AD-A168 477 PROJECT DOCUMENTATION REPORT SOUTHERN CALIFORNIA ASW RANGE (SOAR) SURVEY(U) NAVAL FACILITIES ENGINEERING COMMAND WASHINGTON DC CHESAPEAKE.. K R COOPER ET AL. 1/2

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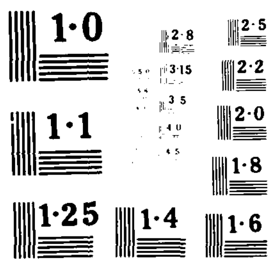

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PROJECT DOCUMENTATION REPORT
SOUTHERN CALIFORNIA ASW RANGE
(SOAR) SURVEY
AUGUST 1985
FPO-1-85 (28)

Ocean Engineering

CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
WASHINGTON NAVY YARD
WASHINGTON, DC 20374

PROJECT DOCUMENTATION REPORT
SOUTHERN CALIFORNIA ASW RANGE
(SOAR) SURVEY
AUGUST 1985
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Prepared By
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John A. Thornton

Approved:

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Head Ocean Engineering &
Construction Project Office

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The Southern California ASW Range (SOAR) Phase 1B will provide a 100 square mile Anti-Submarine Warfare Training Range in 4,500 feet of seawater west of San Clemente Island, California. An underwater survey of the near shore area of SOAR was to provide geotechnical & environmental data for the shore (Con't)

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landing of underwater cables to be installed in 1987 (SOAR Phase 1B). The survey was conducted in two parts: (a) A diver conducted cable inspection of two existing cables and geotechnical data gathering in the near shore area, (b) A hydrographic survey including bathymetry, sub-bottom profile, side scan sonar and current meter data. Both portions of the survey confirmed the presence of two sand covered channels adjacent to West Cove Beach, the proposed cable landing site. They offer potentially good shore landing cable routes to the eastern portion of the survey area where sand thicknesses exceed 60 feet. The western part of the survey area in about 200-300 FSW where sand thicknesses are relatively thin should be avoided although dynamic wave-induced motion of the cable should not be a problem at this depth. The survey provided a good image of the bottom and sub-bottom physical characteristics of the area permitting the development of a cable route to deepwater that provides maximum cable protection. The results of the survey also provide data necessary for cable design and nearshore protection requirements.

EXECUTIVE SUMMARY

The Southern California ASW Range (SOAR) Phase 1B will provide a 100 square mile Anti-Submarine Warfare Training Range in 4,500 feet of seawater west of San Clemente Island, California. An underwater survey of the near shore area of SOAR was conducted in April and May of 1985. The survey was to provide geotechnical and environmental data for the shore landing of underwater cables to be installed in 1987 (SOAR Phase 1B). The survey was conducted in two parts: (a) A diver conducted cable inspection of two existing cables and geotechnical data gathering in the near shore area. (b) A hydrographic survey including bathymetry, sub-bottom profile, side scan sonar and current meter data. Both portions of the survey confirmed the presence of two sand covered channels adjacent to West Cove Beach, the proposed cable landing site. They offer potentially good shore landing cable routes to the eastern portion of the survey area where sand thicknesses exceed 60 feet. The western part of the survey area in about 200-300 FSW where sand thicknesses are relatively thin should be avoided although dynamic wave-induced motion of the cable should not be a problem at this depth. The survey provided a good image of the bottom and sub-bottom physical characteristics of the area permitting the development of a cable route to deepwater that provides maximum cable protection. The results of the survey also provide data necessary for cable design and nearshore protection requirements.

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SOAR SURVEY PROJECT DOCUMENTATION REPORT

1.0 MANAGEMENT SUMMARY

1.1 Introduction

The Southern California ASW Range (SOAR) Phase 1B will provide a 100 square mile Anti-Submarine Warfare training range in 4,500 feet of sea water west of San Clemente Island, California. SOAR will provide accurate tracking of air, surface and submerged targets.

The in-water portion of SOAR (Phase 1A) was installed by the Chesapeake Division, Naval Facilities Engineering Command (CHESNAVFACENGCOM) in September 1984. The cabled system of the range is comprised of two systems: An underwater communications link (WQC); and a sub-surface link (SSL) for data transmission with range transponder units. Each is linked to shore by an underwater cable terminated at West Cove, San Clemente Island, CA.

This Project Documentation Report presents the results of an underwater survey of the near shore area of SOAR conducted in April and May of 1985. The purpose of the survey was to provide geotechnical and environmental data for the shore landing of underwater cables to be installed in 1987 SOAR (Phase 1B). The results of the survey will provide: (a) A basis for environmental factors required for cable design; (b) Geophysical data for cable location; (c) Data necessary for the Naval Ocean System Center (NOSC) to support an environmental impact statement, and (d) Provide to the Naval Underwater System Center (NUSC) the near shore portion of the total (SOAR) range survey (the offshore survey will be completed by NUSC).

The near shore survey was conducted in two parts, as follows:

(a) A diver conducted cable inspection of two existing cables and geotechnical data gathering in the near shore area.

(b) A hydrographic survey of bathymetry, sub-bottom profile, side scan sonar and current meter data.

NUSC, in conjunction with Naval Oceanographic Office (NAVOCEANO) will conduct a survey of the offshore SOAR area. The survey described herein will complement the offshore survey by providing data necessary primarily for cable design, near shore protection requirements and installation. (Refer to Figure 1.)

This Project Documentation Report presents the findings of the two part near shore underwater survey. The Project Execution Plan, Chesapeake Division document number FPO-1-85(28), is referenced as the detailed execution plan.

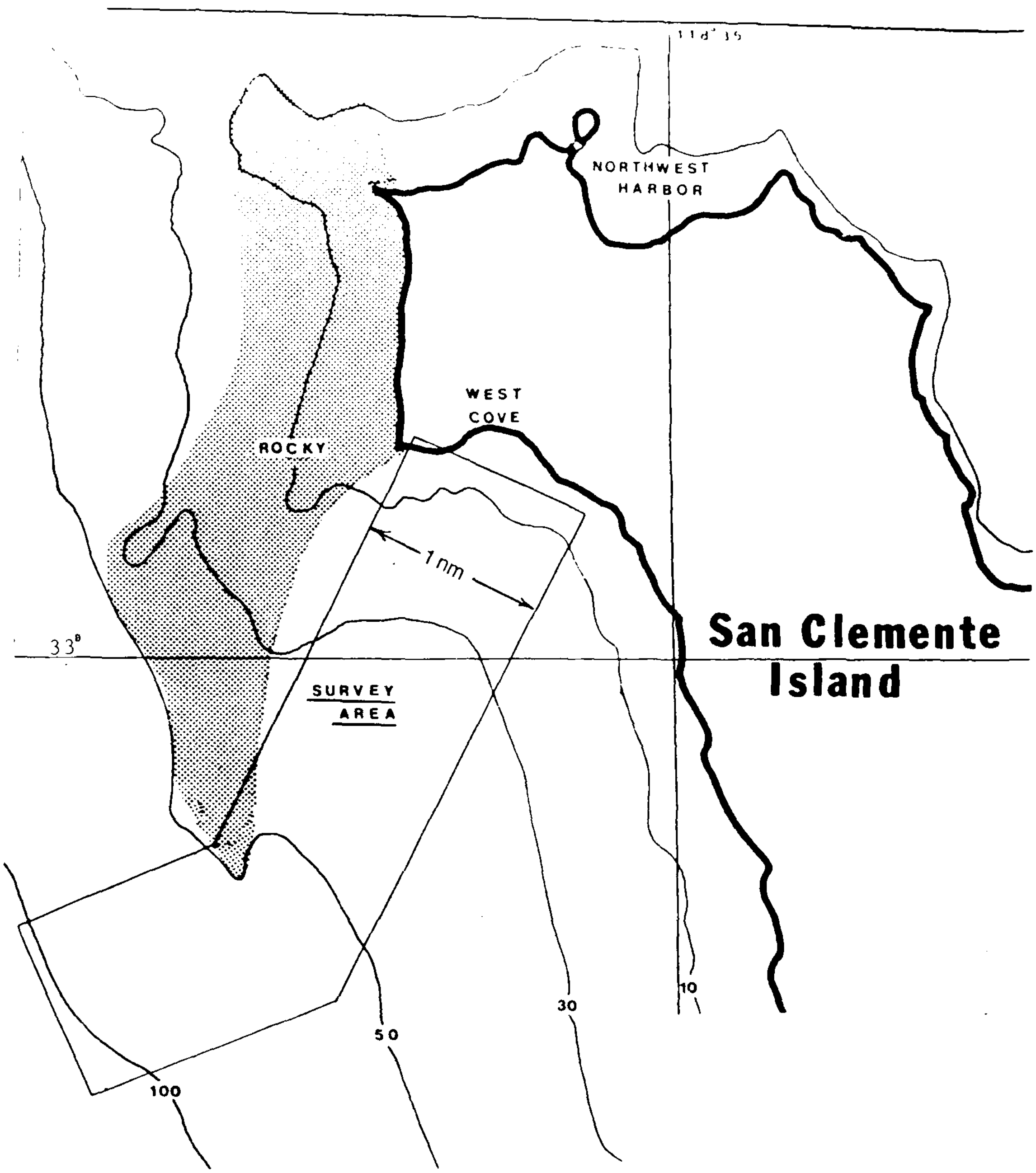


Figure 1
Near Shore Survey Area

1.2 Program Management

The Chief of Naval Operations tasked NAVAIR to form a team for the planning and execution of SOAR. The overall program manager for the SOAR Project is the Director, Range Instrumentation Division (AIR-630) of the Naval Air Systems Command. AIR-6303 is the Head of the Sea Range Projects Branch. Within this branch, the Underwater Systems Engineer (AIR-6303F) is responsible for the management and execution of the Project. NUSC has been assigned as the Technical Direction Agent (TDA) for the project who in turn tasked the Chesapeake Division of Naval Facilities Engineering Command (CHESNAVFACENGCOM), Ocean Engineering and Construction Project Office, Code FPO-1, with the near shore survey portion of the project.

NUSC, as TDA, provided technical direction for the surveys. The in-water portion was managed by CHESNAVFACENGCOM, Code FPO-1. Code FPO-1 was supported by Underwater Construction Team Two (UCT-2), and NOSC, San Diego, as shown in Figure 2.

1.3 Construction Operations Summary

Below is a chronological record of events during the SOAR cable survey.

DATE PLANNED	DATE ACTUAL	EVENT
April 22	April 21	-Mobilization of TRB at NOSC -Installation of SAIC Intergrated Navigation & Data Acquisition Systems *TRB had engine trouble used NOSC IX506
April 23	April 22	-Air transport of survey team to SCI -IX506 transit to SCI -Barge transport of UCT-2 equipment
April 24	April 23	-Start SAIC hydrographic survey
--------	April 24	-Current meters installed *IX506 directed return San Diego due to weather
--------	April 25	*IX506 out of commission due to engine room power box fire

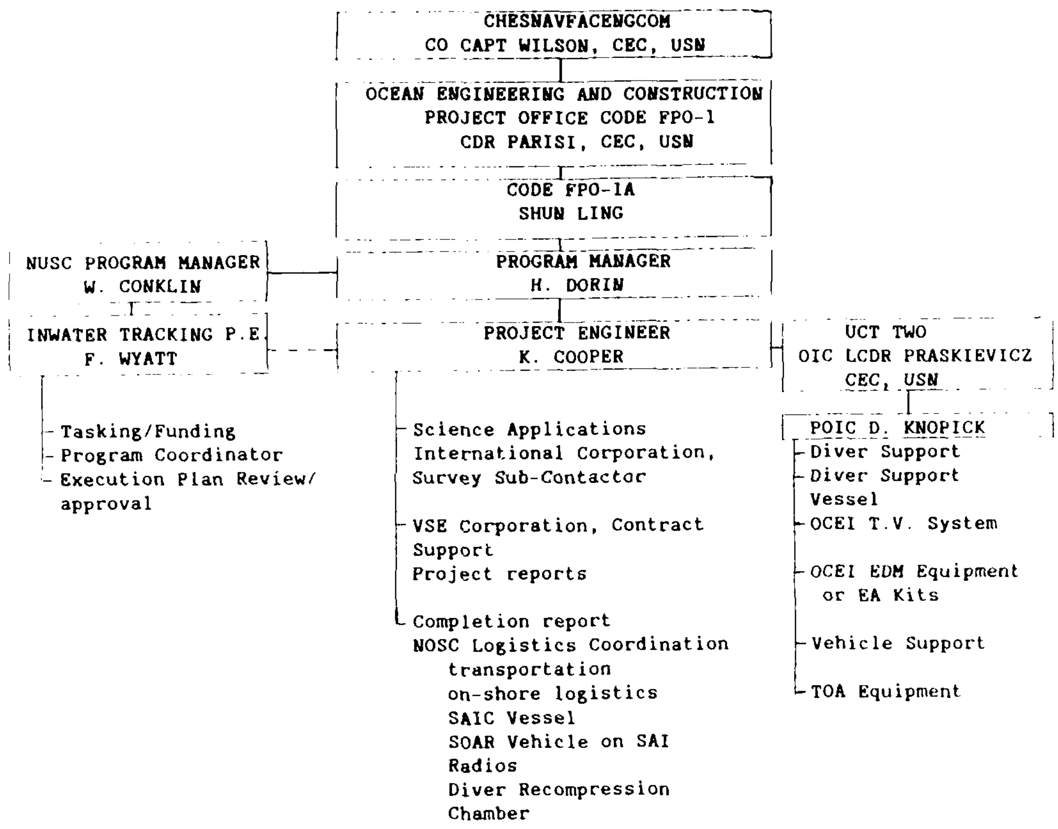


Figure 2
Program Management

--------	April 26	*NUSC contract EGABRAG III via DOE. EGABRAG III in transit to SCI.
April 24	April 27	-EGABRAG III begin survey
April 29	April 29	-UCT-2 personnel transit to SCI
April 30	April 30	-Start Diver Survey
May 1	April 29	-Complete hydrographic survey
May 2	April 29	-Demobilization of Egabrag III
May 9	May 9	-Complete Diver Survey
May 13	May 11	-Transportation of UCT-2 personnel to San Diego
May 15	May 14	-Barge transit of UCT-2 equipment to San Diego

*Denotes unplanned events

2.0 LOCATION DETAILS

2.1 Construction Site

San Clemente Island is used by the Navy as an ordnance delivery test and evaluation site. Transportation to the island, 70 miles west of San Diego, is by daily aircraft flight or by barge once each week. All food, fuels, water, and other supplies are transported to the island.

The West Cove cable landing site consists of rock covered by loose sand. The beach extends seaward at a shallow slope. The near shore underwater area is sand with several outcroppings of rock.

2.2 Geographical Data

The reference stations utilized in both the hydrographic and near shore diver survey were located on control points with coordinates shown below. The hydrographic survey used the Del Norte navigation system with shore stations set on Captaine 3 and Lamar 1. The near shore diver survey utilized transits set an Captaine 3 and Pad 1 and angles turned clockwise from true north. A location map is shown in Figure 3 representing relative distances between control points.

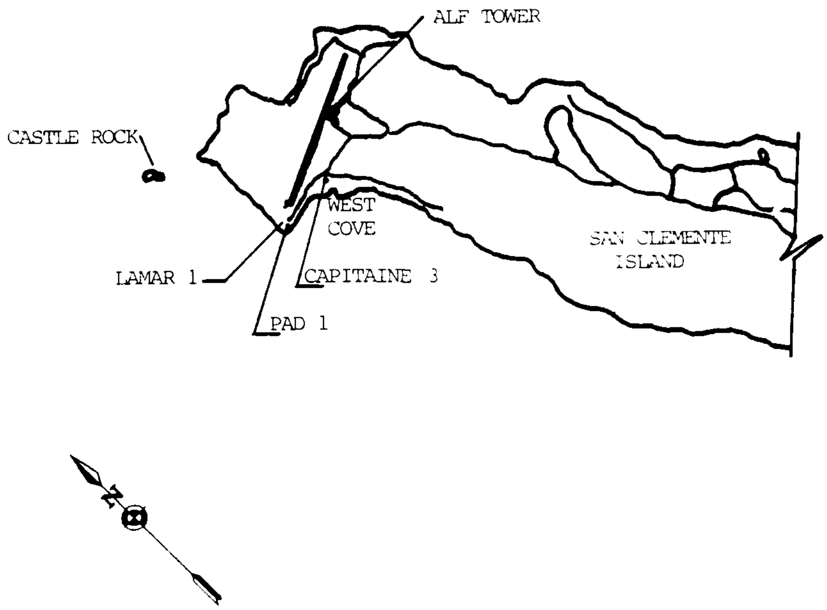


Figure 3
Navigation Shore Stations

	LAMBERT	GEODETIC
"LAMAR 1"	N 316,921.69	N 33^{o} 55' 55.19"
	E 1,278,554.83	W 118^{o} 36' 13.12"
"CAPTAINE 3"	N 317,612.03	N 33^{o} 01' 2.97"
	E 1,282,827.48	W 118^{o} 35' 23.13"
"PAD 1"	N 316,847.76	N 33^{o} 00' 54.60"
	E 1,279,178.97	W 118^{o} 36' 5.77"

2.3 Weather

A single foul weather day occurred during this project where operations had to be scrubbed as the IX506 was directed to return to San Diego. The on site engineer reported 6-8' swells and 20-25 kt winds, and building. Primarily, the weather was calm with 8-12 knot winds and 3-5 ft. swells being reported.

3.0 SURVEY DETAILS

3.1 Diver Cable Inspection and Survey

The two existing WQC & SSL cables were inspected by Underwater Construction Team-Two (UCT-2) as they proceeded along the cable. Marker Buoys were attached to numbered reference tags on the cable and these buoys "shot-in" from shore with transits to verify "as-built" conditions. Survey data with transit angles from control points and diver remarks can be found in Appendix A. The apparent displacement of the cable from the "as-built" conditions could be due to inaccuracies of survey techniques. The condition of the cable is very good with most of the cable buried in sand 4"-6" to 100 FSW, the extent of the diver inspection. The WQC cable does have one suspension that is 100' between suspension points and has a sag of about 8"-12". The suspension will be removed or reduced during the next survey period in the summer of 1986. Underwater video taping from 10 FSW to 90 FSW was performed on each of the cables to document their condition. Original video tapes are in possession of CHESNAVFACENGCOM.

Rock outcroppings were located using the jet probe. A large sand covered channel about 20'-40' in width was found between two rock outcroppings. Sand overlaying rock in this channel is at least 9 feet thick as found by the divers. The sand covered channel could be used as a cable laying lane for future cable lays. The surveyed rock locations and sand depths verified the conditions found during the SAIC geophysical survey.

Four sand sample cores were taken from San Clemente by the divers using the Naval Civil Engineering Laboratory (NCEL) geotechnical diver tools. The locations of these sand samples are shown in Figure 4. After being brought to the beach each sand sample was carefully sealed and prepared for shipment. The samples were delivered to NCEL where an analysis was performed. Detailed results of the laboratory testing of the soil samples are presented in Appendix B, showing general soil data and grain size distribution. The soil is a coarse to medium calcareous sand with densities ranging form 111.6 to 121.3 pcf. Specific gravities ranged from 2.72. to 2.74. The friction angle for all four samples was 37^{o}. All the cores contained shell fragments, the amounts increasing with depth.

The most significant and useful data is the friction angle. This data will be used to determine the holding capacity of propellant embedment anchors being considered for anchoring the junction box.

Rock samples were also secured from the West Cove area and analyzed at NCEL. The results are shown in Appendix B. The rocks were visually identified as volcanic, probably porphyritic felsites. The compressive strengths ranges from 4,500 psi to 8,200 psi, with one test specimen reaching 10,320 psi.

3.2 Hydrographic Survey

To obtain the necessary data for specifying cable design and optimum cable routes, Science Applications International Corporation (SAIC) was tasked to conduct a detailed geophysical survey of an area approximately one nautical mile wide extending from the shore to three nautical miles seaward, (Figure 1) where depth exceeds 600 feet.

Figure 5 shows the ship's track coverage of the survey area. Line spacings varies from about 50m in the Northern part of the survey area to about 100 meters over the southern self and slope areas.

The geophysical survey consisted of side-scan, sub-bottom profiling and bathymetry over the entire study area. In addition, two bottom mounted current meters were installed in about 30 and 65 feet of water off of West Cove in order to obtain data on the dynamic wave-induced current velocity field. Both current meters measure direction and wave pressure fluctuations, the deep meter also measures temperature. Figure 4 shows the locations of the deep and shallow current meter emplacements. Data from the two current meters can be reviewed in Appendix C. Figure 6 shows a typical Side Scan record with a clearly defined sand lens over bedrock.

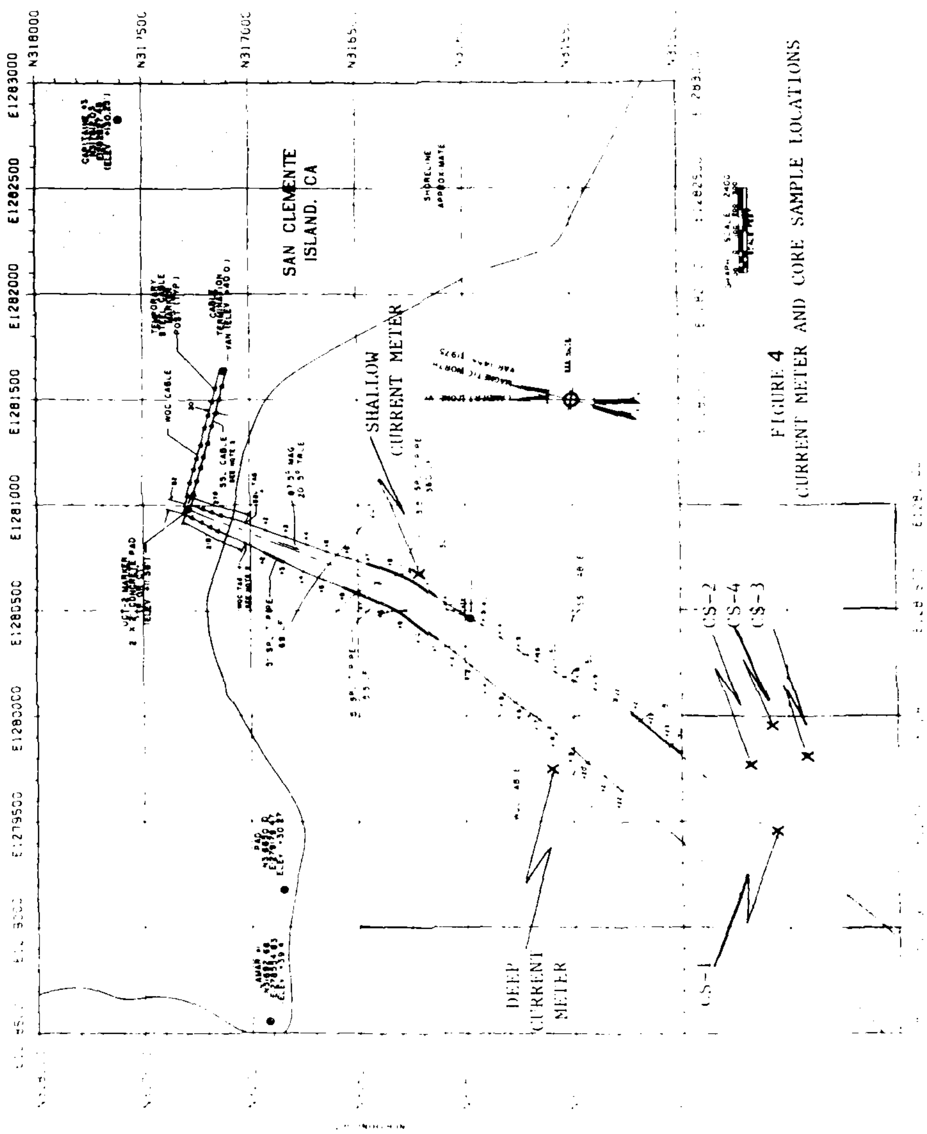


FIGURE 4
CURRENT METER AND CORE SAMPLE LOCATIONS

Figure 4

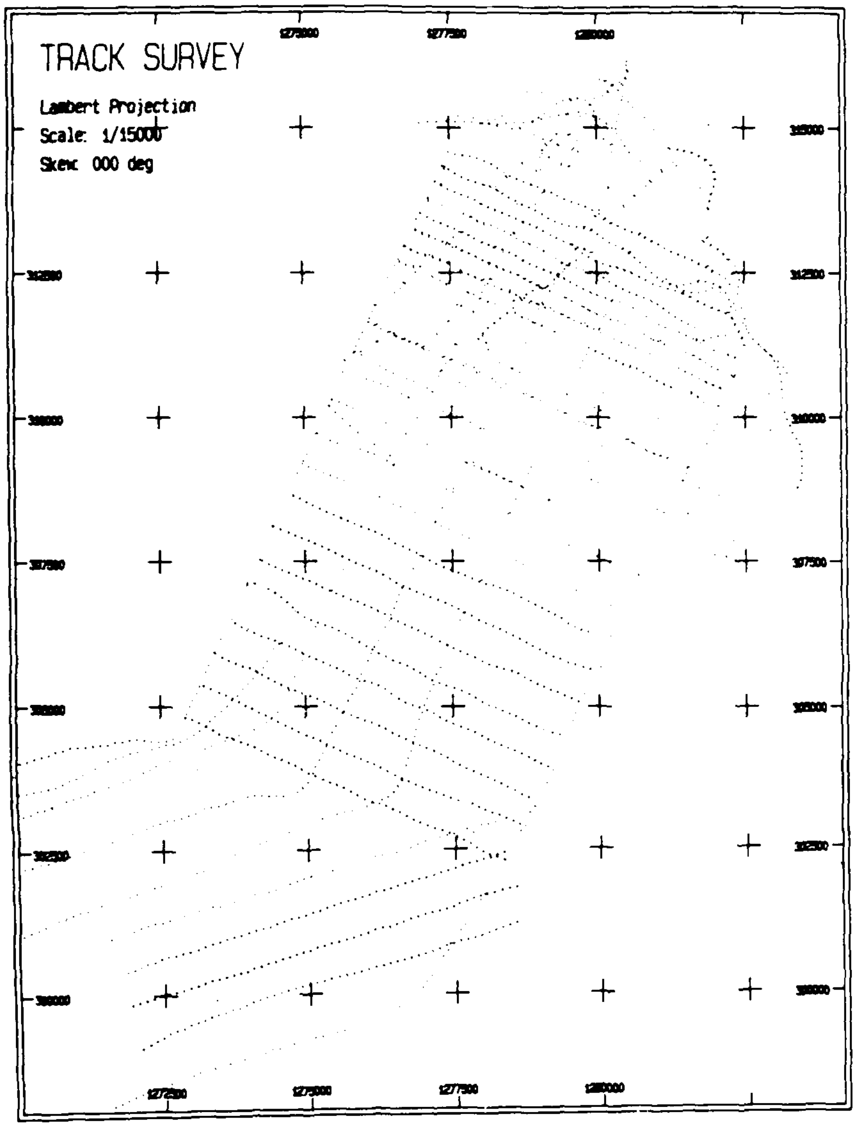


Figure 5 Ship's Track Coverage of Survey Area

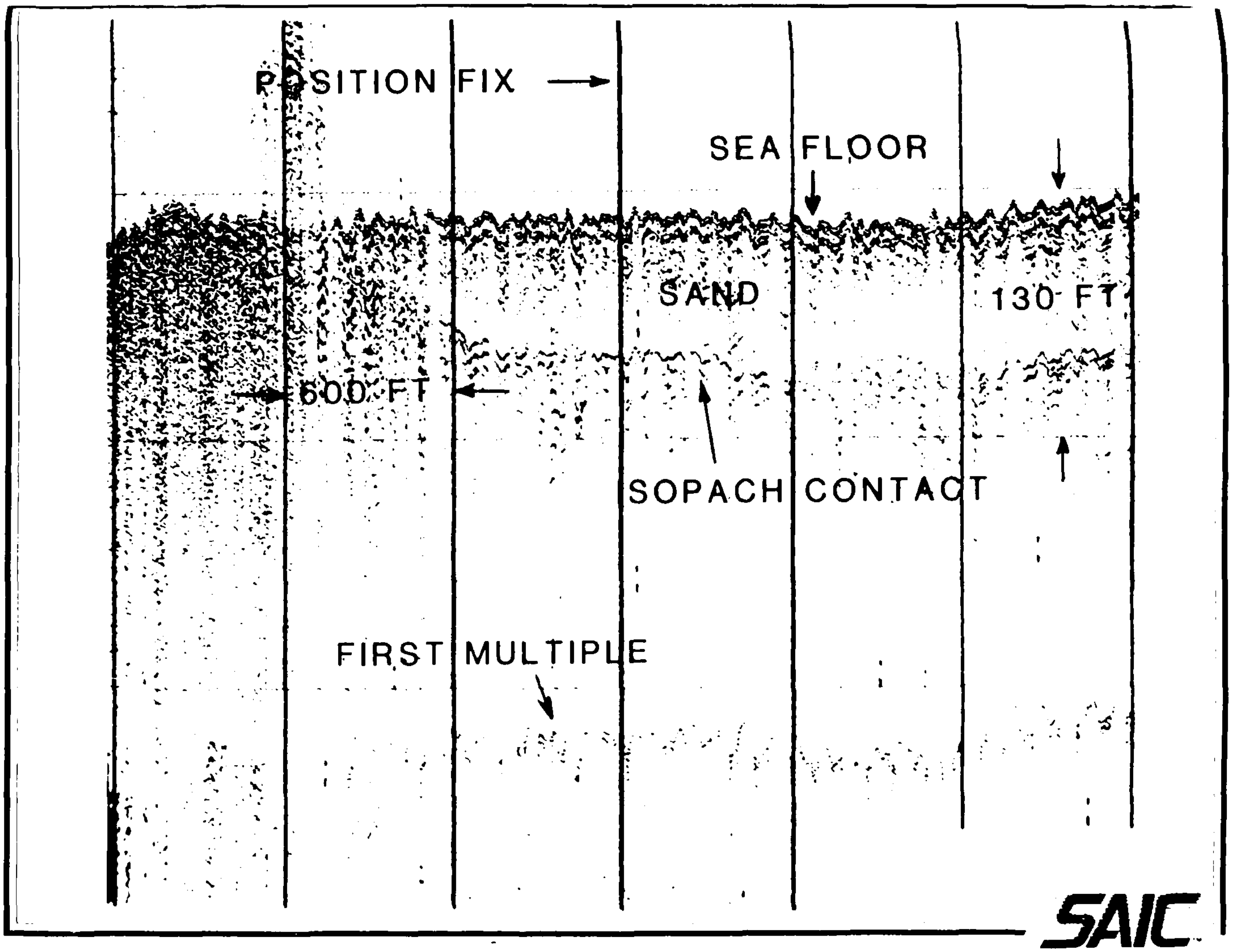


Figure 6   Example of a subbottom record showing a sand lens between the seafloor and the isopach.

Each data set has been analyzed according to procedures outlined in Appendix C. The final product consists of a side scan sonar mosaic which forms a base chart for over laying the bathymetry and isopach charts, reproduced on semi-transparent mylar. The bathymetry and isopach data can be readily assessed in relation to the side scan acoustic image of the bottom. The presence of rock outcroppings in relation to depth and sediment thickness is immediately apparent and provides an efficient method for detailed planning for the in-shore portions of the SOAR cable installation project. The original mosaic, was separated into ten plates and each plate was photographically reduced to a scale of 1:2400. Figure 7 shows the distribution of the 1:2400 scale plates in relation to the 1:8400 chart. Figure 8a, b, and c are the 1:8400 charts reduced to 60% for this report and reproduced in black and white on paper. All original color mylar overlays and Side Scan mosaics are available at CHESNAVFACENGCOM. Commander, Anti Submarine Warfare Wing-Pacific and Naval Underwater Systems Center (NUSC) were provided with copies of all over lays and mosaics.

4.0 CONCLUSIONS

Intergrating the data from UCT-2 underwater survey and SAIC bathymetric survey provides a clear view of the sea bottom at West Cove and seaward. The side scan mosaic of the survey area shows a sand covered bottom with rock outcroppings fringing West Cove to the north and west. The sub-bottom survey indicated a channel in the rock 20 to 40 feet in width with sand thicknesses of 10 to 18 feet extending into West Cove to about 40FSW, the inshore limit of the towed array. The diver survey confirmed this channel running to shore with sand thicknesses of at least 9 feet. This sand channel may be a viable lane to use as a cable route to the east-central portion of the survey area where sand coverage is as thick as 80'.

In the central part of the survey area several rock outcroppings are evident and should be avoided during the next cable lay. The western portion of the survey area, where surface or nearsurface rock outcroppings are present, in about 200-300 FSW, should be avoided although dynamic wave-induced motion of the cable should not be a problem. The current meters scheduled to be recovered in October should be left in place during the winter months to provide information on wave induced currents during the most severe weather windows.

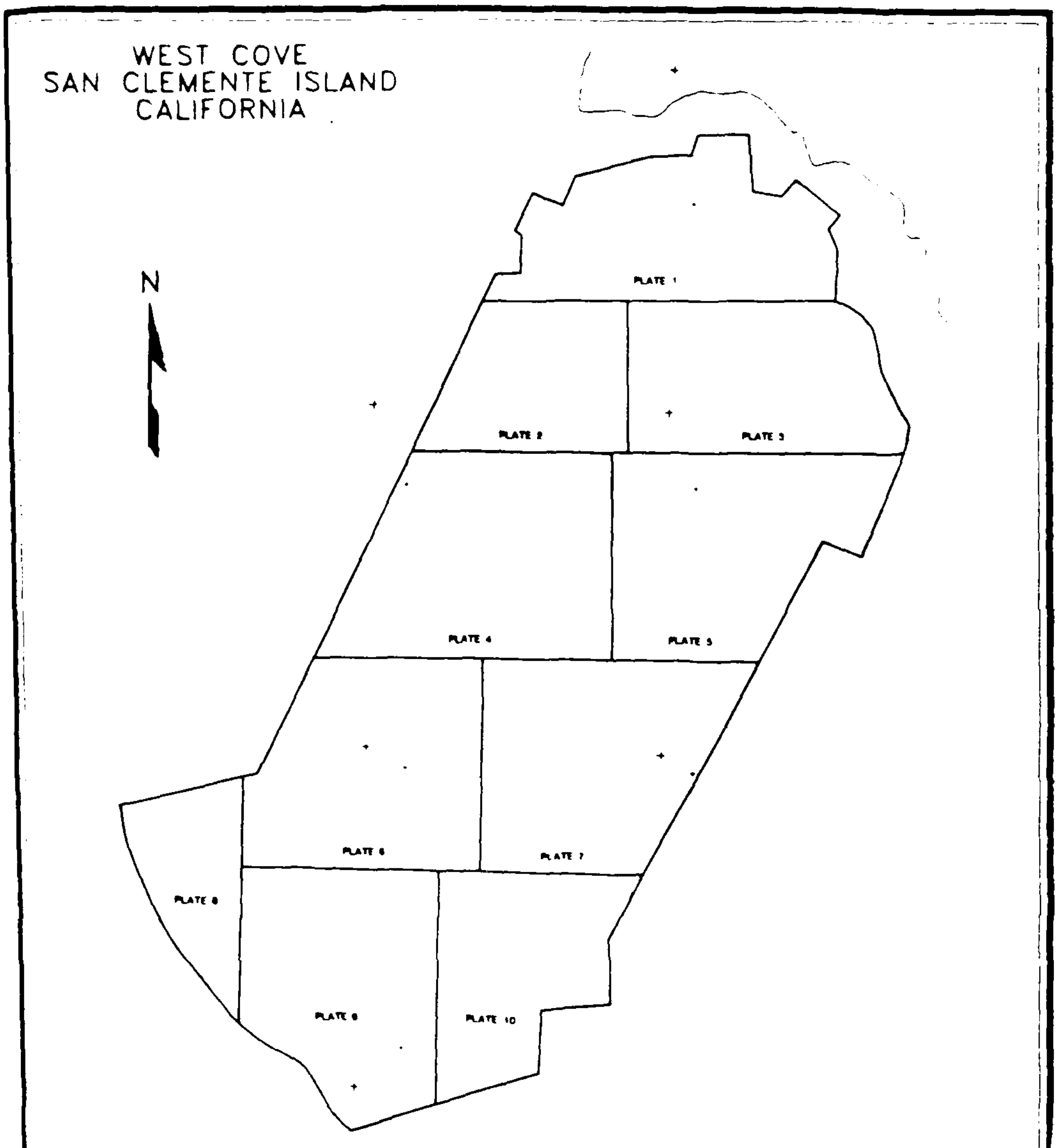


Figure 7 Side Scan Mosaic Index map

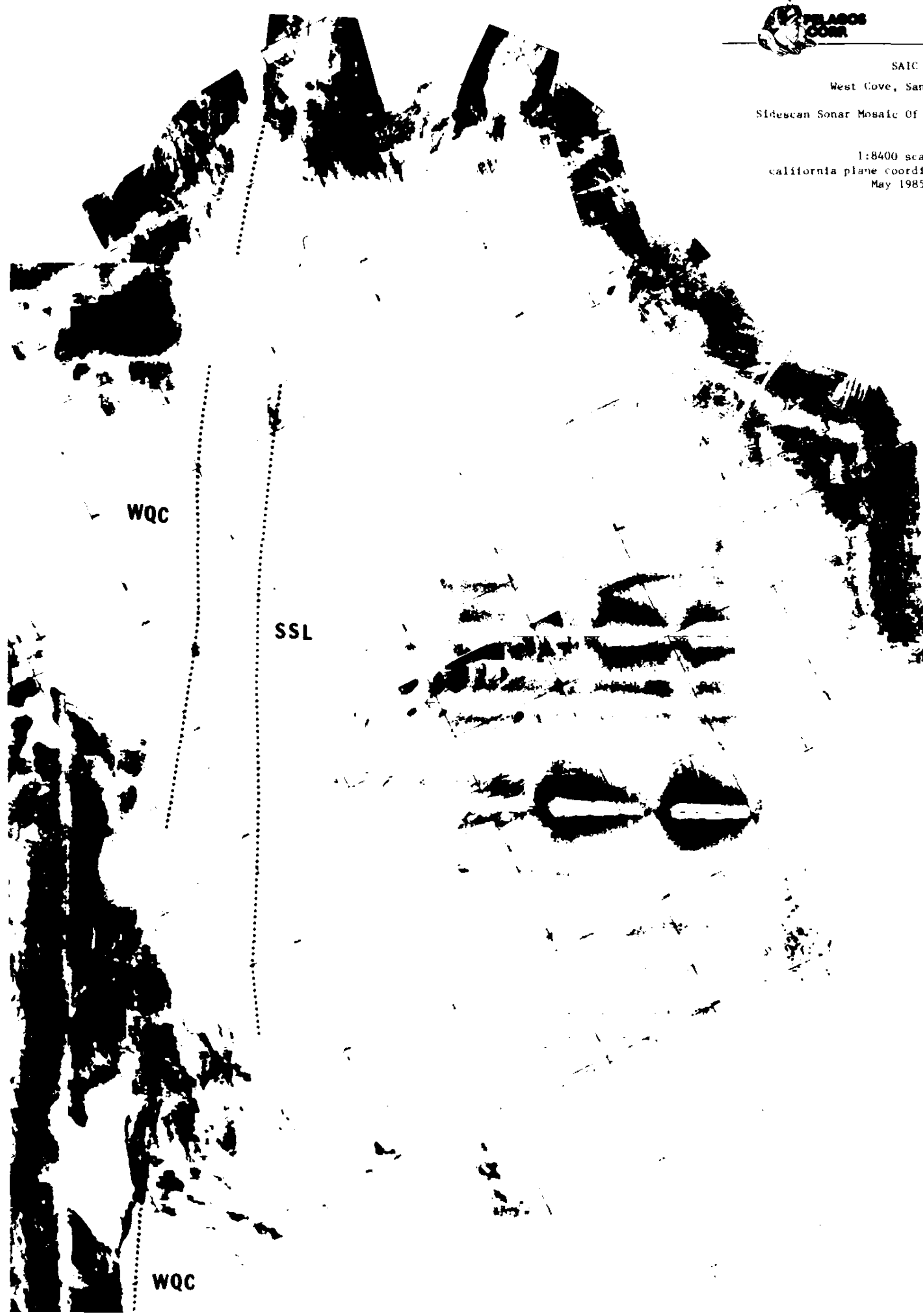
PELAGOS CORP. 9173 Chesapeake Drive
San Diego, CA 92123

SAIC

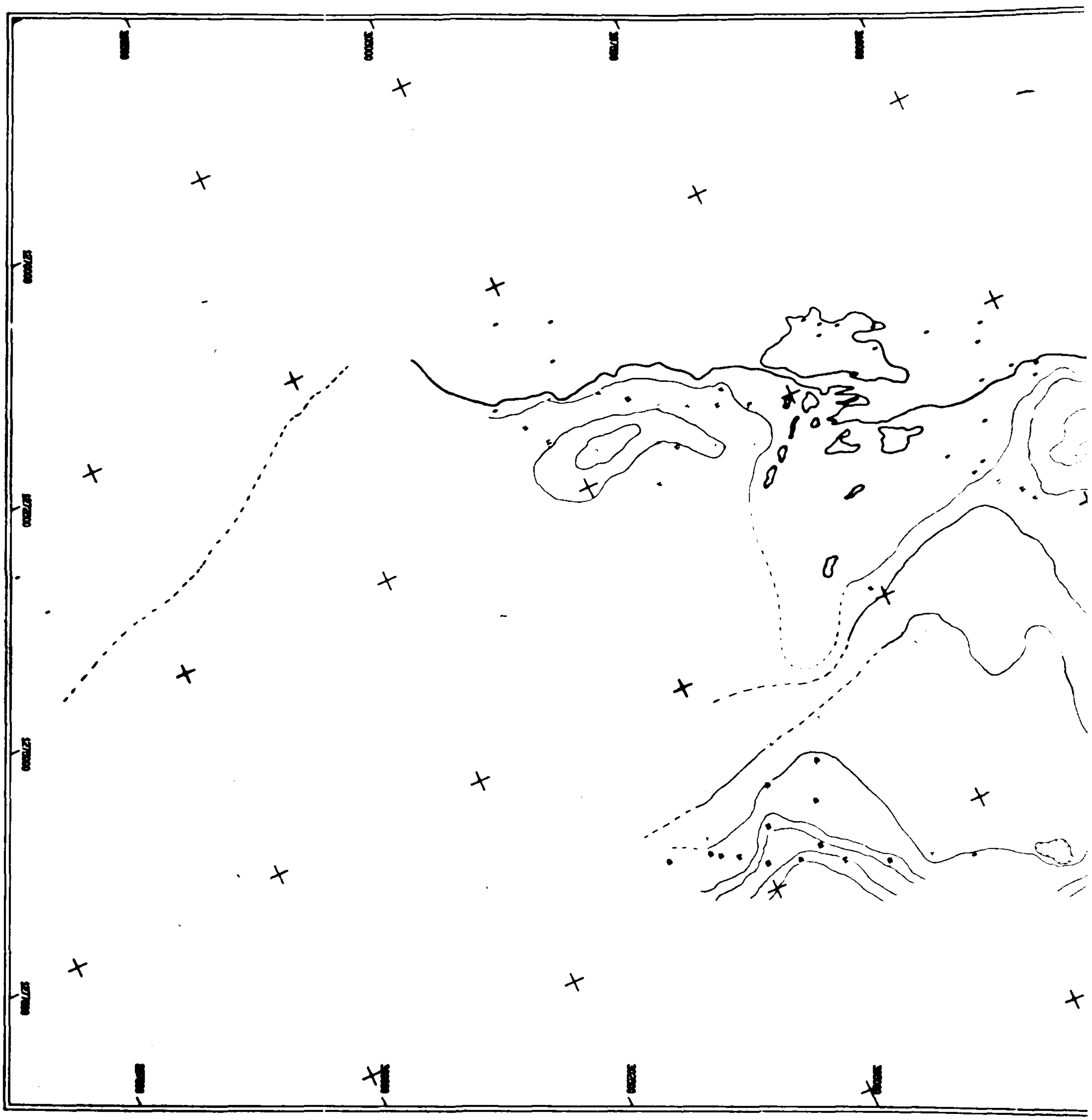
West Cove, San Clemente Is

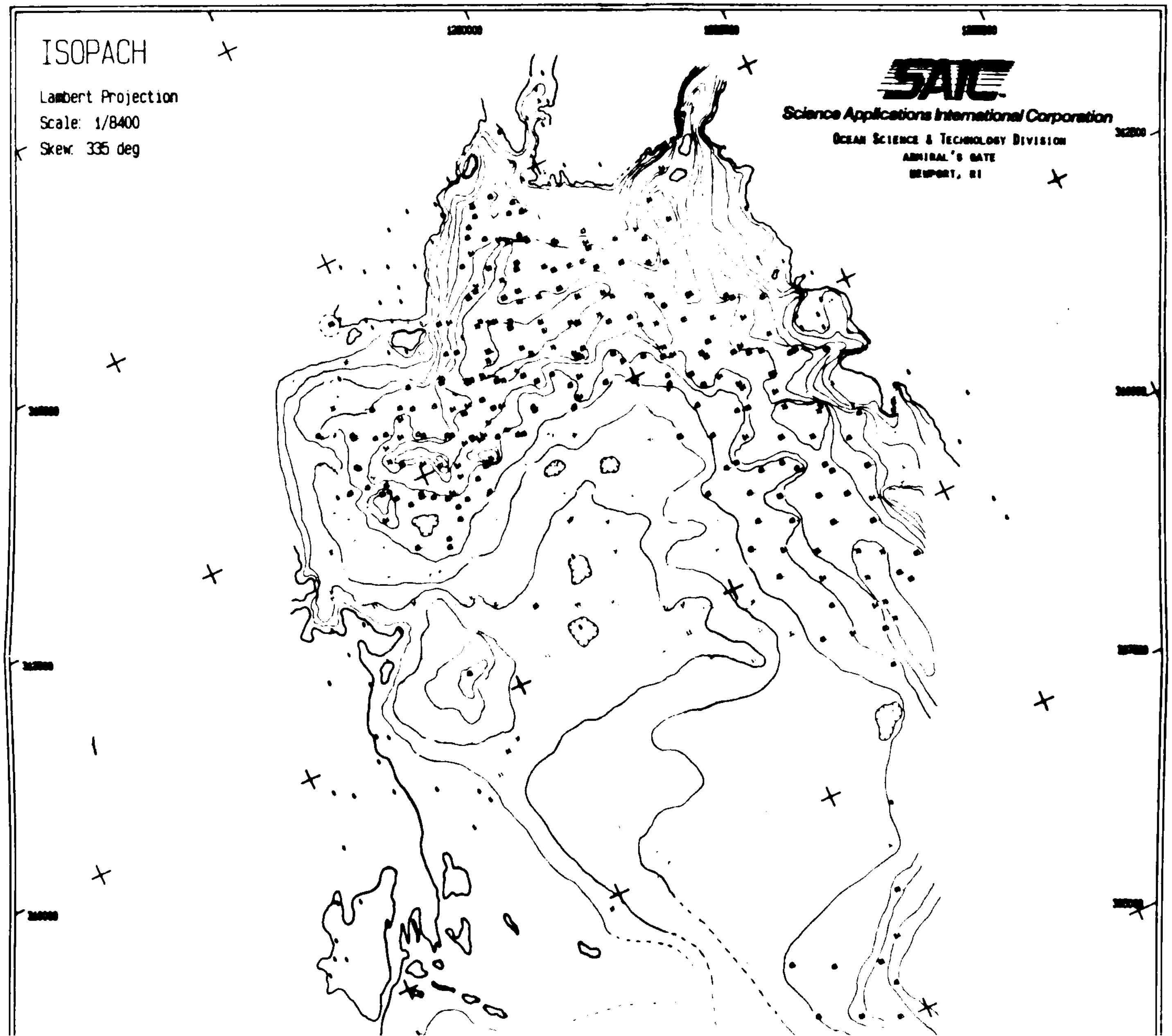
Sidescan Sonar Mosaic Of Proposed Cable Route

1:8400 scale
california plane coordinate system zone 6
May 1985



Science Applications International Corporation
OCEAN SCIENCE & TECHNOLOGY DIVISION
ADMIRAL'S GATE
NEWPORT, RI

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Lambert Projection
Scale: 1/8400
Skew: 335 deg
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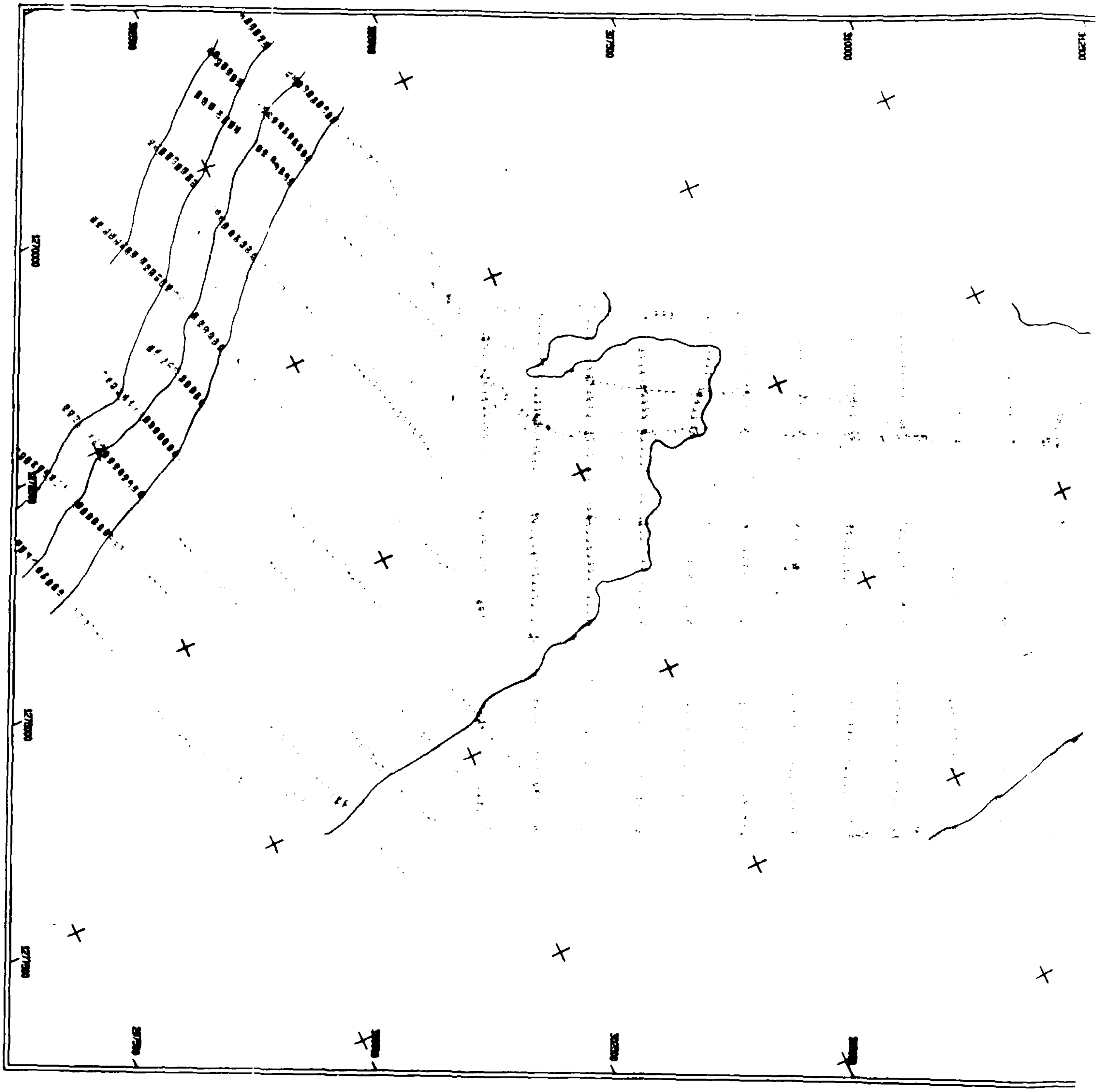

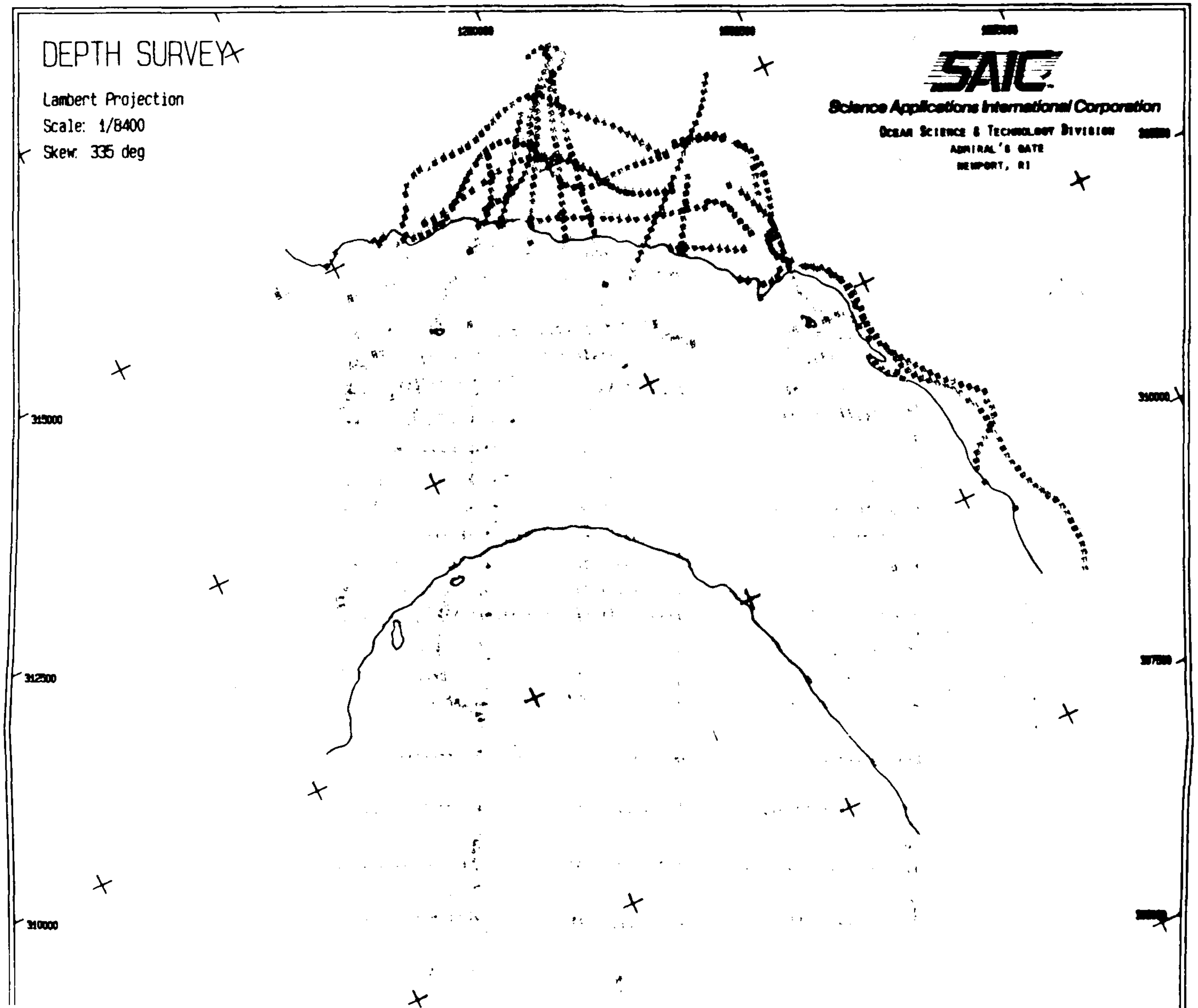

DEPTH SURVEY
Lambert Projection
Scale: 1/8400
Skew: 335 deg
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Science Applications International Corporation
Ocean Science & Technology Division
Admiral's Gate
Newport, RI
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312500
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APPENDIX A

SURVEY DETAILS

SSL CABLE SURVEY

PAD #1 H ∡	V ∡	CAPTAINE #3 H ∡	V ∡	REMARKS
95° 28' 30"	1° 31"	245° 59' 40"	3° 30'	T4 BURIED 2-4"
100° 58' 30"	1° 31"	243° 56' 20"	3° 20'	T6 BURIED 4-6"
106° 21' 30"	1° 30"	240° 32' 20"	3° 13'	T8
115° 44' 00"	1° 30"	237° 08' 0"	3° 0'	T10 LAST SPLIT PIPE
123° 09' 00"	1° 30"	235° 32' 20"	2° 36'	T12 2" SAND
130° 38' 30"	1° 30"	234° 05' 40"	2° 31'	T14 2-4" SAND
137° 15' 20"	1° 30"	233° 52' 20"	2° 20'	T16 ANCHOR AN CABLE
143° 43' 00"	1° 30"	231° 31' 40"	2° 15'	T18 60 FSW 4-6" SAND
148° 20' 06"	1° 30"			T20
155° 00' 0"	1° 30"	229° 30' 10"	2° 13'	T23

~~WQC~~ CABLE SURVEY

PAD #1 H ∡	V ∡	CAPTAINE #3 H ∡	V ∡	REMARKS
90° 45' 20"	1° 40'	249° 48' 40"		T3 UNDER SAND TO
97° 07' 20"	1° 36'	246° 0' 20"		T5 SPLIT PIPE
105° 20' 00	1° 30'	243° 0' 10"		T7 37 FSW SPLIT PIPE
113° 15' 20"	1° 30'	240° 33' 40"	3°	T9 50 FSW
121° 17' 20"	1° 30'	238° 51' 20"	3°	T11
129° 09' 00"	1° 30'	237° 14' 20"	3°	T15
145° 10' 20"	1° 30'	235° 09' 0"	3°	T17
153° 12' 20"	1° 30'	234° 54' 20"	2° 40'	T19 SUSPENSION 100'
160° 09' 20"	1° 30'	233° 56' 20"	2° 40'	T21 LONG 8-12" SAG
165° 57' 10"	1° 30'	232° 15' 20"	2° 4[illegible]'	T23 90 FSW

	CAPTAINE 3	PAD 1	REMARKS
DEPTH/BOUY	V	V	
30/3	216° 29' 20"	125° 43'	Rock commercial yellow float
30/4	228° 40'	127° 07'	All sand
30/5	231° 45'	127° 31'	Sand all around this mark
30/6	235° 10'	128° 0'	Sand-more sand to east-pt. near SSL
60/1	221° 50' 20"	143° 40'	Rock surroundings 50' of this position
60/3	228°	144°	
60/4	229° 44' 10"	144° 30'	Sand-20' east starts rock
60/5	230° 20'	148° 01'	
60/	231° 43' 20"	144° 46'	
60/SSL			4"-6" sand over rock
60/WQC			2"-3" sand over rock
70/1	216° 57' 20"	139° 56'	
70/2	231° 25' 20"	136° 07'	
90/1	224° 10'	163° 08'	Sand
90/2	228° 0'	165° 57'	Sand
90/3	223° 26' 40"	166° 26'	Sand
90/4			On cable-buoy moved
100/1	224° 25' 0"	168° 13' 0"	Sand
100/2	228° 2' 40"	170° 29' 0"	Sand
100/3	230° 0' 40"	173° 14'	Sand
100/4	233° 28' 40"	177° 58'	20' west of SSL

DESIG	CAPTAINE 3	PAD 1	Remarks
	ROCK EDGE SURVEY		
A	231° 40'	156° 47'	80FSW near SSL
B	228° 49' 20"	159° 57'	90FSW near SSL
C	226° 45' 20"		Point of rock-seaward limit 92FSW
D	224° 54'	159° 02'	Sand to east and south
	CORE SAMPLES		
1	227° 10'	173° 30'	105FSW
2	226° 30'	165° 0'	
3	223° 0'	166° 06'	87FSW
4	223° 0'	160° 50'	
	NEAR SHORE INSPECTION		
NS1	225° 25' 10"	117° 15'	2-3' sand cover, 5' north is rock
NS2	221° 44' 20"	122° 32'	3' sand cover, 8'north is rock
NS3	218° 53' 10"	127° 0'	3' sand cover, 10' is rock
NS4	228° 20'	106° 56'	6" sand
NS5	224° 38'	109° 11'	6" sand, heavy keip
NS6	223° 10' 10"	108° 43'	15' into rock
NS7	223° 30'	155° 37'	2' sand cover
NS8	239° 12'	161° 12'	sand-rock on surface 15' west
NS9	224° 13'	103° 20'	all rock to west side
NS10	245° 07'	101° 54'	all rock to west side

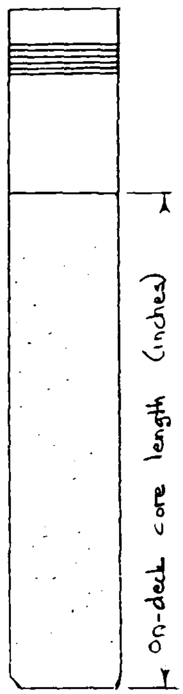
APPENDIX B

GEOTECHNICAL ANALYSIS

Project: SCAR I B

Date: 5/6/85 Time:

Divers: Mark Gray / Bill Gravert (#1) Don Miller / Scott Harding (#2)
Kevin ~~(Dc)~~ Dean / Bill Gravert (#3) Don Miller / Bill Gravert (#4)



Site + Core ID	On-deck core length (inches)	Corer Penetration Depth full / 3/4 / 1/2 / ?	Corer Penetration easy / hard
105FSW #1	21	Full	Hard
97FSW #2	23	Full	Hard
#3	25	Full	Easy
32FSW #4	24 3/4	Full	Easy

Observations: Cap should be carried down by diver. Core sample should be extracted to about one (1) inch of below ~~surface~~ surface and cap put in place to prevent sample from segregating at bottom of tube.

Problems: Tub unscrewed from Head nut

DEPARTMENT OF THE NAVY

3900
Ser L42/1067
18 JUL 1985

From: Commanding Officer, Naval Civil Engineering Laboratory, Port Hueneme
To: Commanding Officer, Chesapeake Division, Naval Facilities Engineering Command, Washington Navy Yard, Washington, D.C. 20374 (FPO-1/Keith Cooper)

Subj: GEOTECHNICAL ANALYSIS - WEST COVE, SAN CLEMENTE ISLAND, CALIFORNIA

Ref: (a) CHESNAVFACENGCOM Work Request N6247785WR50729 of 2 Apr 85
(b) PHONCON CHESNAVFACENGCOM (FPO-1) Keith Cooper/NAVCIVENGRLAB (Code L42) Norm Albertsen of 3 Jul 85

Encl: (1) Soil Data Summary Chart
(2) Grain Size Graphs
(3) Rock Sample Analysis Memorandum
(4) Rock Compressive Strength

1. By reference (a), the Naval Civil Engineering Laboratory (NAVCIVENGRLAB) was requested to provide support to FPO-1 for the site survey of West Cove, San Clemente Island, California. This support consisted of providing the Underwater Construction Team Two (UCT-2) with geotechnical diver tools and supplies and providing laboratory analysis of the samples taken. The diver tool kits (impact corer, MSPT and jet probe) were supplied to UCT-2 and the samples they brought back were analyzed. This letter is a summary report of the geotechnical analysis of those samples.

2. The samples brought to NAVCIVENGRLAB were four cores taken with the impact corer and five rocks that were approximately 12 inches long, 8 inches wide and 5 inches thick. The cores were analyzed in the Seafloor Soils Laboratory at NAVCIVENGRLAB. They were visually examined and subjected to a series of laboratory tests to determine general characteristics and engineering properties. Laboratory tests were performed to determine grain size, density, specific gravity, grain angularity, and friction angle. The rock samples were cored to provide specimens for compressive strength tests.

3. The results of the laboratory testing of the soil samples are shown in enclosure (1). The grain size charts are shown in enclosure (2). The soil is a coarse to medium calcareous sand with densities ranging from 111.6 to 121.3 pcf. The specific gravity ranged from 2.72 to 2.74. The friction angle for all four samples is 37°. All the cores contained shell fragments; the amount of fragments increased with depth in the core. The locations where the cores were taken was not available, therefore, no comment can be made on areal characteristics of the site.

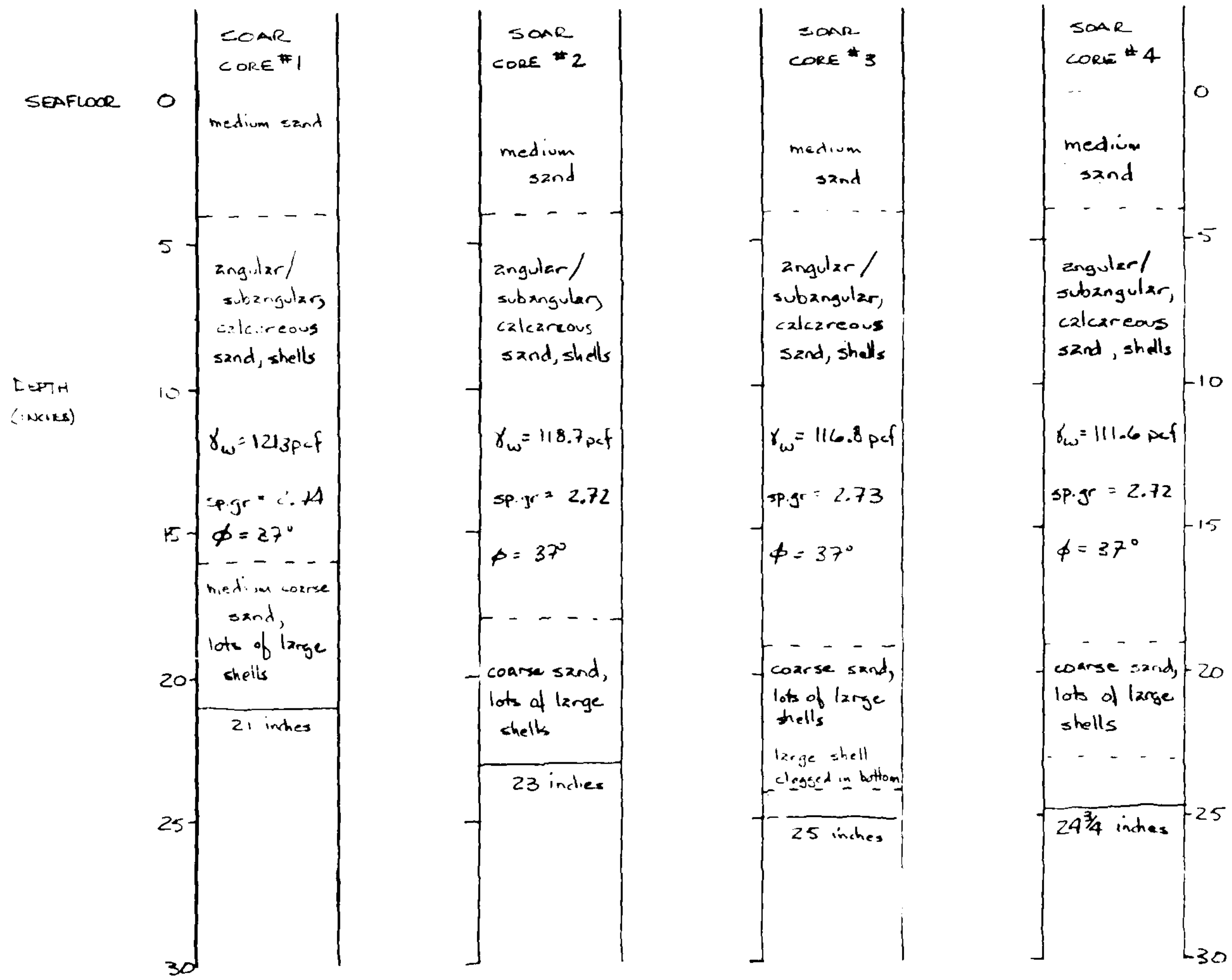
4. The results of the rock sample tests are shown in enclosure (3). Cylindrical specimens were cut from the rocks and compression strength tests were performed on them following ASTM Standard D2938-79. There was some deviation from that standard. The specimens were 1-11/16 inches in diameter rather than 1-7/8 inches and 3-1/2 inches in length which satisfies the requirements of length equal to at least twice the diameter. The rock types were visually identified as volcanic, probably porphyrite felsites. The compressive strengths ranged from 4,500 psi to 8,200 psi, with one test specimen reaching 10,320 psi.

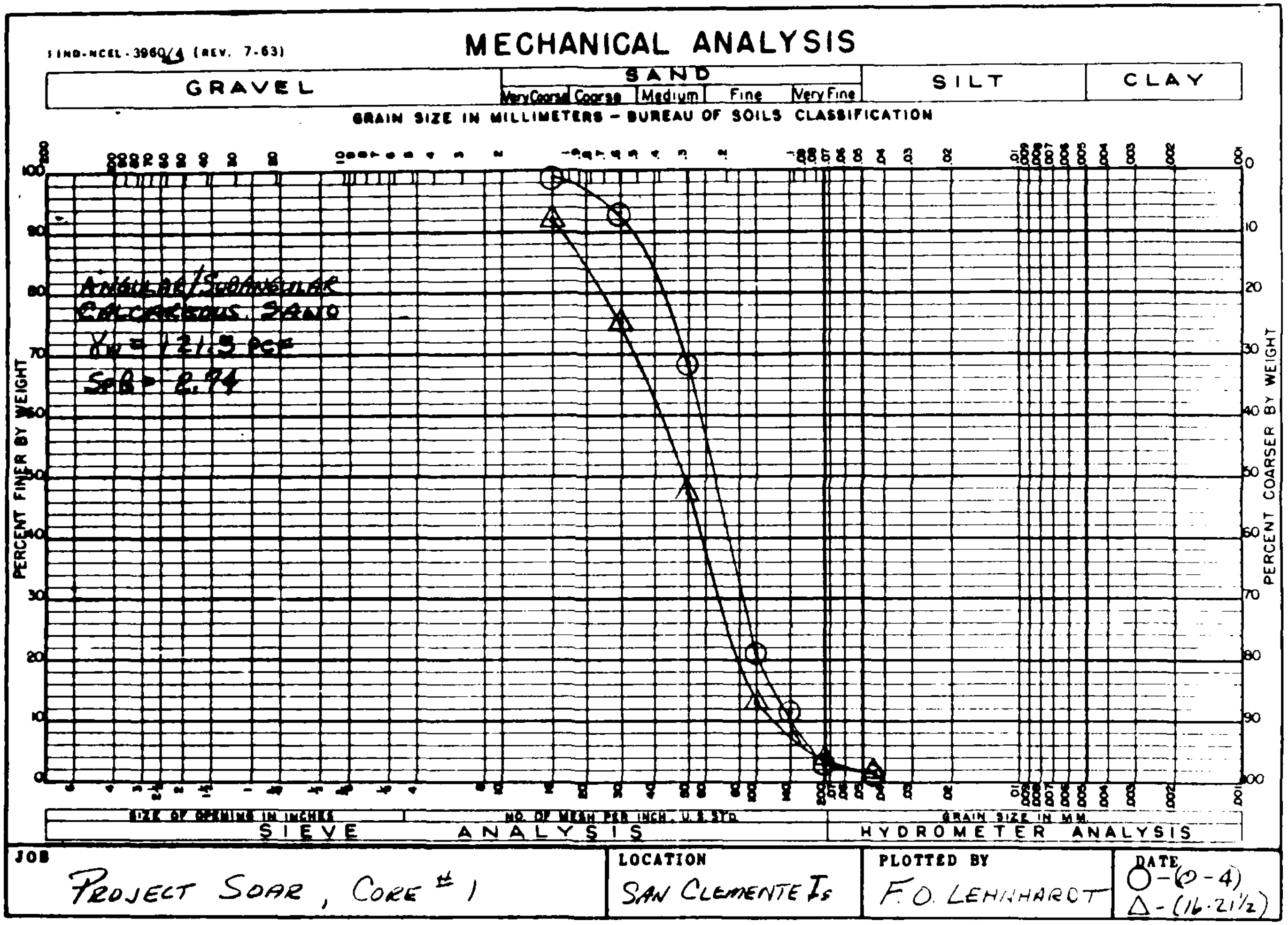
Subj: GEOTECHNICAL ANALYSIS - WEST COVE, SAN CLEMENTE ISLAND, CALIFORNIA

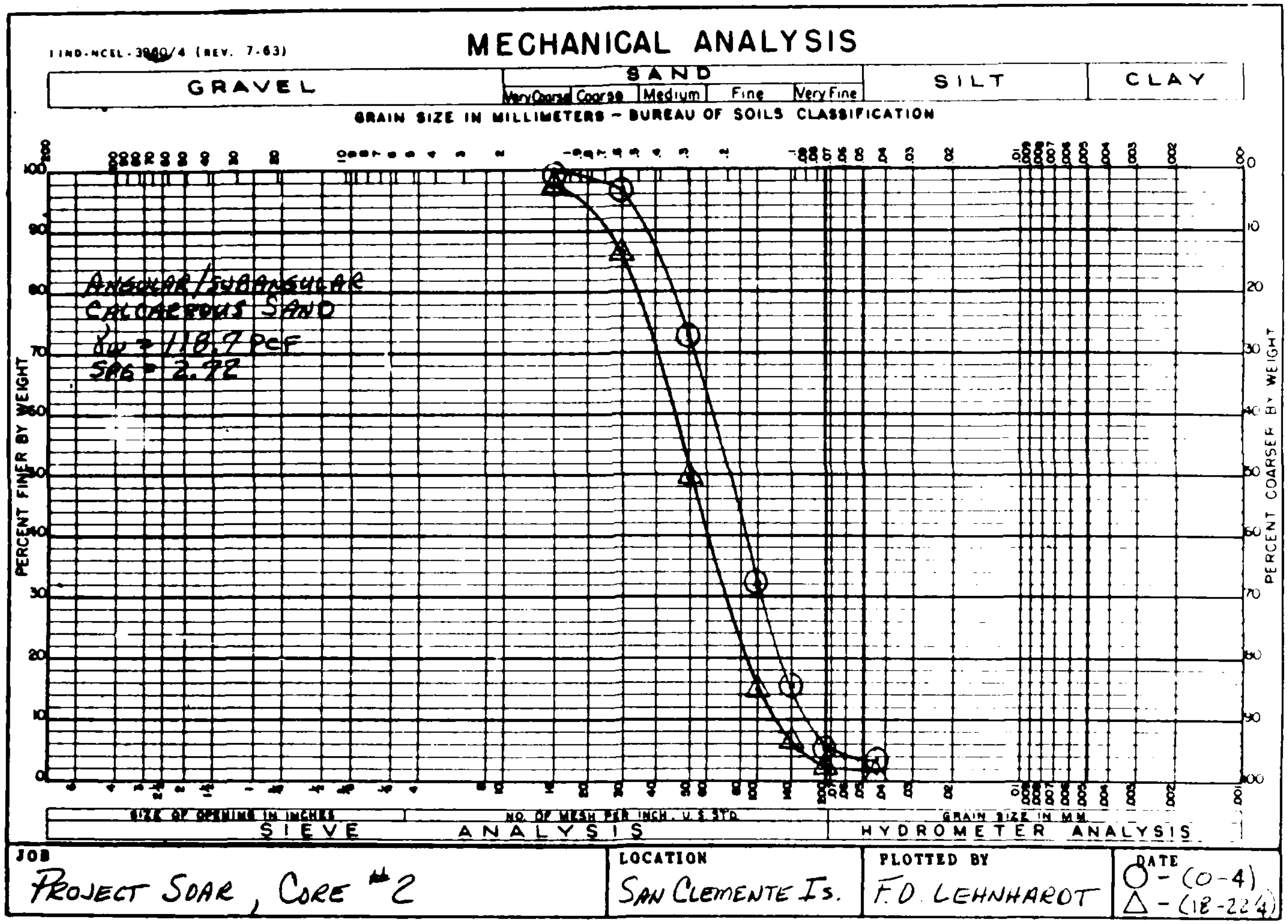
5. Questions concerning this information should be addressed to Barbara Johnson, Code L42, Naval Civil Engineering Laboratory, Port Hueneme, CA 93043, (805) 982-4362, A/V 360-4362, FTS 799-4362.

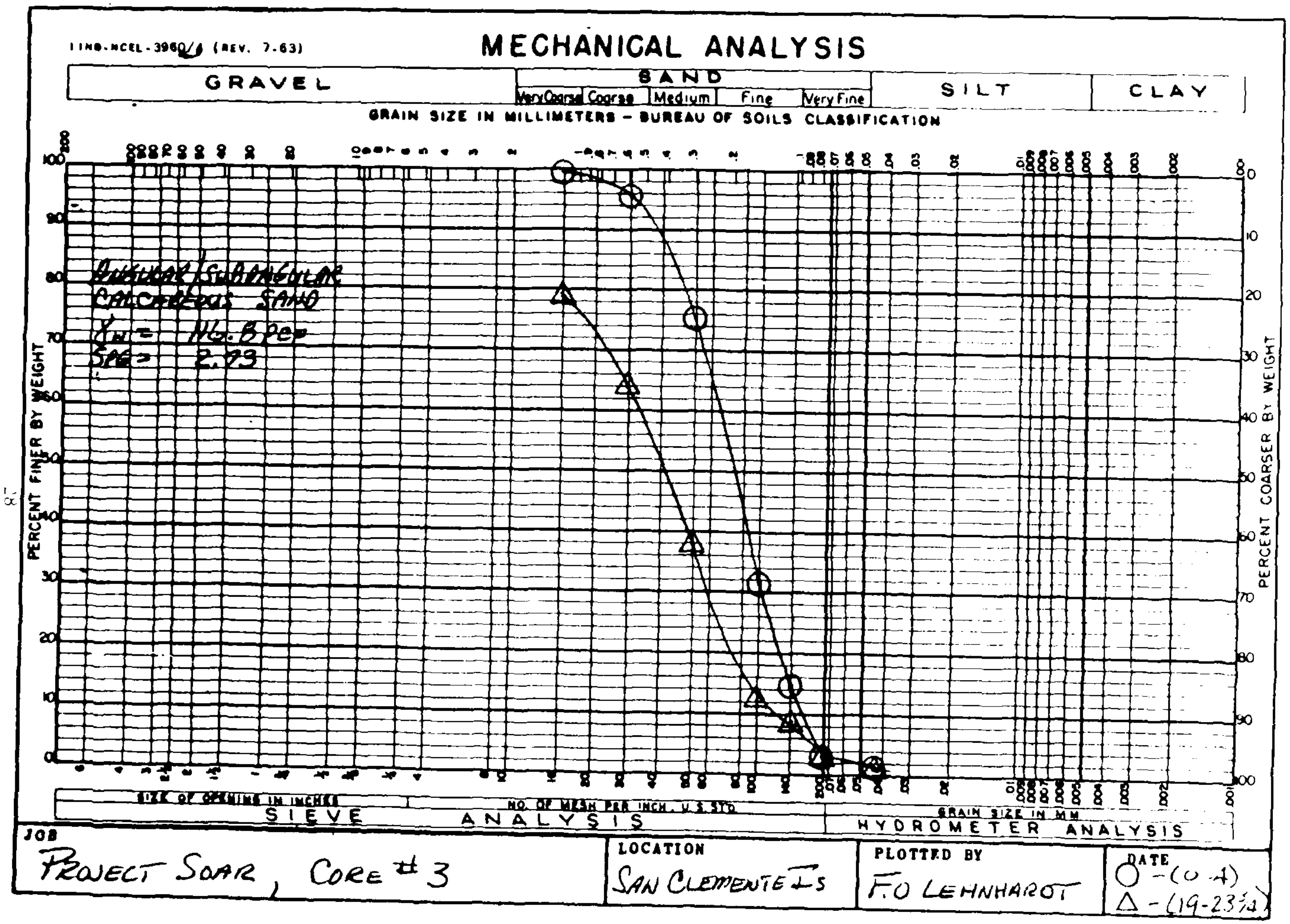
R. N. CORDY
By Direction

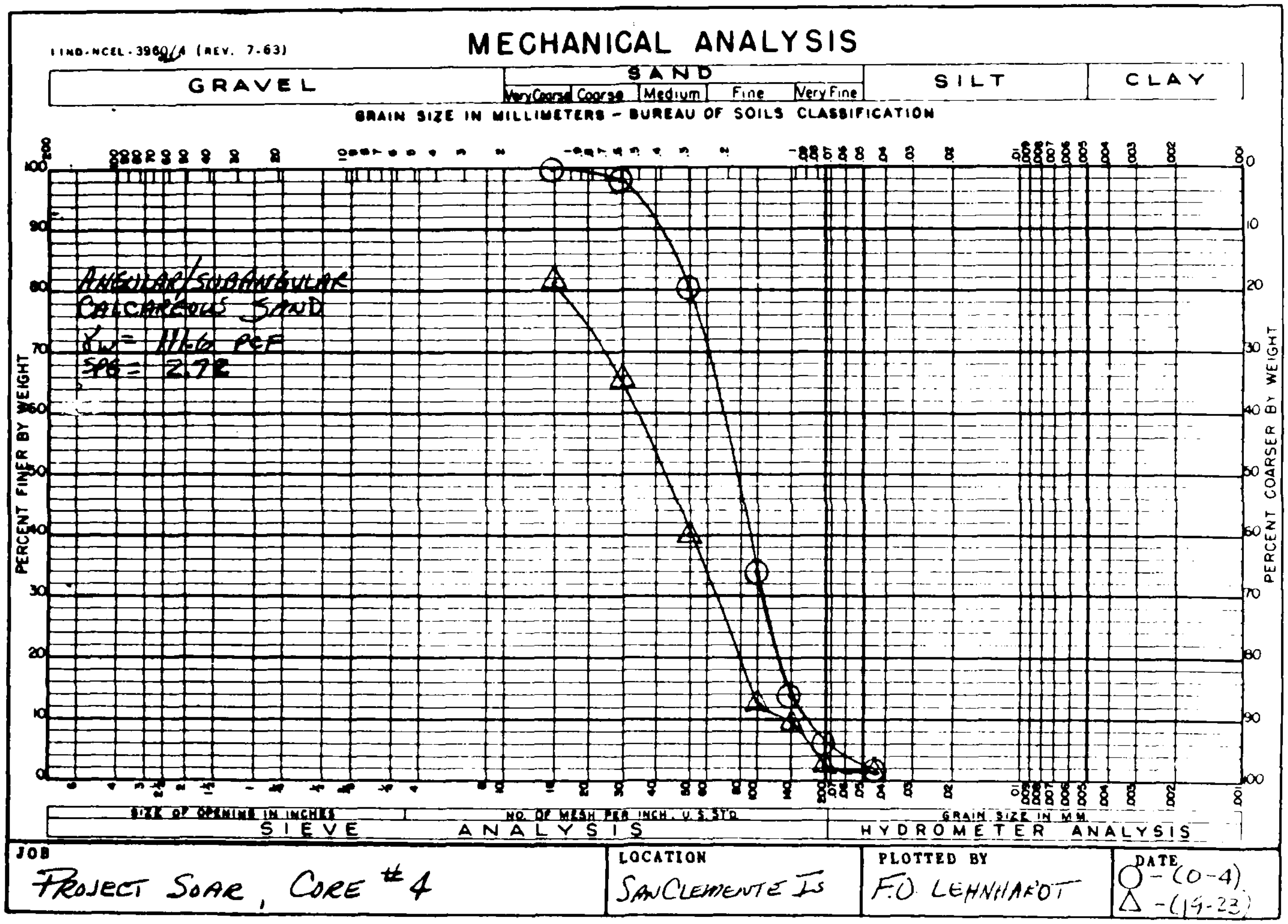
SOIL DATA SUMMARY CHART




FIND-NCEL-3960/4 (REV. 7-63)
MECHANICAL ANALYSIS
GRAVEL
SAND
Very Coarse Coarse Medium Fine Very Fine
SILT
CLAY
GRAIN SIZE IN MILLIMETERS - BUREAU OF SOILS CLASSIFICATION
PERCENT FINER BY WEIGHT
PERCENT COARSER BY WEIGHT
ANGULAR/SUBANGULAR
CALCAREOUS SAND
γ_w = 121.5 PCF
SpG = 2.74
SIZE OF OPENING IN INCHES
NO. OF MESH PER INCH, U.S. STD.
GRAIN SIZE IN MM.
SIEVE ANALYSIS
HYDROMETER ANALYSIS
JOB
PROJECT SOAR, CORE # 1
LOCATION
SAN CLEMENTE Is
PLOTTED BY
F.O. LENNHARDT
DATE
○ - (0-4)
△ - (16-21½)


MECHANICAL ANALYSIS
YIND-NCEL-3960/4 (REV. 7-63)
GRAVEL
SAND
Very Coarse
Coarse
Medium
Fine
Very Fine
SILT
CLAY
GRAIN SIZE IN MILLIMETERS – BUREAU OF SOILS CLASSIFICATION
PERCENT FINER BY WEIGHT
PERCENT COARSER BY WEIGHT
ANGULAR/SUBANGULAR
CALCAREOUS SAND
γw = 118.7 PCF
SPG = 2.72
SIZE OF OPENING IN INCHES
NO. OF MESH PER INCH, U.S. STD.
GRAIN SIZE IN MM.
SIEVE ANALYSIS
HYDROMETER ANALYSIS
JOB
PROJECT SOAR, CORE #2
LOCATION
SAN CLEMENTE IS.
PLOTTED BY
F.D. LEHNHARDT
DATE
○ - (0-4)
△ - (18-22.4)


ENG-NCEL-3960/4 (REV. 7-63)
MECHANICAL ANALYSIS
GRAVEL
SAND
Very Coarse
Coarse
Medium
Fine
Very Fine
SILT
CLAY
GRAIN SIZE IN MILLIMETERS - BUREAU OF SOILS CLASSIFICATION
PERCENT FINER BY WEIGHT
PERCENT COARSER BY WEIGHT
SIZE OF OPENING IN INCHES
NO. OF MESH PER INCH, U.S. STD.
GRAIN SIZE IN MM
SIEVE ANALYSIS
HYDROMETER ANALYSIS
CALCAREOUS SAND
SpG = 2.73
JOB
PROJECT SOAR, CORE #3
LOCATION
SAN CLEMENTE Is
PLOTTED BY
F.O LEHNHARDT
DATE
○ -(0-4)
△ -(19-23½)


MECHANICAL ANALYSIS
FIND-NCEL-3960/4 (REV. 7-63)
GRAVEL
SAND
Very Coarse
Coarse
Medium
Fine
Very Fine
SILT
CLAY
GRAIN SIZE IN MILLIMETERS - BUREAU OF SOILS CLASSIFICATION
PERCENT FINER BY WEIGHT
PERCENT COARSER BY WEIGHT
ANGULAR/SUBANGULAR
CALCAREOUS SAND
γw = 116 PCF
SPG = 2.72
SIZE OF OPENING IN INCHES
NO. OF MESH PER INCH, U.S. STD.
GRAIN SIZE IN MM.
SIEVE ANALYSIS
HYDROMETER ANALYSIS
JOB
PROJECT SOAR, CORE #4
LOCATION
SAN CLEMENTE IS
PLOTTED BY
F.O. LEHNHARDT
DATE
○ - (0-4)
△ - (15-23)

L42
15 July 1985

MEMORANDUM

From: L42/Malloy
To: L42/Files

Subj: ROCK SAMPLES FROM SAN CLEMENTE ISLAND (WEST COVE); IDENTIFICATION OF

1. Five small boulders were collected at West Cove by UCT-2 divers and brought to NCEL for compressive tests and megascopic identification. All five rocks are similar lithologically, and appear to be porphyritic felsites, possibly rhyolite or quartz porphyries. All five samples show alternating dark and light grey banding, presumably flow (?) lines. All samples have rounded, subrounded, or angular fragments, ranging in size from a few millimeters to 5 centimeters. The most common inclusion is yellow, fine grained, soft, and hydroscopic; presumably pumice. All samples exhibited glassy phenocrysts with no plagioclase twinning, suggesting quartz. All samples are highly competent, hammer ringing rocks.

2. Individual differences in the five samples include:

Sample 1: This is the freshest looking rock. Dark and light grey flow (?) lines are parallel to the long axes of the cores taken for compressive tests.

Sample 2: This sample is tinted rust red in streaks throughout the sample. Flow (?) lines are approximately perpendicular to the cores' long axes.

Sample 3: This sample has coloration similar to Sample 1, but the flow (?) lines cut across the cores' long axes at about 30°.

Sample 4: This sample resembles number 2.

Sample 5: Flow (?) lines are less conspicuous in this sample. They appear to be parallel to the cores' long axes. Yellow to rusty porphyritic inclusions make up 30% of the sample.

3. In summary, the rock samples appear to be volcanic extrusives that picked up other volcanic rock debris in the process of flowing and may have included its own cooled fragments (flow breccia). This is a hand specimen identification. Thin section examination by petrographic microscope is recommended if a more precise identification is required.

R. J. Malloy
R.J. MALLOY

ENCLOSURE (3)

ROCK COMPRESSIVE STRENGTH

RESULTS OF AXIAL COMPRESSION TESTING OF SPECIMENS TAKEN FROM FIVE ROCK SAMPLES

FROM SAN CLEMENTE ISLAND

ROCK SAMPLES	CYLINDRICAL TEST SPECIMEN	AVERAGE COMPRESSIVE STRENGTH (PSI)
SAMPLE 1	Specimen A[1] Specimen B, C[2]	10,320 psi 5400 psi
SAMPLE 2	Specimen A, B, C[2]	5700 psi
SAMPLE 3	Specimen A, B, C[2]	4500 psi
SAMPLE 4	Specimen A, B[2]	8200 psi
SAMPLE 5	Specimen A, B, C[2]	6600 psi

1 Specimen A of rock sample 1 showed a compressive strength almost twice that of B and C, therefore, it was not included in the average value.

2 Speciments cut from rock sample showed similar compressive strengths and the values were averaged.

ENCLOSURE (4)

APPENDIX C

SAIC GEOPHYSICAL SURVEY

Copy 4/5

SAIC

Science Applications International Corporation

A GEOPHYSICAL SURVEY
OFF WEST COVE
SAN CLEMENTE ISLAND
for the
SOAR CABLE INSTALLATION PROJECT

July 29, 1985

Submitted to:

CHESNAVFACENGCOM.
CODE FPO-1
Washington Navy Yard
Washington, D.C. 20374-2121

Submitted by:

Science Applications International Corporation
Admiral's Gate
221 Third Street
Newport, RI 02840
(401) 847-4210
Mr. Gerald Cook

SAIC

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SAIC

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SAIC

1.0 INTRODUCTION

The Chesapeake Division, Naval Facilities Engineering Command (CHESDIV) is tasked with the responsibility for the installation of underwater cables for the Southern California Acoustic Range (SOAR) located about 15 NM NW of San Clemente Island (SCI), CA (Fig. 1-1). Current plans require the laying of 22 hydrophone cables from the range area in deep water to a junction point in shallow water off West Cove, SCI. A single larger cable will be layed from the junction box shoreward through the surf zone to the Cable Termination Van (CTV).

The West Cove of SCI is fully exposed to the entire range of weather and oceanographic conditions that can occur. Since weather patterns in the SCI area generally move in an easterly direction, there are no fetch limitations to afford even a reasonable degree of protection for the West Cove area. Consequently, bottom conditions in relation to cable protection designs must be thoroughly assessed in order to insure a reasonable lifetime for the cables and result in longevity of the SOAR.

In order to obtain the necessary data for specifying cable design and optimum cable routes, Science Applications International Corporation (SAIC) was tasked to conduct a detailed geophysical survey of an area approximately one nautical mile wide and extending from the shore three nautical miles seaward (Fig. 1-1) where depths exceed 600 feet.

The geophysical survey consisted of side scan, subbottom profiling and bathymetry over the entire study area. In addition, two bottom mounted current meters were installed in about 30 and 65 feet of water off West Cove in order to obtain data on the dynamic wave-induced current velocity field in relation to the potential sediment transport. These two current meters will be in-situ for a period in excess of 6 months with three servicing periods, one of which has already been accomplished. The second servicing period is scheduled for the week of 15 July 1985. Present plans require removal of the current meters on or about 15 November 1985. A copy of the field log is provided in Appendix A.

The purpose of this report is to present the results of the geophysical survey (i.e. side scan mosaic, bathymetry and isopach (sediment thickness) in a series of overlays in order to select an optimum cable route from shore to the 600 foot isobath. In addition, the synthesis of these data and the results of the wave and current observations will enable the selection of a cable junction point.

Two sets of charts are provided with this report under separate cover: a set of three 1:8400 scale chart comprised of a sidescan mosiac with bathymetry and isopach mylar overlays; a set of ten 1:2400 scale sidescan mosaics, with ten bathymetry and seven isopach mylar overlays.

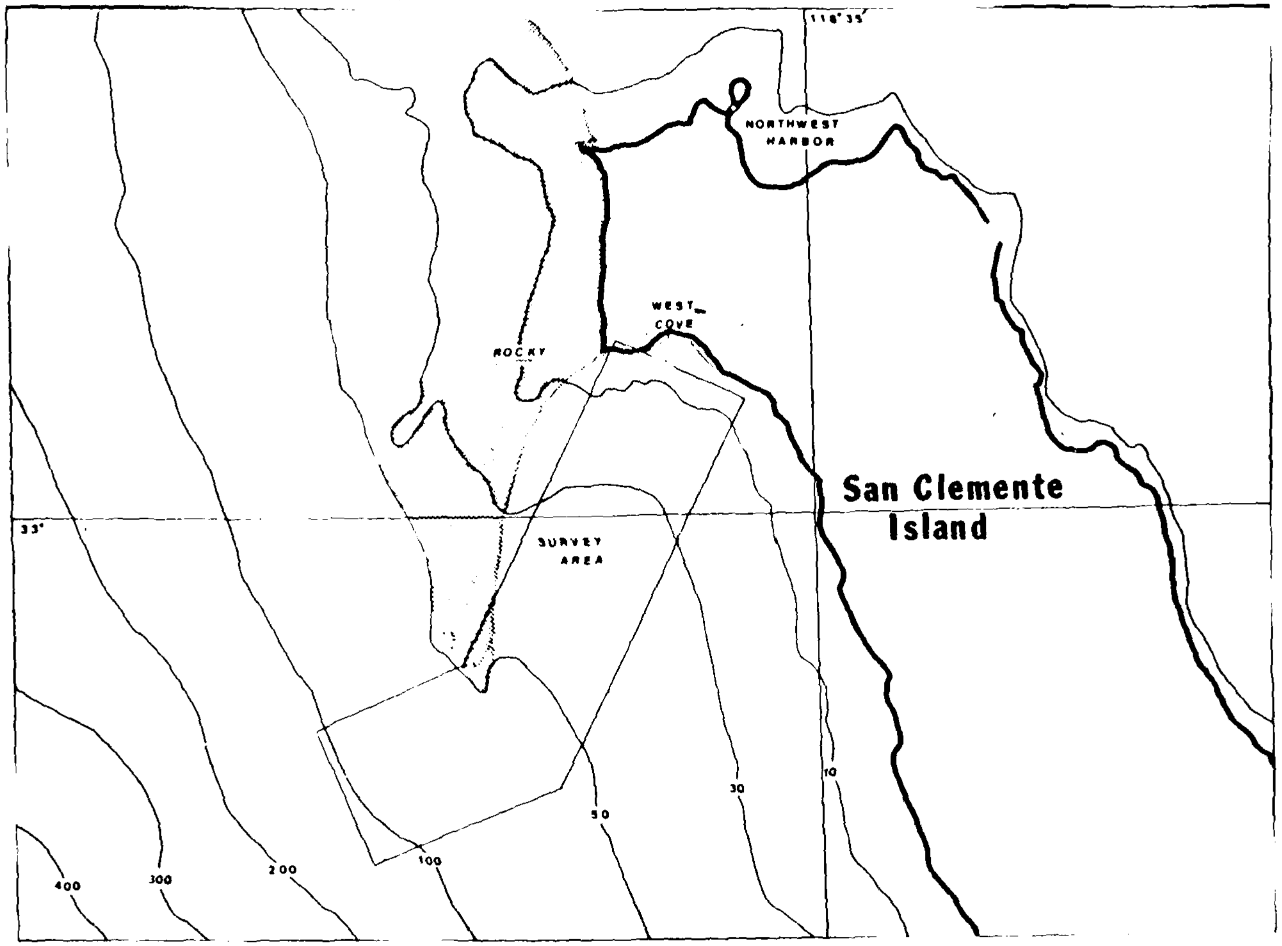


Figure 1-1. West Cove Survey Area

SAIC

2.0 BACKGROUND

During the early stages of the SOAR effort, two previous exploratory surveys were conducted, the results of which provided a basis for the survey presented in this report.

The first survey, conducted by the Naval Oceanographic Office (NAVOCEANO) under the direction of NUSC, Newport,, found that a direct route between West Cove and the SOAR Range was not feasible because the inshore portion of the route was 'blocked' by a rock ridge lying within the depth of storm wave action. A less direct but more suitable route with regard to bottom conditions was suggested, namely SSW from West Cove for about 2 1/2 nautical miles then westerly to the SOAR area.

The second survey, conducted by CHESDIV, was concerned with an investigation of two possible nearshore cable approaches to SCI; West Cove and Northwest Harbor. Bottom conditions at both sites were investigated by divers from about 20 fathoms shoreward and depth survey lines were run using a fathometer and a line-of-sight positioning system for positioning control. Additional geotechnical information was also obtained at West Cove for assessing cable burial ashore. Based on this study West Cove was recommended as the best of the two sites for a cable landing area.

The results of these two reconnaisance surveys led to the conclusion that West Cove would be the best cable termination point and that a detailed geophysical survey of the offshore area should be accomplished in order to provide planning data for installation of underwater cables.

3.0 SURVEY SYSTEM

3.1 SAIC NAVIGATION AND DATA ACQUISITION SYSTEM

The SAIC Navigation and Data Acquisition System was used in conjunction with the Del Norte Trisponder, to provide navigations control for the entire survey. In addition, all bathymetry data were recorded on data disks and later analyzed using the same computer system. The SAIC system consists of an HP 9920A microcomputer interfaced to a dual disk drive, printer and plotter. Environmental systems are interfaced via RS232C or BCD interfaces. SAIC's comprehensive software package controls the entire system, but is designed in a modular fashion to permit the operator to set-up and control the survey specifying data acquisition parameters such as recording, printing and plotting intervals. The system also provides steering guidance during survey operations. This system has been used extensively for all types of surveys including manned submersible tracking and cable laying operations.

Specifications of the SAIC system are presented in Appendix B.

3.2 POSITIONING SYSTEM

A Del Norte Model 540 Trisponder was used to position the vessel during the survey. Operating in the X-Band portion of the radio frequency spectrum, the Trisponder system provides position accuracies of ± 2 to 3 meters to line-of-sight ranges.

The positioning system was calibrated on SCI prior to installation aboard the Research Vessels using horizontal control data provided by NOSC, San Diego.

The control points used for the calibration were the same ones used for the survey operations off West Cove. These points are:

LAMAR #1	N 316921.68 ft. E 1278554.83 ft. Elevation 32 ft.
CAPITAINE #3	N 317612.03 ft. E 1282827.48 ft. Elevation 130.25 ft.

The calculated baseline distance between these two control points is 4329.15 feet (1319.86 meters). With the shipboard Master and DDMU installed at Capitaine #3 and the Remote transmitter/receivers installed at LAMAR #1, the calibration values were determined so that the range between the Master and the Remotes read 1319.9 meters. After completion of the calibration, remote T/R's were installed at Capitaine #3 and LAMAR #1 and the Master T/R and DDMU were installed aboard the research vessel.

A data sheet for the Model 540 Trisponder is presented in Appendix C.

3.3 BATHYMETRY SYSTEM

An Edo Western bathymetry system was used to obtain depth data for the entire survey. Although a Raytheon DE719B with an SSD100 Digitizer was available and used for the first two days aboard the IX 506, after transfer of equipment and personnel to the R/V EGABRAG III, the EDO-Western system was used exclusively for the survey. The decision to use the EDO system was based on the availability of a hull mounted transducer provided by NUSC. Otherwise mounting of the transducer to the side of the vessel would have required extensive fabricating and welding to provide a secure installation.

The 24kHz bathymetry system consists of an Edo-Western Model 615 graphic recorder, a Model 261C Digitrak and a Model

248E sonar transceiver and is capable of measuring depth to about 2000 feet as configured. Greater depth capability can be attained using lower frequency transducers. The output of the Digitrak is interfaced to the navigation computer for recording depth in conjunction with ship position.

Specifications for the EDO system are presented in the Appendix D.

3.4 SUBBOTTOM PROFILER SYSTEM

An ORE Geopulse subbottom profiler system was used for determining the thickness of bottom sediment throughout the survey area. The Geopulse system generates a sharply defined wideband high acoustic source level which can penetrate into the seabottom. Reflections from layers or strata of differing density are received by a hydrophone streamer and displayed on a graphics recorder. The graphic records obtained portray the bottom layers on a known time base and when combined with the velocity of sound for the particular bottom material provides a measure of sediment thickness.

The Geopulse system consists of a lightweight catamaran assembly that containes the sound source, a hydrophone streamer for receiving the reflected signals and shipboard electronics for controlling, filtering, processing and recording the outgoing and incoming acoustic signals. The return signals are displayed on a graphics recorder and also recorded on analog tape for archiving and/or reprocessing.

During the subbottom survey the location of the sound source and hydophone streamer were measured in relation to the shipboard navigation antenna so that position of the vessel (antenna) could be translocated to the Geopulse system during the analysis phase.

Specifications of the Geopulse System are provided in Appendix E.

3.5 SIDESCAN SONAR SYSTEM

An ORE Model sidescan sonar system was used to obtain acoustic images of the sea bottom over the entire survey area. Survey lines were set-up and the range scale of the sidescan was such that approximately 150% bottom coverage was obtained.

All sidescan data were recorded on analog tape for subsequent playback and processing for development of bottom mosaics.

The sidescan system consists of a towfish and a graphic recorder for displaying the sonar images of the bottom. The very short (100 kHz) pulses emanating from the towfish are beamed across the seabed and are reflected from the seafloor and from objects on it to produce images on the recorder. The recorder and towfish are coupled by an armored tow cable to a winch equipped with slip rings. The depth of the towfish is normally maintained at ninety percent of the water's depth. The distance above the bottom is maintained by a combination of ship's speed and amount of cable paid-out. Normal surveying speed is generally 5 - 6 Kts.

Specifications for the sidescan system are presented in Appendix F.

3.6 CURRENT METER INSTRUMENTATION

Two current meters attached to tripods were deployed in West Cove on 24 April 1985 for a planned 6 month deployment. Divers securely mounted the tripods to the bottom with chain and anchors extending from each leg. Spirit levels on each tripod permitted the diver to level the tripods and to observe if any settling had occurred between servicing periods.

Each assembly was equipped with two acoustic locating beacons; one on the current meter and one on the tripod which were used for locating each unit during the servicing periods. In addition, the beacons provide a means of locating the units in the event they are moved by fishing boats that frequent this area.

Both current meters are manufactured by Sea Data Corporation, Newton, MA. The shallow current meter is a Model 621 Directional Wave Current Meter (DWCM) which uses a two-axis electromagnetic current sensor for the current measurement and a quartz pressure transducer to record wave pressure fluctuations. The sophisticated internal data logger permits a variety of sampling schemes, vector averages wave measurement scans and formats the data for recording on the internal cassette.

The deep current meter is a model 635-12 Directional Wave and Tide Recorder that provides basically the same capabilities as the Model 621, but in addition measures temperature.

Specifications for these current meters are provided in Appendix G.

3.7 RESEARCH VESSELS

The Navy initially provided a modified 140 foot landing craft (IX506) for conducting the field surveys. All survey equipment was installed aboard IX506 dockside at NOSC, San Diego, and survey operations commenced off West Cove on 24 April 1985. Several serious problems arose during the early portion of the operations resulting in IX506 returning to NOSC, San Diego on the 26th of April. At that point, a decision was made to transfer equipment and scientific personnel from IX506 to EGABRAG III in order to complete the survey operation and to meet schedule requirements for the SOAR transponder implant operations scheduled for the period immediately following the survey operations.

While aboard IX506, a partial geophysical survey was accomplished and two tripod mounted current meters were installed. The R/V EGABRAG III was used for the entire survey (repeating the survey started aboard IX506), including servicing of the current meters at the end of the SOAR transponder operations.

4.0 DATA ANALYSIS PROCEDURES

Four basic data sets were obtained during the survey: position, sidescan, bathymetry and subbottom. The first data set is common to the other three, so that the results can be presented in a series of charts depicting the respective parameters as a function of position. Each data set has been analyzed according to the general procedures discussed below and the final products consist of a sidescan sonar mosaic which forms a base chart for overlaying the bathymetry and isopach charts. Using semi-transparent mylar base, the bathymetry and isopach data can be readily assessed in relation to the sidescan acoustic image of the bottom. The presence of rock outcrops and other bedforms in relation to depth and sediment thickness is immediately apparent and provides an efficient method for detailed planning for the inshore portion of the SOAR cable installation project.

All the survey data sets were obtained simultaneously with time, position and depth recorded on the SAIC navigation system. An automatic time marker was connected to both the sidescan and subbottom recorders and synchronized with the computer clock resulting in a reference time base for the data acquisition process.

The sidescan mosaics and all overlays are plotted at identical scales using the Lambert Grid for California Zone 6 with coordinate values in feet. Figure 4-1 shows the ship's track coverage of the survey area. Line spacings varied from about 50m in the Northern part of the survey area to about 100 meters over the southern shelf and slope areas.

The following sections describe in detail the general procedures for processing the data sets into overlay charts.

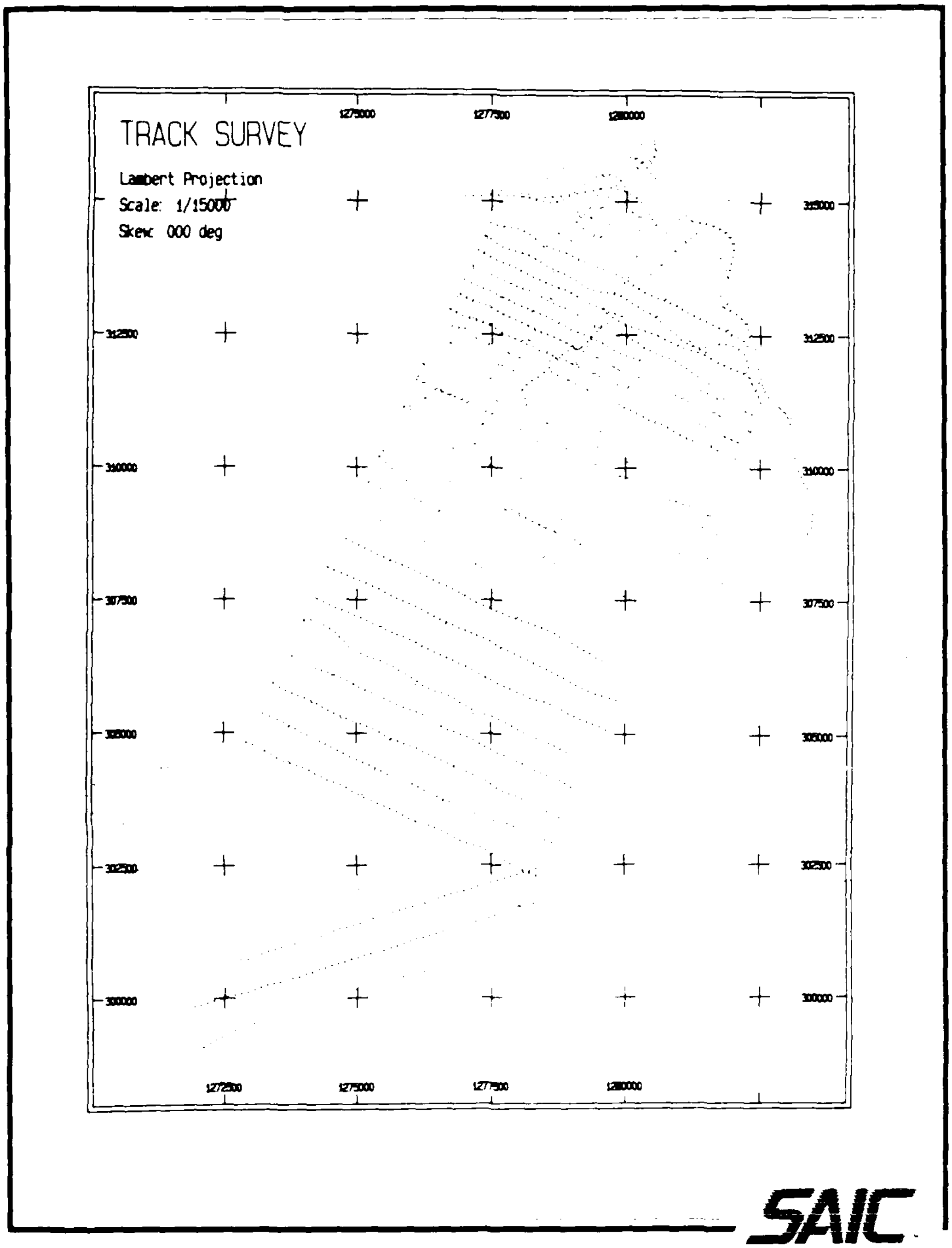


Figure 4-1. Ship's Track Coverage of Survey Area.

4.1 SIDE SCAN MOSAIC

The analog data tapes recorded during the sidescan sonar survey were processed to remove water column, slant range and scale distortion associated with varying ships speed. The scale distortion is corrected by utilizing navigation information whereas water column and slant range are removed using special processors. The 'corrected' tape was played back through the graphic recorder creating sonar images of the bottom without speed distortion and these images were mounted in mosaic form providing an acoustic picture of the entire survey area. The original mosiac, being physically large, was separated into ten plates and each plate was photographically reduced to a scale of 1:2400. An additional mosaic was photographically produced at a scale of 1:8400 which results in a reasonable document size that portrays the entire survey area and is manageable for presentation and general overview discussions. The 1:2400 scale mosaics cover the same area as the 1:8400 mosaic in 10 plates, but provide more detail for precise planning of cable routes and specifying a location for the junction box. Figure 4-2 shows the distribution of the 1:2400 scale plates in relation to the 1:8400 chart.

During the processing phase, the setback or translocated position of the towfish, relative to the positioning system antennna located on the bridge, was determined so that the correct position of the towfish was utilized during development of the mosaics.

4.2 BATHYMETRY

The bathymetry data was recorded simultaneously as a function of position on magnetic disks using the SAIC Navigation and Data Acquisition System. During the processing phase, corrections for transducer draft and tidal elevation were applied and the corrected data were edited for spurious or erroneous values. Tidal elevation corrections were applied by plotting the tidal curve covering the entire survey period (obtained from the NOAA Tide Tables) and digitizing the tidal elevation signature at one hour intervals. The digitized tidal data were input as a 'look-up' table which was accessed by the computer to provide interpolated tidal elevation at the time of each discrete observation. A transducer draft correction of 7 feet was applied to all the depth data.

Editing of spurious or erroneous values was accomplished by converting the binary format field data disks to a text file format. The text file format permits the analyst to access any or all data contained on the disk and to edit or remove invalid data. After completion of the editing procedure, the edited text file disks are converted to new edited binary disks and then plotted at the desired scale. The original data disks are not changed in any way.

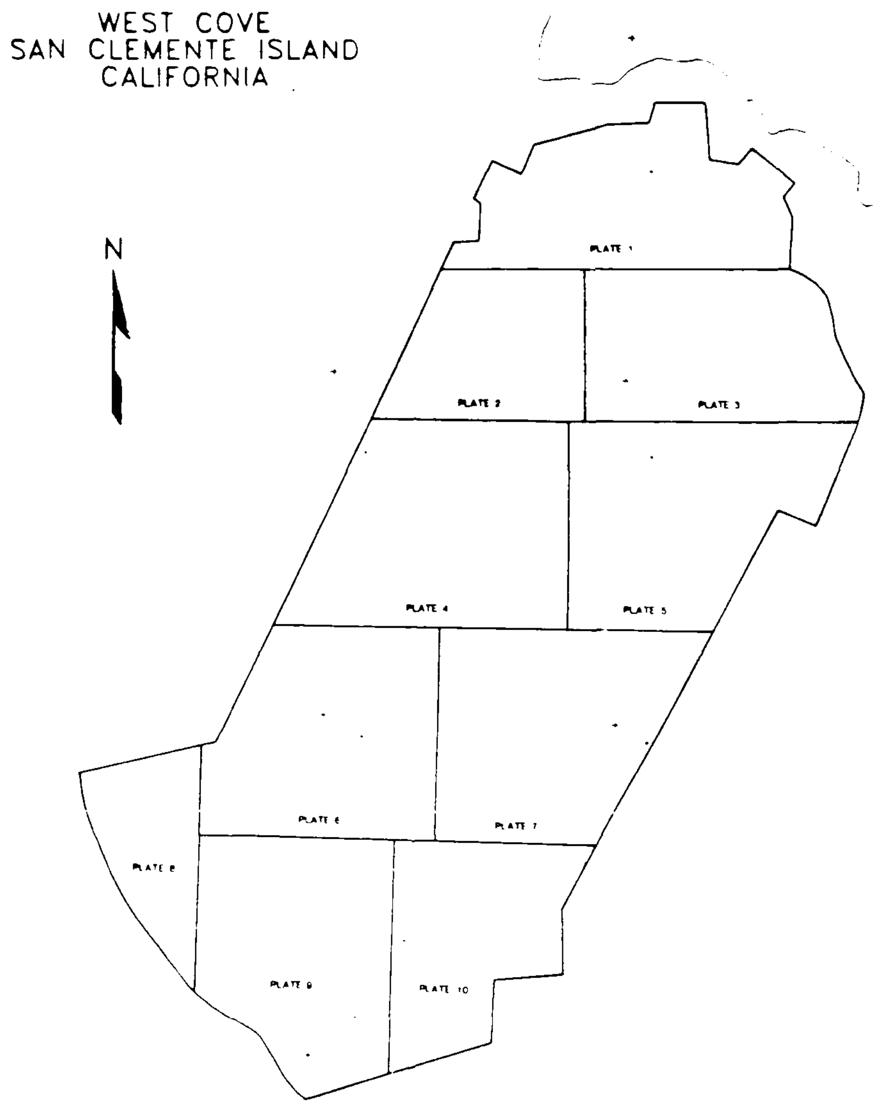


Figure 4-2. SIDESCAN SONAR MOSAIC INDEX MAP

The bathymetry is plotted on a series of charts at the same scale as the sidescan mosaics, namely 1:8400 and 1:2400 in 10 plates. The data are plotted on translucent mylar using waterproof ink and the mylar provides a stable base material which minimizes grid distortion due to temperature and humidity.

All depth sounding on the bathymetry charts are referenced to the standard chart datum for the United States West Coast, Mean Lower Low Water (MLLW).

Each sounding chart has been constructed using different colors to depict different depths in 100 ft. intervals. For example, all depths lying within 0 - 100 ft. are plotted in one color, while all depth within 101 - 200 ft are plotted in a different color, and so on. From the composite bathymetry chart (1:8400 scale), one can readily see the contours formed at the color boundaries. Likewise, the rather abrupt change in bottom gradient at the shelf break is also readily apparent.

Finally, it should be noted that the 1:2400 scale bathymetry charts have been plotted so that a small portion of each chart overlaps each adjacent chart. Consequently, alignment of adjacent charts is easily accomplished by aligning the actual soundings.

4.3 ISOPACH ANALYSIS

The sediment thickness or isopach values were obtained from the subbottom profile records by measuring the (one-way) travel time interval between the sediment water interface and the first acoustic horizon or isopach contact. These travel time values were determined along each survey line at intervals of 30 sec. to 1 minute corresponding to 300 feet and 600 feet of distance over the bottom between observations. These time-values were multiplied by an assumed speed of sound in packed sand of 1650m/sec (URICK, 1975) to obtain the thickness of sand. These values were merged with their respective positions and plotted in the same manner as the bathymetry data (i.e. sediment thickness as a function of position). A representative subbottom profile record for the central and north portion of the survey area is shown in Figure 4-2a, which shows the presence of a ponded sand lens extending from a rock outcrop at the left of the figure. In contrast, Fig 4-2b shows the steeply sloping bedforms which occur in the southern portion of survey area and are noted on Figure 5-1.

The isopach values are presented in feet (below the sediment - water interface) and are plotted at both 1:8400 and 1:2400 scales and overlay the base sidescan mosaics.

The isopachs are also plotted using different colors to represent each 10 feet of sediment thickness. The 1:8400 scale chart has been hand contoured to depict the distribution of sand

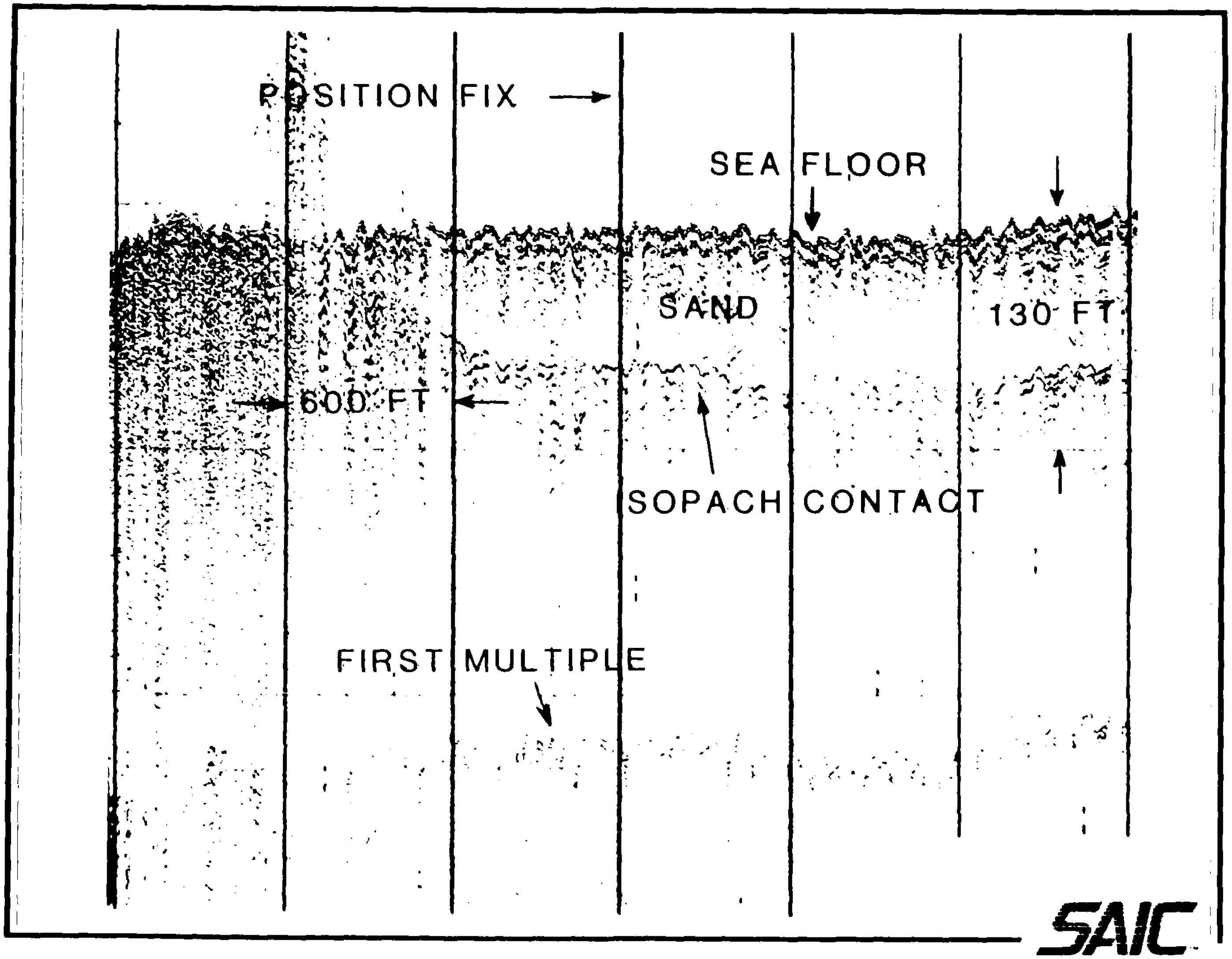


Figure 4-3a. Example of a [illegible] record showing a sand lens between the seafloor and the isopach.

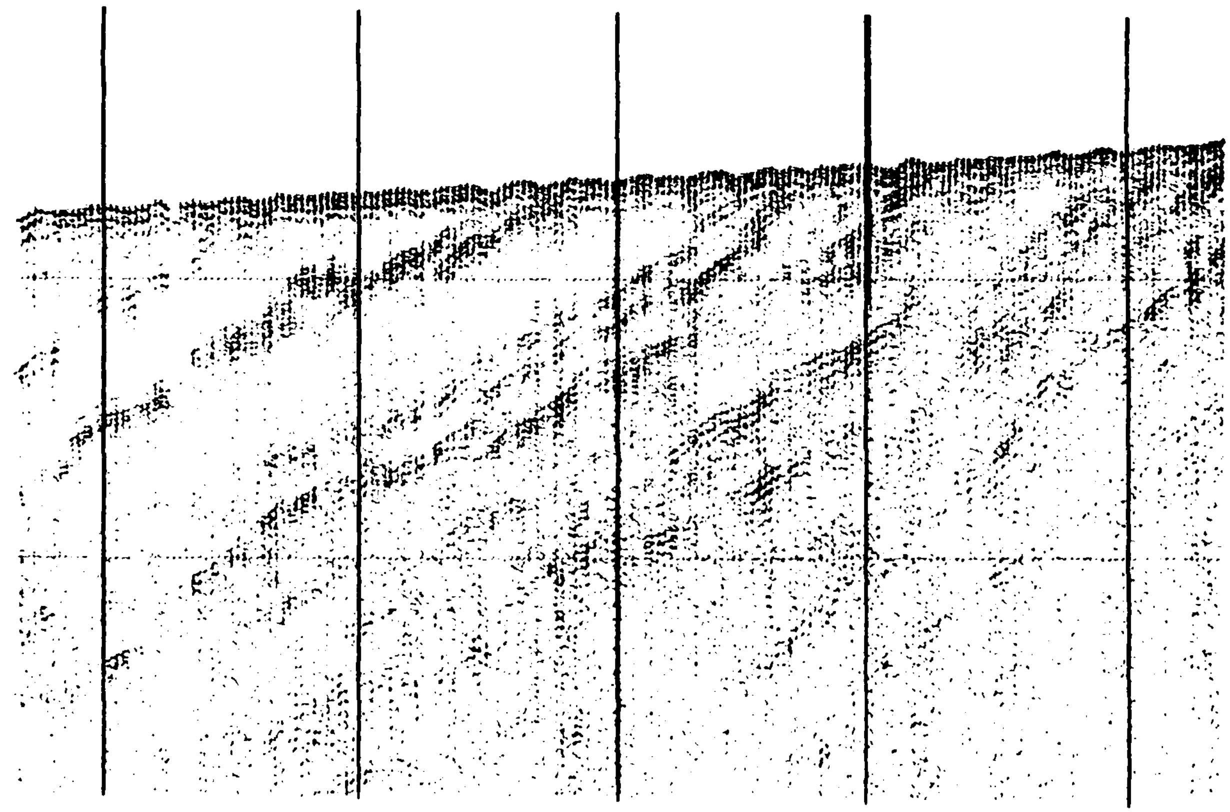


Figure 4-3b. Example of steeply sloping bedforms in the area noted on Figure 5-1.

SAIC

thickness throughout the survey area.

4.4 CURRENT VELOCITY

The two current meter data tapes retrieved at the end of the SOAR transponder implant were sent to Sea Data Corporation for transcription from cassette to 9 track tape. Both records have been transcribed (at different times) and Each record contains nearly 20 days of wave data (significant wave height), current speed, pressure (tide), temperature (degrees C), and U, V components of the current velocity. Plots of these data are presented in the following section.

At the conclusion of the field current measurements program scheduled for early November 1985, a detailed analysis of the current velocity and wave data will be completed and forwarded to CHESDIV. However, the data obtained during the servicing periods will be reduced and informally summarized.

The location of the current meters is shown on Figure 5-1 below.

5.0 RESULTS AND DISCUSSION

The following discussion assumes the reader has available the 1:8400 scale charts comprised of the sidescan mosiac and the bathymetry and isopach overlays that have been provided with the report but under separate cover.

Figure 5-1, a side scan mosaic of the survey area, shows a predominately sand covered bottom with extensive rock outcrops fringing West Cove (to the North) and the western boundary of the survey area. Extensive kelp beds are present off Wilson's Cove and utilize the rock outcrops as an attachment substrate to depths of about 125 feet. The kelp does not generally grow at greater depths even though rock outcrops are present. There are two narrow sand covered channels at the exteme northerly part of the survey area adjacent to the West Cove Beach. They are sand covered and offer potentially good areas for the shoreward portion of a cable route. However, the channel located on the eastern part of West Cove leads to a small rocky bluff which might require rock excavation if this approach is used.

Water depth in the survey area varies from about 30 ft. in the extreme northern part to about 400' at the shelf edge, three miles offshore, after which the bottom gradient increases dramatically. Bottom gradient in the survey area is about 1 - 3%, whereas beyond the shelf break the gradient increases abruptly to about 20%.

In the central part of the survey area, several rock

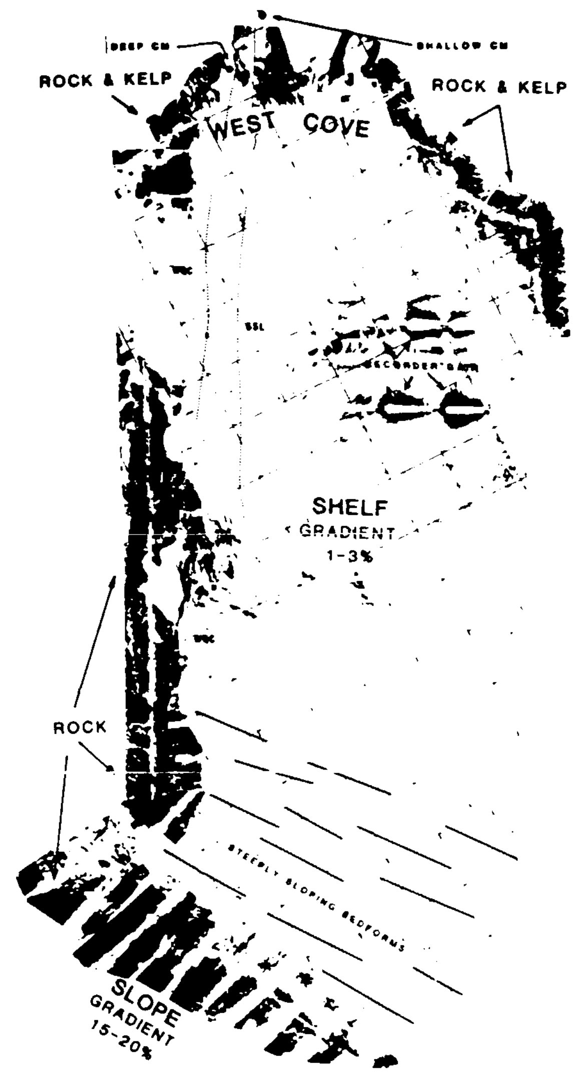


Figure 5-1. West Cove Survey Area

SAIC

outcrops are obvious, exhibited by the discrete dark areas on the side scan mosaic. Here the sand thickness is generally very thin amounting to less than 1 foot. In the east central part of the survey area rather dense but relatively small reflectors is more likely debris; however, based on the isopach analysis, it appears to be that these are remnants of a rock outcrop because the surrounding sand thickness is minimal (the order of 1 foot), whereas, to the north of this area the sand thickness is over 60 feet.

The greatest sand thickness occurs in the northern part of the survey area and exceeds 80 ft., only 2500 feet off Wilson's Cove. The isopach analysis shows a small submerged sand-ponded valley, trending southeasterly across the northern part of the survey area and in an arc parallel to Wilson's Cove.

The central and south portions of the survey area have a relatively thin overburden of sand. The subbottom records for the southern portion of the survey, inshore of the shelf break, depict numerous, steeply dipping bedforms (Fig. 4-2b) which rise to or very near the sediment water interface. Between these bedforms may be several tens of feet of sand. These bedforms are most noticeable in water depth of about 300 ft. where the potential for wave-induced bottom currents and therefore sediment transport is negligible.

At the shelf break, several parallel rock outcrops, devoid of sand are noted on the side scan mosaic.

The data obtained from the current meters in Wilson's Cove are shown in Figures 5-2, 5-3, 5-4, and 5-5. Figure 5-2 shows the significant wave height (height of 1/10 highest waves) and pressure variance. At the shallow site significant wave height was about 75cm at the beginning of the period and gradually decreased to about 50cm. At the deep site a similar trend is noted, but the wave height is about half that at the shallow site. This difference in wave height is the result of the waves becoming steeper and higher as they 'feel the bottom' at the shallow site.

The U, V velocity components at the two sites are shown in Figure 5-3. There is virtually no mean current at the shallow site, but the deep site exhibits a very slight mean westerly current (-U) of about 4 cm/sec.

The maximum speed (orbital velocity) for each one hours burst interval is shown in Figure 5-4. At the 10m site, maximum orbital velocities approach 100cm/sec and follow a decreasing trend over the 20 day period averaging about 35-40 cm/sec over the last half of the record. These speeds are almost wholly associated with wave dynamics because no mean flow was observed.

At the deep site, the maximum speed showed the same trend, but the maximum observed speeds are about 60cm/sec decrease to about 30cm/sec over the remainder of the record.

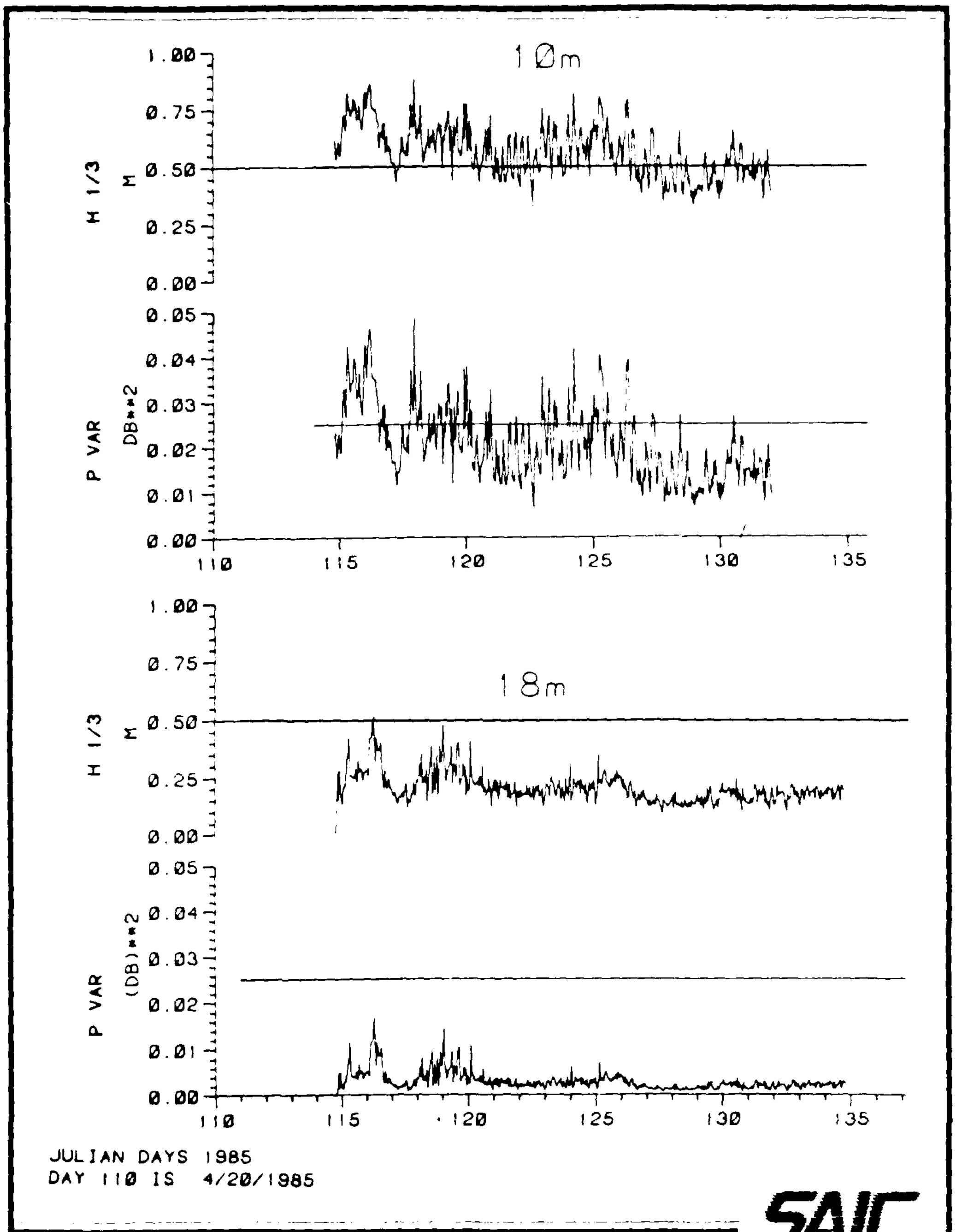


Figure 5-2. Significant Wave Height and Pressure variance at the shallow and deep current meter sites.

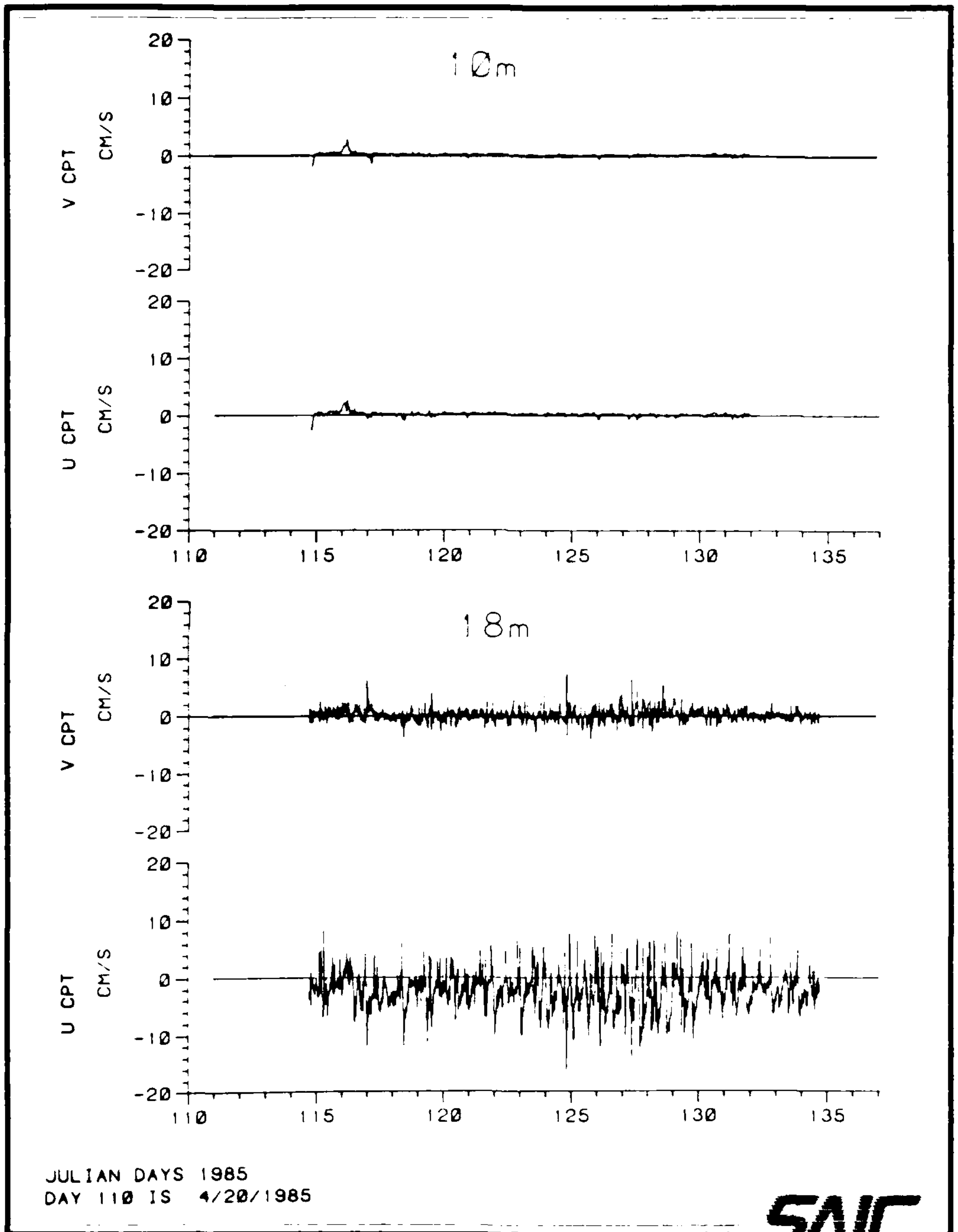


Figure 5-3. U, V Velocity components at current meter sites.

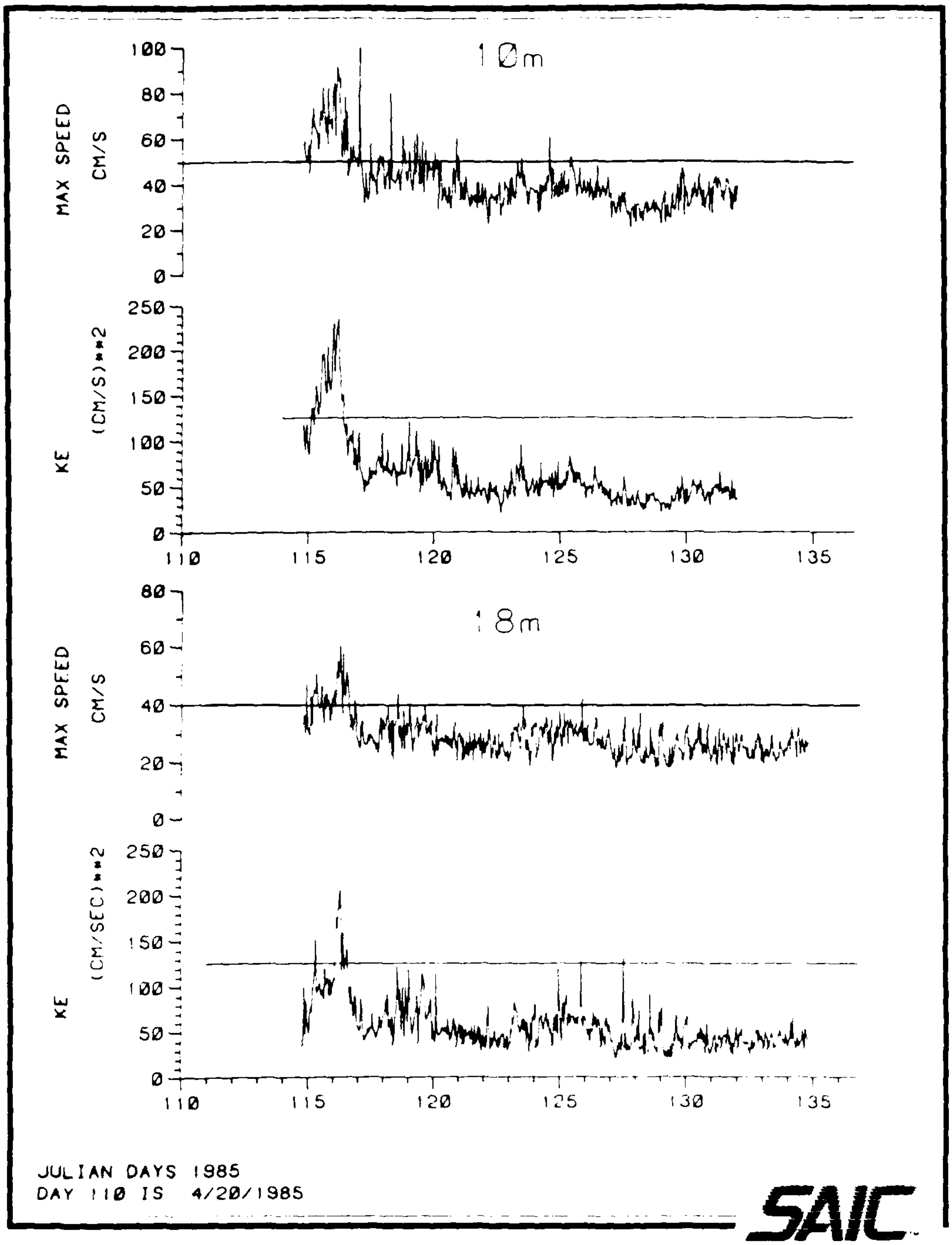


Figure 5-4. Maximum speed per burst interval and kinetic energy.

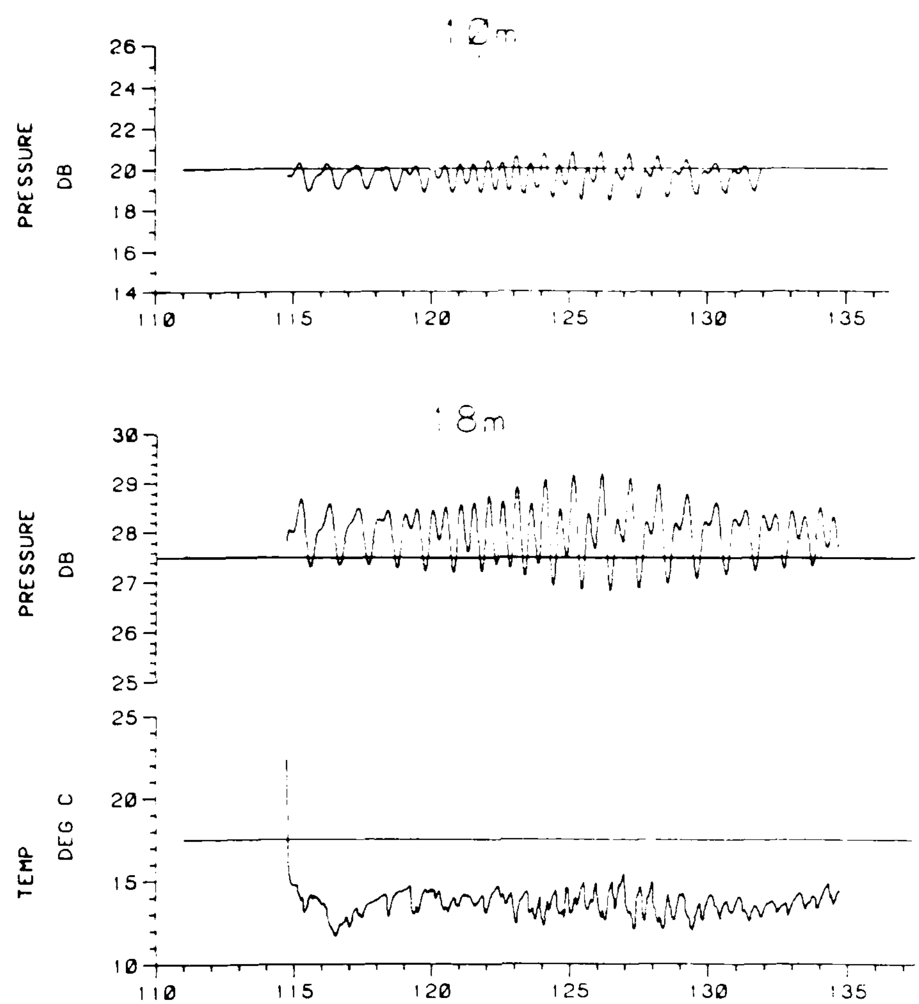


Figure 5-5. Tide and temperature at the Current Meter Sites.

JULIAN DAYS 1985
DAY 110 IS 4/20/1985

SAIC

Figure 5-5 shows the tidal elevations observed at both sites. Note that the ordinate scales for pressure are not identical. Bottom water temperature at the deep site shows fluctuations of 1 to 3^{O} C that correlate with the tide. Average bottom water temperature is about 13^{O} C.

A more detailed analysis and interpretation of these data will be provided when the sampling program is complete. This will include, but not be limited to duration and recurrance statistics, wave energy spectra and the relationship between these parameters and the potential for sand transport.

6.0 CONCLUSIONS

The West Cove of San Clemente Island is surrounded by rock outcrops around the periphery of the Cove except for two relatively narrow sand covered areas that tend toward the shore. Seaward of the Cove the entire bottom is sand covered with the greatest sand thickness (exceeding 80 ft.) 2500 to 3000 ft off the Cove. The remainder of the survey area has a minimal sand thickness of the order of 1 to 2 feet until the shelf break in the southern part of the survey area where rock outcrops and bedforms either reach or penetrate through the sediment water interface. Along the slope where gradients are of the order of 20%, virtually the entire bottom is exposed rock and devoid of sand.

Based on this survey, a cable route from West Cove to the shelf break is suggested over those areas where sand thickness is the greatest and surface or nearsurface bedforms are not present. It is however, recognized that in water depths greater than about 200 feet, dynamic wave-enduced currents will be minimal and the local mean currents are probably not strong enough to initiate sand movement. Consequently, the most direct route may be the best route for the cable in this portion of the study area.

APPENDIX A

4/21/85 Arrived NOSC Post 7 at 0730. Expected Shaker Express to deliver equipment at 0800.

Drove to SB Airport and found Shaker was going to deliver on Monday at 0800. Finally had delivery at IX 506 by approximately 1030 a.m.

Picked up CM (635-12) at United air freight and then met Morton and Brennan at the airport.

Returned to IX 506 at approximately 1500 and completed installation by approximately 1930 hrs.

4/22/85 Arrived at North Island at 0845. Checked in and met Jay Bercaw. Del Norte equipment manifested on same flight. Take off from North Island at 1000.

Arrive SCI at 1030. Check into personnel trailers at 1130. Meet in conference room at 1200.

Attendees:

Neil Lantham	NOSC Test Coordinator
Jay Bercaw	MariPro
Frank Wyatt	NUSC
Keith Cooper	CHESDIV
Ed Saade	Pelagos
Mike Brennan	SAIC
Gerry Cook	SAIC
Robert Morton	SAIC
Mark Silvia	SAIC

Discussed overall survey plan and determined coordinates for survey set-ups.

Calibrate Trisponder between LAMAR#1 and CAPITAINE #3.

Trisponder Cal.

LAMAR#1 N 316921.68
E1278554.83

CAP#3

Baseline 4328.06 ft. (flatplane)

4329.15 actual = 1319.86 m = 1319.9

LAMAR# 1 - CAP#3 (MASTER) (824) 2095.0

1319.86	1319.9

	775.1

CAPITAINE #3	ELEVATION	130.25 + 6 =	136.25
LAMAR#1	ELEVATION	36.25 approx.	36.25

	30.2 PAD 1	start range correction	100.00 ft. = 33 m

Installed LAMAR#1 1500 hrs. approx. - will correct batts tommorrow

764	792.2	
824	774.3	
924	778.8	- LAMAR 1

Bearing CAPITAINE #3 to op. area - 197° M
LAMAR#1 to op. area. 170° M

4/23/85

0645 Cook, Wyatt, & Brennan -Pick up 4 spare batteries and powered-up LAMAR & CAPITAN. (Spare batts at each station)

Left spare Trisponder (code 764) at operations

0745 U/W from dock to IX 506 via launch. U/W for op. area.

Checked out sidescan, but had problems with kelp - one channel inoperative (port) but Ed Saade found and corrected a miswire. Unable to get good side scan record from beach out.

Kelp also fouled 200 KC transducer mounted in Moon pool - This happened several times. Ducer mount was re-rigged by Brennan to elevator frame- transducer pipe looks okay at full speed (8 kts)

Rigged current meter tripods and set each current meter as noted in the tech log. Silvia had to grind a larger diameter for each mounting plate so that the pressure case welds would pass through the plate.

Experienced some phase cancellation of Del Norte System - may be because we're operating too close - we're not sure what the problem is, but intend to check antenna bearings upon arrival dockside.

Boston Whaler over the side with two Navy operators in preparation for supporting the current meter (30') implant dive ops.

Shortly thereafter - Whaler went aground ashore -one sailor injured both feet - Bercaw & Wyatt swam ashore and got the Whaler outside a (mild) surf zone. The IX 506 stood off and Silvia swam in with a line-attached it to the Whaler and the IX crew pulled in the Whaler. The Whaler was smashed on the hard chives, but not holed. After the Whaler was aboard Ix, we connected the gas line and started the engine. It ran fine, but would not turn the prop when engaged in forward gear.

1610 PST — U/W for Wilson Cove to transfer injured sailors asho e.

1721 PST — Arrive Wilson's Cove.
Attempting to get another small boat, Zodiac for example - for support during ops. tommorrow. - Pelagos will provide.

Decided to change location of Master from T. Towers above the Moon pool to the after main mast on IX 506. Will do this at Wilson Cove. Transferred Master to main mast and added an additional 50' of Pwr. Sig. cable inorder to reach DDMU in the lab. Gave Bercaw spare CM batts and two cassett tapes for CM turnaround.

4/24/85

0609 PST — Buoy detail.

0630 app. — U/W for op. area.
Day Plan
Pelagos will ship a Zodiac & motor via Jim's Air - arriving at SCI at 700. Wyatt & Bercaw will assemble on beach at West Cove and rendezvous with IX for current meter implant. Will install deep Cm first - followed by shallow CM. Following CM implant will commence shallow seismic work of near shore area. Note: Wyatt will check bearings of shore stations as per
LAMAR #1 - 170° M

CAP#3 - 197° M app. -200° M

With Master on top of mast - we should have no problems with phase cancellation or drop outs.

0632 Filled metal bucket (with plastic lines) with fresh water and placed 621 sensor head in water for a soak. CM should sample at 0700.

1053 'Deep' CM in water. (See Note)

1135 Shallow CM in water.

Note: Pelagos (via Wyatt) sent Zodiac to SCI. Wyatt/Bercaw rigged on beach and rowed to IX. CM implant commenced and Zodiac provided diver support.
Divers: Wyatt, Bercaw, Silvia

1350 app. Commenced Geo/3.5/Bathy Survey of area offshore. Kelp line. First-outlined seaward extent of Kelp beds and then commenced line surveys.

4/25/85

Staff Meeting

Reviewed Geo & 3.5 Records

1800 - 10 lines at 200 line = 200 M
5 hrs. to complete shallow seismic

Side Scan

1100 Arrived NOSC pier SD

1101 Engine Room Fire aboard IX 506

Spent afternoon making arrangements with Bill McKune, etc. regarding use of Egabrag III in lieu of IX 506. Because of fire in IX, not ready until Tuesday. Decision made by 1700 - Visited Egabrag III for ship check - Met with Capt. Ray Wilson. Vessel very clean and very well equipped.

Tech party broke down all equipment aboard IX for transfer to EGAGRAG III.

Agreed with Capt. Wilson for him to bring Egabrag III alongside IX 506 for equipment transfer at 0700 4/26/85.

All hands spent night at King's Inn.

4/26/85

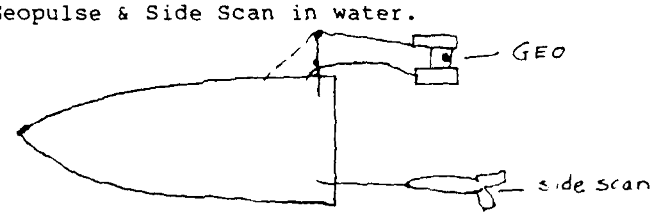
0700	At NOSC - transferred all Pelagos & SAIC equipment to Egabrag III - then returned to Egabrag III berth and completed installation.
1610	U/W for SCI op area
	Testing Sonotech transducer interfaced to EDO.
1830 +	Determined that EDO/Sonatech system capable of operating to about 1700 ft. at 8.5 kts.

4/27/85

ZULU Time

1413 Powered up EDO & DNTI - All okay. Set up for SS/SB/Bathy for 21 lane survey. GEO-Shallow

1507 Geopulse & Side Scan in water.



Ed suggested we use Geopulse and tap off 3.5 KHZ - if that provides good records then we won't need 3.5 KHZ fish.

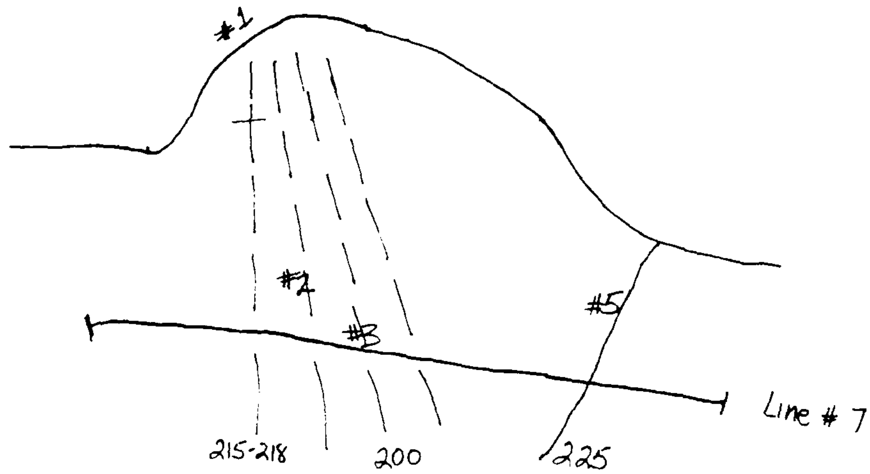
1515	Changing Hydrophase for Geopulse - It was apparently damaged on the IX 506.
1520	Start Line#9 GEO-SHALLOW
1550	Restart Line#10
1610 appr.	Complete Line#10
1620	Start#11

1630 appr.	824 TR off Contact Chuck via Radio to change batteries at both stations.
1659	New batteries on line
1709	Resume Line#11
1715	End (early) line#11 - Kelp Bed
1718	Start#12
1752	Start#13
1806	End#13
1812	Start#14
1829	End#14
1838	Start#15
1851	End#15 Clean Kelp from Geo & S/S
1901	Start#16
1920 appr.	End#16
	End Survey at 2122 hrs.
2307	Start SS/SB WQC/SSL Run#1 End course 250
2400 appr.	End Set up offset 300' East of previous line

4/28/85

0038 Z	SS/SB WQC/SSL Run 2 Start course 075° T appr. Dogleg Course
0125 Z	Complete 2nd WQC/SSL Run
0130 Z	Commence Run out to Shelf Survey Area
0147 Z	End Line#3
0248 Z	Start Shelf Survey
0302:30	EOL #1
0420 appr.	Completed 4 lines of shelf survey

0430 Z	U/W for Wilson's Cove
1449 Z	1) Kelp Boundary Survey 2) Outline seaward boundary of kelp beds.
1456	Commence boundary run
1519	Start Beach Run#1 Course 215-218° T
1525	End Beach Run#1
1608	Start Beach Run#2 Course 210°T appr.
1632	Start Beach Run#3 Course 200°T
1641	End Beach Run#3
1657	Start Beach Run#4 Course 190°T
17?	End Beach Run#4
--	Start Beach Run#5 Course 225°T
--	End Beach Run#5



1740	Launch small boat and divers for CM Inspection & Bio bottom samples Rig for 2nd Kelp boundary run
1944	Start run SS/SB/Bathy around offshore boundary of Kelp

	Pick up small boat
2059	Set up CBL Route Survey
2100 appr.	Start cable Rt.#1
2200	End
	Start CR#2 End CR#2
	Start CR#3

4/29/85

0016:50	End CR#3
	Start CR#4 End CR#4
	Set up survey for completion of shelf survey and slope survey at twice the previous line spacing 600 ft. vs. 300 ft.
	Plan to work until about 0400Z then tie up at Wilson's Cove for the night and complete survey tomorrow AM
	Finish line 10(6) then RON Wilson Cove. Return to op. area tomorrow and complete shelf survey and slope survey.

Monday 29 +	Finish Survey
Tuesday 30 +	Offload Pelagos - Ship SAIC Gear
Wednesday 1	SCI Trispo set-up
Thursday 2	Egabrag III sails for SOAR

1327 Z	GEO/SS in water - NAVDAS on line =305 ft.
1335 Z appr.	Resume Shelf Survey - with line 11 (7)
1345 Z appr.	End Line 7/11
1411 Z	End#12
1421	Start#13
1431	End#13
	Start#14

1505 appr.	Start#15 (Last Line)
1517 Z	End#15
	Set up Slope Survey
	Lane 253°T
1540 Z	Head for start of Slope Survey
	Lane bearing at start 253° T
1549 Z	Start#1
1603 Z	End#1
1720 Z	End Slope Survey
	Inshore Survey Ops. Complete

Monday 29 April

Depart Egabrag III at SCI approx. 1200 PDT
Check out Trispo stations for SOAR project
To SD via Air Resorts, arrive 1700 PDT to
King's Inn

Tuesday 30 April

Offload SAIC Bathygear and pack for return shipment
Visited Pelagos to discuss SS ?? and other data products

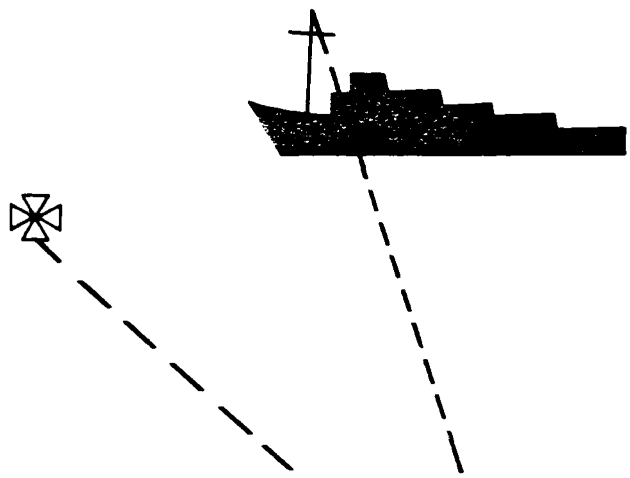
Wednesday 1 May

To SCI with F. Wyatt - Set up station FRANK - No charged batts available so briefed John Thorton (Chesdiv) about station set up - Returned to SD 1700 approx.

APPENDIX B

SCIENCE APPLICATIONS, INC.

Integrated Navigation & Data Acquisition Systems



Firmware Modules For Interfacing Short, Medium & Long Range Positioning Systems.

Integrated Satellite And Acoustic Navigation Techniques.

Accurate & Precise Field Verified Navigation Techniques.

Multi-Ship Tracking, Navigation Control And Reconstruction.

Direct Applications For:

- Bathymetric Surveys
- Side Scan Sonar Surveys
- Search & Salvage Operations
- Repetitive Bottom Sampling
- Geophysical Surveys
- Ocean Disposal Operations
- Mooring Deployment & Retrieval
- Multi-Ship Control
- Exercise Reconstruction

Video Display of Waypoint Navigation

General Features of the SAI Integrated Navigation & Data Acquisition System

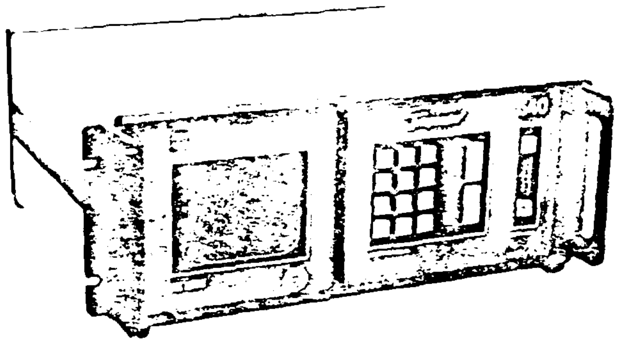
- **INPUT**
  - Multi-System Interface
  - Hyperbolic, Range/Range, X, Y Grid
  - NAVSAT
  - Acoustic
  - Environmental Data (Digital & Analog)
- **POSITION CALCULATIONS**
  - De-Skewing
  - Editing
  - Simple Fix
  - Multirange Fix
  - Integrated Fix (Kalman Filtered, Fix Quality Residual Analysis)
- **NAVIGATION CALCULATIONS**
  - Kalman Filtering, Editing
  - Speed/Course Made Good
  - Range/Bearing (To A Point)
  - Offset/Distance (Along Computed Line)
- **PROJECTIONS**
  - Local - X, Y
  - Transverse Mercator - X, Y, Lat/Long
  - Universal Transverse Mercator - X, Y, Lat/Long
  - Mercator - Lat/Long
  - Lambert - X, Y, Lat/Long
- **DISPLAYS**
  - Video
    - Alphanumeric
    - Graphics
      - Transit Mode
      - Survey Mode
      - Cartography
  - Plotted
    - Ship Track
    - Multi-Ship Track
    - Cartography
    - Precalculated Survey
    - Multi-Destination Points
- **RECORDING**
  - Magnetic Tape
  - Disc
  - Printer
- **SPECIAL FUNCTIONS**
  - Display Controls
  - Recording Controls
  - Navigation Controls
  - Analysis

For Further Information Please Contact
Science Applications, Inc.
Ocean Science And Technology Division
379 Thames St.
Newport, RI 02840
(401) 847-4210

APPENDIX C

DEL NORTE

MICRO PROCESSOR CONTROLLED



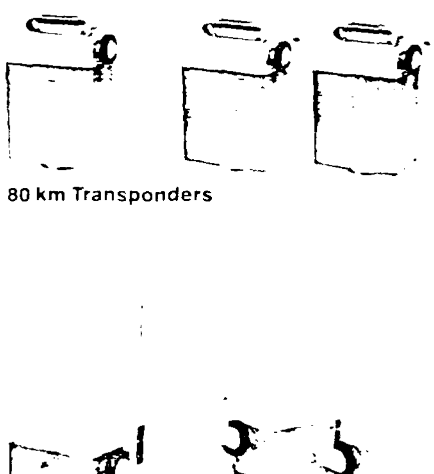
Designed to work with existing Trisponder Master Remote units, this DDMU represents another advance in technology for our family of positioning systems. Microprocessor controlled, this DDMU carries many of the tried and proven outstanding characteristics of the basic Trisponder system — portable, rugged, low current drain, reliable. Also, by using the existing transponders, its same features are still part of the system.

Several significant changes have been made. For example, notice the CRT display. Because this DDMU is programmable and so powerful, a video display of this size is helpful in the recall and presentation of all data you might want to see — all at the same time. Also note the simplicity of the front panel. For operational ease, it has only a power switch, keyboard and an intensity control for the CRT.

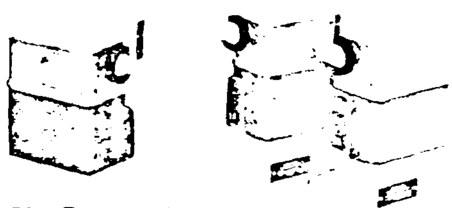
Of special significance, Del Norte has overcome the most common criticism pertaining to range-range type systems. This DDMU automatically presents the range data, whether 2, 3 or 4 different ranges, deskewed to the same point of time. All data is displayed as being simultaneously acquired, thus overcoming time lags (and boat movement) between and during ranging sequences.

All data stored in the non-volatile memory, such as calibration factors, codes, update rate, priority for multi-user, slant range conversion, etc., are secured against power failure and maintained for about 30 days using internal batteries.

The Model 540 DDMU also contains self test circuitry for checking all the way to the output connector.



80 km Transponders



5 km Transponders

APPENDIX D

SAIC

Edo Western CORP.

GENERAL OFFICES: 2645 South 300 West Street, Salt Lake City, Utah 84115 (801) 486 7481 Telex: 388 315

TT-1L

MODEL 248E SOLID STATE SONAR TRANSCEIVER

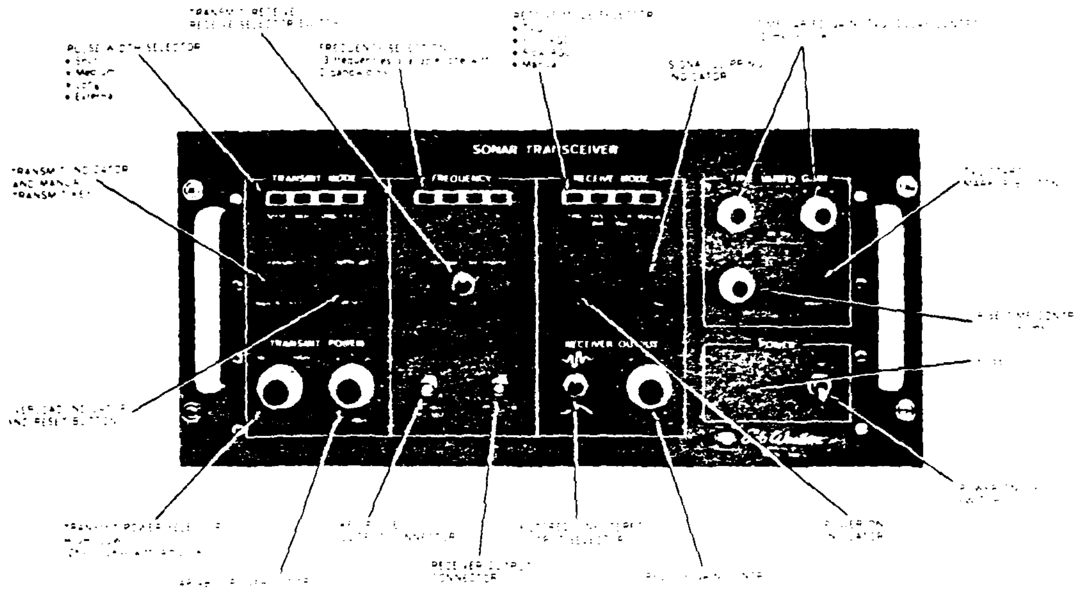
The Model 248E is a versatile compact shipboard transceiver featuring extremely low input power reliable solid state operation and a broad range of output power and frequencies. Because it incorporates a unique receiver which combines Automatic Gain Control (AGC) with Time Varying Gain (TVG), multiple frequency operation, and multiple bandwidth features in a single unit, it will perform a wide range of oceanographic and survey tasks. The Model 248E can be used as a modular "building block" for

- Depth Sounding Systems
- Subbottom Profiling Systems
- Navigational Systems
- Acoustic Command Systems

This rugged solid state sonar transceiver was developed by the designers of the widely used AN/UQN-1 and the AN/UQN-4 Depth Sounders and incorporates all of the design concepts used in the thousands of transceivers built by Edo Western. Specific customer requirements are met through a choice of operating frequencies from 3 to 40 kHz, continuously variable manual control of output power to 2,000 watts, internally or externally controlled pulse lengths, and compatibility with all precision recorders as well as with a wide variety of standard transducers. An MTBF of greater than 5,000 hours has been demonstrated in over four hundred Model 248 series Transceivers in the field. The Model 248E mounts in a 19" standard relay rack but metal cabinets and metal or fiberglass carrying cases are optionally available.

TT-1D

MODEL 248E SOLID STATE SONAR TRANSCEIVER



The Model 248E is unique in that it offers an operator the greatest degree of flexibility of any transceiver available on the market.

1. Variable power	0 to 2000 watts (10,000 watts optional)
2. Three operating frequencies over a .2 to 100 ms pulse	3 to 40 kHz selectable (1-100 kHz optional)
3. Four receiving modes	TVG, Fast AGC, Slow AGC, Manual

MODEL 248E SOLID STATE SONAR RECEIVER

TRANSMITTER

Output power can be controlled from 0 to 2000 watts by the POWER control. The output circuits are protected from damage due to accidental overload, overvoltage or excessive pulse length—an overload reset control is provided on the front panel. Three standard pulse lengths, .3, 1, and 4 ms, are normally provided by a PULSE WIDTH selector for most common applications with Edo systems. Other pulse lengths are available on request over the range of .2 to 100 milliseconds. A MANUAL TRANSMIT key is provided for test purposes with a *transmit indicator lamp*.

The Model 248E Transceiver is designed to accept a 10,000 watt power booster assembly as shown on Page 5 when additional output power is required. A HIGH/LOW power selector switch is provided on the front panel to switch this booster in.

FREQUENCY SELECTION

The Model 248E is normally provided with one operating frequency available from the standard frequencies given in the performance specifications. Up to three operating frequencies in the range of 1 to 100 kHz can be made available as an option with the FREQUENCY selector control. The bandwidth of the receiver is normally 1 kHz which optimizes performance for the Medium pulse length. Other bandwidths can be specified. The four position FREQUENCY selector switch can be used to select any combination of three frequencies and/or four bandwidths.

RECEIVE MODES

Four receiving modes are provided in the standard unit.

Mode	Typical Application
TVG	Sub bottom profiling
Fast AGC	Pipeline location
Slow AGC	Bathymetry operation
Manual	Wide range of miscellaneous operations

In all modes provided, a special front panel indicator is provided which ...s the operator when the receiver gain is set too high and the output is going into saturation. This feature is particularly useful when operating with a wide range of recording devices, such as hard copy, digital or magnetic tape recorders. Saturation should be prevented in the transceiver for high quality recordings.

A built-in Time Varied Gain *feature is provided* in the TVG and AGC modes which reduces the gain of the receiver 40 dB immediately after transmission and allows it to recover in 100 milliseconds. This prevents the saturation of the receiver by excessively strong signals when operating in shallow water. In combination with the 60 dB AGC control, this feature provides virtually "hands off" gain control operation over a 100,000:1 change in signal level.

DELAYED TIME VARYING GAIN (TVG)

When the Model 248E is used in a Sub bottom Profiling mode, the TVG feature is used in the receiver to increase and normalize the gain of the receiver as the weaker echoes from the deeper sub bottom layers return to the recorder. A group of controls on the right side of the front panel perform this function in the following manner.

The start of the TVG is delayed in time manually until the signal has reached the bottom. This can be monitored on the recorder by viewing a special TVG "start pulse" which marks the recording at the beginning of the TVG action. The delay range of this control is two milliseconds to one second continuously adjustable by fine and coarse controls.

Once set, the delay controls need not be varied until the bottom depth changes significantly. To normalize the recorder presentation for varying attenuation in the sub bottom sediments, a receiver gain RISE control is provided which sets the rate of increase in receiver gain of 60 dB over a time range of 2 to 100 milliseconds. The gain RISE time setting is determined by the acoustic attenuation characteristics of the sub bottom. When used with the manual gain control, a normalized display can be produced over a wide range of bottom sediment attenuation characteristics and depth readings.

FAST AGC

When the Model 248E is *utilized to detect* a high intensity signal in a relatively noisy background, such as trying to detect a buried pipeline *in the presence of* sub bottom reflected signals, the FAST AGC mode will normalize the background signals and emphasize the stronger signal. The gain of the receiver is automatically clamped during any return cycle to keep the average signal return well below saturation. A short duration, strong echo will pass through the receiver with little or no gain reduction, thereby creating a dark recorder mark in the presence of a subdued background noise level. The overall AGC range is 60 dB centered about some nominal manual gain setting which also permits 60 dB of gain variation. In actual use, this AGC technique yields almost a total hands *off operation* over a very range of input signal conditions.

SLOW AGC

When used in the deep water bathymetric mode, the SLOW AGC mode should be used to provide "hands off" operation of the system. In this mode, the input signals usually vary *widely* in amplitude from transmission to transmission due to the random movement of the *vessel and the relatively long transmit* time for the signal to make a round trip to the deep ocean bottom. Signal amplitudes are averaged over a 10 second period and the overall gain of the receiver adjusted slowly to account for truly average signal changes rather than random variations during any single transmit/receive cycle. The overall gain variation provided is the same as for the FAST AGC mode.

MANUAL

A MANUAL mode is provided in the Model 248E receiver for use in those general purpose applications where operating conditions do not match the other three operating modes provided. In MANUAL the front panel control provides 100 dB of gain variation; the internal 40 dB time varied gain feature is disabled.

OTHER CONTROLS AND OUTPUTS

A Transmit/Receive selector is provided to permit normal transceiver operation or receive operation alone.

Two very useful signals are available on the front panel which can be used for a wide range of reasons—the KEY PULSE output and the RECEIVER OUTPUT.

The receiver output to the recorder can be selected in a FILTERED or UNFILTERED form. This choice is useful to optimize recordings in a wide range of applications.

MODEL 248E SOLID STATE SONAR RECEIVER

PERFORMANCE CHARACTERISTICS

TRANSMITTER SECTION

Power Output	2000 watts maximum (see Power Frequency graph on page 5)
Output Impedance	50, 100, 175, 250 ohms
Duty Cycle	8%
Pulse Lengths	Short (.3ms), Medium (1ms), Long (4ms), and Externally selectable on front panel. (Other pulse lengths available from .2 to 100 milliseconds on request)
Keying Rate	1200 pulses per minute maximum at the standard pulse lengths. Rate should be reduced when longer pulse lengths are used so as not to exceed specified duty cycle
Frequency	Single frequency selected from the following standard frequencies: 3.5, 5, 7, 12, 16, 24 and 34 kHz. As an option, up to three frequencies can be chosen by front panel selector from the entire range of 1 to 100 kHz (see Power Frequency graph on page 5)
Keying	Remote contact closure, remote + 2 volt pulse, or manual front panel push button
Protective Circuits	Overload circuits to prevent excessive output load current, excessive power supply voltage and excessive pulse length. Reset control on front panel returns operation to normal operation

RECEIVER SECTION

Frequency	Automatically selected with transmitter frequency
Bandwidth	1 kHz standard at standard frequency or to customer's specification when various pulse widths and frequencies specified
Output Impedance	50 ohms
Output Voltage	Greater than 5 volts rms
Minimum Gain	106 dB into a 500 ohm load
Minimum Detectable Signal	Typical 1 microvolt in 1 kHz band at 3.5 kHz
Receiver Modes	TVG, FAST AGC, SLOW AGC, MANUAL (see text for description)
Manual Control Range	100 dB
Internal TVG	40 dB gain variation in first 100 ms on TVG & AGC Modes
AGC Range	60 dB centered around any gain control setting
Variable TVG Characteristics	
TVG Start Delay	2 ms to 1 second
TVG Rise Time	2 to 100 ms
TVG Gain Range	60 dB

POWER REQUIREMENTS

Primary Voltage	115 VAC ± 10%
Primary Line Frequency	50-65 Hz
Power	25 watts quiescent in Receive Mode 60 watts average in Transmit Receive Mode 600 watts peak demand after 2 KW transmission

MODEL 248E SOLID STATE SONAR TRANSCEIVER

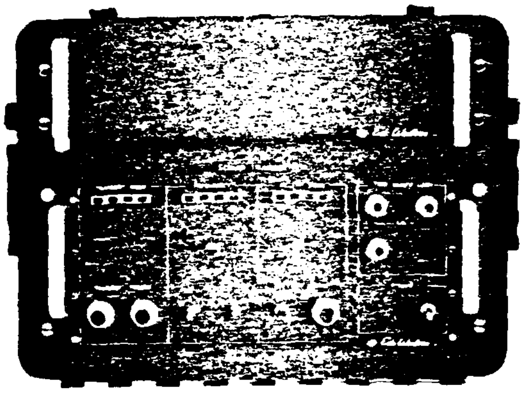
PERFORMANCE CHARACTERISTICS (Cont.)

PHYSICAL CHARACTERISTICS

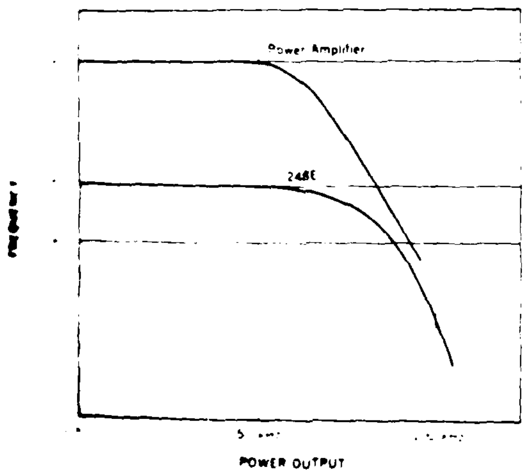
External Connections	Type MS 3102A connectors in rear
Size	19" wide x 8¾" high x approx 17" deep including connectors 48 cm wide x 22 cm high x 38 cm deep
Weight	40 pounds 18 Kg

OPTIONAL 10,000 WATT POWER AMPLIFIER

For Use With the Model 248E Sonar Transceiver



Typical Model 248E and 10,000 Watt Power Amplifier Combination in optional weatherproof metal case



- 10,000 watts output
- Provides an additional sonar channel

INCREASED POWER

When the Model 248E transceiver is used for sub bottom profiling or deep water bathymetric applications the 10,000 watt power amplifier is often added to gain deeper penetration into the sub bottom layers. Output from the amplifier 10 KW as compared to 2 KW from the Model 248E Transceiver alone.

ADDITIONAL SONAR CHANNEL

Because the optional Power Amplifier is a separate instrument it has its own interface for connection to a transducer. This gives the Transceiver Amplifier combination the possibility of being a dual purpose system. Sub bottom information could be obtained using a transducer connected to the Power Amplifier and a transducer better suited for depth soundings could be connected directly to the 248E Transceiver. A single switch on the front panel of the 248E selects which system is to be operated at any given time. The multiple frequency availability on the 248E gives even greater versatility to this combination. The front panel selector could also be programmed to change frequencies at the same time transducers are changed, or separate switches could control frequency and output transducers.

POWER/FREQUENCY RELATIONSHIP

Maximum transmitting power is reduced as higher frequencies are selected as shown in this simplified logarithmic graph.

TT-1D

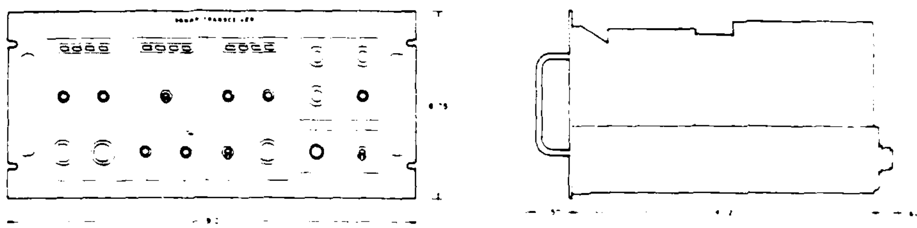
Ulstein

MODEL 248E SOLID STATE SONAR TRANSCEIVER

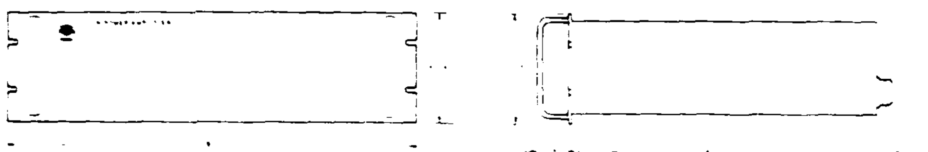
AMPLIFIER SPECIFICATIONS

Output Impedance	10 25 50 ohms
Maximum Duty Cycle	2%
Pulse Width	Selectable from Model 248E (20 msec maximum pulse width for full 10 000 watt output
Protective Circuitry	Output short circuit over voltage
Size	19 wide 5½ high 14¾ deep including connectors
Weight	28 pounds (12 7 kg)

INSTALLATION DATA



Mod. 248E Transceiver



10 KW Power Amplifier (optional)

OPTIONS

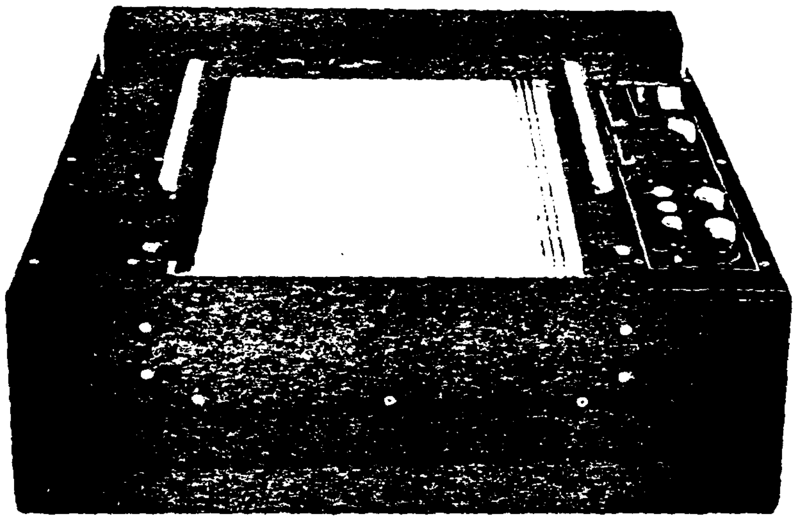
Description	Part Number	Size in inches
Model 248E Cabinet	28235 3	9 31 high x 21 69 deep x 19 75 wide
Model 248E 10 KW Amplifier Cabinet	28235 4	14 81 high x 21 69 deep x 19 75 wide
Model 248E Weatherproof Carrying Case as shown in photo on page 1	14914	11 high x 21 25 deep x 22 wide
Model 248E 10 KW Amplifier Weather proof Carrying Case as shown in photo on page 5	22457	16 high x 21 44 deep x 22 wide

Edo Western CORP.

GENERAL OFFICES: 2645 South 300 West Street, Salt Lake City, Utah 84115 · (801) 486-7481 Telex: 388-315

DR-

MODEL 615
DIGITIZED 9.5 INCH
GRAPHIC RECORDER

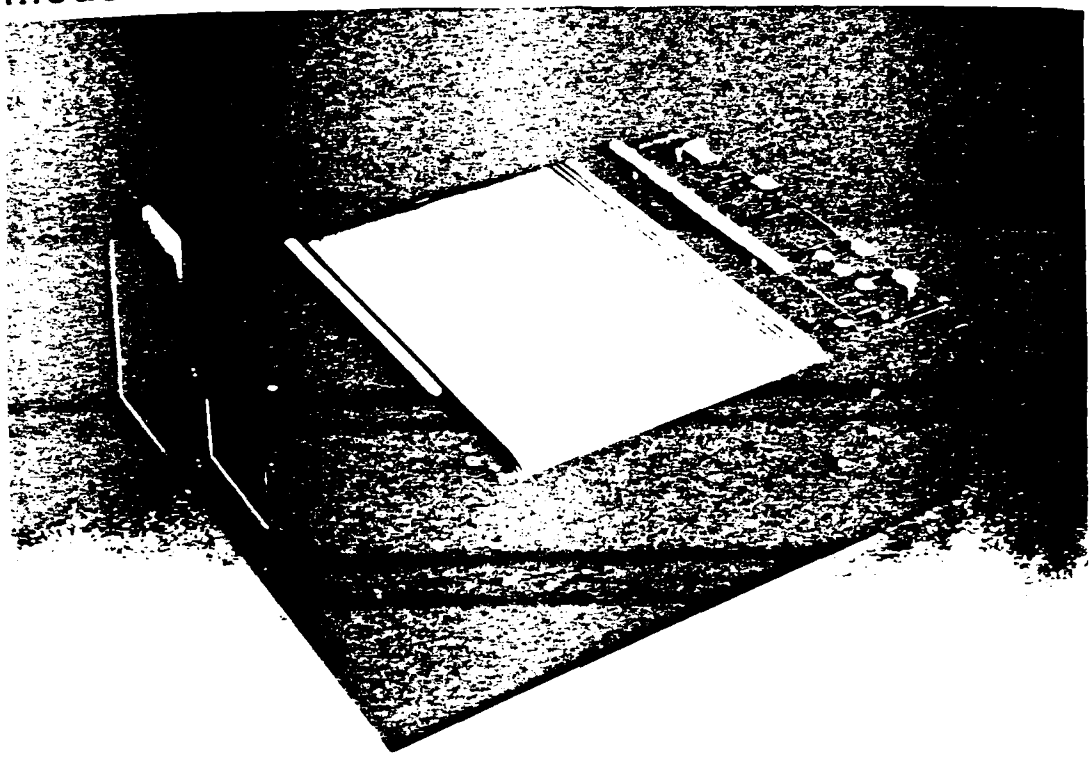


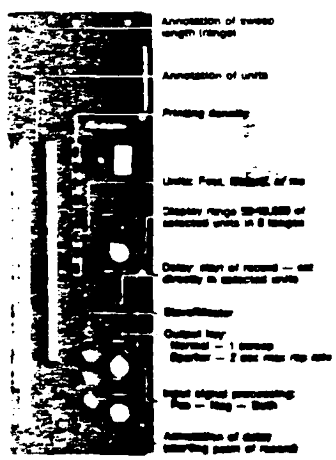
- *40K bits of internal memory*
- *Alphanumeric printout*
- *8 Scale lengths 50 - 10,000 feet, meters or ms.*
- *Thumbwheel selected delay*
- *Sound velocity adjustment*
- *Available in optional rack mount*

Edo Western's Model 615 Recorder is the ultimate general purpose graphic recorder. It's patented* digitizing process offers features not available in any other recorder, to provide broad flexibility under varying operational conditions. Its rugged construction and reliable operation measure up to Edo Western tradition.

*U.S. Patent No. 4,096,484

Model 615 Recorder





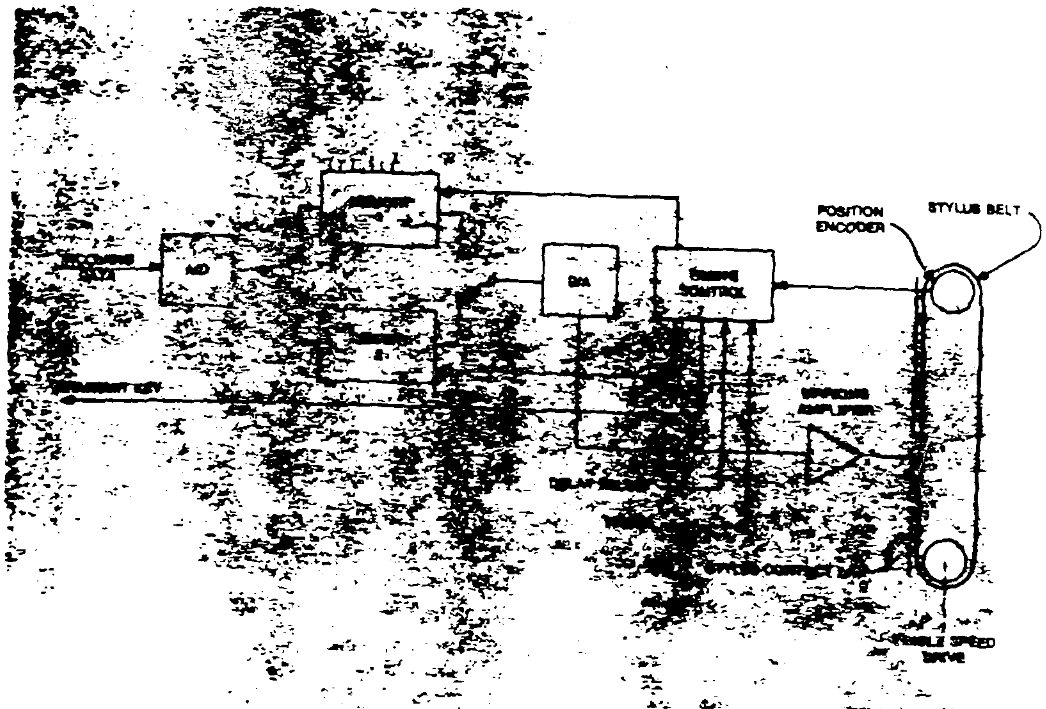
New Generation Recorder

Edo Western's new Model 615 Recorder combines a proven stylus drive mechanism with a unique patented* digital processing system to provide the ultimate general purpose recorder. This new generation recorder offers unmatched capabilities in multiple scales, data expansion and recorder synchronization plus a built in alpha-numeric generator. The model 615 Recorder is designed for applications where precise jitter free operation is required and will meet the most demanding marine, airborne or laboratory requirements. The materials and construction are identical to those Edo Western recorders which have field proven their durability by years of trouble-free performance in environmental extremes. This new generation of graphic recorders is a totally new method of processing and displaying analog data and features:

- Any segment of input data can be expanded to 50 feet, meters or milliseconds across a full [illegible] record
- Operating as a slave recorder to other systems and/or data recorders
- Direct correction for sound velocity
- Direct selection of feet, meters or milliseconds
- Direct automatic record annotation

*U.S. Patent No. 4,096,484

Block Diagram



BASIC RECORDER BLOCK DIAGRAM

Theory of Operation

The model 615 Recorder is designed around a patented* digitized data and memory control to provide range and "phasing" for the recorder. This technique was originally developed for the Edo Western Model 606A Side Scan Recorder.

Operation of the Model 615 can be understood by considering the simplified Block Diagram above. The 615 recorder uses a typical belt driven stylus but is unique in the use of a single belt speed. The generation of various ranges and removal of the water column is accomplished by timing control of the digital memories. The incoming data is first digitized and applied to one of two memories. The two memories are cycled in "ping pong" fashion with one in the "write" mode and the other in the "read" mode at any given time. The memories are cycled after each sounding cycle. Each line of incoming data is divided into 2,048 samples with an amplitude resolution of one part in 32 (5 bit).

The timing of the writing into memory is controlled by the RANGE and DELAY select controls. Following transmission the system will wait for a time equal to the select delay and then sample the incoming signals for a time equal to the selected range (scale factor). The delay time and sample rate are both controlled by a crystal clock that includes a phase locked loop correction circuit to permit speed of sound input.

Following completion of the ranging cycle the memories are switched and the stored data is read and delivered to the paper marking amplifier. The clocking of the data from the memories to the stylus is controlled by an encoder coupled directly to the stylus belt drive mechanism. The result is that the data from the memories is related to stylus position and is independent of belt speed.

The use of the techniques described result in several unique characteristics for the recorder. The most important for precision bathymetry is the capability to expand the graphic presentation of the bottom. this patented design provides maximum flexibility in selecting the optimum range sector to be displayed.

Installation Data

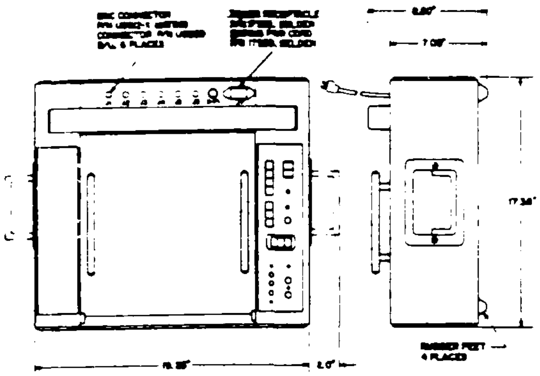
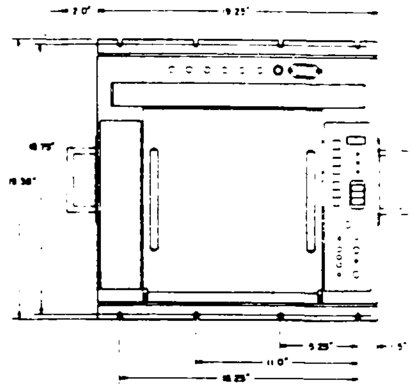


Table Top



Rack Mount

Specifications

Input	
Signal level	100 millivolts r-m-s will produce full black printing. DC to 100 kHz
Input impedance	2500ohms nominal
Event mark	TTL "low" produces mark for the duration of the command
External sync	Starts Delay/Write (data storage) sequence externally
Transmit inhibit	TTL "high" inhibits transmit key pulse
Outputs	
Signal output	Raw sonar signal
Key pulse	TTL level pulse (Note: in the sparker mode the key pulses will be separated by at least 2 seconds.)
Display Modes	
Input signal processing	Detected (Positive only) (Negative only) (Both full-wave)
Data presentation	Left-to-right or right-to-left
Delayed start	See display delay
Scale length (displayed)	50, 100, 200, 500, 1000, 2000, 5000, 10,000 units (Units front panel selected: ft, meters, milliseconds)
Display delay	
3 Decade thumbwheel	0-9990 units (ft, meters, milliseconds) Resolution 10 units

Scale lines	10 or 20 across chart
Sound velocity correction	
Feet	4560-5040 ft/second range 10 ft/second resolution
Meters	1425-1575 M/second range 3 M/second resolution
Milliseconds	Corrections switches set to standard position
Paper speed	75, 100, 150, 200 lines/inch
Internal digitizer resolution	2048 bytes (samples) per sweep Amplitude resolution 32 levels (5 bit binary bytes)
Display dynamic range	26 dB white to black
Power input	115V ± 10V, 50-65 Hz 200 watts max
Environmental	
Temperature	Operating — 10°C to 40°C Storage — 25°C to +65°C
Humidity	90%
Shock & Vibration	To meet normal shipboard requirements
Mechanical	
Paper (electrosensitive)	9.5" (24 cm) wide, 200' (60 m) long
Size	See installation drawing
Weight	57 lbs max

Specifications subject to change without notice

Edo Western CORP.
GENERAL OFFICES: 2645 South 300 West Street, Salt Lake City, Utah 84115 · (801) [illegible] · Telex [illegible]

ES-4

MODEL 261C *Digitrak*®
DIGITAL SIGNAL TRACKER

The Model 261C Digitrak® is a compact and versatile digital output automatic signal tracking device capable of precision measurement and display of the underwater distance between two points. The Model 261C, which is a general purpose unit that interfaces with any conventional depth sounder, is designed to aid the hydrographer or oceanographer in the recording and conversion to digital form of depth sounding or navigational position information for storage or computer processing. The versatility of the Digitrak® lends itself for such system uses as

- Automatic Hydrographic Survey Systems
- Precision Transponder Navigation Systems
- "Flight" Control of Submersibles

The Model 261C Digitrak® is designed to operate on underwater sonar signals, and is calibrated in feet based on an underwater sound velocity of 4800 feet per second. The time interval between a reference pulse and a time varying signal is measured by a precise digital counter. The distance information is available in digital form for transmission to a data storage device, such as a punch tape or magnetic tape or for direct readout on a numeric printer. The information is also displayed in a nixie presentation for the operator's convenience.

The Digitrak® eliminates the major problem in using digital timing techniques for echo ranging measurement (i.e. preventing reverberations, scattering layer echoes, fish echoes, and other unwanted signals from triggering the counting system) by blanking these unwanted signals from the receiver by means of a tracking gate that "locks on" to the desired signal. This gate anticipates the signal position and permits only the desired signal to activate the time measuring circuits. The gate position varies automatically as determined by the echo tracking circuits.

The Digitrak® provides high reliability and minimum power consumption through use of solid state and integrated circuit design. The modular design of the equipment permits modification or addition of circuitry for special requirements and is provided to measure in feet, fathoms or meters at the standard price.

The operation of the Model 261C is completely automatic, following initial adjustment of gate depth, gate width, detector sensitivity and time constant. The gate depth is adjusted to the desired signal by observing the gate location on the front panel indicators and adjusting to the proper signal with the "slew" control. Proper tracking is indicated by simultaneous flashing of the "Gate" and "Echo" indicators and by the tracking light being lit. The detector setting is based on echo characteristics. If the signal is lost the gate width is doubled.

The Model 261C Digitrak® is available with optional cabinet (as shown) or for 19" standard relay rack mounting. Cabinet and slides can be furnished for installation by the customer for conversion from rack mounting to cabinet closure.

ES-4A

Edo Western

MODEL 261C DIGITRAK*

OPERATION

The operation of the Digitrak* can be seen from the block diagram the precision bathymetric recorder (PBR) record and the timing chart on the adjacent page The PBR record illustrates the typical problem of measuring the time between transmission and receipt of the bottom echo in an acoustic underwater echo ranging system The receiver output shown for the typical PBR record has outputs for the transmit pulse reverberations scattering layer echoes fish echoes and the bottom returns These signals are first processed in the Digitrak* input circuits by an AGC threshold circuit that maintains a constant level relative to the average noise output of the receiver and a detector providing a constant amplitude output The output of the detector circuit is shown in the timing chart

The Model 261C Digitrak* provides discrimination against unwanted return signals, similar to those shown for the PBR record, by means of a gate circuit between the detector output and the counter control The gate control signal and gate output are shown in the timing chart on the adjacent page As can be seen from the timing chart only the desired echo is permitted to pass the receive gate and be applied to the counter control circuits The signal tracking portion of the system is used to control the position of the receive gate The tracking circuits sense the position of each echo relative to gate position and corrects the gate position if required, to position the last echo exactly in the center of the gate As can be seen, the tracking gate of the Digitrak* permits continuous precise measurement of underwater distance in the presence of multiple echoes and high noise conditions

OPERATION IN MULTIPLE-PING OR PROGRAMMED BATHYMETRIC SYSTEMS

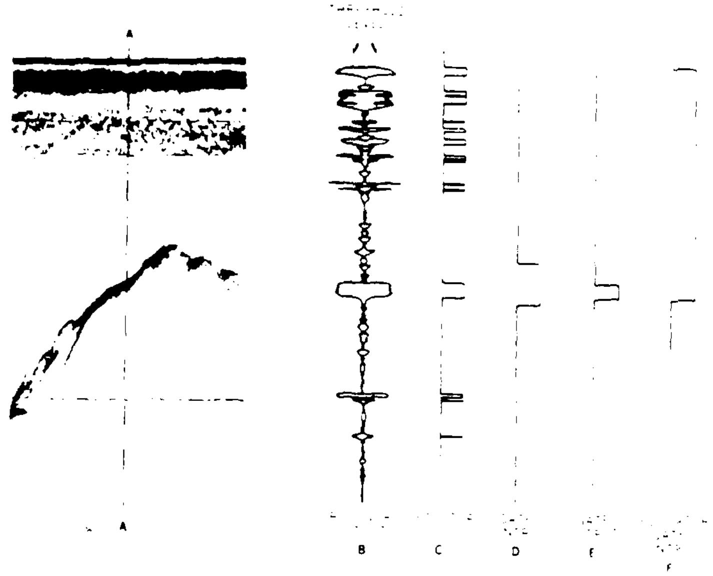
The Digitrak* is provided with a program controller that permits operation in multiple-ping or programmed bathymetric systems For deep water sounding many bathymetric systems use a "one-ping-per-second" type of operation or other programming resulting in more than one acoustic pulse in transit in the water at any specific time This mode of operation provides maximum data rate for the recorder, but can cause difficulties when using a Digitrak* in the bathymetric system As an example for a depth of 1300 fathoms and a 1 pps transmission a transmitted pulse will be generated at depths corresponding to 0 400 800 and 1200 fathoms The 1200-fathom transmission therefore precedes the bottom echo and as the depth approaches 1200 fathoms, the Digitrak* receive gate will permit the transmit pulse to pass and the tracker circuits will "lock-on" the transmit pulse With the program controller a transmit blanking gate is provided that prevents all transmission for a period of one second prior to the anticipated time of arrival of the bottom echo This blanking eliminates the problem of the Digitrak* from "locking-on" to multiple transmissions or reverberations or scattering layer returns from multiple transmissions

RECORDER INDICATION OF DIGITRAK* DATA POINT

For bathymetric systems that include a precision bathymetric recorder as well as the Digitrak* validity of the digital data can be continuously monitored by indicating on the graphic record the point at which the Digitrak* sensed the bottom To provide this capability, the Digitrak* provides an output pulse that can be coupled to the recorder marking amplifier To provide continuous monitoring of this reference point on all portions of the record, the pulse should be converted to a dark mark, followed by a blanked area This marking signal is automatically generated in the Edo Western Model 333 Precision Bathymetric Recorder (reference Data Sheet DR-4)

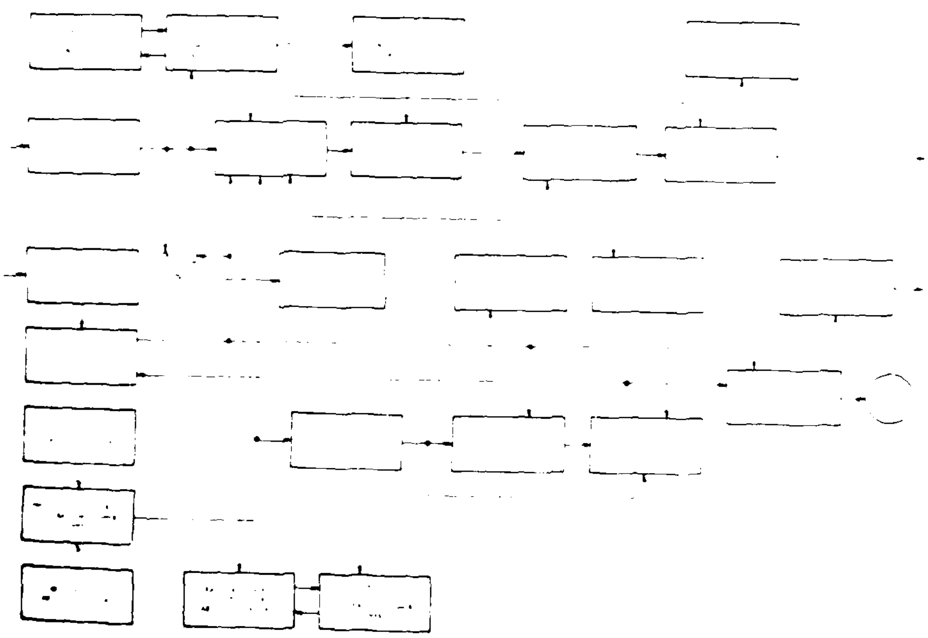
MODEL 261C DIGITRAK*

DIGITRAK* TIMING



TIMING CHART AT POINT A-A

BLOCK DIAGRAM



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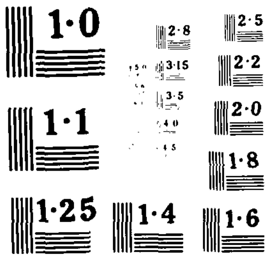
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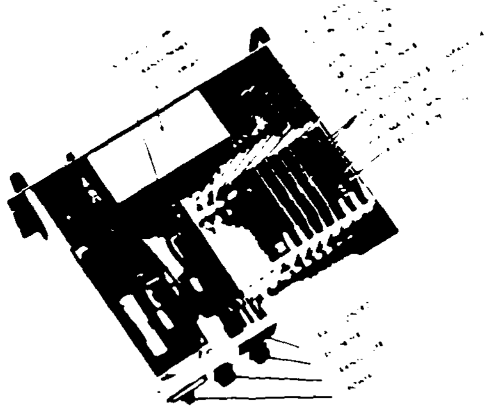
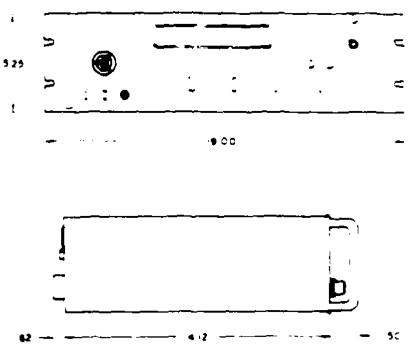
MODEL 261C DIGITRAK*

ES-4A

EXPOSED VIEW



INSTALLATION DATA



PERFORMANCE CHARACTERISTICS

Power Requirements	115 ± 10 Volts AC, 50-400 Hz, 45 Watts
Range	80,000 Feet, Fathoms, or Meters
Minimum Operating Range	2 Feet
Time Base Accuracy	0.012%
Input Signals	Count start circuit operated directly from a transmitter keying signal, recorder signal, internally generated signal or other external signal. Requires two-volt pulse or switch closure. Count stop circuit requires 50 mv rms signal, clamping and gain adjust are provided. Detector provides time constants of 1 and 5 ms. Detector sensitivity adjustable from 50 mv to 5 volts
Tracking Rate	Up to 60° continuous slope on the bottom at 15 knots, greater than 60° slope for short duration, or at reduced speeds
Gate Width	10, 20, 40, 80, 160, 320, 640, 1280, 2560 Feet, Fathoms, or Meters
Gate Speed	1 times gate width per pulse
Program Controller Outputs	Positive pulse which can be set from 20 to 500 milliseconds before start of gate
Digital Display	Display Time - Updated each transmission Display Resolution - 1 foot, fathom or meter with 0.1 foot, fathom or meter optional Registration - Five digits in line with rectangular display tubes
Tracking Alarm	Indicator - Audio and visual Alarm Control - Actuated by 1, 2, 4 or 8 soundings
Print Control	Print command - 4.5 volts, 30 ma maximum output current. Adjustable from 200 to 275 ms duration (Other durations furnished upon request) NOTE: Occurs after each transmission or following external read command
External Read Command	Requires +3.5 to +4.5 VDC pulse; DTL single gate input 1.6 ma sink required
Draft Control	Range 0 - 99.9 feet, fathoms, or meters in 0.1 increments Accuracy ±0.1 foot, fathom, or meter
Operating Temperature	0°C to 50°C
Data Outputs	4-line 1-2-4-8 BCD Code, "1" State, +4.5V; "0" State, 0V, 14 ma maximum output current
Construction	Electronic Circuitry - Solid state, with the majority of the system utilizing integrated circuits Design Guide - MIL-E-16400 Size - 5 1/4" high x 19" wide x 15" deep (including connectors) Weight - 32 pounds (for rack mount)
Optional Equipment	1) Optional available circuit cards provide the additional ability of tracking multiple echoes. This mode of operation requires a constant rate input timing signal whose positive edge is always coincident with the transmitter keying signal. A blanking card is also available which provides systems blanking so as to avoid interference from adjacent transducers. 2) First, last, or strongest signal selection - Front Panel Control. 3) Tracking of multiple signals in multiple ping mode.

Specifications subject to change without notice

APPENDIX E

Model 5810A
High resolution sound source

Description:

The O R E Model 5810A, developed by Scheidegg Research, incorporates two major advances in high resolution sound source technology

The Model 5810A generates a high acoustic source level of up to 220db* at 450 joules This output level combined with a sharply defined wideband outgoing pulse can penetrate deeply into sands and gravels with resolution unmatched by conventional profiling systems

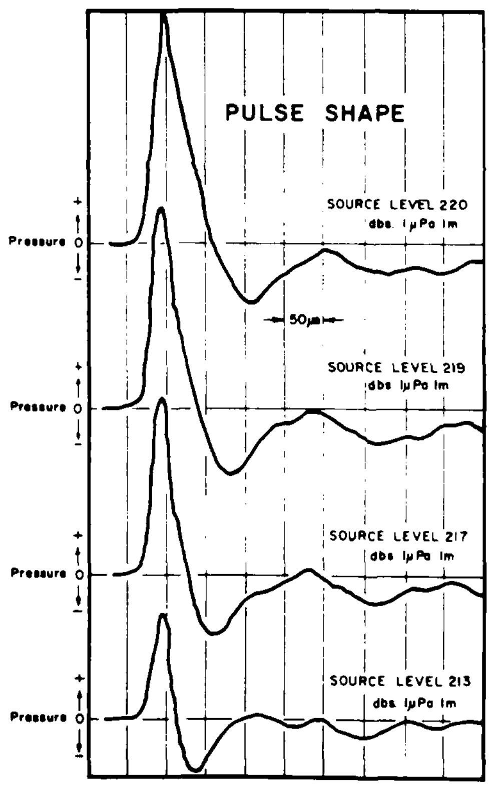
Of equal importance is the size and weight of the Model 5810A plate and catamaran assembly Measuring 15 inches (38 cm) square and 1 25 inches (3 cm) thick the plate is mounted on an ultralight PVC and stainless steel catamaran which is easily dis assembled for transportation and storage The entire unit weighs only 80 lb (36 kg) and can conveniently be launched, operated and recovered by one man without the need for special handling equipment It is suited for operations from the smallest boats to large multi-sensor survey vessels and is compatible with most capacitor discharge power supplies currently available

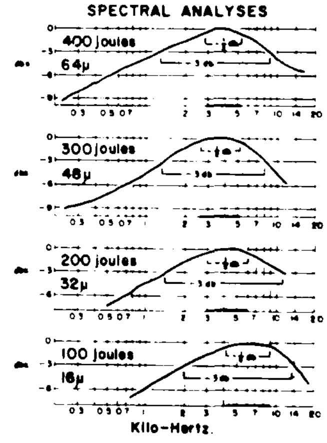
The Model 5810A has been exhaustively field tested in a variety of difficult sub-bottom environments with excellent results This newest addition to the O R E Seabed Survey line is available for sale or lease through O R E offices worldwide

* Ref 1 u pascal at one meter

Features:

- **High Acoustic Output-220db Ref 1 u pascal @ 1 meter.**
- **Lightweight plate and catamaran for ease of handling and shipping.**
- **"Clean" wideband outgoing pulse for superior resolution.**
- **Successful operation even in sand and gravel.**
- **Compatible with existing power supplies and hydrophones.**
- **Field proven — the records speak for themselves.**





Specifications

Model 5810A

Model 5813A Plate

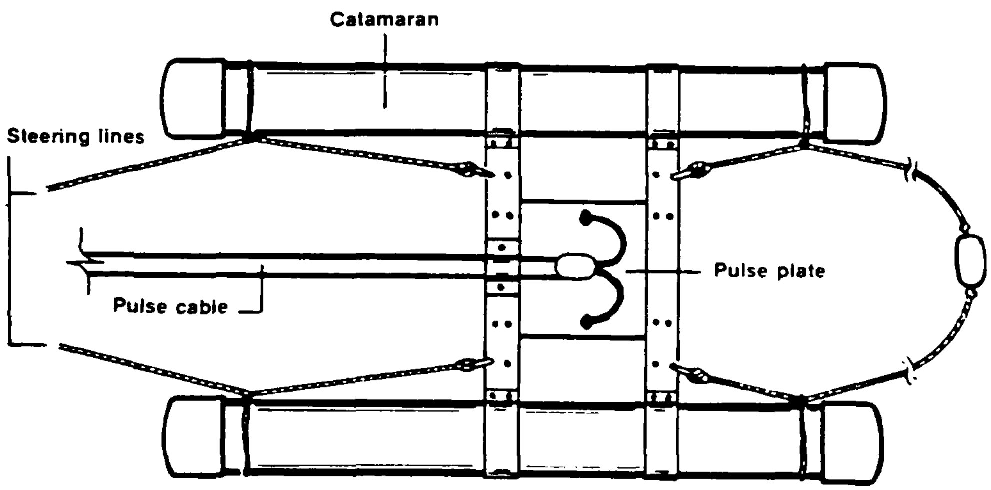
Source Level: 120 db @ 450 Joules
Maximum Input Energy: 600 Joules @ 2 pps (1 2 kilowatts)
Maximum Voltage Input: 4 KV
Size: 15 in (38 cm) square x 1 25 in (3 2 cm) high
Weight: 26 lb (12 Kg)
Connectors: (2) heavy duty manganese bronze with stainless steel retaining sleeves

Model 5812A Catamaran

Size: 52 in (132 cm)L x 38 in (96 5 cm)W x 11 in (28 cm)
Weight: 84 lb (38 KG) complete with Plate
Materials: PVC floats with stainless steel frame Can be disassembled in field for transportation Stainless steel hardware throughout

General

Operating Speed: to 5 knots
Towing Configuration: Surface tow with 2 towing/steering lines



APPENDIX F

Side Scan Transceiver
model 160B

The "All Purpose" Side Scan Transceiver

The unique O.R.E. Model 160B Transceiver will handle the entire range of O.R.E. Side Scan Systems and applications. High or low frequency, shallow water or full ocean depth, standard side scan or fully processed, every O.R.E. Side Scan uses a 160B Transceiver.

Multiplexed for Maximum Versatility

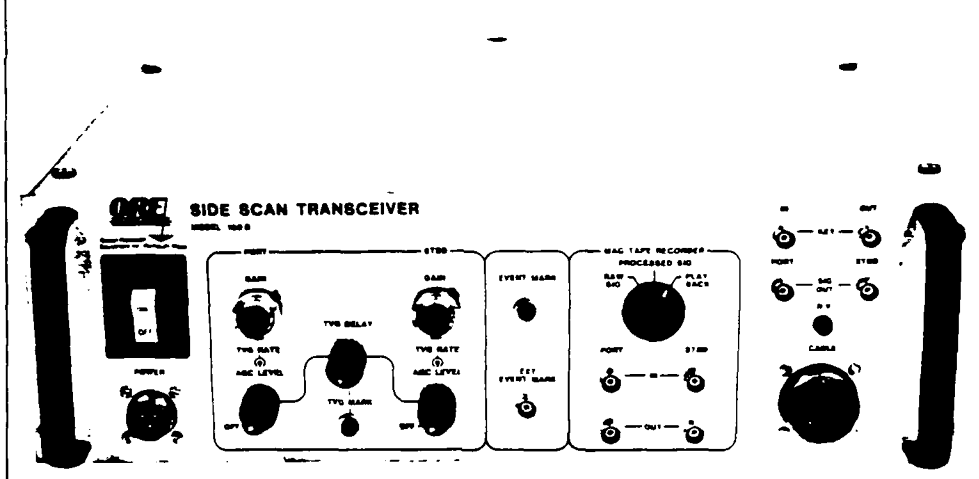
Multiplexing all signals up and down the tow cable eliminates the cross-talk and signal loss problems often encountered with conventional, non-multiplexed systems. Multiplexing also allows use of low-drag, low cost coaxial tow cable. Other O.R.E. systems such as sub-bottom profiling, acoustic navigation, depth measurement, etc. can be added by simply "plugging-in" to the same cable.

Easy to Operate

Simplified basic control/set-up allows the novice operator to obtain good quality data in any terrain. Yet sufficient adjustment flexibility is available to the veteran to fine tune as the situation requires.

Features

- Fully multiplexed.
- Sends only 150VDC on tow cable, no high voltage breakdowns.
- 100 kHz or 30 kHz operation with throw of switch.
- Records obtainable at any control setting.
- All controls have off position for pure data.
- AGC, TVG, TVG Delay, Gain functions present.
- BNC connectors for all magnetic taping functions.
- Playback mode allows enhancement of taped data.
- Modular plug-in printed circuit cards used throughout.
- Compatible with all other O.R.E. survey or positioning systems.
- Operates over any cable length.
- Allows use of low-drag, low cost coax cable or multi-conductor.
- Multiplexing eliminates crosstalk between channels or systems.



ORE® Side Scan Tow Vehicle
model 159

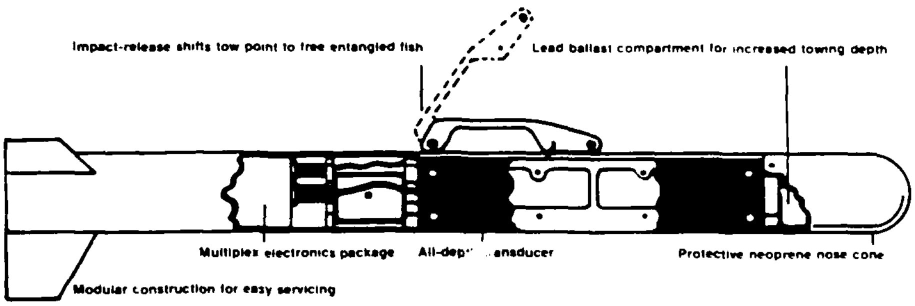
Description:

The O R E Model 159 Multi-Scan Side Scan Vehicle is one of the most versatile 100 kHz tow fish available

Light enough in weight for convenient handling from small vessels it has also set records for deep water operation Because all signals are multiplexed data quality and maximum operating range are maintained despite extreme cable lengths. while the use of small diameter coaxial cable allows increased operating depth and or towing speed

Features:

- **Operating depth— 1500 meters.**
- **All signals multiplexed to eliminate signal loss and crosstalk.**
- **Modular construction for easy assembly and service.**
- **Shock-absorbing nose, and trip-release tow-point pivot arm reduce chance of loss or damage.**
- **Uses low cost, low-drag coaxial cable.**
- **Also operates on existing multi-conductor cable.**
- ***Adjustable* internal ballast for shallow or deep operation**
- **Interfaces with O.R.E. Sub-Bottom Profiling Systems.**
- **Optional tow vehicle navigation package available.**



Lightweight vehicle can be deployed or recovered by one person.

APPENDIX G

621 DWCM

DIRECTIONAL WAVE RECORDER/CURRENT METER

THE 621 CAN STAND UP TO THE JOB

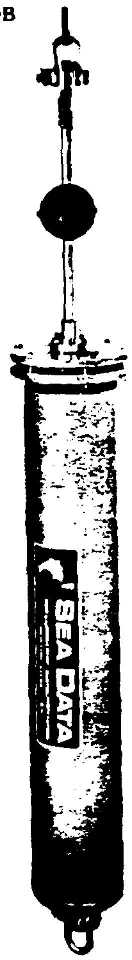
The **621 Directional Wave Recorder/Current Meter** is our newest directional wave sensor. Designed with state of the art technology, the **621 DWCM** measures pressure and 2 axis currents (puv) with every measurement scan to provide a detailed record of wave height and wave orbital velocity.

An outstanding feature of the **621** is its smart "data cruncher" approach to data processing. The **621** vector averages wave measurement scans and efficiently formats the data before writing to tape, and thus enhances the capability of the instrument. In addition, the data cruncher provides many self-checking and error correcting features. Because of its added features, the **621** is a possible replacement for our respected Model 635-9 Directional Wave Recorder. However, the **621** uses a lower cost strain gauge pressure sensor, which is less sensitive than the 635 series quartz sensor.

The **621** is a versatile instrument. It can be used as a current meter, as well as a directional wave recorder. The instrument has switch settings to operate at the slower settings suitable for monitoring turbulence and measuring mean current velocity. However, at these slow measurement intervals, the **621** cannot take concurrent directional wave measurements, as can our 635-12.

The **621** DWCM relies on the ideal cosine tilt response of the Marsh McBirney electromagnetic current sensor, on the sensitivity of a Sensometrics pressure sensor, and on an 8 bit digital optical wheel compass for an accurate measure of near-surface currents. Continuous quarter second sampling, and in situ selectable vector averaging of the data are provided by the Sea Data SB 10 'Sea Brain' data cruncher. High density recording methods and a high capacity battery pack allow for deployments of over a year in length. Offering data recording in any one of five selectable data formats, the **621** is ready to do many types of experiments.

Sea Brain is a trademark of Sea Data Corporation



APPLICATIONS

- SURFACE WAVES
- SITE-SURVEYS
- BEACH EROSION STUDIES
- INLET SURVEY WORK
- TURBULENCE STUDIES

HIGHLIGHTS

- **Switch-selectable puv wave recording rates down to 0.5 seconds**
- **Mature 'Sea Brain' data cruncher with 32-bit arithmetic**
- **DIP switch selection of five operating modes, each with its own unique data format**
- **Switch-selectable burst data or simple mean data, both with averaging intervals from 0.5 to 4096 seconds**
- **Fully vector-averaged north and east current measurements**
- **Seiche and internal wave measuring capability**
- **Marsh-McBirney spherical electromagnetic current sensor**
- **Reliable Sea Data Model 610 recorder with 15-megabit capacity**
- **Inexpensive molded fiberglass alkaline battery pack**
- **A variety of additional sensors available using 6" card electronics**
- **Suitable for independent deployments of over a year in length**
- **RS-232C test interface**
- **Internal self-checking features**
  1. Unique 'mooring rotation rate' compass checking
  2. Zero-offset subtraction for zero drift
  3. Calibration mode at the start of every burst
  4. Processor and CRC autocheck of ROM at powerup
- **Easy-to-use operator's manual**

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621 DWCM GENERAL SPECIFICATIONS

SENSORS — 2-Axis Water Velocity, Magnetic Direction, Depth and Temperature

CONTROLS
- Toggles: POWER/OFF, STANDBY/OPERATE, GAP, RESET, TEST
- Rotary Switches: BURST INTERVAL, SCAN INTERVAL, SCANS PER BURST
- LED Indicators: COMPUTE, RECORD, 48s

WATER VELOCITY
- Sensor: 2-axis Marsh-McBirney 4.0-inch EM sphere with low-voltage electronics
- Range: +/- 300 cm/sec
- Resolution: 0.15 cm/sec (12-bits)
- Threshold: 0.15 cm/sec (12-bits)
- Noise: less than 0.2 cm/sec (rms, typical, with 4 sec or slower scanning)
- Error: steady-state: less than 2 cm/sec + 2% of signal

DIRECTION
- Sensor: #218 Digicourse 8-bit digital optical-wheel compass in Sea Data #418 gimbal mount
- Resolution: 1.4°
- Accuracy: instrument heading 1.4° water direction 5° with typical mild currents (due to small X,Y velocity ratio errors)
- Tilt Range: operational +/-40° from vertical

TEMPERATURE
- Type: YSI 0.1°C endcap-mounted interchangeable thermistor
- Range: -4.5°C to +34°C
- Accuracy: +/- 0.1°C
- Resolution: 0.01°C

DEPTH
- Sensor: custom Sensometrics Strain Gauge
- Conversion: 12 bits
- Range: 100 psi fs (standard), other depths by request
- Accuracy: 1%
- Hysteresis: 0.4%
- Resolution: 1/2 sec 0.05%, 1 sec and slower 0.025%

DATA STORAGE
- Medium: Standard digital certified 300' or 450' cassette tapes
- Formats:

Format	Character Count	Description
DW	82	burst, average, pressure
BACH	74	burst and average
Burst-Only	64	burst only
Compact	26	average only
BCH	79	same as 620 BCH

TIMEBASE
- Crystal: 2.097152-MHz quartz crystal
- Stability: Stable to +/- 1 ppm over +5°C to +40°C
- Accuracy: Better than 30 seconds per 12 months

BURST PROGRAMMING
- Burst Interval: 0.5, 5.0, 7.5, 10, 15, 20, 30, 60 min., 1.5, 2, 3, 4, 6 hours, and continuous
- Burst Duration: 8, 16, 24, 32, 64, 128, 256, 512, 600, 1024, 1200, 2048, 2400, 4096 scans
- Scan Rate: 0.5, 1, 2, 4, 8, 16 sec.
- Typical Duty Cycle: from 5 to 30% as determined by above switches

POWER
- Standard: SDB-9 Sea Data 3-section 30-Ahr Alkaline battery pack (for single experiments)
- Optional: SDB-9L Sea Data 7-section 75-Ahr Lithium battery pack (for multiple experiments, more than 9 months at fast measurement intervals, etc.)

BATTERY CAPACITY OF THE SDB-9

BATTERY SECTION	VOLTAGE (fresh)	TYPICAL CAPACITY SDB-9
Recorder	18	10 Ahr (both together)
Electronics	15	
EM Sensor	+/- 9	20 Ahr

ELECTRONICS RACK
- Size: 33 inches long by 5.8 inches I.D.
- Cards: 9 cards, 3 unused card slots

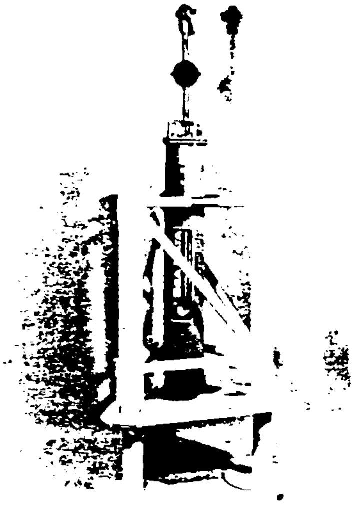
DATA MONITORING
- VDM Form: The data written to the digital recorder may be monitored directly by a VDM plugged into the SERIAL DATA jack. This is serial data with separate SHIFT and DATA lines, MSB first, (measured just before 4-bit "paralleler" for the tape head).
- RS-232C: 300, 600, 1200, or 2400 baud ASCII hexidecimal binary data with CR-LF separating each record (switch-selectable)
- Logic Levels: 0 and +10 volts (most terminals and computers will accept this), optional +/-8 volt converter available for full RS-232 standard

PRESSURE CASE
- Material: 6061-T6 aluminum, rated to 3500 psi
- Finish: Sanford hard-coat anodize overcoated with polyurethane paint
- Size: case 7.0" diameter by 37.5" long, overall 9.0" diameter by 57.5" long
- Weight: operational: 87 lbs air, 34 lbs water, with crate 153 lbs, less battery 139 lbs
- EM sensor: 1.0"-diameter type-316 stainless steel rod
- Tension: in-line tension up to 5000 pounds
- Hardware: Crosby Galvanized steel shackles, 0.75" pin with glass fiber insulators, optional side-mounted tabs with nylon insulators

Contact Sea Data or your area representative for additional information on the *621 DWCM or any other* Sea Data Product. Your area representative is

635-12

SPECIFICATIONS



- Uses the Paroscientific Quartz Sensor, YSI Thermistor Temperature Sensor, Marsh Mcbirney Electromagnetic Flow Sensor
- 0.05 cm Depth Resolution (20 m Range), 0.002°C Temperature Resolution
- 0.2 cm/sec Velocity Resolution, 0.4 cm/sec Orbital Velocity Resolution
- Uses the Sea Data Model 610 Recorder with 15-Megabit Tape Capacity
- Unique Data Compacting Schemes for Maximum Data Capacity
- Fully Reparable (Unpotted) Electronics

THE 635-12 DIRECTIONAL WAVE, TIDE AND CURRENT RECORDER

This specification sheet provides all relevant specifications concerning the Sea Data [illegible] Directional Wave and Tide Recorder. The [illegible] combines the accuracy of the Paroscientific [illegible] pressure transducer and the Marsh-McBirney [illegible] flow sensor with the proven [illegible] and recording [illegible] of the Sea Data [illegible] series instruments. This omnisensor instrument measures mean [illegible], wave height and direction, water temperature and tide information with optional sensors. It can also measure conductivity and wind velocity. The 635-12 is also available with the NBIS acoustic orbital velocity sensor head. The Model 610 Recorder used in the 635-12 is capable of recording 15 megabits on one 450' magnetic tape cassette. Tapes are read by the standard Model 12B reader, and a data processing system is available that vastly simplifies handling the massive amount of data that the 635-12 records.

OTHER VERSIONS OF THE 635-12

In addition to the version of the 635-12 housed in a six-inch pressure housing with an endcap-mounted sensors, the 635-12 is available with multiple transports and multiple remote sensors. Get in touch with us if you need a special configuration. In addition, the 635-12 is available in two alternate chassis styles.

1235-12

The 1235-12 uses the same electronics as the 635-12, but houses them in a 12-inch, environmentally-secure fiberglass case. Power is provided by either a 120 VAC source or [illegible] a [illegible]-Ahr battery. Sensor cabled are available in either S[illegible] or double-armor sheath styles in lengths up to 1500 meters long.

1735-12

The 1735-12 houses the 635-12's electronics in a 17-inch box suitable for mounting in a 19-inch relay rack. Sensor cables are available in either S[illegible] or double-armor sheath styles in lengths up to 1500 meters. The 1735-12 is powered with 120VAC with an internal 5-Ahr rechargeable battery keepalive, or by an external 12-volt source.

The 1735•SCM Weather Station

An alternative to the [illegible] and its [illegible] is the 1735•SCM Weather Station, which [illegible] meteorological data and statistical [illegible] as well as all the parameters measured by the [illegible]

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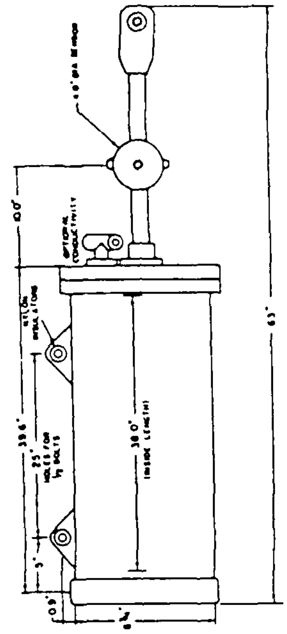

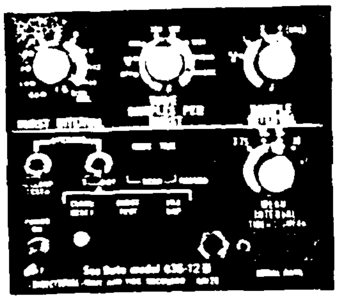

The 635-12's front panel

ORDERING INFORMATION:

A Model 15 VDM Video Display Monitor is essential for testing and predeployment checkout of the 635-12. When ordering, specify the chassis style (635, 1235 or 1235) and the Paros sensor range (10, 20, 60, 120 meters) you desire. The 60 meter sensor is the preferred sensor, due to limited overranging of the sensor and decreased resolution due to attenuation at greater depths. This sensor provides adequate resolution and can be used at more location than the 10 and 20 meter sensors. Additional sensors available for the 635-12 include conductivity, turbidity and our WOTAN accoustic-noise wind sensor. The 635-12 is also available with dual tape transports, 0.25 sec scanning, event detection, multiple sensors and with an external test connector. Spare parts and mooring hardware are available from Sea Data.

If you need more information concerning the 635-12 Directional Wave, Tide and Current Recorder, or about other Sea Data products, please get in touch with us!

SENSOR SPECIFICATIONS:

SENSORS
2-axis water velocity, magnetic direction, depth, temperature

WATER VELOCITY (Marsh-McBirney EM)

Sensor	2-axis, 4.0-inch EM sphere with low-voltage electronics
Range	+/- 300 cm/sec
Resolution	0.2 cm/sec
Threshold	less than 0.5 cm/sec
Noise	less than 0.2 cm/sec
Error	2 cm/sec + 2% of signal

WATER VELOCITY (Neil Brown Accoustic Current Sensor)

Sensor	2-axis, reflecting-accoustic transducer
Range	+/- 250 cm/sec
Accuracy	+/- 1 cm/sec or 5% (whichever greater)
Noise	0.05 cm/sec quiescent, 2.0 cm/sec at full scale
Response Time	0.2 sec

DIRECTION

Sensor	modified Digicourse #225 digital compass
Resolution	1.4°
Accuracy	instrument heading 5°, water direction 5° (max)
Tilt range	operational +/-45 degrees from vertical

PAROSCIENTIFIC "DIGI-QUARTZ" SENSOR SPECS

	100 psia		45 psia	
	feet	meters	feet	meters
Standard Ranges	190	60	65	20
Abs. Maximum Depth	235	70	90	25
Resolution - waves	0.0035	0.1 cm	0.0015	0.045 cm
tides	0.004	0.12 cm	0.0017	0.05 cm
Accuracy*				
less than 80 ft	0.03		0.014	0.4 cm
more than 80 ft	0.05 ft	(these aren't typos!)		
vs temp @30 ft	0.004 ft/°C (max)		0.003 ft/°C (max)	

THERMOMETER

Type	YSI 0.1°C endcap mounted interchangeable thermistor
Range	-4.5 to +34°C
Accuracy	+/- 0.1°C
Resolution	0.01°C

ELECTRONICS SPECIFICATIONS:

CONTROLS POWER, STANDBY/OPERATE, RESET, CAP, TEST, BURST INTERVAL, BURST RATE, BURST DURATION (SCANS) **INDICATORS** WAVE and TIDE SCAN, COMPASS, HEAD CURRENT

DATA STORAGE

Medium	Standard digital certified 300' or 450' cassette tape
Capacity	15 megabits on 450' cassette (400,000 scans of wave height and orbital velocity)
Burst Format	flags, record counter, 8 sets (wave hgt., orb. vel.
Mean Format	flags, time, P1 tide pressure, 8 sets tide height, X and Y mean current, temperature, heading

TIMEBASE

	4.194304 MHz quartz crystal
Stability	Stable to +/- 1 ppm over +5 C to +40 C
Accuracy	Better than 1 minute per 6-months

POWER

SDB-9 Sea Data 9-section 32-Ahr Alkaline battery or good for up to 4 months. SCB-6L 80-Ahr Lithium Battery Pack, good for up to one year

ELECTRONICS RACK

Size	33 inches long by 5.8 inches diameter 16 cards, 1 unused card slot

PHYSICAL SPECIFICATIONS:

PRESSURE CASE

Material
6061-T6 aluminum, rated to 3500 psi

Finish
Sanford hard-coat anodize with fused epoxy overcoat

Size
case, 7.00-inch diameter by 40 inches long
overall, 9.0-inch diameter by 59 inches long.

Weight
operational, air 79 pounds, water 31 pounds
shipping, with crate 143 pounds (less battery 129 lbs

EM sensor
1.0-inch diameter type 316 stainless steel rod

Tension
in-line tension up to 5000 pounds

Hardware
Crosby Galvanized steel shackles, 0.75-inch pin with glass fiber insulators, options: side-mounted tabs with nylon insulators

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