

## FM 503 DEVELOPMENT

### General

At the time of the investigation no previous development of the source had taken place. Development of this source should be of low priority, for the following reasons:

- (a) Access - 12 miles from Fort McPherson. Access road to build.
- (b) Variable material in source.
- (c) Stripped area would be large in relation to volume available.

#### Access

Access to the source from the Dempster Highway is southward for approximately one and a half miles along a cleared seismic line which passes within one half mile of the esker on the western edge of the source. The total distance from the Fort McPherson community to the source is about twelve miles.

For winter operation a winter road could be constructed at little expense. For summer operation a much more expensive access road would have to be constructed.

#### Material Use and Handling

The gravel as encountered in hole 3 of 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 hole 3, the gradation of the natural material is too coarse for the most economical production of coarse and fine aggregates. About 15% surplus coarse aggregate would be produced during the screening operation, which could be used for drains or as general fill.

#### FM 503 STRIPPING AND RESTORATION

The development of this source requires the clearing of all trees and the removal of from 0 to 3 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.

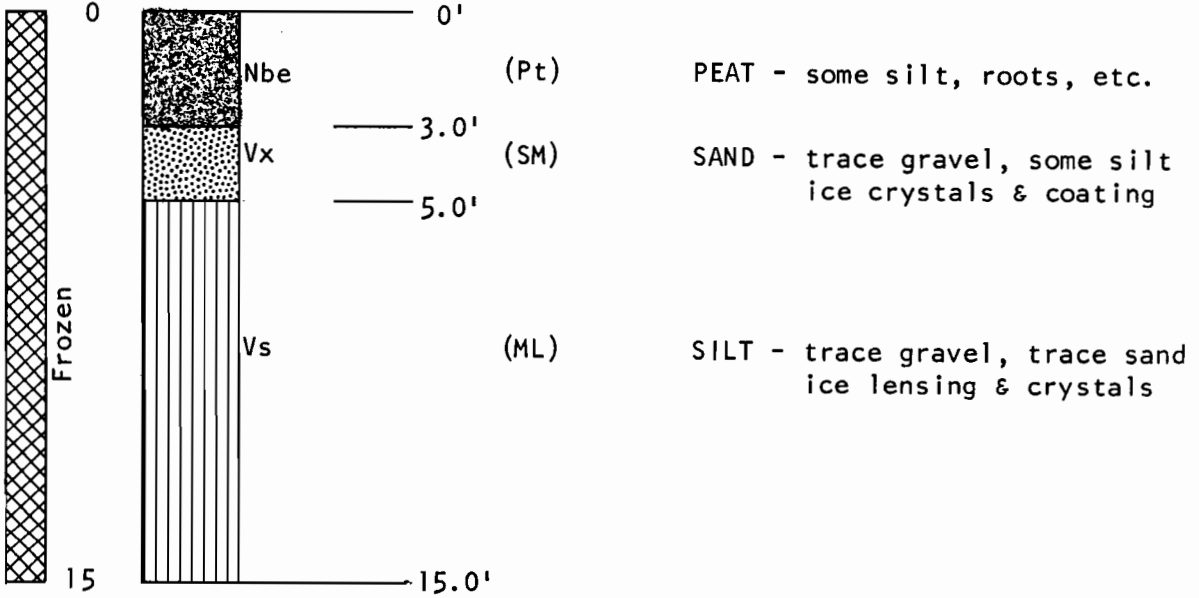
After the granular material is removed the area should be restored by spreading the stripped materials over the exposed borrow area.

Considering the shape and size of the esker, the area required for the development will be large in relation to the volume of available material.

# TEST HOLE LOGS

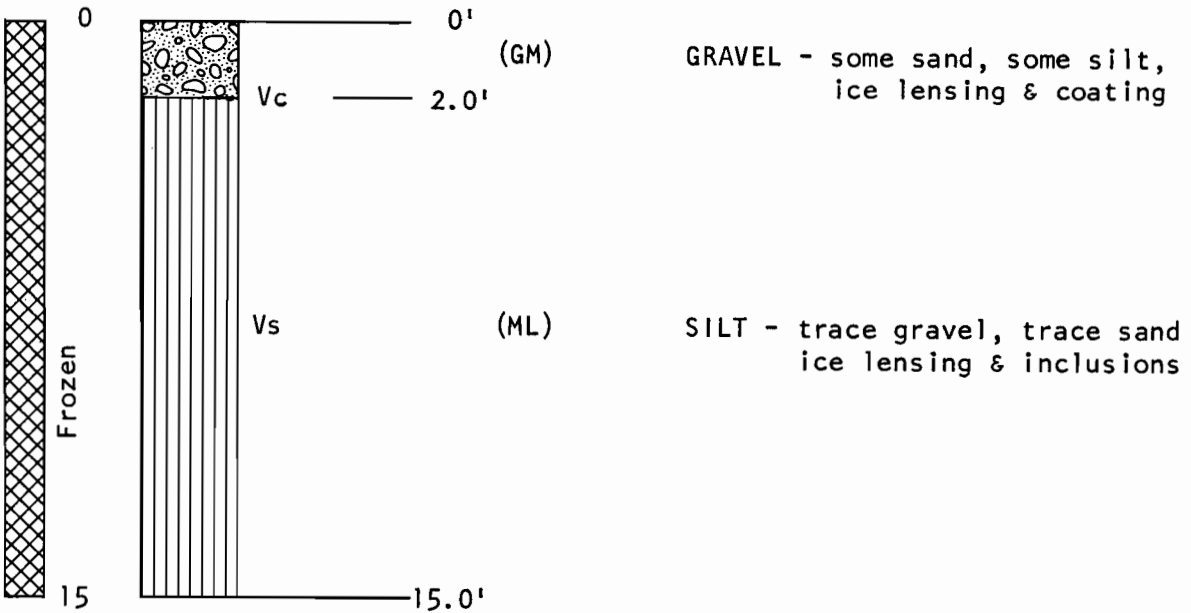
## SOURCE No. FM-503

FM-503-1



Moisture content - Sample 1 Depth 4' - 21.3%

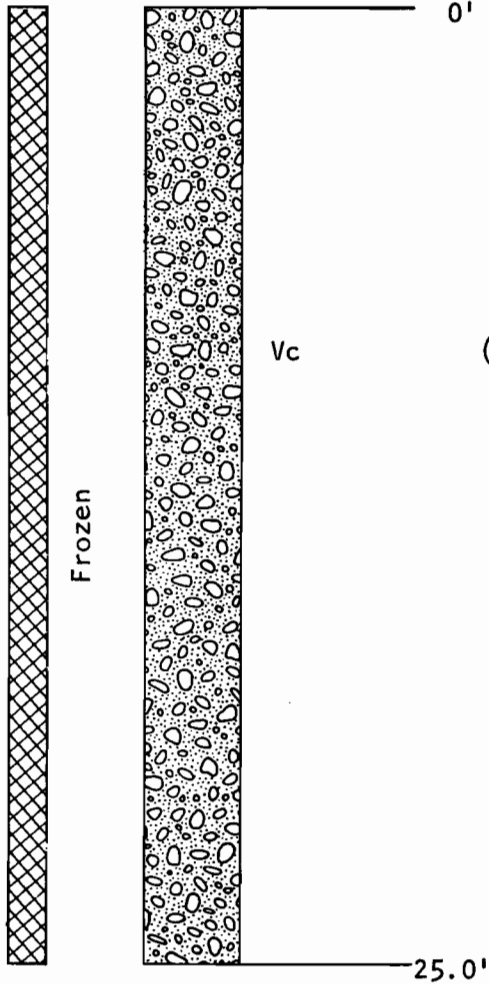
FM-503-2



Moisture content - Sample 1 Depth 2' - 126.8%

TEST HOLE LOGS  
SOURCE No. FM-503

FM 503-3



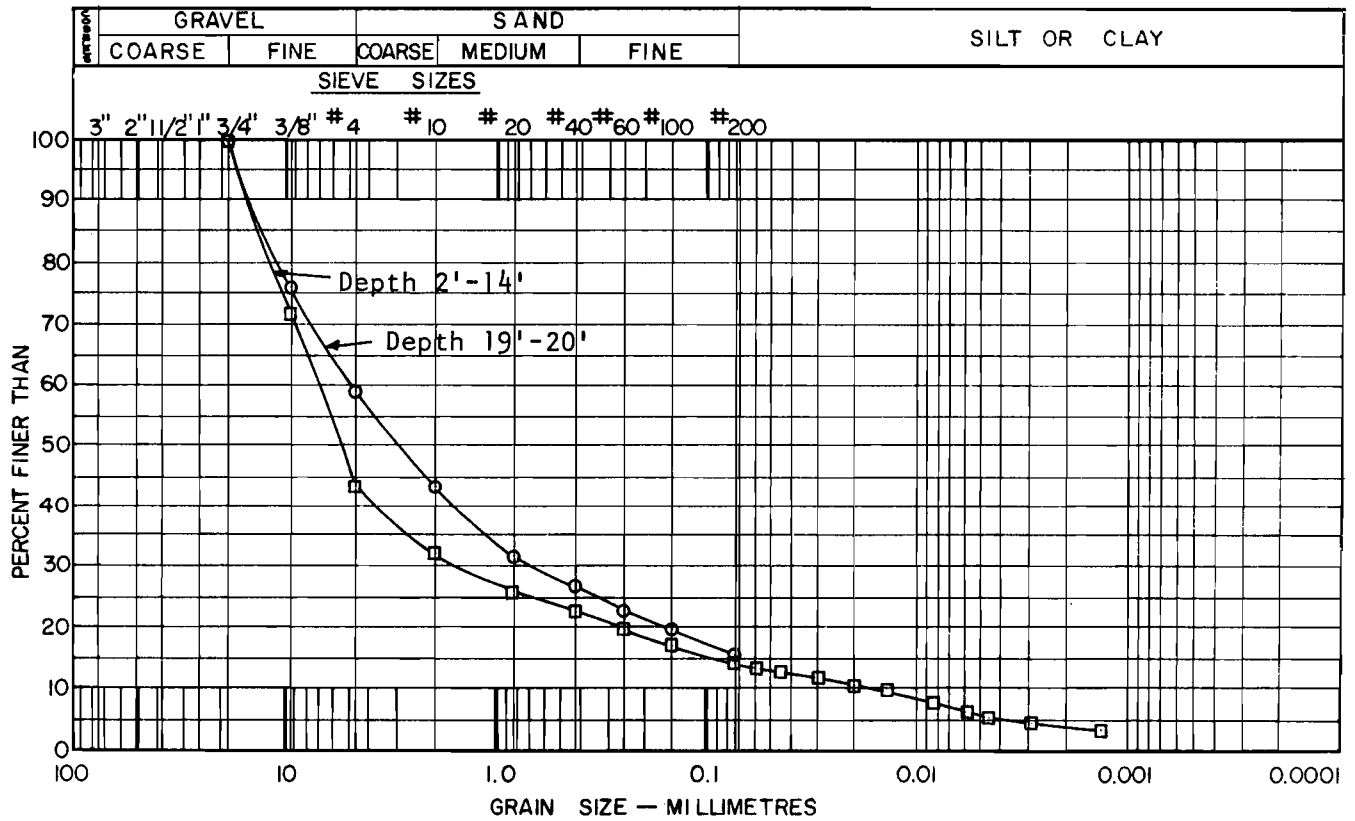
Vc (GM)

GRAVEL - and sand, little silt, well graded, non plastic fines, ice crystals & coating.

# LABORATORY TEST DATA

## TEST HOLE-SOURCE No. FM-503-3

### GRAIN SIZE DISTRIBUTION



### MOISTURE CONTENT

Sample 1	depth	2'	30.5%	Sample 5	depth	10'	10.4%
Sample 2	depth	4'	18.3%	Sample 6	depth	12'	8.9%
Sample 3	depth	6'	16.6%	Sample 7	depth	14'	7.8%
Sample 4	depth	8'	12.3%	Sample 8	depth	20'	14.4%

### ORGANIC CONTENT

### HARDNESS TEST

### PETROGRAPHIC ANALYSIS



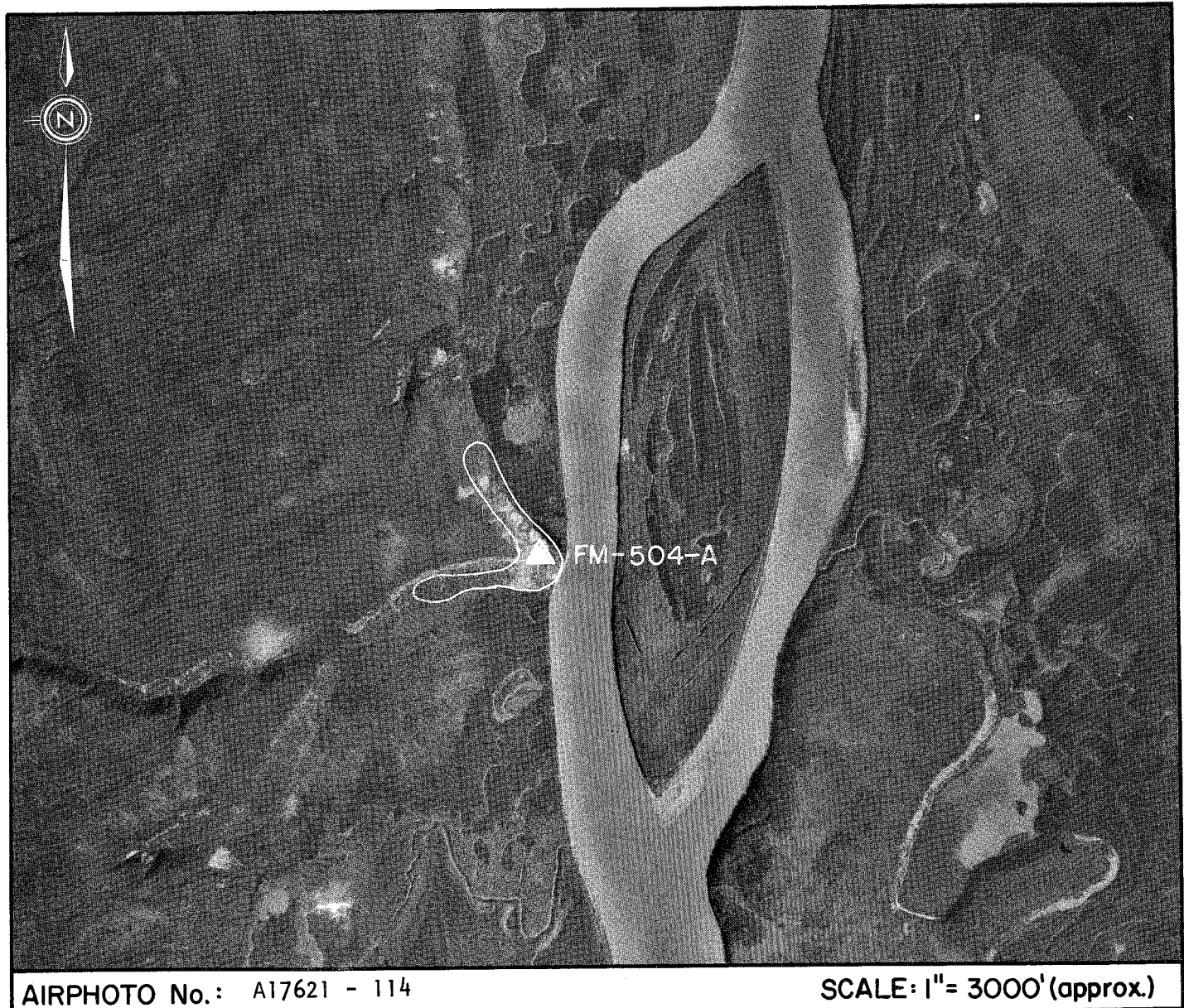
# FORT McPHERSON SOURCE No. FM-504

LANDFORM AND LOCATION: Talus slope below bedrock cliff, about 10 miles south of Fort McPherson.

MATERIAL: COARSE SANDSTONE to 12 inch size, very little fines.

VOLUME: 200,000 cu. yds. approximately.

CONCLUSION: Recommended as a source of common fill or, with crushing and screening, specification aggregate. Ready access by truck in winter, by barge in summer.



## FM 504 ENVIRONMENT

### Physical

The source is a talus slope immediately adjacent to the Peel River at Shiltee Rock which is located approximately ten miles south of the Fort McPherson community on the west side of the Peel River. The talus slope extends for approximately 150 feet above the Peel River level to the base of the near-vertical bedrock cliff.

The source is very well drained.

### Biotic

The vegetation is mainly confined to a sparse covering of spruce and hardwood trees on the steep slope with a thicker growth of spruce on the flatlands at the base of the talus slope.

The area of the Peel River valley is not in any critical wild-life zone. The area is, however, noted for its moose population which is hunted extensively during the summer and fall seasons. The island in the Peel River opposite Shiltee Rock provides back eddies which make this location an important domestic fishing spot for the local population. The Peel River is also part of an important migration route for large quantities of several species of fish.

Lynx, marten, and mink are trapped during the winter months in the lowlands of the river valley adjacent to Shiltee Rock. There is also a significant muskrat population which is trapped during the spring.

## FM 504 MATERIALS AND QUANTITY

The material contained in the talus slope is generally a porous, coarse sandstone which has fallen from the bedrock exposures above. The material ranges in size up to twelve inches in diameter with approximately 75% of the material greater than 1½ inches. Occasional large boulders can be found on the slope. The estimated volume of the material contained in the talus slopes which extend to the northwest and southwest of Shiltee Rock is approximately 200,000 cu. yds.

## FM 504 DEVELOPMENT

### General

At the time of the investigation no previous development of the source had taken place.

### Access

Shiltee Rock is located approximately three and a half miles south of the proposed crossing of the Dempster Highway over the Peel River.

During the winter months the talus materials can be transported along the River to the Dempster Highway and then to Fort McPherson. During the summer months, the materials can be stockpiled adjacent to the river and transported by barge to the community. Alternatively a road could be built along the base of the west bank of the Peel River to the Dempster Highway.

### Material Use and Handling

In its present form the material can be used only as common fill, and for this purpose would need to be covered by finer material. Because of the coarse material contained within the source it could be used only in fills over five feet in depth.

With extensive crushing and screening the source could be developed for concrete and asphalt aggregate and base coarse material. A grainsize test is presented for a sample of the sandstone after it was passed through a crusher with a 1½ inch opening. Natural aggregate is, however, available at other sources (source 650), and we believe that it is not economically sound to process the material from this source at this time.

The materials in this source can be handled with conventional equipment that would be available in the community, such as loaders, bulldozers, and trucks.

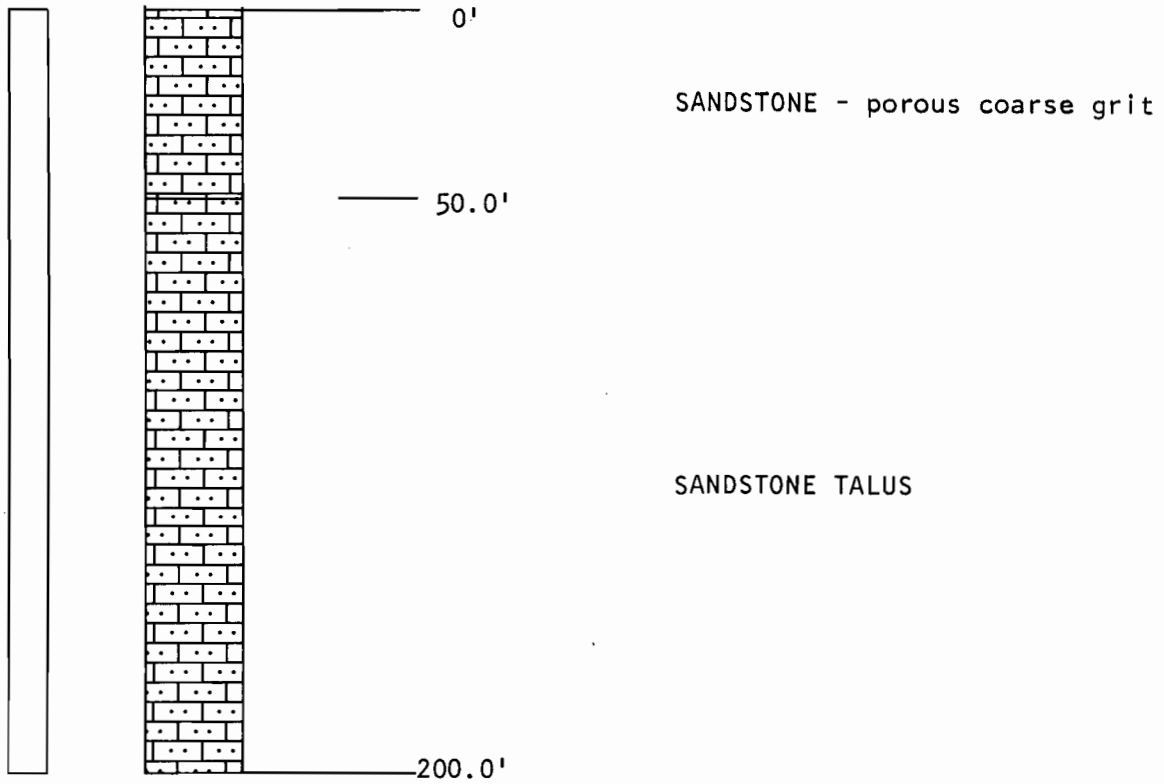
### FM 504 STRIPPING AND RESTORATION

All trees should be cleared and grubbed from the steep slopes and burned. No stripping will be required, as the coarse rock is exposed at the surface of the slopes. After the source has been depleted, little restoration can be done. We recommend that the area be cleaned up and steep slopes trimmed within the source.

Careless development of the source and stockpiling of the materials too close to the Peel River could cause contamination of the river. All stockpiles should be kept away from the river to prevent any problems of this sort.

TEST PIT LOGS  
SOURCE No. FM-504

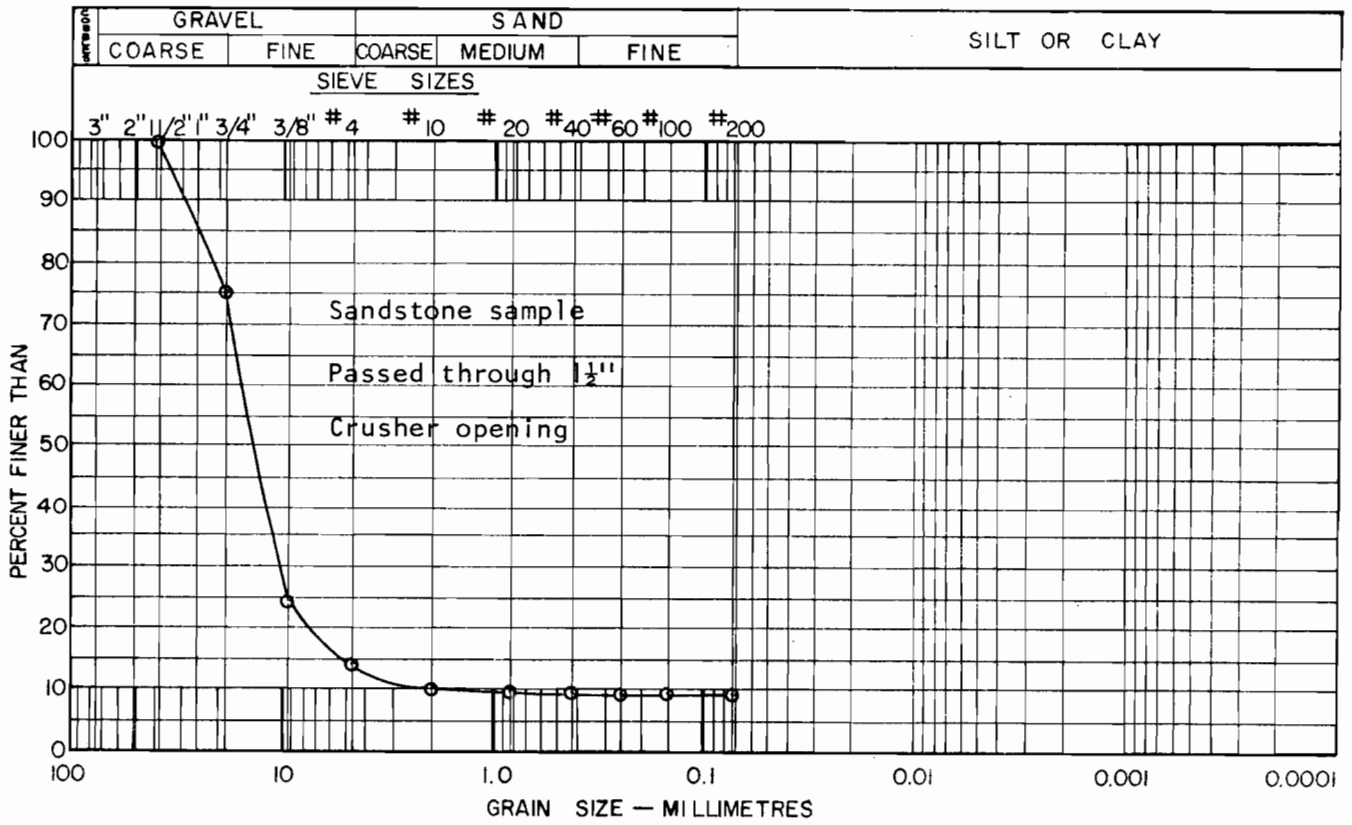
FM-504A



Soil Profile as logged in the field

LABORATORY  
TEST DATA  
TEST PIT-SOURCE No. FM-504

GRAIN SIZE DISTRIBUTION



MOISTURE CONTENT

ORGANIC CONTENT

HARDNESS TEST

PETROGRAPHIC ANALYSIS

FORT McPHERSON  
SOURCE No. FM-505

LANDFORM AND LOCATION: On Peel Plain, only 1 mile southeast of Fort McPherson.

MATERIAL: SHALE, soft and silty in the bank, breaking down to silty clay on exposure.

VOLUME: 6,000 cu. yds.

CONCLUSION: Because of poor quality and small volume, this source rates very low in priority.



AIRPHOTO No. : A12847 - 182

SCALE: 1" = 3000' (approx.)

## FM 505 ENVIRONMENT

### Physical

The source is located within the rolling morainal terrain of the Peel Plain, at the junction of the Dempster Highway and the entrance road to Fort McPherson and is approximately one mile from the center of the community.



Photo No. 1 Source 505 looking northwest at Fort McPherson with existing pit in foreground.

The source has been developed as a borrow area approximately 400 feet long and 200 feet wide for the Dempster Highway. The depth of material removed in this borrow area varies between 10 and 30 feet.

### Biotic

The source is located in an area lightly covered with spruce, birch, and larch up to 20 feet in height. Because of its location close to the community, the area is not located in a critical wild-life zone.

## FM 505 MATERIALS AND QUANTITIES

The material in the source as exposed on the sides and bottom of the developed pit consists of a soft silty shale. When exposed to air and water, the soft shale decomposes to a medium plastic silty clay.

The estimated volume remaining in the borrow pit is about 6,000 cu. yds.

## FM 505 DEVELOPMENT

### General

This source was previously developed to provide material during the construction of the Dempster Highway. Very little material remains in the pit and hence further development should be low priority.

### Access

Access to this source from the community is readily available by one mile of road at all times of the year.

### Material Use and Handling

Due to the decomposition characteristic of this soft shale the material in this source area is only suitable as a poor quality general fill. As a fill it will be subject to extensive frost heaving if exposed to a source of water. Therefore it should only be used as a fill above the general surrounding ground surface and the fill surface should be sealed or graded to allow positive drainage. If used for either roadways or storage platforms, a layer of gravel should be placed on the fill surface to provide a wearing surface.

The equipment required to excavate and haul the material should consist of a ripper-dozer, loader, and trucks.

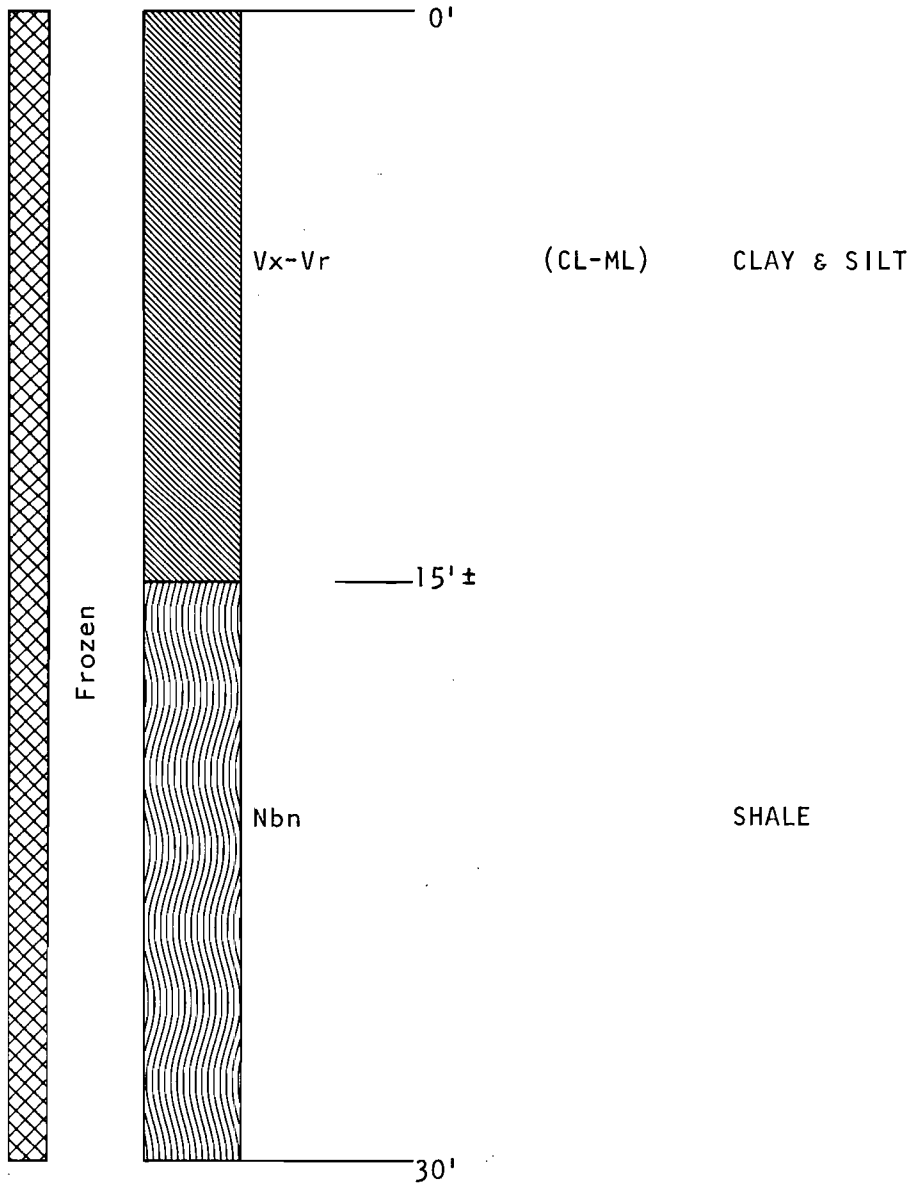
## FM 505 STRIPPING AND RESTORATION

The source as developed has been completely stripped and the stripping disposed of away from the source. Due to the proximity of permanent buildings near the northern pit limit the slopes cannot be graded flatter than the present approximate 2 to 1 slope. Therefore restoration of the pit will be limited to minor contouring and attempts to vegetate the pit base and slopes.

Some water has accumulated within the pit area. Drainage from the pit area should be provided to the south to prevent future ponding.



TEST PIT LOGS  
SOURCE No. FM-505



Soil Profile as Logged from pit wall.

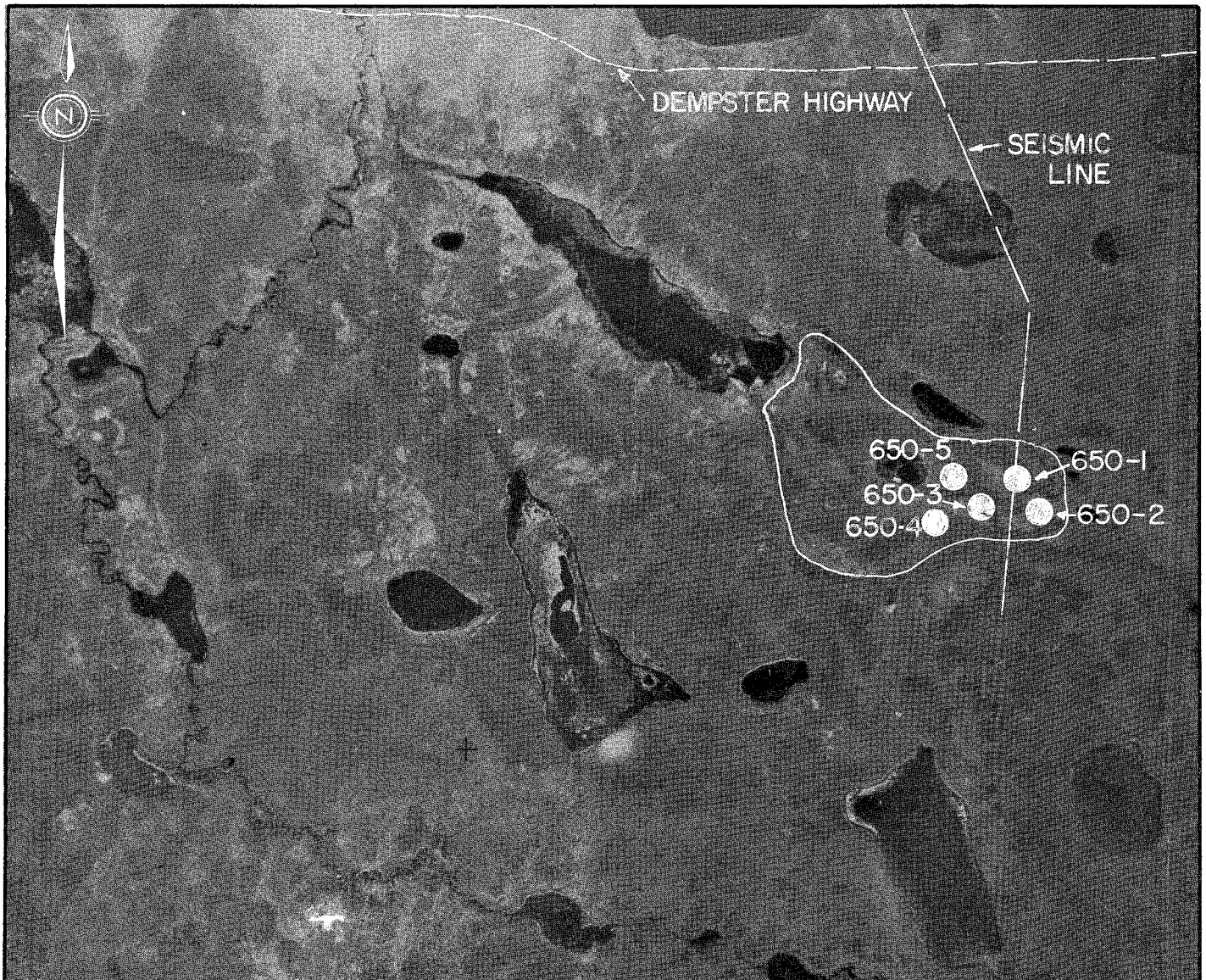
# FORT McPHERSON SOURCE No. 650

LANDFORM AND LOCATION: A glacio-fluvial outwash plain located 27½ miles east of Fort McPherson.

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.)

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.

The topography of the source varies as much as 20 feet, and surface drainage into the small lakes and streams is good.

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 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 investigation, however, it is recommended that concrete produced with this aggregate should be made with cement containing 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 approximately  $1\frac{1}{2}$  miles south of the Dempster Highway along a seismic line which passes through the source, and intersecting the Dempster Highway about 26 miles by road from the community of Fort McPherson. The total distance by road from Fort McPherson to the source will be  $27\frac{1}{2}$  miles.

Year-round access to the intersection with the seismic line will be available along the Dempster Highway. 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 percent 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

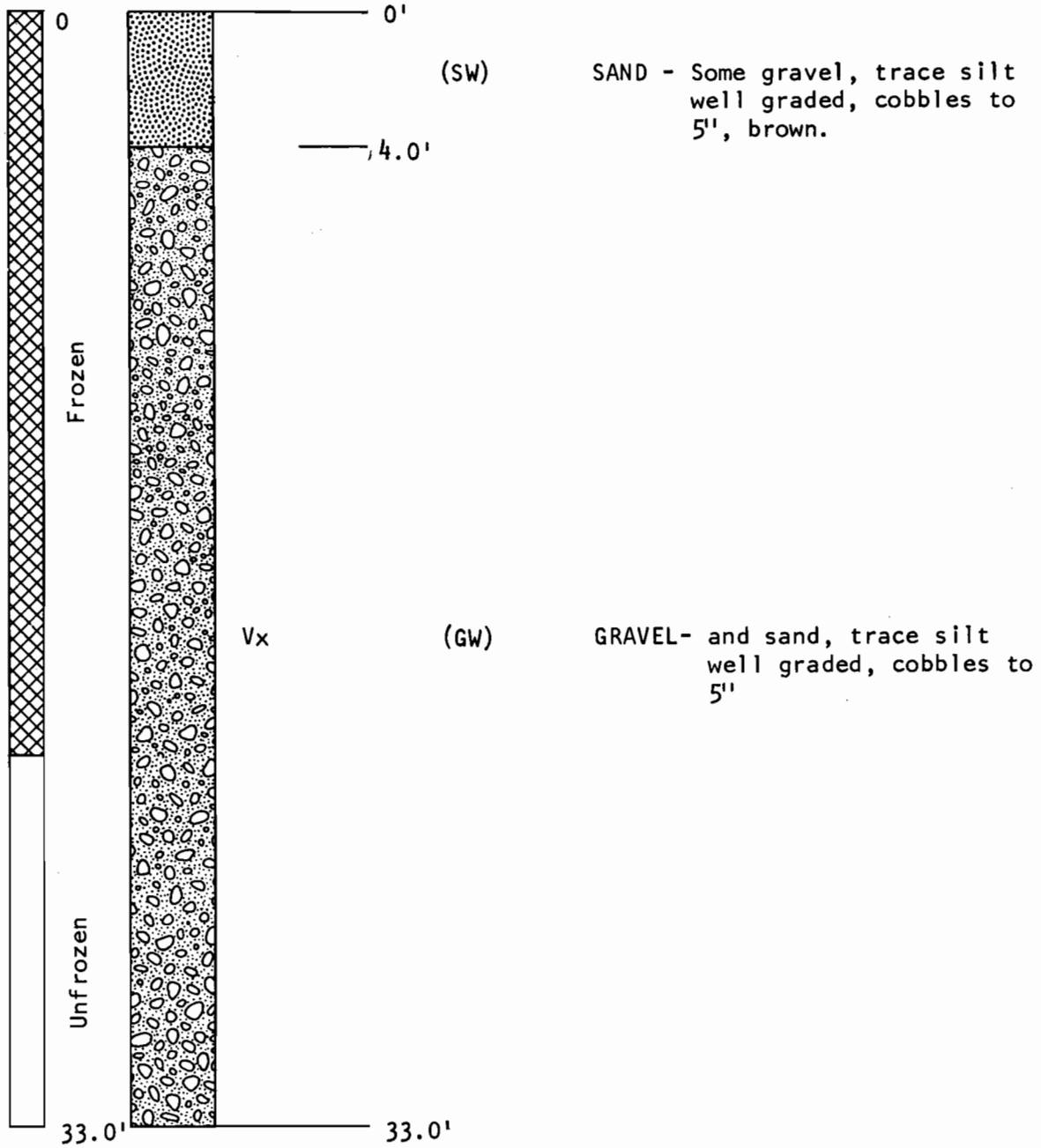
All trees will have to be cut and disposed of by burning. The depth of stripping in the area investigated varies between 0 and 6 feet. These materials can be stored adjacent to that area of the source being developed. After depletion of the gravels, the stripped materials can be used to cover slopes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

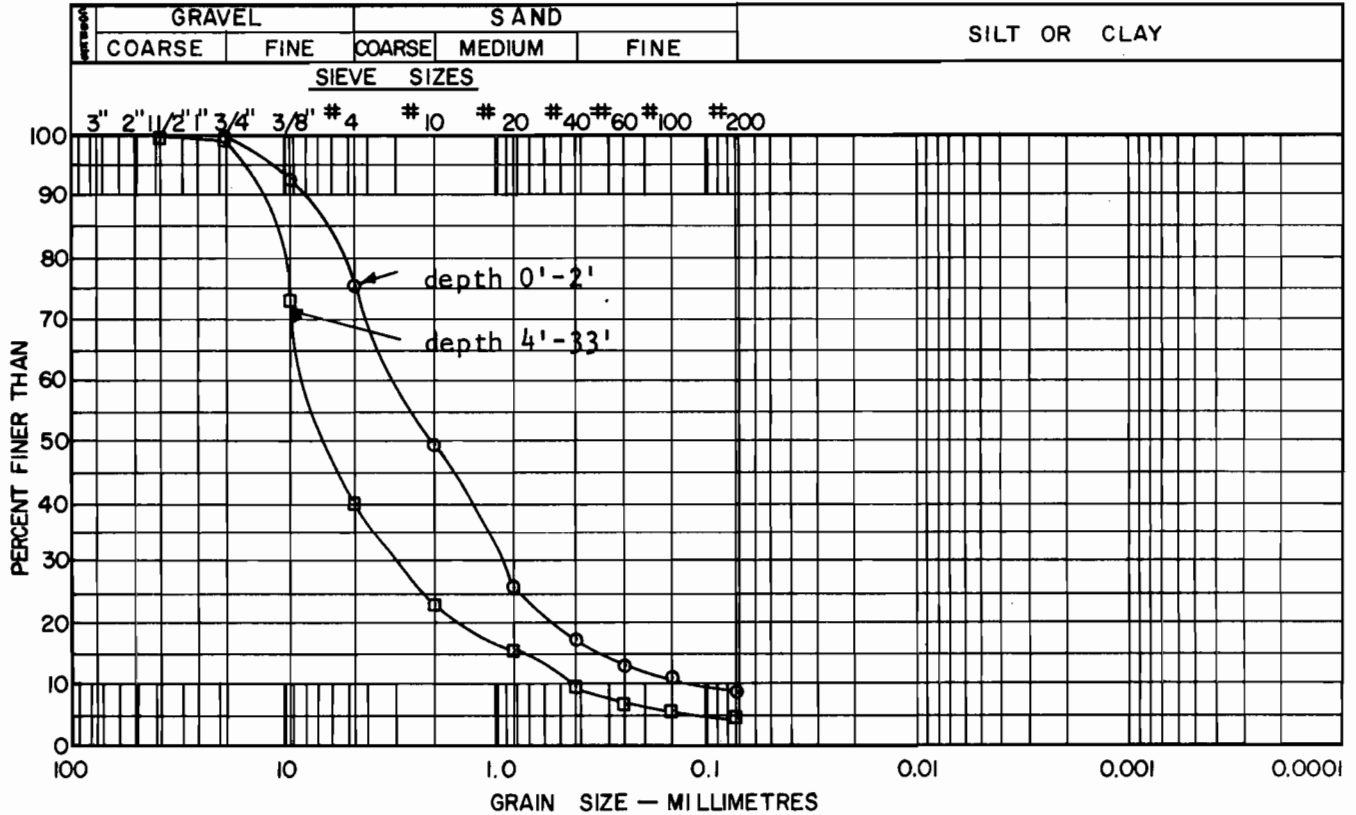
650-1



# 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

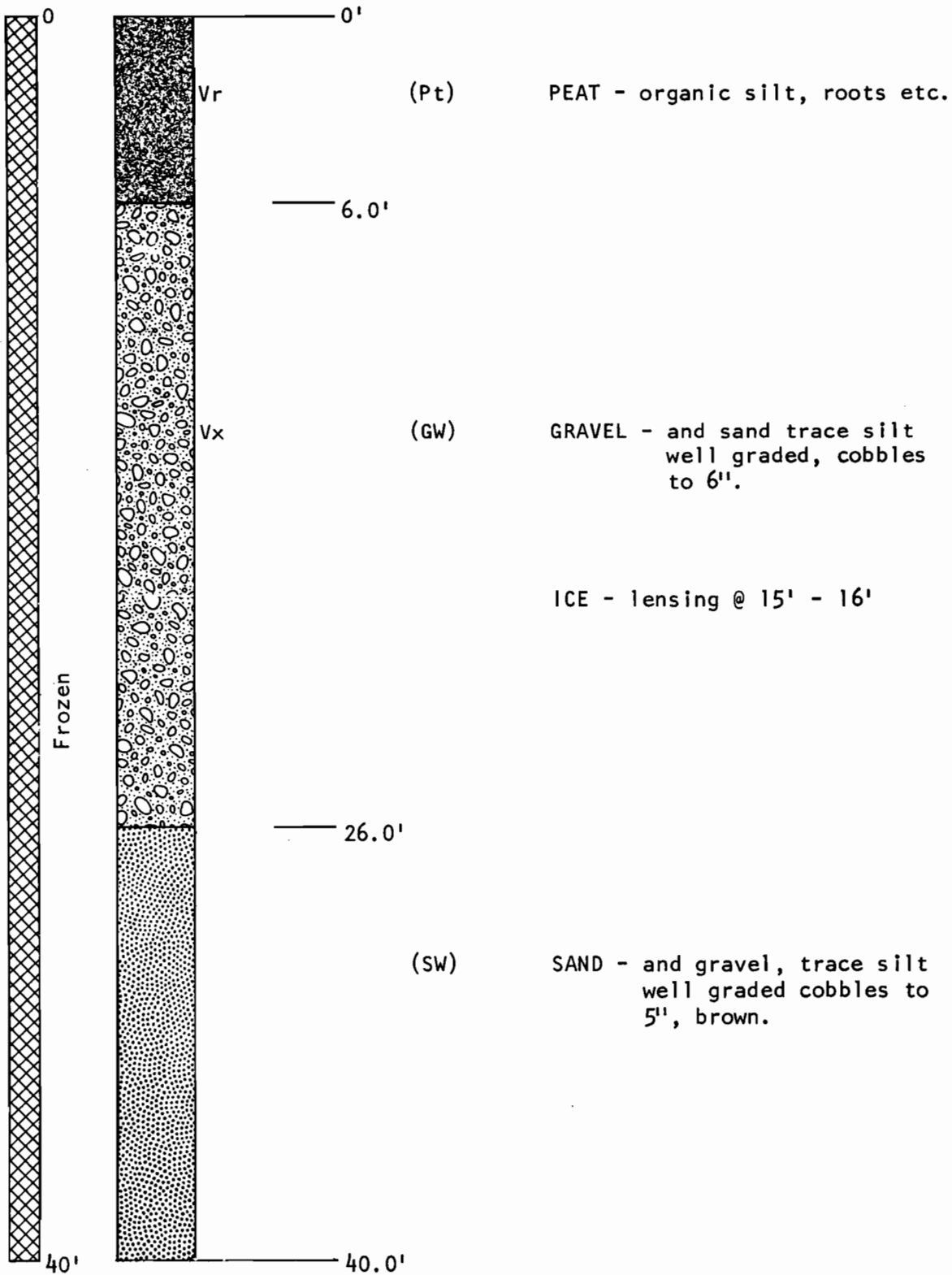
### PETROGRAPHIC ANALYSIS

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

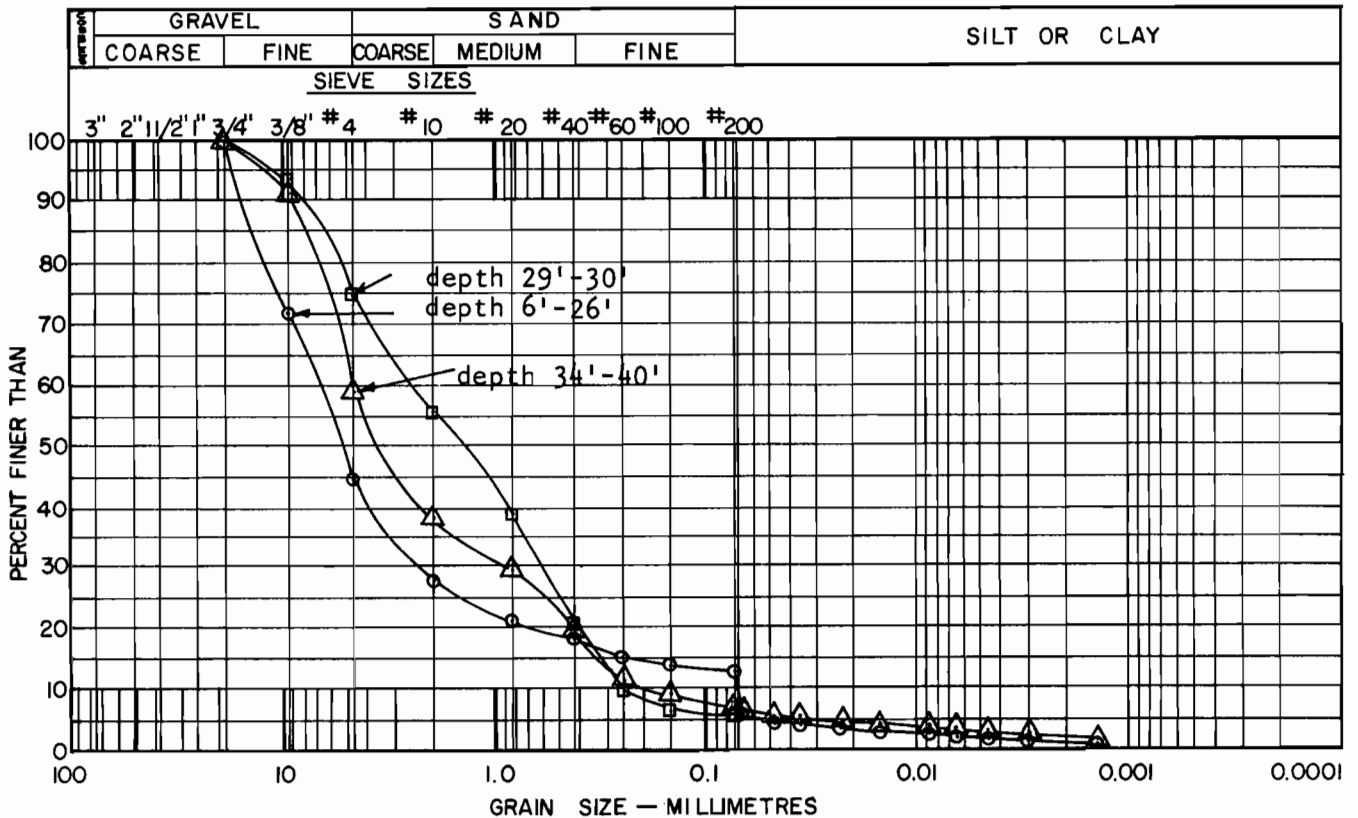




# LABORATORY TEST DATA

## TEST HOLE-SOURCE No. 650-2

### GRAIN SIZE DISTRIBUTION



### MOISTURE CONTENT

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

### ORGANIC CONTENT

\*Bag leaked

Color Test

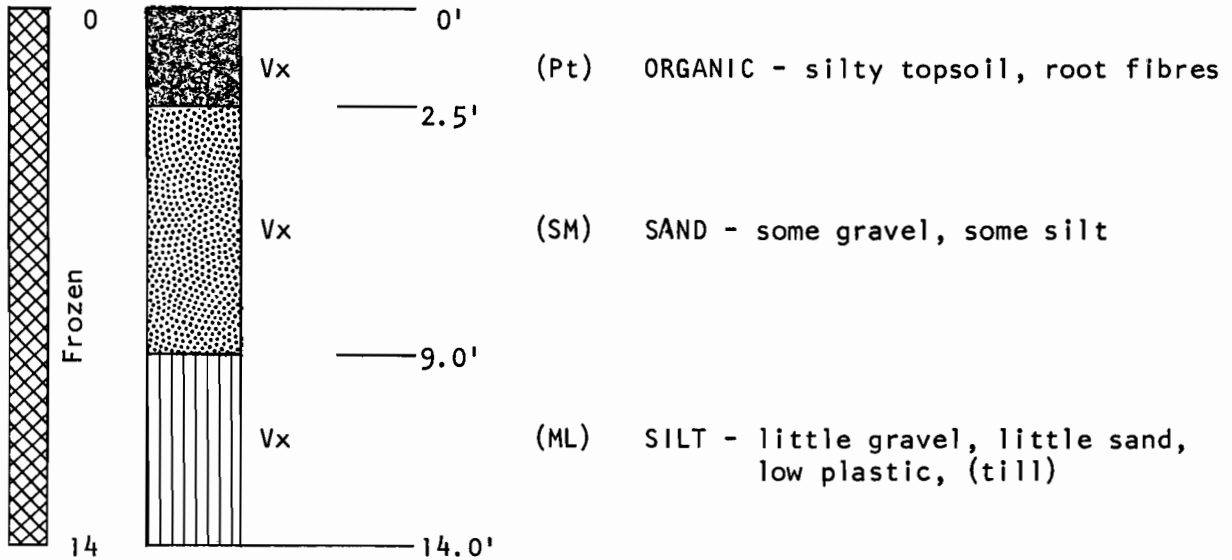
Sample 2 to 7 Depth 6'-26' - Rdg. 4 & 5

### PETROGRAPHIC ANALYSIS

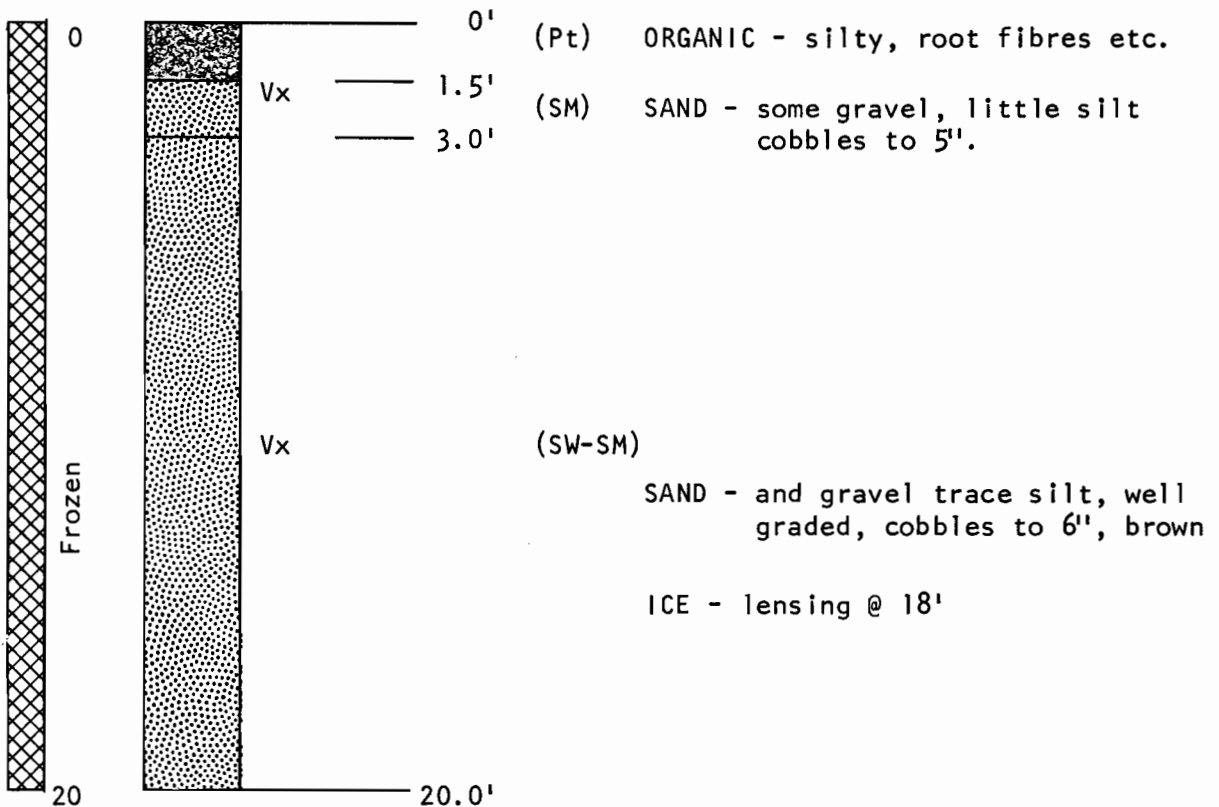
# TEST HOLE LOGS

SOURCE No. 650

650-3



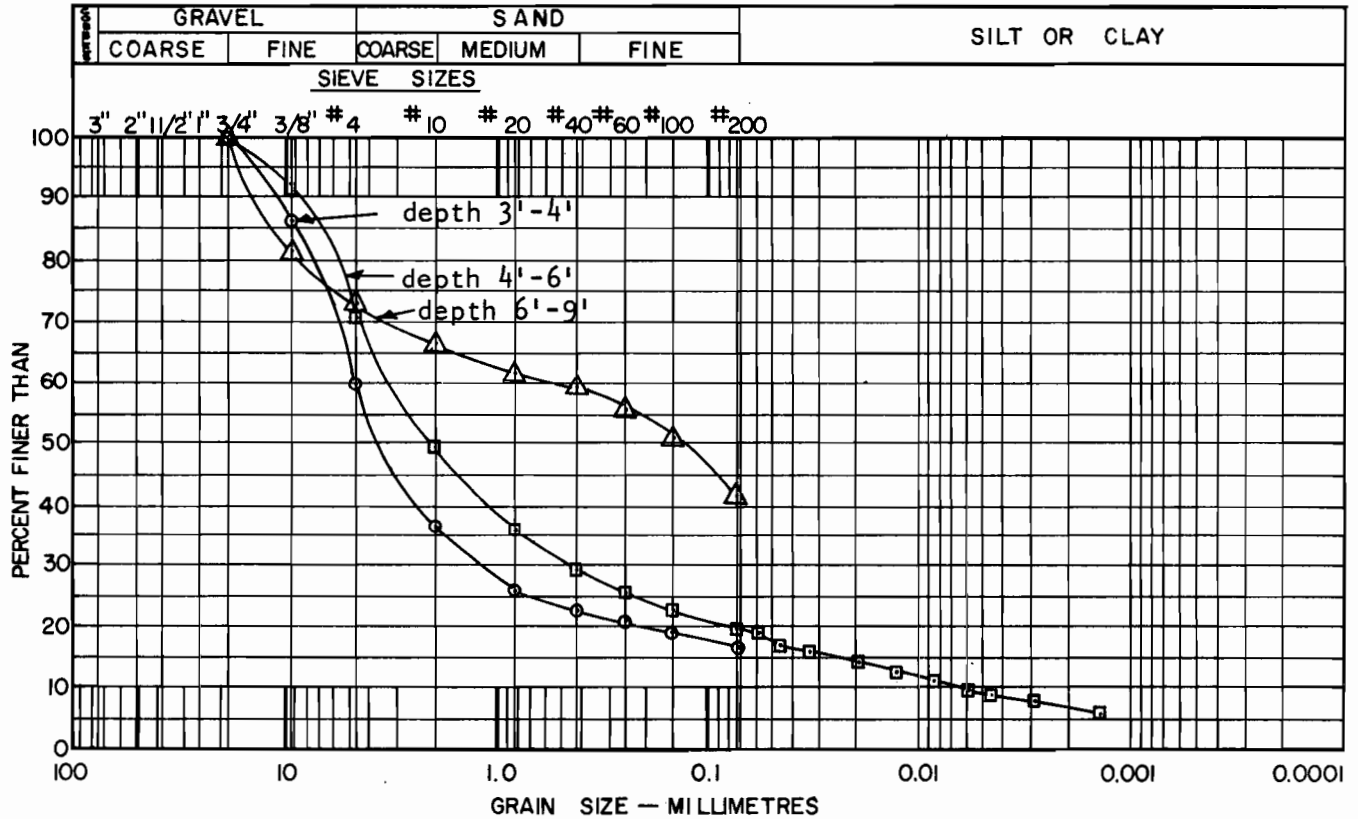
650-4



# LABORATORY TEST DATA

## TEST HOLE-SOURCE No. 650-3

### GRAIN SIZE DISTRIBUTION



### MOISTURE CONTENT

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

### ORGANIC CONTENT

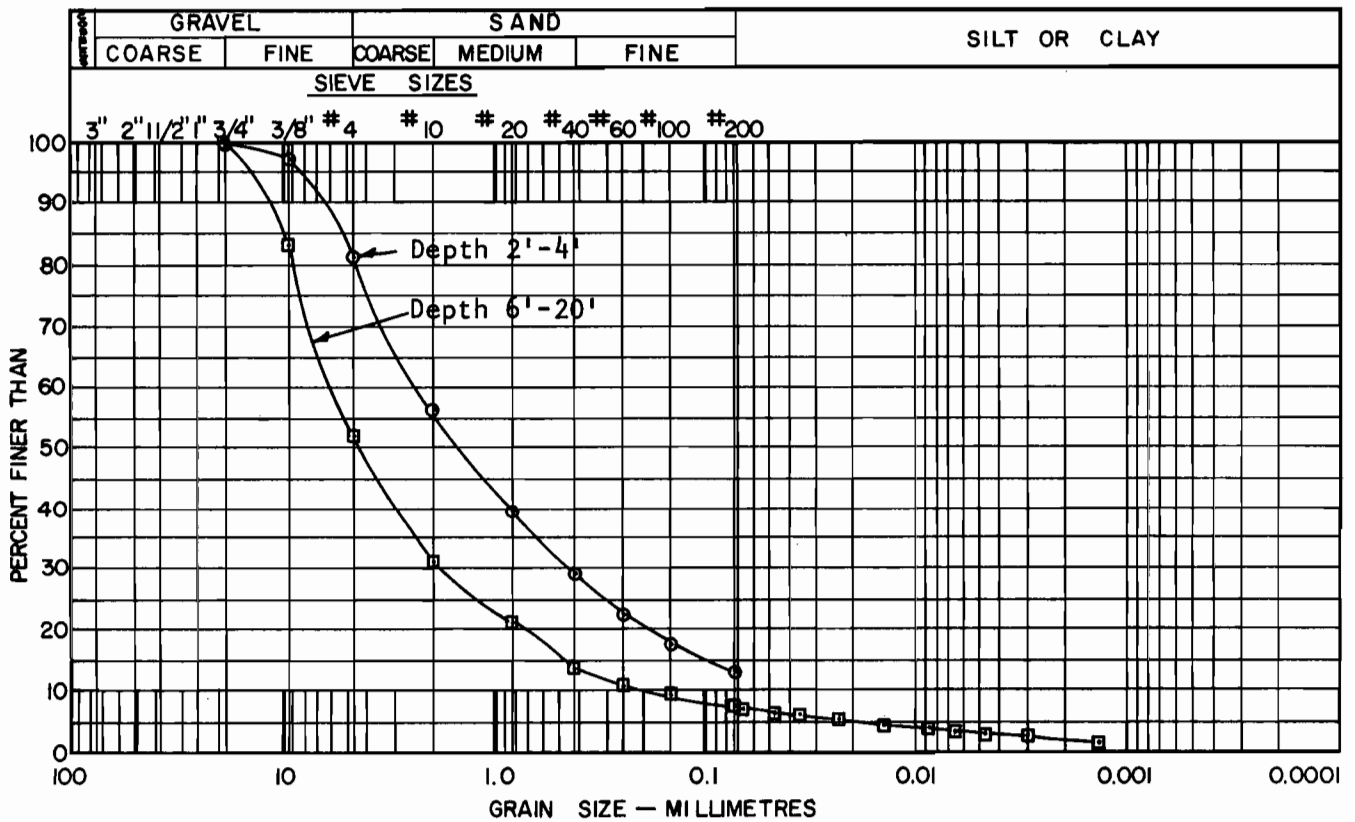
Color Test  
Sample 3 depth 4'-6' - Rdg 3 to 4

### 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

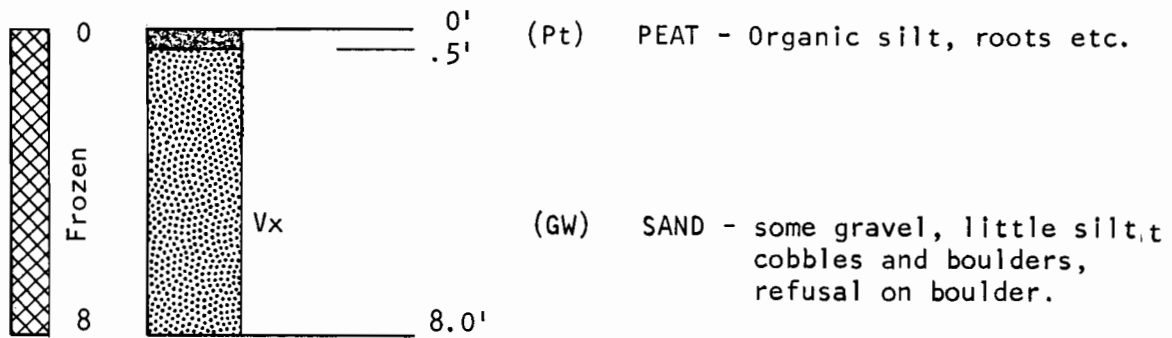
### PETROGRAPHIC ANALYSIS

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

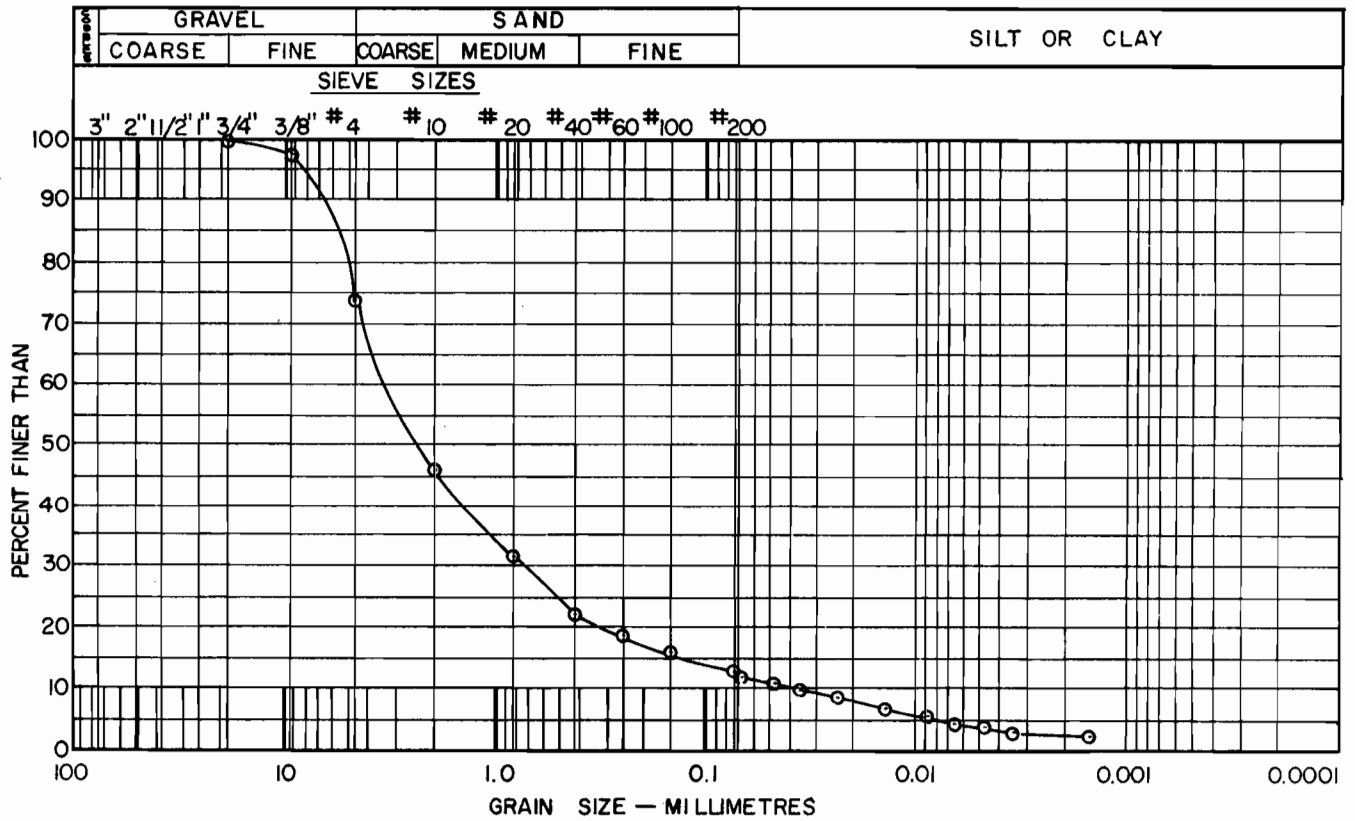
650-5



# 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

Color Test

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

### HARDNESS TEST

### PETROGRAPHIC ANALYSIS