GRANULAR MATERIALS INVENTORY

PARSONS LAKE
N.W.T.

OCTOBER 1974

GULF OIL CANADA LIMITED

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CIVIL & GEOTECHNICAL ENGINEERS



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November 13, 1974

OUR FILE NO. ALO447

Gulf Oil Canada Ltd., 707 - 7th Avenue S.W., CALGARY, Alberta.

Attention: Mr. A. Hochstein, P.Eng.

Dear Sirs:

Following this letter is the text of our report entitled "Parsons Lake Gravel Inventory".

A draft copy of the report was discussed in your office on October 25, 1974. Several minor revisions were made to the text regarding Sources 5 and 7, and the use of sand and silt materials for construction. Also, where possible, additional information on material types, moisture content, depth of overburden, etc. was included to achieve consistency in the description of the sources.

Our Company has enjoyed working on this project. We look forward to assisting you in your future geotechnical requirements. Should you have any questions, please contact us.

Yours very truly,
KLOHN LEONOFF CONSULTANTS LTD.

KRG:bl Encl.

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Appendix A

Symbols and Terms Used in This Report Supplementary Terms, Classification for Ice and Descriptive Soil Terms

Appendix B

Topographic Maps - Scale 1 inch = 2 miles Airphoto Mosaic - Potential Zone 1 Airphoto Mosaic - Potential Zone 2

SOURCES 1 to 11 INCLUSIVE

PARSONS LAKE GRAVEL INVENTORY

1. INTRODUCTION

1.1 Assignment

This report presents the results of a field and laboratory investigation and our assessment of potential gravel sources in the Parsons Lake Area, Northwest Territories, for Gulf Oil Canada Ltd.

The objectives of this assignment were two-fold.

- a) To assess the availability of materials in the Parsons-Eskimo Lakes area and to locate at least 1,500,000 cubic yards of usable gravel and sand materials.
- b) To advise on the suitability of the gravel and sand materials for use in the proposed gas field development.

Authorization for the project was given by Mr. A. Hochstein, P.Eng. through Purchase Order 65890, dated July 2nd, 1974.

1.2 Procedure

The investigation procedure entailed a study of existing geological data from the work of the Geological Survey of Canada and previous work conducted within the designated area by our Company. Airphoto interpretation was used to identify those landforms in which gravel and sand were most likely to be present prior to the field reconnaissance. A field reconnaissance was carried out July 9th to 13th, 1974 to ground check the potential sources and lay out a drilling program. During the reconnaissance, surface gravel exposures were noted and shallow test pits were dug to confirm the presence of gravel and sand materials.

The field reconnaissance identified four potential zones each consisting of several sources. See topo plan, Appendix B, which shows the location of the zones. Due to the extensive investigation required to determine material type and quality in these zones, a priority of drilling was set-up and a total of eleven sources in Zones 1 and 2 were drilled for this program during the period August 13th to 30th, 1974. Seven

of these sources are located in Zone 1 about six miles south of the Parsons 0-27 drill site along the terraces of a small stream which flows eastward towards the Eskimo Lakes. The remaining five sources are located in Zone 2 and were drilled in a large glaciofluvial plain located about three miles north and slightly east of the Parsons 0-27 drill site.

1.3 Data Presented

The information for the granular materials sources is presented in the following sections:

Section 2 contains conclusions and recommendations with respect to the quantity and quality of the gravel and sand materials, the use of the materials, development and restoration of the source areas.

Appendix A contains two sheets describing the symbols and terms used in the report, the classification system for granular soils and for ice in soils, as well as an example of the soil log which is presented for each test hole drilling during this program.

Appendix B contains a topographic map showing the location of the four potential zones. Airphoto mosaics prepared for potential Zones No. 1 and No. 2 which outline the limits of the individual sources are also attached.

Sections for each source are also attached. Each source is identified by a tab which shows Source ______, and includes a description of the source, material, volumes and brief recommendation regarding development of the source. Test hole logs and results of the sieve analyses are also included.

2. CONCLUSIONS AND RECOMMENDATIONS

2.1 Sources and Materials

Eleven sources were investigated within the Parsons-Eskimo Lakes

study area. Seven of these sources (1, 2, 3, 4, 7, 8, and 9) are located along fluvial terraces adjacent to a small stream flowing eastward into Eskimo Lakes. The four remaining sources (5, 6, 10, and 11) are located in a large glaciofluvial plain to the north of Parsons Lake. The locations of all sources are shown on airphoto mosaics No. 1 and 2 which are attached in Appendix B.

Sources 1, 2, 3, and 4 contain gravel and sand materials in sufficient quantities and are recommended for development in order of priority as listed. The minimum quantities of gravel and sand materials which can be removed from these sources have been estimated as follows:

Source 1 - 1,000,000 cubic yards

Source 2 - 250,000 cubic yards

Source 3 - 370,000 cubic yards

Source 4 - 200,000 cubic yards

1,820,000 cubic yards

These sources (1, 2, 3, and 4) contain interbedded gravel, sand, and silt materials. The thickness of the gravel beds is variable, ranging between a maximum of 60 feet down to a few feet. The sand and silt materials enclosed within the thick gravel strata are usually three or four feet or less in thickness, but in isolated areas can be up to ten feet thick. The base material below the gravel stratum is generally fine-grained silt and sand materials with variable ice contents. The size of the gravel ranges from cobbles down to the sand and silt sizes and are generally clean and well-graded although some gap-graded materials were noted. The ground is permanently frozen at shallow depths and some ground ice is present. This is usually associated with the organic overburden or within the sand and silt layers encountered at scattered depths within the sources. However, except in isolated cases, massive ground ice does not appear to be present in the gravel strata.

The remaining sources located in the river terraces (Sources 7, 8, and 9) are not recommended for development. The sources contain interbedded gravels, sands and silt materials, however the gravel layers are generally

less than 10 feet in thickness, and have limited lateral extent.

Layers of ground ice up to ten feet thick and high ice content silt sand materials were encountered between gravel layers in many of the test holes. The organic peat overlying the gravel or sand material can be up to 10 feet in thickness.

Sources 5, 6, 10, and 11 are located in the large glaciofluvial plain. Sources 5 and 6, are large kames and have been used for local projects in the past. There are wide variations in the materials which range between well-graded gravels to fine sands and silts. Massive ground ice is present in both sources. These sources can continue to be developed to provide materials for local projects. Sources 10 and 11, show wide variations between the test holes drilled. These sources are not recommended for development without further drilling investigations.

In Potential Zone 4 gravel and sand are exposed at different locations along the east facing slopes of the Caribou Hills. These exposures are considered to be pre-glacial Tertiary gravel of the same geological age as that exposed in the Caribou Hills along the Mackenzie River.

The major exposure closest to Parsons Lake was investigated for the Department of Indian Affairs and Northern Development in 1972 and 4 holes were drilled and sampled during this program. The material encountered in all test holes was sand and gravel to at least the 30 foot depth. The material is well-graded, of low moisture content with no visible ice observed during drilling.

To properly assess the volume of usable material in this source, additional investigation is necessary. Based on the test holes drilled in one area of the source, approximately 1,000,000 cubic yards could be removed. In the complete area, assuming a depth of removal of 20 feet, the volume of sand and gravel material is estimated to be in excess of 6,000,000 cubic yards.

2.2 Description and Use of Materials

The materials encountered during the field investigation have been shown on the test hole logs which are included in each source section attached to this report. The materials were classified in accordance with the

table entitled "Supplementary Terms Identifying the Composition of Granular Soils" which is enclosed in Appendix A. The principal material types: gravel, sand and silt, are described as follows.

2.2.1 Gravel

The gravel materials generally range in size up to about 6 inches in diameter and contain varying percentages of sand, silt and clay sizes. The gravel is permanently frozen with the contained ice filling most of the voids or occurring as ice lenses throughout the stratum. In clean, well-graded materials the ice content is generally low with moisture contents ranging up to 10%. In gap-graded materials (which have larger void spaces), or those materials with higher percentages of fine sand or silt, the ice content is higher and moisture contents generally range between 10 and 20%.

Frozen gravel, if possible, should be stockpiled, thawed and excess waters be allowed to drain before placing. If this procedure was followed and sufficient thicknesses of gravel were placed to prevent thawing of the permafrost, then the road, aistrip, or facility could be operated on a year-round basis, with minor maintenance. However, these procedures usually cannot be followed because of the volumes involved, time restraints and materials are usually hauled directly to the site of work during the winter months. The moisture content of the gravel gives an indication of the behaviour of the material after placing.

- a) For those gravels with moisture contents of 10% or less, when thawed there is little excess water and there is little or no reduction in the strength of the material. It would be expected that facilities constructed with this low moisture content material would function on a year-round basis with only minor maintenance.
- b) For those materials with higher moisture contents, when thawed the excess water will not drain quickly due to the higher silt and sand content and soft unstable conditions will result.

 Thus, facilities constructed of this material may be subject to a period of closure during drainage of the excess water.

Due to the variation in moisture content of the nature gravels, it will be impractical to select or separate the lower from the higher moisture content materials during excavation. The scheduling of the earthworks - roads, airstrips or plant sites - should be planned with the knowledge that at least one summer may be required for thawing, drying and consolidation of the placed materials.

2.2.2 Sand

The sand materials contain varying percentages of gravel, silt and clay sizes. The sand is permanently frozen, generally well-bonded and with some excess ice on particles. Thin ice lenses ranging up to ice with soil inclusions may also be present in the sand stratum. The moisture content ranges between 10 to 25% depending on the amount of ice present in the sand material.

The sand materials should not be placed when frozen. If so, on thawing and depending on the silt content, the sand could remain in a very soft or loose condition for one or two summer seasons. We consider that the sand materials must be stockpiled in windrows, thawed and allowed to drain before being used. After thawing and drying, the sand can be used as required in deeper fill sections instead of gravel. Generally, the sand should be placed between top and bottom layers of gravel in a cross-section where it is not in contact with water or subject to erosion by wind.

2.2.3 Silt

The silt materials contain varying percentages of fine sand or clay sizes. The silt materials are permanently frozen, well-bonded and have excess ice on particles. Thin ice lenses in the silt and massive ground ice are usually associated with the silt deposits present at depth below granular materials. The moisture content of the silt by itself ranges between 20 and 30%, but there are many exceptions where the moisture content is much higher because of the ice content.

If the silts are placed when frozen, very soft and unstable conditions, as well as excessive settlements will develop during and after the period of thawing. Depending on the drainage characteristics of the silt material, the soft conditions and settlements could continue for a long period of time -- say 10 years. In our opinion, the use of silt materials should not be considered on this project.

2.3 Development and Restoration

Our general comments regarding the development of the sources are as follows:

- a) The organic silt and peat overburden must be removed from that part of the source being developed and hauled to a waste area adjacent to the source. The location of this waste area should be away from any drainage courses. Meltwater caused by the thawing of these frozen waste piles and erosion may cause siltation in the drainage courses in the area and must be avoided.
- b) All of the sources investigated are adjacent to streams or lakes. Considerable meltwater may be generated by the excavations in the pit as ground ice or high ice content zones are uncovered. If so, a berm or dyke and possible retention ponds will be required between the pit area and the stream or lake. These constructive works will ensure that lakes or streams are not polluted during development of the source.
- c) It is emphasized that the sources recommended for development are small and variable in gradation and ice content as compared to the large esker complex near YaYa Lake on Richards Island. Removal of the gravel and sand material must be carefully planned and controlled in order that the resource is efficiently utilized. We recommend that the development of any source be preceded by a review of the available test hole data. If the test hole data shows that high ice content zones of silt and sand are present deep in the deposit and overlie usable gravel, then the high ice content materials should be removed to expose the gravel.
- d) The equipment required for development of the sources is the usual assembly of bulldozers with ripper attachments, front-end

loaders, and trucks. Ripping of the gravel and sand will be required except when close to the existing ground surface.

e) After depletion of the source, all side slopes and the bottom of the pit should be graded to a smooth contour. All organic materials removed in the stripping should be placed in the pit area to promote future vegetative growth.

SYMBOLS AND TERMS USED IN THE REPORT

SYMBOLS

ORGANIC

GRAVEL

SAND

SILT

CLAY











The symbols may be combined to denote various soil combinations.

CLASSIFICATION BY PARTICLE SIZE

BOULDERS- larger than 8 inches. GRAVEL-#4 sieve to 3 in. SILT-0.002 mm to #200 sieve. COBBLES-3 in. to 8 in. SAND-#200 sieve to # 4 sieve. CLAY-finer than 0.002 mm.

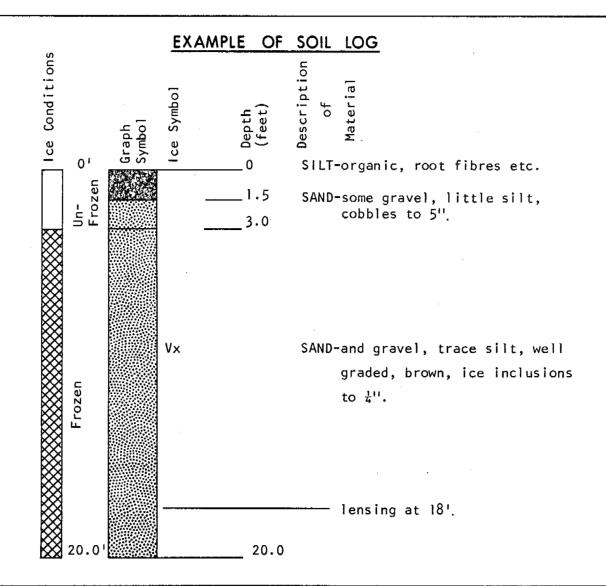
NOTATIONS

Prefix Indicating Source Number. -Number Indicating No. of Test Hole.

Test Hole Location.



Indicates direction of photograph & field of view.



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

CLA	ASSIFICATION	ON 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	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.

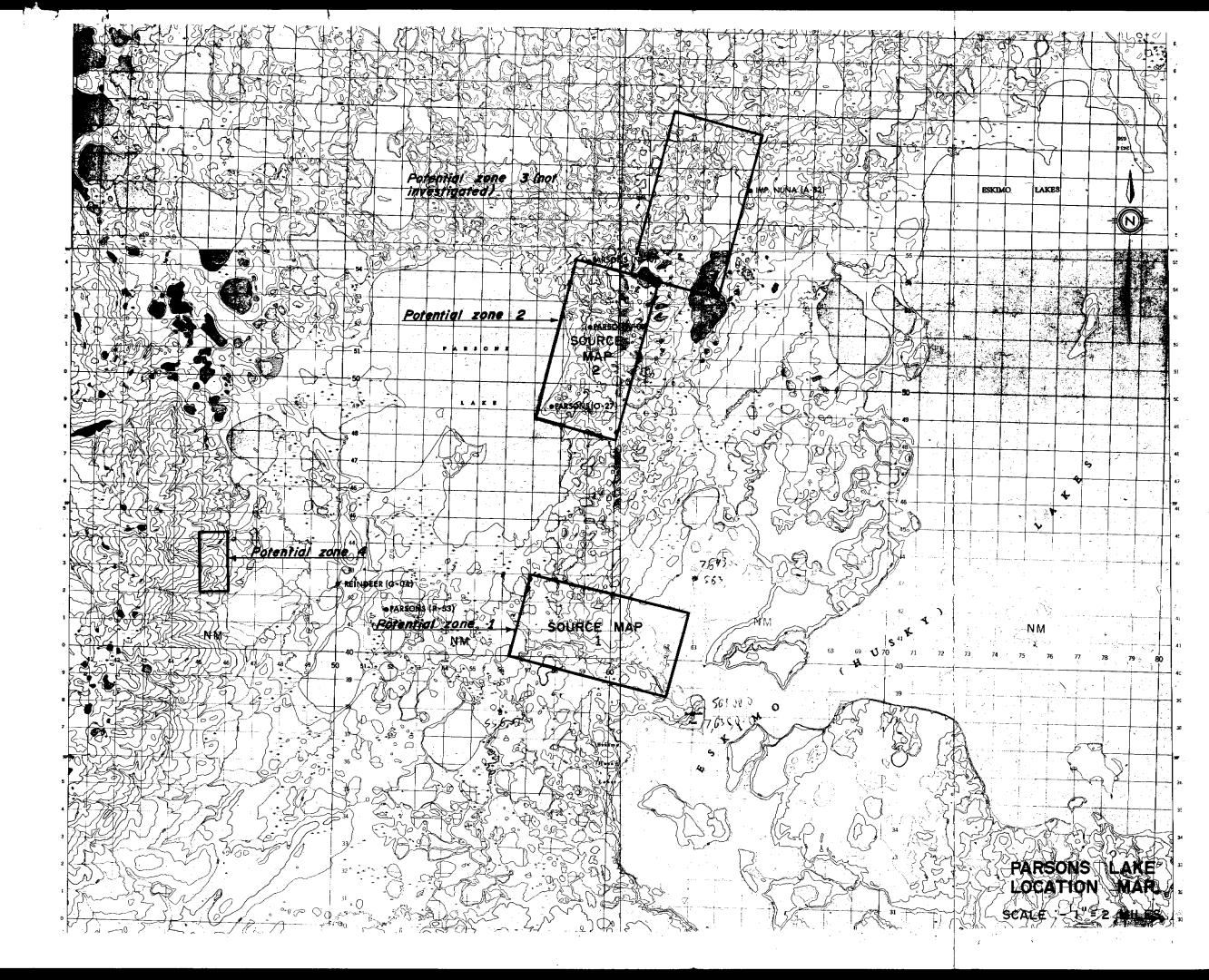
Fine Aggregate . Sand passing $\frac{1}{4}$ inch screen.

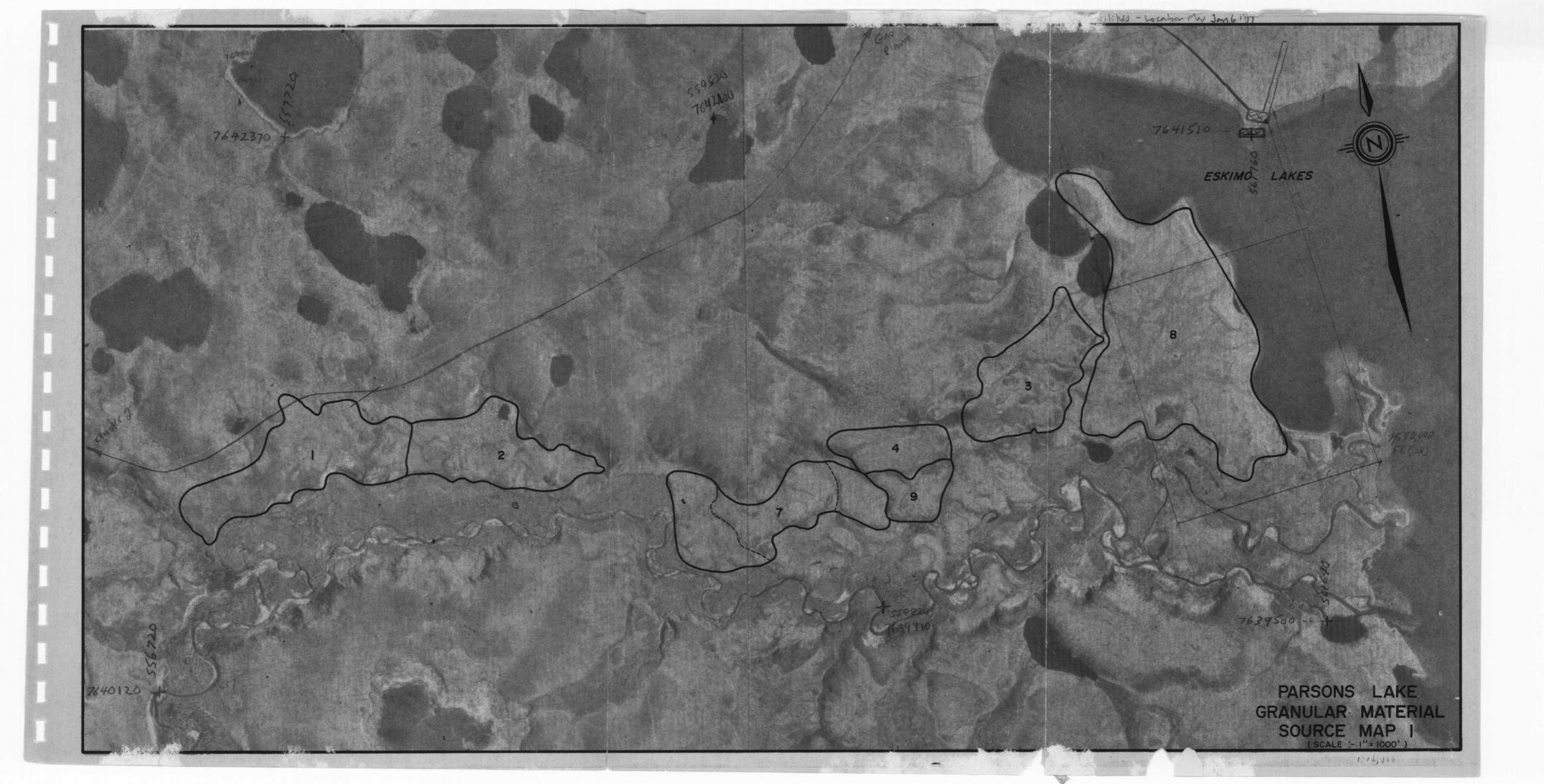
Interbedded composed of alternate layers of different soil or rock types.

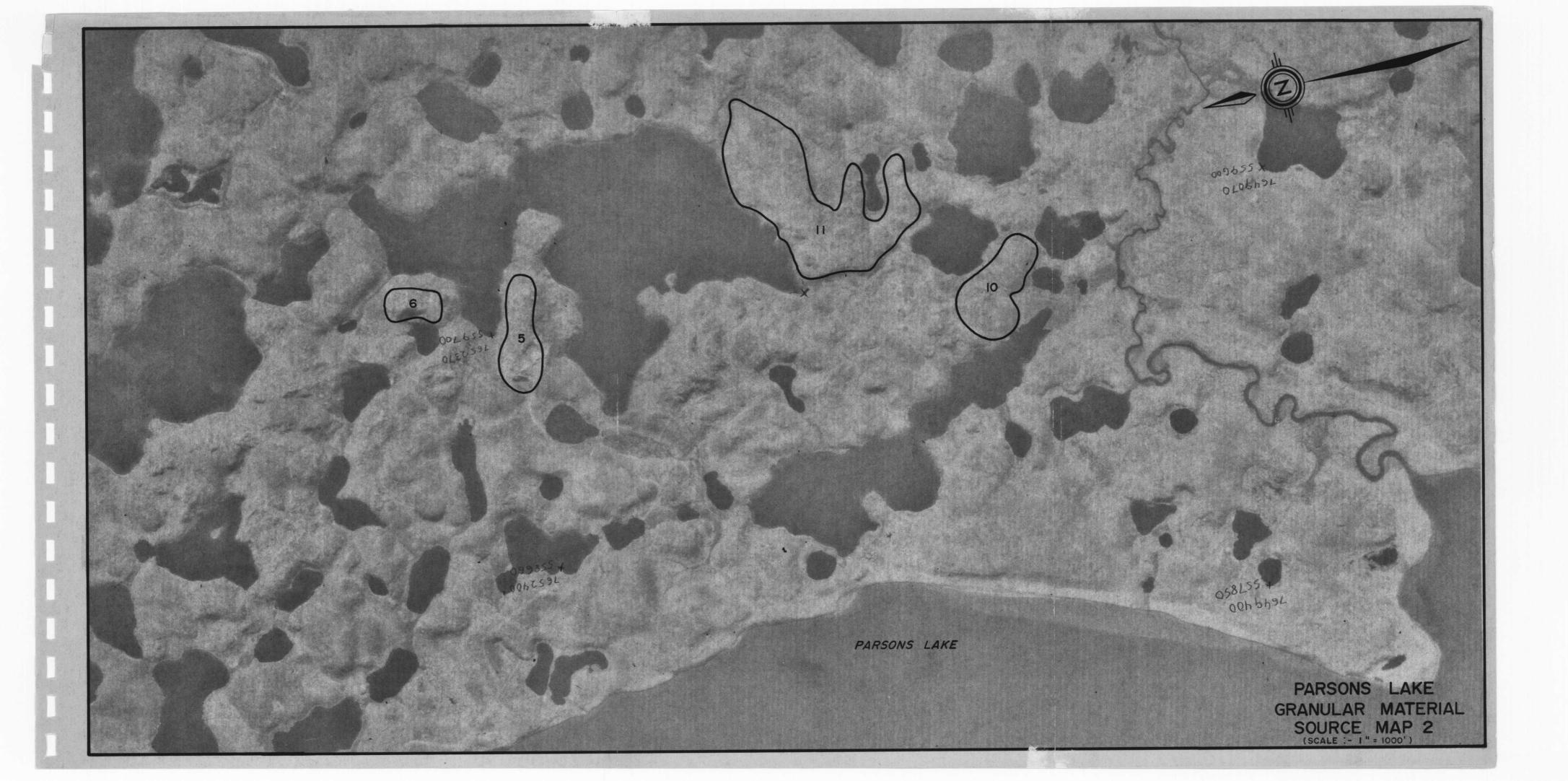
Calcareous containing appreciable quantities of calcium carbonate.

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.







PARSONS LAKE SOURCE No. 1

LANDFORM AND LOCATION: River terrace located 3 miles southeast of

Parsons Lake and 5 miles west of Eskimo Lakes.

MATERIAL: GRAVEL - and sand, trace silt, trace cobbles,

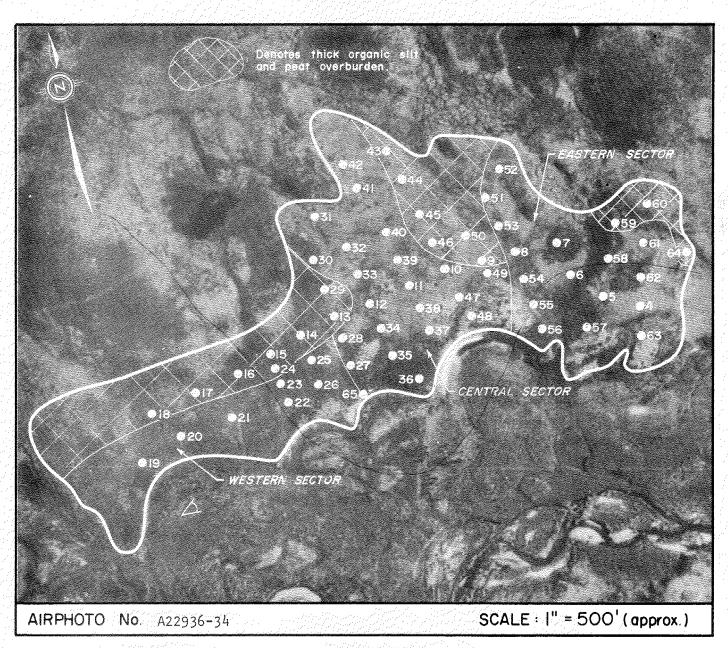
variable.

VOLUME: 1,000,000 cubic yards.

CONCLUSION: Largest source of granular material proven up

during the investigation. Suitable for large scale development. Materials and ice conditions

vary within wide limits.



SOURCE DESCRIPTION

The source is a fluvial river terrace located 3 miles south of Parsons Lake on the north side of a creek which flows easterly into the Eskimo Lakes, north of Bonnieville Point.

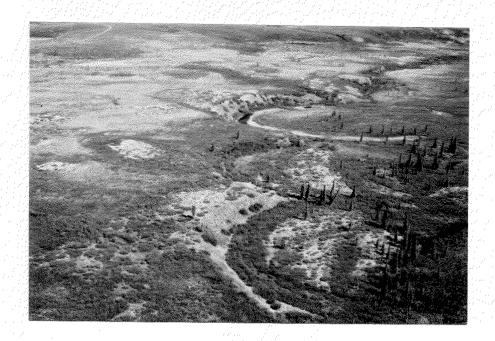


Photo - Source 1 - Looking East

The terrace is roughly rectangular, about 3000 feet long and from 500 to 1000 feet wide. The terrace is bounded on the south and west by riverbanks; on the north by hills and low-lying ice-rich terrain, and on the east by a low, in-active flood plain of a small creek.

The source area slopes gently toward the southwest. In the east and central part of the area the riverbanks are sparsely vegetated and slope at about 1.5:1 (horizontal to vertical). The height of the riverbanks is variable from about 35 feet in the east to about 20 feet in the central part of the area. In the west, the 10 foot high riverbanks are heavily vegetated with scrub brush and slope at about 2:1.

Two small drainage gullies cross the eastern and western portions of the terrace. The area is fairly well drained, although two small lakes surrounded by ice wedge polygonal ground occur immediately to the north. Ice wedge polygons are also apparent in the western part of the source.

MATERIALS AND QUANTITIES

A total of 64 holes were drilled and 2 bank exposures logged in the source area. The subsoils in the source vary within wide limits. This was expected since the materials in this fluvial terrace were subject to seasonal variations during deposition causing stratification and interbedding of the coarse gravels, sands and silt materials. Some of the fine sand and silt materials are slightly laminated.

For ease of discussion, the complete source area has been divided into 3 sectors - eastern, central and western. These are discussed below:

a) Eastern Sector

The eastern sector of the source is covered with an organic silt topstratum ranging between 0.5 feet to 7 feet in thickness and averaging
about 4 feet. The organic topstratum overlies gravel which varies in
thickness from 9 feet in Test Hole 55 to about 57 feet in Test Hole 58
and is estimated to average about 20 feet. The moisture content in the
gravel stratum is generally low and varies from 4.1 and 8.0%, however,
exceptions were noted in the ice-rich layers. The gravel is fairly well
to poorly graded, with some sand, a trace of silt, and a trace of clay.
The ice content of the gravel, which occurs as ice inclusions and lenses,
is estimated to range from about 5% to 10% by volume. The gravel stratum
also contains layers of ice-rich silt and fine sand which ranges in thickness between 1 and 5 feet. The lateral extent of these ice-rich zones is
extremely variable.

The gravel is usually underlain by dark grey silt with some clay. The moisture content varies from 7.7% to 26.9%, averaging about 20%. Ice in this material is usually non-visible and well bonded.

The minimum volume of gravel material which can be removed from this part

of the source has been calculated between 450,000 and 550,000 cubic yards. This is based on a recoverable depth of 16 to 20 feet. The overburden which must be removed before the granular materials can be developed, has been calculated at about 100,000 cubic yards and is based on an average thickness of 4 feet.

b) Central Sector

The central sector of the source is covered with an organic silt and peat material which varies in thickness between 0.5 and 9 feet. The maximum depth of the organic silt (9 feet in Test Hole 37) occurs in an isolated area and the average depth over the complete area is estimated to be about 3 feet. The ice content in the organic silt and peat material is high and ice lenses 1 to 3 feet in thickness were noted during the drilling.

The gravel materials underlying the organic silt topstratum vary in thickness between 4 and 33 feet and average about 15 feet. The gravel materials are well to poorly graded, with some sand and a trace of silt and clay. The moisture content of the gravel is generally low, ranging between 2.0 and 9.1% with an average of about 6%. The ice content in the gravel occurs as ice inclusions or isolated lenses and is estimated to range between 5 and 15% of the volume.

The gravel is usually underlain by dark grey sand or silt materials. The moisture content of these materials ranges between 9 and 28%. Ice in this material is generally non-visible and well bonded.

The minimum volume of gravel material which can be removed from this sector has been calculated between 400,000 and 450,000 cubic yards. This is based on a recoverable depth of 13 to 16 feet. The organic silt and peat overburden which must be removed before the granular materials can be developed have been calculated at about 90,000 cubic yards and is based on an average thickness of 3.5 feet.

c) Western Sector

The western part of the source area is the smallest of the three sectors and parallels the former riverbank. The organic silt and peat materials are usually between 0 and 3 feet in thickness within 300 feet of the bank,

but increase in thickness towards the northern boundary. Test Holes 14 to 18 inclusive were drilled in this northern part of the sector where some polygonal ground is present. The organic silt and peat topstratum contain many thick ice lenses and is between 5.5 and 13 feet in thickness.

The underlying gravel materials are fairly well-graded, with some sand and a trace of silt and clay. The ice content of the material, which occurs as ice inclusions and lenses is estimated to be less than 10% by volume. The moisture content of the gravel is quite low and ranges between 3.0 and 6.0%. Several silt and sand lenses were encountered in the test holes at depth in this sector. These range in thickness between 3 and 6 feet, contain ice lenses and moisture contents were noted up to 25%.

The gravel is underlain by sand or silt materials with moisture contents between 15 and 25%. Ice in this material is generally non-visible and well-bonded.

The minimum volume of gravel material which can be removed from this sector has been calculated between 150,000 and 250,000 cubic yards. This is based on a recoverable depth of 11 to 18 feet depending on the lateral extent and thickness of the high ice content silt layers at depth. The organic silt and peat overburden which must be removed before the granular materials can be developed have been calculated at about 30,000 cubic yards and is based on an average thickness of 2 feet.

CONCLUSIONS

This is the largest source of gravel and sand which was investigated during this drilling program. The source is recommended for development on a large scale to provide good quality fill for construction of roadways, air strips or for general site work. With processing, this source can provide coarse and fine aggregates suitable for use in concrete.

Prior to development, the organic silt and peat overburden must be removed and hauled to a waste area adjacent to the source. The location of this

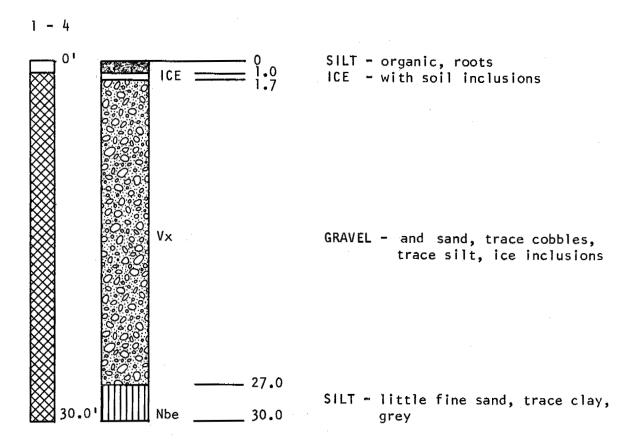
waste area should be to the north of the source and away from any drainage courses. Thawing of these frozen waste piles may cause siltation of the drainage courses in the area and must be avoided.

Development should proceed inland from the riverbank from east to west across the source. A berm or dyke, and likely retaining ponds, will be required on the inactive flood plain between the stream and the southern boundary of the source. These constructions will stop drainage and meltwater from entering the stream. Particular care in the operation is required to avoid siltation of the stream since it flows directly into the Eskimo Lakes.

Operation of the pit will likely proceed during the winter, although the source is large enough to sustain operations on a longer term. Stock-piling of the material may be considered to allow thawing and drainage before placing in the field. If so, stockpiling should be in the form of large, wide, windrows which will provide maximum surface area for thawing and drainage of the frozen material.

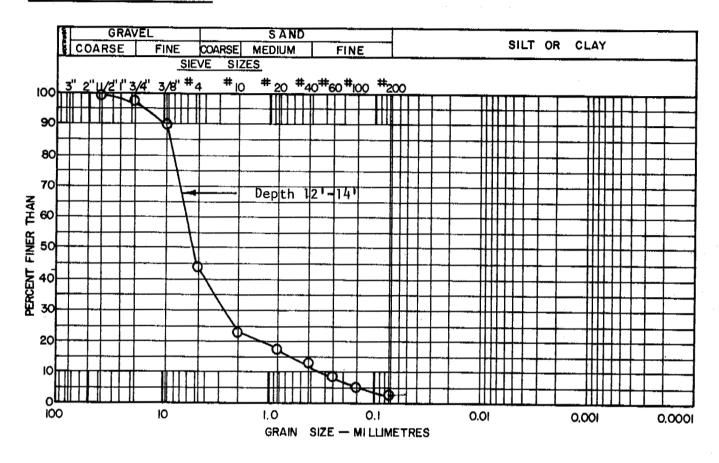
The area exposed for development at any time should be kept at a minimum in order to prevent thermal erosion at the bottom and sides of the pit. The side slopes should be cut to about a $1\frac{1}{2}$:1 slope (horizontal to vertical). After the gravel materials have been removed, the pit should be graded and covered with the organic silt and peat removed during the stripping operation.

TEST HOLE LOGS SOURCE No. 1



LABORATORY TEST DATA TEST HOLE-SOURCE No. 1 - 4

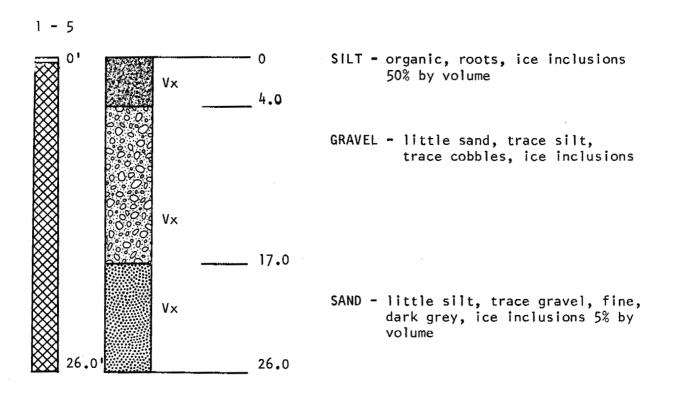
GRAIN SIZE DISTRIBUTION



MOISTURE CONTENT

Depth 24'-26' 7.7%

TEST HOLE LOGS SOURCE No. 1



Moisture Content

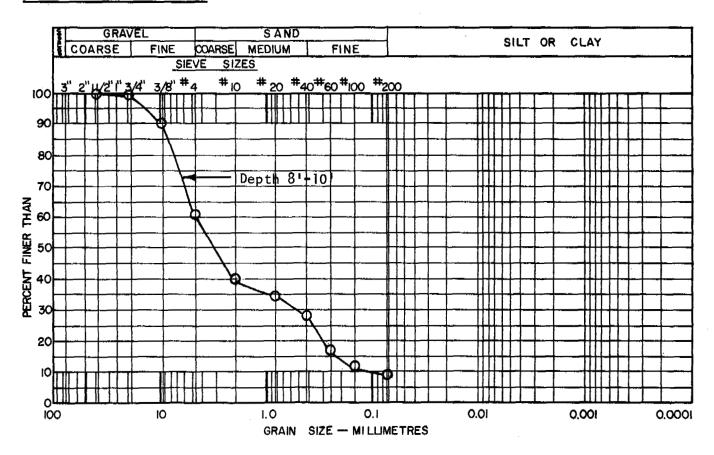
Depth 6'-8' 9.3% Depth 10'-12' 5.8% Depth 22'-26' 17.6%

1 - 6 0 1 0 SILT - organic, roots, some ice inclusions ٧x - 6.5 SAND - some gravel, trace silt, trace cobbles, coarse ٧x - 16.0 SILT - some sand, trace clay, ice inclusions ٧x - 18.0 10% by volume SAND - little silt, fine, stratified, ice inclusions 15% by volume

- 26.0

LABORATORY TEST DATA TEST HOLE-SOURCE No. 1 - 6

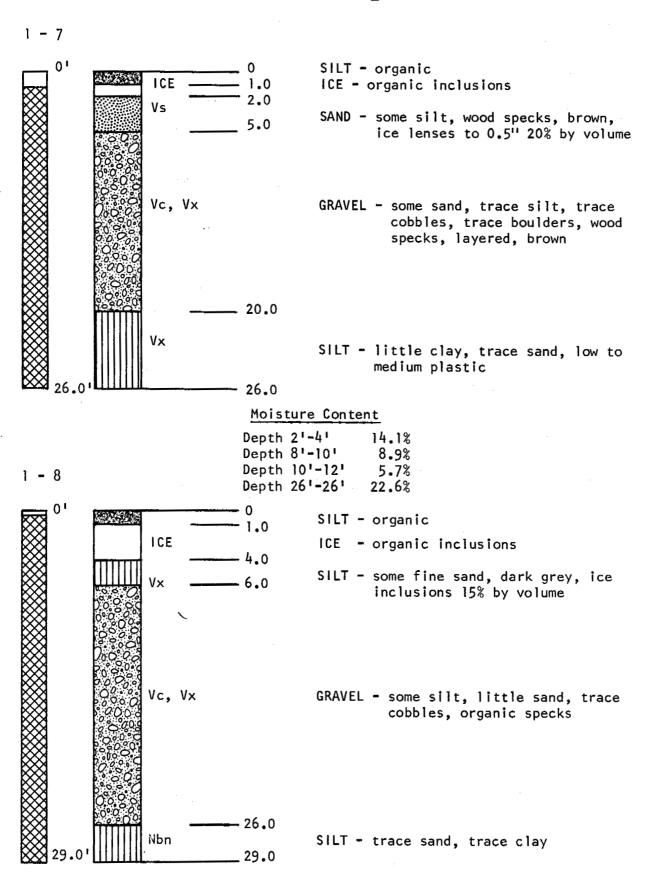
GRAIN SIZE DISTRIBUTION



MOISTURE CONTENT

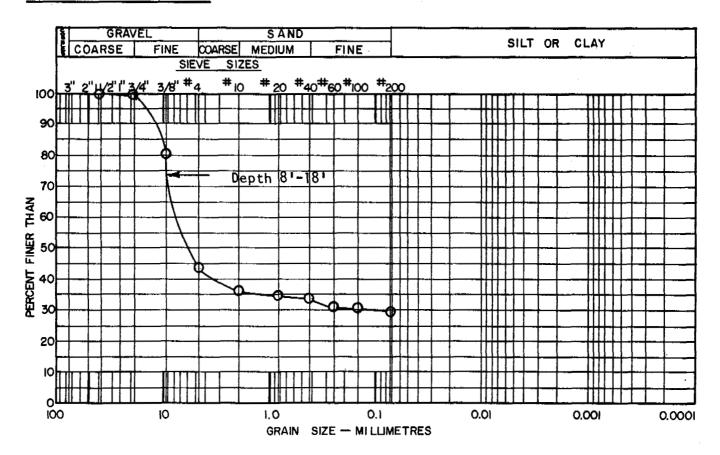
Depth 8'-10' 10.6% Depth 22'-26' 20.3%

TEST HOLE LOGS SOURCE No. 1



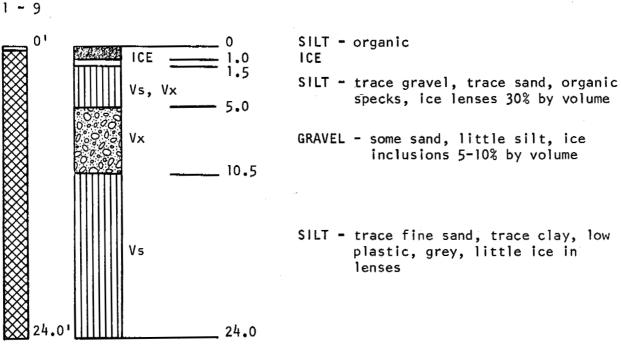
LABORATORY TEST DATA TEST HOLE-SOURCE No. 1 - 8

GRAIN SIZE DISTRIBUTION



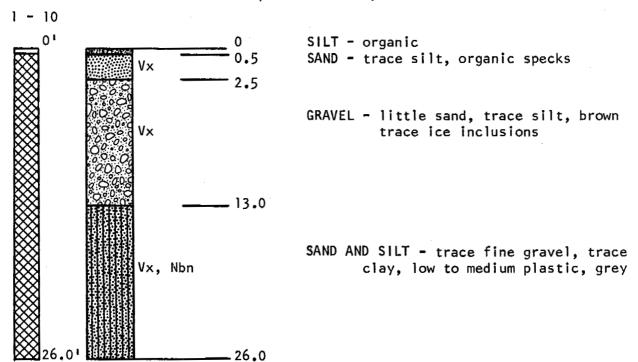
MOISTURE CONTENT

TEST HOLE LOGS SOURCE No. 1



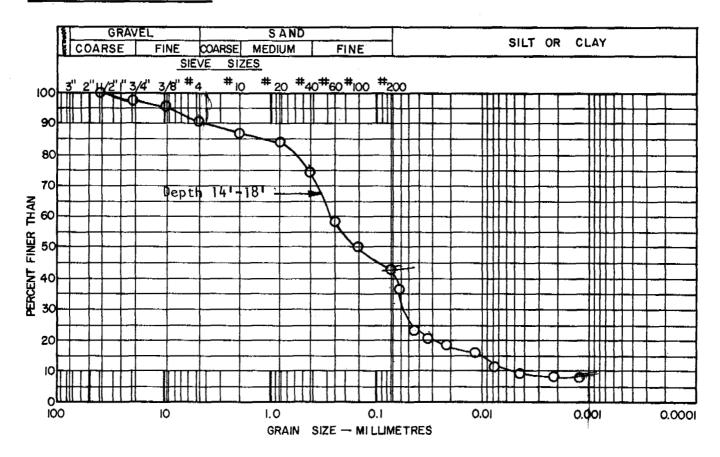
Moisture Content

Depth 10'-12' 6.6% Depth 12'-14' 29.1%



LABORATORY TEST DATA TEST HOLE-SOURCE No. 1 - 10

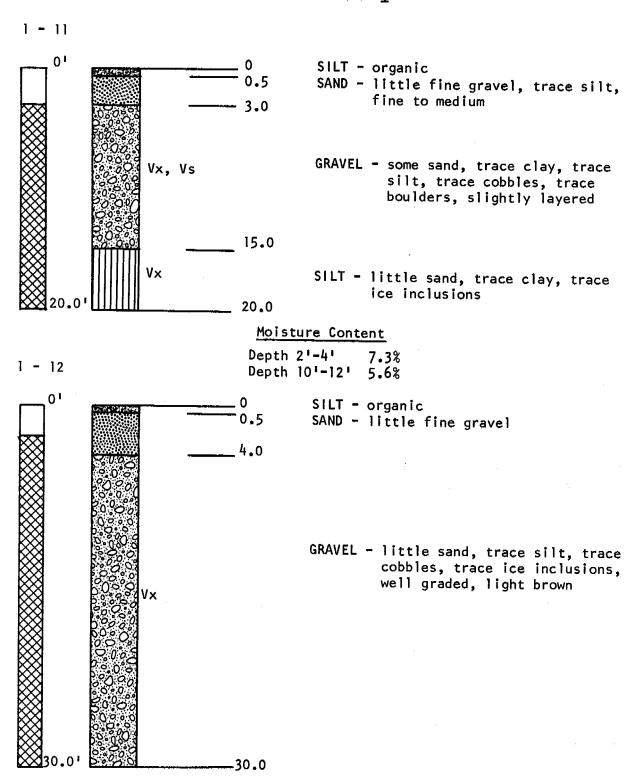
GRAIN SIZE DISTRIBUTION



MOISTURE CONTENT

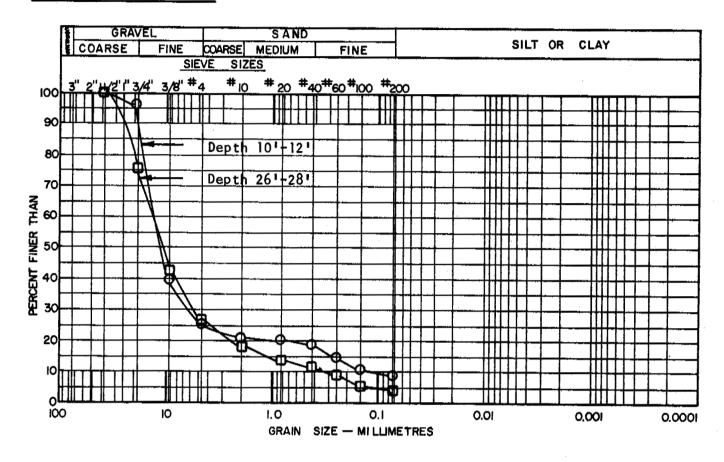
Depth 8'-10' 7.8% Depth 14'-18' 14.2%

TEST HOLE LOGS SOURCE No. 1



LABORATORY TEST DATA TEST HOLE-SOURCE No. 1 - 12

GRAIN SIZE DISTRIBUTION



MOISTURE CONTENT

Depth	61-81	5.0%
Depth	10'-12'	5.2%
Depth	16'-18'	5.6%
Depth	26'-28'	4.7%

TEST HOLE LOGS SOURCE No. 1

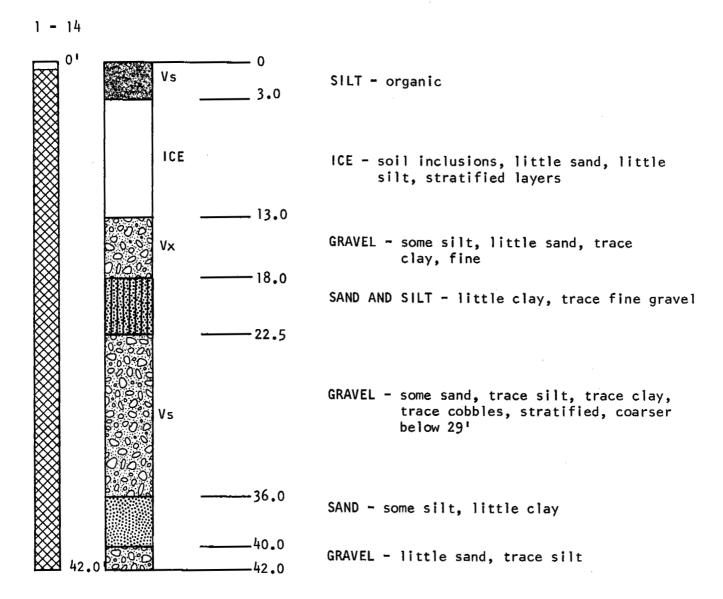
1 -	13
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,)'		OUT.
<u> </u>	70.4	0	SILT - organic
		2.0 ICE	ICE - with soil inclusions
	50.05 50.05	ICE 5.5 7.0 8.0	GRAVEL - little sand, little silt, brown ICE
		Vx, Vs	GRAVEL - some sand, trace to little silt, trace cobbles
		15.5 Vx 19.0	SILT - little fine sand, trace clay
\bowtie		18.0	SAND - trace fine gravel, trace silt
		Vx = 20.0 Vx = 21.0	SILT - little fine sand, trace clay, laminated
		Vs	GRAVEL - some sand, trace silt, trace clay, trace cobbles, stratified, coarser below 26'
	00000000000000000000000000000000000000	39.0	SAND - little silt, trace clay, trace
₩ <u>4</u> 4	١٠٥١	Nbe 44.0	fine gravel

Moisture Content

Denth	8-10'	12.0%
Denth	14'-16'	8.7%
Depth	18'-20'	17.9%
	241-261	8.3%
	26'-28'	6.6%
	40'-44'	14.0%
DEDLII	40 -44	14.06

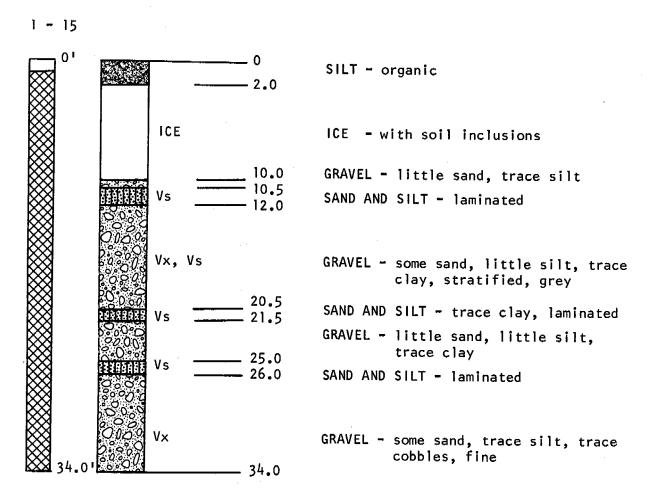
TEST HOLE LOGS SOURCE No. 1



Moisture Content

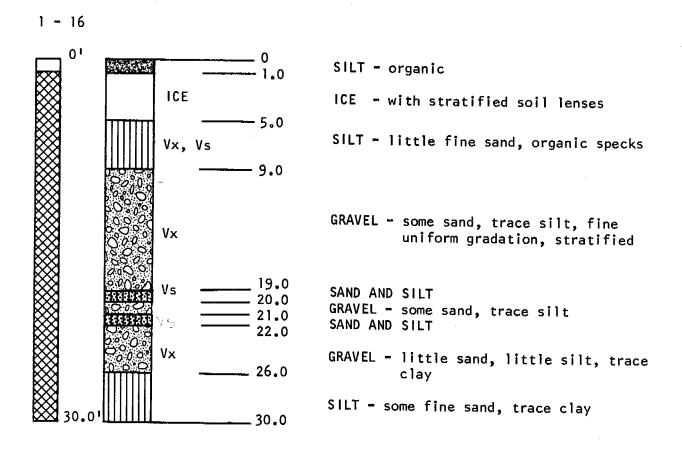
Depth	12'-14'	11.3%
Depth	20'-22'	16.0%
Depth	241-261	19.2%
Depth	40 ' - 42 '	8.7%

TEST HOLE LOGS SOURCE No. 1



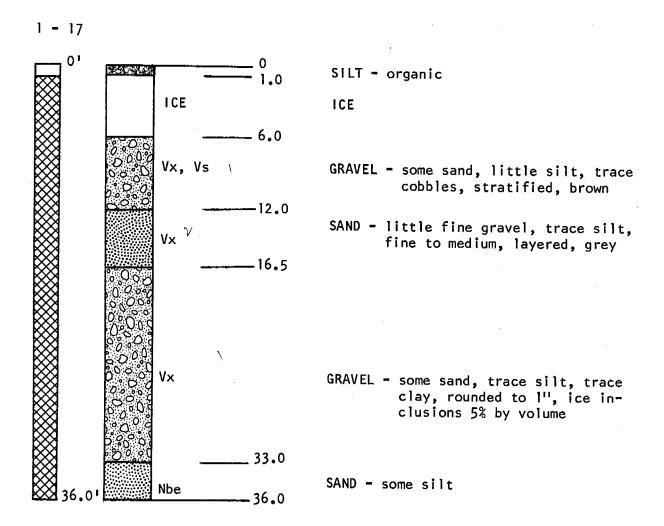
Moisture Content

Depth 10'-10.5' 6.4% Depth 26'-28' 5.5% Depth 32'-34' 5.5%



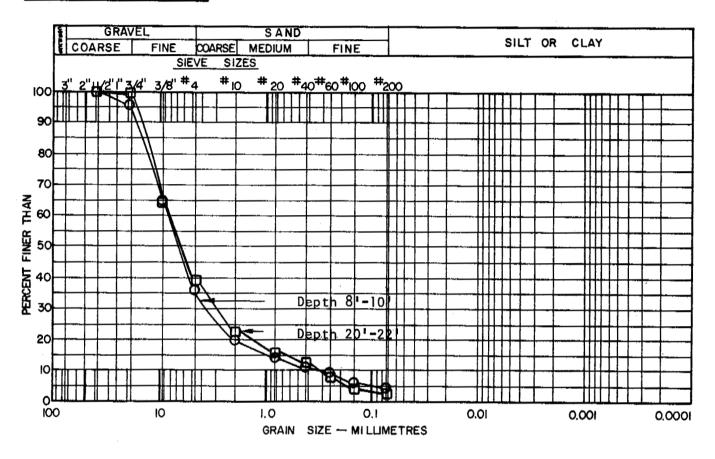
Moisture Content

Depth 10'-12' 9.8% Depth 16'-18' 7.9%



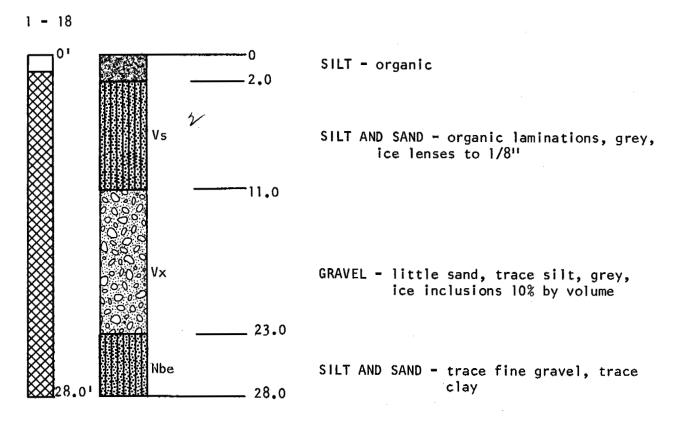
LABORATORY TEST DATA TEST HOLE-SOURCE No. 1 - 17

GRAIN SIZE DISTRIBUTION



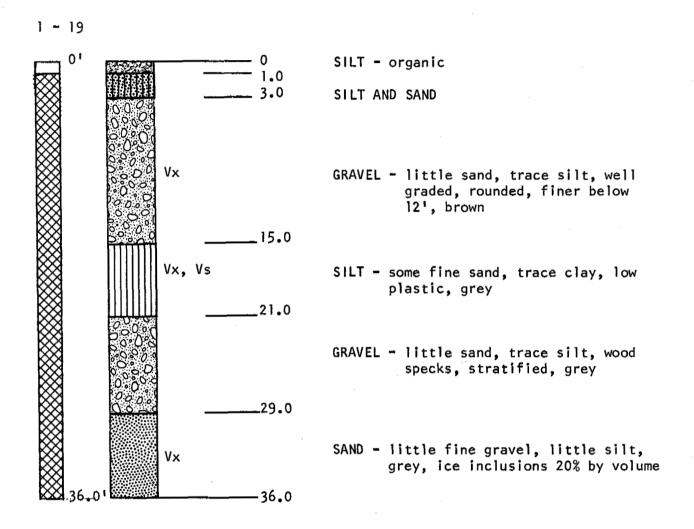
MOISTURE CONTENT

Depth 12'-14' 20.7% Depth 14'-16' 20.0%



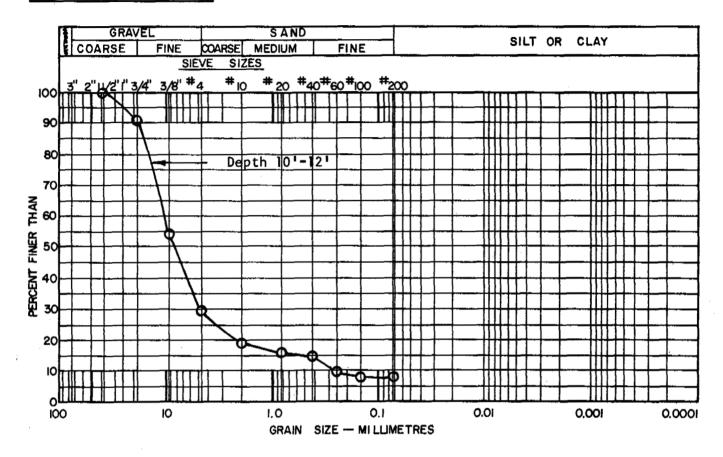
Moisture Content

Depth	41	29.8%
Depth	8'-10'	40.9%
Depth	16'-18'	5.1%
Depth	24'-28'	16.2%



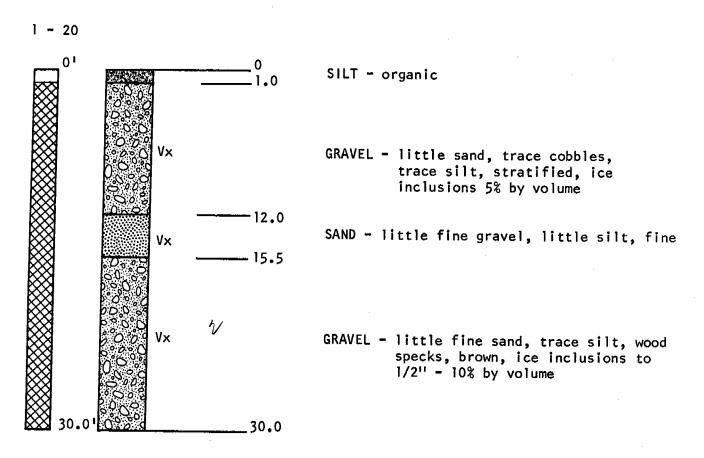
LABORATORY TEST DATA TEST HOLE-SOURCE No. 1 - 19

GRAIN SIZE DISTRIBUTION



MOISTURE CONTENT

Depth	2.51-41	3.4%
	101-121	4.9%
	161-181	22.8%
Depth	291-301	11.8%
Depth	35'-36'	14.9%

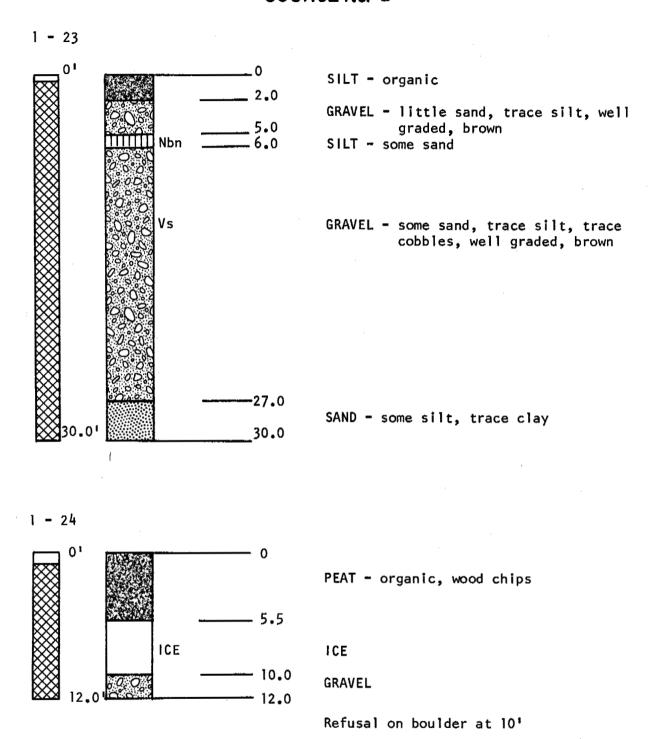


Moisture Content

Depth	21-41	4.6%
Depth	12'-14'	13.8%
Depth	16'-20'	4.7%
Depth	281-301	7.3%

1 - 21					
0,			0. 1.0	SILT -	organic
5.4		, w, w/ ·	 6.0	GRAVEL	- little sand, trace silt, well graded, brown
	8.∩°C °.	Vx Vx	8.5 10.0		little gravel, trace silt, laminated and gravel to !"
		٧x	 15.5	GRAVEL	- little sand, trace silt, well graded, brown, ice inclusions 10% by volume
		Nbn	 17.5	SILT -	little gravel, trace clay, trace sand, low to medium plastic, grey
		V×		GRAVEL	- little sand, trace silt, trace boulders, fine, ice to 1/4" - 15% by volume
 30.0			 30.0		
			Refusa	l on bould	der at 30'
			Mois	ture Conte	<u>ent</u>
1 - 22			Depth	2'-4' 8'-10' 12'-14' 15'-17'	4.0% 9.9% 5.7% 14.2%
0'			0.2 4.0		organic - some sand

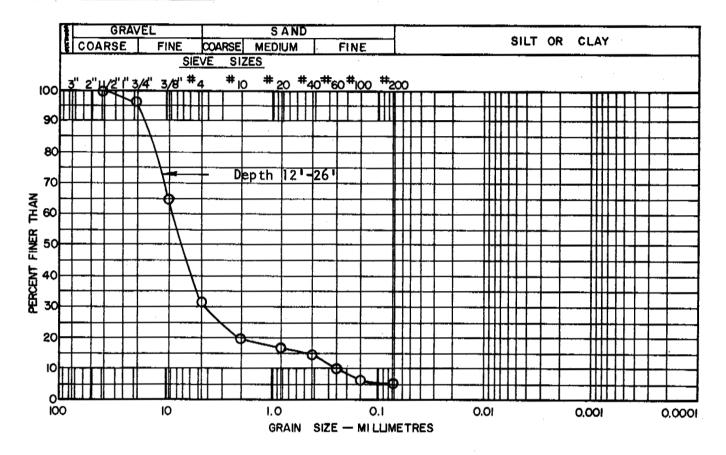
Test hole terminated due to sloughing



LABORATORY TEST DATA

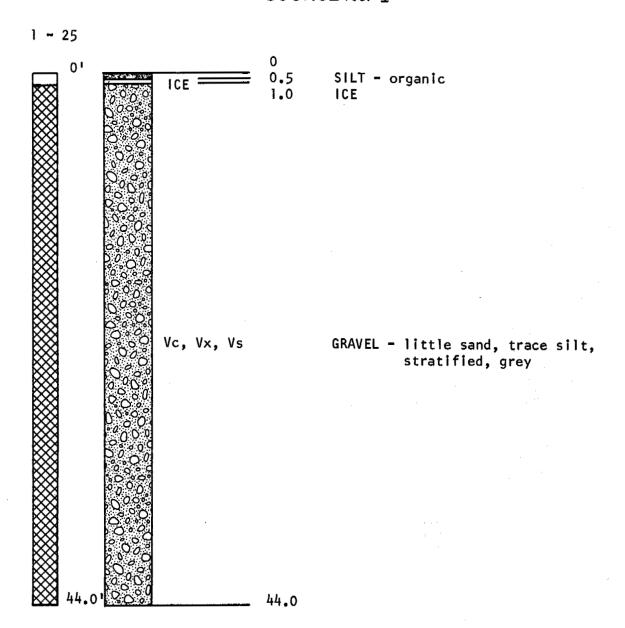
TEST HOLE-SOURCE No. 1 - 23

GRAIN SIZE DISTRIBUTION



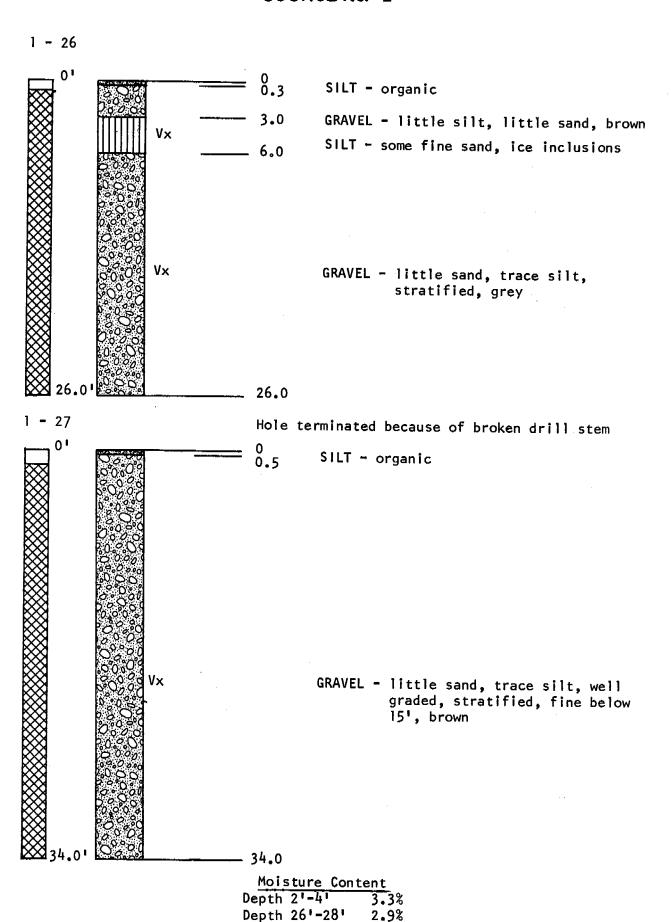
MOISTURE CONTENT

Depth	6'-8'	7.1%
Depth	12'-14'	5.0%
Depth	16'-18'	5.6%
Depth	20'-26'	4.0%



Moisture Content

Depth	2'-4'	7.5%
Depth	8'-10'	7.8%
Depth	12'-14'	10.0%
Depth	18'-20'	6.1%
Depth	42'-44'	3.0%



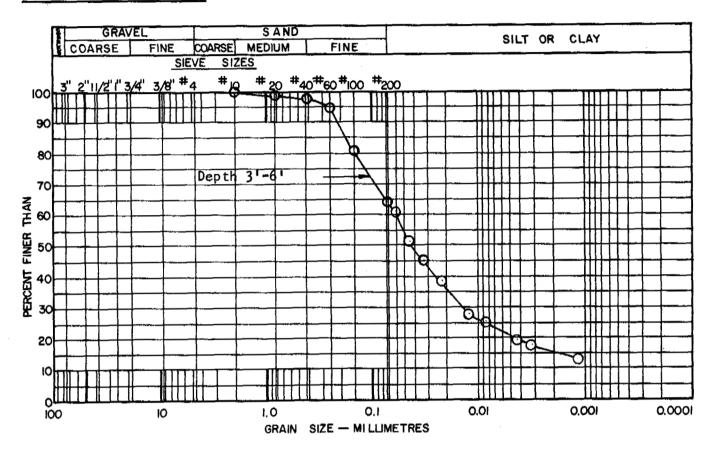
Depth 30'-32'

9.7%

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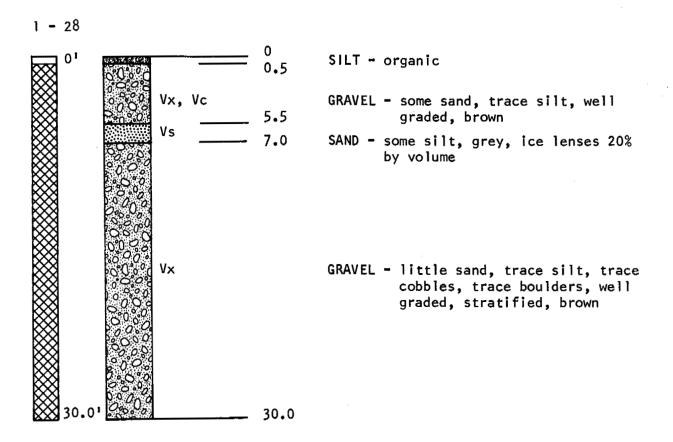
LABORATORY TEST DATA TEST HOLE-SOURCE No. 1 - 26

GRAIN SIZE DISTRIBUTION



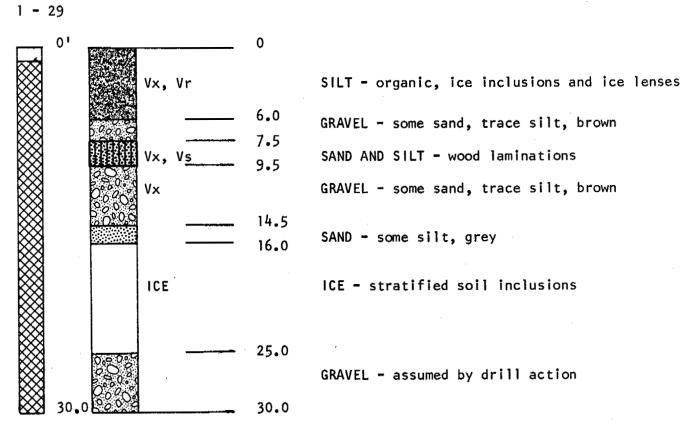
MOISTURE CONTENT

Depth 8'-10' 5.7% Depth 16'-18' 3.8%



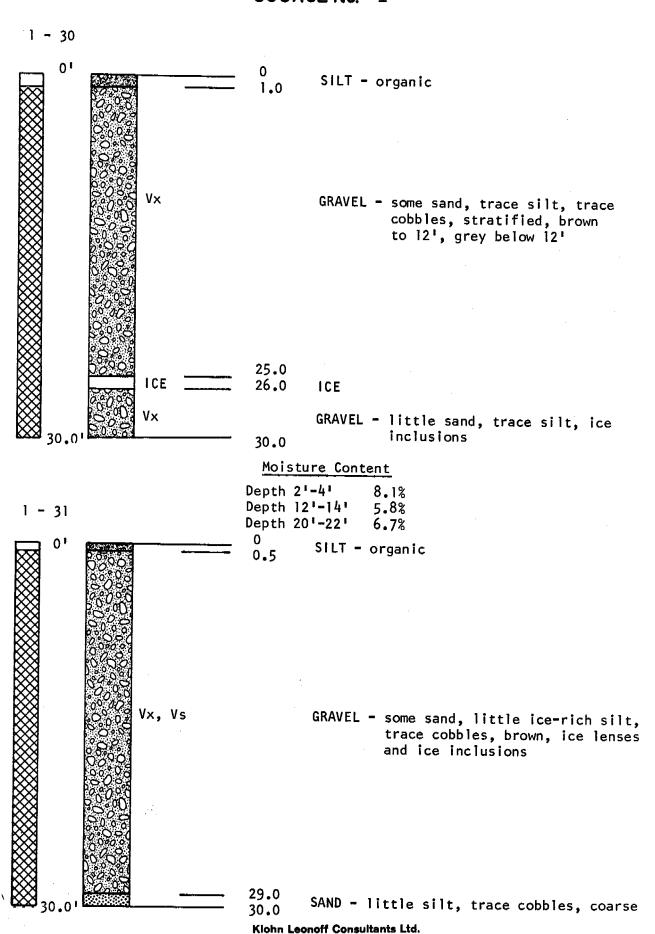
Moisture Content

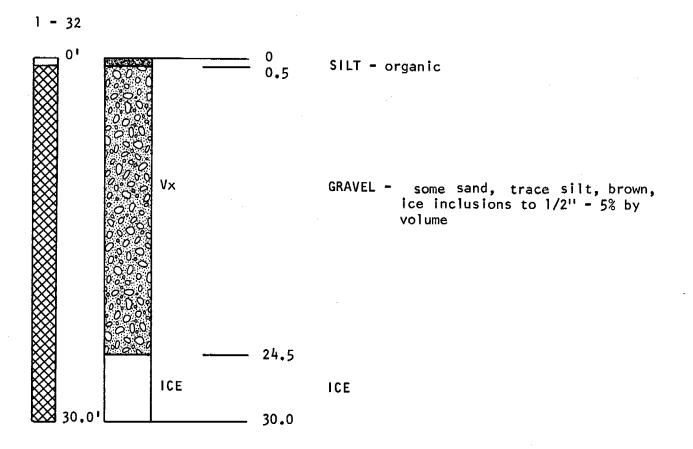
Depth	21-41	5.5%
	61-71	16.3%
Depth	12'-14'	3.6%
Depth	10'-20'	8.1%
Depth	26!-28!	8.5%



Moisture Content

Depth	61-81	11.7%
	8'-10'	29.3%
Depth	12'-14'	7.1%
Depth	14'-16'	51.3%
Depth	281	12.1%

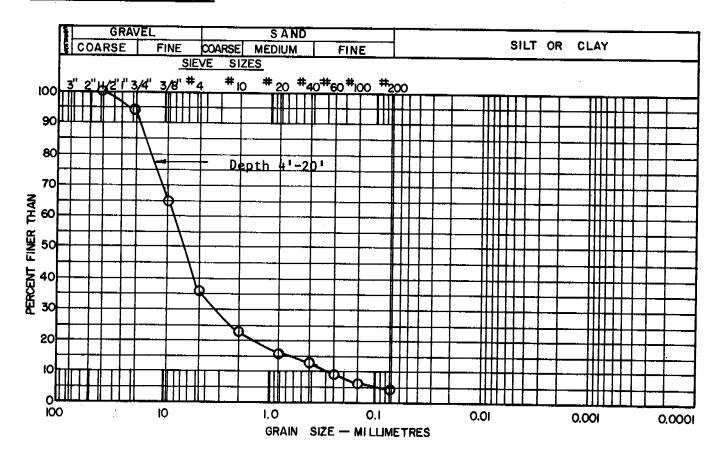




LABORATORY TEST DATA

TEST HOLE-SOURCE No. 1 - 31 & 32

GRAIN SIZE DISTRIBUTION



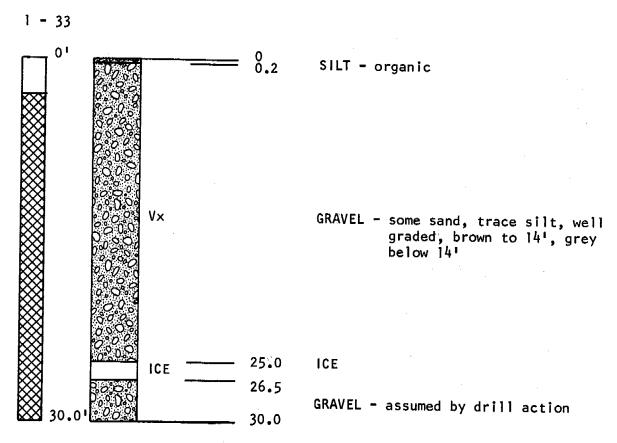
MOISTURE CONTENT

Test	Hole	31
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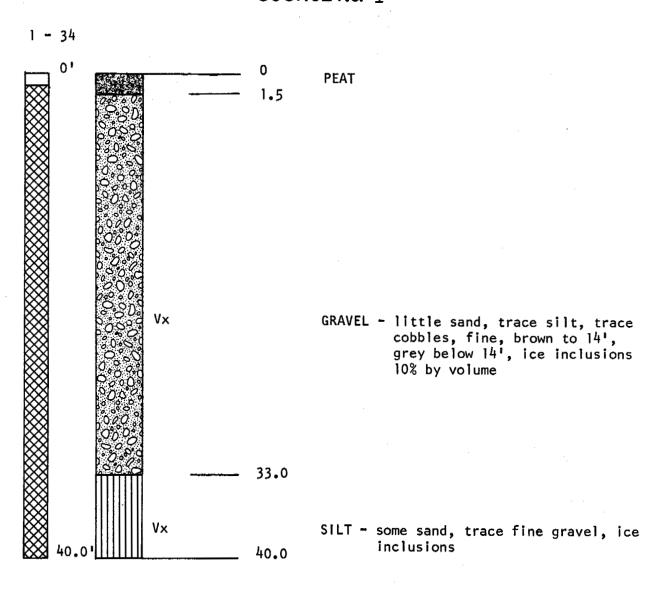
Depth	21-41	4.6%
Depth	8'-10'	6.8%
Depth	18'-20'	3.9%

Test Hole 32

Depth	41-61	6.9%
Depth	12'-14'	6.5%
Depth	18'-20'	6.2%

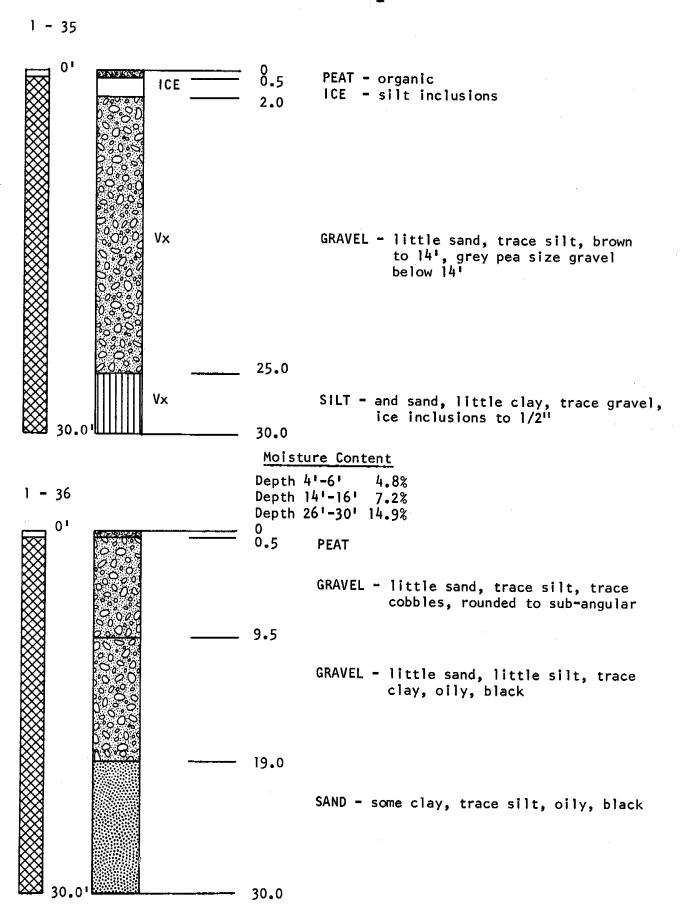


Moisture Content
Depth 6'-8' 4.2%



Moisture Content

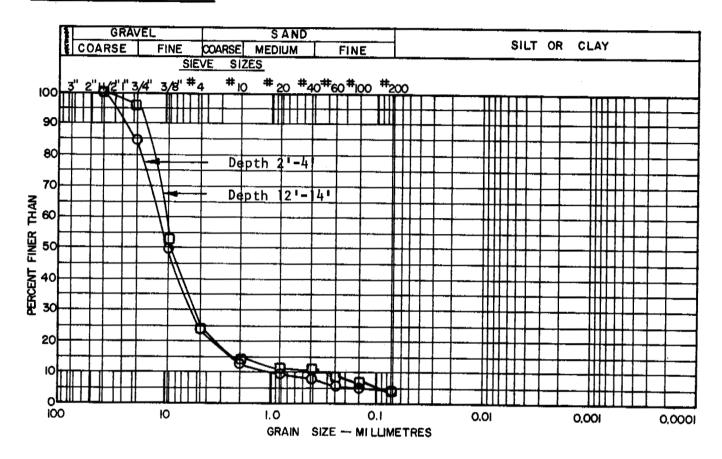
Depth 2'-4' 5.1% Depth 8'-10' 3.4% Depth 16'-18' 3.6% Depth 34'-36' 3.6%



LABORATORY TEST DATA

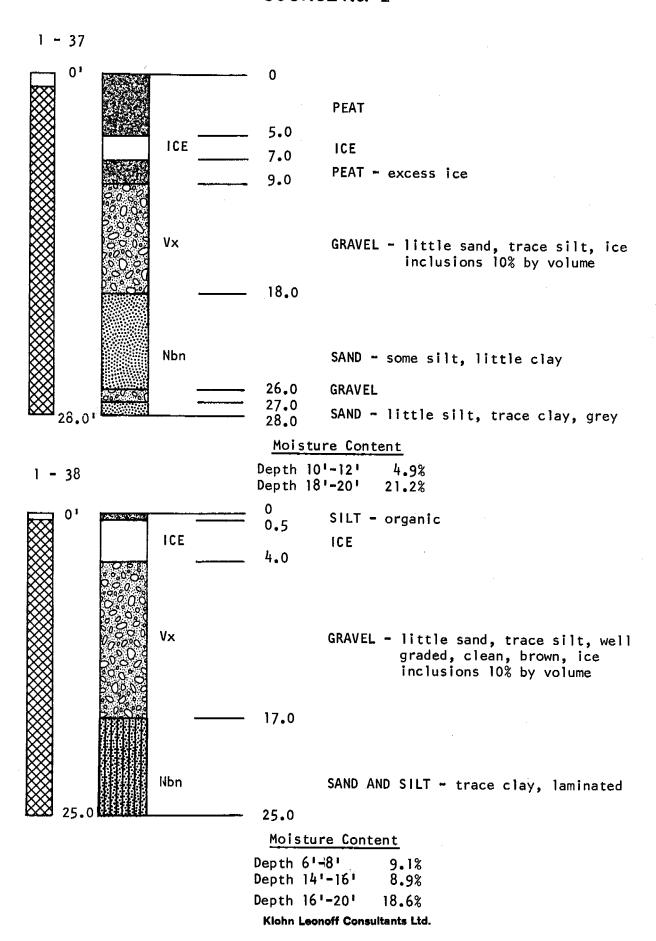
TEST HOLE-SOURCE No. 1 - 36

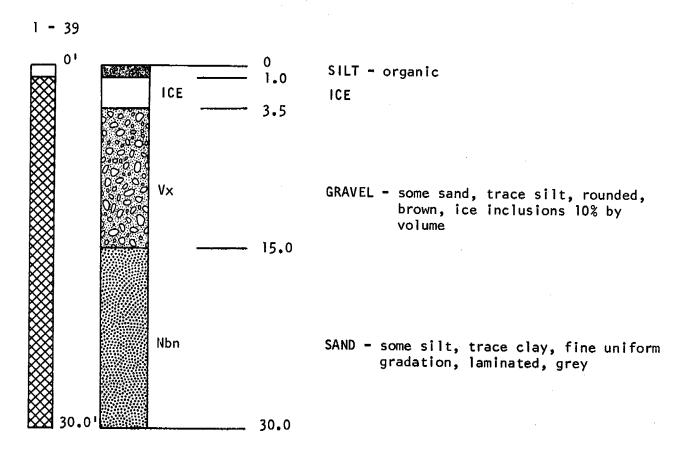
GRAIN SIZE DISTRIBUTION



MOISTURE CONTENT

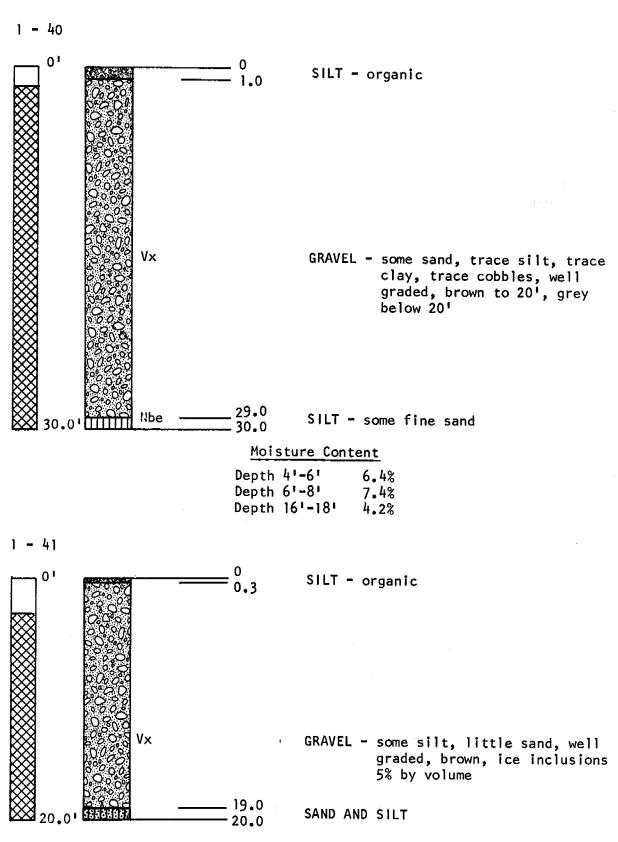
Depth	2'-4'	6.2%
Depth	12'-14'	4.6%
Depth	24'-26'	7.4%





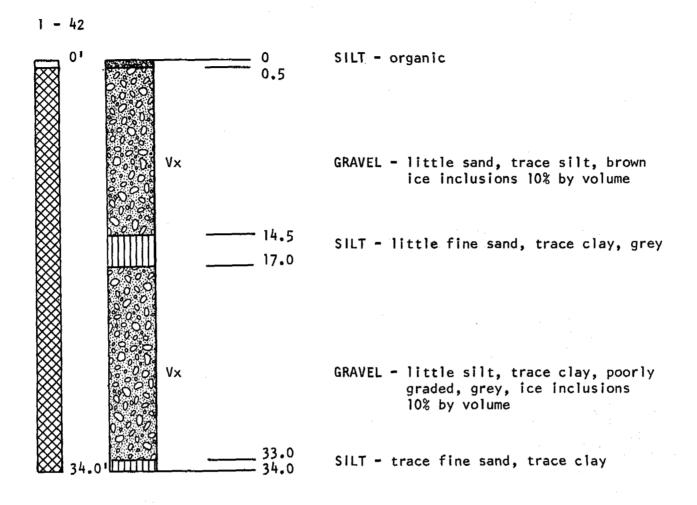
Moisture Content

Depth 6'-8' 6.1% Depth 12'-14' 7.8% Depth 16'-18' 26.1%



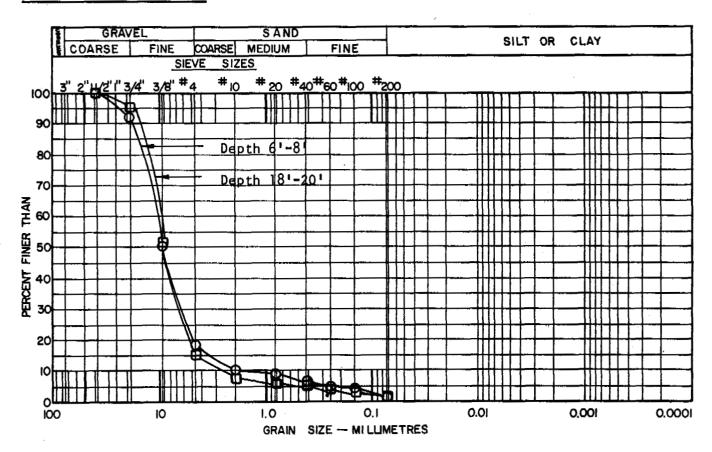
Moisture Content

Depth 8'-10' 6.6%



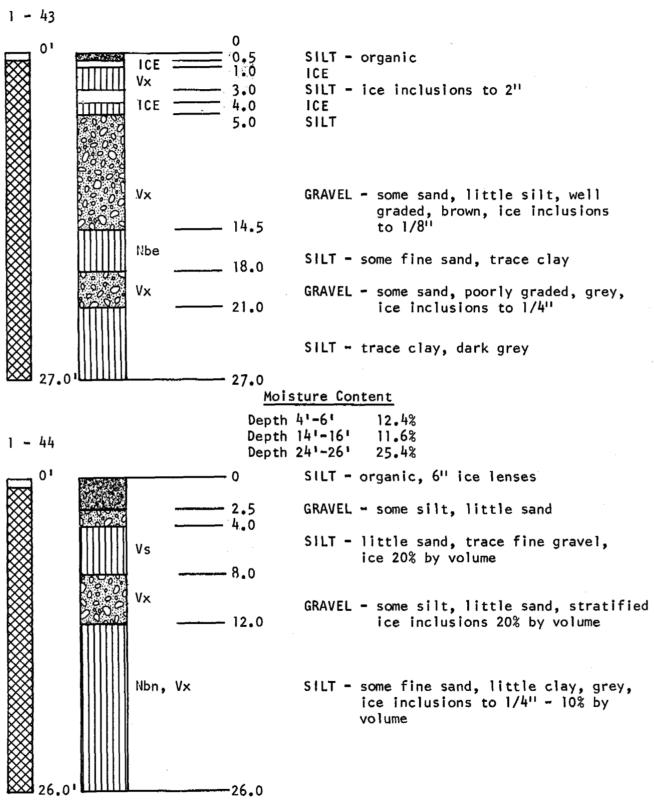
LABORATORY TEST DATA TEST HOLE-SOURCE No. 1 - 42

GRAIN SIZE DISTRIBUTION



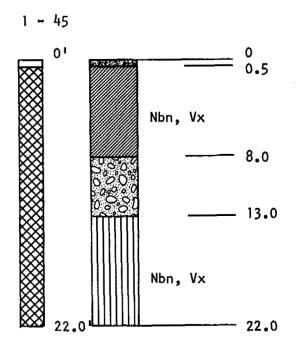
MOISTURE CONTENT

Depth 6'-8' 5.5% Depth 14'-16' 24.9% Depth 18'-20' 4.3%



Moisture Content

Depth 8'-10' 13.3% Depth 12'-14' 20.3% Depth 20'-26' 26.2%

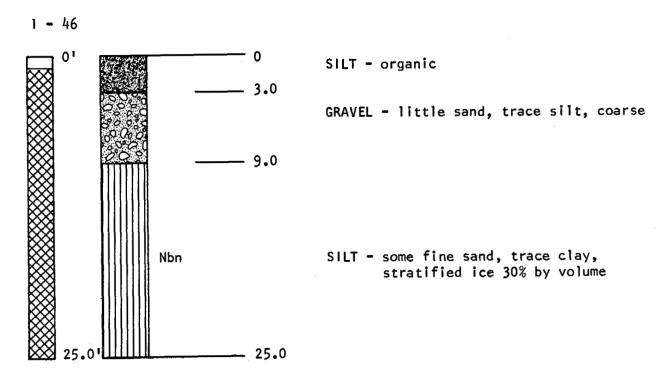


SILT - organic

CLAY - high plasticity, grey, ice inclusions 10% by volume

GRAVEL - some sand, little silt, trace
 clay, grey

SILT - little sand, stratified, ice inclusions 10% by volume

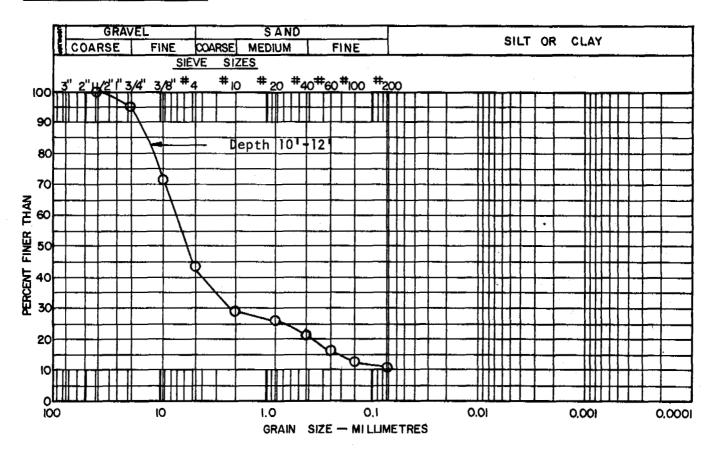


MOISTURE CONTENT

Depth 4'-6' 8.3% Depth 12'-14' 24.0% Depth 18'-20' 27.3%

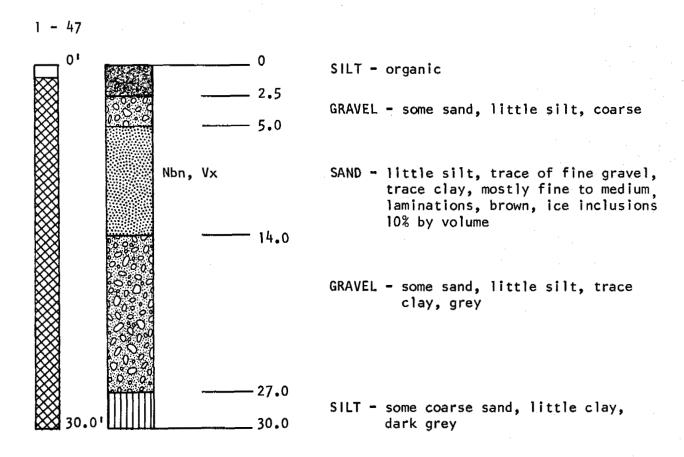
LABORATORY TEST DATA TEST HOLE-SOURCE No. 1 - 45

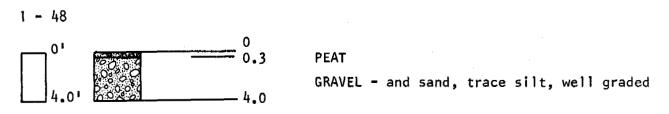
GRAIN SIZE DISTRIBUTION



MOISTURE CONTENT

Depth 4'-6' 33.2% Depth 10'-12' 8.0% Depth 16'-18' 28.4%



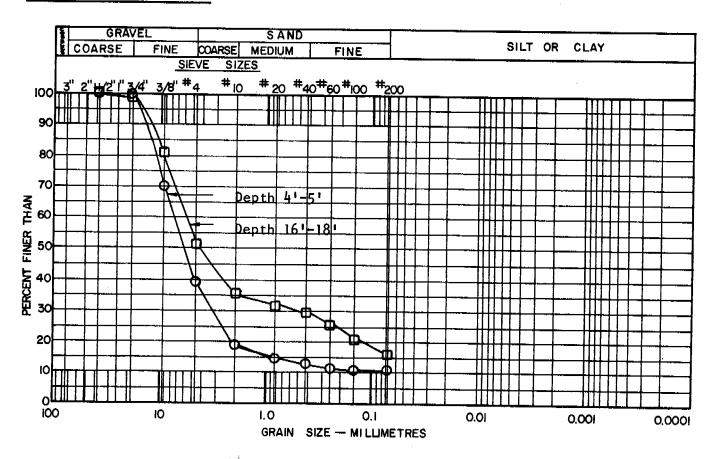


Hole terminated due to sloughing

LABORATORY TEST DATA

TEST HOLE-SOURCE No. 1 - 47

GRAIN SIZE DISTRIBUTION

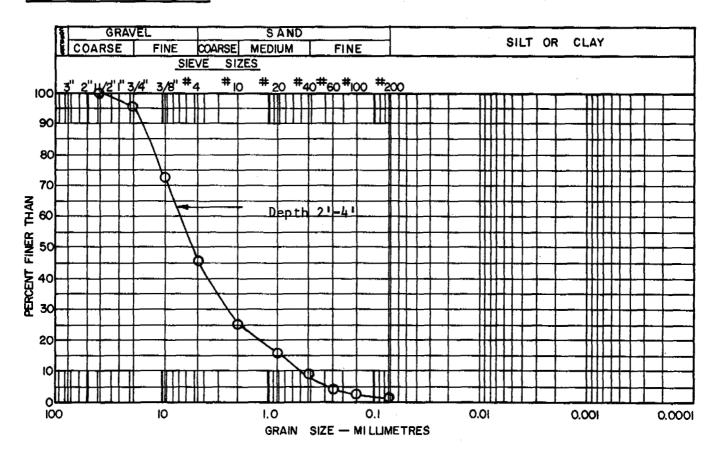


MOISTURE CONTENT

Depth	41-61	11.0%
Depth	10'-12'	15.1%
Depth	16'-18'	9.3%
Depth	261-281	20.4%

LABORATORY TEST DATA TEST HOLE-SOURCE No. 1 - 48

GRAIN SIZE DISTRIBUTION



MOISTURE CONTENT

1 - 49

0'	7.00 0 2.00 0 2.00 0 2.00 0	۷×,	Vs	0 0.2 4.0	SILT - organic SAND - some silt, fine, ice inclusions to 1/32", 10% by volume
		Vs			GRAVEL - some sand, trace silt, well graded, brown
	3°000 			18.0 19.0 20.0	SAND SILT SAND - little silt, trace fine gravel,
		٧x		23.0 26.0 28.0	GRAVEL - little sand, clean, poorly graded, ice inclusions 5% by volume SILT
36.0				32.0 36.0	<pre>GRAVEL - little sand, clean, poorly graded SILT - some clay, trace fine sand</pre>

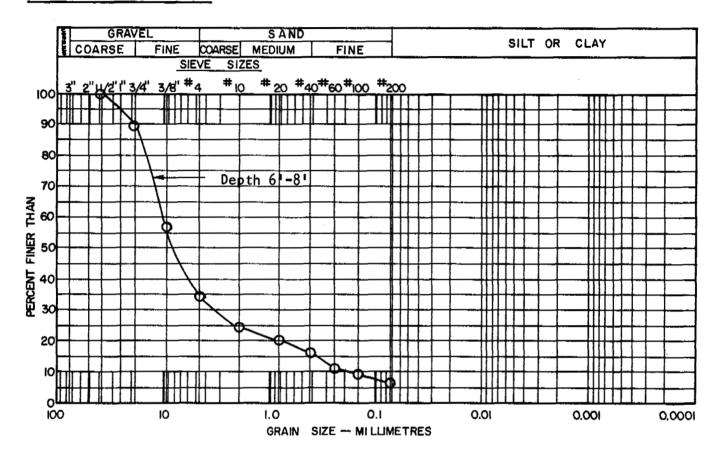
Moisture Content

-Depth	61-81	6.3%
	14'-16'	7.1%
Depth	20'-22'	17.9%
Depth	241-261	5.6%

LABORATORY TEST DATA

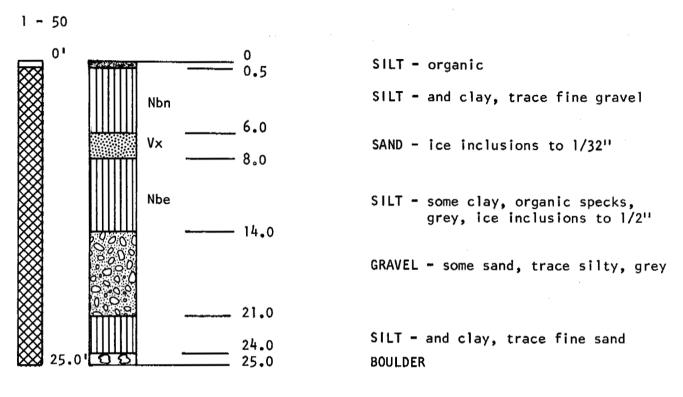
TEST HOLE-SOURCE No. 1 - 49

GRAIN SIZE DISTRIBUTION

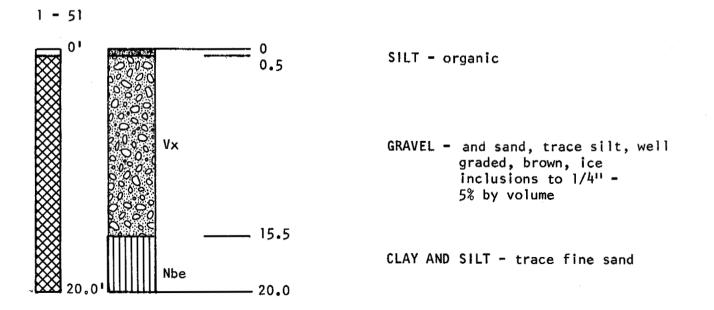


MOISTURE CONTENT

Depth	61-81	6.9%
Depth	14'-16'	7.1%
Depth	20'-22'	17.9%
Depth	241-261	5.6%

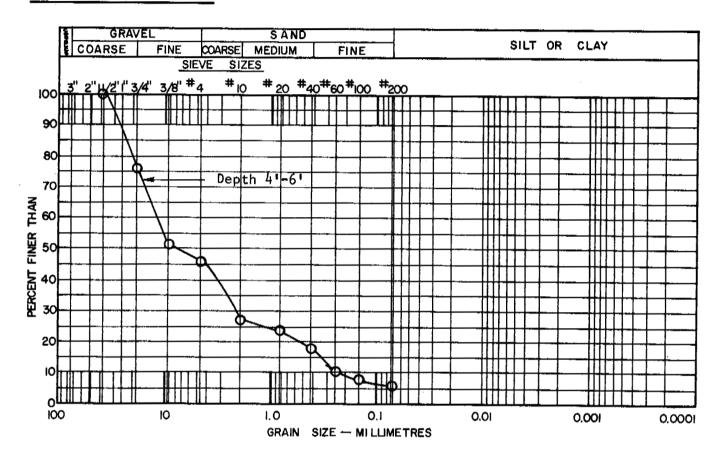


Moisture Content
Depth 14'-16' 8.7%



LABORATORY TEST DATA TEST HOLE-SOURCE No. 1 - 51

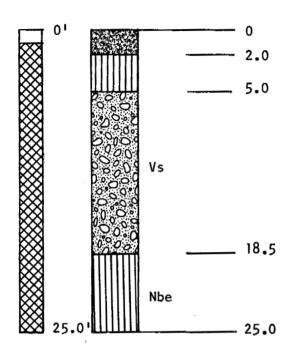
GRAIN SIZE DISTRIBUTION



MOISTURE CONTENT

Depth 4'-6' 6.0%

1 - 52



SILT - organics, ice

SILT - ice

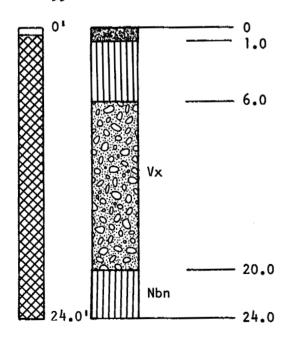
GRAVEL - little sand, trace clay,
 well graded, grey, ice
 inclusions to 1/16"

SILT AND CLAY

Moisture Content

Depth 8'-10' 5.9%

1 - 53



SILT - organics, ice

SILT AND ICE - little gravel, trace organics

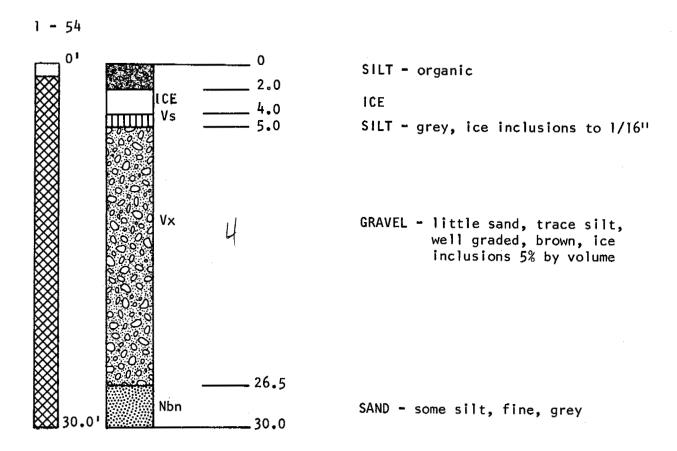
GRAVEL - some sand, trace silt, well
 graded, brown to grey, ice
 inclusions 5-10% by volume

CLAY AND SILT

Moisture Content

Depth 12'-18' 5.1%

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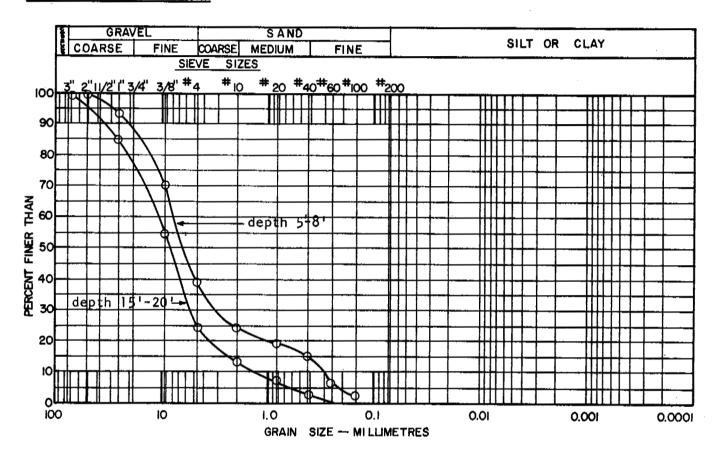


Moisture Content

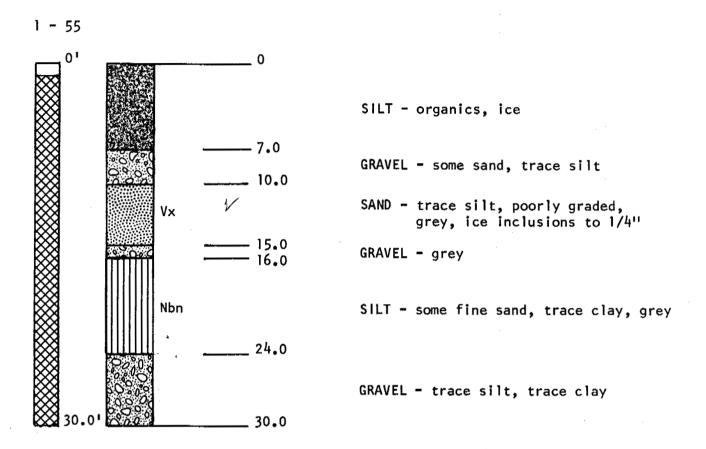
Depth 10'-14' 7.8% Depth 16'-18' 7.6%

LABORATORY TEST DATA TEST HOLE-SOURCE No. 1 - 54

GRAIN SIZE DISTRIBUTION

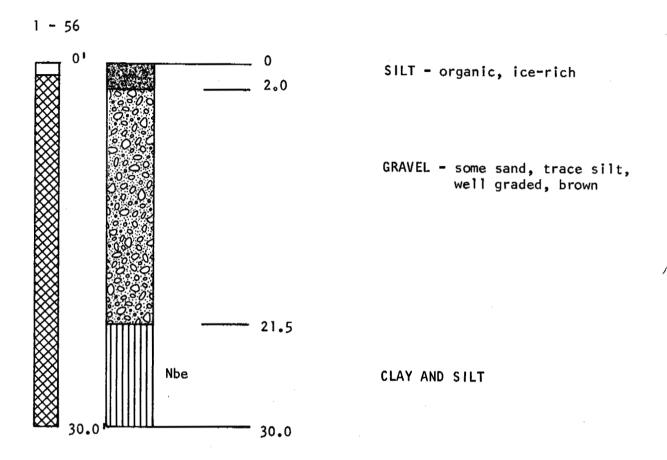


MOISTURE CONTENT



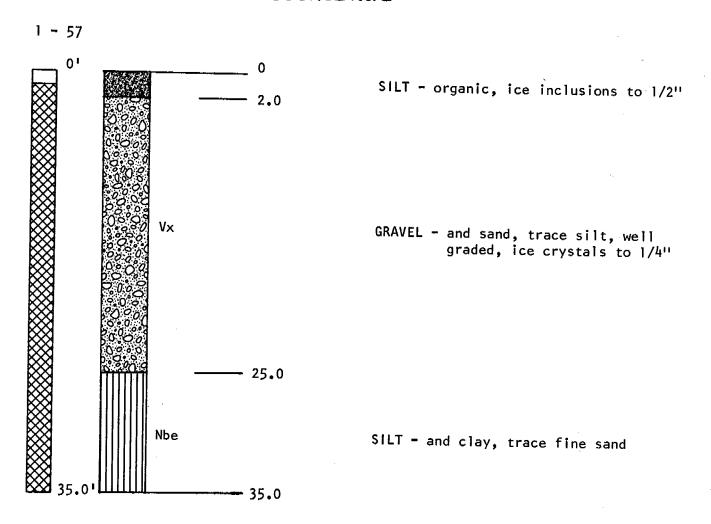
Moisture Content

Depth 10'-10.5' 17.5% Depth 10.5'-11' 9.1% Depth 20'-22' 26.9%



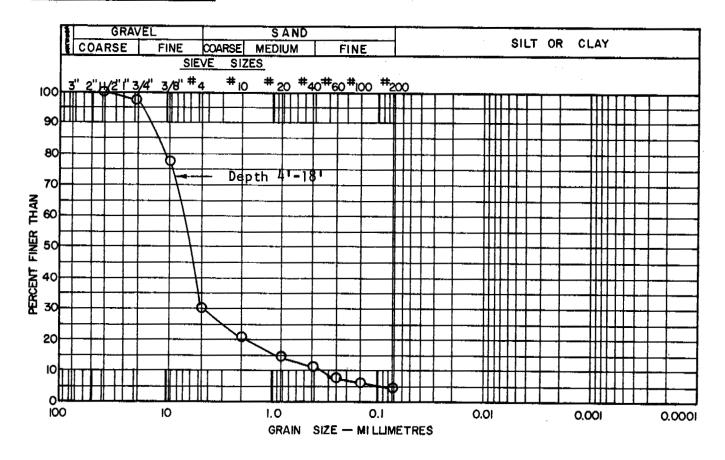
Moisture Content

Depth 4'-6' 8.0% Depth 12'-14' 4.1% Depth 18'-20' 5.8%



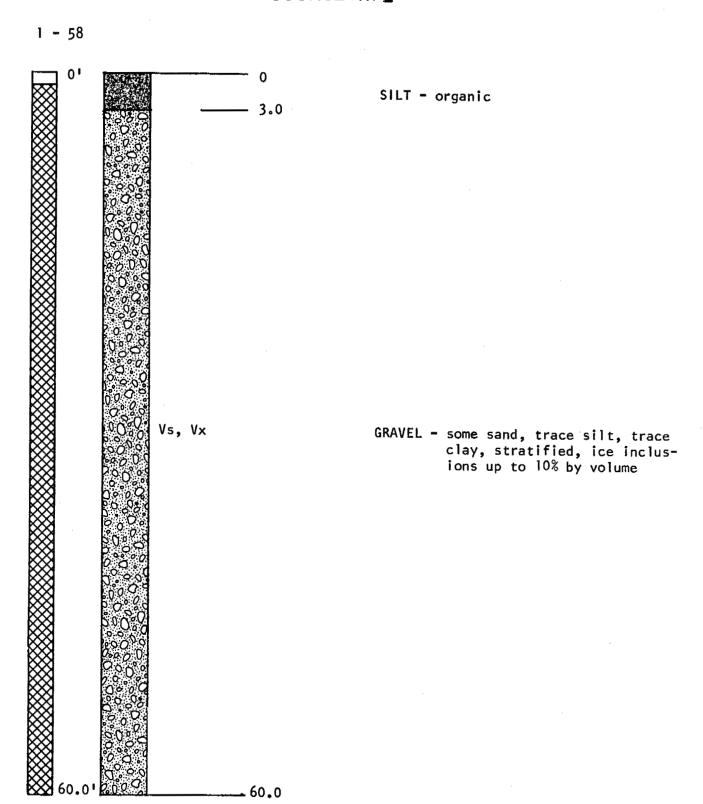
LABORATORY TEST DATA TEST HOLE-SOURCE No. 1 - 57

GRAIN SIZE DISTRIBUTION



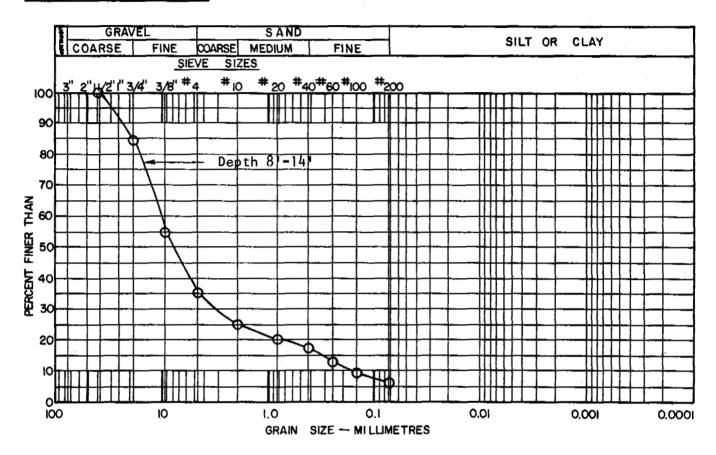
MOISTURE CONTENT

Depth 4'-6' 5.7% Depth 16'-18' 7.5%



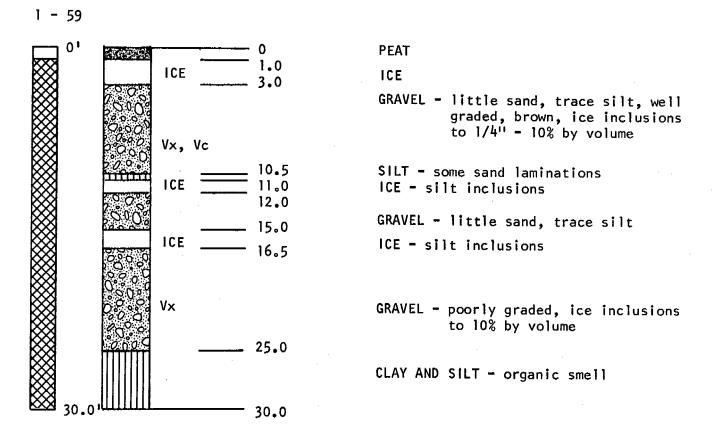
LABORATORY TEST DATA TEST HOLE-SOURCE No. 1 - 58

GRAIN SIZE DISTRIBUTION



MOISTURE CONTENT

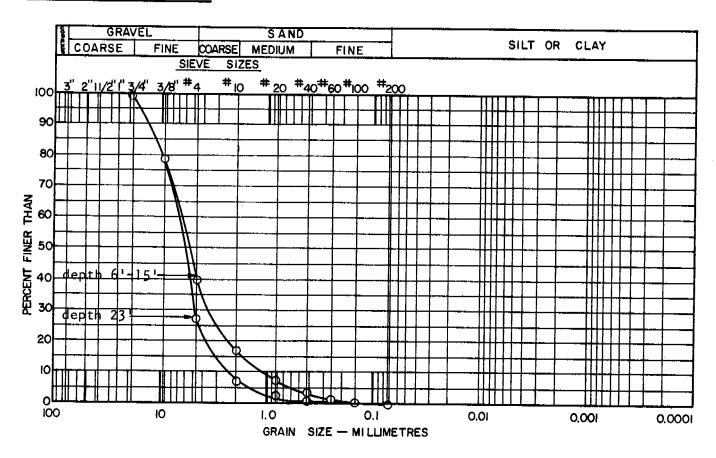
	8'-10'	5.0%
Depth	13'-14' 26'-28'	9.6% 8.8%
	34'-36' 48'-50'	7.2% 5.5%



LABORATORY TEST DATA

TEST HOLE-SOURCE No. 1 - 59

GRAIN SIZE DISTRIBUTION

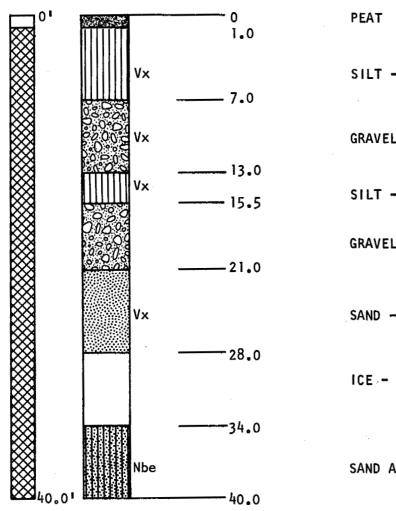


MOISTURE CONTENT

Sample	1	depth	יון	58.8%
Sample		•		6.0%
Sample		•		5.4%
Sample	4	depth	8 '	8.3%
Sample	5	denth	יחו	10 19

Sample	6	depth	151	8.1%
Sample	7	depth	20'	10.0%
Sample	8	depth	221	5.7%





SILT - some clay, little sand, laminated, ice inclusions to 1/2" - 40% by volume

GRAVEL - little sand, trace silt, trace cobbles, well graded, brown, ice inclusions 10% by volume

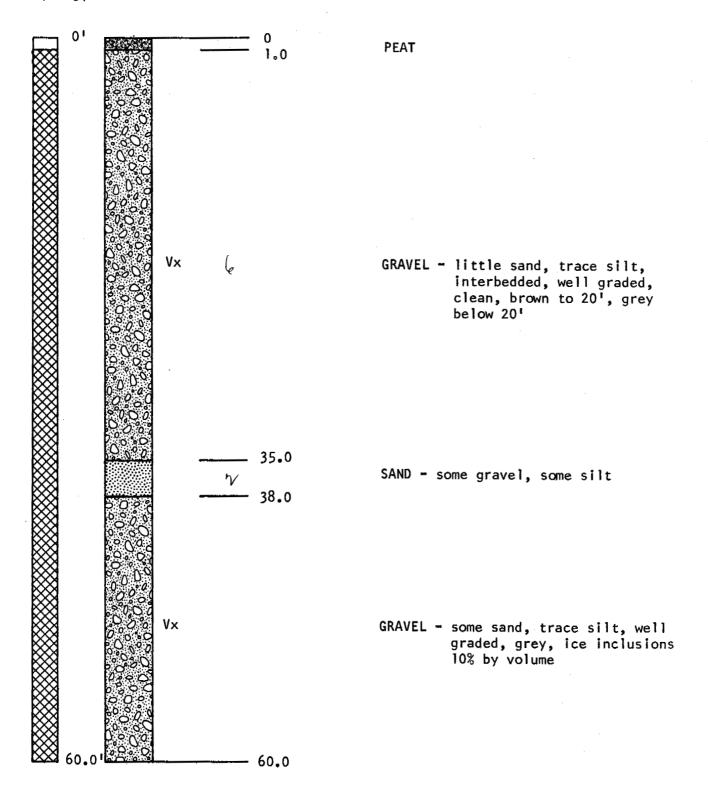
SILT - some sand, ice inclusions to 1/32" 15% by volume

GRAVEL - little sand, trace silt, trace
wood chips, uniform, grey

SAND - some fine gravel, trace silt, well graded, stratified, grey, ice inclusions 10% by volume

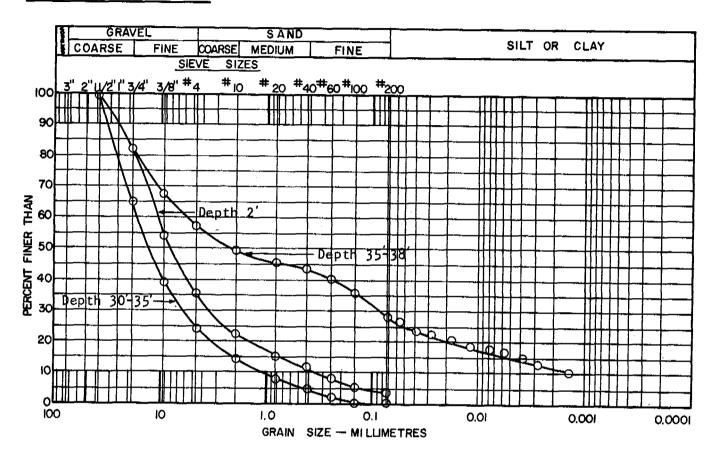
ICE - sand inclusions

SAND AND SILT



LABORATORY TEST DATA TEST HOLE-SOURCE No. 1 - 61

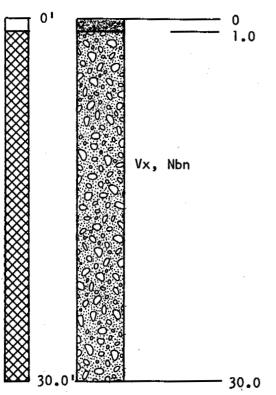
GRAIN SIZE DISTRIBUTION



MOISTURE CONTENT

Sample	}	depth	21	3.2%
Sample	2	depth	41	14.5%
Sample	3	depth	15'	6.2%
Sample	4	depth	201	7.5%
Sample	5	depth	321	4.8%
Sample	6	depth	36'	12.5%

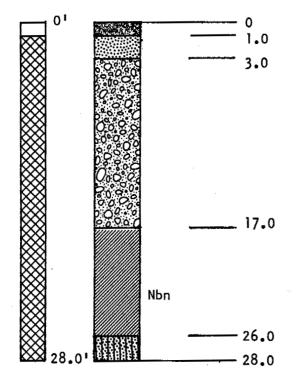




PEAT

GRAVEL - some sand, trace silt, well
 graded, brown, ice inclusions
 lo% by volume. Logged by
 drilling action only from
 14'-30'.

1 - 63



PEAT

SAND - some gravel

GRAVEL - and sand, trace silt, well
 graded, brown

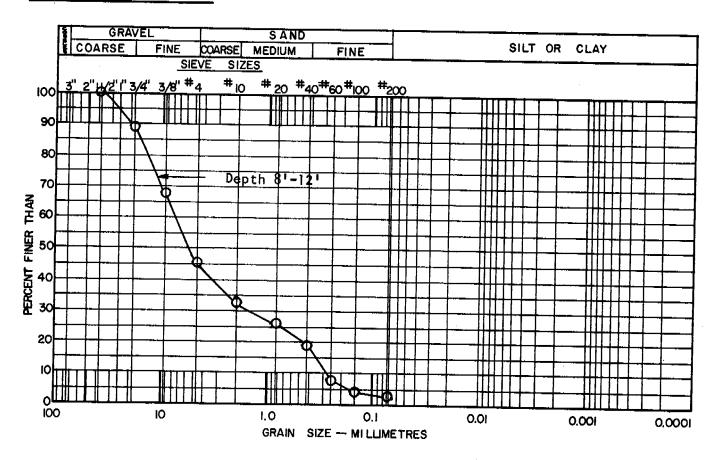
CLAY - some silt, little fine sand, laminated

SILT AND FINE SAND

LABORATORY TEST DATA

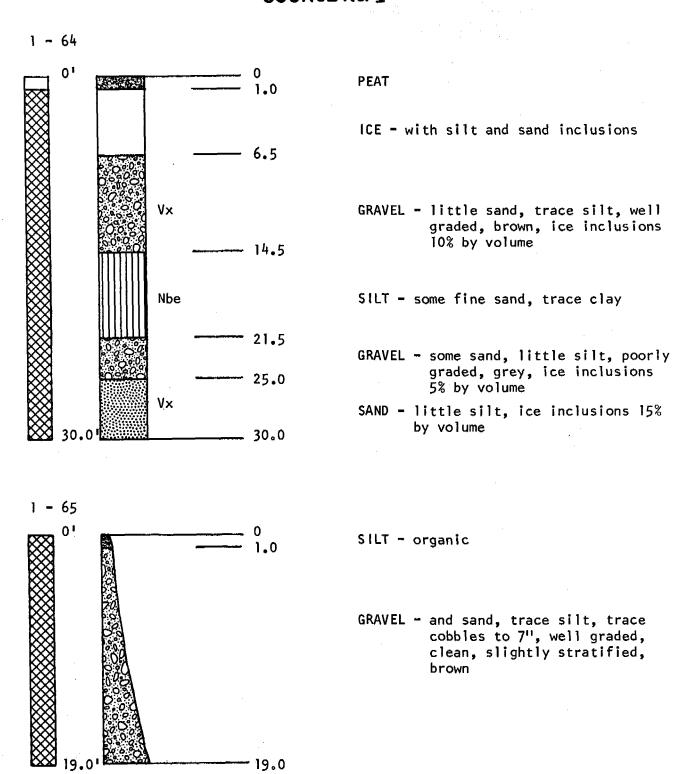
TEST HOLE-SOURCE No. 1 - 63

GRAIN SIZE DISTRIBUTION



MOISTURE CONTENT

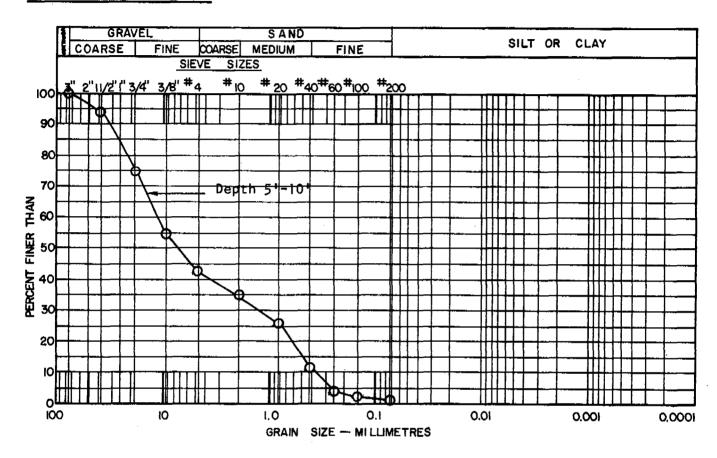
Depth 8'-12' 8.5% Depth 18'-22' 15.7%



Soil profile logged from bank exposure

LABORATORY TEST DATA TEST HOLE-SOURCE No. 1 - 65

GRAIN SIZE DISTRIBUTION



MOISTURE CONTENT

PARSONS LAKE SOURCE No. 2

LANDFORM AND LOCATION: River terrace located 3 miles southeast of

Parsons Lake and 5 miles west of Eskimo Lakes.

MATERIAL: GRAVEL - some sand, trace silt, trace cobbles.

VOLUME: 250,000 cubic yards.

CONCLUSION: Material is generally clean and fairly well graded

with a low ice content. The average thickness of the gravel stratum is only 8 feet. This source should be considered for development upon deple-

tion of Source I to confine the gravel operation

to this general locality.

OA COME **%** 269 1268 **9**276 **0**278 ●118 ●119 ●120 ●121 ●122 ●123 ●124 ●125 ●126 ●127 ●1<u>28</u> **6**20 **6**25 625 SCALE: |" = 500' (approx.) AIRPHOTO No. A22936-34

SOURCE DESCRIPTION

The source is a lower fluvial terrace extending eastward from Source 1. The terrace is roughly rectangular, about 2500 feet long and 500 feet wide. The terrace is bounded by banks on the south which lead to a lower flood plain, and by hills on the north and east which rise to the upland. The north central part of the terrace is a poorly drained area consisting of a small lake surrounded by conspicuous raised center ice wedge polygons.

The banks bounding the southern edge of the source slope at about 3 (horizontal) on 1 (vertical). The bank diminishes in height from about 15 feet in the west to about 10 feet in the east.

MATERIALS AND QUANTITIES

A total of 36 holes were drilled in the source area. The soil consists of organic silt or peat over gravel and sand. The organic cover consists mainly of organic silt, and peat; however, the peat only occurs in the polygonal ground area shown on the photograph. The thickness of organic cover varies from 1 foot or less near the bank but increases to about 9 feet in the area of the polygonal ground. The average thickness of the organic cover is 3.5 feet.

The topstratum is underlain by gravel and sand materials, which varies in thickness between 1.5 feet to 26 feet with an average of about 8 feet. The moisture content in the gravel samples tested varies from 4.4% to 11.1%, averaging about 9%. The gravel is generally stratified with sand layers, fairly well graded, with some sand and a trace of silt. The bottom few feet of the stratum is often very coarse, consisting mostly of cobbles. The ice content of the gravel appears to range from about 5% to 20% by volume, averaging about 10%. The ice generally occurs as inclusions, and less frequently as stratified lenses.

The gravel stratum is underlain by laminated silts, fine sands, and clays. The moisture content varies from 21.0% to 27.7%, averaging about 25%. Ice in this material is usually non-visible, and frequently well bonded.

The estimated volume of gravel and sand material which can be removed from this source was calculated between 250,000 and 360,000 cubic yards. This is based on developing a 500 foot width along the length to remove 5 to 8 feet of

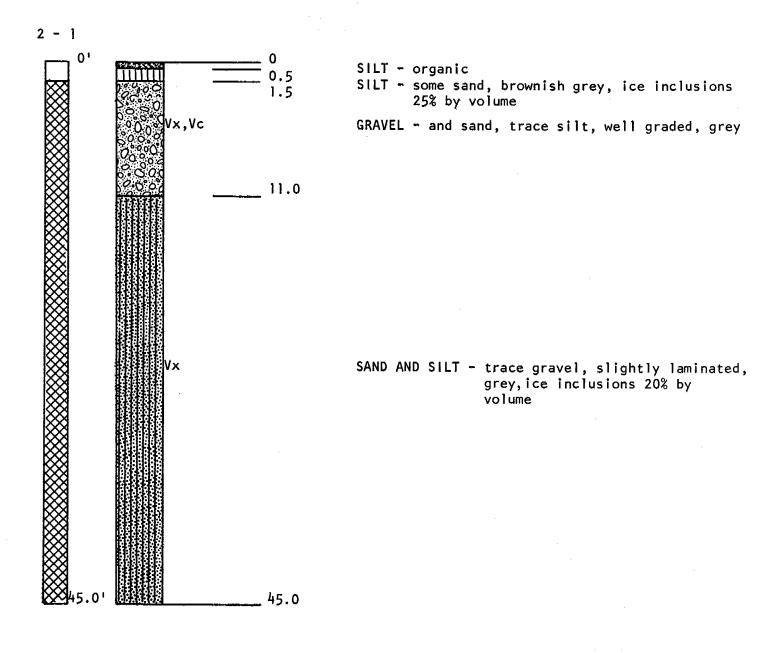
gravel. The volume of organic silt and peat which must be removed is about 135,000 cubic yards based on an average thickness of about 3 feet.

CONCLUSIONS

The source area should be considered for development upon depletion of Source I immediately to the west. This would have the advantage of confining the operation to this locality rather than disturbing another source area.

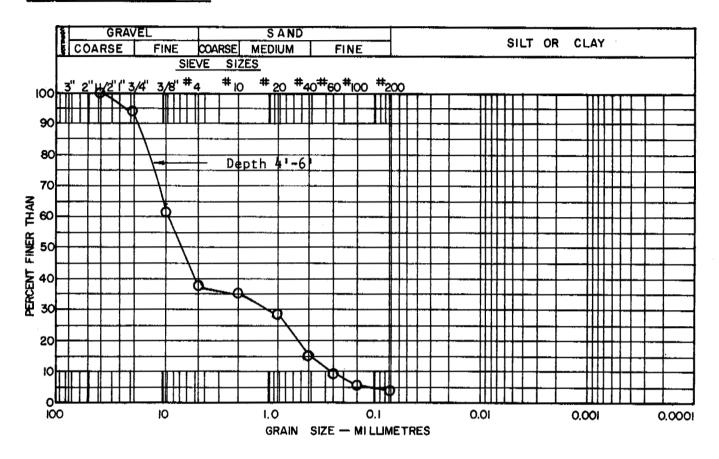
The gravel and sand materials are of good quality and suitable for use as general fill for construction of roadways, airstrips or plant sites.

The waste overburden materials should be stockpiled along the north side of the source to prevent drainage water from reaching the stream. A small berm or dyke may be required between the source and the stream to prevent siltation into the stream.



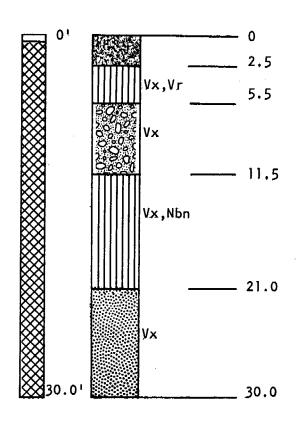
LABORATORY TEST DATA TEST HOLE-SOURCE No. 2 - 1

GRAIN SIZE DISTRIBUTION



MOISTURE CONTENT

2 - 2



SILT - organic

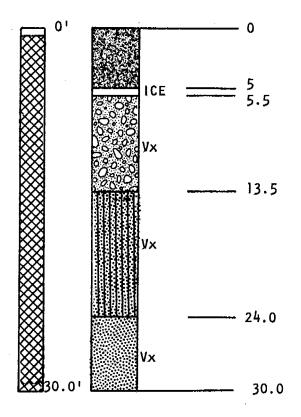
SILT - little fine sand, grey, ice inclusions

GRAVEL - little sand, trace silt, well graded

\$ILT - some fine sand, trace clay, stratified
 grey

SAND - some silt, ice inclusions 10% by yolume

2 - 3



SILT - organic

ICE - with soil inclusions

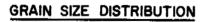
GRAVEL ~ some sand, trace silt, organic specks ice inclusions 5 % by yolume

SAND AND SILT * stratified, ice inclusions 10% by volume

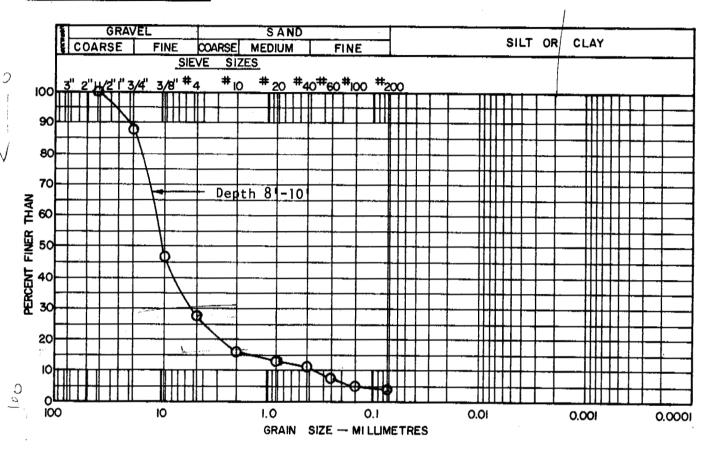
SAND - little silt, ice inclusions 10% by volume

LABORATORY TEST DATA

TEST HOLE-SOURCE No. 2 - 3



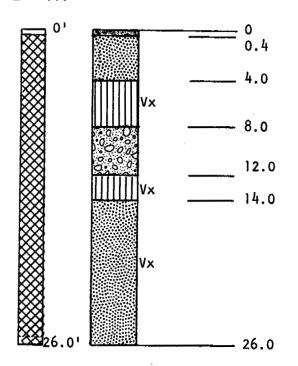




MOISTURE CONTENT

Depth 8'-10' 4.4% Depth 16'-18' 22.4% Depth 26'-30' 21.0%





SILT - organic

SAND - trace gravel, trace silt, brown

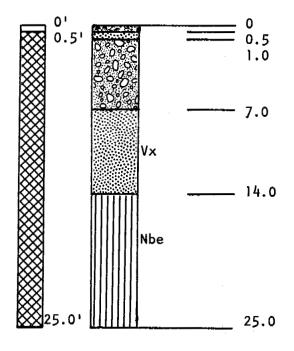
SILT - ice inclusions 40% by volume

GRAVEL - little silt, trace clay, grey

SILT - some clay, ice inclusions 25% by volume

SAND - little silt, fine, ice inclusions 15% by volume

2 - 119

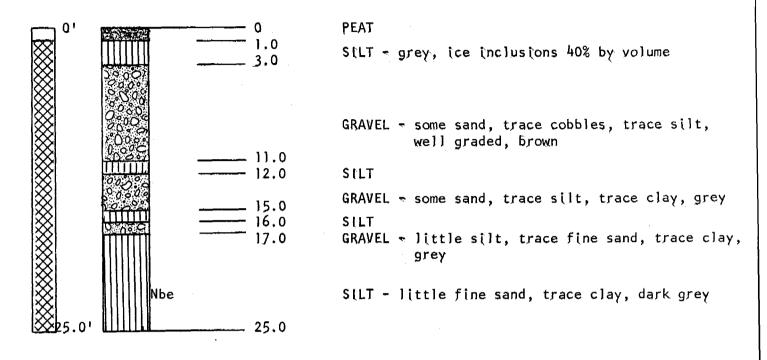


SILT - organic SAND

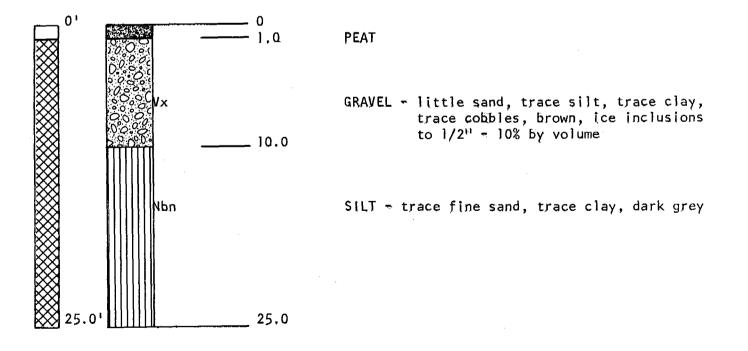
SAND - little silt, fine, ice inclusions 15% by volume

SILT - little fine sand, dark grey

2 - 120



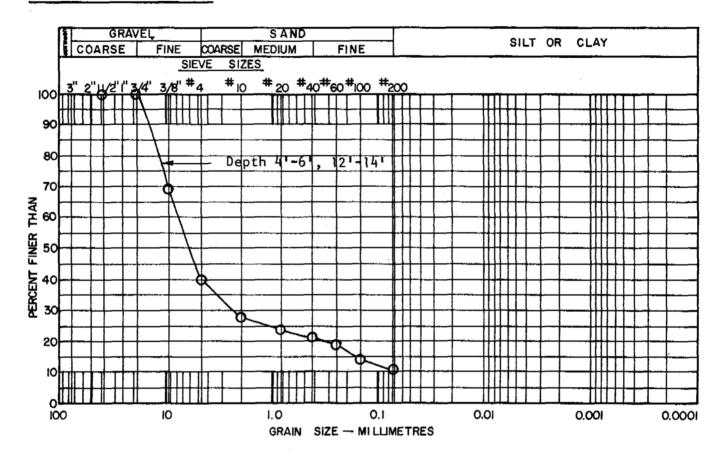
2 - 121



LABORATORY TEST DATA

TEST HOLE-SOURCE No. 2 - 120

GRAIN SIZE DISTRIBUTION



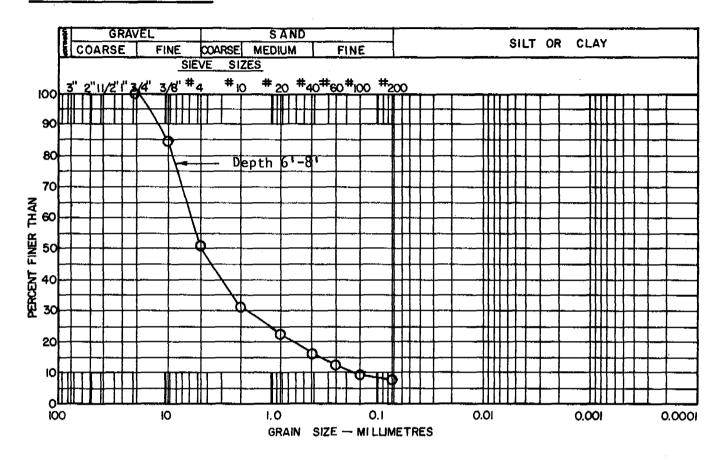
MOISTURE CONTENT

Depth 4'-6' 10.5% Depth 12'-14' 7.2%

LABORATORY TEST DATA

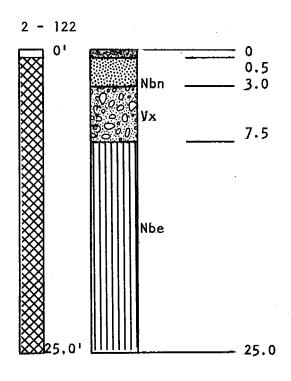
TEST HOLE-SOURCE No. 2 - 121

GRAIN SIZE DISTRIBUTION



MOISTURE CONTENT

Depth 6'-8' 11.1% Depth 20'25' 27.7%

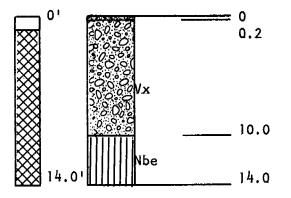


PEAT
SAND = little silt, brown

GRAVEL - little sand, trace silt, clean, well graded, ice inclusions 10% by volume

SLLT - trace fine sand

2 - 123



SILT - organic

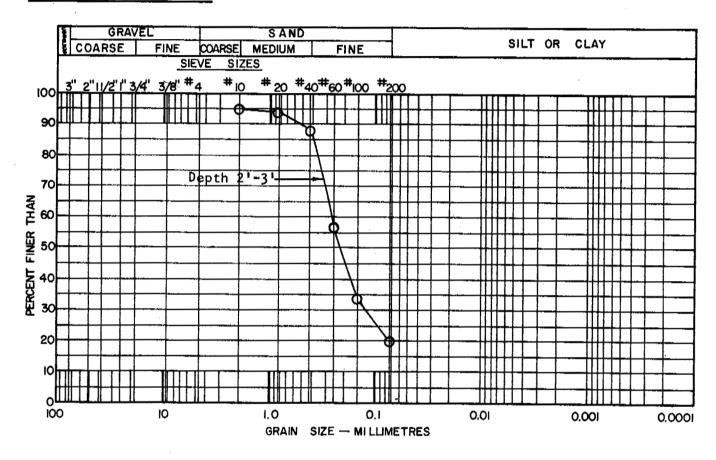
GRAVEL - some sand, trace silt, well graded ice inclusions 5% by volume

SILT - little fine sand, trace clay

LABORATORY TEST DATA

TEST HOLE-SOURCE No. 2 - 122

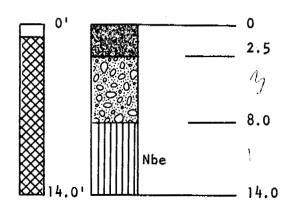
GRAIN SIZE DISTRIBUTION



MOISTURE CONTENT

Depth 2'-3' 19.5%

2 - 124

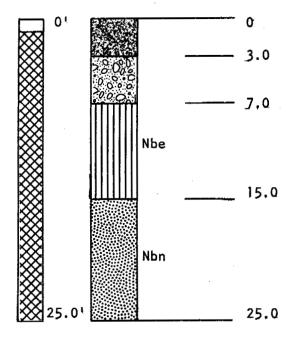


SILT - organic

GRAVEL - little sand, trace silt, well graded, brown

StLT - grey, ice inclusions 30% by volume

2 - 125



SILT - organic

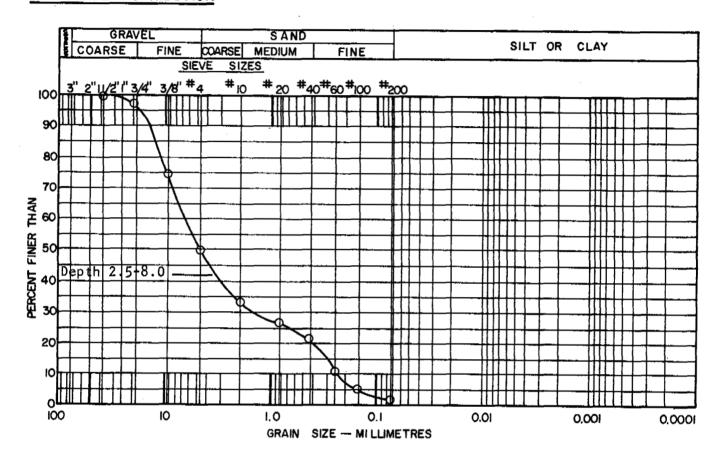
GRAYEL - some sand, trace silt, well graded, brown

SILT - grey, ice inclusions 15% by volume

SAND - little silt, fine

LABORATORY TEST DATA TEST HOLE-SOURCE No. 2~124

GRAIN SIZE DISTRIBUTION



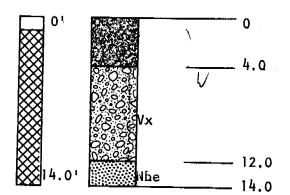
MOISTURE CONTENT

Sample 1 depth 4' 4.9%

Sample 2 depth 6' 6.2%

Sample 3 depth 8' 5.3%

2 - 126

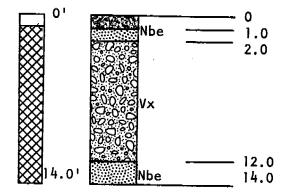


SILT - organic

GRAVEL - little sand, trace silt, well graded, brown, ice inclusions 5% by volume

SAND - some silt, fine

2 - 127



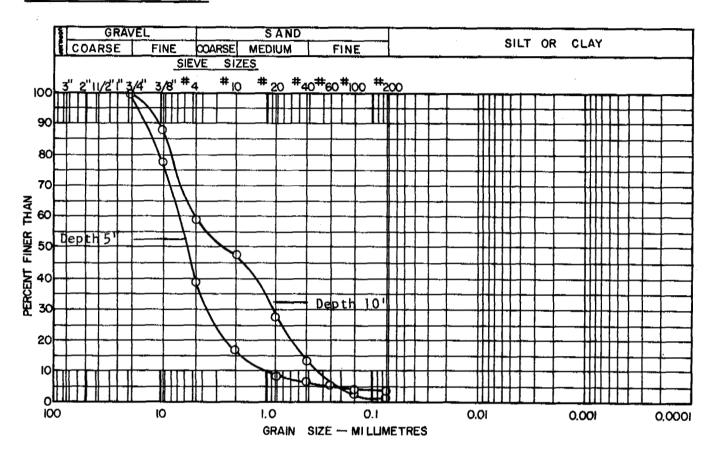
SILT - organic

SAND - little silt, fine uniform gradation

SAND - some silt, fine

LABORATORY TEST DATA TEST HOLE-SOURCE No. 2-126

GRAIN SIZE DISTRIBUTION

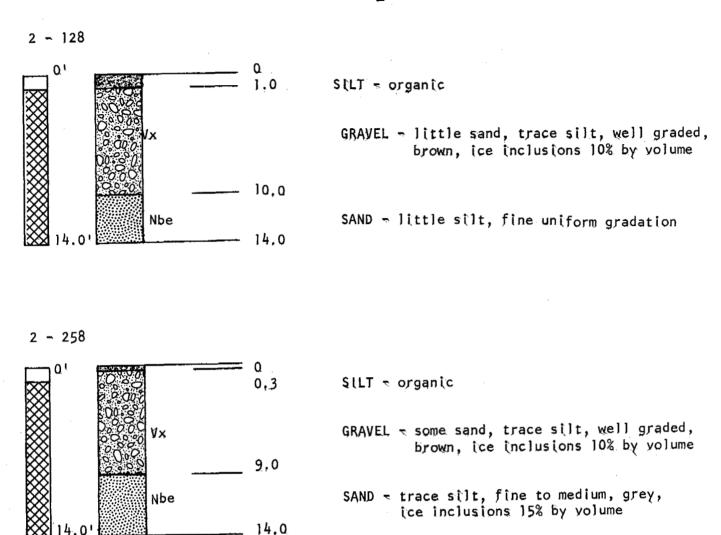


MOISTURE CONTENT

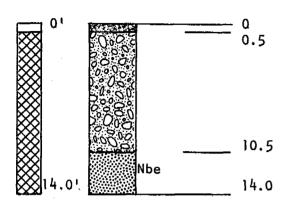
Sample 1 depth 2' 10.5%

Sample 2 depth 5' 5.3%

Sample 3 depth 10' 8.2%



2 - 259

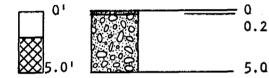


SILT - organic

GRAVEL - some sand, trace silt, well graded, brown

SAND - trace grayel, fine to medium, grey

2 - 260

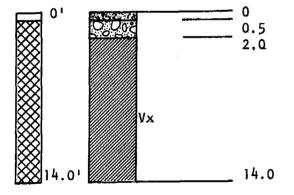


\$LLT → organic

GRAVEL

Hole terminated due to sloughing

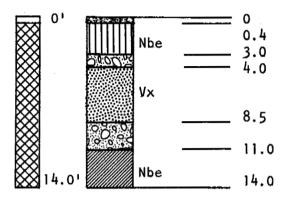
2 - 261



SILT - organic GRAVEL

CLAY - little silt, low plastic, grey, ice inclusions 20% by volume





\$1LT ★ organic

SILT - little sand, ice inclusions 20% by volume

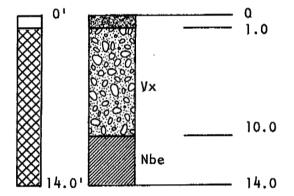
GRAVEL - little sand, fine uniform gradation

SAND - some fine gravel, trace silt, coarse, brown, ice inclusions 10% by volume

GRAVEL - some cobbles, trace sand, trace silt

CLAY - little silt, low plastic, laminated, grey

2 - 263

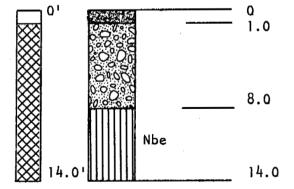


SILT - organic

GRAVEL - some sand, trace silt, trace cobbles, brown, ice inclusions 10% by volume

CLAY - little silt, low plastic, grey, ice inclusions 15% by volume

2 - 264

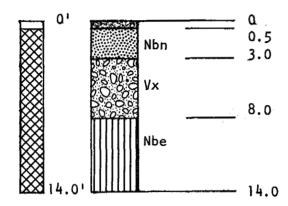


PEAT

GRAVEL - some sand, trace clay, well graded, brown

SILT - some clay, grey, ice inclusions 15% by volume

2 - 265

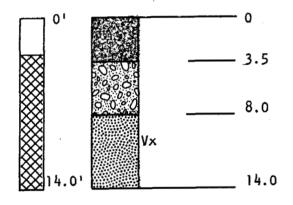


PEAT

SAND - clean, coarse, brown, ice inclusions
10% by volume
GRAVEL - little sand, trace silt, well graded,
brown, ice inclusions 10% by volume

SILT - and clay, low plastic, dark grey

2 - 266

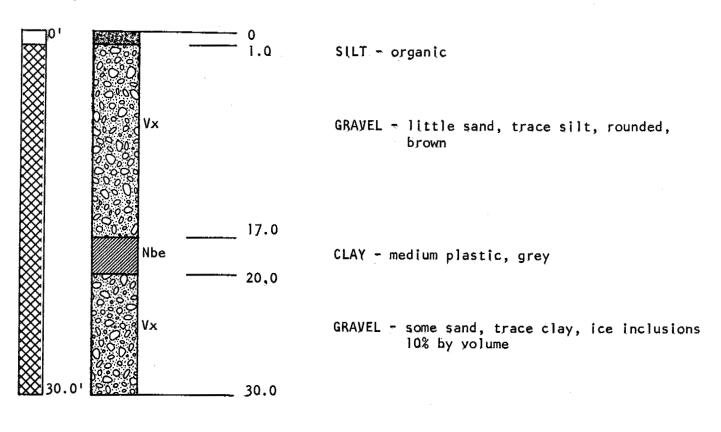


PEAT

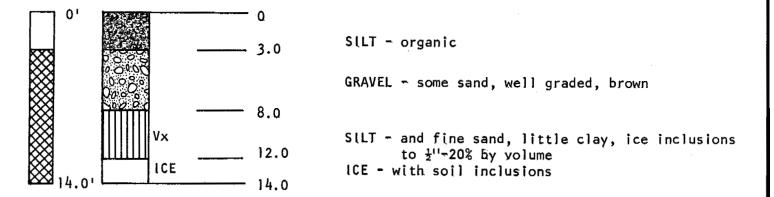
GRAVEL - little sand, trace silt, cobbles 7'-8', brown

SAND * trace clay, trace gravel in layers, medium gradation, brown, ice inclusions 15% by volume

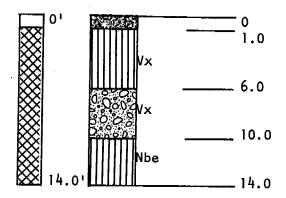
2 - 267



2 - 268



2 - 269



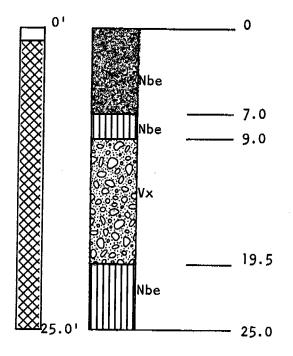
SILT - organic

SILT - ice inclusions to $1^{\prime\prime}$ -50% by volume

GRAVEL - and sand, trace silt, stratified, well graded, brown

SILT - little fine sand, grey

2 - 270



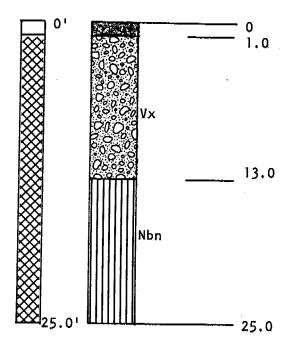
PEAT - some silt, ice inclusions 40% by volume

SILT - grey

GRAVEL - some sand, trace cobbles, trace silt, stratified, brown to 14', grey below 14'

SILT - some fine sand, grey

2 - 271

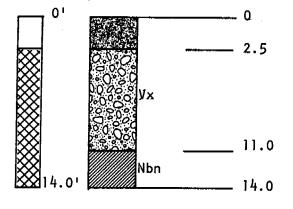


PEAT

GRAVEL - little sand, trace silt, well graded, brown, ice inclusions 5% by volume

SILT - little clay, little sand, laminated, grey

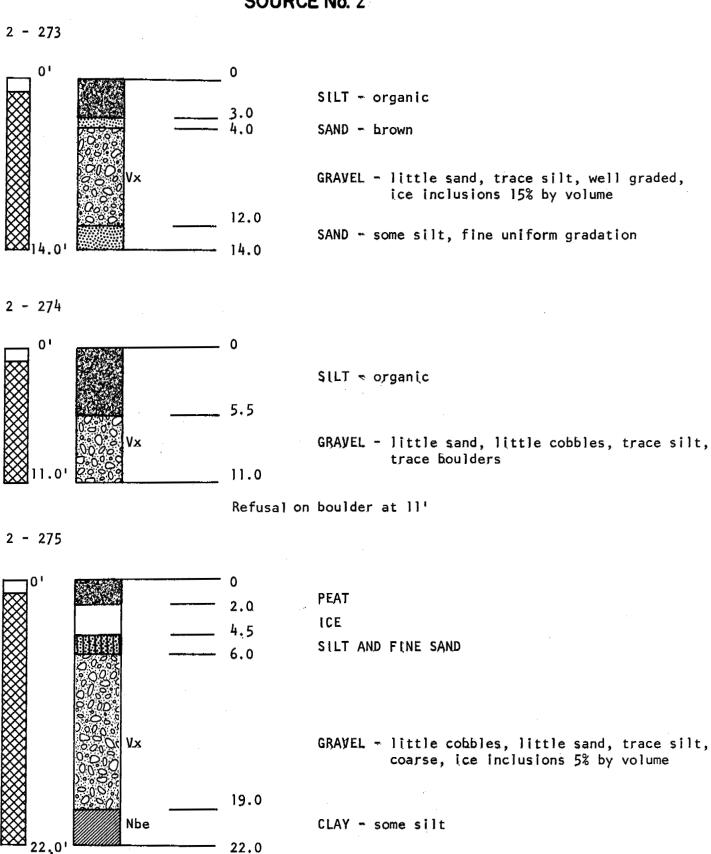
2 - 272

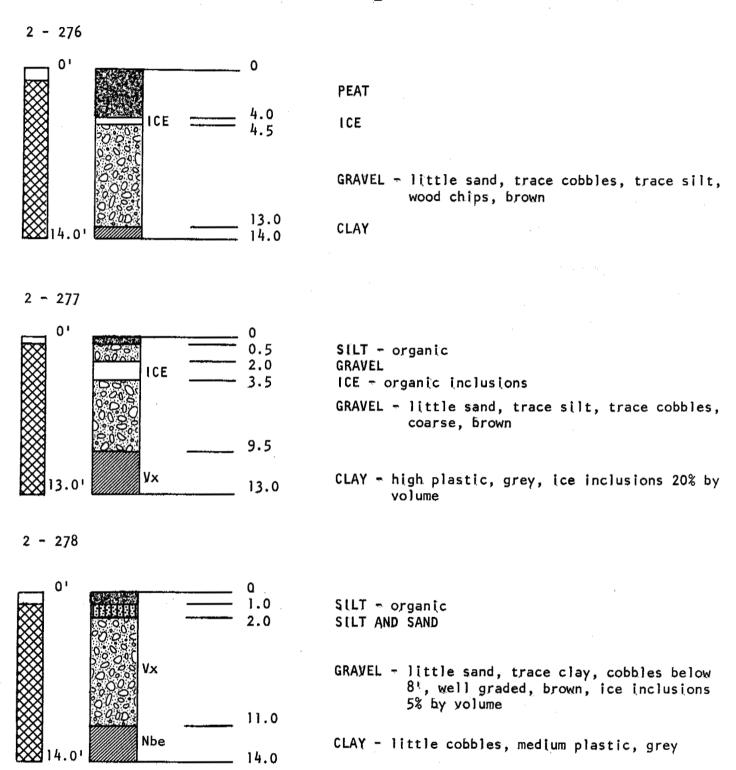


SLLT - organic

GRAVEL ~ some sand, trace silt, wood specks, brown, ice inclusions 5% by volume

CLAY - some silt, trace fine sand, medium plastic





0 0 SILT = organic

GRAVEL - little sand, trace silt, trace cobbles below 7', well graded, brown

8.0' 8.0

Refusal on boulder at 8'

PARSONS LAKE SOURCE No. 3

LANDFORM AND LOCATION: River terrace located 5 miles southeast of

Parsons Lake and I mile west of Eskimo Lakes.

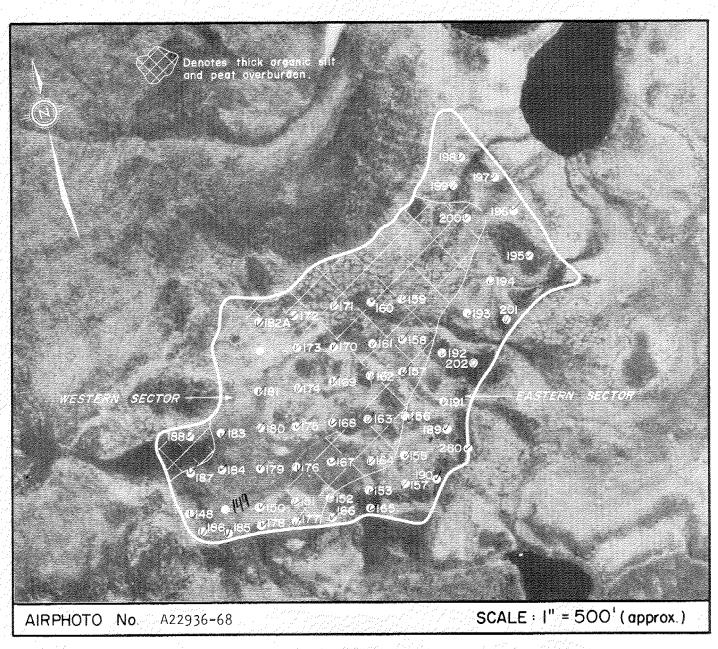
MATERIAL: GRAVEL - and sand, trace silt.

VOLUME: 370,000 cubic yards.

CONCLUSION: This is the third source of gravel and sand proven

up during the investigation and should be considered for development upon depletion of Sources 1

and 2.



SOURCE DESCRIPTION

The source is located within a large fluvial terrace about I mile west of the Eskimo Lakes. The terrace is likely post-glacial, related to the small stream immediately south of the source which flows into the Eskimo Lakes.



Photo looking northeast at source area.

The source is irregularly shaped and extends northward for a distance between 1000 and 2000 feet. The width of the source varies between 1000 and 1500 feet. The ground surface slopes to the east and the maximum elevation difference within the source is approximately 10 feet.

This portion of the terrace is bounded by steep banks which rise to a higher fluvial terrace on the west and north sides. The southern limit of the source is bounded by 30 to 35 foot banks which slope down to a lower flood plain adjacent to a small creek. To the east, a 25 foot bank slopes down to a large terrace (Source 8) which is about 15 feet above lake level.

A number of small drainage gullies bisect the eastern and southern portions

of the terrace, thus drainage of the source is good. Only sparse, thin layers of ground ice were founded from depths of 1 to 6 feet during drilling. An extensive area of ice wedge polygons and thick organic materials is present in the north and central part of the source. This area is outlined on the air photographs and divides the source into east and west sectors.

MATERIALS AND QUANTITIES

A total of 56 holes were drilled and 1 bank exposure logged in the source area. The subsoils are somewhat variable since the materials in this fluvial source were subject to seasonal variations during deposition, causing stratification and interbedding of the coarse gravels, sands and silt materials.

For discussion, the complete source area has been divided into two sectors - eastern sector and western sector. These are discussed below:

a) Eastern Sector

The eastern part of the source is outlined on the air photograph. Eighteen test holes were drilled in this sector. The organic topstratum consists of peat, silt and ice layers which vary from less than a foot to a maximum of 12 feet in thickness. The average thickness is about 4 feet. The moisture content of the organic topstratum is extremely erratic due to the presence of ice layers but is generally greater than 35%.

The organic topstratum generally overlies gravel and sand materials of varying thickness. For example, the thickness of gravel in Test Hole 191 is only 1.5 feet as compared to Test Hole 192 where the gravel is 25 feet thick. The average thickness is about 17 feet. The gravel and sand materials are fairly well to poorly graded with some fine to medium sand, and a trace of silt and clay. The moisture content of the gravel is between 5.5 and 11.3%. The ice content in the gravel stratum consists of ice inclusions and some ice lenses and is estimated at between 5 and 10% by volume. The silt content in the material is variable within the samples and is usually associated with the thin sand layers and ice lenses.

Silt, clay and sand materials usually underlie the gravel and sand stratum. These materials have moisture content between 20 and 30%, and usually contain well-bonded, non-visible ice.

The minimum volume of gravel material which can be removed from this source has been calculated between 220,000 and 380,000 cubic yards. This is based on a recoverable depth of 10 to 17 feet. The volume of overburden material to be removed is estimated at 90,000 cubic yards based on an average thickness of 4 feet.

b) Western Sector

The western part of the source has been outlined on the air photographs. A total of 19 test holes were drilled in this sector. Soil conditions are similar in this sector, however, the thickness of the organic overburden and the gravel materials are different. The organic overburden varies between 1 and 4 feet in thickness and has an average thickness of about 2 feet with moisture content between 30 and 50%. The gravel stratum varies between 5 and 18 feet in thickness with an average of about 10 feet. The moisture content of the gravel varies between 5 and 10%. Silt and clay materials underlie the gravel stratum. The moisture content of the silt and clay varies between 30 and 40%.

The minimum volume of gravel material which can be removed from this source has been calculated between 150,000 and 200,000 cubic yards. This was based on a recoverable depth of 7 to 10 feet. The volume of overburden material to be removed is estimated at about 50,000 cubic yards based on an average thickness of 2 feet.

CONCLUSIONS

This source should be developed after depletion of Sources 1 and 2. Not included in the sectors to be developed is the central area where the organic overburden is between 6 and 14 feet in thickness.

The gravel materials in the source are suitable as good quality fill for construction of roadways, airstrips or general site work. With processing, fine and coarse aggregates can be produced for concrete work.

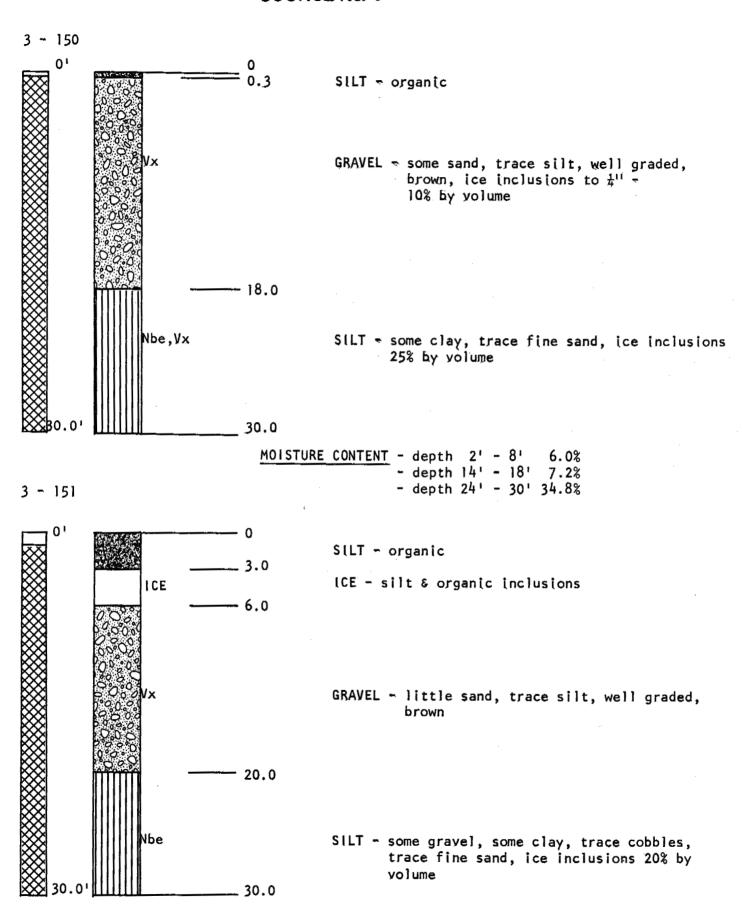
The east and west sectors of the source could be worked independently of each other. All waste material should be stockpiled adjacent to the area being

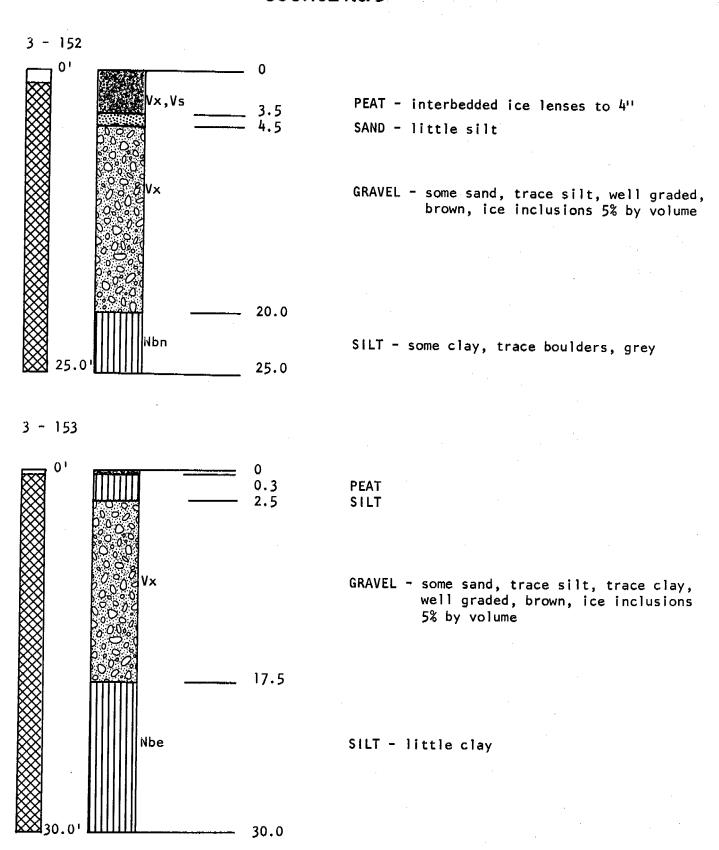
worked for use in future restoration of the pit.

Development of the source should begin from the lower terraces on the east and south sides of the eastern and western sectors respectively. A berm or dyke may be required on the lower terraces to prevent waste materials and water from reaching the adjacent stream or lakes.

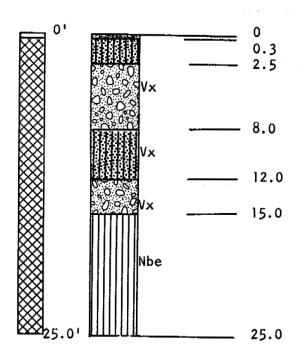
3 - 14801 1.0 SILT - organic 2.0 ICE GRAVEL - some sand, trace silt, well graded, brown, ice inclusions to 4", -10.0 15% by volume Nbe SILT - some fine sand, some clay, trace gravel, trace boulders, medium plastic, grey 24.0 MOISTURE CONTENT - depth - 0' - 2' 39.2% - depth - 2' - 10' 6.4% - depth - 15' - 20' 36.2% 3 - 149٥, 0.5 SILT - organic, brown GRAVEL - some sand, trace silt, well graded, Nbn 8.0 SILT - little clay, black Nbe GRAVEL - some sand, little silt, black 11.0 Nbe SILT - trace fine sand, trace cobbles, grey

25.0









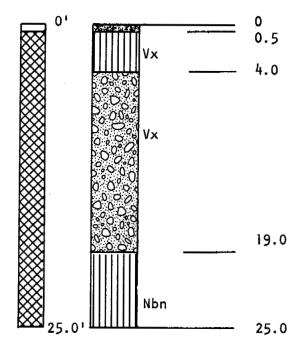
PEAT

SILT AND SAND - travel gravel, brown

SAND AND SILT - trace organics, ice inclusions to \$\frac{1}{4}\display=15\% by volume

SILT - some sand, trace gravel, ice inclusions 20% by volume

3 - 155



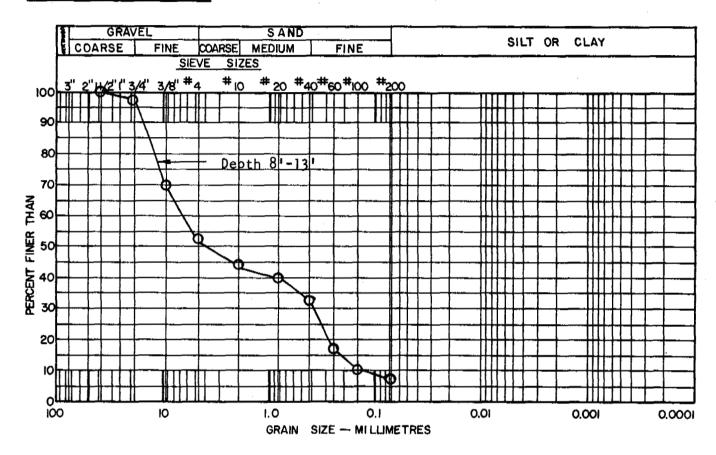
PEAT

SILT - brown to grey, ice inclusions 25% by volume

SILT - some fine sand, grey, ice inclusions to 20% by volume

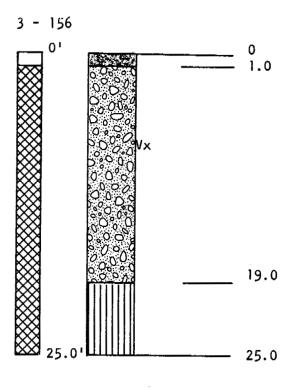
LABORATORY TEST DATA TEST HOLE-SOURCE No. 3 - 155

GRAIN SIZE DISTRIBUTION



MOISTURE CONTENT

Depth	21-41	36.8%
Depth	8'-10'	10.4%
Depth	11'-13'	20.4%
Depth	201-221	19.6%

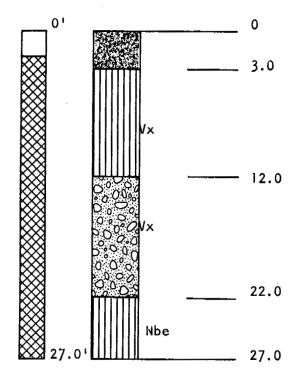


PEAT

GRAVEL - some sand, trace silt, well graded, brown, ice inclusions to 1/8"

SILT - some find sand, little clay, trace gravel

3 - 157



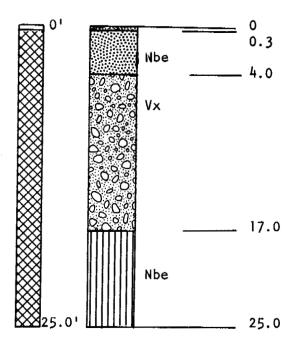
PEAT

SILT - grey, ice inclusions to $\frac{1}{2}$ 11-20% by volume

GRAVEL - some sand, trace silt, well graded, brown, ice inclusions to $\frac{1}{2}$ "-15% by volume

SILT - trace fine sand, trace gravel





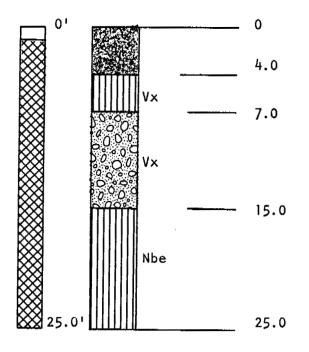
SILT - organic

SAND - some silt, trace clay

GRAVEL - some sand, trace silt, well graded, brown, ice inclusions 5% by volume

SILT - grey

3 - 159



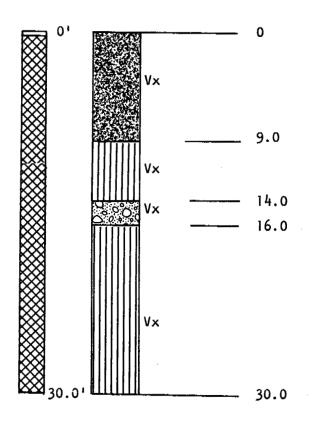
PEAT

SILT - grey, ice inclusions to 1"-30% by volume

GRAVEL - some sand, trace silt, trace clay, well graded, brown, ice inclusions to 4"-15% by volume

SILT - grey





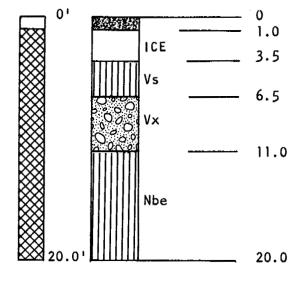
SILT - organic, ice inclusions to 1"-30% by volume

SILT - ice inclusions to 1"-40% by volume

GRAVEL - some silt, grey

SILT - trace cobbles, grey, ice inclusions 30% by volume

3 - 161



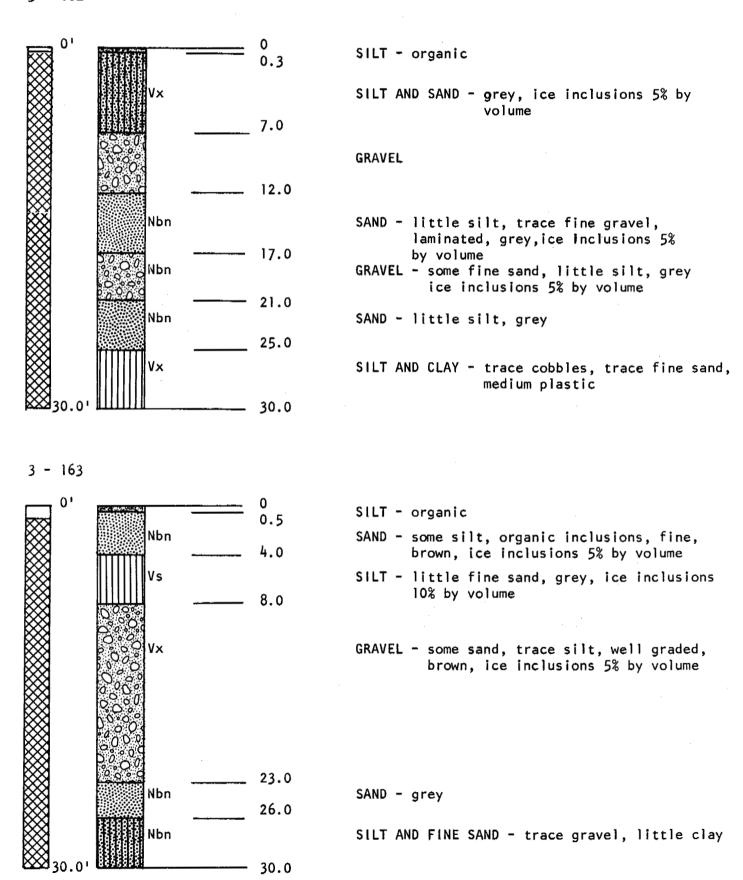
PEAT

ICE

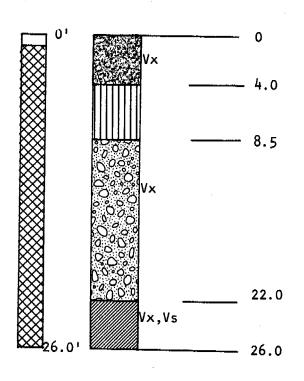
SILT - some fine sand, ice inclusions 20% by volume

GRAVEL - some sand, trace silt, well graded, brown, ice inclusions 10% by volume

SILT - trace fine sand, grey







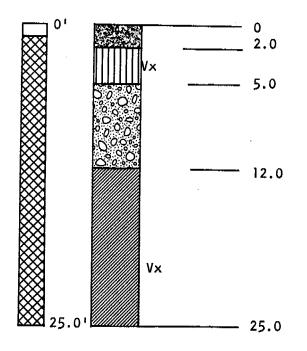
SILT - organic, ice inclusions to $\frac{1}{2}$ 11-15% by volume

SILT - organic inclusions, ice inclusions 20% by volume

GRAVEL - little sand, trace silt, trace clay, trace cobbles, brown, ice inclusions to ½"-15% by volume

CLAY AND SAND - some silt, grey, ice inclusions 30% by volume

3 - 165



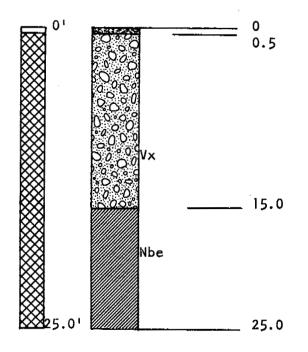
SILT - organic

SILT - ice inclusions 25% by volume

GRAVEL - some sand, trace silt, coarse

CLAY - high plastic, ice inclusions 20% by volume

3 - 166

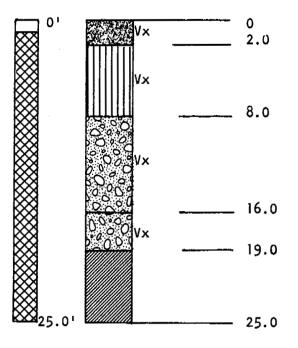


SILT - organic

GRAVEL - some sand, trace silt, well graded, brown, ice inclusions 5% by volume

CLAY - some fine sand, high plastic, grey

3 - 167



PEAT - ice inclusions to 1"-30% by volume

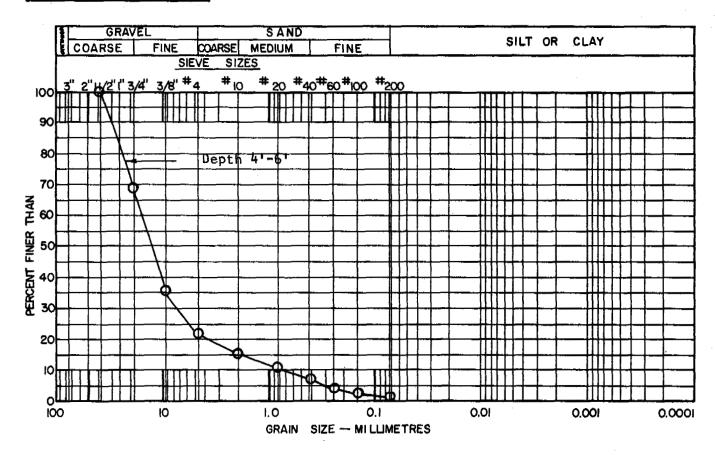
SILT - ice inclusions to 1"-30% by volume

SAND AND GRAVEL - trace clay, grey, ice inclusions 15% by volume

CLAY - some fine sand, trace silt, trace cobbles

LABORATORY TEST DATA TEST HOLE-SOURCE No. 3 - 166

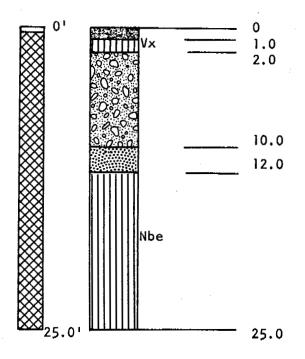
GRAIN SIZE DISTRIBUTION



MOISTURE CONTENT

Depth 4'-6' 3.7% Depth 15'-17' 16.6%





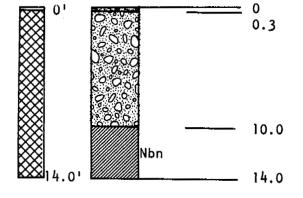
SILT - organic

SILT - ice inclusions to 1"-30% by volume

SAND - some silt, trace clay, trace fine gravel

SILT - some fine sand, trace clay

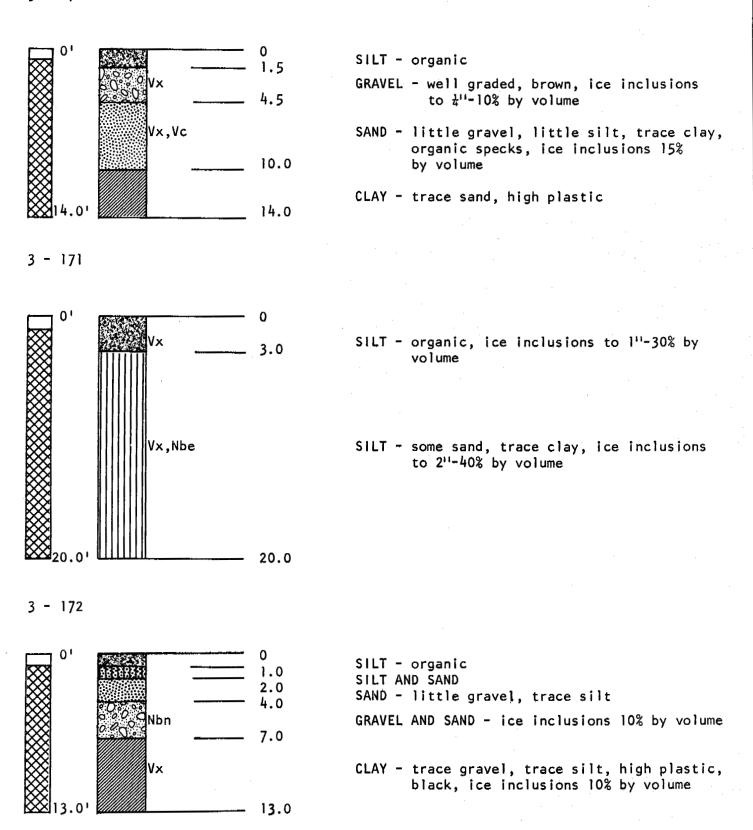
3 - 169

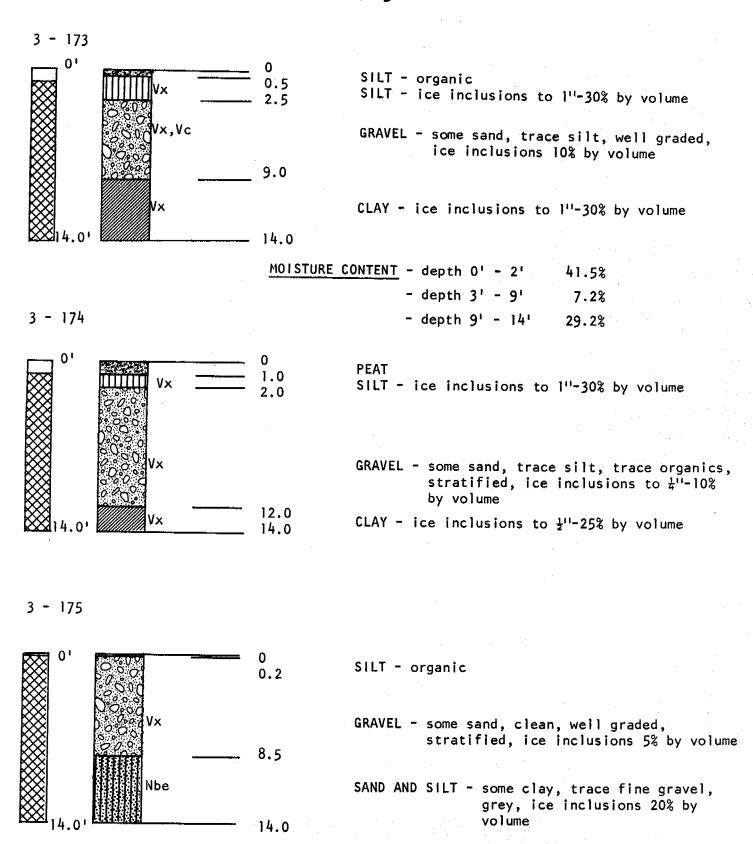


PEAT

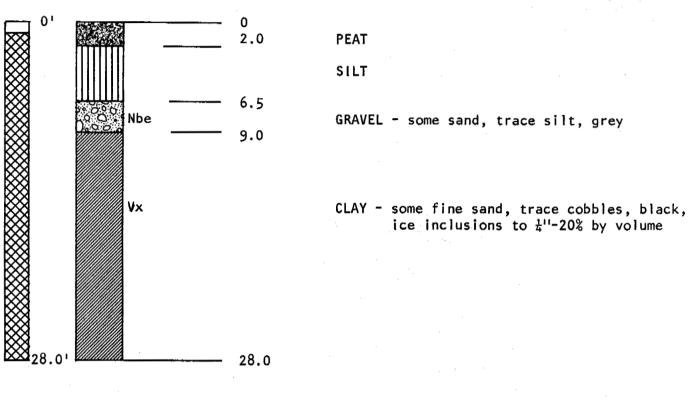
CLAY - little gravel, trace cobbles, trace
 fine sand, organic specks, high plastic,
 black



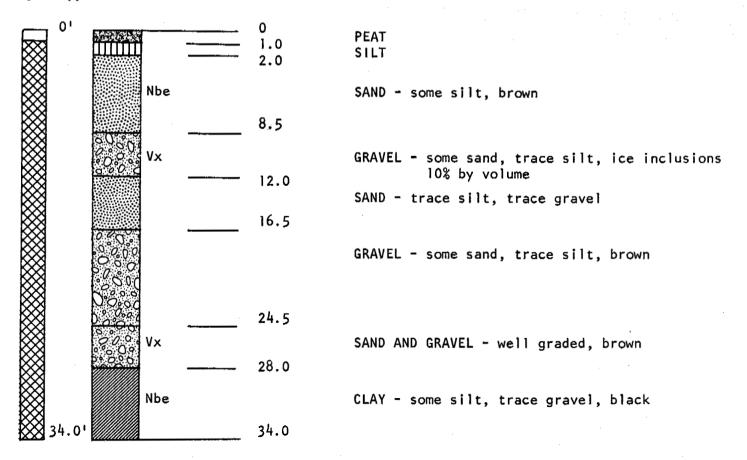


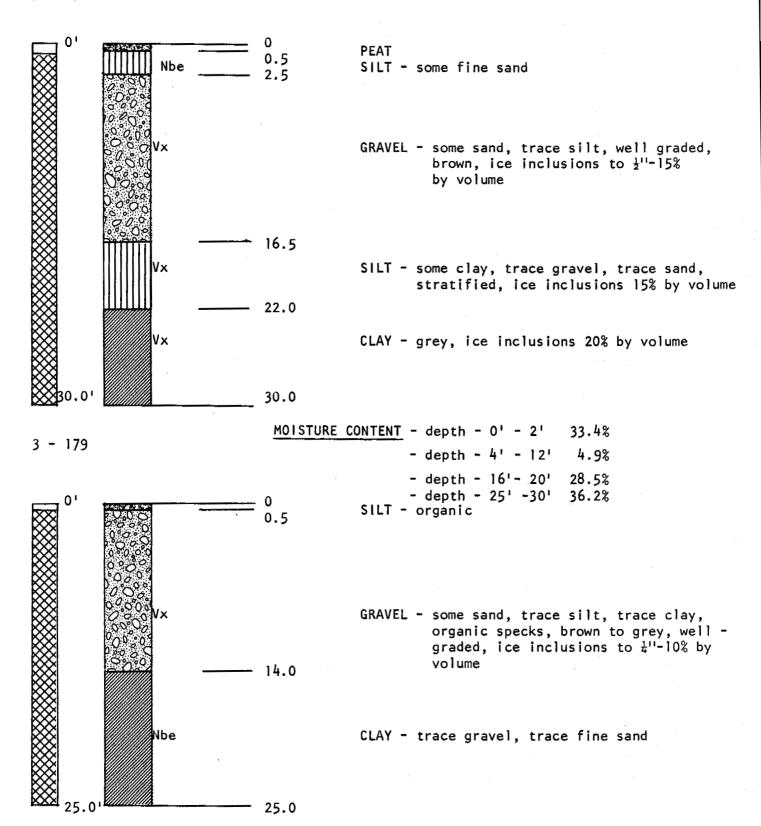


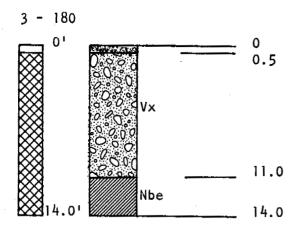
3 - 176



3 - 177





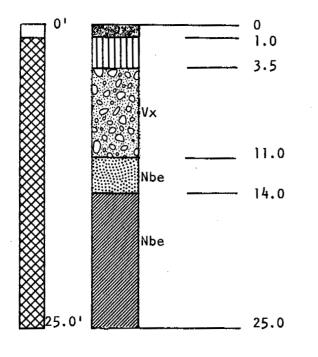


PEAT

GRAVEL - and sand, trace clay, trace silt, well graded, ice inclusions to ±"-10% by volume

CLAY - some sand, stratified, dark grey

3 - 181



SILT - organic

SILT

GRAVEL - some sand, trace silt, well graded, brown, ice inclusions 10% by volume

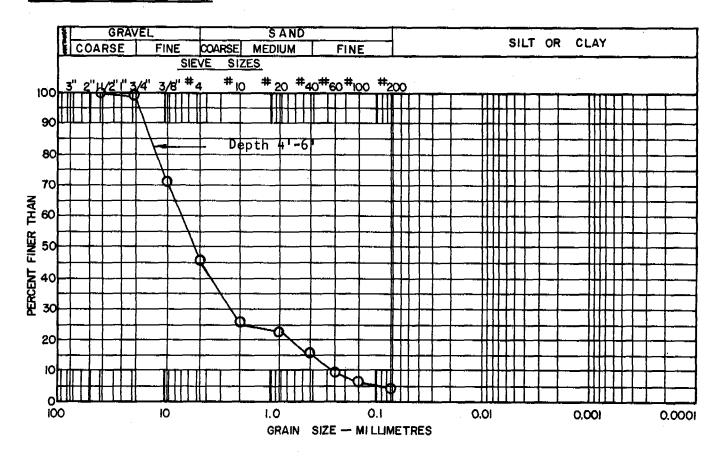
SAND - some gravel, trace silt, grey

CLAY - grey

LABORATORY TEST DATA

TEST HOLE-SOURCE No. 3 - 180

GRAIN SIZE DISTRIBUTION

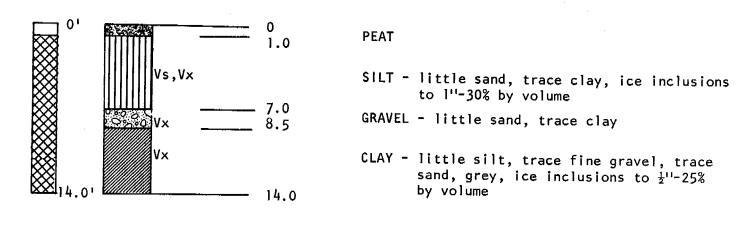


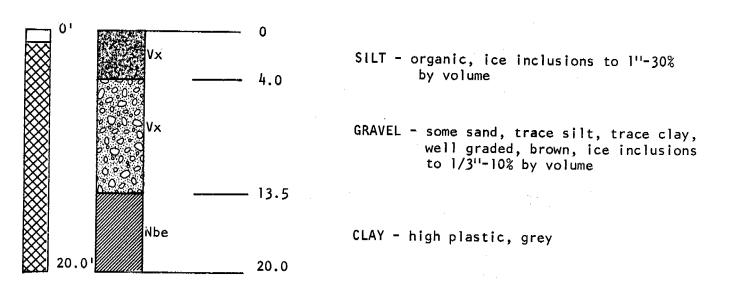
MOISTURE CONTENT

Depth 4'-6' 7.5%

3 - 182A

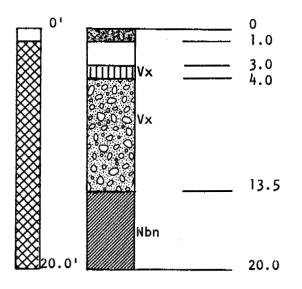
3 - 182





MOISTURE CONTENT - depth 0' - 4' 56.2% - depth 4' - 12' 6.0% - depth 15' - 20' 37.2%

3 - 183



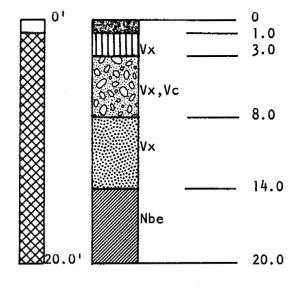
PEAT ICE - silt inclusions, organic inclusions

SILT - ice inclusions to 1"-40% by volume

GRAVEL AND SAND - trace silt, laminated, brown, ice inclusions 5% by volume

CLAY - trace silt, high plastic, grey, ice inclusions 15% by volume

3 - 184



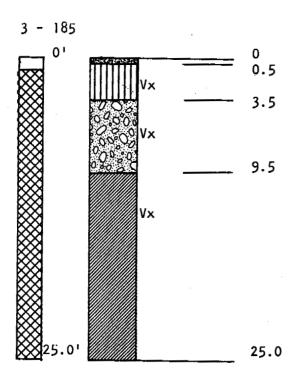
PEAT

SILT - trace fine sand, ice inclusions to 1"-30% by volume

GRAVEL - some sand, trace clay, brown, ice inclusions to 1/8"-15% by volume

SAND - little gravel, clean, grey, ice inclusions to 1/8"-25% by volume

CLAY - trace silt, grey



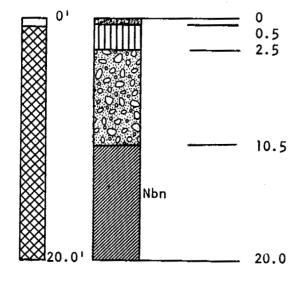
SILT - organic

SILT - some sand, ice inclusions to $\frac{1}{2}$ "-25% by volume

GRAVEL - some sand, trace clay, clean, well - graded, brown, ice inclusions to 1/8"-5% by volume

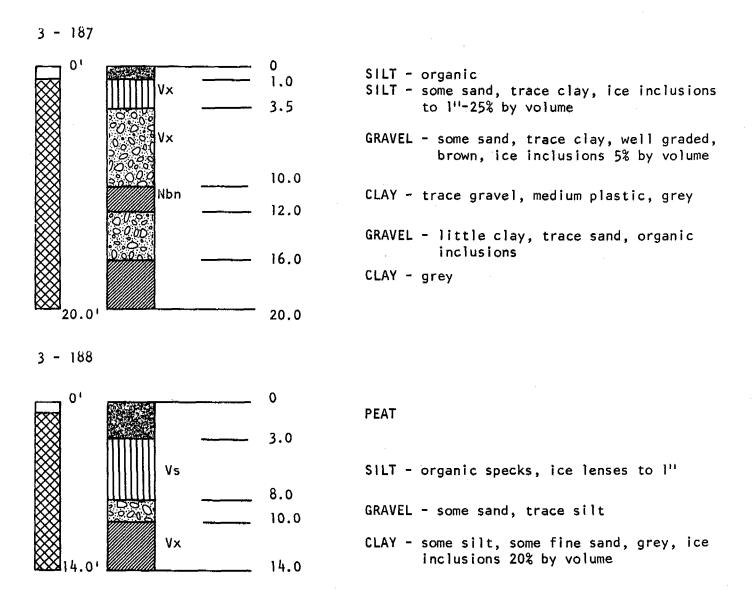
CLAY - trace sand, high plastic, grey

3 - 186

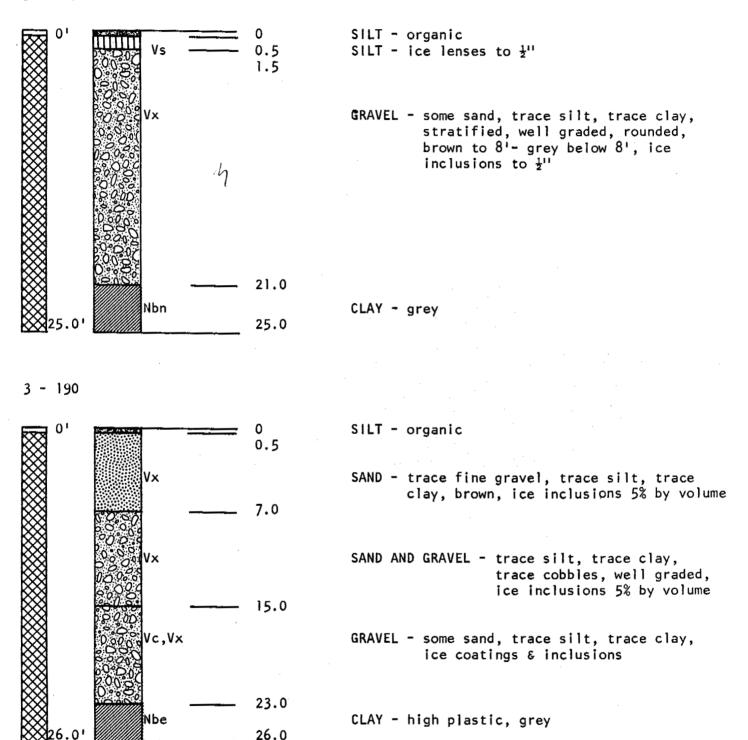


SILT - organic SILT - trace sand

CLAY - medium plastic, grey, ice inclusions 5% by volume



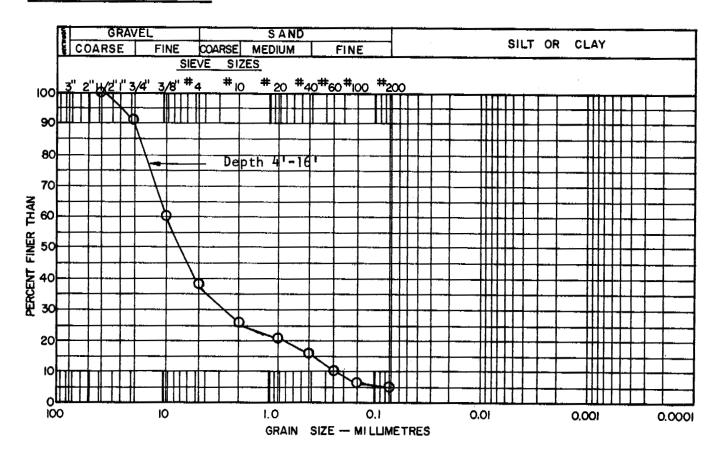




LABORATORY TEST DATA

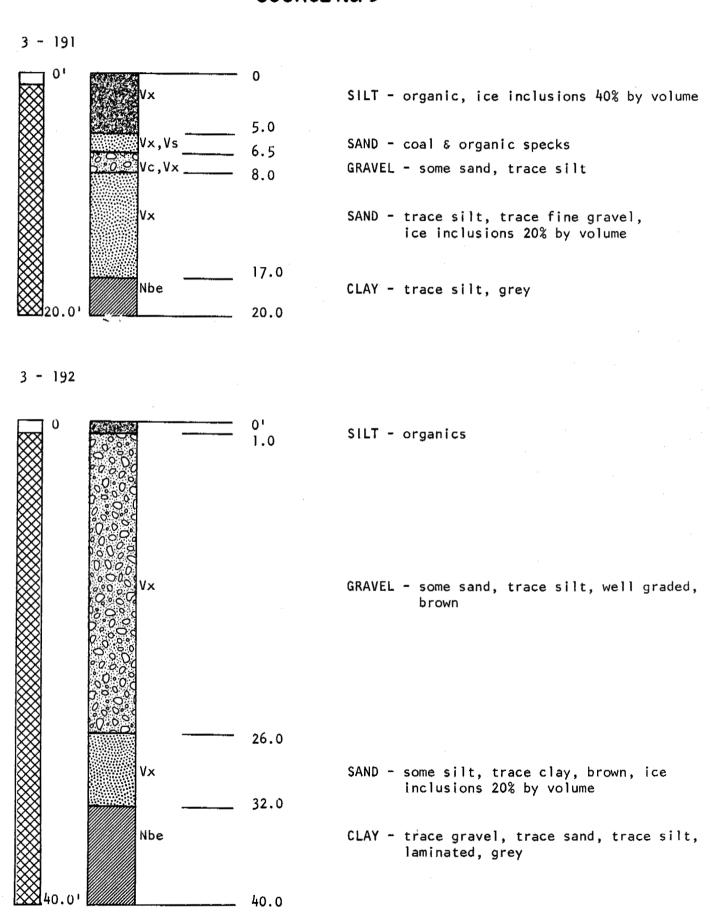
TEST HOLE-SOURCE No. 3 - 189

GRAIN SIZE DISTRIBUTION

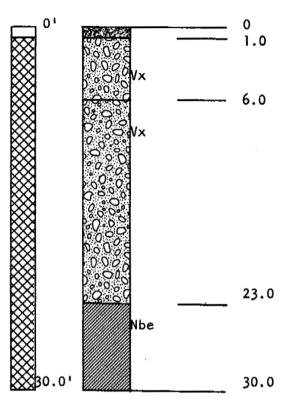


MOISTURE CONTENT

Depth 4'-6' 5.5% Depth 12'-14' 6.7% Depth 22'-24' 18.7%







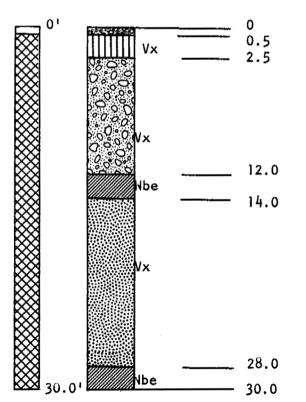
PEAT

GRAVEL - and sand, little silt, trace clay

GRAVEL - and sand, trace silt, well graded, brown, ice inclusions to 1/8"-10% by volume

CLAY - some fine sand, trace silt, grey

3 - 194



PEAT SILT - some fine sand, trace clay, ice inclusions to 1"

GRAVEL - some sand, trace silt, well graded, brown, ice inclusions 10% by volume

CLAY - little sand, trace silt

SAND - some silt, little clay, fine uniform gradation, grey

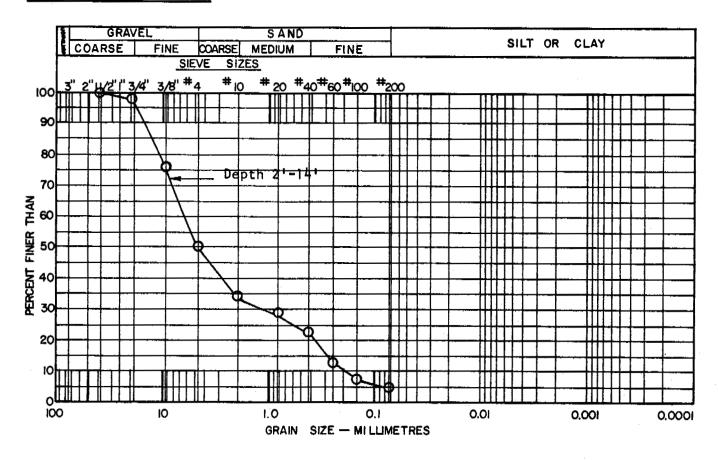
CLAY - little sand, trace silt

Klohn Leonoff Consultants Ltd.

LABORATORY TEST DATA

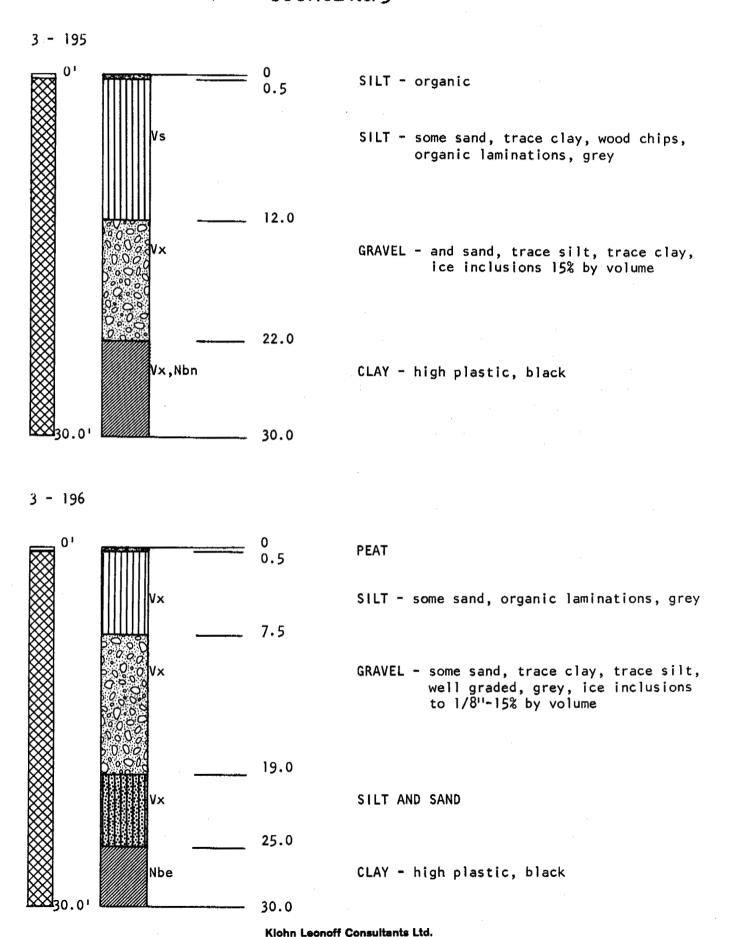
TEST HOLE-SOURCE No. 3 - 193

GRAIN SIZE DISTRIBUTION



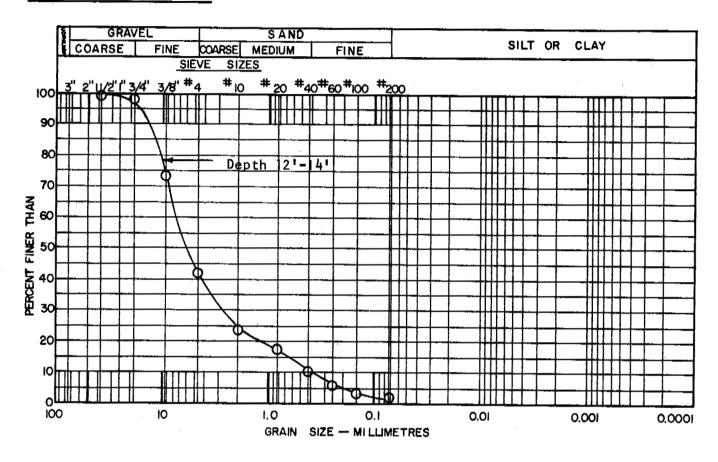
MOISTURE CONTENT

Depth 2'-4' 11.3% Depth 12'-14' 5.5%



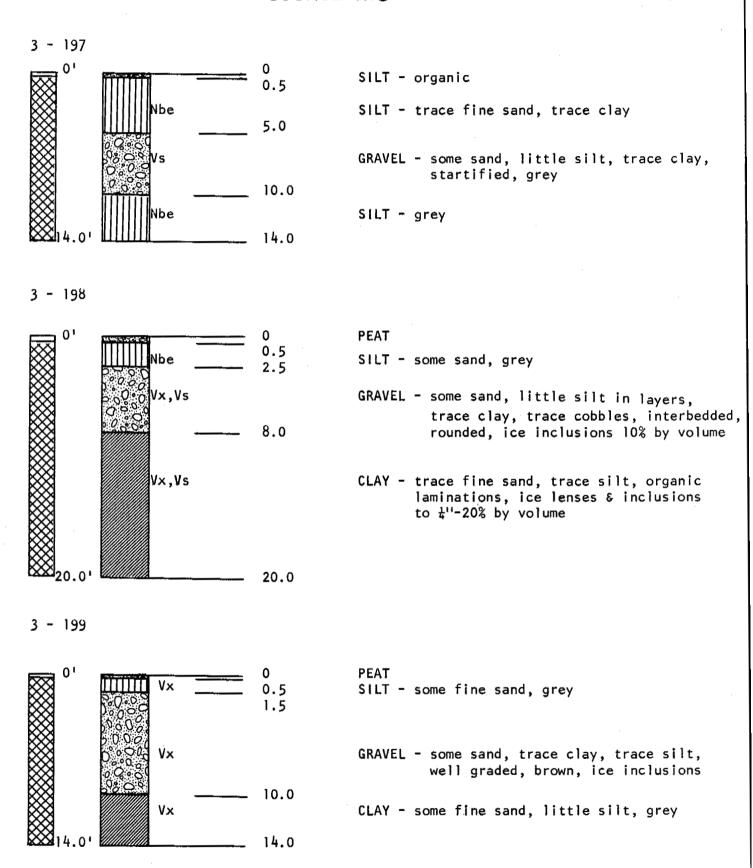
LABORATORY TEST DATA TEST HOLE-SOURCE No. 3 - 196

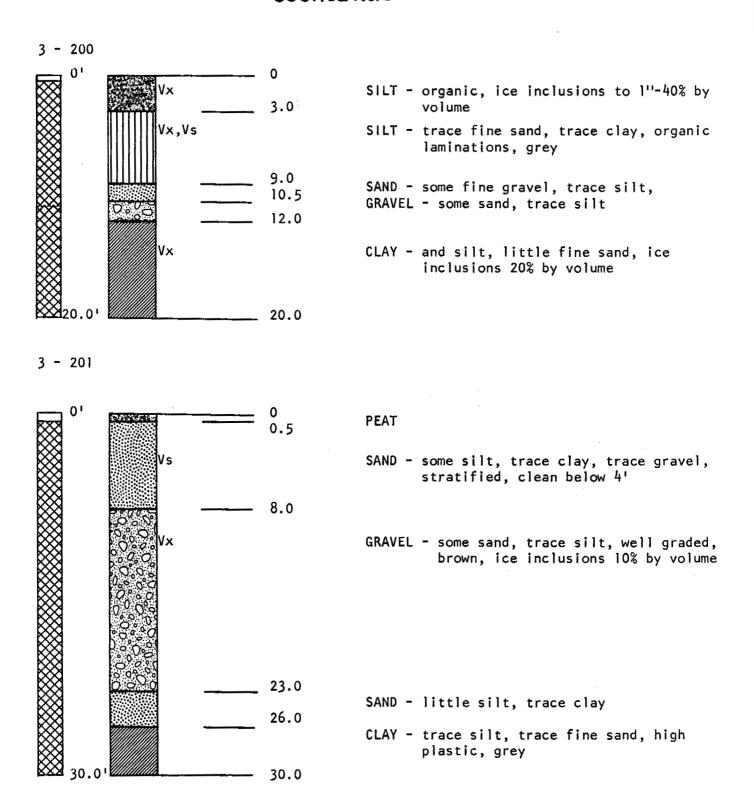
GRAIN SIZE DISTRIBUTION

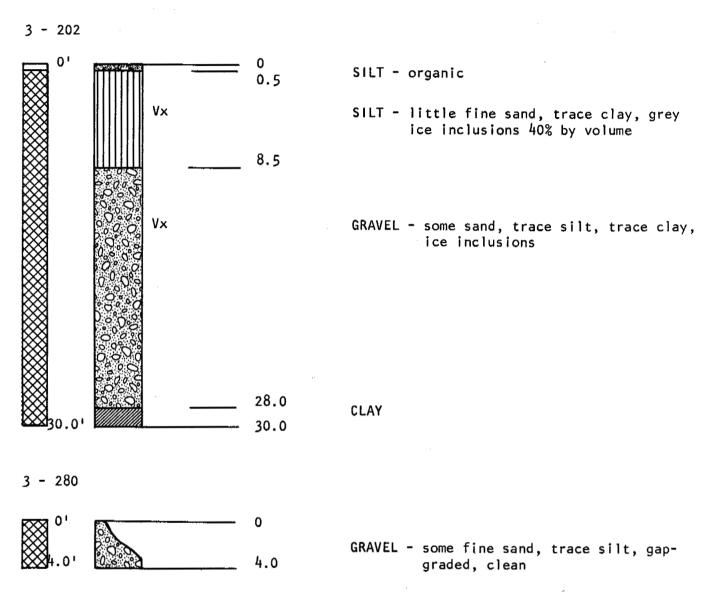


MOISTURE CONTENT

Depth 12'-14' 7.6%





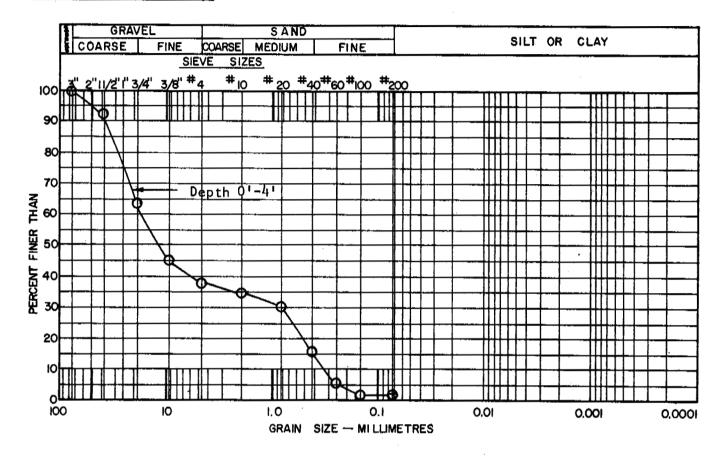


Soil profile logged from bank exposure.

LABORATORY TEST DATA

TEST HOLE-SOURCE No. 3 - 280

GRAIN SIZE DISTRIBUTION



MOISTURE CONTENT

PARSONS LAKE SOURCE No. 4

LANDFORM AND LOCATION: A high terrace located 5 miles southeast of

Parsons Lake and 2 miles west of Eskimo Lakes.

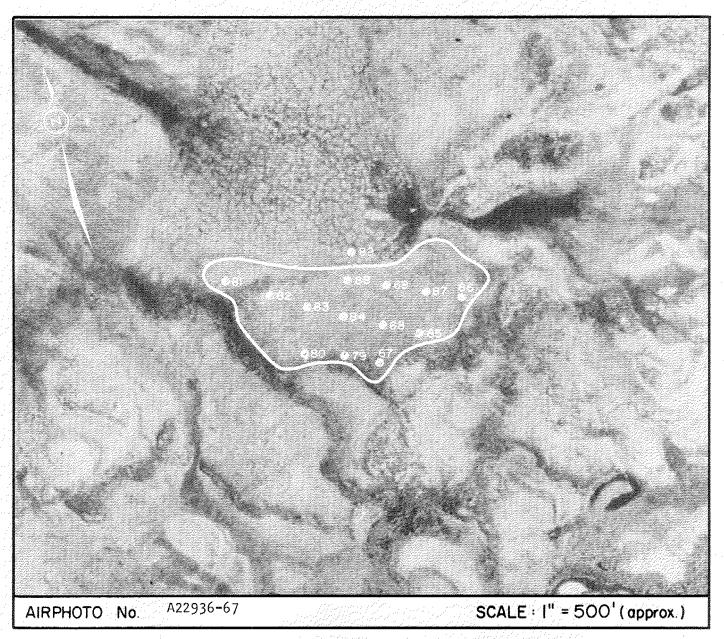
MATERIAL: GRAVEL AND SAND - trace silt.

VOLUME: 200,000 cubic yards.

CONCLUSION: Source is recommended as a low priority devel-

opment because of thickness of overburden and

limited volume of usable material.



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SOURCE DESCRIPTION

The source is an upper fluvial terrace located on the upland north of Source 9 and southwest of Source 3. The terrace is roughly rectangular, about 1000 feet long and 500 feet wide.

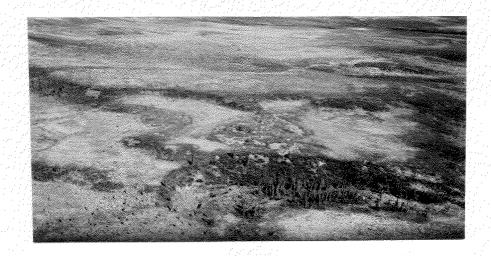


Photo looking north at source area. Source 9 is in foreground.

The terrace is flat lying and extends to the north of the area drilled, however, the northern area is poorly drained, consisting of extensive raised center ice wedge polygons. The terrace is bounded on the southwest and southeast by banks which drop to the lower fluvial terraces. The height of the banks vary between 15 and 25 feet.

MATERIALS AND QUANTITIES

A total of 14 test holes were drilled and I bank exposure logged in the source area. The subsoil conditions in the source are relatively uniform and consist of organic silt and peat overlying the gravel and sand stratum.

The overburden materials range in thickness from 3.5 feet near the banks to 9.5 feet farther inland, averaging about 6 to 7 feet. The moisture content of the silt overburden material varies from 17.5 to 38.9%, averaging about 27%. Ground ice layers are present in the organic silt and peat stratum at shallow depths. Test Hole 89, drilled in the ice wedge polygonal ground immediately north of the source encountered 14 feet of peat, ice and silt.

The overburden materials are underlain by a sequence of interbedded gravels and sands. The gravel stratum varies between 6 and 18 feet in thickness. Sand layers 1 to 3 feet in thickness are present within the gravel stratum. The average thickness of the gravel stratum is about 15 feet. The upper 5 feet of gravel is generally well graded, and coarser than the underlying materials, with an ice content of 5 to 10% by volume. At depth, the finer gravel material contains more sand than above and has an ice content of 15 to 20% by volume.

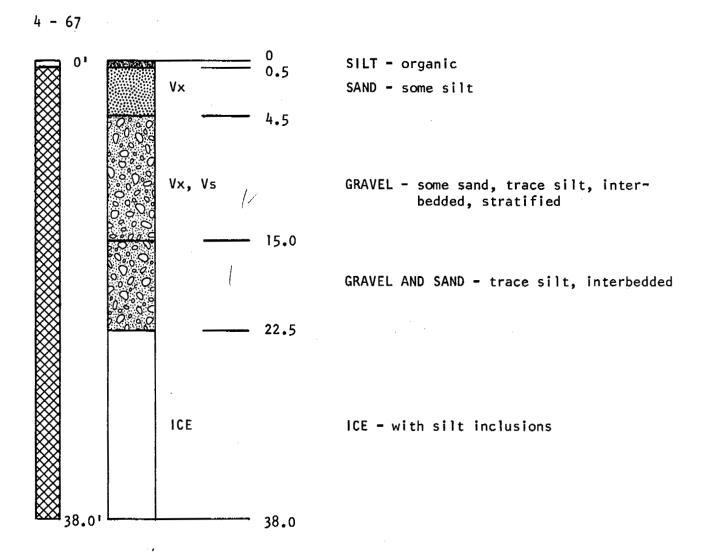
The moisture content of the sand and gravel material varies from 5.5 to 18.3%, averaging about 11%.

The granular stratum is underlain by massive ice up to 17 feet thick, and grey ice-rich laminated silts. The moisture content of the silt is about 28% to 34%, however, ice inclusions and lenses up to 50% by volume were observed in the silt material.

The volume of gravel material which can be removed from this source has been calculated at about 200,000 cubic yards. This is based on an average thickness of gravel of 15 feet. The volume of overburden which must be removed has been calculated at about 90,000 cubic yards, and is based on an average thickness of 6 feet.

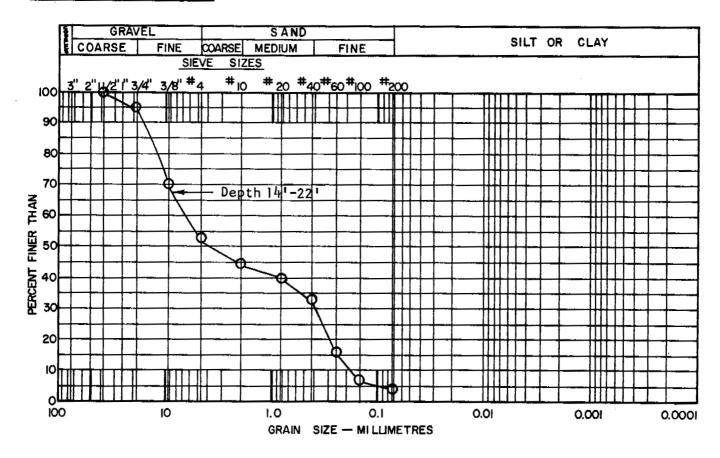
CONCLUSIONS

This source should be considered as a low priority development after depletion of Sources 1, 2, and 3. This is due to the volume of overburden which must be removed as compared to the limited quantity of gravel available.



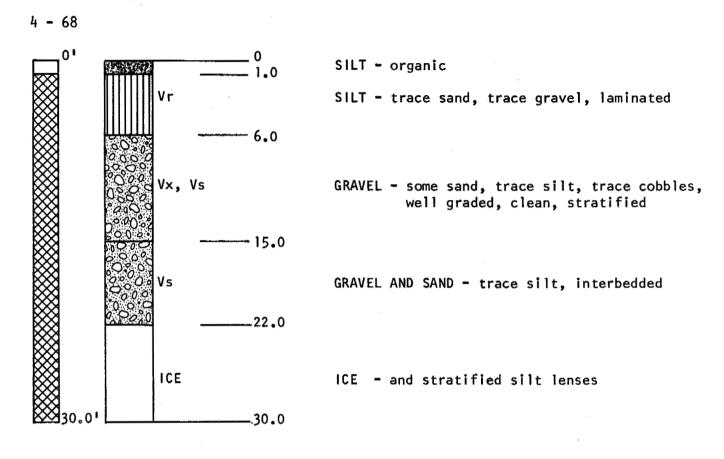
LABORATORY TEST DATA TEST HOLE-SOURCE No. 4 - 67

GRAIN SIZE DISTRIBUTION

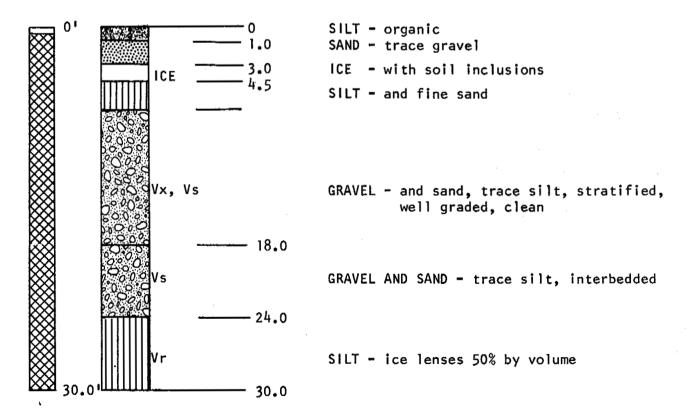


MOISTURE CONTENT

Depth 14'-16' 9.3% Depth 18'-22' 14.9%



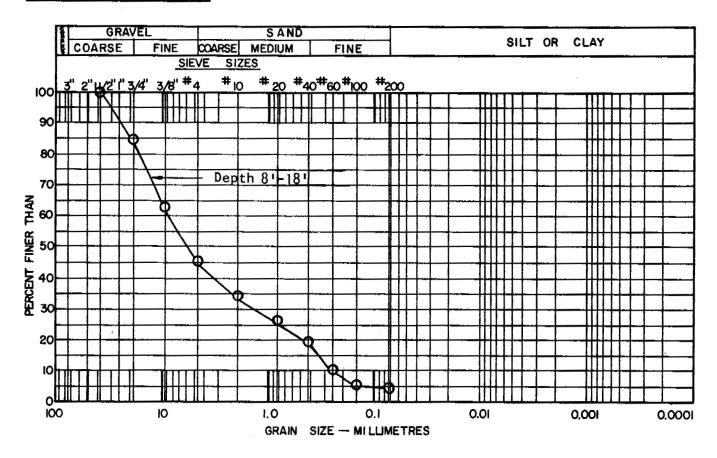




LABORATORY TEST DATA

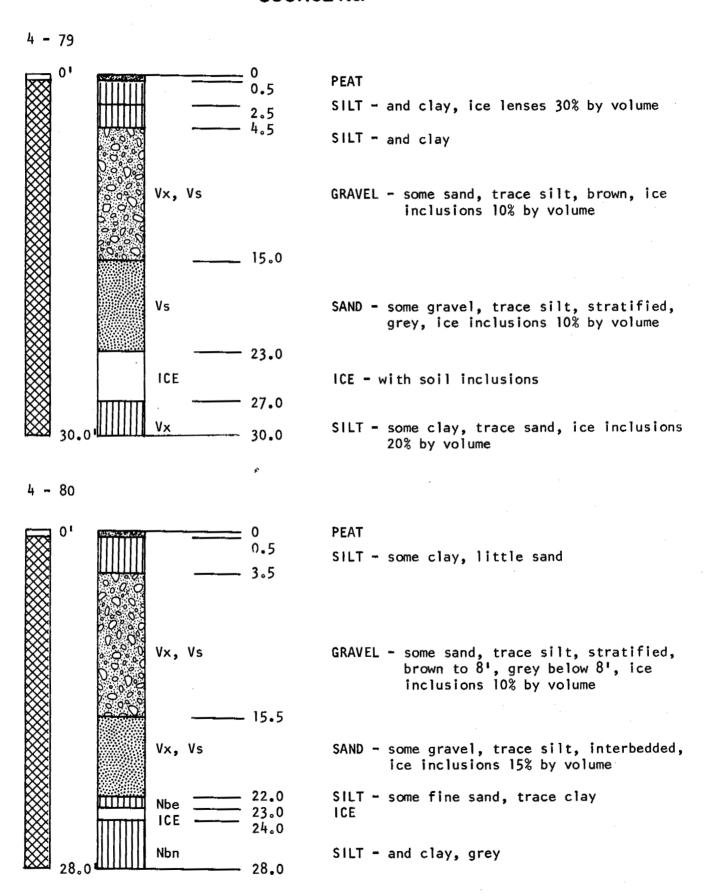
TEST HOLE-SOURCE No. 4 - 69

GRAIN SIZE DISTRIBUTION



MOISTURE CONTENT

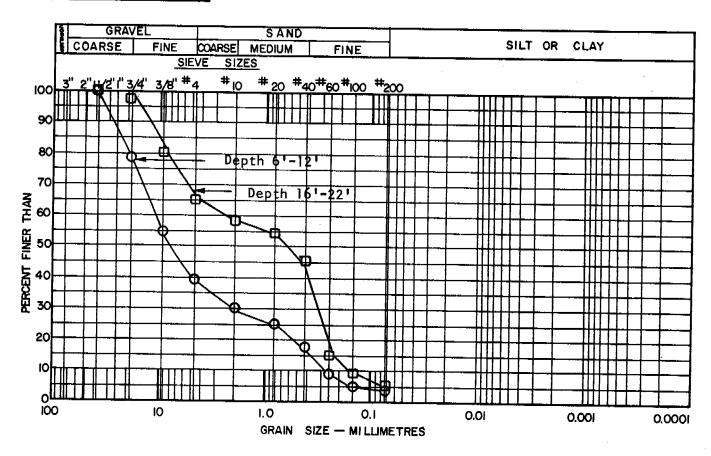
Depth	41-61	22.8%
Depth	8'-10'	5.6%
Depth	16'-18'	10.4%



LABORATORY TEST DATA

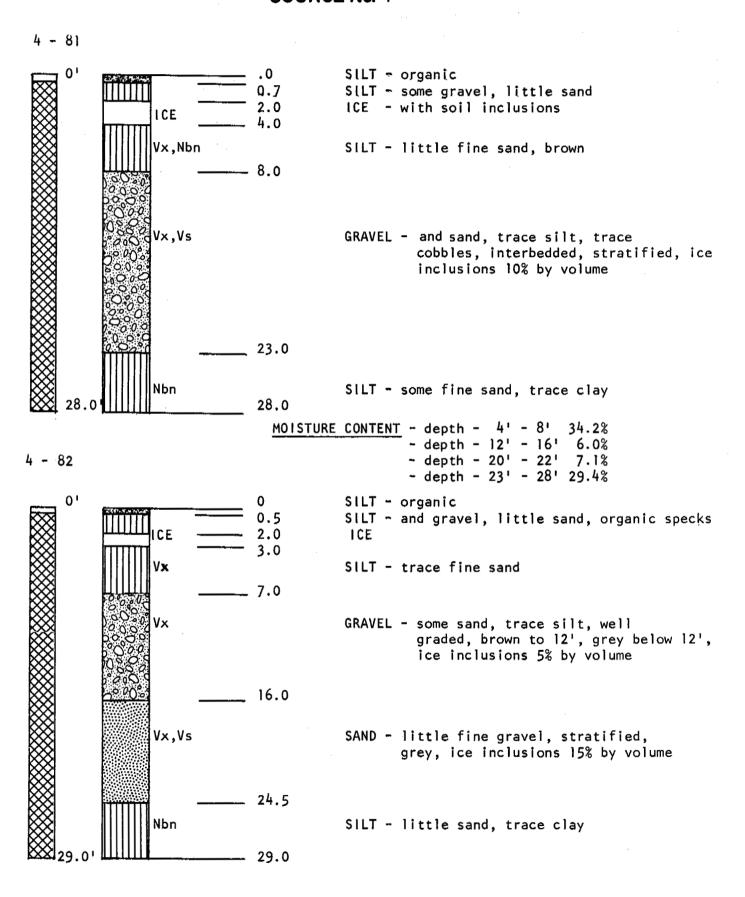
TEST HOLE-SOURCE No. 4 - 79

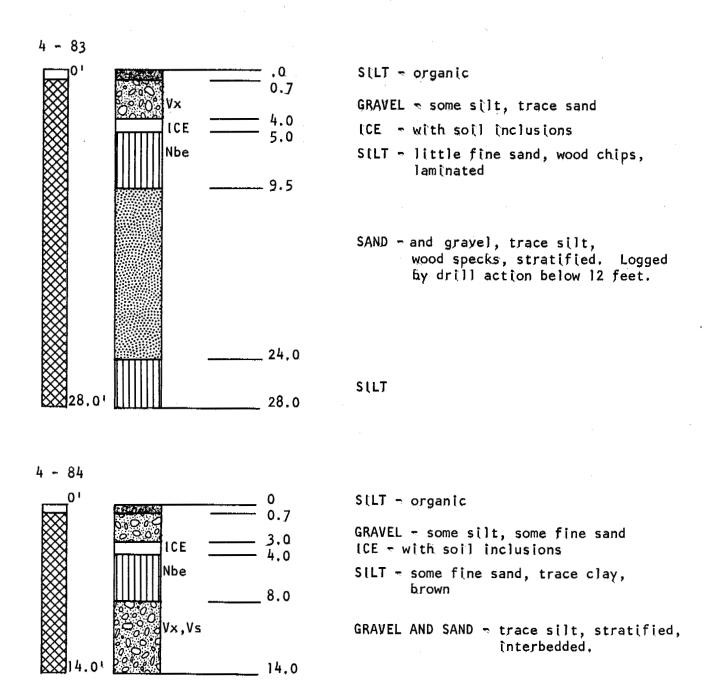
GRAIN SIZE DISTRIBUTION



MOISTURE CONTENT

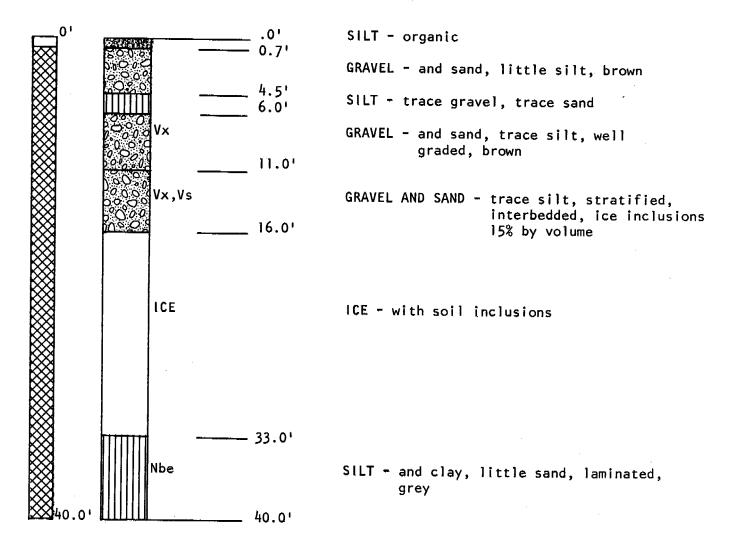
Depth	21-41	26.4%
	61-81	7.4%
Depth	10'-12'	5.5%
Depth	16'-18'	9.8%
Depth	201-221	15.1%
Depth	28'-30'	28.0%





Hole terminated at 14 feet due to sloughing.

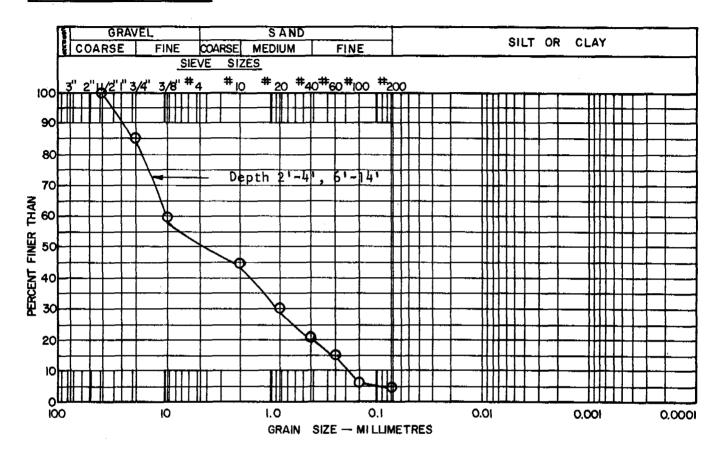




LABORATORY TEST DATA

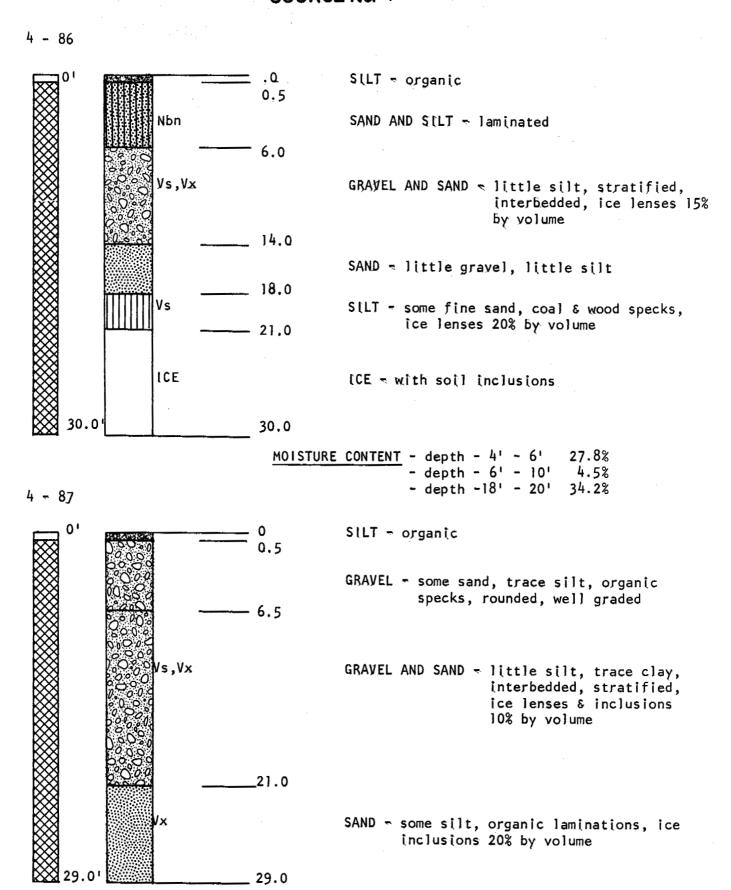
TEST HOLE-SOURCE No. 4 - 85

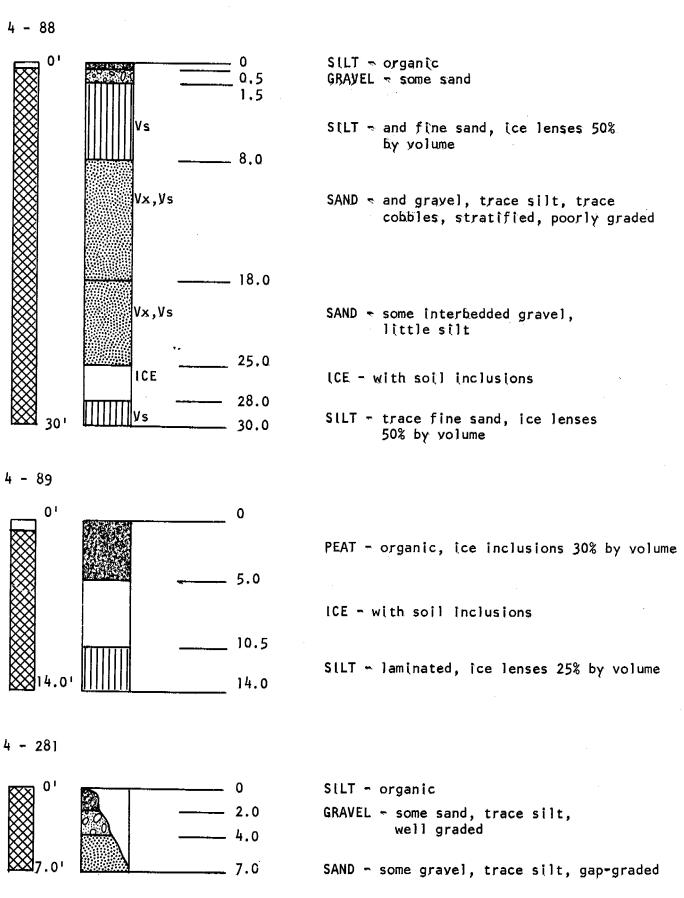
GRAIN SIZE DISTRIBUTION



MOISTURE CONTENT

Depth	2'-4'	5.8%
Depth	4.5'-6'	17.2%
Depth	6'-8'	9.0%
Depth	10'-12'	10.0%
Depth	12'-14'	18.3%

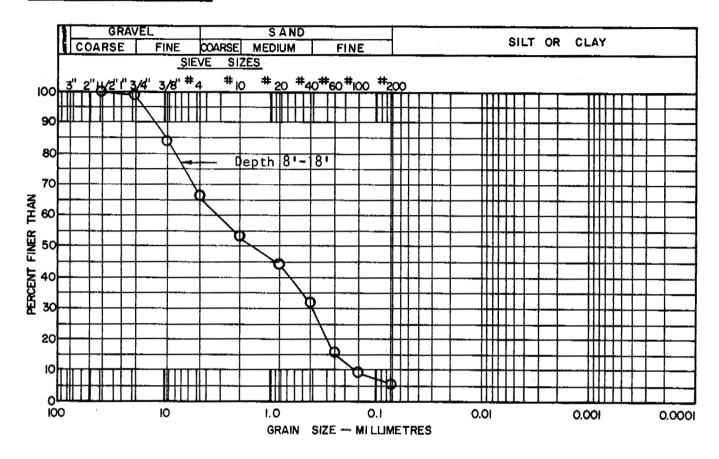




Soil profile logged from bank exposure
Klohn Leonoff Consultants Ltd.

LABORATORY TEST DATA TEST HOLE-SOURCE No. 4 - 88

GRAIN SIZE DISTRIBUTION



MOISTURE CONTENT

Depth	41-61	38.9%
Depth	8'-10'	9.6%
Depth	12'-14'	11.6%
Depth	16'-18'	13.7%

PARSONS LAKE SOURCE No. 5

LANDFORM AND LOCATION: A small kame in a broad glaciofluvial outwash

plain, located 1 mile east of the northeast

corner of Parsons Lake.

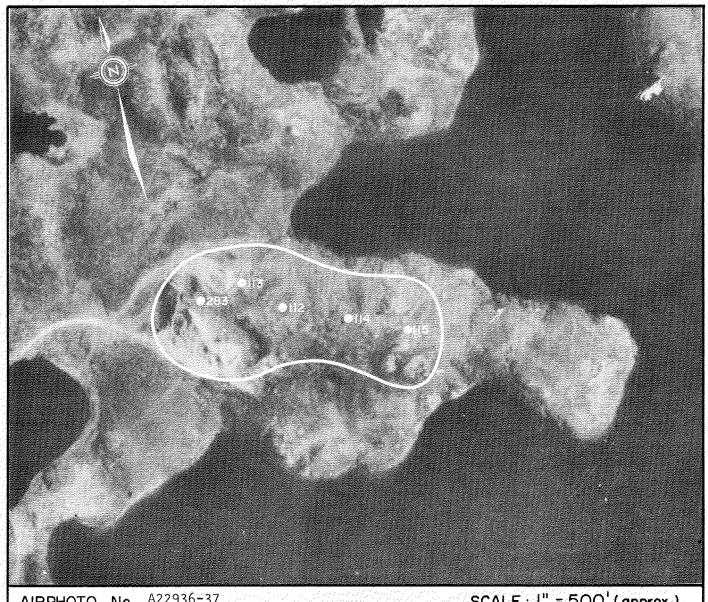
MATERIAL: GRAVEL - and sand, trace cobbles, trace silt.

VOLUME: 40,000 cubic yards.

CONCLUSION: This source has been partially developed.

> Continued development of this source can supply local projects with a limited quantity of good

quality granular material.



AIRPHOTO No. A22936-37

SCALE: I'' = 500' (approx.)

SOURCE DESCRIPTION

This source is single kame in a broadkame field located in the glaciofluvial outwash plain at the northeast corner of Parsons Lake. It is a long narrow peninsula which juts into a lake to the east. The upper part of the kame is greater than 1200 feet long and 200 feet wide. The steep sides of the kames slope at 20 degrees to the lake.

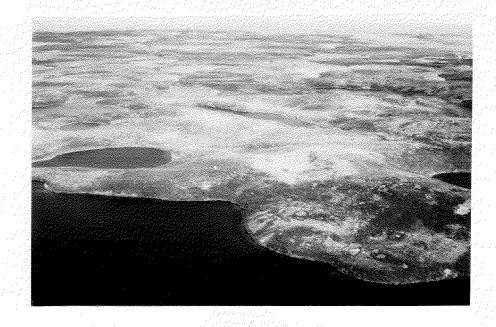


Photo looking west at source area.

Drainage of the kame is good, although ice-rich topstratum materials were encountered in 2 of the 4 holes drilled.

This source has been partially developed for oil and gas exploration in the area.

MATERIALS AND QUANTITIES

A total of 4 holes were drilled and I bank exposure logged in the source area. The subsoils in the source are extremely variable.

Test Holes 112 and 113 encountered 3 to 4 feet of overburden overlying clean well-graded gravel to a maximum depth of 55 feet. Zones of ground ice up to 7 feet in thickness and silt layers up to 3 feet thick were encountered in the gravel stratum. Test Holes 114 and 115 showed silt, sand, thin, gravel layers and ice up to the 22 foot depth. The moisture of the overburden materials, gravel and silt are about 25%, 6%, and 33% respectively.

Sieve analysis on material from a pit face exposure (Test Hole 283) showed the material is well-graded gravel and sand with a trace of silt and of cobbles to 9 inches in size.

The volume of recoverable material in this source is estimated to a minimum of 40,000 cubic yards. This is based on extending the existing pit about 400 feet to the east over a 200 foot width and removing about 15 feet of gravel.

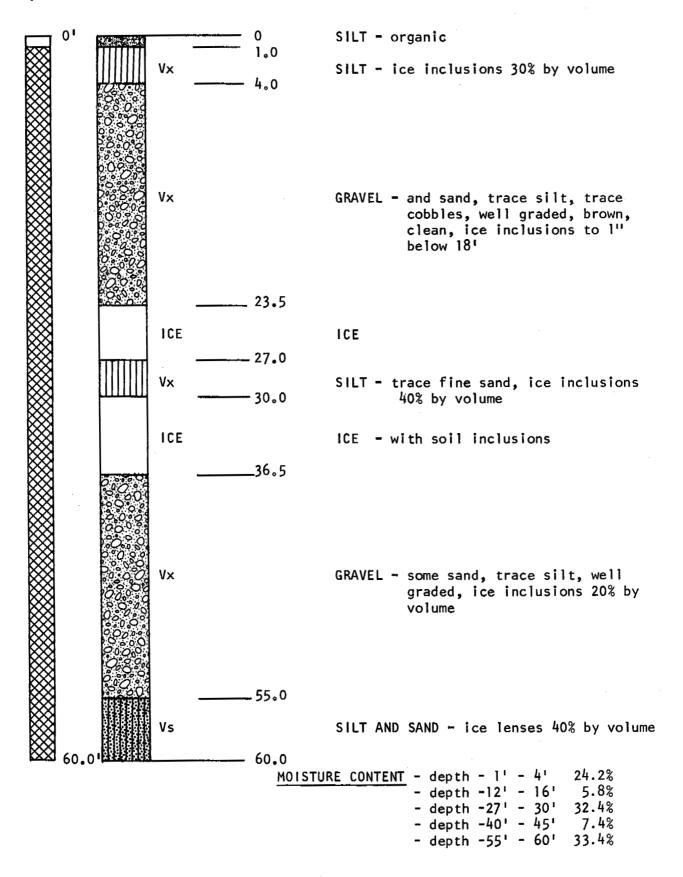
CONCLUSIONS

This source is not recommended for development on a large scale due to the deep overburden at the east end of the source and the ground ice which is present within the gravel stratum. Also, the materials in a kame are likely to be extremely variable with limited lateral continuity between the thick gravel zones. Additional drilling would be required to determine the lateral extent of the thick gravel zones adjacent to Test Holes 112 and 113. We consider that this source should continue to be developed for local projects requiring a limited quantity of good quality granular material.

Based on the test hole information available, the development of the source should be limited to an area which extends not further than 400 feet east of the existing pit face.

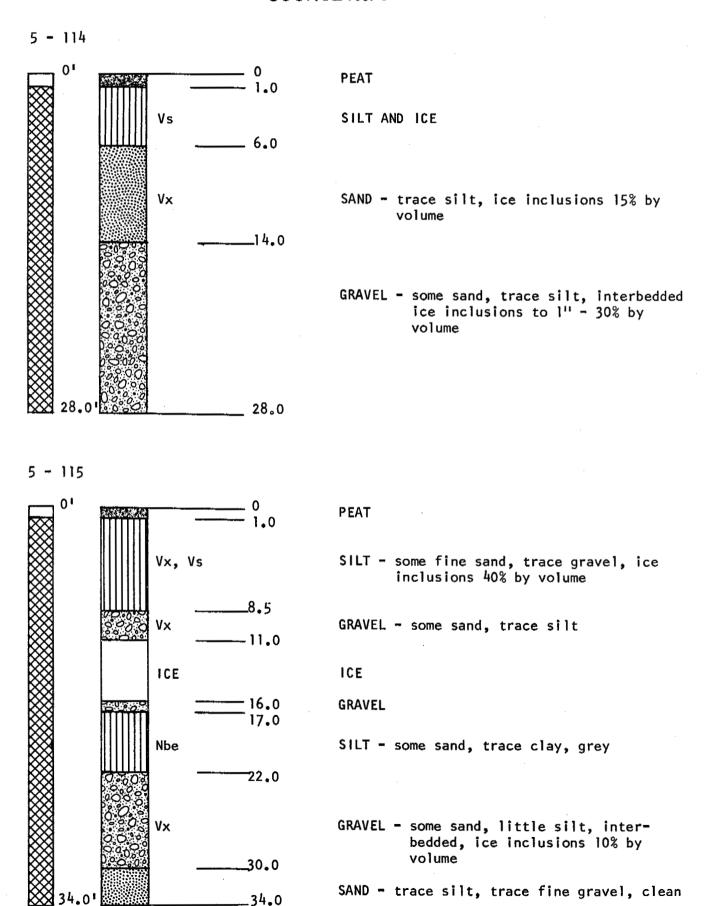
After depletion of the gravel materials, ice rich soil uncovered during the pit operations should be protected with an insulating layer to prevent continued thawing. All side slopes should be graded to a uniform slope upon completion of the development.

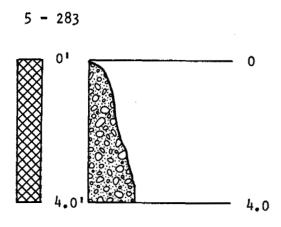
5 - 112



5 - 113

	. 01		ICE	- 0 - 1.5 - 2.0	PEAT ICE - with soil inclusions
		70050000000000000000000000000000000000	Vx, Vc		GRAVEL - some sand, trace cobbles, trace silt, ice coatings and inclusions
		0000 0000 0000 0000	**	- 19 . 5	
		87080	ICE	_ 26.0	ICE - with gravel inclusions
			Vx	- 32.0	GRAVEL - some sand, trace silt, ice inclusions 25% by volume SILT
		2.0°0;		- 34.0 - 36.0	GRAVEL - some sand, trace silt
		,	ICE	38.5	ICE - with soil inclusions
			V×		GRAVEL - some sand, trace silt
\bowtie	44.0	0000 0000	· ·	44.0	



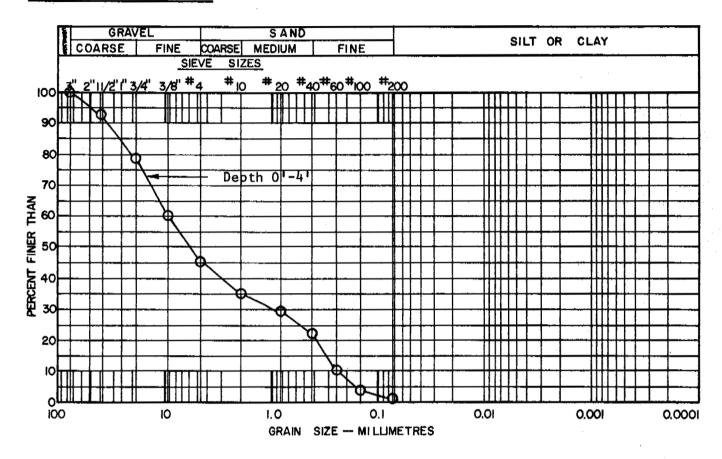


GRAVEL - and sand, trace silt, trace
 cobbles, well graded, clean,
 rounded to sub-angular

LABORATORY TEST DATA

TEST HOLE-SOURCE No. 5 - 283

GRAIN SIZE DISTRIBUTION



MOISTURE CONTENT

PETROGRAPHIC ANALYSIS

Depth 0	-41	
Quartzii Sandstor		39% 26%
Chert	-	16%
Limestor Granite	1e	12% 5%
Quartz		2%
	Total	100%

PARSONS LAKE SOURCE No. 6

LANDFORM AND LOCATION: A small kame in a broad glaciofluvial outwash

plain located I mile east of the northeast

corner of Parsons Lake.

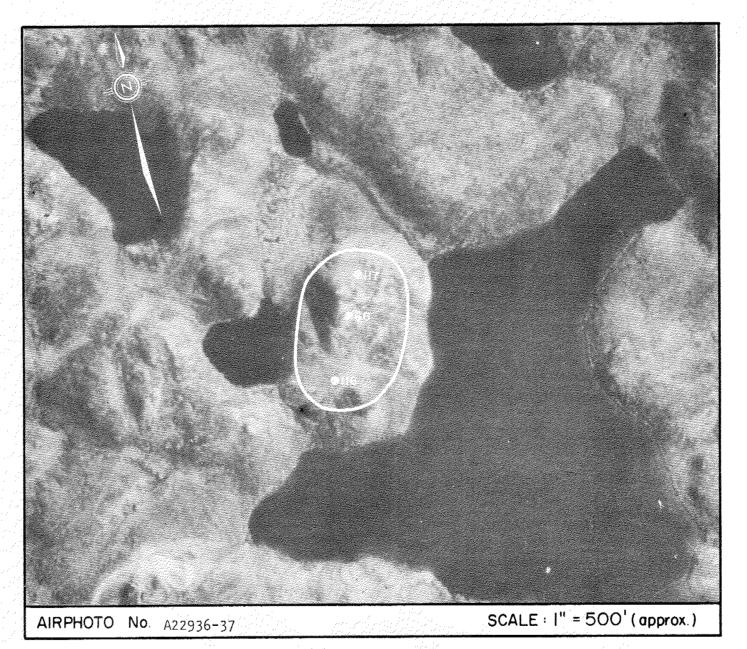
MATERIAL: GRAVEL - and sand, trace silt

VOLUME: 10,000 cubic yards.

CONCLUSION: This source has been partially developed.

Continued development of this source can supply local projects with a limited quantity of good

quality material.



SOURCE DESCRIPTION

This source is a conspicuous steep sided kame knoll. The northwest side of the kame is about 140 feet above the valley floor and slopes steeply at I horizontal on I vertical. A bench about 100 feet wide surrounds a large portion of the kame, 50 to 70 feet below the kame top. On the east the bench slopes at about 3 horizontal to I vertical to a lake. The kame top itself is less than 50 feet across.

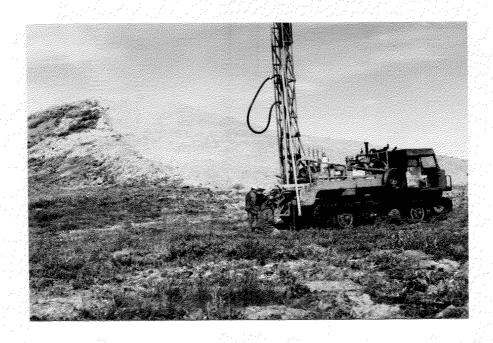


Photo looking northeast at source.

Drill rig on Hole 116.

Drainage of the steep sided kame is good although massive ice lenses were encountered in the near surface soils. The low-lying terrain northwest of the source displays polygonal ground.

The east face of the kame has been stripped of vegetation to expose the underlying gravel and some thawing has taken place. The source has been used as a recent source of granular borrow for local use.

MATERIALS AND QUANTITIES

Two test holes were drilled and I slope exposure logged in the source area.

The drill data indicates the subsoils on the benches adjacent to the main knoll are highly variable. No drill hole was placed on top of the main knoll because it could not be reached by the drill rig.

The material as logged from the slope exposure in Test Hole 66 is clean, fairly well-graded sand and gravel, with a trace of silt, and a trace of cobbles to 1 foot in diameter. Test Hole 116, located on the southern bench (as shown on Photo No. 1) encountered 8 feet of ice-rich silt, overlying 19 feet of massive ice, all of which overlie gravel and sand. The hole was stopped at 43 feet due to boulders. Test Hole 117, located on the northern bench, encountered 13 feet of clean gravel with some sand overlying gravel and ice to a depth of 30 feet. The moisture content of the gravel varies between 7 and 11%.

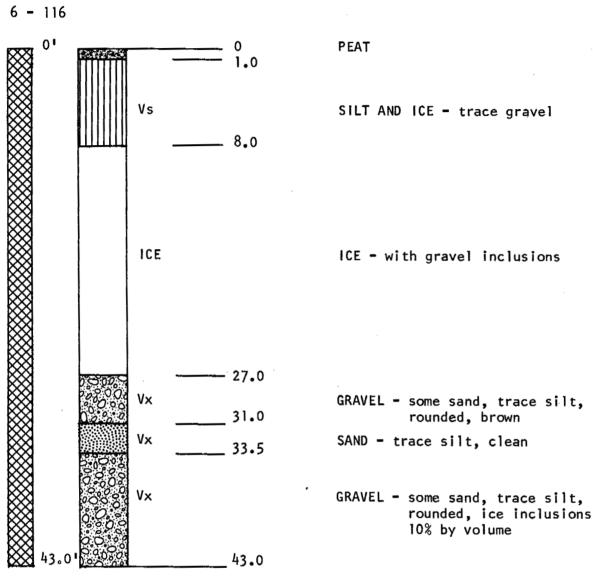
The estimated volume of recoverable material in this source is about 10,000 cubic yards. This figure is based on extending the existing pit area to include the top of the kame. The depth of recovery was estimated at 10 to 20 feet.

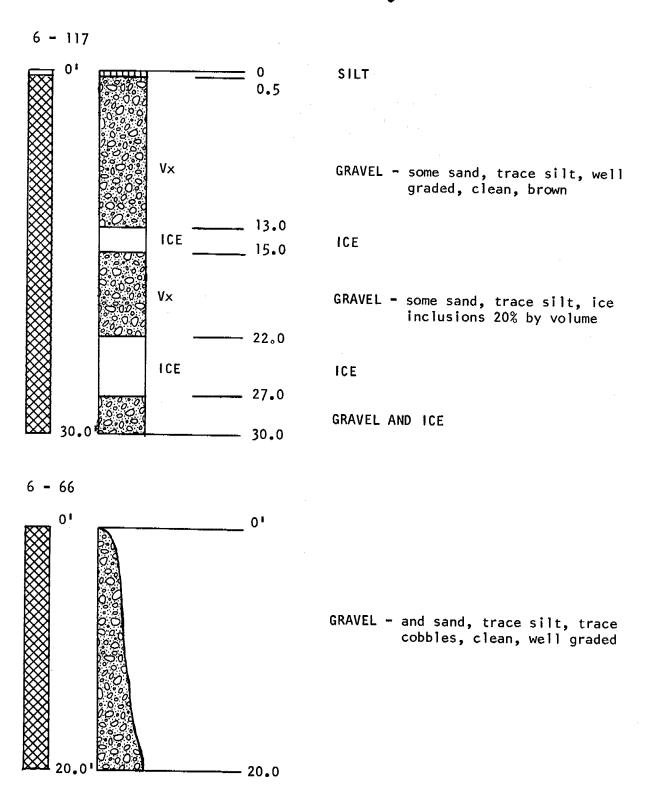
CONCLUSIONS

This source is not recommended for development on a large scale due to the deep overburden at the north end of the source and the ground ice which is present within the gravel stratum. Also, the materials in a kame are likely to be extremely variable with limited lateral continuity between the thick gravel zones. Additional drilling would be required to determine the lateral extent of the gravel zones adjacent Test Hole 117. We consider that this source should continue to be developed for local projects requiring a limted quantity of good quality granular material.

Based on the test hole information available, the development of the source should be limited to the steep sided kame area from which material has already been removed.

After depletion of the gravel materials, any ice rich soil uncovered during the pit operations should be protected with an insulating layer to prevent continued thawing. The pit area should be graded to a uniform slope upon completion of the development.

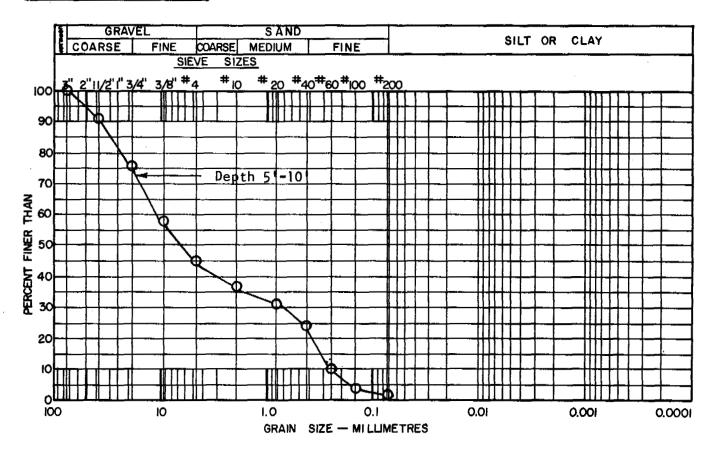




Soil profile logged from excavation exposure

LABORATORY TEST DATA TEST HOLE-SOURCE No. 6 - 66

GRAIN SIZE DISTRIBUTION



MOISTURE CONTENT

PARSONS LAKE SOURCE No. 7

LOCATION AND LANDFORM: River terrace located 5 miles southeast of

Parsons Lake and 3 miles west of Eskimo Lakes.

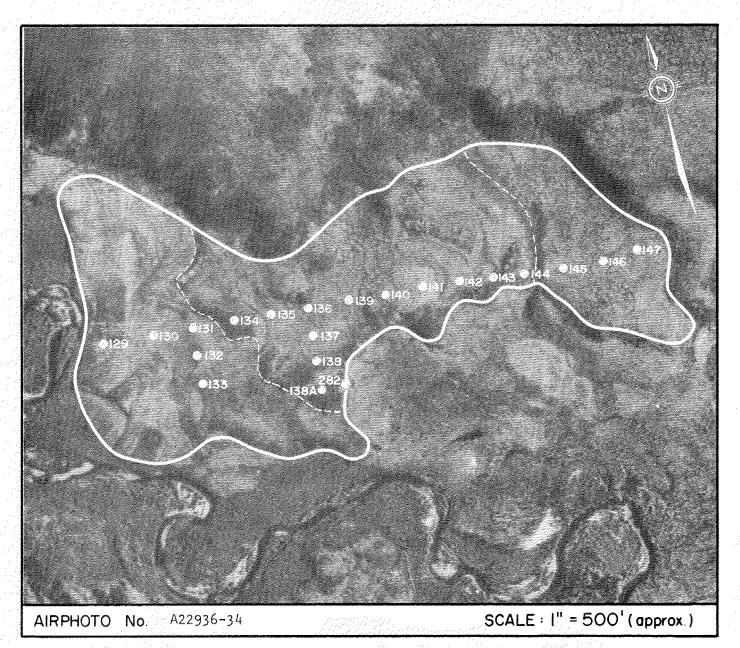
MATERIAL: GRAVEL - and sand, trace cobbles, trace silt.

VOLUME: Not established.

CONCLUSION: Additional test hole drilling necessary to

determine the quantity of granular materials

in source.



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SOURCE DESCRIPTION

The source area is a low-lying three level fluvial terrace adjacent to the stream which flows eastward into Eskimo Lakes. The large low terrace on the west trends generally north-south and is roughly 1400 feet long by 600 feet wide. The second terrace is about 5 to 15 feet higher than the westerly terrace and trends generally east-west, measuring roughly 1600 feet long by 500 feet wide. The third and smallest terrace is situated on the east and is roughly 700 feet square.

The flat-lying terrace areas are fairly well drained, with a few small drainage gulleys trending southerly. Ground ice was encountered in the near surface soils of some drill holes. Faint ice wedge polygonal patterns are also apparent in some areas of the terrace.

MATERIALS AND QUANTITIES

A total of 20 holes were drilled and I bank exposure logged in the source area. The soil strata underlying the source are relatively uniform although the thickness of the usable material and ice conditions are more variable.

The overburden consists of organic silt, sands and peat. The thickness of this topstratum varies between 1 and 8 feet and averages 6 feet over the source area.

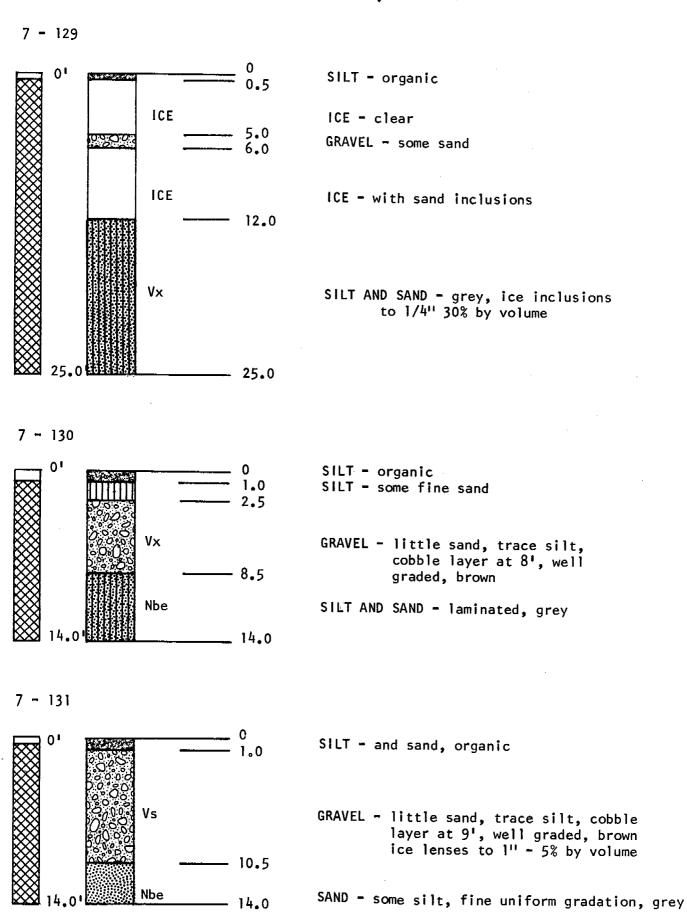
The overburden is underlain by a gravel stratum which varies in thickness from 1 to 15 feet and averages 7 feet. The moisture content in the gravel samples tested varies from 2.8 to 7.0%, averaging about 5%. The material is a slightly stratified, fairly well graded, gravel and sand, with a trace of silt, and cobbles near the base of the stratum. The ice content of the gravel material appears to range from about 5 to 20% by volume, averaging about 10%. The ice generally occurs as inclusions, and less frequently as stratified lenses.

The gravel stratum is underlain by a succession of laminated, dark grey silts and fine sands. The moisture content of the samples tested varies from 14.9 to 27.1%, and averages about 22%. Ice in this material is usually non-visible and frequently well bonded.

The volume of gravel material in this source was not calculated due to insufficient drill holes.

CONCLUSIONS

On the basis of the drill hole information available, the development of this source does not appear to be feasible. The depth of overburden which must be removed is excessive compared to the volume of gravel which is present.

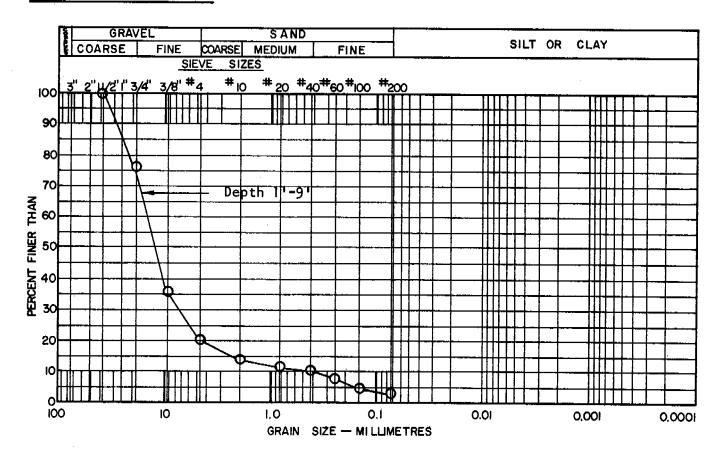


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LABORATORY TEST DATA

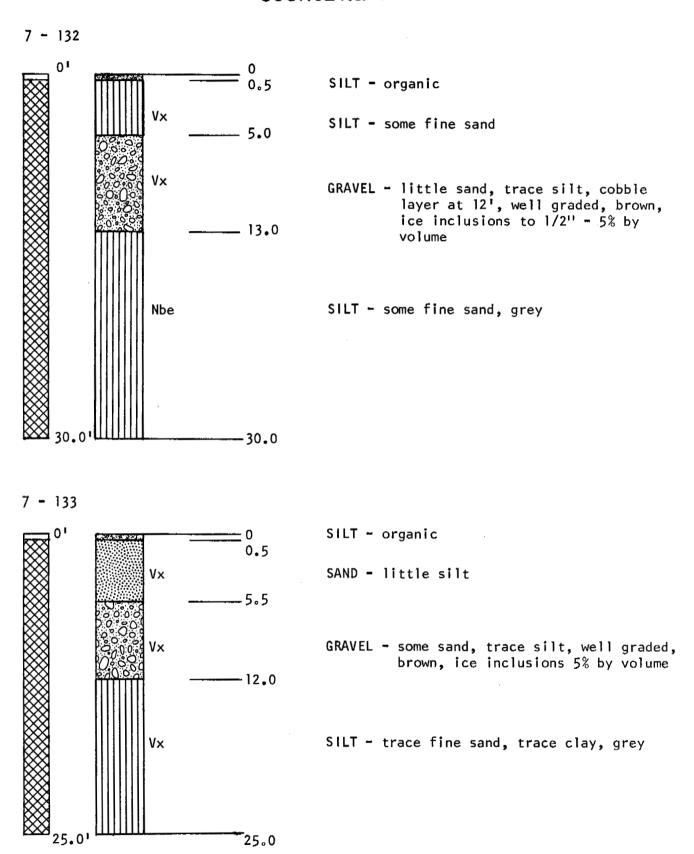
TEST HOLE-SOURCE No. 7 - 130

GRAIN SIZE DISTRIBUTION



MOISTURE CONTENT

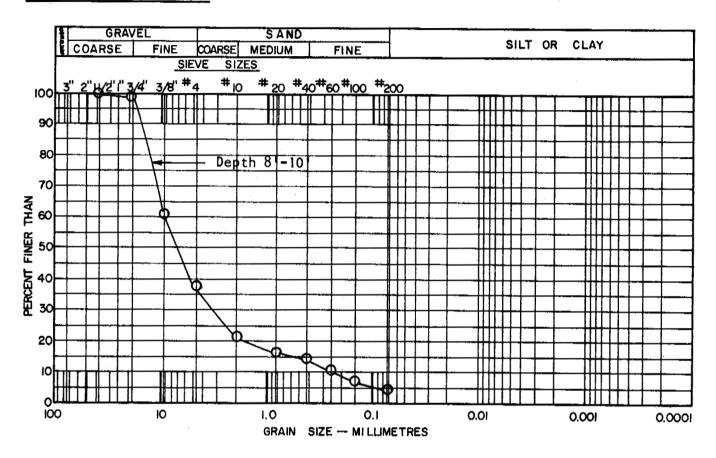
Depth 1'-9' 4.6%



LABORATORY TEST DATA

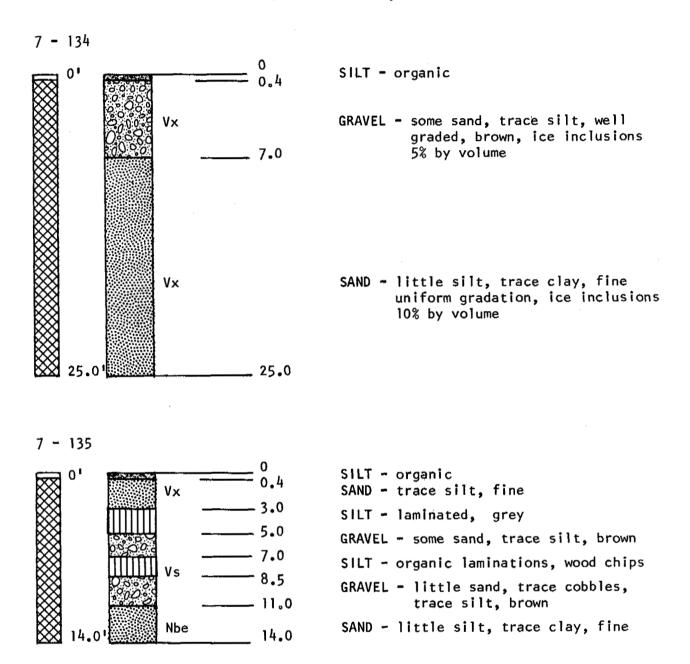
TEST HOLE-SOURCE No. 7 - 133

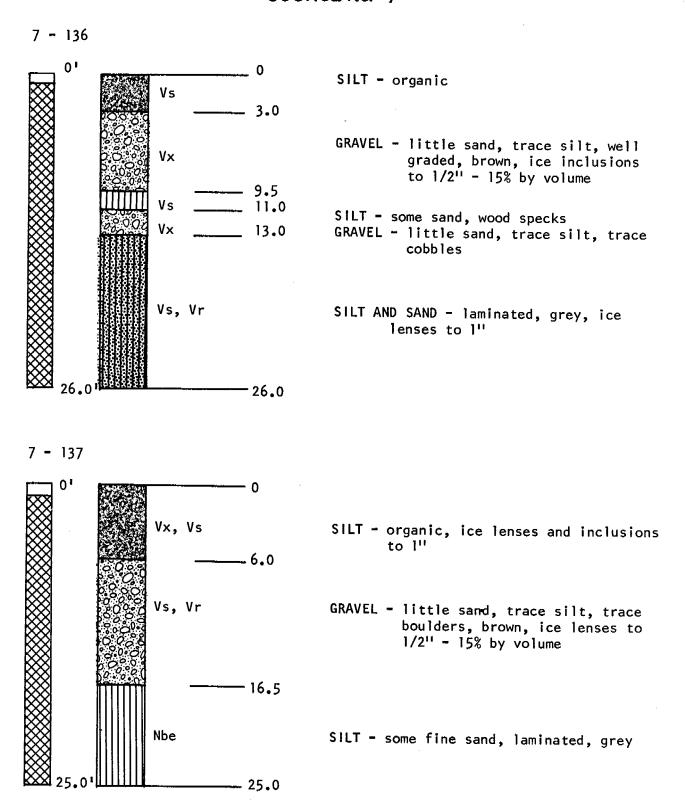
GRAIN SIZE DISTRIBUTION

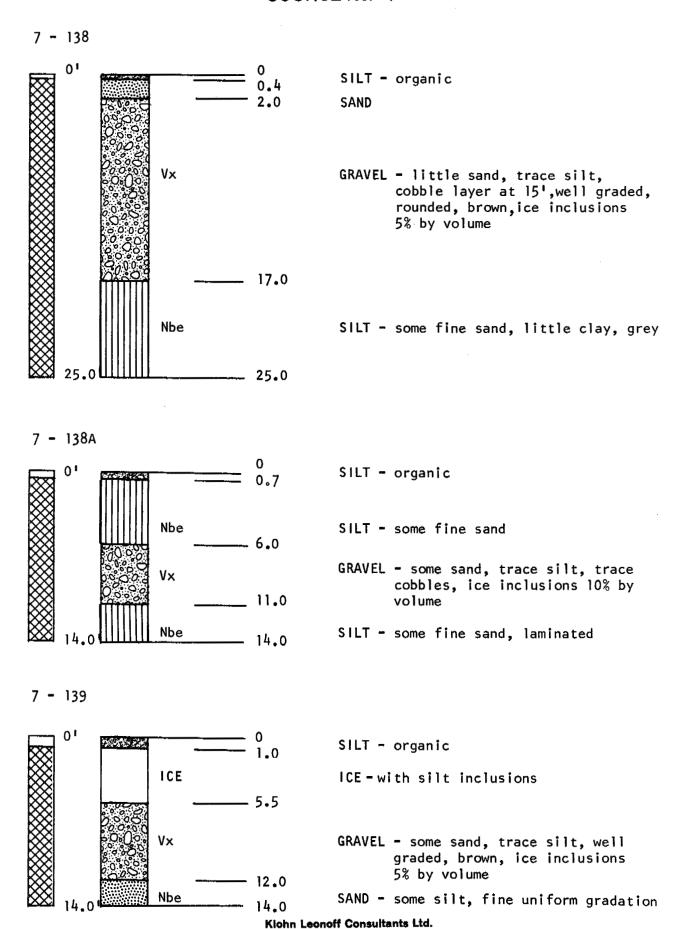


MOISTURE CONTENT

Depth 8'-10' 7.0% Depth 14'-16' 27.1%



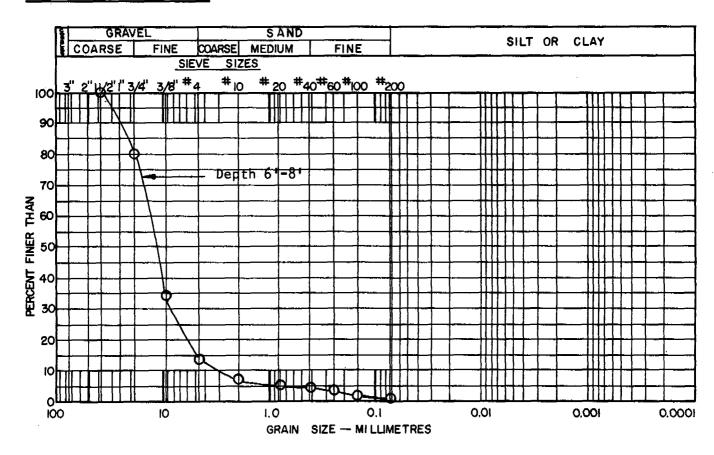




LABORATORY TEST DATA

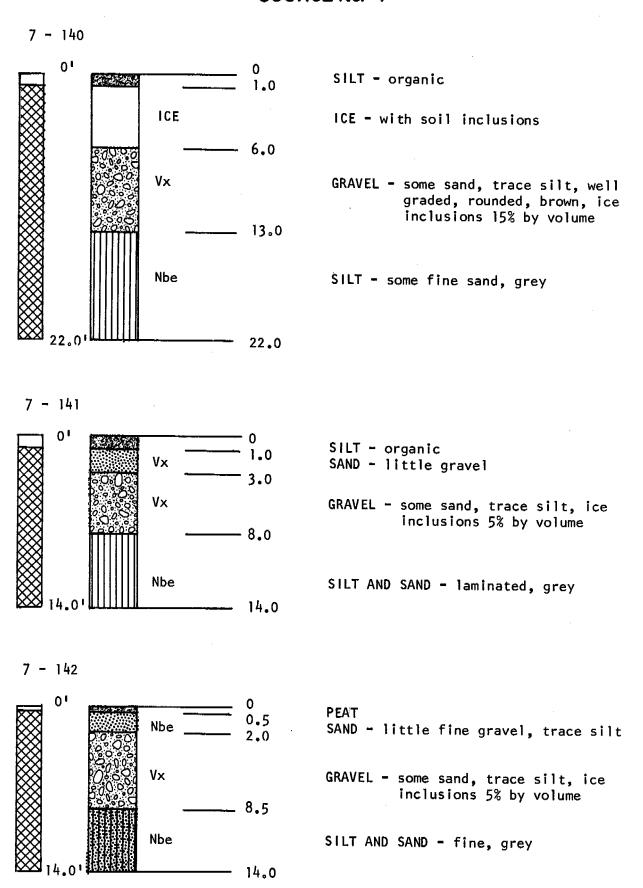
TEST HOLE-SOURCE No. 7 - 138

GRAIN SIZE DISTRIBUTION



MOISTURE CONTENT

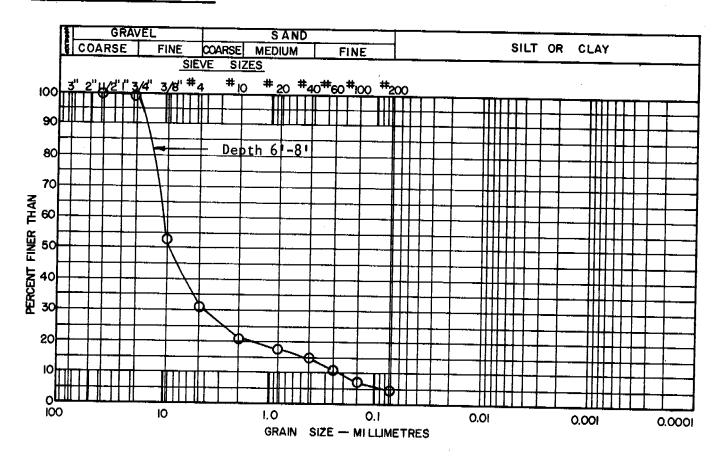
Depth 6'-8' 2.8% Depth 18'-25' 14.9%



LABORATORY TEST DATA

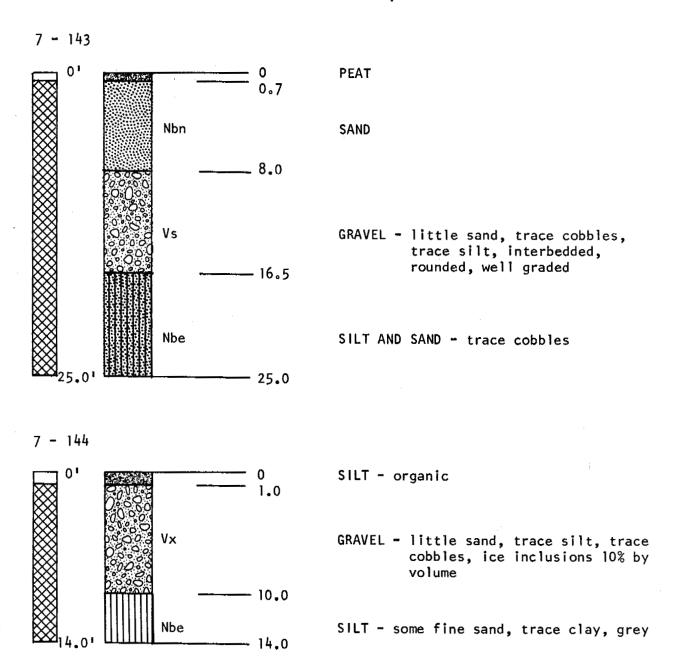
TEST HOLE-SOURCE No. 7 - 142

GRAIN SIZE DISTRIBUTION

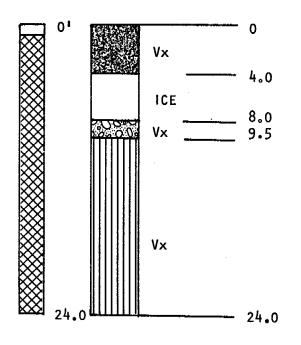


MOISTURE CONTENT

Depth 0.5'-2' 16.6% Depth 6'-8' 5.1% Depth 8.5'-10' 23.8%







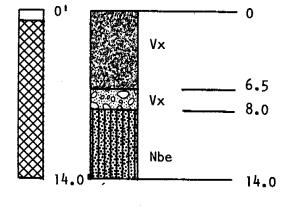
SILT - organic, ice inclusions to 1"

ICE - with silt inclusions

GRAVEL - some sand, little silt, trace clay

SILT - some fine sand, ice inclusions 25% by volume

7 - 146

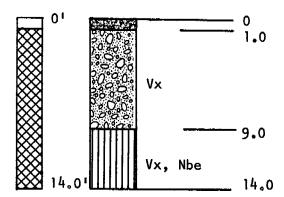


SILT - organic, ice inclusions to 1"

GRAVEL - some sand, trace silt

SILT AND SAND

7 - 147



SILT - organic

SILT - little fine sand, grey

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7 - 282

0 SILT - organic
2.0 GRAVEL - little medium sand, trace silt, maximum 5", brown

Soil profile logged from bank exposure

PARSONS LAKE SOURCE No. 8

LOCATION AND LANDFORM: River terrace located adjacent to the western

shores of Eskimo Lakes, 5 miles southeast of

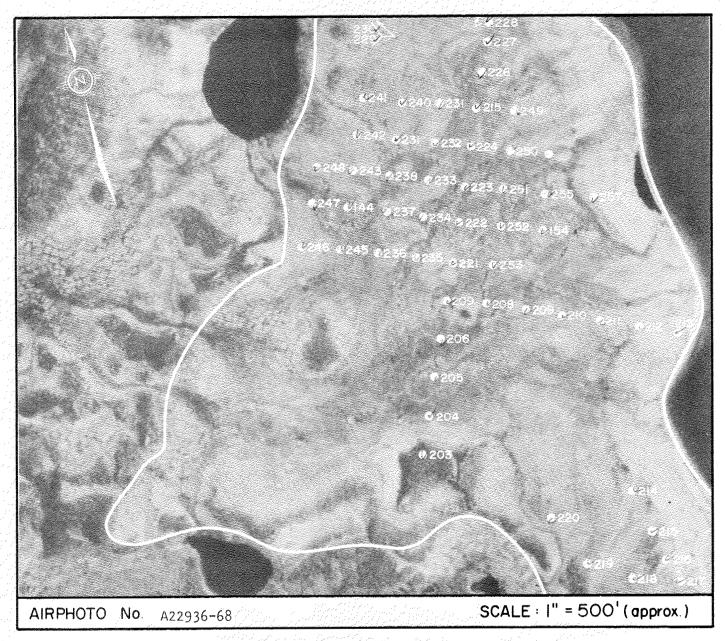
Parsons Lake.

MATERIAL: GRAVEL - and sand, trace silt, variable.

VOLUME: 100,000 cubic yards.

CONCLUSION: The underlying fluvial soils are highly variable.

The source is not recommended for development.



SOURCE DESCRIPTION

This source is a broad, flat-lying terrace located adjacent to the western shores of the Eskimo Lakes. The terrace is about 10 to 15 feet above lake level. The terrace is post-glacial, probably related to the stream that flows into the Eskimo Lakes immediately south of the source.

Drainage of the source is fair, with very little ground ice encountered in the near surface soils. The area displays widespread polygonal ground.

MATERIALS AND QUANTITIES

A total of 52 test holes were drilled in this source. Three additional holes (Test Hole 228, 229, and 230) were drilled just north of the source and are not covered by the air photograph. The organic silt and peat overburden materials is 6 feet or less, although several test holes showed peat to be about 10 feet thick. High ice contents in form of ice lenses are usually associated with these overburden peat soils. The underlying materials are variable and consist of interbedded sands, silts and gravels, with an ice content estimated to be up to 25% by volume. The moisture contents of the sands, silts and gravel materials range between 17 to 25%, 25 to 35%, and 6 to 12% respectively. The largest volume of gravel located in this source is confined to a narrow zone extending east and west of Test Holes 223 and 224, however, the overburden is up to 10 feet in thickness, and there is little lateral continuity between the gravel stratum in the test holes.

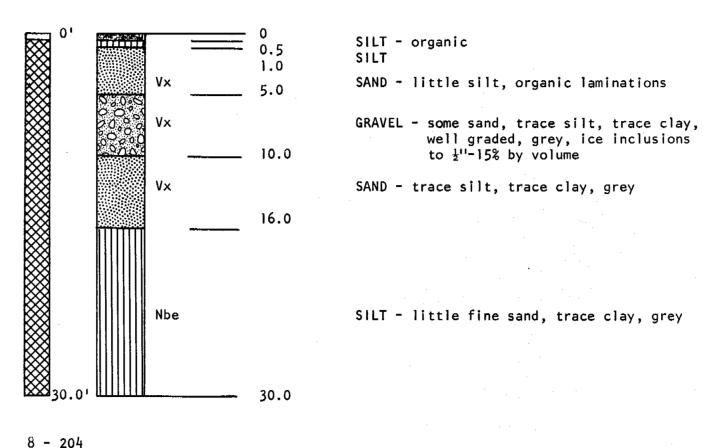
The estimated volume of gravel which could be removed from this area is 100,000 cubic yards based on an average recovery depth of 10 feet. To obtain this volume of material, an equivalent volume of stripping (up to 10 feet) would have to be removed.

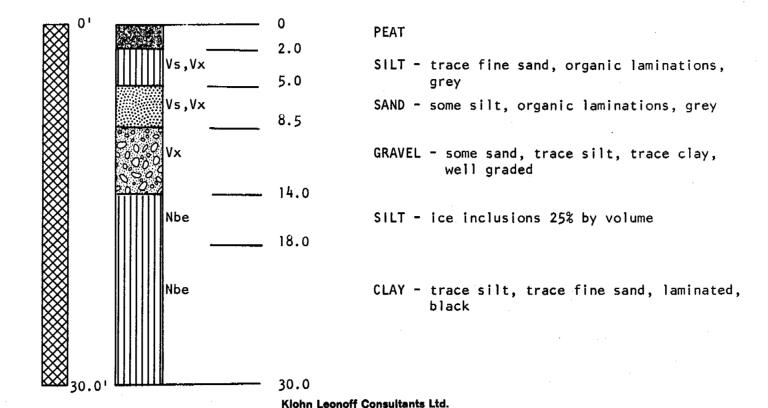
CONCLUSIONS

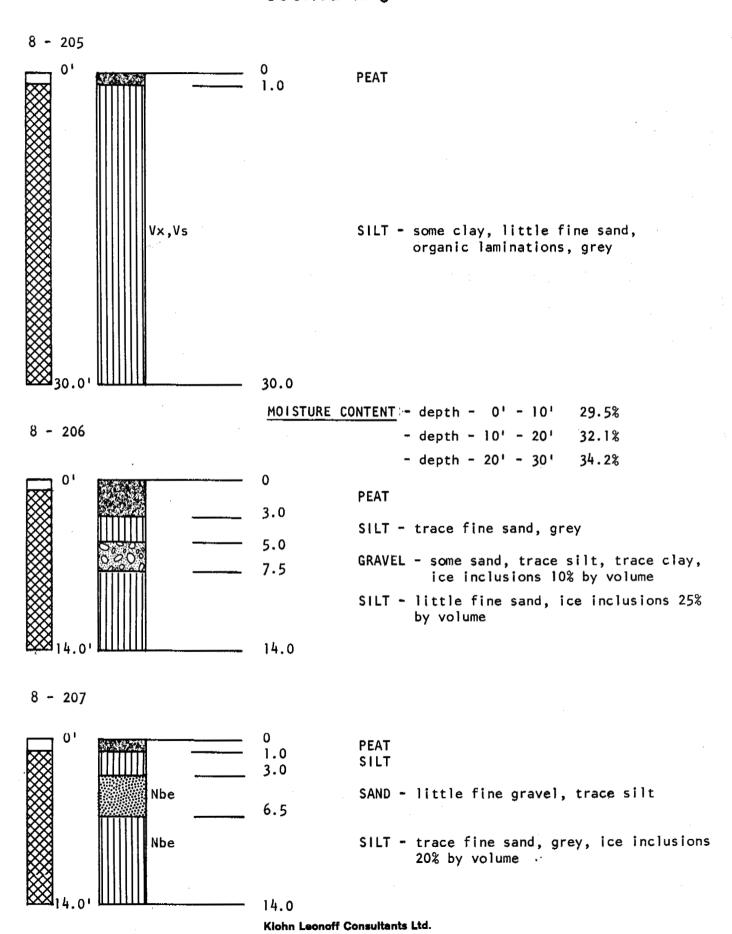
Development of this source is not recommended because of the limited volume of gravel material available and the excessive stripping which must be removed to expose the gravel.

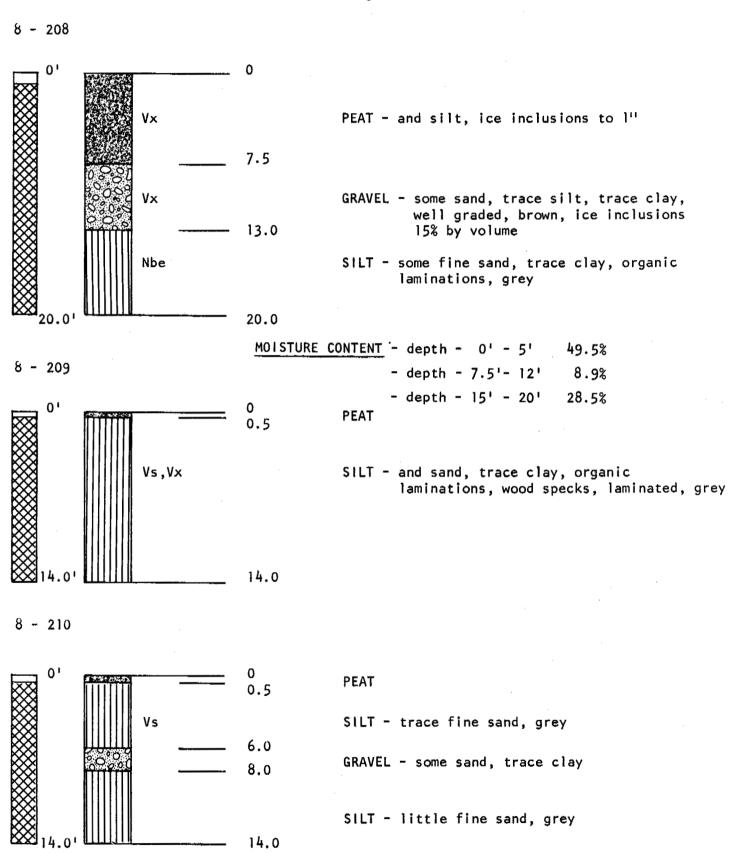
SOURCE No. 8

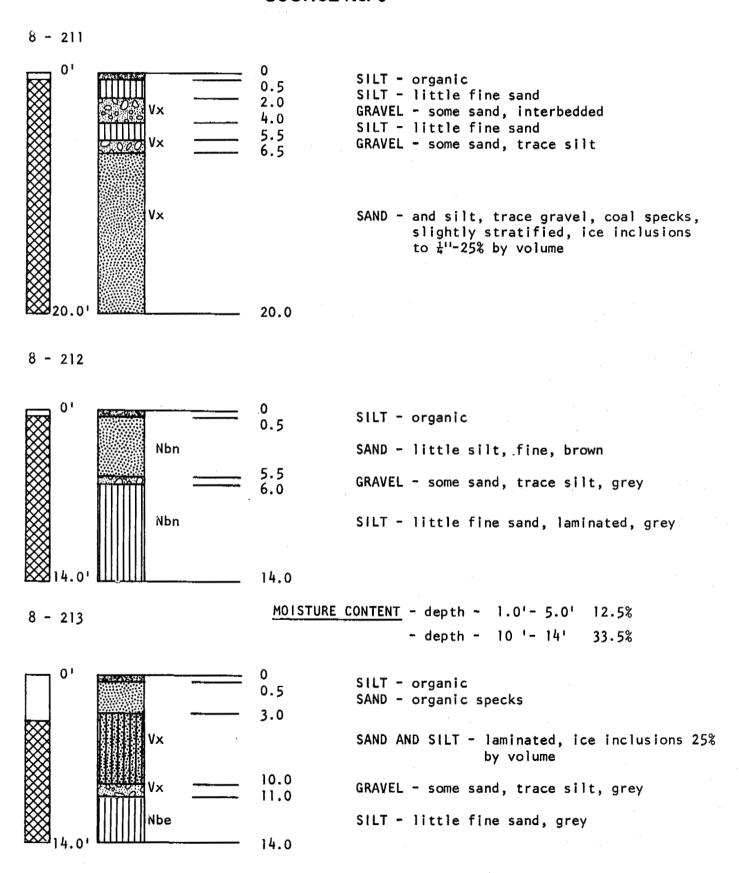
8 - 203

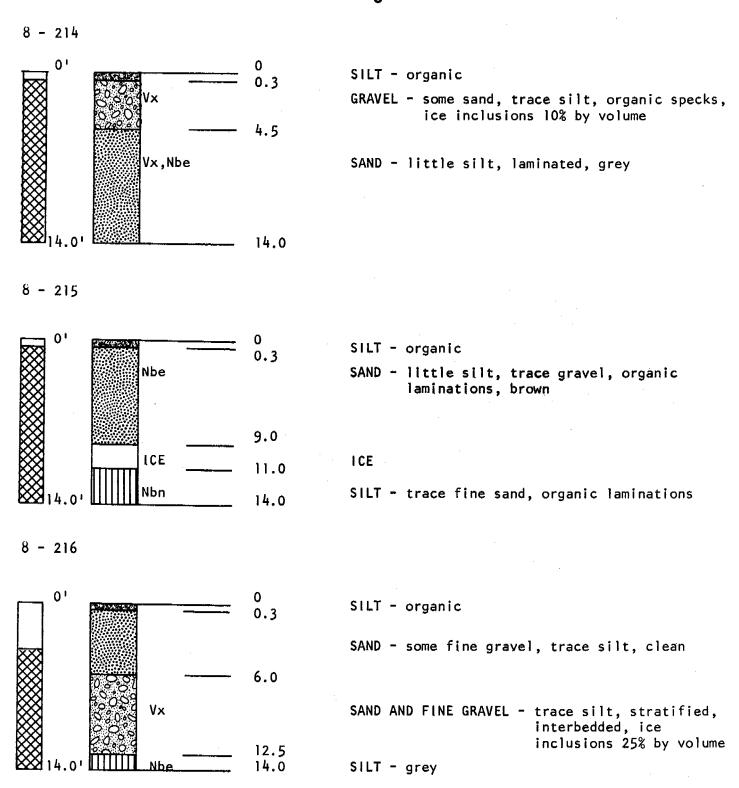


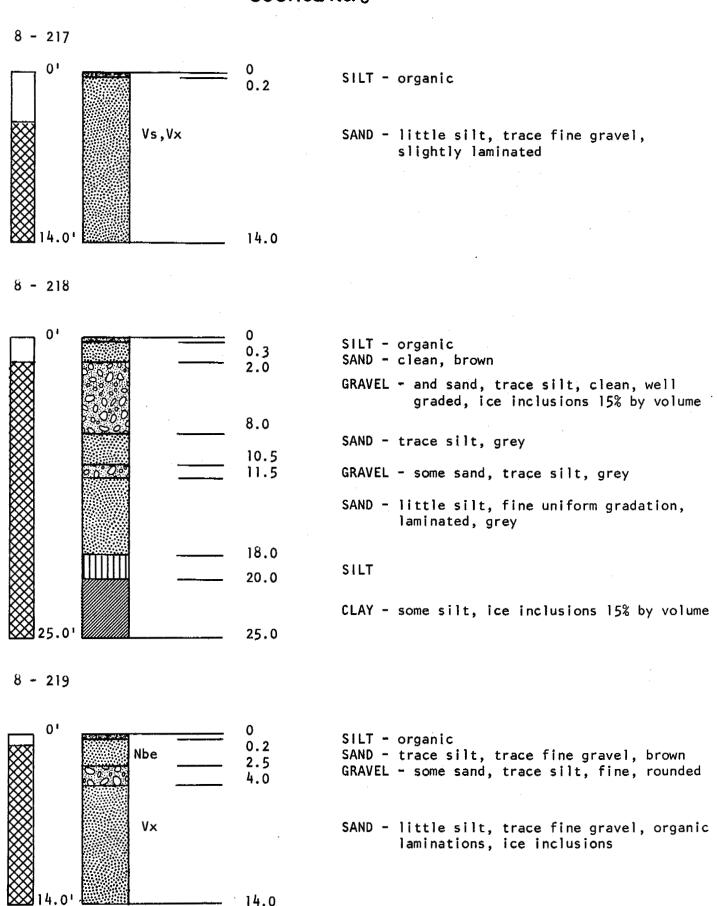


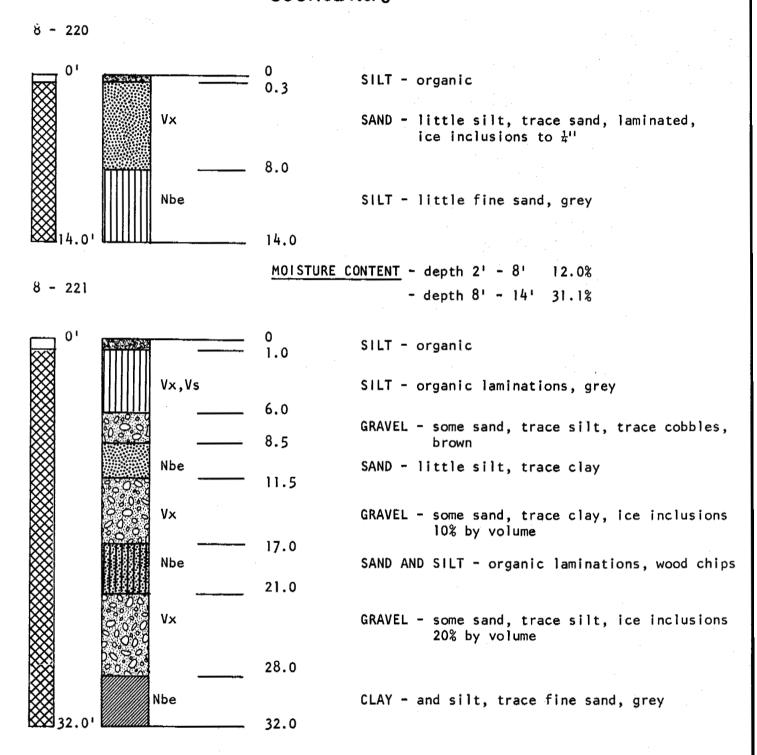










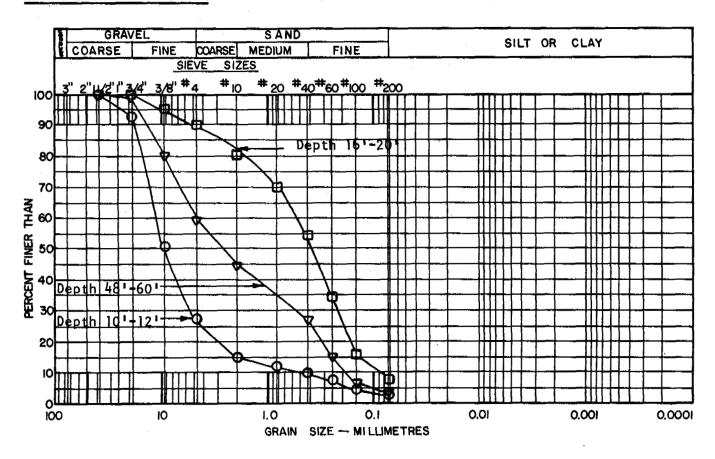


8 - 222			
□ 0'	The state of the s	. 0	DEAT
		2.5	PEAT
	Nbe		SAND - some silt, trace fine gravel, grey
	Nbe	6.5 8.0	SAND - little silt, trace clay
	\$000 5 V×		GRAVEL - some sand, trace silt, interbedded, ice inclusions to $\frac{1}{2}$ "-15% by volume
		15.0	
	Nbe		SAND - little fine gravel, trace silt, grey
		26.0	
		20.0	CRAVEL AND CAND 11443
	ooses v×	31.0	GRAVEL AND SAND - little silt, grey
	Nbe		SAND - little silt, fine uniform gradation
		34.0	GRAVEL - some sand, trace silt, fine
		36.0 38.0	SAND - little silt
	20.50	30.0	
	VX		GRAVEL AND SAND - trace silt, fine, ice inclusions to 11-15% by volume
	<u> </u>	44.0	
			SAND - trace fine gravel
		48.0	
			SAND - and gravel, trace silt, fine pea sized gravel.
₩ 60.0'		60.0	

LABORATORY TEST DATA

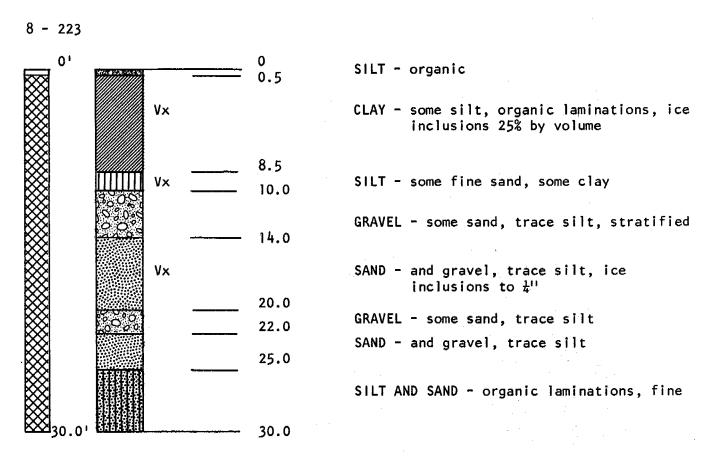
TEST HOLE-SOURCE No. 8 - 222

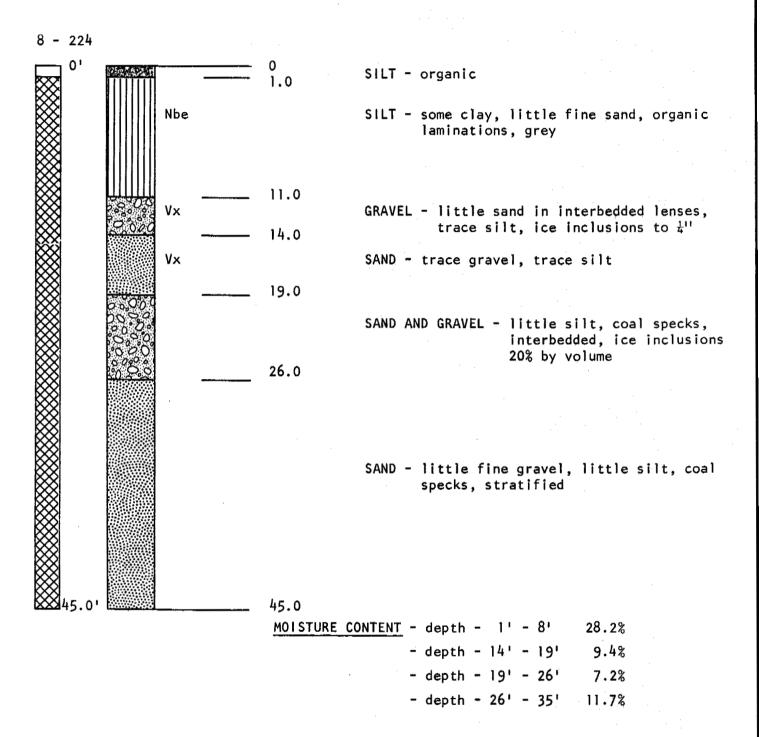
GRAIN SIZE DISTRIBUTION

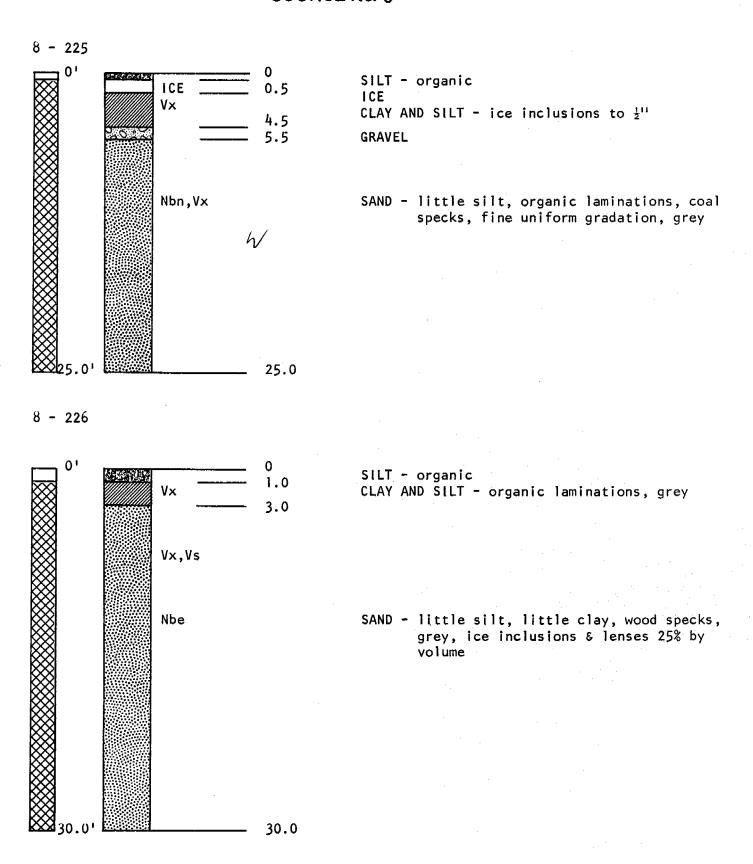


MOISTURE CONTENT

Depth	10'-12'	5.5%
Depth	16'-20'	17.4%
	38'-44'	16.8%
Depth	48'-60'	11.6%

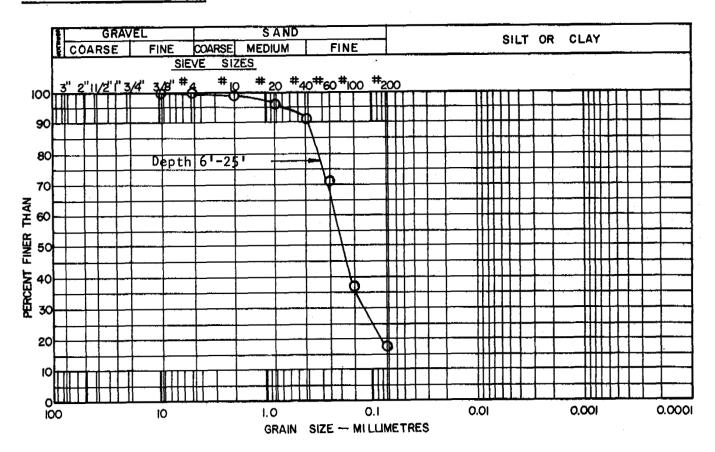






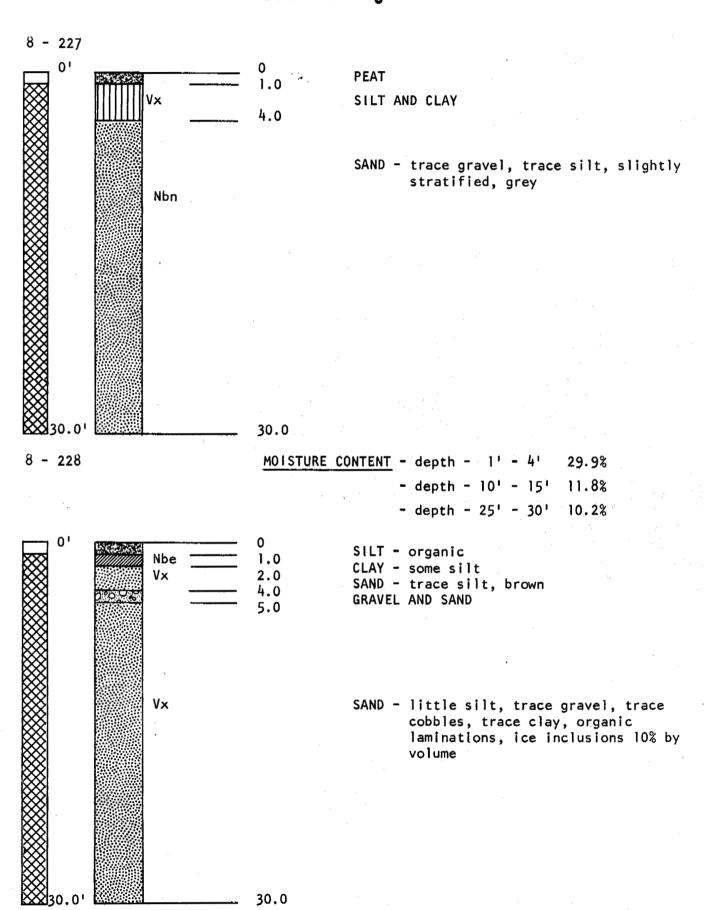
LABORATORY TEST DATA TEST HOLE-SOURCE No. 8 - 225

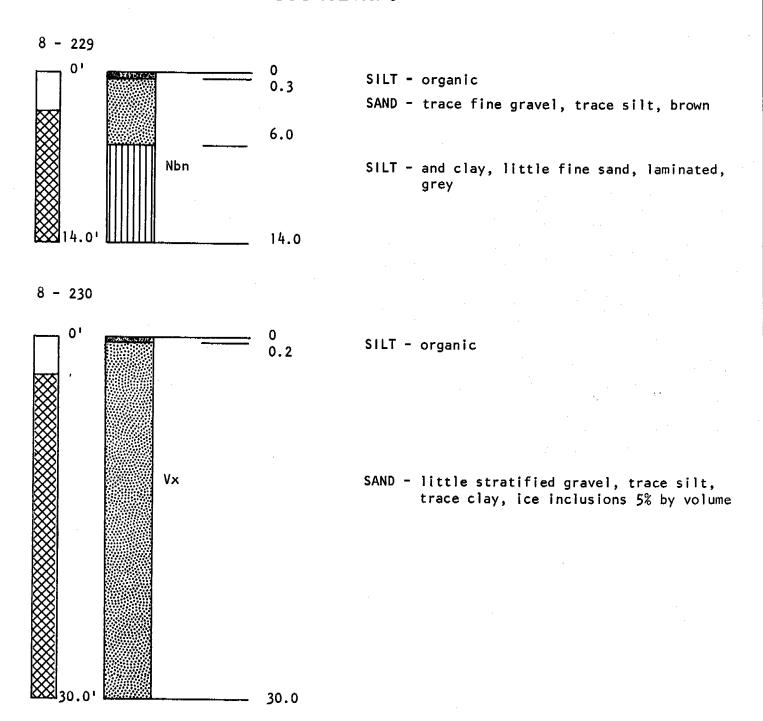
GRAIN SIZE DISTRIBUTION



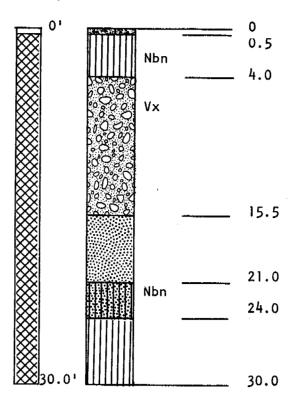
MOISTURE CONTENT

Depth 6'-14' 25.9% Depth 20'-25' 29.9%





8 - 231



PEAT

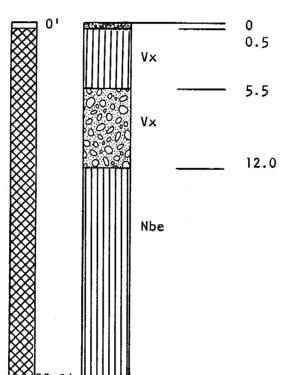
SILT AND CLAY - some fine sand

SAND - little silt, trace gravel, fine

SILT AND SAND - grey

SILT - trace clay, trace sand

8 - 232



PEAT

SILT - some fine sand, ice inclusions to $\frac{1}{2}$ 1120% by volume

SILT - and fine sand, laminated, grey

30.0

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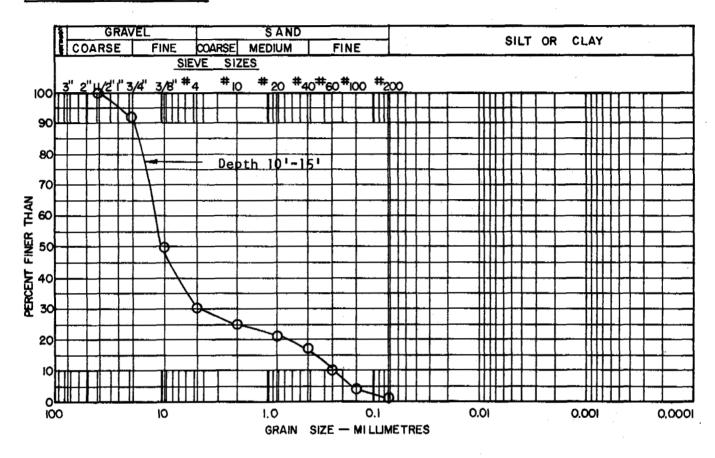
8 - 233

₩ 01	<u> </u>	 0 2.0	PEAT
	00000 00000 00000 00000		GRAVEL - some sand, trace silt, well graded, ice inclusions 5% by volume
	0000 0000 0000 0000	 18.0	SAND - little fine interbedded gravel, trace silt, wood specks, grey
	<u>7555</u> €	 26.0	
	5.8 6 Vs		GRAVEL - and sand, trace silt, grey, ice lenses to 2"
		33.0 36.0	SAND - trace silt, trace clay, grey, fine
	0000 0000 0000 0000	 ,,,,	SAND AND GRAVEL - trace silt
45.0		 43.0 45.0	SAND - fine

LABORATORY TEST DATA

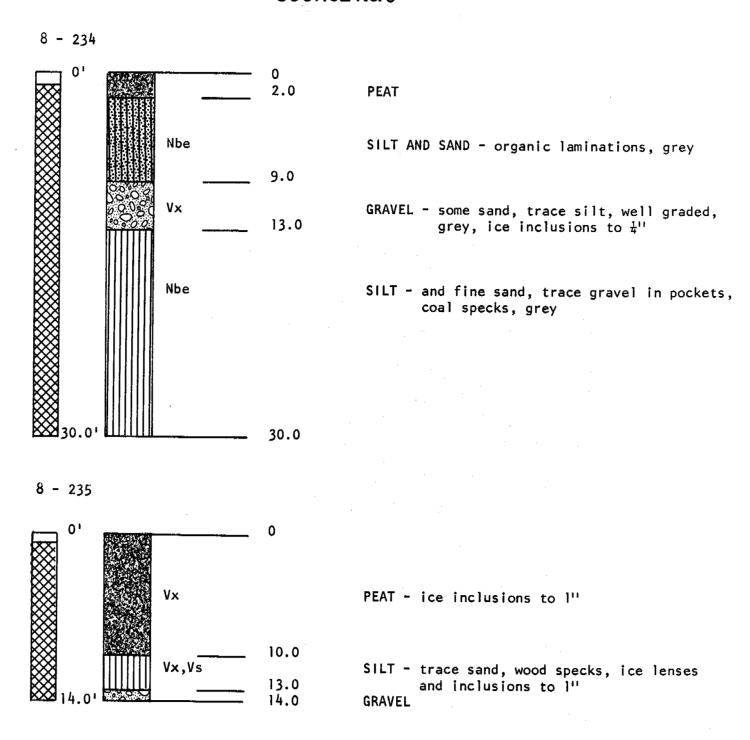
TEST HOLE-SOURCE No. 1 - 233

GRAIN SIZE DISTRIBUTION

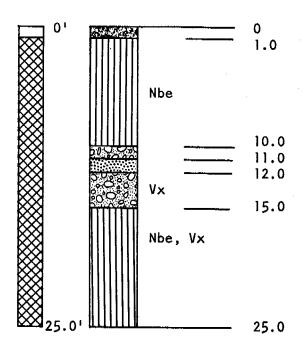


MOISTURE CONTENT

Depth 10'-15' 8.4% Depth 20'-24' 22.5%







PEAT

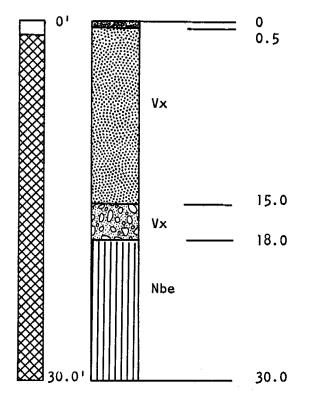
SILT - some fine sand, laminated, grey

GRAVEL AND SAND - trace silt
SAND - little silt, grey

GRAVEL - some sand, trace silt, trace clay

SILT - some fine sand, trace clay, grey

8 - 237

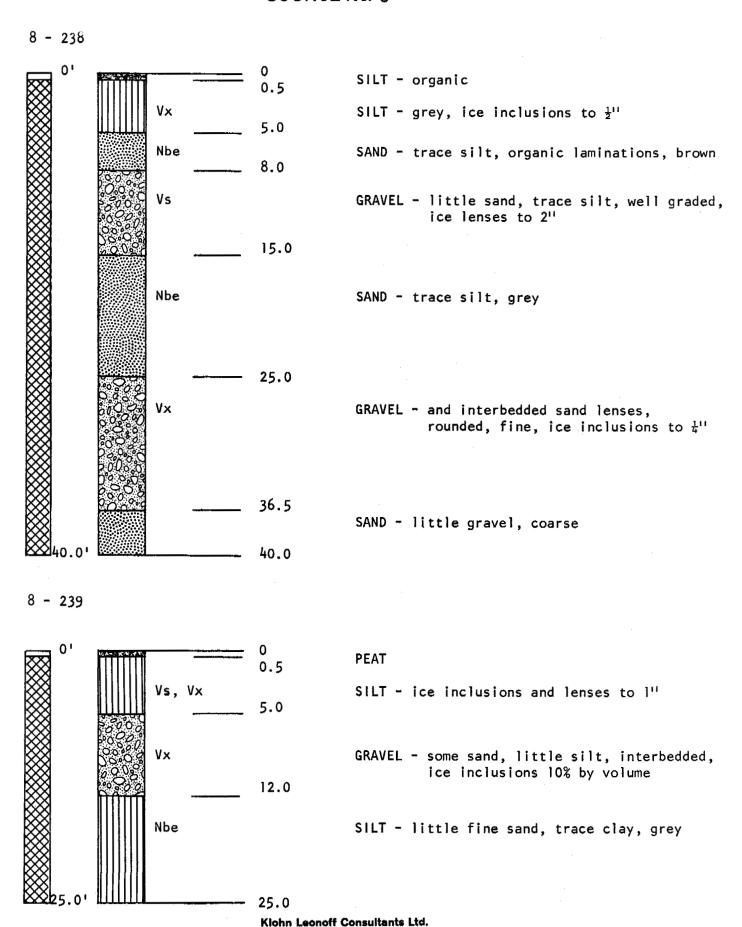


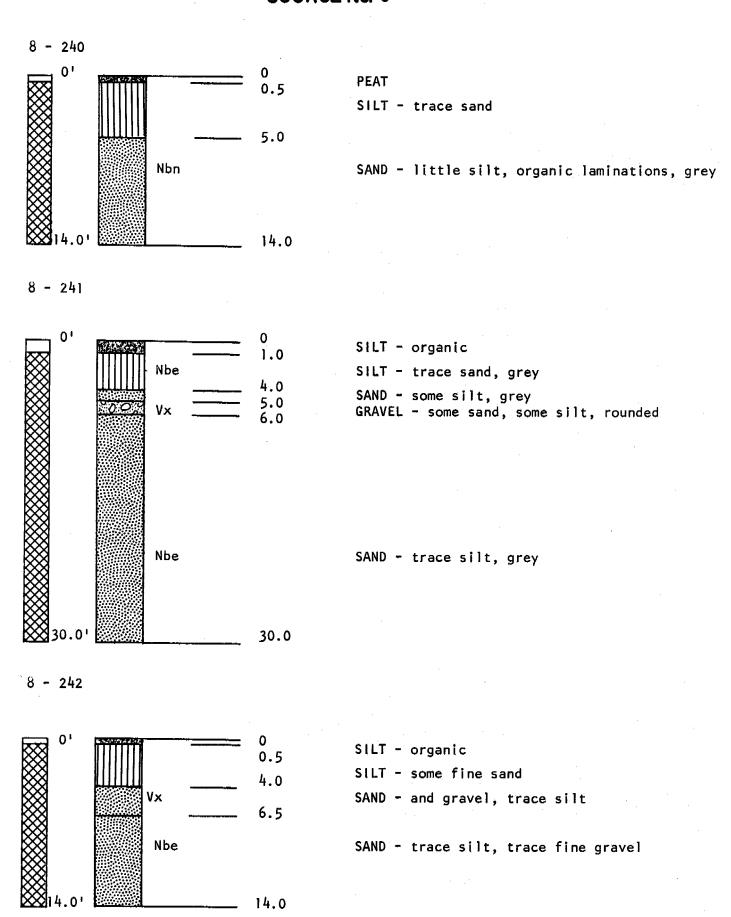
PEAT

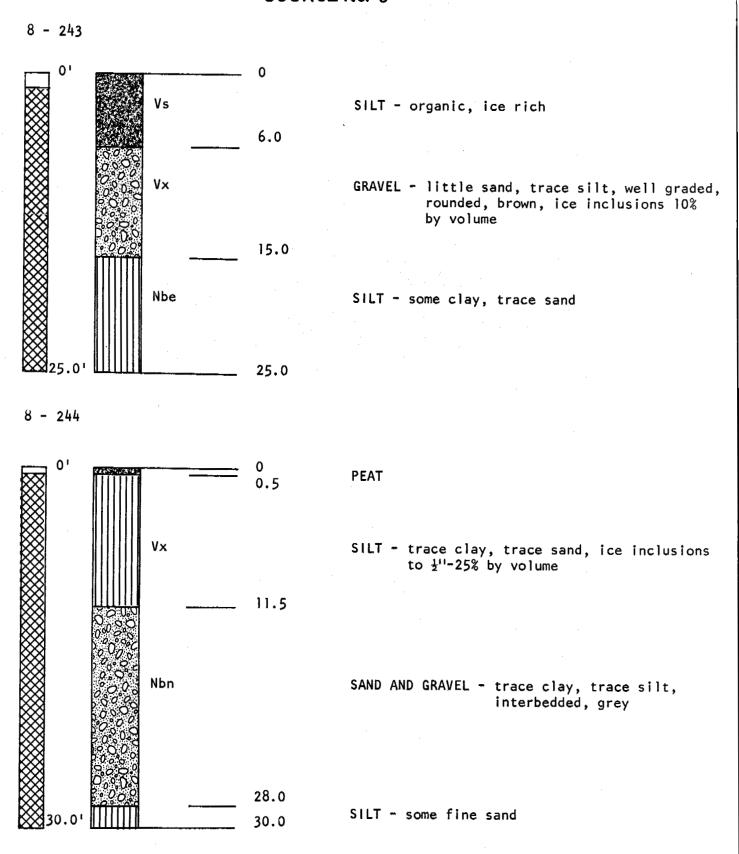
SAND - trace silt, brown, ice inclusions 20% by volume

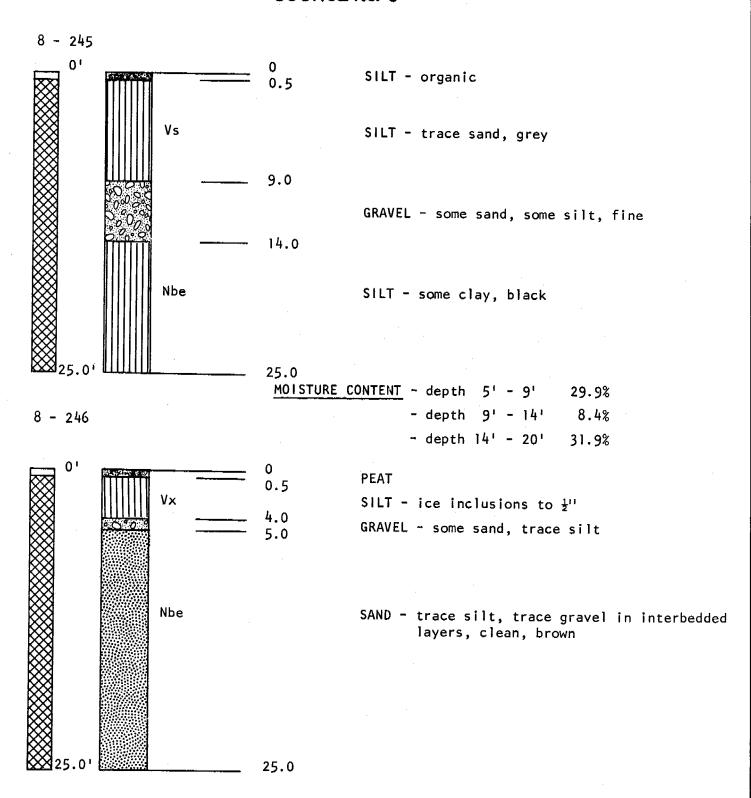
GRAVEL - some sand, trace silt, trace clay,
 well graded

SILT - some fine sand, grey

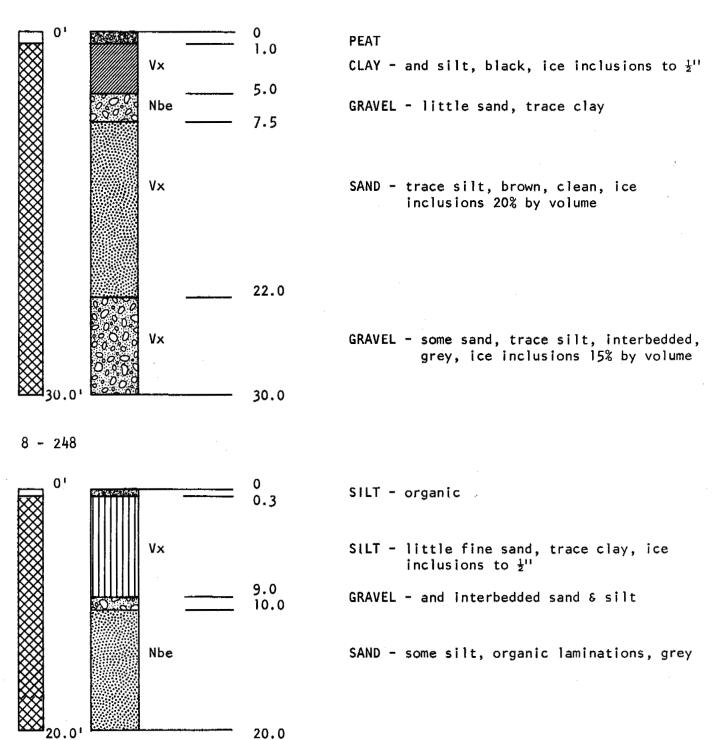


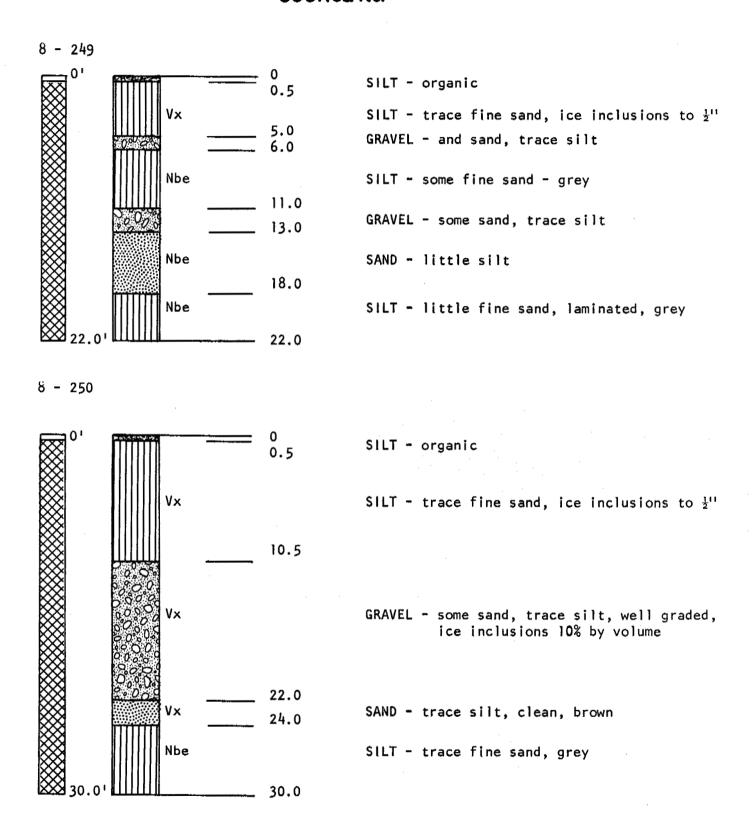




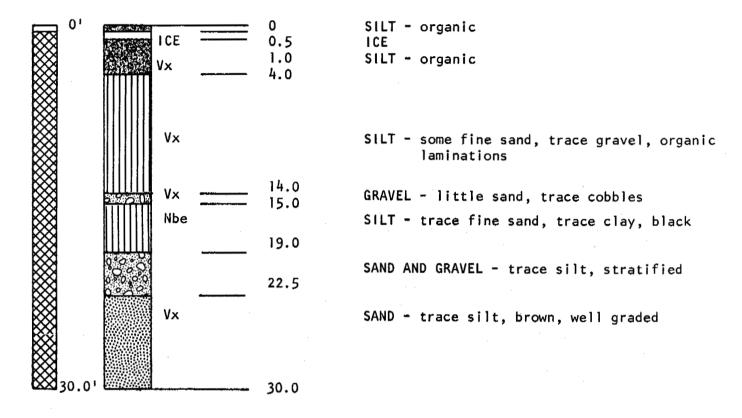


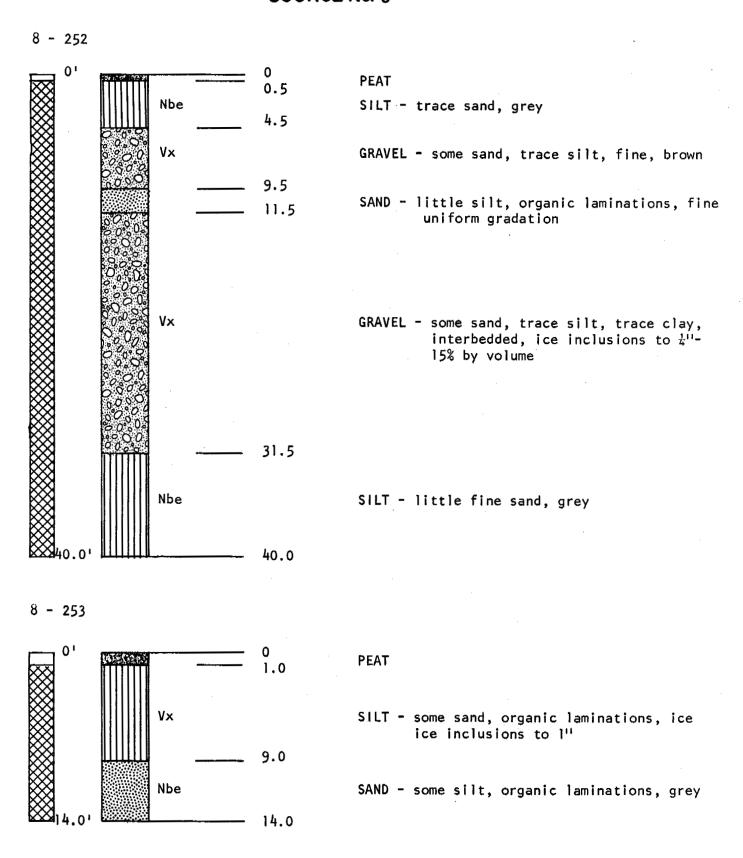


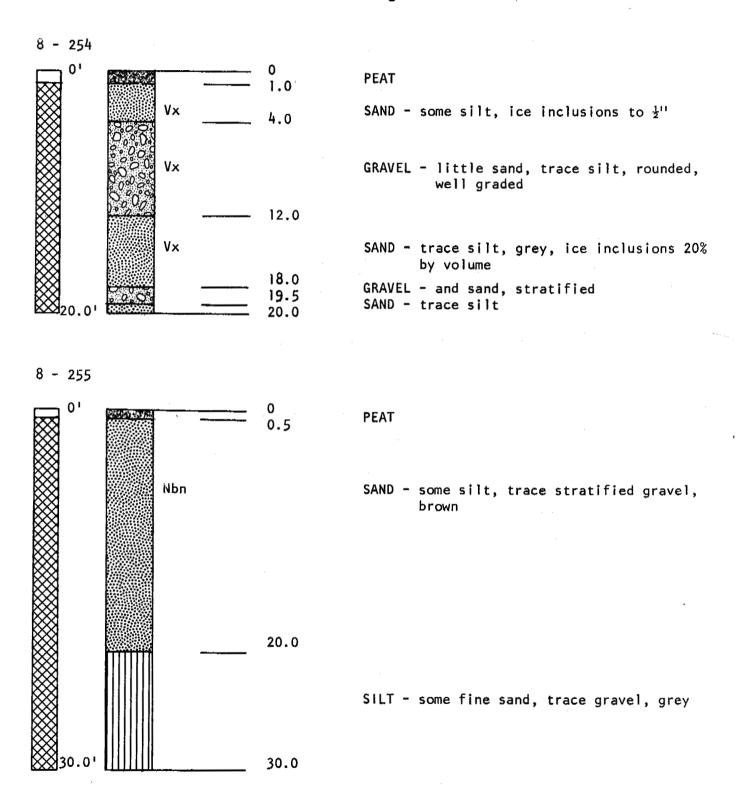




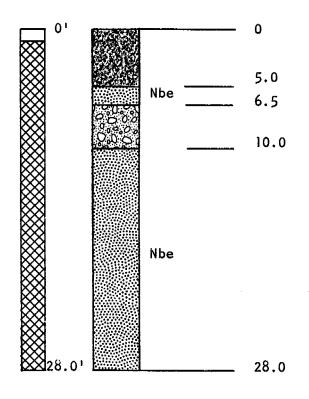
8 - 251







8 - 256

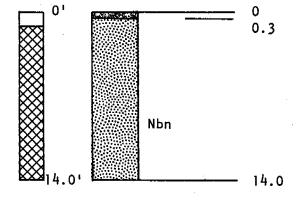


SILT - organic

SAND - some silt, fine, grey

SAND - trace silt, trace fine gravel, trace cobbles

8 - 257



SILT - organic

SAND - trace stratified gravel, trace silt, organic laminations

PARSONS LAKE SOURCE No. 9

LOCATION AND LANDFORM: A high river terrace located 5 miles southeast

of Parsons Lake and 2 miles west of Eskimo Lakes.

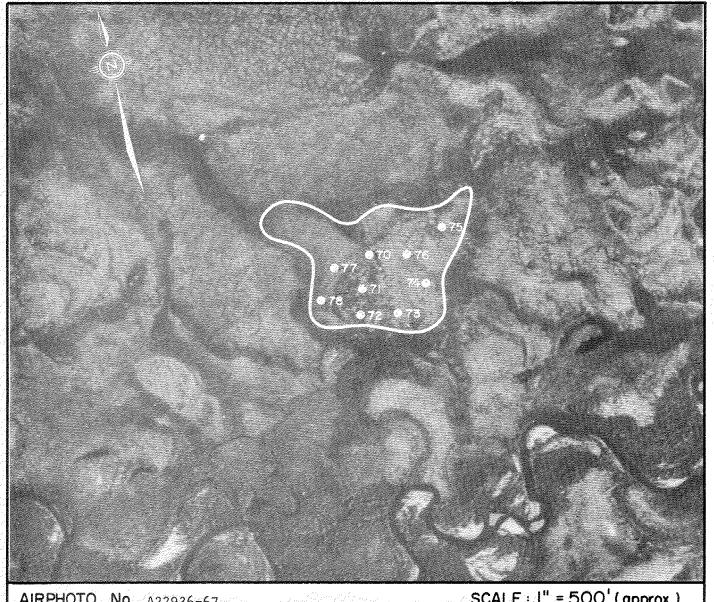
MATERIAL: GRAVEL - and sand, trace silt, variable.

50,000 cubic yards. VOLUME:

CONCLUSION: Development is not recommended due to the variable

overburden materials, and the relatively thin

underlying gravel stratum.



AIRPHOTO No. A22936-67

SCALE : |" = 500' (approx.)

SOURCE DESCRIPTION

The source area is a high river terrace located along a small stream about 1.5 miles upstream of the Eskimo Lakes. It is roughly 700 feet square, and flat except for a central north-south trending ridge which is 5 to 10 feet above the surrounding terrace. It is bounded by lower terraces to the south, east and west, and by a higher terrace (Source 4) to the north. The 50 foot high banks bounding the south end of the source slope at about 2 horizontal to 1 vertical.

Drainage of the source is fair, with 5 feet of ground ice encountered in the upper 8 feet of two of the test holes. Faint ice wedge polygonal ground is apparent on the ground surface.

MATERIALS AND QUANTITIES

A total of 9 holes were drilled in the source area. The soil conditions at the source are relatively consistent, with a thick organic cover, overlying a gravel and sand stratum, all of which overlie a sequence of laminated sands and silts.

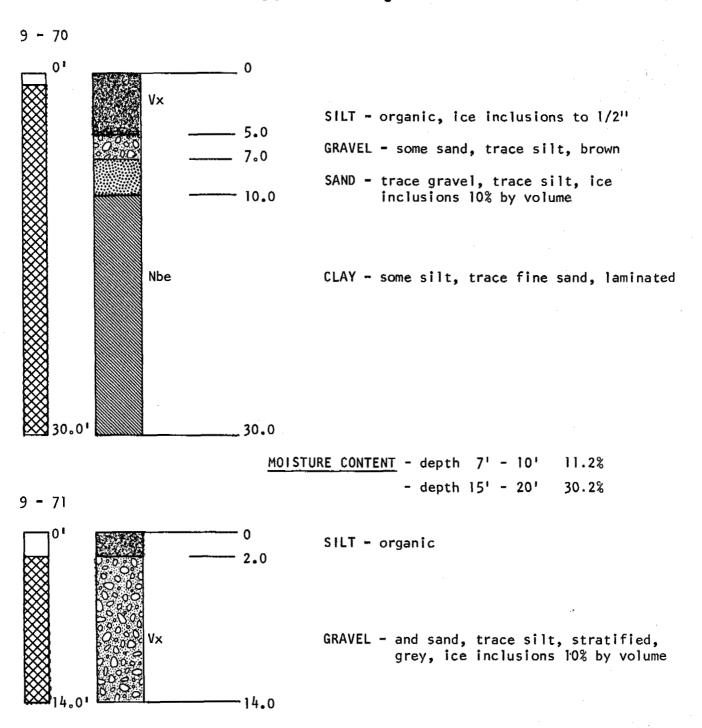
The organic cover is comprised of silt and peat, and varies in thickness from 1 to 10 feet. The gravel and sand stratum ranges from 2 to greater than 12 feet in the central ridge, and from 1.5 to 9.5 feet on the lower part of the terrace. The moisture content of the gravels range between 5 and 10%. The ice volume is estimated to be about 10%.

At depth the materials are laminated silts and fine sands with moisture content around 30%.

The estimated volume of gravel and sand in this source is 50,000 cubic yards.

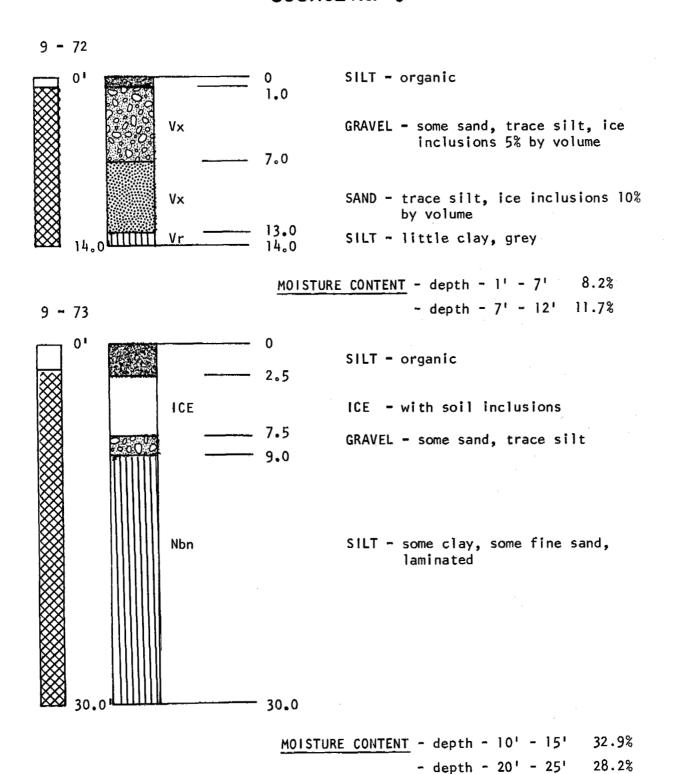
CONCLUSIONS

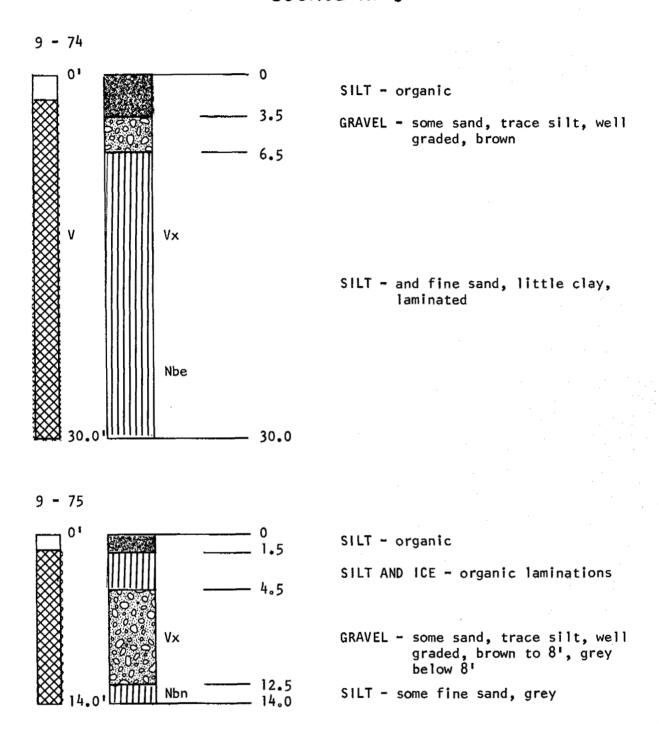
Due to the variable and thick overburden materials, and the thin underlying gravel stratum, development of this source is not recommended.

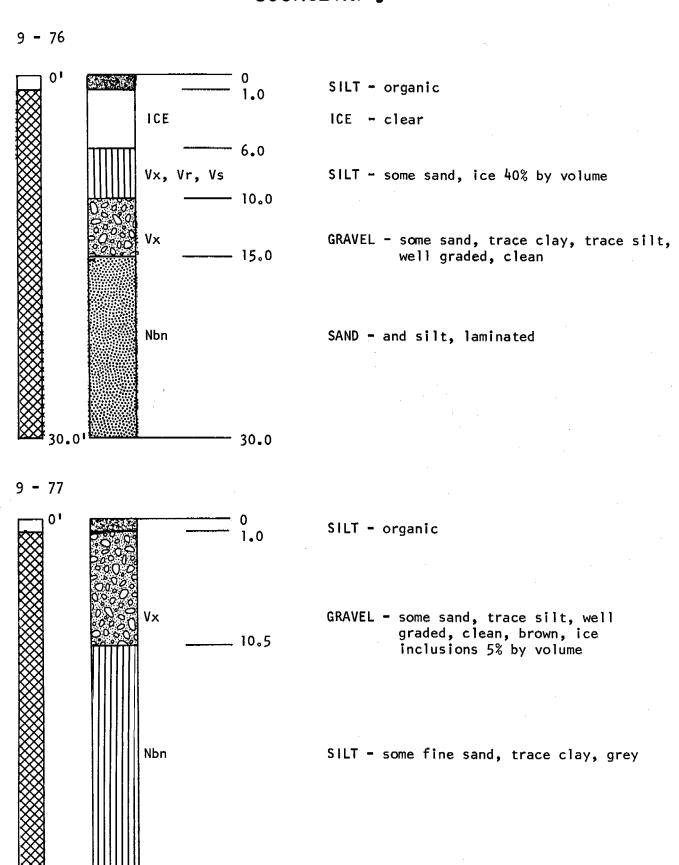


Hole terminated at 14.0' due to sloughing

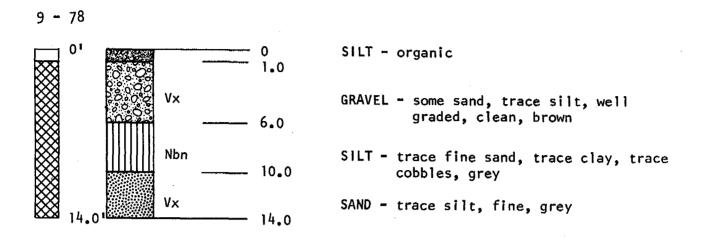
MOISTURE CONTENT - depth 2' - 12' 7.1%







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PARSONS LAKE SOURCE No. 10

LOCATION AND LANDFORM: A kame in a broad glaciofluvial outwash plain

located I mile east of the northeast corner of

Parsons Lake.

MATERIAL: GRAVEL - some sand, trace silt, trace cobbles,

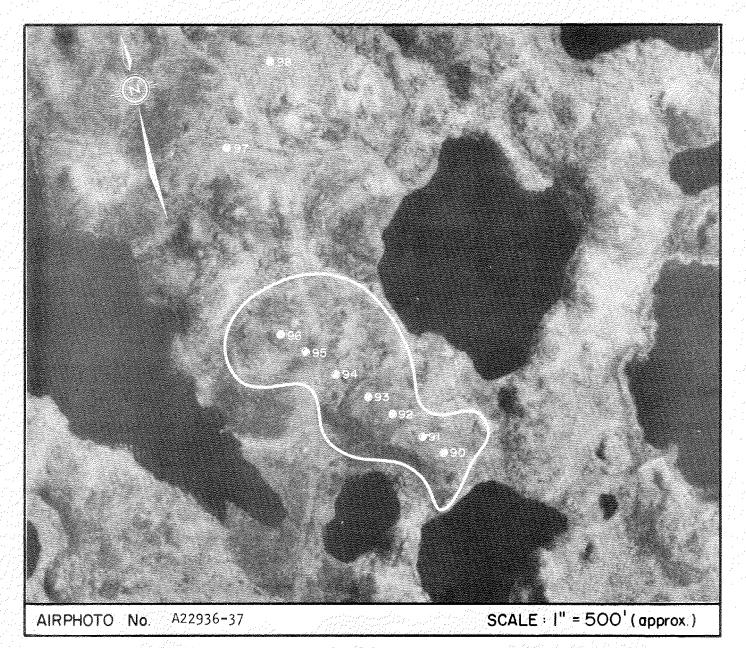
SILT AND ICE

VOLUME: Not calculated.

CONCLUSION: Not recommended for development because of thick

overburden, massive ground ice and variability of

materials.



SOURCE DESCRIPTION

This area is a gently rolling low kame located in the glaciofluvial outwash plain at the northeast corner of Parsons Lake. It is about 600 feet wide in the north, 300 feet wide in the south, and about 1400 feet long.

Drainage of the source is fair, but massive ground ice was encountered in the near surface soils of some test holes. The surrounding low-lying areas contain many small lakes and polygonal patterned ground.

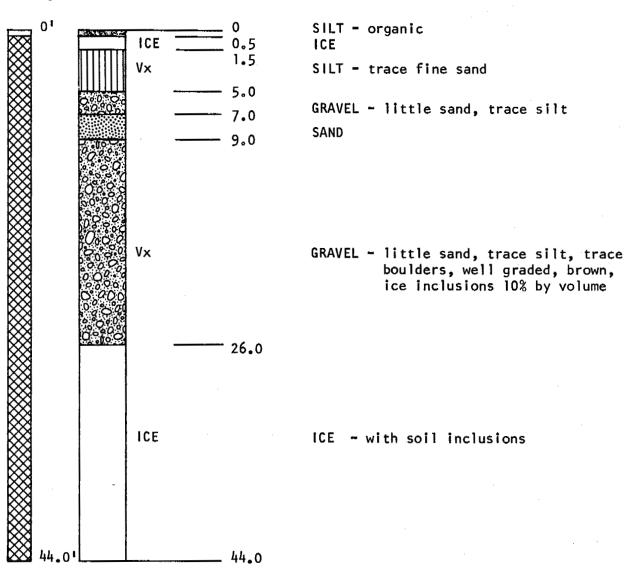
MATERIALS AND QUANTITIES

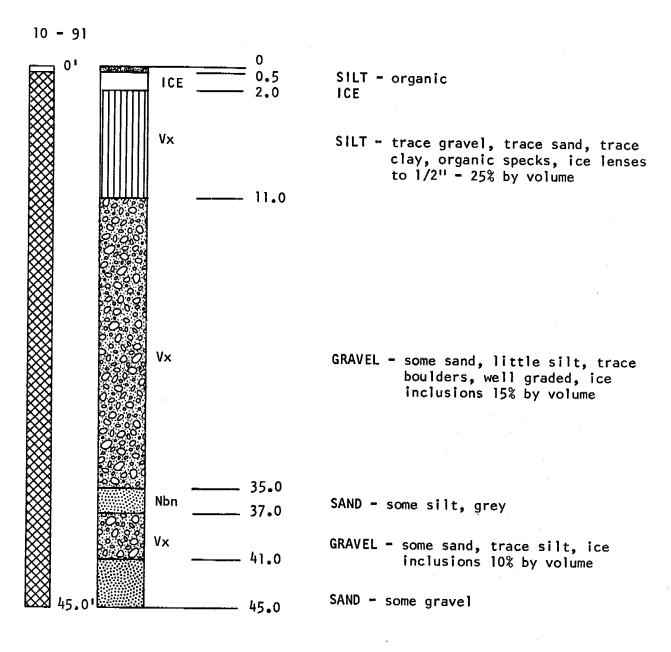
A total of 7 holes were drilled in the source area. The subsoils are variable and ice-rich. Three of the seven holes encountered a gravel stratum 21 to 37 feet thick underlying a 3 to 11 foot thick organic silt cover. The gravel material is clean, well-graded with some sand, trace silt and trace cobbles. However, in 2 of the holes the gravel stratum overlies massive ice up to 18 feet in thickness; and in one hole, ice lenses up to 2 inches thick occurred with the gravel stratum. The moisture content of the gravel is 6 to 8%. The remaining 4 holes encountered silts from the surface and massive ice from 1 to 23 feet thick.

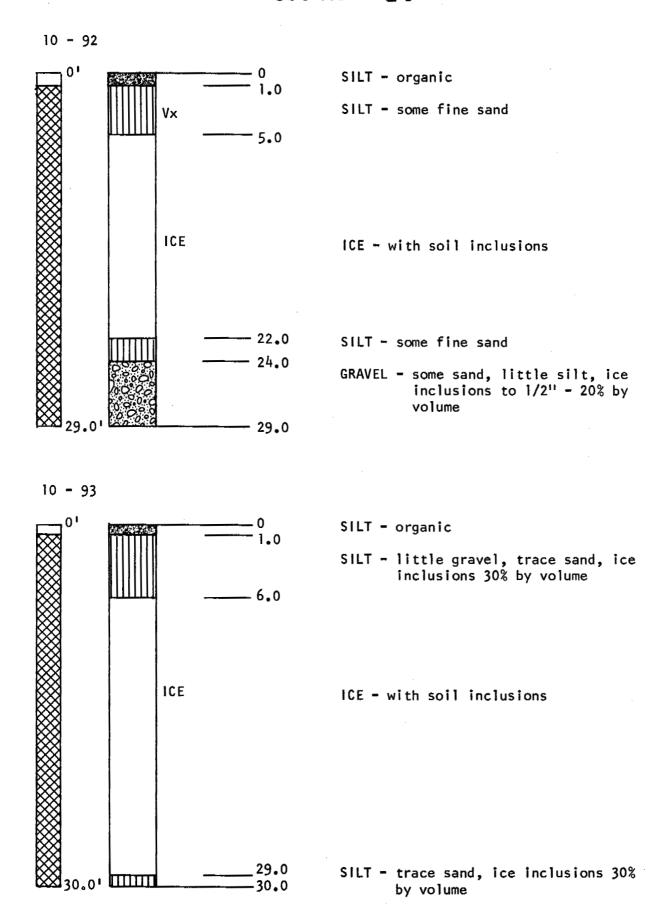
CONCLUSIONS

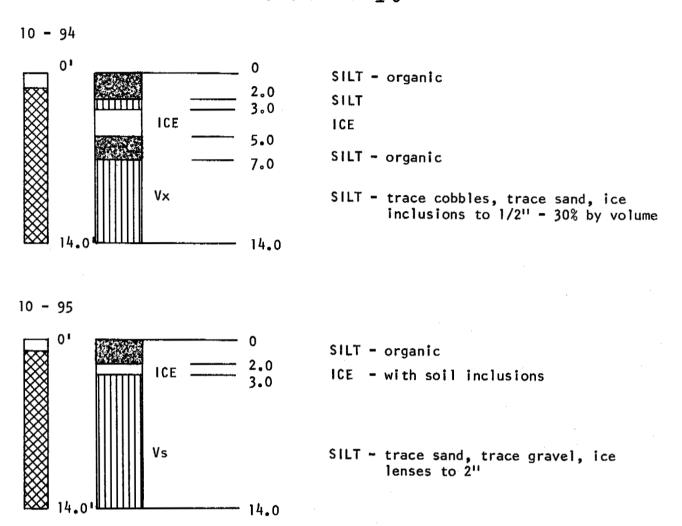
This source is not recommended for development. Any development will expose large areas of ground ice which would necessitate extensive restoration for a very limited volume of usable gravel material.



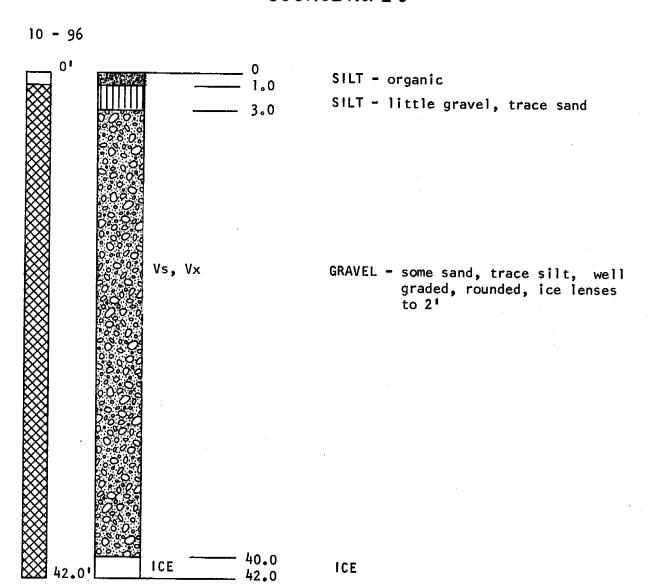




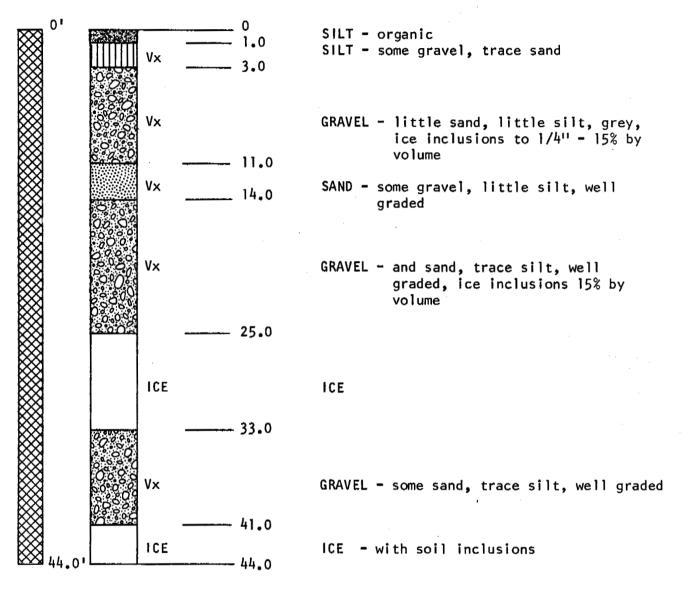




MOISTURE CONTENT - Depth 3' - 14' 37.7%



10 - 97



10 - 98

$\overline{\otimes}$	01	7.52.5		0 1.0	SILT - organic
			Vs, Vx	8.0	SILT - little gravel, trace sand, ice 40% by volume
			ICE		ICE - with gravel pockets
			V×	12.0	GRAVEL - some sand, trace silt
			Nbe	21.0 23.0	SAND AND SILT
			Vx		GRAVEL - some sand, little silt, grey, ice inclusions 15% by volume
	.0	2.0°3 0.0°3	Nbe	34.5 36.5	SAND AND SILT
وتعمه	8.0'	(2.7. × 6C)	<u> </u>	38.0	GRAVEL - little sand, little cobbles

PARSONS LAKE SOURCE No. 11

LOCATION AND LANDFORM: An outwash or morrainal feature in a broad

glaciofluvial outwash plain located 1 mile east of the northeast corner of Parsons Lake.

The state of the s

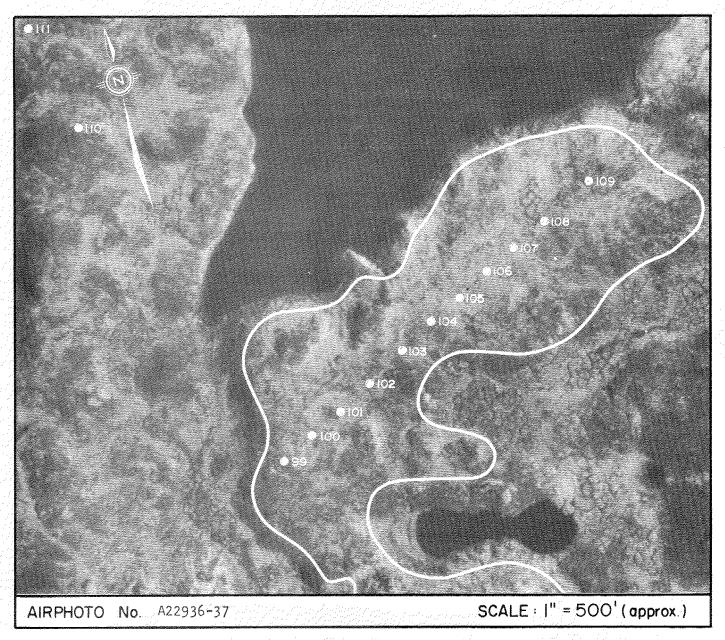
MATERIAL: Ice-rich silts, sands and gravels.

VOLUME: Not calculated.

CONCLUSION: Development is not recommended because the

materials are generally ice-rich and low

quality.



SOURCE DESCRIPTION

This area is a broad, gently rolling glaciofluvial outwash plain at the northeast corner of Parsons Lake. It is about 700 feet wide and 2000 feet long, and adjacent to a small lake.

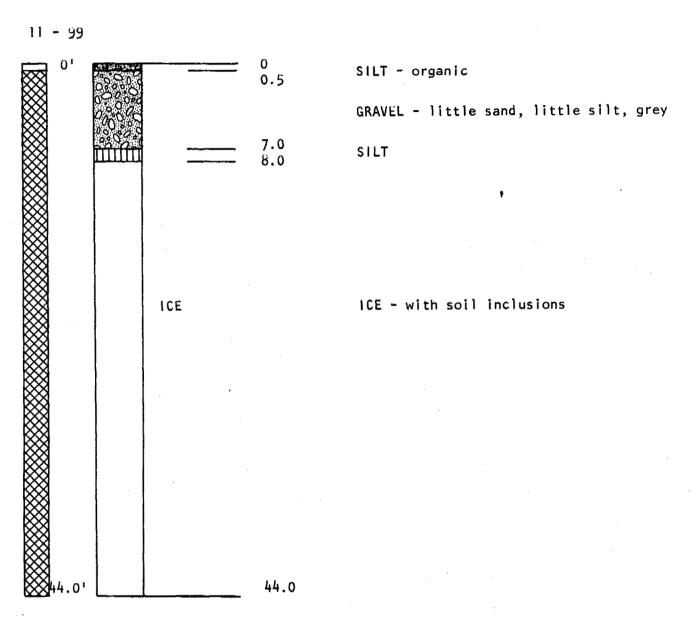
Drainage of the source is fair, but massive ground was encountered in the near surface soils of many test holes. Faint polygonal ground is apparent in parts of the area.

MATERIALS AND QUANTITIES

A total of 13 test holes were drilled in this source area. The overburden is up to 8 feet in thickness and overlies one or more gravel layers which are present at various depths below the ground. The gravel strata are generally 10 feet or less in thickness and separated by high ice content silt layers. In one location (Test Hole II-110), outside the source area outlined on the air photograph, gravel up to the 60 foot depth was encountered, however, this is an isolated case as another Test Hole (No.II-111) drilled in the same area showed thin gravel layers separated by massive ground ice, to the 42 foot depth. The moisture content of the gravel and silt is about 10% and 35% respectively.

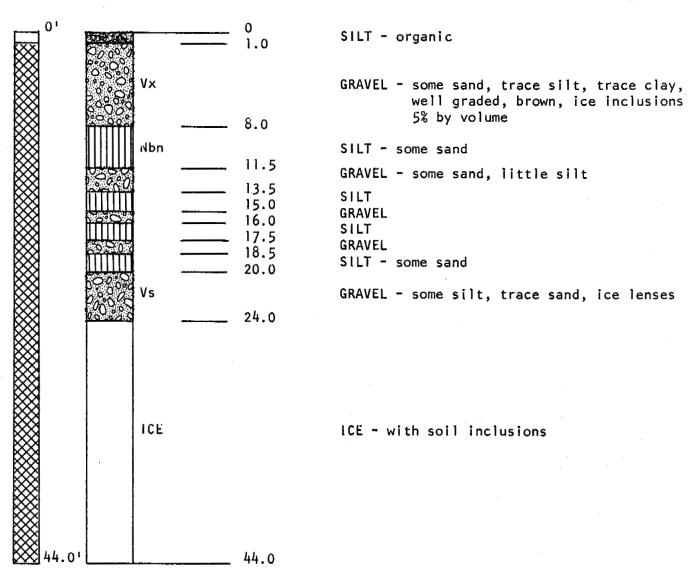
CONCLUSIONS

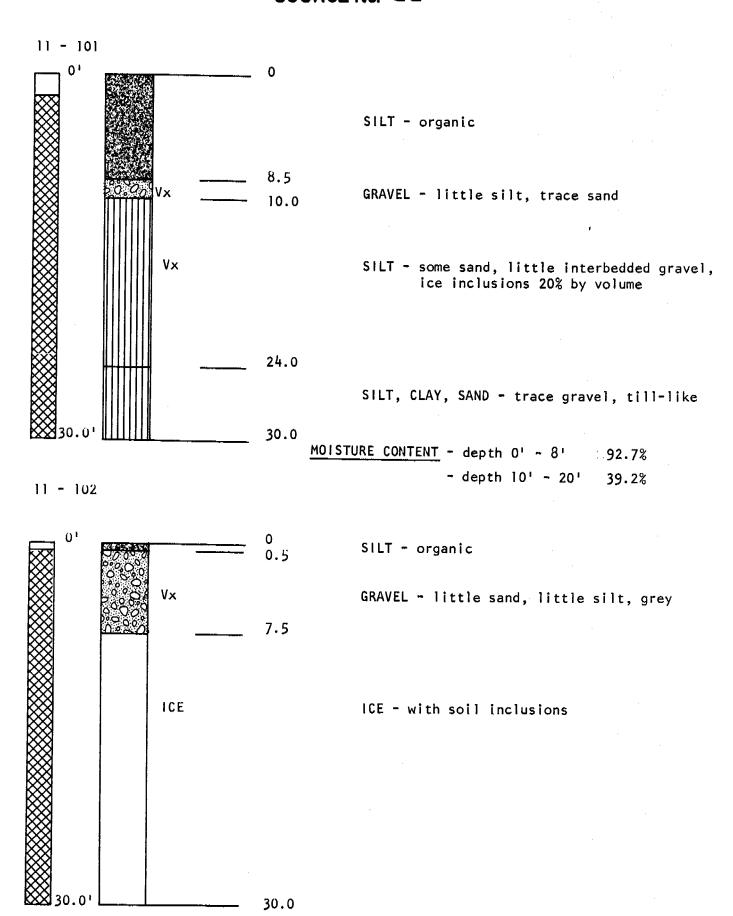
Development of this source is not recommended because of the extreme variation in the thickness of the gravel, the presence of silt deposits and ground ice encountered in most of the test holes.



MOISTURE CONTENT - depth 2' - 7' 10.1%





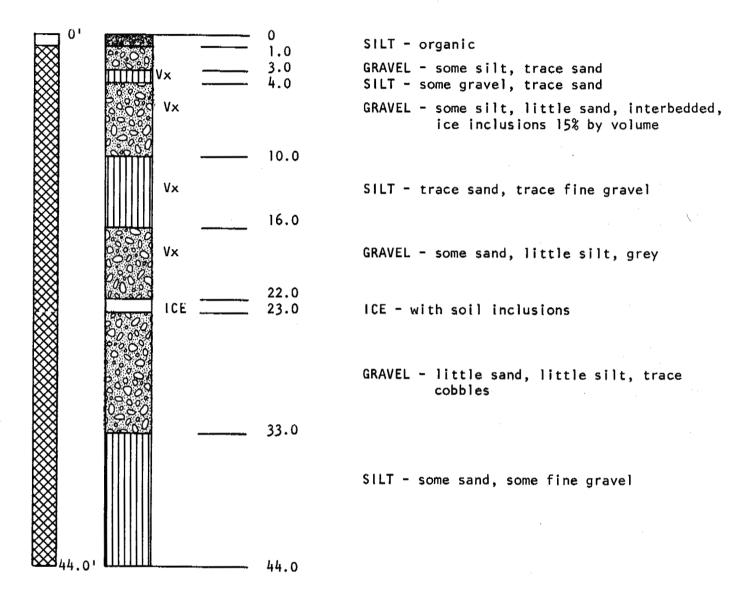


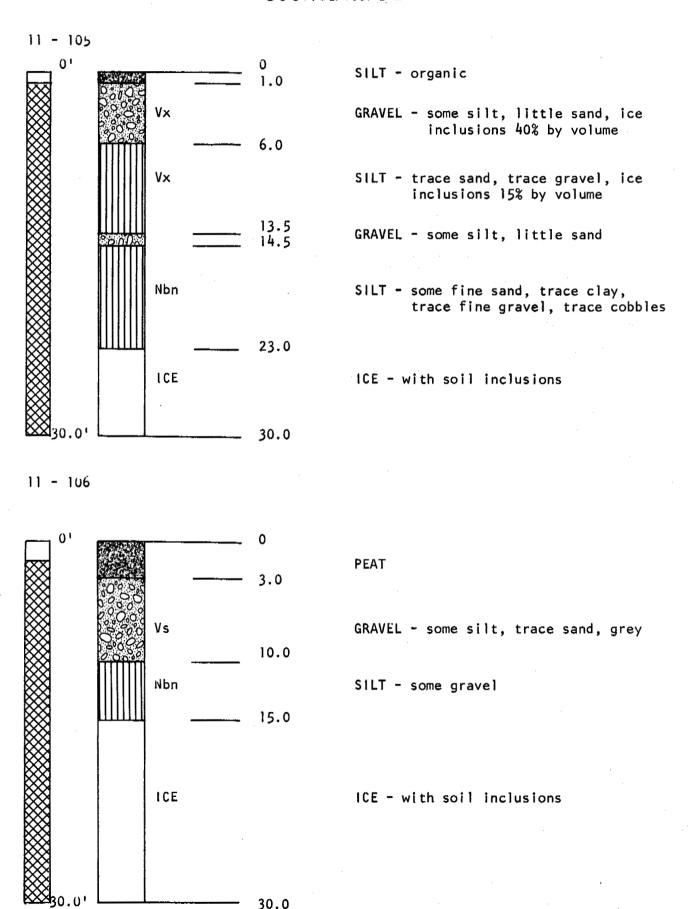
Kiohn Leonoff Consultants Ltd.

11 - 103

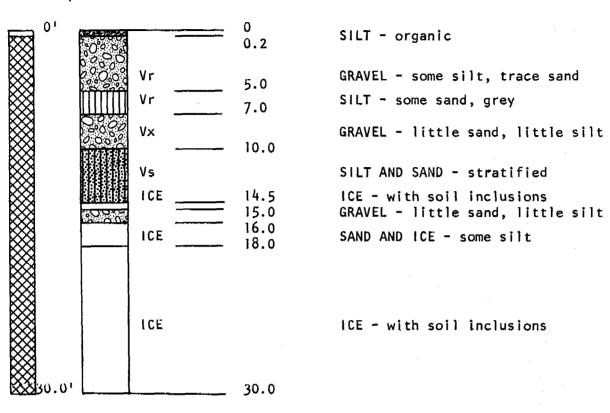
0'		V× ICE	 0 3.0 6.0 7.0	SILT - organic GRAVEL - some silt, trace sand, trace clay, brown ICE - with soil inslusions
		Vx,Vs		GRAVEL - little sand, little silt, brown
		Nbe	 17.0	SILT = little cand trace fine areas
		Vx	 22.0 25.0	SILT - little sand, trace fine gravel GRAVEL - little sand, trace clay
		ÍCE		ICE AND SILT - little gravel
	0.000 0.000 0.000 0.000 0.000	V×	 34.0	GRAVEL - some sand, trace silt, ice inclusions 20% by volume
			41.0 44.0	SAND AND SILT
₩49.0°	30.00 11.00		 47.0 49.0	GRAVEL SAND AND SILT

11 - 104

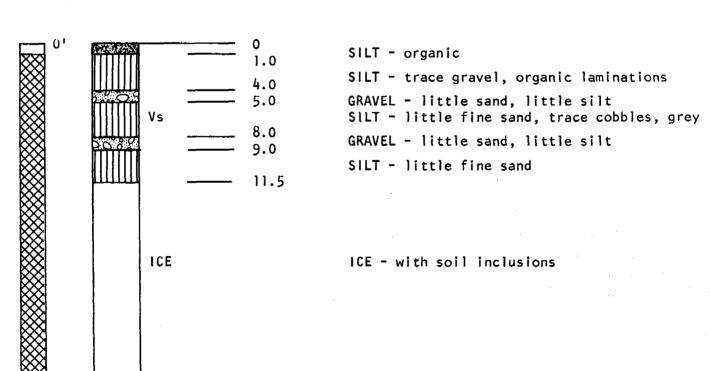




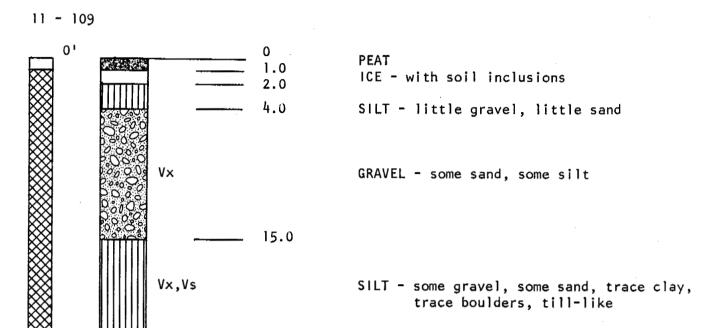
11 - 107



11 - 108



30.0

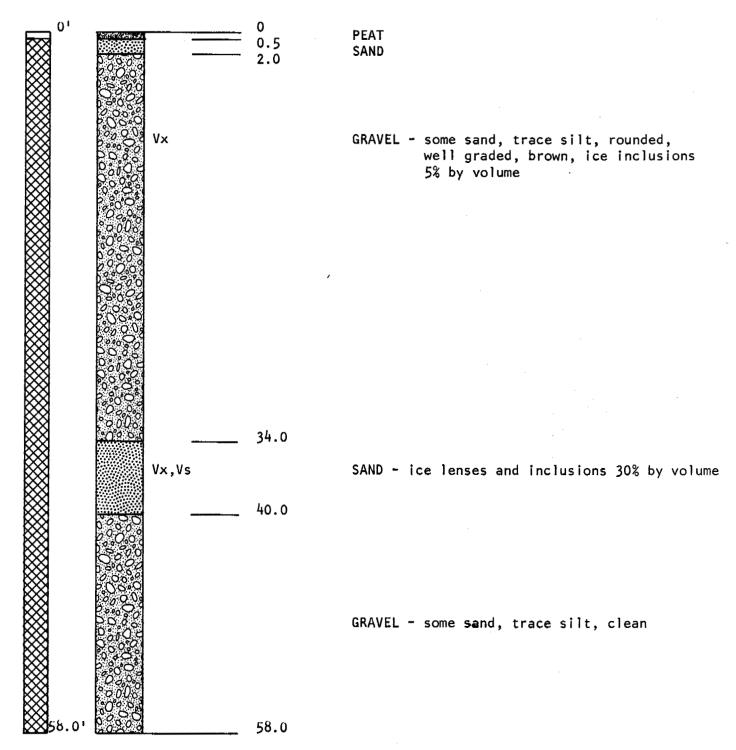


GRAVEL - some sand, little silt, trace clay,

28.0

30.0





11 - 111

0'			0 0.5 3.5	PEAT ICE - with peat inclusions PEAT - ice inclusions 50% by volume
		ICE		ICE - with soil inclusions
) 0 0 0 0 0 0		22.0 24.0	GRAVEL - some sand
		ICE		ICE
	00000	ICE	30.0 33.0 34.	GRAVEL - some sand, trace cobbles
	0.00	Vx	38.0	GRAVEL - some sand, ice inclusions to $\frac{1}{2}$ "
₩ _{42.0}	,	ICE	42.0	ICE