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Date 22 August 1985

RUNWAY ON M.I.

FEASIBILITY REPORT

CONTENTS

CONSTRUCTION OF A RUNWAY ON MARION ISLAND

FEASIBILITY REPORT

1. INTRODUCTION

A visit was paid to Marion Island over the period 2 to 5 October 1984 to investigate the feasibility of constructing a runway on the island. This report briefly describes the most pertinent available information about the island, the findings of the investigation and certain recommendations about further investigations and surveys.

2. INFRA-STRUCTURAL REQUIREMENTS

The following requirements were identified :

- Harbour/beaching facilities are required to bring construction equipment from the ship onto the island.

- A road linking the beach with the runway site.

- A runway to cater for C130 aircraft. The desirable length was stipulated as 6 000 feet (1 800 metres), however a minimum length of 4 500 feet (1 400 metres) would be acceptable. The runway width must be 100 feet (30 m). For a 4 500 feet runway the maximum payload will be 23 000 pounds and 12 000 pounds for landing and take-off respectively.

- Parking area for one aircraft on western end of runway (30 m radius) and turning area only on eastern extremity (45 m radius).

- LCN (Load classification number) of 28.

- Storage facility for 20 000 pounds (± 12 000 litres) of aviation fuel. (Pressure refuelling not required).

- Personnel and facilities to prepare and transmit a 3 to 4 hour local weather forecast to South Africa.

- Normal runway lighting with VASI/PAPI.

- Provision of instrument landing system (ILS) must be investigated.

- Installation of non-directional beacon (NDB).

- VHF radio communication for ground/air communication.

- Overnight accommodation for crew.

3. **BACKGROUND INFORMATION**

The island is located 2 107 km south-east of Cape Town, approximately 38° W longitude and 47° S latitude.

The island, (Figure 1), approximately 22 x 14 km in size rises sharply from the sea (with a rough uneven precipitous coast line) to a height of 1 186 m above sea level. Apart from a fringe of grass on top of the cliffs, the foot hills have a covering of soft spongy and mossy vegetation which together with high rainfall create swampy conditions which make walking most difficult, while mechanical transport cannot be used. There are no trees and bushes of any sort on the island. The mountain peaks are mostly enshrouded in cloud and are permanently covered in snow or ice above 700 m above sea level.

The climate is cold, cloudy and windy. The average annual temperature is 5°C and the sun shines for only 29% of the possible duration. The average annual minimum and maximum temperatures are 2,8°C and 8,1°C, but sub-zero temperatures occur frequently throughout the year. The normal annual rainfall is 2 600 mm.

Marion lies within the "roaring forties" and gales are frequent. There are on average 106 days per year with winds stronger than 55 km/h and on 42 of these days wind speeds exceed 66 km/h. The dominating wind direction is from west to east. A wind-rose is attached as Figure 2.

Weather statistics are attached in Appendix A1.

Marion Island has risen from the sea floor by volcanic processes, and lavas are all basalts. Seen from a distance, Marion Island has a low, dome-like profile diversified by numerous conical hills, built of volcanic ash and scoriae. It actually consists of two distinct regions namely, a central highland and an island slope, separated by an escarpment from a coastal plain in the south-west (Figure 3). The island slope is generally steeper on the western than on the eastern side. The slope is as low as 2 degrees at East Cape. The principal topographical features of the island slope are firstly plateaus and ridges and secondly depressions. The plateaus and ridges rise more than a 100 metres above the adjacent plains and they form a radial pattern around the island. They generally have a thin discontinuous layer of soil and eolian ash between bare outcrops or they are strewn with slabs of frost-shattered grey basalt.

The existing infra-structure on the island comprises a meteriological station with accommodation for 45 people. Radio and telex, normal AC/DC power, single phase and three phase 750 kVa exist at the met. station. All buildings are connected by wooden catwalks.

The method of unloading ships is to stand off outside the belt of kelp surrounding the island; a distance of 2 km. Everything that has to be unloaded is then transported by cutter from the ship to a high platform suspended alongside a 20 m cliff in Transvaal Cove. The loads (2 to 3 tonnes) are then hoisted one at a time by engine driven cranes.

4. SITE INVESTIGATION

The topography, ground conditions and prevailing wind direction confine the area where a runway would be feasible, to the eastern and south eastern side of the island. Three alternative sites were identified all of which are located on ridges which form a radial pattern around the summit of the island. The site finally selected for more detailed investigation is located close to East Cape, and to the immediate south of the met. station at Transvaal Cove. The centreline is virtually in an east/west direction (270°). The site is approximately 2 km from Trypot Beach which appears to be the best available beaching facility, reasonably well protected against high waves and swells (see Figure 4). Due to the limited time and bad weather conditions at the time of the visit, the beaching facility as well as the route between the runway site and Trypot Beach could not be thoroughly investigated.

Despite the appalling weather conditions, a centreline survey of the runway site as well as 30 m wide cross sections were taken at 50 m intervals (Figure 5 depicts the long section). A dynamic cone penetrometer (DCP) was used to assess the quality of the in situ material at 100 m intervals. These results are also shown in Figure 5. Soils samples were taken and laboratory tests indicate a CBR-value of 30 at 95% Mod AASHTO compaction, for the better quality material. Stabilisation with both lime and cement yielded very low strength (UCS results of the order of 200 to 300 KPa).

As can be seen in Figure 5 the length of the ridge is approximately 300 m shorter than the required 1 400 m. The low-lying area (lefthand side of Figure 5) will have to be filled in to achieve the desirable minimum runway length. The longitudinal gradient is relatively flat (of the order of 0,7%).

Normal safety tolerances for take-off in a westerly direction will not be achieved due to the high terrain and wind turbulance as a result of the topography. We however believe that these factors should be acceptable for such a facility.

We estimate that the construction cost could be of the order of R 8,5 million. This figure should however be considered as a very crude estimate made up as follows :

Shipping Costs*	R 2,2 million
Runway Construction Costs	R 3,00 million
Roads and Landing Facilities	R 0,5 million
Refuelling Facility	R 0,1 million
Navigational aids such as ILS, approach lights, edge lights, generator etc	R 2,7 million
TOTAL	R 8,5 million

* Shipping costs are very difficult to quantify but our estimate is based on the assumption that a South African vessel will be charted and paid for in Rands. Payment in foreign exchange, e.g. in dollars could alter the picture significantly.

5. CONCLUSIONS

(a) The visit to Marion Island described above should be considered as a reconnaissance visit and further detailed investigations are essential.

(b) We believe that it is technically feasible to construct a 1 400 m long runway on the island. Due to the high rainfall, rockfill drainage layers and a durable bituminous surface are considered necessary.

(c) No attempt has as yet been made to assess the environmental impact of the construction and operation of a runway on Marion Island. We believe that this issue will require consideration.

(d) Further surveys should include material investigations such as detail centreline sampling, investigations into available aggregate sources, detailed tacheometric surveys and levelling, water table recordings, and investigations into the beaching facilities and access road between the beach and runway. Due to the high costs involved in visiting the island, very thorough planning and preparation will be required for such a visit.

(e) The construction options will have to be very carefully assessed e.g. use of a private contractor, a governmental construction unit, etc. Construction will have to be carried out under very adverse weather conditions.

(f) Taking temperature and rainfall considerations into account, it appears that October to April may be the preferred months during which construction should be carried out.

WEATHER STATISTICS

	MONTH												
	J	F	M	A	M	J	J	A	S	O	N	D	Annual
Average hours sunshine/day	4,9	4,8	3,7	2,6	2,2	1,8	2,0	2,4	3,0	4,4	5,0	5,1	3,5
Number of days with gales > 66 km/h	3,0	2,4	3,1	3,3	2,7	4,6	5,1	3,3	4,7	2,9	3,9	3,7	42,7
Average air temperature @ 24h00 (S A time) °C	5,8	6,4	6,5	5,5	4,6	3,7	3,4	2,9	2,8	3,6	4,2	4,9	4,5
Average air temperature @ 12h00 (S A time) °C	8,0	8,7	8,5	7,0	5,6	4,6	4,2	4,0	4,3	5,6	6,5	7,2	6,2
Rainfall (mm)	222	207	225	238	249	232	231	185	201	165	196	225	2 576
Average number of days with rainfall													
> 1,0 mm	19	18	19	21	23	24	23	22	20	18	19	22	248
> 10 mm	7	7	8	8	9	8	8	6	6	5	6	8	86
> 25 mm	2	2	2	2	2	2	2	1	1	1	2	2	21

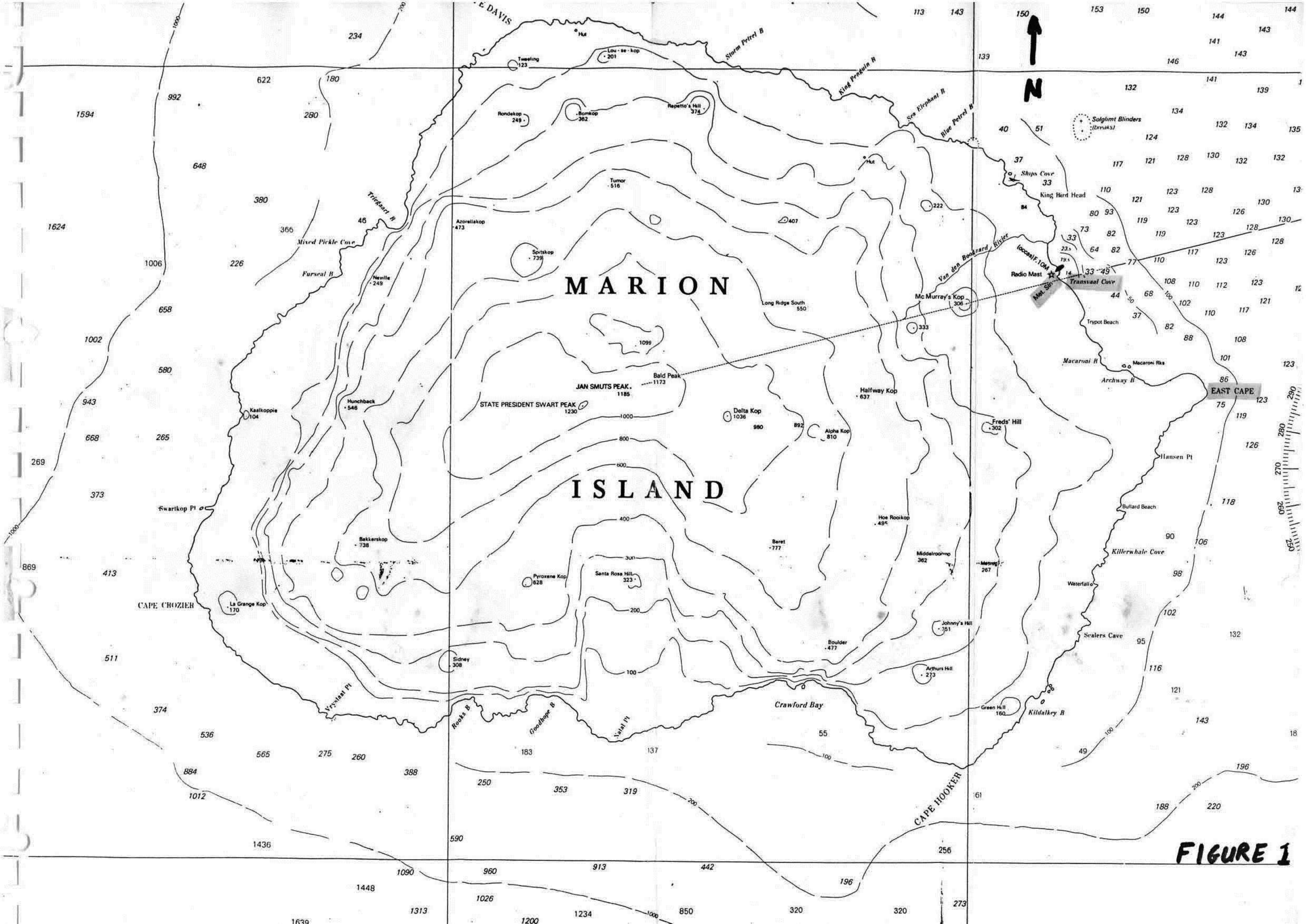
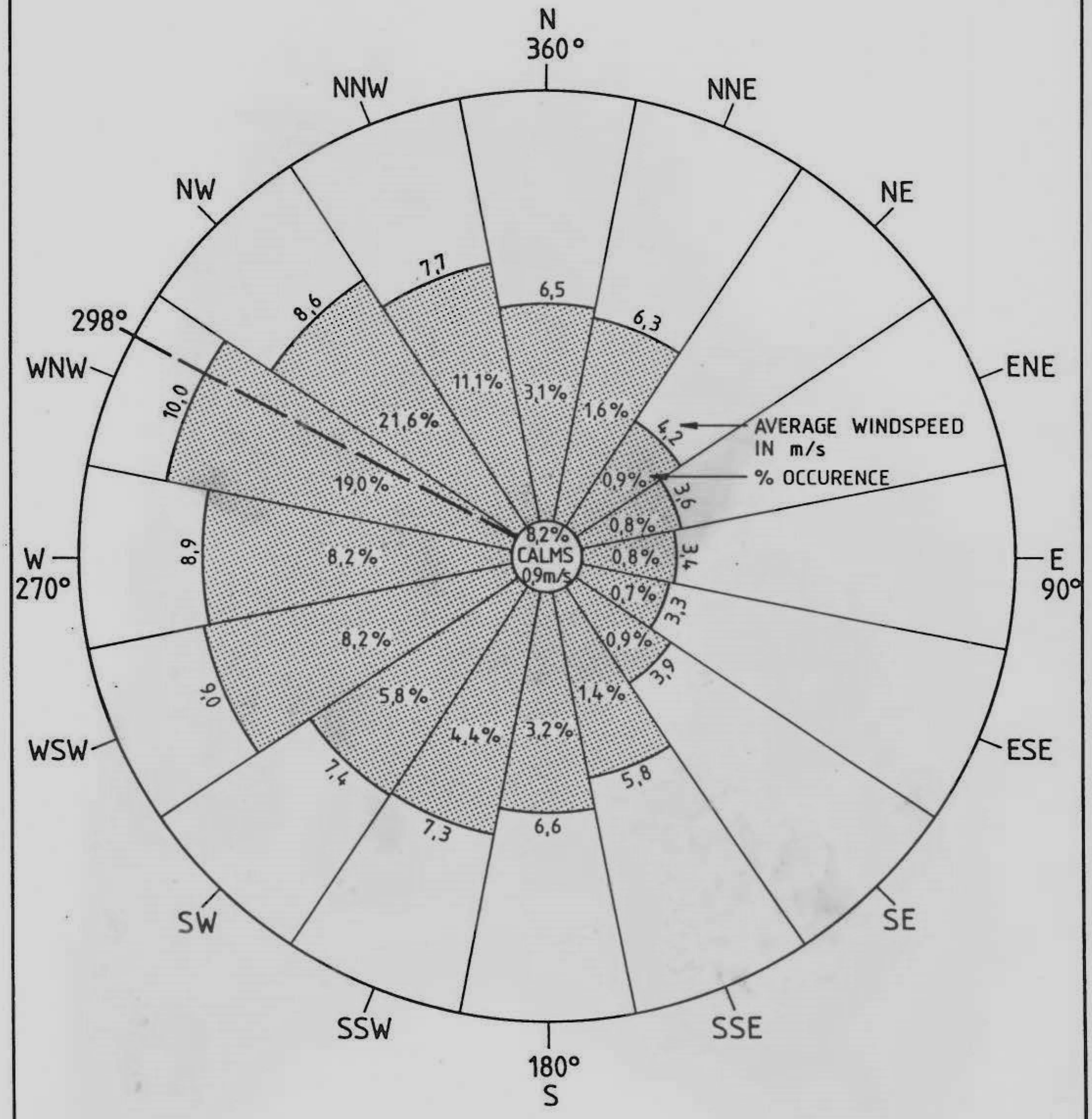

N
MARION
ISLAND
JAN SMUTS PEAK. 1185
STATE PRESIDENT SWART PEAK 1230
Bald Peak 1173
Delta Kop 1036
Alpha Kop 810
Halfway Kop 637
Long Ridge South 550
Mc Murray's Kop 306
Freds' Hill 302
Hoe Rooikop 495
Beret 777
Middelrooikop 362
Santa Rosa Hill 323
Pyroxene Kop 628
Bakkerskop 738
Hunchback 546
Neville 249
Spitskop 739
Azorellakop 473
Tumor 516
Rondekop 249
Bomkop 362
Repetto's Hill 374
Tweeling 123
Lou - se - kop 201
Kaalkoppie 104
La Grange Kop 170
Sidney 308
Boulder 477
Johnny's Hill 351
Arthurs Hill 273
Green Hill 160
Hut
Radio Mast
Met. Stn
Transvaal Cove
(occas)F.10M
Van den Boogaard River
King Bird Head
Ships Cove
Solglimt Blinders (breaks)
Trypot Beach
Macaroni B
Macaroni Rks
Archway B
EAST CAPE
Hansen Pt
Bullard Beach
Killerwhale Cove
Waterfall
Scalers Cave
Kildalkey B
Crawford Bay
CAPE HOOKER
Natal Pt
Goodhope B
Rooks B
Vrystaat Pt
CAPE CROZIER
Swartkop Pt
Furseal B
Mixed Pickle Cove
Triegaart B
Storm Petrel B
King Penguin B
Sea Elephant B
Blue Petrel B

FIGURE 1



WEIGHTED MAJOR WIND DIRECTION = 298°

Uhlmann Witthaus & Prins	WIND DIRECTIONS	FIG. 2

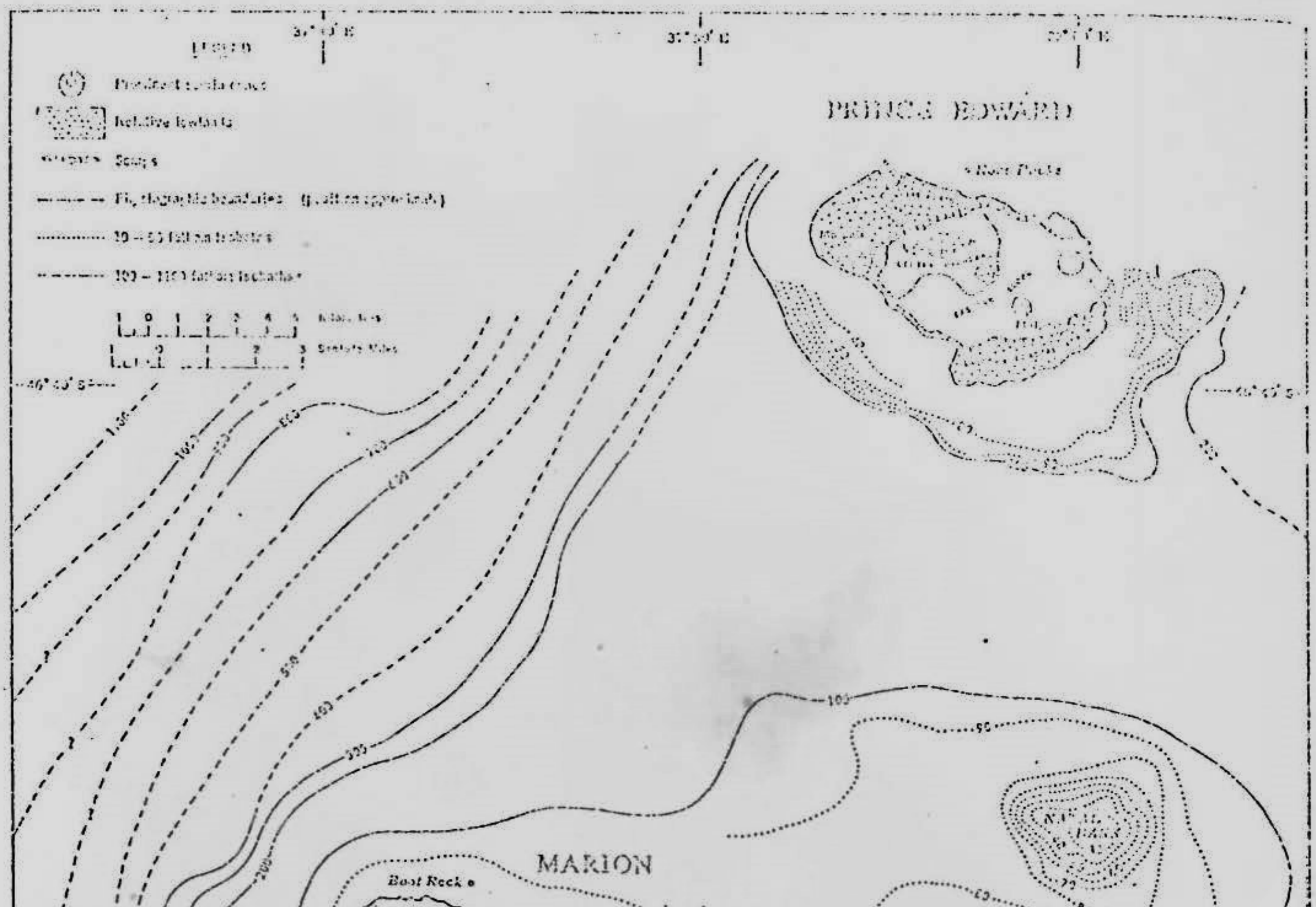


FIGURE 3

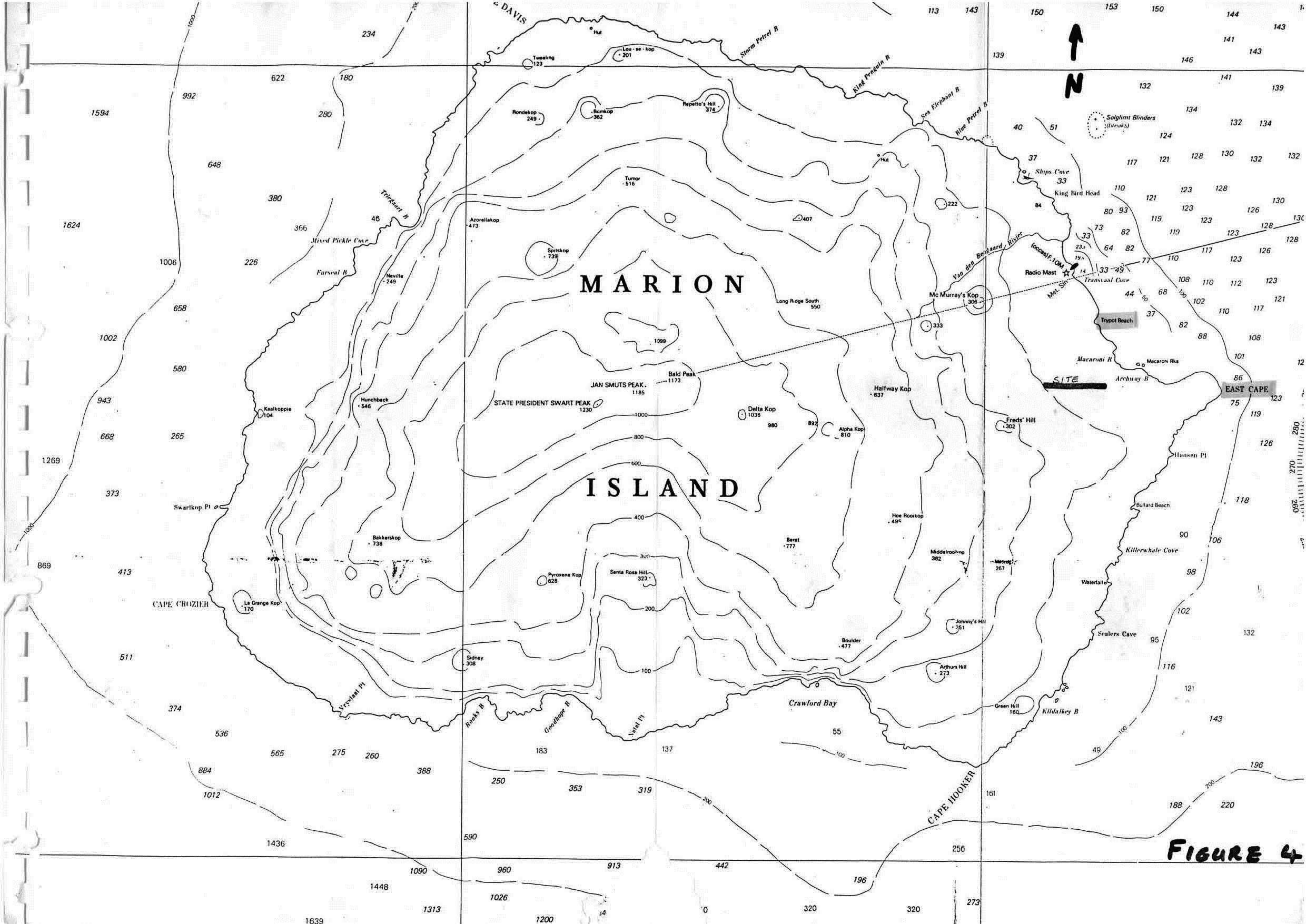
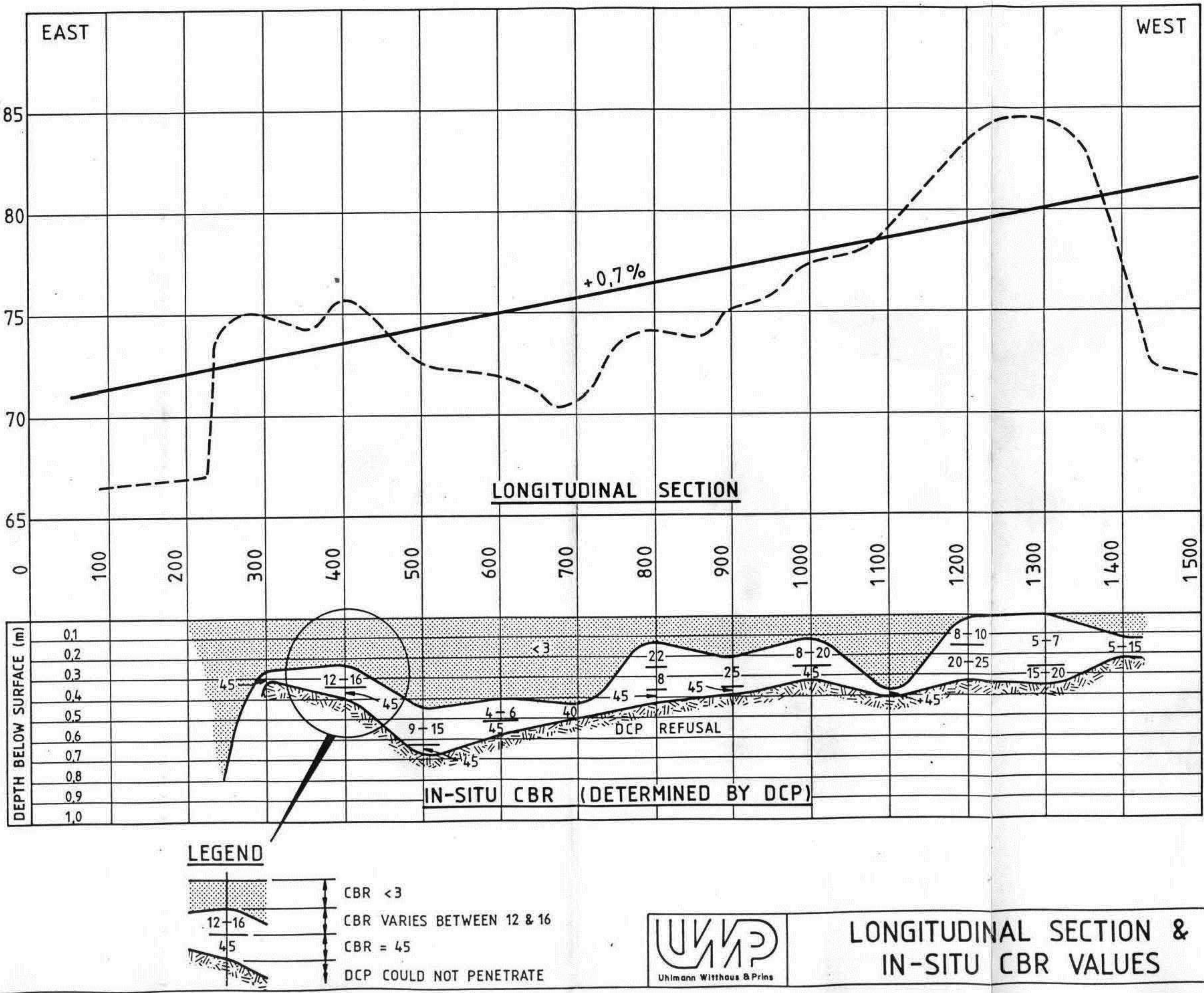

N
MARION
ISLAND
SITE
EAST CAPE
Trypot Beach
Macaroni B
Macaroni Rks
Archway B
Transvaal Cove
Met. Stn
Radio Mast
King Bird Head
Ships Cove
Solglimt Blinders (breaks)
Van den Boogaard River
Mc Murray's Kop
Blue Petrel B
Sea Elephant B
King Penguin B
Storm Petrel B
Hut
Lou - se - kop
Tweeling
Repetto's Hill
Bomkop
Rondekop
Tumor
Azorellakop
Spitskop
Trigkaart B
Mixed Pickle Cove
Furseal B
Neville
Long Ridge South
Bald Peak
JAN SMUTS PEAK
STATE PRESIDENT SWART PEAK
Hunchback
Kaalkoppie
Swartkop Pt
Bakkerskop
CAPE CROZIER
La Grange Kop
Pyroxene Kop
Santa Rosa Hill
Sidney
Vrystaat Pt
Rooks B
Goodhope B
Natal Pt
Crawford Bay
Boulder
Arthurs Hill
Johnny's Hill
Green Hill
Kildalkey B
Beret
Delta Kop
Alpha Kop
Halfway Kop
Hoe Rooikop
Middelrooikop
Freds' Hill
Waterfall
Sealers Cave
Killerwhale Cove
Bullard Beach
Hansen Pt
CAPE HOOKER

FIGURE 4



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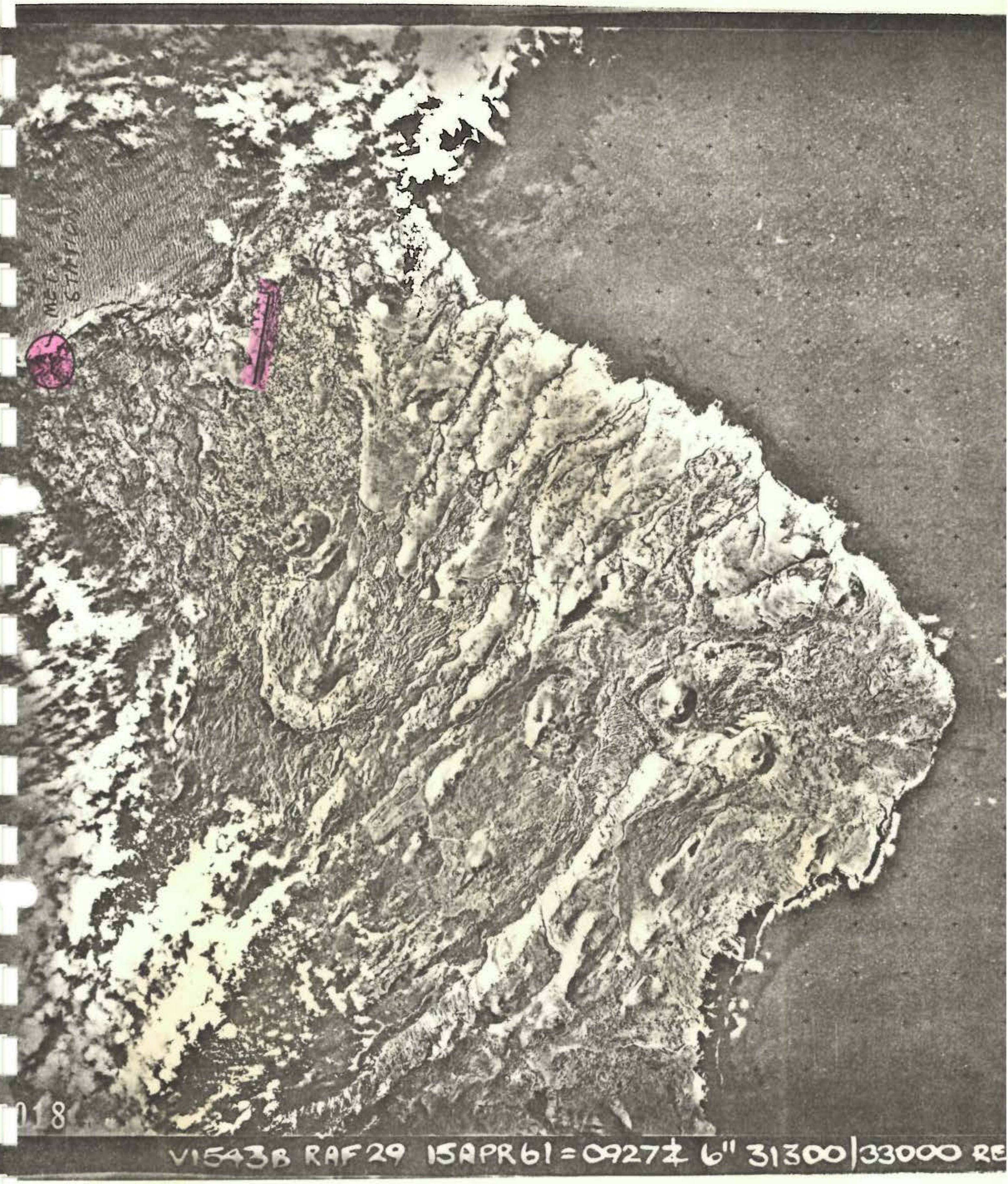
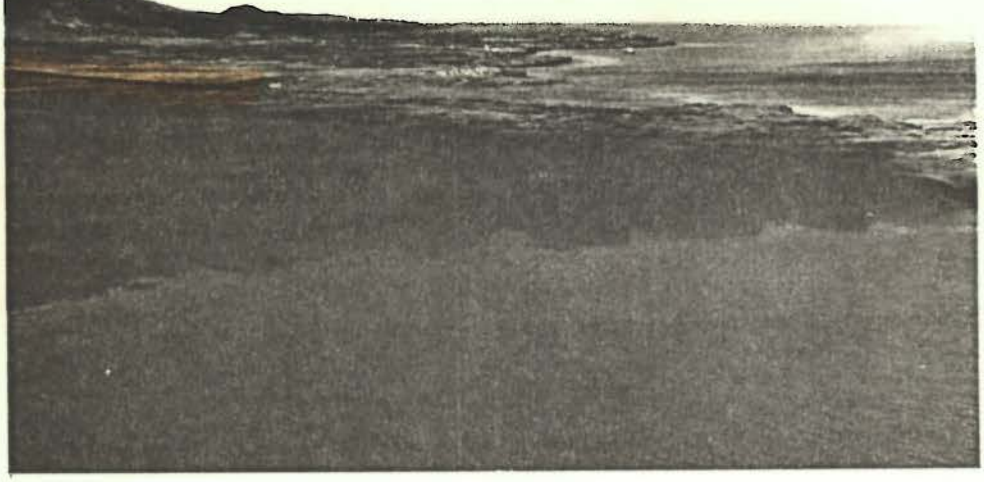
LONGITUDINAL SECTION & IN-SITU CBR VALUES

FIG. 5


MET. STATION
018
V1543B RAF29 15APR61 = 0927Z 6" 31300|33000 RE

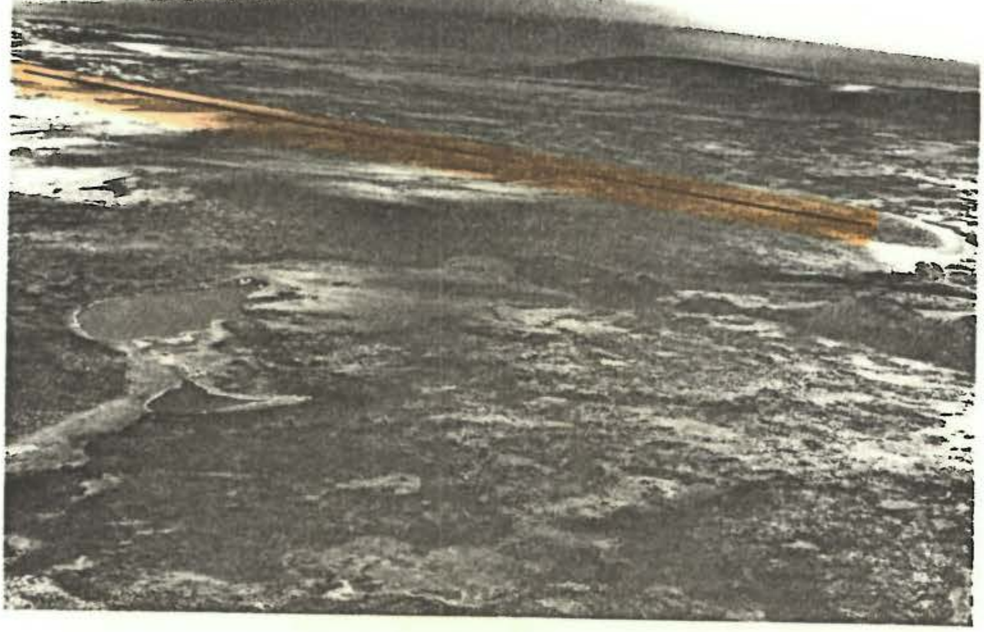
MET. STATION

EAST CAPE

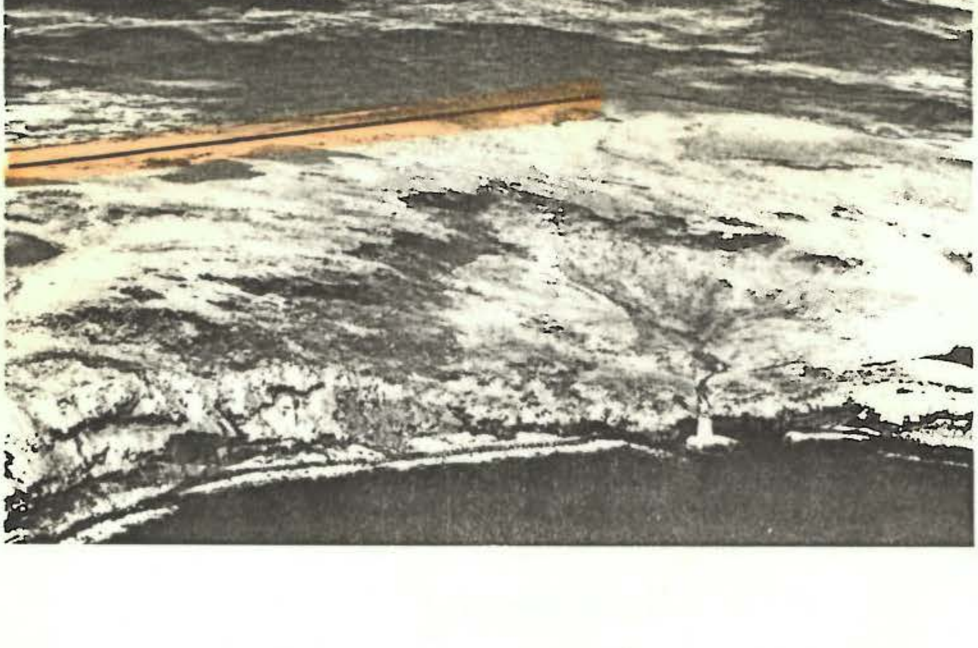


EAST CAPE

EAST WEST

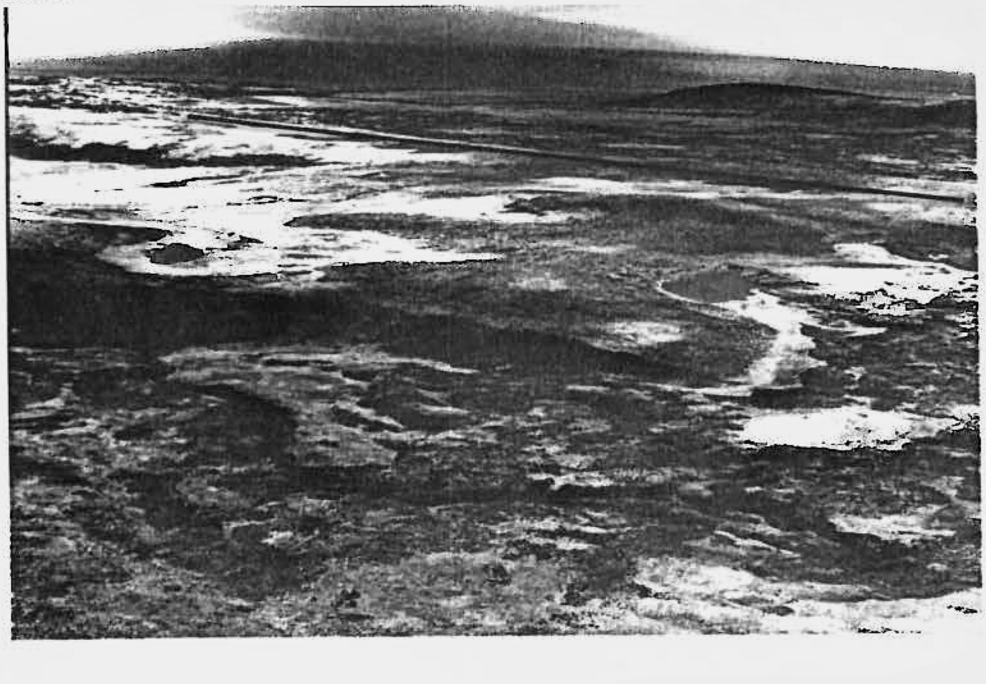


EAST WEST

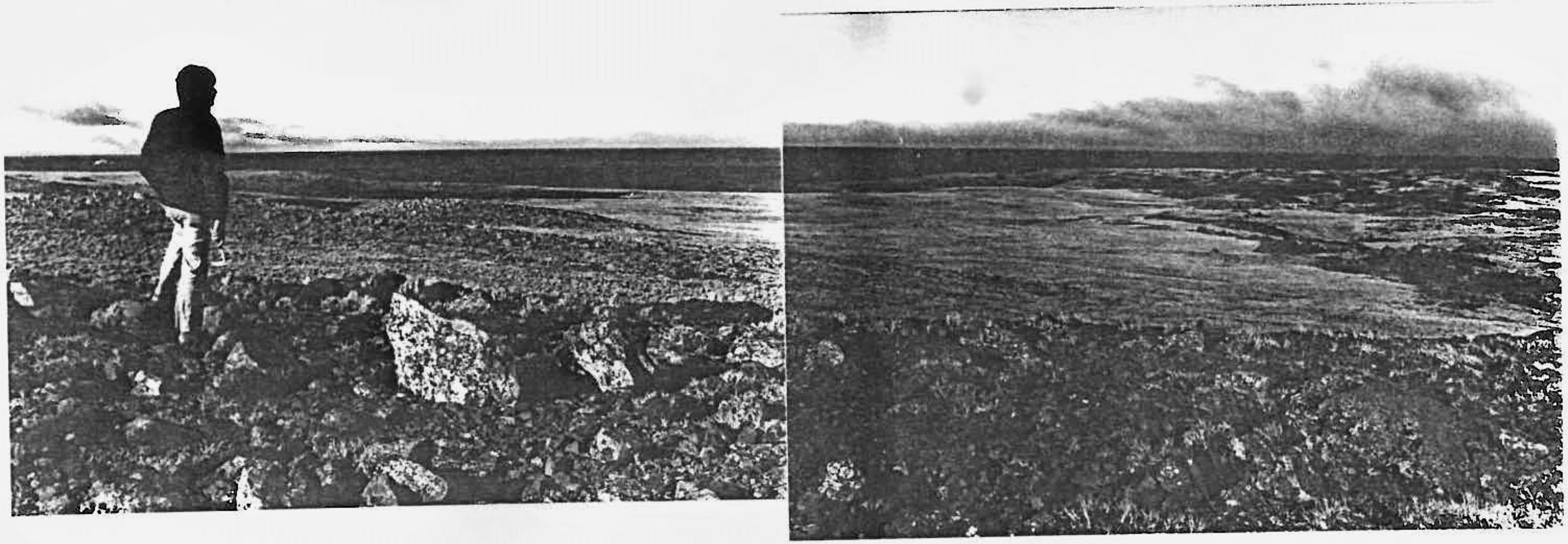


NORTH SOUTH

EAST WEST



NORTH SOUTH



LOOKING EAST FROM EASTERN END OF SITE TOWARDS EAST CAPE