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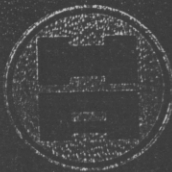
FOR

KADLUK BORROW INVESTIGATION

See: Data Report for Kadluk Borrow Investigation

HARDY.82.30  
R.M. Hardy and Associates  
Ltd.  
Data report for Kadluk  
Borrow investigation

DOXT c. 1 MP



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HARDY.82.30  
R.M. Hardy and Associates  
Ltd.  
Data report for Kadluk  
borrow investigation

2.30

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DOXT c. 1 MP

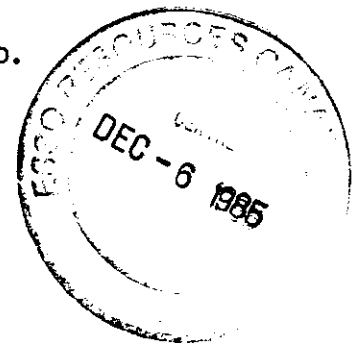


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DATA REPORT  
FOR  
KADLUK BORROW INVESTIGATION

Prepared For  
ESSO RESOURCES CANADA LIMITED

Prepared By  
HARDY ASSOCIATES (1978) LTD.  
Calgary, Alberta



PROJECT NO. CG-14029.A70D

OCTOBER 1982



# HARDY ASSOCIATES (1978) LTD.

CONSULTING ENGINEERING & PROFESSIONAL SERVICES

Our Project No. CG-14029.A70D  
Your Reference No

October 22, 1982

Esso Resources Canada Limited  
237 - 4 Avenue S.W.  
Calgary, Alberta  
T2P 0H6

Attention: Mr. C.V. Mancini, P.Eng.

Dear Sir:

Re: Data Report for Kadluk Borrow Investigation

We are pleased to submit one copy of the subject report for your review and comments. The final data report will be submitted in a binder together with other data reports, as discussed previously.

We trust that the preceding meets with your present requirements. Should you have any questions or comments, please call at your convenience.

Yours truly,

HARDY ASSOCIATES (1978) LTD.

Per:

*J.M. Chevalier*  
J.M. Chevalier, M.Eng., P.Eng .

JMC:mm  
11:12



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1.0 SUMMARY

A preliminary borrow investigation was conducted in the Kadluk block. The purpose was twofold:

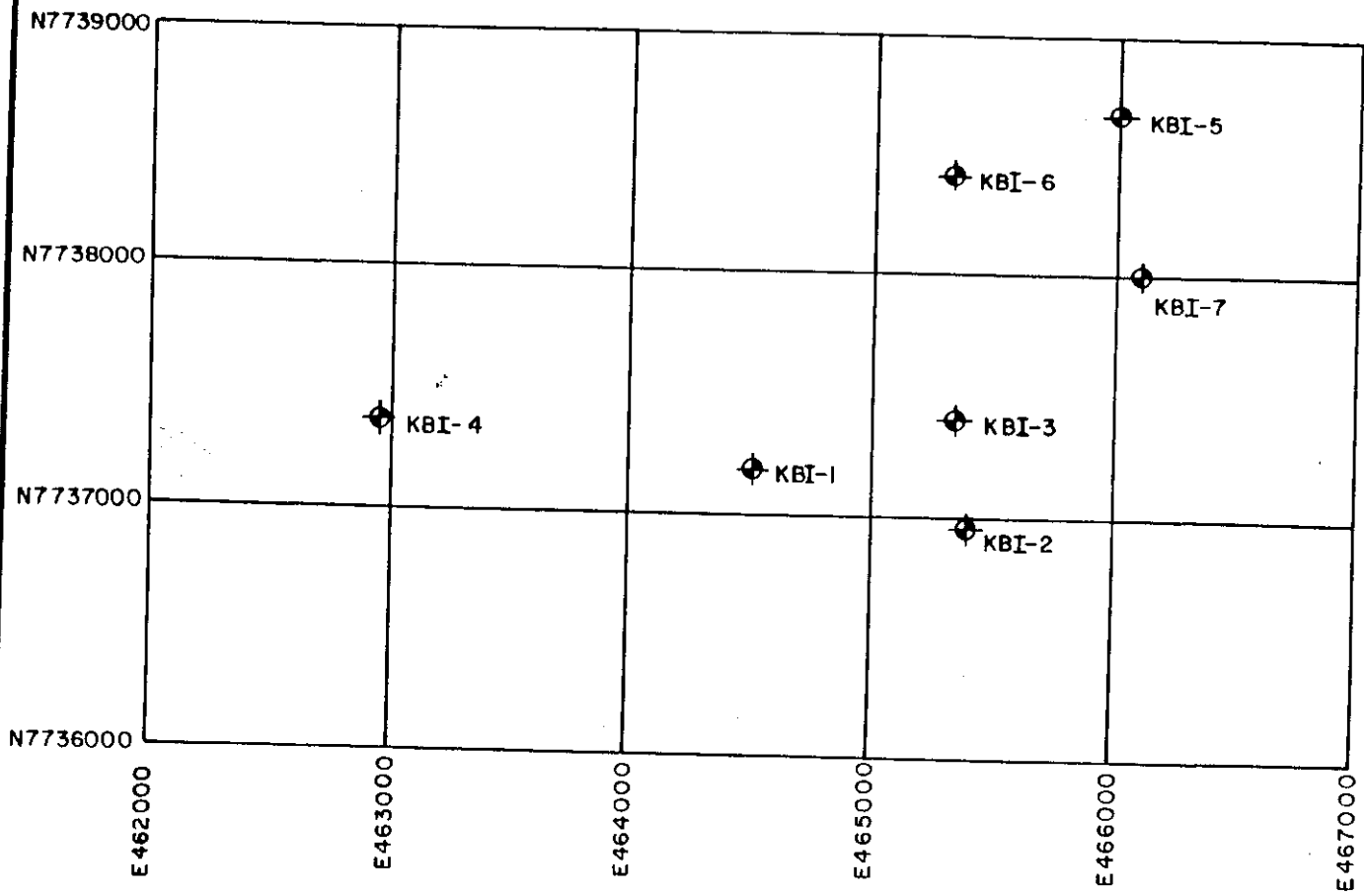
- to assess the quality of the material and its suitability for island construction; and,
- to evaluate the feasibility of exploring the borrow source based on the quantity of suitable material obtained at the borehole locations.

The soil gradation, considered the key factor in meeting the aforementioned objectives, was determined for all cohesionless soil samples.

2.0 SEABED SURFACE SOILS DESCRIPTION

A plan of the borehole locations is given in Figure 1 and a summary of the grain size distribution of the seabed surface soils is shown on Figure 2.

At all borehole locations, except for 82-KBI-2, the sea bottom materials consist of granular soils varying from fine grained sand to fine grained gravel with little coarse grained. Neglecting borehole



KADLUK BORROW		
BOREHOLE N <sup>o</sup>	UTM COORDINATES	
	NORTH	EAST
82-KBI-1	7737173	464510
82-KBI-2	7736962	465396
82-KBI-3	7737396	465339
82-KBI-4	7737351	462955
82-KBI-5	7738679	466010
82-KBI-6	7738425	465316
82-KBI-7	7738004	466103

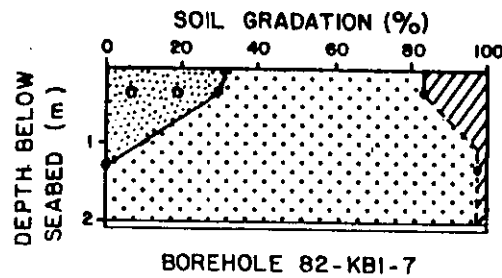
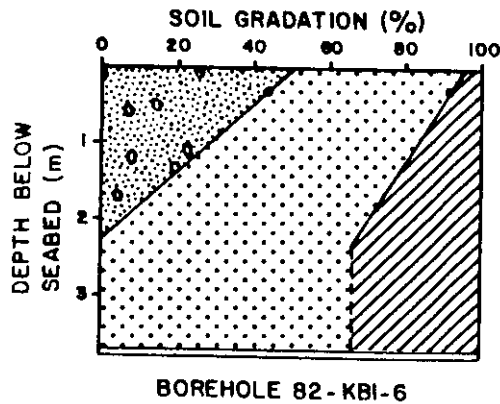
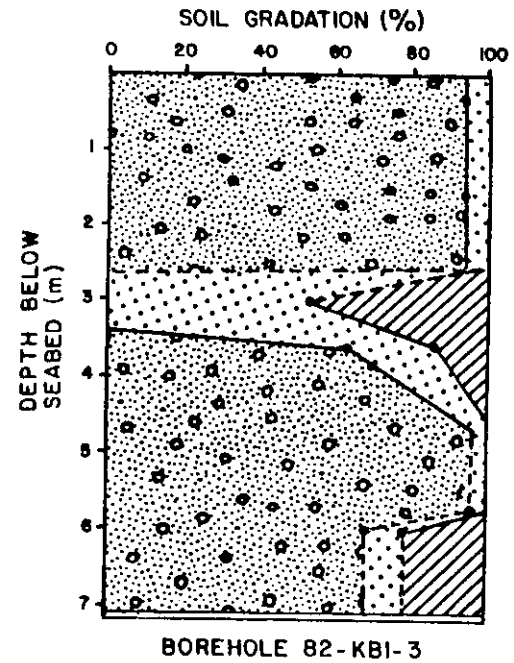
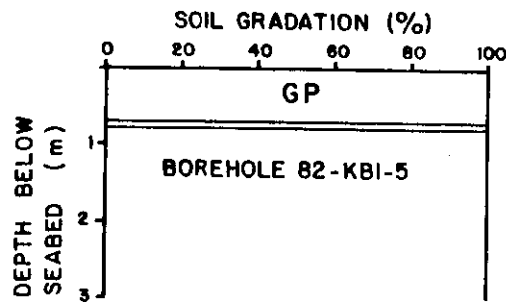
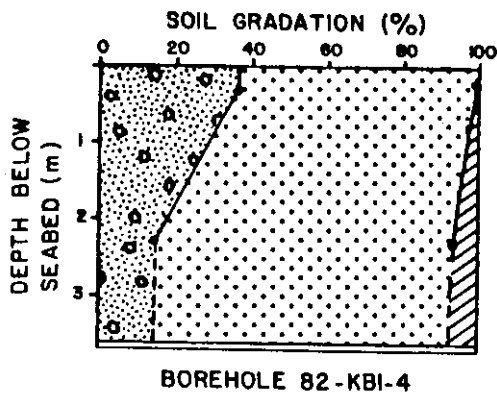
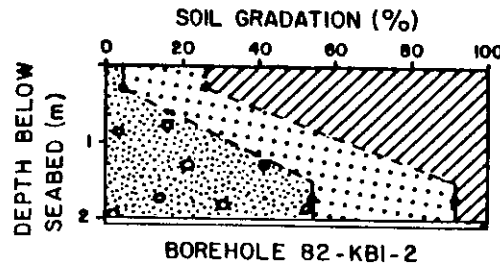
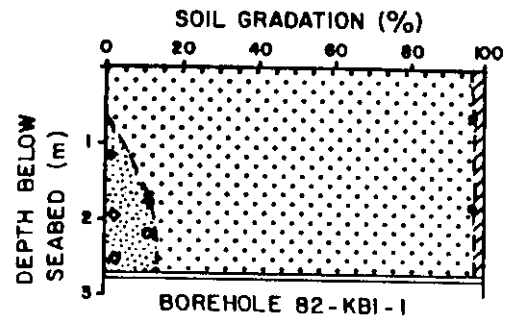


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**KADLUK BORROW  
SITE PLAN AND BOREHOLE LOCATIONS**

CGI4029A70D

FIG 1



LEGEND

-  GRAVEL
-  SAND
-  FINES



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KADLUK BORROW  
SUMMARY OF GRAIN SIZE DISTRIBUTION

CGI4029A70D

FIG. 2



82-KBI-2, the thickness of these granular materials range from 0.7 to 7.1 metres with a mean of approximately 2.4 metres. At the location of borehole 82-KBI-3, layers of silt were noted.

### 3.0 FIELD AND LABORATORY DATA

Explanation of all terms and symbols used on the borehole logs and in the summary of classification test results is given in Attachment I.

A detailed description of the soil stratigraphy together with laboratory data, where appropriate, is presented on the borehole logs, Attachment II.

The classification tests are summarized in Attachment III, for all samples tested.

The grain size distribution curve, for each sample tested, is included in Attachment IV, in the order noted in the summary of classification test results.

### 4.0 CLOSURE

The data from both field and laboratory investigations of borrow in the Kadluk block, at seven borehole locations, are included

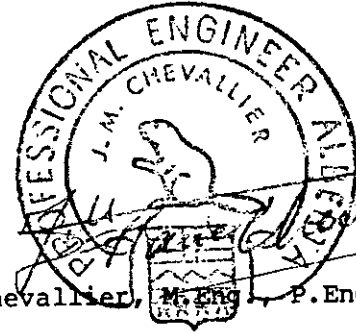




herein. Evaluation and interpretation of the data are presented in a separate report together with appropriate recommendations.

Respectfully submitted,

HARDY ASSOCIATES (1978) LTD.



Per:

J.M. Chevallier, M. Eng., P. Eng.

THE ASSOCIATION OF  
PROFESSIONAL ENGINEERS,  
GEOLOGISTS and GEOPHYSICISTS  
OF ALBERTA  
PERMIT NUMBER  
P 226  
HARDY ASSOCIATES  
(1978) LTD.

Per:

N.C. Burgess, P. Eng.

JMC:mm  
11:12



I. 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 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:

	w	natural moisture content (ASTM D 2216)
	w <sub>P</sub>	plastic limit (ASTM D 424)
	w <sub>L</sub>	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 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 3.

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.

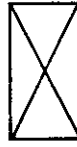


## SOIL SAMPLES

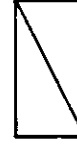
CONDITION — This column graphically indicates the depth and condition of the sample:



undisturbed



disturbed



not recovered

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
*D	Relative density (formerly specific gravity)
*k <sup>R</sup>	Permeability coefficient
*GS	Mechanical grain size analysis and hydrometer test (if appropriate)
pp	Pocket penetrometer strength
*TX	Triaxial compression test
q <sub>u</sub>	Unconfined compressive strength
*DS	Shearbox test
SG	Specific Gravity
SO <sub>4</sub>	Concentration of water-soluble sulphate
OC	Organic Content
*ST	Swelling test
*TV	Torvane shear strength
*LV	Vane shear strength (undisturbed-remolded)
ε <sub>f</sub>	Unit strain at failure
γ	Unit weight of soil or rock
γ <sub>d</sub>	Dry unit weight of soil or rock
ρ	Density of soil or rock
ρ <sub>d</sub>	Dry density of soil or rock

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

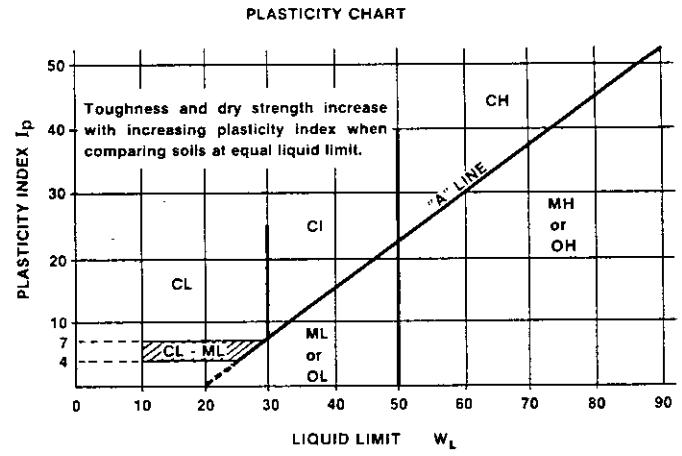
SOIL CLASSIFICATION SYSTEM (MODIFIED U.S.C.)

MAJOR DIVISION		GROUP SYMBOL	GRAPHIC SYMBOL	COLOR CODE	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA	
HIGHLY ORGANIC SOILS		PI		ORANGE	PEAT AND OTHER HIGHLY ORGANIC SOILS	STRONG COLOR OR ODOR, AND OFTEN FIBROUS TEXTURE	
COARSE-GRAINED SOILS (MORE THAN HALF BY WEIGHT LARGER THAN NO. 200 SIEVE SIZE)	GRAVELS MORE THAN HALF COARSE FRACTION LARGER THAN NO. 4 SIEVE SIZE	CLEAN GRAVELS	GW		RED	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, < 5% FINES	$C_u = \frac{D_{60}}{D_{10}} > 6$ $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{ to } 3$
			GP		RED	POORLY-GRADED GRAVELS, AND GRAVEL-SAND MIXTURES, < 5% FINES	NOT MEETING ALL ABOVE REQUIREMENTS
		DIRTY GRAVELS	GM		YELLOW	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES > 12% FINES	ATTERBERG LIMITS BELOW "A" LINE OR $I_p < 4$
			GC		YELLOW	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES > 12% FINES	ATTERBERG LIMITS ABOVE "A" LINE, $I_p > 7$
	SANDS MORE THAN HALF COARSE FRACTION SMALLER THAN NO. 4 SIEVE SIZE	CLEAN SANDS	SW		RED	WELL-GRADED SANDS, GRAVELLY SANDS, < 5% FINES	$C_u = \frac{D_{60}}{D_{10}} > 4$ $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{ to } 3$
			SP		RED	POORLY-GRADED SANDS, OR GRAVELLY SANDS, < 5% FINES	NOT MEETING ALL ABOVE REQUIREMENTS
		DIRTY SANDS	SM		YELLOW	SILTY SANDS, SAND-SILT MIXTURES > 12% FINES	ATTERBERG LIMITS BELOW "A" LINE OR $I_p < 4$
			SC		YELLOW	CLAYEY SANDS, SAND-CLAY MIXTURES > 12% FINES	ATTERBERG LIMITS ABOVE "A" LINE OR $I_p > 7$
FINE-GRAINED SOILS (MORE THAN HALF BY WEIGHT PASSES NO. 200 SIEVE SIZE)	SILTS BELOW "A" LINE ON PLASTICITY CHART; NEGLECTIBLE ORGANIC CONTENT	ML		GREEN	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY SANDS OF SLIGHT PLASTICITY	$W_L < 50$	
		MH		BLUE	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDY OR SILTY SOILS	$W_L > 50$	
	CLAYS ABOVE "A" LINE ON PLASTICITY CHART; NEGLECTIBLE ORGANIC CONTENT	CL		GREEN	INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY, OR SILTY CLAYS, LEAN CLAYS	$W_L < 30$	
		CI		GREEN-BLUE	INORGANIC CLAYS OF MEDIUM PLASTICITY SILTY CLAYS	$W_L > 30, < 50$	
		CH		BLUE	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	$W_L > 50$	
	ORGANIC SILTS & ORGANIC CLAYS BELOW "A" LINE ON PLASTICITY CHART	OL		GREEN	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY	$W_L < 50$	
		OH		BLUE	ORGANIC CLAYS OF HIGH PLASTICITY	$W_L > 50$	

SEE CHART BELOW

- All sieve sizes mentioned on this chart are U.S. Standard, ASTM E11.
- 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.
- 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%



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II. BOREHOLE LOGS











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# BOREHOLE LOG

ESSO RESOURCES CANADA LIMITED

BOREHOLE NO.  
82-KBI-4  
SHEET 1 OF 1

LOGGED BY: JMC      LOCATION: KADLUK      DATE: 82.09.13

RIG: MARL-DGD 2000      METHOD: ROTARY/WIRE-LINE      START: 1400      FINISH: 1515

PROJECT NO. CG14029 A70D      UTM COORD. N: 7737351      E: 462955      FIELD TEST RECORD

$W_p - \square$ $W - \circ$ $W_L - \triangle$ BULK DENSITY (kg/m <sup>3</sup> ) • 1200   1400   1600   1800 MOISTURE CONTENT % 20   40   60   80				DEPTH (metres)	SAMPLE TYPE & No	SAMPLE CONDITION	USC CLASSIFICATION	SOIL GRAPHIC LOG	DESCRIPTION	FIELD TEST RECORD						
										TEMPERATURE (°C)	CONE PENETRATION (CPT)	PRESSUREMETER (PMT)	DILATOMETER (DMT)	FIELD SHEAR VANE (VST)	TORVANE (TV)	POCKET PENET. (PP)
				2					WATER							
				4												
				6												
				8	D1	SP	SP		SAND and GRAVEL fine to coarse sand, fine gravel, grey (gap-graded)							GS
				10	D2	SP-SM	SP-SM		SAND fine to coarse, little fine gravel, trace silt, grey							GS
				12	D3	CI	CI		CLAY silty, medium plastic, stiff, grey							
				14	D4	CL	CL		--- low plastic clay							
				16	D5				--- low to medium plastic clay, (frozen, VxVr = 30%)							
				18					Bottom of Hole at 15.9m							



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# BOREHOLE LOG

ESSO RESOURCES CANADA LIMITED

BOREHOLE NO  
82-KBI-5  
SHEET 1 OF 1

LOGGED BY: BD      LOCATION: KADLUK      DATE: 82.09.13-14

RIG: MARL-DGD. 2000      METHOD: ROTARY/WIRE-LINE      START: 2047 / 09.13      FINISH: 0015 / 09.14

PROJECT NO. CG14029A70D      UTM COORD. N: 7738679      E: 466010      FIELD TEST RECORD

$W_p - \square$ $W - \circ$ $W_L - \triangle$ BULK DENSITY (kg/m <sup>3</sup> ) ● 1200    1400    1600    1800 MOISTURE CONTENT % 20    40    60    80	DEPTH (metres)	SAMPLE TYPE & No	SAMPLE CONDITION	USC CLASSIFICATION	SOIL GRAPHIC LOG	DESCRIPTION	TEMPERATURE (°C)	CONE PENETRATION (CPT)	PRESSUREMETER (PMT)	DILATOMETER (DMT)	FIELD SHEAR VANE (VST)	TORVANE (TV)	POCKET PENET. (PP)	LABORATORY TESTS
--	----------------	------------------	------------------	--------------------	------------------	-------------	------------------	------------------------	---------------------	-------------------	------------------------	--------------	--------------------	------------------

						WATER								
	2													
	4													
	6													
	8													
	10	D1	GP			GRAVEL to 25mm								
	12	D2	CL			CLAY firm to stiff								
	14	D3												
		D4												
		D5												
	16					Bottom of Hole at 14.5m								





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BOREHOLE LOG

ESSO RESOURCES CANADA LIMITED

BOREHOLE NO. 82-KBI-7 SHEET 1 OF 1

LOGGED BY: JMC LOCATION: KADLUK DATE: 82.09.14

RIG: MARL-DG.D. 2000 METHOD: ROTARY/WIRE-LINE START: 1130 FINISH: 1245

PROJECT NO. CG14029A70D UTM COORD. N: 7738004 E: 466103 FIELD TEST RECORD

Table with columns for Depth (metres), Sample Type & No, Sample Condition, USC Classification, Soil Graphic Log, Description, Temperature (°C), Cone Penetration (CPT), Pressuremeter (PMT), Dilatometer (DMT), Field Shear Vane (VST), Torvane (TV), Pocket Penet. (PP), and Laboratory Tests. Includes data for water, sand, and clay layers.



III. SUMMARY OF CLASSIFICATION TEST RESULTS



















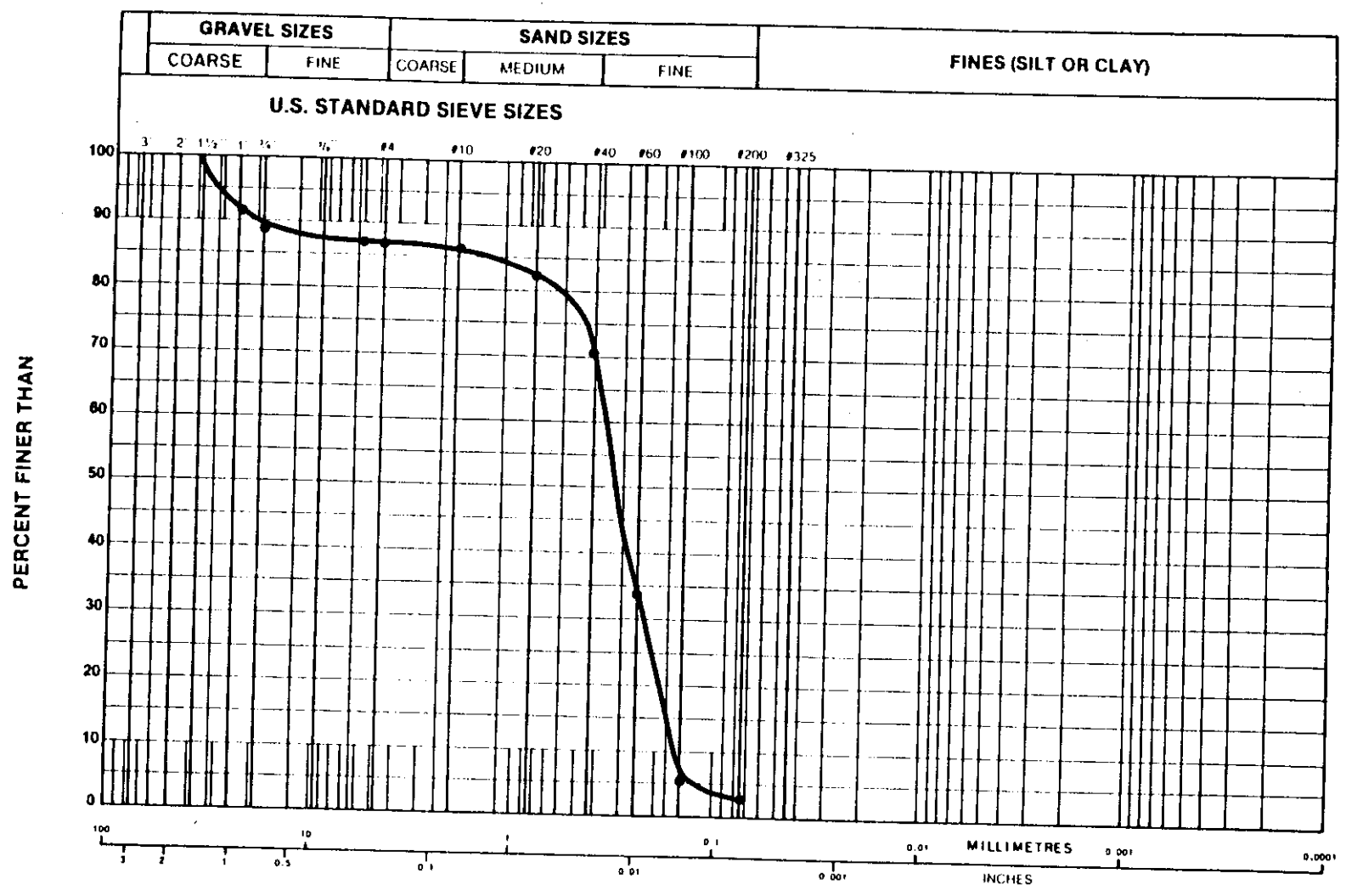
IV. GRAIN SIZE DISTRIBUTION CURVES





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**GRAIN SIZE CURVE**



**GRAIN SIZE**  
 SAND fine to medium-grained, little gravel, trace silt

$D_{10}$	=	0.16	mm.
$D_{30}$	=	0.23	mm.
$D_{60}$	=	0.35	mm.
$C_u$	=	2.2	
$C_c$	=	0.86	

GRAVEL	12.1 %	SAND	85.1 %	FINES	2.8 %	SOIL GROUP	SP
--------	--------	------	--------	-------	-------	------------	----

NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM

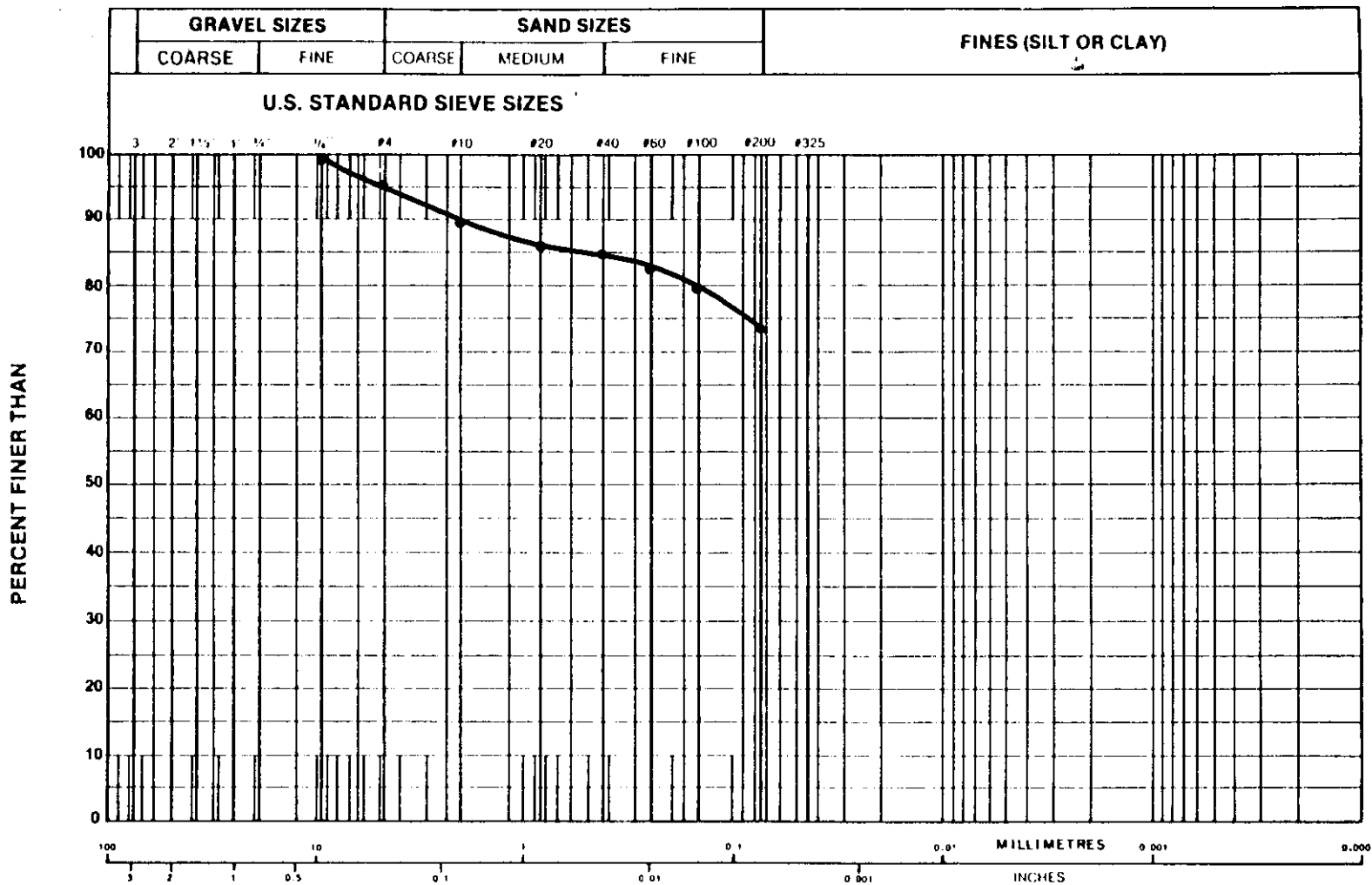
PROJECT NO.	CG 14029-A70D
CLIENT	ESSO RESOURCES CANADA LTD.
BOREHOLE SAMPLE	82-KBI-1
DEPTH (m)	D2 9.4 - 9.9
TECHNICIAN	KK
DATE TESTED	82.10.07





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**GRAIN SIZE CURVE**



**GRAIN SIZE**

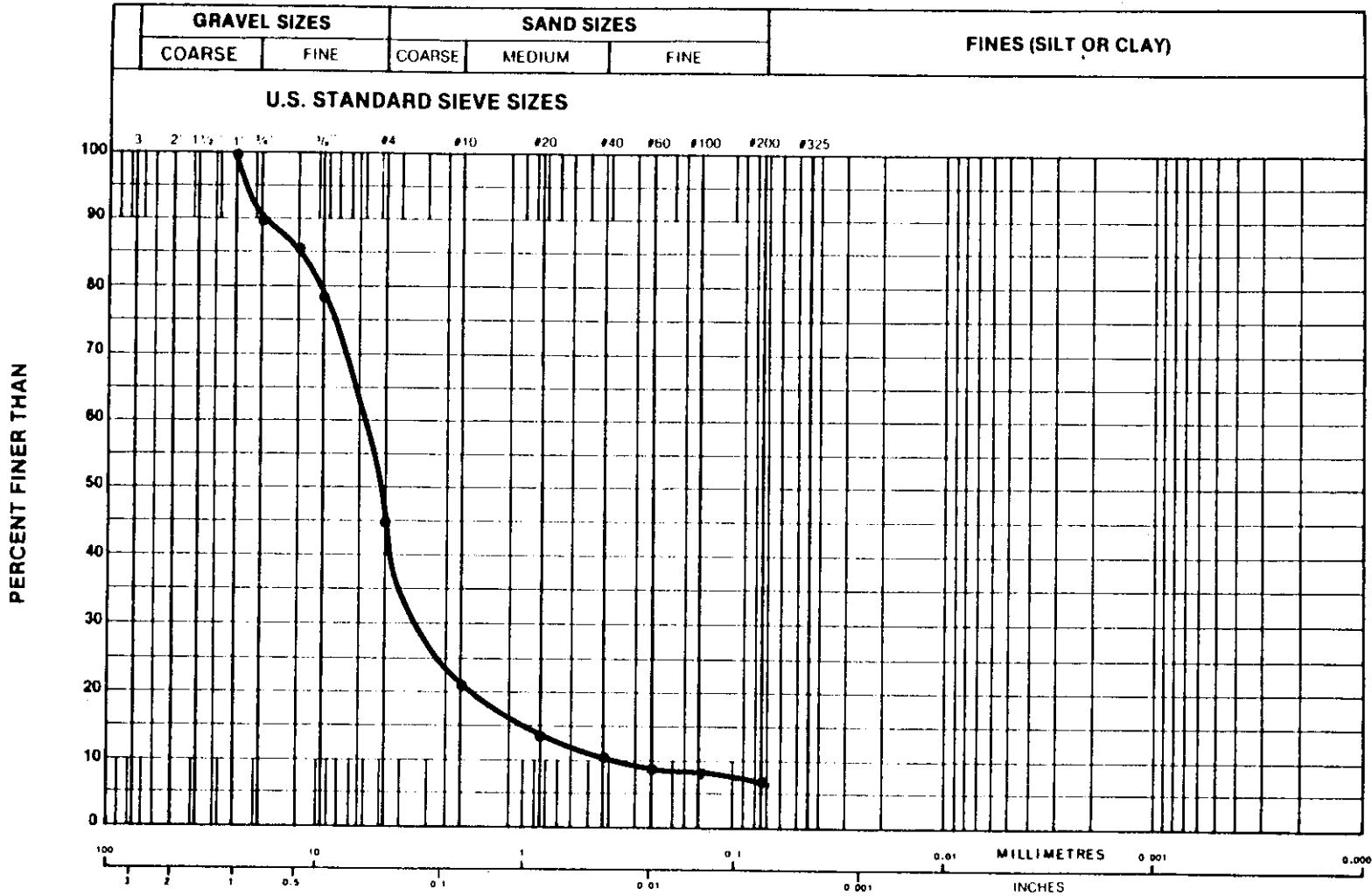
CLAY silty, some fine to coarse sand, trace fine gravel

D <sub>10</sub>	=	_____	mm.
D <sub>30</sub>	=	_____	mm.
D <sub>60</sub>	=	_____	mm.
C <sub>u</sub>	=	_____	
C <sub>c</sub>	=	_____	

GRAVEL	4.4 %	SAND	21.9 %	FINES	73.7 %	SOIL GROUP	SC-CL
--------	-------	------	--------	-------	--------	------------	-------

NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM

PROJECT NO.	CG 14029-470D
CLIENT	ESSO RESOURCES CANADA LTD.
BOREHOLE	82-KBI-2
SAMPLE	D1
DEPTH (m)	8.8 - 9.3
TECHNICIAN	KK
DATE TESTED	82.10.12



GRAVEL and SAND fine to coarse gravel, fine to coarse sand, trace silt

GRAVEL	55.1 %	SAND	37.6 %	FINES	7.3 %	SOIL GROUP	GP-GM
--------	--------	------	--------	-------	-------	------------	-------

NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM

$D_{10}$	=	0.4	mm.
$D_{30}$	=	3.7	mm.
$D_{60}$	=	6.0	mm.
$C_u$	=	15.0	
$C_c$	=	5.7	



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PROJECT NO. CG 14029-A70D  
 CLIENT ESSO RESOURCES CANADA LTD.  
 BOREHOLE 82-KBI-2  
 SAMPLE D2  
 DEPTH (m) 10.1 - 10.5  
 TECHNICIAN KK  
 DATE TESTED 82.10.12

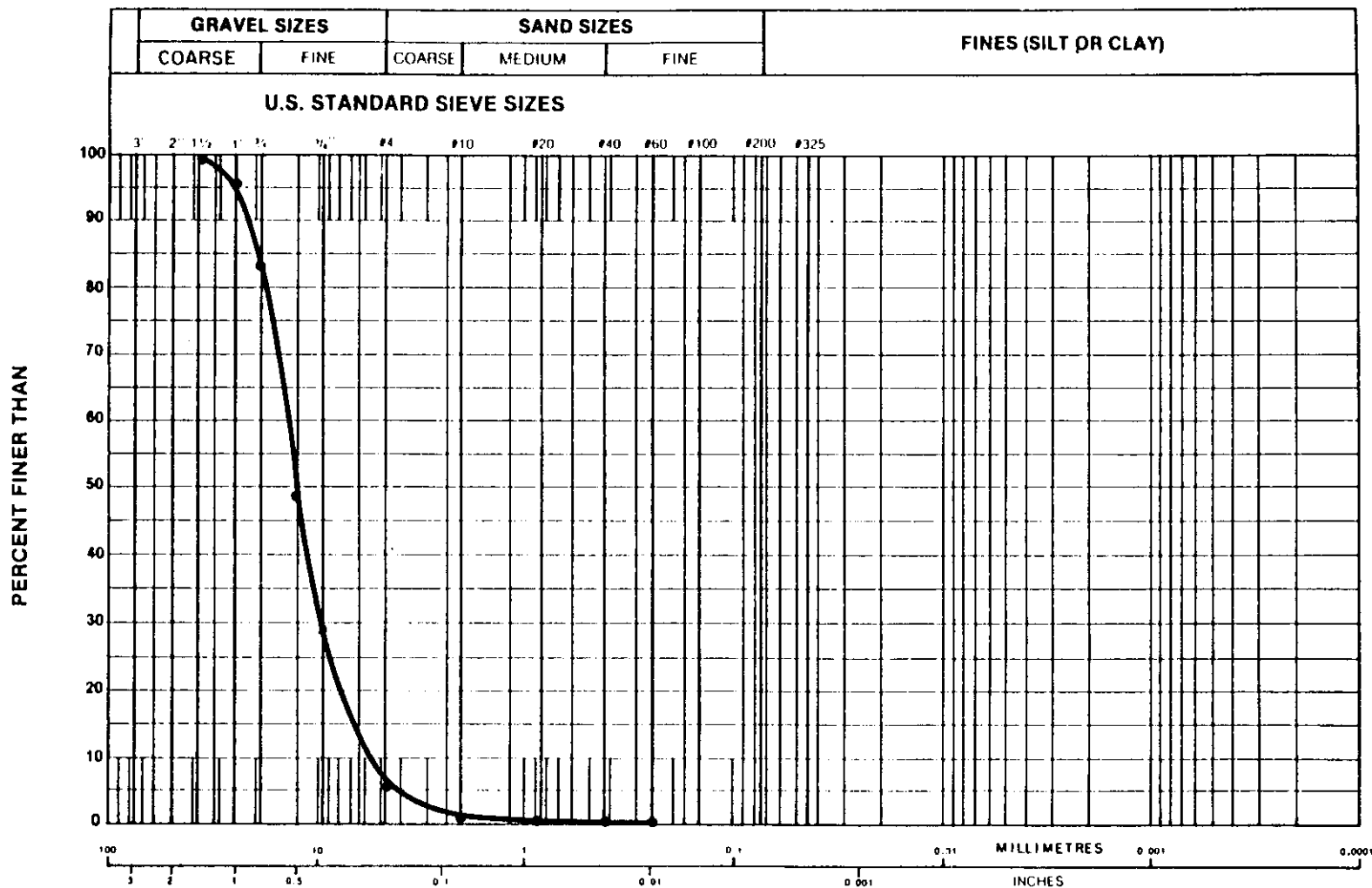




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### GRAIN SIZE CURVE

PROJECT NO. CG 10429-A70D  
CLIENT ESSO RESOURCES CANADA LTD.  
BOREHOLE 82-KBI-3  
SAMPLE D2  
DEPTH (m) 9.8 - 10.2  
TECHNICIAN KK  
DATE TESTED 82.10.01



GRAIN SIZE  
GRAVEL fine to coarse, trace coarse sand

GRAVEL	94.1%	SAND	5.2 %	FINES	0.7 %	SOIL GROUP	GP
--------	-------	------	-------	-------	-------	------------	----

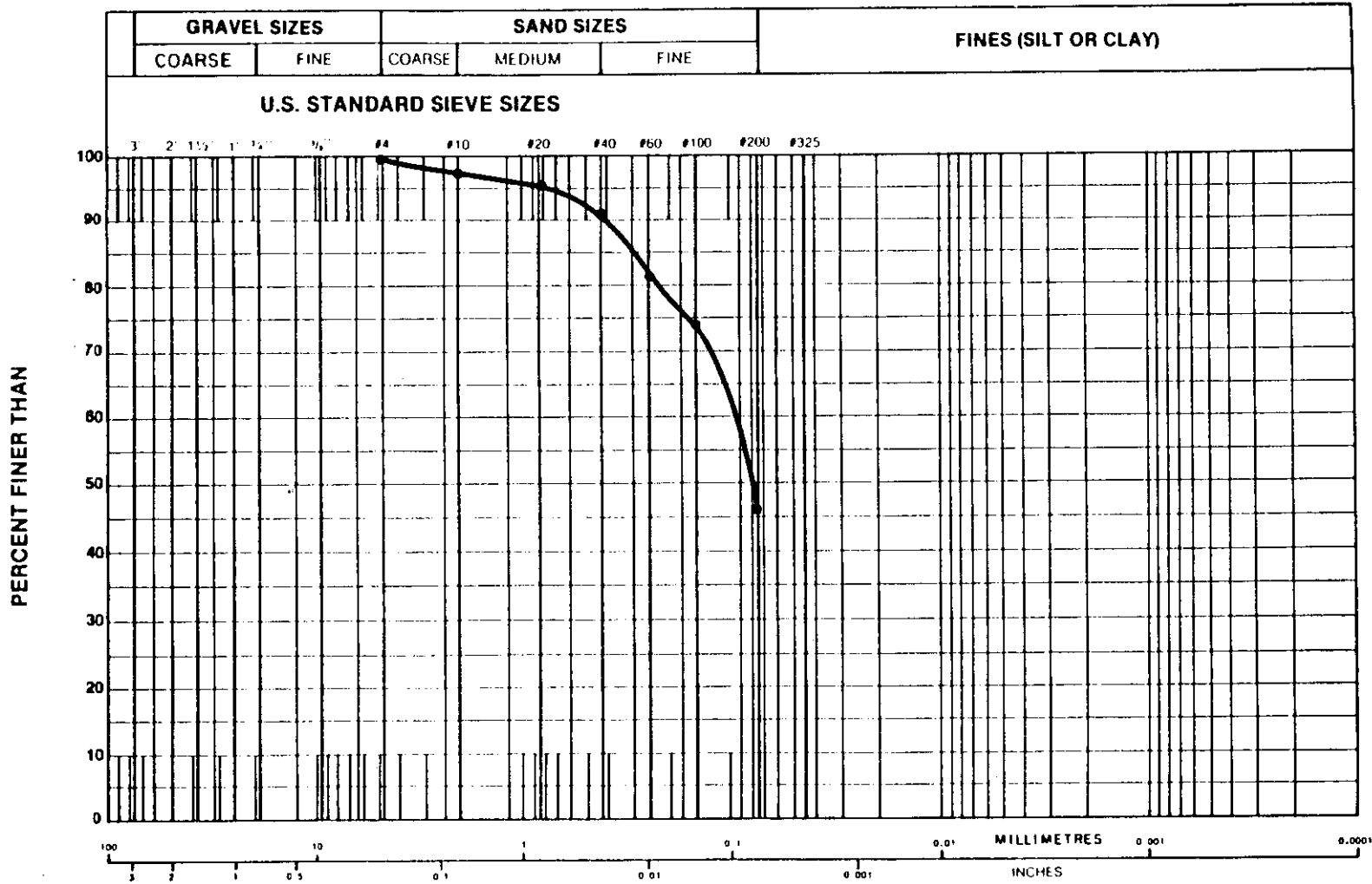
NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM

$D_{10}$	=	5.8	mm.
$D_{30}$	=	9.5	mm.
$D_{60}$	=	14.0	mm.
$C_u$	=	2.4	
$C_c$	=	1.11	



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**GRAIN SIZE CURVE**



SAND and SILT fine to coarse sand

GRAVEL	0 %	SAND	53.7 %	FINES	46.3 %	SOIL GROUP	SM-ML
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NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM

D <sub>10</sub>	=	_____	mm.
D <sub>30</sub>	=	_____	mm.
D <sub>60</sub>	=	_____	mm.
C <sub>u</sub>	=	_____	
C <sub>c</sub>	=	_____	

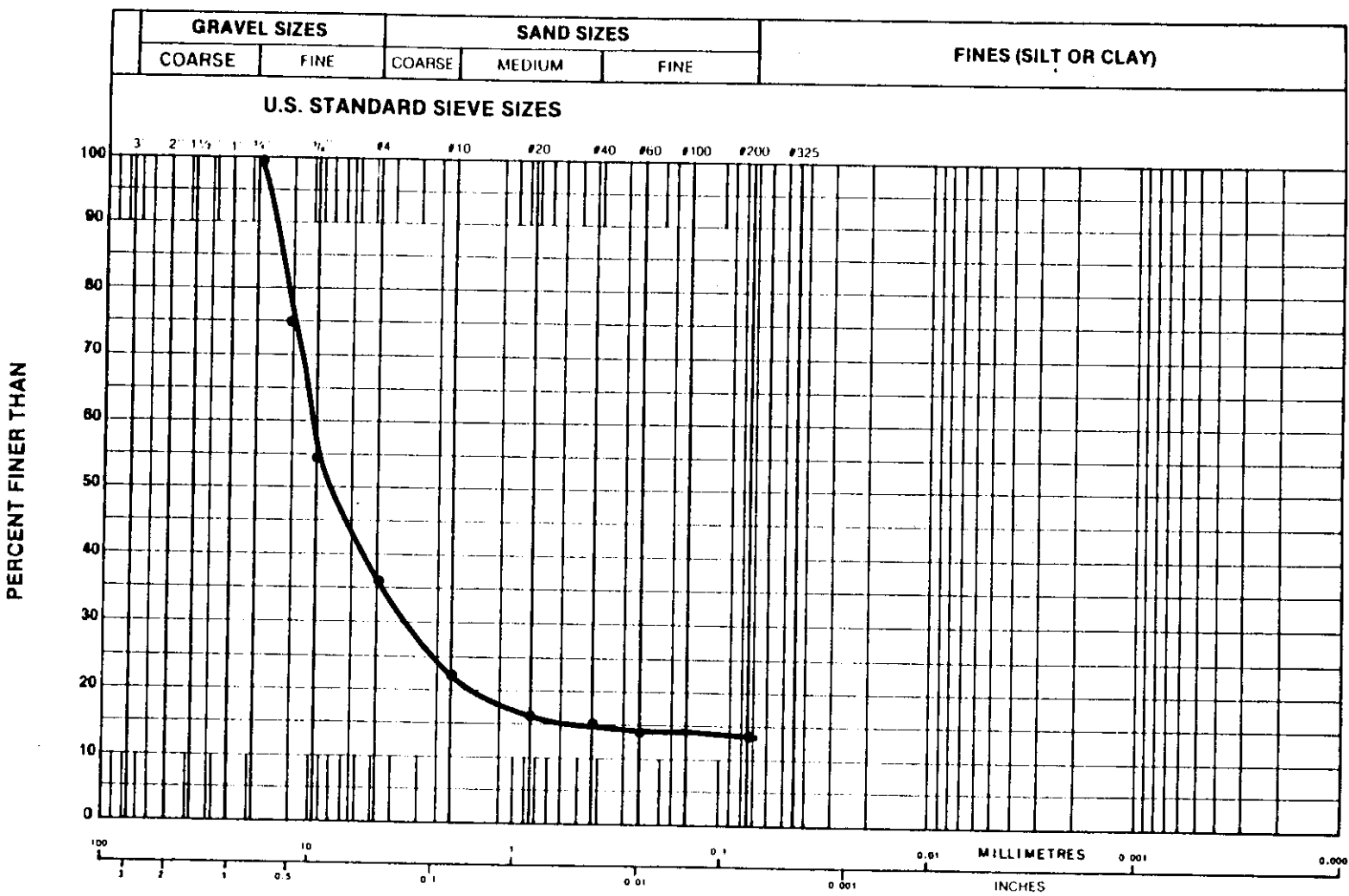
PROJECT NO. CG 14029-A70D  
 CLIENT ESSO RESOURCES CANADA LTD.  
 BOREHOLE 82-KBI-3  
 SAMPLE D3  
 DEPTH (m) 11.0 - 11.4  
 TECHNICIAN KK DATE TESTED 82.10.01



**HARDY ASSOCIATES (1978) LTD.**  
CONSULTING ENGINEERING & PROFESSIONAL SERVICES

**GRAIN SIZE CURVE**

PROJECT NO. CG 10429-A70D  
CLIENT ESSO RESOURCES CANADA LTD.  
BOREHOLE 82-KBI-3  
SAMPLE D4  
DEPTH (m) 11.9 - 12.3  
TECHNICIAN XK  
DATE TESTED 82.10.01

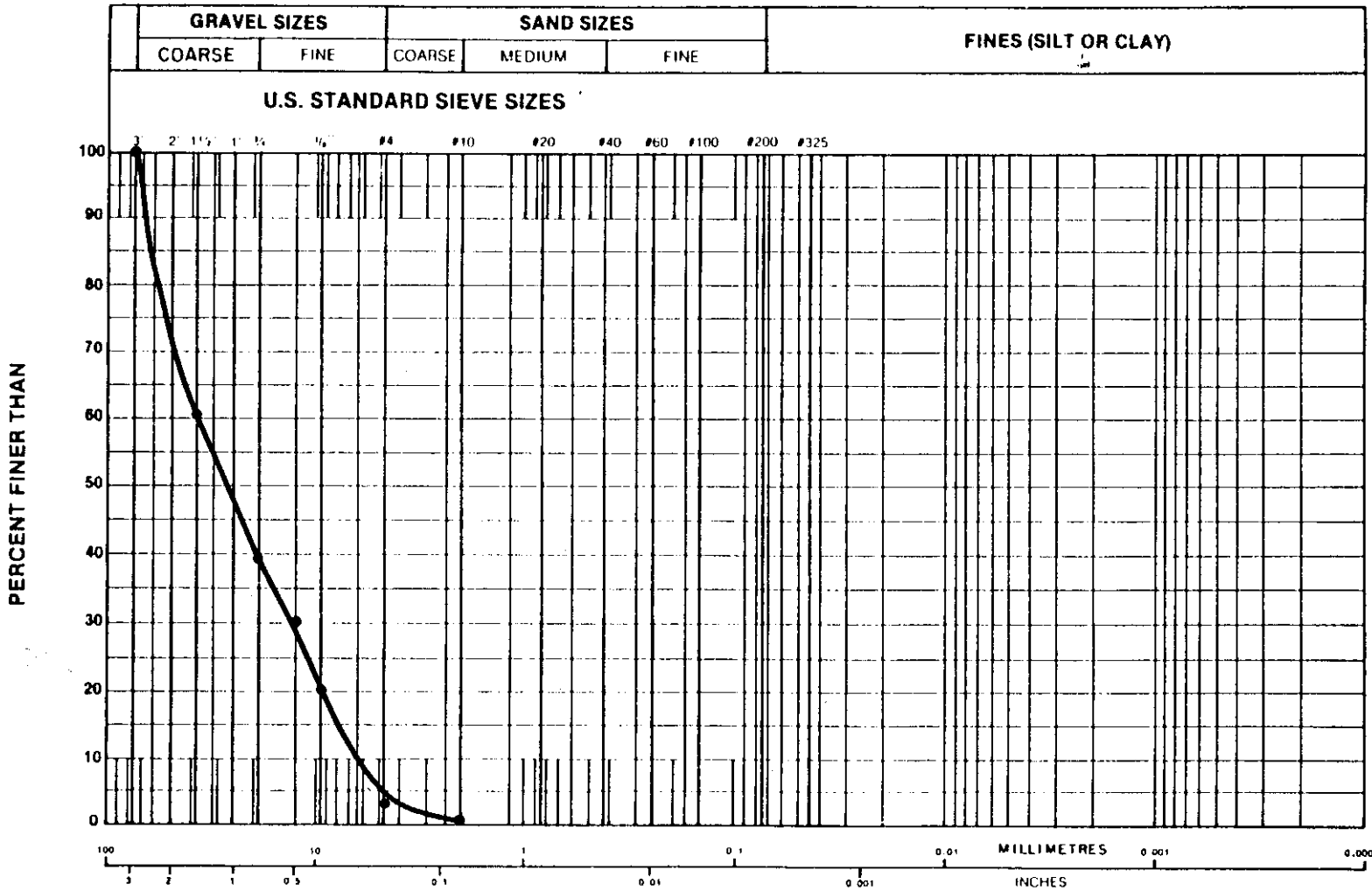


GRAIN SIZE  
GRAVEL fine, some medium to coarse sand, little silty clay

GRAVEL	63.4%	SAND	22.7 %	FINES	13.9 %	SOIL GROUP	GC
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NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM

D <sub>10</sub>	=	_____	mm
D <sub>30</sub>	=	_____	mm
D <sub>60</sub>	=	_____	mm
C <sub>u</sub>	=	_____	
C <sub>c</sub>	=	_____	



PERCENT FINER THAN

GRAIN SIZE

GRAVEL fine to coarse, trace coarse sand, no silt

GRAVEL	96.7%	SAND	3.3%	FINES	0 %	SOIL GROUP	GP
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NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM

D <sub>10</sub>	=	6.3	mm.
D <sub>30</sub>	=	13.0	mm.
D <sub>60</sub>	=	38.0	mm.
C <sub>u</sub>	=	6.0	
C <sub>c</sub>	=	0.7	



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**GRAIN SIZE CURVE**

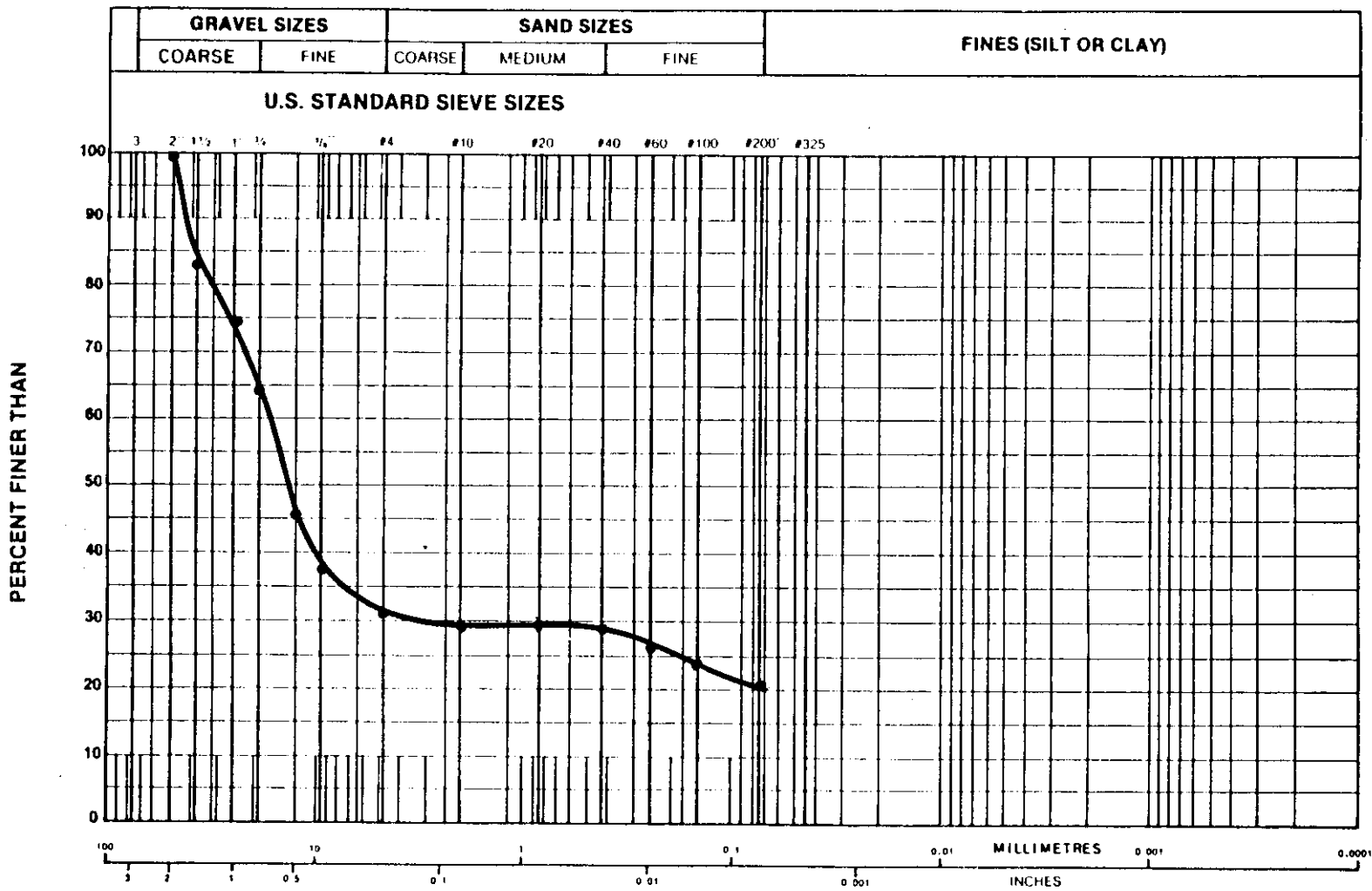
PROJECT NO.	CG 14029-A70D
CLIENT	FSSO RESOURCES CANADA LTD.
BOREHOLE	82-KBI-3
SAMPLE	D5
DEPTH (m)	12.8 - 13.3
TECHNICIAN	KK
DATE TESTED	82.10.01



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**GRAIN SIZE CURVE**

PROJECT NO. CG 14029-A70D  
 CLIENT ESSO RESOURCES CANADA LTD.  
 BOREHOLE 82-KBI-3  
 SAMPLE D6  
 DEPTH (m) 14.0 - 14.5  
 TECHNICIAN KK  
 DATE TESTED 82.10.01



GRAIN SIZE  
 GRAVEL fine to coarse, some silty clay, trace fine sand

D <sub>10</sub>	=	_____	mm.
D <sub>30</sub>	=	_____	mm.
D <sub>60</sub>	=	_____	mm.
C <sub>u</sub>	=	_____	
C <sub>c</sub>	=	_____	

GRAVEL	68.4 %	SAND	9.9 %	FINES	21.7 %	SOIL GROUP	GC
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NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM

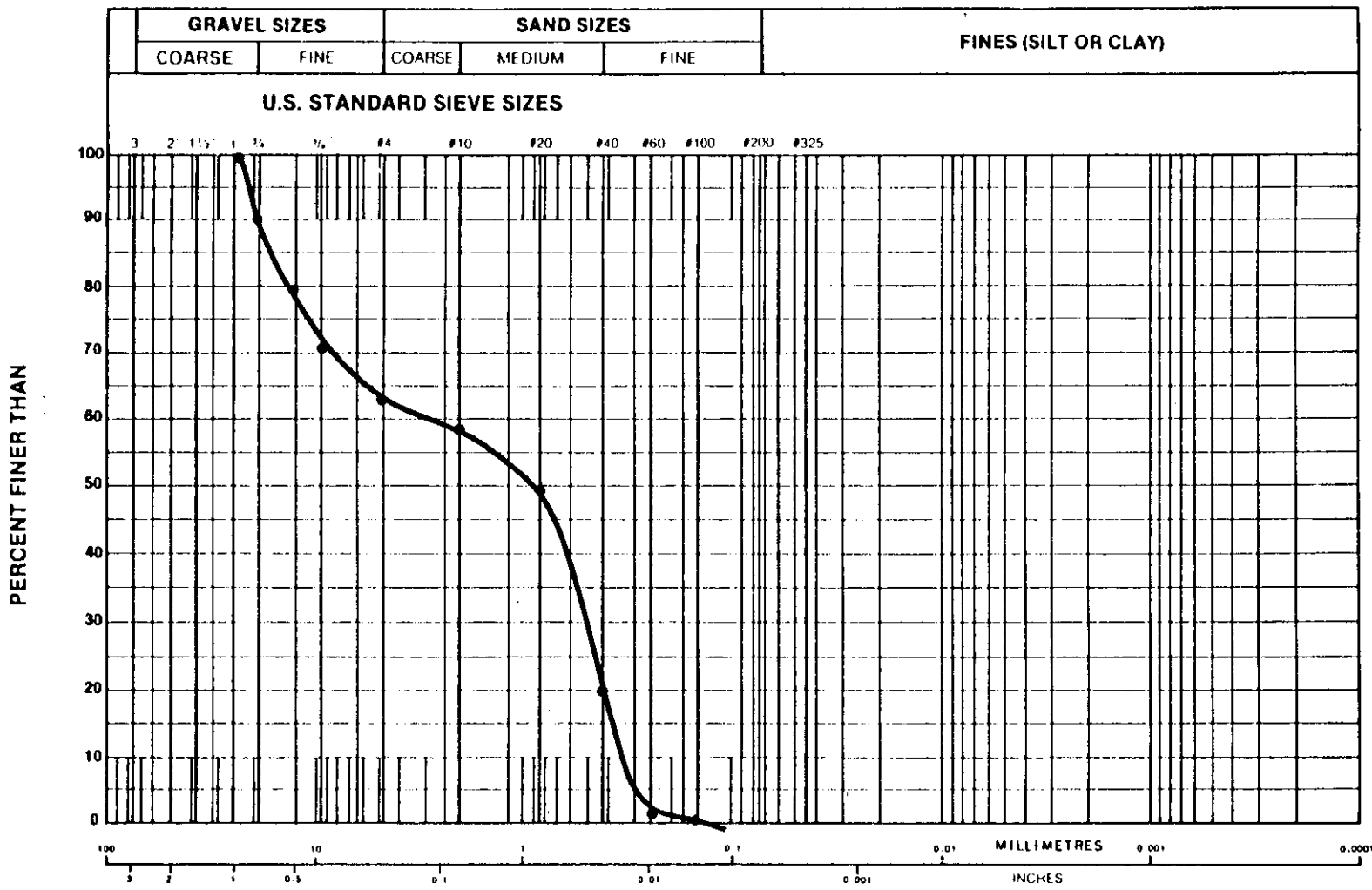




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**GRAIN SIZE CURVE**

PROJECT NO. CG 14029-A/0D  
CLIENT ESSO RESOURCES CANADA LTD.  
BOREHOLE 82-KBI-4  
SAMPLE D1  
DEPTH (m) 8.2 - 8.8  
TECHNICIAN KK  
DATE TESTED 82.10.01



SAND and GRAVEL fine to coarse sand, fine gravel

GRAVEL	36.7 %	SAND	62.9 %	FINES	0.4 %	SOIL GROUP	SP
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NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM

D <sub>10</sub>	=	0.35	mm.
D <sub>30</sub>	=	0.52	mm.
D <sub>60</sub>	=	3.0	mm.
C <sub>u</sub>	=	8.57	
C <sub>c</sub>	=	0.26	

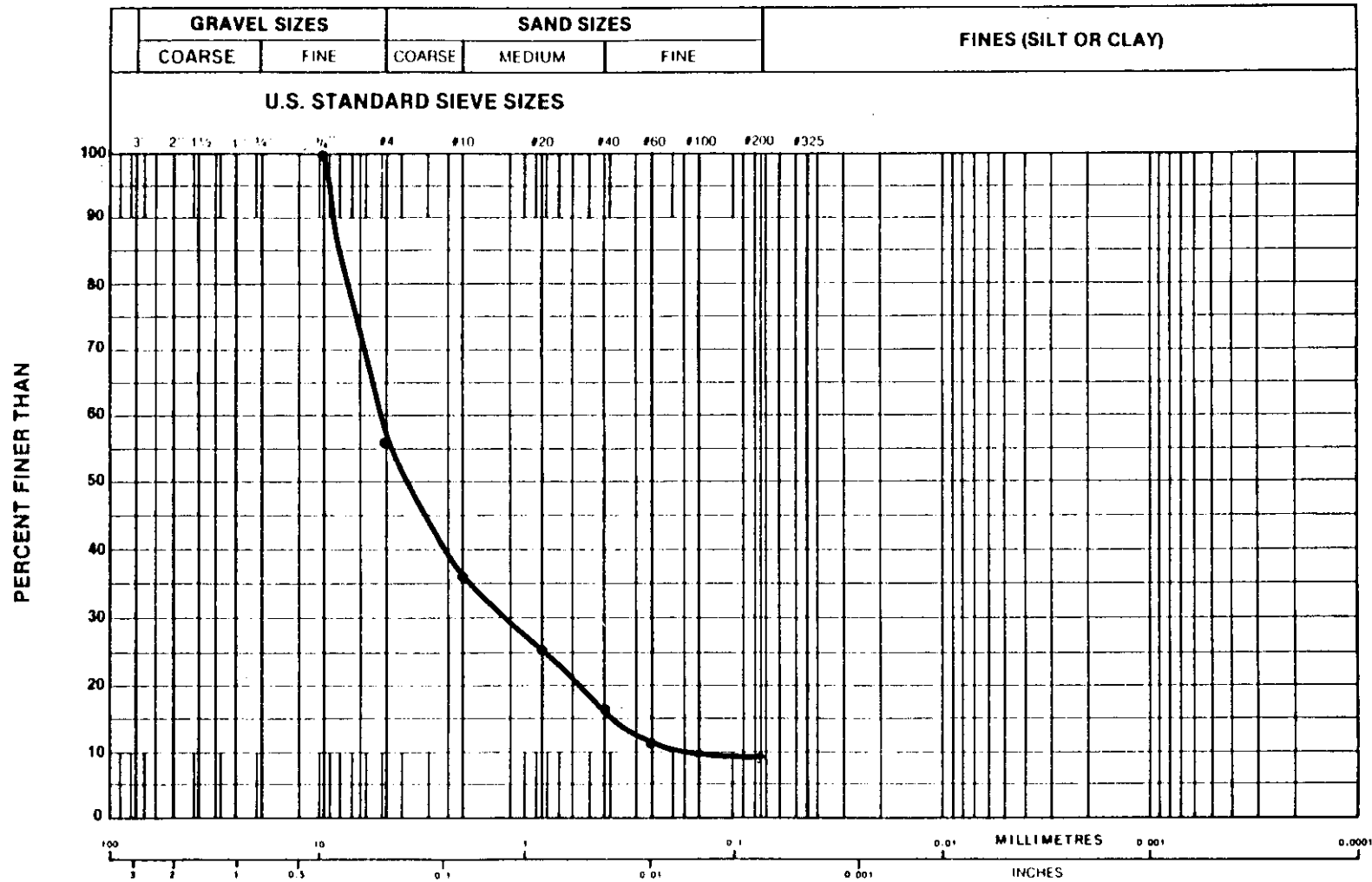




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### GRAIN SIZE CURVE

PROJECT NO. CG 10429-A70D  
CLIENT ESSO RESOURCES CANADA LTD.  
BOREHOLE 82-KB1-6  
SAMPLE D1  
DEPTH (m) 9.1 - 9.8  
TECHNICIAN KK  
DATE TESTED 82.10.01



#### GRAIN SIZE

SAND and GRAVEL fine to coarse sand, fine gravel, trace silt

GRAVEL	44.2 %	SAND	47.3 %	FINES	8.5 %	SOIL GROUP	SW-SM
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NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM

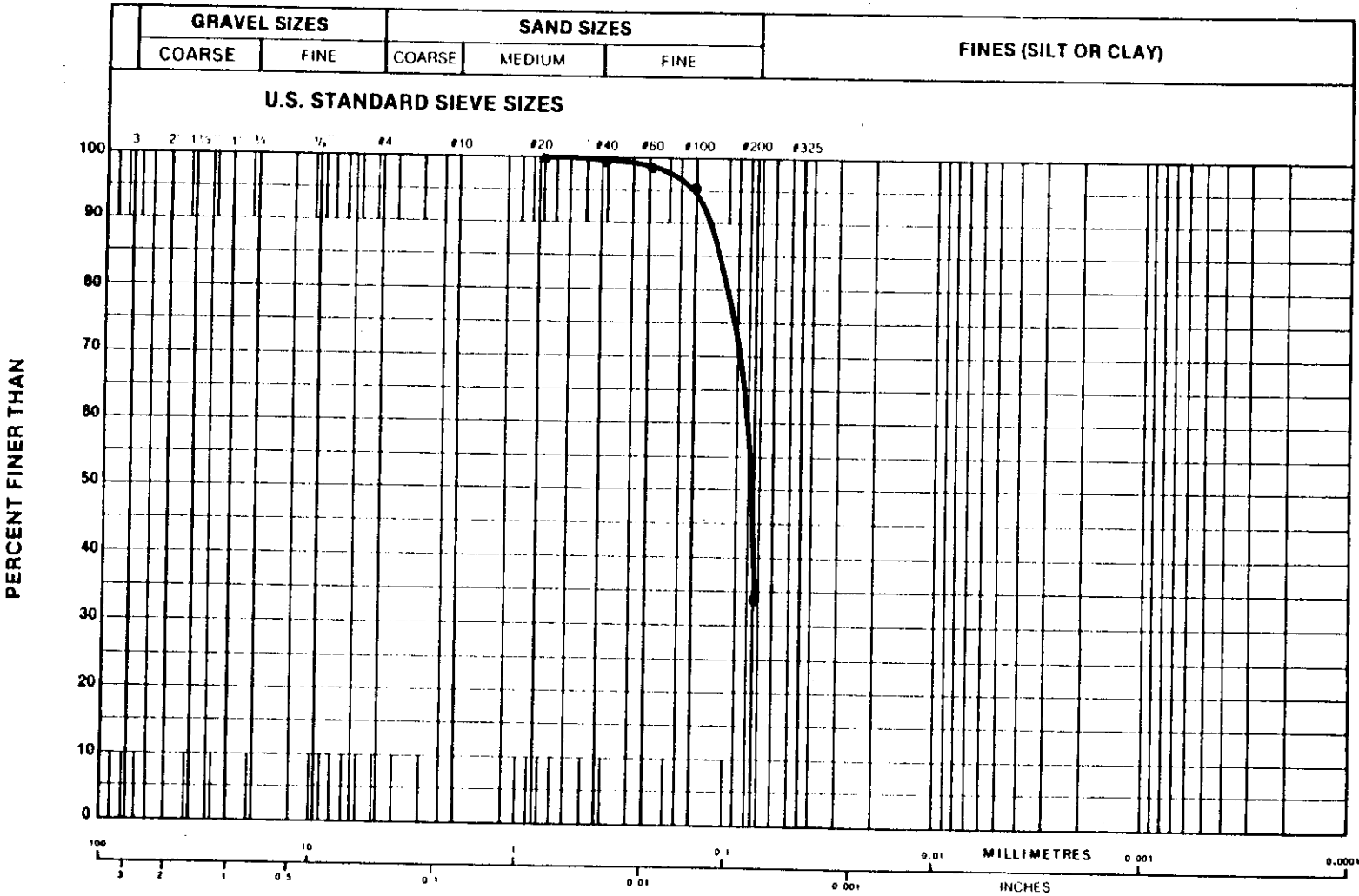
$D_{10}$	=	0.2	mm.
$D_{30}$	=	1.2	mm.
$D_{60}$	=	5.0	mm.
$C_u$	=	25.0	
$C_c$	=	1.44	



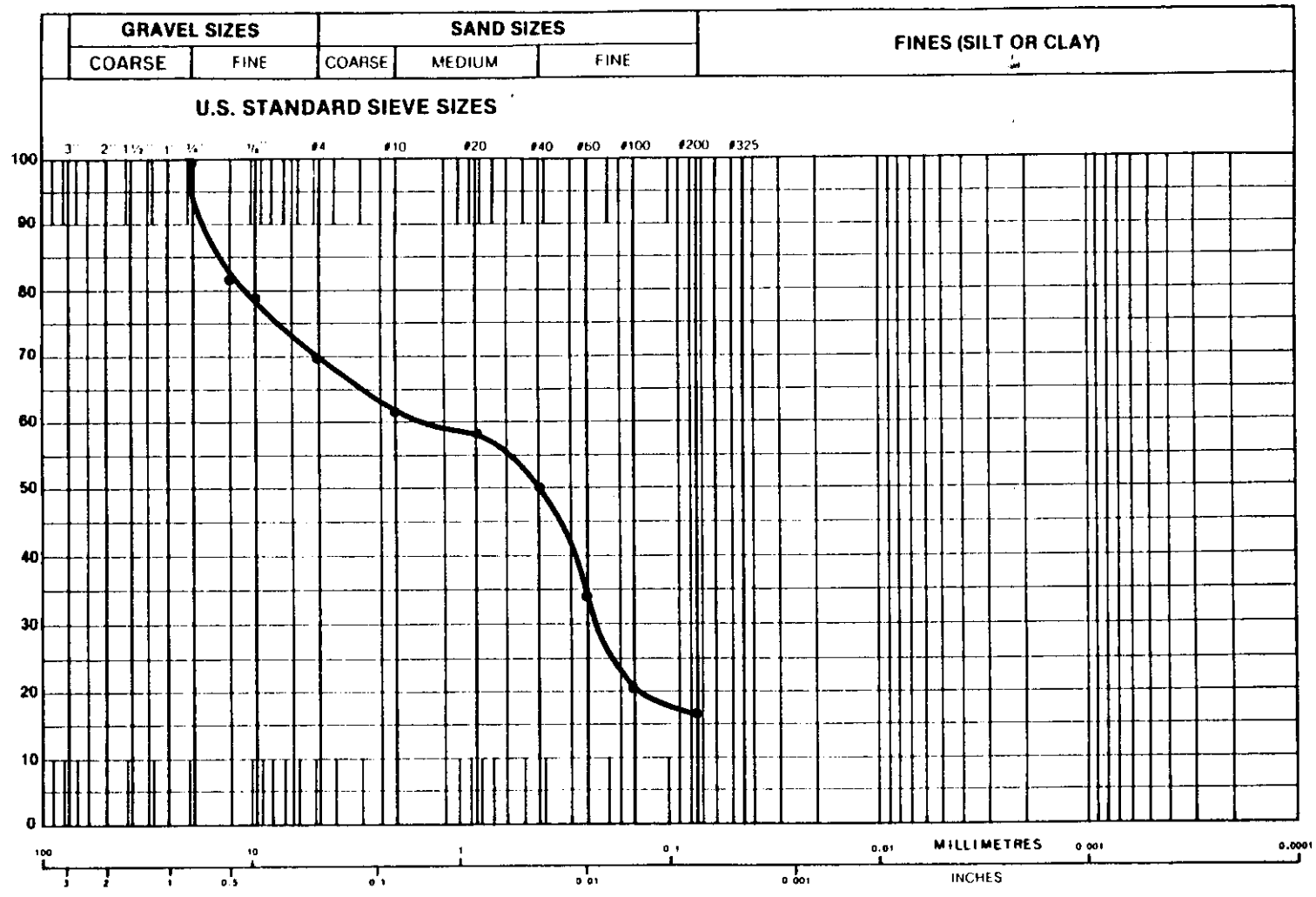
**HARDY ASSOCIATES (1978) LTD.**  
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**GRAIN SIZE CURVE**

PROJECT NO. CG 14029-A70D  
CLIENT ESSO RESOURCES CANADA LTD.  
BOREHOLE 82-KBI-6  
SAMPLE D3  
DEPTH (m) 11.0 - 11.6  
TECHNICIAN KK DATE TESTED 82.10.01



PERCENT FINER THAN



GRAIN SIZE

SAND fine to coarse-grained, some fine gravel, little silty clay

D <sub>10</sub>	=	_____	mm.
D <sub>30</sub>	=	_____	mm.
D <sub>60</sub>	=	_____	mm.
C <sub>u</sub>	=	_____	
C <sub>c</sub>	=	_____	

GRAVEL	30.4 %	SAND	52.9 %	FINES	16.7 %	SOIL GROUP	SC
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NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM



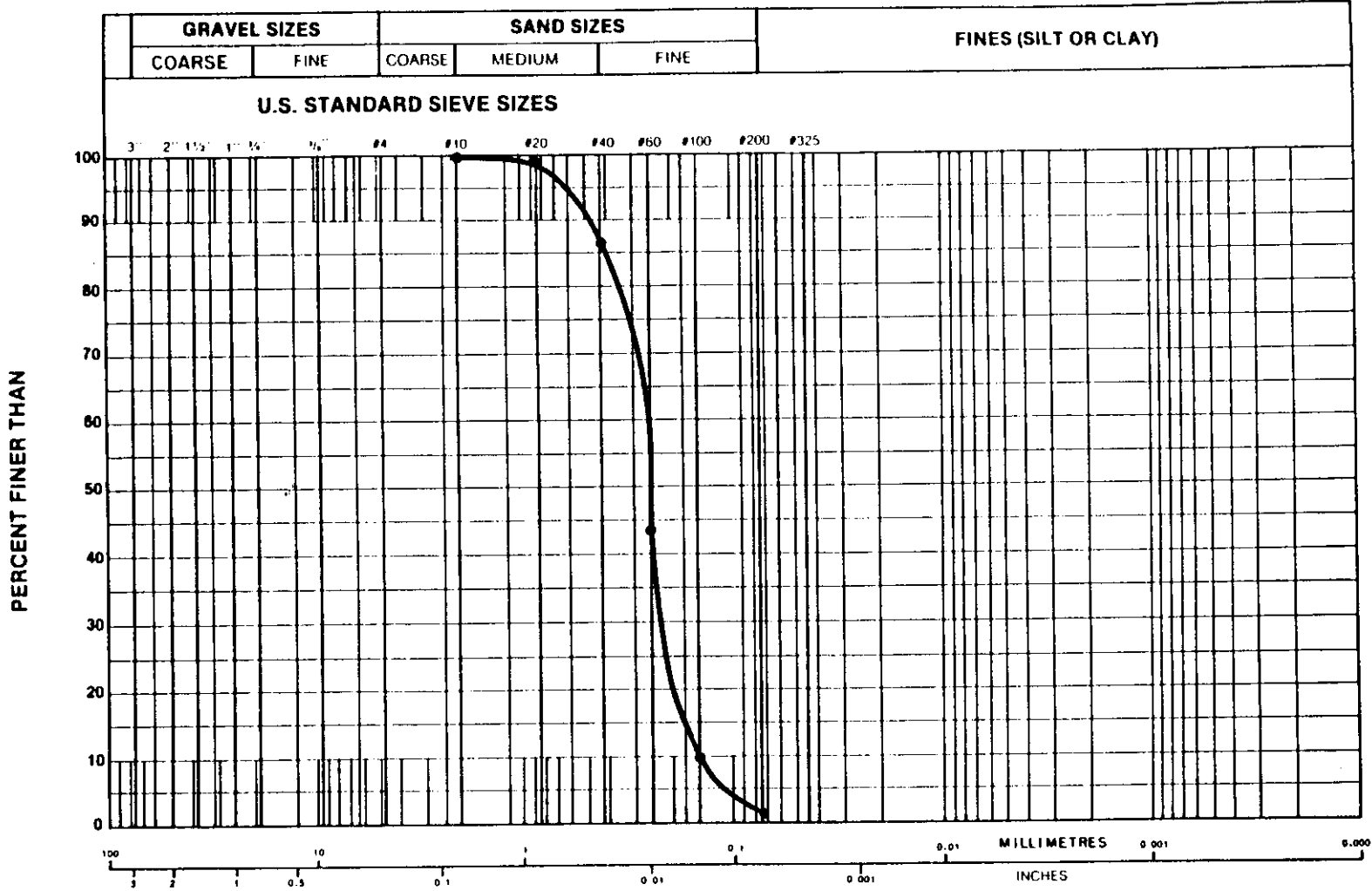
**HARDY ASSOCIATES (1978) LTD.**  
 CONSULTING ENGINEERING & PROFESSIONAL SERVICES  
**GRAIN SIZE CURVE**

PROJECT NO. CG 14029-A70D  
 CLIENT ESSO RESOURCES CANADA LTD.  
 BOREHOLE 82-KBI-7  
 SAMPLE D1  
 DEPTH (m) 8.8 - 9.3  
 TECHNICIAN KK  
 DATE TESTED 82.10.14



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**GRAIN SIZE CURVE**



PERCENT FINER THAN

U.S. STANDARD SIEVE SIZES

GRAVEL SIZES		SAND SIZES			FINES (SILT OR CLAY)
COARSE	FINE	COARSE	MEDIUM	FINE	

3" 2" 1.5" 1" 3/4" 3/8" #4 #10 #20 #40 #60 #100 #200 #325

100 90 80 70 60 50 40 30 20 10 0  
100 10 1 0.1 0.01 0.001 0.0001  
3 2 1 0.5 0.1 0.01 0.001 0.0001  
MILLIMETRES INCHES

**GRAIN SIZE**

SAND fine to medium-grained, trace silt

$D_{10}$	=	0.14	mm.
$D_{30}$	=	0.23	mm.
$D_{60}$	=	0.28	mm.
$C_u$	=	2.0	
$C_c$	=	1.35	

GRAVEL	0	%	SAND	97.7	%	FINES	2.3	%	SOIL GROUP	SP
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NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM

PROJECT NO.	CG 14029-A70D
CLIENT	ESSO RESOURCES CANADA LTD.
BORE HOLE	82-KBI-7
SAMPLE	D2
DEPTH (m)	9.8 - 10.4
TECHNICIAN	KK
DATE TESTED	82.10.14



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CORHARDY.82.30

\*DOXT 1\*



DATE DUE SLIP

APR 01 2002

RET'D JUN 13 2002

UN 15 2006

MAR 15 2006