OCCURRENCE AND DENSITY OF SHELL IN THE VICINITY OF SEVENFOOT KNOLL, MAN O'WAR SHOAL, SIXFOOT KNOLL AND AREA B

by
Robert Cuthbertson

Maryland Geological Survey
2300 St. Paul Street
Baltimore, MD 21218

Coastal and Estuarine Geology Program
File Report No. 56

July 1988

TABLE OF CONTENTS

	Page
List of Figures	2
List of Tables	3
Executive Summary	4
Introduction	5
Methods	5
Results	15
Sevenfoot Knoll	15
Man O'War Shoal	15
Sixfoot Knoll	24
Area B	24
Discussion	24
Sevenfoot Knoll	24
Man O'War Shoal	25
Sixfoot Knoll	27
Area B	30
Conclusions	30
References	32
Appendix A Seismic Data	33
Appendix B Core Data	36
Appendix C Mathematical Calculations	70

LIST OF FIGURES

		Page
Figure 1.	Charts showing proposed areas for seismic subbottom reconnaissance and vibracore groundtruthing.....	6
Figure 2.	Location chart showing coring sites for Sevenfoot Knoll, Man O'War Shoal and Area B and track lines for seismic subbottom reconnaissance in vicinity of Man O'War Shoal.....	10
Figure 3.	Chart showing track lines for seismic subbottom reconnaissance in vicinity of Sixfoot Knoll.....	12
Figure 4.	A contoured chart showing number of bushels of shell per square yard of bottom disturbed for Sevenfoot Knoll, Man O'War Shoal and Area B (on surfaces to bottom of shell bearing layer).....	16
Figure 5.	Section from seismic record along track line 1 at Man O'War Shoal (between LORAN fix marks 1-1 and 1-2) with core #11 location indicated.....	18
Figure 6.	Section from seismic record along track line 2 at Man O'War Shoal (between fix mark 5 and end of line) with core #3 location indicated.....	20
Figure 7.	Section from seismic record along track line 3 at Man O'War Shoal (between LORAN fix marks 3-3 and 3-5).....	22
Figure 8.	Section from seismic record along track line 1 at Sixfoot Knoll (between LORAN fix marks 1-1 and 1-2)....	28

LIST OF TABLES

Page

Appendix 1

Table 1. Corrected track line fix marks for seismic subbottom profiles in vicinity of Man O'War Shoal..... 34

Table 2. Corrected track line fix marks for seismic subbottom profiles in vicinity of Sixfoot Knoll..... 35

Appendix B

Table 3. Core logs recorded by the Exmar Company of Norfolk, Virginia..... 37

Table 4. Corrected core locations..... 64

Table 5. Weight of shell (g) for each core section (shells greater than $^{1}/_{2}$ inch)..... 65

Appendix C

Table 6. Mathematical formulas used for calculations in this report..... 71

Table 7. Basic measurements and calculation of pounds of shell per cubic yard of bottom..... 72

Table 8. Calculated quantities of shell $>^{1}/_{2}$ inch per square yard of subbottom disturbed (to bottom of shell bearing layer..... 73

Table 9. Digitized information from Figure 4 and calculation of amount of bushels for study areas..... 74

EXECUTIVE SUMMARY

This study delineated the shell-bearing zones in the subbottom and estimated the amount of shell present in the areas known as Sevenfoot Knoll, Man O'War Shoal, Sixfoot Knoll and Area B. Interpretation of subbottom records for Man O'War Shoal and Sixfoot Knoll and vibracore data for Sevenfoot Knoll and Man O'War Shoal allowed volumetric estimations of the quantity of shell. The amount of shell calculated in the vicinity of Sevenfoot Knoll was 7.56×10^6 bushels and 94.5×10^6 bushels in the Man O'War Shoal area.

INTRODUCTION

The objective for the study was to locate areas containing sufficient shell occurrence and density for the Shell Repletion Program. This is an ongoing program that supplies shell for the purpose of creating a base on which oyster spat may grow and therefore new shell resources need to be discovered for the program to continue. The Fisheries Division, Tidewater Administration, Department of Natural Resources monitors the progress and needs of the dredging contractor in supplying shell for this program. Sevenfoot Knoll, Man O'War Shoal, Sixfoot Knoll, and Area B, northern Chesapeake Bay, Baltimore and northern Anne Arundel Counties, were chosen as the most likely areas to contain the amounts of shell required to fulfill the needs of the program (Figures 1). Investigation of these areas was performed by the Maryland Geological Survey at the request of the Fisheries Division. The Survey conducted seismic reconnaissance in the vicinity of Man O'War Shoal and Sixfoot Knoll and analyzed vibracores collected by the Exmar Company of Norfolk, Virginia from Sevenfoot Knoll, Man O'War Shoal and in Area B east of Man O'War Shoal. The specific objectives of this report were:

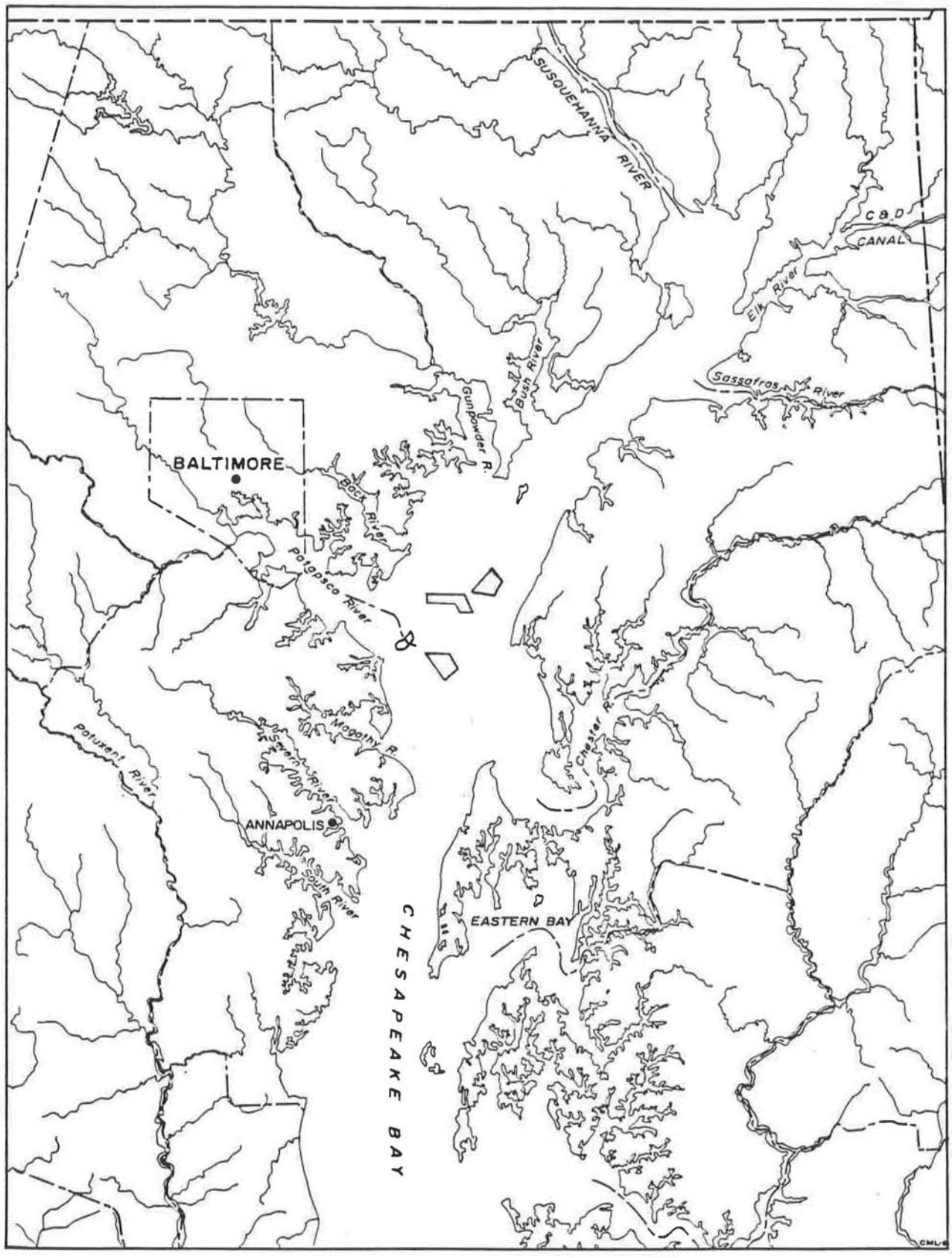
(1) to delineate the shell bearing strata in the suggested areas by analyses of seismic subbottom records and vibracores and

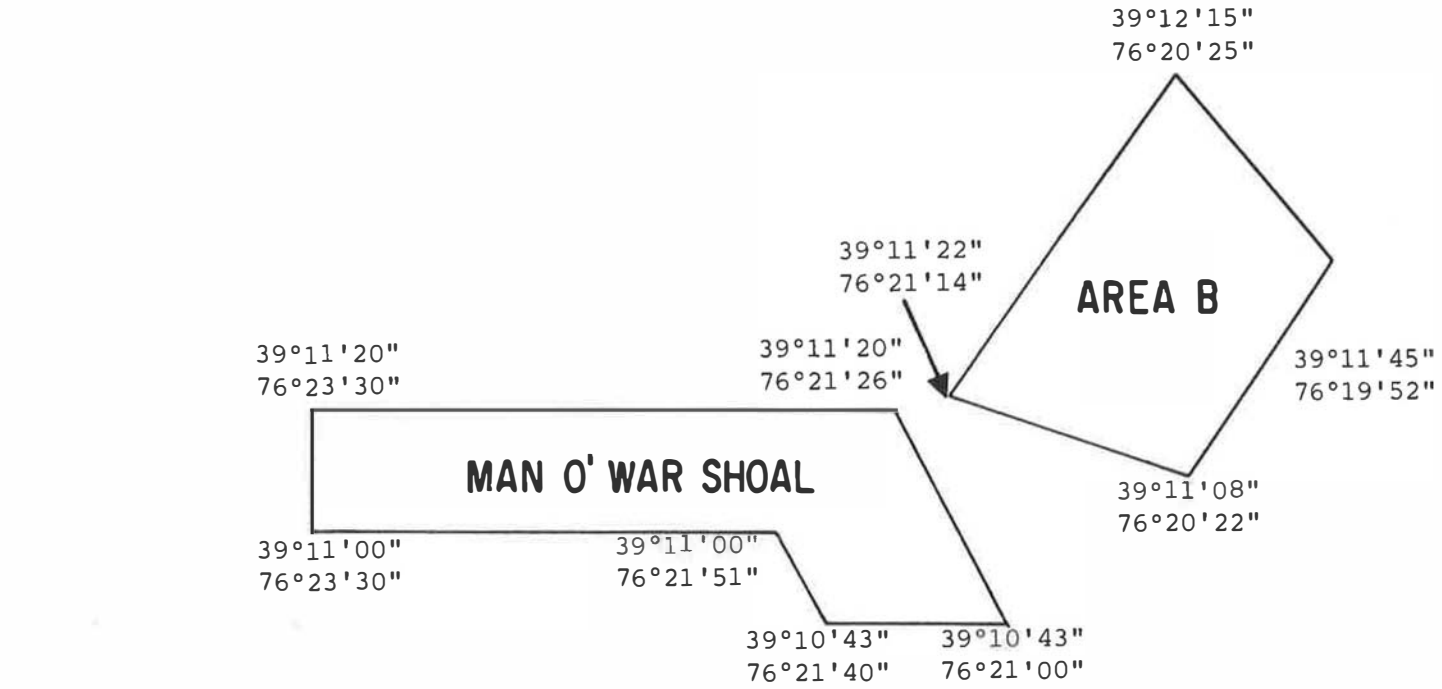
(2) to calculate the volume of shell present for the areas under study from analyses of the vibracores.

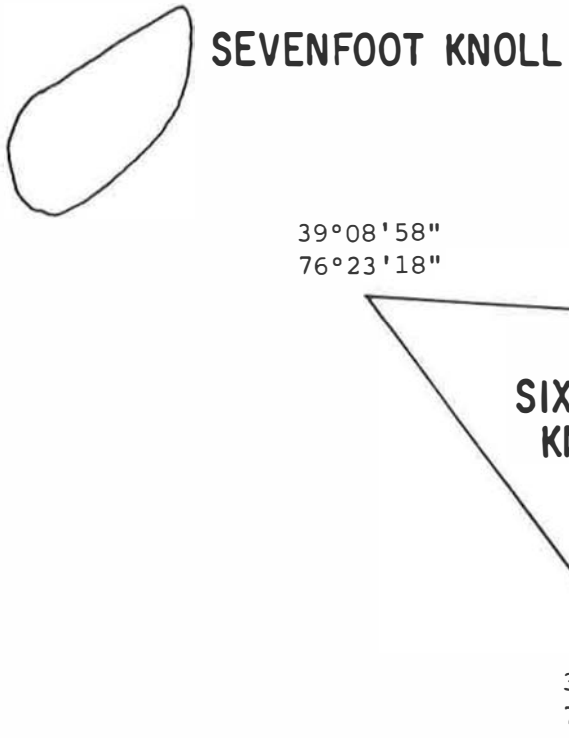
METHODS

In order to accomplish the stated objectives three primary methods were utilized: (1) seismic subbottom surveying, (2) bottom sampling and (3) calculated projections of densities and total amounts of shell present in each of the designated areas.

FIGURES 1. CHARTS SHOWING PROPOSED AREAS FOR SEISMIC SUBBOTTOM RECONNAISSANCE AND VIBRACORE GROUNDTRUTHING


SUSQUEHANNA RIVER
C & D CANAL
Elk River
Bush River
Gunpowder R.
Sassafras River
BALTIMORE
Back River
Patapsco River
Magothy R.
Severn River
Patuxent River
ANNAPOLIS
South River
Chester R.
EASTERN BAY
CHESAPEAKE BAY
CML-6
10 0 10 MILES
10 0 10


39°12'15"
76°20'25"
AREA B
39°11'22"
76°21'14"
39°11'20"
76°21'26"
39°11'45"
76°19'52"
39°11'20"
76°23'30"
MAN O' WAR SHOAL
39°11'08"
76°20'22"
39°11'00"
76°23'30"
39°11'00"
76°21'51"
39°10'43"
76°21'40"
39°10'43"
76°21'00"


SEVENFOOT KNOLL
39°08'58"
76°23'18"
39°08'53"
76°22'09"
SIXFOOT
KNOLL
39°08'20"
76°21'41"
39°07'57"
76°22'23"

1) Seismic subbottom reconnaissance surveys were conducted in the vicinity of Man O'War Shoal and Sixfoot Knoll. There were five track lines followed along the 42xxx LORAN range lines for each of the two areas (Figures 2, 3). The track lines varied from 350 to 500 yards apart. LORAN T-D fix marks were recorded at the beginning and end of each track line and at approximately 900 yard intervals. LORAN T-D coordinates for the seismic record were corrected in accordance with correction factors developed by Halka (1987) (Appendix A; Tables 1, 2).

A Datasonics SBT-220 (5kHz transducer) continuous seismic reflection system produced acoustic pulses under the water surface directed at the bottom. The returning signals from the subbottom provided a graphic record on a chart recorder (EPC model 3200S) of the reflecting horizons within the subbottom stratigraphy.

Sevenfoot Knoll and Area B, probable shell resource areas, were omitted from seismic subbottom reconnaissance due to budget and time constraints.

2) Bottom sampling involved the analyses of 25 vibracores collected by the Exmar Company of Norfolk, Virginia (Figure 2, Appendix B; Table 3). Cores were collected independently of the seismic track lines. Four cores were collected in the Sevenfoot Knoll area, 20 in the vicinity of the Man O'War Shoal priority area, and one in Area B. Cores were not collected in the vicinity of Sixfoot Knoll. LORAN T-D coordinates for the bottom sample locations were corrected in accordance with correction factors developed by Halka (1987) (Appendix B; Table 4). The vibracore barrel length was 40 feet and had a diameter of three inches. The Tidewater Administration supplied Latitude/Longitude coordinates for the coring locations, a barge with a crane to lift the coring tower, and the

FIGURE 2. LOCATION CHART SHOWING CORING SITES FOR SEVENFOOT KNOLL, MAN O'WAR SHOAL, AREA B AND TRACK LINES FOR SUBBOTTOM RECONNAISSANCE IN VICINITY OF MAN O'WAR SHOAL.

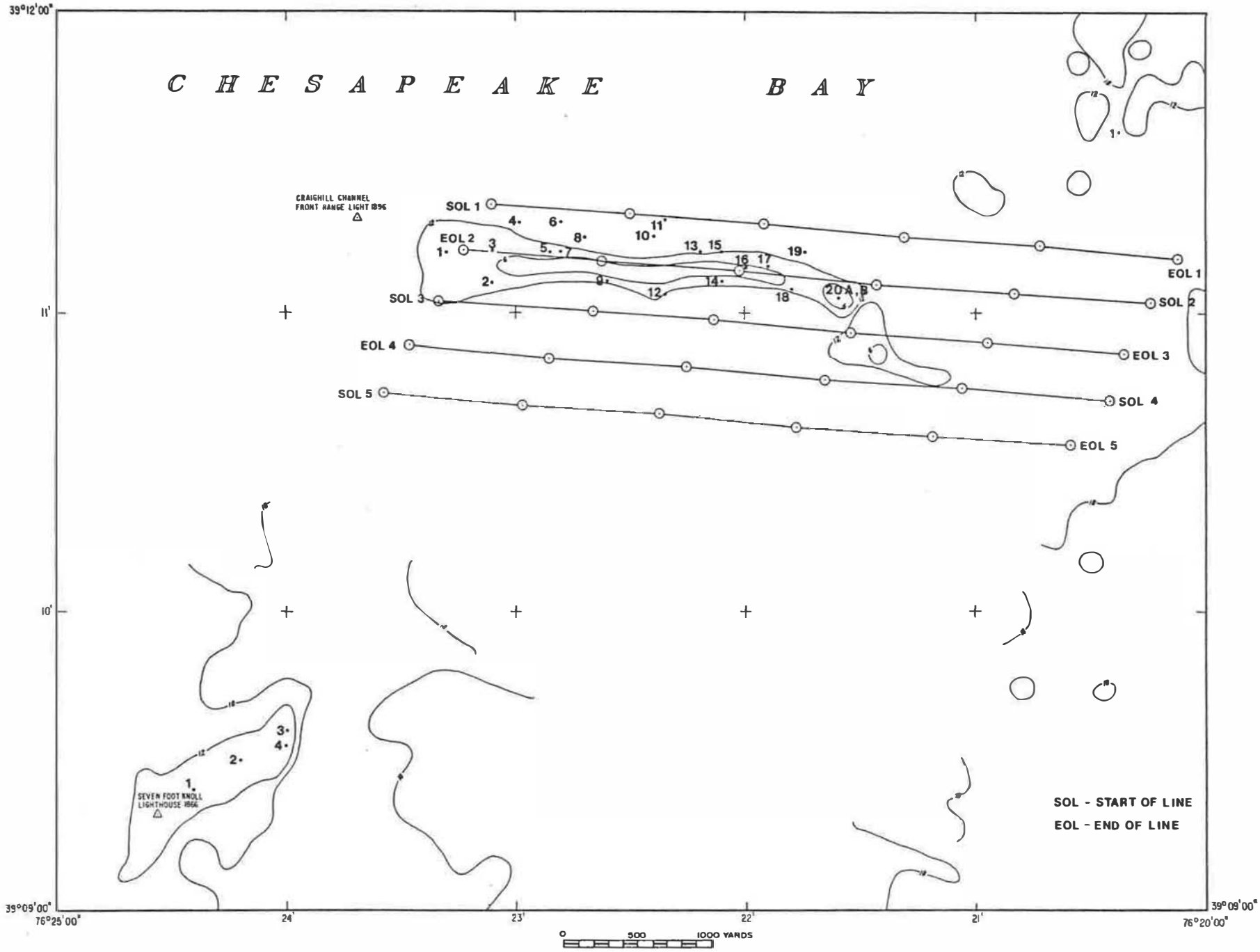
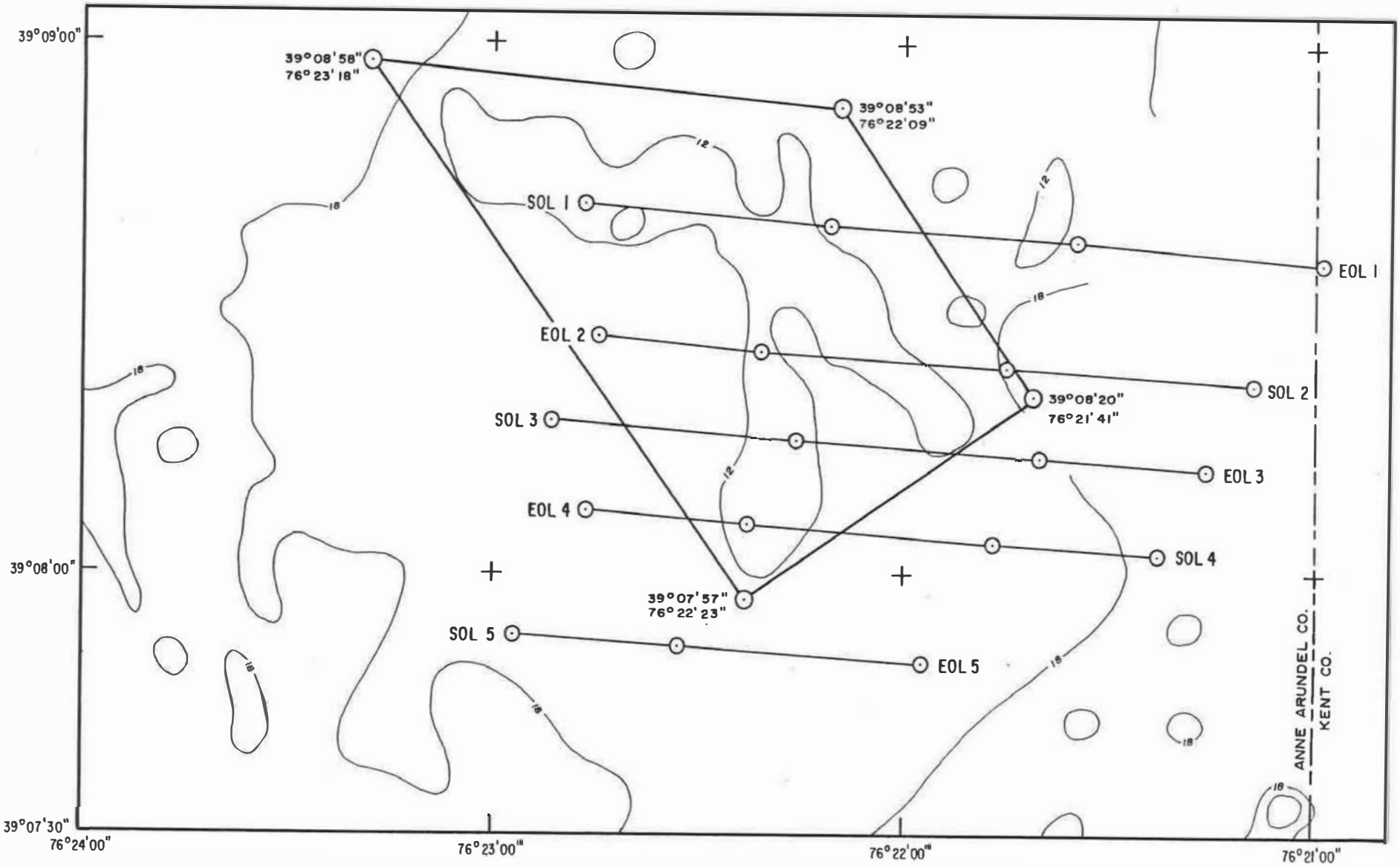

39°12'00"
CHESAPEAKE BAY
CRAIGHILL CHANNEL
FRONT RANGE LIGHT 1896
SOL 1
EOL 1
EOL 2
SOL 2
SOL 3
EOL 3
EOL 4
SOL 4
SOL 5
EOL 5
11'
10'
SEVEN FOOT KNOLL
LIGHTHOUSE 1866
39°09'00"
76°25'00"
24'
23'
22'
21'
76°20'00"
0 500 1000 YARDS
SOL - START OF LINE
EOL - END OF LINE

FIGURE 3. CHART SHOWING TRACK LINES FOR SEISMIC SUBBOTTOM RECONNAISSANCE IN VICINITY OF SIXFOOT KNOLL.



Sixfoot Knoll

0 500 1000 YARDS

SOL - START OF LINE
EOL - END OF LINE

tugboat "Big Lou". The cores were cut in sections approximately five feet in length for ease of transportation and examination. The sections of each core containing shell were washed through a $^{1}/_{2}$ inch sieve using a Teel centrifugal pump. The $^{1}/_{2}$ inch sieve was chosen because the final shell screen size of a dredge is $^{1}/_{2}$ inch. The shells were dried for several days before weighing. The weight of the shell fraction of each section of core was recorded (Appendix B, Table 5). No grain size analyses of the sediments in the vibracores were performed. The designation of silt in the core logs was reclassed as the general category mud except when reference was made directly to the core log (Appendix B, Table 3).

3) The third method of the project correlated seismic subbottom data with vibracore data for estimates of occurrence and density of shell in the Sevenfoot Knoll and Man O'War Shoal areas. Estimates of shell occurrence and density were omitted for the eastern section of the Man O'War Shoal priority area, Sixfoot Knoll and Area B due to insufficient vibracore information.

The formulas for the calculations of shell volume were reported by Hobbs (1987) and those formulas along with other calculations are listed in Appendix C; Table 6. There are two differences, however, between Hobbs' (1987) work and this report; (1) the size of a bushel and, (2) the average weight of five gallons of shell. The Maryland bushel is equal to 2800.9 cubic inches (.060 cubic yards) whereas a Virginia bushel is equal to 3003.9 cubic inches (.064 cubic yards). For volumetric determinations several five gallon pails containing shell $>^{1}/_{2}$ inch were weighed. The average weight of five gallons of shell was 32 pounds. The 32 pounds of shell per five gallons equals 1293 pounds per cubic yard compared to the

28 pounds of shell per 5 gallons or 1084 pounds per cubic yard reported by Hobbs (1987). The density of shell (pounds of shell per cubic yard of bottom) determined the quantities of shell per square yard of bottom disturbed for the shell-bearing layer (Appendix C, Tables, 7, 8).

The number of bushels of shell for Sevenfoot Knoll, Man O'War Shoal and Area B were plotted on a chart at a scale of 1:20,000, contoured and digitized using a Hewlett Packard 9825T desktop computer (Figure 4). From the digitized chart the total number of bushels were calculated (Appendix C, Table 9).

RESULTS

Sevenfoot Knoll

The four vibracores collected in this area indicated five feet of soft gray mud overlying a mixed shell-gray mud layer (Table 3). The lower boundary of the shell bearing layer in each vibracore was delimited by the presence of coarse sand. The thickness of the shell bearing sediments varied from 21.2 to 31.5 feet (Table 5).

Man O'War Shoal

The three seismic subbottom reconnaissance profiles within the Man O'War Shoal priority area showed strong acoustic impedence in the first six feet of bottom sediments (Figures 5-7). The impedence varied vertically and horizontally throughout the seismic records.

The 20 vibracores collected in this area indicated a mixed shell-gray mud layer overlying a coarse sand with only four cores (#1, 2, 5, 7) containing a gray mud overburden (Table 3). The length of the shell bearing section varied from 11.5 to 36.8 feet.

FIGURE 4. A CONTOURED CHART SHOWING NUMBER OF BUSHELS OF SHELL PER SQUARE YARD OF BOTTOM DISTURBED FOR SEVENFOOT KNOLL, MAN O'WAR SHOAL AND AREA B (ON SURFACES TO BOTTOM OF SHELL BEARING LAYER).

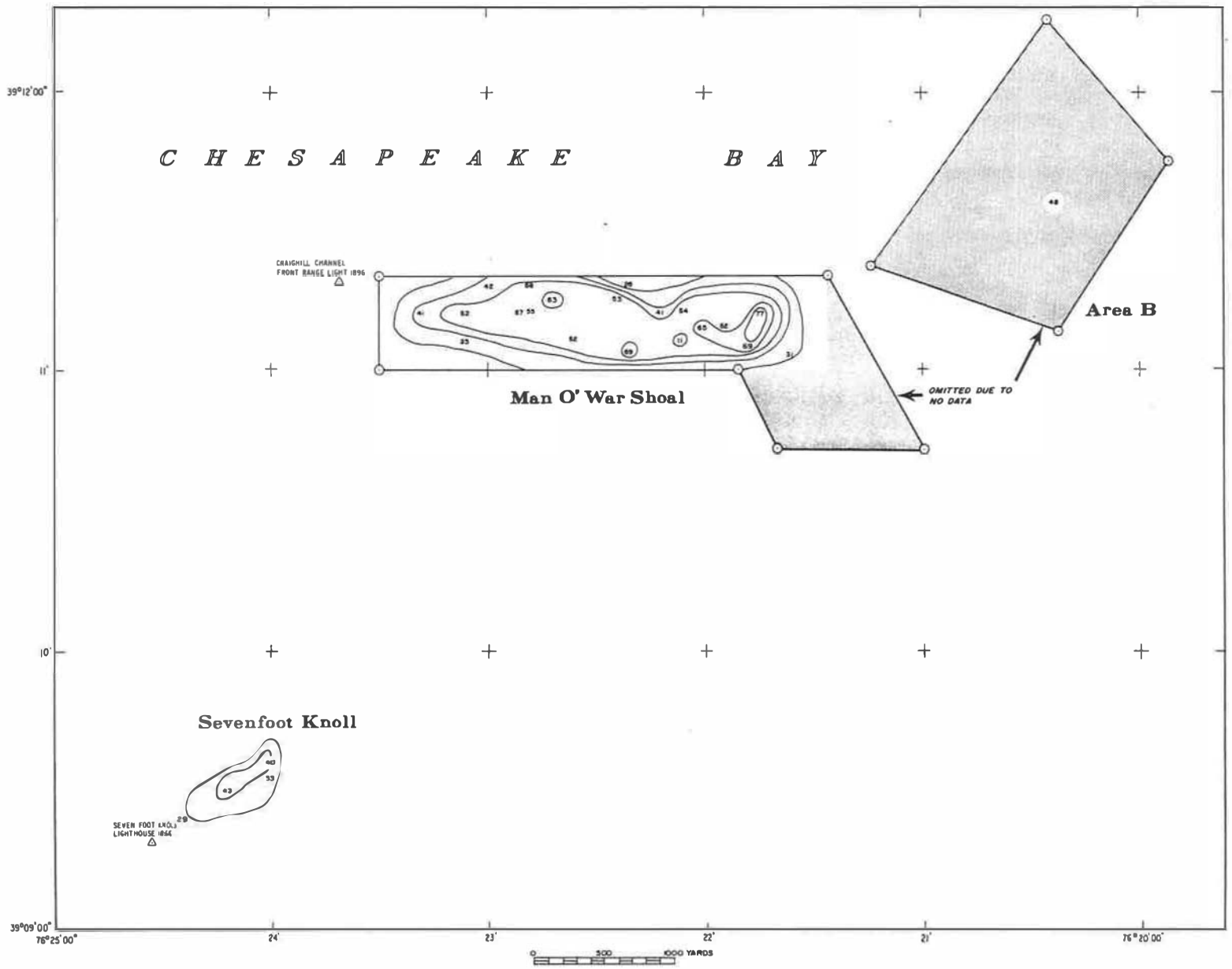

39°12'00"
11'
10'
39°09'00"
76°25'00"
24'
23'
22'
21'
76°20'00"
C H E S A P E A K E
B A Y
CRAIGHILL CHANNEL
FRONT RANGE LIGHT 1896
Man O' War Shoal
Area B
OMITTED DUE TO
NO DATA
Sevenfoot Knoll
SEVEN FOOT KNOLL
LIGHTHOUSE 1864
0
300
1000 YARDS

FIGURE 5. SECTION FROM SEISMIC RECORD ALONG TRACK LINE 1 AT MAN O'WAR SHOAL (BETWEEN LORAN FIX MARKS 1-1 AND 1-2) WITH CORE #11 LOCATION INDICATED.

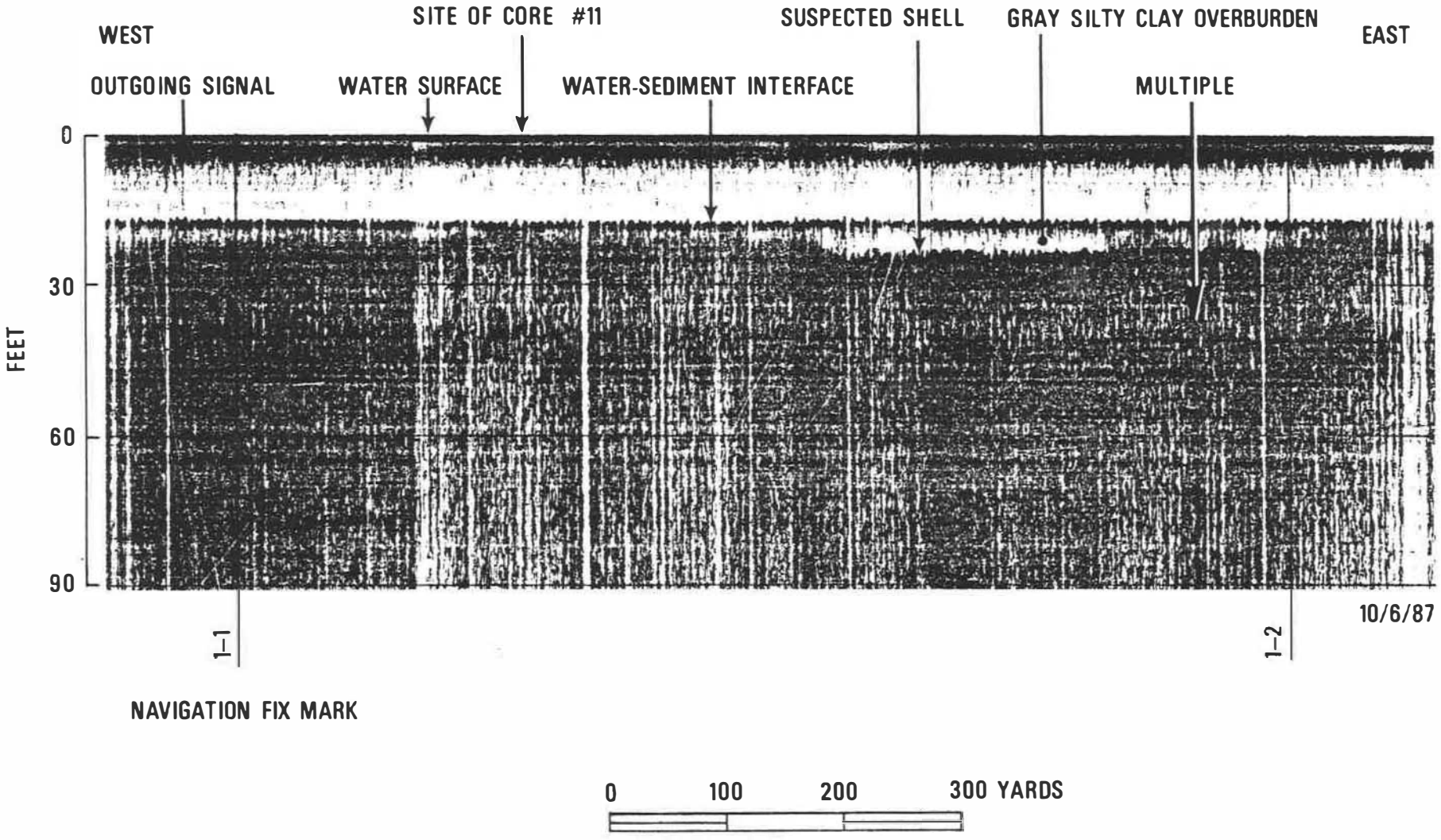

WEST
SITE OF CORE #11
SUSPECTED SHELL
GRAY SILTY CLAY OVERBURDEN
EAST
OUTGOING SIGNAL
WATER SURFACE
WATER-SEDIMENT INTERFACE
MULTIPLE
0
30
60
90
FEET
10/6/87
1-1
1-2
NAVIGATION FIX MARK
0
100
200
300 YARDS

FIGURE 6. SECTION FROM SEISMIC RECORD ALONG TRACK LINE 2 AT MAN O'WAR SHOAL (BETWEEN FIX MARK 5 AND END OF LINE) WITH CORE #3 LOCATION INDICATED.

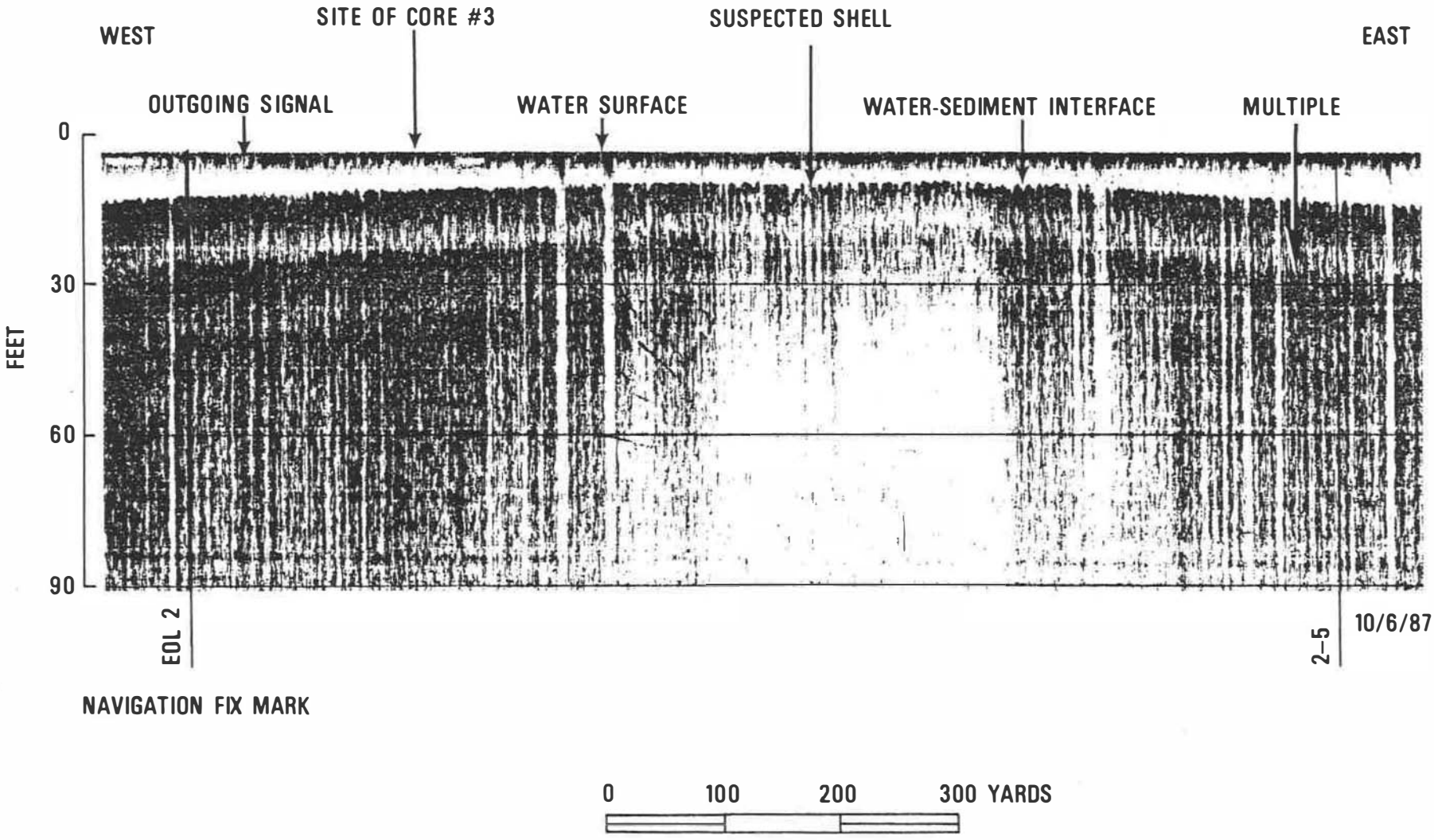
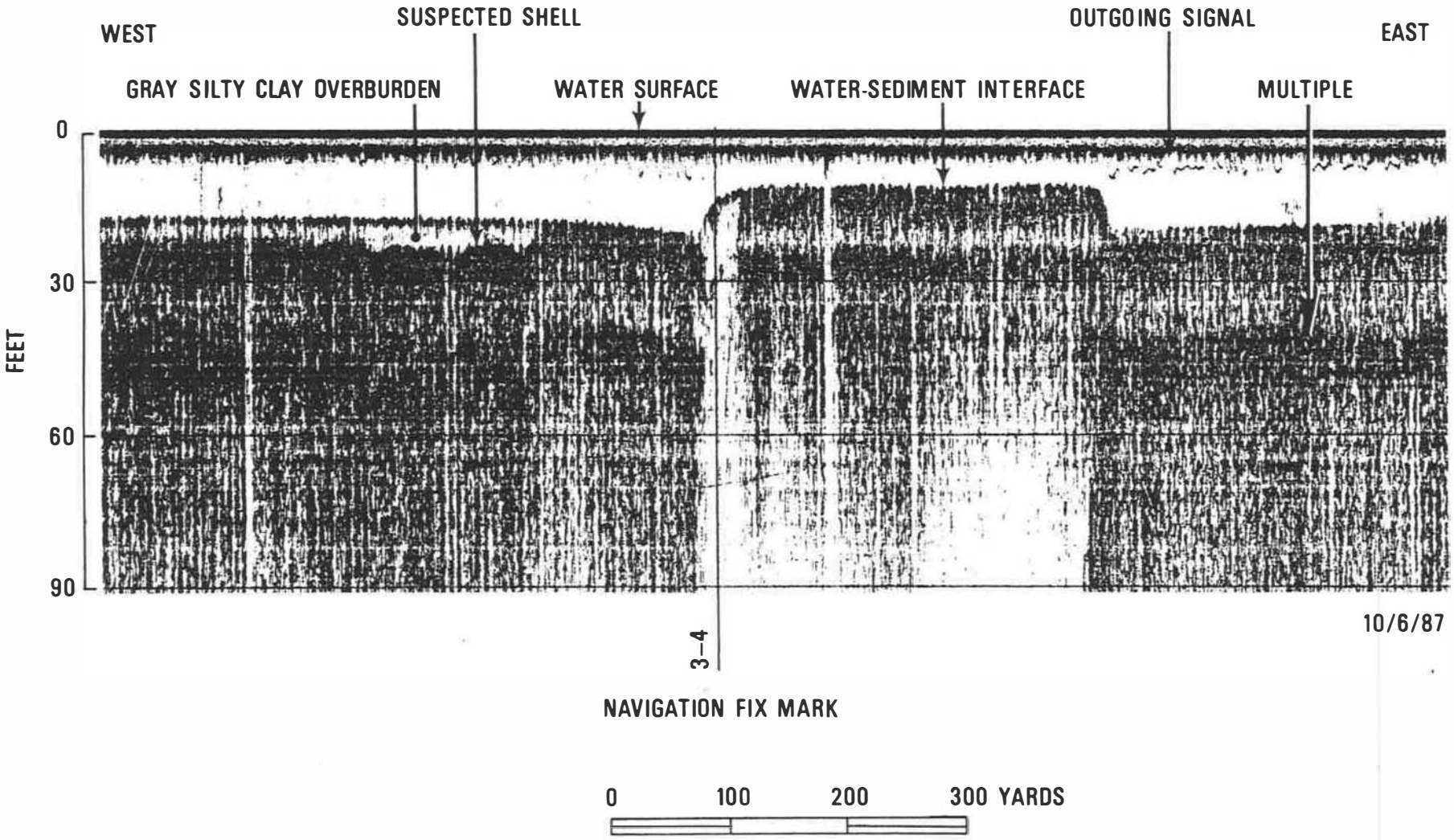

WEST
SITE OF CORE #3
SUSPECTED SHELL
EAST
OUTGOING SIGNAL
WATER SURFACE
WATER-SEDIMENT INTERFACE
MULTIPLE
0
30
60
90
FEET
EOL 2
2-5
10/6/87
NAVIGATION FIX MARK
0
100
200
300 YARDS

FIGURE 7. SECTION FROM SEISMIC RECORD ALONG TRACK LINE 3 AT MAN O'WAR SHOAL (BETWEEN LORAN FIX MARKS 3-3 AND 3-5).


WEST
SUSPECTED SHELL
OUTGOING SIGNAL
EAST
GRAY SILTY CLAY OVERBURDEN
WATER SURFACE
WATER-SEDIMENT INTERFACE
MULTIPLE
0
30
60
90
FEET
10/6/87
3-4
NAVIGATION FIX MARK
0
100
200
300 YARDS

Sixfoot Knoll

The sections of seismic profiles from track lines 1-4 within the designated Sixfoot Knoll area showed strong acoustic impedence within the first six feet of bottom sediments. There were sections present where the impedence was present at the water-sediment interface.

Area B

One core was taken in this area. The core log showed approximately 4 feet of gray mud overlying a mixture of shell and gray mud approximately 23 feet thick. The shell bearing zone was bounded on the bottom by sand (Appendix B, Table 3).

DISCUSSION

Sevenfoot Knoll

The core logs when compared to the sieving analyses present possibly conflicting data (Appendix B; Tables 3, 4). The core logs show a layer of soft gray mud (4-5 feet thick) overlying a layer of shell with soft gray mud. The sieving analyses shows that shell was present for the first six feet of bottom (Appendix B, Table 4). The reason for this discrepancy was probably due to either visual inspection of the core through the core liner with the dark gray mud occluding a view of shells, or that the sieving data was summary data for each section and therefore horizons could not be delineated.

The shell bearing sediments thickness varied from 21.2 to 31.5 feet. However, when the weight of shell fell below the 1000 gram level the density of shell was much reduced. The thickness of shell with the highest densities varied from 16.2 to 26 feet. This suggests that shellfish colonization was spatially variable.

Calculations based on core data indicated there are approximately 453,750 cubic yards (7,562,500 Maryland bushels) of shell within an area of approximately 208,725 square yards in the vicinity of Sevenfoot Knoll (Figure 4, Appendix C, Table 9). This yields an average of approximately 2.2 cubic yards (36 bushels) of shell for each square yard of subsurface material dredged to the bottom of the shell bearing layer.

Man O 'War Shoal

There were three seismic subbottom reconnaissance profile tracks conducted within the Man O'War Shoal area. The records from track lines 1, 2, and part of 3 delineated the extent of the shell bearing layer. The records suggest that a shell resource is present throughout the Man O'War Shoal area. The deposit varies in depth below the water-sediment interface. To substantiate the interpretation of the seismic record vibracores were needed. Only two vibracores, #3 and #11 were in proximity of the track lines to support the seismic interpretation (Figure 2).

Track line 1 borders the northern edge of the priority area at Man O'War Shoal. A strong acoustic impedence (reflector) was recorded varying in depth below the surface of the bottom between 1.5 and 6 feet as seen in Figure 5. The strong reflector was interpreted to be a dense shell layer with a less dense gray mud and shell overburden.

Vibracore #11 is located approximately 250 yards east of LORAN fix mark 2 on track 1. The vibracore log (Table 3) indicated no presence of overburden. The weight of shell present in vibracore #11 (Table 5) and the corresponding density (Table 8) when compared with other cores was much lower for the entire core length. The reduced amount of shell and increased amount of mud may account for the seismic record at core site 11

on track 1. Another possibility is that the overburden on the seismic record varies rapidly over a short distance and therefore the distance between vibracore #11 and track 1 could account for a different stratigraphic column being recorded.

Track line 2 bisected the Man O 'War Shoal. The entire length of track line 2 indicates a strong reflector at the surface of the bottom. This was interpreted to be a densely packed layer of shell with a gray mud matrix. The analysis of vibracore #3, located approximately 760 yards from LORAN fix mark 5 towards the end of the track line (Figure 6), showed that the first 28.5 feet of the core was densely packed shell with gray mud. The reflector present at the surface of the bottom would appear to indicate the top of the densely packed layer of shell.

Track line 3 borders the southern edge and passes through the eastern section of the Man O'War Shoal priority area. The seismic record is similar to that of track line 1 (Figure 7). There is a strong reflector (shell) varying from 1 to 6 feet below the surface of the bottom except when the track line passes over the shoal area on the eastern end (between LORAN fix marks 3 and 4). Here, the strong reflector is present at the surface of the bottom indicating shell present at the water-sediment interface. Unfortunately, no vibracore was taken in the vicinity of track line 3 to substantiate the interpretation of the seismic record.

Calculations based on the core data indicated there are an estimated 5,667,338 cubic yards (94,455,625 Maryland bushels) of shell within an area of approximately 2,156,825 square yards (Figure 4, Appendix C, Table 9). This yields an average of about 2.6 cubic yards (44 bushels) of shell for each square yard of subsurface material dredged to the bottom of the shell bearing layer. These estimates may be conservative for four

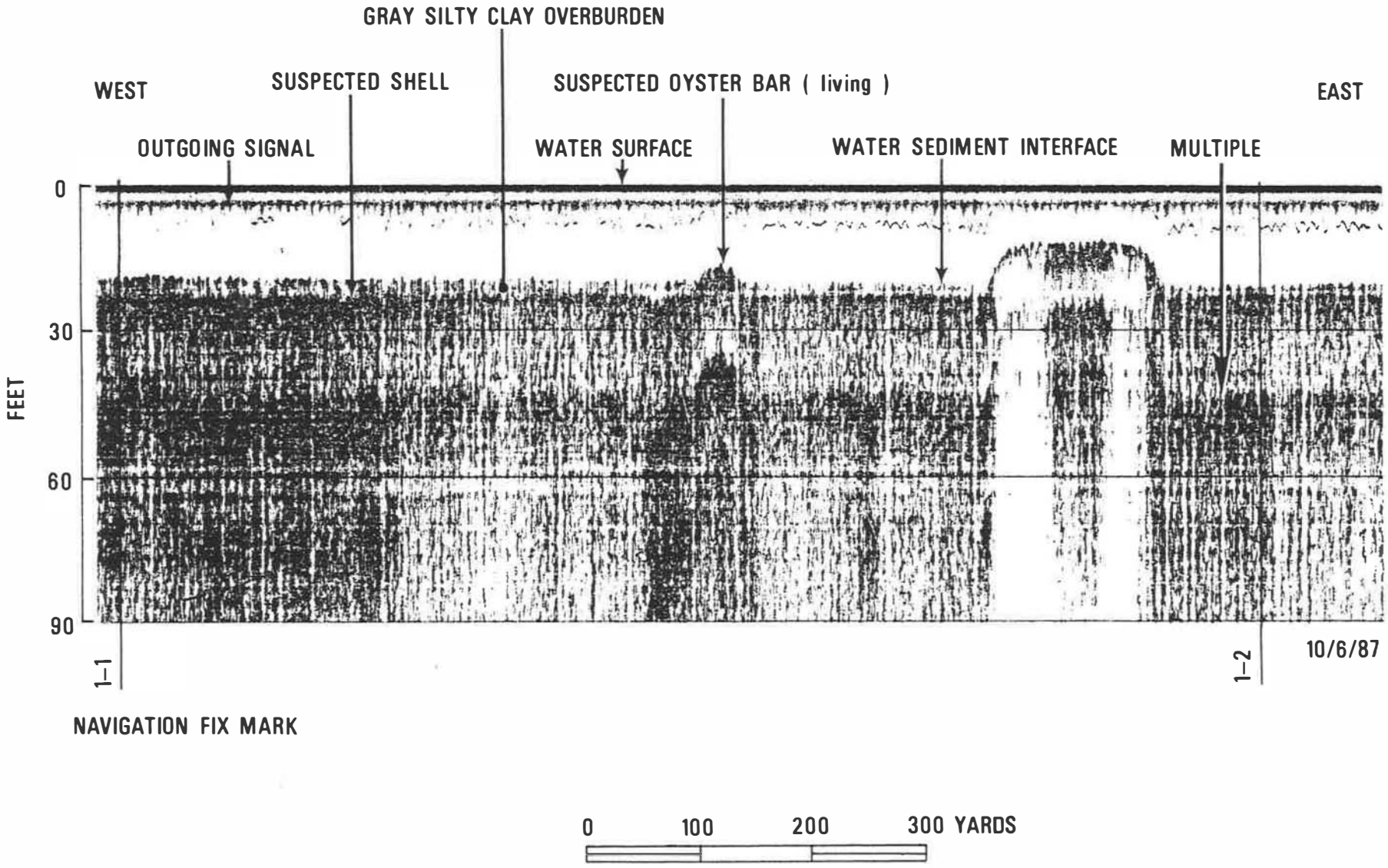
reasons: (1) The seismic records indicate shell is present outside of the priority area, (2) No vibracores were taken in the eastern section of the priority area and therefore omitted from the calculation of shell, (3) Vibracore #20 contained very dense shell but was impeded from penetrating the bottom further due to either the density of shell or an obstruction and (4) The digitization of the core data resulted in an error of approximately -1.8% or a total of 1,700,201 bushels (102,012 cubic yards) under an area of 39,325 square yards.

Sixfoot Knoll

There were five subbottom seismic reconnaissance profiles performed in the vicinity of Sixfoot Knoll. Only sections of the first four were within the designated area of the study (Figure 3). The seismic records revealed the possibility of shell being present at various depths below the water-sediment interface. A section of the seismic record along track line 1, typical of the Sixfoot Knoll area, indicates suspected shell at the water-sediment interface (oyster bar, possibly living) and under three feet of overburden (Figure 8). The inference of shell in this area is drawn from the interpretation of similar seismic records obtained in the Man O 'War Shoal area with vibracores in proximity to the track lines. Interpretation of the seismic records suggests that shell may be present throughout the designated Sixfoot Knoll area. Vertical extent of the shell resource could not be determined from the seismic records.

No calculations estimating the density and quantity of shell could be computed for the Sixfoot Knoll area. However, suspected shell was present throughout the entire area or approximately 2,577,300 square yards.

FIGURE 8. SECTION FROM SEISMIC RECORD ALONG TRACK LINE 1 AT SIXFOOT KNOLL (BETWEEN LORAN FIX MARKS 1-1 AND 1-2).


GRAY SILTY CLAY OVERBURDEN
WEST
SUSPECTED SHELL
SUSPECTED OYSTER BAR (living)
EAST
OUTGOING SIGNAL
WATER SURFACE
WATER SEDIMENT INTERFACE
MULTIPLE
0
30
60
90
FEET
1-1
1-2
10/6/87
NAVIGATION FIX MARK
0
100
200
300 YARDS

Area B

No seismic records were available from this area. Therefore, no estimation of areal extent of suspected shell could be made.

The one core taken in this area indicated a shell bearing section with a four foot gray mud overburden (Appendix B, Table 3). However, the analysis of this core indicated an amount of shell beginning at the water-sediment interface (Appendix B, Table 4). The description of the core is interpreted as being cursory. The low amount of shell present in the 14-19 foot core section possibly indicates a time when the area was uncolonized.

Digitization of Area B indicates there is 2,404,875 square yards of bottom (Appendix C, Table 9). At core location #1 there are 48 bushels of shell per square yard of bottom to the bottom of the shell bearing layer. If this core is representative of the amount of shell within the area then a resource similar to that present at Man O'War Shoal could be expected. However, without more intensive coring the occurrence and density of shell cannot be estimated.

CONCLUSIONS

Based on the available data estimations show approximately 7.56×10^6 bushels of shell in the Sevenfoot Knoll area and 94.5×10^6 bushels of shell in the Man O'War Shoal area. Sixfoot Knoll contains shell but the density could not be determined from the seismic records. Area B contained shell as determined from analysis of one core taken in the area. The one core taken in Area B, however, could not be expanded to encompass the entire area. Therefore, only the local density was determined at 48 bushels of

shell per square yard of subbottom disturbed to the bottom of the shell bearing layer. The actual density of shell in any particular area may only be known after dredging has commenced.

REFERENCES

Halka, Jeffrey P., 1987, LORAN-C Calibration in Chesapeake Bay: Maryland Geological Survey, Report of Investigations No. 47, 34 pp.

Hobbs, Carl H. III, 1987, Occurrence and Distribution of Shell in the vicinity of Parker's Rock, Pocomoke Sound, unpublished report to the Virginia Marine Resources Commission, 17 p.

Langenfelder, C.J., 1988, Telephone conversations on dredging operations in Chesapeake Bay.

APPENDIX A

SEISMIC SUBBOTTOM DATA

TABLE 1. CORRECTED TRACK LINE FIX MARKS FOR SEISMIC SUBBOTTOM PROFILES IN VICINITY OF MAN O'WAR SHOAL

	BOAT LORAN		UNCORRECTED				CORRECTED			
			LATITUDE		LONGITUDE		LATITUDE		LONGITUDE	
	TD-X	TD-Y	DEG	MINUTES	DEG	MINUTES	DEG	MINUTES	DEG	MINUTES
SOL 1										
W→E	27630.00	42862.00	39	11.3184	76	22.7888	39	11.3532	76	23.1102
	27627.00	42862.00	39	11.2830	76	22.1915	39	11.3191	76	22.5124
	27624.00	42862.00	39	11.2482	76	21.5955	39	11.2850	76	21.9159
	27621.00	42862.00	39	11.2134	76	20.9999	39	11.2511	76	21.3199
	27618.00	42862.00	39	11.1788	76	20.4053	39	11.2173	76	20.7253
EOL 1	27615.00	42862.00	39	11.1440	76	19.8116	39	11.1841	76	20.1311
SOL 2										
E→W	27615.00	42860.00	39	10.9856	76	19.9269	39	11.0252	76	20.2464
	27618.00	42860.00	39	11.0204	76	20.5206	39	11.0591	76	20.8406
	27621.00	42860.00	39	11.0552	76	21.1157	39	11.0930	76	21.4362
	27624.00	42860.00	39	11.0905	76	21.7113	39	11.1269	76	22.0322
	27627.00	42860.00	39	11.1255	76	22.3077	39	11.1612	76	22.6291
EOL 2	27630.00	42860.00	39	11.1610	76	22.9051	39	11.1953	76	23.2269
SOL 3										
W→E	27630.00	42858.00	39	11.0030	76	23.0219	39	11.0374	76	23.3437
	27626.60	42858.00	39	10.9625	76	22.3448	39	10.9985	76	22.6657
	27624.00	42858.00	39	10.9323	76	21.8271	39	10.9689	76	22.1484
	27621.00	42858.00	39	10.8973	76	21.2311	39	10.9346	76	21.5520
	27618.00	42858.00	39	10.8623	76	20.6360	39	10.9010	76	20.9564
EOL 3	27615.00	42858.00	39	10.8277	76	20.0418	39	10.8671	76	20.3618
SOL 4										
E→W	27615.00	42856.00	39	10.6698	76	20.1572	39	10.7089	76	20.4776
	27618.00	42856.00	39	10.7043	76	20.7518	39	10.7428	76	21.0722
	27621.00	42856.00	39	10.7394	76	21.3469	39	10.7764	76	21.6682
	27624.00	42856.00	39	10.7744	76	21.9434	39	10.8108	76	22.2647
	27627.00	42856.00	39	10.8099	76	22.5403	39	10.8451	76	22.8621
EOL 4	27630.00	42856.00	39	10.8451	76	23.1386	39	10.8799	76	23.4604
SOL 5										
W→E	27630.00	42854.00	39	10.6874	76	23.2553	39	10.7220	76	23.5771
	27627.00	42854.00	39	10.6519	76	22.6570	39	10.6872	76	22.9784
	27624.00	42854.00	39	10.6165	76	22.0592	39	10.6531	76	22.3810
	27621.00	42854.00	39	10.5812	76	21.4627	39	10.6185	76	21.7841
	27618.00	42854.00	39	10.5462	76	20.8667	39	10.5842	76	21.1880
EOL 5	27615.00	42854.00	39	10.5114	76	20.2721	39	10.5505	76	20.5930

Key
SOL - Start of line
EOL - End of line
W - West
E - East

TABLE 2. CORRECTED TRACK LINE FIX MARKS FOR SEISMIC SUBBOTTOM PROFILES IN VICINITY OF SIXFOOT KNOLL.

	BOAT LORAN		UNCORRECTED				CORRECTED			
			LATITUDE		LONGITUDE		LATITUDE		LONGITUDE	
	TD-X	TD-Y	DEG	MINUTES	DEG	MINUTES	DEG	MINUTES	DEG	MINUTES
SOL 1										
W→E	27619.00	42830.00	39	8.6627	76	22.4510	39	8.6993	76	22.7760
	27616.00	42830.00	39	8.6266	76	21.8523	39	8.6641	76	22.1768
	27613.00	42830.00	39	8.5911	76	21.2549	39	8.6295	76	21.5790
EOL 1	27610.00	42830.00	39	8.5554	76	20.6584	39	8.5947	76	20.9821
SOL 2										
E→W	27610.00	42827.00	39	8.3183	76	20.8301	39	8.3572	76	21.1546
	27613.00	42827.00	39	8.3544	76	21.4270	39	8.3924	76	21.7520
	27616.00	42827.00	39	8.3901	76	22.0253	39	8.4274	76	22.3503
EOL 2	27618.00	42827.00	39	8.4142	76	22.4245	39	8.4503	76	22.7499
SOL 3										
W→E	27618.00	42825.00	39	8.2565	76	22.5398	39	8.2926	76	22.8653
	27615.00	42825.00	39	8.2201	76	21.9411	39	8.2576	76	22.2661
	27612.00	42825.00	39	8.1841	76	21.3432	39	8.2226	76	21.6678
EOL 3	27610.00	42825.00	39	8.1606	76	20.9445	39	8.1992	76	21.2691
SOL 4										
E→W	27610.00	42823.00	39	8.0022	76	21.0590	39	8.0411	76	21.3840
	27612.00	42823.00	39	8.0262	76	21.4572	39	8.0649	76	21.7827
	27615.00	42823.00	39	8.0624	76	22.0560	39	8.0999	76	22.3814
EOL 4	27617.00	42823.00	39	8.0864	76	22.4551	39	8.1232	76	22.7815
SOL 5										
W→E	27617.00	42820.00	39	7.8497	76	22.6282	39	7.8864	76	22.9546
	27615.00	42820.00	39	7.8255	76	22.2285	39	7.8630	76	22.5545
EOL 5	27612.00	42820.00	39	7.7895	76	21.6293	39	7.8275	76	21.9557

Key
SOL - Start of line
EOL - End of line
W - West
E - East

APPENDIX B

VIBRACORE DATA

TABLE 3. CORE LOGS RECORDED BY THE EXMAR COMPANY OF NORFOLK, VIRGINIA.

VIBRATORY CORE SAMPLE LOG

EXMAR VIRGINIA BEACH, VA

Client: Md. Dept. of Nat. Resources

Location: Chesapeake Bay

Support Vessel: Big Lou

Positioning Method: Loran C

Positioning Information:

Lat 39° 09.4'

Long 76° 24.4'

Depth of Water: 10' Est. Current:

Wind: Sea: Swell:

Length of Barrel: 40' Diam. Core: 3.0"

Depth of Penetration: 32' Length Recovered: 26.2'

Remarks: Rapid penetration to 20'
Refusal at 32' in coarse sand.
No loss of sample through the catcher
Short recovery probably due to loss of
some of very soft top silt layer

Description	Depth ft.	Time for Penetration Real	Elapsed	Per ft.
	0			
SOFT GRAY SILT	2			
	4			
	6			
SHELL w/ GRAY SILT	8			
	10			
	12			
	14			
	16			
	18			
COARSE WHITE SAND	20			
	22			
COARSE BROWN SAND	24			
	26			
	28			
	30			
	32			
	34			
	36			
	38			
	40			

Bit Sample & Condition:
Nicked, catcher closed

Operator: M L Clarke Client Rep: Bill Outten

Length Retained: 26.2

Shipped To: Md. Geological Survey

Type Analysis:

Date: 14 March 88 Time: 1140

Site # Seven Foot Knoll #1 Core # 39° 09.4' 76° 24.4'

VIBRATORY CORE SAMPLE LOG

EXMAR VIRGINIA BEACH, VA

Client: Md. Dept. of Nat. Resources

Location: Chesapeake Bay

Description	Depth ft.	Time for Penetration Real	Elapsed	Per ft.
	0			
SOFT GRAY SILT	2			
	4			
	6			
SHELL W/GRAY SILT	8			
	10			
	12			
	14			
	16			
	18			
	20			
	22			
	24			
COARSE SAND	26			
	28			
	30			
	32			
	34			
	36			
	38			
	40			

Bit Sample & Condition: catcher closed

Support Vessel: Big Lou

Positioning Method: Loran C

Positioning Information:

Lat 39° 09.5'

Long 76° 24.2'

Depth of Water: 84. Est.Current:

Wind: Sea: Swell:

Length of Barrel: 40' Diam.Core: 3.0"

Depth of Penetration: 35' Length Recovered: 31.0'

Remarks:

Operator: M. Clarke Client Rep: Bill Outten

Length Retained: 31.0'

Shipped To: Md Geological Survey

Type Analysis:

Date: 14 March '88 Time: 1300

Site # Seven Foot Knoll #2 Core # 39° 09.5' 76° 24.2'

VIBRATORY CORE SAMPLE LOG

EXMAR VIRGINIA BEACH, VA

Client: Md. Dept. of Nat. Resources

Location: Chesapeake Bay

Support Vessel: Big Lou

Positioning Method: Loran C

Positioning Information:

Lat 39° 09.6'

Long 76° 24.0'

Depth of Water: 10' Est.Current:

Wind: Sea: Swell:

Length of Barrel: 40' Diam.Core: 3.0"

Depth of Penetration: 40' Length Recovered: 36.5'

Remarks:

Operator: M. Clarke Client Rep: Bill Outten

Length Retained: 36.5'

Shipped To: Md Geological Survey

Type Analysis:

Date: 14 March '88 Time: 1355

Site # Seven Foot Knoll #3 Core # 39° 09.6' 76° 24.0'

Bit Sample & Condition:

Description	Depth ft.	Time for Penetration Real	Elapsed	Per ft.
	0			
SOFT GRAY SILT	2			
	4			
	6			
	8			
SHELL W/GRAY SILT	10			
	12			
	14			
	16			
	18			
	20			
	22			
	24			
	26			
	28			
COARSE SAND	30			
	32			
	34			
	36			
	38			
	40			

VIBRATORY CORE SAMPLE LOG

EXNAR VIRGINIA BEACH, VA.

Client: Md. Nat. Resources

Location: Chesapeake Bay

Description	Depth ft.	Time for Penetration Real	Elapsed	Per ft.
	0			
SIFT GRAY SILT	2			
	4			
	6			
	8			
SHELL W/GRAY SILT	10			
	12			
	14			
	16			
	18			
	20			
	22			
	24			
BROWN PEAT	26			
	28			
COARSE BROWN SAND	30			
	32			
	34			
	36			
	38			
	40			

Bit Sample & Condition: catcher closed

Support Vessel: Big Loh

Positioning Method: Loran C

Positioning Information:

Lat 39° 09.55'

Long 76° 24.01'

Depth of Water: 11' Est.Current:

Wind: Sea: Swell:

Length of Barrel: 40' Diam.Core: 3.0"

Depth of Penetration: 37' Length Recovered: 31.7

Remarks:

Operator: M.L. Clarke Client Rep: B.M. Cutten

Length Retained: 31.7'

Shipped To: Md. Geological Survey

Type Analysis:

Date: 14 March '88 Time: 1455

Site # Seven Foot Knoll #4 Core # 39° 09.55' 76° 24.01'

VIBRATORY CORE SAMPLE LOG

EXMAR VIRGINIA BEACH, VA

Client: Md. Dept. of Nat Resources

Location: Ches. Bay

Description	Depth ft.	Time for Penetration Real	Elapsed	Per ft.
	0			
GRAY BILT	2			
	4			
	6			
	8			
	10			
SHELL W/ GRAY SILT	12			
	14			
	16			
	18			
	20			
	22			
	24			
	26			
COARSE BROWN SAND	28			
	30			
	32			
	34			
	36			
	38			
	40			

Bit Sample & Condition: closed

Support Vessel: Big Lou

Positioning Method: LoranC

Positioning Information:

LoranC 27 630.1 Lat. 39° 11.2'N

42 859.3 Long. 76° 23.3'W

Depth of Water: Est.Current:

Wind: Sea: Swell:

Length of Barrel: 40' Diam.Core: 3.0"

Depth of Penetration: 32' Length Recovered: 31.8'

Remarks:

Operator: M.L.Clarke Client Rep: Bill Outten

Length Retained: 31.8'

Shipped To: Geology Survey

Type Analysis:

Date: 21 March '98 Time: 0910

Site # Man O'War Shoal #1 Core #

VIBRATORY CORE SAMPLE LOG

EXMAR VIRGINIA BEACH, VA

Client: Md. Dept. of Nat. Resources

Location: C Ches. Bay

Description	Depth ft.	Time for Penetration Real	Elapsed	Per ft.
	0			
GRAY SILT	2			
	4			
	6			
	8			
	10			
SHELLS	12			
	14			
w/ GRAY	16			
SILT	18			
	20			
	22			
	24			
	26			
COARSE BROWN SAND	28			
	30			
	32			
	34			
	36			
	38			
	40			

Bit Sample & Condition: closed

Support Vessel: Big Lou

Positioning Method: LoranC

Positioning Information:

LoranC 27 628.6 Lat. 39° 11.1 N

42 858.2 Long. 76° 23.1 W

Depth of Water: Est. Current:

Wind: Sea: Swell:

Length of Barrel: 40' Diam. Core: 3.0"

Depth of Penetration: 33' Length Recovered: 30.2'

Remarks:

Operator: M. Clarke Client Rep: Bill Outton

Length Retained: 30.2

Shipped To: Md. Geological Survey

Type Analysis:

Date: 21 March '88 Time: 1010

Site # Man O'War Shoal #2 Core #

VIBRATORY CORE SAMPLE LOG

EXMAR VIRGINIA BEACH, VA.

Client: Md. Dept. of Nat. Resources

Location: Ches. Bay

Description	Depth ft.	Time for Penetration Real	Elapsed	Per ft.
	0			
	2			
	4			
SHELL W/GRAY SILT	6			
	8			
	10			
	12			
	14			
	16			
	18			
	20			
	22			
	24			
	26			
	28			
SHELL FRAGMENTS W/GRAY SILT	30			
	32			
COARSE BROWN SAND	34			
	36			
	38			
	40			

Bit Sample & Condition: closed

Support Vessel: Big Lou

Positioning Method: LorancC

Positioning Information:

LorancC 27.629.5 Lat. 39° 11.2N

42.859.6 Long. 76° 23.1W

Depth of Water: Est. Current:

Wind: Sea: Swell:

Length of Barrel: 40' Diam. Core: 3.0"

Depth of Penetration: 36' Length Recovered: 34.8'

Remarks:

Operator: Mike Clarke Client Rep: Bill Outten

Length Retained 34.8'

Shipped To: Md. Geological Survey

Type Analysis:

Date: 21 March 88 Time: 1105

Site # Man O'War Shoal #3 Core #

VIBRATORY CORE SAMPLE LOG

EXMAR VIRGINIA BEACH, VA

Client: Md. Dept. of Nat. Resources

Location: Ches. Bay

Description	Depth ft.	Time for Penetration Real	Elapsed	Per ft.
	0			
	2			
	4			
	6			
SHELL w/GRAY SILT	8			
	10			
	12			
	14			
	16			
	18			
	20			
	22			
	24			
	26			
	28			
GRAY SILTY CLAY	30			
	32			
	34			
COARSE BROWN SAND	36			
	38			
	40			

Bit Sample & Condition: closed

Support Vessel: Big Lou

Positioning Method: Loran C

Positioning Information:

Loran C 27 629.2 Lat. 39° 11.3N

42 860.5 Long. 76° 22.98W

Depth of Water: Est. Current:

Wind: Sea: Swell:

Length of Barrel: 40' Diam. Core: 3.0"

Depth of Penetration: 39' Length Recovered: 35.8'

Remarks:

Operator: M. Clarke Client Rep: Bill Outten

Length Retained: 35.8'

Shipped To: Md. Geological Survey

Type Analysis:

Date: 2-4 March '88 Time: 1150

Site # Man O'War Shoal #4 Core #

VIBRATORY CORE SAMPLE LOG

EXMAR VIRGINIA BEACH, VA

Client: Md- Dept. of Nat. Resources

Location: C Ches. Bay

Description	Depth ft.	Time for Penetration Real	Elapsed	Per ft.
	0			
BLACK SILT	2			
	4			
	6			
	8			
SHELL & GRAY SILT	10			
	12			
	14			
	16			
	18			
	20			
	22			
	24			
	26			
	28			
WHITE SAND	30			
COARSE BROWN SAND	32			
	34			
	36			
	38			
	40			

Bit Sample & Condition: a/cond

Support Vessel: Big Lou

Positioning Method: Loran C

Positioning Information:

Loran C 27.627.9 Lat. 39° 11.2'N

42.859.3 Long. 76° 22.85'W

Depth of Water: Est.Current:

Wind: Sea: Swell:

Length of Barrel: 40' Diam.Core: 3.0"

Depth of Penetration: 36' Length Recovered: 32.7'

Remarks:

Operator: MH Clarke Client Rep: Bill Outten

Length Retained: 32.7'

Shipped To: Md. Geological Survey

Type Analysis:

Date: 21 March 88 Time: 1315

Site # Man O'War Shoal #5 Core #

VIBRATORY CORE SAMPLE LOG

EXMAR VIRGINIA BEACH, VA

Client: Md. Dept. of Nat. Resources

Location: Ches. Bay

Description	Depth ft.	Time for Penetration Real	Elapsed	Per ft.
	0			
	2			
	4			
	6			
	8			
	10			
SHELL W/ GRAY SILT	12			
	14			
	16			
	18			
	20			
	22			
	24			
	26			
	28			
	30			
	32			
WHITE SAND	34			
COARSE BROWN SAND	36			
	38			
	40			

Bit Sample & Condition: closed

Support Vessel: Big Lou

Positioning Method: Loran C

Positioning Information:

Loran C 27 627.9 Lat. 39° 11.3'N

42 859.5 Long. 76° 22.8W

Depth of Water: Est. Current:

Wind: Sea: Swell:

Length of Barrel: 40' Diam. Core: 3.0"

Depth of Penetration: 36' Length Recovered: 35.0'

Remarks:

Operator: M L Clarke Client Rep: Bill Outten

Length Retained: 35.0'

Shipped To: Md Geological Survey

Type Analysis:

Date: 21 March '88 Time: 1315

Site # Man O'War Shoal # 6 Core #

VIBRATORY CORE SAMPLE LOG

EXMAR VIRGINIA BEACH, VA

Client: Md-Dept. Nat. Resources

Location: Ches. Bay

Description	Depth ft.	Time for Penetration Real	Elapsed	Per ft.
	0			
BLACK SILT	2			
	4			
	6			
SHELL W/GRAY SILT	8			
	10			
	12			
	14			
	16			
	18			
	20			
	22			
	24			
	26			
	28			
	30			
COARSE BROWN SAND	32			
	34			
	36			
	38			
	40			

Bit Sample & Condition: closed

Support Vessel: Big Lou

Positioning Method: LoranC

Positioning Information:

LoranC 27 628.1 Lat. 39° 11.2'N

42 859.1 Long. 76° 22.8W

Depth of Water: Est.Current:

Wind: Sea: Swell:

Length of Barrel: 40' Diam.Core: 3.0"

Depth of Penetration: 37' Length Recovered: 33.5'

Remarks:

Operator: M L Clarke Client Rep: Bill Outten

Length Retained: 33.5'

Shipped To: Md. Geological Survey

Type Analysis:

Date: 2/March/88 Time: 1500

Site # Man O'War Shoal # 7 Core #

VIBRATORY CORE SAMPLE LOG

EXMAR VIRGINIA BEACH, VA

Client: Md. Dept. of Nat. Resources

Location: Ches Bay

Support Vessel: Big Lou

Positioning Method: LorancC

Positioning Information:

LorancC 27 627.7 Lat. 39° 11.25'N
42 860.0 Long. 76° 22.7'W

Depth of Water: Est.Current:

Wind: Sea: Swell:

Length of Barrel: 40' Diam.Core: 3.0"

Depth of Penetration: 36' Length Recovered: 35.8'

Remarks:

Operator: M. Clarke Client Rep: R. Cuthbertson Jr.

Length Retained: 35.8'

Shipped To: cut into 7 segments

Type Analysis:

Date: 22 March '88 Time: 0905

Site # Md DNR Shad #8 Core #

Description	Depth ft.	Time for Penetration Real	Elapsed	Per ft.
	0			
	2			
	4			
	6			
SHELL W/GRAY SILT	8			
	10			
	12			
	14			
	16			
	18			
	20			
	22			
	24			
	26			
	28			
	30			
	32			
COARSE BROWN SAND	34			
	36			
	38			
	40			

Bit Sample & Condition: closed

VIBRATORY CORE SAMPLE LOG

EXMAR VIRGINIA BEACH, VA

Client: Md. Dept. of Nat. Resources

Location: Ches. Bay

Description	Depth ft.	Time for Penetration Real	Elapsed	Per ft.
	0			
	2			
	4			
	6			
	8			
	10			
SHELL W/ GRAY SILT	12			
	14			
	16			
	18			
	20			
	22			
	24			
	26			
	28			
DARK SOIL	30			
COARSE BROWN SAND	32			
	34			
	36			
	38			
	40			

Support Vessel: Big Lou

Positioning Method: LoranC

Positioning Information:

LoranC 27626.9 Lat. 39° 11.1'N

42 859.0 Long. 76° 22.6W

Depth of Water: Est. Current:

Wind: Sea: Swell:

Length of Barrel: 40' Diam. Core: 3.0"

Depth of Penetration: 34' Length Recovered: 33.2

Remarks:

Operator: M L Clarke Client Rep: R. Cuthbertson, Jr.

Length Retained: 33.2

Shipped To: cut into 6 segments

Type Analysis:

Bit Sample & Condition: closed

Date: 22 March '88 Time: 1520

Site #Man O'War Shoal #9 Core #

VIBRATORY CORE SAMPLE LOG

EXMAR VIRGINIA BEACH, VA

Client: Md. Dept. of Nat. Resources

Location: Ches Bay

Description	Depth ft.	Time for Penetration Real	Elapsed	Per ft.
	0			
	2			
	4			
	6			
SHELL W/ GRAY SILT	8			
	10			
	12			
	14			
	16			
	18			
	20			
	22			
	24			
	26			
	28			
	30			
	32			
	34			
COARSE BROWN SAND	36			
	38			
	40			

Bit Sample & Condition: Closed

Support Vessel: Big Lou

Positioning Method: LoranC

Positioning Information:

LoranC 27 625.7 Lat. 39° 11.25'N

42 859.7 Long. 76° 22.4'W

Depth of Water: Est.Current:

Wind: Sea: Swell:

Length of Barrel: 40' Diam.Core: 3.0

Depth of Penetration: 40' Length Recovered: 36.8'

Remarks:

Operator: M/V Alaska Client Rep: R. Cuthbertson, Jr.

Length Retained: 36.8'

Shipped To: cut into 7 segments

Type Analysis:

Date: 22 March '88 Time: 1035

Site # Mem O'War Shoal #10 Core #

VIBRATORY CORE SAMPLE LOG

EXMAR VIRGINIA BEACH, VA

Client: Md. Nat. Resources

Location: Ches. Bay

Description	Depth ft.	Time for Penetration Real	Elapsed	Per ft.
	0			
	2			
	4			
	6			
SHELL W/GRAY SILT	8			
	10			
	12			
	14			
	16			
	18			
	20			
	22			
	24			
COARSE BROWN SAND	26			
	28			
	30			
	32			
	34			
	36			
	38			
	40			

Bit Sample & Condition: closed

Support Vessel: Big Lou

Positioning Method: LoranC

Positioning Information:

LoranC 27.626.3 Lat. 39° 11.3'N
42.860.2 Long. 76° 22.35'W

Depth of Water: Est.Current:

Wind: Sea: Swell:

Length of Barrel: 40' Diam.Core: 3.0"

Depth of Penetration: 39' Length Recovered: 31.0'

Remarks: Expect short recovery due loss of upper material by too rapid penetration.

Operator: M. Clarke Client Rep: R. Cuthbertson, Jr.

Length Retained: 31.0'

Shipped To: cut into 6 segments

Type Analysis:

Date: 22 March '88 Time: 1125

Site # Man O'War Shoal #11 Core #

VIBRATORY CORE SAMPLE LOG

EXMAR VIRGINIA BEACH, VA

Client: Md. Dept. of Nat. Resources

Location: Ches. Bay

Support Vessel: Big Lou

Positioning Method: LoranC

Positioning Information:

LoranC 27 625.7 Lat. 39° 11.06'N
42 858.8 Long. 76° 22.35'W

Depth of Water: Est.Current:

Wind: Sea: Swell:

Length of Barrel: 40' Diam.Core: 3.0

Depth of Penetration: 40' Length Recovered: 37.6'

Remarks:

Operator: M h Clarke Client Rep: R. Cuthbertson, Jr.

Length Retained: 37.6'

Shipped To: Cut into 7 segment.

Type Analysis:

Date: 22 Mar Li'88 Time: 1210

Site # Man O War Shoal #12 Core #

Description	Depth ft.	Time for Penetration Real	Elapsed	Per ft.
	0			
	2			
	4			
	6			
SHELL W/ GRAY SILT	8			
	10			
	12			
	14			
	16			
	18			
	20			
	22			
	24			
	26			
	28			
	30			
COARSE BROWN SAND	32			
	34			
	36			
	38			
	40			

Bit Sample & Condition: closed

VIBRATORY CORE SAMPLE LOG

EXMAR VIRGINIA BEACH, VA

Client: Md. Dept. of Nat. Resources

Location: Ches. Bay

Description	Depth ft.	Time for Penetration Real	Elapsed	Per ft.
	0			
	2			
	4			
	6			
SHELL w/ GRAY SILT	8			
	10			
	12			
	14			
	16			
	18			
	20			
	22			
	24			
GRAY CLAY	26			
	28			
COARSE BROWN SAND	30			
	32			
	34			
	36			
	38			
	40			

Bit Sample & Condition: closed

Support Vessel: Big Lou

Positioning Method: LoranC

Positioning Information:

LoranC 27 625.2 Lat. 39° 11.2'N

42 859.0 Long. 76° 22.2'W

Depth of Water: Est.Current:

Wind: Sea: Swell:

Length of Barrel: 40' Diam.Core: 3.0"

Depth of Penetration: 38' Length Recovered: 32.9'

Remarks:

Operator: M L Clark Client Rep: R. Cuthbertson, Jr.

Length Retained: 32.9'

Shipped To: cut into 6 segments

Type Analysis:

Date: 22 March '88 Time: 1255

Site #Man O'War Shoal #13 Core #

VIBRATORY CORE SAMPLE LOG

EXMAR VIRGINIA BEACH, VA

Client: Md. Nat. Resources

Location: Ches Bay

Description	Depth ft.	Time for Penetration Real	Elapsed	Per ft.
	0			
	2			
	4			
SOFT GRAY SILTY CLAY	6			
	8			
	10			
	12			
	14			
SHELL w/ GRAY SILT	16			
	18			
	20			
	22			
COARSE BROWN SAND	24			
	26			
	28			
	30			
	32			
	34			
	36			
	38			
	40			

Bit Sample & Condition: closed

Support Vessel: Big Lou

Positioning Method: LoranC

Positioning Information:

LoranC 27 624.1 Lat. 39° 11.1'N

42 857.8 Long. 76° 22.1'W

Depth of Water: Est.Current:

Wind: Sea: Swell:

Length of Barrel: 40' Diam.Core: 3-0

Depth of Penetration: 40' Length Recovered: 29.5'

Remarks: Expect short recovery due too rapid penetration in upper, soft silty clay layer.

Operator: Mr Clark Client Rep: R. Cuthbertson, Jr.

Length Retained: 29.5'

Shipped To: cut into 6 segments

Type Analysis:

Date: 22 March '88 Time: 1340

Site # Man O'War Shoal #14 Core #

VIBRATORY CORE SAMPLE LOG

EXMAR VIRGINIA BEACH, VA

Client: Md. Dept. of Nat. Resources

Location: Ches. Bay

Description	Depth ft.	Time for Penetration Real	Elapsed	Per ft.
	0			
	2			
	4			
	6			
SHELL W/GRAY SILT	8			
	10			
	12			
	14			
	16			
	18			
	20			
	22			
	24			
	26			
	28			
	30			
	32			
DARK SOIL AND WOOD	34			
	36			
	38			
	40			

Bit Sample & Condition: Sand in bit, closed

Support Vessel: Big Lou

Positioning Method: Loran C

Positioning Information:

Loran C 27624.4 Lat 39° 11.2'N

42860.0 Long. 76° 22.1'W

Depth of Water: Est.Current:

Wind: Sea: Swell:

Length of Barrel: 40' Diam.Core: 3.0"

Depth of Penetration: 40' Length Recovered: 33.7'

Remarks:

Operator: M. Clarke Client Rep: R. Cuthbertson, Jr.

Length Retained: 33.7'

Shipped To: cut into 6 segments

Type Analysis:

Date: 22 March '88 Time: 1430

Site #Mar O'War Shoal #5 Core #

VIBRATORY CORE SAMPLE LOG

EXMAR VIRGINIA BEACH, VA

Client: Md. Dept. of Nat. Resources

Location: Ches. Bay, Man O'War Shoal

Description	Depth ft.	Time for Penetration Real	Elapsed	Per ft.
	0			
	2			
	4			
	6			
	8			
	10			
SHELL W/GRAY SILT	12			
	14			
	16			
	18			
	20			
	22			
	24			
	26			
	28			
	30			
	32			
COARSE SAND	34			
	36			
	38			
	40			

Bit Sample & Condition: closed

Support Vessel: Big Lou

Positioning Method: Loran C

Positioning Information:

Loran C 27 623.6 Lat. 39° 11.15' N

42 859.8 Long. 76° 22.0' W

Depth of Water: Est. Current:

Wind: Sea: Swell:

Length of Barrel: 40' Diam. Core: 3.0"

Depth of Penetration: 37' Length Recovered: 33.6'

Remarks:

Operator: Rich Clarke Client Rep: Bill Outten

Length Retained: 33.6'

Shipped To: cut into 6 segments

Type Analysis:

Date: 23 March '88 Time: 0845

Site # MD O'War Shoal #16 Core #

VIBRATORY CORE SAMPLE LOG

EXMAR VIRGINIA BEACH, VA

Client: Mid-Dept. of Nat. Resources Location: Ches. Bay, Man O'War Shoal

Description	Depth ft.	Time for Penetration Real	Elapsed	Per ft.
	0			
	2			
	4			
	6			
	8			
SHELL w/GRAY SILT	10			
	12			
	14			
	16			
	18			
	20			
	22			
	24			
	26			
	28			
	30			
COARSE BROWN SAND	32			
	34			
	36			
	38			
	40			

Bit Sample & Condition: closed

Support Vessel: Big Lou

Positioning Method:

Positioning Information: Loran C

Loran C 27 623.4 Lat. 39° 11.15'N

42 859.6 Long. 76° 22.9'W

Depth of Water: Est.Current:

Wind: Sea: Swell:

Length of Barrel: 40' Diam.Core: 3.0"

Depth of Penetration: 34' Length Recovered: 31.7'

Remarks:

Operator: M. Clark Client Rep: Bill Outten

Length Retained: 31.7'

Shipped To: cut into 6 segments

Type Analysis:

Date: 23 March 80 Time: 0930

Site # MO'WarShoal # 17 Core #

VIBRATORY CORE SAMPLE LOG

EXMAR VIRGINIA BEACH, VA

Client: Md. Dept. of Nat. Resources

Location: O hes. Bay, Man O'War Shoal

Description	Depth ft.	Time for Penetration Real	Elapsed	Per ft.
	0			
	2			
	4			
	6			
SHELL W/ GRAY SILT	8			
	10			
	12			
	14			
	16			
	18			
	20			
	22			
	24			
	26			
	28			
	30			
COARSE BROWN SAND	32			
	34			
	36			
	38			
	40			

Bit Sample & Condition: closed

Support Vessel: Big Lou

Positioning Method: LoranC

Positioning Information:

LoranC 27623.2 Lat. 39° 11.00'N

42 860.0 Long. 76° 21.8'W

Depth of Water: Est. Current:

Wind: Sea: Swell:

Length of Barrel: 40' Diam. Core: 3.0"

Depth of Penetration: 34' Length Recovered: 32.1'

Remarks:

Operator: MH Clarke Client Rep: Bill Outten

Length Retained: 32.1'

Shipped To: cut into 6 segments

Type Analysis:

Date: 23 March '08 Time: 1015

Site # Man O'War Shoal #18 Core #

VIBRATORY CORE SAMPLE LOG

EXMAR VIRGINIA BEACH, VA

Client: Md. Dept of Nat Resources

Location: Ches. Bay, Man O'War Shoal

Description	Depth ft.	Time for Penetration Real	Elapsed	Per ft.
	0			
	2			
	4			
	6			
	8			
SHELL W/SOFT GRAY SILT	10			
	12			
	14			
	16			
	18			
	20			
	22			
	24			
	26			
	28			
	30			
	32			
	34			
SAND W/SILTY CLAY	36			
	38			
	40			

Bit Sample & Condition: closed

Support Vessel: Big Lou

Positioning Method: Loran C

Positioning Information:

Loran C 27 622.5 Lat. 39° 11.2'N

42 859.7 Long 76° 21.75'W

Depth of Water: Est. Current:

Wind: Sea: Swell:

Length of Barrel: 40' Diam. Core: 3.0"

Depth of Penetration: 34.0' Length Recovered: 36.8'

Remarks:

Operator: M. McClarke Client Rep: Bill Outten

Length Retained: 36.8'

Shipped To: cut into 7 segments

Type Analysis:

Date: 28 March 88 Time: 0925

Site # Man O'War Shoal #19 Core #

VIBRATORY CORE SAMPLE LOG

EXMAR VIRGINIA BEACH, VA

Client: Md. Dept. of Nat. Resources

Location: Ches. Bay, Man O'War Shoal

Description	Depth ft.	Time for Penetration Real	Elapsed	Per ft.
	0			
	2			
SHELL w/GRAY CLAY	4			
	6			
	8			
	10			
	12			
SANDY SILT	14			
	16			
	18			
	20			
	22			
	24			
	26			
	28			
	30			
	32			
	34			
	36			
	38			
	40			

Bit Sample & Condition: closed

Support Vessel: Big Lou

Positioning Method: Loran C

Positioning Information:

Loran C 27 621.6 Lat. 39° 11.05'N

42 858.9 Long. 76° 21.6'W

Depth of Water: Est. Current:

Wind: Sea: Swell:

Length of Barrel: 40' Diam. Core: 3.0"

Depth of Penetration: 40' Length Recovered: 14.1'

Remarks: 1st attempt

No loss through catcher

Expect short recovery due dense layer pushing through very soft lower layer.

Observed gas coming to surface on retrieving corer.

Operator: MH Clarke Client Rep: Bill Outten

Length Retained: 14.1'

Shipped To: cut into 3 segments

Type Analysis:

Date: 28 March '88 Time: 1010

Site # Man O'War Shoal #20A Core # 20A

VIBRATORY CORE SAMPLE LOG

EXMAR VIRGINIA BEACH, VA

Client: Md - Dept. of Nat. Resources

Location: Ches. Bay, Man O'War Shoal

Description	Depth ft.	Time for Penetration Real	Elapsed	Per ft.
	0			
SHELL W/ GRAY SILT	2			
	4			
	6			
	8			
	10			
HARD PACKED SHELL (bit Sample)	12			
	14			
	16			
	18			
	20			
	22			
	24			
	26			
	28			
	30			
	32			
	34			
	36			
	38			
	40			

Bit Sample & Condition: closed
Plugged by shells in stiff matrix.

Support Vessel: Big Lou

Positioning Method: Loran C

Positioning Information:

Loran C 27 624.6 Lat. 39° 11.05'N
42858.9 Long. 76° 21.6'W

Depth of Water: Est. Current:

Wind: Sea: Swell:

Length of Barrel: 40' Diam. Core: 3.0"

Depth of Penetration: 40' Length Recovered: 11.5'

Remarks: Rate of penetration record identical to 1st attempt
No sample loss through bit.
Expect dense layer of shell in bit
pushed through softer lower layers
causing short recovery as in 1st attempt.
Observed gas coming to surface from hole.

Operator: M. Clarke Client Rep: Bill Cutter

Length Retained: 11.5'

Shipped To: cut into 2 segments
plus bit sample

Type Analysis:

Date: 28 March '88 Time: 1035

Site # Man O'War Shoal #20B Core # 20B

VIBRATORY CORE SAMPLE LOG

EXMAR VIRGINIA BEACH, VA

Client: Md - Dept. of Nat. Resources

Location: Ches. Bay, Hill East of Man O'War Shoal

Description	Depth ft.	Time for Penetration Real	Elapsed	Per ft.
	0			
GRAY SILT	2			
	4			
	6			
	8			
SHELL u/GRAY SILT	10			
	12			
	14			
	16			
	18			
	20			
	22			
	24			
	26			
SAND	28			
	30			
	32			
	34			
	36			
	38			
	40			

Bit Sample & Condition: closed

Support Vessel: Big Lou

Positioning Method: Loran C

Positioning Information:

Loran C 27.617.9 Lat. 39° 11.6'N

42.866.7 Long. 76° 20.38'W

Depth of Water: Est. Current:

Wind: Sea: Swell:

Length of Barrel: 40' Diam. Core: 3.0"

Depth of Penetration: 34' Length Recovered: 29.0'

Remarks: Taken at Top of a bank adjacent to deeper water.

Operator: M. McClure Client Rep: Bill Cutter

Length Retained: 29.0'

Shipped To: cut into 6 segments

Type Analysis:

Date: 28 March '88 Time: 1130

Site # East of Man O'War Shoal AREA B Core #

TABLE 4. CORRECTED CORE LOCATIONS

	BOAT LORAN		UNCORRECTED				CORRECTED			
			LATITUDE		LONGITUDE		LATITUDE		LONGITUDE	
	TD-X	TD-Y	DEG	MINUTES	DEG	MINUTES	DEG	MINUTES	DEG	MINUTES
SEVENFOOT KNOLL*										
1			39	09.4	76	24.4				
2			39	09.5	76	24.2				
3			39	09.6	76	24.0				
4			39	09.55	76	24.01				
MAN O'WAR SHOAL										
1	27630.10	42859.30	39	11.1067	76	22.9660	39	11.1413	76	23.2874
2	27628.60	42858.20	39	11.0019	76	22.7312	39	11.0374	76	23.0530
3	27629.50	42859.60	39	11.1237	76	22.8291	39	11.1582	76	23.1505
4	27629.20	42860.50	39	11.1909	76	22.7165	39	11.2257	76	23.0379
5	27627.90	42859.30	39	11.0809	76	22.5279	39	11.1163	76	22.8493
6	27627.90	42859.50	39	11.0964	76	22.5165	39	11.1319	76	22.8378
7	27628.10	42859.10	39	11.0674	76	22.5792	39	11.1028	76	22.9001
8	27627.70	42860.00	39	11.1337	76	22.4469	39	11.1690	76	22.7682
9	27626.90	42859.00	39	11.0454	76	22.3462	39	11.0811	76	22.6671
10	27625.70	42859.70	39	11.0863	76	22.0670	39	11.1223	76	22.3878
11	27626.30	42860.20	39	11.1330	76	22.1571	39	11.1690	76	22.4780
12	27625.70	42858.80	39	11.0156	76	22.1187	39	11.0518	76	22.4396
13	27625.20	42859.00	39	11.0250	76	22.0079	39	11.0614	76	22.3288
14	27624.10	42857.80	39	10.9177	76	21.8587	39	10.9543	76	22.1800
15	27624.40	42860.00	39	11.0950	76	21.7909	39	11.1314	76	22.1114
16	27623.60	42859.80	39	11.0699	76	21.6431	39	11.1067	76	21.9640
17	27623.40	42859.60	39	11.0518	76	21.6151	39	11.0886	76	21.9360
18	27623.20	42860.00	39	11.0811	76	21.5520	39	11.1177	76	21.8729
19	27622.50	42859.70	39	11.0490	76	21.4307	39	11.0863	76	21.7516
20A	27621.60	42858.90	39	10.9753	76	21.2984	39	11.0126	76	21.6188
20B	27621.60	42858.90	39	10.9753	76	21.2984	39	11.0126	76	21.6188
AREA B										
1	27617.90	42866.70	39	11.5489	76	20.1146	39	11.5881	76	20.4332

* uncorrected latitude/longitude values recorded only

TABLE 5. WEIGHT OF SHELL (g) FOR EACH CORE SECTION (SHELLS GREATER THAN $^{1}/_{2}$ INCH)

SEVENFOOT KNOLL	CORE INTERVAL (ft)	WEIGHT OF SHELL COMPONENT (g)
1	0-6.2	1070
	6.2-11.2	1833
	11.2-16.2	2121
	16.2-21.2	526
	21.2-26.2	(no shell), sand
2	0-6	1615
	6-11	1620
	11-16	1686
	16-21	1534
	21-26	1754
	26-31	(no shell), sand
3	0-5.5	2260
	5.5-11	2030
	11-16.5	1029
	16.5-21.5	1000
	21.5-26.5	464
	26.5-31.5	878
	31.5-36.5	(no shell), sand
4	0-5	640
	5-11.7	2462
	11.7-16.7	1031
	16.7-21.7	1766
	21.7-26.7	468
	21.7-22.7	shells
	22.7-26.7	coarse sand, peat at bottom
MAN O'WAR SHOAL		
1	0-5	1701
	5-11.8	1557
	11.8-16.8	1458
	16.8-21.8	980
	21.8-26.8	1706
	26.8-31.8	425
2	0-5	1496
	5-10.2	1317
	10.2-15.2	1257
	15.2-20.2	647
	20-25.2	1423
	25.2-32.2	190
		first 0.5 ft of interval shell, rest sand
3	0-5	2373
	5-10	1475
	10-14.8	1366
	14.8-19.8	1389
	19.8-24.8	1512

MAN O'WAR SHOAL	CORE INTERVAL (ft)	WEIGHT OF SHELL COMPONENT (g)
3 (cont.)	24.8-29.8	1713
	29.8-34.8	no shell first 0.25 ft of interval - shell, rest sand
4	0-5	2173
	5-10	1498
	10-15.8	1580
	15.8-20.8	2037
	20.8-25.8	514
	25.8-30.8	114
	30.8-35.8	141
5	0-5	3219
	5-12.7	2188
	12.7-17.7	1420
	17.7-22.7	1797
	22.7-27.7	1607
	27.7-32.7	544
6	0-5	2845
	5-10	1295
	10-15	1451
	15-20	1253
	20-25	1556
	25-30	1771
	30-35	473
	33-35	muddy sand, last 0.5 ft gravel
7	0-6.5	3885
	6.5-13.5	1384
	13.5-18.5	1438
	18.5-23.5	2018
	23.5-28.5	1716
	28.5-33.5	177
8	0-5	2427
	5-10	1357
	10-15.8	2150
	15.8-20.8	1614
	20.8-25.8	2240
	25.8-30.8	1844
	30.8-35.8	421 first 1.5 ft of interval - shell, rest sand
9	0-6	2516
	6-13.2	1649
	13.2-18.2	1745
	18.2-23.2	1536
	23.2-28.2	1936
	28.2-33.2	532

MAN O'WAR SHOAL	CORE INTERVAL (ft)		WEIGHT OF SHELL COMPONENT (g)
10	0-5		2058
	5-10		1430
	10-16.4		1635
	16.4-21.4		1549
	21.4-26.4		1623
	26.4-31.4		1737
	31.4-36.4		160
		31.4-32.4 shells and sandy mud	
		32.4-33.4 sandy mud	
		33.4-34.4 muddy sand	
		34.4-35.4 coarse sand	
11	0-5		1519
	5-11		590
	11-16		994
	16-21		1086
	21-26		772
	26-31		no shells, sand+gravel
12	0-5		2527
	5-10		3003
	10-17.6		2367
	17.6-22.6		1477
	22.6-27.6		1428
	27.6-32.6		1623
	32.6-37.6		772
		32.6-34.6 shells in sand	
		34.6-35.6 clayey mud	
		35.6-37.6 muddy sand	
13	0-6		2024
	6-12.9		1615
	12.9-17.9		869
	17.9-22.9		1792
	22.9-27.9		1623
		26.9-27.9 sandy clay, very cohesive	
	27.9-32.9		no shell, muddy sand, some gravel
14	0-5		117
	5-9.5		184
	9.5-14.5		136
	14.5-19.5		849
	19.5-24.5		736
	24.5-29.5		no shell, brown sand

MAN O'WAR SHOAL	CORE INTERVAL (ft)	WEIGHT OF SHELL COMPONENT (g)
15	0-7	3475
	7-13.7	1743
	13.7-18.7	883
	18.7-23.7	1735
	23.7-28.7	1245
	28.7-33.7	1279
16	0-6	1923
	6-13.6	3620
	13.6-18.6	1618
	18.6-23.6	1647
	23.6-28.6	1838
	28.6-33.6	1740
17	0-6	2349
	6-11.7	1471
	11.7-16.7	1591
	16.7-21.7	1803
	21.7-26.7	1706
	26.7-31.7	1199
18	0-6	2864
	6-12.1	2709
	12.1-17.1	1388
	17.1-22.1	1602
	22.1-27.1	2752
	27.1-32.1	1863
19	0-5	2780
	5-10	3122
	10-16.8	1911
	16.8-21.8	2349
	21.8-26.8	1832
	26.8-31.8	1678
	31.8-36.8	1151
20A	0-5	3352
*coring stopped by obstruction	5-10	1171
	10-14.1	1824
20B	0-5	2577
*coring stopped by obstruction	5-11.5	2667
	Bit sample	84
AREA B		
1	0-5	2438
	5-9	1443
	9-14	1234
	14-19	290
	19-24	1853
	24-29	1989

APPENDIX C

MATHEMATICAL CALCULATIONS

TABLE 6. MATHEMATICAL FORMULAS USED FOR CALCULATIONS IN THIS REPORT

1. Volume of cylinder (core cylinder); core diameter = 3 in

$V_{cyl} = \pi r^2 h$ $\quad r=1.5$ in $\quad r^2=2.25$ in^2

$= 3.1416(2.25\text{in}^2)(h)$ $\quad \pi=3.1416$

$= 7.07$ in^2(h") $\quad$ h=height in inches of shell bearing section

$= ?$ in^3

$= ?$ yd^3 $\quad 1$ yd^3=46,656 in^3

2. Pounds of shell per yd^3 of bottom;

$$\frac{\text{lbs of shell} > 1/2 \text{ in}}{\text{yd}^3 \text{ of bottom}}$$

3. Pounds of shell per yd^2 of bottom;

$$\frac{\text{lbs of shell}}{\text{yd}^3 \text{ of bottom}} \times \text{thickness of shell bearing layer (yds)} = \frac{\text{lbs of shell}}{\text{yd}^2 \text{ of bottom}}$$

4. yd^3 of shell per yd^2 of bottom;

$$\frac{\text{lbs of shell}}{\text{yd}^2 \text{ of bottom}} \div \frac{1293 \text{ lbs of shell}}{\text{yd}^3 \text{ of shell}} = \frac{\text{yd}^3 \text{ of shell}}{\text{yd}^2 \text{ of bottom}}$$

1-5 gallon pail of shell = 32 lbs of shell > $^1/_2$ inch

1 yd^3 of shell = 1293 lbs of shell

5. bushels per yd^2 of bottom disturbed;

$$\frac{\text{yd}^3 \text{ of shell}}{\text{yd}^2 \text{ of bottom}} \div \frac{.06 \text{ yd}^3}{\text{bushel}} = \frac{\text{bushels}}{\text{yd}^2 \text{ of bottom}}$$

1 Maryland bushel = 2800.9 in^3 = .06 yd^3

TABLE 7. BASIC MEASUREMENTS AND CALCULATION OF POUNDS OF SHELL PER CUBIC YARD OF BOTTOM.

Sevenfoot Knoll	Length of shell bearing section (in)	weight of shell >$^1/_2$" (lbs)	Core Cylinder Volume (yd^3)	Pounds of shell per yd^3 of bottom
1	254.4	12.2	0.039	313
2	312	18.1	0.047	385
3	378	16.9	0.057	296
4	320.4	14	0.049	286
Man O'War Shoal				
1	381.6	17.3	0.058	298
2	308.4	14	0.047	298
3	357.6	21.7	0.054	402
4	429.6	17.8	0.065	274
5	392.4	23.8	0.059	403
6	396	23.5	0.060	392
7	402	23.4	0.061	384
8	387.6	26.6	0.059	451
9	398.4	21.9	0.060	365
10	388.8	22.5	0.059	381
11	312	10.9	0.047	232
12	415.2	29.1	0.063	462
13	322.8	17.5	0.049	357
14	294	4.5	0.045	100
15	404.4	22.8	0.061	374
16	403.2	27.3	0.061	448
17	380.4	22.3	0.058	384
18	385.2	29.1	0.058	502
19	441.6	32.7	0.067	488
20A	169.2	14	0.026	538
20B	138	11.7	0.021	557
AREA B				
1	348	20.4	0.053	385

TABLE 8. CALCULATED QUANTITIES OF SHELL >1/2 INCH PER SQUARE YARD OF SUBBOTTOM DISTURBED (TO BOTTOM OF SHELL BEARING LAYER)

CORE	lbs of shell per yd^2 of bottom	yd^3 of shell per yd^2 of bottom	bushels per yd^2 of bottom
SEVENFOOT KNOLL			
1	2212	1.71	29
2	3337	2.58	43
3	3108	2.40	40
4	2545	1.97	33
MAN O'WAR SHOAL			
1	3159	2.44	41
2	2553	1.97	33
3	3993	3.09	52
4	3270	2.53	42
5	4393	3.40	57
6	4312	3.33	56
7	4288	3.32	55
8	4856	3.76	63
9	4039	3.12	52
10	4115	3.18	53
11	2011	1.56	26
12	5328	4.12	69
13	3201	2.48	41
14	817	0.63	11
15	4201	3.25	54
16	5018	3.88	65
17	4058	3.14	52
18	5371	4.15	69
19	5986	4.63	77
20A	2529	1.96	33
20B	2135	1.65	28
AREA B			
1	3722	2.88	48

TABLE 8. CALCULATED QUANTITIES OF SHELL >$^1/_2$ INCH PER SQUARE YARD OF SUBBOTTOM DISTURBED (TO BOTTOM OF SHELL BEARING LAYER)

CORE	lbs of shell per yd^2 of bottom	yd^3 of shell per yd^2 of bottom	bushels per yd^2 of bottom
SEVENFOOT KNOLL			
1	2212	1.71	29
2	3337	2.58	43
3	3108	2.40	40
4	2545	1.97	33
MAN O'WAR SHOAL			
1	3159	2.44	41
2	2553	1.97	33
3	3993	3.09	52
4	3270	2.53	42
5	4393	3.40	57
6	4312	3.33	56
7	4288	3.32	55
8	4856	3.76	63
9	4039	3.12	52
10	4115	3.18	53
11	2011	1.56	26
12	5328	4.12	69
13	3201	2.48	41
14	817	0.63	11
15	4201	3.25	54
16	5018	3.88	65
17	4058	3.14	52
18	5371	4.15	69
19	5986	4.63	77
20A	2529	1.96	33
20B	2135	1.65	28
AREA B			
1	3722	2.88	48

TABLE 9. DIGITIZED INFORMATION FROM FIGURE 6 AND CALCULATION OF AMOUNT OF BUSHELS FOR STUDY AREAS

DIGITIZED STUDY AREA (in^2)		yd^2	bushels/yd^2 of bottom	bushels
SEVENFOOT KNOLL				
	0.52	157,300	30 to 40 (ave 35)	5,505,500±786,500
	0.17	51,425	>40	2,057,000 minimum
TOTALS	0.69	208,725		7,562,500±786,500
			minimum amount of bushels	6,776,000
			maximum amount of bushels	8,349,000
MAN O'WAR SHOAL				
	0.02	6050	<20	121,000 minimum
	1.45	438,625	<30	13,158,750 minimum
	1.47	444,675	30 to 40 (ave 35)	15,563,625±2,223,375
	1.06	320,650	40 to 50 (ave 45)	14,429,250±1,603,250
	2.62	792,550	50 to 60 (ave 55)	43,590,250±3,962,750
	0.30	90,750	60 to 70 (ave 65)	5,898,750±453,750
	0.08	24,200	>70	1,694,000 minimum
TOTALS	7.04	2,129,600		94,455,625±8,243,125
			minimum amount of bushels	86,212,500
			maximum amount of bushels	102,698,750
SIXFOOT KNOLL				
	8.52	2,577,300	?	?(*)
AREA B				
	7.95	2,404,875	48	?(*)

Figure 6 parameters used in calculations;
chart scale = 1:20,000
1 in = 550 yds

(*) undetermined due to lack of coring data