

SURFICIAL GEOLOGY
and
GRANULAR RESOURCES
SOUTHEAST of HERSCHEL ISLAND
VOLUME II

Prepared for:

Indian and Northern Affairs Canada

June, 1984



D005019

10-260

M.J. O'CONNOR & ASSOCIATES LTD.



A. GEOPHYSICAL SURVEY PARAMETERS

The following information was provided directly by Geoterrex Ltd.

A.1 Survey Vessel

A.1.1 General Specifications

Name:	M. V. Norweta
Year built:	1971
Class:	C.S.T. Arctic Class E
Yard Tonnage:	Northern Arctic Shipyards Hay River, N.W.T.
Dimensions:	Length overall - 39.6 m Breadth moulded - 7.6 m Draft summer - 1.4 m
Registered tonnage:	Gross 286, Net 144.62
Main Engines:	3 independent 8V-71 Detroit diesel
Generators:	1 - 371 6 m 100 Kw 1 - Perkins 72 Kw 1 - Lister Harbout 15 Kw
Capacities:	Fuel oil - 14.5 tonne Fresh Water - 9.07 tonne
Speed maximum:	11 knots
Deck Machinery	Unic Hydraulic Crane, 2994 kg

A.1.2 Electrical Equipment

Radars:	Decca Marine
Gyro compass:	Sperry Marine, SR-120
SSB radios:	Canadian Marconi Ltd., CH25
VHF radio telephone:	Triton 40
Depth sounder:	Heathkit M101

A.2 Geophysical Equipment

A.2.1 Precision Echo Sounder

A.2.1.1 Equipment

Raytheon Model DE-719B

Operating frequency:	200 kHz
Accuracy:	0.5% + 1" depth
Transducer beamwidth:	2.4 m at the half power point
Sounding rate:	265 soundings per minute

Meyer Systems Model H1103 Bottom Tracker

Parallel BCD digital output
Verification trace (tracer) on the echo sounder's echogram
Draft compensation

A.2.1.2 Survey Parameters

Speed of sound in water:	1450 m/s
Transducer draft:	1.3 m
Mode:	Sub-bottom - bathymetry
Range:	Commonly 13 to 46 m
Chart speed:	3 in/min
Scale:	5 m/inch
Other ranges available:	Key edge 0-33, 30-63, 60-93, 90-123 Key centre 13-46, 43-76

A.2.1.3 Heave Compensator - ORE Model 315

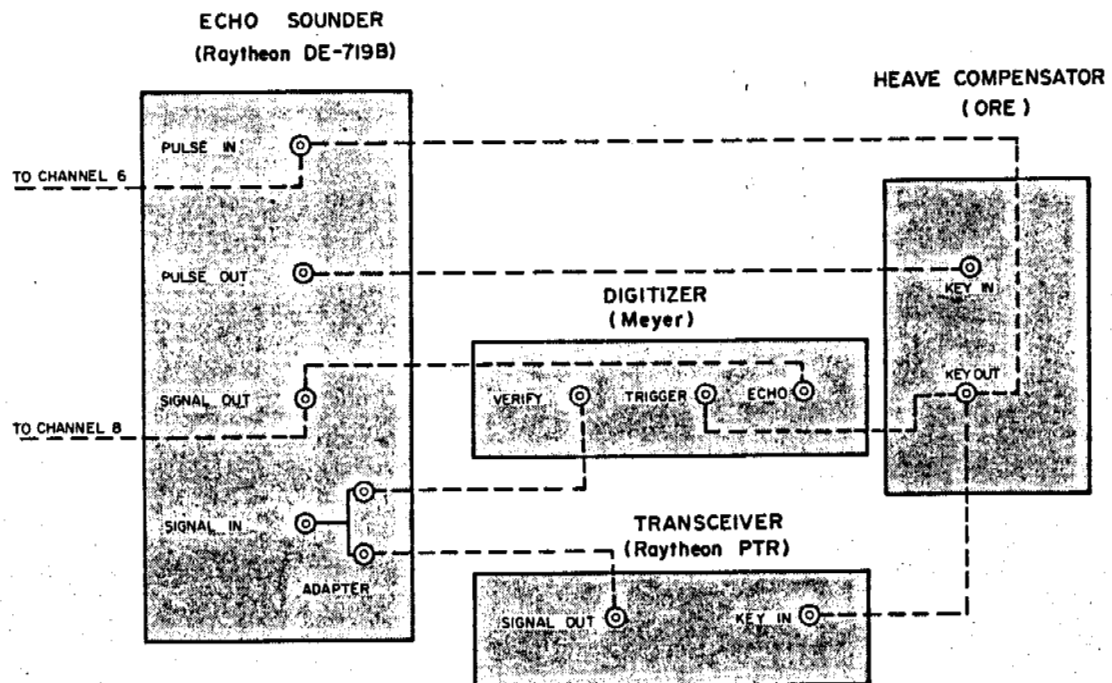
Used to determine the ship's vertical motion with a high degree of accuracy to correct the echo sounder readings.

Consists of an accelerometer with its sensitive axis vertically stabilized by a liquid-erected vertical gyro.

Frequency:	0.25 Hz to 0.08 Hz
Wave Period:	4 sec to 12 sec

A.2.1.4 Wiring Diagram

See Drawing No. A.1.



Schematic of Precision
Echo Sounder

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JOB No.: 10-260

DATE: 84/10/01

DRAWN BY: Geoterrex

DWG. No.: A.1

A.2.2 Side Scan Sonar

A.2.2.1 Equipment

Klein tow fish, 100 kHz, Model 422S-001F
Klein recorder, Model 531T
Klein slant range correction box, Model 606
Klein digital processor, Model 611
Hewlett-Packard tape recorder, Model HP3968

A.2.2.2 Survey Parameters

Horizontal beamwidth:	3/4 degree
Vertical beamwidth:	40 tilted down (10 to 50 from horizontal)
Pulse length:	0.1 millisecond
Weight in water:	20.8 kg
Length:	142.7 cm
Range:	Commonly 150 m
Scale:	12 m/cm

The side scan sonar was supplied for the survey program by McQuest Marine Sciences Ltd. Another system, provided courtesy of the Atlantic Geoscience Centre, was loaded as an alternate in case of malfunction of the first system.

The installation of the side scan sonar system aboard the Norweta was conducted by McQuest Marine Sciences Ltd.

A.2.2.3 Wiring Diagram

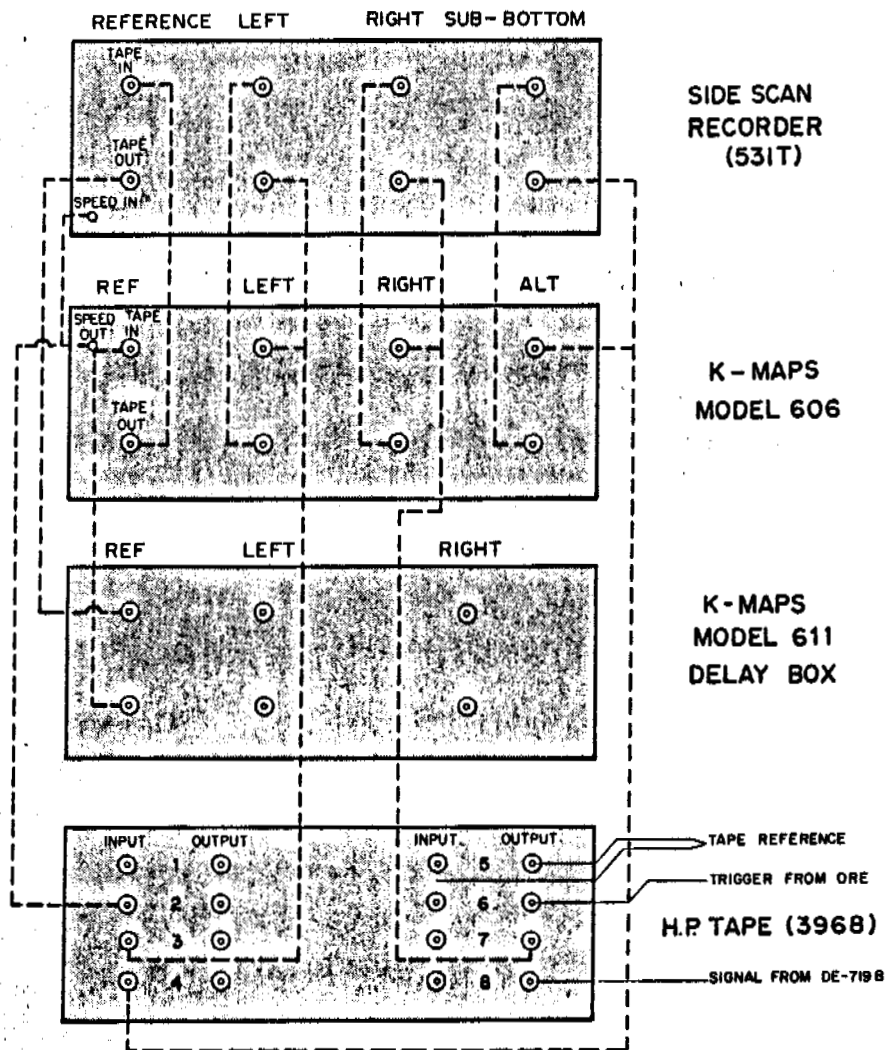
Drawing No. A.2 shows the wiring diagram for the side scan sonar and accompanying K maps processing equipment.

A.2.2 Sub-bottom Profiler

The equipment consisted of:
-Klein tow fish, Model 532S-001
-Raytheon 3.5 and/or 7 kHz transducer
-Raytheon transceiver
-Raytheon 719B recorder

The instrument parameters for the Klein system are as follows:

Output frequency:	3.5 kHz
Acoustic output:	105 dk (peak), reference on microbar at 1 m



Side Scan Wiring Diagram

M.J. O'CONNOR & ASSOCIATES LTD.

JOB No.: 10-260

DATE: 84/ 10/01

DRAWN BY: Geoterrex

DWG. No.: A.2

Pulse length: 0.4 milliseconds
Resolution: Approx. 60 cm in water
Beam angle: 50°

Survey data was recorded on an 8-track H.P. recorder for later playback.

The Klein system was provided by McQuest Marine Sciences Ltd. and Raytheon system by Geoterrex Limited.

A.3 Navigation System

A.3.1 Positioning Equipment

A.3.1.1 ARGO DM-54:

ARGO is a acronym for Automatic Ranging Grid Overlay. It is a multi-range, circular geometry navigation and position system that uses an active mobile interrogator (DM-54) and 4 active responder stations at known fixed locations. Lane width for the ARGO network was approximately 91 m.

A.3.1.2 MX-1107 R/S Satellite Receiver:

A SatNav system was used in order to assist in monitoring ARGO lane count.

A.3.1.3 LEHMKUHL Gyro Repeater:

The ship's gyro was used to assist in filtering the navigation information. The individual components for the ARGO positioning system are:

ARGO Shore Station Installation:

- 1 antenna loading unit plus cable
- 1 range processing unit plus cable
- Texas towers to heights up to 30 m
- 1 thermoelectric generator type 5120 c/w fuel harness for cascade fuel system
- 2 12-volt batteries
- 1 set of ground radials plus stakes

ARGO Vessel Installation:

- 1 antenna loading unit with associated cables
- 1 range processing unit with associated cables
- 1 power supply
- 2 12-volt batteries
- 1 satellite antenna system

A.3.2 Computer Equipment - Navigation

The navigation software system used was operated on standard Hewlett Packard computer equipment which included the following:

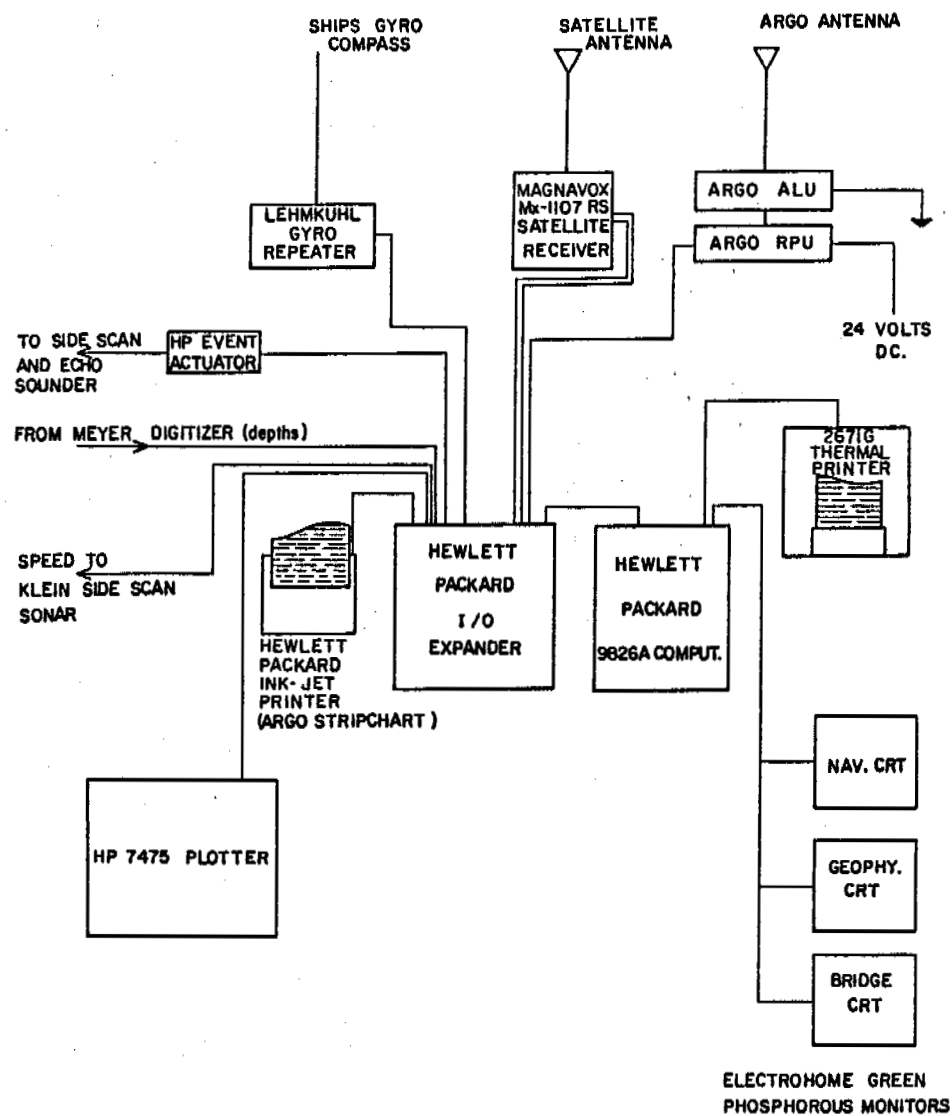
- HP9826A computer memory boards and associated interfaces were used as the central processing unit. This provided fast computation time and thereby enabled integration with satellite and gyro while running lines.
- HP2671G Printer provided hardcopy of collected information
- HP7475 Plotter was used to produce navigation track plots
- Digatek 1331 colour monitor terminal provided a graphic display of information and transferred it to remote displays on the bridge and in the seismic lab
- HP5936 relay actuation acted as the link between the navigation system and data gathering systems on board the vessel
- HP9888 - I/O extender
- HP2225 Inkjet Printer (CDU emulator)

A.3.3 Computer Equipment - Data Processing

The computer equipment used to process and plot the field data included:

HP9845B - Computer Series 275
HP7585 - Plotter with HP-IB
HP82910M- 5-1/4" dual disk drive
Real time clock

Drawing No. A.3 is a diagram of the navigation equipment layout.



Navigation Schematic

M. J. O'CONNOR & ASSOCIATES LTD.

JOB No.: 10-260

DATE: 84/10/01

DRAWN BY: Geoterrex

DWG. No.: A.3

DAILY LOG

DEPARTMENT OF INDIAN AND NORTHERN AFFAIRS

GMT

August 21 0242 Leaving Tuk Harbour bound for Hershel Island.

0500 Crossed Hooper - Esky Base Line.
Obs = 74710.3m, Cal = 74734.4, diff. = 24.1m.

0725 Alter course, heading to Hershel Island.

0806 ARGO RPU lost timing has gone into search mode.

0833 System re-initialized. Will run on same course until we receive satellite updates.

1416 Encounter heavy ice at 69°, 42', 136°, 57.5'
Between two large zones of ice, will circle back around and go South of the ice floes.

1800 Heading for Hershel Island, approximately 60 km to go.

2340 Put in line to tanker "Gulf Beaufort", approximately half hour away.

August 22 0045 At Gulf Beaufort, off Hershel Island. Picking up M.J. O'Connor and R. Quinn.

0051 Heading for line IHR84-3.

0211 SOL IHR84-3, FSP 1, SS, SB, Bath. Speed 4.4 kts. Hdg. 55°. Test line only.

0305 EOL IHR84-3, LSP 36, SS, SB, Bath, Airgun, Speed 4.2 kts, Hdg. 55°. Test line only.

0359 SOL IHR84-6, FSP 37, SS, SB, Bath, Boomer, no Airgun. Speed 3.8 kts, Hdg. 235°.

0447 ARGO 2, esky starting to edit.

0516 A course change necessary to avoid ice. Moving starboard.

	<u>GMT</u>	
August 22	0615	EOL IHR84-6, LSP 119, SS, SB, Bath, no Airgun. Speed 4.0 kts, Hdg. 232°.
	0620	Start Fixing at S.P. 120.
	0647	SOL IHR84-8, FSP 136 SS, SB, Bath, no Airgun. Speed 4.0 kts, Hdg. 54°.
	0720	Encountering ice.
	0820	Still dodging ice.
	0918	EOL IHR84-8, LSP 220 SS, SB, Bath, no Airgun. Speed 3.5 kts, Hdg. 63°.
	0924	Start fixing at SP 221.
	1022	SOL IHR84-9 FSP 253, SS, SB, Bath, no Airgun. Speed 4.4 kts, Hdg. 213°.
	1319	EOL IHR84-9, LSP 358, SS, SB, Bath, no Airgun. Speed 3.7 kts, Hdg. 228°.
	1322	Start fixing at SP 359. SOL IHR84-11, FSP 376, SS, SB, Bath, no Airgun. Speed 3.5 kts, Hdg. 051°.
	1617	EOL IHR84-11, LSP 465, SS, SB, Bath, no Airgun. Speed 4.4 kts, Hdg. 53°.
	1624	Started fixing at SP 466.
	1654	SOL IHR84-13, FSP 488, SS, SB, Bath, no Airgun. Speed 4.2 kts, Hdg. 242°.
	1714	Veering off line for ice.
	1753	EOL IHR84-13, LSP 524, SS, SB, Bath. Speed 3.9 kts, Hdg. 235°.
	1911	EOL IHR84-15, LSP 570, Argo 3.4, SS, SB, Bath, Airgun, Boomer. Speed 3.8 kts, Hdg. 83°.
	1918	SOL IHR-84-32, FSP 571, Argo 3.4, SS, SB, Bath, Boomer. Speed 3.8 kts, Hdg. 003°. We are going to start line NW of dogleg point.

	<u>GMT</u>	
August 22	2029	Encountering scattered ice on line IHR84-32.
	2122	EOL IHR84-32, LSP 653, Speed 4.2 kts, Hdg. 335°. SS, SB, Bath, Boomer, Airgun was off.
	2124	SOL IHR84-1, FSP 654, Speed 4.0 kts. Coming around to starboard. New line heading will be 235°. SS, SB, Bath, Boomer, no Airgun.
	2301	EOL IHR84-1, LSP 718, Speed 3.9 kts, Hdg. 235°. SS, SB, Bath, Boomer.
	2330	SOL IHR84-2, FSP 735, Speed 3.9 kts, Hdg. 54°.
August 23	0137	EOL IHR84-2, LSP 810, Speed 3.9 kts, Hdg. 54°.
	0140	SOL IHR84-3A, FSP 811, Speed 3.9 kts, Hdg. 235°.
	0154	On line at SP 819, SP 819, SS, SB, Bath, Boomer. Line IHR84-34 is run 100 NW of line IHR84-3. Line was calculated short instead of 1 km long. The line was restarted twice, therefore has names B and C as well. To post plot, dump file IHR84-3, B and C.
	0306	EOL IHR84-3A, LSP 859.
	0340	SOL IHR84-4, FSP 876, SS, SB, Bath, Boomer.
	0352	EOL IHR84-4, line aborted due to ice. LSP 883, turning around to try Line number 5.
	0425	SOL IHR84-5, FSP 903, SS, SB, Bath, Boomer, Airgun. Started at SP885, speed 4.7 kts, Hdg. 55°.
	0527	Argo number 2 (Eski) editing, lost 2 lanes.
	0537	Adjusted +2 lanes according to strip chart and res.
	0533	EOL IHR84-5, LSP 945, SS, SB, Bath, Boomer, Airgun.
	0558	SOL IHR84-7, FSP 958, SS, SB, Bath, Boomer, Airgun.

	<u>GMT</u>	
August 23	0558	Started at number 946, speed 3.9 kts, Hdg. 234°.
	0709	EOL IHR84-7, LSP 1000, SS, SB, Bath, Boomer, Airgun. Speed 4.0 kts, Hdg. 233°.
	0713	Started fixing at number 1001.
	0752	SOL IHR84-10, FSP 1022, SS, SB, Bath, Boomer, Airgun. Speed 3.7 kts, Hdg. 56°.
	0816	EOL IHR84-10, LSP 1035, SS, SB, Bath, Boomer, Airgun. Speed 3.7 kts, Hdg. 56°. Line terminated due to RPU lock up. Powered down RPU, re-initialized program, pulled in gear to drift in water and then collect SAT passes. Will then proceed to M/V Fort Good Hope to pick up supplied (food) as the fog and ice makes shooting hazardous.
	0952	First pass in to confirm lane count.
	1100	Third pass in to confirm lane. Proceed to M/V Fort Good Hope to pick up food.
	1105	Decided to put gear in the water. Heading to intersection of Line 33 and 11. Will run north on this line, number 33.
	1207	Start fixes at 1039.
	1225	SOL IHR84-33, FSP 1050, SS, SB, Bath, Boomer, no Airgun. Speed 12.25 kts, Hdg. 322°. Appears to be a problem with routine to do realtime plotting in this new version of Can-Nav.
	1342	Veering offline to starboard. Skipper wants to make sure we are well clear of drilling rig anchors. Heavy fog.

	<u>GMT</u>	
August 23	1423	EOL IHR84-33, LSP 1121, SS, SB, Bath, Boomer, no Airgun. Speed 4.0 kts, Hdg. 339°. Start fixing at number 1122.
	1520	SOL IHR84-1B, FSP 1152, SS, SB, Bath, Boomer, no Airgun. Speed 4.0 kts, Hdg. 76°.
	1602	Received word that we are to be at Gulf Beaufort at noon.
	1622	EOL IHR84-1B, LSP 1191, SS, SB, Bath, Boomer, no Airgun. Speed 4.0 kts, Hdg. 60°.
	1630	Pick up gear to cruise to the Gulf Beaufort.
	1737	Arrive at Gulf Beaufort.
	1933	Testing gear, seas picked up.
	2008	Started line IHR84-34, FSP 1192, test line, data not recorded.
	2021	SOL IHR84-34B, FSP 1199, SS, SB, Bath, Boomer.
	2036	On line SP 1208, this line was started short, close to land.
	2057	Grab angle of approximately 35°.
	2230	Sat pass confirms lane count.
	2332	Station at demarcation point is off the air.
August 24	0046	EOL IHR84-34B, LSP 1385, SS, SB, Bath, Boomer. Speed 4.2 kts, Hdg. 148°.
	0122	SOL IHR84-35, FSP 1408, SB, Bath, Boomer. Speed 3.8 kts, Hdg. 328°.
	0135	EOL IHR84-35, LSP 1418, aborted line.
	0200	All gear onboard, depart for M/V Fort Good Hope.

GMT

August 24 0426 Arrive M/V Fort Good Hope to pick up personnel.

0437 Depart M/V Fort Good Hope.

0636 Start fixing at number 1419.

0720 Discovered Can Nav disk was left in drive after
generator switch. Put in data disk number 1.

0725 SOL IHR84-36, FSP 1448, SS, SB, Bath, Boomer,
no Airgun. Speed 3.7 kts, Hdg. 319°.

0813 EOL IHR84-36, LSP 1478, SS, SB, Bath, Boomer,
no Airgun. Speed 4.1 kts, Hdg. 321°.

0815 Start fixing at number 1479.

0829 SOL IHR84-37, FSP 1488, SS, SB, Bath, Boomer,
no Airgun. Speed 3.9 kts, Hdg. 149°.

1310 EOL IHR84-37, LSP 1666, SS, SB, Bath, Boomer,
no Airgun. Speed 3.7 kts, Hdg. 154°.

1313 Starting fixes at number 1667.
SOL IHR84-35B, FSP 1683, SS, SB, Bath, Boomer,
no Airgun. Speed 3.9 kts, Hdg. 326°.

1617 EOL IHR84-35B, LSP 1781, SS, SB, Bath, Boomer,
no Airgun. Speed 4.5 kts, Hdg. 329°.
Start fixing at number 1783.

1717 SOL IHR84-18, FSP 1821, SS, SB, Bath, Boomer,
no Airgun. Speed 4.5 kts, Hdg. 69°.
Ended short due to ice.

1820 SOL IHR84-20, FSP 1860, SS, SB, Bath, Boomer.
Started shore due to ice, speed 4.0 kts, Hdg. 247°.

1900 Sat pass of 1848 not received at 9826. Checked
all connections.

1925 Line 20 will be extended 3 km.

	<u>GMT</u>	
August 24	2007	EOL IHR84-20, LSP 1923, SS, SB, Bath, Boomer. Speed 3.9 kts, Hdg. 247°.
	2040	SOL IHR84-22, FSP 1943, SS, SB, Bath, Boomer. Speed 4.0 kts, Hdg. 66°. Started fixing at 1924.
	2146	Shot point 1987, getting offline due to ice.
	2210	EOL IHR84-22, LSP 1996, SS, SB, Bath, Boomer. Speed 2.5 kts, Hdg. 143°. Line Hdg. 66°.
	2214	EOL IHR84-24, FSP 1997, SS, SB, Bath, Boomer. Started line shot approximately 2 km due to ice. Speed 2.5 kts, Hdg. 245°.
	2317	EOL IHR84-24, LSP 2031, SS, SB, Bath, Boomer. Speed 4.0 kts, Hdg. 246°. Line was extended 1.5 km.
	2341	SOL IHR84-25, FSP 2045, SS, SB, Bath, Boomer. Speed 3.7 kts, Hdg. 66°. Line was extended and moved south 200 m.
August 25	0111	EOL IHR84-27, ESP 2097, SS, SB, Bath, Boomer. Speed 3.4 kts, Hdg. 66°.
	0127	SOL IHR84-27, FSP 2105, SS, SB, Bath, Boomer. Speed 3.8 kts, Hdg. 245°. Line started short with an offset due to ice.
	0301	EOL IHR84-27, LSP 2164, SS, SB, Bath, Boomer. Speed 4.3 kts, Hdg. 245°. End of disk number 1.
	0348	SOL IHR84-38A, FSP 2189, SS, SB, Bath, Boomer. Speed 3.7 kts, Hdg. 150°. This line was added. Disk number 2 started at SP 2165.
	0403	EOL IHR84-38A, LSP 2198, SS, SB, Bath, Boomer. Speed 3.7 kts, Hdg. 150°.
	0418	SOL IHR84-28, FSP 2207, SS, SB, Bath, Boomer. Speed 4.2 kts, Hdg. 246°. This line was moved.

GMT

August 25 0434 EOL IHR84-28, LSP 2217, SS, SB, Bath, Boomer.
Speed 4.1 kts, Hdg. 246°.

0450 SOL IHR84-29, FSP 2227, SS, SB, Bath, Boomer,
Airgun. Speed 4.4 kts, Hdg. 66°. Line was moved.
Argo number 2 (eski) editing and lossing lanes.

0539 EOL IHR84-29, LSP 2256, SS, SB, Bath, Boomer,
Airgun. Speed 3.5 kts, Hdg. 66°.

 SOL IHR84-29, FSP 2282, SS, SB, Bath, Boomer,
Airgun. Speed 4.5 kts, Hdg. 334°.

0819 EOL IHR84-39, LSP 2353, SS, SB, Bath, Boomer,
Airgun. Speed 4.1 kts, Hdg. 331°.

0822 Start fixing at number 2354.

0845 SOL IHR84-19, FSP 2368, SS, SB, Bath, Boomer,
Airgun. Speed 3.5 kts, Hdg. 92°.

0913 EOL IHR84-19, LSP 2384, SS, SB, Bath, Boomer,
Airgun. Speed 3.4 ktd, Hdg. 93°.

 Line aborted due to heavy ice conditions and
fog. Will pick up line 17 heading West.

0916 Start fixing at number 2385.
Skirting ice, will come on line as soon as possible.

0950 SOL IHR84-17, FSP 2404, SS, SB, Bath, Boomer,
Airgun. Speed 3.8 kts, Hdg. 265°.

1103 EOL IHR84-17, LSP 2447, SS, SB, Bath, Boomer,
Airgun. Speed 4.5 kts, Hdg. 246°.

1105 Starting fixes at number 2448.

1128 SOL IHR84-14, FSP 2460, SS, SB, Bath, Boomer,
Airgun. Speed 4.4 kts, Hdg. 54°.

1309 EOL IHR84-14, LSP 2516, SS, SB, Bath, Boomer,
Airgun. Speed 3.6 kts, Hdg. 70°. Surrounded by ice,
had to pull in gear. Try to pick way back and pick up
line 12. Weather quite bad, snow, winds picking up,
fog.

GMT

August 25 1410 Going to get well clear of ice before putting gear back in.

1441 Two thirds of the way West on Line 12, still lots of ice. Will run to end without putting gear in water to scout ice.

1644 Start fixing at number 2517.

1653 SOL IHR84-40, FSP 2522, SS, SB, Bath, Boomer, Airgun. Speed 4.2 kts, Hdg. 261°.

1725 EOL IHR84-40, LSP 2542, SS, SB, Bath, Boomer, Airgun. Speed 3.7 kts, Hdg. 325°. Terminated to run North.

1729 SOL IHR84-NO, FSP 2543, SS, SB, Bath, Boomer, Airgun. Speed 3.7 ktd, Hdg. 327°. Running North to check conditions, recording as we go. 40 - 60 kt. winds forecasted.

1915 EOL IHR84-NO, LSP 2608, SS, SB, Bath, Boomer, Airgun. Speed 4.4 kts, Hdg. 64°. (snowing).

1935 SOL IHR84-41, FSP 2621, SS, SB, Bath, Boomer, Airgun. Speed 5.0 kts, Hdg. 162°. New line.

1946 Sat Pass confirms lane count.

2022 EOL IHR84-41, LSP 2652, SS, SB, Bath, Boomer, Airgun.

2024 SOL IHR84-42, FSP 2653, SS, SB, Bath, Boomer, Airgun. This line runs in different directions.

2148 EOL IHR84-42, LSP 2705, SS, SB, Bath, Boomer, Airgun.

2150 SOL IHR84-43, FSP 2706, SS, SB, Bath, Boomer, Airgun. Speed 4.0 kts, Hdg. 350°.

2247 EOL IHR84-43, LSP 2742, SS, SB, Bath, Boomer, Airgun. Speed 4.6 kts, Hdg. 36°. This line run in different directions.

GMT

August 25	2257	Sat Pass confirms lane count.
	2315	SOL IHR84-44, FSP 2761, SS, SB, Bath, Boomer, Airgun. Speed 5.6 kts, Hdg. 183°. This line was started short.
August 26	0007	Line IHR84-44 was given new SOL and EOL to accomodate a dog leg.
	0050	EOL IHR84-44, LSP 2826, SS, SB, Bath, Boomer, Airgun. Speed 2.9 kts, Hdg. 159°.
	0112	SOL IHR84-45, FSP 2835, SS, SB, Bath, Boomer. Speed 2.9 kts, Hdg. 347°.
	0119	EOL IHR84-45, LSP 2840. Aborted, weather.
	0148	Gear onboard, heading for cover.
	0234	Adjusted ARGO 0/0/0/+1 according to 2 Sat Pass.
	0309	Standing by, waiting for weather.
	0421	Sat Pass confirms lane count.
	0600	Standing by for weather.
	0808	Engineer changed generators without giving notice.
	1650	Arrive Molikpaq, O'Connor and LaRoche depart.
	1700	Head back to lee of island for protection from wind.
	1708	End of D.I.N.A. contract.

CLIENT: DINA SITE: Herschel Is. SHIP: Norweta

GEOTERREX LTD.

DATE	LINE #	FIX SOL SOL	DIST. (Km)	TIME SOL EOL	SPEED	DIR	AIRGUN	BATH.	SSS	kHz SBP		BOOMER	REMARKS + WEATHER	
										3.5	7.0		SS 3.5 kHz	Boomer + Airgun
Aug. 21	IHR84-3	<u>1</u> 36	7.0	<u>0211</u> 0305	4	55		X	X	X		X	testing boomer, rec. paramete	
	84-6	<u>37</u> 119	16.4	<u>0359</u> 0615	3.8	235		X	X	X	X	X	filters chgd to 320 Hz & 250 Hz midway of line	
Aug. 22	84-8	<u>136</u> 220	16.8	<u>0648</u> 0919	3.8	54		X	X	X	X	X	ice, forced off line, speed reduced to 3.0-3.5 knots	
	84-9	<u>253</u> 358	21.0	<u>1022</u> 1319	4.0	235		X	X	X	X	X	whitecaps, SSS off @ start, on @ fix 259. paper chgd 306 & 308	
	84-11	<u>376</u> 465	17.8	<u>1352</u> 1617	3.8	53		X	X	X	X	X	belt chgd between 361 & 365	
	84-13	<u>488</u> 524	7.2	<u>1654</u> 1735	4.0	235	X	X	X	X	X	X	repair SSS port channel	
	84-15	<u>535</u> 570	7.0	<u>1758</u> 1915	4.0	54	X	X	X	X	X	X		
	84-32	<u>605</u> 653	9.6	<u>2020</u> 2122	4.6	323		X	X	X	X	X	chgd paper between 647-649	
	84-1	<u>665</u> 718	10.6	<u>2141</u> 2302	4.4	235		X	X	X	X	X	chgd belt between 692-694	
	84-2	<u>735</u> 810	15.0	<u>2330</u> 0137	3.8	54		X	X	X	X	X		
	84-3A	<u>819</u> 859	8.0	<u>0154</u> 0306	3.9	235		X	X	X	X	X		
	84-4	<u>876</u> 883	1.4	<u>0341</u> 0353	4.6	55		X	X	X	X	X		
	84-5	<u>903</u> 945	8.4	<u>0425</u> 0533	4.0	55	X	X	X	X	X	X	abort due to ice @ 907, on 908. SSS not slant range corrected.	

CLIENT: DINA SITE: Hershel Is. SHIP: Norweta

GEOTERREX LTD.

DATE	LINE #	FIX SOL EOL	DIST. (Km)	TIME SOL EOL	SPEED	DIR	AIRGUN	BATH.	SSS	kHz SBP		BOOMER	REMARKS + WEATHER
										3.5	7.0		
Aug. 23	84-7	<u>958</u> 1000	8.4	<u>0559</u> 0709	3.8	234	X	X	X	X	X	X	changed paper @ 953, end of
	84-10	<u>1022</u> 1035	2.6	<u>0752</u> 0816	3.6	54	X	X	X	X	X	X	Argo hang up, Nav problems line aborted
	84-33	<u>1050</u> 1121	14.2	<u>1224</u> 1423	3.9	332		X	X	X	X	X	trouble w paper feed, last fix 1108; boomer towed closer to surface. There are 2 #1041 fixes, all nmbrs up to 1100 should be 1 higher.
	84-1B	<u>1152</u> 1191	7.8	<u>1520</u> 1622	4.1	55		X	X	X	X	X	manual speed correction, 115 first fix of line
	84-34B	<u>1208</u> 1385	35.4	<u>2036</u> 0046	4.2	148		X	X	X	X	X	chgd paper between fix 1282 & 1284. chgd belt @ EOL, loose tail of towfish & SSS was unplugged only 3.5 running R. channel of SS not operating
	84-35	<u>1408</u> 1418											line aborted - poor this direction - 328°
Aug. 24	84-36	<u>1448</u> 1478	6.0	0745	4.2	318		X	X	X	X	X	swell filter activated - cause jump in rec. measure from direct arr. 1st. solid band.
	84-37	<u>1488</u> 1666	43.6	<u>0829</u> 1310	4.2	147							paper chgd between 15764 and 1578
	84-35B	<u>1683</u> 1782	19.8	<u>1340</u> 1618	4.0	330		X	X	X	X	X	500 kHz/chgd paper between fix 1282 & 1284, belt chgd at EOL
	84-18	<u>1821</u> 1847	5.2	<u>1718</u> 1758	4.3	66		X	X	X	X	X	

GEO'ERREX LTD.

[illegible]

CLIENT: DINA SITE: Hershel Island SHIP: Norweta GEOTERREX LTD.

DATE	LINE #	FIX SOL EOL	DIST. (Km)	TIME SOL EOL	SPEED	DIR	AIRGUN	BATH.	SSS	KHz SBP		BOOMER	REMARKS + WEATHER
										3.5	7.0		
Aug. 25	84-40	<u>2522</u> <u>2532</u>	2.0	<u>1652</u> <u>1724</u>	5.1	217	X	X	X	X	X	X	223/line 40 turned and became North
	84-NO	<u>2543</u> <u>2608</u>	13.0	<u>1799</u> <u>1915</u>	3.8	324	X	X	X	X	X	X	
	84-41	<u>2621</u> <u>2652</u>	6.2	<u>1935</u> <u>2023</u>	4.9	139	X	X	X	X	X	X	
	84-42	<u>2653</u> <u>2705</u>	10.4	<u>2024</u> <u>2148</u>	3.9	205	X	X	X	X	X	X	185 direction changed to 31
	84-43	<u>2706</u> <u>2742</u>	7.2	<u>2150</u> <u>2247</u>	3.8	354	X	X	X	X	X	X	weather causing streamers to contact source
	84-44	<u>2761</u> <u>2826</u>	13.0	<u>2315</u> <u>0050</u>	3.8	211	X	X	X	X	X	X	swell filter activated at EOL. Gear at short tow after EOL
	84-45	<u>2835</u> <u>2840</u>	1.0	<u>0122</u> <u>0119</u>	4.5	347	X	X	X	X	X	X	swell filter on/line aborted - weather gear brought aboard

DEPTH BELOW SEALED

LOCATION HERSCHEL SILL HS01			WATER DEPTH 12.34 m		UTM COORDINATES 7 715 203 m N 587 000 m E (Zone 7) (TIME MEASURED 04:00 04:10:11)					
SYMBOL	SAMPLE	SOIL DESCRIPTION	GROUND ICE DESCRIPTION	°C	BULK DENSITY 1.4 1.6 1.8 2.0 ▲ PLASTIC LIMIT LIQUID LIMIT WATER CONTENT (%) 20 40 60 80	UNDRAINED SHEAR STRENGTH (kPa) 25 50 75 100	SOIL UNIT	LABORATORY TESTS		
		GRAVEL AND SAND (GW) — trace silt, gravel to 40 mm maximum diameter, sub-rounded to angular, well graded, dense to very dense, dark grey		-0.5	●			Ia		
		<i>Driller defined change (2.1 to 2.45 m)</i>								
		SAND (SM) — silty, trace clay, uniform, fine grained, dark grey — homogeneous structure becoming laminated; continuous, even, parallel laminations		-0.6	●	▲			Ib	S = 24 ppt
		CLAY — silty to some silt, continuous, even, parallel, laminations, moist, firm, high to medium plasticity, dark grey. — trace organics, homogeneous, moist, firm dilatency, medium to low plasticity. — Driller encounters stiff material		-0.4 -0.7	● ●	▲ ▲			IIa	S = 14 ppt S = 11 ppt
		— trace silt, continuous, even, parallel, very thin laminations, dry, very stiff, medium plasticity			●	▲				
		— laminations rising at 15° from horizontal, trace blocky structure, dry, low plasticity		-0.6	●	▲				
		— continuous, even, parallel laminations		-0.6	●	▲				
		— laminations at 5° to horizontal, trace organics		-0.7	●				IIb	
		— parallel laminations		-0.4	●					
		— trace shell fragments		-0.2	●	▲				
		— Driller notes very hard		-0.2	●					
			END OF BOREHOLE 19.68 m (-32.02 m EL.)		-0.2	●	▲			

PROJECT NUMBER 101C-4133 DRILLING COMPLETED 04-10-11 TERMINATION DEPTH 19.7 m DRILLING RIG SIMCO 5000 LOG COMPILED BY MLH/KWJ	SOIL SYMBOLS Gravel Sand Silt Clay	SAMPLE TYPE Thin Wall Tube Split Spoon Liner Core Disturbed No Recovery	SHEAR STRENGTH + Torvane x Mini Vane ▲ Filcon Vane ◇ In Situ Vane ▲ UU Triaxial ▼ Fall Cone	TEST IDENTIFICATION C Consolidation TS Thaw Strain OS Direct Shear DSS Direct Simple Shear T Triaxial Shear S P.W. Salinity G Gas Analysis	BOREHOLE NUMBER HS01 PAGE 1 OF 1
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DEPTH BELOW SEABED

LOCATION HERSCHEL SILL HS02		WATER DEPTH 12.5 m	
UTM COORDINATES 7 715 255 m N 587 095 m E (Zone 7)		(TIME MEASURED 84-10-11)	

DEPTH	SYMBOL	SAMPLE	SOIL DESCRIPTION	GROUND ICE DESCRIPTION t°C	BULK DENSITY 1.4 1.6 1.8 2.0 ▲				UNDRAINED SHEAR STRENGTH (kPa)				SOIL UNIT	LABORATORY TESTS	
					PLASTIC LIMIT		LIQUID LIMIT		WATER CONTENT (%)						
									20 40 60 80						
1			GRAVEL AND SAND (GP) - trace silt, subrounded, mainly coarse gravel to 50 mm maximum diameter, poorly graded, dark to olive grey												
2			SAND - trace silt, uniform, fine to medium grained - becoming gravelly below 1.57 m												
3			CLAY - silty, interbedded, trace fine sand in silt beds, very thinly laminated, continuous, parallel, occasional organic laminae, lens of coal and peat at 2.50 m.												
4			- trace silt, very thin, continuous, even parallel laminations, firm, medium plasticity.												
5			- mottled olive grey and dark grey.												
6			END OF BOREHOLE 5.73 m (-18.23 m El.)												
7															
8															
9															
10															

PROJECT NUMBER 101C-4133 DRILLING COMPLETED 84-10-11 TERMINATION DEPTH 5.73 m DRILLING RIG SIMCO 5000 LOG COMPILED BY KWJ	SOIL SYMBOLS Gravel Sand Silt Clay	SAMPLE TYPE Thin Wall Tube Split Spoon Liner Core Disturbed No Recovery	SHEAR STRENGTH Torvane Alini Vane Pilson Vane In Situ Vane UU Triaxial Fall Cone	TEST IDENTIFICATION C Consolidation TS Thaw Strain DS Direct Shear DSS Direct Simple Shear T Triaxial Shear S P.W. Satinity G Gas Analysis	BOLE N . SR 2 PAGE 1 OF 1
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LOCATION HERSCHEL BASIN			WATER DEPTH 55.6 m							
UTM COORDINATES 7 712 143 mN 348 175 mE (Zone 8)			(TIME MEASURED 23.00 1							
DEPTH BELOW SEABED	10									
	11	*	CLAY (CH - CI) - silty, very thin parallel discontinuous laminations, occasional black organic laminations and pockets, soft, high plasticity, brownish-grey	NOT FROZEN	PLASTIC LIMIT	WATER CONTENT (%)	UNDRAINED SHEAR STRENGTH (kPa)	SOIL UNIT	LABORATORY TESTS	
	12		- more distinct laminations							
	13	*	- blocky structure							
	14	10	- trace black fibrous organics, one 5mm thick organic lamination							
	15									
	16	11	- trace shell fragments							
	17	12								
	18									
	19	13	- driller detects change in consistency							
	20	14	- very thin even parallel continuous laminations, occasional black organic laminations, firm, brownish-grey							

PROJECT NUMBER 101C 4159
 DRILLING COMPLETED OCTOBER 11 1984
 TERMINATION DEPTH 57.9 m
 DRILLING RIG SIMCO 5000 WS
 LOG COMPILED BY TRM / KWJ / MDW

SOIL SYMBOLS	
Gravel	Silt
Sand	Clay

SAMPLE TYPE	
Thin Wall Tube	Core
Split Spoon	Disturbed
Liner	No Recovery

SHEAR STRENGTH	
Torvane	UU Triaxial
Mini Vane	Fall Cone
Pilon Vane	
In Situ Vane	

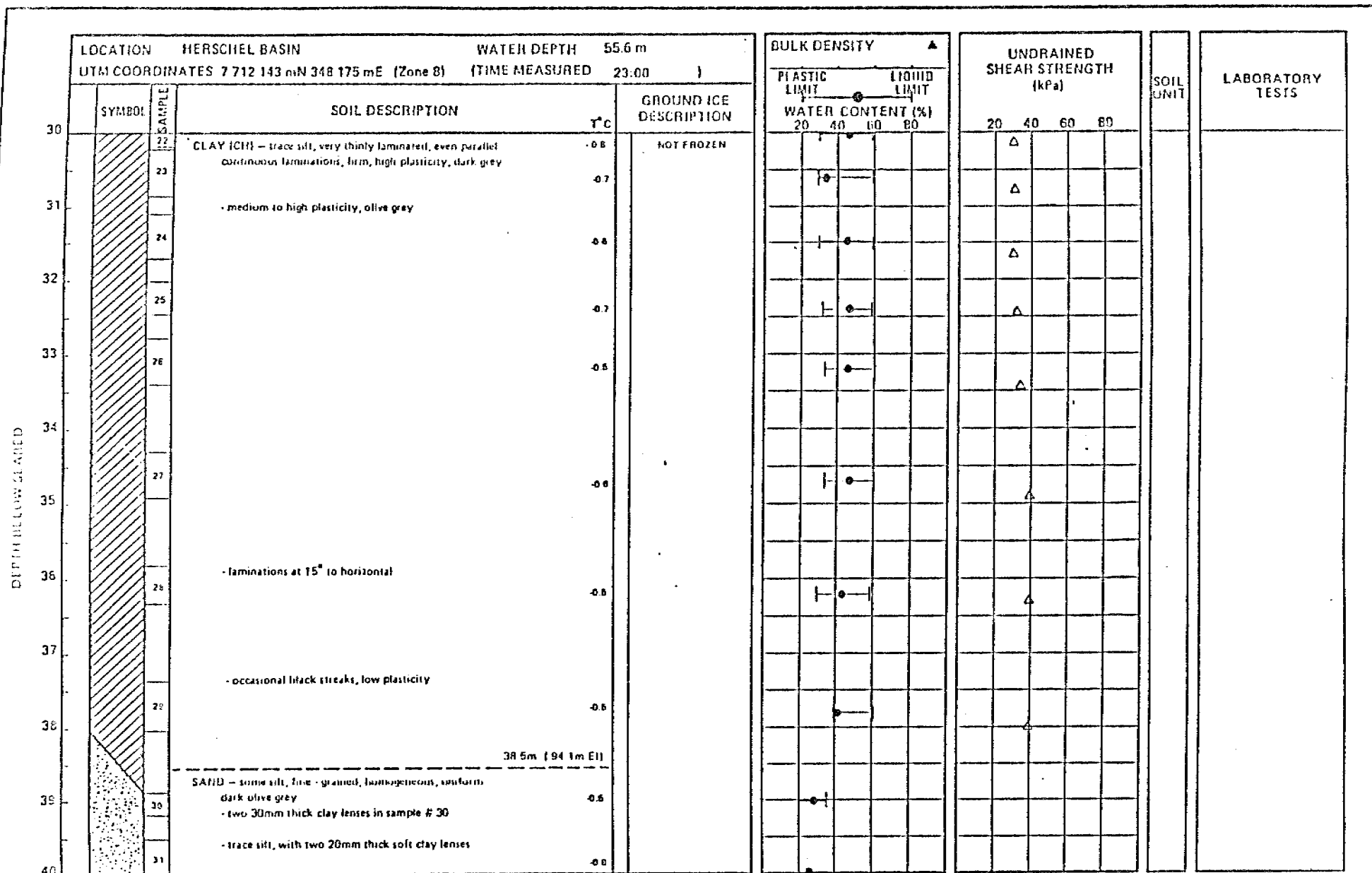
TEST IDENTIFICATION	
Consolidation	Triaxial Shear
Thaw Strain	PW Salinity
Direct Shear	Gas Analysis
Direct Simple Shear	

BOREHOLE NUMBER
ARK84 HB01
PAGE 2 OF 6

DEPTH BELOW SEAWARD

LOCATION		HERSCHEL BASIN		WATER DEPTH		55.6 m			
UTM COORDINATES		7 712 143 mN 318 175 mE		(Zone B)		(TIME MEASURED)		23:00	
SYMBOL		SAMPLE		SOIL DESCRIPTION		T°C		GROUND ICE DESCRIPTION	
		14		CLAY (MH - CH) - silty, trace fibrous organics, very thin, even, parallel, continuous laminations, occasional black organic lamination, firm to stiff, high plasticity, brownish grey				Vs - 10 percent	
				NOTE : Driller observes a chattering of drill stem at 20.7m					
		15						- 50mm thick discrete ICE lens or lamination, clear	
		16		- grey				- CLEAR ICE at end of sample tube; preserve sample in tube because of crimped end	
		17						- two 25mm thick ICE lenses at 24m and 24.15m, white translucent appearance, (cloudy)	
		18		- stiff		-0.5		- 30mm thick ICE lens, cloudy	
		19						- 60mm thick ICE lens, cloudy	
		20		- dark grey		-0.6		- 200 mm thick clear ICE lens	
		21				-0.6		- ICE lens	
		22		- firm					
						-0.8			

PROJECT NUMBER	SOIL SYMBOLS	SAMPLE TYPE	SHEAR STRENGTH	TEST IDENTIFICATION	BOREHOLE NUMBER
101C-4159*	Gravel Sand	Thin Wall Tube Split Spoon Liner	Torvane Mini Vane Pilon Vane In Situ Vane	C Consolidation TS Thaw Strain DS Direct Shear DSS Direct Simple Shear	ARKB4 H801
DRILLING COMPLETED OCTOBER 11, 1984	Silt Clay	Core Disturbed No Recovery	UU Triaxial Fall Cone	T Triaxial Shear S P.W. Salinity G Gas Analysis	PAGE 3 OF 6
TERMINATION DEPTH 57.9 m					
DRILLING RIG SIMCO 5000 WS					
LOG COMPILED BY TRM/KWJ/MDW					



PROJECT NUMBER 101C-4159 DRILLING COMPLETED OCTOBER 11, 1984 TERMINATION DEPTH 57.9 m DRILLING RIG SIMCO 5000 WS LOG COMPILED BY TRM / KWJ / MDW	SOIL SYMBOLS		SAMPLE TYPE		SHEAR STRENGTH		TEST IDENTIFICATION		BOREHOLE NUMBER A11X 54 11801 PAGE 4 OF 6
	Gravel Sand	Silt Clay	Thin Wall Tube Split Spoon Liner	Core Disturbed No Recovery	Torvane Mini Vane Pilon Vane In Situ Vane	UU Triaxial Fall Cone	C Consolidation TS Thaw Stream DS Direct Shear DSS Direct Simple Shear	T Triaxial Shear S PW Satinity G Gas Analysis	

LOCATION HERSCHEL BASIN			WATER DEPTH 28m											
UTM COORDINATES 7 711 770 mN 350 500 mE (Zone B)			(TIME MEASURED 10:00)											
DEPTH BELOW SLAED	SYMBOL	SAMPLE	SOIL DESCRIPTION	GROUND ICE DESCRIPTION	BULK DENSITY				UNDRAINED SHEAR STRENGTH (kPa)				SOIL UNIT	LABORATORY TESTS
					PLASTIC LIMIT	LIQUID LIMIT	WATER CONTENT (%)							
					20	40	60	80	20	40	60	80		
10			CLAY – silty, trace organics, homogeneous, platy structure, firm, dark grey											
11		9			- 40% ICE & 40% SOIL									
12					- 100mm thick ICE interval with trace soil									
13		10	- becoming clay and silt		- 50% / 50% becoming 80% / 20% ICE to SOIL									
14		11			- 70% ICE & 30% SOIL									
15		12			- SOIL interval thin									
16														
17		12			- 80% ICE & 20% SOIL									
18														
19		14			- 50mm thick SOIL interval oriented 60° to horizontal									
20.2		15		NOTE: sample # 15 has discrete ICE layers 10 to 20mm thick spaced at intervals of 150mm, horizontal bedding and lensing, 3mm thick ICE lenses in soil interval, soil appears to be unfrozen at some depths and thin occasionally	- driller notes very hard drilling through ice									
				END OF BOREHOLE	20.2m (68.2m Ft) 0.7									

PROJECT NUMBER 101C-4159
 DRILLING COMPLETED OCTOBER 15, 1984
 TERMINATION DEPTH 20.21m
 DRILLING RIG SIMCO 5000 WS
 LOG COMPILED BY MDW/TRM

SOIL SYMBOLS
 Gravel
 Sand
 Silt
 Clay

SAMPLE TYPE
 Thin Wall Tube
 Split Spoon
 Liner
 Core
 Disturbed
 No Recovery

SHEAR STRENGTH
 + Torvane
 x Mini Vane
 Δ Pilcon Vane
 ◇ In Situ Vane
 ▲ UU Triaxial
 ▼ Fall Cone

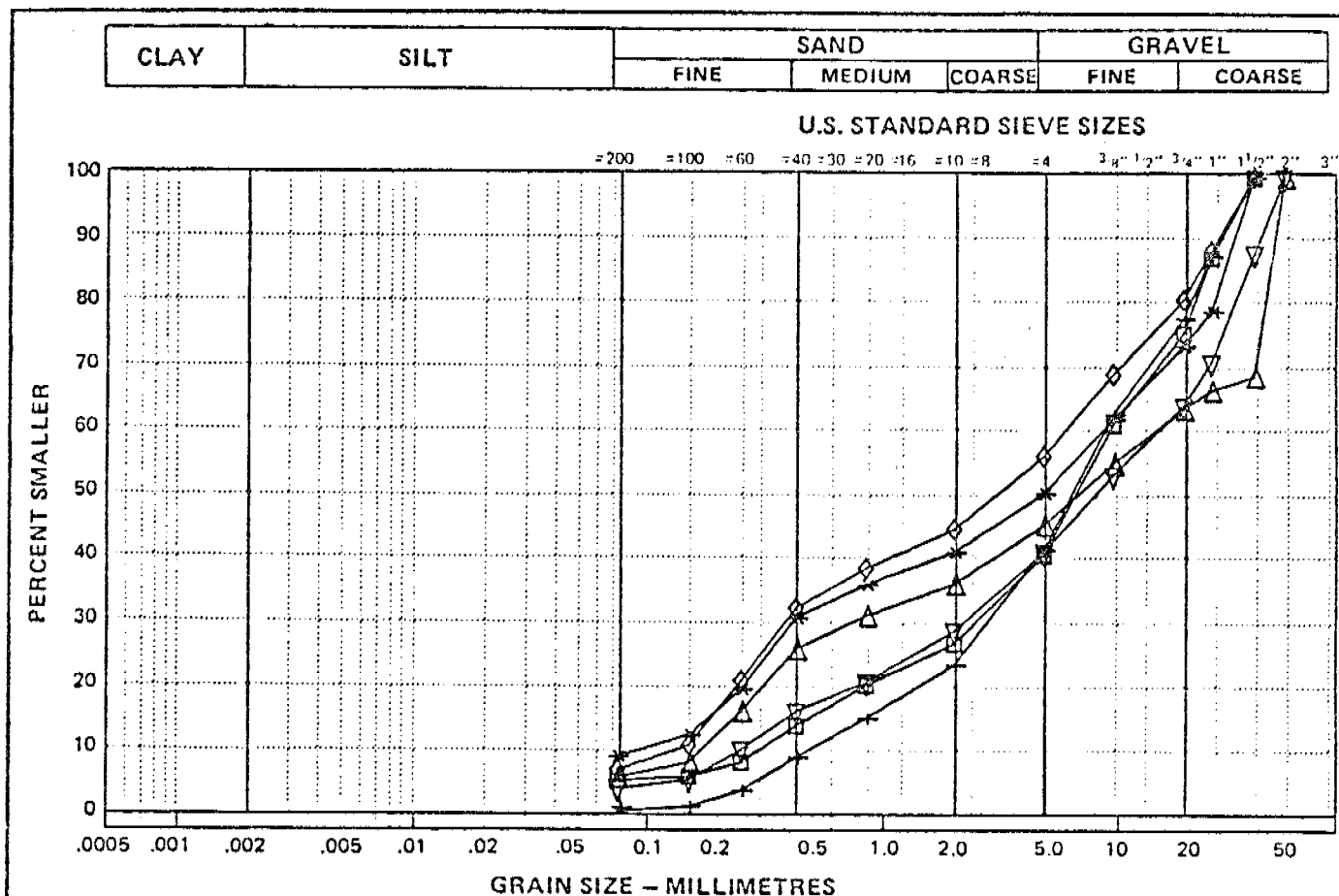
TEST IDENTIFICATION
 C Consolidation
 TS Thaw Strain
 DS Direct Shear
 DSS Direct Simple Shear
 T Triaxial Shear
 S P.W. Salinity
 G Gas Analysis

BOREHOLE NUMBER
 ARK24 HB32
 PAGE 2 OF 2

APPENDIX E.1

Grain Size Distribution Curves
from Area 1, Herschel Sill
(after EBA Engineering Consultants Ltd., 1981)

PARTICLE - SIZE ANALYSIS OF SOILS

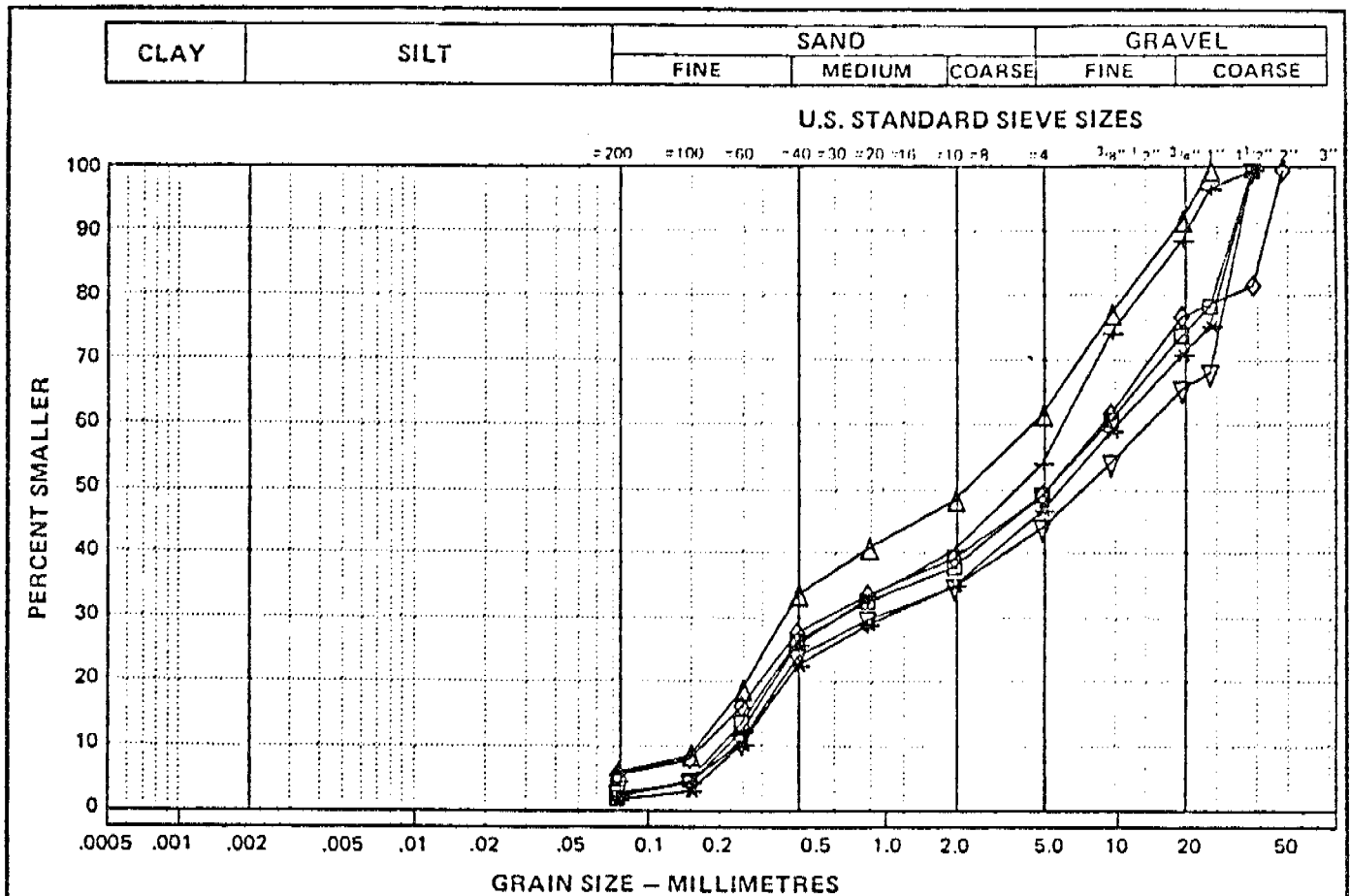


JOB NO. 101-3210

DATE

81- 8- 4

PARTICLE - SIZE ANALYSIS OF SOILS

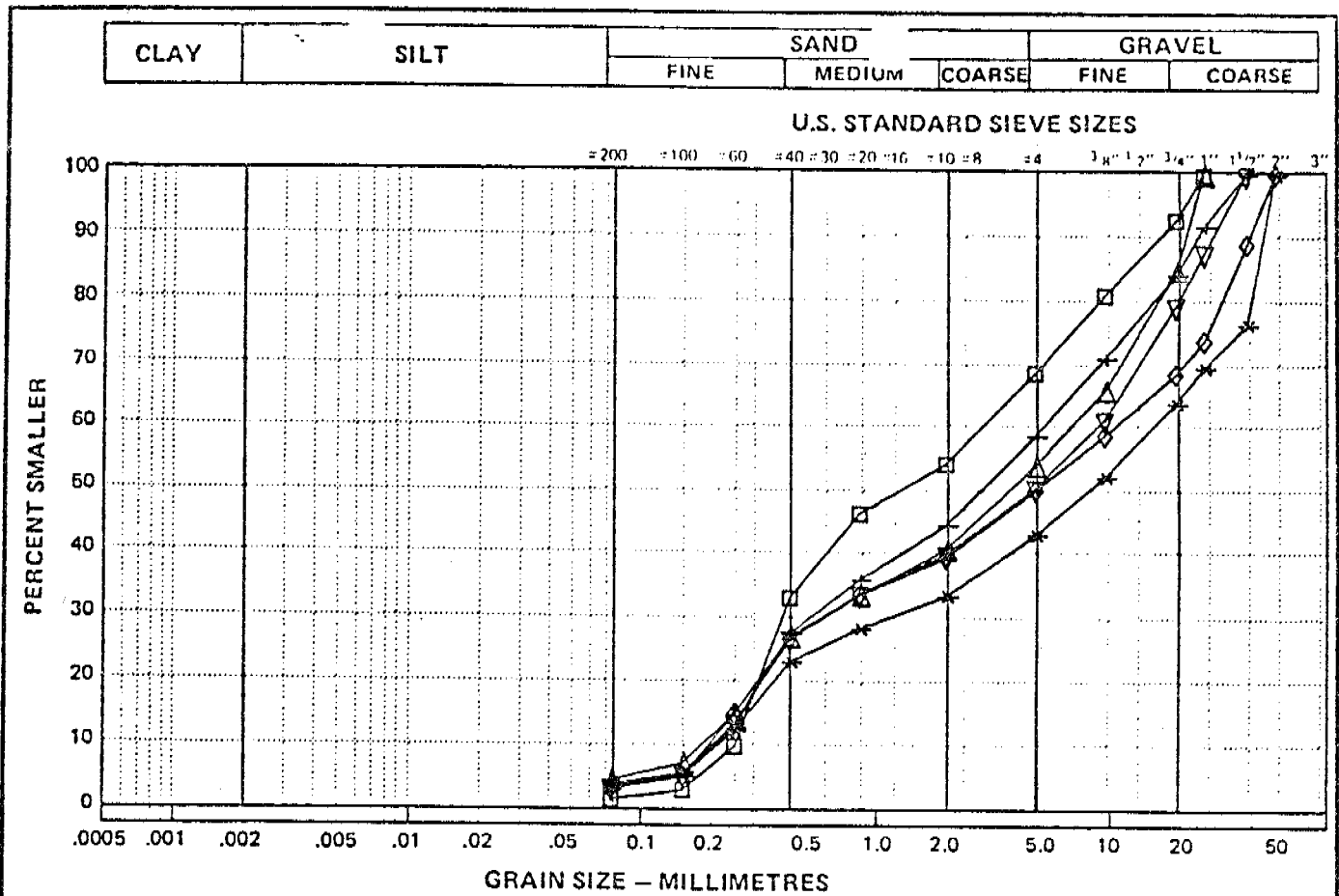


SYMBOL	BOREHOLE NUMBER	DEPTH (m)	DESCRIPTION				Cu	Cc	U.S.C.
			CLAY (%)	SILT (%)	SAND (%)	GRAVEL (%)			
—*	03-1E	0.00- 0.00	—	2	45	53	41.7	.4	GP
—▽	03-2E	0.00- 0.00	—	3	41	56	58.6	.2	GP
—◇	03-3E	0.00- 0.00	—	6	43	51	51.9	.2	GP-GM
—△	03-4E	0.00- 0.00	—	7	55	38	26.9	.2	SP-SM
—□	03-5E	0.00- 0.00	—	3	47	50	45.4	.2	GP
—+	03-6E	0.00- 0.00	—	3	51	46	27.7	.3	SP

JOB NO. 101-3210

DATE 81-8-4

PARTICLE - SIZE ANALYSIS OF SOILS

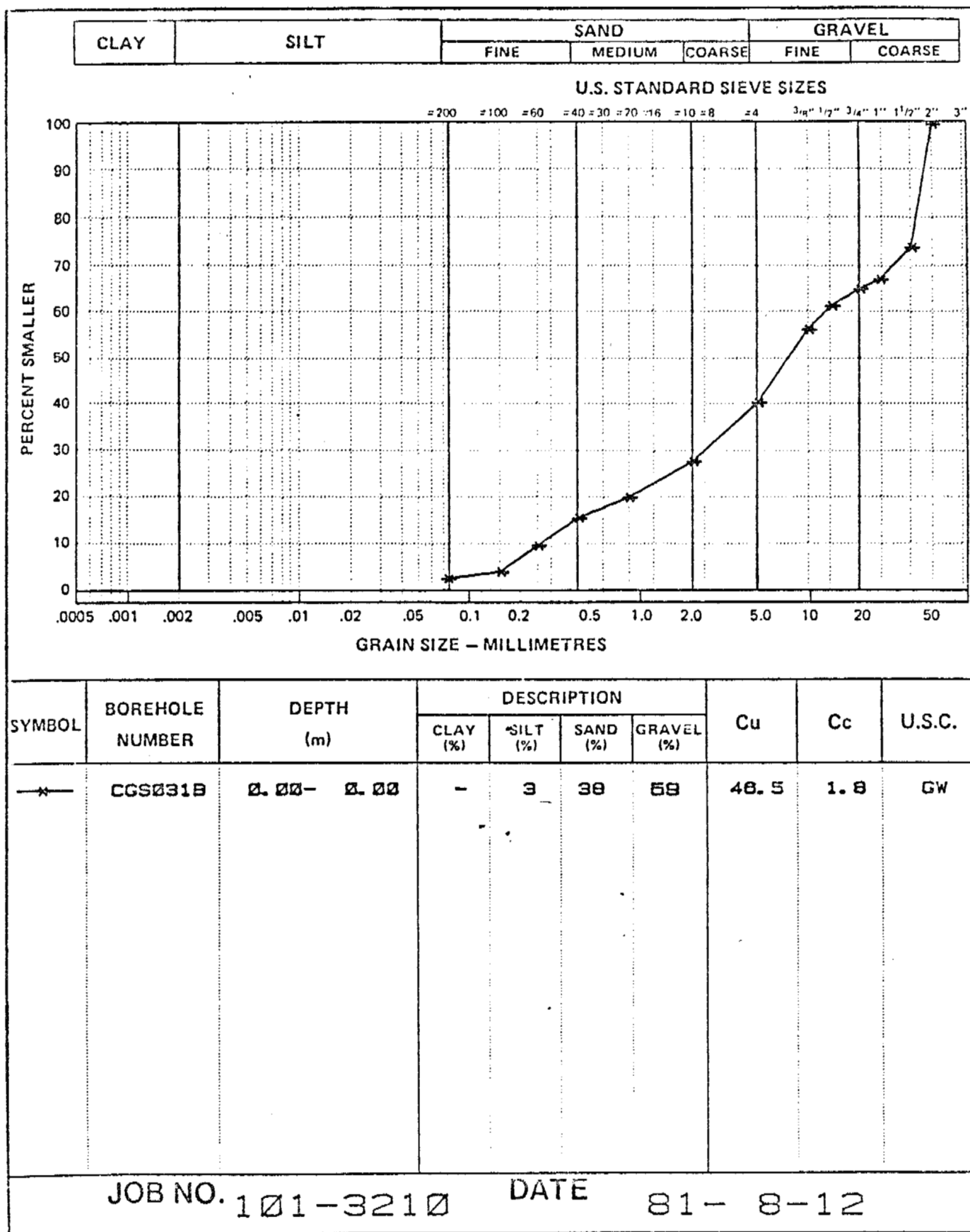


SYMBOL	BOREHOLE NUMBER	DEPTH (m)	DESCRIPTION				Cu	Cc	U.S.C.
			CLAY (%)	SILT (%)	SAND (%)	GRAVEL (%)			
—*—	03-7E	0.00- 0.00	-	4	39	57	72.8	.4	GP
—▽—	06-1B	0.00- 0.00	-	4	48	50	44.6	.2	GP
—◇—	06-1A	0.00- 0.00	-	4	46	50	54.7	.2	GP
—△—	07-1A	0.00- 0.00	-	5	49	46	38.2	.3	SP
—□—	08-1A	0.00- 0.00	-	2	67	31	11.3	.2	SP
—+—	09-1A	0.00- 0.00	-	4	54	42	25.7	.3	SP

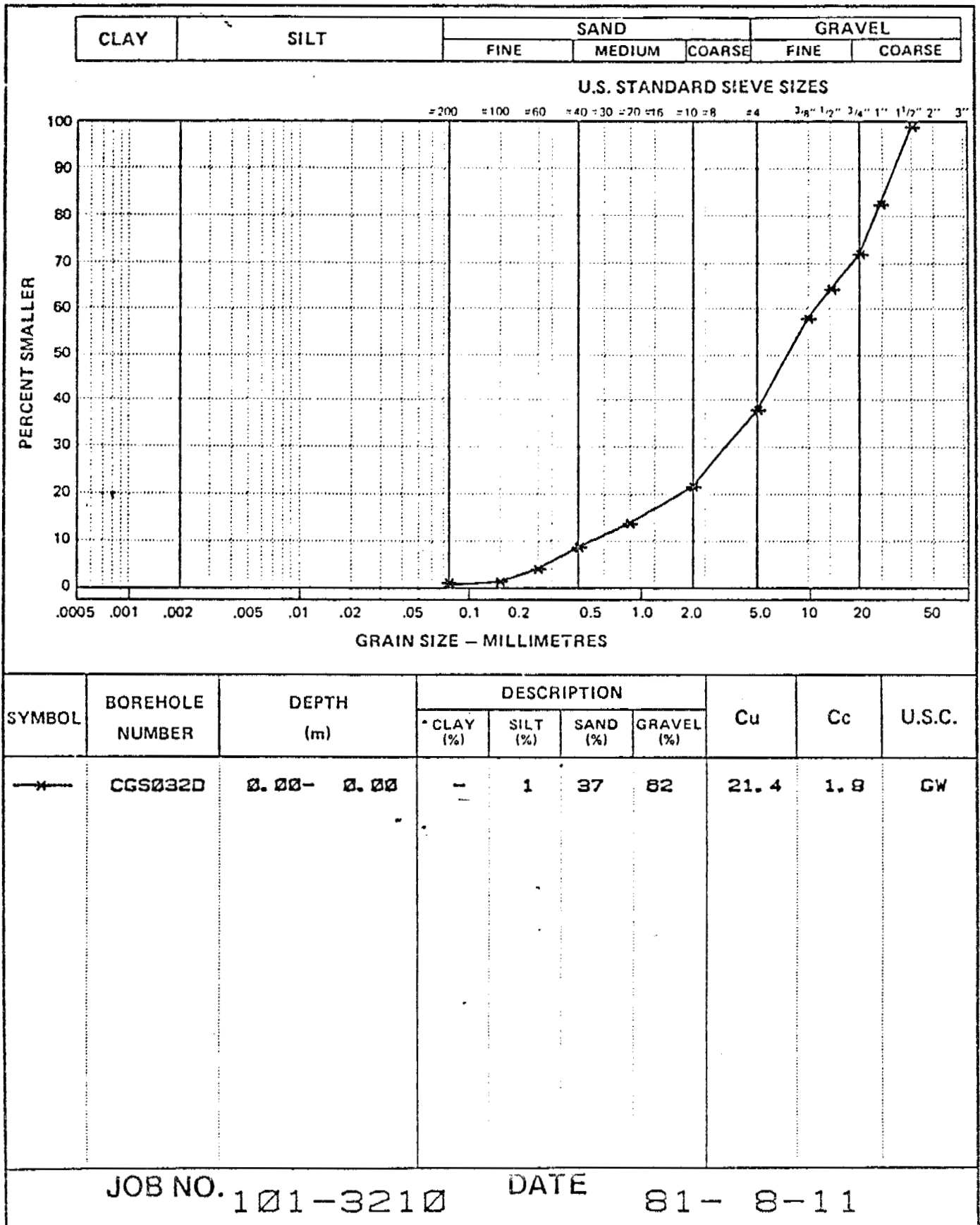
JOB NO. 101-3210

DATE 81- 8- 4

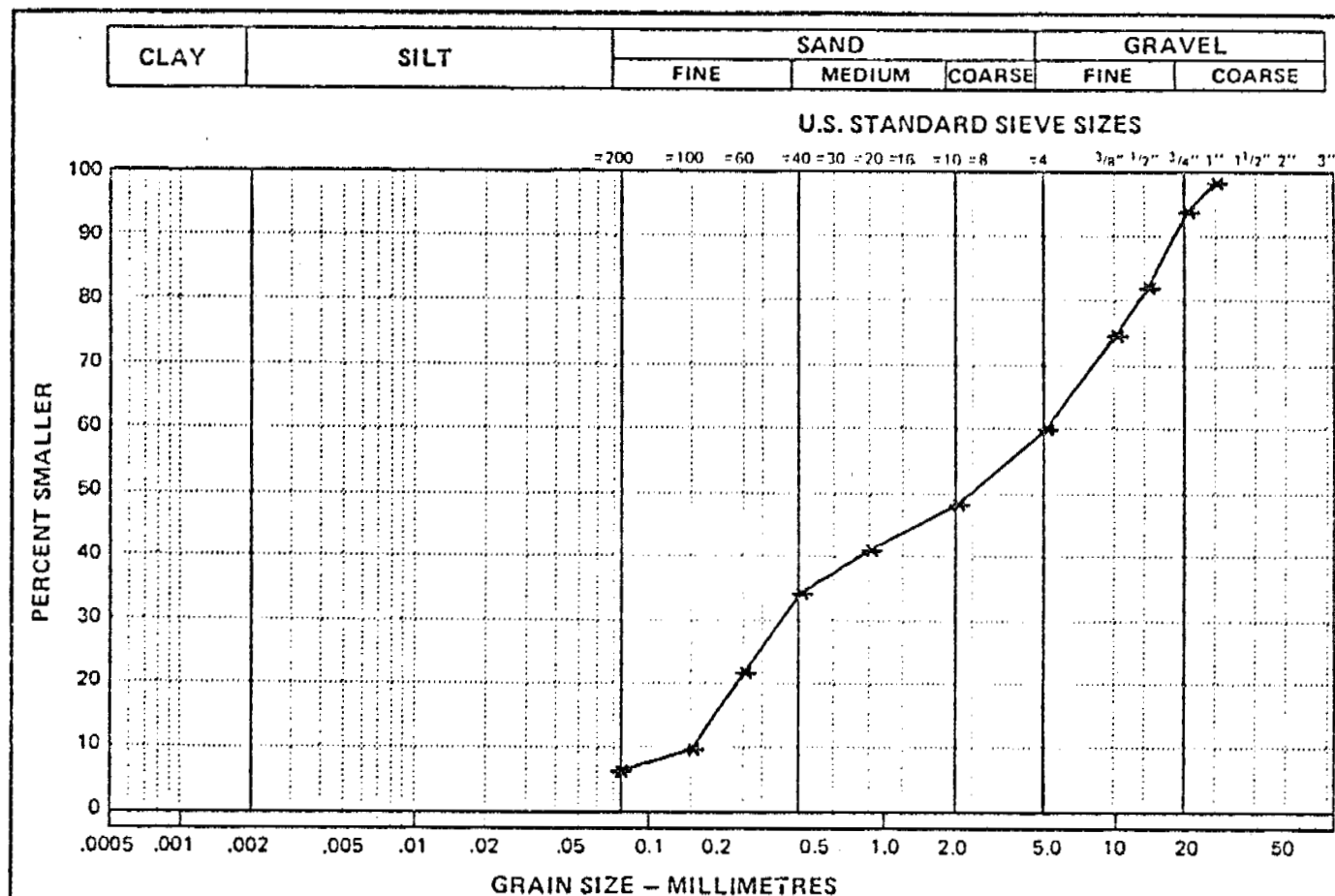
PARTICLE - SIZE ANALYSIS OF SOILS



PARTICLE - SIZE ANALYSIS OF SOILS



PARTICLE - SIZE ANALYSIS OF SOILS

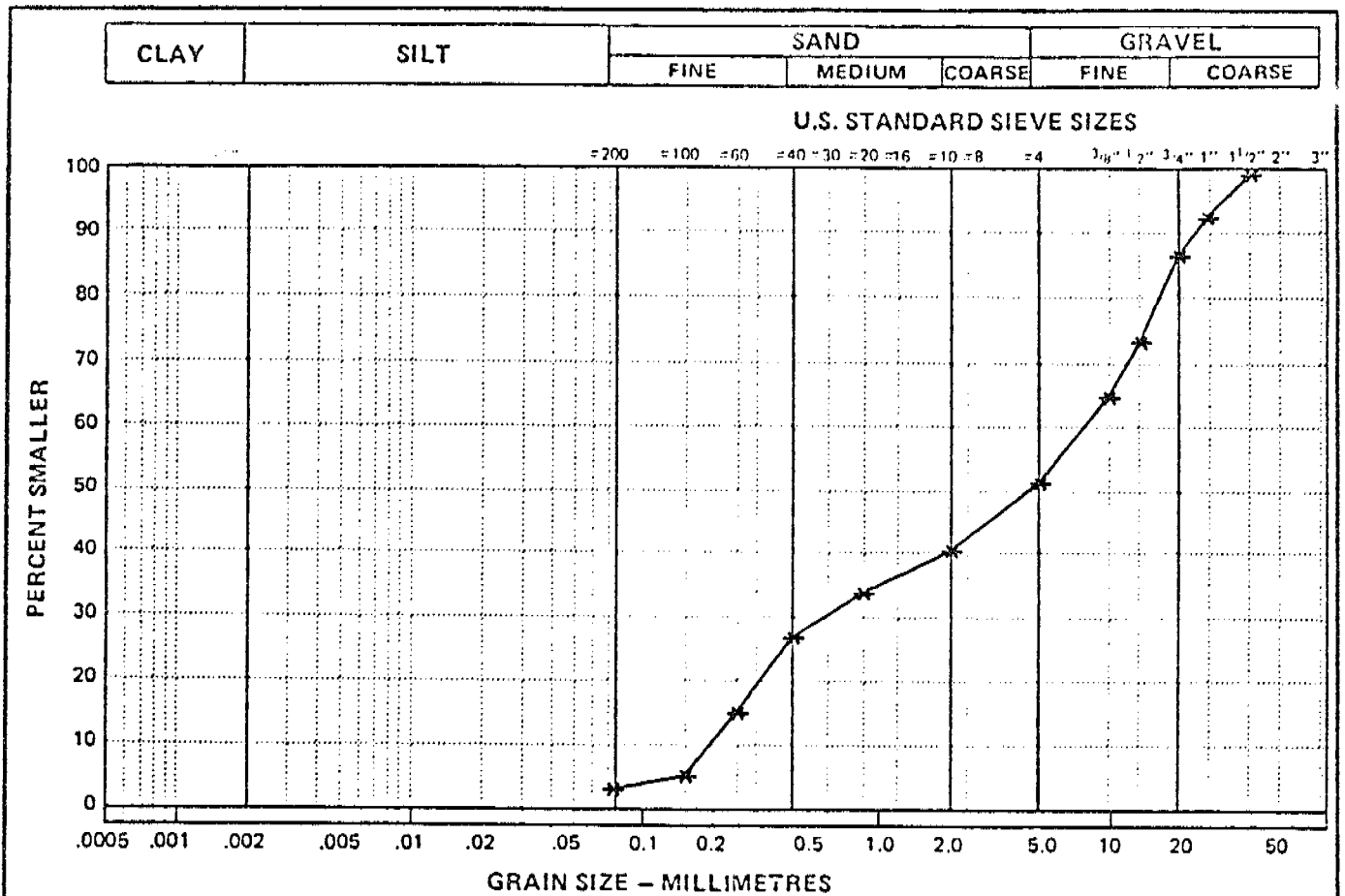


SYMBOL	BOREHOLE NUMBER	DEPTH (m)	DESCRIPTION				Cu	Cc	U.S.C.
			CLAY (%)	SILT (%)	SAND (%)	GRAVEL (%)			
—*—	CGS033E	0.00- 0.00	—	7	54	39	33.7	.2	SP-SM

JOB NO. 101-3210

DATE 81- 8-11

PARTICLE SIZE ANALYSIS OF SOILS



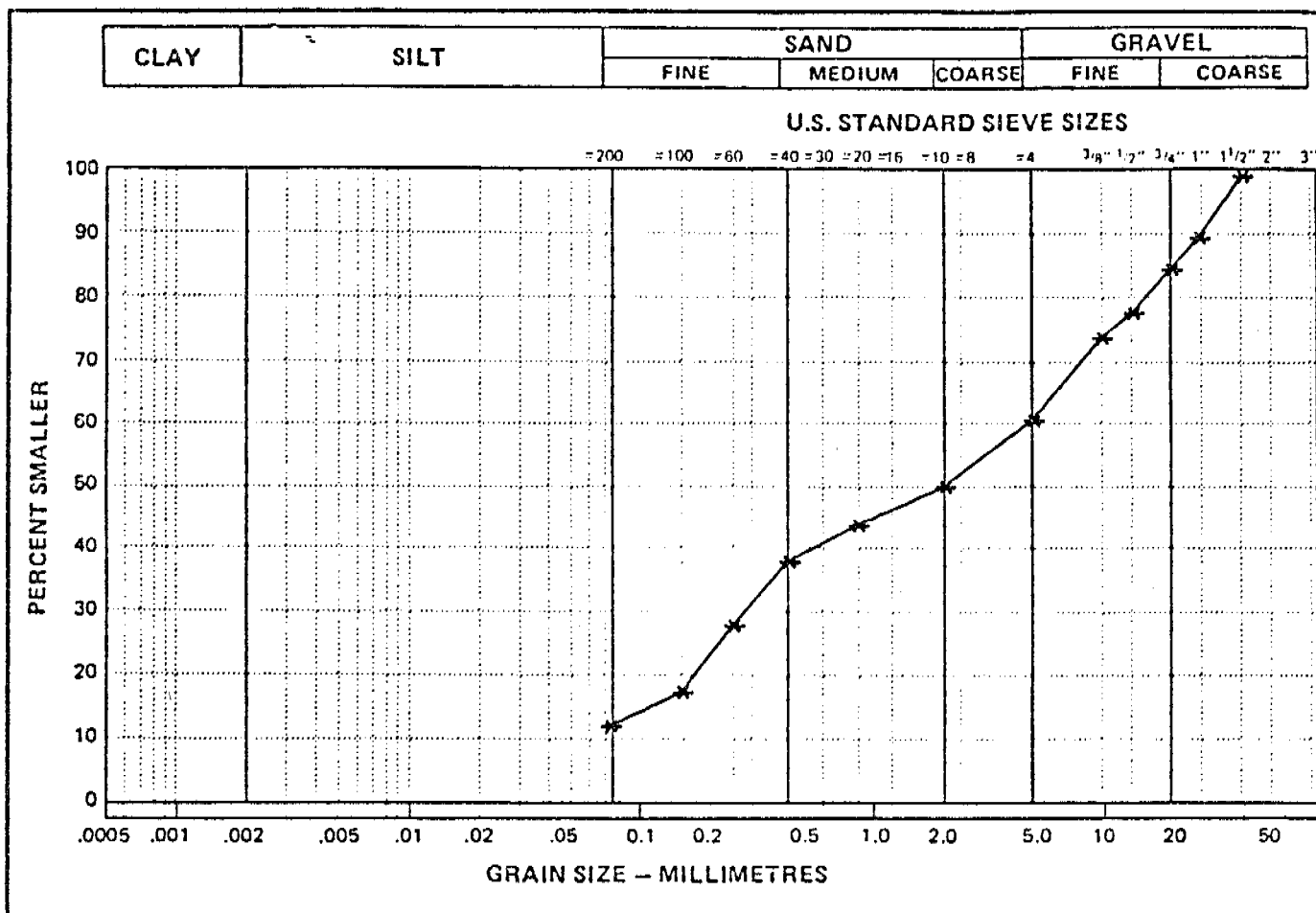
SYMBOL	BOREHOLE NUMBER	DEPTH (m)	DESCRIPTION				Cu	Cc	U.S.C.
			CLAY (%)	SILT (%)	SAND (%)	GRAVEL (%)			
—x—	CGS081A	0.00- 0.00	—	4	48	48	38.7	.2	GP

JOB NO. 101-3210

DATE

81- 8-11

PARTICLE - SIZE ANALYSIS OF SOILS

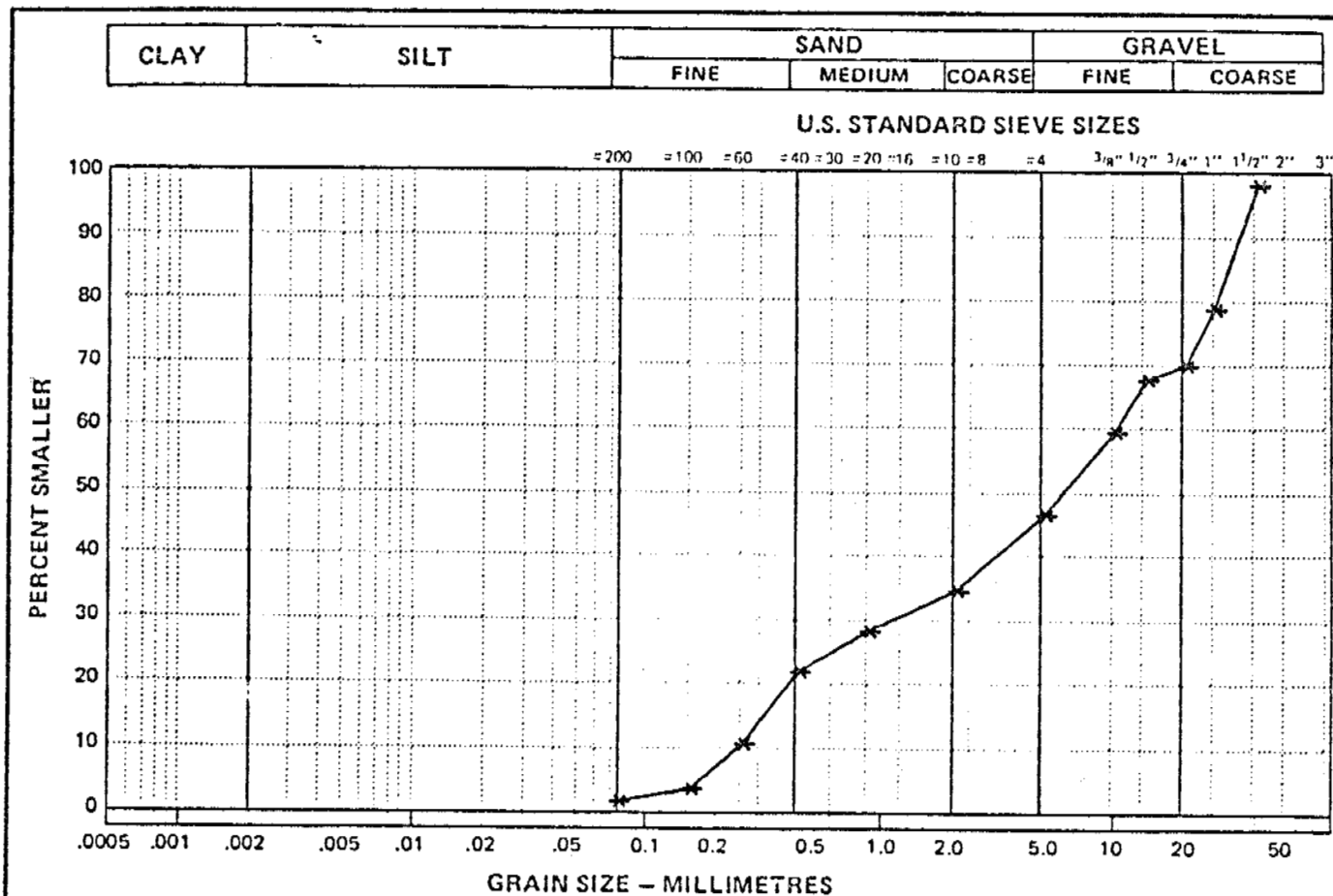


SYMBOL	BOREHOLE NUMBER	DEPTH (m)	DESCRIPTION				Cu	Cc	U.S.C.
			CLAY (%)	SILT (%)	SAND (%)	GRAVEL (%)			
—*—	CGS038E	0.00- 0.00	—	13	48	39	—	—	SM

JOB NO. 101-3210

DATE 81- 8-11

PARTICLE - SIZE ANALYSIS OF SOILS



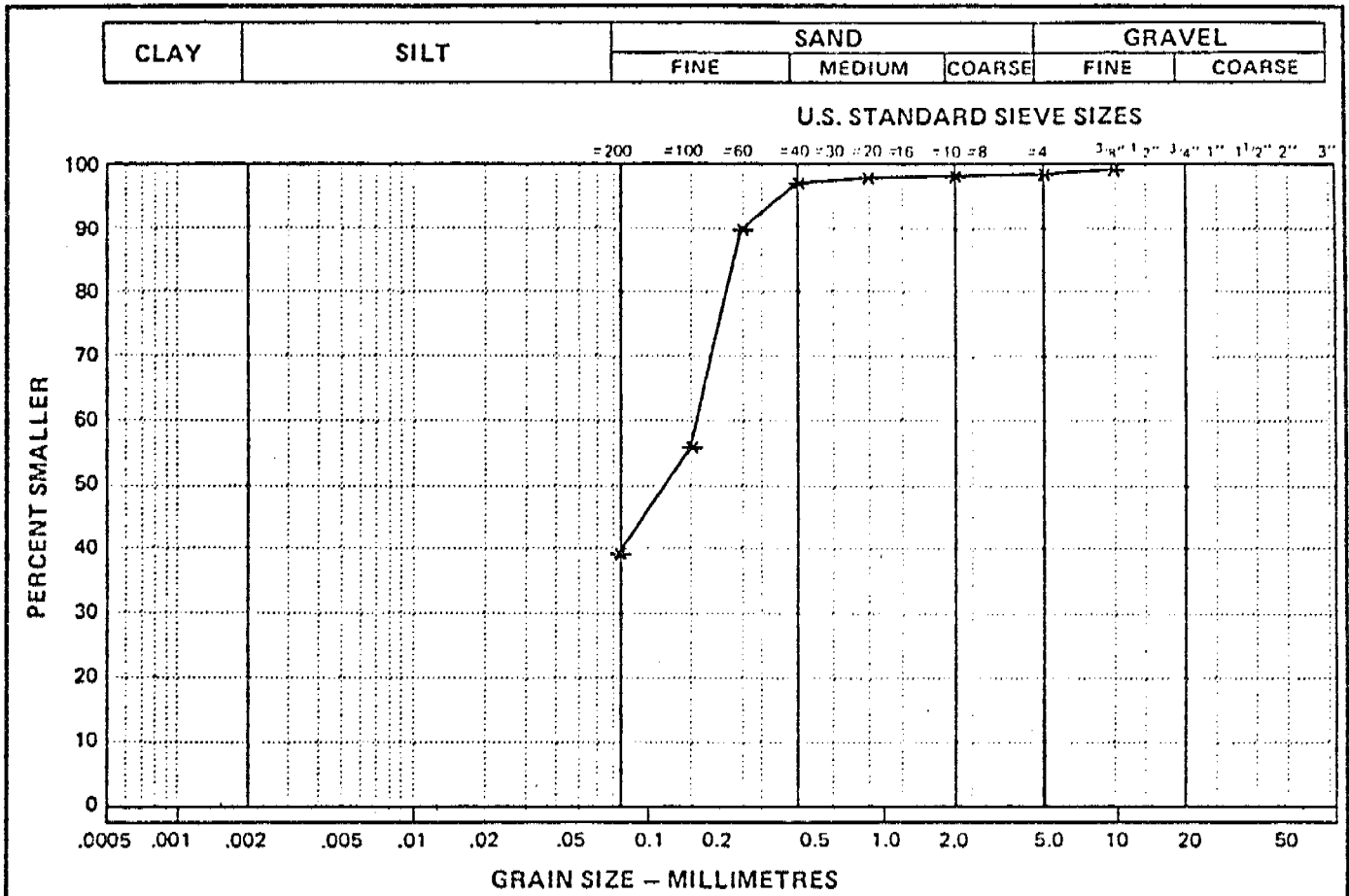
SYMBOL	BOREHOLE NUMBER	DEPTH (m)	DESCRIPTION				Cu	Cc	U.S.C.
			CLAY (%)	SILT (%)	SAND (%)	GRAVEL (%)			
—*—	CGS091A	0.00 - 0.00	—	3	45	52	42.0	.4	GP

JOB NO. 101-3210 DATE 81-8-11

APPENDIX E.2

Grain Size Distribution Curves
from Area 2, Herschel Sill
(after EBA Engineering Consultants Ltd., 1981)

ARTICLE - SIZE ANALYSIS OF SOIL



SYMBOL	BOREHOLE NUMBER	DEPTH (m)	DESCRIPTION				Cu	Cc	U.S.C.
			CLAY (%)	SILT (%)	SAND (%)	GRAVEL (%)			
—*—	05-1B	0.00- 0.00	-	40	59	1	-	-	SM

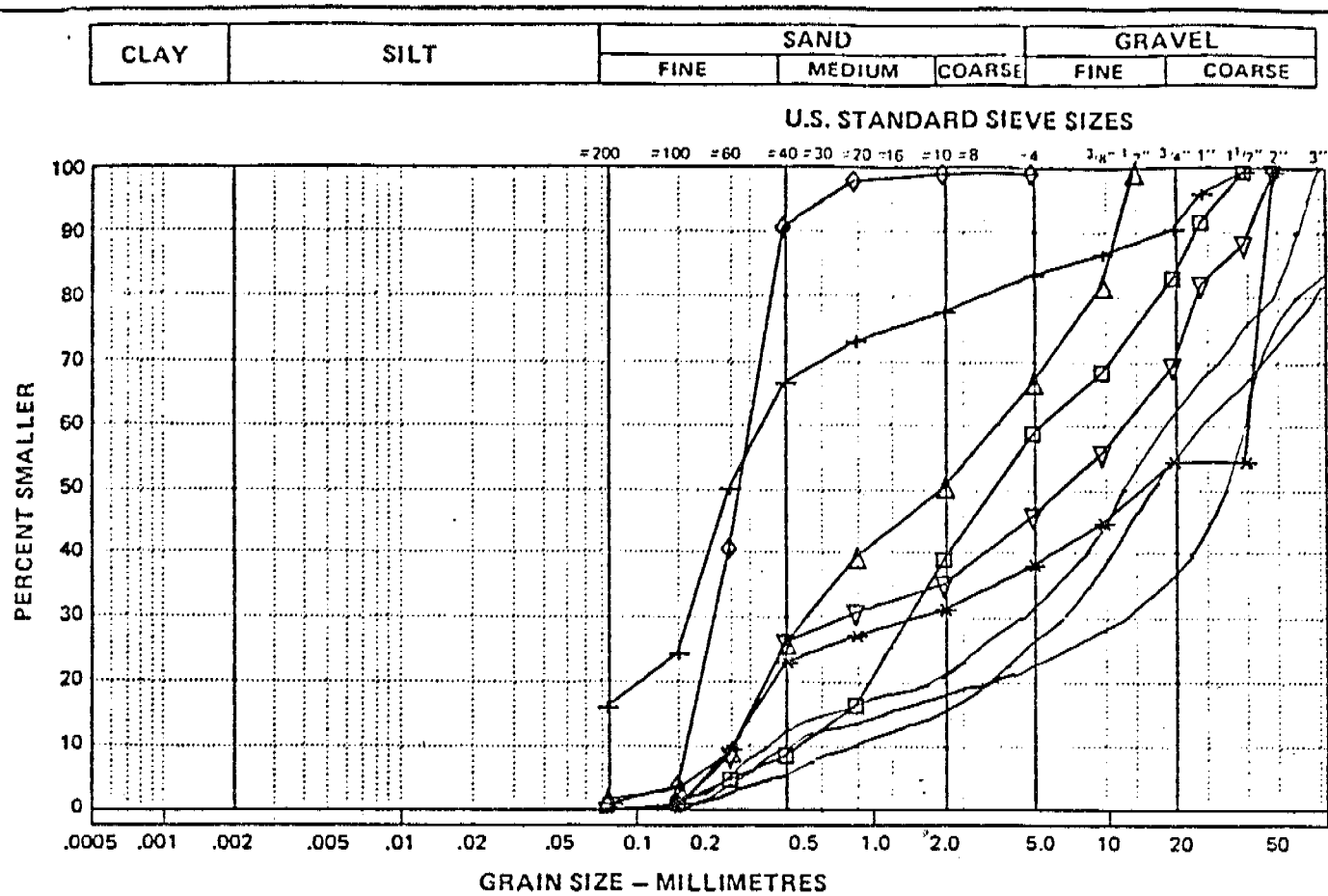
JOB NO. 101-3210

DATE 81- 8- 4

APPENDIX E.3

Grain Size Distribution Curves
from Area 3, Herschel Sill
(after EBA Engineering Consultants Ltd., 1981)

PARTICLE - SIZE ANALYSIS OF SOILS

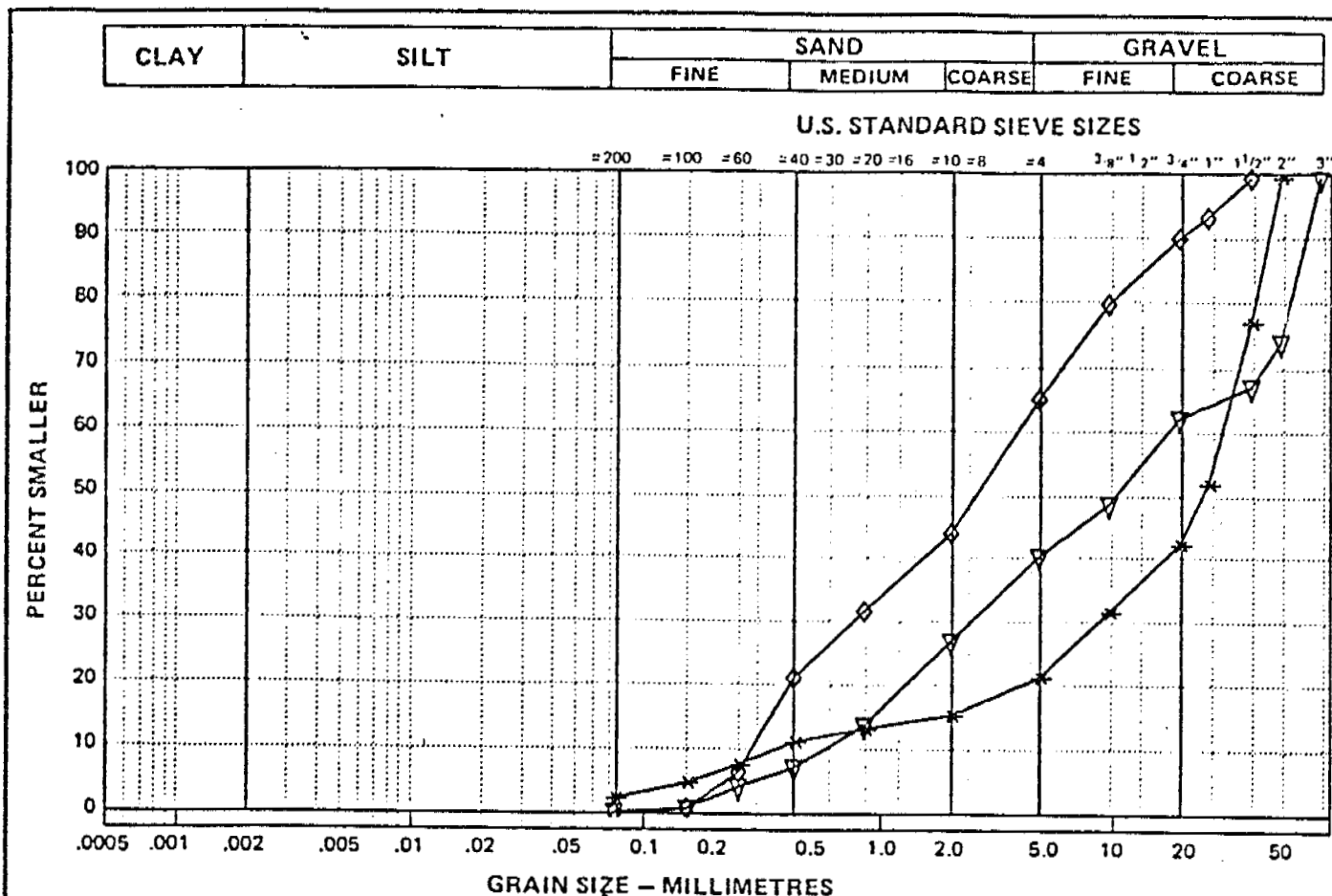


SYMBOL	BOREHOLE NUMBER	DEPTH (m)	DESCRIPTION				Cu	Cc	U.S.C.
			CLAY (%)	SILT (%)	SAND (%)	GRAVEL (%)			
—x—	01-1A	0.00- 0.00	—	0	38	62	156.9	.2	GP
—▽—	01-1C	0.00- 0.00	—	0	46	54	45.0	.2	GP
—◇—	10-1A	0.00- 0.00	—	1	99	0	1.9	.9	SP
—△—	11-1A	0.00- 0.00	—	2	65	33	12.9	.3	SP
—□—	12-1A	0.00- 0.00	—	0	68	41	10.8	.8	SP
—+—	13-1A	0.00- 0.00	—	17	67	16	—	—	SM

JOB NO. 101-3210

DATE 81- 8- 4

PARTICLE - SIZE ANALYSIS OF SOILS

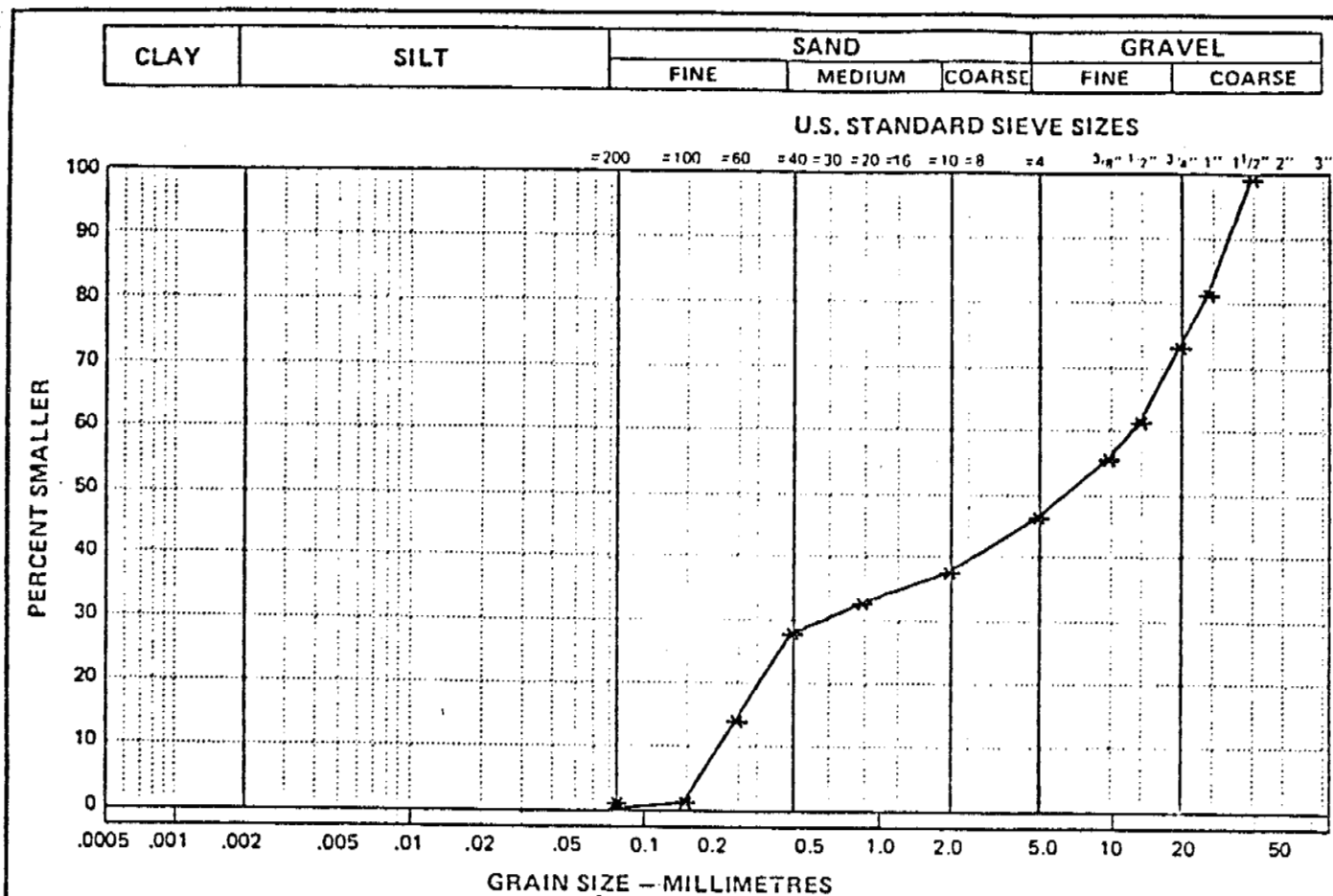


SYMBOL	BOREHOLE NUMBER	DEPTH (m)	DESCRIPTION				Cu	Cc	U.S.C.
			CLAY (%)	SILT (%)	SAND (%)	GRAVEL (%)			
—*—	14-1A	0.00- 0.00	-	3	19	78	84.7	7.4	GP
—▽—	15-1A	0.00- 0.00	-	1	40	59	30.1	.8	GP
—◇—	16-1A	0.00- 0.00	-	1	65	34	13.6	.5	SP

JOB NO. 101-3210

DATE 81- 8- 4

PARTICLE - SIZE ANALYSIS OF SOILS

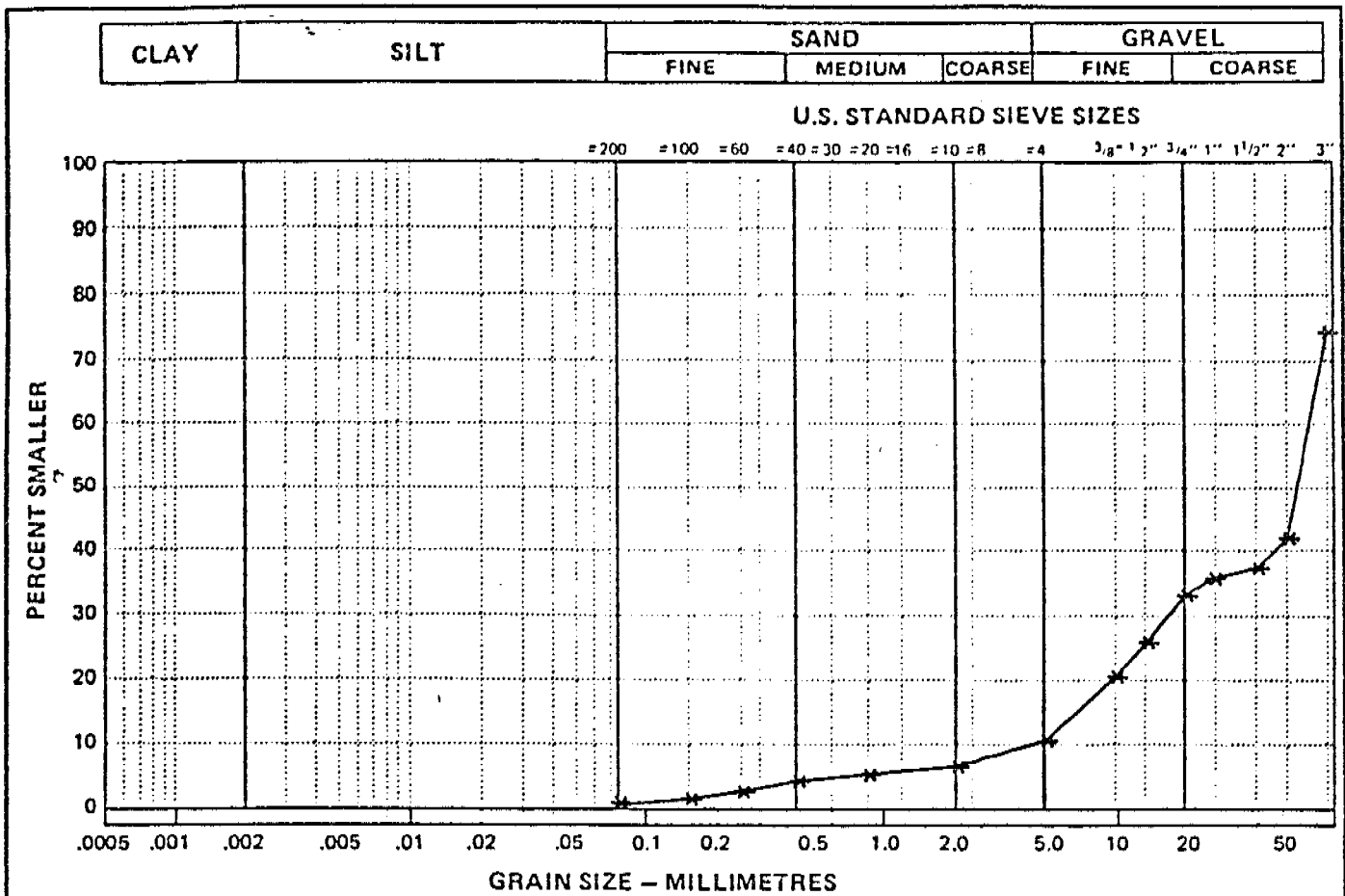


SYMBOL	BOREHOLE NUMBER	DEPTH (m)	DESCRIPTION				Cu	Cc	U.S.C.
			CLAY (%)	SILT (%)	SAND (%)	GRAVEL (%)			
— * —	CGS011A	0.00- 0.00	—	1	48	53	58.4	.1	GP

JOB NO. 101-3210

DATE 81- 8-11

PARTICLE SIZE ANALYSIS OF SOILS



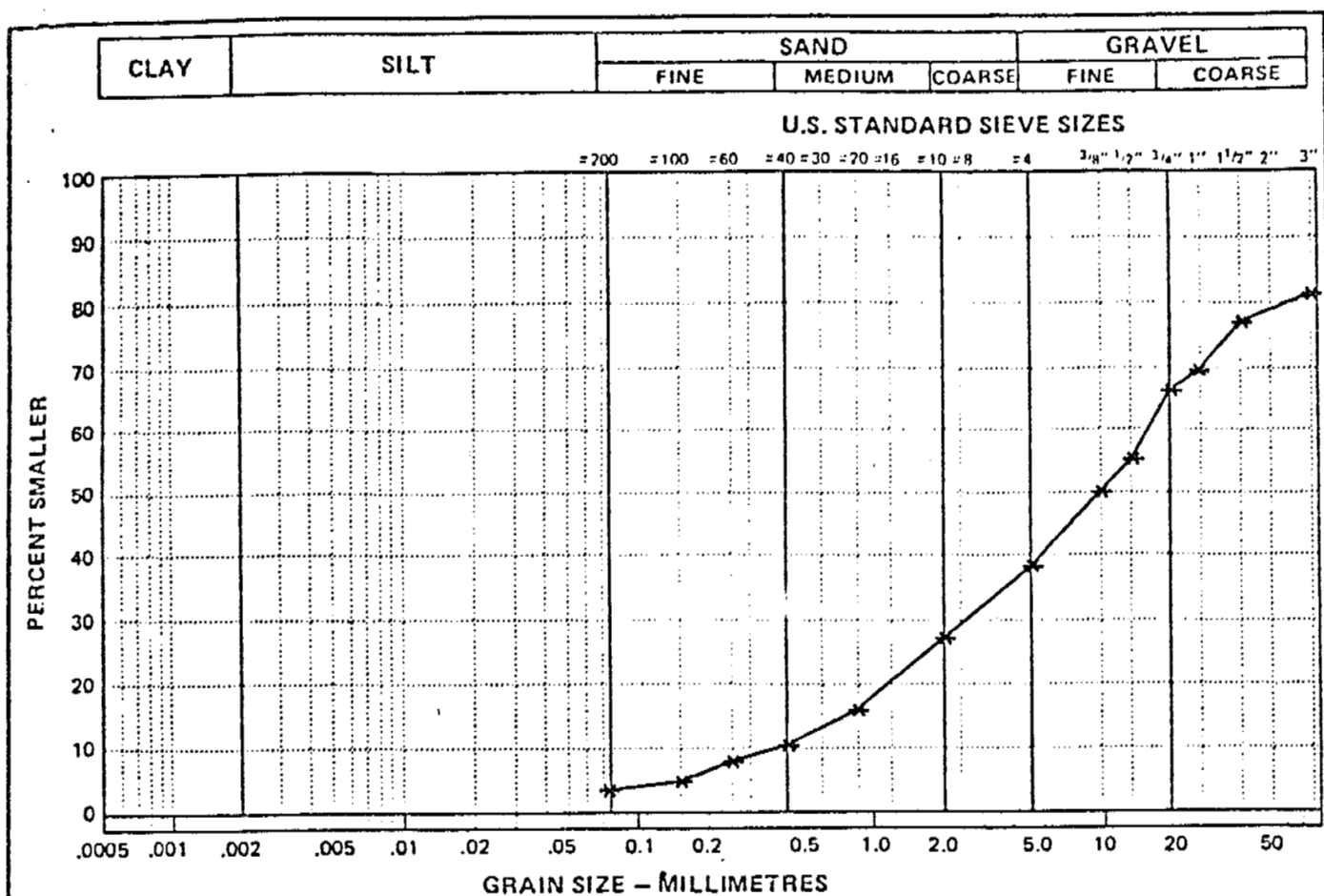
SYMBOL	BOREHOLE NUMBER	DEPTH (m)	DESCRIPTION				Cu	Cc	U.S.C.
			CLAY (%)	SILT (%)	SAND (%)	GRAVEL (%)			
—*—	CGS141A	0.00- 0.00	-	1	10	89	16.7	1.0	GW

JOB NO. 101-3210

DATE

81- 8-11

PARTICLE - SIZE ANALYSIS OF SOILS



SYMBOL	BOREHOLE NUMBER	DEPTH (m)	DESCRIPTION				Cu	Cc	U.S.C.
			CLAY (%)	SILT (%)	SAND (%)	GRAVEL (%)			
—x—	CGS151A	0.00- 0.00	—	4	35	61	41.5	1.1	GW

JOB NO. 101-3210

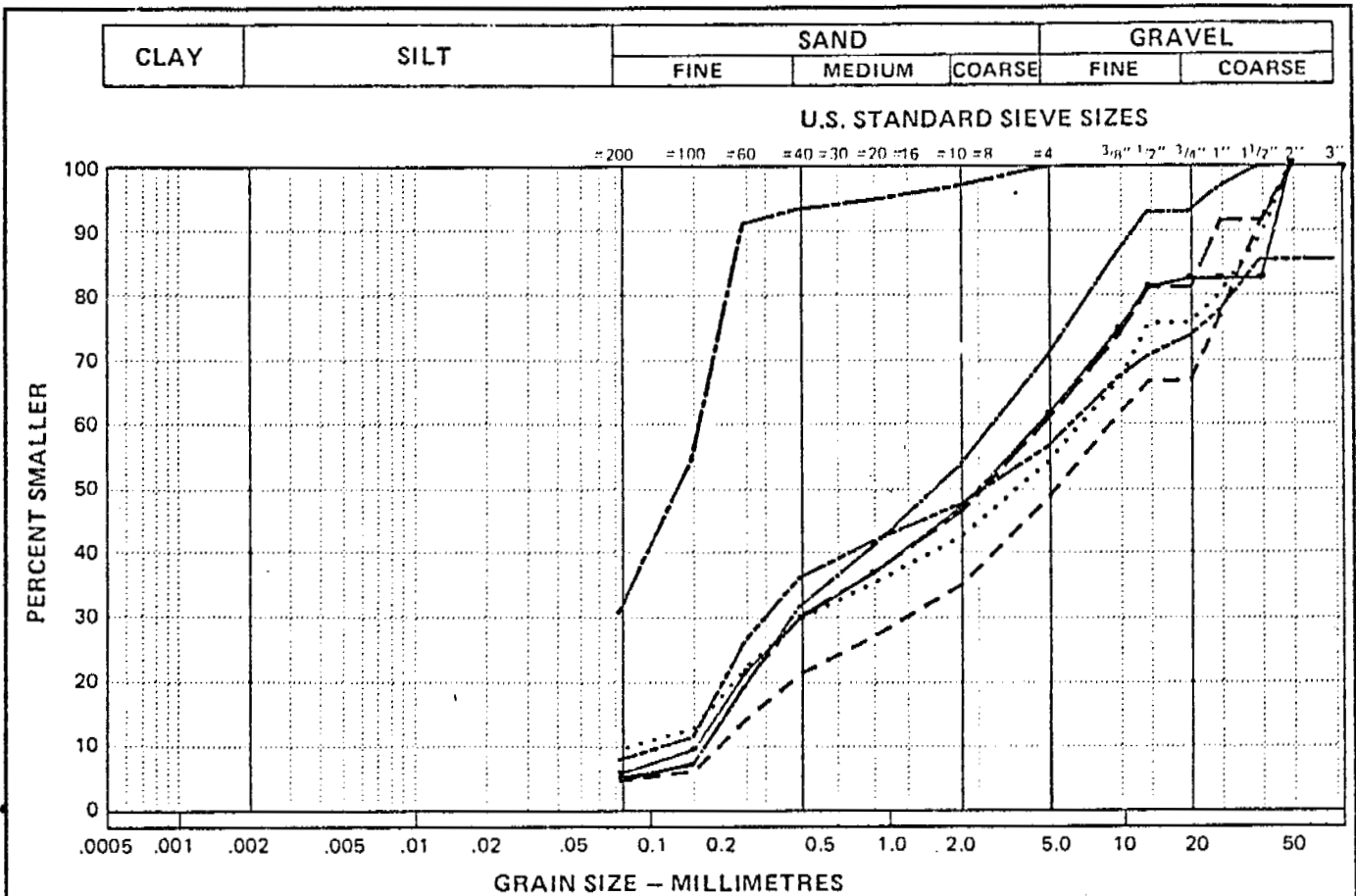
DATE 81- 8-11

APPENDIX E.4

Grain Size Distribution Curves

Obtained from the 1984 DIAND Programme on Herschel Sill
(after EBA Engineering Consultants Ltd., 1984)

PARTICLE - SIZE ANALYSIS OF SOILS

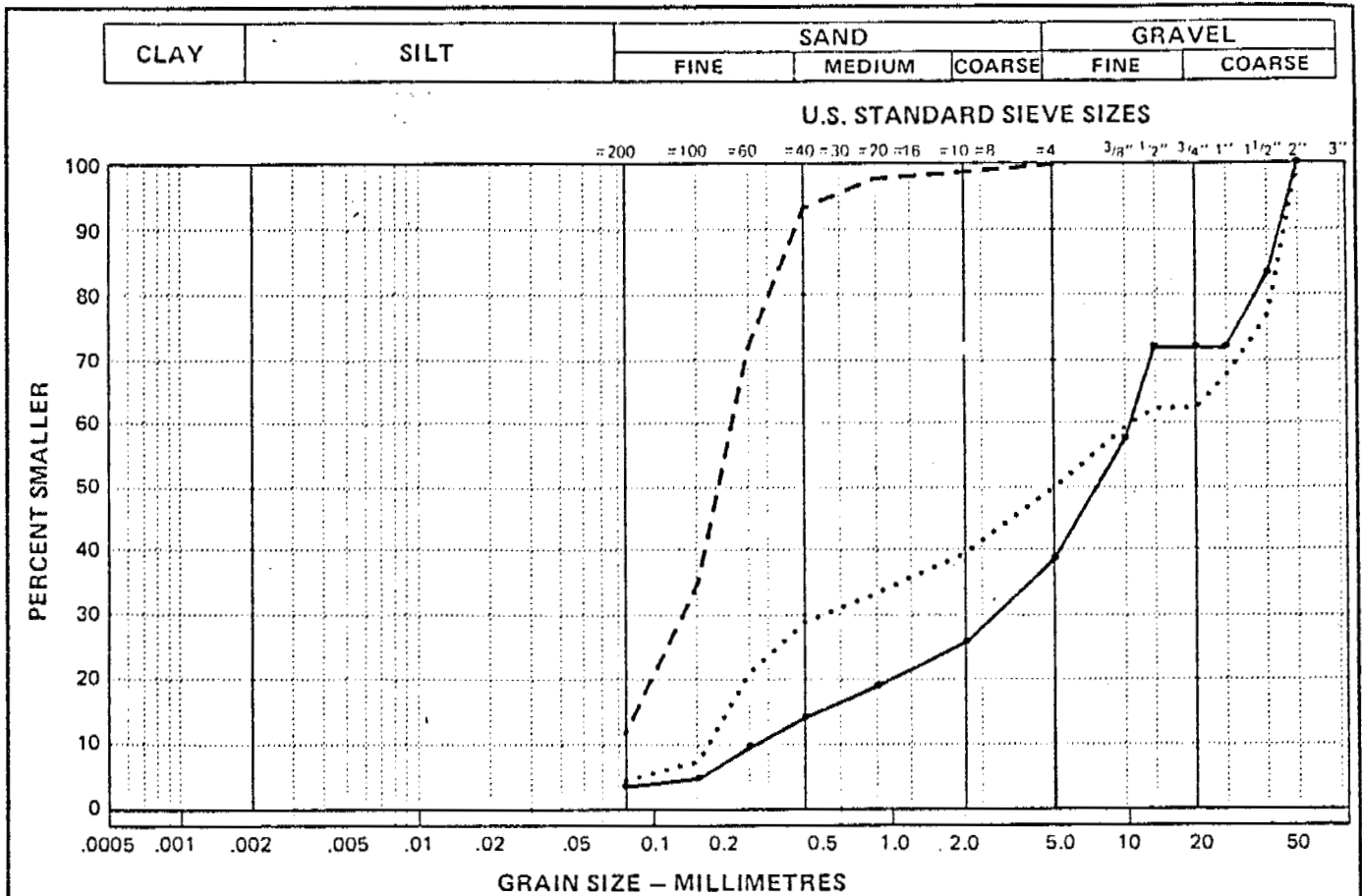


SYMBOL	BOREHOLE NUMBER	DEPTH (m)	DESCRIPTION				Cu	Cc	U.S.C.
			CLAY (%)	SILT (%)	SAND (%)	GRAVEL (%)			
_____	HS1	0.00 - .30	-	4.5	56.1	39.4	28.6	.3	SP
.....	HS1	.50 - .60	-	8.5	44.8	46.7	67.1	.3	GP-GM
___	HS1	.70 - .80	-	3.6	44.1	52.3	44.4	.9	GP
___	HS2	0.00 - .40	-	3.7	56.8	39.5	27.1	.2	SP
-----	HS3	0.00 - .40	-	3.9	66.0	30.1	16.3	.3	SP
-----	HS3	.90 - 1.20	-	30.0	70.0	0.0	-	-	-
-----	HS4	0.00 - .40	-	6.8	49.0	44.2	44.9	.1	SP-SM

JOB NO. 101 -4133

DATE 84-10-13

PARTICLE - SIZE ANALYSIS OF SOILS



SYMBOL	BOREHOLE NUMBER	DEPTH (m)	DESCRIPTION				Cu	Cc	U.S.C.
			CLAY (%)	SILT (%)	SAND (%)	GRAVEL (%)			
—	HS1	0.00 - .30	—	2.3	35.3	62.4	33.8	2.7	GW
.....	HS2	0.00 - .25	—	3.4	45.6	51.0	63.1	.2	GP
— — —	HS2	1.37 - 1.67	—	10.7	89.3	0.0	—	—	—

JOB NO. 101 -4133

DATE 84-10-11

APPENDIX E.5

Test Pit Logs from the Spit at Catton Point
(after R. M. Hardy and Associates Ltd., 1976)

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	GP	0.5	GRAVEL - coarse, rounded.		UF		Moisture Content: 5.6%
2	SW		SAND - well graded, and gravel to 1 1/4" size, rounded.				Lightweight Pieces - Fine Aggregate: 0.18%
3	SP	2.5 2.8	SAND - fine.				
4	GP	4.0	GRAVEL - fine to 3/4" size and fine to coarse sand, stratified, 6" layers, subrounded to rounded.				
5			- - thin layer of woody detritus.				
6		6.2		Nbn		5.2	
7			Bottom of Pit				Sample from 0'-6.2'

DATE: Sept. 21, 1976

LOGGED BY: GCD

DRWN BY: MB/vh

CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND
NORTHERN DEVELOPMENT



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

TEST PIT NO.
Y39-A

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
	GW		GRAVEL - well graded to 2" size, rounded, sandstones, cherts.		UF		
1	GP		GRAVEL - fine, and medium to coarse sand.				
2	GW		GRAVEL - well graded to 2" size, some medium to coarse sand, sub-rounded to rounded, sandstones, cherts.				
		2.6 — ▽ 2.8	saturated				
3			Bottom of Pit				No sample taken.

DATE: Sept. 21, 1976

LOGGED BY: GCD

DRWN BY: MB/vh

CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND
NORTHERN DEVELOPMENT



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

TEST PIT NO.
Y39-B
SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	GW		GRAVEL - well graded to 2" size, and fine to medium sand, occasional cobble to 4" size, subrounded to rounded, sandstones, cherts, clean.		UF		Lightweight Pieces - Fine Aggregate: 0.36%
2							
3							
4	GP		GRAVEL - fine to 3/4" size, and fine to medium sand, subrounded to rounded, sandstones, cherts, clean.				
5							
6							
7			3.6 — sand becoming coarser.				
8			4.1 —  saturated.				
9			4.3 — Bottom of Pit				Sample from 0'-4.3'

DATE: Sept. 21, 1976

LOGGED BY: GCD

DRWN BY: MB/vh

CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND
NORTHERN DEVELOPMENT



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

TEST PIT NO.
Y39-C

SHEET 1 OF 1

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
1	GW		GRAVEL - well graded to 3" size, some medium sand, subrounded to rounded, sandstones, cherts.		UF		
2		 18 - ∇ 20	saturated				
3			Bottom of Pit				No sample taken.

DATE: Sept. 21, 1976	LOGGED BY: GCD	DRWN BY: MB/vh	CHKD BY: GCD/TJF
GOVERNMENT OF CANADA DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT		 R.M. HARDY & ASSOCIATES LTD. CONSULTING ENGINEERS & PROFESSIONAL SERVICES • GEOTECHNICAL DIVISION	TEST PIT NO. Y39-D SHEET 1 OF 1

APPENDIX E.6

Test Pit Logs from the Spit at Stokes Point
(after R. M. Hardy and Associates Ltd., 1976)

TEST HOLE LOG

[illegible]

TEST HOLE LOG

DEPTH (FT)	SOIL GROUP SYMBOL	SOIL GRAPHIC LOG	MATERIAL DESCRIPTION	ICE GRAPHIC LOG	NCR ICE TYPE VISUAL ICE %	DEPTH (FT)	OTHER INFORMATION
Pt	PT		03 PEAT - fine, fibrous.		UF		Organic Color: #3
1	GW		GRAVEL - well graded, some fine to coarse sand, occasional cobbles and boulders to 10" size, trace silty fines, subrounded to subangular, brown, damp.				Lightweight Pieces - Fine Aggregate: 0.11%
2							
3							
4							
5			49 — — decreasing fines content				
6		59	Bottom of Pit				Sample from 0.3'-5.9'

DATE: Oct. 6, 1976

LOGGED BY: CPM

DRWN BY: MB/vh

CHKD BY: GCD/TJF

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND
NORTHERN DEVELOPMENT



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

TEST PIT NO.
Y48-A

SHEET 1 OF 1

APPENDIX E.7

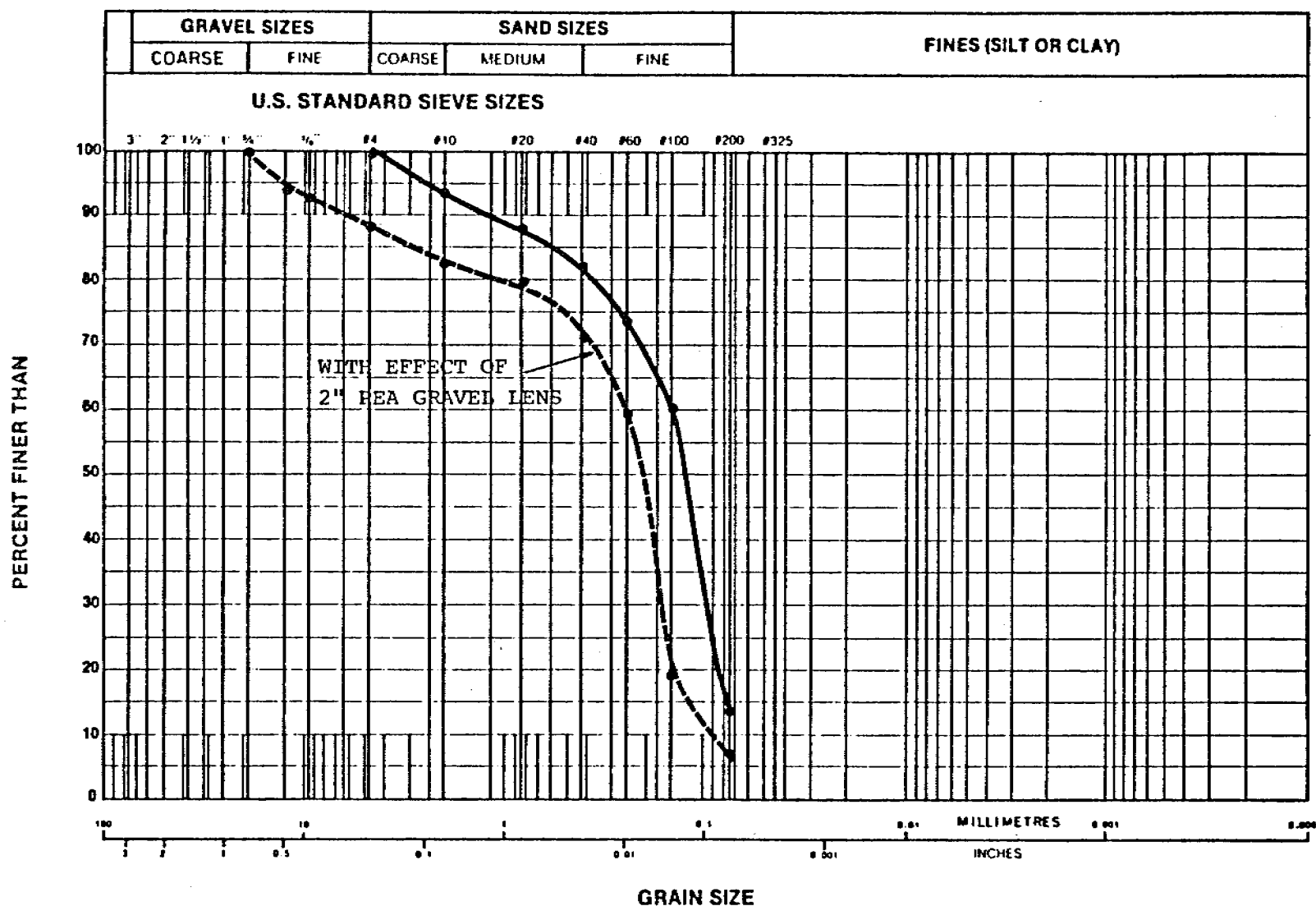
Grain Size Distribution Curves from Stokes Point
(data from Hardy Associates (1978) Ltd., 1983)



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

GRAIN SIZE CURVE

PROJECT NO.	CG 14038D
CLIENT	GULF CANADA RESOURCES INC
BOREHOLE	82-SP-2
SAMPLE	D2
DEPTH (m)	1.98 - 2.44
TECHNICIAN	SK
DATE TESTED	82.12.30

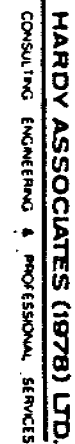


FINE-COARSE SAND some silt

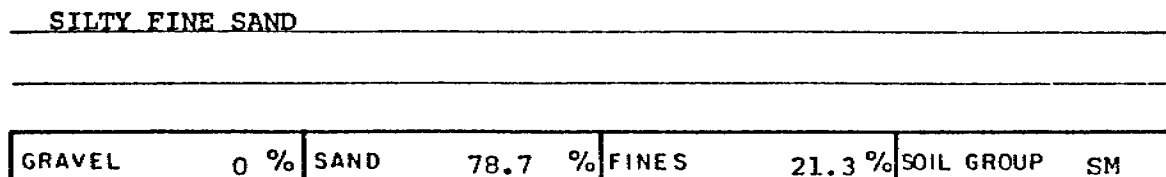
GRAVEL	0 %	SAND	86.5 %	FINES	13.5 %	SOIL GROUP	SM
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NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM

D ₁₀	=	_____	mm.
D ₃₀	=	_____	mm.
D ₅₀	=	_____	mm.
C _u	=	_____	
C _c	=	_____	



PROJECT NO.	CG 14038D
CLIENT	GULF CANADA RESOURCES INC.
BOREHOLE	82-SP-3
SAMPLE	D1
DEPTH (m)	4.57 - 5.03
TECHNICIAN	SK DATE TESTED 82.12.30



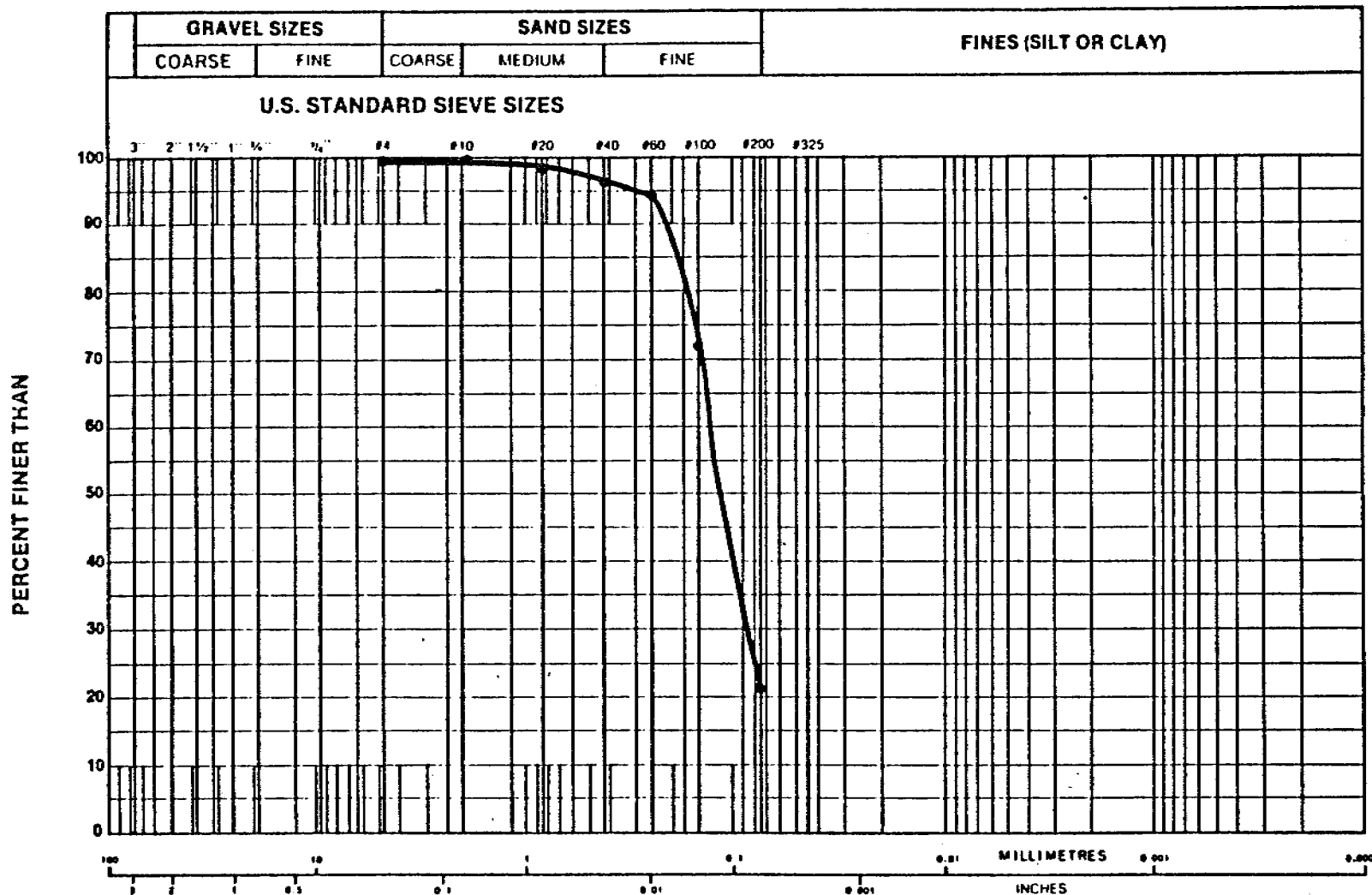
NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM

$D_{10} = \underline{\hspace{2cm}} \text{ mm.}$
 $D_{30} = \underline{\hspace{2cm}} \text{ mm.}$
 $D_{60} = \underline{\hspace{2cm}} \text{ mm.}$
 $C_u = \underline{\hspace{2cm}}$
 $C_c = \underline{\hspace{2cm}}$



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

GRAIN SIZE CURVE

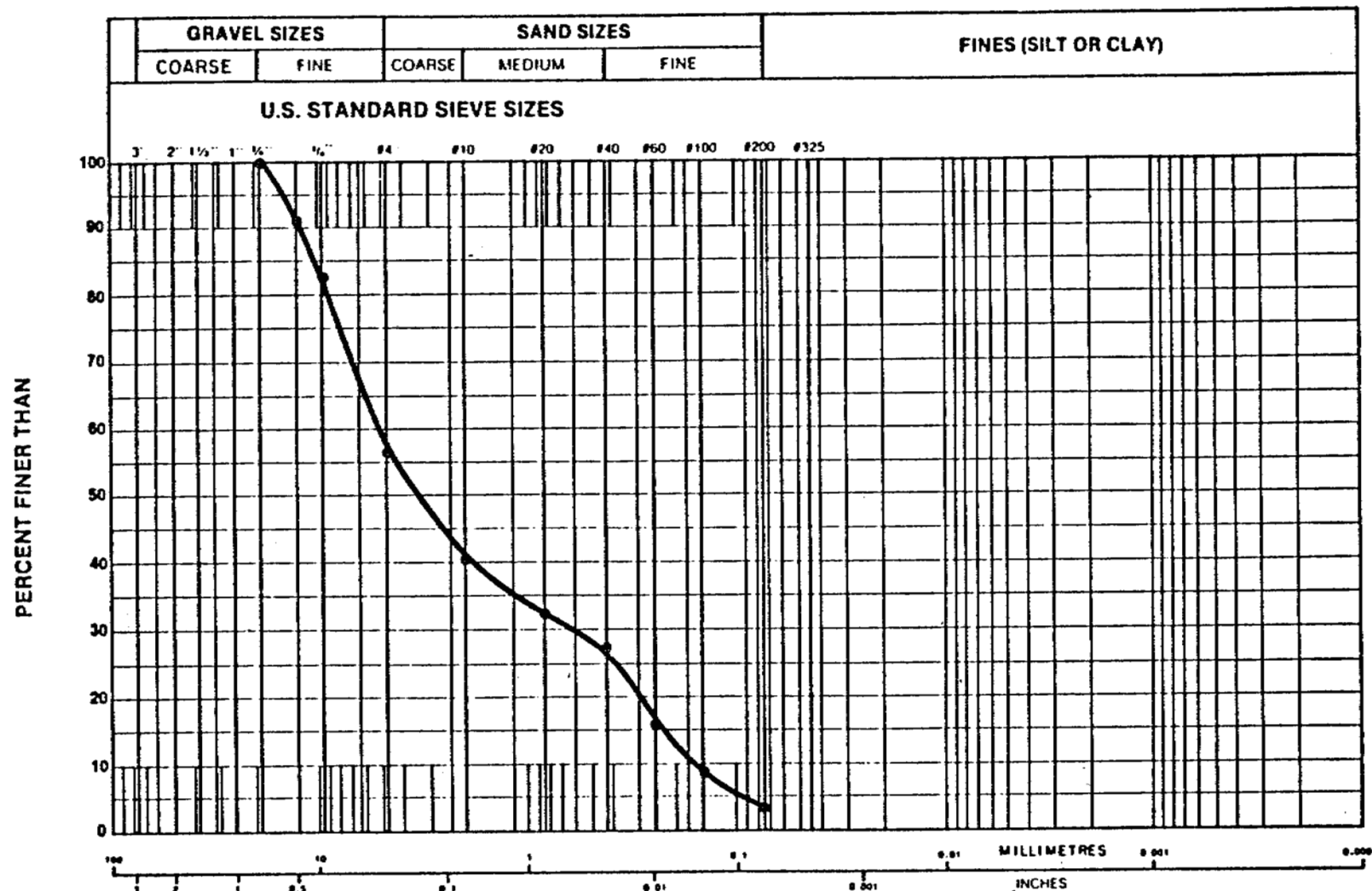


D_{10} = _____ mm.
 D_{30} = _____ mm.
 D_{60} = _____ mm.
 C_u = _____
 C_c = _____



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

GRAIN SIZE CURVE



GRAIN SIZE

"B" Grain size on sand and gravel portion of D1 only

FINE-COARSE SAND AND FINE GRAVEL trace silt

GRAVEL	43.4%	SAND	52.5%	FINES	4.1%	SOIL GROUP	GP-SP
--------	-------	------	-------	-------	------	------------	-------

NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM

D_{10}	=	0.15	mm.
D_{30}	=	0.60	mm.
D_{60}	=	5.50	mm.
C_u	=	36.6	
C_c	=	0.44	

PROJECT NO. CG 14038D

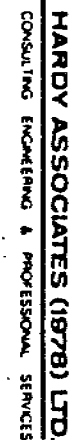
CLIENT GULF CANADA RESOURCES INC

BOREHOLE 82-SP-7

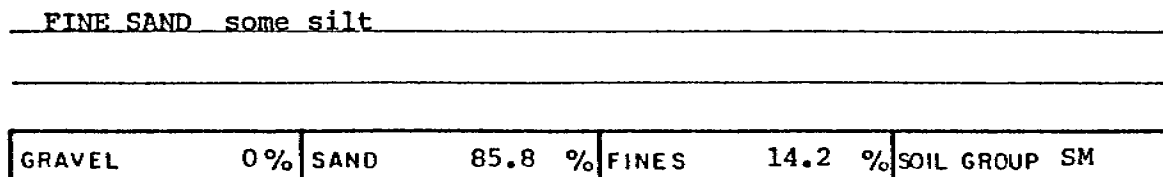
SAMPLE D1

DEPTH (m) 1.52 - 1.98 ("B")

TECHNICIAN SK DATE TESTED 82.12.30



PROJECT NO.	CG 14038D
CLIENT	GULF CANADA RESOURCES INC.
BOREHOLE	82-SP-8
SAMPLE	D1
DEPTH (m)	2.74 - 3.20
TECHNICIAN	SK DATE TESTED 82.12.30



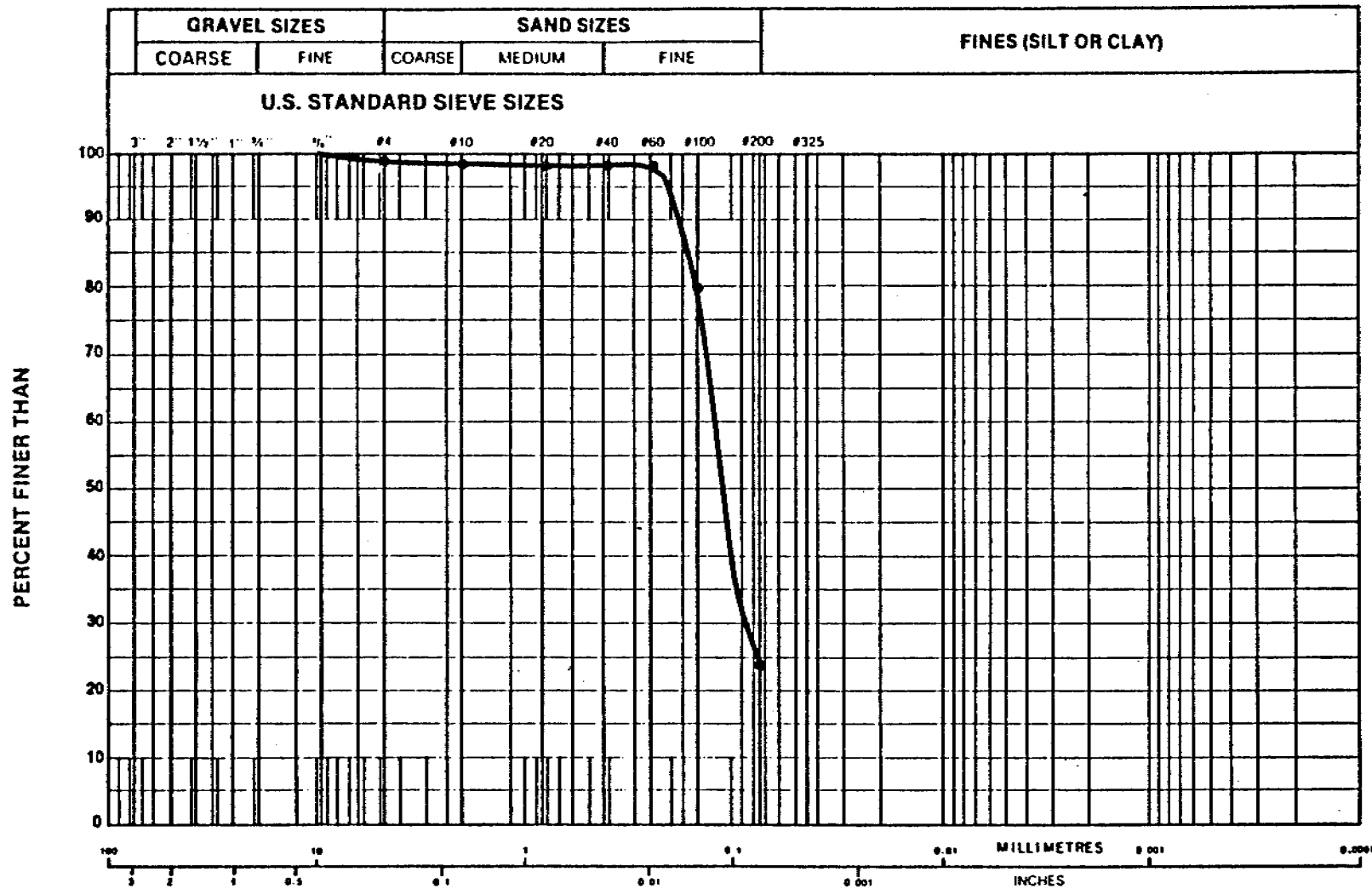
NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM

$D_{10} = \underline{\hspace{2cm}} \text{ mm.}$
 $D_{30} = \underline{\hspace{2cm}} \text{ mm.}$
 $D_{60} = \underline{\hspace{2cm}} \text{ mm.}$
 $C_u \underline{\hspace{2cm}}$
 $C_c \underline{\hspace{2cm}}$



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

GRAIN SIZE CURVE



SILTY FINE SAND trace fine gravel

GRAVEL	1.3 %	SAND	74.4 %	FINES	24.3 %	SOIL GROUP	SM
--------	-------	------	--------	-------	--------	------------	----

NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM

D_{10} = _____ mm.
 D_{30} = _____ mm.
 D_{60} = _____ mm.
 C_u = _____
 C_c = _____

PROJECT NO. CG 14038D

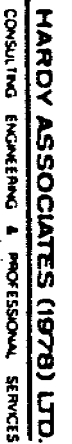
CLIENT GULF CANADA RESOURCES INC

BOREHOLE 82-SP-9

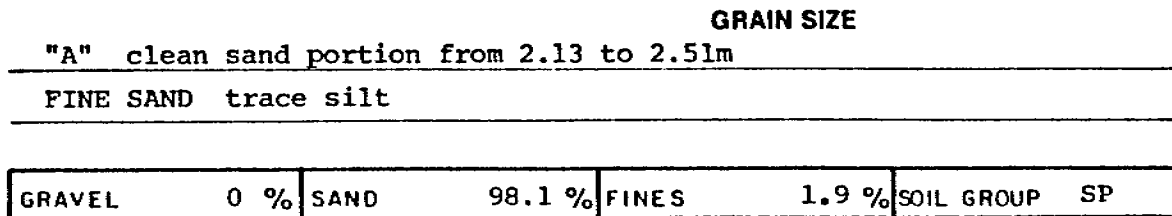
SAMPLE D1

DEPTH (m) 7.47 - 7.92

TECHNICIAN SK DATE TESTED 82.12.30



PROJECT NO.	CG 14038D
CLIENT	GULF CANADA RESOURCES INC
BOREHOLE	82-SP-10
SAMPLE	U2 "A"
DEPTH (m)	2.13 - 2.51
TECHNICIAN	SK DATE TESTED 82.12.30



NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM

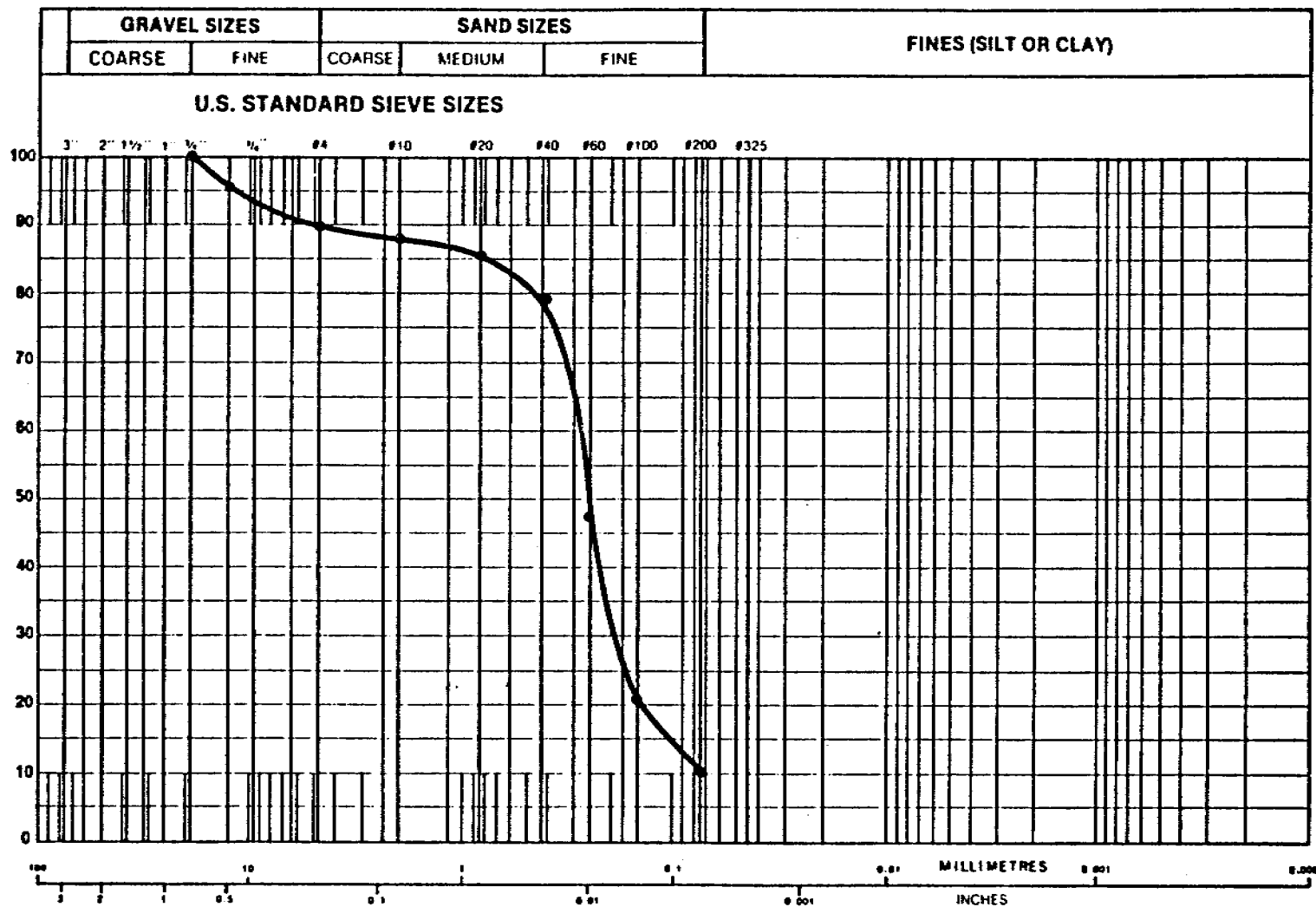
$$\begin{array}{r} D_{10} = \frac{0.15}{1.67} \text{ mm.} \\ D_{30} = \frac{0.20}{1.67} \text{ mm.} \\ D_{60} = \frac{0.25}{1.67} \text{ mm.} \\ C_u = \frac{0.25}{1.67} \\ C_c = \frac{1.67}{1.67} \end{array}$$



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GRAIN SIZE CURVE

PERCENT FINER THAN



GRAIN SIZE

"B" sand with gravel/silt portion from 2.51 to 2.74m

FINE-MEDIUM SAND (GAP GRADED) trace fine gravel, trace silt

GRAVEL	10.1 %	SAND	79.8 %	FINES	10.1 %	SOIL GROUP	SP-SM
--------	--------	------	--------	-------	--------	------------	-------

NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM

D_{10}	=	0.10	mm.
D_{30}	=	0.20	mm.
D_{60}	=	0.26	mm.
C_u	=	2.6	
C_c	=	1.54	

PROJECT NO. CG 14038D

CLIENT GULF CANADA RESOURCES INC

BOREHOLE 82-SP-10

SAMPLE U2 "B"

DEPTH (m) 2.51 - 2.74

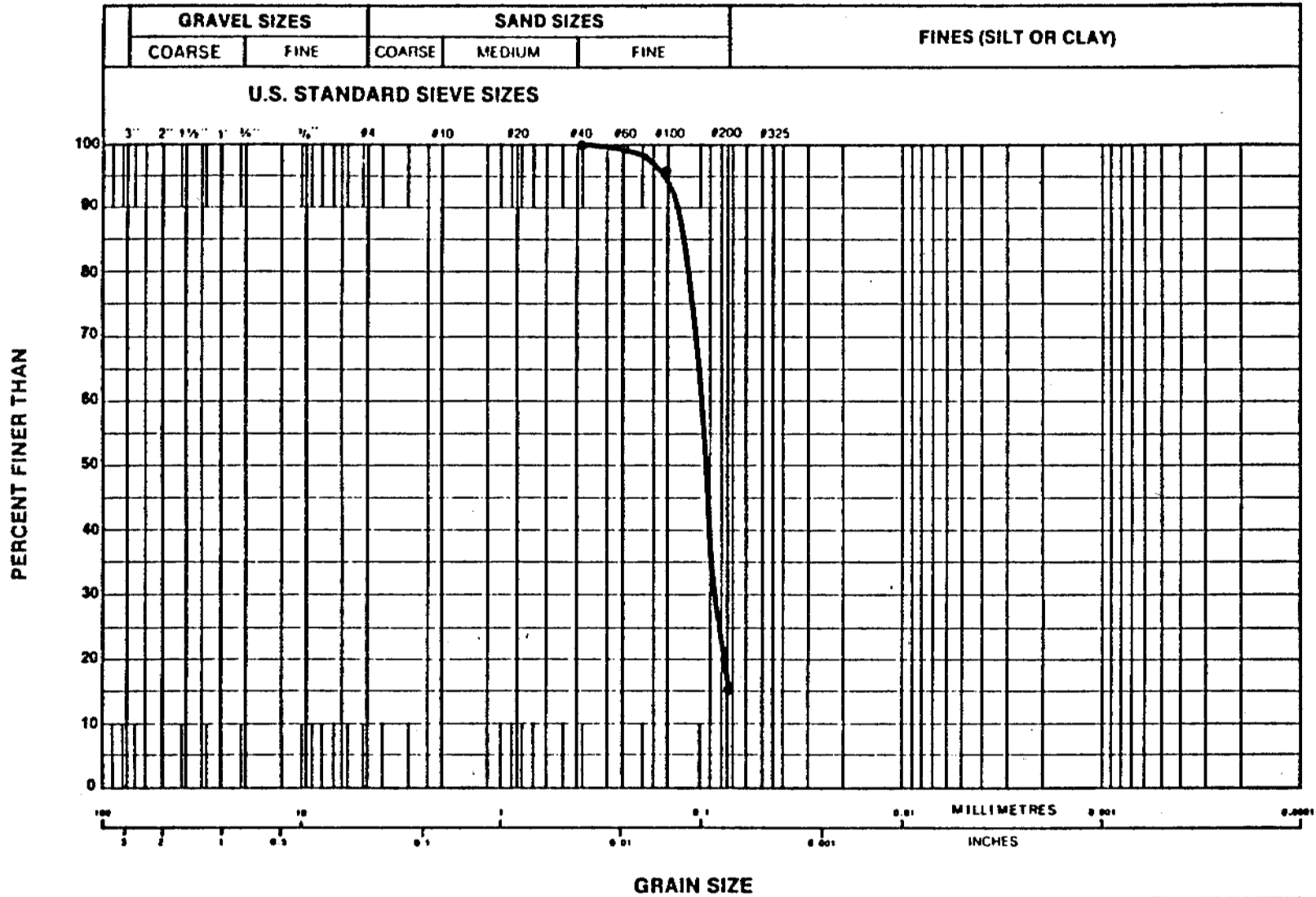
TECHNICIAN SK DATE TESTED 82.12.30



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

GRAIN SIZE CURVE

PROJECT NO. CG 14038D
CLIENT GULF CANADA RESOURCES INC.
BOREHOLE 82-SP-11
SAMPLE U1
DEPTH (m) 3.20 - 4.11
TECHNICIAN SK DATE TESTED 82.12.31

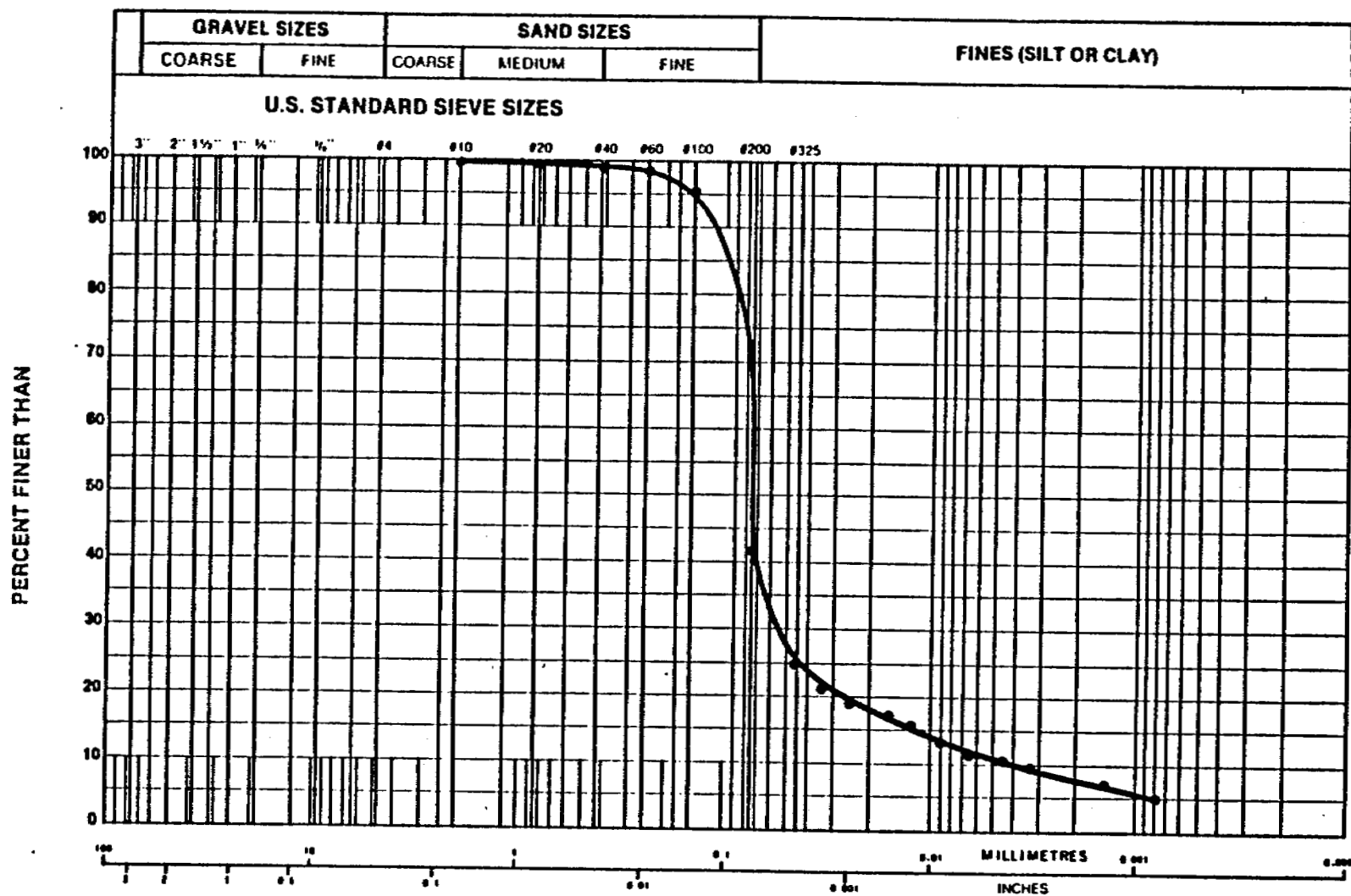




HARDY ASSOCIATES (1978) LTD.
CONSULTING ENGINEERING & PROFESSIONAL SERVICES

GRAIN SIZE CURVE

PROJECT NO. CG 14041
CLIENT GULF CANADA RESOURCES INC.
BOREHOLE 82-SP-12
SAMPLE U1 (CU Sample)
DEPTH (m) 5.2
TECHNICIAN DATE TESTED



FINE SAND AND SILT trace clay

GRAVEL	0 %	SAND	57.3 %	FINES	42.7 %	SOIL GROUP	SM-ML
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NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM

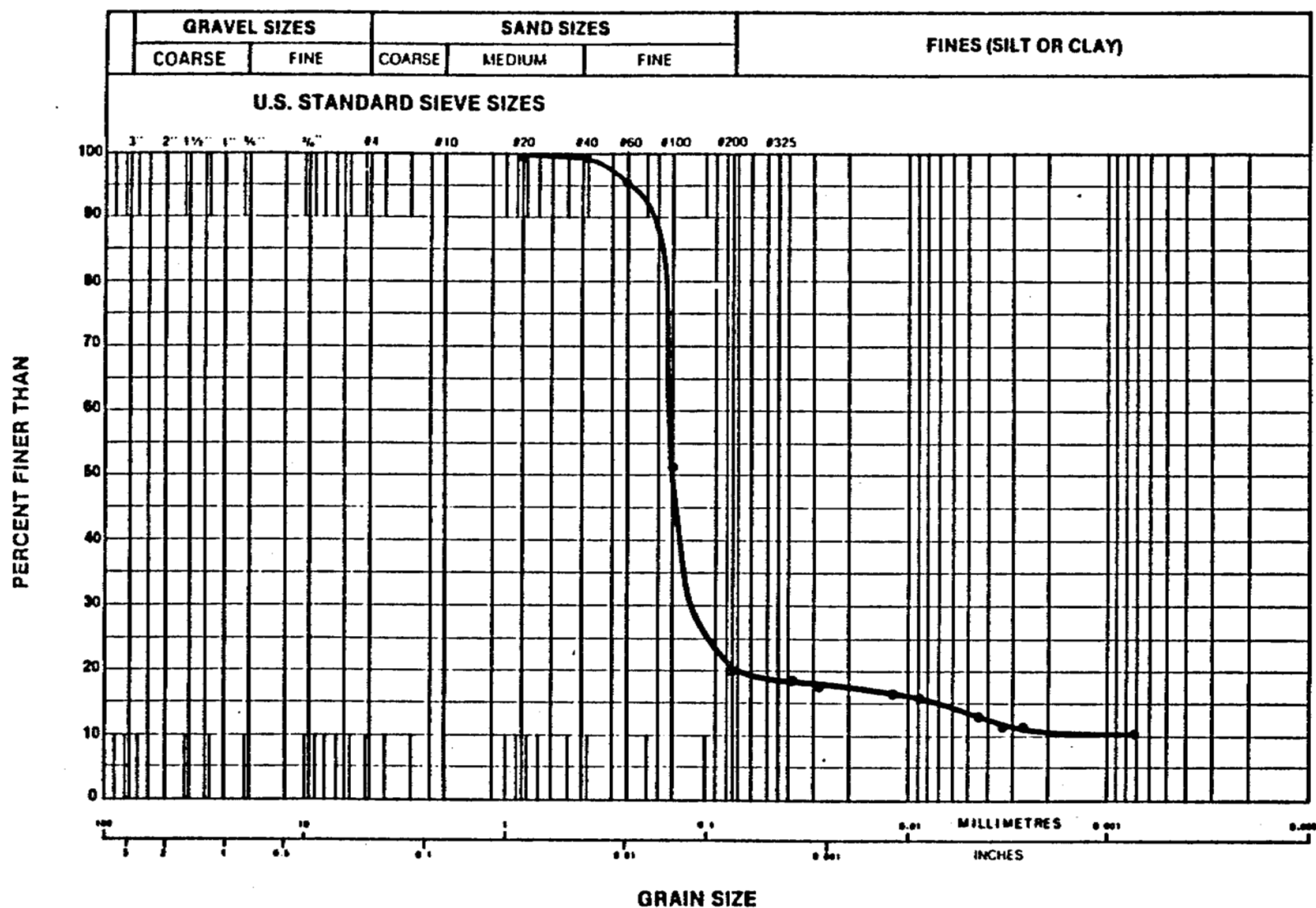
D_{10} = _____ mm.
 D_{30} = _____ mm.
 D_{60} = _____ mm.
 C_u = _____
 C_c = _____



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

GRAIN SIZE CURVE

PROJECT NO.	CG 14041
CLIENT	GULF CANADA RESOURCES INC
BOREHOLE	82-SP-12
SAMPLE	U2 (UU Sample)
DEPTH (m)	6.2
TECHNICIAN	RB
DATE TESTED	82.12.30



FINE SAND some silt

GRAVEL	0%	SAND	80.8%	FINES	19.2%	SOIL GROUP	SM
--------	----	------	-------	-------	-------	------------	----

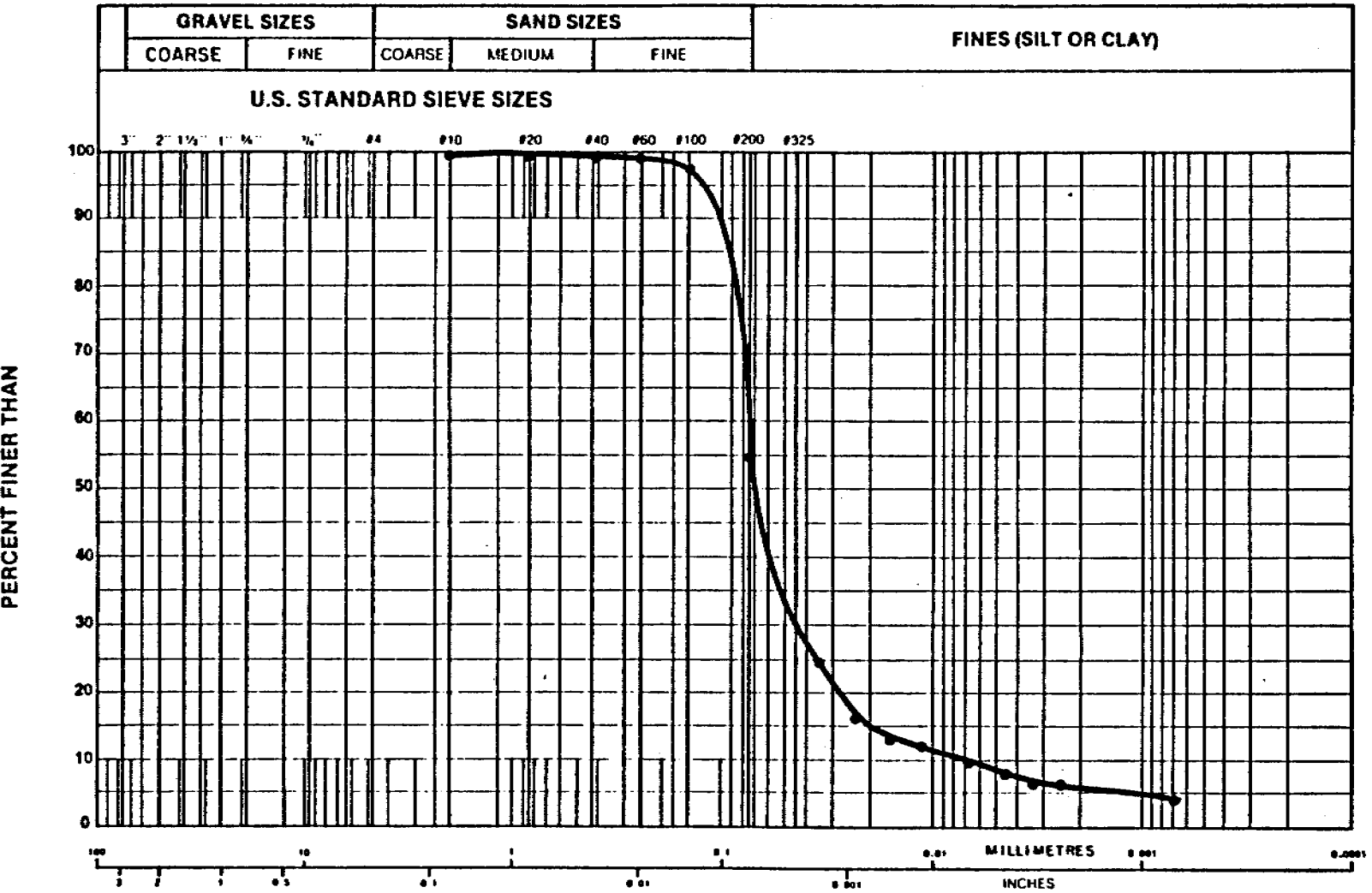
NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM

D ₁₀	=	_____	mm.
D ₃₀	=	_____	mm.
D ₆₀	=	_____	mm.
C _u	=	_____	
C _c	=	_____	



HARDY ASSOCIATES (1978) LTD.
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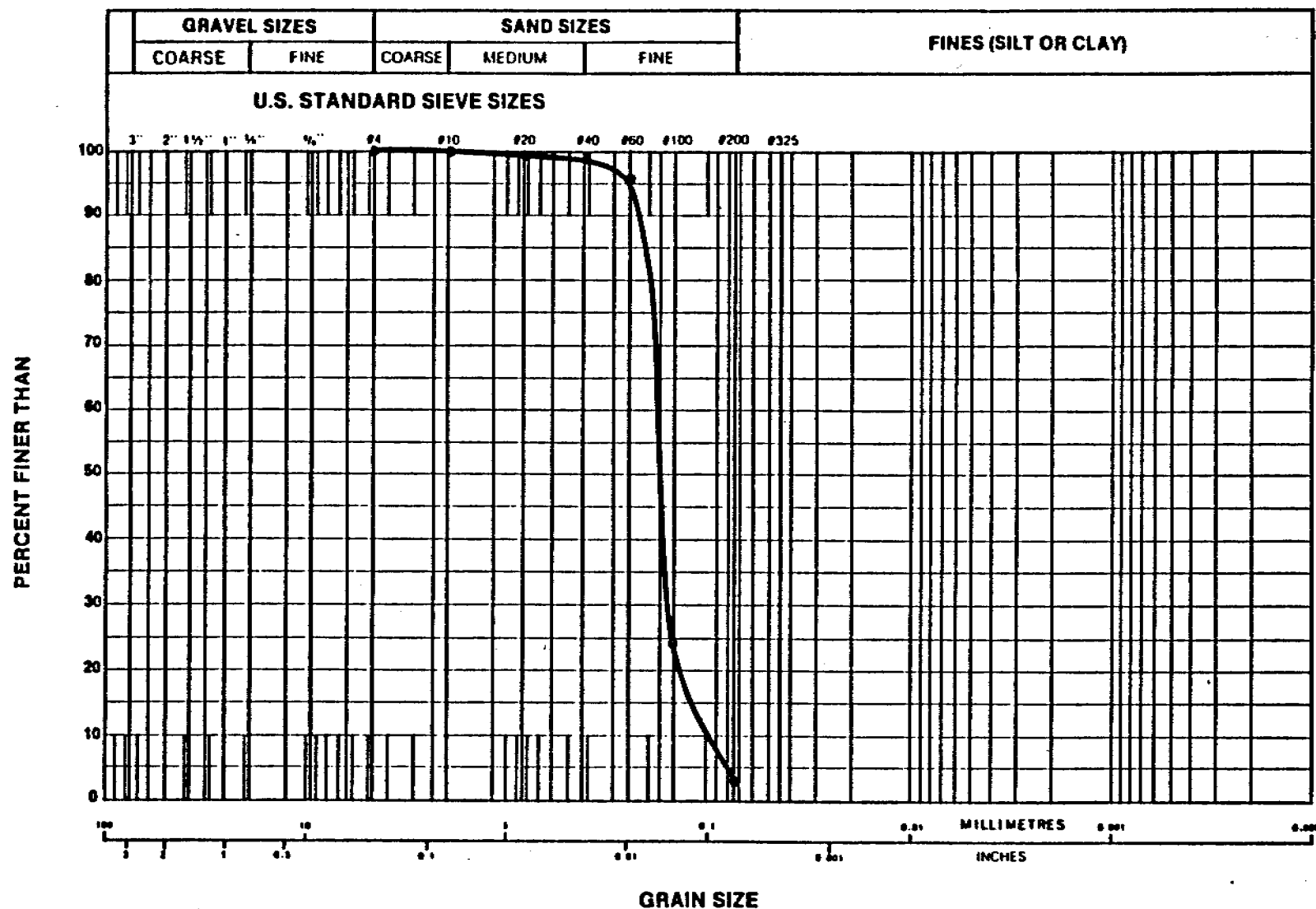
GRAIN SIZE CURVE





HARDY ASSOCIATES (1978) LTD.
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GRAIN SIZE CURVE



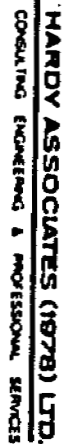
FINE SAND trace silt

GRAVEL	0	%	SAND	97.5	%	FINES	2.5	%	SOIL GROUP	SP
--------	---	---	------	------	---	-------	-----	---	------------	----

NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM

D_{10}	=	0.10	mm.
D_{30}	=	0.17	mm.
D_{60}	=	0.18	mm.
C_u	=	1.8	
C_c	=	1.6	

PROJECT NO. CG 14041D
CLIENT GULF CANADA RESOURCES INC.
BOREHOLE 83-SP-18
SAMPLE U1
DEPTH (m) 1.6 - 2.3
TECHNICIAN AW
DATE TESTED 83.02.18



PROJECT NO.	CG 14041D
CLIENT	GULF CANADA RESOURCES INC.
BOREHOLE	83-SP-18
SAMPLE	D1
DEPTH (m)	3.1 ~ 3.5
TECHNICIAN	AW
	DATE TESTED 83.02.18



GRAVEL	1.2%	SAND	83.5 %	FINES	15.3 %	SOIL GROUP	SM
--------	------	------	--------	-------	--------	------------	----

NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM

$D_{10} = \underline{\hspace{2cm}} \text{ mm.}$
 $D_{30} = \underline{\hspace{2cm}} \text{ mm.}$
 $D_{60} = \underline{\hspace{2cm}} \text{ mm.}$
 $C_u \underline{\hspace{2cm}}$
 $C_c \underline{\hspace{2cm}}$

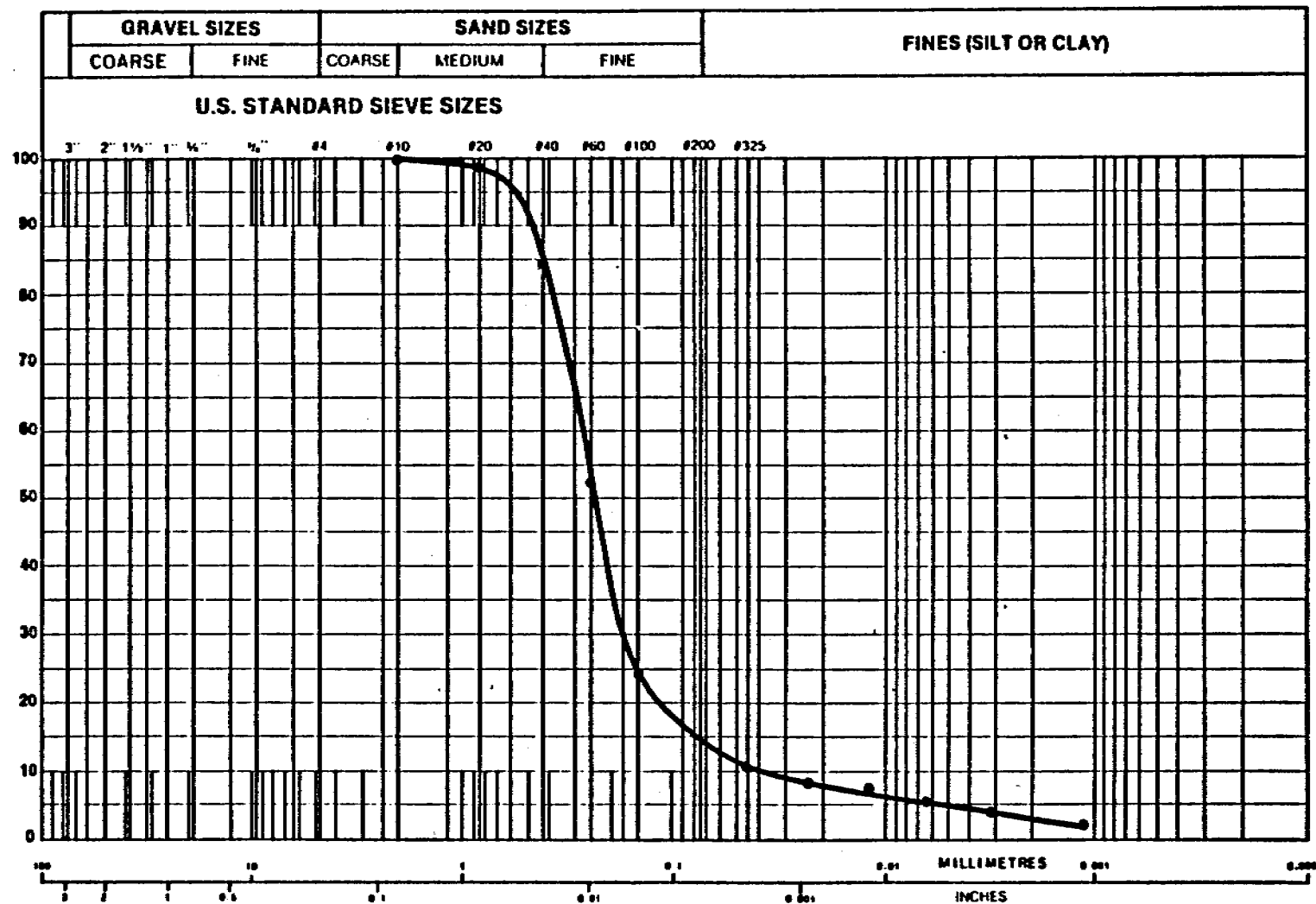


HARDY ASSOCIATES (1978) LTD.
CONSULTING ENGINEERING & PROFESSIONAL SERVICES

GRAIN SIZE CURVE

PROJECT NO. CG 14041
CLIENT GULF CANADA RESOURCES INC
BOREHOLE 83-SP-18
SAMPLE U2
DEPTH (m) 4.57 - 4.80
TECHNICIAN GW DATE TESTED 83.03.02

PERCENT FINER THAN



FINE TO MEDIUM SAND some silt

GRAVEL	0 %	SAND	86.4 %	FINES	13.6 %	SOIL GROUP	SM
--------	-----	------	--------	-------	--------	------------	----

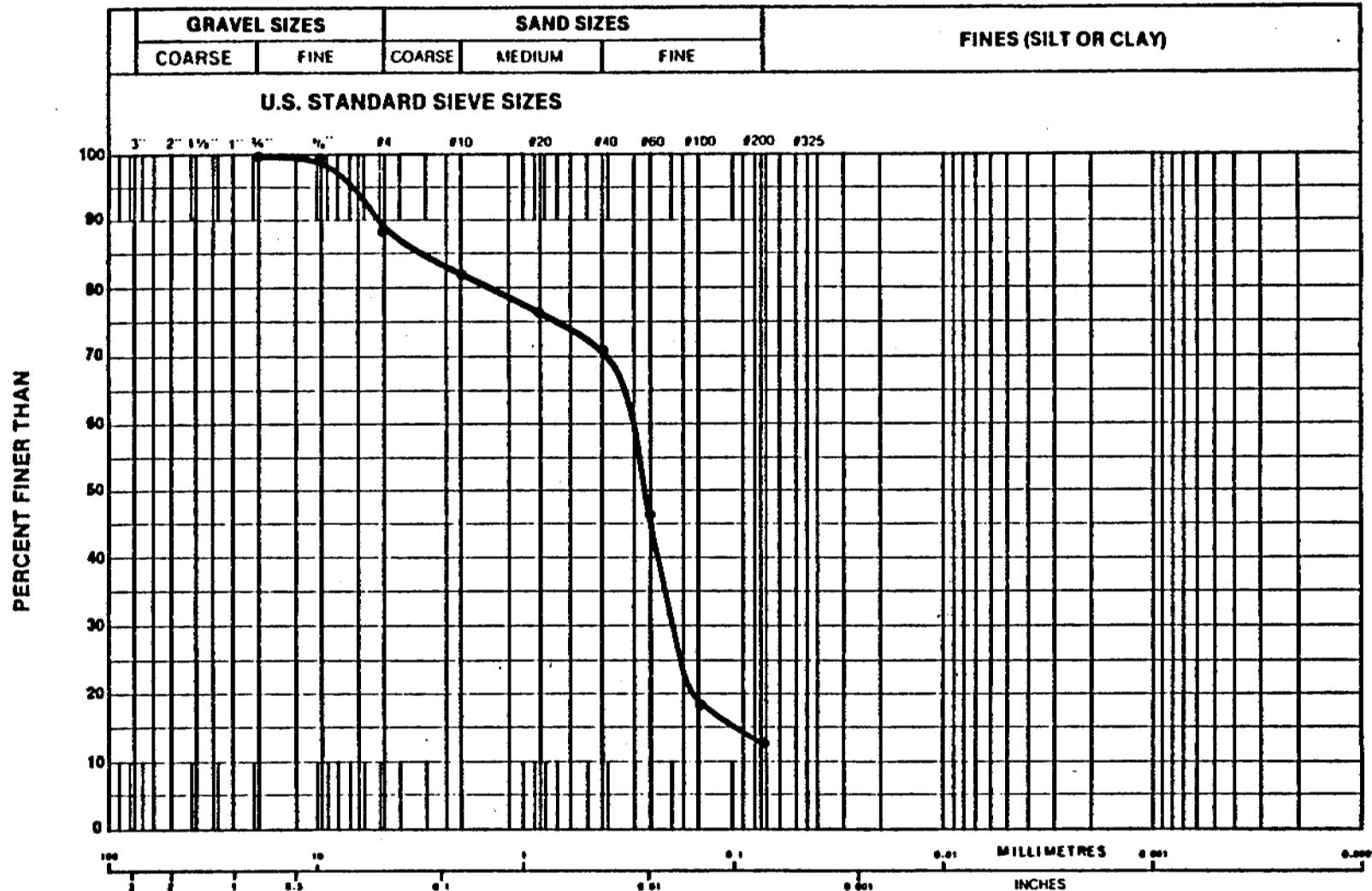
NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM

D₁₀ = _____ mm.
D₃₀ = _____ mm.
D₆₀ = _____ mm.
C_u = _____
C_c = _____



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GRAIN SIZE CURVE

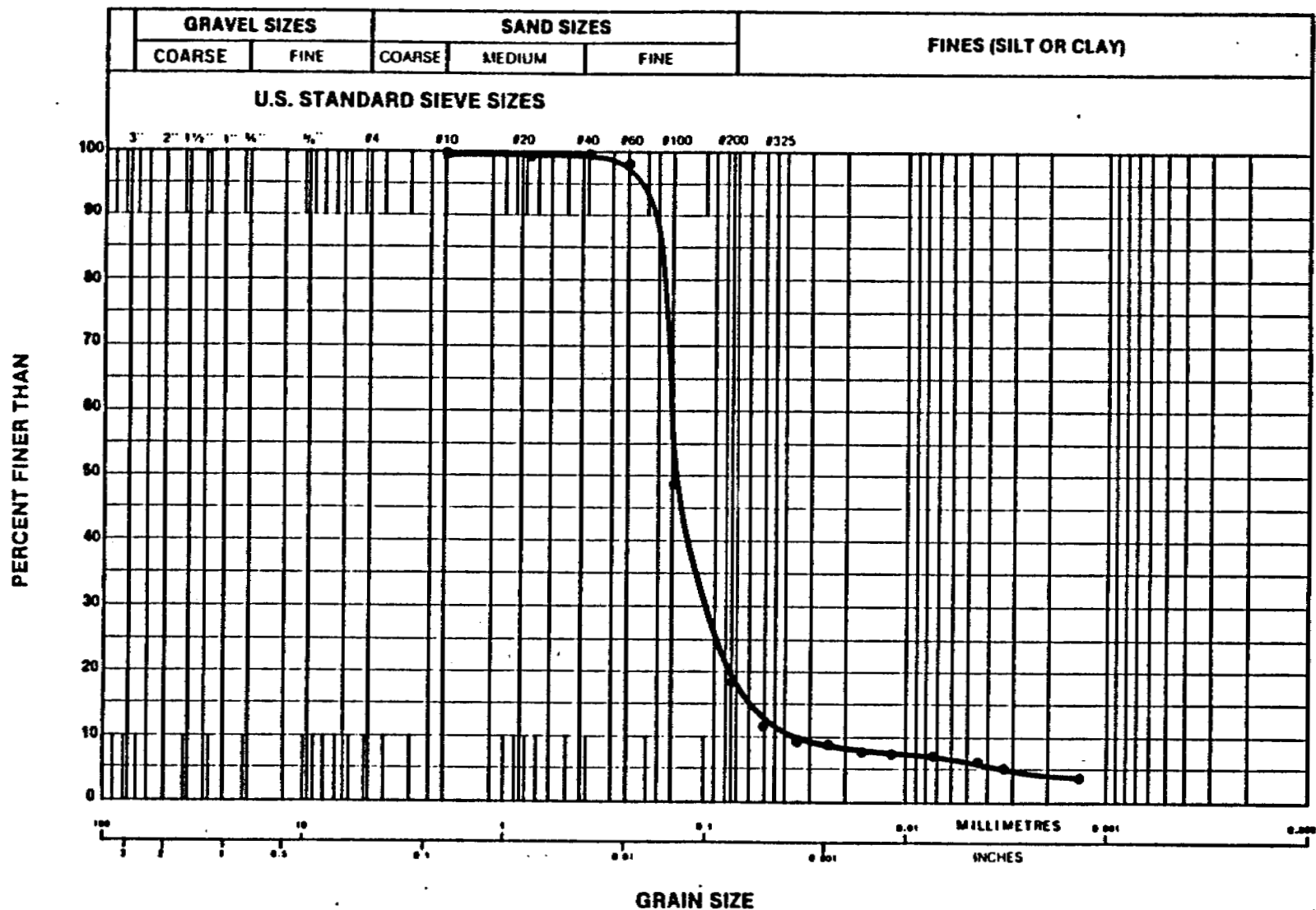




HARDY ASSOCIATES (1978) LTD.
CONSULTING ENGINEERING & PROFESSIONAL SERVICES

GRAIN SIZE CURVE

PROJECT NO. CG 14041
CLIENT GULF CANADA RESOURCES INC
BOREHOLE 83-SP-23
SAMPLE U2
DEPTH (m) 7.92-8.53
TECHNICIAN RB DATE TESTED 83.03.05



FINE SAND some silt

GRAVEL	0	%	SAND	81.7	%	FINES	18.3	%	SOIL GROUP	SM
--------	---	---	------	------	---	-------	------	---	------------	----

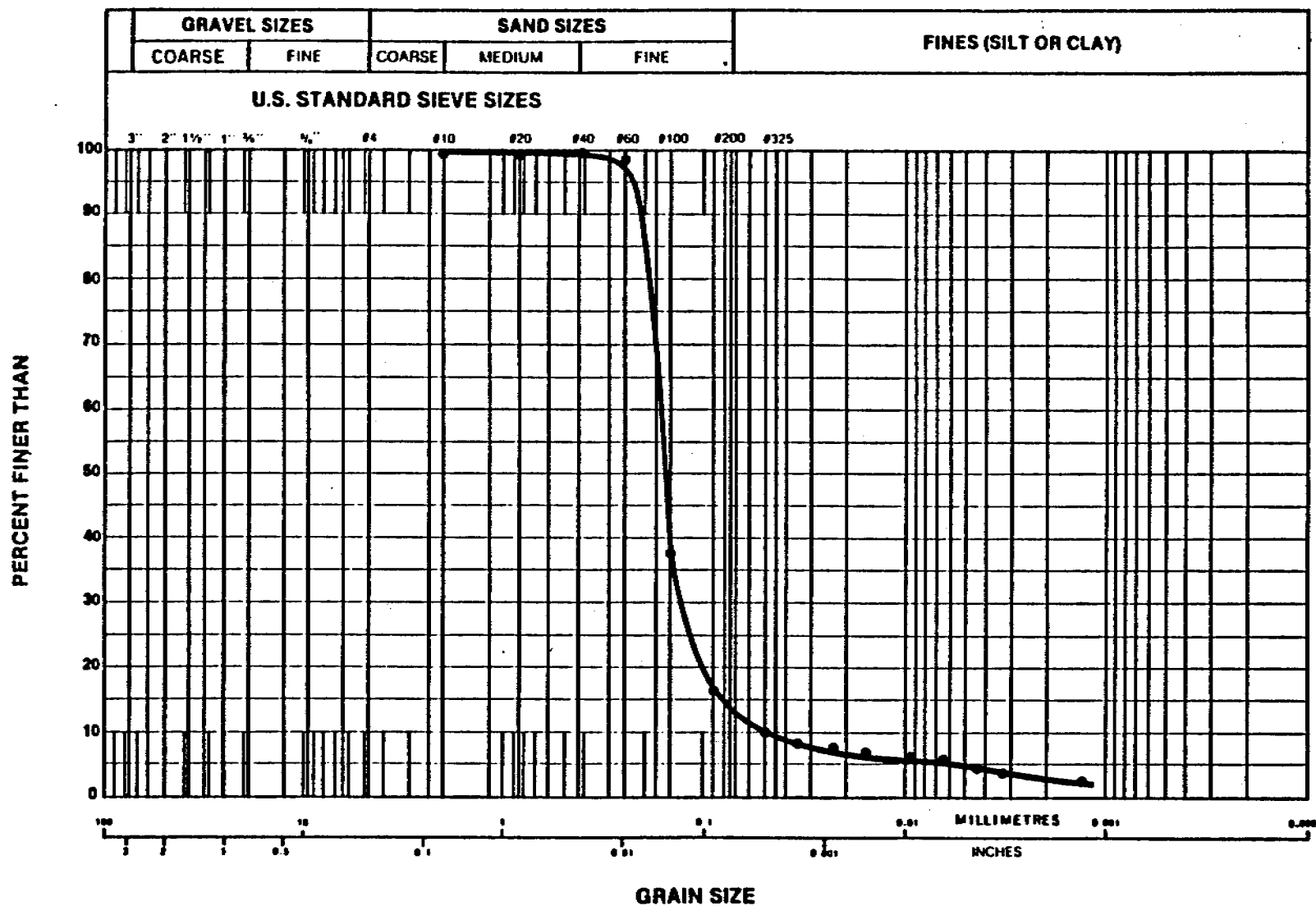
NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM

D_{10} = _____ mm.
 D_{30} = _____ mm.
 D_{60} = _____ mm.
 C_u = _____
 C_c = _____



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

GRAIN SIZE CURVE



FINE SAND some silt

GRAVEL	0	%	SAND	84.3	%	FINES	15.7	%	SOIL GROUP	SM
--------	---	---	------	------	---	-------	------	---	------------	----

NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM

D ₁₀	=	_____	mm.
D ₃₀	=	_____	mm.
D ₆₀	=	_____	mm.
C _u	=	_____	
C _c	=	_____	

PROJECT NO. CG 14041

CLIENT GULF CANADA RESOURCES INC

BOREHOLE 83-SP-23

SAMPLE U3 (CU sample)

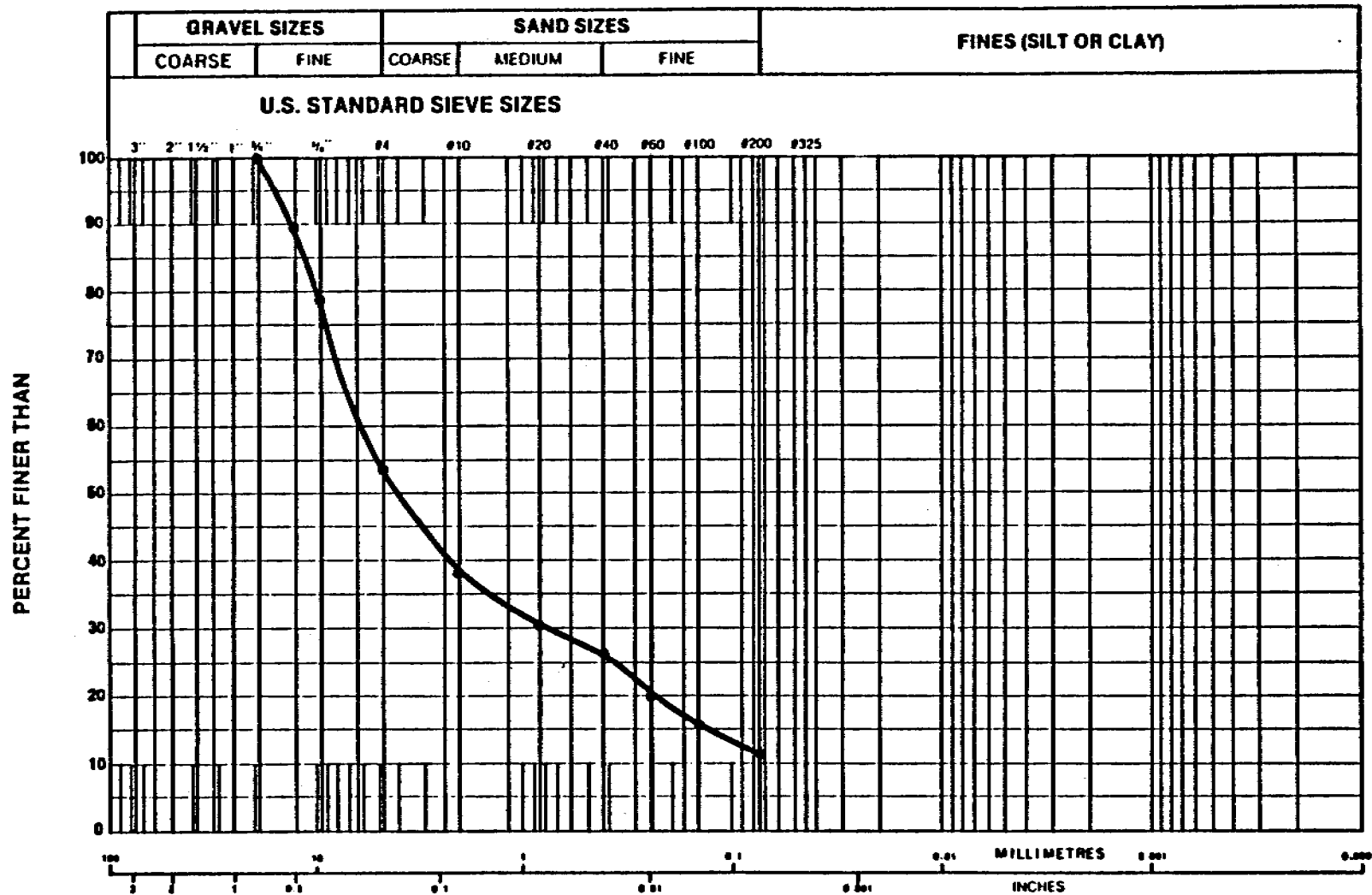
DEPTH (m) 13.0m

TECHNICIAN RB DATE TESTED 83.03.05



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

GRAIN SIZE CURVE



GRAIN SIZE

FINE GRAVEL AND FINE-COARSE SAND some silt

GRAVEL	46.0%	SAND	41.8 %	FINES	12.2 %	SOIL GROUP	GM
--------	-------	------	--------	-------	--------	------------	----

NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM

D₁₀ _____ mm.
D₃₀ _____ mm.
D₅₀ _____ mm.
C_u _____
C_c _____

PROJECT NO. CG 14041D

CLIENT GULF CANADA RESOURCES INC.

BOREHOLE 83-SP-23

SAMPLE D6

DEPTH (m) 15.9 - 16.3

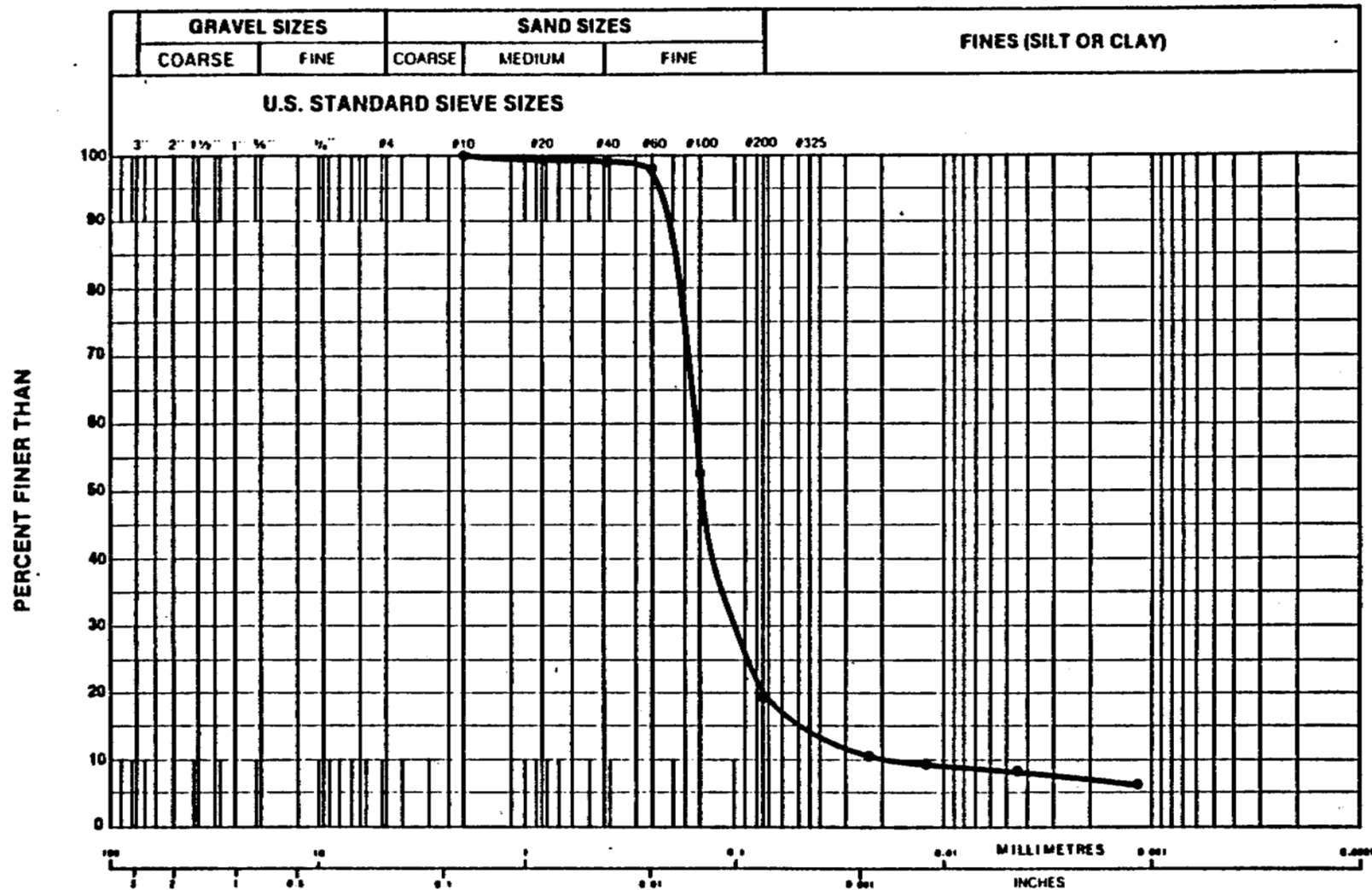
TECHNICIAN AM DATE TESTED 83.02.18



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

GRAIN SIZE CURVE

PROJECT NO. CG 14041
CLIENT GULF CANADA RESOURCES INC
BOREHOLE 83-SP-24
SAMPLE U3
DEPTH (m) 6.5 - 7.0
TECHNICIAN GIN DATE TESTED 83.03.02



FINE SAND some silt

GRAVEL	0 %	SAND	81.1 %	FINES	18.9 %	SOIL GROUP	SM
--------	-----	------	--------	-------	--------	------------	----

NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM

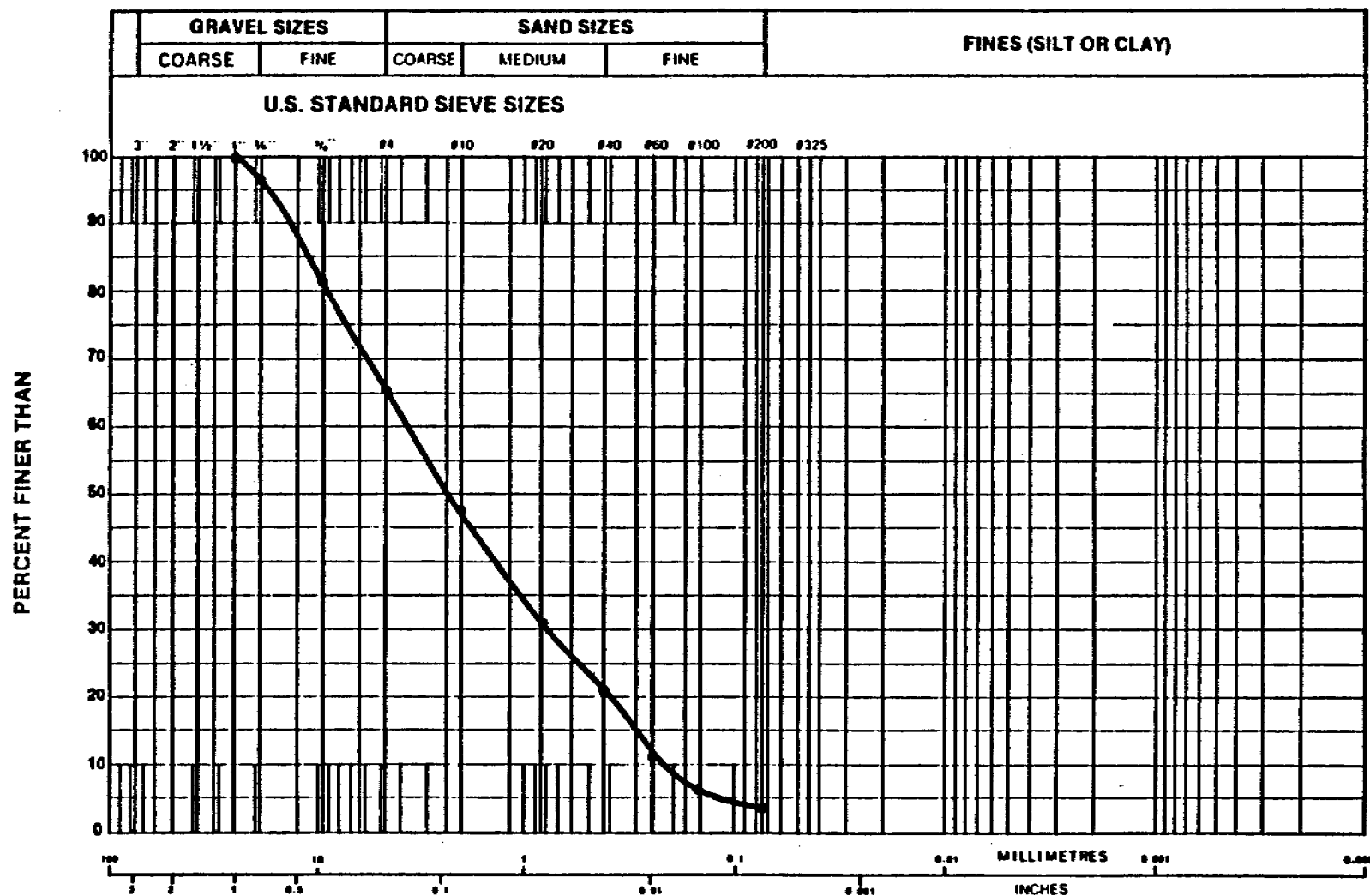
D₁₀ = _____ mm.
D₃₀ = _____ mm.
D₅₀ = _____ mm.
C_u = _____
C_c = _____



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

GRAIN SIZE CURVE

PROJECT NO. CG 14041D
CLIENT GULF CANADA RESOURCES INC.
BOREHOLE 83-SP-28
SAMPLE D1
DEPTH (m) 1.5 - 2.0
TECHNICIAN AM DATE TESTED 83.02.18



GRAVELLY FINE to COARSE SAND trace silt

GRAVEL	33.8%	SAND	62.2 %	FINES	4.0 %	SOIL GROUP	SP
--------	-------	------	--------	-------	-------	------------	----

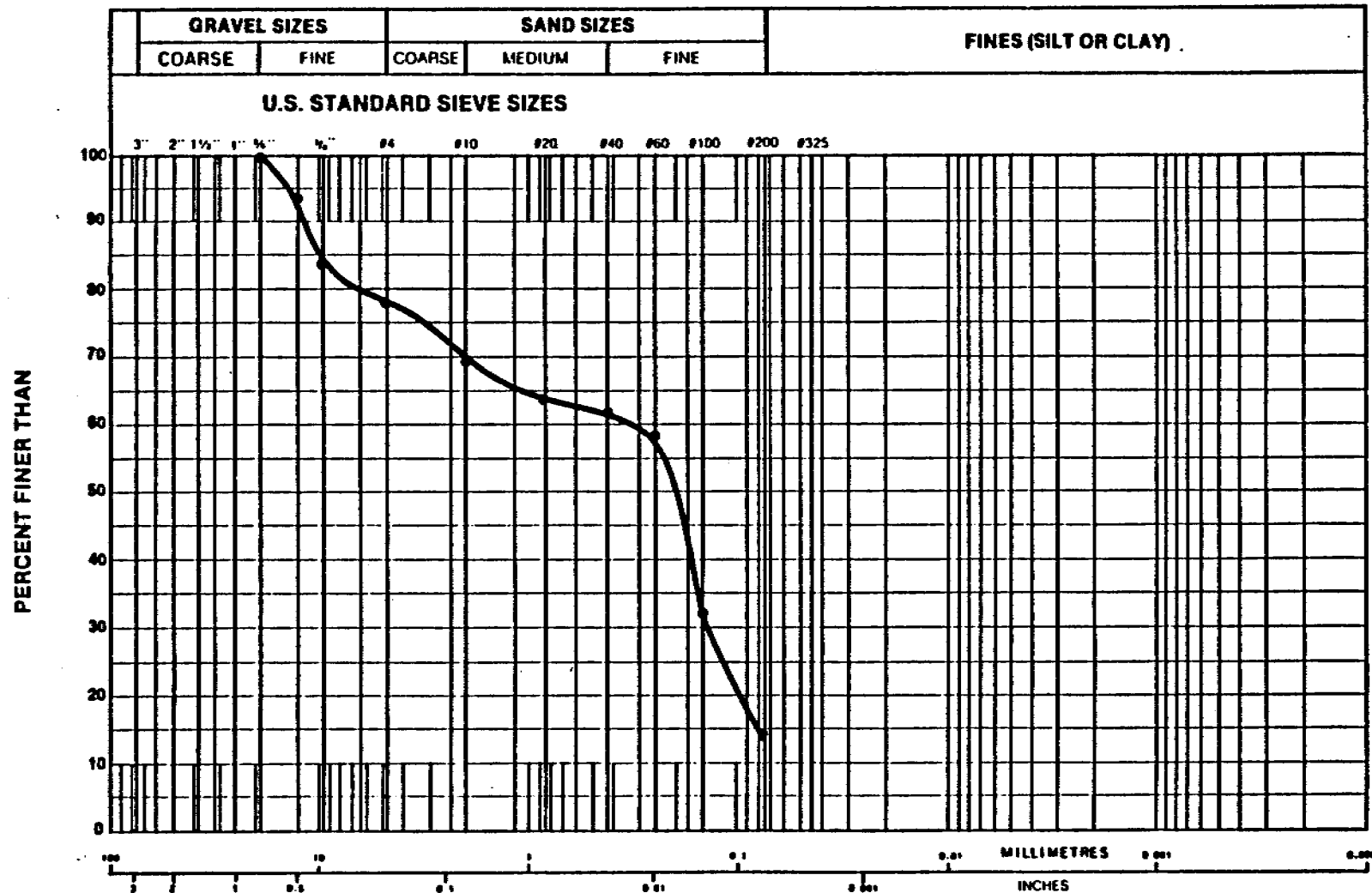
NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM

D_{10}	=	0.22	mm.
D_{30}	=	0.75	mm.
D_{60}	=	3.90	mm.
C_u	=	17.7	
C_c	=	0.65	



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

GRAIN SIZE CURVE



FINE to COARSE SAND some fine gravel, some silt
(GAP GRADED)

GRAVEL	21.7%	SAND	64.2 %	FINES	14.1 %	SOIL GROUP	SM
--------	-------	------	--------	-------	--------	------------	----

NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM

D_{10} = _____ mm.
 D_{30} = _____ mm.
 D_{60} = _____ mm.
 C_u = _____
 C_c = _____

PROJECT NO. CG 14041D

CLIENT GULF CANADA RESOURCES INC.

BOREHOLE 83-SP-28

SAMPLE D2

DEPTH (m) 2.7-3.2

TECHNICIAN AM

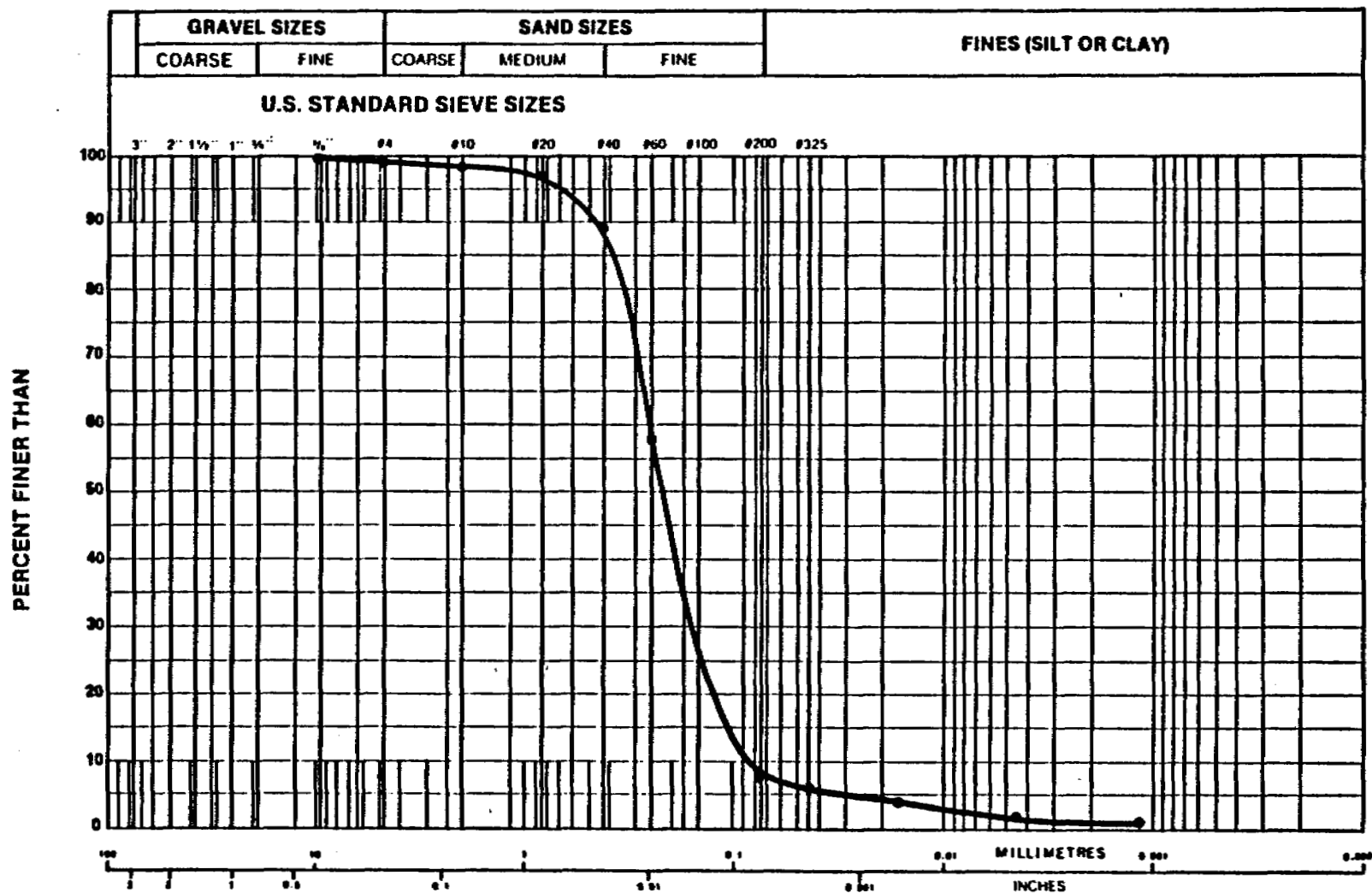
DATE TESTED 83.02.18



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

GRAIN SIZE CURVE

PROJECT NO. CG 14041
CLIENT GULF CANADA RESOURCES INC.
BOREHOLE 83-SP-33
SAMPLE D1
DEPTH (m) 2.13 - 2.40
TECHNICIAN GW DATE TESTED 83.03.02



GRAIN SIZE
FINE TO MEDIUM SAND trace silt, trace fine gravel

GRAVEL	1.0 %	SAND	92.2 %	FINES	6.8 %	SOIL GROUP	SP-SM
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NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM

D_{10}	=	0.09	mm.
D_{30}	=	0.16	mm.
D_{60}	=	0.25	mm.
C_u	=	2.78	
C_c	=	1.14	

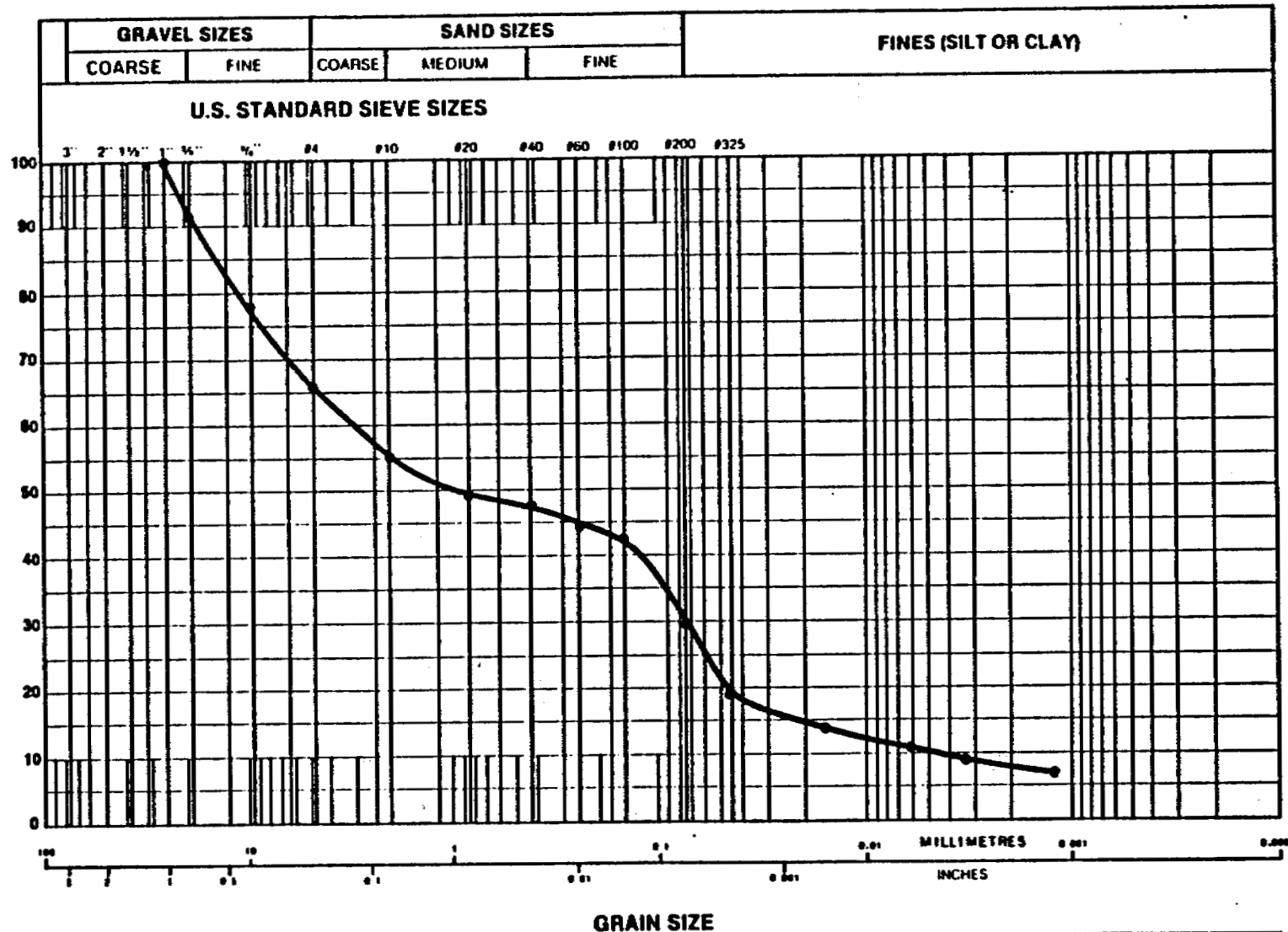


HARDY ASSOCIATES (1978) LTD.
CONSULTING ENGINEERING & PROFESSIONAL SERVICES

GRAIN SIZE CURVE

PROJECT NO. CG 14041
CLIENT GULF CANADA RESOURCES INC.
BOREHOLE 83-SP-33
SAMPLE D3
DEPTH (m) 5.94 - 6.40
TECHNICIAN RB DATE TESTED 83.02.28

PERCENT FINER THAN



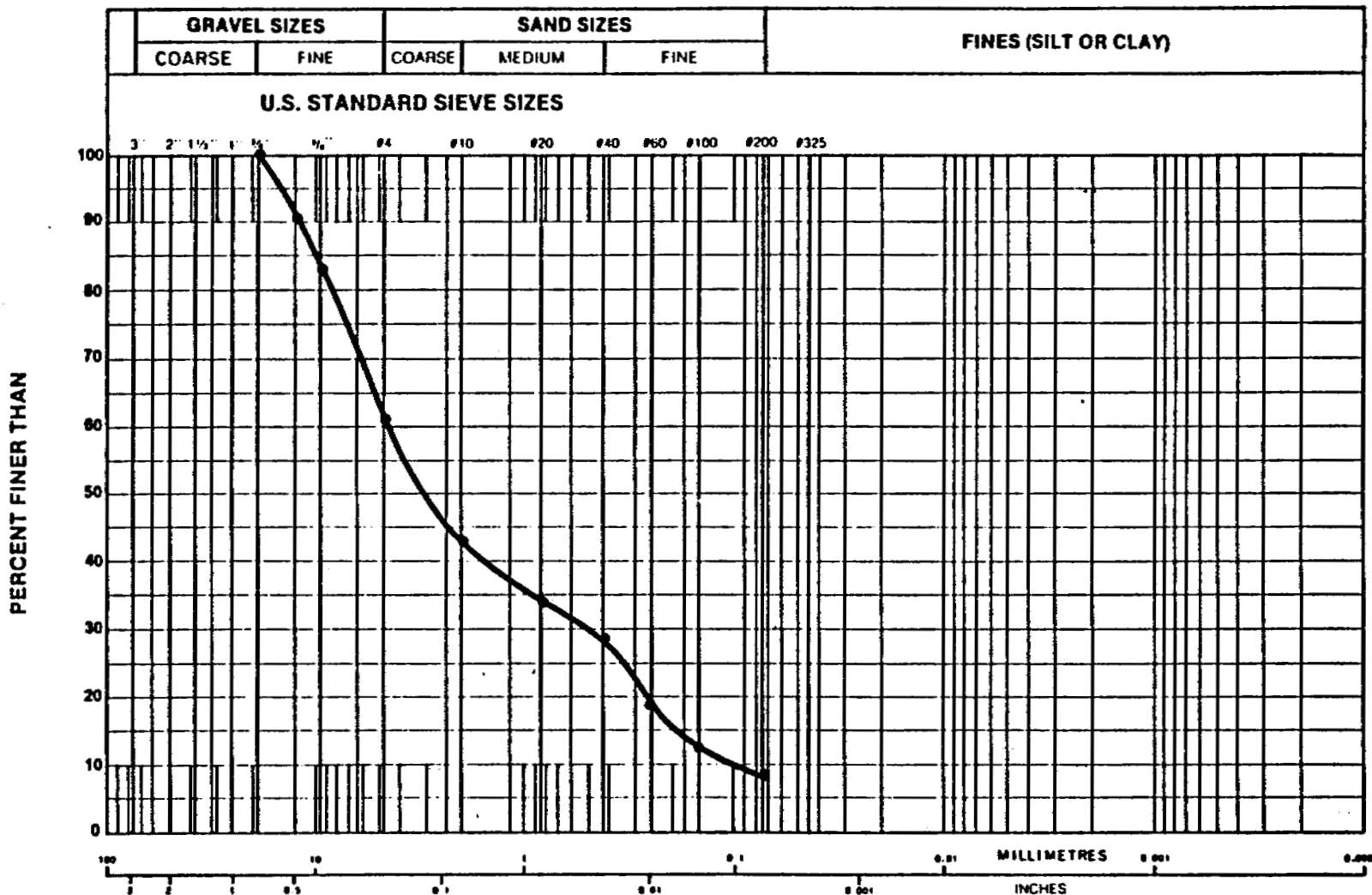
APPENDIX E.8

Grain Size Distribution Curves from Roland Bay
(data from Hardy Associates (1978) Ltd., 1983)



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

GRAIN SIZE CURVE



FINE-COARSE SAND AND FINE GRAVEL trace silt

GRAVEL	39.1 %	SAND	52.3 %	FINES	8.6 %	SOIL GROUP	GP-SP
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NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM

D_{10}	=	0.10	mm.
D_{30}	=	0.50	mm.
D_{60}	=	4.5	mm.
C_u	=	45	
C_c	=	0.56	

PROJECT NO. CG 14038D

CLIENT GULF CANADA RESOURCES INC

BOREHOLE 82-RB-5

SAMPLE D1

DEPTH (m) 4.34 - 4.80

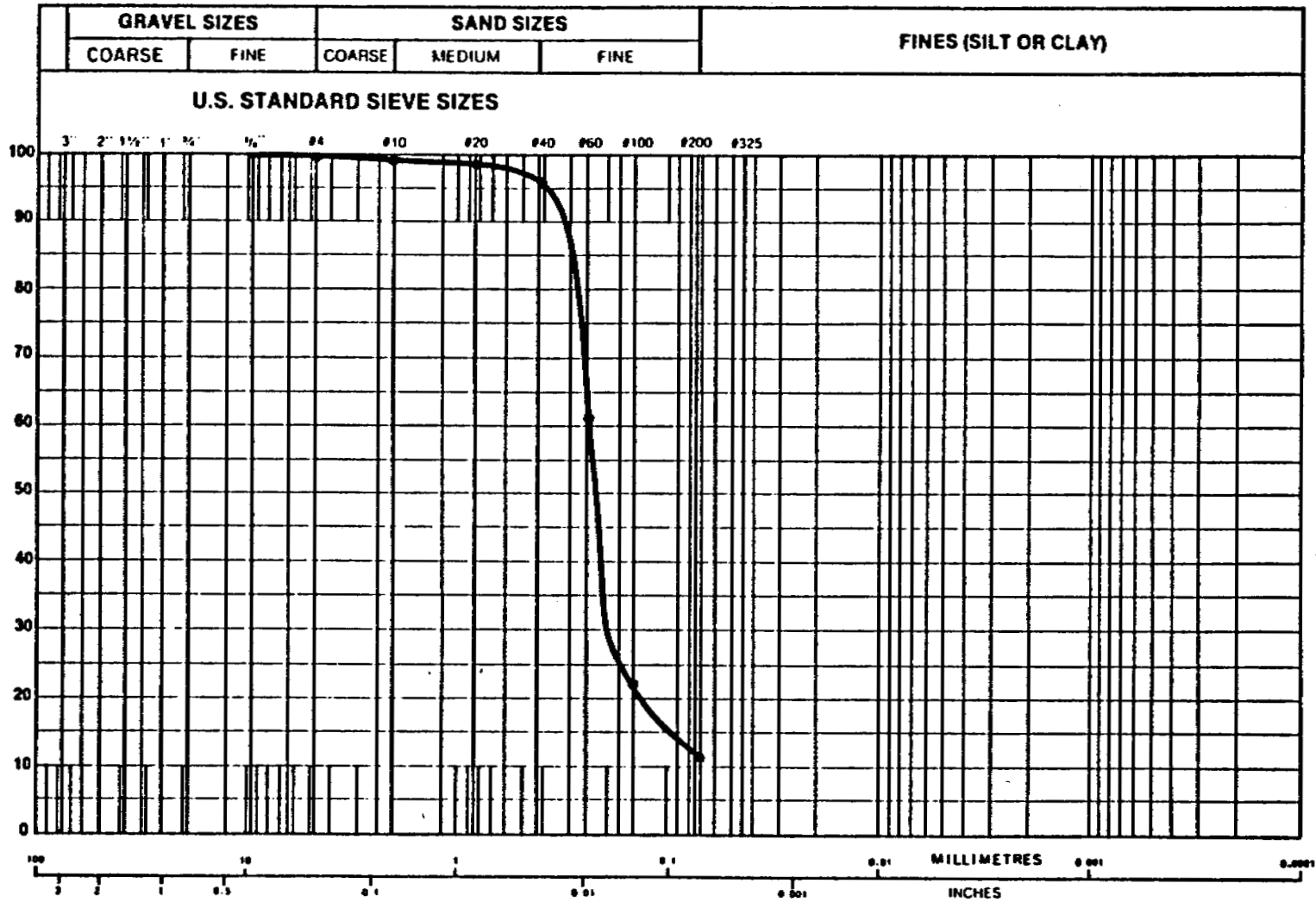
TECHNICIAN SK DATE TESTED 82.12.30



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

GRAIN SIZE CURVE

PERCENT FINER THAN

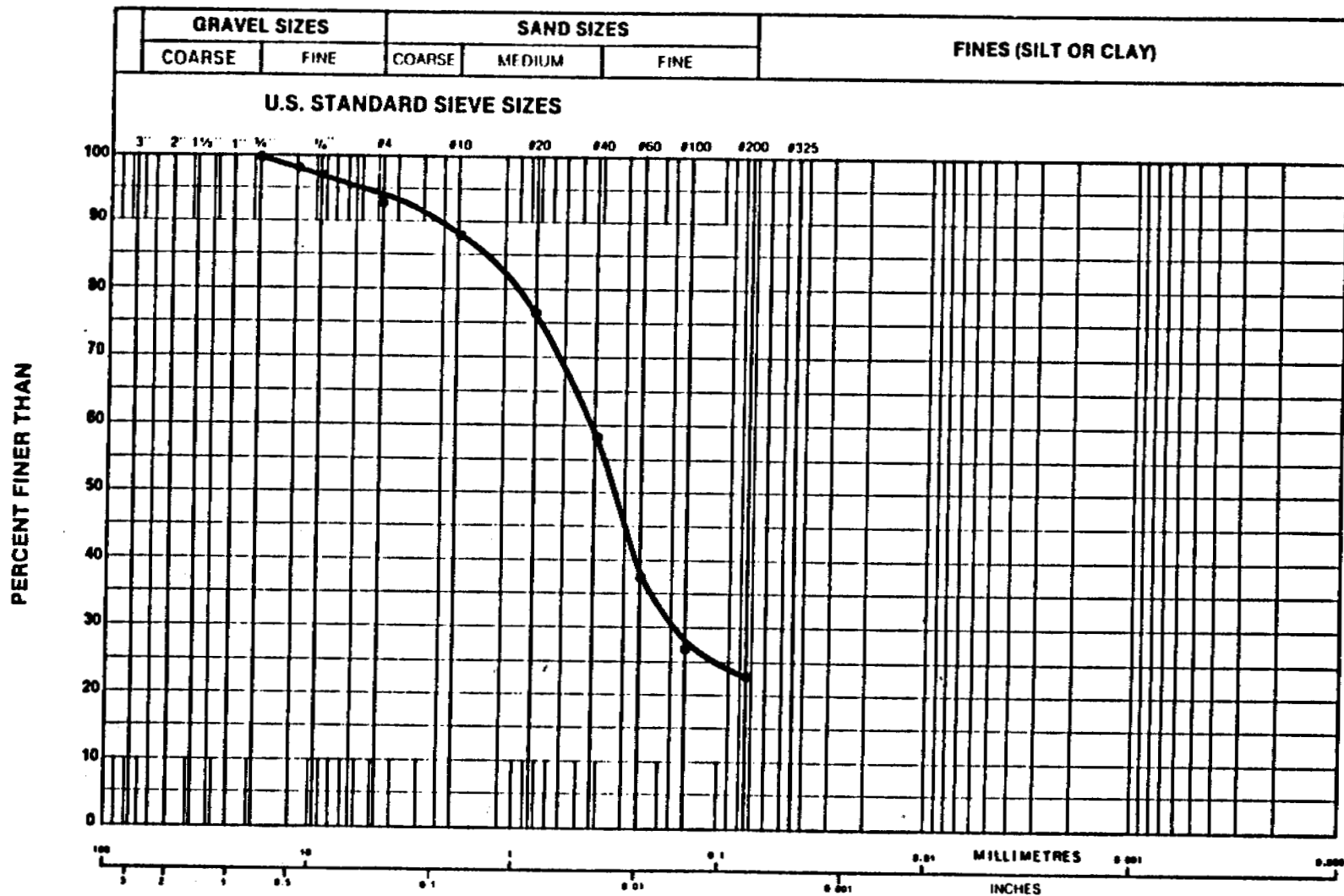




HARDY ASSOCIATES (1978) LTD.
CONSULTING ENGINEERING & PROFESSIONAL SERVICES

GRAIN SIZE CURVE

PROJECT NO. CG 14038D
CLIENT GULF CANADA RESOURCES INC
BOREHOLE 82-RB-6
SAMPLE D1
DEPTH (m) 7.62 - 8.07
TECHNICIAN SK DATE TESTED 82.12.30

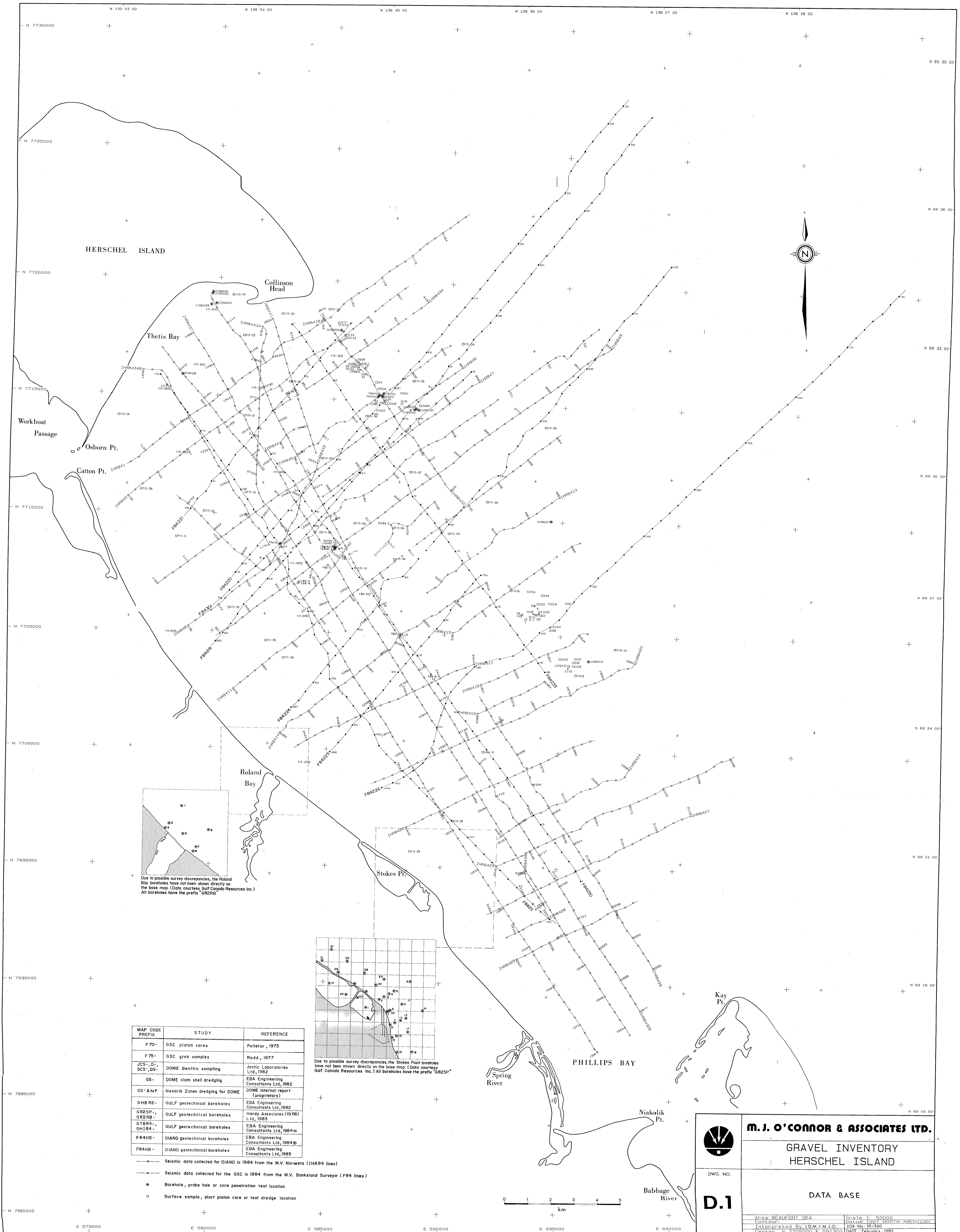


SILTY FINE - COARSE SAND trace fine gravel

GRAVEL	7.2 %	SAND	70.0 %	FINES	22.8 %	SOIL GROUP	SM
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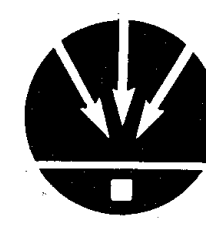
NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM

D_{10} = _____ mm.
 D_{30} = _____ mm.
 D_{60} = _____ mm.
 C_u = _____
 C_c = _____



MAP CODE PREFIX	STUDY	REFERENCE
F70-	GSC piston cores	Pelletier, 1975
F75-	GSC grab samples	Rodd, 1977
GS-	DOME Benthic sampling	Arctic Laboratories Ltd., 1982
GS-	DOME clam shell dredging	EBA Engineering Consultants Ltd., 1982
GS-AtoF	Hendrik Zonen dredging for DOME	DOME internal report (proprietary)
GHB82-	GULF geotechnical boreholes	EBA Engineering Consultants Ltd., 1982
G82SP-, G82RB-	GULF geotechnical boreholes	Hardy Associates (1978) Ltd., 1983
GHB84-, GHB84-	GULF geotechnical boreholes	EBA Engineering Consultants Ltd., 1984a
F84HS-	DIAND geotechnical boreholes	EBA Engineering Consultants Ltd., 1984b
F84HB-	DIAND geotechnical boreholes	EBA Engineering Consultants Ltd., 1985

- Seismic data collected for DIAND in 1984 from the M.V. Norweta (F84 lines)
- Seismic data collected for the GSC in 1984 from the M.V. Banksland Surveyor (F70 lines)
- Borehole, probe hole or cone penetration test location
- Surface sample, short piston core or test dredge location

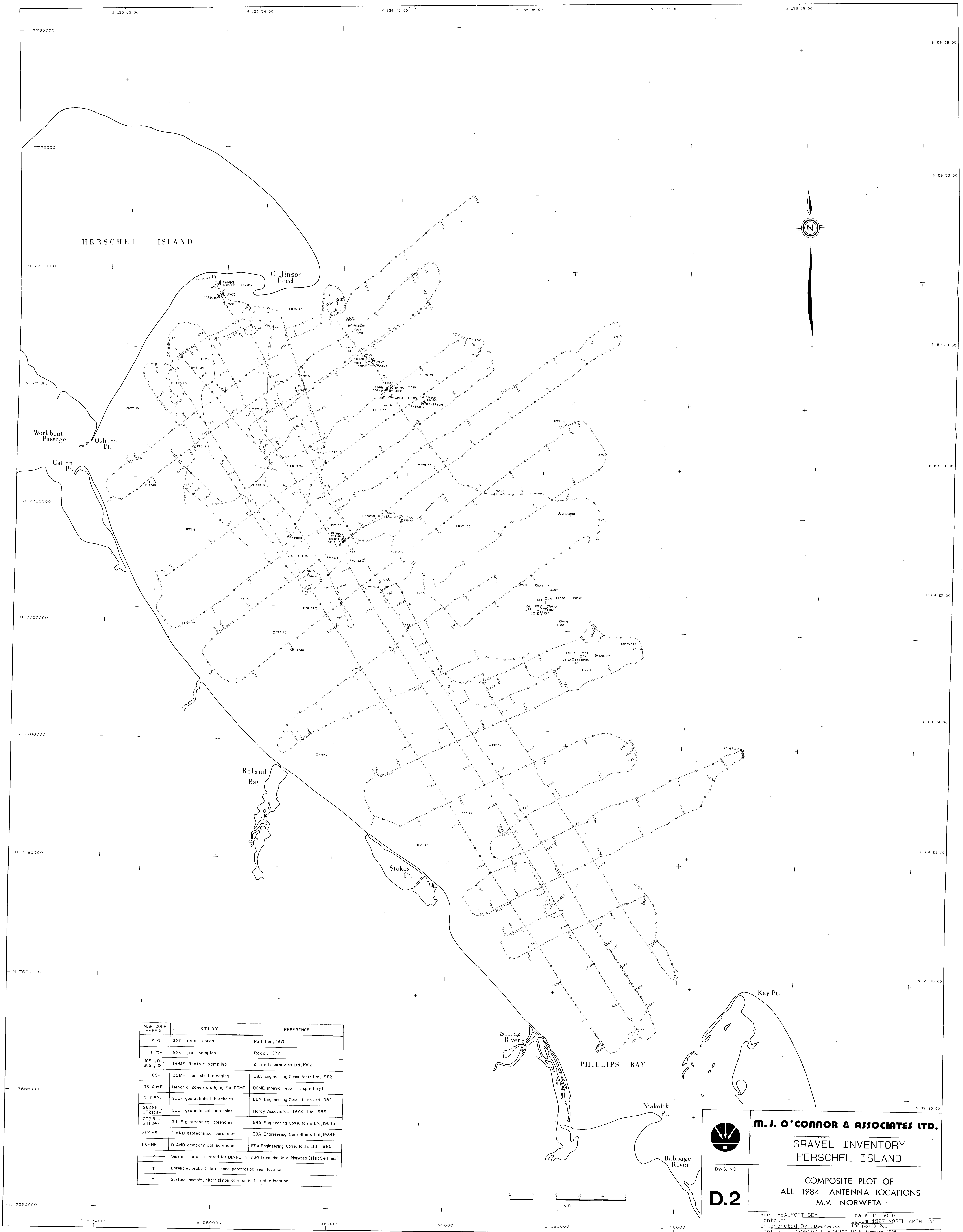
**M. J. O'CONNOR & ASSOCIATES LTD.**

GRAVEL INVENTORY
HERSCHEL ISLAND

DWG. NO.
D.1

DATA BASE

Area: BEAUFORT SEA	Scale: 1:50000
Contour: 10m	Datum: 1987 NORTH AMERICAN
Interpreted By: J.M.M./M.J.O.	Job No: 10-260
Center: N 7705000 E 581300	DATE: February, 1985



MAP CODE PREFIX	STUDY	REFERENCE
F 70-	GSC piston cores	Pelletier, 1975
F 75-	GSC grab samples	Rodd, 1977
JCS-, D-, SCS-, DS-	DOME Benthic sampling	Arctic Laboratories Ltd, 1982
GS-	DOME clam shell dredging	EBA Engineering Consultants Ltd, 1982
GS-A to F	Hendrik Zonen dredging for DOME	DOME internal report (proprietary)
GHB 82-	GULF geotechnical boreholes	EBA Engineering Consultants Ltd, 1982
G82 SP-, G82 RB-	GULF geotechnical boreholes	Hardy Associates (1978) Ltd, 1983
G78 B4-, GH1 B4-	GULF geotechnical boreholes	EBA Engineering Consultants Ltd, 1984a
F84 HS-	DIAND geotechnical boreholes	EBA Engineering Consultants Ltd, 1984b
F84 HB-	DIAND geotechnical boreholes	EBA Engineering Consultants Ltd, 1985
Seismic data collected for DIAND in 1984 from the M.V. Norweta (1HR84 lines)		
Borehole, probe hole or cone penetration test location		
Surface sample, short piston core or test dredge location		



M. J. O'CONNOR & ASSOCIATES LTD.

DWG. NO.
D.2

**GRAVEL INVENTORY
HERSCHEL ISLAND**

COMPOSITE PLOT OF
ALL 1984 ANTENNA LOCATIONS
M.V. NORWETA

Area: BEAUFORT SEA

Scale: 1: 50000

Contour:

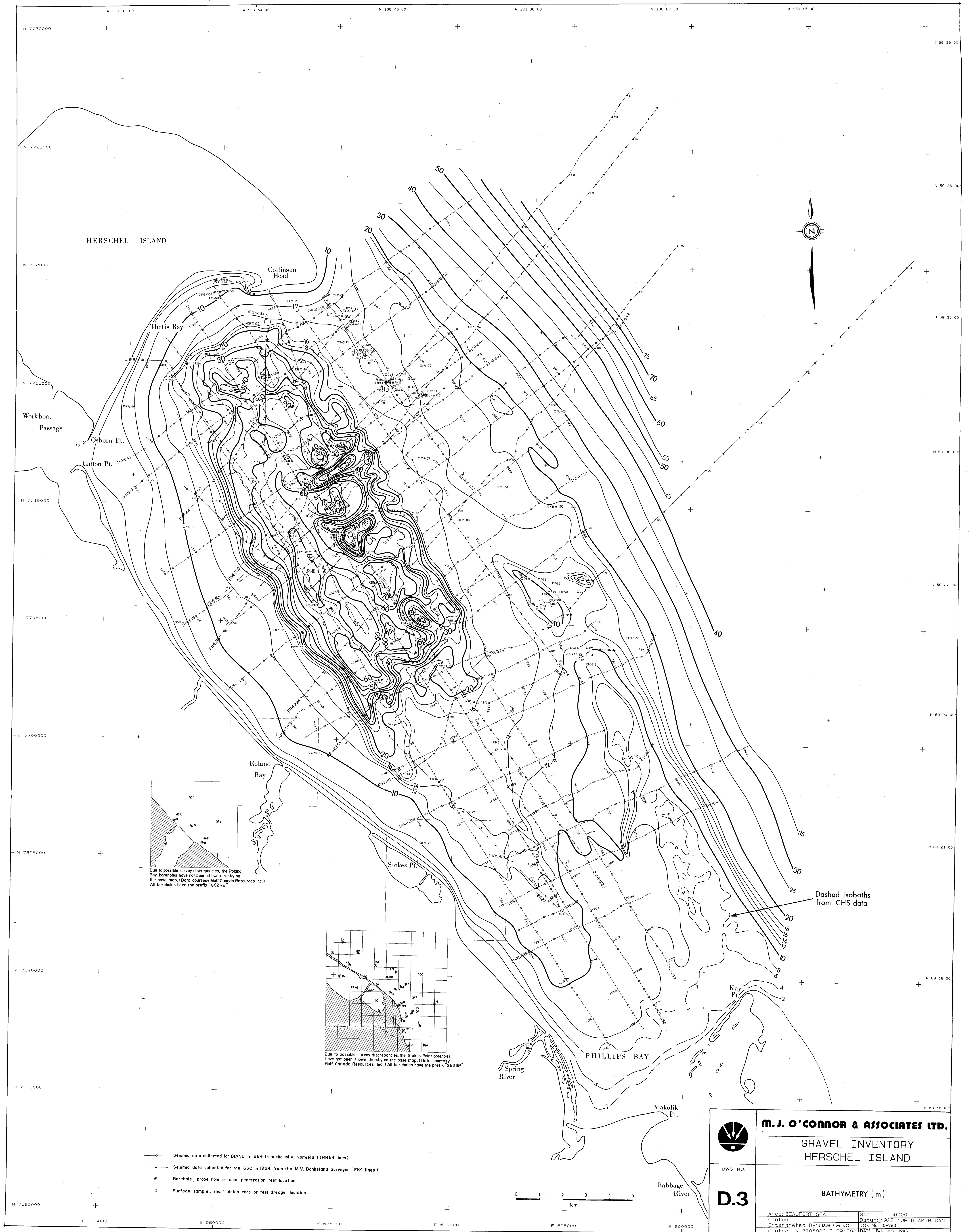
Datum: 1927 NORTH AMERICAN

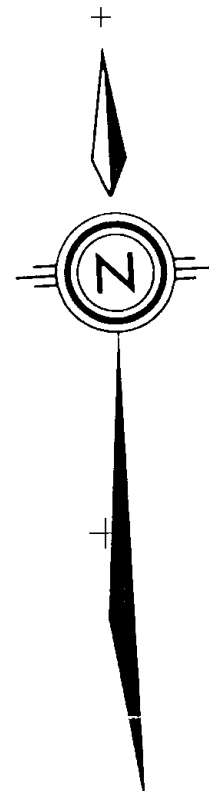
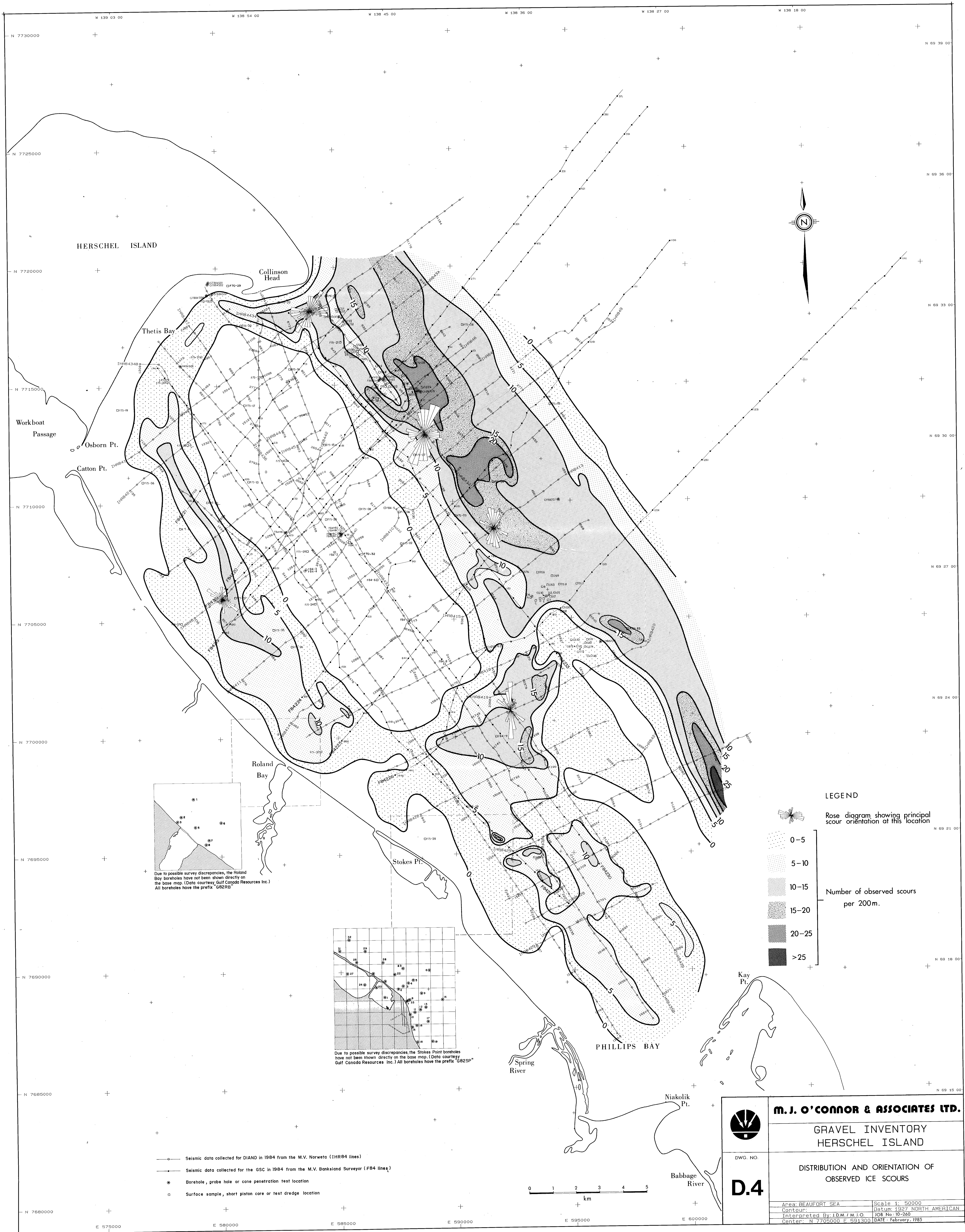
Interpreted by: J.D.M./M.J.O.

JOB No: 10-260

Center: N 7705000 E 581300

DATE: February, 1985





LEGEND

Rose diagram showing principal scour orientation at this location

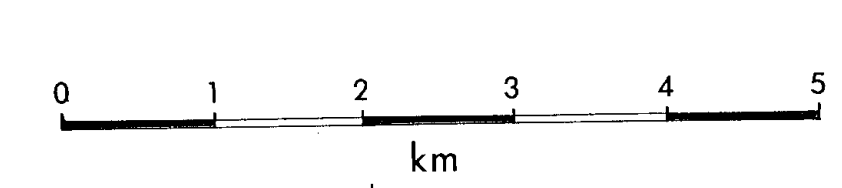
Number of observed scours per 200m.

- 0-5
- 5-10
- 10-15
- 15-20
- 20-25
- >25

Due to possible survey discrepancies, the Roland Bay boreholes have not been shown directly on the base map. (Data courtesy Gulf Canada Resources Inc.) All boreholes have the prefix "GB2RB"

Due to possible survey discrepancies, the Stokes Point boreholes have not been shown directly on the base map. (Data courtesy Gulf Canada Resources Inc.) All boreholes have the prefix "GB2SP"

- Seismic data collected for DIAND in 1984 from the M.V. Norweta (IHR84 lines)
- Seismic data collected for the GSC in 1984 from the M.V. Banksland Surveyor (F84 lines)
- Borehole, probe hole or cone penetration test location
- Surface sample, short piston core or test dredge location



DWG. NO.

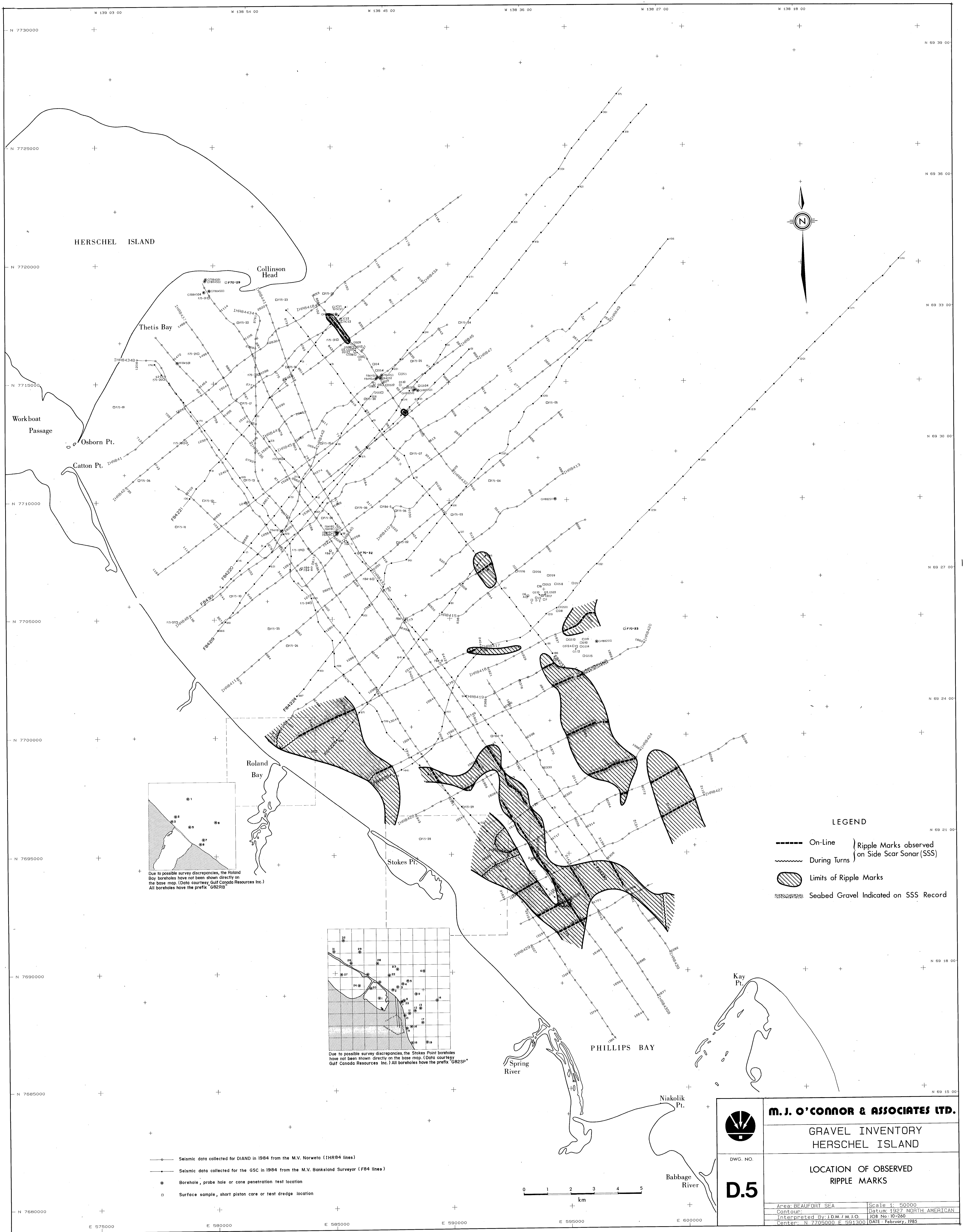
D.4

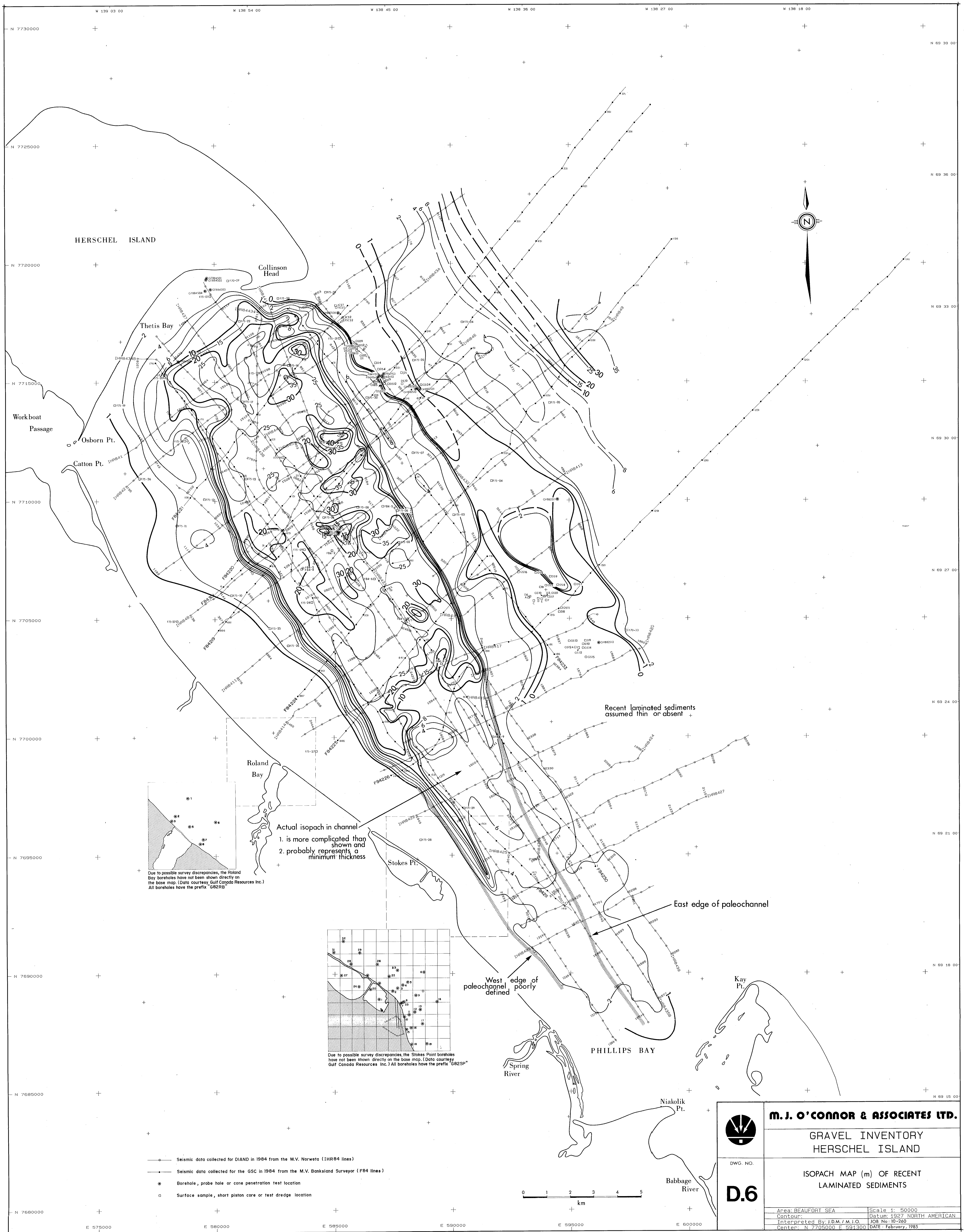
M. J. O'CONNOR & ASSOCIATES LTD.

**GRAVEL INVENTORY
HERSCHEL ISLAND**

DISTRIBUTION AND ORIENTATION OF
OBSERVED ICE SCOURS

Area: BEAUFORT SEA	Scale: 1: 50000
Contour:	Datum: 1927 NORTH AMERICAN
Interpreted By: J.D.M./M.J.O.	JOB No: 10-260
Center: N 7705000 E 591300	DATE: February, 1985





HERSCHEL ISLAND

Collinson Head

Thetis Bay

Workboat Passage

Catton Pt.

Roland Bay

Actual isopach in channel
1. is more complicated than shown and
2. probably represents a minimum thickness

Stokes Pt.

Recent laminated sediments assumed thin or absent

East edge of paleochannel

West edge of paleochannel defined

edge of poorly defined

PHILLIPS BAY

Spring River

Niakolik Pt.

Babbage River



M. J. O'CONNOR & ASSOCIATES LTD.

GRAVEL INVENTORY
HERSCHEL ISLAND

DWG. NO.

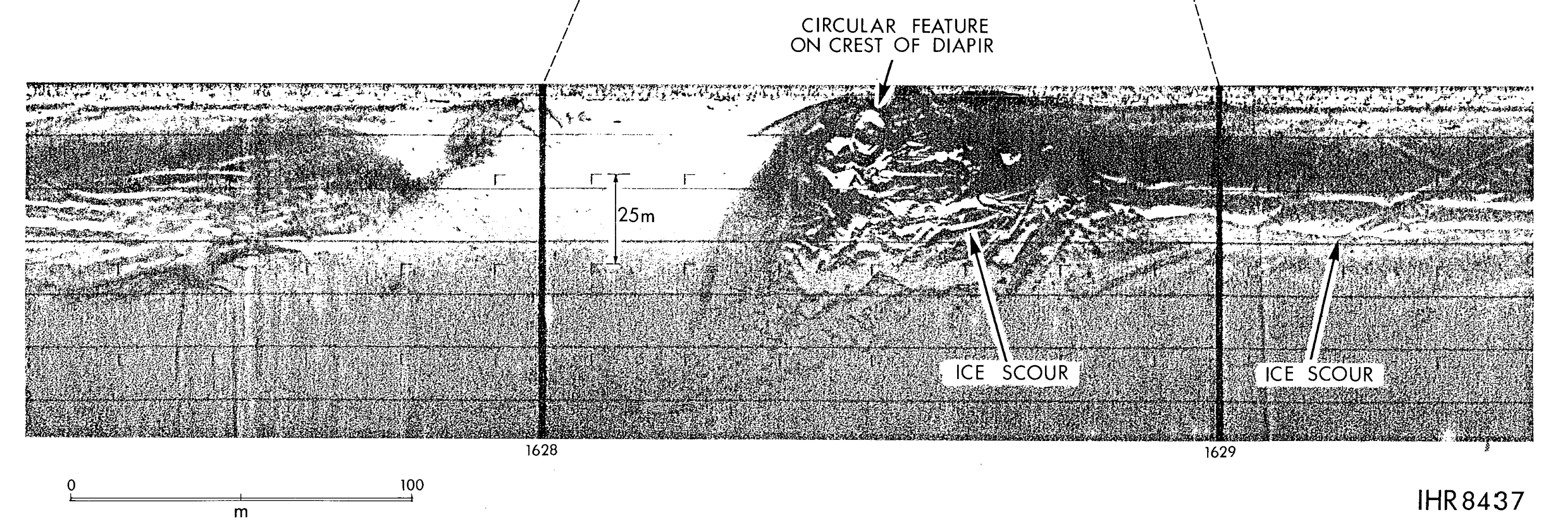
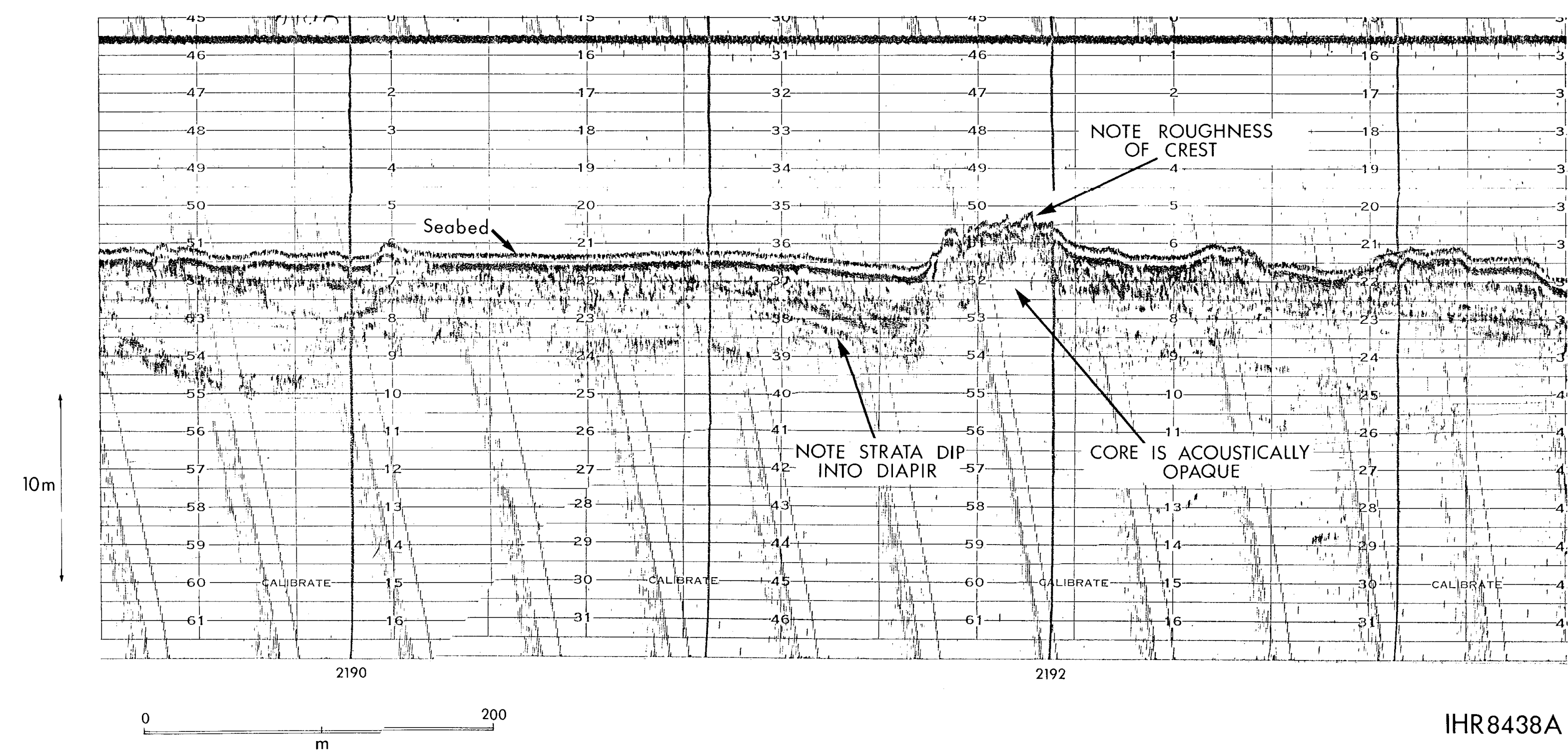
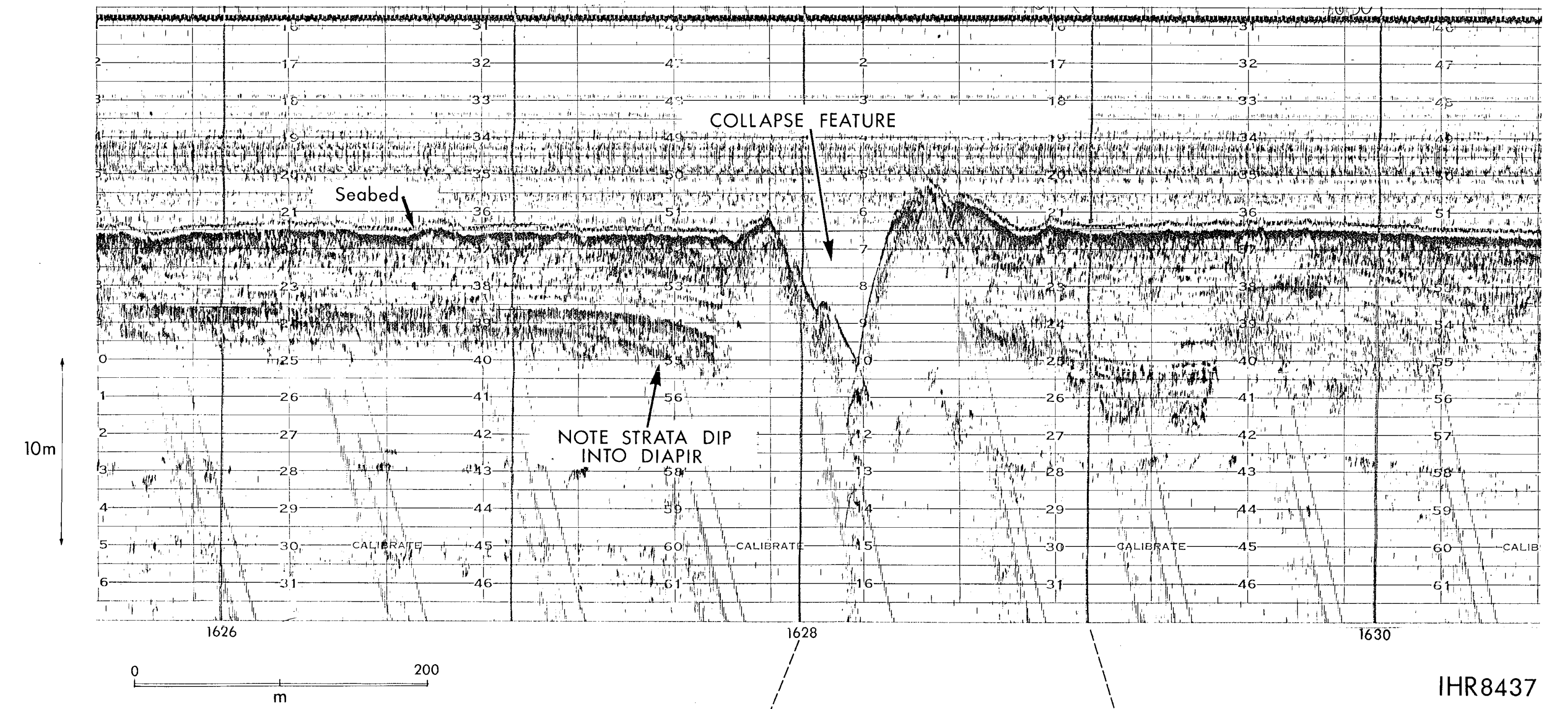
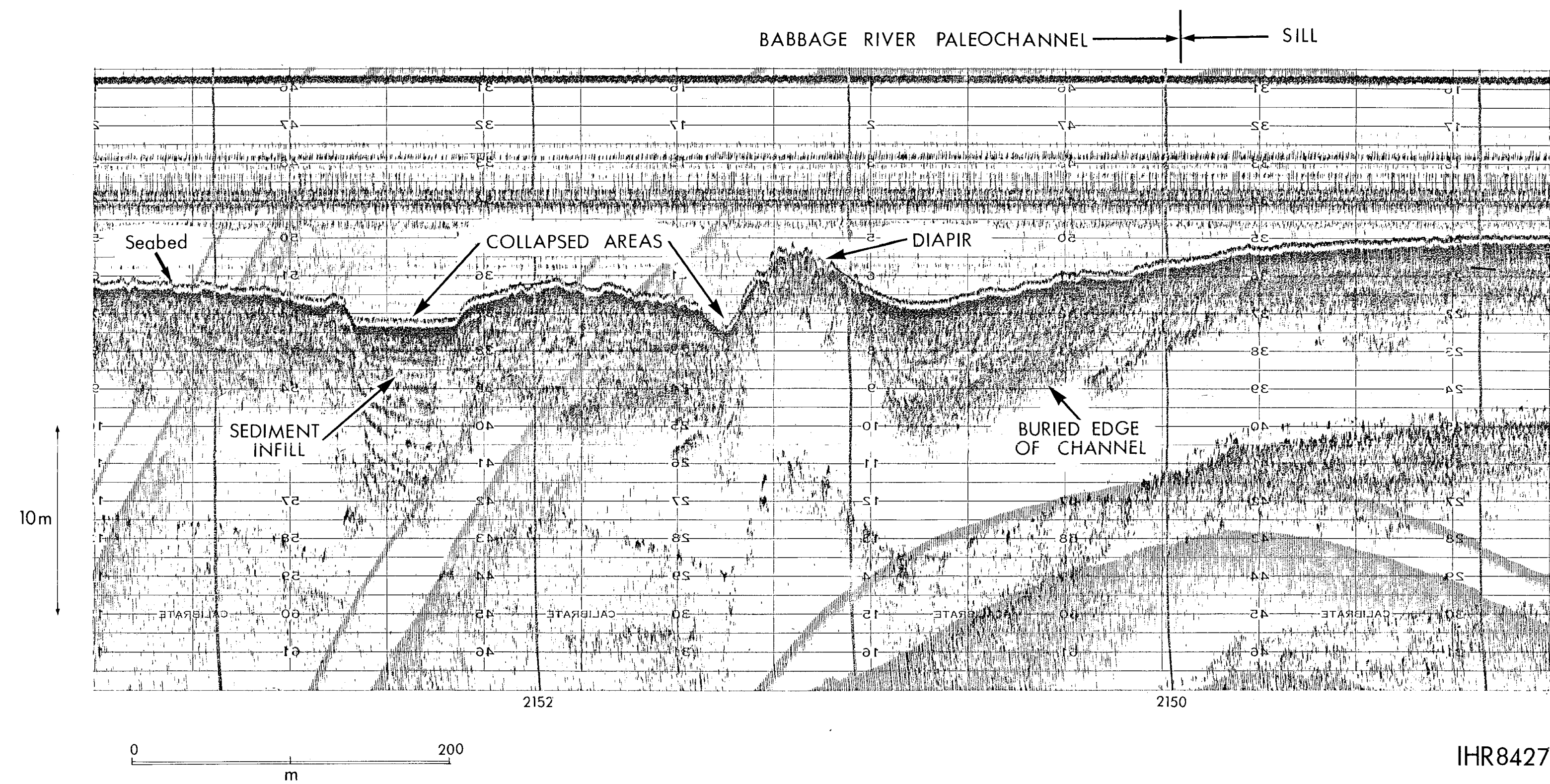
ISOPACH MAP (m) OF RECENT
LAMINATED SEDIMENTS

D.6

Area: BEAUFORT SEA Scale: 1: 50000
Datum: 1927 NORTH AMERICAN
Interpreted By: J.D.M./M.I.O. JOB No: 10-260
Center: N 7705000 E 591300 DATE: February, 1985

- Seismic data collected for DIAND in 1984 from the M.V. Norweta (IHR84 lines)
- Seismic data collected for the GSC in 1984 from the M.V. Banksland Surveyor (F84 lines)
- Borehole, probe hole or cone penetration test location
- Surface sample, short piston core or test dredge location

0 1 2 3 4 5
km



MORPHOLOGY OF A MODERN ARCTIC DIAPIR

M. J. O'CONNOR & ASSOCIATES LTD.

SCALE as shown DATE 85/01/12 JOB No 10-260 DWG No.

D.7

