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COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORDS 1956, No. 24

GEOPHYSICAL SURVEY IN THE MANTON DAM CATCHMENT AREA, NORTHERN TERRITORY

by

A. J. BARLOW

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ABSTRACT.

Radiometric, self-potential and electromagnetic surveys were made in the Manton Dam Reserve, Northern Territory, at the request of the Administrator of the Northern Territory. The geology of the area is very similar to that at Rum Jungle. Sediments of the Brock's Creek Group, including the Crater grits and quartzites, haematite quartzite breccia and Rum Jungle shales, limestone, and quartzite, overlie a highly radioactive granite stock.

A radiometric contour plan was compiled from data obtained from a car-borne unit comprising scintillometer and odograph. Small areas of up to three times background were located over an area of deep soil overlying the Rum Jungle shale horizon, but they may not be directly connected with the radioactivity of the bed-rock in the immediate vicinity. Testing of the radiometric anomalies by costeans is recommended.

The self-potential results showed several strong anomalies within the Rum Jungle shales. A diamond drill hole which was put down to test one of the anomalies revealed no strong mineralisation or radioactivity and it is probable that the anomaly is due to disseminated pyrite in the Rum Jungle shale beds.

A few test traverses were surveyed by the electromagnetic method, but no results of any significance were obtained.

1. INTRODUCTION

Manton Dam, which provides the water supply for the town of Darwin, is about 45 miles by road south of Darwin, and about half-a-mile west of the Stuart Highway.

Mapping by the geologists of Rio Tinto Ltd. led that company to believe that an area immediately to the west of the dam offers favourable prospects for the discovery of uranium and other minerals and the company has applied to the Northern Territory Administrator for mining tenements over the site. The area applied for lies in the water catchment reserve surrounding the dam, and the Administrator of the Northern Territory requested that the Bureau of Mineral Resources examine the area by any means considered desirable, to assess its prospects, so that he could decide whether the granting of leases is warranted.

A geophysical survey was made, using vehicle-borne radiometric equipment and also employing self-potential and electromagnetic methods. The survey covered an area of about one square mile, and was carried out from September to November, 1954. The geophysical party consisted of A.J. Barlow (party leader), one geophysical assistant, and two field assistants.

2. GEOLOGY

The area has been geologically mapped by members of the field staff of Rio Tinto Ltd., and the information given below was furnished to the Bureau by Mr. R.S. Matheson of that company.

The Manton Dam area lies at the north-eastern corner of the Rum Jungle Granite, and rocks of the Brock's Creek Group, similar to those at Rum Jungle and in the same stratigraphic sequence, occur near the dam. The sequence at Manton Dam has been established as follows (from south to north):-

Granite stock, showing unusually high radioactivity.

Crater beds (quartzites, grits, etc.) with pyrite mineralisation.

Silicified limestone breccia.

Rum Jungle shales, with some quartzites and crystalline limestones.

Quartzites.

In the area surveyed, the beds strike nearly east and dip to the north at angles between 45° and 80°. Further to the east, the beds swing to the south, following the eastern edge of the granite.

Air photographs show several linear features across the strike of the beds, and these may represent shears or faults of small displacement. Detailed geological mapping is difficult because of soil cover, particularly over the Rum Jungle shales.

The following reasons led to the belief that the area may be worthy of prospecting for deposits of uranium and other minerals:-

(i) The unusually high radioactivity of the granite stock.

(ii) The general geological similarity to Rum Jungle, where deposits of uranium minerals and sulphides of various types occur in the Rum Jungle shales.

3. CHOICE OF GEOPHYSICAL METHODS

The formations of particular interest are the Rum Jungle shales and the Crater beds, and the survey was directed to investigating the possibilities of these formations. With regard to the Crater beds, although the presence of sulphide mineralisation in the outcrops could be considered as a favourable indication, previous drilling of similar beds at Rum Jungle has given inconclusive results. Tests on samples from the Crater beds, both at Rum Jungle and near Manton Dam, have shown that radioactivity in the outcropping portions is essentially due to thorium. The beds are highly weathered and the outcrops give little guidance as to the nature of the mineralisation at depth. However, attempts have been made to test the beds at Rum Jungle in the primary zone by drilling. Detailed information on the results of the drilling is not available, but it is understood that, where intersected in drill holes at depths up to 250 feet, the beds have preserved the same character and no indication of primary mineralisation has been obtained. A small amount of test geophysical work, using self-potential and magnetic methods, was done over the Crater beds at Rum Jungle, but no useful indications were obtained. For these reasons, it was not expected that the results of the present survey would be of much value as regards these beds.

Experience at Rum Jungle indicates that the Rum Jungle shales may contain deposits which are well suited to prospecting by geophysical methods. In these beds in the Rum Jungle area, sulphide bodies of considerable size and varied composition occur, some of which are associated with uranium mineralisation. The association is probably fortuitous, to the extent that uranium and sulphide mineralisation are probably subject to the same structural control, although the two types of mineralisation may have occurred at different times. Tests in the Rum Jungle area have proved that self-potential anomalies are associated with the known sulphide bodies. On this basis, it appeared that the most suitable method of testing the Rum Jungle shales in the Manton Dam area would be a surface radioactive survey, together with a self-potential survey. These methods were used in the present work.

4. DESCRIPTION OF METHODS

The radioactivity survey was made using a continuously recording scintillation counter constructed by the Bureau and mounted in a Land Rover. The course of the vehicle was controlled using a continuous course-plotting device known as an odograph, manufactured by the Monroe Calculating Machine Co. Inc., U.S.A. The terrain was favourable for this type of operation and little trouble was experienced in maintaining traverse lines at a spacing of approximately 100 feet. About 20 line-miles per day were surveyed.

The self-potential method involves measuring ground potentials over a grid, using a high-impedance voltmeter. Ground potentials are due primarily to chemical action of ground waters on geological formations of suitable composition. When such a formation is immersed in electrolytes of different composition, a potential difference may be established between points in the formation. In the Darwin area, where rainfall is relatively high and ground water stands at varying but shallow depths, such conditions are frequently encountered. The ground potential map of such an area shows a complex of anomalies, to most of which no specific cause can be assigned. However, it is found that a body of sufficiently dense sulphides, lying partly above and partly below ground-water level, often produces fairly high potential differences, of the order of hundreds of millivolts. The anomaly due to such a body appears as a negative centre of considerable horizontal extent. Similar anomalies are sometimes caused by deposits of other types, pyritised fault and shear zones, graphitic slates, etc., and the presence of such an anomaly may only be taken therefore as evidence of the possible presence of a sulphide body.

The self-potential traverses were spaced 100 feet apart, with observation stations 50 feet apart along the traverses. Potentials were measured using a Cambridge pH meter as a millivoltmeter.

A small number of test traverses was surveyed using an electromagnetic method. In these methods a low-frequency electromagnetic field is applied at the surface of the ground, and the distribution of the resulting electromagnetic field in the ground is investigated. Anomalies in the resulting field are caused by formations whose electrical conductivity is significantly greater than that of the surrounding formations. Sulphide bodies frequently have considerably higher conductivity than the surrounding country rocks, and may give rise to electromagnetic anomalies. The equipment was of the Slingram type, manufactured by A.B.E.M., Sweden. Because of lack of time, the electromagnetic work was confined to a few test traverses which, as later evidence showed, did not cover the most interesting part of the area.

5. INTERPRETATION OF RESULTS

(a) Radiometric

The radiometric contour plan is shown on Plate 2. The average background reading has been taken as 15 counts per second and contours have been drawn at 1, 1.5, 2 and 3 times background count. Some difficulty was experienced in correlating records obtained just after rain with those obtained when the ground was dry. Readings were much lower when the ground was wet, possibly due to soluble radioactive materials being carried down by the water and possibly also due to partial screening by the water.

Broad radioactive anomalies occur within the Rum Jungle shale beds. Experience has shown that such anomalies can arise from a number of causes which may have no direct connection with deposits of uranium minerals. Comparison of Plates 2 and 4 shows that the distribution of radioactive highs over the Rum Jungle slates is very roughly parallel to the distribution of self-potential anomalies A, B and C, and it is possible that the radioactive anomalies are more significant due to this fact. It is recommended that the radioactive high centred at about 4300W/200N, which lies closest to the corresponding self-potential anomaly (anomaly C), be tested by a costean extending from 4200W/300N to 4700W/100S. If this testing indicates that the radioactive anomaly has any connection with uranium mineralisation, the other two radioactive highs in the Rum Jungle shales should be tested by means of costeans suitably disposed.

Two large areas of abnormally low radioactivity in the south-eastern part of the area correspond closely with areas of outcropping quartz-haematite breccia. Thus it is probable that no significant uranium deposits are associated with the small self-potential anomalies which were obtained over this horizon.

(b) Self-potential

The self-potential results are shown as profiles on Plate 3 and as contours on Plate 4. The contour plan has been drawn from smoothed profiles. The most important feature of the results is the series of four anomalies, marked A, B, C and D, which occurs over the Rum Jungle shale beds. The axes of the anomalies coincide with the strike of the beds and the relative displacement of the anomalies suggests cross-faulting. Anomaly D is the strongest and three of the traverses across this anomaly were repeated in detail so that a comparison could be made with calculated theoretical profiles. The detailed profiles and a theoretical profile calculated for two parallel dipping bodies are shown in Plate 5. The observed profiles are closely similar to the calculated profile. The theoretical profile was calculated for bodies 400 feet long, 200 feet apart, dipping 45° to the north, and with their tops at a depth of 100 feet. As the country rock dips at approximately 45° in this area it is probable that the cause of the anomaly is directly connected with the bedding. Possible causes are graphitic shales or mineralised shales, although it was considered unlikely that graphitic shales alone would cause a self-potential anomaly of this type. The results give no indication as to the nature of any mineralisation which may be present.

A recommendation was made that Anomaly D be tested by a drill hole at 5500W/750N, bearing 190° magnetic, depression 70° and length about 400 feet. As a result of this recommendation, the Bureau decided to test the deposit, and drilling was commenced in July 1955. A core recovery of 15 per cent was obtained for inspection, and the hole was radiometrically logged (Dow,1955). No strong mineralisation or significant radioactivity was observed, and drilling was stopped at 500 feet drill depth.

A geochemical survey was also made (Debnam, 1955) around a costean which was dug over the centre of Anomaly D. This revealed only a weak lead anomaly over most of the area and a weak copper anomaly extending eastwards from the costean. Such anomalies, although insignificant in comparison with results obtained from similar surveys in other parts of the Northern Territory, could well be the surface expression of mineralisation at depth, but taking into account the results of the diamond drilling, it is probable that the self-potential anomaly is due to disseminated pyrite in the Rum Jungle shale beds.

The self-potential readings over the quartz-haematite breccia were very irregular, particularly near the outcrops. This indicates that the self-potential anomalies are due to surface effects only, although the anomalies marked E and F are fairly well-defined and it may be of interest to test them by shallow holes or costeans.

Strong positive anomalies were obtained over parts of the Crater beds to the south-east. Although strong pyrite mineralisation is present, no well-defined negative centres were located. Similar results have been obtained over these beds in the Rum Jungle area. No definite cause can be assigned to these anomalies, but the positive anomalies are probably caused by surface or pH effects.

(c) Electromagnetic

Profiles using the "Slingram" equipment were obtained over the Crater beds and over one of the weaker self-potential anomalies. Results of both in-phase and quadrature readings are shown on Plate 6. A 200-foot spacing between transmitting and receiving loops was used and readings were taken at 25-foot intervals. The equipment was affected by rain and results are not particularly reliable. Weak but well-defined anomalies which agree well with the position of the self-potential anomaly are shown in the profiles of the quadrature component.

The profiles show no distinct conducting zones corresponding to self-potential anomalies A and B. A possible reason for this is that the surface soil was soaked by two days of heavy rains, which may have formed a more conducting surface layer which would screen or mask any indications from conductors at depth. Moreover, the work done was insufficient to enable any definite conclusions to be drawn from the electromagnetic results.

6. CONCLUSIONS.

Radiometric highs occur in the Rum Jungle shales. The significance of these cannot be determined without testing. It is recommended that, in the first instance, one radioactive anomaly be tested by a costean extending from 4200W/300N to 4700W/100S.

The self-potential anomalies give no indication of the nature of the mineralisation, but as the area is geologically favourable for the occurrence of uranium, the latter may well be associated with any other mineralisation which may occur. Diamond drilling was therefore recommended to test one of the self-potential anomalies. This was later carried out, but revealed no strong mineralisation or radioactivity, and it is considered that the self-potential anomaly is probably due to disseminated pyrite in the Rum Jungle shale beds.

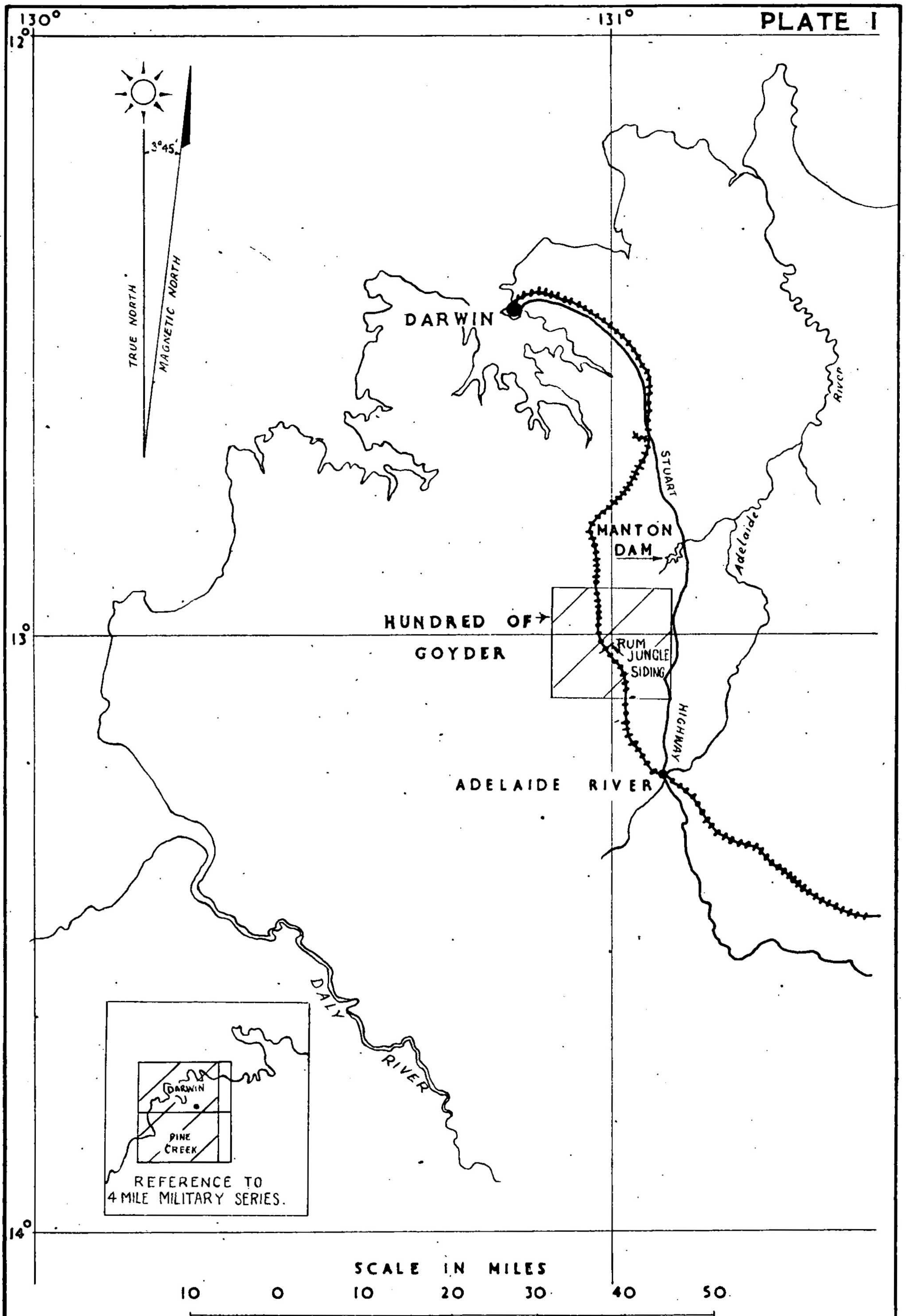
Although the electromagnetic results were negative; further checks on the self-potential anomalies should be made by this method.

7. REFERENCES.

Debnam, H. B., 1955 - Report on geochemical survey at Manton Dam Prospect, N.T. Bur. Min. Res. Geol. & Geophys., Records 1955, No. 67.

Dow, D. B., 1955 - Report on the diamond drilling of a self-potential anomaly near Manton Dam, N.T. Bur. Min. Res. Geol. & Geophys., Records 1955, No. 118.

PLATE I

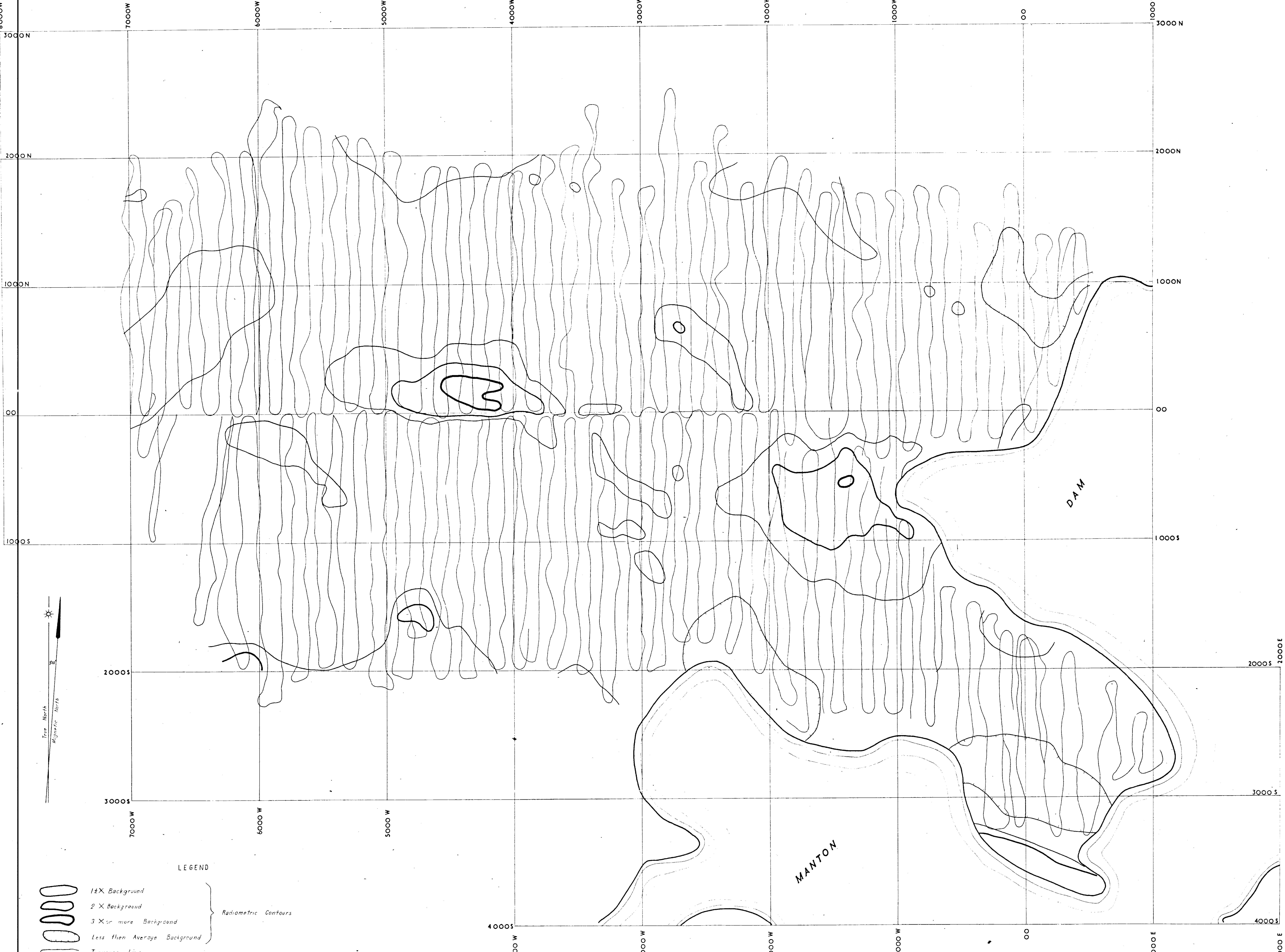


GEOPHYSICAL SURVEY
IN THE MANTON DAM CATCHMENT AREA, N.T.

LOCALITY MAP

Geophysical Section, Bureau of Mineral Resources, Geology and Geophysics G 185—2

PLATE 2



SCALE IN FEET

400 0 400 800 1200 1600

GEOPHYSICIST

GEOPHYSICAL SURVEY IN THE MANTON DAM CATCHMENT AREA, N.T.

TRAVERSE LINES AND RADIOMETRIC CONTOURS

Geophysical Section, Bureau of Mineral Resources, Geology and Geophysics

G185–3

GEOPHYSICAL SURVEY IN THE MANTON DAM CATCHMENT AREA, N.T.

SELF-POTENTIAL PROFILES

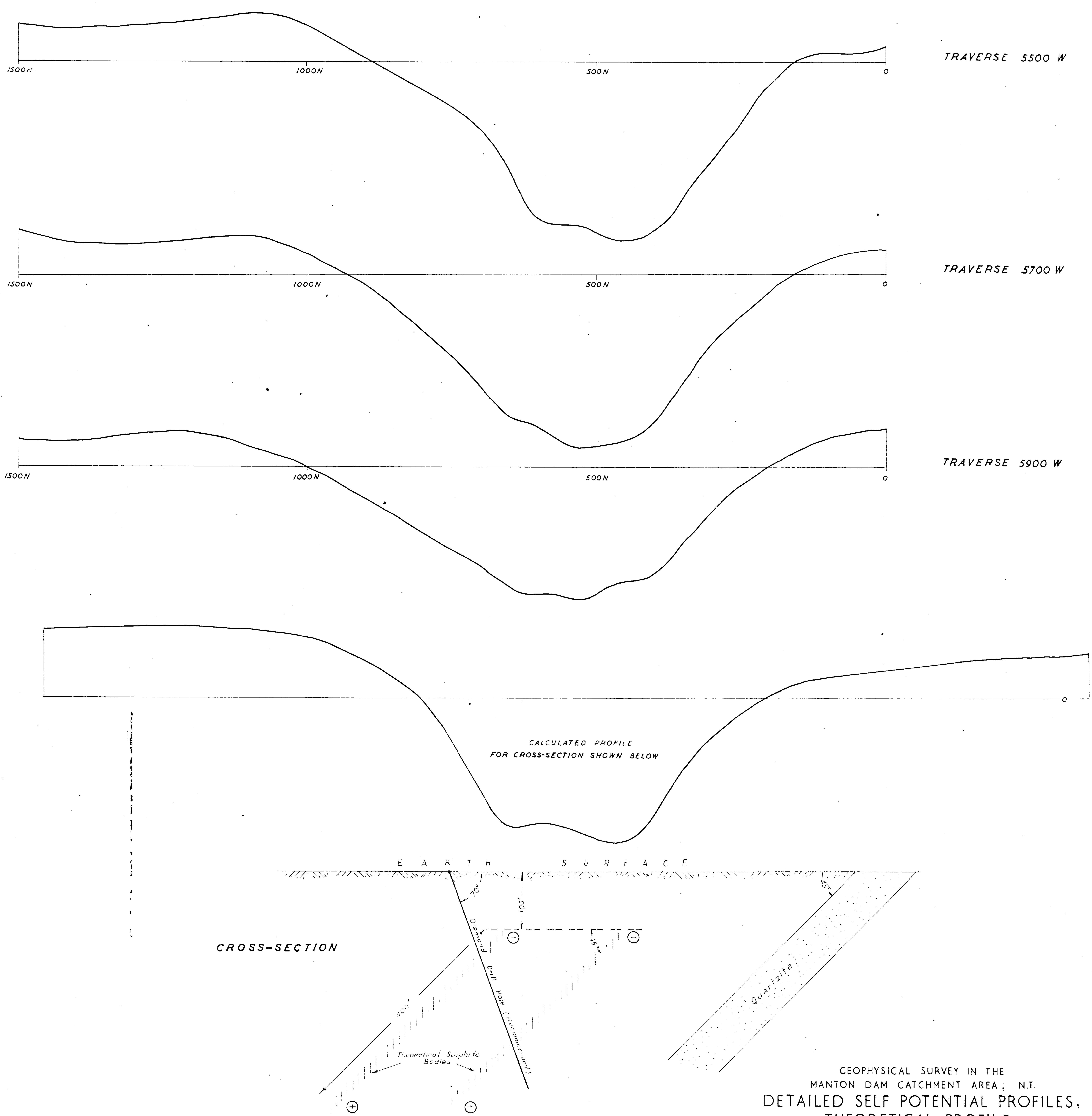
GEOPHYSICIST

PLATE 4

GEOPHYSICAL SURVEY OF MANTON DAM CATCHMENT AREA, N.T.

SELF – POTENTIAL CONTOURS

Geophysical Section, Bureau of Mineral Resources, Geology and Geophysics. G 185 - 5



SCALES

HORIZONTAL 100 0 100 200 300 FEET

VERTICAL 100 0 100 200 300 MILLIVOLTS

GEOPHYSICIST

GEOPHYSICAL SURVEY IN THE
MANTON DAM CATCHMENT AREA, N.T.

DETAILED SELF POTENTIAL PROFILES, THEORETICAL PROFILE, AND DRILLING RECOMMENDATION

Note. The theoretical profile involves no assumption as to actual pole strengths involved except that all poles are of equal strength. There is no basis for relating the pole strengths to the widths of the bodies or to the nature or intensity of sulphide mineralisation

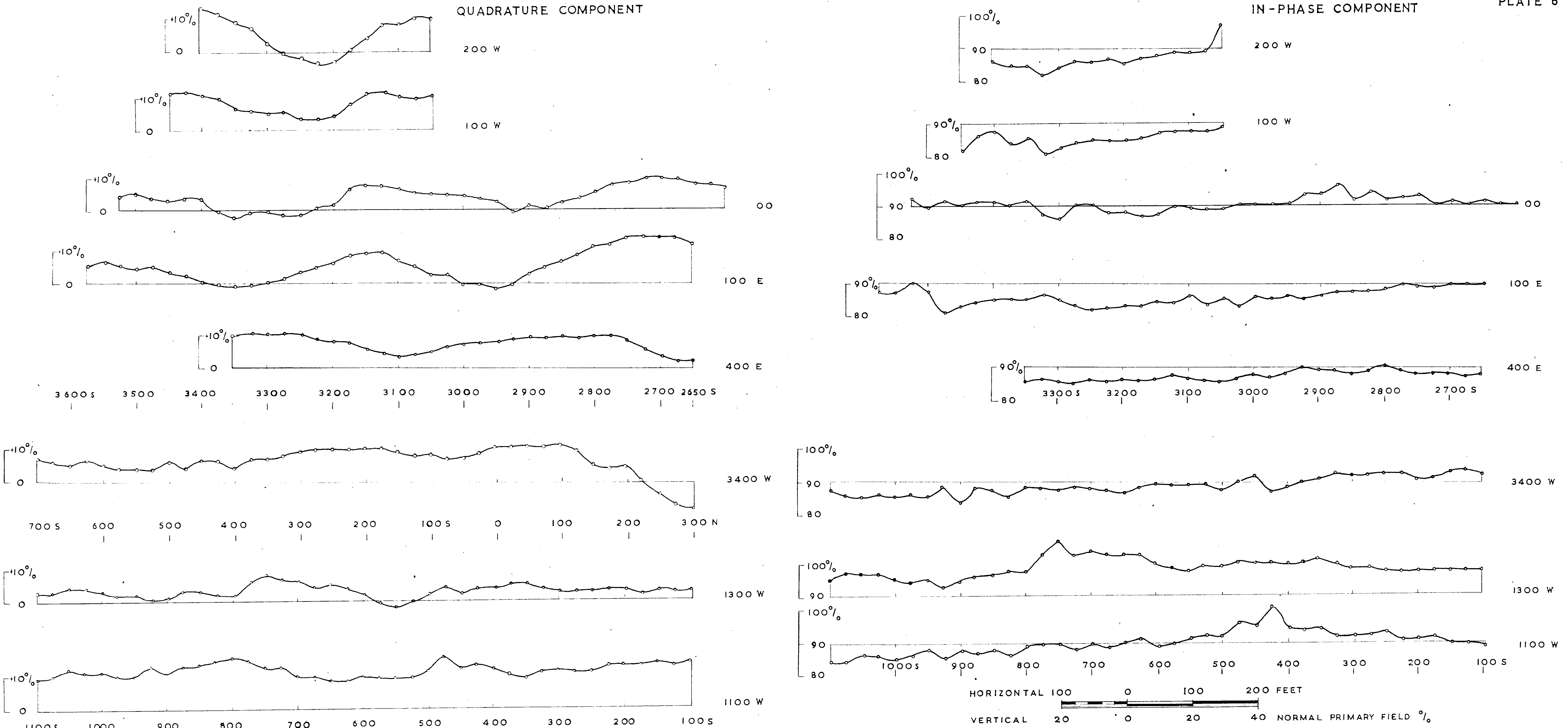


PLATE 6

GEOPHYSICAL SURVEY
MANTON DAM CATCHMENT AREA, N.T.

ELECTROMAGNETIC PROFILES

Geophysical Section, Bureau of Mineral Resources, Geology and Geophysics G 185-7