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MAGNETOMETER SHORE STATIONS FOR THE CONTINENTAL MARGIN SURVEY, 1970-73.

by

J.C. MUTTER

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SUMMARY

Twelve shore station installations were erected and operated by Compagnie Generale de Geophysique for BMR during the period from September 1970 to January 1973, while The Gulf of Papua and Bismarck Sea Survey and the Continental Margin Survey were in progress. A magnetometer and VLF equipment were operated at the stations.

This report presents all the data BMR has on the magnetometer locations, the method of siting stations, operational procedures used by the contractor, a description of the equipment used and its performance, and a summary of the quality of data obtained at each site.

Data recorded are generally of good standard, although recording at three of the stations was poor. Station positions as listed are of uncertain accuracy, and station descriptions have been compiled from the best information available.

A set of siting requirements and operational standards has been drawn up to provide a guide to good operation and reporting at a magnetometer shore station in future.

INTRODUCTION

As part of its contract for The Gulf of Papua and Bismarck Sea Survey and the Continental Margin Survey, Compagnie Generale de Geophysique (C.G.G.) installed and operated a shore station concurrently with the survey work. The station was moved as surveying progressed, so that it was always near to the survey area; twelve locations were used to cover more than 100,000 nautical miles of survey, conducted between September 1970 and January 1973 (Plate 1). A magnetometer and VLF radio receiving equipment were operated at the shore station. The equipment recorded the total magnetic field and VLF phase and amplitude. The VLF equipment was used to measure long term drift and the diurnal variation in radio transmissions which were used as an auxiliary navigation system for the survey vessel.

This report presents all the data BMR has on the magnetometer locations, the method of siting stations, the operational procedures used by the contractor, a description of the equipment used and its performance, together with a summary of the quality of data obtained at each of the sites. Operational procedures are proposed for future contractors to follow, to ensure that shore stations are operated at a standard satisfactory to BMR.

A proton precession magnetometer was used to measure the total magnetic field. Because the magnetic field is strongly influenced by the presence of ferromagnetic material great care was needed in siting the magnetometer. In most cases,before the sensor was installed, the site was surveyed to determine roughly the strength of local magnetic gradients. No similar restrictions applied to locating the VLF equipment, but for ease of operation this was generally located near the magnetometer. The siting of all the equipment was restricted to some extent by the need for AC power. An accurate position for the sensor only was recorded.

Nine major ports were suggested by BMR in the contract as suitable places for shore stations, "the station to be currently at the closest of these ports to the area of operation". This selection of ports was not intended to be final and was to be altered if necessary. The ports suggested gave a guide to the expected frequency with which the shore station would be shifted and the approximate spread of sites necessary to cover the survey area adequately. In the course of events, only two of the suggested sites were used and the station spacing varied considerably; on the east coast six stations were installed, and on the west coast only three (Plate 1). The time spent at a particular station ranged from 15 to 109 days, representing an equivalent survey mileage of 2820 to 16 290 nautical miles. In many cases the shore station was a considerable way from the furthest parts of the survey area, and this has given rise to concern over the applicability of the magnetic diurnal measured on shore to magnetic readings made at sea, hundreds of miles away. The problem has been investigated by the writer, using harmonic analysis techniques, and a report is being compiled.

Shore stations were operated 24 hours a day while surveying was under way. The site was usually visited regularly, as the equipment was normally close to the operator's residence. During visits the records were annotated and some brief checks made. A record chart was removed at the start of every GMT day, and from this, values were scaled at the hour points, an average removed, and the magnetic diurnal sent to the ship for on-board processing. Ten-minute values were also scaled off, and recorded on coding sheets for future processing.

The preliminary hourly diurnal values recorded at the shore station have been used in the preparation of contour maps and profiles. The quality of the diurnal data is variable; Port Moresby records are unusable because of level shifts in the data; records from Mackay are poor, owing to poor functioning of the magnetometer; but records from stations on the south and west coasts are generally of very good quality. This variability in quality of shore station data is passed on to the maps and profiles.

With regard to the ship data, a noise analysis has been performed by Garnett (pers. comm.), Watt (in prep.) has investigated the phenomenon of jumps in the magnetic data at turns in the survey tracks, and several authors have studied histograms of magnetic misties (Tilbury, pers. comm.; Mutter, 1974; Willcox, 1974). The errors in magnetic field data recorded at sea are therefore, as a result of these studies, relatively well known, but the quality of shore station data has not been investigated before now. Apart from their immediate use for correcting data collected aboard ship, the shore station data are of interest to scientists who study geomagnetic phonomenon such as magnetic storms and other disturbances.

The fact that twelve sites were occupied over the course of $2\frac{1}{2}$ years means that twelve sites should now be available for reoccupation during future surveys. Reoccupation at later periods can provide secular drift data useful for determining regional field variations.

Table 1. Basic Location Data

Station	Lat. S.	Long. E.	IGRF+ (nT)	Shore Station coverage of Survey SS. DD*	Equiv. Mileage	Comments
Port Moresby	09°25'	147°09'	43 082	05.01 - 10.09	16 285	Reoccupiable
Hobart	42°50.6'	147°30.4'	63 059	11.01 - 11.36	2 996	Difficult to reoccupy
Eden	37°04.2'	149°53.1'	60 038	12.01 - 12.16	2 818	Difficult to reoccupy
Coff's Harbour	30°16.3'	153°08.3'	55 789	12.20 - 13.15	12 546	Difficult to reoccupy
Mackay	21°01.5'	149°09.25'	50 456	13.19 - 14.22	13 155	Difficult to reoccupy
Cairns	16°45.70'	145°40.52'	48 003	14.28 - 14.58	7 727	Difficult to reoccupy
Launceston I	41°24.44'	147°06.07'	62 492	14.76 - 15.45	5 755	Reoccupiable
Launceston II	41°33.30'	147°16.10'	62 536	15.86 - 16.18	0	Reoccupiable
Coffin Bay	34°27.47'	135°28.60'	60 300	16.22 - 16.69	7 179	Reoccupiable
Albany	35°01.17'	117°54.36'	60 597	16.77 - 17.10	3 116	Not reoccupiable
Onslow	21°38.25'	115°06.58'	52 891	17.16 - 18.11	10 820	Reoccupiable
Darwin	12°25.50'	130°49.90'	46 447	18.19 - 18.45	3 990	Difficult to reoccupy
Emu Point	35°00.00'	117°56.00'	60 598	18.53 - 19.24	8 092	Reoccupiable

* - SS is the BMR Survey number and DD is the BMR day number.

+ - International Geomagnetic Reference Field (Cain, et. al., 1968).

LOCATION DATA

Latitudes and longitudes for the magnetometer sensor head have been provided by C.G.G. (Table 1), but without details of the method of position fixing. One of the shore station operators (Amar, pers. comm.) has stated that the position was usually obtained from Port Authorities or the local Surveyor's Department, and in other cases a position was scaled off the most accurate map available. Because of a lack of information about position fixing, limits cannot be put on the position data. The precision of the positions given by C.G.G. ranges from 1 minute to .01 minutes of latitude and longitude, equivalent to about 1 mile to 15 metres, but the precision is not known to bear a meaningful relation to the accuracy with which the stations were located.

To locate any of the shore stations, reference should be made to the sketches in Plates 2 to 15. The positions given in Table 1 should be used only as a check. The contract did not require C.G.G. to made a sketch of the shore station location. The sketches shown in Plates 2 to 15 have been derived from a number of sources; the Port Moresby diagram was got from a sketch and photographs provided by the Observer-in-Charge of BMR's Port Moresby Observatory; the Hobart information was got by an officer of the Marine Group, while on holiday in Hobart in 1974; the rest of the information was given by Ms Amar who operated the shore station during most of the survey. Ms Amar's data are entirely from memory, prompted by maps of the areas and photographs taken at the time for her own amusement and not for the purpose of site relocation. Since the sketches were not made on-site some inaccuracy probably exists in their detail. However, Ms Amar spent a considerable time at each site, visiting it several times a day, so the important features of the sketches should be substantially correct.

The following descriptions of the sites are, in small part, from correspondence between the shore station operator and C.G.G.'s Canberra Office, and largely from the recollections of Ms Amar and BMR officers who visited the shore stations during port calls.

Port Moresby

The shore station was located on Tabletop Mountain, in a reserve used by BMR's Port Moresby Geophysical Observatory. The magnetometer and chart recorder were in an instrument shelter to the left and uphill of a track, leading to the "Absolute" hut from the main track entering the reserve. The instrument shelter normally housed the observatory's batteries and trickle-charger. The "Absolute" hut can be seen from the instrument shelter, as shown in Plate 3.

The magnetometer sensor head was about 20 metres further uphill from the instrument shelter, as shown in Plate 2. Plates 2 and 3 should be sufficient to permit relocation of the site to within about 3 metres. The contractor has not provided information on any site survey which he may have conducted, so the 3 metre error in position cannot be related to a total magnetic intensity error, and this cannot be assumed to be small.

Hobart

The station was in a field next to Hobart airport (Plate 4), and the magnetometer and chart recorder, in a hut in which the University of Tasmania keeps radio astronomy equipment. The sensor was to the rear of the hut in a clearing in rough scrub. No details of a site survey are available so it cannot be assumed that magnetic gradients are low.

This site would be difficult to relocate with any precision. The area where the sensor head was installed is not distinctive in any way, being convered in low scrub of uniform appearance. Relocation to within about 6 metres should be possible. However, this position error cannot be related to magnetic field error, owing to lack of site survey information.

Eden, Coffs' Harbour, Mackay, Cairns

The only information on these stations is the set of sketch maps shown in Plates 5 to 8. No written information is available, or details of site surveys. The sketch for Mackay applies to the second of two sites used; no information exists for the first site. It is impossible to give a reasonable estimate of how accurately these sites could be relocated. Any party wishing to reoccupy these locations should be extremely careful, and make a site survey of the vicinity to ensure that errors caused by inexact relocation are within tolerable limits.

Launceston I and Launceston II

Site I: The shore station was in a field about 30 metres from Stamford Farm, 1.6 kilometres from the Tamar River (Plate 9). The area was carefully checked and found to be free from ferromagnetic material. The sensor was placed at its full cable length (180m) from the caravan in which the magnetometer and chart recorder were kept. A rought site survey was conducted; the sensor was moved in a circle of 10 metre radius, centred on the site. The magnetic variation was less than 2 gammas. Relocation of this site should be possible to within reasonable limits of position accuracy.

Site II: After the shore station had been operating at site 1, for about 45 days during the first two cruises of survey 15, it was dismantled and a new site sought. This was not found until 40 days later, by which time survey 15 had finished. Site II provided no data of use in the processing.

Site II is in Evandale, Tasmania, and the sketch in Plate 10 is the only available location data.

Coffin Bay

The station was behind the Beachcomber Motel Units, from which power was obtained. The sensor was about 200 metres from the units and about 30 metres from the tent in which the magnetometer and chart recorder were kept. The sensor was moved in a circle of 10 metre radius and gave magnetic variations less than 2 nT.

The sketch in Plate 11 and the fact that local gradients are very shallow allow the site to be relocated to a degree of accuracy sufficient for most purposes.

Albany-Middleton Beach

The station was in a field directly behind flat No. 3 in the C.W.A. flats, Flinders Parade, Middleton Beach, W.A. The field is opposite the local golf course. The exact position of the site (Plate 12) is umimportant, as an Old Peoples Home has been built on the site and relocation is not possible.

Onslow

The equipment was in a shed behind the police station, but away from the gaols and other habitations (Plate 13). The sensor was placed about 35 metres from the shed and well clear of any ferromagnetic material. When moved in a circle of 10 metre radius, it showed the local magnetic gradients to be insignificant.

The proximity of clearly identifiable landmarks which are presumably quite permanent, and the shallowness of the local magnetic gradient make this an easily reoccupiable location.

Darwin

The sensor was near the Fannie Bay Hotel on the local golf course. It was in the "light rough", just off one of the fairways (Plate 14). Magnetic gradients in the vicinity are stronger than normally tolerated, being about 0.5 nT per metre.

Some difficulty would probably be found in relocating the site as few clearly identifiable landmarks were available. This uncertainty, together with the relatively high local gradients makes this site unsuitable for reoccupation.

Albany-Emu Point

The equipment was in a field behind the Emu Point Motel (Plate 15). The sensor was approximately 75 metres from the Motel's laundry. A rough site survey showed the field gradients in a 10 metre radius of the sensor to be very low.

Relocation to an accuracy sufficient for most purposes should be possible.

OPERATIONS, EQUIPMENT PERFORMANCE AND DATA QUALITY

Operations

Once installed the shore station was operated continuously during surveying. Major exceptions to this occurred on four occasions. Days 64 to 76 of Survey 14 have no diurnal recordings. During this time the shore station was being moved from Cairns to Launceston. There is a forty day gap in recording between the end of monitor operations at Launceston I and the start of Launceston II. During this time the ship was re-surveying an area of poor quality seismic work on the east coast. Three days monitor recording in the Great Australian Bight was missed while the shore station was being moved from Coffin Bay to Albany. Similarly, five days recording north of Perth was missed while the station was being moved from Albany to Onslow. Plate 16 shows the survey lines which have no simultaneous diurnal recording.

The operator visited the station three or four times each day, depending on the nearness of the station to the operator's residence. At each visit the record was annotated with the time and total field value. Checks were made that the ink pen in the chart recorder was not clogging and had sufficient ink for several hours operations. Other checks included the amount of paper available and the chart speed, time mark generator etc. BMR was not provided with any documentation describing what checking was done and when. However, it is understood that the above checks were made routinely. Other more detailed checks on the equipment's functioning were probably carried out and possibly documented but no relevant information has been provided to BMR.

At the end of each GMT day a record was removed. Values were scaled off at the hour points and recorded on a log sheet provided by BMR. A diurnal value at the hour points was sent to the ship by radio. This was computed by removing an average field value from the observed value. The average value was generally kept constant for a given shore station. However, in some cases it was varied daily, while in others the average removed was such that the resulting diurnal had an average value of several hundred nT. These were incorrect procedures and had to be remedied at a later stage during data processing. Values at the ten minute points were also scaled off and recorded on coding sheets to be used for final reductions. These were provided by C.G.G. in written form on coding sheets, as punched cards and on magnetic tape.

Equipment Performance

The basic components of the equipment used for magnetic monitoring are shown schematically in Plate 17. While the shore station was at Port Moresby, a Sud-Aviation magnetometer and a Survogor chart recorder were used. The width of the chart recorder was 20cm and it ran at a chart speed of about 12.5cm/hour. Time marks for the chart recorder were obtained from the nearby BMR Port Moresby Geophysical Observatory.

When the shore station was at Hobart, Eden, Coffs Harbour and Mackay, a Varian V4970 magnetometer and G.1000 recorder were used. The chart width was 5 inches and operated at chart speeds from 17.5cm/hour to 150cm/hour. The recorder time marks were derived from a Sultzer clock, whose frequency was counted down by the "CGG Box", then converted to a timing mark signal by the "Diurnal Box" as shown in Plate 17. After the move to Cairns the Varian G.1000 recorder was replaced by a Westronics dot recorder. This recorder has a 10 inch chart width and usually operated at a chart speed of about 8 inches/hour.

The magnetometer was normally operated on a 10 second cycling period and the full scale width of the chart recorder was always 99 nT. This chart width gave sensitivities of 4.0 nT/cm or 2.0 nT/cm, depending on the recorder used. In general the magnetometer operated very faithfully; most breakdowns were very minor in nature, and short lived. However, for reasons which are now obscure, the cycling period of the magnetometer was kept at 1 minute instead of the required 10 seconds for a period of more than 120 days spread over the time the shore stations were at Coff's Harbour and Mackay. During this same period trouble was experienced with the paper speed of the Varian G.1000 chart recorder; paper often jammed and this caused failure of the paper drive mechanism. This in turn required that the paper speed by greatly increased, and this, combined with the 1 minute cycling rate makes these records very difficult to handle and read!

In general the Varian G.1000 recorder operated less reliably than either of the other two used. Paper often jammed, the pen would tear the paper or smudge and timing marks were often not written. The Westronics recorder was by far the best, with only minor inking problems.

Data Quality

The following is a summary review of the data quality obtained at each of the shore stations. The quality is basically dependent on the performance of the equipment and to some extent the standard of operator control over the equipment.

Port Moresby

All recordings made at Port Moresby are considered of such doubtful value in data reduction that they have not been used. Instead, the records from BMR's Port Moresby Geophysical Observatory were employed. The shore station records were not used because they contain steps in the recorded magnetic trace of the order of 10 nT (Plate 18). These steps occurred unpredictably, although most often during daylight hours. The time and effort involved in sorting out these steps would be considerable and it is possible that the true field value could not be recovered.

Apart from the steps, data from Port Moresby suffer from fairly high noise levels. Peak to peak noise amplitude varies from about one nT, at best, to over six nT. The common level is 3 to 5 nT. The noise level generally increases during the hottest part of the day, so it is possible that the noise resulted from overheating of the fluid in the sensor.

These records may be of use to people studying geomagnetic phenomena such as storm disturbances, but are of little value in data reduction.

Hobart

Records from the Hobart shore station are generally of very good quality. Noise levels of one to two gammas were recorded (Plate 19). Only the occasional lack of 10 minute time marks degrades the record quality.

Several days in which the magnetic field was influenced by disturbance phenomenon are well recorded. The records are useful for both data reduction and geomagnetism studies.

Eden

Records from the Eden shore station are also of generally good quality, although the type of record written is variable. This varies from ink pen on 5 inch paper at 17.5 cm/hour to a trace on pressure sensitive paper, 5 inches wide at 150 cm/hour. The latter are very difficult to handle, but the recorded trace shows low noise levels and hence the data must be considered of good quality. During three days the magnetometer was operated on a one minute cycling period and records from those days are of poor quality.

Coff's Harbour and Mackay

Although variable, the quality of data recorded at these two locations is generally poor (Plate 20).

Records from the first 40 days at Coff's Harbour are written on pressure sensitive paper at a variable, but usually slow, paper speed. The magnetometer, however, was operated at a one minute cycle period, and the recorded trace shows oscillatory noise of about 3 nT amplitude and 5 minute wavelength.

The last 40 days of Coff's Harbour recording was made with an ink pen on paper running at a slow paper speed. As with the first 40 days, a one minute magnetometer cycling period was used. The recorded trace shows oscillations with an amplitude of up to 10 nT and a period of about 8 minutes. With this interference it is not possible to detect genuine wavelenths in the data of less than 30 minutes. For this reason the records are judged to be of poor quality.

Similar problems occur with data from the Mackay shore station. Oscillatory noise up to 5 nT amplitude is present and the magnetometer was cycled with a one minute period. A variety of paper speeds, from very fast to very slow, was used. In most instances the record quality is such that periods of less than 20 to 30 minutes cannot be detected in the data. The records are considered to be of poor quality.

Cairns to Emu Point

At Cairns a Westronics recorder was installed and the magnetometer cycle period was put back to 10 seconds. This cleared up most of the problems which occurred at Coff's Harbour and Mackay. Only minor problems such as ink smudging occurred from then on. The record quality for all shore stations between Cairns and Emu Point is generally quite good (Plate 21).

SITING AND OPERATIONAL REQUIREMENTS FOR MAGNETOMETER SHORE STATIONS

The part of the contract, for the 1970-73 Marine Survey, which dealt with the installation and running of shore stations was very brief. It gave an outline of what the contractor was required to do and left the details to him. As a result, the shore monitor operation and the data from it both proved unsatisfactory.

To avoid a recurrence of this situation, the following siting and operational requirements are proposed for future surveys. It would be unpractical to go into detail on many of the points so only an outline is given as a guide.

Site Requirements

1. The site must be reoccupiable; i.e., the magnetometer should be in a place which is not subject to rapid change with time. The site should, wherever possible, be identifiable by reference to buildings or similar structures, which should preferably be permanent.

2. The local magnetic gradients should be small and the site chosen should not be on a large local anomaly. This should be established by reference to results of ground or airborne magnetometer surveys, if available.

3. The sensor should be well away from power lines, generators, electric motors, large magnetic structures (bridges, wharves, wire fences, etc.) and frequently used roads.

4. Where practicable the magnetometer and recording equipment should be located close to the shore station operator's residence.

5. A set of photographs (not less than 3) which show the magnetometer sensor head in relation to the local surroundings must be supplied. The photographs must be clear and marked with the direction in which the viewer is looking. Both the film negative and positive print must be provided.

6. Location sketches must be made. They should be roughly to scale and show all the major local landmarks within at least 100 metres around the site. The direction of north should be clearly marked.

7. A precise latitude and longitude (better than .1 min.) for the magnetometer sensor must be obtained.

8. A site survey as described below must be conducted to determine the local magnetic gradient. The survey should be conducted over a regular grid of reading points, and the results logged. A sketched contour map of the local field at an interval of 1 nT should be prepared and used to determine the suitability of the site. Field gradients in excess of 0.1 nT/metre should be avoided.

There is no need for high precision in locating the reading points of the site survey. They should be no more than 10 metres apart and form a regular grid such as that shown in plate 22. Such a grid can be easily measured out in the north and east directions and if the gradients are found to be too high the grid can be extended. For example, in Plate 22, points 1 to 5 extend the grid east, and points 6 and 7 extend the grid N.W.

9. If the survey area is large, the shore station must be regularly re-sited to keep the magnetometer reasonably close to the survey ship. The range over which diurnal readings can be used without introducing serious errors will vary with latitude, the position of the sensor with respect to water masses, and many other factors. The range could be considerably different for a number of shore stations covering one large survey area. An investigation into the applicability of shore station magnetic data to shipboard magnetic recordings was made by the writer using harmonic analysis techniques. Results of this work, presently being compiled into a report, suggest that the shore magnetometer should be relocated if the ship is surveying more than 2 degrees of latitude or 4 degrees of longitude from the shore station. Practical limitations will prevent adherence to this rule in many cases.

New sites for the magnetometer should be chosen well in advance so that as little time as possible will be lost during relocation.

10. Most of the above site requirements are fulfilled by BMR's first Order Magnetic stations (Van der Linden, 1969). Many of these are located in coastal towns and are in sufficient number to be suitably located for shore stations. Wherever it is practical, the First Order station should be used as a shore station. Location sketches for all stations, photographs for most, and site surveys for many are available from the Observatories Group at BMR.

Operations and Maintenance

1. The magnetometer must be operated continuously while the survey is in progress. Recording should only be stopped for station relocation or repairs to the equipment. The station should be relocated while the ship is in port, not while the survey is under way.

2. If a proton precession magnetometer is being used a cycle period not exceeding 10 seconds must be maintained.

3. The width of the recording chart should not be less than 100 mm nor greater than 250 mm. A continuous pen type chart recorder is considered the most acceptable. Full scale chart width should be 99 gammas. Paper speeds in the range 150 mm/hour to 300 mm/hour are considered acceptable. The chart must be clearly marked with timing lines every 10 minutes. This may be achieved with a second pen or by making a large deflection of the recording pens. The time signal used to generate timing lines for the recorder chart should be derived from a low-drift, atomic vibration clock. The drift should be checked against a precise reference, such as the radio signal WWV, at least once a week, and the clock corrected if the departure exceeds 1 second. The chart must be clearly labelled at every hour mark with survey and day number, hour and minute (SSDDHHMM), and the value of the total field reading from the digital display.

4. One complete record is to be made every day. The record should be removed at zero hours G.M.T., i.e. at the end of a survey day.

5. The station should be visited by the operator at an interval not exceeding 12 hours at night and 6 hours during the day. This is considered the upper limit and should never be exceeded. Installing the recording equipment close to the operator's residence would be an advantage in keeping this interval reasonable. At each visit to the site the following routine checks should be made.

(i) Check that the record is being written clearly, that the timing marks are clear and that sufficient ink is in the reservoirs for eight hours operation.

(ii) Make comparison between analogue and digital outputs of the magnetometer, if available, and investigate fully if the difference exceeds 2 nT.

(iii) Check the noise level of recording during the previous eight hours and investigate fully if the noise exceeds 3 nT.

(iv) Check that the magnetometer is cycling with the correct period and investigate fully if a discrepancy occurs.

(v) Check that the recorder chart speed has remained constant at the required setting and investigate fully if a discrepancy occurs.

(vi) Check zero and full scale calibration but do not reset unless the error is greater than one nT; mark "calibration" on the chart.

(vii) Vary the tuning and inspect the result on an oscilloscope; the amplitude of the precession signal should reach a maximum and the signal should be clearest when the equipment is properly tuned.

If any malfunctions are detected by the above checks, the chart must be clearly labelled with sufficient information to describe the fault, the recording stopped and the malfunction rectified.

6. The operator must keep a log in which all recording breaks and the reasons for them should be noted together with details of maintenance or repairs carried out. The log should also contain routine information such as the time of inspection visits. BMR will provide log sheets of a format suitable for punching on standard 80 column computer cards. Strict computer card format should be adhered to when filling out the log sheets. A new sheet should be started for each day.

7. Sufficient spare parts should be kept so that repair by component exchange is possible.

8. At the beginning of each new G.M.T. day the previous day's records should be removed and a new record started. About 30 cm of blank paper should be run out at the start and end of each days record and marked with the following information.

Survey SS Day DD

Shore station location

Base value of chart at zero GMT

The base value of the chart should be adjusted such that the quiet day diurnal lies entirely within one chart width.

At each change of record the following checks should be made in addition to those made at every visit.

(i) Check zero and full scale deflections on the recorder and reset the calibration if the error is greater than 1 nT. Mark "reset calibration" clearly on the chart if this was required.

(ii) Monitor the most critical internal voltages. Rectify if necessary.

(iii) Monitor the level of the polarizing current. Rectify if necessary.

(iv) Clean the pens of the recorder and ensure that enough paper is available for 24 hours operation.

(v) Check that the sensor has not been disturbed or damaged.

9. The chart must be clearly labelled if any other stoppage or non-standard event occurs. A short comment should be made on the chart and details kept by the operator on the log sheet.

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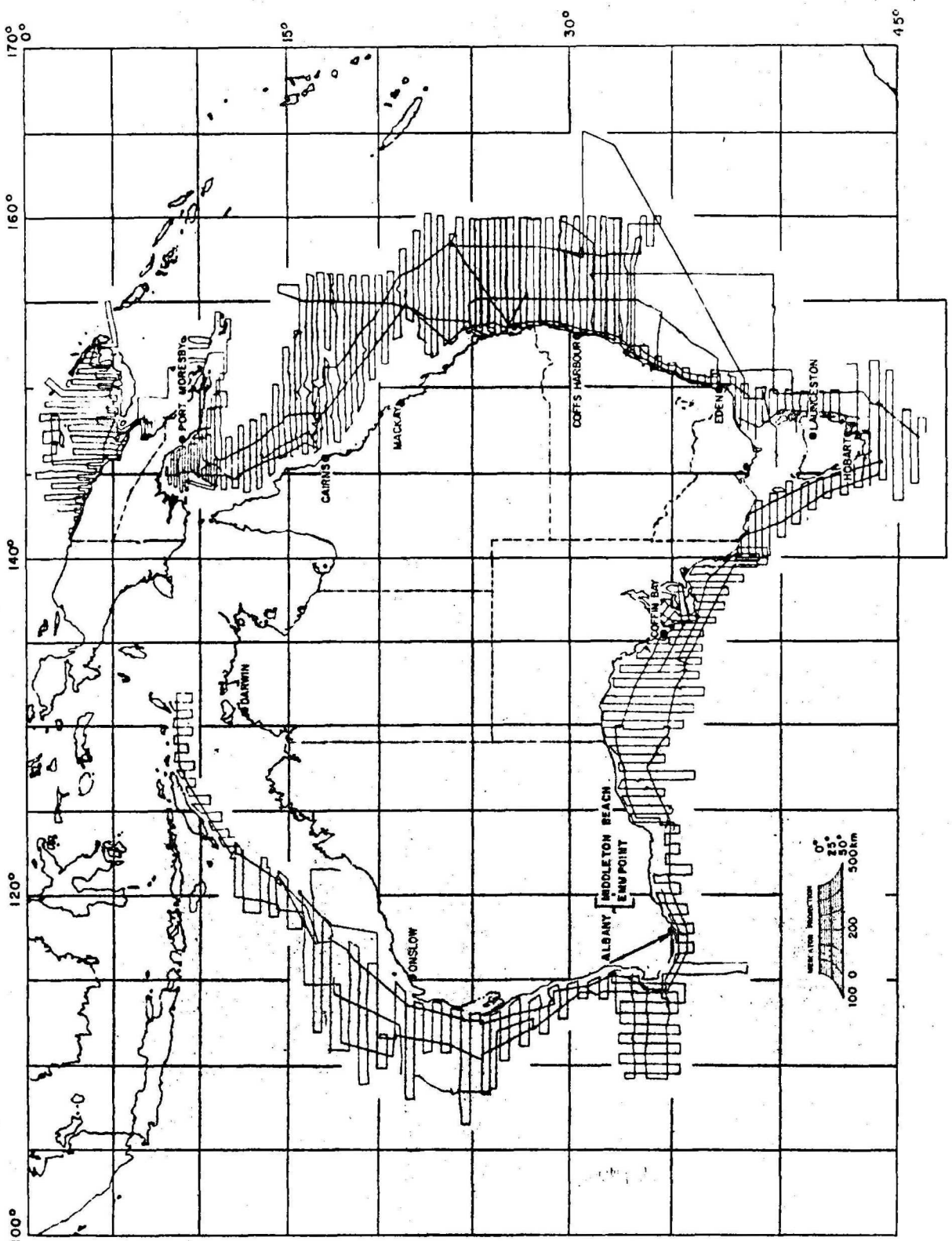


1970–1973 SHORE STATION LOCATIONS

WITH MARINE TRAVERSES

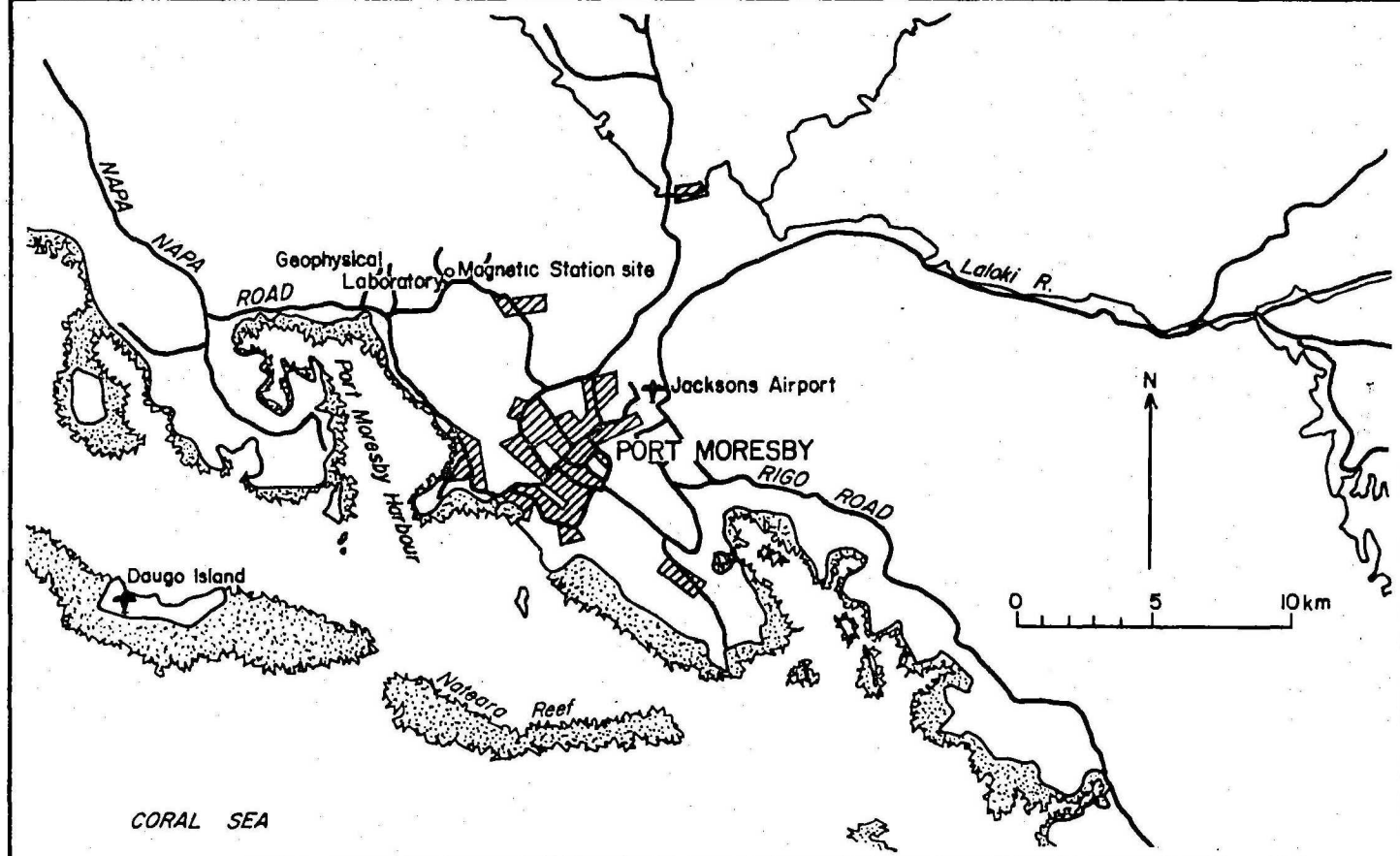
PLATE 2

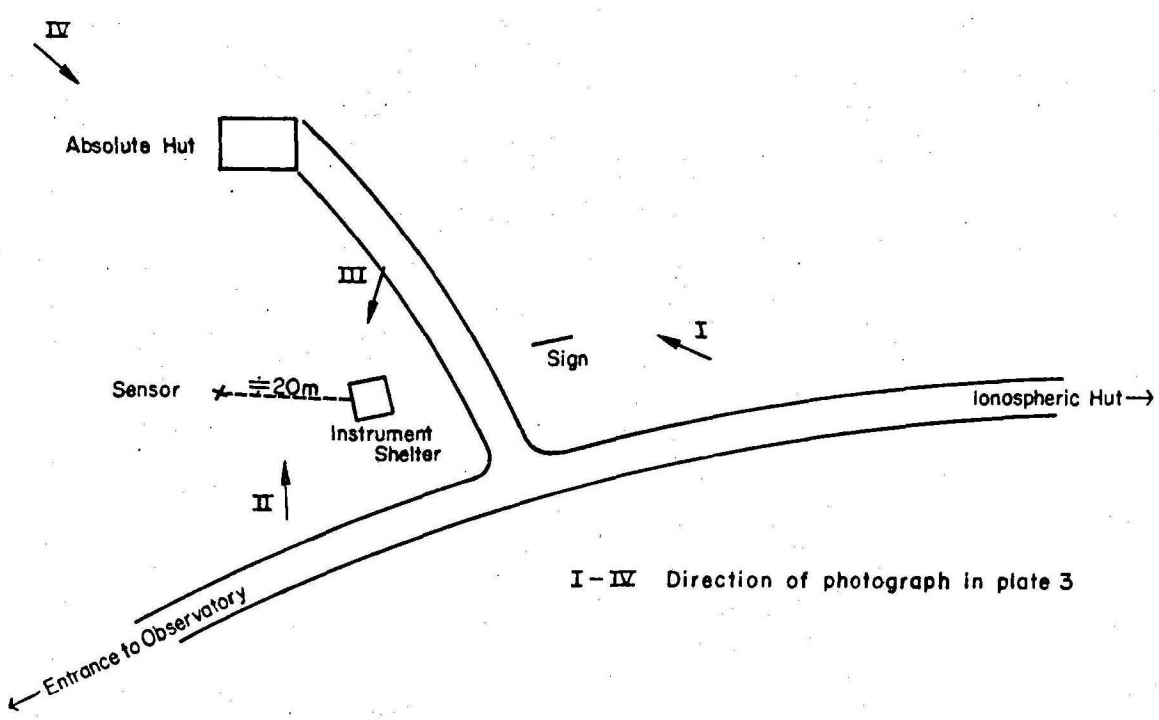
MARINE SURVEY

PORT MORESBY, PNG

MAGNETOMETER SHORE STATION

TABLETOP MOUNTAIN





I – IV Direction of photograph in plate 3

Record No. 1975/116

C55/88—59A

I

Absolute hut

Instrument shelter

Track

II

Absolute hut

Instrument shelter

III

Instrument shelter

Absolute hut

IV

Instrument shelter

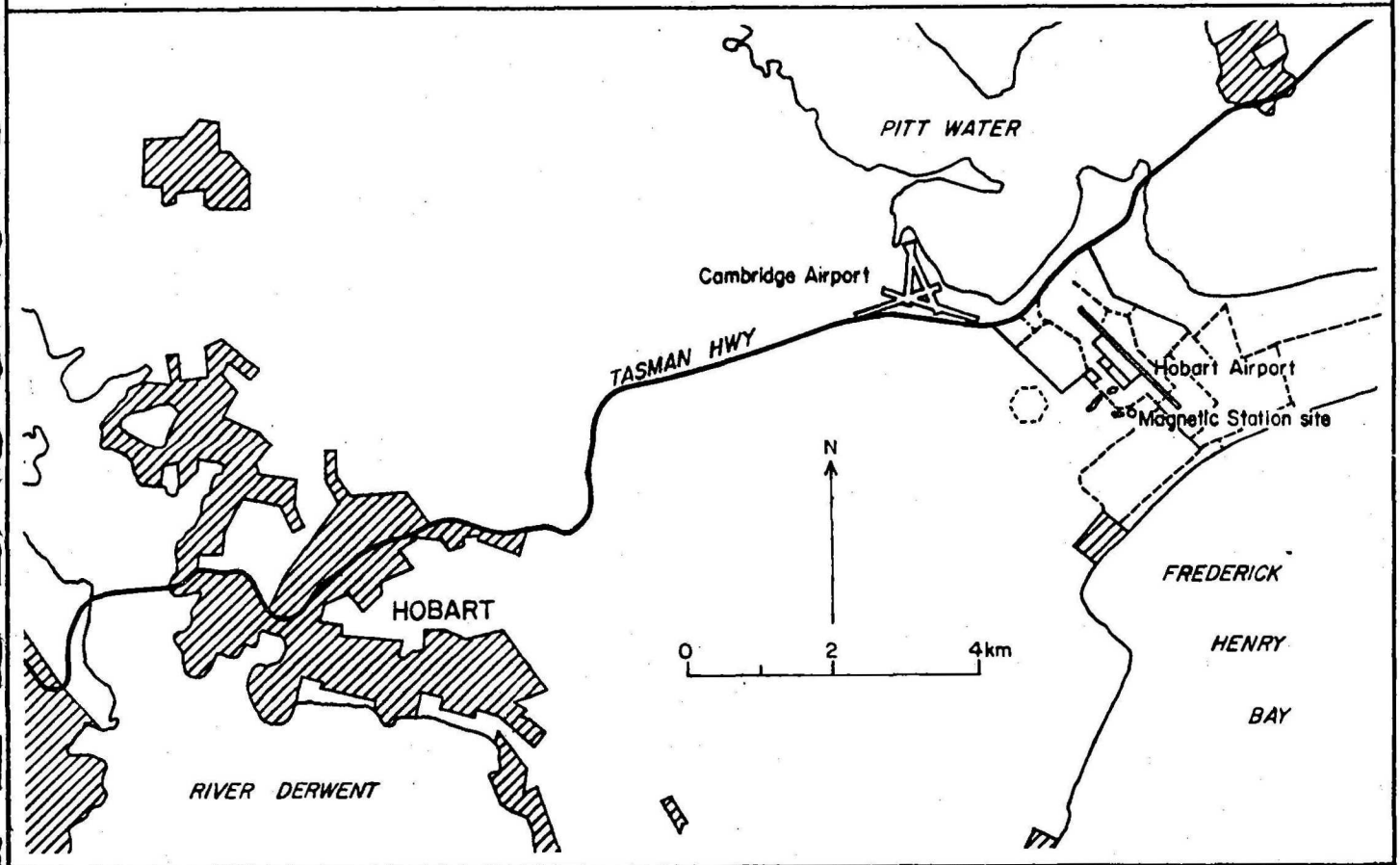
PORT MORESBY SHORE MAGNETOMETER STATION

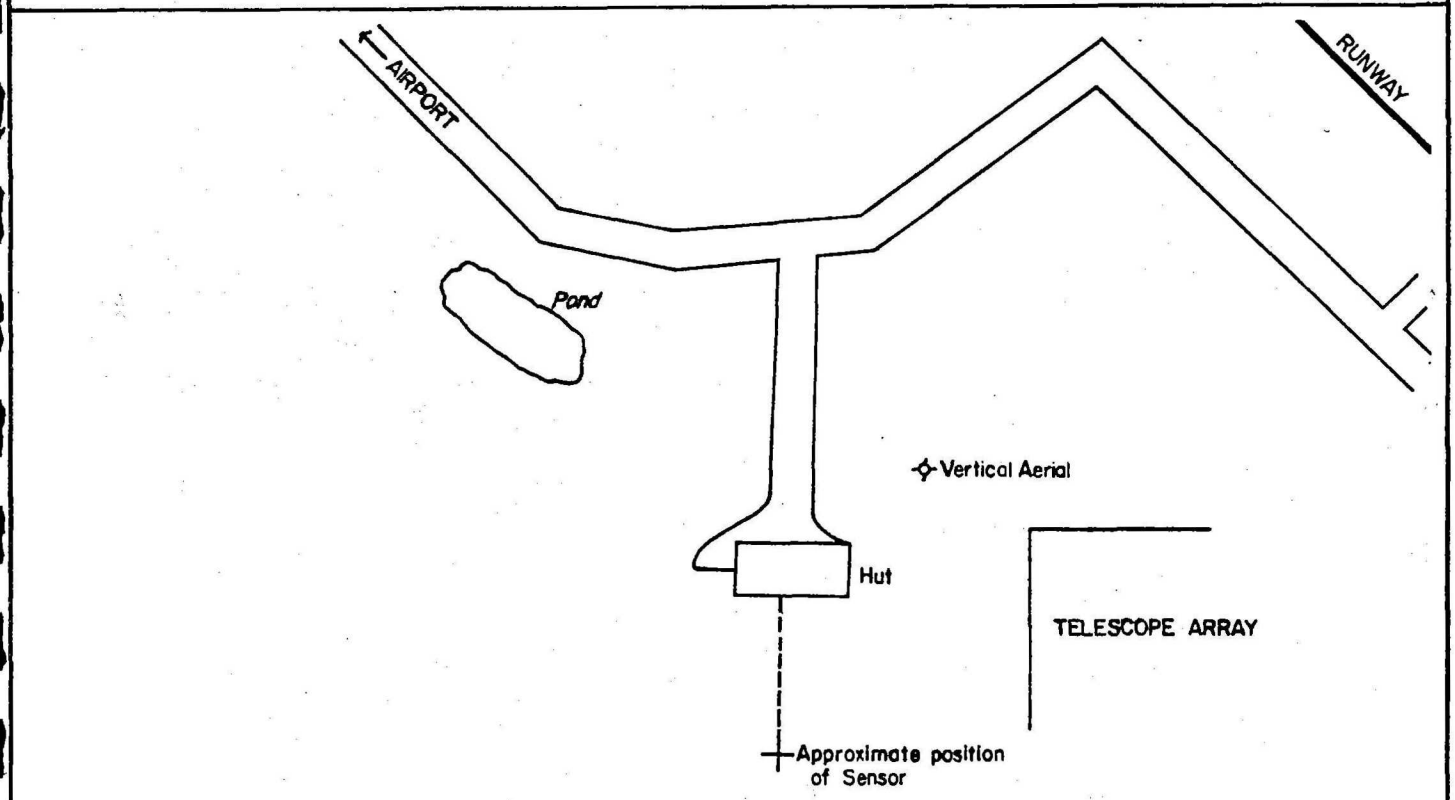
PLATE 4

MARINE SURVEY

HOBART, TAS.

MAGNETOMETER SHORE STATION





Record No 1975/116

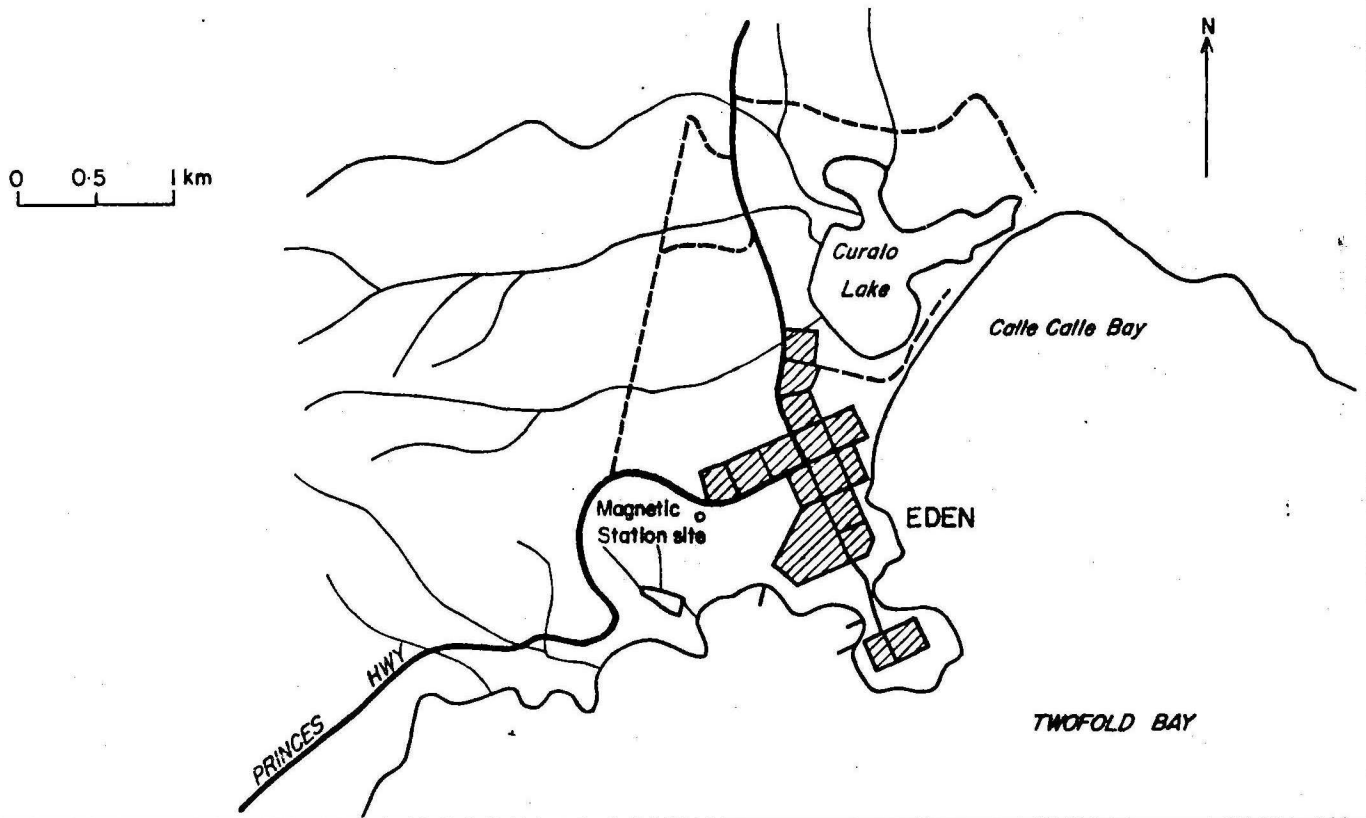
K55/B8-31A

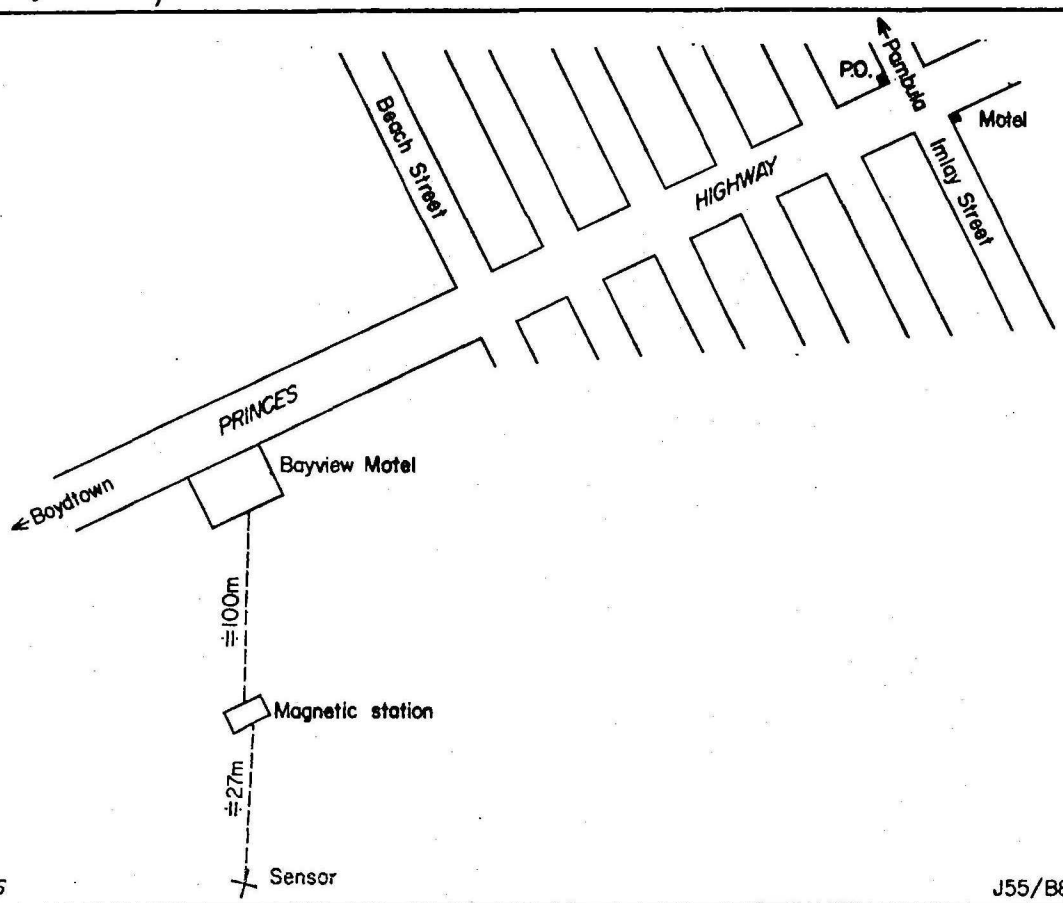
PLATE 5

MARINE SURVEY

EDEN,NSW

MAGNETOMETER SHORE STATION





Record No. 1975/116

J55/B8—22A

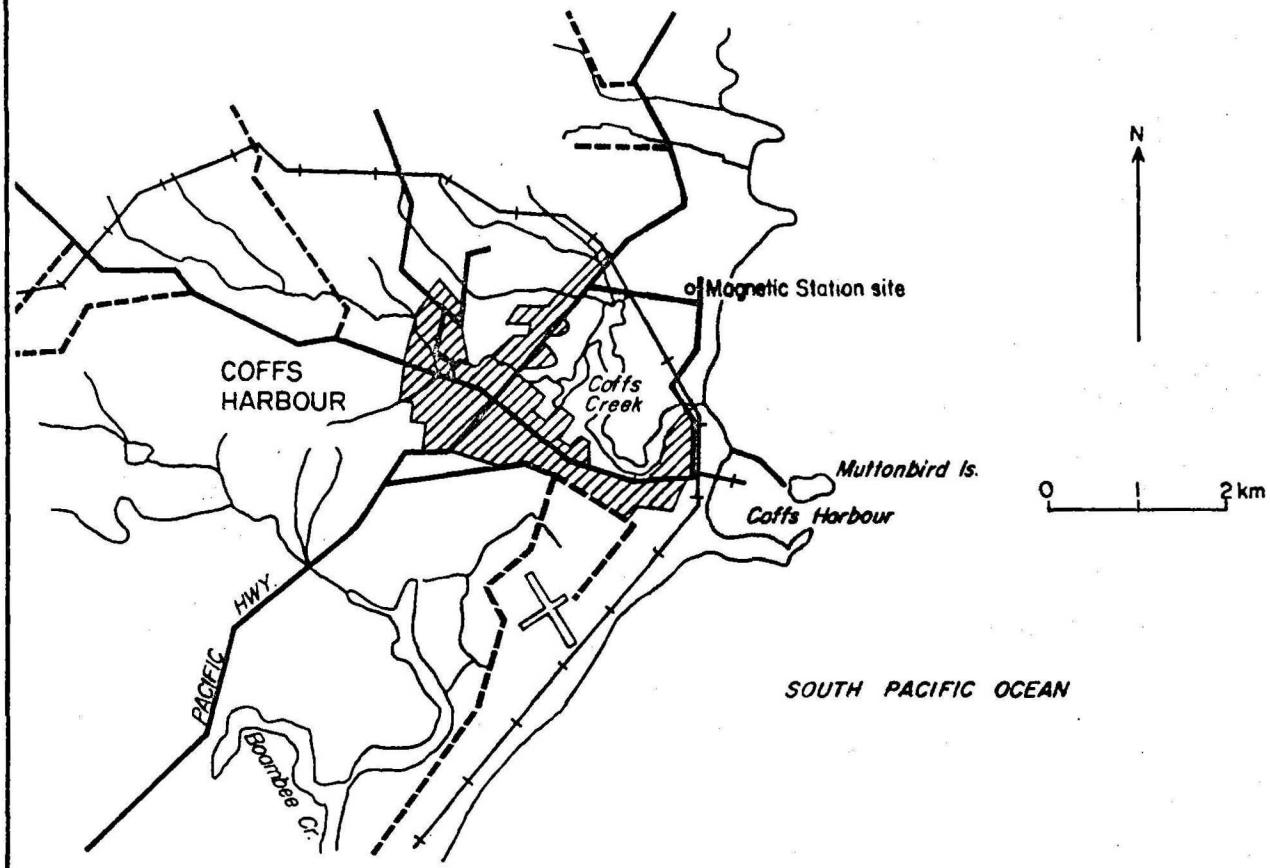
PLATE 6

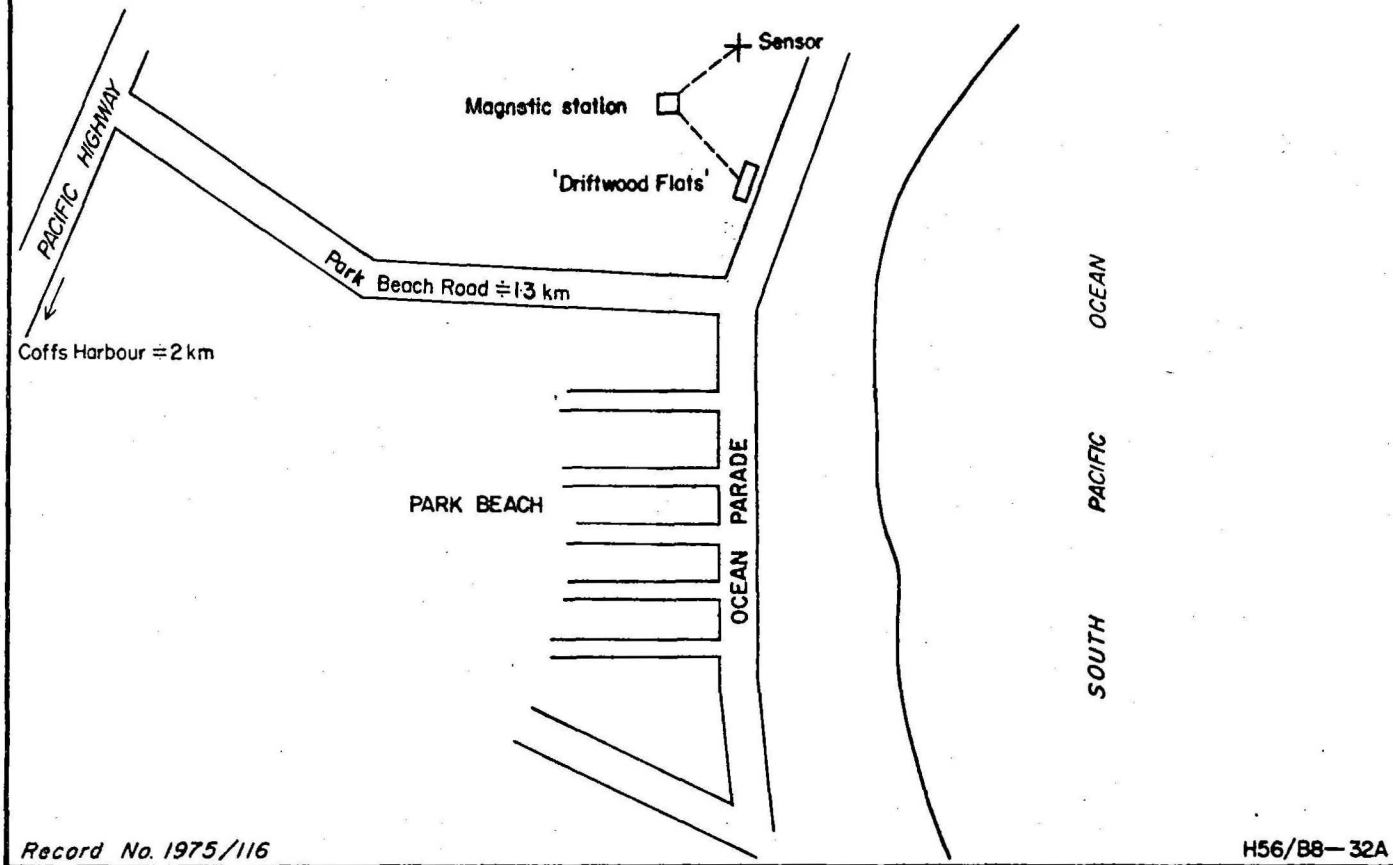
MARINE SURVEY

COFFS HARBOUR, NSW

MAGNETOMETER SHORE STATION

PARK BEACH





Record No. 1975/116

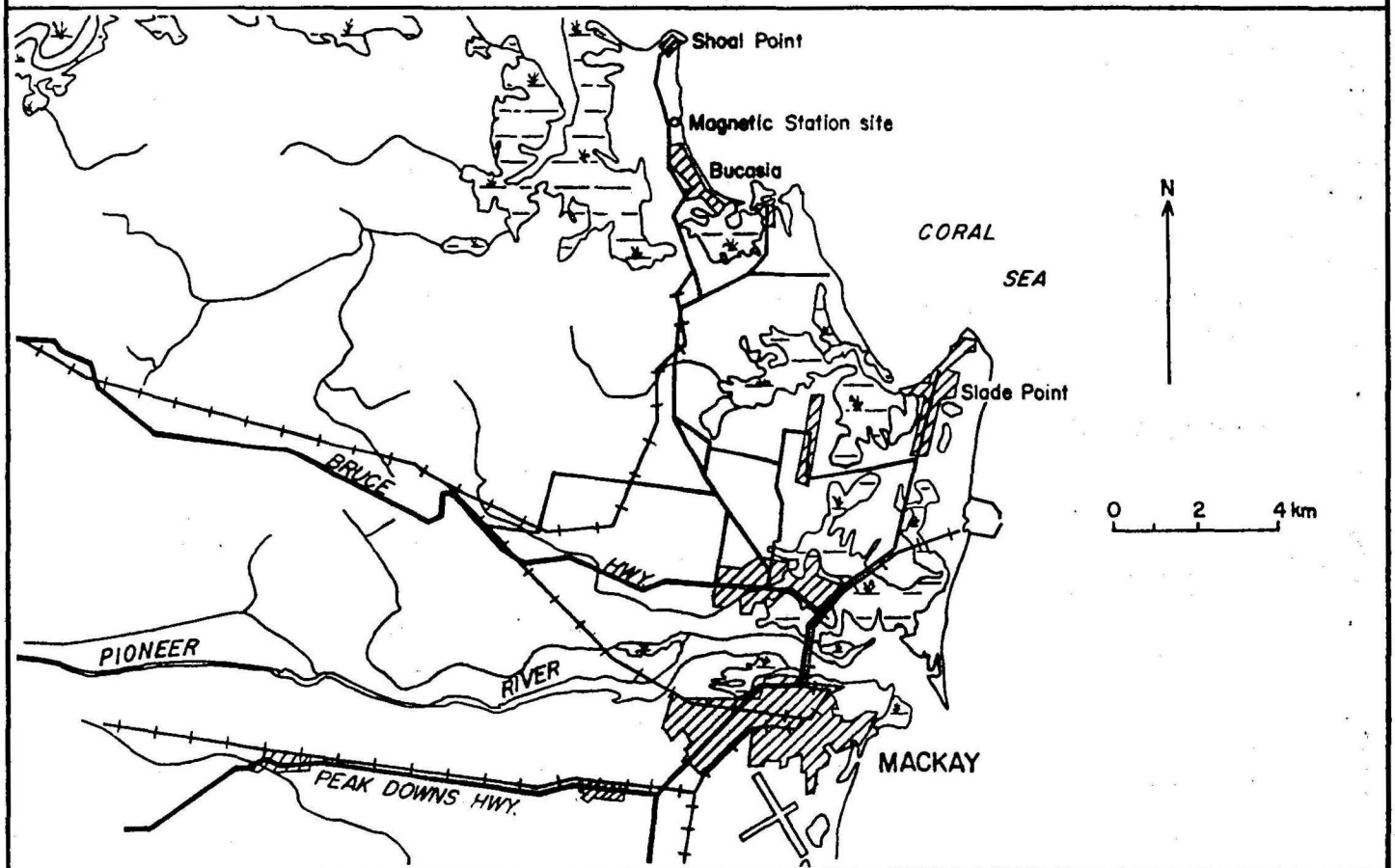
H56/B8—32A

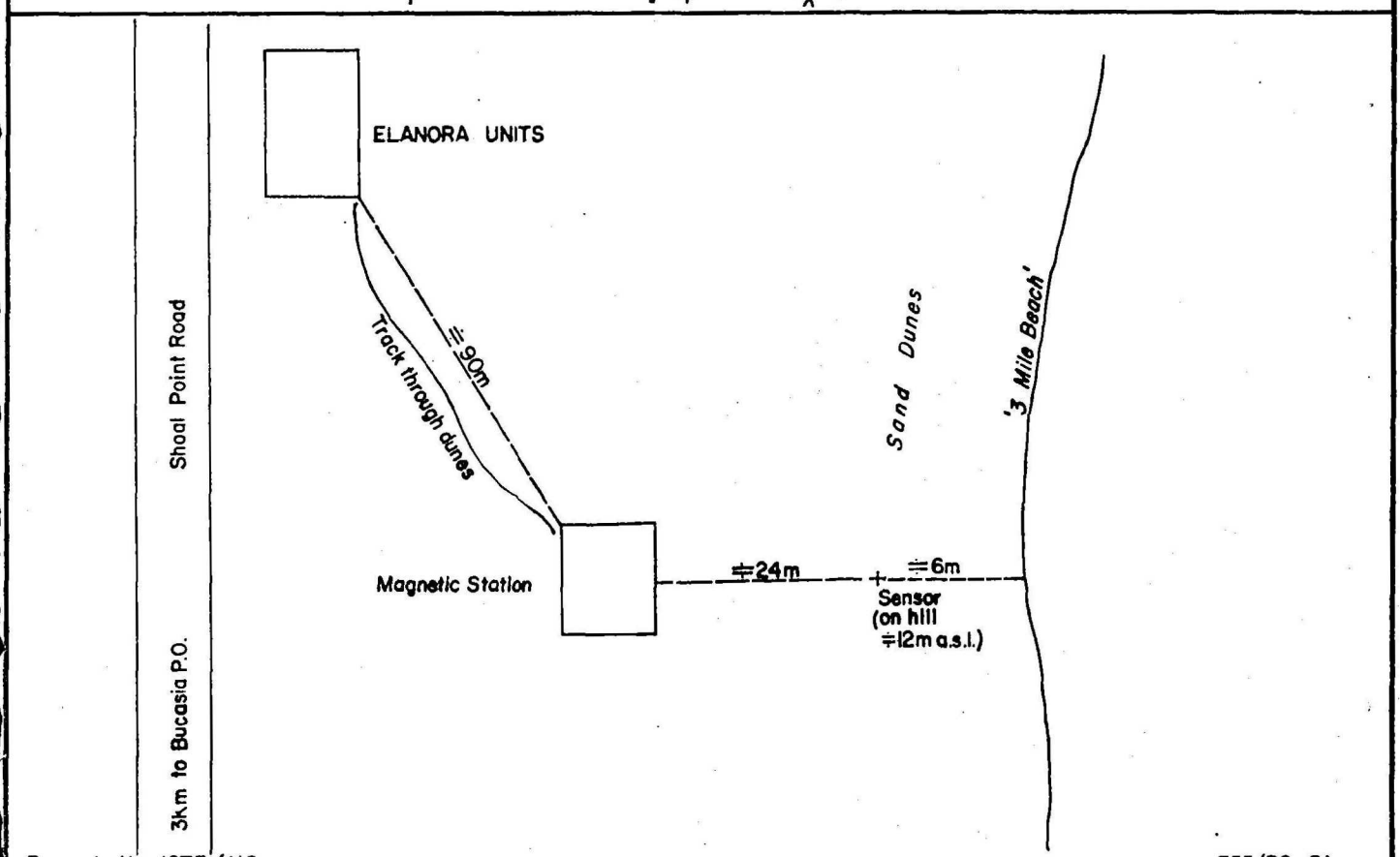
PLATE 7

MARINE SURVEY

MACKAY, QLD

MAGNETOMETER SHORE STATION





Record No. 1975/116

F55/88-5A

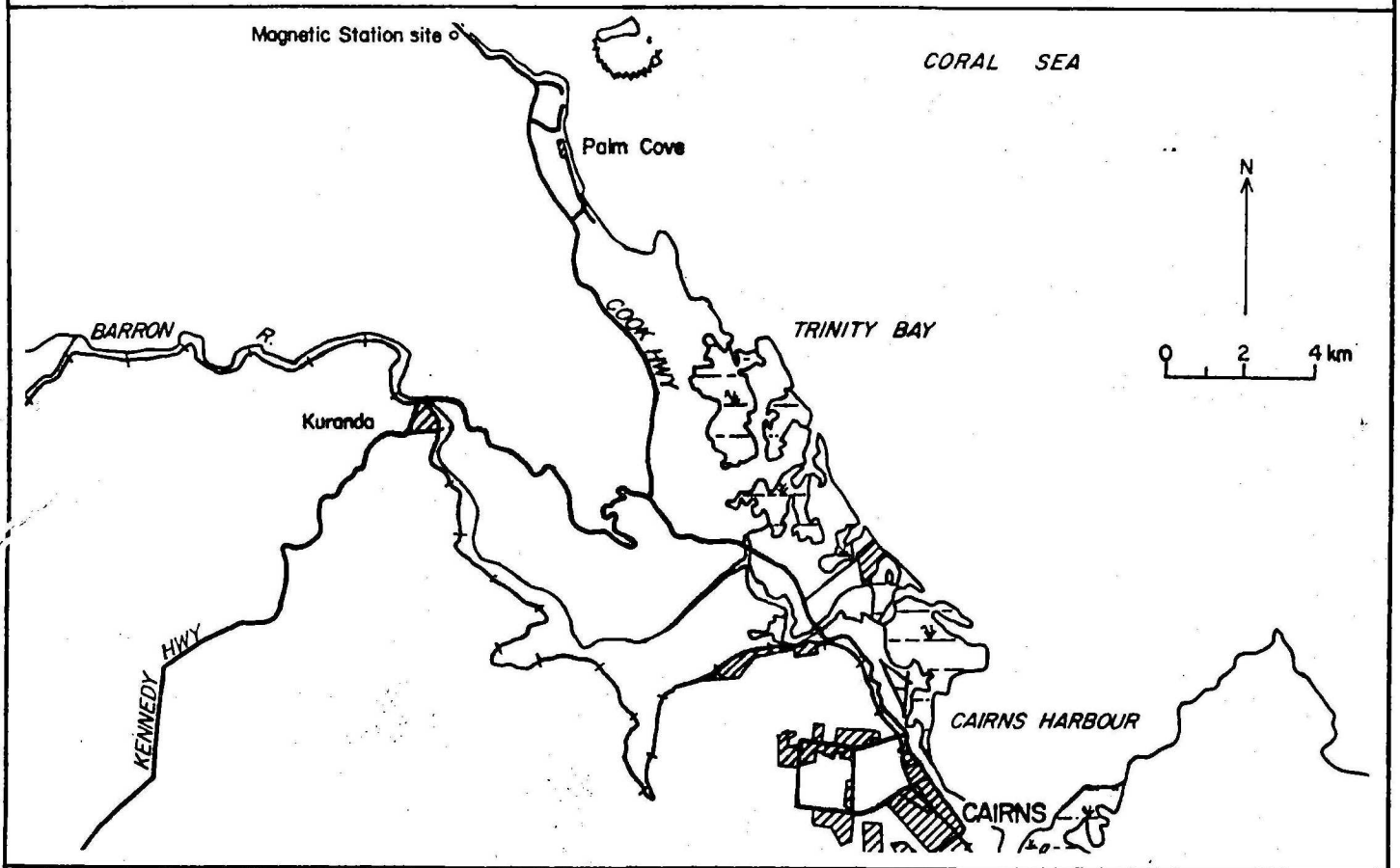
PLATE 8

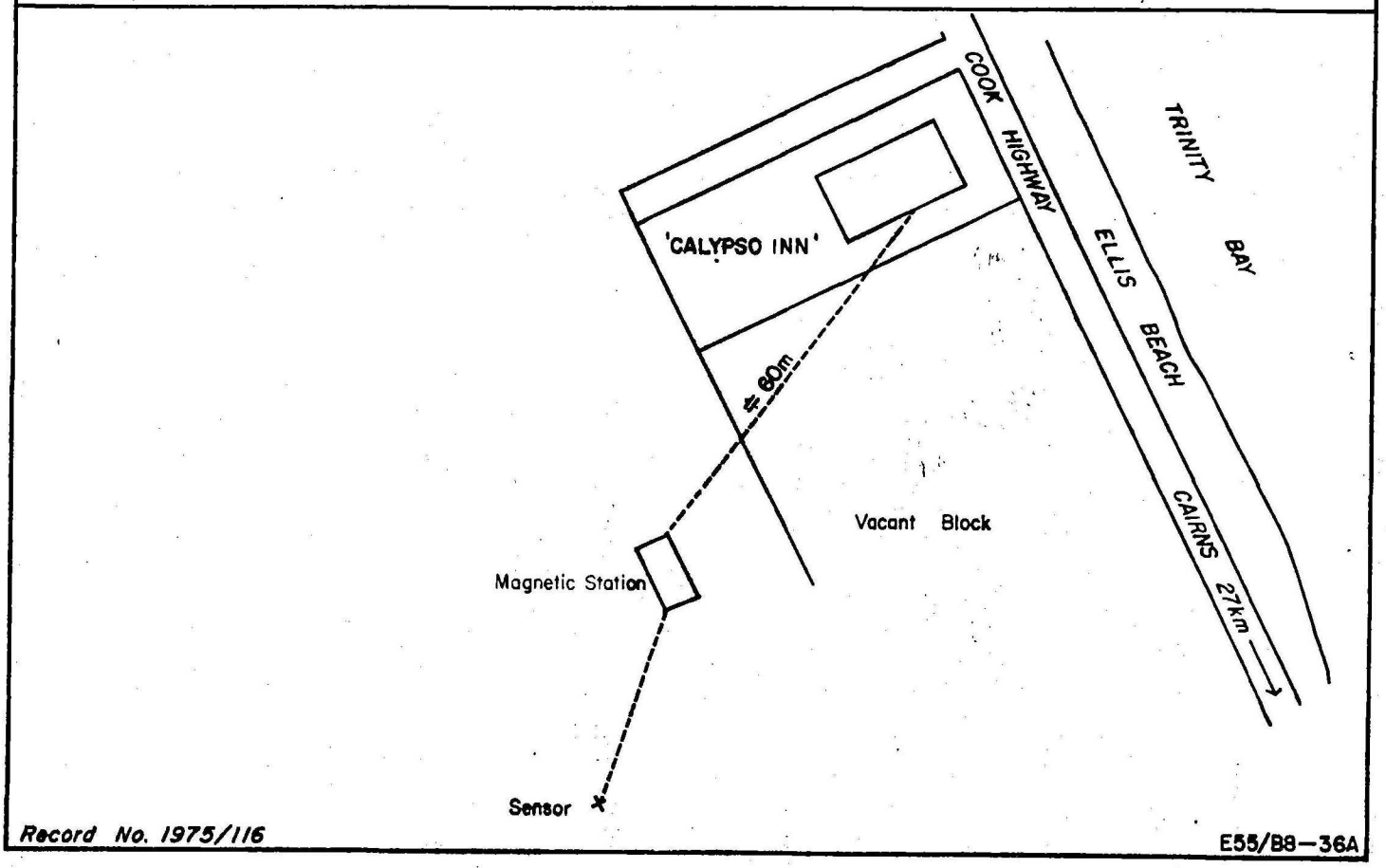
MARINE SURVEY

CAIRNS, QLD

MAGNETOMETER SHORE STATION

PALM COVE





Record No. 1975/116

E55/B8-36A

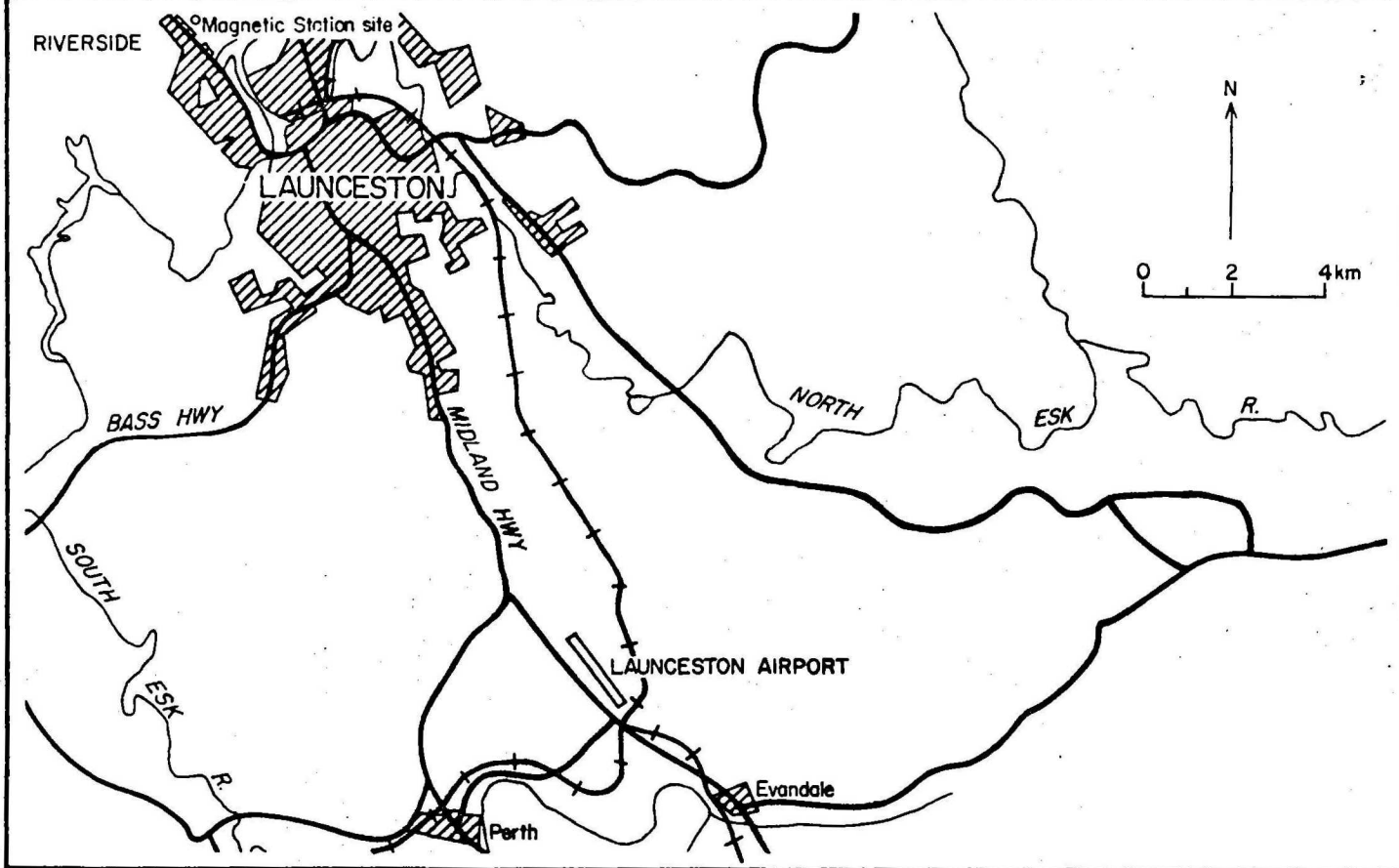
PLATE 9

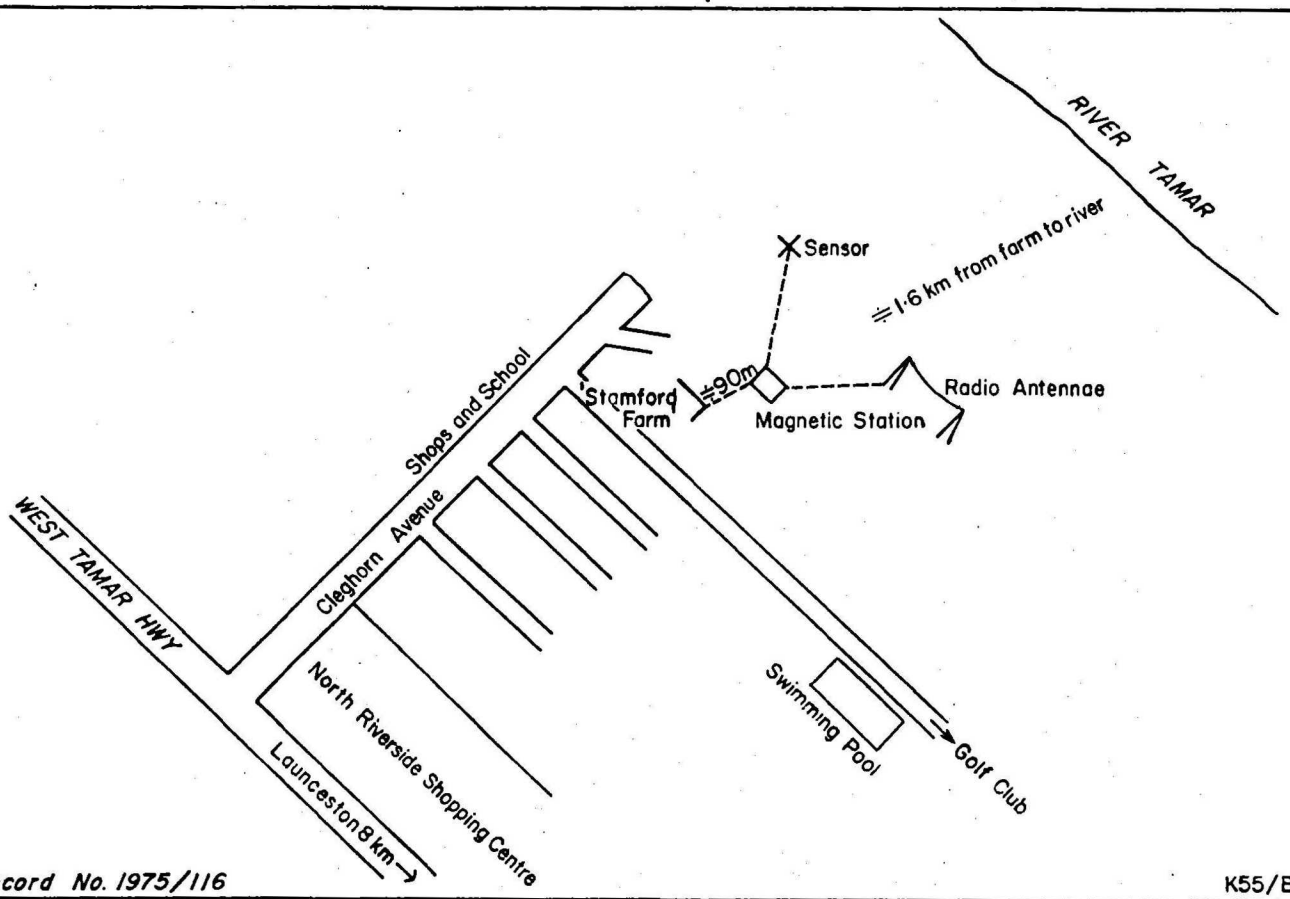
MARINE SURVEY

LAUNCESTON I, TAS.

MAGNETOMETER SHORE STATION

RIVERSIDE





Record No. 1975/116

K55/B8–32A

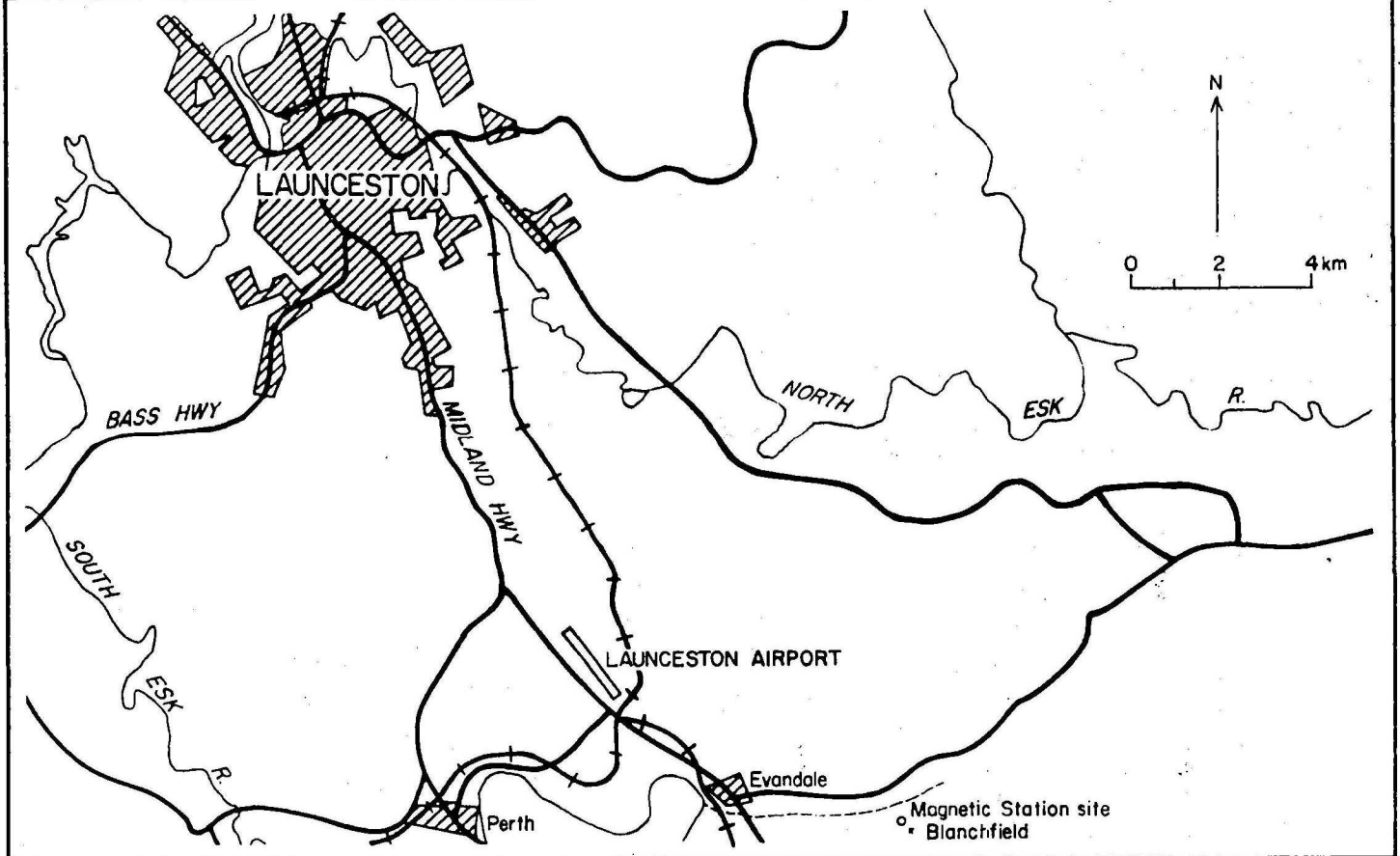
PLATE 10

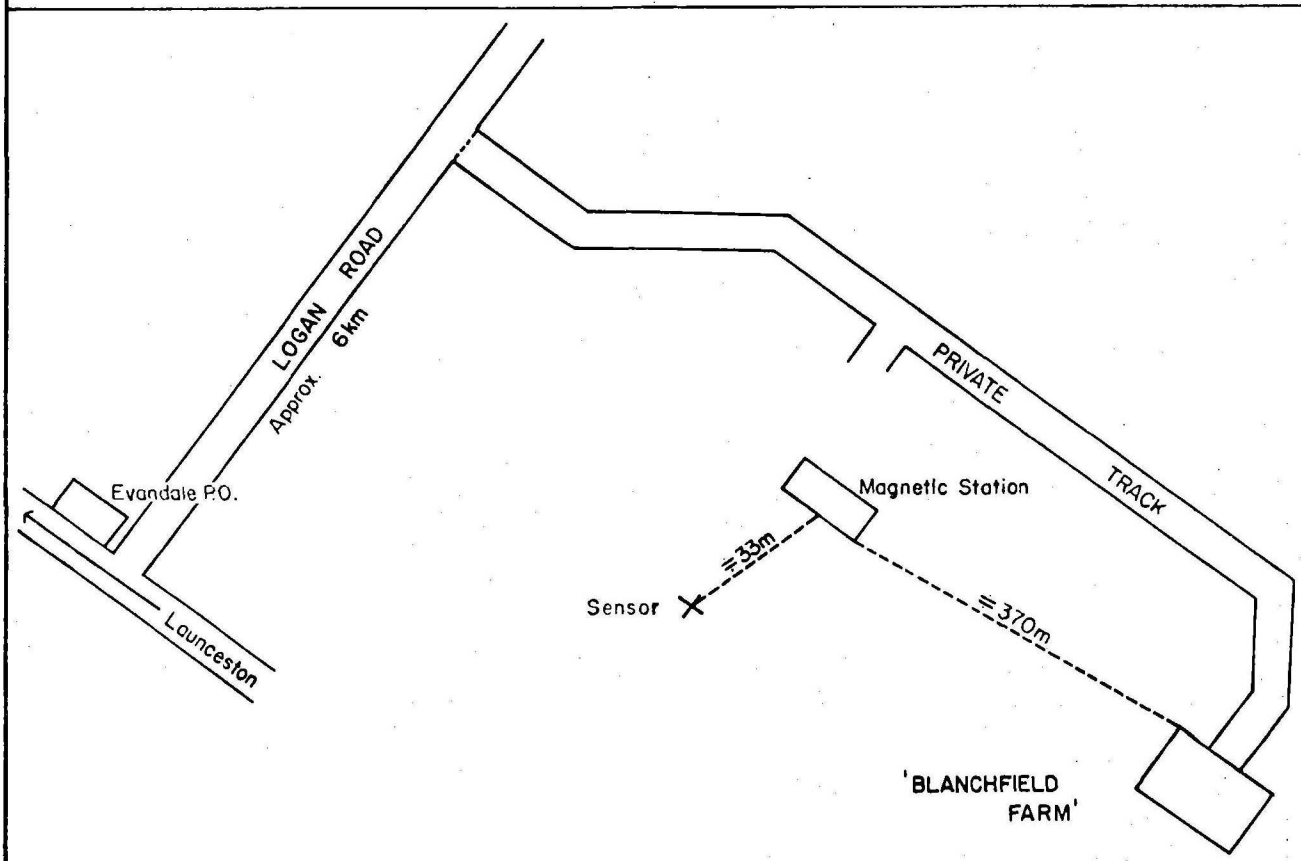
MARINE SURVEY

LAUNCESTON II, TAS.

MAGNETOMETER SHORE STATION

EVANDALE





Record No. 1975/116

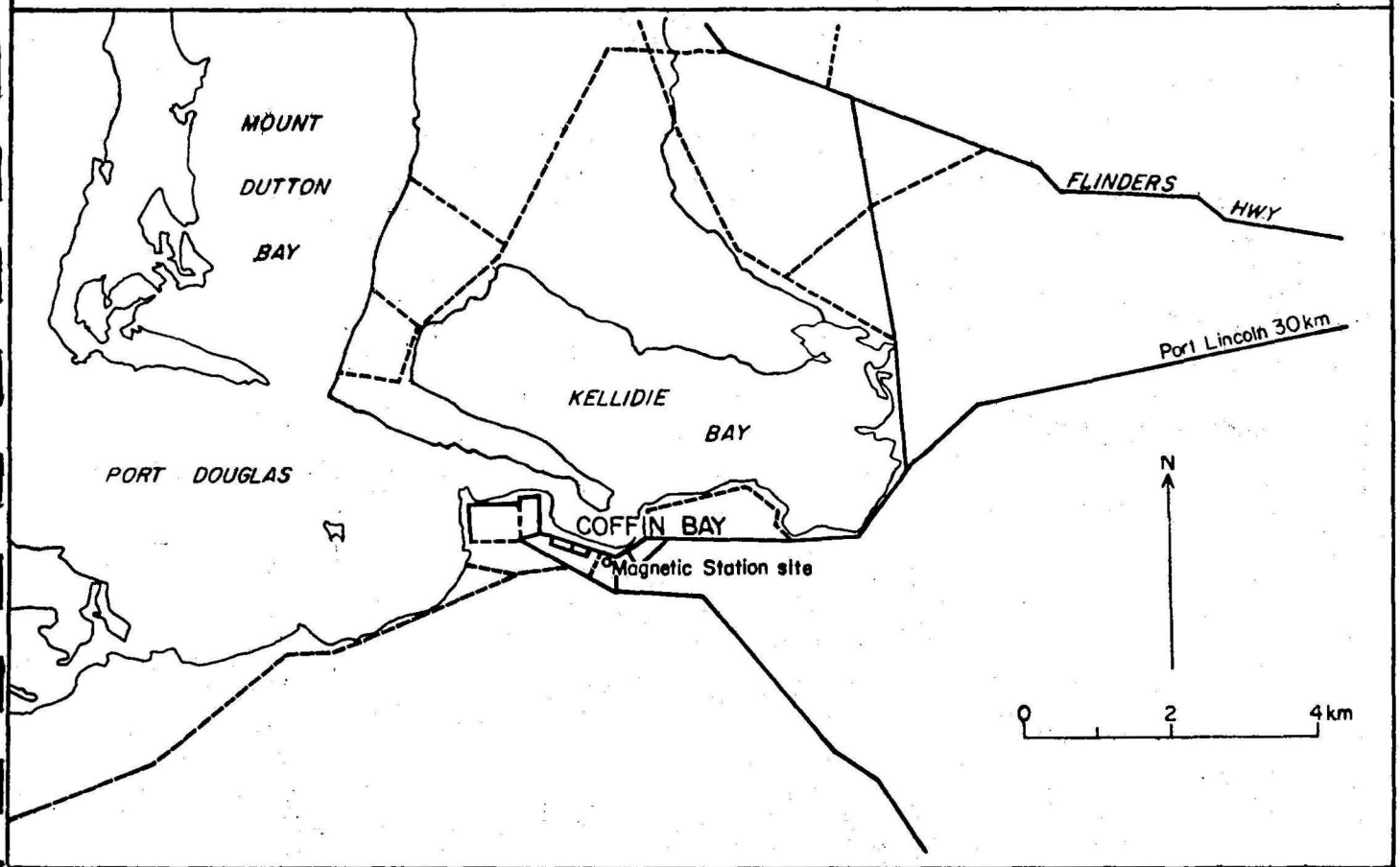
K55/B8-33A

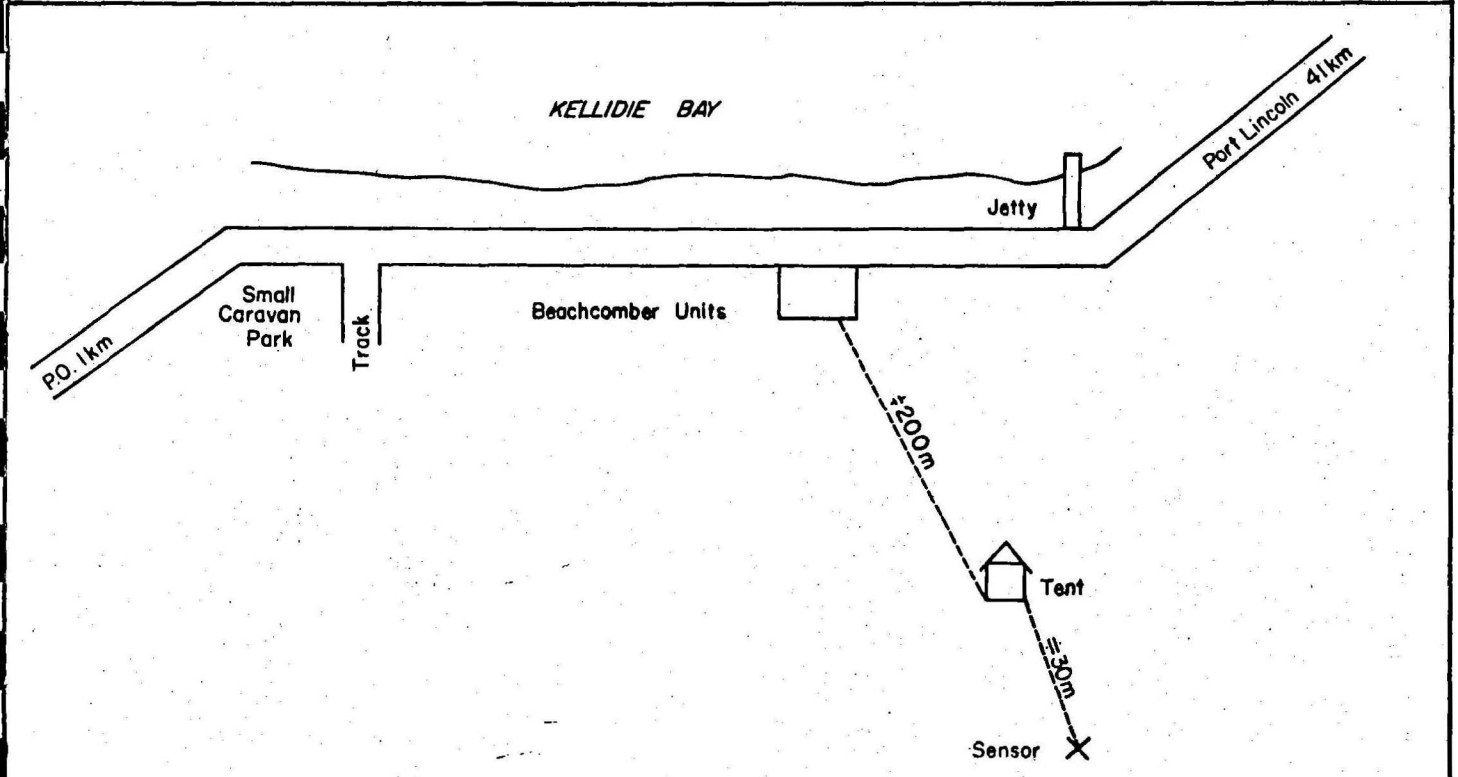
PLATE II

MARINE SURVEY

COFFIN BAY, SA

MAGNETOMETER SHORE STATION





Record No 1975/116

153/B8-23A

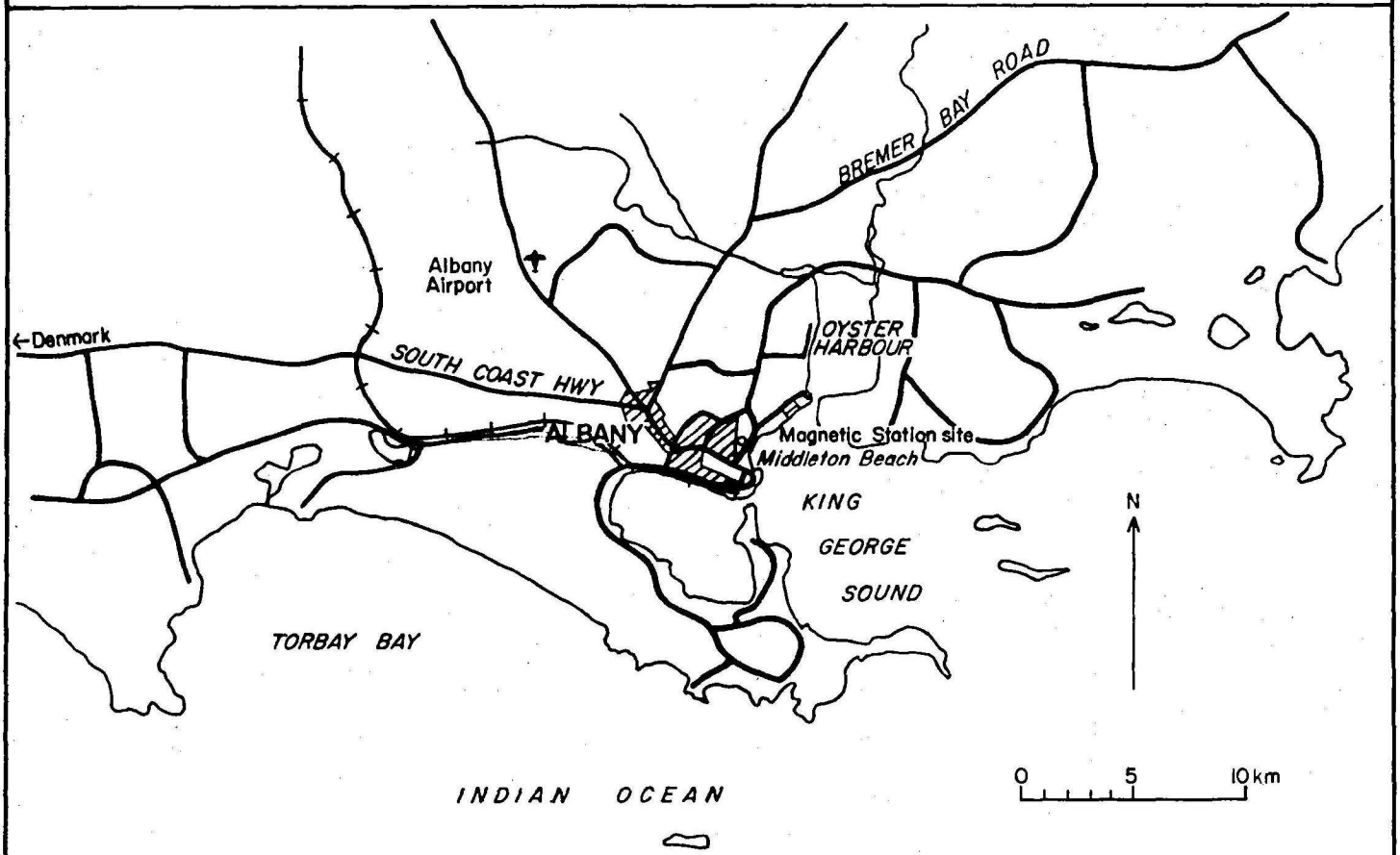
PLATE 12

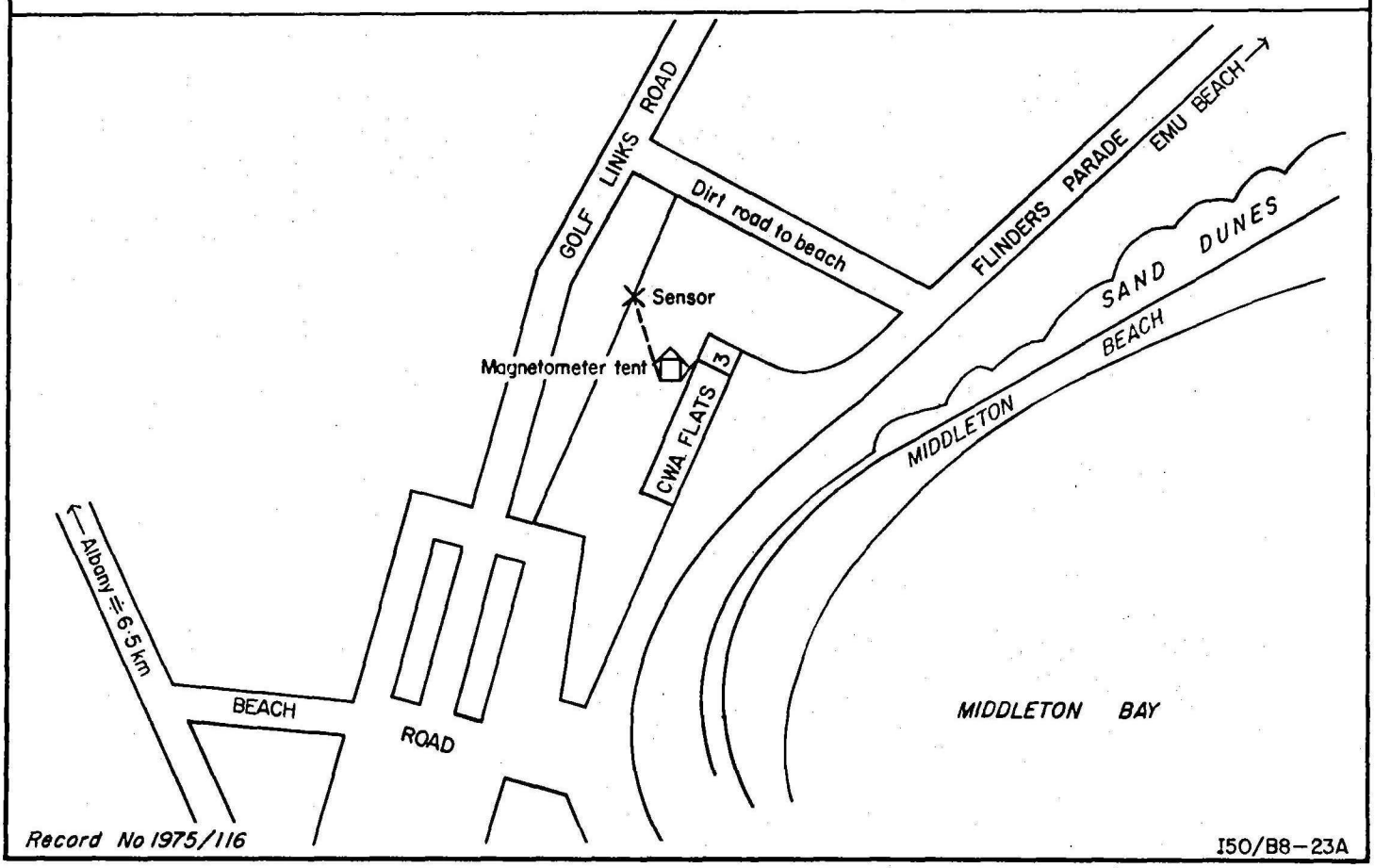
MARINE SURVEY

ALBANY, WA

MAGNETOMETER SHORE STATION

MIDDLETON BEACH





Record No 1975/116

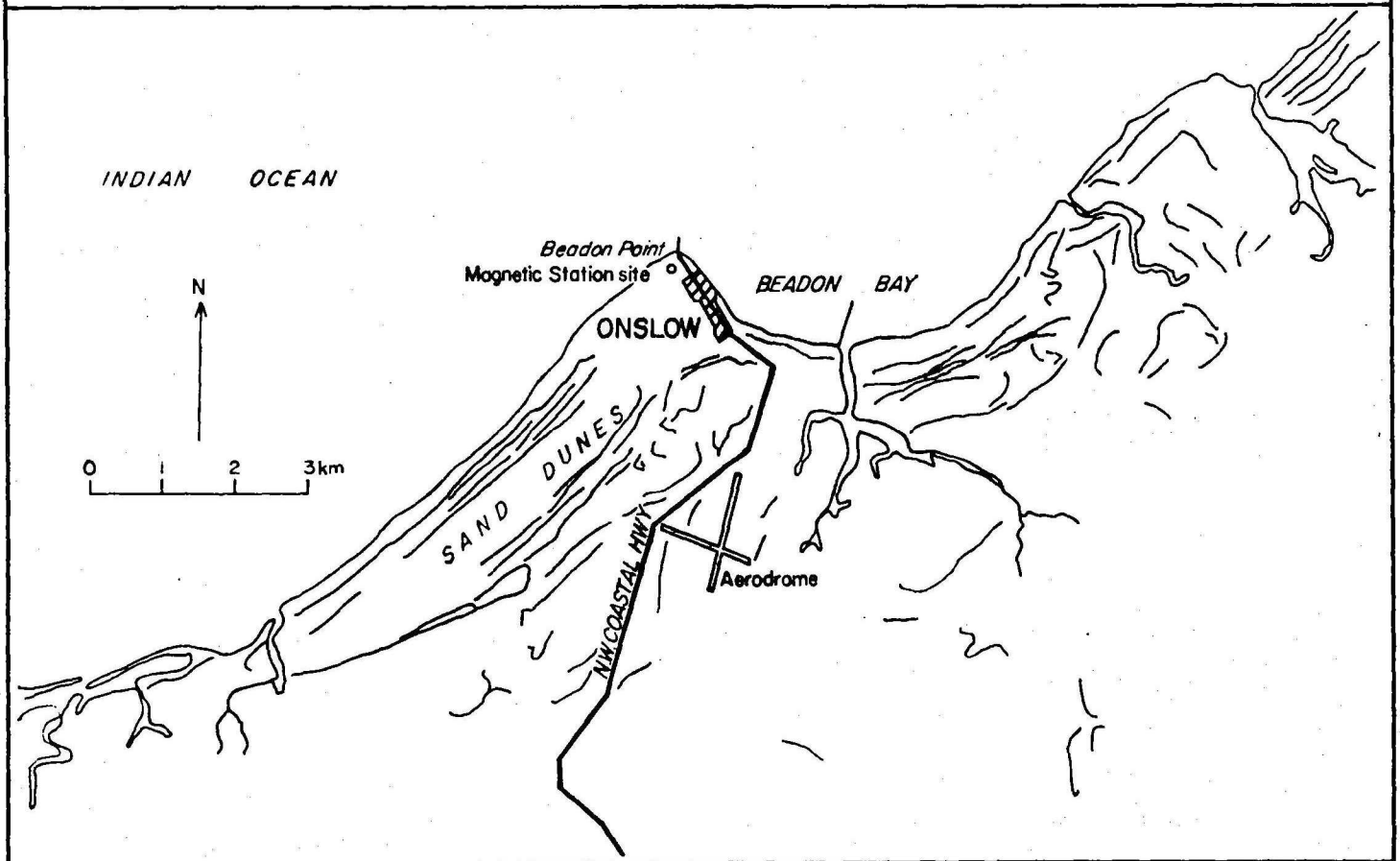
I50/B8-23A

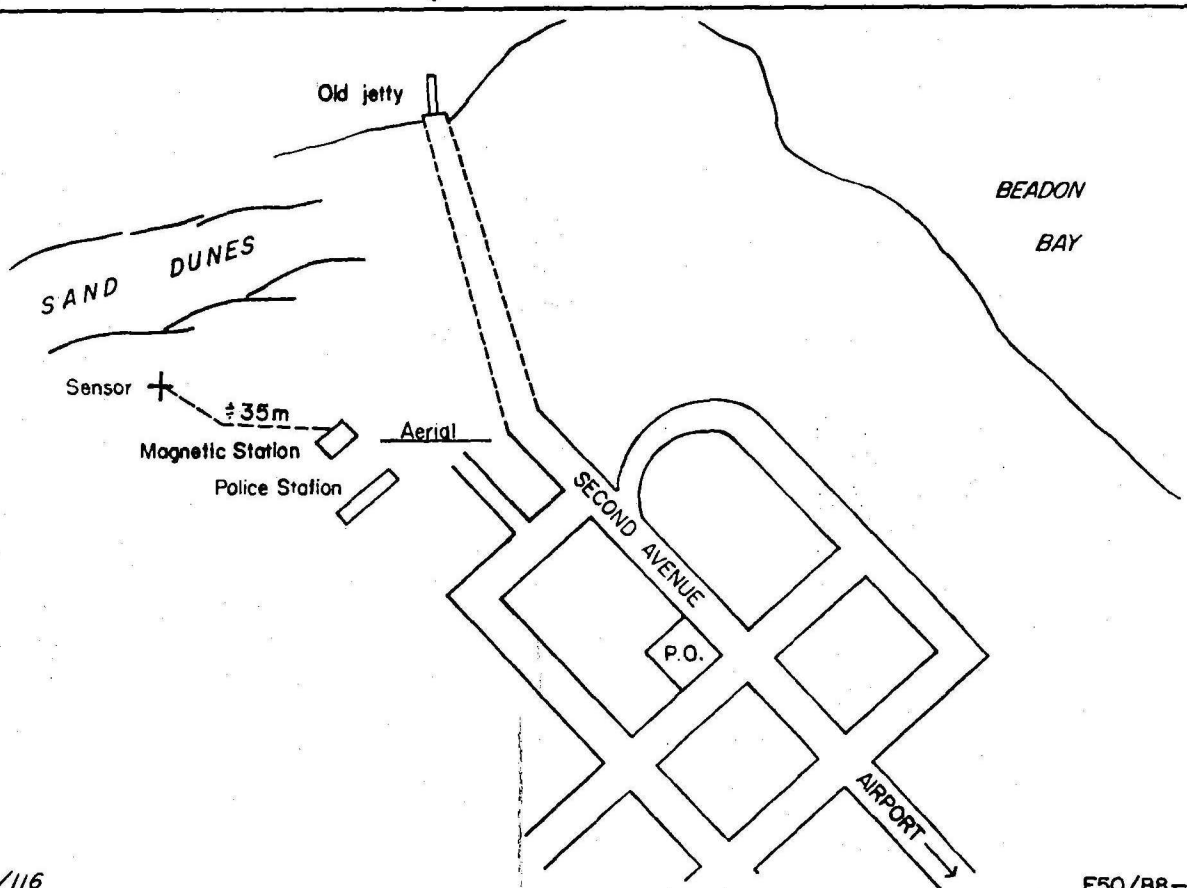
PLATE 13

MARINE SURVEY

ONSLOW,WA

MAGNETOMETER SHORE STATION





Record No. 1975/116

F50/88-25A

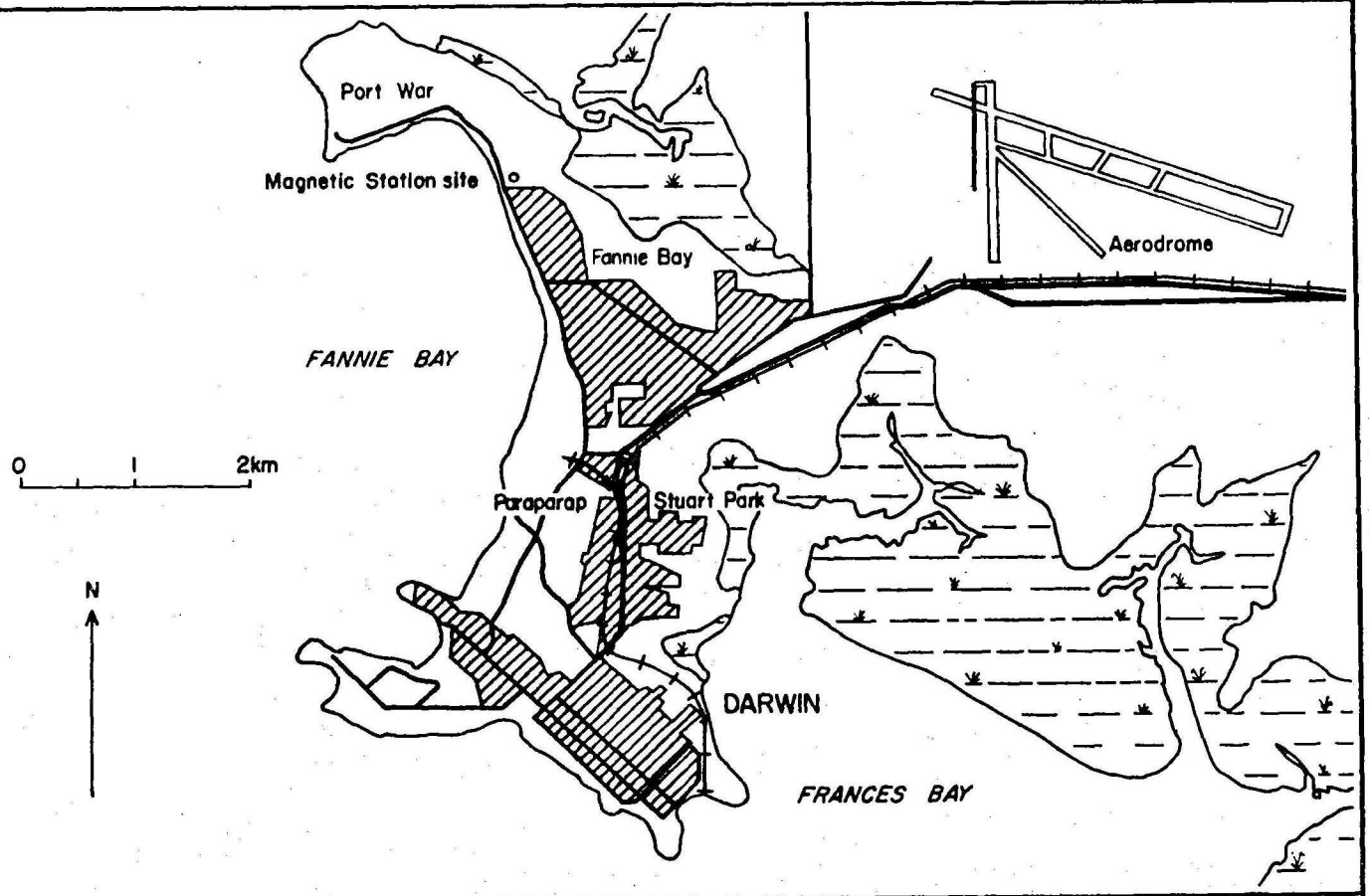
PLATE 14

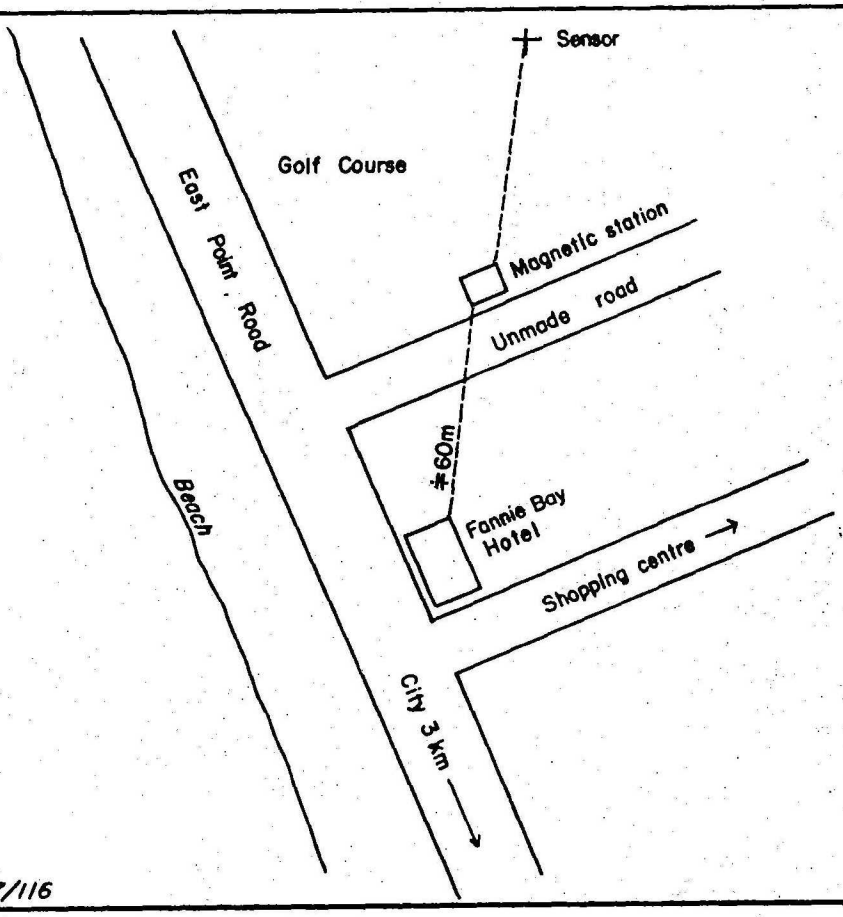
MARINE SURVEY

DARWIN, NT

MAGNETOMETER SHORE STATION

FANNIE BAY





Record No. 197/116

D52/B8-26A

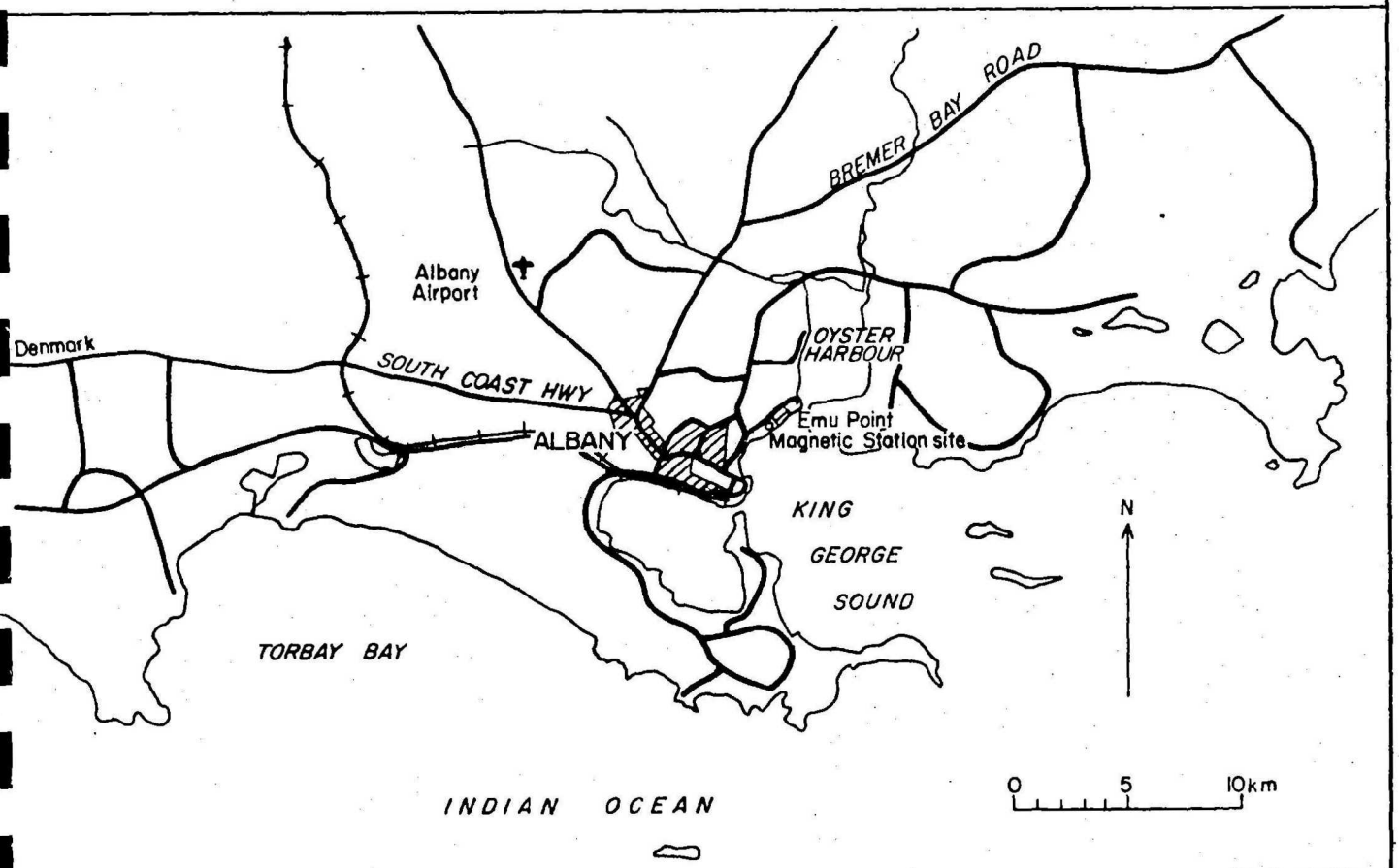
PLATE 15

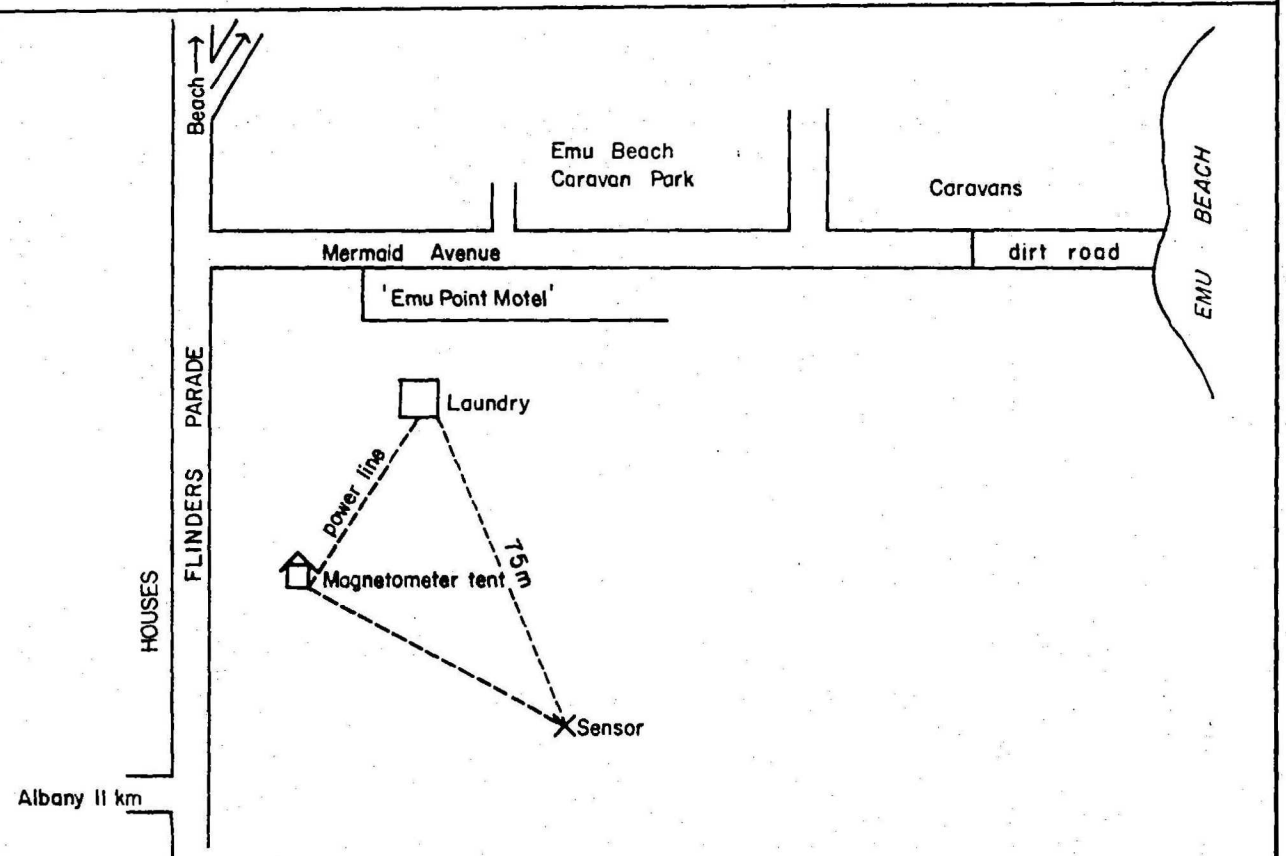
MARINE SURVEY

ALBANY, WA

MAGNETOMETER SHORE STATION

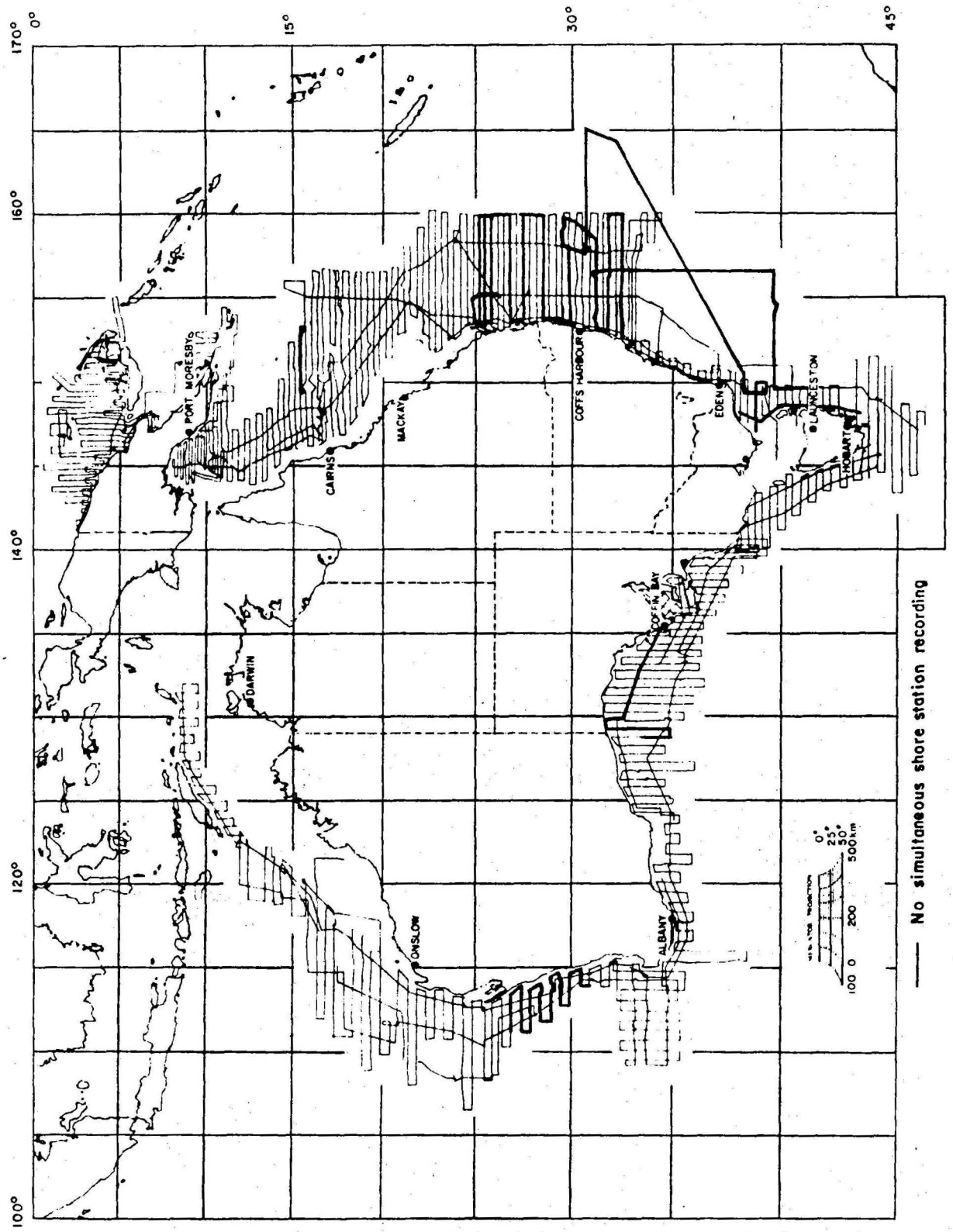
EMU POINT



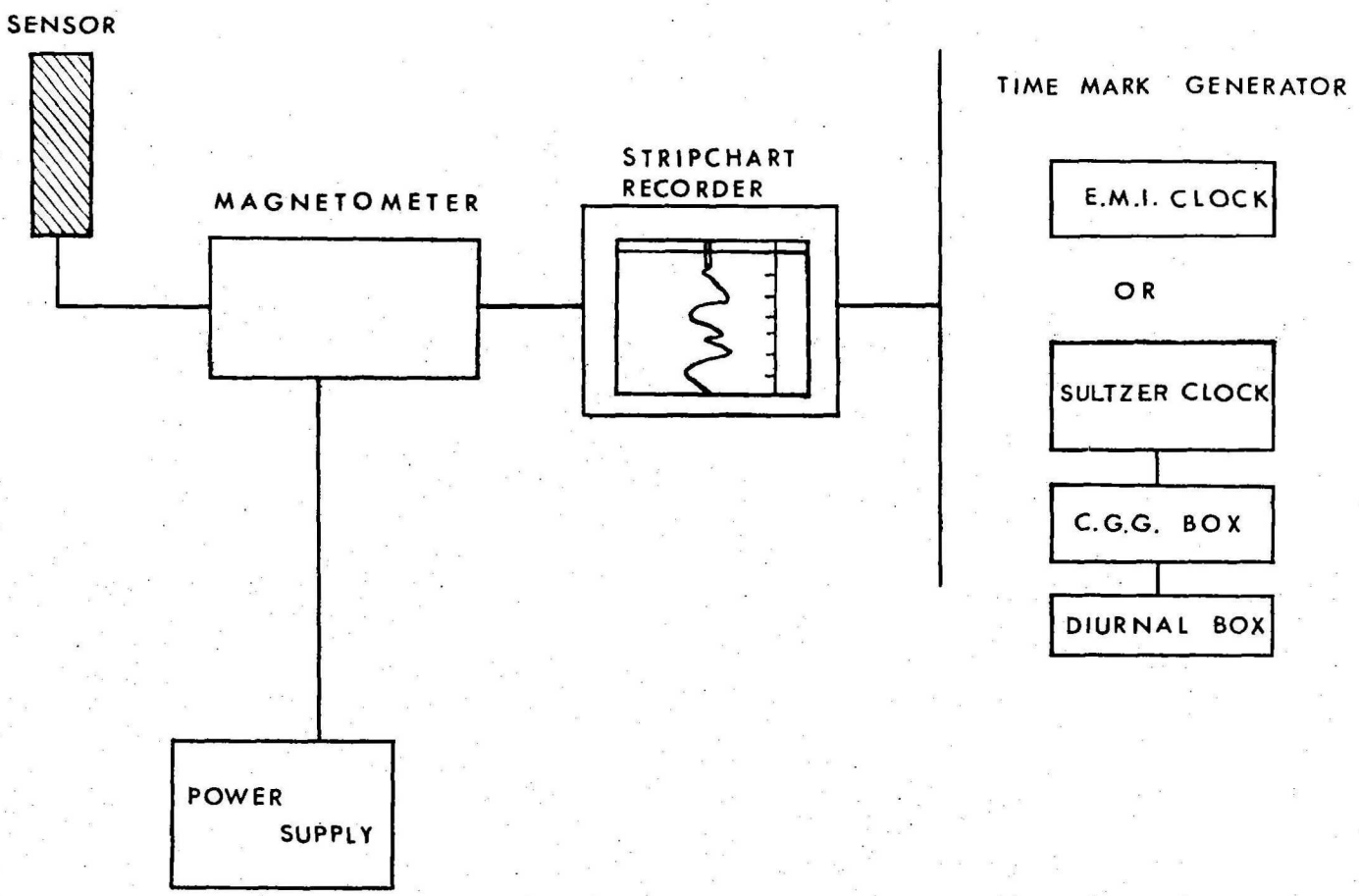


Record No. 1975/116

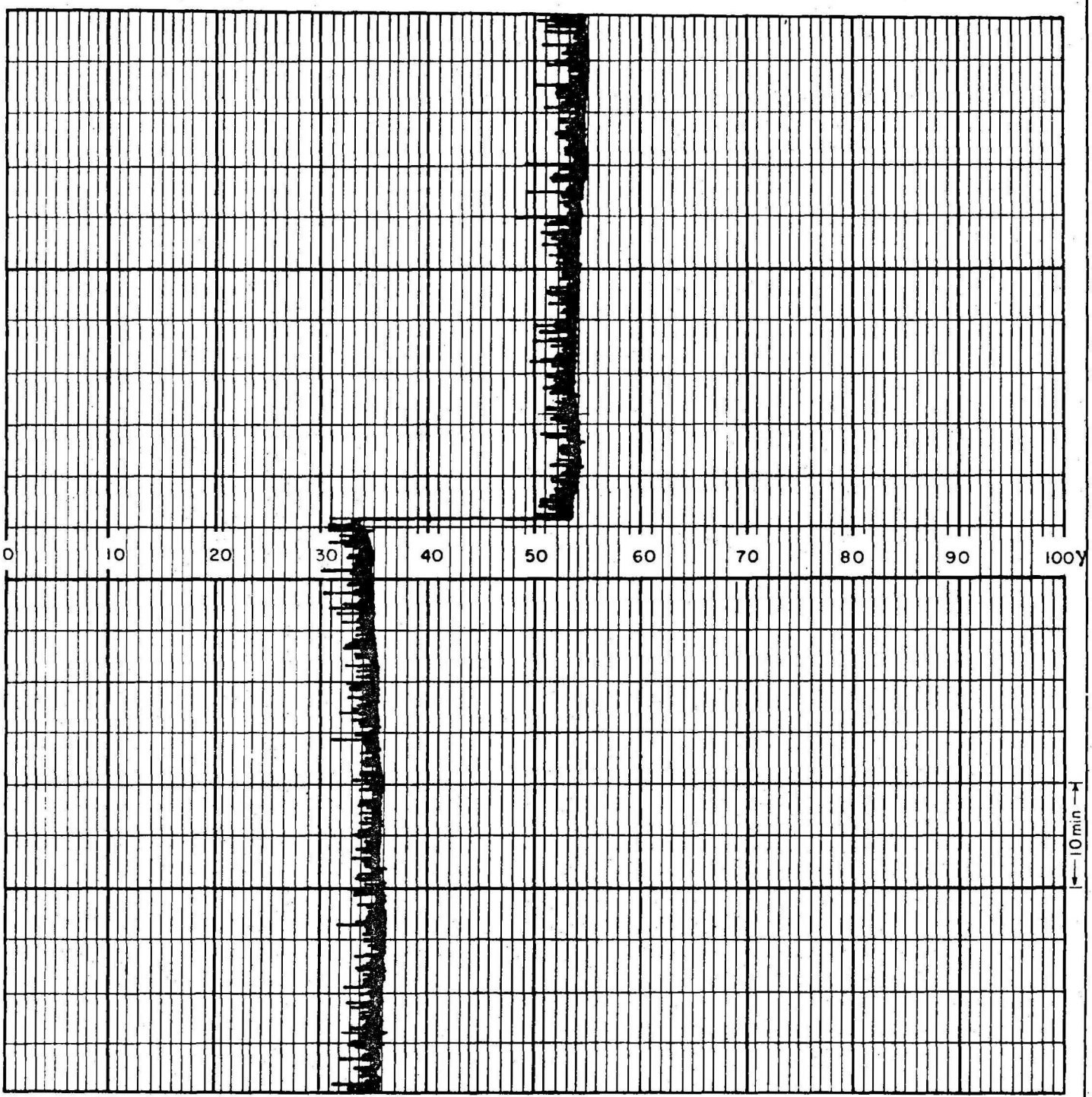
150/B8-22A



SURVEY LINES WITHOUT SHORE MAGNETOMETER DATA



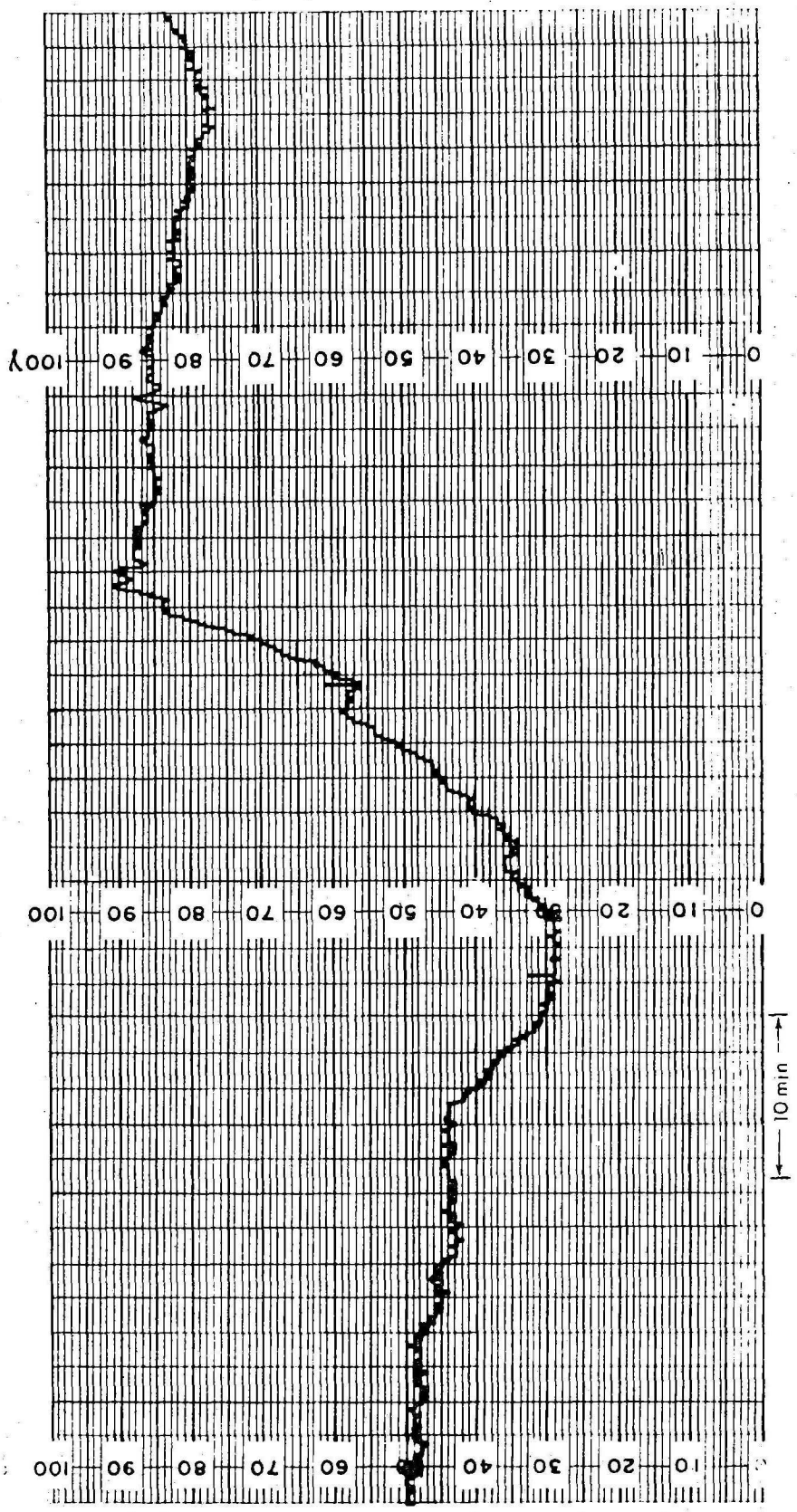
SHORE MAGNETOMETER EQUIPMENT BLOCK DIAGRAM



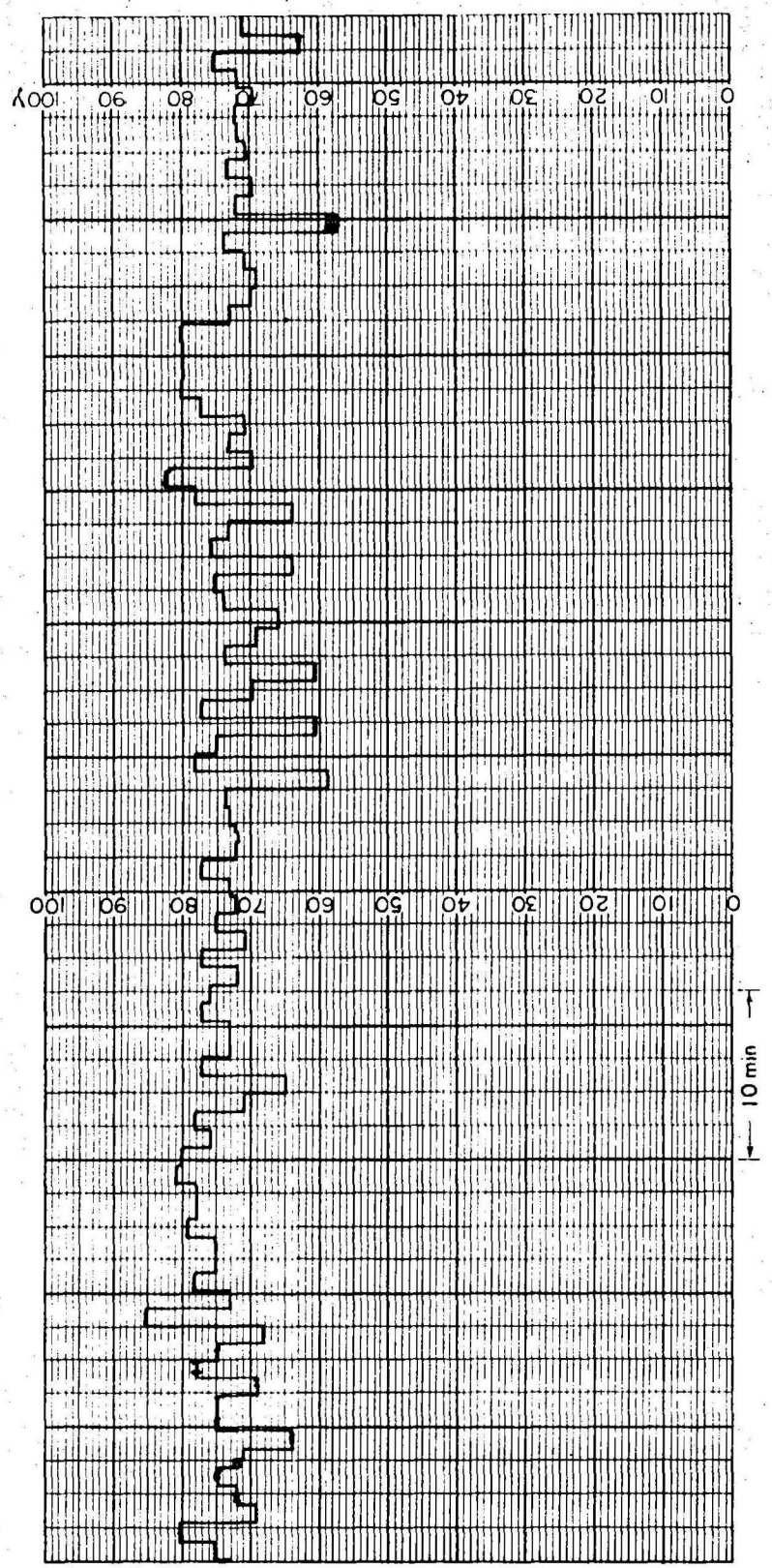
EXAMPLE OF SHORE MAGNETOMETER RECORD
SURVEY 05 DAY 74 PORT MORSBY

Record No. 1975/116

C55/B8-57A

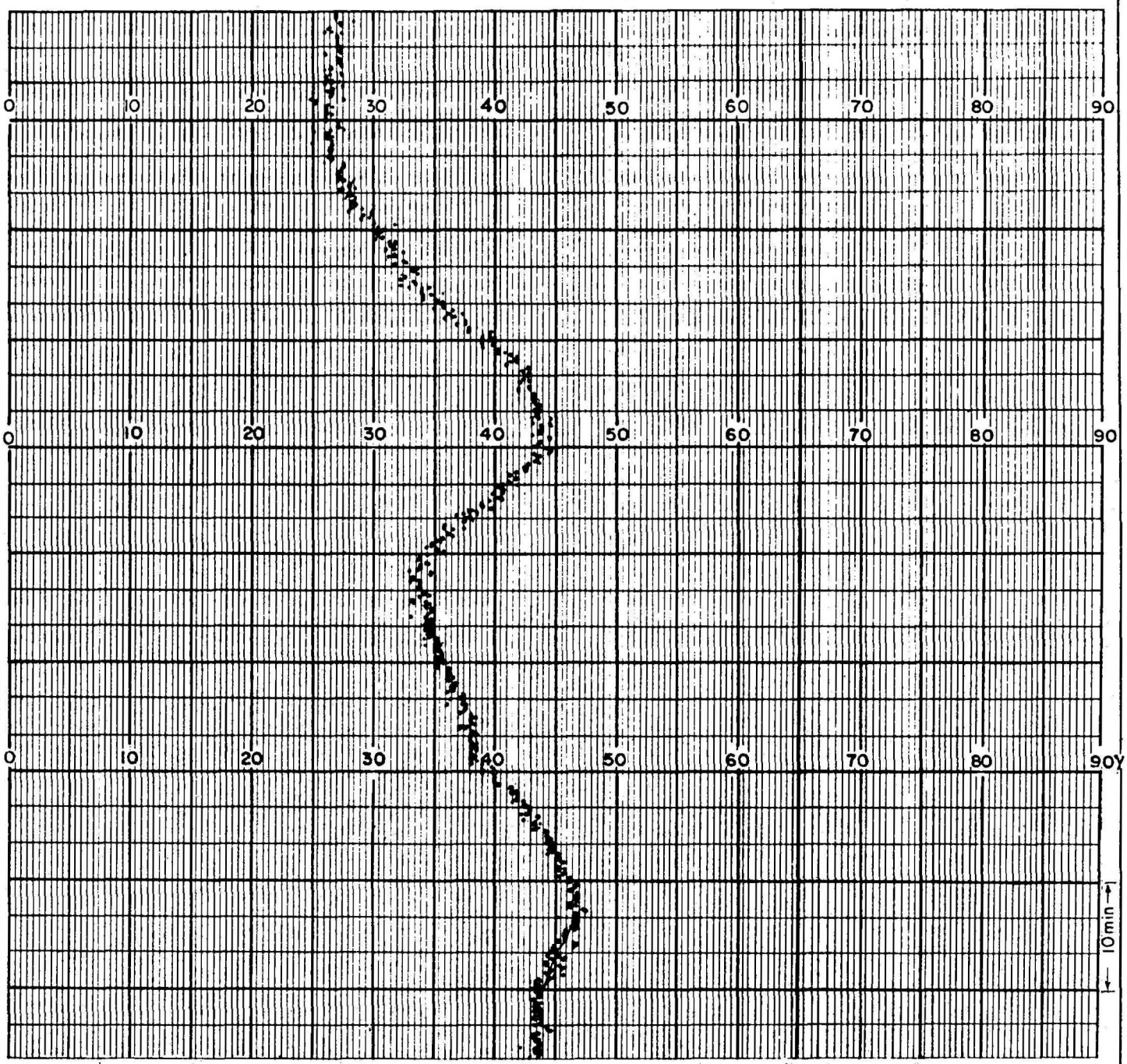


EXAMPLE OF SHORE MAGNETOMETER RECORD
SURVEY II DAY 26 HOBART



EXAMPLE OF SHORE MAGNETOMETER RECORD
SURVEY 12 DAY 82 COFFS HARBOUR

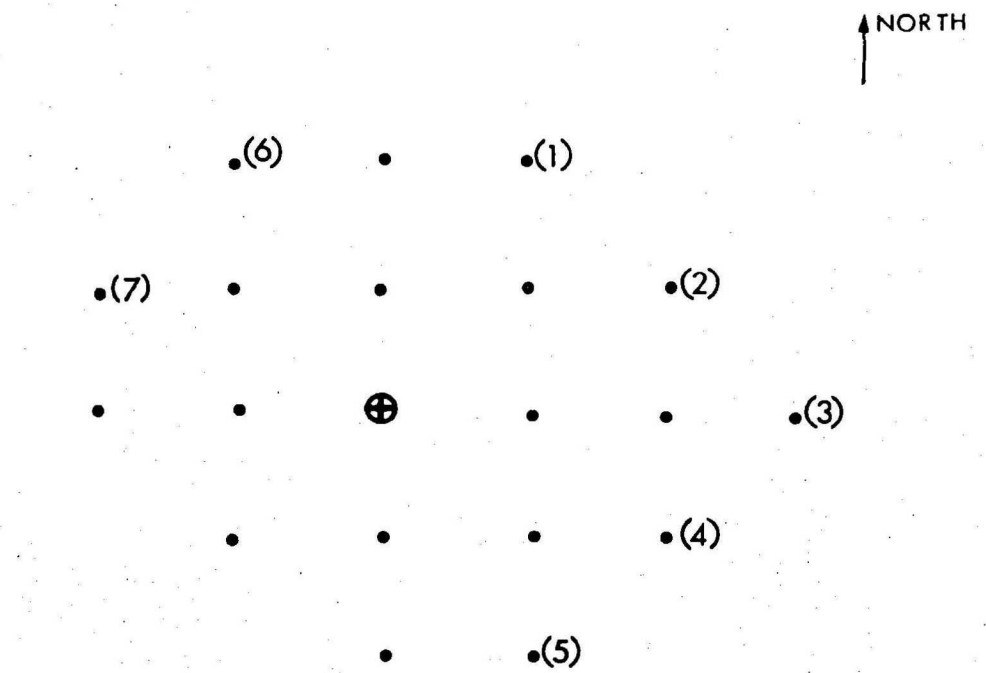
PLATE 21



EXAMPLE OF SHORE MAGNETOMETER RECORD
SURVEY 15, DAY 31, LAUNCESTON I

Record No. 1975/116

K55/88-30A



⊕ Proposed location of sensor

• Reading point of site survey

•(1) Reading points added to extend site survey

EXAMPLE OF SUITABLE SITE SURVEY GRID