

GEOTECHNICAL INVESTIGATION  
PROPOSED AIRSTRIP AND ACCESS ROAD  
FORT GOOD HOPE, NORTHWEST TERRITORIES

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*Earth & Environmental*

Keith Barnes

GEOTECHNICAL INVESTIGATION  
PROPOSED AIRSTRIP AND ACCESS ROAD  
FORT GOOD HOPE, NORTHWEST TERRITORIES

**COPY**

Prepared For  
Government of the Northwest Territories  
Department of Transportation  
Yellowknife, Northwest Territories

Prepared By  
HBT AGRA Limited  
Yellowknife, Northwest Territories

YX00354  
November, 1993

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## 1.0 INTRODUCTION

HBT AGRA Limited (HBT) was retained by the Government of the Northwest Territories, Department of Transportation (DOT), Airport Division Yellowknife, Northwest Territories to conduct a geotechnical investigation for a proposed airstrip and access road. A proposal to conduct this work dated July 23, 1993 was submitted to DOT. This work was authorized under Contract CT 933188.

### 1.1 SCOPE OF WORK

The scope of work for this project was as follows:

- determine the subsurface soils and the conditions at the proposed airstrip site and along the access road.
- identify and investigate potential granular sources for use in the construction of the airstrip and access road.
- conduct a laboratory testing program to determine the engineering properties of the soils.
- prepare a report outlining the results of the field work and laboratory testing, and present recommendations.

## 2.0 PROPOSED DEVELOPMENT

The proposed development includes the construction of an access road, approximately 3 km in length and the construction of an approximately 900 m long gravel surface airstrip with associated apron area. As part of the access road construction, a bridge is to be constructed at Jackfish Creek, and a culvert is to be installed on a stream at Curve 3 (Station 1+583 approximately).

### 3.0 FIELD AND LABORATORY INVESTIGATION

#### 3.1 FIELD PROGRAM

The field work was conducted from September 29, to October 2, 1993. Twenty-nine boreholes were drilled along the access road alignment, airstrip alignment, and offset from the airstrip. The depth of boreholes ranged from 4.0 to 10.5 m below existing grade. The boreholes were drilled using a track-mounted B61 auger rig contracted from Mobile Augers and Research Ltd. The field work was supervised by Mr. J.L. Anklewich, P.Eng. of HBT. The subsurface conditions were logged on a continuous basis as drilling proceeded. Disturbed soil specimens were collected from most boreholes. In selected boreholes undisturbed samples of permafrost soils were recovered for inspection and photographing. Borehole locations are shown on the site plan, Figure 1. All boreholes were backfilled upon completion.

#### 3.2 LABORATORY TESTING

Specimens retrieved during the drilling program were returned to HBT's laboratory for testing and classification to determine the engineering properties of the soils. The following tests were conducted on selected specimens:

- natural water content
- Atterberg Limits
- grain size analysis

The results of the laboratory tests are presented on, and following, the borehole logs in Appendix B.

#### 4.0 SURFACE AND SUBSURFACE CONDITIONS

##### 4.1 SITE DESCRIPTION

###### Access Road

The access road alignment had a cleared width of 20 to 30 m. The road begins on the east side of the community and traverses Jackfish Creek approximately 1500 m upstream of its confluence with the MacKenzie River. The north slope of the Jackfish valley has a maximum angle of about 16°, but along the alignment is about 12.5°. The south slope has angles up to 16.5° locally, but along the road alignment the overall angle is about 6°.

Vegetation consists of a mixture of coniferous and deciduous trees. Spruce and pine trees, up to about 10 m are the most common coniferous species and poplar/birch trees are the most common deciduous species, with heights up to about 7 m.

At Station 1+583 (approximately) the access road traverses a seasonal stream.

Selected site photographs of the access road are presented in Appendix A.

###### Airstrip

The airstrip had been grubbed approximately 120 m wide along its alignment.

The airstrip slopes slightly downward from the apron area to the west and east ends. The maximum grade change from the apron area to the west end is about 6.5 m.

At the west end of the airstrip the predominant tree cover was of coniferous species. Tree heights were up to about 8 m. Deciduous species became present and the total tree density increased to the east from a point about 200 m from the west end of the airstrip. Figures 4 and 5 present photographs of the airstrip at the time of the field investigation. There was a light snow cover. Access for the drill rig was reasonably good.

#### 4.2 RELATED STUDIES

In addition to the geotechnical drilling conducted at this site, HBT has undertaken drilling for several other projects in the community.

- Geotechnical Investigation - Health Centre, Fort Good Hope, NWT. Prepared for the Department of Government Services and Public Works, Inuvik, Northwest Territories.
- Geotechnical Investigation - Subdivision Roadway, Fort Good Hope, NWT. Prepared for the Department Government Services and Public Works, Inuvik, NWT.
- Geotechnical Investigation - School Addition, Fort Good Hope, NWT. Prepared for the Department of Government Services and Public Work, Inuvik, NWT.

Other reports also reviewed to obtain relevant information were:

- Granular Resource Inventory - Proposed Mackenzie Highway. Prepared for the Government of Canada by Pencam Services.



#### 4.3 PERMAFROST CONDITIONS

The community of Fort Good Hope lies on the Arctic Circle, and on the physiographic boundary between continuous and discontinuous permafrost. Permafrost is likely to occur on highlands (away from streams and rivers) where the natural vegetative cover is intact. Normal seasonal thaw is likely limited to 0.5 m to 1.5 m below grade. In areas where the vegetation cover has been disturbed or removed, the seasonal thaw may be much greater and permafrost degradation can occur. In well drained granular soils, the seasonal that may be greater than 1.5 m.

The mean annual air temperature in Fort Good Hope is  $-7.8^{\circ}\text{C}$ . Ground temperature information is scarce in the Fort Good Hope Area. A thermistor string installed at the location of the proposed health centre measured the following temperatures with depth in early October, 1993.

<u>Depth Below Ground Surface (m)</u>	<u>Temperature (<math>^{\circ}\text{C}</math>)</u>
0	+0.7
1	+0.5
2	-0.1
3	-0.5
4	-0.8
5	-0.9
6	-0.8
7	-1.0
8	-1.1
9	-1.2

This data, measured in fine grained soils indicate that the permafrost is relatively warm, and potentially thermally unstable.

#### 4.4 SUBSURFACE CONDITIONS

Boreholes logs are presented in Appendix B. An explanation of the terms and symbols used in the logs is provided in Appendix C.

##### North Slope of Jackfish Creek - Station 2+860 to Station 3+120

Three boreholes (1,2, and 3) were advanced on the north slope of Jackfish Creek. The subsurface conditions encountered in Borehole 1 consisted of sand and/or gravels throughout its entire depth of 8.5 m. The soil was thawed to a depth of 2.1 m. The sand was generally coarse grained gravel, with sizes up to about 40 mm was present from about 2.4 m to 7.5 m depth. Ice crystals were encountered at a depth of about 5 m.

In Boreholes 2 and 3, sand, overlying clay till was encountered. The sand was silty, fine grained with some gravel sizes. At 0.9 m and 1.5 m in Boreholes 2 and 3 respectively clay till was encountered. The soil was unfrozen to a depth of 2.1 m. The clay was firm when thawed, medium plastic, containing some silt and coarser grained materials. Ice crystals were common throughout the clay till.

##### Jackfish Creek

Boreholes 4 and 5 were drilled on the north and south sides of the creek, respectively. Cohesionless soils were encountered to a depth of 2.7 m to 3.3 m below ground surface. The soils were thawed throughout this strata. The soils consisted predominantly of sands and gravels with sizes up to 75 mm. Groundwater seepage was experienced below about 2 m.

Underlying the cohesionless soils, frozen clay till was noted. The strata was firm when thawed, medium plastic, with frequent sand and gravel particles. Drilling below about 4 m was difficult due to sloughing within the granular layer near surface.

#### Access Road - Jackfish Creek to Airstrip

Boreholes 6 to 17 were drilled along the alignment of the access road. The depth of drilling ranged from 4 to 5.5 m. The subsurface conditions generally consisted of sand, or sand and gravel for the entire depth, or underlain by clay till. The depth of thaw was variable, ranging in depth from about 2 m to 4 m. From Station 0+880 (Borehole 14) to the airstrip no fine grained soils were encountered in the boreholes.

#### Airstrip

Twelve boreholes (Boreholes 18 to 29) were drilled on the airstrip alignment and right-of-way. Boreholes 18 to 22, drilled on the airstrip centerline encountered predominantly cohesionless soils throughout their depth. In Boreholes 18, strata of sand, gravel and sand and silt was observed with descending depth. The silt strata appeared to be limited to the west end of the airstrip.

In Boreholes 19 to 22 the subsurface soils generally consisted of sand and gravel to a depth of 4.3 to 5.2 m. The sand was fine to coarse grained and the gravel had gravel sizes to 50 mm. Underlying the sand and gravel was a strata of fine to coarse grained sand. The thawed depth was variable, ranging from 0.6 to 6.0 m below ground.

## 5.0 GRANULAR RESOURCES

### 5.1 GENERAL

The proposed airstrip and apron are located on a significant volume of granular material. This source was identified during the 1970's as part of work associated with the proposed Mackenzie Highway and oil and gas pipeline routes. It represents the largest granular source in the Fort Good Hope area. Construction of the airstrip over the deposit may seriously inhibit its full potential development. Consideration should be given to the impact of the construction of the airstrip on other project requirements for granular materials.

It is estimated that the total volume of granular soils in this deposit exceeds 1,000,000 m<sup>3</sup>. Within the upper 3 m, where the most suitable sand and gravel materials may be present, the estimated volume is 300 000 m<sup>3</sup> to 500 000 m<sup>3</sup>.

Grain size curves for samples collected during the field program are presented in Appendix B. The natural material surrounding the airstrip is very good quality for embankment fill. However, the material encountered is unsuitable for crushing to produce the required volume of surfacing aggregate.

Inquiries were made of the availability of suitable crush source material near the community. Apparently there is no supply of oversize material (cobbles, boulders) that have been stockpiled at existing borrow pits. It may be necessary to consider using limestone from the nearby Ramparts.

## 5.2 BORROW SOURCE DEVELOPMENT

It is considered that the south side of the airstrip could be developed as a borrow source for granular soils. The eastern half of the site may require less overburden removal than the west end. As shown on the summary gradation curves in Appendix B the deposit is generally uniform with depth, but the upper 3 m of material may be somewhat more suitable than those at greater depths.

The thickness of overburden that will have to be removed to access the underlying granular soils may be estimated from the borehole logs. In most cases the organic layer is very thin, likely less than 200 mm. In a number of boreholes, such as Borehole 18, 22 and 28 a surficial layer of silt, up to 1.2 m thick, was encountered. Surficial silt should be expected to occur anywhere within the borrow source area.

The observed depth of thaw is variable, but deeper than normal. The depth to the permafrost was generally 3 to 4 m, or more. The natural water content was found to be less than 5% in most cases. This suggests that excavation of the borrow material should not be unduly hampered by ice rich (bonded) frozen granular soils.

## 6.0 SLOPE STABILITY - JACKFISH CREEK

One issue requiring serious consideration is the stability of the proposed alignment on the slopes facing Jackfish Creek. Degradation of permafrost will occur as a result of the clearing of the right-of-way and roadway construction. As this permafrost thaws the stability of the slope could decrease, if the soils are ice-rich and an increase in porewater pressures occur during the thawing process.

The north slope is likely to experience greater, and more rapid thaw than the south slope due to the greater exposure to the sun.

The soils on the north slope, and in particular in Boreholes 2 and 3 are predominantly clay till. The water content ranges from about 15% to 20%, with one single water content over 30%. These values indicate that the soil is not ice rich, and that thawing should not result in high porewater pressures. This is consistent with much of the clay till encountered in the Mackenzie Valley.

The north slope along the road alignment is about 12.5°, although the steepest grade is about 16°. These slope angles are considered to be thaw stable for ice poor clay tills, and consequently significant slope instability is not expected, based on the existing topography. The road alignment, however, crosses the contours at an angle and side slopes may pose a problem. Where significant earth works are envisioned (i.e. cuts and fills) as part of the road construction, the proposed section should be specifically evaluated from a slope stability perspective.

The south slope is in the order of 6° overall, along the road alignment. There is however a locally steep 15° section. As with the north side, stability of the slope during thawing is likely, providing grades are not steepened during construction.

## 7.0 BRIDGE FOUNDATIONS

Two methods of bridge foundations are presented here. They are driven pile foundation and a crib foundation. Both are considered feasible.

It is understood that ice jamming may be a factor in establishing the elevation of the bridge deck, and in the design of the abutments. Although a study of the hydrology of Jackfish Creek is beyond the scope of this report, such a study could be undertaken by HBT who have recently conducted hydrographic studies of tributaries to the Mackenzie River.

### 7.1 DRIVEN STEEL PILES

Driven steel piles may be considered for use on this project. The allowable adhesion is derived from side bond between the steel and the frozen soil and thawing soil, and considers the potential for creep settlement. For this project, a ground temperature of  $-1^{\circ}\text{C}$  has been used for design, and a creep settlement rate of 1.6 mm/year.

The capacity of driven steel piles in static compressive, or tensile loading, may be calculated on the basis of an allowable adhesion of 50 kPa, subject to the comments provided below.

The steel pile should consist of hollow structural steel sections, (not lacquered pipe steel), or H-sections. The section should be free of severe rust, scale, grease and lacquer. The upper sections may be painted with rust inhibiting paint.

Hollow section piles may be driven open-ended, with or without pre-drilling. Where pre-drilling is used to improve pile installation, the drill hole diameter should be at least 50 mm smaller than the pile diameter. H-pile sections should not be pre-drilled beyond a depth of 2 m below final grade.

The adhesion capacity of the pile within 2 m of the final ground surface and within any fill material should be ignored. The pile length should be embedded at least 7 m in natural soil. The top 2 m, in the seasonal active layer, should be covered with greased polythene sheets to reduce frost jacking forces.

The piles section should be selected with consideration of available pile driving equipment. Stresses during driving should not exceed approximately 40 percent of the yield strength of the pile section.

Where practical refusal is met during pile installation at a depth shallower than that specified by the design, a revised capacity may be established by review of the pile installation records.

For the purpose of lateral loading, the portion of the piles above a depth of 2 m below the final ground surface should be considered to be structurally unsupported.

## 7.2 CRIB FOUNDATION

A crib structure, placed in or on the banks of Jackfish Creek may be a suitable method of supporting the bridge deck. The design of the crib should consider issues such as bearing capacity, settlement, earth pressures and fill materials. A schematic of a crib is shown in Figure 6.



A crib constructed of timber or steel sections should be placed on a level surface with a bearing surface comprising of granular soils on clay tills. Silty soils, such as those encountered in Borehole 4 are not considered a suitable bearing soil. For a crib supported on compact to dense gravelly soil, or firm to stiff, ice-poor clay till, an allowable bearing capacity of 150 kPa may be used for design.

The lateral stability of the crib will depend on the earth pressures acting on it and the available frictional resistance along the base of the crib. The crib should be designed to resist an active force acting on the upslope side of the crib as follows:

$$P_A = 1/2\gamma'h^2K_A$$

where  $P_A$  = active force on the crib (kN/m width)

$\gamma'$  = effective unit weight of soil on upslope side of crib (assume 19 kN/m<sup>3</sup>)

$h$  = height of crib (m)

$K_A$  = active earth pressure (assume 0.33)

The main resisting force will be derived from inter-particle friction along the base of the crib structure:

$$F_R = l\gamma'h \tan \phi$$

where  $F_R$  = resisting force of crib (kN/m width)

$l$  = length of the crib (m)

$\gamma'$  = effective unit weight of crib fill (assume 20 kN/m<sup>3</sup>)

$h$  = height of crib (m)

$\phi$  = effective friction angle at crib - subgrade interface  
(assume 30°)

In calculating the stability of the structure, the ratio  $F_R/P_A$  should be at least 1.50.

The backfill used in the crib should consist of well compacted granular soils with a fines content of less than 10%. The fill should be compacted to at least 95 percent of Standard Proctor maximum dry density. The design of the crib should consider the earth pressures induced by the compacted fill and surcharge loadings due to construction, or traffic.

It is expected that the crib will experience some long term settlement due to permafrost degradation, fill settlement, and subgrade loading. Provisions should be included in the design to accommodate a settlement in the order of 50 mm. The approach to the crib may require periodic maintenance in light of vertical crib movement.

## 8.0 REVIEW AND INSPECTION

It is recommended that the geotechnical aspects of the final design be submitted to HBT for review and comments. This is to ensure that the design and proposed construction methods are consistent with the recommendations contained in this report.

It is also recommended that on-site monitoring and review be performed during construction to ensure that the subsurface conditions encountered are similar to those on which the design was based. This review is considered to be part of

the overall design process, and may be required by the National Building Code of Canada.

## 9.0 LIMITATIONS

Recommendations presented in this report are based on a geotechnical evaluation of the findings in 29 boreholes and a review of other available information. The subsurface conditions noted at the borehole locations have been assumed to be representative of the rest of the site. However, if conditions other than those reported herein are encountered during subsequent phases of this project, HBT should be notified and given the opportunity to review the recommendations in light of the new findings.

The subsurface investigation reported herein was performed for the purpose of providing foundation recommendations. An assessment of the subsurface conditions with respect to soil or groundwater contamination was beyond the scope of this report.

This report has been prepared for the exclusive use of the Government of the Northwest Territories for specific application to the development described in Section 2 of this report. It has been prepared in accordance with generally accepted soil and foundation engineering practices. No other warranty is made, either expressed, or implied.

## 10.0 CLOSURE

We trust this report meets your present requirements. We would be pleased to provide any further information that may be needed during the design and to

advise on the geotechnical aspects for inclusion in contract documents. Should you require additional information or inspection services, please do not hesitate to contact our office.

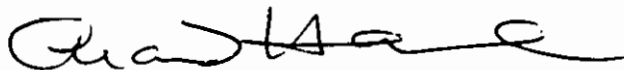
Respectfully submitted

**HBT AGRA Limited**

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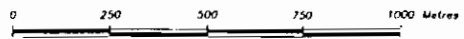
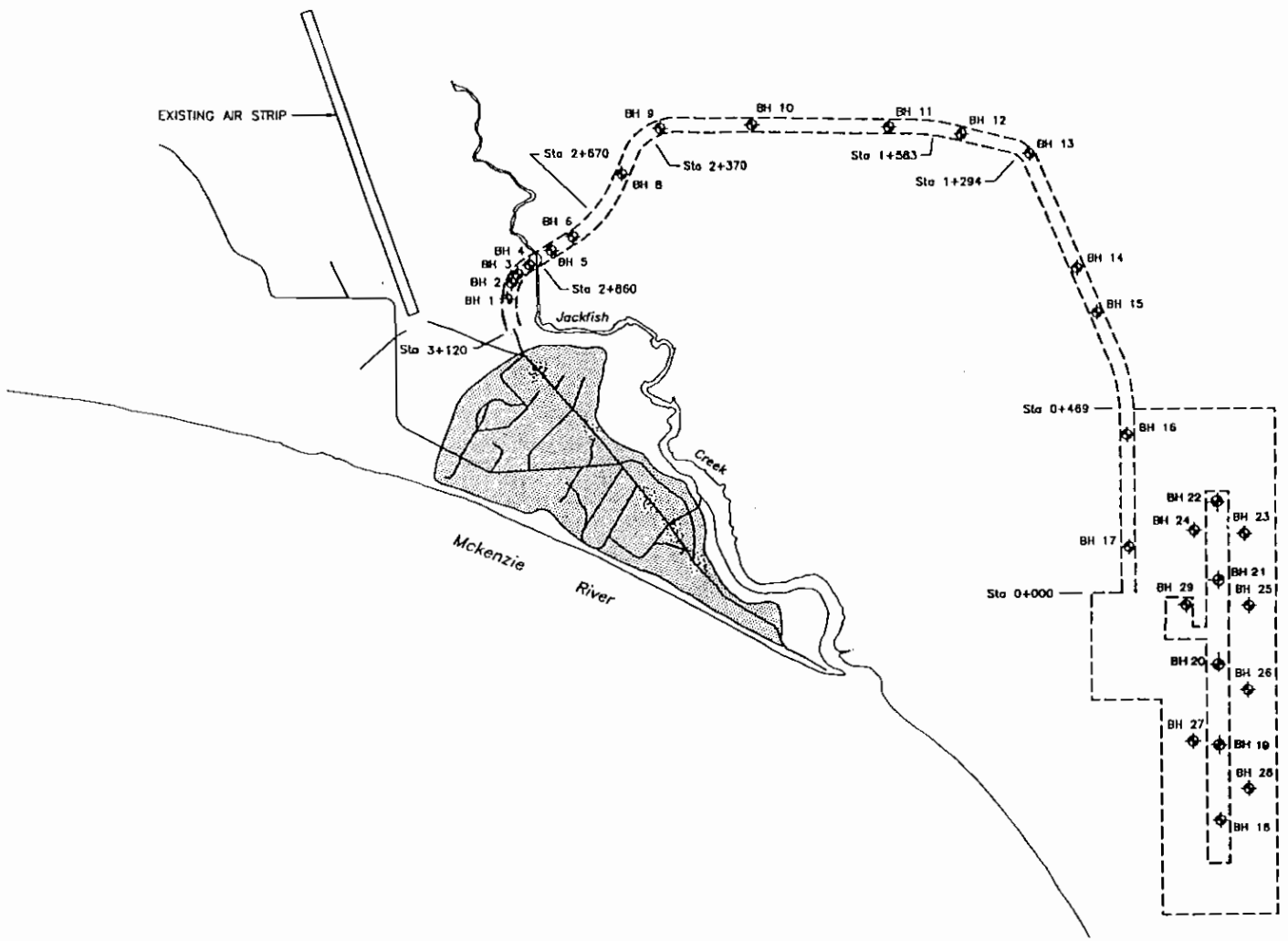
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APPENDIX A

Figure 1  
Access Road and Airstrip Alignments  
Site and Borehole Location Plan

Selected Site Photographs



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GOVERNMENT OF THE NORTHWEST TERRITORIES  
 DEPARTMENT OF TRANSPORTATION  
**FORT GOOD HOPE AIRPORT AND ACCESS ROAD**  
 YX00354

FIGURE 1



FIGURE 2: Fort Good Hope Access Road, Station 3+000 looking south towards Jackfish Creek



FIGURE 3: Fort Good Hope Airport Access Road looking north from Jackfish Creek. Note Borehole 4 on north side, and granular soils on north bank.



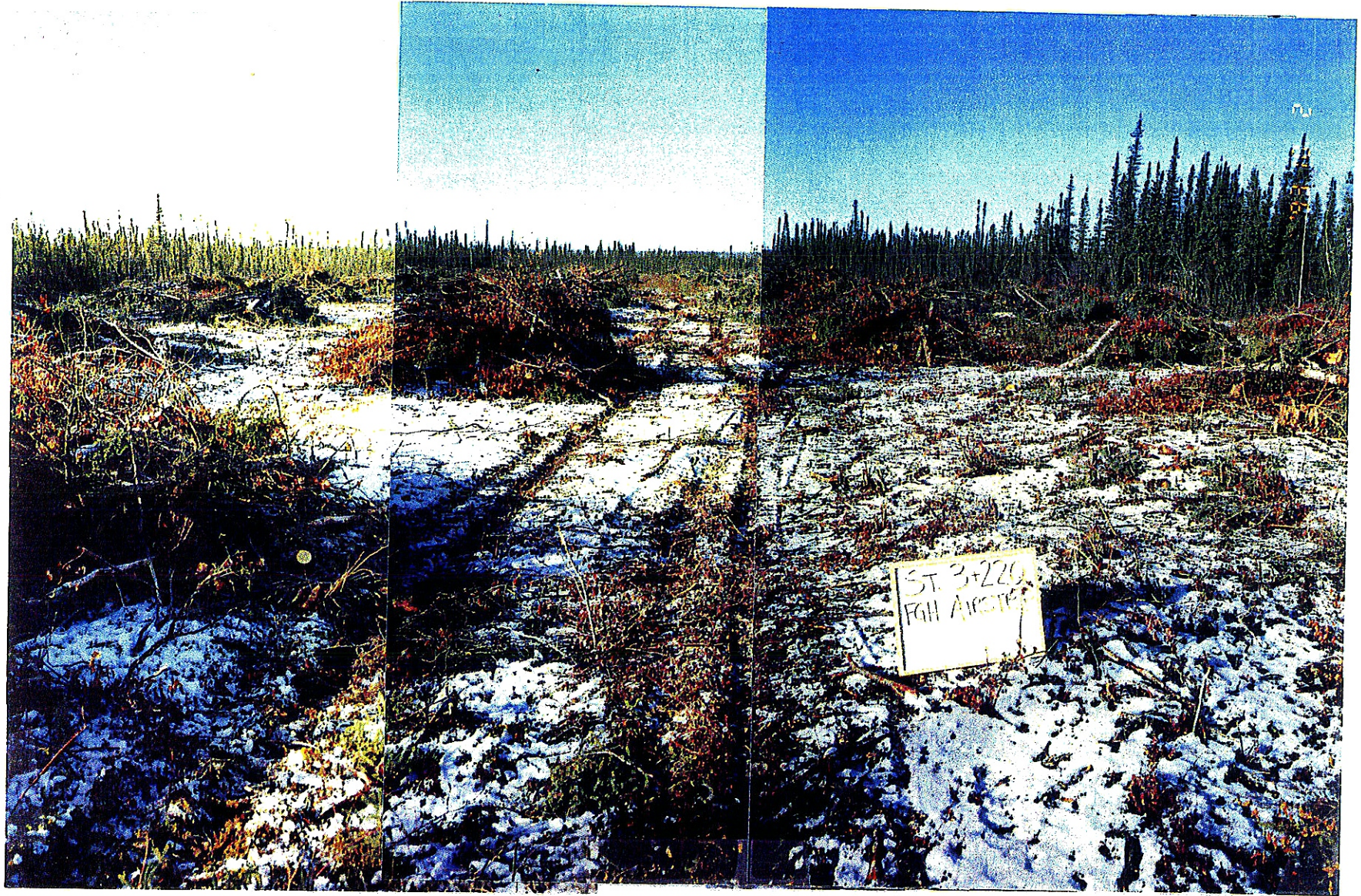
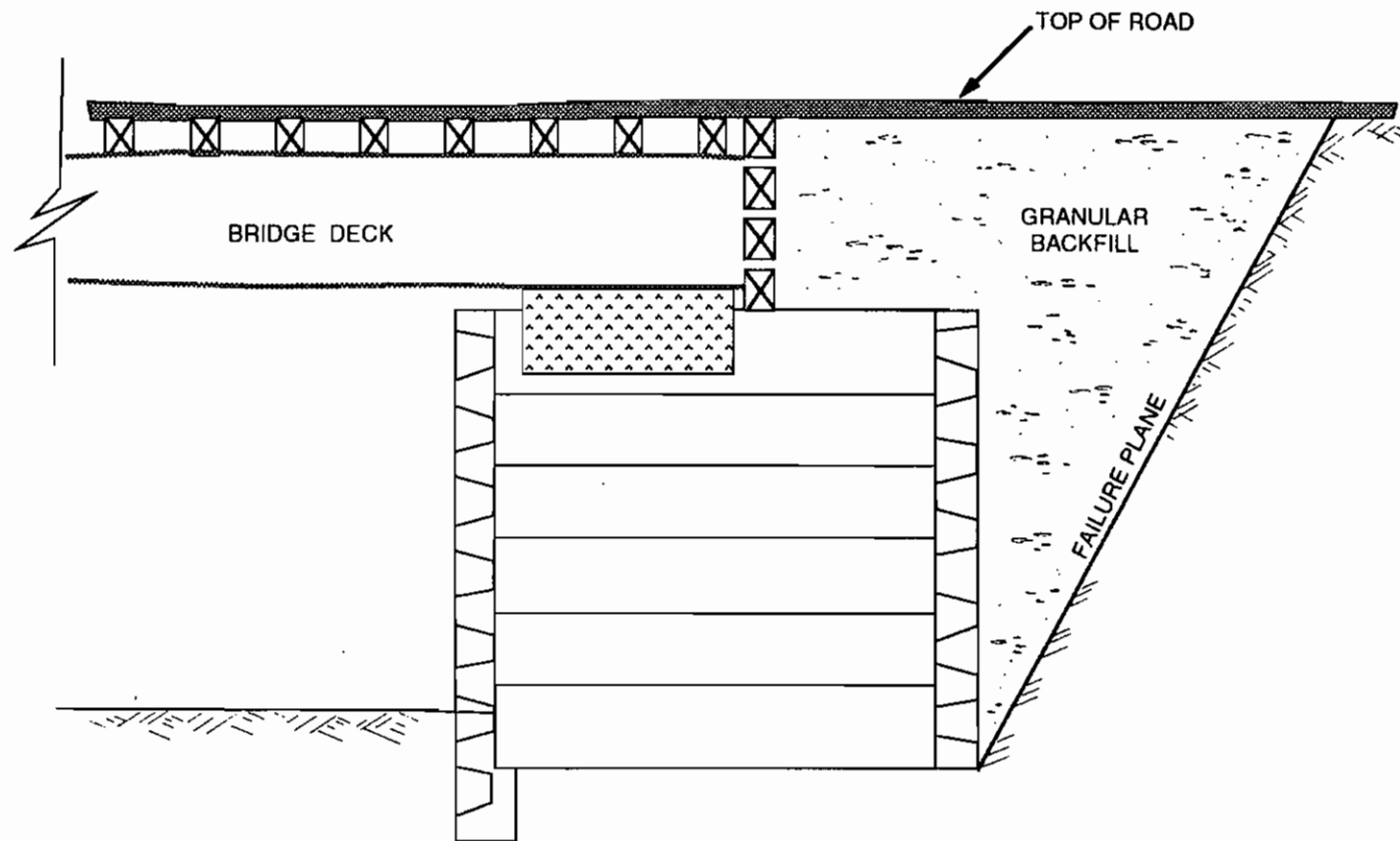


FIGURE 4: Fort Good Hope Airstrip at Station 3+220, looking west.



FIGURE 5: Fort Good Hope Airstrip, Station 3+880, looking east.



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**SECTION THROUGH CRIB ABUTMENT  
STRUCTURE**

E22AH01

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**FIGURE 6**

APPENDIX B

Borehole Logs and Laboratory Test Results

PROJECT: FORT GOOD HOPE AIRPORT	METHOD: TRACK MOUNTED AUGER	BOREHOLE No: 1
CLIENT: DEPARTMENT OF TRANSPORTATION	DATUM:	Project No: YX00354
CONTRACTOR: MOBILE AUGERS AND RESEARCH	LOCATION: STATION 3+000	ELEVATION: 0.000 (m)
SAMPLE TYPE <input checked="" type="checkbox"/> DISTURBED	<input type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT
	<input type="checkbox"/> A-CASING	<input type="checkbox"/> SHELBY TUBE
		<input type="checkbox"/> CORE

DEPTH (m)	PLASTIC	M.C.	LIQUID	SOIL SYMBOL	SOIL DESCRIPTION	WELL INSTALLATION	SAMPLE TYPE	SAMPLE NO	TEST COMMENTS	DEPTH (ft)
0.0					SAND - loose, fine grained to medium grained, trace of silt, dry, yellowish brown					0.0
1.0					- brown at 0.8m			D1		5.0
2.0					- frozen at 2.1m			D2		10.0
					- hard drilling at 2.3m					15.0
3.0					SAND & GRAVEL					20.0
4.0					- fine grained gravel, fine grained to coarse grained sand, little silt, rounded, moist to wet and brown			D3	Gravel = 39% Sand = 50% Fines = 11%	25.0
5.0					- coarse grained gravel (40mm)					30.0
6.0					- ice crystals noticed in gravel at 5.0m			D4		35.0
7.0					- wet			D5		40.0
8.0					SAND - medium to coarse grained sand, little to some silt, trace of gravel, moist, frozen, and brown			D6		45.0
9.0					End of Borehole at 8.5m					50.0
10.0										55.0
11.0										60.0

PROJECT: FORT GOOD HOPE AIRPORT	METHOD: TRACK MOUNTED AUGER	BOREHOLE No: 2
CLIENT: DEPARTMENT OF TRANSPORTATION	DATUM:	Project No: YX00354
CONTRACTOR: MOBILE AUGERS AND RESEARCH	LOCATION: STATION 2+910	ELEVATION: 0.000 (m)
SAMPLE TYPE <input checked="" type="checkbox"/> DISTURBED <input checked="" type="checkbox"/> NO RECOVERY <input checked="" type="checkbox"/> SPT <input type="checkbox"/> A-CASING <input type="checkbox"/> SHELBY TUBE <input type="checkbox"/> CORE		

DEPTH (m)	PLASTIC	M.C.	LIQUID	SOIL SYMBOL	SOIL DESCRIPTION	WELL INSTALLATION	SAMPLE TYPE	SAMPLE NO	TEST COMMENTS	DEPTH (ft)
0.0					SAND - top 200mm high in organics - loose, silty, fine grained to medium grained sand, dry, brown					0.0
1.0					CLAY (Till) - silty, sandy, gravelly, medium plastic, damp to moist, greyish-brown			D1		5.0
2.0					- frozen at 2.3m			D2		
3.0										10.0
4.0					- ice crystals at 3.7m			D3		
5.0					Permafrost core barrel at 4.9m - ice seam between 4.9-5.5m			D4		15.0
6.0								C1		20.0
7.0								D6		25.0
8.0										30.0
9.0										35.0
10.0										
11.0					End of Borehole at 7.0m					

<b>HBT AGRA Limited</b> <b>YELLOWKNIFE, N.W.T.</b>	LOGGED BY: JLA	COMPLETION DEPTH: 7.0 m
	REVIEWED BY:	COMPLETE: 93/09/29
	Fig. No:	Page 1 of 1

PROJECT: FORT GOOD HOPE AIRPORT	METHOD: TRACK MOUNTED AUGER	BOREHOLE No: 3
CLIENT: DEPARTMENT OF TRANSPORTATION	DATUM:	Project No: YX00354
CONTRACTOR: MOBILE AUGERS AND RESEARCH	LOCATION: STATION 2+892	ELEVATION: 0.000 (m)
SAMPLE TYPE <input checked="" type="checkbox"/> DISTURBED <input type="checkbox"/> NO RECOVERY <input checked="" type="checkbox"/> SPT <input type="checkbox"/> A-CASING <input type="checkbox"/> SHELBY TUBE <input type="checkbox"/> CORE		

DEPTH (m)	PLASTIC M.C. LIQUID	SOIL SYMBOL	SOIL DESCRIPTION	WELL INSTALLATION SAMPLE TYPE	SAMPLE NO	TEST COMMENTS	DEPTH (ft)
0.0	20 40 60 80		SAND - top 200mm high in organics - fine grained sand to coarse grained gravel - little silt, wet, brown at 0.6m  - gravel seam between 0.9-1.5m				0.0
2.0			CLAY (Till) - silty, sandy, gravelly, medium plastic, wet (water coming into hole), greyish brown - collapsing hole		D1		5.0
4.0					D2		15.0
5.0					D3		20.0
7.0			- hole sloughing in		D4		25.0
8.0			- ice crystals between 7.9-8.5m		D5		30.0
8.5			End of Borehole at 8.5m				35.0

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YELLOWKNIFE, N.W.T.

LOGGED BY: JLA  
REVIEWED BY:  
Fig. No:

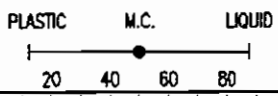
COMPLETION DEPTH: 8.5 m  
COMPLETE: 93/09/29

PROJECT: FORT GOOD HOPE AIRPORT		METHOD: TRACK MOUNTED AUGER		BOREHOLE No: 4						
CLIENT: DEPARTMENT OF TRANSPORTATION		DATUM:		Project No: YX00354						
CONTRACTOR: MOBILE AUGERS AND RESEARCH		LOCATION: STATION 2+865		ELEVATION: 0.000 (m)						
SAMPLE TYPE <input checked="" type="checkbox"/> DISTURBED		<input type="checkbox"/> NO RECOVERY		<input checked="" type="checkbox"/> SPT						
		<input type="checkbox"/> A-CASING		<input type="checkbox"/> SHELBY TUBE						
				<input type="checkbox"/> CORE						
DEPTH (m)	PLASTIC	M.C.	LIQUID	SOIL SYMBOL	SOIL DESCRIPTION	WELL INSTALLATION	SAMPLE TYPE	SAMPLE NO	TEST COMMENTS	DEPTH (ft)
0.0					SILT AND SAND - 300mm of organics					0.0
1.0					- grey at 1.1m - soft, coarse grained gravel (150mm) moist, brown at 1.2-1.8m			D1		5.0
2.0					GRAVEL - sandy, wet, brown - hard drilling					10.0
3.0										
4.0					CLAY (Till) - frozen at 3.4m					15.0
5.0					End of Borehole at 4.0m due to sloughing conditions.					20.0
6.0										25.0
7.0										30.0
8.0										35.0
9.0										
10.0										
11.0										
HBT AGRA Limited YELLOWKNIFE, N.W.T.					LOGGED BY: JLA		COMPLETION DEPTH: 4.0 m			
					REVIEWED BY:		COMPLETE: 93/09/29			
					Fig. No:		Page 1 of 1			



PROJECT: FORT GOOD HOPE AIRPORT	METHOD: TRACK MOUNTED AUGER	BOREHOLE No: 5
CLIENT: DEPARTMENT OF TRANSPORTATION	DATUM:	Project No: YX00354
CONTRACTOR: MOBILE AUGERS AND RESEARCH	LOCATION: STATION 2+840	ELEVATION: 0.000 (m)
SAMPLE TYPE <input type="checkbox"/> DISTURBED <input checked="" type="checkbox"/> NO RECOVERY <input checked="" type="checkbox"/> SPT <input type="checkbox"/> A-CASING <input type="checkbox"/> SHELBY TUBE <input type="checkbox"/> CORE		

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	WELL INSTALLATION	SAMPLE TYPE	SAMPLE NO	TEST COMMENTS	DEPTH (ft)
0.0		GRAVEL - fine grained sand to coarse grained gravel (gravel sizes upto 75mm), little sand, trace of silt, dry, rusty-brown  - moist at 1.5m					0.0
1.0							5.0
2.0					D1	Gravel = 73% Sand = 19% Fines = 8%	
3.0		CLAY (Till) - firm, silty, sandy, gravelly, medium plasticity, wet, grey - hole collapsing - frozen between 2.8-4.0m					10.0
4.0					D2		
5.0					A1		15.0
6.0							20.0
7.0					D3		25.0
8.0							
9.0					D4		30.0
10.0							
11.0					D5		35.0
		End of Borehole at 10.5m					



PROJECT: FORT GOOD HOPE AIRPORT	METHOD: TRACK MOUNTED AUGER	BOREHOLE No: 6
CLIENT: DEPARTMENT OF TRANSPORTATION	DATUM:	Project No: YX00354
CONTRACTOR: MOBILE AUGERS AND RESEARCH	LOCATION: STATION 2+760	ELEVATION: 0.000 (m)
SAMPLE TYPE <input checked="" type="checkbox"/> DISTURBED <input type="checkbox"/> NO RECOVERY <input checked="" type="checkbox"/> SPT <input type="checkbox"/> A-CASING <input type="checkbox"/> SHELBY TUBE <input type="checkbox"/> CORE		

DEPTH (m)	PLASTIC M.C. LIQUID 20 40 60 80	SOIL SYMBOL	SOIL DESCRIPTION	WELL INSTALLATION SAMPLE TYPE	SAMPLE NO	TEST COMMENTS	DEPTH (ft)
0.0			ORGANICS - soft, silty sand, rootlets				0.0
1.0			SAND - soft, silty, damp, brownish grey - frozen at 0.8m		D1 D2		
2.0			CLAY (Till) - silty, sandy, gravelly (40mm), medium plastic, dry		D3		5.0
3.0			- hard drilling between 2.7-3.0m				10.0
4.0			End of Borehole at 4.0m		D4		15.0
5.0							20.0
6.0							25.0
7.0							30.0
8.0							35.0
9.0							
10.0							
11.0							

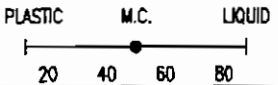
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LOGGED BY: JLA  
REVIEWED BY:  
Fig. No:

COMPLETION DEPTH: 4.0 m  
COMPLETE: 93/09/29

PROJECT: FORT GOOD HOPE AIRPORT	METHOD: TRACK MOUNTED AUGER	BOREHOLE No: 7
CLIENT: DEPARTMENT OF TRANSPORTATION	DATUM:	Project No: YX00354
CONTRACTOR: MOBILE AUGERS AND RESEARCH	LOCATION: STATION 2+700	ELEVATION: 0.000 (m)
SAMPLE TYPE <input checked="" type="checkbox"/> DISTURBED	<input checked="" type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT
	<input type="checkbox"/> A-CASING	<input type="checkbox"/> SHELBY TUBE
		<input type="checkbox"/> CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	WELL INSTALLATION	SAMPLE TYPE	SAMPLE NO	TEST COMMENTS	DEPTH (ft)
0.0		SAND - loose, fine grained sand, trace of silt, dry, brownish grey					0.0
1.0		- medium grained sand, trace to little silt at 1.1m			D1		5.0
2.0		- frozen at 1.2m			D2		
3.0							10.0
4.0		End of Borehole at 4.0m			D3		15.0
5.0							20.0
6.0							25.0
7.0							30.0
8.0							35.0
9.0							
10.0							
11.0							

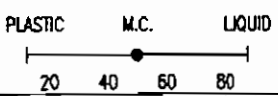


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PROJECT: FORT GOOD HOPE AIRPORT	METHOD: TRACK MOUNTED AUGER	BOREHOLE No: 8
CLIENT: DEPARTMENT OF TRANSPORTATION	DATUM:	Project No: YX00354
CONTRACTOR: MOBILE AUGERS AND RESEARCH	LOCATION: STATION 2+540	ELEVATION: 0.000 (m)
SAMPLE TYPE <input checked="" type="checkbox"/> DISTURBED	<input checked="" type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT
	<input type="checkbox"/> A-CASING	<input type="checkbox"/> SHELBY TUBE
		<input type="checkbox"/> CORE

DEPTH (m)	PLASTIC	M.C.	LIQUID	SOIL SYMBOL	SOIL DESCRIPTION	WELL INSTALLATION	SAMPLE TYPE	SAMPLE NO	TEST COMMENTS	DEPTH (ft)
0.0					SAND - loose, fine grained sand, trace of silt, dry, yellowish brown					0.0
1.0					- little silt and moist at 0.9m			D1		5.0
2.0					- frozen at 1.5m					5.0
					- medium grained sand, little silt			D2		5.0
3.0										10.0
4.0					End of Borehole at 4.0m					15.0
5.0										15.0
6.0										20.0
7.0										25.0
8.0										25.0
9.0										30.0
10.0										35.0
11.0										35.0



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PROJECT: FORT GOOD HOPE AIRPORT	METHOD: TRACK MOUNTED AUGER	BOREHOLE No: 9
CLIENT: DEPARTMENT OF TRANSPORTATION	DATUM:	Project No: YX00354
CONTRACTOR: MOBILE AUGERS AND RESEARCH	LOCATION: STATION 2+360	ELEVATION: 0.000 (m)
SAMPLE TYPE <input checked="" type="checkbox"/> DISTURBED	<input type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT
	<input type="checkbox"/> A-CASING	<input type="checkbox"/> SHELBY TUBE
		<input type="checkbox"/> CORE

DEPTH (m)	PLASTIC	M.C.	LIQUID	SOIL SYMBOL	SOIL DESCRIPTION	WELL INSTALLATION	SAMPLE TYPE	SAMPLE NO	TEST COMMENTS	DEPTH (ft)
0.0					SAND - fine grained sand, trace of silt dry, brown			D1		0.0
1.0										5.0
2.0					- silty, low plasticity, and moist at 1.2m - frozen at 1.7m - medium grained sand, little to some silt			D2		10.0
3.0										15.0
4.0					End of Borehole at 4.0m			D3		20.0
5.0										25.0
6.0										30.0
7.0										35.0
8.0										
9.0										
10.0										
11.0										

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COMPLETION DEPTH: 4.0 m  
COMPLETE: 93/09/29

PROJECT: FORT GOOD HOPE AIRPORT	METHOD: TRACK MOUNTED AUGER	BOREHOLE No: 10
CLIENT: DEPARTMENT OF TRANSPORTATION	DATUM:	Project No: YX00354
CONTRACTOR: MOBILE AUGERS AND RESEARCH	LOCATION: STATION 2+040	ELEVATION: 0.000 (m)
SAMPLE TYPE <input checked="" type="checkbox"/> DISTURBED <input checked="" type="checkbox"/> NO RECOVERY <input checked="" type="checkbox"/> SPT <input type="checkbox"/> A-CASING <input type="checkbox"/> SHELBY TUBE <input type="checkbox"/> CORE		

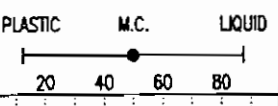
DEPTH (m)	PLASTIC	M.C.	LIQUID	SOIL SYMBOL	SOIL DESCRIPTION	WELL INSTALLATION	SAMPLE TYPE	SAMPLE NO	TEST COMMENTS	DEPTH (ft)
0.0					SAND - 250mm of organics - trace of silt, dry, light brown					0.0
1.0					- black grey silt seams - fine to medium grained sand, damp to moist - frozen at 1.5m			D1		5.0
2.0					CLAY - silty, medium plastic, frozen, greyish brown			D2		10.0
3.0								D3		15.0
4.0					- ice crystal noted between 3.4-4.0m End of Borehole at 4.0m			D4		20.0
5.0										25.0
6.0										30.0
7.0										35.0
8.0										40.0
9.0										45.0
10.0										50.0
11.0										55.0

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PROJECT: FORT GOOD HOPE AIRPORT	METHOD: TRACK MOUNTED AUGER	BOREHOLE No: 11
CLIENT: DEPARTMENT OF TRANSPORTATION	DATUM:	Project No: YX00354
CONTRACTOR: MOBILE AUGERS AND RESEARCH	LOCATION: STATION 1+790	ELEVATION: 0.000 (m)
SAMPLE TYPE <input checked="" type="checkbox"/> DISTURBED <input type="checkbox"/> NO RECOVERY <input checked="" type="checkbox"/> SPT <input type="checkbox"/> A-CASING <input type="checkbox"/> SHELBY TUBE <input type="checkbox"/> CORE		

DEPTH (m)	PLASTIC	M.C.	LIQUID	SOIL SYMBOL	SOIL DESCRIPTION	WELL INSTALLATION	SAMPLE TYPE	SAMPLE NO	TEST COMMENTS	DEPTH (ft)
0.0					SILT - soft, sandy, low plastic, moist, and beige			D1		0.0
1.0					- wet at 1.2m					5.0
2.0								D2		10.0
3.0										15.0
4.0					- frozen at 4.10m					20.0
5.0					SAND - silty, medium grained sand, frozen, brown, low plasticity					25.0
6.0					End of Borehole at 5.5m					30.0
7.0										35.0
8.0										40.0
9.0										45.0
10.0										50.0
11.0										55.0



PROJECT: FORT GOOD HOPE AIRPORT	METHOD: TRACK MOUNTED AUGER	BOREHOLE No: 12
CLIENT: DEPARTMENT OF TRANSPORTATION	DATUM:	Project No: YX00354
CONTRACTOR: MOBILE AUGERS AND RESEARCH	LOCATION: STATION 1+520	ELEVATION: 0.000 (m)
SAMPLE TYPE <input checked="" type="checkbox"/> DISTURBED	<input type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT
	<input type="checkbox"/> A-CASING	<input type="checkbox"/> SHELBY TUBE
		<input type="checkbox"/> CORE

DEPTH (m)	PLASTIC	M.C.	LIQUID	SOIL SYMBOL	SOIL DESCRIPTION	WELL INSTALLATION	SAMPLE TYPE	SAMPLE NO	TEST COMMENTS	DEPTH (ft)
0.0					SAND - 250mm of organic cover - silty, black					0.0
1.0					SILT - soft, sandy, low plastic, moist, brown			D1		
					- frozen at 1.5m			D2		5.0
2.0					GRAVEL - sandy, trace of silt, frozen, brown					
3.0					CLAY - silty, medium-high plastic, frozen					10.0
4.0					End of Borehole at 4.0m					15.0
5.0										20.0
6.0										25.0
7.0										30.0
8.0										35.0
9.0										
10.0										
11.0										

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Fig. No:

COMPLETION DEPTH: 4.0 m  
COMPLETE: 93/09/29



PROJECT: FORT GOOD HOPE AIRPORT	METHOD: TRACK MOUNTED AUGER	BOREHOLE No: 13
CLIENT: DEPARTMENT OF TRANSPORTATION	DATUM:	Project No: YX00354
CONTRACTOR: MOBILE AUGERS AND RESEARCH	LOCATION: STATION 1+290	ELEVATION: 0.000 (m)
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DEPTH (m)	PLASTIC	M.C.	LIQUID	SOIL SYMBOL	SOIL DESCRIPTION	WELL INSTALLATION	SAMPLE TYPE	SAMPLE NO	TEST COMMENTS	DEPTH (ft)
0.0					SILT - sandy, low to medium plastic, moist to wet, brownish grey			D1		0.0
1.0										
2.0					GRAVEL - loose, some sand, trace of silt, damp, brown - moist at 1.8m - wet at 2.3m - frozen at 2.75m			D2	Gravel = 62% Sand = 33% Fines = 5%	5.0
3.0										10.0
4.0					End of Borehole at 4.0m			D3		15.0
5.0										20.0
6.0										25.0
7.0										30.0
8.0										35.0
9.0										
10.0										
11.0										

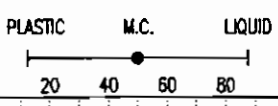
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Fig. No:

COMPLETION DEPTH: 4.0 m  
COMPLETE: 93/09/29

PROJECT: FORT GOOD HOPE AIRPORT	METHOD: TRACK MOUNTED AUGER	BOREHOLE No: 14
CLIENT: DEPARTMENT OF TRANSPORTATION	DATUM:	Project No: YX00354
CONTRACTOR: MOBILE AUGERS AND RESEARCH	LOCATION: STATION 0+880	ELEVATION: 0.000 (m)
SAMPLE TYPE <input checked="" type="checkbox"/> DISTURBED	<input checked="" type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT
	<input type="checkbox"/> A-CASING	<input type="checkbox"/> SHELBY TUBE
		<input type="checkbox"/> CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	WELL INSTALLATION	SAMPLE TYPE	SAMPLE NO	TEST COMMENTS	DEPTH (ft)
0.0		SILT - top 250mm high in organics with black silty sand - brownish grey silt at 0.25m - soft, low plastic, moist					0.0
1.0		SAND AND GRAVEL - fine grained sand to coarse grained gravel, trace to little silt, wet, brown - saturated at 1.2m (hole flooded)					5.0
2.0							10.0
3.0		- hard drilling at 2.75m suspect frozen					15.0
4.0		End of Borehole at 4.0m					20.0
5.0							25.0
6.0							30.0
7.0							35.0
8.0							
9.0							
10.0							
11.0							



PROJECT: FORT GOOD HOPE AIRPORT	METHOD: TRACK MOUNTED AUGER	BOREHOLE No: 15
CLIENT: DEPARTMENT OF TRANSPORTATION	DATUM:	Project No: YX00354
CONTRACTOR: MOBILE AUGERS AND RESEARCH	LOCATION: STATION Q+735	ELEVATION: 0.000 (m)
SAMPLE TYPE <input checked="" type="checkbox"/> DISTURBED <input type="checkbox"/> NO RECOVERY <input checked="" type="checkbox"/> SPT <input type="checkbox"/> A-CASING <input type="checkbox"/> SHELBY TUBE <input type="checkbox"/> CORE		

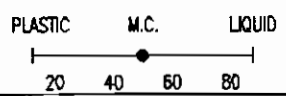
DEPTH (m)	PLASTIC	M.C.	LIQUID	SOIL SYMBOL	SOIL DESCRIPTION	WELL INSTALLATION	SAMPLE TYPE	SAMPLE NO	TEST COMMENTS	DEPTH (ft)
0.0					SAND AND SILT - loose, trace of gravel, fine grained to medium grained, reddish brown			D1		0.0
1.0					- damp, brownish grey at 0.6m			D2	Gravel = 7% Sand = 50% Fines = 43%	3.0
2.0					GRAVEL - medium dense, sandy, little silt, rounded, moist, brown			D3		6.6
3.0					- wet at 2.0m					9.8
4.0					- frozen at 2.1m					13.1
4.0					End of Borehole at 4.0m					13.1
5.0										16.4
6.0										19.7
7.0										23.0
8.0										26.2
9.0										29.5
10.0										32.8
11.0										36.1

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PROJECT: FORT GOOD HOPE AIRPORT	METHOD: TRACK MOUNTED AUGER	BOREHOLE No: 16
CLIENT: DEPARTMENT OF TRANSPORTATION	DATUM:	Project No: YX00354
CONTRACTOR: MOBILE AUGERS AND RESEARCH	LOCATION: STATION 0+443	ELEVATION: 0.000 (m)
SAMPLE TYPE <input checked="" type="checkbox"/> DISTURBED <input checked="" type="checkbox"/> NO RECOVERY <input checked="" type="checkbox"/> SPT <input type="checkbox"/> A-CASING <input type="checkbox"/> SHELBY TUBE <input type="checkbox"/> CORE		

DEPTH (m)	PLASTIC	M.C.	LIQUID	SOIL SYMBOL	SOIL DESCRIPTION	WELL INSTALLATION	SAMPLE TYPE	SAMPLE NO	TEST COMMENTS	DEPTH (ft)
0.0					SAND - loose, trace of silt, dry to damp, reddish brown					0.0
1.0					- fine grained to medium grained sand damp, brown with greyish white silt silt seams at 0.6m			D1		5.0
2.0					- frozen at 1.1m			D2		
3.0					SAND AND GRAVEL - fine grained sand to fine grained gravel, trace of silt, frozen			D3		10.0
4.0					- ice crystals at 3.1m			D4		15.0
5.0					End of Borehole at 4.0m					20.0
6.0										25.0
7.0										30.0
8.0										35.0
9.0										
10.0										
11.0										

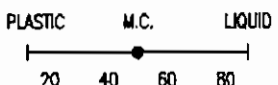


<b>HBT AGRA Limited</b> YELLOWKNIFE, N.W.T.	LOGGED BY: JLA	COMPLETION DEPTH: 4.0 m
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PROJECT: FORT GOOD HOPE AIRPORT	METHOD: TRACK MOUNTED AUGER	BOREHOLE No: 17
CLIENT: DEPARTMENT OF TRANSPORTATION	DATUM:	Project No: YX00354
CONTRACTOR: MOBILE AUGERS AND RESEARCH	LOCATION: STATION 0+085	ELEVATION: 0.000 (m)

SAMPLE TYPE  DISTURBED  NO RECOVERY  SPT  A-CASING  SHELBY TUBE  CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	WELL INSTALLATION	SAMPLE TYPE	SAMPLE NO	TEST COMMENTS	DEPTH (ft)
0.0		GRAVEL AND SAND - loose, coarse grained gravel up to 50mm, reddish brown - trace of silt, dry to damp at 0.6m					0.0
1.0		- damp at 1.5m			D1	Gravel = 57% Sand = 40% Fines = 3%	3.0
2.0		SAND AND GRAVEL - trace of silt			D2	Gravel = 37% Sand = 60% Fines = 3%	6.6
3.0		- wet at 2.6m - frozen at 2.75m					10.0
4.0		End of Borehole at 4.0m			D3		13.1



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Fig. No:

COMPLETION DEPTH: 4.0 m  
COMPLETE: 93/09/30

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PROJECT: FORT GOOD HOPE AIRPORT		METHOD: TRACK MOUNTED AUGER		BOREHOLE No: 18						
CLIENT: DEPARTMENT OF TRANSPORTATION		DATUM:		Project No: YX00354						
CONTRACTOR: MOBILE AUGERS AND RESEARCH		LOCATION: STATION 3+060 RUNWAY		ELEVATION: 0.000 (m)						
SAMPLE TYPE <input checked="" type="checkbox"/> DISTURBED		<input checked="" type="checkbox"/> NO RECOVERY		<input checked="" type="checkbox"/> SPT						
		<input type="checkbox"/> A-CASING		<input type="checkbox"/> SHELBY TUBE						
				<input type="checkbox"/> CORE						
DEPTH (m)	PLASTIC	M.C.	LIQUID	SOIL SYMBOL	SOIL DESCRIPTION	WELL INSTALLATION	SAMPLE TYPE	SAMPLE NO	TEST COMMENTS	DEPTH (ft)
0.0					SILT - soft, very fine sand, low plastic, moist to wet, brown					0.0
1.0	●				SAND AND SILT - loose, brown - frozen at 0.8m			D1	Gravel = 0% Sand = 61% Fines = 39%	5.0
2.0					GRAVEL AND SAND - fine grained to coarse grained sand, fine grained gravel, damp, brown			D2		10.0
3.0					- ice crystals noted at 2.6m					
4.0					- sand content increased at 4.0m			D3		15.0
5.0	●				- hard drilling at 4.9m			D4		20.0
6.0					SILT - clayey, brownish-grey - ice crystals noted in seams					25.0
7.0					GRAVEL AND SAND - ice crystals noted at 6.0m					30.0
					SILT - ice seams					35.0
					End of Borehole at 7.0m					
HBT AGRA Limited YELLOWKNIFE, N.W.T.						LOGGED BY: JLA		COMPLETION DEPTH: 7.0 m		
						REVIEWED BY:		COMPLETE: 93/10/01		
						Fig. No:		Page 1 of 1		

PROJECT: FORT GOOD HOPE AIRPORT	METHOD: TRACK MOUNTED AUGER	BOREHOLE No: 19
CLIENT: DEPARTMENT OF TRANSPORTATION	DATUM:	Project No: YX00354
CONTRACTOR: MOBILE AUGERS AND RESEARCH	LOCATION: STATION 3+270 RUNWAY	ELEVATION: 0.000 (m)
SAMPLE TYPE <input checked="" type="checkbox"/> DISTURBED	<input type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT
	<input type="checkbox"/> A-CASING	<input type="checkbox"/> SHELBY TUBE
		<input type="checkbox"/> CORE

DEPTH (m)	PLASTIC	M.C.	LIQUID	SOIL SYMBOL	SOIL DESCRIPTION	WELL INSTALLATION	SAMPLE TYPE	SAMPLE NO	TEST COMMENTS	DEPTH (ft)
0.0					SAND - loose, little gravel, trace of silt rusty brown					0.0
1.0					SAND AND GRAVEL - loose, fine grained sand to coarse grained sand, trace to little silt, brown			D1		5.0
2.0										
3.0					- wet at 2.75m - frozen at 2.9m			D2		10.0
4.0										
5.0								D3		15.0
6.0					SAND - little to some gravel, fine grained to coarse grained sand, frozen, wet			D4		20.0
7.0					End of Borehole at 7.0m					25.0
8.0										30.0
9.0										35.0
10.0										
11.0										

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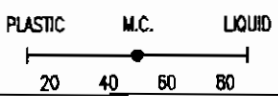
Fig. No:

COMPLETION DEPTH: 7.0 m

COMPLETE: 93/10/01

PROJECT: FORT GOOD HOPE AIRPORT	METHOD: TRACK MOUNTED AUGER	BOREHOLE No: 20
CLIENT: DEPARTMENT OF TRANSPORTATION	DATUM:	Project No: YX00354
CONTRACTOR: MOBILE AUGERS AND RESEARCH	LOCATION: STATION 3+490 RUNWAY	ELEVATION: 0.000 (m)
SAMPLE TYPE <input checked="" type="checkbox"/> DISTURBED	<input type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT
	<input type="checkbox"/> A-CASING	<input type="checkbox"/> SHELBY TUBE
		<input type="checkbox"/> CORE

DEPTH (m)	PLASTIC	M.C.	LIQUID	SOIL SYMBOL	SOIL DESCRIPTION	WELL INSTALLATION	SAMPLE TYPE	SAMPLE NO	TEST COMMENTS	DEPTH (ft)
0.0					SAND AND GRAVEL - fine grained sand to coarse grained gravel, trace of silt rusty brown					0.0
1.0										5.0
2.0										10.0
3.0										15.0
4.0										20.0
5.0					- suspect frozen at 4.6m			D1		25.0
6.0										30.0
7.0					End of Borehole at 7.0m					35.0
8.0										
9.0										
10.0										
11.0										



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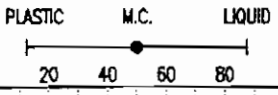
LOGGED BY: JLA  
REVIEWED BY:  
Fig. No:

COMPLETION DEPTH: 7.0 m  
COMPLETE: 93/10/01  
Page 1 of 1



PROJECT: FORT GOOD HOPE AIRPORT	METHOD: TRACK MOUNTED AUGER	BOREHOLE No: 21
CLIENT: DEPARTMENT OF TRANSPORTATION	DATUM:	Project No: YX00354
CONTRACTOR: MOBILE AUGERS AND RESEARCH	LOCATION: STATION 3+725 RUNWAY,	ELEVATION: 0.000 (m)
SAMPLE TYPE <input type="checkbox"/> DISTURBED	<input checked="" type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT
	<input type="checkbox"/> A-CASING	<input type="checkbox"/> SHELBY TUBE
		<input type="checkbox"/> CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	WELL INSTALLATION	SAMPLE TYPE	SAMPLE NO	TEST COMMENTS	DEPTH (ft)
0.0		SAND AND GRAVEL - fine grained sand to coarse grained gravel, trace of silt dry, rusty brown. - dark brown at 0.5m					0.0
1.0							5.0
2.0							10.0
3.0							15.0
4.0		- damp at 3.7m					20.0
5.0		SAND - trace to little gravel, fine grained to coarse grained sand, trace of silt, moist, brown			D1		25.0
6.0							30.0
7.0		- suspected frozen at 6.4m			D2		35.0
8.0							40.0
9.0							45.0
10.0							50.0
11.0		End of Borehole at 7.0m					55.0

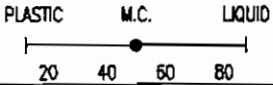


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LOGGED BY: JLA	COMPLETION DEPTH: 7.0 m
REVIEWED BY:	COMPLETE: 93/10/01
Fig. No:	Page 1 of 1

PROJECT: FORT GOOD HOPE AIRPORT	METHOD: TRACK MOUNTED AUGER	BOREHOLE No: 22
CLIENT: DEPARTMENT OF TRANSPORTATION	DATUM:	Project No: YX00354
CONTRACTOR: MOBILE AUGERS AND RESEARCH	LOCATION: STATION 3+950	ELEVATION: 0.000 (m)
SAMPLE TYPE <input checked="" type="checkbox"/> DISTURBED <input checked="" type="checkbox"/> NO RECOVERY <input checked="" type="checkbox"/> SPT <input type="checkbox"/> A-CASING <input type="checkbox"/> SHELBY TUBE <input type="checkbox"/> CORE		

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	WELL INSTALLATION SAMPLE TYPE	SAMPLE NO	TEST COMMENTS	DEPTH (ft)	
0.0		SILT - soft, trace to little sand, low to medium plastic, moist, beige		D1		0.0	
1.0		SAND - fine grained to coarse grained sand moist, frozen, brown - ice lenses noted at 1.2m - some gravel and trace to little silt at 1.5m		D2		5.0	
2.0				D3	Gravel = 14% Sand = 78% Fines = 8%	10.0	
3.0						15.0	
4.0					D4		20.0
5.0					D5		25.0
6.0					D6		30.0
7.0		End of Borehole at 7.0m				35.0	
8.0							
9.0							
10.0							
11.0							



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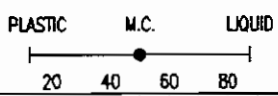
LOGGED BY: JLA  
REVIEWED BY:  
Fig. No:

COMPLETION DEPTH: 7.0 m  
COMPLETE: 93/10/01

PROJECT: FORT GOOD HOPE AIRPORT		METHOD: TRACK MOUNTED AUGER		BOREHOLE No: 23			
CLIENT: DEPARTMENT OF TRANSPORTATION		DATUM:		Project No: YX00354			
CONTRACTOR: MOBILE AUGERS AND RESEARCH		LOCATION: STATION 3+840 5.5m SOUTH OF CL		ELEVATION: 0.000 (m)			
SAMPLE TYPE <input checked="" type="checkbox"/> DISTURBED		<input type="checkbox"/> NO RECOVERY		<input checked="" type="checkbox"/> SPT			
		<input type="checkbox"/> A-CASING		<input type="checkbox"/> SHELBY TUBE			
				<input type="checkbox"/> CORE			
DEPTH (m)		SOIL SYMBOL	SOIL DESCRIPTION	WELL INSTALLATION SAMPLE TYPE	SAMPLE NO	TEST COMMENTS	DEPTH (ft)
0.0			SAND AND GRAVEL - coarse grained gravel, fine to coarse grained sand, trace to little silt, cobbles near the surface, dry, brown				0.0
1.0							5.0
2.0					D1		
3.0							10.0
4.0			SAND - some gravel, trace of silt, damp, brown		D2		
5.0							15.0
6.0							20.0
7.0			- trace of gravel at 6.7m				25.0
8.0			- little silt at 7.6m		D4		
9.0							30.0
10.0							35.0
11.0			End of Borehole at 8.5m				
<b>HBT AGRA Limited</b> <b>YELLOWKNIFE, N.W.T.</b>				LOGGED BY: JLA REVIEWED BY: Fig. No:		COMPLETION DEPTH: 8.5 m COMPLETE: 93/10/01	
						Page 1 of 1	

PROJECT: FORT GOOD HOPE AIRPORT	METHOD: TRACK MOUNTED AUGER	BOREHOLE No: 24
CLIENT: DEPARTMENT OF TRANSPORTATION	DATUM:	Project No: YX00354
CONTRACTOR: MOBILE AUGERS AND RESEARCH	LOCATION: STATION 3+840 60m North of CL	ELEVATION: 0.000 (m)
SAMPLE TYPE <input checked="" type="checkbox"/> DISTURBED	<input type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT
	<input type="checkbox"/> A-CASING	<input type="checkbox"/> SHELBY TUBE
		<input type="checkbox"/> CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	WELL INSTALLATION	SAMPLE TYPE	SAMPLE NO	TEST COMMENTS	DEPTH (ft)
0.0		GRAVEL AND SAND - medium grained sand (gravel sizes to 20mm), trace of silt, dry, rusty brown					0.0
1.0		- fine grained to coarse grain gravel sizes, damp, dark brown at 1.1m					5.0
2.0				D1		Gravel = 54% Sand = 43% Fines = 3%	
3.0		SAND - little gravel (fine grained), fine to coarse grained sand, trace of silt, damp to moist, brown					10.0
4.0		- frozen at 4.0m					15.0
5.0							20.0
6.0		- some coarse grained gravel sizes at 6.1m.					25.0
7.0		- saturated at 6.1m					30.0
8.0							35.0
9.0							
10.0							
11.0		End of Borehole at 10.1m					



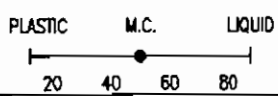
HBT AGRA Limited  
YELLOWKNIFE, N.W.T.

LOGGED BY: JLA  
REVIEWED BY:  
Fig. No:

COMPLETION DEPTH: 10.1 m  
COMPLETE: 93/10/01

PROJECT: FORT GODD HOPE AIRPORT	METHOD: TRACK MOUNTED AUGER	BOREHOLE No: 25
CLIENT: DEPARTMENT OF TRANSPORTATION	DATUM:	Project No: YX00354
CONTRACTOR: MOBILE AUGERS AND RESEARCH	LOCATION: STATION 3+600 60m South of CL	ELEVATION: 0.000 (m)
SAMPLE TYPE <input checked="" type="checkbox"/> DISTURBED <input type="checkbox"/> NO RECOVERY <input checked="" type="checkbox"/> SPT <input type="checkbox"/> A-CASING <input type="checkbox"/> SHELBY TUBE <input type="checkbox"/> CORE		

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	WELL INSTALLATION	SAMPLE TYPE	SAMPLE NO	TEST COMMENTS	DEPTH (ft)
0.0		GRAVEL AND SAND - coarse grained gravel, medium grained sand, trace of silt, dry, rusty brown - dark brown at 0.8m					0.0
2.0				D1		Gravel = 50% Sand = 46% Fines = 4%	5.0
3.5		- fine grained gravel, fine grained sand, trace of silt, damp, brown at damp, brown		D2		Gravel = 52% Sand = 45% Fines = 3%	10.0
4.3		- suspected frozen at 4.3m - little gravel at 4.3m		D3			15.0
6.1		- some gravel at 6.1m		D4			20.0
				D5			25.0
				D6			30.0
10.1		End of Borehole at 10.1m					35.0



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LOGGED BY: JLA  
REVIEWED BY:  
Fig. No:

COMPLETION DEPTH: 10.1 m  
COMPLETE: 93/10/02

PROJECT: FORT GOOD HOPE AIRPORT	METHOD: TRACK MOUNTED AUGER	BOREHOLE No: 26
CLIENT: DEPARTMENT OF TRANSPORTATION	DATUM:	Project No: YX00354
CONTRACTOR: MOBILE AUGERS AND RESEARCH	LOCATION: STATION 3+380 60m South of CL	ELEVATION: 0.000 (m)
SAMPLE TYPE <input checked="" type="checkbox"/> DISTURBED <input type="checkbox"/> NO RECOVERY <input checked="" type="checkbox"/> SPT <input type="checkbox"/> A-CASING <input type="checkbox"/> SHELBY TUBE <input type="checkbox"/> CORE		

DEPTH (m)	PLASTIC	M.C.	LIQUID	SOIL SYMBOL	SOIL DESCRIPTION	WELL INSTALLATION	SAMPLE TYPE	SAMPLE NO	TEST COMMENTS	DEPTH (ft)
0.0					SAND AND GRAVEL - coarse grained gravel fine grained sand, trace of silt, dry, rusty brown - dark brown at 0.8m					0.0
1.0										5.0
2.0										
3.0					GRAVEL AND SAND - fine to coarse grained sand, trace of silt, wet, brown - suspected frozen at 3.0m				Gravel = 49% Sand = 47% Fines = 4%	10.0
4.0								D1		
5.0								D2		
6.0										
7.0										
8.0					- little gravel at 4.3m			D3		20.0
9.0										25.0
10.0								D4		30.0
11.0					End of Borehole at 10.1m					35.0

HBT AGRA Limited YELLOWKNIFE, N.W.T.	LOGGED BY: JLA	COMPLETION DEPTH: 8.5 m
	REVIEWED BY:	COMPLETE: 93/10/02
	Fig. No:	Page 1 of 1

PROJECT: FORT GOOD HOPE AIRPORT	METHOD: TRACK MOUNTED AUGER	BOREHOLE No: 27
CLIENT: DEPARTMENT OF TRANSPORTATION	DATUM:	Project No: YX00354
CONTRACTOR: MOBILE AUGERS AND RESEARCH	LOCATION: STATION 3+260 60m North of CL	ELEVATION: 0.000 (m)
SAMPLE TYPE <input checked="" type="checkbox"/> DISTURBED	<input checked="" type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT
	<input type="checkbox"/> A-CASING	<input type="checkbox"/> SHELBY TUBE
		<input type="checkbox"/> CORE

DEPTH (m)	PLASTIC      M.C.      LIQUID 20      40      60      80	SOIL SYMBOL	SOIL DESCRIPTION	WELL INSTALLATION	SAMPLE TYPE	SAMPLE NO	TEST COMMENTS	DEPTH (ft)
0.0			SAND AND GRAVEL - coarse grained gravel, fine grained sand, trace of silt, dry, rusty brown - dark brown at 0.8m			D1		0.0
1.0								5.0
2.0						D2		
3.0			SAND - little to some gravel, trace of silt, wet, brown - suspected frozen at 2.9m			D3		10.0
4.0								15.0
5.0			- trace to little gravel at 4.6m					
6.0						D4		20.0
7.0								
8.0			SILT - clayey, medium plastic, grey					25.0
9.0			End of Borehole at 8.5m					30.0
10.0								35.0
11.0								

PROJECT: FORT GOOD HOPE AIRPORT		METHOD: TRACK MOUNTED AUGER		BOREHOLE No: 28	
CLIENT: DEPARTMENT OF TRANSPORTATION		DATUM:		Project No: YX00354	
CONTRACTOR: MOBILE AUGERS AND RESEARCH		LOCATION: STATION 3+160 60m South of CL		ELEVATION: 0.000 (m)	
SAMPLE TYPE <input checked="" type="checkbox"/> DISTURBED		<input checked="" type="checkbox"/> NO RECOVERY		<input checked="" type="checkbox"/> SPT	
		<input type="checkbox"/> A-CASING		<input type="checkbox"/> SHELBY TUBE	
				<input type="checkbox"/> CORE	

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	WELL INSTALLATION	SAMPLE TYPE	SAMPLE NO	TEST COMMENTS	DEPTH (ft)
0.0		SILT - soft, clayey, low to medium plastic, moist to wet, brownish grey - frozen at 0.6m					0.0
1.0							5.0
2.0		GRAVEL - fine grained gravel, some fine grained sand, trace to little silt wet, brown			D1		
3.0							10.0
4.0					D2	Gravel = 77% Sand = 20% Fines = 3%	15.0
5.0							
6.0		- hard drilling at 6.1m			D3		20.0
7.0							
8.0		SAND - little to some fine grained gravel, coarse grained sand, trace of silt, wet, brown					25.0
9.0							
10.0		SILT - low to medium plasticity, frozen, brown-grey					30.0
11.0		End of Borehole at 10.1m					35.0

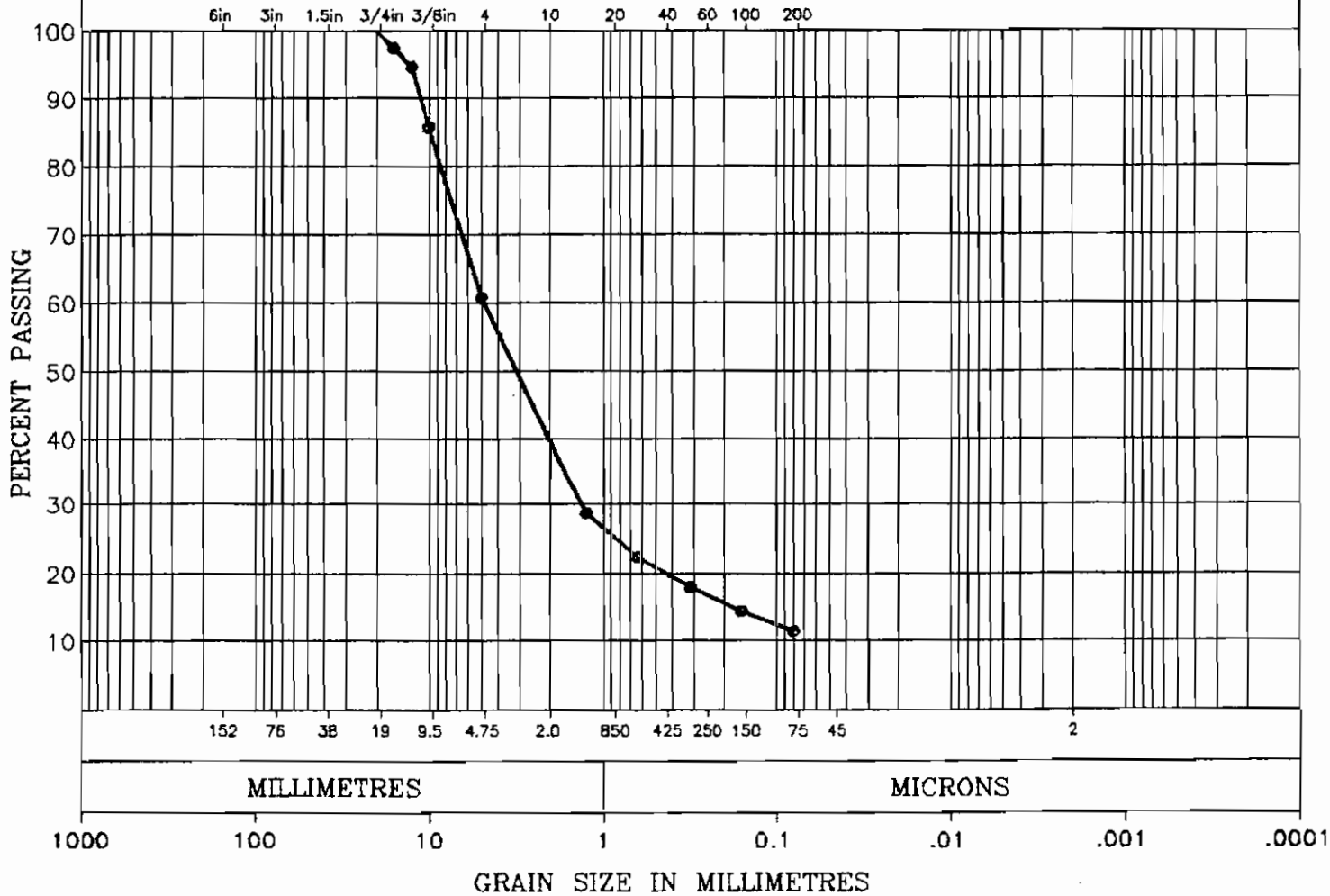
<b>HBT AGRA Limited</b> <b>YELLOWKNIFE, N.W.T.</b>		LOGGED BY: JLA	COMPLETION DEPTH: 10.1 m
		REVIEWED BY:	COMPLETE: 93/10/02
		Fig. No:	Page 1 of 1



PROJECT: FORT GOOD HOPE AIRPORT		METHOD: TRACK MOUNTED AUGER		BOREHOLE No: 29				
CLIENT: DEPARTMENT OF TRANSPORTATION		DATUM:		Project No: YX00354				
CONTRACTOR: MOBILE AUGERS AND RESEARCH		LOCATION: STATION 3+650 100m North of CL		ELEVATION: 0.000 (m)				
SAMPLE TYPE <input checked="" type="checkbox"/> DISTURBED <input checked="" type="checkbox"/> NO RECOVERY <input checked="" type="checkbox"/> SPT <input type="checkbox"/> A-CASING <input type="checkbox"/> SHELBY TUBE <input type="checkbox"/> CORE								
DEPTH (m)		SOIL SYMBOL	SOIL DESCRIPTION	WELL INSTALLATION	SAMPLE TYPE	SAMPLE NO	TEST COMMENTS	DEPTH (ft)
	PLASTIC      M.C.      LIQUID 		SAND AND GRAVEL - coarse grained gravel fine grained sand, trace of silt, dry, rusty brown - brown at 0.8m					
0.0								0.0
1.0								5.0
2.0								
3.0								10.0
4.0			SAND - little to some gravel, trace of silt, wet, brown - fine grained sand to fine grained gravel  - suspected frozen at 4.3m					15.0
5.0								
6.0			End of Borehole at 5.5m					20.0
7.0								25.0
8.0								
9.0								30.0
10.0								35.0
11.0								
<b>HBT AGRA Limited</b> <b>YELLOWKNIFE, N.W.T.</b>				LOGGED BY: JLA REVIEWED BY: Fig. No:		COMPLETION DEPTH: 5.5 m COMPLETE: 93/10/02		Page 1 of 1

COBBLES	GRAVEL SIZES		SAND SIZES			SILT	CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE		

U.S. STANDARD SIEVE SIZES



REMARKS:

SUMMARY

D <sub>10</sub> =	mm	GRAVEL	39. %	
D <sub>30</sub> =	1.4	mm	SAND	49. %
D <sub>60</sub> =	4.9	mm	FINES	12. %
C <sub>u</sub> =				
C <sub>c</sub> =				

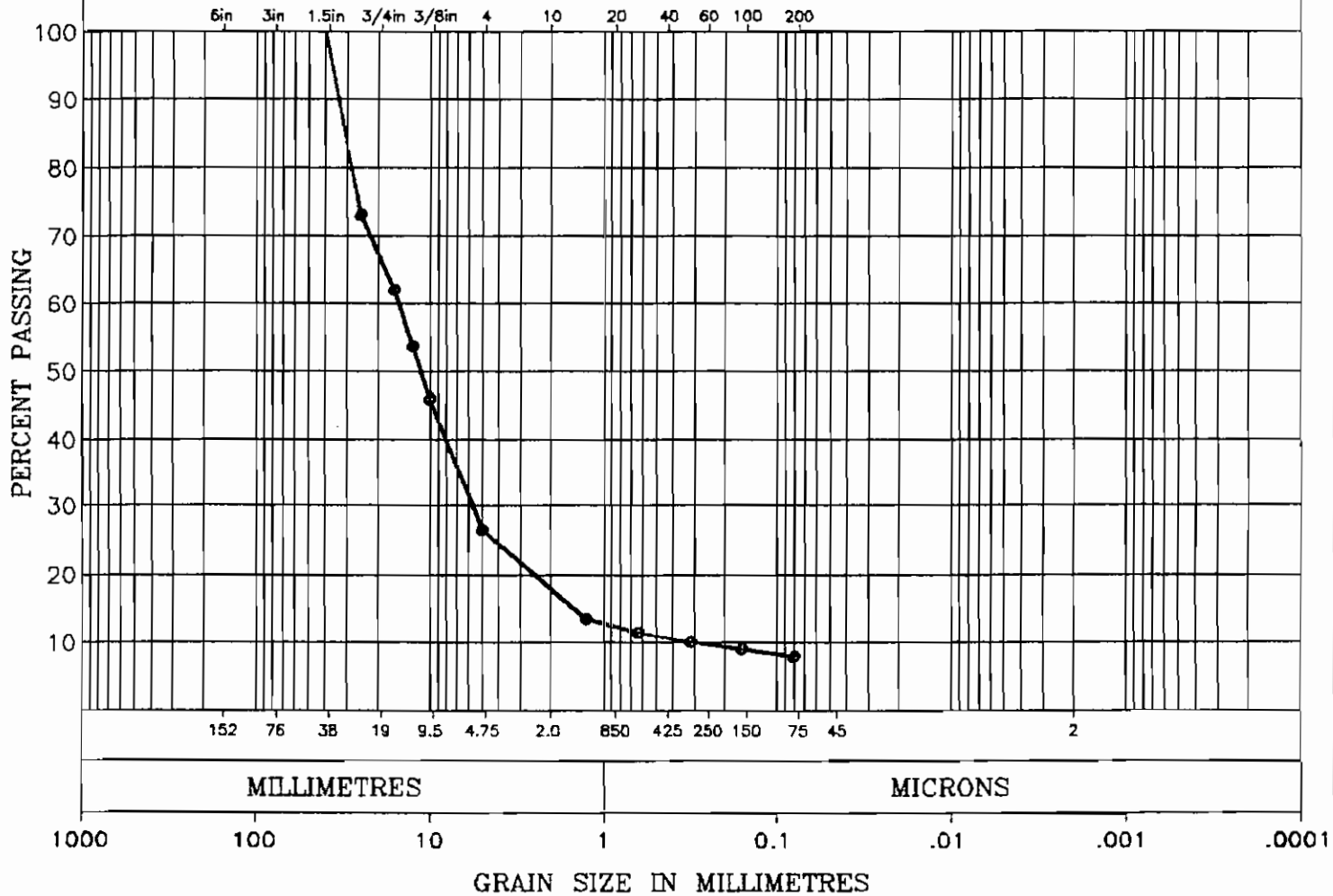
HBT AGRA Limited

GRAIN SIZE DISTRIBUTION

PROJECT No: YX00354.200      DATE: 93.11.03  
 LOCATION: FORT GOOD HOPE AIRPORT  
 HOLE: BH1      SAMPLE:  
 DEPTH: 3.35-3.96 m  
 TECHNICIAN: LR

COBBLES	GRAVEL SIZES		SAND SIZES			SILT	CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE		

U.S. STANDARD SIEVE SIZES



REMARKS:

SUMMARY

$D_{10} = 0.29$	mm	GRAVEL	73. %
$D_{30} = 5.9$	mm	SAND	19. %
$D_{60} = 15.$	mm	FINES	8. %
$C_u = 51.$			
$C_c = 7.8$			

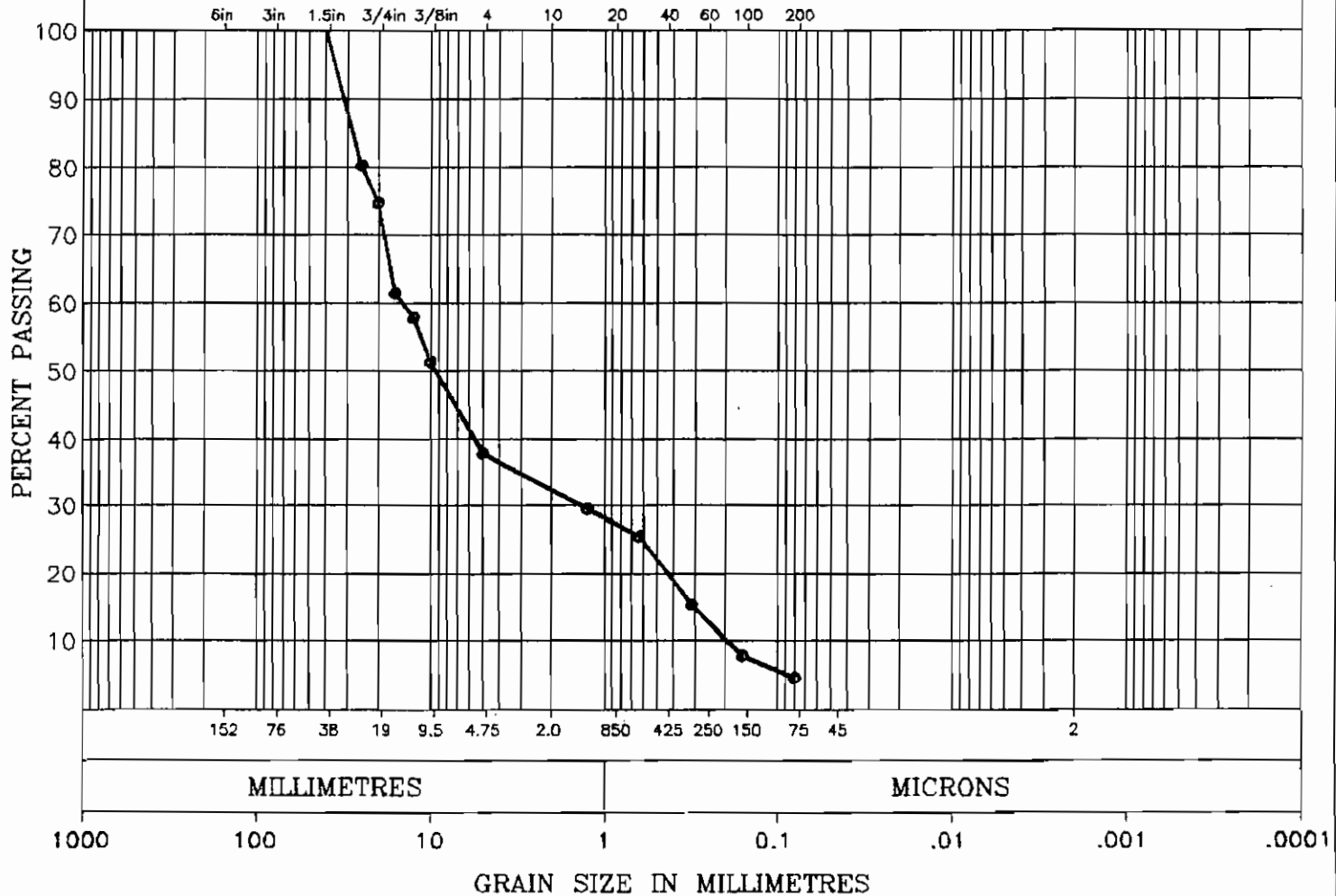
HBT AGRA Limited

GRAIN SIZE DISTRIBUTION

PROJECT No: YX00354.200      DATE: 93.11.03  
 LOCATION: FORT GOOD HOPE AIRPORT  
 HOLE: BH.5      SAMPLE:  
 DEPTH: 1.83-2.13 m  
 TECHNICIAN: LR

COBBLES	GRAVEL SIZES		SAND SIZES			SILT	CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE		

U.S. STANDARD SIEVE SIZES



REMARKS:

SUMMARY

$D_{10} = 0.20$	mm	GRAVEL	62. %
$D_{30} = 1.5$	mm	SAND	33. %
$D_{60} = 14.$	mm	FINES	5. %
$C_u = 71.$			
$C_c = 0.72$			

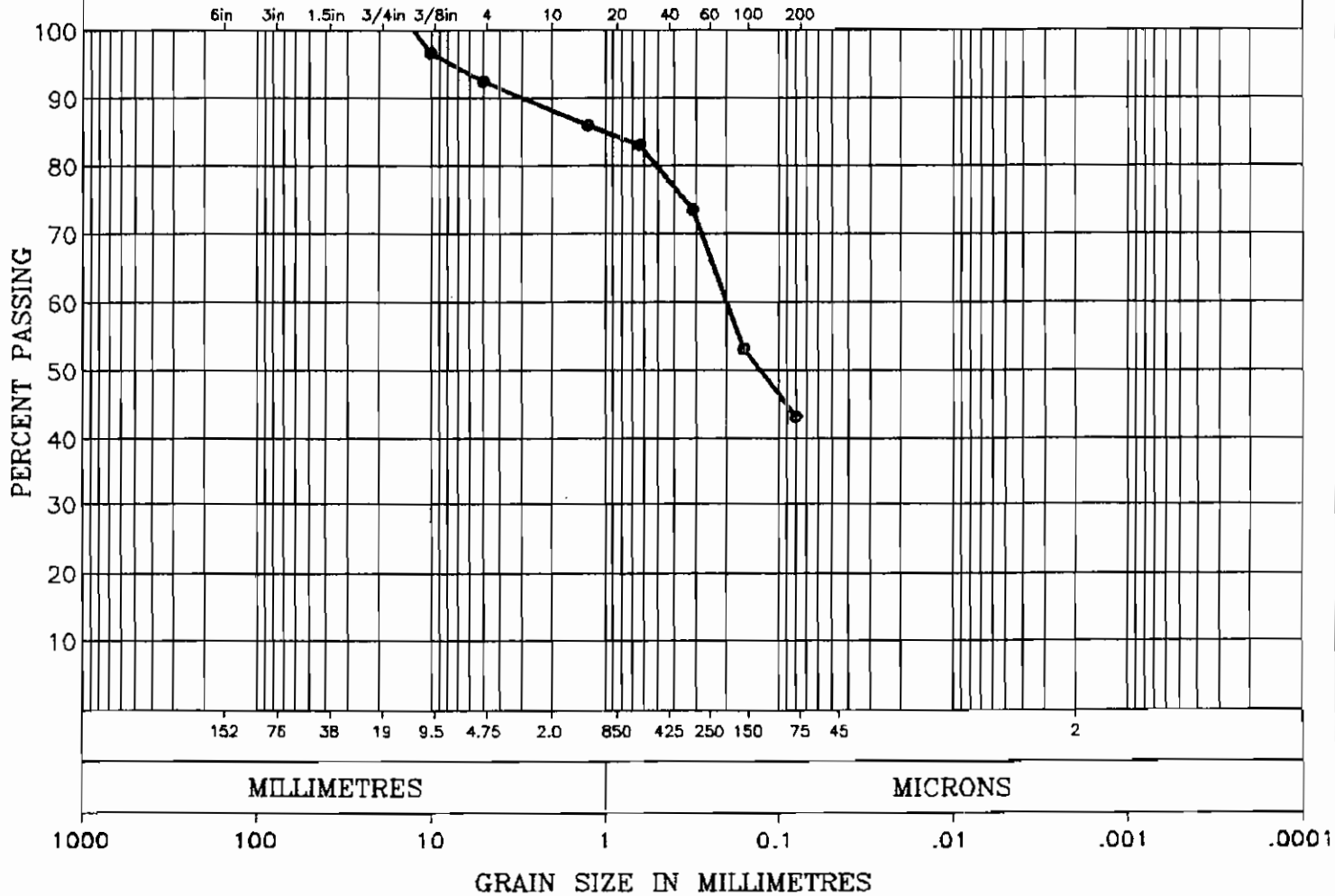
**HBT AGRA Limited**

GRAIN SIZE DISTRIBUTION

PROJECT No: YX00354.200    DATE: 93.11.03  
 LOCATION: FORT GOOD HOPE AIRPORT  
 HOLE: BH.13    SAMPLE:  
 DEPTH: 1.52-2.13 m  
 TECHNICIAN: LR

COBBLES	GRAVEL SIZES		SAND SIZES			SILT	CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE		

U.S. STANDARD SIEVE SIZES



REMARKS:

SUMMARY

D <sub>10</sub> =	mm	GRAVEL	7. %
D <sub>30</sub> =	mm	SAND	49. %
D <sub>60</sub> = 0.21	mm	FINES	44. %
C <sub>u</sub> =			
C <sub>c</sub> =			

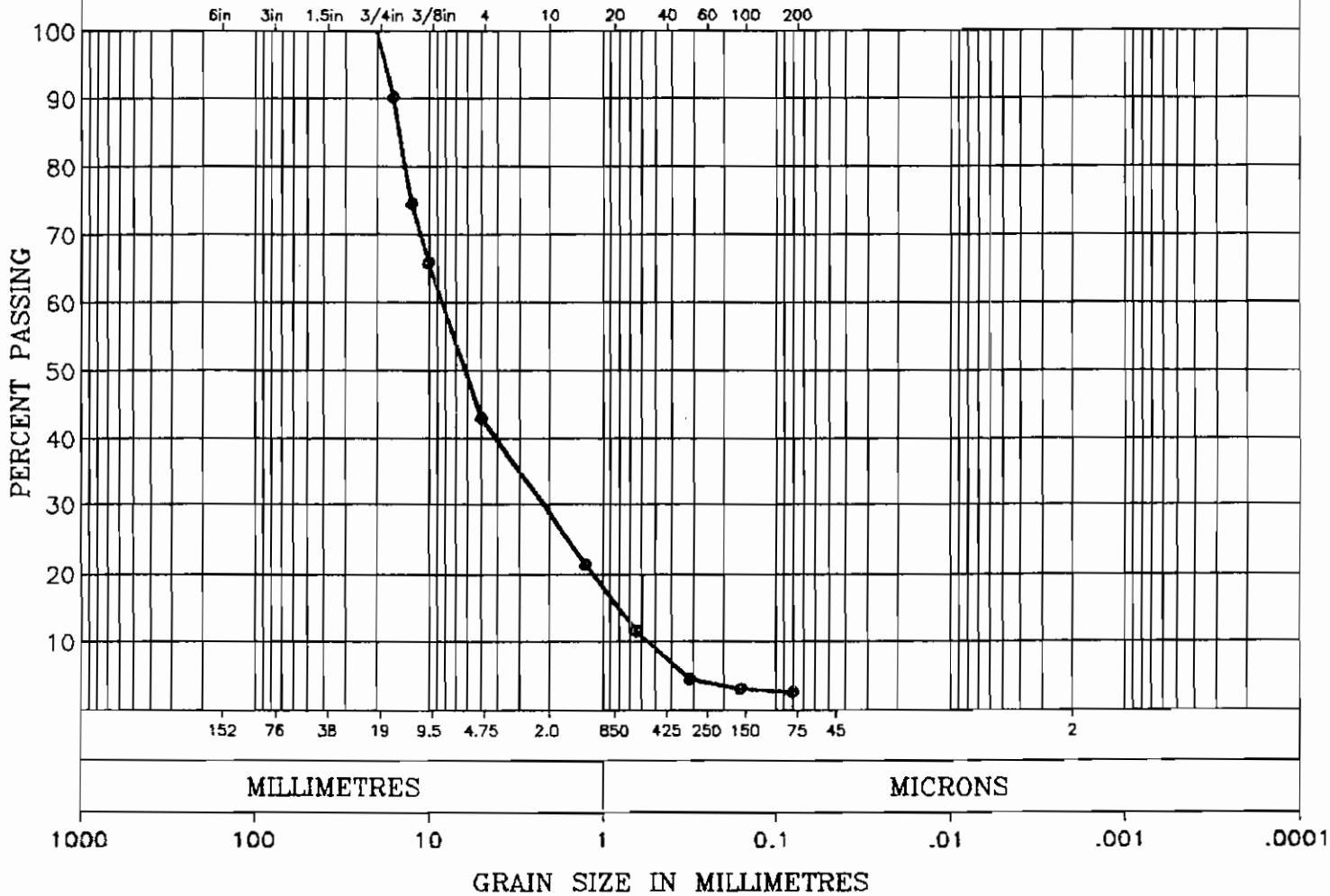
**HBT AGRA Limited**

GRAIN SIZE DISTRIBUTION

PROJECT No: YX00354.200      DATE: 93.11.03  
 LOCATION: FORT GOOD HOPE AIRPORT  
 HOLE: BH.15      SAMPLE:  
 DEPTH: 0.91      m  
 TECHNICIAN: LR

COBBLES	GRAVEL SIZES		SAND SIZES			SILT	CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE		

U.S. STANDARD SIEVE SIZES



REMARKS:

SUMMARY

$D_{10} = 0.56$	mm	GRAVEL	57. %
$D_{30} = 2.7$	mm	SAND	40. %
$D_{60} = 8.7$	mm	FINES	3. %
$C_u = 16.$			
$C_c = 1.5$			

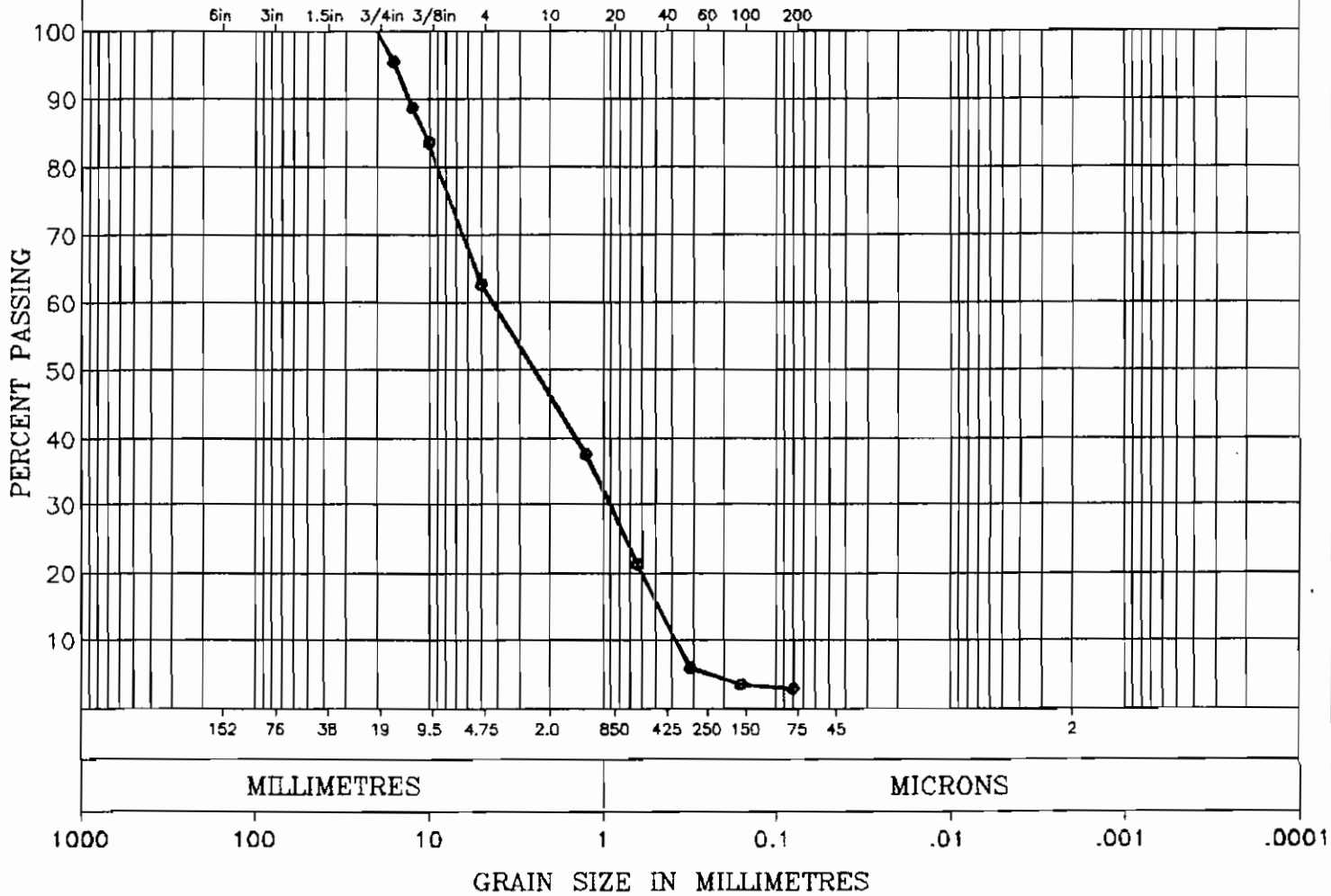
**HBT AGRA Limited**

GRAIN SIZE DISTRIBUTION

PROJECT No: YX00354.200      DATE: 93.11.03  
 LOCATION: FORT GOOD HOPE AIRPORT  
 HOLE: BH.17      SAMPLE:  
 DEPTH: 0.61-0.91 m  
 TECHNICIAN: LR

COBBLES	GRAVEL SIZES		SAND SIZES			SILT	CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE		

U.S. STANDARD SIEVE SIZES



REMARKS:

SUMMARY

$D_{10} = 0.40$	mm	GRAVEL	37. %
$D_{30} = 0.96$	mm	SAND	60. %
$D_{60} = 4.6$	mm	FINES	3. %
$C_u = 12.$			
$C_c = 0.51$			

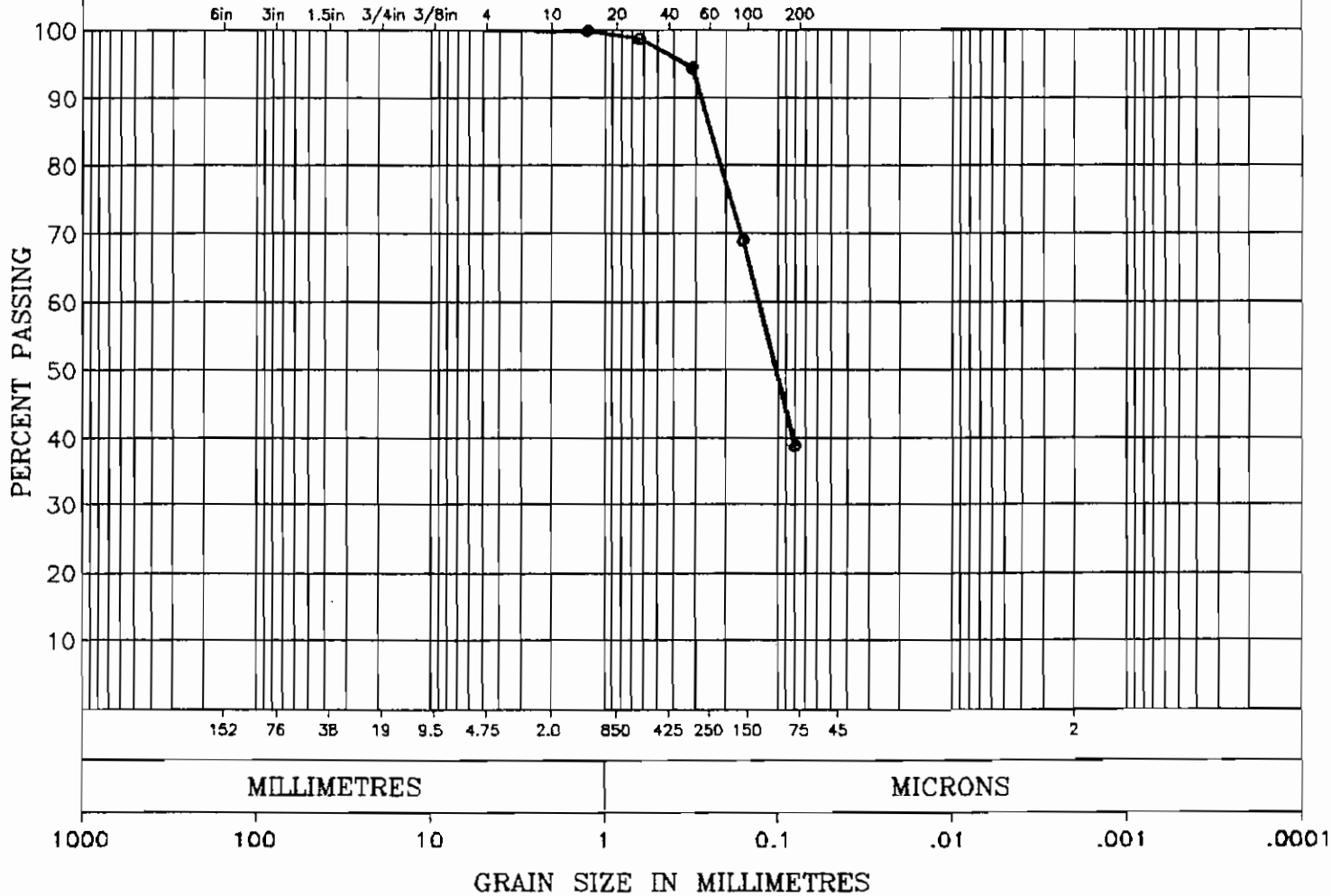
**HBT AGRA Limited**

GRAIN SIZE DISTRIBUTION

PROJECT No: YX00354.200      DATE: 93.11.03  
 LOCATION: FORT GOOD HOPE AIRPORT  
 HOLE: BH.17      SAMPLE:  
 DEPTH: 1.83-2.44 m  
 TECHNICIAN: LR

COBBLES	GRAVEL SIZES		SAND SIZES			SILT	CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE		

U.S. STANDARD SIEVE SIZES



REMARKS:

SUMMARY

D <sub>10</sub> =	mm	GRAVEL	%
D <sub>30</sub> =	mm	SAND	61. %
D <sub>60</sub> = 0.14	mm	FINES	39. %
C <sub>u</sub> =			
C <sub>c</sub> =			

**HBT AGRA Limited**

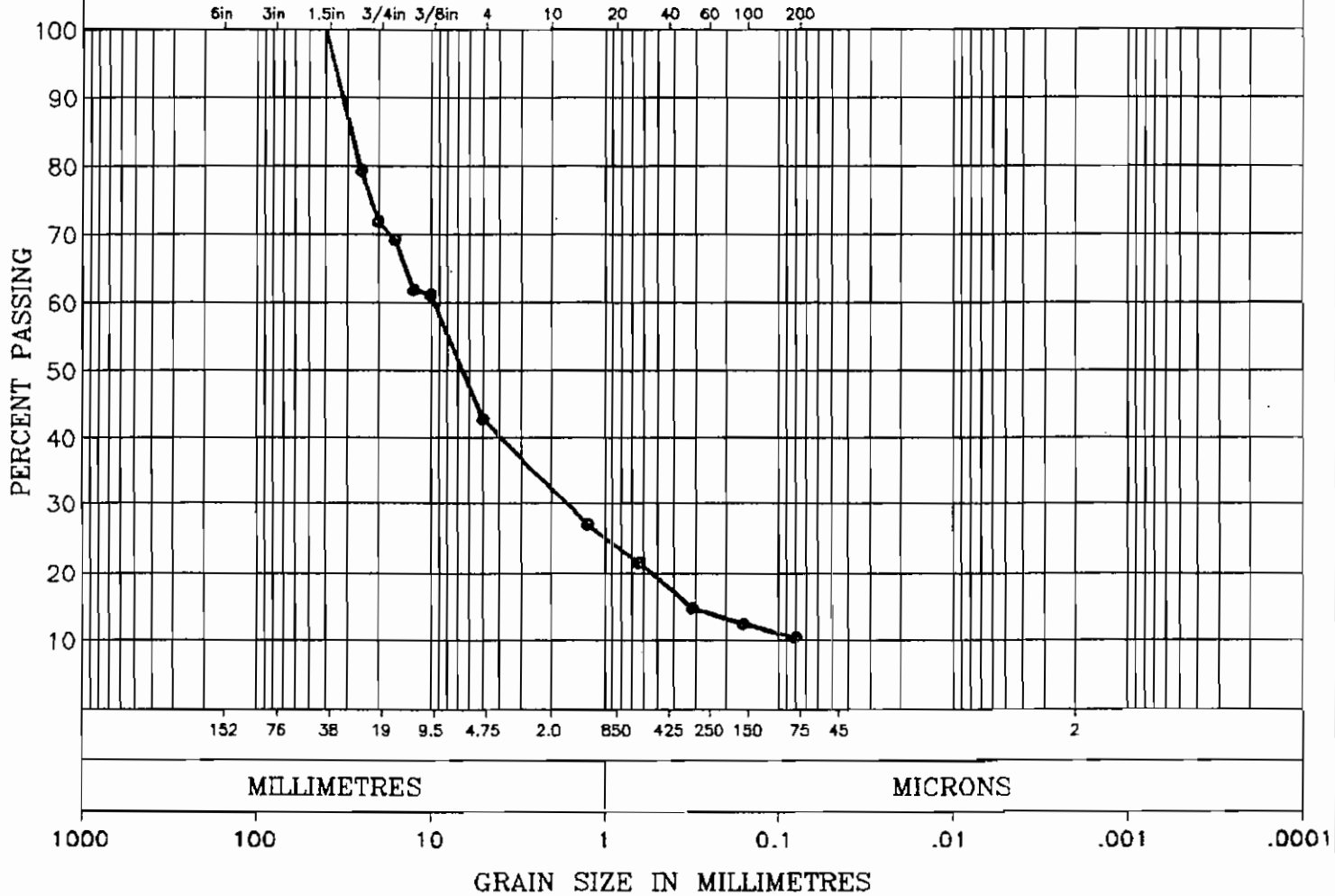
GRAIN SIZE DISTRIBUTION

PROJECT No: YX00354.200      DATE: 93.11.03  
 LOCATION: FORT GOOD HOPE AIRPORT  
 HOLE: BH.18      SAMPLE:  
 DEPTH: 0.91      m  
 TECHNICIAN: LR



COBBLES	GRAVEL SIZES		SAND SIZES			SILT	CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE		

U.S. STANDARD SIEVE SIZES



REMARKS:

SUMMARY

D <sub>10</sub> =	mm	GRAVEL	57. %	
D <sub>30</sub> =	2.0	mm	SAND	32. %
D <sub>60</sub> =	9.7	mm	FINES	11. %
C <sub>u</sub> =				
C <sub>c</sub> =				

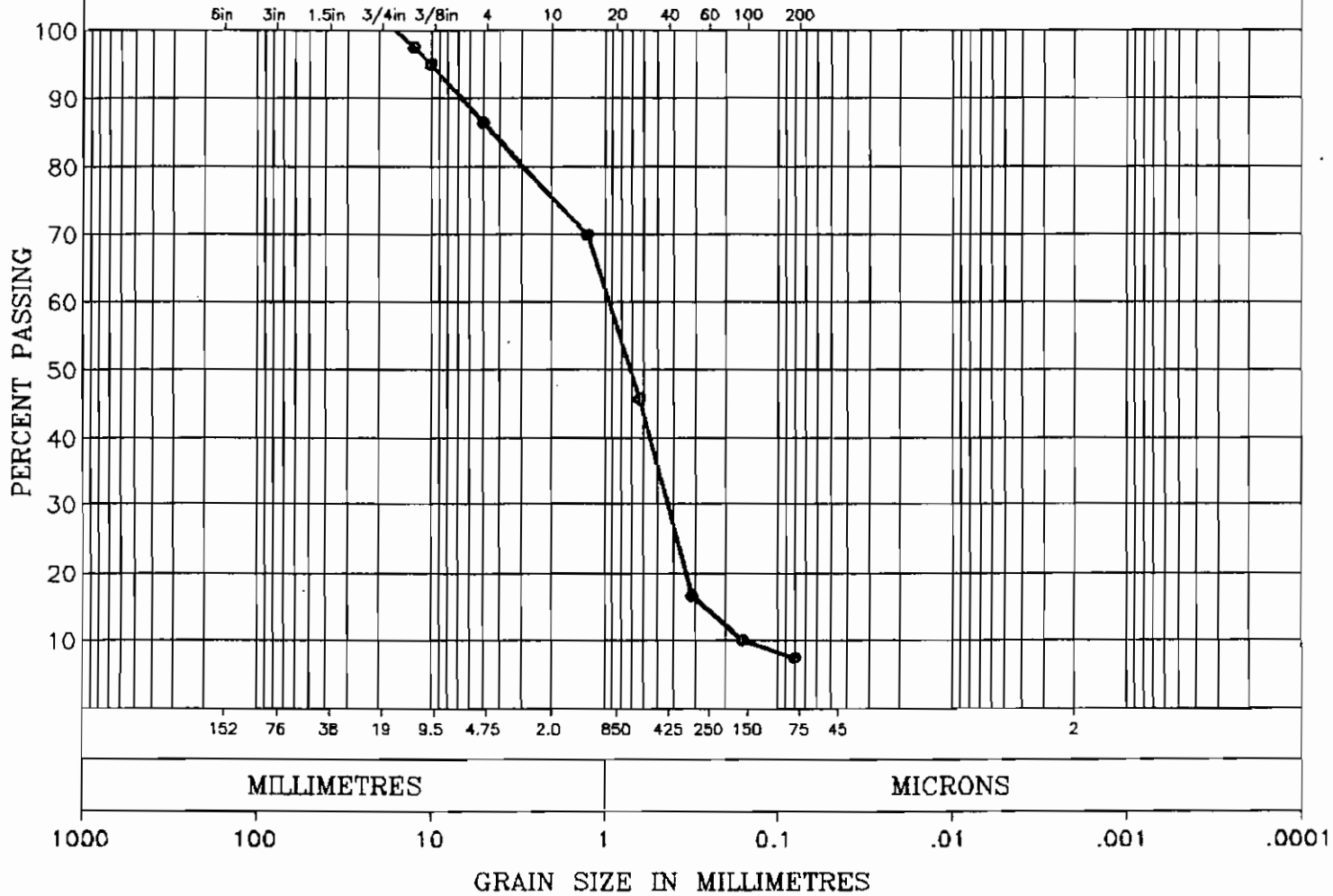
**HBT AGRA Limited**

GRAIN SIZE DISTRIBUTION

PROJECT No: YX00354.200      DATE: 93.11.03  
 LOCATION: FORT GOOD HOPE AIRPORT  
 HOLE: BH.19      SAMPLE:  
 DEPTH: 0.61      m  
 TECHNICIAN: LR

COBBLES	GRAVEL SIZES		SAND SIZES			SILT	CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE		

U.S. STANDARD SIEVE SIZES



REMARKS:

SUMMARY

$D_{10} = 0.16$	mm	GRAVEL	14. %
$D_{30} = 0.46$	mm	SAND	79. %
$D_{60} = 0.99$	mm	FINES	7. %
$C_u = 6.3$			
$C_c = 1.3$			

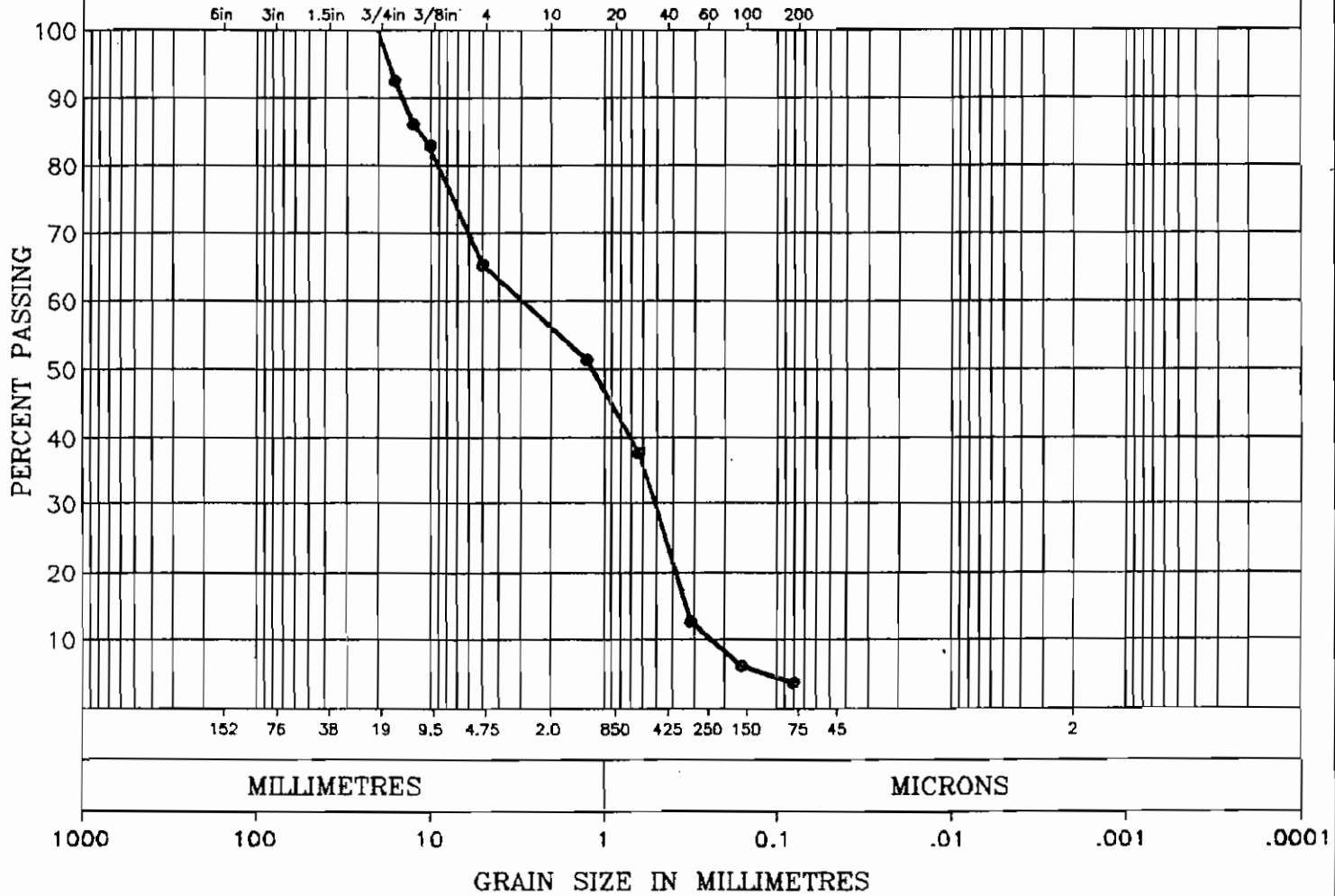
**HBT AGRA Limited**

GRAIN SIZE DISTRIBUTION

PROJECT No: YX00354.200    DATE: 93.11.03  
 LOCATION: FORT GOOD HOPE AIRPORT  
 HOLE: BH.22    SAMPLE:  
 DEPTH: 2.13-2.44 m  
 TECHNICIAN: LR

COBBLES	GRAVEL SIZES		SAND SIZES			SILT	CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE		

U.S. STANDARD SIEVE SIZES



REMARKS:

SUMMARY

$D_{10} = 0.25$	mm	GRAVEL	35. %
$D_{30} = 0.53$	mm	SAND	62. %
$D_{60} = 3.6$	mm	FINES	3. %
$C_U = 14.$			
$C_C = 0.32$			

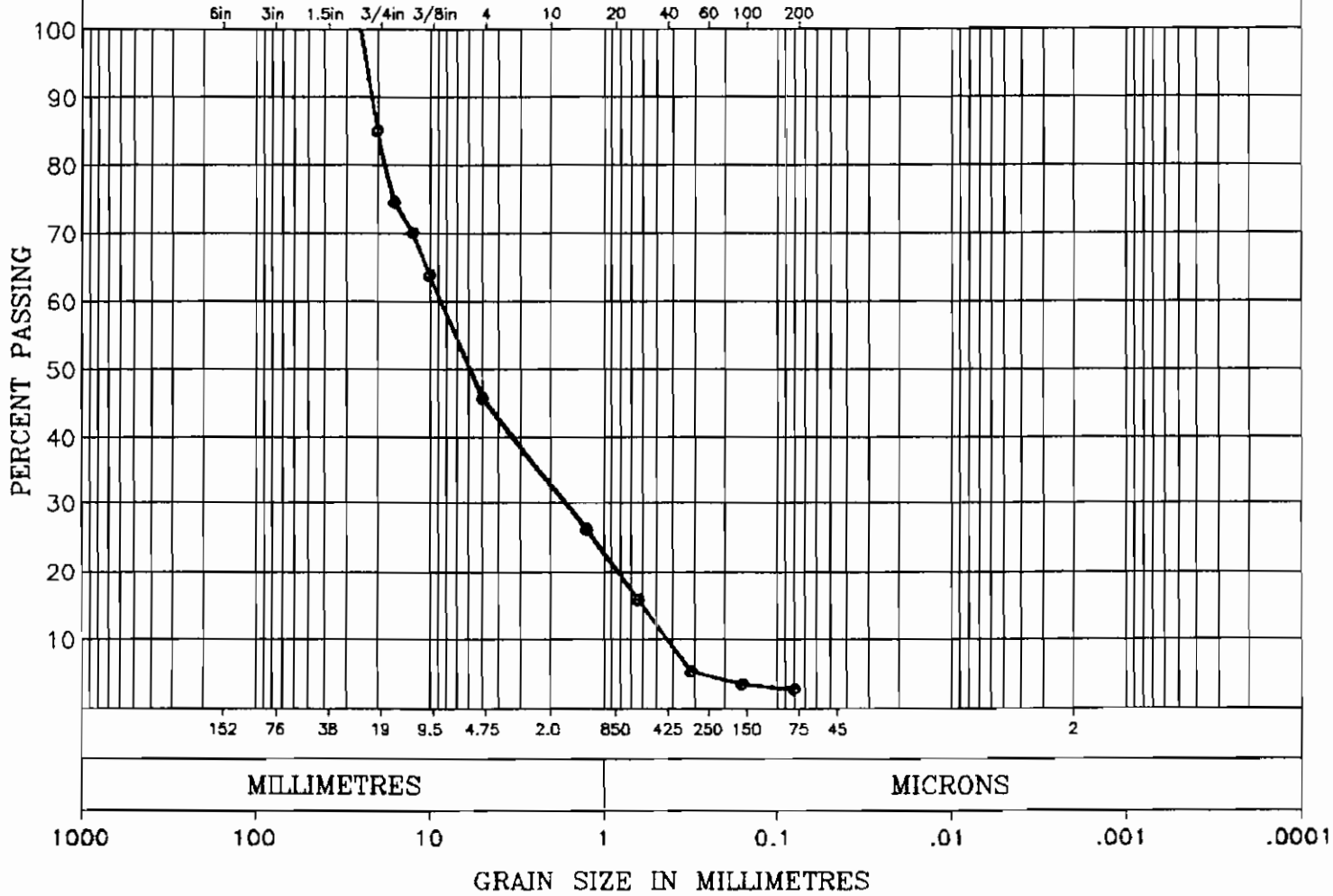
HBT AGRA Limited

GRAIN SIZE DISTRIBUTION

PROJECT No: YX00354.200      DATE: 93.11.03  
 LOCATION: FORT GOOD HOPE AIRPORT  
 HOLE: BH.23      SAMPLE:  
 DEPTH: 7.01-10.06 m  
 TECHNICIAN: LR

COBBLES	GRAVEL SIZES		SAND SIZES			SILT	CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE		

U.S. STANDARD SIEVE SIZES



REMARKS:

SUMMARY

$D_{10} = 0.45$	mm	GRAVEL	54. %
$D_{30} = 2.0$	mm	SAND	43. %
$D_{60} = 8.9$	mm	FINES	3. %
$C_u = 20.$			
$C_c = 0.97$			

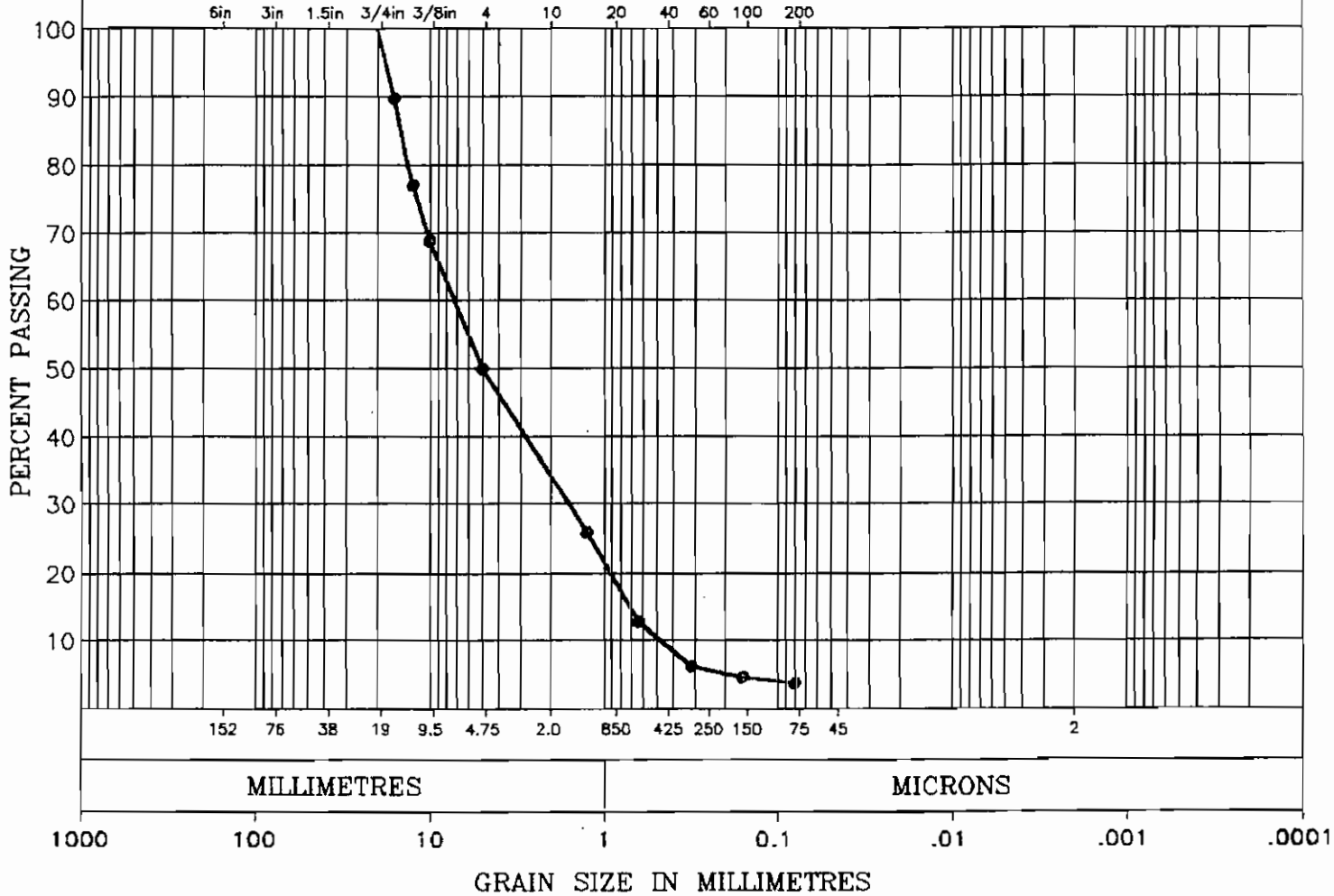
HBT AGRA Limited

GRAIN SIZE DISTRIBUTION

PROJECT No: YX00354.200      DATE: 93.11.03  
 LOCATION: FORT GOOD HOPE AIRPORT  
 HOLE: BH.24      SAMPLE:  
 DEPTH: 1.52-2.44 m  
 TECHNICIAN: LR

COBBLES	GRAVEL SIZES		SAND SIZES			SILT	CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE		

U.S. STANDARD SIEVE SIZES



REMARKS:

SUMMARY

$D_{10}$ = 0.50	mm	GRAVEL	50. %
$D_{30}$ = 1.9	mm	SAND	46. %
$D_{60}$ = 7.6	mm	FINES	4. %
$C_u$ = 15.			
$C_c$ = 0.94			

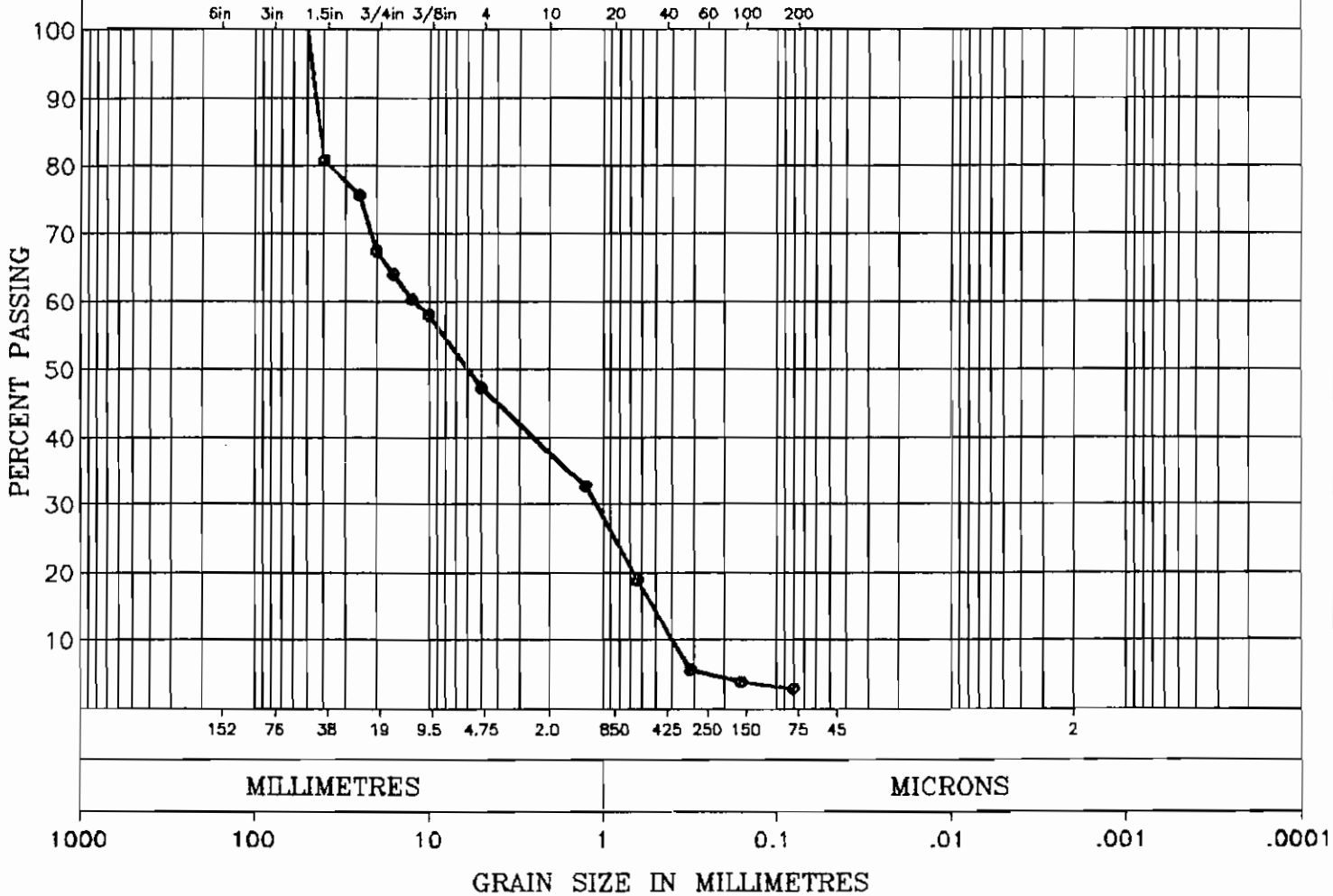
HBT AGRA Limited

GRAIN SIZE DISTRIBUTION

PROJECT No: YX00354.200      DATE: 93.11.03  
 LOCATION: FORT GOOD HOPE AIRPORT  
 HOLE: BH.25      SAMPLE:  
 DEPTH: 1.52-2.44 m  
 TECHNICIAN: LR

COBBLES	GRAVEL SIZES		SAND SIZES			SILT	CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE		

U.S. STANDARD SIEVE SIZES



REMARKS:

SUMMARY

$D_{10} = 0.42$	mm	GRAVEL	53. %
$D_{30} = 1.1$	mm	SAND	44. %
$D_{60} = 12.$	mm	FINES	3. %
$C_u = 29.$			
$C_c = 0.25$			

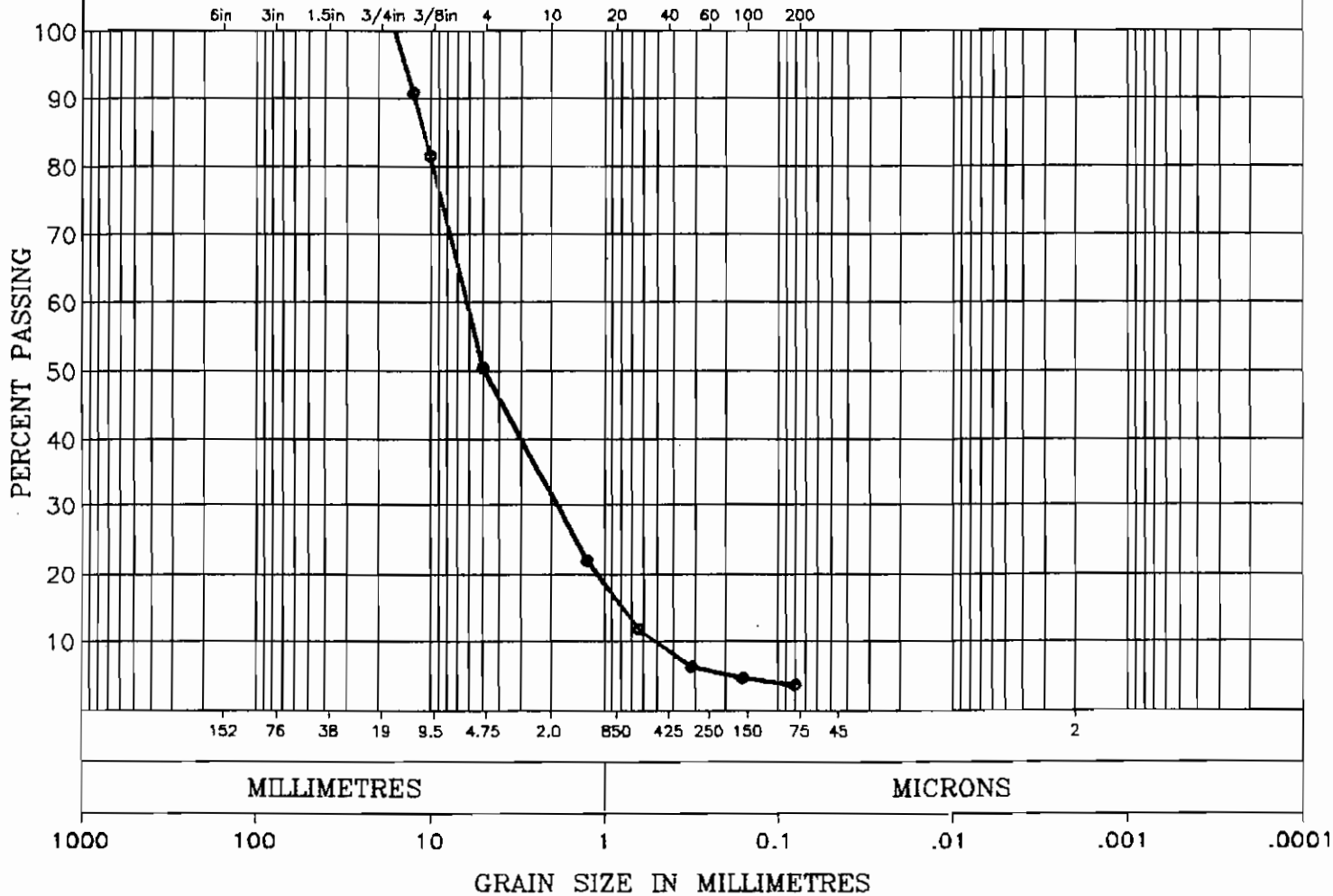
**HBT AGRA Limited**

GRAIN SIZE DISTRIBUTION

PROJECT No: YX00354.200    DATE: 93.11.03  
 LOCATION: FORT GOOD HOPE AIRPORT  
 HOLE: BH.25    SAMPLE:  
 DEPTH: 3.05-3.96 m  
 TECHNICIAN: LR

COBBLES	GRAVEL SIZES		SAND SIZES			SILT	CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE		

U.S. STANDARD SIEVE SIZES



REMARKS:

SUMMARY

$D_{10} = 0.52$	mm	GRAVEL	49. %
$D_{30} = 2.3$	mm	SAND	47. %
$D_{60} = 6.5$	mm	FINES	4. %
$C_u = 12.$			
$C_c = 1.6$			

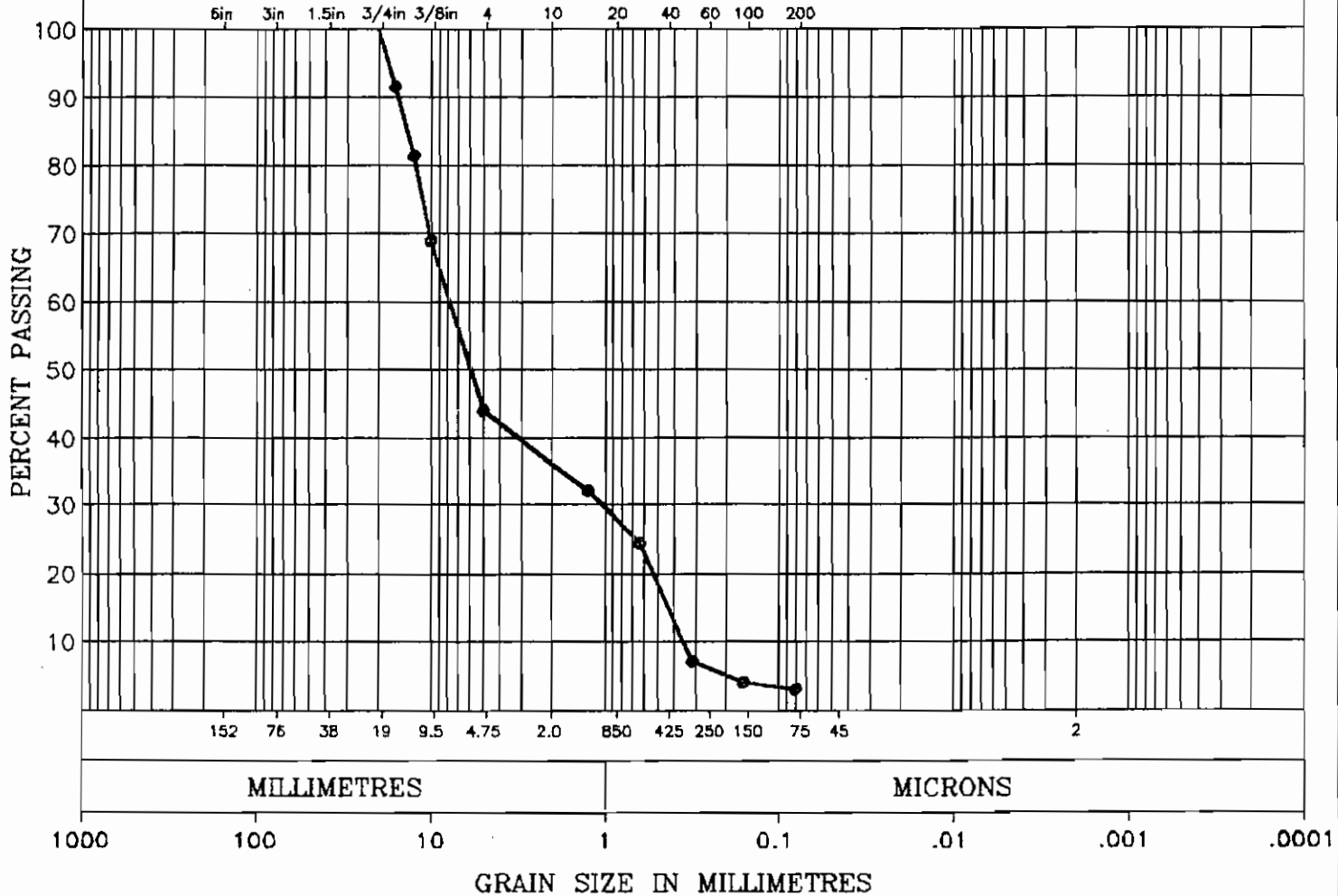
**HBT AGRA Limited**

GRAIN SIZE DISTRIBUTION

PROJECT No: YX00354.200      DATE: 93.11.03  
 LOCATION: FORT GOOD HOPE AIRPORT  
 HOLE: BH.26      SAMPLE:  
 DEPTH: 3.05-3.96 m  
 TECHNICIAN: LR

COBBLES	GRAVEL SIZES		SAND SIZES			SILT	CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE		

U.S. STANDARD SIEVE SIZES



REMARKS:

SUMMARY

$D_{10} = 0.37$	mm	GRAVEL	56. %
$D_{30} = 1.1$	mm	SAND	41. %
$D_{60} = 8.2$	mm	FINES	3. %
$C_u = 22.$			
$C_c = 0.39$			

**HBT AGRA Limited**

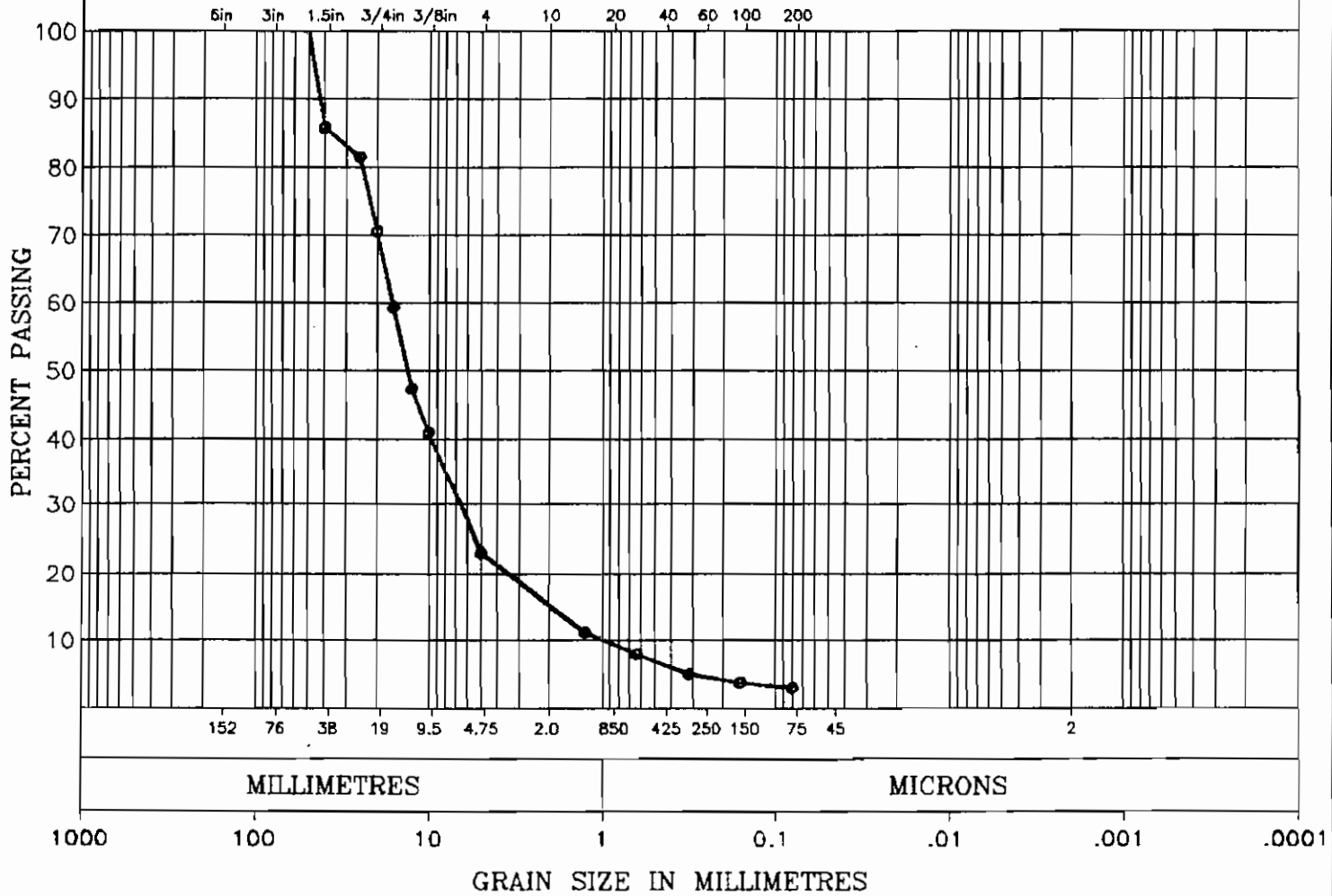
GRAIN SIZE DISTRIBUTION

PROJECT No: YX00354.200      DATE: 93.11.03  
 LOCATION: FORT GOOD HOPE AIRPORT  
 HOLE: BH.27      SAMPLE:  
 DEPTH: 1.83-2.44 m  
 TECHNICIAN: LR



COBBLES	GRAVEL SIZES		SAND SIZES			SILT	CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE		

U.S. STANDARD SIEVE SIZES



REMARKS:

SUMMARY

$D_{10} = 1.0$	mm	GRAVEL	77. %
$D_{30} = 6.9$	mm	SAND	20. %
$D_{60} = 16.$	mm	FINES	3. %
$C_u = 16.$			
$C_c = 2.9$			

**HBT AGRA Limited**  
GRAIN SIZE DISTRIBUTION

PROJECT No: YX00354.200    DATE: 93.11.03  
 LOCATION: FORT GOOD HOPE AIRPORT  
 HOLE: BH.28    SAMPLE:  
 DEPTH: 3.35-3.96 m  
 TECHNICIAN: LR

APPENDIX C

Explanation of Terms and Symbols

## 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 these pages.

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

### TEST DATA

Data obtained during the field investigation and from laboratory testing are shown at the appropriate depth interval.

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

*C	Consolidation test	*ST	Swelling test
$D_R$	Relative density (formerly specific gravity)	TV	Torvane shear strength
Fines	Percentage by weight smaller than #200 sieve	VS	Vane shear strength (undisturbed-remolded)
k	Permeability coefficient	w	Natural water content (ASTM D 2216)
*MA	Mechanical grain size analysis and hydrometer test	$w_L$	Liquid limit (ASTM D 423)
N	Standard penetration test (CSA A119.1-60)	$w_p$	Plastic limit (ASTM D 424)
$N_d$	Dynamic cone penetration test	$\epsilon_f$	Unit strain at failure
NP	Non plastic soil	$\gamma$	Unit weight of soil or rock
pp	Pocket penetrometer strength	$\gamma_d$	Dry unit weight of soil or rock
*q	Triaxial compression test	$\rho$	Density of soil or rock
$q_u$	Unconfined compressive strength	$\rho_d$	Dry density of soil or rock
*SB	Shearbox test	→	seepage
SO <sub>4</sub>	Concentration of water-soluble sulphate	▼	observed water level

*\*The results of these tests usually are reported separately*

### 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 System<sup>1</sup> 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.<sup>2</sup>

The soil classification system is shown in greater detail on page 2.

**SAMPLE TYPE** — The type of sample is shown at the appropriate depth interval using the following abbreviations:

- A auger sample
- B block sample
- C rock core, or frozen soil core
- D drive sample/SPT sample
- P pitcher tube sample
- U tube sample (usually thin-walled)
- W wash or air return sample
- O other (see report text)
- ☐ indicates no sample recovery

1. "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.

2. 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.

**MODIFIED UNIFIED CLASSIFICATION SYSTEM FOR SOILS**

MAJOR DIVISION		GROUP SYMBOL	GRAPH SYMBOL	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		WELL GRADED GRAVELS, LITTLE OR NO FINES	$C_u = \frac{D_{60}}{D_{10}} > 4$ $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{ to } 3$	
		POORLY GRADED GRAVELS, AND GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	GP				NOT MEETING ABOVE REQUIREMENTS
		DIRTY GRAVELS (WITH SOME FINES)	GM		SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12%	ATTERBERG LIMITS BELOW "A" LINE OR P.I. LESS THAN 4
			GC		CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES		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		WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	$C_u = \frac{D_{60}}{D_{10}} > 6$ $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{ to } 3$	
			SP		POORLY GRADED SANDS, LITTLE OR NO FINES		NOT MEETING ABOVE REQUIREMENTS
		DIRTY SANDS (WITH SOME FINES)	SM		SILTY SANDS, SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12%	ATTERBERG LIMITS BELOW "A" LINE P.I. LESS THAN 4
			SC		CLAYEY SANDS, SAND-CLAY MIXTURES		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 NEGLECTIBLE ORGANIC CONTENT	$W_L < 50\%$	ML		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		INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDY OR SILTY SOILS	
CLAYS ABOVE "A" LINE ON PLASTICITY CHART NEGLECTIBLE ORGANIC CONTENT		$W_L < 30\%$	CL		INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY, OR SILTY CLAYS, LEAN CLAYS		
		$30\% < W_L < 50\%$	CI		INORGANIC CLAYS OF MEDIUM PLASTICITY, SILTY CLAYS		
		$W_L > 50\%$	CH		INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS		
ORGANIC SILTS & CLAYS BELOW "A" LINE ON CHART		$W_L < 50\%$	OL		ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY	WHENEVER THE NATURE OF THE FINE CONTENT HAS NOT BEEN DETERMINED, IT IS DESIGNATED BY THE LETTER "F". E.G. SF IS A MIXTURE OF SAND WITH SILT OR CLAY	
		$W_L > 50\%$	OH		ORGANIC CLAYS OF HIGH PLASTICITY		
HIGHLY ORGANIC SOILS		PI		PEAT AND OTHER HIGHLY ORGANIC SOILS	STRONG COLOR OR ODOR, AND OFTEN FIBROUS TEXTURE		

**SPECIAL SYMBOLS**



**BEDROCK**  
(Undifferentiated)



**VOLCANIC ASH**

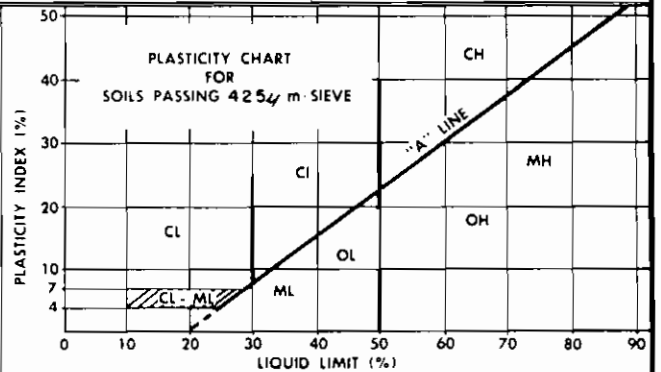
**SOIL COMPONENTS**

FRACTION	U.S. STANDARD SIEVE SIZE		DEFINING RANGES OF PERCENTAGE BY WEIGHT OF MINOR COMPONENTS	
	PASSING	RETAINED	PERCENT	DESCRIPTOR
GRAVEL	75 mm	19 mm	50 - 35	and
	19 mm	4.75 mm		
SAND	4.75 mm	2.00 mm	35 - 20	some
	2.00 mm	425 μm		
	425 μm	75 μm		
SILT (non plastic) or CLAY (plastic)	75 μm		10 - 1	trace

**OVERSIZE MATERIAL**

Rounded or subrounded  
COBBLES 75 mm to 200 mm  
BOULDERS > 200 mm

Not rounded  
ROCK FRAGMENTS > 75 mm  
ROCKS > 0.76 cubic metre in volume



- ALL SIEVE SIZES MENTIONED ON THIS CHART ARE U.S. STANDARD, A.S.T.M. E.11.
- 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%.

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*Engineering & Environmental Services*