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INTERIM REPORT - PHASE II

FIELD RECONNAISSANCE

COMMUNITY GRANULAR MANAGEMENT PLAN

TUKTOYAKTUK, NWT

PROJECT NO. 86-9128A

Prepared For:

GOVERNMENT OF THE NORTHWEST TERRITORIES
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November, 1986 CG14096

5/38



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1.0 INTRODUCTION

The study to develop a community granular management plan for Tuktoyaktuk is being conducted in four phases, with interim reporting and reviews between each phase. In accordance with the terms of Contract No. 86.32. 1D41 (259) Hardy BBT Limited have undertaken Phase II of this study, and are pleased to present this interim report. The report details the results of the Phase II Field Reconnaissance and provides recommendations for Phase III. The Phase I interim report was submitted in July 1986.

1.1 SCOPE OF WORK

The terms of reference for Phase II, were as follows:

- undertake airphoto interpretation (as required) prior to any field work
- undertake a field reconnaisance in the late summer/early fall to spot check the surficial geology, land forms and most promising potential granular sources
- carry out a limited program of test pitting and sampling
- take spot elevations of selected features that are recognizable on the airphotos to facilitate future preparation of a topographic plan for the most promising granular sources
- take photographs and prepare detailed field notes of granular sources, giving a description of: stratigraphy



and geomorphic development together with comments on distribution, estimated volumes, expected quality, depth of overburden, potential ground ice, ease of access, possible development problems, drainage requirements, etc.

- photograph representative samples and run gradation tests, carry out limited petrographic analyses, moisture content, ice content, organic content, hardness, soundness, specific gravity and absorption tests on selected representative samples.
- update the annotated airphotos to reflect the results of the field checking
- prepare 10 copies of a brief interim report summarizing the results of the field reconnaissance and providing recommendations for Phase III.

During a review meeting in our office on October 30, 1986, it was decided that this report should outline in more detail than originally requested our present thoughts on the development of granular sources. This has been requested primarily because our field reconnaissance has identified numerous potential small and shallow granular deposits relatively close to Tuktoyaktuk. Because of their probable shallow nature a different method of investigation, other than drilling. should be considered. Also, if a number of relatively small granular deposits were to be considered for development close to Tuktoyaktuk, it was decided to introduce at this stage some preliminary discussion on planning a satisfactory restoration and revegetation of the sources.



2.0 METHODOLOGY

2.1 AIRPHOTO INTERPRETATION

Prior to organizing the field reconnaissance a detailed review of airphotographs was undertaken of selected areas and known deposits. Particular attention was placed on the area south and southeast of Tuktoyaktuk (south of line A-A', defined during Phase I) in an attempt to locate suitable granular material relatively close to Tuktoyaktuk. In addition, a review of Deposits 155 and 163 was undertaken with the objective to conduct some limited field reconnaissance of these deposits.

Black and white panchromatic air photographs at a scale of 1:20,000 were available for most of the area south and southeast of Tuktoyaktuk. Recent airphotographs (1985) for Deposits 155 and 163 were available only at a scale of 1:60,000.

The airphotographs were used to identify and delineate the distribution of glaciofluvial deposits in the areas of interest, and as an aid to planning the logistics for ground-truthing during the field reconnaissance.

The annotated airphotographs are retained in our files for reference during future phases. They will be made available with the final report at the end of Phase IV.



2.2 FIELD RECONNAISSANCE

The field reconnaissance was conducted in the period September 4-12, 1986 under the direction Mr. N. Mosley P. Geol., Senior Engineering Geologist with Hardy BBT Limited. A Bell Jet Ranger 206B helicopter (contracted from Sunrise Helicopters of Inuvik) was used to transport our geologist and two local labourers (plus equipment) to various locations for the purpose of documenting, test-pitting and sampling granular materials.

A total of 38 test pits were excavated in Deposits 181, 183, 184, 169, 155 and 163. The test pits were taken to a maximum depth of 1.7 m, but the average depth was about 0.8-0.9 m. Deposits 181, 183 and 184 were defined during this study (in the area south and southeast of Tuktoyaktuk) and are described in section 3.0. Parts of Deposit 169 are now included in Deposit 183. Logs of the test pits are presented in Appendix "B" to this report.

Throughout the field reconnaissance, as information became available, the airphoto interpretation was revised and new areas of interest were identified and field checked. In this manner a comprehensive delineation of glaciofluvial deposits in the area south/southeast of Tuktoyaktuk was achieved. Reconnaissance of Deposits 155 and 163 was of a less detailed nature, however, several new glaciofluvial deposits were identified in the area of 155, and the areal extent of 163 was increased.



2.3 LABORATORY TESTING

A large number of samples were returned to our Calgary laboratory for classification and aggregate quality testing. The laboratory testing program comprises 32 grain size analyses, 5 petrographic analyses, and 2 sets of aggregate tests comprising: Los Angeles abrasion, sulphate soundness, organic impurities, absorption and specific gravity. The results of this testing program are presented in Appendix "C".

3.0 GEOLOGIC EVALUATION OF DEPOSITS

3.1 GENERAL

Glaciofluvial deposits in the area between Tuktoyaktuk and the Eskimo Lakes are considered to be part of a pro-glacial outwash plain, deposited as outwash fans and valley trains. However, scattered groups of kames and esker ridges are known in the area.

Most of the outwash consists of fine to coarse sand, and to a minor extent gravel. Gravel often is found as a thin layer on the surface of the outwash, as irregular lenses and layers in sand deposits, and in some instances as channel fillings. The gravel is generally crudely stratified with variable grading and content of fines. Most of the glaciofluvial sand is fine to coarse-grained and crossbedded.

In the area around Deposit 155 the glaciofluvial materials are considered to be kame deposits with some terrace deposits adjacent to glacial meltwater channels. The kame deposits, consist of fine to coarse sand with a minor gravel content and



occasional cobbles and boulders; however the terrace deposits are significantly gravelly with cobbles and some boulders.

Deposit 163 is a large terraced glaciofluvial outwash plain with a flat to gently undulating surface. The outwash consists of fine to coarse sand with a variable gravel content such that some areas comprise sand with some gravel.

In general the glaciofluvial sands contain 5 to 20 percent excess ice by volume, although occassionally excess ice is absent. The gravels are generally free of excess ice, although some may contain up to 20 percent by volume. Isolated bodies of massive ice may be present in the glaciofluvial deposits. Ice wedges are more common where the sand and gravel is covered by silt or peat.

In the following sections a brief description is given of the deposits investigated during this study.

3.2 DEPOSITS 181, 183 AND 184

Setting

The distribution of these three deposits is illustrated on Figure 1, and they are described together due to their close proximity and probable common genesis. The distance of these deposits from Tuktoyaktuk is as follows:

Deposit 181 - 8 to 12 km
Deposit 183 - 12 to 17 km
Deposit 184 - 19 to 22 km

49. 50, 35 **(A)** 043 Ó DEPOSIT 181 A 181-16 -5 E DEPOSIT 183 DEPOSIT 184 JB1-13 181-15 **(A)** T83-4 COMMUNITY GRANULAR MANAGEMENT PLAN TUKTOYAKTUK, NWT Hardy BBT Limited DEPOSIT 181 , 183 & 184 TEST PIT LOCATIONS CG14096 Scale 1: 50,000 FIG . I



Deposit 169, which was previously identified by Hardy Associates in 1977, forms part of Deposit 183. All of these deposits are south of the line A-A' (defined in Phase I) and north of which no development of granular materials is desired. Deposits 181, 183 and part of 184 all occur at relatively low elevation (less than 30 m above sea level) as and generally thin glaciofluvial numerous small The remainder of Deposit 184 is a relatively accummulations. large deposit which occurs on an upland plateau area (disected by small lakes) which is about 50-60 m above sea level.

Most of the deposits occur as localized accumulations of outwash on the flanks and tops of low hills, or as small kame-like features in low-lying areas. This gives the impression of either deposition in discreet areas, or erosion and disection of more extensive outwash deposits. The former explanation may be more likely because the occurrence of many deposits have the appearance of irregular terraces.

The large area of granular material in Deposit 184 occurs as disected outwash which has accumulated around two small lakes on the upland area. The two lakes appear to occupy parts of a glacial meltwater channel with lateral channels either side. The meltwater channels disect the deposit such that granular material occupies the higher ground and channel flanks, but is absent within the channels.

Materials

Based upon an inspection of all the gradations performed on samples from Deposits 181, 183 (169) and 184, it is apparent that they are all composed of similar proportions of granular



material. They all comprise mainly sand, fine to medium grained with a trace to some gravel, and a trace of fines. However, about forty percent of the material is sand and gravel, having about 30-60 percent gravel content, and a trace of fines. Occasional cobbles and boulders occur quite commonly in these coarser materials.

Some areas display clear evidence of stratification, such as thin gravel layers within sand, yet in other areas the test pits revealed no discernable bedding structure.

The active layer thickness generally varies from 0.7 m to 1.3 m but may be greater than 1.7 m locally, and the peat overburden is generally less than 0.1 m but locally may be up to 0.3 m in thickness. In a few locations permafrost was not encountered by 1.2 m and 1.7 m depth, where the test pit was terminated. But generally the sand and gravel is underlain by frozen, fine to medium grained sand or frozen sand and gravel. Where frozen fine to medium sand occurs it is always bonded into a hard solid mass with no visible ice i.e. well bonded, little excess ice. The sand is interpreted to be either glaciofluvial in origin or of pre-glacial deltaic origin. Where frozen sand and gravel is encountered, it is well bonded and often contains ice crystals or ice-coatings on particles i.e. some excess ice.

The granular material in these deposits is considered to vary from poor to good quality, with an overall "bulk" quality estimated to be fair. Qualitative explanations of these materials quality grades are included in Appendix "A". The material from these deposits would be useful for embankment fill.



Volume

The volume of granular material available from these deposits is limited due to their relative thinness and small areal extent. However, if an average extraction depth of 1.0 m is assumed, the following volumes of fair quality granular material are estimated to be recoverable:

Deposit 181 - 260,000 m³
Deposit 183 - 118,500 m³
Deposit 184 - 220,000 m³

These volumes are generated by estimating the surface areas of individual deposits, scaled from the airphotographs (1:20,000 scale). Estimated volumes of granular material in individual deposits are shown on Figure 2.

Additional Exploration

The majority of discrete deposits comprising Deposits 181, 183 and 184 are considered to be of only surficial thickness i.e. about one metre thick. Hence it is not considered cost effective to undertake an extensive drilling program to prove the deposits. However, at a few locations frozen sand and gravel was encountered and at others the permafrost table was not located within the test pit depth. At some of these locations additional testing would be warranted to prove the thickness. In addition the frozen sand encountered in numerous pits may be underlain by sand and gravel at depth, so this possibility could be investigated.

69" 20" **(**A) ₹. DEPOSIT IN 12,000 3 (VOL 260,000 m) 6,000 * DEPOSET 183 (VOL. 118,500 m 3) DEPOSIT 184 (VOL 220,000 m3) £.000 6,000 **(A)** 49 * 28 (1,000) COMMUNITY GRANULAR MANAGEMENT PLAN TUKTOYAKTUK, NWT Hardy BBT Limited DEPOSIT 181,183 & 184 ESTIMATED GRANULAR MATERIAL VOLUME (m3) CG14096 Scale 11 50,000



Access and Development

Access to Deposit 181 from the community of Tuktoyaktuk is relatively easy during winter operations (the preferred approach) due to the close proximity (8-12 km). The majority of the access route (55-70%) would be ice road, with the remainder being overland.

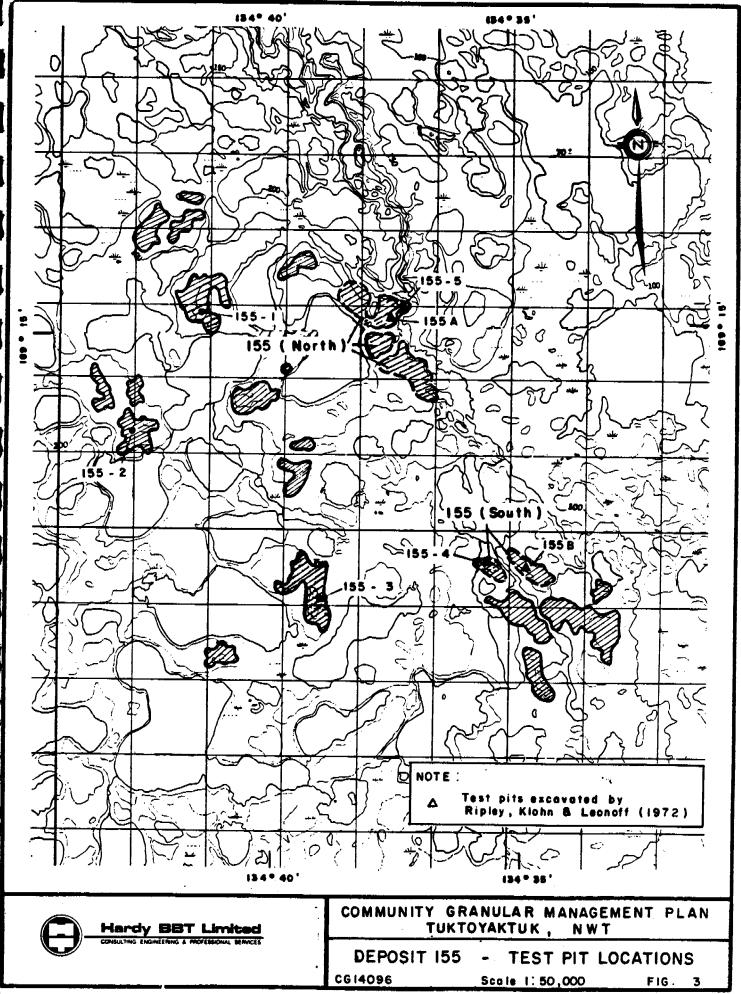
Access to Deposits 183 and 184 is more difficult due to increased distance from Tuktoyaktuk and proportionately more overland travel involved. However, it is possible to optimise routes across lakes to keep overland sections to an acceptable minimum. Access to the large portion of Deposit 184 involves a significant climb in elevation i.e. 30-45 m.

Drainage of most of the deposits is not anticipated to be of concern due to their location on the tops and flanks of low hills. However, some deposits are close to lakes, therefore careful borrow pit operation will be required to avoid siltation. Ice wedges (polygons) likely exist in some deposits, associated with the underlying fine to medium sand.

3.3 DEPOSIT 155

Setting

The extent of Deposit 155 is illustrated on Figure 3, which shows the original deposits (155 north and south) together with those located during the course of this study. Deposit 155 is located approximately 32 km radially to the west of Tuktoyaktuk, but access to it is relatively good by winter ice road. The surface distance is about 45 km, with about 40 km



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being ice road (coast, Kittigazuit inlet and creek) and the remainder being overland.

The deposits originally identified at 155 (i.e 155 north and south) have the appearance of irregular glacifluvial terraces adjacent to meltwater channels which trend roughly NW-SE in this area. The newly identified deposits are at a higher elevation generally being draped over the tops of hills as irregular kame-like mounds and ridges.

Materials

The kames are composed predominantly of sand with a variable gravel content and some cobbles and boulders. A layer of sand and gravel typically occurs at the surface, and some occur within the sand bodies, however stratification is poorly developed. The glaciofluvial terraces comprise mainly silty sand and gravel with good stratification, particularly in the 155 (north) terrace. Structure is less well developed in the irregular 155 (south) terraces where units of sand are interbeded with sand and gravel.

The active layer thickness varies from 0.8 m to 1.3 m. The overburden of peat varies in thickness from less than 0.1 m to about 0.6 m (estimated), although in localized areas it may be thicker. The thawed granular materials within the active layer are underlain by frozen, well bonded fine to medium sand, or sand with some gravel, generally with no discernable excess ice.

The quality of material in these deposits is quite variable. The kame deposits are only of poor to fair quality and as such



would be useful only for general (embankment) fill. The irregular glaciofluvial terraces, in the 155 (south) area, are of variable quality between fair to good, but overall are probably only of fair quality in bulk, and thus would be useful for embankment fill. The 155 (north) terrace is considered to be of good quality and could provide a good source of base and surface course aggregates.

Volume

The total volume of granular material contained in these deposits is difficult to estimate without information on their stratigraphic thickness and lateral continuity. However, the following estimates have been made:

- (a) kame deposits: assuming an average extraction depth of 1.0 m, approximately 1.1 x 10^6 m³ of fair quality granular material is recoverable
- (b) 155 (south) area: assuming an average extraction depth of 1.0 m, approximately 800,000 m³ of fair quality granular material is recoverable
- (c) 155 (north) area: assuming an average extraction depth of 1.5 m, approximately 700,000 m³ of good quality granular material is recoverable

These volumes are generated by estimating the surface areas of individual deposits, scaled from the airphotographs (1:60,000



scale) and topographic maps (1:50,000 scale). Estimated volumes of granular material in individual deposits are shown on Figure 4.

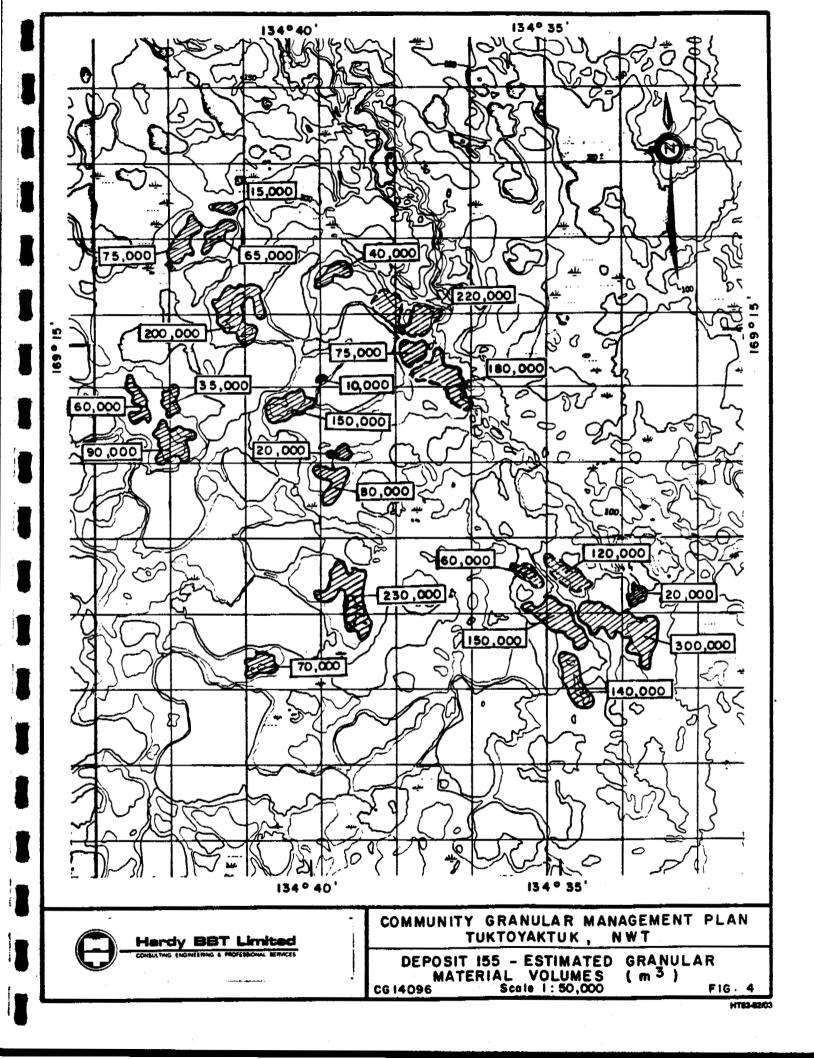
Additional Exploration

We consider that some additional exploration is warranted to determine: stratigraphic thickness, lateral and vertical variation, permafrost conditions (particularly the presence of massive ice). This work is required to prove up material quality and quantities which is particularly important in the 155 (north) deposit as it may be an important source of good quality material.

Access and Development

The access to Deposit 155 has already been discussed, except that the final 5 km of the route involves a significant climb in elevation of about 40-60 m. Surface drainage conditions for the majority of deposits are good, due to the rolling to hilly relief. Exceptions to this are 155 (north) and (south) which include extensive areas of level to undulating terrain which are potentially poorly drained. The 155 (north) area is presently well drained, however parts of 155 (south) are poorly drained and boggy. However, due to the close proximity of all deposits to lakes and or creeks (including the important Kittigazuit Creek) careful pit management will be required to avoid siltation.

Based on the present knowledge of these deposits, massive ice, in the form of ice wedges (polygons), likely exist in the level and poorly drained areas.





3.4 DEPOSIT 163

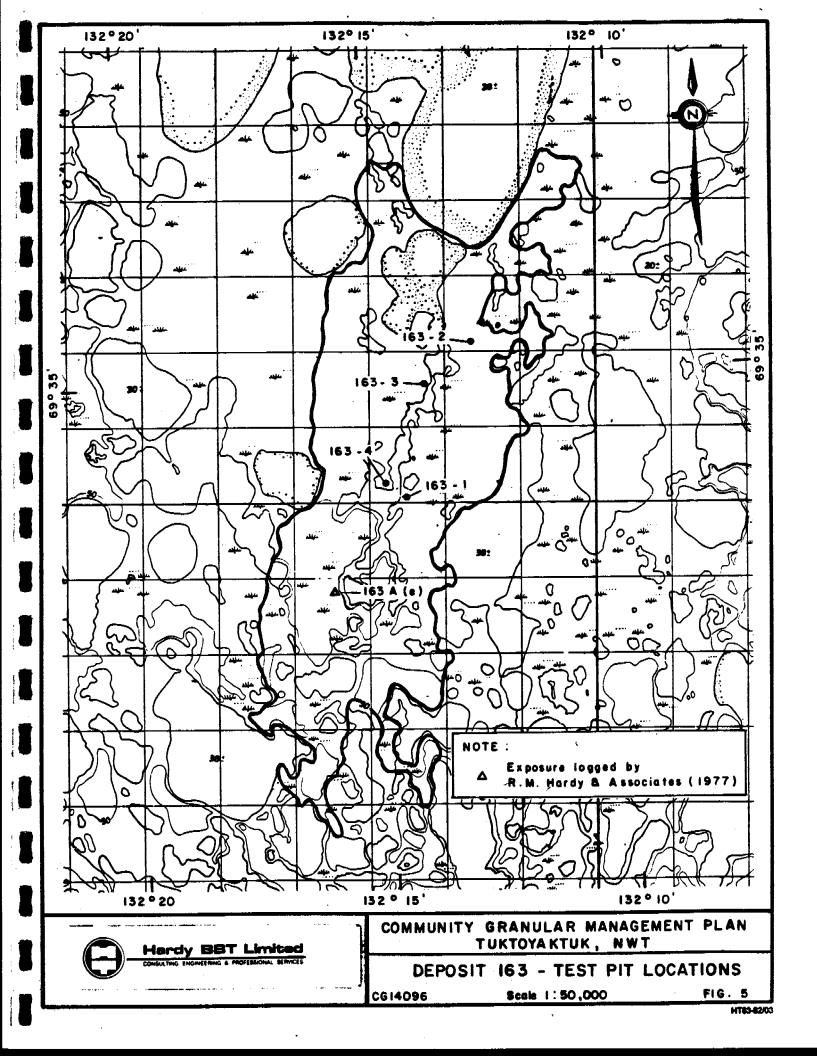
Setting

The location and extent of Deposit 163 is illustrated on Figure 5. Deposit 163 is located approximately 33 km (radial distance) to the east-northeast of Tuktoyaktuk. As a result of this study the deposit is considered to be more extensive than originally mapped. However, it is our interpretation that the granular materials likely have a finer gradation towards the periphery of the deposit.

Deposit 163 is a large glaciofluvial outwash plain which is bisected by a continuous line of interconnected thermokarst lakes. The surface is flat to undulating however the slopes to the internal thermokarst lakes are terraced, which is considered indicative of horizontal layering. The relief is up to about 15 m with two significant terraces, each about 7-8 m high.

Materials

The outwash plain is typically composed of fine to medium sand with a little gravel (fine to coarse), and a variable silt content (trace to silty). The overburden is of variable thickness, from almost none over large parts, to an unknown maximum thickness elsewhere. In TP 163-2 on the upper terrace at the north end of the deposit, silt overburden was determined to be 0.30 m thick. In TP 163-4 on the lower terrace, the granular materials were found to be underlain by silt of unknown thickness and extent. It is possible that layers of silt may be quite extensive and numerous, throughout





the stratigraphic sequence in Deposit 163, however this can only be determined by drilling. Despite the terraced form of the deposit, stratification is generally poorly developed and irregular, and is only evidenced by thin layers of gravelly sand.

The active layer thickness varies from 0.75 m to greater than 1.6 m in an area which has been stripped and worked. Frozen materials beneath the active layer consist of similar sands with a little gravel, and probably frozen silt in places. The frozen sands are well bonded, with some excess ice (visible ice crystals) being noted.

The overall quality of material in Deposit 163 is only fair, and is locally poor. As such it would be useful only for general fill (embankment).

Volume

The total volume of granular material in Deposit 163 is extremely large and is difficult to estimate without detailed stratigraphic information. It is possible that the whole sequence may be in excess of 15 m in thickness, which for the mapped area would suggest a total volume of about 150 x $10^6 \, \mathrm{m}^3$.

Additional Exploration

Due to the only fair quality of granular material in Deposit 163, and its distance from Tuktoyaktuk we do not consider it worthwhile to undertake a drilling program in this area. However, the relatively significant gravel content (up to 20%)



in some areas indicates that a considerable amount of gravel could be obtained from this deposit, albeit with extensive processing.

Access and Development

The preferred winter access to Deposit 163 is along a coastal ice-road for about 45 km, then inland for 10 km. The last 10 km includes a number of large lakes, such that only about 2-3 km comprises overland "portages".

Surface drainage conditions on the upper terrace are poor due to the level topography. However, drainage is good along the flanks of the thermokarst lakes, but careful pit management will be required to avoid siltation of the lakes. There is evidence of ice wedge polygons in these granular deposits, and the presence of massive ice bodies cannot be discounted.

4.0 DISCUSSION

The Phase II field reconnaissance has identified numerous small deposits quite close to Tuktoyaktuk, and has expanded information on previously known deposits, i.e. 155 and 163. In terms of the mandate for this study, these deposits will be considered, along with several others, as potential sources for the twenty year community supply.

Plate 1 illustrates the distribution of deposits which will be considered further in this study for the community supply. All other deposits have been eliminated at this stage due to excessive distance, inadequate volume or unsuitable material. The deposits still under consideration are as follows: 162,



160, 161, 158, 181, 183 (169), 184, 177, 168, 167, 155, 163, 211 and Yaya Lakes.

In the following sections we present some points for discussion concerning the development of certain deposits, relatively close to Tuktoyaktuk.

4.1 DEPOSITS 160 AND 161

The community concerns with respect to development of these sources was presented in our Phase I report. It is our proposal that rather than leaving the presently disturbed areas as they are, they should be restored and reclamined (revegetated). In the process of restoration it is proposed that some of the thawed and drained granular materials be taken for granular supply.

It is our opinion that a significant volume (with respect to the community requirements) of fair quality granular material (embankment) still remains in these deposits. There has been partial development to date, which was ceased due to community concerns for scaring of the landscape close to Tuktoyaktuk. In their present state the deposits are left as bare exposures of granular material which are undergoing progressive degradation of permafrost as the new thermal regime becomes established. Ground-ice is melting out to produce an irregular thermokarst topography with accummulating thaw ponds.

It is still possible to salvage some of the remaining granular material through early winter operations, then regrade the disturbed areas ready for reclamation. The reclamation would



be undertaken during summer months by replacing stripped organic material, scarifying the surface and seeding with adapted grasses. The scarified surface, with mixed-in organics, serves to provide moisture retention and local micro-climates which encourages the establishment of vegetation. A more detailed discussion of this approach is presented in Section 4.2, below.

We propose this approach, for government and community consideration because it serves three purposes: Firstly, the scarred land close to Tuktoyaktuk may be prevented from getting any worse, and by reclamation may be returned to its natural state in some years time. Secondly, it is possible to satisfy part of the community requirements for granular material from local deposits which will enable considerable cost savings. Thirdly, the partially exploited material may be fully worked out and utilized, rather than being ignored and wasted, as is the present case.

4.2 DEPOSITS 181, 183 and 184

During Phase II of this study numerous relatively small and thin granular deposits were identified in a region, 8-22 km from Tuktoyaktuk. While the quality of granular material varies from good to poor, and the volume contained in them ranges from 1500 m³ to 200,000 m³, it is our opinion that some of these should be seriously considered as sources for community supply (embankment material).

We accept that the smaller deposits are probably not worth exploiting, but it is felt that any with volumes greater than about $10,000 \text{ m}^3$ are worthy of consideration.



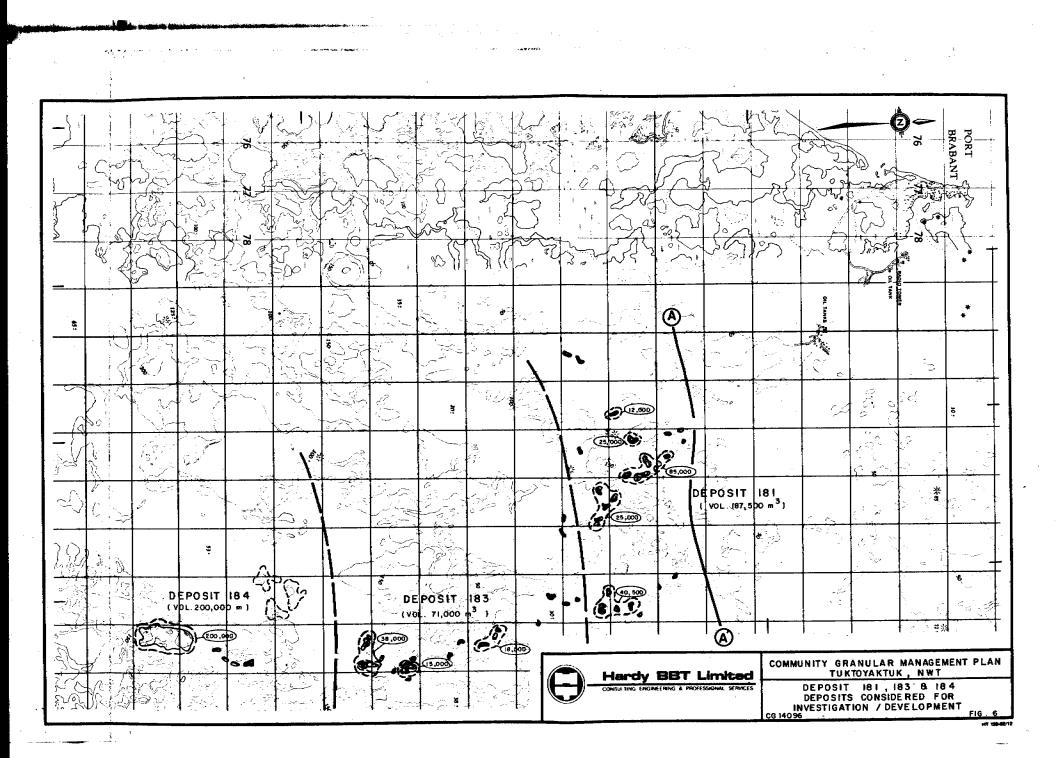
It is proposed that certain deposits could be designated (individually) as the deposit(s) to be worked in one particular season. As they are small areas with a thin surficial layer of useful material, they would be stripped and worked out completely in one season, or at the most two seasons. Then, they would be regraded and prepared for reclamation, which would ideally be completed the following summer. Some remedial re-vegetation would likely be required in subsequent years. In this manner scaring of the landscape would be minimized.

Some permafrost degradation is unavoidable and it is expected that small thermokarst ponds will form in places associated with the thawing of ice wedges. Since ponds and small lakes are very numerous in the region, it is assumed that thaw ponds resulting from pit development will be environmentally acceptable. Degradation will eventually cease and the disturbed area will continue to improve (esthetically) as vegetation becomes better established with time.

We estimate that about $187,000 \text{ m}^3$ of granular material could be obtained from Deposit 181, specifically from the deposits indicated on Figure 6. Similarly Deposits 183 and 184 could provide about $70,000 \text{ m}^3$ and $200,000 \text{ m}^3$ respectively (See Figure 6).

The development of these deposits would ideally be strictly controlled such that:

(i) a reclamation plan would be prepared prior to any issuing of permits for development.





- (ii) permits would be issued only for one, or a few, specific deposits each season and the deposits would be clearly staked.
- (iii) inspections would be carried out periodically, to ensure that only permitted deposits were being worked, that they were being fully worked-out, and that they were being regraded for re-vegetation.
- (iv) once re-vegetated, they would be monitored and assessed for possible remedial measures.

There need not be and should not be any reason to leave any granular source as a bare gravel surface following development. Reclamation of gravel pads in the Tuktoyaktuk region has been successfully achieved in the past by environmental personnel in our company.

5.0 RECOMMENDATIONS FOR PHASE III

In light of results from the Phase II field reconnaissance we consider that additional exploration work is warranted. However our recommendations for the Phase III detailed field program are somewhat different from the approach in our proposal of May, 1986.

The following deposits are recommended for detailed exploration:

(i) Deposits 181, 183 and 184: Due to their close proximity to Tuktoyaktuk and comprising of embankment quality material, these deposits warrant additional exploration



to prove out the quantity and quality. However, it is only worthwhile studying these deposits further, provided the Government and the Hamlet of Tuktoyaktuk are in agreement with developing small deposits in these areas. We have presented a development/reclamation approach to exploiting these deposits (Section 4.0), which could be adopted to mitigate the environmental impact and community concerns.

(ii) Deposit 155: The 155 (north) area of this deposit appears to have the potential to supply a significant volume of good quality granular material (i.e. base and/or surface course). In addition, there is apparently a large volume of fair quality (potential embankment) granular material available from the surrounding deposits.

We consider that 155 (north) certainly warrants detailed exploration, as a potential substitute for YaYa Lakes type material. Also, that certain of the surrounding deposits could be further explored and proved out as potential sources of embankment material. It is possible that all of the community requirement for embankment fill, base and surface course material may be available from Deposit 155.

5.1 DETAILED FIELD PROGRAM

We propose that two separate field programs (approaches) be undertaken. A test pitting program in Deposits 181, 183 and 184 and a drilling program in Deposit 155. Both programs will remain within the Phase III budget.



5.1.1 Deposits 181, 183 and 184

Due to the relatively thin distribution of suitable granular materials in these deposits, a drilling program is considered inappropriate (i.e not cost effective). The use of a dozer could provide much more detailed and useful information, at less cost. Therefore, we propose that the initial part of the field program be based out of Tuktoyaktuk (i.e. no mobile camp costs) and that about 30-40 test pits be excavated, logged and sampled in the deposits indicated in Figure 6.

We propose to employ a D8 Cat with ripper to push out small pits. We estimate the work can be completed in about 6-7 days (single shift) at a daily cost of about \$3,000 for all men, equipment, accommodations etc. Hence this phase of the detailed field program will use about \$20,000-\$25,000 of the field budget.

5.1.2 Deposit 155

It is proposed to conduct a drilling program, in the manner outlined in our proposal, to prove out the potentially good quality material in the 155 (north) area. In addition, it is proposed to drill some of the surrounding deposits, to obtain more information on material quality and volumes.

We estimate that about 8 days of drilling time will be available in the remaining budget. Hence about 25-35 boreholes could be drilled in Deposit 155. We have allowed for about 15 boreholes to be drilled in the 155 (north) area.



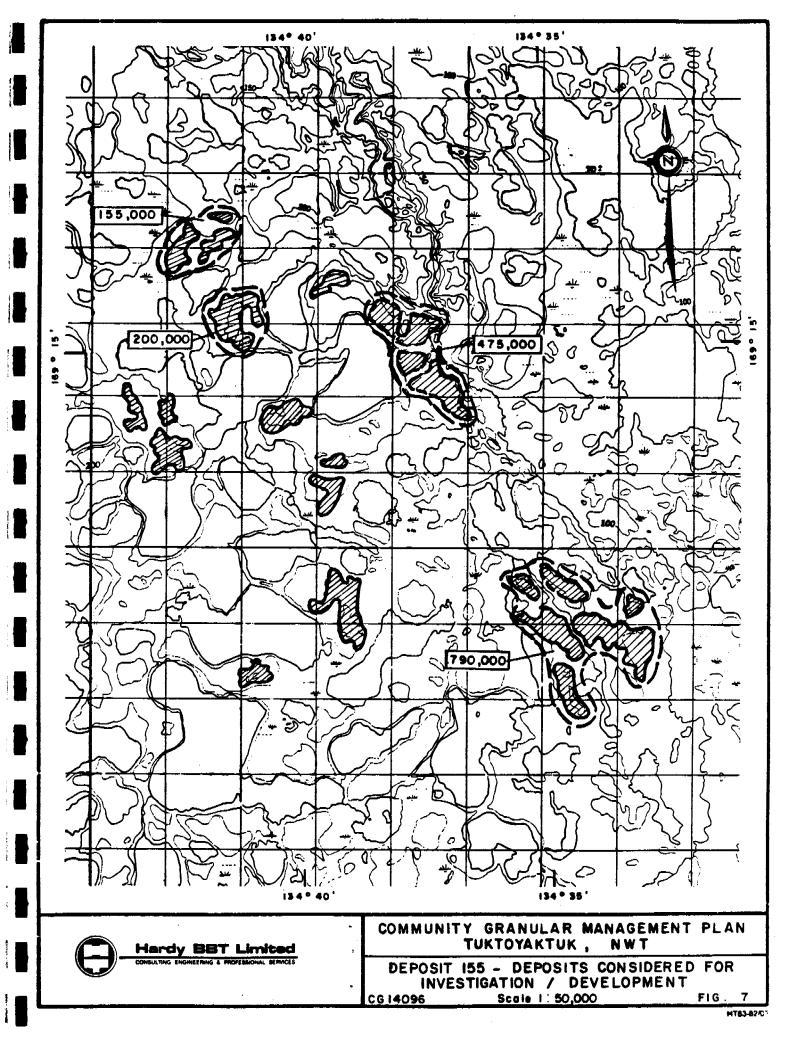
The remaining boreholes will be located in the deposits indicated in Figure 7.

Should it be decided that Deposits 181, 183 and 184 are not acceptable for additional investigation, then more emphasis will be placed on Deposit 155. More effort will be put into proving out a larger volume of embankment quality material.

6.0 CONCLUSION

This study has identified three new deposits 181, 183 (169) and 184 in the area south-southeast of Tuktoyaktuk. In addition, new deposits have been identified in the area of Deposit 155, and the extent of Deposit 163 has been increased.

Deposits 181, 183 and 184 occur between 8 and 22 km from Tuktoyaktuk and contain numerous small and thin deposits of poor to good quality granular material. One area of Deposit 155 may contain a significant volume of good quality granular material, however, the remaining deposits appear to comprise only poor to fair quality material. Deposit 163 contains a very large volume of only fair (and often poor) quality granular material, and is not considered for detailed investigation.





It is recommended that Deposits 181, 183, 184 and 155 be investigated in detail during Phase III, as potential sources of community supply.

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APPENDIX "A"

Explanation Sheets



EXPLANATION OF TERMS AND SYMBOLS

The terms and symbols used on the borehole logs to summarize the results of field investigation and subsequent laboratory testing are described in the following pages.

It should be noted that materials, boundaries, and conditions have been established only at the borehole locations, and are not necessarily representative of subsurface conditions elsewhere across the site.

TEST DATA

Data obtained from laboratory and field testing are shown on the grid at the appropriate depth interval.

The natural moisture (water) content of the soil at the time of drilling is plotted against depth, together with the plastic and liquid limits where determined.

Abbreviations, graphic symbols, and relevant test method designations are as follows:

0	w	natural moisture content (ASTM D 2216)
⊡	Wp	plastic limit (ASTM D 424)
Δ	WL	liquid limit (ASTM D 423)
	NP	non plastic soil
		seepage
	▼	observed water level

Other abbreviations and symbols are as shown on the borehole log sheet.

DEPTH

The depth of borehole below existing ground surface is shown. Corresponding elevations sometimes are shown with respect to the datum given.

SOIL CLASSIFICATION AND DESCRIPTION

Soils are classified and described according to their engineering properties and behaviour.

The soil of each stratum is described using the Unified Soil Classification System¹ modified slightly so that an inorganic clay of "medium plasticity" is recognized.

The use of modifying adjectives may be employed to define the actual or estimated percentage range by weight of minor components. This is similar to a system developed by D.M. Burmister.²

The soil classification system is shown in greater detail on page 3.

 [&]quot;Unified Soil Classification System", Technical Memorandum 3-357 prepared for Office, Chief of Engineering, by Waterways Experiment Station, Vicksburg, Mississippi, Corps. of Engineers, U.S. Army. Vol. 1, March 1953.

American Society for Testing and Materials. Procedures for Testing Soils, "Suggested Methods of Testing for Identification of Soils", 4th Ed; pp 221-233, Dec. 1964.



SOIL SAMPLES

CONDITION - This column graphically indicates the depth and condition of the sample:



TYPE — The type of sample is indicated in this column as follows:

- A auger sample
- B block sample
- C rock core, or frozen soil core
- D drive sample
- P Pitcher tube sample
- U tube sample (usually thin-walled)
- W wash or air return sample
- O other (see report text)

PENETRATION RESISTANCE — Unless otherwise noted this column refers to the number of blows (N) of a 140 pound (63.5 kg) hammer freely dropping 30 inches (0.76 m) required to drive a 2 inch (50.8 mm) O.D. open-end sampler 0.5 feet (0.15 m) to 1.5 feet (0.45 m) into the soil, or until 100 blows have been applied, in which case, the penetration is stated. This is the standard penetration test referred to in ASTM D 1586.

OTHER TESTS

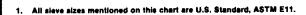
In this column are tabulated results of other laboratory tests as indicated by the following symbols:

·c	Consolidation test
Fines	Percentage by weight smaller than #200 sieve
₽R	Relative density (formerly specific gravity)
k	Permeability coefficient
*MA	Mechanical grain size analysis and hydrometer test (if appropriate)
pр	Pocket penetrometer strength
* q	Triaxial compression test
qu	Unconfined compressive strength
*SB	Shearbox test
SO,	Concentration of water-soluble sulphate
*\$T	Swelling test
TV	Torvane shear strength
VS	Vane shear strength (undisturbed-remolded)
ϵ_{f}	Unit strain at failure
γ	Unit weight of soil or rock
γď	Dry unit weight of soil or rock
ρ	Density of soil or rock
ρ d	Dry density of soil or rock

^{*} The results of these tests usually are reported separately.

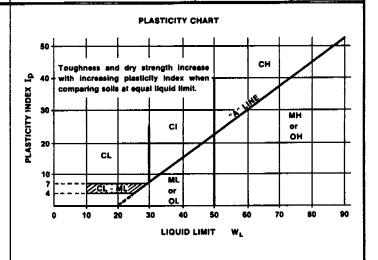
SOIL CLASSIFICATION SYSTEM (MODIFIED U.S.C.)

:	MAJOR	DIVISION	GROUP SYMBOL	GRAPHIC SYMBOL	COLOR	TYPICAL DESCRIPTION	LABORAT CLASSIFIC CRITER	ATION
	HIGHLY OR	GANIC SOILS	PI		ORANGE	PEAT AND OTHER HIGHLY ORGANIC SOILS	STRONG COLOR OR OF FIBROUS TEXTURE	OOR, AND OFTEN
SIZE)	IRSE tan	CLEAN GRAVELS	GW	A A A	RED	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, < 5% FINES	$C_U = \frac{D_{80}}{D_{10}} > 4$ $C_C = \frac{1}{D_{10}}$	D ₃₀) ² x D ₆₀ = 1 to 3
200 SIEVE	FELS IALF COJ IRGEN TI	CEAN GNAVELS	GP		RED	POORLY-GRADED GRAVELS, AND GRAVELSAND MIXTURES, < 5% FINES	NOT MEETIN ABOVE REQUIR	
SOILS THAN NO. 200 SIEVE SIZE)	GRAVELS GRAVELS ACTION LARGER THAN NO. 4 SIEVE SIZE		GM		AETTOM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES > 12% FINES	ATTERBERG BELOW "A" L I _D < 4	INE OR
INED SC	FRA	DIRTY GRAVELS	GC		AETTOM	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES > 12% FINES	ATTERBERG ABOVE "A" Ip > 7	LINE,
COARSE-GRAINED BY WEIGHT LARGER	ASE		sw		RED	WELL-GRADED SANDS, GRAVELLY SANDS, < 5% FINES	$C_u = \frac{D_{60}}{D_{10}} > 6 C_C = \frac{(}{D_1}$	$\frac{D_{30})^2}{0 \times D_{60}} = 1 \text{ to } 3$
COA	SANDS SANDS MORE THAN HALF COARSE FRACTION SMALLER THAN NO. 4 SIEVE SIZE	CLEAN SANDS	SP		RED	POORLY-GRADED SANDS, OR GRAVELLY SANDS, < 5% FINES	NOT MEETIN ABOVE REQUIP	
CO (MORE THAN HALF BY	SANDS E THAN HALF TION SMALL NO. 4 SIEVE		SM		AETTOM	SILTY SANDS, SAND-SILT MIXTURES > 12% FINES	ATTERBERG BELOW "A" L Ip < 4	INE OR
(MORE	FRACE	DIRTY SANDS	sc		YELLOW	CLAYEY SANDS, SAND-CLAY MIXTURES > 12% FINES	ATTERBERG ABOVE "A" L Ip > 7	INE OR
E SIZE)	1	SILTS W "A" LINE ON	ML.		GREEN	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY SANDS OF SLIGHT PLASTICITY	W _L < 50	
200 SIEVE		ICITY CHART; GIBLE ORGANIC ENT	мн		BLUE	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDY OR SILTY SOILS	W _L > 50	
FINE-GRAINED SOILS HALF BY WEIGHT PASSES NO.		CLAYS	CL		GREÉN	INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY, OR BILTY CLAYS, LEAN CLAYS	W _L < 30	
RAINED IGHT PAS	PLAST	E "A" LINE ON TCITY CHART;	CI		GREEN- BLUE	INORGANIC CLAYS OF MEDIUM PLASTICITY SILTY CLAYS	W _L > 30, < 50	SEE CHART BELOW
FINE-G	CONT	IGIBLE ORGANIC ENT	СН		BLUE	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	W _L > 50	
THAN	ORGANIC SI	LTS & ORGANIC CLAYS	OL		GREEN	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY	WL < 50	
(MORE 1		OW "A" LINE ON ITICITY CHART	он		BLUE	ORGANIC CLAYS OF HIGH PLASTICITY	W _L > 50	



- Boundary classifications possessing characteristics of two groups are given combined group symbols eg GW-GC is a well-graded gravel-sand mixture with clay binder between 5% and 12%.
- Soil fractions and limiting textural boundaries are in accordance with the Unified Soil Classification System, except that an inorganic clay of medium plasticity (CI) is recognized.
- 4. The following adjectives may be employed to define percentage ranges by weight of minor components:

and 50 - 36% some 35 - 21% little 20 - 11% trace 10 - 1%





HARDY ASSOCIATES (1978) LTD.

CONSULTING ENGINEERING & PROFESSIONAL SERVICES

	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 Roofing 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 subbase. Winter sand backfill for trenches and slabs. Pads for structures.
(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 subbase 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.

NOTE: Classification developed by DIAND.



CLASSIFICATION OF GRANULAR MATERIALS

ORGANIC IMPURITIES Fine Aggregate

Organic Color Number	Interpretation
1 to 1+	Sand suitable for use in high grade concrete.
2 to 2+	Sand which may be used in unimportant concrete work.
3 to 3+	Sand which should not be used in concrete without processing.
4 to 5+	Sand with high organic content that should not be used in concrete.



APPENDIX "B"
Test Pit Logs



BOREHOLE LOG

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BOREHOLE LOG

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BOREHOLE LOG

HT11 • 79/05

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BOREHOLE LOG

PROJECT COMMUNITY GRANULAR MANAGEMENT PLAN
TUKTOYAKTUK, N.W.T.

HT11 - 79-05

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			I.M.		CG14096	HOLE NO. TP181-7
CABING R	ESISTANCE blows/to	er (0.3m) 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	r essential	SOIL DESCRIPTION DATUM	SOIL SAMPLE	DRILL TYPE Hand Excavation
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ATER CONTEN	No. Web - No. No		0.5	PEAT, organic material and organic soil, peaty, some clay and silt, dark brown, moist CLAY(TILL), very sandy (fine), silty, some gravel, brown, moist (CL) SAND, fine grained, trace to some silt, loose to compact, grey brown, occasional gravel (fm), well rounded, moist (SP) becoming wet, free water Trozen fine sand, ice bonded, no visible ice, (permafrost) End of Test Pit at 0.9 m	8 2 2	MA(Plate C7)

BOREHOLE LOG

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BOREHOLE LOG

HT11 - 79/05

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BOREHOLE LOG

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BOREHOLE LOG

PROJECT COMMUNITY GRANULAR MANAGEMENT PLAN TUKTOYAKTUK, N.W.T.

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BOREHOLE LOG

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BOREHOLE LOG

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BOREHOLE LOG

PROJECT COMMUNITY GRANULAR MANAGEMENT PLAN
TUKTOYAKTUK, N.W.T.

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BOREHOLE LOG

PROJECT COMMUNITY GRANULAR MANAGEMENT PLAN
TUKTOYAKTUK, N.W.T.

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BOREHOLE LOG

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BOREHOLE LOG

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BOREHOLE LOG

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	LOG	GE	D/D	WN.		N	W	QF.	C	KD.		N,I	М.		DATE OF IN	меят. Ѕер	t 10, 1986	J08 NO.	CG	140	96	HOLE NO. TP183-6
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ı	+	+	+	╀	\vdash	Н	Н	+	╁	+	\vdash	Н			dark-t	rown, m	noist				•	
	\dagger	†	T	T	1		Н	+	T	†	Τ	Н			SAND	(fmc) }ii	ttle grave	, trace o	f]
-		I	I	L				I	I	Ι					silt,	compac	t, brown,	some root	П			
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	+	+	+	╀	\vdash	\vdash	H	+	╀	+	\vdash	Н			(31)				M			-
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BOREHOLE LOG

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BOREHOLE LOG

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BOREHOLE LOG

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BOREHOLE LOG

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BOREHOLE LOG

PROJECT COMMUNITY GRANULAR MANAGEMENT PLAN
TUKTOYAKTUK, N.W.T.

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BOREHOLE LOG

PROJECT COMMUNITY GRANULAR MANAGEMENT PLAN TUKTOYAKTUK, N.W.T.

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BOREHOLE LOG

PROJECT COMMUNITY GRANULAR MANAGEMENT PLAN TUKTOYAKTUK, N.W.T.

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BOREHOLE LOG

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-8	LO	BGE	WATER CONTENT								N,N	١		DATE OF IM	vest. Sept. 11,	1986	JOB NO.	GI	409	96	HOLE NO.	
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		. 1	%p -	O		W - (0	٧	N _L - 2	7			Ĕ	DATUM				ğ	_	100		and evation
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		1								土	I				(f), with some y, loose to co			L			1]
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	${oldsymbol{dash}}$	╁	╀┥	Н	4	+	╂┤	Н	-+	+	+			\ _damp .	to moist			M				4
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							T		1	1	\top			grave	el(fmc), silty	/ , bro	wn,	I/\				- 1
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	+	+	Н	$\vdash \vdash$	+	+	╁┤	1	+	+	Н		1984	CAND	(fmc), and GR	AVEL (4	imc)	1	1			- 1
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	П	L		\Box]		П	\Box		I	\Box			to w		· • ···· ,		IV	A ₂		MA (Pla	te C27)
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					1		\Box		丁	1		1.0			mafrost)	י שו טובי	, 50				l	7
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BOREHOLE LOG

						. 1	۳.					DATE OF INVEST. Sept. 11, 1986 JOS NO. C	G14	109	6	HOLE NO.TP155-4	
LOG	JED/	DWN.							N,A	<u>n. </u>					MPLE	DRILL TYPE	1
<u> </u>		WA.	_	_				_		1	8	DATUM	1			Hond	
Ì	W	p - 🗅		w -		,	W _L - ,	Δ		l	<u>E</u>	DATUM	COMPANY	THE STATE OF THE S	PENETHATION RESISTANCE	Excavation	1
1	10	20	-		40		Ď.	•	,	DEPTH	ğ	SURFACE ELEVATION Not determined	8		¥ §	OTHER TESTS	1
	ĺΠ	Ť	Τ	T	1	Γ]		PEAT, organic material, brown					\mathbf{I}
廿		П.	Γ	П	1	L			П	1		damp	H		ļ		1
Ц.	_	\perp	╂-	H	-	+	╀	╀	╁┼	1		SAND (fmc), silty, clayey, with trace gravel (fmc), well rounded	IV	Δ			1
H	┨┤	+	╀╴		+	╁╌	╁	╁╌	╁┼	1		trace gravel (fmc), well rounded	1λ!	A۱		_]
	╅	\top	+-	H	+		T			•		<pre>firm/compact, low plastic, rusty brown, root fibres, moist</pre>	Δ				┨
				\square		\perp		\prod	\Box	1		(SM)					1
Ц.	↓_	Н	+	Н		+	╀	╀-	\vdash	-		SAND(fmc), some gravel, well	1			ļ.	1
╁	+-		+-	H	+	╁	╀	╁	╂┼	1		rounded, trace to no silt,				_	1
╂┼	╁	┼┼	+-	H	+	+	†	+-	††	0.5		compact, brown, moist	1			Ì	1
	T		1	\prod	_	1		I	\coprod	1		(SP)	W			WA (D)	ŀ
	I		I	\square				Γ	П	1			IX	A ₂		MA(Plate C28)	4
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	+-	$oldsymbol{arphi}$	+	┦	+	+	+	+-	╂┼	+		r frozen sand, ice bonded / (permafrost)	1	1	<u>l</u>]
H	+-	╁	+	╁	+	+-	+	+	$\dagger \dagger$	1	100	End of Test Pit at 0.80 m	1				1
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BOREHOLE LOG

LOG	GED	/DW	N.	A.	W /	DE	. 1	CKE). <u> </u>	V 44			DATE OF INVEST. Sept. 10, 1986 JOS NO. (GI	409	6	HOLE NO. TP155-5
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		•			CEN			٠		-	DEPTH	1.8		Į	E	PENETTATTO	Excavation
	10	3	•	×		40		?	e p		m	1608	SURFACE ELEVATION Not determined	8		§ §	OTHER TESTS
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Ц.	\perp	Ц	Ц	4	4	1	Н	\vdash	- -	H			silty, compact, stratified with				1
╟	╁╌	Н	\vdash	+	+	╂╌	Н	\vdash	╅	H			thin gravel layers, brown, some cobbles and boulders, dry to	I۷			
╁	╁	Н	Н	+	+	+	Н	\vdash	╅	╁┪		472	damp	I	Α ₁		MA (Plate C29)
	T			1	\perp	1				\Box	•	8	(GP)	I۸	1		Petrographic
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	I	I				1			I	\square			End of Test Pit at 1.2 m No permafrost encountered	ı		1	1 4
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H	╁	╁	\vdash	Н	+	╅	┿	┨┤	+	╁			area which had been	1	l		l j
	+	+	T	H	+	+	†	H	\top	⇈	1,5		stripped/worked the				1 7
	1	Ι							\perp	\square			previous winter				1 4
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BOREHOLE LOG

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				WA	TE	R C	ON	TEI	NT					ğ			OIL DESCR					AMPL	Ε	DRILL	TYPE
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BOREHOLE LOG

OGGED/DWN.	NM/DF. CKD. N	М	DATE OF INVEST. Sept. 11, 1986 JOB N		HOLE NO.TP163-2
WAT	ER CONTENT]	SOIL DESCRIPTION	SOIL SAMPLI	
Wp - D	W+0 W₁+Δ		DATUM	OTTON TRATION	Hand Excovation
10 20	PERCENT % 30 40 80 60	DEPTH 8	SURFACE ELEVATION Not determined	COMOTTO TYPE PENETRATI	OTHER TESTS
			PEAT and organic soil, some		
		⊣ 🖺	silt, dark brown, moist		
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┤┩┤┩ ┥	├┨┤┨┼┨ ┼ 	┨	organic silt), sandy, some of	lav	
 		†	firm, low plastic, light bro		
]	occasional gravel(fm), roots	.	
$\Box \Box \Box \Box$		- ↓ ↓	moist (ML)		
┞ ┩╌╃╺┩	╏┋┋┋	- ▮	SAND (fm), silty, trace of gr		1
╅╂┿	├╃ ┤╉ ┦┫┩	- 0.5	(fmc), well rounded, loose t compact, brown, moist to wet	111	MA (D1 -t - C3)
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	│ ┃ ┩┩┩	→	frozen sand with trace grave	1, [- 	
╁╂┼╂┥	╎┩┩┪┪ ┩	-	ice bonded, some visible ice	: // /	
┥┈╽╶┨╺ ┥	├╶╂╌┆╶┨╴┼╌╂┈╃╼┩	-	crystals (permafrost)		i
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BOREHOLE LOG

PROJECT COMMUNITY GRANULAR MANAGEMENT PLAN
TUKTOYAKTUK, N.W.T.

HT08 - 79/05

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BOREHOLE LOG

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S,	LOG	WATER CONTENT). 	N,N	1			NO. TP163-4
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APPENDIX "C"

Laboratory Test Results
Grain Size Curves
Petrographic Analyses
Aggregate Tests



CLIENT:	GN	WT		
PROJECT NUMB		14096	• • • • • • • • • • • • • • • • • • • •	
LAB. NUMBER:	•			
LOCATION:	Tu	ktoyaktuk		
HOLE: TP18	1-1	SAMPLE:	A1	
DEPTH:	0.3 -	0.9 m		
TECHNICIAN:	L.R.	DATE:	01/10/86	

COBBLES	GRAVEL SIZ	ES SAND SIZ	ZES	Ou T	51.47
CODBLES	COARSE	FINE COARSE MEDIUM	FINE	SILT	CLAY
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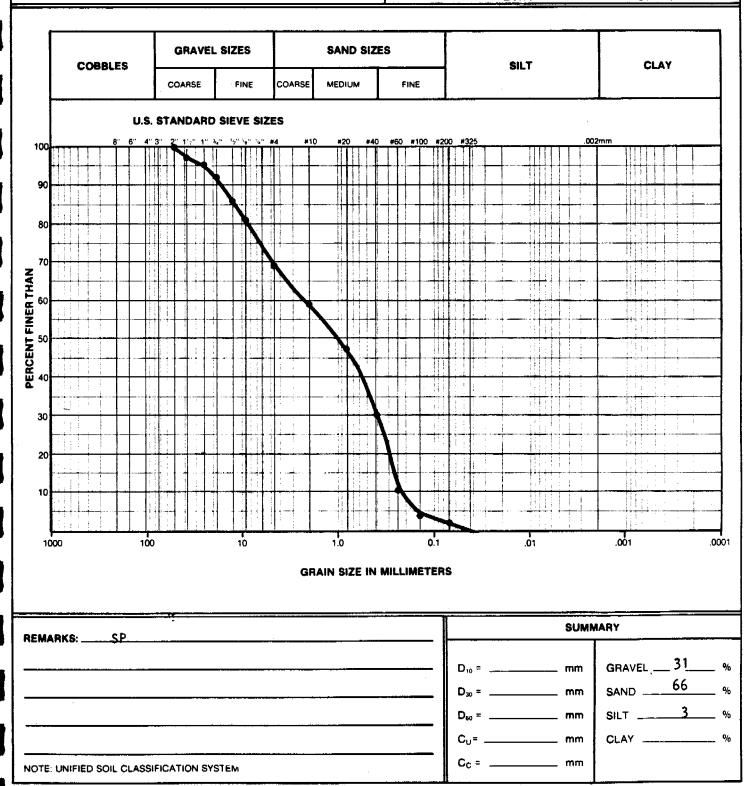


HARDY ASSOCIATES (1978) LTD.

CONSULTING ENGINEERING & PROFESSIONAL SERVICES

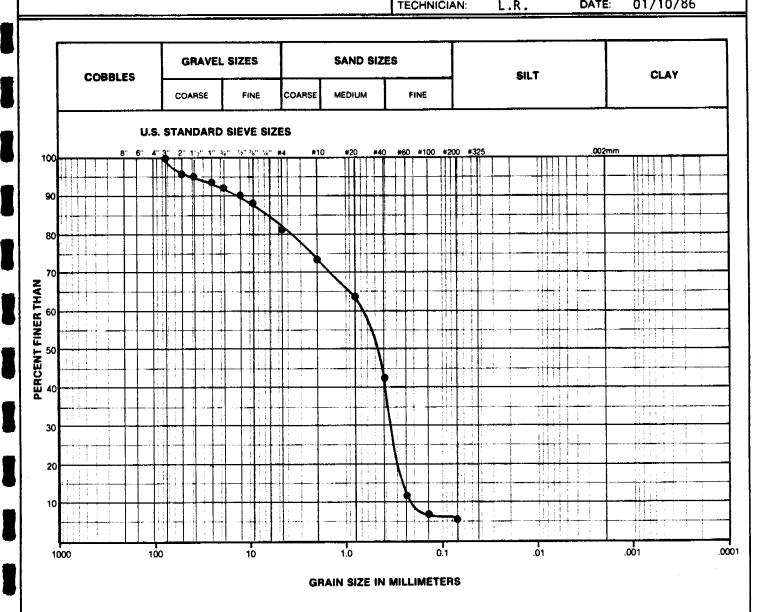
GRAIN SIZE CURVE

CLIENT:	GNWT		
PROJECT NUMBER:	CG14096		
LAB. NUMBER:			
LOCATION:	Tuktoyaktuk		
HOLE: TP181-3	SAMPLE:	A2	
DEPTH:	0.5 - 1.2 m		
TECHNICIAN: L.	R. DATE:	03/10/86	





CLIENT:		GNWT		
PROJECT NUMBER	R:	CG14096		
LAB. NUMBER:				
LOCATION:		Tuktoyakt	uk	
HOLE: TP18	1-4	SAMPLE:	A1	
DEPTH:	0.2 -	0.7 m		
TECHNICIAN	1 0	DATE	01/10/86	



REMARKS: SP	SUMM	MARY
	D ₁₀ = mm	GRAVEL
	D ₃₀ = mm	
·	D ₆₀ = mm	SILT5 %
	C _U = mm	CLAY %
NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM	C _C = mm	



CLIENT:	GNWT	
PROJECT NUMBER:	CG14096	
LAB. NUMBER:		
LOCATION:	Tuktoyaktuk	
HOLE: TP181-4	SAMPLE:	A2
DEPTH:	0.7 - 0.9 m	
TECHNICIAN: L.I	R . DATE:	02/10/86

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PROJECT	NUMBER:	CG1	4096		
LAB. NUM	MBER:				
LOCATIO	N:	Tuk	tovaktuk		
HOLE:	TP181-		SAMPLE:	A1	
DEPTH:	0.3 -	1.0 m		-	
TECHNIC	IAN:	L.R.	DATE:	01/10/86	

COBBLES	GRAVEL SIZE	S	SAND SIZE	s	SILT	CLAY
COBBLES	COARSE FI	E COARSE	MEDIUM	FINE		V 2
U	S. STANDARD SIEV	E SIZES				
8" 6"	4" 3" 2" 1 %" 1" 34" 5" 3	" '-" #4 #	10 #20 #40	#60 #100 #200	#325 .002	?mm
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		<u> </u>		1		
				11		

GRAIN SIZE IN MILLIMETERS

REMARKS: SP	SUMA	ARY
	D ₃₀ = mm D ₅₀ = mm C _U = mm	GRAVEL
NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM	C _C = mm	

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CLIENT:			GI	TWP			
PROJECT NL	MBER:		C	3140	96		
AB. NUMBE	R:		_				
OCATION:			Tı	ıkto	yaktuk	<	
HOLE:	TP18	1-6		SA	MPLE:	A1	
DEPTH:		0.4	_	1.0	m		
TECHNICIAN		D			DATE:	01/10/86	

COARSE FINE COARSE MEDIUM FINE U.S. STANDARD SIEVE SIZES B 6 4 3 2 1 7 1 4 4 4 10 920 440 920 4325 002mm	CORPLEC		G	RAV	ÆL	. SIZ	ZES	}			S	AND	SIZ	ES										0.49					
8* 6* 4* 3* 2* 13* 15* 15* 15* 15* 15* 15* 15* 15* 15* 15	COBBLES	Ī	co	ARSE			FIN.	E	co	ARSE	M	EDIUI	vi		FINE						CL	AY							
	U).s. s	TAN	NDA	RD	SIE	EVE	SIZ	ES								•			•									
	8" 6"	4" 3"	2"	1'5"	1" 3,	·" 1/	5" 2 ₅ "		#4	#10		#20	#4() #B	0 #1	00 #	200	#325		.,	1.7	,	.00	2mm		, ,			_
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GRAIN SIZE IN MILLIMETERS

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SUMN	/ARY
D ₁₀ = mm D ₃₀ = mm C _U = mm C _C = mm	GRAVEL 42 % SAND 52 % SILT 6 % CLAY — %
ŀ	D ₁₀ = mm D ₃₀ = mm D ₈₀ = mm

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CLIENT:		GNWT		
PROJECT NUM	BER:	CG14096		
LAB. NUMBER:				
LOCATION:		Tuktovakti	ık	
HOLE:	TP181-7	SAMPLE:	A1	
DEPTH:	0.	4 - 0.6 m		
TECHNICIAN	1 5	DATE	03/10/96	

		~	BBLE			G	RA	VEL	SIZI	ES		SANE	SIZE	S			SIL	-			CI	.AY	
			, DBLC	.5		co	ARSI	E	F	INE	COARSE	MEDIU	м	FIN	E		SIL	•					
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GRAIN SIZE IN MILLIMETERS

REMARKS: SP	SUMMARY							
	D ₁₀ = mm	GRAVEL3 %						
	D ₃₀ = mm	SAND93%						
	D ₆₀ = mm	SILT4 %						
	C _U = mm	CLAY %						
NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM	C _C = mm							



CLIENT:		GNWT		
PROJECT NU	JMBER:	CG14096		
LAB. NUMBE	R:			
LOCATION:	Tu	ktoyaktuk		
HOLE:	TP181-11	SAMPLE:	A1	
DEPTH:	0.	3 - 0.9 m		
TECHNICIAN	t L.R.	DATE:	15/10/86	

COBBLES		EL SIZES	SAND SIZ		SILT	CLAY
	COARSE	FINE COA	ARSE MEDIUM	FINE		
		D SIEVE SIZES				
8° 6°	4" 3" 2" 1 %" 1"	· 34" ½" 34" ¼" #4	#10 #20 #4	0 #60 #100 #20	00 #325 .00	2mm
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00	100	10	1.0	0.1	.01	.001
			GRAIN SIZE IN		_	

REMARKS: SP	SUMA	MARY
	D ₁₀ = mm	GRAVEL %
·	D ₃₀ = mm	SAND69 %
	D ₆₀ = mm	SILT4 %
	C _u = mm	CLAY %
NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM	C _C = mm	



CLIENT:		GN	TWI								
PROJECT N	JMBER:	CG	CG14096								
LAB. NUMBE	R:										
LOCATION:		Τμ	ıktoyaktuk								
HOLE:	TP181-11	i ,	SAMPLE:	A2							
DEPTH:		0.9	- 1.0 m								
TECHNICIA	V). I	D	DATE:	02/10/86							

GRAVEL SIZES SAND SIZES SILT CLAY **COBBLES** COARSE MEDIUM FINE COARSE FINE U.S. STANDARD SIEVE SIZES .002mm 100 90 80 PERCENT FINER THAN 30 Ш 20 1 10

GRAIN SIZE IN MILLIMETERS

1.0

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REMARKS:SP	SUMMARY										
nemanno.											
	D ₁₀ = mm	GRAVEL %									
		SAND98 %									
	D ₆₀ = mm	SILT %									
	C _U = mm	CLAY %									
NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM	Cc = mm										

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CLIENT:		GNWT							
PROJECT NUM	IBER:	CG14096							
LAB. NUMBER		-							
LOCATION:		Tuktoyakt	uk						
HOLE:	TP181-12	SAMPLE:	A1						
DEPTH:	0.2	- 0.8 m							
TECHNICIAN:	L.R.	DATE:	02/10/86						

	COBBLES		7	GRAVE	L SIZES		SAND SIZE	ES		SILT	CLAY
	COBBLE	> 	cc	OARSE	FINE	COARSE	MEDIUM	FINE		JIL!	CLAT
		U.S.	. STA	NDARI	D SIEVE SIZ	ES.	-				
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V	ARKS:	SP.	<u> </u>							SUMI	MARY
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									D ₃₀ =	mm	SAND92
_									Den =	mm	SILT3
-					 ,			 _	l		
_					<u> </u>				C _U =	mm	CLAY
F	: UNIFIED SOIL (CLASS	IFICA	TION SY	/STEM				Cc =	mm	

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CLIENT: GNWT PROJECT NUMBER: CG14096 LAB. NUMBER: LOCATION: Tuktoyaktuk HOLE: SAMPLE: TP181-13 Α1 DEPTH: 0.3 - 0.7 mTECHNICIAN: DATE: 09/10/86 L.R.

GRAIN SIZE CURVE

COBBLES			G	RAN	ÆL.	SIZ	ES		<u>.</u>		SA	ND	SIZE	ES						SI	LT				l		CI	LA'	Y		
	0020110			co	ARSE		FINE		COARSE		MEDIUM				FINE																
		U.	s. s	TAI	NDA	RD	SIE	Æ S	IZE	ES																					
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REMARKS: SP :	SUMMARY											
	D ₃₀ = mm	GRAVEL 45 % SAND 52 % SILT 3 % CLAY %										

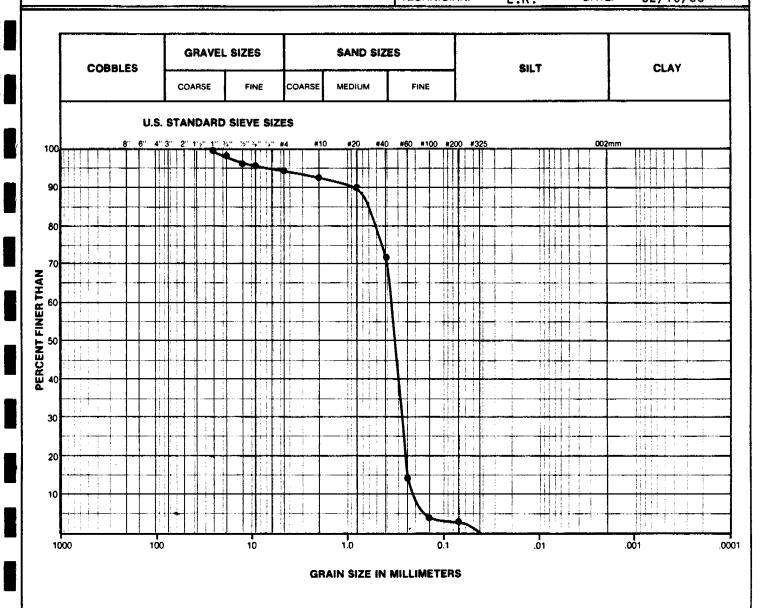


HARDY ASSOCIATES (1978) LTD.

CONSULTING ENGINEERING & PROFESSIONAL SERVICES

GRAIN SIZE CURVE

CLIENT:		GNWT							
PROJECT NUI	MBER:	CG14096							
LAB. NUMBER	1 :								
LOCATION:		Tuktoyaktı	uk						
HOLE:	TP181-14	SAMPLE:	A1						
DEPTH:	0.3	- 1.0 m							
TECHNICIAN:	I D	DATE:	02/10/86						



REMARKS: SP	SUMMARY									
		GRAVEL								
	D ₃₀ = mm	SILT3%								
NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM	C _U =mm	CLAY %								
NOTE: CALLED GOLD GOLD AND AND AND AND AND AND AND AND AND AN		<u> </u>								

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Plate C12



CLIENT:		GNWT		
PROJECT NUMBER:	(CG14096		
LAB. NUMBER:				
LOCATION:	Tukt	toyaktuk		
HOLE: TP181-16	SA	SAMPLE:	A2	
DEPTH:	0.5	- 0.1 m		
TECHNICIAN:	R	DATE:	15/10/86	

İ	CO	BBLES	GF	RAVEL S	IZES		SAND SIZI	ES		SILT	CLAY						
			COA	RSE	FINE	COARSE	MEDIUM	FINE			Ψ=						
					 EVE SIZ %" \%" \%"		#20 #4 <u>0</u>	#60 #100 #2	00 #325	.002n	ım						
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GRAIN SIZE IN MILLIMETERS

REMARKS: SP	SUMMARY								
	D ₁₀ = mm	GRAVEL 46 %							
	D ₃₀ = mm	sand50_ %							
	D ₆₀ = mm	SILT4 %							
	C _u = mm	CLAY%							
NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM	C _C = mm								



CLIENT:	GNWT	
PROJECT NUMBER:	CG14096	
LAB. NUMBER:		
LOCATION:	Tuktoyaktı	ık
HOLE: TP183-1	SAMPLE:	A2
DEPTH:	0.5 - 0.8 m	
TECHNICIAN: I	R DATE:	03/10/86

COBBL	EC	GR	AVEL	SIZES		SAND SIZE	ES		SILT	CLAY				
COBBL	ES	COAR	SE	FINE	COARSE	MEDIUM	FINE		JIL!					
				SIEVE SIZ										
	8" 6" 4"	3" 2" 1"		" \\" \\" \\" \\" \\" \\" \\" \\" \\" \	#4 #10	*20 *40	#50 #100 #	200 #325		2mm				
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REMARKS:SP	SUMN	MARY
	D ₁₀ = mm	GRAVEL
	D ₃₀ = mm	SAND87%
	D ₆₀ = mm	SILT 1 %
	C _U = mm	CLAY %
NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM	C _C = mm	



CLIENT:			GNWT		
PROJEC	NUMBER:		CG14096		
LAB. NU	MBER:				
LOCATIO	DN:		Tuktoyal	ktuk	
HOLE:	TP183-2	!	SAMPLE:	A2	
DEPTH:		0.7	- 0.9 m		
TECHNIC	CIAN:	1 .R .	DATE:	03/10/86	

СОВ	RI FS	GI	RAVEL	SIZES		SAND SIZ	ES	SILT	CLAY
000	JEE 0	COA	RSE	FINE	COARSE	MEDIUM	FINE	311.1	CLAY
				SIEVE SIZ					
	8" 6" 4"	3" 2" 1	1':" 1" %	" '' '' '' '' '' '' '' '' '' '' '' '' ''	#4 #10	#20 #40	#60 #100 #2	00 #325	.002mm
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REMARKS: SP	SUMMARY								
	D ₁₀ = mm	GRAVEL % SAND 97 %							
	D ₆₀ = mm	SILT 2 %							
	C _U = mm	CLAY %							
NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM	C _C = mm								



CLIENT:	G	NWT	
PROJECT NUME	BER: C	G14096	
LAB. NUMBER:			
LOCATION:	Т	uktoyaktul	<
HOLE:	TP183-5	SAMPLE:	A1
DEPTH:	0.1	- 0.5 m	
TECHNICIAN:	L.R.	DATE:	01/10/86

l		cc	881	EC		GRAVEL SIZES								SAND SIZES									SILT								CLAY											
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GRAIN SIZE IN MILLIMETERS

REMARKS:SP	SUMMARY									
NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM	D ₁₀ = mm D ₃₀ = mm D ₆₀ = mm C _U = mm C _C = mm	GRAVEL 43 % SAND 53 % SILT 4 % CLAY								
NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM		L.,								



HARDY ASSOCIATES (1978) LTD.

CONSULTING ENGINEERING & PROFESSIONAL SERVICES

GRAIN SIZE CURVE

CLIENT:		GNW"	Τ	
PROJECT NUI	MBER:	CG14	4096	
LAB. NUMBER) ;			
LOCATION:		Tuktoya	aktuk	
HOLE:	ГР183-5	SAMP		
DEPTH:		0.7 - 1.1	1 m	
TECHNICIAN:	L.	R. DA	TE: 09/10/	86

COBB	LES	L	GRAVI	EL SIZI	ES		SAND SI	ÆS		SILT	CLAY
		G	OARSE	F	INE	COARSE	MEDIUM	FINE		OIL I	CLAT
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REMARKS: SP	SUMM	MARY
	D ₁₀ = mm	GRAVEL 26 %
	D ₃₀ = mm	SAND
	D ₆₀ = mm	SILT2 %
	C _U = mm	CLAY %
NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM	C _C = mm	



CLIENT:			NWT		
PROJECT	NUMBER:	(G14096		
LAB. NUM	BER:				
LOCATION	1:	7	Tuktoyaktuk		
HOLE:	TP183-6	<u></u>	SAMPLE:	A1	
DEPTH:		0.2	- 0.8 m		
TECHNICI	AN: I	- Q	DATE:	01/10/86	

COBBLES

GRAVEL SIZES

COARSE FINE COARSE MEDIUM FINE

U.S. STANDARD SIEVE SIZES

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GRAIN SIZE IN MILLIMETERS

0.1

1.0

D ₃₀ =		GRAVEL1		%
C _U =	mm	SILT	5	%

NOTICE: Hardy Associates (1978) Ltd. has not interpreted or analysed the test results reported above. Use of these results is therefore subject to the following terms and conditions:

(1) Any oral presentation made or opinion given by Hardy Associates (1978) Ltd. or any of its officers, agents, servants or employees with respect to the interpretation of these test results is or was given without responsibility for the accuracy of any such presentations or opinions, regardless of whether such representations or opinions were negligently formed or given.

(2) The liability of Hardy Associates (1978) Ltd. for the use of these test results shall in any and all events be limited to the fees received by it for providing the said test results.

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100

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CLIENT:	(TWA		
PROJECT NUMI	BER:	CG14096		
LAB. NUMBER:				
LOCATION:	Tuk	ctovaktuk		
HOLE: T	169-1	SAMPLE:	A1	
DEPTH:	0.6	5 - 1.2 m		
TECHNICIAN:	L.R.	DATE:	15/10/86	

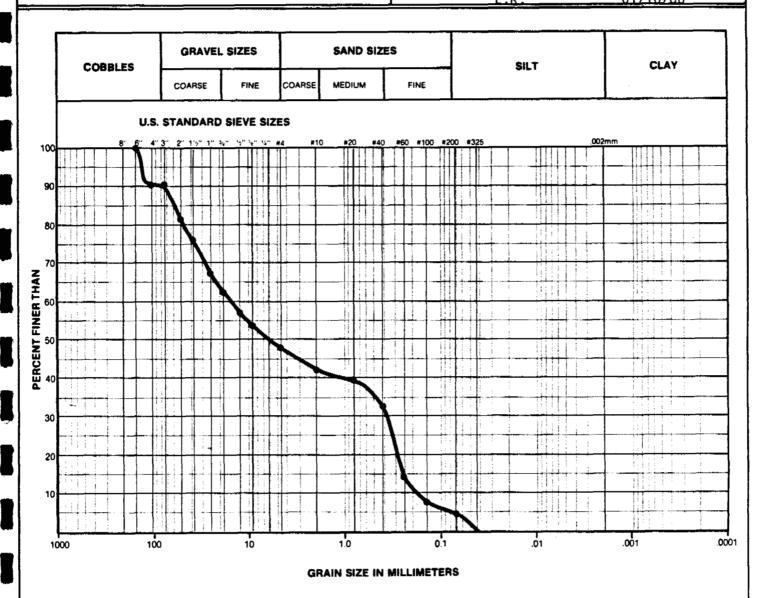
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GRAIN SIZE IN MILLIMETERS

REMARKS:SP	SUMI	MARY
NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM	D ₃₀ = mm	GRAVEL 24 % SAND 72 % SILT 4 % CLAY %



CLIENT:	GNWT
PROJECT NUMBER:	CG14096
LAB. NUMBER:	
LOCATION:	Tuktoyaktuk
HOLE: TP169-2	SAMPLE: A1
DEPTH: 0.1	2 - 0.7 m
TECHNICIAN: 1 D	DATE: 01/10/86



SUMA	MARY
D ₁₀ = mm	GRAVEL 52 % SAND 43 %
D ₆₀ = mm	SILT5 %
Cu=mm	CLAY %
C _C = mm	
	D ₁₀ = mm D ₃₀ = mm D ₆₀ = mm C _U = mm



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GRAIN SIZE CURVE

CLIENT:		GNWT	
PROJECT NUM	BER:	CG1409	16
LAB. NUMBER:			
LOCATION:		Tuktoyakt	uk
HOLE:	TP184-2	SAMPLE:	_A1
DEPTH:		0.2 - 0.6	· π
TECHNICIAN:	L.R.	DATE:	09/10/86

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REMARKS: SP	SUMA	AARY
	D ₃₀ = mm	GRAVEL 21 % SAND 77 % SILT 2 % CLAY — %
NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM	C _C = mm	CLAY %



CLIENT:		GNWT		
PROJECT NUM	ABER:	CG14096		
LAB. NUMBER				
LOCATION:	T	uktoyaktuk		
HOLE:	TP184-3	SAMPLE:	<u>A1</u>	
DEPTH:		$0.2 - 0.6 \mathrm{m}$		
TECHNICIAN:	1 . R	DATE:	03/10/86	

	GRAVEL	SIZES		SAND SIZI	ES	<u> </u>	SILT	CLAY			
COBBLES	COARSE	FINE	COARSE	MEDIUM	FINE						
	STANDARD				#50 #100 #	200 #255	.002r	pm			
8" 6" 4"	3" 2" 1" 1" 3	an 1972an 147	#4 #10) #20 #40	#60 #100 #	200 #325 					
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DEMARKS: SP	SUMM	IARY
AEMAINS.		GRAVEL
NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM	C _C = mm	



CLIENT:		GNWT		
PROJECT NUM	ABER:	CG14096		
LAB. NUMBER	:			
LOCATION:		Tuktoyaktuk		
HOLE:	TP184-5	SAMPLE:	A1	
DEPTH:		0.2 - 0.6 m		_
TECHNICIAN:	I R	DATE:	03/10/86	

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REMARKS: SM	SUMMARY							
	D ₁₀ = mm	GRAVEL%						
	D ₃₀ = mm	SAND77 %						
	D ₁₀ = mm D ₃₀ = mm D ₆₀ = mm C _U = mm	SILT13%						
	C _U = mm	CLAY %						
NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM	C _C = mm							



CLIENT:		GNWT		
PROJECT NU	MBER:	CG14096		
LAB. NUMBER	₹:			
LOCATION:		Tuktoyaktuk		
HOLE:	TP184-6	SAMPLE:	A1	
DEPTH:		0.3 - 0.8 m		
TECHNICIAN	1 8		09/10/86	

١	COBBLES			GRAVE	L SI	ZES			SAND	SIZE	S			SILT	CLAY
	COBBLE		С	OARSE		FINE	СО	ARSE	MEDIUN	1	FINE			GIL 1	OLA!
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GRAIN SIZE IN MILLIMETERS

REMARKS: GP-SP	SUMMARY							
	D ₁₀ = mm	GRAVEL 46 %						
	D ₃₀ = mm	sand46%						
	D ₆₀ = mm	SILT8 %						
	C _U = mm	CLAY %						
NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM	C _C = mm							



CLIENT:		GNWT								
PROJECT NUM	ABER:	CG14096								
LAB. NUMBER										
LOCATION:		Tuktoyak	tuk							
HOLE:	TP184-7	SAMPLE:	A2							
DEPTH:	0.5	- 0.7 m								
TECHNICIAN:	<u> </u>	DATE:	01/10/86							

00001		9	RAVEL	. SIZES		SAND SIZ	ES		SILT	CLAY	
COBBLE	1			COARSE FINE		MEDIUM	FINE		GIL I	J. J.	
8) \$IEVE SIZ) .#20 #40) #60 <u>#100</u> #2	00 #325	.002	2mm	
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CLIENT:		GNWT		
PROJECT NUM	BER:	CG14096		
LAB. NUMBER:				
LOCATION:	Tukto	oyaktuk		
HOLE:	TP155-2	SAMPLE:	A1	
DEPTH:	0.2	- 0.5 m		
TECHNICIAN:	L.R.	DATE:	06/10/86	

GRAIN SIZE IN MILLIMETERS

REMARKS:	SM ';	SUMMARY				
nemanks.		 D ₃₀ = mm	GRAVEL			
NOTE: UNIFIED	SOIL CLASSIFICATION SYSTEM	 C _C = mm				

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HARDY ASSOCIATES (1978) LTD.

CONSULTING ENGINEERING & PROFESSIONAL SERVICES

GRAIN SIZE CURVE

CLIENT:		GNWT		
PROJECT NU	MBER:	CG14096		
LAB. NUMBE	R:			Ī
LOCATION:	Tuk	tovaktuk		_
HOLE:	TP155-2	SAMPLE:	A2	_
DEPTH:	0.7	- 0.9 m		
TECHNICIAN	1 R	DATE:	09/10/86	_

COBBLES			GRAVEL SIZES			SAND SIZES			SILT		CLAY	
		COARSE FINE		FINE	COARSE MEDIUM		FINE		SIL I	CLA!		
	U.S	. ST	ANDA	RD ŞI	EVE SIZ	ES						
	8" 6" 4	71 <u>971 - :</u>	2″ 1'5″ 1 T U !	" ¾"	½" ≥ ₈ " ¼"	#4 #10) #20 #40	#60 #100 #20	00 #325	.002r	nm	
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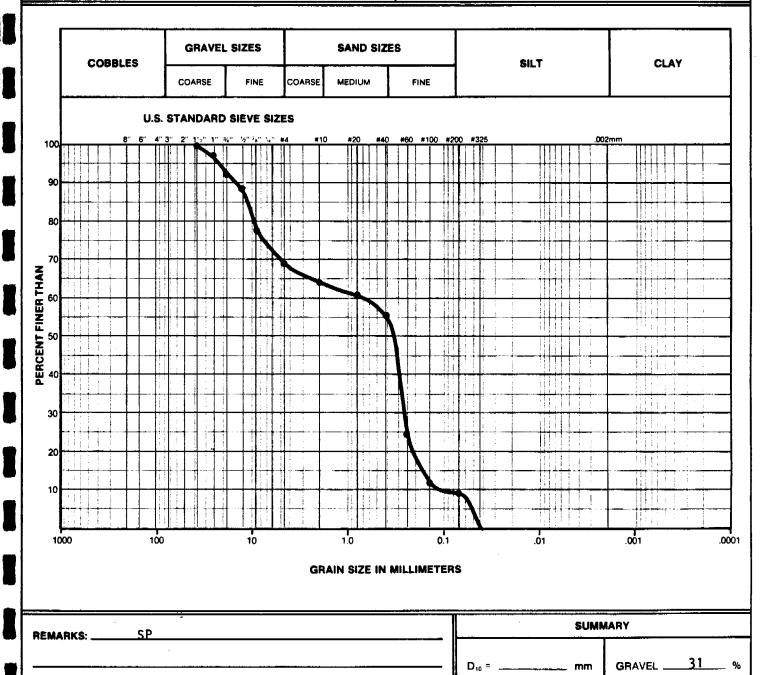
REMARKS: SP	SUMMARY			
	D ₁₀ = mm	GRAVEL 38 %		
		SAND53%		
	D ₆₀ = mm	SILT9_ %		
	C _U = mm	CLAY %		
NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM	C _C = mm	·		



CONSULTING ENGINEERING & PROFESSIONAL SERVICES

GRAIN SIZE CURVE

CLIENT:		GNWT				
PROJECT NUI	MBER:	CG14096				
LAB. NUMBER	₹:					
LOCATION:		Tuktovak	tuk			
HOLE:	TP155-4	SAMPLE:	A2			
DEPTH:	0.5	- 0.8 m				
TECHNICIAN:	L.R.	DATE:	01/10/86			



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SAND __

SILT ____

CLAY .

mm

_ mm

_ mm

NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM



CLIENT:		GNWT		
PROJECT NUI	MBER:	CG14096		
LAB. NUMBEF	₹:			
LOCATION:		Tuktovaktuk		
HOLE:	TP155-5	SAMPLE:	A1	
DEPTH:		0 - 0.4 m		
TECHNICIAN		DATE	15/10/96	

GRAIN SIZE CURVE

	COBBLES	•	۱ ،	GRAVE	EL SI	ZES		SAND SIZI	ES		SILT	CLAY
	COBBLE	•	CC	ARSE	T	FINE	COARSE	MEDIUM	FINÉ		ŞIL I	
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GRAIN SIZE IN MILLIMETERS

REMARKS: GP	SUMMARY			
nemanno.	D ₁₀ = mm	GRAVEL 54 %		
	D ₃₀ = mm	SAND 40 %		
	D ₆₀ = mm	SILT6 %		
	C _U = mm	CLAY %		
NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM	C _C =mm			

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CONSULTING ENGINEERING & PROFESSIONAL SERVICES

GRAIN SIZE CURVE

CLIENT:		GNWT		
PROJECT NUM	IBER:	CG14096		
LAB. NUMBER:				
LOCATION:	Tuk	tovaktuk		
HOLE:	TP163-1	SAMPLE:	A1	
DEPTH:		3 - 1.3 m		
TECHNICIAN:	1 R	DATE:	15/10/86	

15/10/86

COB	BLES	GRA	AVEL SI	ZES	ļ	SAND SIZ	ES		SILT	CLAY
	ple3	COAR	SE	FINE	COARSE	MEDIUM	FINE		SILI	CLAY
	U.S	. STAND	ARD ŞI	EVE SIZ	ES					
	8' 6' 4	" 3" 2" 1' _?	" 1" 1."	19" 1 ₉ " 1 ₉ "	#4 #10	#20 #40	#60 #100 #20	00 #325	.002	<u>nm</u>
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REMARKS:SP	SUMMARY				
	D ₃₀ = mm	CLAY %			

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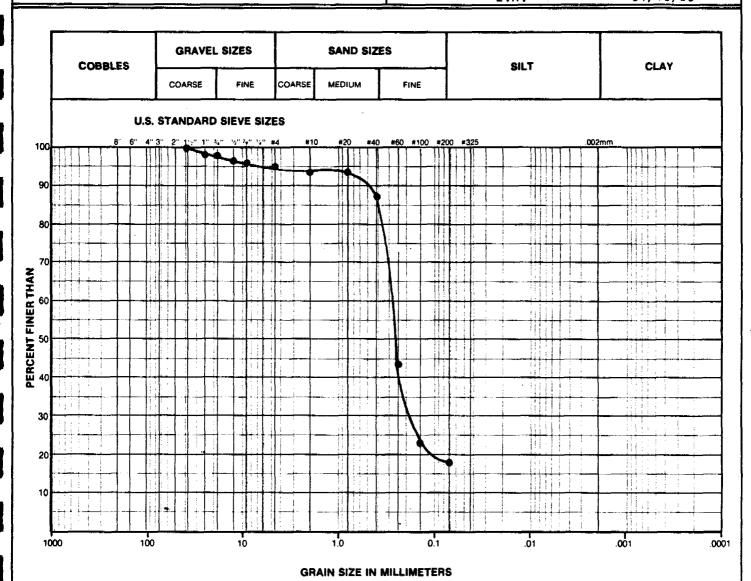
(2) The liability of Hardy Associates (1978) Ltd. for the use of these test results shall in any and all events be limited to the fees received by it for providing the said test results.



CONSULTING ENGINEERING & PROFESSIONAL SERVICES

GRAIN SIZE CURVE

CLIENT:		GNWT				
PROJECT NUI	MBER:	CG14096				
LAB. NUMBER	<u> </u>					
LOCATION:		Tuktoya	ktuk			
HOLE:	TP163-2	SAMPLE:	A1			
DEPTH:	0.4	4 - 0.7 m				
TECHNICIAN:	I.R.	DATE:	01/10/86			



SUMMARY REMARKS: _6_ D₁₀ = _____ __ mm 76 SAND ____ D₃₀ = ____ _ നന 18 SILT ____ D₆₀ = _____ _ mm ____ mm CLAY __ NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM

NOTICE: Hardy Associates (1978) Ltd. has not interpreted or analysed the test results reported above. Use of these results is therefore subject to the following terms and conditions: (1) Any oral presentation made or opinion given by Hardy Associates (1978) Ltd. or any of its officers, agents, servants or employees with respect to the interpretation of these test results is or was given without responsibility for the accuracy of any such presentations or opinions, regardless of whether such representations or opinions were negligible formed or given.

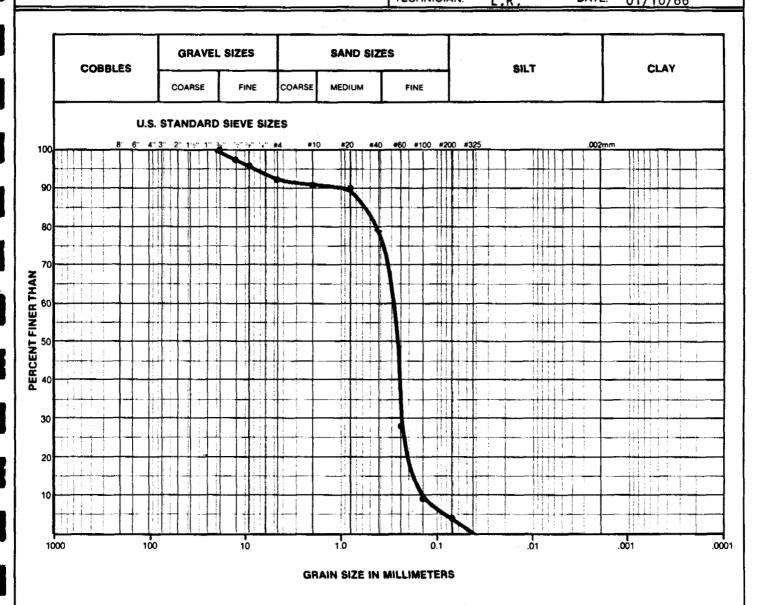
(2) The liability of Hardy Associates (1978) Ltd. for the use of these test results shall in any and all events be limited to the fees received by it for providing the said test results.



CONSULTING ENGINEERING & PROFESSIONAL SERVICES

GRAIN SIZE CURVE

CLIENT:		GNWT				
PROJECT NUMBER:		CG14096				
LAB. NUMBER						
LOCATION:		Tuktoya	ktuk			
HOLE:	TP163-3	SAMPLE:	Α1			
DEPTH:	0.3	- 0.9 m				
TECHNICIAN:	1 0	DATE	01/10/96			



D ₃₀ = mm D ₈₀ = mm C _U = mm	SUMMARY				
NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM	CLAY %				

NOTICE: Hardy Associates (1978) Ltd. has not interpreted or analysed the test results reported above. Use of these results is therefore subject to the following terms and conditions: (2) The liability of Hardy Associates (1978) Ltd. for the use of these test results shall in any and all events be limited to the fees received by it for providing the said test results.

TEST PIT: 181-16A, SAMPLE: A2, DEPTH: 0.5-1.0 m, PN = 105

Rock Type	Classification	Total Weighted Composition %
Crystalline	Good	2.4
Quartzite		3.9
Quartzite/Sand	stone	66.0
Slate		13.5
Carbonate		4.1
Conglomerate		1.1
Sandstone		7.8
Sandstone	Fair	0.9
Sandstone	Poor	0.1
Volcanic		0.2
		100%

<u>Comments:</u> Excellent quality for concrete aggregate

TEST PIT: 169-1, SAMPLE: Al, DEPTH: 0.6-1.2 m, PN = 190

Rock Type	Classification	Total Weighted Composition %
Crystalline	Good	4.4
Quartzite		53.4
Sandstone/Silts	tone	6.8
Slate		10.4
Conglomerate		0.5
Shale/Siltstone	Fair	5.4
Sandstone/Silts		13.2
Sandstone	Poor	5.9
		100%

Comments: Poor quality for concrete aggregate

TEST PIT: 184-6, SAMPLE: Al, DEPTH: 0.3-0.8 m, PN = 114

Rock Type	Classification	Total Weighted Composition %
Crystalline	Good	7.0
Sandstone (quai	rtzose)	64.1
Slate/Siltstone	e/Shale	11.8
Quartzite		4.8
Carbonate		3.9
Conglomerate		0.6
Sandstone/Silt:	stone	1.0
Shale	Fair	0.2
Sandstone/Silts	stone	6.5
Carbonate		0.1
		100%

Comments: Good quality for concrete aggregate

TEST PIT: 155-5, SAMPLE: Al, DEPTH: 0-0.4 m, PN = 101

Rock Type	Classification	Total Weighted Composition %
Crystalline	Good	3.5
Quartzite		4.2
Sandstone (quar	tzose)	76.1
Slate		9.9
Carbonate		2.6
Sandstone		3.3
Sandstone	Fair	0.4
		100%

<u>Comments:</u> Excellent quality for concrete aggregate

TEST PIT: 163-1, SAMPLE: Al, DEPTH: 0.3-1.3 m, PN = 110

Rock Type	Classification	Total Weighted Composition %
Crystalline	Good	4.0
Quartzite		10.6
Quartzite/Sand	stone	32.0
Sandstone		29.4
Slate		17.9
Carbonate		3.2
Conglomerate		0.1
Carbonate	Fair	0.4
Siltstone/Sand	stone	1.8
Chert	Deleterious	0.4
Sandstone/Silt	stone	0.2
•		100%

::



TECHNICAL REPORT

To: Government of Northwest Territories Department of Public Works Highways Diivsion Yellowknife, N.W.T. XlA 2L9

FILE

4195-CG-14096

DATE

November 13, 1986

CLIENT P.O.

Ç.C.

PROJECT:

Community Granular Management Plan - Tuktoyaktuk N.W.T.

SUBJECT:

Physical Tests of Aggregate

Sample Identification

Coarse Aggregate (+4.75 mm) Specific Gravity

Fine Aggregate (-4.75 mm) Organic Impurities

Color Test

Pit 184

2.59

Bulk

2.62

SSD

1.21

Absorption %

#4

184-6 Al 0.3-0.8 m

Tests performed in accordance with the following standards: Comments:

- Specific Gravity and Absorption (Coarse Aggregate) ASTM C127.
- (2) Organic Impurities Color Test (Fine Aggregate) ASTM C40.

Hardy BBT Limited

K. W. Gillingwater,

Senior Supervisor

KWG: dw

Plate C38

PAGE

WINNIPEG



LOS ANGELES ABRASION TEST REPORT

TO: Government of Northwest Territories
Department of Public Works
Highways Division
Yellowknife, N.W.T.
X1A 2L9

OFFICE: Calgary

PROJECT NO.: 4195-CG-14096

DATE:

November 13, 1986

CC:

•

PROJECT Community Granular Ma	nagement Plan - Tuktoyaktuk	N.W.T.		
Test Holes 184-2-Al, 184-3-Al, - SOURCE 184-5-A2, 184-6-Al TYPE O		SAMPLED BY	Client	
DATE SAMPLED Oct./86 DATE R	ECEIVED Oct. 22/86	DATE TESTED	Oct. 31/86	
MATERIAL GRADING: "A	11			
ACTUAL SIEVE SIZES	A	MOUNT		
— 1 1/2"38.1 mm 1" (25.0 mm)		<u></u> .	1249.7	g
- 1" 25.0 mm + 3/4"(19.0 mm)			1250.0	9
- 3/4" 19.0 mm ⁺ 1/2"(12.5 mm)			1249.7	g
— 1/2" 12.5 mm+ 3/8"(9.5 mm)			1249.6	9
	TOTAL SAMPLE		4999.1	9
NO. OF REVOLUTIONS 500				
NO. OF SPHERES 12	TOTAL SAMPLE		4999.1	9
WT. OF SPHERES 4994, 4	+ # 12 MATERIAL AFTER		4103.8	9
	-# 12 MATERIAL AFTER		895.3	9
LOSS = 4999 1 -#12 TOTAL SAMPLE	× 100 = <u>895.3</u> × 100 = 4999.1	=17.9	%	

COMMENTS:

Test performed in accordance with ASTM C131. Clay lump deposits were present throughout the size fractions.

TECHNICIAN R.L.D.

REPORT CERTIFIED

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CONSULTING ENGINEERING & PROFESSIONAL SERVICES

SOUNDNESS OF AGGREGATE SULPHATE TEST REPORT

FILE:

4195-CG-14096

DATE:

November 13, 1986

CLIENT P.O .: -

C.C.:

PROJECT Community Granular Management Plan - Tuktovaktuk N.W.T.

Test Holes 184-2-A1, - Composite Sample for Test

Highways Division Yellowknife, N.W.T.

SOURCE 184-6-A1

X1A 2L9

TYPE OF SAMPLECoarse Aggregate SAMPLED BY Client DATE RECEIVED Oct. 22/86

DATE TESTED Nov. 5/86

DATE SAMPLED Oct./86

NUMBER OF CYCLES 5 SOLUTION Magnesium Sulphate

TO: Government of Northwest Territories

Department of Public Works

COARSE AGG	REGATE			FINE AGGREGATE			
SIEV	E SIZE	ORIGINAL	T	SIEV	E SIZE	ORIGINAL	WEIGHED
PASSING	RETAINED	GRADING PERCENT	AVERAGE PERCENT LOSS	PASSING	RETAINED	GRADING PERCENT	AVERAGE PERCENT LOSS
4 IN.	2 IN.	12.6	0.08*	3/8 IN.	NO. 4		
2 IN.	1 - ½ IN.	7.2	0.04*	NO. 4	NO. 8		
1 - 1/2 IN.	1 IN.	13.0	0.08	NO. 8	NO. 16		
1 IN.	3/4 IN.	10.4	0.03	NO. 16	NO. 30		
¾ IN.	1/2 IN.	18.7	0.84	NO. 30	NO. 50		
½ IN.	3/8 IN.	13.3	1.15	NO. 50	NO. 100		
3/8 IN.	NO. 4 IN.	24.8	0.48	NO. 100			1
	TALS	100.0	2.70	TO	TALS		<u> </u>

SIZE FRACTION	NO.	'S	QUALITATIVE EXAMINATION OF PLUS 34" MATERIAL
2" 2"	ORIGINAL	-]	
3" - 2"	FINAL	-	
2" - 1/2"	ORIGINAL		
	FINAL	-	
1)/2" - 1"	ORIGINAL	20	
	FINAL	20	Some cracking and flaking was observed.
•" 1/*	ORIGINAL	27	-
1" - 34".	FINAL	27	Some cracking and flaking was observed.

COMMENTS: *Weighted average percent loss adjustment as per testing requirement. Clay lump deposits were present throughout the size fractions.

REPORT CERTIFIED

(E)

TECHNICIAN R.L.D. TESTED IN ACCORDANCE WITH ASTM C88

. 9

CALGARY DAWSON CREEK

CALGARY EDMONTON

ALBERTA GRANDE PRAIRIE

72€ 6.5 LETHBRIDGE

272-8761 4031 PRINCE GEORGE RED DEER

610-821-1388 WINNIPEG



TECHNICAL REPORT

To: Government of Northwest Territories Department of Public Works Highways Division Yellowknife, N.W.T. Xla 2L9

4195-CG-14096 FILE November 13, 1986 DATE CLIENT P.O. ~ C.C.

PROJECT: Community Granular Management Plan - Tuktoyaktuk N.W.T.

SUBJECT:

Physical Tests of Aggregate

Coarse Aggregate (+4.75 mm) Sample Specific Gravity

Bulk Absorption % Fine Aggregate (-4.75 mm)

Organic Impurities Color Test

#5 Pit 155 2.58 2.61 1.17

155-5 Al 0-0.4 m

Identification

Comments: Tests performed in accordance with the following standards:

- Specific Gravity and Absorption (Coarse Aggregate) ASTM C127.
- (2) Organic Impurities Color Test (Fine Aggregate) ASTM C40.

Hardy BBT Limited

K. W. Gillingwater, ₫/E.T.,

Senior Supervisor

KWG: dw



LOS ANGELES ABRASION **TEST REPORT**

TO: Government of Northwest Territories Department of Public Works Highways Division Yellowknife, N.W.T. XlA 2L9

OFFICE:

Calgary

PROJECT NO.: 4195-CG-14096

DATE:

November 13, 1986

CC:

155 Pit SOURCE (155-5 Al 0-04 m) TYPE OF SAMPLE Coarse Aggregate SAMPLED BY Client DATE SAMPLED Oct. 18/86 DATE RECEIVED Oct. 22/86 DATE TESTED Oct. 31/86 MATERIAL GRADING: "A" ACTUAL SIEVE SIZES AMOUNT 1 1/2"(38.1mm) 1" (25.0mm) 1250.2	
DATE SAMPLED Oct. 18/86 DATE RECEIVED Oct. 22/86 DATE TESTED Oct. 31/86 MATERIAL GRADING: "A" ACTUAL SIEVE SIZES AMOUNT 1 1/2" (38.1mm) 1" (25.0mm) 1250.2	
MATERIAL GRADING: "A" ACTUAL SIEVE SIZES AMOUNT 1 1/2" (38.1mm) 1" (25.0mm) 1250.2 1" (25.0mm) 3/4" (19.0mm) 1250.4	
ACTUAL SIEVE SIZES AMOUNT 1 1/2" (38.1mm) 1" (25.0mm) 1250.2 1" (25.0mm) 3/4" (19.0mm) 1250.4	
ACTUAL SIEVE SIZES AMOUNT 1 1/2" (38.1mm) 1" (25.0mm) 1250.2 1" (25.0mm) 3/4" (19.0mm) 1250.4	
— 1 1/2"(38.1mm) 1" (25.0mm) 1250.2 — 1" (25.0mm) 3/4"(19.0mm) 1250.4	
— 1 1/2"(38.1mm) 1" (25.0mm) 1250.2 — 1" (25.0mm) 3/4"(19.0mm) 1250.4	
— 1" (25.0mm [†]) 3/4"(19.0mm) 1250.4	
	g
	g
	g
- 1/2" (12.5mm) 3/8"(9.5mm) 1248.5	9
TOTAL SAMPLE 4999.9	9
NO. OF REVOLUTIONS 500	
NO OF SPHERES TOTAL SAMPLE 4999.9	9
WT. OF SPHERES 9 + # 12 MATERIAL AFTER 4130.4	g
-# 12 MATERIAL AFTER 869.5	9
LOSS =	

COMMENTS:

Test performed in accordance with A.S.T.M. Cl31.

Clay lump deposits were found present throughout the size fractions.

TECHNICIAN R.L.D. REPORT CERTIFIED

NOTICE: Hardy Associates (1978) Ltd. has not interpreted or analysed the test results reported above. Use of these results is therefore subject to the following terms and condition of the condition made or opinion given by Hardy Associates (1978) Ltd. or any of its officers, agents, servants or employees with respect to the interpretation of these is or was given without responsibility for the accuracy of any such presentations or opinions, regardless of whether such representations or opinions were neeligently formed (2). The liability of Hardy Associates (1978) Ltd. for the use of these test results shall in any and all events be limited to the fees received by it for provided the said test results.



CONSULTING ENGINEERING & PROFESSIONAL SERVICES

SOUNDNESS OF AGGREGATE SULPHATE TEST REPORT

FILE:

4195-CG-14096

DATE:

November 13, 1986 1

CLIENT P.O .:-

C.C.:

to: Government of Northwest Territories Department of Public Works Highways Division Yellowknife, N.W.T.

XlA 2L9

PROJECT Community Granular Management Plan - Tuktovaktuk N.W.T.

Test Holes 155-2-A2-0.7-0.9 m ,

155-4-A1-0.1-0.3 m, 155-4-A2-0.5-0.8 m, - Composite Sample

SOURCE 155-5-A1-0.7-0.9 m

TYPE OF SAMPLE Coarse AggregateSAMPLED BY Client

DATE SAMPLED Oct./86

DATE TESTED Oct. 31/86 DATE RECEIVED Oct. 22/86

NUMBER OF CYCLES SOLUTION Magnesium Sulphate COARSE AGGREGATE FINE AGGREGATE ORIGINAL SIEVE SIZE ORIGINAL WEIGHED SIEVE SIZE AVERAGE GRADING AVERAGE GRADING PASSING RETAINED PASSING RETAINED PERCENT PERCENT LOSS PERCENT PERCENT LOSS 3/8 IN. NO. 3 IN. 2 IN. 5.4 A 01.* NO. NO. 4 R 2 IN. 1 - 1/2 IN. 0.01* 9.7 1 IN. NO. 8 NO. 16 1 - 1/2 IN. 15.9 0.02 34 IN. NO. 30 1 IN. NO. 16 16.5 0..07 ⅓ IN. NO. 50 34 IN. NO. 30 18.7 0.631: IN. 3/8 IN. NO: 50 NO. 100 13.7 0.94 NO. 100 3/8 IN. NO. 4 IN. 20.1 1.96 3.64 TOTALS TOTALS 100-0

SIZE FRACTION	NO.	s	QUALITATIVE EXAMINATION OF PLUS 14" MATERIAL
	ORIGINAL		•
3" - 2"	FINAL	-	-
2" - 1%"	ORIGINAL	_	
	FINAL	_	
1%" - 1"	ORIGINAL	19	
	FINAL	19	Some cracking was observed.
•" - 1/"	ORIGINAL	24	
1" - ¾"	FINAL	24	Some cracking was observed.

COMMENTS: *Weighted average percent loss adjustment as per testing requirement. Clay lump deposits were present throughout the size fractions.



PEPORT CERTIFIED

TECHNICIAN R.L.D.

TESTED IN ACCORDANCE WITH ASTM C88

BURNABY CALGARY

STREET DAWSON CREEK

CALGARY EDMONTON

ALBERTA. GRANDE PRAIRIE

LETHBRIDGE

272-8761 PRINCE GEORGE

TWX RED DEER 610-821-1366 WINNIPEG



TECHNICAL REPORT

To: Government of Northwest Territories
Department of Public Works
Highways Division
Yellowknife, N.W.T.
X1A 2L9

FILE 4195-CG-14096

DATE November 13, 1986

CLIENT P.O.
C.C. -

PROJECT: Community Granular Management Plan - Tuktoyaktuk N.W.T.

SUBJECT:

Physical Tests of Aggregate

Fine Aggregate (-4.75 mm) Coarse Aggregate (+4.75 mm) Organic Impurities Sample Specific Gravity Identification Bulk Absorption % Color Test SSD Pit 163 2.59 2.63 #2.5 1.31 161-1 A1 0.3-1.3 m

Comments: Tests performed in accordance with the following standards:

- (1) Specific Gravity and Absorption (Coarse Aggregate) ASTM Cl27
- (2) Organic Impurities Color Test (Fine Aggregate) ASTM C40.

Hardy BRT Limited

Per:

K. W. Gillingwater, C.E.T.,

Senior Supervisor

KWG: dw