Indian and Northern Affairs

Affaires indiennes et du Nord

GRANULAR MATERIALS INVENTORY

Yukon Coastal Plain and Adjacent Areas

DECEMBER 1976

REPORT PREPARED BY

R.M. HARDY & ASSOCIATES LT
CONSULTING ENGINEERS & PROFESSIONAL SERV
• GEOTECHNICAL DIVI

and

Terrain Analysis and Mapping Services Ltd.

GRANULAR MATERIALS INVENTORY

YUKON COASTAL PLAIN AND ADJACENT AREAS

Prepared for

DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

By

R. M. HARDY & ASSOCIATES LTD.

and

TERRAIN ANALYSIS AND MAPPING SERVICES LIMITED

January, 1977

TABLE OF CONTENTS

TABLE OF CONTENTS - continued

LIST OF TABLES

LIST OF PHOTOGRAPHS

1.0 SUMMARY

This report outlines the results of a detailed assessment of granular and rock material sources along the Yukon Coastal Plain and adjacent areas of the British and Richardson Mountains as requested by the Department of Indian Affairs and Northern Development (DIAND). The study concentrated on investigating potential sources not previously documented by industry or government agencies. Information regarding the geographic, geologic and biologic setting, quantity and quality of available material and nature of the surrounding terrain was documented for each deposit investigated. Each deposit has also been outlined on a location map and an air photo covering the immediate area.

The geomorphology, drainage, ice contents, overburden, vegetation cover, and accessibility of each deposit are described from field and laboratory studies. Observed and recorded mammal, bird, and fish use of each area are also briefly summarized.

Descriptions of materials were established from observations of natural exposures, detailed logs of exposures and test pits excavated with jack hammers, and laboratory tests on representative samples. Volumes were calculated on the basis of depths estimated from stratigraphic observations, geomorphology and geometry of deposits, and drillhole data from similar adjacent deposits. These volumes are not necessarily available for extraction, but given any practical depth of extraction, an extractable volume can be calculated as the depth and total volume have been estimated. Also, an estimate of volumes that might be extracted per year by conventional techniques was calculated based on probably restrictions imposed by drainage and permafrost.

Comments relevant to extraction and environmental considerations are outlined specifically in The Development Section of the "Individual Deposit Reports".

Large volumes of poor quality bedrock, consisting of argillites and cherts, are available along the northern edge of the British Mountains and Buckland Hills. Isolated lentils of quartzite and limestone, which have potential as riprap and crushed rock, are the exception. The northern and central Richardson Mountains consist of a folded sequence of sandstones and shales. Hills and ridges consisting of the Jurassic Bug Creek quartz sandstone, and quartz sandstones and quartzites of the Lower Sandstone Division of Early Cretaceous age may have potential as riprap or crushed rock, including concrete aggregate. Lithic sandstones and conglomerates of the Cretaceous Aptian-Albian Flysh Division and Cuesta Creek Member of the Tent Island Formation have potential as riprap or crushed rock. Other geological units appear to have less potential as construction materials.

Preglacial gravels of fair to good quality cap gently-sloping pediments and are exposed along stream-cut escarpments beyond the limit of glaciation. Gravels away from the escarpments are covered by ice-rich silts. Near Shingle Point, gravels and sands of good to potentially excellent quality are exposed along coastal and stream-cut escarpments. Inland from the escarpments, large volumes are covered by morainal deposits. All preglacial gravels appear to have low ice contents.

Numerous kame terraces containing fair to poor quality material with high shale and argillite content were deposited along the mountain fronts as glacial ice covering the coastal plain diverted drainage westward along its edge. Near the western edge of the glacier, eskers, kames, and outwash plains of better quality material were deposited by meltwater streams flowing across and around the glacier toward the Beaufort Sea. A long still-stand by the retreating glacier near the coast has resulted in the deposition of good to potentially excellent quality material in the form of coalescing outwash fans on the landward side of the ridge running from Kay Point to east of Shingle Point. Kame deltas were also formed at the mountain front just west of Aklavik. Glaciofluvial deposits are well drained and free of overburden except on broad flat surfaces. Massive ice, if present, is usually indicated by thermokarst lakes or the hummocky nature of the deposit.

Broad alluvial-fans west of the Firth River contain relatively large volumes of good quality granular material, although it may locally be very bouldery. Low gradients and permafrost result in shallow perched ground water in summer. Springs and aufeis are fed from water at depth.

Low stream terraces are generally poorly drained and covered by overburden. However good quality granular material, well drained and free of overburden, is readily available near scarps. High terrace gravels in the eastern part of the area are poorer in quality because of higher shale contents and access to these deposits is restricted by deep canyons.

Active floodplains consisting of point bars, islands, and braided bar and channel complexes contain significant volumes of thawed gravel in summer. However, removal will be confined by stream levels and environmental concerns, thus only a small fraction of total volumes may be excavated. Developed floodplains would probably be restored by natural fluvial processes. The quality of contained materials reflects nearby bedrock lithology.

Spits, bay-mouth bars, and beach ridges contain shallow depths of gravel and sand. Development may be confined by the depth to sea level, archeological and environmental concerns, and effects of development on coastline retreat.

A total of 4,733,000,000 cubic yards of granular material and 151,700,000 cubic yards of rock were mapped during this investigation.

2.0 INTRODUCTION

The Government of Canada, through the offices of the Department of Indian Affairs and Northern Development, commissioned R. M. Hardy & Associates Ltd. of Calgary, Alberta and Terrain Analysis & Mapping Services Ltd. of Stittsville, Ontario to carry out a detailed assessment of granular and rock material sources along the Yukon Coastal Plain and adjacent areas. The work was formally authorized by the Department of Supply and Services in their Contract Serial Number OSU76-00123 dated September 8, 1976. The official communique to proceed with the study was received by telex on September 2, 1976 from the Department of Supply and Services and work was initiated immediately.

The study area covered by this investigation encompasses the entire Yukon Coastal Plain and the northern portion of the British and Richardson Mountains extending east from the Yukon/Alaska border to the western edge of the Mackenzie Delta immediately west of Aklavik, N.W.T. The study concentrated on investigating potential borrow material sources which had not been previously documented by industry or government agencies; and that are below 1000 feet in elevation and within 30 miles of the Beaufort Sea on the western edge of the Mackenzie Delta.

The study was carried out in accordance with the "Terms of Reference" as outlined in Appendix A of the contract which are outlined in detail under "Scope" in Section 3.0 of this report. The field work was initiated on September 8, 1976 by Dr. V. N. Rampton's geological reconnaissance and completed on October 16, 1976 with the complete demobilization of personnel, supplies, samples and equipment to the Calgary office of R. M. Hardy & Associates Ltd.

A total of 72 deposits were investigated in detail during the investigation and are documented in this report.

The successful completion of this study was enhanced by the cooperation and contributions of the respective Territorial Land Use agencies, Department of National Defence and numerous northern based

industry and govenment organizations. In particular, we wish to acknowledge the hospitality, cooperation and assistance of Mr. John Sheldon and his staff of the Bar-2 DEW Line Station at Shingle Point, Yukon Territory for the provision of accommodation and logistics support during our field program.

3.0 SCOPE

The program was oriented toward providing DIAND with a highly selective, carefully planned and executed survey which will delineate in detail the granular material and rock sources not previously assessed by industry or government. Specifically, this investigation will supplement the information provided by studies by Northern Engineering Services Company Ltd. on behalf of Canadian Arctic Gas Study Ltd. and by Klohn, Leonoff Consultants Ltd. for Imperial Oil Ltd.

The investigation was carried out in strict accordance with the Terms of Reference specified in Appendix A of the contract, which are outlined as follows:

a) Conduct a geotechnical investigation to provide the Department of Indian Affairs and Northern Development (DIAND) with detailed information on those borrow sources on the Yukon Coastal Plain and adjacent areas which have not been adequately assessed in previous programs conducted by industry and government.

b) Review all of the available files, maps, reports and documents relating to the surficial geology of the study area to identify sources requiring further investigation in the field.

c) Use a very high degree of selectivity and care in ensuring that the field investigation provides DIAND with sufficient, detailed information to complete a comprehensive inventory of the principal rock and granular material sources in the study area.

d) Survey representative examples of the following landforms, together with any others which you may suggest:

Alluvial fans;

Bars on braided flood plains and stream courses;

Marine spits, beaches and bars;

Glaciofluvial deposits;

Escarpments in unconsolidated materials;

Bedrock escarpments;

Stream cut bedrock canyons;

Scree covered bedrock hills and uplands;

e) Consider test pitting with the use of jackhammers, supported by appropriate laboratory analyses of representative samples.

f) Provide information on the quantity, quality and distribution of material, together with an indication of the extent of ground ice.

4.0 PERSONNEL AND EQUIPMENT

4.1 Personnel

The investigation was carried out under the technical supervision of Dr. V. N. Rampton, P.Eng., of Terrain Analysis & Mapping Services Ltd. This technical supervision included the selection of sources to be investigated, location of test pits, depth of test pits, sampling criteria, handling of samples, modifications and adjustments of test pitting procedures, selection of laboratory tests to be carried out on representative samples and the final report preparation.

The responsibility for project management was carried out by Mr. T. J. Fujino, P.Eng., of R. M. Hardy & Associates Ltd. Mr. Fujino's responsibilities included the management of subcontractors, administration and selection of the field team, logistics support and planning, organization of laboratory and specialist services, and the coordination and administration of the report team.

Messrs. G. Daw and C. Magee, geotechnical field engineers, were responsible for the direct supervision and field management of the test pitting operations. Mr. G. Daw was, also, responsible for the daily supervision and coordination of the drafting and laboratory testing programs for the final report preparations.

4.2 Equipment

A Bell 206B Jet Ranger Helicopter was used for the geological reconnaissance work. A Bell 204B helicopter with a capacity to carry eleven passengers or sling up to 4000 pounds was selected to provide the air support for the test pitting operations. The Bell 204B helicopter provided a very efficient and economical mode of transportation in that it was able to transport the 2-test pitting crews, bulky gravel samples, and small equipment in a single air lift operation. Both the Bell 206B and Bell 204B helicopters were supplied by Associated Helicopters Ltd. from their northern base at Inuvik, N.W.T.

The two 150-cfm gas-powered Smith air compressors, which were used to facilitate the test pit excavations, were each equipped with two 60-pound air hammers, 200 feet of steel reinforced rubber air hose, and an assortment of 3-inch wide clay spades and 2-inch wide asphalt spades. The air compressors and associated equipment were supplied by Modern Industrial Rentals Ltd., Calgary, Alberta and were equipped with an upper hook for slinging by helicopter. The air compressor with its complete complement of tools weighed approximately 2500 pounds. Each test pitting crew of three men was provided with air compressor equipment, two short handled spades and one pick (Photos 1 and 2).

The support facilities consisted primarily of fixed-wing air charters and expediting services. Light fixed-wing charters consisting of Cessna 185 float plane charters were provided by Aklak Ltd. or Aklavik Flying Services Ltd. of Inuvik, N.W.T. Fixed-wing charters for bulkier equipment and fuel transportation was provided by Gateway Aviation Ltd. of Inuvik, N.W.T., using their DC-3 aircraft.

PHOTO 1; Test Pit Y35-A

Typical test pitting operation with Bell 204 helicopter, air compressor, and crew.

PHOTO 2; Test Pit Y102-B

Stockpiling organic cover for replacement after pitting. Frozen ground is broken up using air hammer.

The field personnel for this program were billeted at the Bar-2 DEW Line Station at Shingle Point for the duration of the field program. The Shingle Point airstrip was also used for fuel caching, staging of equipment and sample storage.

5.0 INVESTIGATION PROCEDURE

5.1 Literature Review and Office Study

The reports of studies carried out in the Yukon Coastal Plain area by Canadian Arctic Gas Study Ltd. and Imperial Oil Ltd. were used as the baseline information to initiate the detailed assessment of other granular material deposits. In addition, Geological Survey of Canada maps and reports, other private industry reports and other existing maps were analyzed to assist in the total assessment of granular and rock material sources for the Yukon Coastal Plain and adjacent areas. This data served as a focus for airphoto interpretation to map and delineate favorable areas of prospective granular material deposits.

This phase of the study was completed in a matter of a few days after the authorization to proceed with the study was received since Dr. V. N. Rampton has extensive and intimate geological experience in the area. A total of 187 locations were identified in the study area for further detailed field investigations and Land Use approvals were applied for from the respective territorial governments.

5.2 Geological Field Reconnaissance

The airphoto interpretation and office studies served as a focus for planning and conducting the preliminary geological field reconnaissance. Dr. V. N. Rampton, Project Geologist, carried out the ground check of each potential material deposit selected by airphoto interpretation. The outlines of prospective borrow sites were carefully delineated on the corresponding airphoto along with any additional salient features of the deposit. The exact locations of the test pits

were designated during this reconnaissance at each deposit selected for additional detailed investigation. The test pit locations were clearly marked using 4 foot long stakes, painted a fluorescent red and adorned with red flagging tape.

A total of 140 locations were designated for detailed test pitting and sampling during the geological reconnaissance. In view of the inclement weather conditions which can be experienced along the Yukon Coast during this period each of the sites designated for test pitting were assigned priorities as follows:

a) Priority 1 Sites: - maximum effort be made to complete the test pitting and sampling of these sites.

b) Priority 2 Sites: - preferred for test pitting and sampling if adequate time and good weather permits.

c) Priority 3 Sites: - test pitting and sampling be carried out, only, if any additional time is available.

All priority 1 and 2 sites were successfully test pitted and sampled during the field operations.

5.3 Field Investigations

On the basis of the geological reconnaissance and the time period available to complete the detailed field investigation along the Yukon Coastal Plain, 140 locations were selected for test pitting. This schedule was based on the completion of 5 to 6 locations during each work day. A total of 129 locations were successfully test pitted and sampled during the field investigation. An additional 8 locations were ground checked during the geological reconnaissance.

Each test pitting crew consisted of two northern labourers who were supervised by a geotechnical field engineer or technician. The test pits excavated were generally 4 by 6 feet in area and extended from

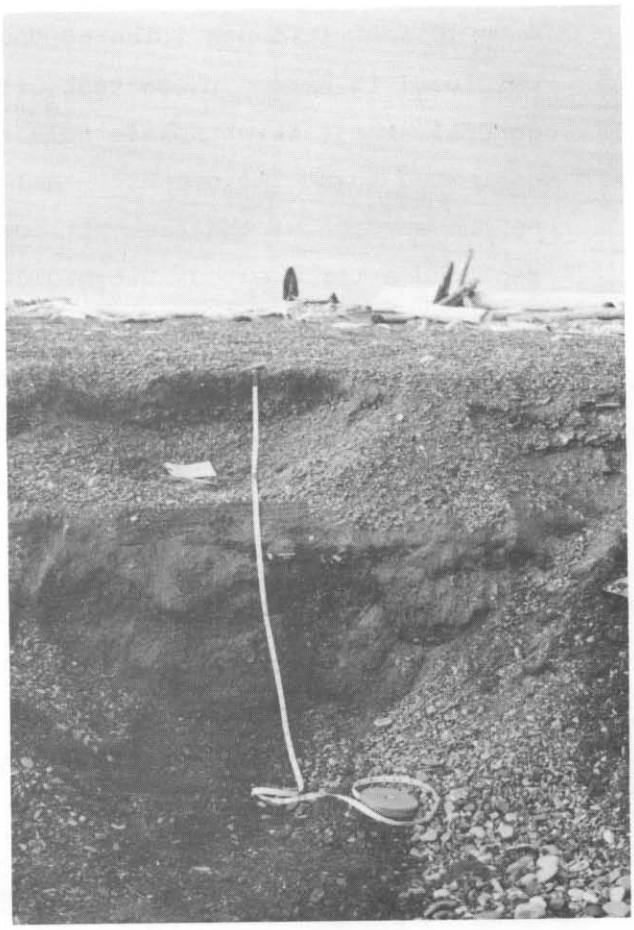


PHOTO 3; Test Pit Y10-E(e)

Natural exposure on beach ridge, cleaned down for logging.

PHOTO 4; Test Pit Y15-D(e)

Close up view of test pit wall after excavation showing sub-surface stratigraphic variation of granular material.

4 to 10 feet in depth. The 60-pound hammers, powered by compressed air, were used to extend these test pits beneath the permafrost table. In general, the test pits were selected in areas where the active layer was estimated to be the deepest. All organic peat and/or vegetation material on the surface of the test pit location was carefully removed and replaced after the test pit had been backfilled.

When the test pit had been excavated to depth, a detailed log and a representative sample of granular material was taken from the exposed vertical wall of the test pit (Photos 3 and 4). These samples generally weighed 100 to 150 pounds and consisted of one to two sample bags. The granular material was retained in heavy plastic bags in order to minimize the loss of moisture content and fines. In addition to the samples, a photographic record was made of one vertical face. Records were made of vegetation description, animal and fish habitat and other pertinent information of the deposit area.

5.4 Laboratory Testing

The entire series of test pit samples obtained for this study were forwarded to R. M. Hardy & Associates Ltd. Calgary, Alberta. The following laboratory tests were carried out:

a)	Mechanical Grain Size Analysis	ASTM C 136 - 71
b)	Moisture Content	ASTM C 566 - 67
c)	Petrographic Analysis	ASTM C 295 - 65
d)	Lightweight Pieces in Aggregate	ASTM C 123 - 69
e)	Sulphate Soundness Test	ASTM C 88 - 73
f)	Organic Content	ASTM C 40 - 73
g)	Specific Gravity and Absorption:	
	- Coarse Aggregate	ASTM C 127 - 73
	- Fine Aggregate	ASTM C 128 - 73

In addition, eleven selected rock specimens were forwarded to Dolmage Campbell and Associates (1975) Ltd. in Vancouver, B.C. for

microscopic petrographic analysis to assess the mineralogy of these samples. The results of the laboratory tests are included in the individual site reports.

5.5 Report Format

The specific information for each deposit investigated is incorporated in the "Individual Deposit Reports" as outlined in Section 10 of this report.

6.0 LOGISTICS

In view of the lateness in the year when the field program for this study was undertaken, the rapid and efficient mobilization of technical field staff, helicopters and equipment, fuel caches and northern labourers was imperative. The authorization to proceed with the Yukon Coastal Plain Granular Materials Study was received on September 2, 1976 and a brief description of the logistical planning and execution of the study is outlined herewith:

a) The office studies, airphoto interpretations and applications for Land Use permits were completed by September 6, 1976. Dr. V. N. Rampton arrived in Inuvik, N.W.T. on September 7, 1976, took receipt of the contracted Bell 206B helicopter from Associated Helicopters Ltd., and began his geological reconnaissance from Shingle Point on September 8, 1976. Twenty-eight drums of jet fuel had been cached at Shingle Point on September 5, 1976 by Gateway Aviation Ltd.

b) The two air compressors and their ancillary equipment, field supplies and tools, sample bags and miscellaneous supplies were staged and mobilized from our Calgary office on September 10, 1976 to the attention of Mr. Bill Farmer of Points North Services Ltd. in Inuvik, N.W.T.

c) The field technical staff from R. M. Hardy & Associates Ltd. arrived in Inuvik, N.W.T. on September 15; signed on the four northern labourers who had been selected by Nortran; and departed for Shingle Point in the Bell 204B helicopter to commence the test pitting operations on September 16, 1976. The Bell 206B helicopter was released on the arrival of the Bell 204B, which was used for the test pitting operations and for the remaining geological reconnaissance.

d) The test pitting operations were carried out westward from Shingle Point to the Yukon/Alaska border with the Priority 1 sites being completed in the initial stages. On the return leg of the westward sweep the remaining Priority 2 and 3 sites were test pitted and sampled. The portion of the program west of Shingle Point was completed on October 6, 1976 and constituted approximately 80 percent of the locations to be test pitted.

e) The first group of the technical field staff was relieved by the second crew on September 30, 1976.

f) The field testing operations continued to October 14, 1976 at which time the decision to terminate the field work was made because productivity had been reduced to less than 30 percent by inclement weather. At this time 129 locations out of a total of 140 locations had been completed.

g) All personnel, equipment, supplies and samples were demobilized to Calgary, Alberta on October 19, 1976. All empty fuel drums were removed from Shingle Point and returned to Inuvik, N.W.T. for credit.

7.0 GEOLOGIC AND GEOMORPHIC ANALYSIS OF INVESTIGATED DEPOSITS

7.1 General

Basic characteristics of investigated deposits, such as size of material, lithology and soundness of different fractions, drainage, ice contents, amount of overburden, accessibility, and ease of restoration, all relate to their geologic or geomorphic setting. Deposits with similar geologic and geomorphic settings, have nearly identical characteristics, and can be grouped for engineering purposes according to their setting.

The whole area lies within the continuous permafrost zone. Active layer thickness varies according to vegetative and overburden cover. Areas covered by peat and moss usually have active layers less than 1 foot thick, whereas gravels having a broken vegetative cover usually have active layers varying from 4 feet near the Alaska Boundary to over 8 feet in the Richardson Mountains. All deposits of granular materials contain ice wedges, except active floodplains, spits, bay-mouth bars, and beach ridges where deep active layers and active geologic processes hinder their formation.

7.2 Bedrock - British Mountains and Buckland Hills

The northern edge of the British Mountains and the Buckland Hills are underlain by the Precambrian Neruokpuk Formation, which consists mainly of argillites (rocks with somewhat higher degree of induration than shale, but not metamorphosed to the degree that a slate has been), cherts, limestones, and quartzites (Table 1). Along the accessible northeastern flank of the mountains, the Neruokpuk Formation is composed predominantly of argillites with numerous cherty beds and bands, and occasional lentils of quartzite. The quartzite is massive to thinly bedded. The whole complex is folded and faulted.

TABLE 1.

CHRONOLOGY AND LITHOLOGY OF BEDROCK,
YUKON COASTAL PLAIN AND ADJACENT AREAS

AGE		NAME	LITHOLOGY	LOCATION
TERTIARY		Reindeer Formation (Aklak Member)	mudstone siltstone sandstone shale, coal	Northern Richardson Mountains and Adjacent Areas
MESOZOIC	LATE CRETACEOUS	Moose Channel Formation (Basal Sandstone Member)	mudstone, coal sandstone* conglomerate*	
		Tent Island Formation (Cuesta Creek Member)	mudstone conglomerate* sandstone*	
	EARLY CRETACEOUS	Aptian-Albian Flysh Division	shale, siltstone conglomerate* sandstone*	
		Upper Sandstone Division	siltstone sandstone	
		Upper Shale-Siltstone Division	shale, siltstone sandstone*	
		Lower Sandstone Division	sandstone*, shale siltstone quartzite*	
	JURO-CRETACEOUS	Husky Formation (& Kingkak Formation)	shale	
	JURASSIC	Bug Creek Formation	sandstone*	
	TRIASSIC	Shublik Formation	limestone* sandstone* siltstone*	Northern British Mountains, Buckland Hills, and Adjacent Terrain
PALEOZOIC	CARBON-IFEROUS	Lisburne Group (Wahoo Formation)	limestone*	
		Kyak Formation	shale, coal quartzite	
		Kekiktuk Formation	conglomerate quartzite	
PRECAMBRIAN		Neruokpuk Formation	argillite*, chert* quartzite* limestone	

* indicates strata investigated during this study.

Mountains and hills underlain by argillites and chert provide large volumes of shallow poor quality, well-drained and relatively accessible scree. Depth to competent rock limits conventional extraction. Deposits Y5, Y16, Y27, and Y34 are typical.

The quartzite lentils and associated blocky rubble are probable sources of durable riprap and crushed rock including concrete aggregate. Although they are cliff and ridge formers, the lenticular form of individual outcrops limit volumes available at each outcrop. Deposit Y26 is typical.

Bands of younger Paleozoic and Mesozoic rocks are present along the northern edge of the British Mountains due to faulting and folding. Predominant among the Paleozoic rocks are the cherty limestones of the Carboniferous Lisburne Group, namely the Wahoo Formation, that form cliffs and resistant pinnacles. The limestone outcrops and talus derived from it are a possible source of riprap, although the discontinuous nature of the outcrops limits volumes. Due to the location of these outcrops in the British Mountains access is a problem, although Fish Creek provides a possible route for transporting material from Deposit Y8.

Deposit Y6 appears to consist of rocks of the Upper Triassic Shublik Formation, which consists of limestones, sandstones, and siltstones. The Shublik Formation appears to have a limited, discontinuous distribution along the northern flank of the Buckland Hills west of Babbage River. Although it is fairly accessible, its questionable quality probably limits its engineering value.

7.3 Bedrock - Northern Richardson Mountains

The northern end of the Richardson Mountains and the adjacent Coastal Plain are underlain by Jurassic and Cretaceous rocks, namely a thick sequence of shale and sandstone. Outcrop patterns reflect faulted, northern-trending broad anticlines and synclines.

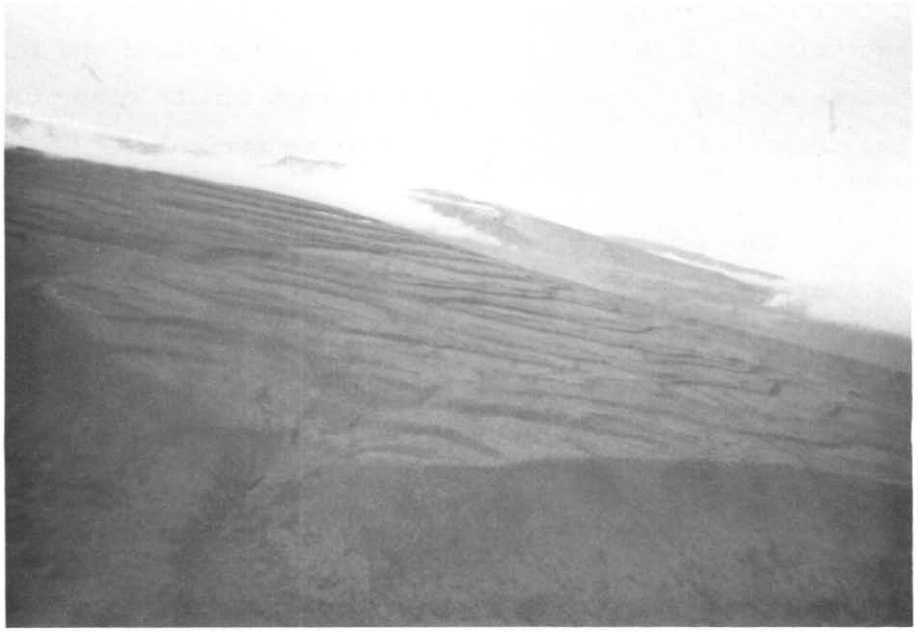


PHOTO 5; Deposit 465

Altiplanation terraces and cliffs developed on quartz sandstone of the Jurassic Bug Creek Formation in central Richardson Mountains.

PHOTO 6; Deposit Y-94

Escarpment and talus apron developed in lithic sandstone and conglomerate of the Cuesta Creek member of the Late Cretaceous Tent Island Formation.

Many of the more massive hills and dominant ridges of the north central part of the Richardson Mountains are underlain by sandstones of the Bug Creek Formation of Jurassic age. The Bug Creek Formation consists of 400 to 800 feet of quartz sandstone with minor interbeds of siltstone, shale and conglomerate; the upper member of the Bug Creek Formation varies between 200 and 250 feet in thickness and is primarily sandstone. In the central part of the Richardson Mountains, weathered Bug Creek sandstones often form blocky boulder fields on altiplanation terraces (Photo 5) or talus aprons below cliffs which may be a viable source of riprap. On the northern flanks of the Richardson Mountains, the Bug Creek sandstones appear more friable and less durable. Deposit 465 is typical of the former and Deposit 463 of the latter. Because of steep cliffs and stream canyons in the northern Richardson Mountains, access to exposed sandstones is difficult.

Another consistent ridge and cliff former in the northern Richardson Mountains is the Lower Sandstone Division of Early Cretaceous age, consisting of a succession of sandstone beds with interbeds of siltstone and shale. The lower member of this unit is characteristically a thinly bedded, hard to friable, fine-grained quartz sandstone with minor layers of friable silty fine-grained sandstone, siltstone, and shale and is 350 to 370 feet thick. The upper member is fine- to coarse-grained quartz sandstones, commonly carbonaceous, and is 150 to 400 feet thick; it includes a quartzite unit, which thickens near Rapid Creek. Deposits Y98, 464 and 468 are typical of this unit, which weathers to blocky rubble of variable size and durability. This unit outcrops near the edge of the Mackenzie Delta, which allows for moderately easy access.

Above this unit lies the Upper Shale-Siltstone Division. Although this unit is primarily composed of shale and siltstone, sandstone beds are common. Deposit 469 is a typical sandstone bed within this unit and indicates that small volumes of riprap or crushed rock may be obtained from isolated outcrops.

At the headwaters of the Willow River, the Upper Shale-Siltstone Division is overlain by the Upper Sandstone Division, which consists of 600 feet of cliff-forming sandstone with siltstone interbeds. However to the north it becomes predominantly siltstone, and no outcrops typical of the unit were examined.

The highest unit in the Early Cretaceous sequence is the Astian-Albian Flysh Division, which consists of a thick sequence of shale, siltstone, lithic (cherty) sandstone and conglomerate in the vicinity of the Blow River. The sandstone and conglomerate breaks down into fine rubble that might provide large volumes of fair to good quality granular material. Deposit Y89 was the only deposit from this unit that was examined.

Folded late Cretaceous rocks underlie the coastal plain in the Deep Creek/Babbage River area, and adjacent to the lower reaches of Rapid Creek and Big Fish River. Rocks within this sequence that might be considered as a source of riprap or good quality crushed rock are the Cuesta Creek Member of the Tent Island Formation and the Basal Sandstone Member of the Moose Channel Formation. Both form prominent hills and ridges. The Cuesta Creek Member is 280 to 360 feet thick and consists primarily of tough lithic (cherty) conglomerate and sandstone, which breaks down into blocky rubble, occasionally large angular blocks. Deposit Y94 is typical of this unit (Photo 6). The Basal Sandstone Member is 1000 to 2000 feet thick and is predominantly a lithic sandstone that breaks down into granular sand or flaggy slate. A reconnaissance of hill crests underlain by this unit suggest that the unit is not well exposed on hill tops and has only marginal potential as a construction material.

The Reindeer Formation of Tertiary Age outcrops near Coal Mine Lake, but its sandstone and conglomerate facies (Aklak Member) appear to be only moderately durable and do not form any major ridges or hills.

7.4 Preglacial Gravels

Most of the Yukon Coastal Plain is underlain by late Tertiary and early Quaternary broad pediments (gently sloping erosion surfaces). Following formation of the pediments but preceeding glaciation of the Coastal Plain, thick alluvium was deposited over much of the pediment surface. Near mountain fronts the alluvium consists of coarse sub-angular gravels composed of local lithologies including chert and argillite, which detracts from the quality of the granular material; whereas toward the coast in the Shingle Point area the alluvium consists of rounded to subrounded gravels and sands, good to potentially excellent quality granular material; locally rounded gravels and sands are interbedded with finer-grained sediments between King and Kay Points. The gravels near the mountain front beyond the glacial limit are overlain by thick ice-rich silts, and those near the coast by ice-rich glacial deposits. Recent coastal erosion and down-cutting by streams have exposed the gravels along escarpments. Slumping of overlying sediments has thinned the overburden along a zone bordering the crest of the escarpments. The preglacial alluvium has low moisture contents and contains no massive ice; both factors favour rapid thawing and easy excavation of these deposits. Deposits Y18, Y22, Y40, and Y43 are typical of gravels near the mountain front. Deposits Y61, Y71, Y78, Y85, Y93, and Y102 are typical of gravels closer to the coast. All deposits are adjacent to river courses or the ocean and access is good.

7.5 Glaciofluvial Deposits

Glaciation of the Yukon Coastal Plain and adjacent terrain by continental ice flowing westward along the coastal plain diverted streams flowing out of the Richardson and British Mountains to the west. These ice-marginal streams cut meltwater channels across bedrock divides and deposited kame terraces at the downstream end of the channels and along the edge of the mountain slopes at the edge of the ice (Photo 7). The kame terrace gravels are generally poor to fair quality granular material because of high argillite and shale contents. Typical are Deposits Y30, Y33, Y35, Y36, and Y88. Occasionally, streams flowed north across the

glacier ice and formed eskers and kames. These gravels and sands were further washed and appear to be better quality granular material; Deposits Y48 and Y67 are typical. Kames, eskers, and kame terraces are generally well drained and free of overburden because of their elevated positions. If ground ice is present in these deposits, it is usually indicated by thermokarst lakes and hummocky topography. Access to many of these deposits is usually fair to good. In some cases access is limited by surrounding ice-rich materials and moderate slopes.

At the western edge of the glacier, kame terraces and large outwash plains were formed and subsequently terraced as the ice retreated eastward. Again the gravels were well washed and are good quality granular material. Because of the relatively low elevations, they are poorly drained and covered by thick icy overburden except near scarp edges. Deposits Y28 and Y37 are typical of areas where the overburden is relatively thin.

Eastward retreat of the glaciers from the coastal plain was interrupted by a still-stand that produced the coalescing outwash fans on the landward side of the ridge running from Kay Point eastward to beyond Shingle Point. These fans have been subsequently terraced by meltwater flowing westward parallel to their downstream edges. This outwash is generally good to potentially excellent quality granular material, although some parts are very sandy. The outwash is free of overburden only near scarp edges and massive ice is locally present within the outwash itself and within the underlying sediments. Deposits Y59, Y62, Y70 and Y74 are separate groups of outwash fans.

Kame deltas and meltwater channels were formed along the eastern flank of the Aklavik Range at elevations of 500 feet as retreating ice continued to divert the Willow River. The kame deltas, Deposit 467, have thin overburden, are moderately well drained, contain no massive ice, and are easily accessible.

PHOTO 7; Deposit Y-30

Kame terraces and meltwater channels along the edge of the Buckland Hills.

PHOTO 8; Deposit Y-15

Active floodplain of Malcolm River with its braided pattern of bars and channel beds. Aluvial fan of the Malcolm River in right-central part of photo.

7.6 Alluvial-fans

West of the Firth River, all major streams, including the Firth River, have developed large alluvial-fans in postglacial time. Generally, these fans show braided patterns on their surface, which have localized veneers of silt and peat. Although the gravels in the fans contain little ice, their low gradients and shallow depths to permafrost have resulted in saturated active layers. Generally the materials vary from bouldery gravels at the apex of the fans to coarse to fine gravels at the distal edge of the fans. Local bedrock types present in the nearby British Mountains are mainly limestones, quartzites, argillites, and sandstones or common lithologies. Access to these features is good. Typical are Deposits Y7, Y14, and Y21.

7.7 Stream Terraces

Low postglacial terraces flank most streams crossing the Arctic Coastal Plain. They are generally poorly drained and much of their areas are covered by overburden consisting of ice-rich organic silt and peat. Active layers are saturated due to low gradients and shallow permafrost. Pits developed on terraces would flood upon abandonment. Low stream terraces generally contain good quality granular material. River channels, floodplains, and the terraces themselves provide good access. Typical are Deposits Y41, Y51, Y64, and Y79.

High postglacial terraces flank the deeply incised streams of the eastern Coastal Plain and have characteristics similar to the low terraces. However, the adjacent canyons limit access, and the gravel and sand is higher in shale content because shale is a more common rock type in this area. Deposits Y76, Y87, and 462 are typical.

7.8 Active Floodplains

All major streams crossing the Yukon Coastal Plain have unvegetated gravel floodplains adjacent to them. The active floodplains

vary in form from those consisting of braided bar and channel complexes on the western Coastal Plain (Photo 8) to those consisting mainly of large point bars and islands on the eastern Coastal Plain. Isolated occurrences of aufeis are present on the floodplains, especially west of Babbage River. Most active floodplains have thick active layers and stand 2 to 8 feet above low stream levels. The active floodplains are frequently inundated, although not necessarily annually. Considerable bed load is moved during floods, which would slowly fill pits developed on their surface. Gravels in active floodplains reflect local rock types and are variable in quality. Generally, floodplain gravels west of the Babbage River are better quality granular material than those east of the Babbage River. Floodplain gravels are very coarse and bouldery near the mountain fronts. Typical are Deposits Y2, Y3, Y11, Y15, Y23, Y42, Y47, Y54, Y56, Y60, Y80, Y86, Y95, 460, and 466.

7.9 Spits, Bay-Mouth Bars and Beach Ridges

Numerous spits and bay-mouth bars are present along the Beaufort Sea Coast. Except for the Nunaluk Spit, which fronts the Firth River alluvial fan, most spits are located near sediment sinks. The gravel and sand in the spits, bay-mouth bars, and beach ridges is from nearby escarpments and submerged coarse alluvium, and it is generally expected that these features would slowly repair themselves if developed. Most spits, bay-mouth bars, and beach ridges are broad single ridges although the distal end of some spits and bay-mouth bars consist of numerous recurved ridges (Photo 9). The crest of these features generally stands 3 to 8 feet above sea level. Frost was present at depths of 4 to 7 feet on most spits and bay-mouth bars. Typical are Deposits Y4, Y10, Y13, Y29, Y39, Y45, Y72 and Y77.

8.0 BIOLOGIC ANALYSIS OF INVESTIGATED DEPOSITS

8.1 General

The deposits in each of the major geomorphic regions noted in Section 7.0 generally have similar vegetative covers and wildlife

PHOTO 9; Deposit Y-72

Bay-mouth bar at King Point. Recurved ridges at eastern end of bar mark distal ends of former spits at this locality.

PHOTO 10; Deposit Y-74

Typical vegetation cover on well drained gravel surface. At this locality the flag is located about 100' from a 70' scarp. A shallow trench has developed over an ice wedge.

associations. The following sections describe the vegetative cover, and summarize possible wildlife utilization of deposits.

8.2 Bedrock Areas

Most areas of bedrock outcrop and coarse bedrock rubble have sparse vegetation cover. Scattered patches of alpine tundra mainly of *Dryas*, *Minuartia* and lichens on well-drained scree and sedge tussock tundra of *Carex*, *Dryas*, dwarf *Salix*, and liches on poorly drained swales are present on deposits in the mountains. A list of species and their common name appears in Appendix B, Glossary. Shrubby dwarf birch tundra with *Vaccinium* spp., *Carex* spp. and dwarf willow as associates is common at lower elevations even amongst bouldery scree.

In general, the mountains provide habitat for caribou and grizzly bear. Some deposits lie adjacent to caribou migration routes. The central Richardson Mountains are critical to a small population of Dall sheep. A few cliffs may provide nesting sites for raptors.

8.3 Preglacial Gravels

Preglacial gravels usually have some organic overburden and are characteristically covered by sedge tussock tundra (*Carex* spp, dwarf *Salix*, lichens). Near the edge of escarpments, the surface is a mosaic of exposed gravel and low dwarf shrub tundra (dwarf *Salix*, *Vaccinium* spp., *Minuartia*, *Betula glandulosa*, lichens). Coastal escarpments are often bare of vegetation, although shrubbery may be present along stabilized scarps.

Gravels overlying pediment surface lie in areas that are utilized by grizzly bear and Arctic fox, and may be critical to caribou calving.

Escarpments along the coast lie in areas utilized by grizzly bear, Arctic fox, and waterfowl. The cliffs may also serve as nesting sites for raptors.

8.4 Glaciofluvial Deposits

Kame terraces along the flanks of the Richardson Mountains and Buckland Hills are generally covered by patches of tundra composed of *Dryas*, lichen, and dwarf shrubs (*Salix* spp., *Betula glandulosa*) and are in areas utilized by grizzly bear and caribou.

Outwash fans and plains, and kame terraces at lower elevations have similar vegetation cover on better drained areas near scarps (Photo 10), but less well drained areas are covered by sedge tussock tundra (*Carex* spp., *Dryas*, lichens). These deposits lie in an area utilized by caribou, grizzly bear, Arctic fox and waterfowl. Some deposits are in areas utilized by caribou for calving and by waterfowl for staging activities.

The kame deltas west of Aklavik are covered by both herbaceous and shrubby tundra (*Salix* spp., *Vaccinium* spp., *Ledum palustre*), and are utilized by caribou.

8.5 Alluvial-fans

Vegetation on alluvial-fans varies from sedge tundra on poorly drained areas to bare gravel with patches of tundra consisting of *Dryas*, lichen, and low dwarf shrubs (*Salix* spp.), on well drained areas. Areas with scattered plants of *Dryas* spp., *Vaccinium uliginosum*, *Calamagrostis* spp. and *Carex* spp. were also noted for this terrain. They provide habitat for Arctic fox, grizzly bear, caribou and waterfowl. Fans near the Firth River are utilized by caribou for calving and by waterfowl for staging activities.

8.6 Stream Terraces

Moderately well to imperfectly drained stream terraces are covered by tundra consisting of sedges, moss, lichen and dwarf shrubs (*Salix* spp.). Poorer drained areas are covered by sedge tussock tundra

of *Carex* spp., dwarf *Salix*, *Dryas*, and lichens. Well drained areas near scarps have broken cover of dwarf shrubs, mainly dwarf birch, *Dryas* and other herbs.

Stream terraces, especially marshy areas, are utilized by waterfowl for staging. They also provide habitat for grizzly bear, caribou, and Arctic fox. Higher terraces near the Blow River lie on a major caribou migration corridor.

8.7 Active Floodplains

Active floodplains appear devoid of vegetation from a distance, but in fact a good part of them support patches of low willows, grasses and other herbs (*Silene acaulis*, *Oxytropis* spp.). Driftwood is sometimes present on their surface, especially toward the eastern end of the Coastal Plain. The upper edge of the active floodplain often merges with willow covered stabilized floodplain.

Moose, grizzly bear, and caribou were all noted along floodplains, both inactive and active. Willow shrubbery provides browse for moose.

Most rivers are utilized by Arctic grayling and Arctic char for feeding, spawning, and migration. Over-wintering is confined to stream reaches that remain open all winter, mainly near areas of aufeis. Whitefish, cisco, and pike are found in the lower reaches of some rivers east of, and including, Running River.

8.8 Spits, Bay-Mouth Bars and Beach Ridges

Except for patches of moss, grass, and sedge in isolated swales, and on the backshore of the Stokes Point spit complex, these terrain features are bare of vegetation. Their crests and backshores are usually covered by driftwood, including very large logs.

Coastal features are used for nesting, moulting, and feeding by a number of bird species, and are utilized by Arctic fox, grizzly bear, and in winter, by polar bear.

Adjacent waters are inhabited by Beluga whale and numerous fish species, notably Arctic char, Arctic cisco and least cisco.

9.0 HISTORICAL AND HUMAN ASPECTS

9.1 Archeological and Historic Sites

Archeological sites and areas of historic interest appear to be concentrated along the coastline and river valleys. Decayed log structures, and grave markers were observed along the coastline, and have been noted on spits, bay-mouth bars and at the crest of coastal escarpments, some of which are composed of preglacial gravels. The other areas having the most potential for archeological sites are fluvial landforms along the Firth River and Rapid Creek and hills along the edge of the Buckland Hills west of the Firth River.

9.2 Present Activities

Presently, only a limited amount of hunting and trapping is done along the coastal plain and adjacent areas. It is concentrated near Herschel Island and Aklavik.

Lagoons and bays formed by spits and bay-mouth bars serve as harbours for small boats. In the past they were often the centre of fishing, sealing, and whaling activities along the coast. The small amount of fishing, sealing and whaling carried out today is concentrated at the Shingle Point spit and Herschel Island.

DEW Line sites are present at Komakuk Beach and Shingle Point; one was formerly located at Stokes Point. One native family lives at Herschel Island, which is also used by government departments as a base for research activities.

9.3 Future Parks and Preserves

All of the Yukon Coastal Plain and adjacent areas within the Yukon Territory considered in this report lie within a proposed Arctic Wildlife Range.

Herschel Island has been proposed as a National Park or Historical Site, and all of the study area west of Firth River lies within a proposed International Biologic Reserve.

10.0 DATA PRESENTATION

10.1 Individual Deposit Reports

10.1.1 General

The data has been presented so that all information related to a given borrow deposit is available as an individual package in the "Deposit Reports" section. The deposits located in the Yukon Territory have been prefixed with a "Y" whereas the deposits in the Northwest Territories have been sequentially numbered from Deposit 460 in order to maintain the continuity of previously established Deposit Numbers during the 1972-73 DIAND Stage 1, Zone IV, Granular Materials Inventory Report. The information includes:

1) Airphoto and Summary
2) Site Report
3) Test Pit Logs
4) Laboratory Test Data

10.1.2 Airphoto and Summary

An airphoto and synoptic page introduces each individual deposit report. The physical outline of the deposit and location of

test pits and exposures are noted on the airphoto. A brief summary outlining the Setting, Material, Volume, and Assessment for each individual deposit is denoted on the airphoto page.

10.1.3 Deposit Report

All pertinent data and assessments which have been compiled for the deposits investigated in this study are discussed and presented on a site specific basis under the following headings:

a) Setting - location of deposit in relation to known cartographical features and the geological setting. Drainage is given (ref. Appendix A) as well as geomorphology, ice contents and organic soil cover. A general description of vegetation, observed and recorded mammal and bird use of the area, and fisheries potential of adjacent waterbodies are given for each site. Any known or observed archeological features or finds were noted in this section.

b) Materials - description of soils which are classified according to the Terms and Symbols Section in Appendix A and noted on the test pit logs. In the Materials and Development sections the materials are indicated as being sources of excellent, good, fair and poor quality granular material. These terms are based upon the definitions as found in "Appendix A".

c) Volume - estimated total volume of granular material as calculated by planimetering the outline of the deposit and using a conservative estimate of total depth of the deposit, according to site observations and comparison with drilled depths at adjacent similar deposits. Calculated volumes may not necessarily be available for extraction due to a number of practical limitations. Total available volume for extraction of any deposit will be a function of the depth of extraction con-

sidered practical. For most deposits, extractable volume could be calculated by the following formula:

$$\text{Extractable Volume} = \frac{\text{depth of extraction}}{\text{total estimated depth}} \times \text{Total Volume}$$

An annual volume based on a per acre or 1000 foot segment for linear features that could be extracted by conventional techniques using dozers, rippers, scrapers, loaders was calculated for most deposits. These volumes are based on estimated depths that yearly extraction might practically be limited to by water levels or thawing of permafrost. Changes in these estimated depths would proportionally change the volumes.

d) Development - the sections on Setting, Material, and Volume were used to describe some of development criteria for the deposit. Extraction techniques, access and some environmentally sensitive criteria are discussed in this section.

10.1.4 Test Pit Logs

Test pit logs have been prepared on a standard form in accordance with the standardized "Terms and Symbols" section, which is included in Appendix A.

10.1.5 Laboratory Test Data

The grain size information for each sample tested is presented on the "Grain Size Distribution Curve", plotted and produced by R. M. Hardy & Associates Ltd. The remaining laboratory tests such as specific gravity, absorption, sulphate soundness, organic content and petrographic analyses are summarized and tabulated on the form entitled: "Summary of Laboratory Tests to Determine Aggregate Suitability in Concrete". In those cases where the fine aggregate was also tested the results are similarily tabulated and cross-referenced to the coarse aggregate results. Petrographic analyses for rocks are summarized and tabulated

on the form entitled: "Summary of Petrographic Data for Rock Samples". Each individual deposit report includes all test results which are pertinent to that specific deposit.

10.2 Strip Maps

In addition to the site specific airphotos, the location and shape of each deposit which has been investigated in the Yukon Coastal Plain and Adjacent Area has been plotted on the Strip Maps at a scale of 1:250,000. These strip maps were produced using the National Topographic Surveys map series and are presented in Appendix C.

The deposits which have been investigated and mapped by other industry sources have been sequential numbered as a part of this study and have been denoted on the strip maps.

11.0 CONCLUSIONS

The 1976 investigation for the Granular Materials Inventory along the Yukon Coastal Plain and Adjacent Areas was completed within the Terms of Reference received from the Department of Indian Affairs and Northern Development. A total of 72 deposits were investigated and the detailed assessment of each deposit is presented in "Individual Deposit Reports". An additional 43 deposits that had been previously investigated in detail by other agencies have been incorporated and designated on the attached "Location Map" in Appendix C. A brief summary of all Deposits mapped is presented in Table II.

Granular deposits along the Yukon Coastal Plain are concentrated on pediments near mountain fronts and in alluvial-fans, river terraces, floodplains, outwash fans and plains, kame deltas and terraces, eskers, escarpments along the coast near Shingle Point, spits, bay-mouth bars and beach ridges. As would be expected, rock deposits are concentrated on ridges and hill tops. Characteristics of the various landforms and the inherent materials are summarized in the preceeding Section 7.0, titled "Geologic and Geomorphic Analysis of Investigated Deposits".

TABLE II

SUMMARY OF GRANULAR AND ROCK DEPOSITS
YUKON COASTAL PLAIN

DEPOSIT NO.	VOLUME ($x10^6$ cu.yd)		LANDFORM	DEPOSIT NO. PREVIOUS STUDY
	GRANULAR	ROCK		
Y1	16.0		Terrace	N117C-B3
Y2	3.9		Active Floodplain	
Y3	45.0		Active Floodplain	
Y4	0.8		Bay-mouth Bar	
Y5		3.0	Bedrock Ridges	
Y6		0.2	Bedrock Hill	
Y7	590.0		Alluvial-fan	N117C-B1
Y8		1.3	Outcrop and Talus Cone	
Y9	8.9		Terrace	N117C-B4
Y10	2.1		Beach Ridge	
Y11	14.5		Active Floodplain	
Y12	34.0		Terraces	N117C-B2
Y13	9.0		Spit	
Y14	1200.0		Alluvial-fan	N117D-B1
Y15	280.0		Active Floodplain	
Y16		7.2	Bedrock Hills	
Y17	60.0		Terrace	N117D-B2
Y18	3.3		Pediment	
Y19	2.5		Kame Terrace	N117D-B3
Y20	12.0		Terrace	N117D-B4
Y21	500.0		Alluvial-fan	
Y22	10.5		Pediment	
Y23	440.0		Active Floodplain	
Y24	40.0		Terraces	N117D-B5
Y25	11.0		Kame Deltas	N117D-B6
Y26		0.1	Outcrop and Talus Cone	
Y27		1.0	Bedrock Ridge	
Y28	5.5		Outwash Plain	
Y29	3.7		Spit	
Y30	8.5		Kame Terraces	
Y31	20.0		Kame Deltas	N117D-B9
Y32	5.5		Outwash Plain	N117D-B7
Y33	2.1		Kame Terraces	
Y34		2.2	Bedrock Ridges	
Y35	2.8		Kame Terrace	
Y36	1.8		Kame Terrace	
Y37	5.5		Kame Terrace	N117D-B14
Y38	7.5		Outwash Plain	N117D-B8
Y39	1.2		Spit and Bay-mouth Bar	
Y40	2.0		Pediment	
Y41	51.0		Terraces	
Y42	27.0		Active Floodplain	
Y43	1.4		Pediment	

Note: Deposits prefixed N refer to investigations by Northern Engineering Services Company Limited, 1975.
Deposits prefixed KL refer to investigation by Klohn Leonoff Consultants Ltd., 1975.

TABLE II - continued

SUMMARY OF GRANULAR AND ROCK DEPOSITS
YUKON COASTAL PLAIN

DEPOSIT NO.	VOLUME ($x10^6$ cu.yd)		LANDFORM	DEPOSIT NO. PREVIOUS STUDY
	GRANULAR	ROCK		
Y44	125.0		Terraces	N117D-B10
Y45	1.4		Spit	
Y46	2.5		Kame Delta	N117D-B11
Y47	72.0		Active Floodplain	
Y48	3.9		Esker	
Y49	0.5		Outwash Plain	KL-15
Y50	6.5		Outwash Plain	N117D-B12, KL-18
Y51	210.0		Terraces	KL-2
Y52	-		Outwash Plain	KL-16
Y53	17.0		Terraces	N117D-B15, KL-10
Y54	12.0		Active Floodplain	
Y55	-		Terraces	KL-21
Y56	19.0		Floodplain	
Y57	-		Terrace	KL-17
Y58	-		Terrace	KL-19
Y59	17.0		Outwash Fans	
Y60	46.0		Active Floodplain	
Y61	8.5		Scarp (Preglacial Sediments)	
Y62	18.0		Outwash Fans	KL-20
Y63	0.1		Glaciofluvial Terrace	KL-12
Y64	27.0		Floodplain and Terraces	
Y65	0.5		Terrace	KL-9
Y66	2.0		Kame Complex	KL-8
Y67	2.6		Esker and Kames	
Y68	1.1		Glaciofluvial Terrace	N117D-B13, KL-14
Y69	-		Glaciofluvial Terraces	KL-22
Y70	5.7		Outwash Fans	KL-11
Y71	2.4		Scarp (Preglacial Sediments)	
Y72	1.0		Bay-mouth Bar	
Y73	2.5		Bedrock Ridge	N117A-B1
Y74	33.0		Outwash Fans	KL-7
Y75	12.0		Outwash Fans	N117A-B2, KL-7
Y76	91.0		Terraces	
Y77	0.8		Spit	
Y78	14.0		Scarp (Preglacial Gravels)	
Y79	44.0		Terraces	KL-4
Y80	22.0		Active Floodplain	
Y81	14.0		Esker	N117A-B6, KL-6
Y82	0.5		Complex - Not Fluvial	KL-13
Y83	17.0		Scarp (Preglacial Gravels)	N117A-B4, KL-5
Y84	4.8		Kame Deltas	N117A-B3
Y85	76.0		Scarp (Preglacial Gravels)	
Y86	140.0		Active Floodplain	

Note: Deposits prefixed N refer to investigations by Northern Engineering Services Company Limited, 1975.
Deposits prefixed KL refer to investigation by Klohn Leonoff Consultants Ltd., 1975.

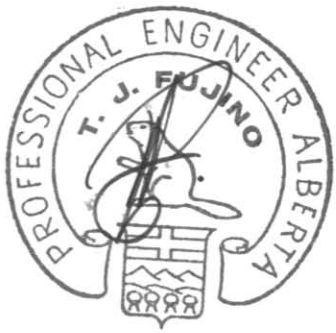
TABLE II - continued

SUMMARY OF GRANULAR AND ROCK DEPOSITS
YUKON COASTAL PLAIN

DEPOSIT NO.	VOLUME ($x10^6$ cu.yd)		LANDFORM	DEPOSIT NO. PREVIOUS STUDY
	GRANULAR	ROCK		
Y87	20.0		Terraces	
Y88	7.4		Kame Complex	
Y89		14.0	Bedrock Hill	
Y90	16.5		Terraces	N117A-B7, KL-1
Y91	-		Terrace	KL-3
Y92	3.5		Terraces	N117A-B8, KL-3
Y93	21.0		Scarp (Preglacial Gravels)	
Y94		1.6	Cuesta (Bedrock)	
Y95	46.0		Active Floodplain	
Y96	3.5		Kame Deltas	N117A-B9
Y97	3.5		Kame Deltas	N117A-B10
Y98		3.9	Hogbacks (Bedrock)	
Y99	7.5		Valley Train	N117A-B11
Y100	7.5		Kame	N117A-B12
Y101	1.0		Kames	N117A-B13
Y102	20.0		Scarp (Preglacial Gravels)	
455	0.5		Terrace	455
456A	-		Alluvial-fan	456A
457A	-		Alluvial-fan	457A
460	25.0		Active Floodplain	
461	4.0		Terrace	N117A-B14
462	16.5		Terraces	
463		4.1	Bedrock Ridge	
464		7.7	Roche moutonnés (Bedrock)	
465		100.0	Cliffs and Altiplanation Terraces	
466	7.3		Active Floodplain	
467	20.0		Kame Deltas	
468		5.0	Bedrock Ridge	
469		0.4	Cuesta (Bedrock)	
TOTAL	4733.0	151.7		

Note: Deposits prefixed N refer to investigations by Northern Engineering Services Company Limited, 1975.
Deposits prefixed KL refer to investigation by Klohn Leonoff Consultants Ltd., 1975.
Deposits 455, 456A, 457A, investigated by Ripley, Klohn, Leonoff Ltd., 1972.

Results of the study indicate that large quantities of naturally occurring, good quality, and accessible granular materials are available on the Yukon Coastal Plain and Adjacent Areas. A total of 4,733,000,000 cubic yards of granular materials, and 151,700,000 cubic yards of rock were mapped in the study area. Rock includes bedrock, scree, talus, and weathered rubble. All mapped volumes may not be feasibly excavated as is indicated in Section 10.1.3(c). However, given practical depths of extraction, extractable volumes can be easily calculated from mapped volumes documented in this report.



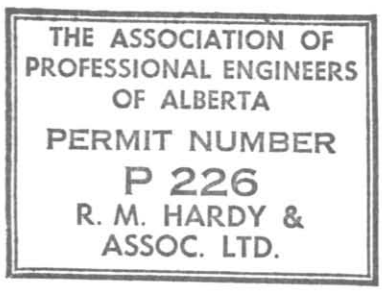
Respectfully submitted,

R. M. HARDY & ASSOCIATES LTD.,

Per: T. J. Fujino, P.Eng.

TERRAIN ANALYSIS & MAPPING SERVICES LTD.,

Per: V. N. Rampton, Ph.D.,P.Eng.



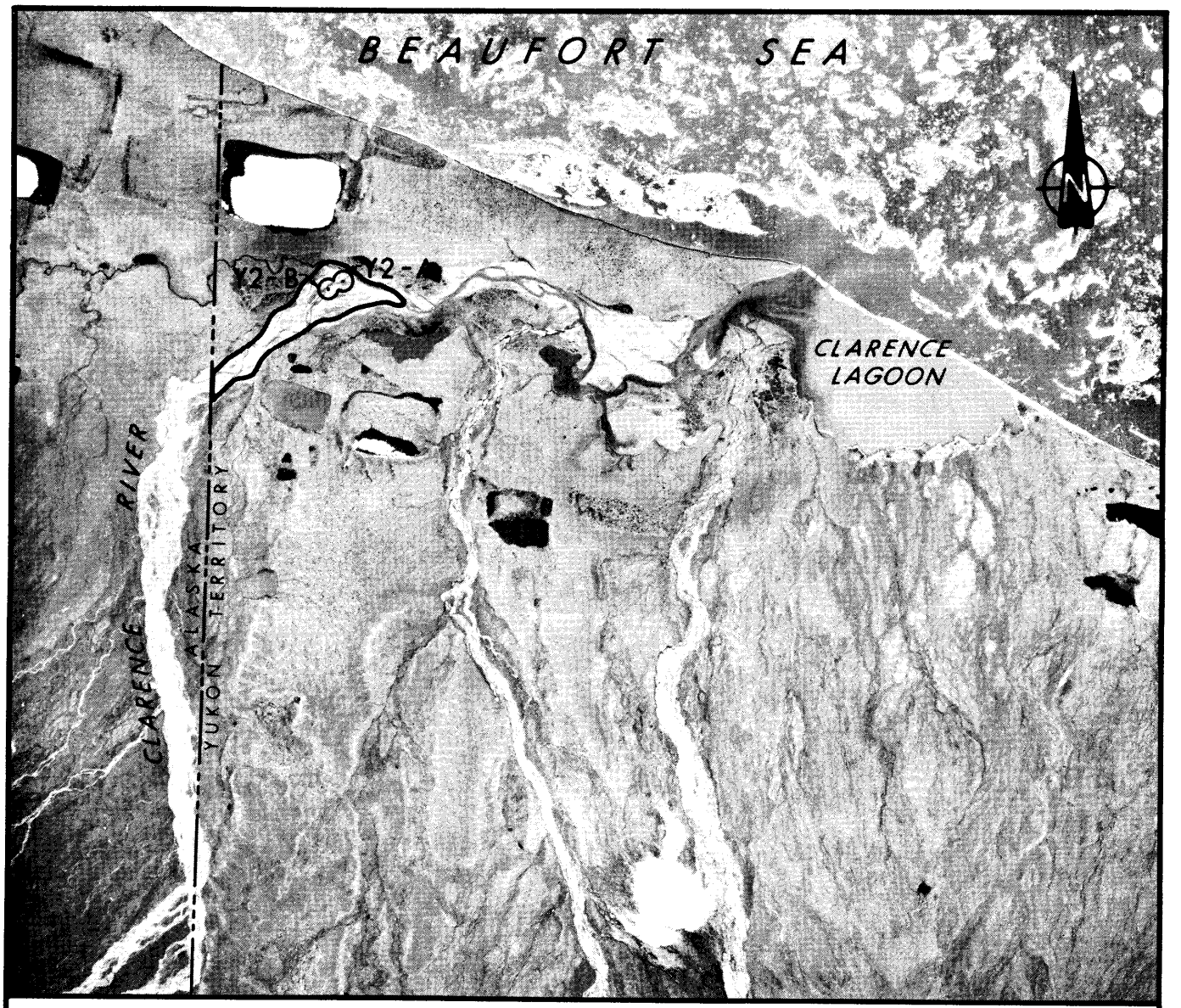
DEPOSIT Y2

Setting: Active floodplain of the lower reaches of the Clarence River. Located immediately adjacent to the Yukon/Alaska border.

Material: Gravel; fine to coarse, and fine to coarse sand.

Volume: 3,900,000 cubic yards total.

Assessment: Contains good quality granular material. Extraction will be limited by ground water levels, and fish migrations in the Clarence River. Restoration should occur slowly through natural processes. Good access.
Recoverable volume may be limited to 350,000 cubic yards.



DEPOSIT Y2

SETTING

Deposit Y2 consists of the vegetation-bare floodplain along the lower reaches of the Clarence River and parts of its channel bed lying above late fall water levels.

The floodplain is characterized by a few broad swales and occasional small irregularly-shaped sand dunes. The deposit is free of overburden, and is well drained except for the bottom of some swales containing shallow pools of water. Most of the deposit stands ½ to 2½ feet above low water levels. The thickness of the active layer is estimated to exceed 6 feet.

Most of the deposit is free of vegetation except for occasional growths of grass, herb, and small prostrate willow on the small dunes. Clarence River is a migratory route for Arctic char and grayling.

Immediately adjacent to the deposit are low fluvial terraces, which are well-drained at their outer edges, but marshy on their centres and inner edges. The Clarence River valley is bordered by imperfectly-drained, ice-rich lacustrine deposits in both a coastward and inland direction. This terrain provides marginal habitat for grizzly bear and Arctic fox, but is a major staging area for lesser snow geese in the fall.

MATERIAL

Deposit Y2 contains good quality granular material consisting of stratified gravel and sand. Larger clasts are mainly subrounded to angular quartzite, sandstone, and argillite with rare chert and quartz. A thin layer of fine silty sand covers the higher part of the floodplain and the base of most swales.

VOLUME

The total volume of 3,900,000 cubic yards is based on a conservative depth of 15 feet. Fluvial deposits are commonly in excess of 45 feet on this part of the coastal plain.

Annually, 2,000 cubic yards per acre could be extracted by conventional techniques assuming that static ground water levels limit the extractable granular material to an average depth of 1½ feet over the floodplain and exposed channel bed. Volume of recoverable material may be limited to 350,000 cubic yards because of static ground water conditions.

DEVELOPMENT

Extraction of material at Deposit Y2 will probably be confined to summer and fall when stream levels were low. Unless special drainage controls are undertaken large areas will have to be harvested for relatively small volumes because of shallow ground water levels. Adequate areas for stockpiling are available.

The developed pit areas should be restored by natural fluvial processes over a period of time. Streams of the coastal plain are known to move significant quantities of coarse sediment.

Access to the coast or inland is good along stream courses or frozen water bodies.

Development of Deposit Y2 should be planned so as to minimize interference with fish migrations within the Clarence River. Deposit Y2 lies within a proposed Arctic Wildlife Range and the Firth River IBP Reserve, which may restrict development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
0	SW		SAND - fine to coarse, and well graded gravel to 2" size, occasional cobble, becoming coarser with depth, angular to subangular, medium brown, damp, clean.		UF		Organic Color: #2+
1							Lightweight Pieces - Fine Aggregate: 0.22%
2							
3			3.0 ▽ Bottom of Pit				Sample from 0'-3.0'
4							

DATE: Sept. 19, 1976 | LOGGED BY: JDF | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y2-A

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	SW		SAND - fine to coarse, some gravel to 1" size, angular to subangular, wet.		UF		
			1.2 1.4 - fine gravel layer.				
2			2.0 ▽				
			Bottom of Pit				No sample taken.
3							

DATE: Sept. 19, 1976	LOGGED BY: JDF	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y2-B

SHEET 1 OF 1

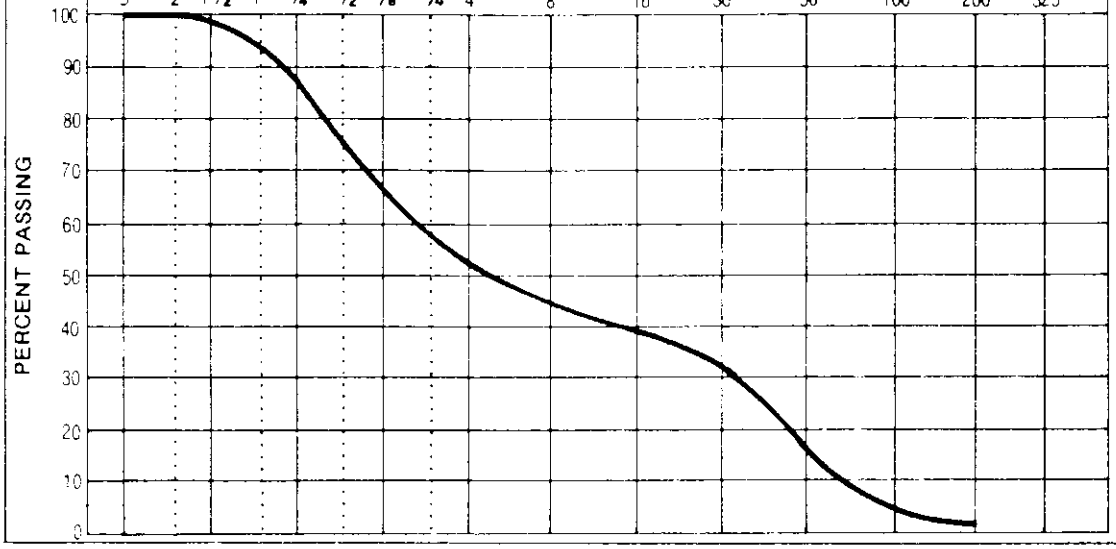
GRAIN SIZE ANALYSIS

SAMPLE Y2-A DEPTH 0'-3.0'

DATE SAMPLED Sept. 19, 1976 SAMPLED BY JDF

LAB TEST NUMBER: TP6

GRAVEL SIZES		SAND SIZES			FINES
12.9 %	34.9 %	9.2 %	17.0 %	24.3 %	1.7 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
2"	0

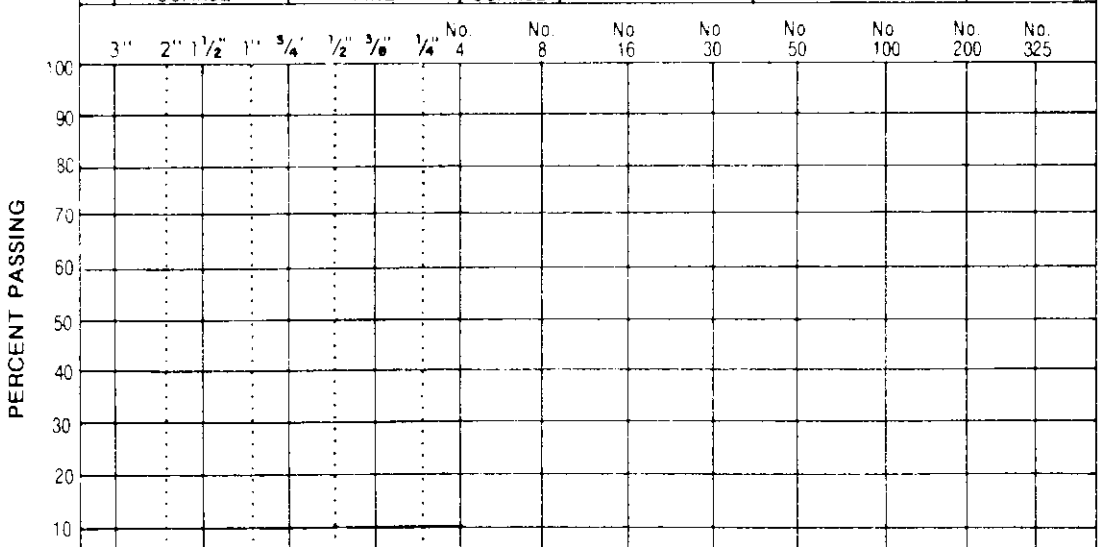
SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	100.0
1 1/2"	99.4
1"	93.5
3/4"	87.1
1/2"	76.6
3/8"	68.1
1/4"	
No. 4	52.2
No. 8	44.8
No. 16	39.2
No. 30	32.2
No. 50	15.2
No. 100	3.9
No. 200	1.7

SAMPLE _____ DEPTH _____

DATE SAMPLED _____ SAMPLED BY _____

LAB TEST NUMBER

GRAVEL SIZES		SAND SIZES			FINES
%	%	%	%	%	%
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"

SIEVE SIZE	PERCENT PASSING
3"	
2"	
1 1/2"	
1"	
3/4"	
1/2"	
3/8"	
1/4"	
No. 4	
No. 8	
No. 16	
No. 30	
No. 50	
No. 100	
No. 200	

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No.
Y2

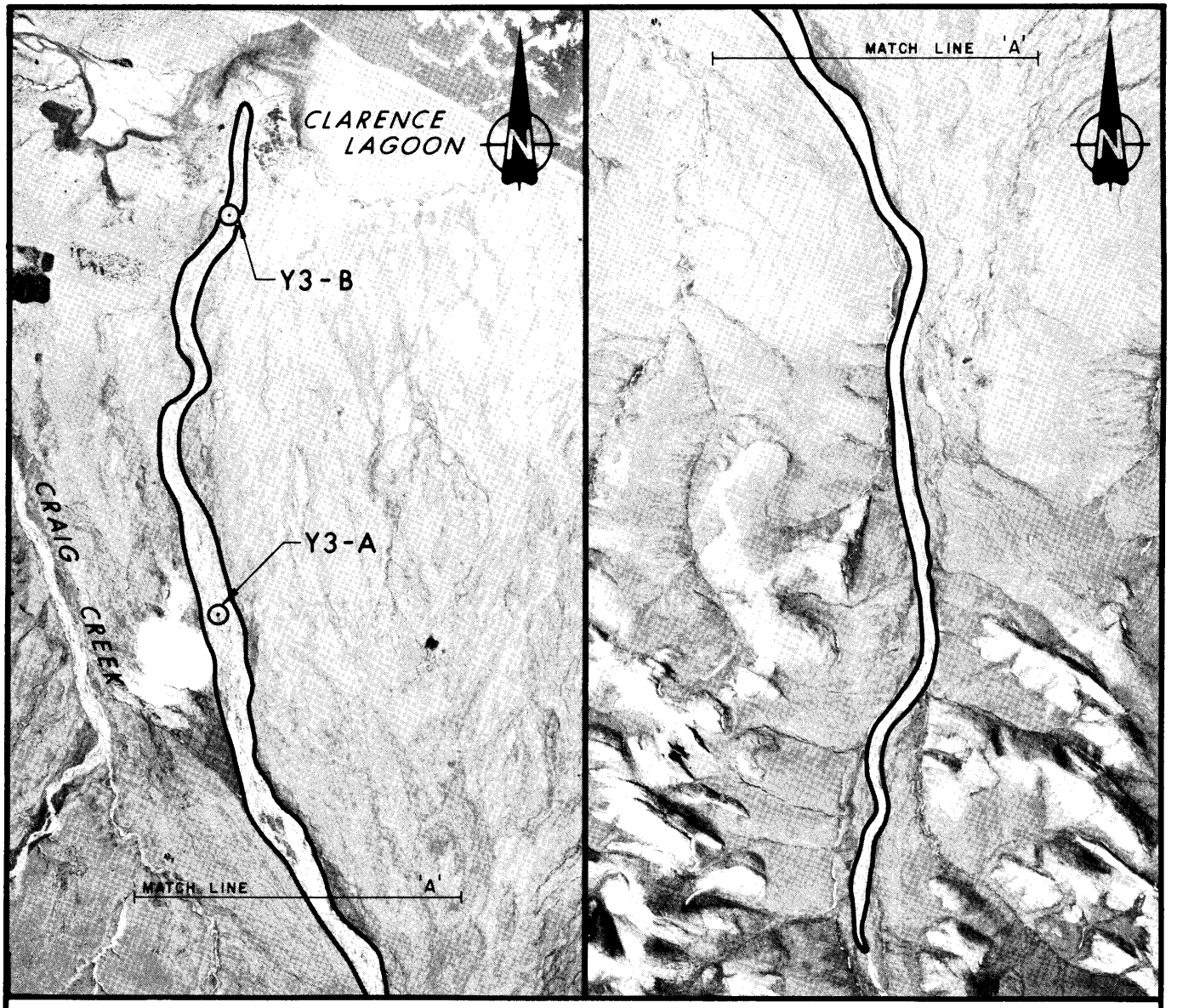
DEPOSIT Y3

Setting: Active floodplain of an unnamed stream flowing into Clarence Lagoon.

Material: Gravel; well graded, fine to coarse, some sand.

Volume: 45,000,000 cubic yards total.

Assessment: Contains good to excellent quality granular material. Extraction will be limited by ground water levels, and should not be carried out near aufeis. Natural fluvial processes should slowly restore the floodplain. Good access.
Recoverable volume may be limited to 3,800,000 cubic yards.



Airphoto No.: A13138-153/152
Approx. Scale: 1"=5800'
Deposit Outline - R.M. Hardy
Test Pit ⊙
Deposit Outline - Others
Exposures ✠

DEPOSIT Y3

SETTING

Deposit Y3 consists of the narrow vegetation-bare braided bar and channel bed complex of a major unnamed stream flowing north from the British Mountains into the western end of Clarence Lagoon.

The deposit is well drained and free of overburden. Bars standing 2 to 5 feet above late fall stream level make up about 40 percent of the complex while the remainder is within 2 feet of stream level. The depth of the active layer at this deposit is estimated to be 4 to 6 feet.

Patches of herbaceous plants and prostrate willows are scattered over the deposit. The adjacent unnamed stream is a migratory route for Arctic char and grayling.

This deposit is bordered by a moderately to well drained alluvial-fan surface for much of its length, 3 to 5 feet above the highest part of the floodplain. At its southern end it abuts directly against moderately sloping uplands mantled by ice-rich silty colluvium. This area is a major staging area for waterfowl in the fall and is suitable habitat for grizzly bear and Arctic fox.

Immediately west of test pit Y3-A, a large aufeis field is present that impinges onto the western edge of the deposit. Open water is known to occur throughout the winter and provides overwintering areas for fish.

MATERIAL

Deposit Y3 contains good to potentially excellent quality granular material consisting of fine to coarse gravel with some sand. The gravel is coarser at the upstream end of the deposit. At test pit

Y3-B pebbles rarely exceed 2 inches, whereas at test pit Y3-A boulders to 12 inches in size are present. Larger clasts are mainly subangular quartzite, sandstone, limestone, and argillite with rare chert.

VOLUME

The total volume of 45,000,000 cubic yards is based on an estimated conservative depth of 30 feet. Fluvial deposits are known to be more than 60 feet deep along this part of the coastal plain.

Annually, 60,000 cubic yards per 1000 feet length of floodplain and channel bed could be extracted by conventional techniques. Static ground water levels will limit the extractable granular material to an average depth of 2 feet over the floodplain and exposed channel bed. Volume of recoverable material may be limited to 3,800,000 cubic yards because of ground water conditions.

DEVELOPMENT

Extraction at Deposit Y3 will probably be confined to summer and fall when water levels are low. Unless special drainage controls are undertaken large areas will be required for small volumes because of shallow ground water levels. Adequate areas for stockpiling are available.

The pit areas should be restored by natural fluvial processes as streams of the coastal plain are known to move significant amounts of coarse sediment. Access to this deposit is good along the stream course itself or adjacent alluvial-fan.

Development of Deposit Y3 should be planned to minimize interference with waterfowl staging or any fish overwintering areas along the stream course. Excavation within the immediate vicinity of the aufeis should be avoided. Deposit Y3 lies within a proposed Arctic Wildlife Range and the Firth River IBP Reserve; which may restrict development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	GW		GRAVEL - well graded, some fine to coarse sand, occasional cobbles, rootlets, angular to subangular, medium brown, clean.		UF		Lightweight Pieces - Fine Aggregate: 0.25%
2			2.6 ▽				
3			Bottom of Pit				Sample from 0'-2.6'

DATE: Sept. 19, 1976	LOGGED BY: JDF	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y3-A

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	GW		GRAVEL - well graded to 2" size, and fine to coarse sand, occasional cobble, rootlets, angular to sub-angular, medium brown, wet, clean.		UF		Lightweight Pieces- Fine Aggregate: 0.27%
2			2.4 ▽				
			2.6				
3			Bottom of Pit				Sample from 0'-2.6'

DATE: Sept. 19, 1976	LOGGED BY: JDF	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y3-B

SHEET 1 OF 1

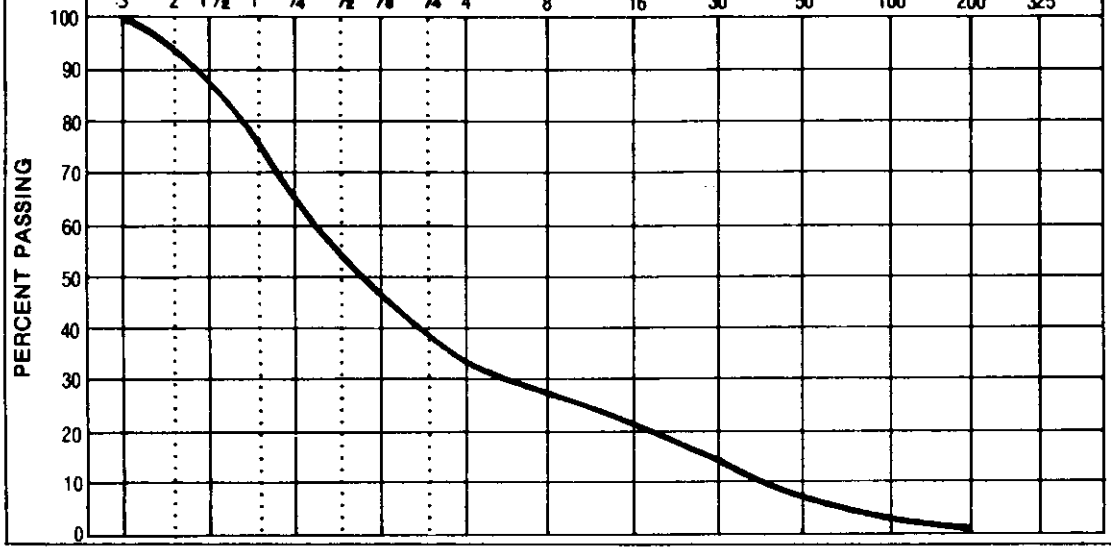
GRAIN SIZE ANALYSIS

SAMPLE Y3-A DEPTH 0'-2.6'

DATE SAMPLED Sept. 19, 1976 SAMPLED BY JDF

LAB TEST NUMBER TP8

GRAVEL SIZES		SAND SIZES			FINES
34.2 %	33.2 %	5.6 %	17.3 %	8.1 %	1.6 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
5"	7.1

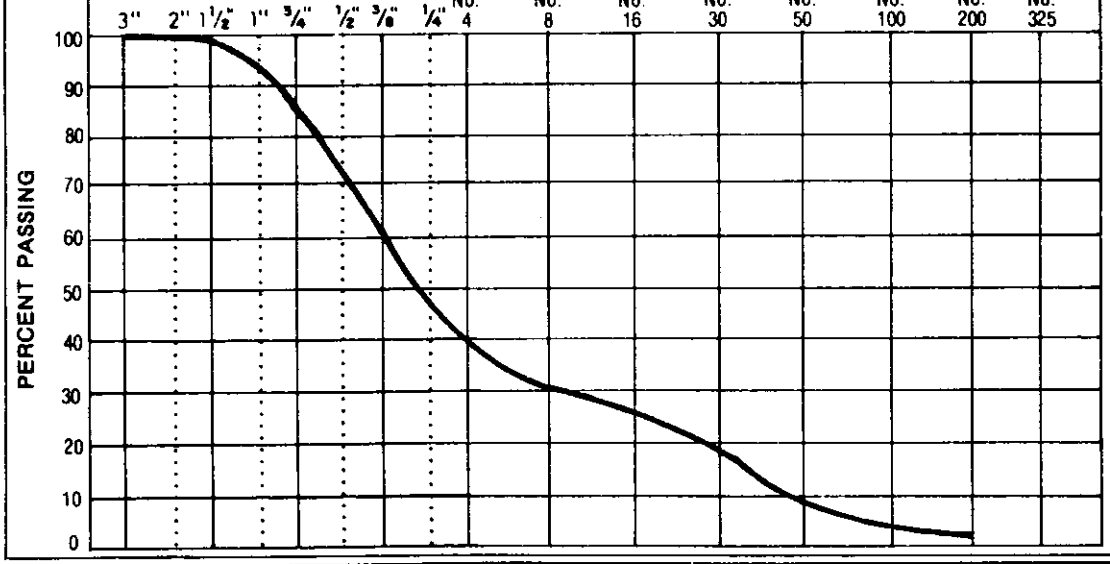
SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	94.3
1 1/2"	86.2
1"	75.0
3/4"	65.8
1/2"	54.0
3/8"	46.4
1/4"	
No. 4	32.6
No. 8	26.9
No. 16	20.6
No. 30	14.0
No. 50	7.3
No. 100	3.0
No. 200	1.6

SAMPLE Y3-B DEPTH 0'-2.6'

DATE SAMPLED Sept. 19, 1976 SAMPLED BY JDF

LAB TEST NUMBER TP7

GRAVEL SIZES		SAND SIZES			FINES
14.3 %	48.1 %	7.6 %	7.5 %	13.6 %	1.4 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
2"	0

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	100.0
1 1/2"	99.2
1"	92.8
3/4"	85.7
1/2"	72.7
3/8"	60.9
1/4"	
No. 4	37.6
No. 8	30.1
No. 16	24.4
No. 30	18.5
No. 50	8.4
No. 100	2.5
No. 200	1.4

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No. Y3

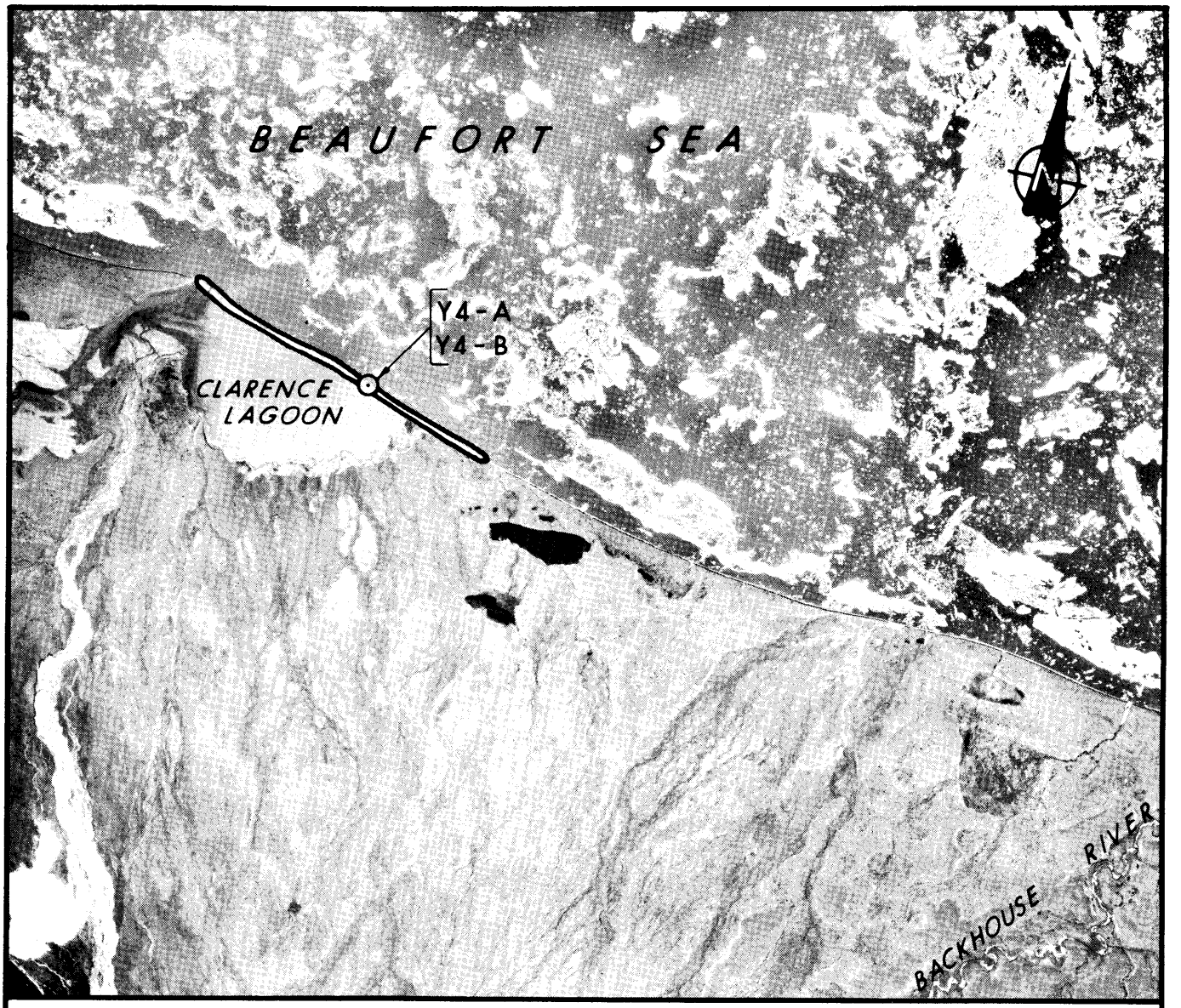
DEPOSIT Y4

Setting: Bay-mouth bar along the seaward side of Clarence Lagoon.

Material: Gravel and Sand; poor to well graded, fine to coarse.

Volume: 800,000 cubic yards total.

Assessment: Contains good quality granular material. Extraction may increase the rate of coastal retreat to the west, although the bar will be restored by natural coastal processes. Good access. Recoverable volume may be limited to 460,000 cubic yards.



Airphoto No.: A13231-67
Approx. Scale: 1"=5700'
Deposit Outline - R.M. Hardy
Test Pit
Deposit Outline - Others
Exposures

DEPOSIT Y4

SETTING

Deposit Y4 consists of a bay-mouth bar that forms the seaward edge of Clarence Lagoon, near the Alaska Boundary. The bar is breached by a narrow channel near its western end.

The bar averages 200 feet in width with a crest standing 6 to 8 feet above sea level. The foreshore is about 100 feet wide; its surface is characterized by loose, poorly graded gravel and a number of minor ridges near sea level. The backshore slopes gently away from the sea and terminates in a small 2 foot scarp at the edge of Clarence Lagoon.

The surface of the bay-mouth bar is well-drained and devoid of vegetation. Driftwood is scattered along the crest and surface of the backshore. Deposit Y4 is completely inundated during major storm surges. Frost was encountered in the bar at a depth of 4 feet.

Westward long-shore drift dominates this portion of the coast. The source of gravel in Deposit Y4 is the eroding seaward edge of the alluvial-fan to the southeast of Clarence Lagoon. The western end of Deposit Y4 adjoins a flat lacustrine plain composed of silty moderately icy sediments, and the eastern end adjoins an imperfectly drained alluvial-fan.

Deposit Y4 lies within a critical staging area for waterfowl and provides habitat for grizzly bear, Arctic fox, caribou, and for polar bear in the winter. Arctic char are known to frequent Clarence Lagoon.

MATERIAL

Deposit Y4 contains fair to good quality granular material with individual strata being poorly graded. The surface of the foreshore and test pit Y4-A indicate that this area is underlain by strati-

fied, poorly graded gravel and sand. The surface of the crest and backshore at test pit Y4-B indicate that this area is underlain by poor to well graded gravel and sand. A few cobbles, 8 inches in size, were noted on the surface. Larger clasts are mainly rounded sandstone, quartzite and argillite.

VOLUME

The total volume of 800,000 cubic yards is based on an average depth of 9 feet as bathymetric configurations and data from other spits suggest that the bay-mouth bar is more than 12 feet thick.

Annually, 37,000 cubic yards per 1000 feet length of the spit could be extracted by conventional techniques assuming that only material above sea level can be considered for extraction. Volume of recoverable material may be limited to 460,000 cubic yards because of static water levels.

DEVELOPMENT

Deposit Y4 may be easily developed by conventional techniques during summer and fall, although storm tides would curtail operations. The adjacent terrain is adequate for long-term stockpiling, but is susceptible to thermokarst. Extraction of material from Deposit Y4 may hasten coastal erosion rates to the west as long-shore drift is mainly in that direction. Restoration of the spit will be relatively rapid as ample coarse-grained sediments are being eroded in small cliffs east of Deposit Y4.

Access to deposit is good over sea ice or inland along a gently sloping alluvial-fan to the Buckland Hills.

Development of Deposit Y4 should be planned to minimize interference with waterfowl staging and the fish population in Clarence Lagoon. Deposit Y4 lies within the proposed Arctic Wildlife Range and Firth River IBP Reserve, which may restrict development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
	SW		SAND - fine to coarse, and fine gravel to 3/8" size. 0.3		UF		Lightweight Pieces - Fine Aggregate: 0.05%
	SP		0.5 SAND - coarse, and fine gravel to ¼" size.				
	GM		GRAVEL - well graded to 2" size, little silty fines. 1.0				
1	SP		SAND - coarse, some fine gravel to ¼" size, clean. 1.5				
	GW		GRAVEL - well graded to 3" size, clean. 2.2				
2	GP		GRAVEL - fine to ½" size, and fine to coarse sand, clean. 2.6 fine to ½" size, increasing sand content with depth, clean.				
3							
4					Vx 10%	4.0	
5			5.0 Bottom of Pit				Sample from 0'-4.0'

DATE: Sept. 19, 1976	LOGGED BY: GCD	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y4-A
SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
	SP		SAND - medium to coarse. 0.4		UF		Organic Color: #2
	GP		GRAVEL - fine to 2" size, and medium to coarse sand, rounded, wet, clean.				Moisture Content: 2.9%
1							Lightweight Pieces - Fine Aggregate: 0.06%
2							
3			3.5				hole abandoned due to sloughing.
			Bottom of Pit				Sample from 0'-3.5'
4							

DATE: Sept. 19, 1976	LOGGED BY: GCD	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

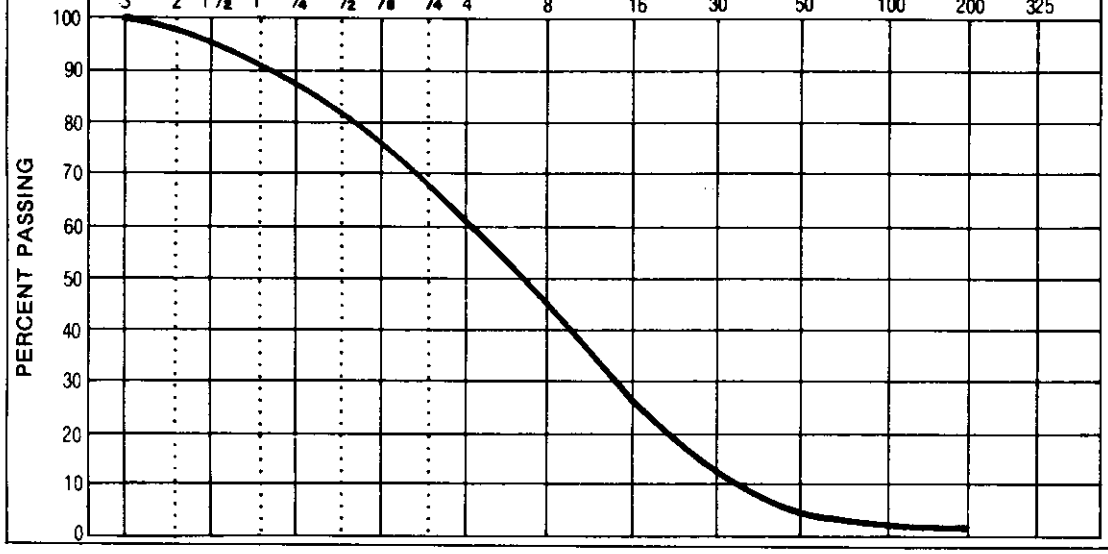
R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO.
Y4-B
SHEET 1 OF 1

GRAIN SIZE ANALYSIS

SAMPLE Y4-A DEPTH 0'-4.0'
DATE SAMPLED Sept. 19, 1976 SAMPLED BY GCD
LAB TEST NUMBER 5HA-A

GRAVEL SIZES		SAND SIZES			FINES
12.2 %	27.7 %	18.1 %	34.5 %	5.7 %	1.8 %
COARSE	FINE	COARSE	MEDIUM	FINE	

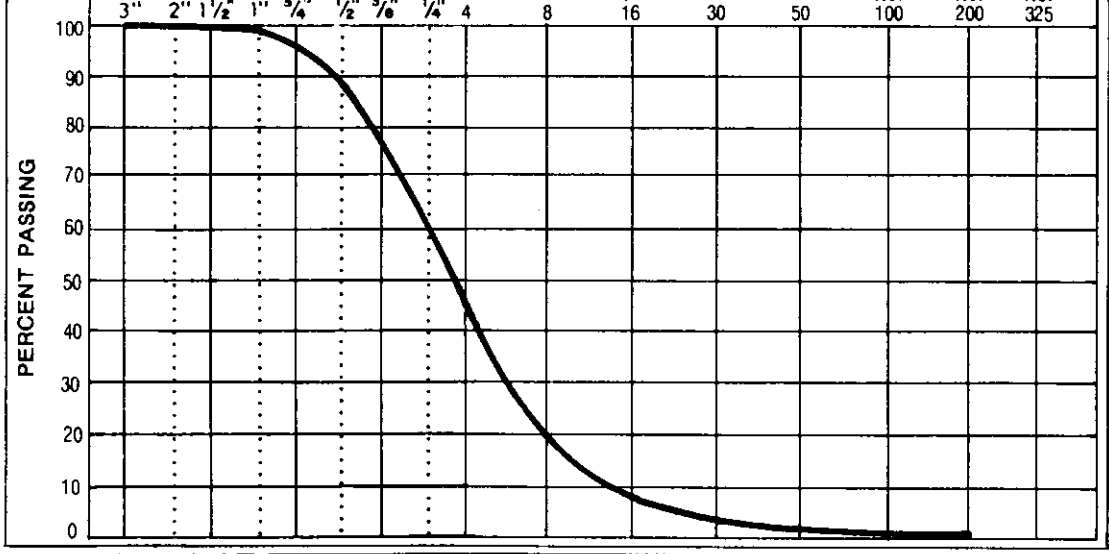


MAX. SIZE	% > 3"
3"	0

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	98.8
1 1/2"	96.7
1"	91.4
3/4"	87.8
1/2"	82.6
3/8"	77.1
1/4"	
No. 4	60.1
No. 8	47.0
No. 16	26.7
No. 30	11.5
No. 50	4.3
No. 100	2.1
No. 200	1.8

SAMPLE Y4-B DEPTH 0'-3.5'
DATE SAMPLED Sept. 19, 1976 SAMPLED BY GCD
LAB TEST NUMBER 5HA-B

GRAVEL SIZES		SAND SIZES			FINES
3.6 %	51.0 %	28.6 %	13.8 %	2.6 %	0.4 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
1½"	0

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	100.0
1 1/2"	100.0
1"	98.8
3/4"	96.4
1/2"	88.8
3/8"	78.4
1/4"	
No. 4	45.4
No. 8	19.7
No. 16	7.7
No. 30	2.7
No. 50	0.9
No. 100	0.5
No. 200	0.4

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No.
Y4

DEPOSIT Y5

Setting: Scree-covered bedrock ridges in northern part of British Mountains, 10 miles south of Clarence Lagoon.

Material: Argillite rubble; platy and flaky, little fines.

Volume: 3,000,000 cubic yards where applicable.

Assessment: Contains poor quality granular material. Large areas must be developed for small volumes unless the underlying bedrock is excavated. Moderately good access to coast.

Airphoto No.: A13138-151		Approx. Scale:	1"=5700'
Deposit Outline - R.M. Hardy	———	Test Pit	⊙
Deposit Outline - Others	—·—·—	Exposures	✠

DEPOSIT Y5

SETTING

Deposit Y5 consists of a number of adjoining ridges and saddles in the northern British Mountains about 10 miles south of Clarence Lagoon. The ridge crests are approximately 1500 feet above sea level with the saddles being about 500 feet lower. The ridges and saddles have a general east-west alignment. Slopes are generally moderate to steep, and the deposit is well drained and free of overburden.

Vegetation is sparse; a few patches of Dryas are present. Caribou trails are abundant in the saddles.

Deposit Y5 is largely covered by flaky and platy argillite fragments, especially on the saddles. In some areas, bands of chert fragments are present and may be more common on the upper part of the ridges. The parent rock underlying the scree is predominantly argillite of the Neruokpuk Formation. Scattered chert interbeds, especially under the ridges, occur throughout the sequence. This lithologic sequence is typical of this part of the British Mountains.

Scree-covered hills and mountains are present both north and south of Deposit Y5. To the east, silt-mantled moderate to gentle slopes lead to a major braided stream channel and its terraces. The silt mantle is generally very ice-rich. This area is utilized by caribou for calving and provides habitat for grizzly bear.

MATERIAL

Deposit Y5 contains poor quality material consisting of platy and flaky fragments of argillite with a matrix of clayey silt. In some areas blocky angular chert fragments are present. This rubble grades to competent rock at depths of 1 to 5 feet.

VOLUME

The total volume 3,000,000 cubic yards is based on a depth of 5 feet of rubble to competent rock. This volume could be greatly increased if the underlying rock was ripped or quarried. Annually, 8,000 cubic yards per acre could be extracted by conventional techniques if only the disintegrated rock was removed.

DEVELOPMENT

Development of this deposit will involve conventional scarifying and scraping of the rubble. The underlying competent rock could be quarried. Pits should be positioned so that the aesthetics of the area are maintained.

Access to this deposit would locally involve crossing slopes that are susceptible to thermokarst. The fluvial system to the east of Deposit Y5 provides a good route to the coast.

Development should be planned to minimize interference with caribou calving or migrations. Deposit Y5 lies within the proposed Arctic Wildlife Preserve and the Firth River IBP Reserve, which may restrict development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
0	BR		SHALE and ARGILLITE - little sand, little clayey fines, occasional granite-like cobbles to 4" size, friable, flaky, green and orange.		UF		
3.5			becoming cleaner				
4.6			Bottom of Pit				Sample from 3.5'-4.6'

DATE: Sept. 25, 1976 | LOGGED BY: GCD | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y5-A

SHEET 1 OF 1

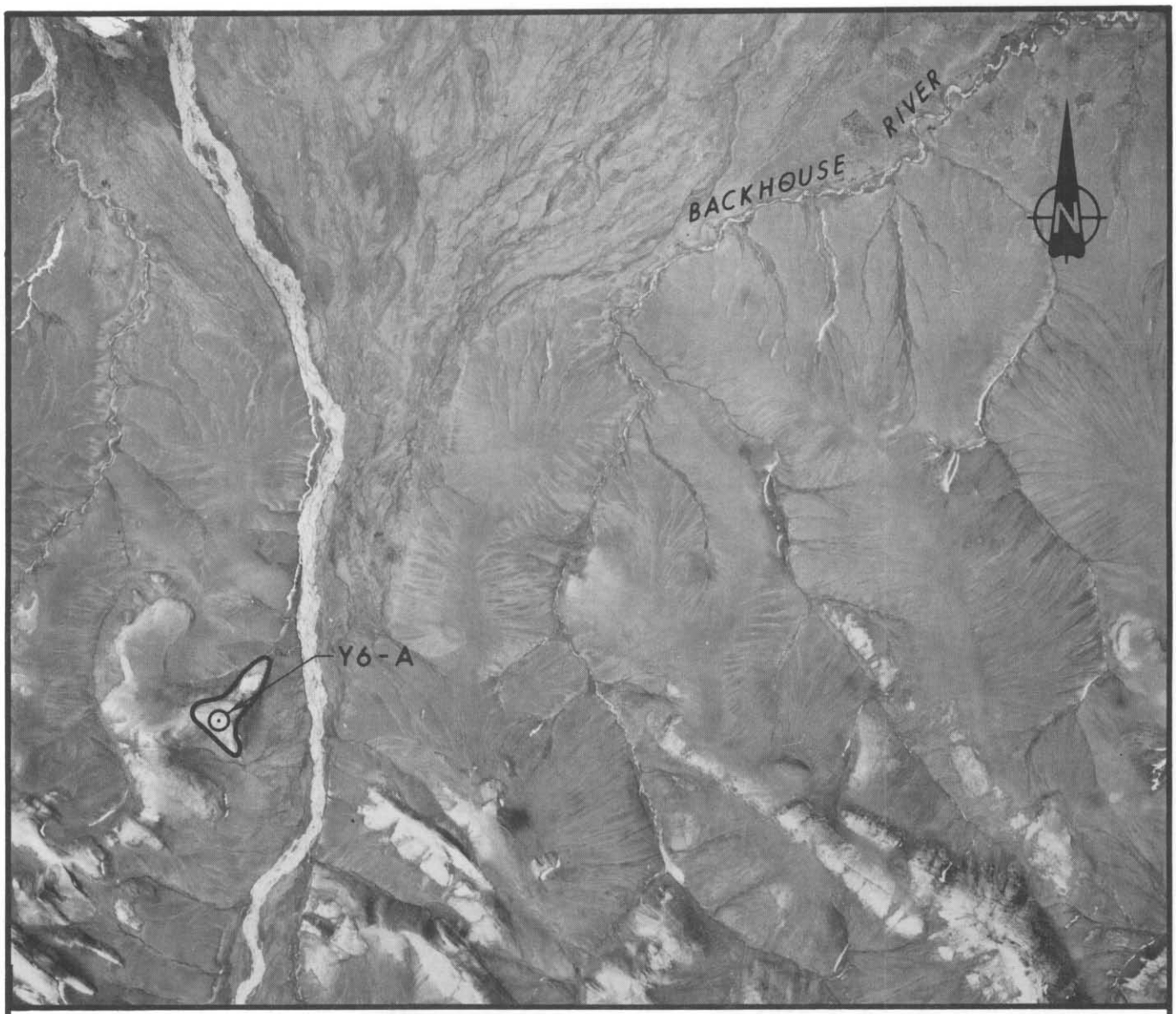
DEPOSIT Y6

Setting: Scree-covered bedrock hill at northern edge of British Mountains, 6½ miles south of Clarence Lagoon.

Material: Rubble; gravel sized, little fines.

Volume: 220,000 cubic yards total.

Assessment: Contains fair to poor quality granular material. Shallow depth to bedrock indicates large area required for small volumes. Processed rock may provide good quality material. Fair access to coast.



Airphoto No.: A13231-65		Approx. Scale:	1"=6000'
Deposit Outline - R.M. Hardy	———	Test Pit	⊙
Deposit Outline - Others	—·—·—	Exposures	✠

DEPOSIT Y6

SETTING

Deposit Y6 consists of a scree-covered hill at the northern edge of the British Mountains about 6½ miles directly south of Clarence Lagoon.

The broad crest of the hill rises 500 feet above sea level and about 350 feet above the nearby valley to the east. Its edges are formed by moderate to steep slopes. Some incipent soil stripes are present on the hill sides. The surface of Deposit Y6 is well drained, free of overburden and covered by a broken cover of typical upland tundra.

The parent rock underlying the scree at Deposit Y6 are probably thinly bedded Triassic limestone and siltstone. The surface scree is primarily fragments of limestone and siltstone, and Triassic sediments are known to overlie the Neruokpuk Formation that forms the core of the British Mountains. Other hills on the northern flank of the British Mountains near the Alaska Boundary are probably of similar composition.

The deposit is bordered by moderately sloping silt-mantled slopes. The silt generally has very high ice contents. Higher hills and mountains are present to the south. This area is utilized by caribou for calving and provides habitat for grizzly bear.

MATERIAL

Deposit Y6 contains poor to fair quality granular materials consisting of angular fragments of siltstone and limestone, ¼ to 8 inches in size, with a matrix of sand and silt. Competent rock is encountered at a depth of 1 to 2 feet.

Although the scree is only poor to fair quality granular material, the underlying rock may provide good quality material if limestone predominates the sequence.

VOLUME

The total volume of 220,000 cubic yards is based on a depth of 1½ feet to competent rock. This volume could be greatly increased if the underlying rock was ripped or quarried. Annually, 2,500 cubic yards per acre could be extracted by conventional techniques if only fragmented rock was removed.

DEVELOPMENT

Development of this deposit will involve scarifying and scraping unless the underlying rock is quarried. The aesthetics of the area would be significantly modified by quarrying.

Access to this deposit will locally involve crossing slopes that are susceptible to thermokarst. An alluvial-fan leads to the coast.

Development should be planned to minimize interference with caribou calving. Deposit Y6 lies within the proposed Arctic Wildlife Preserve and Firth River IBP Reserve, which may restrict development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	GP	1.4	RUBBLE - fragments to 8" size, little silty sand to 6" depth, platy, siltstone and limestone with quartz veins.		UF		pit abandoned at competent rock.
2			Bottom of Pit				Sample at 1.4'

DATE: Sept. 22, 1976	LOGGED BY: GCD	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y6-A

SHEET 1 OF 1

SUMMARY OF PETROGRAPHIC DATA FOR ROCK SAMPLES

PETROGRAPHIC ANALYSIS

PARTICLE TYPE	PERCENT
Calcite	100

ROCK NAME: Limestone

GRAIN SIZE: Maximum crystal size less than 0.1 mm.

GRAIN SHAPE: -

MATRIX AND CEMENT: Fine fractures are filled with coarsely-crystalline calcite.

POROSITY AND PACKING: Nil porosity.

COMMENTS: Slabby rock although bedding orientation not seen; rock probably has no directional weakness.

NOTE: PETROGRAPHIC ANALYSIS BY DOLMAGE CAMPBELL & ASSOCIATES (1975) LTD.

GOVERNMENT OF CANADA DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT	R.M. HARDY & ASSOCIATES LTD. CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION	TEST PIT NO. Y6-A

DEPOSIT Y7

Setting : Large alluvial-fan lying between the British Mountains and Clarence Lagoon.

Material: Gravel; well-graded, fine to coarse, little sand.

Volume : 590,000,000 cubic yards total.

Assessment : Contains good quality granular material. Permafrost and ground water will limit depths of extraction by conventional techniques, especially on the lower fan where some clay layers are present in the near-surface strata. Abandoned pits will result in small ponds. Access is good.
Recoverable volume may be limited to 55,000,000 cubic yards.

Airphoto No. : A13231-66		Approx. Scale :	1"=6000'
Deposit Outline - R.M. Hardy	———	Test Pit	⊙
Deposit Outline - Others	—·—·—	Exposures	✠

DEPOSIT Y7

SETTING

Deposit Y7 is the major part of a large alluvial-fan sloping gently from its apex at the base of the British Mountains to the Clarence Lagoon. This deposit has been previously mapped by NESCL and designated as 117C-B1. Bars and channel traces give the fan surface a braided pattern. The surface is also characterized by periglacial features, especially towards the base of the fan. Typical are shallow trenches overlying ice-wedges and forming 150 foot polygons, small hummocks, and frost boils.

The deposit is free of overburden except in the bottom of some channel traces and on broad shallow marshy depressions where 1 to 2 feet of silt and peat may be present. Parts of the alluvial-fan covered by thicker peat and having poor drainage have been excluded from the deposit.

On better drained parts of the alluvial-fan, the active layer is 2 to 5 feet thick. Sediments immediately above permafrost are water saturated because of a perched water table. Water is present in some ice-wedge trenches, especially on the lower part of the fan. Deposit Y7 is bordered by an active floodplain to its west. Poorly-drained ice-rich lacustrine sediments and upland slopes covered by ice-rich coluvium are to the east and southeast.

Better drained areas are covered by broken tundra consisting mainly of Dryas, sedge, moss, and lichen. In poorly drained areas, sedge-dominated tundra is present. Deposit Y7 and adjacent terrain is used by snow geese as a staging area and provides habitat for Arctic fox and grizzly bear.

MATERIAL

Deposit Y7 contains good quality granular material, although some near surface material may be fair to poor quality. Generally, the

deposit consists of stratified well graded, fine to coarse gravel with little to some sand. Cobbles, 5 inches in size, are common in the upper part of the alluvial-fan, whereas cobbles are infrequent near the base of the fan. Lenses of silty pebbly clay and clayey sand are present in the upper 1 to 3 feet of the alluvial-fan near its distal edge.

Larger clasts are mainly subangular to subrounded sandstone, quartzite, argillite, and limestone with rare chert.

VOLUME

The total volume of 590,000,000 cubic yards is based on a conservative depth of 45 feet. Fluvial deposits are known to be more than 60 feet deep on this part of the coastal plain.

Annually, 5,800 cubic yards per acre could be extracted by conventional techniques assuming that permafrost and ground water would limit yearly excavation depths to 4 feet. Volume of recoverable material may be limited to 55,000,000 cubic yards because of ground water and permafrost tables.

DEVELOPMENT

Excavation will be hampered by shallow active layers and perched ground water especially on the lower part of the fan. Stripping schedules will be required to promote melting of the permafrost. Generally, extracted materials will be damp and require draining. Some drainage control measures will be required for pits excavated to any depth on the fan surface. Abandoned deeper pits will probably result in small ponds on the surface of the alluvial-fan.

Access to Deposit Y7 is good from all directions. Care must be exercised in crossing thermokarst susceptible terrain to the east of this deposit.

Development of Deposit Y7 should be planned to minimize interference with the staging activities of waterfowl. This deposit lies within the proposed Arctic Wildlife Range and the Firth River IBP Reserve, which may restrict development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
	OL		SILT - organic, and gravel to 2" size, angular to subrounded.		UF		
			0.5				
	GW		GRAVEL - well graded to 2" size, little sand, trace clayey fines, angular to subrounded, light browns, quartzite.				
1							
2			2.2				
	CL		CLAY - silty, grey, some fine sub-angular gravel.				
			2.6				
	SP		SAND - medium, and fine gravel, trace clayey fines, subangular to sub-rounded.				
3			frozen at 3.3'				
			3.3			3.3	
			Bottom of Pit				No sample taken.
4							

DATE: Sept. 22, 1976	LOGGED BY: GCD	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y7-A

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
	OL		SILT - organic, and gravel, subangular to rounded, quartzite.		UF		Lightweight Pieces - Fine Aggregate: 0.20%
0.8	GW		GRAVEL - well graded to 1½" size, little fine to coarse sand, trace clayey fines, clean, angular to subrounded, quartzites and sandstones.				
2.5			becoming coarser to 3" size at 2.5'.				
8.0			Bottom of Pit				Sample from 0.8'-8.0'

DATE: Sept. 22, 1976	LOGGED BY: GCD	DRWN BY: MB/vh	CHKD BY: GDC/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y7-B(e)

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
	Pt		0.2 PEAT - moss cover, brown, dry.		UF		Organic Color: #2+
1	GC		GRAVEL - well graded to 2" size, some fine to coarse sand, little clayey fines, occasional cobble, rootlets, subangular, light grey, wet.				Lightweight Pieces - Fine Aggregate: 0.06%
2							
3							pit walls differ, south wall is coarse gravel with no fines.
4			4.5 ▽ saturated, frozen at 4.5'.			4.5	
5			Bottom of Pit				Sample from 0.2'-4.5'

DATE: Sept. 22, 1976 | LOGGED BY: JDF | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y7-C

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
	Pt		PEAT - grass. 0.3		UF		
1	CL		CLAY - little fine to medium sand, trace fine gravel, silty, low plastic, peat layers, rootlets, grey, wet. 1.3				
2	GP		GRAVEL - coarse, little fine to coarse sand, trace fines, occasional cobble, angular to subangular shale fragments, becoming finer with depth, increasing sand content, grey-brown. 2.4 ▽				
3			Bottom of Pit				No sample taken.

DATE: Sept. 19, 1976 | LOGGED BY: JDF | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y7-D(e)

SHEET 1 OF 1

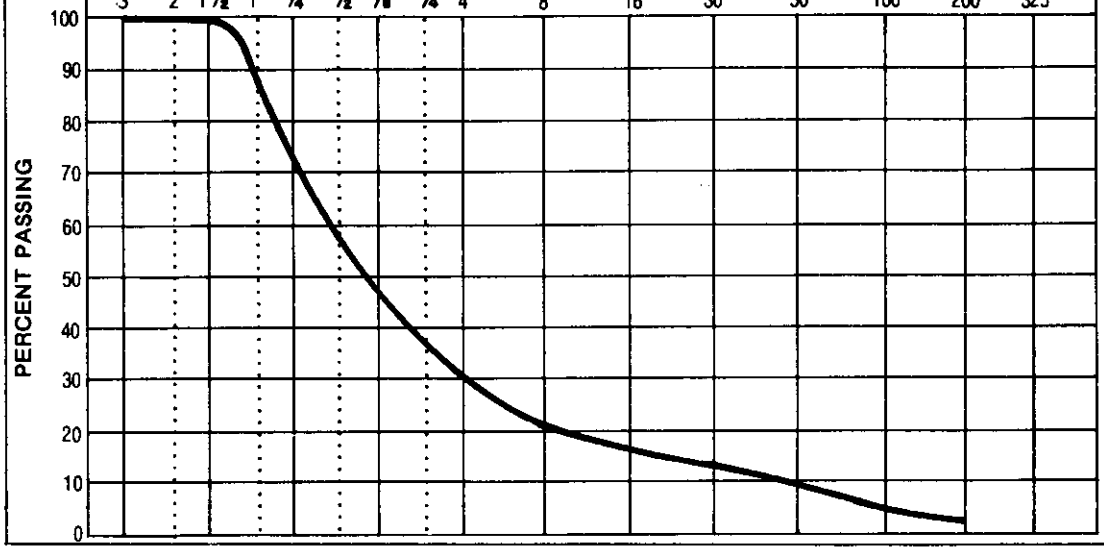
GRAIN SIZE ANALYSIS

SAMPLE Y7-B(e) DEPTH 0.8'-8.0'

DATE SAMPLED Sept. 22, 1976 SAMPLED BY GCD

LAB TEST NUMBER 4HA-B

GRAVEL SIZES		SAND SIZES			FINES
24.2 %	46.8 %	9.0 %	7.5 %	9.0 %	3.5 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
2"	0

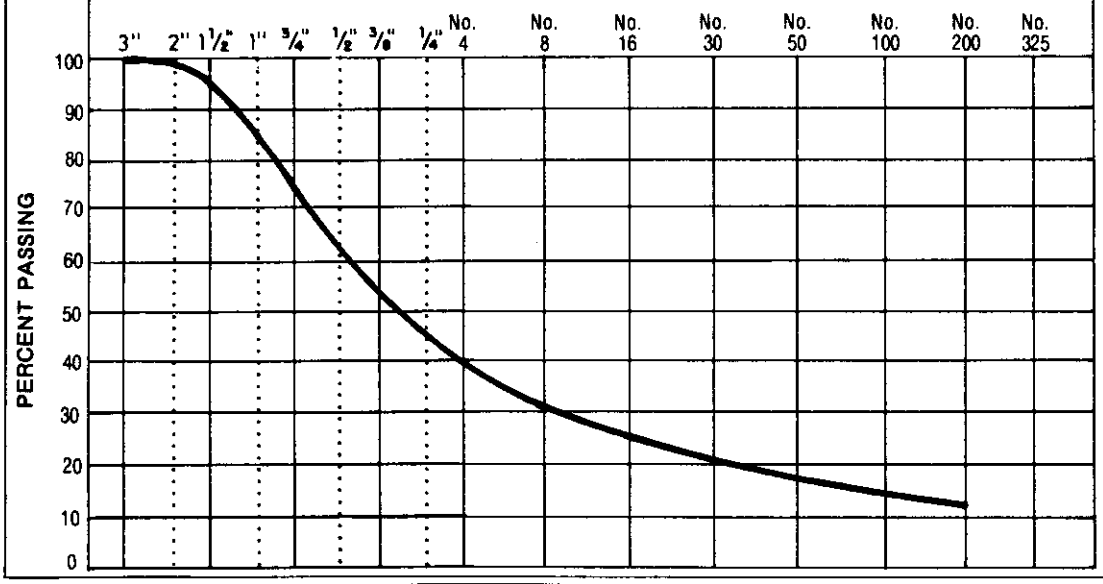
SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	100.0
1 1/2"	98.9
1"	89.1
3/4"	75.8
1/2"	60.1
3/8"	44.8
1/4"	29.0
No. 4	
No. 8	21.0
No. 16	17.1
No. 30	13.9
No. 50	8.5
No. 100	4.7
No. 200	3.5

SAMPLE Y7-C DEPTH 0.2'-4.5'

DATE SAMPLED Sept. 22, 1976 SAMPLED BY GCD

LAB TEST NUMBER TP 11

GRAVEL SIZES		SAND SIZES			FINES
25.2 %	36.1 %	8.7 %	12.0 %	6.9 %	11.1 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
2"	0

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	100.0
1 1/2"	95.8
1"	84.4
3/4"	74.8
1/2"	63.5
3/8"	54.7
1/4"	
No. 4	38.7
No. 8	31.7
No. 16	25.0
No. 30	20.3
No. 50	15.8
No. 100	12.5
No. 200	11.1

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No. Y7

DEPOSIT Y8

Setting: Limestone outcrops and associated blocky talus on the upper reaches of Fish Creek, 12 miles south-southwest of Komakuk Beach.

Material: Limestone rock and coarse rubble.

Volume: 1,300,000 cubic yards total.

Assessment: Exhibits potential as a source of crushed rock and a limited volume of riprap. Access to the coast is fair.

Airphoto No.: A13140-113		Approx. Scale: 1"=5800'	
Deposit Outline - R.M. Hardy	———	Test Pit	⊙
Deposit Outline - Others	—·—·—	Exposures	✠

DEPOSIT Y8

SETTING

Deposit Y8 consists of limestone outcrops and talus on the southern valley wall of Fish Creek. Located approximately 12 miles south-southwest of Fish Creek and 6 miles west-southwest of Mount Conybeare.

The outcrops consist of a number of rock pinnacles about 100 feet to 350 feet below the crest of the ridge whose summit is about 700 feet above the level of Fish Creek. Outcrops are discontinuous because of stratigraphic facies change or tectonic pinching. Continuous talus cones blanket the slope from the base of the outcrops to the valley floor.

The rock is fine-grained gray limestone with thin cherty beds and quartz veins. Outcrops have irregularly fractured surfaces, although one set of distinctive vertical joints is distinguishable. Recessive areas between limestone pinnacles are probably underlain by shaley materials, although limestone may be present at depth.

Outcrops and talus are bare of vegetation except for crustose lichens.

The limestone is part of the Wahoo Formation of Carboniferous age, which have been folded and faulted into the older surrounding Neruokpuk Formation. Within the general region, up to 300 feet of the limestone was noted at other localities where the Wahoo Formation outcrops.

Deposit Y8 is bordered by hilly terrain to the north and by well drained terraces of Fish Creek along its southern periphery. The area provides habitat for caribou and grizzly bear. Fish may overwinter near areas of aufeis along Fish Creek, downstream from this deposit.

MATERIAL

Deposit Y8 may be a source for the production of good quality granular material consisting of competent rock and talus cones. The rock outcrops consist of limestone with chert beds and quartz veins. Fracture planes suggest that blocks, in excess of 6 feet, could be quarried. The talus consists of angular blocks ranging from 1 inch to 4 feet in size and averages 1 foot. The material will require extensive testing before being considered for production of concrete aggregate because of the high chert content.

VOLUME

The total volume of 1,300,000 cubic yards assumes that the rock can be quarried a distance of 30 feet into the hill and that the talus is in excess of 30 feet thick.

DEVELOPMENT

Preliminary blasting tests to determine breakage characteristics of the rock would be necessary before considering Deposit Y8 as a source of riprap. The material could be mined from benches along the side of the ridge or from talus cones at the base of the slope.

Access to the coast may be achieved along the Fish Creek fluvial system. Any open water areas along Fish Creek during the winter should be avoided because fish may overwinter at these localities. Development should also be planned not to interfere with Caribou migration.

Deposit Y8 lies within the proposed Arctic Wildlife Preserve and the Firth River IBP Reserve, which may restrict development.

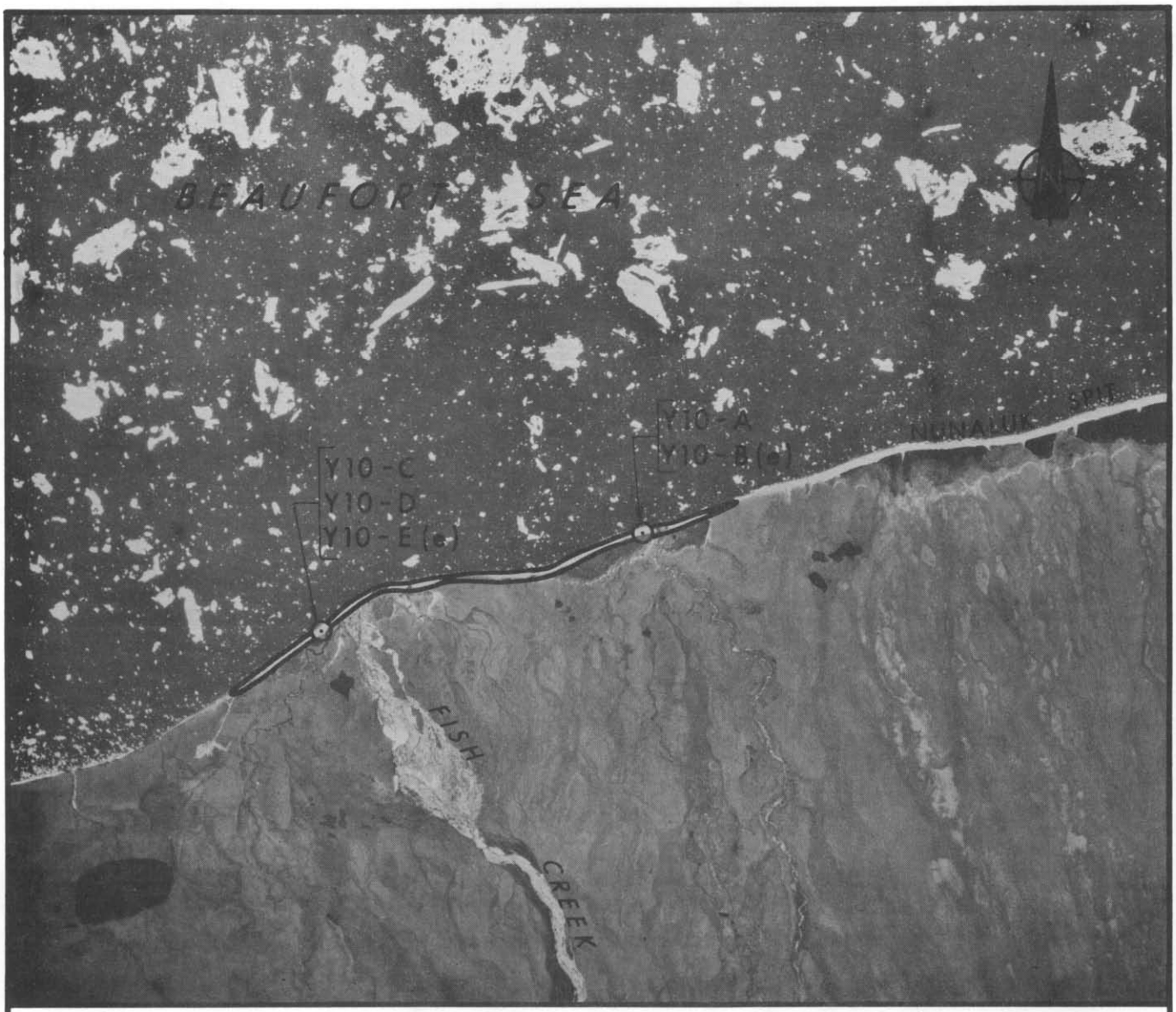
DEPOSIT Y10

Setting: Beach ridge to the east of Komakuk Beach.

Material: Gravel and Sand; poor to well graded, fine to medium, stratified.

Volume: 2,100,000 cubic yards total.

Assessment: Contains good quality granular material. The beach ridge will be restored by natural coastal processes. Good access.
Recoverable volume may be limited to 1,200,000 cubic yards.



Airphoto No.: A14361-87		Approx. Scale:	1"=5800'
Deposit Outline - R.M. Hardy	———	Test Pit	⊙
Deposit Outline - Others	—·—·—	Exposures	✠

DEPOSIT Y10

SETTING

Deposit Y10 consists of a beach ridge, 2½ miles in length, extending east of Komakuk Beach. The ridge is breached by a couple of narrow channels; one near the mouth of Fish Creek and one near the mouth of a small creek at its eastern end. The bar averages about 300 feet in width with a crest standing 10 feet above sea level. The foreshore is about 150 feet wide with a rise of 4 feet over the first 25 feet of width. The backshore slopes gently away from the sea with a 2 to 3 foot scarp at its inland edge.

Deposit Y10 is well-drained and devoid of vegetation. Driftwood is scattered along the crest and surface of the backshore. The beach ridge is completely inundated during intense storm surges. Frost was encountered at a depth of 4 feet. Most of the gravel in Deposit Y10 consists of eroded sediment from the sub-sea part of the large alluvial-fan that borders this deposit and sediment transported to the coast from Fish Creek.

The beach bar adjoins an imperfectly drained alluvial-fan over most of its length; the remainder being bordered by tidal flats where polygonal ground has developed with flooded ice-wedge trenches. The active floodplain of Fish Creek also abuts against the beach ridge.

Deposit Y10 lies within a staging area for waterfowl and provides habitat for caribou, Arctic fox, grizzly bear, and, in winter, polar bear. Coastal waters are inhabited by various fish species.

MATERIAL

Deposit Y10 contains fair to excellent quality granular material. Individual stratum consist of poorly graded material. Test pits and the surface of the foreshore and crest indicate that these areas are underlain by stratified poorly graded fine to medium gravel and poorly sorted

medium to coarse sand with pebbles rarely exceeding 2 inches in size. The surface of the backshore indicates that this zone is underlain by stratified, well graded, fine to medium gravel with some medium to coarse sand, by poorly graded fine gravel and by medium to coarse sand. Larger clasts are mainly rounded to subrounded sandstone, quartzite and limestone with rare granitics. Shale and argillite are present in the fines.

VOLUME

The total volume of 2,100,000 cubic yards is based on an average thickness of 10 feet as bathymetric configurations and data from other spits suggest that the beach ridge is more than 12 feet thick. Annually, 55,000 cubic yards per 1000 feet length of the beach ridge could be extracted by conventional techniques assuming that only material above sea level is considered for extraction. Volume of recoverable material may be limited to 1,200,000 cubic yards because of static water level.

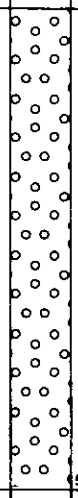
DEVELOPMENT

Deposit Y10 could be easily developed by conventional excavation techniques during summer and fall, although storm tides would interrupt operations. Adjacent terrain is adequate for stockpiling.

Extraction of granular material from Deposit Y10 would probably not seriously affect the rate of coastal retreat. Material taken from this source for the DEW-line station has not affected coastal dynamics. The beach has been restored by normal geologic processes.

Development of Deposit Y10 should be planned to minimize interference with waterfowl staging. Deposit Y10 lies within the proposed Arctic Wildlife Range and Firth River IBP Reserve, which may restrict development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
0	GP		GRAVEL - fine to 3/4" size, and fine to coarse sand, trace coarse gravel, occasional cobble and boulder, stratified, medium brown, damp, gravel mostly flat.		UF		
1							
2							
3							
4							
5		5.0	Bottom of Pit				Sample from 0'-5.0'
6							

DATE: Sept. 19, 1976 | LOGGED BY: JDF | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y10-A

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
0	GW		GRAVEL - well graded, some medium to coarse sand, trace fines, sub-rounded, stratified into 3" layers, wet.		UF		
4.5	OL		SILT - organic, low plastic, rootlets, dark grey, wet.				
5.0			Bottom of Pit				No sample taken.

DATE: Sept. 19, 1976 | LOGGED BY: JDF | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y10-B(e)

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
0	SP		SAND - medium to coarse, some fine gravel to 3/8".		UF		Organic Color: #2
1							Moisture Content: 2.5%
			1.3 — — gravel content increasing to 3/4" size, occasional coarse gravel to 1½", subrounded to rounded, cherts, sandstones, quartzites.				Lightweight Pieces - Fine Aggregate: 0.16%
2							
3							
4						4.1	
5			5.4	+ + + + +	Vx 5%		
6			Bottom of Pit				Sample from 0'-4.1'

DATE: Sept. 19, 1976 | LOGGED BY: GCD | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y10-C

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
0	GW		GRAVEL - well graded to 2" size, some medium sand, trace coarse gravel to 3" size, rounded, brown.		UF		
1.8	SP		SAND - medium to coarse, trace gravel to ½" size.				
2.3	GP		GRAVEL - fine, some medium to coarse sand, well rounded.				
3.6 ▽							
4.1			Bottom of Pit				No sample taken
5							

DATE: Sept. 19, 1976 | LOGGED BY: GCD | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y10-D

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	GP		GRAVEL - fine to 3/4" size, some coarse sand, rounded.		UF		
		1.4					
	SP		SAND - medium to coarse.				
2		2.0					
	GP		GRAVEL - fine to 3/4" size, little coarse sand, rounded.				
3		3.8					
4			Bottom of Pit				No sample taken

DATE: Sept. 19, 1976 | LOGGED BY: GCD | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y10-E(e)

SHEET 1 OF 1

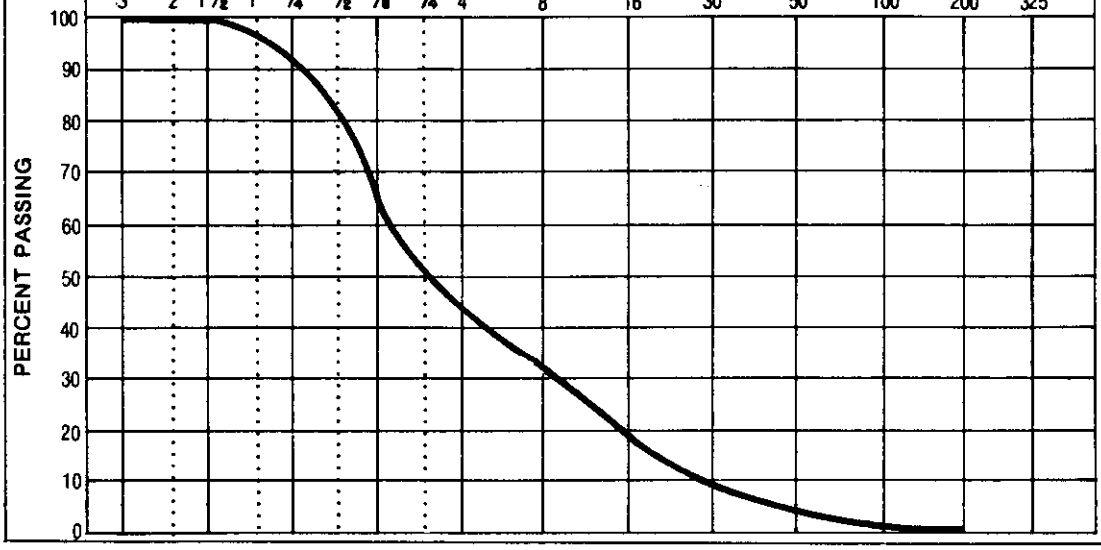
GRAIN SIZE ANALYSIS

SAMPLE Y10-A DEPTH 0'-5.0'

DATE SAMPLED Sept. 19, 1976 SAMPLED BY JDF

LAB TEST NUMBER TP39

GRAVEL SIZES		SAND SIZES			FINES
6.8 %	50.4 %	13.3%	24.6 %	3.8 %	1.1 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
3"	0

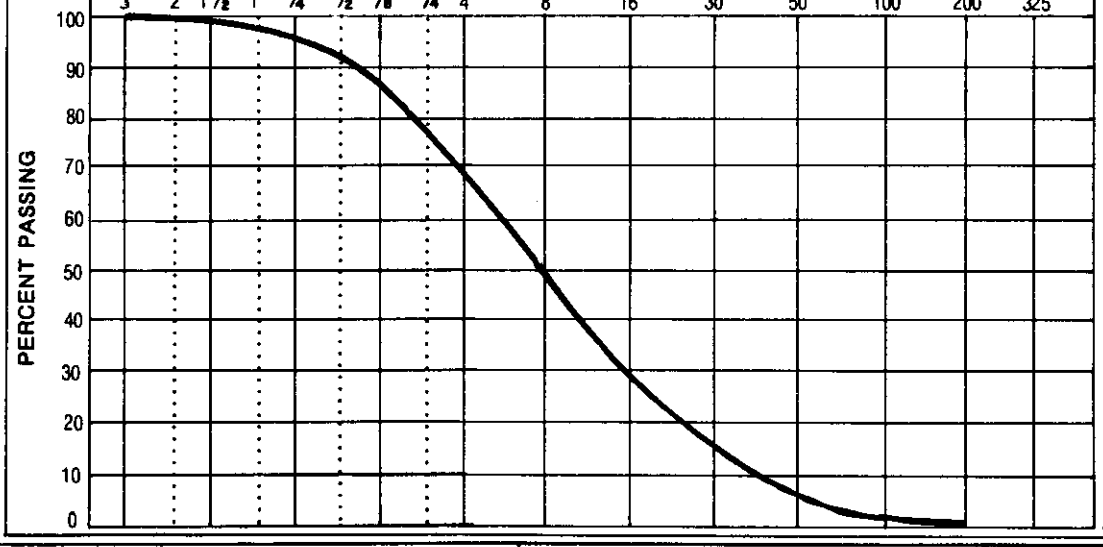
SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	98.9
1 1/2"	98.9
1"	97.5
3/4"	93.2
1/2"	79.8
3/8"	63.5
1/4"	
No. 4	42.8
No. 8	32.0
No. 16	18.9
No. 30	7.5
No. 50	2.2
No. 100	1.3
No. 200	1.1

SAMPLE Y10-C DEPTH 0'-4.1'

DATE SAMPLED Sept. 19, 1976 SAMPLED BY GCD

LAB TEST NUMBER 40HA-A

GRAVEL SIZES		SAND SIZES			FINES
1.4 %	30.1 %	23.5%	36.0 %	8.2 %	0.8 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
2"	0

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	100.0
1 1/2"	99.7
1"	99.4
3/4"	98.6
1/2"	94.6
3/8"	90.0
1/4"	
No. 4	68.5
No. 8	50.2
No. 16	29.8
No. 30	14.9
No. 50	4.7
No. 100	1.3
No. 200	0.8

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No. Y10

SUMMARY OF LABORATORY TEST DATA FOR SUITABILITY OF AGGREGATES IN CONCRETE

PETROGRAPHIC ANALYSIS
COARSE AGGREGATE

ROCK TYPE	CLASSIFICATION	TOTAL WEIGHTED COMPONENT %
Quartzite	Strong to Very Strong, Good	25.0
Quartzitic Sandstone		47.9
Sandstone		6.3
Granite		1.1
Limestone		18.0
Slate	Flaky, Fair	0.2
Chert	Potentially Reactive, Fair	1.5

PN: =	INTERPRETATION:	
105	Good to excellent quality for coarse aggregate	100.0

SOUNDNESS OF AGGREGATE - SULPHATE TEST

COARSE AGGREGATE: LOSS = 1.34%

FINE AGGREGATE: LOSS = 6.10%

OTHER TESTS

LIGHTWEIGHT PIECES IN AGGREGATE: Fine: 0.05%

SPECIFIC GRAVITY: Fine: 2.64, Coarse: 2.66

WATER ABSORPTION: Fine: 1.46%, Coarse: 0.96%

ORGANIC IMPURITIES TEST

NUMBER : 2+
COAL REMOVED :
COAL & ROOTLETS REMOVED :
COAL CONTENT : 0.05%

COMMENTS:

Sulphate test was performed for 5 cycles in Magnesium Sulphate solution.
Specific Gravity Test was performed at 20°C.
Lightweight Pieces were determined by floating on Zinc Chloride solution with a specific gravity of 2.0.

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO.
Y10-A

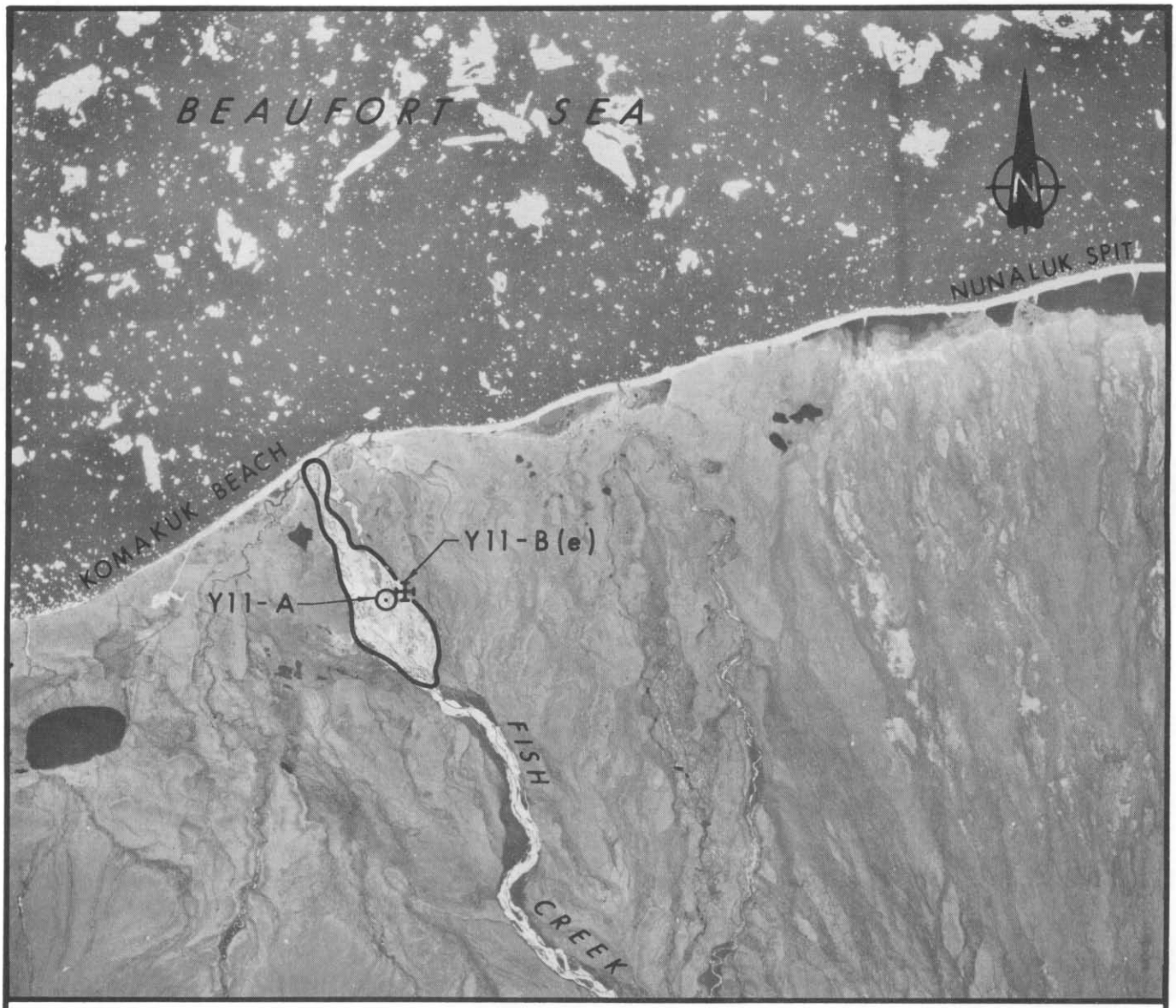
DEPOSIT Y11

Setting: Active broad floodplain near the mouth of Fish Creek. Immediately east of Komakuk Beach.

Material: Gravel; fine to coarse, some fine to coarse sand.

Volume: 14,500,000 cubic yards total.

Assessment: Contains good quality granular material. Extraction would be limited by the presence of aufeis. Fish over-wintering areas may restrict development. Good access.
Recoverable volume may be limited to 500,000 cubic yards.



Airphoto No.: A14361-86		Approx. Scale:	1"=5700'
Deposit Outline - R.M. Hardy	———	Test Pit	⊙
Deposit Outline - Others	—·—·—	Exposures	✣

DEPOSIT Y11

SETTING

Deposit Y11 consists of a relatively vegetation-bare, braided bar and channel bed complex near the mouth of Fish Creek where its floodplain broadens. The DEW-line station at Komakuk Beach is about one mile west of this deposit.

The deposit is free of overburden and is well drained. Half of the deposit stands 2 feet above late fall water levels. Local relief of 1½ feet is common on the surface of Deposit Y11 because of scour holes and channel traces. The thickness of the active layer is estimated to exceed 5 feet.

Although Deposit Y11 was completely free of aufeis in the fall of 1976, air photos indicate that aufeis usually covers much of the deposit. Area previously covered by aufeis shows a thin precipitated crust of undetermined salts. Open water has been noted during winter near the aufeis. The deposit is bordered by well to imperfectly drained low terraces and is separated from the ocean by a beach ridge.

Patches of herbaceous tundra cover a quarter of Deposit Y11. The presence of open water during mid-winter suggests that fish may use this area for overwintering. This area is a major staging area for snow geese and provides habitat for grizzly bear and Arctic fox.

MATERIAL

Deposit Y11 contains good quality granular material consisting of fine to coarse, well graded gravel with cobbles to 6 inches and some sand. Larger clasts are mainly platy subangular to subrounded fine-grained quartzite, sandstone, and argillite with rare limestone and chert.

Patches of fine to medium sand were noted at the bottoms of scour holes and channel traces.

VOLUME

The total volume of 14,500,000 cubic yards is based on a conservative depth of 45 feet. Adjacent low terraces are underlain by more than 60 feet of gravel.

Annually, 2,000 cubic yards per acre could be extracted by conventional techniques assuming that static ground water levels limit the extractable granular material to an average depth of 1½ feet. Volume of recoverable material may be limited to 500,000 cubic yards because of static ground water conditions.

DEVELOPMENT

Excavation at Deposit Y11 will be confined to fall when water levels are low, and areas covered by aufeis are minimal. Large areas will be required for small volumes because of shallow ground water levels. Stockpiling on adjacent terraces for winter hauling will be necessary to avoid aufeis development.

Natural fluvial processes would restore the pit, as streams of the coastal plain are known to move significant amounts of coarse sediment. Fish Creek and its terraces provide good access to Deposit Y11.

Development of Deposit Y11 should be planned to minimize interference with fish migration along Fish Creek. Further investigations should be carried out to determine if extraction of gravel would jeopardize local hydrology, and maintenance of mid-winter open water and fish populations. Deposit Y11 lies within a proposed Arctic Wildlife Range and the Firth River IBP Reserve; which may restrict development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	GW		GRAVEL - well graded to 4" cobbles, some fine to coarse sand, subangular to subrounded, clean.		UF		Lightweight Pieces - Fine Aggregate: 0.16%
2			2.0 ▽ saturated at 2.0'			2.0	
			Bottom of Pit				Sample from 0'-2.0'.
3							

DATE: Sept. 19, 1976	LOGGED BY: GCD	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y11-A

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	SM		SAND - fine, little silty fines, trace fine gravel to ¼" size, brown.		UF		
1.8 / 2.0			some gravel to 1½" size, rounded, orange.				
2	GP		GRAVEL - fine to 3" size, and fine to coarse sand, trace silty fines, subrounded to rounded.				
3.5							
4			Bottom of Pit				No sample taken.

DATE: Sept. 19, 1976	LOGGED BY: GCD	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y11-B(e)

SHEET 1 OF 1

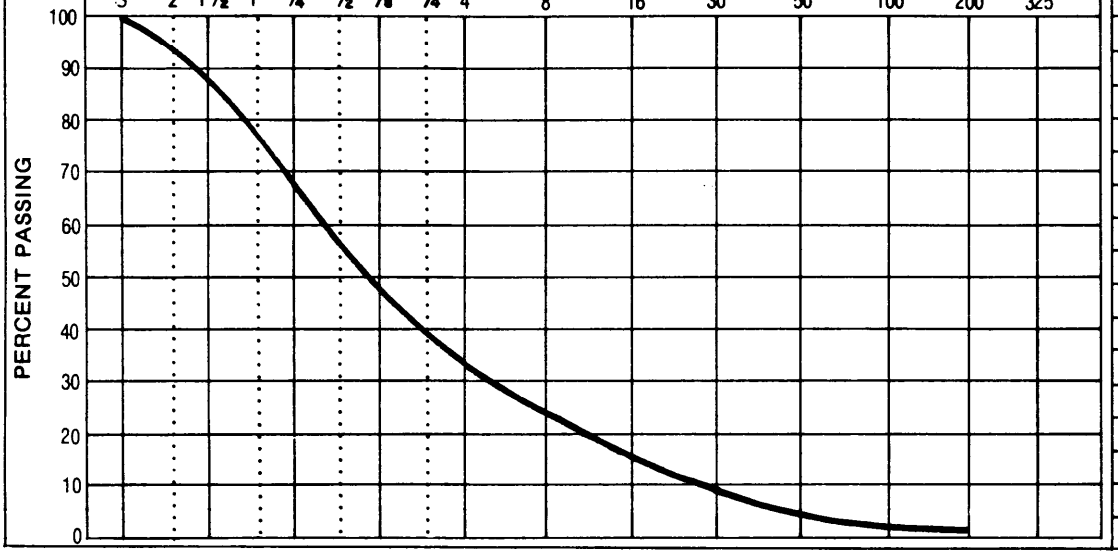
GRAIN SIZE ANALYSIS

SAMPLE Y11-A DEPTH 0'-2.0'

DATE SAMPLED Sept. 19, 1976 SAMPLED BY GCD

LAB TEST NUMBER 41HA-A

GRAVEL SIZES		SAND SIZES			FINES
31.9 %	35.3 %	9.8%	16.3 %	5.8 %	0.9 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
3"	0

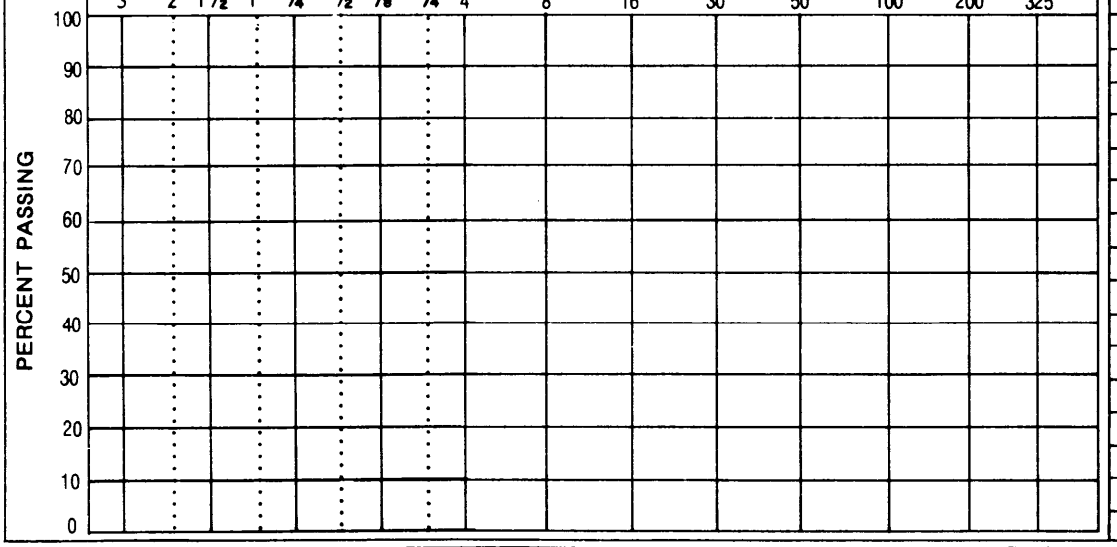
SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	93.9
1 1/2"	87.3
1"	77.1
3/4"	68.1
1/2"	56.9
3/8"	48.0
1/4"	
No. 4	32.8
No. 8	25.1
No. 16	17.8
No. 30	9.4
No. 50	3.3
No. 100	1.4
No. 200	0.9

SAMPLE _____ DEPTH _____

DATE SAMPLED _____ SAMPLED BY _____

LAB TEST NUMBER

GRAVEL SIZES		SAND SIZES			FINES
%	%	%	%	%	%
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"

SIEVE SIZE	PERCENT PASSING
3"	
2"	
1 1/2"	
1"	
3/4"	
1/2"	
3/8"	
1/4"	
No. 4	
No. 8	
No. 16	
No. 30	
No. 50	
No. 100	
No. 200	

GOVERNMENT OF CANADA

DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.

CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

DEPOSIT No. Y11

DEPOSIT Y13

Setting: Spit fronting the Malcolm River alluvial-fan (known as Nunaluk Spit).

Material: Gravel and Sand; poorly graded, fine to medium.

Volume: 9,000,000 cubic yards total.

Assessment: Contains fair to good quality granular material. Extraction of material should not seriously affect coastal dynamics and natural processes will restore the spit. Access is good, although the eastern end of the spit is far from the mainland unless water is crossed. Recoverable volume may be limited to 4,000,000 cubic yards.

Airphoto No.: A22881-117, 163, 166 — Approx. Scale: 1"=4900'

Deposit Outline - R.M. Hardy ——— Test Pit ⊙

Deposit Outline - Others —·—·— Exposures ✣

DEPOSIT Y13

SETTING

Deposit Y13 consists of a long spit, known as Nunaluk Spit, extending across the front of the Malcolm River fan. It is attached to the mainland at its western end about three miles east of Komakuk Beach, and near its mid point. A number of spurs project into the narrow lagoon formed by these two attachments. The spit is breached by one narrow channel along the lagoon. Numerous recurved ridges form the eastern end of the spit. Near its eastern end, the spit adjoins a small island rising about 30 feet above sea level.

The spit averages 400 feet in width with a crest standing 6 feet above sea level. The foreshore is about 150 feet wide with a rise of 3 feet over the first 10 to 20 feet. The backshore slopes gently away from the crest to a 2 to 3½ foot scarp at its inland edge.

The surface of the beach ridge is well drained and devoid of vegetation. Driftwood is concentrated along the crest of the spit. Deposit Y13 is likely inundated during intense storm surges. Frost was encountered at depths of 4 to 5½ feet.

The source of the granular material in Nunulak Spit consists of eroded sediment from the sub-sea part of the Malcolm River alluvial-fan. The spit is presently quite stable except for continued extension of its eastern end.

Deposit Y13 lies within a staging area for waterfowl and provides habitat for Arctic fox and for polar bear in the winter. Adjacent waters are occupied by a number of fish species.

MATERIAL

Deposit Y13 contains fair to good quality granular material consisting of stratified, poorly graded fine to medium gravel and poorly

graded medium to coarse sand. Pockets of well graded gravel and sand are present. Pebbles rarely exceed 1½ inches in size. Larger clasts are mainly subrounded to rounded sandstone and quartzite with rare argillite, chert, and conglomerate.

VOLUME

The total volume of 9,000,000 cubic yards is based on an average thickness of 9 feet as bathymetric configurations and data from other spits suggest that the spit is at least 12 feet thick.

Annually, 60,000 cubic yards per 1000 feet length of spit could be extracted by conventional techniques assuming that only material above sea level is harvested. Recoverable volume may be limited to 4,000,000 cubic yards because of static water level.

DEVELOPMENT

Deposit Yl3 could be developed by conventional techniques during summer and fall, although storm tides would halt operations. The adjacent Malcolm River alluvial-fan is adequate for long-term stock-piling, although the eastern end of the spit is some distance overland from where the spit adjoins the alluvial-fan.

Sediment extraction from Nunulak Spit would not significantly affect coastal erosion rates as the spit is near a sediment sink. Restoration of the spit would be relatively rapid through long-shore drift as indicated by the rate at which the spit is extending eastward.

Access to the deposit is good over sea ice or inland along the gently sloping alluvial-fans of either the Firth or Malcolm Rivers.

Some evidence of former Eskimo camps was noticed on the lower Malcolm River alluvial-fan and the small island near the eastern end of the spit. These localities should be avoided if the spit is developed.

Development of Deposit Y13 should be planned to minimize interference with waterfowl staging and the fish population in adjacent waters. Deposit Y13 lies within the proposed Arctic Wildlife Range and Firth River IBP Reserve, which may restrict development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
0	SP		SAND - medium to coarse, and fine gravel to 3/4" size, stratified, 2" layers, subrounded to rounded.		UF		Organic Color: #2+ Moisture Content: 2.1% Lightweight Pieces - Fine Aggregate: 0.06%
2.0	GP		GRAVEL - fine to ½" size, some medium to coarse sand.				
2.8	SP		SAND - medium to coarse, and fine gravel to ½" size.				
3.5			- decreasing gravel content.				
4.9					Vx 5%	5.2	
5.3	GW		GRAVEL - well graded to 1½" size, and medium to coarse sand.				Sample from 0'-5.3'
			Bottom of Pit				

DATE: Sept. 26, 1976	LOGGED BY: GCD	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y13-A

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
0	SP		SAND - medium to coarse, little fine gravel to ½" size.		UF		
			0.3 — coarse sand and fine gravel to ¼" size.				
			0.8 — little gravel to ½" size.				
1							
			1.5 — alternating 4" layers of medium to coarse sand and fine gravel to ½" size, stratified, sub-rounded to rounded, assorted colors.				
2							
3							
			3.8				
4			Bottom of Pit				No sample taken.

DATE: Sept. 26, 1976	LOGGED BY: GCD	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y13-B

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	GP		GRAVEL - 1" maximum size, and medium to coarse sand, subrounded to rounded.		UF		
1.0			4" layers of fine gravel to ½" size and medium to coarse sand, stratified.				
2							
2.9							
3.1			- trace coarse gravel to 2" size.				
3							
4.0 ▽			saturated at 4.0'				
4			Bottom of Pit				No sample taken.
5							

DATE: Sept. 26, 1976	LOGGED BY: GCD	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y13-C

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
0	GW		GRAVEL - well graded to 2" size, some medium to coarse sand, occasional cobbles, stratified, subrounded, medium brown, clean.		UF		Moisture Content: 9.0% Lightweight Pieces - Fine Aggregate: 0.05%
4.5			Bottom of Pit				Sample from 0'-4.5'

DATE: Sept. 19, 1976 | LOGGED BY: JDF | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y13-D

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	GW		GRAVEL - well graded, some medium to coarse sand, occasional cobble, medium brown, wet.		UF		
2							
3							
4		4.0	frozen at 4.0'			4.0	
			Bottom of Pit				No sample taken.
5							

DATE: Sept. 17, 1976	LOGGED BY: JDF	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y13-E

SHEET 1 OF 1

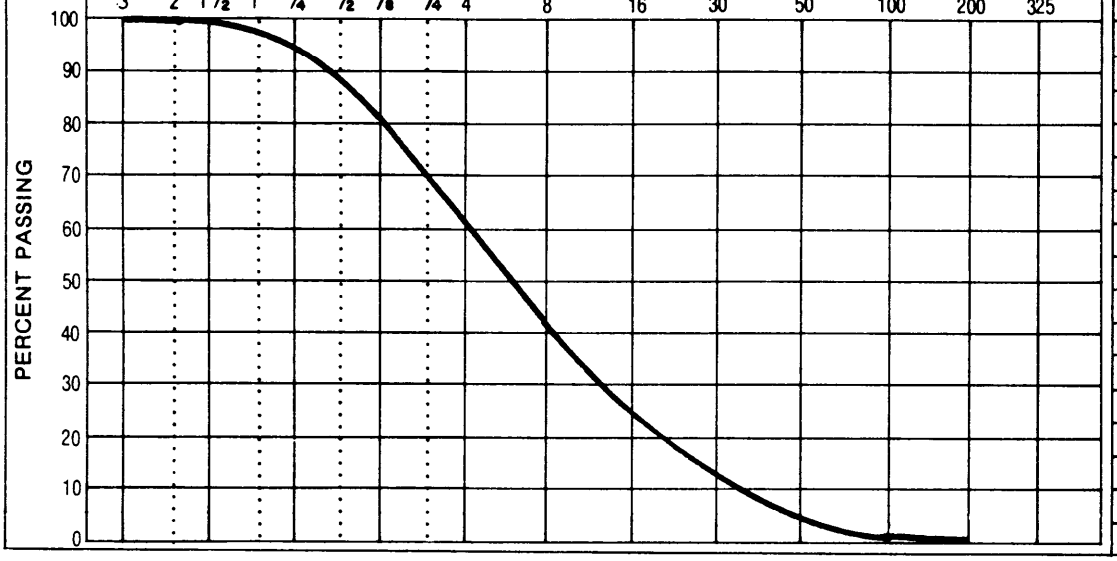
GRAIN SIZE ANALYSIS

SAMPLE Y13-A DEPTH 0'-5.3'

DATE SAMPLED Sept. 26, 1976 SAMPLED BY GCD

LAB TEST NUMBER 36HA-A

GRAVEL SIZES		SAND SIZES			FINES
4.8 %	36.4 %	21.8%	29.0 %	7.7 %	0.3 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
1½"	0

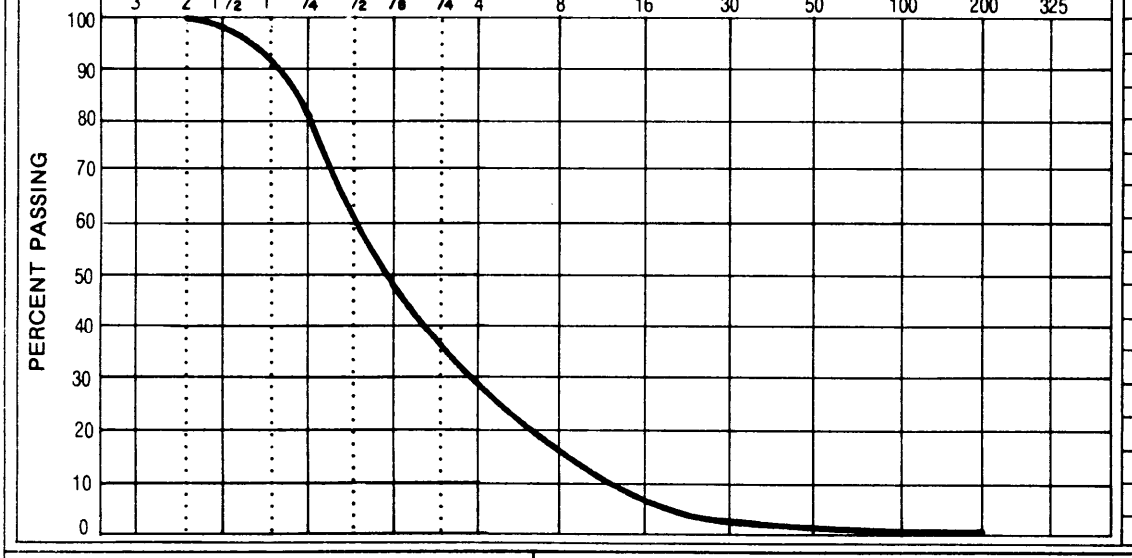
SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	100.0
1 1/2"	100.0
1"	97.9
3/4"	95.2
1/2"	88.4
3/8"	81.3
1/4"	
No. 4	58.8
No. 8	43.4
No. 16	24.6
No. 30	11.3
No. 50	3.9
No. 100	0.6
No. 200	0.3

SAMPLE Y13-D DEPTH 0'-4.5'

DATE SAMPLED Sept. 19, 1976 SAMPLED BY JDF

LAB TEST NUMBER TP37

GRAVEL SIZES		SAND SIZES			FINES
18.6 %	52.2 %	16.0%	12.2 %	0.8 %	0.2 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
2"	0

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	100.0
1 1/2"	97.7
1"	92.1
3/4"	81.4
1/2"	60.4
3/8"	47.3
1/4"	
No. 4	29.2
No. 8	17.4
No. 16	5.8
No. 30	1.4
No. 50	0.5
No. 100	0.3
No. 200	0.2

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No. Y13

DEPOSIT Y14

Setting: Large, inactive alluvial-fan of the Malcolm River.

Material: Gravel; well graded, fine to coarse, some sand.

Volume: 1,200,000,000 cubic yards total.

Assessment: Consists of good to excellent quality granular material. Permafrost and ground water will limit extraction depths especially on the lower part of the fan. Abandoned pits will generally result in small pools. Access is excellent.
Recoverable volume may be limited to 100,000,000 cubic yards.

Airphoto No.: A22881-117, 119, 162, 163
Approx. Scale: 1"=8500'
Deposit Outline - R.M. Hardy
Test Pit
Deposit Outline - Others
Exposures

DEPOSIT Y14

SETTING

Deposit Y14 is part of a large alluvial-fan that has been deposited by the Malcolm River, which occupies a broad channel along the eastern edge of the fan. The fan slopes gently from its apex in the Buckland Hills to its base at a small lagoon adjoining the Beaufort Sea. Bars and channel traces give its surface a braided pattern with local relief of 3 to 5 feet. Parts of the lower fan are characterized by periglacial features such as sorted circles, small hummocks, and ice-wedge trenches. This deposit has been designated as N117D-B1 in a previous investigation by Northern Engineering Services Co. Ltd.

The deposit is relatively free of overburden except in some channel traces and broad flat areas where peat, in excess of 2 feet, may be present. Except for some channel traces and lower areas which are marshy, the surface drainage is good. Water may seasonally accumulate in pools on exposed gravel areas on the lower part of the fan.

Deposit Y14 is bordered by the active floodplain of the Malcolm River and adjacent parts of the alluvial-fan having thicker overburden. The base of the fan merges into a lagoon separated from the Beaufort Sea by a spit.

On the better drained parts of the alluvial-fan the active layer is 4 to 5 feet thick. These areas are covered by broken tundra consisting mainly of Dryas, lichen, moss, and dwarf shrubs. Poorly drained areas are covered by sedge tundra.

This deposit and adjacent terrain are used by snow geese as a staging area and provides habitat for Arctic fox and grizzly bear.

MATERIAL

Deposit Y14 contains good to excellent quality granular material consisting of stratified, well graded, fine to coarse gravel with some sand and occasional cobbles. Upper strata contain silt lenses. Larger clasts are mainly sandstone, quartzite, argillite with rare limestone and chert.

VOLUME

The total volume of 1,200,000,000 cubic yards is based on a conservative depth of 45 feet. Fluvial deposits are known to be more than 60 feet deep on this part of the coastal plain.

Annually, 5,800 cubic yards per acre could be extracted by conventional techniques assuming that permafrost and ground water would limit yearly extraction to a conservative thickness of 4 feet. It is considered that 100,000,000 cubic yards of granular material are recoverable above the ground water table.

DEVELOPMENT

Excavation will be hampered by shallow active layers and perched ground water, especially on the lower part of the fan. Scarifying and stripping operations will have to be scheduled to enhance the melting of the permafrost. The extracted materials will be damp and require draining. Onsite drainage controls will be required for pits excavated to any depth in this deposit. Moderately deep pits will result in small ponds on the surface of the alluvial-fan. Access to Deposit Y14 is good from all directions.

Development of Deposit Y14 should be planned to minimize interference with the staging activities of waterfowl. This deposit lies within the proposed Arctic Wildlife Range and the Firth River IBP Reserve, which may restrict development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
	Pt		02 PEAT		UF		Lightweight Pieces - Fine Aggregate: 0.14%
1	GM		GRAVEL - well graded, little fine to medium sand, little silty fines, rootlets, damp, sandstones. 15				
2	GW		GRAVEL - well graded, some fine to coarse sand, trace silty fines, rounded, medium brown.				
3			33 — — - becoming cleaner, grey, wet.				
4			40 ▽ saturated at 4.0'			40	
			Bottom of Pit				Sample from 1.5'-4.0'
5							

DATE: Sept. 22, 1976 | LOGGED BY: JDF | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y14-A

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
	Pt		PEAT		UF		Organic Color: #3 Moisture Content: 2.1%
0.7							
1	GM		GRAVEL - well graded, some fine to coarse sand, little fines, occasional cobble, trace organics, dry.				Lightweight Pieces - Fine Aggregate: 0.06%
2							
2.0							
	GW		GRAVEL - well graded to 5" cobbles, some fine to coarse sand, subangular to subrounded, medium brown, damp, clean.				
3							
4			- becoming wetter with depth.				
5							
5.0			Bottom of Pit				Sample from 2.0'-5.0'
6							

DATE: Sept. 26, 1976	LOGGED BY: JDF	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

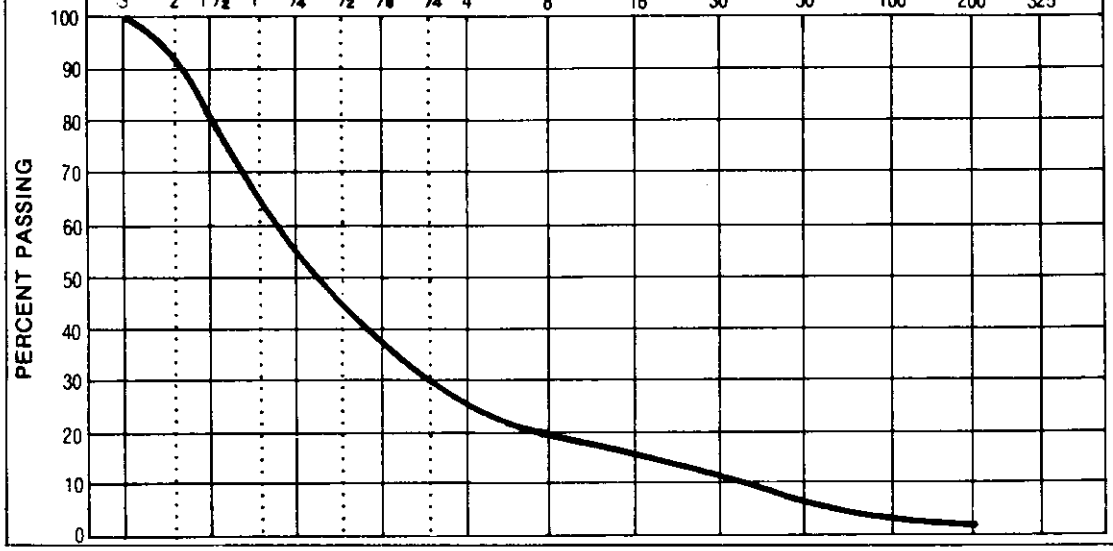
TEST PIT NO. Y14-B

SHEET 1 OF 1

GRAIN SIZE ANALYSIS

SAMPLE Y14-A DEPTH 1.5'-4.0'
DATE SAMPLED Sept. 22, 1976 SAMPLED BY JDF
LAB TEST NUMBER TP38

GRAVEL SIZES		SAND SIZES			FINES
43.4 %	32.7 %	4.9 %	9.5 %	7.2 %	2.3 %
COARSE	FINE	COARSE	MEDIUM	FINE	

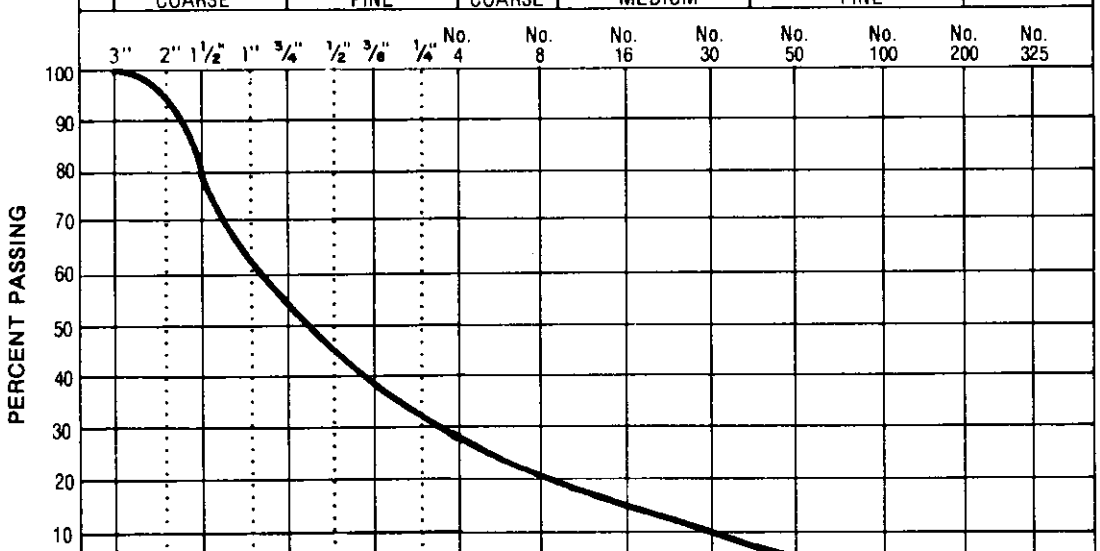


MAX. SIZE	% > 3"
4"	4.7

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	93.8
1 1/2"	80.6
1"	66.5
3/4"	56.6
1/2"	45.3
3/8"	36.9
1/4"	
No. 4	23.9
No. 8	19.7
No. 16	16.0
No. 30	12.1
No. 50	7.2
No. 100	3.6
No. 200	2.3

SAMPLE Y14-B DEPTH 2.0'-5.0'
DATE SAMPLED Sept. 26, 1976 SAMPLED BY JDF
LAB TEST NUMBER TP44

GRAVEL SIZES		SAND SIZES			FINES
45.9 %	25.9 %	8.7 %	12.5 %	6.2 %	0.8 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
5"	10.0

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	94.8
1 1/2"	77.8
1"	63.3
3/4"	54.1
1/2"	43.9
3/8"	37.9
1/4"	
No. 4	28.2
No. 8	18.1
No. 16	13.8
No. 30	9.6
No. 50	4.2
No. 100	1.4
No. 200	0.8

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No.
Y14

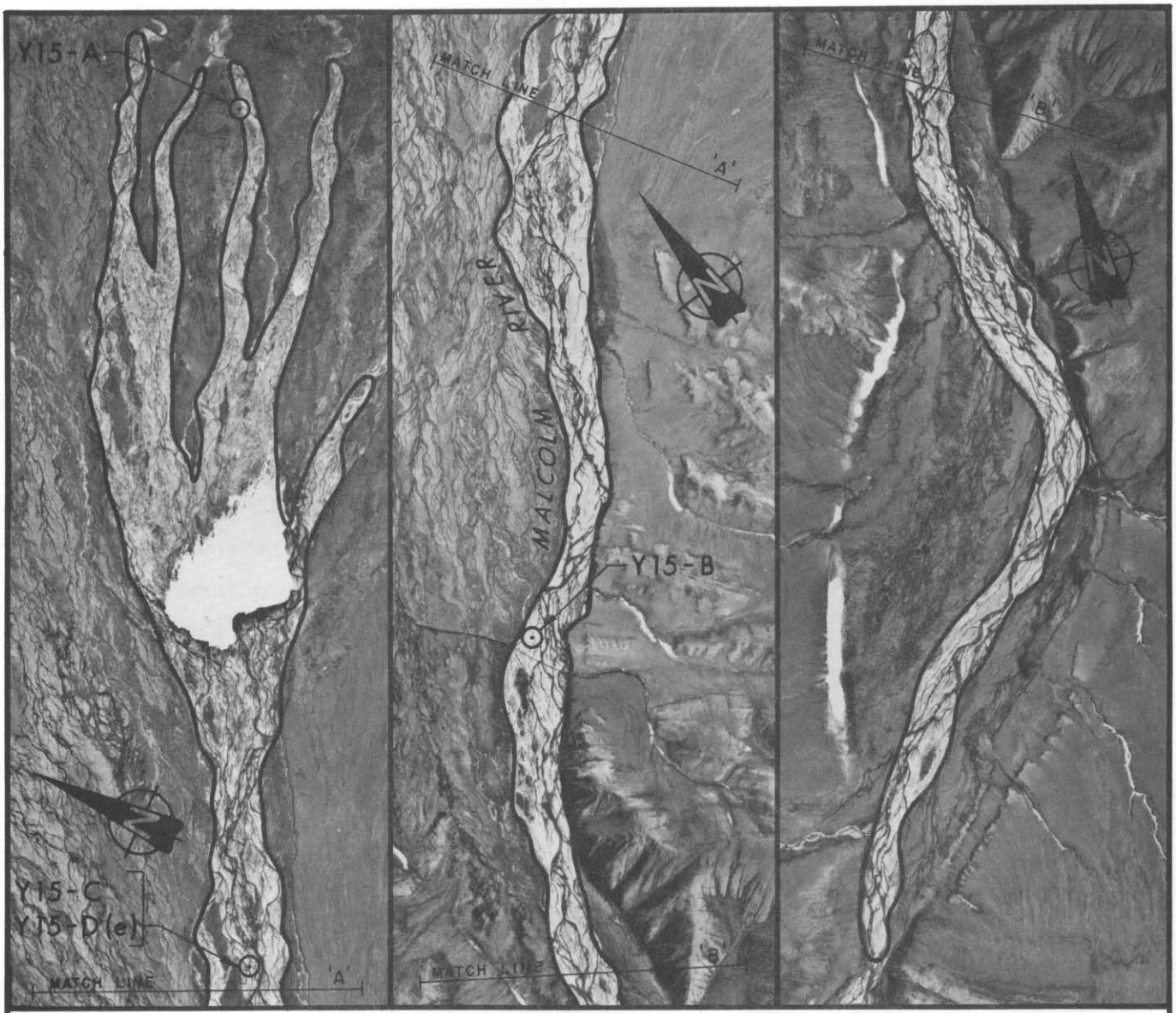
DEPOSIT Y15

Setting: Active floodplain of the Malcolm River.

Material: Gravel; fine to coarse, little fine to coarse sand.

Volume: 280,000,000 cubic yards total.

Assessment: Contains good to excellent quality granular material with a moderate amount of oversize particles. Extraction depths will be limited by ground water levels. Fluvial processes will slowly restore the developed floodplain areas to their natural state. Access is good. Recoverable volume may be limited to 9,000,000 cubic yards.



Airphoto No.: A22881-119, 120, 161, 162		Approx. Scale:	1"=4900'
Deposit Outline - R.M. Hardy	———	Test Pit	⊙
Deposit Outline - Others	—·—·—	Exposures	✣

DEPOSIT Y15

SETTING

Deposit Y15 consists of the braided bar and channel bed complex of the Malcolm River active floodplain. This floodplain averages 1,500 feet across near the mountain front, but widens slightly and finally fans out into a number of distributaries near the coast.

The deposit is free of overburden and is well drained. One half of the deposit stands 4 feet above late fall water levels along the upper reaches of the deposit, whereas only one third of the deposit is 3 feet above late fall water levels along the lower reaches. Local relief of 2 feet is common on the deposit surface because of scour holes and channel traces. Thickness of the active layer is estimated to be 4 to 6 feet.

A perennial aufeis field is located just upstream from the distributaries and fish may overwinter there because of open water. The Malcolm River is used by fish for migration, spawning and feeding.

Sparse vegetation covers less than 15 percent of the surface of the deposit. Scattered driftwood is present.

This deposit is bordered by a gently sloping, well-drained alluvial-fan on its western edge and by moderate to steep bedrock slopes, ice-rich colluvial slopes, and a gently sloping peat-covered terrace on its eastern edge. Steep sloping terrain provides excellent grizzly bear habitat, whereas gently sloping terrain is used as staging areas for waterfowl in the fall.

MATERIAL

Deposit Y15 contains good to excellent quality granular material consisting of well graded, fine to coarse gravel with sand. Toward the

mountain front the gravel is coarser with many boulders to 10 inches in size. Larger clasts are mainly subangular to subrounded sandstone and quartzite with rare limestone and chert. Argillite fragments are common in the fines.

VOLUME

The total volume of 280,000,000 cubic yards is based on a conservative depth of 45 feet. Fluvial deposits on this part of the coastal plain are generally underlain by more than 60 feet of gravel.

Annually, 100,000 cubic yards per 1000 feet length of floodplain could be extracted by conventional techniques assuming that static ground water levels limit the recoverable granular material to an average depth of 2½ feet. Approximately 9,000,000 cubic yards of granular material may be recovered above the static ground water table.

DEVELOPMENT

Extraction of material at Deposit Y15 would probably be confined to winter and fall when water levels are low. Large areas will have to be harvested for small volumes of material because of shallow ground water levels unless special drainage controls are established. Adequate areas for stockpiling are available.

The developed pit areas will be restored by natural fluvial processes as streams of the coastal plain are known to carry significant amounts of coarse sediment.

Access to the deposit is easily attained from all directions along the stream channel itself or the adjacent alluvial fan. Access to the southeast is impeded by steep slopes and thermokarst-susceptible terrain.

Development of Deposit Y15 should be planned to minimize interference of critical fish activities. This deposit lies within a proposed Arctic Wildlife Range and the Firth River IBP Reserve, which may restrict development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1 2 3 4	GW	45	GRAVEL - well graded, some fine to coarse sand, occasional cobble, rootlets, subangular, medium brown, damp.		UF		Lightweight Pieces - Fine Aggregate: 0.21%
5			Bottom of Pit				Sample from 0'-4.5'

DATE: Sept. 19, 1976	LOGGED BY: JDF	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y15-A

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	GW		GRAVEL - well graded to 6" cobbles, little fine to coarse sand, sub-angular, medium brown, damp, sandstones, cherts, shale, clean.		UF		Lightweight Pieces - Fine Aggregate: 0.12%
2							
3							
4							
5			5.4 ▽ free water at 5.4'.			5.4	
6			Bottom of Pit				Sample from 0'-5.4'

DATE: Sept. 25, 1976	LOGGED BY: JDF	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y15-B
SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	GW		GRAVEL - well graded to 8" cobbles, little fine to coarse sand, sandstones, cherts.		UF		Lightweight Pieces - Fine Aggregate: 0.12%
2							
3			3.4 ▽ saturated at 3.4'			3.4	
4			Bottom of Pit				Sample from 0'-3.4'

DATE: Sept. 19, 1976. | LOGGED BY: GCD | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y15-C

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
0	GW		GRAVEL - well graded to 10" boulders, little medium to coarse sand, subangular to rounded, sandstones, cherts.		UF		
4.0			Bottom of Pit				No sample taken.

DATE: Sept. 19, 1976 | LOGGED BY: GCD | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

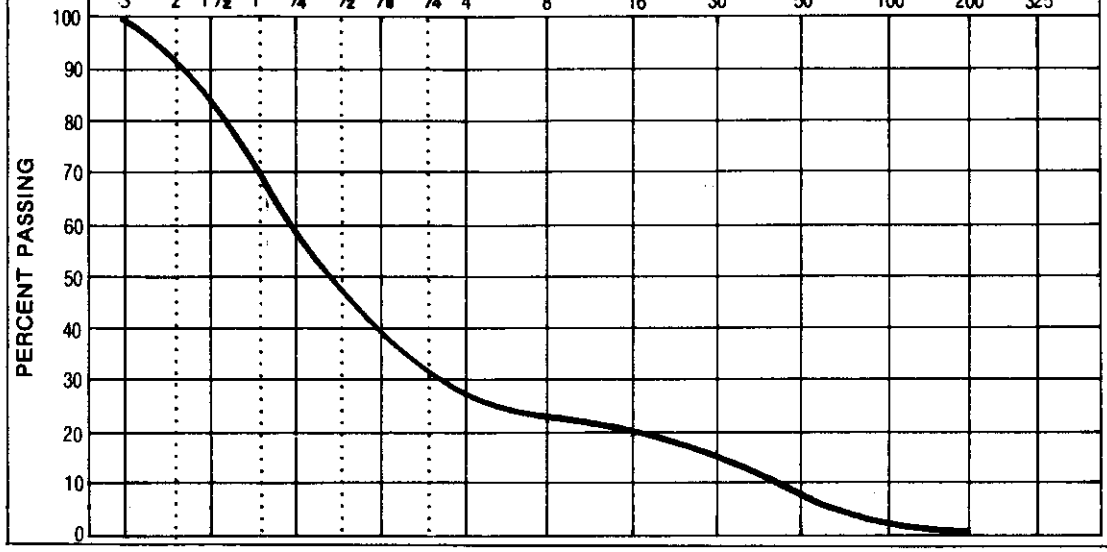
TEST PIT NO. Y15-D(e)

SHEET 1 OF 1

GRAIN SIZE ANALYSIS

SAMPLE Y15-A DEPTH 0'-4.5'
DATE SAMPLED Sept. 19, 1976 SAMPLED BY JDF
LAB TEST NUMBER TP35

GRAVEL SIZES		SAND SIZES			FINES
42.0 %	30.4 %	5.1 %	10.5 %	11.2 %	0.8 %
COARSE	FINE	COARSE	MEDIUM	FINE	

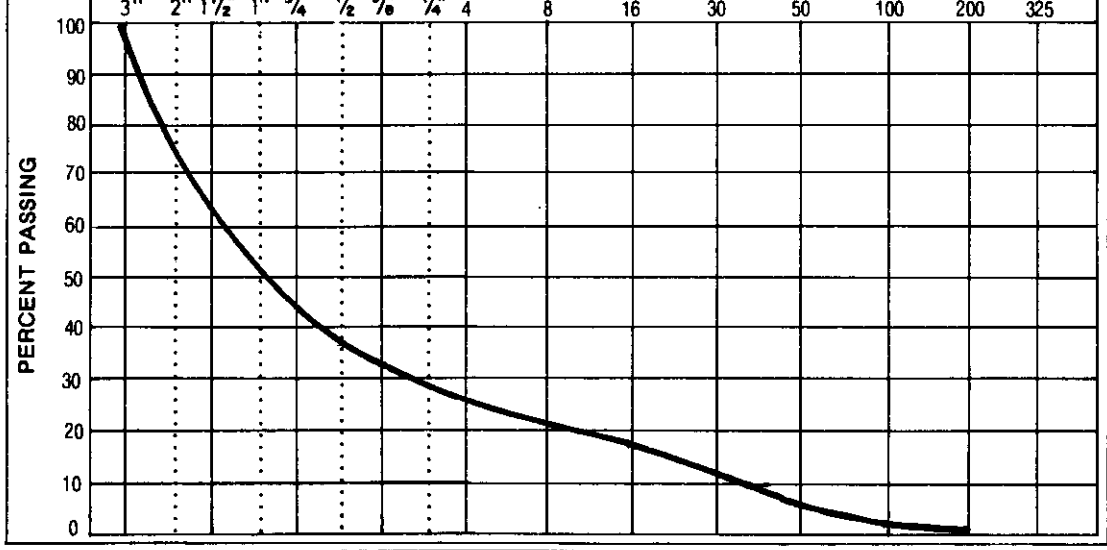


MAX. SIZE	% > 3"
4"	1.9

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	92.3
1 1/2"	82.8
1"	67.7
3/4"	58.0
1/2"	45.5
3/8"	38.2
1/4"	
No. 4	27.6
No. 8	22.7
No. 16	19.9
No. 30	16.0
No. 50	7.1
No. 100	1.9
No. 200	0.8

SAMPLE Y15-B DEPTH 0'-5.4'
DATE SAMPLED Sept. 25, 1976 SAMPLED BY JDF
LAB TEST NUMBER TP43

GRAVEL SIZES		SAND SIZES			FINES
56.9 %	17.8 %	4.6 %	12.2 %	7.8 %	0.7 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
6"	23.1

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	76.6
1 1/2"	63.1
1"	49.1
3/4"	43.1
1/2"	36.9
3/8"	32.5
1/4"	
No. 4	25.3
No. 8	21.3
No. 16	17.7
No. 30	12.5
No. 50	5.5
No. 100	1.6
No. 200	0.7

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

DEPOSIT No. Y15

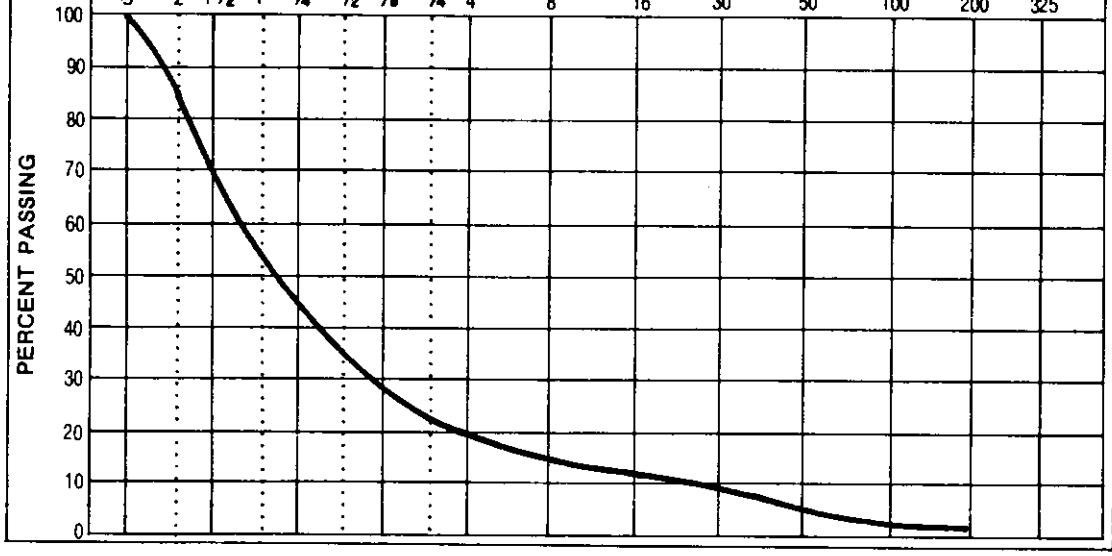
GRAIN SIZE ANALYSIS

SAMPLE Y15-C DEPTH 0'-3.4'

DATE SAMPLED Sept. 19, 1976 SAMPLED BY GCD

LAB TEST NUMBER: TP45HA

GRAVEL SIZES		SAND SIZES			FINES
55.6 %	25.1 %	5.8 %	6.0 %	6.2 %	1.3 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
5"	16.1

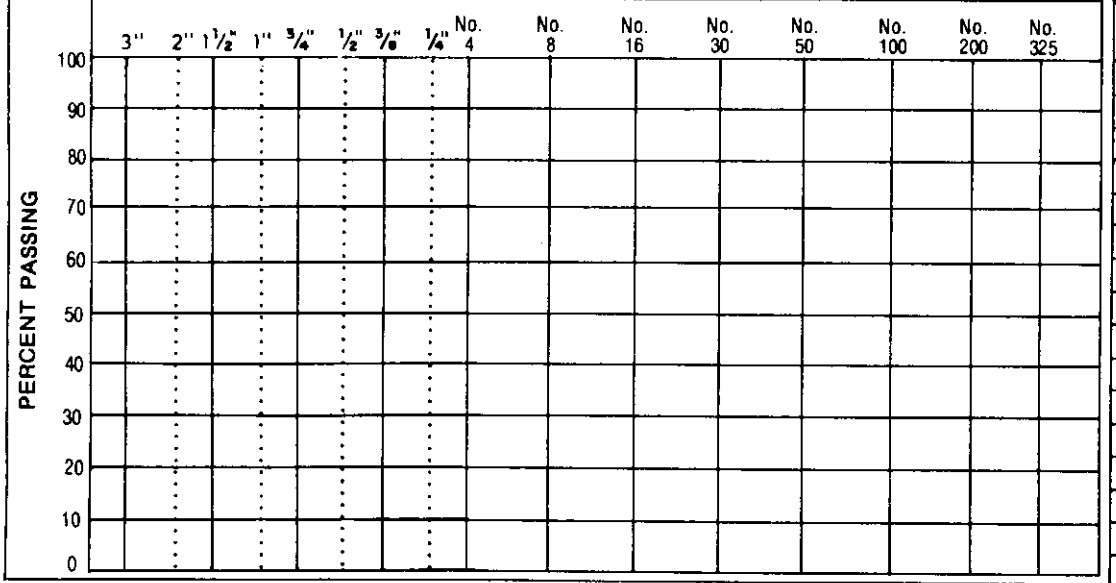
SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	85.0
1 1/2"	69.9
1"	53.8
3/4"	44.4
1/2"	34.6
3/8"	28.2
1/4"	
No. 4	19.3
No. 8	14.3
No. 16	11.6
No. 30	8.9
No. 50	4.8
No. 100	2.2
No. 200	1.3

SAMPLE _____ DEPTH _____

DATE SAMPLED _____ SAMPLED BY _____

LAB TEST NUMBER

GRAVEL SIZES		SAND SIZES			FINES
%	%	%	%	%	%
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"

SIEVE SIZE	PERCENT PASSING
3"	
2"	
1 1/2"	
1"	
3/4"	
1/2"	
3/8"	
1/4"	
No. 4	
No. 8	
No. 16	
No. 30	
No. 50	
No. 100	
No. 200	

GOVERNMENT OF CANADA

DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.

CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

DEPOSIT No.

Y15

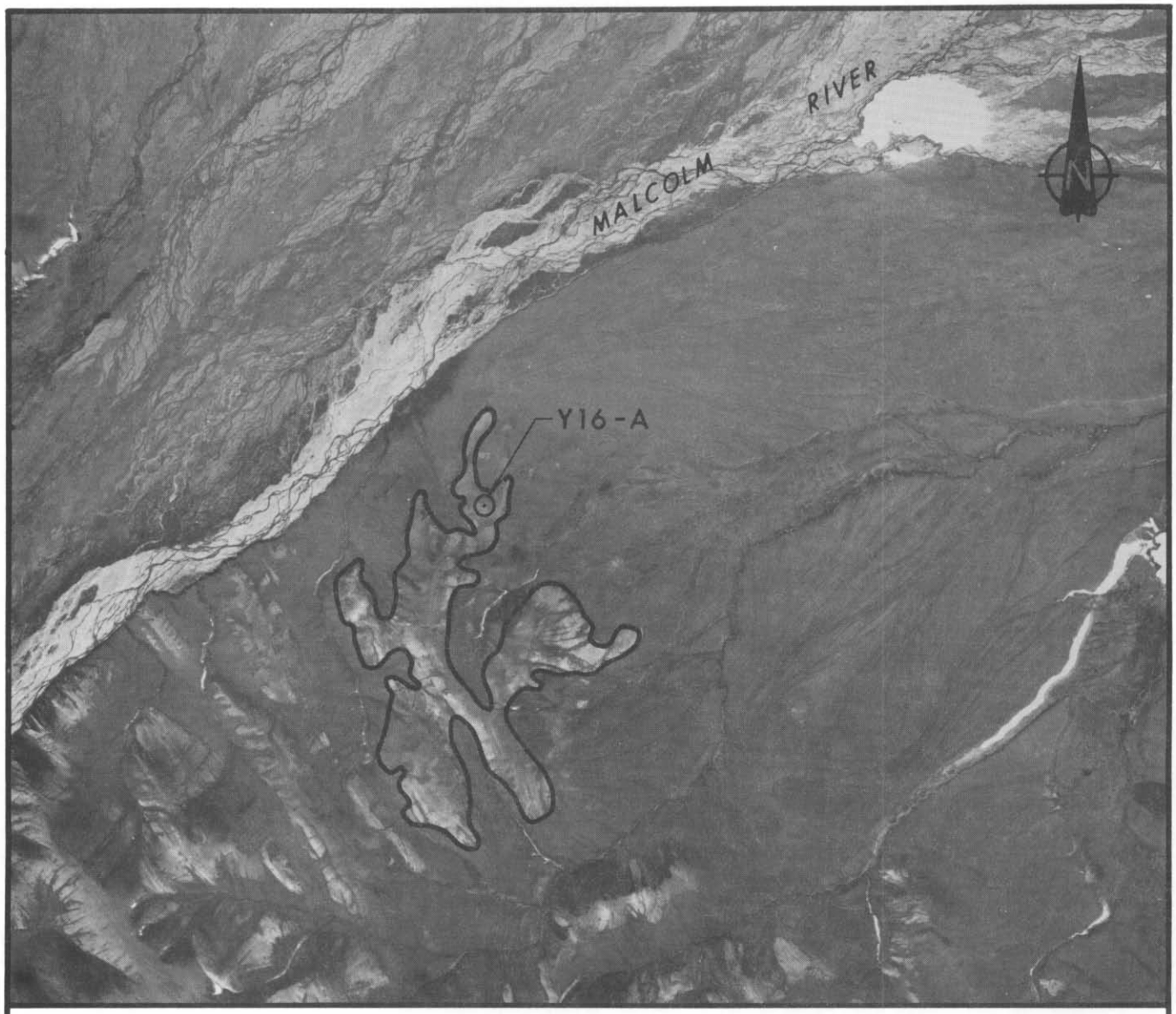
DEPOSIT Y16

Setting: Scree-covered hills and ridges. Located one mile southwest of the Malcolm River and about 8 miles upstream of its mouth.

Material: Argillite and chert rubble.

Volume: 7,200,000 cubic yards total.

Assessment: Contains poor quality granular material. Access to the deposit is fair.



Airphoto No.: A24123-209		Approx. Scale:	1"=4900'
Deposit Outline - R.M. Hardy	———	Test Pit	⊙
Deposit Outline - Others	—·—·—	Exposures	✠

DEPOSIT Y16

SETTING

Deposit Y16 consists of scree-covered hills and ridges at the edge of the Buckland Hills. Located one mile southwest of Malcolm River and about 8 miles upstream of its mouth.

The higher ridge crests at an elevation of 1000 feet rise about 800 feet above the level of the Malcolm River. The majority of the slopes are gentle to moderate and the surface of the deposit is covered by broken upland tundra consisting mainly of Dryas, grasses, and low ericaceous schrubs.

Rock underlying the scree at this deposit are argillites containing thin chert beds of the Precambrian Neruokpuk Formation. Other hills in the immediate region are of the same composition, although locally quartzite may be present.

Deposit Y16 is flanked by higher hills to the southwest. Gently sloping pediment slopes mantled with high ice content silts lie to the northeast. Directly to the north lies the well drained, gently sloping alluvial-fan of the Malcolm River.

The area provides habitat for caribou, Arctic fox, and grizzly bear; and is used for staging by waterfowl.

MATERIAL

Deposit Y16 contains poor quality granular materials consisting of small cubes and plates of argillite and angular fragments of chert averaging 1 inch in size. Local bands of chert are present. The deposit grades to competent rocks at depths of 2 to 5 feet.

VOLUME

A total volume of 7,200,000 cubic yards is based on a depth of 5½ feet to competent rock. This volume could be increased if the underlying rock was ripped or quarried.

Annually, 8,000 cubic yards per acre could be extracted by conventional techniques if only fragmented rock debris was removed.

DEVELOPMENT

Development of this deposit will involve simple scraping and stripping operations unless the underlying rock is quarried. Removal of large volumes will significantly modify the aesthetics of the area, although most hillsides are only locally visible.

Access to the coast would involve crossing adjacent moderate slopes which are mantled by silts with high ice contents. The well-drained alluvial-fan offers good access to the coast.

Development should be planned to minimize intereference with caribou calving. Deposit Y16 lies within the proposed Arctic Wildlife Preserve and Firth River IBP Reserve, which may restrict development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
	OL		SILT - and fractured shale and argillite, organic. 0.6		UF		
1	BR		ARGILLITE - light brown, green, fractured, platy.				
2							
3			3.0 becoming blocky with fracture planes dipping at 10° to horizontal.				
4							
5			5.4 massive at 5.4'.		Vx <5%	5.3	
6			Bottom of Pit				Sample from 4.5'-5.4'

DATE: Sept. 25, 1976 | LOGGED BY: GCD | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y16-A

SHEET 1 OF 1

SUMMARY OF PETROGRAPHIC DATA FOR ROCK SAMPLES

PETROGRAPHIC ANALYSIS

PARTICLE TYPE	PERCENT
Individual mineral components are too fine for identification, but are mainly muscovite and biotite with quartz and feldspar.	

ROCK NAME: Argillite

GRAIN SIZE: Extremely fine-grained, maximum crystal size 0.07 mm.

GRAIN SHAPE: -

MATRIX AND CEMENT: Fine fractures are filled with siliceous cement.

POROSITY AND PACKING: Non-porous; dense.

COMMENTS: Microcrystalline and distinctly foliated; tends to blocky fracturing and jointing.

NOTE: PETROGRAPHIC ANALYSIS BY DOLMAGE CAMPBELL & ASSOCIATES (1975) LTD.

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO.
Y16-A

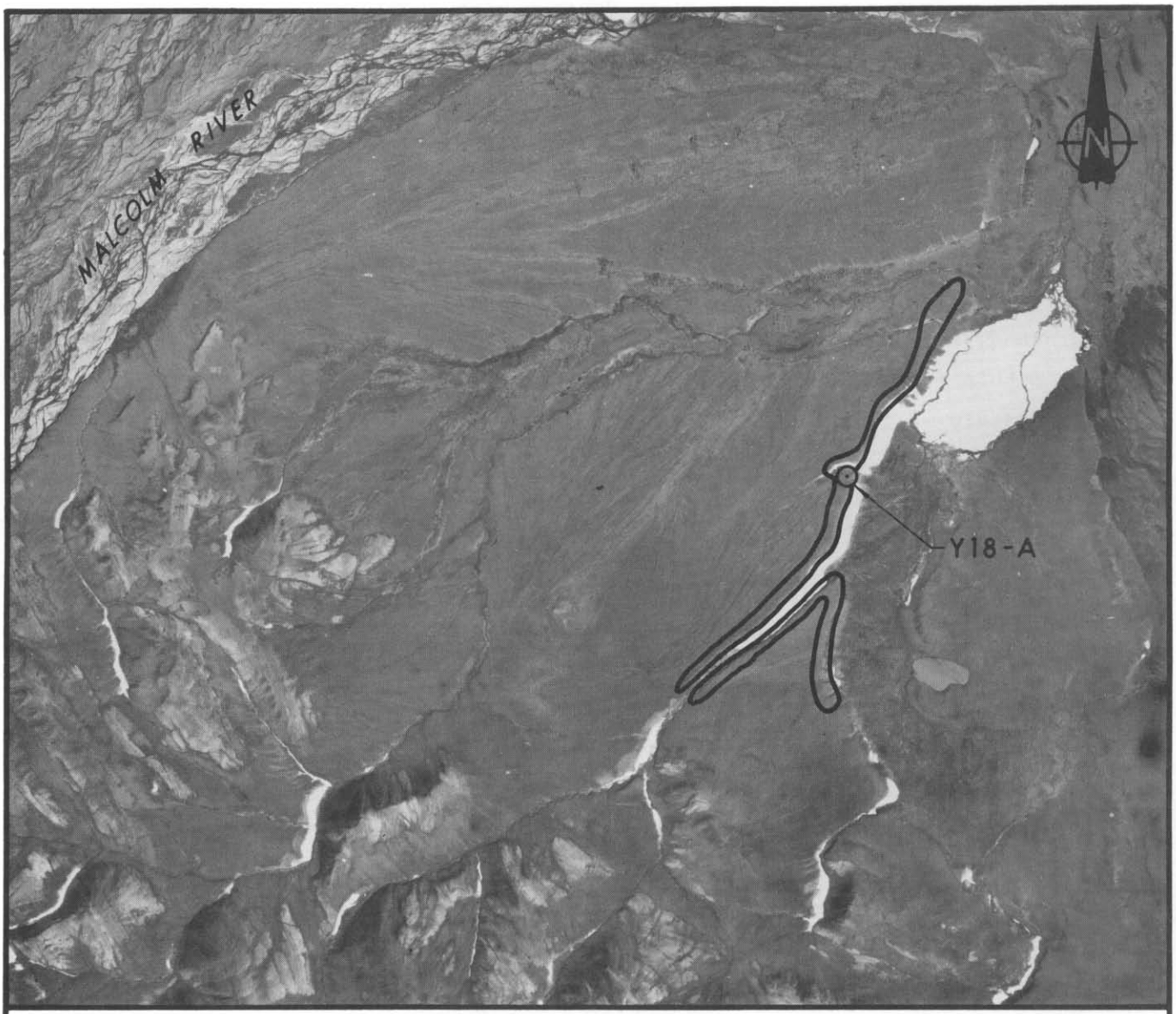
DEPOSIT Y18

Setting: Exhumed pediment surface and its gravel cover. Located 5 miles from the Beaufort Sea on the coastal plain midway between the Malcolm and Firth Rivers.

Material: Gravel; well to poorly graded, little sand.

Volume: 3,300,000 cubic yards total.

Assessment: Contains fair to good quality granular material. Extraction will be initiated along the edge of the deposit. Access is good.



Airphoto No.: A22881-161		Approx. Scale:	1"=4800'
Deposit Outline - R.M. Hardy	———	Test Pit	⊙
Deposit Outline - Others	—·—·—	Exposures	✣

DEPOSIT Y18

SETTING

Deposit Y18 consists of an exhumed pediment surface and its gravel cover, located 5 miles inland from the Beaufort Sea on the coastal plain approximately midway between the Malcolm and Firth Rivers. The pediment surface slopes gently northward from the Buckland Hills toward the Beaufort Sea. The overlying gravel is exposed only near stream-eroded scarps; away from these scarps the gravel is covered by thick ice-rich organic silt.

At Deposit Y18, a 30 to 70 foot high scarp separates the gravel-capped pediment from the base of a broad poorly drained meltwater channel presently occupied by a small creek. Nivation hollows along the scarp are indicative of snow drifts persisting into the summer. The outer edge of the pediment surface slopes up to the silt-covered main pediment surface over a distance of one to two hundred feet.

Near the scarp, the surface is free of overburden, well drained, and shows bare gravel with patches of Dryas and grasses. Away from this fringe, the overburden slowly thickens and the surface is only moderately well drained and covered by sedge tussock tundra. On areas without overburden, the active layer is about 6½ feet thick, but thins to 1 to 2 feet where the overburden thickens.

This area is within a major staging and feeding ground for waterfowl, and provides habitat for grizzly bear, Arctic fox, and caribou.

Deposit Y18 is bordered on the east by a large meltwater channel containing a major aufeis field, beyond which lies the Firth River alluvial fan. The deposit is bordered by an alluvial-fan surface and the Malcolm River floodplain to the west and north.

MATERIAL

Deposit Y18 contains fair to good quality granular material consisting of well to poorly graded, fine to coarse gravel with little sand. Upper strata are silty. Larger clasts are mainly angular to subrounded quartzite, sandstone, and argillite with some chert and rare quartz.

VOLUME

The total volume of 3,300,000 cubic yards is based on a depth of 20 feet. There is no sign of bedrock along the escarpment and the gravel may possibly be as thick as the total height of the escarpment.

Annually, 25,000 cubic yards could be extracted by conventional techniques per 1000 foot length parallel to the scarp. This assumes that the gravel will be well drained and easy to thaw throughout its thickness along the scarp.

DEVELOPMENT

Excavation of Deposit Y18 may be initiated as a series of benches along the scarp where drainage is good and materials should thaw easily. Upon exhausting the more easily extractable material, further excavation would require removal of significant overburden and may only be feasible where material is required over a long term. The developed benches should blend aesthetically into the surrounding terrain upon abandonment.

Good access to this deposit is available across the pediment and fluvial systems of the Firth or Malcolm Rivers.

Development of Deposit Y18 should be planned to minimize interference with waterfowl staging and caribou calving. This deposit lies within the proposed Arctic Wildlife Range and Firth River IBP Reserve, which may restrict development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
0	GW		GRAVEL - well graded to 3" size, some fine to coarse sand, trace silty fines, angular to sub-angular, shales, sandstones, decreasing fines content with depth.		UF		Lightweight Pieces - Fine Aggregate: 0.11%
3	GP	3.0	GRAVEL - fine to 3/4" size, some medium to coarse sand, little coarse gravel, flat shale pieces.				
6		6.3	frozen at 6.3'.				
7			Bottom of Pit				Sample from 0'-6.3'

DATE: Sept. 22, 1976 | LOGGED BY: GCD | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y18-A
SHEET 1 OF 1

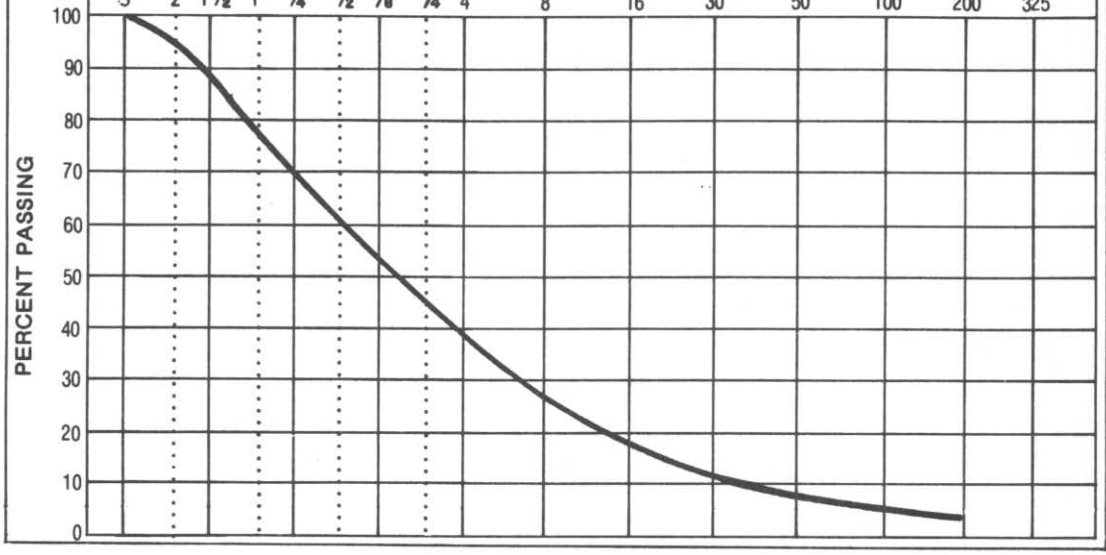
GRAIN SIZE ANALYSIS

SAMPLE Y18-A DEPTH 0'-6.3'

DATE SAMPLED Sept. 22, 1976 SAMPLED BY GCD

LAB TEST NUMBER 47HA

GRAVEL SIZES		SAND SIZES			FINES
31.3 %	32.0 %	9.7 %	17.0 %	5.7 %	4.3 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
3"	0

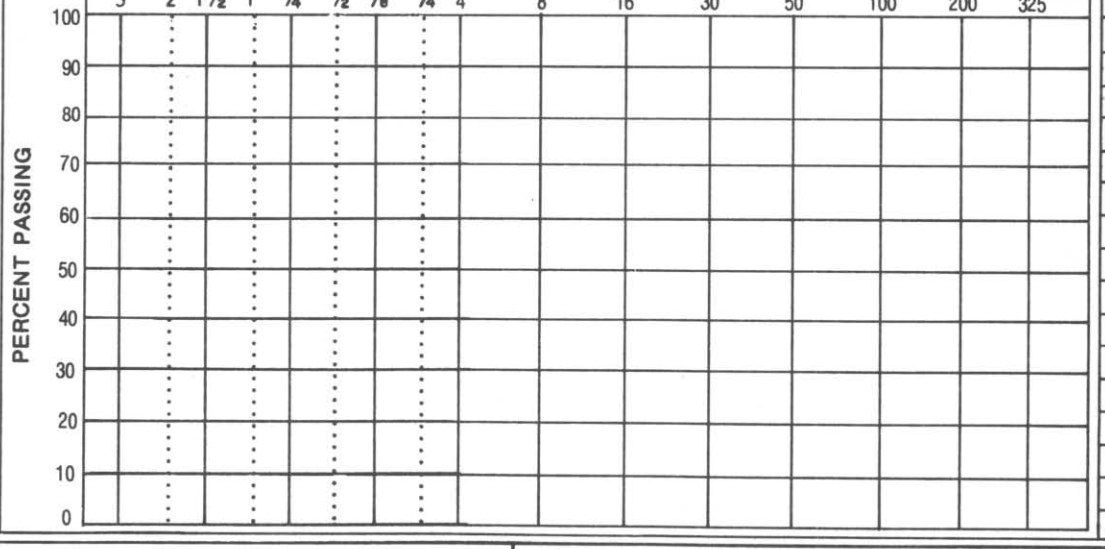
SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	92.6
1 1/2"	88.9
1"	76.9
3/4"	68.7
1/2"	58.1
3/8"	51.0
1/4"	
No. 4	36.7
No. 8	28.6
No. 16	19.1
No. 30	11.8
No. 50	7.4
No. 100	5.3
No. 200	4.3

SAMPLE _____ DEPTH _____

DATE SAMPLED _____ SAMPLED BY _____

LAB TEST NUMBER

GRAVEL SIZES		SAND SIZES			FINES
%	%	%	%	%	%
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"

SIEVE SIZE	PERCENT PASSING
3"	
2"	
1 1/2"	
1"	
3/4"	
1/2"	
3/8"	
1/4"	
No. 4	
No. 8	
No. 16	
No. 30	
No. 50	
No. 100	
No. 200	

GOVERNMENT OF CANADA

DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.

CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No. Y18

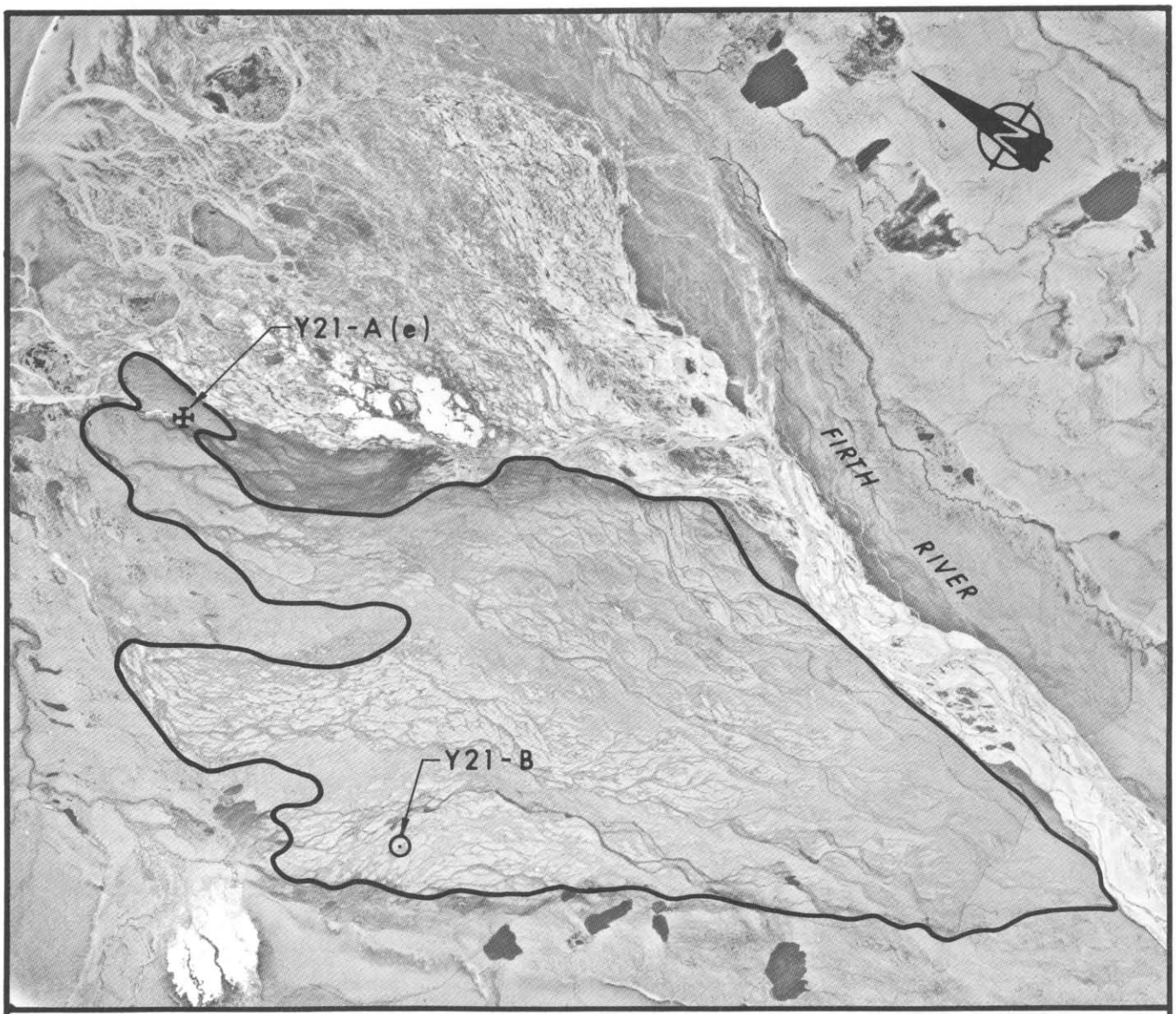
DEPOSIT Y21

Setting: Inactive alluvial-fan of the Firth River.

Material: Gravel; well graded, fine to coarse, some sand.

Volume: 500,000,000 cubic yards total.

Assessment: Consists of good to excellent quality granular material. Permafrost and ground water will limit extraction depths by conventional techniques. Abandoned pits will form small ponds. Access is good. Recoverable volume may be limited to 50,000,000 cubic yards.



Airphoto No.: A13751-113/114 — Approx. Scale: 1"=5800'

Deposit Outline - R.M. Hardy ——— Test Pit ⊙

Deposit Outline - Others —·—·— Exposures ✢

DEPOSIT Y21

SETTING

Deposit Y21 comprises part of a large alluvial-fan that has been deposited by the Firth River. The active floodplain bisects the deposit; the larger part lies west of the Firth River. The fan slopes gently from its apex at the edge of the Buckland Hills to its base within a mile of the Beaufort Sea. Bars and channel traces give the fan surface a braided pattern and shallow ice-wedge trenches outline broad polygons in excess of 150 feet in diameter.

The deposit is generally free of overburden, except in a few channel traces that may contain thin silty sand and peat strata.

Surface drainage is good except for some channel traces that are marshy. Also, ground water seepage across the fan flows into small rills having bare gravel bottoms near the base of the fan.

On better drained parts of the deposit, the active layer is 4 to 5 feet thick. Poorer drained parts with thicker vegetation cover will have shallower active layers.

The better drained parts of the fan are covered by broken tundra with Dryas, numerous dwarf shrubs, sedges, and lichen. Poorer drained areas are covered by sedge meadows. This deposit and adjacent terrain are a staging area for waterfowl, a calving ground for caribou, and provides adequate habitat for grizzly bear and Arctic fox.

Deposit Y21 is bordered by a marshy peat-covered alluvial fan to the northwest and by ice-rich morainal deposits to the east and west.

MATERIAL

Deposit Y21 contains good to excellent quality granular material consisting of stratified, well graded, fine to coarse gravel

with some sand. Few cobbles to 4 inches were noted. Larger clasts are mainly quartzite and sandstone with rare limestone and chert. Argillite forms a major part of the fines.

VOLUME

The total volume of 500,000,000 cubic yards is based on a conservative depth of 45 feet. Fluvial deposits on this part of the coastal plain generally exceed 60 feet in depth.

Annually, 6,000 cubic yards per acre would be extracted by conventional techniques assuming that permafrost and ground water would limit yearly extraction to an average depth of 4 feet. Approximately, 50,000,000 cubic yards of material can be recovered above the ground water table.

DEVELOPMENT

Excavation will be impeded by shallow active layers and perched ground water, especially on the lower part of the fan. Pit developments will have to be scheduled to promote melting of the permafrost. Extracted materials will require stockpiling and draining. Moderately deep pits will result in small ponds on the alluvial-fan surface. Good access to Deposit Y21 is available. Hauling across terrain, which is susceptible to thermokarst, must be carried out with care.

Development of Deposit Y21 should be planned to minimize interference with the staging activities of waterfowl and calving by caribou. This deposit lies within the proposed Arctic Wildlife Range and the Firth River IBP Reserve, which may restrict development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
	Pt		PEAT 0.5		UF		Moisture Content: 2.5%
1	ML		SILT - low plastic, rootlets, grey, damp.				Lightweight Pieces - Fine Aggregate: 0.13%
2			2.2				
	GW		GRAVEL - well graded, some medium to coarse sand, occasional cobble, subangular, rootlets, damp.				
3							
4							
5			5.3				
			Bottom of Pit				Sample from 2.2'-5.3'
6							

DATE: Sept. 22, 1976	LOGGED BY: JDF	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO.
Y21-A(e)
SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
	Pt		0.5 PEAT - little gravel, dark brown.		UF		Organic Color: #4 Coal Removed: #2 Moisture Content: 3.6% Lightweight Pieces - Fine Aggregate: 3.1%
1	GW		GRAVEL - well graded to 3" size, little medium to coarse sand.				
			1.5				
	SW		SAND - well graded				
2			2.2				
	GW		GRAVEL - well graded to 3" size, little medium to coarse sand, subangular to subrounded, cherts, sandstones, fragmented shale.				
3							
4			4.5 ▽ free water at 4.5'			4.5	
			4.6				
5			Bottom of Pit				Sample from 0.5'-4.6'

DATE: Sept. 22, 1976	LOGGED BY: JDF	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y21-B

SHEET 1 OF 1

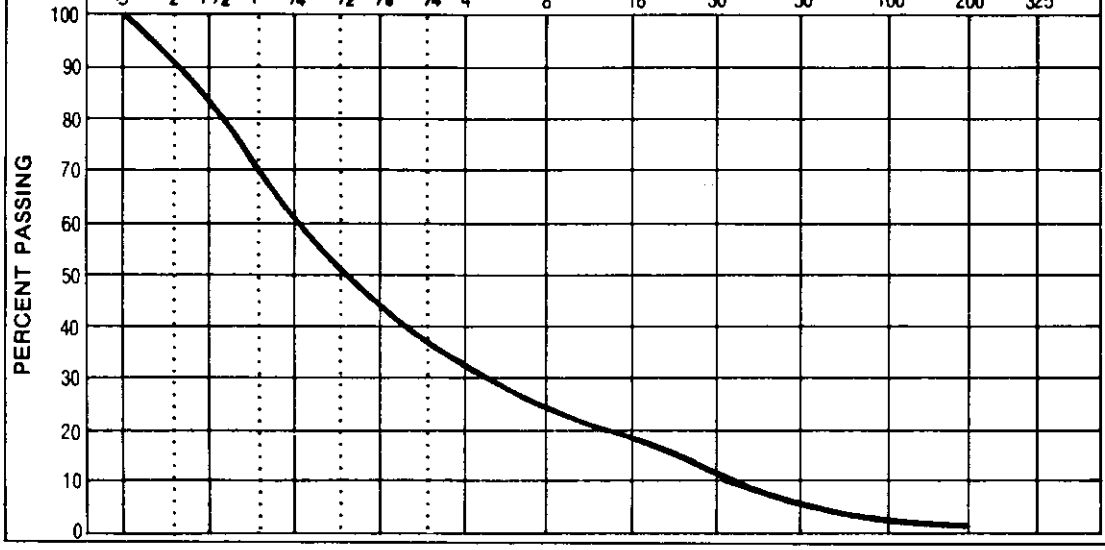
GRAIN SIZE ANALYSIS

SAMPLE Y21-A(e) DEPTH 2.2'-5.3'

DATE SAMPLED Sept. 22, 1976 SAMPLED BY JDF

LAB TEST NUMBER TP49

GRAVEL SIZES		SAND SIZES			FINES	MAX. SIZE	% > 3"
38.8 %	28.5 %	9.7 %	15.0 %	6.5 %	1.5 %	4"	11.2
COARSE	FINE	COARSE	MEDIUM	FINE			



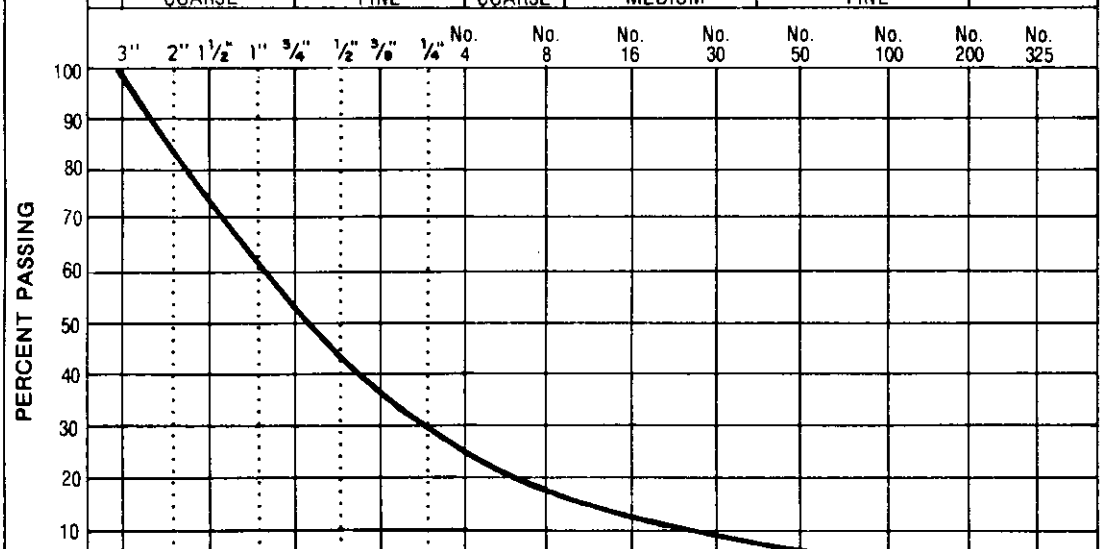
SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	92.4
1 1/2"	80.2
1"	69.5
3/4"	61.2
1/2"	50.0
3/8"	43.5
1/4"	
No. 4	32.7
No. 8	24.9
No. 16	18.2
No. 30	11.4
No. 50	5.1
No. 100	2.6
No. 200	1.5

SAMPLE Y21-B DEPTH 0.5'-4.6'

DATE SAMPLED Sept. 22, 1976 SAMPLED BY JDF

LAB TEST NUMBER TP48

GRAVEL SIZES		SAND SIZES			FINES	MAX. SIZE	% > 3"
46.4 %	28.7 %	8.4 %	9.0 %	6.1 %	1.4 %	3"	0
COARSE	FINE	COARSE	MEDIUM	FINE			



SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	84.9
1 1/2"	74.3
1"	62.7
3/4"	53.6
1/2"	43.0
3/8"	35.9
1/4"	
No. 4	24.9
No. 8	17.5
No. 16	13.1
No. 30	9.2
No. 50	4.5
No. 100	2.0
No. 200	1.4

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No. Y21

DEPOSIT Y22

Setting: Exhumed pediment surface and its gravel cover near the confluence of Loney Creek and Firth River.

Material: Gravel; well graded, fine to coarse, some sand.

Volume: 10,500,000 cubic yards total.

Assessment: Contains fair to good quality granular material. Extraction should be initiated along edge of deposit. Access is good.

Airphoto No.: A22881-170		Approx. Scale:	1"=4900'
Deposit Outline - R.M. Hardy	———	Test Pit	⊙
Deposit Outline - Others	—·—·—	Exposures	✣

DEPOSIT Y22

SETTING

Deposit Y22 consists of an exhumed pediment surface and its gravel cover near the confluence of Loney Creek and the Firth River. At this locality a broad pediment surface slopes gently northeast toward the Firth River. The pediment surface and overlying gravel are exposed only near stream-eroded scarps. Away from these scarps the gravel is covered by thick ice-rich organic silts. A 120 foot scarp separates the gravel-capped pediment surface from low terraces along the Firth River.

Near the crest of the scarp the pediment surface is free of overburden, is very well drained and shows bare gravel covered by scattered patches of Dryas and dwarf birch. The overburden is thin on adjacent terrain where the surface is only moderately well drained and covered by sedge tussock tundra. The thickness of the active layer is estimated to exceed 6 feet under exposed gravel and decrease to less than 2 feet where overburden is present.

This area is considered to be a major calving ground for caribou, and provides habitat for grizzly bear. A few rodent burrows were noted at the test pit sites.

Deposit Y22 is bordered by the Firth River and its associated terraces to the east, and by the silt-mantled pediment surface to the west.

MATERIAL

Deposit Y22 contains fair to good quality granular material consisting of well graded, fine to coarse gravel with variable sand and silt contents. Cobbles to 6 inches are common. Larger clasts are mainly angular to subrounded quartzite, sandstone and argillite. Argillite and shale fragments dominate the fines.

VOLUME

The total volume of 10,500,000 cubic yards is based on an average depth of 25 feet. Exposures along the scarp indicate that the gravel thickness consistently averages about 30 feet.

Annually, 26,000 cubic yards may be extracted by conventional techniques per 1000 foot length parallel to the scarp. This assumes that the gravel is well drained and easily thawed throughout its thickness along the scarp.

DEVELOPMENT

Excavation of Deposit Y22 should be initiated along the scarp. When the more easily extractable material along the scarp is exhausted, further excavation would require removal of significant overburden and would only be feasible where material is required over a long term. Pits could be left as benches that would blend into the surrounding landscape with minor grading upon abandonment.

Access to this deposit is good from the coast along the Firth River fluvial system and from the west over gently sloping pediment. Some difficulty will be encountered in ascending to the deposit from the Firth River terraces.

Development of Deposit Y22 should be planned to minimize interference with caribou calving. The deposit should also be checked for artifacts before any development commences because archeological sites are evident in adjacent areas. This deposit lies within the proposed Arctic Wildlife Range and Firth River IBP Reserve, which may restrict development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
0	GW		GRAVEL - well graded to 4" size, little fine to coarse sand, trace fines, occasional cobble, subangular to rounded, medium brown, damp.		UF		Moisture Content: 9.9%
2.7			-increasing sand content.				
5.6			Bottom of Pit				Sample from 0.4'-5.6'

DATE: Sept. 26, 1976 | LOGGED BY: JDF | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y22-A
SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
0	CL		SILT - organic, dark brown.		UF		Moisture Content: 3.7%
1		1.1					Lightweight Pieces - Fine Aggregate: 0.41%
	ML		SILT - low plastic, grey, some angular to subrounded gravel, occasional cobbles to 6" size.				
2		2.1					
	GW		GRAVEL - well graded to 6" cobbles, trace silty fines decreasing with depth, sandstones, quartz impregnated rock.		Vx <5%	2.3	fragmentation of cobbles due to use of air hammer in digging of pit.
3		3.8					
4			Bottom of Pit				Sample from 3.0'-3.8'
5							

DATE: Sept. 26, 1976	LOGGED BY: GCD	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y22-B

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
0	OL		SILT - organic, dark brown.		UF		Lightweight Pieces - Fine Aggregate: 0.36%
2		2.0					
	GW		GRAVEL - well graded, and fine to coarse sand, occasional cobbles to 5" size, trace silty fines, angular to subrounded, brown.				
4							
6							
8							
							only the upper 34' of 170' exposure was logged.
26							
28							
30	ML		SILT - and shale.				
32		32	Bottom of Pit				Sample from 2.0'-30.0'

DATE: Sept. 26, 1976 | LOGGED BY: GCD | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y22-C(e)

SHEET 1 OF 1

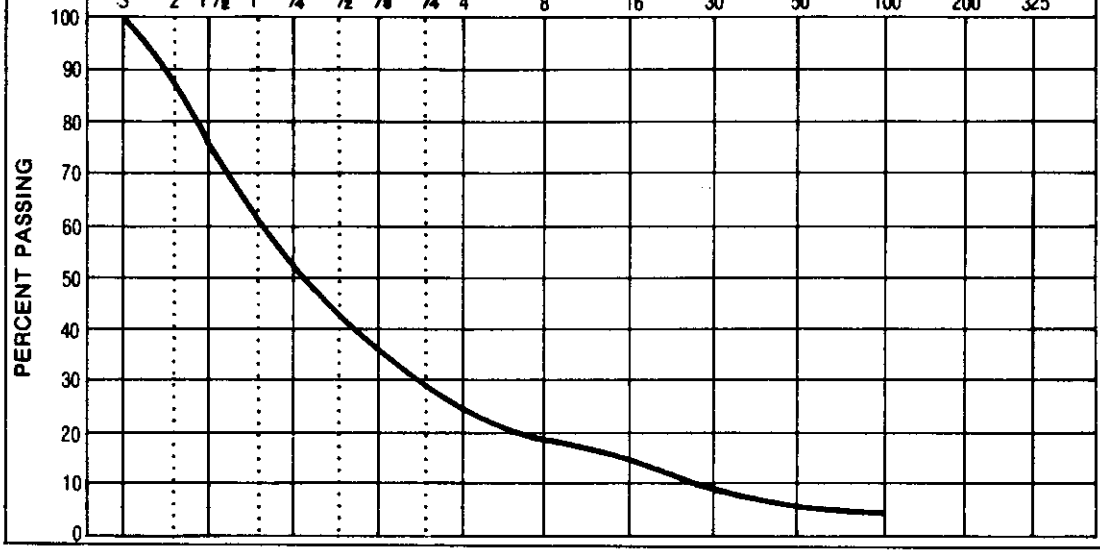
GRAIN SIZE ANALYSIS

SAMPLE Y22-A DEPTH 0.4'-5.6'

DATE SAMPLED Sept. 26, 1976 SAMPLED BY JDF

LAB TEST NUMBER TP71

GRAVEL SIZES		SAND SIZES			FINES
49.2 %	23.0 %	9.8 %	10.5 %	3.3 %	4.2 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
4"	10.2

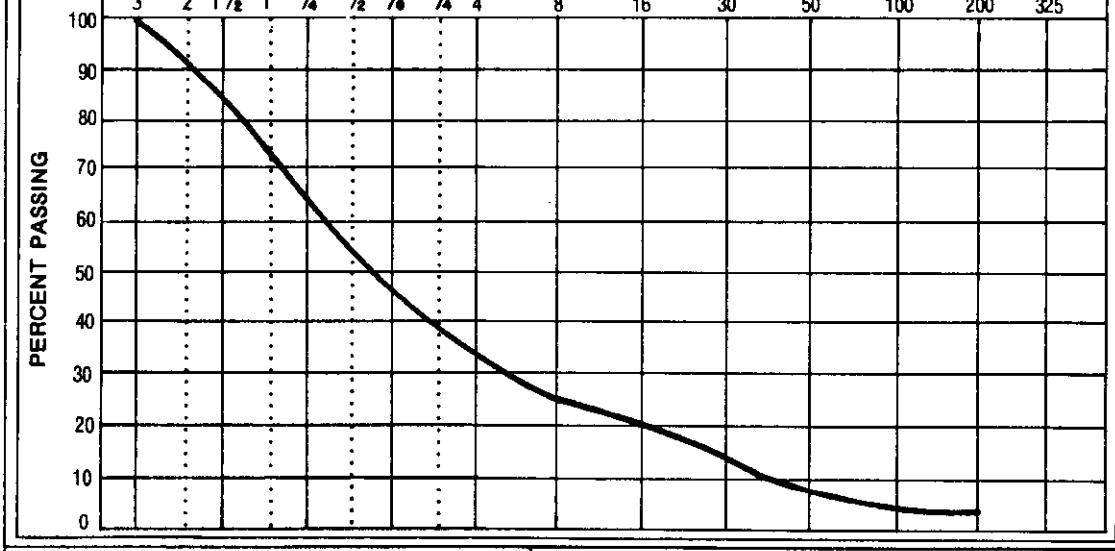
SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	88.3
1 1/2"	76.2
1"	61.2
3/4"	50.8
1/2"	42.8
3/8"	37.8
1/4"	
No. 4	27.8
No. 8	23.2
No. 16	19.2
No. 30	15.1
No. 50	9.7
No. 100	5.9
No. 200	4.2

SAMPLE Y22-B DEPTH 3.0'-3.8'

DATE SAMPLED Sept. 26, 1976 SAMPLED BY GCD

LAB TEST NUMBER 72HA-A

GRAVEL SIZES		SAND SIZES			FINES
36.6 %	30.9 %	8.5 %	14.5 %	6.4 %	3.1 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
3"	0

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	92.3
1 1/2"	85.4
1"	72.9
3/4"	63.4
1/2"	52.8
3/8"	45.7
1/4"	
No. 4	32.5
No. 8	25.4
No. 16	19.6
No. 30	14.1
No. 50	7.0
No. 100	3.8
No. 200	3.1

GOVERNMENT OF CANADA

DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.

CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No. Y22

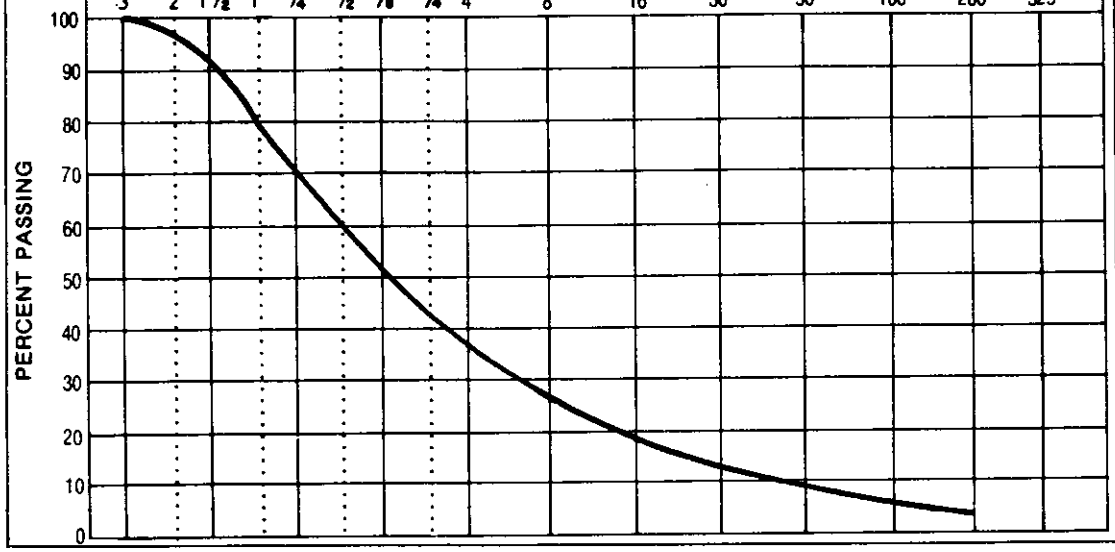
GRAIN SIZE ANALYSIS

SAMPLE Y22-C(e) DEPTH 2.0'-30.0'

DATE SAMPLED Sept. 26, 1976 SAMPLED BY GCD

LAB TEST NUMBER 72HA-B

GRAVEL SIZES		SAND SIZES			FINES
29.7 %	34.0 %	11.3 %	14.0 %	7.1 %	3.9 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
3"	0

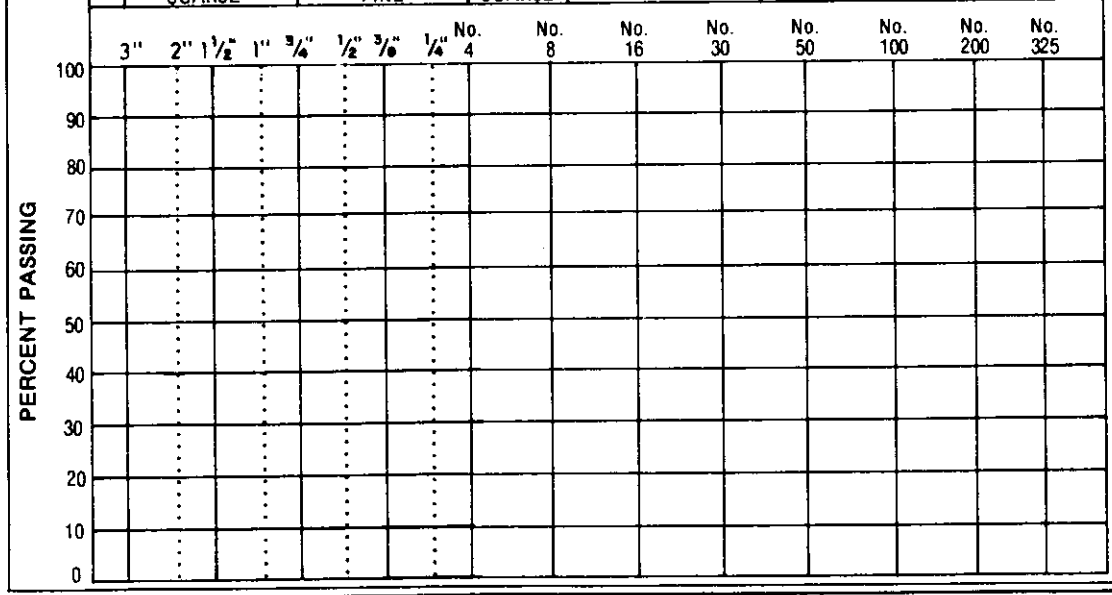
SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	97.7
1 1/2"	90.7
1"	79.1
3/4"	70.3
1/2"	58.8
3/8"	51.0
1/4"	
No. 4	36.3
No. 8	27.5
No. 16	20.0
No. 30	13.6
No. 50	7.8
No. 100	4.9
No. 200	3.9

SAMPLE _____ DEPTH _____

DATE SAMPLED _____ SAMPLED BY _____

LAB TEST NUMBER

GRAVEL SIZES		SAND SIZES			FINES
%	%	%	%	%	%
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"

SIEVE SIZE	PERCENT PASSING
3"	
2"	
1 1/2"	
1"	
3/4"	
1/2"	
3/8"	
1/4"	
No. 4	
No. 8	
No. 16	
No. 30	
No. 50	
No. 100	
No. 200	

GOVERNMENT OF CANADA

DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.

CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

DEPOSIT No. Y22

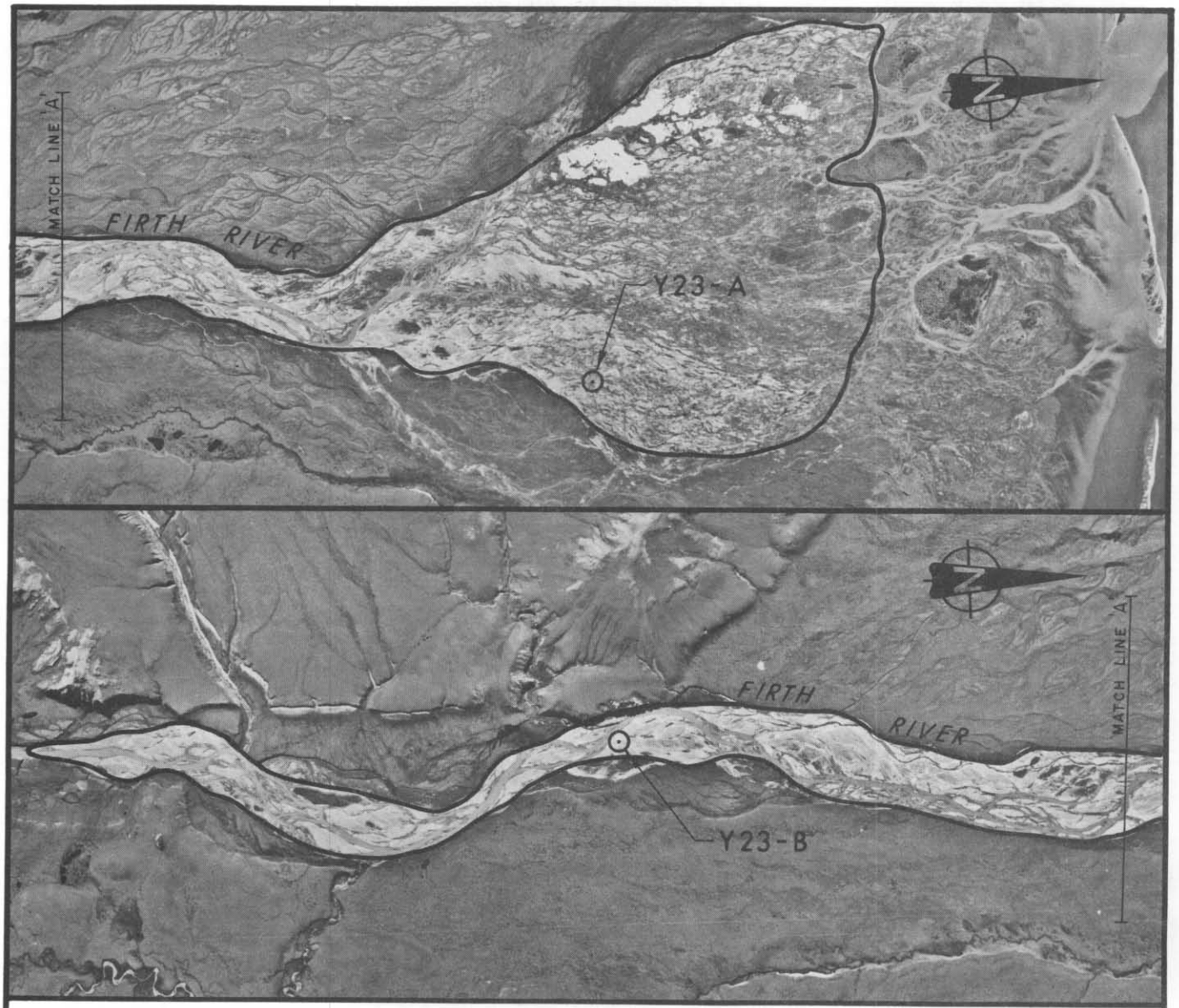
DEPOSIT Y23

Setting: Active floodplain of the Firth River.

Material: Gravel; well graded, fine to coarse, and sand.

Volume: 440,000,000 cubic yards total.

Assessment: Contains good to excellent quality granular material but with small amount of oversize particles. Extraction would be limited by ground water levels and stream channels. Fluvial processes would restore the floodplain to its natural state. Access is good.
Recoverable volumes may be limited to 40,000,000 cubic yards.



Airphoto No.: A13751-113/115		Approx. Scale:	1"=5800'
Deposit Outline - R.M. Hardy	———	Test Pit	⊙
Deposit Outline - Others	—·—·—	Exposures	✠

DEPOSIT Y23

SETTING

Deposit Y23 consists of the Firth River active floodplain which is composed of bars and channel beds having a braided pattern.

The deposit is well-drained and free of overburden. On the upper reaches of Deposit Y23, water is confined to a few channels, and over one half of the deposit is 4 feet above low water levels with scour holes and channel traces giving its surface a local relief of up to 2 feet. On the lower reaches, the active floodplain broadens into a fan with many water-filled distributaries and only 20 percent of the area stands more than 3 feet above fall water levels.

The thickness of the active layer was estimated to exceed 5½ feet.

Aufeis often covers a good portion of the northern part of the deposit where the active floodplain broadens out into a fan. Vegetation is negligible with only occassional willows and herbs on the crests of higher bars. The Firth River is a major migratory route and a spawning, feeding, and over-wintering area for Arctic char and grayling. Over-wintering within Deposit Y23 is probably confined to areas near the aufeis.

This deposit is bordered by a low gently sloping well-drained alluvial-fan along its lower reaches and by moderately well drained terraces on its upper reaches. The deposit is separated from the coast by a sandy and poorly drained continuation of the active floodplain.

This area provides staging ground for waterfowl and suitable habitat for Arctic fox and grizzly bear. Near the more southern parts of the deposit is a known caribou calving ground.

MATERIAL

Deposit Y23 contains good to excellent quality granular material consisting of well graded, fine to coarse gravel and sand. A general upstream coarsening of the insitu material was noted. Larger clasts are mainly subangular to subrounded quartzite and sandstone with rare quartz and chert. Argillite fragments predominate the fines.

VOLUME

The total volume of 440,000,000 cubic yards is based on a conservative depth of 45 feet. Fluvial deposits in adjacent terraces are known to exceed this depth.

Annually, 240,000 cubic yards per 1000 feet of length of the floodplain could be extracted from the southern part of the deposit by conventional techniques assuming that static ground water levels limit the extractable granular material to an average depth of 4 feet. On the northern part of the deposit where static ground water levels average within 1½ feet of the surface, only 1,500 cubic yards per acre could be extracted.

Volume of recoverable material above the static ground water level may be limited to 40,000,000 cubic yards.

DEVELOPMENT

Excavation operations at Deposit Y23 should probably be confined to summer and fall when water levels are low, and will require large areas for the recovery of comparatively small volumes because of shallow ground water levels unless drainage controls are undertaken. This is especially true on the fan-shaped floodplain near the coast. Locally aufeis may impede excavation. Adequate areas for stockpiling are available.

Following any development, the pit will be restored by natural fluvial processes as streams of the coastal plain are known to move significant amounts of coarse sediment.

Access to this deposit is available along the stream course on adjacent low terraces.

Development of Deposit Y23 should be planned to minimize interference with caribou calving, or fish activities. Extraction on parts of the northern portion of the deposit might be difficult because of the many channels carrying water, even at low water levels, that would necessarily have to be crossed or interfered with during development. Extraction from near aufeis should be avoided if fish over-winter in these areas. Deposit Y23 lies within a proposed Arctic Wildlife Range and the Firth River IBP Reserve, which may limit development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	GW		GRAVEL - well graded to 8" cobbles, little fine to coarse sand, sub-rounded to subangular, cherts and sandstones.		UF		Lightweight Pieces - Fine Aggregate: 0.19%
2							
3			3.8				
4			Bottom of Pit				Sample from 0'-4.0'
5							

DATE: Sept. 22, 1976	LOGGED BY: GDC	DRWN BY: MB/vh	CHKD BY: GDC/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO.
Y23-A
SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	GW		GRAVEL - well graded to 6" cobbles, some fine to coarse sand, 10" cobbles on surface, subangular to sub-rounded, stratified, brown, red, green, sandstones, quartz veins.		UF		Lightweight Pieces - Fine Aggregate: 0.06%
2							
3							difficult digging due to instability of pit walls.
4	SW		3.8 SAND - well graded.				
	GW		4.3 GRAVEL - well graded, and sand.				
	SP		4.7 4.9 SAND - fine.				
5	SW		5.3 ▽ SAND - well graded, saturated at 5.3'.			5.3	
6			Bottom of Pit				Sample from 0'-5.3'

DATE: Sept. 26, 1976 | LOGGED BY: GCD | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y23-B

SHEET 1 OF 1

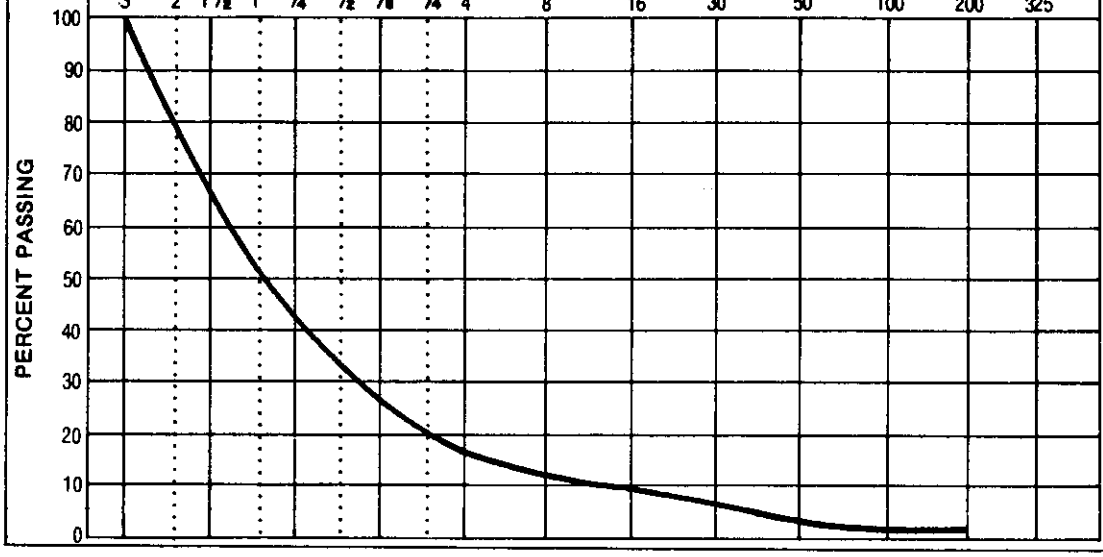
GRAIN SIZE ANALYSIS

SAMPLE Y23-A DEPTH 0'-4.0'

DATE SAMPLED Sept. 22, 1976 SAMPLED BY GCD

LAB TEST NUMBER 50HA

GRAVEL SIZES		SAND SIZES			FINES
57.7 %	25.0 %	5.3 %	6.5 %	4.6 %	0.9 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
5"	14.8

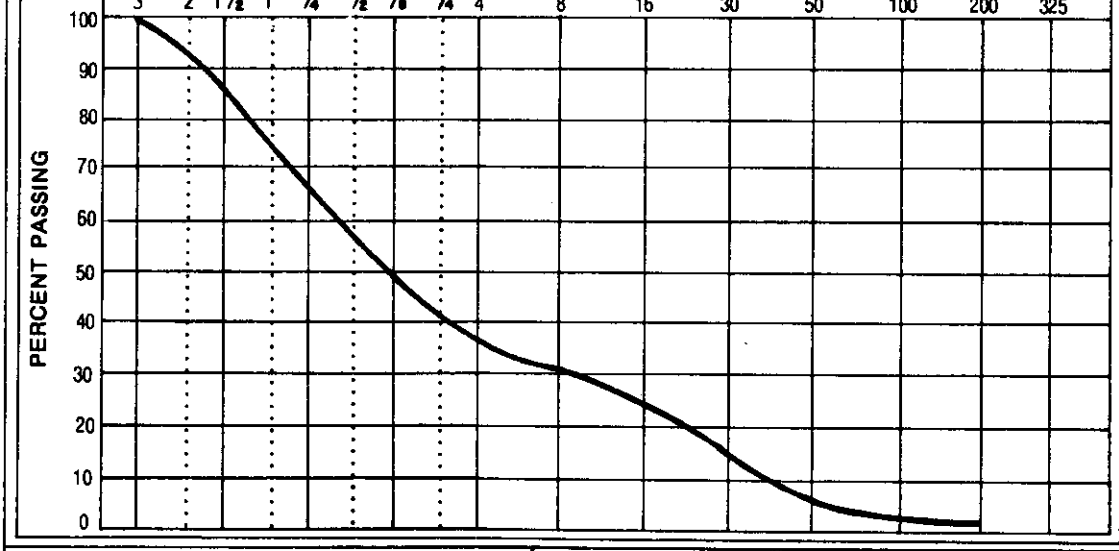
SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	84.3
1 1/2"	66.0
1"	51.9
3/4"	42.3
1/2"	32.4
3/8"	26.6
1/4"	
No. 4	17.3
No. 8	12.7
No. 16	9.4
No. 30	5.9
No. 50	2.9
No. 100	1.4
No. 200	0.9

SAMPLE Y23-B DEPTH 0'-5.3'

DATE SAMPLED Sept. 26, 1976 SAMPLED BY GCD

LAB TEST NUMBER 70HA

GRAVEL SIZES		SAND SIZES			FINES
35.0 %	29.2 %	6.3 %	19.5 %	8.7 %	1.3 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
4"	6.4

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	94.3
1 1/2"	86.2
1"	72.2
3/4"	65.0
1/2"	55.9
3/8"	49.7
1/4"	
No. 4	35.8
No. 8	30.1
No. 16	23.6
No. 30	15.0
No. 50	5.5
No. 100	2.1
No. 200	1.3

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No. Y23

DEPOSIT Y26

Setting: Quartzite outcrops and associated blocky talus. Located 1 mile northwest of Okpioyuak Creek and about 4 miles upstream of its confluence with the Firth River.

Material: Quartzite rock and coarse rubble.

Volume: 93,000 cubic yards total.

Assessment: Exhibits potential as a source of crushed rock or riprap. Fair access to the coast. The limited quantities available from this outcrop negates its choice as a source of construction materials.

Airphoto No.: A24123-196		Approx. Scale:	1"=5200'
Deposit Outline - R.M. Hardy	———	Test Pit	⊙
Deposit Outline - Others	—·—·—	Exposures	✣

DEPOSIT Y26

SETTING

Deposit Y26 consists of quartzite outcrops and talus on the northern side of a meltwater channel at the northern edge of the Buckland Hills. The deposit is located 1 mile northwest of Okpioyuak Creek at a point 4 miles upstream of its confluence with the Firth River.

The outcrops consist of a number of 40 foot high rock knobs along the upper edge of a 100 foot high scarp forming the northern edge of a narrow meltwater channel. These outcrops are discontinuous because of facies changes or tectonic pinching and are flanked by talus cones and coarse rubbly scree.

The rock is a tough, light gray, medium-grained quartzite. Bedding is massive, strikes at N90°E and dips 50°S. A major joint system strikes north to south and dips 40°W. Recessive areas may be underlain by thinly bedded quartzite and argillite.

Outcrops and talus are generally bare of vegetation except for scattered Dryas and shrubs on protected slopes. Crustose lichens cover the rocks.

This outcrop is part of the Neruokpuk Formation composing the northern part of the British Mountains. The Neruokpuk Formation is primarily composed of argillites in this area, but numerous lentils of quartzite occur. Deposit Y26 is typical.

This deposit is bordered on the south by a poorly-drained, peat-filled meltwater channel with gentle to moderate hillslopes lying beyond. Ice-rich rolling morainal and flat, peat-covered lacustrine and glaciofluvial deposits are present to the north. The area provides habitat for grizzly bear and is occasionally utilized by caribou for calving.

MATERIAL

Deposit Y26 may be a source of good quality granular material and riprap if quarried and crushed. The rock outcrop consists of quartzite. Jointing suggests that certain parts of the outcrop could produce blocks of up to 8 cubic yards. The talus consists of angular blocks and some plates, 3 inches to 6 feet in size.

VOLUME

The total volume of 93,000 cubic yards assumes that the rock may be quarried a distance of 30 feet into the hill.

DEVELOPMENT

Preliminary blasting tests to determine breakage characteristics of the rock would be necessary before considering Deposit Y26 as a source of riprap. If quarried the rock can be mined from benches or at the base of the slope.

Access to the coast involves crossing slopes that are susceptible to thermoakrst. Development should be planned to minimize interference with caribou calving. Deposit Y26 lies within the proposed Arctic Wildlife Preserve and Firth River IBP Reserve, which may restrict development.

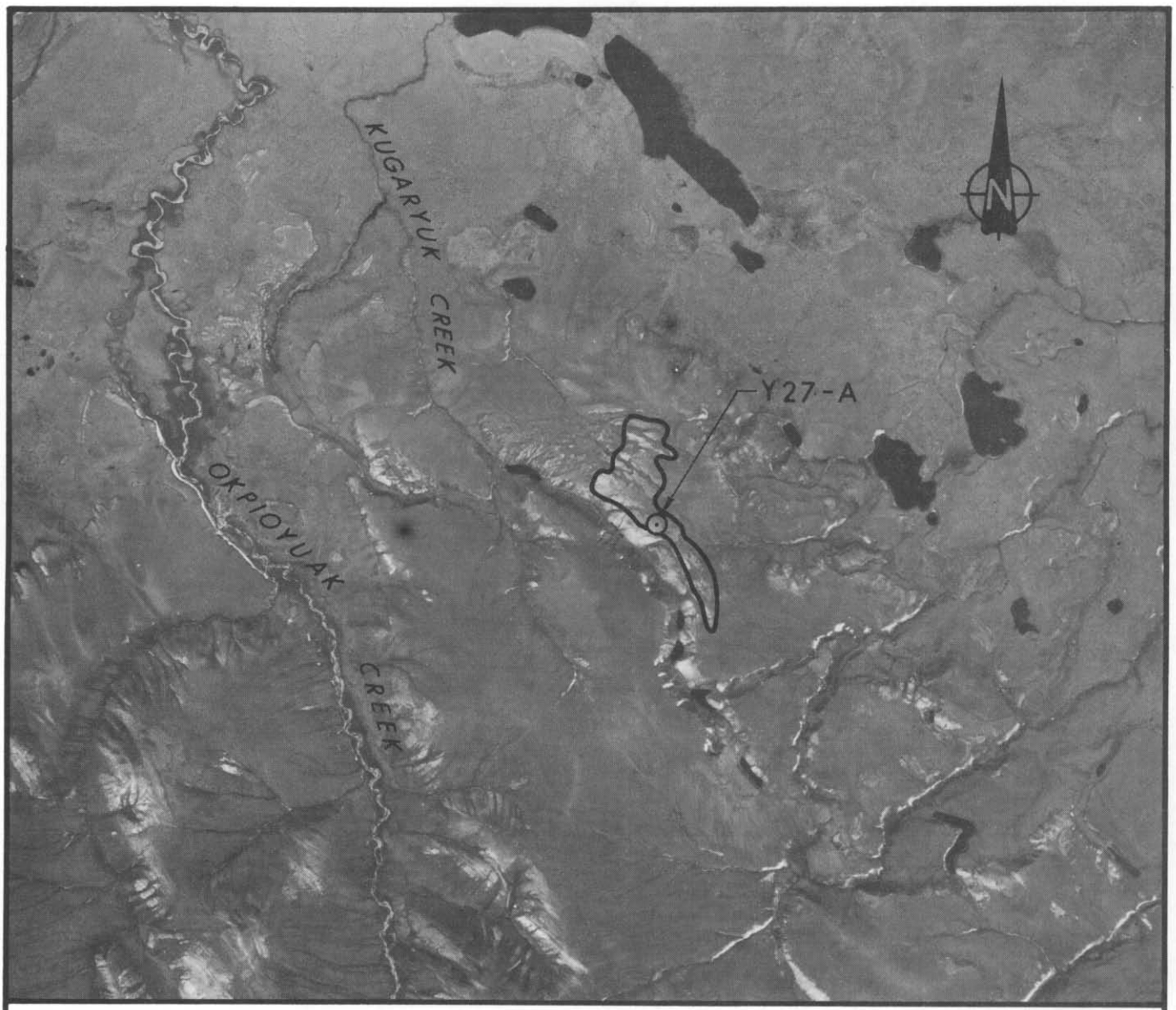
DEPOSIT Y27

Setting: Scree-covered ridge at edge of Buckland Hills adjacent to Kugaryuk Creek. Located 12 miles west-southwest of Roland Bay.

Material: Coarse bedrock fragments; with silty clay matrix.

Volume: 970,000 cubic yards total.

Assessment: Contains poor to potentially good quality granular material. Fair access.



Airphoto No.: A24123-195		Approx. Scale:	1"=4900'
Deposit Outline - R.M. Hardy	———	Test Pit	⊙
Deposit Outline - Others	—·—·—	Exposures	✠

DEPOSIT Y27

SETTING

Deposit Y27 consists of a scree-covered ridge at the edge of the Buckland Hills on the east bank of Kugaryuk Creek and 10 miles upstream of its confluence with the Firth River. The deposit is located 12 miles west-southwest of Roland Bay.

The adjacent uplands at Deposit Y27 are gently rolling except for a few small scarps and steep slopes. Boulder fields are locally present. The surface of Deposit Y27 is well drained and free of overburden, although some of the bedrock weathers to clay. Scattered Dryas spot the generally bare surface; some swales have a cover of sedge tussock tundra.

The parent rock at Deposit Y27 appears to be the Precambrian Neruokpuk Formation as blocky quartzite fragments and argillite flakes are present in the scree. A few lentils of younger Paleozoic limestones may be folded and faulted into the sequence.

Deposit Y27 is bordered by a steep-walled meltwater channel on its southwestern edge. Moderately sloping uplands and morainal deposits and flat peat-covered, poorly drained lacustrine and glaciofluvial deposits are present towards the coast. A moderate to steep 250 foot escarpment separates the upland from the other deposits on the low lying coastal plain. The area provides habitat for grizzly bear, Arctic fox, and caribou.

MATERIAL

Deposit Y27 contains poor to potentially good quality granular material consisting of silty clay and argillite flakes with occasional angular quartzite cobbles and boulders to 24 inches in size. Blocky quartzite boulders to 5 feet in size and smaller fragments of quartzite

rubble are prevalent in some areas. Locally, quartzite would be good quality granular material if crushable.

VOLUME

The total volume of 970,000 cubic yards is based on a depth of 4 feet of scree overlying rock, and does not include any volumes that may be quarried.

Annually, 6,500 cubic yards per acre could be extracted by conventional techniques if only fragmented and weathered rock were removed.

DEVELOPMENT

Development of this deposit will involve surface scraping and stripping unless the underlying rock was quarried. Further field investigations are required to delineate areas of preferred material. Development will significantly modify the aesthetics of the area.

Access to this deposit toward the coast would involve descending a steep 250 foot slope and crossing terrain which is susceptible to thermokarst.

Deposit Y27 lies within the proposed Arctic Wildlife Perserve which may restrict development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
0	GC		GRAVEL - well graded, some clayey fines, occasional cobbles and boulders to 2' size, angular, damp.		UF		Organic Color: #2 Lightweight Pieces - Fine Aggregate: 0.07%
4			Bottom of Pit				Sample from 0'-4.0'

DATE: Sept. 30, 1976 | LOGGED BY: CPM | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y27-A

SHEET 1 OF 1

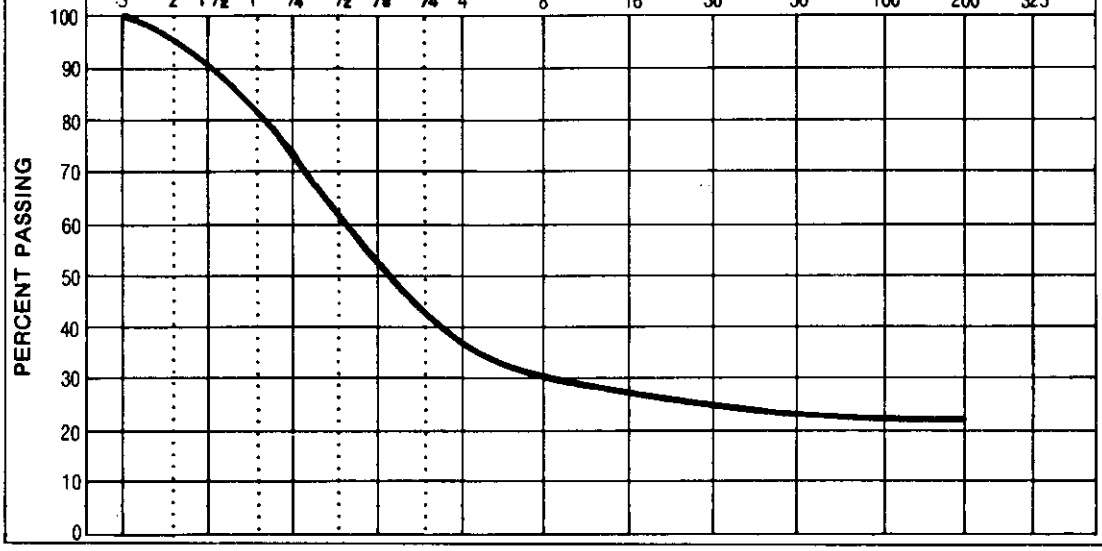
GRAIN SIZE ANALYSIS

SAMPLE Y27-A DEPTH 0'-4.0'

DATE SAMPLED Sept. 30, 1976 SAMPLED BY CPM

LAB TEST NUMBER 75HA

GRAVEL SIZES		SAND SIZES			FINES
27.0 %	38.6 %	4.9 %	5.5 %	2.0 %	22.0 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
3"	0

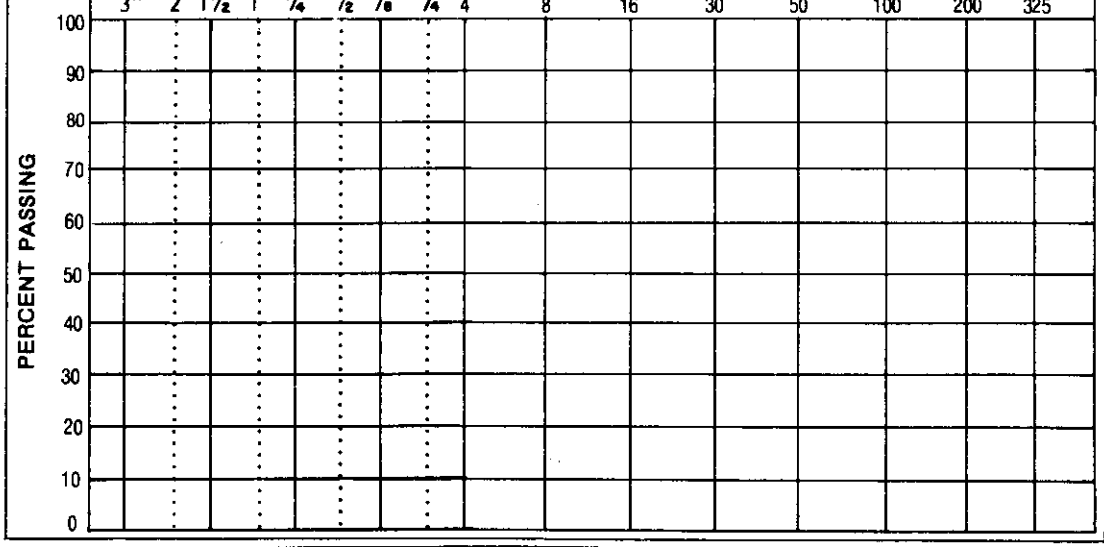
SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	97.0
1 1/2"	90.4
1"	80.1
3/4"	73.0
1/2"	61.8
3/8"	53.6
1/4"	
No. 4	34.4
No. 8	30.2
No. 16	27.2
No. 30	25.5
No. 50	24.4
No. 100	23.4
No. 200	22.0

SAMPLE _____ DEPTH _____

DATE SAMPLED _____ SAMPLED BY _____

LAB TEST NUMBER

GRAVEL SIZES		SAND SIZES			FINES
%	%	%	%	%	%
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"

SIEVE SIZE	PERCENT PASSING
3"	
2"	
1 1/2"	
1"	
3/4"	
1/2"	
3/8"	
1/4"	
No. 4	
No. 8	
No. 16	
No. 30	
No. 50	
No. 100	
No. 200	

GOVERNMENT OF CANADA

DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.

CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No.

Y27

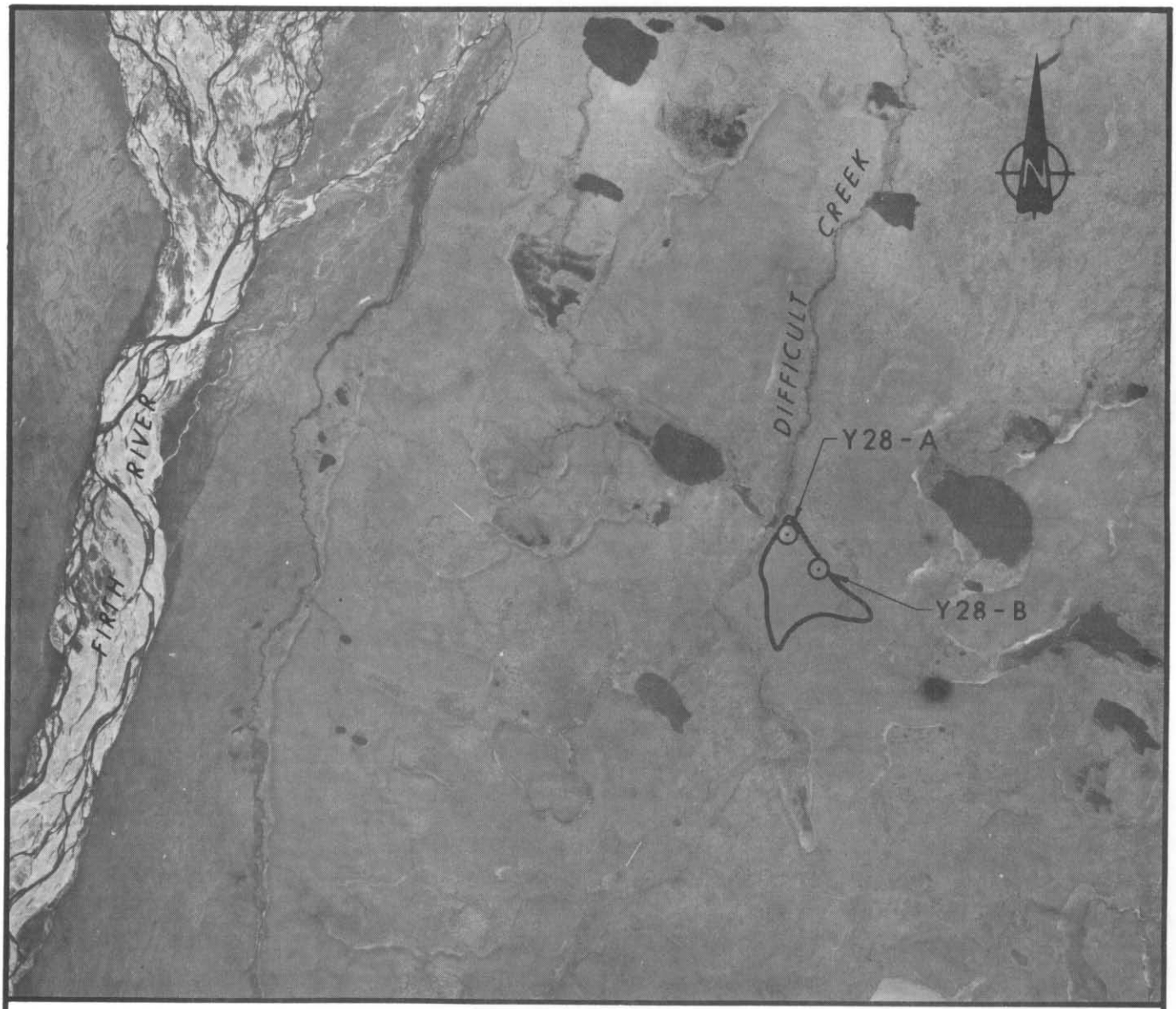
DEPOSIT Y28

Setting: Terraced outwash plain near the headwaters of Difficult Creek.

Material: Gravel; well graded, and Sand; poorly graded, stratified.

Volume: 5,500,000 cubic yards total.

Assessment: Contains good quality granular material. Pits may be flooded upon abandonment. Access is good. Shallow active layers and perched ground water tables will impede extraction operations.



Airphoto No.: A24123-198
Deposit Outline - R.M. Hardy
Deposit Outline - Others
Approx. Scale: 1"=5000'
Test Pit ⊙
Exposures ✠

DEPOSIT Y28

SETTING

Deposit Y28 consists of part of an outwash plain near the headwaters of Difficult Creek. Subsequent to its deposition, further meltwater activity was at lower levels and has left the present deposit as a terrace standing more than 10 feet above the main peat-covered outwash plain.

Near the 8 to 10 foot scarp at the edge of the outwash terrace, the surface is well drained and overburden is thin with many areas of bare gravel. Toward the back edge of the outwash terrace, the overburden thickens, and the terrace is moderately well to imperfectly drained. The active layer is 3 to 5 feet thick under the well drained areas, and probably thinner under areas where overburden is thicker.

The outer edge of the terrace is covered by tundra consisting of moss, lichen, and ericaceous schrubs. Toward the inner edge, sedge tussocks become prevalent. Patches of grass and low willow grow on small mounds near the edge of the terrace.

Deposit Y28 adjoins poorly drained peat covered outwash at lower levels and gently rolling, moderately well drained morainal deposits. The area provides habitat for grizzly bear, Arctic fox, and lies within a critical calving area for caribou and staging area for waterfowl.

MATERIAL

Deposit Y28 contains good quality granular material consisting of stratified, well graded, fine to coarse gravel with some medium to fine sand, and poorly graded medium to coarse sand with little gravel. Larger clasts are mainly subangular to subrounded quartzite and sandstone with some argillite and chert.

VOLUME

A total volume of 5,500,000 cubic yards is based on a conservative estimated thickness of 30 feet. Similar deposits nearby are known to be more than 48 feet thick.

Annually, 7,300 cubic yards may be extracted per acre by conventional excavation techniques assuming that permafrost will only limit extraction to depths of 5 feet.

DEVELOPMENT

Effective development of Deposit Y28 will be minimized by shallow active layers and perched ground water. Stripping of granular materials will have to be scheduled to promote melting of permafrost. Proper drainage measures will be required for deep excavations. Deeper excavations will result in ponds upon abandonment.

Good access to the deposit is available because the surrounding terrain is flat.

Development of Deposit Y28 should be planned to minimize interference with caribou calving and waterfowl staging. This deposit lies within the proposed Arctic Wildlife Range, which may restrict development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
	Pt		0.2 PEAT		UF		Moisture Content: 7.3%
1	ML		SILT - low plastic, and gravel to 2" size, subangular to subrounded. 1.1				Lightweight Pieces - Fine Aggregate: 0.30%
2	GW		GRAVEL - well graded, some fine to coarse sand, occasional cobbles to 5" size, sandstones.				
3			3.5				
4	SP		SAND - medium to coarse, little gravel to 1" size, subangular to rounded.				
5			5.0 — — increasing gravel content	+ + + +	Vx 5%	4.9	
6			5.9 Bottom of Pit				Sample from 1.1'-5.9'
7							

DATE: Sept. 21, 1976	LOGGED BY: GCD	DRWN BY: MB/vh	CHKD BY: GDC/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y28-A

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
0	Pt		0.4 PEAT		UF		Organic Color: #5+ Moisture Content: 8.5% Lightweight Pieces - Fine Aggregate: 0.46%
1	OL		SILT - organic, low plastic, trace coarse gravel, rootlets, dark grey, wet.				
			1.8				
2	GW		GRAVEL - well graded to 3" size, and fine to coarse sand, occasional cobble, subangular, wet.				
3					Vs 5%	2.8	
4			4.0 gravel becoming finer.				
5							
6			6.0				
			Bottom of Pit				Sample from 0'-6.0'
7							

DATE: Sept. 21, 1976	LOGGED BY: JDF	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

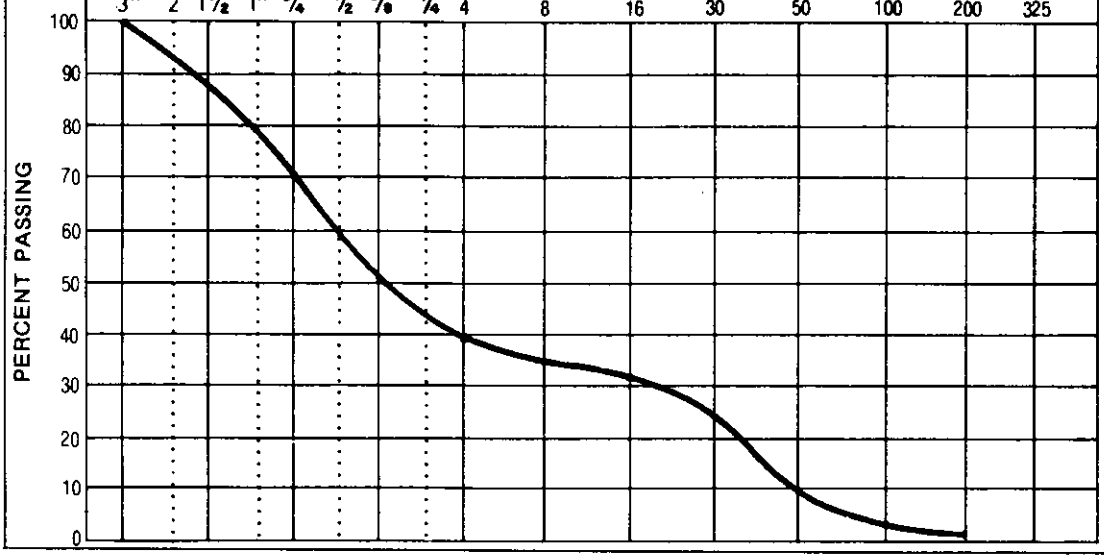
TEST PIT NO. Y28-B

SHEET 1 OF 1

GRAIN SIZE ANALYSIS

SAMPLE Y28-A DEPTH 1.1'-5.9'
DATE SAMPLED Sept. 21, 1976 SAMPLED BY GCD
LAB TEST NUMBER 68HA

GRAVEL SIZES		SAND SIZES			FINES
29.7 %	31.2 %	5.1 %	1.9 %	12.4 %	2.6 %
COARSE	FINE	COARSE	MEDIUM	FINE	

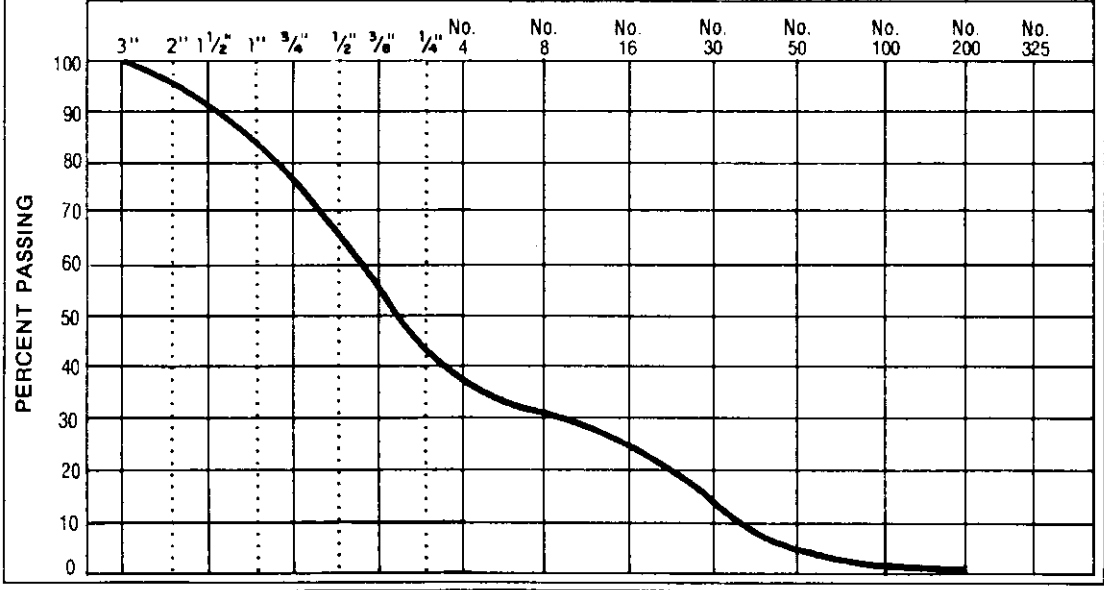


MAX. SIZE	% > 3"
4"	2.5

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	94.4
1 1/2"	89.4
1"	79.7
3/4"	70.3
1/2"	58.8
3/8"	51.2
1/4"	
No. 4	39.1
No. 8	35.0
No. 16	32.0
No. 30	24.1
No. 50	9.0
No. 100	3.4
No. 200	2.6

SAMPLE Y28-B DEPTH 0'-6.0'
DATE SAMPLED Sept. 21, 1976 SAMPLED BY JDF
LAB TEST NUMBER TP69

GRAVEL SIZES		SAND SIZES			FINES
24.3 %	38.2 %	8.0 %	21.5 %	6.7 %	1.3 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
3"	0

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	95.0
1 1/2"	91.0
1"	82.4
3/4"	75.7
1/2"	64.8
3/8"	54.8
1/4"	
No. 4	37.5
No. 8	31.7
No. 16	24.9
No. 30	14.5
No. 50	5.0
No. 100	1.8
No. 200	1.3

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No.
Y28

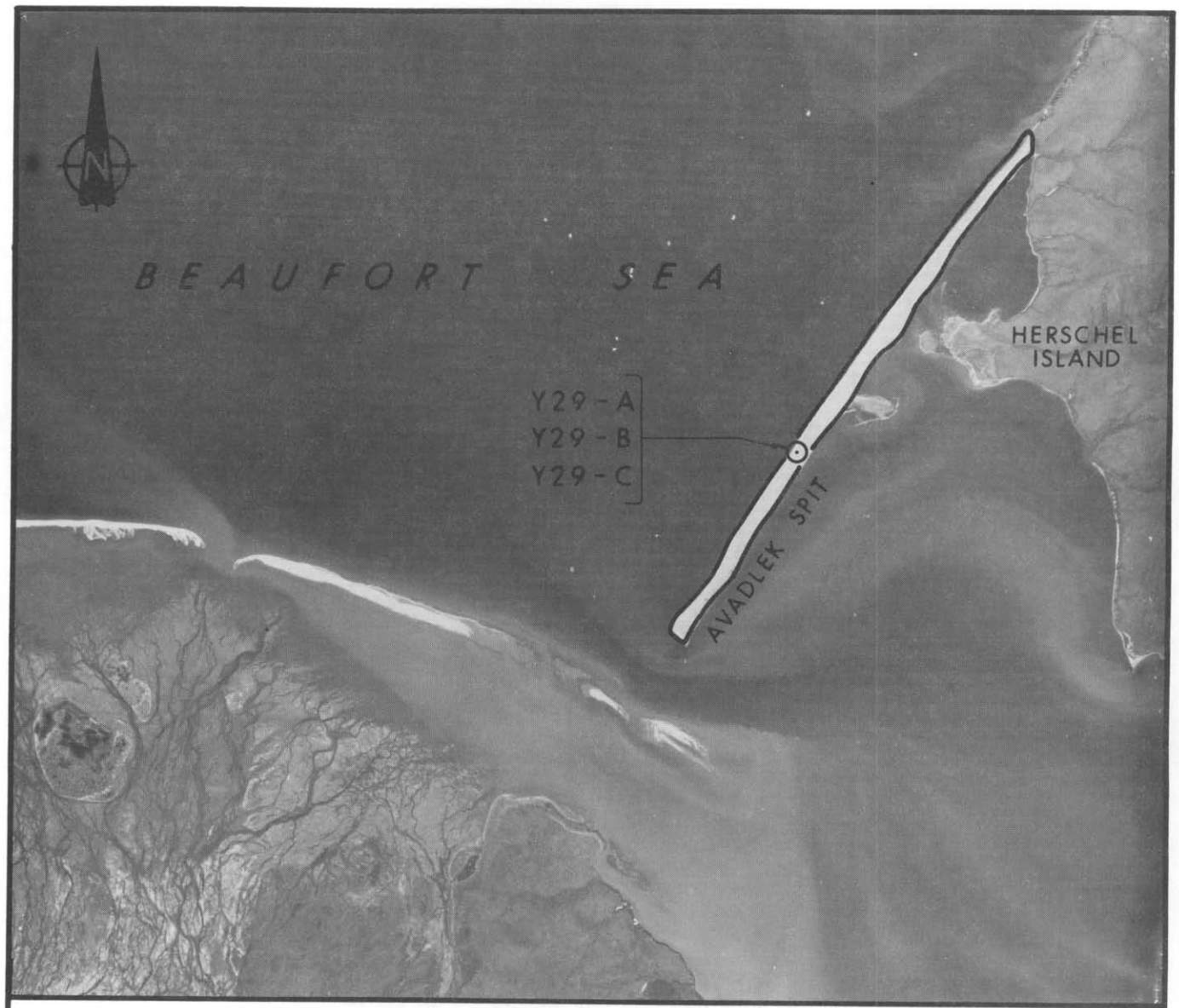
DEPOSIT Y29

Setting: Located on Avadlek Spit, which is attached to the western tip of Herschel Island.

Material: Gravel; stratified, fine to coarse, some sand.

Volume: 3,700,000 cubic yards total.

Assessment: Contains good to excellent quality granular material. Extraction may not seriously alter coastal processes. Spit restoration would be slow. Access limited by open water.
Recoverable volume may be limited to 1,500,000 cubic yards.



Airphoto No.: A24123-200
Deposit Outline - R.M. Hardy
Deposit Outline - Others
Approx. Scale: 1"=5000'
Test Pit
Exposures

DEPOSIT Y29

SETTING

Deposit Y29 consists of Avadlek Spit, 3½ miles long, that extends toward the mainland from the western tip of Herschel Island.

The spit is about 600 feet across and its crest stands 4 to 8 feet above sea level over its length. The crest of the spit is about 150 feet from the outer edge of the foreshore, which is characterized by minor ridges and trenches paralleling the trend of the spit. The broad backshore slopes very gently to the east where it terminates in a 1 to 2 foot scarp.

The surface of the spit is well drained and devoid of vegetation. Driftwood is scattered over the surface of the backshore.

Nearby bathymetric configurations and data from other nearby spits suggest the spit is at least 12 feet thick. Water was encountered 5 feet below the crest of the spit. The active layers exceeds 5 feet in early fall.

The position and shape of Avadlek Spit has shown little change over the last 20 years. The spit is nourished by longshore moving southward along the western edge of Herschel Island. The foreshore is continuously being reworked by wave action. The backshore is inundated during storm surges, and affected by washover from the west during major storms.

Avadlek Spit is separated from the mainland by one mile of water, including an adjacent 35 foot channel characterized by strong currents. The northern end of Avadlek Spit is attached to Herchel Island where the immediate terrain is moderately sloping and underlain by ice-rich, fine-grained colluvium and deformed Pleistocene marine sediments.

Shore birds and arctic fox probably utilize the spit.

MATERIAL

Deposit Y29 contains good quality granular material.

The surface of the foreshore and test pit Y29-B indicate that this zone is underlain by poorly graded gravel with occasional cobbles to 2½ inches. The surface of the backshore and test pits Y29-A and Y29-C indicate that it is underlain by stratified well-graded gravel and sand with few cobbles to 8 inches.

Larger clasts are mainly sandstone, quartzite, and chert with rare granite.

VOLUME

The total volume of Avadlek Spit based on a conservative thickness of 9 feet is 3,700,000 cubic yards.

Annually, 78,000 cubic yards per 1000 feet of its length could be extracted by conventional techniques. Volume of recoverable material may be limited to 1,500,000 cubic yards because of static water level.

DEVELOPMENT

Development could be carried out by conventional techniques during summer and early fall, although major storm tides would require temporary abandonment of operations. The adjacent terrain on Herschel Island would be available for stockpiling and support facilities, but may be susceptible to thermokarst and erosion. Access to the mainland is inhibited during the summer and early fall by open water. As the spit is located in a sediment sink, extraction would not affect rates of coastal retreat. However, refurbishment of the spit might be slow as little gravel is exposed along the eroding west coast of Herschel Island.

Before development, the possibility of archeological sites at the northern end of the spit should be investigated. Also Herschel Island has been proposed as a national historic site or park, which may restrict development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	GW		GRAVEL - well graded, some fine to coarse sand, trace fines, occasional cobble, stratified, sub-rounded, medium brown.		UF		
2							
3			3.5 ▽				
4			Bottom of Pit				No sample taken.

DATE: Sept. 21, 1976	LOGGED BY: JDF	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y29-A

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	GW		GRAVEL - well graded, little medium to coarse sand, trace fines, occasional cobble, rounded, medium brown, wet, cherts.		UF		
2							
3		3.0	Bottom of Pit				No sample taken.
4							

DATE: Sept. 29, 1976	LOGGED BY: JDF	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y29-B

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
0	SP		SAND - medium to coarse, and gravel to 2" size, stratified, medium brown, wet, clean.		UF		Organic Color: #2 Lightweight Pieces - Fine Aggregate: 0.05%
1							
2							
3							
4			4.6 ▽ free water at 4.6'.				
5			5.0 Bottom of Pit				Sample from 0'-5.0'.
6							

DATE: Sept. 21, 1976	LOGGED BY: JDF	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y29-C

SHEET 1 OF 1

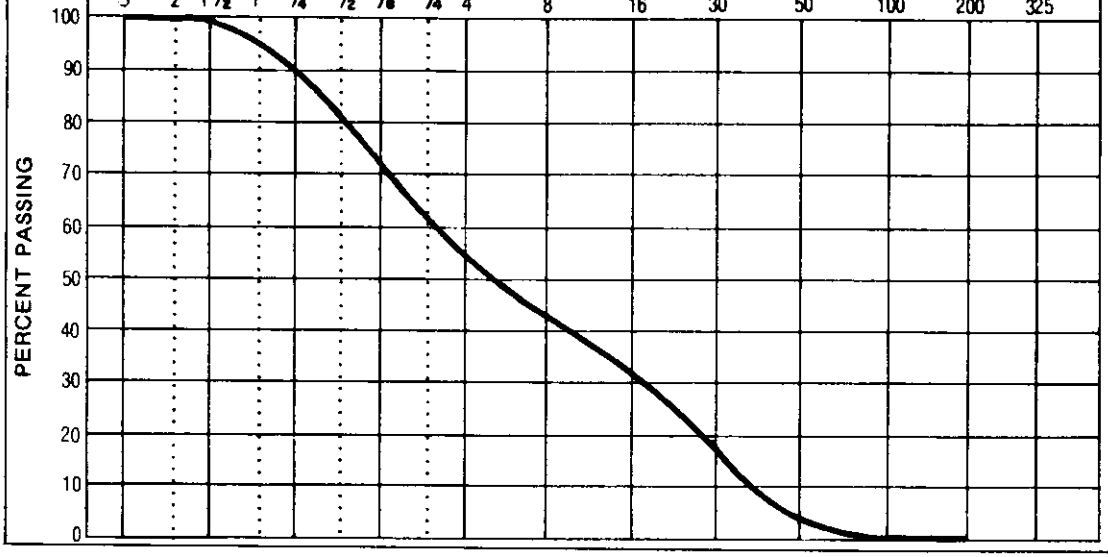
GRAIN SIZE ANALYSIS

SAMPLE Y29-C DEPTH 0'-5.0'

DATE SAMPLED Sept. 21, 1976 SAMPLED BY JDF

LAB TEST NUMBER TP51

GRAVEL SIZES		SAND SIZES			FINES
10.3 %	35.5 %	13.0%	31.5 %	9.6 %	0.1 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
2"	0

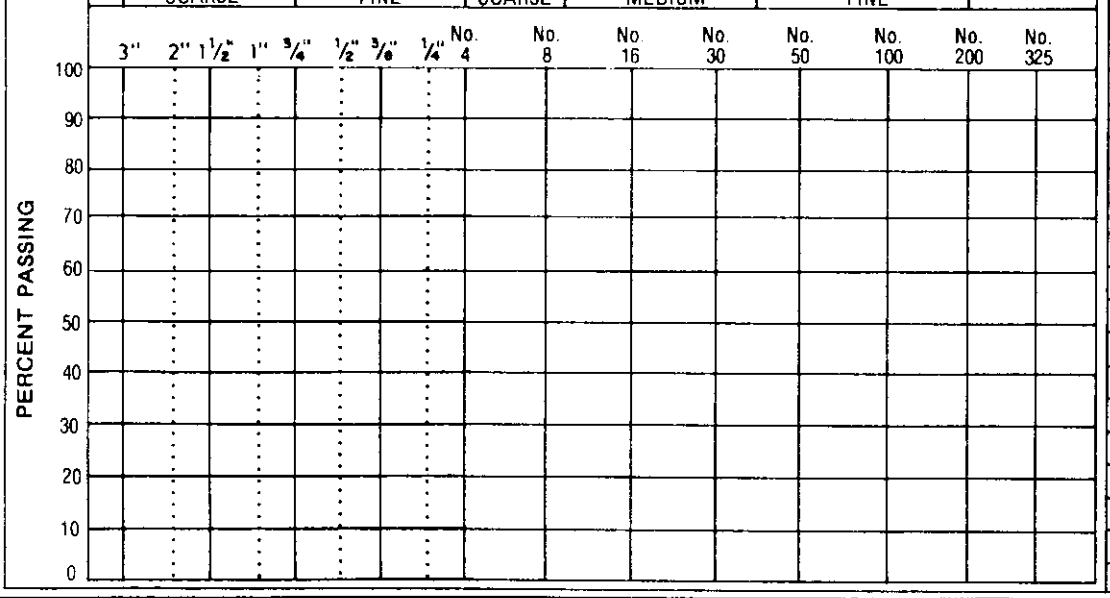
SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	100.0
1 1/2"	99.2
1"	95.5
3/4"	89.7
1/2"	81.2
3/8"	73.1
1/4"	
No. 4	54.2
No. 8	43.4
No. 16	32.6
No. 30	17.9
No. 50	3.1
No. 100	0.1
No. 200	0.1

SAMPLE _____ DEPTH _____

DATE SAMPLED _____ SAMPLED BY _____

LAB TEST NUMBER

GRAVEL SIZES		SAND SIZES			FINES
%	%	%	%	%	%
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"

SIEVE SIZE	PERCENT PASSING
3"	
2"	
1 1/2"	
1"	
3/4"	
1/2"	
3/8"	
1/4"	
No. 4	
No. 8	
No. 16	
No. 30	
No. 50	
No. 100	
No. 200	

GOVERNMENT OF CANADA

DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.

CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

DEPOSIT No.

Y29

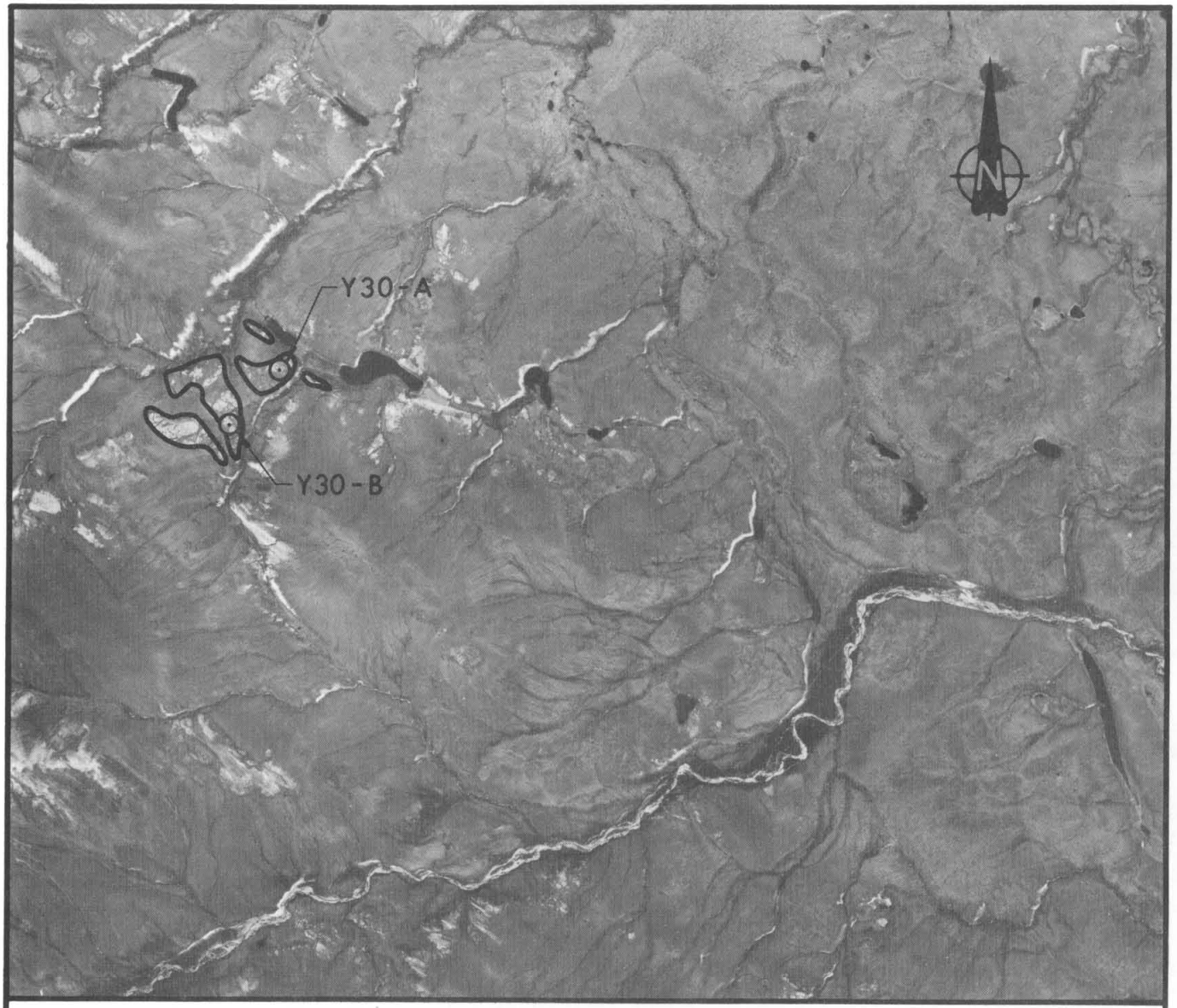
DEPOSIT Y30

Setting: Kame terraces along the edge of the Buckland Hills. Located 12 miles southwest of Roland Bay and 3½ miles east of Okpioyuak Creek.

Material: Sand; some fine to coarse gravel.

Volume: 8,500,000 cubic yards total.

Assessment: Contains poor quality granular material. Shale fragments are predominant. Access is fair.



Airphoto No.: A24123-156
Deposit Outline - R.M. Hardy
Deposit Outline - Others
Approx. Scale: 1"=5200'
Test Pit ⊙
Exposures ✠

DEPOSIT Y30

SETTING

Deposit Y30 consists of a number of kame terraces located at the limit of glaciation along the northeastern edge of the Buckland Hills, 12 miles southwest of Roland Bay and 3½ miles east of Okpioyuak Creek. The terraces lie at the downstream end of a meltwater channel which is incised into bedrock. The northeastern edge is also flanked by an incised meltwater channel, which was formed after the glacier had wasted to a lower level.

The terrace surfaces, which slope gently to the north are separated by stable 40 to 70 foot scarps. The bare surface of the terraces show a series of low 1 to 2 foot trenches outlining a broad polygonal pattern. Gentle swales also spot the surface of the terraces.

Except for minor accumulations of peat, one to five feet deep, in the shallow trenches and swales, the surface of Deposit Y30 is free of overburden. The deposit is largely bare of vegetation except for a broken mat of Dryas, lichen, and prostrate dwarf birch. Swales are covered by sedge tussock tundra. Protected slopes have growth of willows and prostrate alders, 5 feet high. The active layer varies from 4½ feet to over 6 feet.

Deposit Y30 is adjacent to ice-rich, silt-mantled uplands with a narrow creek valley to the east and west and an incised meltwater channel to the north. The area provides habitat for caribou, Arctic fox, and grizzly bear. The bordering creeks drain to small lakes where Arctic grayling may spawn and overwinter.

MATERIAL

Deposit Y30 contains poor quality granular material with a predominance of platy and angular to subangular shale and argillite

fragments. The material consists of sand and gravel sized material with pebbles to 3 inches in size and averaging ½ inch. Sandstone and quartzite clasts were also noted. Angular quartzite boulders to 15 inches in size are scattered over the surface.

VOLUME

The total volume of 8,500,000 cubic yards is based on an average thickness of 24 feet as slope morphologies indicate the terraces are probably 30 to 60 feet thick at their outer edge.

Annually, 8,700 cubic yards may be extracted per acre by conventional techniques assuming that permafrost will limit extraction to yearly depths of 6 feet.

DEVELOPMENT

Development of Deposit Y30 should be initiated by excavating material along benches at the outer edge of the terraces to minimize disruption of natural drainage courses. These benches would easily blend into the landscape with minor grading when abandoned.

Access to the coast involves the crossing of an incised meltwater channel. The moderate slopes of the surrounding uplands which are susceptible to thermokarst, would have to be crossed.

Deposit Y30 lies within the proposed Arctic Wildlife Range, which may restrict development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	SW		SAND - little gravel, trace silty fines, angular to subangular, platy, brown, damp, predominantly shale.		UF		
			1.0				
	GW		GRAVEL - fine to 2" size, and fine to coarse sand, trace fines, angular to subangular, platy, predominantly shale.				
2							
3							
4							
						4.5	
5					Nbe		
6			6.0				
			Bottom of Pit				Sample from 1'-6.0'
7							

DATE: Sept. 30, 1976 | LOGGED BY: SA | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y30-A

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
0	GP		GRAVEL - predominantly shale to 2" size, some medium to coarse sand, sub-rounded to subangular, dry, brown with grey sand.		UF		Lightweight Pieces - Fine Aggregate: 0.07%
6			6.0 Bottom of Pit				Sample from 0'-6.0'

DATE: Sept. 30, 1976 | LOGGED BY: SA | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

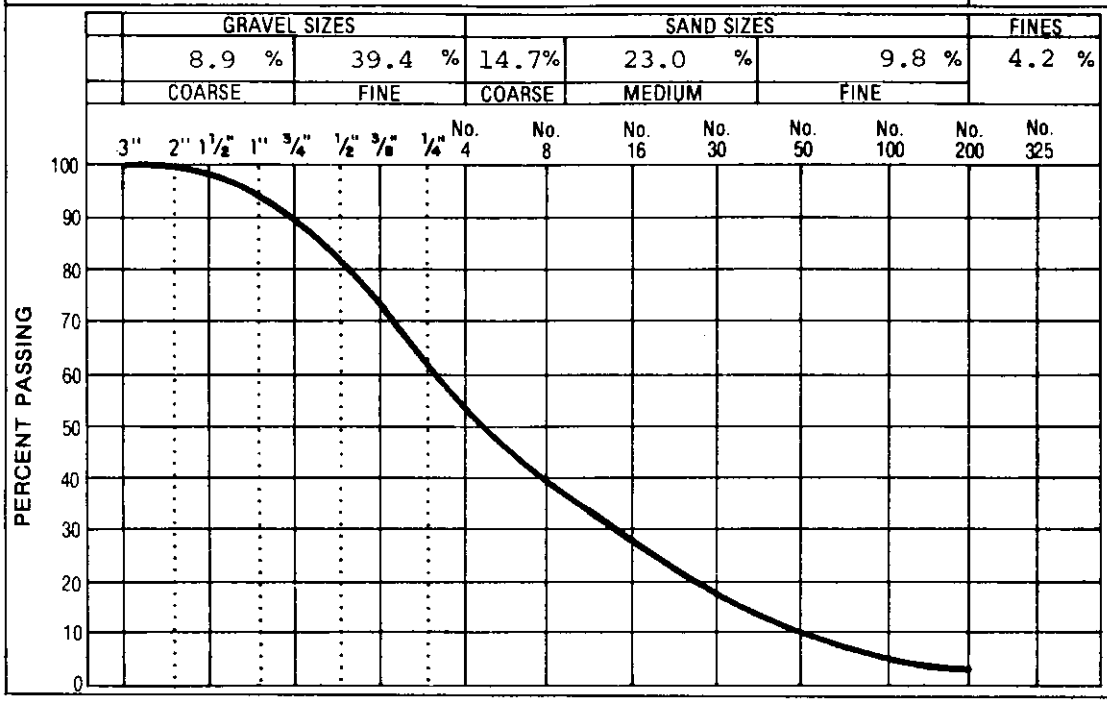
R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y30-B

SHEET 1 OF 1

GRAIN SIZE ANALYSIS

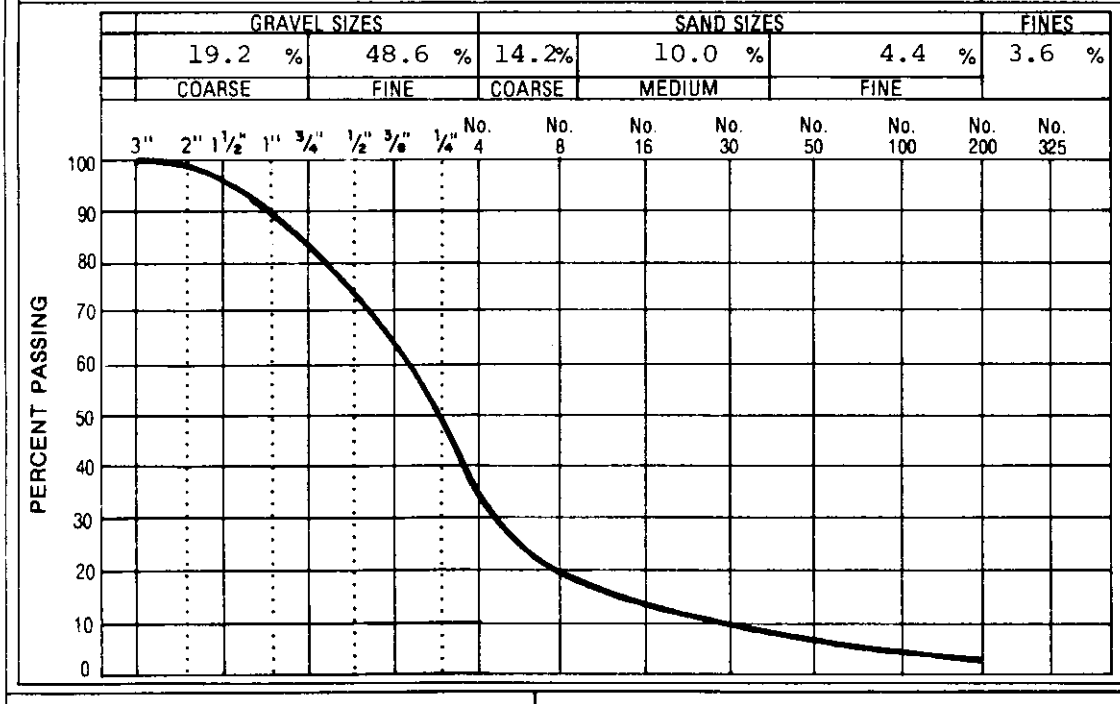
SAMPLE Y30-A DEPTH 1.0'-6.0'
DATE SAMPLED Sept. 30, 1976 SAMPLED BY SA
LAB TEST NUMBER TP80HA



MAX. SIZE	% > 3"
3"	0

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	98.7
1 1/2"	98.2
1"	95.2
3/4"	91.1
1/2"	82.5
3/8"	73.5
1/4"	
No. 4	51.7
No. 8	39.1
No. 16	29.2
No. 30	20.6
No. 50	10.0
No. 100	4.8
No. 200	4.2

SAMPLE Y30-B DEPTH 0'-6.0'
DATE SAMPLED Sept. 30, 1976 SAMPLED BY SA
LAB TEST NUMBER 77HA



MAX. SIZE	% > 3"
3"	0

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	100.0
1 1/2"	93.8
1"	87.8
3/4"	80.8
1/2"	66.3
3/8"	56.0
1/4"	
No. 4	32.2
No. 8	19.7
No. 16	12.3
No. 30	8.2
No. 50	5.9
No. 100	4.5
No. 200	3.6

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No. Y30

SUMMARY OF LABORATORY TEST DATA FOR SUITABILITY OF AGGREGATES IN CONCRETE

PETROGRAPHIC ANALYSIS

COARSE AGGREGATE

ROCK TYPE	CLASSIFICATION	TOTAL WEIGHTED COMPONENT %
Quartzite, Quartzitic Sand-	Medium Strong to Strong, Good	7.7
stone		
Sandstone		21.6
Limestone		3.0
Slate	Flaky, Poor	6.6
Shale	Weak, Deleterious	61.0
Ironstone	Weak, Deleterious	0.1
PN:= 683	INTERPRETATION: Unsuitable for aggregate.	100.0

SOUNDNESS OF AGGREGATE - SULPHATE TEST

COARSE AGGREGATE: LOSS= 54.33

FINE AGGREGATE: LOSS= 45.55

OTHER TESTS

LIGHTWEIGHT PIECES IN AGGREGATE: FINE: 0.05%

SPECIFIC GRAVITY: FINE: 2.59, COARSE: 2.60

WATER ABSORPTION: FINE: 3.61%, COARSE: 2.77%

ORGANIC IMPURITIES TEST

NUMBER	:	4
COAL REMOVED	:	3
COAL & ROOTLETS REMOVED	:	
COAL CONTENT	:	0.05%

COMMENTS: Sulphate Test was performed for 5 cycles in Magnesium Sulphate solution. Visual disintegration after 3 cycles.
Specific Gravity Test was performed at 20°C.
Lightweight Pieces were determined by floating on Zinc Chloride solution with a Specific Gravity of 2.0.

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO.
Y30-A

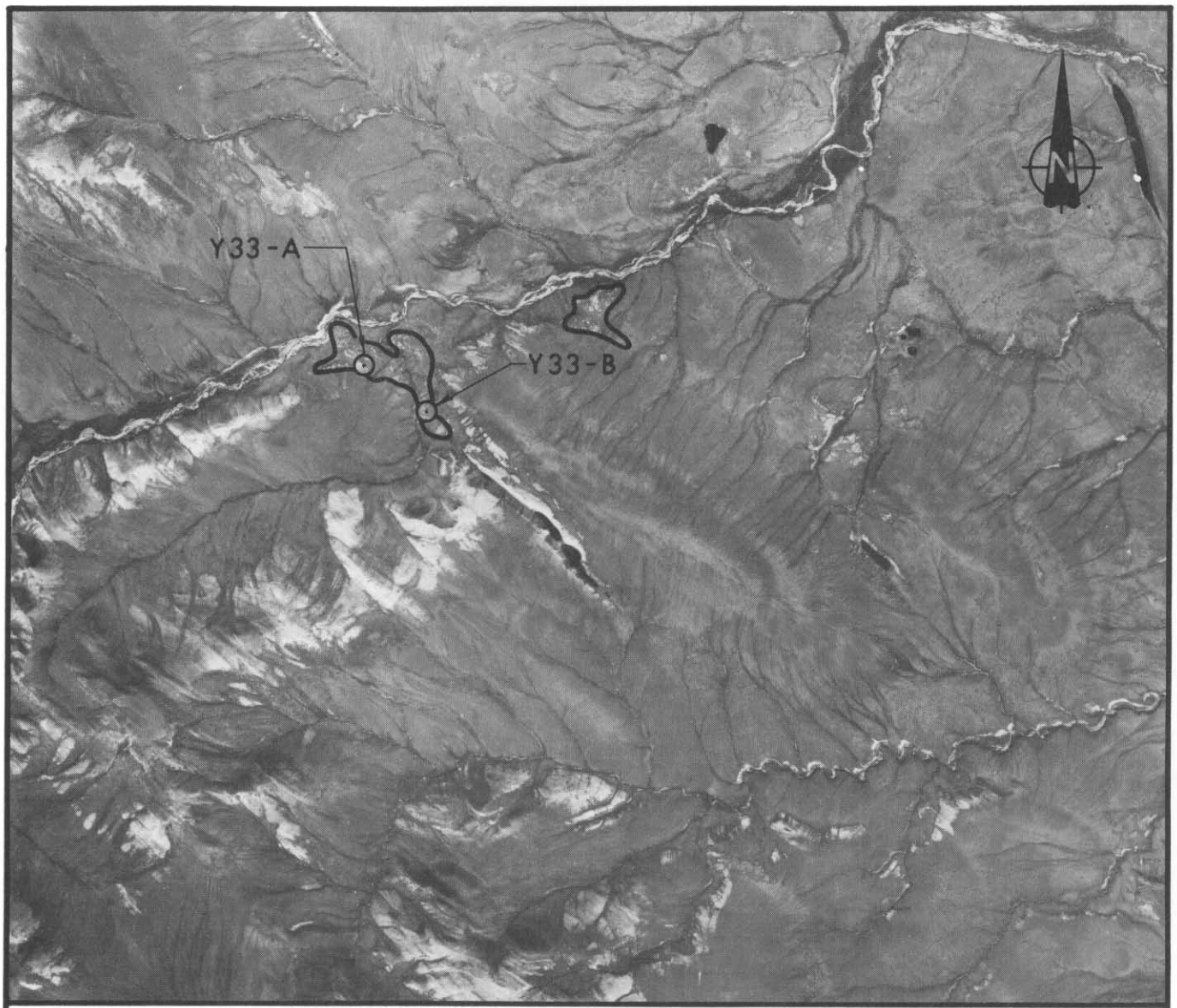
DEPOSIT Y33

Setting: Kame terraces along the southeastern edge of the Buckland Hills about 13 miles southwest of Roland Bay and 7½ miles west of Spring River.

Material: Gravel; well graded, fine to coarse, some sand.

Volume: 2,100,000 cubic yards total.

Assessment: Contains poor quality granular material with significant amounts of oversize particles. Shale fragments dominate and massive ice may be encountered. Good access to deposit area.



Airphoto No.: A24123-157		Approx. Scale:	1"=5400'
Deposit Outline - R.M. Hardy	———	Test Pit	⊙
Deposit Outline - Others	—·—·—	Exposures	✣

DEPOSIT Y33

SETTING

Deposit Y33 consists of a pair of kame terraces located along the southeastern side of the valley of a major creek flowing out of the Buckland Hills. The kames are located 13 miles southwest of Roland Bay and 7½ miles west of Spring River. One kame terrace is positioned at the mouth of a small tributary creek at the downstream end of a melt-water channel incised in bedrock. The other kame terrace is positioned on a long hillslope at the very edge of the Buckland Hills.

The western kame terrace has a rolling to hummocky nature, indicative of recent thermokarst which may suggest the possibility of massive ground ice within or underlying the deposit. A small creek also bisects it.

Deposit Y33 is well drained and has a local relief of 30 feet due to its hummocky nature and stream dissection. Ice-wedge trenches, 1 to 3 feet deep, outline a broad polygonal pattern over part of the deposit's surface. The deposit is covered by patches of fell field; willow shrubbery is present along the small creek dissecting the western terrace. The active layer is likely in excess of 6 feet deep over most of the deposit.

Deposit Y33 is bordered by moderately sloping ice-rich silt-mantled uplands to the south and gently rolling morainal deposits to the north. Scree-covered slopes are also common in the Buckland Hills to the south. The area provides habitat for caribou, Arctic fox, and grizzly bear. Arctic char and Arctic grayling inhabit the adjoining creek when not frozen over.

MATERIAL

Deposit Y33 contains poor quality granular material consisting of stratified, well graded, fine to coarse gravel with some sand. Some

beds are very coarse with angular boulders to 14 inches in size. The larger clasts are mainly angular to subangular shale and argillite with some quartzite, chert and, sandstone. Shale and argillite are predominant in the fines.

VOLUME

The total of 2,100,000 cubic yards is based on a minimum average thickness of 15 feet. The morphology of the deposit suggests a minimum of 30 feet of granular material underlies most hills. One-half of the volume of positive areas has been assumed to be composed of massive ice.

Annually, 7,000 cubic yards per acre can be extracted by conventional techniques assuming that permafrost will limit the yearly depth of excavation to 6 feet.

DEVELOPMENT

Material from Deposit Y33 should be excavated so resulting slopes maintain their natural drainage. Massive ice, if encountered, will require special techniques to waste or preserve it depending on its configuration.

Good access to the coast is easily attained along the creek valley in which the deposit is located. Direct southeast-northwest travel would be difficult over steep slopes.

Deposit Y33 lies within the proposed Arctic Wildlife Range, which may restrict development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	GW		GRAVEL - well graded to 8" cobbles, little fine to coarse sand, occasional boulder to 14" size, angular to subangular, cobbles coated with cementing agent, brown, damp, predominantly shale fragments.		UF		Lightweight Pieces - Fine Aggregate: 0.33%
2							very difficult digging
3							
4							
5			5.5				
6			Bottom of Pit				Sample from 0'-5.5'

DATE: Oct. 2, 1976 | LOGGED BY: CPM | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y33-A

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
	Pt		PEAT - fibrous, silty. 0.5		UF		Lightweight Pieces - Fine Aggregate: 0.11%
1	GW		GRAVEL - well graded, little sand, angular, predominantly shale, loose, brown, wet.				
2			2.5 numerous cobbles and boulders to 10" size, subangular.				
3							
4							
5							
6			6.0 frozen at 6.0'			6.0	
			Bottom of Pit				Sample from 0.5'-6.0'
7							

DATE: Oct. 2, 1976	LOGGED BY: SA	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y33-B
SHEET 1 OF 1

GRAIN SIZE ANALYSIS

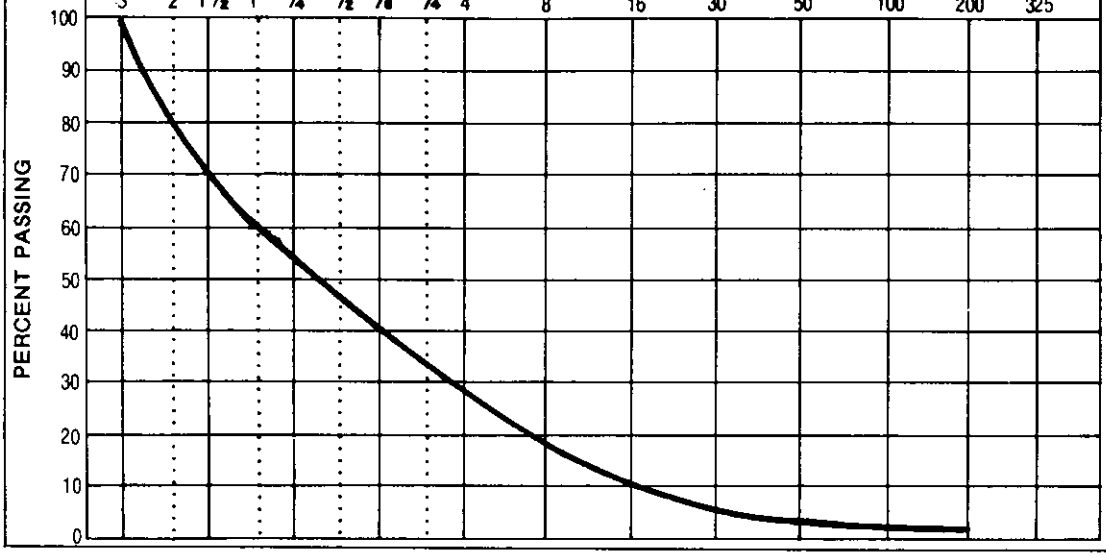
SAMPLE Y33-A DEPTH 0'-5.5'

DATE SAMPLED Oct. 2, 1976 SAMPLED BY CPM

LAB TEST NUMBER 153HA

GRAVEL SIZES		SAND SIZES			FINES
43.4 %	26.2 %	12.9 %	13.0 %	1.9 %	3.1 %
COARSE	FINE	COARSE	MEDIUM	FINE	

MAX. SIZE	% > 3"
5"	29.5



SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	85.0
1 1/2"	75.0
1"	62.8
3/4"	56.6
1/2"	49.0
3/8"	43.5
1/4"	
No. 4	30.4
No. 8	19.6
No. 16	10.5
No. 30	6.1
No. 50	4.7
No. 100	3.9
No. 200	3.1

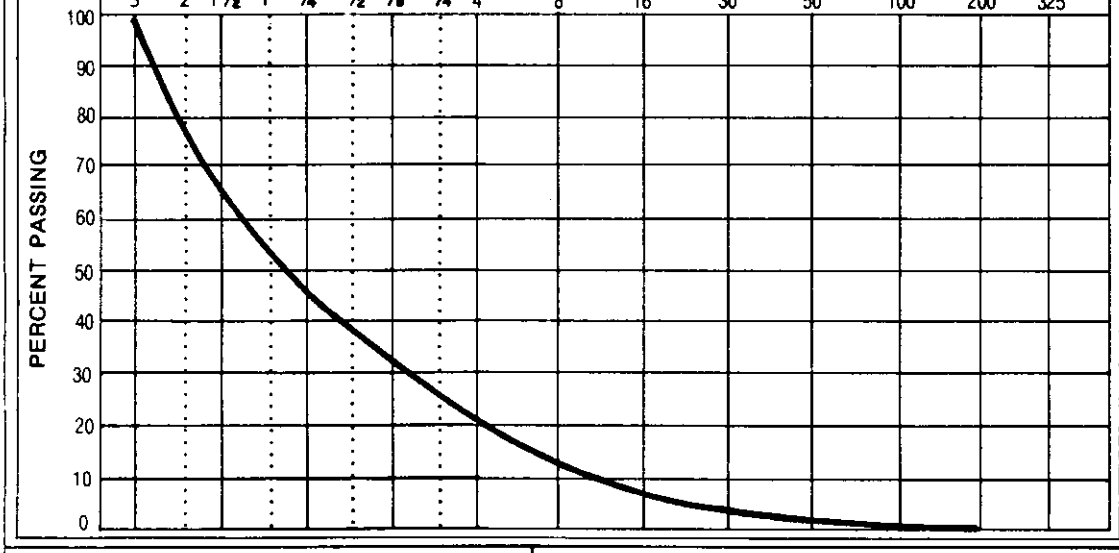
SAMPLE Y33-B DEPTH 0.5'-6.0'

DATE SAMPLED Oct. 2, 1976 SAMPLED BY SA

LAB TEST NUMBER 154HA

GRAVEL SIZES		SAND SIZES			FINES
51.2 %	25.0 %	10.3 %	10.0 %	1.5 %	2.0 %
COARSE	FINE	COARSE	MEDIUM	FINE	

MAX. SIZE	% > 3"
6"	20.7



SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	70.0
1 1/2"	65.4
1"	53.7
3/4"	48.8
1/2"	41.8
3/8"	36.6
1/4"	
No. 4	23.8
No. 8	15.3
No. 16	8.4
No. 30	4.6
No. 50	3.3
No. 100	2.5
No. 200	2.0

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No. Y33

DEPOSIT Y34

Setting: Scree-covered ridges at the edge of the Buckland Hills, 6 miles west of the Spring River and 16 miles southwest of Stokes Point.

Material: Quartzite and Argillite Rubble; coarse, and silty clay.

Volume: 2,200,000 cubic yards total.

Assessment: Contains areas of good and poor quality granular material. The quartzite has potential as a source of crushed rock and riprap. Local steep slopes impede access.

Airphoto No.: A24123-158
Deposit Outline - R.M. Hardy
Deposit Outline - Others
Approx. Scale: 1"=5300'
Test Pit
Exposures

DEPOSIT Y34

SETTING

Deposit Y34 consists of high ridge crests and adjacent hillsides at the northeastern edge of the Buckland Hills, located 6 miles west of the Spring River and 16 miles southwest of Stokes Point.

The ridge crests stand at elevations of 1600 to 1800 feet and rise 1000 feet above the creek valley to the west. The crest of the ridge has gentle to moderate slopes. The edge of the deposit has steep slopes. Locally steep slopes and scarps are present on the upper part of the ridge.

Deposit Y34 is free of overburden and generally well drained. The deposit is bare of vegetation, except in the poorer drained saddles, which have a continuous cover of sedges and low shrubs. Permafrost is at depths of 5 to 6 feet under the scree.

The parent rock at Deposit Y34 is the Precambrian Neruokpuk Formation as the scree is mixed blocky quartzite and platy argillite fragments. The surrounding hills and mountains are typically composed of the Neruokpuk Formation.

Deposit Y34 is bordered by hills and valleys increasing in elevation to the southwest. Moderate silt-mantled slopes extend to the northeast to morainal deposits on the Yukon Coastal Plain. The area provides habitat for grizzly bear and caribou.

MATERIAL

Deposit Y34 contains both good and poor quality granular material. Areas of good quality material consist of quartzite rubble. Some parts of the deposit contain quartzite blocks averaging 6 to 12 inches in size, whereas on other parts of the deposit the blocks and plates are only 2 inches in size. This deposit should be investigated

further to determine whether quarrying and crushing would be desirable. Areas of poor quality material consist of weathered argillite.

VOLUME

The total volume of 2,200,000 cubic yards is based on an average depth to competent rock of 4 feet, and does not include any rock that might be quarried. Further investigation is recommended to estimate volume of good quality granular material.

Annually, 6,500 cubic yards per acre could be extracted by conventional techniques if only distintegrated and weathered material was removed.

DEVELOPMENT

Development of this deposit will involve conventional scraping unless the underlying rock is quarried for riprap or crushed for aggregate.

Access to this deposit is difficult. The more moderate slopes to the northeast would have to be traversed with caution to avoid initiating thermokarst.

Deposit Y34 lies within the proposed Arctic Wildlife Preserve, which may restrict development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
0	CL		CLAY - low plastic, and shale fragments, stiff, brown, wet.		UF		
3.5	BR		ARGILLITE - badly fractured to 2½" size, platy, angular, grey, wet.				
5.5			frozen at 5.5'			5.5	
6			Bottom of Pit				Sample from 4.0'-5.5'

DATE: Oct. 3, 1976	LOGGED BY: SA	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y34-A

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
0	BR		ROCK - to maximum 3" size, little low plastic clay to 1' depth, badly fractured and weathered, angular, oxidized, rusty brown.		UF		
4.0			Bottom of Pit				Sample taken at 4.0'.

DATE: Oct. 3, 1976	LOGGED BY: SA	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO.
Y34-B
SHEET 1 OF 1

SUMMARY OF PETROGRAPHIC DATA FOR ROCK SAMPLES

PETROGRAPHIC ANALYSIS

PARTICLE TYPE	PERCENT
Quartz	95
Interstitial limonite	5
Pyroxene	trace
Zircon	trace

ROCK NAME: Quartzite

GRAIN SIZE: 0.06 to 0.6 mm, most grains 0.2 to 0.3 mm

GRAIN SHAPE: Angular

MATRIX AND CEMENT: Throughgoing siliceous cementation by recrystallization and overgrowths of secondary silica.

POROSITY AND PACKING: Grains are closely interlocked; densely packed; nil porosity.

COMMENTS: Highly competent except for rusty undulating parting surfaces.

NOTE: PETROGRAPHIC ANALYSIS BY DOLMAGE CAMPBELL & ASSOCIATES (1975) LTD.

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO.
Y34-B

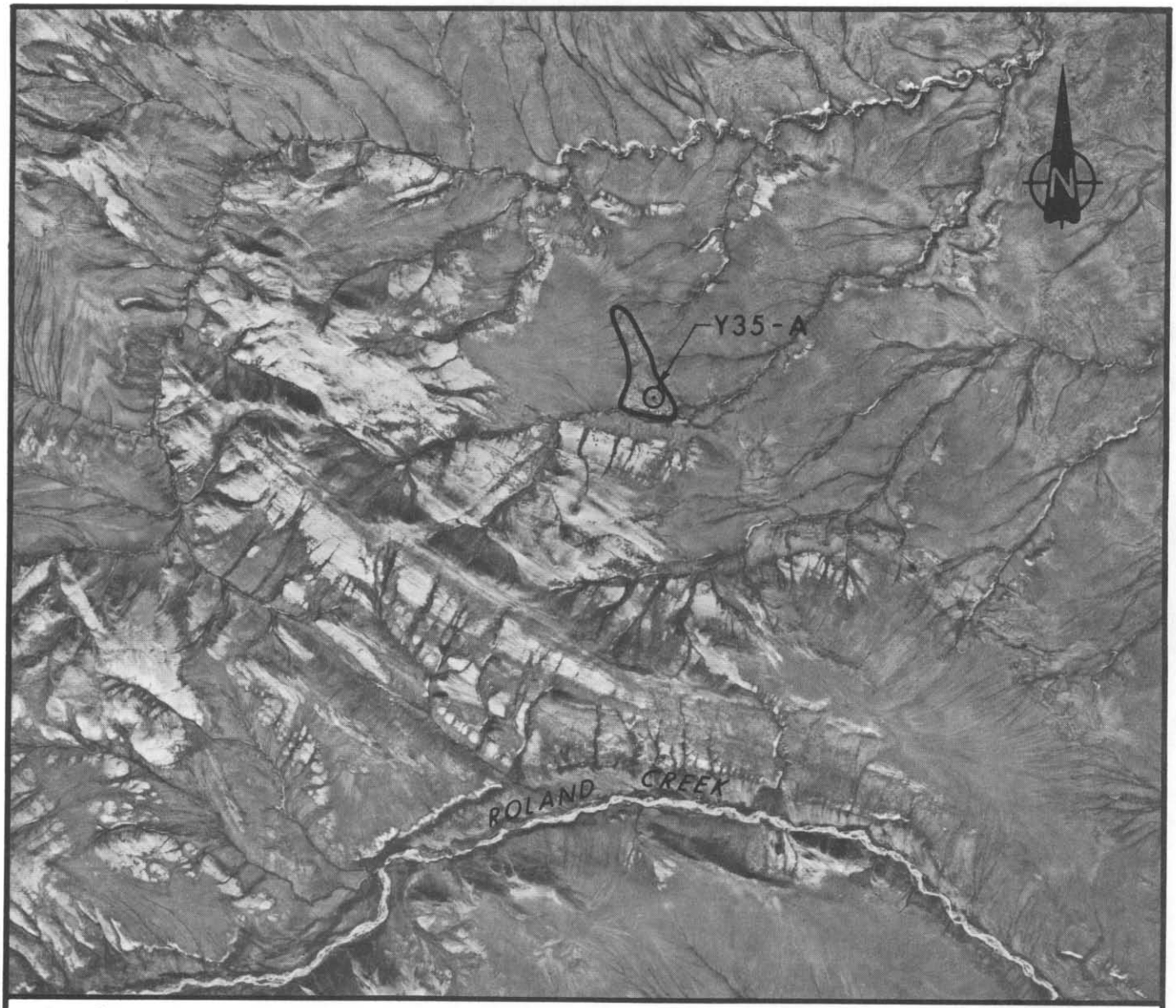
DEPOSIT Y35

Setting: Kame terrace along the southeastern edge of the Buckland Hills about 4 miles west of the Spring River and 14 miles southwest of Stokes Point.

Material: Gravel; well graded, fine to coarse, some sand.

Volume: 2,800,000 cubic yards total.

Assessment: Contains poor to fair quality granular material. Fair access to the east.



Airphoto No.: A24123-158
Deposit Outline - R.M. Hardy
Deposit Outline - Others
Approx. Scale: 1"=5300'
Test Pit
Exposures

DEPOSIT Y35

SETTING

Deposit Y35 consists of a kame terrace along the southeastern edge of the Buckland Hills at the limit of glaciation. It is located 4 miles west of the Spring River and 14 miles southwest of Stokes Point. Its outer edge stands about 50 feet above the adjacent coastal plain. A 100 foot ravine occupied by a small creek forms the southern edge of the kame terrace.

The surface of Deposit Y35 is flat except for 2 to 5 foot deep trenches forming 70 to 80 foot diameter polygons on its surface. Except for a few low swales and the ice-wedge trenches, its surface is well drained and free of overburden. Thin overburden is present in the swales and ice-wedge trenches. The active layer is more than 6 feet thick under well drained areas bare of overburden.

Approximately one-half of the surface of Deposit Y35 is bare of vegetation; the remainder is covered by tundra dominated by Dryas. Ice-wedge trenches and swales support tundra consisting of sedge, moss, dwarf birch, willow, and ericaceous shrubs.

Deposit Y35 is flanked by silt-mantled, moderately-sloping hillsides and scree-covered steep slopes on the southwest, and rolling morainal deposits on the northeast. Entrenched small creek valleys lie north and south of the deposit. This area provides habitat for caribou, Arctic fox, and grizzly bear.

MATERIAL

Deposit Y35 contains poor to fair quality granular material consisting of well graded gravel with some sand. Boulders to 10 inches in size are prevalent. Larger clasts are mainly angular to subangular chert and quartzite. Argillite and shale predominate the fines.

VOLUME

A total volume of 2,800,000 cubic yards is based on a conservative estimate of an average thickness of 21 feet. The morphology of the deposit suggests that it is wedge-shaped and varies in thickness from 0 to more than 50 feet.

Annually, 10,000 cubic yards of material per acre can be excavated by conventional techniques assuming that permafrost would limit extraction to depths of about 7 feet.

DEVELOPMENT

Development of Deposit Y35 would best be accomplished by excavating along the outer edge in order to maintain the natural drainage. Benches created by development operations would easily blend into the landscape upon abandonment.

Access in any direction would be limited by slopes that are either steep or susceptible to thermokarst. Gentle slopes are available to the east leading to the Spring River fluvial system, which offers a good route to the coast.

Deposit Y35 lies within the proposed Arctic Wildlife Range, which may restrict development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	GM		GRAVEL - well graded to 3" size, some sand, little silty fines, angular to subangular, brown, damp.		UF		Organic Color: #5 Coal Removed: #5 Lightweight Pieces - Fine Aggregate: 1.09%
		1.1					
2	GW		GRAVEL - well graded to 8" cobbles, some fine to coarse sand, few boulders to 10" size, trace rootlets, angular to subangular, brown, moist.				
3							
4							
5							
		5.7					
6			Bottom of Pit				Sample from 1.1'-5.7'

DATE: Oct 3, 1976 | LOGGED BY: CPM | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y35-A

SHEET 1 OF 1

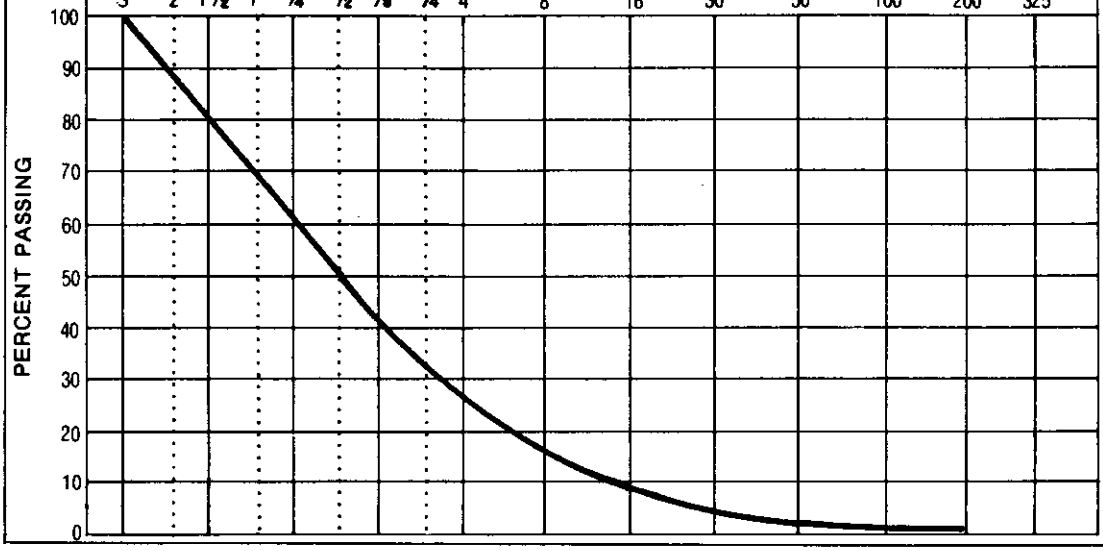
GRAIN SIZE ANALYSIS

SAMPLE Y35-A DEPTH 1.1'-5.7'

DATE SAMPLED Oct. 3, 1976 SAMPLED BY CPM

LAB TEST NUMBER 150HA

GRAVEL SIZES		SAND SIZES			FINES
38.1 %	35.7 %	11.7 %	11.5 %	1.5 %	1.5 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
4"	5.8

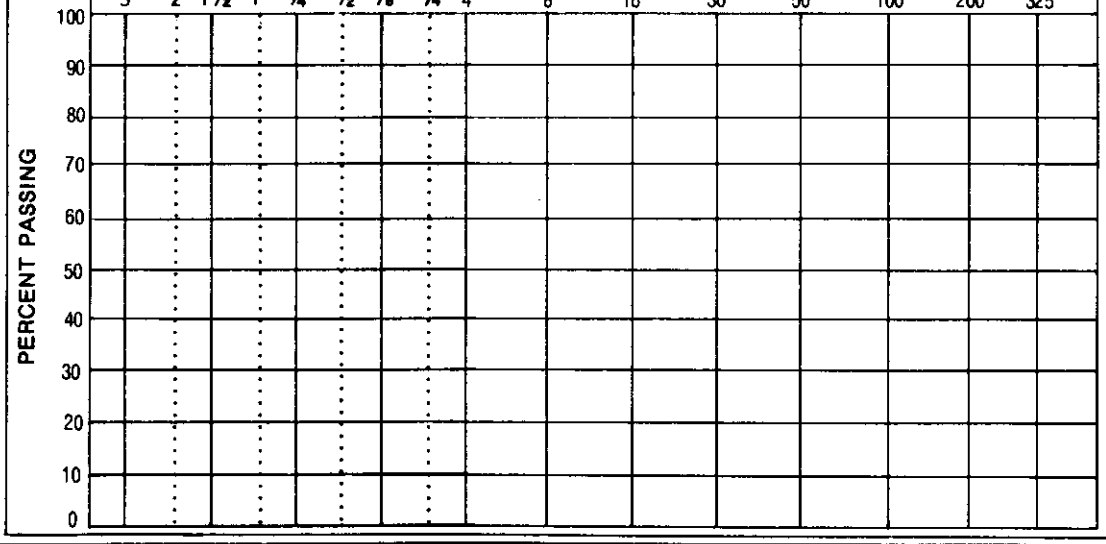
SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	88.1
1 1/2"	78.8
1"	69.0
3/4"	61.9
1/2"	49.6
3/8"	41.9
1/4"	
No. 4	26.2
No. 8	15.0
No. 16	7.8
No. 30	3.9
No. 50	2.4
No. 100	1.9
No. 200	1.5

SAMPLE _____ DEPTH _____

DATE SAMPLED _____ SAMPLED BY _____

LAB TEST NUMBER

GRAVEL SIZES		SAND SIZES			FINES
%	%	%	%	%	%
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"

SIEVE SIZE	PERCENT PASSING
3"	
2"	
1 1/2"	
1"	
3/4"	
1/2"	
3/8"	
1/4"	
No. 4	
No. 8	
No. 16	
No. 30	
No. 50	
No. 100	
No. 200	

GOVERNMENT OF CANADA

DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.

CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

DEPOSIT No. Y35

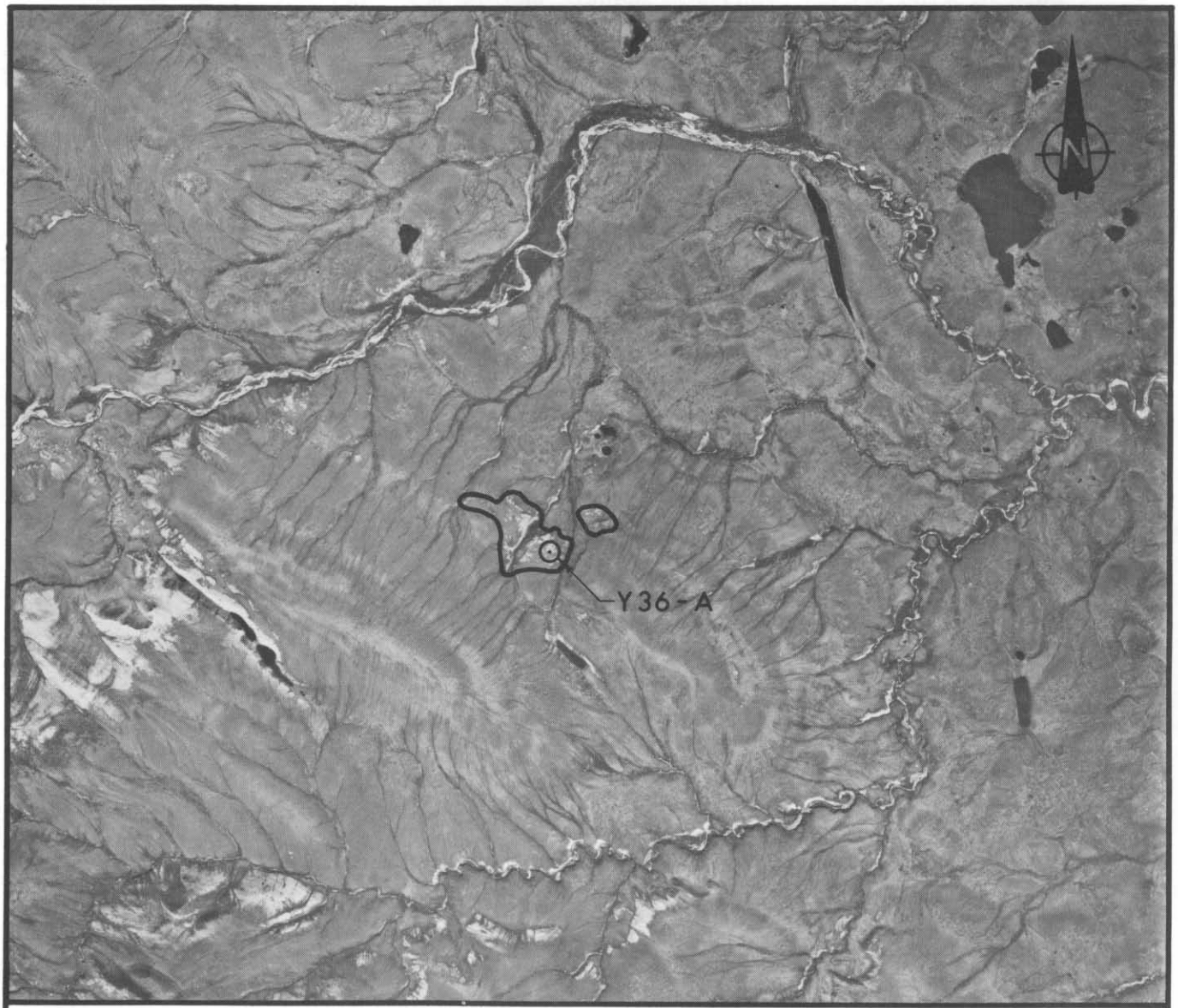
DEPOSIT Y36

Setting: Kame terrace along the edge of the Buckland Hills, 12 miles southwest of Stokes Point and 6 miles west of Spring River.

Material: Gravel; fine to medium, primarily shale fragments.

Volume: 1,800,000 cubic yards total.

Assessment: Contains poor quality granular material consisting primarily of shale fragments. Ground ice in underlying material. Fairly good access.



Airphoto No.: A24123-157		Approx. Scale:	1"=5000'
Deposit Outline - R.M. Hardy	———	Test Pit	⊙
Deposit Outline - Others	—·—·—	Exposures	✣

DEPOSIT Y36

SETTING

Deposit Y36 consists of a kame terrace along the edge of the Buckland Hills located 12 miles southwest of Stokes Point and 6 miles west of Spring River. Three segments of the kame terrace are separated by small creek valleys, approximately 50 feet deep.

The terrace surface has a broad polygonal pattern of 2 foot deep ice wedge trenches. The surface and adjoining 30 foot scarp along the outer edge of the kame terrace are well drained and free of overburden. The trenches and some gentle swales are imperfectly drained and contain 1 to 2 feet of peat and icy silt. Permafrost was encountered at a depth of 4 feet in the test pit.

Most of the deposit is devoid of vegetation. Areas with overburden are covered by sedges and dwarf birch.

Deposit Y36 adjoins gently sloping silt-mantled uplands and morainal deposits, which contain ice-rich sediments. The area provides habitat for caribou, Arctic fox, and grizzly bear.

MATERIAL

Deposit Y36 contains poor quality granular material consisting of fine to medium gravel. The gravel is composed of angular shale fragments.

VOLUME

The total of 1,800,000 cubic yards is based on an average thickness of 12 feet. The morphology of the terrace indicates its outer edge is probably underlain by a thickness of 20 to 30 feet of granular material.

Annually, 7,300 cubic yards of material per acre can be extracted by conventional techniques assuming that permafrost will limit yearly extraction depths to 5 feet.

DEVELOPMENT

Development of Deposit Y36 would best be accomplished by excavating material along benches at the outer edge of the terrace to minimize disruption of drainage. The benches would also easily blend into the landscape with minor grading when abandoned ensuring minimal disturbance to the aesthetics of the area.

Access to the coast would involve crossing terrain which is susceptible to thermokarst. Similar thermokarst sensitive terrain having steeper slopes would have to be crossed in other directions from the deposit.

Deposit Y36 lies within the proposed Arctic Wildlife Range, which may restrict development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	GW		GRAVEL - well graded to 2" maximum, some sand sizes, predominantly shale, weathered, fractured, angular, loose, grey, wet.		UF		Lightweight Pieces - Fine Aggregate: 0.06%
2							
3							
4					Vr 10%	4.0	
5							
6		6.0	Bottom of Pit				Sample from 0.5'-6.0'
7							

DATE: Oct. 2, 1976 | LOGGED BY: SA | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y36-A

SHEET 1 OF 1

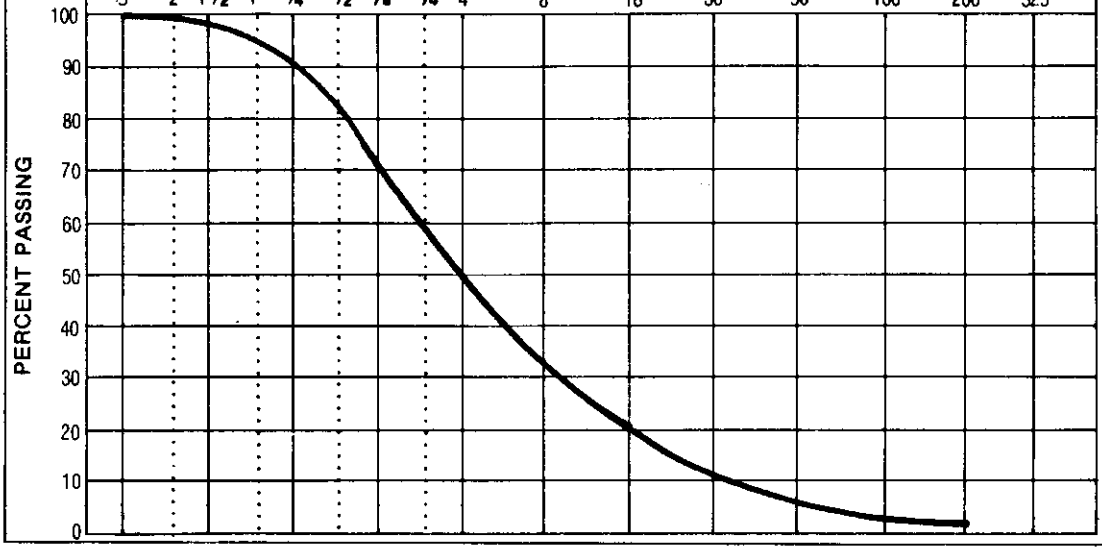
GRAIN SIZE ANALYSIS

SAMPLE Y36-A DEPTH 0.5'-6.0'

DATE SAMPLED Oct. 2, 1976 SAMPLED BY SA

LAB TEST NUMBER 108HA

GRAVEL SIZES		SAND SIZES			FINES
6.7 %	46.5 %	17.3 %	21.0 %	6.6 %	1.9 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
5"	18.6

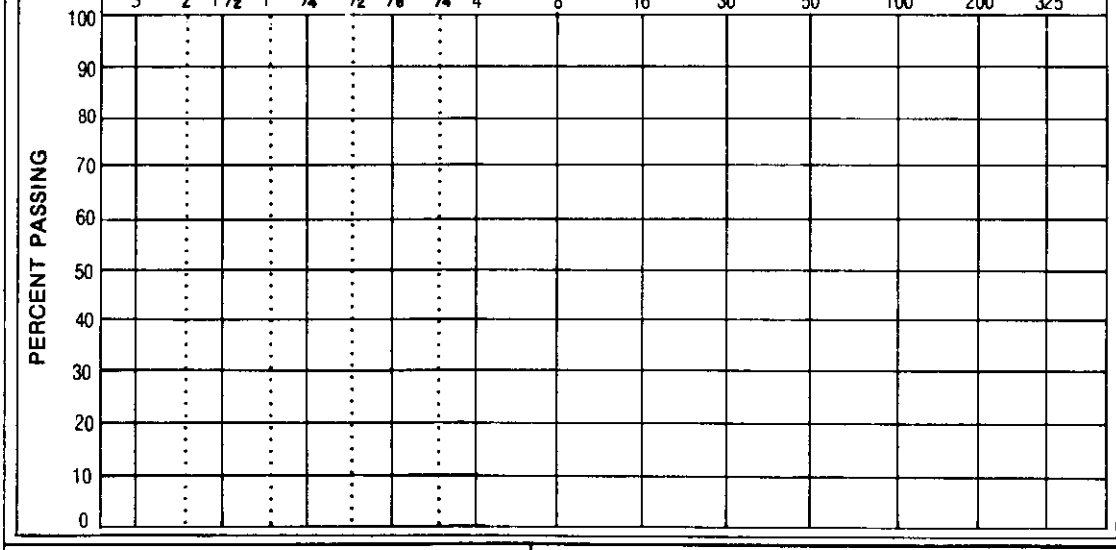
SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	100.0
1 1/2"	98.9
1"	97.3
3/4"	93.3
1/2"	82.4
3/8"	71.3
1/4"	
No. 4	46.8
No. 8	34.8
No. 16	20.9
No. 30	11.2
No. 50	5.4
No. 100	2.6
No. 200	1.9

SAMPLE DEPTH

DATE SAMPLED SAMPLED BY

LAB TEST NUMBER

GRAVEL SIZES		SAND SIZES			FINES
%	%	%	%	%	%
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"

SIEVE SIZE	PERCENT PASSING
3"	
2"	
1 1/2"	
1"	
3/4"	
1/2"	
3/8"	
1/4"	
No. 4	
No. 8	
No. 16	
No. 30	
No. 50	
No. 100	
No. 200	

GOVERNMENT OF CANADA

DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.

CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

DEPOSIT No. Y36

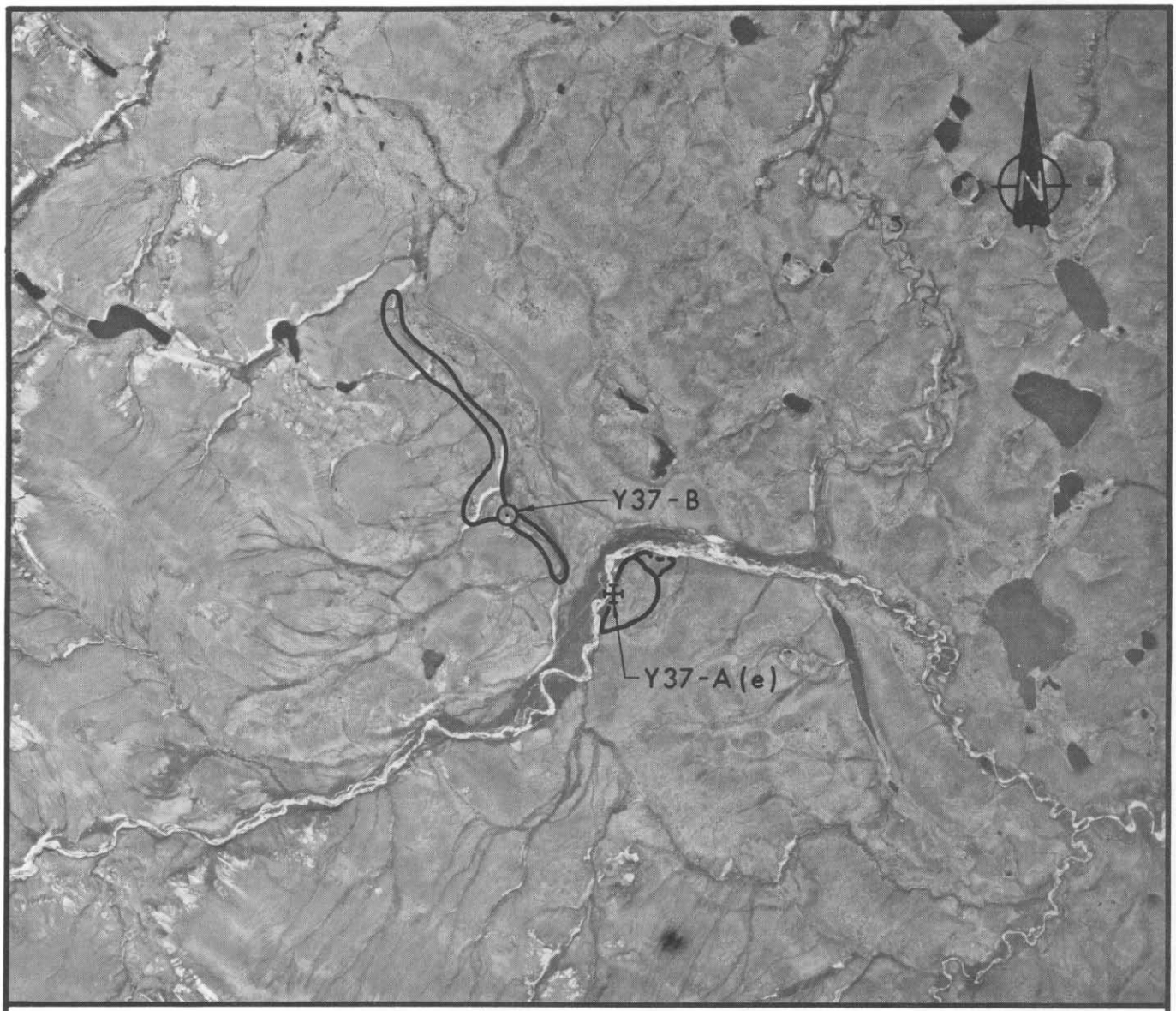
DEPOSIT Y37

Setting: Kame terrace on the Yukon Coastal Plain, about 10 miles southwest of Stokes Point and 6 miles west of Spring River.

Material: Gravel; well graded, fine to coarse, some sand.

Volume: 5,500,000 cubic yards total.

Assessment: Contains fair to good quality granular material with a significant quantity of shale in the fines; moderate amount of oversize. Material should be easy to extract. Fairly good access.



Airphoto No.: A24123-156		Approx. Scale:	1"=5000'
Deposit Outline - R.M. Hardy	———	Test Pit	⊙
Deposit Outline - Others	—·—·—	Exposures	✣

DEPOSIT Y37

SETTING

Deposit Y37 consists of a kame terrace bisected by a post-glacial creek valley. The deposit is located about 10 miles southwest of Stokes Point and 6 miles west of Spring River near a major elbow in a stream valley. This deposit has been designated as 117D-B14 in a previous investigation by Northern Engineering Services Co. Ltd.

The eastern part of the deposit is the remnant of a broad outwash body deposited into a valley at the edge of the ice. The western part consists of a bench deposited along the edge of the Buckland Hills. This bench has been subsequently incised by further meltwater flow at a lower level. A number of small streams dissect this portion of the deposit.

Parts of Deposit Y37 may be covered by 2 to 10 feet of overburden, and are only moderately well drained. However much of the surface is free of overburden and is well drained. These areas have shallow trenches forming a broad polygonal pattern. The active layer was only 4 feet thick under an area overlain by 2 feet of overburden, but probably exceeds 6 feet under areas of exposed gravel.

Most well drained areas are covered by fell field. Sedge tussock tundra grows on areas having any thickness of overburden. Willows, 3 feet high, grow along the stabilized escarpment on the eastern edge of the deposit.

Deposit Y37 adjoins gentle to moderate drift-mantled slopes to the south. Immediately north of the deposit is an imperfectly drained outwash train within a meltwater channel. Beyond this, gently rolling ice-rich morainal deposits cover much of the area between the deposit and the coast. This area provides habitat for caribou, Arctic fox, and grizzly bear. The stream bisecting the deposit is seasonally inhabited by Arctic char and Arctic grayling.

MATERIAL

Deposit Y37 contains fair to good quality granular material, consisting of stratified, well graded, fine to coarse gravel with some sand. Cobbles to 6 inches in diameter and boulders to 14 inches are prevalent. Larger clasts are mainly subrounded to angular sandstone. Shale chips predominate the fines.

VOLUME

The total volume of 5,500,000 cubic yards is based on an average thickness of 21 feet. Exposures and bank morphology indicate that the depth of granular material may be in excess of 30 feet.

Annually, 73,000 cubic yards per 1000 foot length of scarp can be extracted by conventional techniques from the eastern part, and 32,000 cubic yards per 1000 foot length of scarp from the western part. Permafrost may limit annual extraction depths to between 4 and 6 feet, but greater depths will be obtained near scarps.

DEVELOPMENT

Development of Deposit Y37 would be best accomplished by excavating a number of benches along the scarp edges in order to minimize drainage disruption. These benches would easily blend into the landscape with minor grading upon abandonment.

Access to the coast or inland is easily attained along the stream channels that bisect the deposit. An alternate route to the coast is available to the north-northwest over peat-covered outwash.

Deposit Y37 lies with the proposed Arctic Wildlife Range, which may restrict development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
	Pt		0.5 PEAT		UF		Lightweight Pieces - Fine Aggregate: 0.40%
2	GM		GRAVEL - well graded, little silty fines. 2.0				
	GW		GRAVEL - well graded to 3" size, some medium to coarse sand, angular, platy particles, medium dense, grey, wet.				
4							
6							
8							
10							
12							
14							
16							
18							
20			21.0				
22			Bottom of Pit				Sample from 3.0'-15.0'

DATE: Oct. 2, 1976 | LOGGED BY: SA | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y37-A(e)

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
	Pt		PEAT - fine, fibrous. 0.6		UF		Organic Color: #3+
1	CL		CLAY - silty, little sand, trace gravel to 1½" size, brown, moist. 2.0				Lightweight Pieces - Fine Aggregate: 0.18%
2	GW		GRAVEL - well graded to 8" cobbles, little fine to coarse sand, sub-angular to subrounded, brown, damp. 6.0				
3							
4					Vc Vx 5%	4.0	
5							
6			Bottom of Pit				Sample from 2.0'-6.0'
7							

DATE: Oct. 2, 1976	LOGGED BY: CPM	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

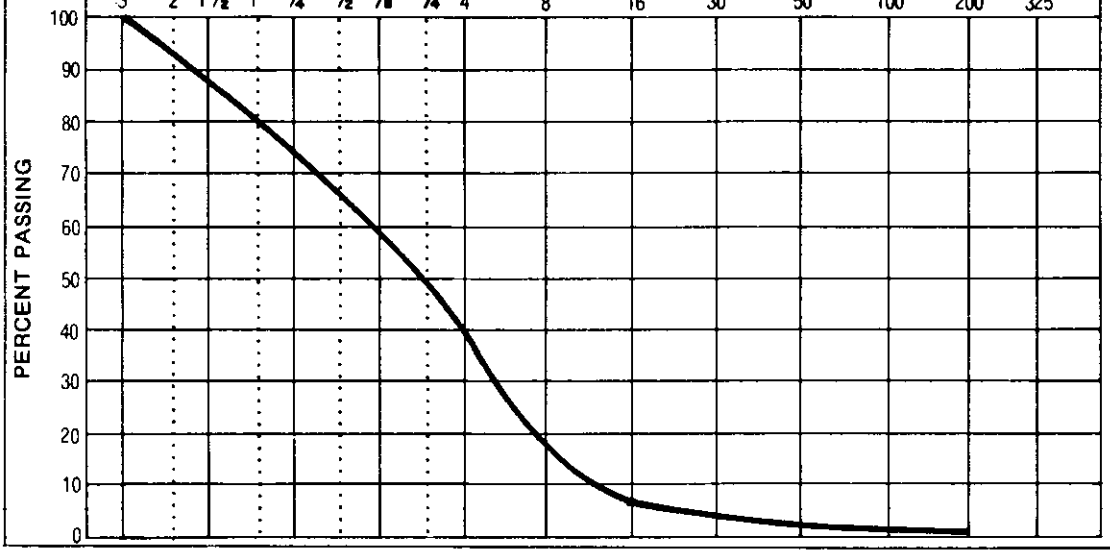
TEST PIT NO. Y37-B

SHEET 1 OF 1

GRAIN SIZE ANALYSIS

SAMPLE Y37-A(e) DEPTH 3.0'-15.0'
DATE SAMPLED Sept. 2, 1976 SAMPLED BY SA
LAB TEST NUMBER 109HA

GRAVEL SIZES		SAND SIZES			FINES
26.3 %	34.8 %	26.1 %	10.0 %	1.7 %	1.1 %
COARSE	FINE	COARSE	MEDIUM	FINE	

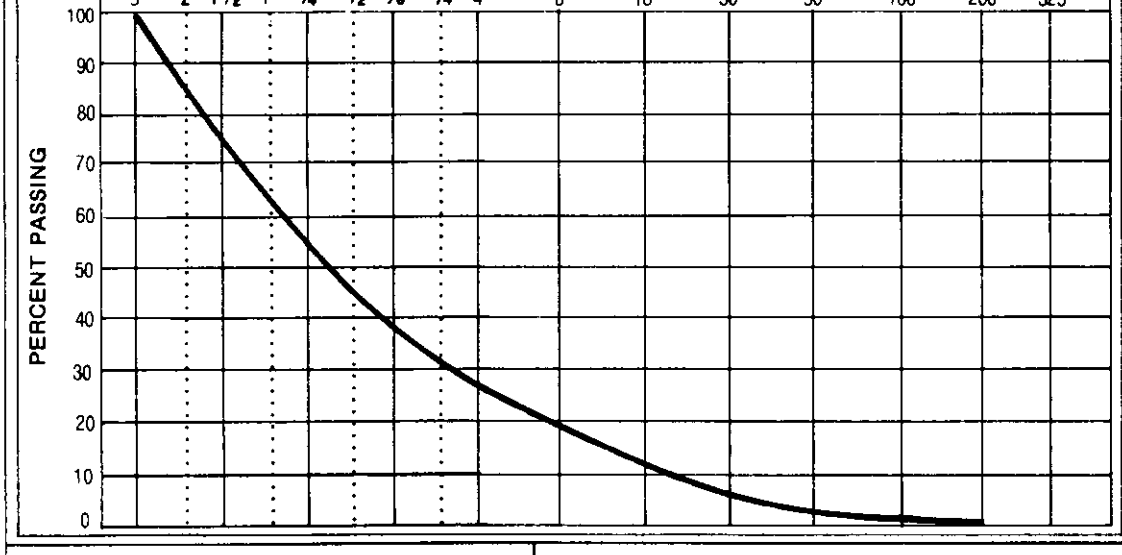


MAX. SIZE	% > 3"
3"	0

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	96.1
1 1/2"	86.1
1"	79.7
3/4"	73.7
1/2"	65.8
3/8"	58.8
1/4"	
No. 4	38.9
No. 8	15.6
No. 16	6.6
No. 30	2.7
No. 50	1.5
No. 100	1.2
No. 200	1.1

SAMPLE Y37-B DEPTH 2.0'-6.0'
DATE SAMPLED Oct 2, 1976 SAMPLED BY CPM
LAB TEST NUMBER 110HA

GRAVEL SIZES		SAND SIZES			FINES
44.9 %	26.4 %	11.5 %	12.2 %	3.1 %	1.9 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
5"	15.2

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	84.2
1 1/2"	74.8
1"	62.0
3/4"	55.1
1/2"	46.5
3/8"	40.8
1/4"	
No. 4	28.7
No. 8	19.8
No. 16	12.0
No. 30	6.9
No. 50	3.7
No. 100	2.3
No. 200	1.9

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No.
Y37

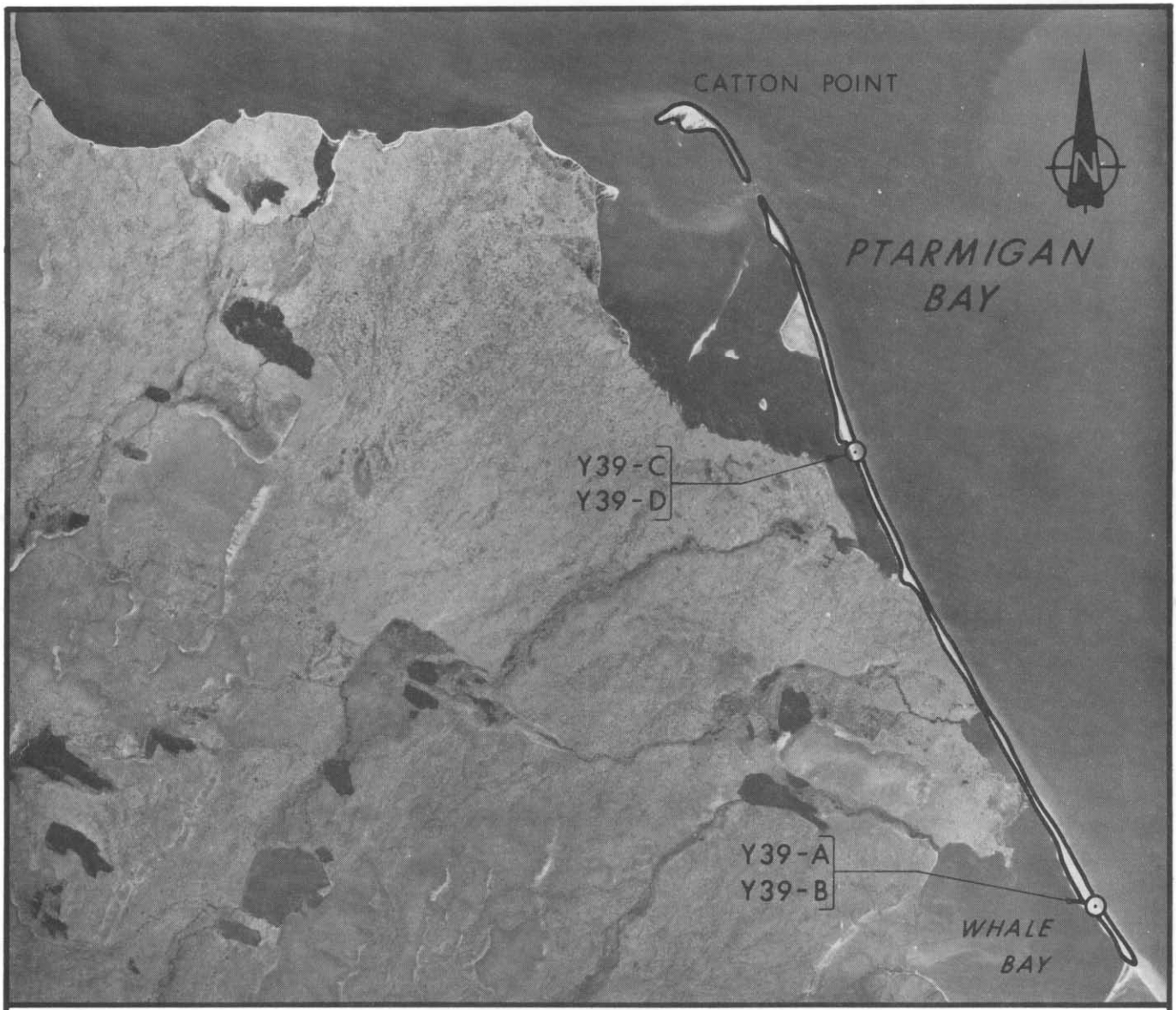
DEPOSIT Y39

Setting: Spit, beach, and bay-mouth bar adjacent to Ptarmigan Bay south of Herschel Island.

Material: Gravel; poor to well graded, some medium to coarse sand.

Volume: 1,200,000 cubic yards total.

Assessment: Contains fair to good quality granular material. Extraction may speed coastal retreat at the eastern end. Restoration would proceed through natural coastal processes. A number of archeological sites may be present on the deposit and adjoining area. Good access. Recoverable volume may be limited to 600,000 cubic yards.



Airphoto No.: A24123-152		Approx. Scale:	1"=5000'
Deposit Outline - R.M. Hardy	———	Test Pit	⊙
Deposit Outline - Others	—·—·—	Exposures	✠

DEPOSIT Y39

SETTING

Deposit Y39 consists of a bay-mouth bar, beach and spit. The bay-mouth bar streches across an inlet known as Whale Bay and extends northward along the edge of the coastal plain in the form of a broad beach. The northern portion of the deposit consists of a long spit extending northwestward toward Herschel Island where it terminates in a number of recurved ridges at Catton Point. This spit adjoins a small island about 1½ miles from the mainland at its midpoint.

Deposit Y39 averages about 180 feet in width. Its crest is 3 to 4 feet above sea level. The foreshore of the spit and bay-mouth bar average about 60 feet across and the crest and backshore about 120 feet across. The eroded sediments from cliffs to the east, and the outwash plain, to which the deposit is joined west of Whale Bay, is the source of granular material.

The surface of Deposit Y39 is generally well drained and bare of vegetation, except on broader parts of the bay-mouth bar where swales have been formed by washover lobes and tufts of grass are present. Driftwood is concentrated on the crest of the bay-mouth bar and spit. Deposit Y39 is completely inundated during major storm surges. Frost was encountered within the spit at a depth of 5.2 feet.

The bay-mouth bar adjoins an ice-cored drift-covered hill at its eastern end and peat-covered outwash at its western end. The spit is attached at its eastern end to the same outwash.

Deposit Y39 and the adjacent terrain lie in a waterfowl staging and caribou calving area and provides habitat for Arctic fox and grizzly bear.

MATERIAL

Deposit Y39 contains good to fair quality granular material consisting of stratified, poor to well graded, fine to medium gravel with some medium to coarse sand and poor to well graded sand with some fine gravel. Larger clasts are mainly rounded to subangular sandstone with some chert and argillite and rare quartz.

VOLUME

The total volume of 1,200,000 cubic yards is based on an average thickness of 6 feet as bathymetric configurations and data from other spits suggest that Deposit Y39 is at least 9 feet thick. Annually, 20,000 cubic yards per 1000 foot length of spit could be extracted by conventional techniques assuming that only material above sea level is removed. Volume of recoverable material may be limited to 600,000 cubic yards because of static water level.

DEVELOPMENT

Deposit Y39 would be easily developed by conventional techniques during summer and fall, although storm tides would interrupt operations. The adjacent peat-covered outwash is adequate for long-term stockpiling. Extraction of material from beyond the island at the midpoint of the spit would not greatly alter coastal dynamics. However, extraction east of this point may cause an increase in the rate of erosion of the local coast. The deposit would probably restore rapidly with eroded gravel and sand from the adjacent outwash.

Numerous decayed log structure and artifacts indicate that both the deposit and adjacent low hills may be of archeological significance. Detailed site investigations are required to delineate areas that should not be developed. Development of Deposit Y39 should be planned to minimize interference with the waterfowl staging and caribou calving. The deposit lies within the proposed Arctic Wildlife Range, which may restrict development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
0	GP		GRAVEL - coarse, rounded. 0.5		UF		Moisture Content: 5.6%
1	SW		SAND - well graded, and gravel to 1½" size, rounded.				Lightweight Pieces - Fine Aggregate: 0.18%
2			2.5				
	SP		SAND - fine. 2.8				
3	GP		GRAVEL - fine to 3/4" size and fine to coarse sand, stratified, 6" layers, subrounded to rounded.				
4			4.0 — thin layer of woody detritus.				
5					Nbn	5.2	
6			6.2				
7			Bottom of Pit				Sample from 0'-6.2'

DATE: Sept. 21, 1976 | LOGGED BY: GCD | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y39-A

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
	GW		GRAVEL - well graded to 2" size, rounded, sandstones, cherts.		UF		
			0.5				
	GP		GRAVEL - fine, and medium to coarse sand.				
1			1.1				
	GW		GRAVEL - well graded to 2" size, some medium to coarse sand, sub-rounded to rounded, sandstones, cherts.				
2			2.6 ▽ saturated				
			2.8				
3			Bottom of Pit				No sample taken.

DATE: Sept. 21, 1976	LOGGED BY: GCD	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y39-B
SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
0	GW		GRAVEL - well graded to 2" size, and fine to medium sand, occasional cobble to 4" size, subrounded to rounded, sandstones, cherts, clean.		UF		Lightweight Pieces - Fine Aggregate: 0.36%
1.9	GP		GRAVEL - fine to 3/4" size, and fine to medium sand, subrounded to rounded, sandstones, cherts, clean.				
3.6			sand becoming coarser.				
4.1			saturated. ▽				
4.3			Bottom of Pit				Sample from 0'-4.3'

DATE: Sept. 21, 1976 | LOGGED BY: GCD | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y39-C

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	GW		GRAVEL - well graded to 3" size, some medium sand, subrounded to rounded, sandstones, cherts.		UF		
2			18/20 ▽ saturated				
			Bottom of Pit				No sample taken.
3							

DATE: Sept. 21, 1976	LOGGED BY: GCD	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y39-D

SHEET 1 OF 1

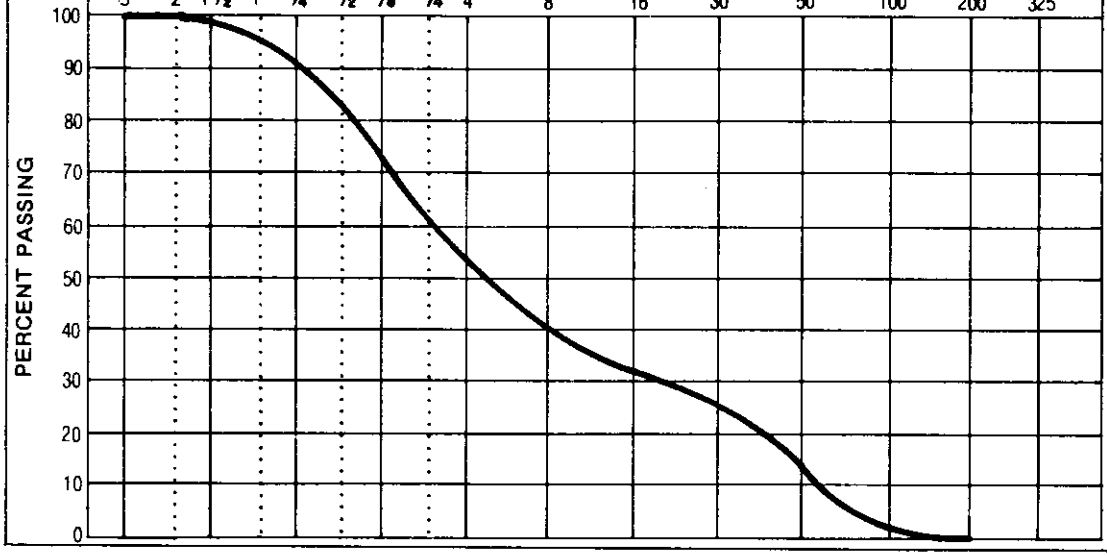
GRAIN SIZE ANALYSIS

SAMPLE Y39-A DEPTH 0'-6.2'

DATE SAMPLED Sept. 21, 1976 SAMPLED BY GCD

LAB TEST NUMBER 66HA-A

GRAVEL SIZES		SAND SIZES			FINES
7.5 %	39.4 %	15.1%	17.5 %	20.3 %	0.2 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
2"	0

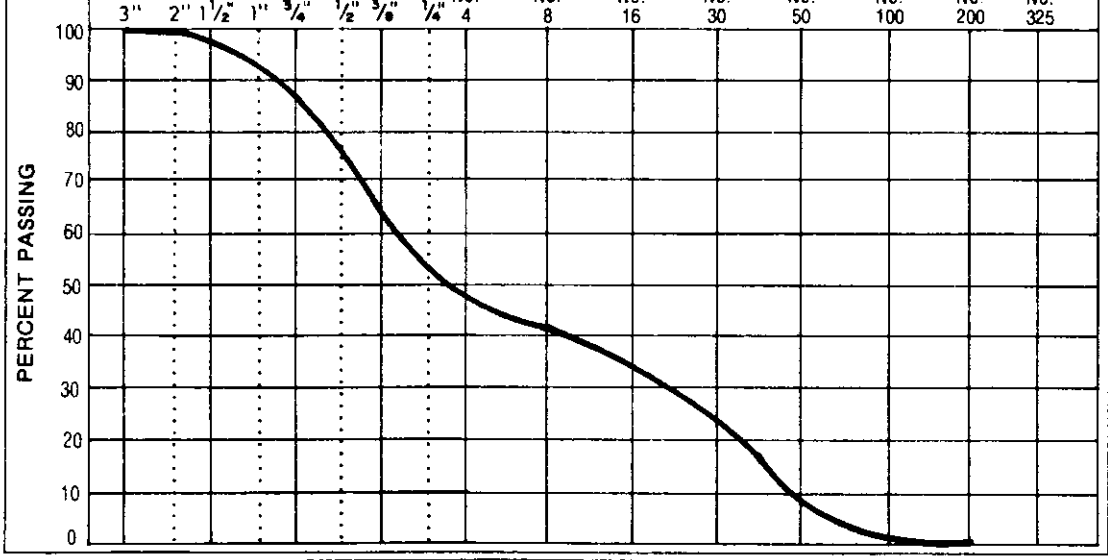
SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	100.0
1 1/2"	99.5
1"	97.2
3/4"	92.5
1/2"	83.4
3/8"	72.5
1/4"	
No. 4	53.1
No. 8	39.7
No. 16	32.2
No. 30	27.0
No. 50	13.2
No. 100	0.6
No. 200	0.2

SAMPLE Y39-C DEPTH 0'-4.3'

DATE SAMPLED Sept. 21, 1976 SAMPLED BY GCD

LAB TEST NUMBER 67HA-A

GRAVEL SIZES		SAND SIZES			FINES
15.1 %	38.7 %	6.2 %	22.5 %	17.1 %	0.4 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
3"	0

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	97.4
1 1/2"	98.2
1"	90.9
3/4"	84.9
1/2"	74.5
3/8"	63.5
1/4"	
No. 4	46.2
No. 8	40.2
No. 16	33.8
No. 30	22.2
No. 50	7.8
No. 100	1.1
No. 200	0.4

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No.
Y39

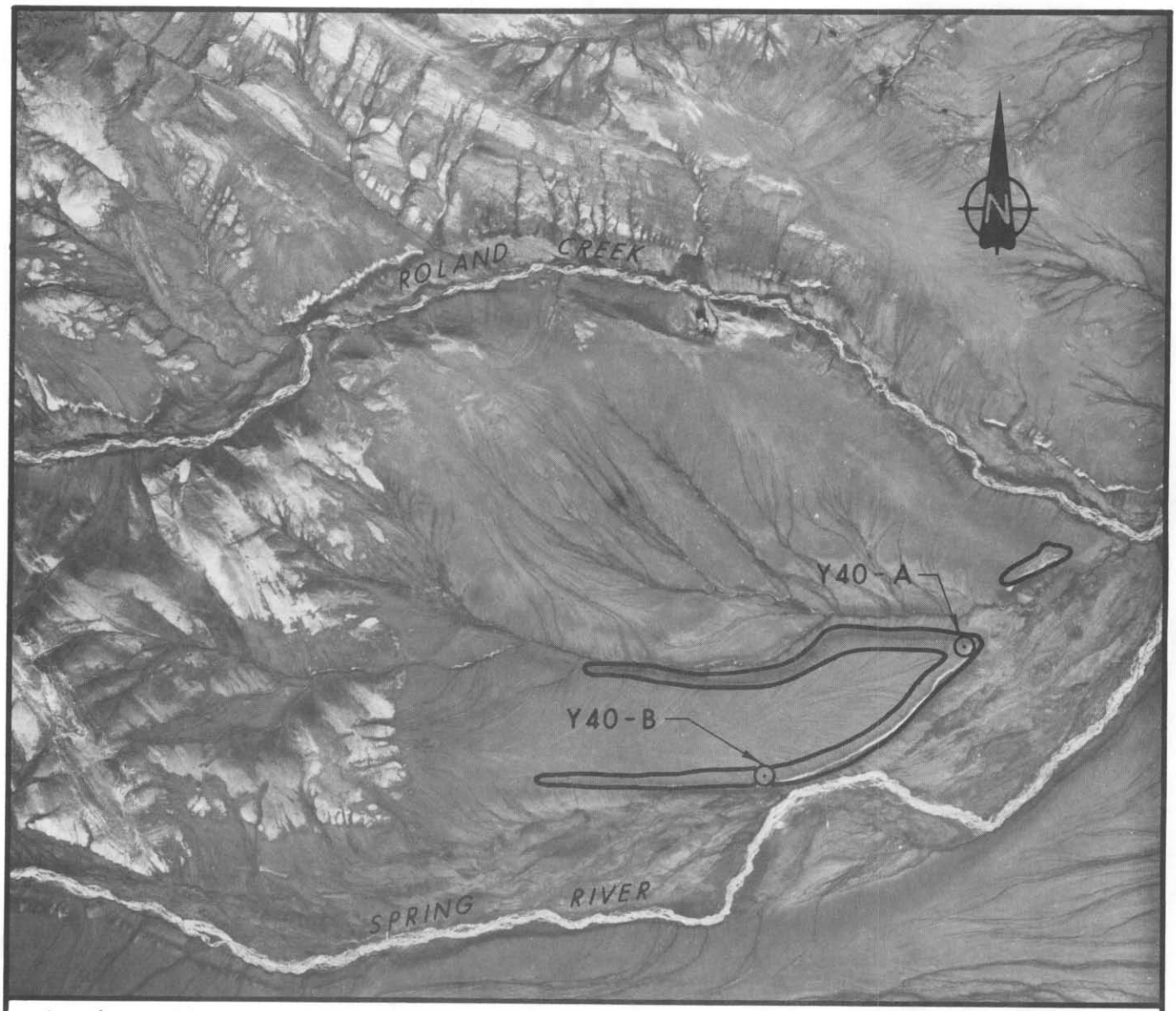
DEPOSIT Y40

Setting: Exhumed pediment surface and gravel cover near confluence of Roland Creek and Spring River.

Material: Gravel; well graded, some sand, little fines.

Volume: 2,000,000 cubic yards total.

Assessment: Contains fair to good quality granular material. Pit development should be initiated along the edge of the deposit. Access is good.



Airphoto No.: A24123-159		Approx. Scale:	1"=5000'
Deposit Outline - R.M. Hardy	———	Test Pit	⊙
Deposit Outline - Others	—·—·—	Exposures	✣

DEPOSIT Y40

SETTING

Deposit Y40 consists of an exhumed pediment surface and gravel cover near the confluence of Roland Creek and Spring River. The truncated bedrock that forms the pediment is overlain by gravel and ice-rich organic silts. Subsequent stream dissection and mass movement has removed the ice-rich organic silts from that area immediately adjacent to the stream-cut scarps.

A 50 to 60 foot scarp separates the gravel-capped pediment from low terraces of Spring River and a small tributary. From the crest of the scarp, the pediment surface rises 10 feet over a distance of 100 feet to the gently sloping crest of the pediment.

Near the scarp edge the ground is covered by low shrub tundra consisting mainly of dwarf birch, although one-third of the area shows bare gravel. The surface is free of overburden and very well drained. Incipient soil stripes and small hummocks indicate active periglacial processes. Away from this fringe area the overburden thickens slowly, the surface is only moderately well drained, and is covered by sedge tussock tundra with scattered dwarf shrubs. The thickness of the active layer ranges from more than 6 feet under well-drained bare gravel to less than 2 feet under overburden.

Deposit Y40 is flanked by imperfectly drained terraces of the Spring River to the north and east. Pediment slopes lead up to moderate and steep bedrock hills mantled with scree to the south and west. The area provides habitat for grizzly bear.

MATERIAL

Deposit Y40 contains fair to good quality granular material consisting of stratified, well graded, fine to coarse gravel with some

sand and varying silt contents. Numerous cobbles and boulders to 14 inches in size are interspersed. Larger clasts are mainly angular to subangular sandstone and quartzite with rare chert. Shale is common in the fines.

VOLUME

The total volume of 2,000,000 cubic yards is based on an average depth of 25 feet. Slumps and scarp morphology indicate that the gravel may exceed 30 feet in depth.

Annually, 30,000 cubic yards of material may be extracted by conventional techniques for each 1000 foot length along the scarp edge, assuming that the gravel will be well drained and easy to thaw throughout its thickness.

DEVELOPMENT

Excavation of Deposit Y40 should be initiated as a series of benches along the scarp where drainage is good and the ground will thaw quickly. Upon exhausting the more easily excavated material, further excavation would require removal of significant depths of overburden and may only be tenable if material is required over a number of years. The pits could be left as benches which would easily blend into the surrounding landscape upon abandonment.

Good access to this deposit is available along the Spring River terraces and floodplain. Terrain to the northwest and east is susceptible to thermokarst.

Deposit Y40 lies within the proposed Arctic Wildlife Range, which may restrict development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	GM		GRAVEL - well graded, some fine to coarse sand, little silty fines, occasional cobble to 8" size, angular to subangular, brown.		Vc Vx 5%	1.4	-well bonded with frost. Lightweight Pieces - Fine Aggregate: 0.28%
2		2.3			UF		
3	GW		GRAVEL - well graded to 8" cobbles, some fine to coarse sand, occasional boulders to 14", angular to subangular, very dense, brown damp.				
4		4.2					
	GM		- 6" layer, little silty fines.				
5		4.7					
	GW						
6		6.0					
			Bottom of Pit				Sample from 1.4'-6.0'
7							

DATE: Oct. 3, 1976	LOGGED BY: CPM	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO.
Y40-A
SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
	Pt		PEAT - fibrous, brown, wet. 0.5		UF		Lightweight Pieces - Fine Aggregate: 0.23%
1	OL		SILT - organic, rootlets, occasional cobble, grey-brown, moist. 1.0				
	ML		SILT - low plastic, clayey, brown, little subangular gravel, occasional cobble, oxidized, wet. 2.5				
3	GW		GRAVEL - well graded, some fine to coarse sand, trace silty fines, occasional cobble to 6" size, dense, greyish brown, wet. 4.5 ▽ 5.0				
5			Bottom of Pit				Sample from 3.0'-5.0'
6							

DATE: Oct. 4, 1976	LOGGED BY: SA	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y40-B

SHEET 1 OF 1

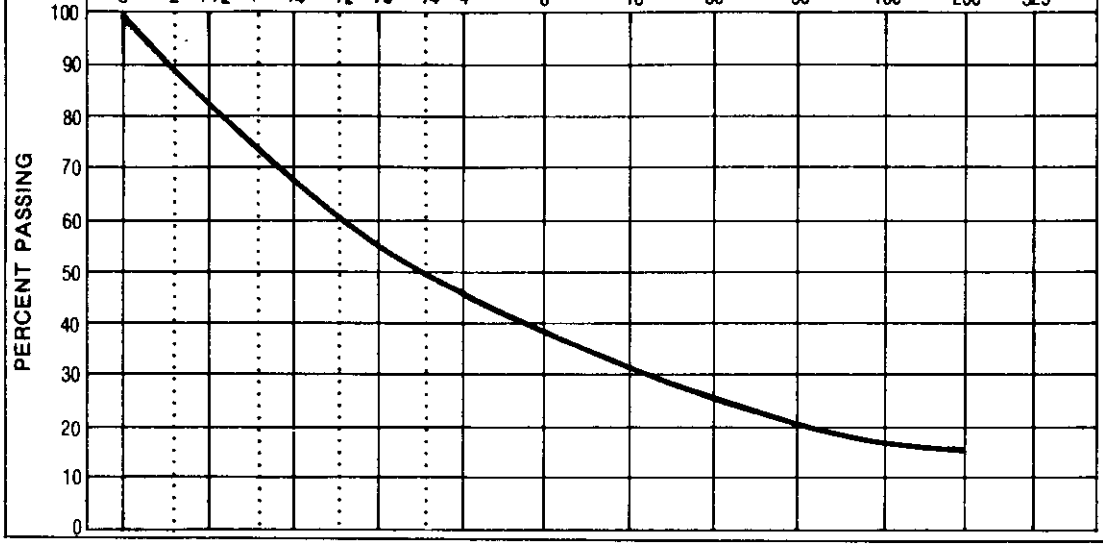
GRAIN SIZE ANALYSIS

SAMPLE Y40-A DEPTH 1.4'-6.0'

DATE SAMPLED Oct. 3, 1976 SAMPLED BY CPM

LAB TEST NUMBER 104HA

GRAVEL SIZES		SAND SIZES			FINES
32.2 %	22.1 %	8.7 %	15.7 %	6.0 %	15.3 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
3"	0

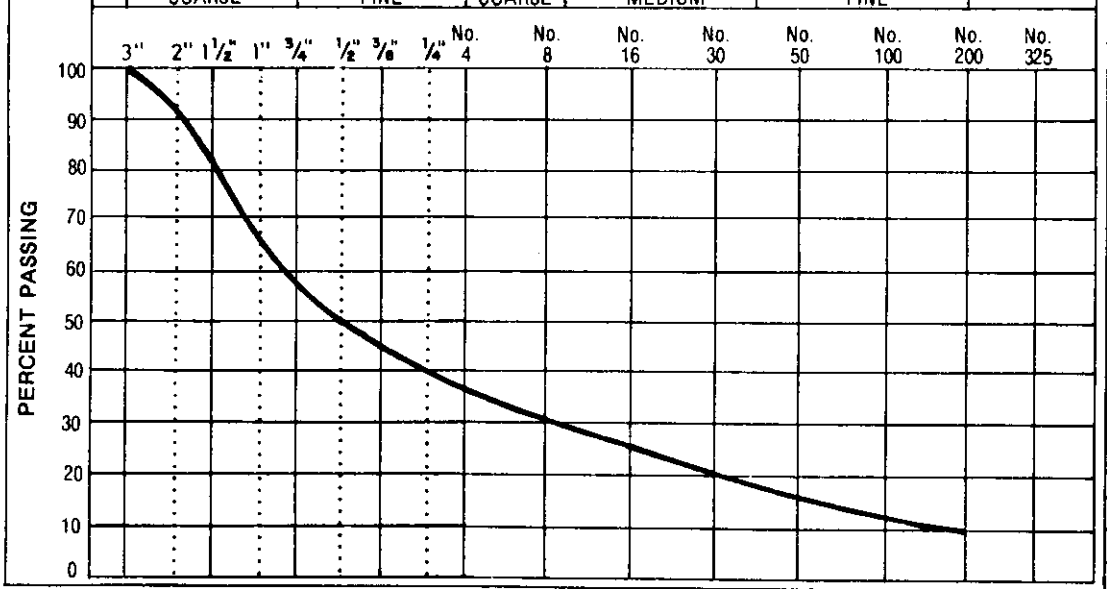
SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	88.5
1 1/2"	79.5
1"	73.9
3/4"	67.8
1/2"	61.3
3/8"	56.5
1/4"	
No. 4	45.7
No. 8	39.9
No. 16	32.9
No. 30	27.0
No. 50	21.7
No. 100	17.7
No. 200	15.3

SAMPLE Y40-B DEPTH 3.0'-5.0'

DATE SAMPLED Oct. 4, 1976 SAMPLED BY SA

LAB TEST NUMBER 103HA

GRAVEL SIZES		SAND SIZES			FINES
42.5 %	20.2 %	8.3 %	11.8 %	7.3 %	9.9 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
4"	10.7

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	93.5
1 1/2"	81.2
1"	65.4
3/4"	57.5
1/2"	50.0
3/8"	45.6
1/4"	
No. 4	37.3
No. 8	31.4
No. 16	26.3
No. 30	21.6
No. 50	16.5
No. 100	12.3
No. 200	9.9

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No. Y40

DEPOSIT Y41

Setting: Fluvial terraces along middle reaches of Spring River.

Material: Gravel; fine to coarse, little sand.

Volume: 51,000,000 cubic yards total.

Assessment: Contains good quality granular material with a moderate amount of oversize. Permafrost will limit extraction depths. Terrace scarps are best areas to initiate development. Access is good.

Airphoto No.: A14361-102		Approx. Scale:	1"=5700'
Deposit Outline - R.M. Hardy	———	Test Pit	⊙
Deposit Outline - Others	—·—·—	Exposures	✠

DEPOSIT Y41

SETTING

Deposit Y41 consists of low fluvial terraces rising 10 to 30 feet above the Spring River floodplain. Some old channel traces and bars can be detected on the surface of the terraces. Broad polygons, in excess of 100 feet in size, are formed by shallow trenches tracing ice wedges on the surface of the deposit.

Only those parts of the terraces that are relatively free of overburden and moderately well drained have been included within the deposit. However some of the deposit may be covered by organic silt and peat up to 5 feet in depth. The active layer thickness at Deposit Y41 is estimated to average 4 to 6 feet.

Better drained parts of the terrace have a broken tundra cover consisting mainly of Dryas and small shrubs. Poorer drained areas are covered by sedge meadows. Deposit Y41 and adjacent terrain provides habitat for grizzly bear.

Deposit Y41 is dissected by the active floodplain of the Spring River, which is used by Arctic grayling. It is bordered on each side by pediment surfaces covered by ice-rich sediments.

MATERIAL

Deposit Y41 contains good quality granular material consisting of well graded, fine to coarse gravel with a little sand. Some boulders, 10 inches in size are common within the gravel. The upper 1 to 2 feet may be very sandy. Larger clasts are mainly subangular to subrounded sandstone and quartzite with rare chert. Shale and argillite chips are common in the fines.

VOLUME

The total volume of 51,000,000 cubic yards is based on a conservative depth of 30 feet. Gravel is known to range between 30 and 100 feet under these terraces.

Annually, 9,600 cubic yards per acre could be extracted by conventional techniques assuming that permafrost limits the extractable granular material to an average depth of 6 feet. Greater depths could probably be extracted near scarps.

DEVELOPMENT

Depth of excavation will be limited by permafrost and possibly ground water levels. Pits developed near scarps will be relatively easy to restore to acceptable grades, whereas those developed away from terrace scarps will probably become water filled ponds when abandoned.

Good access to Deposit Y41 is available especially along the Spring River. Caution should be exercised in crossing the ice-rich terrain adjacent to the terraces as it is susceptible to thermokarst.

Development of Deposit Y41 should be planned to minimize interference with the fish population of Spring River. This deposit lies within the proposed Arctic Wildlife Range, which may restrict development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
	Pt		0.4 PEAT - and grass cover.		UF		Lightweight Pieces - Fine Aggregate: 0.26%
1	OL		SILT - some fine to coarse gravel, little fine to coarse sand, organic, low plastic, brown.				
2			2.4				
3	GW		GRAVEL - well graded to 5" cobbles, some fine to coarse sand, trace fines, subangular.				
4							
9							
10			10.0 — increase in fines content.				
18							
19							
20			20.0				
			Bottom of Pit				Sample from 2.4'-20.0'
21							

DATE: Sept. 23, 1976	LOGGED BY: JDF	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y41-A(e)

SHEET 1 OF 1

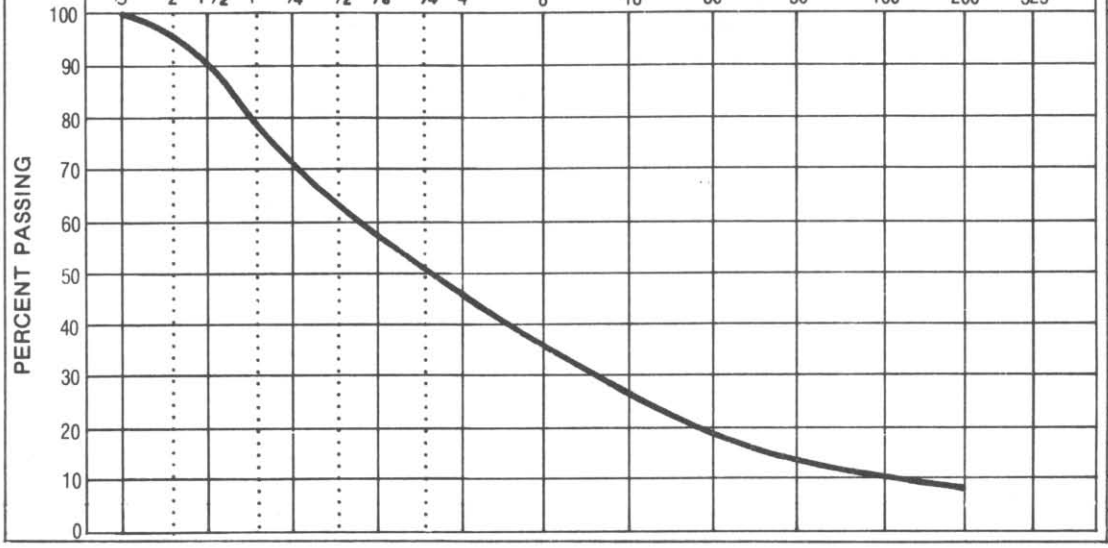
GRAIN SIZE ANALYSIS

SAMPLE Y41-A(e) DEPTH 2.4'-20.0'

DATE SAMPLED Sept. 23, 1976 SAMPLED BY JDF

LAB TEST NUMBER TP105

GRAVEL SIZES		SAND SIZES			FINES
28.4 %	24.3 %	14.3 %	17.2 %	7.9 %	7.9 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
5"	15.7

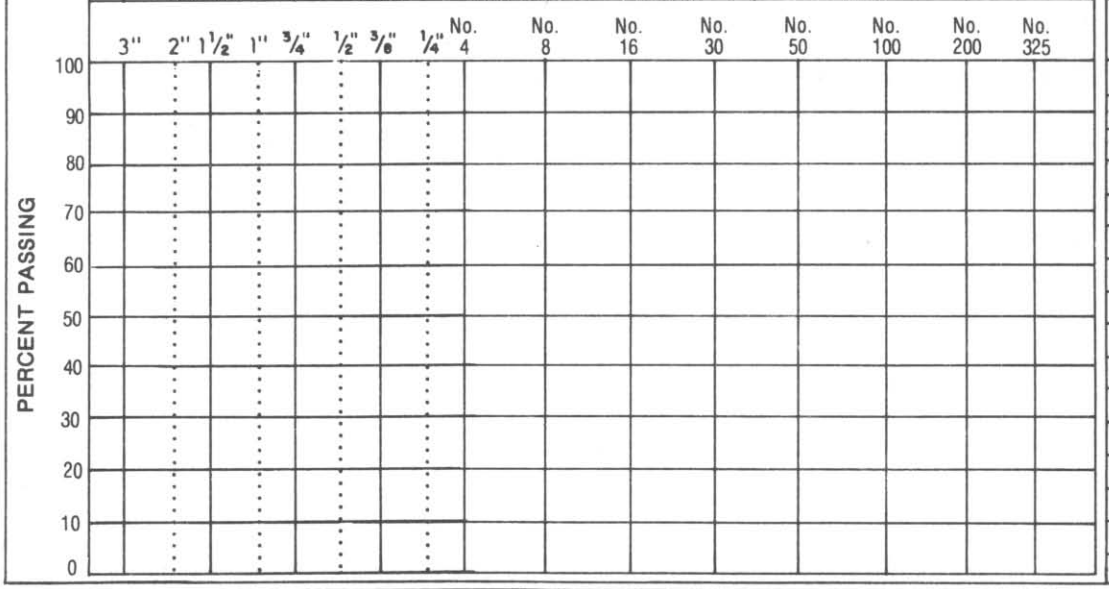
SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	97.1
1 1/2"	90.9
1"	78.4
3/4"	71.6
1/2"	64.1
3/8"	58.3
1/4"	
No. 4	47.3
No. 8	35.7
No. 16	27.0
No. 30	19.3
No. 50	13.4
No. 100	10.1
No. 200	7.9

SAMPLE _____ DEPTH _____

DATE SAMPLED _____ SAMPLED BY _____

LAB TEST NUMBER

GRAVEL SIZES		SAND SIZES			FINES
%	%	%	%	%	%
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"

SIEVE SIZE	PERCENT PASSING
3"	
2"	
1 1/2"	
1"	
3/4"	
1/2"	
3/8"	
1/4"	
No. 4	
No. 8	
No. 16	
No. 30	
No. 50	
No. 100	
No. 200	

GOVERNMENT OF CANADA

DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.

CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

DEPOSIT No. Y41

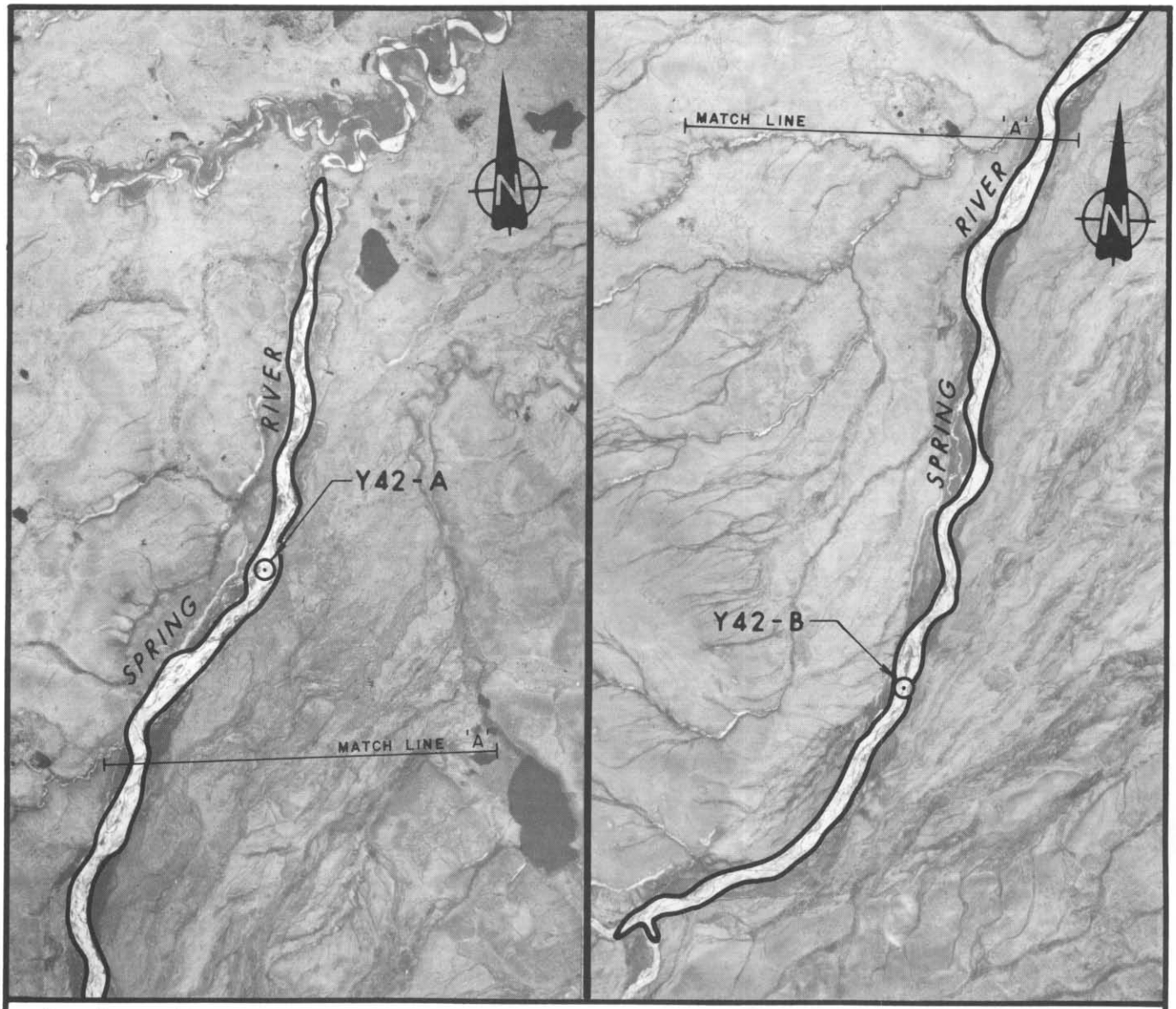
DEPOSIT Y42

Setting: Active floodplain of the Spring River.

Material: Gravel; well graded, little fine to coarse sand.

Volume: 27,000,000 cubic yards total.

Assessment: Contains good quality granular material with a moderate amount of oversize. Extraction would be limited by ground water levels. Fluvial processes would restore floodplain to its natural state. Local access to this deposit is good, but thermokarst susceptible terrain lies north of deposit.
Recoverable volume may be limited to 1,700,000 cubic yards.



Airphoto No.: A24123-131/132
Deposit Outline - R.M. Hardy
Deposit Outline - Others
Approx. Scale: 1"=5000'
Test Pit
Exposures

DEPOSIT Y42

SETTING

Deposit Y42 is the active floodplain of the Spring River, which consists of bars and channel beds having a braided pattern. During low water, the Spring River is generally confined to one or two channels.

The deposit is well-drained and free of overburden. About one-half of the floodplain surface is 1½ to 4 feet above late fall stream levels. The stream is more deeply entrenched in its upper reaches within the deposit area. Local relief on the floodplain is about 2 feet due to scour holes and channel terraces. The thickness of the active layer was not determined, but normally exceeds 4½ feet.

The deposit is bare of vegetation except for scattered patches of herbs and scattered willows. Some small driftwood is present. The Spring River is a fish migration route and spawning area for Arctic grayling. Some fish may overwinter at local aufeis fields.

This deposit is bordered by a low moderately well to imperfectly drained terrace and, to a lesser degree, by ice-rich morainal deposits. This terrain provides some habitat for grizzly bear and Arctic fox, and is a critical waterfowl staging area.

MATERIAL

Deposit Y42 contains good quality granular material consisting of well graded, fine to coarse gravel with a little medium to coarse sand. Oversize material may be significant as cobbles to 8 inches in size were noted at test pit Y42-A and boulders to 15 inches in size at test pit Y42-B. Larger clasts are mainly subangular to subrounded sandstone and quartzite with rare quartz, conglomerate, and chert. Shale and arglillite chips are common in the fines.

VOLUME

The total volume of 27,000,000 cubic yards is based on a conservative depth of 30 feet of granular material. Gravel in the adjacent terrace is considered to range between 30 and 100 feet.

Annually, 35,000 cubic yards of material per 1000 foot length of floodplain could be extracted by conventional techniques assuming that static ground water levels would limit the extractable granular material to an average depth of 2 feet. Volume of recoverable material may be limited to 1,700,000 cubic yards because of static ground water conditions.

DEVELOPMENT

Extraction of material from Deposit Y42 would be limited to late summer and fall when water levels are low. Large areas for proportionately small volumes would have to be developed due to shallow ground water. Following development, the pit should be restored through natural fluvial processes as streams of the coastal plain are known to move significant amounts of coarse sediment.

Local access to the deposit would be good along the stream course or adjacent terraces. Traffic across morainal deposits toward the coast should be carried out with caution as these deposits are susceptible to thermokarst processes.

Development of Deposit Y42 should be planned to minimize interference with waterfowl staging or fish activities. Deposit Y42 lies within the proposed Arctic Wildlife Range, which may restrict development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	GW		GRAVEL - well graded to 5" cobbles, some fine to coarse sand, subangular to subrounded, sandstones with igneous intrusions.		UF		Lightweight Pieces - Fine Aggregate: 0.06%
2							
3							
4		4.0 ▽	- saturated at 4.0'				
			Bottom of Pit				Sample from 0'-4.0'
5							

DATE: Sept. 23, 1976 | LOGGED BY: GCD | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y42-A

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
0	GP		GRAVEL - coarse to cobble sizes.		UF		Lightweight Pieces - Fine Aggregate: 0.18%
0.4							
1	GW		GRAVEL - well graded, little fine to coarse sand, occasional cobbles, subangular, medium brown, wet, cherts, sandstones, shale fragments, clean.				
2							
2.5			becoming finer grained at 2.5'.				
3							
4			free water at 4.5' ▽				
4.5			Bottom of Pit			4.5	Sample from 0'-4.5'
5							

DATE: Sept. 23, 1976 | LOGGED BY: JDF | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y42-B

SHEET 1 OF 1

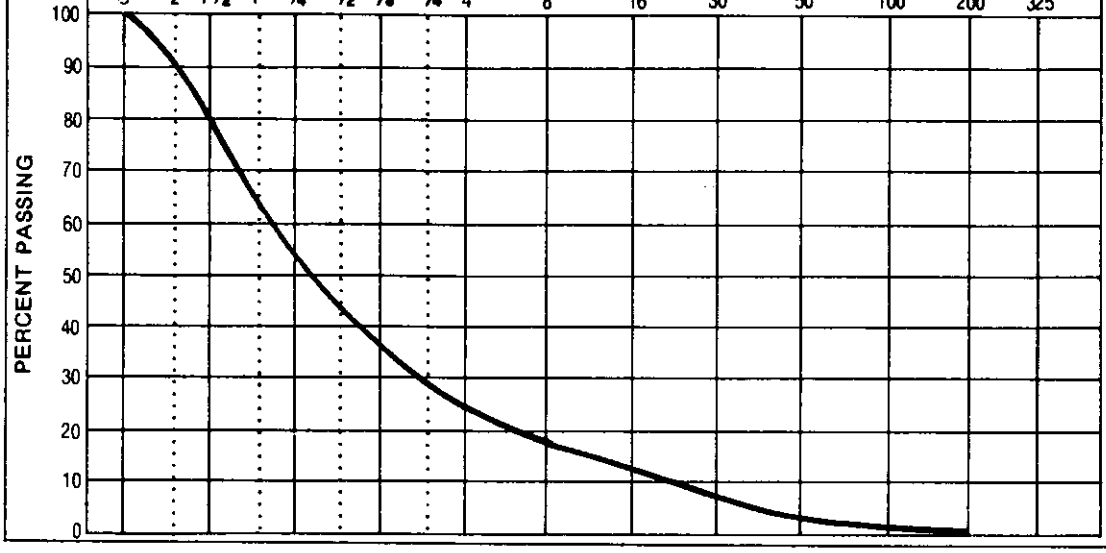
GRAIN SIZE ANALYSIS

SAMPLE Y42-A DEPTH 0'-4.0'

DATE SAMPLED Sept. 23, 1976 SAMPLED BY GCD

LAB TEST NUMBER 101HA

GRAVEL SIZES		SAND SIZES			FINES
45.6 %	29.9 %	7.0 %	12.5 %	4.4 %	0.6 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
4"	2.7

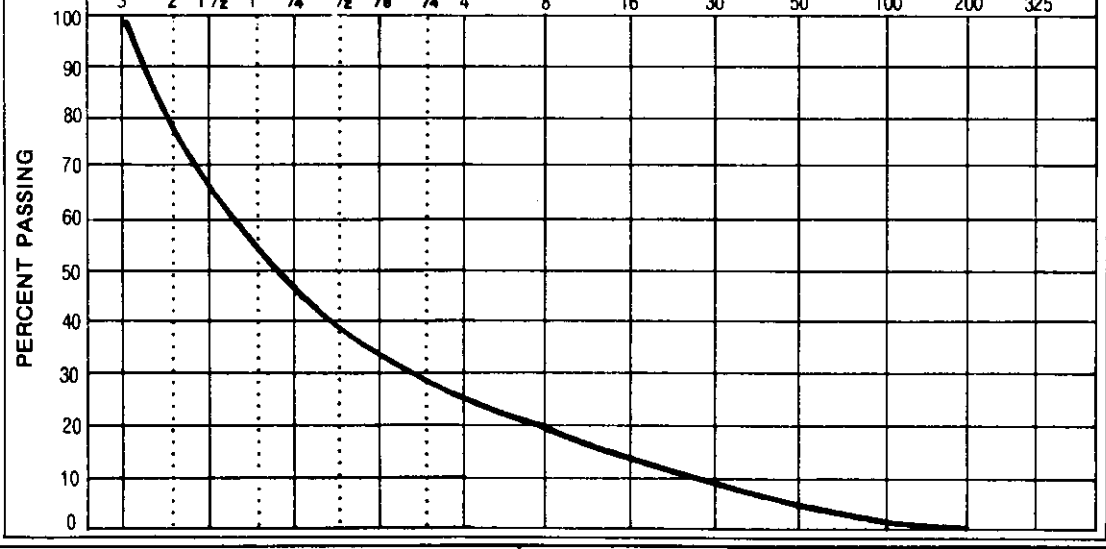
SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	93.3
1 1/2"	80.8
1"	64.2
3/4"	54.4
1/2"	42.2
3/8"	35.2
1/4"	
No. 4	24.5
No. 8	18.9
No. 16	13.9
No. 30	8.2
No. 50	2.8
No. 100	0.9
No. 200	0.6

SAMPLE Y42-B DEPTH 0'-4.5'

DATE SAMPLED Sept. 29, 1976 SAMPLED BY JDF

LAB TEST NUMBER TP102

GRAVEL SIZES		SAND SIZES			FINES
60.8 %	14.9 %	6.3 %	11.0 %	6.8 %	0.2 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
6"	24.1

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	78.4
1 1/2"	59.2
1"	46.0
3/4"	39.2
1/2"	33.6
3/8"	30.4
1/4"	
No. 4	24.3
No. 8	20.0
No. 16	15.3
No. 30	9.4
No. 50	3.7
No. 100	1.2
No. 200	0.2

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No. Y42

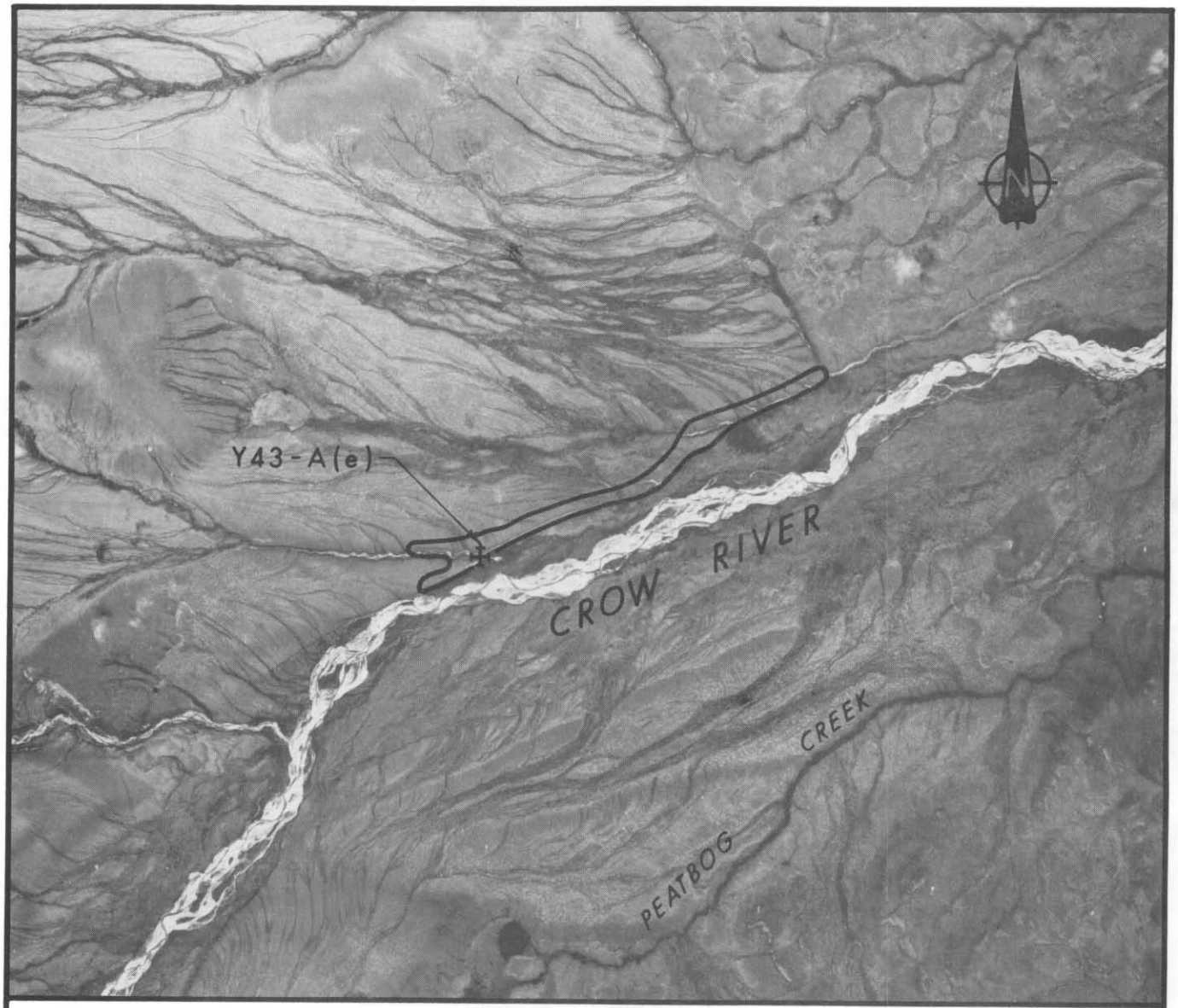
DEPOSIT Y43

Setting: Gravel veneer of an exhumed pediment surface located along the Crow (Tulugag) River about 5 miles upstream of its confluence with Peatbog Creek.

Material: Gravel; well graded, some sand, varying silt content.

Volume: 1,400,000 cubic yards total.

Assessment: Contains fair to good quality granular material with moderate amount of oversize. Pit development should be initiated along the edge of the deposit. Access is good.



Airphoto No.: A24123-128		Approx. Scale:	1"=5000'
Deposit Outline - R.M. Hardy	———	Test Pit	⊙
Deposit Outline - Others	—·—·—	Exposures	✣

DEPOSIT Y43

SETTING

Deposit Y43 consists of an exhumed pediment surface and gravel cover located north of the Crow (Tulugag) River about 5 miles upstream of its confluence with Peatbog Creek. The pediment surface slopes gently to the north. The truncated bedrock that forms the pediment is overlain by gravel and ice-rich silts. Subsequent stream dissection and mass movement has removed the organic silts from that area immediately adjacent to the stream-cut scarp.

A 50 to 60 foot scarp separates the gravel-capped pediment from the low terraces of the Crow (Tulugag) River. From the crest of the scarp the pediment surface rises 10 feet over a distance of about 200 feet to the gently sloping crest of the pediment.

The deposit is imperfectly to moderately well drained. Overburden is variable in depth. The active layer is only 1 to 2 feet thick. Near the edge of the scarp the ground is covered by sedge hummocks with scattered small willow and dwarf birch, one foot in height.

Deposit Y43 is flanked by the Crow River terraces on the south and ice-rich silt-mantled pediments slopes to the north and west. Rolling morainal deposits lie to the northeast. The area provides habitat for grizzly bear.

MATERIAL

Deposit Y43 contains fair to good quality granular material consisting of well graded, fine to coarse gravel with some sand. Boulders to 15 inches in size are interspersed. The upper strata may be siltier. Larger clasts are mainly quartzite and sandstone. Shale is common in the fines.

VOLUME

The total volume of 1,400,000 cubic yards is based on an average depth of 30 feet. Slumps and scarp morphology indicate that gravel varies between 30 and 70 feet in depth.

Annually, 23,000 cubic yards could be extracted by conventional techniques per 1000 foot length along the scarp edge assuming that gravel will be well drained and easy to thaw throughout its depth.

DEVELOPMENT

Excavation of Deposit Y43 would initially be concentrated on a series of benches along the scarp edge where drainage is good, the overburden is relatively thin, and ground would thaw quickly. When the more easily excavated materials are exhausted, further excavation would require removal of significant overburden and would only be feasible if the material is required for long term prospects. The benches would blend into the surrounding area with minor grading upon abandonment.

Access to the deposit is easily attained along the Crow River terrace system or across the pediment surface and morainal deposits to the north and east.

The deposit lies with the proposed Arctic Wildlife Range, which may restrict development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
0	Pt	? ? ? ?	PEAT - organic cover.		UF		
1.0	ML		SILT - low plastic.				
2.0	GW		GRAVEL - well graded to 15" boulders, some fine to coarse sand, little silty fines, subangular				
4.5			clean below 4.5'.				
							Note: Permafrost encountered at 12 inches on upland portion of scarp.
13.0			Bottom of Pit				Sample from 2.0'-13.0'

DATE: Sept. 23, 1976	LOGGED BY: GCD	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y43-A(e)

SHEET 1 OF 1

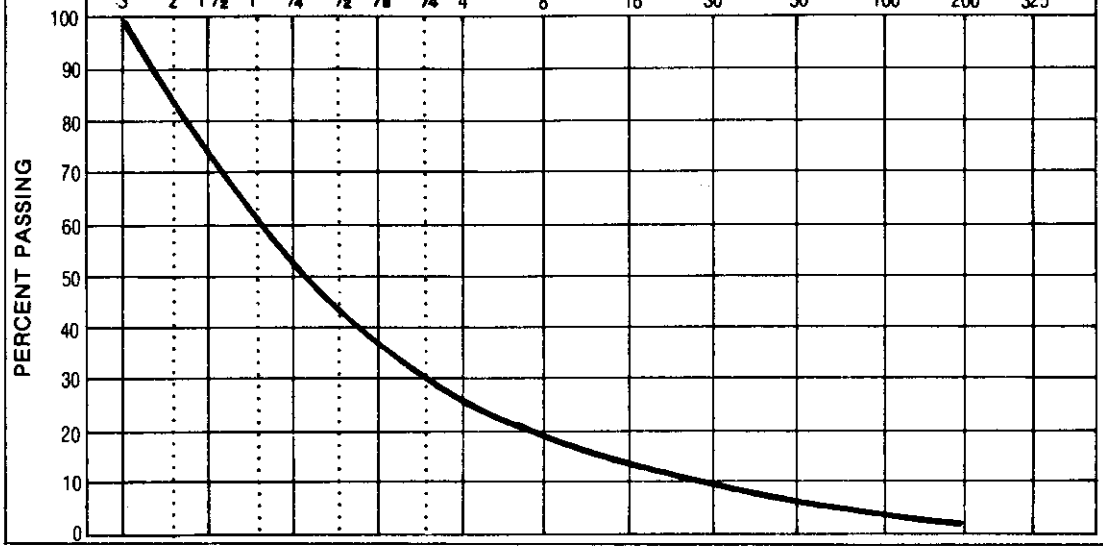
GRAIN SIZE ANALYSIS

SAMPLE Y43-A(e) DEPTH 2.0'-13.0'

DATE SAMPLED Sept. 23, 1976 SAMPLED BY GCD

LAB TEST NUMBER 30HA

GRAVEL SIZES		SAND SIZES			FINES
48.3 %	25.2 %	8.5 %	10.5 %	4.8 %	2.7 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
5"	14.3

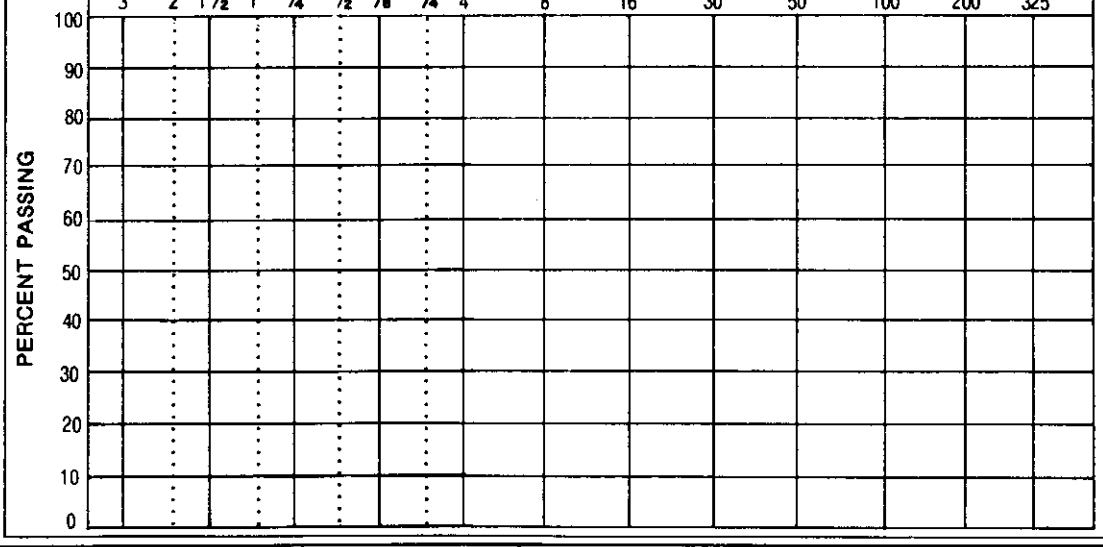
SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	87.0
1 1/2"	72.5
1"	59.0
3/4"	51.7
1/2"	43.5
3/8"	37.6
1/4"	
No. 4	26.5
No. 8	18.6
No. 16	12.3
No. 30	8.2
No. 50	5.4
No. 100	3.6
No. 200	2.7

SAMPLE _____ DEPTH _____

DATE SAMPLED _____ SAMPLED BY _____

LAB TEST NUMBER

GRAVEL SIZES		SAND SIZES			FINES
%	%	%	%	%	%
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"

SIEVE SIZE	PERCENT PASSING
3"	
2"	
1 1/2"	
1"	
3/4"	
1/2"	
3/8"	
1/4"	
No. 4	
No. 8	
No. 16	
No. 30	
No. 50	
No. 100	
No. 200	

GOVERNMENT OF CANADA

DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.

CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No. Y43

SUMMARY OF LABORATORY TEST DATA FOR SUITABILITY OF AGGREGATES IN CONCRETE

PETROGRAPHIC ANALYSIS

COARSE AGGREGATE

ROCK TYPE	CLASSIFICATION	TOTAL WEIGHTED COMPONENT %
Quartzite	Very strong. Good	42.1
Sandstone		41.3
Sandstone	Strong to medium strong, Good	9.1
Limestone		3.5
Aplite		0.4
Slate	Flaky, Fair	0.3
Sandstone	Medium strong to weak, Poor	0.8
Chert	Potentially reactive, Fair	0.5
Flint		2.0
PN: = 110	INTERPRETATION: Good to Excellent Quality for Aggregate	100.0

SOUNDNESS OF AGGREGATE - SULPHATE TEST

COARSE AGGREGATE: LOSS = 3.09%

FINE AGGREGATE: LOSS = 9.20%

OTHER TESTS

LIGHTWEIGHT PIECES IN AGGREGATE: FINE: 0.37%

SPECIFIC GRAVITY: FINE: 2.57, COARSE: 2.59

WATER ABSORPTION: FINE: 3.01%, COARSE: 1.78%

ORGANIC IMPURITIES TEST

NUMBER	: 2+
COAL REMOVED	:
COAL & ROOTLETS REMOVED	:
COAL CONTENT	: 0.37%

COMMENTS: Sulphate Test was performed for 5 cycles in Magnesium Sulphate solution.
Specific Gravity Test was performed at 20°C.
Lightweight Pieces were determined by floating on Zinc Chloride solution with a Specific Gravity of 2.0.

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y43-A(e)

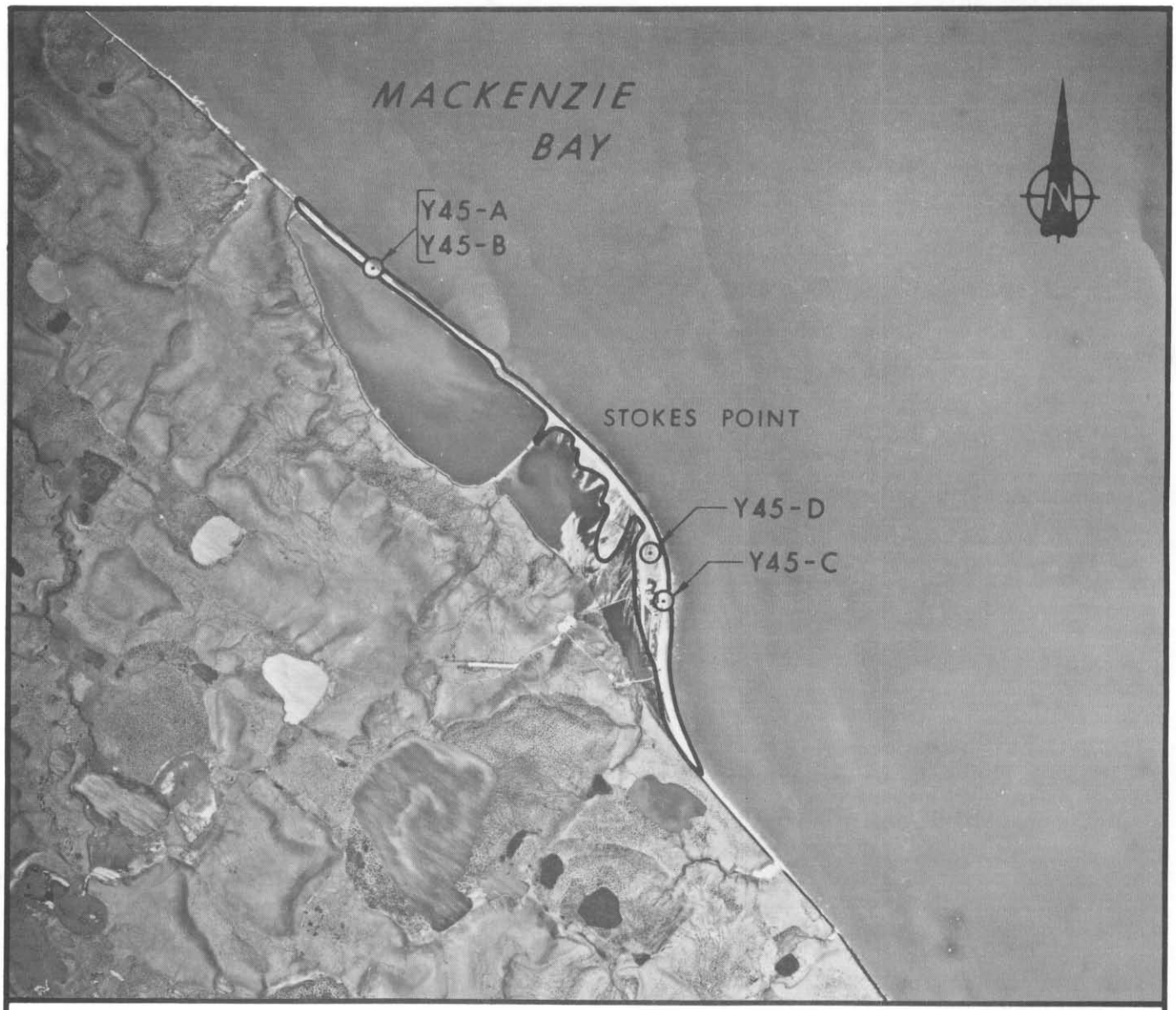
DEPOSIT Y45

Setting: Spit at Stokes Point; attached to mainland at both ends.

Material: Gravel and Sand; poorly graded, fine to medium.

Volume: 1,400,000 cubic yards total.

Assessment: Contains fair to good quality material. Marine processes may not restore spit to its original form. Possible archeological site near western end. Good access. Gravel pits have been previously developed. Recoverable volume may be limited to 530,000 cubic yards.



Airphoto No.: A22975-29
Deposit Outline - R.M. Hardy
Deposit Outline - Others
Approx. Scale: 1"=4800'
Test Pit ⊙
Exposures ✣

DEPOSIT Y45

SETTING

Deposit Y45 consists of a spit with a number of recurving ridges at its distal end that have attached themselves to the mainland. The spit has formed a lagoon with a single channel to the sea just west of a large spur that projects into the lagoon. An airstrip, road and some gravel mounds are present on the eastern part of the deposit near a former DEW-line site. Here, the deposit consists of low ridges representing former spit tips that have been truncated by the present outer active spit.

At the western end, the spit averages about 150 feet in width with a crest standing 4½ feet above sea level; the foreshore is about 30 feet across and driftwood is common along its upper edge. At the eastern end, the crest of the outer ridge is about 60 feet across with a 40 foot wide foreshore, characterized by scattered driftwood. Behind the spit, ridges, 40 to 80 feet across, and intervening swales, 20 to 80 feet across, give the area a relief of 2 feet. This area has driftwood and debris scattered over its surface.

The surfaces of the ridge forming the western part of Deposit Y45 and the outer ridge of the eastern part are well drained and devoid of vegetation except for a few patches of grass on the crest. The broad eastern part of Deposit Y45 is only moderately well drained with ridges covered by grass and moss and swales by sedge meadows. Old excavations are filled by water. Deposit Y45 is completely inundated during major storm surges. Permafrost was encountered at depths of 4 to 6 feet.

The source of granular materials in Deposit Y45 is probably sediments in cliffs to the northwest, as strata with high percentages of coarser materials are not present along the coast south of Deposit Y39. Although the coast has retreated significantly over the last couple of decades, Deposit Y45 is maintaining a relatively static form.

Deposit Y45 adjoins areas characterized by ice-rich rolling morainal and flat peat-covered lacustrine deposits. A small lacustrine bench is present at its immediate western end.

Deposit Y45 and the adjoining area lie within a staging area for waterfowl and provide habitat for Arctic fox and grizzly bear. Numerous fish inhabit the offshore waters.

MATERIAL

Deposit Y45 contains fair to good quality granular material although individual beds are often poorly graded. The main part consists of stratified poorly graded, fine to medium gravel with medium to coarse sand and poorly graded fine to coarse sand with fine gravel. Pebbles rarely exceed 1½ inches. The broad eastern part is characterized by medium to coarse sand with little gravel. Larger clasts are mainly rounded to subrounded sandstone and quartzite with rare limestone, chert, quartz and granite. Chert is common in the fines.

VOLUME

The total volume of 1,400,000 cubic yards is based on an average thickness of 9 feet under the ridge forming the west part of the deposit, and 8 feet under the broad eastern part. Bathymetry of adjacent waters and data from other spits suggest that Deposit Y45 is at least 12 feet thick.

Annually, 20,000 cubic yards per 1000 foot length of the spit could be extracted by conventional techniques from the western part of Deposit Y45, and 4,800 cubic yards per acre from the eastern part assuming that only material above sea level can be recovered. Volume of recoverable material may be limited to 530,000 cubic yards because of static water levels.

DEVELOPMENT

Deposit Y45 can be easily developed by conventional techniques as is evident from recent excavations. Storm surges would interrupt operations.

Extraction of material from the outer part of Deposit Y45 could hasten the local rate of coastal retreat. The capability of the spit to restore itself to its original configuration is indeterminate because the source of granular material is not obvious.

Inland access is good if care is taken to prevent thermokarst.

Decayed log structures and artifacts at the western end of the deposit indicate that the area has archeological potential and should be investigated before development. Development should be planned to minimize interference with waterfowl staging.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
0	SP		SAND - medium to coarse, some fine gravel to 3/8" size, rounded, clean.		UF		Lightweight Pieces - Fine Aggregate: 0.06%
1.7	GP		GRAVEL - fine to ½" size, little medium to coarse sand.				
2.0	SP		SAND - medium, trace coarse gravel to 3" size.				
2.8	Pt		PEAT - organic layer.				
3.0	GP		GRAVEL - fine to 3/4" size, and coarse sand.				
4.0	SP		SAND - fine.				
5.0	GP		GRAVEL - fine to 3/4" size, some medium to coarse sand, clean.				
6.0 ▽			water level rose to 6.0' after ice layer was penetrated.	+ +	Vx 5%	6.0	
6.2					UF	6.2	
6.5			Bottom of Pit				Sample from 0'-6.5'

DATE: Sept. 19, 1976	LOGGED BY: GCD	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y45-A
SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	SP		SAND - medium to coarse, some fine gravel, trace coarse gravel, rounded.		UF		
		1.5					
2	SP GP		SAND and GRAVEL - alternate 4" layers of medium sand and fine gravel, trace coarse gravel to 2" size.				
3		3.0					
	GP		GRAVEL - fine to 3/4" size.				
4		4.0 ▽	free water at 4.0'			4.0	
			Bottom of Pit				No sample taken.
5							

DATE: Sept. 19, 1976 | LOGGED BY: GCD | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y45-B

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	SW		SAND - fine to coarse, some gravel to 1½" size, stratified, wet, cherts, clean.		UF		
2							
3							
4							
5			5.2/5.4 ▽ free water.				
6			Bottom of Pit				Sample from 0'-5.4'

DATE: Sept. 29, 1976	LOGGED BY: JDF	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y45-C

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
	Pt		0.3 PEAT		UF		
	SP		SAND - medium to coarse, few 2" layers fine gravel, light brown, damp to wet, cherts.				
1							
2							
3			3.8 ▽ free water				
4			4.0 frozen at 4.0'			4.0	
			Bottom of Pit				No sample taken.
5							

DATE: Sept. 21, 1976	LOGGED BY: JDF	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

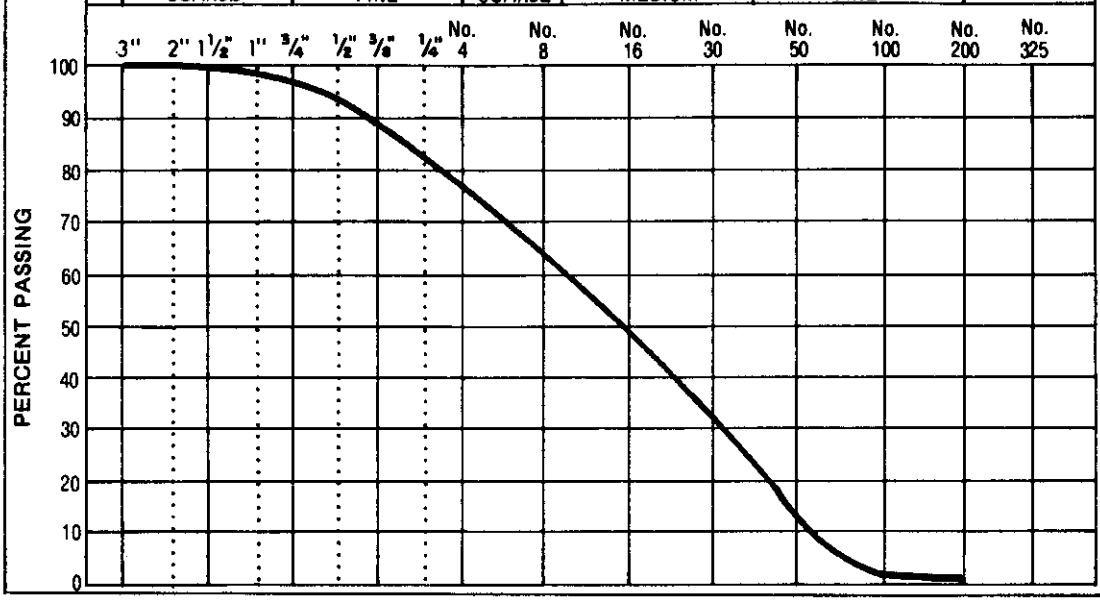
TEST PIT NO. Y45-D

SHEET 1 OF 1

GRAIN SIZE ANALYSIS

SAMPLE Y45-A DEPTH 0'-6.5'
DATE SAMPLED Sept. 9, 1976 SAMPLED BY GCD
LAB TEST NUMBER 65HA-1

GRAVEL SIZES		SAND SIZES			FINES
2.1 %	23.5 %	13.4%	38.5 %	22.3 %	0.2 %
COARSE	FINE	COARSE	MEDIUM	FINE	

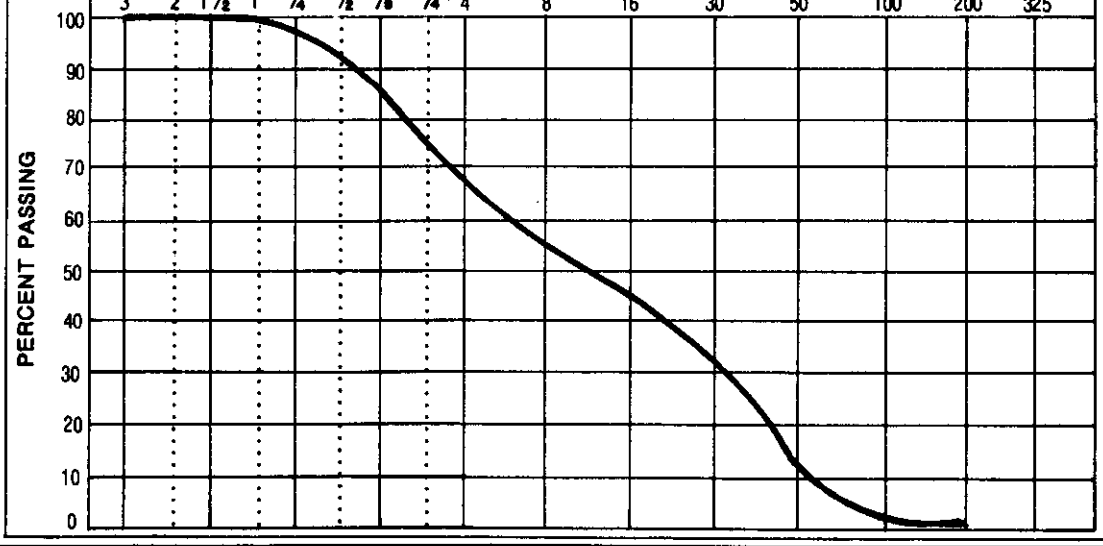


MAX. SIZE	% > 3"
2"	0

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	100.0
1 1/2"	99.4
1"	98.9
3/4"	97.9
1/2"	93.8
3/8"	88.5
1/4"	
No. 4	75.4
No. 8	63.9
No. 16	49.6
No. 30	32.5
No. 50	12.7
No. 100	0.6
No. 200	0.2

SAMPLE Y45-C DEPTH 0'-5.4'
DATE SAMPLED Sept. 21, 1976 SAMPLED BY JDF
LAB TEST NUMBER TP12

GRAVEL SIZES		SAND SIZES			FINES
2.2 %	31.2 %	12.6 %	30.0 %	23.1 %	0.9 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
1.5"	0

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	100.0
1 1/2"	100.0
1"	99.7
3/4"	97.8
1/2"	93.1
3/8"	86.4
1/4"	
No. 4	66.6
No. 8	56.1
No. 16	47.5
No. 30	34.0
No. 50	10.5
No. 100	1.8
No. 200	0.9

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No.
Y45

SUMMARY OF LABORATORY TEST DATA FOR SUITABILITY OF AGGREGATES IN CONCRETE

PETROGRAPHIC ANALYSIS
COARSE AGGREGATE

ROCK TYPE	CLASSIFICATION	TOTAL WEIGHTED COMPONENT %
Quartzite	Very strong, Good	15.2
Sandstone		15.4
Granite		0.4
Sandstone	Medium strong, Good	0.1
Limestone		1.1
Flint	Potentially reactive, Fair	0.3
Chert		0.9
PN:= 131	INTERPRETATION: Fair quality for aggregate	33.4

SOUNDNESS OF AGGREGATE - SULPHATE TEST

COARSE AGGREGATE: LOSS= 1.25%

FINE AGGREGATE: LOSS= 2.59%

OTHER TESTS

LIGHTWEIGHT PIECES IN AGGREGATE: FINE: 0.06%

SPECIFIC GRAVITY: FINE: 2.63, COARSE: 2.64

WATER ABSORPTION: FINE: 0.74%, COARSE: 0.85%

ORGANIC IMPURITIES TEST

NUMBER	:	2
COAL REMOVED	:	
COAL & ROOTLETS REMOVED	:	
COAL CONTENT	:	0.06%

COMMENTS: Sulphate Test was performed for 5 cycles in Magnesium Sulphate solution.
Specific Gravity Test was performed at 20°C.
Lightweight Pieces were determined by floating on Zinc Chloride solution with a Specific Gravity of 2.0.

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO.
Y45-C

SUMMARY OF LABORATORY TEST DATA FOR SUITABILITY OF AGGREGATES IN CONCRETE

PETROGRAPHIC ANALYSIS

FINE AGGREGATE

ROCK TYPE	CLASSIFICATION	TOTAL WEIGHTED COMPONENT %
Quartz, Quartzite	Strong to very strong, Good	46.1
Sandstone		4.6
Granite		0.1
Limestone		4.6
Ironstone	Potentially reactive, Fair	0.1
Chert		1.15
Flint		9.05
PAN	Deleterious	0.9
PN:= 131	INTERPRETATION: Fair quality for aggregate.	66.6

SOUNDNESS OF AGGREGATE - SULPHATE TEST

COARSE AGGREGATE: LOSS=

FINE AGGREGATE: LOSS=

OTHER TESTS

LIGHTWEIGHT PIECES IN AGGREGATE:

SPECIFIC GRAVITY:

WATER ABSORPTION:

ORGANIC IMPURITIES TEST

NUMBER :
COAL REMOVED :
COAL & ROOTLETS REMOVED :
COAL CONTENT :

COMMENTS: Continued from page 260

PN number was calculated for coarse and fine gravel components combined. The coarse component is of higher quality than the fine.

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y45-C

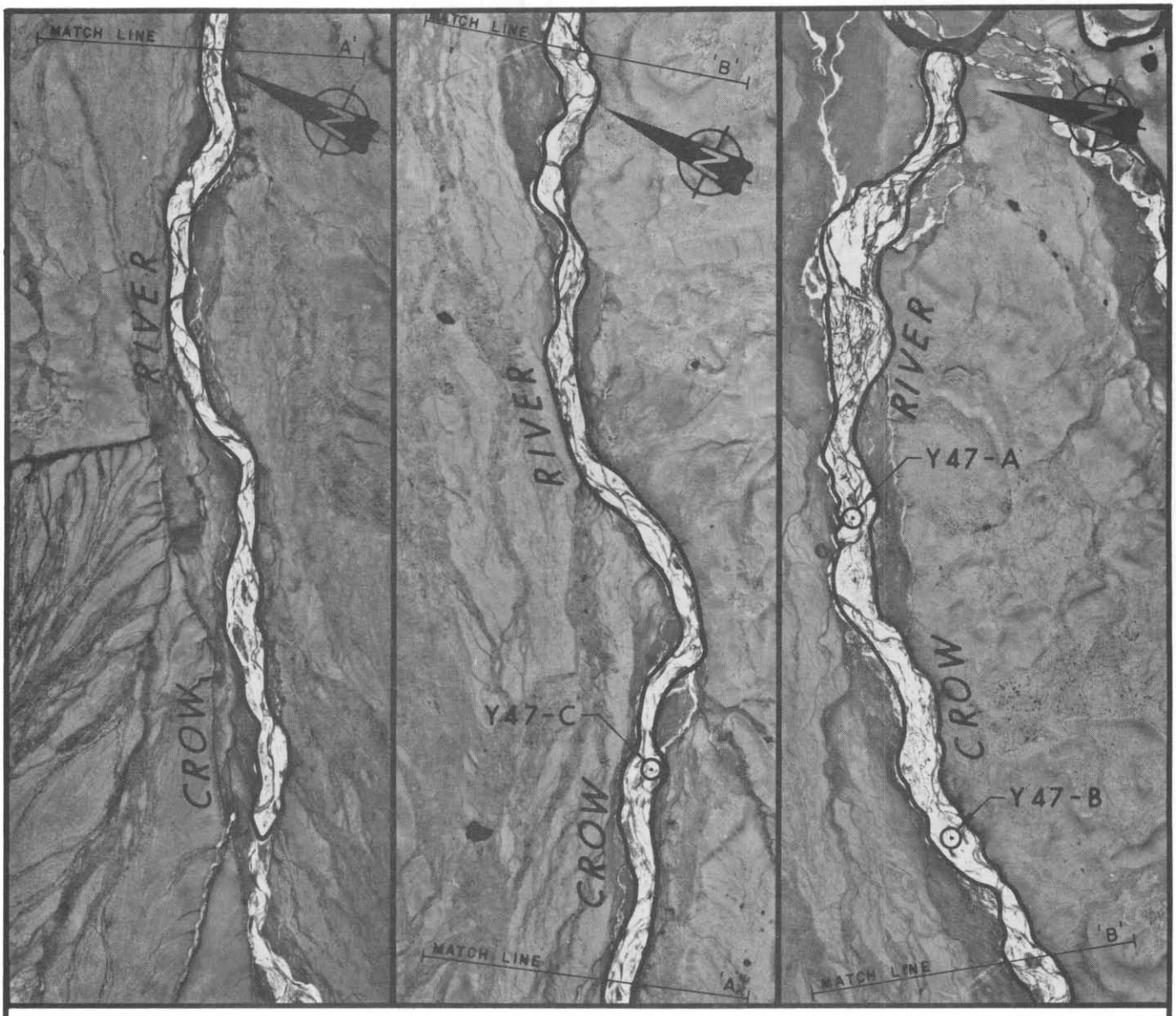
DEPOSIT Y47

Setting: Active floodplain of the Crow (Tulugag) River.

Material: Gravel; fine to coarse, some well graded sand.

Volume: 72,000,000 cubic yards total.

Assessment: Contains good quality granular material with moderate amount of oversize. Extraction will be limited by ground water levels, but restoration will occur through natural fluvial processes. Access is good.
Recoverable volume may be limited to 8,200,000 cubic yards.



Airphoto No.: A22975-14, 34, 52
Approx. Scale: 1"=4800'
Deposit Outline - R.M. Hardy
Test Pit
Deposit Outline - Others
Exposures

DEPOSIT Y47

SETTING

Deposit Y47 is the active floodplain of the Crow (Tulugag) River, which consists of bars and channel beds having a braided pattern. During low water periods, the Crow River tends to be confined to one or two channels, except near its mouth where it follows a more braided pattern.

The deposit is well-drained and free of overburden. One-half of the floodplain surface is 3 to 4 feet above late fall stream levels. The stream is slightly more incised in the upper reaches. Scour holes and channel traces give the floodplain a local relief of 1 to 3 feet. The thickness of the active layer is estimated to exceed 6½ feet.

Up to 15 percent of the floodplain is covered by tufts of grasses and small clumps of prostrate willows. The Crow River is a spawning, rearing and feeding area for Arctic grayling and char.

Deposit Y47 is bordered by low, moderately-well to imperfectly drained terraces and ice-rich morainal deposits. Coastward, the terrain is ice-rich rolling morainal deposits, except for terraces of the Babbage River. This terrain provides critical staging areas for waterfowl, and suitable habitat for Arctic fox and grizzly bear.

MATERIAL

Deposit Y47 contains good quality granular material consisting of stratified, well-graded, fine to coarse gravel with some fine to coarse sand. Cobbles, 7 inches in size, were noted at test pit Y47-A. Boulders to 9 and 15 inches in size, were noted at test pit Y47-B, and test pit Y47-C, respectively, where much of the floodplain is covered by a boulder/cobble lag. Larger clasts are mainly subangular to subrounded

sandstone and quartzite with rare quartz and chert. Shale and argillite are common in the fines.

VOLUME

The total volume of 72,000,000 cubic yards is based on a conservative depth of 30 feet. Gravel in the adjacent terrace is known to range between 30 and 90 feet in depth. Annually, 100,000 cubic yards per 1000 foot length of floodplain can be extracted by conventional techniques assuming that static ground water levels limit the extractable granular material to an average depth of 3½ feet. Volume of recoverable material may be limited to 8,200,000 cubic yards because of static ground water conditions.

DEVELOPMENT

Extraction at Deposit Y47 may be confined to summer and fall when water levels are low. Large areas will have to be harvested for small volumes because of shallow ground water unless special drainage controls are undertaken. Adequate areas for stockpiling are available.

The developed pit areas will be restored by natural fluvial processes because streams of the coastal plain are known to move significant amounts of coarse sediment.

Access to this deposit is good along stream courses and adjacent terraces. The Babbage River and its terraces also provide an adequate route to the coast.

Development of Deposit Y47 should be planned to minimize interference with fish activities in the Crow River. Deposit Y47 lies within the proposed Arctic Wildlife Range, which may restrict development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	GW		GRAVEL - well graded to 4" cobbles, some fine to coarse sand, angular to subangular, wet, clean.		UF		Lightweight Pieces - Fine Aggregate: 0.17%
2							
3			3.5 ▽ free water at 3.5'			3.5	
4			Bottom of Pit				Sample from 0'-3.5'

DATE: Sept. 20, 1976	LOGGED BY: JDF	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y47-A

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
	GP		0.4 GRAVEL - cobbles and boulders.		UF		Lightweight Pieces - Fine Aggregate: 0.06%
1	GW		GRAVEL - well graded to 8" cobbles, some fine to coarse sand, subangular, medium brown, damp, clean.				
2							
3							
4							
5							
6			6.3 ▽ free water at 6.3'			6.3	
			Bottom of Pit				Sample from 0'-6.3'
7							

DATE: Sept. 23, 1976 | LOGGED BY: JDF | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y47-B

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	GW		GRAVEL - well graded to 10" boulders, little fine to coarse sand, sub-rounded to rounded, clean, sand-stones, cherts.		UF		Lightweight Pieces - Fine Aggregate: 0.06%
2							
3							
4			3.8 well graded to 3" size, trace sand, rounded.				
			4.5 ▽				
5			Bottom of Pit				Sample from 0'-4.5'
6							

DATE: Sept. 20, 1976 | LOGGED BY: GCD | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y47-C

SHEET 1 OF 1

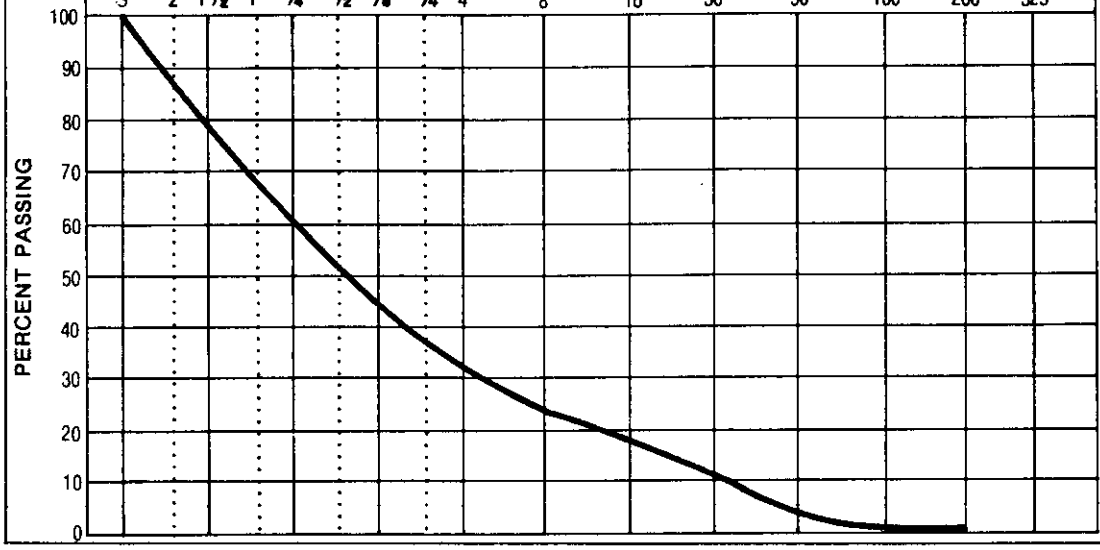
GRAIN SIZE ANALYSIS

SAMPLE Y47-A DEPTH 0'-3.5'

DATE SAMPLED Sept. 20, 1976 SAMPLED BY JDF

LAB TEST NUMBER TP26

GRAVEL SIZES			SAND SIZES			FINES
39.1 %	30.0 %		7.4 %	16.5 %	6.4 %	0.6 %
COARSE	FINE		COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
4"	2.0

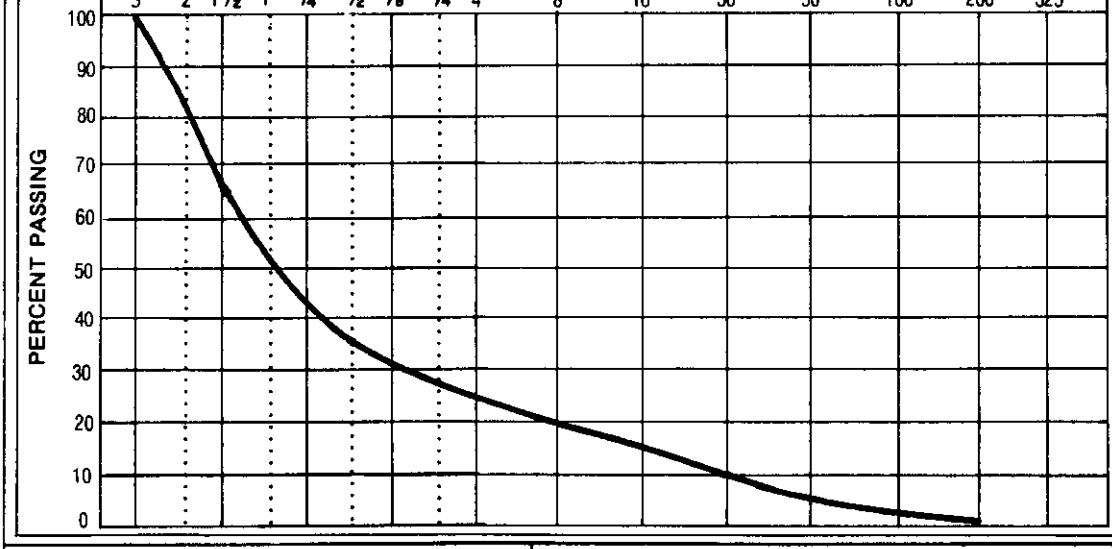
SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	87.6
1 1/2"	79.4
1"	69.0
3/4"	60.9
1/2"	51.1
3/8"	43.4
1/4"	
No. 4	30.9
No. 8	24.3
No. 16	18.6
No. 30	11.2
No. 50	3.5
No. 100	1.1
No. 200	0.6

SAMPLE Y47-B DEPTH 0'-6.3'

DATE SAMPLED Sept. 28, 1976 SAMPLED BY JDF

LAB TEST NUMBER TP29

GRAVEL SIZES			SAND SIZES			FINES
55.7 %	18.8 %		7.0 %	11.0 %	6.7 %	0.8 %
COARSE	FINE		COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
4"	15.6

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	82.1
1 1/2"	66.0
1"	50.9
3/4"	44.3
1/2"	36.2
3/8"	32.1
1/4"	
No. 4	25.5
No. 8	19.8
No. 16	15.0
No. 30	9.8
No. 50	3.9
No. 100	1.3
No. 200	0.8

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No. Y47

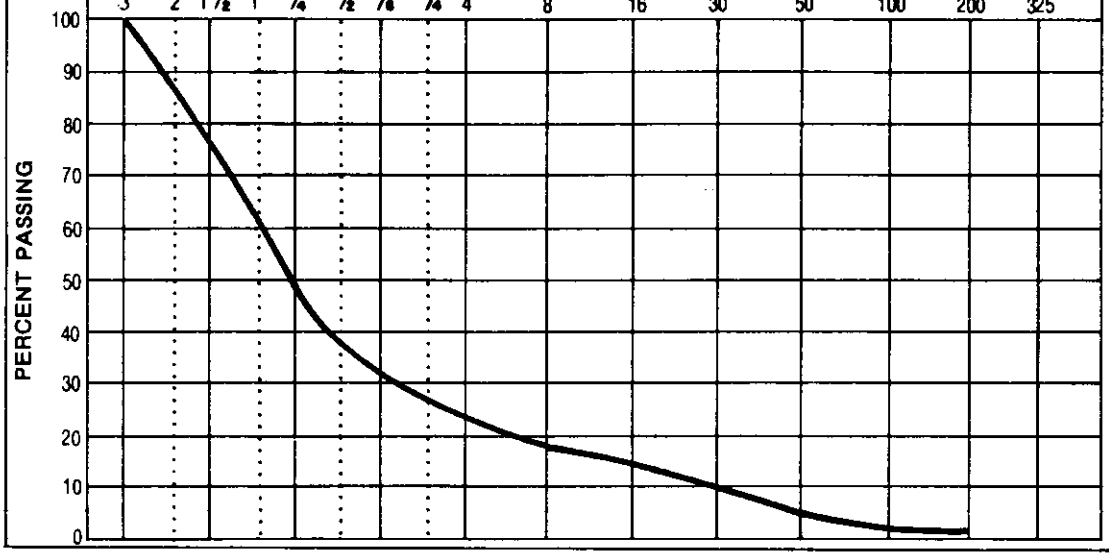
GRAIN SIZE ANALYSIS

SAMPLE Y47-C DEPTH 0'-4.5'

DATE SAMPLED Sept. 20, 1976 SAMPLED BY GCD

LAB TEST NUMBER 27HA

GRAVEL SIZES		SAND SIZES			FINES
51.1 %	27.4 %	4.5 %	9.5 %	6.3 %	1.2 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
5"	2.9

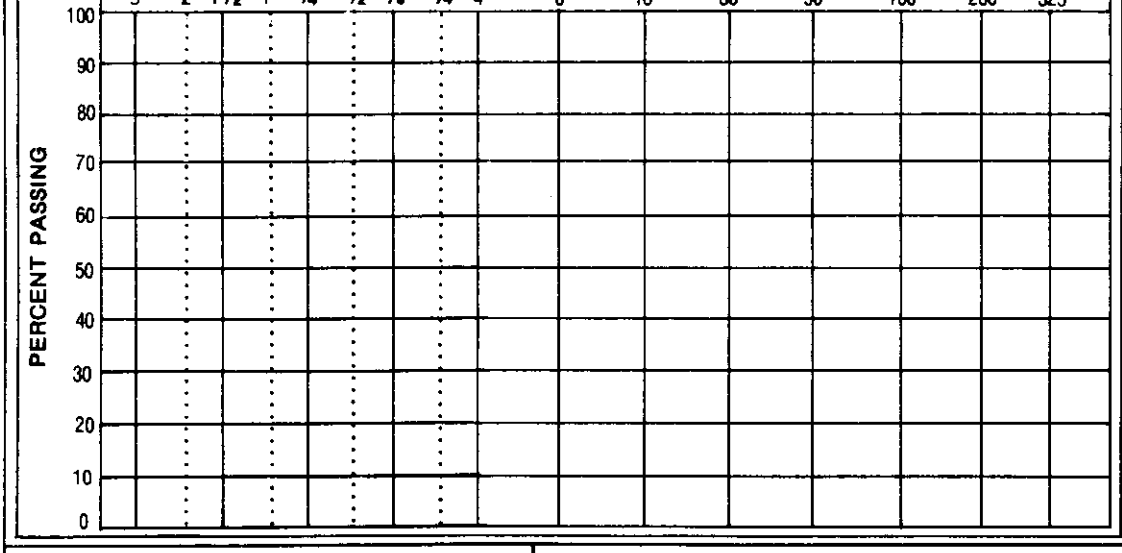
SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	87.9
1 1/2"	74.9
1"	61.0
3/4"	48.9
1/2"	37.8
3/8"	31.1
1/4"	
No. 4	21.5
No. 8	17.8
No. 16	14.4
No. 30	10.1
No. 50	4.7
No. 100	1.9
No. 200	1.2

SAMPLE _____ DEPTH _____

DATE SAMPLED _____ SAMPLED BY _____

LAB TEST NUMBER

GRAVEL SIZES		SAND SIZES			FINES
%	%	%	%	%	%
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"

SIEVE SIZE	PERCENT PASSING
3"	
2"	
1 1/2"	
1"	
3/4"	
1/2"	
3/8"	
1/4"	
No. 4	
No. 8	
No. 16	
No. 30	
No. 50	
No. 100	
No. 200	

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No. Y47

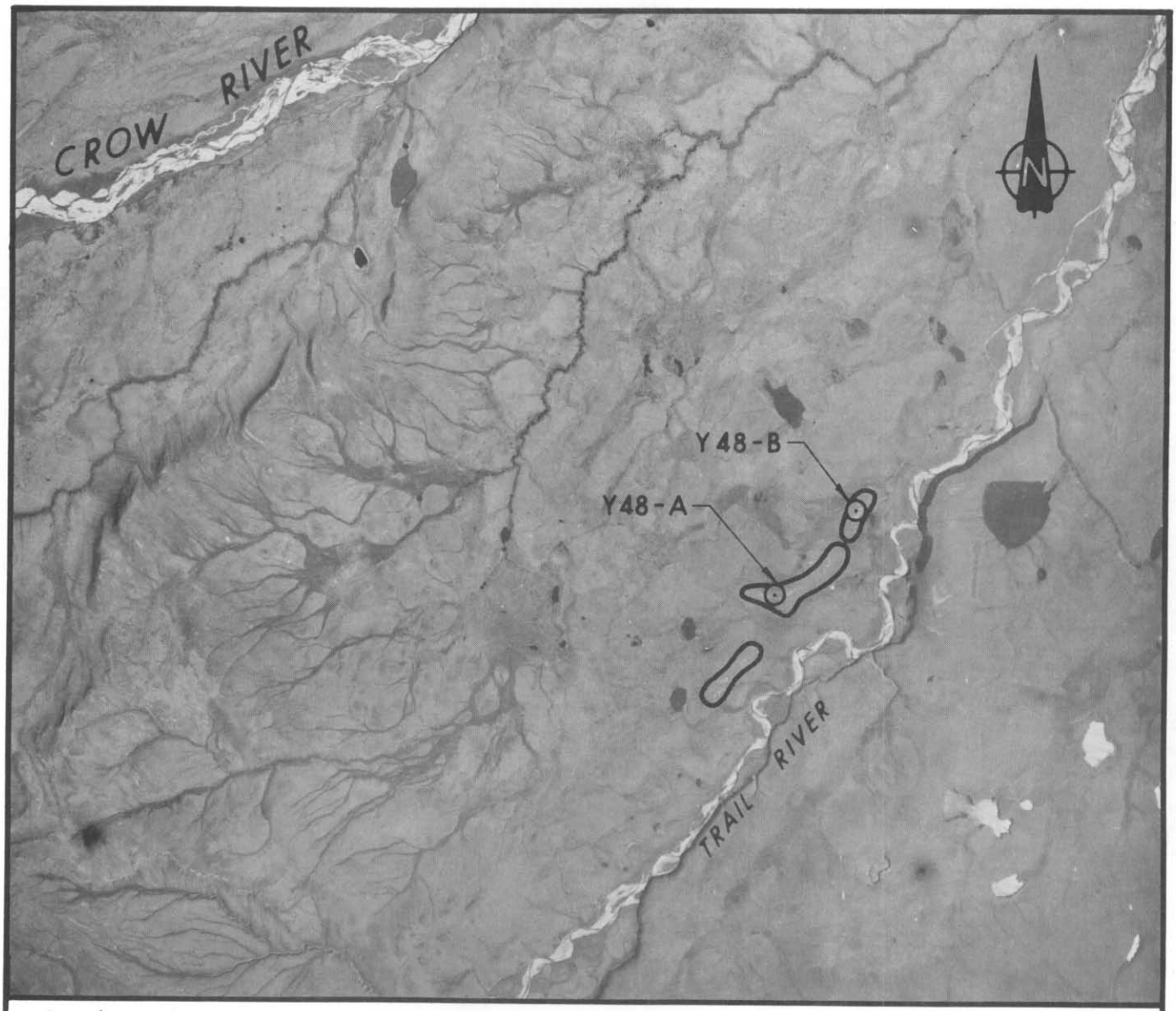
DEPOSIT Y48

Setting: Esker, located ½ mile north of the Trail River and about 8 miles above its mouth.

Material: Gravel; well graded, fine to coarse, some sand.

Volume: 3,900,000 cubic yards total.

Assessment: Contains good quality granular material. Massive ice may be encountered. Access is good. Pit development and restoration procedures can be easily carried out.



Airphoto No.: A13383-160
Deposit Outline - R.M. Hardy
Deposit Outline - Others
Approx. Scale: 1"=5600'
Test Pit
Exposures

DEPOSIT Y48

SETTING

Deposit Y48 consists of three segments of an esker located about ½ mile north of the Trail River and 8 miles above its mouth. The esker has a broad rounded crest that stands about 50 feet above the surrounding terrain.

The esker is well drained and is free of overburden. Some areas may have a thin mantle of sand or silty gravel. The surface of the esker is marked by 1 to 2 foot deep trenches outlining polygons having 30 foot diameters. The active layer is more than 6 feet deep.

The surface is covered by a thin broken turf consisting of Dryas, lichen, and ericaceous schrubs. Willows to a height of 1 foot are present in the trenches.

The surrounding terrain is flat to gently sloping, imperfectly to poorly drained, peat-covered fluvial and morainal deposits. The area provides habitat for caribou, Arctic fox, and grizzly bear. Waterfowl use the area for staging.

MATERIAL

Deposit Y48 contains good quality granular material consisting of stratified, well graded, fine to coarse gravel with some sand. Cobbles and boulders to 12 inches in size are present. Larger clasts are mainly subrounded to subangular sandstone, argillite and chert with rare granitics.

VOLUME

A total volume of 3,900,000 cubic yards has been based on a granular material depth of 50 feet under the crest of the esker. Some allowance has been made for minor amounts of massive ice.

Annually, 12,000 cubic yards of material can be extracted per acre of the deposit by conventional excavating techniques assuming that permafrost will limit the yearly recoverable depth to 8 feet.

DEVELOPMENT

Development of Deposit Y48 should be carried out to maintain good drainage. Massive ice, if encountered, will require wasting or special efforts to preserve it. Final restoration will depend on the final depth of excavation. Excavation below the level of the surrounding terrain will result in a pond when the site is abandoned.

Access to the coast can be easily attained along the Trail and Babbage River systems. Access from other directions will not be difficult because of flat, uninterrupted terrain.

Borrow operations should be planned to minimize interference with waterfowl staging. Deposit Y48 lies within the proposed Arctic Wildlife Range, which may limit development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
	Pt		0.3 PEAT - fine, fibrous.		UF		Organic Color: #3
	GW		GRAVEL - well graded, some fine to coarse sand, occasional cobbles and boulders to 10" size, trace silty fines, subrounded to subangular, brown, damp.				Lightweight Pieces - Fine Aggregate: 0.11%
1							
2							
3							
4							
5			4.9 —— decreasing fines content				
			5.9				
6			Bottom of Pit				Sample from 0.3'-5.9'

DATE: Oct. 6, 1976 | LOGGED BY: CPM | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y48-A

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
0	GM		GRAVEL - well graded, some fine to coarse sand, little silty fines, trace organics, loose, damp.		UF		Organic Color: #2
1			1.0				Lightweight Pieces - Fine Aggregate: 0.06%
	GW		GRAVEL - well graded, some fine to coarse sand, trace silty fines, subrounded, loose, moist, grey.				
2							
3							
			3.5 — — becoming coarser, occasional cobbles to 6" size.				
4							
5							
6			6.0				
			Bottom of Pit				Sample from 0.5'-6.0'
7							

DATE: Oct. 4, 1976	LOGGED BY: SA	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

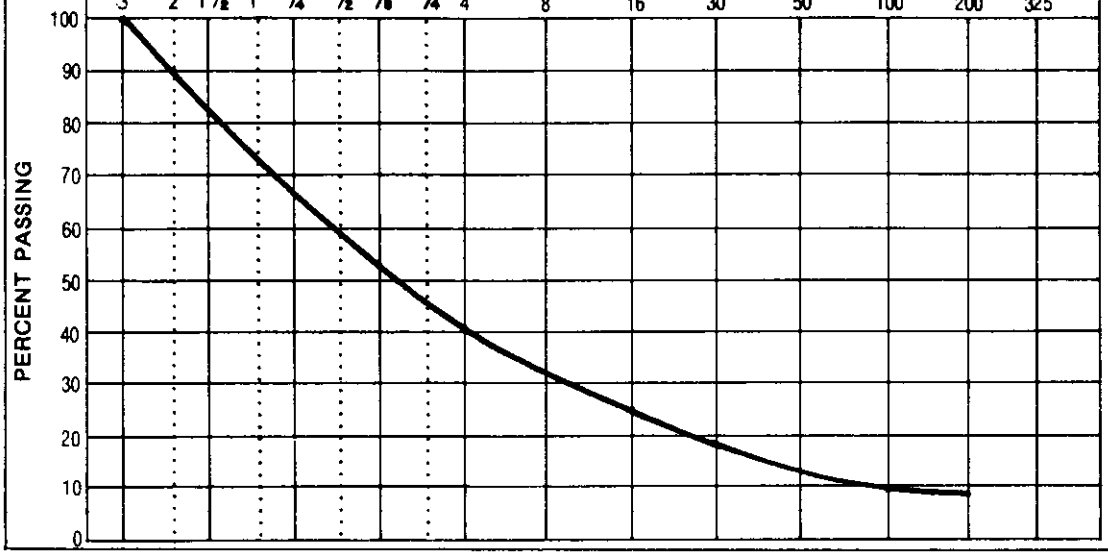
TEST PIT NO.
Y48-B

SHEET 1 OF 1

GRAIN SIZE ANALYSIS

SAMPLE Y48-A DEPTH 0.3'-5.9'
DATE SAMPLED Oct. 4, 1976 SAMPLED BY CPM
LAB TEST NUMBER 31HA

GRAVEL SIZES		SAND SIZES			FINES
33.4 %	25.8 %	10.8 %	13.8 %	8.2 %	8.0 %
COARSE	FINE	COARSE	MEDIUM	FINE	

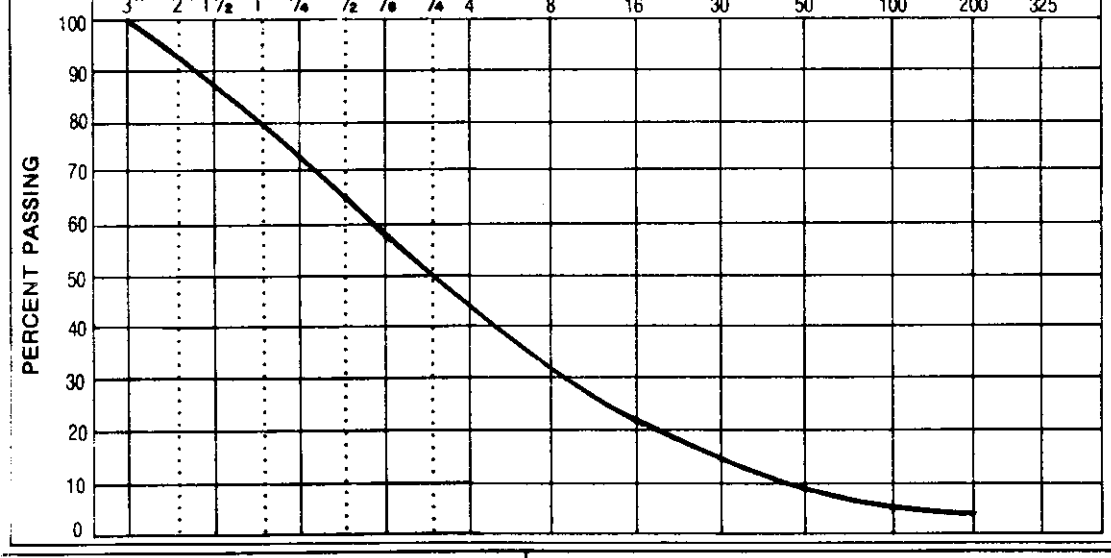


MAX. SIZE	% > 3"
5"	18.6

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	90.4
1 1/2"	81.7
1"	74.0
3/4"	66.6
1/2"	58.6
3/8"	52.7
1/4"	
No. 4	40.8
No. 8	33.5
No. 16	25.7
No. 30	18.4
No. 50	12.9
No. 100	9.8
No. 200	8.0

SAMPLE Y48-B DEPTH 0.5'-6.0'
DATE SAMPLED Oct. 4, 1976 SAMPLED BY SA
LAB TEST NUMBER 32HA

GRAVEL SIZES		SAND SIZES			FINES
24.3 %	33.8 %	12.9 %	16.8 %	8.2 %	4.0 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
5"	14.1

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	93.5
1 1/2"	88.5
1"	82.3
3/4"	75.7
1/2"	65.3
3/8"	58.0
1/4"	
No. 4	41.9
No. 8	30.9
No. 16	21.4
No. 30	14.8
No. 50	9.2
No. 100	5.5
No. 200	4.0

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No.
Y48

DEPOSIT Y51

Setting: Fluvial terraces along the lower reaches of the Crow (Tulugag) River.

Material: Gravel; well graded, fine to coarse, some sand.

Volume: 210,000,000 cubic yards total.

Assessment: Contains good quality granular material. Permafrost and ground water will limit extraction depths. Abandoned pits will become ponds. Access is good.

Airphoto No.: A13383-149/158
Deposit Outline - R.M. Hardy
Deposit Outline - Others
Approx. Scale: 1"=5600'
Test Pit
Exposures

DEPOSIT Y51

SETTING

Deposit Y51 consists of low terraces standing 3 to 15 feet above the floodplain of the lower Crow (Tulugag) River. The terraces lie along the north edge of the river and slope gently to the northeast toward the Babbage River. Broad bars and shallow channel traces give the surface a braided pattern. This deposit has been, previously, designated as "Source Area 2" by Klohn, Leonoff Consultants Ltd.

Only areas of the terrace that are relatively free of overburden have been included within this deposit. However, many bars will have ½ to 2 feet of organic silty sand and peat overlying the gravel, and channel traces appear to be filled with similar materials. Most of the terrace is only imperfectly to moderately well drained except near scarps where drainage is improved. Channel traces are poorly drained. The active layer under most of Deposit Y51 is only 1 to 3 feet thick due to the overburden cover.

Most of the deposit is covered by tundra consisting of moss and lichen with sedges and small dwarf shrubs, primarily dwarf willow. Poorly drained areas are covered by sedge tundra. Deposit Y51 is confined by terraces and floodplains of the Crow and Babbage Rivers to the south and east and gently rolling morainal deposits to the northwest.

Deposit Y51 and the adjacent terrain is critical staging and feeding area for waterfowl and provides habitat for Arctic fox and grizzly bear.

MATERIAL

Deposit Y51 contains good quality granular material consisting of well graded, fine to coarse gravel with some sand. Occasional cobbles and boulders to 14 inches were noted. Larger clasts are mainly

subrounded to subangular sandstone and quartzite with rare chert. Shale and argillite chips are common in the fines.

VOLUME

The total volume of 210,000,000 cubic yards is based on a conservative depth of 50 feet. Gravel depths under Deposit Y51 are estimated to exceed 90 feet.

Annually, 6,000 cubic yards per acre could be extracted by conventional techniques provided that permafrost and ground water will limit the extractable granular material to an average depth of 4 feet. Extraction during the initial year of development might be less if overburden retards the thaw of the underlying gravel.

DEVELOPMENT

Excavation at Deposit Y51 will be limited initially by overburden and then by permafrost and ground water. Deep excavation will require drainage controls. Abandoned pit areas will become ponds.

Access to Deposit Y51 is good. Care must be exercised in crossing thermokarst susceptible, morainal deposits to the northwest.

Development of Deposit Y51 should be planned to minimize interference with waterfowl staging. This deposit lies within the proposed Arctic Wildlife Range, which may restrict development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
	Pt		0.4 PEAT - fine, fibrous.		UF		Organic Color: #2+
	GW		GRAVEL - well graded, some fine to coarse sand, occasional cobbles and boulders to 14" size, sub-angular to subrounded, grey to brown, moist.				Lightweight Pieces - Fine Aggregate: 0.18%
1							
2						2.3	Frozen gravel is well bonded.
3					Vx-Vc 5%		
4							
5							
6			6.0 Bottom of Pit				Sample from 0.4'-6.0'
7							

DATE: Oct. 3, 1976 | LOGGED BY: CPM | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y51-A

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
	Pt		0.4 PEAT		UF		Organic Color: #3+
1	SM		SAND - fine to medium, little silty fines, trace coarse gravel, rootlets, grey-brown, wet. 1.6				Lightweight Pieces - Fine Aggregate: 0.15%
2	GW		GRAVEL - well graded to 3" size, some fine to coarse sand, trace fines, occasional cobbles and boulders, rootlets, brown.		Nbn	1.7	
3			3.2 ▽ hole filling with water at 3.2'.			3.2	
			Bottom of Pit				Sample from 1.6'-3.2'
4							

DATE: Sept. 20, 1976	LOGGED BY: JDF	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y51-B
SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
	Pt		PEAT - (mostly moss). 0.3		UF		Lightweight Pieces - Fine Aggregate: 4.31%
1	GW		GRAVEL - well graded, little fine to coarse sand, occasional cobbles to 5" size, subangular to sub-rounded, cherts. 1.0 ▽ 1.2				
2			Bottom of Pit				Sample taken 0'-1.2'

DATE: Sept. 21, 1976 | LOGGED BY: GCD | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

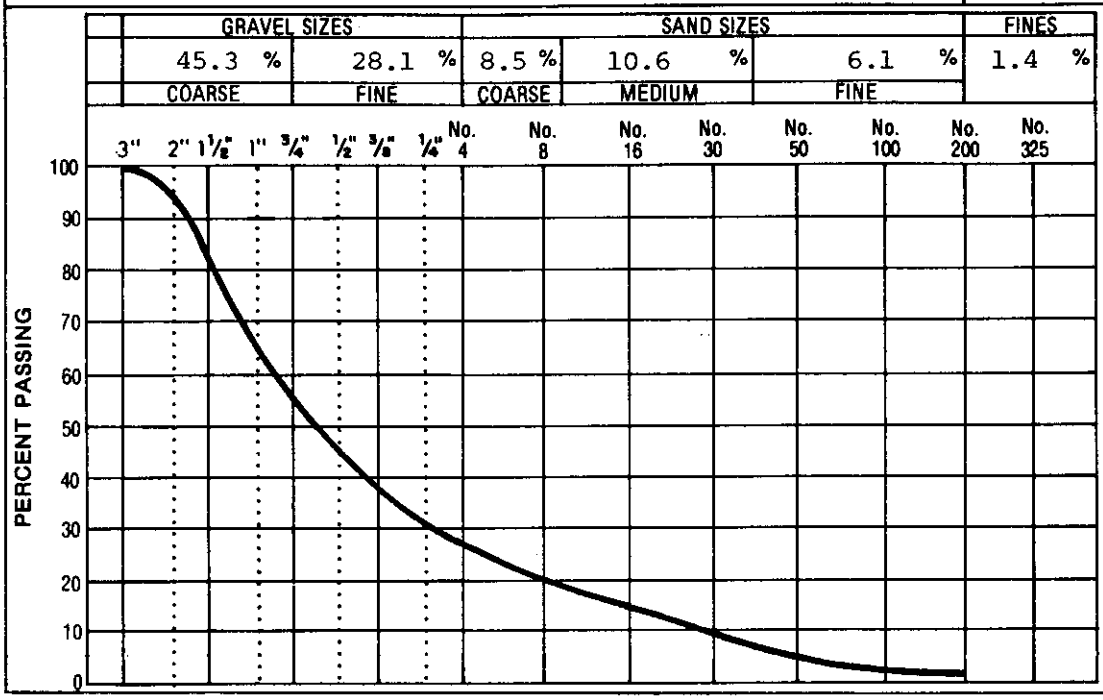
R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y51-C

SHEET 1 OF 1

GRAIN SIZE ANALYSIS

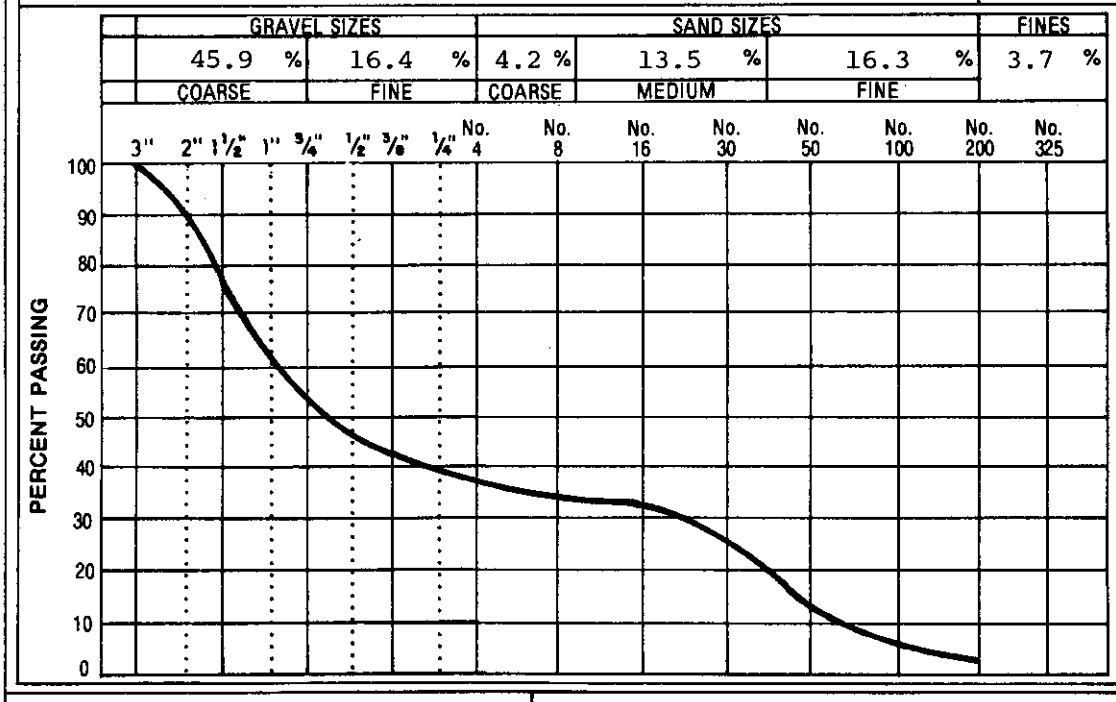
SAMPLE Y51-A DEPTH 0.4'-6.0'
DATE SAMPLED Oct. 3, 1976 SAMPLED BY CPM
LAB TEST NUMBER 28HA



MAX. SIZE	% > 3"
5"	7.5

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	93.8
1 1/2"	78.5
1"	63.3
3/4"	54.7
1/2"	43.6
3/8"	37.4
1/4"	
No. 4	26.6
No. 8	20.5
No. 16	14.7
No. 30	9.2
No. 50	4.2
No. 100	2.1
No. 200	1.4

SAMPLE Y51-B DEPTH 1.6'-3.2'
DATE SAMPLED Sept. 20, 1976 SAMPLED BY JDF
LAB TEST NUMBER TP25



MAX. SIZE	% > 3"
3"	0

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	90.9
1 1/2"	76.3
1"	62.7
3/4"	54.1
1/2"	46.5
3/8"	42.8
1/4"	
No. 4	37.7
No. 8	35.2
No. 16	32.4
No. 30	24.9
No. 50	12.8
No. 100	6.2
No. 200	3.7

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No.
Y51

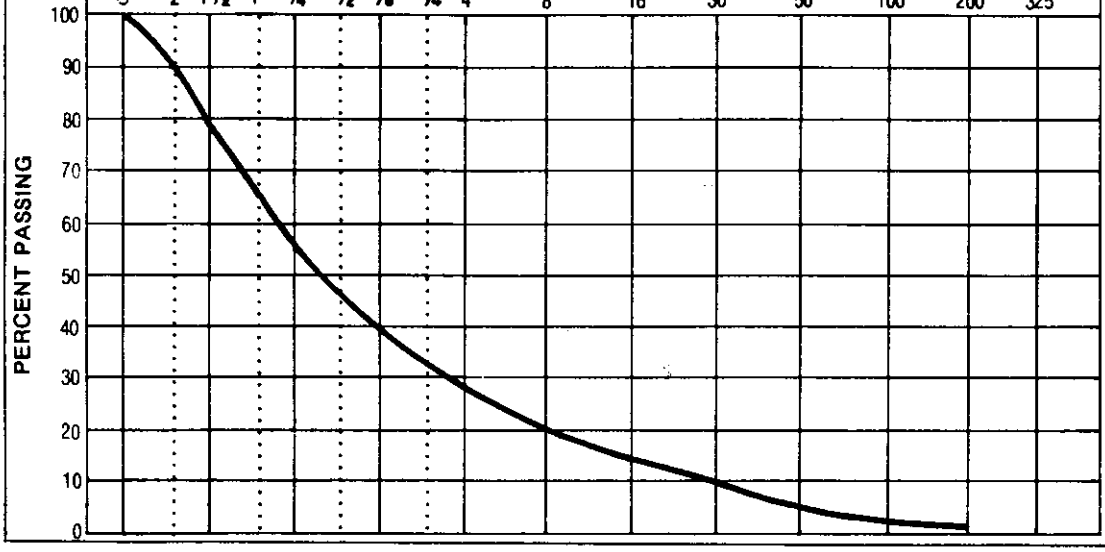
GRAIN SIZE ANALYSIS

SAMPLE Y51-C DEPTH 0'-1.2'

DATE SAMPLED Sept. 21, 1976 SAMPLED BY GCD

LAB TEST NUMBER 24HA

GRAVEL SIZES		SAND SIZES			FINES
43.4 %	27.1 %	10.5 %	12.0 %	4.6 %	2.4 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
3"	0

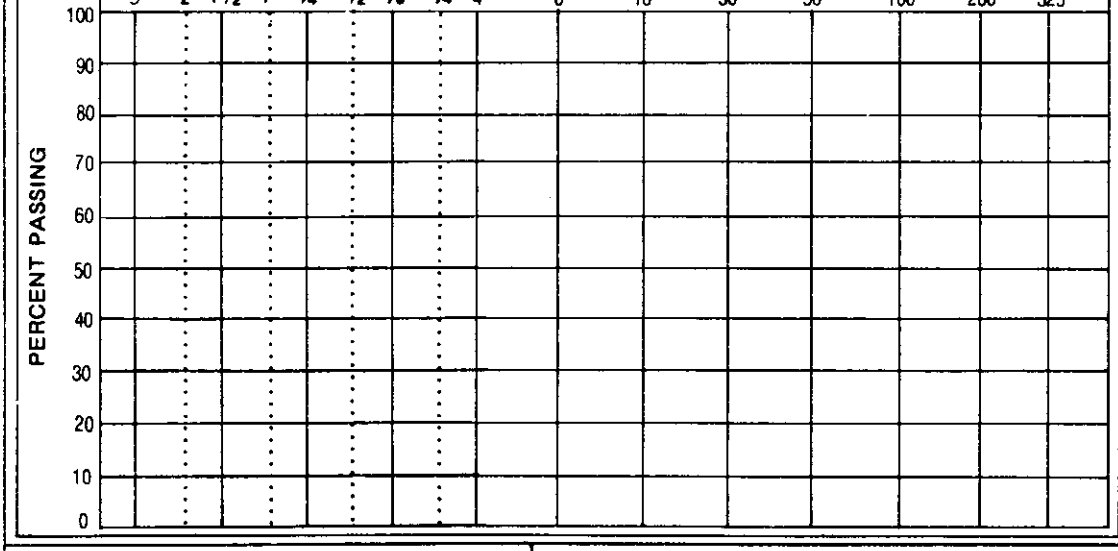
SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	91.7
1 1/2"	78.6
1"	65.3
3/4"	56.6
1/2"	46.2
3/8"	39.8
1/4"	
No. 4	29.5
No. 8	19.1
No. 16	14.7
No. 30	9.9
No. 50	5.4
No. 100	3.3
No. 200	2.4

SAMPLE _____ DEPTH _____

DATE SAMPLED _____ SAMPLED BY _____

LAB TEST NUMBER

GRAVEL SIZES		SAND SIZES			FINES
%	%	%	%	%	%
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"

SIEVE SIZE	PERCENT PASSING
3"	
2"	
1 1/2"	
1"	
3/4"	
1/2"	
3/8"	
1/4"	
No. 4	
No. 8	
No. 16	
No. 30	
No. 50	
No. 100	
No. 200	

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No. Y51

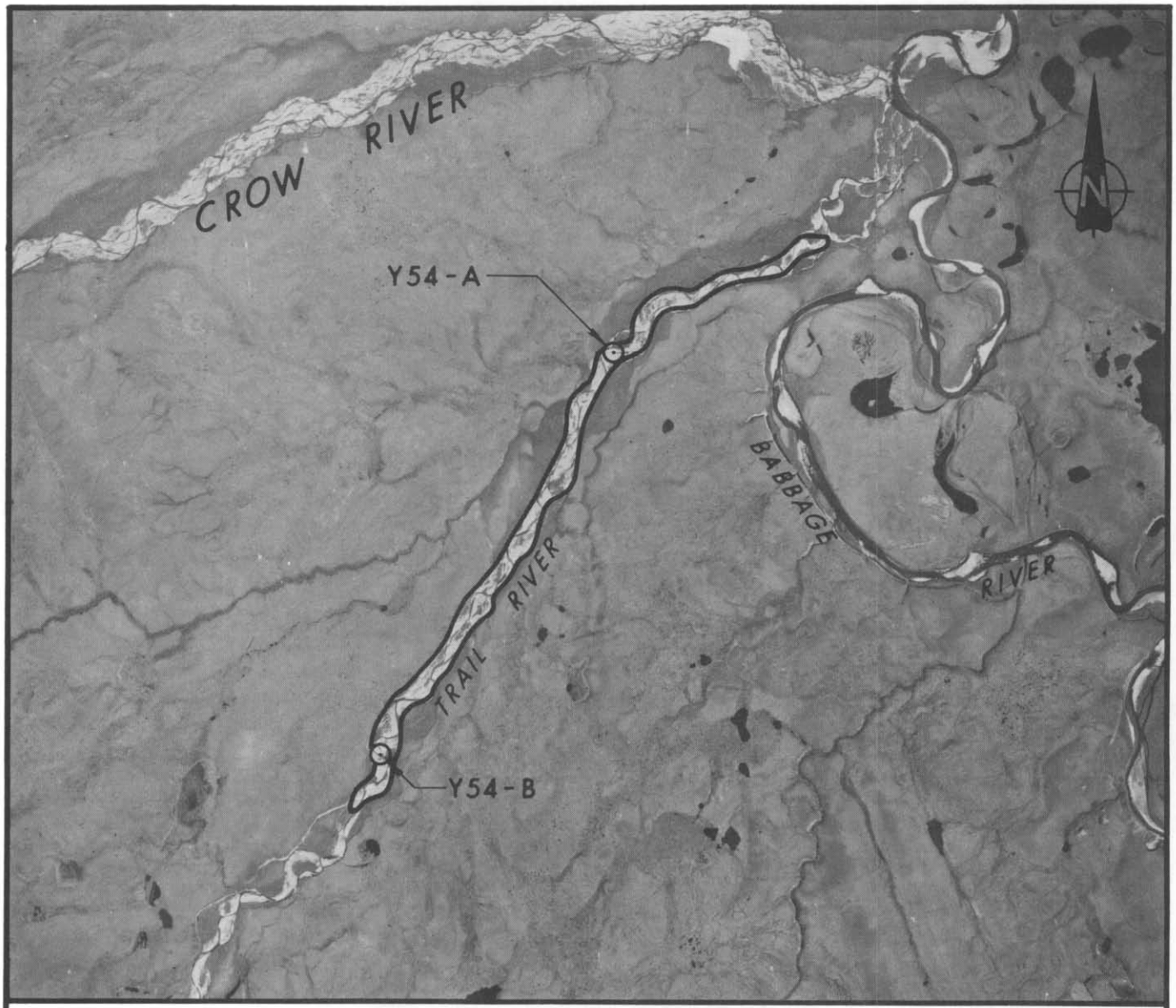
DEPOSIT Y54

Setting: Active floodplain of the Trail River.

Material: Gravel; well graded, fine to coarse, some sand.

Volume: 12,000,000 cubic yards total.

Assessment: Contains good quality granular material with moderate amount of oversize. Extraction will be limited by ground water. Restoration will occur through natural fluvial processes. Good access along the stream course.
Recoverable volume may be limited to 3,000,000 cubic yards.



Airphoto No.: A13383-147		Approx. Scale:	1"=5800'
Deposit Outline - R.M. Hardy	———	Test Pit	⊙
Deposit Outline - Others	—·—·—	Exposures	✣

DEPOSIT Y54

SETTING

Deposit Y54 is the active floodplain of the Trail River, which consists of bars and channel beds exhibiting a braided pattern. At low water the Trail River is confined to a single channel.

The deposit is well-drained and free of overburden. Approximately one-half of the floodplain surface is more than 5 feet above low stream levels on the lower reaches and more than 7 feet above low stream levels on the upper reaches. Scour holes and channel traces give the floodplain a local relief in excess of 3 feet. The thickness of the active layer is estimated to exceed 6½ feet.

Tufts of grass and low willows cover half of the active floodplain surface. The Trail River provides a migration route for fish and a spawning area for Arctic grayling.

Deposit Y54 is bordered by a narrow band of moderately well drained low terraces, which in turn are flanked by imperfectly to poorly drained peat-covered glaciofluvial and lacustrine sediments. This terrain provides critical feeding and staging areas for waterfowl, and adequate habitat for grizzly bear and Arctic fox.

MATERIAL

Deposit Y54 contains good quality granular material consisting of stratified, well graded, fine to coarse gravel with some fine to coarse sand. Oversize material may form a major part of the deposit, as cobbles to 7 inches are common, and parts of the surface is covered by a boulder lag. Larger clasts are mainly subrounded to subangular sandstone and quartzite with some granitics and rare chert, limestone, and conglomerate. Shale chips are common in the fines.

Up to 6 inches of sand may cover the bottom of some channel traces.

VOLUME

The total volume of 12,000,000 cubic yards is based on a conservative depth of 20 feet. Gravel in adjacent terraces is known to exceed 30 feet.

Annually, 110,000 cubic yards for each 1000 feet segment of the floodplain can be extracted by conventional techniques assuming that static ground water levels limit the extractable granular material to an average depth of 5 feet. Volume of recoverable material may be limited to 3,000,000 cubic yards because of static ground water conditions.

DEVELOPMENT

Extraction of material at Deposit Y54 would probably be confined to summer and fall when water levels are low, and large areas are required for the recovery of comparatively small volume. Adequate areas for stockpiling are available. The areas of excavation would slowly be restored by natural fluvial processes as streams along the coastal plain are known to move significant amounts of coarse sediment.

Access to this deposit is good along the stream course, but overland access would be restricted by thermokarst susceptible, poorly drained terrain. The Babbage River and its terraces provide a good route to the coast.

Development of Deposit Y54 should be planned to minimize interference with waterfowl staging or fish spawning areas. This deposit lies within the proposed Arctic Wildlife Range, which may restrict development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
0	GW		GRAVEL - well graded to 7" cobbles, little fine to coarse sand, sub-angular, weathered.		UF		Moisture Content: 3.6%
1							Lightweight Pieces -
2							Fine Aggregate: 0.06%
3			3.0				
	SW		SAND - fine to coarse, some gravel to 2" size.				
			3.6				
4	GW		GRAVEL - well graded to 6" cobbles, little fine to coarse sand, sub-angular				
5							
6			6.0				
			Bottom of Pit				Sample from 0'-6.0'
7							

DATE: Sept. 23, 1976	LOGGED BY: GCD	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

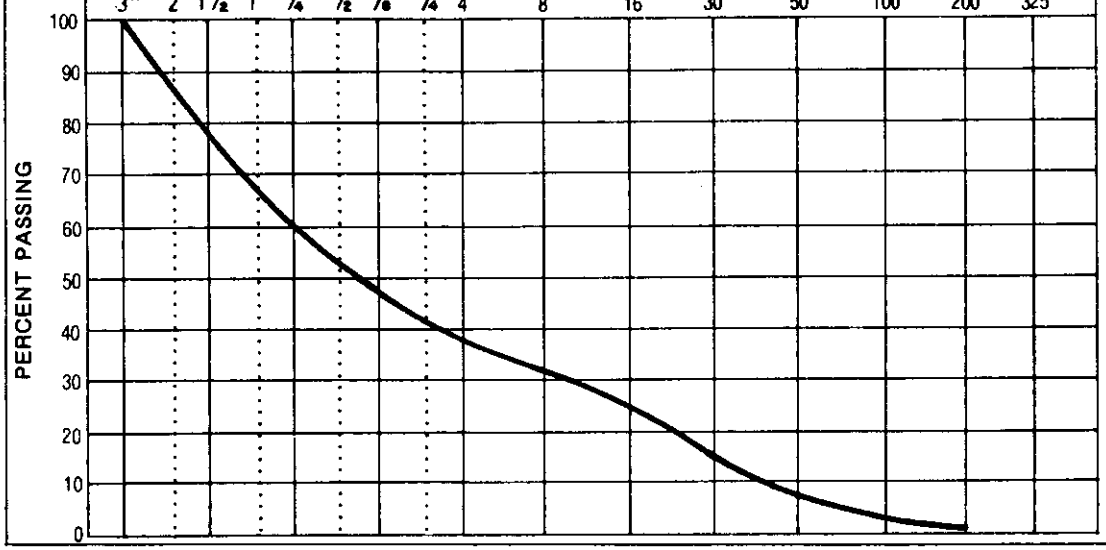
TEST PIT NO.
Y54-B

SHEET 1 OF 1

GRAIN SIZE ANALYSIS

SAMPLE Y54-A DEPTH 0'-5.8'
DATE SAMPLED Sept. 20, 1976 SAMPLED BY JDF
LAB TEST NUMBER TP34

GRAVEL SIZES		SAND SIZES			FINES
39.5 %	22.6 %	7.4 %	20.0 %	9.3 %	1.2 %
COARSE	FINE	COARSE	MEDIUM	FINE	

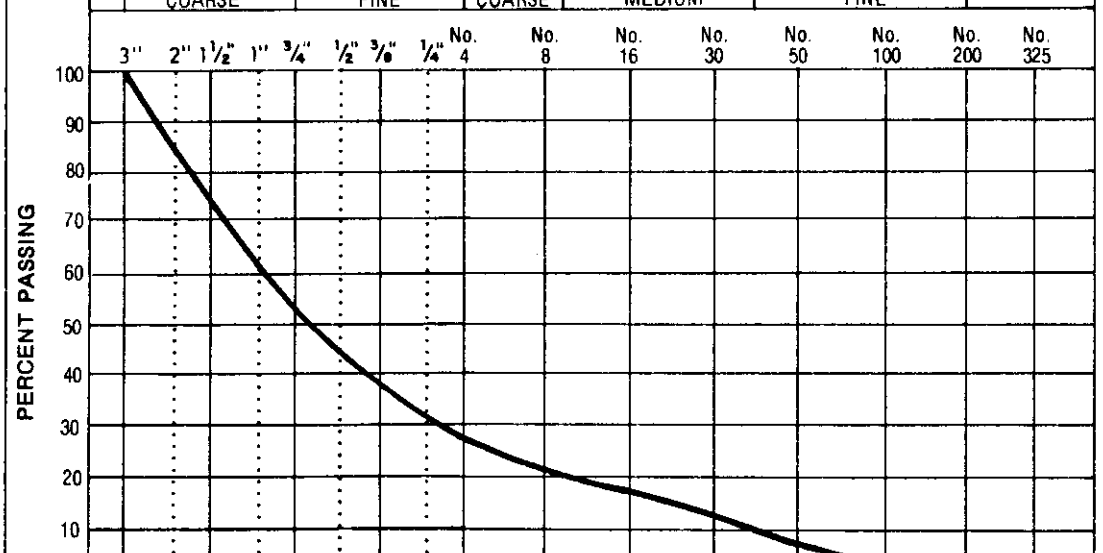


MAX. SIZE	% > 3"
3"	0

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	85.8
1 1/2"	78.3
1"	67.0
3/4"	60.5
1/2"	52.7
3/8"	47.3
1/4"	
No. 4	37.9
No. 8	31.3
No. 16	23.9
No. 30	15.3
No. 50	5.9
No. 100	2.0
No. 200	1.2

SAMPLE Y54-B DEPTH 0'-6.0'
DATE SAMPLED Sept. 23, 1976 SAMPLED BY GCD
LAB TEST NUMBER 33HA

GRAVEL SIZES		SAND SIZES			FINES
44.6 %	29.4 %	6.0 %	10.0 %	7.9 %	2.1 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
5"	26.2

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	92.1
1 1/2"	76.1
1"	63.5
3/4"	55.4
1/2"	43.6
3/8"	37.2
1/4"	
No. 4	26.0
No. 8	22.4
No. 16	17.8
No. 30	12.2
No. 50	6.4
No. 100	3.1
No. 200	2.1

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No. Y54

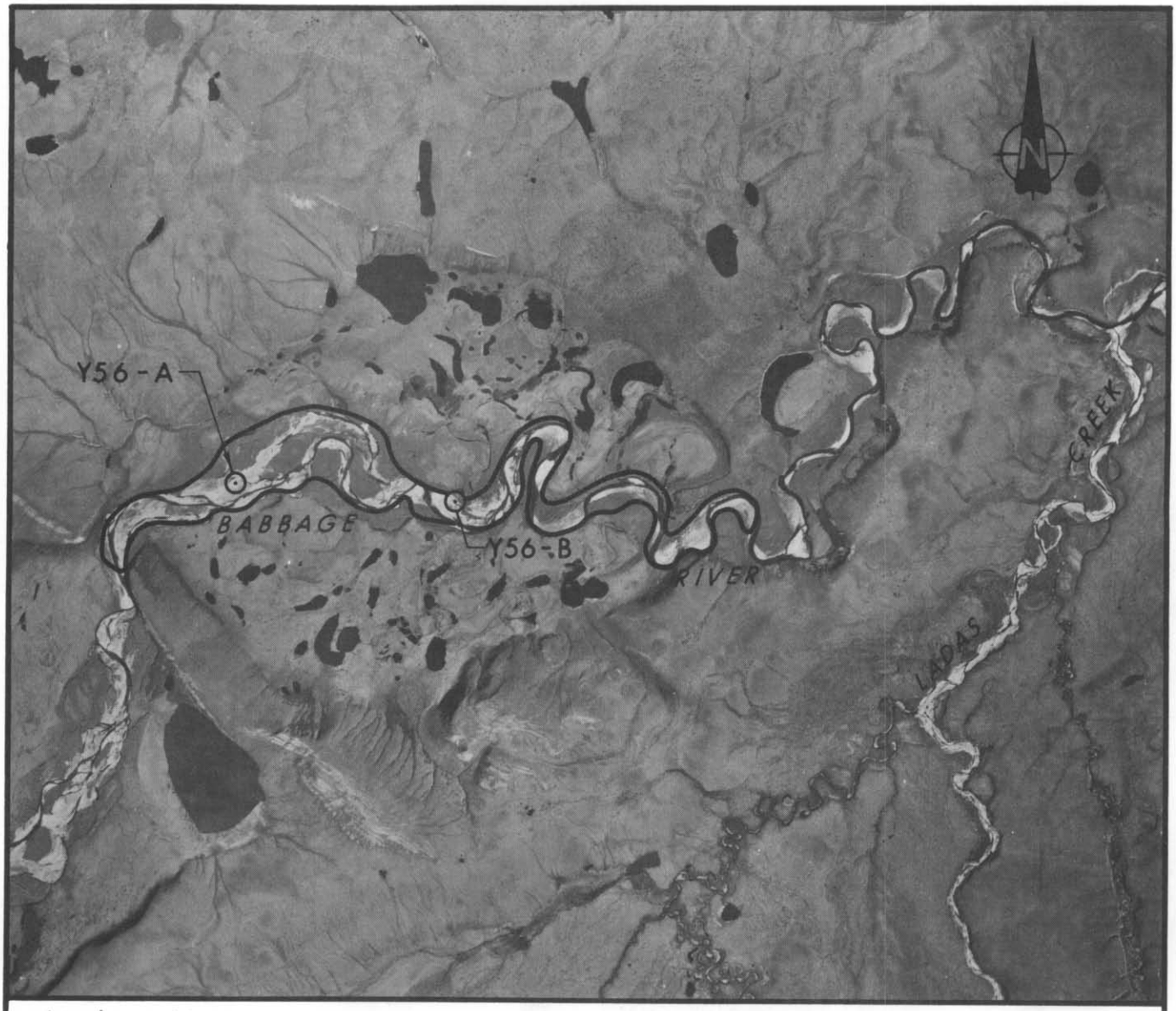
DEPOSIT Y56

Setting: Floodplain of the Babbage River upstream from the mouth of Ladas Creek.

Material: Gravel; well graded, little fine to coarse sand.

Volume: 19,000,000 cubic yards total.

Assessment: Contains fair to good quality granular material. Extraction would be limited by ground water levels. Restoration should occur through natural processes. Access is good along the Babbage River. Recoverable volume may be limited to 4,800,000 cubic yards.



Airphoto No.: A13383-145		Approx. Scale:	1"=5700'
Deposit Outline - R.M. Hardy	———	Test Pit	⊙
Deposit Outline - Others	—·—·—	Exposures	✠

DEPOSIT Y56

SETTING

Deposit Y56 includes both the active vegetation-bare and the adjacent stabilized vegetated parts of the Babbage River floodplain along an eastward flowing segment upstream from Ladas Creek. The active floodplain consists of large point bars with local scour holes and channel traces. The vegetated floodplain is generally flat.

The deposit is well drained and the low terraces may have up to 4 feet of silty sand on their surface. Approximately three-quarters of the active floodplain is 4 feet above low water level and the vegetated floodplain is usually 6 to 8 feet above low water level.

The active layer is probably 3 to 5 feet deep on the vegetated floodplain, and over 8 feet deep under the active floodplain.

The active floodplain is generally free of vegetation, but the stabilized floodplain has a near continuous vegetation cover with willows to 6 feet in height. Deposit Y56 is bordered by low, poorly-drained, peat-covered terraces, which are flanked by ice-cored morainal deposits and an occasional scree-covered bedrock hill.

The terrain provides feeding and staging areas for waterfowl and adequate habitat for grizzly bear and Arctic fox. The Babbage River is a migratory route for Arctic char.

MATERIAL

Deposit Y56 contains fair to good quality granular material consisting mainly of well graded, fine to coarse gravel with little sand and cobbles to 6 inches in size. Fine to medium sand beds composed of small shale fragments are present. Larger clasts are mainly subrounded sandstone.

VOLUME

The total volume of 19,000,000 cubic yards is based on a conservative depth of 15 feet. Gravel under the floodplain in a downstream direction exceeds 25 feet in depth.

This volume could be significantly increased by including the broad floodplain of the Babbage River above the upstream limit of Deposit Y56 in the Bain Mountains, or the narrower floodplain below the downstream limit of the deposit.

Annually 150,000 cubic yards per 1000 foot length of floodplain can be extracted by conventional techniques assuming that static ground water levels and permafrost limit the extractable granular material to an average depth of 4 feet. Volume of recoverable material may be limited to 4,800,000 cubic yards because of static ground water and permafrost tables.

DEVELOPMENT

Extraction at Deposit Y56 would probably be confined to summer and fall when water levels are low. Adequate areas for stockpiling are available on adjacent low terraces.

Pits should be developed so that following development they will be filled by natural fluvial processes, as streams of the coastal plain are known to move significant amounts of coarse sediment.

Access to the deposit is good along the Babbage River, but thermokarst susceptible material would require crossing if access from other directions was intended.

Development of Deposit Y56 should be planned to minimize interference with waterfowl staging and fish migration. Deposit Y56 lies within the proposed Arctic Wildlife Range, which may restrict development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	GW		GRAVEL - well graded to 6" cobbles, some fine to coarse sand, medium dense, dark grey to black, wet, clean.		UF		Lightweight Pieces - Fine Aggregate: 0.61%
2							
2.5			loosely packed below 2.5'.				
3							
4							
5							
5.3 / 5.5			▽ water seepage				
6			Bottom of Pit				Sample from 0.5'-5.0'

DATE: Oct. 6, 1976	LOGGED BY: SA	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y56-A

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	GW		GRAVEL - well graded to 6" size, little fine to coarse sand, subrounded, dense, dark grey to black, moist, clean.		UF		Lightweight Pieces - Fine Aggregate: Sample 1: 0.16% Sample 2: 0.16%
2							
		2.5					
3	SP		SAND - fine to medium, shaley, medium dense, black, wet.				
4		4.0 ▽	- water seeping into pit.				
		4.5			F	4.4	
5			Bottom of Pit				Sample 1, 0'-2.5' Sample 2, @ 3.5'

DATE: Oct. 6, 1976	LOGGED BY: SA	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y56-B

SHEET 1 OF 1

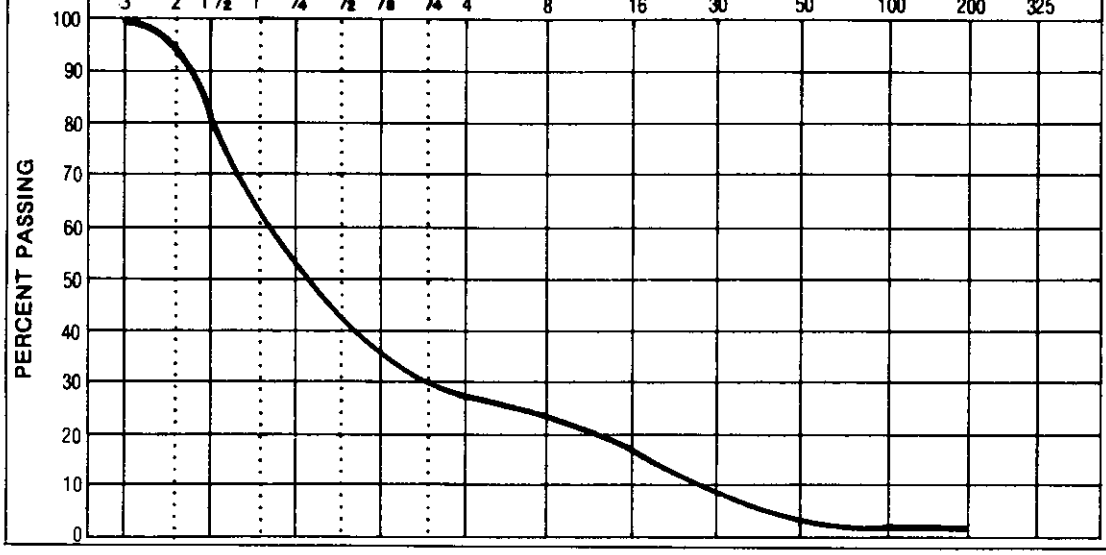
GRAIN SIZE ANALYSIS

SAMPLE Y56-A DEPTH 0.5'-5.0'

DATE SAMPLED Oct. 6, 1976 SAMPLED BY SA

LAB TEST NUMBER 91HA

GRAVEL SIZES		SAND SIZES			FINES
46.8 %	25.5 %	5.7%	16.2 %	5.5 %	0.8 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
5"	17.0

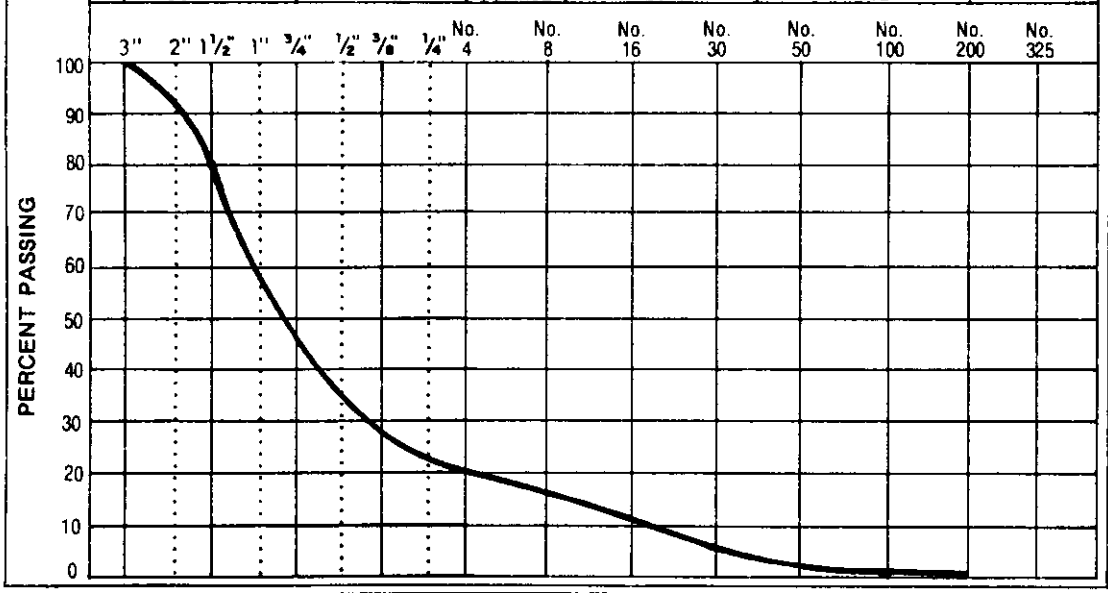
SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	94.0
1 1/2"	78.1
1"	63.4
3/4"	53.2
1/2"	42.7
3/8"	36.9
1/4"	
No. 4	27.7
No. 8	23.8
No. 16	17.7
No. 30	8.3
No. 50	2.7
No. 100	1.2
No. 200	0.8

SAMPLE Y56-B-1 DEPTH 0'-2.5'

DATE SAMPLED Oct. 6, 1976 SAMPLED BY SA

LAB TEST NUMBER 92HA

GRAVEL SIZES		SAND SIZES			FINES
54.7 %	24.5 %	4.3%	12.5 %	3.3 %	0.7 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
4"	5.0

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	93.0
1 1/2"	77.6
1"	64.4
3/4"	45.3
1/2"	36.4
3/8"	28.4
1/4"	
No. 4	20.8
No. 8	17.6
No. 16	13.2
No. 30	5.8
No. 50	2.1
No. 100	1.1
No. 200	0.7

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No. Y56

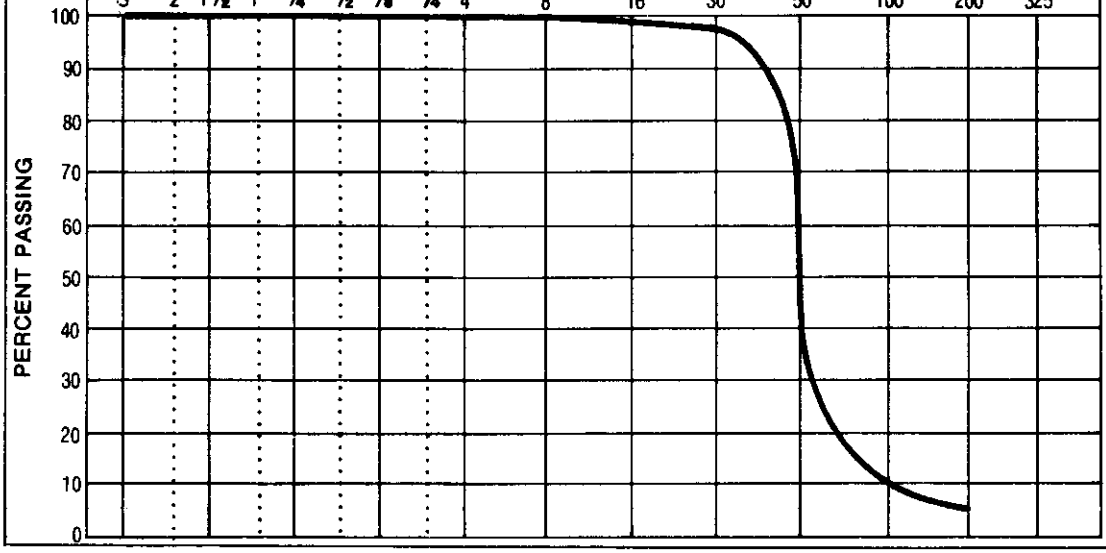
GRAIN SIZE ANALYSIS

SAMPLE Y56-B-2 DEPTH 3.5'

DATE SAMPLED Oct. 6, 1976 SAMPLED BY SA

LAB TEST NUMBER: 92HA @ 3.5'

GRAVEL SIZES		SAND SIZES			FINES
0 %	0 %	1.0 %	7.0 %	85.9 %	6.1 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
No. 8	0

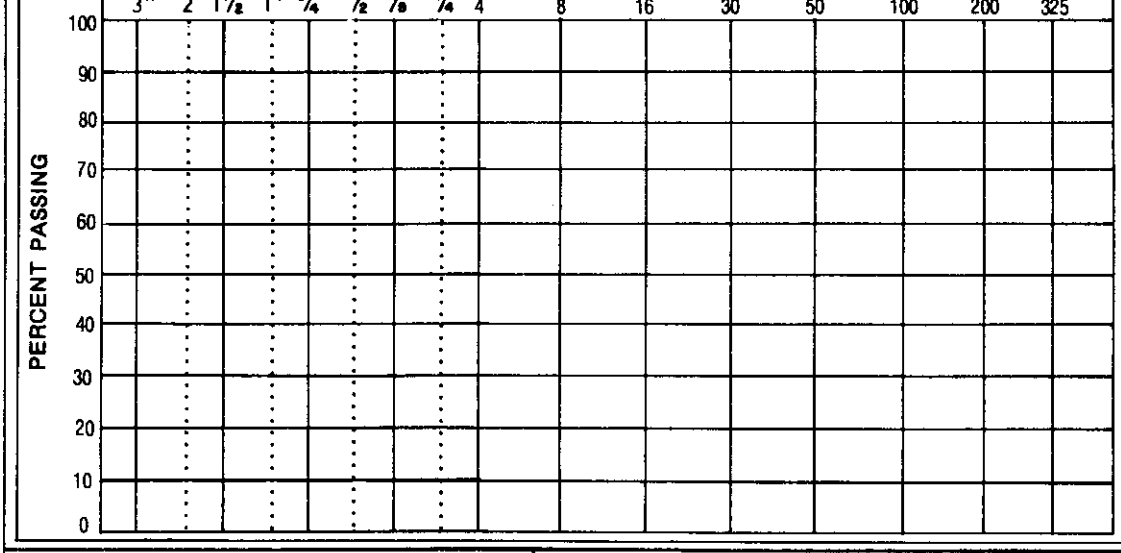
SIEVE SIZE	PERCENT PASSING
3"	
2"	
1 1/2"	
1"	
3/4"	
1/2"	
3/8"	
1/4"	
No. 4	
No. 8	100.0
No. 16	99.8
No. 30	97.6
No. 50	50.7
No. 100	10.6
No. 200	6.1

SAMPLE _____ DEPTH _____

DATE SAMPLED _____ SAMPLED BY _____

LAB TEST NUMBER

GRAVEL SIZES		SAND SIZES			FINES
%	%	%	%	%	%
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"

SIEVE SIZE	PERCENT PASSING
3"	
2"	
1 1/2"	
1"	
3/4"	
1/2"	
3/8"	
1/4"	
No. 4	
No. 8	
No. 16	
No. 30	
No. 50	
No. 100	
No. 200	

GOVERNMENT OF CANADA

DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.

CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No.

Y56

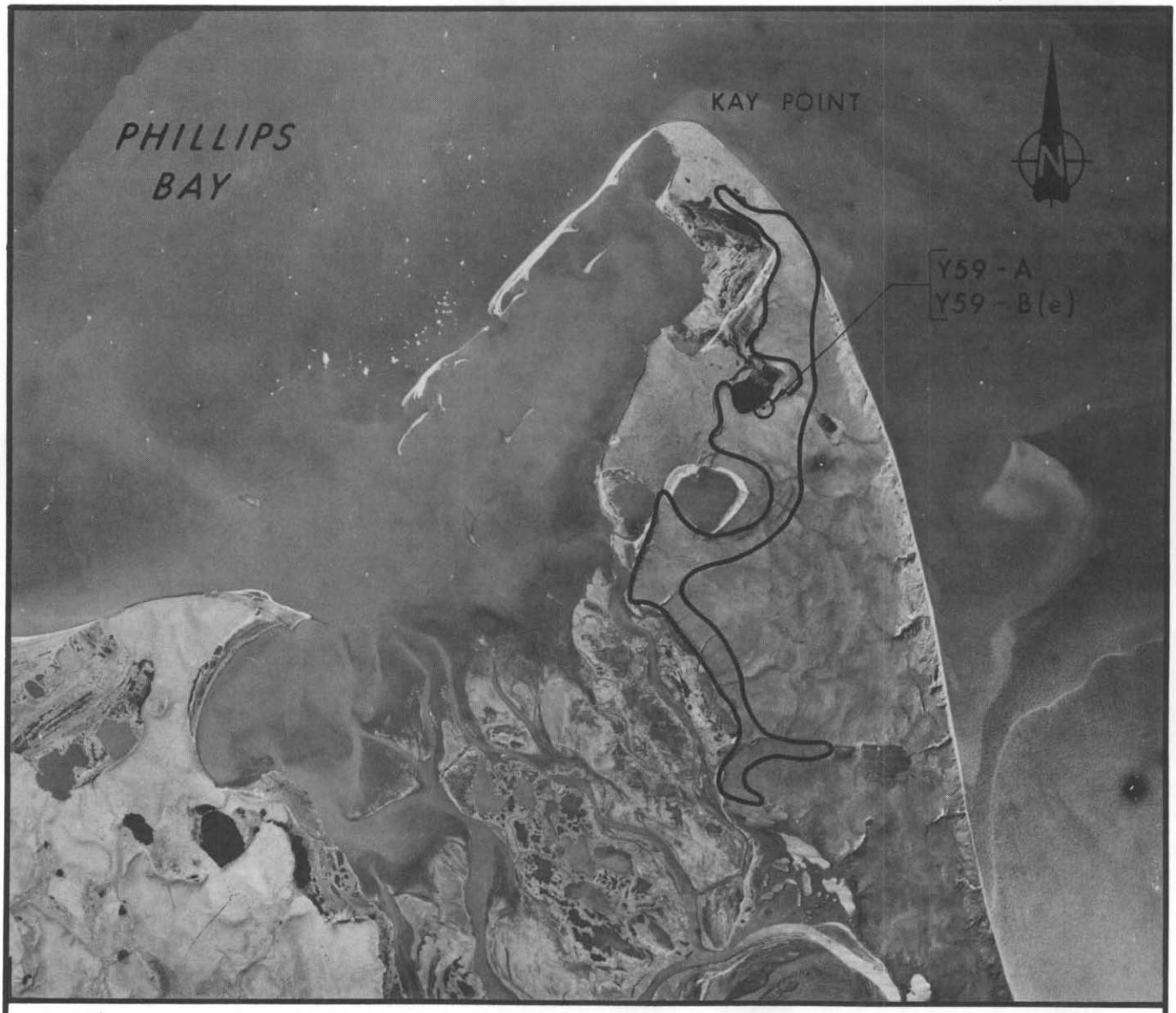
DEPOSIT Y59

Setting: Terraced remanents of coalescing outwash fans along northern edge of the Babbage estuary south of Kay Point.

Material: Sand and Gravel; poorly graded, fine to coarse, silty fines.

Volume: 17,000,000 cubic yards total.

Assessment: Contains poor to good quality granular material. Overburden depths are significant. High ground ice content. Access to coast good.



Airphoto No.: A13383-151		Approx. Scale:	1"=5700'
Deposit Outline - R.M. Hardy	———	Test Pit	⊙
Deposit Outline - Others	—·—·—	Exposures	✠

DEPOSIT Y59

SETTING

Deposit Y59 consists of coalescing outwash fans that are located on the western edge of the ridge running along the Beaufort coast south of Kay Point.

The outwash fans slope gently to the west where they are separated from lower surfaces and the Babbage delta by stable 10 to 30 foot scarps. Ice wedge trenches, 3 feet deep, are present on the surface of this deposit. The northeastern edge of the deposit is being actively-eroded by wave action.

Most of the surface of Deposit Y59 is covered by peat and sandy organic silts, varying from 5 to 10 feet plus, having moderately high ice contents. The surface is moderately well to imperfectly drained. The active layer is probably only 1 to 3 feet thick.

Deposit Y59 is covered by sedge tussock tundra; low willows, ericaceous schrubs and moss grow in ice wedge trenches.

Adjacent to the eastern perimeter of Deposit Y59 is a high ridge of deformed fine-grained Pleistocene sediment with some massive ice. The Babbage estuary and delta lie toward the west. A low bench, underlain by peat-covered lacustrine silty sands and gravels, is located to the northwest. This area provides ground for staging and feeding activities of waterfowl.

MATERIAL

Deposit Y59 contains mainly poor to fair quality granular material, although scattered pockets of good quality material are present. The deposit consists of poorly graded, silty, fine to medium sand with pockets of stratified fine to coarse gravel. The gravels contain few cobbles to 4 inches in size. Larger clasts are mainly sandstone and quartzite.

VOLUME

The total volume of 17,000,000 cubic yards is based on a conservative estimated thickness of 15 feet. Exposures show 15 to 40 feet of sand and gravel.

Annually, 3,900 cubic yards per acre could be removed by conventional extraction assuming a yearly recoverable depth of 3 feet, after the overburden has been removed.

DEVELOPMENT

Development of this deposit would involve removal and disposal of significant quantities of overburden. Development would probably be best along scarp edges where natural drainage is easily maintained. Massive ice, if encountered at depth, would require consideration in pit development. Pit restoration would involve simple grading of benches along scarps, or flooding of deeper pits.

Access to the coast is very good as the deposit is adjacent to the coast.

Development should be planned to minimize interference with staging activities of waterfowl. Deposit Y59 lies within the proposed Arctic Wildlife Preserve, which may restrict development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
	Pt	? ? ? ?	PEAT - moss cover. 0.4		UF		
	ML		SILT - little sand, low plastic, organic, rootlets, dark brown, moist. 0.8				
1	SP		SAND - fine to medium, little fines, rootlets, brown, damp.				
2							
3			wet at 3.2'.				
	GM		3.2 GRAVEL - little fine sand, little silty fines.		F	3.2	No sample taken.
			Bottom of Pit				

DATE: Sept. 20, 1976 | LOGGED BY: JDF | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y59-A

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
	Pt		PEAT - moss cover. 0.4		UF		Lightweight Pieces - Fine Aggregate: 0.76%
1	SP		SAND - fine, little fines, rootlets, medium brown, damp. 1.8				
2	GW		GRAVEL - well graded to 3" size, and fine to coarse sand, trace fines, occasional cobbles, rounded, layered, damp.				
3							
4							
5							
6							
7							
8							
9							
10			10.3				
11			Bottom of Pit				Sample from 1.8'-10.3'

DATE: Sept. 20, 1976 | LOGGED BY: JDF | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y59-B(e)

SHEET 1 OF 1

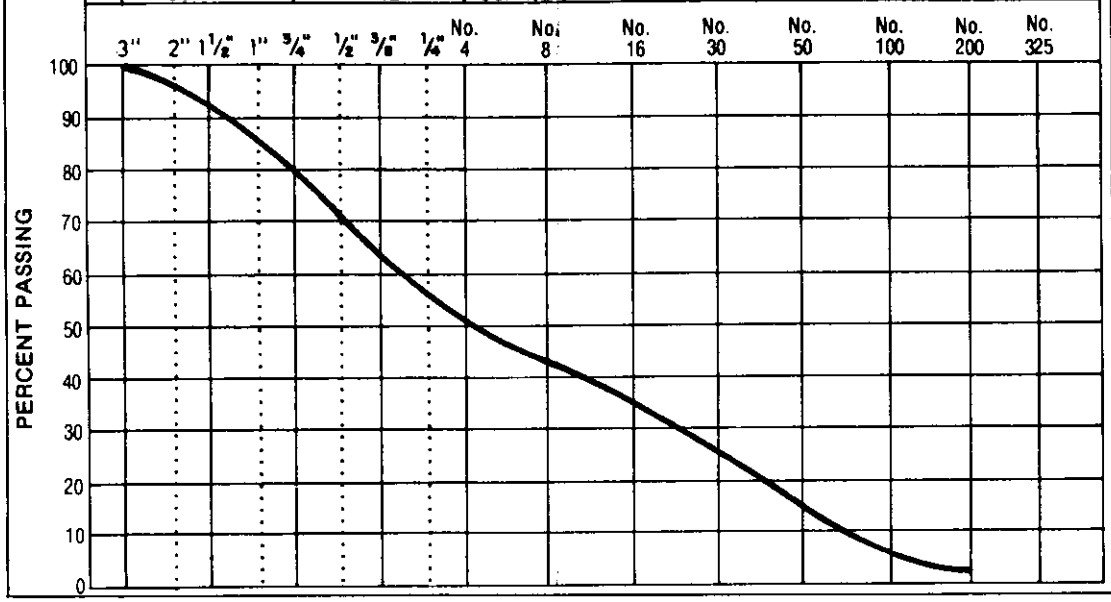
GRAIN SIZE ANALYSIS

SAMPLE Y59-B(e) DEPTH 1.8'-10.3'

DATE SAMPLED Sept. 20, 1976 SAMPLED BY JDF

LAB TEST NUMBER: TP20A

GRAVEL SIZES		SAND SIZES			FINES
19.8 %	31.1 %	6.6 %	22.5 %	17.7 %	2.3 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
3"	0

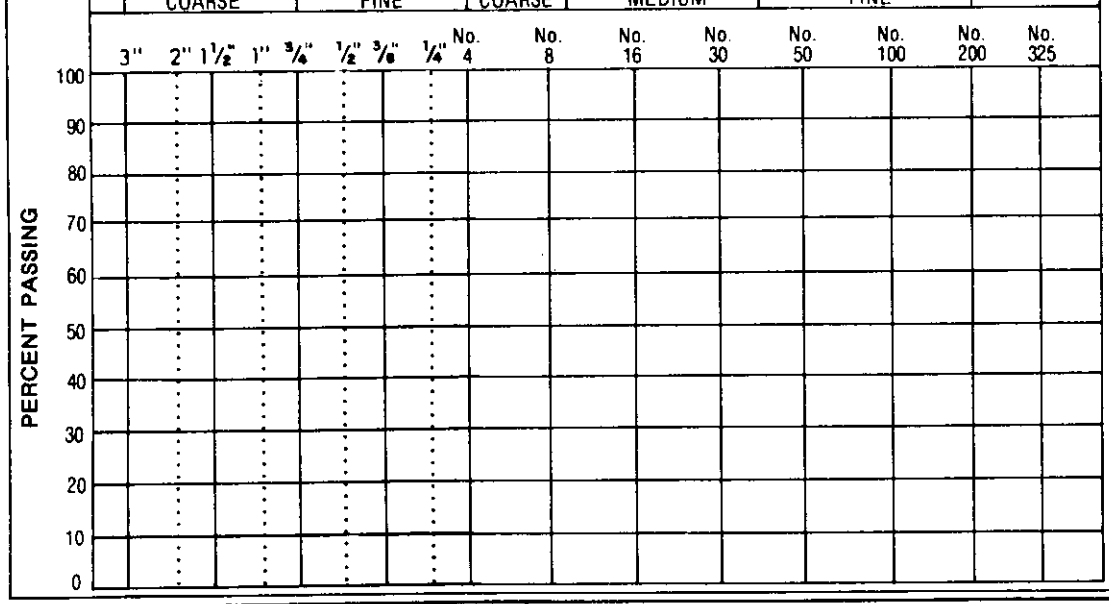
SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	97.3
1 1/2"	93.3
1"	85.3
3/4"	80.2
1/2"	71.3
3/8"	63.9
1/4"	
No. 4	49.1
No. 8	42.9
No. 16	35.1
No. 30	26.5
No. 50	14.1
No. 100	4.7
No. 200	2.3

SAMPLE _____ DEPTH _____

DATE SAMPLED _____ SAMPLED BY _____

LAB TEST NUMBER

GRAVEL SIZES		SAND SIZES			FINES
%	%	%	%	%	%
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"

SIEVE SIZE	PERCENT PASSING
3"	
2"	
1 1/2"	
1"	
3/4"	
1/2"	
3/8"	
1/4"	
No. 4	
No. 8	
No. 16	
No. 30	
No. 50	
No. 100	
No. 200	

GOVERNMENT OF CANADA

DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.

CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

DEPOSIT No.

Y59

DEPOSIT Y60

Setting: Active floodplain of the lower Babbage River.

Material: Gravel; fine to coarse, some fine to coarse sand.

Volume: 46,000,000 cubic yards total.

Assessment: Contains good quality granular material. Extraction would be limited by ground water levels. Natural fluvial processes would rapidly restore floodplain. Access to deposit is good.
Recoverable volume may be limited to 3,600,000 cubic yards.

Airphoto No.: A14406-48		Approx. Scale:	1"=5700'
Deposit Outline - R.M. Hardy	———	Test Pit	⊙
Deposit Outline - Others	—·—·—	Exposures	✠

DEPOSIT Y60

SETTING

Deposit Y60 is the active floodplain of the Babbage River, downstream from the confluence of the Trail and Crow (Tulugag) Rivers. It consists of large vegetation-free point bars and islands. Scour holes up to 2 feet deep are present. The Babbage River is confined to mainly one channel at low water.

The deposit is well-drained and free of overburden. Approximately three-quarters of the bars and islands are 4 feet above low water levels. The thickness of the active layer is estimated to be in excess of 8 feet.

Deposit Y60 is bordered by low moderately-well to imperfectly drained terraces with low willow shrubbery to 3 feet in height. Coastward the ice-rich silty Babbage delta is present. The Babbage River is a migration route for Arctic char. The terrain provides suitable habitat for Arctic fox, moose, and grizzly bear, and critical staging areas for waterfowl.

MATERIAL

Deposit Y60 contains good quality granular material consisting of stratified, fine to coarse gravel with some fine to coarse sand. The surface of some point bars have a pebbly cobble pavement with cobbles to 7 inches in size. Larger clasts are mainly subangular to subrounded sandstone and quartzite with rare limestone and chert. Shale forms a good part of the fines.

The granular material is potentially very reactive and is not suitable for concrete aggregates.

VOLUME

The total volume of 46,000,000 cubic yards is based on a conservative depth of 45 feet. Gravel in the adjacent terraces is known to exceed 60 feet in thickness.

Annually, 140,000 cubic yards per 1000 foot length of floodplain can be extracted by conventional techniques assuming that static ground water levels limit the extractable granular material to an average depth of 5 feet. Volume of recoverable material may be limited to 3,600,000 cubic yards because of static ground water conditions.

DEVELOPMENT

Extraction of material from Deposit Y60 would probably be confined to summer and fall when water levels are low. Adequate areas are available for stockpiling.

Developed areas in the floodplain would be restored by natural fluvial processes. Streams of the coastal plain are known to move significant amounts of coarse sediment.

Local access to this deposit is good along stream courses and terraces, although care should be taken to avoid damaging extensive areas of willow used by moose as browse. Development of Deposit Y60 should be planned to minimize interference with fish activities. The deposit lies within the proposed Arctic Wildlife Range, which may restrict development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
	Pt	? ?	0.4 PEAT - grass cover		UF		
1	SM		SAND - fine to medium, little silty fines, rootlets, moist.				
2			2.0				
	GW		GRAVEL - well graded to 3" size, and fine to coarse sand, occasional cobble, subangular, moist, clean.				
4			4.0 — — fine gravel lenses.				
5							
6							
7							
8			8.5 ▽				
9			Bottom of Pit				Sample from 2.0'-8.5'

DATE: Sept. 20, 1976 | LOGGED BY: JDF | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y60-A(e)

SHEET 1 OF 1

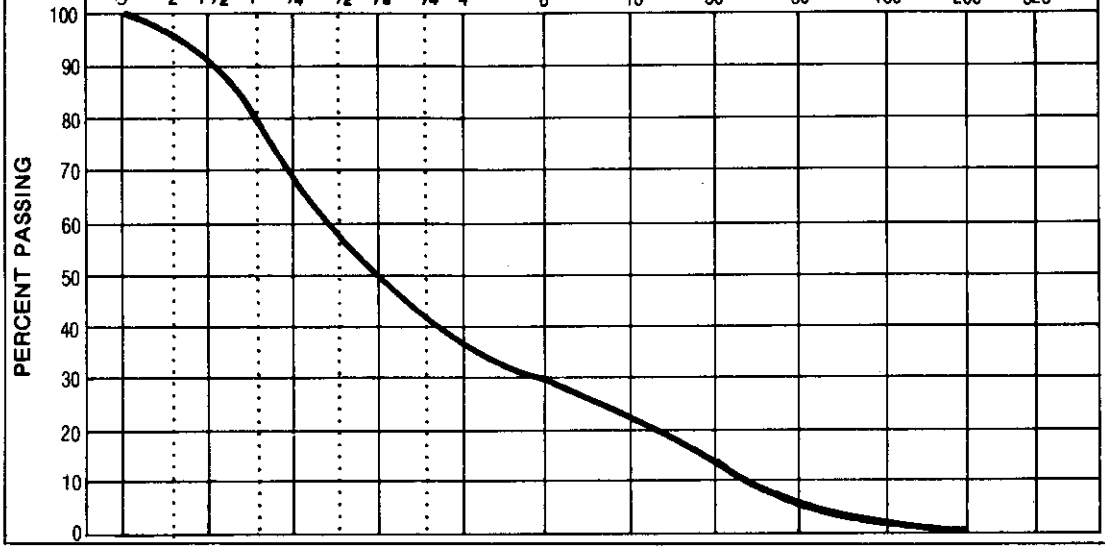
GRAIN SIZE ANALYSIS

SAMPLE Y60-A(e) DEPTH 2.0'-8.5'

DATE SAMPLED Sept. 20, 1976 SAMPLED BY JDF

LAB TEST NUMBER TP23

GRAVEL SIZES		SAND SIZES			FINES
32.3 %	31.6 %	8.1 %	19.5 %	7.6 %	0.9 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
3"	0

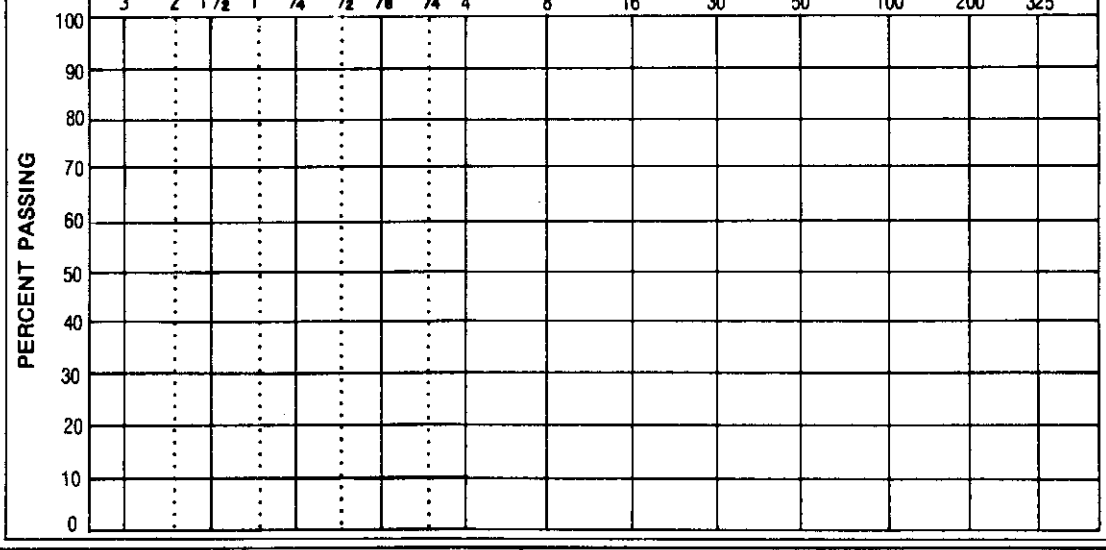
SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	97.4
1 1/2"	91.7
1"	78.4
3/4"	67.7
1/2"	57.5
3/8"	48.5
1/4"	
No. 4	36.1
No. 8	29.4
No. 16	22.8
No. 30	13.0
No. 50	3.9
No. 100	1.5
No. 200	0.9

SAMPLE _____ DEPTH _____

DATE SAMPLED _____ SAMPLED BY _____

LAB TEST NUMBER

GRAVEL SIZES		SAND SIZES			FINES
%	%	%	%	%	%
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"

SIEVE SIZE	PERCENT PASSING
3"	
2"	
1 1/2"	
1"	
3/4"	
1/2"	
3/8"	
1/4"	
No. 4	
No. 8	
No. 16	
No. 30	
No. 50	
No. 100	
No. 200	

GOVERNMENT OF CANADA

DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.

CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

DEPOSIT No. Y60

SUMMARY OF LABORATORY TEST DATA FOR SUITABILITY OF AGGREGATES IN CONCRETE

PETROGRAPHIC ANALYSIS

COARSE AGGREGATE

ROCK TYPE	CLASSIFICATION	TOTAL WEIGHTED COMPONENT %
Quartzite	Strong to very strong, Good	25.6
Quartzitic Sandstone		1.7
Sandstone		36.5
Limestone		9.9
Chert & Chert-like rocks	Potentially reactive, Fair	26.3
PN:= 153	INTERPRETATION: Poor quality for aggregate	100.0

SOUNDNESS OF AGGREGATE - SULPHATE TEST

COARSE AGGREGATE: LOSS= 0.47%

FINE AGGREGATE: LOSS= 10.53%

OTHER TESTS

LIGHTWEIGHT PIECES IN AGGREGATE: FINE: 0.27%

SPECIFIC GRAVITY: FINE: 2.62, COARSE: 2.63

WATER ABSORPTION: FINE: 1.80%, COARSE: 0.98%

ORGANIC IMPURITIES TEST

NUMBER : 2
COAL REMOVED :
COAL & ROOTLETS REMOVED :
COAL CONTENT : 0.27%

COMMENTS: Sulphate Test was performed for 5 cycles in Magnesium Sulphate solution.
Specific Gravity Test was performed at 20°C.
Lightweight Pieces were determined by floating on Zinc Chloride solution with a Specific Gravity of 2.0.

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO.
Y60-A(e)

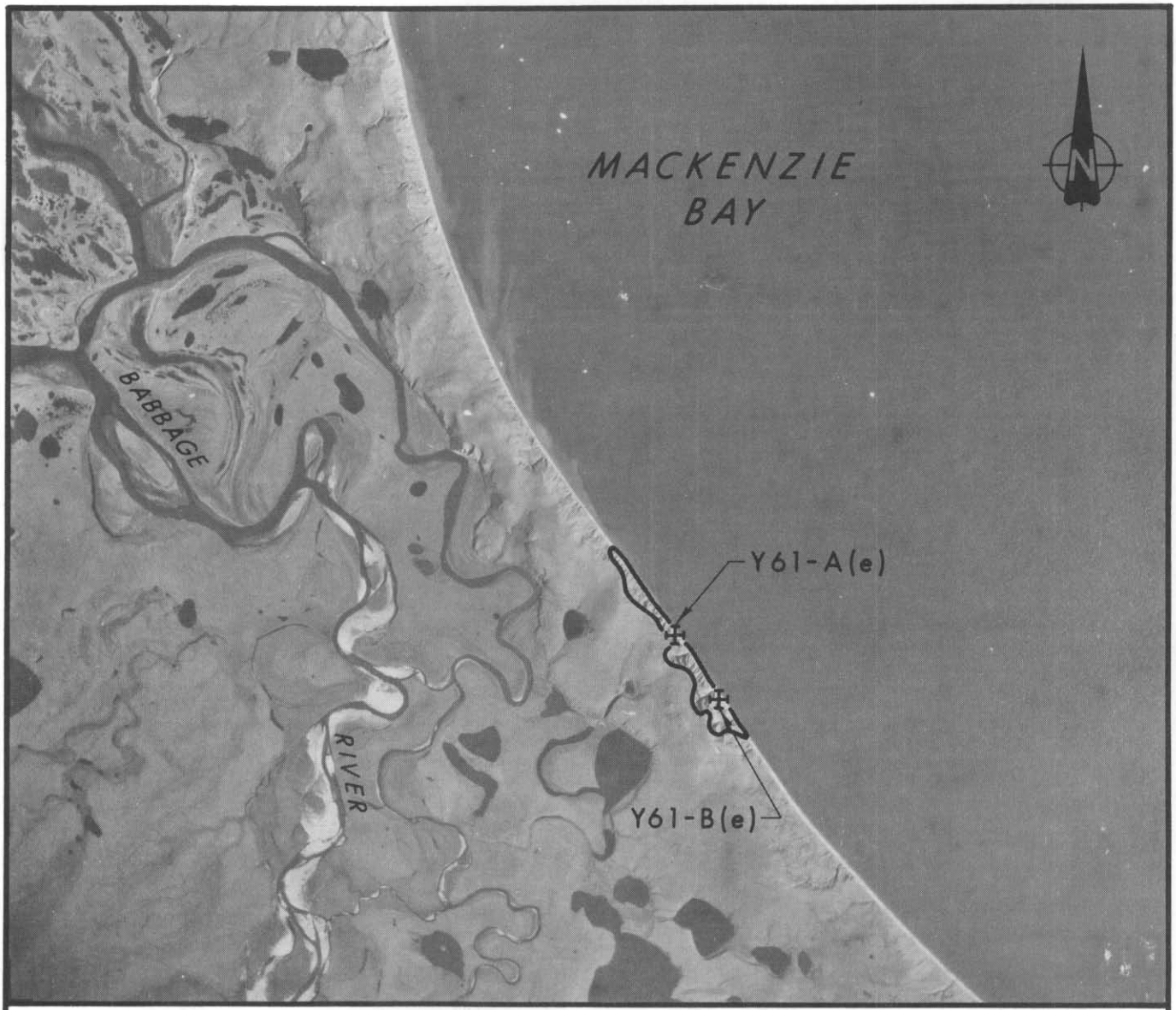
DEPOSIT Y61

Setting: Deformed preglacial gravel and sand along the coastal escarpment. Located 10 miles southeast of Kay Point.

Material: Gravel; well graded, fine to coarse, some sand.

Volume: 8,500,000 cubic yards total.

Assessment: Only part of the escarpment face exposes good quality granular material. The clean excavation of good quality granular material is difficult because of the stratified nature of the deposit. Coastal retreat would be increased by development of this deposit.



Airphoto No.: A14406-49		Approx. Scale:	1"=6000'
Deposit Outline - R.M. Hardy	———	Test Pit	⊙
Deposit Outline - Others	—·—·—	Exposures	✣

DEPOSIT Y61

SETTING

Deposit Y61 consists of deformed preglacial gravels and sands exposed along an escarpment and associated steep ravines, and is located 10 miles southeast of Kay Point. The crest of the escarpment rises 200 feet above sea level along this part of the coast. The stratigraphic sequence consists of 4 to 20 foot thick beds of sand and gravel interbedded with 2 to 20 foot beds of silt and silty sand containing peat layers. Thinner beds of silt are contained in beds of oxidized sand and gravel. The above sequence has been deformed and is repeated on exposures due to folding and faulting.

The cliffs are generally bare of vegetation and are eroding, although coastal retreat has recently been insignificant in this immediate area. Their stability probably retards the rate of coastal retreat along a portion of the coast lateral to Deposit Y61. The beach at Deposit Y61 is narrow and gravelly. The upland above the crest of the escarpment is well-drained and covered by sedge tundra with scattered dwarf shrubs.

South of Deposit Y61, a narrow band of deformed sediments, morainal deposits, and outwash is bordered by the Deep Creek/Babbage River fluvial system. The surrounding area provides feeding and staging ground for waterfowl. The Beaufort Sea serves as a feeding area for fish and Beluga whale. Raptors may nest along these cliffs.

MATERIAL

Deposit Y61 contains good quality granular material consisting of stratified, oxidized, fine to coarse gravel with some sand. Thin silt beds are present in some of the strata. Pebbles, rarely exceeding 2 inches, are mainly rounded to subrounded sandstone and quartzite with rare quartz and chert. Shale is common in the fines.

These granular materials are well drained and have negligible ice contents.

VOLUME

The total volume of 8,500,000 cubic yards is based on the observation that only one quarter of the strata in the cliffs appears to be granular materials. Annual extractable volume was not calculated because the deformed and interbedded nature of the strata would make annual volumes extremely variable.

DEVELOPMENT

Excavation at Deposit Y61 would be difficult because of the interbedded nature of the deposit. Large volumes of fine-grained sediments would need to be separated from the granular material and then wasted in order to obtain clean granular material for construction requirements. Coastal configuration would require that large stockpiles be placed at the top of the cliffs or along the coast to the west where the adjacent upland slopes gently to sea level.

Access to the deposit is good as it borders the Beaufort Sea. Inland access would be more difficult as it involves not only ascending the escarpment at Deposit Y61, but descent of a similar slope onto the Babbage River/Deep Creek fluvial system.

Development would involve major environmental disruption, especially of the aesthetics, relative to the volumes that might be obtained. Extraction of material from this segment of the coast would also hasten coastal retreat in the vicinity.

TEST HOLE LOG

DEPTH (FT)	U.S.C.S. GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
					UF		
150			150.0				Logged Exposed interval begins 150' below crest of cliff
			GRAVEL - well graded to 2" size, and fine to coarse sand, subrounded to rounded, some platy, dense.				Lightweight Pieces - Fine Aggregate: 0.26%
	SM		164.0 SAND - fine, and silty fines, layered brown, wet.				
190							
195	GW		198.0 GRAVEL - some sand, occasional cobbles and boulders to 2 cu. ft.				
200			2010 ▽ -approx. sea level.				Sample from 150'-164'
			Bottom of Pit				

DATE: Oct. 1, 1976.	LOGGED BY: SA	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y61-A(e)

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
0	SW		SAND - well graded, and fine gravel, trace silty fines, subrounded to rounded, stratified, rust to black.		UF		Logged Exposed interval near base of 200' cliff. Lightweight Pieces - Fine Aggregate: 0.27%
3.0			no gravel sizes, dark brown, damp.				
5.0	GW		GRAVEL - well graded to 2" size, little fine to coarse sand, occasional cobble, subrounded to rounded, rusty brown.				
7.0			Bottom of Pit				Sample from 0'-3.0'/ 5.0'-7.0'

DATE: Oct. 1, 1976 | LOGGED BY: CPM | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y61-B(e)

SHEET 1 OF 1

GRAIN SIZE ANALYSIS

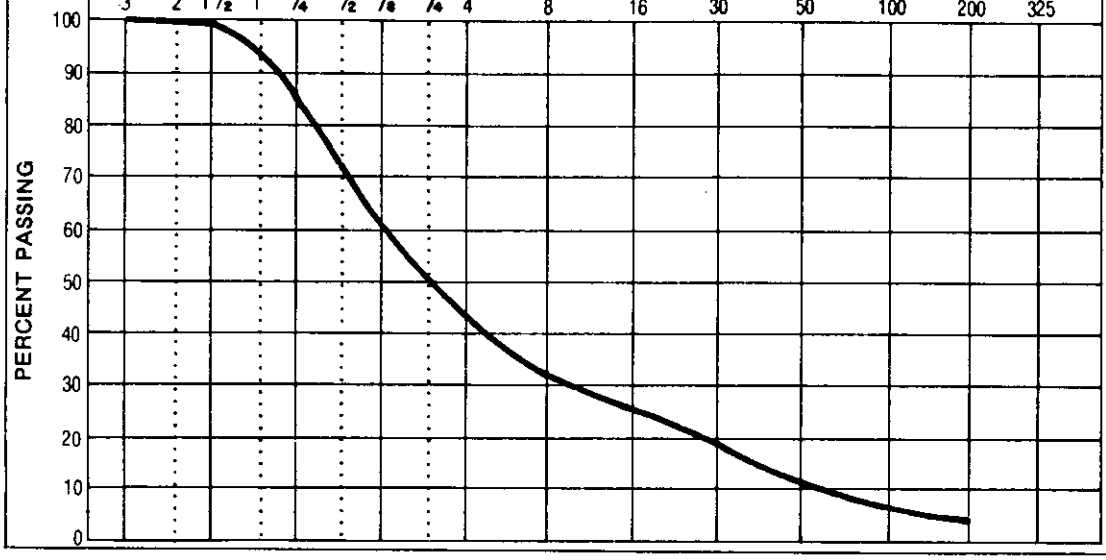
SAMPLE Y61-A(e) DEPTH 150.0'-164.0'

DATE SAMPLED Oct. 1, 1976 SAMPLED BY SA

LAB TEST NUMBER 98HA

GRAVEL SIZES		SAND SIZES			FINES
14.9 %	42.3 %	12.8 %	15.0 %	12.4 %	2.6 %
COARSE	FINE	COARSE	MEDIUM	FINE	

MAX. SIZE	% > 3"
1½"	0



SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	100.0
1 1/2"	100.0
1"	93.6
3/4"	85.1
1/2"	72.0
3/8"	61.7
1/4"	
No. 4	42.8
No. 8	36.0
No. 16	31.1
No. 30	24.4
No. 50	11.3
No. 100	4.3
No. 200	2.6

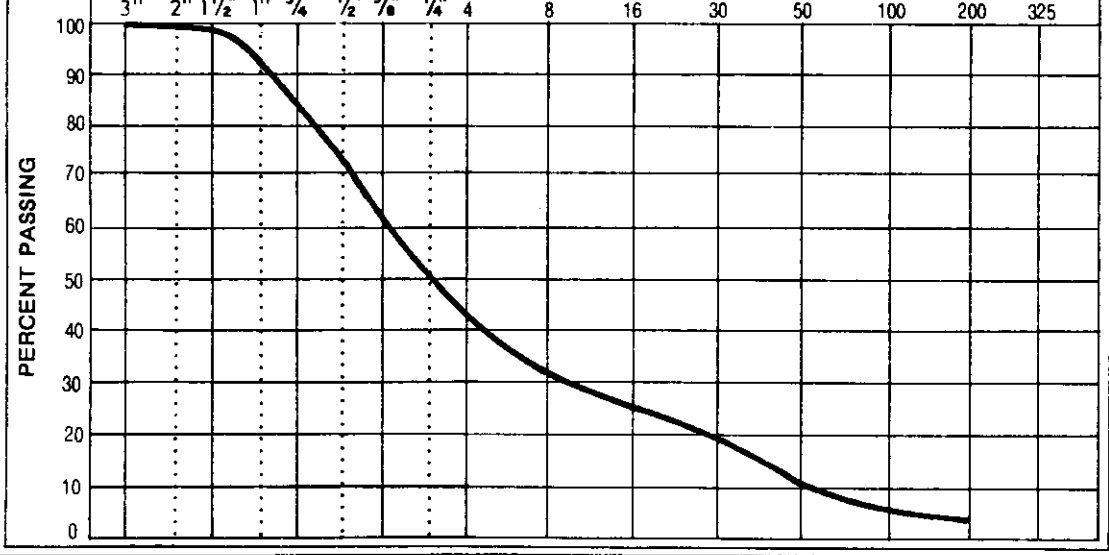
SAMPLE Y61-B(e) DEPTH 0'-3.0'/5.0'-7.0'

DATE SAMPLED Oct. 1, 1976 SAMPLED BY CPM

LAB TEST NUMBER 99HA

GRAVEL SIZES		SAND SIZES			FINES
15.9 %	41.6 %	12.5 %	14.5 %	10.8 %	4.7 %
COARSE	FINE	COARSE	MEDIUM	FINE	

MAX. SIZE	% > 3"
2"	0



SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	100.0
1 1/2"	98.8
1"	91.5
3/4"	84.1
1/2"	72.3
3/8"	62.0
1/4"	
No. 4	42.5
No. 8	32.1
No. 16	26.0
No. 30	19.2
No. 50	10.8
No. 100	6.4
No. 200	4.7

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No. Y61

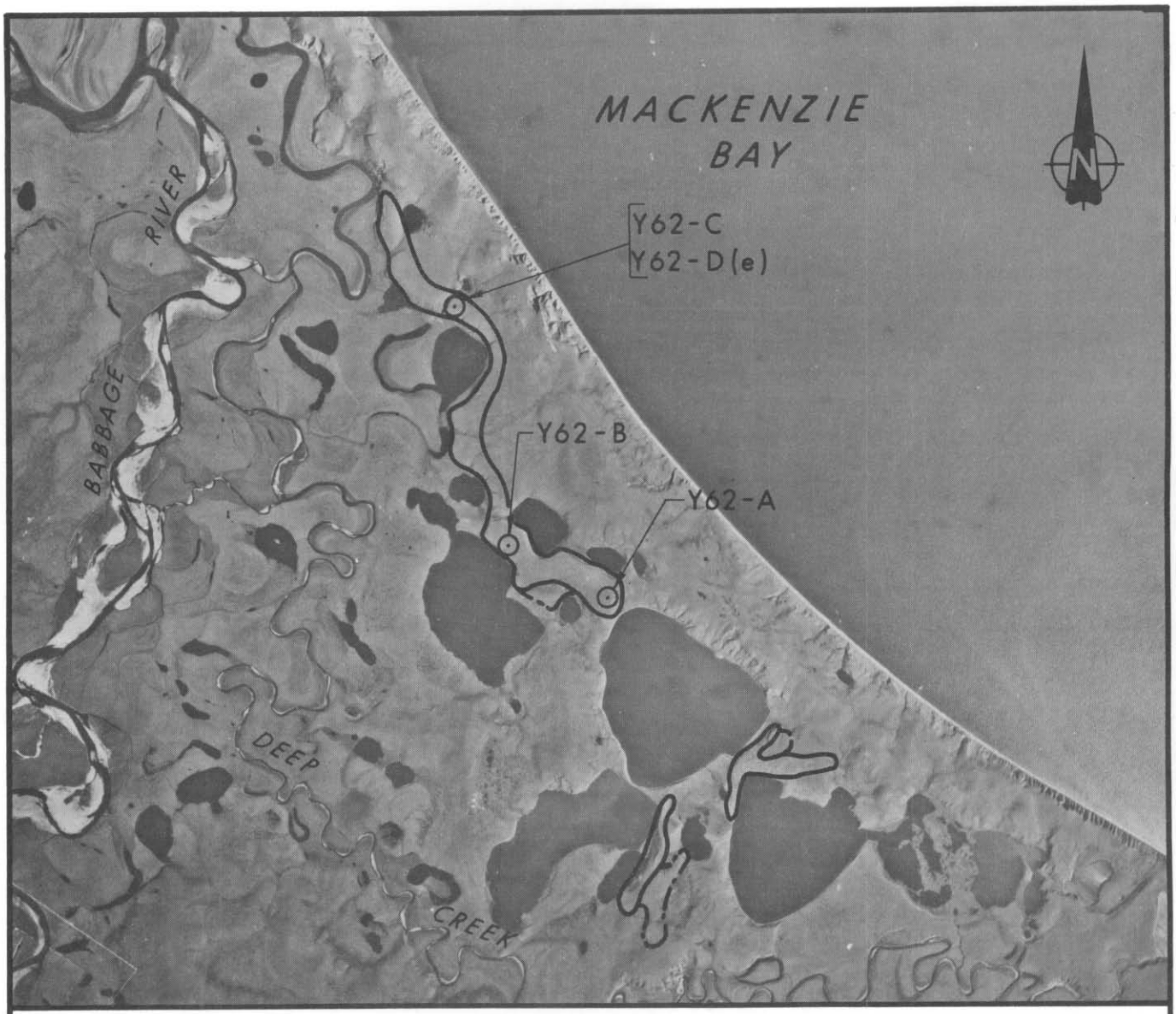
DEPOSIT Y62

Setting: Terraced remanents of coalescing outwash fans along inland edge of ridge running between Kay and King Point. Located 10 miles southeast of Kay Point.

Material: Gravel; well to poorly graded, fine to coarse, some sand.

Volume: 18,000,000 cubic yards total.

Assessment: Contains some good quality granular material. Significant overburden depths were noted. Massive ice may be present at depth. Access is fair.



Airphoto No.: A14406-48		Approx. Scale:	1"=5700'
Deposit Outline - R.M. Hardy	———	Test Pit	⊙
Deposit Outline - Others	—·—·—	Exposures	✣

DEPOSIT Y62

SETTING

Deposit Y62 consists of coalescing outwash fans that are located on the southwestern edge of the ridge running along the Beaufort Sea coast between Kay and King Points. The fans slope gently to the southwest where they are separated from the Deep Creek floodplain and inset thermokarst basins by 35 to 100 foot scarps. These scarps are generally stable, although a few slump blocks and unstable slopes suggest that some massive ice may be present within the deposit or in sediments underlying it. This deposit has been previously designated as Source Area 20 by Klohn, Leonoff Consultants Ltd.

Except for a few areas on the eastern part of the deposit, most of the deposit is covered by 5 to 10 feet of ice-rich peat and organic silts. The deposit is moderately well to imperfectly drained, except near scarps and on the eastern part where drainage is improved. Locally these well drained areas are covered by a polygonal pattern of 1 to 5 foot deep trenches. The active layer is 1 to 2 feet thick under overburden and in excess of 5 feet in areas free of overburden. Groundwater is present above the permafrost table on flatter areas away from scarps.

Most of the deposit is covered by tundra consisting of sedge tussocks, moss and dwarf shrubs. Better drained parts have broken cover of Dryas, grass, and dwarf birch. On stabilized scarps willows and dwarf birch, 3 feet high, are present.

The deposit is bordered on the northeast by deformed marine deposits having a blanket of ice-rich till. A complex of rolling to hummocky ice-rich morainal and flat peat-covered floodplain deposits lie to the southwest. This area provides habitat for caribou, Arctic fox and grizzly bear, and is a critical staging area for snow geese. Lake trout, northern pike, lake cisco and whitefish are known to overwinter in larger adjacent lakes.

MATERIAL

Deposit Y62 contains fair to good quality granular material consisting of stratified, well to poorly graded, fine to coarse gravel with some sand. Few cobbles, 8 inches in size, are scattered over the surface at the eastern end of the deposit. Larger clasts are mainly subrounded to rounded sandstone with some conglomerate, quartzite, shale and rare chert.

VOLUME

The estimated volume of 18,000,000 cubic yards is based on a depth of 40 feet with allowance for significant massive ice. Exposures and bank morphologies suggest that the granular materials are at least 50 feet thick.

Annually, 5,800 cubic yards per acre could be extracted by conventional techniques assuming yearly recoverable depths of 4 feet, which would be reduced during early development by overburden removal.

DEVELOPMENT

Limited development of this deposit should be initiated by excavating material from well-drained areas having little overburden and along scarps, where natural drainage can be easily maintained. Extensive excavation would involve the removal and disposal of significant overburden. Excavation to greater depths would require plans for management of ground ice. Pits could be left as benches that would blend into the surrounding terrain with minor grading upon abandonment.

Although local scarps would need to be traversed, gentle slopes are available for direct access to the coast. The floodplain of Deep Creek and fluvial system of the Babbage River provide inland access. Slopes toward the coast would need to be treated with caution to avoid initiating thermokarst processes.

Development of Deposit Y62 should be planned to minimize interference with the staging activities of snow geese or local fish populations. Deposit Y62 lies within the proposed Arctic Wildlife Preserve, which may restrict development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	GW		GRAVEL - well graded to 3" size, and fine to coarse sand, subrounded to rounded, light to dark brown, wet below 2'.		UF		Lightweight Pieces - Fine Aggregate: 0.07%
2							
3			3.0 ▽				
			3.5				
4			Bottom of Pit				Sample from 0'-3.0'

DATE: Sept. 19, 1976 | LOGGED BY: GCD | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y62-A

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
0	Pt		0.5 PEAT		UF		Organic Color: #5+ Coal Removed: #2
1	ML		SILT - low plastic, trace fine to medium sand, brown.			1.3	Lightweight Pieces - Fine Aggregate: 0.23%
			1.8	+ +	Vx 30%	1.7	
2	GP		GRAVEL - fine, and fine to coarse sand, subrounded to rounded, becoming rounded and coarser to 2" size at 2.5', cherts, sandstones, trace friable gravels.		Vc 20%		
5			5.9				
6			Bottom of Pit				Sample from 1.8'-5.9'
7							

DATE: Sept. 20, 1976	LOGGED BY: GCD	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y62-B

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
	Pt		PEAT - organic cover. 0.5		UF		
1	OL		SILT - organic, low plastic, black.		Vr Vs 10%	1.0	ice lenses to ½".
2							
3							
4			4.0				
			Bottom of Pit				No sample taken.
5							

DATE: Sept. 19, 1976 | LOGGED BY: JDF | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y62-C

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	SM		SAND - fine to medium, little silty fines, organic, light brown.		UF		Top of exposure at Y62-D(e) 10' in elevation below ground surface at Y62-C on nearby crest of out-wash fan.
2							
		2.5					Lightweight Pieces - Fine Aggregate: 0.19%
3	GW		GRAVEL - well graded to 3" size, and fine to coarse sand, trace silty fines, rootlets to 5.0' depth, subangular sandstones, angular shale fragments, dark brown, wet.				
4							
5							
6							
7							
8							
9							
10		10.0	Bottom of Pit				Sample from 2.5'-10.0'
11							

DATE: Sept. 19, 1976 | LOGGED BY: JDF | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

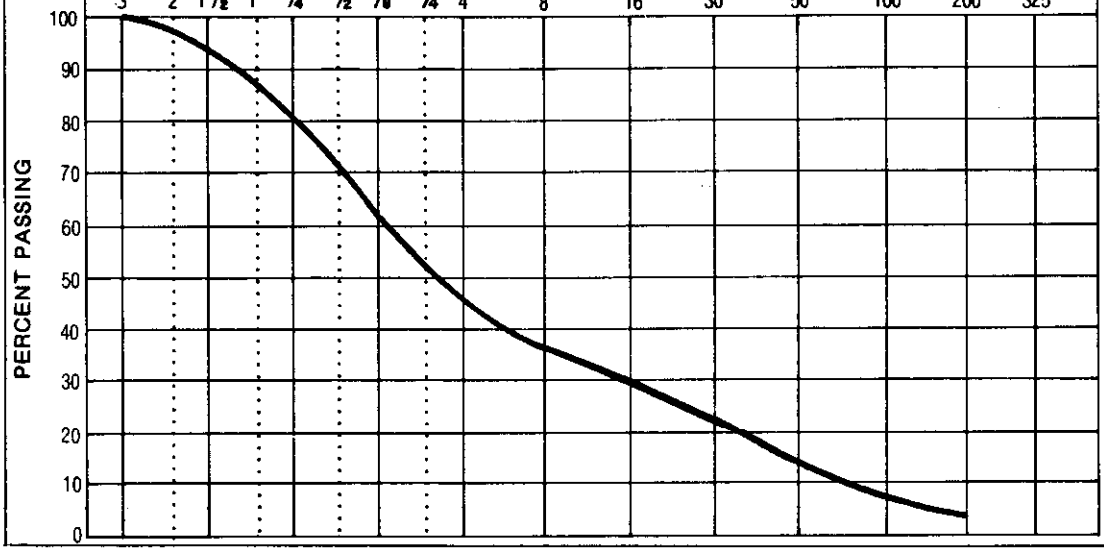
TEST PIT NO. Y62-D(e)

SHEET 1 OF 1

GRAIN SIZE ANALYSIS

SAMPLE Y62-A DEPTH 0'-3.0'
DATE SAMPLED Sept. 19, 1976 SAMPLED BY GCD
LAB TEST NUMBER 18HA

GRAVEL SIZES		SAND SIZES			FINES
18.5 %	36.1 %	9.4 %	18.0 %	13.5 %	4.5 %
COARSE	FINE	COARSE	MEDIUM	FINE	

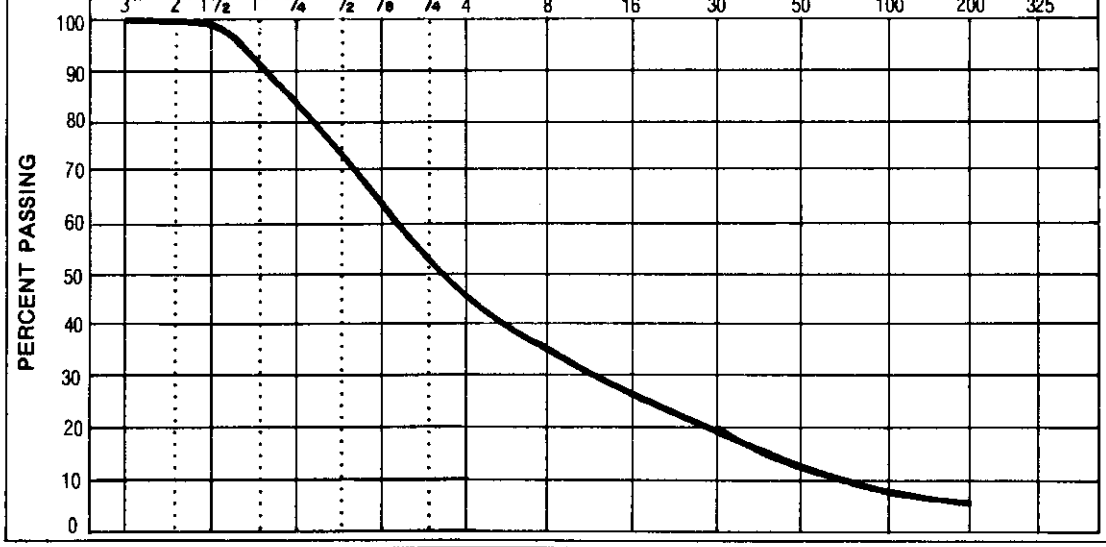


MAX. SIZE	% > 3"
3"	0

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	98.0
1 1/2"	95.7
1"	87.6
3/4"	81.5
1/2"	70.0
3/8"	61.5
1/4"	
No. 4	45.4
No. 8	36.6
No. 16	30.1
No. 30	23.3
No. 50	14.0
No. 100	7.2
No. 200	4.5

SAMPLE Y62-B DEPTH 1.8'-5.9'
DATE SAMPLED Sept. 20, 1976 SAMPLED BY GCD
LAB TEST NUMBER 19HA

GRAVEL SIZES		SAND SIZES			FINES
15.4 %	40.4 %	11.2 %	18.0 %	8.9 %	6.1 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
3"	0

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	100.0
1 1/2"	98.2
1"	90.9
3/4"	84.6
1/2"	73.2
3/8"	64.2
1/4"	
No. 4	44.2
No. 8	35.6
No. 16	27.0
No. 30	19.2
No. 50	11.8
No. 100	7.9
No. 200	6.1

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No.
Y62

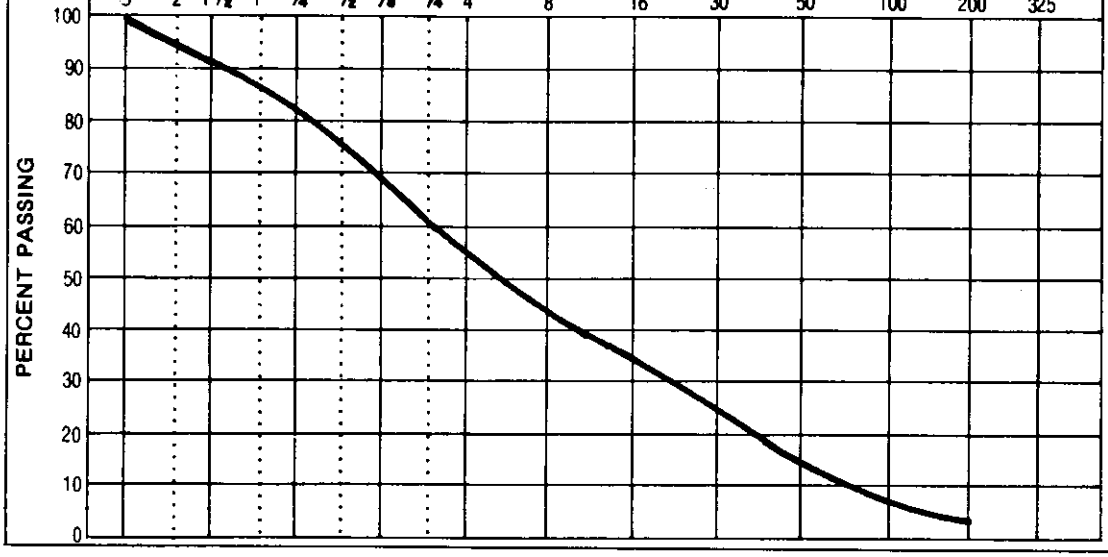
GRAIN SIZE ANALYSIS

SAMPLE Y62-D(e) DEPTH 2.5'-10.0'

DATE SAMPLED Sept. 19, 1976 SAMPLED BY JDF

LAB TEST NUMBER 149B

GRAVEL SIZES			SAND SIZES			FINES
16.8 %	31.1 %		9.6 %	23.5 %	15.0 %	4.0 %
COARSE	FINE		COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
3"	0

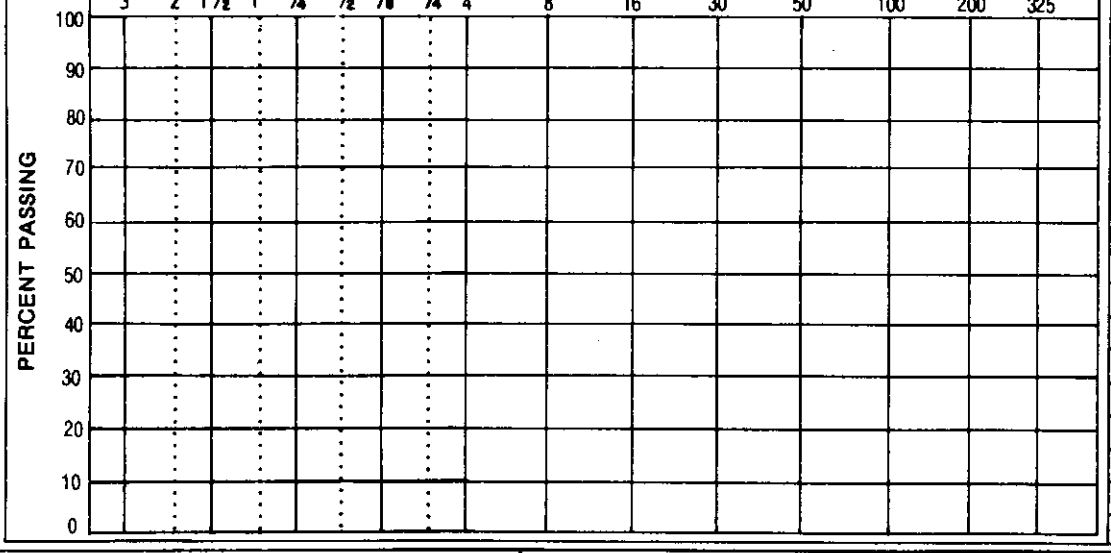
SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	94.4
1 1/2"	91.6
1"	87.3
3/4"	83.2
1/2"	75.2
3/8"	69.2
1/4"	
No. 4	52.1
No. 8	43.6
No. 16	33.6
No. 30	24.0
No. 50	13.6
No. 100	6.1
No. 200	4.0

SAMPLE _____ DEPTH _____

DATE SAMPLED _____ SAMPLED BY _____

LAB TEST NUMBER

GRAVEL SIZES		SAND SIZES			FINES
%	%	%	%	%	%
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"

SIEVE SIZE	PERCENT PASSING
3"	
2"	
1 1/2"	
1"	
3/4"	
1/2"	
3/8"	
1/4"	
No. 4	
No. 8	
No. 16	
No. 30	
No. 50	
No. 100	
No. 200	

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No.
Y62

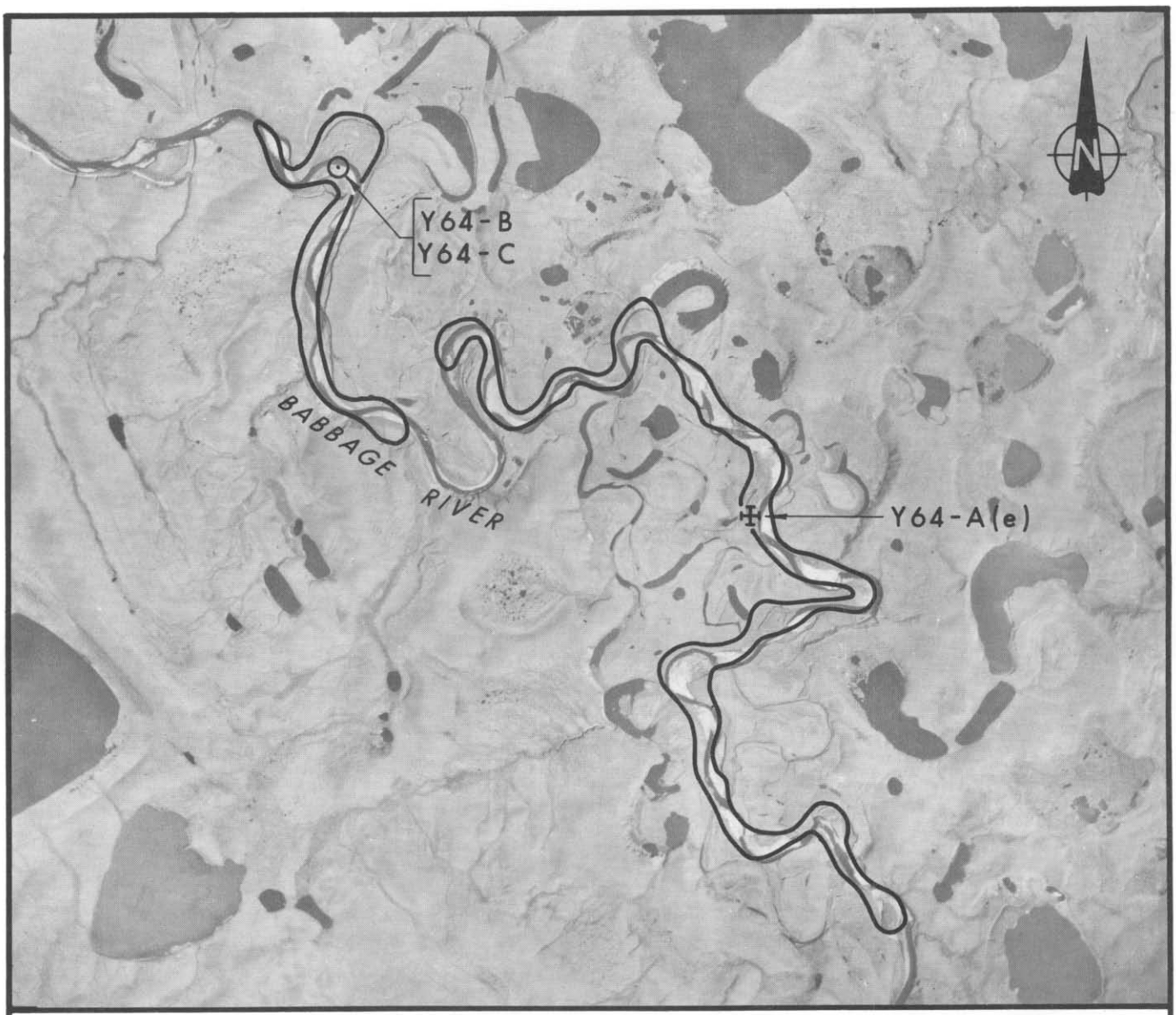
DEPOSIT Y64

Setting: Low terraces and floodplain along the middle reaches of the Babbage River.

Material: Gravel; well graded, and sand, variable fines.

Volume: 27,000,000 cubic yards total.

Assessment: Contains fair to good quality material. Overburden, permafrost, groundwater, and the geometry of the deposit relative to the Babbage River, will limit extraction. Access is good along the Babbage River.
Recoverable volume may be limited to 3,800,000 cubic yards.



Airphoto No.: A14406-46
Deposit Outline - R.M. Hardy
Deposit Outline - Others
Approx. Scale: 1"=5800'
Test Pit
Exposures

DEPOSIT Y64

SETTING

Deposit Y64 consists of narrow active floodplain and low terraces along the middle reaches of the Babbage River.

The active floodplain consists of large point bars having numerous scour channels to 4 feet in depth. The point bars are well-drained and free of overburden. Over half of the active floodplain is more than 6 feet above low water levels. The active layer is in excess of 6 feet under the active floodplain.

The low terraces and vegetation-covered floodplain stand 8 to 15 feet above low water levels. Their surfaces are occasionally dotted by small hummocks. These low terraces generally have thin peat cover and 1½ to 3 feet of sandy silt. The active layer is probably 1 to 3 feet deep.

Stabilized floodplain and low terraces are often covered by willow thickets, 4 feet in height. Tracks indicate browsing by moose. The Babbage River is a migration route for Arctic char.

Deposit Y64 is flanked by poorly-drained peat-covered terraces and ice-rich rolling morainal deposits. This terrain provides staging and feeding areas for waterfowl.

MATERIAL

Deposit Y64 contains fair to good quality granular material consisting of stratified, well graded gravel with sand and cobbles to 6 inches in size; and medium to coarse sand with little fine gravel and variable silty fines. Larger clasts are mainly subrounded sandstone with shale chips dominating the fines.

VOLUME

The total of 27,000,000 cubic yards is based on a conservative depth of 15 feet. Annually, 51,000 cubic yards per 1000 foot length of floodplain and terrace could be extracted by conventional techniques assuming that the permafrost and ground water tables limit the extractable granular material to an average depth of 4 feet. Extraction may be initially slow on the low terraces because of the need to thaw and remove overburden. Volume of recoverable material may be limited to 3,800,000 cubic yards because of permafrost and ground water tables.

DEVELOPMENT

Development of Deposit Y64 would be confined mainly to summer and fall when river levels are low. Overburden would have to be removed and stockpiled or disposed of from the low terraces. Pits will be restored through natural fluvial processes. The narrowness of this deposit would make it difficult to obtain large volumes from any portion of the deposit and would make it mandatory to criss-cross the Babbage River for large volumes.

Access to this deposit is good along the Babbage River, but terrain, susceptible to thermokarst, would have to be crossed if movement in an east or west direction is desired.

Development of Deposit Y64 should be planned to minimize interference with fish migration along the Babbage River and staging activities of waterfowl. Large areas of willow shrubs should be protected as they support local moose. The deposit lies within the proposed Arctic Wildlife Range, which may restrict development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
0	Pt		PEAT		UF		Organic Color: #3
1			1.0				Lightweight Pieces -
	ML		SILT - roots.				Fine Aggregate: 0.12%
2			2.3				
	GW		GRAVEL - well graded to 4" cobbles, and fine to coarse sand, trace silty fines, sandstones.				
3			3.2				
	SM		SAND - fine, some silty fines, black.				
4			4.1				
	GW		GRAVEL - well graded, and fine to coarse black sand, subrounded.				
5							
6							
7							water level 6" below bottom of pit.
8			8.0				
			Bottom of Pit				Sample from 4.1'-8.0'
9							

DATE: Sept. 23, 1976 | LOGGED BY: GCD | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y64-A(e)

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	SP		SAND - medium to coarse, some gravel to 1½" size, subangular to rounded.		UF		
			1.2				
2	ML		SILT - dark brown.				
3							
4			4.0				
	SP		SAND - coarse, little fine gravel.				
5			frozen ground below 5.0'			5.0	
			5.0				
6			Bottom of Pit				No sample taken.

DATE: Sept. 20, 1976	LOGGED BY: GCD	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO.
Y64-B
SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	ML		SILT - dark brown.		UF		
			1.7				
2	SP		SAND - medium to coarse, trace gravel to 2" size, subangular.				
			3.0				
3	GW		3.1 GRAVEL				
			Bottom of Pit				No sample taken.
4							

DATE: Sept. 20, 1976 | LOGGED BY: GCD | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y64-C

SHEET 1 OF 1

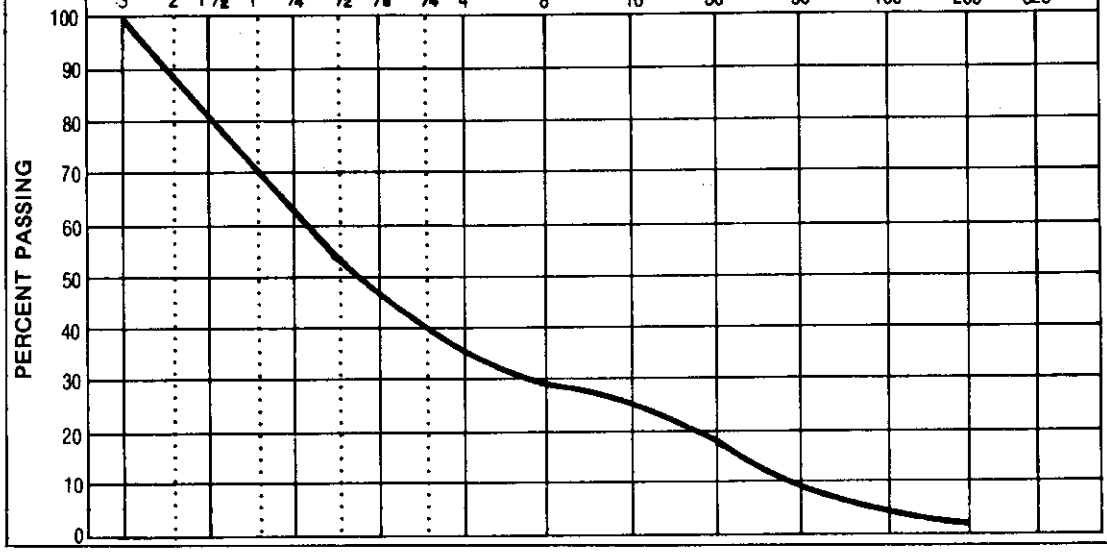
GRAIN SIZE ANALYSIS

SAMPLE Y64-A(e) DEPTH 4.1'-8.0'

DATE SAMPLED Sept. 23, 1976 SAMPLED BY GCD

LAB TEST NUMBER 21HA

GRAVEL SIZES		SAND SIZES			FINES
37.2 %	27.1 %	7.7 %	14.5 %	11.3 %	2.2 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
3"	0

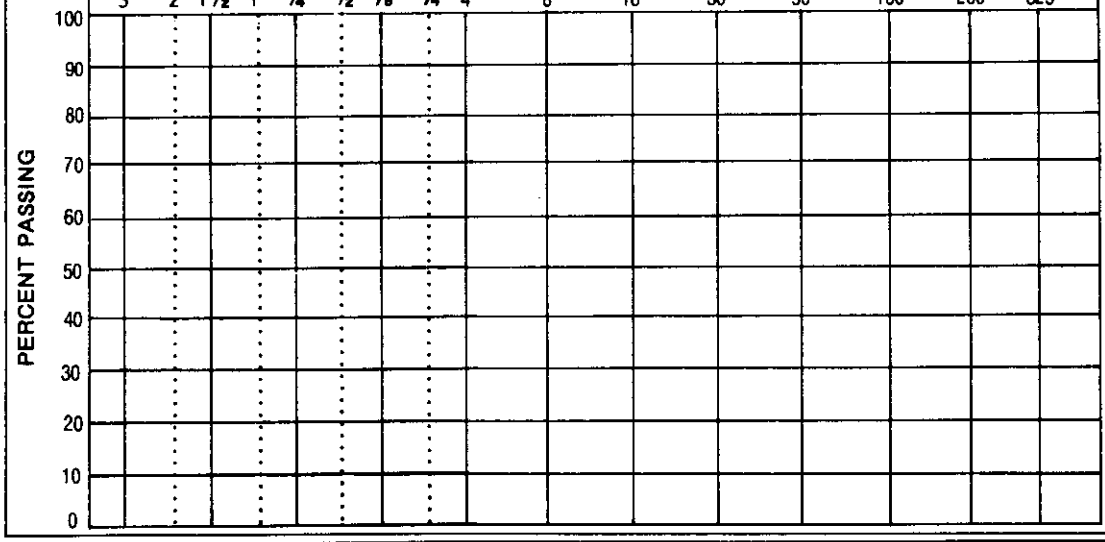
SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	87.0
1 1/2"	80.7
1"	70.2
3/4"	62.8
1/2"	53.5
3/8"	47.5
1/4"	
No. 4	35.7
No. 8	29.5
No. 16	26.9
No. 30	18.3
No. 50	8.7
No. 100	3.4
No. 200	2.2

SAMPLE _____ DEPTH _____

DATE SAMPLED _____ SAMPLED BY _____

LAB TEST NUMBER

GRAVEL SIZES		SAND SIZES			FINES
%	%	%	%	%	%
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"

SIEVE SIZE	PERCENT PASSING
3"	
2"	
1 1/2"	
1"	
3/4"	
1/2"	
3/8"	
1/4"	
No. 4	
No. 8	
No. 16	
No. 30	
No. 50	
No. 100	
No. 200	

GOVERNMENT OF CANADA

DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.

CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

DEPOSIT No. Y64

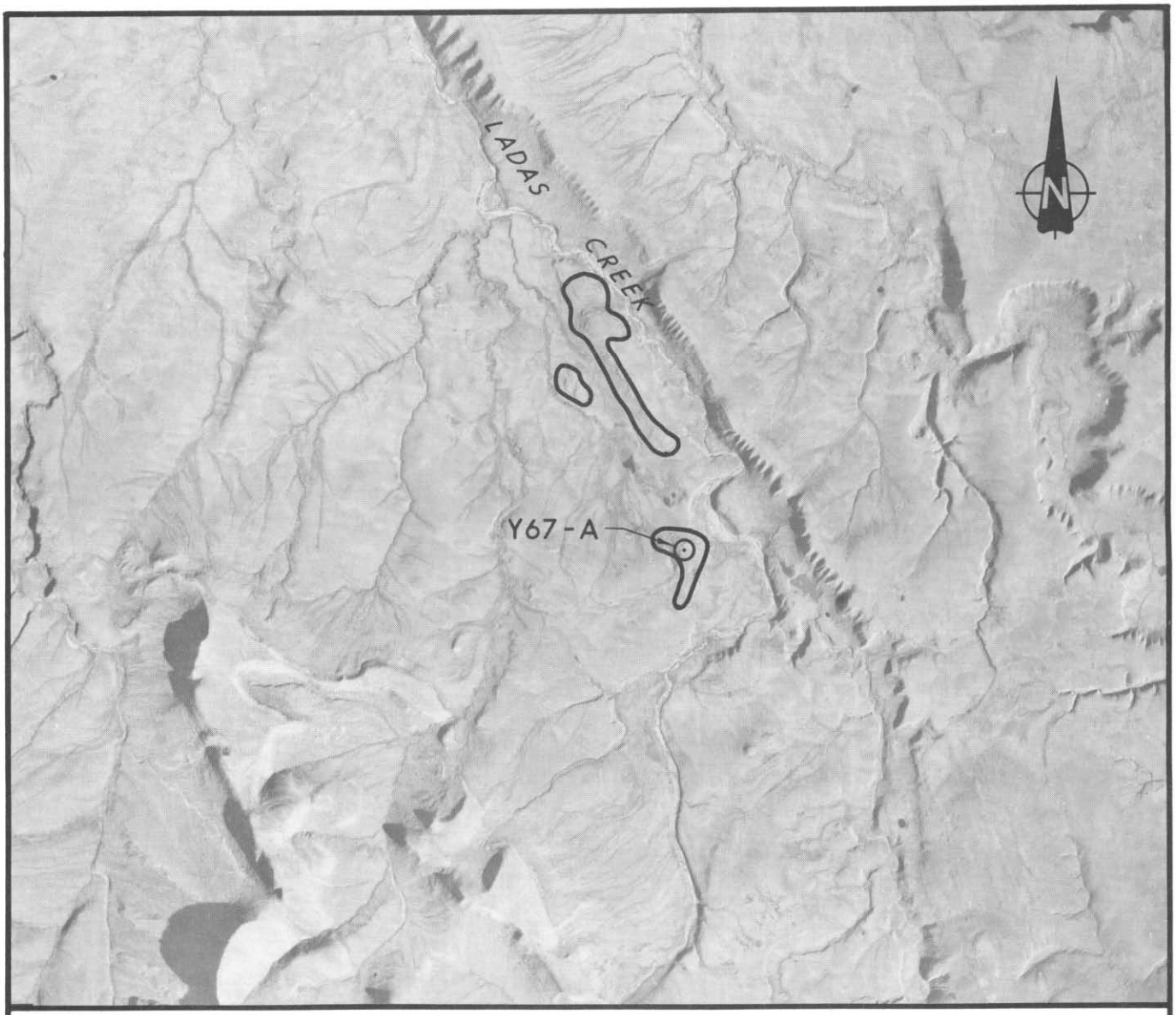
DEPOSIT Y67

Setting: Esker and kame complex located west of Ladas Creek, and about 12 miles upstream of its confluence with the Babbage River.

Material: Gravel and Sand; high shale content.

Volume: 2,600,000 cubic yards total.

Assessment: Contains poor to fair quality granular material, underlain by massive ice. Easy development and restoration. Access is limited to east.



Airphoto No.: A14406-41		Approx. Scale:	1"=5700'
Deposit Outline - R.M. Hardy	———	Test Pit	⊙
Deposit Outline - Others	—·—·—	Exposures	✣

DEPOSIT Y67

SETTING

Deposit Y67 consists of kames and an esker west of Ladas Creek at a point about 12 miles above its confluence with the Babbage River. The deposit is located 4 miles northwest of Hidden Lake. The southern part is an oblong broad-crested kame standing 40 feet above the surrounding terrain. The northern part is a low flat-topped ridge and associated kames standing 15 to 20 feet above the surrounding terrain.

The kames are well-drained, show little overburden and are marked by polygonal patterns due to shallow ice-wedge trenches. The crest of the esker is only moderately well drained and may have a thin cover of peat or silt.

Well-drained parts of the deposit have a thin broken turf, whereas tussock tundra covers areas with overburden and poorer drainage.

The surrounding terrain is gently sloping morainal deposits with peat filled depressions. Ladas Creek and a steep bedrock escarpment lie immediately east of the deposit.

The area provides habitat for Arctic fox and grizzly bear and lies on a migratory route for caribou.

MATERIAL

Deposit Y67 contains poor to fair quality granular material. Sand and gravel composed mainly of subangular to subrounded shale fragments were found in test pit Y67-A. Other lithologies noted on the surface were conglomerate and sandstone.

VOLUME

The total volume of 2,600,000 cubic yards is based on a depth of 30 feet under the crest of the kame and 15 feet under the crest of the esker. Volumes could be increased by including similar features on the east side of Ladas Creek.

Annually, 10,000 cubic yards can be extracted per acre by conventional techniques assuming that permafrost will limit yearly extraction depths to 8 feet.

DEVELOPMENT

Development of Deposit Y67 should be carried out in such a manner that good natural drainage is maintained. The morphology of the slopes suggest the materials underlying the granular materials may have high ice contents and require further investigation and consideration prior to development.

Access to this deposit from the east would be difficult due to the steep bedrock slopes lying east of Ladas Creek. Otherwise, gentle slopes and the Ladas Creek valley ensure good access.

Development of Deposit Y67 should be planned to minimize interference with any caribou migrations. The deposit lies within the proposed Arctic Wildlife Range, which may restrict development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
	Pt	0.5	PEAT - fibrous, silty, brown, moist.		UF		Lightweight Pieces - Fine Aggregate: 0.06%
1	SP		SAND - medium to coarse, and gravel to 2" size, trace silty fines, gravel is mostly shale, sub-angular to subrounded, medium dense, grey, moist.				
2							
3		3.5					
4			Bottom of Pit				Sample from 0.5'-3.5'

DATE: Oct. 13, 1976 | LOGGED BY: SA | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y67-A

SHEET 1 OF 1

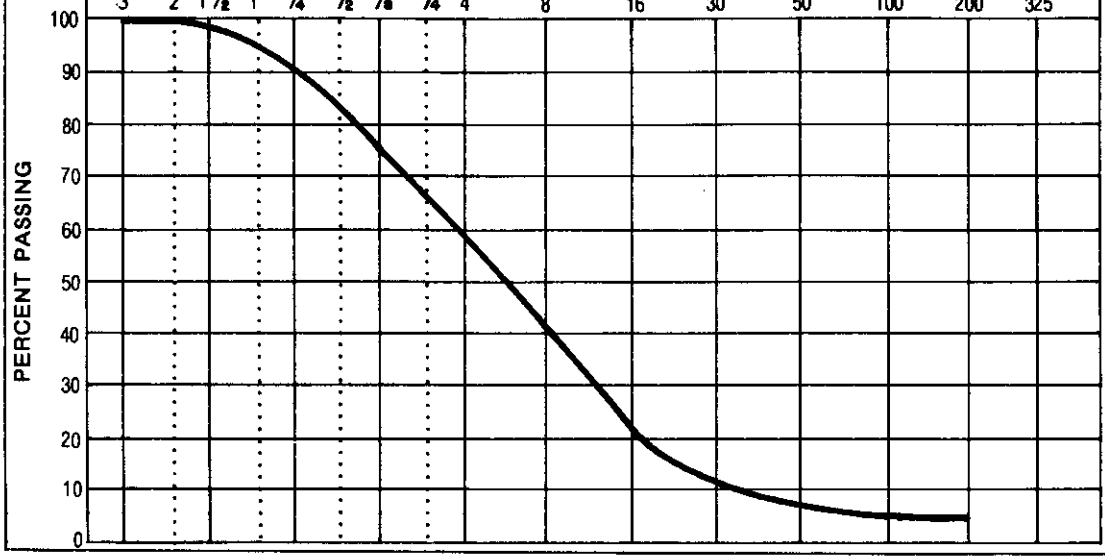
GRAIN SIZE ANALYSIS

SAMPLE Y67-A DEPTH 0.5'-3.5'

DATE SAMPLED Oct. 31, 1976 SAMPLED BY SA

LAB TEST NUMBER 89HA

GRAVEL SIZES		SAND SIZES			FINES
8.9 %	31.7 %	21.9 %	29.5 %	2.3 %	5.7 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
2"	0

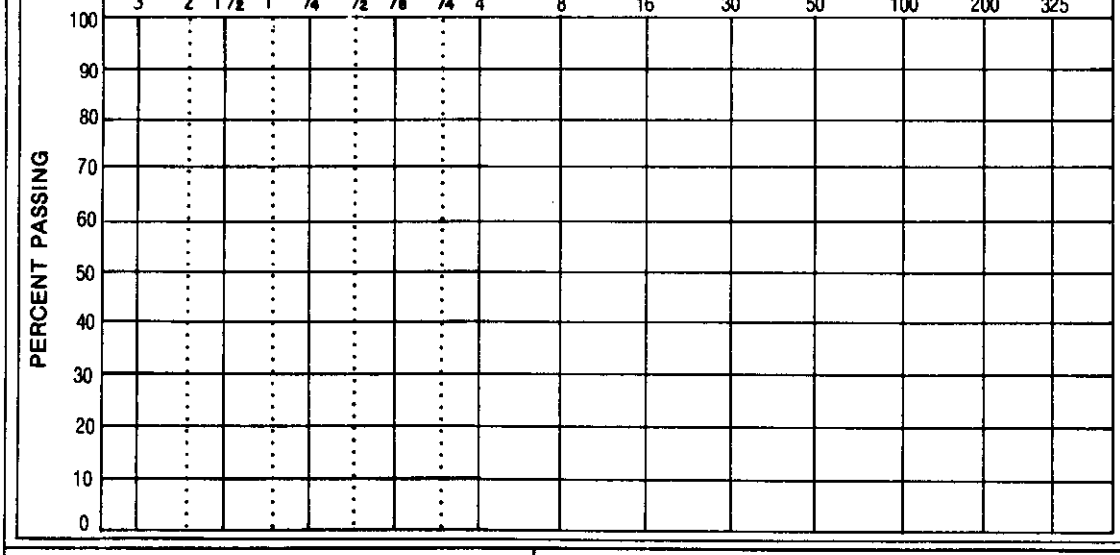
SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	100.0
1 1/2"	98.4
1"	95.4
3/4"	91.1
1/2"	83.4
3/8"	75.4
1/4"	
No. 4	59.4
No. 8	40.8
No. 16	21.4
No. 30	10.8
No. 50	7.8
No. 100	6.6
No. 200	5.7

SAMPLE _____ DEPTH _____

DATE SAMPLED _____ SAMPLED BY _____

LAB TEST NUMBER

GRAVEL SIZES		SAND SIZES			FINES
%	%	%	%	%	%
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"

SIEVE SIZE	PERCENT PASSING
3"	
2"	
1 1/2"	
1"	
3/4"	
1/2"	
3/8"	
1/4"	
No. 4	
No. 8	
No. 16	
No. 30	
No. 50	
No. 100	
No. 200	

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No. Y67

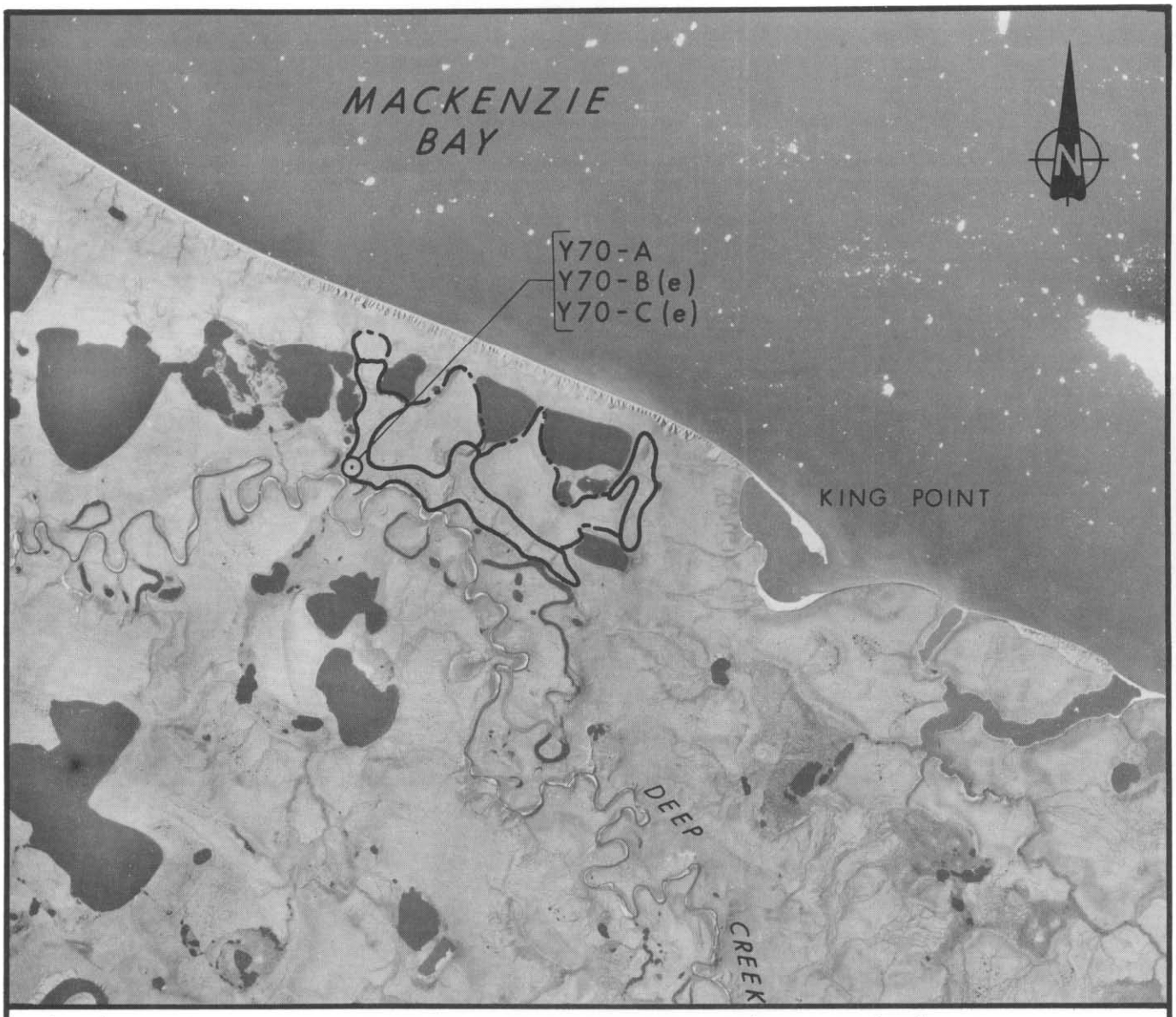
DEPOSIT Y70

Setting: Terraced remanents of coalescing outwash fans along inland edge of ridge. Located 2 miles west of King Point.

Material: Gravel and Sand; poor to well graded, some medium to coarse sand.

Volume: 5,700,000 cubic yards total.

Assessment: Contains good quality granular material. Significant overburden depths on parts of deposit. Massive ice and icy sediments underlie deposit. Fair access to King Point lagoon.



Airphoto No.: A14363-54		Approx. Scale:	1"=5900'
Deposit Outline - R.M. Hardy	———	Test Pit	⊙
Deposit Outline - Others	—·—·—	Exposures	✣

DEPOSIT Y70

SETTING

Deposit Y70 consists of part of a number of coalescing outwash fans along the southwestern edge of a ridge paralleling the Beaufort Sea coastline. It is located about 2 miles west of King Point. Only those portions of the outwash fans having thin overburden are outlined as part of the deposit. This deposit was designated as Source Area 11 in a previous study by Klohn, Leonoff Consultants Ltd.

The fans slope gently to the southwest where 40 to 50 foot high scarps separate their surface from the Deep Creek floodplain. Large thermokarst lakes at the head of the fans are inset 40 to 60 feet below the upper surface of the deposit. Slumps and retrogressive thaw flow slides suggest the presence of massive ice within the deposit.

Although part of the deposit has negligible overburden, thicknesses of 2 to 6 feet are common. Shallow ice-wedge trenches are obvious under bare gravel. Deposit Y70 is moderately well to well drained.

Deposit Y70 is covered by tundra composed of sedges, grasses, moss, lichen and small dwarf shrubs. Willows, 4 feet in height, grow on stable scarps.

The outwash fans abut against a high ridge of glacially-deformed sediments that form high cliffs along the coast. Rolling to hummocky ice-rich morainal deposits and the incised valley of Deep Creek lie to the south. This area provides habitat for caribou, Arctic fox and grizzly bear, and is a critical staging area for snow geese. Lake trout, northern pike, lake cisco, and whitefish are known to overwinter in the larger lakes adjacent the deposit.

MATERIAL

Deposit Y70 contains fair to good quality granular material consisting of stratified, poor to well graded, fine to medium gravel and sand. Occasional cobbles to 7 inches in size are present. Larger clasts are mainly sandstone with some limestone, argillite and limestone and rare chert.

VOLUME

The total volume of 5,700,000 cubic yards is based on an estimated depth of 20 feet and allows for significant content of massive ice. Local exposures and related deposits suggest that parts of the deposit may be underlain by granular materials in excess of 40 feet.

Annually 5,800 cubic yards per acre could be extracted by conventional techniques assuming an excavation depth of 4 feet.

DEVELOPMENT

Selective development of this deposit should be considered whereby material from the edge of well-drained areas having little overburden along the scarps are initially excavated. Extensive excavation would involve the removal and disposal of significant quantities of overburden and processing of material with high ice contents. Developed areas may be left as benches that would blend into the surrounding terrain with minor grading.

Because of the coastal escarpment and Deep Creek valley, steep slopes are common around Deposit Y70 and good access is only available on gentle to moderate slopes that lead to the lagoon near King Point.

Development of Deposit Y70 should be planned to minimize interference with the staging activities of snow geese or fish populations in the adjacent lakes. Deposit Y70 lies within the proposed Arctic Wildlife Preserve, which may restrict development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
	Pt		PEAT		UF		
			0.5				
	CI		CLAY - silty, medium plastic, brown.				
1			1.2				
	CL		CLAY - silty, little medium to coarse sand, low plastic, grey.				
2					Vx 50%	2.0	
						2.3	
3					Nf		
4							
			4.5			4.5	
	SW		4.6 SAND - little fine gravel to ½" size, trace silty fines.		Vx 5%		No sample taken.
5							

DATE: Sept. 17, 1976 | LOGGED BY: GCD | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y70-A

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
	Pt		PEAT - coarse, roots.		UF		Lightweight Pieces - Fine Aggregate: 0.18%
0.7							
1	ML		SILT - clayey.				
2							exposed face has slumped 4' down scarp.
3							
3.0							
	SW		SAND - well graded, some gravel to 1" size.				
4							
4.3							
	GW		GRAVEL - well graded, some fine to coarse sand, occasional cobble to 7" size, subangular to rounded, some fragmented sandstones, cherts.				
5							
6							
7							
8							
8.5			—— cobbles to 5" size				
9							Bottom of scarp is 25' below bottom of pit.
10							
10.0			Bottom of Pit				Sample from 4.3'-10.0'
11							

DATE: Sept. 17, 1976 | LOGGED BY: GCD | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y70-B(e)

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
	Pt		0.5 PEAT		UF		Organic Color: #2+
1	CI		CLAY - silty, medium plastic, grey.				Lightweight Pieces - Fine Aggregate: 0.12%
2			2.0				
	SP		SAND - fine, trace fine gravel to ½" size.				
3			3.5				
	GW		GRAVEL - well graded to 2" size, and medium to coarse sand, subrounded to rounded, cherts.				
4							
			5.0				
5			- layer of coarse gravel to 3" size.				
			5.5				
6							
7							Bottom of scarp is 30' below bottom of pit.
8			8.5				
			Bottom of Pit				Sample from 2.0'-8.5'
9							

DATE: Sept. 17, 1976	LOGGED BY: GCD	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y70-C(e)

SHEET 1 OF 1

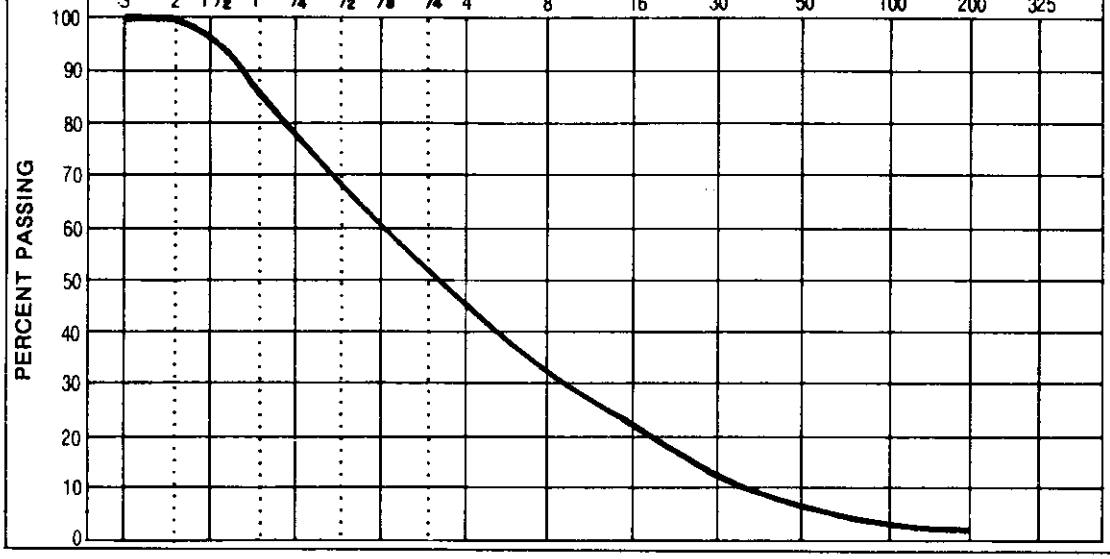
GRAIN SIZE ANALYSIS

SAMPLE Y70-B(e) DEPTH 4.3'-10.0'

DATE SAMPLED Sept. 17, 1976 SAMPLED BY GCD

LAB TEST NUMBER 14HA-2

GRAVEL SIZES		SAND SIZES			FINES
20.9 %	34.2 %	15.9 %	21.0 %	6.5 %	1.5 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
2"	0

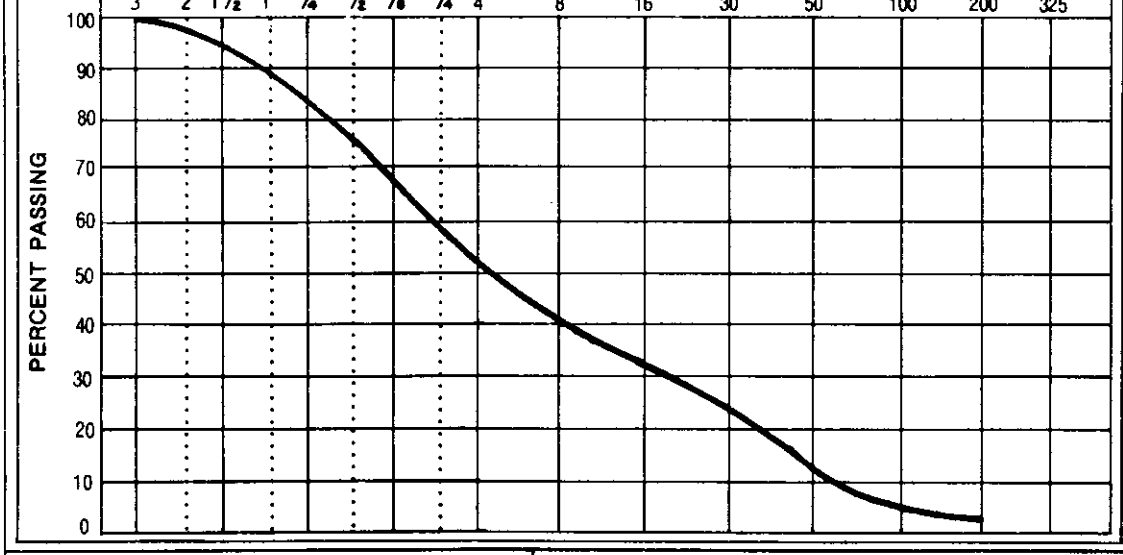
SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	100.0
1 1/2"	95.8
1"	86.6
3/4"	79.1
1/2"	68.3
3/8"	59.9
1/4"	
No. 4	44.9
No. 8	32.6
No. 16	22.7
No. 30	14.3
No. 50	5.7
No. 100	2.1
No. 200	1.5

SAMPLE Y70-C(e) DEPTH 2.0'-8.5'

DATE SAMPLED Sept. 17, 1976 SAMPLED BY GCD

LAB TEST NUMBER 14HA-3

GRAVEL SIZES		SAND SIZES			FINES
16.6 %	31.4 %	14.0 %	22.2 %	14.2 %	1.6 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
3"	0

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	97.0
1 1/2"	95.1
1"	88.7
3/4"	83.4
1/2"	75.3
3/8"	67.1
1/4"	
No. 4	52.0
No. 8	39.3
No. 16	31.5
No. 30	24.1
No. 50	11.9
No. 100	3.4
No. 200	1.6

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No. Y70

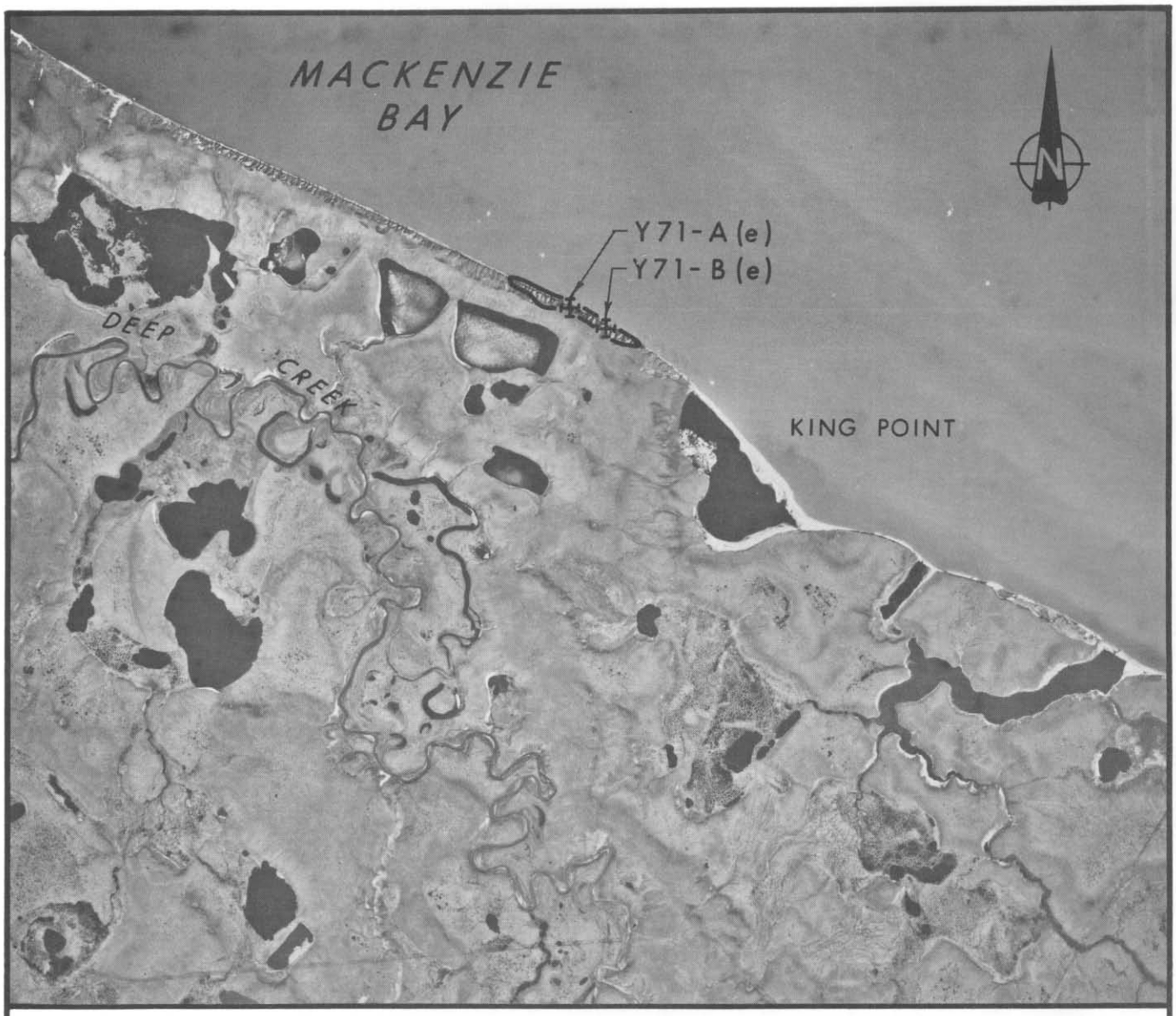
DEPOSIT Y71

Setting: Deformed preglacial gravels and sands along the coastal escarpment immediately northwest of King Point.

Material: Gravel and Sand; well graded, fine to coarse, some sand, silt interbeds.

Volume: 2,400,000 cubic yards total.

Assessment: Only part of the escarpment face exposes good quality granular material. Because of the stratified nature of the deposit, it would be difficult to cleanly excavate good quality material. Coastal retreat may be hastened by removal of material.



Airphoto No.: A22879-105		Approx. Scale:	1"=4900'
Deposit Outline - R.M. Hardy	———	Test Pit	⊙
Deposit Outline - Others	—·—·—	Exposures	✠

DEPOSIT Y71

SETTING

Deposit Y71 consists of deformed preglacial sands and gravels which are exposed along an escarpment and associated steep ravines, immediately west of King Point. The crest of the escarpment is about 175 feet above sea level.

Although the stratigraphy is variable, the sequence basically consists of 2 to 40 foot thick beds of gravel and sand interbedded with 10 to 30 foot thick beds of silt and sandy silt containing wood and woody detritus. The gravel and sand contain thin beds of silt and isolated lenses of wood and peat. The whole sequence has been deformed and the strata are inclined due to faulting and folding.

Although the cliffs are generally bare of vegetation and are eroding, coastal retreat appears to be insignificant near Deposit Y71 during recent times. Parts of the cliff that are vegetated are covered by grass and a variety of herbs. The beach at Deposit Y71 is narrow and consists of poorly sorted pebbly gravel. Terrain above the escarpment is moderately well-drained and covered by sedge tussock tundra.

South of Deposit Y71, ice-rich rolling and hummocky morainal deposits and the incised Deep Creek valley provide staging grounds for waterfowl. The adjacent Beaufort Sea serves as a feeding area for fish and Beluga whale. Raptors may nest along the cliffs.

MATERIAL

Deposit Y71 contains good quality granular material consisting of stratified, oxidized, fine to coarse gravel with some sand. A few thin silty interbeds and lenses of coarse woody detritus or peat are present in the gravels. Pebbles in the gravel rarely exceed 2 inches. Larger clasts are mainly rounded to subrounded sandstone and quartzite with rare quartz and chert. Shale is common in the fines.

The granular materials are well drained and have negligible ice contents.

VOLUME

The total volume of 2,400,000 cubic yards is based on the observation that approximately one-third of the strata in the cliffs appears to be granular materials. No annual extractable volume has been calculated because the deformed and interbedded nature of the deposit makes accurate evaluations difficult.

DEVELOPMENT

Excavation of Deposit Y71 would be difficult because of the interbedded nature of the deposit. Large volumes of fine-grained material would have to be separated from the granular material. Coastal configuration would require that stockpiles be placed at the top of cliffs or on low benches immediately east of the deposit.

Access to the deposit is good as it borders the Beaufort Sea. Inland access would be more difficult as the escarpment at Deposit Y71 would require ascending and thermokarst-susceptible morainal deposits and the valley of Deep Creek would have to be crossed.

Development would involve major environmental disruption, especially of the site aesthetics, for relatively small volumes of material. Extraction of material would also hasten coastal retreat. Development should be planned to minimize interference with waterfowl staging.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
0	GW		GRAVEL - well graded, little medium to coarse sand, occasional cobble, brown.		UF		
2.5	SM		SAND - and low plastic silty fines, dark grey, moist.				
3.2	GW		GRAVEL - well graded, some fine to coarse sand, trace silty fines, occasional cobble, light brown, rusty spots.				
6.0	ML		SILT - low plastic, dark grey, wet.				Base of exposure is 20 feet above sea level.
7.0			Bottom of Pit				Sample from 3.2'-6.0'

DATE: Sept. 23, 1976 | LOGGED BY: JDF | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y71-A(e)

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
0	ML		SILT - trace gravel, trace sand.		UF		Organic Color: #4 Lightweight Pieces - Fine Aggregate: 0.23%
22.0			oxidized layer				
27.0	GW		GRAVEL - well graded to 10" cobbles, and medium to coarse sand, sandstones.				
35.0			sand becoming finer, trace silty fines.				
51.0							
51.3	Pt		PEAT - organic layer				
	ML		SILT				
200.0 ▽			sea level at approx. 200' depth.				
			Bottom of Pit				Sample from 27.0'-51.0'

DATE: Sept. 23, 1976 | LOGGED BY: GCD | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y71-B(e)

SHEET 1 OF 1

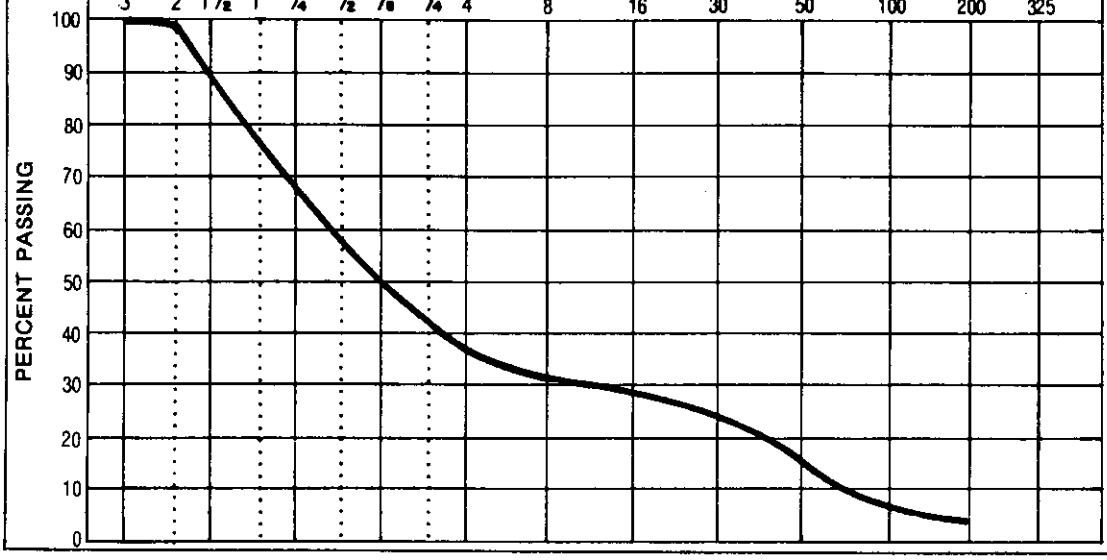
GRAIN SIZE ANALYSIS

SAMPLE Y71-A(e) DEPTH 3.2'-6.0'

DATE SAMPLED Sept. 23, 1976 SAMPLED BY JDF

LAB TEST NUMBER TP96

GRAVEL SIZES		SAND SIZES			FINES
31.2 %	32.3 %	6.3 %	10.8 %	16.2 %	3.2 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
2"	0

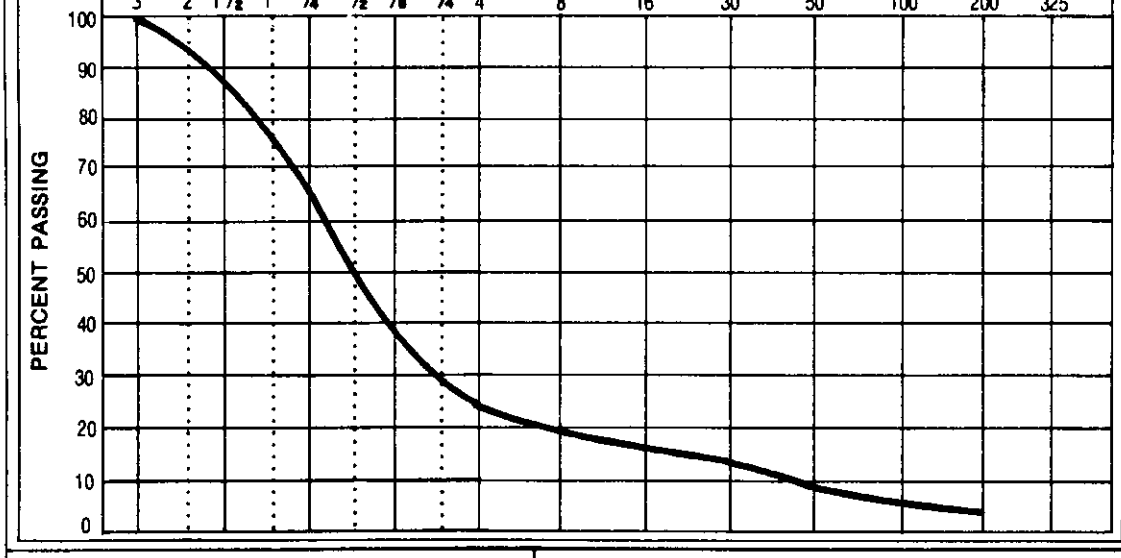
SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	100.0
1 1/2"	86.8
1"	76.7
3/4"	68.8
1/2"	59.3
3/8"	50.7
1/4"	
No. 4	36.5
No. 8	31.0
No. 16	27.9
No. 30	24.8
No. 50	15.8
No. 100	6.5
No. 200	3.8

SAMPLE Y71-B(e) DEPTH 27.0'-51.0'

DATE SAMPLED Sept. 23, 1976 SAMPLED BY GCD

LAB TEST NUMBER 97HA

GRAVEL SIZES		SAND SIZES			FINES
45.0 %	30.5 %	6.0 %	6.5 %	7.8 %	4.2 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
3"	0

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	93.6
1 1/2"	82.8
1"	66.1
3/4"	55.0
1/2"	42.5
3/8"	35.0
1/4"	
No. 4	24.5
No. 8	20.4
No. 16	16.9
No. 30	13.4
No. 50	9.4
No. 100	5.9
No. 200	4.2

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No. Y71

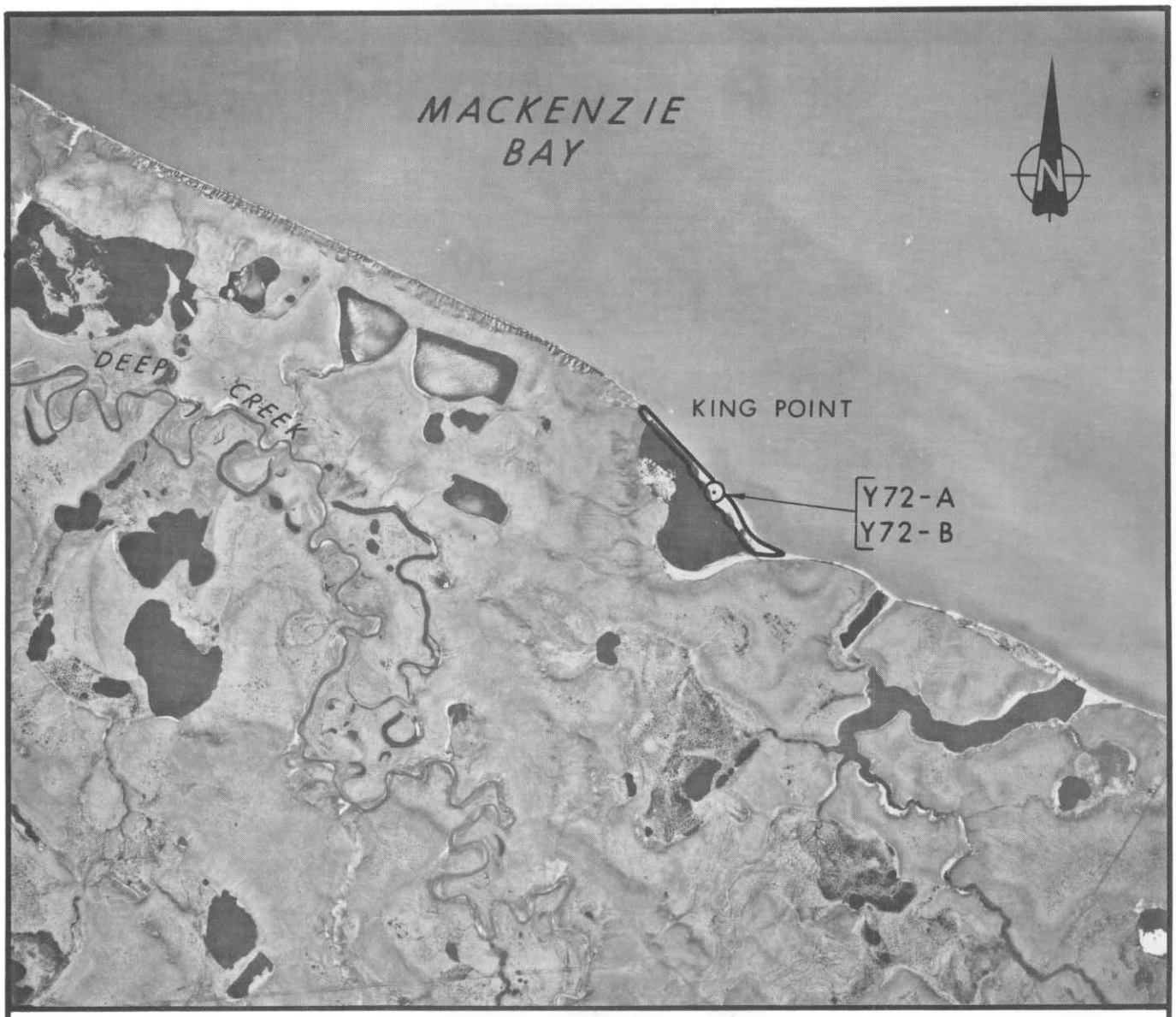
DEPOSIT Y72

Setting: Bay-mouth bar immediately southeast of King Point.

Material: Gravel and Sand; well to poorly graded, fine to coarse.

Volume: 1,000,000 cubic yards total.

Assessment: Contains fair to good quality granular material. Natural restoration of the bay-mouth bar would be rapid. Inland access is fair. Recoverable volume may be limited to 340,000 cubic yards.



Airphoto No.: A22879-105		Approx. Scale:	1"=5000'
Deposit Outline - R.M. Hardy	———	Test Pit	⊙
Deposit Outline - Others	—·—·—	Exposures	✠

DEPOSIT Y72

SETTING

Deposit Y72 consists of a bay-mouth bar, which encloses a small lagoon directly south of King Point. Until recently this feature was a broad spit attached only to the western end of the King Point headland.

The spit averages about 470 feet in width with a crest standing 3 to 4 feet above sea level. It consists of a narrow ridge at its western end and broadens at its eastern end where a number of recurving ridges lie on the landward side of the crest of the bar. This bay-mouth bar is inundated during intense storm surges. The depth of the active layer is estimated to exceed 5 feet.

The foreshore is approximately 100 feet across, with driftwood concentrated at its midpoint. The backshore has a variable width and 1 to 2 feet of local relief along its eastern part due to alternating low ridges and swales south of the crest of the baymouth bar. Driftwood is scattered over its surface.

The western part of Deposit Y72 and the crest and foreshore of the eastern part are well drained and devoid of vegetation. Some of the swales of the backshore at the eastern end of the deposit are imperfectly to moderately well drained with patches of grass, sedge, and moss.

The source of granular materials in Deposit Y72 is the cliffs to the northwest of King Point that contain significant quantities of gravel and sand (ref. Deposit Y71). Over the last 20 years the tip of the spit, which formed the nucleus of the present bay-mouth bar, has extended 330 feet to the southeast even though the aforementioned cliffs exhibit an insignificant degree of retreat during the same time. This indicates an efficient transfer of material from these cliffs to the bay-mouth bar.

Deposit Y72 abuts against a flat peat-covered lacustrine bench at its eastern end. This bench is inset in ice-rich rolling morainal deposits. Deposit Y72 and the adjacent area are within a staging area for waterfowl and provide habitat for Arctic fox and grizzly bear. Adjacent waters serve as a feeding ground and migratory route for a number of fish species.

MATERIAL

Deposit Y72 contains fair to good quality granular material consisting of stratified, well to poorly graded, fine to coarse gravel with medium to coarse sand and poorly graded medium to coarse sand with little gravel. Although samples were not obtained, the broad backshore at the eastern end of the deposit is probably underlain by sandier materials. Larger clasts are mainly subrounded to rounded sandstone and quartzite with rare chert and granitics.

VOLUME

The total volume of 1,000,000 cubic yards is based on an average thickness of 9 feet. Bathymetry under adjacent waters and data from other spits suggest that Deposit Y72 is at least 12 feet thick.

Annually, 57,000 cubic yards per 1000 feet of spit could be extracted by conventional techniques assuming that only material above sea level is considered. Volume of recoverable material may be limited to 340,000 cubic yards because of static water level.

DEVELOPMENT

Deposit Y72 would be easily developed by conventional techniques, although storm surges may interrupt operations. Adequate ground is available for long-term stockpiling at the eastern end of the bar.

Extraction of material from Deposit Y72 may alter the rate of coastal retreat immediately to the southeast. Restoration of the bay-mouth bar would probably be rapid judging by the rate of recent growth of the bar.

Inland access is only fair because of the rolling ice-rich terrain, which is susceptible to thermokarst and the incised valley of Deep Creek with its steep valley walls.

Decayed log structures along the inner edge of the lagoon adjacent to Deposit Y72 indicate that the archeological history of the area should be investigated before development is allowed. Development should be properly managed to minimize interference with the staging activities of waterfowl. Deposit Y72 lies within the proposed Arctic Wildlife Range, which may restrict development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
0	GP		GRAVEL - poorly graded to 2", and medium to coarse sand, subrounded to rounded, stratified 4" layers, clean.		UF		
3.2	SP		SAND - medium to coarse, subrounded.				hole abandoned due to sloughing.
4.6			Bottom of Pit				Sample from 0'-4.6'

DATE: Sept. 23, 1976 | LOGGED BY: GCD | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y72-A

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	SP		SAND - medium to coarse, and well graded gravel to 3" size, occasional cobbles, subangular, medium brown, wet, clean.		UF		Lightweight Pieces - Fine Aggregate: 0.05%
2							
3			3.5 ▽ free water at 3.5'.			3.5	
4			Bottom of Pit				Sample from 0'-3.5'

DATE: Sept. 23, 1976 | LOGGED BY: JDF | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

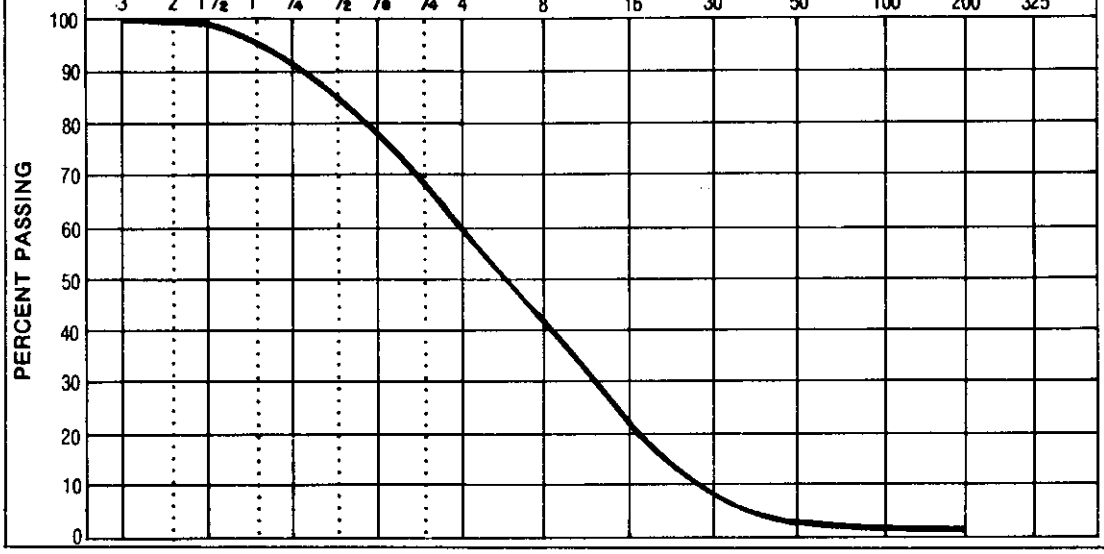
TEST PIT NO. Y72-B

SHEET 1 OF 1

GRAIN SIZE ANALYSIS

SAMPLE Y72-A DEPTH 0'-4.6'
DATE SAMPLED Sept. 23, 1976 SAMPLED BY GCD
LAB TEST NUMBER 13HA-A

GRAVEL SIZES		SAND SIZES			FINES
9.0 %	31.0 %	2.8 %	33.0 %	3.7 %	0.3 %
COARSE	FINE	COARSE	MEDIUM	FINE	

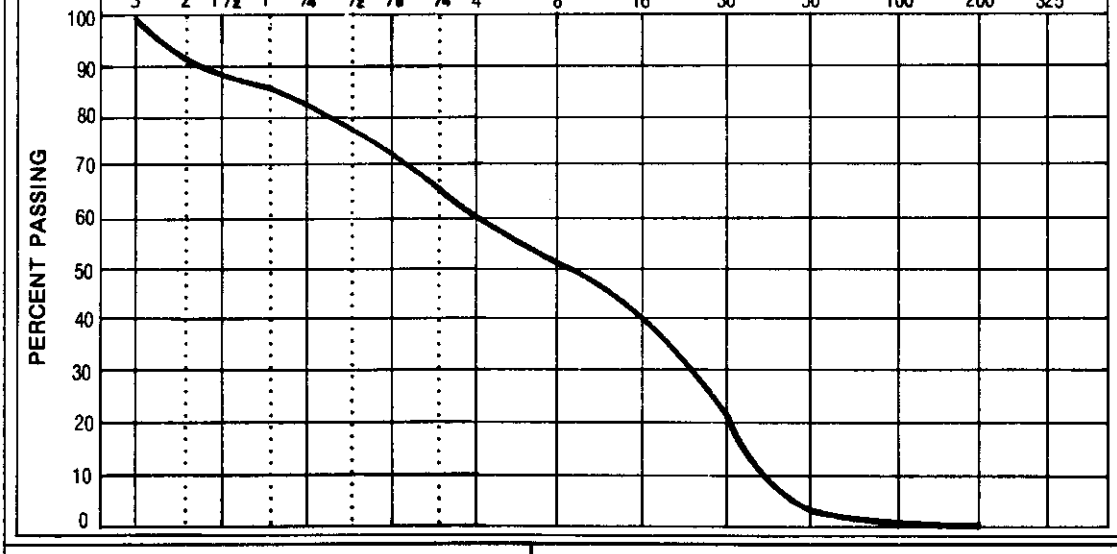


MAX. SIZE	% > 3"
4"	3.2

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	100.0
1 1/2"	98.7
1"	94.5
3/4"	91.0
1/2"	83.9
3/8"	76.3
1/4"	
No. 4	60.0
No. 8	47.5
No. 16	22.8
No. 30	12.2
No. 50	2.8
No. 100	0.3
No. 200	0.3

SAMPLE Y72-B DEPTH 0'-3.5'
DATE SAMPLED Sept. 23, 1976 SAMPLED BY JDF
LAB TEST NUMBER TP 13 B

GRAVEL SIZES		SAND SIZES			FINES
16.9 %	26.6 %	7.5 %	41.5 %	7.5 %	0.0 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
3"	

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	90.5
1 1/2"	
1"	86.0
3/4"	83.1
1/2"	76.5
3/8"	71.3
1/4"	
No. 4	56.5
No. 8	50.9
No. 16	41.6
No. 30	21.1
No. 50	2.7
No. 100	0.1
No. 200	0.0

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No.
Y72

SUMMARY OF LABORATORY TEST DATA FOR SUITABILITY OF AGGREGATES IN CONCRETE

PETROGRAPHIC ANALYSIS
COARSE AGGREGATE

ROCK TYPE	CLASSIFICATION	TOTAL WEIGHTED COMPONENT %
Quartzite	Strong to very strong, Good	15.3
Sandstone		24.2
Granite		0.1
Limestone		0.7
Cherty Conglomerate	Potentially reactive, Fair	0.2
Flint		0.5
Chert		0.9
PN:= 137	INTERPRETATION: Fair Quality for Aggregate	41.9

SOUNDNESS OF AGGREGATE - SULPHATE TEST

COARSE AGGREGATE: LOSS= 1.79%

FINE AGGREGATE: LOSS= 6.30%

OTHER TESTS

LIGHTWEIGHT PIECES IN AGGREGATE:

SPECIFIC GRAVITY: FINE: 2.63, COARSE: 2.60

WATER ABSORPTION: FINE: 0.81%, COARSE: 1.00%

ORGANIC IMPURITIES TEST

NUMBER : 2
COAL REMOVED :
COAL & ROOTLETS REMOVED :
COAL CONTENT :

COMMENTS: Sulphate test was performed for 5 cycles in Magnesium Sulphate solution.
Specific Gravity Test was performed at 20°C.
PN number was calculated for coarse and fine gravel components combined.

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO.
Y72-A

SUMMARY OF LABORATORY TEST DATA FOR SUITABILITY OF AGGREGATES IN CONCRETE

PETROGRAPHIC ANALYSIS

FINE AGGREGATE

ROCK TYPE	CLASSIFICATION	TOTAL WEIGHTED COMPONENT %
Quartz & Quartzite	Strong to very strong, Good	14.3
Sandstone		25.7
Limestone		1.7
Flint & Chert	Potentially reactive, Fair	16.3
PAN	Deleterious	0.2
PN:= 137	INTERPRETATION: Fair Quality for Aggregate	58.1

SOUNDNESS OF AGGREGATE - SULPHATE TEST

COARSE AGGREGATE: LOSS=

FINE AGGREGATE: LOSS=

OTHER TESTS

LIGHTWEIGHT PIECES IN AGGREGATE:

SPECIFIC GRAVITY:

WATER ABSORPTION:

ORGANIC IMPURITIES TEST

NUMBER :
COAL REMOVED :
COAL & ROOTLETS REMOVED :
COAL CONTENT :

COMMENTS: see page 362

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y72-A

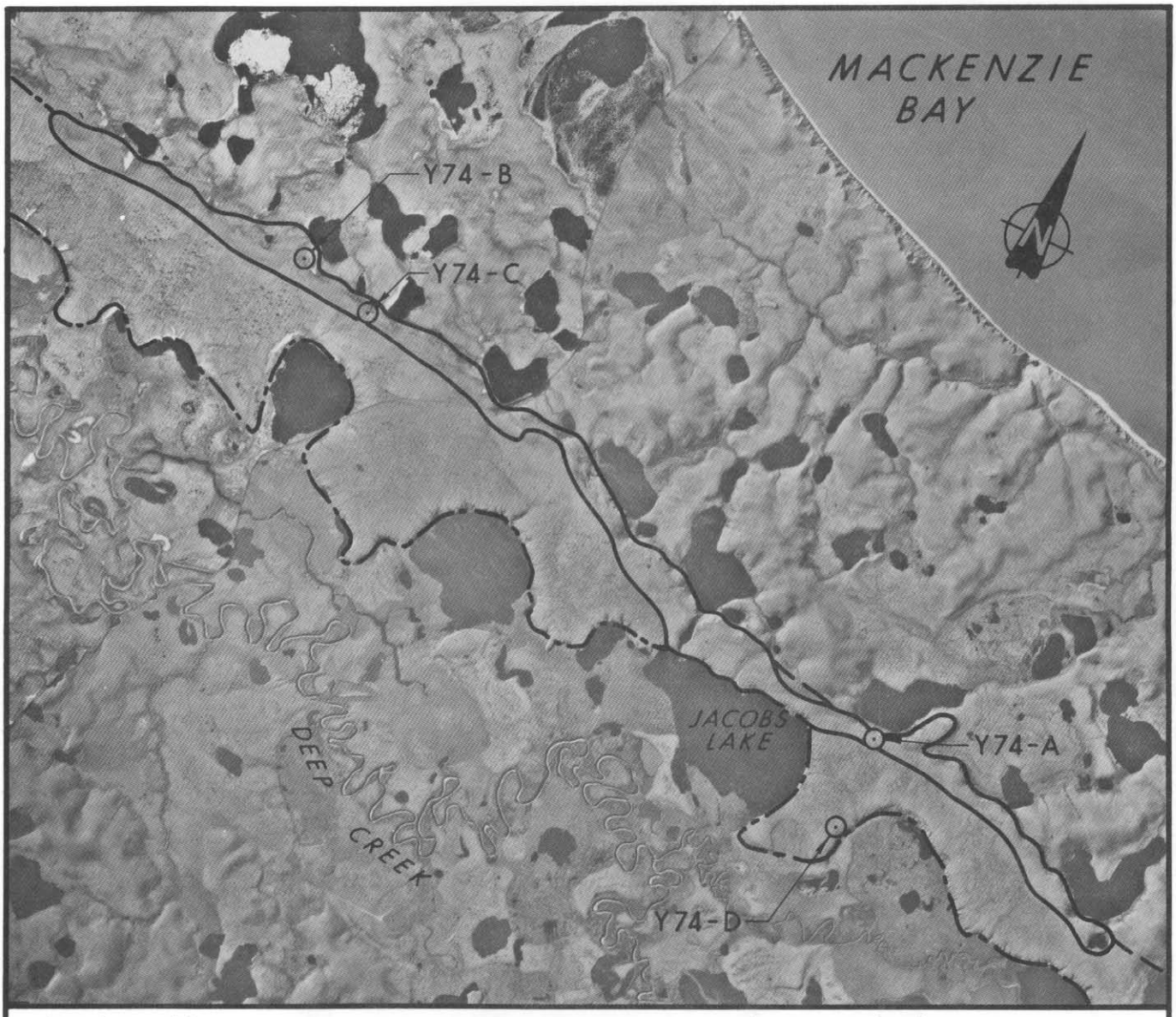
DEPOSIT Y74

Setting: Ice contact edge of coalescing outwash fans that form a ridge running from Jacobs Lake north.

Material: Gravel; well to poorly graded, fine to coarse, some sand.

Volume: 33,000,000 cubic yards total.

Assessment: Contains good to potentially excellent quality granular material. Ground ice possible at depth. Moderately good access to deposit.



Airphoto No.: A22975-153/A22882-24
Approx. Scale: 1"=4900'
Deposit Outline - R.M. Hardy
Deposit Outline - Others
Test Pit
Exposures

DEPOSIT Y74

SETTING

Deposit Y74 consists of the upper edge of a long series of coalescing alluvial fans that slope gently inland from near Peat Lake to a point 4 miles southwest of Sabine Point. Only the part from just east of Jacobs Lake to its western end has been included in this deposit. This deposit has been designated as Source Area 7 in a previous investigation by Klohn, Leonoff Consultants Ltd.

The upper edge of these coalescing alluvial-fans, sloping gently to the south, form a ridge that parallels the Beaufort Sea coast and outlines the former position of a major glacial still-stand. The northern edge of this deposit that is characterized by a 30 to 80 foot scarp is a former ice contact slope.

The moderately steep ice contact slope is well drained. On the upper surface, the first 50 to 300 feet immediately adjacent to the ice contact slope has thin to negligible overburden and is well drained; overburden thickens gradually to the south. Shallow one to two foot deep trenches form a polygonal pattern. The active layer is about 7 feet thick on bare gravel and 2 to 4 feet thick where a thin cover of silt is present.

The well drained part of this deposit is covered by a broken growth of lichen, moss and ericaceous schrubs. Willow and dwarf birch grow to 4 feet in height on the adjacent scarp. Sedges become more common on the poorer drained parts.

Deposit Y74 is bordered on the north by rolling to hummocky ice-rich morainal and peat-covered flat lacustrine deposits, and on the south by the flat peat-covered inset valley of Deep Creek. The area is critical to staging activities of snow geese.

MATERIAL

Deposit Y74 contains good to potentially excellent quality granular material consisting of stratified, well to poorly graded, fine to coarse gravel with some sand. Cobbles to 6 inches in size are noted. Larger clasts are mainly sandstone with some quartzite and chert and rare conglomerate.

VOLUME

The total volume of 33,000,000 cubic yards is based on a thickness of 50 feet with allowance for major thicknesses of massive ice that are known to underlie outwash to the east. Drill holes to the east indicate that the granular materials are well in excess of 48 feet. This volume could be increased by including contiguous outwash to the south.

Annually, 10,000 cubic yards per acre could be extracted by conventional techniques assuming that permafrost will limit yearly recoverable depth to 7 feet.

DEVELOPMENT

Development of Deposit Y74 should be initiated by excavations along the upper edge of the scarp along the northern part of the deposit where drainage could be maintained and pit restoration would be easiest. Massive ice, if present, will require special consideration and management.

Access to the coast from this deposit is good, although care must be exercised in traversing slopes susceptible to thermokarst. Inland access would be best along the Deep Creek valley.

Development of Deposit Y74 should be planned to minimize interference with the staging activities of snow geese. Deposit Y74 lies within the proposed Arctic Wildlife Preserve, which may restrict development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
	Pt		0.3 PEAT		UF		Moisture Content: 4.1%
	ML		SILT - low plastic, little coarse gravel, trace sand, rootlets,				Lightweight Pieces -
1	GM		0.9 light brown, wet. 1.2				Fine Aggregate: 0.29%
	GW		GRAVEL - some fine to coarse sand, little silty fines, occasional cobble, subangular, wet.				
2							
			GRAVEL - well graded, some fine to coarse sand, trace silty fines.				
3							
4							
5							
			6.0				
6			Bottom of Pit				Sample from 1.2'-6.0'
7							

DATE: Sept. 17, 1976 | LOGGED BY: JDF | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y74-A

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
	SM		0.4 SAND - fine to medium, little silty fines, trace gravel, organic, rootlets, brown, wet.		UF		
1	GW		GRAVEL - well graded to 4" cobbles, and fine to coarse sand, trace fines, subangular, damp.				
2							
3			3.0 3.2 - layer of clean subangular gravel.				
4							
5			5.0 wet.				depth of active layer estimated at 6.5' by probe.
			5.6 ▽ saturated at 5.6'.				
6			Bottom of Pit				Sample from 0.4'-5.6'

DATE: Sept. 17, 1976	LOGGED BY: JDF	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y74-B

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	GW		GRAVEL - well graded to 4" cobbles, some fine to coarse sand, subrounded to rounded, brown to black, damp, sandstones.		UF		Organic Color: #4 Coal Removed: #2+ Moisture Content: 4.2%
		1.6					
2	GP	2.0	GRAVEL - fine to ½" size, some coarse sand.				Lightweight Pieces - Fine Aggregate: 0.07%
3	GW		GRAVEL - well graded to 6" cobbles, some fine to coarse sand, subrounded to rounded, moist from 3.5', sandstones, cherts, coal to 1" size.				
		3.9					
4	GP	4.1	GRAVEL - fine, and coarse sand.				
5	GW		GRAVEL - well graded to 3" size, some fine to coarse sand, subrounded to rounded, sandstones, cherts.				
6		6.5 ▽					
		7.0					
7	GP	7.5	GRAVEL - fine to ½" size, some fine to coarse sand.	+ + +	Vx 5%	7.0	
8			Bottom of Pit				Sample from 0'-7.5'

DATE: Sept. 17, 1976	LOGGED BY: GCD	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y74-C

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
0	Pt		PEAT - fine, fibrous. 0.5		UF		Organic Color: #5+
1	CL		CLAY - silty, trace gravel, low plastic, brown, moist. 1.5				Lightweight Pieces - Fine Aggregate: 0.25%
2	GW		GRAVEL - well graded to 3" size, some fine to coarse sand, occasional cobbles to 5" size, trace silty fines, subangular to rounded, brown, moist.			2.7	
3					Vc Vx 7%		
4							
5							
6			6.0				
			Bottom of Pit				Sample from 1.5'-6.0'
7							

DATE: Oct. 6, 1976 | LOGGED BY: CPM | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y74-D

SHEET 1 OF 1

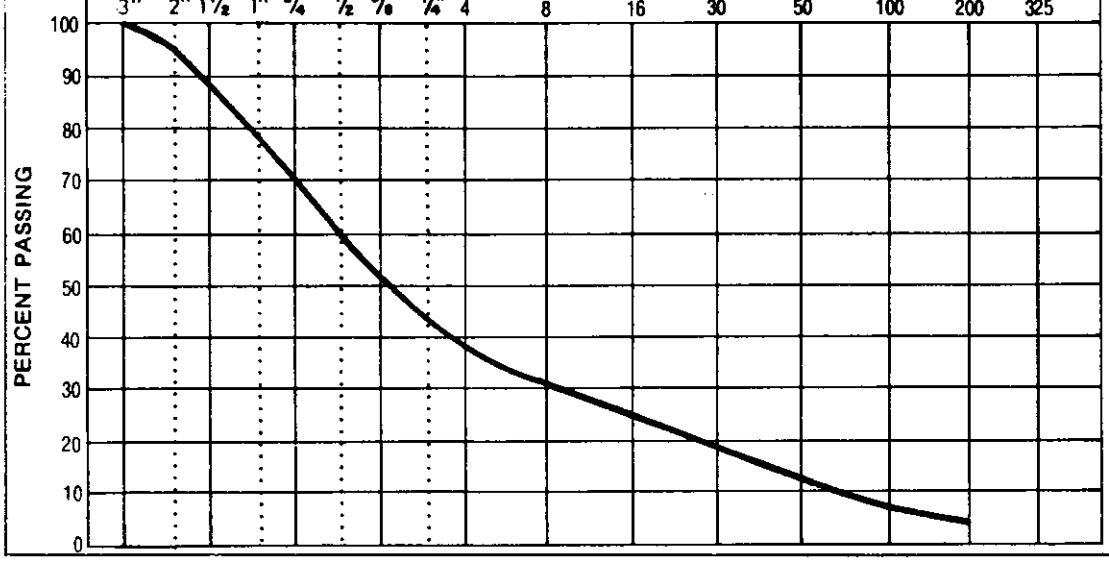
GRAIN SIZE ANALYSIS

SAMPLE Y74-A DEPTH 1.2'-6.0'

DATE SAMPLED Sept. 17, 1976 SAMPLED BY JDF

LAB TEST NUMBER TH147

GRAVEL SIZES		SAND SIZES			FINES
29.6 %	33.5 %	7.4 %	13.5 %	11.8 %	4.2 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
3"	0

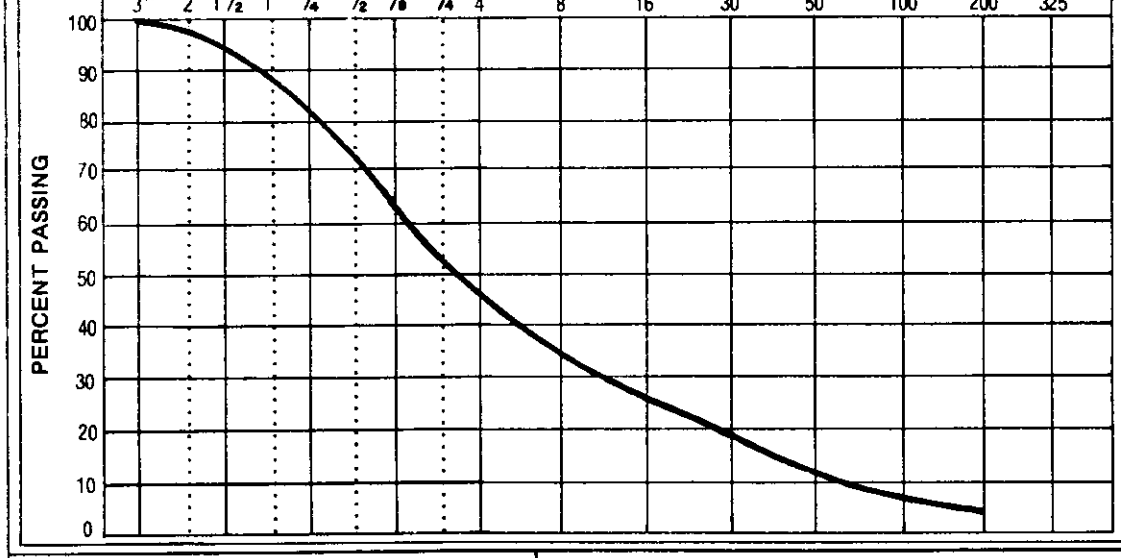
SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	95.9
1 1/2"	86.9
1"	78.4
3/4"	70.4
1/2"	59.9
3/8"	51.4
1/4"	
No. 4	36.9
No. 8	30.3
No. 16	24.7
No. 30	18.8
No. 50	12.0
No. 100	6.6
No. 200	4.2

SAMPLE Y74-B DEPTH 0.4'-5.6'

DATE SAMPLED Sept. 17, 1976 SAMPLED BY JDF

LAB TEST NUMBER TP148

GRAVEL SIZES		SAND SIZES			FINES
17.8 %	36.8 %	12.9 %	17.5 %	11.5 %	4.0 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
4"	4.2

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	97.3
1 1/2"	95.3
1"	88.2
3/4"	82.7
1/2"	72.4
3/8"	63.7
1/4"	
No. 4	45.9
No. 8	34.1
No. 16	26.2
No. 30	19.2
No. 50	11.4
No. 100	6.2
No. 200	4.0

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

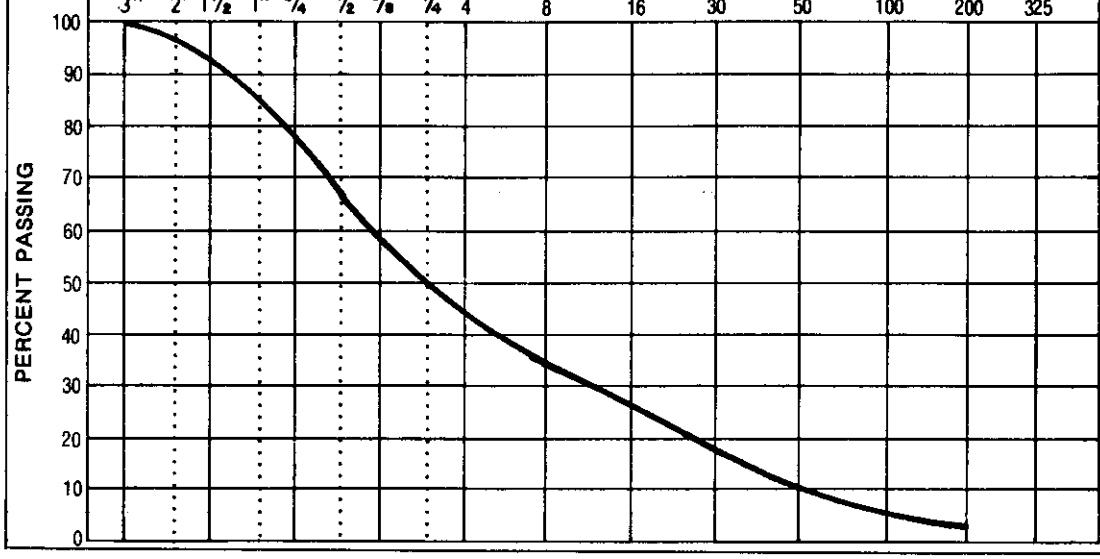
R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No. Y74

GRAIN SIZE ANALYSIS

SAMPLE Y74-C DEPTH 0'-7.5'
DATE SAMPLED Sept. 17, 1976 SAMPLED BY GCD
LAB TEST NUMBER 2HA

GRAVEL SIZES		SAND SIZES			FINES
21.9 %	36.6 %	8.5 %	19.0 %	10.6 %	3.4 %
COARSE	FINE	COARSE	MEDIUM	FINE	

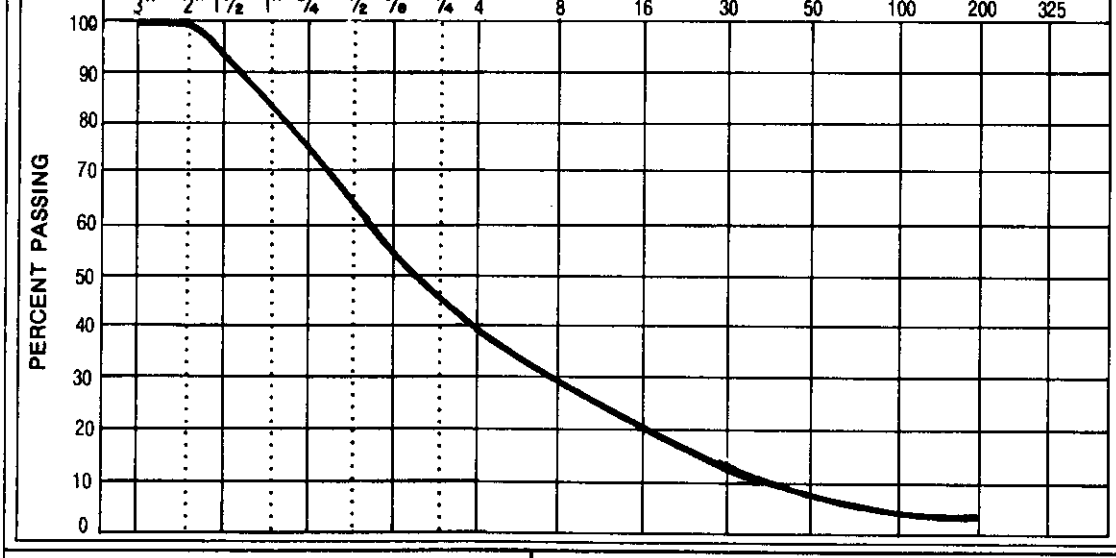


MAX. SIZE	% > 3"
4"	4.0

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	97.4
1 1/2"	93.8
1"	85.7
3/4"	78.1
1/2"	67.3
3/8"	59.3
1/4"	
No. 4	41.5
No. 8	34.6
No. 16	26.8
No. 30	18.6
No. 50	10.5
No. 100	5.6
No. 200	3.4

SAMPLE Y74-D DEPTH 1.5'-6.0'
DATE SAMPLED Oct. 6, 1976 SAMPLED BY CPM
LAB TEST NUMBER 1HA

GRAVEL SIZES		SAND SIZES			FINES
25.3 %	36.6 %	11.1 %	17.0 %	6.6 %	3.4 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
2"	0

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	100.0
1 1/2"	92.5
1"	83.2
3/4"	74.7
1/2"	62.9
3/8"	54.2
1/4"	
No. 4	38.1
No. 8	28.6
No. 16	20.4
No. 30	13.4
No. 50	7.5
No. 100	4.7
No. 200	3.4

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

DEPOSIT No. Y74

SUMMARY OF LABORATORY TEST DATA FOR SUITABILITY OF AGGREGATES IN CONCRETE

PETROGRAPHIC ANALYSIS

COARSE AGGREGATE

ROCK TYPE	CLASSIFICATION	TOTAL WEIGHTED COMPONENT %
Quartzite	Strong to very strong, Good	41.6
Sandstone		47.2
Limestone		0.1
Conglomerate		0.1
Cherty Conglomerate	Potentially Reactive, Fair	1.6
Chert		2.7
Flint		6.7
PN: = 122	INTERPRETATION: Good Quality for Aggregate	100.0

SOUNDNESS OF AGGREGATE - SULPHATE TEST

COARSE AGGREGATE: LOSS = 2.79%

FINE AGGREGATE: LOSS = 7.59%

OTHER TESTS

LIGHTWEIGHT PIECES IN AGGREGATE: FINE: 0.07%

SPECIFIC GRAVITY: FINE: 2.61, COARSE: 2.59

WATER ABSORPTION: FINE: 1.50%, COARSE: 1.23%

ORGANIC IMPURITIES TEST

NUMBER	: 4+
COAL REMOVED	: 3
COAL & ROOTLETS REMOVED	:
COAL CONTENT	: 0.07%

COMMENTS: Sulphate test was performed for 5 cycles in Magnesium Sulphate solution.
Specific Gravity test was performed at 20°C.
Lightweight Pieces were determined by floating on a Zinc Chloride solution with a Specific Gravity of 2.0.

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO.
Y74-B

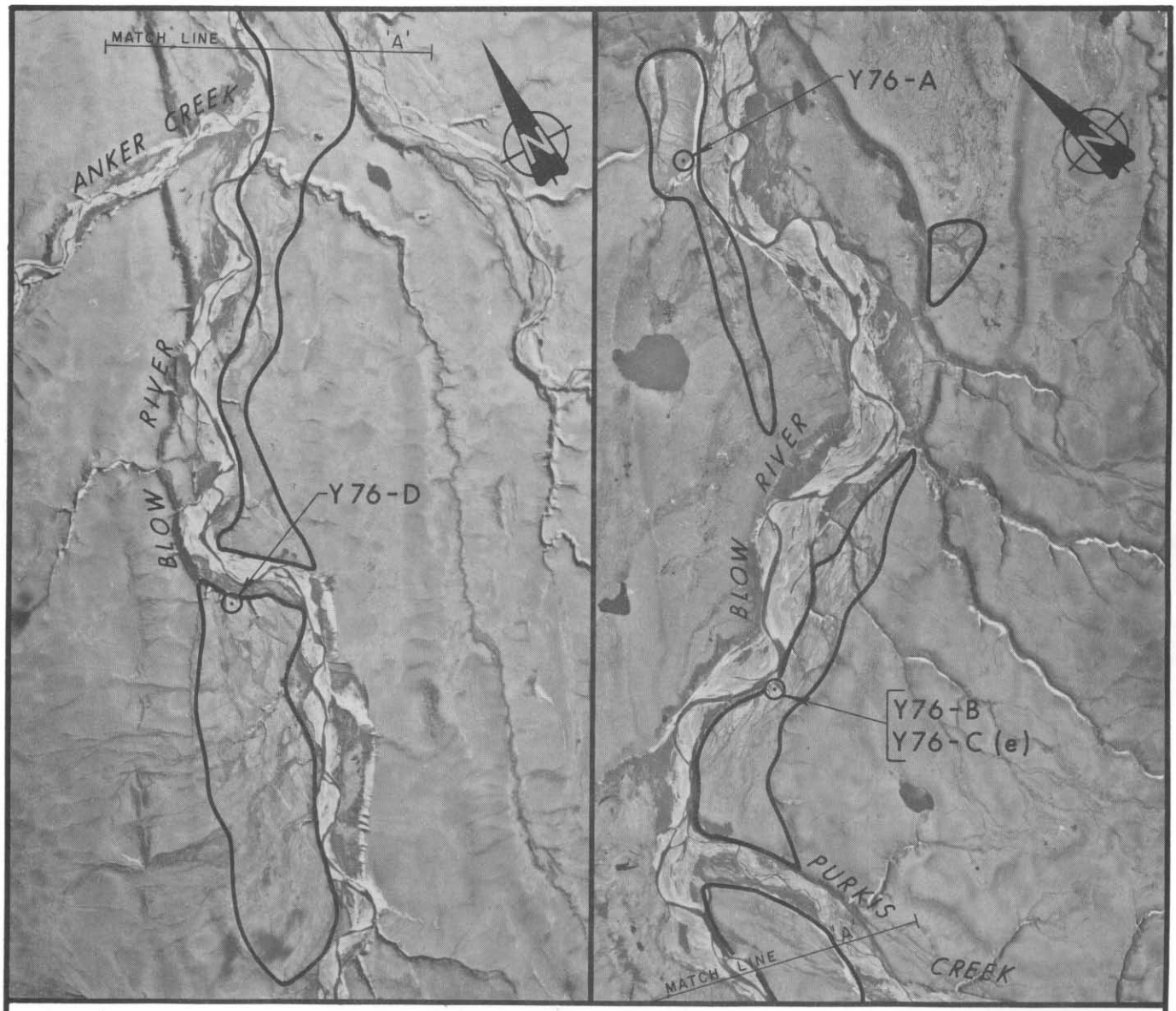
DEPOSIT Y76

Setting: High terraces along the lower middle reaches of the Blow River.

Material: Gravel; well graded, fine to coarse, little sand.

Volume: 91,000,000 cubic yards total.

Assessment: Contains good quality granular material, but with a moderate amount of oversize. Deep pits could be easily developed near scarps. Access to the Blow River valley would be difficult.



Airphoto No.: A14451-19/A14363-31
Approx. Scale: 1"=5900'
Deposit Outline - R.M. Hardy
Deposit Outline - Others
Test Pit
Exposures

DEPOSIT Y76

SETTING

Deposit Y76 consists of a segmented high terrace system along the middle reaches of the Blow River. Bedrock canyon walls, 100 to 120 feet high, are capped by fluvial gravels. The surfaces of the high terraces are frequently divided into a number of benches by 10 to 20 foot scarps. Occasional ravines leading to the Blow River interrupt the terraces. A braided pattern of bars and channel traces and ice-wedge polygons is obvious on the terraces.

The terrace surfaces are generally free of overburden and well-drained although some channel traces and swales contain peat and are imperfectly drained. The active layer is in excess of 6 feet under bare gravel, and ranges between 2 and 4 feet where overburden is present.

Well-drained parts of Deposit Y76 have a broken vegetation cover with patches of small herbs and dwarf birch. Sedges are present along ice-wedge trenches. Sedge meadows and incipient sedge tussock tundra cover poorer drained areas. This area provides marginal ground for waterfowl staging and lies on a major caribou migration corridor. Raptors may nest along the cliffs.

Deposit Y76 is flanked by gently rolling morainal deposits.

MATERIAL

Deposit Y76 contains good quality granular material consisting of well graded, fine to coarse gravel with little sand and a moderate amount of oversize material. Boulders to 12 inches in size were noted in the gravel. Larger clasts are mainly subrounded sandstone and quartzite. Shale chips dominate the fines.

VOLUME

The northern segment contains a total volume of 20,000,000 cubic yards based on an average depth of 25 feet. River-bank exposures showed 10 to 40 feet of gravel. The north central segment contains a total volume of 14,000,000 cubic yards based on an average depth of 15 feet; river-bank exposures showed 10 to 75 feet of gravel. The south central and southern segments contain total volumes of 27,000,000 and 30,000,000 cubic yards respectively based on average depths of 20 feet.

Annually, 12,000 cubic yards per acre can be extracted by conventional techniques assuming that permafrost limits the yearly extractable depth to 8 feet.

DEVELOPMENT

Excavation depths will be limited by permafrost and will be easiest in areas where the terrace shows a bare gravel surface. Pits would best be developed by excavating benches along scarps where drainage can easily be maintained. Also the benches will easily blend into the terraced landscape upon abandonment.

Local east and west access to segments of Deposit Y76 on the respective sides of the Blow River valley would be relatively easy, although care must be exercised in crossing thermokarst susceptible terrain. Access to the coast would be somewhat difficult as it requires descending into the Blow River valley and following the river channel.

Development of Deposit Y76 should be planned to minimize interference with caribou migration or waterfowl staging. Cliffs having raptor nests should be avoided. This deposit lies within the proposed Arctic Wildlife Range, which may restrict development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
0	Pt		PEAT - fibrous, brown, wet.		UF		
1			1.0				
	OL		CLAY - silty, highly organic, low plastic, rootlets, brown, wet.				
2						2.5	
					Nbe		
3			3.0			3.0	
	GW		GRAVEL - well graded to 4" size, some fine to coarse sand, subrounded. clean.		Vc 15%		test pit on slope of 1.5:1, gravel extends down slope from 3' to 40'; rock forms remainder of cliff to river level.
4							
5							
6			6.0				
			Bottom of Pit				Sample from 3.0'-6.0'
7							

DATE: Oct. 9, 1976 | LOGGED BY: SA | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y76-A
SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
0	GW		GRAVEL - well graded to 8" cobbles, some medium to coarse sand, occasional boulders to 12" size, subangular to subrounded, brown, wet, clean.		UF		Organic Color: #5+
1							Lightweight Pieces -
2							Fine Aggregate: 0.17%
3							
3.8							
4	GP		- poorly graded gravel to ½" size.				
4.5							
5	GW						
6.0							
6			Bottom of Pit				Sample from 0'-6.0'
7							

DATE: Oct. 1, 1976	LOGGED BY: CPM	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y76-B

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
0	GW		GRAVEL - little sand, occasional cobbles and boulders to 12" size, sub-rounded, dark brown, damp.		UF		
37.0			- numerous subrounded cobbles.				
42.0	BR		SHALE - clayey, fractured, grey, moist.				Bottom of exposure approx. 80' below bottom of pit.
45.0			Bottom of Pit				No sample taken.

DATE: Oct. 1, 1976 | LOGGED BY: CPM | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y76-C(e)

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1 2 3 4 5 6	GW		GRAVEL - well graded to 5" cobbles, little sand, occasional cobble to 8" size, rootlets in top 2', subrounded, loose, grey, wet, clean. 6.0		UF		Lightweight Pieces - Fine Aggregate: 0.05%
6 7			Bottom of Pit				Sample from 0'-6.0'

DATE: Oct. 9, 1976	LOGGED BY: SA	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

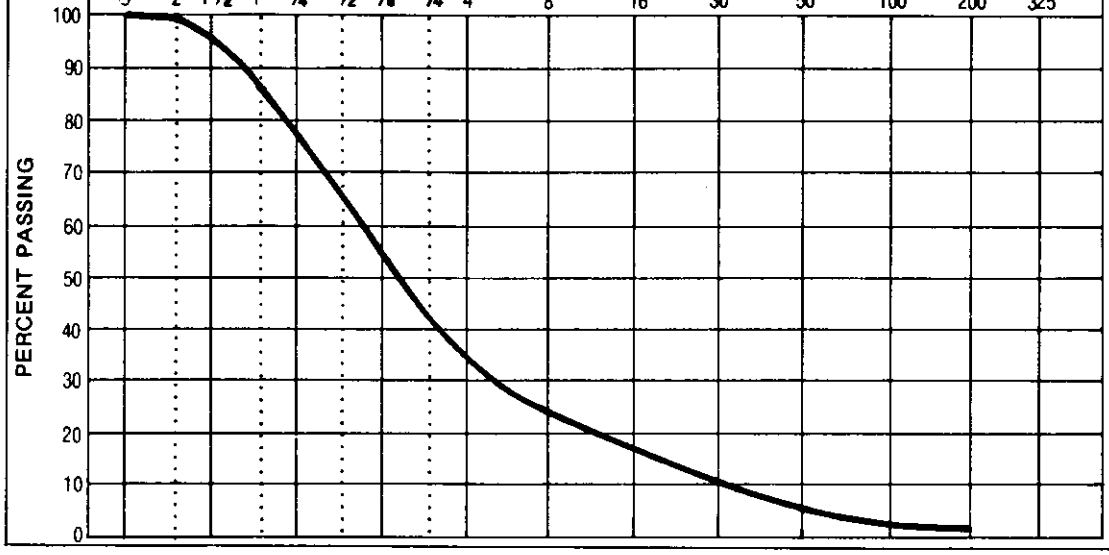
TEST PIT NO. Y76-D

SHEET 1 OF 1

GRAIN SIZE ANALYSIS

SAMPLE Y76-A DEPTH 3.0'-6.0'
DATE SAMPLED Oct. 7, 1976 SAMPLED BY SA
LAB TEST NUMBER 55HA

GRAVEL SIZES		SAND SIZES			FINES
22.6 %	44.0 %	11.0 %	14.9 %	5.7 %	1.8 %
COARSE	FINE	COARSE	MEDIUM	FINE	

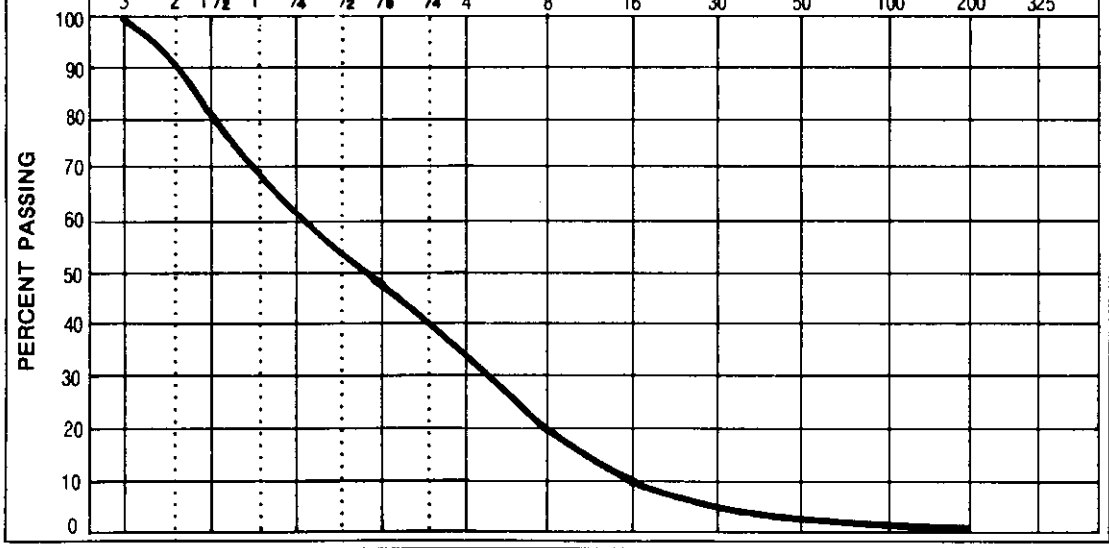


MAX. SIZE	% > 3"
4"	3.9

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	100.0
1 1/2"	95.7
1"	86.4
3/4"	77.4
1/2"	65.5
3/8"	54.0
1/4"	
No. 4	33.4
No. 8	24.8
No. 16	17.6
No. 30	10.8
No. 50	4.7
No. 100	2.2
No. 200	1.8

SAMPLE Y76-B DEPTH 0'-6.0'
DATE SAMPLED Oct. 1, 1976 SAMPLED BY CPM
LAB TEST NUMBER 56HA-A

GRAVEL SIZES		SAND SIZES			FINES
39.7 %	27.3 %	15.5 %	13.5 %	2.9 %	1.1 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
5"	28.5

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	90.7
1 1/2"	81.2
1"	70.7
3/4"	60.3
1/2"	53.9
3/8"	47.0
1/4"	
No. 4	33.0
No. 8	19.8
No. 16	9.5
No. 30	3.6
No. 50	1.7
No. 100	1.3
No. 200	1.1

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No. Y76

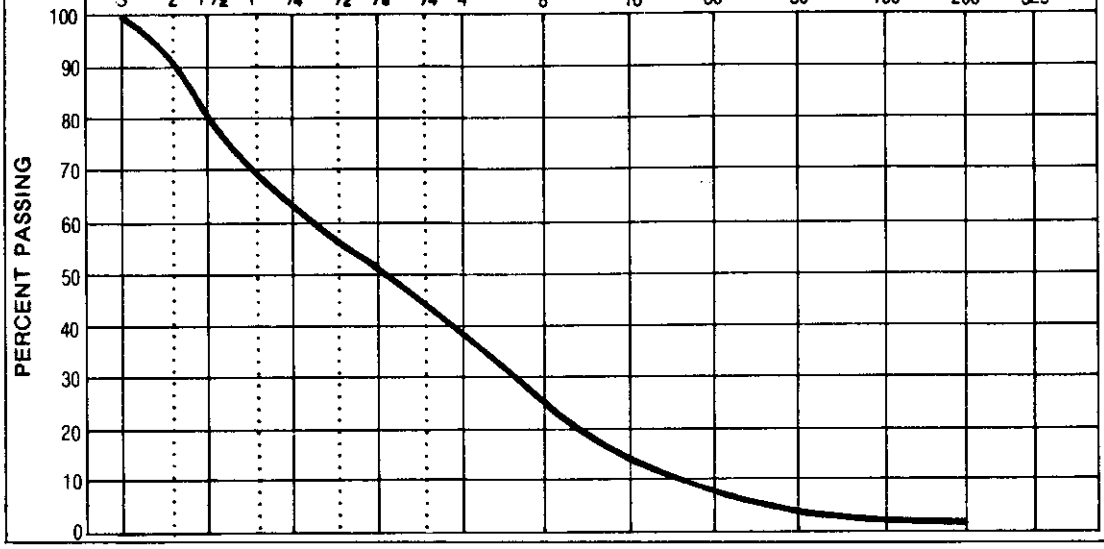
GRAIN SIZE ANALYSIS

SAMPLE Y76-D DEPTH 0'-6.0'

DATE SAMPLED Oct. 9, 1976 SAMPLED BY SA

LAB TEST NUMBER 58HA

GRAVEL SIZES		SAND SIZES			FINES
35.3 %	27.0 %	13.2 %	18.0 %	5.1 %	1.4 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
5"	27.8

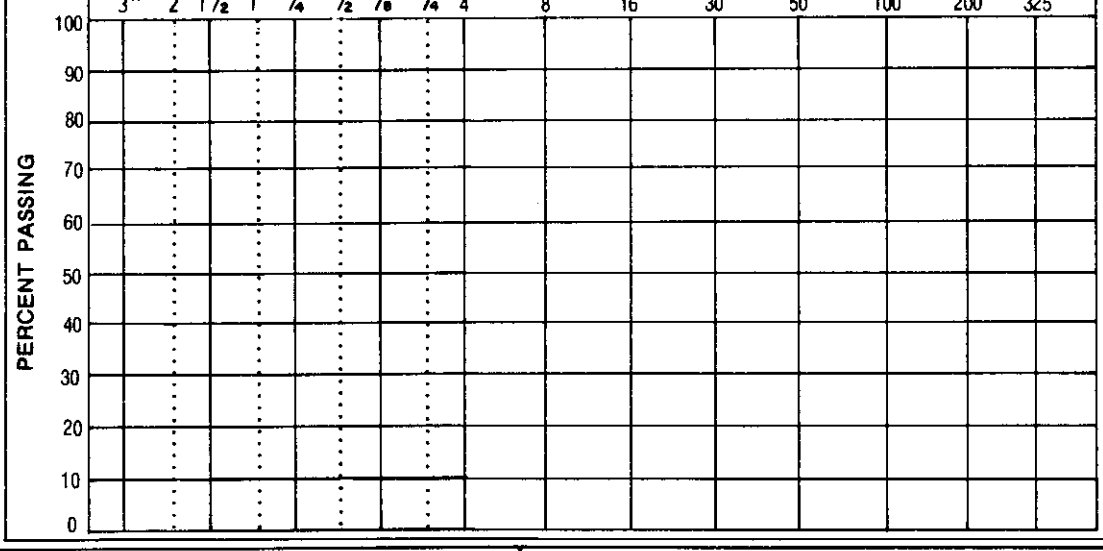
SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	91.4
1 1/2"	78.1
1"	70.1
3/4"	64.7
1/2"	57.1
3/8"	52.0
1/4"	
No. 4	37.7
No. 8	26.5
No. 16	13.9
No. 30	6.0
No. 50	2.8
No. 100	1.7
No. 200	1.4

SAMPLE _____ DEPTH _____

DATE SAMPLED _____ SAMPLED BY _____

LAB TEST NUMBER

GRAVEL SIZES		SAND SIZES			FINES
%	%	%	%	%	%
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"

SIEVE SIZE	PERCENT PASSING
3"	
2"	
1 1/2"	
1"	
3/4"	
1/2"	
3/8"	
1/4"	
No. 4	
No. 8	
No. 16	
No. 30	
No. 50	
No. 100	
No. 200	

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No. Y76

SUMMARY OF LABORATORY TEST DATA FOR SUITABILITY OF AGGREGATES IN CONCRETE

PETROGRAPHIC ANALYSIS

COARSE AGGREGATE

ROCK TYPE	CLASSIFICATION	TOTAL WEIGHTED COMPONENT %
Quartzite	Strong to very strong, Good	20.2
Sandstone		59.5
Limestone		0.2
Chert	Potentially reactive, Fair	16.2
Cherty Conglomerate		3.9
PN:= 140	INTERPRETATION: Fair to Good Quality for Aggregate	100.0

SOUNDNESS OF AGGREGATE - SULPHATE TEST

COARSE AGGREGATE: LOSS= 3.47%

FINE AGGREGATE: LOSS= 8.36%

OTHER TESTS

LIGHTWEIGHT PIECES IN AGGREGATE: FINE: 0.05%

SPECIFIC GRAVITY: FINE: 2.60, COARSE: 2.59

WATER ABSORPTION: FINE: 1.83%, COARSE: 1.34%

ORGANIC IMPURITIES TEST

NUMBER	: 4
COAL REMOVED	: 4-
COAL & ROOTLETS REMOVED	:
COAL CONTENT	: 0.05%

COMMENTS: Sulphate Test was performed for 5 cycles in Magnesium Sulphate solution.
Specific Gravity Test was performed at 20°C.
Lightweight Pieces were determined by floating on Zinc Chloride solution with a Specific Gravity of 2.0.

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO.
Y76-A

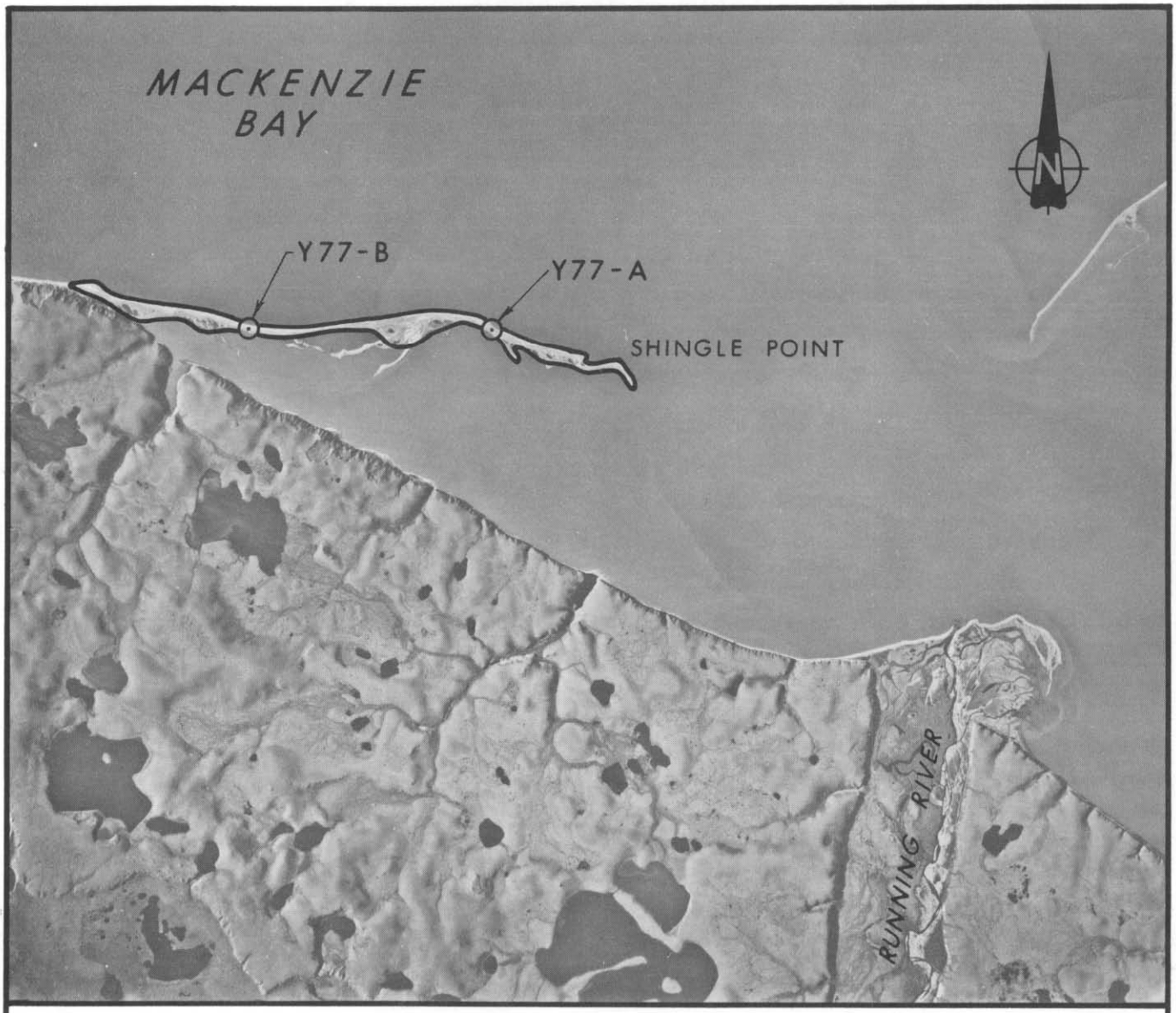
DEPOSIT Y77

Setting: Complex spit at Shingle Point. Located 5 miles northwest of the mouth of the Running River.

Material: Gravel and Sand; poorly graded, fine to medium, clean.

Volume: 800,000 cubic yards total.

Assessment: Contains fair to good quality granular material. Extraction operations may eliminate its backwater as a harbour and hinder its potential as a whaling and fishing campsite. Natural restoration of the spit would be fairly quick. Inland access is fair.
Recoverable volume may be limited to 390,000 cubic yards.



Airphoto No.: A22975-144		Approx. Scale:	1"=4900'
Deposit Outline - R.M. Hardy	———	Test Pit	⊙
Deposit Outline - Others	—·—·—	Exposures	✠

DEPOSIT Y77

SETTING

Deposit Y77 consists of a long spit extending 3½ miles eastward from the headland known as Shingle Point. Numerous long spurs, ½ mile in length, extend inland from its southern edge. The configuration of these spurs is such that they have created a few ponds on the surface of the spit.

Deposit Y77 averages 200 feet plus in width but is extremely variable being narrower where it is a single ridge, and much wider where secondary ridges extend inland from its southern edge. The crest of Deposit Y77 ranges from 3 to 4 feet above sea level. The foreshore of the spit averages about 60 feet in width with more variability in width being exhibited by the backshore.

The surface of the spit is well drained and devoid of vegetation, except in some swales along the backshore where drainage is only moderately good and a few tufts of grass have been established. Deposit Y77 is completely inundated during major storm surges. No permafrost was encountered in this deposit to depths of 6 feet.

The source of granular material in Deposit Y77 appears to be eroded sediments from cliffs west of the deposit containing moderate amounts of coarser material. Recently, the spit has extended both along its breadth in a seaward direction and lengthwise to the east.

Deposit Y77 adjoins a steep 70 foot bank capped by ice-rich morainal deposits. The deposit and the adjoining area are a critical staging area for waterfowl and provide habitat for Arctic fox and grizzly bear. The adjacent coastal water provides habitat for Beluga whale and numerous fish including lake herring, whitefish, inconnu, cisco, Arctic char, and smelt.

MATERIAL

Deposit Y77 contains fair to good quality granular material consisting of stratified, poorly graded fine to medium gravel and sand. Material on some backshore spurs may be sandier. Pebbles, rarely exceeding 1 inch in size, are mainly subrounded to rounded sandstone and chert with rare quartz. Shale is a major component of the fines.

VOLUME

The total volume of 800,000 cubic yards is based on an average thickness of 6 feet as bathymetry and data from other spits suggest that Deposit Y77 is at least 10 feet thick.

Annually, 23,000 cubic yards per 1000 foot length of spit could be extracted by conventional techniques assuming that only material above sea level is removed. Volume of recoverable material may be limited to 390,000 cubic yards because of static water level.

DEVELOPMENT

Deposit Y77 could be developed during summer and fall by conventional techniques, although storm tides would interrupt operations. A steep bank would have to be ascended if stockpiles are placed on the adjacent upland.

Extraction of material from Deposit Y77 would have little effect on coastal erosion as its partial removal would not change current patterns or longshore drift to the west. The net recent expansion of Deposit Y77 indicates that it would be restored quite rapidly following any extraction.

Direct inland access involves crossing ice-rich rolling morainal and peat-covered lacustrine deposits which are susceptible to

thermokarst. The Running River fluvial system to the east could be used for inland access.

Before development, Deposit Y77 should be assessed for archeological sites as it has long been central to fishing and whaling activities. Consideration should also be given to the fact the small boats use the spit backwater as a harbour. Presently, it is used periodically as a whaling or fishing camp. Development should also be planned to minimize interference with staging activities of waterfowl or pupping by Beluga whale.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	GW		GRAVEL - well graded to 2" size, and fine to coarse sand, subrounded to rounded, brown, wet, cherts and sandstones, clean.		UF		Lightweight Pieces - Fine Aggregate: 0.10%
2							
3							pit abandoned due to sloughing.
4			4.5				sea level approx. 2' below bottom of pit.
5			Bottom of Pit				Sample from 0'-4.5'

DATE: Sept. 24, 1976	LOGGED BY: JDF	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y77-A

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	GW		GRAVEL - well graded to 2" size, and medium to coarse sand, stratified, 2" layers, subrounded.		UF		Lightweight Pieces - Fine Aggregate: 0.10%
1.8							
2	SP		SAND - medium to coarse, trace fine gravel to ½" size, subrounded.				
2.8							
3	GP		GRAVEL - fine to ½" size, subrounded.				
3.7			increasing medium to coarse sand, stratified, 4" layers, subrounded.				
4							
5							
5.8			▽ - saturated at 5.8'.				
6.0							
6			Bottom of Pit				Sample from 0'-6.0'
7							

DATE: Sept. 24, 1976	LOGGED BY: GCD	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

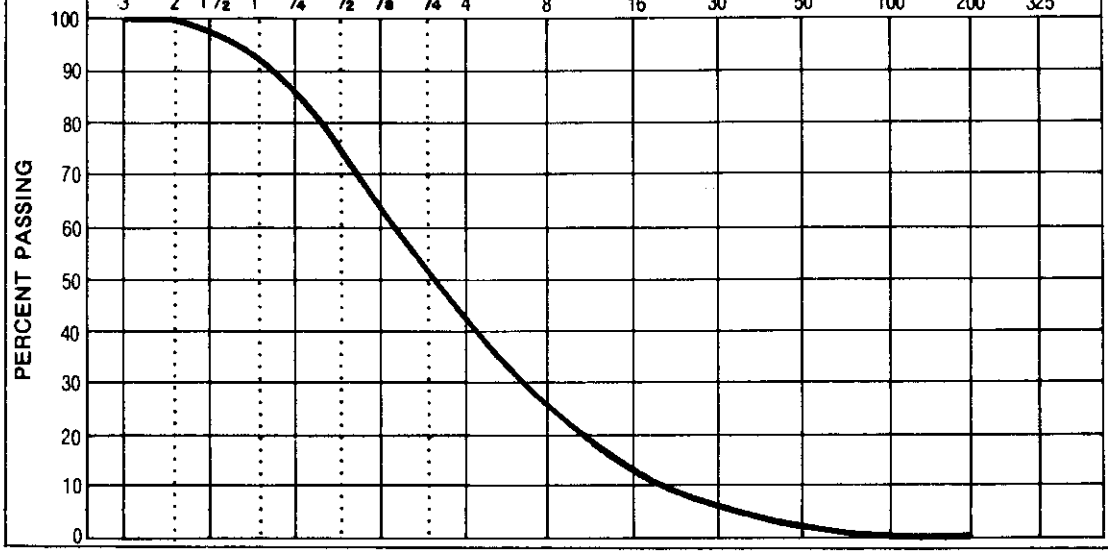
TEST PIT NO. Y77-B

SHEET 1 OF 1

GRAIN SIZE ANALYSIS

SAMPLE Y77-A DEPTH 0'-4.5'
DATE SAMPLED Sept. 24, 1976 SAMPLED BY JDF
LAB TEST NUMBER TP145

GRAVEL SIZES			SAND SIZES			FINES
13.0 %	49.3 %		14.2 %	19.0 %	4.3 %	0.2 %
COARSE	FINE		COARSE	MEDIUM	FINE	

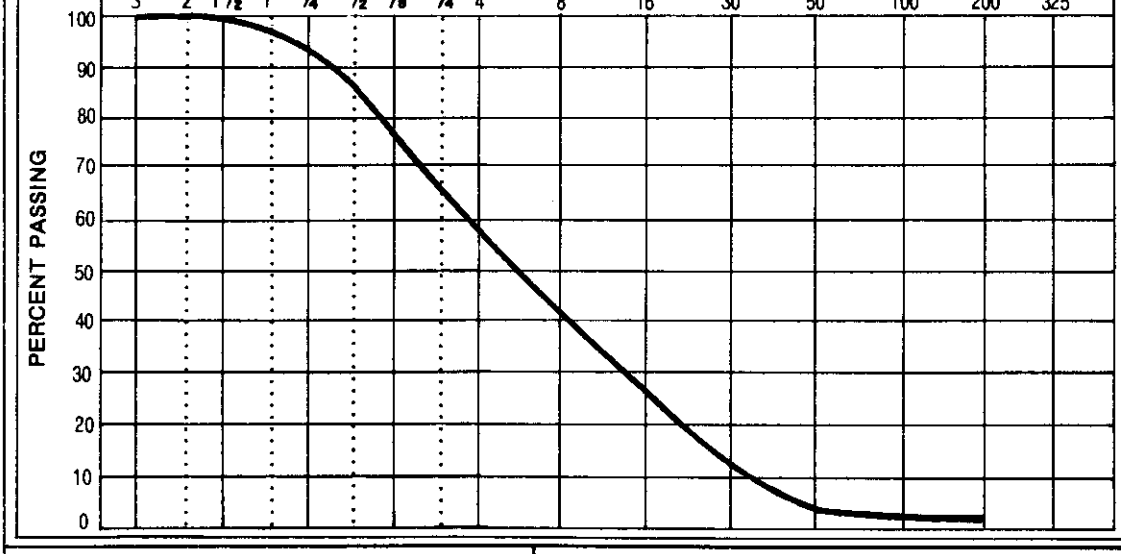


MAX. SIZE	% > 3"
2"	0

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	100.0
1 1/2"	98.6
1"	92.4
3/4"	87.0
1/2"	75.5
3/8"	63.8
1/4"	
No. 4	37.7
No. 8	26.4
No. 16	13.2
No. 30	4.2
No. 50	1.4
No. 100	0.3
No. 200	0.2

SAMPLE Y77-B DEPTH 0'-6.0'
DATE SAMPLED Sept. 24, 1976 SAMPLED BY GCD
LAB TEST NUMBER 146HA

GRAVEL SIZES			SAND SIZES			FINES
5.6 %	38.2 %		16.7 %	32.0 %	4.8 %	2.7 %
COARSE	FINE		COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
2"	0

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	100.0
1 1/2"	99.0
1"	97.5
3/4"	94.4
1/2"	86.9
3/8"	76.9
1/4"	
No. 4	56.2
No. 8	43.3
No. 16	26.5
No. 30	13.5
No. 50	3.6
No. 100	2.7
No. 200	2.7

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No. Y77

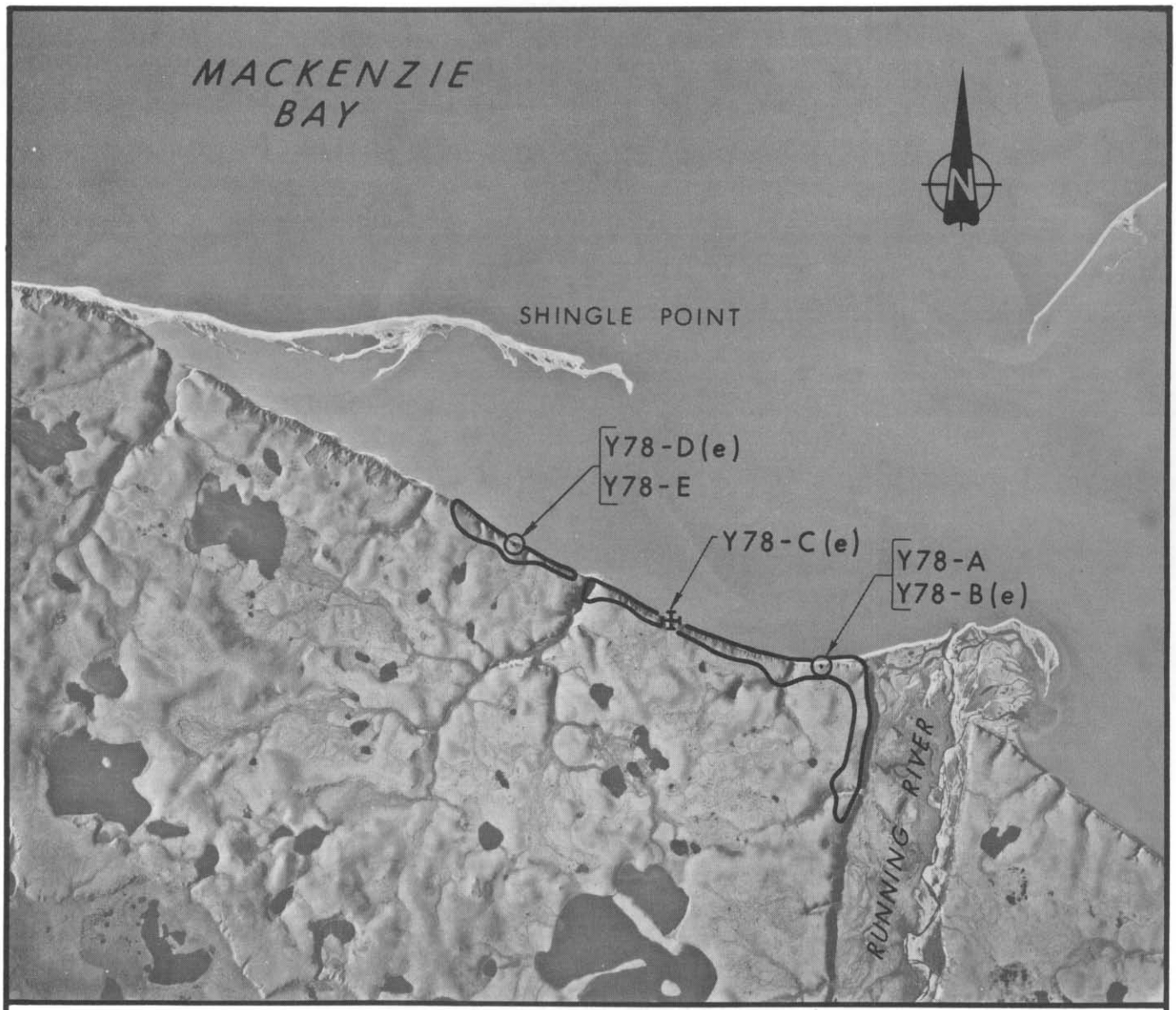
DEPOSIT Y78

Setting: Exposed preglacial fluvial gravels along an escarpment west of the mouth of Running River.

Material: Gravel; well graded, fine to coarse, some sand, few silty layers.

Volume: 14,000,000 cubic yards total.

Assessment: Contains good to excellent quality granular material. Development would be relatively easy along the escarpment although thick overburden would have to be removed for large-scale development. Good access is available.



Airphoto No.: A22975-144		Approx. Scale:	1"=4900'
Deposit Outline - R.M. Hardy	———	Test Pit	⊙
Deposit Outline - Others	—·—·—	Exposures	✠

DEPOSIT Y78

SETTING

Deposit Y78 consists of preglacial gravels along a 50 to 70 foot escarpment along the Beaufort Sea and west bank of the Running River valley. Ice-wedge casts and a zone of oxidation indicate that at least two identifable fluvial units having different depositional histories compose these preglacial gravels which extend below sea level and are overlain by ice-rich morainal and lacustrine sediment. Coastal retreat and stream incission have exposed the gravels and slumping has thinned the cover over these gravels along the edge of the escarpments.

Overburden along the crest of the scarp probably averages about 10 feet in thickness, and thickens gradually away from the scarp. These gentle slopes exhibit moderately good drainage, and are covered by tundra with mosses, ericaceous shrubs, dwarf willow and birch growing between sedge hummocks. The active layer is about 1 to 2 feet thick.

The coastal scarp is bare and eroding, but is retreating at a minimal rate as the coastline is protected by the Shingle Point Spit and Escape Reef. A few active retrogressive thaw flow slides are present along the crest of the scarp. The gravel beach below is narrow.

Inland and east of Running River, the terrain consists of ice-rich rolling moraine and flat peat-covered lacustrine basins. The area is within a critical staging and feeding ground for waterfowl; numerous fish inhabitat the adjacent ocean. Raptors may nest along the cliffs.

MATERIAL

Deposit Y78 contains excellent to good quality granular material consisting of stratified, well graded, fine to coarse gravel with some sand. A few beds are poorly graded or silty. Rare wood

fragments and lenses of woody detritus are also present. A major oxidized zone was noted about 25 feet below the top of the gravel. Larger clasts in the deposit are mainly subrounded sandstone with rare black chert. Excavations at Shingle Point indicate these gravels are low in ice contents and are easy to excavate.

VOLUME

The total calculated volume of the deposit of 14,000,000 cubic yards could be increased by adding large volumes of gravel underlying thicker overburden in the inland direction.

Annually, 16,000 cubic yards could be extracted by conventional techniques per 1000 foot length of scarp, although periodic need to remove overburden might reduce this figure.

DEVELOPMENT

Development of Deposit Y78 would involve excavating gravel from the face and crest of scarps. Significant overburden would need to be removed as the pit expanded inland. Retrogressive thaw flow slides would necessarily develop and aid in overburden removal. The escarpment along the Running River and a couple of minor ravines offer local sites for pit development that do not directly border the coast.

Winter access to this deposit would be relatively easy. Material could be easily hauled inland along the Running River valley.

Before development, the crest of the escarpment would need to be checked for graves and artifacts as the area is known to be subject to intense historic and prehistoric Eskimo activity; grave markers and cabin ruins were noted near the eastern end of the deposit. Development

should also be planned to minimize interference with the waterfowl staging and fish populations of adjacent waters. This deposit lies within the proposed Arctic Wildlife Range, which may restrict development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
	Pt	? ? ? ?	PEAT - silty, little sand and rounded gravel. 0.7		UF		
1	CH		CLAY - high plastic. frozen at 1.4' 1.4			1.4	
2			Bottom of Pit				No sample taken.

DATE: Sept. 27, 1976	LOGGED BY: GCD	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y78-A

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
	CI		CLAY - silty, medium plastic, some sub-rounded gravel to 3" size.		UF		Lightweight Pieces - Fine Aggregate: 0.26%
			3.0				
5	GW		GRAVEL - well graded to 3" size, some fine to coarse sand, subangular to subrounded, black, sandstones.				
			8.5				
10	GM		GRAVEL - well graded to 3" size, some sand, little silty fines, sub-angular to subrounded, black.				
			13.5				
	GP		15.0 GRAVEL - fine to ½" size, and coarse sand.				
15	GM		GRAVEL - well graded to 2" size, and fine to coarse sand, alternating layers of clean and silty.				
			20.0				
20	GW		GRAVEL - well graded to 6" cobbles, and fine to coarse sand, subrounded.				
25							
30							
			32.0				
	SP		33.0 SAND - fine.				
35	GW		GRAVEL - well graded to 2" size, and fine to coarse sand.				
40							
45							5' to bottom of exposure from bottom of pit, covered by sloughed sediment.
			50.0				
50			Bottom of Pit				Sample from 3.0'-50.0'
55							

DATE: Sept. 27, 1976	LOGGED BY: GCD	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y78-B(e)

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
0			Overburden, partially slumped.		UF		Lightweight Pieces - Fine Aggregate: 0.12%
20.0	GW		GRAVEL - well graded, some medium to coarse sand, occasional 1" layer of fine silty sand, occasional cobble, subangular, medium brown, damp, sandstones, cherts, occasional 6" thick oxidized layers below 24.5', reddish brown.				
24.5							
30.0						30.0	Exposure covered by mud slide, approx. 12' above sea level.
			Bottom of Pit				Sample from 20.0'-30.0'

DATE: Sept. 27, 1976	LOGGED BY: JDF	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y78-C(e)

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
0	Pt		PEAT - fibrous, brown, wet.		UF		Lightweight Pieces - Fine Aggregate: 0.25%
		2.0					
	CL		CLAY - silty, some sand and gravel to 3" size, low plastic, brown, moist.				Gravel present at higher levels, but covered by thin layer of clay slumping down bank.
5							
10							
15							
20							
25		26.0					
	GW		GRAVEL - well graded to 2" size, and fine to coarse sand, medium dense, grey-brown, moist.				
30							
35		36.5	oxidized layer, decreasing sand content.				
40							
45							
		48.0	unoxidized, increasing sand content.				
50							
55							
		58.0					
60			Bottom of Pit				Sample 1, 36.5'-48.0' Sample 2, 48.0'-58.0'

DATE: Oct. 6, 1976	LOGGED BY: SA	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y78-D(e)

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
0	Pt		PEAT - fibrous, brown, moist.		UF		
1.0							
1	ML		SILT - low plastic, clayey, trace organics, brown, wet.		Vr 30%	1.6	
2.0							
2			Bottom of Pit				No sample taken
3							

DATE: Oct. 10, 1976	LOGGED BY: SA	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

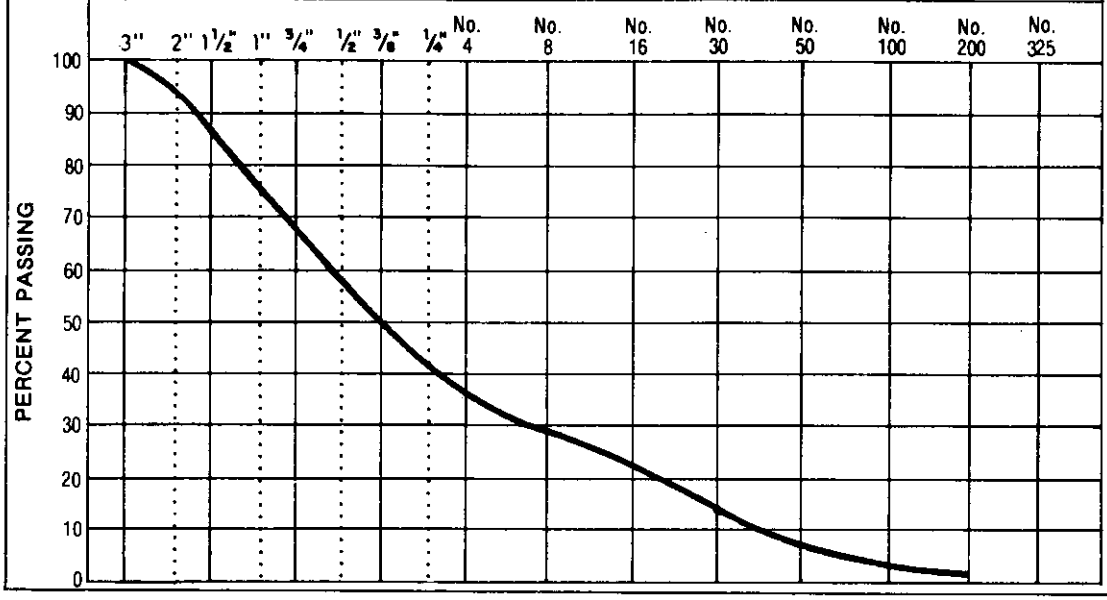
TEST PIT NO. Y78-E

SHEET 1 OF 1

GRAIN SIZE ANALYSIS

SAMPLE Y78-B(e) DEPTH 3.0'-50.0'
DATE SAMPLED Sept. 27, 1976 SAMPLED BY GCD
LAB TEST NUMBER 93HA-B

GRAVEL SIZES		SAND SIZES			FINES
30.8 %	33.2 %	8.0 %	19.3 %	6.5 %	2.2 %
COARSE	FINE	COARSE	MEDIUM	FINE	

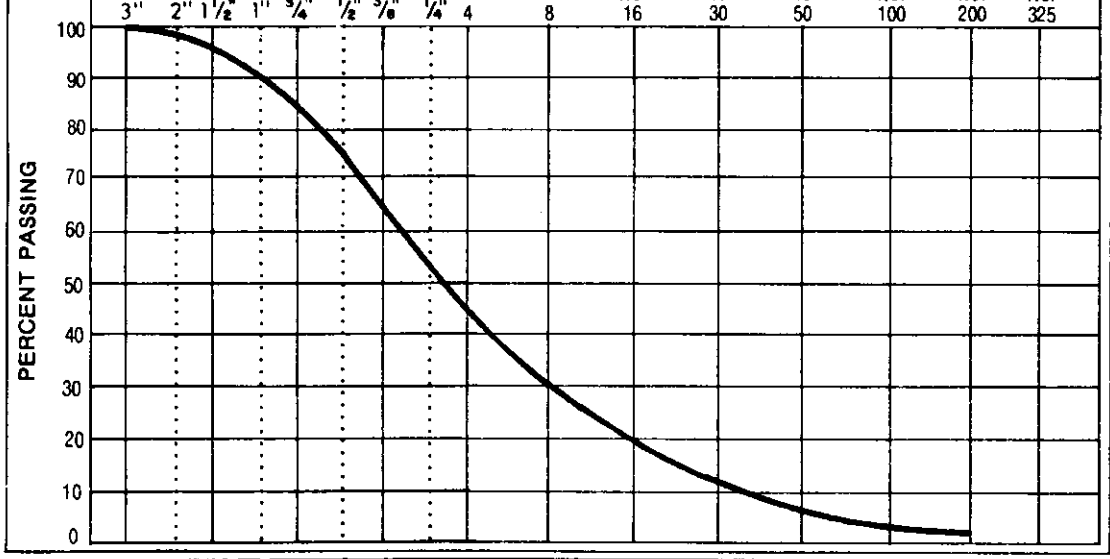


MAX. SIZE	% > 3"
4"	2.0

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	94.0
1 1/2"	85.8
1"	76.2
3/4"	69.2
1/2"	58.3
3/8"	50.4
1/4"	
No. 4	36.0
No. 8	30.5
No. 16	22.2
No. 30	13.2
No. 50	6.1
No. 100	3.1
No. 200	2.2

SAMPLE Y78-C(e) DEPTH 20.0'-30.0'
DATE SAMPLED Sept. 27, 1976 SAMPLED BY JDF
LAB TEST NUMBER TP94

GRAVEL SIZES		SAND SIZES			FINES
14.7 %	40.7 %	17.6 %	18.5 %	6.2 %	2.3 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
3"	0

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	99.0
1 1/2"	97.0
1"	90.2
3/4"	85.3
1/2"	74.1
3/8"	64.4
1/4"	
No. 4	44.6
No. 8	29.9
No. 16	20.4
No. 30	13.3
No. 50	6.0
No. 100	3.1
No. 200	2.3

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

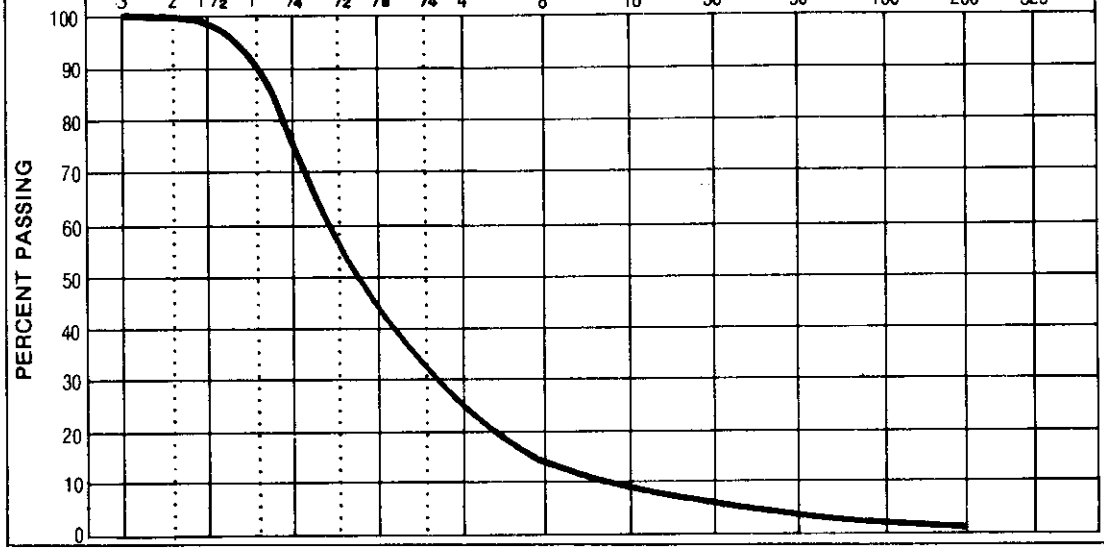
R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No. Y78

GRAIN SIZE ANALYSIS

SAMPLE Y78-D(e)-1 DEPTH 36.5'-48.0'
DATE SAMPLED Sept. 6, 1976 SAMPLED BY SA
LAB TEST NUMBER 95HA-A-1

GRAVEL SIZES		SAND SIZES			FINES
23.0 %	52.7 %	11.3 %	8.5 %	3.0 %	1.5 %
COARSE	FINE	COARSE	MEDIUM	FINE	

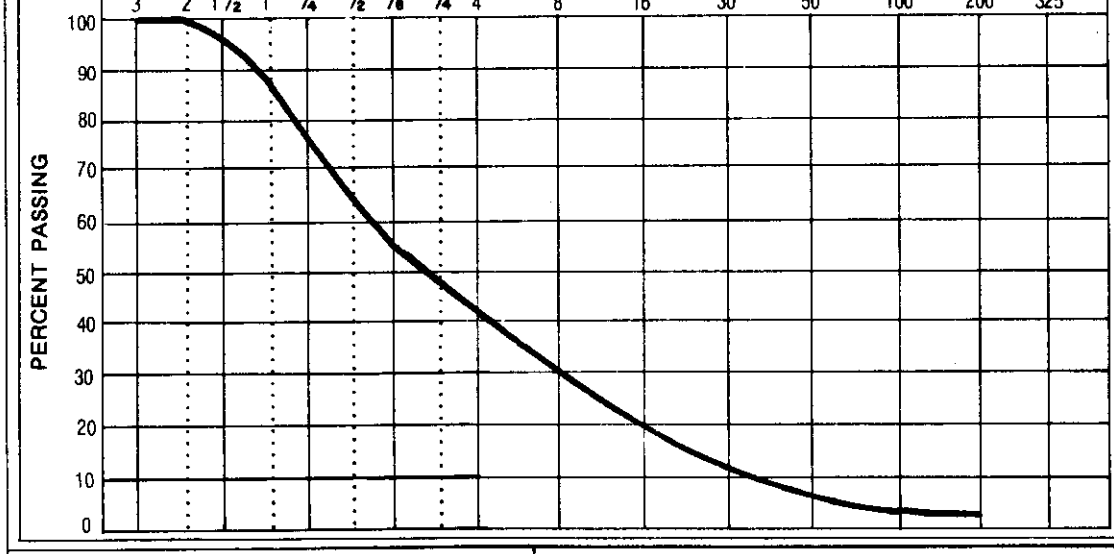


MAX. SIZE	% > 3"
2"	0

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	100.0
1 1/2"	99.2
1"	88.6
3/4"	77.0
1/2"	58.9
3/8"	44.5
1/4"	
No. 4	24.3
No. 8	15.1
No. 16	10.0
No. 30	6.2
No. 50	3.0
No. 100	2.1
No. 200	1.5

SAMPLE Y78-D(e)-2 DEPTH 48.0'-58.0'
DATE SAMPLED Sept. 6, 1976 SAMPLED BY SA
LAB TEST NUMBER 95HA-A-2

GRAVEL SIZES		SAND SIZES			FINES
21.2 %	36.9 %	14.9 %	18.5 %	5.9 %	2.6 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
2"	0

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	100.0
1 1/2"	95.2
1"	87.5
3/4"	78.8
1/2"	65.4
3/8"	55.3
1/4"	
No. 4	41.9
No. 8	29.9
No. 16	20.7
No. 30	12.6
No. 50	6.1
No. 100	3.5
No. 200	2.6

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No.
Y78

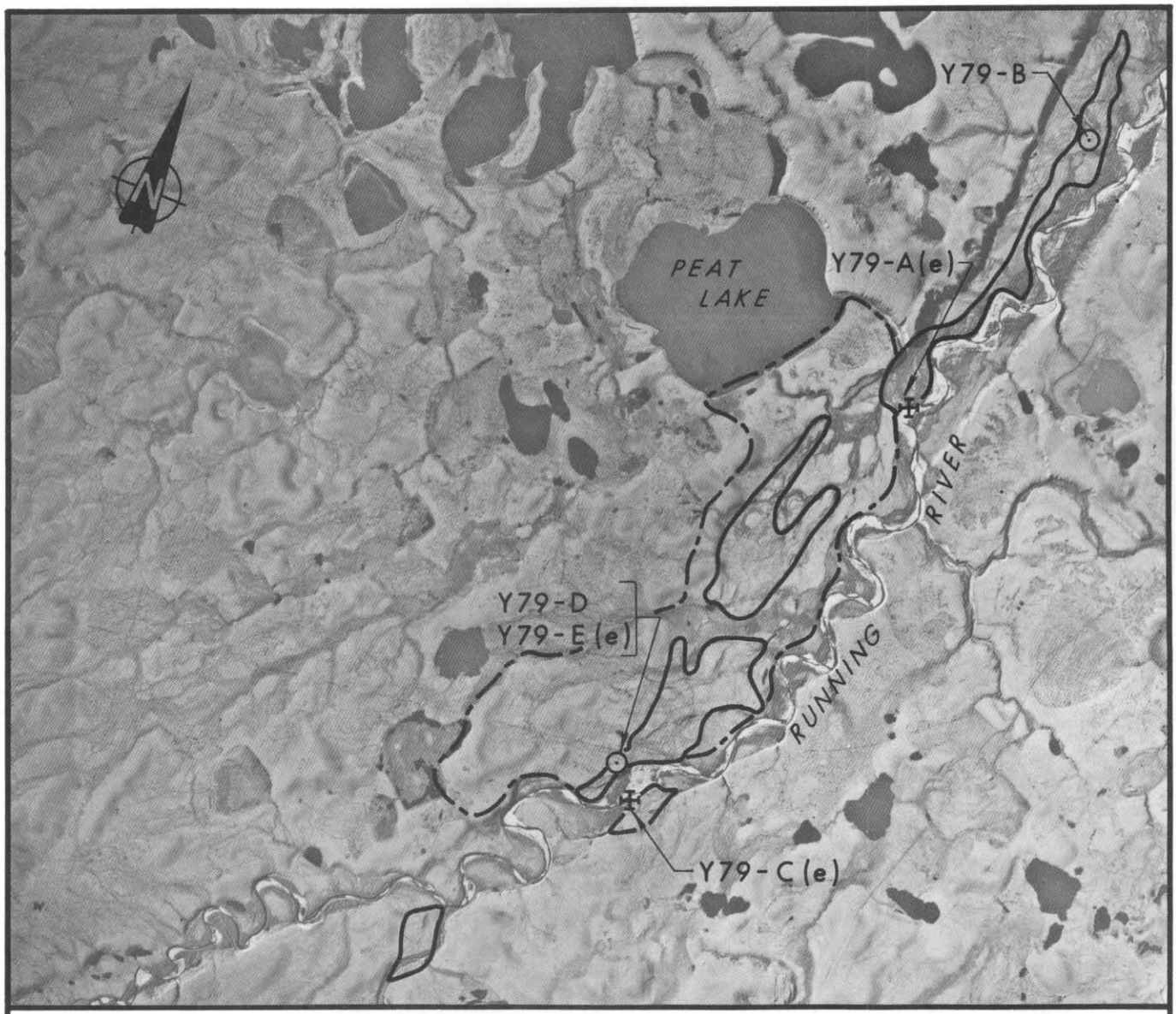
DEPOSIT Y79

Setting: Fluvial terraces along the lower reaches of the Running River.

Material: Gravel; well graded, fine to coarse, some sand.

Volume: 44,000,000 cubic yards total.

Assessment: Contains good quality granular material. Permafrost and ground water will limit development. Extraction will be easiest along scarps. Good access to this deposit is available along the Running River.



Airphoto No.: A22975-146		Approx. Scale:	1"=4900'
Deposit Outline - R.M. Hardy	———	Test Pit	⊙
Deposit Outline - Others	—·—·—	Exposures	✢

DEPOSIT Y79

SETTING

Deposit Y79 consists of fluvial terraces along the lower reaches of Running River. Numerous terraces stand 5 to 50 feet above the level of the Running River floodplain; their surfaces are broken by a number of 5 to 30 foot high scarps. The terraces slope gently to the north. A few channel traces on the surfaces give a local relief of 2 to 4 feet. This deposit has been designated as Source Area 4 in a previous investigation by Klohn Leonoff Consultants Ltd.

Only terrace surfaces that have major areas free of overburden and that are at least moderately well-drained over most of their area have been included in Deposit Y79. However, parts of the terraces will have overburden comprised of organic silty sand and peat up to 10 feet thick and may be poorly drained. Near scarp edges, terraces are well drained and completely free of overburden.

The thickness of the active layer under exposed portions of the terrace was not determined, but is estimated to exceed 6 feet. Active layers under surfaces having any overburden were 1½ to 3 feet thick.

Better drained parts of Deposit Y79 are covered either by a broken turf supporting heath-like tundra with numerous small shrubs and lichen or by willow shrubbery to 8 feet. Poorly drained areas are covered either by tundra consisting mainly of mosses, lichens, and a few small shrubs or by sedge tussock tundra. This area is a critical staging area for waterfowl, particularly snow geese, and provides habitat for Arctic fox and grizzly bear.

The terrace system comprising Deposit Y79 is bordered by poorly drained, peat-covered lacustrine deposits and rolling morainal deposits. The downstream part of the deposit lies within a broad canyon incised by the Running River. Running River is used by Arctic grayling and other fish populations.

MATERIAL

Deposit Y79 contains good quality granular material consisting of stratified, well-graded, fine to coarse gravel with some sand. Some beds are cobbly and contain occasional boulders to 12 inches in size. A few thin silty and sandy beds are present within the sequence. Larger clasts are mainly subrounded to subangular sandstone with rare chert and conglomerate. Shale comprises a large part of the fines.

VOLUME

The total volume of 44,000,000 cubic yards is based on a conservative depth of 30 to 45 feet for different gravel strata. Gravel under these terraces is known to generally exceed 40 feet in thickness. Annually, 14,000 cubic yards per acre could be extracted by conventional techniques assuming that ground water will limit the extractable depth of granular materials to an average depth of 4 to 6 feet. Greater thicknesses will be available on an annual basis from well-drained and overburden-free parts of the terraces.

DEVELOPMENT

Depth of extraction will be limited by the permafrost and ground water tables, with the deepest extraction being near the scarps. Pits developed near scarps will be easily restored to acceptable grades, whereas those developed on low poorly-drained flat areas will become water-filled ponds when abandoned.

Good access to Deposit Y79 is available along the Running River. Travel in an east-west direction will have to be carried out with caution because the adjacent terrain is susceptible to thermo-karsting.

Development should be planned to minimize interference with staging activities of waterfowl.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
	Pt	???	0.3 PEAT		UF		Lightweight Pieces - Fine Aggregate: 0.05%
1	GW		GRAVEL - well graded, some fine to coarse sand, occasional cobble to 6" size, subangular, grey, dry, rootlets.				
			1.4 — damp below 1.4'				
2							
3							
4							
5							
6			6.0 — saturated.				
7			7.4 ▽ free water at 7.4'			7.4	
			Bottom of Pit				Sample from 1.4'-7.4'
8							

DATE: Sept. 27, 1976	LOGGED BY: JDF	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y79-A(e)

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
	Pt		PEAT - fine, fibrous.		UF		
			0.5				
	CL		CLAY - silty, dark brown, moist.				
1			1.0				
	GW		GRAVEL - well graded, some sand, occasional cobbles, subrounded to rounded, wet. ▽				
			1.5				
			Bottom of Pit				Sample from 1.0'-1.5'
2							

DATE: Oct 1, 1976	LOGGED BY: CPM	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y79-B

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	GW		GRAVEL - well graded to 3" size, and fine to coarse sand, in 2" layers, subangular to subrounded.		UF		Lightweight Pieces - Fine Aggregate: 0.05%
2			2.0				
	SP		SAND - fine to medium, 1" layer of fine gravel to ½" size.				
			2.4				
3	GW		GRAVEL - 1½" maximum size, some fine to coarse sand, subangular to sub-rounded, sandstones.				
4							
			4.5 — — increasing in size to 7" cobbles.				
5							
6							
7							
			7.4 — — decreasing to 3" maximum size.				
8							
9							
10							river level 2' below bottom of pit.
11			11.0				
			Bottom of Pit				Sample from 0'-11.0'
12							

DATE: Sept. 27, 1976	LOGGED BY: GCD	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y79-C(e)

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	Pt		PEAT - fibrous, brown. 1.0		UF		
	ML		SILT - firm, brown, wet.				
2			- frozen at 2.4'. 2.4			2.4	
3			Bottom of Pit				No sample taken.

DATE: Oct. 1, 1976	LOGGED BY: SA	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO.
Y79-D
SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
10	GW		GRAVEL - well graded to 3" size, some fine to coarse sand, trace silty fines, subrounded to rounded, medium dense, grey-brown, wet.		UF		Lightweight Pieces - Fine Aggregate: 0.69%
			16.5				
	ML		SILT - trace sand and gravel, clayey firm, grey-brown, wet.				
20			19.5				
	GM-SM		GRAVEL AND SAND - well graded to 3" size, little silty fines, sub-rounded to rounded, medium dense, wet, predominantly shale particles.				
30			38.0				
	GW		GRAVEL - well graded to 3" size, little sand, subrounded to rounded, medium dense, wet, some platy rock.				
40			47.0				
			Bottom of Pit				Sample from 10.0'-15.0'
50							

DATE: Oct. 1, 1976	LOGGED BY: SA	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y79-E(e)

SHEET 1 OF 1

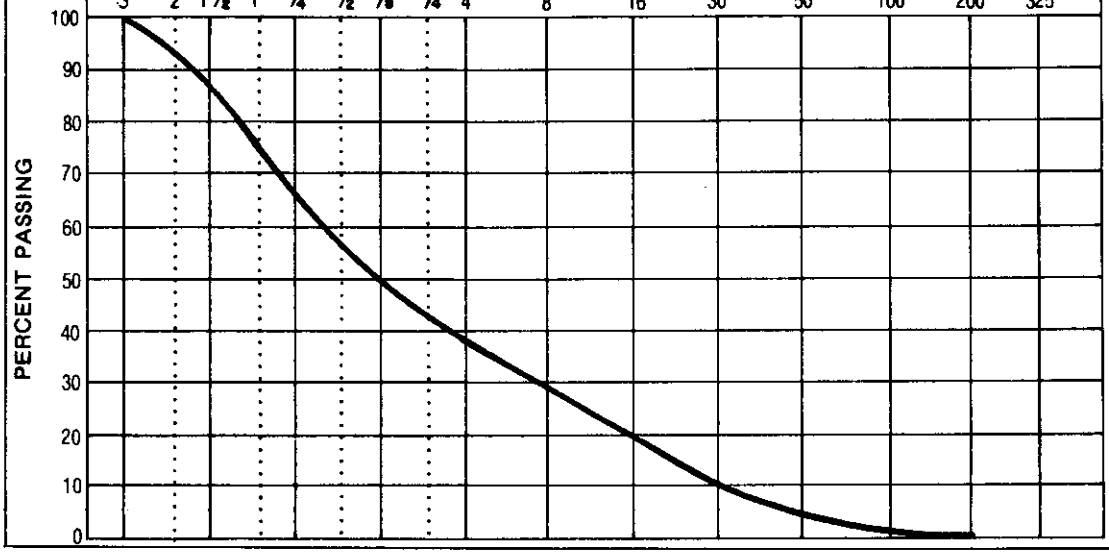
GRAIN SIZE ANALYSIS

SAMPLE Y79-A(e) DEPTH 1.4'-7.4'

DATE SAMPLED Sept. 27, 1976 SAMPLED BY JDF

LAB TEST NUMBER TP81

GRAVEL SIZES		SAND SIZES			FINES
34.2 %	27.0 %	10.3 %	21.5 %	5.1 %	1.9 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
4"	10.9

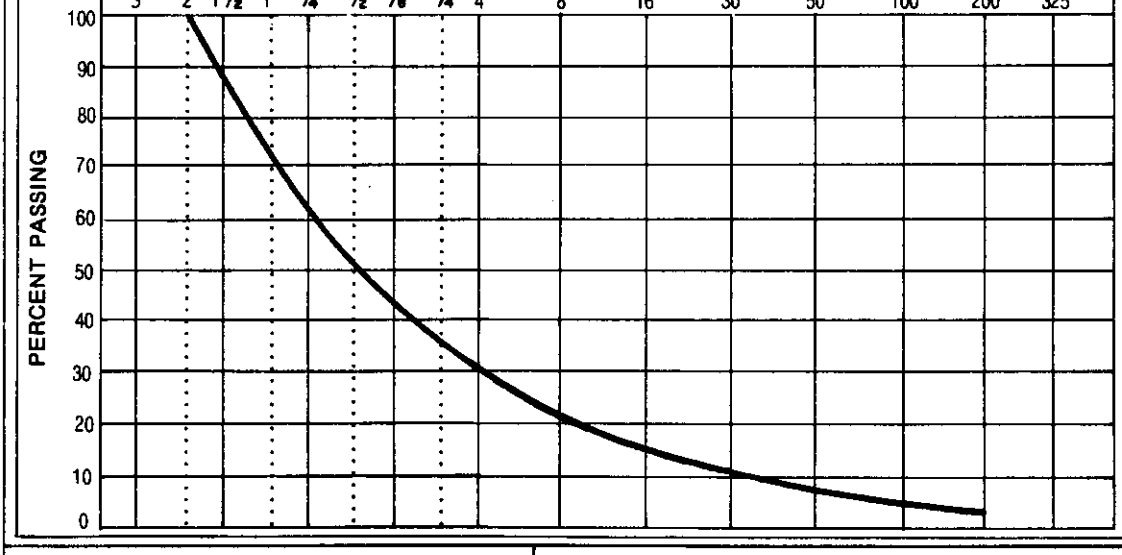
SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	95.7
1 1/2"	88.0
1"	75.9
3/4"	65.8
1/2"	58.8
3/8"	51.6
1/4"	
No. 4	38.8
No. 8	32.4
No. 16	22.2
No. 30	11.2
No. 50	4.3
No. 100	2.5
No. 200	1.9

SAMPLE Y79-B DEPTH 1.0'-1.5'

DATE SAMPLED Oct. 1, 1976 SAMPLED BY CPM

LAB TEST NUMBER 83HA

GRAVEL SIZES		SAND SIZES			FINES
37.4 %	32.3 %	10.3%	11.5 %	4.8 %	3.7 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
2"	0

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	100.0
1 1/2"	83.6
1"	72.7
3/4"	62.6
1/2"	50.8
3/8"	43.1
1/4"	
No. 4	30.3
No. 8	23.4
No. 16	16.6
No. 30	10.9
No. 50	7.3
No. 100	4.8
No. 200	3.7

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

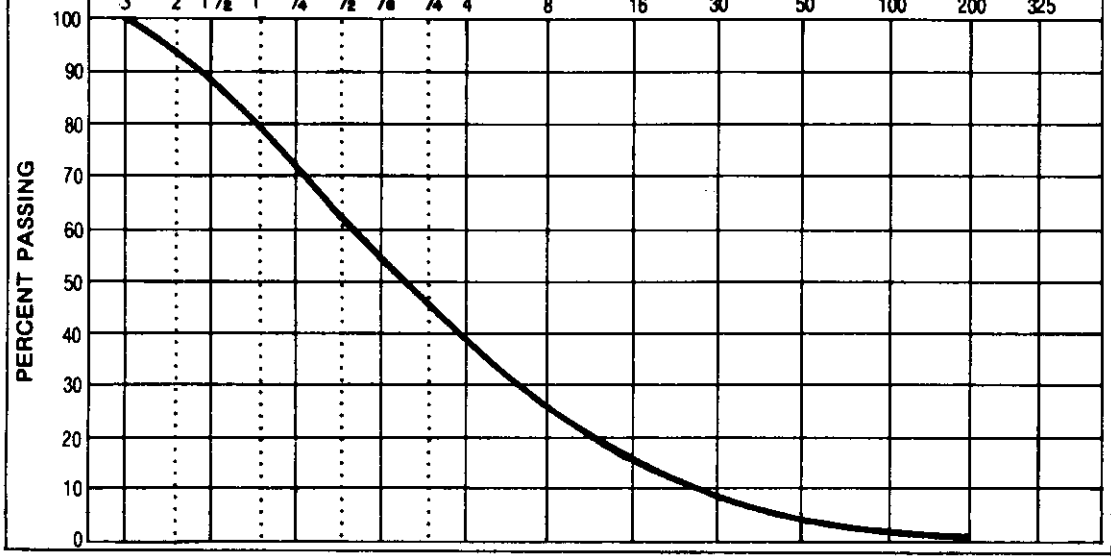
R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No. Y79

GRAIN SIZE ANALYSIS

SAMPLE Y79-C(e) DEPTH 0'-11.0'
DATE SAMPLED Sept. 29, 1976 SAMPLED BY GCD
LAB TEST NUMBER 85HA

GRAVEL SIZES		SAND SIZES			FINES
26.1 %	34.9 %	15.5 %	16.5 %	5.7 %	1.3 %
COARSE	FINE	COARSE	MEDIUM	FINE	

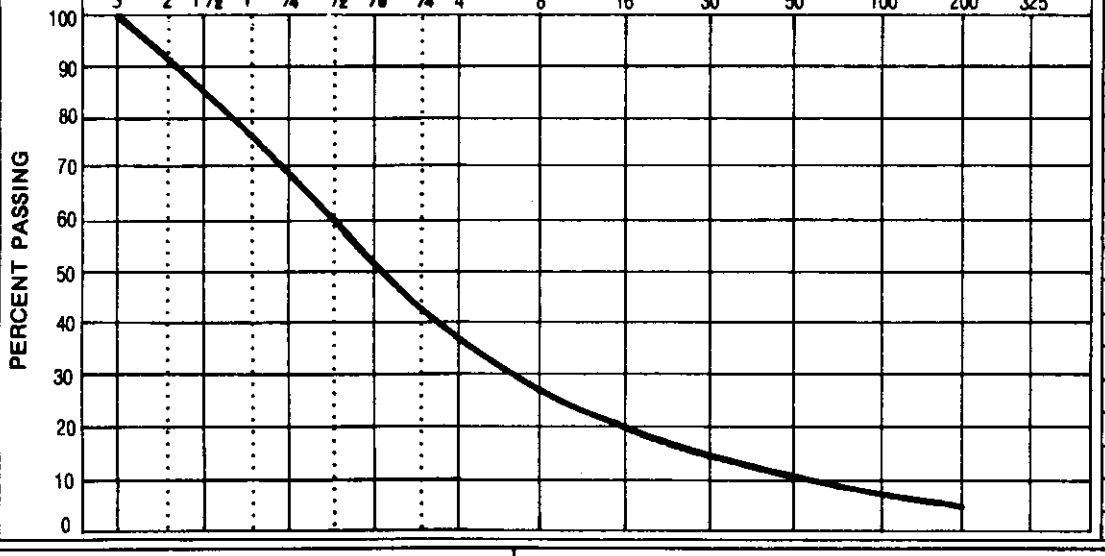


MAX. SIZE	% > 3"
4"	17

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	100.0
1 1/2"	91.7
1"	81.7
3/4"	73.9
1/2"	62.7
3/8"	54.6
1/4"	
No. 4	39.0
No. 8	27.1
No. 16	17.0
No. 30	8.5
No. 50	3.1
No. 100	1.6
No. 200	1.3

SAMPLE Y79-E(e) DEPTH 10.0'-15.0'
DATE SAMPLED Oct. 1, 1976 SAMPLED BY SA
LAB TEST NUMBER 86HA

GRAVEL SIZES		SAND SIZES			FINES
28.6 %	34.2 %	10.7 %	12.5 %	9.5 %	4.5 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
3"	0

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	94.2
1 1/2"	87.6
1"	77.9
3/4"	71.4
1/2"	60.2
3/8"	52.2
1/4"	
No. 4	37.2
No. 8	28.8
No. 16	21.0
No. 30	15.3
No. 50	10.3
No. 100	6.2
No. 200	4.5

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

DEPOSIT No. Y79

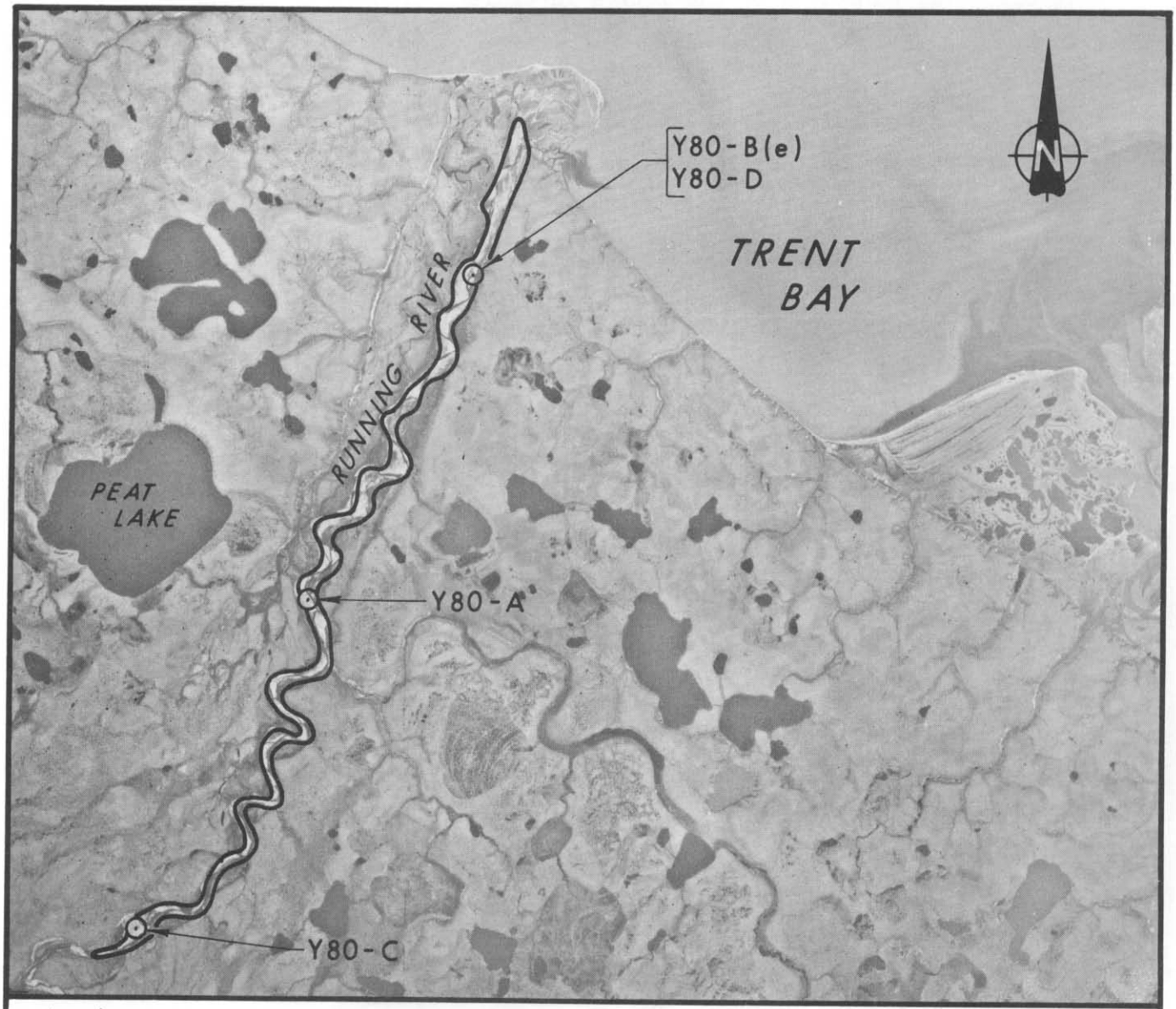
DEPOSIT Y80

Setting: Active floodplain of Running River.

Material: Gravel; well graded, fine to coarse, some sand.

Volume: 22,000,000 cubic yards total.

Assessment: Contains good quality granular material; significant oversize on upper reaches. Extraction will be limited by ground water levels. Natural fluvial processes will restore pit areas. East-west access is limited by terrain susceptible to thermokarst. Access to the coast is good.
Recoverable volume may be limited to 2,400,000 cubic yards.



Airphoto No.: A13751-32
Deposit Outline - R.M. Hardy
Deposit Outline - Others
Approx. Scale: 1"=5700'
Test Pit
Exposures

DEPOSIT Y80

SETTING

Deposit Y80 is the active floodplain of the Running River consisting mainly of vegetation-free point bars and islands. Scour holes and channel traces give the floodplain local relief of 1 to 2 feet. The Running River is confined to one or two channels at low water.

The deposit is well-drained and free of overburden. Approximately one-half of the floodplain is more than 3 feet above low water levels. The thickness of the active layer is estimated to exceed 8 feet.

A few tufts of vegetation including isolated shrubs and driftwood are present on the floodplain. Running River is a migration route and spawning area for Arctic grayling. The lower reaches are used as a feeding area for a number of other fish species.

Deposit Y80 is immediately bordered by low, well to poorly drained terraces. The terraces lie within a broad canyon at its northern end, and are flanked by ice-rich morainal deposits and poorly-drained peat-covered glaciofluvial and lacustrine deposits at its southern end. This terrain provides critical staging and feeding areas for lesser snow geese, and adequate habitat for grizzly bear and Arctic fox. Isolated moose browse on willows on low terraces.

MATERIAL

Deposit Y80 contains good quality granular material consisting of stratified, fine to coarse, well graded gravel with some sand. Cobbles to 8 inches are common; oversize forms a significant component on upper reaches. Vegetated islands within the floodplain have a 1 to 2 foot thick cover of fine-grained silty sand. Larger clasts are mainly

subangular to rounded sandstone with rare quartz, chert, and conglomerate. Shale is common in the fines.

VOLUME

The total volume of 22,000,000 cubic yards is based on a conservative depth of 30 feet. Gravel under the adjacent low terraces is known to vary between 40 and 50 feet in thickness.

Annually, 53,000 cubic yards per 1000 foot length of floodplain can be extracted by conventional techniques assuming that static ground water levels limit the extractable granular material to an average depth of 3 feet. Volume of recoverable material may be limited to 2,400,000 cubic yards because of static ground water conditions.

DEVELOPMENT

Extraction of material from Deposit Y80 should be confined to summer and fall when water levels are low. Large areas will be required for comparatively small volumes because of shallow ground water unless special drainage controls are undertaken. Adequate areas for stockpiling are available.

The developed pit areas would fill through natural fluvial processes as streams of the coastal plain are known to move significant amounts of coarse sediment.

Access to this deposit is good from the coast along the stream course and its low terrace. Hauling in a east or west direction would involve climbing a scarp near the northern end of the deposit and crossing poorly-drained terrain susceptible to thermokarst.

Development of Deposit Y80 should be planned to minimize interference with staging activities of snow geese and migration or spawning of Arctic grayling. Deposit Y80 lies within the proposed Arctic Wildlife Range, which may restrict development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	GW		GRAVEL - well graded to 4" cobbles, some fine to coarse sand, medium brown, damp, clean.		UF		Lightweight Pieces - Fine Aggregate: 0.05%
2							
3			30/32 - fine sand layer.				
4			40 wet.				
			45 ▽ free water.				
5			Bottom of Pit				Sample from 0'-4.5'

DATE: Sept. 27, 1976	LOGGED BY: JDF	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y80-A

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
0	GW		GRAVEL - well graded, some fine to coarse sand, subrounded to rounded, platy, dense, brown, moist, clean.		UF		
1							
2							
3							
4			4.0 ▽ - river level at 4.0'				
			Bottom of Pit				Sample from 0'-4.0'
5							

DATE: Oct. 1, 1976	LOGGED BY: SA	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO.
Y80-B(e)

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
0	GW		GRAVEL - well graded to 12" boulders, little fine to coarse sand, sub-angular to subrounded, igneous rocks, sandstones, fine gravel cementations, clean.		UF		Moisture Content: 2.2%
1							Lightweight Pieces - Fine Aggregate: 0.06%
2							
3							
4							
5			5.7				hole sloughing in.
6			Bottom of Pit				Sample from 0'-5.7'

DATE: Sept. 27, 1976	LOGGED BY: GCD	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO.
Y80-C

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
	SM		SAND - fine, silty, organic, rootlets, grey-brown, wet.		UF		Organic Color: #5+
0.5							
	GW		GRAVEL - well graded to 2½" size, some fine to coarse sand, layered, subrounded to rounded, grey-brown, wet.				Lightweight Pieces -
1							Fine Aggregate: 0.07%
2							
3							
4.0							
4			Bottom of Pit				Sample from 0.5'-3.5'
5							

DATE: Oct. 1, 1976	LOGGED BY: SA	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO.
Y80-D
SHEET 1 OF 1

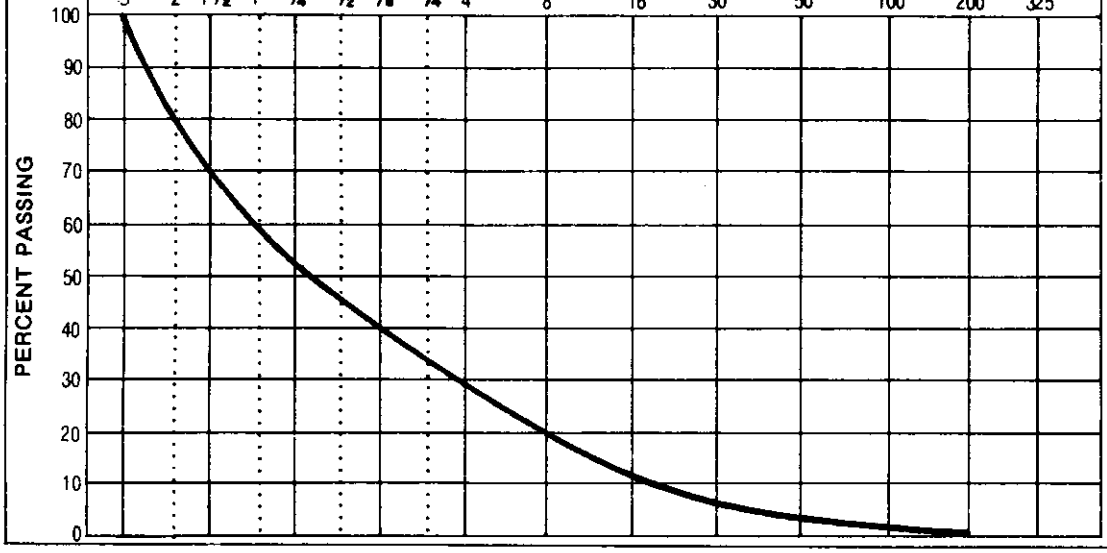
GRAIN SIZE ANALYSIS

SAMPLE Y80-A DEPTH 0'-4.5'

DATE SAMPLED Sept. 27, 1976 SAMPLED BY JDF

LAB TEST NUMBER TP82

GRAVEL SIZES		SAND SIZES			FINES
47.5 %	23.2 %	11.9 %	12.9 %	4.0 %	0.5 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
4"	15.4

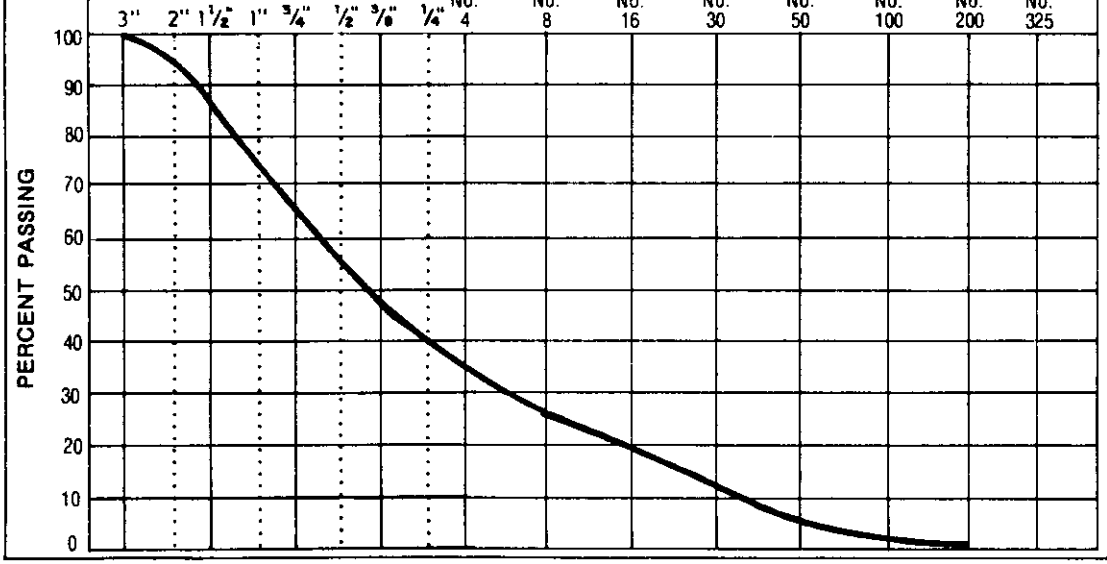
SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	79.9
1 1/2"	69.6
1"	59.4
3/4"	52.5
1/2"	45.5
3/8"	39.5
1/4"	
No. 4	29.3
No. 8	18.8
No. 16	12.3
No. 30	6.2
No. 50	2.2
No. 100	1.1
No. 200	0.5

SAMPLE Y80-B(e) DEPTH 0'-4.0'

DATE SAMPLED Oct. 1, 1976 SAMPLED BY SA

LAB TEST NUMBER 78HA

GRAVEL SIZES		SAND SIZES			FINES
35.0 %	31.6 %	8.4 %	17.0 %	6.9 %	1.1 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
3"	0

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	95.7
1 1/2"	87.1
1"	75.0
3/4"	65.0
1/2"	54.3
3/8"	46.4
1/4"	
No. 4	33.4
No. 8	26.5
No. 16	19.7
No. 30	12.3
No. 50	5.0
No. 100	1.8
No. 200	1.1

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

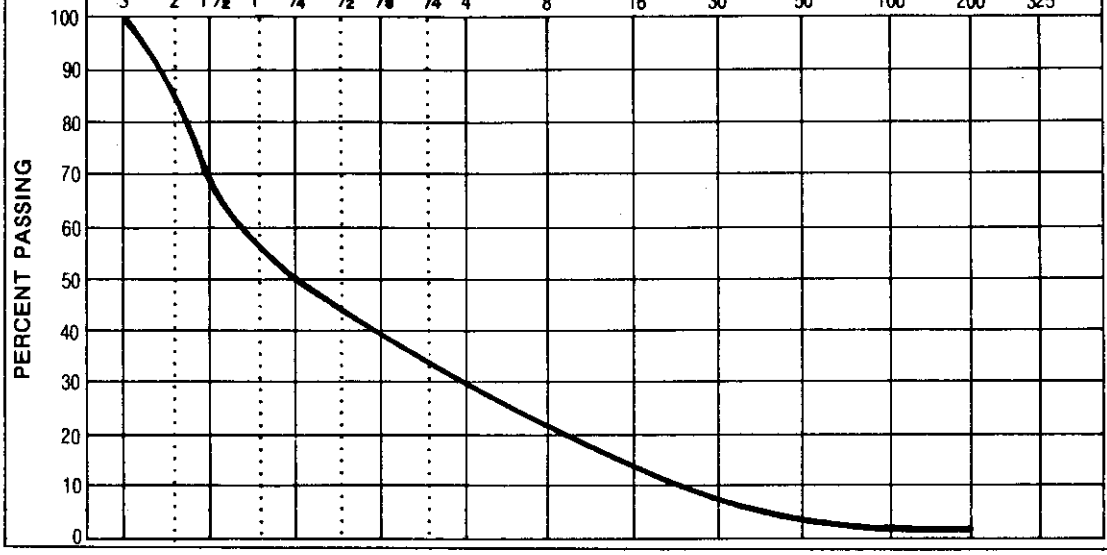
R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No. Y80

GRAIN SIZE ANALYSIS

SAMPLE Y80-C DEPTH 0'-5.7'
DATE SAMPLED Sept. 27, 1976 SAMPLED BY GCD
LAB TEST NUMBER 84HA

GRAVEL SIZES		SAND SIZES			FINES
49.9 %	22.2 %	7.9 %	12.0 %	6.8 %	1.2 %
COARSE	FINE	COARSE	MEDIUM	FINE	

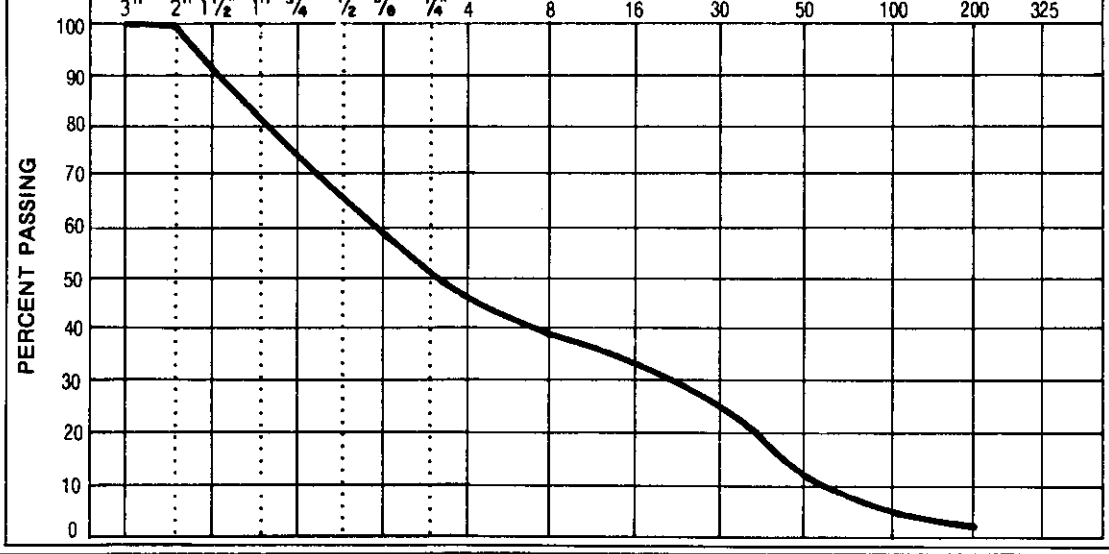


MAX. SIZE	% > 3"
5"	45.1

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	86.1
1 1/2"	67.0
1"	56.1
3/4"	50.1
1/2"	42.8
3/8"	37.8
1/4"	
No. 4	27.9
No. 8	20.9
No. 16	13.6
No. 30	7.6
No. 50	3.9
No. 100	1.6
No. 200	1.2

SAMPLE Y80-D DEPTH 0.5'-3.5'
DATE SAMPLED Oct. 2, 1976 SAMPLED BY SA
LAB TEST NUMBER TP79

GRAVEL SIZES		SAND SIZES			FINES
24.0 %	30.6 %	7.9 %	20.0 %	14.6 %	2.9 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
2"	0

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	100.0
1 1/2"	90.1
1"	82.4
3/4"	76.0
1/2"	66.9
3/8"	59.4
1/4"	
No. 4	45.4
No. 8	39.6
No. 16	33.4
No. 30	25.9
No. 50	12.3
No. 100	5.4
No. 200	2.9

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No. Y80

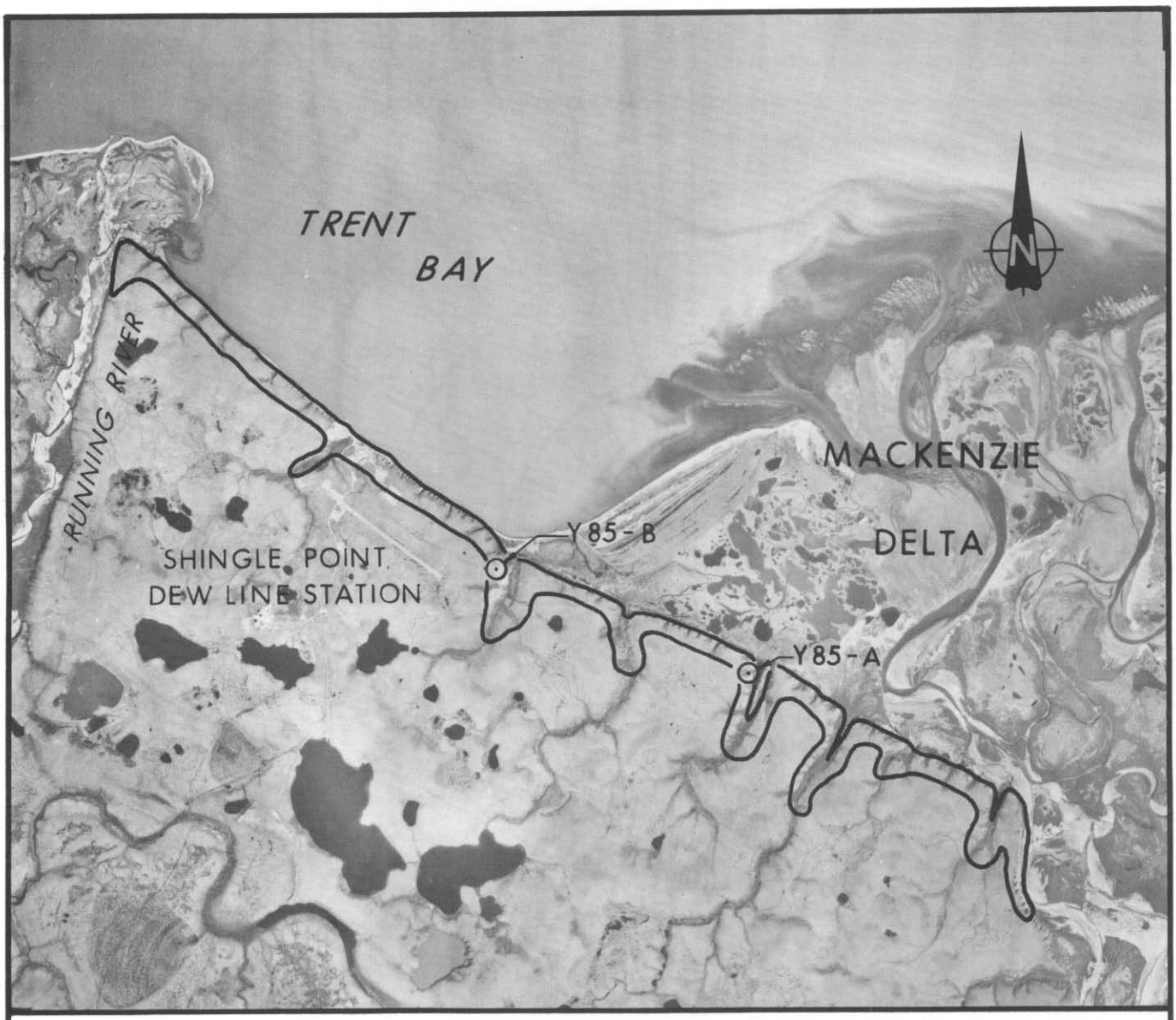
DEPOSIT Y85

Setting: Exposed preglacial fluvial gravels along a coastal escarpment between the Running and Blow Rivers.

Material: Gravel; well graded, some sand.

Volume: 76,000,000 cubic yards total.

Assessment: Contains good to excellent quality granular material. Borrow pits may be easily developed along the escarpment, especially where the overburden is thin. Access is good.



Airphoto No.: A23828-26		Approx. Scale: 1"=5000'	
Deposit Outline - R.M. Hardy	———	Test Pit	⊙
Deposit Outline - Others	—·—·—	Exposures	✠

DEPOSIT Y85

SETTING

Deposit Y85 consists of preglacial gravels along a 60 to 100 foot high coastal escarpment along Trent Bay between the mouths of the Running and Blow Rivers. This deposit has been designated as 117A-B3 in a previous investigation by Northern Engineering Services Co. Ltd.

Coastal retreat has exposed the gravels, which extend below sea level and are overlain by ice-rich morainal deposits. Slumping along the edge of the escarpment has thinned, and possibly removed, overburden on the initial 30 to 150 feet on the upland crests adjacent to the scarp. A number of ravines, which interrupt the coastal escarpment also appear to have thin overburden at the top of their banks.

Where the overburden is thin, the ground is covered by tundra dominated by small shrubs, with numerous exposed gravel areas. Although these areas are well drained, small mounds, 10 to 15 feet across indicate some active periglacial development. Upland areas, removed from the escarpment have overburden probably exceeding 20 feet, have moderately good drainage and are covered by sedge tussocks with scattered ericaceous shrubs and low willow shrubs.

The escarpment is stabilized over most of its length. It is protected by a narrow gravel beach at its western end and by the Blow River delta at its eastern end. A few slumps have developed in the active layer on the north-facing escarpment. Shrubbery and vegetation indicate that snow banks persist in the late spring along the escarpment.

Inland the terrain consists of ice-rich rolling moraine. This area is within a staging area for waterfowl, mainly snow geese. A few raptors may nest along the cliffs. Numerous fish inhabit Trent Bay.

MATERIAL

Deposit Y85 contains good to excellent quality granular material consisting of stratified, well graded, fine to coarse gravel with some sand. Wood fragments and lenses of woody detritus were noted. Large clasts in the deposit are mainly subrounded sandstone with rare black chert. Shale particles are obvious in the fines.

Excavations at Shingle Point indicate that these gravels have low ice contents and are easily excavated.

VOLUME

Although the total volume of Deposit Y85 has been calculated at 76,000,000 cubic yards, this volume could be greatly increased if the quantity of gravels in the upland direction underlying thicker overburden were considered.

Annually, 24,000 cubic yards of gravel could be extracted by conventional techniques along each 1000 foot length of the scarp.

DEVELOPMENT

Development of Deposit Y85 would involve excavating gravel from the face and along the top of the escarpment. A significant quantity of overburden would need to be removed if the pit was developed for any distance inland. Slumps would be initiated in the ice-rich overburden if these areas were developed.

The banks and adjacent upland surface of ravines interrupting the main escarpment offer sites for pit development away from the coast. One pit is presently being developed at the east end of the DEW-line airstrip on the flank of a ravine.

Access to this deposit is excellent. Material could be hauled inland along the Running River or Blow River valleys.

Before development, the crest of the escarpment would need to be checked for graves or artifacts as the area is known to have been exploited by historic and prehistoric Eskimos. Development should also be planned to minimize interference with the staging activities of waterfowl or the fish population of adjacent waters.

Presently, the Department of National Defense leases part of the area covered by this deposit.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
	Pt		PEAT - fibrous, soft, brown, wet. 0.5		UF		Lightweight Pieces - Fine Aggregate: 0.06%
1	CI		CLAY - medium plastic, silty, little sand, little gravel to 4" cobbles, stiff, brown, moist.				
2			2.3 —— becoming very stiff, grey.				
3							
4			4.2				
	GW		GRAVEL - well graded to 2½" size, and medium to coarse sand, subrounded, medium dense, grey, moist.				
5							
6			6.0				
			Bottom of Pit				Sample from 4.5'-6.0'
7							

DATE: Oct. 7, 1976 | LOGGED BY: SA | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y85-A

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
	Pt	0.5	PEAT - fine, fibrous.		UF		Lightweight Pieces - Fine Aggregate: 0.29%
1	GC		GRAVEL - well graded to 3" size, little fine to coarse sand, little low to medium plastic clayey fines, occasional cobbles to 7", sub-angular to subrounded, brown, damp.				
2							
3							
4							
5		5.5					
	GW		GRAVEL - well graded to 3" size, and fine to coarse sand, occasional cobbles, subangular to sub-rounded.			5.9	
6		6.0			Vc-Vx 25%		Sample from 0.5'-6.0'
7							

DATE: Oct. 6, 1976	LOGGED BY: CPM	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y85-B

SHEET 1 OF 1

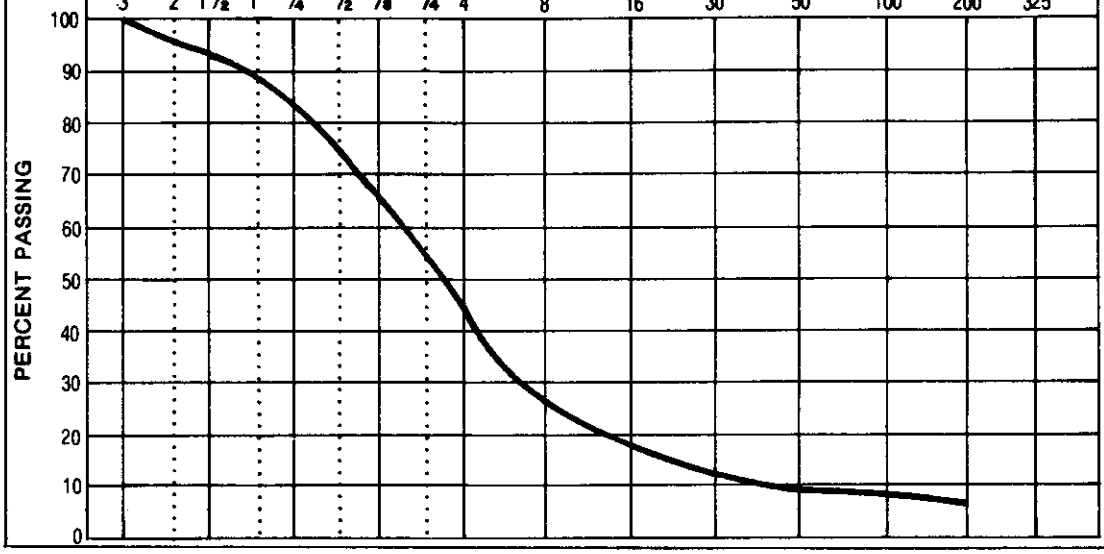
GRAIN SIZE ANALYSIS

SAMPLE Y85-A DEPTH 4.5'-6.0'

DATE SAMPLED Oct. 7, 1976 SAMPLED BY SA

LAB TEST NUMBER 135HA

GRAVEL SIZES		SAND SIZES			FINES
16.3 %	37.0 %	21.7%	14.1 %	4.5 %	6.4 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
3"	0

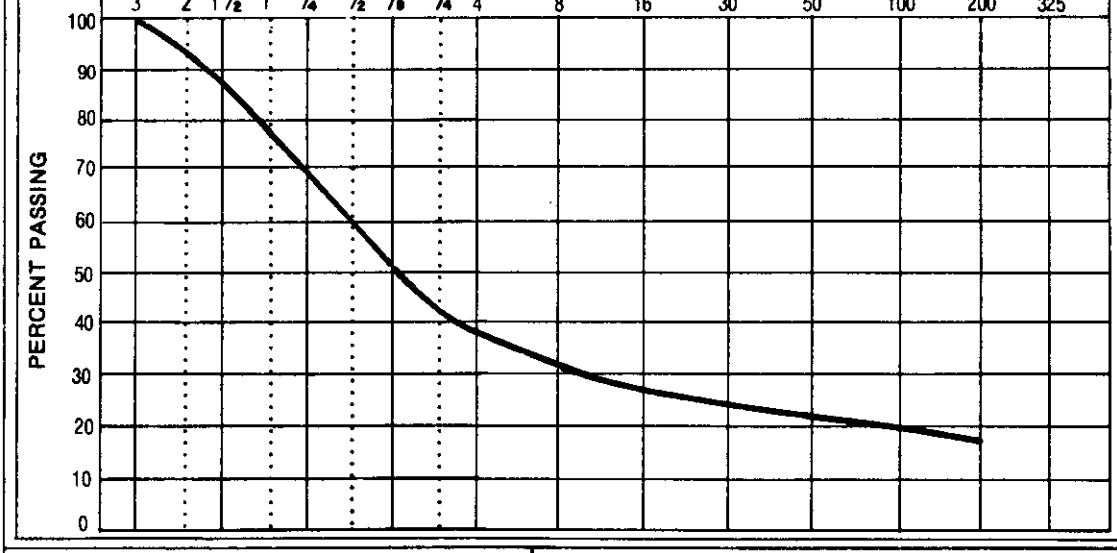
SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	97.1
1 1/2"	94.0
1"	89.8
3/4"	83.7
1/2"	74.0
3/8"	66.5
1/4"	
No. 4	46.7
No. 8	27.3
No. 16	18.1
No. 30	13.1
No. 50	9.8
No. 100	7.9
No. 200	6.4

SAMPLE Y85-B DEPTH 0.5'-6.0'

DATE SAMPLED Oct. 6, 1976 SAMPLED BY CPM

LAB TEST NUMBER 144HA

GRAVEL SIZES		SAND SIZES			FINES
29.8 %	35.0 %	4.7 %	7.5 %	6.1 %	16.9 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
3"	0

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	93.5
1 1/2"	88.4
1"	77.0
3/4"	70.2
1/2"	59.9
3/8"	51.4
1/4"	
No. 4	35.2
No. 8	31.5
No. 16	27.4
No. 30	24.5
No. 50	22.2
No. 100	19.7
No. 200	16.9

GOVERNMENT OF CANADA

DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.

CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No.

Y85

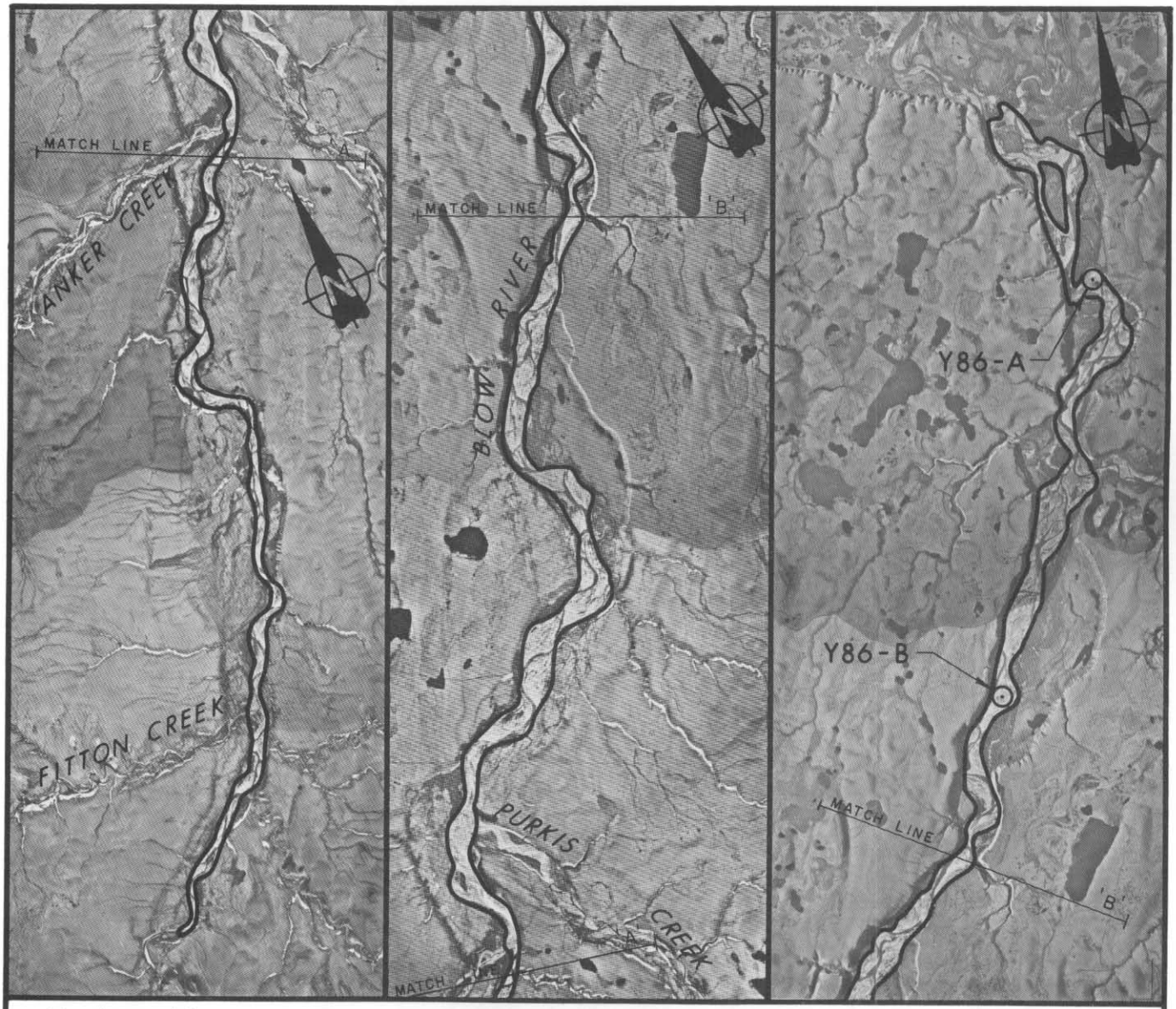
DEPOSIT Y86

Setting: Active floodplain of the Blow River.

Material: Gravel; well graded, fine to coarse, some fine to coarse sand.

Volume: 140,000,000 cubic yards total.

Assessment: Consists of fair to good quality granular material. High shale contents and oversize limit the quality. Recoverable quantities limited by water levels. Natural fluvial processes will restore developed areas. Access is limited to the fluvial system of the Blow River.
Recoverable volume may be limited to 31,000,000 cubic yards.



Airphoto No.: A22975-136,138; A27882-78,80,87,89
Approx. Scale: 1"=10,000'
Deposit Outline - R.M. Hardy
Test Pit
Deposit Outline - Others
Exposures

DEPOSIT Y86

SETTING

Deposit Y86 is the active floodplain of the Blow River consisting mainly of bars and channel beds having a braided pattern, and large point bars. At low water, the Blow River tends to be confined to one or two channels.

The deposit is well-drained and free of overburden. On the lower reaches one-half of the floodplain surface is only 4 feet above low water, whereas on the higher reaches one-half of the surface is 8 feet above low water. Channel traces and scour holes give the floodplain surface a local relief of 2 to 4 feet. The thickness of the active layer is estimated to be in excess of 8 feet.

Tufts of grass and willow clumps are present on the generally bare floodplain surface. The Blow River is a spawning and rearing area for Arctic grayling.

Deposit Y86 and flanking well-drained and poorly drained low terraces lie in a deep bedrock canyon. The terraces often are covered by willow and alder thickets to eight feet in height. Fluvial deposits and ice-rich morainal deposits prevail along the upper edges of the canyon. This terrain provides area for waterfowl staging and feeding. Canyon walls provide nesting habitat for raptors.

MATERIAL

Deposit Y86 contains fair to good quality granular material consisting of stratified, well graded, fine to coarse gravels with some sand. Cobbles to 8 inches are common on the surface. Often the floodplain surface is covered by a cobble pavement. Some channel traces and scour holes have fine shaley gravel and sand on their bottoms. Larger

clasts are mainly subrounded to subangular sandstone with occasional conglomerate and rare quartz, chert and granitics. Shale chips predominate the fines.

VOLUME

The total volume of 140,000,000 cubic yards is based on a conservative depth of 20 feet. Gravel depths within the canyon are known to range up to 30 feet.

Annually, 200,000 cubic yards per 1000 foot length of floodplain can be extracted by conventional techniques assuming that ground water will limit the extractable granular material to an average depth of 5½ feet. Volume of recoverable material may be limited to 31,000,000 cubic yards because of ground water conditions.

DEVELOPMENT

Extraction of material at Deposit Y86 would probably be confined to summer and fall when water levels are low. Adequate areas for stockpiling are available although areas with willow thickets should not be extensively utilized for this purpose. The developed pits should be restored by natural fluvial processes as streams of the coastal plain are known to move significant amounts of coarse sediment.

Winter access to Deposit Y86 is good parallel to the course of the Blow River. However, east-west access is impeded by the steep canyon walls.

Development of Deposit Y86 should be planned to minimize interference with fish activities. This deposit lies within the proposed Arctic Wildlife Range, which may restrict development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	GW		GRAVEL - well graded, some fine to coarse sand, subangular, dark grey, damp, clean.		UF		Lightweight Pieces - Fine Aggregate: 0.11%
2							
3							
4			4.0 / 4.2 - fine gravel layer, predominantly shale fragments.				
5	-		free water at 6.0'.				
6		6.0	Bottom of Pit			6.0	Sample from 0'-6.0'
7							

DATE: Sept. 28, 1976 | LOGGED BY: JDF | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y86-A

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	GW		GRAVEL - well graded, some fine to coarse black sand, occasional cobbles to 5" size, subangular to subrounded, brown, grey, black, sandstones, quartz impregnated rock.		UF		Lightweight Pieces - Fine Aggregate: 0.06%
1.8							
2	GP		- layer of fine gravel and sand from 1.8' to 2.1'.				
2.1							
3	GW						
4							
5							
6							
7							
7.5 ▽							
8			Bottom of Pit				Sample from 0'-7.5'

DATE: Sept. 28, 1976	LOGGED BY: GCD	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

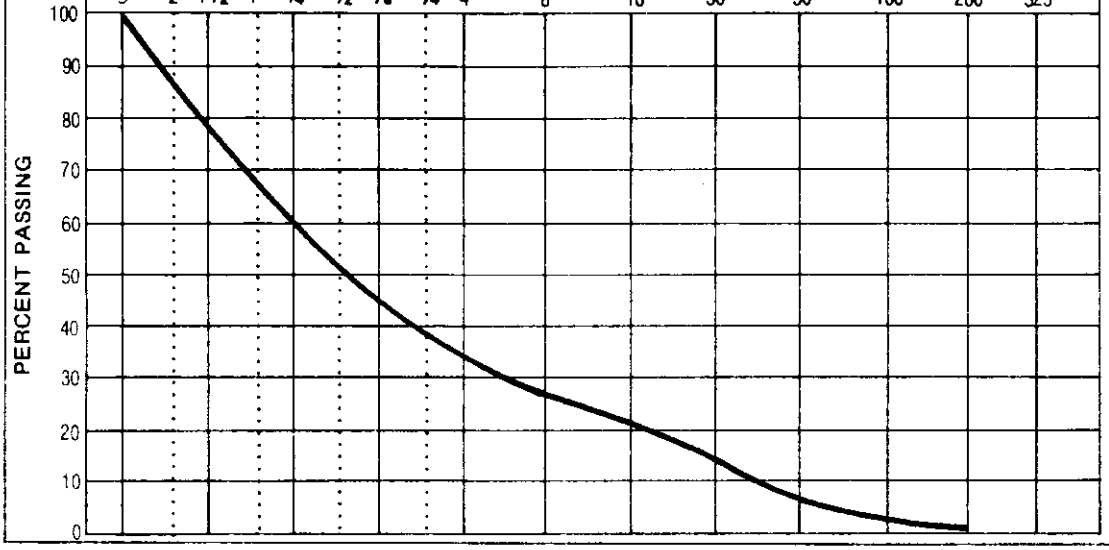
TEST PIT NO. Y86-B

SHEET 1 OF 1

GRAIN SIZE ANALYSIS

SAMPLE Y86-A DEPTH 0'-6.0'
DATE SAMPLED Sept. 28, 1976 SAMPLED BY JDF
LAB TEST NUMBER TP53

GRAVEL SIZES		SAND SIZES			FINES
38.5 %	27.1 %	7.9 %	16.5 %	8.4 %	1.6 %
COARSE	FINE	COARSE	MEDIUM	FINE	

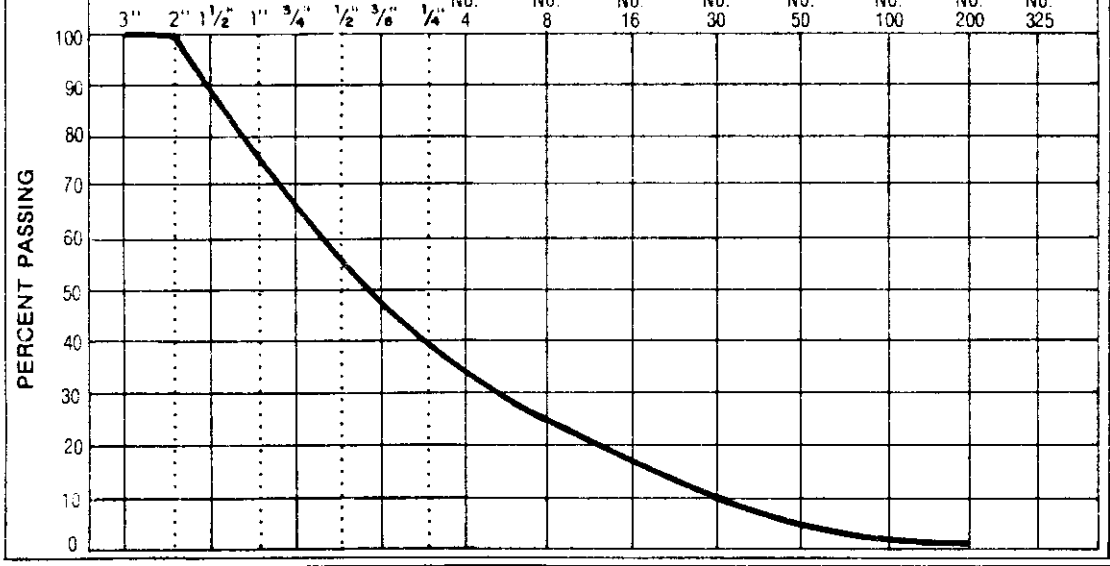


MAX. SIZE	% > 3"
4"	4.1

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	88.0
1 1/2"	79.5
1"	68.8
3/4"	61.5
1/2"	53.4
3/8"	47.4
1/4"	
No. 4	34.4
No. 8	27.5
No. 16	21.7
No. 30	15.6
No. 50	6.3
No. 100	2.3
No. 200	1.6

SAMPLE Y86-B DEPTH 0'-7.5'
DATE SAMPLED Sept. 28, 1976 SAMPLED BY GCD
LAB TEST NUMBER 52HA

GRAVEL SIZES		SAND SIZES			FINES
33.4 %	31.1 %	15.5 %	12.5 %	6.7 %	0.8 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
2"	0

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	100.0
1 1/2"	88.5
1"	75.7
3/4"	66.6
1/2"	55.9
3/8"	49.0
1/4"	
No. 4	35.5
No. 8	25.7
No. 16	18.7
No. 30	10.2
No. 50	3.7
No. 100	1.2
No. 200	0.8

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No.
Y86

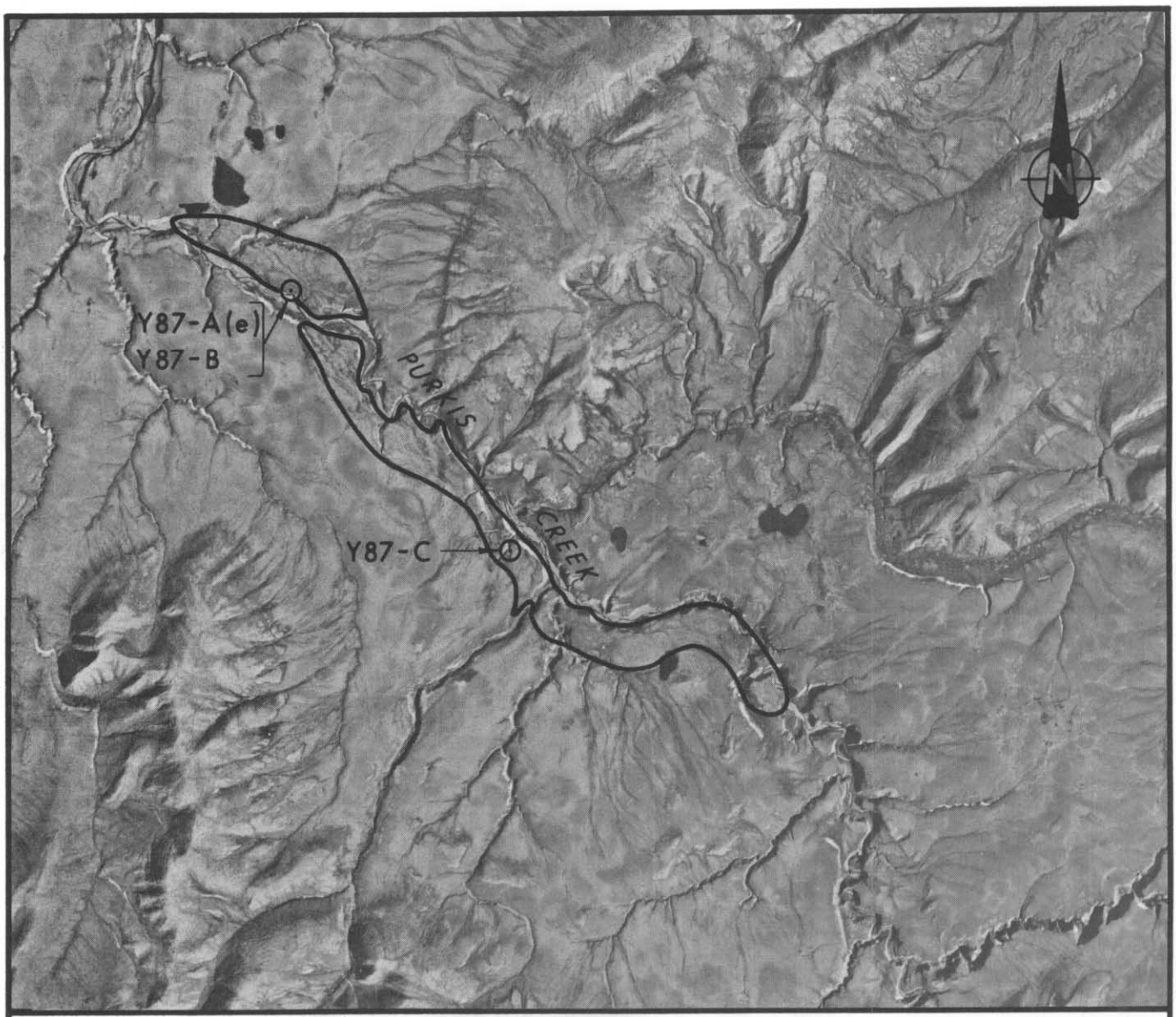
DEPOSIT Y87

Setting: High terraces along the lower reaches of Purkis Creek.

Material: Gravel and Sand; trace to little fines.

Volume: 20,000,000 cubic yards total.

Assessment: Contains fair quality granular material. High shale contents in gravel. Access is difficult.



Airphoto No.: A14363-33		Approx. Scale:	1"=5600'
Deposit Outline - R.M. Hardy	———	Test Pit	⊙
Deposit Outline - Others	—·—·—	Exposures	✠

DEPOSIT Y87

SETTING

Deposit Y87 consists of a segmented high terrace system along the lower reaches of Purkis Creek where bedrock canyon walls, 100 to 120 feet high, are capped by fluvial gravels. The terrace system is segmented by the deep narrow canyon of Purkis Creek and its tributaries. Small scarps up to 15 feet high separate the terrace into a number of levels. Shallow trenches outlining ice-wedge polygons are obvious on parts of the terrace surface.

Deposit Y87 is, generally, well drained and free of overburden. Some swales and broad flat areas are imperfectly drained and may be covered by 1 to 5 feet of organic silt and peat. The active layer can be expected to be 2 to 3 feet thick where overburden is present, and greater than 6 feet under bare gravel.

Well drained parts of Deposit Y87 have a broken vegetation cover with patches of dwarf birch and other small shrubs. Less well drained surfaces are covered by mixed sedge/heath tundra. This deposit and adjacent areas lies on a major caribou migration corridor. During the fall of 1976, snow geese were feeding on the poorly drained area east of Deposit Y87. The canyon walls may provide nesting sites for raptors.

Deposit Y87 is surrounded by gently rolling ice-rich morainal deposits on all sides except to the north where a large bedrock hill is present.

MATERIAL

Only fair quality granular material was noted at Deposit Y87 consisting of gravel and sand with varying silt content. Much of the gravel is platy, angular to subangular shale fragments, although numerous subangular to subrounded sandstone and conglomerate are present.

VOLUME

The total volume of 20,000,000 cubic yards is based on a conservative average depth of 15 feet. Exposures indicate gravel thicknesses of 10 to 40 feet.

Annually, 8,700 cubic yards per acre could be extracted by conventional techniques assuming that permafrost limits the yearly extractable depth to 6 feet.

DEVELOPMENT

Extraction will be limited in depth by permafrost and will be easiest in areas of exposed gravel. Pits would most easily be developed by excavating benches along scarps where drainage will easily be maintained and thaw rates will be maximum. Also, these pits will easily blend into the landscape with minor grading at abandonment.

Access is difficult because the canyon of Purkis Creek is not easily traversed and long moderate to steep hillsides are encountered to the northwest. The portion of the deposit lying north of Purkis Creek may be approached by crossing the gently rolling terrain to the north.

Any development of Deposit Y87 should be planned to minimize interference with caribou migration or snow geese feeding and staging activities. This deposit lies within the proposed Arctic Wildlife Range, which may restrict development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
2	SM		SAND - and silty fines, trace organics, very shaley, grey-brown, moist.		UF		
			3.0				
4	GW		GRAVEL - well graded to 3" size, some fine to coarse sand, trace silty fines, angular to subangular, platy, brown, wet, shale.				
6							
8							
10			10.5 — color becomes grey.				
12							
14							
16							Shale exposed from base of pit to creek level approximately 100' below.
18							
20			20.0				
			Bottom of Pit				Sample from 3.5'-15.0'
22							

DATE: Oct. 1, 1976. | LOGGED BY: SA | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y87-A(e)

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
	Pt		PEAT - fiberous, spongy, brown, wet.		UF		
			0.8				
1	ML		SILT - clayey, low plastic, brown.				
2			2.3				
	GW		GRAVEL - well graded to 5" cobbles, some fine to coarse sand, trace silty fines, angular to subangular, platy, brown, wet, shale				
			2.8				
3			frozen below 2.8'				No sample taken.
			Bottom of Pit				

DATE: Oct. 1, 1976	LOGGED BY: SA	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y87-B

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
	Pt		PEAT - fine, fibrous. 0.6		UF		Organic Color: #5 Coal Removed: #4
1	CL		CLAY - silty, trace gravel to 1" size, brown, moist.				Lightweight Pieces - Fine Aggregate: 0.05%
2			2.0				
	GW		GRAVEL - well graded to 4" cobbles, some fine to coarse sand, subangular to subrounded, brown, damp, clean.				
3			3.5				
			Bottom of Pit				Sample from 2.0'-3.5'
4							

DATE: Oct. 1, 1976	LOGGED BY: CPM	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y87-C

SHEET 1 OF 1

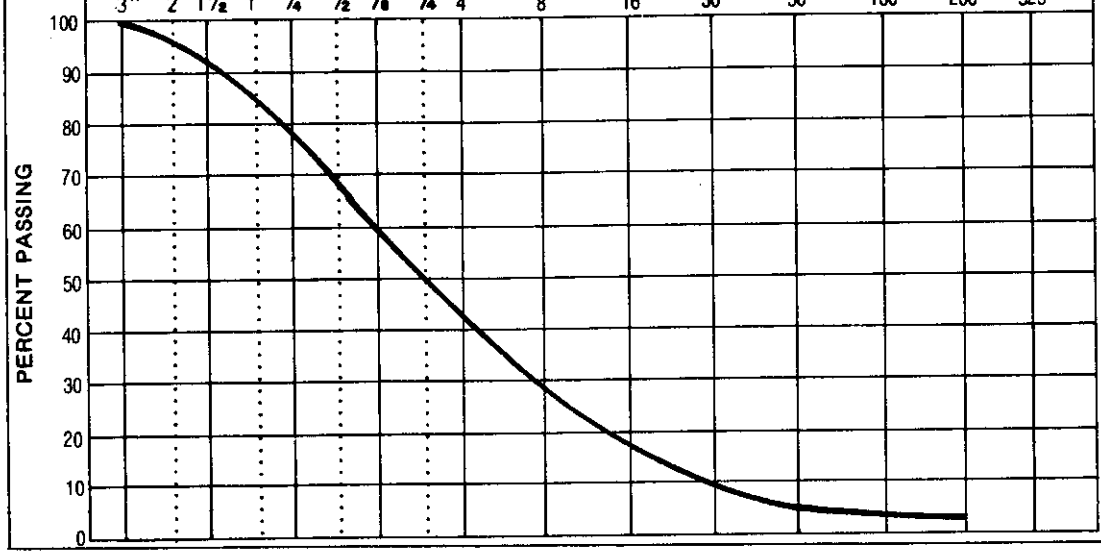
GRAIN SIZE ANALYSIS

SAMPLE Y87-A(e) DEPTH 3.5'-15.0'

DATE SAMPLED Oct. 1, 1976 SAMPLED BY SA

LAB TEST NUMBER 60HA

GRAVEL SIZES		SAND SIZES			FINES
21.2 %	39.1 %	14.7%	15.0 %	3.6 %	3.4 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
5"	6.7

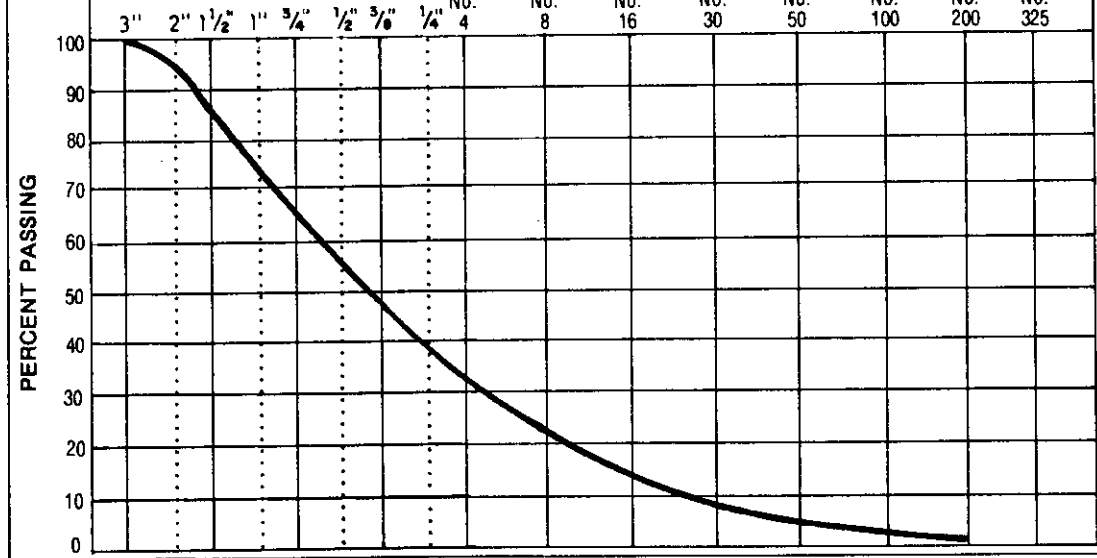
SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	95.2
1 1/2"	92.1
1"	85.7
3/4"	78.8
1/2"	68.9
3/8"	59.1
1/4"	
No. 4	39.7
No. 8	27.3
No. 16	16.9
No. 30	9.1
No. 50	5.6
No. 100	4.1
No. 200	3.4

SAMPLE Y87-C DEPTH 2.0'-3.5'

DATE SAMPLED Oct. 1, 1976 SAMPLED BY CPM

LAB TEST NUMBER 61HA-A

GRAVEL SIZES		SAND SIZES			FINES
35.2 %	33.9 %	10.9%	13.5 %	5.1 %	1.4 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
4"	13.8

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	95.7
1 1/2"	83.6
1"	74.3
3/4"	64.8
1/2"	54.6
3/8"	46.9
1/4"	
No. 4	30.9
No. 8	22.5
No. 16	13.6
No. 30	7.0
No. 50	3.0
No. 100	1.8
No. 200	1.4

GOVERNMENT OF CANADA

DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.

CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

DEPOSIT No. Y87

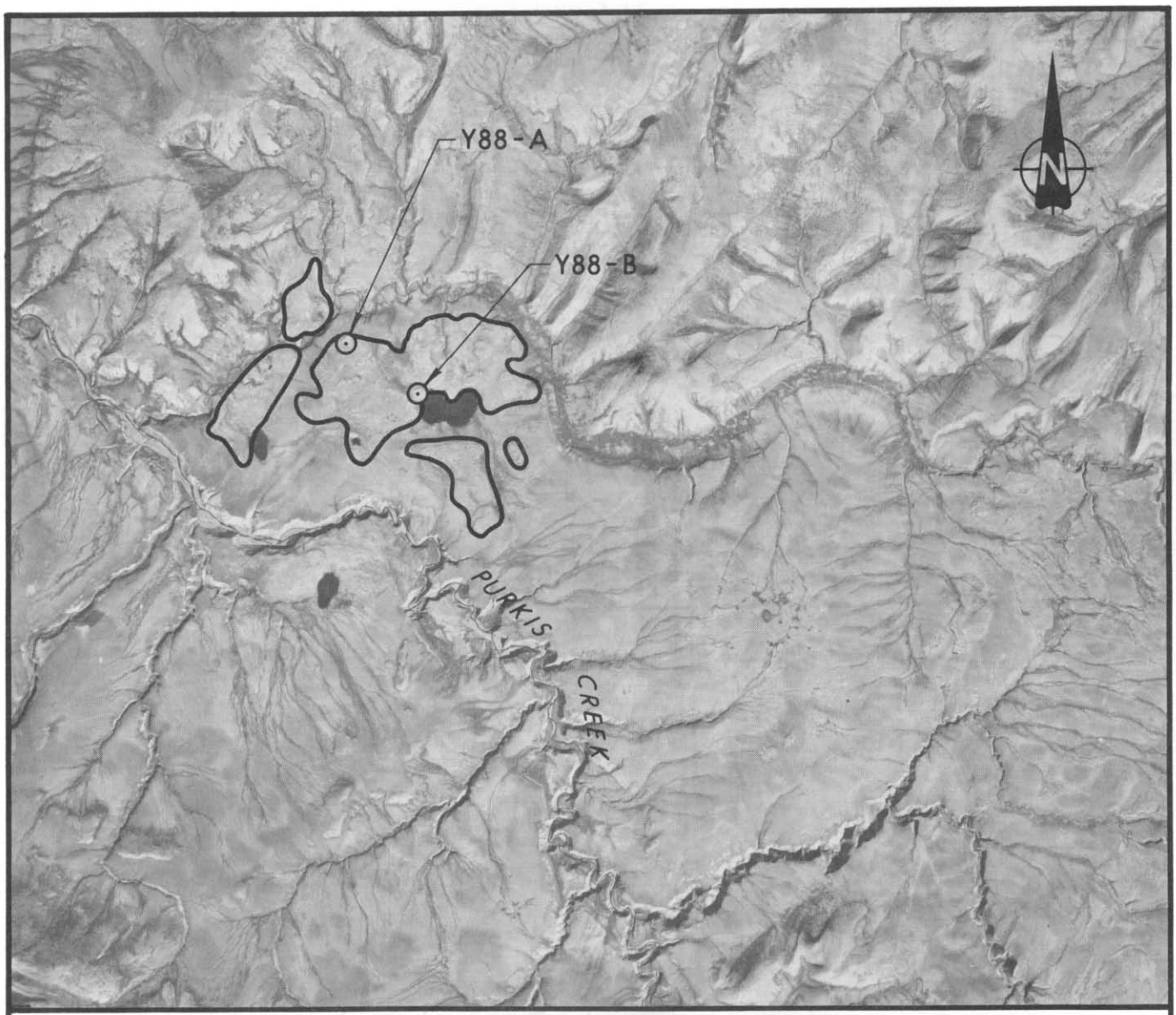
DEPOSIT Y88

Setting: Kame complex north of Purkis Creek, 7 miles southwest of its confluence with the Blow River.

Material: Sand and Gravel; poorly graded, fine to coarse.

Volume: 7,400,000 cubic yards total.

Assessment: Contains poor to fair quality granular material. High in shale content. Possibility of massive ice within deposit. Limited local access; poor access in coastal direction.



Airphoto No.: A23838-32		Approx. Scale:	1"=4800'
Deposit Outline - R.M. Hardy	———	Test Pit	⊙
Deposit Outline - Others	—·—·—	Exposures	✠

DEPOSIT Y88

SETTING

Deposit Y88 consists of a kame complex in the northern foothills of the Richardson Mountains. It is located on the north side of a broad lowland north of Purkis Creek approximately 7 miles southeast of its confluence with the Blow River. It lies at the western end of a meltwater channel, which has further incised itself into Deposit Y88 following deposition of the constituent materials.

The various parts of the kame complex have a rolling surface with individual kames standing as much as 20 feet above the broad depressions. Kames are well drained and free of overburden, whereas depressions are imperfectly to poorly drained and contain moderate amounts of overburden. The surface of the kames are marked by one foot deep trenches forming a broad polygonal pattern. The active layer is more than 6 feet deep.

Kame surfaces are largely bare of vegetation with the remainder being covered by a mixture of sedges, dwarf birch, and ericaceous shrubs. Depressions are covered by sedge tussock tundra.

The deposit is bordered by deep canyons to the north, west and south. Beyond the canyon to the north a broad scree-covered hill rises about 800 feet. Gently sloping morainal deposits containing significant ground ice are present to the east. This area provides habitat for grizzly bear and lies on a major migratory route for caribou. Moose were noted near the deposit. Large flocks of snow geese were seen feeding on the flat marshy surfaces to the east in late September. Purkis Creek is a spawning and rearing area for Arctic grayling.

MATERIAL

Deposit Y88 contains poor to fair quality material consisting of poorly graded sand and fine to medium gravel with pebbles to 3 inch

size. Larger clasts are mainly subrounded, platy shale fragments and sandstone.

VOLUME

The total volume of 7,400,000 cubic yards is based on an estimated thickness of 30 feet of granular material under the crest of each knoll and allows for approximately one-half of the deposit's relief being due to massive ice. Massive ice is common in hummocky kames in this region.

Annually, 13,000 cubic yards per acre can be extracted by conventional techniques assuming that permafrost may limit the annual depth of extraction to 9 feet.

DEVELOPMENT

Material from Deposit Y88 should be excavated from the kames so that proper drainage is maintained. Massive ice, if present, will require special consideration. Restoration will depend mainly on amounts of material removed and position of ground ice in the deposit. Dug-outs would probably flood and become small ponds.

Deep canyons and high bedrock hills make access to the coast difficult. Local access to Deposit Y88 is good over gentle slopes, although care must be exercised to minimize thermokarst development.

Development of Deposit Y88 should be planned to minimize interference with caribou migration or staging activities of snow geese. This deposit lies within the proposed Arctic Wildlife Range, which may restrict development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
0	SW		SAND - well graded, and gravel to 2" size, subrounded and platy, medium dense, greyish brown, wet.		UF		Lightweight Pieces - Fine Aggregate: 0.05%
1							
2							
3							
4							
5			5.0 Bottom of Pit				Sample from 0'-5.0'
6							

DATE: Oct. 12, 1976 | LOGGED BY: SA | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y88-A

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
	Pt	0.5	PEAT - silty, trace gravel, fibrous		UF		Lightweight Pieces - Fine Aggregate: 0.11%
1	GW		GRAVEL - shaley, some medium to coarse sand, subrounded and platy, medium dense, grey, wet.				
2							
3							
4							
5							
6		6.0	Bottom of Pit				Sample from 1.0'-6.0'
7							

DATE: Oct. 12, 1976 | LOGGED BY: SA | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y88-B

SHEET 1 OF 1

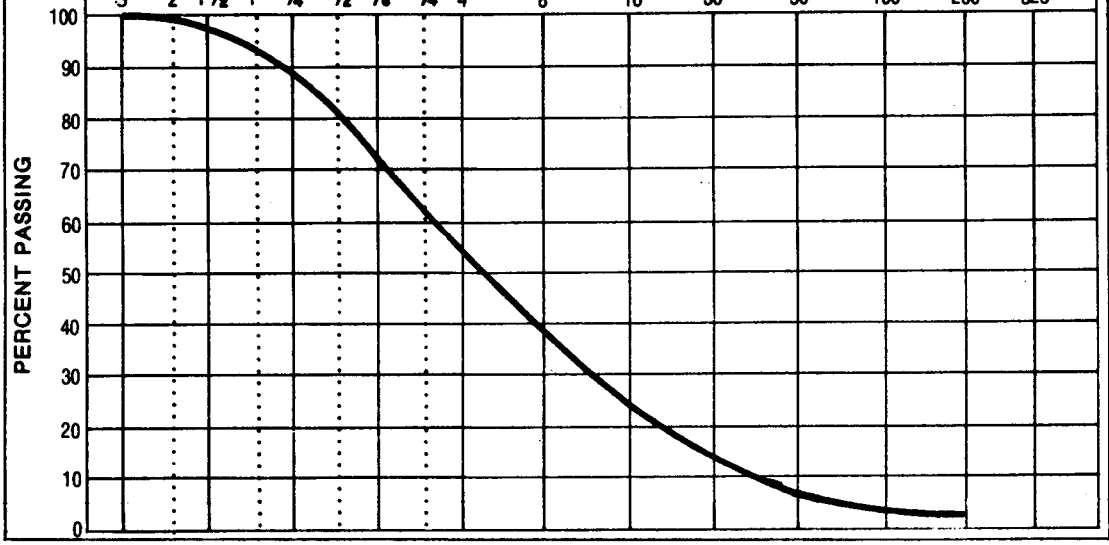
GRAIN SIZE ANALYSIS

SAMPLE Y88-A DEPTH 0'-5.0'

DATE SAMPLED Oct. 12, 1976 SAMPLED BY SA

LAB TEST NUMBER 63HA

GRAVEL SIZES		SAND SIZES			FINES
9.3 %	37.5 %	18.2%	26.1 %	5.0 %	3.9 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
3"	0

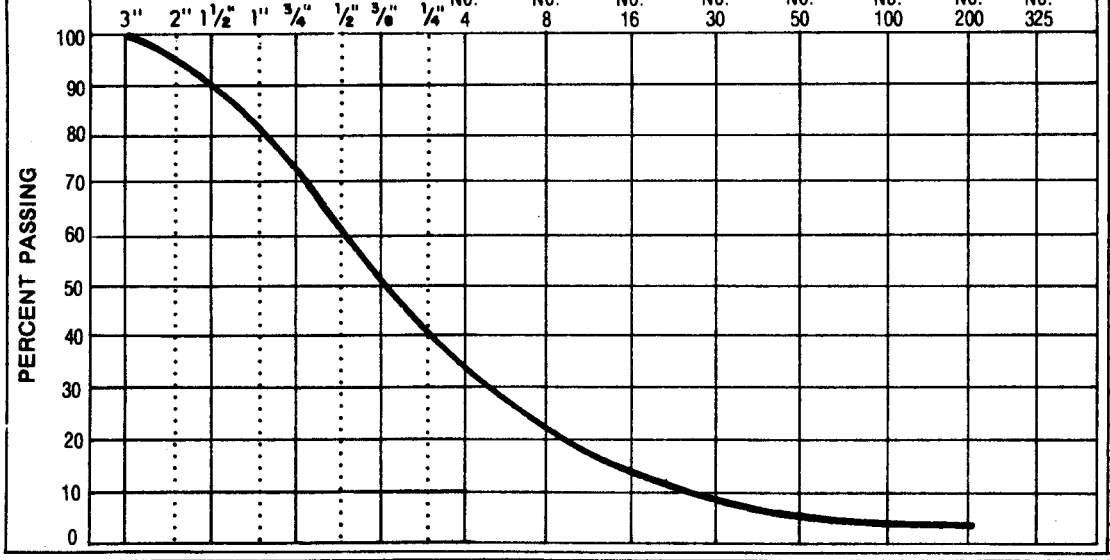
SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	100.0
1 1/2"	99.6
1"	96.0
3/4"	90.7
1/2"	81.0
3/8"	72.7
1/4"	
No. 4	53.2
No. 8	39.8
No. 16	25.2
No. 30	12.5
No. 50	5.4
No. 100	4.4
No. 200	3.9

SAMPLE Y88-B DEPTH 1.0'-6.0'

DATE SAMPLED Oct. 12, 1976 SAMPLED BY SA

LAB TEST NUMBER 62HA

GRAVEL SIZES		SAND SIZES			FINES
27.0 %	40.7 %	13.3%	12.5 %	3.9 %	2.6 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
3"	0

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	96.6
1 1/2"	92.4
1"	81.9
3/4"	73.0
1/2"	58.3
3/8"	49.7
1/4"	
No. 4	32.3
No. 8	22.3
No. 16	13.4
No. 30	6.5
No. 50	3.7
No. 100	3.0
No. 200	2.6

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No. Y88

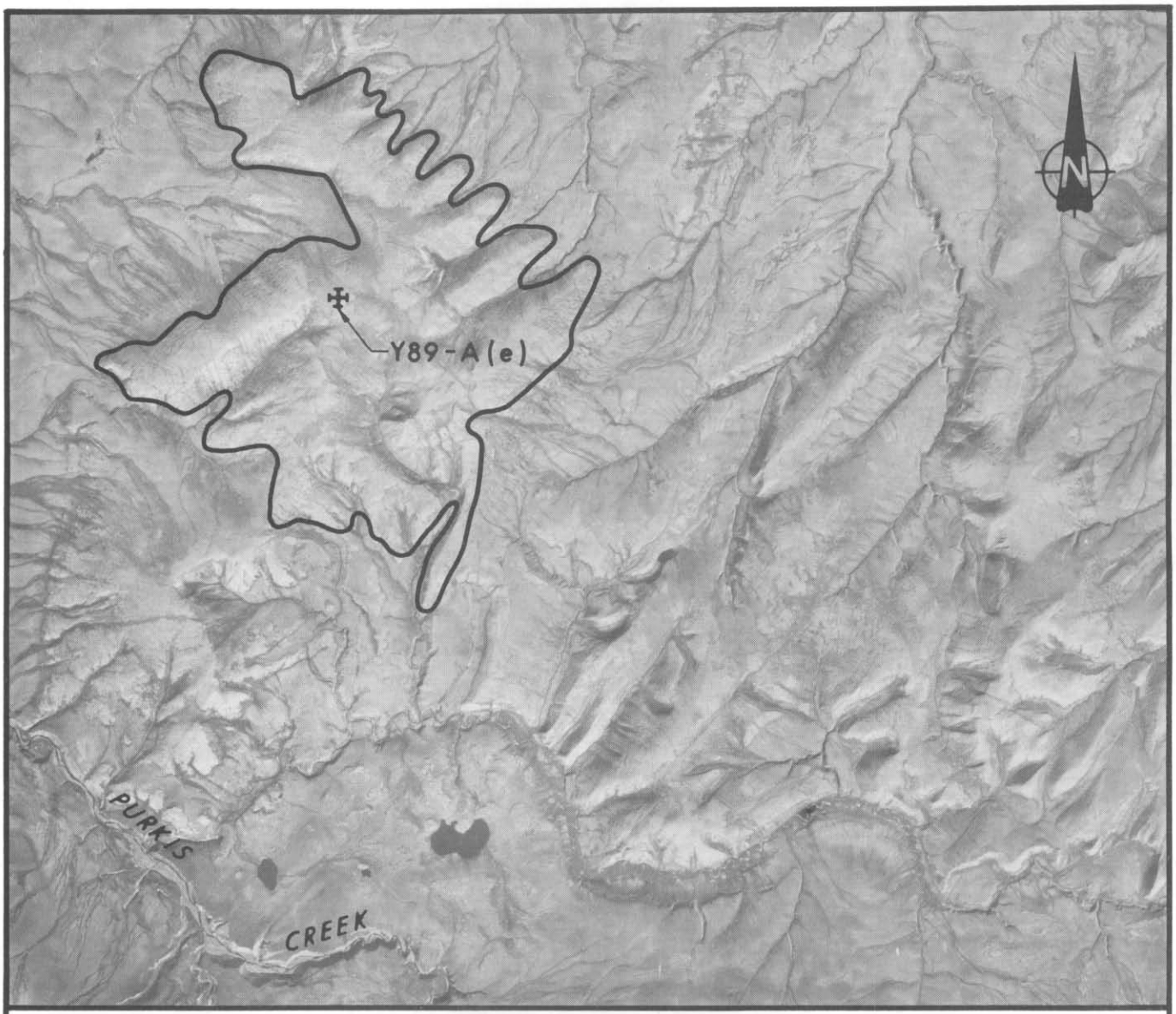
DEPOSIT Y89

Setting: Scree-covered hill about 5 miles east-southeast of the confluence of Purkis Creek and Blow River.

Material: Sandstone rubble.

Volume: 14,000,000 cubic yards total.

Assessment: Contains fair to good quality granular material. Large volumes available if quarried. Fair access to deposit.



Airphoto No.: A23838-31		Approx. Scale:	1"=4700'
Deposit Outline - R.M. Hardy	———	Test Pit	⊙
Deposit Outline - Others	—·—·—	Exposures	✠

DEPOSIT Y89

SETTING

Deposit Y89 consists of a large hill located about 5 miles east-southeast of the confluence of Purkis Creek and Blow River. The Shingle Point DEW Line station is 16 miles north of this deposit.

The crest of Deposit Y89 rises 600 feet above the surrounding lowlands to an elevation of 1600 feet, and is rolling with gentle to moderate slopes. Moderate to steep slopes form the edges of the deposit.

Deposit Y89 is free of overburden and is well-drained. On flatter areas, ½ foot deep trenches and indistinct mounds, 20 feet in diameter, are present. Some steeper slopes show incipient stone stripes. The deposit is generally bare of vegetation, except for a few patches of Dryas and grass. The thickness of the active layer is estimated to range from 4 to 6 feet.

The scree is composed of fragments of lithic sandstone of late Early Cretaceous age. The extent of similar Early Cretaceous lithic sandstones in the nearby region is not known. Rock outcrops were not seen on the mountain.

The deposit is bordered by similar hills to the east, by gently sloping morainal deposits with flat peat-covered depressions to the north and west, and the Purkis Creek canyon to the south. This area provides habitat for caribou, grizzly bear, and waterfowl.

MATERIAL

Deposit Y89 contains fair to good quality granular material consisting of angular plates and cubes of lithic sandstone, ¼ to 1 inch thick and ¼ to 10 inches across. The sandstone is tough, but contains abundant chert grains and other grains that are highly weathered, which

may detract from its possible use as concrete aggregate. The absence of outcrop and large plates suggests that the rock lacks the durability required for riprap.

VOLUME

The total volume of 14,000,000 cubic yards is based on an average depth of 4 feet to competent rock. This volume would be increased significantly if the underlying rock was ripped or quarried. Large areas would be required for the recovery of relatively small volumes.

DEVELOPMENT

Development of Deposit Y89 would involve simple surface scraping unless the underlying rock was quarried. Although it would provide a large source of readily excavated general fill, its durability and composition might limit its use and further tests are required. The location of pit areas for development should maintain the aesthetics of the region.

Access to the deposit would locally involve descending moderate slopes which may be susceptible to thermokarst. Access to the coast can be attained along the Blow River but will require descending into the canyon.

Deposit Y89 lies within the proposed Arctic Wildlife Preserve, which may restrict development.

SUMMARY OF PETROGRAPHIC DATA FOR ROCK SAMPLES

PETROGRAPHIC ANALYSIS

PARTICLE TYPE	PERCENT
Detrital quartz	39.0
Altered quartz, feldspar, and chert	11.5
Chert	13.5
Plagioclase	2.5
Shale fragments	8.5
Fragments of argillaceous, micaceous, and chlortic material	4.5
Mixed Matrix	20.5
Silicaceous cement	0.5

ROCK NAME: Lithic Sandstone

GRAIN SIZE: Ranges from 0.6 mm down to clay sizes

GRAIN SHAPE: Angular to subangular, some fragments subrounded.

MATRIX AND CEMENT: Matrix is comprised of ultra-fine rock fragments, which bonds the rocks; minor cementation

POROSITY AND PACKING: Nil porosity; grains and matrix are densely packed

COMMENTS: Cohesive and firm rock; slabby character reflects bedding.

NOTE: PETROGRAPHIC ANALYSIS BY DOLMAGE CAMPBELL & ASSOCIATES (1975) LTD.

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO.
Y89-A(e)

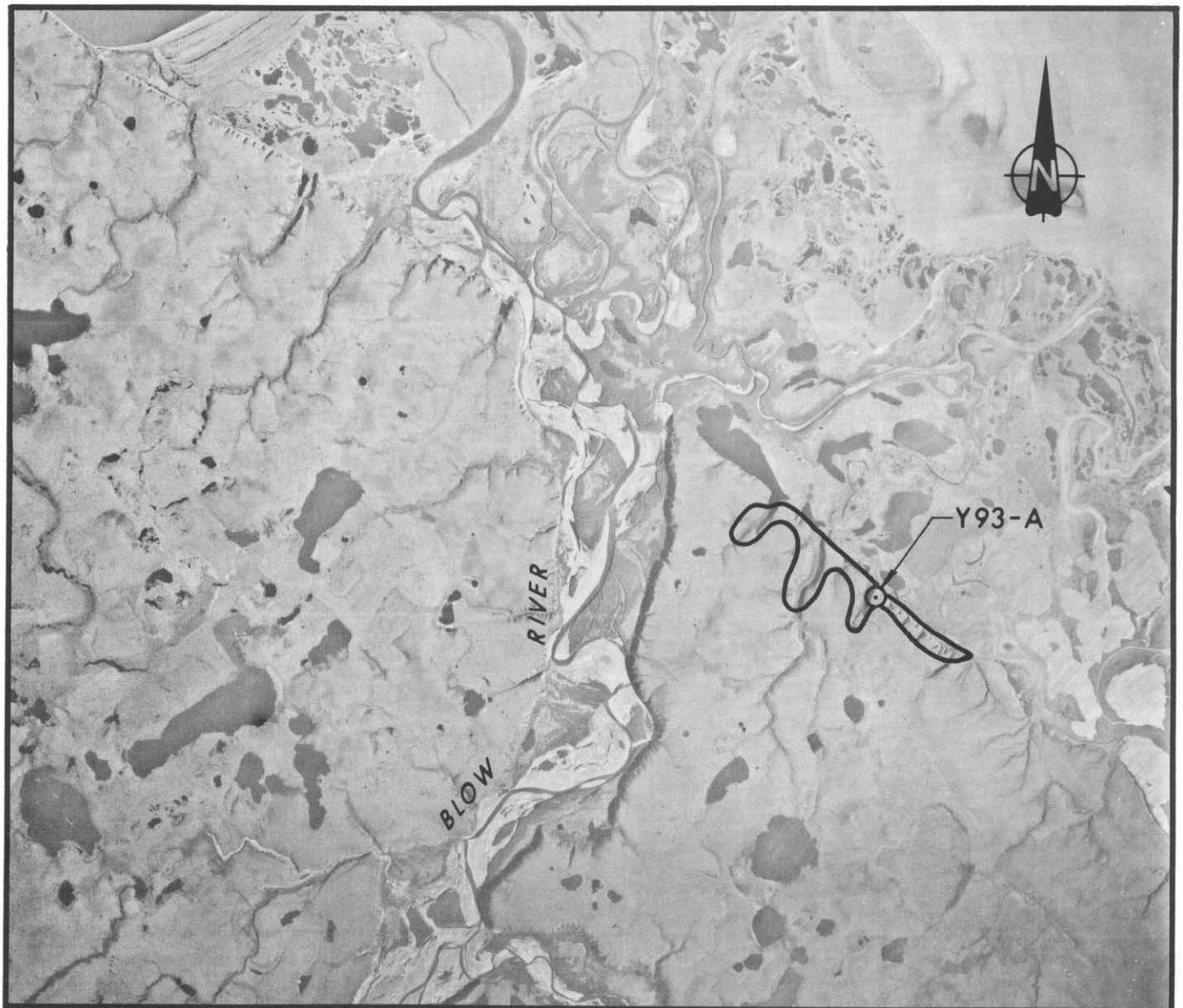
DEPOSIT Y93

Setting: Preglacial fluvial gravels along an escarpment east of the Blow River delta.

Material: Gravel; well graded, fine to coarse, some sand.

Volume: 21,000,000 cubic yards total.

Assessment: Contains good to excellent quality material. Development easiest along the escarpment, although some overburden removal is necessary. Good access is available.



Airphoto No.: A13232-44
Deposit Outline - R.M. Hardy
Deposit Outline - Others
Approx. Scale: 1"=6000'
Test Pit
Exposures

DEPOSIT Y93

SETTING

Deposit Y93 consists of preglacial gravels along a 80 to 100 foot escarpment east of the Blow River delta. Coastal retreat has exposed the gravels, which extend below sea level and are overlain by ice-rich morainal deposits. Slumping along the edge of the escarpment has thinned, and possibly removed the overburden for a 30 to 100 feet distance on the upland adjacent to the scarp. A number of ravines also appear to have thin overburden at the top of their banks.

Where the overburden is thin, the deposit is well drained and covered by tundra dominated by small shrubs. Away from the escarpment the overburden thickens, the drainage is moderately good, and the ground cover is sedge tussock tundra.

The escarpment appears to be stable, although a few active layer flows were noted. Some alder shrubbery is present along this scarp and in the ravines.

The poorly drained Blow River/Mackenzie River delta complex lies north of this deposit. The terrain consists of ice-rich morainal and lacustrine deposits to the south and east.

Deposit Y93 is within a staging area for waterfowl. A few burrows were noted in the deposit.

MATERIAL

Deposit Y93 contains good to potentially excellent quality granular material, consisting of stratified, well graded, fine to coarse gravel with some sand. Wood fragments and lenses of woody detritus were noted in exposures. Large clasts are mainly subrounded sandstone.

Excavations at Shingle Point indicate that these gravels have low ice contents and are easily excavated.

VOLUME

Although the total volume of the deposit is calculated as 21,000,000 cubic yards, this volume could be increased significantly by considering gravel underlying thicker overburden in an inland direction.

Annually, 24,000 cubic yards could be extracted by conventional techniques for each 1000 foot length along the scarp.

DEVELOPMENT

Development of Deposit Y93 would involve excavating gravel from the face and along the top of the escarpment. Significant overburden would need to be removed if it was necessary to develop the pit for any distance inland.

Access to this deposit is good across the Blow River/Mackenzie River delta complex. Inland access is available along the Blow River valley.

Before development, the crest of the escarpment should be investigated for graves and artifacts as the area is known to have been a centre for historic and prehistoric Eskimo activity. Development should also be planned to minimize interference with waterfowl staging. Deposit Y93 lies within the proposed Arctic Wildlife Range, which may restrict development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
0	Pt	0.2	PEAT - fine, fibrous.		UF		Organic Color: #3+
	ML		SILT - some subrounded gravel to 3" size, little sand, little organics, occasional cobble to 7" size, brown, moist.				Lightweight Pieces -
1		1.0					Fine Aggregate: 0.06%
	GW		GRAVEL - well graded to 3" size, some fine to coarse sand, few cobbles to 6" size, subrounded, grey-brown, damp.				
2							
3							
4							
5						5.1	
					Vx-Vc 5%		
6		6.0					
			Bottom of Pit				Sample from 1.0'-6.0'
7							

DATE: Oct. 7, 1976	LOGGED BY: CPM	DRWN BY: MB/vh	CHKD BY: GDC/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y93-A

SHEET 1 OF 1

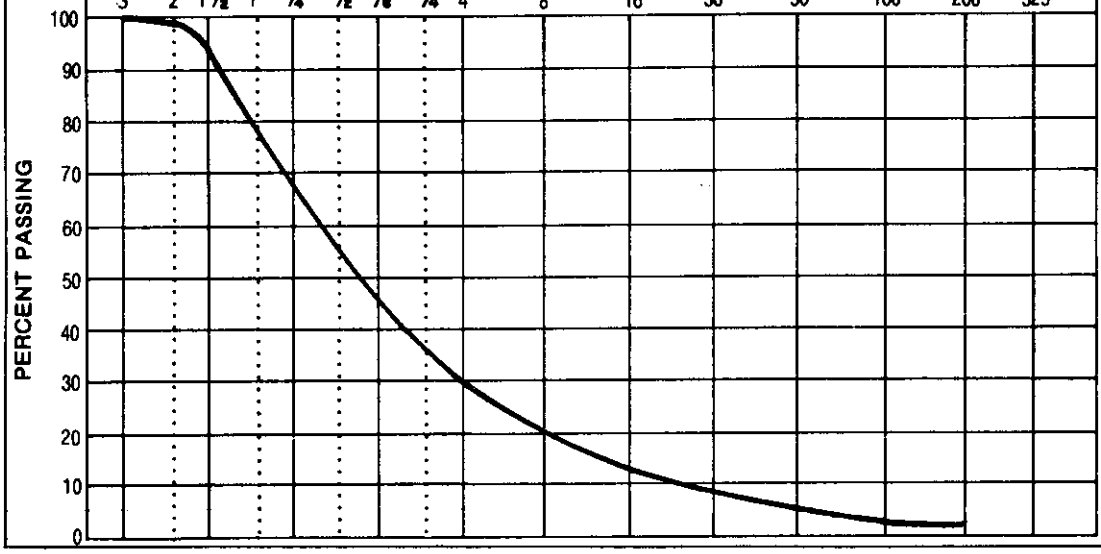
GRAIN SIZE ANALYSIS

SAMPLE Y93-A DEPTH 1.0'-6.0'

DATE SAMPLED Oct. 7, 1976 SAMPLED BY CPM

LAB TEST NUMBER 137HA

GRAVEL SIZES		SAND SIZES			FINES
30.9 %	40.6 %	10.0%	11.5 %	4.2 %	2.8 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
2"	0

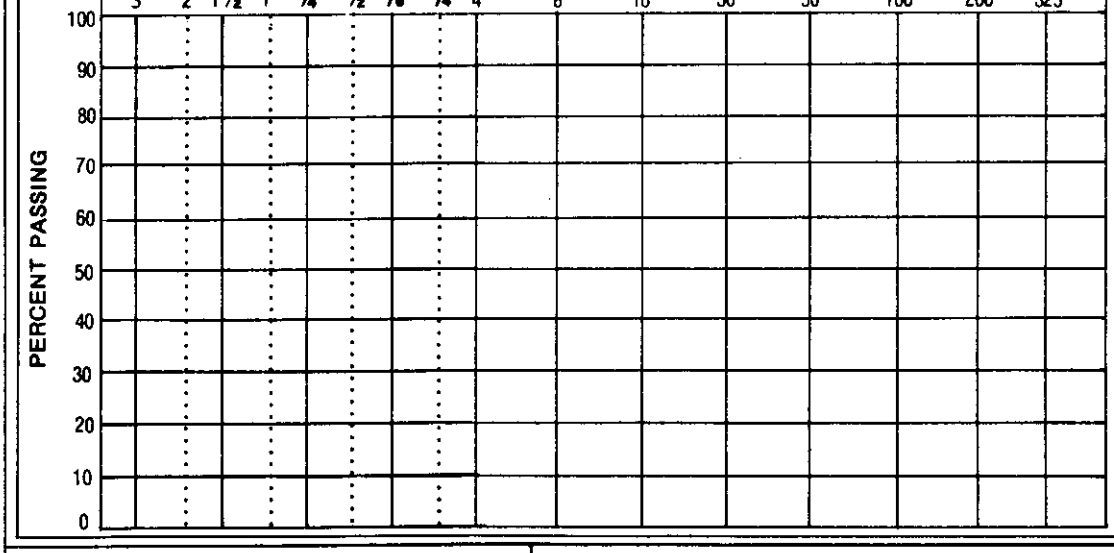
SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	100.0
1 1/2"	93.4
1"	78.0
3/4"	69.1
1/2"	55.5
3/8"	45.5
1/4"	
No. 4	28.5
No. 8	19.2
No. 16	12.8
No. 30	8.0
No. 50	5.0
No. 100	3.7
No. 200	2.8

SAMPLE _____ DEPTH _____

DATE SAMPLED _____ SAMPLED BY _____

LAB TEST NUMBER

GRAVEL SIZES		SAND SIZES			FINES
%	%	%	%	%	%
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"

SIEVE SIZE	PERCENT PASSING
3"	
2"	
1 1/2"	
1"	
3/4"	
1/2"	
3/8"	
1/4"	
No. 4	
No. 8	
No. 16	
No. 30	
No. 50	
No. 100	
No. 200	

GOVERNMENT OF CANADA

DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.

CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

DEPOSIT No. Y93

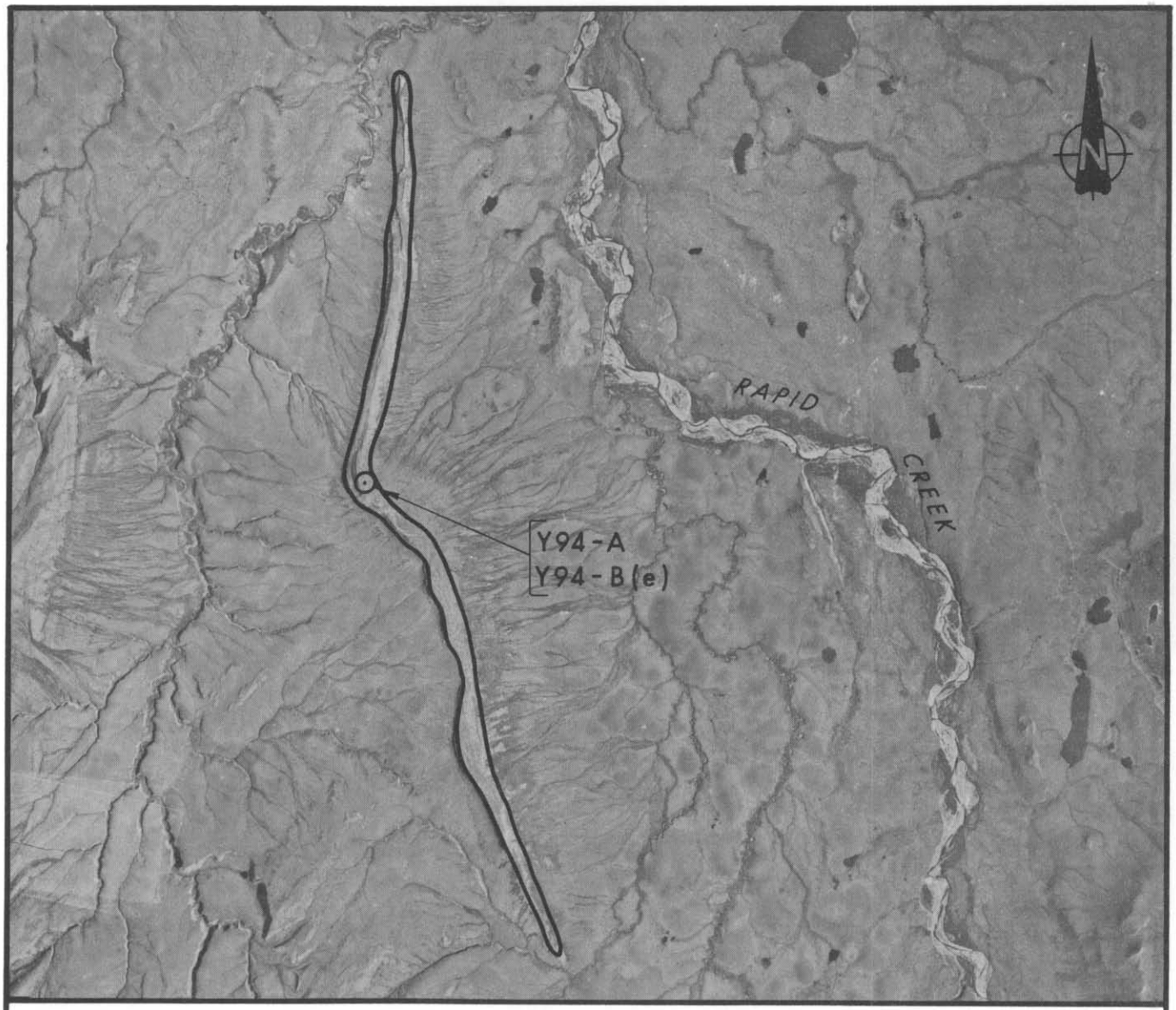
DEPOSIT Y94

Setting: Cuesta located 1½ miles west of Rapid Creek. It parallels Rapid Creek for 5 miles from a point about 7 miles above the confluence of Rapid Creek and the Blow River.

Material: Lithic sandstone and conglomerate rock and rubble.

Volume: 1,600,000 cubic yards total.

Assessment: Potential source of crushed rock or riprap. Access to coast is limited by terrain.



Airphoto No.: A13232-52
Deposit Outline - R.M. Hardy
Deposit Outline - Others
Approx. Scale: 1"=5400'
Test Pit ⊙
Exposures ✠

DEPOSIT Y94

SETTING

Deposit Y94 consists of a cuesta that is 1½ miles west of Rapid Creek, and streches 5 miles south from a point about 7 miles above the confluence of Rapid Creek and Blow River. The northern end of the deposit is 2 miles southwest of the confluence of Cuesta Creek and Rapid Creek.

Bedrock outcrops sporadically along a 50 to 150 foot scarp along the west side of the cuesta. An apron of bouldery talus is present at the base of the scarp. On the eastern side of the ridge blocky scree covers the upper part of the slope. The strata strike north-south and dip at about 30°E along the cuesta. Outcrops show irregular jointing patterns. The rock is an interbedded lithic sandstone and conglomerate containing mainly subangular quartz and chert clasts to ½ inch in size, but generally less than 1/8 inch. Other grains are mainly rock fragments and feldspars. Recessive areas may be underlain by siltstones and shale.

Outcrops and talus are largely bare of vegetation except for patches of moss, lichen, and small shrubs.

The rock forming the cuesta is representative of the Cuesta Creek Member of the Fish Creek Group of Late Cretaceous age. This rock unit outcrops only at a few localities in the area, notably the canyons of Eagle Creek and Big Fish River.

Deposit Y94 is bordered by till-blanketed moderate to gentle slopes leading down to Rapid Creek and its tributaries. The till has moderate ice content. Beyond Rapid Creek, ice-rich rolling morainal deposits separate Rapid Creek from the Mackenzie Delta. The area provides habitat for grizzly bear and lies on a major caribou migration route.

MATERIAL

Deposit Y94 contains rock and rubble, which may be processed into good quality aggregate and riprap. The rock is probably fairly durable as it is difficult to break at the outcrop and petrographic examination of hand samples indicates that it is hard and cohesive. The high percentage of chert may limit the value of this deposit for concrete aggregate.

Some areas on the dip slope are characterized by blocky scree averaging 2 to 4 inches in size. Local areas on the dip slope and talus cone are characterized by platy blocks 2 to 4 feet across and 1 to 2 feet thick.

VOLUME

The total volume of 1,600,000 cubic yards assumes that the rock may be quarried a distance of 30 feet into the side of the ridge and that some talus is present at its base.

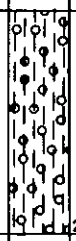
DEVELOPMENT

Preliminary blasting tests to determine breakage characteristics of the rock is required before considering Deposit Y94 as a source of riprap or aggregate. Any development would require blasting and quarrying of material along benches or at the base of scarp on the west side of the deposit.

Access to the coast involves crossing terrain that is moderately susceptible to thermokarst and a number of moderately steep slopes near Rapid Creek, and at the edge of the Mackenzie Delta.

Deposit Y94 lies within the proposed Arctic Wildlife Range, which may limit development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	GM		GRAVEL - well graded to 4" size, some fine to coarse sand, trace silty fines, angular, fractured sandstones, shale, more competent with depth.		UF		Competent rock at 2.3'.
2							
3			Bottom of Pit				Sample from 0'-2.3'

DATE: Oct. 1, 1976 | LOGGED BY: SA | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y94-A

SHEET 1 OF 1

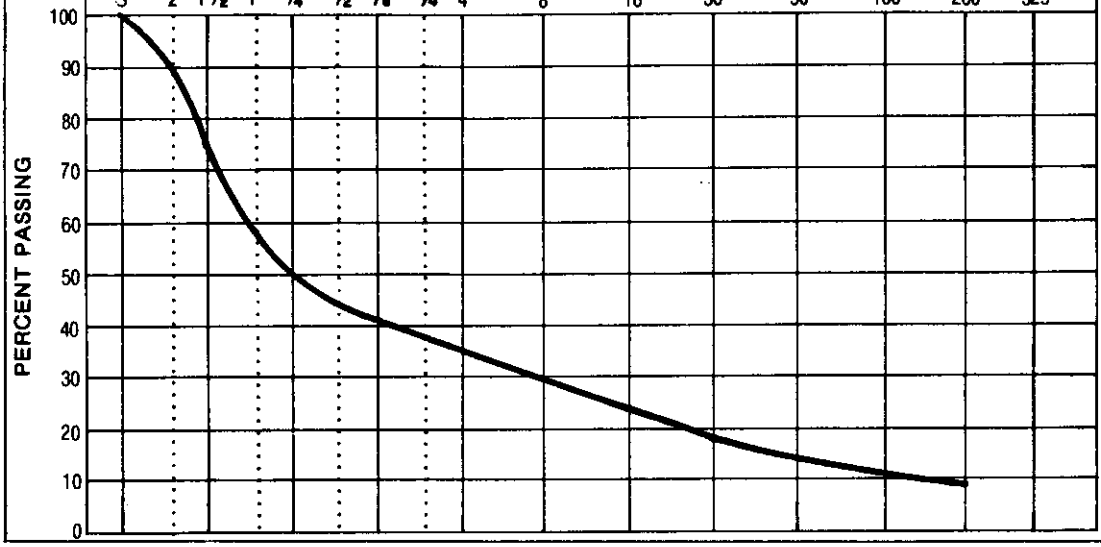
GRAIN SIZE ANALYSIS

SAMPLE Y94-A DEPTH 0'-2.3'

DATE SAMPLED Oct. 1, 1976 SAMPLED BY SA

LAB TEST NUMBER 112HA-A

GRAVEL SIZES		SAND SIZES			FINES
50.3 %	15.8 %	5.4 %	12.5 %	6.1 %	9.9 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
4"	3.0

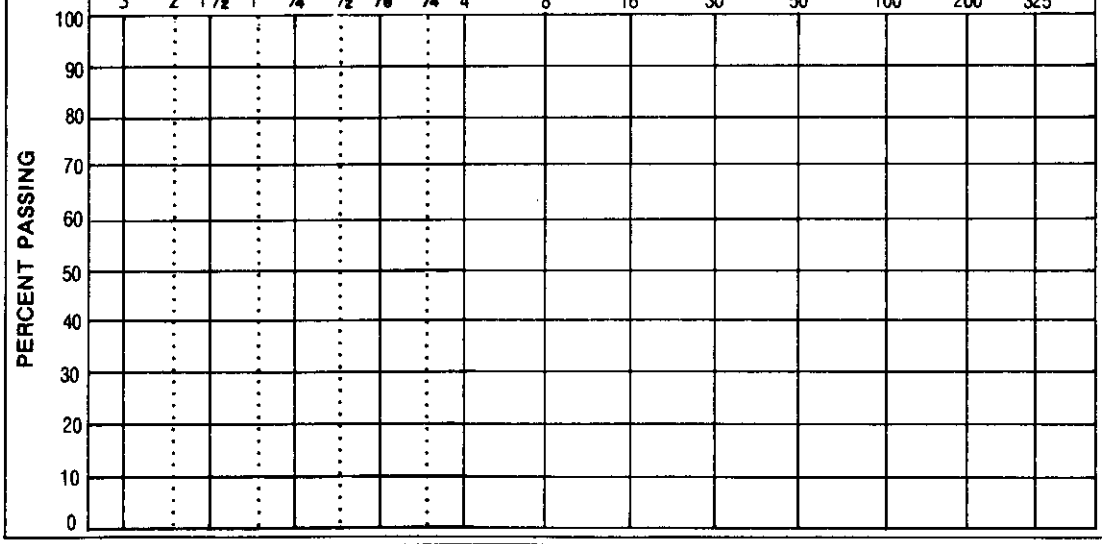
SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	90.2
1 1/2"	75.2
1"	57.5
3/4"	49.7
1/2"	44.2
3/8"	40.1
1/4"	
No. 4	33.9
No. 8	29.2
No. 16	24.0
No. 30	18.3
No. 50	14.5
No. 100	11.8
No. 200	9.9

SAMPLE _____ DEPTH _____

DATE SAMPLED _____ SAMPLED BY _____

LAB TEST NUMBER

GRAVEL SIZES		SAND SIZES			FINES
%	%	%	%	%	%
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"

SIEVE SIZE	PERCENT PASSING
3"	
2"	
1 1/2"	
1"	
3/4"	
1/2"	
3/8"	
1/4"	
No. 4	
No. 8	
No. 16	
No. 30	
No. 50	
No. 100	
No. 200	

GOVERNMENT OF CANADA

DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.

CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

DEPOSIT No.

Y94

SUMMARY OF PETROGRAPHIC DATA FOR ROCK SAMPLES

PETROGRAPHIC ANALYSIS

PARTICLE TYPE	PERCENT
Chert	45.5
Quartz	18.0
Argillite fragments	19.0
Shale fragments	9.0
Sandstone fragments	1.0
Matrix and cement	7.5

ROCK NAME: Lithic sandstone

GRAIN SIZE: 0.01 to 9 mm; most grains 0.5 to 2 mm.

GRAIN SHAPE: Angular to subangular, minor subrounded.

MATRIX AND CEMENT: Eighty-eight percent siliceous, remainder argillaceous and limonitic; hard and cohesive.

POROSITY AND PACKING: Negligible porosity; grains are densely packed.

COMMENTS: Relatively competent rock with no identifiable planes of weakness.

NOTE: PETROGRAPHIC ANALYSIS BY DOLMAGE CAMPBELL & ASSOCIATES (1975) LTD.

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO.
Y94-B(e)-1

SUMMARY OF PETROGRAPHIC DATA FOR ROCK SAMPLES

PETROGRAPHIC ANALYSIS

PARTICLE TYPE	PERCENT
Chert	64.0
Argillite fragments	15.5
Detrital quartz & quartzite	7.0
Shale fragments	5.0
Mixed matrix	5.5
Siliceous cement	3.0

ROCK NAME: Chert conglomerate (pebble conglomerate).

GRAIN SIZE: Most grains 2 to 10 mm, remainder finer down to clay size.

GRAIN SHAPE: Coarser grains rounded to subrounded; smaller grains angular to subangular.

MATRIX AND CEMENT: Small interstices filled with matrix; well-cemented as even some fine fractures are filled with cement.

POROSITY AND PACKING: Very low porosity, dense packing of mixed grain sizes.

COMMENTS: Hard, cohesive rock due to cementation and packing. A few uncemented irregular fractures in hand specimen.

NOTE: PETROGRAPHIC ANALYSIS BY DOLMAGE CAMPBELL & ASSOCIATES (1975) LTD.

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO.
Y94-B(e)-2

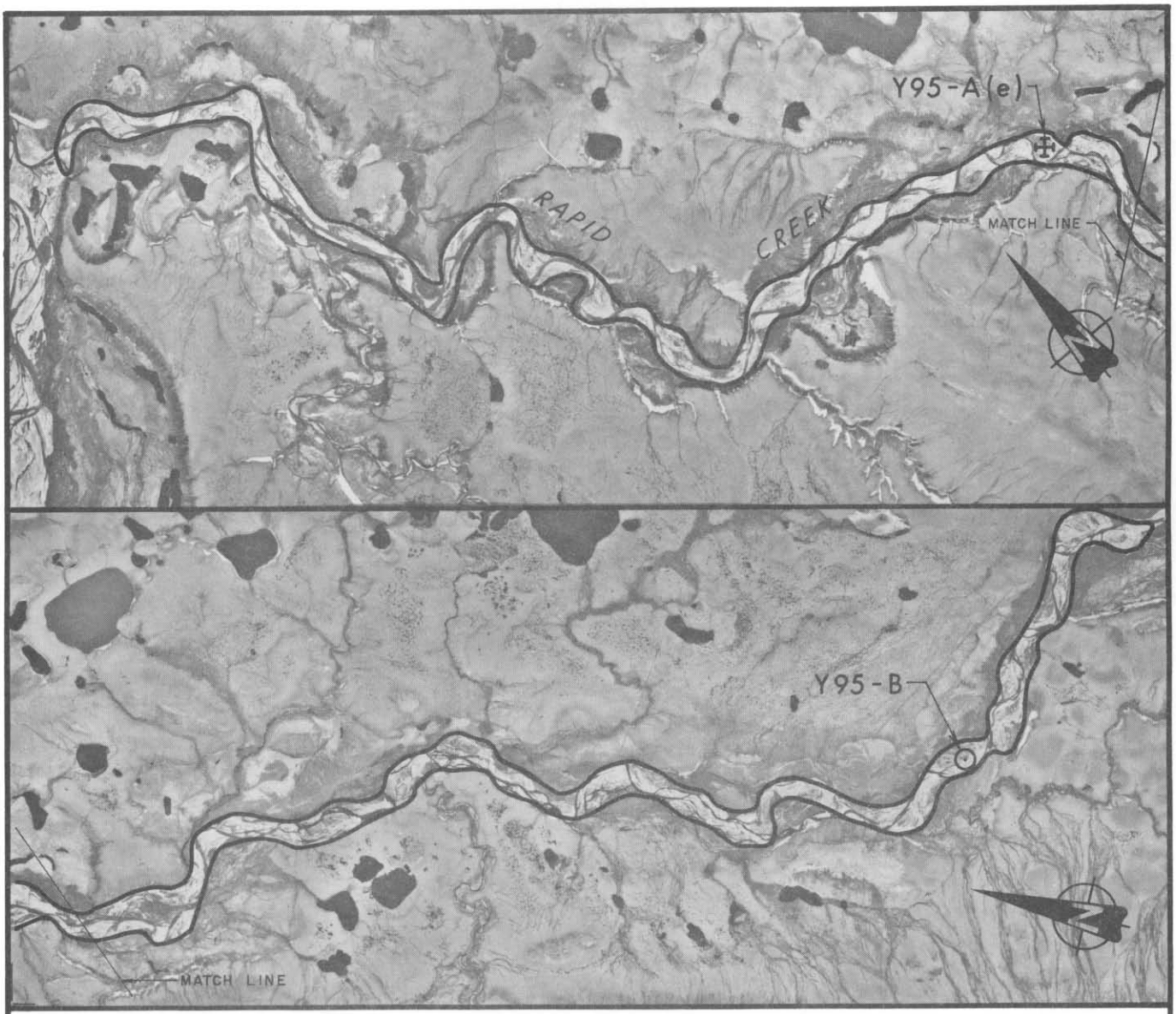
DEPOSIT Y95

Setting: Active floodplain of Rapid Creek.

Material: Gravel; well graded, some fine to coarse sand.

Volume: 46,000,000 cubic yards total.

Assessment: Contains fair to good quality granular material, with a moderate amount of oversize. Extraction will be limited by ground water. Fluvial processes will restore the floodplain to its natural state. Access to the deposit is limited only along the lower reaches where it lies within a canyon.
Recoverable volume may be limited to 5,700,000 cubic yards.



Airphoto No.: A22882-140, 141, 143
Approx. Scale: 1"=4900'
Deposit Outline - R.M. Hardy
Test Pit ⊙
Deposit Outline - Others
Exposures ✠

DEPOSIT Y95

SETTING

Deposit Y95 is the active floodplain of Rapid Creek, which consists of large point bars and large islands, having little vegetation cover. The surface of the floodplain shows a braided pattern of bars and channel beds. Numerous channel traces and scour holes give its surface a local relief of 1 to 2 feet.

The deposit is well drained and free of overburden. Approximately one-half of the active floodplain stands more than 3 feet above low water levels.

The thickness of the active layer is estimated to be in excess of 8 feet. The active layer may be shallower under clumps of willow.

One-third of the floodplain is covered by willow thickets, 6 feet in height. Deposit Y95 is bordered by low narrow well-drained terraces and broader poorly-drained peat-covered terraces. The downstream part of the deposit is inset into a bedrock canyon. Terraces along the upstream part are flanked by morainal deposits.

The terrain is used by waterfowl for feeding and staging, and provides adequate habitat for grizzly bear and moose. Rapid Creek provides spawning and rearing areas for Arctic grayling.

MATERIAL

Deposit Y95 contains fair to good quality granular material consisting of well graded, fine to coarse gravel with some sand. Cobbles, 5 inches in size, are common at test pit Y95-B and boulders, 12 inches in size, are common at test pit Y95-A(e). Silty sand covers the bottom of some channel traces. Larger clasts are mainly subrounded to subangular sandstone. Shale chips predominate the fines.

VOLUME

The total volume of 46,000,000 cubic yards is based on a conservative average depth of 20 feet. Gravel in the bordering terraces is known to be between 20 and more than 30 feet in depth.

Annually, 65,000 cubic yards per 1000 foot length of the floodplain can be extracted by conventional techniques assuming that ground water would limit extractable granular material to a yearly average depth of 3 feet. Volume of recoverable material may be limited to 5,700,000 cubic yards because of ground water conditions.

DEVELOPMENT

Extraction of material from Deposit Y95 would probably be restricted to summer and fall when water levels are low. Areas for stockpiling are available and accessible. The developed areas on the floodplain would be slowly restored by natural fluvial processes as streams of the coastal plain are known to move significant amounts of coarse sediment.

Local access to this deposit is good along the course of Rapid Creek and its adjacent terraces. However, access on the lower reaches of Rapid Creek would be restricted by the bedrock canyon.

Development of Deposit Y95 should be planned to minimize interference with staging of waterfowl or fish activities. The deposit lies within the proposed Arctic Wildlife Range, which may restrict development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	GW		GRAVEL - well graded to 4" cobbles, some fine to coarse sand, occasional cobble, subangular, dark grey, mostly shale, clean.		UF		Lightweight Pieces - Fine Aggregate: 0.11%
2							
3							
4							
5			5.0 ▽ free water at 5.0'.			5.0	
			Bottom of Pit				Sample from 0'-5.0'
6							

DATE: Sept. 28, 1976 | LOGGED BY: JDF | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y95-A(e)

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	GW		GRAVEL - well graded, little fine to coarse black sand, frequent cobbles to 8" size, subangular to subrounded, grey, brown, sandstones.		UF		Organic Color: #2+ Lightweight Pieces - Fine Aggregate: 0.05%
2							
3							
4			4.4 ▽				
			Bottom of Pit				Sample from 0'-4.4'
5							

DATE: Sept. 28, 1976 | LOGGED BY: GCD | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. Y95-B

SHEET 1 OF 1

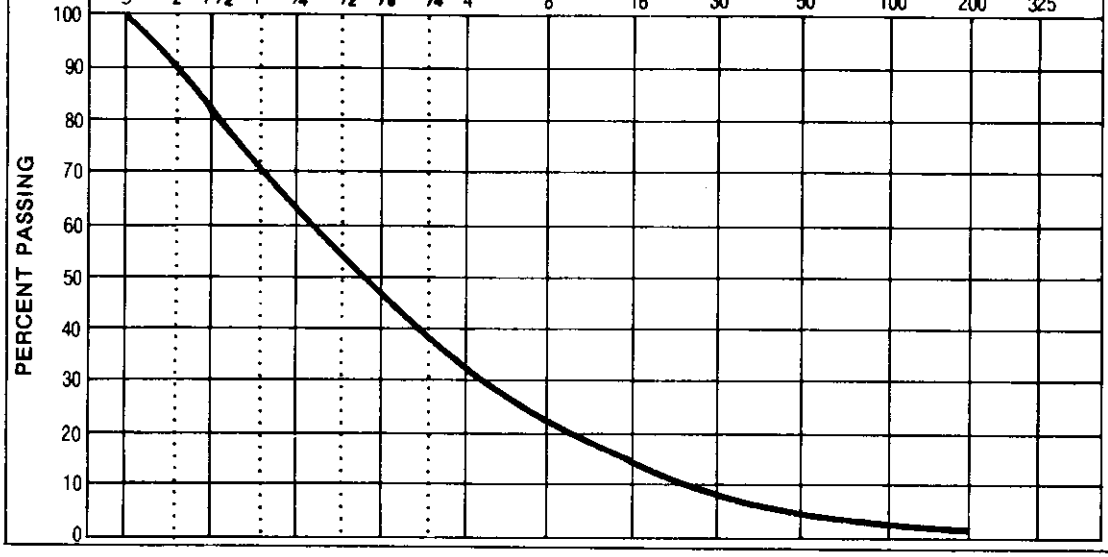
GRAIN SIZE ANALYSIS

SAMPLE Y95-A(e) DEPTH 0'-5.0'

DATE SAMPLED Sept. 28, 1976 SAMPLED BY JDF

LAB TEST NUMBER TP111

GRAVEL SIZES		SAND SIZES			FINES
39.6 %	27.2 %	12.9%	13.8 %	5.0 %	1.5 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
4"	8.2

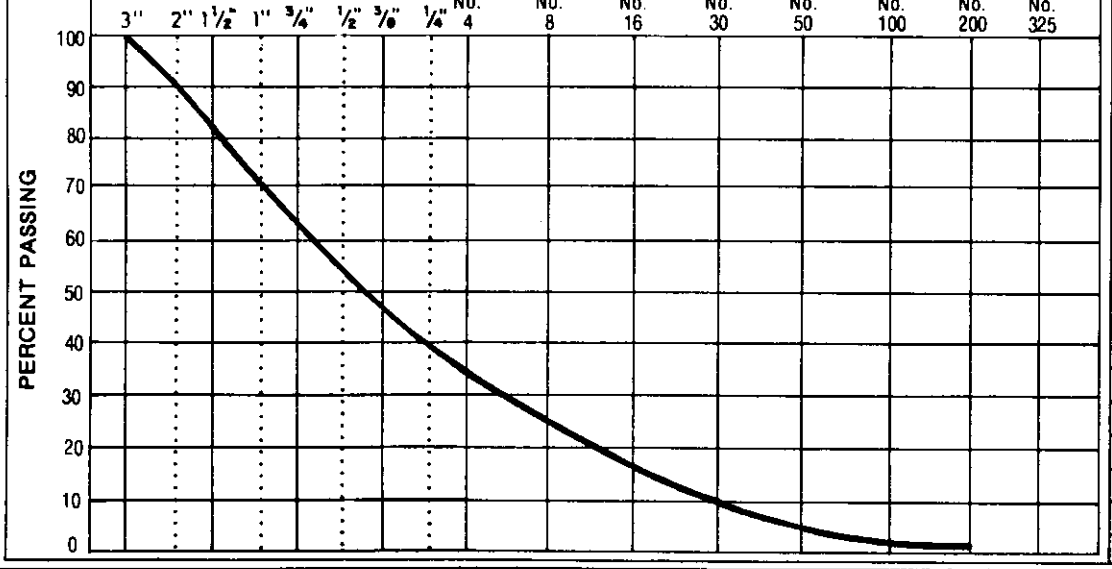
SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	92.8
1 1/2"	80.7
1"	69.2
3/4"	60.4
1/2"	51.4
3/8"	44.5
1/4"	
No. 4	33.2
No. 8	21.5
No. 16	15.6
No. 30	9.4
No. 50	3.7
No. 100	1.9
No. 200	1.5

SAMPLE Y95-B DEPTH 0'-4.4'

DATE SAMPLED Sept. 28, 1976 SAMPLED BY GCD

LAB TEST NUMBER 113HA

GRAVEL SIZES		SAND SIZES			FINES
38.1 %	27.1 %	20.8%	6.5 %	6.0 %	1.5 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
5"	22.7

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	91.0
1 1/2"	81.2
1"	70.1
3/4"	61.9
1/2"	53.0
3/8"	46.6
1/4"	
No. 4	34.8
No. 8	26.5
No. 16	19.0
No. 30	9.9
No. 50	3.7
No. 100	1.9
No. 200	1.5

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No. Y95

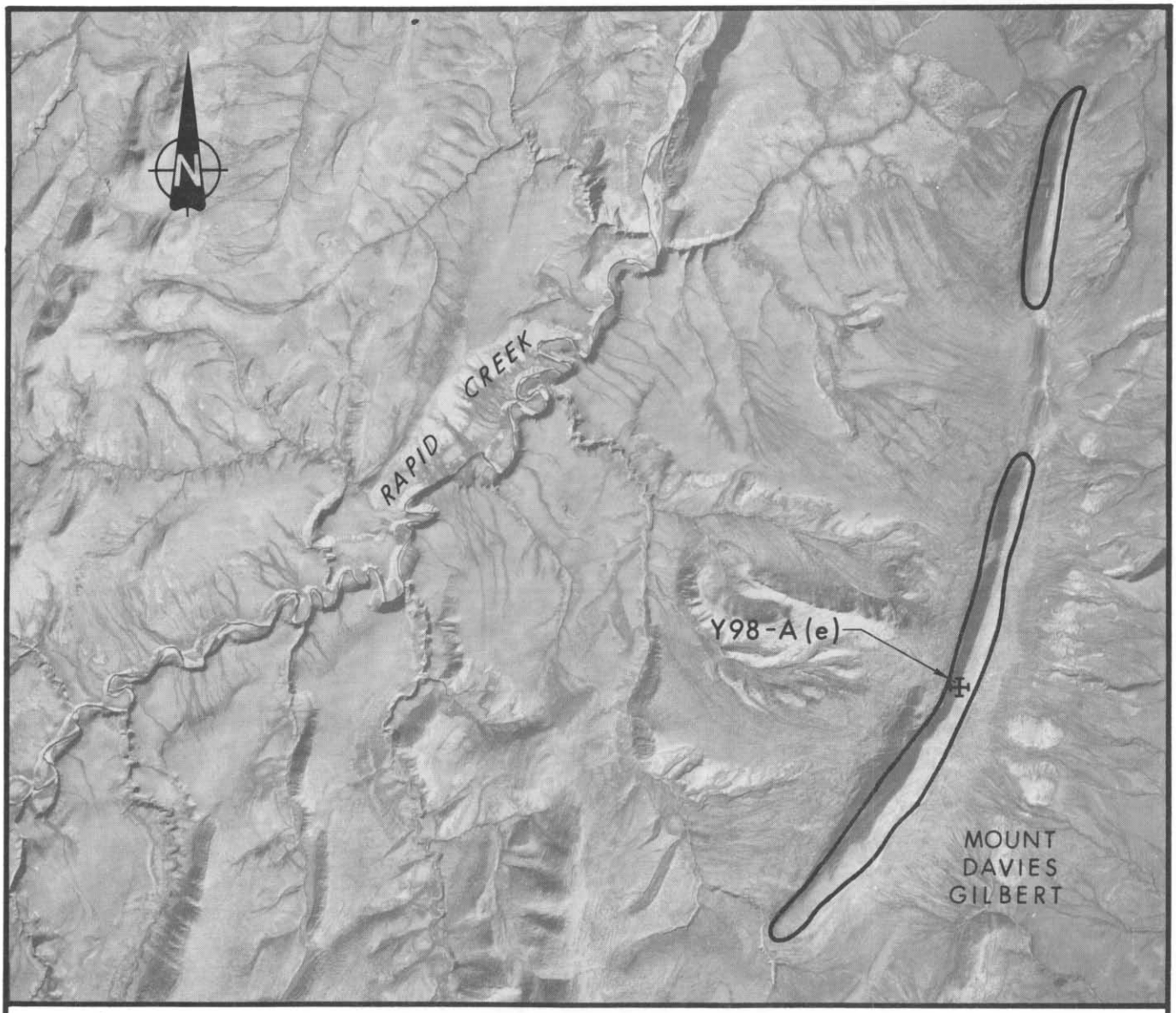
DEPOSIT Y98

Setting: Hogbacks north of and including Mt. Davies Gilbert. Located 18 miles southwest of the mouth of Big Fish River.

Material: Quartzite; rock and rubble.

Volume: 3,900,000 cubic yards total.

Assessment: Contains rock suitable for riprap or aggregate production. Fair access to site.



Airphoto No.: A23838-14		Approx. Scale:	1"=5100'
Deposit Outline - R.M. Hardy	———	Test Pit	⊙
Deposit Outline - Others	—·—·—	Exposures	✠

DEPOSIT Y98

SETTING

Deposit Y98 consists of two hogback ridges, the southern one being Mt. Davies Gilbert. Mt. Davies Gilbert is located 18 miles southwest of the mouth of the Big Fish River.

Mt. Davies Gilbert rises 600 feet above the adjacent terrain, whereas the northern ridge stands only 350 feet above the adjacent terrain. The crests of the ridges are generally less than 50 feet across and have very steep flanks.

Talus is present at the base of both slopes and on the actual slopes themselves. Outcrops are discontinuous. The rock is steeply inclined, and jointed. Joints and fractures produce blocks, 2 to 8 feet to a side, at some outcrops. The rock is a light gray, fine grained quartzite.

Ridge and steep slopes are bare of vegetation. Talus flanking the base of the ridges have patches of sedges and dwarf shrubs on flatter areas.

The rock forming Mt. Davies Gilbert probably belongs to the white and coaly quartzite unit of the Lower Sandstone Division of Early Cretaceous age.

Although gentle slopes are adjacent to the western flank of Deposit Y98, they quickly merge into steeper slopes and the upper canyon of Rapid Creek. Toward the east and north, gently sloping till-mantled slopes with poor drainage and many peat-covered flat areas are present.

The area lies on a major caribou migration route and provides habitat for grizzly bear and possibly nesting areas for raptors.

MATERIAL

Deposit Y98 contains rock suitable for riprap or aggregate production. Angular blocks in the talus up to 6 feet in size and the blocky nature of outcrops indicate that some large blocks are available. The rock is moderately durable as large blocks are present in the talus and is hard to break at the outcrop.

VOLUME

The total volume of 3,900,000 cubic yards assumes that the rock may be quarried to a depth of 30 feet into the ridge and that some talus is available along the base of steep slopes.

DEVELOPMENT

Preliminary blasting and crushing tests to determine breakage characteristics of the rock will be necessary before Deposit Y98 is considered as a source of aggregate or riprap. Development would require blasting and quarrying with materials being mined from benches or at the base of the steep slopes on either side of the hogbacks. Quarrying would locally modify aesthetics.

Access to the coast would be best to the northeast because of gentle slopes, although the terrain may be susceptible to thermokarst. A scarp will need to be descended at the edge of the Mackenzie Delta.

Development should be planned to minimize interference with caribou migration. This deposit lies within the proposed Arctic Wildlife Range, which may restrict development.

SUMMARY OF PETROGRAPHIC DATA FOR ROCK SAMPLES

PETROGRAPHIC ANALYSIS

PARTICLE TYPE	PERCENT
Quartz	98
Chert	2
Hornblende	trace
Pyroxene	trace
Limonite	trace

ROCK NAME: Quartzite

GRAIN SIZE: 0.06 to 0.8 mm; most grains 0.2 to 0.25 mm

GRAIN SHAPE: Angular to subangular.

MATRIX AND CEMENT: Grain boundaries interlocked due to recrystallization and overgrowth of secondary silica.

POROSITY AND PACKING: Packing density extreme reflecting pervasive cementation. Nil porosity (1%).

COMMENTS: Massive with no indication of bedding orientation.

NOTE: PETROGRAPHIC ANALYSIS BY DOLMAGE CAMPBELL & ASSOCIATES (1975) LTD.

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO.
Y98-A(e)

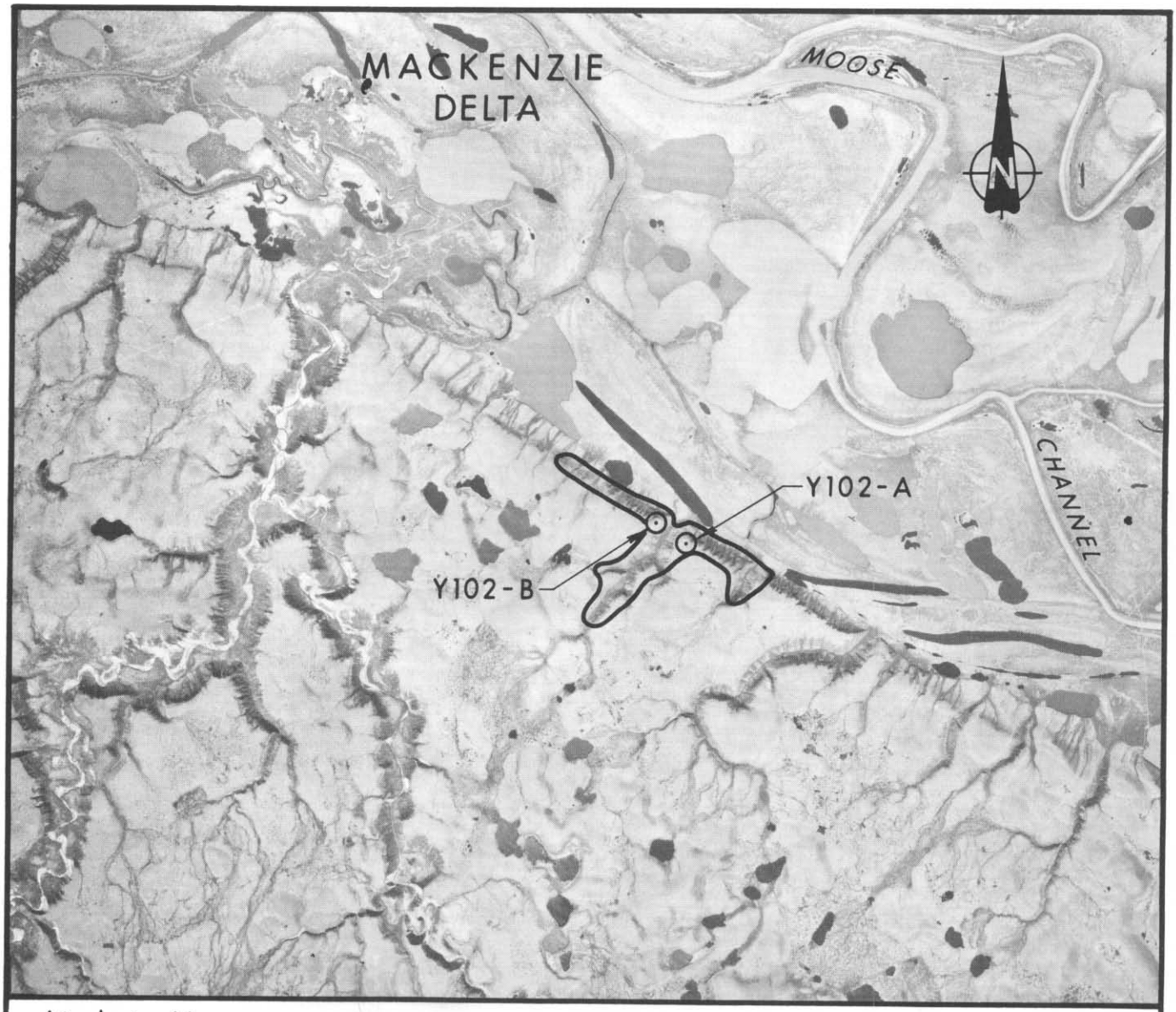
DEPOSIT Y102

Setting: Preglacial fluvial gravels along an escarpment between the mouth of Eagle Creek and the Yukon/Northwest Territories boundary.

Material: Gravel; well graded, fine to coarse, some sand.

Volume: 20,000,000 cubic yards total.

Assessment: Contains good to potentially excellent quality material, although oversize content is significant. Drilling is required to substantiate material depths. Development would be mainly confined to the escarpment. Some overburden removal is required. Access is good.



Airphoto No.: A23816-174
Deposit Outline - R.M. Hardy
Deposit Outline - Others
Approx. Scale: 1"=5000'
Test Pit
Exposures

DEPOSIT Y102

SETTING

Deposit Y102 consists of preglacial gravels along a 300 foot escarpment, located one mile east of where Eagle Creek flows onto the Mackenzie Delta. The morphology of the escarpment suggests that the gravels form at least the upper 100 feet of the escarpment. The gravels, which are overlain by ice-rich morainal deposits, have been exposed by coastal retreat and stream incission. Slumping along the edge of the escarpment has thinned overburden for the first 50 to 100 feet adjacent to the escarpment.

Along the upper edges of the escarpment where the overburden is relatively thin, probably 2 to 8 feet thick, the ground is well drained and covered by tundra characterized by grasses, lichen, and dwarf shrubs. From the area along the edge of the escarpment, the ground slopes gently up to moderately well drained rolling moraine covered by tundra composed of sedge, low willow, and lichen.

The escarpment is well drained and covered by broken xeric tundra. A few alder thickets are present on the lower part of the north-facing escarpment. Below Deposit Y102, the Mackenzie Delta is covered by poorly drained sedge tussock tundra and sedge meadows. A few peat-covered areas covered by lichen and mosses are better drained.

The whole area is critical to feeding and staging activities of waterfowl. The area also provides habitat for grizzly bear and caribou. Numerous burrows have been dug near the top of the escarpment. Raptors may nest along the escarpment.

MATERIAL

Deposit Y102 probably contains good to potentially excellent quality granular material if thick preglacial gravels exposed at Deposit

Y100, examined by Northern Engineering Services Co. Ltd. and found to be of excellent quality, are equivalent strata. The material consists of well graded, fine to coarse gravel with some sand. Oversize material appears to form a major part with boulders to 18 inches in size. Larger clasts are mainly subrounded to subangular sandstone. Preglacial gravels generally have very low ice contents.

VOLUME

The total volume of the deposit is estimated to be 20,000,000 cubic yards based on a conservative depth estimate of 60 feet. This volume could be significantly increased by including areas to the southwest underlain by gravel, but having substantial thickness of overburden.

Annually, 9,000 cubic yards could be extracted by conventional techniques per 1000 foot length along the scarp.

DEVELOPMENT

Before development of Deposit Y102, additional drilling is recommended to determine depths, extent of overburden, and material quality.

Development would involve excavating gravel from the face and along the top of the escarpment. Significant overburden would need to be removed if the pit were developed for any distance inland.

The edges of the large ravines interrupting the main escarpment offer sites for development that would not be easily visible from the Mackenzie Delta and would minimize alteration of aesthetics in the area.

Winter access to the deposit is good across the frozen lakes and channels of the Mackenzie Delta. Rolling morainic topography which is susceptible to thermokarst and the presence of an escarpment deters inland access.

Development should be planned to minimize interference with the staging of waterfowl. Deposit Y102 lies within the proposed Arctic Wildlife Range, which may restrict development.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
0	Pt		0.2 PEAT - fine, fibrous.		UF		Lightweight Pieces - Fine Aggregate: 0.11%
1	CI		CLAY - medium plastic, some gravel, few cobbles and boulders to 10" size, brown, damp to wet.				
2							
3					Vc-Vx 20%	2.7	
4			4.2				
5	GW		GRAVEL - well graded to 6" cobbles, some fine to coarse sand, sub-angular to subrounded, well bonded.				
			5.5				
6			Bottom of Pit				Sample from 4.2'-5.5'

DATE: Oct. 9, 1976 | LOGGED BY: CPM | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y102-A

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
	Pt		0.5 PEAT - fine, fibrous.		UF		
1	SM		SAND - some gravel, little silty fines, occasional cobbles.				
			1.7				
2	GW		GRAVEL - well graded to 13" boulders, little fine to coarse sand, trace fines, subangular to subrounded.				
3							
4							
5			5.5				
6			Bottom of Pit				Sample from 1.7'-5.5'

DATE: Oct. 12, 1976	LOGGED BY: CPM	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y102-B

SHEET 1 OF 1

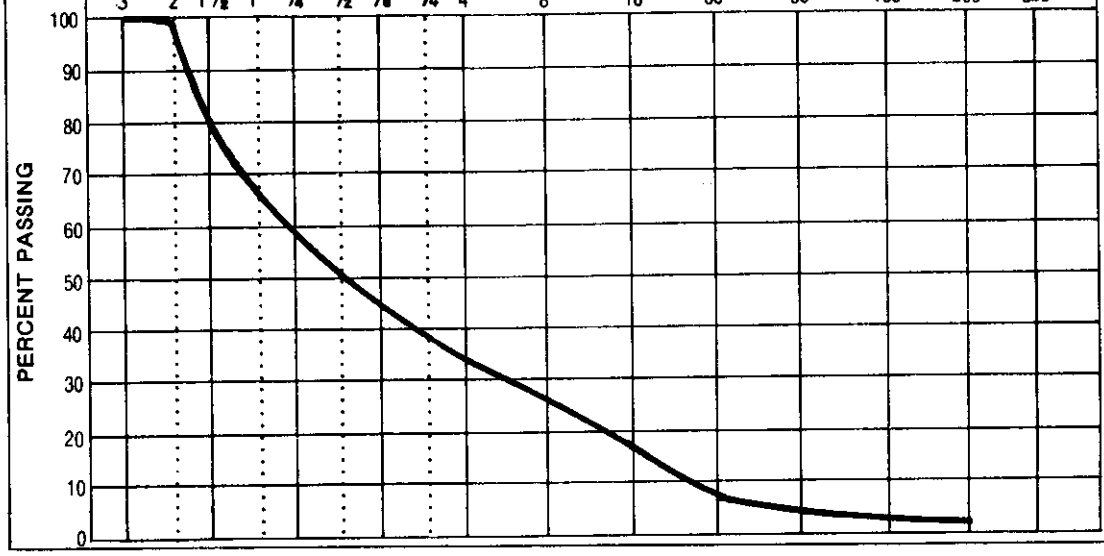
GRAIN SIZE ANALYSIS

SAMPLE Y102-A DEPTH 4.2'-5.5'

DATE SAMPLED Oct. 9, 1976 SAMPLED BY CPM

LAB TEST NUMBER 139HA

GRAVEL SIZES		SAND SIZES			FINES
40.6 %	25.8 %	8.6 %	19.5 %	3.1 %	2.4 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
4"	10.5

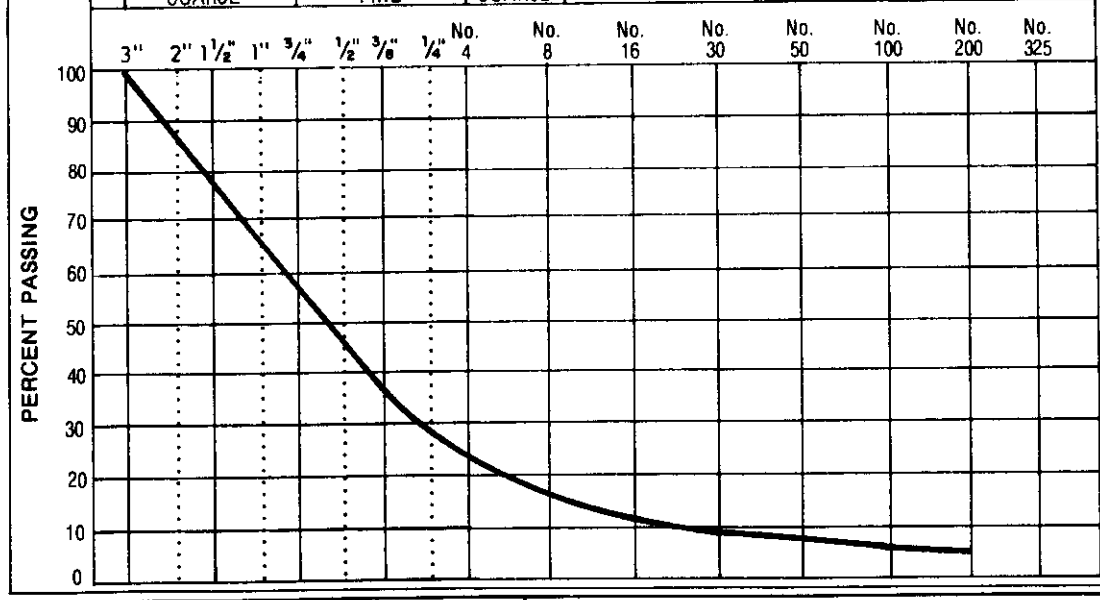
SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	100.0
1 1/2"	79.3
1"	68.0
3/4"	59.4
1/2"	50.8
3/8"	45.1
1/4"	
No. 4	33.6
No. 8	27.3
No. 16	17.0
No. 30	7.3
No. 50	4.1
No. 100	3.1
No. 200	2.4

SAMPLE Y102-B DEPTH 1.7'-5.5'

DATE SAMPLED Oct. 12, 1976 SAMPLED BY CPM

LAB TEST NUMBER 139HA(B)

GRAVEL SIZES		SAND SIZES			FINES
43.1 %	33.4 %	7.5 %	7.5 %	4.3 %	4.2 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
7"	25.0

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	86.5
1 1/2"	76.1
1"	66.1
3/4"	56.9
1/2"	46.6
3/8"	38.2
1/4"	
No. 4	23.5
No. 8	16.7
No. 16	12.7
No. 30	9.9
No. 50	7.2
No. 100	5.3
No. 200	4.2

GOVERNMENT OF CANADA

DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.

CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

DEPOSIT No. Y102

SUMMARY OF LABORATORY TEST DATA FOR SUITABILITY OF AGGREGATES IN CONCRETE

PETROGRAPHIC ANALYSIS
COARSE AGGREGATE

ROCK TYPE	CLASSIFICATION	TOTAL WEIGHTED COMPONENT %
Quartzite	Strong to very strong, Good	7.1
Quartzitic Sandstone		92.2
Sandstone		0.5
Fragile Siliceous	Friable, Poor	0.1
Siltstone		
Flint	Potentially reactive, Fair	0.1
PN:= 101	INTERPRETATION: Excellent quality for coarse aggregate	100.0

SOUNDNESS OF AGGREGATE - SULPHATE TEST

COARSE AGGREGATE: LOSS= 2.01%

FINE AGGREGATE: LOSS= 14.34%

OTHER TESTS

LIGHTWEIGHT PIECES IN AGGREGATE: FINE: 0.32%

SPECIFIC GRAVITY: FINE: 2.64, COARSE: 2.63

WATER ABSORPTION: FINE: 3.18%, COARSE: 1.50%

ORGANIC IMPURITIES TEST

NUMBER	: 2+
COAL REMOVED	:
COAL & ROOTLETS REMOVED	:
COAL CONTENT	: 0.32%

COMMENTS: Sulphate Test was performed for 5 cycles in Magnesium Sulphate solution.
Specific Gravity Test was performed at 20°C.
Lightweight Pieces were determined by floating on Zinc Chloride solution with a specific gravity of 2.0.

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO.
Y102-B

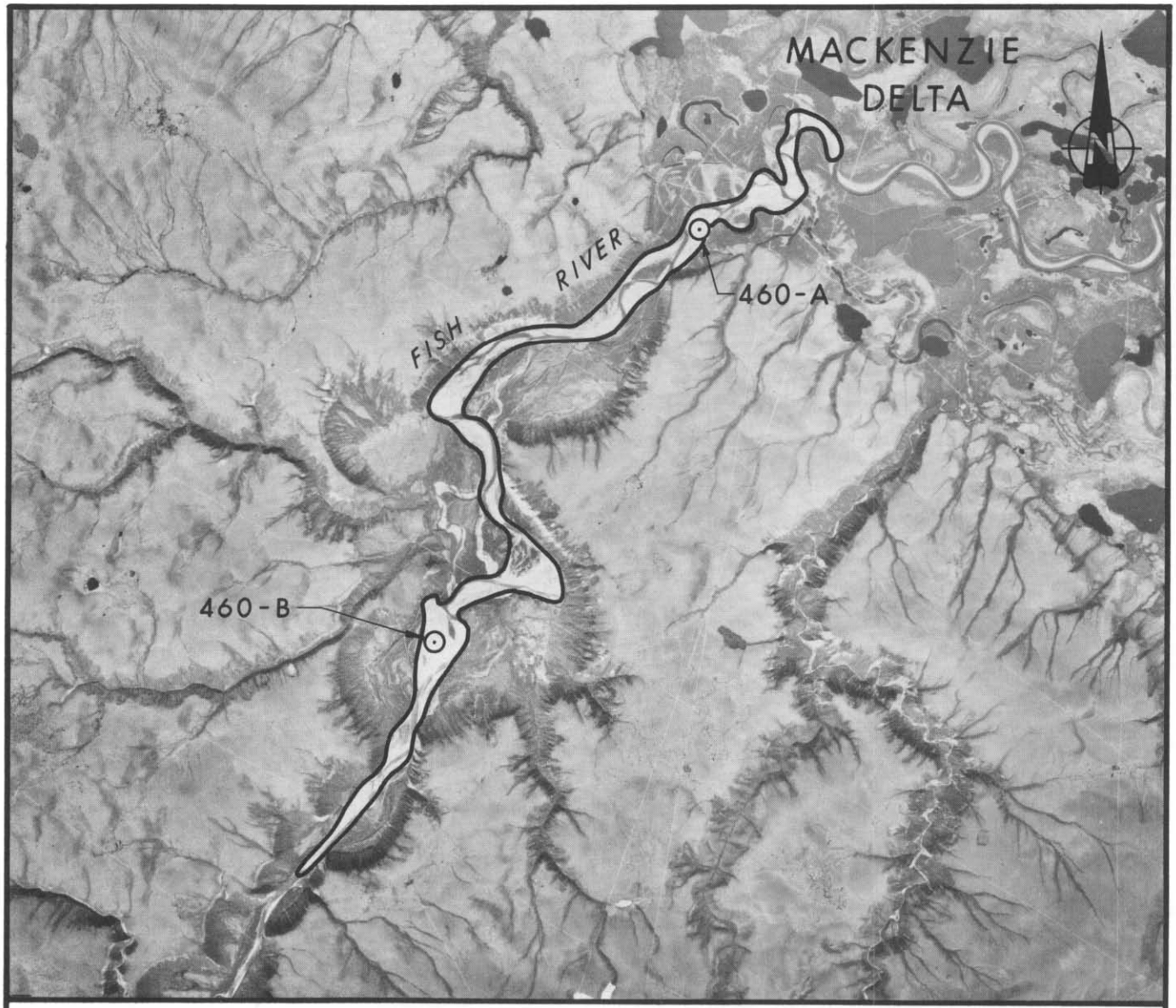
DEPOSIT 460

Setting: Active floodplain of the lower reaches of the Fish River.

Material: Gravel; poor to well graded, fine to coarse, little sand.

Volume: 25,000,000 cubic yards total.

Assessment: Contains good to excellent quality granular material with moderate amount of oversize. Extraction will be limited by ground water. Natural fluvial processes will restore developed pits. Access is limited due to the steep canyon walls.



Airphoto No.: A23816-132
Deposit Outline - R.M. Hardy
Deposit Outline - Others
Approx. Scale: 1"=5000'
Test Pit ⊙
Exposures ✣

DEPOSIT 460

SETTING

Deposit 460 is the active floodplain of the lower reaches of the Fish River, consisting of large point bars having channel traces and scour holes on their surface.

The deposit is well-drained and free of overburden. However, in addition to normal springtime flooding, the downstream part of the deposit may be affected by fall storm surges on Mackenzie Bay. Over half of the floodplain surface is more than 3 feet above low water levels. The thickness of the active layer is estimated to be in excess of 8 feet.

Patchy herbaceous plants and willow shrubs cover less than 5 percent of the floodplain surface. Some driftwood is present on the surface. The Fish River is used by a number of fish species including Arctic grayling, Arctic char, round whitefish and burbot.

Deposit 460 and adjoining low fluvial terraces, which are covered by willow and alder thickets, 8 feet high, lie within a deep bedrock canyon. This terrain provides habitat for grizzly bear and wolverine. The Mackenzie Delta, a choice habitat for waterfowl, is north of Deposit 460.

MATERIAL

Deposit 460 contains good to excellent quality granular material consisting of stratified, poor to well graded, fine to coarse, gravel with little sand. Cobbles to 5 inches are common in the gravel. Some sandy layers are present within the deposit. The bottom of channel traces and scour holes are often covered by sand. Larger clasts are commonly subrounded to rounded sandstone and quartzite with rare quartz, granitics, conglomerate and black chert. Shale chips predominate the fines.

VOLUME

The total volume of 25,000,000 cubic yards is based on a conservative depth of 30 feet. Gravel under parts of the lower canyon of the Fish River is known to locally exceed 75 feet in thickness.

Annually, 78,000 cubic yards per 1000 foot length of floodplain can be extracted by conventional techniques assuming that ground water limits the extractable granular material to an average depth of 3½ feet.

DEVELOPMENT

Extraction of material from Deposit 460 should be confined to summer and fall when water levels are low. Large areas would be required for recovery of comparatively small volumes. Adequate areas are available for stockpiling, although care should be taken to avoid destroying large areas of shrubbery adjacent to this deposit.

Developed areas would be restored to a natural state by fluvial processes as streams of this area are known to move significant amounts of coarse sediment.

Access to this deposit is restricted to the stream course because of the canyon walls. Winter access from the coast can be attained across the delta and along delta channels.

Development of Deposit 460 should be planned to minimize interference with fish activities.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	GW		GRAVEL - well graded to 5" cobbles, some fine to coarse sand, subrounded, medium dense, grey, wet.				
2							
3							
4							
5			5.0 ▽			5.0	water running into hole.
			Bottom of Pit				Sample from 0'-5.0'
6							

DATE: Oct. 9, 1976	LOGGED BY: SA	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. 460-A

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
0	GW		GRAVEL - well graded to 5" size, little fine to coarse sand, trace silty fines, subrounded to rounded, grey, moist.		UF		Lightweight Pieces - Fine Aggregate: 0.06%
1							
2							
3							
4							
4.5			wet.				
5			free water at 5.4'				
5.4			Bottom of Pit			5.4	Sample from 0'-5.4'
6							

DATE: Oct. 11, 1976 | LOGGED BY: SA | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. 460-B
SHEET 1 OF 1

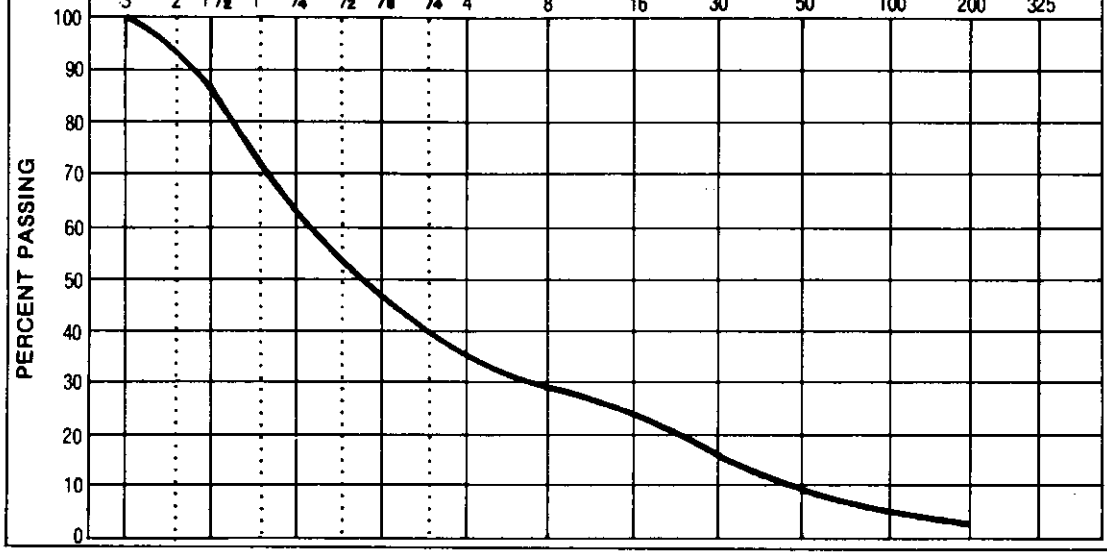
GRAIN SIZE ANALYSIS

SAMPLE 460-A DEPTH 0'-5.0'

DATE SAMPLED Oct. 9, 1976 SAMPLED BY SA

LAB TEST NUMBER 131HA

GRAVEL SIZES		SAND SIZES			FINES
36.3 %	29.6 %	6.1 %	15.5 %	10.0 %	2.5 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
5"	13.6

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	95.3
1 1/2"	86.9
1"	72.9
3/4"	63.7
1/2"	53.5
3/8"	46.2
1/4"	
No. 4	34.1
No. 8	29.9
No. 16	25.1
No. 30	16.1
No. 50	8.0
No. 100	4.0
No. 200	2.5

SAMPLE 460-B DEPTH 0'-5.4'

DATE SAMPLED Oct. 11, 1976 SAMPLED BY SA

LAB TEST NUMBER 132HA

GRAVEL SIZES		SAND SIZES			FINES
37.8 %	16.9 %	7.8 %	24.5 %	10.7 %	2.3 %
COARSE	FINE	COARSE	MEDIUM	FINE	

MAX. SIZE	% > 3"
4"	18.5

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	87.1
1 1/2"	75.6
1"	68.0
3/4"	62.2
1/2"	56.3
3/8"	52.9
1/4"	
No. 4	45.3
No. 8	38.3
No. 16	31.5
No. 30	19.8
No. 50	8.0
No. 100	3.3
No. 200	2.3

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No. 460

SUMMARY OF LABORATORY TEST DATA FOR SUITABILITY OF AGGREGATES IN CONCRETE

PETROGRAPHIC ANALYSIS

COARSE AGGREGATE

ROCK TYPE	CLASSIFICATION	TOTAL WEIGHTED COMPONENT %
Quartzite	Strong to very strong, Good	12.5
Quartzitic Sandstone		58.4
Sandstone		26.6
Cherty conglomerate	Potentially reactive, Fair	1.4
Chert, flint, opal,		1.0
jasper		
Weak sandstone	Weak, Poor	0.1
PN:= 106	INTERPRETATION: Good quality for aggregate	100.0

SOUNDNESS OF AGGREGATE - SULPHATE TEST

COARSE AGGREGATE: LOSS= 17.56

FINE AGGREGATE: LOSS= 29.56

OTHER TESTS

LIGHTWEIGHT PIECES IN AGGREGATE: FINE: 0.06%

SPECIFIC GRAVITY: FINE: 2.61, COARSE: 2.54

WATER ABSORPTION: FINE: 3.69%, COARSE: 2.79%

ORGANIC IMPURITIES TEST

NUMBER	:	2+
COAL REMOVED	:	
COAL & ROOTLETS REMOVED	:	
COAL CONTENT	:	0.06%

COMMENTS: Sulphate test was performed for 5 cycles in Magnesium Sulphate solution. Visible signs of crumbling in both fine and coarse fractions after 3 cycles.
Specific Gravity test was performed at 20°C.
Lightweight Pieces were determined by floating on Zinc Chloride solution with a Specific Gravity of 2.0.

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. 460-A

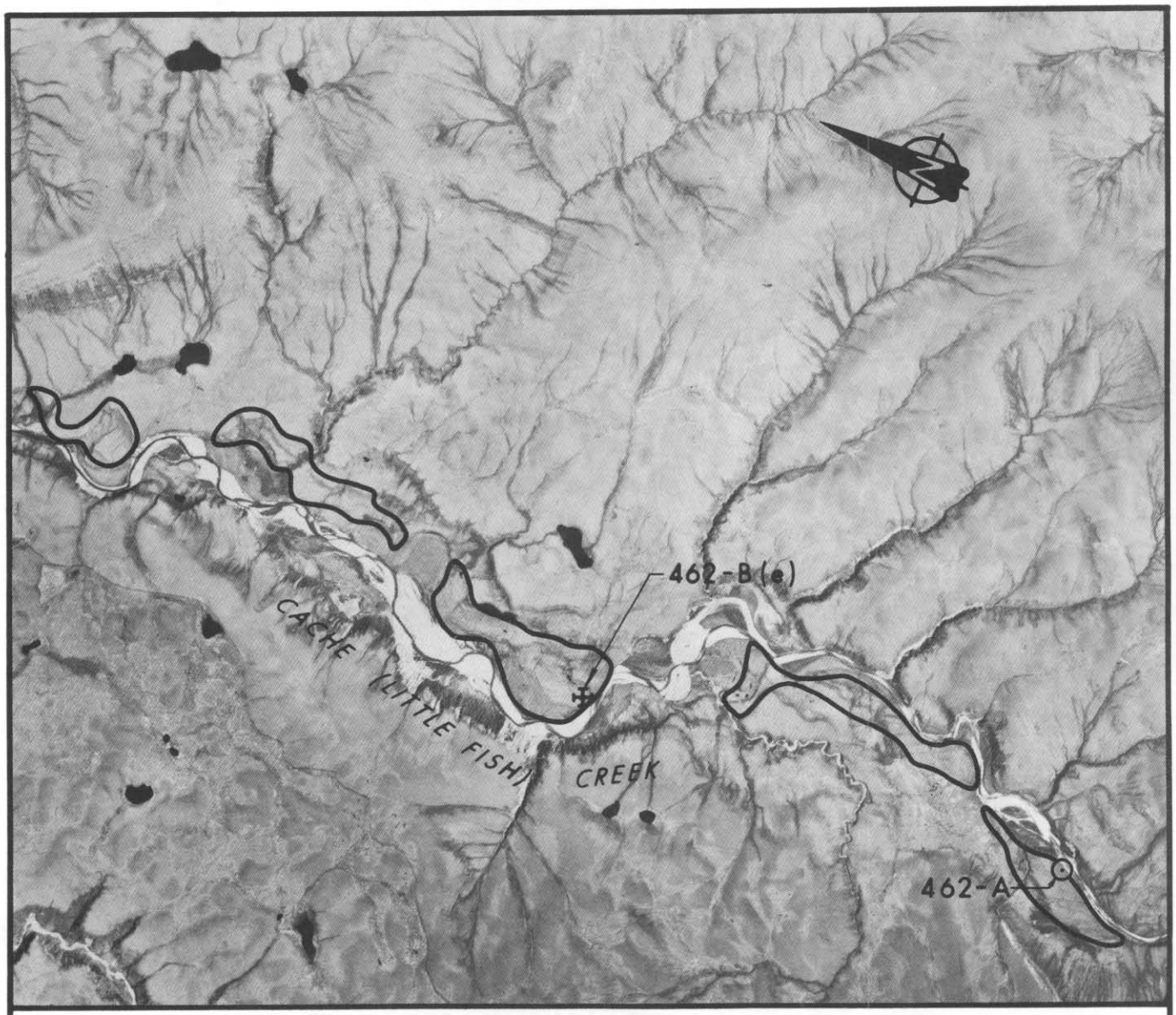
DEPOSIT 462

Setting: Fluvial terraces along lower reaches of Cache (Little Fish) Creek.

Material: Gravel; coarse to fine, and sand, little fines.

Volume: 16,500,000 cubic yards total.

Assessment: Contains fair to good quality material. Further investigation is recommended to determine overburden thicknesses. Access is moderately difficult.
Recoverable volume may be limited to 5,600,000 cubic yards.



Airphoto No.: A23816-135		Approx. Scale:	1"=4700'
Deposit Outline - R.M. Hardy	———	Test Pit	⊙
Deposit Outline - Others	—·—·—	Exposures	✣

DEPOSIT 462

SETTING

Deposit 462 consists of a number of fluvial terraces along the lower reaches of Cache (Little Fish) Creek. Steep bedrock cliffs 30 to 120 feet high are capped by fluvial gravels. Scarps 10 to 60 feet high separate the different terrace levels within the deposit.

Although the terraces are usually free of overburden and well drained, parts are covered with thin to moderate thicknesses of organic silt or peat overburden, 2 to 10 feet thick, and are locally poorly drained. The thickness of the active layer was not determined, but is estimated to be 2 to 3 feet under most areas covered by overburden.

Most of Deposit 462 is covered by sedge tussock tundra characterized by mosses, ericaceous shrubs, and dwarf shubs growing between sedge hummocks. Poorly drained areas are covered by sedge meadows. Deposit 462 and adjacent areas provide habitat for caribou and grizzly bear. Cache Creek is inhabited by Arctic grayling, Arctic char, and whitefish.

MATERIAL

Deposit 462 contains fair to good quality granular material, consisting of stratified gravel and sand with varying fines content. The gravel is coarse to fine grained. At test pit 462-A where 35 feet of gravel locally overlies the bedrock, the lower beds are bouldery and cobbles are common throughout. Some strata are deeply iron-stained. Larger clasts are mainly subangular to subrounded sandstone. Shale chips dominate the fines.

VOLUME

A total volume of 8,500,000 cubic yards for the northern and north central segments is based on an estimated depth of 15 feet. A total volume of 6,500,000 cubic yards is estimated for the south central segment based on an average thickness of 30 feet. A total volume of 1,500,000 cubic yards is estimated for the southern segment based on a depth of 10 feet where gravels may locally be 35 feet thick, but average only 10 feet in most exposures.

Annually, 8,700 cubic yards per acre could be extracted by conventional techniques assuming that permafrost limits annual extraction to 6 foot depths. This would be a long-term annual average as extraction during the first year would be much less where overburden is present. Volume of recoverable material may be limited to 5,000,000 cubic yards because of permafrost table.

DEVELOPMENT

Further drilling and test pitting would be required to delineate areas of good quality material and thin overburden. Extraction would require the stripping and disposal of overburden except near the scarp edges. Pits would most easily be developed by excavating benches along scarps where thaw rates will be maximum and drainage could be easily maintained. Also the pit could be easily blended into the terraced landscape with only minor grading upon abandonment.

Access to this pit involves crossing moderate to steep uplands covered with ice-rich colluvium and till or moving along Cache Creek and Big Fish River canyons to the north. The latter would involve finding a good slope to ascend from the Cache Creek floodplain to the terrace surfaces. Development should be planned to minimize interference with any fish activities in Cache Creek.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	Pt	1.3	PEAT - fine, fibrous		UF		Organic Color: #5+ Coal removed: #4 Lightweight Pieces - Fine Aggregate: 0.35%
2	ML	2.4	SILT - clayey, little gravel to 3" size trace organics, low plastic, brown, moist.				
3	GW		GRAVEL - well graded to 3" size, some fine to coarse sand, occasional cobble to 7" size, trace silty fines, trace organics, sub-angular to subrounded, brown, damp.				Gravel extends down exposure 30' below bottom of pit; the lower 15' is bouldery and iron-stained.
4							
5		5.2					
6			Bottom of Pit				Sample from 2.4'-5.2'

DATE: Oct. 12, 1976 | LOGGED BY: CPM | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. 462-A
SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
	Pt		PEAT - fibrous, brown, wet		UF		Lightweight Pieces - Fine Aggregate: 0.13%
1.0							
2	GW		GRAVEL - well graded to 5" cobbles, little fine to coarse sand, trace clayey fines, brown, medium dense, damp.				
4							
6							
8							
10							
12							
14							
16							
18							Gravel extends down exposure 20' below bottom of pit; 40' of shale exposed below base of gravel.
20							
22.0							
22			Bottom of Pit				Sample from 1.0'-22.0'

DATE: Oct. 12, 1976	LOGGED BY: SA	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. 462-B(e)

SHEET 1 OF 1

GRAIN SIZE ANALYSIS

SAMPLE 462-A DEPTH 2.4'-5.2'
DATE SAMPLED Oct. 12, 1976 SAMPLED BY CPM
LAB TEST NUMBER 116HA

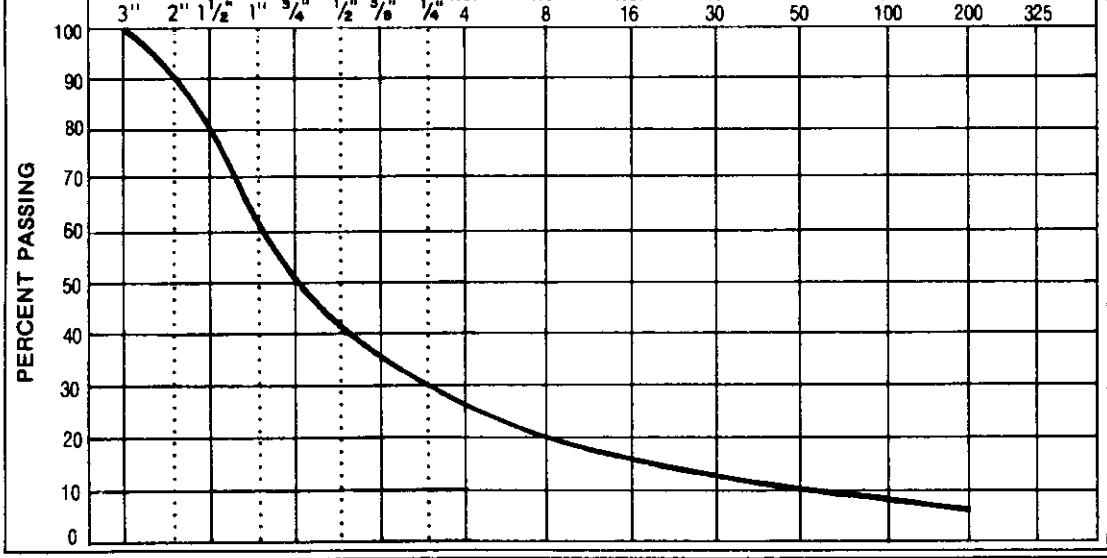
GRAVEL SIZES		SAND SIZES			FINES
35.5 %	30.3 %	6.4%	8.8 %	9.9 %	9.1 %
COARSE	FINE	COARSE	MEDIUM	FINE	

MAX. SIZE	% > 3"
4"	1.0

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	95.5
1 1/2"	87.4
1"	72.8
3/4"	64.5
1/2"	53.3
3/8"	46.8
1/4"	
No. 4	34.2
No. 8	28.1
No. 16	24.7
No. 30	22.3
No. 50	16.6
No. 100	12.0
No. 200	9.1

SAMPLE 462-B(e) DEPTH 1.0'-22.0'
DATE SAMPLED Oct. 12, 1976 SAMPLED BY SA
LAB TEST NUMBER 117HA

GRAVEL SIZES		SAND SIZES			FINES
47.6 %	27.3 %	6.3 %	6.8 %	5.5 %	6.5 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
4"	4.0

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	85.5
1 1/2"	72.9
1"	59.8
3/4"	52.4
1/2"	42.0
3/8"	35.8
1/4"	
No. 4	25.1
No. 8	20.8
No. 16	16.4
No. 30	12.7
No. 50	10.2
No. 100	8.6
No. 200	6.5

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No. 462

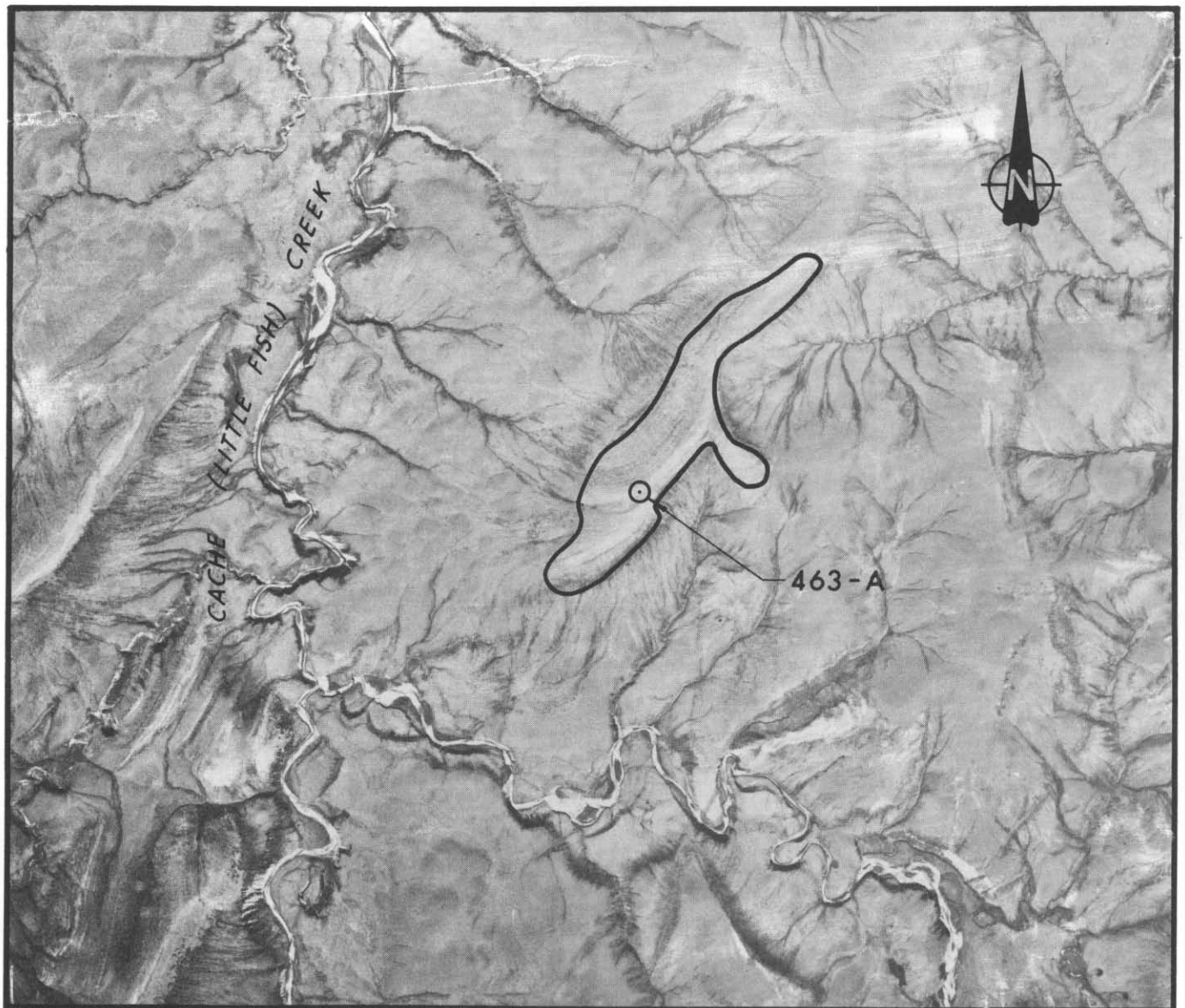
DEPOSIT 463

Setting: Scree-covered ridge, 2 miles west of Cache (Little Fish) Creek at a point 10 miles above its confluence with the Fish River.

Material: Quartz sandstone rubble.

Volume: 4,100,000 cubic yards total.

Assessment: Contains fair quality granular material. The rock fractures easily and is not very durable. Access to the deposit is difficult.



Airphoto No.: A23816-136		Approx. Scale:	1"=4700'
Deposit Outline - R.M. Hardy	———	Test Pit	⊙
Deposit Outline - Others	—·—·—	Exposures	✠

DEPOSIT 463

SETTING

Deposit 463 consists of a broad ridge about 2 miles west of a point on Cache (Little Fish) Creek located 10 miles above its confluence with the Big Fish River. The deposit is 9 miles east of the Yukon-Northwest Territories boundary.

The ridge is rounded with gentle to moderate slopes and stands about 500 feet above the level of the adjacent lowland. Cache Creek lies 1000 feet below the ridge.

The ridge is covered by platy sandstone rubble. The ridge surface is well drained and bare of vegetation. Local patterned ground is present with shallow trenches separating small mounds, 30 feet across. Deposit 463 is bare of vegetation except for patches of moss, sedges, lichen and ericaceous shrubs.

The parent rock of this deposit is part of the Jurassic Bug Creek Formation. Presumably, sandstones in similar nearby outcrops have the same characteristics as those at Deposit 463.

Deposit 463 is bordered by rolling terrain with bedrock blanketed by ice-rich morainal deposits. Creeks have been incised two to five hundred feet into the upland as they grade into major streams flowing in deep canyons. The area provides habitat for grizzly bear and caribou.

MATERIAL

Deposit 463 contains only fair quality granular material. The sandstone appears to weather rapidly to a fine sand. Platy sandstone fragments present on the surface are usually ½ to 2 inches thick and 3 to 15 inches across. The sandstone appears to lack the strength and durability to provide material for riprap.

VOLUME

The total volume of 4,100,000 cubic yards is based on an average depth of 6 feet to competent rock. This volume could be increased if the underlying rock was ripped or quarried.

Annually, 10,000 cubic yards per acre could be extracted by conventional techniques if only the disintegrated rock was removed.

DEVELOPMENT

Development of Deposit 463 would involve only conventional scraping unless the underlying rock was quarried. Large-scale development would certainly modify local aesthetics.

Access to the deposit would be difficult as it requires the crossing of many moderate slopes even if vehicle travel was confined to ridge tops. Some of the slopes may be susceptible to thermokarst.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
0	GP		GRAVEL - rock fragments to 8" size, trace silty sand, blocky, angular, brown, predominantly sandstone, siltstone.		UF		
2.6	SP		SAND - fine, trace silty fines, angular rock fragments to 6" size, brown, moist.				
3.8			Bottom of Pit				Sample from 0'-2.5'

DATE: Oct. 12, 1976 | LOGGED BY: SA | DRWN BY: MB/vh | CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. 463-A

SHEET 1 OF 1

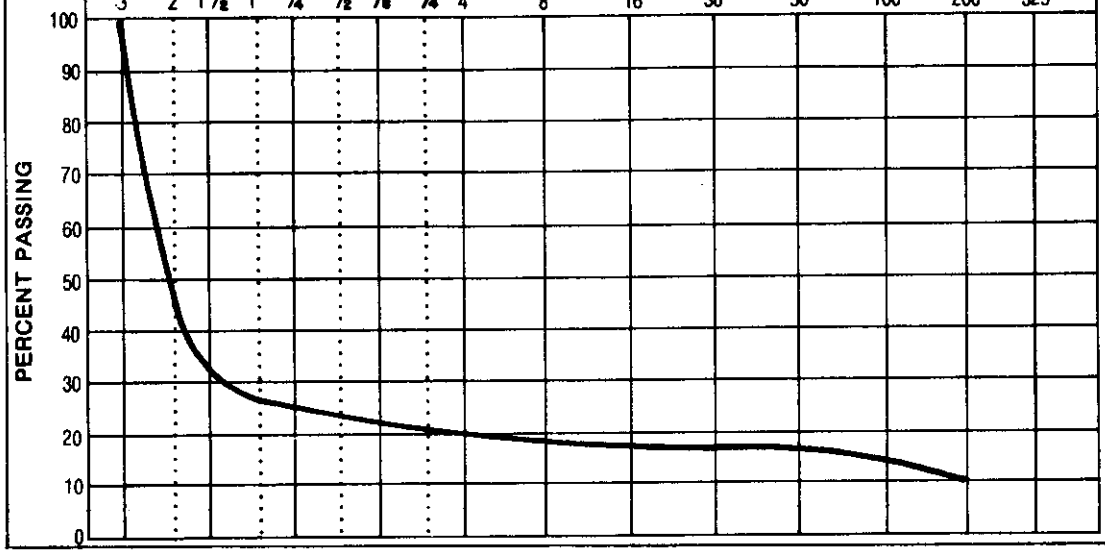
GRAIN SIZE ANALYSIS

SAMPLE 463-A DEPTH 0'-2.5'

DATE SAMPLED Oct. 12, 1976 SAMPLED BY SA

LAB TEST NUMBER 115HA

GRAVEL SIZES		SAND SIZES			FINES
74.4 %	5.0 %	2.6 %	1.0 %	7.0 %	10.0 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
6"	61.9

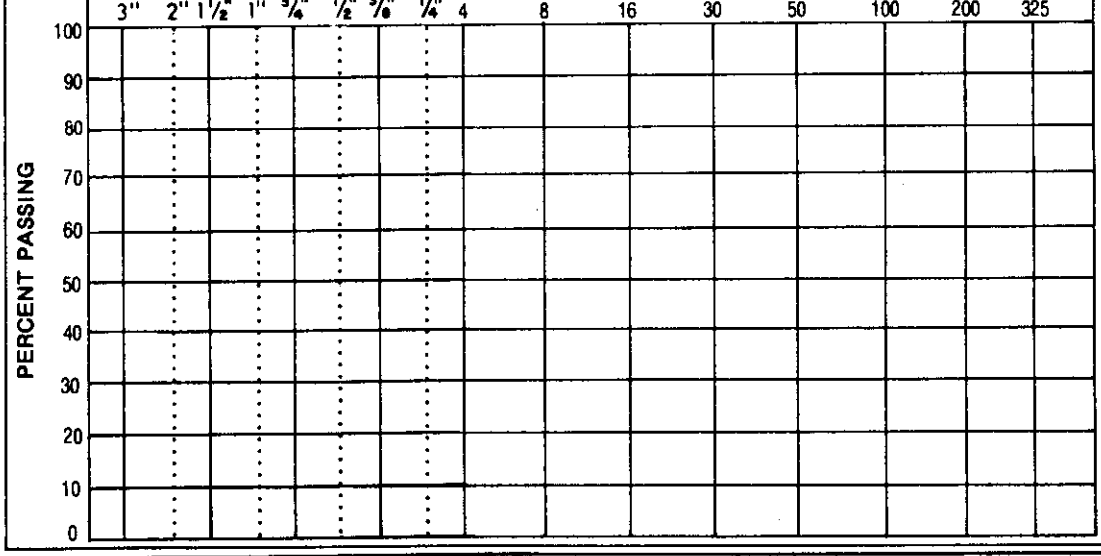
SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	46.8
1 1/2"	30.7
1"	27.0
3/4"	25.6
1/2"	23.6
3/8"	22.8
1/4"	
No. 4	20.6
No. 8	18.8
No. 16	17.7
No. 30	17.0
No. 50	16.7
No. 100	16.3
No. 200	10.0

SAMPLE _____ DEPTH _____

DATE SAMPLED _____ SAMPLED BY _____

LAB TEST NUMBER

GRAVEL SIZES		SAND SIZES			FINES
%	%	%	%	%	%
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"

SIEVE SIZE	PERCENT PASSING
3"	
2"	
1 1/2"	
1"	
3/4"	
1/2"	
3/8"	
1/4"	
No. 4	
No. 8	
No. 16	
No. 30	
No. 50	
No. 100	
No. 200	

GOVERNMENT OF CANADA

DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.

CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

DEPOSIT No. 463

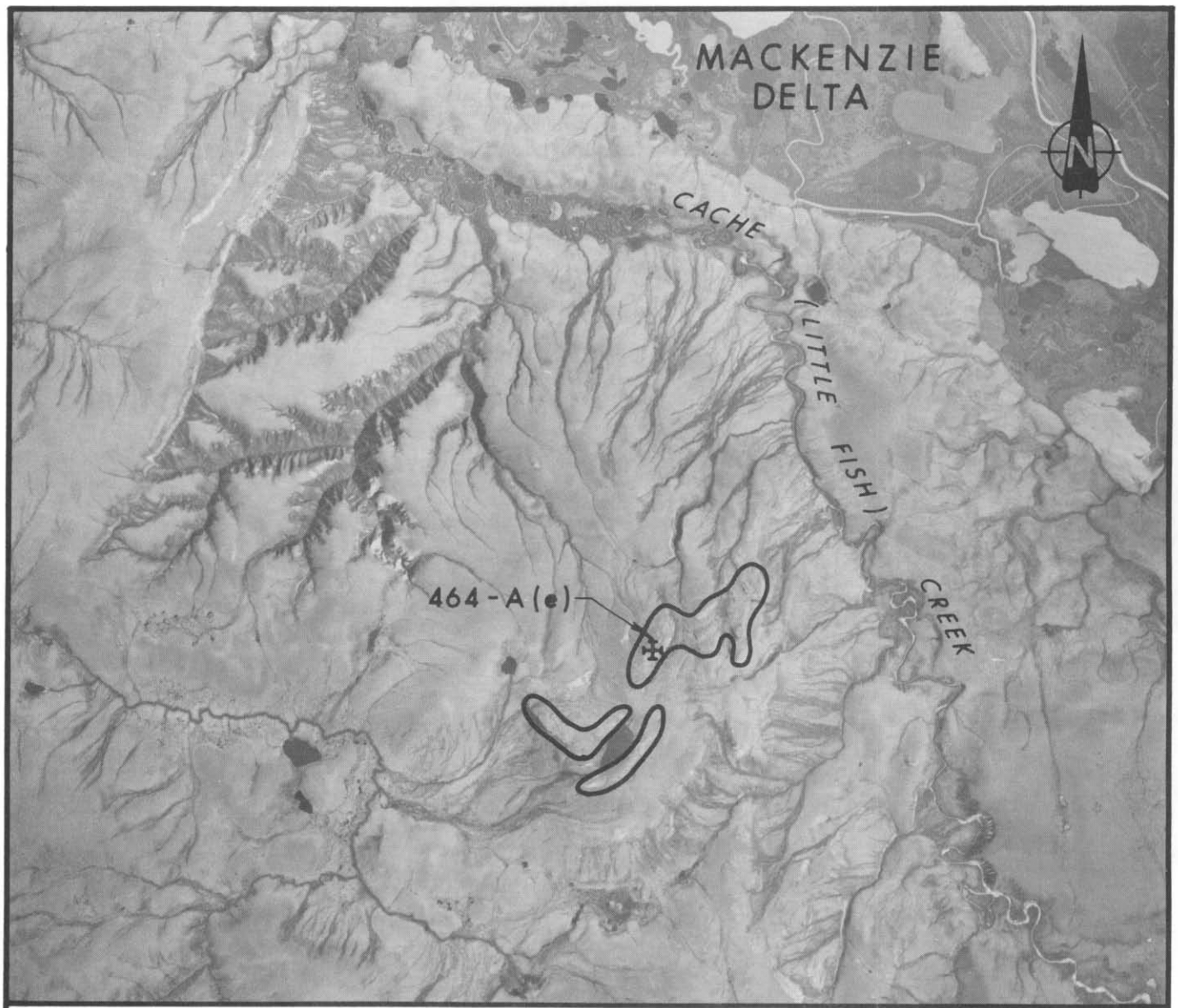
DEPOSIT 464

Setting: Roche mountonnées, located about 4 miles southeast of the mouth of Cache (Little Fish) Creek and 4 miles west of the West Channel (Mackenzie River).

Material: Quartz sandstone; rock and rubble.

Volume: 7,700,000 cubic yards total.

Assessment: Contains rock suitable for riprap and crushing. Possible source of concrete aggregate. Access is moderately difficult.



Airphoto No.: A23476-58
Deposit Outline - R.M. Hardy
Deposit Outline - Others
Approx. Scale: 1"=4800'
Test Pit
Exposures

DEPOSIT 464

SETTING

Deposit 464 consists of a group of roche moutonnées, located about 4 miles southeast of the mouth of Cache (Little Fish) Creek and near the edge of the Mackenzie Delta, 4 miles west of West Channel on the Mackenzie River.

The roche moutonnées are on the crest and eastern side of a hill rising 500 feet above the Mackenzie Delta. The rock forms irregularly shaped smooth knobs with local cliffs up to 80 feet high. Small talus cones are present at the base of these small cliffs.

The rock is a gray to light yellowish brown, medium grained, quartz sandstone. Most grains are subrounded to subangular. The deposit strikes N15°E with a gentle westward dip. A two-dimensional system of vertical joints is obvious on the outcrop and suggests that it would break into blocks, 3 to 5 feet to the side.

The deposit is bare of vegetation, although patches of reindeer moss (lichen), sedges, and ericaceous herbs cover level areas having some soil cover.

The rock forming Deposit 464 is known locally as the Lower Sandstone Division of Early Cretaceous age and is relatively resistant to weathering as is indicated by its ridge and cliff forming character.

Deposit 464 is at the northeastern edge of a rolling upland where bedrock hills are mantled with ice-rich drift. Toward the Mackenzie Delta, moderate to steep slopes lead down to a narrow bench of rolling ice-rich morainal deposits. A poorly drained delta surface, 1 mile in width, lies between the eastern edge of the morainal deposits and West Channel. The Mackenzie Delta provides habitat for waterfowl, muskrat, beaver, mink and a number of fish species.

MATERIAL

Deposit 464 is comprised of rock suitable for riprap or crushed aggregates. Angular blocks in the talus measuring 6 feet to the side, and the general jointed nature of the outcrop indicate that some large blocks are available. The rock is moderately durable and only slightly friable on freshly fractured surfaces.

VOLUME

The total volume of 7,700,000 cubic yards assumes that the rock might be quarried to an average depth of 30 feet over most of the area.

DEVELOPMENT

Preliminary blasting and crushing tests to determine breakage characteristics of the rock would be necessary before considering Deposit 464 as a source of aggregate or riprap. Development would require blasting and quarrying and would initially be concentrated along scarps.

Access to this deposit will be difficult as steep slopes and thermokarst-susceptible terrain surrounds the deposit. Channels of the Mackenzie delta offer good winter access to the edge of the Delta.

Development should be planned to minimize interference with wildlife on the Mackenzie Delta.

SUMMARY OF PETROGRAPHIC DATA FOR ROCK SAMPLES

PETROGRAPHIC ANALYSIS

PARTICLE TYPE	PERCENT
Detrital quartz	99
Chert	1
Interstitial limonite	trace
Hornblende	trace
Zircon	trace
Rock fragments	trace
Siliceous cement	trace

ROCK NAME: Quartz sandstone

GRAIN SIZE: .06 to 0.3 mm; most grains 0.1 to 0.15 mm.

GRAIN SHAPE: Angular to subangular, occasionally subrounded.

MATRIX AND CEMENT: Partially cemented by interstitial limonite and minor secondary silica at grain contacts.

POROSITY AND PACKING: Highly porous (34%); grains display open packing, although some are grouped in clusters.

COMMENTS: Partial cementation may affect rock competence.

NOTE: PETROGRAPHIC ANALYSIS BY DOLMAGE CAMPBELL & ASSOCIATES (1975) LTD.

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO.
464-A(e)

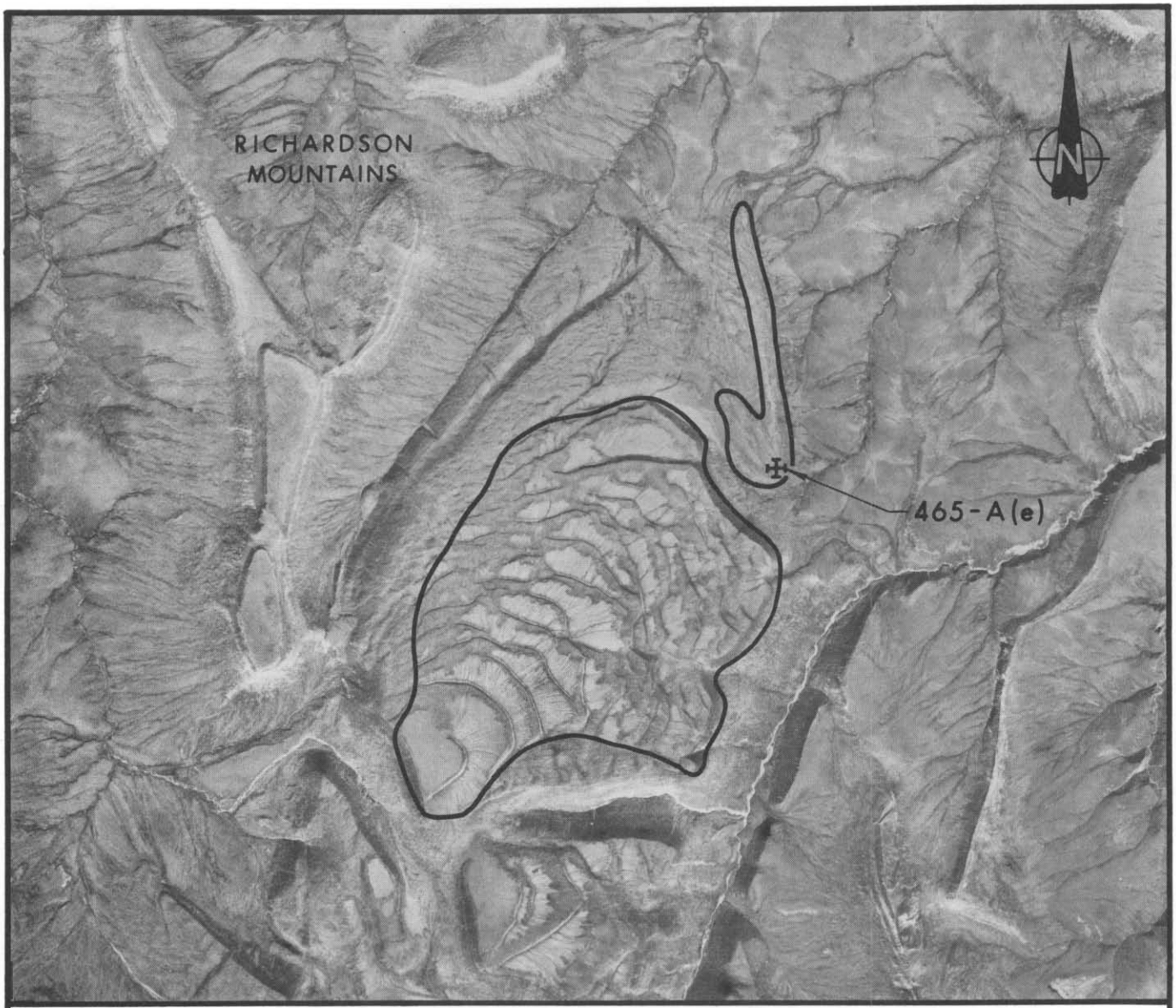
DEPOSIT 465

Setting: Cliffs and altiplanation terraces in the Richardson Mountains. Located 9 miles west of Jurassic Butte.

Material: Quartz sandstone; rock and rubble.

Volume: 100,000,000 cubic yards total.

Assessment: Contains rock suitable for processing for aggregate and riprap. Difficult access.



Airphoto No.: A23816-77		Approx. Scale:	1"=4700'
Deposit Outline - R.M. Hardy	———	Test Pit	⊙
Deposit Outline - Others	—·—·—	Exposures	✠

DEPOSIT 465

SETTING

Deposit 465 consists of altiplanation terraces and bedrock cliffs in the Richardson Mountains, and is located 9 miles west of Jurassic Butte and 23 miles southwest of Aklavik, N.W.T.

The altiplanation terraces have formed on a broad hill that slopes from its crest at 3700 feet to 2900 feet at its eastern edge. Each terrace consists of a small scarp at its upper edge, 20 to 100 feet high, and a gently sloping terrace surface where the upper two-thirds is vegetation-covered and the lower third is covered by a boulder field. The cliffs are 100 to 200 feet high and marked by bedrock near their crests and extensive talus aprons at their base.

The rock in Deposit 465 appears to be flat-lying near the western and central part and dipping at 20°E near its eastern edge. Geologic maps show Deposit 465 as part of a broad northeast plunging anticline. The rock itself is a light gray to pale orange, fine-grained quartz sandstone. Most grains are rounded to subrounded.

Except for crustose lichens and patches of tundra with some small shrubs, the cliffs, blocky boulder fields and talus aprons are bare of vegetation. The upper part of the terrace surfaces are covered by sedge tundra and appear to be imperfectly drained.

The rock is typical of the Bug Creek Formation of the Jurassic age. Locally, massive to indistinctly bedded and blocky jointed sandstone in excess of 200 feet thick, characterize this formation. Interbeds of more friable sandstone are present.

Deposit 465 is surrounded by hilly to mountainous terrain. Hills and ridges are marked by scree-covered bedrock and the valleys are filled with ice-rich morainal deposits. The Willow River canyon lies to the northwest. The whole area provides habitat for grizzly bear and caribou and possible nesting sites for raptors. Deposit 465 lies on the northern fringe of terrain utilized by Dall sheep.

MATERIAL

Deposit 465 contains rock having good potential as riprap and may provide good concrete aggregate in an area where local gravels contain a significant quantity of shale. Angular blocks, in excess of 4 feet to the side, indicate that large blocks can probably be obtained through quarrying. The large blocks in the talus indicate the rock is moderately durable. Although the freshly fractured surfaces are somewhat friable, weathered surfaces are relatively cohesive. Further investigation is required to locate preferred rock types for different uses.

VOLUME

The total volume of 100,000,000 cubic yards assumes that the rock may be quarried to a depth of 30 feet over the complete area of the deposit. Rock is available to significantly greater depths in adjacent areas.

DEVELOPMENT

Blasting, durability and crushing tests to determine physical characteristics of the rock are necessary to determine the applicability of this rock for riprap, concrete aggregate, or crushed rock. Development will require blasting and quarrying, presumably along the edges of scarps and cliffs. Quarrying could be confined to local cliffs to minimize landscape modification.

Access to this deposit involves traversing moderate slopes that are susceptible to thermokarst and ascending the walls of the Willow River canyon. The Willow River canyon should provide a good winter access road.

Development should be planned to minimize intereference with activities of Dall sheep.

SUMMARY OF PETROGRAPHIC DATA FOR ROCK SAMPLES

PETROGRAPHIC ANALYSIS

PARTICLE TYPE	PERCENT
Detrital quartz	95
Interstitial limonite	5
Pyroxene	trace
Zircon	trace
Chert fragments	trace
Siliceous cement	trace

ROCK NAME: Quartz sandstone

GRAIN SIZE: 0.06 mm to 0.5 mm; most grains 0.15 mm to 0.25 mm.

GRAIN SHAPE: Angular to subrounded.

MATRIX AND CEMENT: Firmly cemented by quartz overgrowths and recrystallization of grain contacts. Interstitial limonite also forms cement.

POROSITY AND PACKING: Reduced porosity (19.5%) due to fine-grained component and interstitial limonite.

COMMENTS: Cohesive and firmly cemented; a few discontinuous streaks of dark minerals suggest bedding.

NOTE: PETROGRAPHIC ANALYSIS BY DOLMAGE CAMPBELL & ASSOCIATES (1975) LTD.

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. 465-A(e)

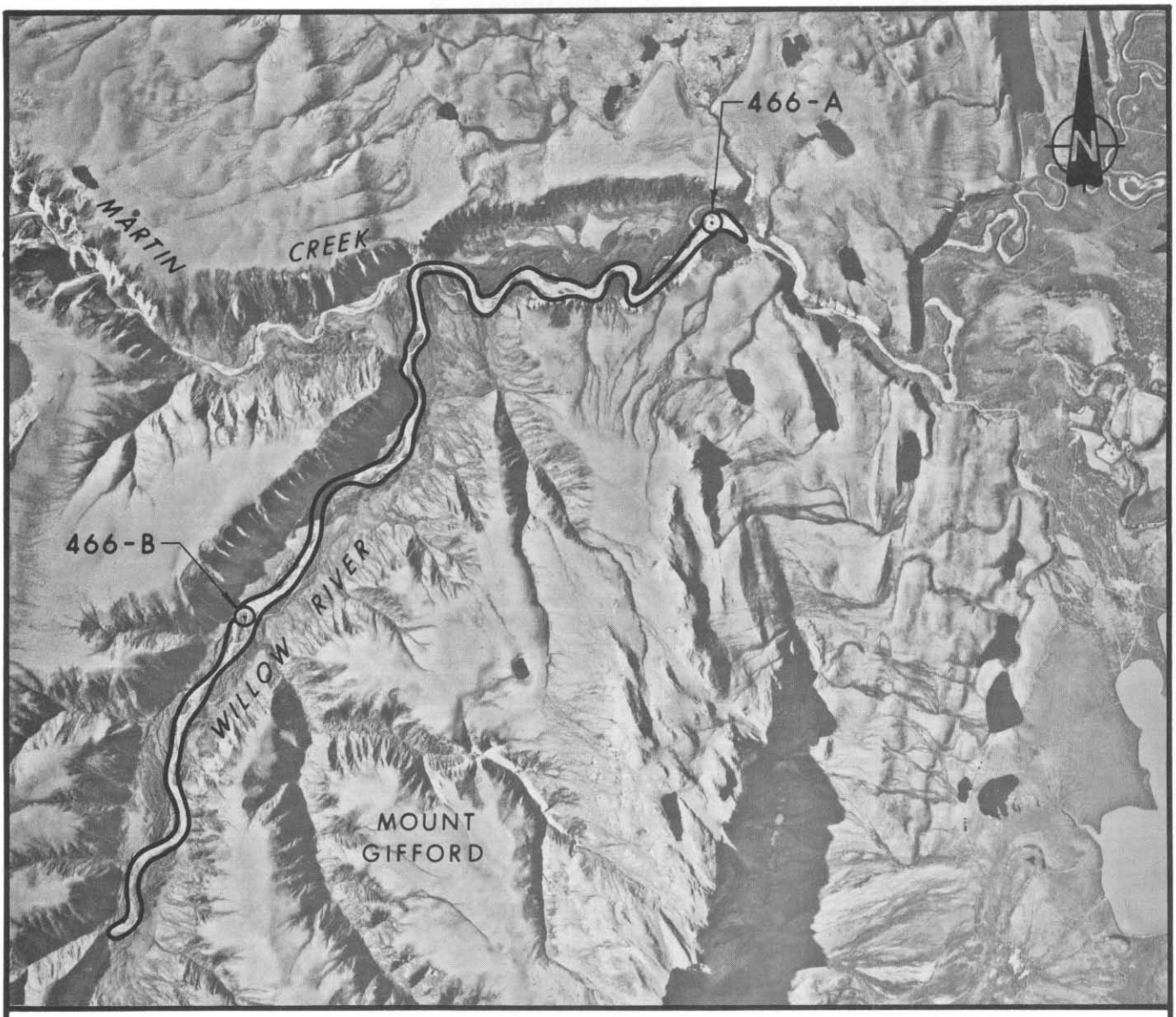
DEPOSIT 466

Setting: Floodplain of the Willow River, located 13 miles west of Aklavik, N.W.T.

Material: Gravel; poor and well graded, fine to coarse, some sand.

Volume: 7,300,000 cubic yards total.

Assessment: Contains fair quality granular material with high shale contents and oversize. Extraction would be limited by ground water and the narrowness of the floodplain. Fluvial processes would restore pit areas to a natural state. Access is limited along the stream course and by a narrow bedrock canyon at its downstream end. Recoverable volume may be limited to 1,000,000 cubic yards.



Airphoto No.: A22885-80		Approx. Scale:	1"=4800'
Deposit Outline - R.M. Hardy	———	Test Pit	⊙
Deposit Outline - Others	—·—·—	Exposures	✣

DEPOSIT 466

SETTING

Deposit 466 comprises the floodplain, mainly active, of the Willow River. The active floodplain consists primarily of large bars; minor channeling on the bars has resulted in local relief of 1½ feet. The Willow River is confined to a single channel during low water.

This deposit is free of overburden and is well drained. Less than one-half of the floodplain is more than 3 feet above low water level. Sparse patches of willow and alders, 6 feet high, cover the active floodplain. Alder and willow thickets cover the stabilized parts of the floodplain. Driftwood is strewn over much of the floodplain surface.

Deposit 466 and adjoining low, poorly drained terraces and silty ice-rich colluvial fans lie within a deep bedrock canyon. The deposit is separated from the Mackenzie Delta by a narrow bedrock canyon. Some raptors may nest along the edges of the Willow River canyon.

MATERIAL

Deposit 466 contains fair quality granular material consisting of well to poorly graded, fine to coarse gravel with some sand. The gravel is generally quite bouldery. Larger clasts are mainly subrounded to rounded sandstone with occasional black chert. Shale predominates the fines.

VOLUME

The total volume of 7,300,000 cubic yards is based on a conservative depth of 15 feet. Gravel strata in parts of the Willow River canyon are known to range between 25 and 75 feet.

Annually, 30,000 cubic yards per 1000 foot length of floodplain can be extracted by conventional techniques assuming that ground water will limit the extractable granular material to an average depth of 3 feet. Volume of recoverable material may be limited to 1,000,000 cubic yards because of ground water conditions.

DEVELOPMENT

Extraction of material from Deposit 466 would be confined to periods of low water and might be difficult due to the narrowness of the deposit. Adequate area is available for stockpiling on the floodplain. Natural fluvial processes would restore the developed pits to a natural state as these mountain streams such as the Willow River are known to move significant amounts of coarse sediment.

Access to this deposit is only practical through the narrow bedrock canyon at its lower end and along the stream course.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	GM	1.3	GRAVEL - coarse to 12" boulders, little fine gravel, little silty fines, subrounded to rounded.		F	1.3	Lightweight Pieces - Fine Aggregate: 1.12%
2	GP	2.0	GRAVEL - coarse to 24" boulders, little fine gravel, trace sand.		UF		
3	GW	5.8 ▽	GRAVEL - well graded to 15" boulders, some fine to coarse sand, sub-rounded to rounded, damp.				
4							
5							
6			Bottom of Pit				Sample from 1.3'-5.8'

DATE: Oct. 11, 1976 | LOGGED BY: CPM | DRWN BY: MB/vh | CHKD BY: GDC/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. 466-A

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
0	GW		GRAVEL - well graded to 5" cobbles, some fine to coarse sand, trace silty fines, subrounded to rounded, medium dense, brown, wet.				Lightweight Pieces - Fine Aggregate: 0.20%
1.8	GP		GRAVEL - poorly graded, little fine to coarse sand, trace silty fines, subrounded to rounded, medium dense, grey-brown, wet, saturated at 3.3'				
3.3 ▽							
4.0			Bottom of Pit			4.0	Sample from 0'-4.0'

DATE: Oct. 11, 1976	LOGGED BY: SA	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

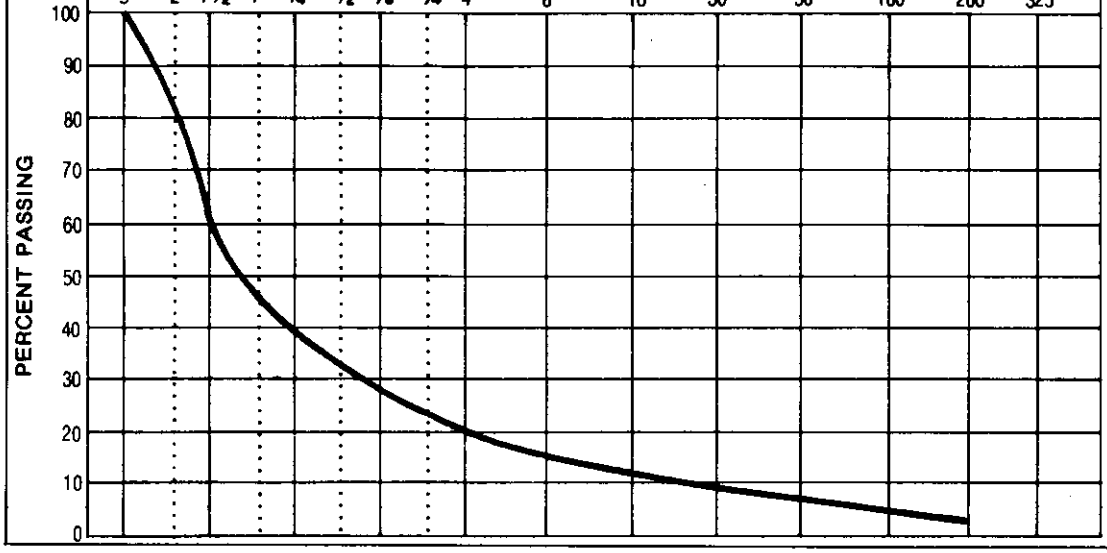
TEST PIT NO. 466-B

SHEET 1 OF 1

GRAIN SIZE ANALYSIS

SAMPLE 466-A DEPTH 1.3'-5.8'
DATE SAMPLED Oct. 11, 1976 SAMPLED BY CPM
LAB TEST NUMBER 121HA

GRAVEL SIZES		SAND SIZES			FINES
60.3 %	20.4 %	3.3 %	7.5 %	5.7 %	2.8 %
COARSE	FINE	COARSE	MEDIUM	FINE	

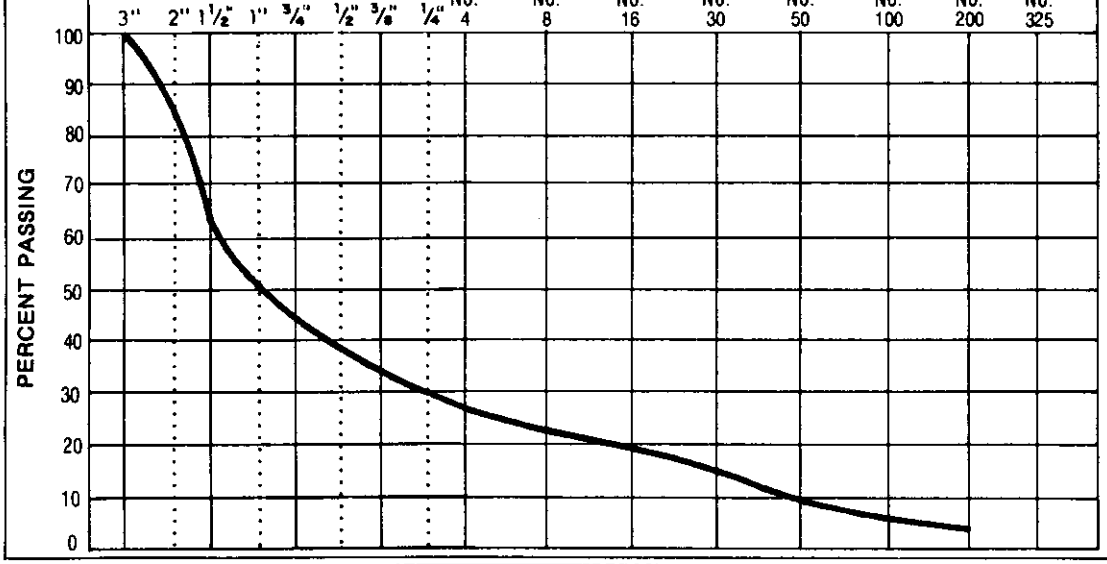


MAX. SIZE	% > 3"
5"	32.6

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	82.3
1 1/2"	62.4
1"	46.7
3/4"	39.7
1/2"	31.8
3/8"	27.2
1/4"	
No. 4	19.3
No. 8	15.7
No. 16	12.6
No. 30	9.3
No. 50	6.5
No. 100	4.3
No. 200	2.8

SAMPLE 466-B DEPTH 0'-4.0'
DATE SAMPLED Oct. 11, 1976 SAMPLED BY SA
LAB TEST NUMBER 123HA

GRAVEL SIZES		SAND SIZES			FINES
55.4 %	18.8 %	3.3 %	10.0 %	8.3 %	4.2 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
5"	20.5

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	84.2
1 1/2"	63.4
1"	50.9
3/4"	44.6
1/2"	37.6
3/8"	33.2
1/4"	
No. 4	25.8
No. 8	22.2
No. 16	19.2
No. 30	14.5
No. 50	8.6
No. 100	5.5
No. 200	4.2

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No.
466

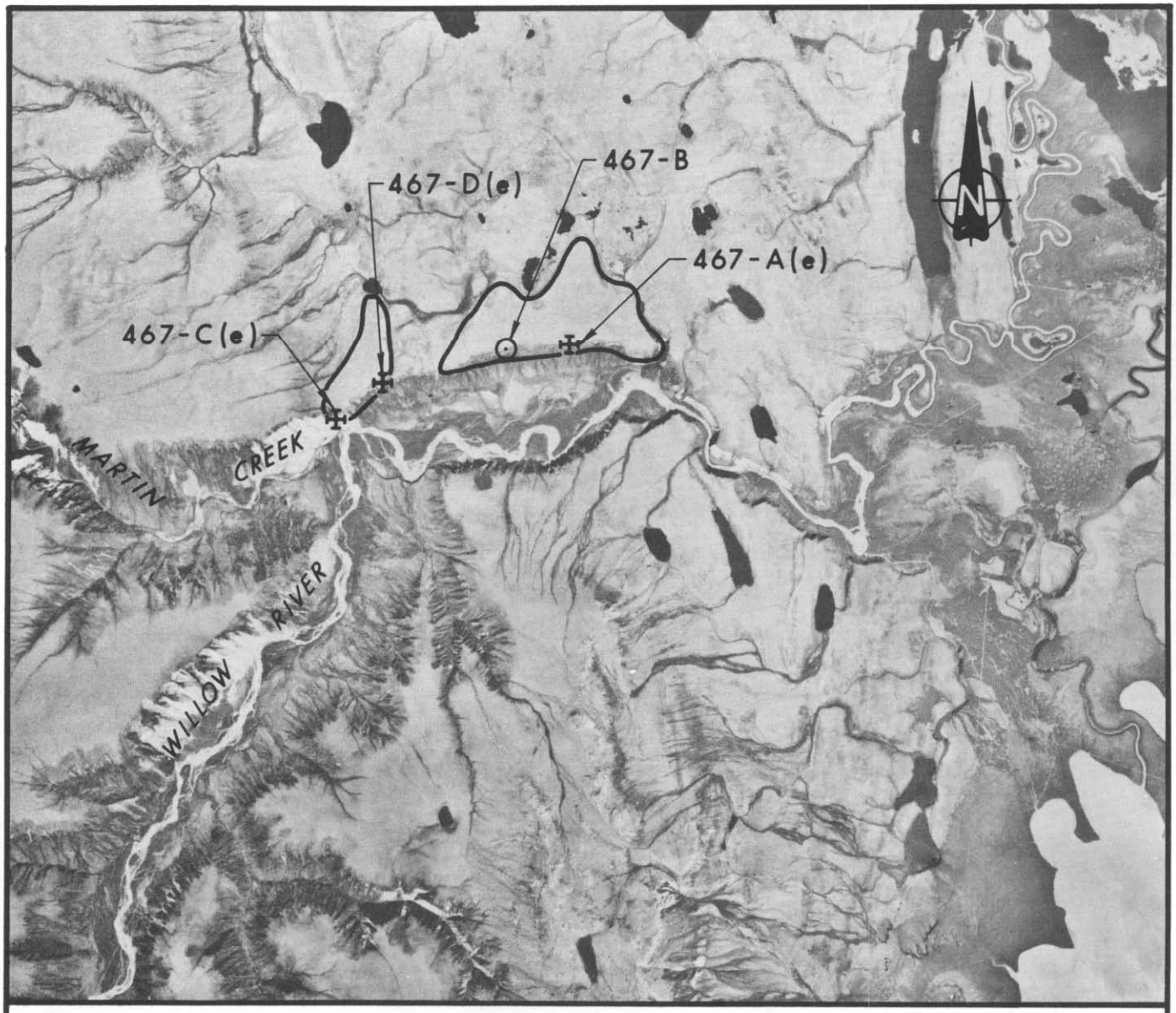
DEPOSIT 467

Setting: Kame deltas north of the Willow River. Located 12 miles west of Aklavik, N.W.T.

Material: Gravel; well to poorly graded, fine to coarse, some sand.

Volume: 20,000,000 cubic yards total.

Assessment: Contains good quality granular material with moderate amounts of oversize. Thin overburden and may easily be excavated. Good winter access from Aklavik.



Airphoto No.: A23816-47
Deposit Outline - R.M. Hardy
Deposit Outline - Others
Approx. Scale: 1"=5300'
Test Pit ⊙
Exposures ✣

DEPOSIT 467

SETTING

Deposit 467 consists of two kame deltas flanking the north bank of the Willow River canyon, located about 12 miles west of Aklavik. Both kame deltas are located on a broad bench, 200 to 400 feet above sea level. West of these kame deltas a steep slope rises up to the uplands and hills, which are part of the northern Richardson Mountains. The deltas were formed by streams flowing out of the northern Richardson Mountains against the edge of a glacier covering the Mackenzie Delta and adjacent low benches.

The surface of the eastern (lower) kame delta appears to have only a thin cover of overburden, 0 to 2 feet of organic clay or silt. Adjacent to the 250 foot escarpment that forms its southern edge, the surface is well drained; it is only moderately good to imperfectly drained on the northern part. Shallow trenches outline a polygonal pattern on its surface.

The western (upper) kame delta may have a thicker cover of overburden with 1 to 5 feet of peat and organic silt on the southeastern part adjacent to the 350 foot deep Willow River Canyon. Greater thicknesses of overburden are probably present on its northwestern part adjacent to the steep slope rising to the west. The surface of this kame delta is moderately well drained.

The active layer is estimated to exceed 6 feet under bare gravels and is 2 to 3 feet where overburden is present.

The surface of the lower kame delta is covered by a mixed cover of lichen and low ericaceous shrubs. On poorer drained segments sedges become more common. The surface of the upper kame delta is similar to that of the lower kame delta, except that the turf is thicker. Scarp edges along the south edge of both kame deltas are characterized by shrubbery consisting of dwarf birch, 3 feet high. Spruce are present on the scarp.

East of Deposit 467, the terrain consists of gently sloping morainal deposits leading down to the Mackenzie Delta. Moderately sloping colluvial slopes lie to the west. A poorly drained lake basin lies north of the lower kame delta. This area provides habitat for caribou and grizzly bear. Willow River canyon may provide nesting sites for raptors.

MATERIAL

Deposit 467 contains fair to good quality granular material consisting of well to poorly graded, fine to coarse gravel with some sand. Cobbles to 8 inches and boulders to 15 inches are common. Larger clasts are mainly subangular to subrounded sandstone and quartzite with rare chert. Shale forms a good part of the fines.

VOLUME

The total volume of 20,000,000 cubic yards is based on an average depth of 30 feet. Bank morphologies along the southern edge of the eastern part indicate that in excess of 30 feet of gravel is present. An exposure at the southern edge of the western part at test pit 467-C(e) exposes 85 feet of gravel.

Annually, 12,000 cubic yards per acre could be extracted by conventional techniques assuming that permafrost would limit annual extraction to depths of 8 feet.

DEVELOPMENT

Granular material should be excavated so that good drainage is maintained. Benches would best be excavated along scarps, as dugouts on the upper surface of the kame deltas would probably flood, especially if they were excavated below the base of the active layer. These

benches would blend into the surrounding terrain with little grading upon abandonment.

Access to Akalvik would be good, along gentle slopes to the east and northeast that lead down to the surface of the Mackenzie Delta. Channels, lakes, and seismic lines would provide a route across the Mackenzie Delta to Aklavik. Development should be planned to minimize interference with wildlife on the Mackenzie Delta.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
	Pt	0.2	PEAT - organic cover.		UF		
1	CL	1.6	CLAY - little gravel, silty, brown, damp.				
2	GW		GRAVEL - well graded to 8" cobbles, little fine to coarse sand, trace fines, occasional boulder to 20" size, subrounded to rounded, loose, brown, damp.				
3							
4							
5							
6							
7		7.5					
8			Bottom of Pit				Sample from 1.6'-2.5'

DATE: Oct. 10, 1976	LOGGED BY: CPM	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. 467-A(e)

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
0	Pt		PEAT (0.3)		UF		Organic Color: #5+ Coal Removed: #2+
1	ML		SILT - little gravel, little sand, trace organics, brown, damp. (1.3)				Lightweight Pieces - Fine Aggregate: 0.05%
2	GW		GRAVEL - well graded to 13" boulders, some fine to coarse sand, sub-angular to rounded, brown, damp.				
3							
4			(4.2) becoming cleaner.				
5							
6			(6.2)				
7			Bottom of Pit				Sample from 1.3'-6.2'

DATE: Oct. 11, 1976	LOGGED BY: CPM	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO.
467-B
SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
	Pt		PEAT - fibrous, silty, brown, moist.		UF		Lightweight Pieces - Fine Aggregate: 0.20%
5	GW		5.0 GRAVEL - well graded to 7" cobbles, little fine to coarse sand, trace silty fines, subangular to subrounded, brown moist.				
10							
15							Exposure not logged in detail below 14' because of steepness of bank.
55							
60							
65			65.0 increasing in cobble and boulder sizes.				
70							
75							
80							
85			85.0 Bottom of Pit				Sample from 5.0'-13.0'
90							

DATE: Oct. 10, 1976	LOGGED BY: SA	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. 467-C(e)

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	Pt		PEAT - fibrous, silty, brown, moist.		UF		Lightweight Pieces - Fine Aggregate: 11.23%
		1.2					
	GW		GRAVEL - well graded, some fine to coarse sand, frequent cobbles to 6" size, subrounded, medium dense, brown, moist, rootlets to 3.5' depth.				
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							Gravel continues to estimated depth of 65'.
12		12.5					
13			Bottom of Pit				Sample from 2.0'-12.0'

DATE: Oct. 11, 1976	LOGGED BY: SA	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

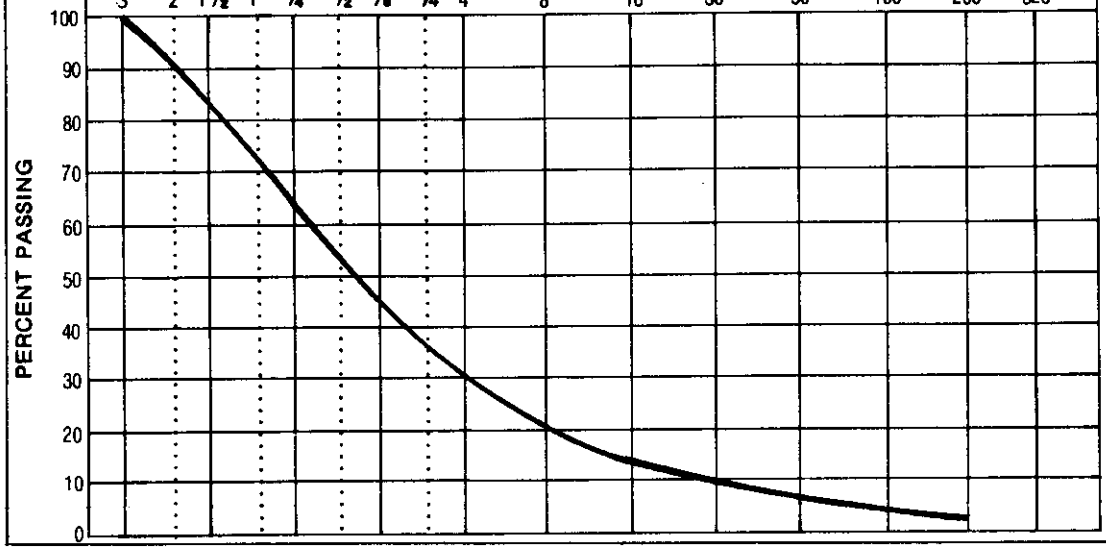
TEST PIT NO. 467-D(e)

SHEET 1 OF 1

GRAIN SIZE ANALYSIS

SAMPLE Y67-A(e) DEPTH 1.6'-2.5'
DATE SAMPLED Oct. 10, 1976 SAMPLED BY CPM
LAB TEST NUMBER 119HA

GRAVEL SIZES		SAND SIZES			FINES
36.6 %	33.3 %	11.6 %	10.5 %	4.6 %	3.4 %
COARSE	FINE	COARSE	MEDIUM	FINE	

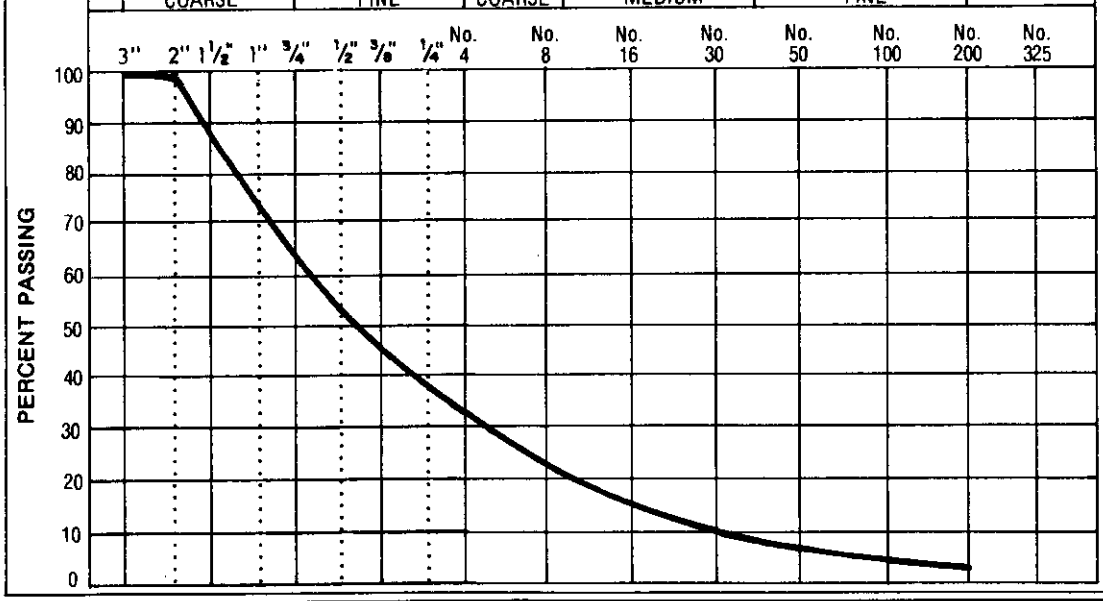


MAX. SIZE	% > 3"
9"	33.2

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	89.8
1 1/2"	85.3
1"	71.9
3/4"	63.4
1/2"	53.4
3/8"	45.1
1/4"	
No. 4	30.1
No. 8	19.0
No. 16	13.3
No. 30	9.7
No. 50	6.6
No. 100	4.6
No. 200	3.4

SAMPLE 467-B DEPTH 1.3'-6.2'
DATE SAMPLED Oct. 11, 1976 SAMPLED BY CPM
LAB TEST NUMBER 120HA

GRAVEL SIZES		SAND SIZES			FINES
37.8 %	29.6 %	11.6 %	12.5 %	4.9 %	3.6 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
4"	17.0

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	100.0
1 1/2"	84.7
1"	70.3
3/4"	62.2
1/2"	51.9
3/8"	45.5
1/4"	
No. 4	32.6
No. 8	22.3
No. 16	15.5
No. 30	10.6
No. 50	7.0
No. 100	5.0
No. 200	3.6

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

DEPOSIT No. 467

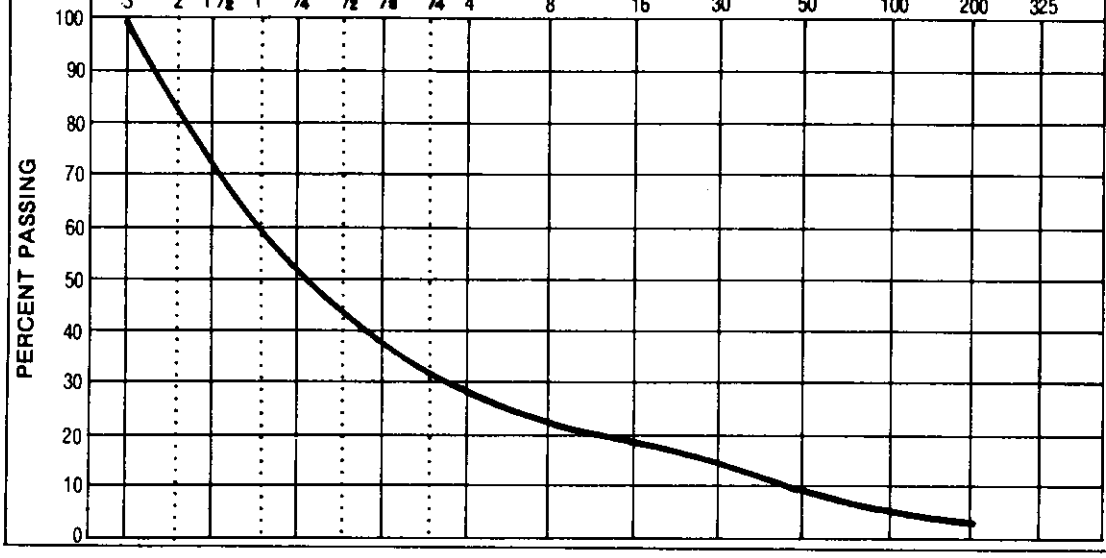
GRAIN SIZE ANALYSIS

SAMPLE 467-C(e) DEPTH 5.0'-13.0'

DATE SAMPLED Oct. 10, 1976 SAMPLED BY SA

LAB TEST NUMBER 122HA

GRAVEL SIZES		SAND SIZES			FINES
48.8 %	23.0 %	6.2 %	10.0 %	8.9 %	3.1 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
5"	3.3

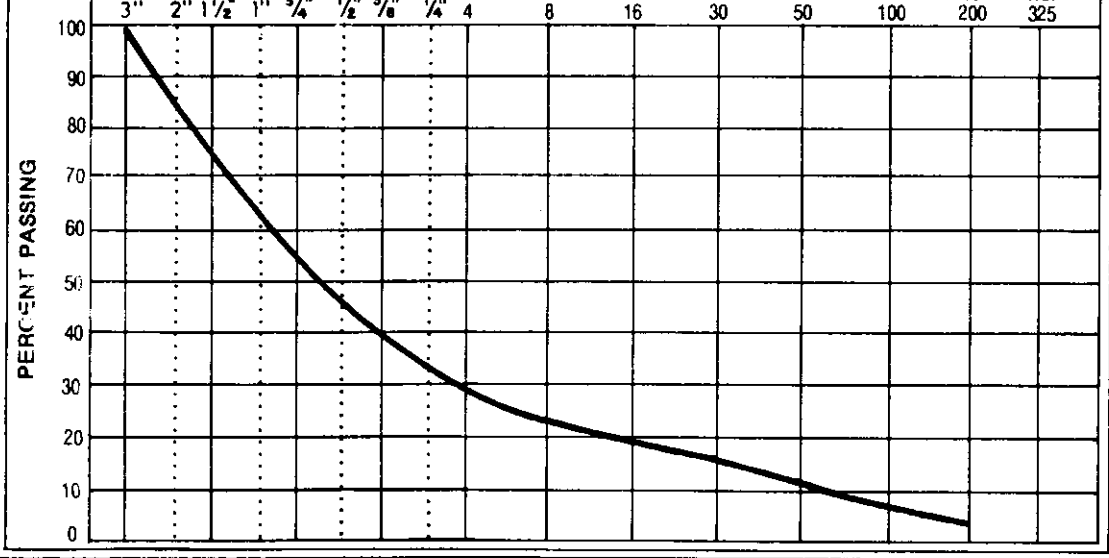
SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	85.4
1 1/2"	72.3
1"	58.8
3/4"	51.2
1/2"	42.3
3/8"	37.2
1/4"	
No. 4	28.2
No. 8	23.2
No. 16	19.0
No. 30	14.6
No. 50	9.0
No. 100	5.0
No. 200	3.1

SAMPLE 467-D(e) DEPTH 2.0'-12.0'

DATE SAMPLED Oct. 11, 1976 SAMPLED BY SA

LAB TEST NUMBER 122HA-B

GRAVEL SIZES		SAND SIZES			FINES
45.1 %	27.2 %	5.2 %	9.5 %	9.5 %	3.5 %
COARSE	FINE	COARSE	MEDIUM	FINE	



MAX. SIZE	% > 3"
4"	10.2

SIEVE SIZE	PERCENT PASSING
3"	100.0
2"	85.7
1 1/2"	72.6
1"	62.3
3/4"	54.9
1/2"	44.9
3/8"	38.2
1/4"	
No. 4	27.7
No. 8	22.6
No. 16	19.2
No. 30	16.2
No. 50	11.4
No. 100	6.0
No. 200	3.5

GOVERNMENT OF CANADA

DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.

CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

DEPOSIT No. 467

SUMMARY OF LABORATORY TEST DATA FOR SUITABILITY OF AGGREGATES IN CONCRETE

PETROGRAPHIC ANALYSIS

COARSE AGGREGATE

ROCK TYPE	CLASSIFICATION	TOTAL WEIGHTED COMPONENT %
Quartzite	Strong to very strong, Good	33.7
Quartzitic Sandstone		1.9
Sandstone		59.9
Granite		0.3
Chert	Potentially reactive, Fair	0.1
Ironstone	Friable, Poor	4.0
Clay lumps	Deleterious	0.1
PN: = 121	INTERPRETATION: Good quality for aggregate	100.0

SOUNDNESS OF AGGREGATE - SULPHATE TEST

COARSE AGGREGATE: LOSS = 4.37

FINE AGGREGATE: LOSS = 14.39

OTHER TESTS

LIGHTWEIGHT PIECES IN AGGREGATE: 0.21%

SPECIFIC GRAVITY: FINE: 2.59, COARSE: 25.8

WATER ABSORPTION: FINE: 2.54%, COARSE: 2.11%

ORGANIC IMPURITIES TEST

NUMBER	:	4
COAL REMOVED	:	2
COAL & ROOTLETS REMOVED	:	
COAL CONTENT	:	0.21%

COMMENTS: Sulphate Test was performed for 5 cycles in Magnesium Sulphate solution.
Specific Gravity Test was performed at 20°C.
Lightweight Pieces were determined by floating on Zinc Chloride solution with a Specific Gravity of 2.0.

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION

TEST PIT NO. 467-A(e)

DEPOSIT 468

Setting: Glacially scoured bedrock ridges at the crest of large escarpment located 1 mile north of Mount Gifford.

Material: Quartz sandstone; rock and rubble.

Volume: 5,000,000 cubic yards total.

Assessment: Contains rock suitable for crushing. Further testing is required to determine its suitability for riprap or concrete aggregate. Access to site is difficult.

Airphoto No.: A22885-80		Approx. Scale:	1"=4800'
Deposit Outline - R.M. Hardy	———	Test Pit	⊙
Deposit Outline - Others	—·—·—	Exposures	✠

DEPOSIT 468

SETTING

Deposit 468 consists of a number of glacially-scoured bedrock ridges at the northern end of a long 1500 foot high escarpment running parallel to the western edge of the Mackenzie Delta. The deposit is located 1 mile north of Mount Gifford and 12½ miles west of Aklavik, N.W.T.

Scarps, 10 to 100 feet high, often form the sides of the long bedrock ridges. Small talus fans are commonly present at the base of the scarps. Numerous faults are present in this area and the rocks have various strikes and dips. Most rocks are inclined at dips of 10 to 45 degrees. The outcrop shows a 2-dimensional jointing pattern that compliments the bedding. The rock is a very light gray, fine-grained quartz sandstone containing minor rock fragments. The rock at Deposit 468 is known locally as the Lower Sandstone Division of the Early Cretaceous age.

The deposit is generally bare of vegetation, although a few swales have a continuous cover of tundra.

Deposit 468 is at the northern end of a large steep escarpment, and steep slopes to the northeast lead to a flatter bench and the Mackenzie Delta. The Willow River canyon is located to the northwest and its steep escarpment may provide nesting sites for raptors.

MATERIAL

Deposit 468 contains rock which may be suitable for concrete aggregate or riprap after processing. The talus is very variable with cubes ranging from 2 inches to the side to 6 feet to the side. Generally, the blocks average 1 inch in thickness and 1½ feet across. Additional investigation will be necessary to outline areas of different

rock quality. The size of some fragments and the friable nature of the rock on freshly fractured surfaces indicate that this rock may not be durable.

VOLUME

The total volume of 5,000,000 cubic yards assumes that the rock might be quarried to an average depth of 20 feet over most of the area.

DEVELOPMENT

Durability and crushing tests to determine the breakage characteristics of the rock would be necessary before Deposit 468 is developed as a source of aggregate or riprap. Development would require blasting and quarrying.

Access to this deposit will be difficult as steep slopes, susceptible to thermokarst and erosion, will have to be traversed. Frozen lakes and channels will provide smooth haul roads across the Mackenzie Delta during the winter.

SUMMARY OF PETROGRAPHIC DATA FOR ROCK SAMPLES

PETROGRAPHIC ANALYSIS

PARTICLE TYPE	PERCENT
Detrital quartz	99
Chert	1
Limonite	trace
Siliceous cement	trace

ROCK NAME: Quartz sandstone

GRAIN SIZE: 0.7 mm to less than 0.06 mm, most grains 0.15 to 0.25 mm

GRAIN SHAPE: Angular to subrounded

MATRIX AND CEMENT: Poorly cemented although some siliceous overgrowth and recrystallization is present.

POROSITY AND PACKING: Grain boundaries interlock, but moderately porous (22.5%). Few clusters of grains densely packed, but generally not.

COMMENTS: Cohesive, but slightly friable; color banding indicates bedding.

NOTE: PETROGRAPHIC ANALYSIS BY DOLMAGE CAMPBELL & ASSOCIATES (1975) LTD.

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO.
468-A(e)

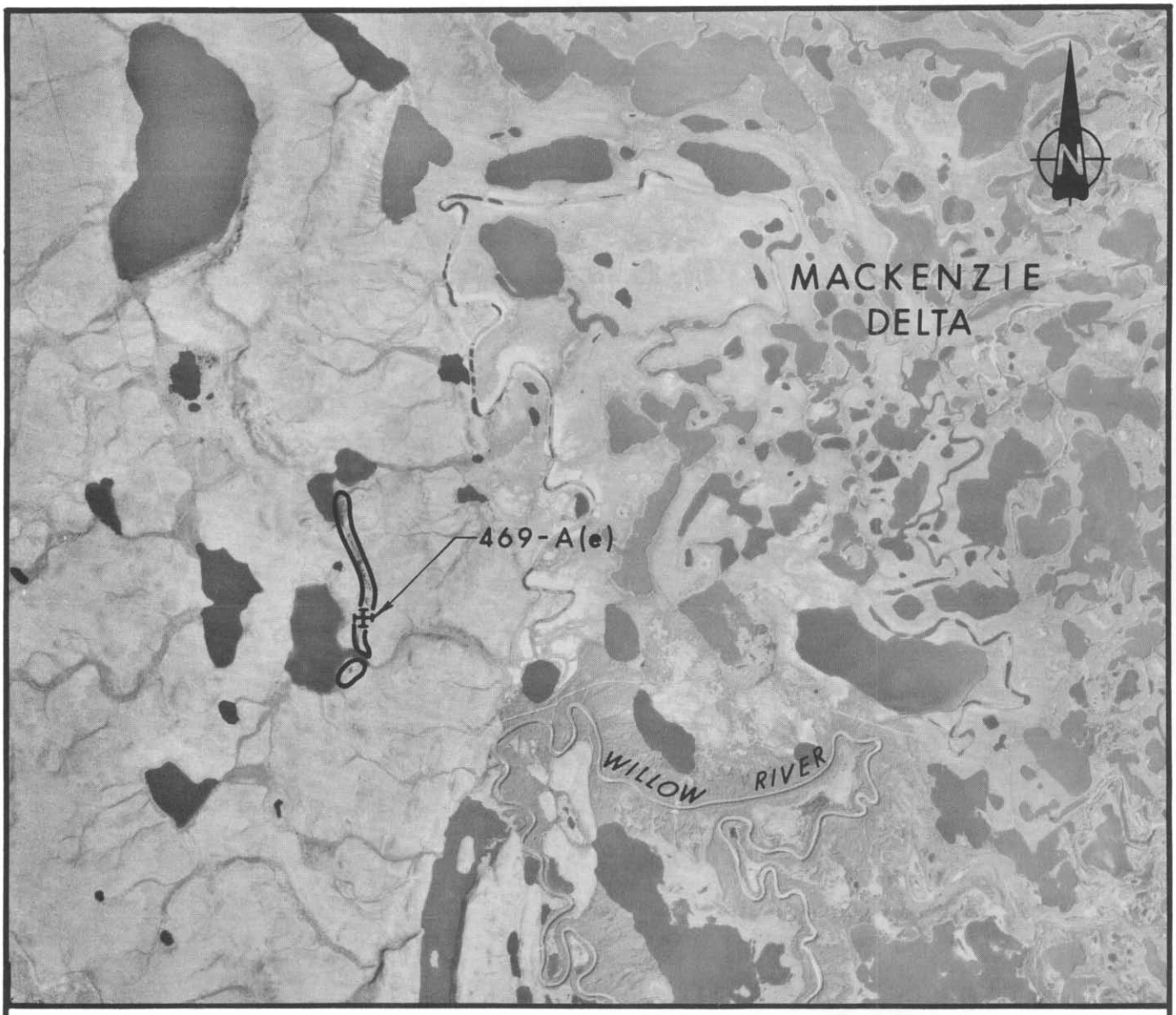
DEPOSIT 469

Setting: Small cuesta near the western edge of the Mackenzie Delta, 10 miles west of Aklavik, N.W.T.

Material: Quartz sandstone rock and rubble.

Volume: 420,000 cubic yards total.

Assessment: Contains a modest quantity of rock and rubble having potential as riprap and crushed aggregates. Further testing is required to determine suitability for concrete aggregate. Good access to deposit.



Airphoto No.: A22480-50		Approx. Scale:	1"=8300'
Deposit Outline - R.M. Hardy	———	Test Pit	⊙
Deposit Outline - Others	—·—·—	Exposures	✣

DEPOSIT 469

SETTING

Deposit 469 consists of a small cuesta, approximately ½ mile from the western edge of the Mackenzie Delta and 10 miles west of Aklavik, N.W.T. The cuesta consists of westward facing scarps, 20 to 30 feet high, with small talus cones at their base. On the eastern side of the ridges, the rock surface slopes gently to the east under a cover of colluvium and till.

The rock in the cliff strikes N20°E with a dip of 25°E. Bedding planes plus a vertical 2-dimensional jointing indicate that the rock would locally break into 1 to 5 foot blocks. The rock is a gray, medium grained quartz sandstone containing a small proportion of chert and coal fragments. Some beds are carbonaceous.

Only the cliff and some of the coarser talus are bare of vegetation. The remainder of the deposit is covered by dwarf birch, 5 feet high, with occasional willow.

The rock at Deposit 469 is a sandstone bed in the Upper Shale-Siltstone Division of Early Cretaceous age. This geologic unit is predominantly shale and siltstone, but minor beds of resistant sandstone that form small ridges are present.

Deposit 469 is bordered by rolling morainal deposits to the west and east. The flat, poorly-drained Mackenzie Delta is less than a mile to the east. The immediate terrain and the Mackenzie Delta provide habitat for waterfowl, muskrat, beaver, mink, and a variety of fish.

MATERIAL

Deposit 469 contains rock exhibiting fair to good potential for use as riprap or crushed aggregate. Angular blocks in the talus,

one to 3 cubic yards in size, and the nature of the outcrop itself, indicate that some large blocks are available. The rock is moderately durable as large blocks are present in the talus, and it is only slightly friable on some freshly fractured surfaces. Minor components of the rock, such as chert and coal fragments, may limit its use as a concrete aggregate.

VOLUME

The total volume of 420,000 cubic yards assumes that the rock might be quarried to a depth of 30 feet into the cliff and that a limited amount of talus is available at the base of the cliff.

DEVELOPMENT

Preliminary blasting and crushing tests to determine breakage characteristics of the rock would be necessary before considering Deposit 469 as a source of aggregate or riprap. Development would require blasting and quarrying along the westward-facing scarp.

Access to this deposit is moderately easy, although care must be exercised crossing slopes that are susceptible to thermokarst. Winter access across the Mackenzie Delta is good because the frozen lakes and channels provide smooth haul roads.

Development should be planned to minimize interference with wildlife on the Mackenzie Delta.

SUMMARY OF PETROGRAPHIC DATA FOR ROCK SAMPLES

PETROGRAPHIC ANALYSIS

PARTICLE TYPE	PERCENT
Detrital quartz	76.5
Chert	1.5
Argillite	0.5
Matrix	21.7

ROCK NAME: Quartz sandstone

GRAIN SIZE: 0.05 to 1.6 mm; most grains 0.15 to 0.3 mm

GRAIN SHAPE: Angular to subangular

MATRIX AND CEMENT: Matrix fills interstitial space; minor recrystallization and cementation at grain contacts.

POROSITY AND PACKING: Grains show open packing, but matrix reduces porosity (3.3%).

COMMENTS: Crude bedding gives parting surfaces allowing rock to break into lenticular segments; between parting surfaces the rock is cohesive.

NOTE: PETROGRAPHIC ANALYSIS BY DOLMAGE CAMPBELL & ASSOCIATES (1975) LTD.

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO.
469-A(e)

APPENDIX A

EXPLANATION OF TERMS AND SYMBOLS

APPENDIX A - EXPLANATION OF TERMS AND SYMBOLS

1. General

The terms and symbols used on the test hole logs to summarize the results of the field investigation and of subsequent laboratory testing are described in detail below and are illustrated in the appended exhibit test hole log (Figure 1).

General information, such as test hole number, date of pitting and inspector, is noted in the lower portion of the test hole log. Detailed sub-surface information observed at each test hole location and laboratory test data, are presented in columnar form on the test hole log. Each column used is described in detail below using the reference numbers shown on the appended blank test hole log (Figure 2).

It should be noted that the soil type, stratigraphic boundaries, and in situ conditions have been established only at the test hole location and that they are not necessarily representative of subsurface conditions elsewhere across the site.

Column 1: Depth: The depth of test hole below existing ground surface is shown in this column.

Column 2: Soil Group Symbol: A soil classification symbol in accordance with a modification of the Unified Soil Classification System[1] is noted in this column. A definition of each Group Symbol is given in Figure 3 "Soil Classification System".

Column 3: Soil Graphic Log: Soil strata are depicted graphically in accordance with the "Graphic Symbol" as given in Figure 3.

---

(1) References are listed on page A-13.

Column 4: Material Description: A detailed engineering description of each soil stratum encountered is noted in this column. This description is given in accordance with the criteria outlined in Section 2.1 "Soil Description". The depths to ground water level, seepage, and the interface between different soil strata are indicated in this column. The interface between soil strata is shown as a single continuous line. A short broken line indicates a change in soil type descriptors, the soil type remaining the same.

Column 5: Ice Graphic Log: The various types of ground ice are depicted graphically according to Figure 4 "Ground Ice Classification".

Column 6: NRC Ice Type: (Visual Ice %): Abbreviated symbols for the forms of ground ice are noted in this column. A description of the NRC classification[2] is contained in Section 2.2 "NRC Ice Type", and in Figure 4 "Ground Ice Classification". The volume of ground ice is estimated visually and expressed as a percentage of the total volume of soil and ice.

Column 7: Depth: The specific depth of observations such as ice type or depth of water table is noted in this column.

Column 8: Other Information: Test data and field observations not incorporated into the previous columns are presented here including test results for Organic Impurities, Moisture Content and Lightweight Pieces in Aggregate. Also in this column sample depths are listed. Information from Grain Size Analysis, Petrographic Analysis, and Suitability of Aggregates in Concrete are included on separate forms which follow the Test Hole Log.

2. Description Details

The various terms, symbols, and abbreviations are discussed in detail to facilitate interpretation and understanding of the data presented on the test hole logs.

2.1 Soil Description (Column 4)

Soils are classified and described according to their engineering properties and behaviour.

2.1.1 Soil Description System

The following properties are described for a comprehensive soil classification system:

Grain size distribution or plasticity, colour, moisture, sensitivity, structure, foreign materials, and consistency or strength.

The soil in each stratum is described on the test hole logs using the Unified Soil Classification System[1] modified slightly so that an inorganic clay of "medium plasticity" is recognized. Selected adjectives are used to define the actual or estimated percentage range by weight of the various components. The use of the modifying adjectives is similar to a system developed by D. M. Burmister[3].

The identification of soil components and fractions is defined by the Modified Unified Soil Classification System which classifies soils into three major divisions:

Coarse-grained soils - gravel and sand
Fine-grained soils - silt and clay
Highly organic soils - peat

Classification of soils is based on the grain size distribution of that portion of the soil smaller than the 3-inch U.S. Standard sieve size.

Soils with 50 percent or more of the components coarser than the No. 200 U.S. Standard sieve size (0.074 mm) are described as COARSE-GRAINED (or granular) soils. Coarse-grained soils (gravel and sand) are classified by grain size distribution and are subdivided into coarse and fine gravel, and coarse, medium, and fine sand.

Soils with 50 percent or more of the components finer than the No. 200 sieve size are described as FINE-GRAINED soils. These may be cohesive or non-cohesive. Note that for visual classification the No. 200 sieve size is about the smallest size of particle that can be distinguished individually by the unaided eye.

Fine-grained soils (silt and clay) are classified by behaviour on the basis of the liquid limit and plasticity index of the fraction finer than the No. 40 U.S. Standard sieve size. The boundaries defining the fine-grained soil groups are shown on the Plasticity Chart in Figure 3 "Soil Classification System". The Plasticity Chart is also used to determine the behaviour of the fines content of coarse-grained soils.

Particle size and shape are usually described for coarse-grained soils, and plasticity is usually described for fine-grained soils. An exception to this rule applies when describing glacial till, then plasticity, particle size, and shape are all included in the description.

The principal component of the fraction of the soil passing the 3-inch U.S. Standard sieve size is shown capitalized on the test hole logs.

The proportions by weight of the minor components are defined according to the following descriptors:

Descriptor	Proportion
"and"	50 to 35 percent
"some"	35 to 20 percent
"little"	20 to 10 percent
"trace"	10 to 1 percent

The descriptors used must not contradict the classification by the Modified Unified Soil Classification System.

The terms given above are used to define proportions by weight of granular components, but they may also be used to define the proportion of minor components of fine-grained material, according to the subdivisions of the Plasticity Chart, Table 1 "Soil Classification System". The adjectives are not used to subdivide a principal fine-grained component. The modifier "y" or "ey" (i.e., SILT - clayey) is used when the liquid limit and plasticity index plot close to the "A-line" on the Plasticity Chart.

Peat and other highly organic soils are classified under the Group Symbol "Pt". Peat may be categorized and described using the Radforth Classification System.[4]

The soil is described first by identifying the principal component, followed by the minor components in order of decreasing proportion by weight. This is followed by other significant identifying features such as plasticity, colour, moisture, structure, and strength.

2.1.2 Typical Example of a Complete Soil Description

"CLAY, silty, little medium sand, trace coarse gravel, medium plasticity, yellow-brown", describes a yellow-brown fine-grained silty clay soil containing 50 percent or more of components finer than the No. 200 U.S. Standard sieve size with minor components of sand and gravel. The fraction passing the No. 40 U.S. Standard sieve size plots above, and close to the "A-line" on the Plasticity Chart. The soil contains

between 10 percent and 20 percent of sand particles generally in the size range No. 10 to No. 40 (i.e., finer than the No. 10 Standard sieve size and larger than the No. 40 Standard sieve size) and between 1 percent and 10 percent of gravel in the size range 3/4 inch to 3 inch. The identifying feature "medium plasticity" indicates that the liquid limit plots between 30 and 50 on the Plasticity Chart. Such a soil is classified as CI by the Modified Unified Soil Classification System.

2.1.3 Typical Examples of the Use of Modifiers and Descriptors

(a) Coarse-grained soil with minor fine-grained component:

"GRAVEL, fine, some silty clay", describes a coarse-grained soil with a minor component of fines, which has a liquid limit and plasticity index that plot above and close to the "A-line" on the Plasticity Chart. Such a soil is classified as GC by the Unified Soil Classification System.

"SAND, some silt," is correct in that "silt" in this case is a minor component of non-plastic fines which plot below the A-line on the Plasticity Chart.

(b) Fine-grained soil with a minor coarse-grained component:

"CLAY, silty, some fine sand", describes a fine-grained soil having a fines content in excess of 50 percent (i.e., 50% of material finer than the No. 200 U.S. Standard sieve size), which plots above the "A-line", on the Plasticity Chart, with a liquid limit less than 50 on the Plasticity Chart, and has a minor component of fine sand.

"CLAY, some silt, some fine sand", would not be used as the fines are classified by behaviour (plasticity) and not by particle size. Such a soil would be classified as CI or CL according to the Unified Soil Classification System.

2.2 NRC Ice Type and Estimated Visual Ice (Column 6)

Ground ice is divided by the NRC system on the basis of examination by the unaided eye into the three major cateogries shown below. A complete description of this system is contained in the NRC "Guide to a Field Description of Permafrost for Engineering Purposes".[2]

2.2.1 Ground Ice Classification Categories

Non-visible ice	N
Visible ice less than on inch thick	V
Visible ice greater than one inch thick	ICE or ICE + soil type

Figure 4 "Ground Ice Classification" shows the various types of ground ice recognized by the NRC classification system. Graphic symbols for ground ice have been devised to complement the graphic soil log.

Frozen soils in the N group may, on close examination, indicate presence of ice within the voids of the material by crystalline reflections or by a sheen on fractured or trimmed surfaces. The impression received by the unaided eye, however, is that the ice does not occupy space in excess of the original voids in the soil. Excess ice in the N group can be identified by use of a hand magnifying lens, or by placing some frozen soil in a small jar, allowing it to melt and observing the supernatant water. To the unaided eye, ice in frozen soils in the V group appears to occupy space in excess of the original voids in the soils.

The volume of ground ice can be described quantitatively in two ways. "Excess ice" is the volume of supernatant water expressed as a percentage of the total volume of the thawed soil and water. This quantity is often referred to as "excess moisture". "Visual ice" is the estimated volume of segregated ice discernible by eye in the frozen sample and is expressed as a percentage of the total volume of the frozen soil. By these definitions the quantity "excess ice" and

"visual ice" are not necessarily the same for a given frozen soil. Care is taken when estimating the volume of ice coatings on granular material (Vc). The ice is usually obvious, giving the impression of "excess ice", which may not necessarily be the case.

2.2.2 Ice Description Terminology

The following terminology has been generally taken from Table II of the NRC Guide.[2]

"Ice Coatings on Particles" are discernible layers of ice found on or below the larger soil particles in a frozen soil mass. They are associated sometimes with hoarfrost crystals that have grown into voids produced by the freezing action.

"Ice Crystal" is a very small individual ice particle visible in the face of a soil mass. Crystals may be present alone or in combination with other ice formations.

"Clear Ice" is transparent and contains only a moderate number of air bubbles.

"Cloudy Ice" is relatively opaque due to entrained air bubbles or other reasons, but is essentially sound and non-pervious.

"Porous Ice" contains numerous voids, usually interconnected, and generally results from melting at air bubbles or along crystal interfaces, from presence of salt or other materials in the water, or from the freezing of saturated snow; though porous, the mass retains its structural unity.

"Candled Ice" is ice that has rotted or otherwise formed into long columnar crystals very loosely bonded together.

"Granular Ice" is composed of coarse, more or less equidimensional ice crystals weakly bonded together.

"Ice Lenses" are lenticular ice formations in soil occurring essentially parallel to each other, generally normal to the direction of heat loss and commonly in repeated layers.

"Ice Segregation" is the growth of ice as distinct lenses, layers, veins, and masses in soils, commonly but not always oriented normally to direction of heat loss.

"Well-bonded" signifies that the soil particles are strongly held together by the ice and that the frozen soil possesses relatively high resistance to chipping or breaking.

"Poorly-bonded" signifies that the soil particles are weakly held together by the ice that the frozen soil possesses poor resistance to chipping or breaking.

"Friable" denotes extremely weak bonds between soil particles. The material is easily broken up.

The symbols "UF" or "F" may be used in Column 6. "UF" is added to indicate unfrozen zones in areas of generally frozen ground and also to avoid possible errors of omission. "F" is used in certain cases along with the corresponding graphic representation for "Undifferentiated" permafrost or frozen active layer soils. It may be used where the soil is known to be frozen but, due to circumstances beyond field control, the ice type cannot be determined because of grinding or temporary thawing of the material by the drilling operation.

2.3 Classification of Construction Materials

2.3.1 Granular Material

The following is a description of materials that was used within the "Material" and "Development" sections of Individual Deposit Reports. Material classification has been based on the potential construction usage of the granular material for each deposit. This classification system for Granular Materials was provided by DIAND.

TABLE A1

CLASSIFICATION OF GRANULAR MATERIALS

Source Quality Description	General Description of Material	Minimum Technical Identification Parameters	Suggested Uses of Material
(1) Excellent	Well graded sands and gravel suitable for use as aggregates with a minimum of processing	Petrographic Number - 160 max. Los Angles Abrasion Loss - 35% max. Soundness Loss (Magnesium Sulphate) - 12% max. and meeting other requirements of CSA A23.1 - 1973	Portland Cement Concrete, Asphaltic Concrete, Masonry Sand, Concrete Block, Surface Treatment and Rooting Aggregate.
(2) Good	Graded sands and gravels with varying quantities of silt.	Petrographic Number - 200 max. Los Angeles Abrasion Loss - 60% max. Fines greater than 10% passing the 200 sieve can be removed with minimum of processing	Granular base and sub-base. Winter sand backfill for trenches and slabs. Pads for structure.
(3) Fair	Poorly graded sands and gravels with or without substantial silt content	Petrographic Number 250 max. Can be processed to meet local frost susceptibility criteria	Granular sub-base General backfill Material, Pads for equipment.
(4) Poor	Poorly graded granular soils of high silt content, possibly containing very weak particles and deleterious materials	Nil	General non-structural fill.

2.3.2 Rock

Various non-granular deposits have been investigated for use as riprap, or crushed aggregate. Rock type and characteristics have been determined by Petrographic Analysis of thin sections. This was done by Dolmage Campbell and Associates (1975) Ltd., and is summarized on "Summary of Petrographic Data for Rock Samples" forms, included in the "Individual Deposit Reports".

2.4 Soil Drainage Classes

The Soil Drainage Classes were used in describing the drainage of each deposit that was investigated. The following set of definitions was used to determine the drainage of each site.

The following is extracted from pages 215 and 216 of National Soil Survey Committee, 1970 "The System of Soil Classification for Canada", Canada Department of Agriculture, Ottawa. The system, although devised primarily for agricultural purposes is suitable for engineering purposes and was employed when describing soil drainage at the deposit locations. The soil drainage classes are defined in terms of:

(i) actual moisture in excess of field moisture capacity, and

(ii) the extent of the period during which such excess water is present in the plant-root zone.

Permeability, groundwater levels and seepage affect the moisture status but these are not easily observed in the field and therefore cannot generally be used as criteria for moisture status. The recommended definitions are as follows:

(1) Rapidly drained - The soil moisture content seldom exceeds field capacity in any horizon except immediately after water conditions.

(2) Well drained - The soil moisture content does not normally exceed field capacity in any horizon for a significant part of the year. ("significant" - as used in the definitions is considered in relation to plant growth).

(3) Moderately well drained - The soil moisture in excess of field capacity remains for a small but significant period of the year.

(4) Imperfectly drained - The soil moisture in excess of field capacity remains in subsurface horizons for moderately long periods during the year.

(5) Poorly drained - The soil moisture in excess of field capacity remains in all horizons for a large part of the year.

(6) Very poorly drained - Free water remains at or within 12 inches of the surface most of the year.

2.5 Topography

The topography of each deposit was described using the following table of terms in the Individual Deposit Reports.

Topography is described in the following terms:

Single Slopes	Complex Slopes	Slope %	Slope °
flat	flat depressional	0- 2	0- 1
gently sloping	undulating, smoothly rounded	2- 5	1- 3
moderately sloping	rolling ridgy, choppy	5-15	3- 8
steeply sloping	kettled, knobby	15-60	8-31
precipitous	precipitous	>60	>31

"Region" is general area around the deposit location and is generally within 1500' of the test pit(s).

"Site: refers to the area within 100' of the test pit(s).

REFERENCES

1. "Unified Soil Classification System" Technical Memorandum 3-357 prepared for Office, Chief of Engineering, by Waterways Experimental Station, Vicksburg, Mississippi, Corps of Engineers, U.S. Army. Volume I, March 1953.

2. National Research Council, Canada, "Guide to a Field Description of Permafrost for Engineering Purposes", prepared by Pihlainen, J.A. and Johnston, G.H., Technical Memorandum 79, NRC 7576, Ottawa, 1963.

3. American Society for Testing and Materials, Procedures for Testing Soils, "Suggested Methods of Testing for Identification of Soils", Fourth Ed. pp 221-233, December 1964.

4. National Research Council, Canada "Guide to a Field Description of Muskeg", (Based on the Radforth Classification System) compiled by MacFarlane, I.C. Technical Memorandum 44 (Revised Edition) NRC 4214, Ottawa, 1958.

5. American Society for Testing and Materials, "Annual Book of Standards", (Part 19, 1974 or latest Standard) Philadelphia, Pa., U.S.A.

6. Goodman L.J. and Lee, C.N. 1962 "Laboratory and Field Data on Engineering Characteristics of Some Peat Soils", Proc. 8th Muskeg Res. Cong. NRC ACSSM Tech. Memo 74 pp 107-129.

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
	Pt		PEAT - fibrous, brown. 0.5		UF		Organic Color: #2+ Moisture Content: 2.3%
1	CI		CLAY - silty, medium plastic, grey.				Lightweight Pieces - Fine Aggregate: 0.12%
2			2.0				
	SP		SAND - fine, trace fine gravel to ½" size. 3.5				
4	GW		GRAVEL - well graded to 2" size, and medium to coarse sand, sub-rounded to rounded, cherts.			4.3	
5			5.0 — —		Vx 10%		
			5.5 — — - layer of coarse gravel to 3" size.				
6							
7							Bottom of scarp is 30' below bottom of pit.
8			8.5				
9			Bottom of Pit				Sample from 2.0'-8.5'

DATE: Sept. 17, 1976	LOGGED BY: GCD	DRWN BY: MB/vh	CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO. Y120-A(e)
SHEET 1 OF 1

FIGURE 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)

DATE:	LOGGED BY:	DRWN BY:	CHKD BY:

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

TEST PIT NO.

SHEET OF

FIGURE 2

MODIFIED UNIFIED CLASSIFICATION SYSTEM FOR SOILS

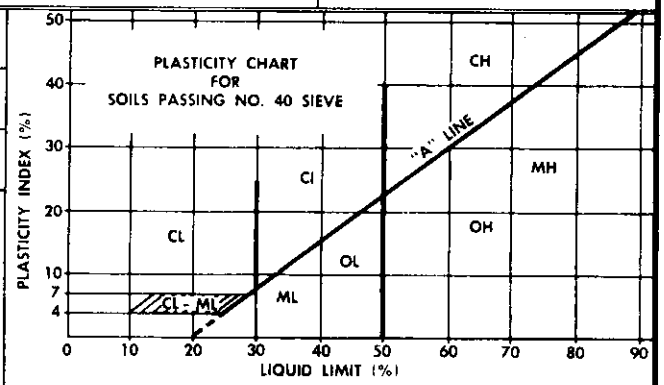
MAJOR DIVISION			GROUP SYMBOL	GRAPH SYMBOL	COLOR CODE	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA
COARSE-GRAINED SOILS (MORE THAN HALF BY WEIGHT LARGER THAN 200 SIEVE)	GRAVELS MORE THAN HALF COARSE GRAINS LARGER THAN NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)	GW		RED	WELL GRADED GRAVELS, LITTLE OR NO FINES	$C_U = \frac{D_{60}}{D_{10}} > 4$ $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1$ to 3
			GP		RED	POORLY GRADED GRAVELS, AND GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS
		DIRTY GRAVELS (WITH SOME FINES)	GM		YELLOW	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12%: ATTERBERG LIMITS BELOW "A" LINE OR P.I. LESS THAN 4
			GC		YELLOW	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES	CONTENT OF FINES EXCEEDS 12%: ATTERBERG LIMITS ABOVE "A" LINE P.I. MORE THAN 7
	SANDS MORE THAN HALF FINE GRAINS SMALLER THAN NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)	SW		RED	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	$C_U = \frac{D_{60}}{D_{10}} > 6$ $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1$ to 3
			SP		RED	POORLY GRADED SANDS, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS
		DIRTY SANDS (WITH SOME FINES)	SM		YELLOW	SILTY SANDS, SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12%: ATTERBERG LIMITS BELOW "A" LINE P.I. LESS THAN 4
			SC		YELLOW	CLAYEY SANDS, SAND-CLAY MIXTURES	CONTENT OF FINES EXCEEDS 12%: ATTERBERG LIMITS ABOVE "A" LINE P.I. MORE THAN 7
FINE-GRAINED SOILS (MORE THAN HALF BY WEIGHT PASSES 200 SIEVE)	SILTS BELOW "A" LINE NEGLIGIBLE ORGANIC CONTENT	$W_L < 50\%$	ML		GREEN	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY SANDS OF SLIGHT PLASTICITY	CLASSIFICATION IS BASED UPON PLASTICITY CHART (see below)
		$W_L > 50\%$	MH		BLUE	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDY OR SILTY SOILS	
	CLAYS ABOVE "A" LINE ON PLASTICITY CHART NEGLIGIBLE ORGANIC CONTENT	$W_L < 30\%$	CL		GREEN	INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY, OR SILTY CLAYS, LEAN CLAYS	
		$30\% < W_L < 50\%$	CI		GREEN-BLUE	INORGANIC CLAYS OF MEDIUM PLASTICITY, SILTY CLAYS	
		$W_L > 50\%$	CH		BLUE	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	
	ORGANIC SILTS & CLAYS BELOW "A" LINE ON CHART	$W_L < 50\%$	OL		GREEN	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY	
		$W_L > 50\%$	OH		BLUE	ORGANIC CLAYS OF HIGH PLASTICITY	
HIGHLY ORGANIC SOILS			Pt		ORANGE	PEAT AND OTHER HIGHLY ORGANIC SOILS	STRONG COLOR OR ODOR, AND OFTEN FIBROUS TEXTURE

SOIL COMPONENTS

FRACTION	U S STANDARD SIEVE SIZE		DEFINING RANGES OF PERCENTAGE BY WEIGHT OF MINOR COMPONENTS	
	PASSING	RETAINED	PERCENT	DESCRIPTOR
GRAVEL			50 - 35	and
coarse	3 inch	¾ inch		
fine	¾ inch	No 4		
SAND			35 - 20	some
coarse	No 4	No 10	20 - 10	little
medium	No 10	No 40		
fine	No 40	No 200	10 - 1	trace
SILT (non plastic) or CLAY (plastic)	No 200			

OVERSIZE MATERIAL

Rounded or subrounded COBBLES 3 inch to 8 inch BOULDERS > 8 inch	Not rounded ROCK FRAGMENTS > 3 inch ROCKS > 1 cubic yard in volume



1. ALL SIEVE SIZES MENTIONED ON THIS CHART ARE U.S. STANDARD, A.S.T.M. E.11.
2. BOUNDARY CLASSIFICATIONS POSSESSING CHARACTERISTICS OF TWO GROUPS ARE GIVEN COMBINED GROUP SYMBOLS, E.G. GW-GC IS A WELL GRADED GRAVEL SAND MIXTURE WITH CLAY BINDER BETWEEN 5% AND 12%.

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

FIGURE 3

GROUND ICE CLASSIFICATION

Category	Group Symbol	Subgroup Symbol	Graphic Symbol	Description
		F		Undifferentiated
Non-visible Ice	N	Nf		Poorly bonded or friable frozen soil
		Nbn		Well bonded frozen soil with no excess ice
		Nbe		Well bonded frozen soil with excess ice. Free water present when sample thawed
Visible Ice less than one inch thick	V	Vx		Individual ice crystals or inclusions
		Vc		Ice coatings on particles
		Vr		Random or irregularly oriented ice formations
		Vs		Stratified or distinctly oriented ice formations
Visible Ice greater than one inch thick	ICE	ICE + soil type		Ice greater than one inch thick with soil inclusions
		ICE		Ice greater than one inch thick without soil inclusions

Adapted from NRC 7576

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

FIGURE 4

APPENDIX B

BIBLIOGRAPHY

BIBLIOGRAPHY

American Society for Testing and Materials, 1975. 1975 Annual Book of ASTM Standards, Part 14, Concrete and Mineral Aggregates (including Manual of Concrete Testing).

_____, 1974. (or latest standard) Annual Book of Standards, Part 19.

_____, December 1964. Procedures for Testing Soils, Suggested Methods of Testing for Identification of Soils, Fourth Ed. pp. 221-223.

Bamber, E. W., 1972. Description of Carboniferous and Permian Stratigraphic Sections, Northern Yukon Territory and Northwestern District of Mackenzie. Geol. Surv. Can. Paper 72-19.

Canadian Standards Association, 1973. Concrete Materials and Methods of Concrete Construction, A23.1-1973.

_____, 1973. Methods of Tests for Concrete, A23.2-1973.

Department of Environment, 1976. Land Use Information Series Maps; NTS 117A, 117C, 117D.

_____, 1975. Beaufort Sea Bathymetric Charts 7601, 7602.

_____, 1972. Land Use Information Series Maps; NTS 107B.

Department of Indian Affairs and Northern Development, 1974. Mackenzie Valley Pipeline Assessment.

Goodman, L. J. and Lee, C. N., 1962. Laboratory and Field Data on Engineering Characteristics of Some Peat Soils, Proc. 8th Muskeg Res. Cong. NRC ACSSM Technical Memorandum 74, pp. 107-129.

Hettinger, L., A. Janz and R. Wein, 1973. Vegetation of the Northern Yukon Territory. CAGSL Biol. Rep. Ser. Vol 1.

Hughes, O. L., 1972. Surficial Geology of Northern Yukon Territory and Northwestern District of Mackenzie, Northwest Territories. Geol. Surv. Can. Paper 69-36.

Jeletzky, J. A., 1967. Jurassic and Triassic Rocks of the Eastern Slope of Richardson Mountains, Northwestern District of Mackenzie. Geol. Surv. Can. Paper 66-50.

_____, 1960. Uppermost Jurassic and Cretaceous Rocks, East Flank of Richardson Mountains Between Stoney Creek and Lower Donna River, Northwest Territories. Geol. Surv. Can. Paper 59-14.

_____, 1958. Uppermost Jurassic and Cretaceous Rocks of Aklavik Range, Northeastern Richardson Mountains, Northwest Territories. Geol. Surv. Can. Paper 58-2.

Klohn Leonoff Consultants Ltd., 1975. Gravel Search Program - Yukon Coastal Plain, King Point Area, Phase II - Field Reconnaissance. Report prepared for Imperial Oil Limited.

Lewis, C. P., and D. L. Forbes, 1975. Coastal Sedimentary Processes and Sediments, Southern Canadian Beaufort Sea. Beaufort Sea Project, Technical Report No. 24.

MacFarlane, I. C., 1958, Guide to a Field Description of Muskeg, (Based on the Radforth Classification System) National Research Council, Canada, Technical Memorandum 44 (Revised Edition) NRC 4214.

McDonald, B. C., and C. P. Lewis, 1973. Geomorphic and Sedimentologic Processes of Rivers and Coasts, Yukon Coastal Plain. Environmental-Social Program, Northern Pipelines, Report No. 73-39.

Norris, D. K., 1973. Tectonic Styles of Northern Yukon Territory and Northwestern District of Mackenzie, Canada. In: M. G. Ritcher, ed., Arctic Geology. Am. Assoc. Petral. Geol. Memoir 19.

_____, 1972. Structural and Stratigraphic Studies in the Tectonic Complex of Northern Yukon Territory, North of Porcupine River. Geol. Surv. Can. Paper 72-1B.

Northern Engineering Services Company Limited, May 1976. Volume 1 - 1975 Pipeline Borrow Investigations, Yukon Coastal Plain. Report prepared for Canadian Arctic Gas Study Limited.

_____, November 1975. Pipeline Related Borrow Studies, Cross Delta Alternative Route and East of Fort Simpson Realignment. Report prepared for Canadian Arctic Gas Study Limited.

_____, July 1974. Pipeline Related Borrow Studies Report and maps prepared for Canadian Arctic Gas Study Limited.

Pihlainen, J. A. and Johnston, G. H., 1963. Guide to a Field Description of Permafrost for Engineering Purposes. National Research Council, Canada, Technical Memorandum 79, NRC 7576.

Rampton, V. N., 1974. Terrain Evaluation, Mackenzie Transportation Corridor, Northern Part. Environmental-Social Program, Northern Pipelines, Report No. 73-74.

_____, 1974. Surficial Geology and Landforms, NTS 107B-W½, 117A, 117C, 117D. Geol. Surv. Can. Open File 191.

Ripley, Klohn and Leonoff International Ltd., 1972 and 1973. Granular Material Inventory - Zone IV, V, VI (Mackenzie Delta - South). Report with maps prepared for the Department of Indian Affairs and Northern Development.

Waterways Experimental Station, Vicksburg, Mississippi, Corps. of Engineers, U.S. Army, March 1953, United Soil Classification System, Technical Memorandum 3-357, Volume 1. Prepared for Office, Chief of Engineering.

Yorath, C. J. and D. K. Norris, 1975. The Tectonic Development of the Southern Beaufort Sea and Its Relationship to the Origin of the Arctic Ocean Basin. In: C. J. Yorath et al., ed., Canada's Continental Margins and Offshore Petroleum Exploration. Cdn. Soc. Petrol. Geol. Memoir 4.

Young, F. G., 1975. Upper Cretaceous Stratigraphy, Yukon Coastal Plain and Northwestern Mackenzie Delta. Geol. Surv. Canada Bull. 249.

_____, 1974. Cretaceous Stratigraphic Displacements Across Blow Fault Zone, Northern Yukon Territory, Geol. Surv. Can. Paper 75-1 Part B, pp. 291-296.

APPENDIX B

GLOSSARY

GLOSSARY

COMMON FLORA OF THE YUKON COASTAL PLAIN

SCIENTIFIC DESIGNATION	COMMON NAME
Betula glandulosa	dwarf birch
Calamagrostis spp.	blue stem
Carex spp.	sedge
Dryas spp.	avens
Ledum palustre	Labrador tea
Minuartia spp.	minuartia
Oxytropis spp.	loco weed
Salix spp.	willow
Silene acaulis	moss campion
Vaccinium spp.	heath, blueberry etc.
Vaccinium uliginosium	alpine blueberry

DEPOSIT LOCATIONS
GRANULAR MATERIALS INVENTORY
YUKON COASTAL PLAIN AND ADJACENT AREAS

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

R.M. HARDY & ASSOCIATES LTD.
CONSULTING ENGINEERS & PROFESSIONAL SERVICES
• GEOTECHNICAL DIVISION

PLATE NO. 1

APPENDIX C

DEPOSIT LOCATION MAP