

U.S. DEPARTMENT OF THE INTERIOR

U.S. GEOLOGICAL SURVEY

**Sand Resource Survey Offshore Sand Key  
Pinellas County, Florida**

by

**Guy Gelfenbaum, Stanley D. Locker, and Gregg R. Brooks**

**Open-File Report 95-547**

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**Guy Gelfenbaum<sup>1</sup>, Stan D. Locker<sup>2</sup>, and Gregg R. Brooks<sup>3</sup>**

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## **I. INTRODUCTION**

The purpose of this investigation is to identify potential sand sources for beach nourishment on the north end of Sand Key in Pinellas County, west-central Florida (Plate 1). Much of Sand Key is considered a "critical erosion area" by the state's Department of Environmental Protection (Clark, 1992). This designation is used for "segments of the shoreline where substantial development or recreational interests are threatened by the erosion processes." Since the late 1960's, various segments of Sand Key have been nourished, including Indian Rocks Beach, Indian Shores, and North Redington Beach (Loeb, 1994). A primary source of sand for these nourishment projects has been the ebb tidal delta on the north side of the main Egmont channel. The primary Egmont borrow area is 20 miles away from the northern end of Sand Key. Future nourishment projects on the north end of Sand Key would benefit from a closer borrow area. Location of a closer source of sand could result in significant savings in cost.

A previous investigation offshore of Sand Key identified limited sand resources in the adjacent vicinity. A survey conducted in the early 1980's extended approximately 5 miles offshore of Sand Key (D. Rosen, unpub. mapping, 1984). This survey found a thin sand cover approximately 2-4 ft thick over most of the area and several sand ridges extending nearly perpendicular to shore that had sand up to 15 ft thick. This previous study showed a potential sand resource offshore of Sand Key. The purpose of the present investigation is to further identify sand sources in this region.

Two areas, marked A and B in Plate 1, have been selected for detailed geophysical and vibracoring surveys. Area A is approximately 12 miles long and one mile wide and extends along most of the length of Sand Key from just north of John's Pass to just south of Clearwater Pass. Area B is 6 miles long and one mile wide and is located offshore of area A along the northern part of Sand Key. The geophysical surveys were used to identify potential sand deposits and to select sites for vibracoring. Twenty-two vibracore sites were selected based on these geophysical surveys, as well as previously gathered data.



## II. METHODS

### GEOPHYSICAL SURVEYS

A total of 135 trackline nautical miles of seismic reflection and side-scan sonar data were collected on October 12-13, 1994 using the Florida Institute of Oceanography vessel R/V Suncoaster (Plate 2). The geophysical instrumentation were deployed at the same time and included a high-resolution "boomer" type seismic system and an EG&G side-scan sonar. Tracklines were run in the defined survey areas A and B at a 1000 ft spacing. Navigation was by differential GPS, WGS84 datum, using the differential correction broadcast by the USCG from Egmont Key. Time (GMT), latitude and longitude were logged at 1 minute intervals by computer, annotated on seismic profiles and recorded with seismic shot headers at 1 minute intervals, and annotated on the side scan records every two minutes. The side scan data were recorded on 8 mm tape in EG&G format and include navigation fixes approximately every 2 seconds.

Navigation data were post-cruise processed to remove bad fixes and to correct for the offset between the GPS antenna and the survey equipment location. The final navigation used for mapping has an accuracy estimated at 20-30 feet.

#### High-Resolution Seismic Survey

##### *Acquisition*

Seismic data were recorded using a digital, single-channel acquisition system. This included a HUNTEC Sea Otter boomer source powered at 135 Joules, an ITI 10-channel streamer with 4 adjacent channels selected for this survey, and an Elics Delph2 digital acquisition and processing package. Digital acquisition parameters were set at a 400 ms shot rate, 150 ms record length, and 10,000 Hz sample rate. Separation between the Hunttec source and streamer was approximately 5 feet.

### *Processing*

All seismic data were processed using the Elics Delph2 system at USF with the objective of enhancing resolution of the thin sedimentary cover in the survey area. Pertinent processing parameters found to work best were 1000-3500 Hz bandpass filter, the Elics ADD AGC (gain), stacking 3 shots, and positive polarity display. Reflector resolution to 0.5 milliseconds (~1 ft.) was obtained.

### *Interpretation*

The seismic data were used to map sediment thickness in the survey area and to choose targets for vibracoring. Sediment thickness estimates were compared to results from vibracore and jet probe penetrations. Good agreement was found between predicted and actual measurements. Seismic interpretation also incorporated information on rock or sediment at the seafloor as determined from side scan sonographs. Interpreted seismic profiles were digitized to output a file of time of day and sediment thickness measurements in milliseconds. Times were merged with the corrected navigation to calculate positions, and thickness in ms was converted to feet using a sound velocity of 5250 ft/s. The sediment isopach map was drawn by hand using 4 overlays of, in order of importance, the actual digitized values, the side scan interpretation map showing rock outcrop and sediment-covered areas, a computer generated contour map of sediment thickness based on a gridded cell size of about 350 ft, and bathymetry from NOAA Chart 11412. Actual digitized values took precedence and the smoothing of values inherent in computer contouring was eliminated. Where the side scan sonographs indicated oriented bedform topography, such as in the southern portion of area A, that trend was applied as a bias for contouring where small scale variability was noticeable.

### *Side-Scan Sonar Survey*

An EG&G side scan sonar was deployed to help define the spatial extent of unconsolidated sediment and hardbottoms in the study area. An EG&G 272-TD towfish was

operated at 100 kHz with a total swath of 300 m (984 ft), or 150 m (492 ft) on a side. Digital side scan data were taped on an EG&G 380 Exabyte unit.

Side scan data were used to map the distribution of sediment and rock in the study area (Plate 3). The technique used was to "paint in" a 300 m (984 ft) swath display of the cruise track. Three bottom types were identified: 1) a coarse, irregular high backscatter bottom return, 2) a low backscatter return, and 3) a high backscatter return but smoother bottom. These three acoustic patterns are inferred to be sediment, rock (hardground), and other (uncertain), respectively (Figure 1). Experience has shown us that rock/hardbottom exposures exhibit a distinctive coarse, high-backscatter image, while unconsolidated sediments typically exhibit low backscatter, with or without bedforms. A third type mapped exhibited a high-backscatter bottom but smoother and may not have been rock. This "other" type occurred in the southern portion of the study area and often correlated to rock interpreted on adjacent lines.

## VIBRACORE SAMPLING

A total of 20 sites were originally selected for vibracoring. Site selection was based upon seismic and side scan sonar data collected for this project as well as previously collected geophysical data. Sites were selected in what were interpreted to represent thick sediment accumulations. Most sites were on bathymetric highs that were interpreted from the seismic data to represent sediment accumulations, whereas others were located in subbottom depressions believed to represent sediment fill. Seismic expressions of core sites are shown in Appendix A1. Due to poor recovery at a few sites and additional side-scan sonar data, an additional two sites were added, making a total of 22 sites occupied (Plate 2).

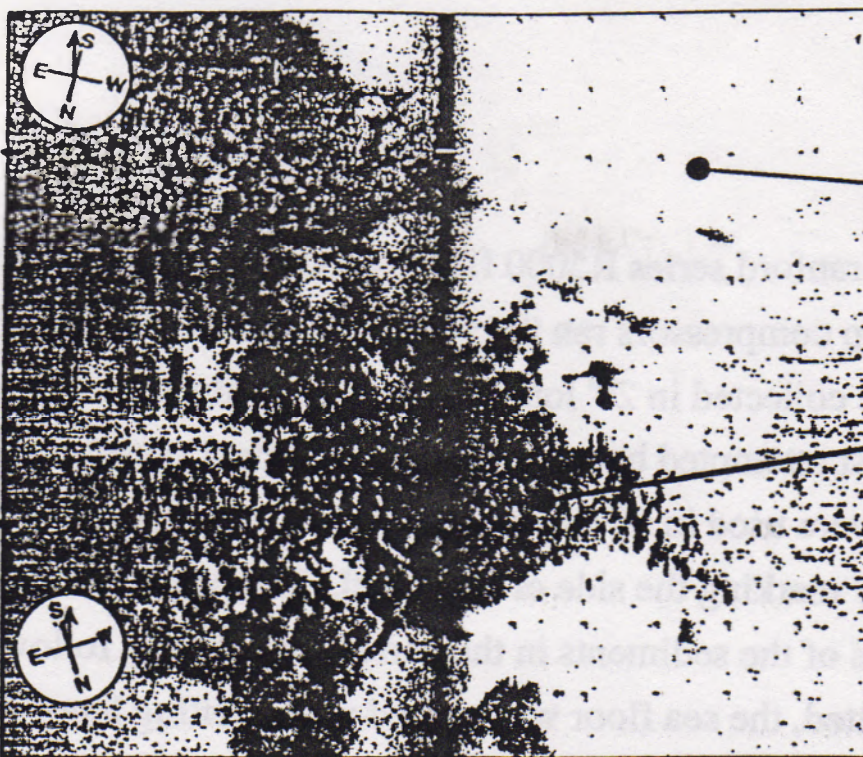
### Field

All vibracoring was conducted aboard the USGS vessel R/V G. K. Gilbert during October - December, 1994. Navigation was by a Trimble NavGraphic GPS used in differential mode. It is estimated that cores were collected within twenty feet of the GPS antennae and that accuracy of the differential GPS was between 10-15 feet. The vibracoring



A. SC94, line 9

0910 (turn to SE)



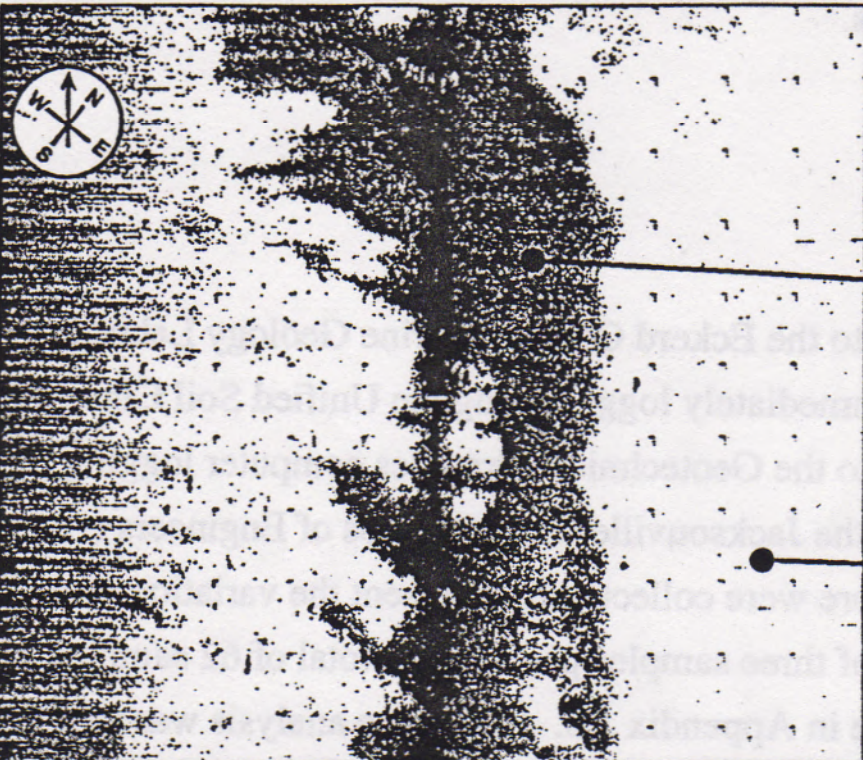
SEDIMENT  
(low backscatter)

HARDGROUND  
(high backscatter)

B. SC94, line 11

0609

0608



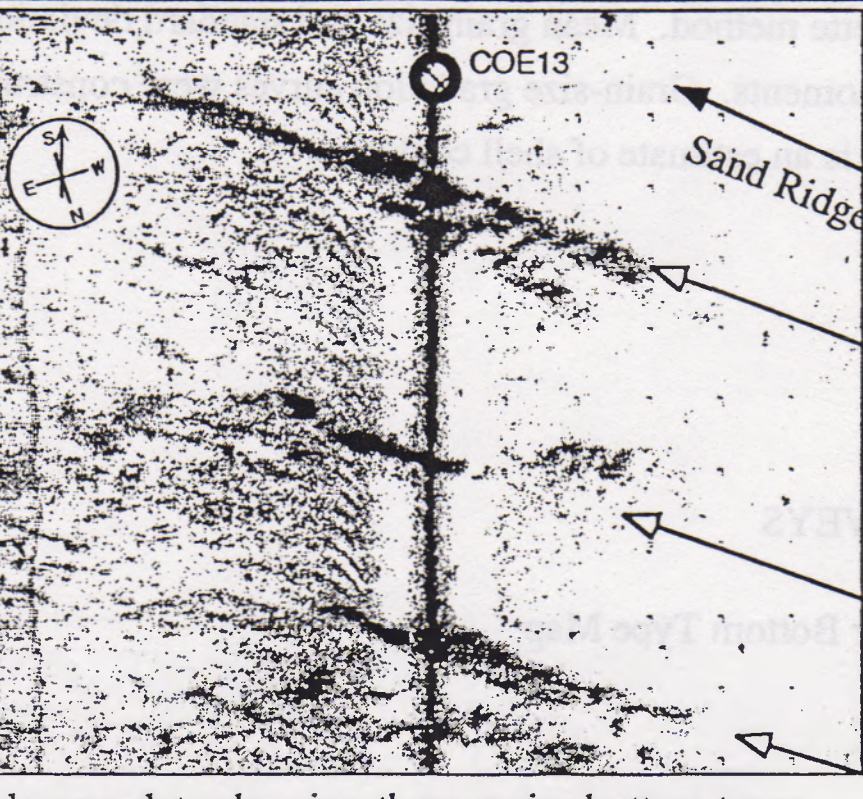
"OTHER" probably  
hardgrounds

SEDIMENT

C. SC94, line 10

1412

1411

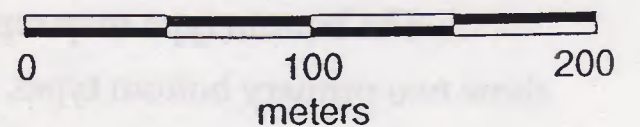


Sand Ridge Trend

Sand waves delineated  
by dark troughs.

High backscatter in  
trough probably due  
to coarser grain size.

Figure 1. A and B) side scan data showing three major bottom types mapped. C) Bedforms ( $\lambda \sim 60-80$  m) on sand ridge at vibracore site COE 13 (see seismic in Appendix A1). Ridge trend and bedform axes are nearly parallel. Dark return = high backscatter.





system utilized consisted of a Branford series R5000 flange-mount vibrating head mounted on an aluminum frame. Two 7.5 hp compressors ran the vibrator at a pressure of 60 psi and a volume of 45 scfm. Cores were collected in 20' long x 3" diameter aluminum barrels. A series of 10' long tubes were first attempted but abandoned due to poor penetration and recovery. Brass core catchers were used in all cases to insure full recovery. Penetration was determined both visually and by marking the side of the barrel. Recovery was determined by directly measuring the thickness of the sediments in the barrel immediately following retrieval. When weather permitted, the sea floor was probed with a jetting lance in an attempt to determine sediment thickness.

### **Laboratory**

Cores were transported to the Eckerd College Marine Geology Laboratory where they were split longitudinally and immediately logged using the Unified Soil Classification System (USCS). Logs were entered into the Geotechnical Graphics computer logging program GTLog, using a template from the Jacksonville District Corps of Engineers (Appendix A2). Sediment samples from each core were collected to represent the variation of sediments encountered, with a minimum of three samples per core. A total of 62 samples were collected and analyzed and the results are in Appendix A3. Grain-size analysis was performed on each sample using the sieve and pipette method. Mean grain size and standard deviation were determined by the method of moments. Grain-size gradation curves were constructed and are reported on ENG form 2087 as is an estimate of shell content.

## **III. RESULTS**

### **GEOPHYSICAL SURVEYS**

#### **Side Scan Sonar Bottom Type Map**

The bottom type map represents a direct interpretation of the side scan sonographs to show two primary bottom types - sediment or hardground (Plate 3). Examples of the side

scan data are shown in Figure 1. Side scan images suggest hardgrounds are extensive, with sand occurring as positive relief lenses or ridges above a relatively flat bedrock surface that is exposed between the sediment accumulations. Bathymetry is often a good indicator of sand or rock, the lows being hardbottom, and highs correlating to a sandy bottom. The side scan interpretation was used to aid and verify seismic interpretations and to guide sediment thickness contouring.

Several observations can be made based on the side scan data. In the northern part of the study area (survey areas B and north part of A) sediments occur in large-scale ridge deposits trending NW-SE. These deposits are on the order of 1 km wide and extend for several kilometers. The sediment cover increases in an onshore direction and is mostly continuous near the beach. Toward the southern part of area A more complex side scan backscatter patterns are observed. This appears to reflect a thinner sediment cover over the rock surface, although some thicker deposits do occur. Additionally, east-west lineation patterns are more common associated with large bedforms and perhaps a more mobile substrate.

### **Sediment Thickness Map**

The sediment thickness map represents an integration of all available data on sand thickness and trends (Plate 4). It should be viewed as a conservative estimate of sediment thickness that would correlate with the upper clean quartz sand unit recovered in the cores. Thickest sediment accumulations occur in the northern and far southern portions of the study area in the form of WNW-ESE trending ridges. Almost all of the sediment thickness is due to positive relief accumulation above the generally flat rock surface in this area.

Although the bedrock surface underlying the shelf sediments is generally flat, a few subsurface lows contained unconsolidated sediments penetrated by coring. Examples of this are found in vibracores 9 and 10. However these type of deposits are uncommon and restricted in extent. Where cores penetrated the upper sand unit and encountered organic-rich sediments or other sediment types, a seismic reflector was sometimes evident (see Appendix A). These reflectors typically matched the elevation of the surrounding rock surface. The



interpretive approach used here tended to exclude the presence of these deeper style deposits in the isopach map. In general, sediment thickness on the seismic records was determined to be from the seafloor to the first subbottom return.

Finally, the isopach map represents a significant smoothing of the true variability in thickness due to the depositional geometries. The larger sand ridges themselves are mantled by large sand waves creating highly variable relief (and associated thickness variability) (for example, see Appendix A1 core 13).

## VIBRACORES

A summary of the vibracoring cruise log is given in Table 1. Core penetration ranged from 2' to 14'. Recovery ranged from 0 to 12.5'. Jetted depth to refusal ranged from 5.3' to 16.7'. The percent of sediment recovered versus penetration ranged from 65% to 93%. The difference between the amount recovered and that penetrated was mostly due to compaction of the sediments in the core. Longest cores (>7') were collected from sites 1, 6, 8, 9, 13, 16, 17, 18, and 22; most of which are in the northern and inshore portion of the study area. Eight cores (sites 1, 3, 8, 9, 11, 13, 21, and 22) had the bottoms of the barrels chewed up as if encountering a hard refusal layer. Eight cores (sites 1, 3, 9, 10, 12, 13, 15 and 21) contained limestone fragments wedged in the bottom. Three cores (sites 8, 10 and 18) contained a compact blue-gray clay in the bottom. Cores 4, 9, 11, 13, 17, and 22 contained large shell fragments at the base. Core 14 contained a large quantity of blackened (phosphatic?) sand grains at the base.

## Core Logs

Core logs are shown in Appendix A2. In general, seven basic lithologies are represented. Relatively clean, fine-grained quartz sand is the dominant lithology, generally occupying the uppermost portion of the cores. Thickest accumulations of clean sand were encountered in cores 6, 9, 13, 17, 18, and 22; most of which are located in the northern portion of the study area. A mixture of quartz sand and shell fragments is common in layers that can be found at any depth downcore and throughout the study area. Quartz sands mixed with blackened grains (phosphorite ?) were abundant in cores 4, 11 and 14. These sediments were found most often in the central to southern part of the study area. Cores were generally

quite short (<3') and, at least in the case of core 14, these blackened sands constitute refusal. Dark brown to black, organic-rich, fine-grained sediments were found in cores 6 and 16 in the northern portion of the study area. They generally occur as relatively thin layers near the core base. Thin layers of light-colored, lime mud were found near the base of cores 8 and 18, both located in the northern region. A hard, compact, blue-gray clay was found at the base of several cores (listed previously) and is thought to represent refusal. Large fragments of limestone found at the base of some cores (listed previously) is interpreted to represent refusal as the core penetrated the underlying limestone surface.

### Grain Size Analysis

Grain size data for all sediment samples are presented in Appendix A3 and Table 2. These include two samples (15 and 19) that were collected directly from the sediment surface (i.e., there was no core retrieval). Mean grain size ranges from -0.7 phi (approximately 1.6 mm; very coarse sand) to 6.2 phi (approximately 0.015 mm; medium silt). Most, however, are between 2 and 3 phi (fine sand), especially in the uppermost portions of the core. Standard deviation (a measure of sediment sorting) ranges from 0.8 to 3.8 phi, but the majority are in the 1 to 2 phi range indicating sediments are generally poorly sorted. Grain size gradation curves show that most samples fall into the fine sand-size category. This is especially true for the relatively clean quartz sand samples (described above), which are consistently composed of 50% to 80% fine sand. Sediments containing an appreciable amount of shell material, limestone fragments and/or blackened grains are consistently coarser. Sediment samples containing organic-rich material and the blue-gray clay layers (both of which are located near the bottom of some cores) are consistently finer.

Table 1. Summary of Vibracore Sampling

Core #	State Plane X (feet)	State Plane Y (feet)	Water Depth	Core Penetration	Core Recovery	%Recovery	Jet Probe Depth	Comments
COE-94-1(2)*^	193,223	1,310,701	28.2'	—	10.5'	—	7.3'	
COE-94-2(2)	195,640	1,312,888	23.5'	—	6.2'	—	10'	
COE-94-3(2)*^	199,634	1,314,366	23.4'	—	5.4'	—	5.3'	
COE-94-4(2):	190,929	1,296,199	24'	6.4'	5.9'	92%	—	
COE-94-5	199,756	1,310,663	25'	2.4'	—	—	—	Hardgrounds listed on navigation chart.
COE-94-6(2)	209,354	1,312,403	22'	14'	12.5'	89%	16.7'	Muddy, organic material at core bottom.
COE-94-7	197,476	1,301,045	21'	<1'	—	—	—	Attempted 3 times, penetration < 1', no recovery.
COE-94-8(2)*~	210,621	1,310,539	18'	—	9.6'	—	8.5'	
COE-94-9(2)*^:	208,502	1,294,641	19'	10.5'	8.1'	77%	—	
COE-94-10(2)~	209,027	1,291,347	22'	2.5'	2.8'	93%	—	This site was cored 2 times.
COE-94-11(2)*	218,222	1,263,823	14'	4'	2.9'	73%	—	
COE-94-12	221,870	1,258,525	14.8'	8'	6.2'	78%	—	
COE-94-13(2)^	213,024	1,310,073	19'	—	9.5'	—	5.5'	
COE-94-14	219,815	1,262,860	11.8'	4'	2.6'	65%	8.3'	
COE-94-15(2)^	217,193	1,320,393	16'	3.5'	+++	—	5.3'	Limestone in core catcher.
COE-94-16	214,074	1,308,702	16'	9'	7.9'	88%	—	
COE-94-17(2):	226,036	1,257,745	11'	—	7.7'	—	—	
COE-94-18(2)~	216,612	1,309,132	15'	12'	9.5'	79%	—	
COE-94-19(2B)	216,311	1,279,204	15'	4'	+++	—	—	Attempted 3 times.
COE-94-20	199,811	1,310,838	24'	2'	—	—	—	Hardgrounds listed on the navigation chart.
COE-94-21*^	205,547	1,308,480	23'	—	—	—	—	Limestone in core catcher.
COE-94-22*:	210,794	1,288,546	17'	9.5'	7.9'	83%	—	

\* Bottom of core barrel banged up.  
~ Blue-gray clay layer found at base of core.  
^ Limestone fragments at base of core.

+++ No core, sample bag only.  
: Gravel size shells in core bottom.

--- No data.  
(2) Second time site occupied.  
(2B) Second attempt at same site.

Table 2. Grain Size Statistics

CORE #	INTERVAL (FEET)	MEAN GRAIN SIZE (PHI)	STANDARD DEVIATION (PHI)	CORE#	INTERVAL (FEET)	MEAN GRAIN SIZE (PHI)	STANDARD DEVIATION (PHI)
COE-94-1(2)	2.0-2.1	2.8	1.1	COE-94-12	0.7-0.8	1.6	1.2
	7.3-7.4	2.3	1.3		3.2-3.3	2.1	1.1
	8.7-8.8	0.5	2.0		5.3-5.4	-0.7	1.6
COE-94-2(2)	1.0-1.1	2.7	0.9	COE-94-13(2)	1.0-1.1	3.0	1.7
	3.0-3.1	1.7	1.8		6.5-6.6	2.0	2.2
	5.0-5.1	2.9	1.0		7.5-7.6	1.1	2.3
COE-94-3(2)	1.0-1.1	2.3	1.2		8.4-8.5	0.6	2.6
	3.5-3.6	2.9	1.2	COE-94-14	0.4-0.5	1.9	1.6
	4.8-4.9	-0.4	2.1		1.3-1.4	2.0	1.6
COE-94-4(2)	1.0-1.1	2.4	1.1		2.4-2.5	1.5	1.8
	3.9-4.0	2.8	1.0	COE-94-15(2)		2.1	1.6
	5.7-5.8	0.9	2.3				
COE-94-6(2)	1.0-1.1	3.0	1.3	COE-94-16	0.1-0.2	1.9	1.3
	2.4-2.5	1.8	1.9		1.1-1.2	2.6	0.9
	7.5-7.6	2.1	2.3		4.2-4.3	1.8	1.7
	8.7-8.8	2.8	2.4		6.7-6.8	2.8	1.9
	10.7-10.8	6.2	2.2		7.7-7.8	3.4	2.0
	12.2-12.3	4.8	2.3				
COE-94-8(2)	1.5-1.6	2.8	1.3	COE-94-17(2)	0.2-0.3	2.0	1.2
	3.6-3.7	2.5	1.9		1.8-1.9	1.0	1.8
	7.6-7.7	2.0	3.1		4.0-4.1	2.4	0.9
	8.7-8.8	5.6	2.6		6.2-6.3	0.5	2.2
COE-94-9(2)	1.1-1.2	2.8	1.0	COE-94-18(2)	2.0-2.1	2.4	1.1
	3.8-3.9	2.7	1.0		6.4-6.5	3.2	2.1
	4.9-5.0	2.3	1.1		8.0-8.1	1.4	2.4
	5.8-5.9	0.4	1.8		9.2-9.3	3.1	1.7
	7.5-7.6	-0.6	1.9	COE-94-19(2)		2.6	1.1
COE-94-10(2)	0.4-0.5	2.7	1.3				
	1.1-1.2	1.0	1.9	COE-94-19(2B)		3.0	1.5
	2.2-2.3	4.3	3.8				
COE-94-11(2)	0.5-0.6	2.4	1.4	COE-94-22	1.0-1.1	2.8	0.8
	1.6-1.7	1.3	2.2		4.8-4.9	2.3	1.1
	2.7-2.8	1.1	2.3		7.3-7.4	1.2	1.6

#### IV. INTERPRETATION

Vibracoring results suggest that the majority of unconsolidated sediment was penetrated by the corer and retrieved. The 65% - 93% recovery rate is consistent with this type of coring technique and is interpreted to be a result of sediment compaction. A comparison of the core recovery to the jetted depth (Table 1) indicates that for most sites the core bottomed out within two feet of the jetted depth. In three instances, however, the core penetrated deeper than was jetted, indicating that jetting did not always reach the refusal depth. The ten cores that contained limestone fragments and/or blue-gray clay at their bases, are interpreted to have penetrated the entire thickness of surficial unconsolidated sediments. The limestone fragments indicate penetration into a lithified or semi-lithified surface. The blue-gray clay probably represents the top of the Hawthorn Formation, a phosphatic limestone deposited during the Miocene (Stahl, 1970; Campbell, 1973; Brooks and Doyle, 1989). This blue-gray clay is quite distinctive and has been encountered throughout the Tampa Bay region. The cores bottoming out in the coarse shell layer may have penetrated the entire thickness of the surficial sediment layer as core logs show that it is quite common to encounter a coarse shell layer immediately above (or even in addition to) the limestone or blue-gray clay (Appendix A2). Evidence is purely circumstantial at this point, however, as shell layers are encountered at all depths. Sediments rich in blackened grains were found to be unrecoverable or yielded short cores. The reason for this is unknown but previous workers have suggested that blackened grains consist of phosphorite that has been winnowed from the underlying Hawthorn Formation (Doyle and Sparks, 1980). A reasonable interpretation is that sediment cover may be very thin in these areas.

Of the longest cores retrieved, most (cores 1, 6, 8, 13, and 18) were consistently located in a relatively confined zone in the northernmost portion of the study area (Plate 2). These cores also exhibited the thickest layers of relatively clean quartz sand, which was consistently found on, or near, the surface. The interpretation is that this area exhibits the thickest accumulation of unconsolidated surface sediments, including the thickest deposit of relatively clean, quartz sand. Seismic and vibracore data show that the bottom is represented by a series of roughly parallel, northwest-southeast trending sand ridges. The largest of these sand ridges in the study area is roughly 1 mile wide by 5 miles long. Whether they are presently mobile is unknown.

Our recommendation at this stage is that future work be focused on these sand ridges, or similar features identified within the study area. Future studies should address the geologic history of these sand ridges, as well as, whether modern processes play a role in modifying these features.

## **V. ACKNOWLEDGEMENTS**

This work was primarily funded by the U.S. Army Corps of Engineers, Jacksonville District, and supplemented by funds from the U.S. Geological Survey's Marine and Coastal Program. We wish to thank the captain and crew of the R/V Suncoaster for their help in collecting the geophysical data, and the captain of the R/V Gilbert for his help in collecting the vibracores. We also want to thank Nancy DeWitt, Jim Edwards, Sean Leatham, and Kevin Geraghty for their help in collecting and processing the vibracores. Finally, we thank Mark Hansen and Jennifer Bexley for producing the maps.



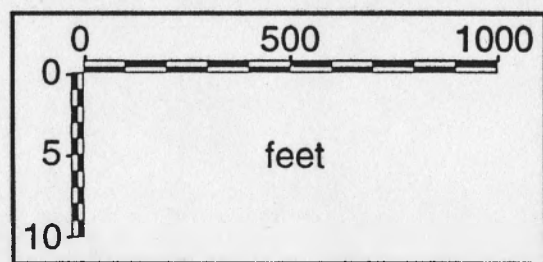
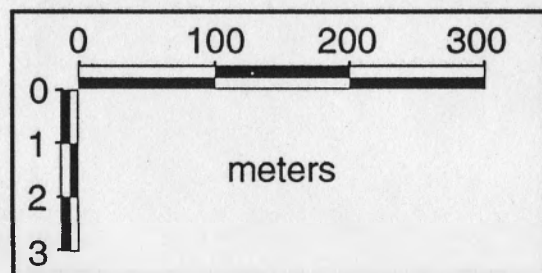
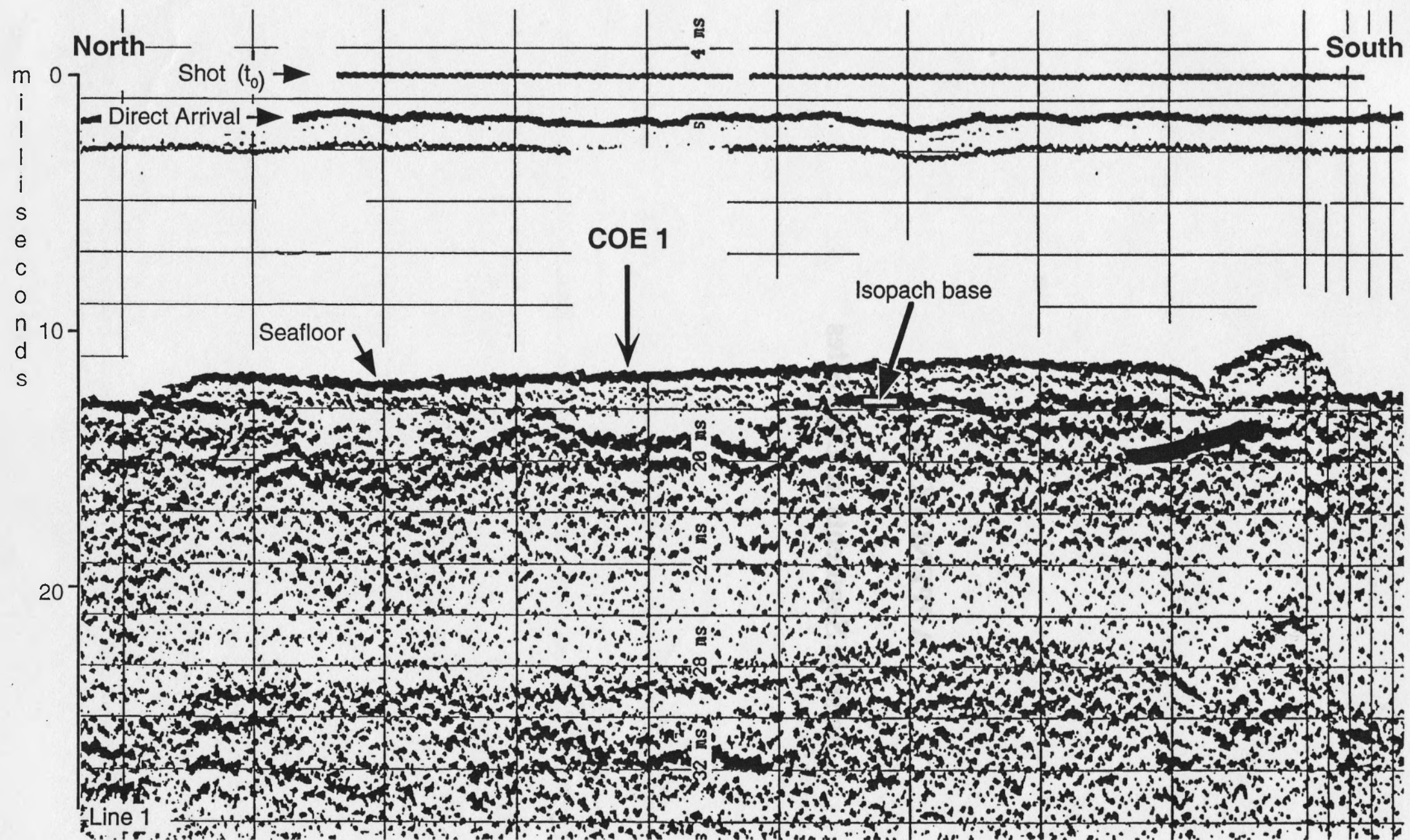
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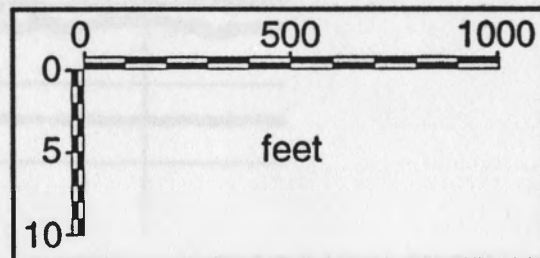
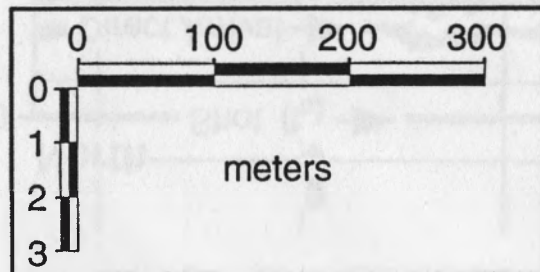
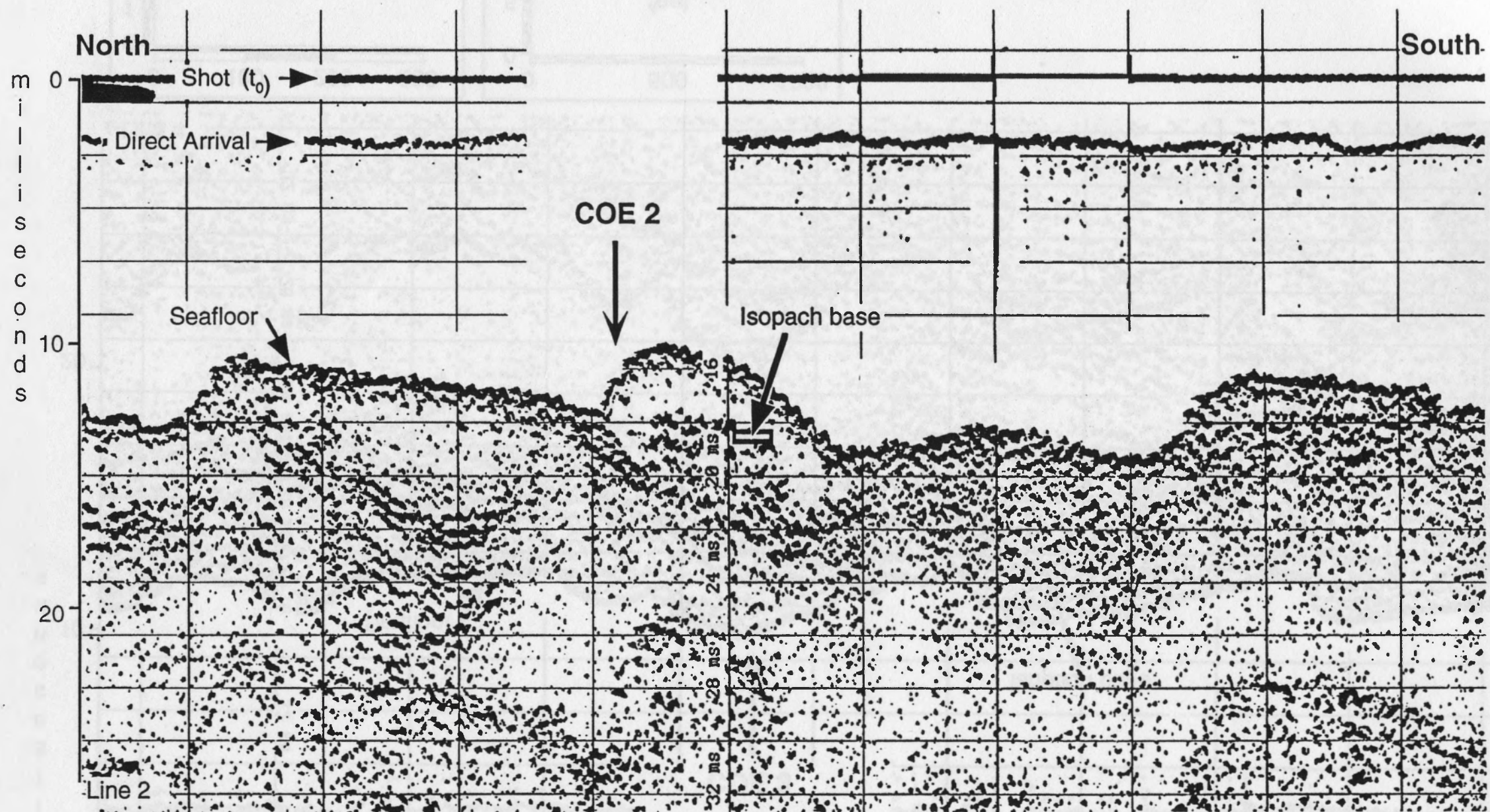
## **APPENDIX A1**

### **Seismic Segments at Core Sites**

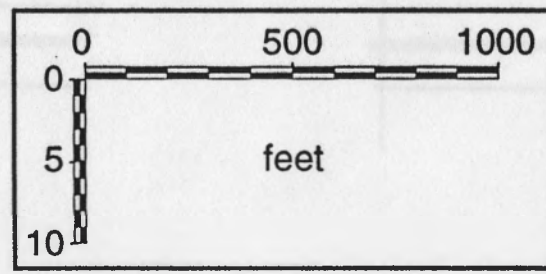
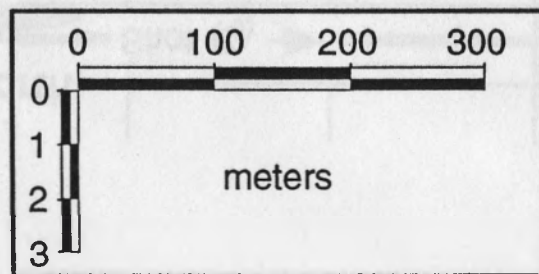
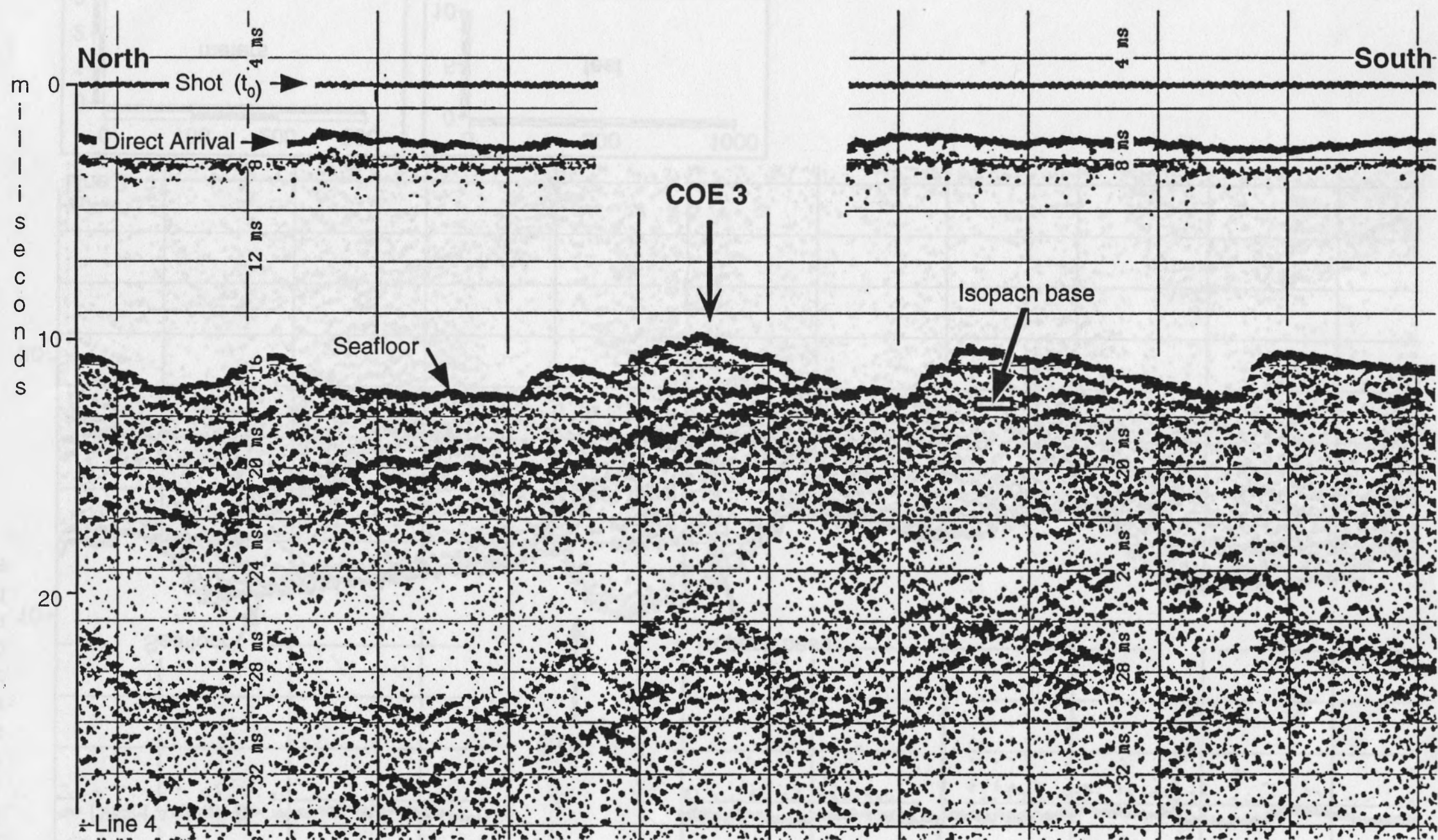




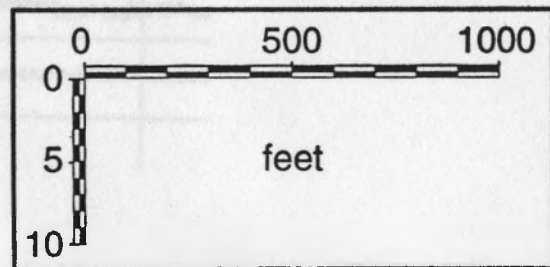
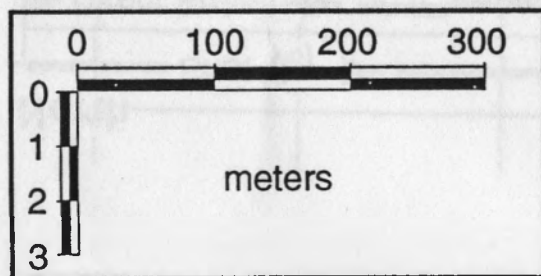
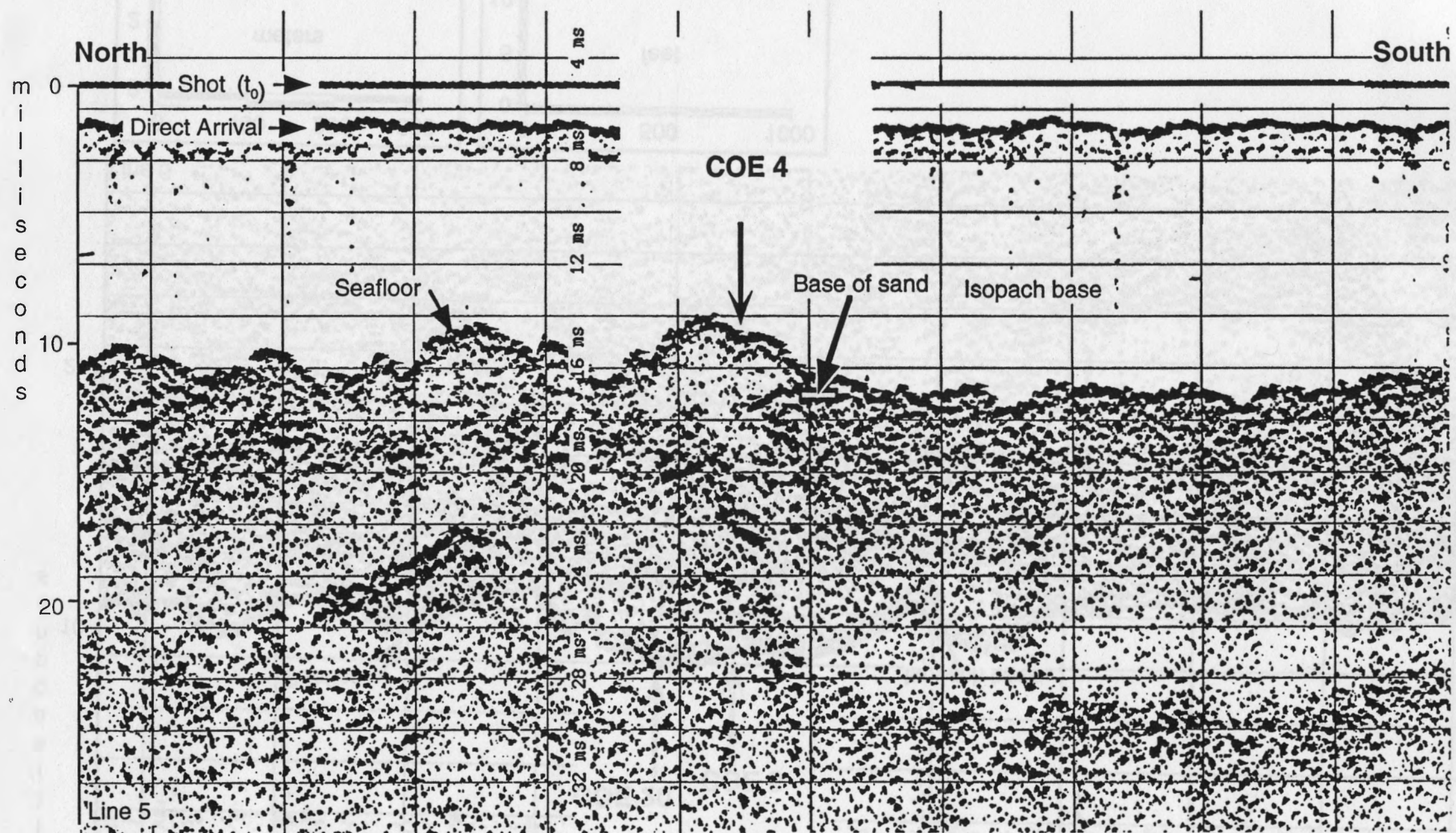




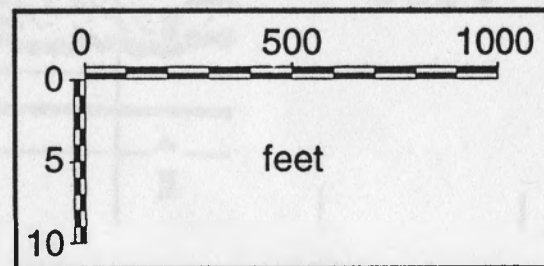
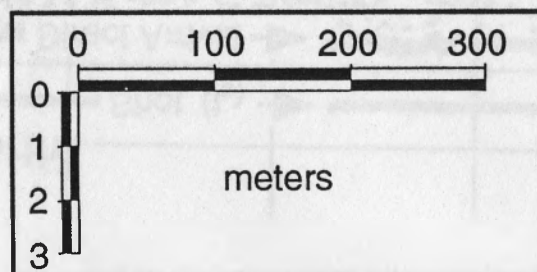
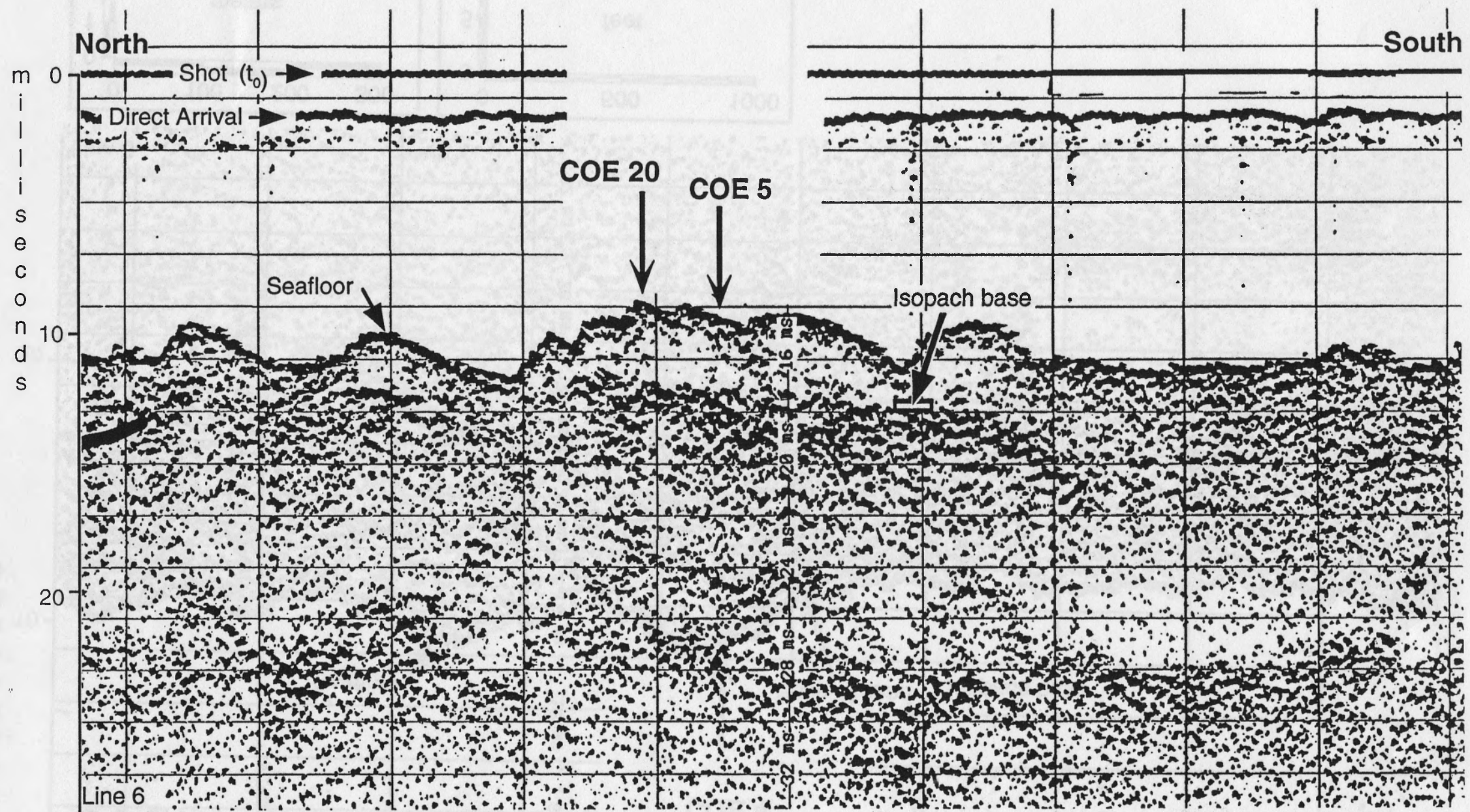




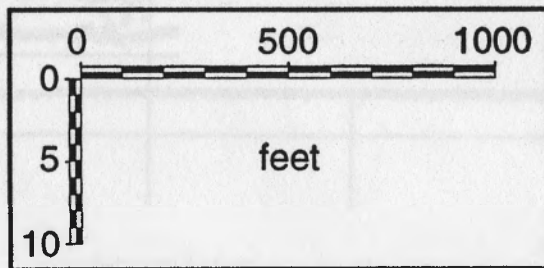
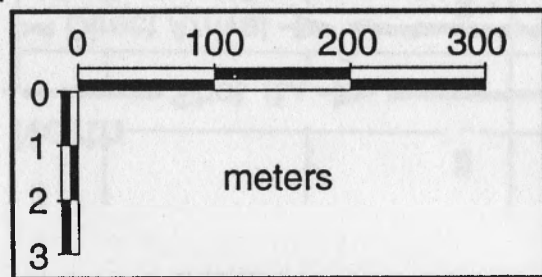
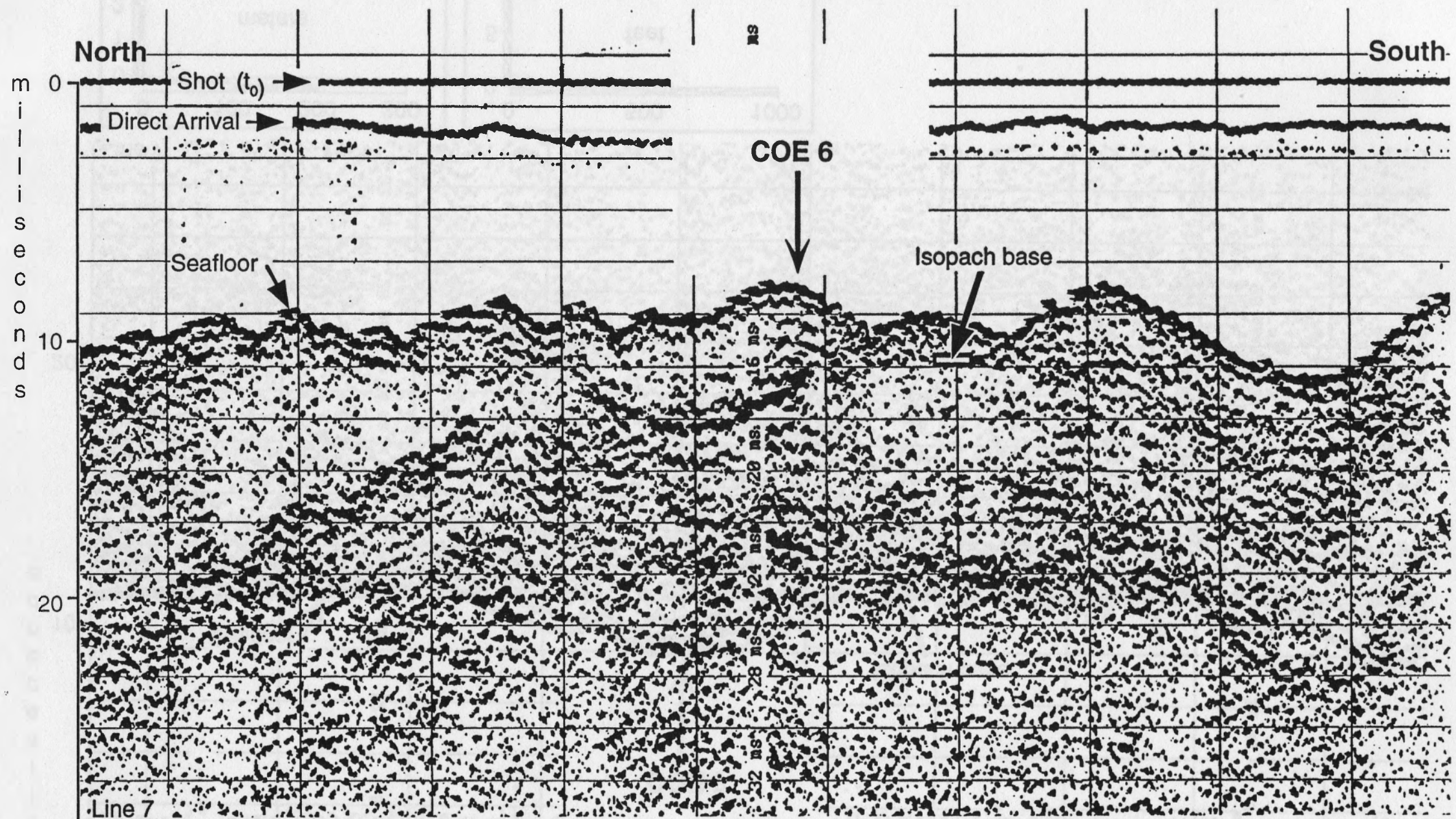




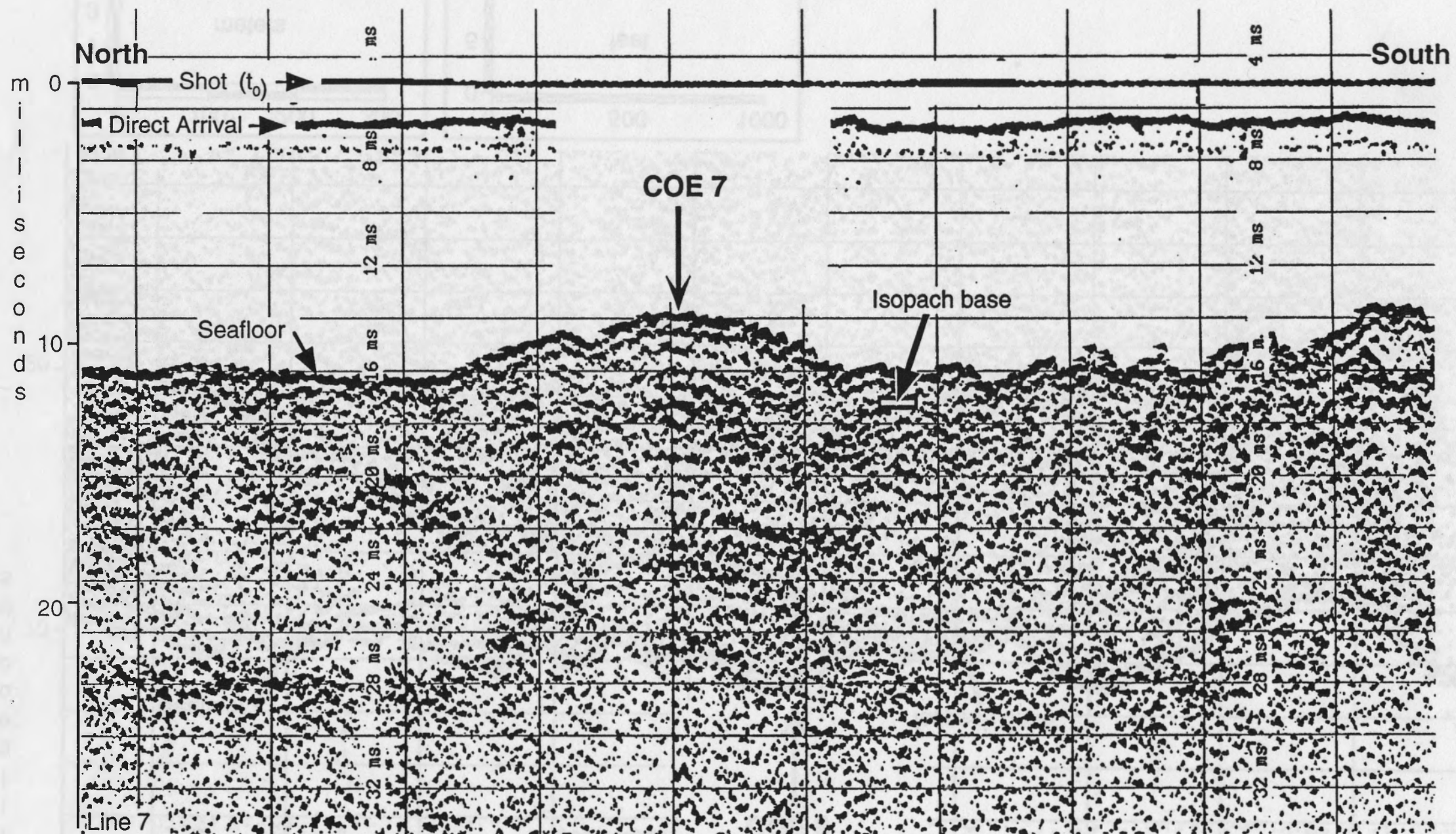




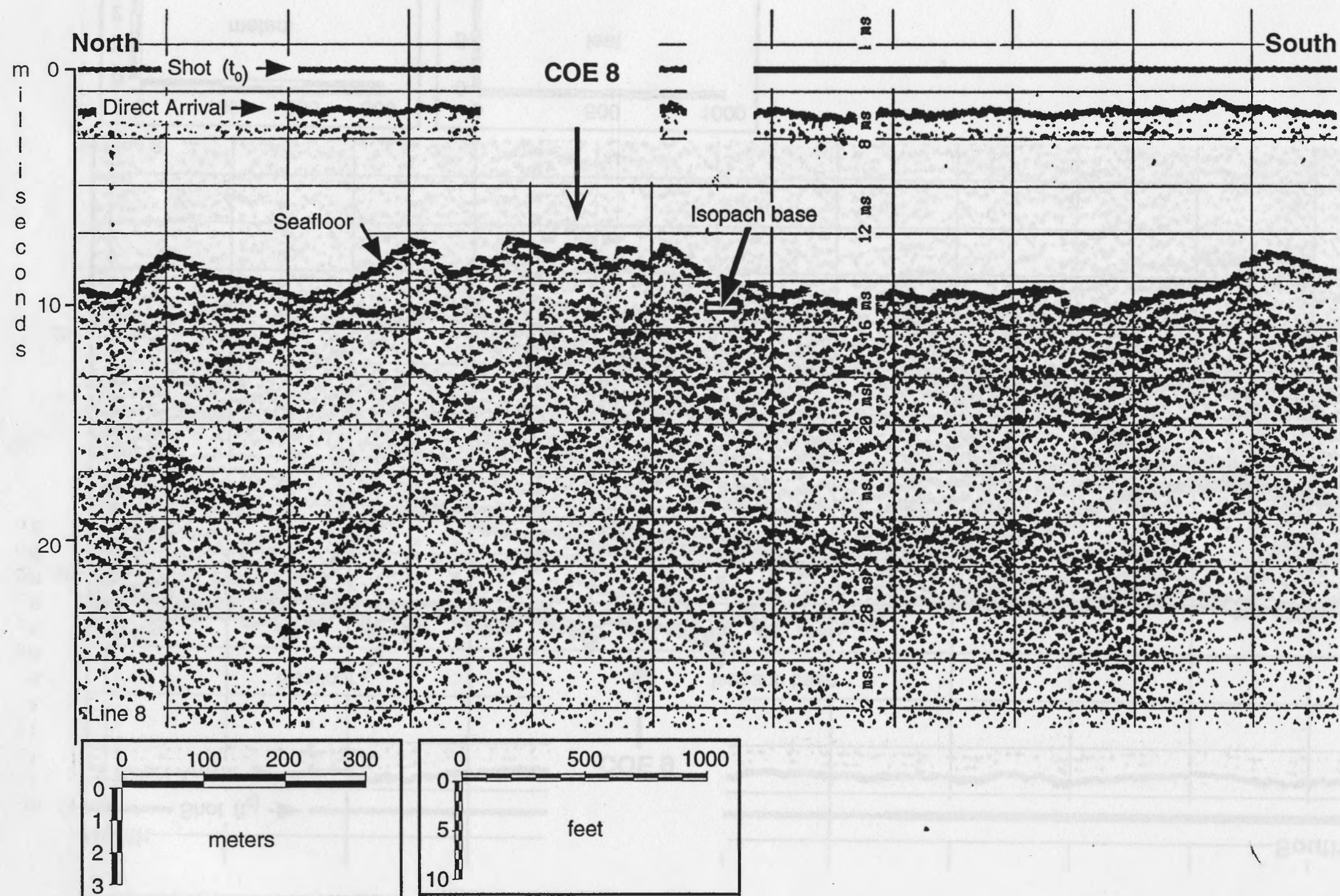




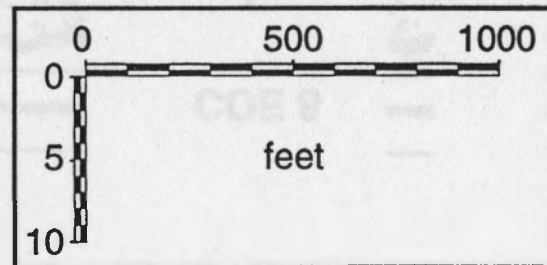
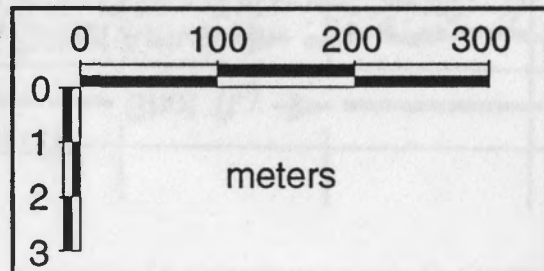
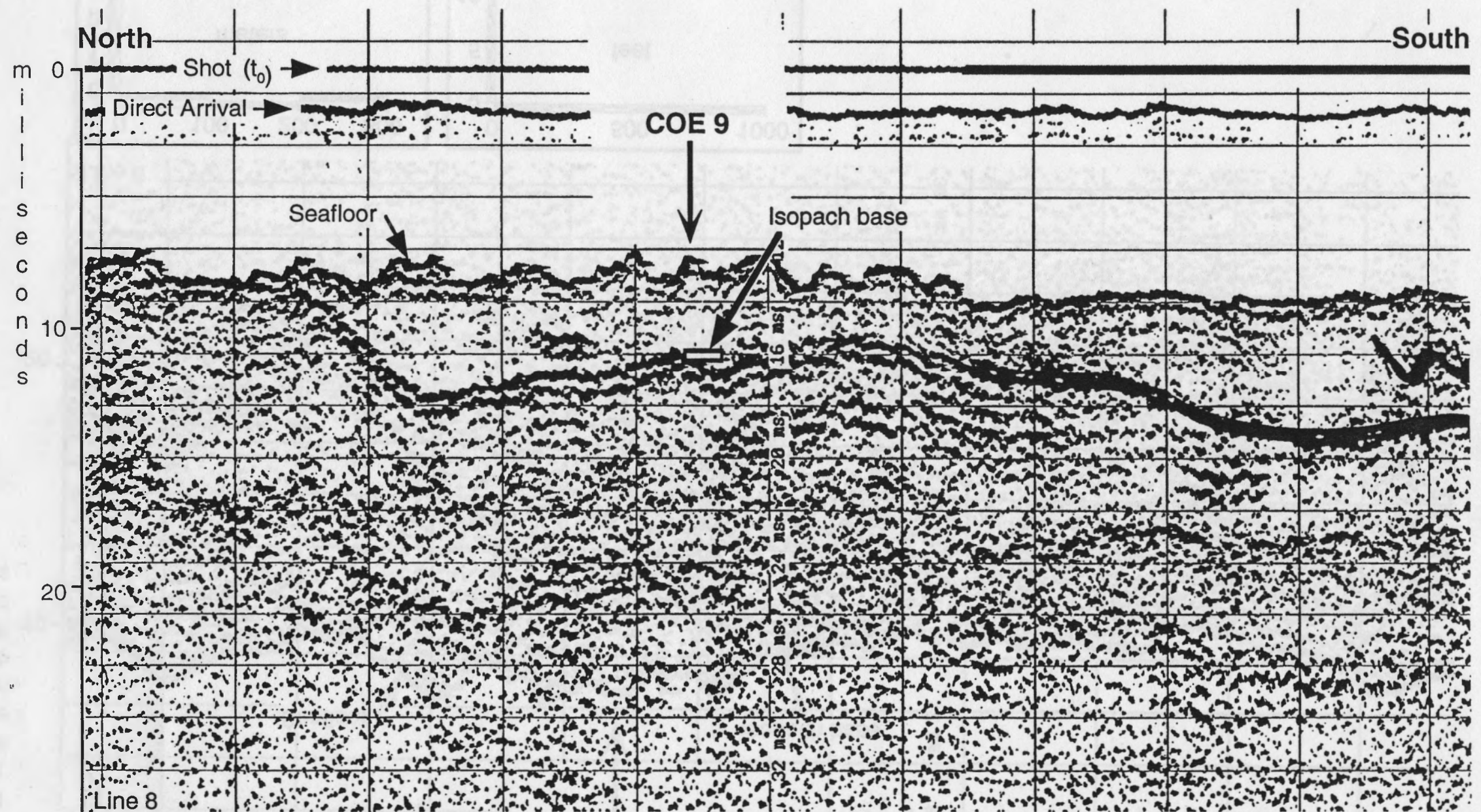




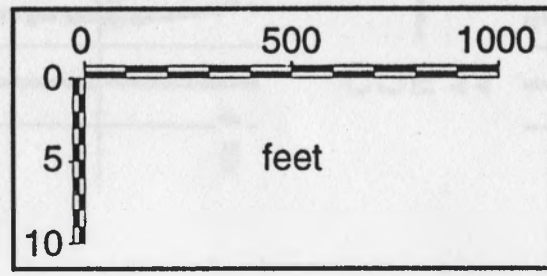
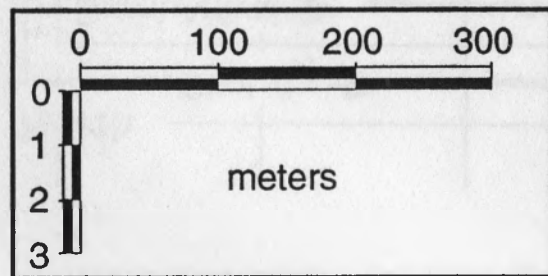
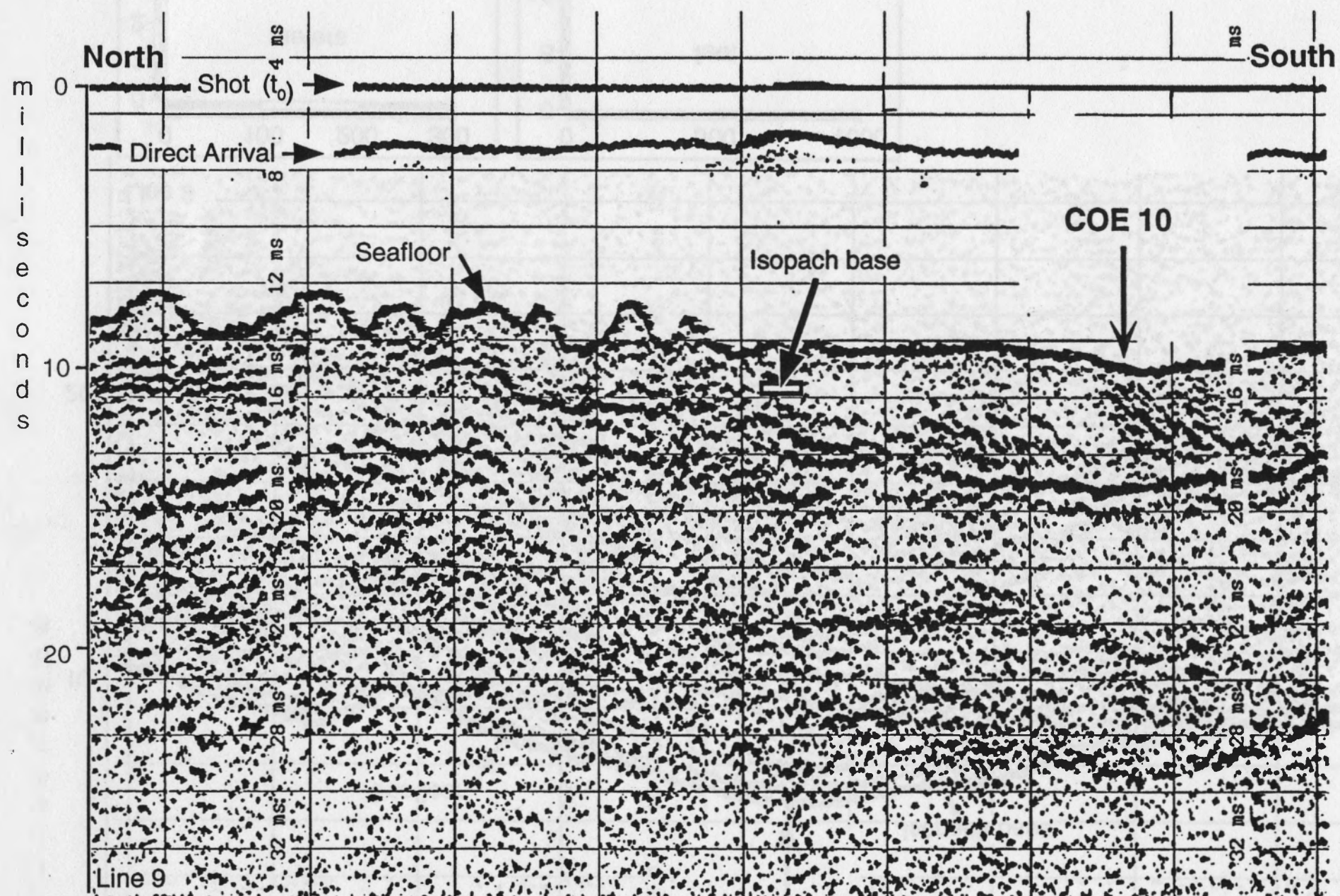




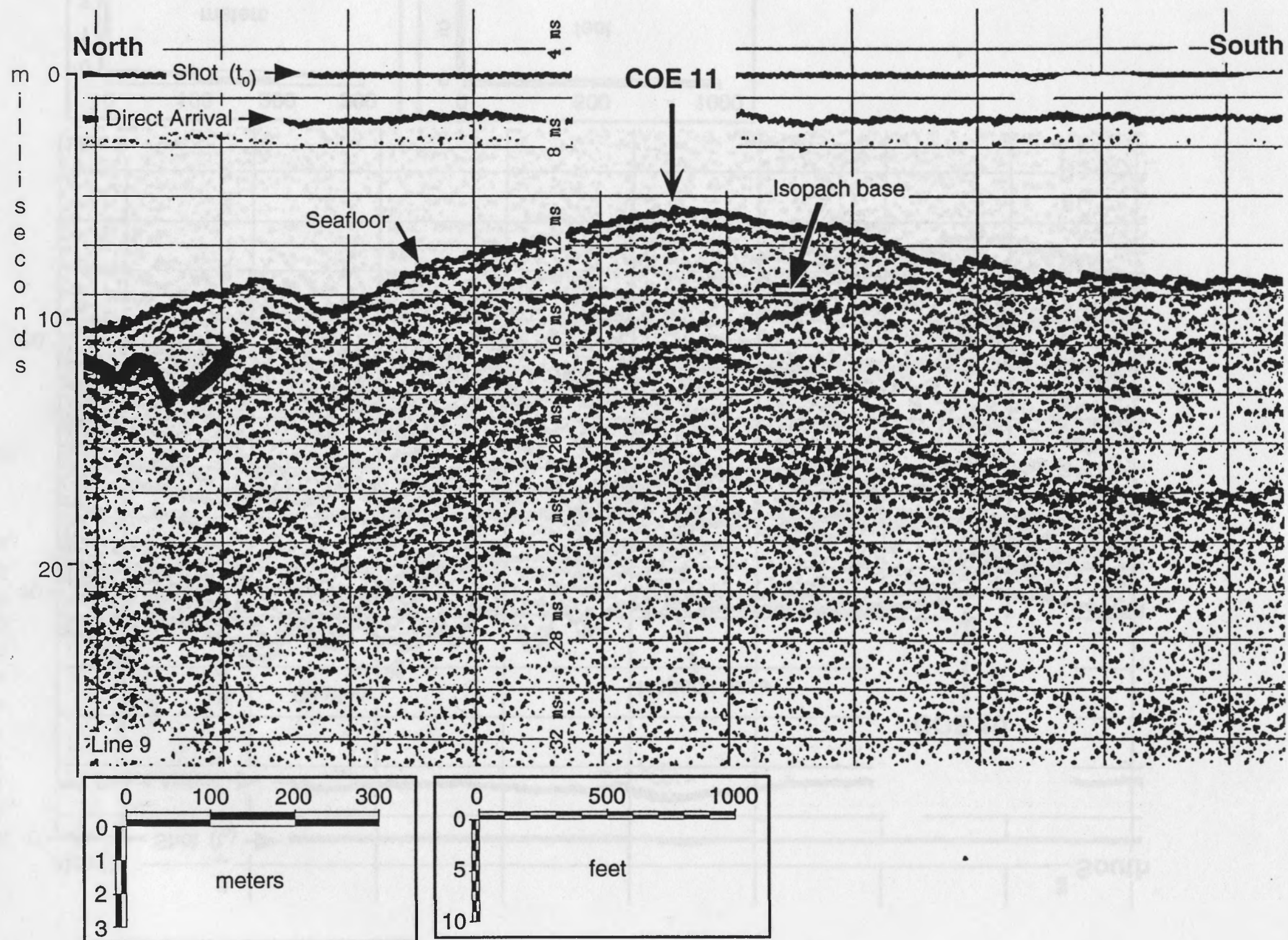




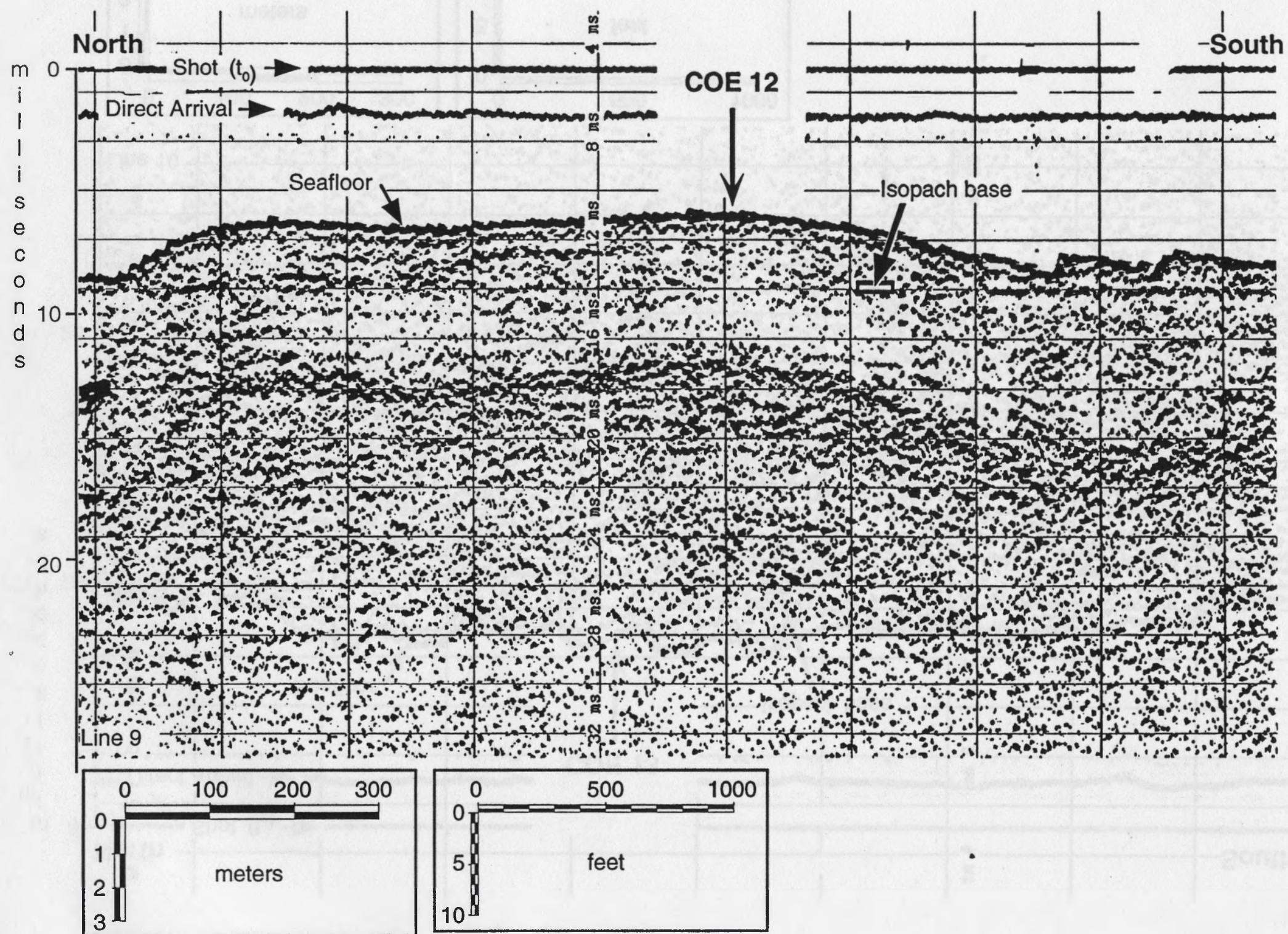




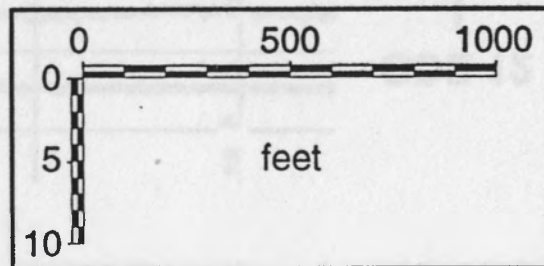
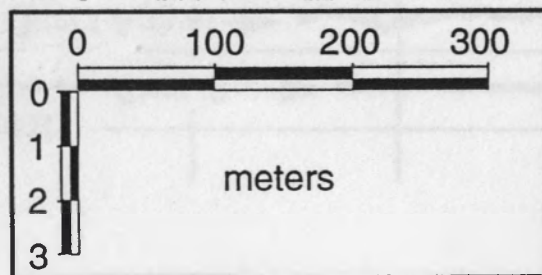
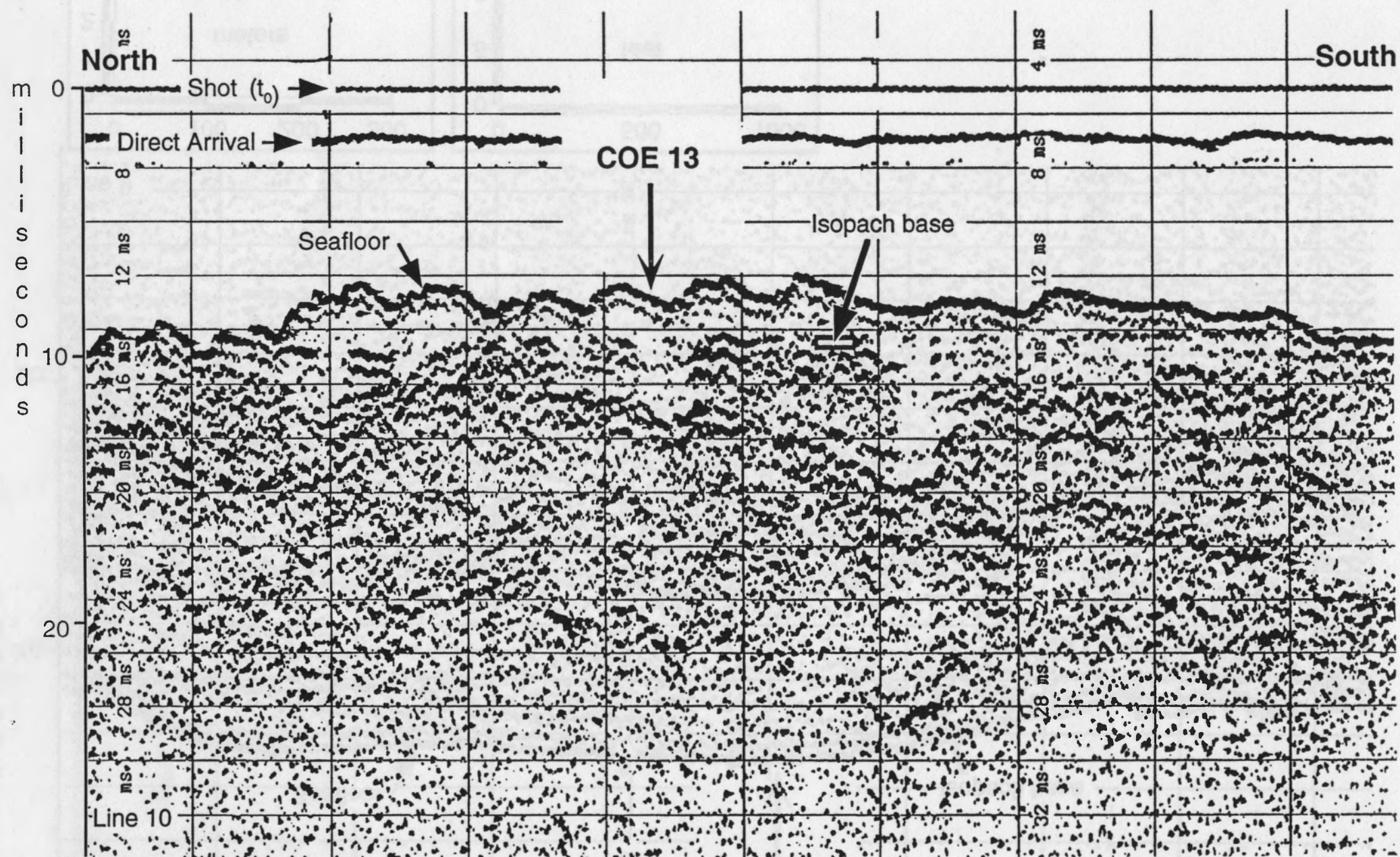




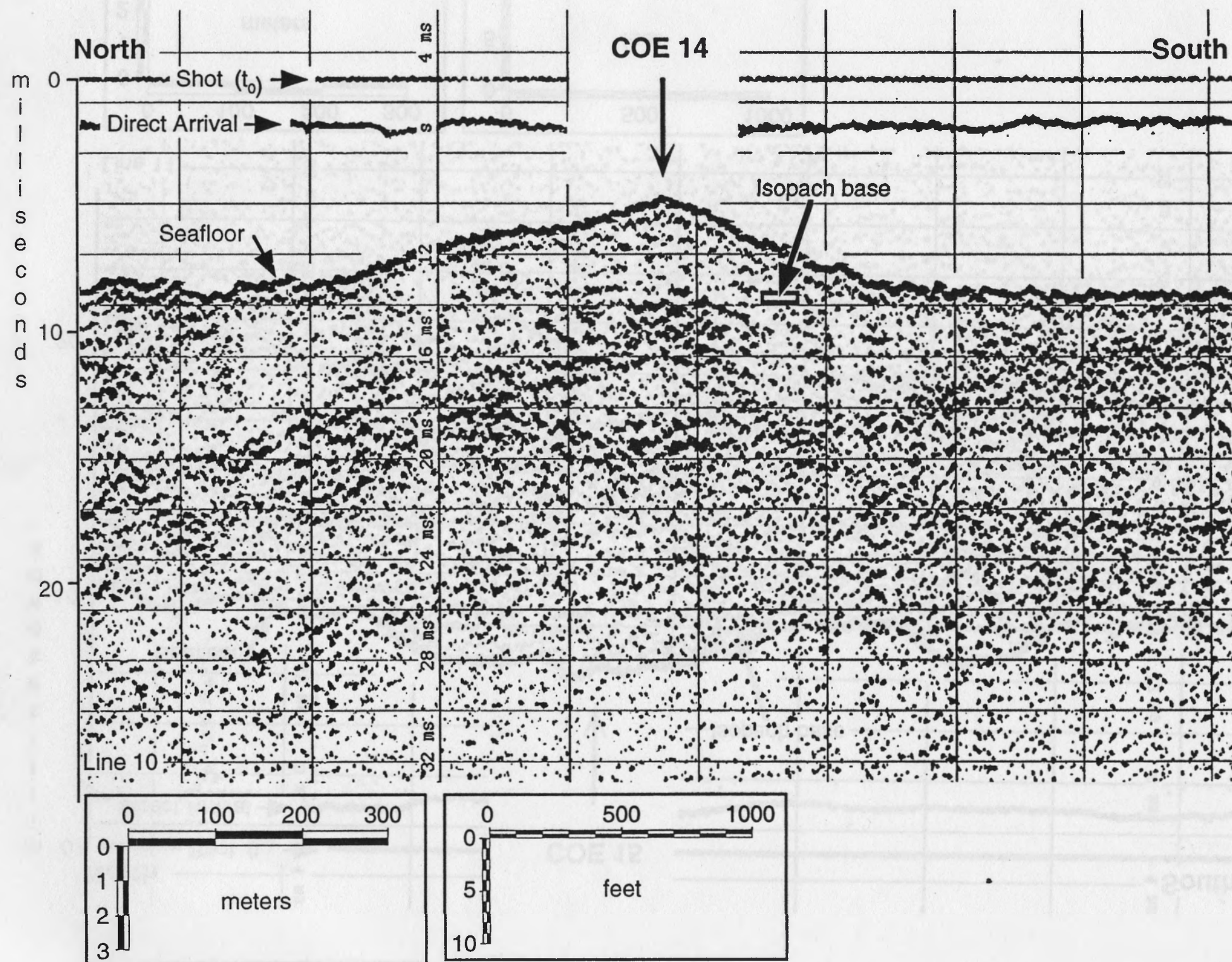




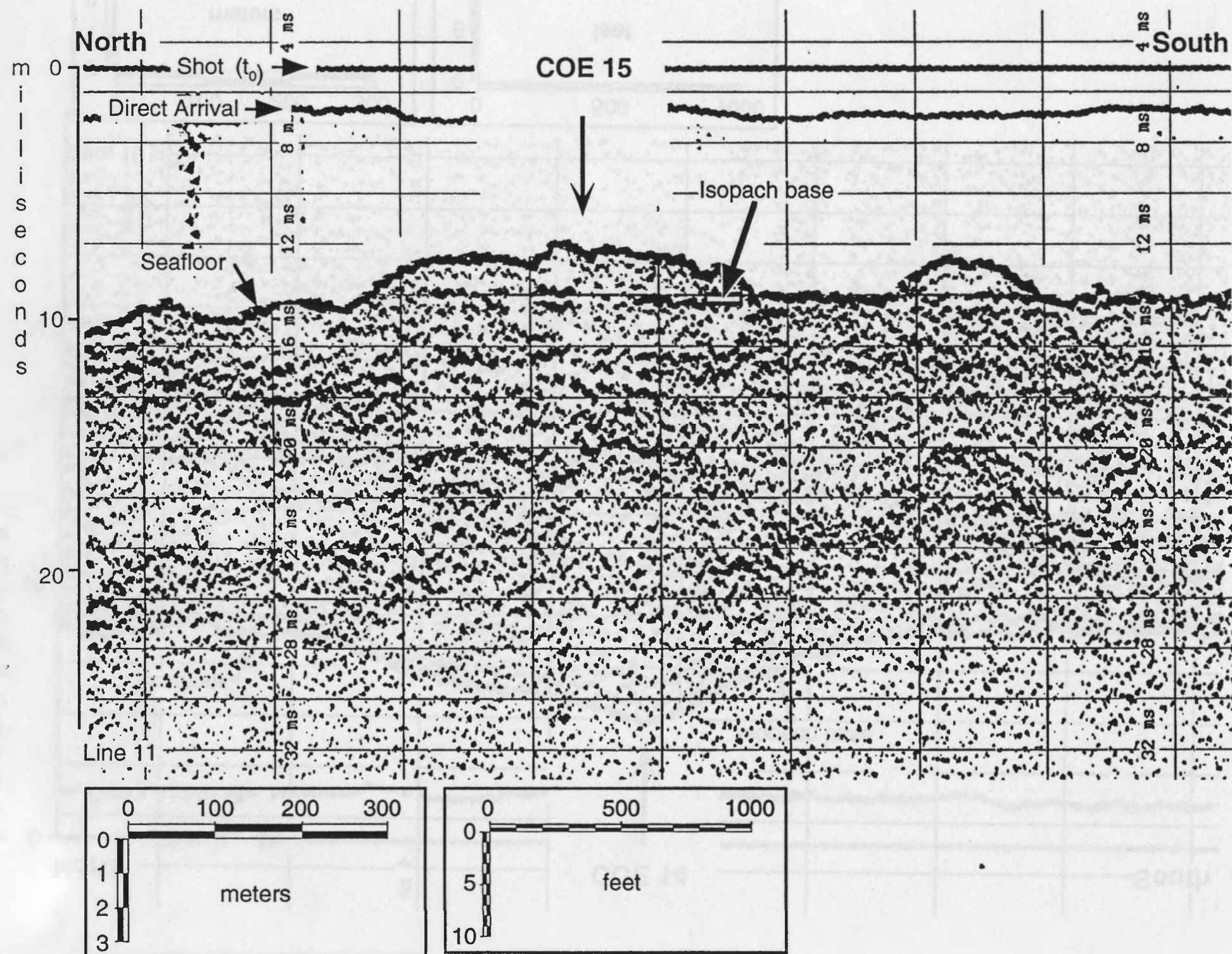




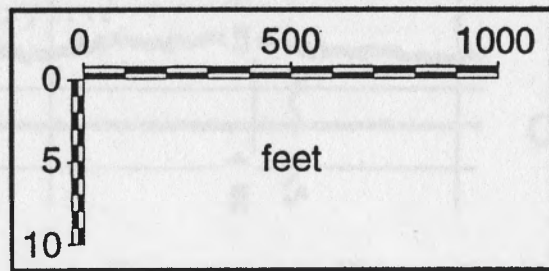
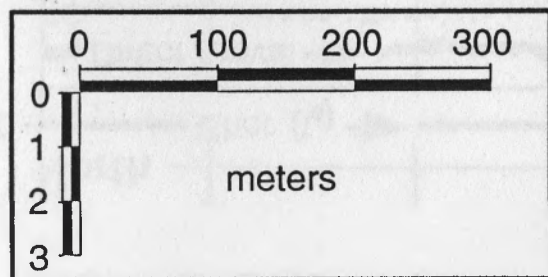
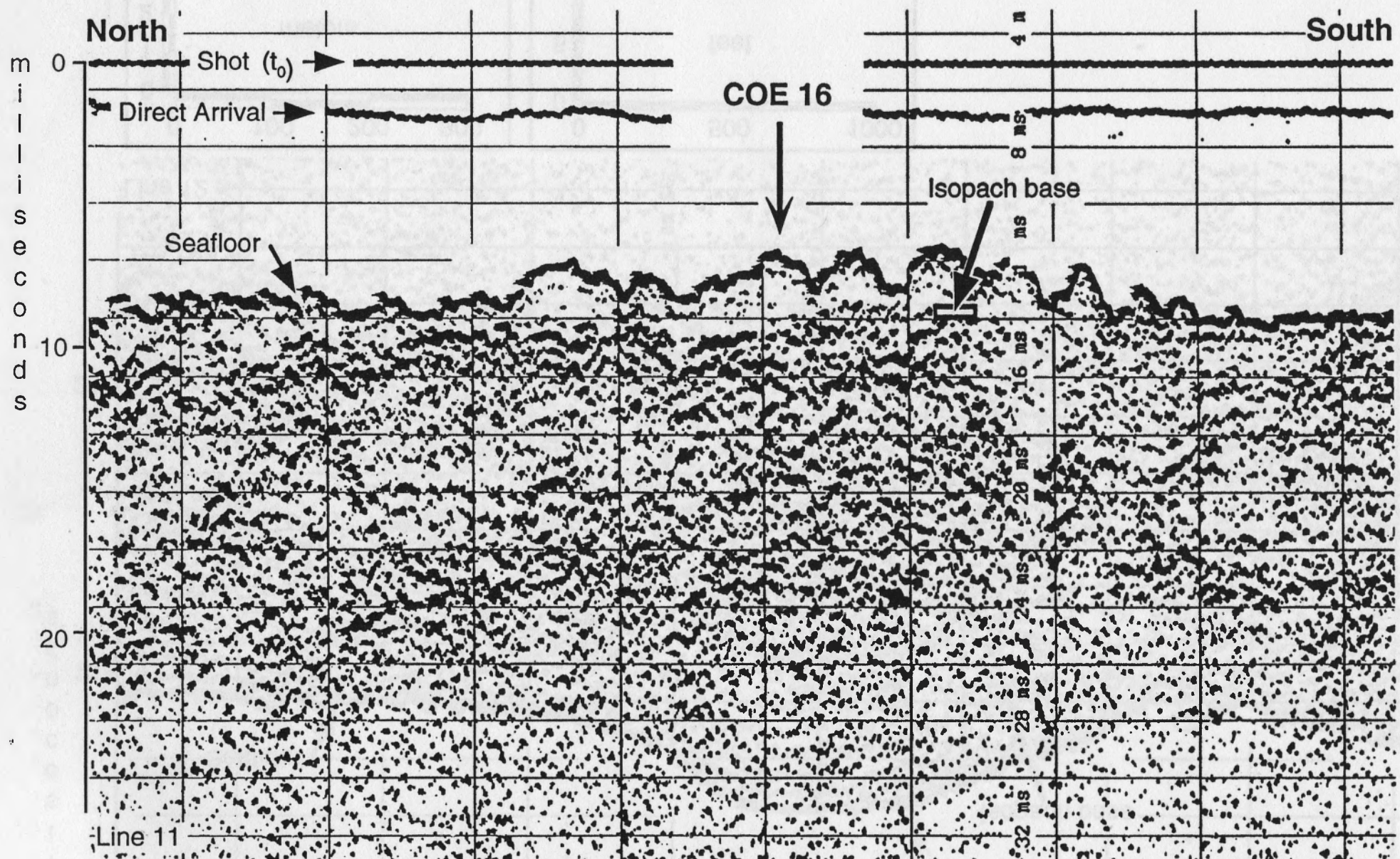




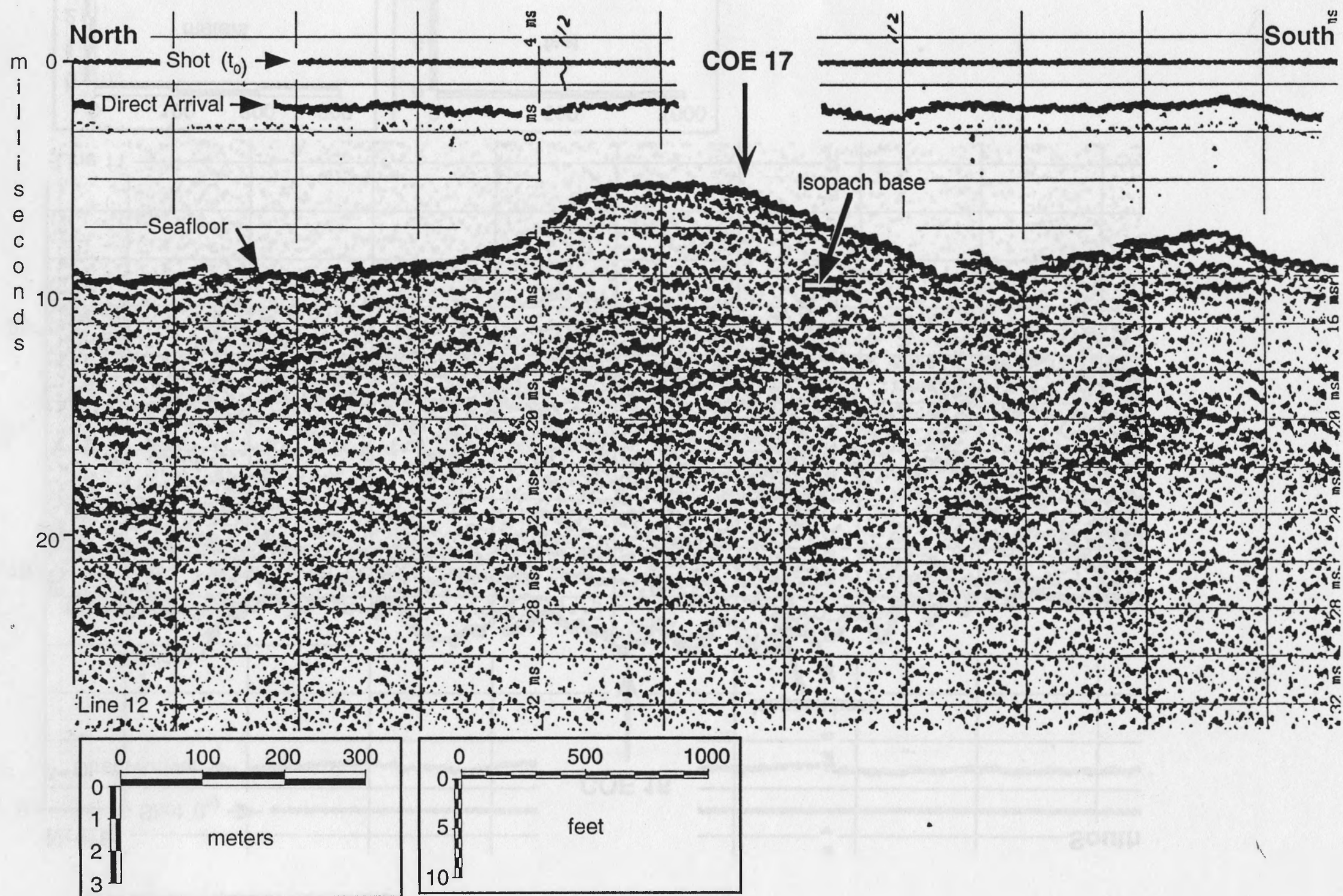




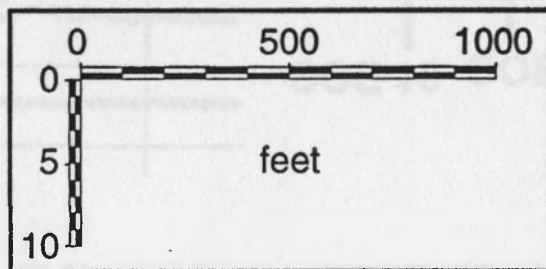
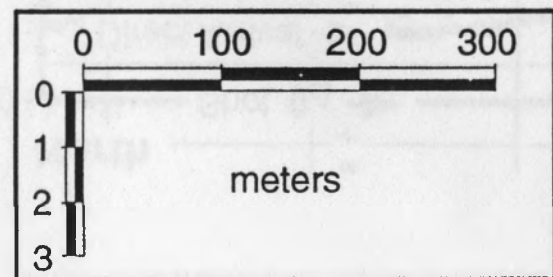
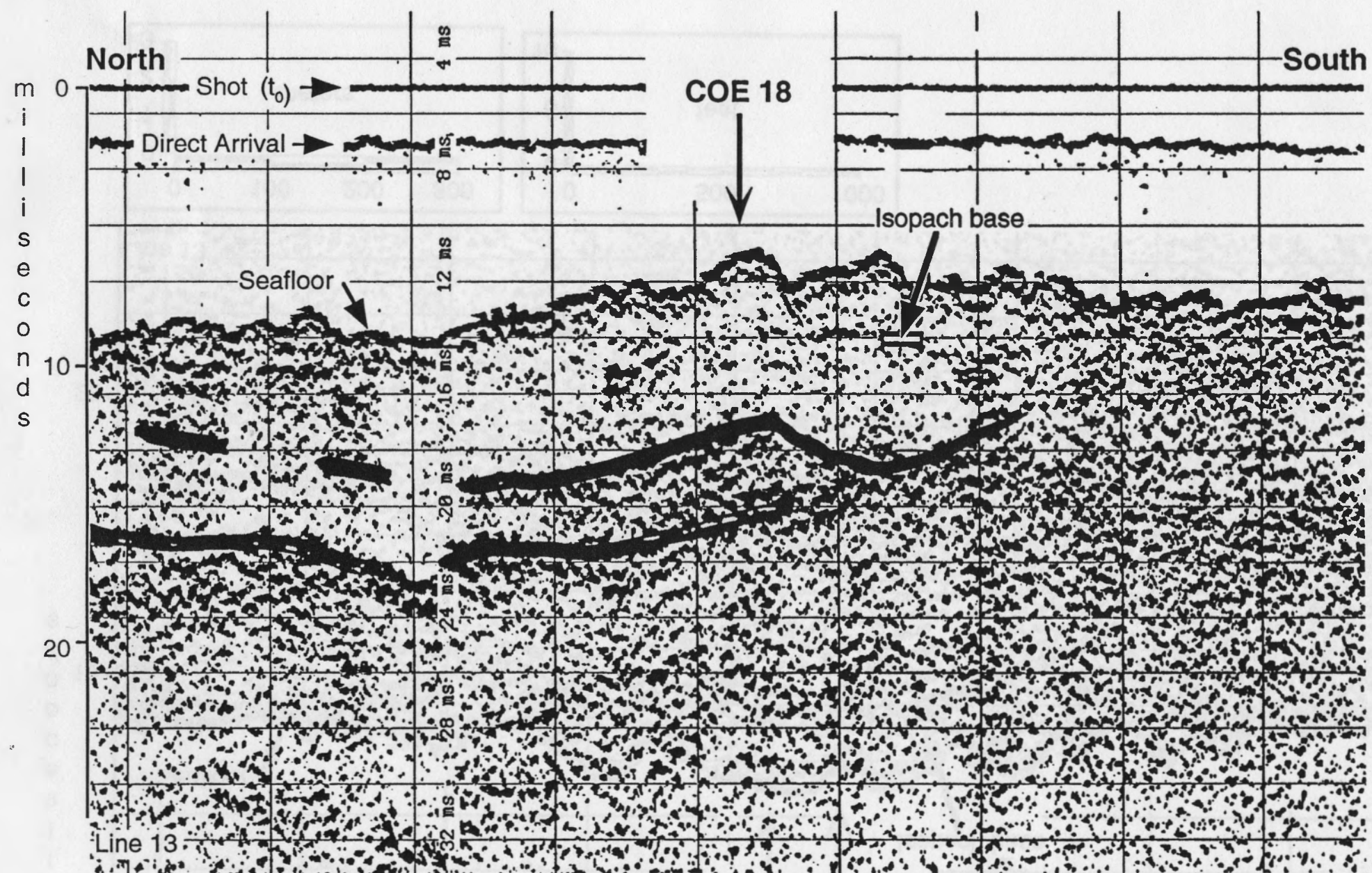




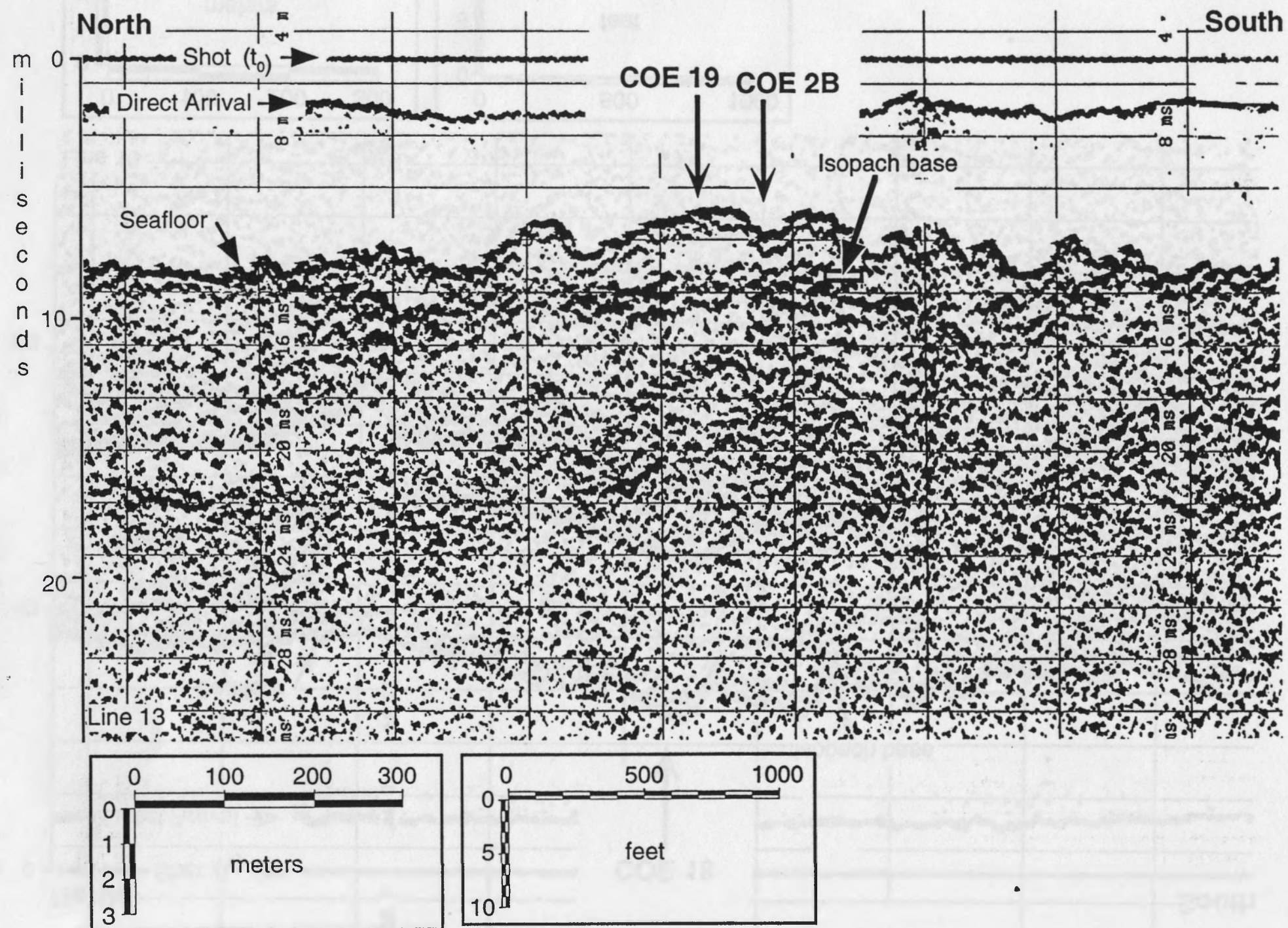




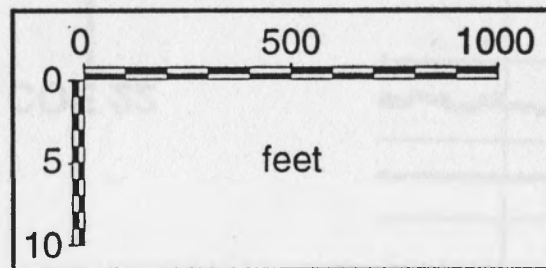
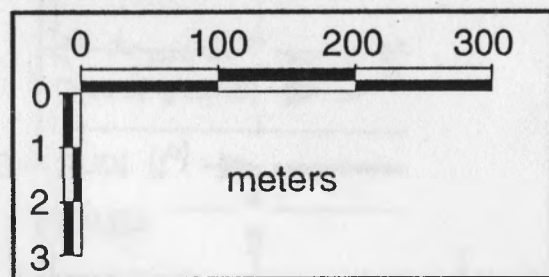
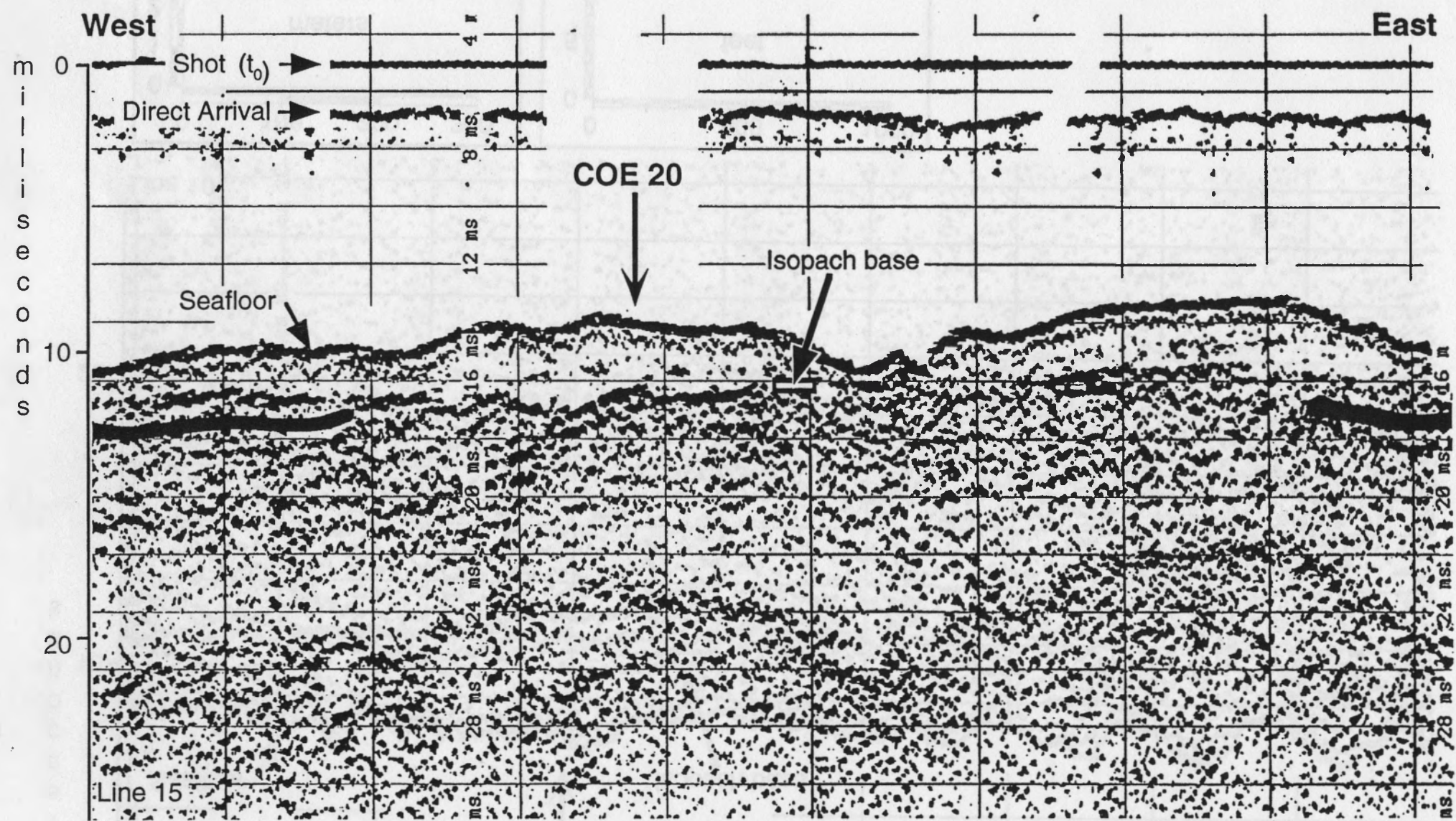




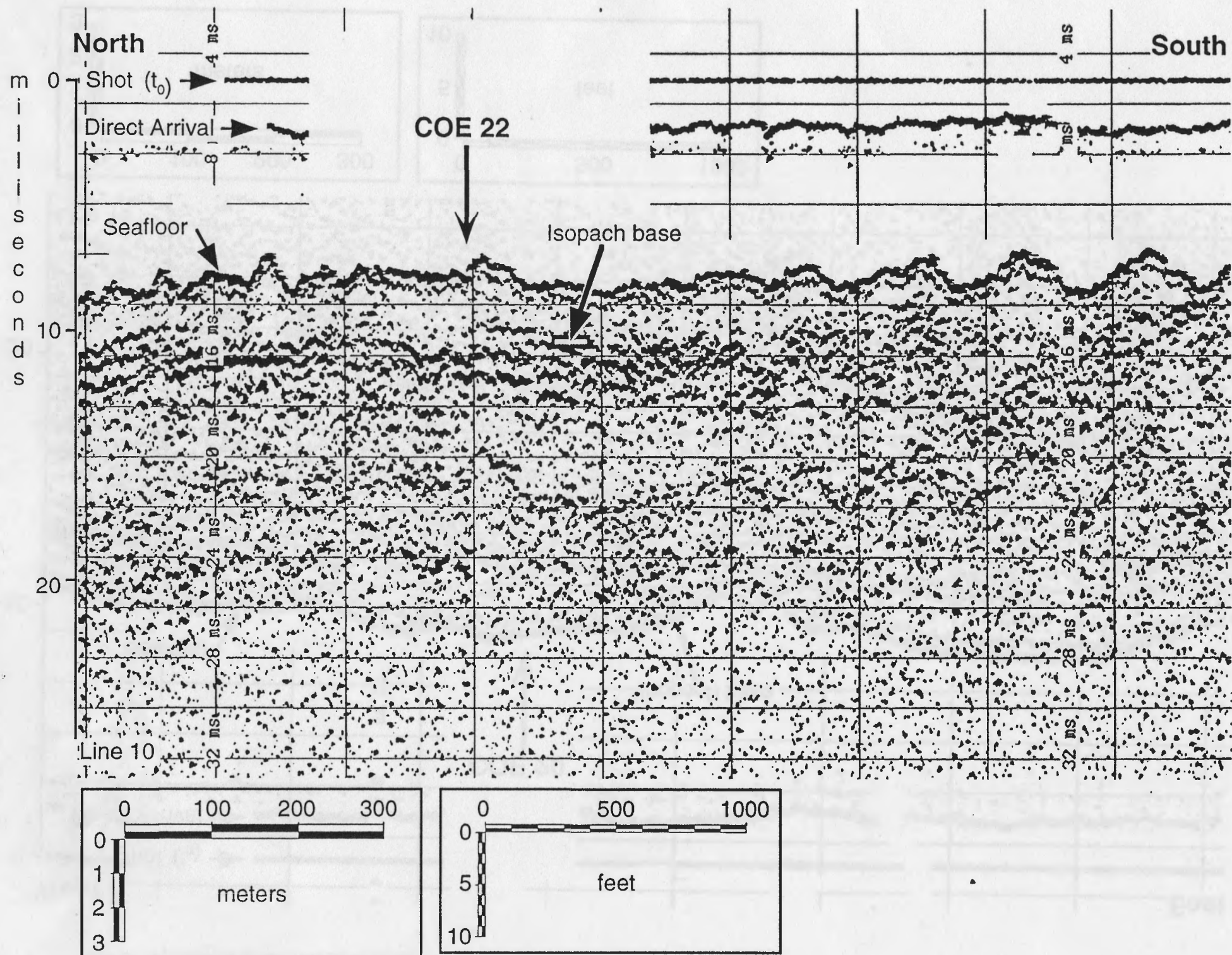












## **APPENDIX A2**

### **Core Logs**

<b>DRILLING LOG</b>		DIVISION South Atlantic	INSTALLATION Jacksonville	SHEET 1 OF 1
1. PROJECT Sand Resource Survey off Sand Key		10. SIZE AND TYPE OF BIT 3" light vibracore		
2. LOCATION (Coordinates or Station) X=193,223 Y=1,310,701		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MLLW (FEET)		
3. DRILLING AGENCY U.S. Geological Survey		12. MANUFACTURER'S DESIGNATION OF DRILL United States Geological Survey		
4. HOLE NO. (As shown on drawing title and file number) COE-94-1 (2)		13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN disturbed: 0 undisturbed: 0		
5. NAME OF DRILLER Guy Gelfenbaum/Richard W. Young		14. TOTAL NUMBER OF CORE BOXES 1		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED		15. ELEVATION GROUND WATER +1.61		
7. THICKNESS OF BURDEN 0 Ft.		16. DATE HOLE STARTED COMPLETED 12/28/94 12/28/94		
8. DEPTH DRILLED INTO ROCK 0 Ft.		17. ELEVATION TOP OF HOLE -26.59 Ft.		
9. TOTAL DEPTH OF HOLE 10.5 Ft.		18. TOTAL CORE RECOVERY FOR BORING NA %		
		19. SIGNATURE OF GEOLOGIST <i>Guy Gelfenbaum</i>		

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel
-26.6	.0					-26.6
			SAND, fine grained quartz, tan, (SP)			
			Gradual transition into medium to coarse quartz, clean, trace shell content, (SP).			
-34.7	8.1					
-36.1	9.5		SAND, gravelly, mostly angular shell fragments, small amount of black sands (phosphates?), (SW).			
-37.1	10.5		GRAVEL, fine to coarse gravel size limestone fragments, small amount of sand, (GW).			
			Cobble size limestone at base.			
NOTE: The lines in the SAMPLE NUMBER column indicate the intervals at which samples were taken for laboratory grain size analysis.						
NOTE: LABORATORY CLASSIFICATION Sample Depth / Classification						
2.0-2.1 SP 7.3-7.4 SP 8.7-8.8 SW						
Classification is based upon a gradation curve.						



## Hole No.COE-94-2 (2)

DRILLING LOG		DIVISION South Atlantic		INSTALLATION Jacksonville		SHEET 1 OF 1	
1. PROJECT Sand Resource Survey off Sand Key				10. SIZE AND TYPE OF BIT 3" light vibracore			
2. LOCATION (Coordinates or Station) X=195,640 Y=1,312,888				11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MLLW (FEET)			
3. DRILLING AGENCY U.S. Geological Survey				12. MANUFACTURER'S DESIGNATION OF DRILL United States Geological Survey			
4. HOLE NO. (As shown on drawing title and file number) COE-94-2 (2)				13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN disturbed: 0 undisturbed: 0			
5. NAME OF DRILLER Guy Gelfenbaum/Richard W. Young				14. TOTAL NUMBER OF CORE BOXES 1			
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED				15. ELEVATION GROUND WATER +1.03			
7. THICKNESS OF BURDEN 0 Ft.				16. DATE HOLE STARTED COMPLETED 12/28/94 12/28/94			
8. DEPTH DRILLED INTO ROCK 0 Ft.				17. ELEVATION TOP OF HOLE -22.47 Ft.			
9. TOTAL DEPTH OF HOLE 6.2 Ft.				18. TOTAL CORE RECOVERY FOR BORING NA %			
				19. SIGNATURE OF GEOLOGIST <i>Guy Gelfenbaum</i>			
ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	
-22.5	.0					-22.5	0
			SAND, clean, fine to medium quartz, gray color, trace shell fragments, (SP)				
-25.4	2.9						2.5
-25.7	3.2		SAND, some angular shell fragments, small amount black sands (phosphates?), (SW)				
			SAND, quartz, clean, fine to medium, gray color, trace shell content, (SP)				5
-28.7	6.2						
						NOTE: The lines in the SAMPLE NUMBER column indicate the intervals at which samples were taken for laboratory grain size analysis.	7.5
						NOTE: LABORATORY CLASSIFICATION Sample Depth / Classification 1.0-1.1 SP 3.0-3.1 SP 5.0-5.1 SP	10
						Classification is based upon a gradation curve.	12.5
							15
							17.5
							20
							22.5

DRILLING LOG		DIVISION South Atlantic		INSTALLATION Jacksonville		SHEET 1 OF 1	
1. PROJECT Sand Resource Survey Off Sand Key				10. SIZE AND TYPE OF BIT 3" light vibracore			
2. LOCATION (Coordinates or Station) X=199,634 Y=1,314,366				11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MLLW (FEET)			
3. DRILLING AGENCY U.S. Geological Survey				12. MANUFACTURER'S DESIGNATION OF DRILL United States Geological Survey			
4. HOLE NO. (As shown on drawing title and file number) COE-94-3 (2)				13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN disturbed: 0      undisturbed: 0			
5. NAME OF DRILLER Guy Gelfenbaum/Richard W. Young				14. TOTAL NUMBER OF CORE BOXES 1			
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED				15. ELEVATION GROUND WATER +0.84			
7. THICKNESS OF BURDEN 0 Ft.				16. DATE HOLE STARTED COMPLETED 12/28/94 12/28/94			
8. DEPTH DRILLED INTO ROCK 0 Ft.				17. ELEVATION TOP OF HOLE -22.56 Ft.			
9. TOTAL DEPTH OF HOLE 5.4 Ft.				18. TOTAL CORE RECOVERY FOR BORING NA %			
				19. SIGNATURE OF GEOLOGIST <i>Guy Gelfenbaum</i>			
ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	
-22.6	.0					-22.6	0
			SAND, fine to medium quartz, gray color, trace black sands (phosphates?), trace fine shell fragments, (SP)				
			Thin lens of black sands (phosphates?), 0.1' thick.				2.5
-25.9	3.3		SILTY SAND, dark gray, (SM)				
-27.2	4.6						
-28.0	5.4		GRAVEL, limestone fragments, small amount of silty sand. Cobble size limestone at base. (GP)				5
							7.5
							10
							12.5
							15
							17.5
							20
							22.5

NOTE:  
The lines in the SAMPLE NUMBER column indicate the intervals at which samples were taken for laboratory grain size analysis.

NOTE:  
LABORATORY CLASSIFICATION  
Sample Depth / Classification

1.0-1.1	SP
3.5-3.6	SP
4.8-4.9	SW

Classification is based upon a gradation curve.



<b>DRILLING LOG</b>		<b>DIVISION</b> South Atlantic	<b>INSTALLATION</b> Jacksonville	<b>SHEET 1</b> OF 1
<b>1. PROJECT</b> Sand Resource Survey Off Sand Key		<b>10. SIZE AND TYPE OF BIT</b> 3" light vibracore		
<b>2. LOCATION (Coordinates or Station)</b> X=190,929 Y=1,296,199		<b>11. DATUM FOR ELEVATION SHOWN (TBM or MSL)</b> MLLW (FEET)		
<b>3. DRILLING AGENCY</b> U.S. Geological Survey		<b>12. MANUFACTURER'S DESIGNATION OF DRILL</b> United States Geological Survey		
<b>4. HOLE NO. (As shown on drawing title and file number)</b> COE-94-4 (2)		<b>13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN</b> disturbed: 0      undisturbed: 0		
<b>5. NAME OF DRILLER</b> Nancy T. DeWitt/Richard W. Young		<b>14. TOTAL NUMBER OF CORE BOXES</b> 1		
<b>6. DIRECTION OF HOLE</b> <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED		<b>15. ELEVATION GROUND WATER</b> +1.68		
<b>7. THICKNESS OF BURDEN</b> 0 Ft.		<b>16. DATE HOLE STARTED COMPLETED</b> 12/20/94    12/20/94		
<b>8. DEPTH DRILLED INTO ROCK</b> 0 Ft.		<b>17. ELEVATION TOP OF HOLE</b> -22.32 Ft.		
<b>9. TOTAL DEPTH OF HOLE</b> 5.9 Ft.		<b>18. TOTAL CORE RECOVERY FOR BORING</b> See Note %		
		<b>19. SIGNATURE OF GEOLOGIST</b> <i>Nancy T. DeWitt</i>		

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel
-22.3	.0					-22.3
			SAND, quartz, fine to medium, gray color, trace black sands (phosphates?), (SP)			
			Thin lens with some black sands (phosphates?), 0.2' thick.			
-27.8	5.5					
-28.2	5.9		SAND, with some coarse, gravel size, angular shell fragments, small amount black sands (phosphates?), (SW)			
						NOTE: The lines in the SAMPLE NUMBER column indicate the intervals at which samples were taken for laboratory grain size analysis.
						NOTE: Penetration    6.4' 92% Recovery due to compaction
						NOTE: LABORATORY CLASSIFICATION Sample Depth / Classification
						1.0-1.1      SP
						3.9-4.0      SP
						5.7-5.8      SW/SM
						Classification is based upon a gradation curve.



## Hole No.COE-94-6 (2)

DRILLING LOG		DIVISION South Atlantic	INSTALLATION Jacksonville	SHEET 1 OF 1
1. PROJECT Sand Resource Survey Off Sand Key		10. SIZE AND TYPE OF BIT 3" light vibracore		
2. LOCATION (Coordinates or Station) X=209,354 Y=1,312,403		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MLLW (FEET)		
3. DRILLING AGENCY U.S. Geological Survey		12. MANUFACTURER'S DESIGNATION OF DRILL United States Geological Survey		
4. HOLE NO. (As shown on drawing title and file number) COE-94-6 (2)		13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN disturbed: 0 undisturbed: 0		
5. NAME OF DRILLER Nancy T. DeWitt/Richard W. Young		14. TOTAL NUMBER OF CORE BOXES 1		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED		15. ELEVATION GROUND WATER +0.60		
7. THICKNESS OF BURDEN 0 Ft.		16. DATE HOLE STARTED COMPLETED 12/08/94 12/08/94		
8. DEPTH DRILLED INTO ROCK 0 Ft.		17. ELEVATION TOP OF HOLE -21.40 Ft.		
9. TOTAL DEPTH OF HOLE 12.5 Ft.		18. TOTAL CORE RECOVERY FOR BORING See Note %		
		19. SIGNATURE OF GEOLOGIST <i>Nancy T. DeWitt</i>		

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel
-21.4	.0					-21.4
-23.7	2.3		SAND, clean fine to medium quartz, (SP)			
-23.9	2.5		Thin layer with small amount black sands (phosphates?), and fine gravel size shells (whole and fragments), 0.2' thick, (SW)			NOTE: clean, fine to medium quartz sand down to 7.1 feet with the exception of the layers listed.
-25.2	3.8					
-25.6	4.2		SANDS fine to medium with some coarse gravel size shells (whole and fragments), (SW)			
			SAND, clean fine to medium quartz, (SP)			
-28.3	6.9					
-28.5	7.1		Thin layer with mostly black sands (phosphates?) and gravel size limestone fragments, 0.2' thick, (SW)			Transitional zone from sands to sandy silts
-29.4	8.0		SAND, quartz, trace of fine gravel size shell fragments, (SP)			
			SILTY SAND, small amount of gravel size shell fragments, (SM)			
-31.5	10.1					
			ORGANIC SILT, dark brown and black, trace of fine gravel size shells, (whole and fragments), wet, low to medium plasticity, (OL)			
-33.4	12.0					
-33.9	12.5		ORGANIC SILT, trace clays, homogenous, black color, medium plasticity, wet, organic odor, (OL)			NOTE: The lines in the SAMPLE NUMBER column indicate the intervals at which samples were taken for laboratory grain size analysis.
						NOTE: Penetration 14' 89% Recovery due to compaction.
						NOTE: LABORATORY CLASSIFICATION Sample Depth / Classification
						1.0-1.1 SP/SC
						2.4-2.5 SW
						7.5-7.6 SP/SM
						8.7-8.8 SM
						10.7-10.8 ML
						12.2-12.3 ML
						Classification is based upon a gradation curve.

# Hole No.COE-94-8 (2)

DRILLING LOG		DIVISION South Atlantic		INSTALLATION Jacksonville		SHEET 1 OF 1	
1. PROJECT Sand Resource Survey Off Sand Key				10. SIZE AND TYPE OF BIT 3" light vibracore			
2. LOCATION (Coordinates or Station) X=210,621 Y=1,310,539				11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MLLW (FEET)			
3. DRILLING AGENCY U.S. Geological Survey				12. MANUFACTURER'S DESIGNATION OF DRILL United States Geological Survey			
4. HOLE NO. (As shown on drawing title and file number) COE-94-8 (2)				13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN disturbed: 0 undisturbed: 0			
5. NAME OF DRILLER Nancy T. DeWitt/Richard W. Young				14. TOTAL NUMBER OF CORE BOXES 1			
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED				15. ELEVATION GROUND WATER +1.13			
7. THICKNESS OF BURDEN 0 Ft.				16. DATE HOLE STARTED COMPLETED 12/08/94 12/08/94			
8. DEPTH DRILLED INTO ROCK 0 Ft.				17. ELEVATION TOP OF HOLE -16.87 Ft.			
9. TOTAL DEPTH OF HOLE 9.6 Ft.				18. TOTAL CORE RECOVERY FOR BORING NA %			
				19. SIGNATURE OF GEOLOGIST <i>Nancy T. DeWitt</i>			

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel
-16.9	.0					-16.9
-19.5	2.6		SAND, quartz, fine to medium grained, (SP)			NOTE: The (SW) layers from depth 0.0' - 7.0' all have the same description as the first (SW) layer described.
-21.0	4.1		SAND, fine to medium quartz mixed with fine, gravel size whole shells, (SW)			
-21.5	4.6					
-21.9	5.0					
-22.2	5.3					
-22.4	5.5					NOTE: The (SP) layer from depth 0.0' - 7.0' all have the same description as the first (SP) layer described.
-22.8	5.9					
-23.0	6.1					
-23.9	7.0					
-24.9	8.0		Carbonate silt, light tan color, (CL)			
-26.5	9.6		CLAY, blueish green-gray color, wet, (CH)			

0  
2.5  
5  
7.5  
10  
12.5  
15  
17.5  
20  
22.5

NOTE:  
The lines in the SAMPLE NUMBER column indicate the intervals at which samples were taken for laboratory grain size analysis.




NOTE:  
LABORATORY CLASSIFICATION  
Sample Depth / Classification

1.5-1.6	SP
3.6-3.7	SP/SC
7.6-7.7	SM
8.7-8.8	CL

Classification is based upon a gradation curve.



<b>DRILLING LOG</b>		<b>DIVISION</b> South Atlantic	<b>INSTALLATION</b> Jacksonville	<b>SHEET 1</b> OF 1
1. PROJECT Sand Resource Survey Off Sand Key		10. SIZE AND TYPE OF BIT 3" light vibracore		
2. LOCATION (Coordinates or Station) X=208,502 Y=1,294,641		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MLLW (FEET)		
3. DRILLING AGENCY U.S. Geological Survey		12. MANUFACTURER'S DESIGNATION OF DRILL United States Geological Survey		
4. HOLE NO. (As shown on drawing title and file number) COE-94-9 (2)		13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN disturbed: 0      undisturbed: 0		
5. NAME OF DRILLER Gregg Brooks/Richard W. Young		14. TOTAL NUMBER OF CORE BOXES 1		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED		15. ELEVATION GROUND WATER +0.73		
7. THICKNESS OF BURDEN 0 Ft.		16. DATE HOLE STARTED COMPLETED 11/10/94    11/10/94		
8. DEPTH DRILLED INTO ROCK 0 Ft.		17. ELEVATION TOP OF HOLE -18.27 Ft.		
9. TOTAL DEPTH OF HOLE 8.1 Ft.		18. TOTAL CORE RECOVERY FOR BORING See Note %		
		19. SIGNATURE OF GEOLOGIST <i>Gregg R. Brooks</i>		

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel	
-18.3	.0					-18.3	0
			SAND, fine to medium quartz, light tan color, (SP)				2.5
			Slight increase in sand grain size.				5
-23.7	5.4		GRAVEL, fine to coarse angular shell fragments, some sand, (GP)				7.5
-26.4	8.1		GRAVEL, coarse size shells (whole and fragments), and limestone fragments, some sand, (GP)				10
						NOTE: The lines in the Sample Number column indicate the intervals at which samples were taken for laboratory grain size analysis.	12.5
						NOTE: Penetration 10.5' 77% Recovery due to compaction.	15
						NOTE: LABORATORY CLASSIFICATION Sample Depth / Classification	
						1.1-1.2 SP	
						3.8-3.9 SP	
						4.9-5.0 SP	
						5.8-5.9 SW	
						7.5-7.6 SW	
						Classification is based upon a gradation curve.	17.5
							20
							22.5



## Hole No. COE-94-10 (2)

DRILLING LOG		DIVISION South Atlantic		INSTALLATION Jacksonville		SHEET 1 OF 1	
1. PROJECT Sand Resource Survey Off Sand Key				10. SIZE AND TYPE OF BIT 3" light vibracore			
2. LOCATION (Coordinates or Station) X=209,027 Y=1,291,347				11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MLLW (FEET)			
3. DRILLING AGENCY U.S. Geological Survey				12. MANUFACTURER'S DESIGNATION OF DRILL United States Geological Survey			
4. HOLE NO. (As shown on drawing title and file number) COE-94-10 (2)				13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN disturbed: 0      undisturbed: 0			
5. NAME OF DRILLER Nancy T. DeWitt/Richard W. Young				14. TOTAL NUMBER OF CORE BOXES 1			
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED				15. ELEVATION GROUND WATER +0.95			
7. THICKNESS OF BURDEN 0 Ft.				16. DATE HOLE STARTED COMPLETED 12/13/94    12/13/94			
8. DEPTH DRILLED INTO ROCK 0 Ft.				17. ELEVATION TOP OF HOLE -21.05 Ft.			
9. TOTAL DEPTH OF HOLE 2.8 Ft.				18. TOTAL CORE RECOVERY FOR BORING See Note %			
				19. SIGNATURE OF GEOLOGIST <i>Nancy T. DeWitt</i>			

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel
-21.0	.0					-21.0
-22.0	.9		SAND, fine to medium quartz, dark gray, trace shell fragments, trace black sands (phosphates?), (SP)			
-22.5	1.4					
-23.0	1.9		SAND, with mostly fine grained angular shell fragments, trace black sands (phosphates?), (SW)			
-23.9	2.8		Cobble size, limestone (GP)			
			CLAY, blue/green to gray color, with distinct white, coarse, gravel size limestone fragments, (CH)			

NOTE:  
The lines in the SAMPLE NUMBER column indicate the interval at which samples were taken for laboratory grain size analysis.

NOTE:  
Penetraton 3'  
93% Recovery due to compaction.

NOTE:  
LABORATORY CLASSIFICATION  
Sample Depth / Classification

0.4-0.5	SP
1.1-1.2	SP
2.2-2.3	ML

Classification is based upon a gradation curve.



<b>DRILLING LOG</b>		DIVISION South Atlantic	INSTALLATION Jacksonville	SHEET 1 OF 1
1. PROJECT Sand Resource Survey Off Sand Key		10. SIZE AND TYPE OF BIT 3" light vibracore		
2. LOCATION (Coordinates or Station) X=218,222 Y=1,263,823		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MLLW (FEET)		
3. DRILLING AGENCY U.S. Geological Survey		12. MANUFACTURER'S DESIGNATION OF DRILL United States Geological Survey		
4. HOLE NO. (As shown on drawing title and file number) COE-94-11 (2)		13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN disturbed: 0      undisturbed: 0		
5. NAME OF DRILLER Nancy T. DeWitt/Richard W. Young		14. TOTAL NUMBER OF CORE BOXES 1		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED		15. ELEVATION GROUND WATER +1.10		
7. THICKNESS OF BURDEN 0 Ft.		16. DATE HOLE STARTED COMPLETED 12/13/94   12/13/94		
8. DEPTH DRILLED INTO ROCK 0 Ft.		17. ELEVATION TOP OF HOLE -12.90 Ft.		
9. TOTAL DEPTH OF HOLE 2.9 Ft.		18. TOTAL CORE RECOVERY FOR BORING See Note %		
		19. SIGNATURE OF GEOLOGIST <i>Nancy T. DeWitt</i>		

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel
-12.9	.0					-12.9
-14.4	1.5		SAND, medium grained quartz, dark gray, small amount black sands (phosphates?), trace angular shell fragments, (SP)			
-14.7	1.8		SAND, some medium to coarse sand size, angular shell fragments (SW)			
-15.8	2.9		Some medium to coarse size, angular shell fragments at base.			
NOTES: The lines in the SAMPLE NUMBERS column indicate the intervals at which samples were taken for grain size analysis.  NOTE: Penetration 4' 73% Recovery due to compaction.  NOTE: LABORATORY CLASSIFICATION Sample Depth / Classification  0.5-0.6      SP/SC 1.6-1.7      SW/SC 2.7-2.8      SW/SC  Classification is based upon a gradation curve.						



<b>DRILLING LOG</b>		DIVISION South Atlantic	INSTALLATION Jacksonville	SHEET 1 OF 1
1. PROJECT Sand Resource Survey Off Sand Key		10. SIZE AND TYPE OF BIT 3" light vibracore		
2. LOCATION (Coordinates or Station) X=221,870 Y=1,258,525		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MLLW (FEET)		
3. DRILLING AGENCY U.S. Geological Survey		12. MANUFACTURER'S DESIGNATION OF DRILL United States Geological Survey		
4. HOLE NO. (As shown on drawing title and file number) COE-94-12		13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN disturbed: 0      undisturbed: 0		
5. NAME OF DRILLER Nancy T. DeWitt/Richard W. Young		14. TOTAL NUMBER OF CORE BOXES 1		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED		15. ELEVATION GROUND WATER +0.90		
7. THICKNESS OF BURDEN 0 Ft.		16. DATE HOLE STARTED COMPLETED 11/18/94    11/18/94		
8. DEPTH DRILLED INTO ROCK 0 Ft.		17. ELEVATION TOP OF HOLE -13.90 Ft.		
9. TOTAL DEPTH OF HOLE 6.2 Ft.		18. TOTAL CORE RECOVERY FOR BORING See Note %		
		19. SIGNATURE OF GEOLOGIST <i>Nancy T. DeWitt</i>		

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel
-13.9	.0					-13.9
			SAND, quartz, fine to medium, tan color, some sand size shell fragments (SP)			
-15.9	2.0		SAND with mostly coarse angular shell fragments, 0.2' thick, (SW)			
-17.5	3.6		SAND with mostly coarse, angular shell fragments, 0.1' thick, (SW)			
-18.4	4.5		SAND with mostly coarse shell fragments, 0.1' thick, (SW)			
-19.0	5.1					
-19.4	5.5		GRAVEL, with cobble size limestone, some sand, (GP)			
-20.1	6.2		Same sand as in (SP) above.			
			NOTE: There are black sands (phosphates?) throughout the entire core.			
						NOTE: The lines in the SAMPLE NUMBER column indicate the intervals at which samples were taken for laboratory grain size analysis.
						NOTE: Penetration 8' 78% Recovery due to compaction.
						NOTE: LABORATORY CLASSIFICATION Sample Depth / Classification
						0.7-0.8      SP
						3.2-3.3      SP
						5.3-5.4      SW
						Classification is based upon a gradation curve.



<b>DRILLING LOG</b>		<b>DIVISION</b> South Atlantic	<b>INSTALLATION</b> Jacksonville	<b>SHEET 1</b> OF 1
1. PROJECT Sand Resource Survey Off Sand Key		10. SIZE AND TYPE OF BIT 3" light vibracore		
2. LOCATION (Coordinates or Station) X=213,024 Y=1,310,073		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MLLW (FEET)		
3. DRILLING AGENCY U.S. Geological Survey		12. MANUFACTURER'S DESIGNATION OF DRILL United States Geological Survey		
4. HOLE NO. (As shown on drawing title and file number) COE-94-13 (2)		13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN disturbed: 0 undisturbed: 0		
5. NAME OF DRILLER Nancy T. DeWitt/Richard W. Young		14. TOTAL NUMBER OF CORE BOXES 1		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED		15. ELEVATION GROUND WATER +1.80		
7. THICKNESS OF BURDEN 0 Ft.		16. DATE HOLE STARTED COMPLETED 12/08/94 12/08/94		
8. DEPTH DRILLED INTO ROCK 0 Ft.		17. ELEVATION TOP OF HOLE -17.20 Ft.		
9. TOTAL DEPTH OF HOLE 9.5 Ft.		18. TOTAL CORE RECOVERY FOR BORING NA %		
		19. SIGNATURE OF GEOLOGIST <i>Nancy T. DeWitt</i>		

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel									
-17.2	.0					-17.2	0								
			SAND, fine to medium quartz, tan color, homogenous, (SP)				2.5								
-23.3	6.1						5								
-24.4	7.3		SAND, fine to medium quartz, some coarse gravel size shell fragments, (SP)				7.5								
-25.1	7.9		SILT lense, inorganic, (MH)												
			SAND, coarse grained with black sands (phosphates?), (SP)												
-26.7	9.5		GRAVEL, limestone fragments, and angular shell fragments, (GW)				10								
<p>NOTE: The lines in the SAMPLE NUMBER column indicate the intervals at which samples were taken for laboratory grain size analysis.</p> <p>NOTE: LABORATORY CLASSIFICATION <u>Sample Depth / Classification</u></p> <table><tr><td>1.0-1.1</td><td>SP/SC</td></tr><tr><td>6.5-6.6</td><td>SP</td></tr><tr><td>7.5-7.6</td><td>SW/SC</td></tr><tr><td>8.4-8.5</td><td>SW/SC</td></tr></table> <p>Classification is based upon a gradation curve.</p>							1.0-1.1	SP/SC	6.5-6.6	SP	7.5-7.6	SW/SC	8.4-8.5	SW/SC	12.5
							1.0-1.1	SP/SC							
							6.5-6.6	SP							
							7.5-7.6	SW/SC							
							8.4-8.5	SW/SC							
							15								
							17.5								
							20								
							22.5								



<b>DRILLING LOG</b>		DIVISION South Atlantic	INSTALLATION Jacksonville	SHEET 1 OF 1
1. PROJECT Sand Resource Survey Off Sand Key		10. SIZE AND TYPE OF BIT 3" light vibracore		
2. LOCATION (Coordinates or Station) X=219,815 Y=1,262,860		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MLLW (FEET)		
3. DRILLING AGENCY U.S. Geological Survey		12. MANUFACTURER'S DESIGNATION OF DRILL United States Geological Survey		
4. HOLE NO. (As shown on drawing title and file number) COE-94-14		13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN disturbed: 0 undisturbed: 0		
5. NAME OF DRILLER Nancy T. DeWitt/Richard W. Young		14. TOTAL NUMBER OF CORE BOXES 1		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED		15. ELEVATION GROUND WATER -0.35		
7. THICKNESS OF BURDEN 0 Ft.		16. DATE HOLE STARTED COMPLETED 12/05/94 12/05/94		
8. DEPTH DRILLED INTO ROCK 0 Ft.		17. ELEVATION TOP OF HOLE -12.15 Ft.		
9. TOTAL DEPTH OF HOLE 2.6 Ft.		18. TOTAL CORE RECOVERY FOR BORING See Note %		
		19. SIGNATURE OF GEOLOGIST <i>Nancy T. DeWitt</i>		

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel							
-12.1	.0					-12.1	0						
			SAND, quartz, fine to coarse, dark gray color, some black sands (phosphates?), and mostly angular shell fragments throughout (SW)										
-14.7	2.6						2.5						
						<p>NOTE: The lines in the SAMPLE NUMBER column indicate the intervals at which samples were taken for laboratory grain size analysis.</p> <p>NOTE: Penetration 4' 65% Recovery due to compaction.</p> <p>NOTE: LABORATORY CLASSIFICATION <u>Sample Depth / Classification</u></p> <table><tr><td>0.4-0.5</td><td>SP</td></tr><tr><td>1.3-1.4</td><td>SP</td></tr><tr><td>2.4-2.5</td><td>SP/SC</td></tr></table> <p>Classification is based upon a gradation curve.</p>	0.4-0.5	SP	1.3-1.4	SP	2.4-2.5	SP/SC	7.5
0.4-0.5	SP												
1.3-1.4	SP												
2.4-2.5	SP/SC												
							10						
							12.5						
							15						
							17.5						
							20						
							22.5						



<b>DRILLING LOG</b>		DIVISION South Atlantic	INSTALLATION Jacksonville	SHEET 1 OF 1
1. PROJECT Sand Resource Survey Off Sand Key		10. SIZE AND TYPE OF BIT 3" light vibracore		
2. LOCATION (Coordinates or Station) X=214,074 Y=1,308,702		11. DATUM FOR ELEVATION SHOWN (TBN or MSL) MLLW (FEET)		
3. DRILLING AGENCY U.S. Geological Survey		12. MANUFACTURER'S DESIGNATION OF DRILL United States Geological Survey		
4. HOLE NO. (As shown on drawing title and file number) COE-94-16		13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN disturbed: 0      undisturbed: 0		
5. NAME OF DRILLER Nancy T. DeWitt/Richard W. Young		14. TOTAL NUMBER OF CORE BOXES 1		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED		15. ELEVATION GROUND WATER +1.51		
7. THICKNESS OF BURDEN 0 Ft.		16. DATE HOLE STARTED COMPLETED 10/21/94    10/21/94		
8. DEPTH DRILLED INTO ROCK 0 Ft.		17. ELEVATION TOP OF HOLE -14.49 Ft.		
9. TOTAL DEPTH OF HOLE 7.9 Ft.		18. TOTAL CORE RECOVERY FOR BORING See Note %		
		19. SIGNATURE OF GEOLOGIST <i>Nancy T. DeWitt</i>		

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel
-14.5	.0					-14.5
-15.1	.6		SILTY SAND, dark gray color, some black sands (phosphates?), trace angular shell fragments, (SM)			
-16.5	2.0		SAND, clean, quartz, gray color, trace black sands (phosphates?) (SP)			
-17.8	3.3		SAND, quartz, gray color, sand size angular shell fragments, trace black sands (phosphates?), (SP)			
			Cobble size limestone fragment, gravel size shells, some sand			
-20.4	5.9		SAND, same as SP above			
-21.3	6.8		SANDY SILT with some organics, (OL)			
-21.7	7.2		Organic rich layer (OL)			
-22.4	7.9		SILTY CLAY with medium stiffness (OL)			
						NOTE: The lines in the SAMPLE NUMBER column indicate the intervals at which samples were taken for laboratory grain size analysis.
						NOTE: Penetration 9' 88% Recovery due to compaction.
						NOTE: LABORATORY CLASSIFICATION Sample Depth / Classification
						0.1-0.2      SP
						1.1-1.2      SP
						4.2-4.3      SP
						6.7-6.8      SP/SM
						7.7-7.8      SC
						Classification is based upon a gradation curve.



<b>DRILLING LOG</b>		DIVISION South Atlantic	INSTALLATION Jacksonville	SHEET 1 OF 1
1. PROJECT Sand Resource Survey Off Sand Key		10. SIZE AND TYPE OF BIT 3" light vibracore		
2. LOCATION (Coordinates or Station) X=226,036 Y=1,257,745		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MLLW (FEET)		
3. DRILLING AGENCY U.S. Geological Survey		12. MANUFACTURER'S DESIGNATION OF DRILL United States Geological Survey		
4. HOLE NO. (As shown on drawing title and file number) COE-94-17 (2)		13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN disturbed: 0      undisturbed: 0		
5. NAME OF DRILLER Gregg Brooks/Richard W. Young		14. TOTAL NUMBER OF CORE BOXES 1		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED		15. ELEVATION GROUND WATER +0.34		
7. THICKNESS OF BURDEN 0 Ft.		16. DATE HOLE STARTED COMPLETED 11/10/94   11/10/94		
8. DEPTH DRILLED INTO ROCK 0 Ft.		17. ELEVATION TOP OF HOLE -10.66 Ft.		
9. TOTAL DEPTH OF HOLE 7.7 Ft.		18. TOTAL CORE RECOVERY FOR BORING NA %		
		19. SIGNATURE OF GEOLOGIST <i>Gregg R. Young</i>		

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel
-10.7	.0					-10.7
-11.7	1.0		Thin sandy shell layer 0.1' thick			
-12.5	1.8		Thin sandy shell layer 0.1' thick			
			SAND, clean fine quartz, gray color, trace black sands (phosphates?) throughout the entire core. (SP)			
-16.9	6.2		Thin layer of coarse gravel size shells, 0.1' thick.			
-17.7	7.0		Thin layer of gravel size shell fragments 0.1' thick			
-18.4	7.7					
<div>NOTE: The lines in the Sample Number column indicate the intervals at which samples were taken for laboratory grain size analysis.</div> <div>NOTE: LABORATORY CLASSIFICATION Sample Depth / Classification</div> <div><div>0.2-0.3</div><div>1.8-1.9</div><div>4.0-4.1</div><div>6.2-6.3</div><div>SP</div><div>SW</div><div>SP</div><div>SW</div></div> <div>Classification is based upon a gradation curve.</div>						



## Hole No. COE-94-18 (2)

DRILLING LOG		DIVISION South Atlantic	INSTALLATION Jacksonville	SHEET 1 OF 1										
1. PROJECT Sand Resource Survey Off Sand Key		10. SIZE AND TYPE OF BIT 3" light vibracore												
2. LOCATION (Coordinates or Station) X=216,612 Y=1,309,132		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MLLW (FEET)												
3. DRILLING AGENCY U.S. Geological Survey		12. MANUFACTURER'S DESIGNATION OF DRILL United States Geological Survey												
4. HOLE NO. (As shown on drawing title and file number) COE-94-18 (2)		13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN disturbed: 0      undisturbed: 0												
5. NAME OF DRILLER Nancy T. DeWitt/Richard W. Young		14. TOTAL NUMBER OF CORE BOXES 1												
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED		15. ELEVATION GROUND WATER +1.48												
7. THICKNESS OF BURDEN 0 Ft.		16. DATE HOLE STARTED COMPLETED 12/20/94 12/20/94												
8. DEPTH DRILLED INTO ROCK 0 Ft.		17. ELEVATION TOP OF HOLE -13.52 Ft.												
9. TOTAL DEPTH OF HOLE 9.5 Ft.		18. TOTAL CORE RECOVERY FOR BORING See Note %												
		19. SIGNATURE OF GEOLOGIST <i>Nancy T. DeWitt</i>												
ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel								
-13.5	.0					-13.5								
			SAND, quartz, fine to medium, clean, gray color, trace black sands (phosphates?), (SP)											
-18.8	5.3													
-19.6	6.1		SAND with gravel size angular shell fragments, (SW)											
-20.5	7.0		SANDY SILTS to sandy clays, dark brown to gray color variations, trace shell fragments, (ML)											
-22.5	9.0		CARBONATE MUD; sandy mud and silty gravel mixture, coarse gravel size shell fragments, (GM)											
-23.0	9.5		CLAY, blue mixed with small amount of carbonate mud, (CH)											
<p>NOTE: The lines in the SAMPLE NUMBER column indicate the intervals at which samples were taken for laboratory grain size analysis.</p> <p>NOTE: Penetration 12' 79% Recovery due to compaction.</p> <p>NOTE: LABORATORY CLASSIFICATION Sample Depth / Classification</p> <table> <tr> <td>2.0-2.1</td> <td>SP</td> </tr> <tr> <td>6.4-6.5</td> <td>SM</td> </tr> <tr> <td>8.0-8.1</td> <td>SW/SM</td> </tr> <tr> <td>9.2-9.3</td> <td>SP/SM</td> </tr> </table> <p>Classification is based upon a gradation curve.</p>						2.0-2.1	SP	6.4-6.5	SM	8.0-8.1	SW/SM	9.2-9.3	SP/SM	
2.0-2.1	SP													
6.4-6.5	SM													
8.0-8.1	SW/SM													
9.2-9.3	SP/SM													



<b>DRILLING LOG</b>		DIVISION South Atlantic	INSTALLATION Jacksonville	SHEET 1 OF 1
1. PROJECT Sand Resource Survey Off Sand Key		10. SIZE AND TYPE OF BIT 3" light vibracore		
2. LOCATION (Coordinates or Station) X=210,794 Y=1,288,546		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MLLW (FEET)		
3. DRILLING AGENCY U.S. Geological Survey		12. MANUFACTURER'S DESIGNATION OF DRILL United States Geological Survey		
4. HOLE NO. (As shown on drawing title and file number) COE-94-22		13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN disturbed: 0 undisturbed: 0		
5. NAME OF DRILLER Nancy DeWitt/Richard W. Young		14. TOTAL NUMBER OF CORE BOXES 1		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED		15. ELEVATION GROUND WATER +1.23		
7. THICKNESS OF BURDEN 0 Ft.		16. DATE HOLE STARTED COMPLETED 12/20/94 12/20/94		
8. DEPTH DRILLED INTO ROCK 0 Ft.		17. ELEVATION TOP OF HOLE -15.77 Ft.		
9. TOTAL DEPTH OF HOLE 7.9 Ft.		18. TOTAL CORE RECOVERY FOR BORING See Note %		
		19. SIGNATURE OF GEOLOGIST <i>Nancy T. DeWitt</i>		

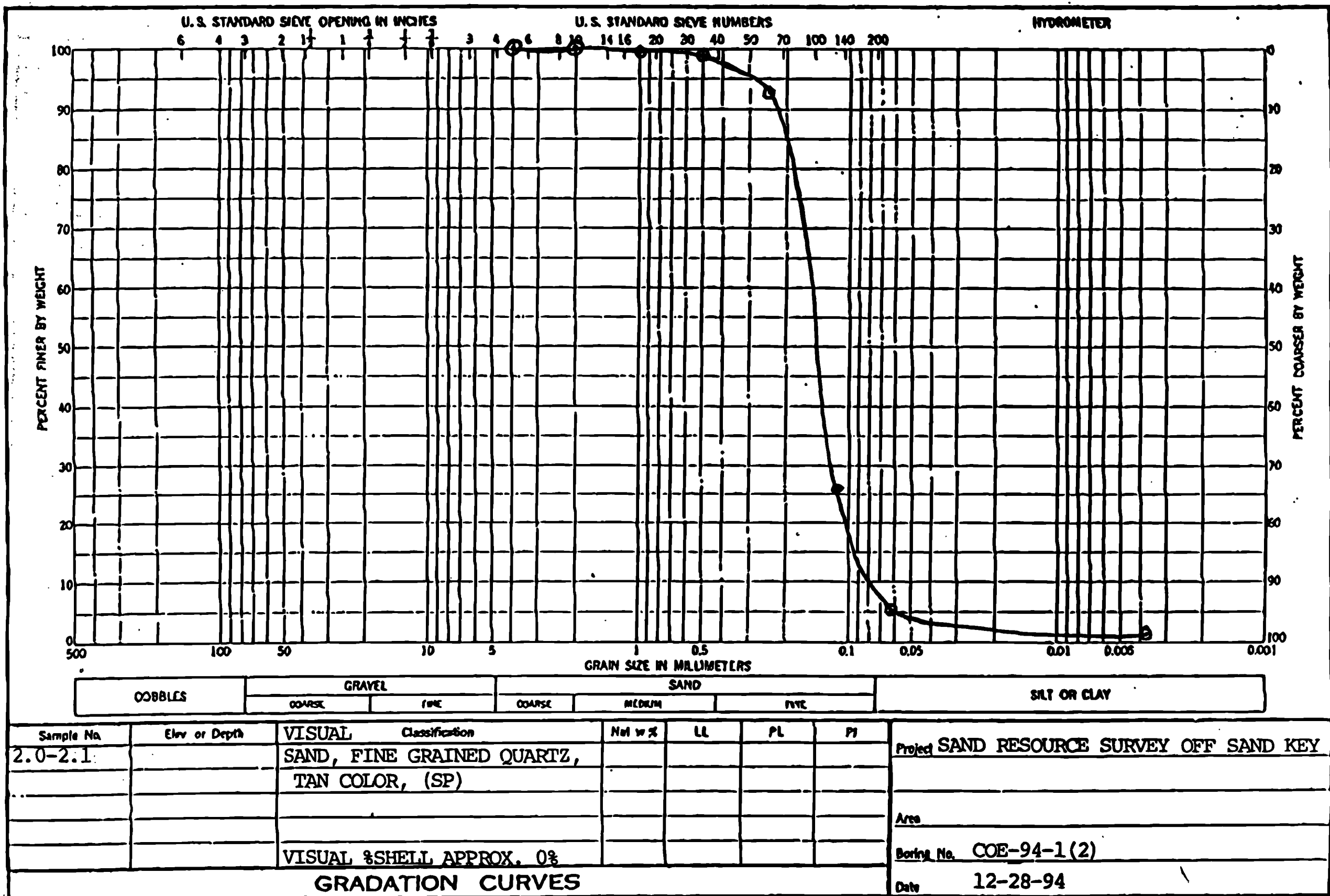
ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	CORE REC %	SAMPLE NUMBER	REMARKS Bit or Barrel
-15.8	.0					-15.8
			SAND, fine to medium quartz, clean, gray color, with finer grains at the top, (SP)			
-21.4	5.6					
			SAND, fine, gravel size angular shell fragments with whole shells intermixed, some black sands (phosphates?), (SW)			
-23.7	7.9					
			Coarse gravel size angular shell fragments and gravel size whole shells at base, (SW)			
NOTE: The lines in the SAMPLE NUMBER column indicate the intervals at which samples were taken for grain size analysis.						
NOTE: Penetration 9.5' 83% Recovery due to compaction.						
NOTE: LABORATORY CLASSIFICATION Sample Depth / Classification						
1.0-1.1 SP 4.8-4.9 SP 7.3-7.4 SW						
Classification is based upon a gradation curve.						



**APPENDIX A3**

**Grain-Size Gradation Curves**

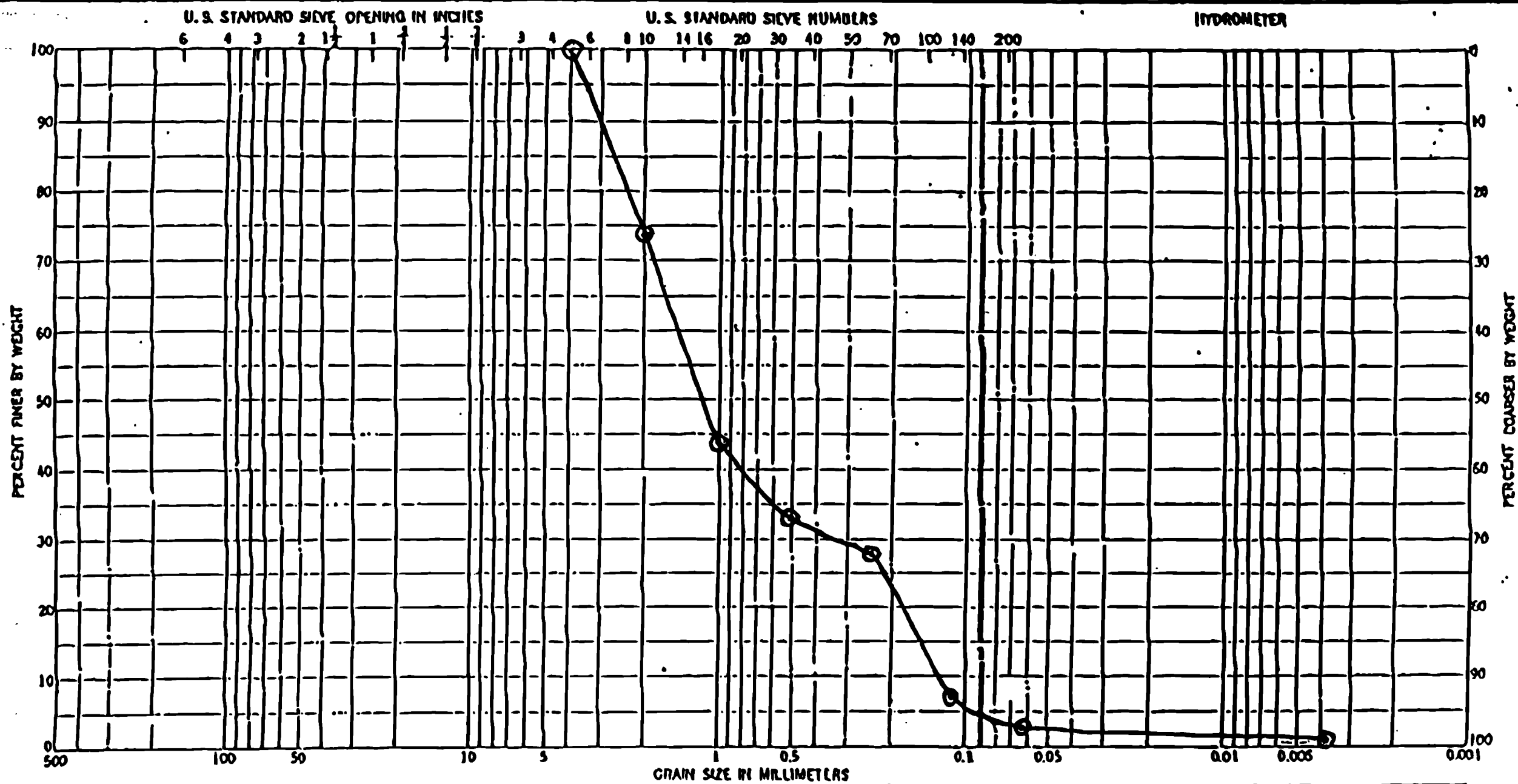








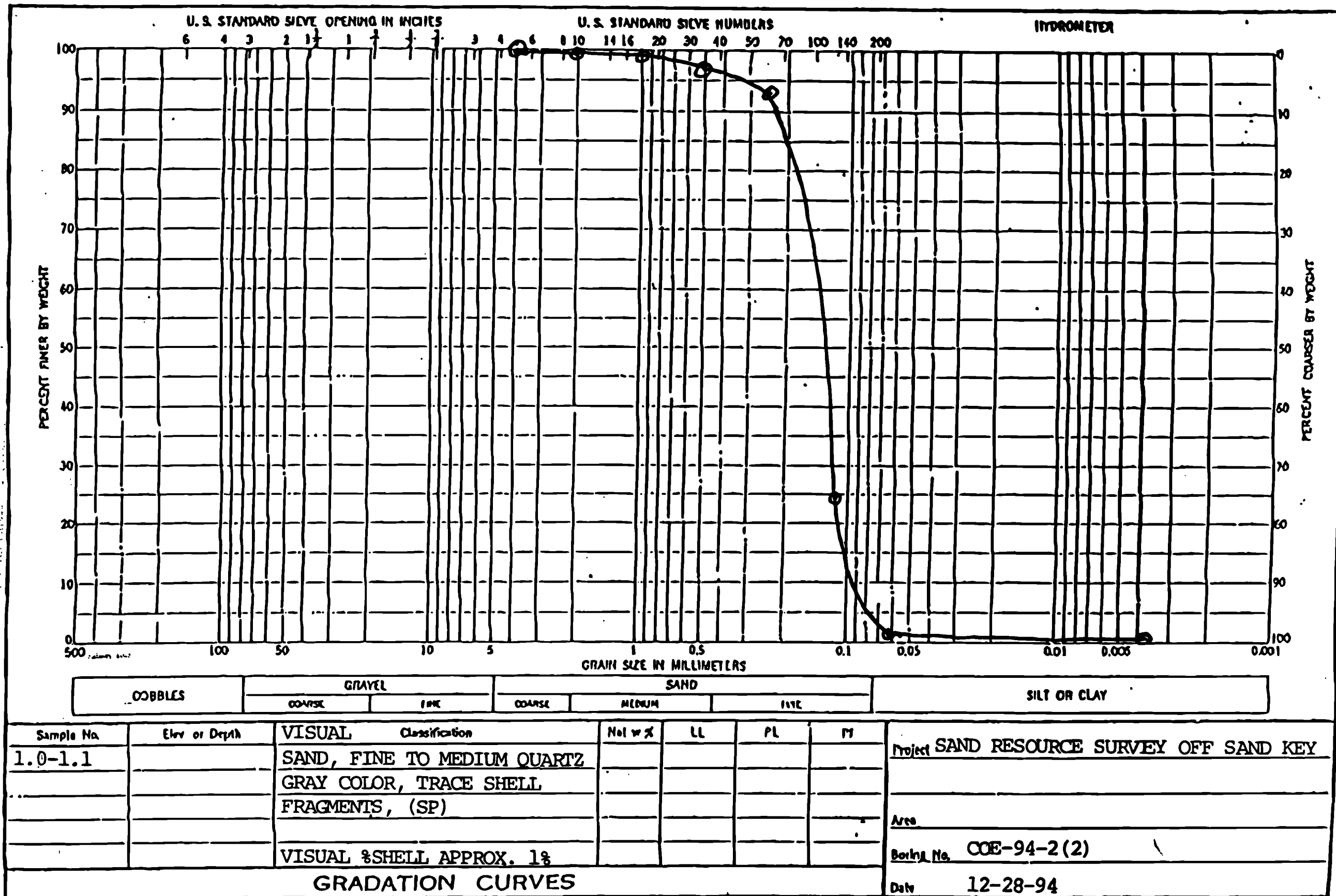




COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

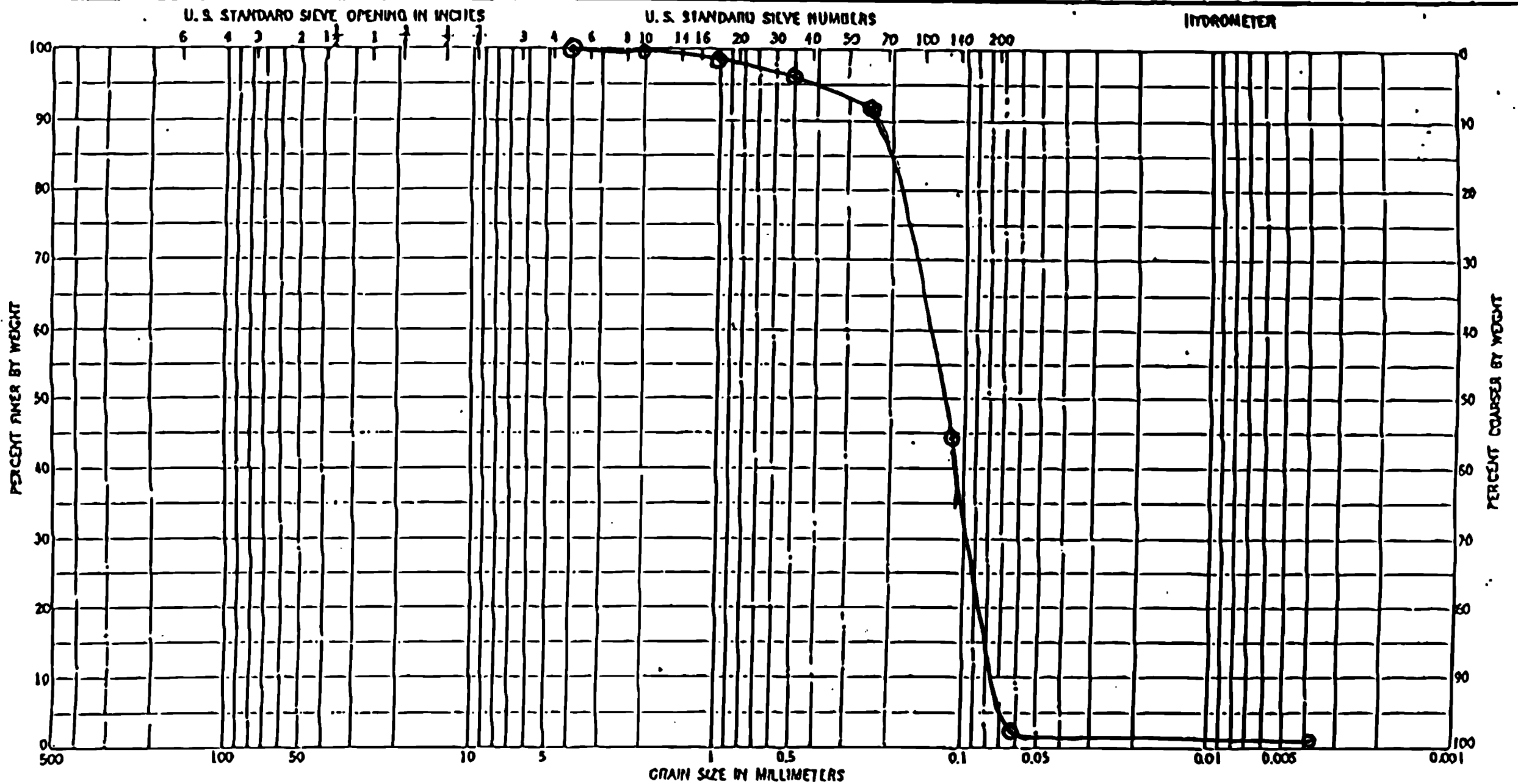
Sample No	Elev or Depth	VISUAL Classification	Nat w %	LL	PL	PI	Project
8.7-8.8		GRAVELLY SANDS, MOSTLY ANGULAR SHELL FRAGMENTS, SMALL AMOUNT BLACK SANDS (PHOSPHATES?), (SW)					SAND RESOURCE SURVEY OFF SAND KEY
		VISUAL %SHELL APPROX. 80%					Area
GRADATION CURVES							Boring No. COE-94-1 (2)
							Date 12-28-94











COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Sample No.	Elev or Depth	VISUAL Classification	Moisture %	LL	PL	PI	Project
5.0-5.1		SAND, FINE TO MEDIUM QUARTZ, CLEAN, GRAY COLOR, TRACE SHELL CONTENT, (SP)					SAND RESOURCE SURVEY OFF SAND KEY
							Area
		VISUAL %SHELL APPROX. 1%					Boring No. COE-94-2(2)
							Date 12-28-94

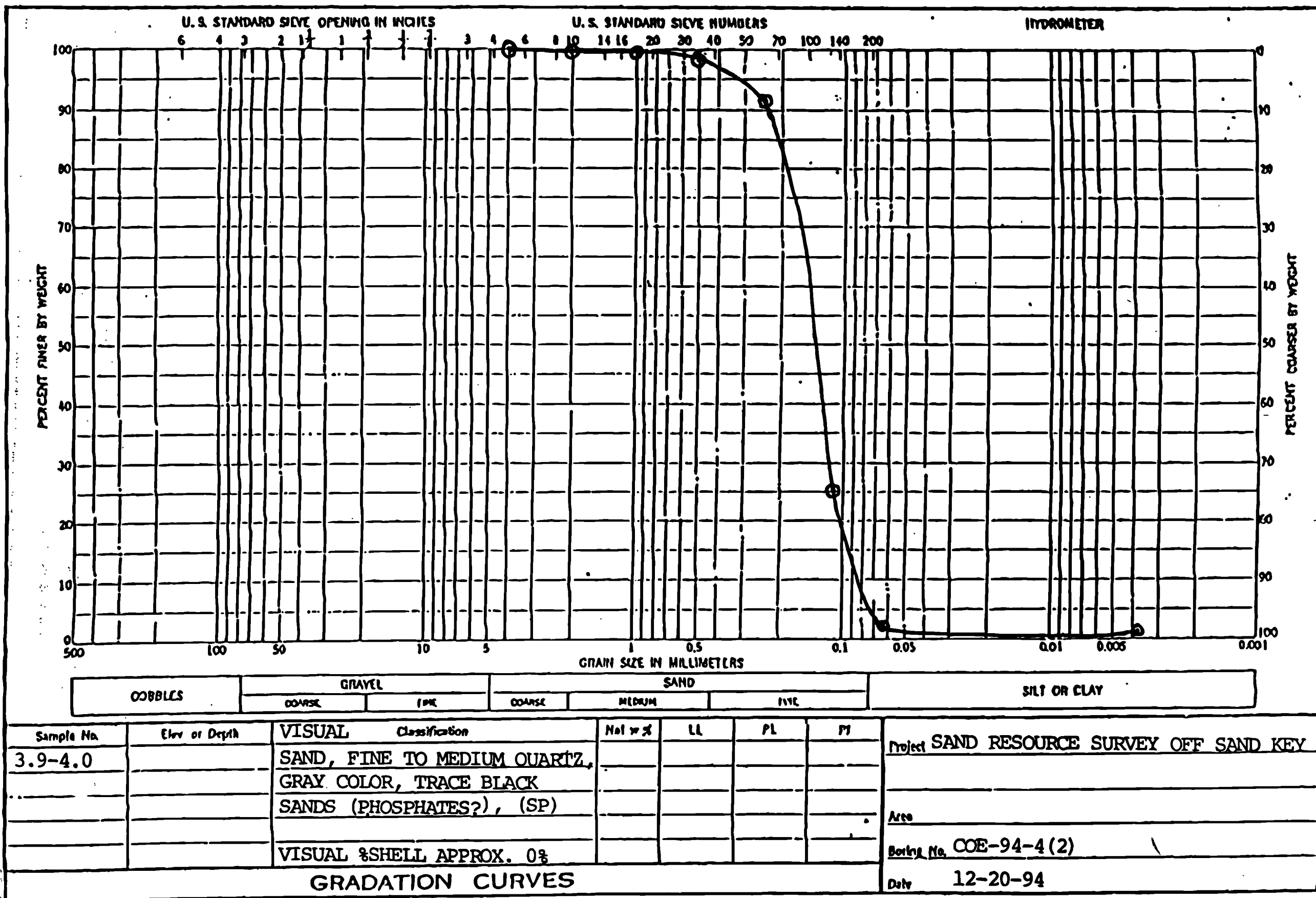
GRADATION CURVES

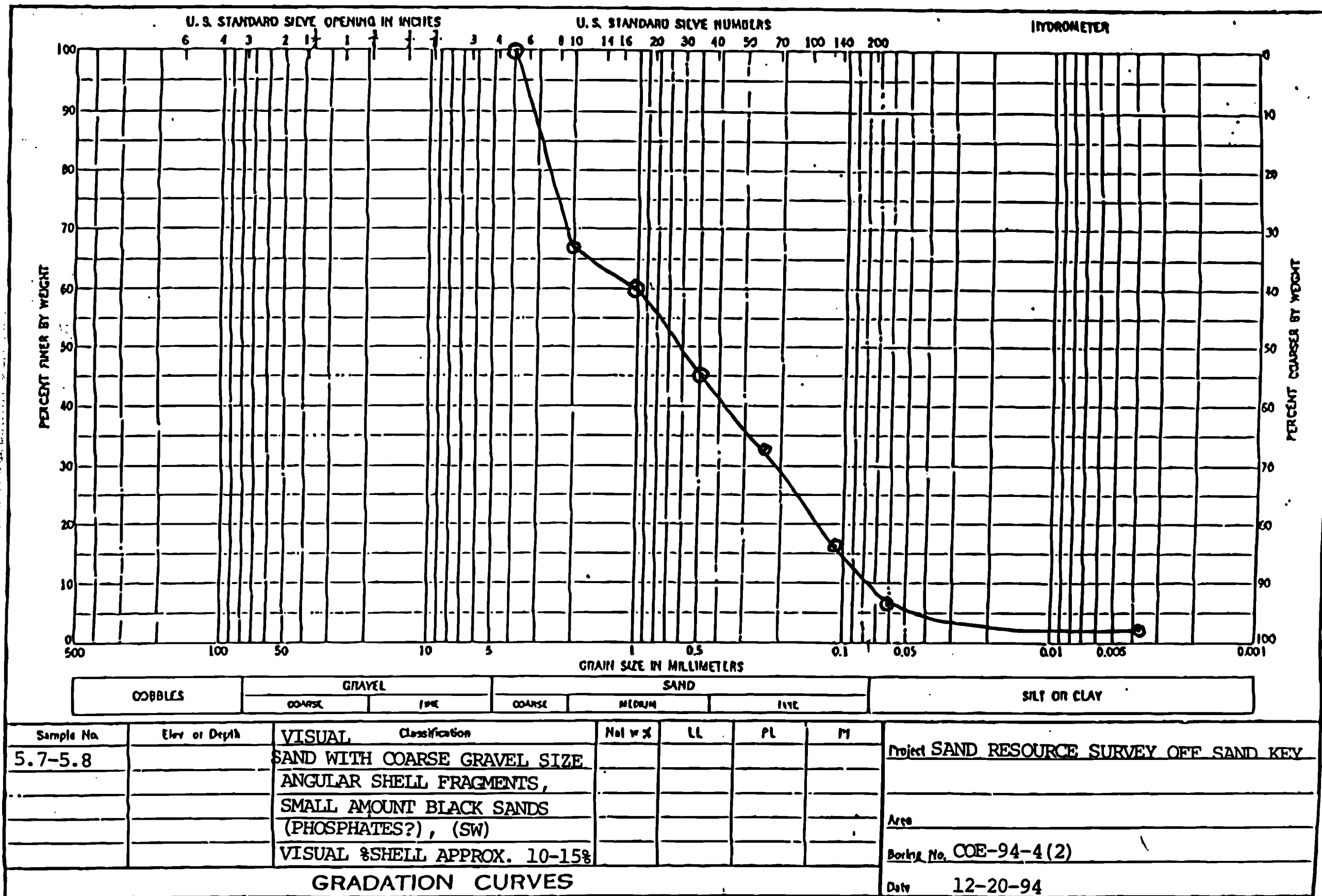




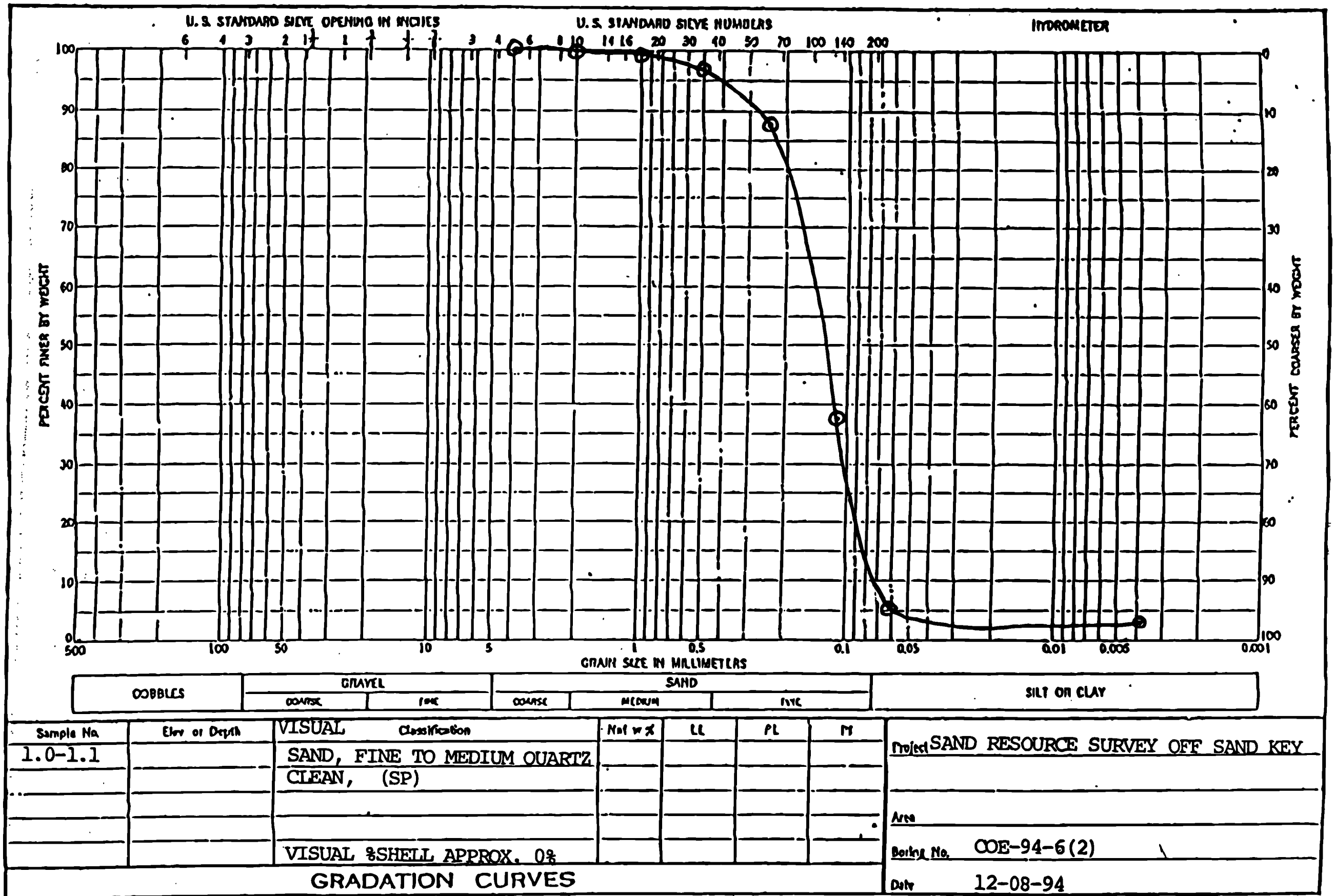


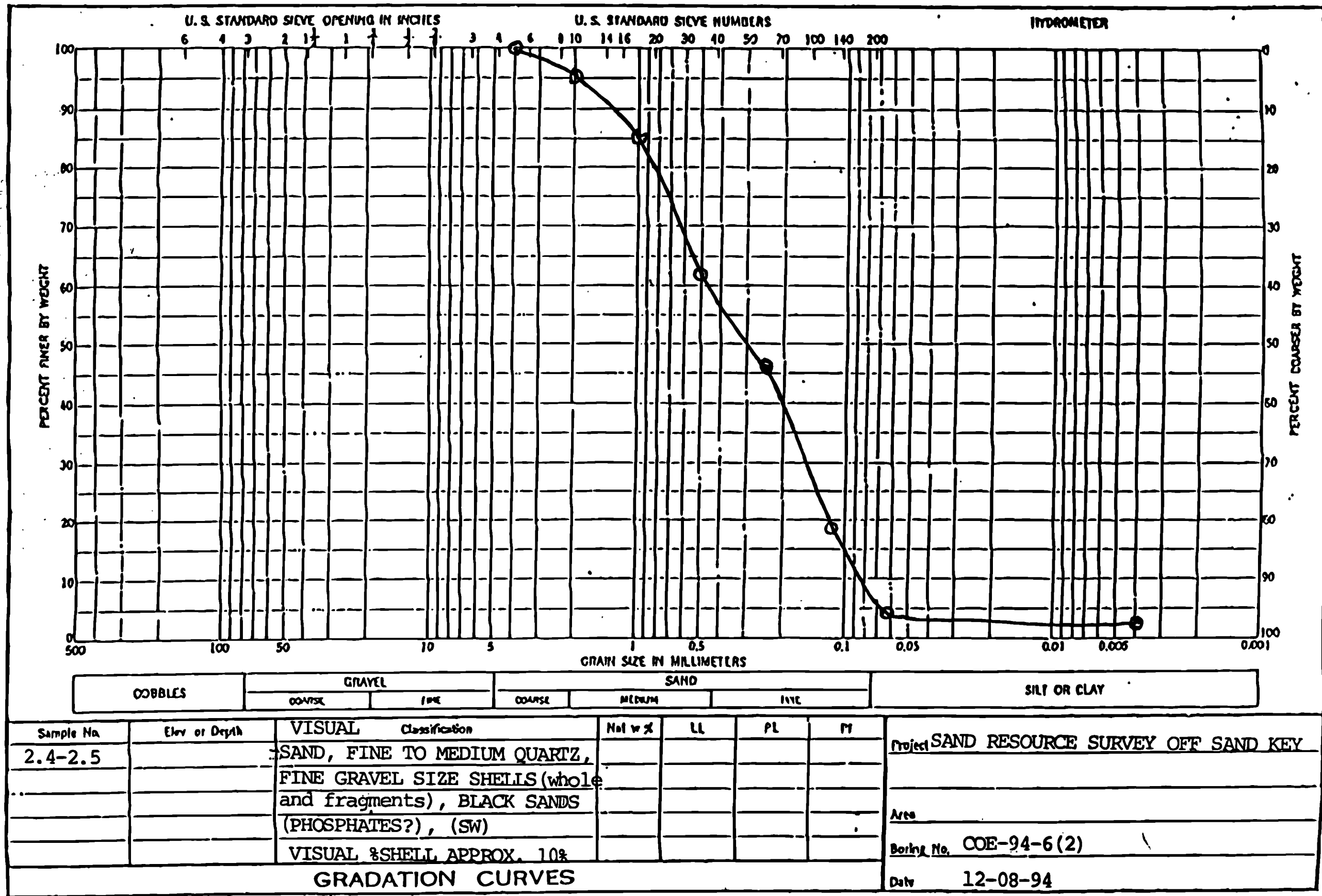






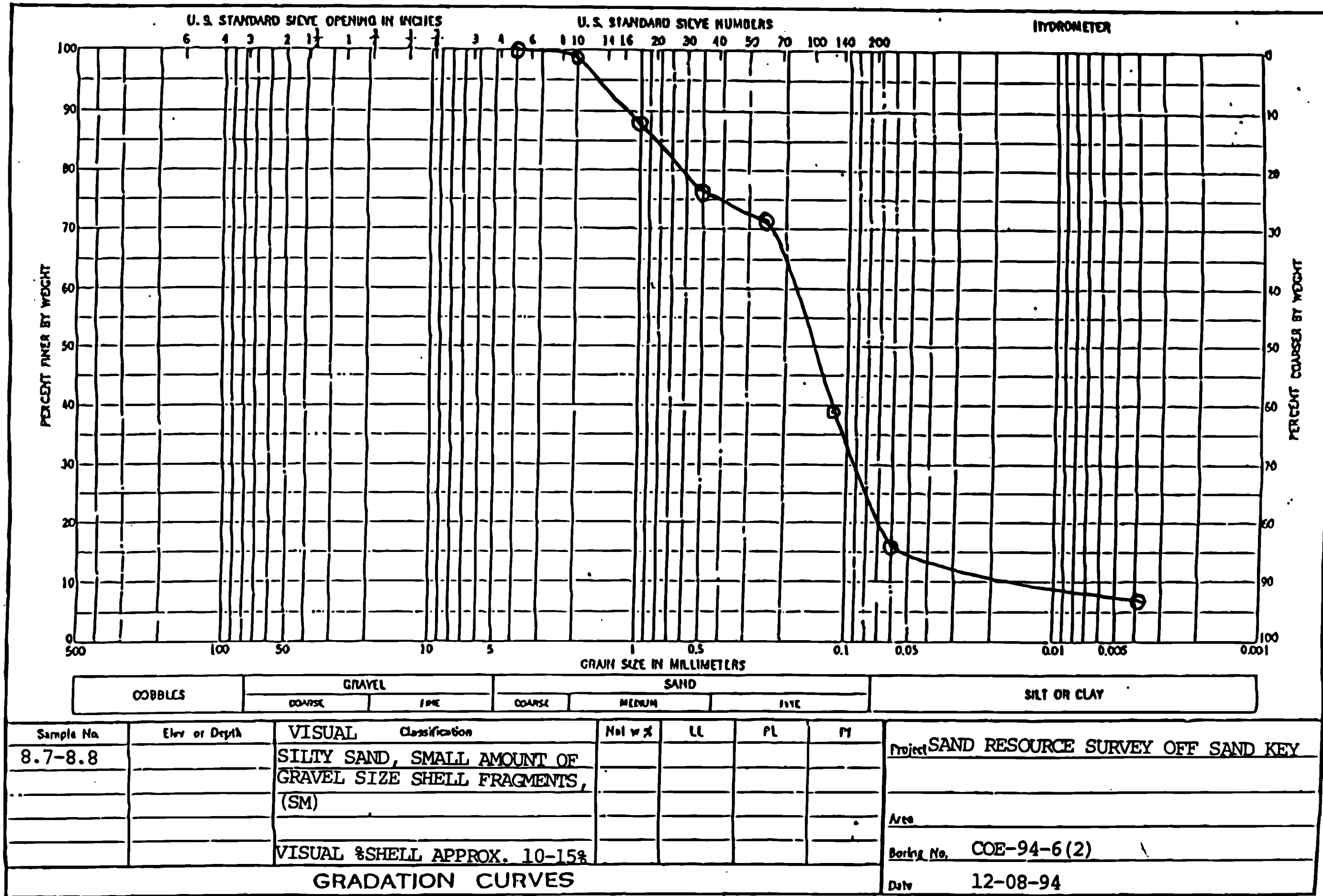










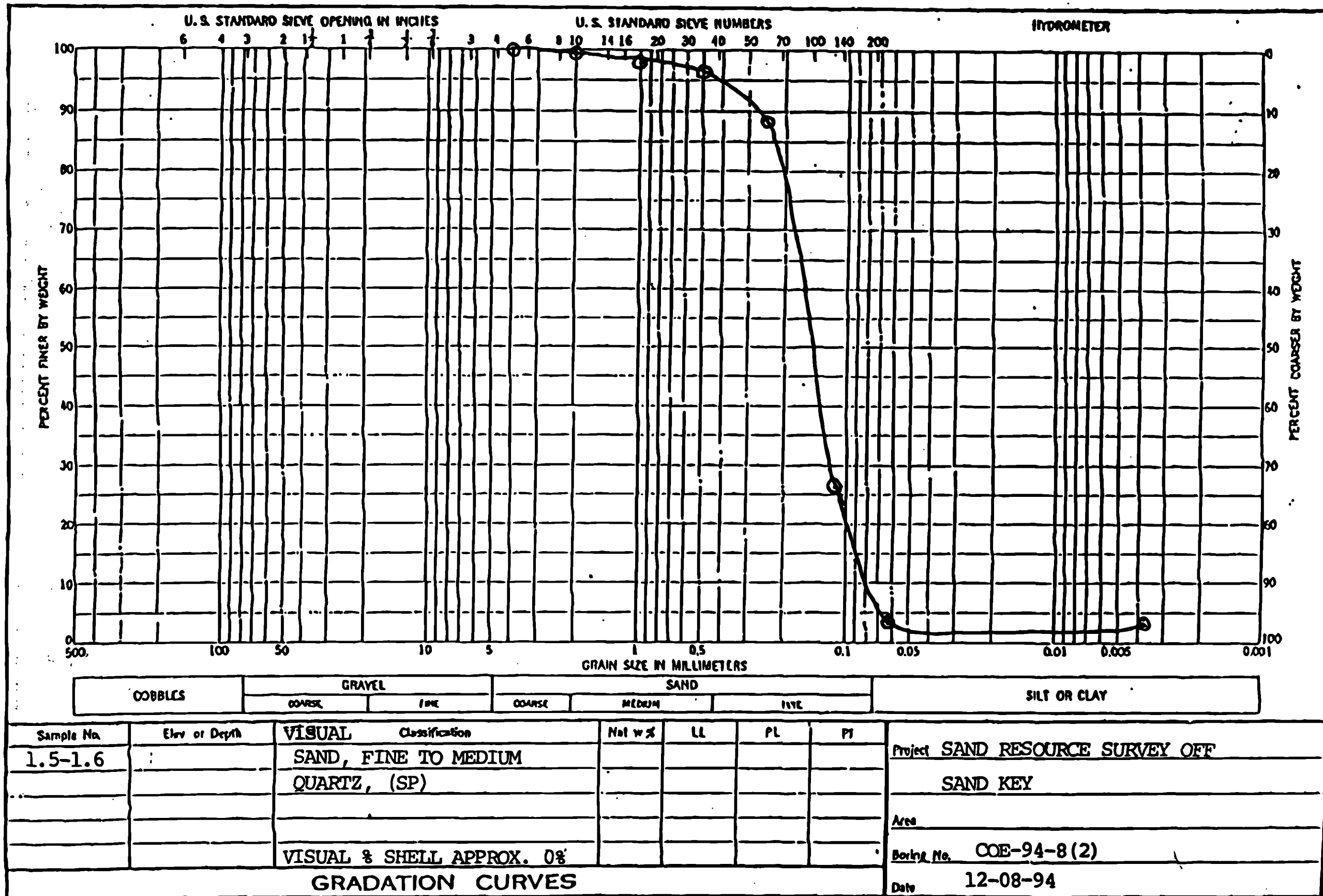


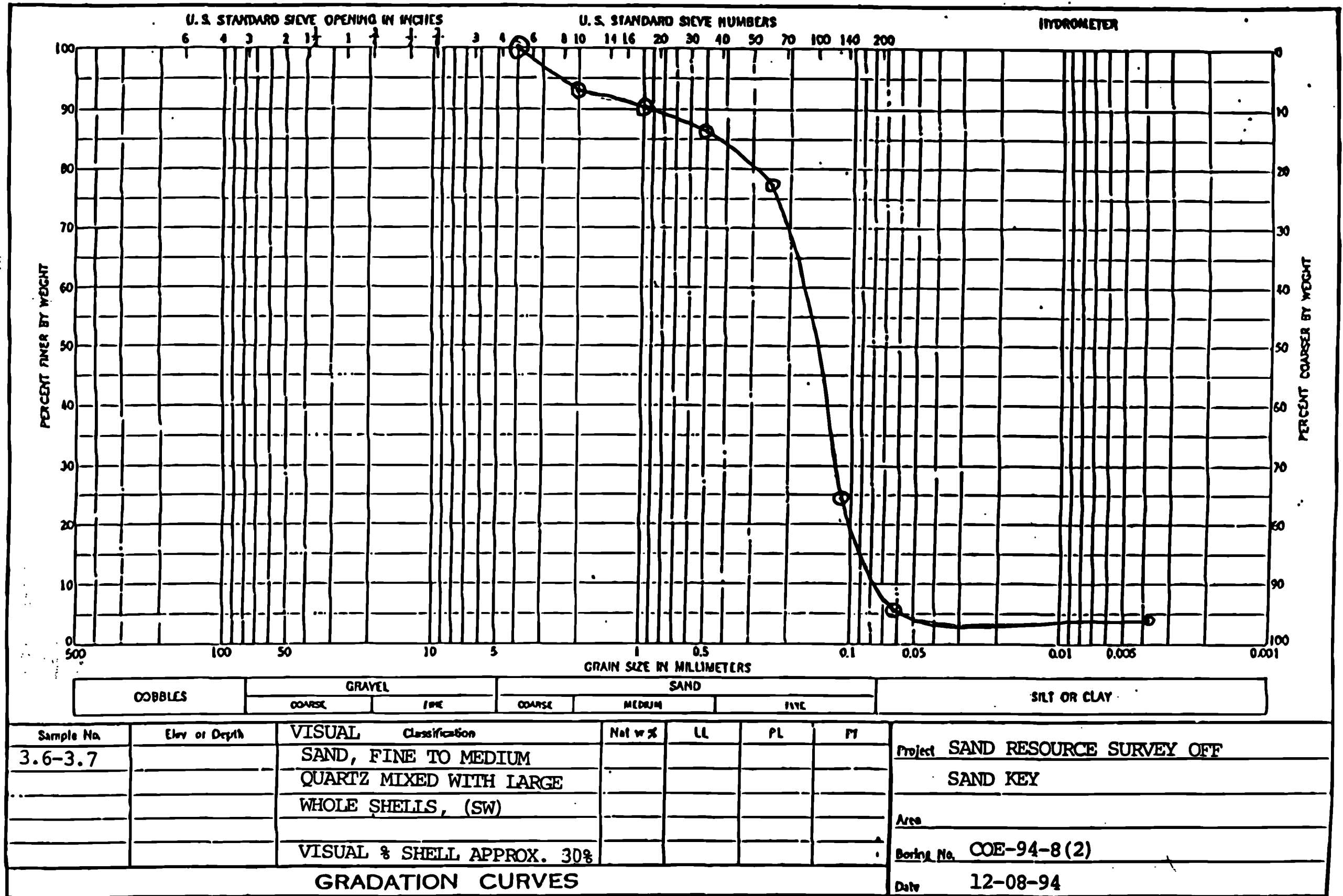




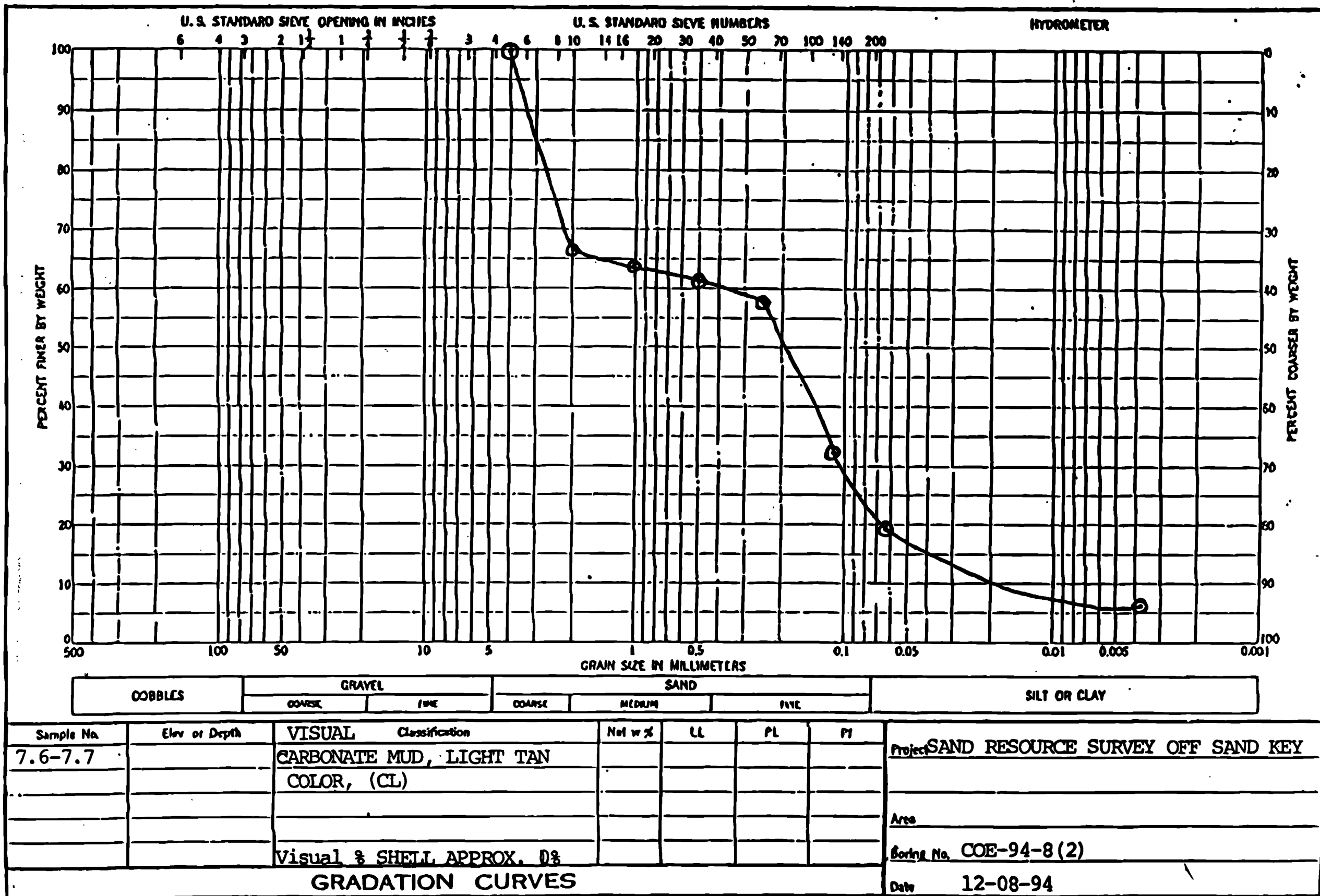


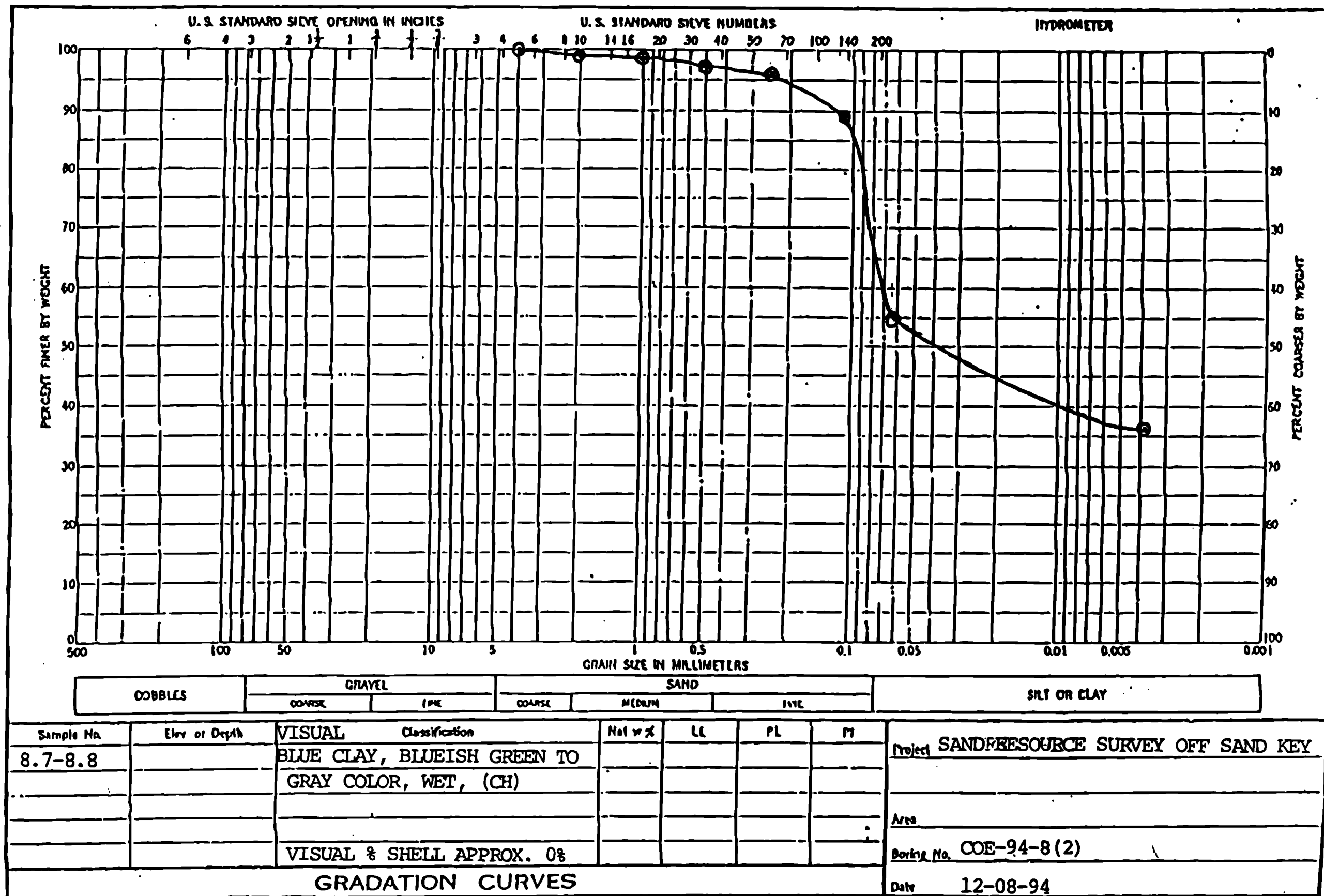




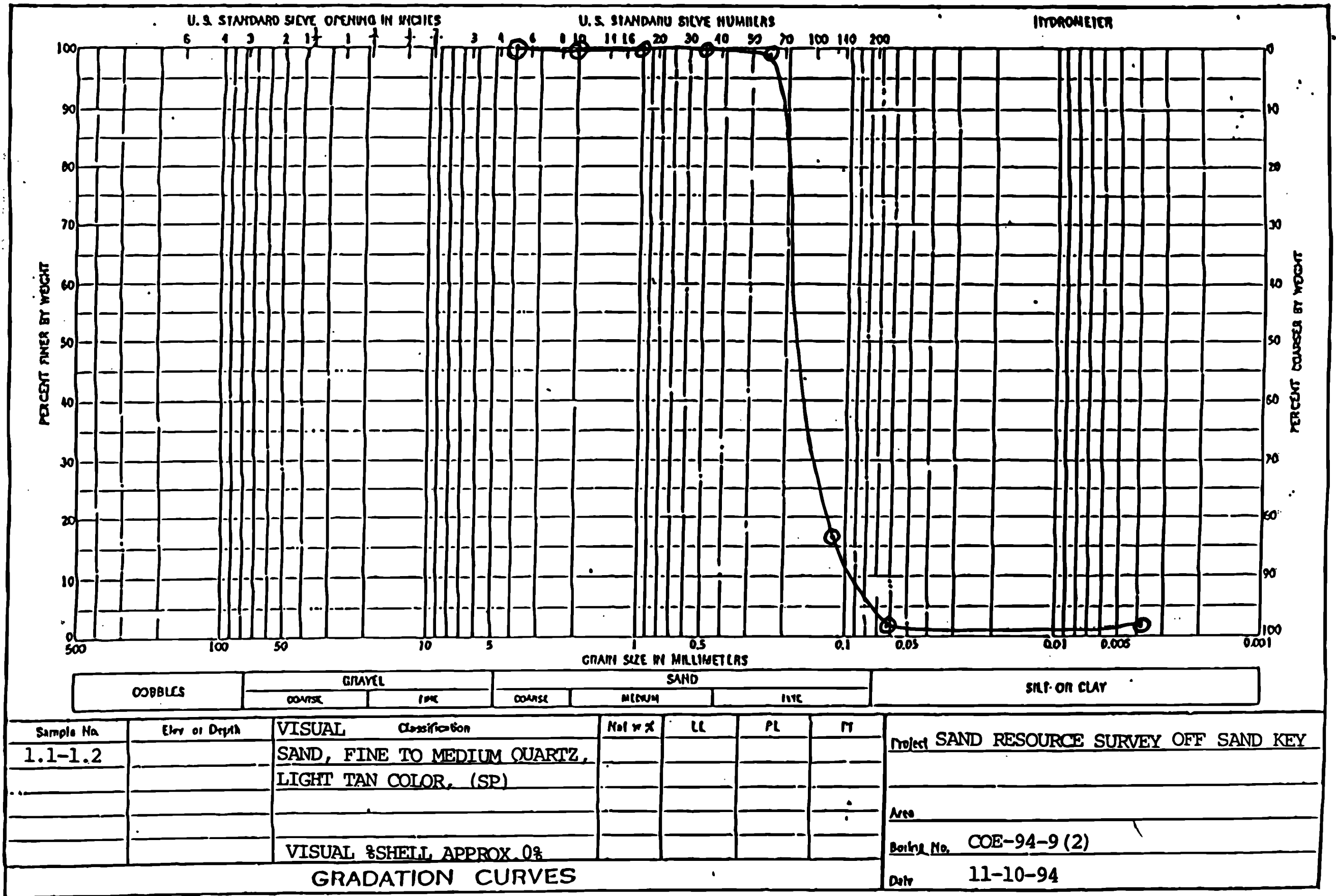


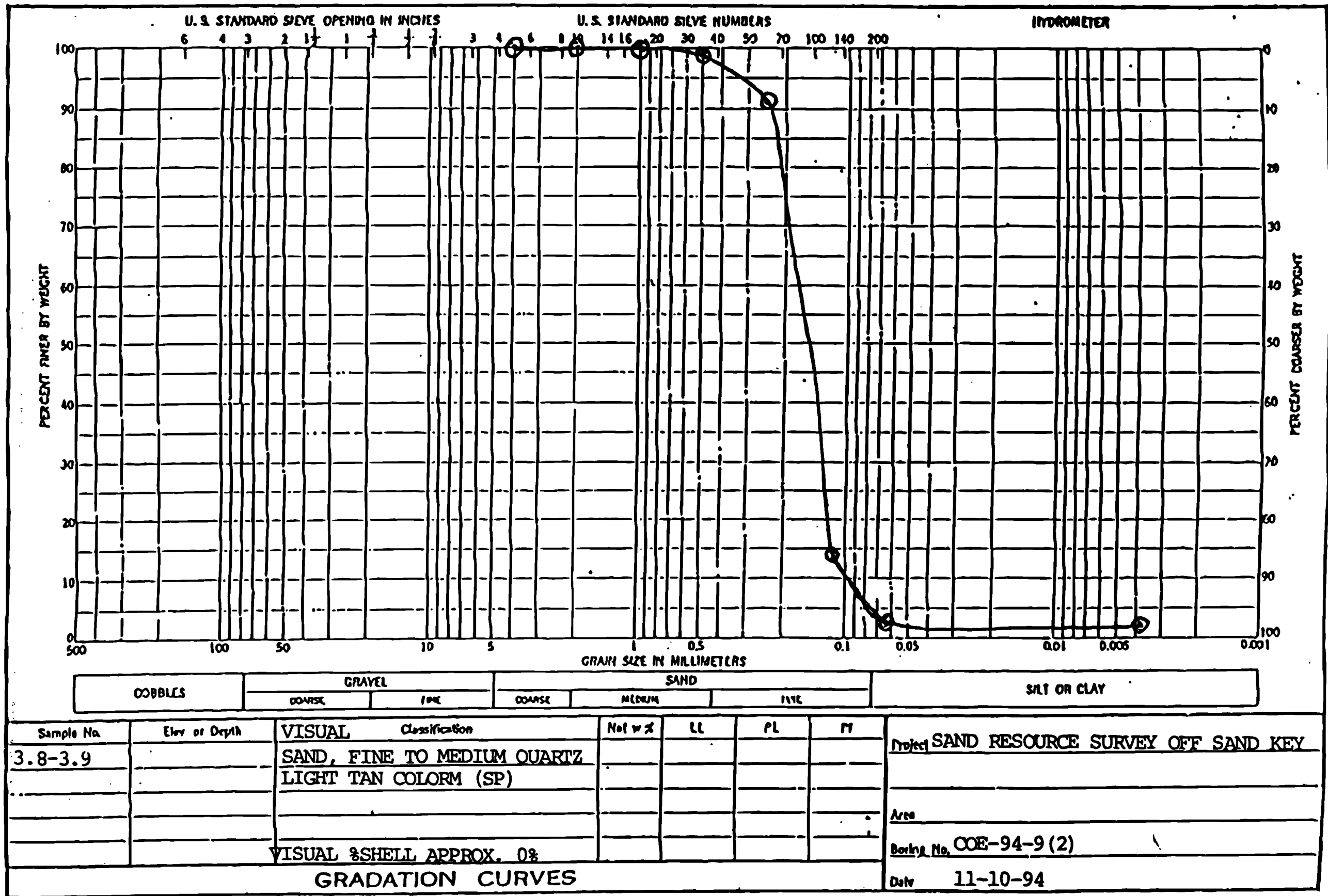




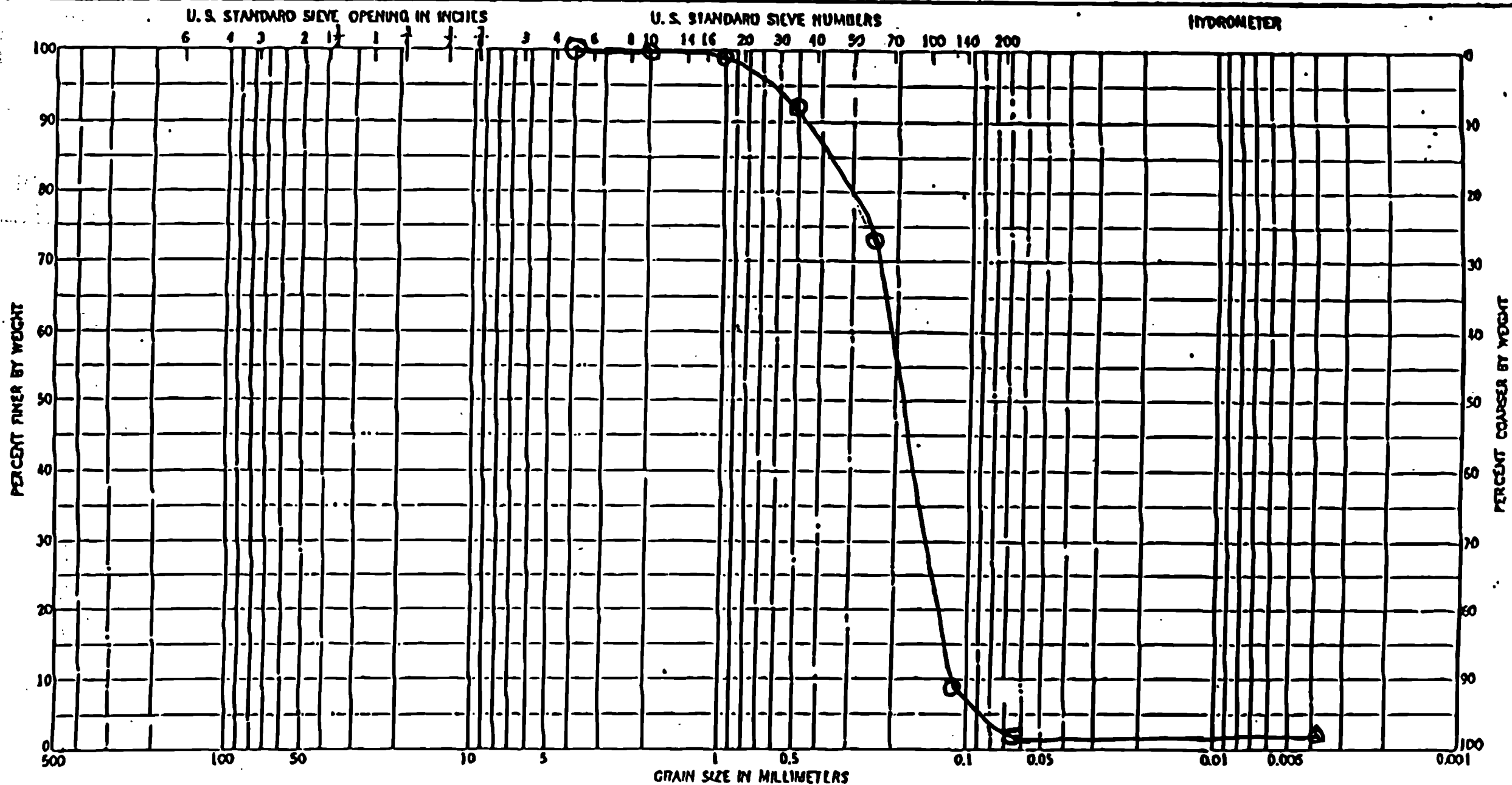












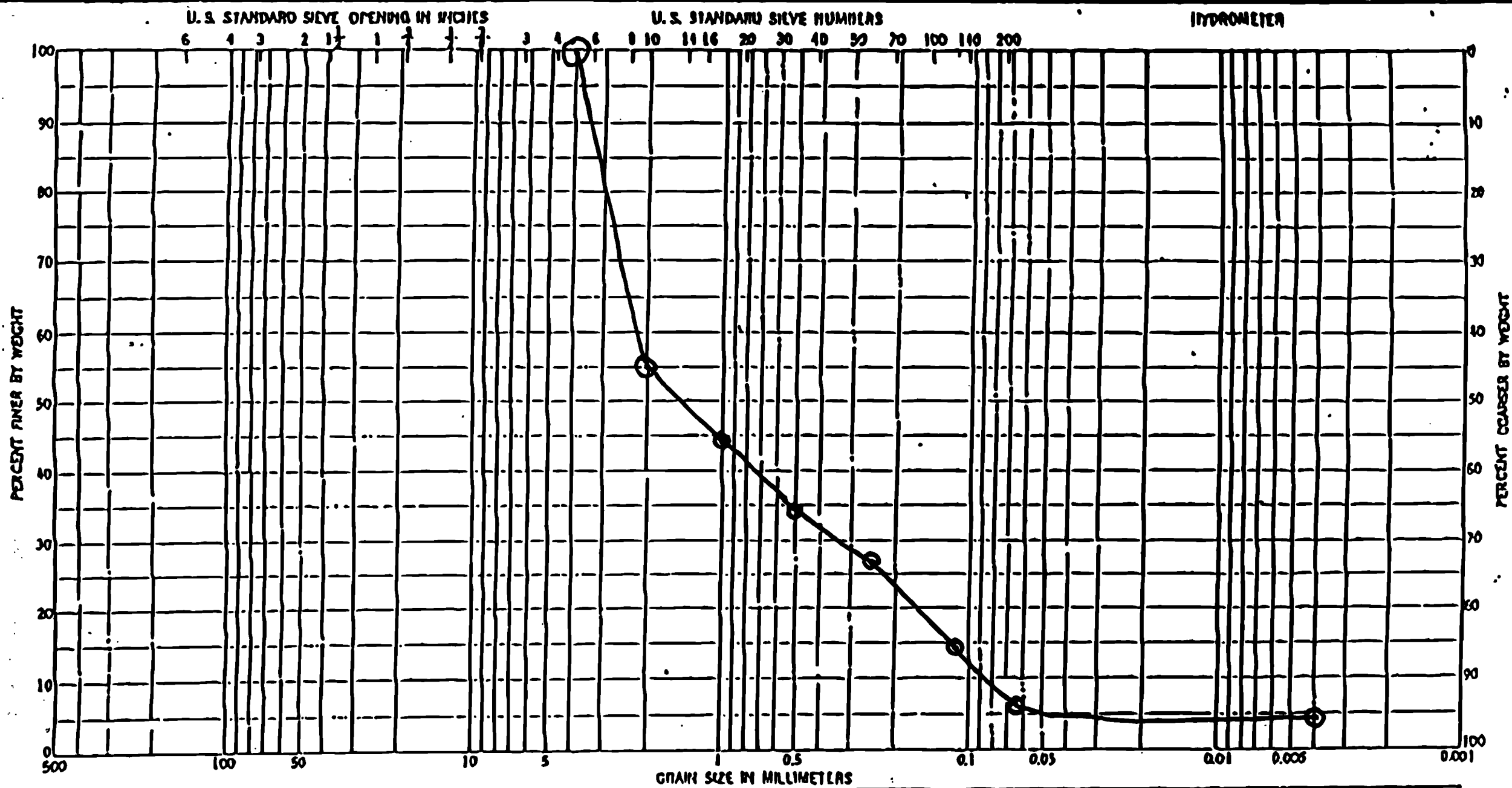
COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Sample No	Elev or Depth	VISUAL Classification	Moisture %	LL	PL	PI	Project
4.9-5.0		SAND, QUARTZ, MEDIUM TO COARSE					SAND RESORCE SURVEY OFF SAND KEY
		TAN COLOR, (SP)					
							Area
		VISUAL % SHELL APPROX. 0%					Boring No. COE-94-9 (2)
							Date 11-10-94

GRADATION CURVES





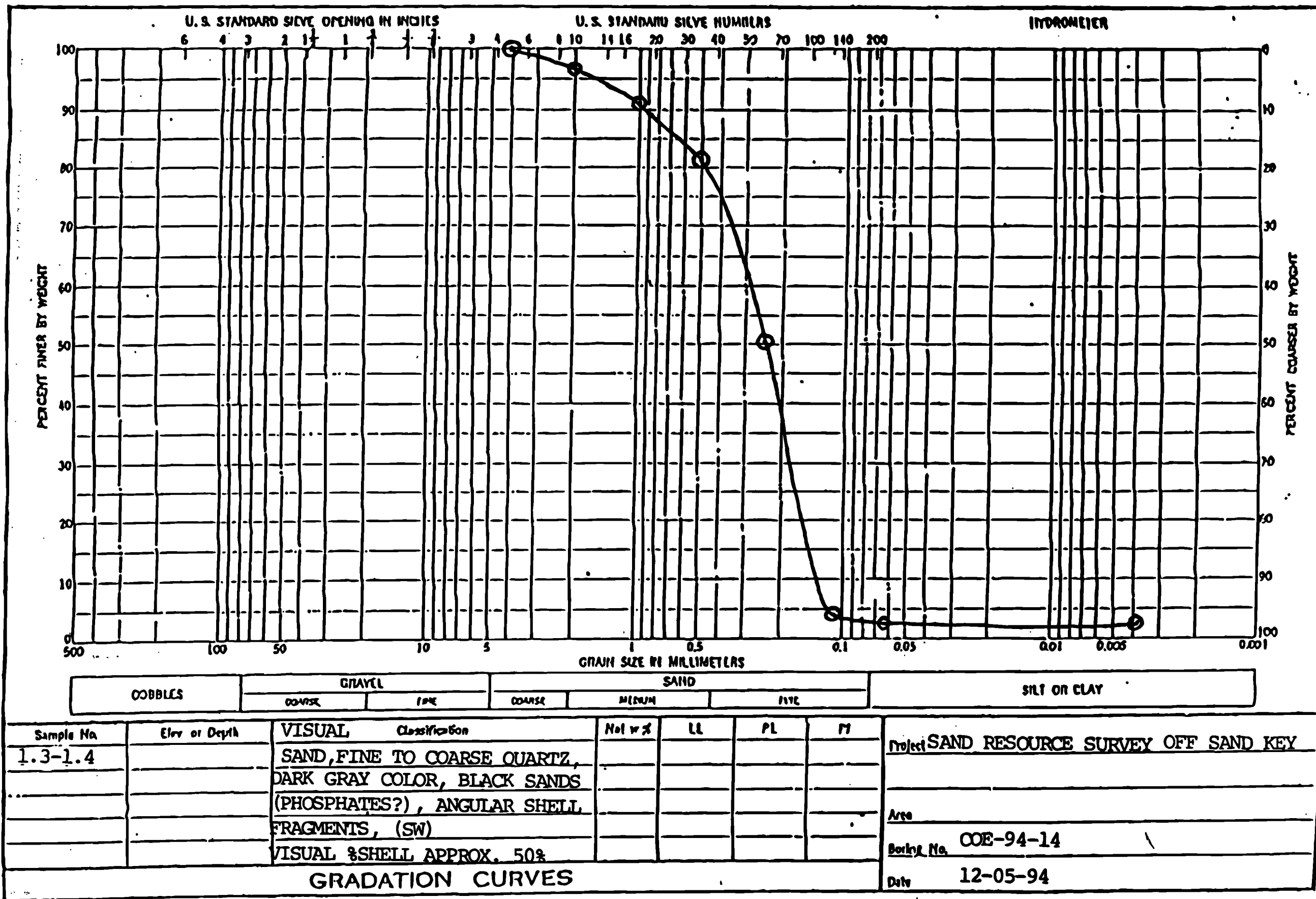


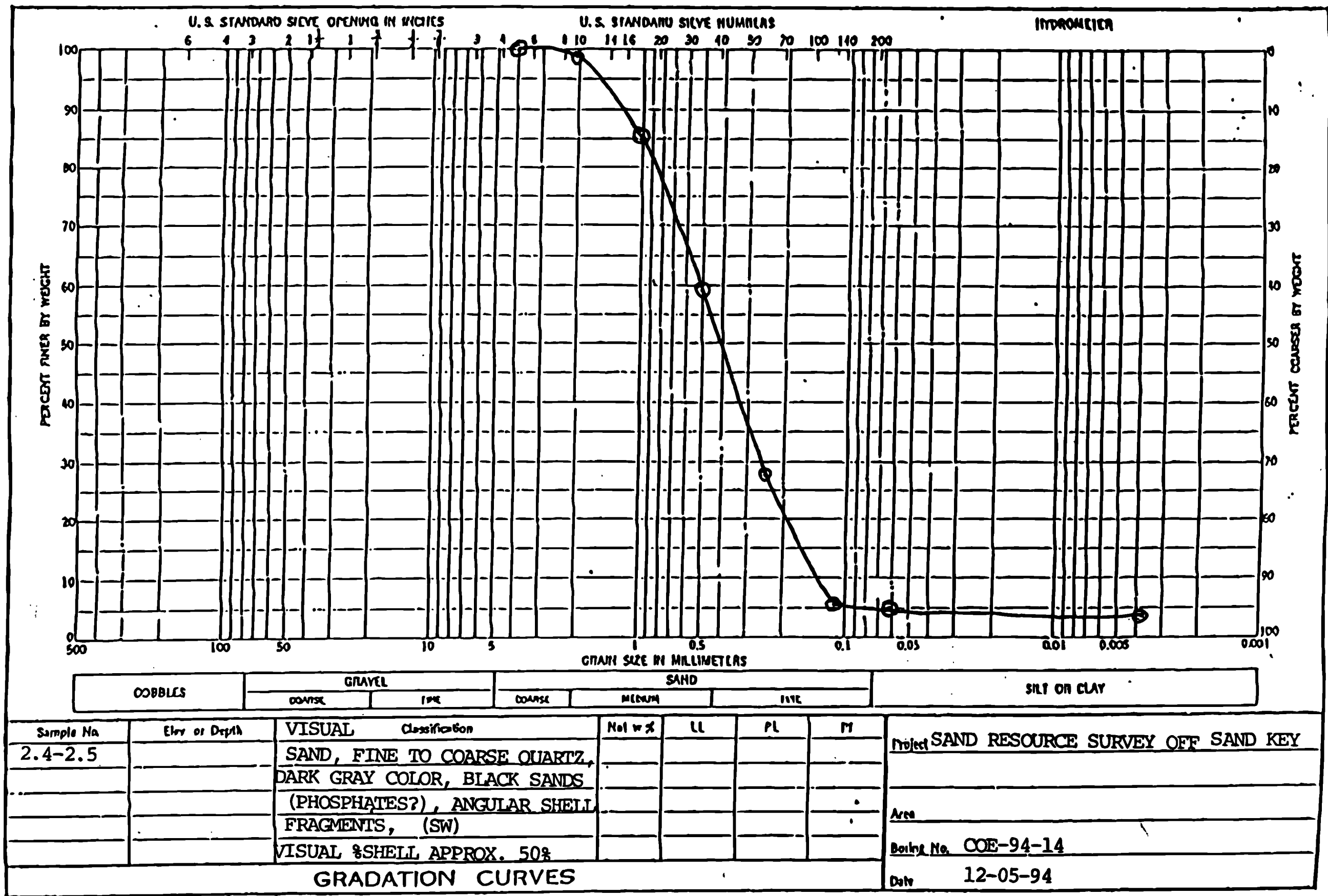
COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Sample No.	Elev or Depth	VISUAL Classification	Moisture %	LL	PL	P	Project SAND RESOURCE SURVEY OFF SAND KEY
8.4-8.5		GRAVELS: LIMESTONE FRAGMENTS					
		AND ANGULAR SHELL FRAGMENTS					
		(GW)					
		VISUAL %SHELL APPROX. 40%					
GRADATION CURVES							Area
							Boring No. COE-94-13(2)
							Date 12-08-94

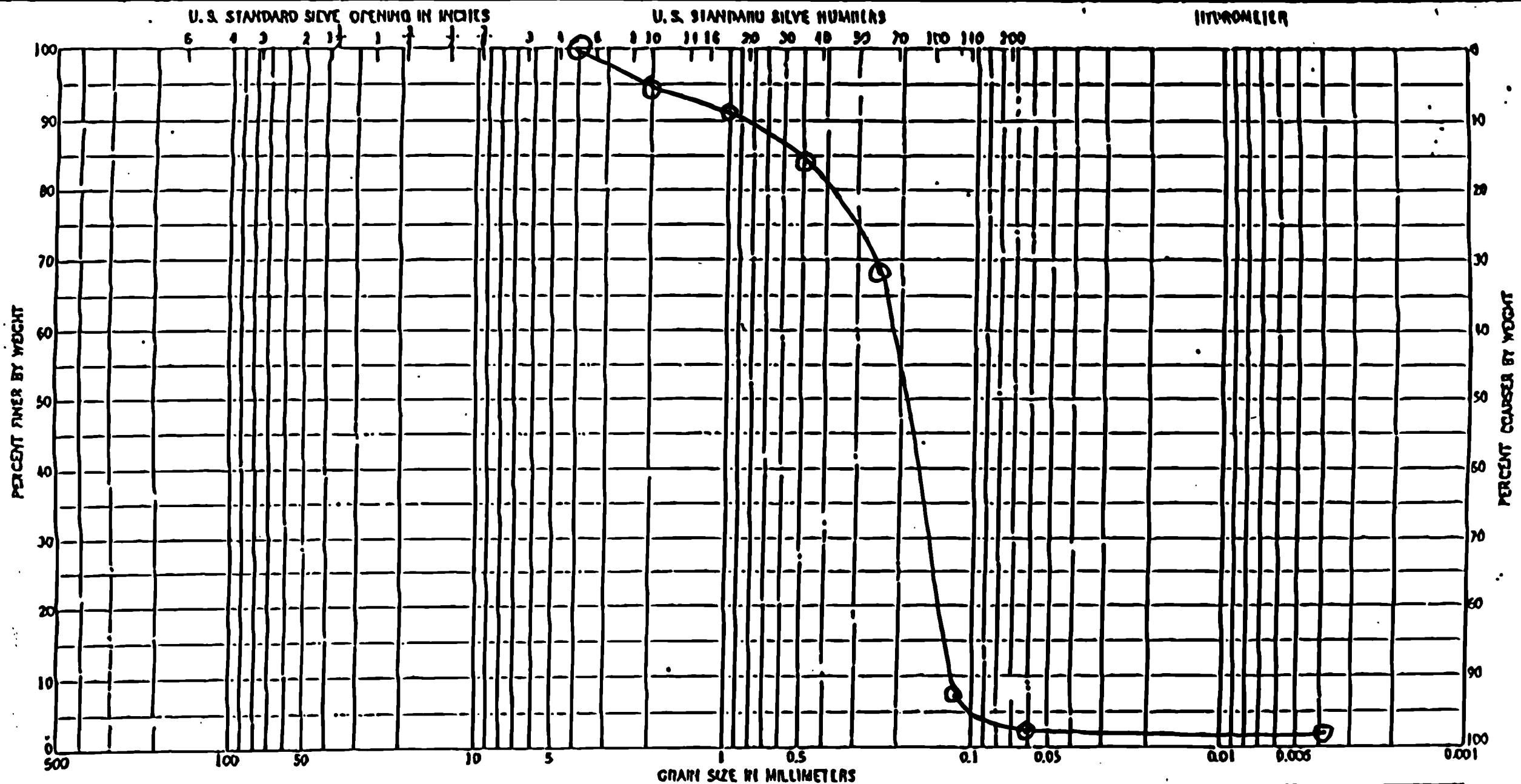










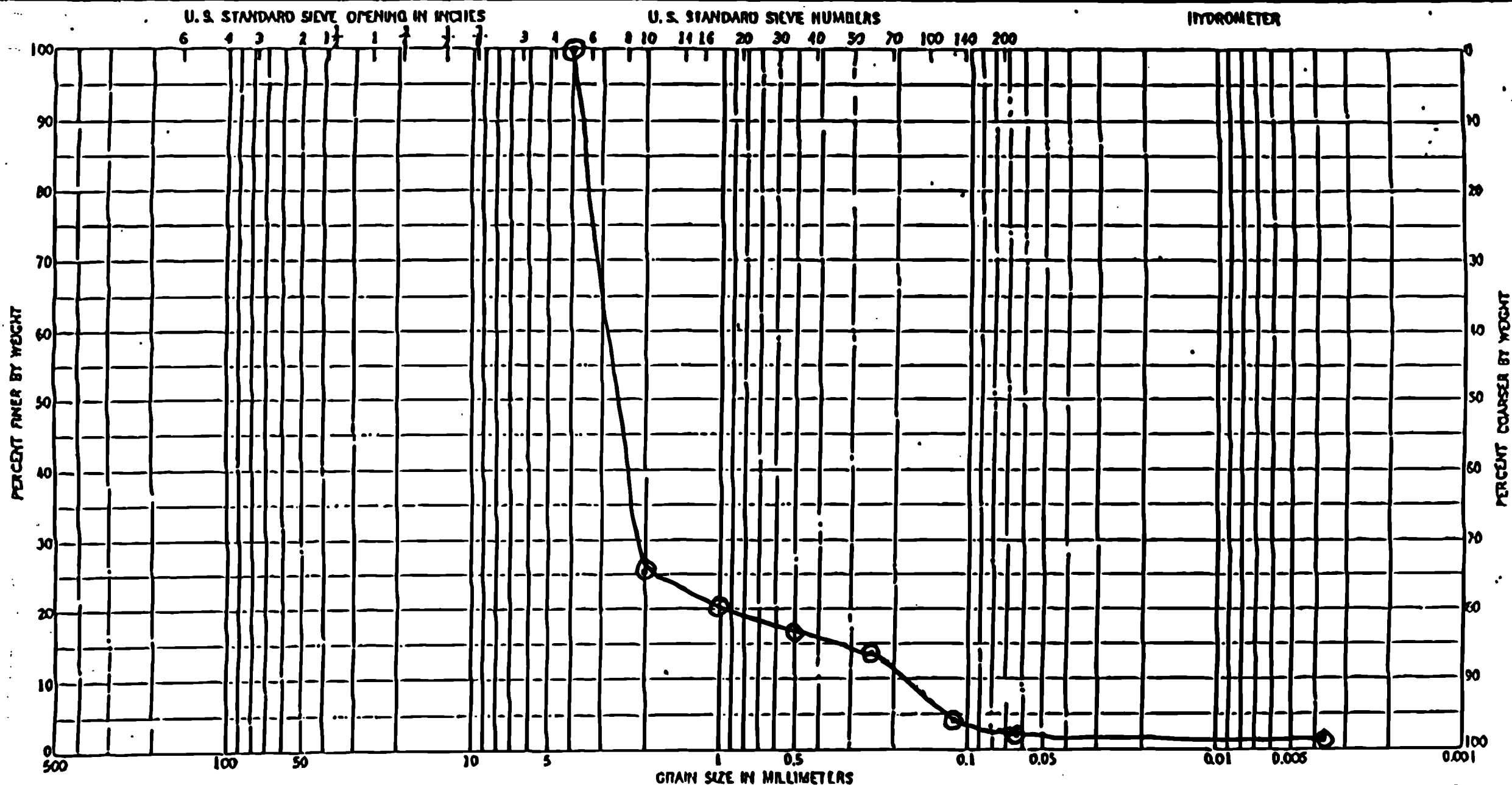


COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Sample No.	Elev or Depth	<b>VISUAL Classification</b> SAND, FINE TO MEDIUM QUARTZ, DARK GRAY COLOR, SMALL AMOUNT BLACK SANDS (PHOSPHATES?), COBBLE SIZE LIMESTONE ASSOCIATED WITH THIS SAMPLE.	Nat w %    	LL    	PL    	PI    	Project SAND RESOURCE SURVEY OFF SAND KEY   Area Boring No. COE-94-15(2) Date 12-08-94
<b>GRADATION CURVES</b>							

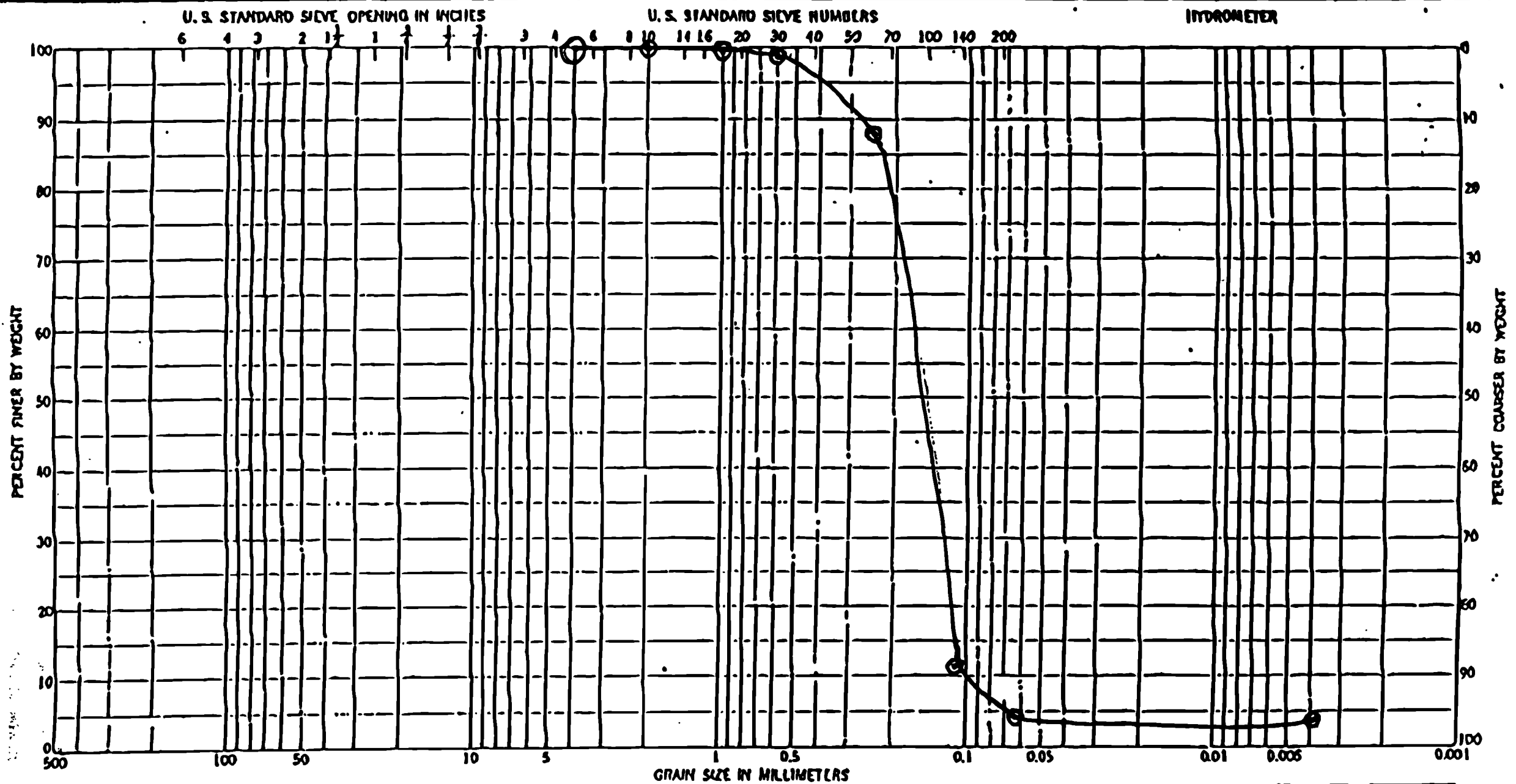






COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

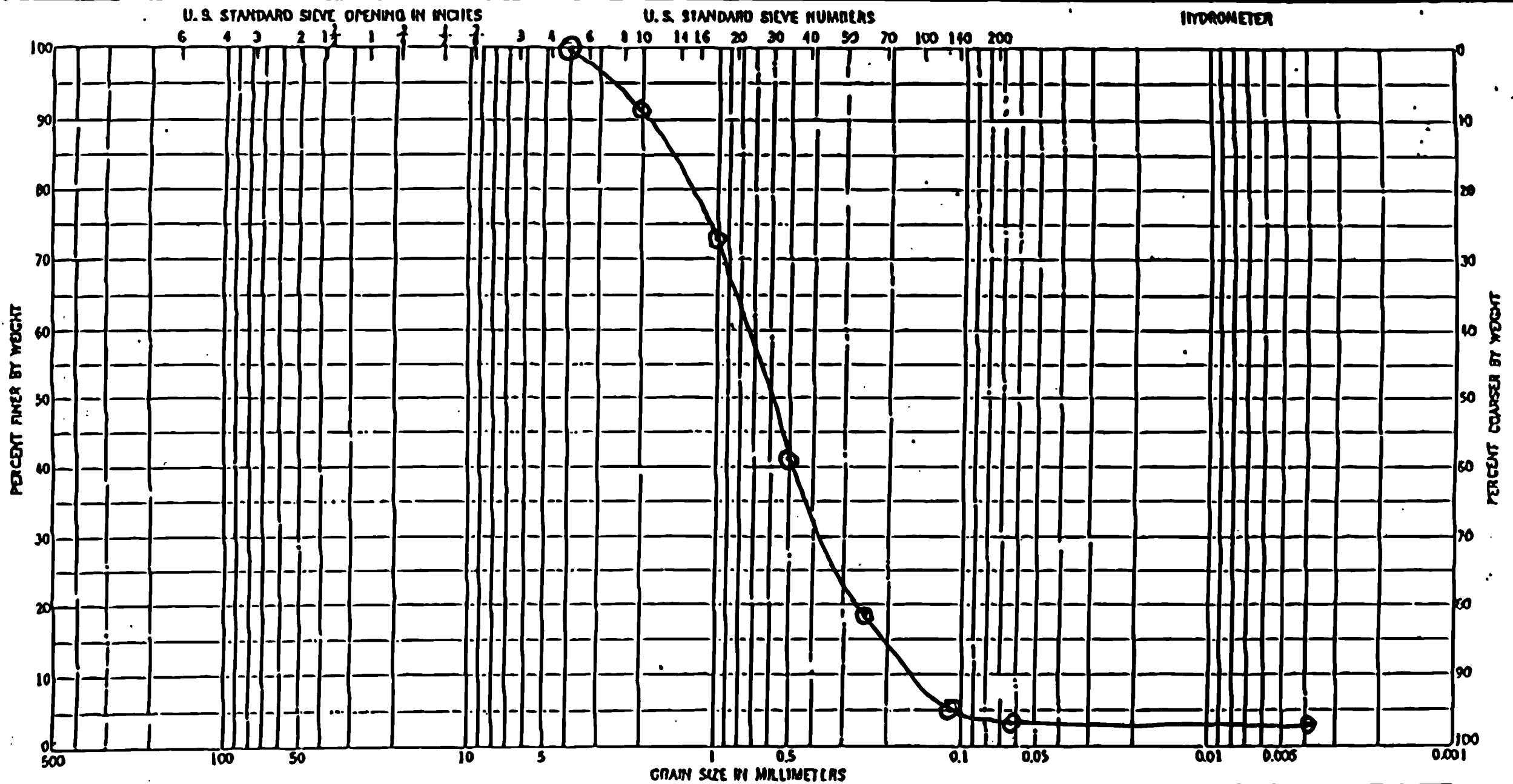
Sample No	Elev or Depth	VISUAL Classification	No. w %	LL	PL	PI	Notes
7.5-7.6		GRAVELS: COARSE GRAVEL SIZE SHELLS (WHOLE & FRAGMENTS), AND LIMESTONE FRAGMENTS, SOME SAND, (GP)					SAND RESOURCE SURVEY OFF SAND KEY
		VISUAL % SHELL APPROX. 60%					Area
GRADATION CURVES							Boring No. COE-94-9 (2)
							Date 11-10-94



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

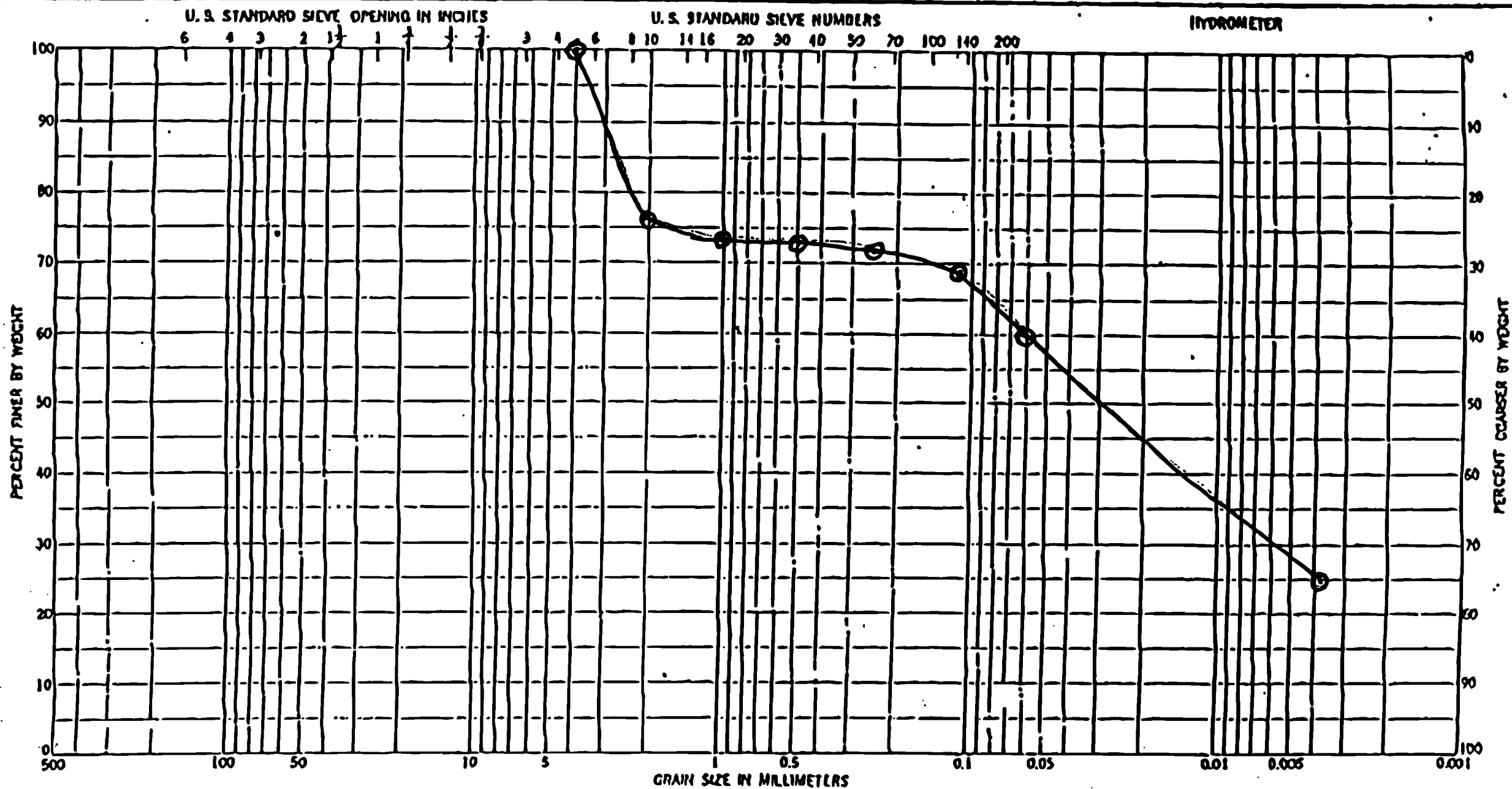
Sample No.	Elev or Depth	VISUAL Classification	Moisture %	LL	PL	PI	Project
0.4-0.5		SAND, FINE TO MEDIUM QUARTZ, DARK GRAY, SHELL FRAGMENTS, TRACE BLACK SANDS (PHOSPHATES?) (SP)					SAND RESOURCE SURVEY OFF SAND KEY
		VISUAL %SHELL APPROX. 5%					Area
							Boring No. COE-94-10(2)
							Date 12-13-94



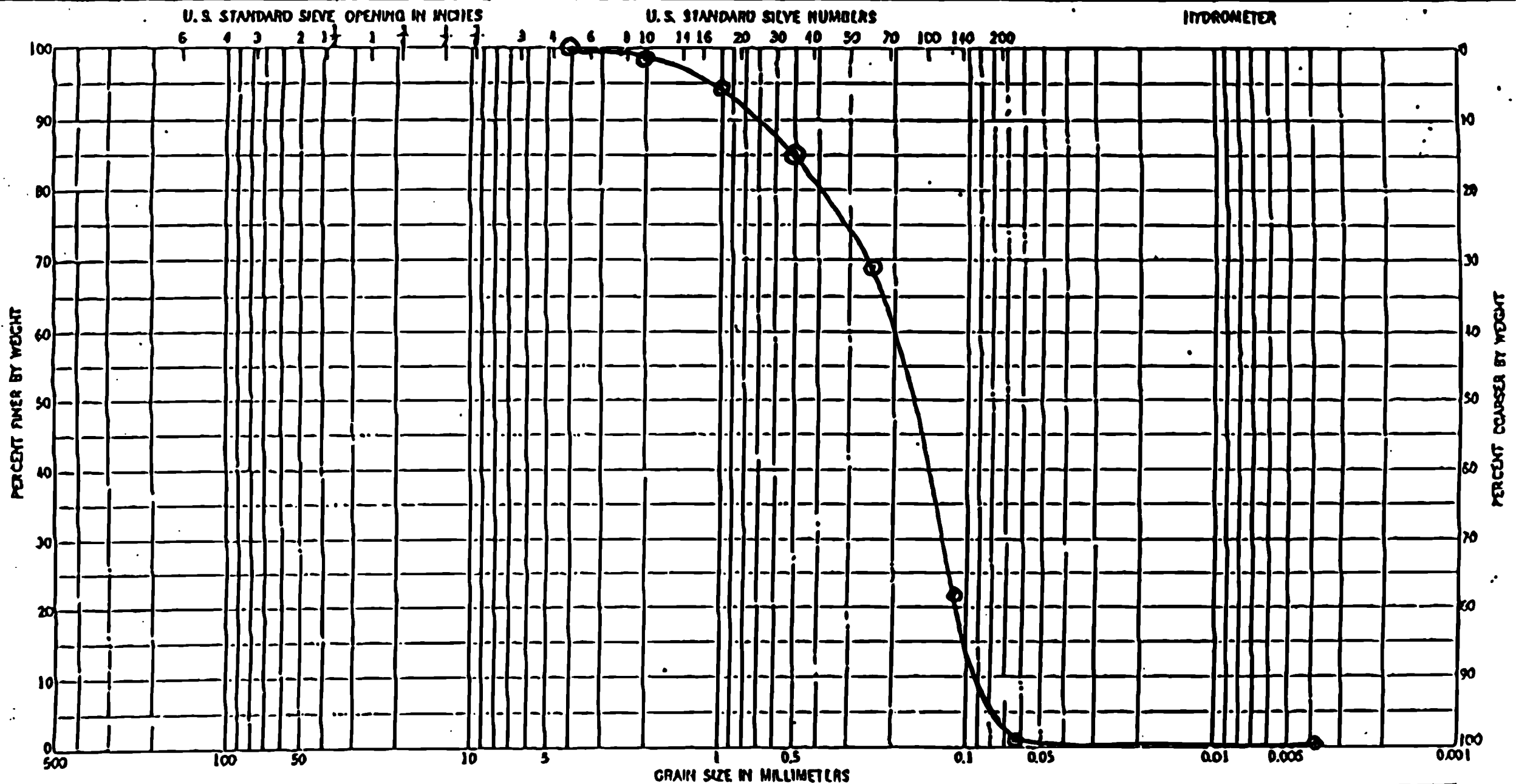


COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Sample No.	Elev. or Depth	VISUAL Classification	Moisture %	LL	PL	PI	Project
1.1-1.2		SAND, FINE TO MEDIUM QUARTZ, DARK GRAY COLOR, FINE GRAINED ANGULAR SHELL FRAGMENTS, (SW)					SAND RESOURCE SURVEY OFF SAND KEY
							Area
		VISUAL %SHELL APPROX. 45%					Boring No. COE-94-10.(2)
GRADATION CURVES							Date 12-13-94

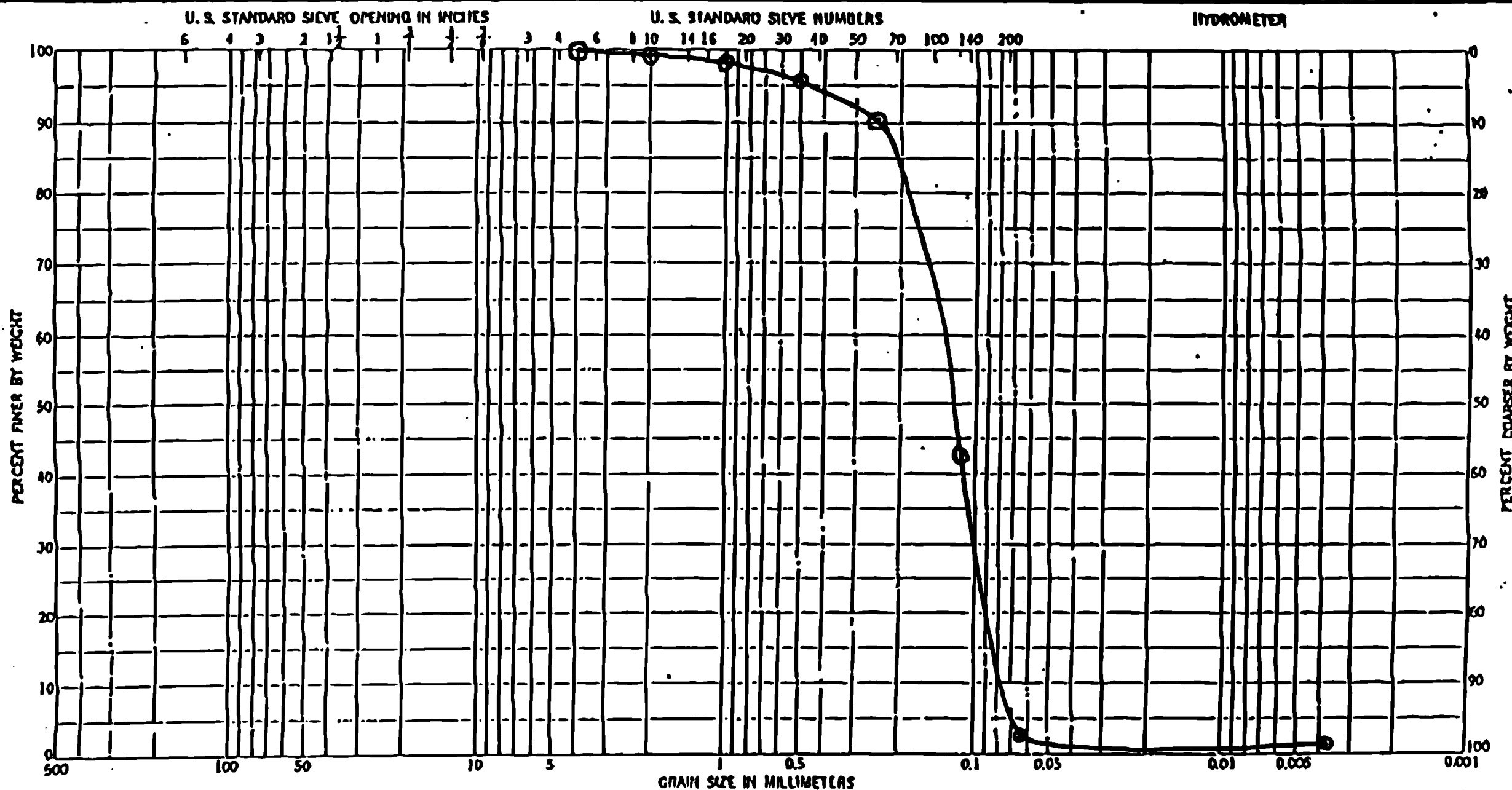






COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Sample No	Elev or Depth	VISUAL Classification	Moisture %	LL	PL	PI	Project
1.0-1.1		SAND, FINE TO MEDIUM QUARTZ, TRACE SHELL FRAGMENTS, GRAY COLOR, TRACE BLACK SANDS (PHOSPHATES?), (SP)					SAND RESOURCE SURVEY OFF SAND KEY
		VISUAL %SHELL APPROX. 5%					Area
GRADATION CURVES							Boring No. COE-94-3(2)
							Date 12-28-94

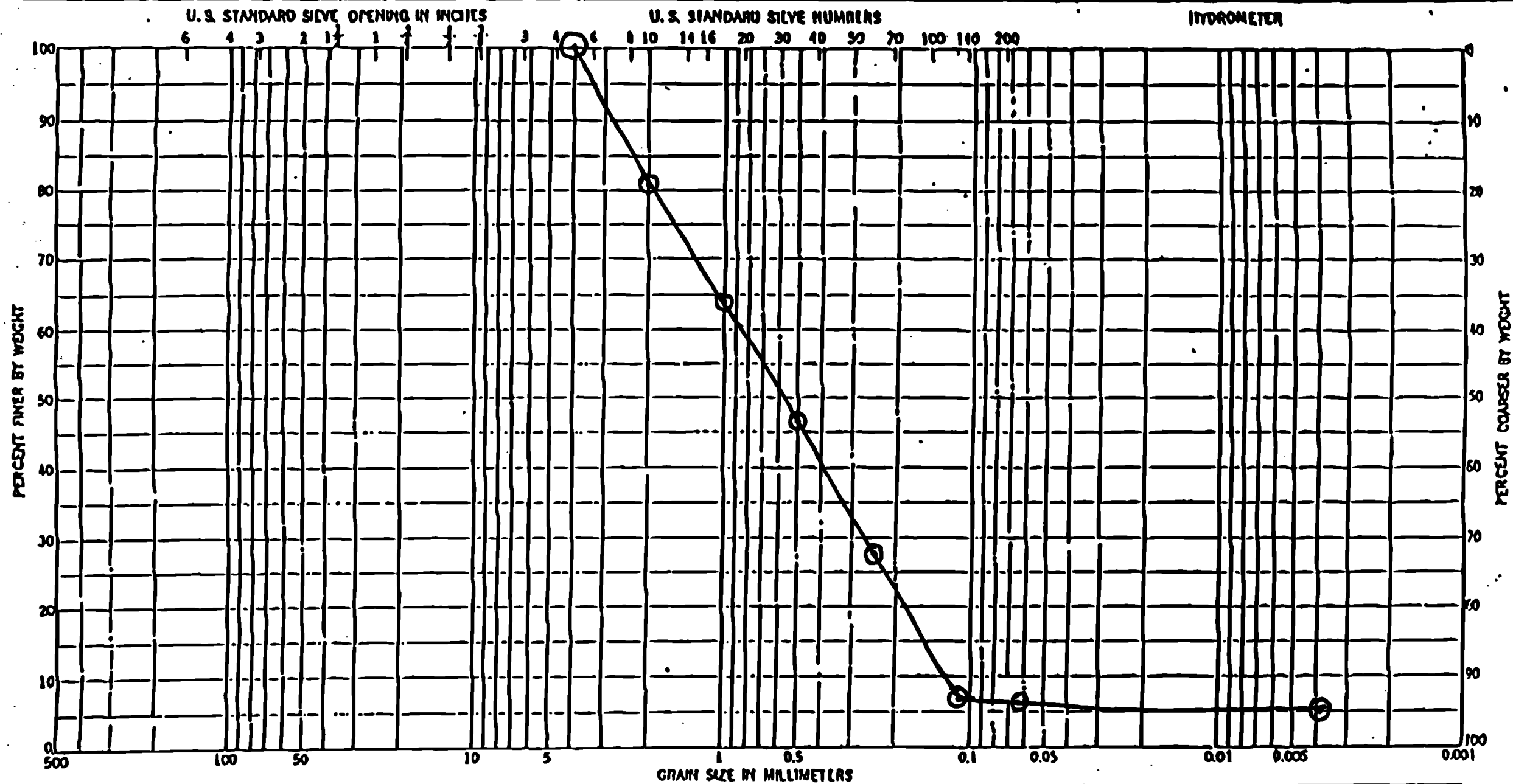


COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Sample No.	Elev or Depth	VISUAL Classification	Moisture %	LL	PL	PI	Project
3.5-3.6		SILTY SAND, (SM)					SAND RESOURCE SURVEY OFF SAND KEY
		VISUAL %SHELL APPROX. 0%					Area
							Boring No. COE-94-3 (2)
							Date 12-28-94

GRADATION CURVES



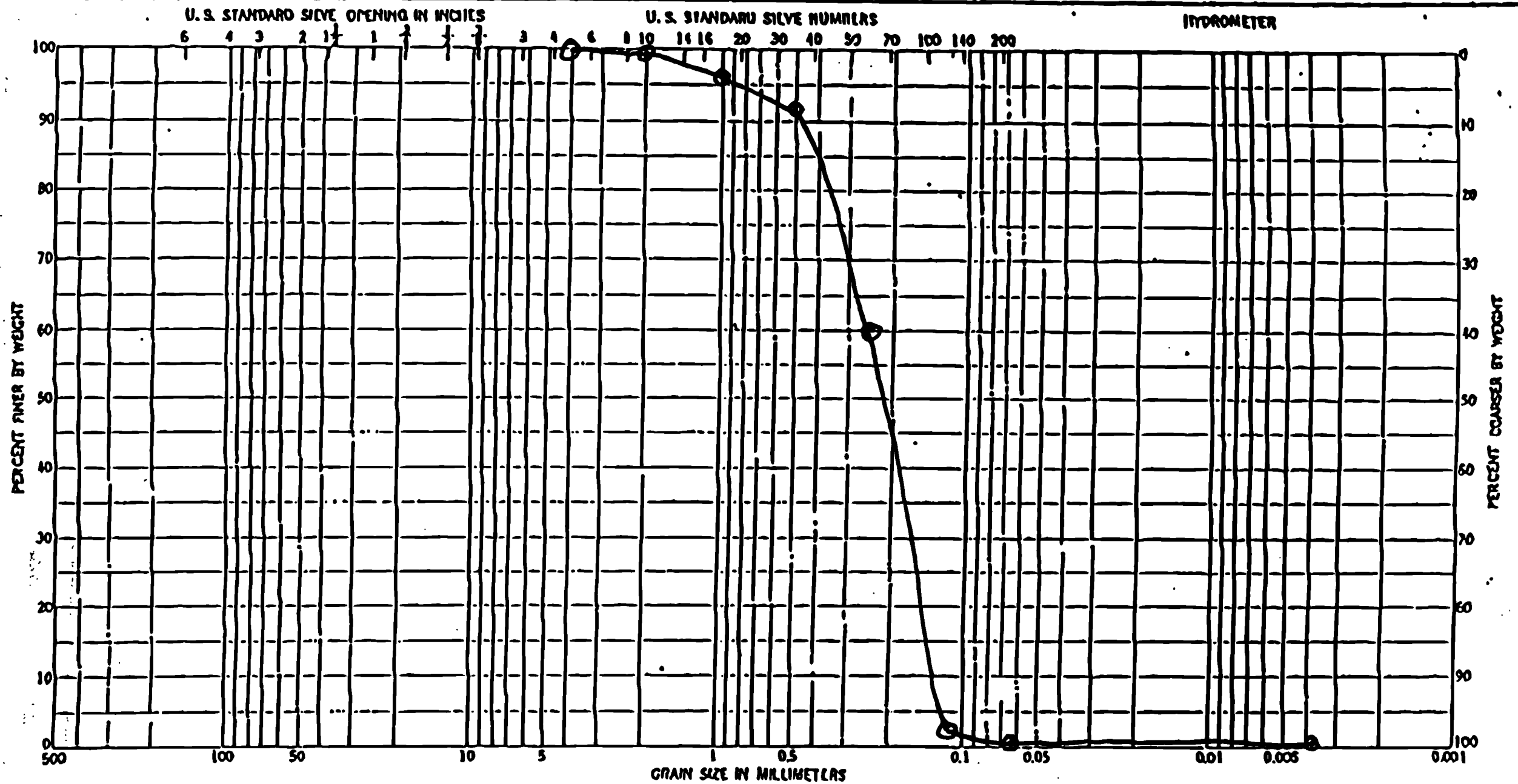


COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Sample No.	Elev or Depth	VISUAL Classification	Moisture %	LL	PL	PI	Project
2.7-2.8		MEDIUM QUARTZ SAND, DARK GRAY COLOR, MEDIUM TO COARSE SAND SIZE SHELL FRAGMENTS, (SW)					SAND RESOURCE SURVEY OFF SAND KEY
							Area
							Boring No. COE-94-11(2)
							Date 12-13-94
GRADATION CURVES							



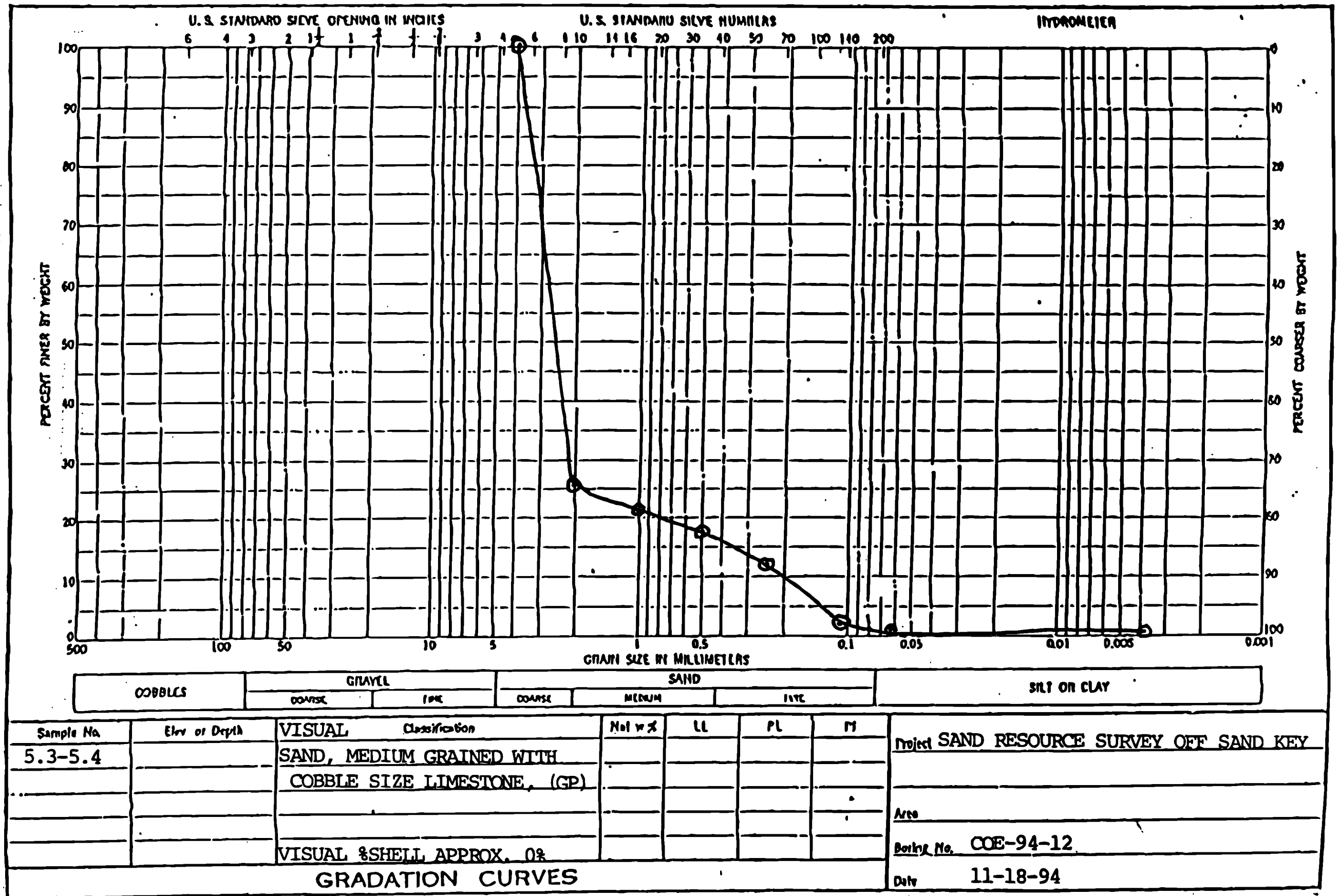




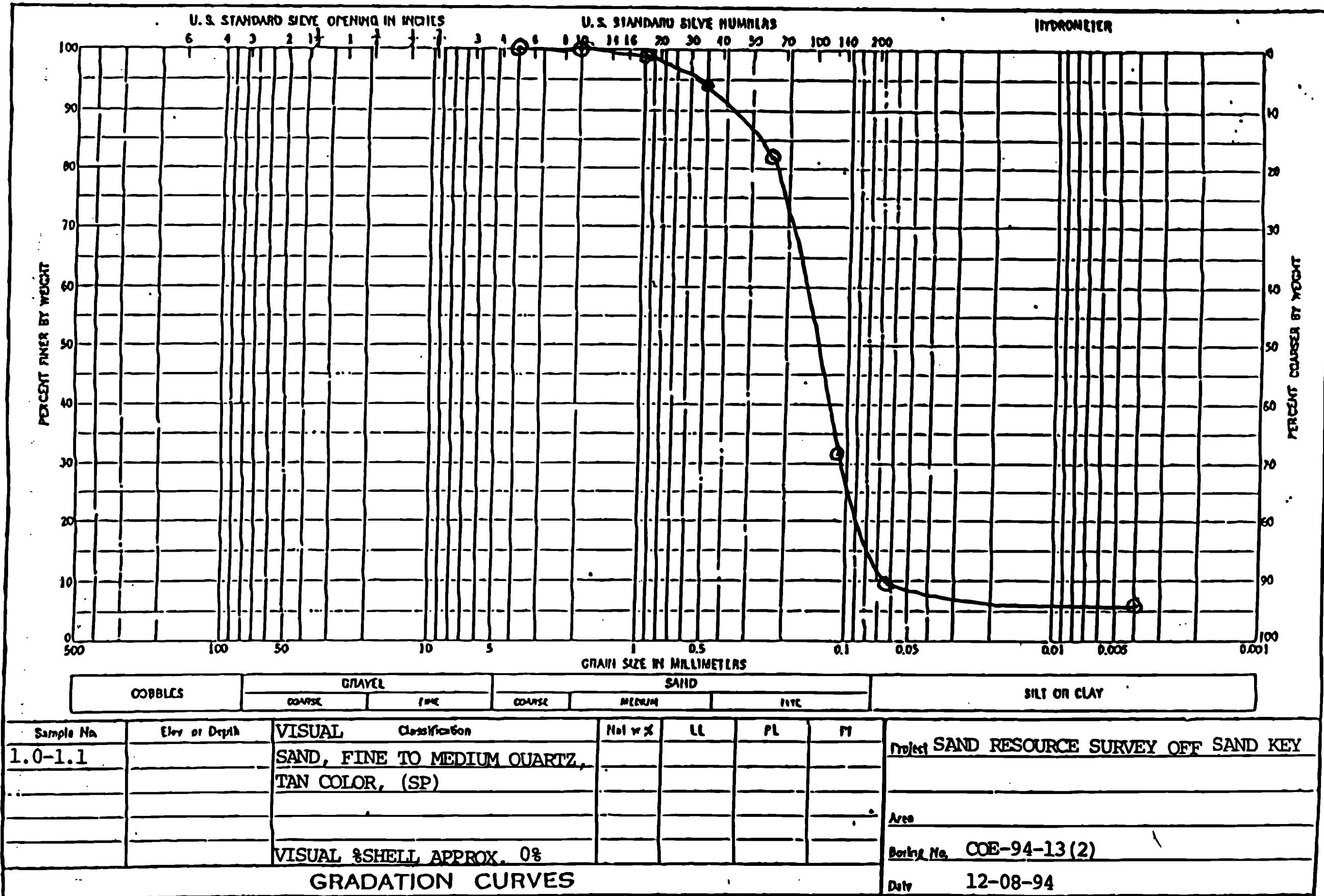
COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Sample No.	Elev. or Depth	VISUAL Classification	Moisture %	LL	PL	PI	Project
3.2-3.3		SAND, QUARTZ, TAN COLOR, FINE TO MEDIUM SIZE SHELL FRAGMENTS, (SP)					SAND RESOURCE SURVEY OFF SAND KEY
							Area
							Boring No. COE-94-12
							Date 11-18-94

GRADATION CURVES

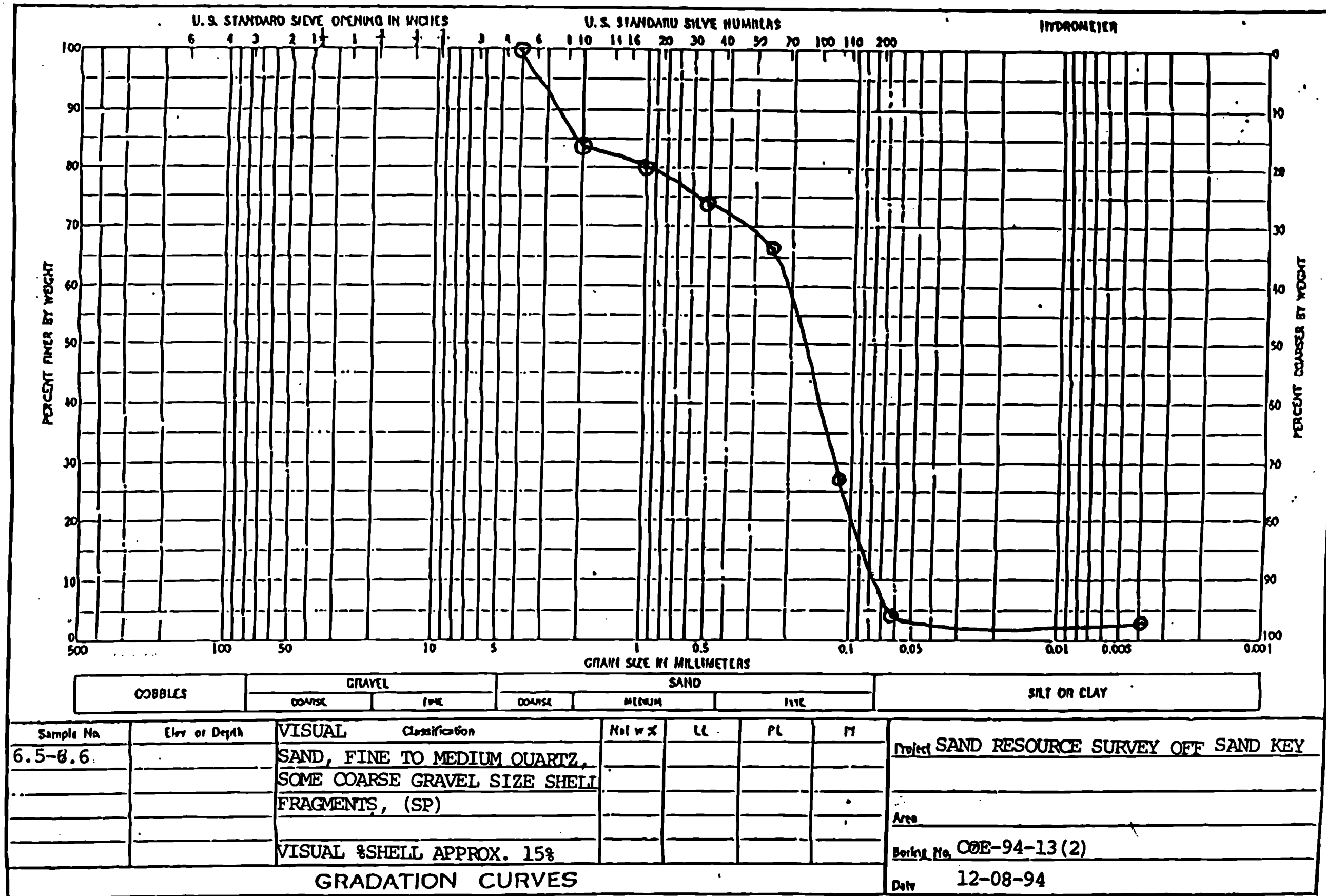






COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Sample No.	Elev or Depth	VISUAL Classification	Moisture %	LL	PL	PI	Project
1.0-1.1		SAND, FINE TO MEDIUM QUARTZ, TAN COLOR, (SP)					SAND RESOURCE SURVEY OFF SAND KEY
							Area
							Boring No. COE-94-13(2)
							Date 12-08-94

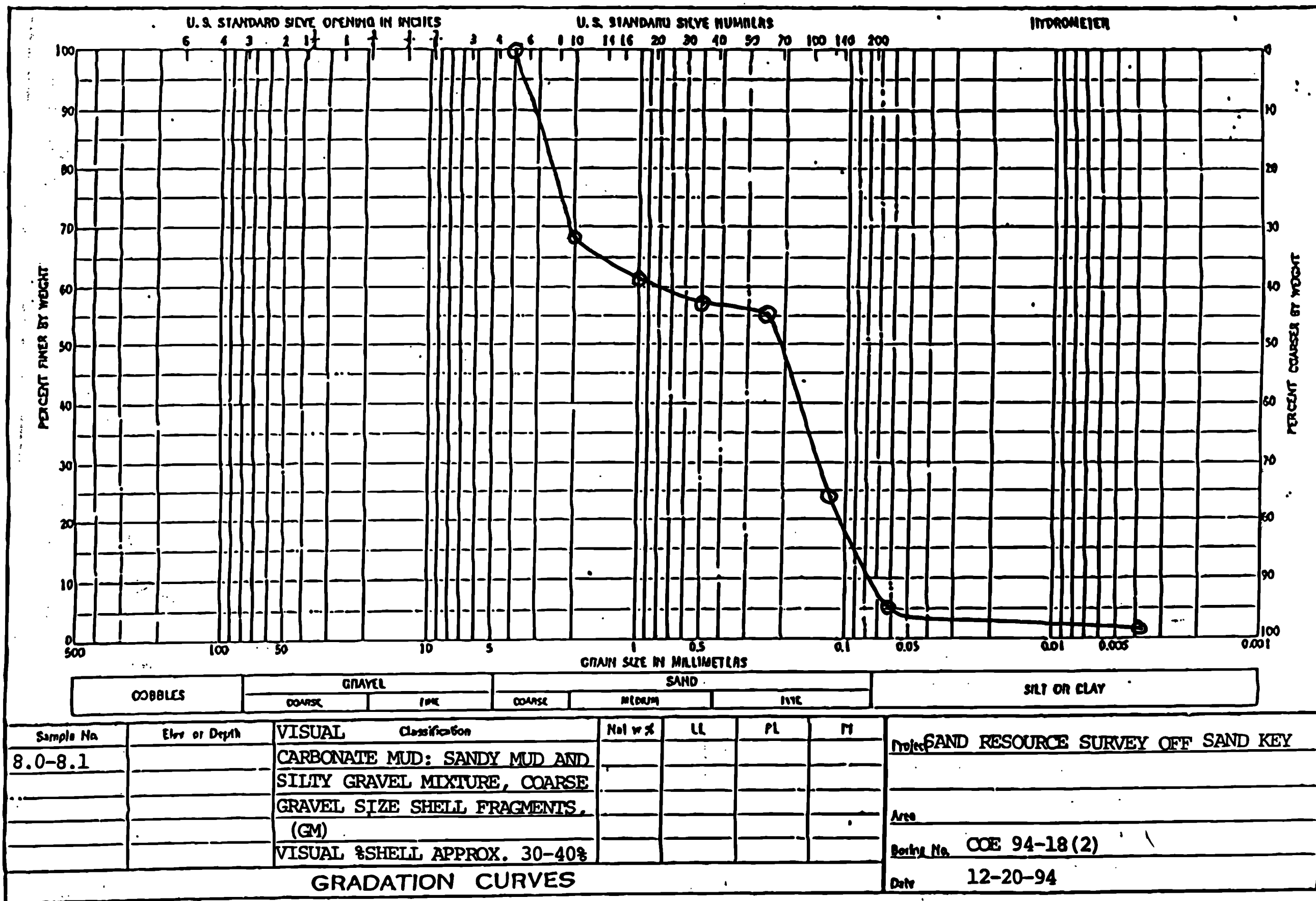


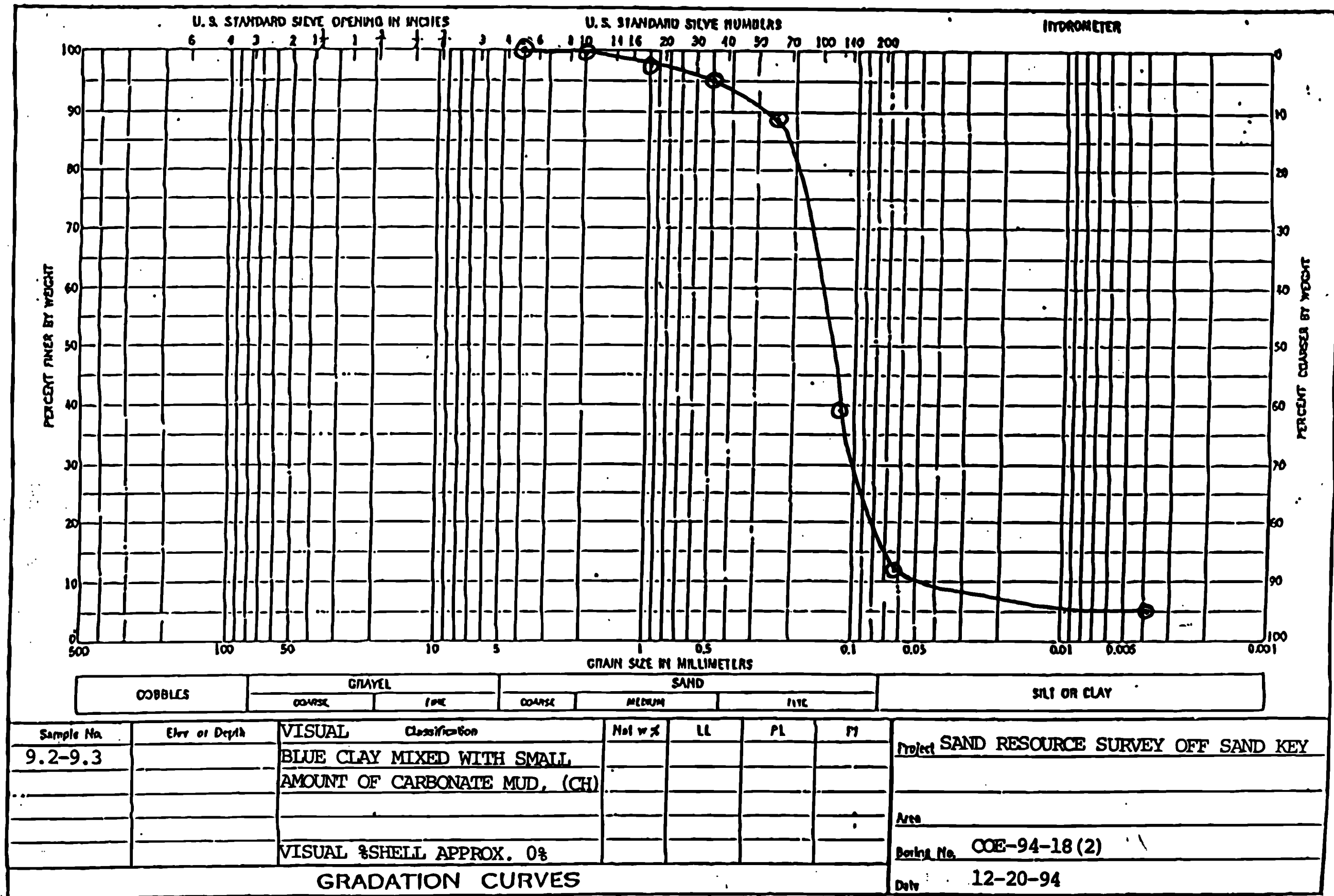


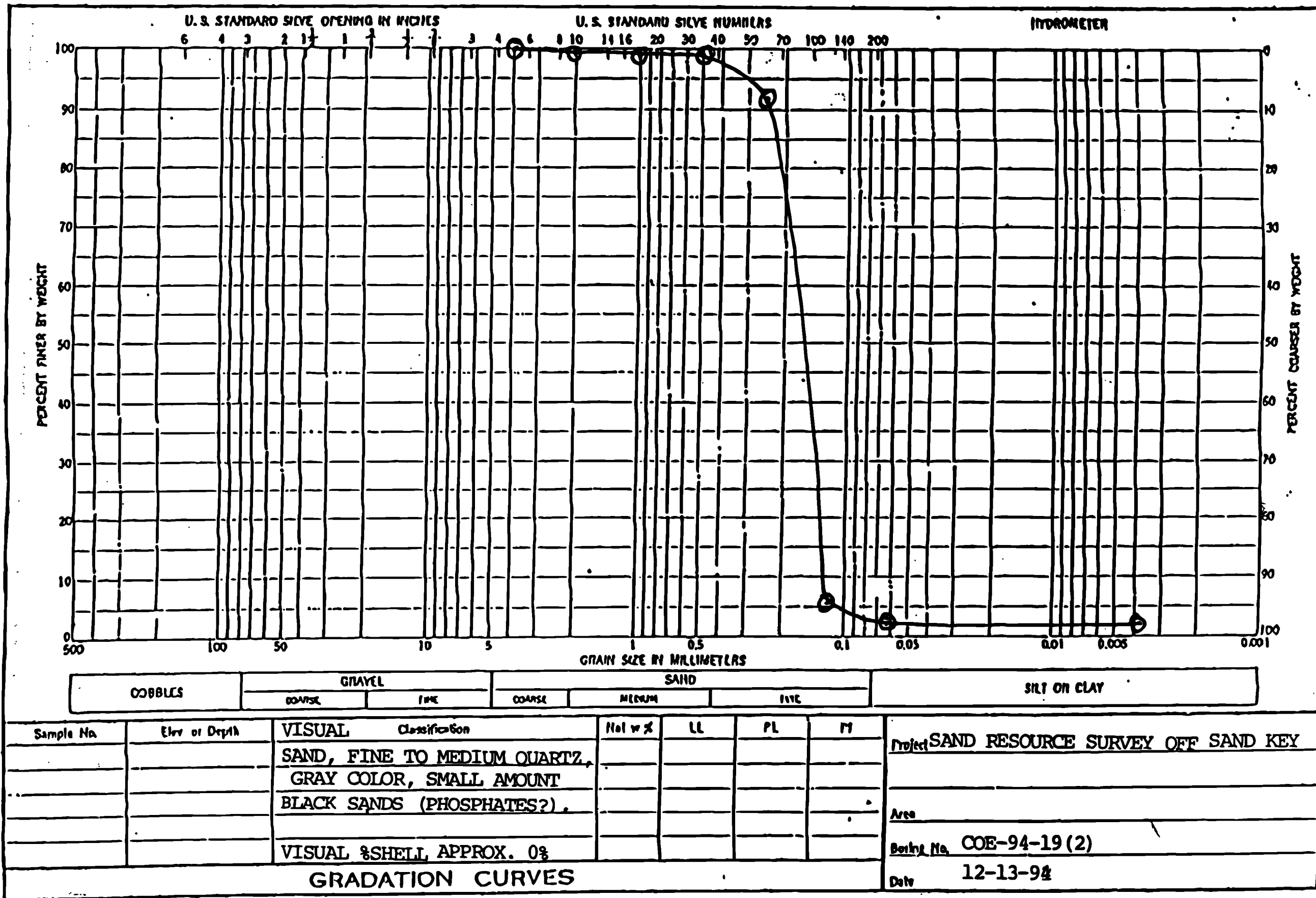




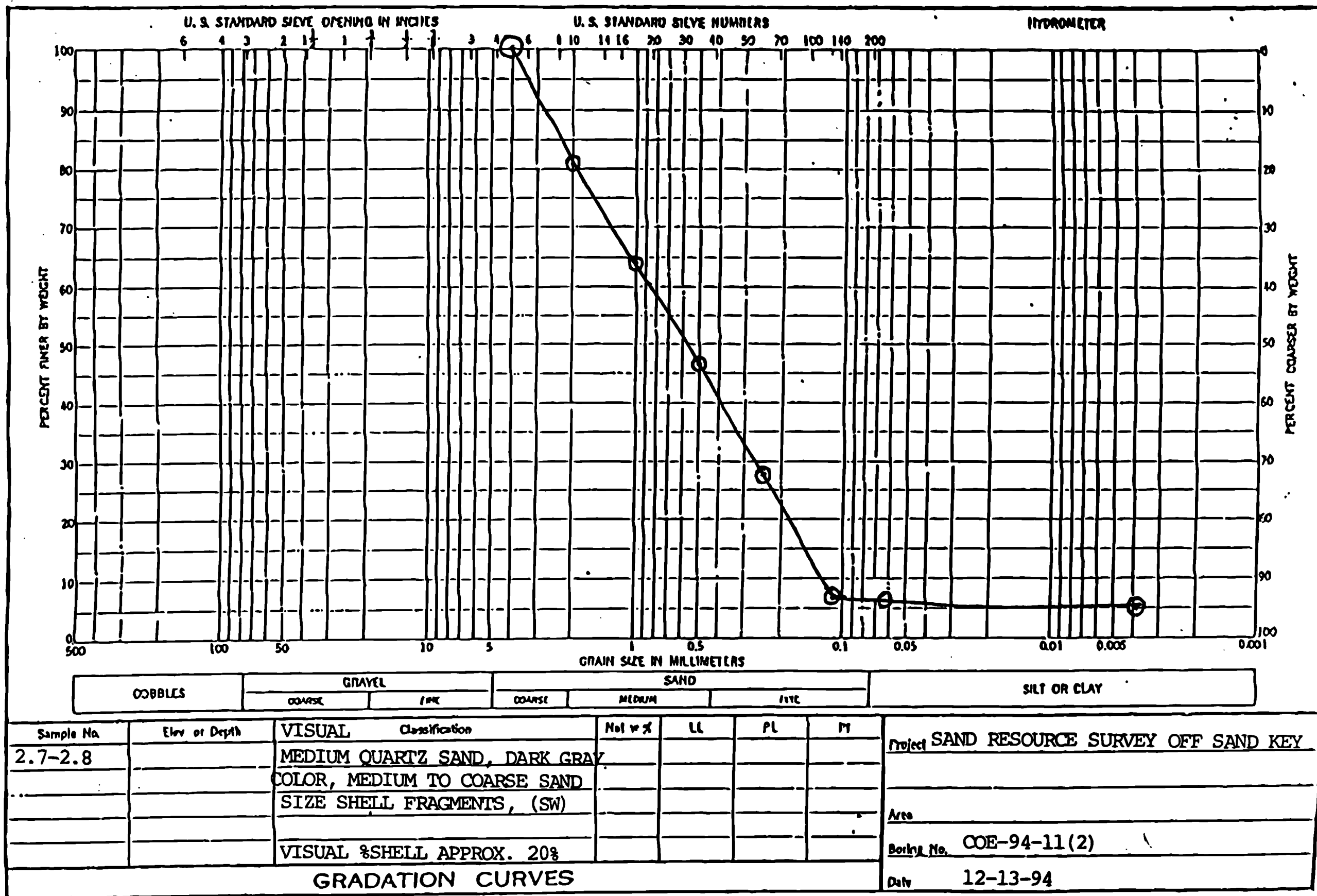


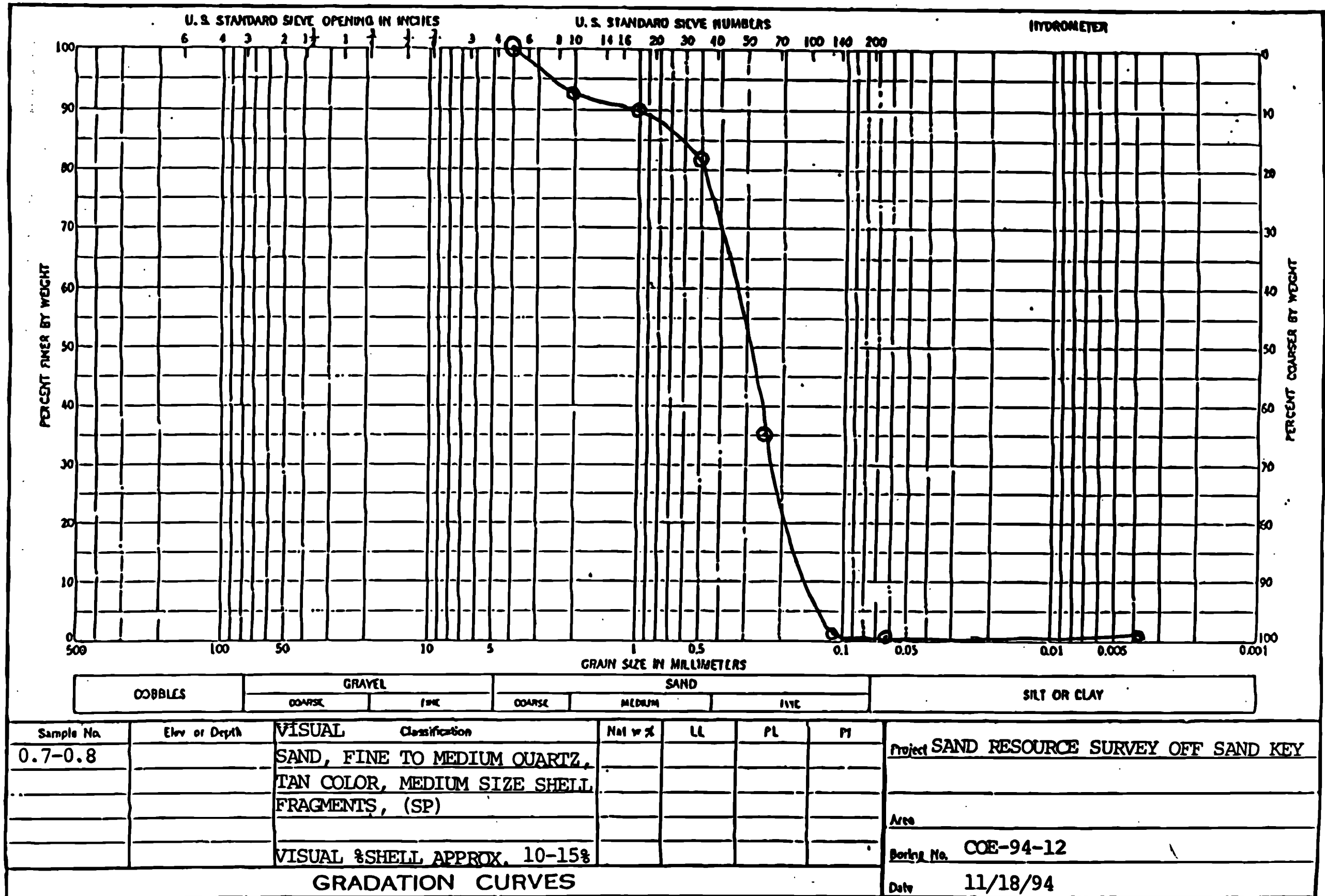






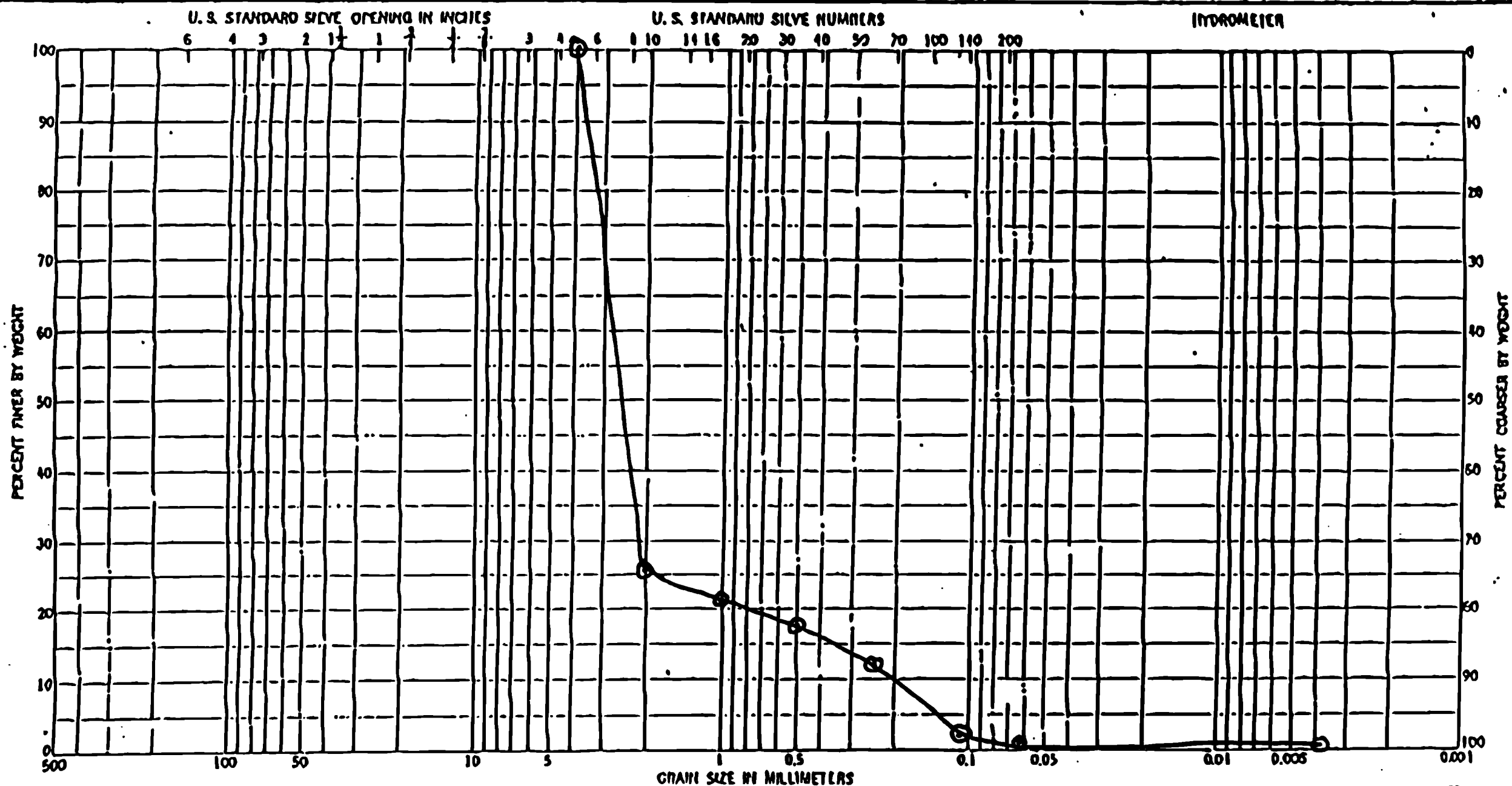






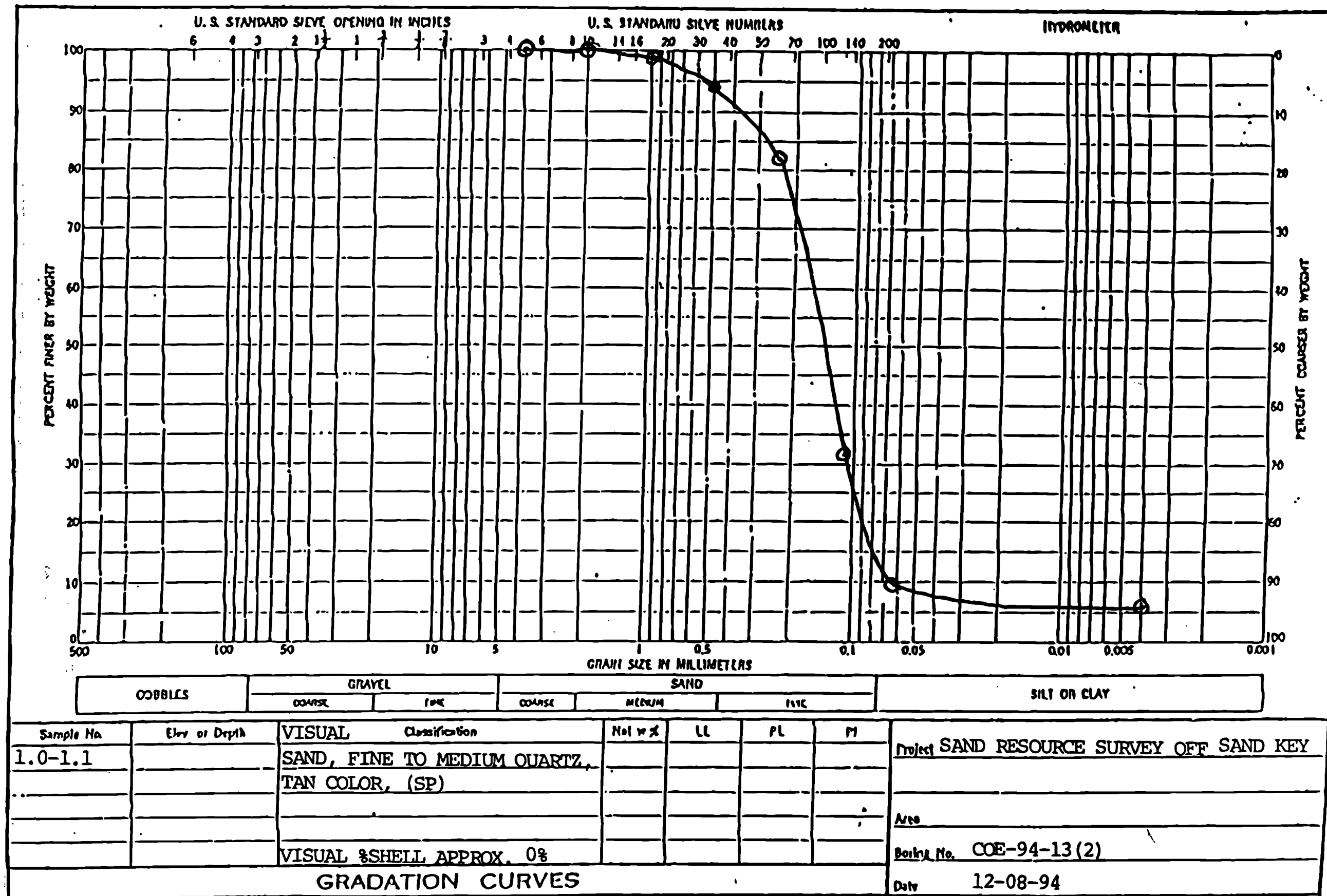


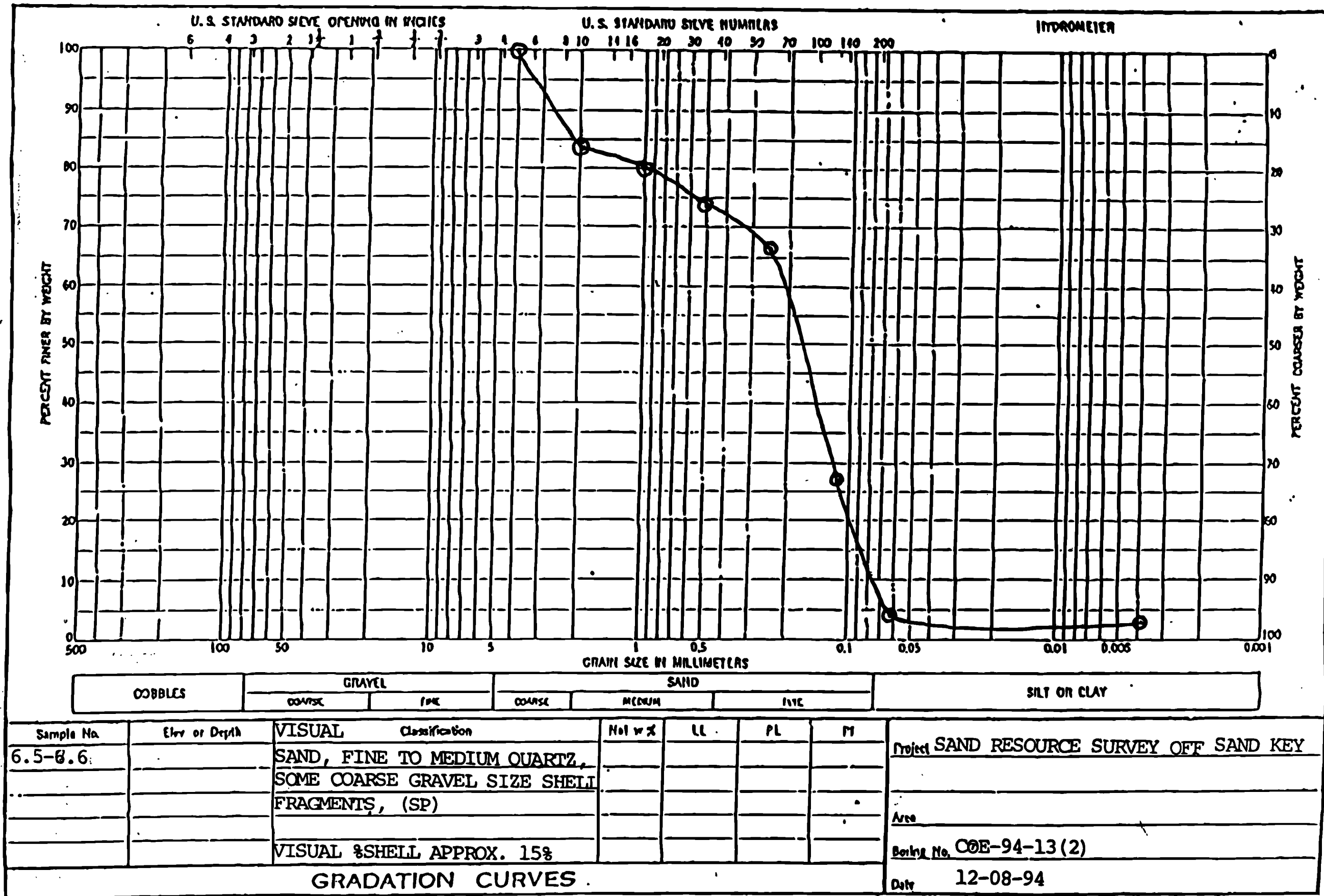




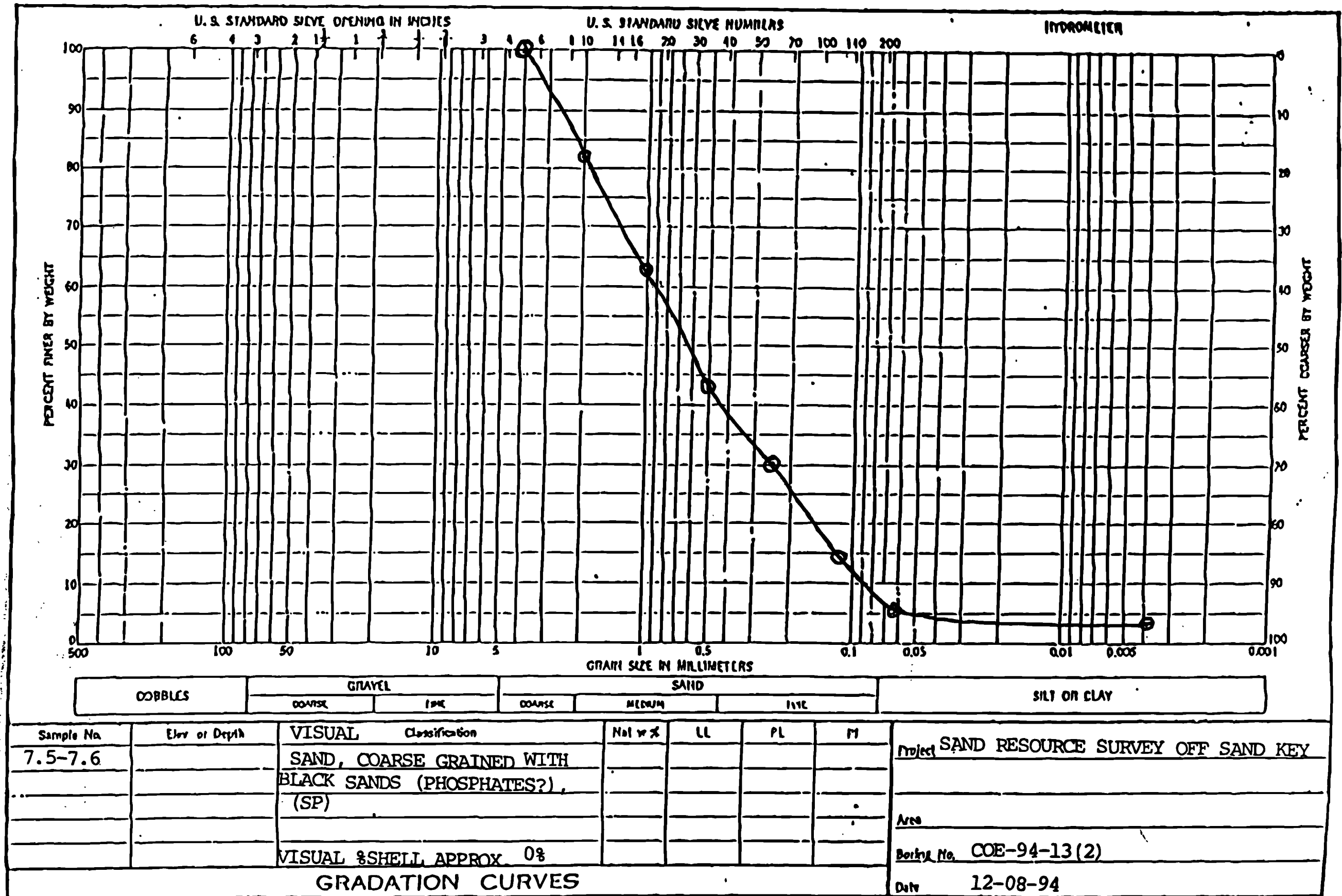
COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

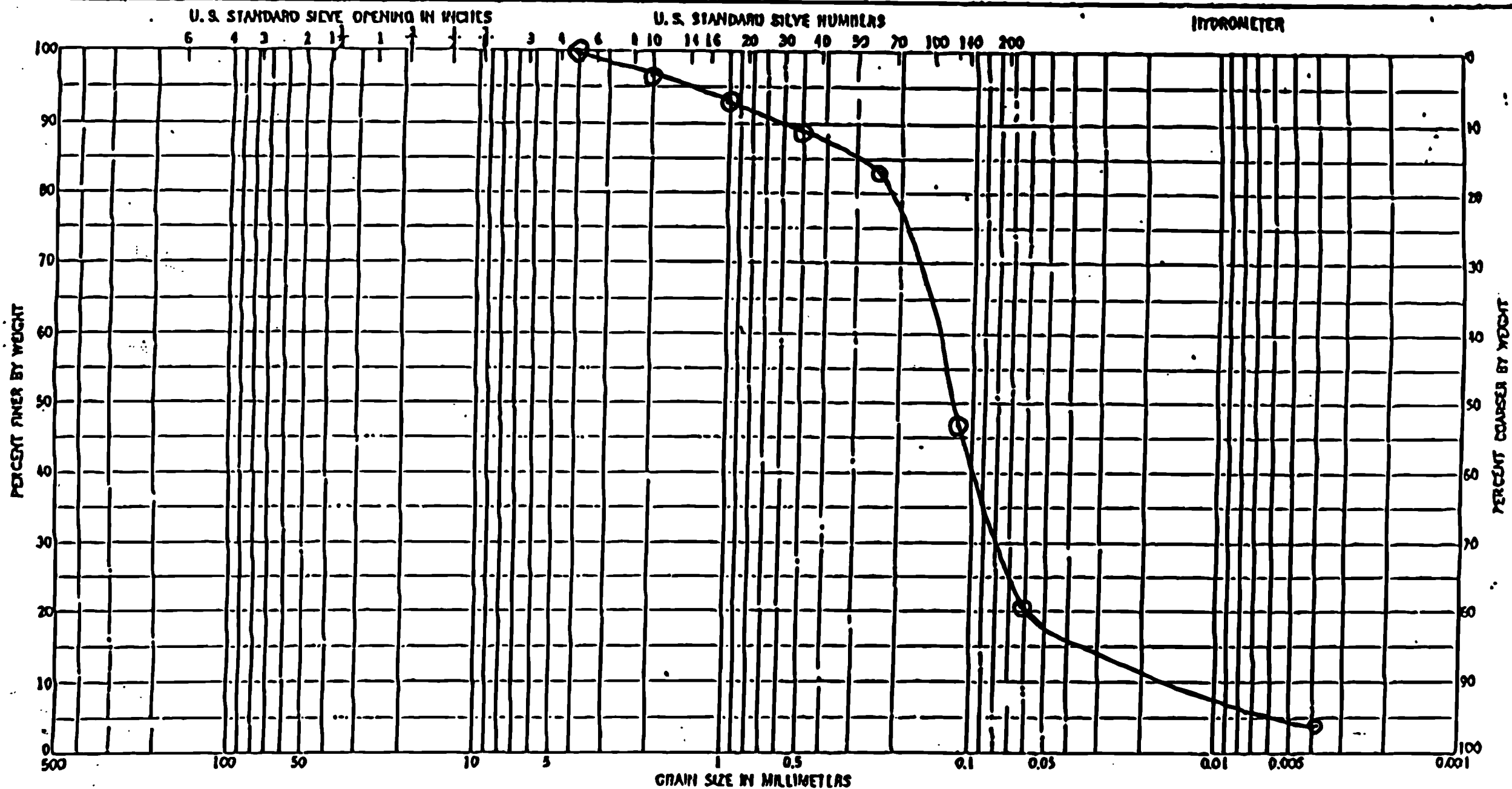
Sample No.	Elve or Depth	VISUAL Classification	Moist w %	LL	PL	P	Project SAND RESOURCE SURVEY OFF SAND KEY
5.3-5.4		SAND, MEDIUM GRAINED WITH COBBLE SIZE LIMESTONE, (GP)					
		VISUAL %SHELL APPROX. 0%					Area
GRADATION CURVES							Boring No. COE-94-12
							Date 11-18-94





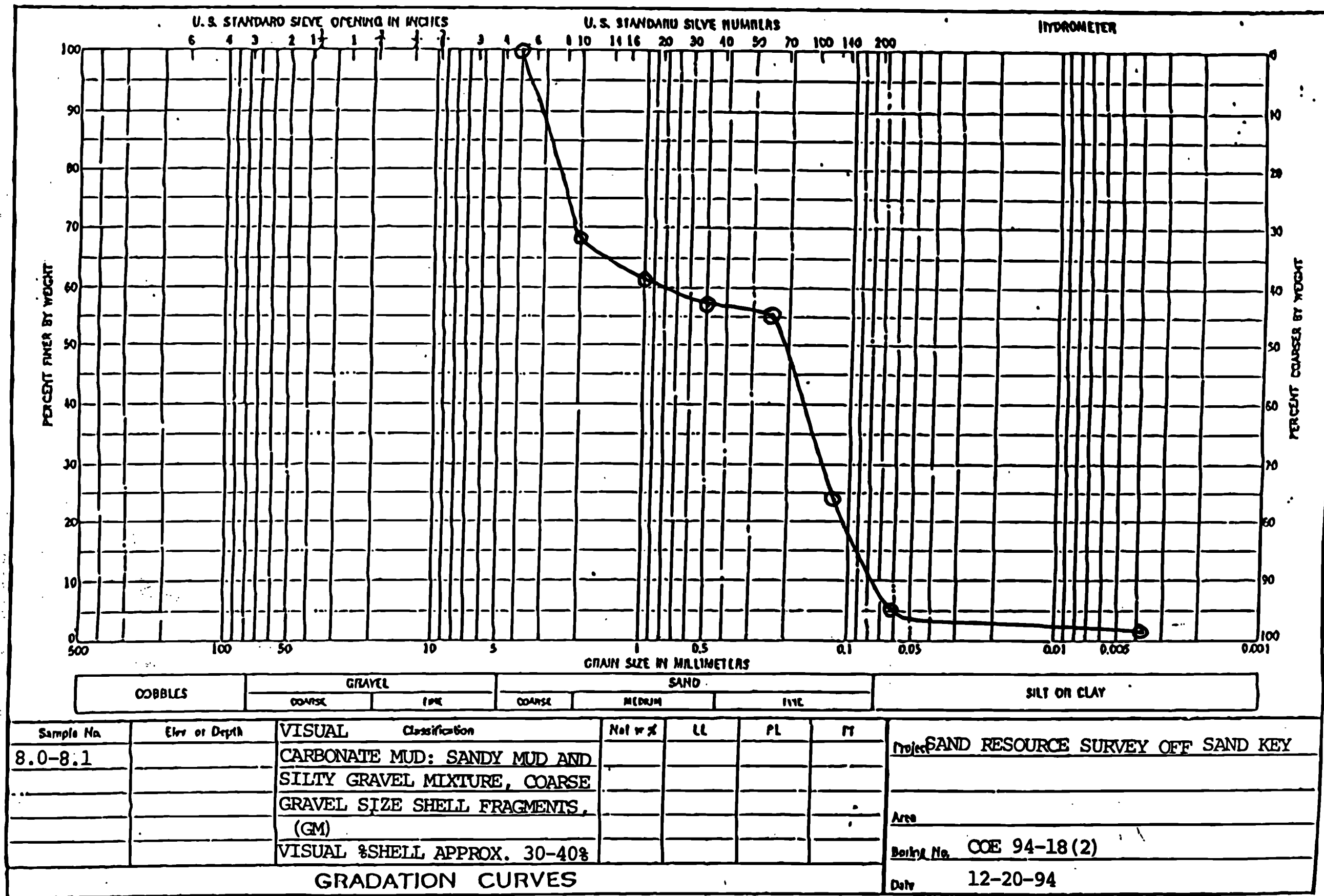




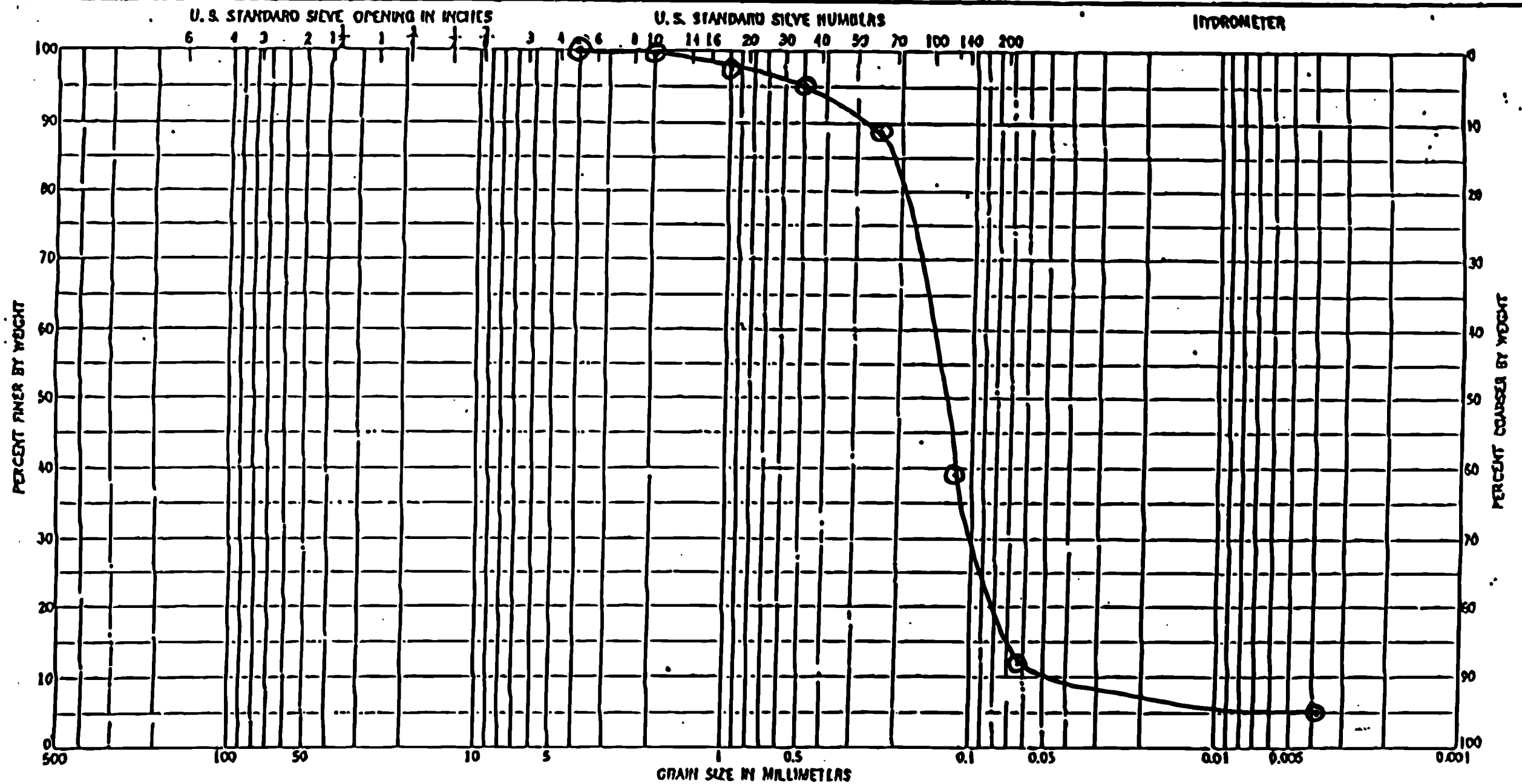


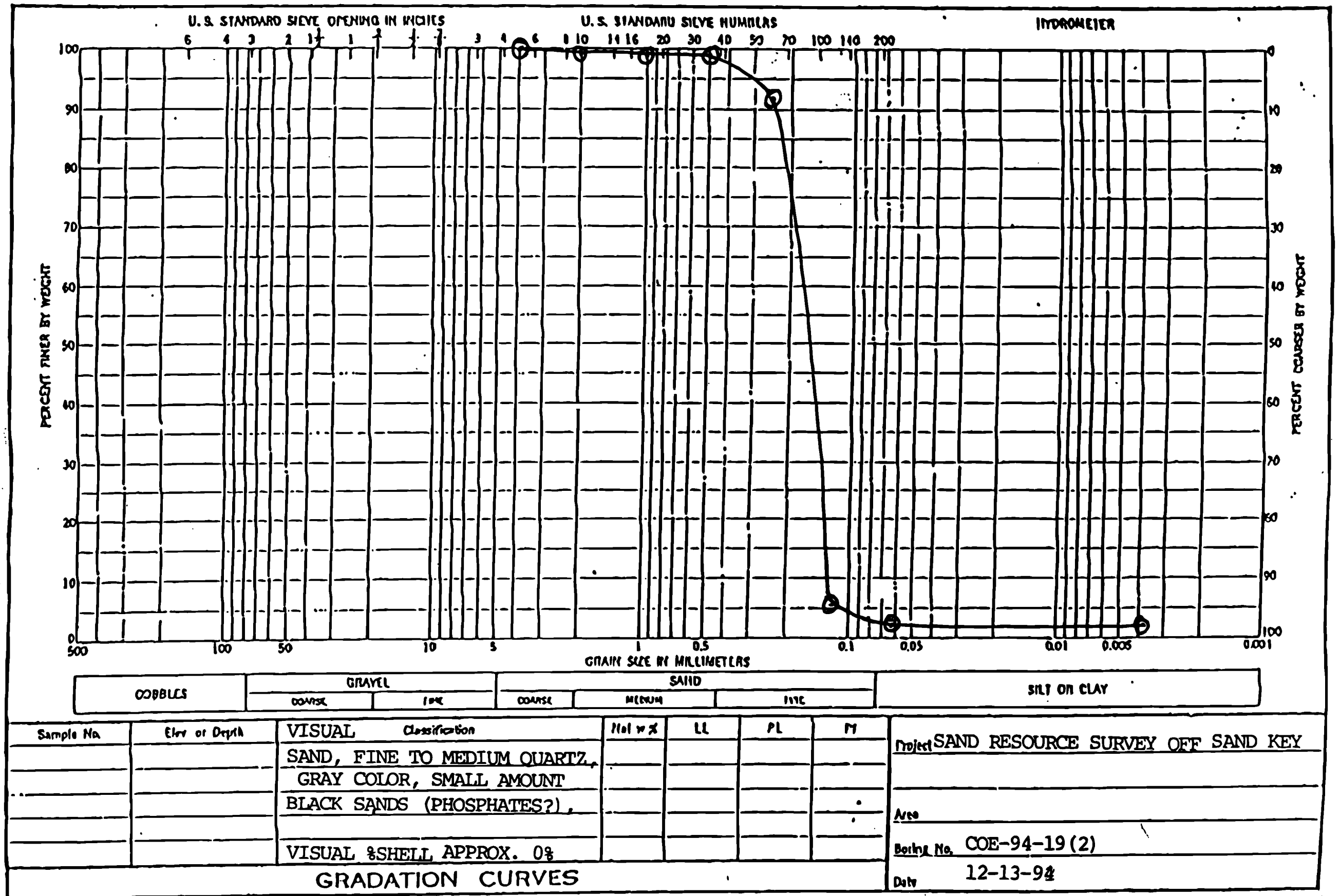
COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

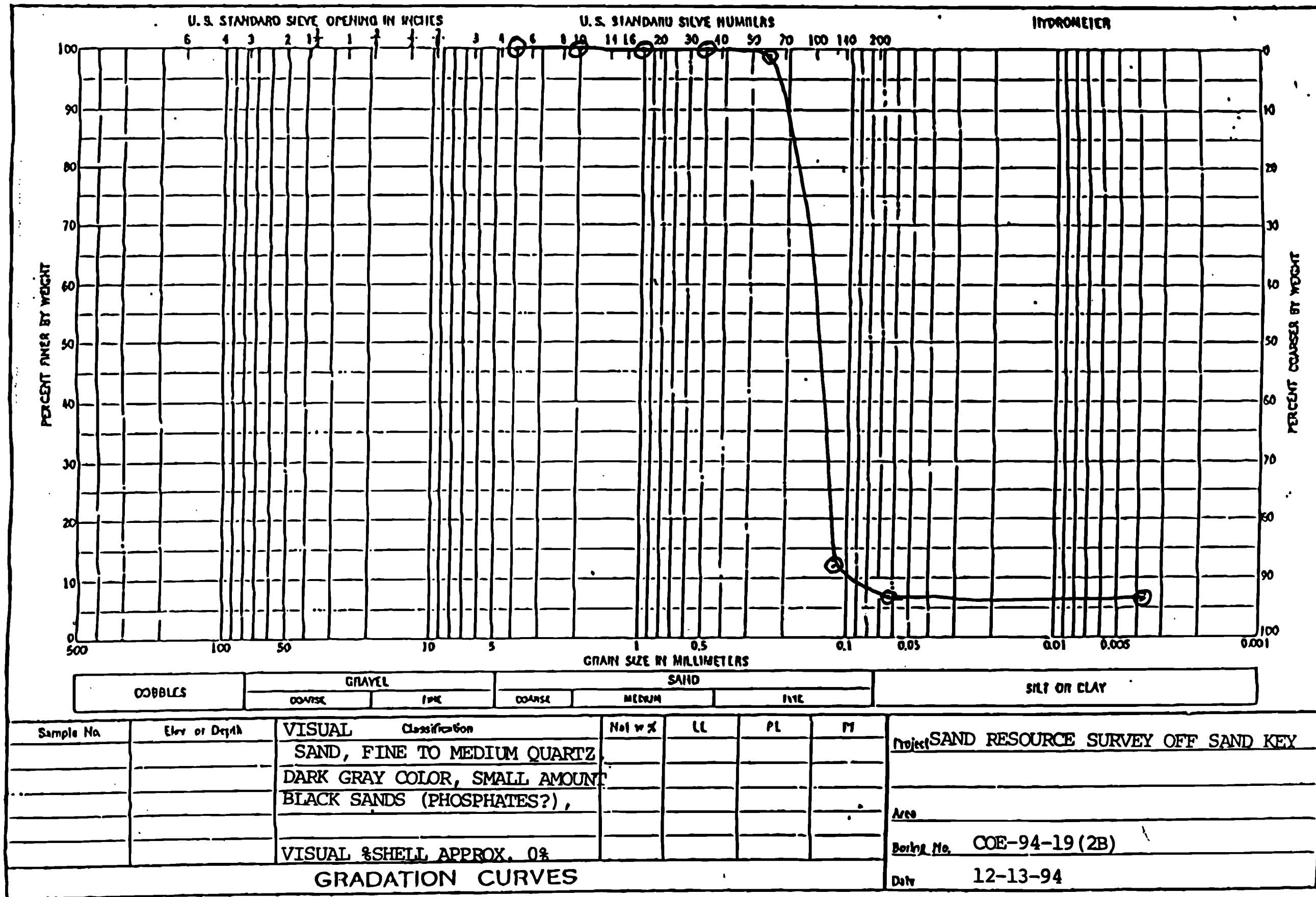
Sample No	Elev or Depth	VISUAL Classification	Moisture %	LL	PL	PI	Notes
6.4-6.5		SANDY SILTS TO SANDY CLAYS, TRACE SHELL FRAGMENTS, DARK BROWN TO GRAY COLOR VARIATIONS (ML)					SAND RESOURCE SURVEY OFF SAND KEY
		VISUAL %SHELL APPROX. 5%					Area
							Booth No. COE-94-18 (2)
							Date 12-20-94



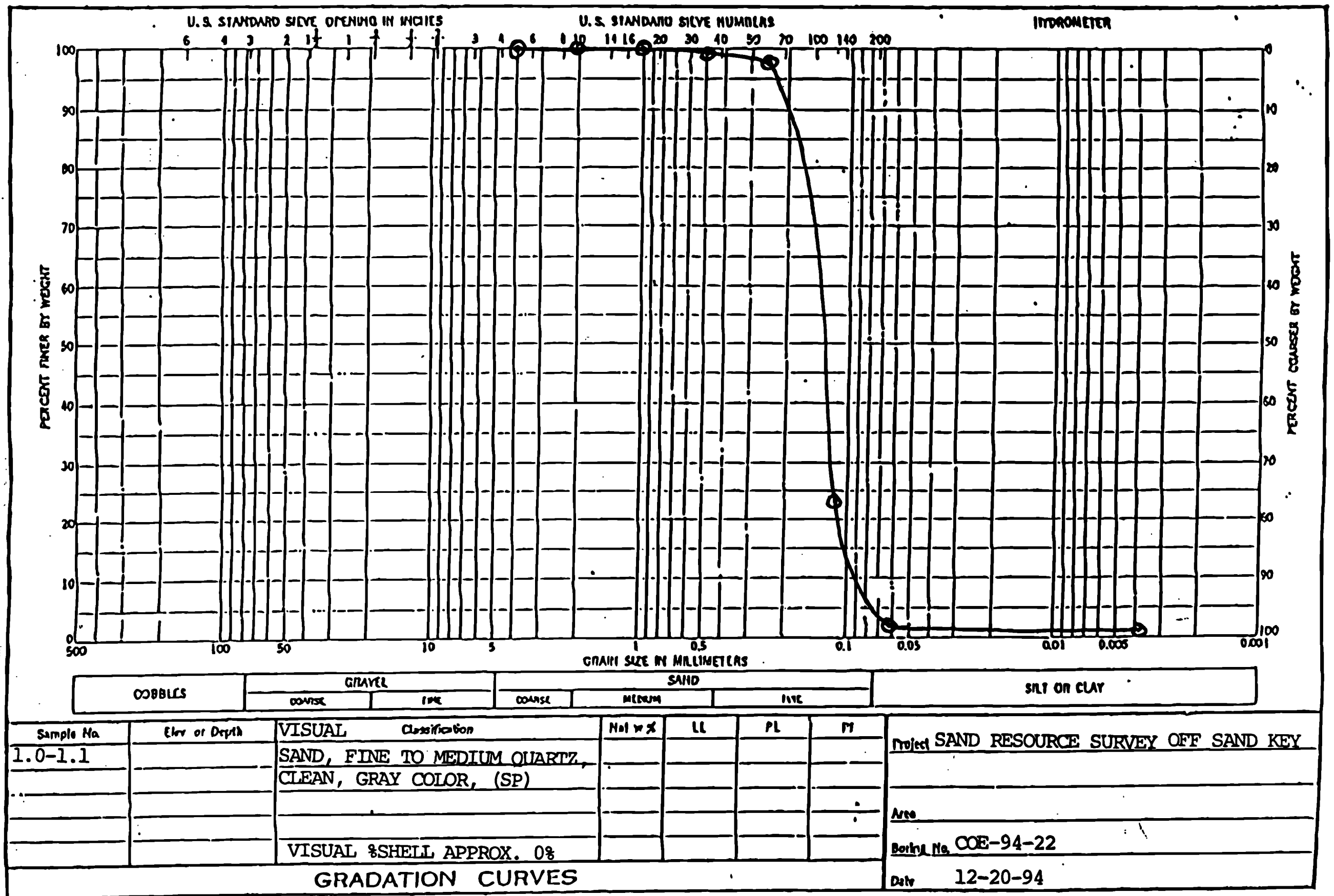


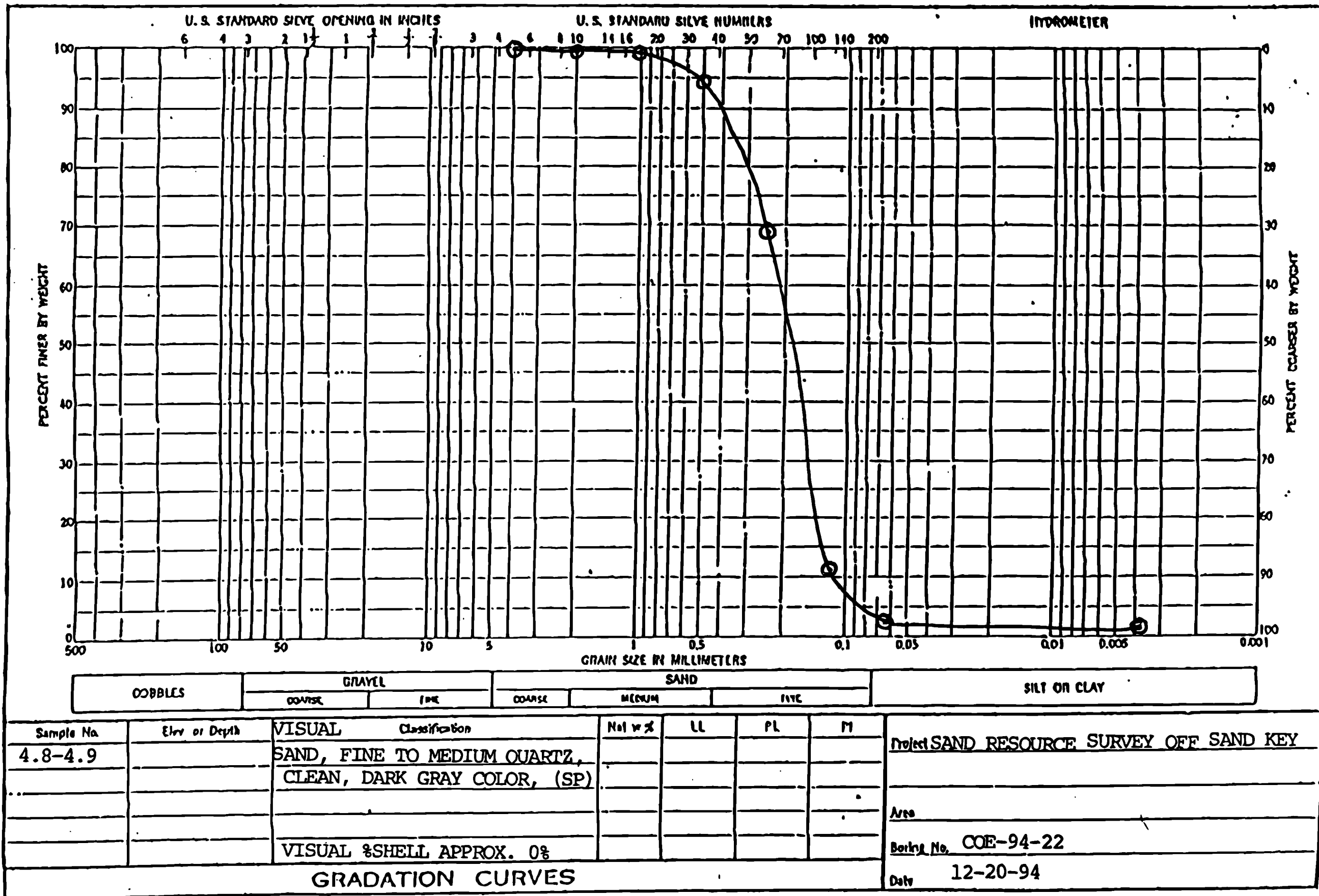


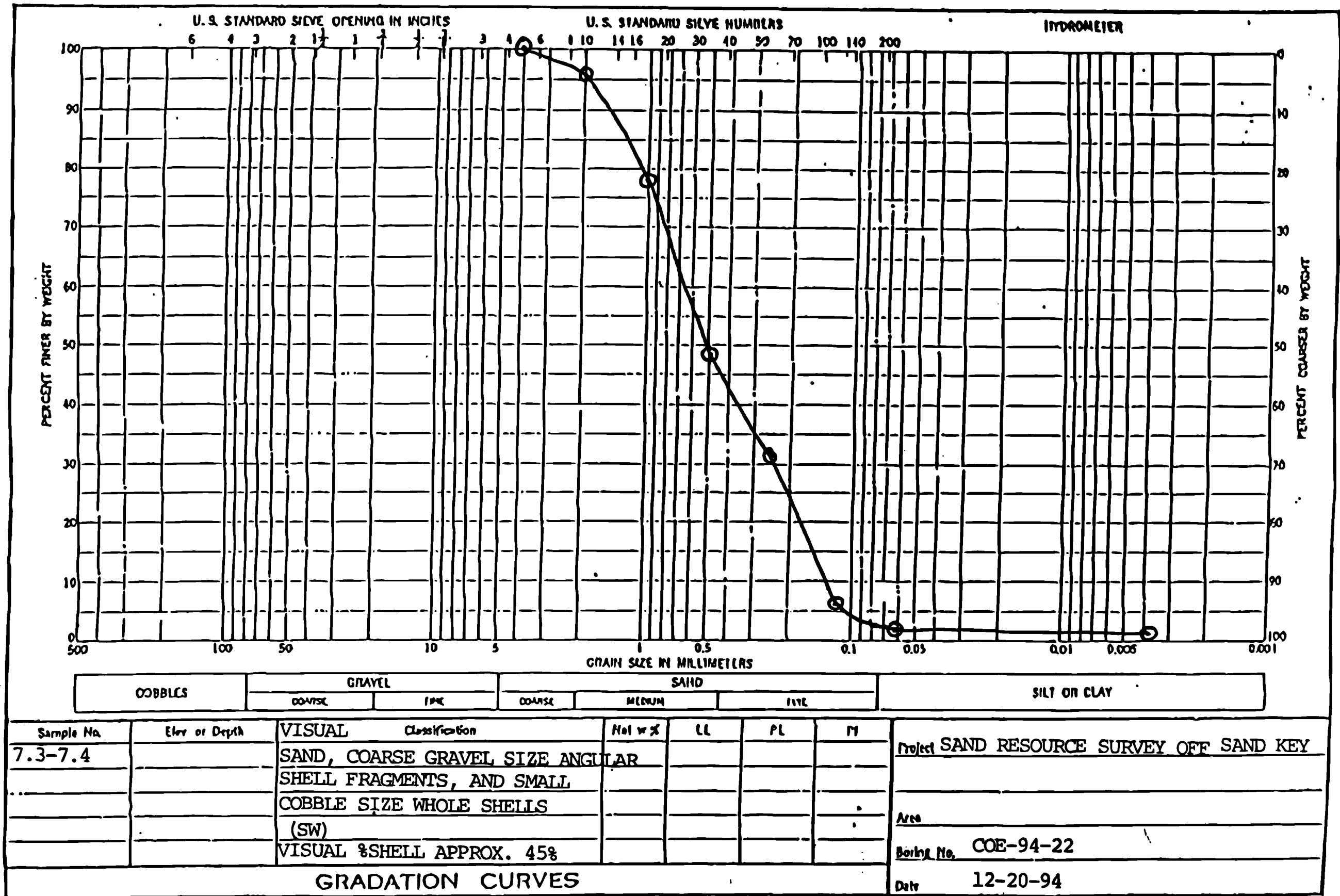














# Location Map



Scale = 1:300,000

5 0 5 10 15 MILES

5 0 5 10 15 KILOMETERS

Contours in feet

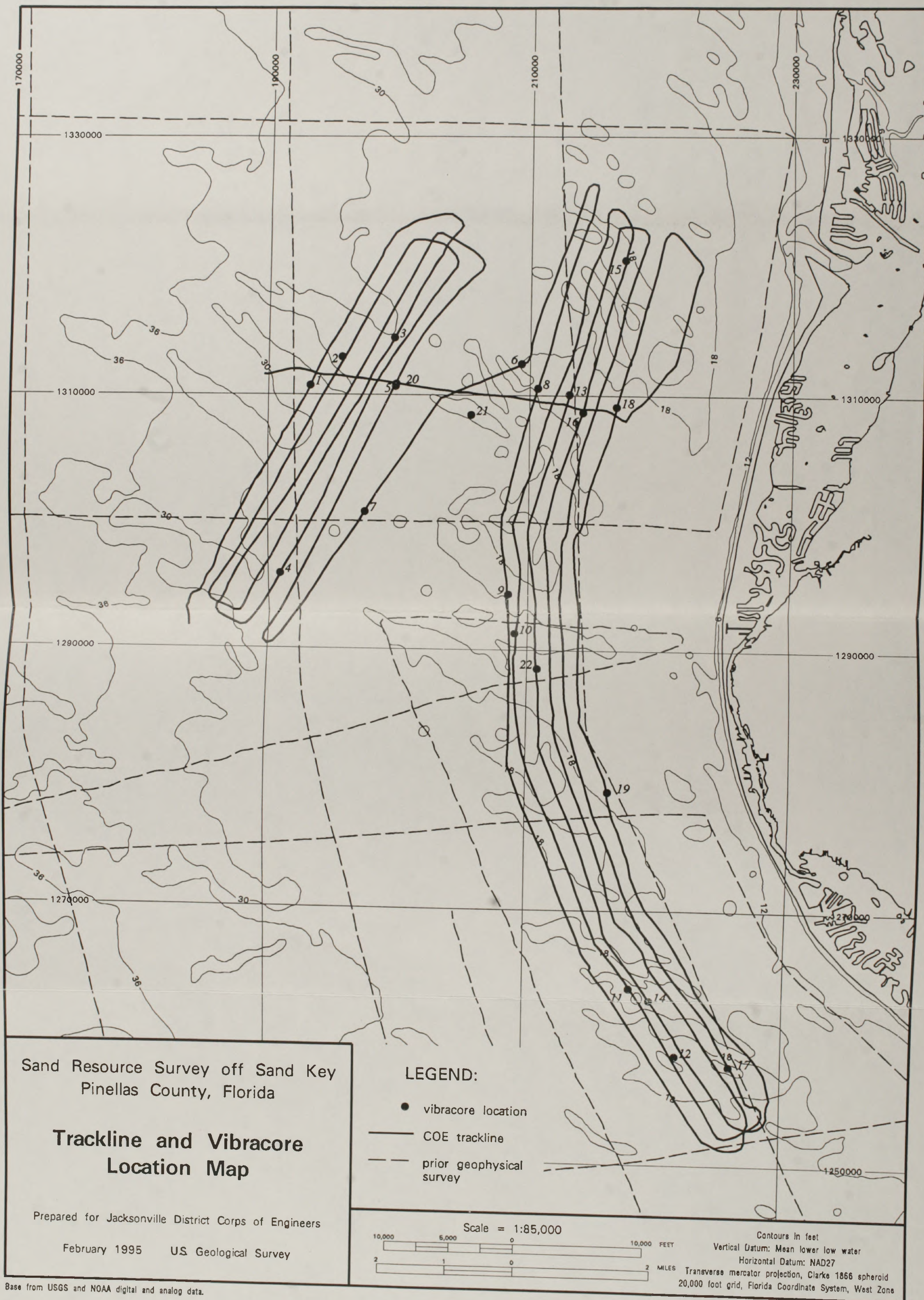
Vertical Datum: Mean lower low water

Horizontal Datum: NAD27

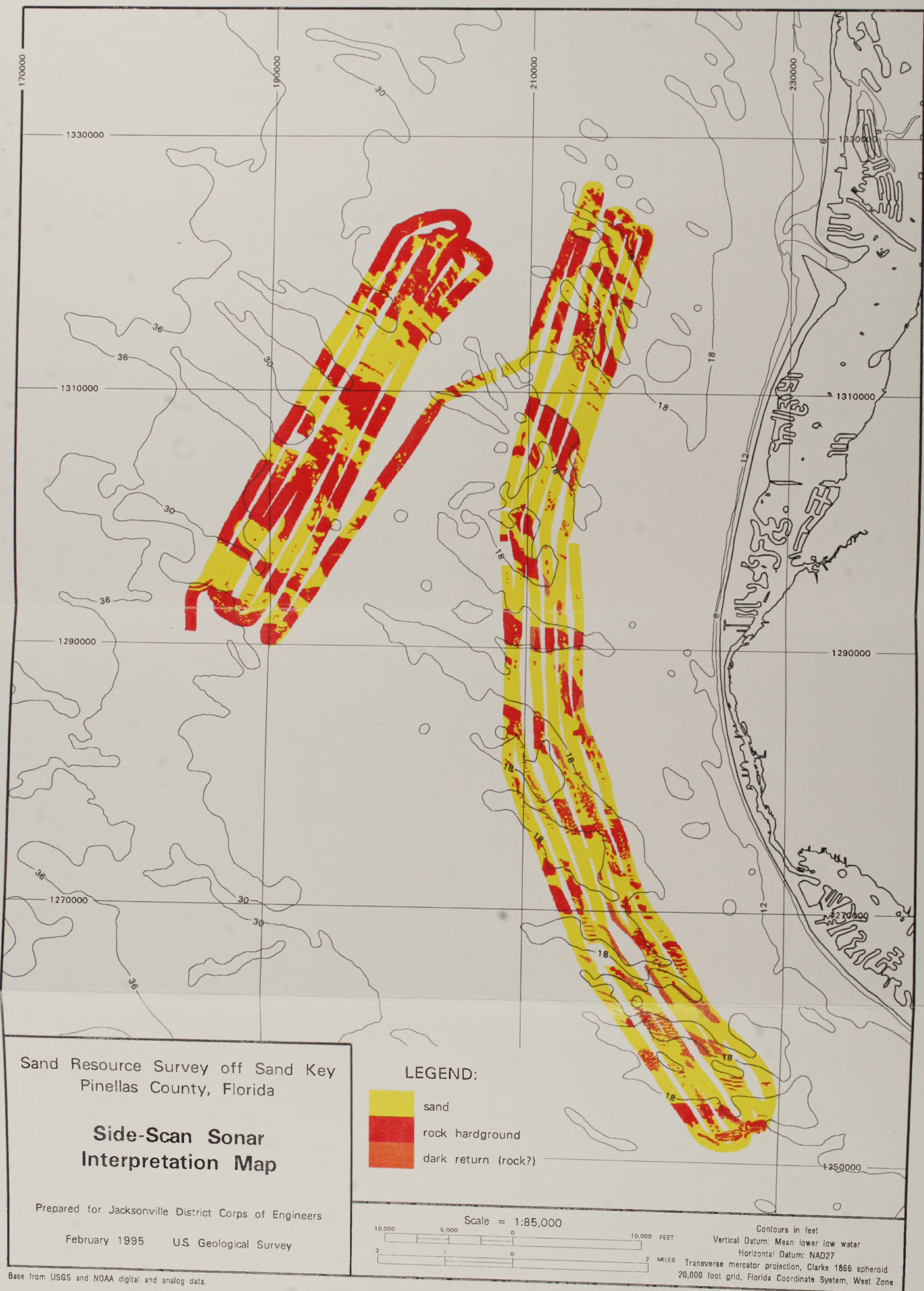
Transverse mercator projection, Clarke 1866 spheroid

20,000 foot grid based on Florida Coordinate System, West Zone









Sand Resource Survey off Sand Key  
Pinellas County, Florida

**Side-Scan Sonar  
Interpretation Map**

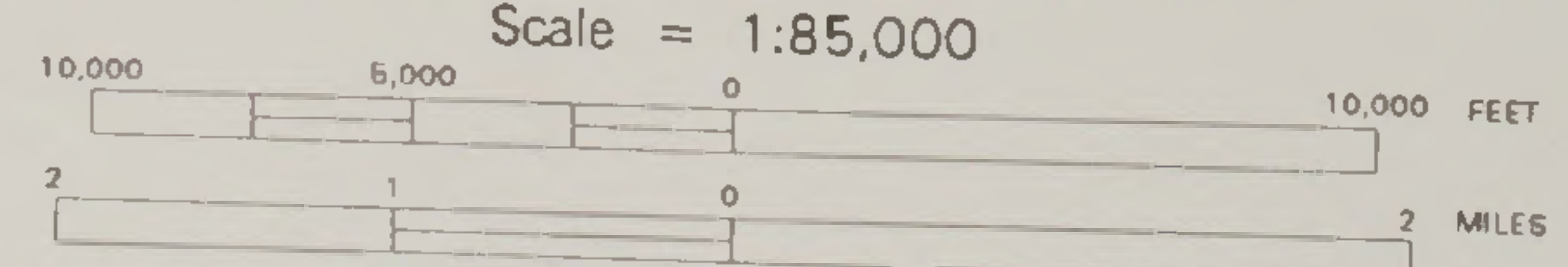
Prepared for Jacksonville District Corps of Engineers

February 1995      U.S. Geological Survey

**LEGEND:**

- sand
- rock hardground
- dark return (rock?)

Scale = 1:85,000



Contours in feet  
 Vertical Datum: Mean lower low water  
 Horizontal Datum: NAD27  
 Transverse mercator projection, Clarke 1866 spheroid  
 20,000 foot grid, Florida Coordinate System, West Zone

Base from USGS and NOAA digital and analog data.





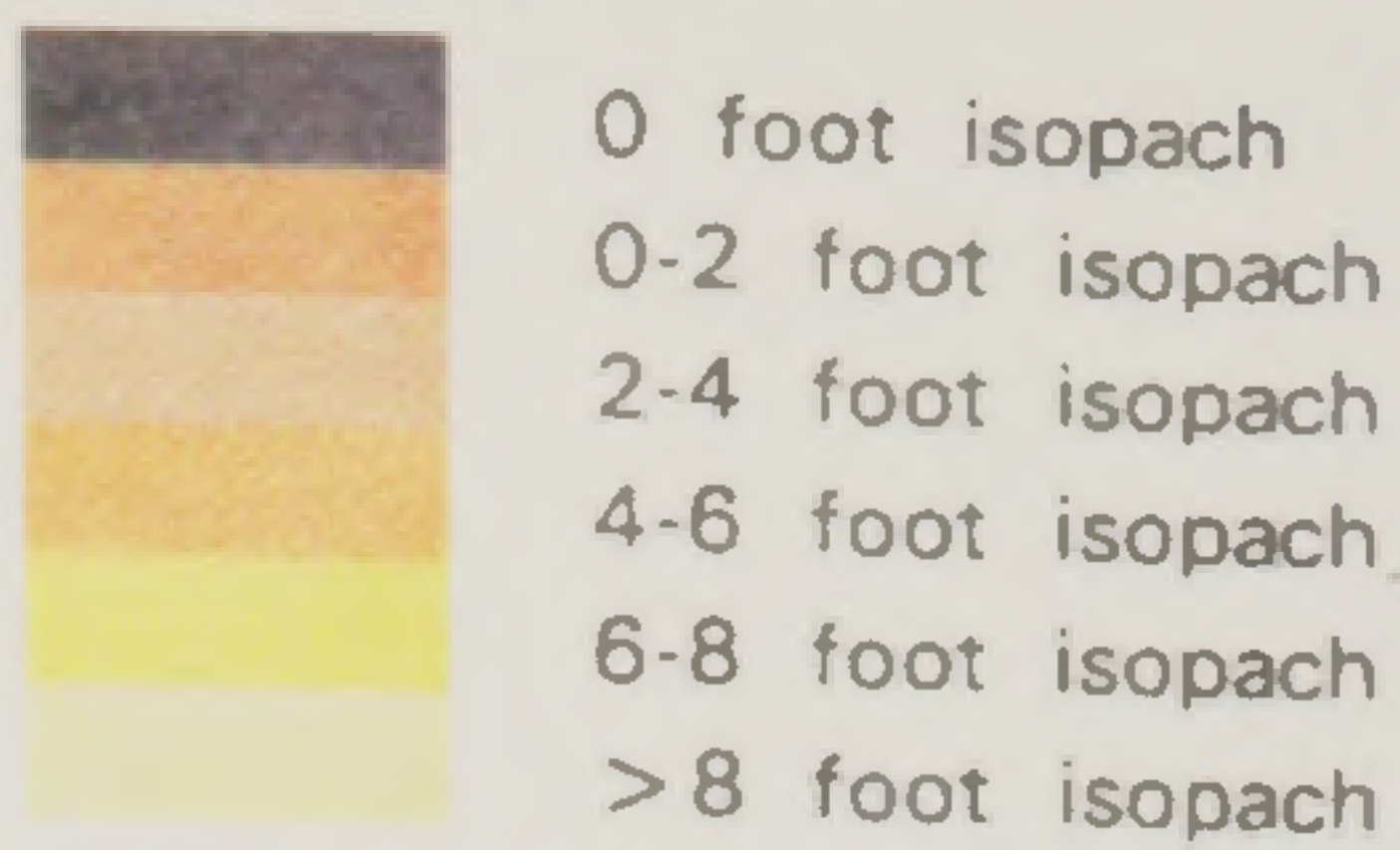
Sand Resource Survey off Sand Key  
Pinellas County, Florida

### Sediment Isopach Map

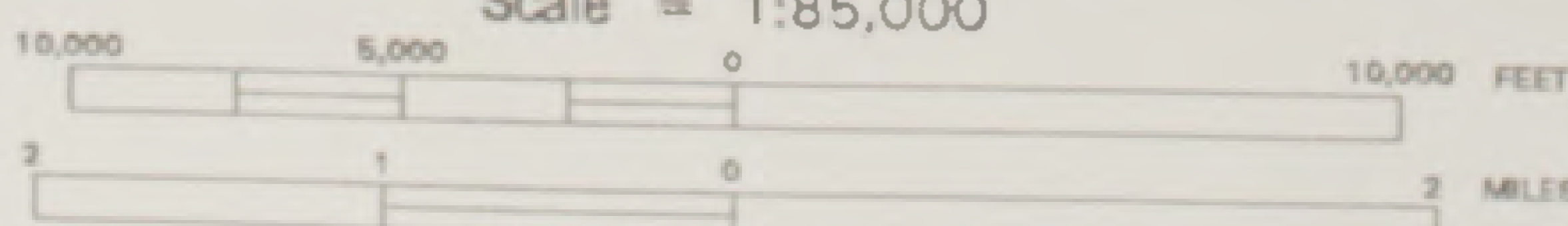
Prepared for Jacksonville District Corps of Engineers

February 1995 U.S. Geological Survey

#### LEGEND:



Scale = 1:85,000



Contours in feet  
Vertical Datum: Mean lower low water  
Horizontal Datum: NAD27  
Transverse mercator projection, Clarke 1866 spheroid  
20,000 foot grid, Florida Coordinate System, West Zone

Base from USGS and NOAA digital and analog data.