

327001

48/85

AMOCO AUSTRALIA PETROLUEM COMPANY

REPORT

ON

SEABED INVESTIGATION SURVEY

AND

POSITIONING OF RIG

"DIAMOND .M. EPOCH"

ON

LOCATION

"TILANA NO 1"

IN

BLOCK T-14-P

BASS STRAIT

AUSTRALIA

Dated: SEPTEMBER, 1985.

Report No. K096/85/AM

OR-0330

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1

INTRODUCTION

GEOMEX SURVEYS (AUSTRALIA) PTY. LTD. was contracted by AMOCO AUSTRALIA PETROLEUM COMPANY to carry out a site investigation survey around the "TILANA-1" location in permit area T-14-P, in Bass Strait, Australia.

The proposed survey area comprised of a 4 kilometre square site centered on the well co-ordinates, supplied as follows.

Location: TILANA-1  
Latitude: 39 Deg. 53 Min. 36.96 Sec. South  
Longitude: 145 Deg. 58 Min. 42.20 Sec. East

The vessel "M/V LOMBARDINA CREEK" was mobilized for this survey in Devonport between 28th and 29th August, 1985 and the survey undertaken between 30th August and 4th September 1985. The geophysical investigation was carried out with echo sounder, side-scan sonar, and shallow seismic profiling system.

The navigation system employed was the Oceano satellite-acoustic navigation system which comprises of seabed transponders laid and calibrated using satellite information.

On the 4th September 1985, the semi-submersable vessel "DIAMOND .M. EPOCH" was ready for positioning on the above location. The satellite-acoustic navigation system was transferred to the rig.

The rig was positioned over location on the 5th September, 1985 with the final co-ordinates for the drill stem confirmed on the 7th September, 1985 as being:

Latitude: 39 Deg. 53 Min. 36.857 Sec. South  
Longitude: 145 Deg. 58 Min. 38.517 Sec. East

1

INTRODUCTION

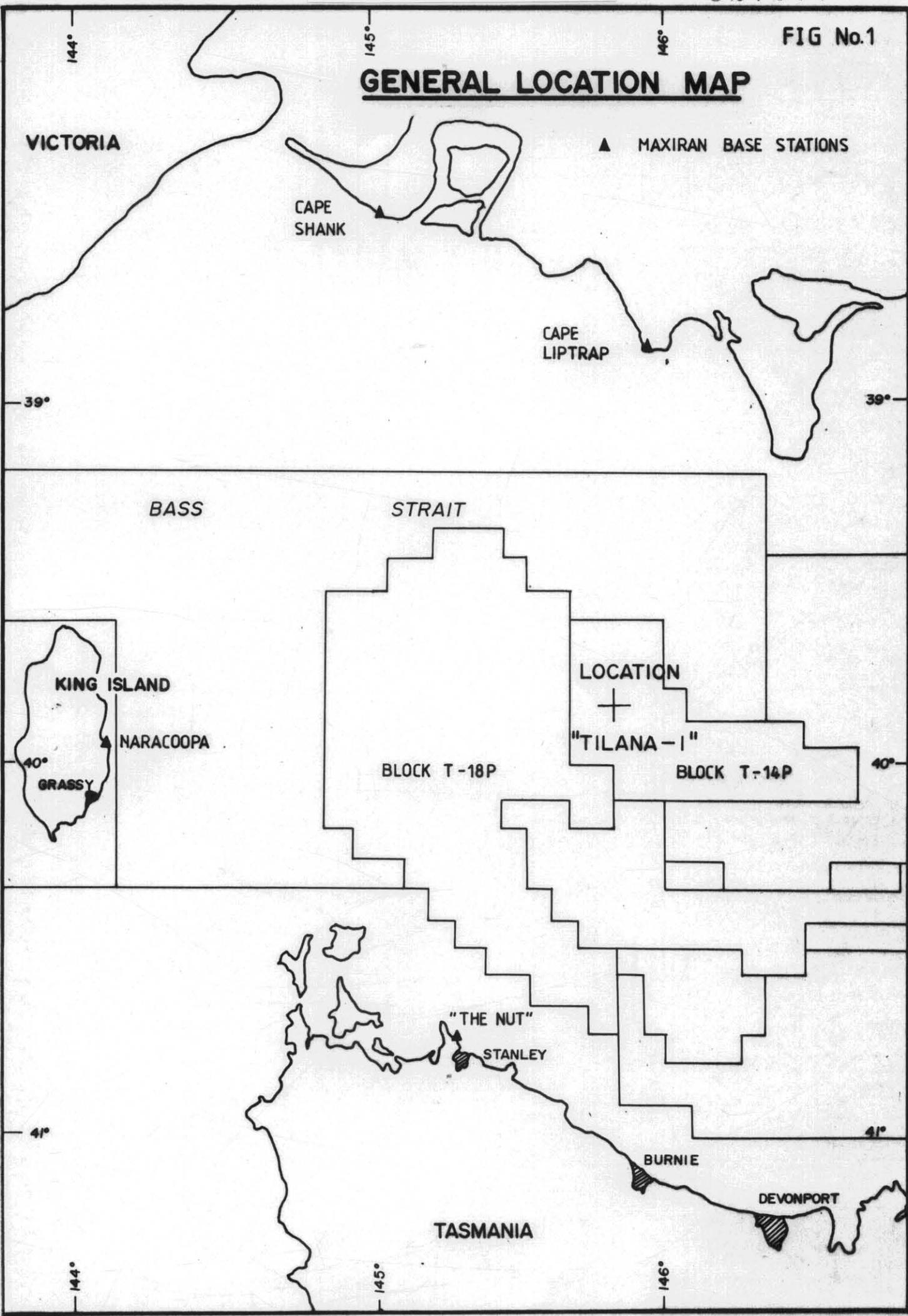
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This position is 87.5 Metres at 91.4 degrees from the proposed location.

Upon completion of the rig move, the equipment returned to Devonport via Hobart.

FIG No.1

**GENERAL LOCATION MAP**



2

PERSONNEL, EQUIPMENT AND LOGISTICS SUPPORT2.1 Personnel

The following survey personnel were engaged on this project:

Graham Harries	: Hydrographic Surveyor/Party Chief
Bruce Maluish	: Hydrographic Surveyor
Jim Anderson	: Geophysicist
Kevin Bryant	: Acoustic Engineer
Cliff McCarthy	: Engineer (Analogue)
Rodney Harris	: Engineer (Analogue)

Client's Representative:

Frank Renton	: E.C.L. Australia Pty. Ltd.
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2

PERSONNEL, EQUIPMENT AND LOGISTICS SUPPORT2.2 Equipment

The following survey equipment was employed on this project:

2.2.1 Navigation (Satellite-acoustic System)- The Navigation computing System comprising:

- Two - HP 9836 Computers
- Two - HP 2671G Printers
- One - Scope III Interface Unit
- Helsman's Monitor
- Software etc.

- The Magnavox Satellite Receiver comprising:

- One - MX 1107 Magnavox Receiver
- One - Marine Antenna
- Cables
- One - Set of Spare Boards

- The Oceano Acoustic Positioning System comprising:

- One - Oceano RM201 Range Meter
- One - Oceano TT201 Tele Command Module
- One - Oceano IM200 Interface Module
- One - Oceano PS100 Power Supply
- One - Grundig Velocimeter
- One - Oceano Spares Kit
- Two - AM 121 Acoustic Module Transducer (4 and 19 PIN)
- Two - Acoustic Deck Cables (4 and 19 PIN)
- One - Streamlined Towfish
- One - Handwinch with Towfish Cable
- One - Spare Towfish Cable
- Six - Oceano RT 121 Transponders
- Consumables

2

PERSONNEL, EQUIPMENT AND LOGISTICS SUPPORT2.2 Equipment (Cont'd)2.2.2 Geophysical

- ELAC Echo Sounder System comprising:
  - One - ELAC Echo Sounder Recording Unit
  - One - Echo Sounder Transducer
    - Cables, Power Supplies
    - Spares
  
- The EG & G Side-scan Sonar System comprising:
  - Two - EG&G 259-4 Side-scan Sonar Recorder
  - Two - EG&G 272 Towfish
  - One - EG&G Sonar Cable (Length 250M.)
  - One - Side-scan Sonar Winch
    - Spares
  
- The 1000 Joule Shallow Seismic System comprising:
  - Two - Multi Electrode Sparkers
  - One - EG&G 232 Power Supply
  - One - EG&G 231 Trigger/Capacitor Bank
  - Two - EPC 4600 Graphic Recorders
  - Two - EG&G 265 Hydrophone Streamer
  - One - Krohn-Hite Filter
  - One - T.V.G. Amplifier
  - One - Swell Filter
    - Transformers, Power Supplies

2

PERSONNEL, EQUIPMENT AND LOGISTICS SUPPORT2.3 Logistic Support

The Vessel "M/V LOMBARDINA CREEK" operating out of Devonport in Tasmania was used as the survey and accomodation vessel for the work.

Co-ordination and support also being provided by the Geomex Surveys base in Perth.

3

CHRONOLOGICAL RECORD OF EVENTSSunday 25th August, 1985

Party Chief (Surveyor) and Technician arrive in Devonport from rig GLOMAR "ROBERT. F. BAUER".

Monday 26th August, 1985

- 08:00 Preliminary preparation for mobilization of equipment. Informed "M/V LOMBARDINA CREEK" E.T.A. Devonport Tuesday 16:00 Hrs.
- 10:00 Survey party departs for Hobart to carry out reconnaissance onboard "DIAMOND. M. EPOCH".
- 13:30 Arrive in Hobart and obtain permission to go onboard the "DIAMOND. M. EPOCH".
- 14:30 Onboard "DIAMOND. M. EPOCH" discuss rig positioning with master of "DIAMOND. M. EPOCH".
- 17:30 Surveyor party returns to Devonport to plan operation.

Tuesday 27th August, 1985

- 08:00 Preparation for survey.
- 16:00 "M/V LOMBARDINA CREEK" arrives. Onboard to carry out initial evaluation and call tradesman to carry out modifications.
- 17:00 Depart for Launceston to pick up geophysical equipment and Geophysicist.
- 18:30 Arrive at Launceston and informed that equipment will be available at 04:00 Hrs 29th August, 1985.

Wednesday 28th August, 1985

- 04:30 Pick up geophysical equipment and depart for Devonport.
- 07:00 Off-load equipment on wharf and start preparing vessel. Due to lack of room onboard vessel container required.
- 10:00 Surveyor and Engineer arrive in Devonport.

3

CHRONOLOGICAL RECORD OF EVENTSWednesday 28th August, 1985 (Cont'd)

11:00 Continue mobilization of navigation and geophysical equipment onboard survey vessel. Due to extreme weather progress slow.

Thursday 29th August, 1985

01:00 Discontinue mobilization for rest period.  
06:00 Continue mobilization of navigation and geophysical equipment onboard survey vessel.  
21:00 Survey vessel departs Devonport for site "TILANA-1".

Friday 30th August, 1985

06:30 Pass through location.  
07:10 Obtain good satellite pass and then proceed to deploy marker buoy in site survey area.  
07:30 Take two satellite passes on location buoy of good quality to confirm position.  
10:00 Prepare to start deploying acoustic transponders.  
10:10 -  
15:40 Deploy six (6) acoustic transponders around the survey area.  
16:20 Recover location buoy.  
16:45 Begin bar check on echo sounder, and water velocity measurement with Grundig velocimeter.  
17:30 Velocity profile completed.  
  
18:00 Preparation for relative calibration.  
19:00 Start relative calibration. Due to problems with RM201 relative calibration postponed till fault rectified.

3

CHRONOLOGICAL RECORD OF EVENTSSaturday 31st August, 1985

01:00 Re-commence relative calibration.  
11:00 Complete relative calibration.  
13:00 Relative adjustment of transponder array completed.  
16:00 Commenced absolute calibration of transponder array.  
20:00 Two satellite passes - confirm preliminary  
absolute position of transponder array.  
20:00 Deploy geophysical equipment.  
23:00 Ready to start seismic lines.

Sunday 1st September, 1985

00:00 Completed running survey lines L29, L31.  
01:35 Weather downtime - continue acquiring satellite  
passes for absolute transponder calibration.  
08:00 Deploy geophysical equipment.  
08:30 Completed running survey lines L23, L21.  
10:30 Transducer pole of ELAC sounder broke, due  
to its deployment in heavy weather conditions.  
18:00 Continued running survey lines L27 and L25.  
19:30 Weather downtime - continued acquiring  
satellite passes for absolute transponder  
calibration.

3

CHRONOLOGICAL RECORD OF EVENTSMonday 2nd September, 1985

- 01:00 Recover acoustic fish due to extreme weather.  
Standby for weather. 32 satellite passes recorded,  
10 very good.
- 14:00 Prepare to deploy marker buoys - weather still poor.
- 16:30 Dropped 'Anchor Marker Buoy' No. 3.
- 16:30 Change acoustic cable due to damage by extreme  
weather.
- 18:10 Dropped 'Anchor Marker Buoy' No. 6.
- 18:30 Discontinue dropping Anchor Marker Buoys due  
to weather.

Tuesday 3rd September, 1985

- 02:30 Deploy acoustic equipment - weather reasonable.
- 03:45 Dropped 'Anchor Marker Buoy' location.
- 04:04 Dropped 'Anchor Marker Buoy' No. 2.
- 04:23 Dropped 'Anchor Marker Buoy' No. 7.
- 04:39 Dropped 'Anchor Marker Buoy' No. 8.
- 04:58 Dropped 'Anchor Marker Buoy' No. 1.
- 05:21 Dropped 'Anchor Marker Buoy' No. 4.
- 05:28 Dropped 'Anchor Marker Buoy' No. 5.
- Note: All marker buoys were dropped on the  
relative net position corrected for an absolute  
translation of: East +156.38 M.  
North -228.76 M.
- i.e. All co-ordinates for the buoy were adjusted  
by the reverse of the absolute translation.
- 07:00 Standby location for rig "DIAMOND. M. EPOCH"  
approch.
- 08:00 2nd cable (acoustic) failure.
- 10:45 Continued with absolute calibration procedure,  
using deck cable with transducer "AM 121",  
while letting the vessel run with the swell.

3

CHRONOLOGICAL RECORD OF EVENTSTuesday 3rd September, 1985 (Cont'd)

19:10 Satellite pass taken on a "Drift Mode",  
42 satellite passes collected.

Wednesday 4th September, 1985

00:00 Absolute calibration adjustment carried out.  
01:30 Except total number of rejections and obtain  
figures for absolute calibration of acoustic array.  
03:30 Agree to except the above absolute calibration  
and start another calibration.  
13:00 Six (6) satellite passes obtained. There is a  
difference in the easterly direction translation  
with the previous absolute. But due to statically  
the greater number of results obtained in the  
previous absolute had to accept those results  
as correct. A note was taken as to the possible  
error in this direction in the absolute calibration.  
Demobilization of all equipment onboard the survey  
vessel as no more geophysical lines to be carried  
out, and the transfer of navigation equipment  
to "DIAMOND. M. EPOCH" arranged.  
15:15 Transfer navigation equipment and three Geomex  
personnel to "DIAMOND. M. EPOCH". K. Bryant,  
J. Anderson depart for Devonport.  
16:30 Acoustic navigation system mobilized onboard  
"DIAMOND. M. EPOCH". Inform client that require  
to move 172 M. at 207°.  
24:00 "DIAMOND. M. EPOCH" was positioned close to  
the proposed location.

3

CHRONOLOGICAL RECORD OF EVENTS

Thursday 5th September, 1985

- 11:24 Final position obtained using acoustic navigation system.
- 12:48 Telex sent to Amoco Australia Pty. Ltd. with co-ordinates of drill stem but with limitations noted.
- 13:00 3D satellite passes started for confirmation with Magnavox 1107RS. Party chief and surveyor depart for "ROBERT. F. BAUER" and transponders were switched off. One Geomex personnel left onboard "DIAMOND. M. EPOCH" for 3D satellite passes.
- 14:00 Rodney Harris depart rig for Devonport.

Friday 6th September, 1985

Continue with 3D satellite passes.

Saturday 7th September, 1985

- 09:00 Final 3D satellite pass taken. 34 passes in-all collected. Demobilization of satellite equipment and ready for transfer to Devonport.
- 12:00 Cliff McCarthy departs for Devonport.

SURVEY METHODS AND PROCEDURES4.1 Satellite-Acoustic Positioning System4.1.1 Mode of Operation

The system comprises a marine satellite receiver and acoustic positioning which are intergrated to provide high accuracy navigation and tracking for a vessel, or a number of vessels, any distance from the shore.

The MARINE SATELLITE RECEIVER is a MAGNAVOX MX 1107 complete with antenna and cable, which operates by monitoring the change in frequency, or doppler effect, of the 400 MHz and 150 MHz frequencies transmitted by each of the five transit satellites circling the earth in polar orbits.

Orbital data and time are received from each satellite with an up-dated message every two minutes. Interpolation of the satellite's position monitored with the change of received frequencies will provide a line of position on which the receiver lies. The recording of data from a number of satellites will therefore provide the position of the receiver. The greater the number of good satellite passes recorded, the greater the accuracy of the results.

The receiver will take account of the course and speed of a moving vessel while recording satellite passes, and interfaced to the acoustic system will provide a means of co-ordinating seabed transponders on the earth's surfaces to an accuracy of better than 10 metres.

SURVEY METHODS AND PROCEDURES4.1 Satellite-Acoustic Positioning System4.1.1 Mode of Operation (Cont'd)

The ACOUSTIC POSITIONING SYSTEM used was an OCEANO system comprising four (4) onboard units; a range meter, a telecommand, an interface unit and dedicated power supply. These interrogate a number of transponders, laid on the seabed, via a transducer mounted-over-the-side of a vessel in a streamlined towfish. The travel time to each transponder is recorded, processed onboard and passed to a HP 9826/36 computer with graphic and numeric display monitors for surface, and if required, sub-surface positioning, navigation, tracking and data logging.

The accuracy and operation of the acoustic positioning system is largely dependent on the calibration of the seabed transponder network on which all ranges and subsequent position fixing is based.

The calibration of the system is usually carried out at the time of deployment and involves the survey vessel steaming through the array, collecting data from both the acoustic system and the satellite navigation receiver or Maxiran, to derive the transponder co-ordinates from a series of least squares fit computations.

SURVEY METHODS AND PROCEDURES4.1 Satellite-Acoustic Positioning System4.1.1 Mode of Operation (Cont'd)

The relative accuracy of this system is 1.5 - 3.0 metres; in operating this system these high accuracies are attained by making allowance for a number of variable factors including the seawater temperature profile, salinity, tidal heights, etc.

This system has interrogation frequencies of 8 KHz to 16 KHz on 0.5 KHz stepping, with a reception bandwidth of 300 Hz and a pulse-width which can be adjusted from 6-15 milliseconds. The 16 receivers have similar frequency settings and bandwidth to the interrogation pulse.

Working ranges for the acoustic system are 3 km. to 8 km. dependent on the water depth and temperature. Up to 16 seabed transponders may be interrogated simultaneously.

All position data is displayed graphically and constantly updated on the computing system's VDU monitors or plotters.

SURVEY METHODS AND PROCEDURES4.1 Satellite-Acoustic Positioning System4.1.2 Installation and Calibration

On Friday 30th August, 1985, the survey vessel began to deploy the acoustic array for the location 'TILANA-1'. A marker buoy was first dropped in the survey area and checked by satellite passes as a visual site for the deployment of the array. The transponders were deployed between 10:10 and 15:40 on the above day.

A velocity profile was recorded at the centre of the location at 17:00, and stored in the computer. The profile as has been the case from the previous survey's in this area was linear and only varying from 1498.0 to 1498.2 m/sec. A mean value of 1498.1 m/sec was excepted.

The relative calibration was started at 19:00 but due to interface problems between the RM 201 and the computer HP 9836 a postponement of five hours was incurred. An initial relative calibration was carried out to bring the approximate transponder co-ordinates closer to their true positions before commencing the full relative calibration.

SURVEY METHODS AND PROCEDURES4.1 Satellite-Acoustic Positioning System4.1.2 Installation and Calibration (Cont'd)

The final relative calibration was completed at 09:00 on Saturday 31st August, 1985. This produced results of an excellent quality with only 23 ranges from a total of 185 ranges being rejected and a R.M.S. value of 1.24 metres. See APPENDIX A for relative calibration results.

To obtain absolute co-ordinates for the transponders the procedure described in Section 4.1.1 is used. Due to extreme weather patterns that were in the area during this time of collecting satellite passes a high number were rejected due to their quality.

Of the fifteen (15) passes accepted at least two were from each of the five satellites in operation, elevations between  $12^{\circ}$  -  $78^{\circ}$ , and good quality. (see APPENDIX A). However, the fifteen (15) passes out of the forty-two (42) collected, all have risen in one of the eastern quadrants. In fact out of the 42 passes only five (5) had risen in a western quadrant. This was noted and a caution was given as to the limitations in the error of the east-west translation for the absolute calibration.

SURVEY METHODS AND PROCEDURES4.1 Satellite-Acoustic Positioning System4.1.2 Installation and Calibration (Cont'd)

A thorough evaluation of the rejection process of satellites was carried out to make sure that the absolute calibration was statistically correct as could be obtained.

A subsequent mini-absolute calibration was carried out and this gave the survey team some data that showed a possible error in the E-W translation. Due to the time factor placed upon the operation it was decided to except the initial absolute and carry out the rig positioning with those co-ordinates for the transponders, but put possible errors on the E-W direction of 10 metres to the east and 90 metres to the west.

The rig positioning for the "DIAMOND. M. EPOCH" was subsequently carried out on Thursday 5th September, 1985 using these absolute co-ordinates and knowing of the possible errors.

Figure 4.1 TRANSPONDER POSTIONS

TRANSPONDER			POSITION	
NO.	SERIAL NO.	CHAN CODE	EASTINGS	NORTHINGS
1	488	9	411887.6	5584648.7
2	644	11	413934.0	5582287.9
3	766	1	412582.1	5580490.3
4	695	8	415868.9	5583289.7
5	486	7	409915.1	5583783.6
6	595	16	413223.5	5586497.4

SURVEY METHODS AND PROCEDURES4.2 Navigation Computer System (Cont'd)

The computer accepts the raw ranges from the Oceano RM 201 received by the acoustic fish and applies the velocity profile to compute the vessel's position. The computer monitors continuously the quality of those ranges and performance from each seabed transponder. From this data the computer can display the results on a choice of projections and monitor the vessel's layback position in relation to a number of targets or survey line.

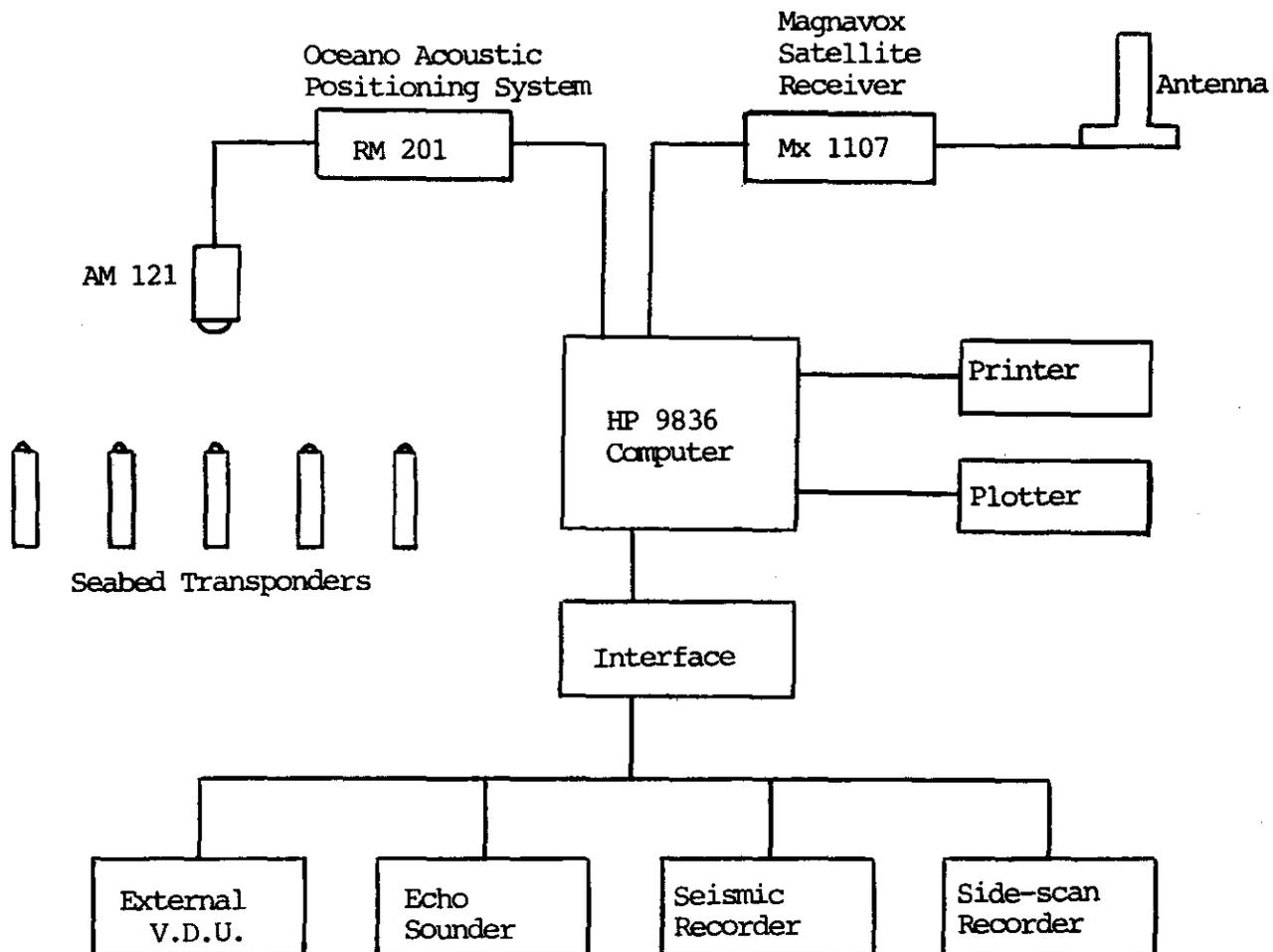
The absolute calibration with satellites can be run concurrently with the analogue survey as the computer also continuously checks the Magnavox satellite receiver for satellite information which is recorded on disc for later processing.

The time interval between each fix was chosen to give a spacing of about 100 m. The fix datum used was the satellite navigation aerial and offsets used to compute the positions of the various items of geophysical equipment, as shown in Figure 2, "Configuration of Equipment". The "Survey Line Layout" is given in Figure 3.

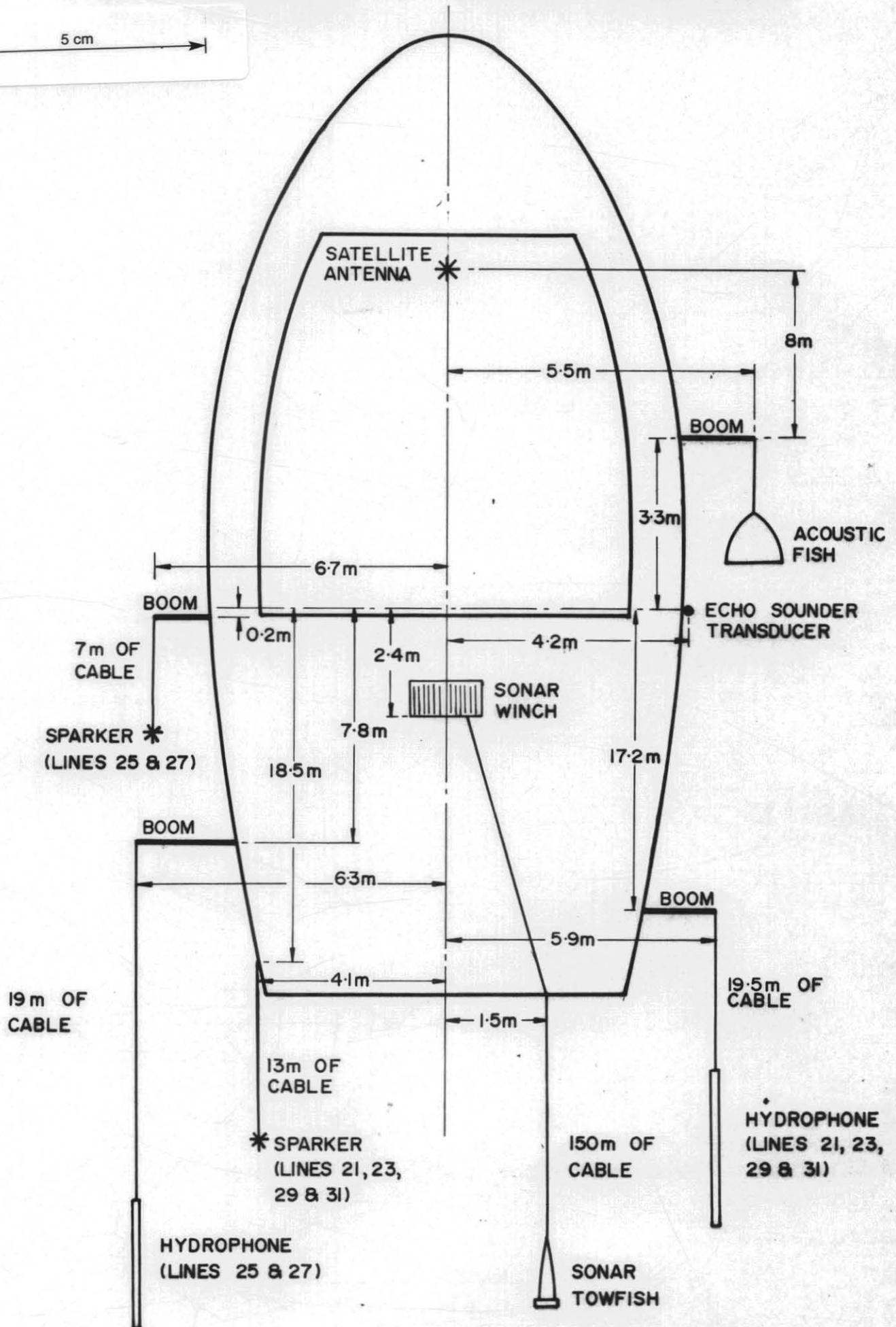
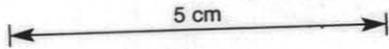
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SURVEY METHODS AND PROCEDURES4.2 Navigation Computer System

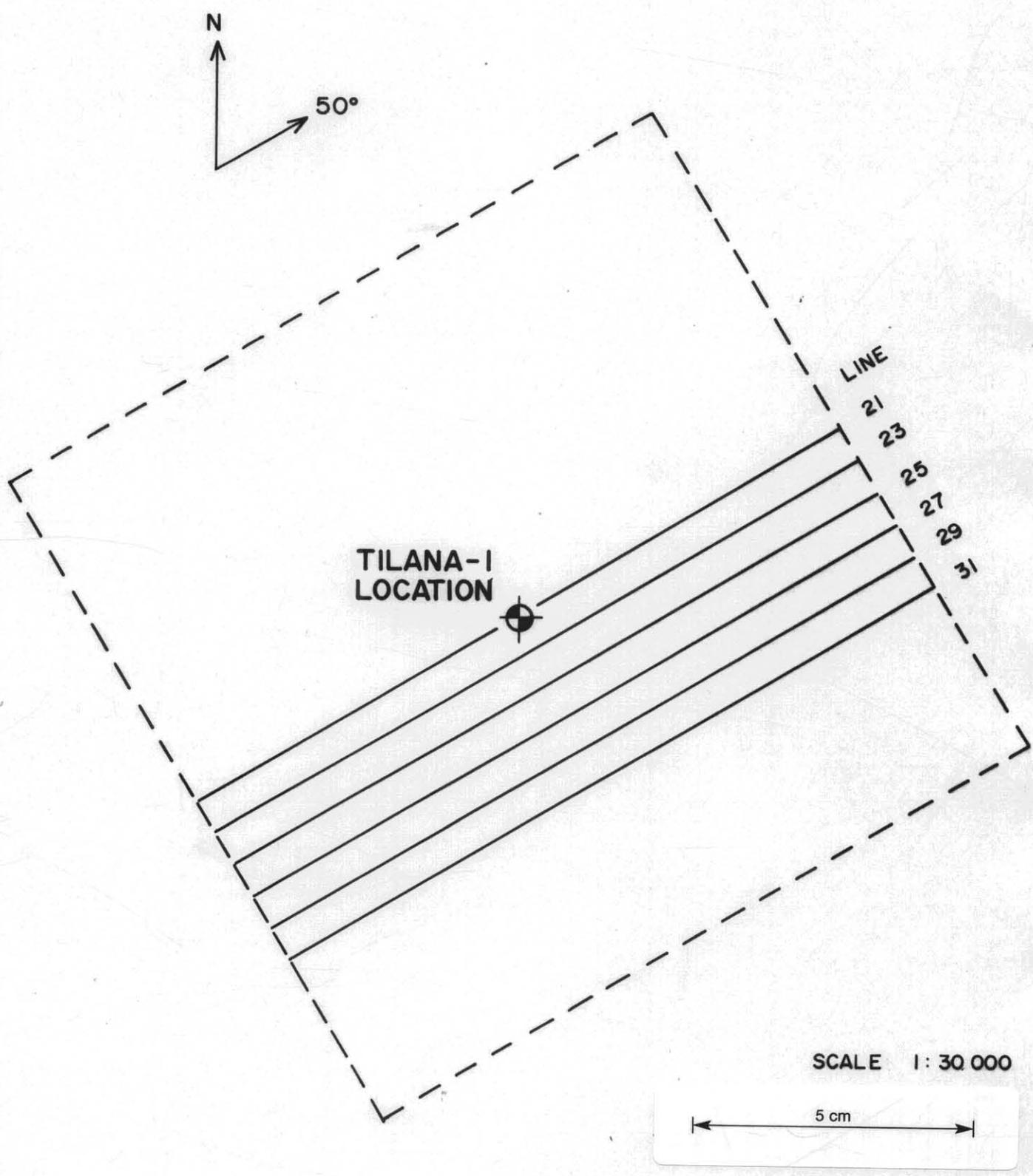
The survey was carried out using the satellite-integrated underwater acoustic navigation system coupled to a HP 9836 computer. From the computer, a hard copy of survey data was available on a HP 2671G printer and positional information displayed via a Scope III interface box to an external V.D.U. on the bridge. From the Scope interface box, fix commands were sent to the analogue equipment on a set time interval controlled by the HP 9836 computer.



# CONFIGURATION OF SURVEY EQUIPMENT



# LAYOUT OF SURVEY LINES



4

SURVEY METHODS AND PROCEDURES4.3 Satellite Confirmation

The MAGNAVOX MX 1107 Receiver was used to provide confirmation of the rig's drillstem position, once on location.

This was carried out on the 5th to 7th September, 1985 with the receiver and antenna installed near the helicopter pad, and thirty four (34) 3D satellite passes recorded.

SURVEY METHODS AND PROCEDURES4.4 Geodetic Parameters

Due to the satellite receiver using W.G.S. 72 spheroid and the proposed position given in Australian National Spheroid (A.N.S.), it was decided to transform the co-ordinates from A.N.S. to W.G.S. 72. Given below are Geodetic Parameters for both spheroids and the subsequent cartesian shifts applied between the two spheroids of reference.

Spheroid	: Australian Map Grid
Projection	: UTM Zone 55
False Easting	: 500 000
False Northing	: 10 000 000
Scale Factor	: 0.9996
Semi-Major Axis	: 6378 160
Flattening	: 298.25
Central Meridian	: 147° East

Shift Parameters - A.N.S. - W.G.S. 72

$\Delta X$	-	124.2
$\Delta Y$	-	28.8
$\Delta Z$	+	137.2

Spheroid	: W.G.S. 72
Projection	: UTM Zone 55
False Easting	: 500 000
False Northing	: 10 000 000
Scale Factor	: 0.9996
Semi-Major Axis	: 6378 135
Flattening	: 298.26
Central Meridian	: 147° East

4

SURVEY METHODS AND PROCEDURES4.5 Echo Sounding

Continuous bathymetric profiles were obtained using an ELAC echo sounder, with its transducer mounted on the starboard side of the survey vessel (see Figure 2).

The sounder was calibrated by the disk-check method to compensate for transducer draft (1.3m) and the prevailing speed of acoustic transmission in the water column (1498 m/sec). This velocity figure agreed with the mean velocity derived by the velocimeter, prior to the calibration of the acoustic transponder array.

For two of the six lines surveyed (no's 25 and 27), the water depth data was taken from the seismic records, as the echo sounder transducer pole had broken in the rough seas. The seismic recorder was calibrated by comparison with the echo sounder records on the initial four lines.

The data was reduced first by drawing a mean line through the wave motion (up to  $3\frac{1}{2}$  m) superimposed on the bottom trace. No specific tidal data was available for the Tilana location, and as the survey completed did not include any cross-lines, the technique known as "Crossing Analysis" could not be employed to derive the actual tidal variation during the survey. Application of the method to the results of the YOLLA-1 and KOORKAH-1 surveys indicated that the tide at the two locations had a similar phase, but a reduced amplitude (approximately 0.7 and 0.6 respectively) to the predicted tide for the port of Stanley. Therefore, to reduce the bathymetry for TILANA -1, a tide curve of 0.7 times the predicted Stanley tide was applied to the data. The datum used was the mean sea level at Stanley, for consistency with the implied datum of the Crossing Analysis procedure.

4 SURVEY METHODS AND PROCEDURES4.5 Echo Sounding (Cont'd)

The predicted tide curve for Stanley, and the curve used for data reduction are presented as Figure 4.

The bathymetric record for the line running NE-SW through the location has been reproduced as Figure 5. The sounding plan is presented as Map 2 and the results are discussed in Section 5.3.

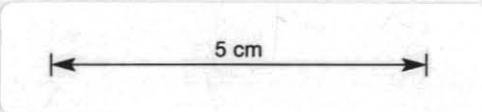
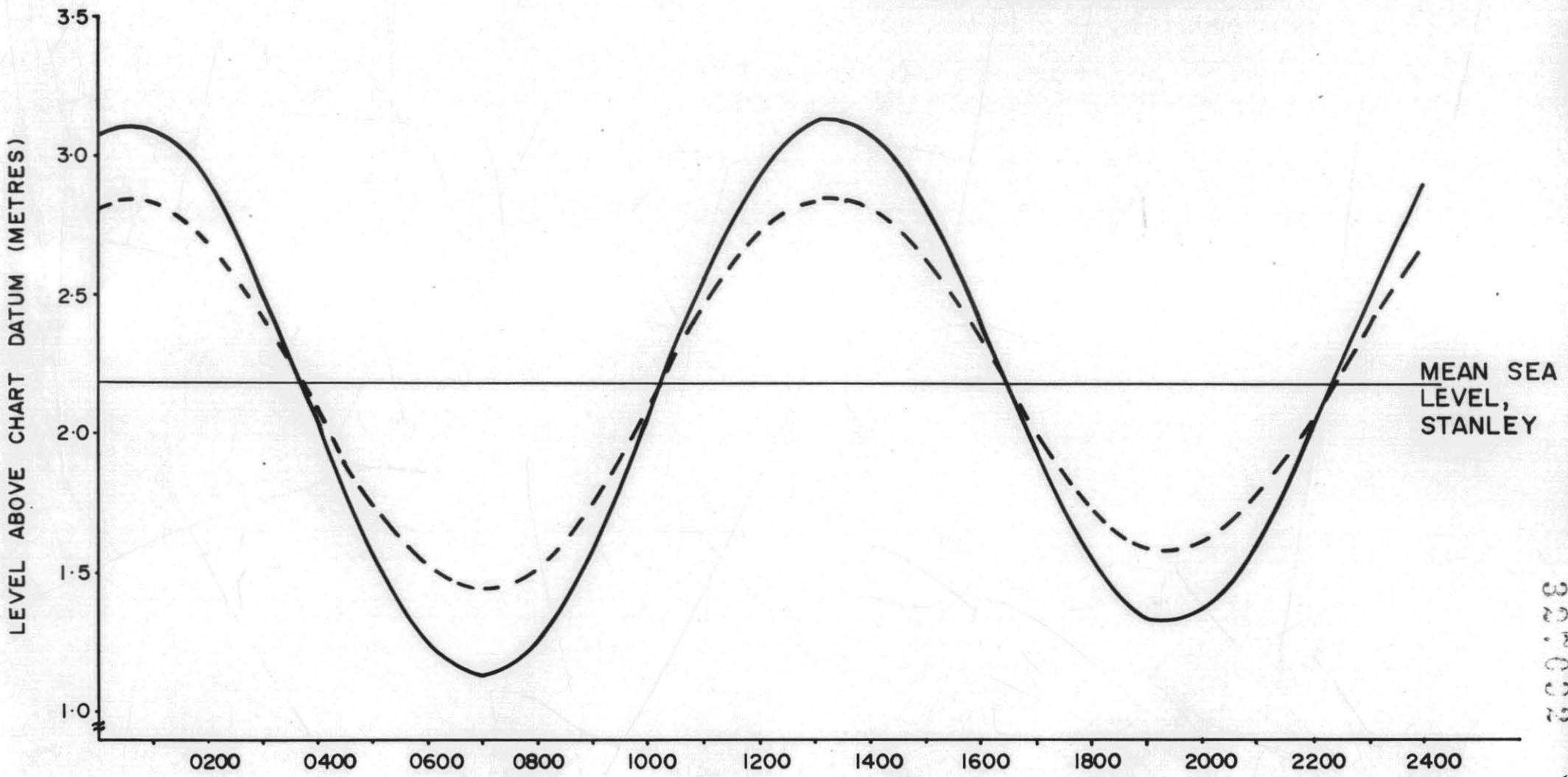


FIGURE 4

— PREDICTED TIDE CURVE, STANLEY 1/9/85  
- - - ASSUMED TIDE CURVE FOR TILANA LOCATION (0.7 OF STANLEY AMPLITUDE)



32002  
.28.

ECHO SOUNDER RECORD THROUGH LOCATION "TILANA-1"

5 cm

NORTH-WEST

SOUTH-WEST

327033

10 m

DRILLING  
LOCATION



100m

123 124 125 26 127 128 129 130 131 132 133 134 135



4.6 Side-scan Sonar

An EG&G side-scan sonar was used to map changes in seabed lithology and search for any anomalous objects on the seafloor. The fish was towed off the stern of the vessel, on 150 m. of cable, which placed the fish about 30 m above the seabed. The recorder was set to a sweep speed giving 125 m. slant range per channel.

The side-scan sonar utilizes an acoustic beam which is very narrow in the horizontal plane yet sufficiently broad in the vertical plane to impinge on targets ranging from directly under the fish out to 500 m. abeam. The two channels are fired simultaneously and then each receives echoes from the seafloor sediments to port or starboard. These acoustic signals are converted to voltages and fed up the tow cable to the wet paper recorder which uses dual helix electrodes sweeping out from the centre of the recording drum. The signal voltages cause a current to flow from the helix, through the recording paper to another electrode, and marks are created on the paper in proportion to the strength of the seabed echoes. The helix on the right receives signals from the starboard side of the towfish, while the helix on the left prints those from the port side. The results from successive firings of the fish are printed close together on the recording paper, thereby building up a graphic representation of the seafloor nature as the vessel proceeds.

The strength of the echoes (and thus the darkness of the record) will depend on the grainsize of the seabed material (coarse sediments reflect a higher proportion of the incident energy), and the attitude to the sonar beam of any object protruding above the surrounding level. Thus, targets such as wrecks or rock outcrops will typically appear as very dark markings on the paper, with an acoustic shadow (light area) behind them.

4

SURVEY METHODS AND PROCEDURES

(Cont'd)

4.6

Side-scan Sonar

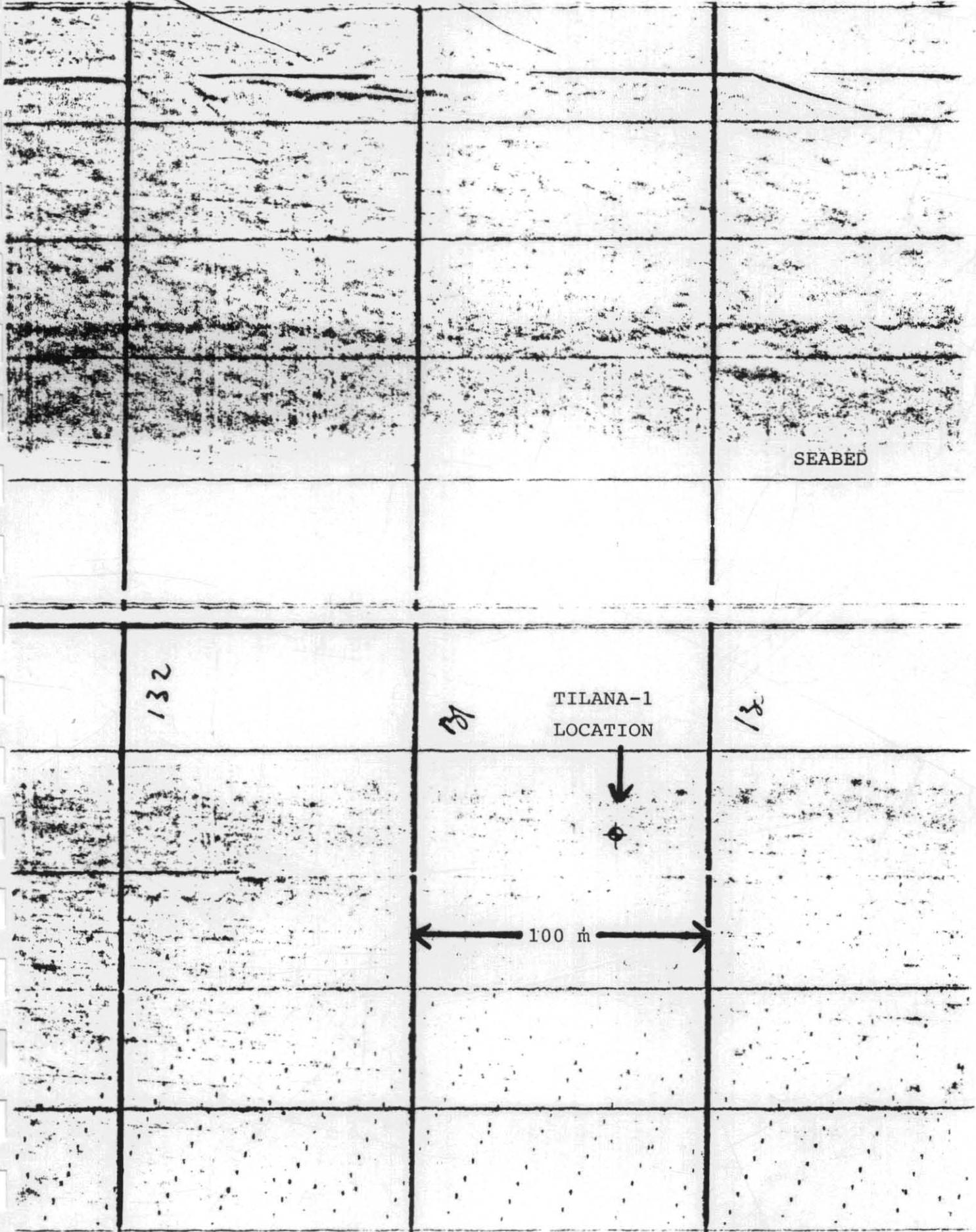
(Cont'd)

The records are reduced by first identifying zones of contrasting reflectivity (i.e. sediment type), and anomalous features such as scours, pipelines, craters, outcrop, etc. then plotting these results on either side of the fish track, after adjustment of the slant ranges to true horizontal ranges.

A photocopy of the sonar record running NE-SW through the location is presented as Figure 6. The results are discussed in Section 5.3.

FIGURE 6

SIDE-SCAN SONAR RECORD  
THROUGH TILANA-1 LOCATION



5 cm

4.7 Seismic Reflection Profiling

The technique of seismic profiling employs a source of acoustic energy with sufficient power and low-enough frequency content to penetrate the seafloor and obtain echoes from the underlying strata. The sound source, typically a boomer or sparker, sends a pulse of energy to the seabed, where part is transmitted and part reflected. The transmitted signal, as it penetrates the sub-seafloor sediments, is in turn part reflected and part transmitted at succeeding interfaces separating materials with different acoustic impedances. The reflected components travel as a long wave-train up through the water column and are received by a hydrophone towed at the sea-surface next to the sound source. The hydrophone passes the signal inboard to various filters and amplifiers, before presentation on a graphic recorder. A continuous time section is built-up on the recorder by firing the acoustic source several times per second and printing the returned echoes side-by-side on the paper record.

For the TILANA-1 site survey, a multi-electrode sparker was employed as the sound source. Short, high voltage electrical pulses are passed from the capacitor bank, down the electrical cable to the sparker, which discharges into the water, causing vapourisation in the vicinity of the spark tips. A short-duration, multi-frequency shock wave is thereby produced, which travels downwards towards the seabed.

The sparker was initially towed on 13.4 m of cable from the port stern of the survey boat and the hydrophone was suspended from a boom on the starboard side, to ensure it was well out of the vessel's wake. For lines 25 and 27, both the sparker and hydrophone were boomed-out on the port side of the survey vessel, to minimize noise on the acoustic fish.

4 SURVEY METHODS AND PROCEDURES

(Cont'd)

4.7 Seismic Reflection Profiling

(Cont'd)

Before commencement of the survey, several trial runs were made to test the effect on record quality of various filter and amplifier settings. The filter bandpass was eventually optimized at 600 - 2000 Hz. Before presentation to the recorder, the seismic signals were passed through a two stage T.V.G. (Time-Variable-Gain amplifier). This enables the gain to be kept very low until the seabed echo is received, thereby minimising the obscuring effect of the direct sparker-hydrophone arrival on the part of the record representing the water column. The seabed return is then employed to trigger a second amplifier ramp which is used to compensate for spreading loss and absorption on the sub-seabed material.

Additional processing of the seismic signal was carried out with an electronic swell filter. This device retards or advances each sweep of the recorder to compensate for the vertical motion of the sound source and hydrophone caused by sea swell. Reflectors can then be identified that might otherwise be broken up by the superimposed wave action.

The sparker was fired every 500 ms at a power of 300 joules.

A copy of the seismic record for the line running NE-SW through the location has been given as Figure 7. The seismic results are presented as Map 3, and discussed in Section 5.4.

SPARKER RECORD  
THROUGH LOCATION  
"TILANA-1"

DRILLING  
LOCATION

FIGURE 7

124

126

128

130

132

134

136

NORTH-EAST

SOUTH-WEST

UNCEMENTED  
SAND

SEA-BED

REFLECTOR 1

REFLECTOR 2

REFLECTOR 3

REFLECTOR 4

REFLECTOR 5

5 cm

10ms = 9m IN SAND

100m

327039

RESULTS5.1 Acoustic Positioning

The transponders were deployed and then a relative calibration was carried out. Due to the interfacing problems between the RM 201 and computer, this procedure entailed more time than normal, but when completed gave the required results. The absolute calibration was then undertaken.

Throughout the survey, satellite passes were taken to be used to calculate the absolute co-ordinates. A timing error was found in the computer which had the affect of losing four (4) satellite passes. Also due to weather conditions the number of rejected satellite passes in the absolute calibration was high. At the completion of 42 satellite passes and carrying out the least squares adjustment to find a mean rotation and translation for the transponder array only 15 satellites could be used. (see APPENDIX A). The results are as follows:

Translation East	:	144.4 m.
Translation North	:	- 213.4 m.
Rotation	:	0.21°

However, on checking the excepted satellite passes, it was found that all passes had risen in the eastern quadrants. It was felt that this could have effected the absolute calibration but the degree to which it may have, could not be determined.

It was decided to except these absolute co-ordinates as correct and carry out a short absolute calibration. This absolute gave a possible correction in the westerly direction of 110 metres.

5

RESULTS5.1 Acoustic Positioning (Cont'd)

Once again however, the satellites had risen in the eastern quadrant, and due to no statistical reason of not accepting the original absolute it was decided to except the previous absolute.

The final position for the drill stem was found to be: -

Latitude	:	39° 53' 36.7346" South
Longitude	:	145° 58' 41.969" East
Eastings	:	412 653.668 m.
Northings	:	5 583 544.119 m.

This position is 9 metres at 141 degrees to the intended location.

5

RESULTS

5.2 Satellite Positioning

A further check of the position was made using the MAGNAVOX MX 1107 Satellite Receiver, thirty-four (34) passes were accepted by the MX 1107 for 3D processing, to give the position of the drill stem: -

Latitude	:	39° 53' 36.8573"	South
Longitude	:	145° 58' 38.517"	North
Eastings	:	412 571.730	m.
Northings	:	5 583 539.400	m.

The difference between the satellite fix and the final acoustic fix is given as: -

Satellite Fix	412 571.730	5 583 539.400
Acoustic Fix	<u>412 653.668</u>	<u>5 583 544.119</u>
	-81.938	-4.719

This position confirmed that due to the predominance of easterly rising satellite passes the satellite-acoustic position was bias in the easterly direction. It was therefore decided to except the satellite pass as the final location.

RESULTS5.3 Echo Sounding

The bathymetric plan, for the 1km x 4km area surveyed, is presented as Map 2. Little variation in seabed levels can be seen, with values ranging from 81.6 to 82.8 m. below datum (mean sea level at Stanley). Seabed gradients derived from soundings showed gradients to be less than 1 in 500.

At the proposed drilling location, the seafloor is at 82.1 m. below datum.

5 RESULTS

(Cont'd)

5.4 Side-scan Sonar

The sonar revealed a featureless seafloor, with an acoustic reflectivity consistent with fine to medium grade sandy sediment. No sand waves or other sedimentary features indicative of strong bottom current action were observed on the records. Some small bottom ridges (only centimetres high) could be seen when the fish dipped very close to the seafloor, due to the acute angle of sonar illumination. These probably comprise banks of shells and marine growth.

Although no grab samples of bottom sediment were taken on this survey, the similarity of the sonar reflectivity with the YOLLA-1 and KOORKAH-1 surveys results suggests that similar fine to medium shelly sand is present.

5

RESULTS

(Cont'd)

5.5 Seismic

Weather conditions during the survey were adverse, with winds of 15 to 25 knots and a moderate sea. Nevertheless, the use of the swell filter improved record quality sufficiently to reveal a series of flat-lying reflectors down to about 110 ms two-way travel time beneath the seabed. Below this level the arrival of the first seabed multiple echo made identification of deeper horizons impossible. At an assumed average propagation velocity of 1800 m/sec, this effective penetration time is equivalent to 99m.

This efficient propagation of the seismic signals into the seabed and to considerable depths indicates an absence of cemented material at the seafloor. No shallow geological information is available within the surveyed area, hence a precise lithology cannot be assigned to each reflecting layer. The seismic boundaries represent interfaces across which there is a change in acoustic impedance (the product of the compressional shock-wave velocity and the density of the transmitting medium). Thus, sudden changes in cementation or consolidation, or grain-size changes (e.g. silt to sand or sand to gravel) may generate reflections. The acoustic boundaries recorded in the TILANA-1 area are all laterally-persistent, and of roughly similar amplitude. Therefore major changes in cementation or grainsize are considered unlikely and it is believed the sequence represents an interbedded series of silts and sands, with different degrees of consolidation.

Due to the almost horizontal nature of the strata, it was not feasible to present any particular layer as a contour plan. Three SW-NE sections have therefore been drawn up to show the interrelationship of the various horizons (Map 3).



6

CONCLUSIONS

During the period August 28th to September 4th 1985, a site survey was carried out over the TILANA-1 location in Bass Strait. Owing to bad weather only 6, four kilometer lines could be completed before the arrival of the drilling rig "DIAMOND. M. EPOCH". The survey techniques comprised echo sounding, side-scan sonar and shallow-penetration seismic reflection (sparker).

The bathymetry revealed an almost horizontal seafloor, with levels ranging from 81.6 to 82.8, below datum (mean sea level Stanley). At the location, the seabed is at -82.1 m.

The sonar records were of low to moderate reflectivity, indicating a seafloor comprising fine to medium grade sand.

The sparker survey recorded a series of flat-lying reflectors to depths of over 90 m. beneath the seabed. No significant horizon was evident in the top 15 m. below the seabed, suggesting that the uncemented, largely unconsolidated sand prevails to at least this depth.

The "DIAMOND. M. EPOCH" was positioned over location "TILANA NO 1" on the 5th September, 1985, with the final co-ordinates of the drill stem being:

Latitude	: 39° 53' 36.8573" South
Longitude	: 145° 58' 38.517" North
Eastings	: 412 571.730 m.
Northings	: 5 583 539.400 m.

This position being 87.5 metres at 91.4° from the intended location.

APPENDIX A

ACOUSTIC TRANSPONDER ARRAY CALIBRATION RESULTS

## ABSOLUTE - WAS CARRIED OUT AFTER ACCEPTED ABSOLUTE

## Results of the absolute calibration

Rejected stations : none

fix	satellite position		corrected acous. posit.		distance
1	410212.45	5588514.40	410163.63	5588539.74	55.00
2	410090.36	5584535.13	410116.34	5584496.49	46.56
3	413603.48	5586562.18	413669.26	5586589.13	71.09
4	410545.68	5582634.92	410550.21	5582676.02	42.97
5	413351.33	5580640.26	413471.41	5580647.57	120.31
6	414837.09	5582267.16	414661.53	5582205.09	186.21

channel	position on file		new position	
9	411887.60	5584648.70	411812.28	5584643.34
11	413934.00	5582287.90	413825.31	5582262.48
1	412582.10	5580490.30	412465.75	5580478.30
8	415868.90	5583289.70	415779.99	5583245.16
7	409915.10	5583783.60	409831.35	5583797.73
16	413223.50	5586497.40	413166.34	5586478.78

Mean Error : 101.03  
 Acoustic rotation point : 412186.49 5584200.62  
 Translation (east = +) : -79.75  
 Translation (north = +) : -8.28  
 Rotation : .56  
 Heading of transponder 1 to transponder 2 : 139.65

## Results of the absolute calibration

Rejected stations : ,6

fix	satellite position		corrected acous. posit.		distance
1	410212.45	5588514.40	410175.31	5588543.98	47.48
2	410090.36	5584535.13	410080.23	5584501.57	35.05
3	413603.48	5586562.18	413657.64	5586552.07	55.09
4	410545.68	5582634.92	410500.55	5582676.00	61.03
5	413351.33	5580640.26	413389.57	5580613.27	46.81
6	*****,**	*****,**	*****,**	*****,**	*****,**

channel	position on file		new position	
9	411887.60	5584648.70	411777.78	5584628.36
11	413934.00	5582287.90	413772.53	5582223.76
1	412582.10	5580490.30	412381.98	5580455.89
8	415868.90	5583289.70	415728.69	5583183.38
7	409915.10	5583783.60	409787.00	5583806.22
16	413223.50	5586497.40	413153.44	5586447.67

Mean Error : 49.87  
 Acoustic rotation point : 411671.63 5584593.02  
 Translation (east = +) : -110.97  
 Translation (north = +) : -15.64  
 Rotation : 1.24  
 Heading of transponder 1 to transponder 2 : 140.32

## Results of the absolute calibration

Rejected stations : .5,6,7,8,9,10,11,13,14,15,16,18,21,22,24,25,26,27,28,29,3  
1,32,33,35,39,42

fix	satellite position		corrected acous. posit.		distance
1	414217.30	5584368.21	414319.15	5584377.93	102.31
2	412678.33	5580951.76	412703.95	5580941.19	27.71
3	414129.85	5586108.41	414077.73	5586106.33	52.16
4	414286.01	5583804.47	414233.73	5583820.41	54.66
5	*****	*****	*****	*****	*****
6	*****	*****	*****	*****	*****
7	*****	*****	*****	*****	*****
8	*****	*****	*****	*****	*****
9	*****	*****	*****	*****	*****
10	*****	*****	*****	*****	*****
11	*****	*****	*****	*****	*****
12	412081.64	5583393.54	412002.19	5583431.99	88.26
13	*****	*****	*****	*****	*****
14	*****	*****	*****	*****	*****
15	*****	*****	*****	*****	*****
16	*****	*****	*****	*****	*****
17	415450.51	5583526.86	415435.32	5583556.67	33.46
18	*****	*****	*****	*****	*****
19	412057.69	5584038.77	412105.99	5584065.81	55.35
20	412742.24	5584187.15	412671.94	5584204.73	72.46
21	*****	*****	*****	*****	*****
22	*****	*****	*****	*****	*****
23	414821.19	5583198.31	414818.64	5583182.28	16.23
24	*****	*****	*****	*****	*****
25	*****	*****	*****	*****	*****
26	*****	*****	*****	*****	*****
27	*****	*****	*****	*****	*****
28	*****	*****	*****	*****	*****
29	*****	*****	*****	*****	*****
30	*****	*****	*****	*****	*****
31	*****	*****	*****	*****	*****
32	*****	*****	*****	*****	*****
33	*****	*****	*****	*****	*****
34	412078.42	5584150.96	412215.95	5584152.25	137.54
35	*****	*****	*****	*****	*****
36	412235.46	5582302.00	412252.78	5582286.63	23.17
37	410391.75	5580589.40	410256.48	5580595.46	135.41
38	410943.81	5581374.76	411020.47	5581357.35	78.61
39	*****	*****	*****	*****	*****
40	411377.00	5584192.87	411362.67	5584133.69	60.90
41	411935.63	5584759.09	411949.85	5584733.84	28.97
42	*****	*****	*****	*****	*****

channel	position on file		new position	
9	411738.50	5584858.80	411887.58	5584648.66
11	413793.80	5582505.70	413934.04	5582287.87
1	412448.60	5580703.10	412582.10	5580490.33
8	415724.90	5583514.80	415858.91	5583289.73
7	409769.30	5583986.30	409915.12	5583783.55
16	413067.50	5586712.50	413223.52	5586497.36

Mean Residual : 74.36  
 Acoustic rotation point : 412617.40 5583609.86  
 Translation (east = +) : 144.39  
 Translation (north = +) : -213.43  
 Rotation : .21  
 Heading of transponder 1 to transponder 2 : 139.08

RELATIVE CALIBRATION

	Xp. 1	Xp. 2	Xp. 3	Xp. 4	Xp. 5	Xp. 6	St	RMS
St. 1	*****	1.4E+0	2.6E+0	1.1E+0	1.3E+0	4.9E-1		1.5E+0
St. 2	2.6E+0	8.6E-1	2.1E+0	7.1E-1	5.1E-1	7.0E-1		1.5E+0
St. 3	9.9E-1	7.5E-1	*****	5.4E-1	2.4E-1	6.1E-1		6.7E-1
St. 4	*****	6.3E-1	8.7E-1	5.6E-1	1.5E-1	6.7E-1		6.2E-1
St. 5	*****	5.8E-1	*****	1.6E-1	4.4E-1	3.8E-2		3.7E-1
St. 6	1.9E+0	7.3E-1	2.8E+0	8.4E-1	2.8E-1	7.6E-1		1.5E+0
St. 7	9.5E-1	5.4E-1	1.8E+0	4.6E-1	1.5E-1	6.5E-1		9.1E-1
St. 8	*****	2.5E-1	*****	1.6E-1	8.5E-2	1.1E-1		1.6E-1
St. 9	6.4E-1	7.3E-1	1.8E+0	5.7E-1	3.3E-1	8.1E-1		9.5E-1
St. 10	2.0E+0	7.4E-1	*****	1.8E-1	9.5E-2	1.7E+0		1.2E+0
St. 11	*****	*****	*****	*****	*****	*****		*****
St. 12	2.7E+0	5.6E-1	*****	1.1E+0	4.3E-1	2.4E+0		1.7E+0
St. 13	2.4E-1	2.3E-1	*****	4.5E-2	4.0E-2	*****		1.7E-1
St. 14	4.8E-1	2.8E-1	*****	1.0E+0	4.4E-1	3.9E-1		5.8E-1
St. 15	*****	2.1E-1	*****	4.9E-2	6.3E-4	2.0E-1		1.5E-1
St. 16	1.4E+0	6.1E-3	*****	2.0E-1	9.6E-1	6.1E-1		8.2E-1
St. 17	1.9E+0	3.9E-1	*****	9.1E-1	9.6E-1	3.1E-2		1.0E+0

Press one of the labeled keys according to your choice

help	reject	station	reject	xponder	max err	(stat)	reject	N stats
max err (dist)	reject	n dist	cancel	lgraphic	lgraphic	lgraphic	lend	rejections *
St. 18	6.6E-1	4.5E-1	*****	4.9E-1	1.0E-1	4.6E-1		4.7E-1
St. 19	*****	4.4E-1	*****	6.1E-1	*****	8.3E-1		6.5E-1
St. 20	*****	3.0E-1	3.0E-2	2.1E-1	1.3E-1	4.3E-1		2.6E-1
St. 21	2.1E+0	7.0E-2	*****	1.6E+0	2.9E-1	2.3E-1		1.2E+0
St. 22	3.2E-1	2.4E+0	4.0E+0	4.4E-1	1.7E+0	1.3E+0		2.1E+0
St. 23	1.7E+0	4.5E-1	*****	2.9E+0	1.7E+0	6.6E-1		1.7E+0
St. 24	2.4E+0	6.0E-1	4.2E+0	2.0E+0	1.4E+0	1.9E+0		2.4E+0
St. 25	*****	2.9E-1	2.9E+0	7.0E-1	1.5E+0	2.2E+0		1.8E+0
St. 26	4.3E-1	4.9E-1	3.5E-2	6.2E-1	2.7E-1	1.3E-1		3.9E-1
St. 27	2.8E-1	1.4E+0	3.0E-1	1.3E+0	2.9E-1	1.2E-1		8.1E-1
St. 28	3.3E-1	1.5E-1	7.7E-1	7.0E-1	3.1E-1	9.7E-1		6.1E-1
St. 29	2.6E+0	1.8E-1	8.1E-1	6.3E-1	6.6E-1	1.3E+0		1.3E+0
St. 30	*****	2.5E+0	3.6E+0	1.0E+0	3.8E-1	3.3E+0		2.5E+0
St. 31	*****	5.3E-1	1.4E-2	-----	5.6E-1	6.6E-1		5.1E-1
Xp RMS	1.6E+0	8.6E-1	2.3E+0	9.7E-1	7.4E-1	1.2E+0		

----- : distance not known \*\*\*\*\* : distance rejected  
 first distance: st 24 to Xponder 3 worst station : 30

RELATIVE CALIBRATION (Cont'd)

relative position of the transponders

Xp01 :	0.00	0.00	50.00
Xp02 :	3124.32	0.00	50.00
Xp03 :	3597.04	-2198.90	50.00
Xp04 :	3634.68	2118.33	50.00
Xp05 :	-638.34	-2057.05	50.00
Xp06 :	-521.83	2220.40	50.00

Square residum 2.37E+02 Valid dist 153 Variance : 1.24E+00

## Absolute Positions of Transponders

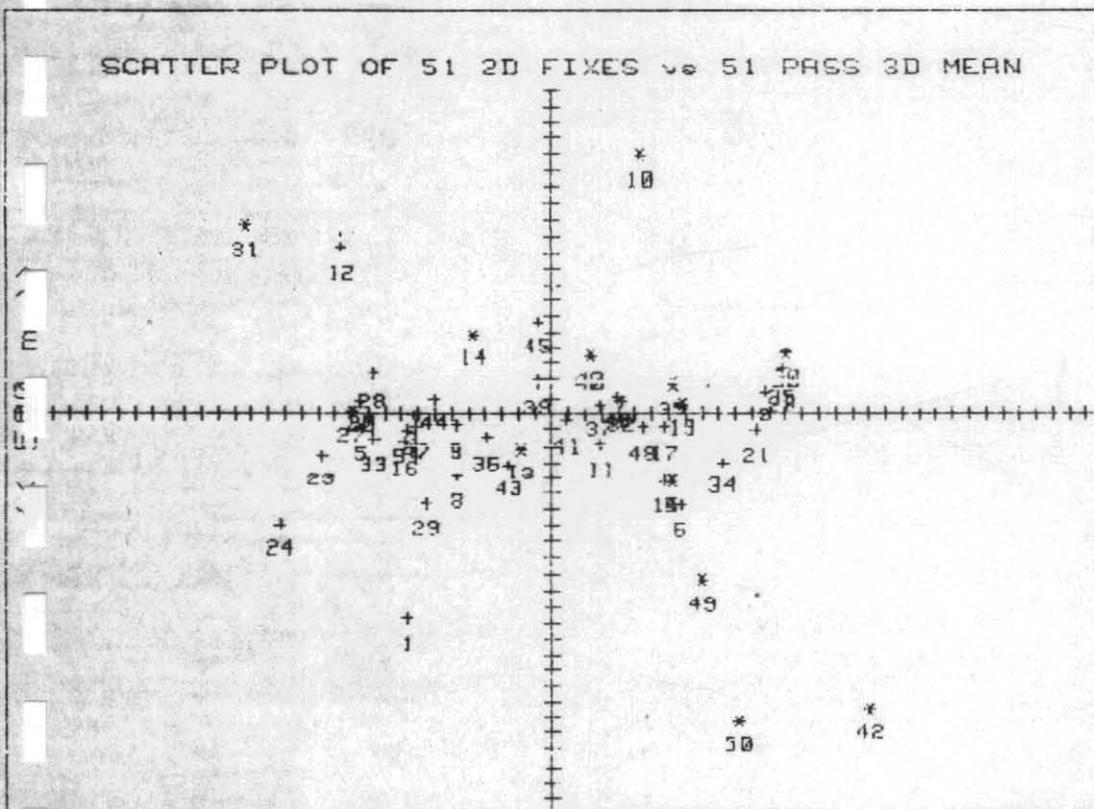
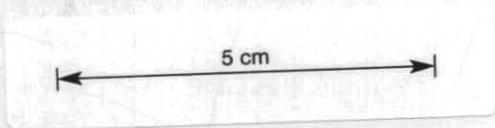
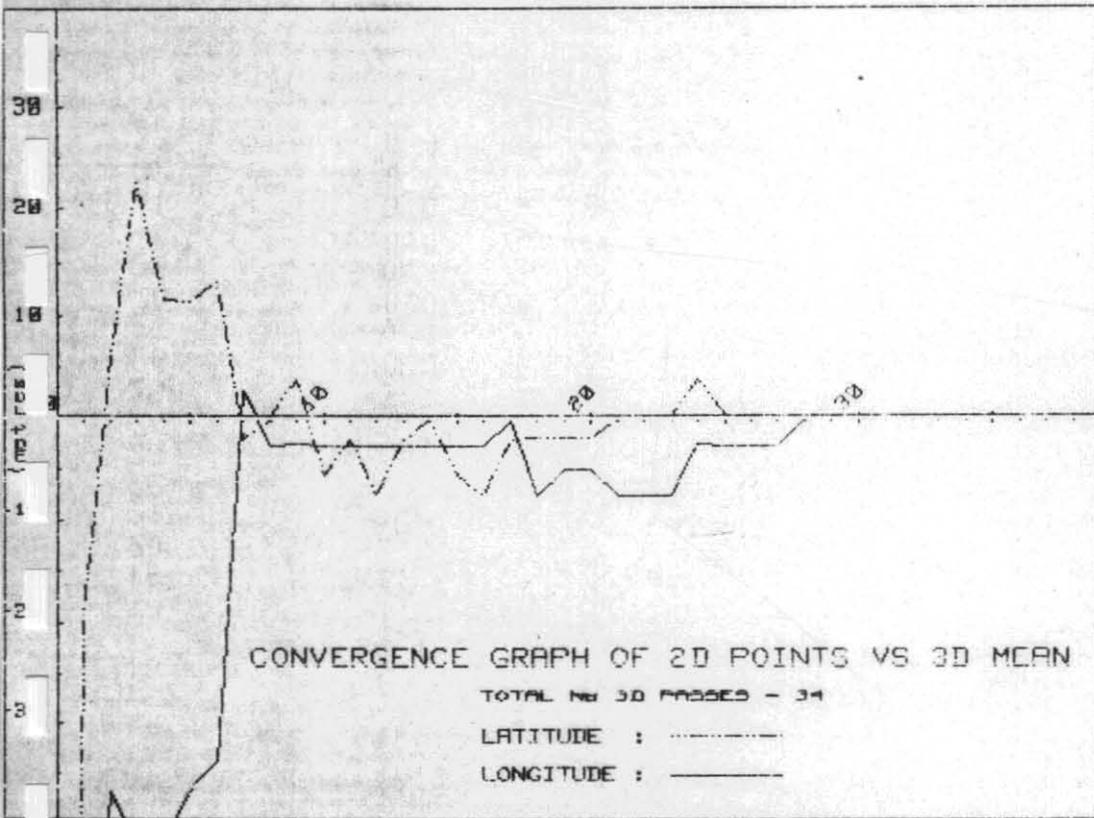
	On File	Calculated	Difference		
Xp 1 :09:	411735.70	5584879.70	411738.48	5584858.77	21.11
Xp 2 :11:	413770.60	5582498.90	413793.77	5582505.65	24.13
P 3 :01:	412500.00	5580700.00	412448.61	5580703.10	51.48
P 4 :08:	415700.90	5583493.40	415724.95	5583514.78	32.18
Xp 5 :07:	409770.50	5584000.00	409769.27	5583986.34	13.71
Xp 6 :16:	413064.90	5586709.10	413067.53	5586712.45	4.26

APPENDIX B

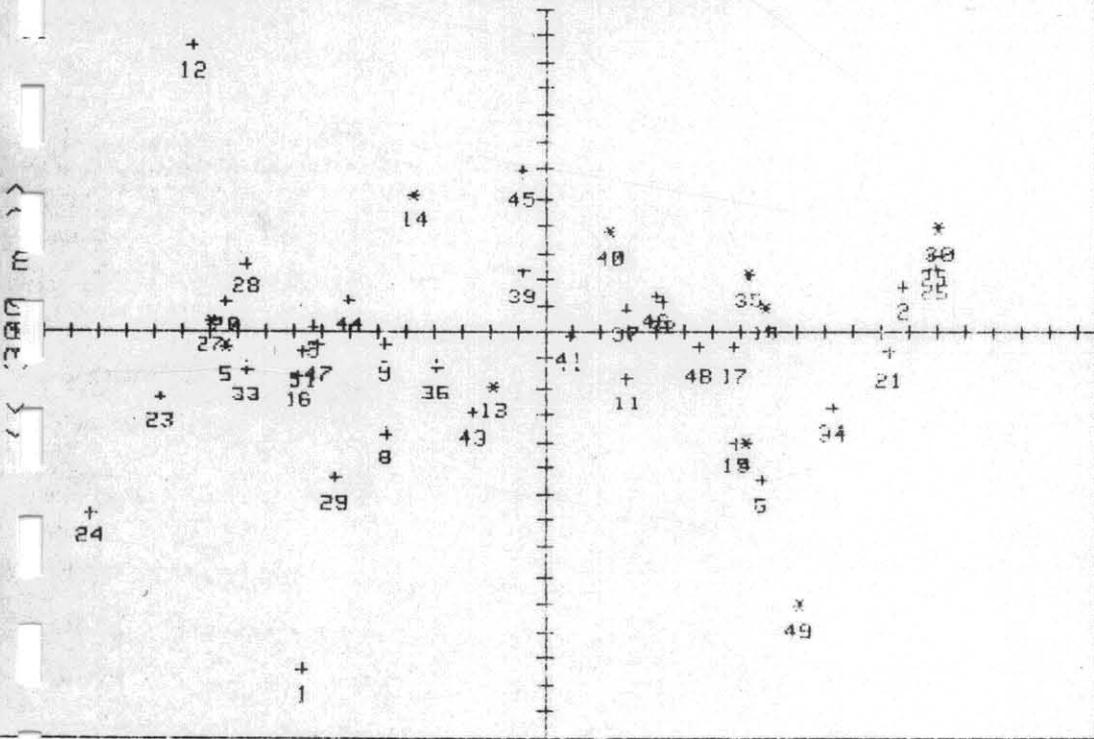
SATELLITE (2D & 3D) POSITIONING

## 3D SCATTER PLOT COMPONENTS RELATIVE TO MEAN

Pass #	DEast	DNorth
1	-599.9	-167.6
2	-19.0	-109.6
3	5.9	-36.4
4	22.5	-41.1
5	11.5	-41.2
6	11.4	-36.3
7	13.2	-33.9
8	-1.9	2.4
9	0.0	-2.4
10	3.7	-2.4
11	-5.5	-2.5
12	-1.8	-2.5
13	-7.3	-2.5
14	-1.8	-2.5
15	0.0	-2.4
16	-5.5	-2.5
17	-7.3	-2.5
18	-1.8	-0.0
19	-1.8	-7.3
20	-1.8	-4.9
21	-1.8	-4.9
22	.1	-7.3
23	.1	-7.3
24	.1	-7.3
25	3.7	-2.4
26	0.0	-2.4
27	0.0	-2.4
28	0.0	-2.4
29	0.0	0.0
30	0.0	0.0
31	0.0	0.0
32	0.0	0.0
33	0.0	0.0
34	0.0	0.0



SCATTER PLOT OF 51 2D FIXES vs 51 PASS 3D MEAN



5 cm

APPENDIX C

NAVIGATION LOG

JOB NO: K096

## NAVIGATION LOG

Page: 1SPHEROID: WGS 72; a: 6378135; b: .....Date: 31/08 - 01/09 1985PROJECTION: UTM; C.M.: 147 °E; Scale Factor @ C.M.: 0.9996

Local Time/GMT .....

False E: 500 000 m; False N: 10 000 000 m; False Lat.: ..... N/S; False Long.: ..... E;

Velocity Factor: .....; Fix Interval: .....; Fix Increment: .....; Mobile Height: .....

STATIONS (8):

Name	Easting (m)	Northing (m)	Delay	Serial No.	Ht.	Name	Easting (m)	Northing (m)	Delay	Serial No.	Ht.
CODE 9	411 887.6	5584 648.7	-	488		CODE 7	409 915.1	5583 783.6	-	486	
" 11	413 934.0	5582 287.9	-	644		" 16	413 223.5	5586 497.4	-	595	
" 1	412 582.1	5580 490.3	-	766							
" 8	415 868.9	5583 289.7	-	695							

LINE	Easting	Northing	Fix No.	Time	Gyro	Track	File	Tape No.	Config.	Remarks
SOL L29	414 668	5584 542	1	00:09	230			A		
EOL	411 604	5581 971	53	00:43						
SOL L31	414 797	5584 389	15	01:02	050			A		
EOL	411 733	5581 818	64	01:35						
SOL L23	411 219	5582 431	65	08:56	050			A		
EOL	414 283	5585 002	106	09:28						
SOL L21	414 155	5585 155	108	09:58	230			A		OFFLINE 100M at 3KM MARK
EOL	411 090	5582 584	149	10:31						
SOL L27	414 540	5584 695	167	18:18	230			A		OFFLINE 100M at START
EOL	411 476	5582 124	222	18:55						
SOL L25	414 411	5584 848	223	19:03	050			A		
EOL	411 347	5582 277	271	19:34						
SOL										
EOL										
SOL										
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SOL										
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EOL

APPENDIX D

COMPUTATIONAL DATA

COMPUTATIONAL DATA

Computational co-ordinates of proposed position from  
A.N.S. to W.G.S. 72:

## Proposed Position (A.N.S.):

Latitude : 39° 53' 36.96" South  
Longitude : 145° 58' 42.20" East

Converting the above position to spatial co-ordinates:

X - 4 061 507.999  
Y 2 741 751.217  
Z - 4 068 942.641

Shifts from A.N.S. to W.G.S. 72:

$\Delta X$  - 124.2  
 $\Delta Y$  - 28.8  
 $\Delta Z$  + 137.2

Spatial co-ordinates of proposed location in W.G.S. 72:

X - 4 061 632.199  
Y 2 741 722.417  
Z - 4 068 805.441

Converting new spatial co-ordinates to geographicals  
and cartesian:

## Proposed Position (W.G.S.72):

Latitude : 39° 53' 31.7159" South  
Longitude : 145° 58' 46.130" East  
E : 412 751.061  
N : 5 583 716.515

CONVERTING FINAL DRILL STEM LOCATION FOR SATELLITE-  
ACOUSTIC POSITIONING SYSTEM

## Final Drill Stem Location (W.G.S.72):

E : 412 745.5  
N : 5 583 723.4  
Latitude : 39° 53' 31.4905" South  
Longitude : 145° 58' 45.899" East

## Converting to spatial co-ordinates:

X - 4 061 630.732  
Y 2 741 728.039  
Z - 4 068 797.994

## Shifts from W.G.S.72 to A.N.S.:

$\Delta X$  + 124.2  
 $\Delta Y$  + 28.8  
 $\Delta Z$  - 137.2

## Spatial co-ordinates of drill stem in A.N.S.:

X - 4 061 506.532  
Y 2 741 756.839  
Z - 4 068 935.194

## Final drill stem location (A.N.S.):

E : 412 653.668  
N : 5 583 544.119  
Latitude : 39° 53' 36.7346" South  
Longitude : 145° 58' 41.969" East

## Final location to proposed:

Distance : 9 metres  
Bearing : 141°

SATELLITE 3D POSITION

Final position of satellite antenna (DIAMOND. M. EPOCH) WGS72:

E : 412 648.86  
N : 5 583 688.26

Satellite antenna to drill stem:

Distance : 34.49 metres  
Bearing : 25.2276°

Final 3D position of drill stem (W.G.S.72):

E : 412 663.56  
N : 5 583 719.46  
Latitude : 39° 53' 31.6132" South  
Longitude : 145° 58' 42.447" East

Converting to spatial co-ordinates:

X - 4 061 578.828  
Y 2 741 791.951  
Z - 4 068 796.857

Shift from W.G.S. 72 to A.N.S.:

$\Delta X$  + 124.2  
 $\Delta Y$  + 28.8  
 $\Delta Z$  - 137.2

Spatial co-ordinates of final location in A.N.S.:

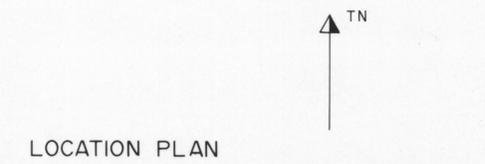
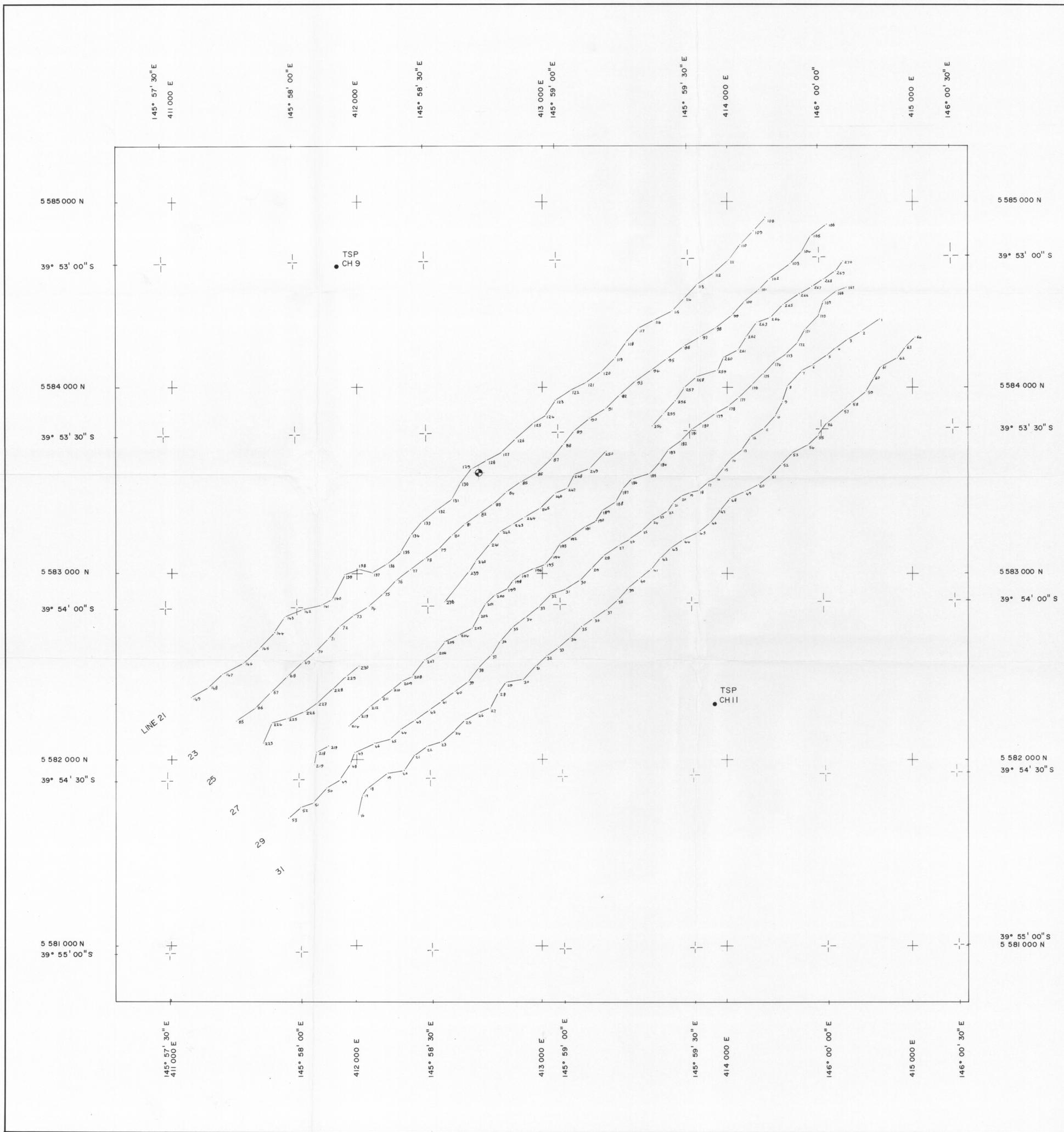
X - 4 061 454.628  
Y 2 741 820.751  
Z - 4 068 934.057

Final '3D' drill stem location (A.N.S.):

E : 412 571.730  
N : 5 583 539.400  
Latitude : 39° 53' 36.8573" South  
Longitude : 145° 58' 38.517" East

Final location to Proposed:

Distance : 87.5 metres  
Bearing : 91.4°

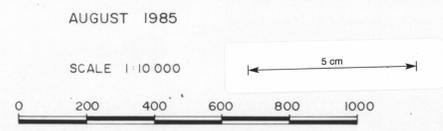


LEGEND:

- LOCATION OF TILANA-1  
GEOGRAPHICAL 39° 53' 36.96" S  
145° 58' 42.20" E  
U.T.M. 5583537.2 m N  
412659.2 m E
- SURVEY LINE, SHOWING POSITION OF SATELLITE ANTENNA AT EACH FIX POINT

SURVEY DATA

DATUM	AUSTRALIAN GEODETIC
SPHEROID	AUSTRALIAN NATIONAL
PROJECTION	UNIVERSAL TRANSVERSE MERCATOR ZONE 55
CENTRAL MERIDIAN	147° EAST
FALSE NORTHING	10 000 000 m AT EQUATOR
FALSE EASTING	500 000 m AT C.M.



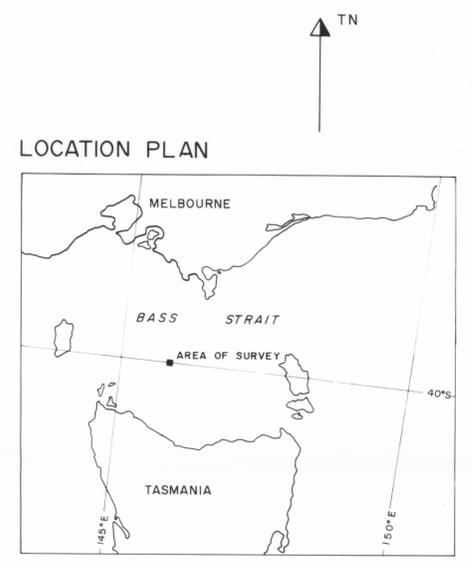
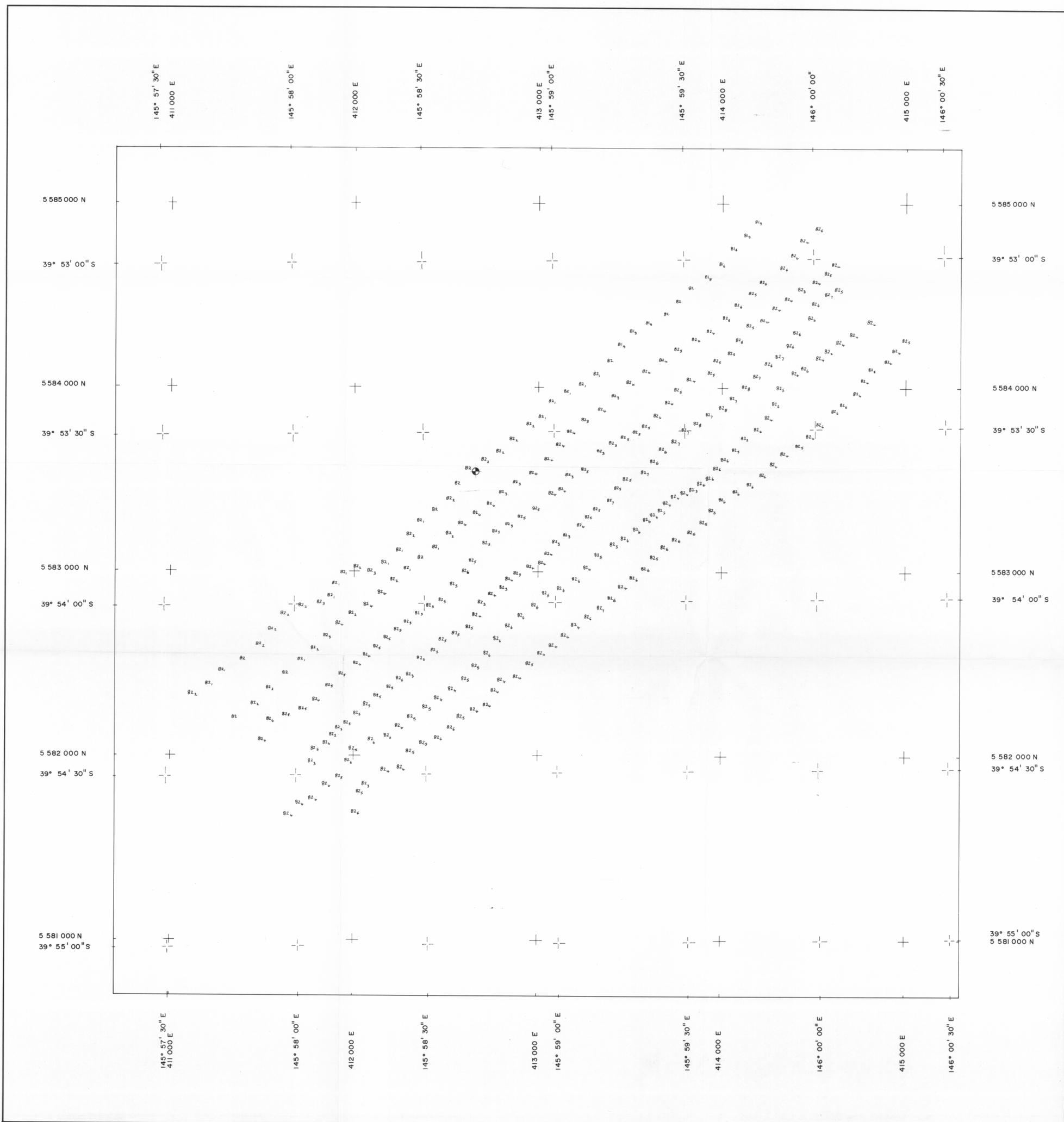
AMOCO AUSTRALIA PETROLEUM COMPANY

SITE SURVEY ON  
LOCATION TILANA-I

POSITIONING PLAN OF  
SATELLITE ANTENNA

327063 OR-0330

	MAP No 1
	JOB No K096/85/AM

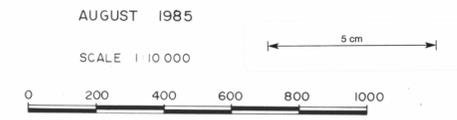


**LEGEND:**

- ⊗ LOCATION OF TILANA-I  
GEOGRAPHICAL 39° 53' 36.96" S  
145° 58' 42.20" E  
UTM. 5583537.2 m N  
412659.2 m E
- ⊙ SOUNDING IN METRES BELOW MEAN SEA LEVEL STANLEY

**SURVEY DATA**

DATUM	AUSTRALIAN GEODETIC
SPHEROID	AUSTRALIAN NATIONAL
PROJECTION	UNIVERSAL TRANSVERSE MERCATOR ZONE 55
CENTRAL MERIDIAN	147° EAST
FALSE NORTHING	10 000 000 m AT EQUATOR
FALSE EASTING	500 000 m AT C.M.



AMOCO AUSTRALIA PETROLEUM COMPANY

SITE SURVEY ON  
LOCATION TILANA-I

BATHYMETRIC PLAN

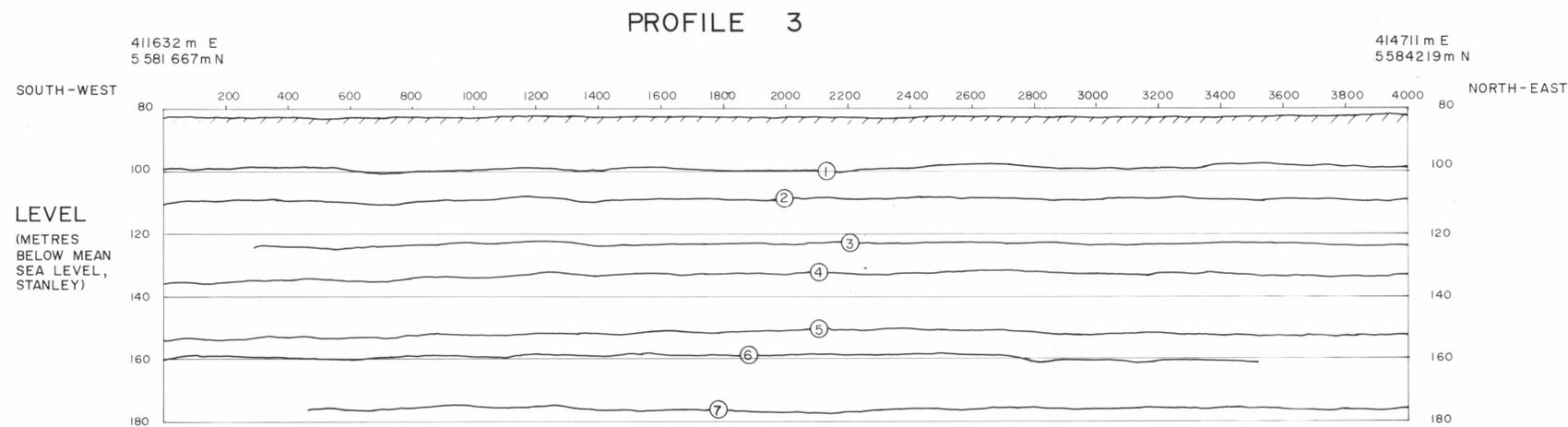
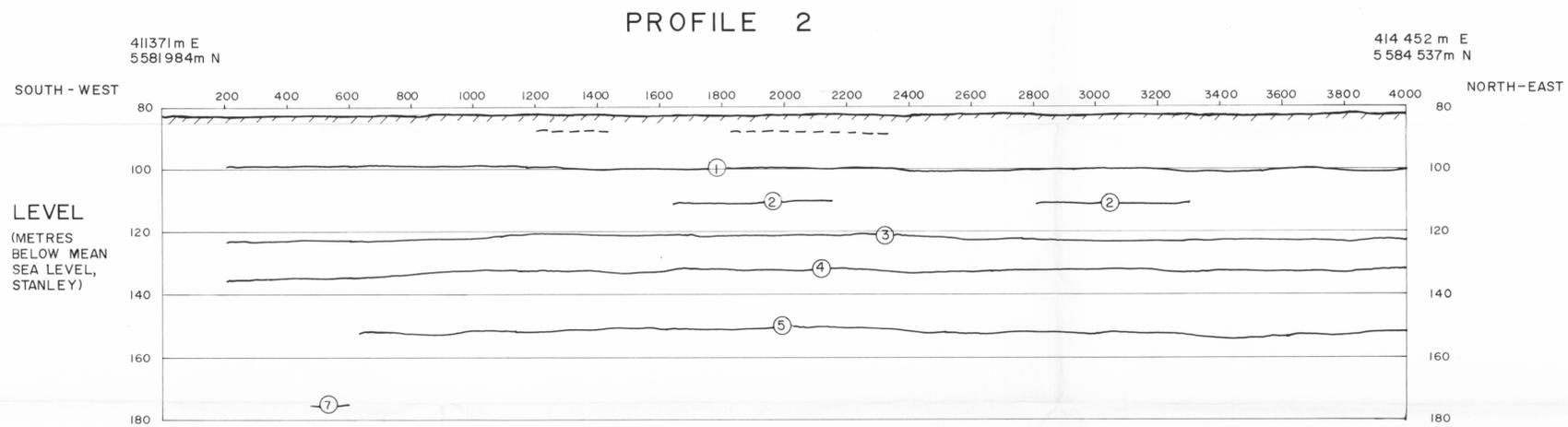
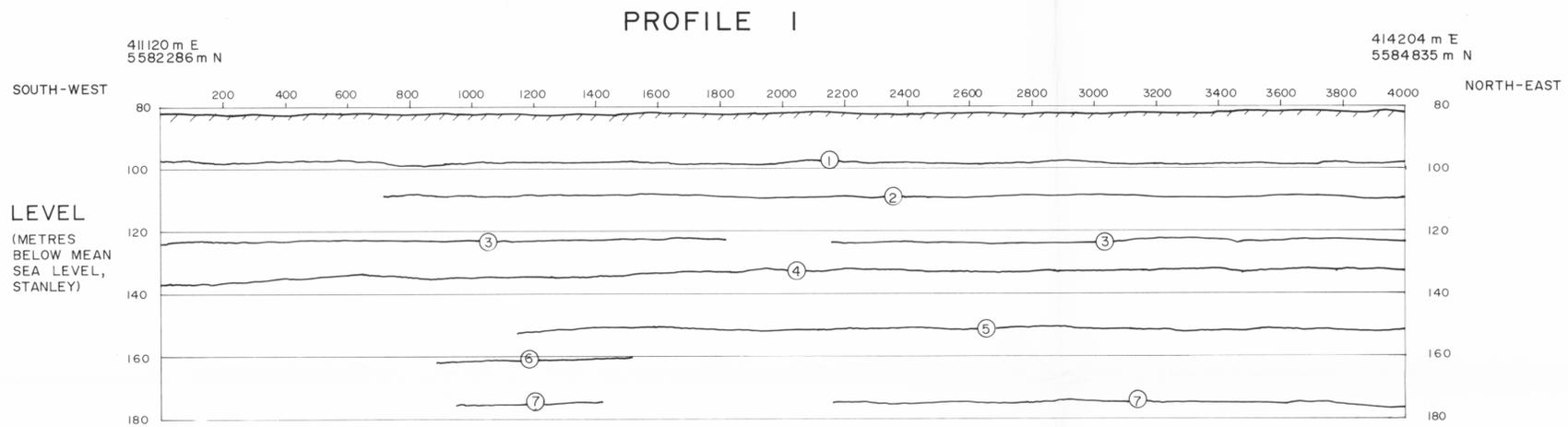
327064 OR-C330



GEOMEX SURVEYS

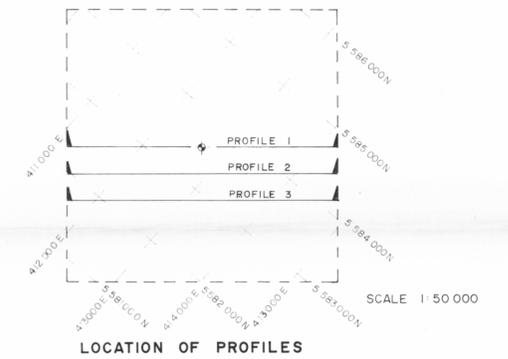
MAP No 2

JOB No K096/85/AM



**LEGEND:**

- SEABED
- MAJOR REFLECTING HORIZONS (AND IDENTIFYING NUMBER).
- MINOR REFLECTORS



**SURVEY DATA**

DATUM	AUSTRALIAN GEODETIC
SPHEROID	AUSTRALIAN NATIONAL
PROJECTION	UNIVERSAL TRANSVERSE MERCATOR ZONE 55
CENTRAL MERIDIAN	147° EAST
FALSE NORTHING	10 000 000m AT EQUATOR
FALSE EASTING	500 000m AT C.M.

SCALE: HORIZONTAL 1:10 000  
VERTICAL 1:1 000

AUGUST 1985



AMOCO AUSTRALIA PETROLEUM COMPANY

SITE SURVEY ON  
LOCATION TILANA-I

SEISMIC SECTIONS

327065 OR-0330



GEOMEX SURVEYS

MAP No 3

JOB No K096/85/AM