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No. 1196

PEL'S 10 & 11

Eastern Officer Basin Helicopter Gravity Survey

Murumba Oil N.L

Submitted by
Geophysical Associates Pty Ltd

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Enquiries: Customer Services Branch
Minerals and Energy Resources
7th Floor
101 Grenfell Street, Adelaide 5000

Telephone: (08) 8463 3000
Facsimile: (08) 8204 1880



Government of South Australia
Primary Industries and Resources SA

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MURUMBA OIL N.L.

GPO Box 4802,

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SYDNEY. N.S.W. 2000.

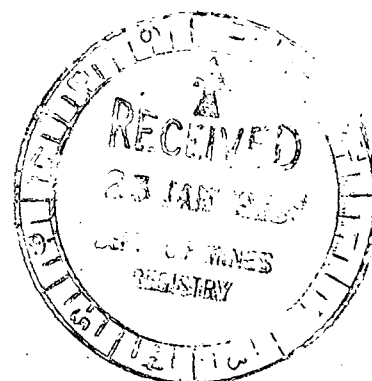
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PHONE ~~XXXXXX~~ 29-8361

13th January, 1970.

The Director,
Bureau of Mineral Resources,
Geology and Geophysics,
Cnr. Constitution Avenue &
Anzac Parade,
PARKES. A.C.T. 2600.



Dear Sir,

Murumba Oil N.L. respectfully submits the following application for Commonwealth Subsidy under the Petroleum Search Subsidy Act 1959-1967.

<u>NAME OF PROJECT:</u>	Eastern Officer Basin Helicopter Gravity Survey.
<u>NAME OF APPLICANT:</u>	Murumba Oil N.L., C/- Hopkins Gibson & Co. 33 Pirie St., Adelaide, South Australia 5000.
<u>NOMINEE OF APPLICANT:</u>	Analytical Exploration Australia Pty. Ltd., Consultants to Murumba Oil N.L., A.D.C. Building, 189 Kent Street, SYDNEY. N.S.W. 2000.
<u>LOCATION OF PROJECT:</u>	P.E.L. 10 and 11 Eastern Officer Basin, South Australia.

The survey will cover roughly the area bounded by the following co-ordinates, latitude $27^{\circ} 30' S$, Longitude $130^{\circ} 30' E$ to longitude $132^{\circ} 00' E$ to latitude $27^{\circ} 00' S$; to longitude $133^{\circ} 30' E$; to latitude $28^{\circ} 00' S$; to longitude $133^{\circ} 00' E$; to latitude $29^{\circ} 00' S$; to longitude $131^{\circ} 00' E$; to latitude $28^{\circ} 00' S$; to longitude $130^{\circ} 30' E$ and thence to the starting point at latitude $27^{\circ} 30' S$.

The exact location of the survey is shown on the accompanying programme map.

13th January, 1970.

The Director

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APPRECIATION OF REGIONAL GEOLOGY

(Also see accompanying Geological Map and Cross Sections A-A', B-B')

Basement rocks in the Eastern Officer Basin consist of metamorphics, granites, granulites and metamorphosed basic rocks, overlain by Upper Proterozoic tillites, basic volcanics, shales, limestone and quartzites of the Adelaidean System. A strong unconformity exists between the Proterozoic section and the overlying Palaeozoic rocks. The basal Palaeozoic rocks are the Davies Bore Beds, which consist of 1,500 feet of shales with cherty horizons, silty shales, with sandstones and basal conglomerates, outcropping on the eastern side of the Mt. John's Range. The formation is considered as probable marine due to the presence of limestone lenses; cherty concretionary bodies, and a thick shaley sequence lacking sandy beds. Packham and Webby (1969) have correlated the outcrop with the lower formation of laminated grey shale containing some limestone bands between 5,420 to 9,520 feet (T.D.) in Munyarai No. 1 Well. Chitinozoans in the Munyarai shales indicate an Ordovician to Early Carboniferous Age. Packham suggests a late Silurian-Early Devonian Age.

The Mt. John's Beds (unit defined by Packham) consists of a succession of clayey quartz-rich, ferruginous and micaceous sandstone, red and green shales and conglomerate, reaching maximum thickness of 2,000 feet. Previous workers have grouped this unit in part of the Davies Bore Beds and in part with the overlying Mt. Chandler Group. Tentative correlation with the succession of purple-brown shales and sandstones between 5,150 and 5,420 ft. in the Munyarai Well has been made. The deposition of the unit is considered as a regression to fluvial conditions following the restricted marine environment of the Davies Bore Beds. The overlying Mt. Chandler Group can be subdivided into three units, the basal unit is the Chambers Bluff Sandstone which consists of well sorted, clean white and red, quartz rich, fine grained sandstones, with occasional beds of medium grained sandstones and some rare beds containing vein quartz pebbles. The existence of Diplocraterion and Skolithos indicate deposition on a tidal delta - tidal flat environment with the section thinning northward. The section varies from 225 to 2,000 feet thick. The Chambers Bluff Sandstone is overlain by 150 feet of red to green shale and fine silty sandstone, known as the Indulkana Shale, that represents a muddy bay facies

13th January, 1970.

The Director

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spreading northwards and eastwards over the delta sands. The Indulkana Shale is in turn overlain by a fine to medium grained quartzite with some conglomerate and soft clayey sandstone. Known as the Policeman Well Sandstone, it is a blanket-type deposit about 2,500 feet thick. The maximum transgression is seen as a laminated sequence in the middle of the formation, followed by a regression during which the coarsely crossbedded sequence of the upper part of the formation was deposited in the east.

The section (4450-5150 ft.) in the Munyarai Well, is similar to the Indulkana Shale, but generally more clayey and silty, indicating deposition on the landward side of the clean sands seen in outcrop in the N.E. area of the Officer Basin. The section (2360 ft. to 4450 ft.) consists of clean, coarse to fine grained often porous quartz sandstones, which have been correlated with the Policeman's Well sandstone. Sedimentation continued in a delta environment, with the deposition of the Mintabie Group, consisting of interbedded arkosic sandstones and shales tentatively dated as Middle to Upper Devonian. The interval 0'-2360' in the Munyarai Well has been correlated, to the Mintabie Beds on the basis of lithology. Deposition in the Officer Basin terminated between the Upper Devonian and the Lower Carboniferous, with the discontinuous fluvial Officer Beds.

APPRECIATION OF PREVIOUS GEOPHYSICS

The first survey carried out in the area was a series of aeromagnetic reconnaissance lines flown by the B.M.R. in 1958. The results of this survey indicated a thick sedimentary sequence within the basin. In 1960 a gravity survey was carried out by the South Australian Department of Mines for Exoil Pty. Ltd. This survey confirmed the presence of a thick sedimentary section.

During 1964-65 Adastra Hunting carried out a reconnaissance aeromagnetic survey, which was interpreted by Geophysical Associates Pty. Ltd. The survey, known as the "Eastern Officer Basin Aeromagnetic Survey" and covered the whole area of P.E.L's 10 and 11. The results showed the Eastern Officer Basin to be a large east-west orientated half-graben trough, possibly faulted against the Musgrave graben with maximum sedimentary section of at least 14,000 feet. Magnetic

13th January, 1970.

The Director

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basement is considered to correspond to the crystalline rocks underlying the Adelaidean Sequence.

In 1966, the South Australian Department of Mines conducted a seismic reflection, refraction and gravity survey along a single north-south traverse across the aeromagnetic trough. Although the results were generally poor, they did indicate a sedimentary section greater than 18,000 feet and supported the general structure of the trough. A prominent dip reversal throughout the section supported by gravity and aeromagnetic results, occurred near the centre of the trough.

In 1967, Namco Geophysical conducted the "Eastern Officer Basin Seismic and Gravity Survey" for Continental Oil Company (Aust.) Pty. Ltd., to confirm closure on and define the crest of the structure, indicated by the Mines Department survey. From this work the Munyarai No. 1 well was drilled.

In 1969 the South Australian Mines Department conducted a helicopter gravity survey on a $4\frac{1}{2}$ mile grid immediately east of P.E.L. 11. A ridge trending NE-SW, and continuing into the permit area, was located. This gravity high corresponds to a magnetic low indicating the possible existence of a dense intrabasinal carbonate body in the narrow trough.

REASONS FOR CONDUCTING GRAVITY SURVEY

The only possible source rocks in the Eastern Officer Basin, are the Davies Bore Beds. At the base of the Emu No. 1 well there is a quite porous sandstone unit at least 100 ft. thick, which may represent a basal sand in the Palaeozoic section. The basal transgressive sand is considered the best objective in the basin.

In planning any survey for the area it would be best to concentrate on possible traps within the basal Palaeozoic section. Seismic control, where available, indicates intra-basinal sediments reflect basement structures. A large regional reconnaissance gravity survey with follow-up detail work over areas where anomalies have been delineate would provide useful information about structures in the Officer Basin. The basal transgressive sand or structures in the centre of the basin may be too deep to evaluate. However other structures, located where there may be some pinch out against the Musgrave Craton block to the north or situated on the

13th January, 1970.

The Director

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hinge south of the trough, would be more practical targets.

The results of the "Eastern Officer Basin Gravity and Seismic Survey" show the suitability of the gravity method for reconnaissance purposes in this area. The results of this gravity survey would be used to plan a follow-up detailed seismic programme if there is any indication of prospective targets in favourable areas.

DEFINITION OF OBJECTIVES

To locate and define within the limits of a gravity survey, possible basement structures within or along the margins of the Eastern Officer Basin.

LOGISTICS OF THE SURVEY

The survey will be conducted in two stages by Geophysical Associates Pty. Ltd., in conjunction with Rotowork Helicopter Pty. Ltd.

The first stage will consist of regional survey on a $4\frac{1}{2} \times 4\frac{1}{2}$ grid tying to S.A. Mines Department (1969) survey in the east, and to the planned B.M.R. Survey (1970) in the south, west and possibly to the north. The survey will be flown using the cell centre method defined in B.M.R. records. Each traverse from the cell centre will cover about 16 stations. La Costa gravity meters and Mechanism's barometers will be used. A ground levelling traverse from Emu No. 1 well to Everard Park, via Munyarai No. 1 well, will be included in this stage. (For location of traverse - see programme map). As often as possible cell centres will be located on this traverse, or existing B.M.R. levelling traverses in the area.

The second stage will consist of a detail survey of approximately 4,000 stations with meter readings every $\frac{1}{2}$ mile on a 2 - $2\frac{1}{2}$ mile grid. The location of the detail survey will depend on the results of the reconnaissance survey. Areas suggested for the detail survey, on the basis of known geology and aeromagnetism, are shaded on the programme map.

13th January, 1970.

The Director

KEY PERSONNEL

Analytical Exploration:

John Burbury - Chief Geophysicist

- 14 years Geophysical experience, including supervision of helicopter gravity work in desert areas.

Robert Murdoch - Geophysicist

- 2 years general Geophysical experience.

Geophysical Associates:

Frank Hickey - Chief Geophysicist

- Experience includes a number of helicopter gravity surveys.

Tin Magub - Party Chief

- 5 years experience helicopter gravity and seismic surveys.

Rotcwork Helicopters:

Mike Gray - Senior Pilot

- 5 years experience flying helicopter gravity surveys.

ADDRESSES FOR CORRESPONDENCE

Attn: Mr. J. Mead,
Murumba Oil N.L.,
C/- Hopkins Gibson & Co.,
33 Pirie Street,
Adelaide, South Australia 5000.

Attn: Mr. J.E. Burbury,
Analytical Exploration Australia Pty. Ltd.,
6th Floor,
A.D.C. Building,
189 Kent Street,
SYDNEY. N.S.W. 2000.

13th January, 1970.

The Director

ADDRESSES AND CORRESPONDENCE continued

Attn: Mr. J. Campbell,
Geophysical Associates Pty. Ltd.,
399 Honour Avenue,
Graceville, BRISBANE. QUEENSLAND 5075.
Phone: 79-6847

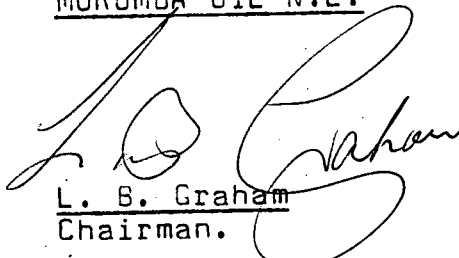
Attn: Mr. J. Ferguson,
Rotowork Helicopters Pty. Ltd.,
P.O. Box 174,
AVALON BEACH. N.S.W. 2107.

REFERENCE

Packham, Dr. G. and Webby, B.D.:

"The geology of the Officer Basin in the Everard
1:250,000 map area" - unpublished report for
Murumba Oil N.L.

Yours faithfully,
MURUMBA OIL N.L.



L. B. Graham
Chairman.

Enclosures.

DETAILS OF TENEMENT

(P.E.L. 10 and 11, South Australia)

Tenement Holders:

Continental Oil Co. of Australia Ltd.,
G.P.O. Box 2726,
SYDNEY. N.S.W. 2000.

Exoil N.L.,
Perry House,
Elizabeth Street,
BRISBANE. QUEENSLAND 3000.

Transoil N.L.,
Perry House,
Elizabeth Street,
BRISBANE. QUEENSLAND 3000.

Australia Sun Oil Company,
G.P.O. Box X2282,
PERTH. WESTERN AUSTRALIA 6000.

Date Granted:

6th August, 1969.

Date of Expiry:

6th August, 1974.

Description of Area: P.E.L. 10: That portion of the State of South Australia bounded as follows:- Commencing at the point latitude $27^{\circ} 7'$ South and Longitude $131^{\circ} 30'$ E, thence East to longitude $132^{\circ} 15'$ E, south to latitude $28^{\circ} 45'$ S; west to longitude $132^{\circ} 00'$ E, north to latitude $28^{\circ} 00'$ S, west of longitude $130^{\circ} 30'$ E, north to latitude $27^{\circ} 30'$ S; east of longitude $130^{\circ} 45'$ E; north to latitude $27^{\circ} 26'$ S; east of longitude $131^{\circ} 30'$ north to point of commencement.

Total 9,600 square miles.

P.E.L. 11: That portion of the State of South Australia bounded as follows:- Commencing at the point latitude $27^{\circ} 00'$ S and longitude $132^{\circ} 15'$ E, thence east to longitude $133^{\circ} 49'$ E; south to latitude $29^{\circ} 00'$ S; west to longitude $133^{\circ} 00'$ E; north to latitude $28^{\circ} 45'$ S, east to longitude $132^{\circ} 00'$ E, north to latitude $28^{\circ} 45'$ S, east to longitude $132^{\circ} 15'$ E; north to point of commencement.

Total 9,400 square miles.

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PROGRAMME OF WORKS

During the first two years an evaluation of the area is to be carried out with suitable geophysical investigation. Further programmes to be dependent on the locating of prospective anomalies and structures of interest.

DETAILS OF FARMOUT AGREEMENT P.E.L. 10 and 11, SOUTH AUSTRALIA,
BETWEEN THE TENEMENT HOLDERS AND MURUMBA OIL N.L.

Murumba Oil shall perform the following work obligations and upon completing fully these obligations, shall be granted the right to obtain a 50% participating interest in the licence areas.

(a) Complete with 12 months of issuance of the new licences (by 6th August, 1970) a gravity survey of approximately 5,000 stations or approximately 2,500 line miles consisting of a 5 x 10 mile grid with stations every half mile at an estimated cost of at least \$125,000. Such gravity survey shall be conducted in such a manner that it satisfies the minimum work obligations that may be specified by the South Australian Mines Department in the licences for the first year of the Licence.

(b) Following completion of (a) above, Murumba shall within two years of the issuance of the Licence (by 6th August, 1971) either:

(i) perform a seismic programme at a cost of at least \$275,000 on one or more of the gravity anomalies to be mutually agreed upon

or

(ii) perform a sufficient work expenditure to satisfy the first two year period work obligation as specified in the Licence.

(c) Following completion of (b) above, Murumba shall:

(i) commence and complete drilling phase prior to the end of the third year of issuance of the Licence, an exploratory well on a mutually agreeable location to a depth of 10,000 feet or to a sufficient depth to test the Ordovician section of basement, whichever first occurs.

0012

(ii) Thereafter perform at its' own risk and expense any additional geological and geophysical work or drilling of such exploratory well or wells as shall be necessary to comply with the work obligations or minimum expenditure requirements.

Murumba may withdraw from the Agreement following the completion of the gravity survey.

After Murumba has earned its' 50% interest in the Licence the Participating interests will be as follows:

Murumba	50%
Conaus	12 $\frac{1}{2}$ %
Ausun	12 $\frac{1}{2}$ %
Exoil	17 $\frac{1}{2}$ %
Transoil	7 $\frac{1}{2}$ %

PREDICTED COSTS OF THE SURVEY

1. Reconnaissance Survey:

about 800 stations @ \$36.00 per station	\$28,800
Levelling Survey	3,000
Computing of data	200
	\$32,040

2. Detail Survey:

about 3,960 stations @ \$20.40 per station	\$80,784
Depositioning	2,000
Computing of data	1,990
Final Report	4,900
Supervision	3,300
	\$92,974

Total cost of Survey:

\$125,014

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5th March, 1970.

The Director,
Bureau of Mineral Resources,
Petroleum Exploration Branch,
P.O. Box 378,
CANBERRA. A.C.T. 2600.

Re: Eastern Offshore Basin Holocene Gravity Survey

Dear Sir,

Further to discussions held earlier today between Mr. Smith and Mr. Robertson of the Petroleum Exploration Branch, Bureau of Mineral Resources and Mr. Murdoch from this company, we would like to add the following information regarding the planned objectives of the second stage of the above survey to support our application for an extension of Commonwealth Subsidy.

The basic objects of the second stage of the survey are to accurately define and delineate structures indicated by the first stage of this survey, in order that detailed residual maps of these structures can be obtained for follow-up seismic planning. To be prospective in such an isolated area, structures need to be large, say in the order of 3-4 miles across. Assuming average sedimentation and a depth to basement of 8,000 ft. as being characteristic of possible test-structures, then the offset on gravity of such a structure, using the horizontal cylinder gravity model, is about 10 mgals, the offset becoming less as the structure becomes deeper. Therefore, in looking for prospective structures within the gravity contours, we would want to define accurately all those showing variations of 10 mgals and possibly less, where they correspond to an isomagnetic high.

5th March, 1970.

The Director

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A feature of regional work is the very steep gradient on the southern side of the Officer Basin and a flatter gradient than would be expected from the aeromagnetics, on the northern side. Seismic and aeromagnetic control in the basin indicate a sedimentary section of less than 20,000 ft. Assuming 20,000 ft. of section, the expected gravity effect of the basin sediments would be about 80 mgals. The total gravity variation on the southern side of the basin is over 150 mgals, which indicates that some other gravity effect is present. Removing the effect of the basin sediments, a profile across the basin shows a source depth of about 20 miles for this second source, indicating some isostatic crustal thickening close to the boundary between the Officer Basin and the Musgrave Block, or even under the Musgrave Block. The point of this is that structures of interest located on the steep southern gradient, expected to be the most prospective part of the basin, could be expressed by gravity variations only half that normally expected (i.e. as low as 5 mgals). Such variations are difficult to recognise and define without further gravity coverage.

Gravity and seismic surveys conducted by Continental Oil at Munyaral have indicated extremely good comparison between the structure defined by seismic work and that defined by gravity. Any seismic survey conducted within P.E.L. 10 or 11 would prove to be extremely expensive and before any such survey could be approved or conducted by Muramba the maximum amount of low cost reconnaissance geophysical information would need to be compiled. When a seismic crew was moved into the area it would be optimum to have available four or five structures indicated as being of prospective size, accurately defined, as Munyaral has indicated they can be, by a relatively detailed gravity survey. There is evidence of several such prospective structures which require further investigation. Two large structures, the one at Munyaral and a large nose plunging N and N.E., in the west of the survey area are well indicated. The structure at Munyaral has been well defined previously and can be regarded as a test structure for the area. The western structure has a large aeromagnetic nose, plunging N.E., from outside the lease boundary, associated with it. The Munyaral structure and all but the deep extension of the plunging nose have been included in the area to be detailed.

5th March, 1970.

The Director

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Several smaller gravity variations, still large enough to be prospective, and corresponding to aeromagnetic highs occur northwest, south and southeast of Munyarai No. 1, northwest of Emu No. 1., and in the far northeast of the planned survey area. The structures south and southeast of Munyarai, show good correspondence with aeromagnetic trends, and need further definition to indicate their relationship to Munyarai. The structure northwest requires detailing to show whether this is a continuation of the Munyarai structure, or a separate structure, as indicated by aeromagnetics.

The structure northwest of Emu No. 1. is associated with two aeromagnetic trends and detailing is required to show what the exact relationship of gravity to aeromagnetism is in this area. It is of particular interest that it is located on the expected hinge-line of the basin. The gravity effect of the structure exceeds 10 mgals, and is superimposed on a very steep gradient.

The structure in the far northeast of the area to be surveyed was found by more accurate contouring in that area and although small is associated with an aeromagnetic high, located on the hinge-line. Further gravity is required for accurate seismic planning over this structure.

It should be noted that the gravity map of the Officer Basin is in fact not as smooth as is indicated by the contouring on the enclosed preliminary map.

The area of the planned second stage has been designed to gain sufficient control over the seven prospective structures mentioned to allow good seismic planning. The area between each of these structures has been included to gain continuous control and to allow more accurate residual maps to be computerized. It is our firm conclusion that this detailed phase of the gravity survey, as programmed, constitutes a proper and valid next step in the geophysical evaluation of this basin.

Yours faithfully,
MURUMBA OIL N.L.

John L. Elliott
Director and General Manager.

OPEN FILE

4TH FLOOR Strongroom

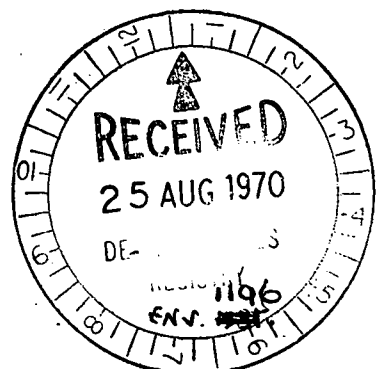
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EASTERN OFFICER BASIN HELICOPTER GRAVITY SURVEY
PEL 10 AND 11, SOUTH AUSTRALIA

MURUMBA OIL N.L.,
GPO BOX 4802, SYDNEY, NEW SOUTH WALES.

GEOPHYSICAL ASSOCIATES PTY LTD,
399 HONOUR AVENUE, GRACEVILLE, QUEENSLAND.

August, 1970



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Frontispiece-Location Map

Inside Report Cover

- Figure 1 Composite North-South Profile, Officer,
Amadeus and Ngalia Basins, scale 1:2,500,000
- Figure 2 Schematic Cross Section of the Officer
Basin with gravity profile added
- Figure 3 Velocity data with density estimates
added

Figure 4 Stratigraphic Column, Munyarai # 1 test
with density data added.

Figure 5 Gravity Profile, Line IV, Munyarai Structure.

Figure 6 Gravity Profile, Line I, Anomaly B

Figure 7 Gravity Profile, Line II, Anomaly C

Figure 8 Gravity Profile, Line III, Anomaly D

PLATE I GRID GRAVITY, 1:250,000

PLATE II GRID RESIDUAL NO 3, 1:250,000

In Map Folder

PLATE III BOUGUER GRAVITY, 8 sheets 1:100,000

PLATE IV GRID RESIDUAL NO 1, 8 sheets 1:100,000

PLATE V GRID RESIDUAL NO 3, 8 sheets 1:100,000

This report covers the results of a helicopter gravity survey over the eastern arm of the Officer Basin which extends into the extreme northwestern part of South Australia. The East Officer Basin is quite similar in general structural character to the Amadeus and Ngalia Basins to the north. The negative gravity anomaly, with a relief of over 100 mg, corresponds generally with the structural form of the basin from previous work, but the gravity suggests a steeper, possibly overthrust north flank.

This report reads on the Bouguer Gravity Map, computer contoured from a 4 km grid of values from the original gravity and on Grid Residual Map No. 3; both are at scale 1/250,000. Anomaly outlines, trends, profile locations, magnetic features, etc., referred to in this report are marked on these maps.

The overall gravity pattern shows a strong minimal axis with a trend slightly north of east which is closely parallel with but some 10 to 20 miles north of the basin axis from the magnetic interpretation. The southeasterly half of the map is dominated by strong northeast-southwest trends, most of which are near or parallel with features shown by the Magnetic Basement Map.

A study of densities based on velocities from the Munyarai seismic survey and on limited measurements on cores from the Munyarai test indicates a general increase of density with depth from about 2.2 at shallow densities to around 2.7 near the basement. A conspicuous exception is that the Mt. Chandler beds apparently are about 0.3 g/cc lower in density than the general trend. The basement depth of about 15,000 ft from magnetic data requires an average density contrast of about 0.6 to account for the 100+ mg relief of the basin gravity anomaly. The smaller value from the density analysis requires gravity contribution from well below the magnetic basement.

The seismic anomaly on which the Munyarai test was drilled corresponds closely with the central part of one of the larger gravity anomalies. The gravity relief is much larger than would be expected from the seismic relief which suggests substantial gravity contributions from depths below the seismic mapping.

Shown on Plate I (1195-16)
The northeast-southwest trending features in the southeast half of the map, some of which extend for over 100 miles, must be caused by very profound structural disturbances. In particular, anomaly (B) is analyzed as a fault with many thousands of feet of relief and anomaly (C) as a quite symmetrical anticlinal feature some 60 miles long. Other smaller faults and anticlinal features are marked on the maps and discussed in the report.

? Carter

between Carter + Munyarai

INTRODUCTION

The area of this survey is in the extreme northwestern part of South Australia and is over the easterly arm of the large Officer Basin. This arm is a generally east-west trending basin centering approximately 230 miles south of the Amadeus Basin. Its general form appears to be similar to that of the Amadeus Basin and the smaller but also similar Ngalia Basin still farther north. All three are asymmetrical with very steep north flanks and much more gently dipping south flanks.

THE GRAVITY SURVEY

The gravity field work was done with helicopters using barometric elevations. The survey was made in two parts; the first part, with stations at four and one-half mile intervals, was mapped at scale 1/250,000. The detail survey was made with most of the stations on north-south lines approximately two and one-fourth miles apart with station spacing of one-half and three-fourths mile along the lines. The detailing included 3726 stations accomplished in 27 days of field work using two helicopters. The detail work was mapped at scale 1/100,000 in 8 sheets. From general inspection of the maps, it is evident that there are errors of one milligal or more in individual stations as shown by the local roughness of the contours. This is to be expected where barometric elevations are used as such elevations commonly have errors of ten feet or more. Such errors do not appreciably detract from the application of the survey for reconnaissance and to define and outline the basin itself and the larger features within it.

COMPUTER CONTOURED GRID MAPS

The detail maps were "digitized"* for grid calculations. The grid interval used is 4 km which was chosen as appropriate to the distance between the north-south lines of stations. The grid lines are located on a rectangular (Lambert) grid which is shown at 10 km intervals on the base maps. This grid was used as shown on these maps for the areas west of longitude 132°00'. The same grid was projected eastward over the rest of the maps where, because of a change in the central meridian, there is a slight change of orientation of the map grid beginning at this longitude.

Originally, two Grid Residual Maps were made. The following comments are based, in part, on the explanation of the formulas used and others in the paper, "Regionals, Residuals, and Structures" from GEOPHYSICS, V. 19, No. 1 (Jan. 1954), pp. 1-22.

Grid Residual Map No. 1 (Map at scale 1/100,000 in 8 sheets)

This map uses weighting coefficients corresponding to Elkins' equation 15 which

*This is the process of writing, from the contours, a gravity value at each corner of a regular square grid.

is No. 7 in the list of equations and the weighting factors of Table 2 (p. 7 of the paper). In the grid calculation the coefficient, $1/s^2$, and the factor K were not used which leaves the numbers derived from the operation as simple gravity differences. The effective radius of this operation is $S \times \sqrt{5}$ where S is the grid spacing; this is because the relatively small weightings and opposite signs of the first two rings (+ .364 and - .273) tend to cancel so that the result is dominated by the negative value (-1.091) of the outer ring. With the grid spacing of 4 km, the effective diameter is $8 \times \sqrt{5} = 17.9 \text{ km} = 11 \text{ miles}$. This was intended to cover the outer part of the instruction of Mr. Murdoch's letter of 6 April, " . . . to obtain the isolated gravitational effect of structures having gravity responses between 4 and 12 miles in width. " In general, this result is quite satisfactory and the larger gravity anomalies are well developed on this map.

Grid Residual Map No. 2 (Map at scale 1/100,000 in 8 sheets)

This map was calculated from the weighting coefficients of Henderson and Zietz equation 13 which is No. 3 in the Table, p. 7 of the GEOPHYSICS paper. In this case, the large negative value (-1.333) of the coefficient of the first ring makes this result very much dominated by this first ring with a radius of 4 km and a diameter of 8 km or 5 miles. This was intended to give emphasis to the inner part of the 4 to 12 mile range of Mr. Murdoch's letter. The result is quite unsatisfactory as the much sharper coefficients tend to emphasize very local features and the errors of measurement which result from the use of barometric elevations.

Grid Residual Map No. 3

(Map at scale 1/250,000 in one sheet and at 1/100,000 in 8 sheets)

From a telephone conversation with Mr. Burbury in Sydney on Saturday, 20 June, (Sydney time) a new Grid Residual Map using a simple center-point-and-one-ring-system was calculated. This corresponds to Formula No. 1 of the Table, p. 7; the calculation was made from the eight points on the circle with a radius of the grid spacing $\times \sqrt{5}$ which has a diameter of $8 \times \sqrt{5} \text{ km} = 17.9 \text{ km} = 11 \text{ miles}$ which is the same as used for the outer ring of Grid Residual Map No. 1 and gives a very similar result. An example of a comparison, which corresponds to that between Grid Residual Maps Nos. 1 and 3, is given by Figures 9 and 10 of the GEOPHYSICS paper. The principal difference is that the three-ring formula (Residual Map No. 1) gives some smoothing because of the use of the two inner rings.

It must be pointed out that, while the GEOPHYSICS paper referred to has its emphasis on "second derivative" operations, all of the grid residuals of this report are calculated and mapped as gravity differences. The similarity to second derivatives is that the relative weighting for gravity values is exactly the same and the contour pattern would be the same as for second derivatives but the values are in gravity (mg) units rather than second derivative units.

A comparison of Grid Residual Map No. 3 with No. 1 shows the expected close similarity in relief and areal extent of the features shown. No. 1 is a little smoother but, for the most part, there is little to choose between them. Therefore, in the discussion which follows, anomaly references are to their expression on Map No. 3 at scale 1/250,000, which is on only one sheet but is large enough to clearly show all the detail resulting from the calculation and is more convenient to use than the larger map with 8 separate sheets.

The Grid Gravity Map (Scale 1/250,000 and 1/100,000 in 8 sheets)

This is simply a gravity map computer contoured from the digitized grid values as written in from the original contour map. This tends to be smoother than the original map because the grid spacing of 4 km misses some of the detail where station spacing is smaller than this interval. However, for the indication of any features large enough to be of probable interest in this area, we do not feel that this loss of detail is a detriment. The map at 1/250,000 is very convenient for comparison with the grid residual at the same scale.

The various anomaly outlines, trends, profile locations and other features referred to in this report are marked on the Grid Gravity and Grid Residual No. 3 Maps at scale 1/250,000.

DISCUSSION OF RESULTS

REGIONAL GEOLOGY AND REGIONAL GRAVITY

It was mentioned in the Introduction that the East Officer Basin is similar in its general configuration with the basins to the north. This is illustrated by Figure 1 which is a north-south regional gravity and magnetic basement profile along longitude 132°40'. Both the gravity and magnetic basement information is incomplete (the 1/250,000 scale gravity maps listed as accompanying the Hall and Townsend report, G.S. 4206, on the helicopter gravity survey were not in the material as received here). The profile shows that all three basins have deep negative anomalies with Bouguer values of approximately -100, -125, and -150 for the Ngalia, Amadeus and East Officer Basins, respectively. In all three cases also, the gravity minimal axis is very near the north limb of the basin, indicating strong asymmetry with a very much steeper or possibly overturned north flank.

The regional relations for the East Officer Basin are shown in more detail in Figure 2. This shows the cross section, Figure 6, from the Packham and Webby 1969 report, along the 132°00' meridian, to which the gravity profile has been added. The bottom of the Adelaide formation in this section is the magnetic basement as calculated from the aeromagnetic survey over the basin (from Continental Oil Co. of Australia, Ltd., Map 52F1 Magnetic, scale 1/500,000). The magnetic basin axis is shown on the Observed and Grid Gravity Maps and

is generally closely parallel with the negative gravity axis but is from 16 to 20 miles south.

It is evident that the gross structure of the basin, as indicated by the cross section of Figure 2, is generally in accord with the form of the gravity profile but does not fit it in detail. It would take a steeper north flank of the basin than that shown to account quantitatively for the gravity anomaly.

The basement is shown with a maximum depth of about 15,000 ft. The bottom of the gravity minimum is a negative anomaly of about 100 to 120 mg. The structural relief of 15,000 ft and gravity relief of 100 mg requires an average negative density contrast of about 0.6 between the basin sediments and the underlying or laterally adjacent old rocks. Thus, to account for the gravity as the direct effect of the basin, the sediments would have a density of around 2.2 if we assumed a density of 2.8 for the old rocks. From the section below on densities, it is indicated that the density of the section ranged from about 2.2 at shallow depths to around 2.6 near the basement suggesting an overall density of basin sediments of around 2.3 to 2.4. Therefore, there must be contributions to the gravity anomaly from crustal deformation and density contrasts in the older rocks below the magnetic basement which apparently account for about half of the overall gravity anomaly. *? or > 15000' sed. No*

DENSITY RELATIONS

It is, of course, fundamental in the analysis of gravity data that all gravity anomalies have their source in horizontal variations in density within the geologic section. If we had flat-lying beds, there would be no gravity anomalies no matter how strong the density contrasts might be between successive horizontal layers because the mass of material under gravity stations at different locations would be unchanged. If there are structural disturbances to give vertical displacements to layers of different density there will then be horizontal variations in the mass distribution below different points of observation which will cause gravity anomalies. The anomaly magnitudes depend on the differences of density or density contrasts between layers and on the magnitudes and sharpness of the vertical components of their structural displacement.

It is obvious from the strong features of the Bouguer Gravity Map that there are very definite density differences within the sedimentary section under this survey. Other than the gravity anomalies themselves, we have only rather scattered or indirect information on which to base estimates of the probable density variations within the sedimentary section of the Eastern Officer Basin.

Density Estimates from Seismic Velocities

During the reflection seismic survey of the Munyarai structure a special spread was shot for determination of velocities. The results are shown by Figure 3

which is based on Enclosure VIII of the report by NAMCO Geophysical Company. This figure includes a plot of average interval velocities between discrete depths to which average velocities were determined. These results give a somewhat irregular series of velocity steps. These interval velocities range from about 14,000 to nearly 20,000 ft/sec.

In the geophysical literature there are several examples of estimates of relations between seismic velocity and density.* We have estimated densities corresponding to the interval velocities based on a curve averaged from several sources and have constructed a similar series of steps of the corresponding densities as shown on the figure. From these steps we have estimated a general curve of the increase of density with depth as shown by the smooth dashed line on the figure.

Densities from Measurements on Cores

The well completion report on the Munyarai No. 1 drill hole contains a table of core analysis data. The tabulations include porosity, dry bulk density, apparent grain density, and fluid saturation. From these values the indicated in situ density has been calculated by adding, to the dry bulk density, the indicated water content as the product of the porosity and the percent saturation. The values thus obtained are plotted, at the core depth, as triangles on Figure 3.

In general, the values from cores are in crude agreement with those derived from the seismic velocities with the rather conspicuous exception of the depth interval from about 2000 to 5000 ft where the core densities are distinctly lower.

In Figure 4 the density data from Figure 3 have been added to a reproduction of the summarized stratigraphic column given as Plat 2 in the well completion report. From this comparison, it appears that the zone of low density values from cores corresponds quite well with the red quartz sandstone which, it is suggested in the report, may be correlated with the Mt. Chandler quartzites mapped in the outer part of the basin.

The above density data are uncertain at best but do give some information that is helpful in the gravity interpretation: 1) there appears to be an overall increase of density with depth from around 2.2 at shallow depths to about 2.7 near the bottom of the sedimentary section, and 2) the red sandstone section apparently has a density which is lower by 0.2 to 0.3 g/cc than the sediments above and below.

*See, for instance, Grant and West; Interpretation Theory in Applied Geophysics, p. 200.

The remarks which follow discuss the more conspicuous local anomalies and are based on their expression on the Grid Gravity Map and the Grid Residual Map, scale 1/250,000, and on the various trends, axes and outlines as shown on these maps.

In considering the relations between the expressions on the Gravity and Grid Residual Maps, it must be kept in mind that the grid residual expression for a simple positive anomaly of the gravity map consists of a central positive with flanking minima. This is illustrated by Figure 6, p. 13, of the GEOPHYSICS paper. Thus, there is a tendency for anomalies to appear much narrower and sharper on the Grid Residual Map than on the Grid Gravity Map. A positive anomaly on the Grid Residual Map with more or less parallel and symmetrical flanking minima is the expression of a single positive feature. Parallel positive and negative grid residual anomalies are the typical expression of a fault with its location approximately along the zero contour between them. These general properties should be kept in mind in examining the Grid Residual Map and in reading the comments on individual anomalies which follow.

For specific locations we have shown on the two maps, at scale 1/250,000, the numbers of the rows and columns of the grid system used for the computer calculation; these numbers are shown along the top and right-hand margins of the contoured areas. This makes a convenient reference for specific points or anomalies which are designated by numbers such as R25C60 which means Row 25, Column 60.

General Comments

The Gravity and Grid Residual Maps both show a very strong development of northeast-southwest trends over the southeastern half of the area. The most extensive of these is in the southeastern part of the map running from R40C100 across the gap in the survey to R7C56, a distance of nearly 150 miles. A magnetic basement axis shown by the Parkham and Webby Figure 1 (or by the Continental Magnetic Basement Map) runs southwesterly from R24C100 to R5C55 and rather closely parallels the gravity axis but with a southeasterly displacement of about ten miles. The basement, along this axis is only about 2000 ft deep. The gravity anomaly must represent a very large fold extending from the basement to relatively shallow depths and probably includes a substantial gravity contribution from below the magnetic basement.

In the northerly part of the survey area the trends change to a more nearly east-west direction and are generally parallel with the basin axis as shown by both gravity and magnetic basement maps. In the western part, (west of longitude 132° and south of the basin axis) the anomalies are weaker and trends are much less definite and with mixed directions. The one strong north-south feature

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Anomaly B) is discussed in the following section.

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LOCAL ANOMALIES

The features discussed in the remainder of this report are the more conspicuous anomalies of the Gravity and Grid Residual Maps. Some are quite large and extensive and must represent very large structural disturbances. The anomalies are outlined on the maps and are designated by letters A to F.

Anomaly A, the Munyarai Feature, R41C54, (See Profile, Fig. 5)

The large gravity anomaly here is clearly evident on the observed gravity map and on all the Grid Residual Maps. This is the feature on which the Munyarai No. 1 test was drilled to a total depth of 9510 ft.

The reflection seismic survey by NAMCO Geophysical Company is within the general area of the anomaly as outlined on Grid Residual Map No. 3. The seismic interpretation develops an elongated closed structure with the Munyarai well in its west-central part. The relief as shown by the deepest map (horizon "C") is nearly 0.5 seconds with indications of faulting on both the north and south flanks. These faults are shown on the Gravity and Grid Residual Maps.

Figure 5 shows the gravity profile across the figure and the resolution of the local gravity anomaly. This local anomaly, with relief of nearly 15 mg and with a very steep flank, is shown also by the shaded area on the gravity map. The figure also shows a cross section based on horizon "C" of the seismic map. The section has approximately the same vertical and horizontal scales with the vertical relief based on an interval velocity of 20,000 ft per second.

The structural relief indicated by this section approaches 5000 ft but may be a little exaggerated. (The 20,000 ft per second velocity is a little too high on the basis of the interval velocities, Figure 3, but was used for convenience in plotting.) Even though the structural relief is considerable, the seismic feature is quite small compared with the breadth and magnitude of the gravity anomaly. It is probable that the entire structural deformation is considerably broader than has been mapped by the limited extent of the seismic survey. The gravity anomaly must have contributions from both above and below the horizon mapped. On the basis of the 5000 ft of relief, it would require an average density contrast of approximately 0.3 to account for the 15 mg gravity anomaly. This is almost too large a contrast to be consistent with the densities of Figures 3 and 4. The cross section, Figure 2, suggests a slight thinning of the Mt. Chandler Group and partial replacement by Mt. John's beds. Any thinning of the low density Mt. Chandler Group could make a contribution to the gravity anomaly. For instance, a thinning of, say, 1000 ft with density contrast of 0.3 as suggested by Figure 4, would make a positive contribution of about 3.5 mg.

It is probable that, at depth, the structural relief may be even greater than is shown by the deepest reflection map. This is based on the large gravity relief of the anomaly together with rather moderate density contrasts indicated by Figures 3 and 4. The faulting suggested by the steep south flank of the gravity anomaly is very closely at the same location as the faulting which terminates most of the reflections on the south flank of the structure as shown on the horizon "C" map.

On the whole, we can summarize the gravity-seismic relations on this anomaly as:

- a) The general location of the gravity and seismic anomalies is closely coincident.
- b) The gravity anomaly is considerably larger in areal extent and its magnitude indicates that the relief at depth is greater than is shown by the seismic results.

Anomaly B, R41C87 (See Profile, Line 1, Figure 6)

On the gravity map this anomaly appears as a relatively mild maximum with a closely parallel minimum which interrupt a very steep southeasterly gravity rise. When taken in relation to this gravity rise, as shown by the profile on Line 1, (Fig. 6) this maximum and minimum, shown by the upward and downward arrows, are part of a very large fault indication. This appears on the profile as the upward step between the two parallel lines which represent the general southeasterly rise of the gravity in this area which is part of the southeasterly rise to the maximal axis near the right-hand edge of the profile sheet, i.e., the "major gravity axis" crossing the southeast part of the survey area.

Taking the vertical difference between the observed gravity and the more southeasterly of the two parallel lines gives the "residual anomaly" as shown on the profile sheet. This is a very sharp step of about 34 mg, up to the northwest. The form of the residual is typical of the type of gravity caused by a fault and requires a very profound geological feature. The indicated displacement is around 8000 ft with a density contrast of about 0.35. This is of the nature of an antithetic fault (so named by Bucher) in that the southeasterly upthrown side is in the direction of the dip into the basin. The length, within the gravity mapped area is about 30 miles and it could extend southwest well into the blank area. There is a closely parallel magnetic axis suggesting that the fault is a result of large basement movement.

map indicates SE is down throw

The low density Mt. Chandler zone might be involved in this fault. If these beds were truncated basinward from the fault and then re-appear in the section on the southeast or downthrown side, the abrupt occurrence of the low-density material could contribute substantially to the local southeasterly gravity decrease at the

fault.

Because of its very profound nature, it would seem that this feature would deserve particular attention in any future exploration of this basin if other conditions are at all favorable. A possibly farfetched comparison can be made with the Temblador antithetic fault on the south flank of the Orinoco Basin in Venezuela, with about 1000 ft of displacement, which has caused a substantial oil accumulation there.

Anomaly C, R34C71 (See Profile, Line II, Figure 7)

On the Bouguer Gravity Map this anomaly appears as a flattening of the contours which, on the Grid Residual Map, develops into a well defined anticlinal feature with central maximum and flanking minima. As outlined on the maps, the feature is quite regular and continuous over a length of nearly 60 miles. The north-east-southwest trend direction is closely parallel with that of the gravity and magnetic features in the area. On the profile sheet (Fig. 7) the residual anomaly is a quite regular and symmetrical positive anomaly with a relief of about 9 mg and "half-width" (i. e., the horizontal distance between the flank positions where the amplitude is one-half the maximum) of about nine miles. This must represent a very substantial structural disturbance. For an overall density contrast of 0.3, the required relief is about 3000 ft. The positive gravity effect could include thinning of the low density Mt. Chandler beds over a structure.

The gravity expression of this feature is much stronger and much more extensive than is that of the Munyarai structure. Because of its large extent and relief, we might expect some expression in the Magnetic Basement Map. There is no corresponding reversal but there is a broad flattening along the -8000 ft contour which could be a confirmatory indication.

Anomaly D, R21C48 (See Profile, Line III, Figure 8)

This is one of the very few north-south trending anomalies on the map. On the Observed Gravity Map it appears as a local change of contour direction. On the Grid Residual Map it appears as an elongated minimum on the west and maximum on the east with a band of parallel contours between. On the profile sheet, Figure 8, the anomaly appears as a steep, local step within the easterly gravity increase.

A resolution of the anomaly after taking out the regional gravity slope is indicated in the lower part of the figure and shows a very sharp increase of about 8 mg. Because of this sharpness, the feature must come to quite shallow depths, quite possibly almost to the surface. For a density contrast of, say, 0.3 such as might occur if the low density Mt. Chandler beds were faulted out, the displacement required is about 3000 ft.

Anomaly E, R42C70

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On the Bouguer Gravity Map, this anomaly is indicated by the typical "S" shaped contours, expressive of a fault, or step, within the regional southeasterly gravity rise. On the Grid Residual Map this feature has the typical parallel maximum and minimum with a band of nearly parallel contours between. An analysis of a north-south profile on column 73 indicates a relief of about 10 mg, suggesting some 3000 ft or more of displacement. The anomaly is relatively broad and could have a depth of 5000 ft or a little more.

The Magnetic Basement Map shows a local closure of the -12,000 ft contour and an extension to the east which makes the axis shown on the maps just a little south of the gravity feature. It seems quite probable that the deep basement feature has affected the overlying sediments to give the closely parallel gravity anomaly. The two fairly concordant indications make a very definite indication of a large structural disturbance.

Anomaly F, R45C45

This anomaly appears on the gravity map as a flattening of the contours and then a southward steepening toward the minimal axis. On the Grid Residual Map, it appears as a very strong positive anomaly with a steep south flank and parallel negative suggesting that the disturbance may be bounded on the south by a down-to-the-south fault. The grid residual expression is of rather similar horizontal dimensions but much stronger and steeper than the Munyarai feature and represents much shallower disturbances as, from an analysis of the gravity profile on column 45, it has a maximum depth of about 6000 ft to the top and could be much shallower. The shallow depth is to be expected from the Magnetic Basement Map as the gravity anomaly lies well up on the steep north flank of the basin.

Minor Anomalies

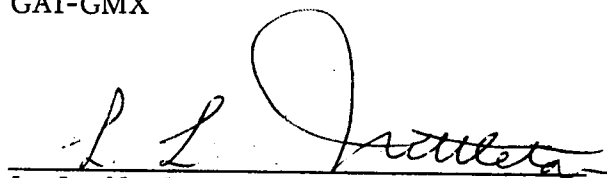
The Bouguer Gravity Map and particularly the Grid Residual Map show many local features with smaller relief and more limited extent than the principal anomalies which have been described in the foregoing discussions. It is quite possible that some of these may represent anticlinal structures or faults but, presumably, the corresponding geological disturbance would be considerably smaller than those corresponding to the more prominent anomalies included in the discussion. Some, of course, particularly those shown by small closures and without definite trends may result from errors due to lack of precision in the barometric elevations.

At this time when the nature and causes of the very large gravity anomalies are not defined, it is felt that attempts at further analysis of these minor features are not justified. It is suggested that, until the geologic nature of the large anom-

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alies is better understood, these minor features simply remain as anomalies on the map which may deserve some attention when and if more detailed exploration of this basin is carried out.

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A handwritten signature in cursive script, appearing to read "L. L. Nettleton", is written over a horizontal line.

L. L. Nettleton

Basement rocks in the Eastern Officer Basin consist of metamorphics, granites, granulites and metamorphosed basic rocks, overlain by Upper Proterozoic tillites, basic volcanics, shales, limestone and quartzites of the Adelaidean System. A strong unconformity exists between the Proterozoic section and the overlying Palaeozoic rocks. The basal Palaeozoic rocks are the Davies Bore Beds, which consist of 1,500 feet of shales with cherty horizons, silty shales, with sandstones and basal conglomerates, outcropping on the eastern side of the Mt. John's Range. The formation is considered as probable marine due to the presence of limestone lenses; cherty concretionary bodies, and a thick shaley sequence lacking sandy beds. Packham and Webby (1969) have correlated the outcrop with the lower formation of laminated grey shale containing some limestone bands between 5,420 to 9,520 feet (T.D.) in Munyarai # 1 Well. Chitinozoans in the Munyarai shales indicate an Ordovician to Early Carboniferous Age. Packham suggests a late Silurian-Early Devonian Age.

The Mt. John's Beds (unit defined by Packham) consists of a succession of clayey quartz-rich, ferruginous and micaceous sandstone, red and green shales and conglomerate, reaching maximum thickness of 2,000 feet. Previous workers have grouped this unit in part of the Davies Bore Beds and in part with the overlying Mt. Chandler Group. Tentative correlation with the succession of purple-brown shales and sandstones between 5,150 and 5,420 ft in the Munyarai Well has been made. The deposition of the unit is considered as a regression to fluvial conditions following the restricted marine environment of the Davies Bore Beds. The overlying Mt Chandler Group can be subdivided into three units, the basal unit is the Chambers Bluff Sandstone which consists of well sorted, clean white and red, quartz rich, fine grained sandstones, with occasional beds of medium grained sandstones and some rare beds containing vein quartz pebbles. The existence of Diplocraterion and Skolithos indicate deposition on a tidal delta - tidal flat environment with the section thinning northward. The section varies from 225 to 2,000 feet thick. The Chambers Bluff Sandstone is overlain by 150 feet of red to green shale and fine silty sandstone, known as the Indulkana Shale, that represents a muddy bay

facies spreading northwards and eastwards over the delta sands. The Indulkana Shale is in turn overlain by a fine to medium grained quartzite with some conglomerate and soft clayey sandstone. Known as the Policeman Well Sandstone, it is a blanket-type deposit about 2,500 feet thick. The maximum transgression is seen as a laminated sequence in the middle of the formation, followed by a regression during which the coarsely crossbedded sequence of the upper part of the formation was deposited in the east.

The section (4450-5150 ft) in the Munyarai Well, is similar to the Indulkana Shale, but generally more clayey and silty, indicating deposition on the landward side of the clean sands seen in outcrop in the N.E. area of the Officer Basin. The section (2360 ft to 4450 ft) consists of clean, coarse to fine grained often porous quartz sandstones, which have been correlated in a delta environment, with the deposition of the Mintabie Group, consisting of interbedded arkosic sandstones and shales tentatively dated as Middle to Upper Devonian. The interval 0' - 2360' in the Munyarai Well has been correlated, to the Mintabie Beds on the basis of lithology. Deposition in the Officer Basin terminated between the Upper Devonian and the Lower Carboniferous, with the discontinuous fluvial Officer Beds.

APPRECIATION OF PREVIOUS GEOPHYSICS

The first survey carried out in the area was a series of aeromagnetic reconnaissance lines flown by the B.M.R. in 1958. The results of this survey indicated a thick sedimentary sequence within the basin. In 1960 a gravity survey was carried out by the South Australian Department of Mines for Exoil Pty Ltd. This survey confirmed the presence of a thick sedimentary section.

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During 1964-65 Adastra Hunting carried out a reconnaissance aeromagnetic survey, which was interpreted by Geophysical Associates Pty Ltd. The survey, known as the "Eastern Officer Basin Aeromagnetic Survey" and covered the whole area of P.E.L's 10 and 11. The results showed the Eastern Officer Basin to be a large east-west orientated half-graben trough, possibly faulted against the Musgrave graben with maximum sedimentary section of at least 14,000 feet. Magnetic basement is considered to

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1. The first part of the document is a letter from the President of the United States to the Congress, dated January 3, 1862. It is a very important document, as it contains the President's annual message to Congress. The letter is written in a formal, dignified style, and it is one of the most important documents in the history of the United States.

2. The second part of the document is a report from the Secretary of the Interior, dated January 3, 1862. It is a very important document, as it contains the Secretary's annual report to the President. The report is written in a formal, dignified style, and it is one of the most important documents in the history of the United States.

3. The third part of the document is a report from the Secretary of the Treasury, dated January 3, 1862. It is a very important document, as it contains the Secretary's annual report to the President. The report is written in a formal, dignified style, and it is one of the most important documents in the history of the United States.

4. The fourth part of the document is a report from the Secretary of the War, dated January 3, 1862. It is a very important document, as it contains the Secretary's annual report to the President. The report is written in a formal, dignified style, and it is one of the most important documents in the history of the United States.

correspond to the crystalline rocks underlying the Adelaidean Sequence.

In 1966, the South Australian Department of *EO LINE* Mines conducted a seismic reflection, refraction and gravity survey along a single north-south traverse across the aeromagnetic trough. Although the results were generally poor, they did indicate a sedimentary section greater than 18,000 feet and supported the general structure of the trough. A prominent dip reversal throughout the section supported by gravity and aeromagnetic results, occurred near the centre of the trough.

In 1967, Namco Geophysical conducted the "Eastern Officer Basin Seismic and Gravity Survey" for Continental Oil Company (Aust.) Pty Ltd, to confirm closure on and *ENV 829* define the crest of the structure, indicated by the Mines Department survey. From this work the Munyarai #1 well was drilled.

In 1969 the South Australian Mines Department conducted a helicopter gravity survey on a 4½ mile grid *RB 68/55* immediately east of P.E.L. 11. A ridge trending NE-SW, and continuing into the permit area, was located. This gravity high corresponds to a magnetic low indicating the possible existence of a dense intrabasinal carbonate body in the narrow trough.

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- 1969 "Helicopter Gravity Survey of areas marginal to the Western Great Artesian Basin". S.A. Dept. Mines report.

APPENDIX IOPERATIONAL REPORTa. Location and Date

Murumba Oil N.L., P.O. Box 4802 G.P.O., Sydney selected Geophysical Associates Pty Ltd, 399 Honour Avenue, Graceville, Queensland to conduct a regional and detailed helicopter gravity survey in Petroleum Exploration Leases 10 and 11 South Australia. The G.A.P.L. crew departed Brisbane January 26, 1970 and arrived at Emu Flat within the survey area on February 2, 1970. A Bell G3B1 helicopter (AHI) contracted from Rotor-Work Pty Ltd, Sydney arrived at Emu Flat the same day and field operations commenced on February 3, 1970. A second Bell G3B1 helicopter (AHD) arrived at the survey area on February 12, 1970 and was immediately utilized. The regional programme was completed February 17, 1970 and during this period 19 cell centres and 26 tie points were established and 814 grid stations occupied.

The G.A.P.L. and Rotor-Work Pty Ltd crews were shut down whilst regional results were examined and the detailed helicopter gravity survey was planned.

Operations recommenced on February 26, 1970 utilizing two Rotor-Work Pty Ltd helicopters, one Bell G3B1 (AHD) and on Bell 47J (INF). The detailed programme was completed on March 25, 1970 and during this period 27 new bases and 94 tie points were established and 3605 grid stations occupied.

The survey area is located between parallels of latitude 27° S and 29° S and meridians of longitude 130° 30' E and 133° 30' E. The crew was based at Emu Flat a deserted weapons' testing ground, 175 miles west of the opal mining town of Coober Pedy. The operation was supplied from Coober Pedy via a poorly maintained sandy road. The area is traversed by poor quality tracks leading from Emu Flat to Maralinga (150 miles south), Laverton (630 miles west), Mt Davies (250 miles northwest), and a north-south seismic line from Emu Flat to Munyarai No 1 then via station trails to Everard Park homestead (170 miles north). East-west

sand dunes averaging 25 feet in height covered 90% of the survey area and combined with dense mulga vegetation restricted everyday ground operations and on numerous occasions station positions had to be shifted up to half a mile from proposed locations.

A system of permanently marked stations were set up by a G.A.P.L. surveyor along the north-south seismic line from Emu Flat to Munyarai # 1, and north-east along station trails to Officer # 1 and Everard Park homestead. This traverse was designed to make available a base line with accurate elevations every 5 miles to which the regional and detailed surveys could be tied.

During the period of operation in Petroleum Exploration Leases 10 and 11 South Australia, the severest possible physical and topographical conditions were encountered. Temperatures soared to maximums of 156° F in the sun and temperatures of 120° F shade were not uncommon. These temperatures restricted aircraft and human capabilities during most of the programme.

The system of east-west-trending symmetrical sand dunes coupled with the lack of other distinguishable features resulted in navigational difficulties and any irregularities arising in Bouguer anomalies could possibly be attributed to this factor.

b. Field Procedures

1. Regional

The regional helicopter gravity survey was planned in accordance with Bureau of Mineral Resources techniques utilizing the cell centre - tie point mode of operation. Stations were positioned on a 4½ x 4½ mile grid, each cell contained an average of 42 grid stations. Cell centres and tie points were permanently marked with 5 feet steel posts and aluminium tags showing station number and contractors name. Photographs were taken of each cell centre and tie point using a 35 mm Pentax camera with wide angle lens to conform to Bureau of Mineral Resources specifications. Flying time around each loop averaged 2 hours and loops were planned to

For discussion of accuracy of
Gravity values see Murinda's Bouger
1973 Magnetic Computations
folder - Seismic Geophysics Section →

keep field barometers within 30 miles of base barometers. Gravity loop closures were excellent and averaged 0.09 mgals., with a maximum misclosure of 0.19 mgals. Elevation loop closures were well within Bureau of Mineral Resources requirements and averaged 0.27 mbars with a maximum misclosure of 0.50 mbars.

A tie was made to Isogal Station 6792-9201 at Emu Flat airstrip to establish observed gravity values. Throughout the survey barometric ties were made to existing third order bench marks set by the South Australian Lands Department and permanently marked stations positioned by the South Australian Mines Department. More often than not topographical features partly obscured these bench marks and many were found to be unrecognisable from the air.

On the eastern boundary of the survey area three ties were made to the South Australian Mines Department Helicopter Gravity Survey (1968) stations 2734, 2440 and 2982. The resultant observed readings were within 0.10 mgals gravity and 10 feet elevation.

2. Detail

The detailed helicopter survey was planned after close inspection of regional Bouguer contours and comparison with previous magnetic data. Initially it was planned to cover a large portion of the regional area with a $\frac{1}{2}$ x 2 $\frac{1}{4}$ mile grid spacing, but after only one days flying it was changed to a $\frac{3}{4}$ x 2 $\frac{1}{4}$ mile grid to obtain maximum ground coverage in areas of prime interest.

Loops were planned in accordance with access for support of the operation and safe maximum flying time for aircraft. North-south flight lines were positioned on aerial photographs with station spacing of $\frac{3}{4}$ mile north-south and 2 $\frac{1}{4}$ miles east-west and a system of cell centres and tie points were arranged in east-west lines across the area to be detailed utilizing where possible previously established cell centres and tie points from the regional survey. A

maximum of 30 stations were allocated for each loop and flying commenced from a cell centre and progressed to a tie point then the tie point of the previously flown loop was revisited and the aircraft returned to the initial cell centre.

This method of flying proved quite satisfactory considering the very limited access and ruggedness of the terrain.

Ties were made to existing cell centres and tie points positioned during the regional survey and every second regional grid station was reoccupied to check against instrument drift and to give secondary tie values.

Observed gravity loop closures averaged 0.06 mgals with a maximum misclosure of 0.24 mgals and observed elevation loop closures averaged 0.15 mbars with a maximum misclosure of 0.6 mbars.

A tie line was flown along the north-south seismic line from Emu Flat to Munyarai # 1 to occupy permanent markers positioned by the G.A.P.L. surveyor and to tie existing permanently marked stations located during previous seismic and gravity surveys. During this flight gravity and barometric readings were taken at Munyarai # 1 and the well location was accurately positioned on the relevant aerial photograph.

Ties were made from the G.A.P.L. permanent markers to the surrounding cell centres and tie points of both the regional and detailed surveys thereby creating an accurate elevation network coupled with excellent ties to existing third order bench marks in the area.

Ties to existing permanent markers and third order bench marks were well within required limits and these tie stations were marked accordingly on aerial photographs for future reference.

c. Surveying

Vertical survey control for the north-south seismic line was established by ties to South Australian Lands Department third order bench marks at Emu Flat (# 4789) and at Everard Park homestead (# 3078). This traverse encompassed approximately 170 miles of surveying through arduous conditions of temperature and topography and shots of only 400 feet were not uncommon due to fierce heat wave conditions. Twenty one permanently marked stations were positioned, each marked with a 5 foot steel post and aluminium tag showing station number and contractors name.

Ties were made to Munyarai # 1 and permanent markers positioned during previous gravity and seismic surveys by Namco International (1967) and South Australian Mines Department (1968). The line terminated at BM-3078 situated at Everard Park homestead 50 miles north of the survey area and mistied by -2.32 feet, well within the $\frac{1}{2}\sqrt{M}$ ft (M in miles) limit allowable by the Bureau of Mineral Resources.

Horizontal ties were made to topographical features in the survey area and all permanently marked stations were accurately located on aerial photography by helicopter crews.

d. Computation

Three gravity meters were utilized throughout the survey, one La Coste and Romberg Land Meter # G-84, one La Coste and Romberg Geodetic Meter # G-224 and one Worden Meter # W-592. Each meter was checked in Brisbane on the Queensland University to Mt Coot-tha calibration range to reaffirm their instrument calibration factor. This is 0.08437 for # G-84; 1.053 for # G-224 and 0.0976 for # W-592.

These meters were recalibrated at the completion of the survey and no apparent changes in calibration factors were observed. Five Mechanisms Ltd. barometers were utilized throughout the survey for establishing

1'250,000 sheets to
the rate of this
order.

elevations and these instruments were checked for excessive instrument drift prior to and at the conclusion of the survey.

Gravity meter readings adjusted for tidal and instrument drift variations were reduced to gravity units by application of the calibration factor. Barometric readings were adjusted for diurnal pressure and temperature changes and reduced to feet by application of the factor 28 feet equals one millibar. Station locations were transferred from aerial photographs to photo centre base maps by the use of proportional dividers and station co-ordinates calculated. Bouguer values were then calculated by application of the appropriate latitude and elevation corrections.

← The Bouguer density was taken at 2.2 gms/cm³ corresponding to an elevation factor of 0.06599 to conform to the B.M.R. helicopter gravity survey (1970). Latitude corrections were determined from the International Ellipsoid Equation: $G = 978.04900 (1 + 0.0052884 \sin^2 \theta - 0.0000059 \sin^2 2\theta)$.

For the regional survey, calculations were made in the field office and values transferred to the Bouguer maps and contoured in the Brisbane office of G.A.P.L. The reduction of observed data for the detailed survey was undertaken completely in the Brisbane office of G.A.P.L. whilst loop closures were accurately kept in the field office to safeguard against excessive instrument drifts and misreadings.

HALL & TOWNSEND

The South Australian Mines Department Helicopter Gravity Survey (1968) and the Namco International Gravity Survey (1967) undertaken in conjunction with a seismic survey were integrated with observed values recorded during the Eastern offshore Basin Helicopter Gravity Survey.

The South Australian Mines Department survey was originally compiled using a density factor of 1.9 gms/cm³ and for the purpose of integration with the present work this information was recomputed using a density factor of 2.2 gms/cm³.

Subtract .91 mgs latitude correction and ^{add} 46.19 mgs elevation datum correction to bring Nanco ~~gas~~ observed gravities to Murumba observed gravities.

Elevations of Murumba ^{now} are 88 feet higher than Nanco elevations so that 5.48 mgs should be added to correct to Murumba ^{now}.

Adding these corrections up gives

Overall correction to Nanco ^{now} to bring it to be same as Murumba ^{now} is +50.8 mgs. This agrees with differences in Bouguer gravity values as shown on Nanco and Murumba maps.

To correct Murumba ^{now} to 1973 Mines Dept ^{now} subtract 2.09 mgs (Observed Gravity difference) and subtract .69 mgs (elevation difference)
Total corr = -2.8 mgs.

In practice the difference between Murumba and Mines Dept 1973 ^{now} varies. For variations see "1973 Magnetic Computation" folder in Seismic geophysics Section.

To correct Mines 1973 ^{now} to BMR 1970 Helicopter ^{now} (assumed to be correct) add 2.01 mgs to observed and Bouguer gravity values.

Elevation Namco add $83' - 9.5' = 73.5'$ to M D 4 BMR
 Bouguer add 50.8 mgal less 5.48 is $45.32 + 0.91$ is 46.23 mg
 to give marumba observed B 0042

Investigation of the Namco International Survey revealed a 700 feet above mean sea level elevation datum had been used for reduction of results. When G.A.P.L. permanently marked stations and aerial photographs of Namco International station positions were plotted, it was possible to correctly reposition the old survey. *lots and large of Namco Survey are*

A common factor compensating for datum differences and latitude changes was applied to the Namco Bouguer values to reduce these stations to a common datum. All integrated values from previous surveys fitted perfectly into results obtained during the Eastern Officer Basin Helicopter Gravity Survey.

$+50.8 \text{ mg}$
 $\frac{46.19}{4.71}$

A study of the gravity meter loop closures, the barometrically controlled elevations and the air photo positioning suggests that the probable accuracy of the mapped Bouguer values would be $\pm 0.7 \text{ mgals}$.

The final interpretation and computer processed maps were prepared at GAI-GMX Houston, Texas. Progress reports were sent fortnightly to the Bureau of Mineral Resources, Canberra, South Australian Mines Department, Adelaide and Murumba Oil N.L., Sydney.

GRAVITY BMR 1970 —
 SADM 1973 add 2.01

BMR 1970 —
 MARUMBA subtract 0.07
 NAMCO add 46.16

ELEVATION

BMR —
 SADM —
 MARUMBA - 9.5'
 NAMCO + 73.5'

LATITUDE NAMCO add $0.0123^\circ \equiv 0.91 \text{ mgal}$

27-78

APPENDIX II

0043

EQUIPMENT

- 1 - Toyota FJ45 Land Cruiser - Party Chief vehicle
- 2 - Toyota FJ45 Land Cruisers - Helicopter support vehicles
- 2 - Toyota FJ45 Land Cruisers - Survey Party
- 1 - Ford F750 4 wheel drive truck with 1000 gallon flat bed water tank - supply vehicle.

- 1 - Kitchen utility trailer fully equipped with shower.
- 1 - Office caravan fully equipped with Rotolite printer, light table, drafting equipment, calculators and client and supervisory accommodation.
- 1 - 500 gallon water trailer.

- 5 - 2 man tents, fully equipped.

- 1 - La Coste & Romberg Land gravity meter # G-84
- 1 - La Coste & Romberg Geodetic gravity meter # G-224
- 1 - Worden Gravity meter # W-592.
- 5 - Mechanism Ltd barometers
- 1 - Topcon AG-2 theodolite with rods and auxiliary survey gear.

- 1 - K & E transit
- 2 - Wet and dry bulb hygrometers
- 2 - Truck mounted 25 watt CM7 Traeger transceivers with 35' telescopic aerials - 4010 mhz 6890 mhz 3172 mhz.
- 2 - Truck mounted 25 watt 6104 Eilco transceivers with 35' telescopic aerials - 4010 mhz 6890 mhz 3172 mhz.
- 1 - Base station radio 25 watt CM7 Traeger with 35' telescopic aerial - 4010 mhz 6890 mhz 3172 mhz.
- 1 - Base station radio 50 watt CM5 Traeger with 35' telescopic aerial - 4010 mhz 6890 mhz 3172 mhz.

APPENDIX III

0044

PERSONNEL

Party Chief	T.A. Magub
Computer	A.S. Gell
Surveyor	J. Baxter
Meter Operator	H. Reith
	D. Durant
	E. Geyer
Mechanic	N. Griffin
Supply Driver	H. Herman
Cook	M. Brooks
Rodman	T. Brady
Rodman	I. Pilgrim
Helper	D. Dally
Murumba supervision	R. Murdoch (Analytical Exploration Aust. N.L.)
G.A.P.L. "	F.L. Hickey
Final Interpretation Houston, Texas	Dr. L.L. Nettleton.

Rotor-Work Pty Ltd

Pilot	M. Gray
	A. Blundell
	J. Woods
	K. Wandell
Engineer	K. West
	D. Hobbs

1	Bell	G3B1	Helicopter	AHD
1	"	"	"	AHI
1	"	47J	"	INF
1	"	"	"	AHT

APPENDIX IVSTATISTICSa. Regional

Cell centres established	19
Tie points established	26
Grid stations occupied	814
Miles surveyed	80
Days worked	15
Days lost due weather	0
" " " equipment	0
Days lost helicopter	
unserviceability	0

b. Detail

Cell centres established	27
Tie points established	94
Grid stations occupied	3605
Days worked	27
Days lost due weather	0
" " " equipment	0
Days lost due helicopter	
unserviceability	
	AHD 1
	AHI 0
	AHT 3½
	INF 3

0046

<u>Station No.</u>	<u>Latitude</u>	<u>Longitude</u>	<u>Elevation</u>	<u>Observed Gravity</u>	<u>Bouguer Gravity</u>
GAI - 7	28°04.0'	132°07.7'	1164	979,024.28	- 88.92
GAI - 8	27°58'56"	132°7'40"	1406.03'		
GAI - 8A	27°54.3'	07.8'	1216	978,986.71	-110.94
GAI - 9	27°50'28"	132°7'26"	1216.81'		
GAI - 10	47.4'	07.4'	1372	978,960.22	-118.69
GAI - 11 ^{ON ROAD}	42.9'	07.3'	1339	978,957.25	-118.27
6792:9201	28°37.7'	11.6'	844	979,167.33	- 9.21
GAI - 12	27°41'40"	132°14'19"	1183.49'		
GAI - 13	27°33'30"	132°20'10"	1279.25'		
GAI - 14	27°28'00"	132°16'21"	1321.74'		
GAI - 15	27°22'26"	132°16'50"	1360.54'		
GAI - 16 Maynard's Bore	27°18'40"	132°23'41"	1365.69'		
GAI - 17	27°11'25"	132°27'54"	1500.11'		
GAI - 18 Sandy's Bore	27°9'27"	132°28'59"	1532.77'		
GAI - 19 Victory Well	27°3'20"	132°30'23"	1691.56'		
GAI - 20	27°01'27"	132°36'49"	1682.47'		
GAI - 21 B.M. 3078	27°00'40"	132°42'45"	1630.01'		

EMU FIELD NO 1

EVERARD PARK HS

Reading at brand 1627.69

2.32 feet below BM 3078 value of

all other readings are as measured and have not been corrected for this mistake -

APPENDIX V

0047

TABLE OF PRINCIPAL FACTS

a. Regional

Cell centres and Permanently marked stations

<u>Station No.</u>	<u>Latitude</u>	<u>Longitude</u>	<u>Elevation</u>	<u>Observed Gravity</u>	<u>Bouguer Gravity</u>
7030:9000	27°29.6'	131°58.1'	1444	978,958.85	- 93.27
9001	29.1'	36.9'	1582	978,929.66	-112.75
9002	32.8'	130°34.6'	1716	978,962.29	- 75.59
9003	32.8'	56.5'	1484	978,961.90	- 91.15
9004	49.5'	47.7'	1316	978,982.74	-102.43
9005	44.3'	131° 5.0'	1374	978,950.72	-124.13
9006	43.7'	28.1'	1374	978,942.75	-131.34
9007	44.0'	48.8'	1485	978,940.05	-127.12
9008	59.4'	130°33.9'	1474	978,998.50	- 88.50
9009	59.7'	56.3'	1232	978,998.24	-105.14
9010	59.2'	131°14.3'	1352	978,984.31	-110.50
9011	59.4'	35.1'	1304	978,975.44	-122.76
9012	28°13.5'	5.1'	1206	979,023.69	- 98.55
9013	12.8'	29.9'	1041	979,030.06	-102.19
9014	13.5'	51.5'	1021	979,048.22	- 86.28
9015	27.7'	12.8'	1030	979,066.60	- 85.08
9016	27.3'	38.4'	982	979,085.95	- 68.38
9017	49.0'	5.9'	932	979,120.20	- 64.89
9018	49.0'	26.4'	949	979,141.60	- 42.38
9019	47.6'	46.8'	823	979,169.49	- 20.99
9020	59.8'	12.7'	971	979,152.85	- 43.31
9021	29°00.1'	36.3'	904	979,187.05	- 13.97
9022	27°17.4'	132°47.0'	1423	978,890.23	-148.34

<u>Station No.</u>	<u>Latitude</u>	<u>Longitude</u>	<u>Elevation</u>	<u>Observed Gravity</u>	<u>Bouguer Gravity</u>
7030:9023	27°17.4'	133°10.1'	1270	978,926.29	-122.38
9024	22.0'	132°11.4'	1392	978,909.47	-136.78
9025	28.7'	133°30.5'	998	979,038.07	- 42.38
9026	29.7'	132°02.6'	1507	978,918.70	-129.41
9027	29.3'	30.5'	1274	978,931.17	-131.80
9028	29.6'	133°00.3'	1183	978,952.29	-117.19
✓ 9029	43.9'	132°16.7'	1235	978,968.43	-115.09
9030	43.9'	48.0'	1162	978,992.26	- 96.06
✓ 9031	45.0'	133°18.6'	937	979,081.67	- 23.19
✓ 9032	58.7'	132°03.9'	1217	979,000.79	-102.34
9033	28°00.3'	33.5'	1025	979,050.74	- 67.01
9034	00.1'	59.8'	1021	979,096.17	- 21.64
9035	27°59.7'	133°28.9'	872	979,149.46	+ 22.37
9036	28°14.7'	132°15.7'	1147	979,080.35	- 47.33
9037	15.4'	46.5'	965	979,131.79	- 8.75
9038	29.4'	02.9'	844	979,142.60	- 23.50
9039	29.6'	32.2'	945	979,170.55	+ 10.73
9040	30.2'	133°02.2'	825	979,157.56	- 10.82
9041	44.9'	132°16.8'	1001	979,172.85	- 2.43
9042	47.8'	46.5'	772	979,177.35	- 16.73
9043	58.5'	131°59.8'	700	979,203.18	- 9.27
9044	29°00.0'	132°33.7'	766	979,197.21	- 12.78
9045	28°59.8'	59.7'	649	979,207.50	- 9.94
9046	32.5'	131°08.6'	1042	979,072.60	- 84.32
9047	25.4'	24.0'	1072	979,060.60	- 85.42
9048	44.0'	01.7'	1070	979,098.73	- 70.94
9049	STATION NUMBER NOT USED				
9050	39.9'	12.8'	1102	979,087.11	- 75.81

0049

<u>Station No.</u>	<u>Latitude</u>	<u>Longitude</u>	<u>Elevation</u>	<u>Observed Gravity</u>	<u>Bouguer Gravity</u>
7030:9051	28°38.1'	131°14.4'	1142	979,082.53	- 74.89
9052	37.5'	16.1'	1161	979,080.87	- 74.50
9053	35.4'	20.7'	969	979,093.38	- 71.75
9054	34.1'	22.9'	1002	979,088.69	- 73.05
9055	33.1'	25.7'	1030	979,085.58	- 72.93
9056	17.9'	01.2'	1291	979,025.72	- 96.38
9057	18.5'	03.9'	1249	979,031.27	- 94.39
9058	18.5'	06.5'	1157	979,036.90	- 95.24
9059	19.3'	08.9'	1336	979,027.37	- 93.12
9060	20.1'	11.4'	1219	979,039.34	- 89.97
9061	19.2'	18.8'	1086	979,042.52	- 94.93
9062	19.0'	21.0'	1058	979,042.84	- 96.07
9063	18.7'	23.2'	1097	979,039.59	- 96.40
9064	17.8'	25.8'	1044	979,039.85	- 98.59
9065	17.8'	28.4'	1035	979,043.10	- 95.76
9066	07.3'	04.2'	1215	979,013.83	- 99.05
9067	06.1'	14.9'	1128	979,012.30	-105.97
9068	03.6'	23.8'	1312	978,989.61	-113.35
9069	40.1'	29.6'	1004	979,112.73	- 56.36
9070	39.9'	33.7'	920	979,123.91	- 50.38
9071	40.5'	37.7'	920	979,130.05	- 43.89
9072	40.1'	42.4'	912	979,133.10	- 40.93
9073	41.7'	46.7'	884	979,147.80	- 31.19
9074	STATION NUMBER NOT USED				
9075	"	"	"	"	"
9076	31.7'	29.1'	1010	979,085.50	- 72.61
9077	30.9'	39.1'	923	979,104.51	- 58.27

<u>Station No.</u>	<u>Latitude</u>	<u>Longitude</u>	<u>Elevation</u>	<u>Observed Gravity</u>	<u>Bouguer Gravity</u>
7030:9078	28°33.3'	131°49.4'	9001	979,129.65	- 37.66
9079	16.6'	31.8'	1130	979,034.52	- 96.81
9080	16.7'	36.7'	1116	979,037.87	- 94.28
9081	17.1'	40.0'	1133	979,039.94	- 91.64
9082	17.0'	44.4'	1086	979,046.76	- 87.83
9083	21.6'	49.5'	1164	979,072.30	- 62.92
9084	21.1'	52.2'	1240	979,068.60	- 61.23
9085	21.3'	56.1'	1077	979,084.66	- 55.89
9086	09.5'	39.0'	1226	979,009.09	-106.93
9087	03.5'	30.5'	1083	979,001.43	-116.47
9088	03.6'	34.1'	1282	978,987.05	-117.88
9089	27°55.3'	33.7'	1234	978,970.59	-127.12
9090	55.8'	38.7'	1410	978,957.85	-128.93
9091	55.9'	42.9'	1282	978,968.35	-126.62
9092	55.6'	47.5'	1296	978,971.37	-122.68
9093	57.8'	50.3'	1161	978,989.58	-116.07
9094	57.7'	52.6'	1161	978,992.53	-113.08
9095	57.9'	54.4'	1119	978,997.64	-110.90
9096	57.1'	56.3'	1209	978,989.05	-112.63
9097	57.5'	58.3'	1342	978,982.39	-111.02
9098	48.1'	29.3'	1511	978,941.21	-129.40
10001	32.1'	47.9'	1522	978,924.65	-125.45
10002	32.3'	56.0'	1398	978,930.84	-127.61
10006	28°41.3'	132°11.7'	934	979,171.89	- 3.29
10007	32.1'	01.1'	856	979,148.72	- 20.06
10008	32.0'	11.6'	853	979,156.19	- 12.68
10009	22.0'	01.6'	1139	979,087.64	- 49.73
~ 10010	27°31.8'	05.5'	1414	978,928.80	-128.00

	<u>Station No.</u>	<u>Latitude</u>	<u>Longitude</u>	<u>Elevation</u>	<u>Observed Gravity</u>	<u>Bouguer Gravity</u>
	7030:10011	STATION NUMBER NOT USED				
	10012	28°22.4'	132°09.7'	985	979,115.67	- 32.35
	10015	12.3'	08.7'	1024	979,070.50	- 62.29
N	10016	27°57.6'	00.3'	1327	978,985.48	-108.95
N	10017	58.7'	06.1'	1301	978,994.51	-103.03
N	10018	58.5'	08.0'	1325	978,993.30	-102.40
N	10019	58.3'	09.7'	1303	978,995.36	-101.56
N	10020	58.5'	11.4'	1193	979,004.35	-100.03
N	10021	58.4'	14.0'	1142	979,010.12	- 97.55
N	10022	32.2'	01.1'	1400	978,931.16	-127.07
N	10023	32.5'	09.2'	1334	978,935.37	-127.63
N	10024	33.1'	13.5'	1352	978,935.47	-127.01
N	10025	57.6'	16.3'	1170	979,006.62	- 98.23
N	10027	58.5'	19.0'	1161	979,012.04	- 94.43
N	10028	32.5'	18.2'	1319	978,937.22	-126.68
	10029	09.6'	20.6'	1183	979,064.37	- 54.52
N	10030	58.1'	21.2'	1070	979,019.56	- 92.55
N	10031	44.9'	00.4'	1350	978,956.52	-120.74
N	10034	33.1'	22.7'	1282	978,940.94	-126.18
N	10035	56.9'	28.0'	1030	979,027.26	- 85.91
N	10036	32.9'	26.7'	1273	978,941.95	-125.57
	10037	02.1'	29.2'	1142	979,045.41	- 66.84
N	10038	56.9'	29.2'	1007	979,030.07	- 84.69
	10040	56.5'	31.4'	1182	979,017.29	- 85.38
	10041	32.7'	31.0'	1234	978,943.59	-126.20
	10042	28°03.8'	35.8'	1010	979,062.72	- 60.37
	10043	27°32.7'	35.9'	1240	978,942.61	-126.85
	10044	28°04.0'	40.1'	1032	979,067.42	- 54.49

0052

<u>Station No.</u>	<u>Latitude</u>	<u>Longitude</u>	<u>Elevation</u>	<u>Observed Gravity</u>	<u>Bouguer Gravity</u>
7030:10045	27°32.6'	132°40.7'	1206	978,944.75	-126.81
10046	36.8'	131°33.6'	1382	978,934.50	-130.50
10047	27.9'	33.9'	1570	978,936.65	-105.04
10048	26.1'	37.2'	1581	978,935.12	-103.72
10049	36.9'	37.6'	1430	978,928.56	-133.44
10050	25.7'	38.1'	1550	978,936.65	-103.70
10051	24.4'	40.0'	1548	978,943.32	- 95.62
10052	36.0'	41.8'	1545	978,921.81	-131.59
10053	24.2'	41.4'	1494	978,944.64	- 97.59
10054	23.5'	44.3'	1492	978,942.95	- 98.52
10055	21.9'	47.2'	1475	978,941.28	- 99.37
10056	21.6'	48.9'	1466	978,943.62	- 98.23
10057	21.4'	52.0'	1492	978,933.32	-105.67
~ 10090	58.0'	132°23.1'	1004	979,026.42	- 89.86
10091	28.4'	131°43.8'	1511	978,934.02	-112.24
10092	36.7'	40.8'	1525	978,922.55	-133.01
10093	32.1'	51.5'	1542	978,924.54	-124.27
10094	28°04.0'	132°44.9'	1116	979,070.58	- 45.76
10096	22.4'	15.5'	833	979,129.37	- 28.64
~ Munyarai# 1	27°42.4'	00.3'	1379	978,956.26	-115.05
~ 47/L2	44.5'	02.8'	1400	978,953.56	-119.86
? 15/LN2	42.9'	09.4'	1342	978,956.95	-117.37
GAI - 1	28°34.1'	11.6'	853	979,156.19	- 15.26
GAI - 2	29.2'	10.7'	815	979,148.60	- 19.26
GAI - 3	24.3'	09.9'	854	979,131.05	- 27.96
GAI - 4	19.5'	09.3'	962	979,103.62	- 42.22
GAI - 5	14.3'	08.9'	997	979,080.52	- 56.61
GAI - 6	09.0'	08.4'	1020	979,056.52	- 72.42

0053

	<u>Station No.</u>	<u>Latitude</u>	<u>Longitude</u>	<u>Elevation</u>	<u>Observed Gravity</u>	<u>Bouguer Gravity</u>
	GAI - 7	28°04.0'	132°07.7'	1164	979,024.28	- 88.92
N E	GAI - 8A	27°54.3'	07.8'	1216	978,986.71	-110.94
N	GAI - 10	47.4'	07.4'	1372	978,960.22	-118.69
? N	GAI - 11	42.9'	07.3'	1339	978,957.25	-118.27
	6792:9201	28°37.7'	11.6'	844	979,167.33	- 9.21

→ EMU FIELD #1

+2.24

QAL 60

CARMBENA

ETITNNA

WANTAPELLA

NARANA

OOLARINBA

AMMAROODINIA

Σ0280 (1966) Observed gravity is 978,955.17
at 2.08 mgs above normal.

Station
1364.10 SP 28 (L192) (from station
field book)

at SP 28 (L192)
min Aug 1973 level is 1353.70' at
10.40' below normal

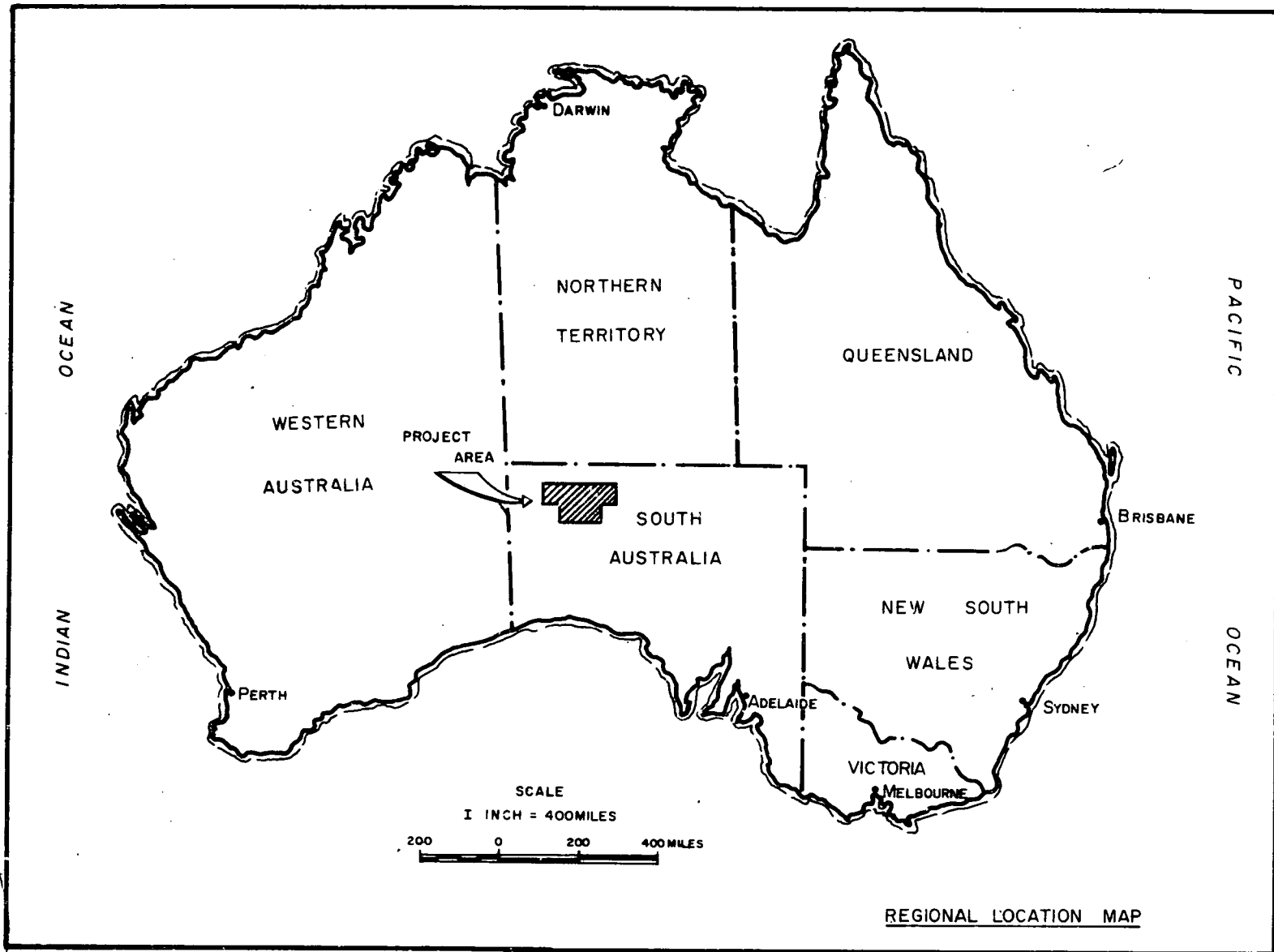
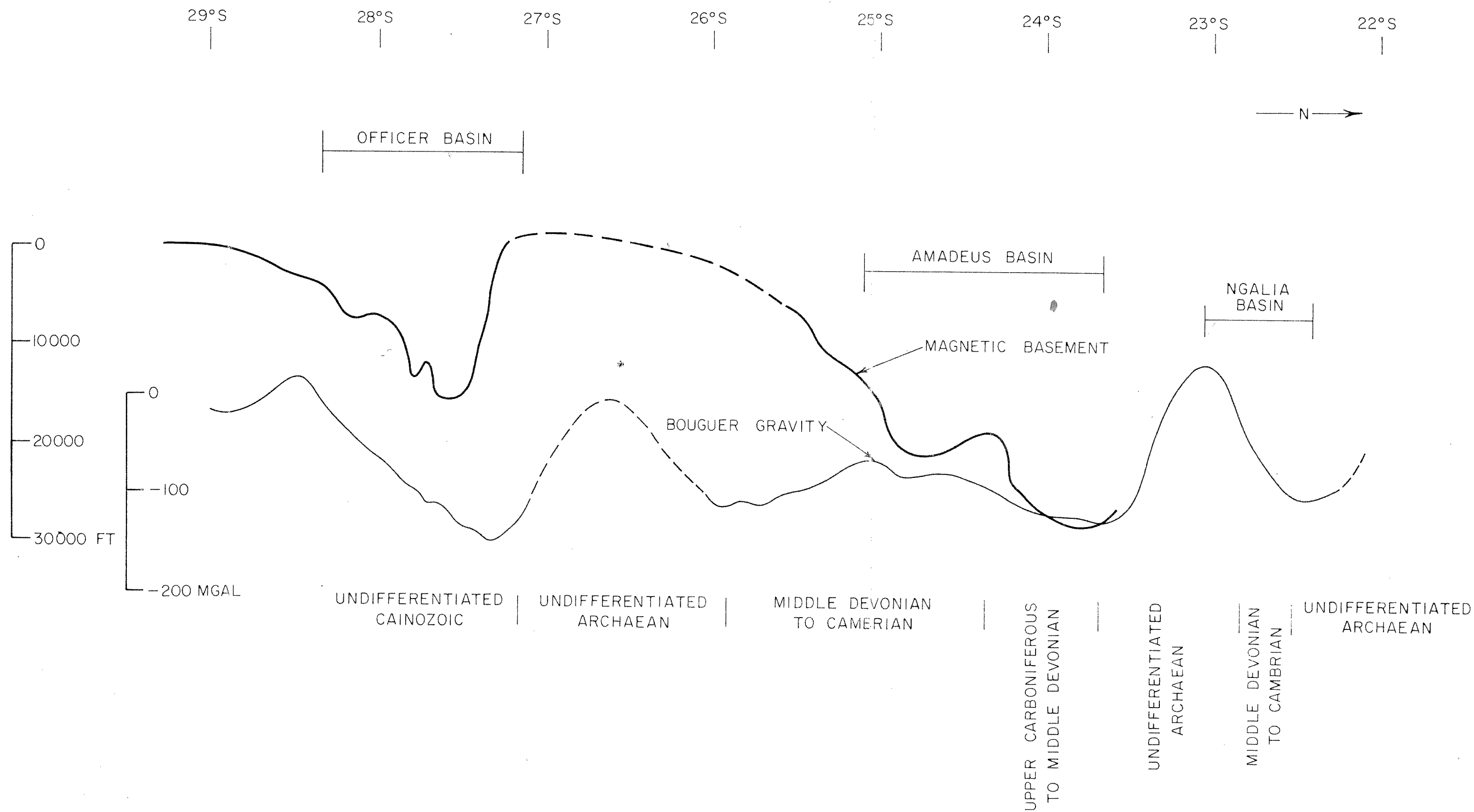
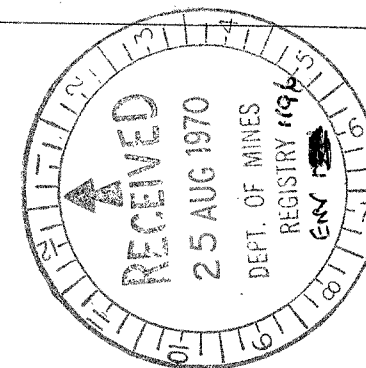


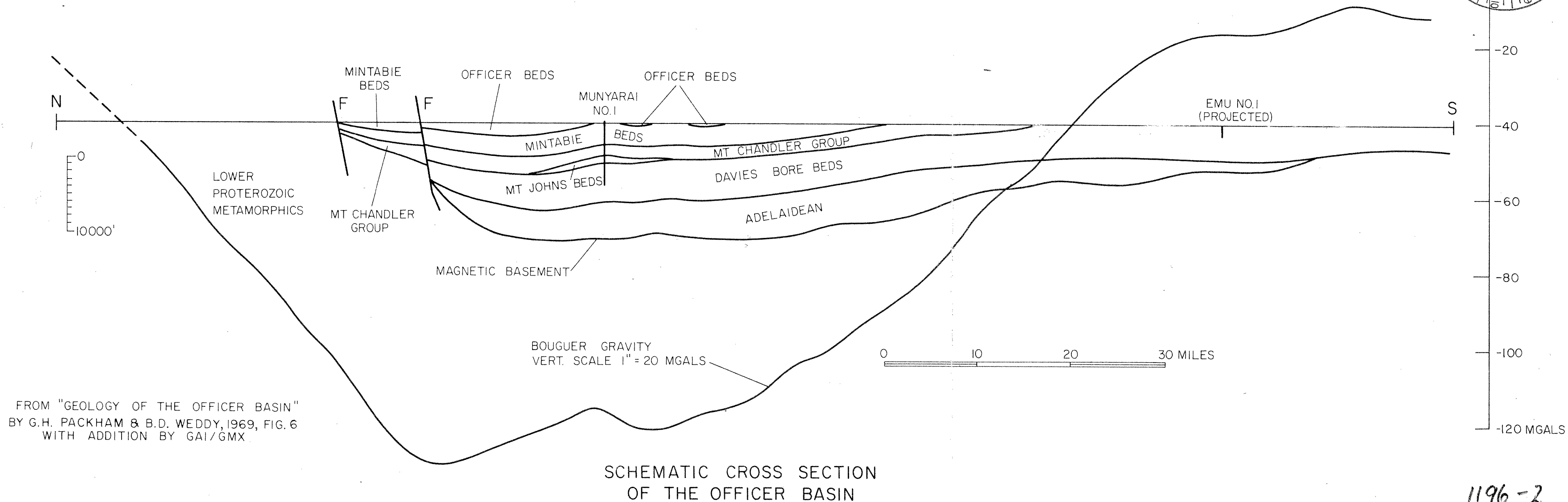
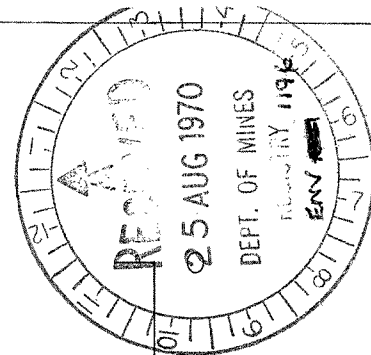
Figure 1



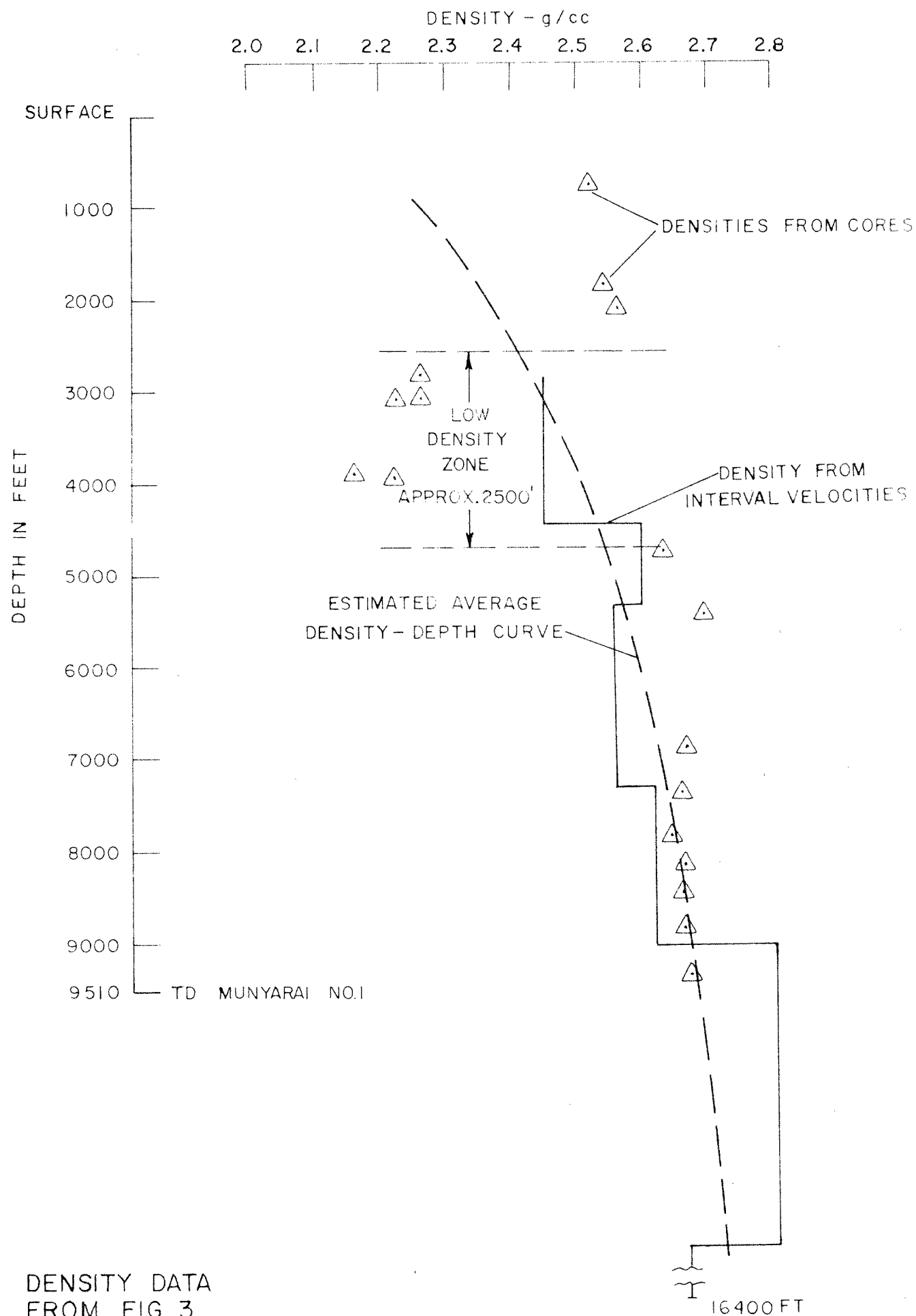
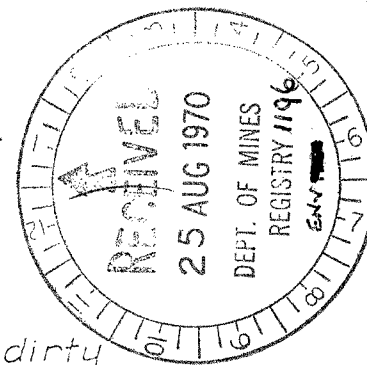
COMPOSITE N-S PROFILE
OF BOUGUER GRAVITY
AND MAGNETIC BASEMENT
ALONG LONG. 132°40'E
SCALE 1:2 500 000

FIG 1

1-9611

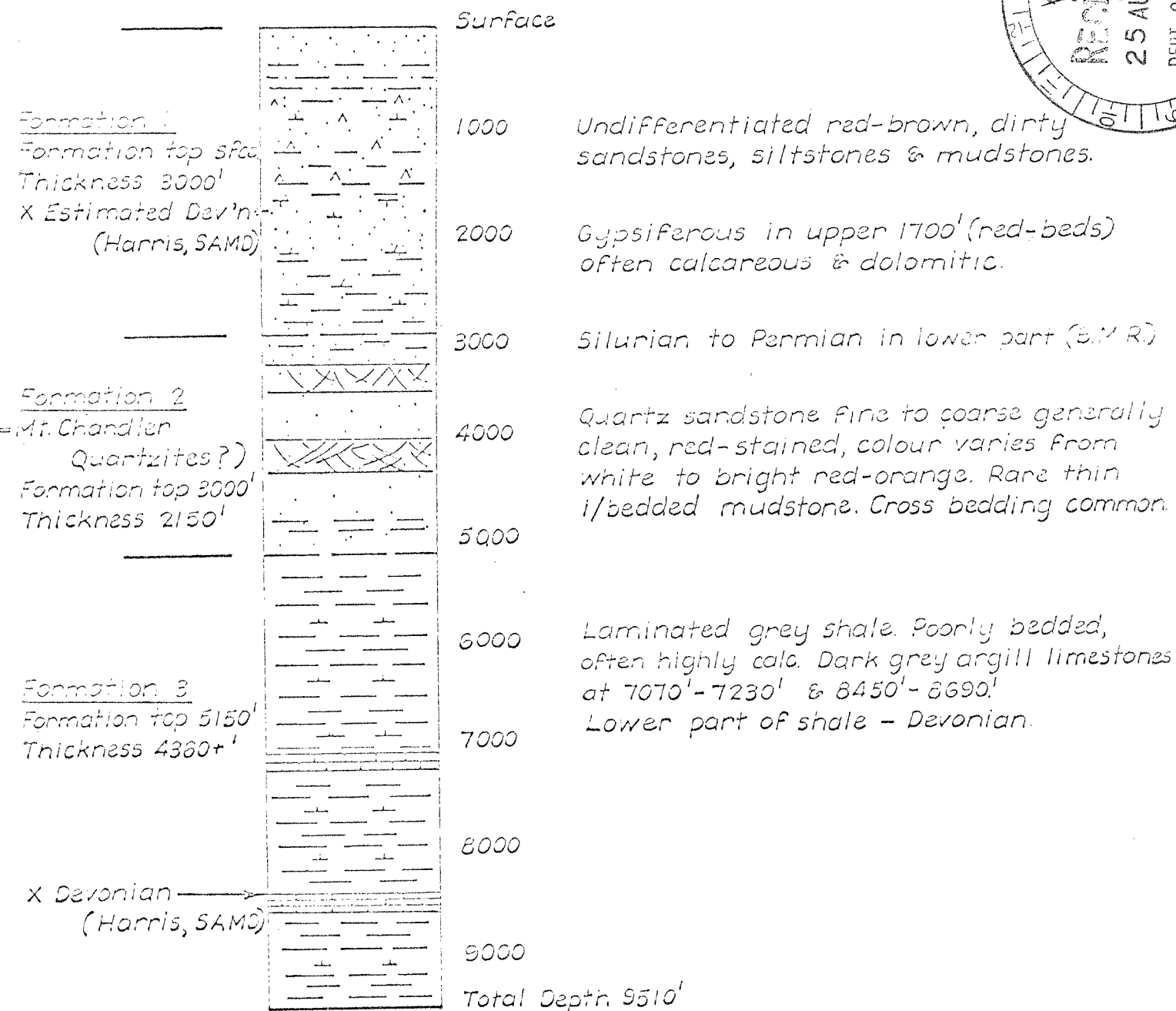


1196-2
FIG 2



Formation

Lithology



R.T. Farmer
Sept. 1968

STRATIGRAPHIC COLUMN
MUNYARAI NO.1 EASTERN OFFICER BASIN
(FROM PLAT 2 WELL COMPLETION REPORT)

FIG 4

1196-3

DENSITY DATA
FROM FIG 3

1196-4.

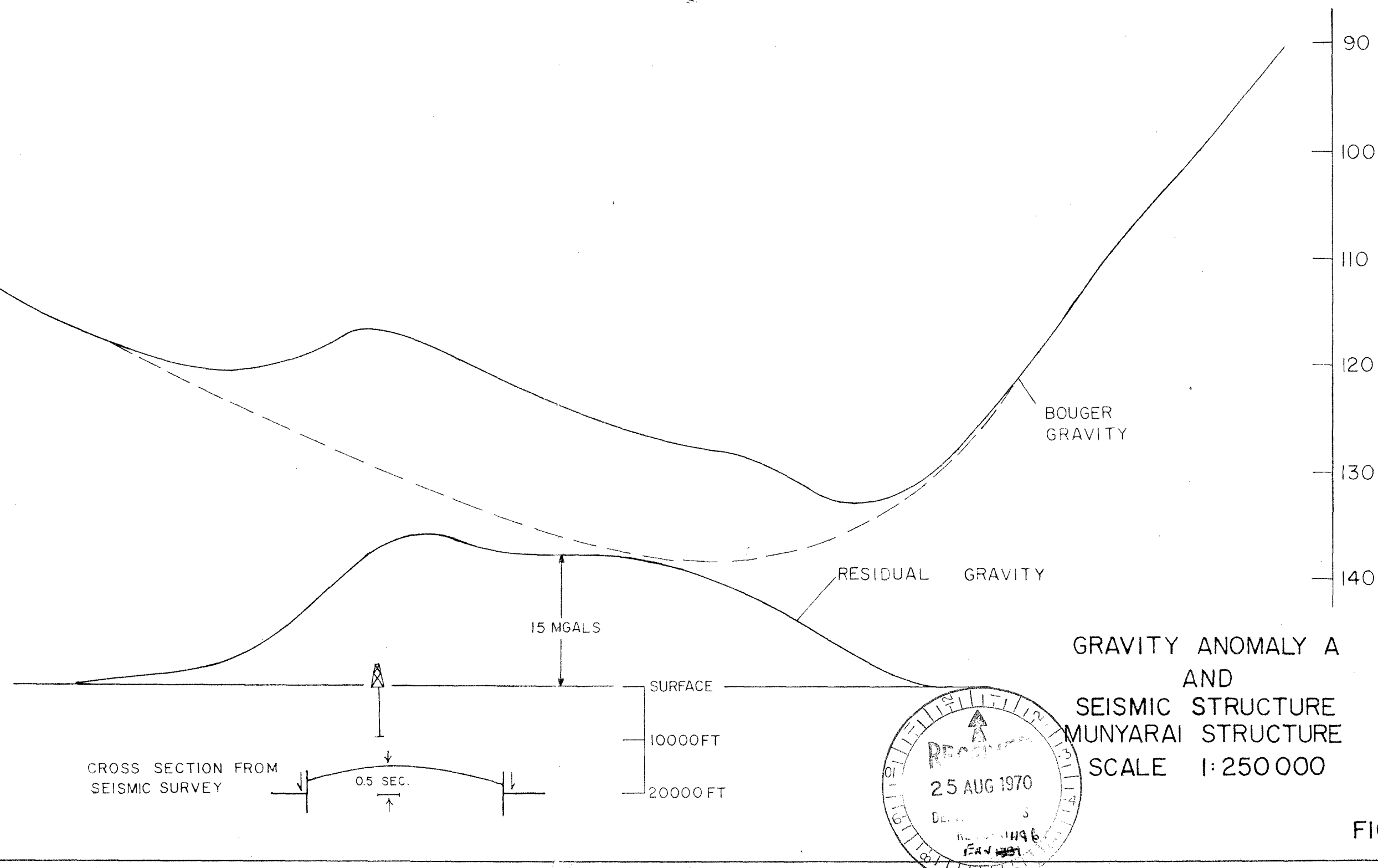


FIG 5

S 9611

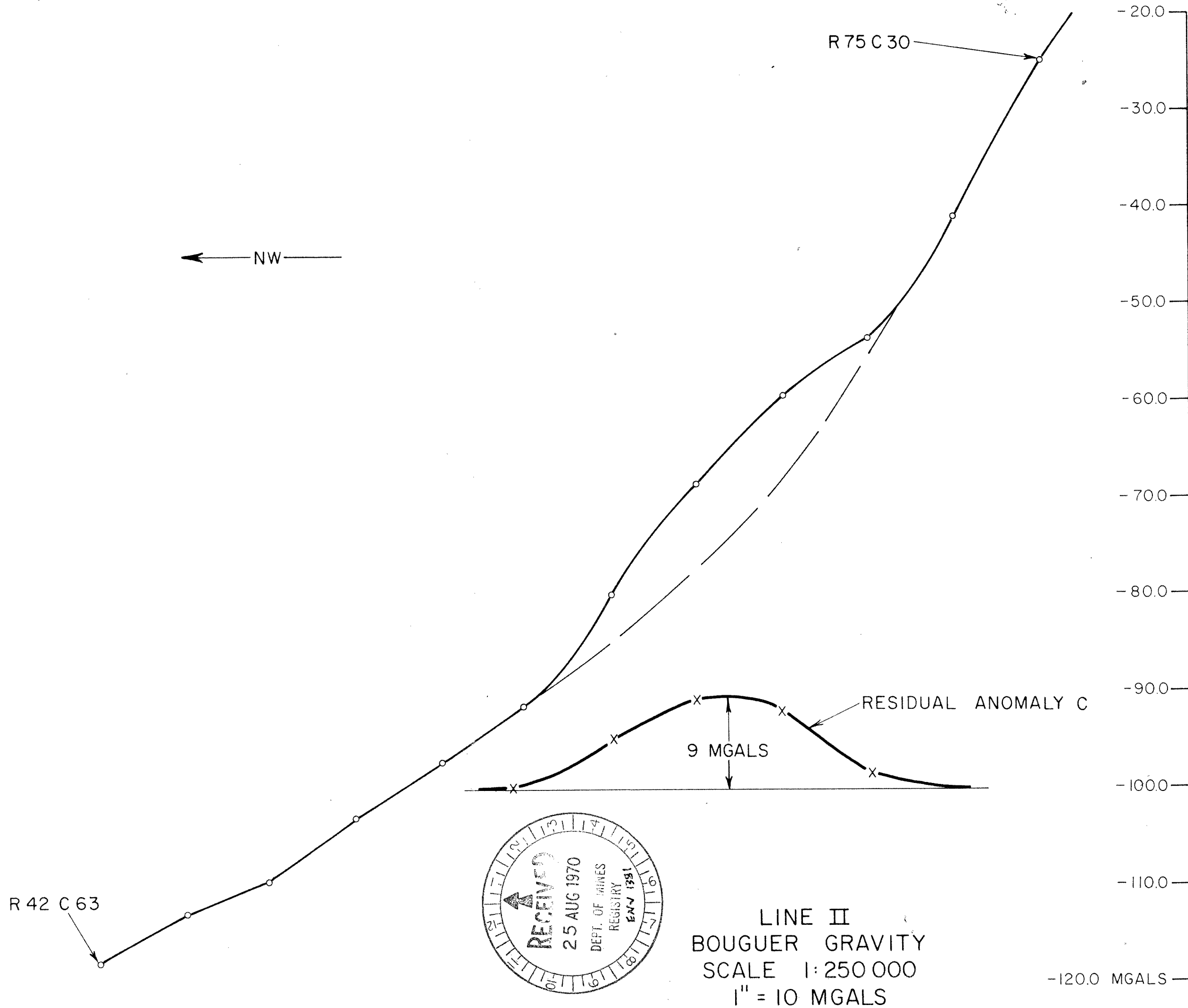


FIG 7

-70.0 MGALS

-80.0

-90.0

-100.0

-110.0

-120.0

R 47 C 80

NW

34 MGALS

RESIDUAL ANOMALY B

R 32 C 95

-50.0 MGALS

LINE I
BOUGUER GRAVITY
SCALE 1:250 000
1" = 10 MGALS

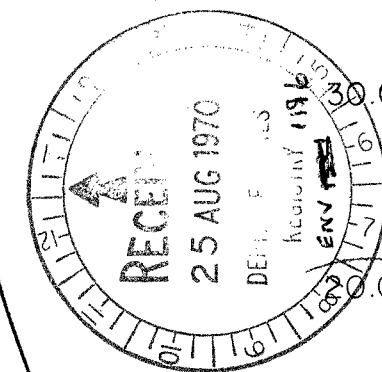
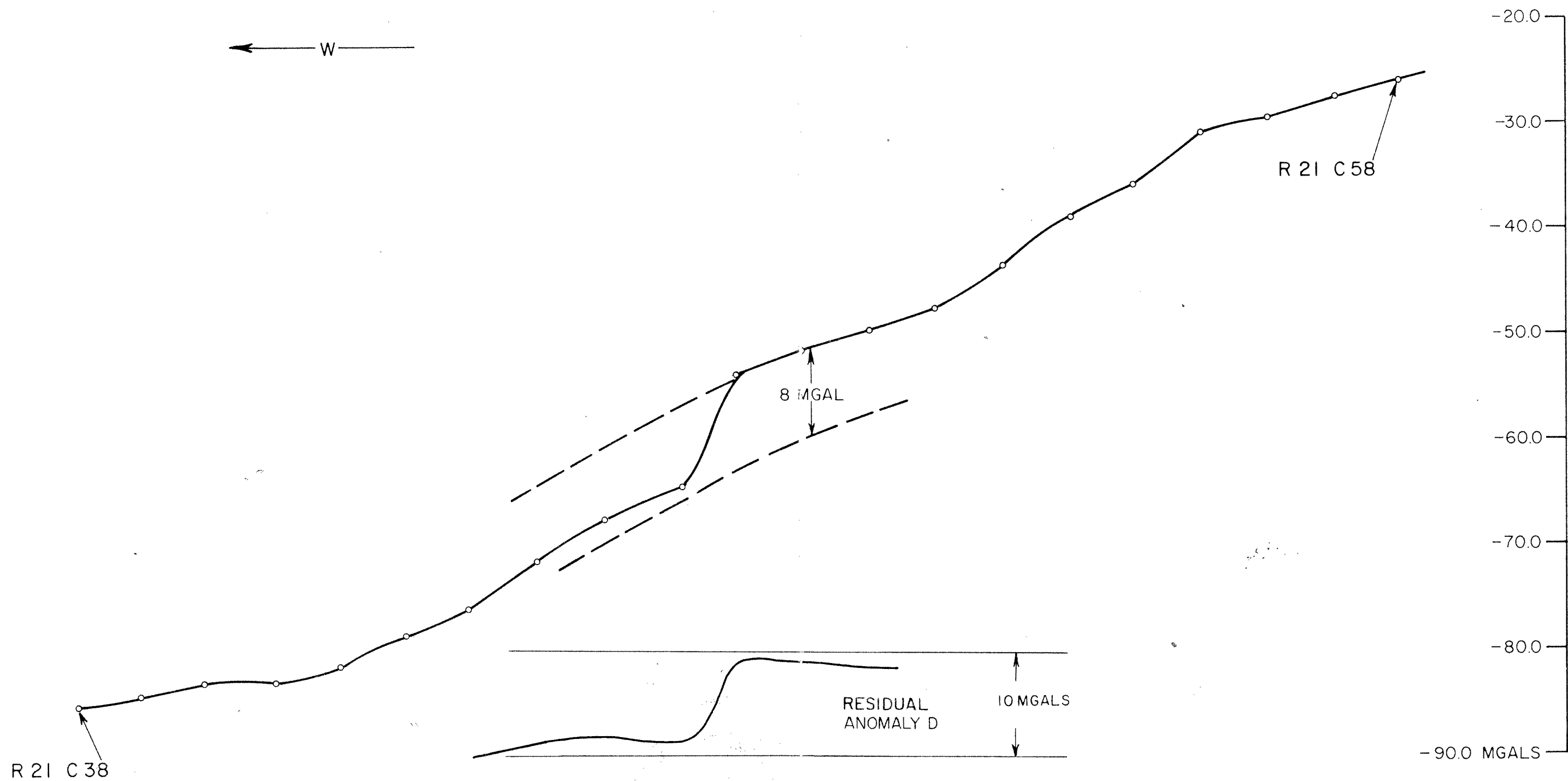
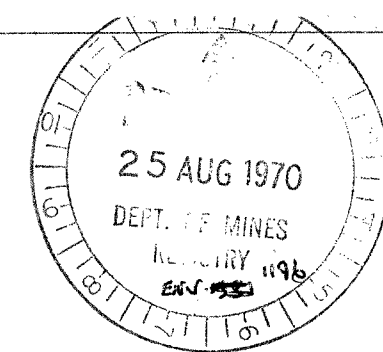
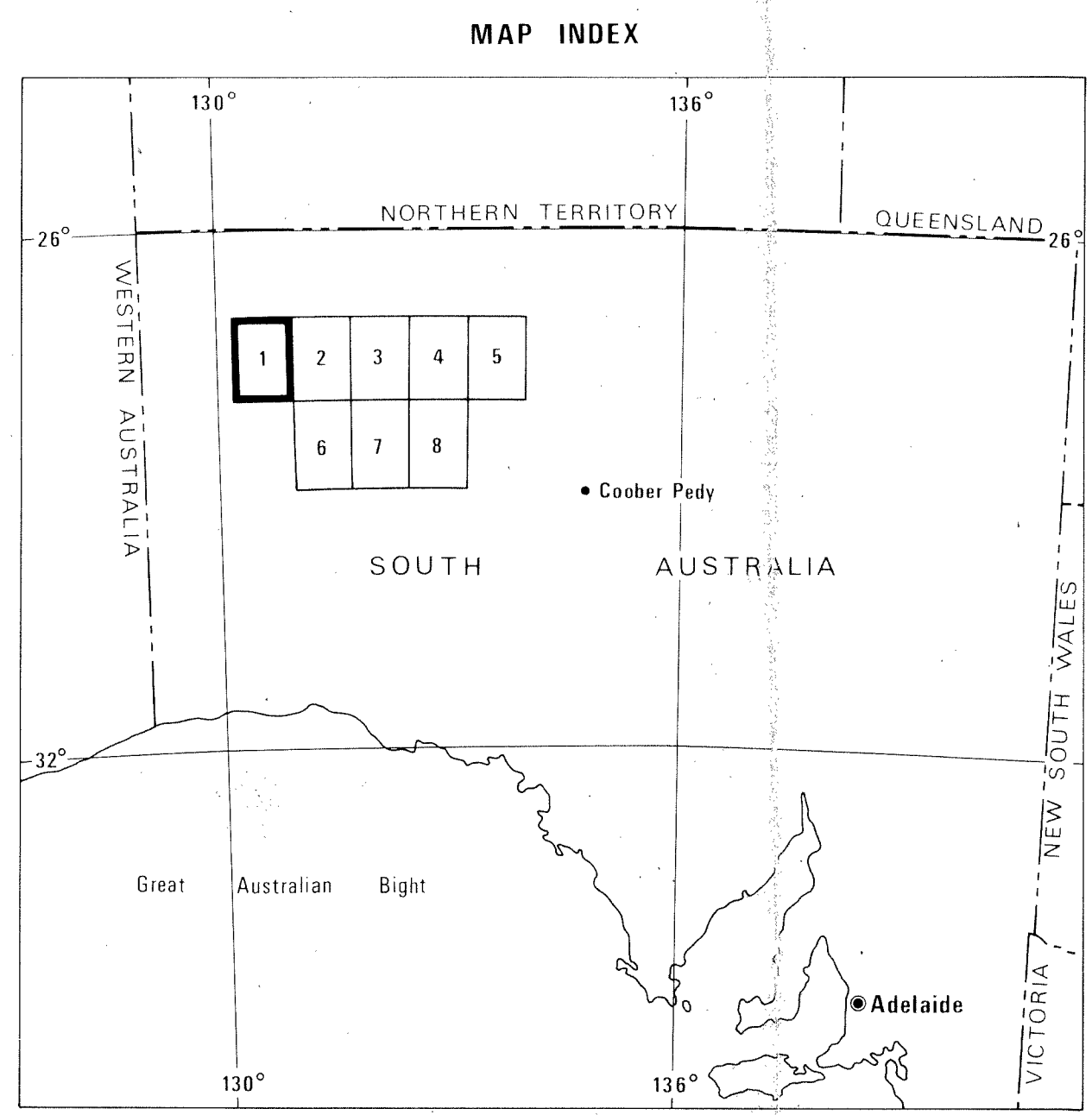
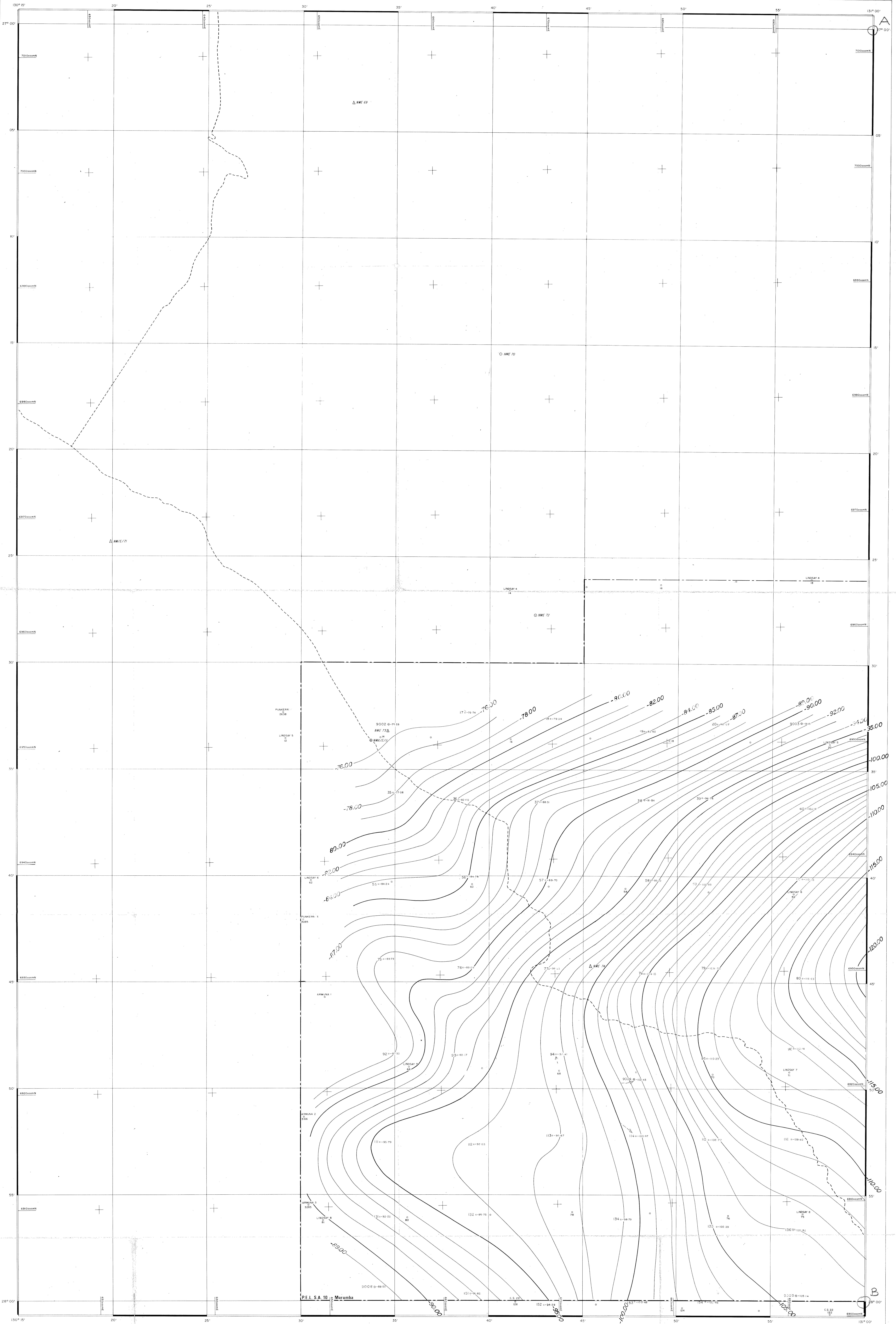


FIG 6

L-9611



LINE III
BOUGUER GRAVITY
SCALE 1:250 000
1" = 10 MGALS



- LEGEND
- Dry and abandoned well
 - △ Major control point
 - Minor control point
 - ⊙ Astronomical control point
 - ⊙ Photo-centre, run number, photo number
 - Petroleum tenement boundary
 - - - Approximate position of existing roads and tracks (1:250,000 topographic maps)

MURUMBA OIL N.L.
EASTERN OFFICER BASIN
HELICOPTER GRAVITY SURVEY
P.E.L. 10 & 11. South Australia

BOUGUER GRAVITY

EG&G INTERNATIONAL
GEOPHYSICAL ASSOCIATES PTY LTD

FLYING BY: ROTOR-WORK HELICOPTERS PTY LIMITED SYDNEY
SUPERVISION BY: ANALYTICAL EXPLORATION (AUST) PTY LTD.

SCALE 1:100,000

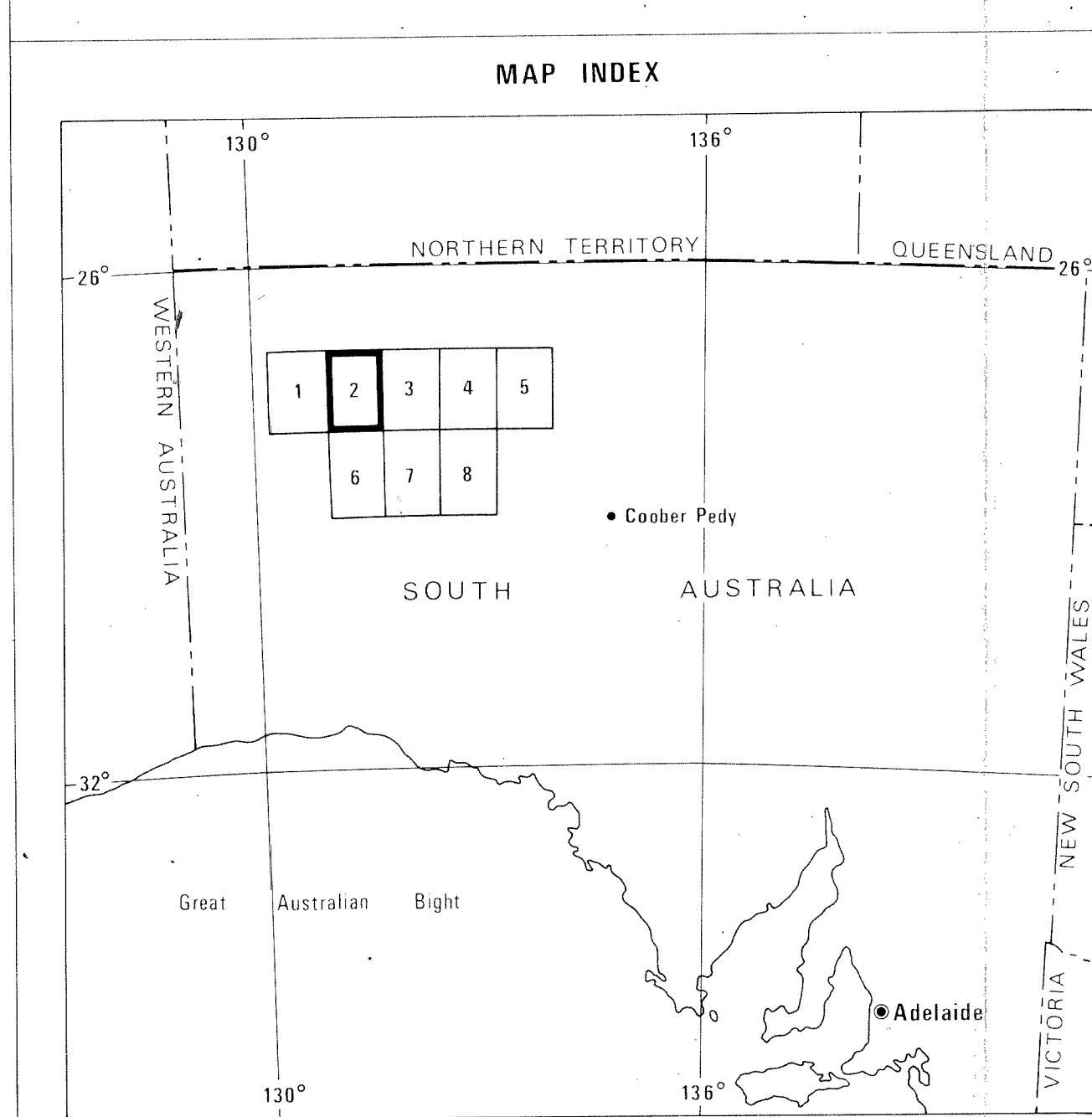
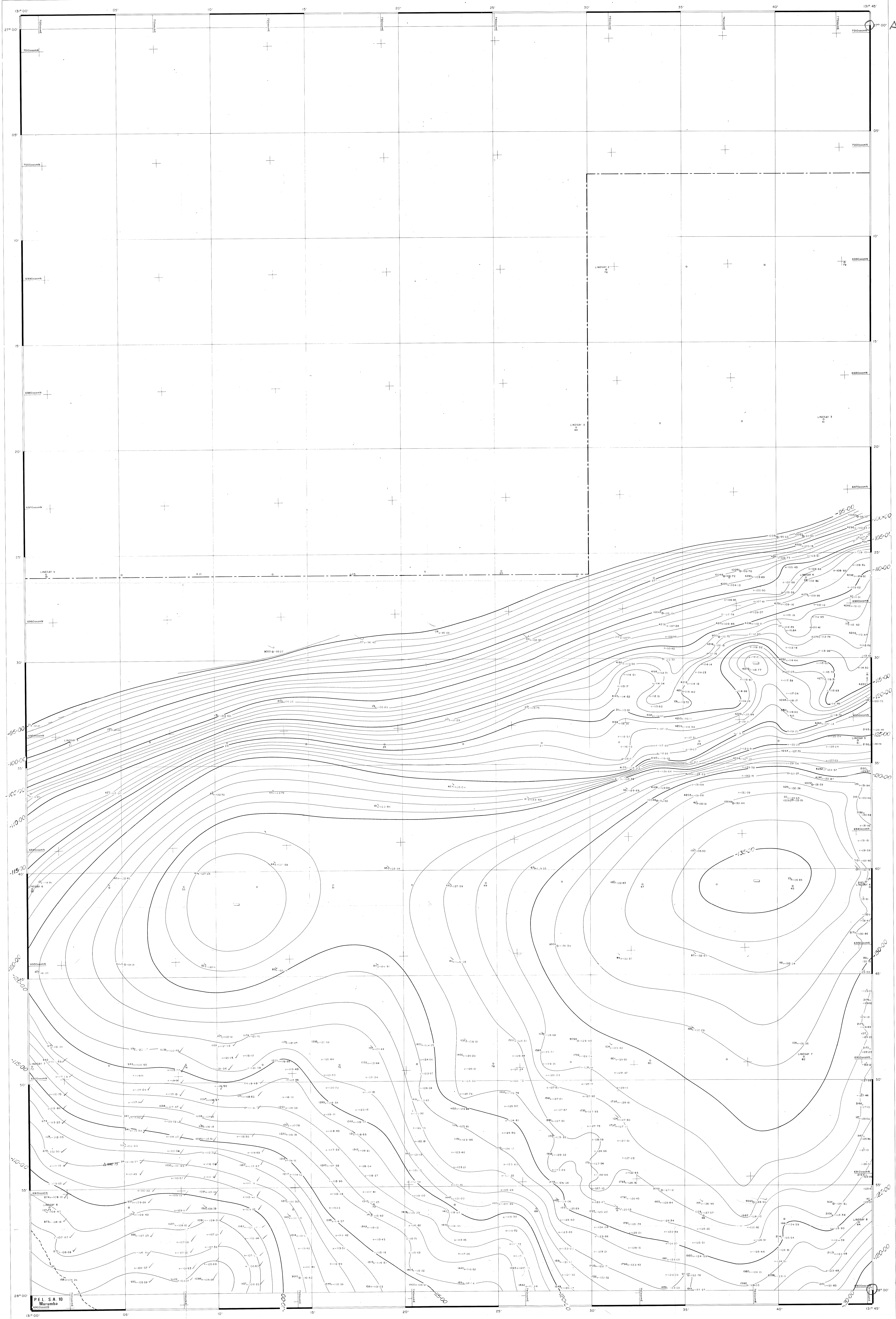
ELEVATION FACTOR: 0.00599 milligals/m
DENSITY: 2.67 gm/cc
CONTOUR INTERVAL: 1.0 milligals
GAMMA: 9.80665 m/s²

SHEET 1

PLATE III

1196-B

TRANSVERSE MERCATOR PROJECTION, ZONE 52, AUSTRALIAN MAP GRID, 1966



- LEGEND
- Dry and abandoned well
 - △ Major control point
 - Minor control point
 - ⊕ Astronomical control point
 - ⊙ Photo - centre, run number, photo number
 - Petroleum tenement boundary
 - Approximate position of existing roads and tracks (1:250,000 topographic maps)

MURUMBA OIL N.L.
EASTERN OFFICER BASIN
HELICOPTER GRAVITY SURVEY
P.E.L. 10 & 11. South Australia

BOUGUER GRAVITY

EG&G INTERNATIONAL
GEOPHYSICAL ASSOCIATES PTY LTD

FLYING BY: ROTOR-WORK HELICOPTERS PTY LIMITED SYDNEY
SUPERVISION BY: ANALYTICAL - EXPLORATION (AUST) PTY LTD.

SCALE 1:100,000

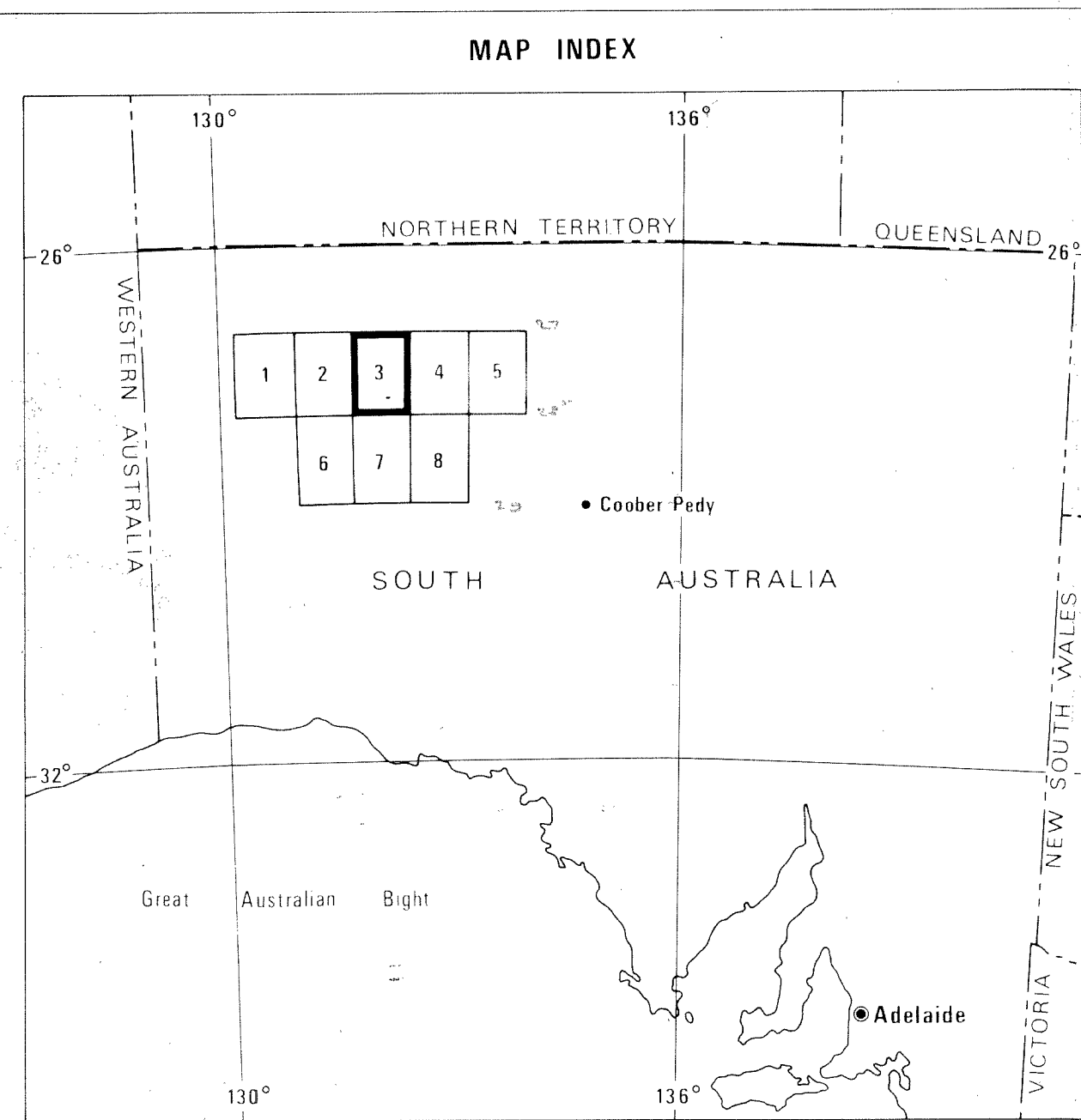
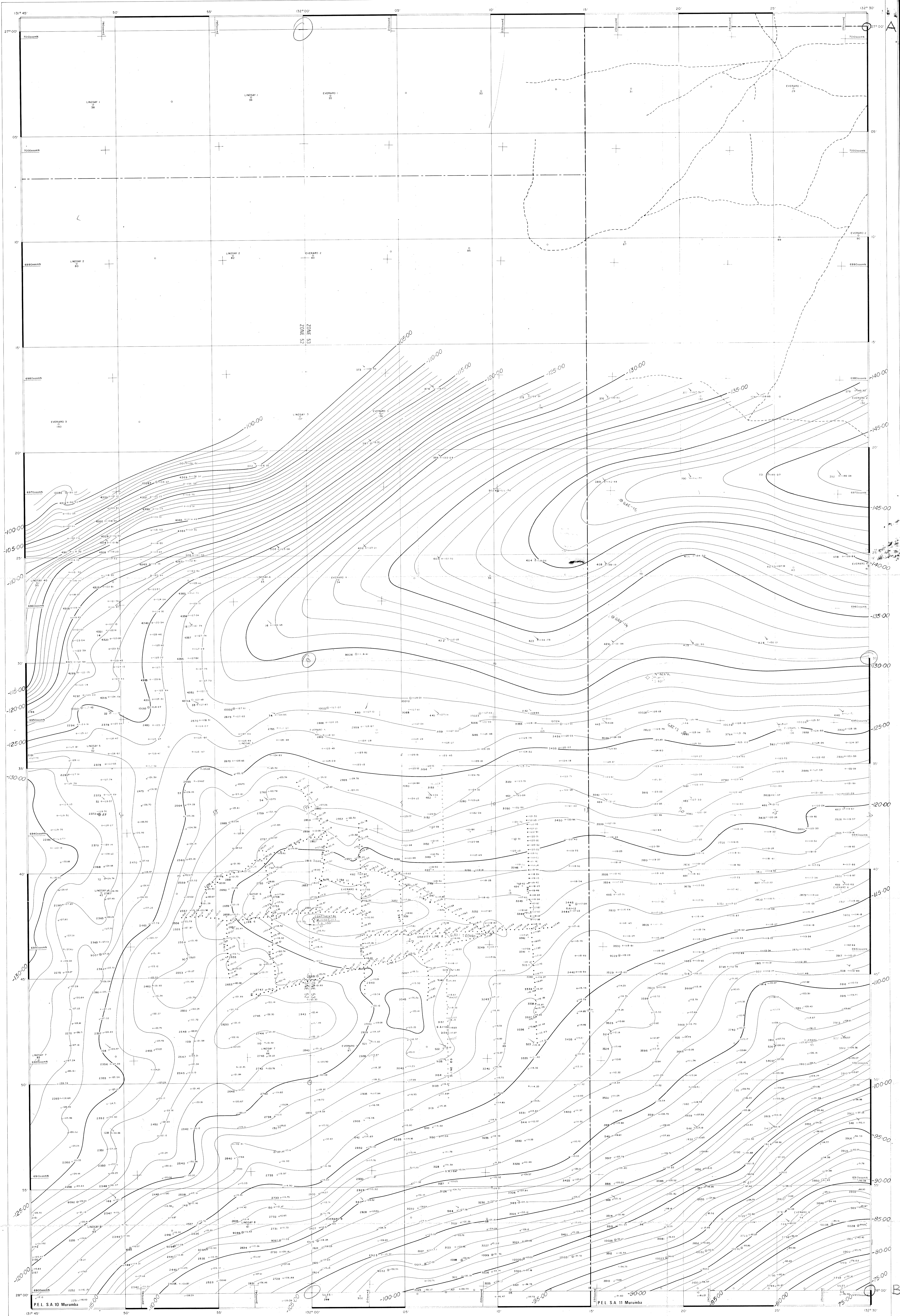
ELEVATION FACTOR: 0.6599 milligals/m
DENSITY: 2.29 gm/cc

CONTOUR INTERVAL: 1.0 milligals
DATUM: M.S.L.

SHEET 2

PLATE 111

1196-9



LEGEND

-  Dry and abandoned well
 Major control point
 Minor control point
 Astronomical control point
 Photo-centre, run number, photo number
 Petroleum tenement boundary
 Approximate position of existing roads at 1:250,000 topographic maps

MURUMBA OIL N.L.
EASTERN OFFICER BASIN
HELICOPTER GRAVITY SURVEY
P.E.L. 10 & 11. South Australia

BOUGUER GRAVITY

 EG&G INTERNATIONAL
AUGUST 970
SPRINGSIDE QLD.
GEOPHYSICAL ASSOCIATES PTY LTD

FLYING BY: ROTOR-WORK HELICOPTERS PTY LIMITED SYDNEY
SUBMISSION: OK ANALYTICAL: EXPLORATION (AUST) PTY LTD

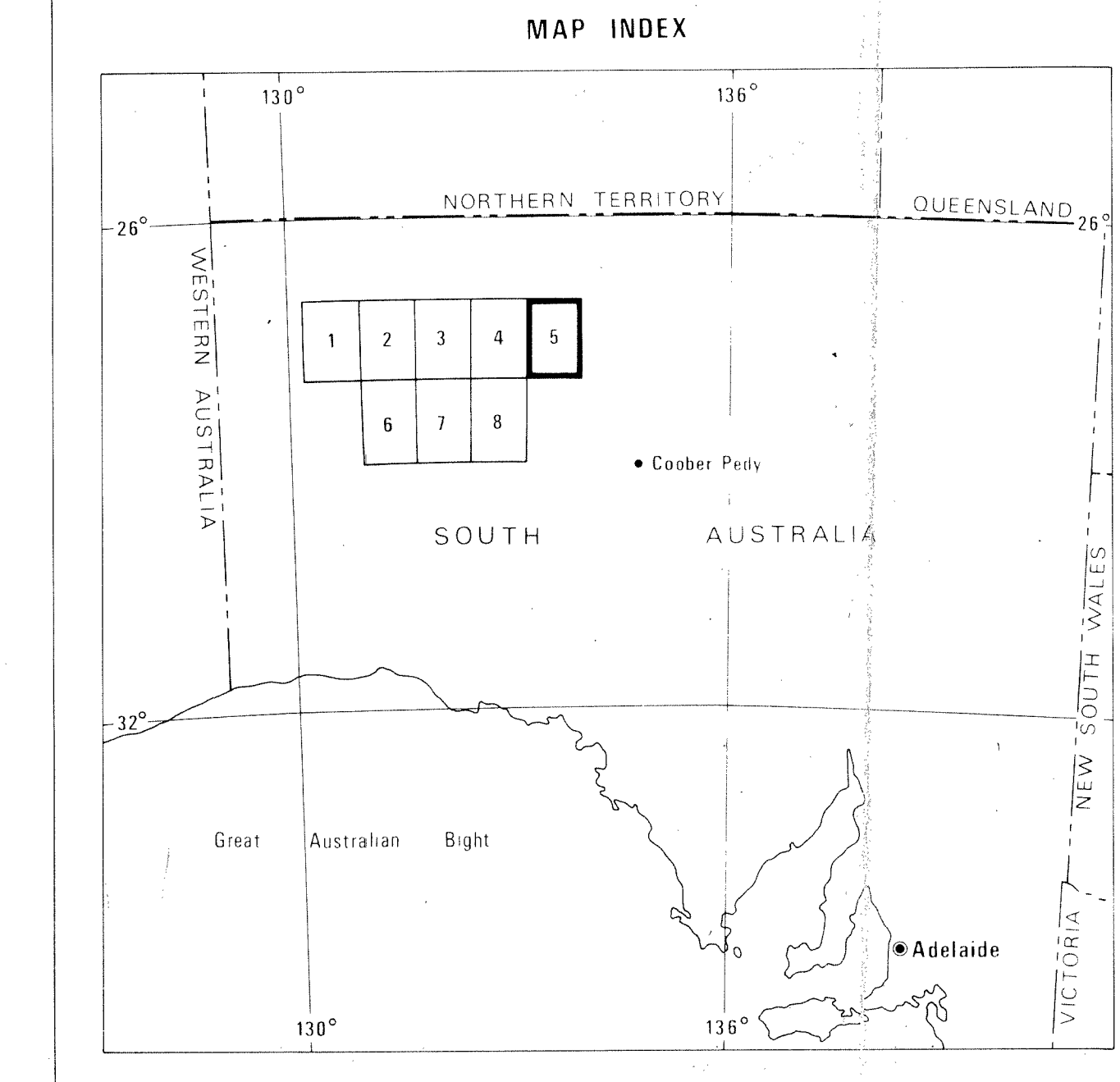
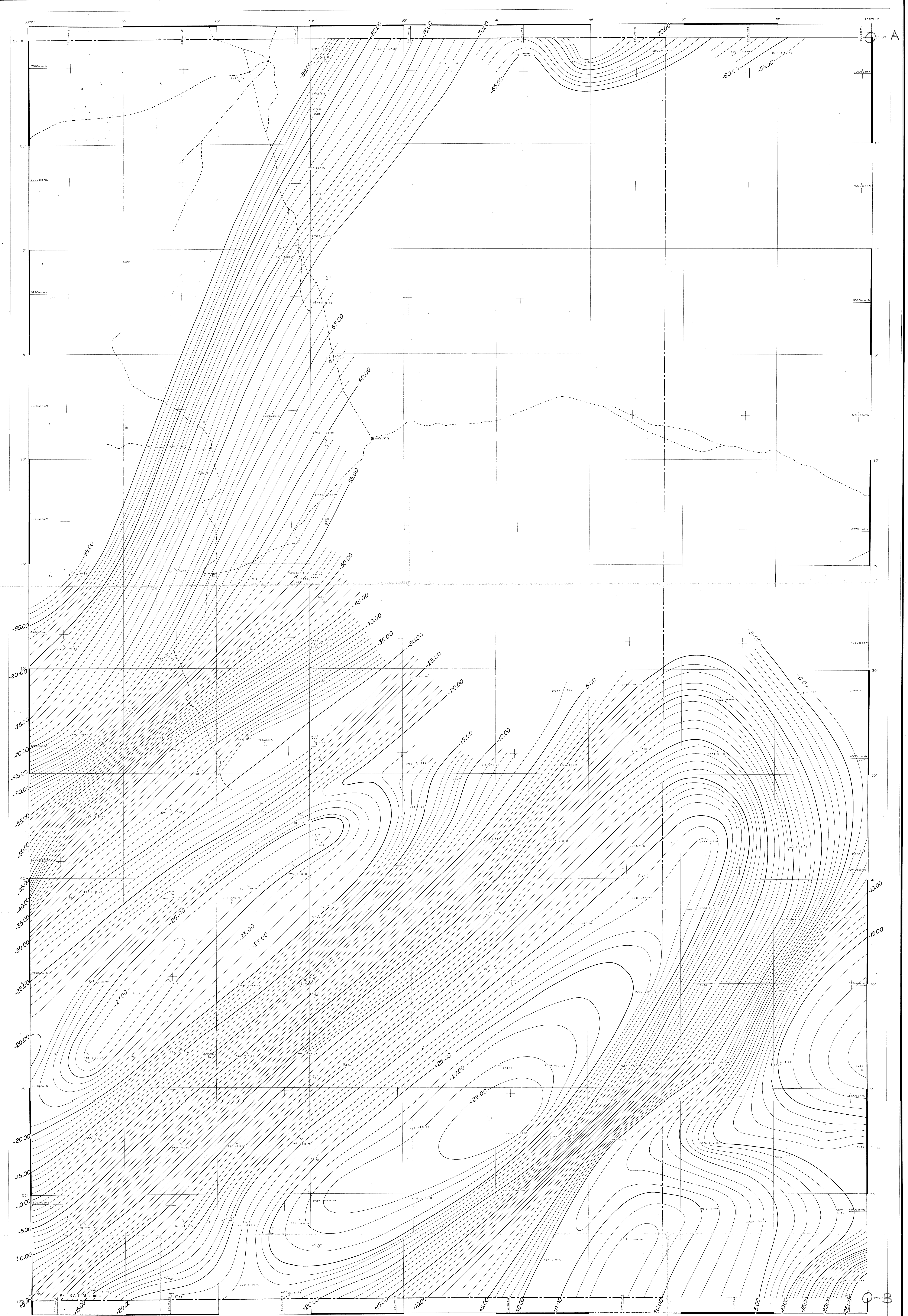
SCALE 1:100,000

ELEVATION FACTOR 0.06599 milligals " CONTOUR INTERVAL 10 m/m
DENSITY 1.2 gms/cc DATUM W.S.M.

SHEET 3

PLATE: III

1196-10



- LEGEND
- Dry and abandoned well
 - △ Major control point
 - Minor control point
 - ⊕ Astronomical control point
 - ⊕ Photo-centre, run number, photo number
 - Petroleum tenement boundary
 - - - Approximate position of existing roads and tracks (1:250,000 topographic maps)

MURUMBA OIL N.L.
EASTERN OFFICER BASIN
HELICOPTER GRAVITY SURVEY
P.E.L. 10 & 11. South Australia

BOUGUER GRAVITY

EG&G INTERNATIONAL
GEOPHYSICAL ASSOCIATES PTY LTD

FLYING BY ROTOR-WORK HELICOPTERS PTY LIMITED SYDNEY
SUPERVISION BY ANALYTICAL EXPLORATION (AUST) PTY LTD.
SCALE 1:100,000

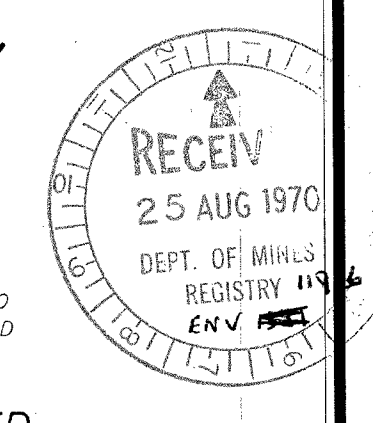
2 0 2 4 6 Miles
2 0 2 4 6 Kilometres

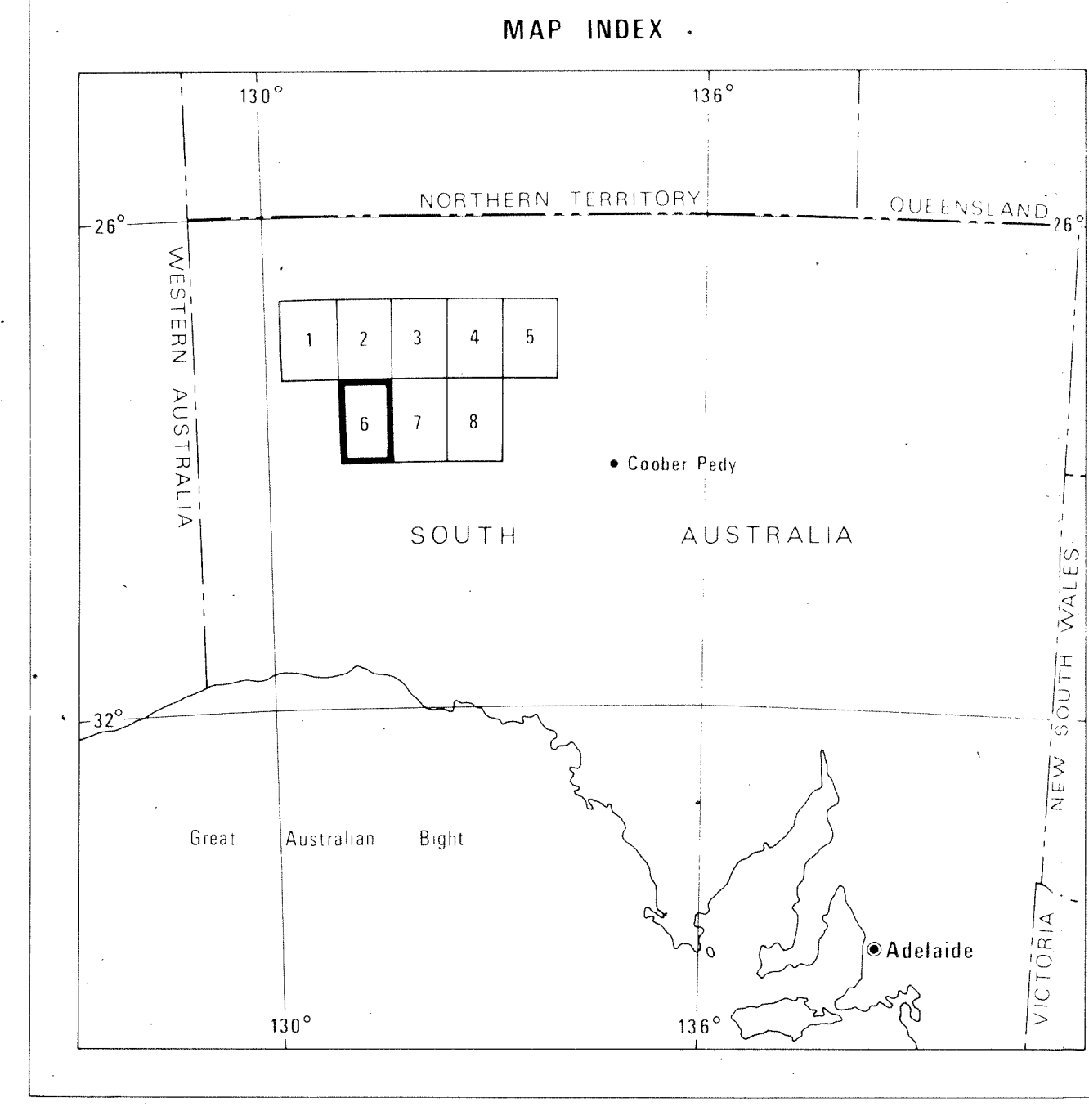
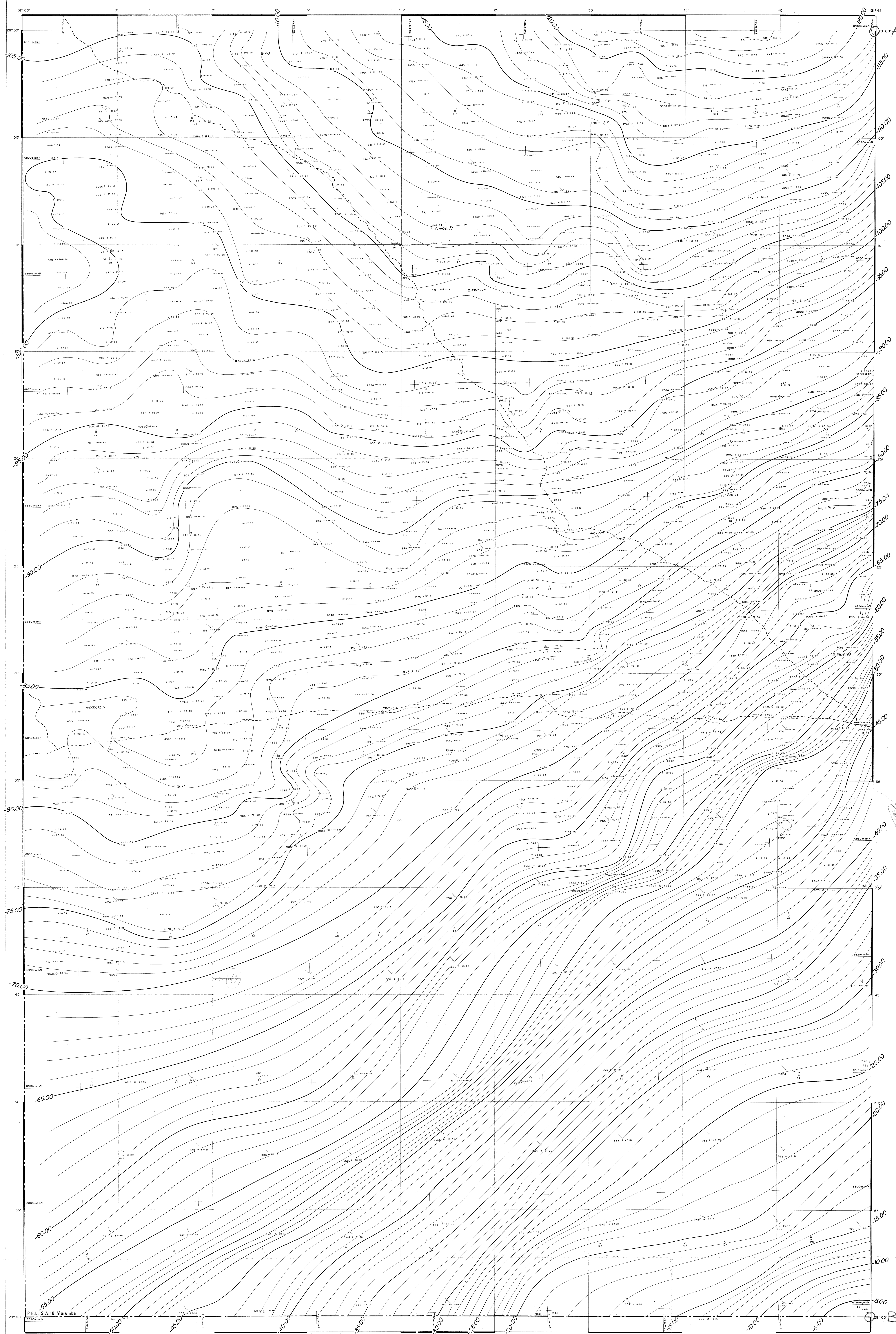
ELEVATION FACTOR: 0.06589 milligals/ft
DENSITY: 2.2 gms/cc

CONTOUR INTERVAL: 5.0 milligals
DATUM: M.S.L.

SHEET 5

PLATE III





LEGEND

- ⊕ Dry and abandoned well
- Δ Major control point
- Minor control point
- ⊕ Astronomical control point
- ⊕ Photo-centre, run number, photo number
- Petroleum tenement boundary
- Approximate position of existing roads and tracks (1:250,000 topographic maps)

MURUMBA OIL N.L.
EASTERN OFFICER BASIN
HELICOPTER GRAVITY SURVEY
P.E.L. 10 & 11, South Australia

BOUGUER GRAVITY

EG&G INTERNATIONAL
GEOPHYSICAL ASSOCIATES PTY LTD

FLYING BY: ROTOR-WORK HELICOPTERS PTY LIMITED SYDNEY
SUPERVISION BY: ANALYTICAL EXPLORATION (AUST) PTY LTD.

SCALE 1:100,000

ELEVATION FACTOR: 0.0599 milligals/ft
DENSITY: 2.65 gm/cc

CONTOUR INTERVAL: 10 milligals
CATUM M.S.L.

SHEET 6

PLATE 11

MURUMBA OIL N.L.
EASTERN OFFICER BASIN
HELICOPTER GRAVITY SURVEY
P.E.L. 10 & 11, South Australia

BOUGUER GRAVITY

EG&G INTERNATIONAL
GEOPHYSICAL ASSOCIATES PTY LTD

FLYING BY: ROTOR-WORK HELICOPTERS PTY LIMITED SYDNEY
SUPERVISION BY: ANALYTICAL EXPLORATION (AUST) PTY LTD.

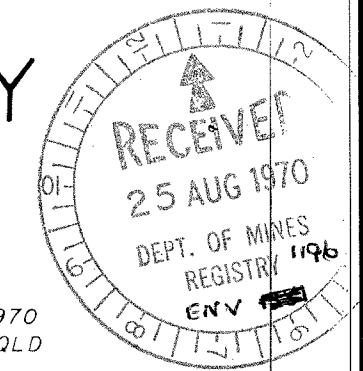
SCALE 1:100,000

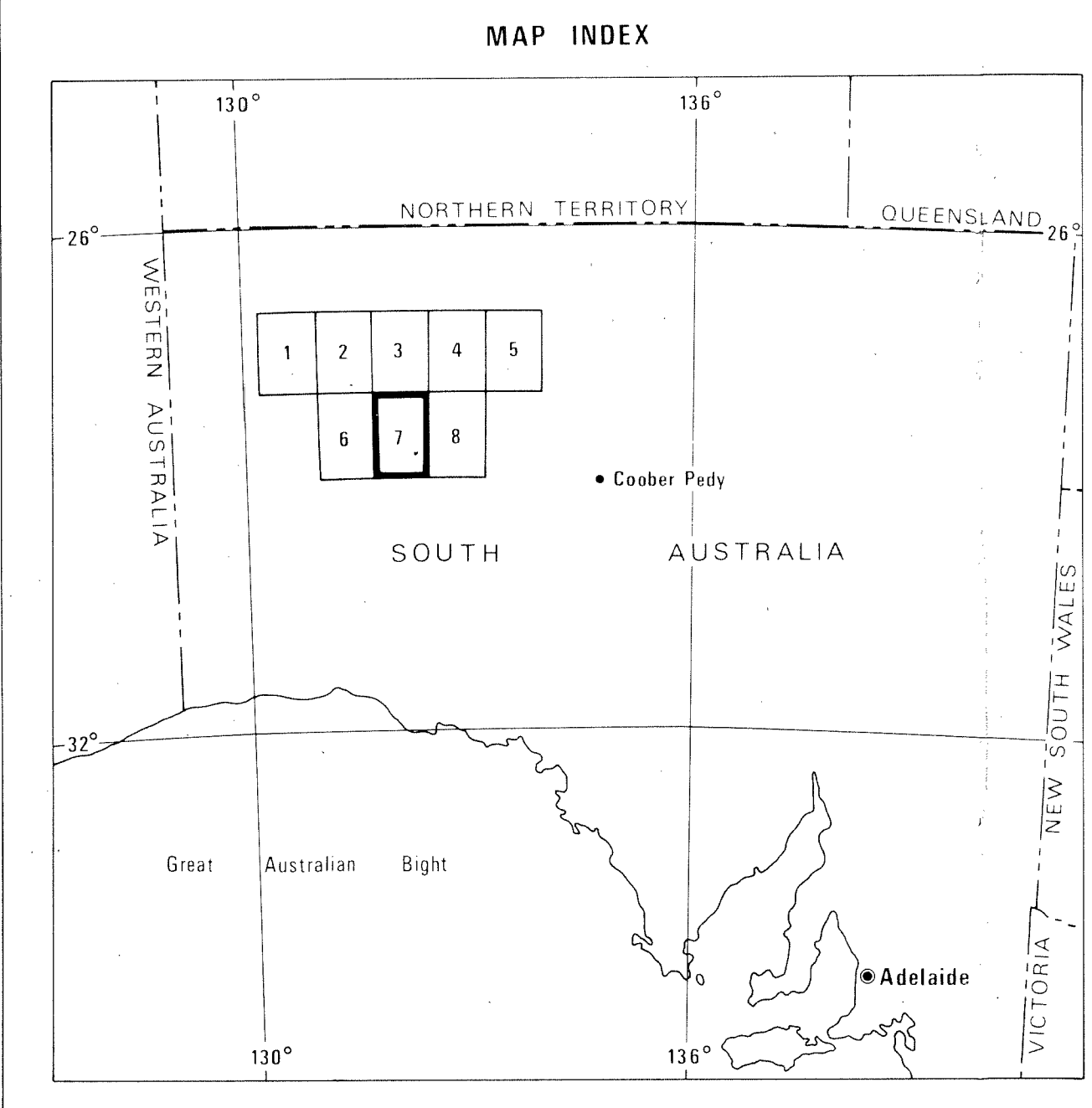
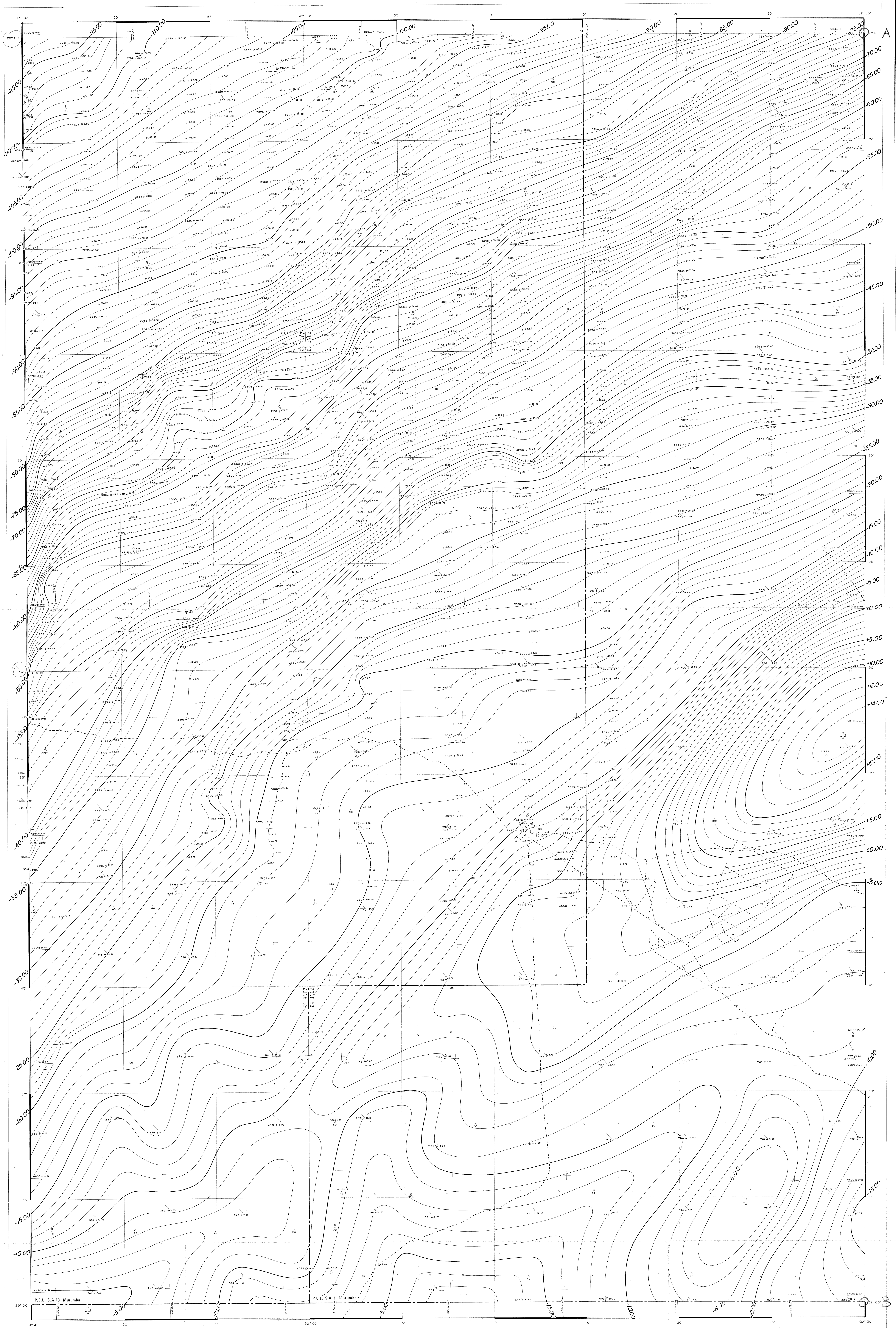
ELEVATION FACTOR: 0.0599 milligals/ft
DENSITY: 2.65 gm/cc

CONTOUR INTERVAL: 10 milligals
CATUM M.S.L.

SHEET 6

PLATE 11





- LEGEND
- Dry and abandoned well
 - △ Major control point
 - Minor control point
 - ⊕ Astronomical control point
 - ⊗ Photo-centre, run number, photo number
 - Petroleum tenement boundary
 - Approximate position of existing roads and tracks (1:250,000 topographic maps)

MURUMBA OIL N.L.
EASTERN OFFICER BASIN
HELICOPTER GRAVITY SURVEY
P.E.L. 10 & 11, South Australia

BOUGUER GRAVITY

EG&G INTERNATIONAL
GEOPHYSICAL ASSOCIATES PTY LTD

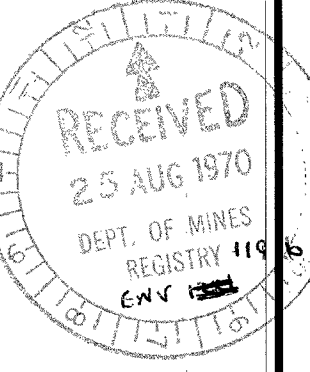
MADE BY: BUTCH-WORK HELICOPTERS PTY LTD
SURVEYED BY: G.A. & J.L. EXPLORATION (AUSTRALIA) PTY LTD

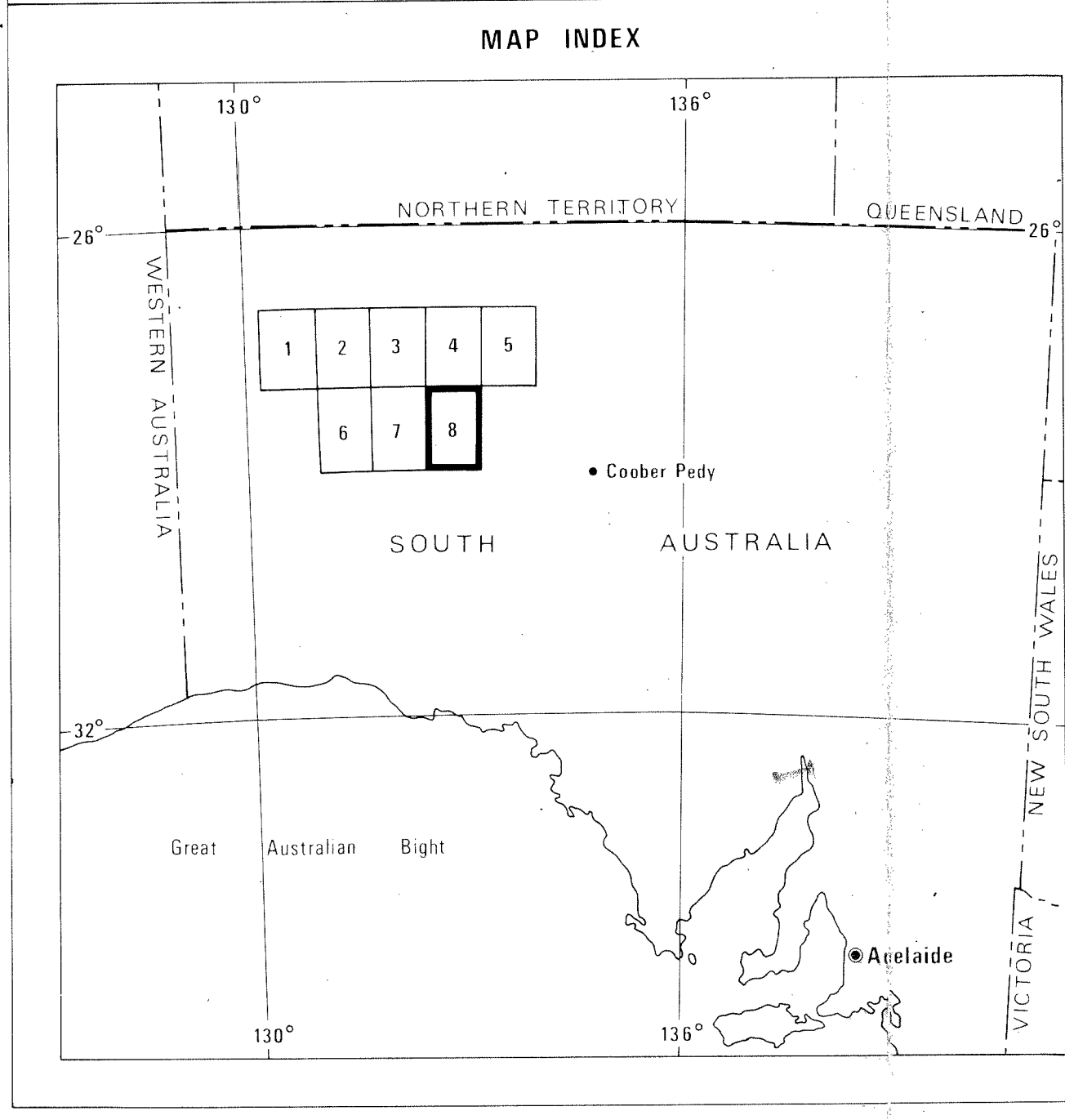
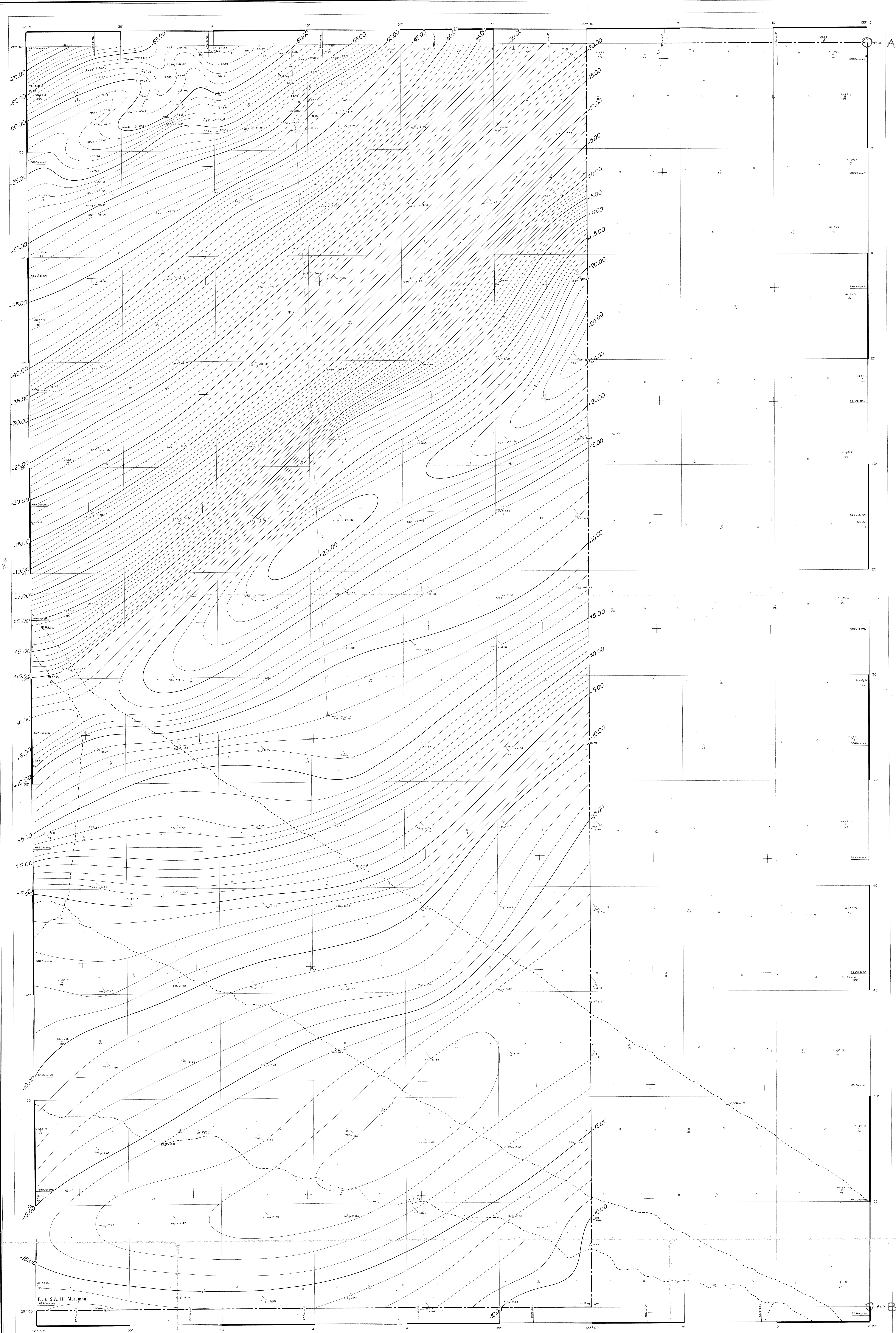
SCALE 1:25,000

ELEVATION: 1000 METERS
DENSITY: 2.67 g/cm³

SHEET 7

PLATE III





- LEGEND
- ✦ Dry and abandoned well
 - Δ Major control point
 - Minor control point
 - ⊕ Astronomical control point
 - ⊙ Photo - centre, run number, photo number
 - Petroleum tenement boundary
 - Approximate position of existing roads and tracks (1:250,000 topographic maps)

MURUMBA OIL N.L.
EASTERN OFFICER BASIN
HELICOPTER GRAVITY SURVEY
P.E.L. 10 & 11. South Australia

BOUGUER GRAVITY

EG&G INTERNATIONAL
GEOPHYSICAL ASSOCIATES PTY LTD

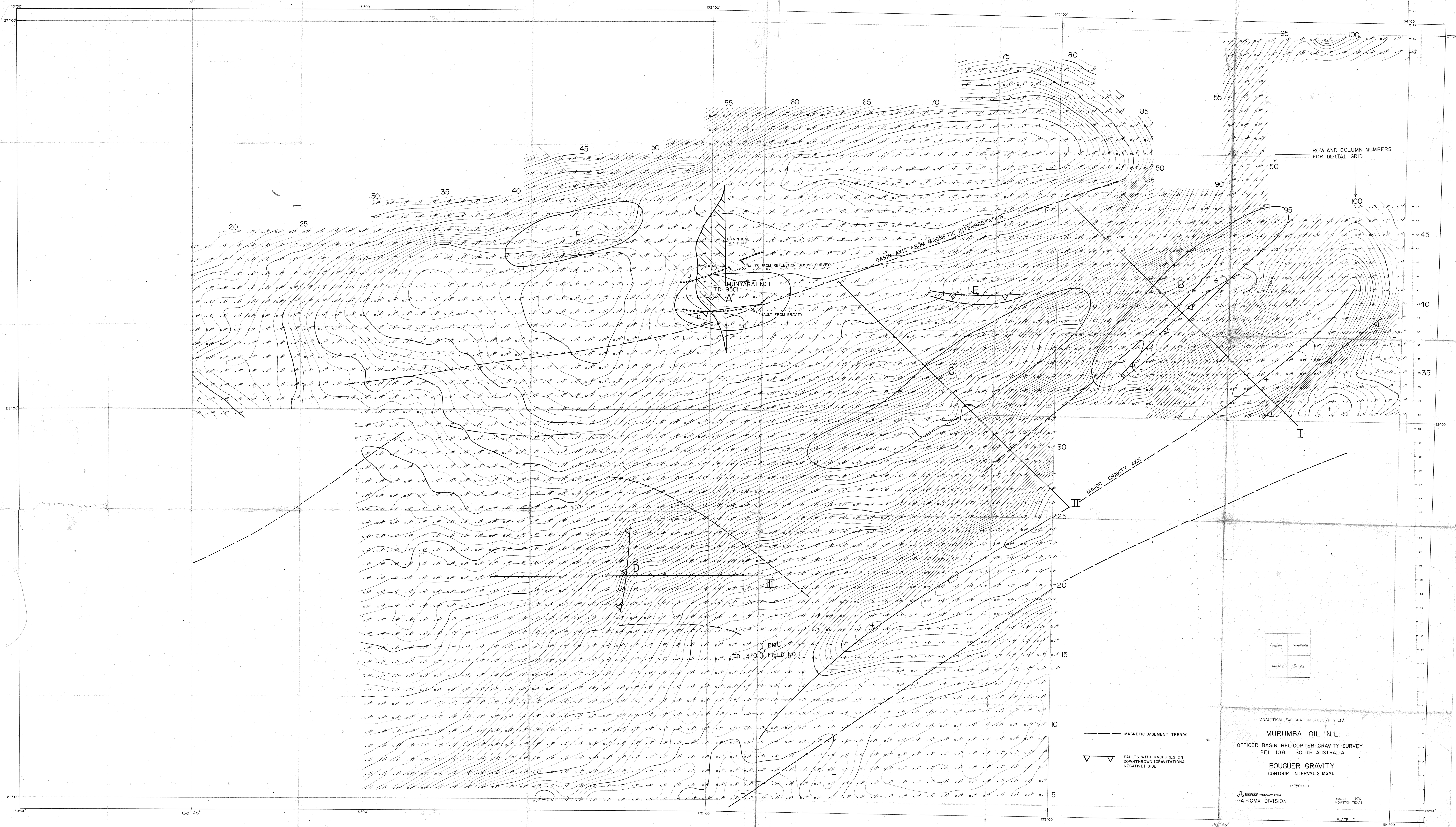
FLYING BY ROTOR-WORK HELICOPTERS PTY LIMITED SYDNEY
SUPERVISION BY ANALYTICAL EXPLORATION (AUST) PTY LTD.
SCALE 1:100,000

ELEVATION FACTOR: 0.06599 milligals/ft CONTOUR INTERVAL: 1.0 milligals
DENSITY: 2.2 gms/cc DATUM: M.S.L.

SHEET 8

PLATE III

1196-15



Legend	Explains
NAMES	CLIPS

ANALYTICAL EXPLORATION (AUSTRALIA) LTD.
MURUMBA OIL N.L.
OFFICER BASIN HELICOPTER GRAVITY SURVEY
PEL 108/11 SOUTH AUSTRALIA
BOUGUER GRAVITY
CONTOUR INTERVAL 2 MGAL
1/250 000
AUGUST 1970
HOUSTON TEXAS
GAI-GMX DIVISION
PLATE 1

130°15'
27°00'

30'

45'

131°00'
27°00'

15'

15'

30'

30'

45'

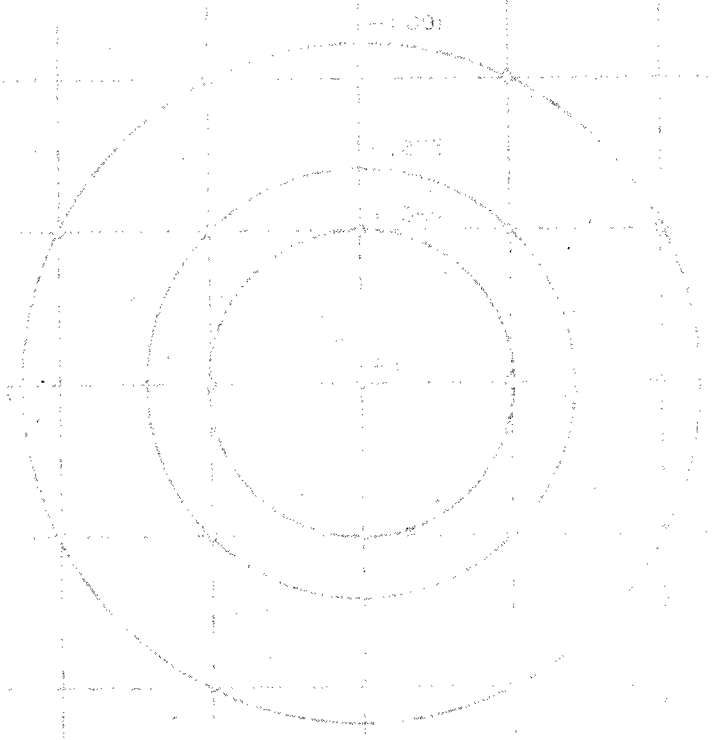
45'

28°00'
130°15'

30'

45'

28°00'
131°00'



GRID RESIDUAL NO. 1

MURUMBA OIL N.L.
EASTERN OFFICER BASIN
HELICOPTER GRAVITY SURVEY
P.E.L. 10 & 11, South Australia

GRID RESIDUAL NO. 1

EG&G INTERNATIONAL
GEOPHYSICAL ASSOCIATES PTY LTD

FLYING BY: ROTOR-WORK HELICOPTERS PTY. LIMITED SYDNEY
SUPERVISION BY: ANALYTICAL EXPLORATION (AUST) PTY. LTD.

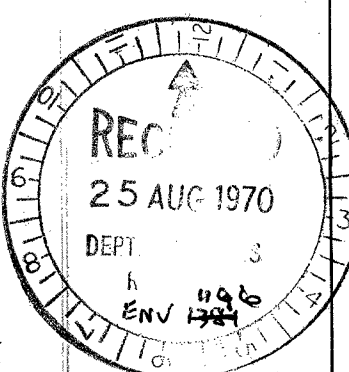
SCALE 1:100,000

ELEVATION FACTOR 0.00599 milligals/m
DENSITY 2.2 gms/cc
CONTOUR INTERVAL 1.0 milligals
ELEVATION 0 S.L.

PLATE IV

ENV. 1196-17

SHEET 1 OF 8



131°00'
27°00'

15'

30'

131°45'
27°00'

15'

15'

30'

30'

45'

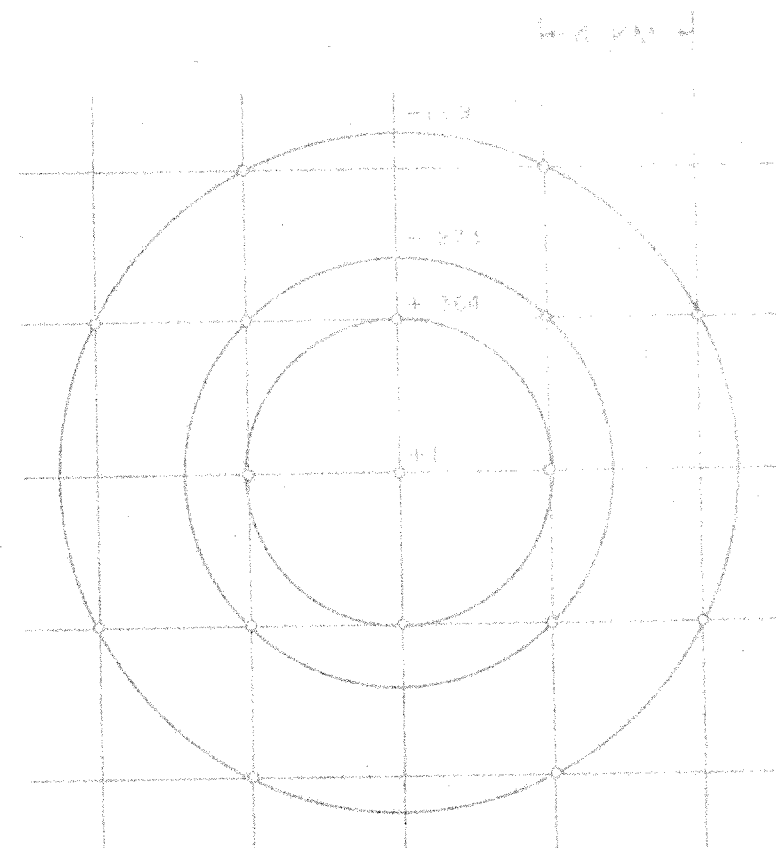
45'

28°00'
131°00'

15'

30'

28°00'
131°45'



GRID RESIDUAL CALCULATION PATTERN
AND WEIGHTING COEFFICIENTS

MURUMBA OIL N.L.
EASTERN OFFICER BASIN
HELICOPTER GRAVITY SURVEY
P.E.L. 10 & 11, South Australia

GRID RESIDUAL NO.1

E G & G INTERNATIONAL
GEOPHYSICAL ASSOCIATES PTY LTD

FLYING BY: ROTOR-WORK HELICOPTERS PTY LIMITED SYDNEY
SUPERVISION BY: ANALYTICAL EXPLORATION (AUST) PTY LTD.

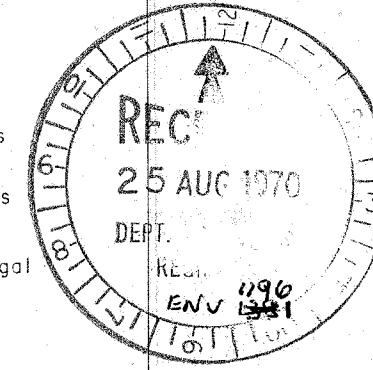
SCALE 1:100,000

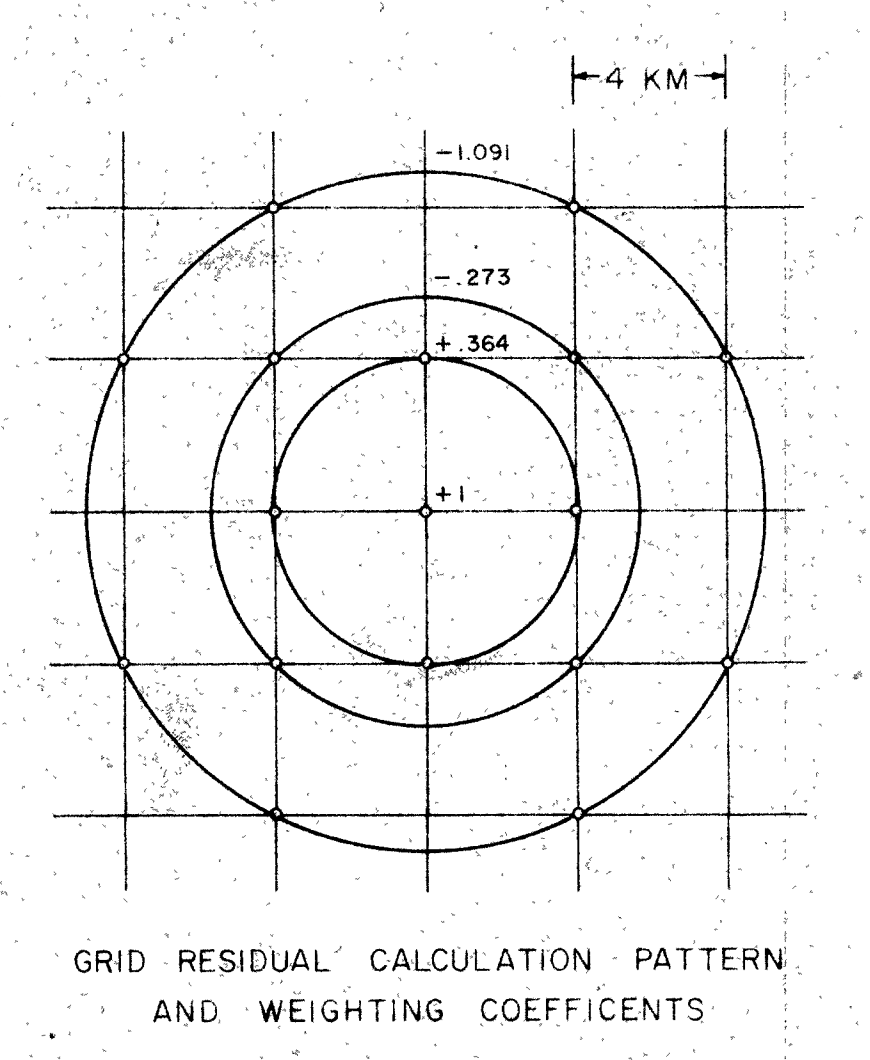
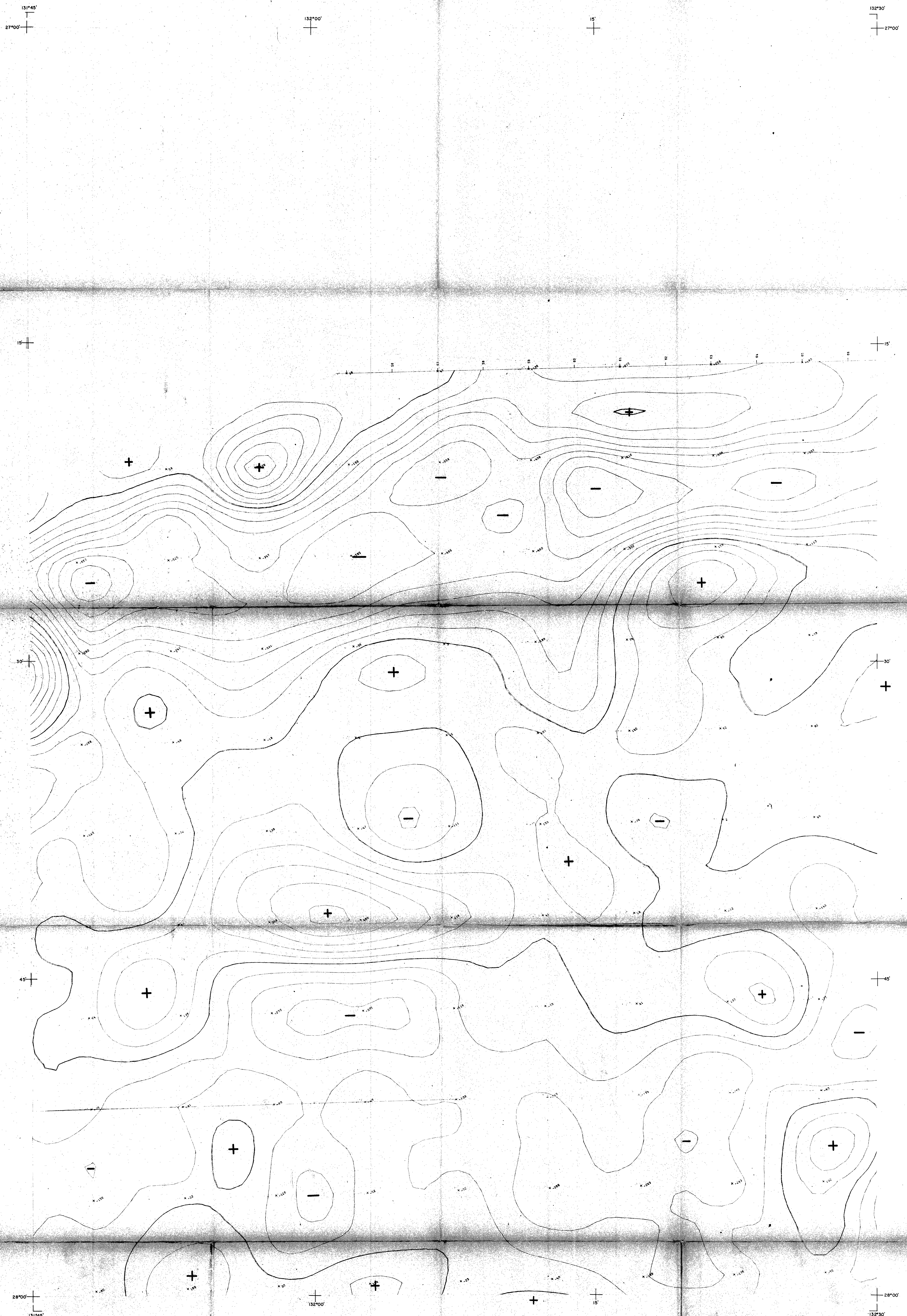
ELEVATION FACTOR: 0.06599 milligals/m
DENSITY: 2.2 gms/cc
CONTOUR INTERVAL: 1.0 milligal
DATUM: M.S.L.

PLATE IV

ENV 1196-18

SHEET 2 OF 8





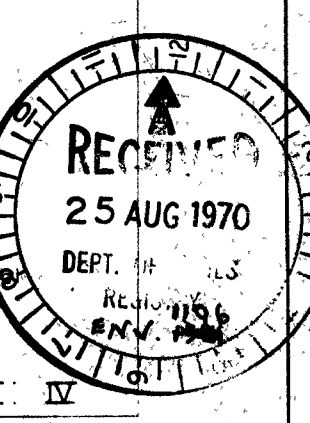
GRID RESIDUAL CALCULATION PATTERN
AND WEIGHTING COEFFICIENTS

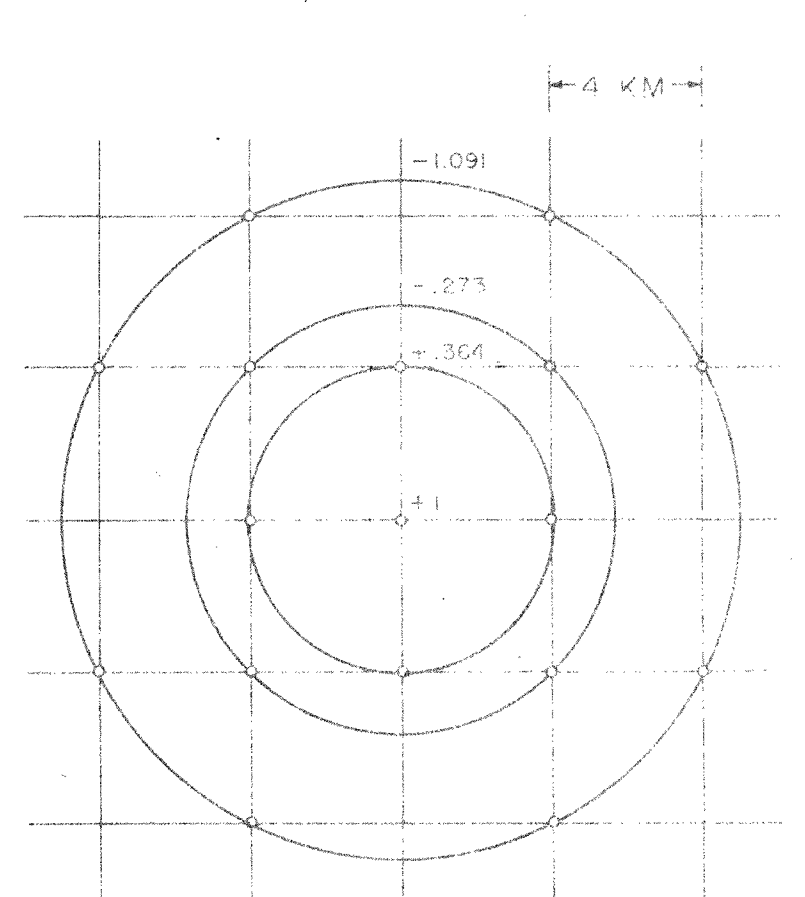
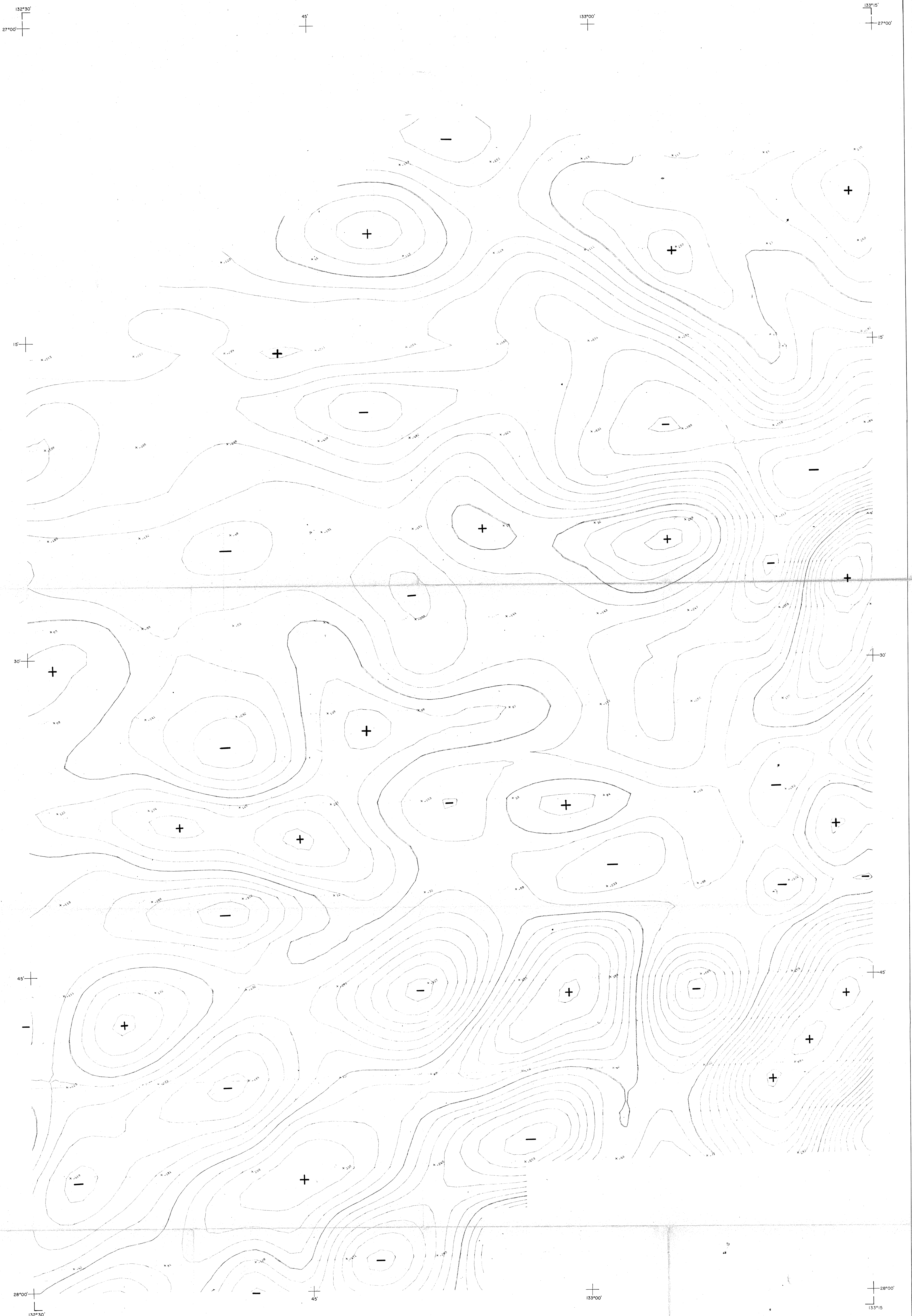
MURUMBA OIL N.L.
EASTERN OFFICER BASIN
HELICOPTER GRAVITY SURVEY
P.E.L. 10 & 11. South Australia

GRID RESIDUAL NO.1

EG&G INTERNATIONAL
GEOPHYSICAL ASSOCIATES PTY LTD

FLYING BY: ROTOR-WORK HELICOPTERS PTY LIMITED SYDNEY
SUPERVISION BY: ANALYTICAL EXPLORATION (AUST) PTY LTD.
SCALE 1:100,000
ELEVATION FACTOR: 0.06559 milligals/ft
DENSITY: 2.2 gms/cc
CONTOUR INTERVAL: 10 milligals
CATUM M.S.L.



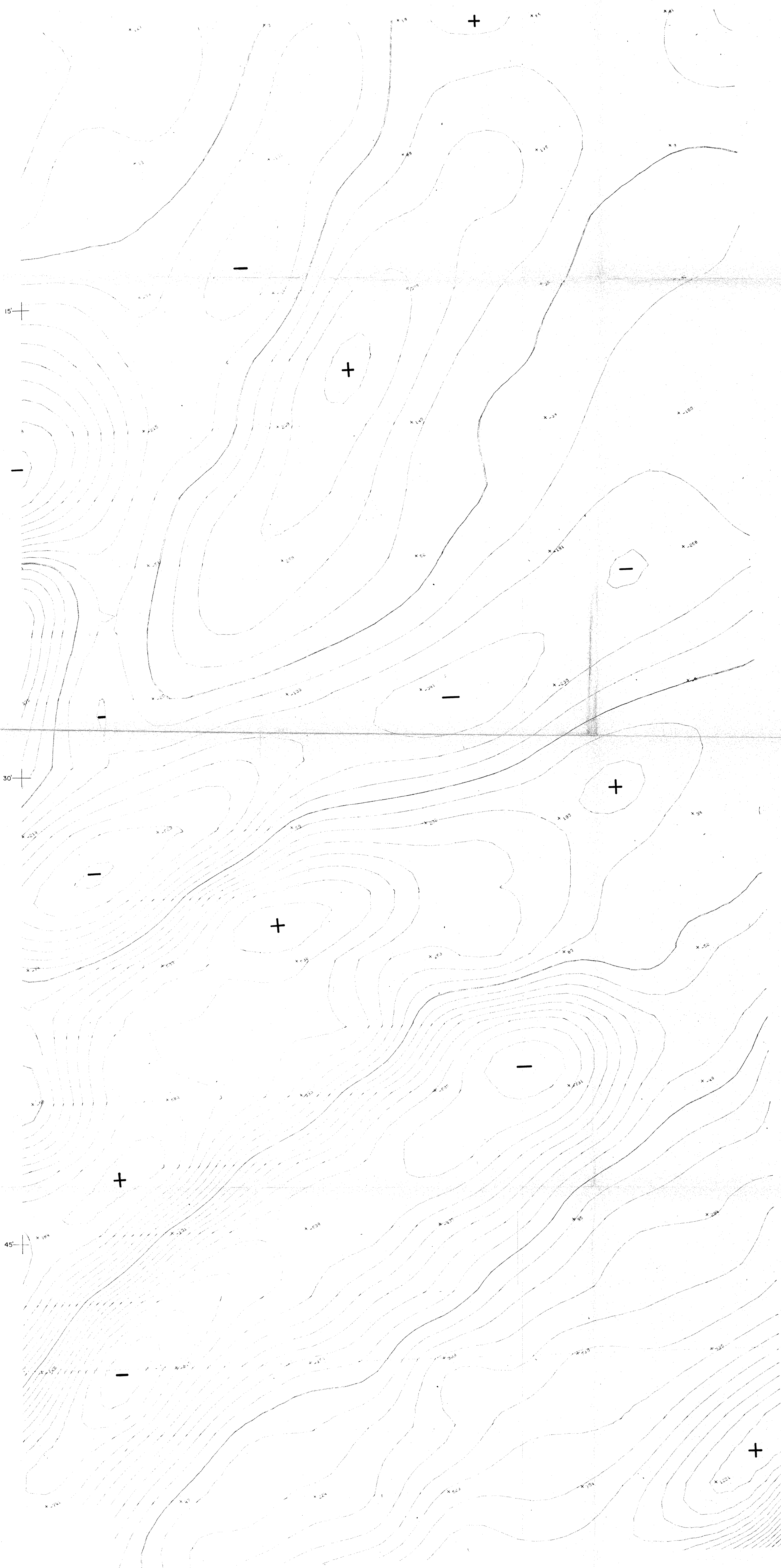


133°15'
27°00'

30'

45'

134°00'
27°00'

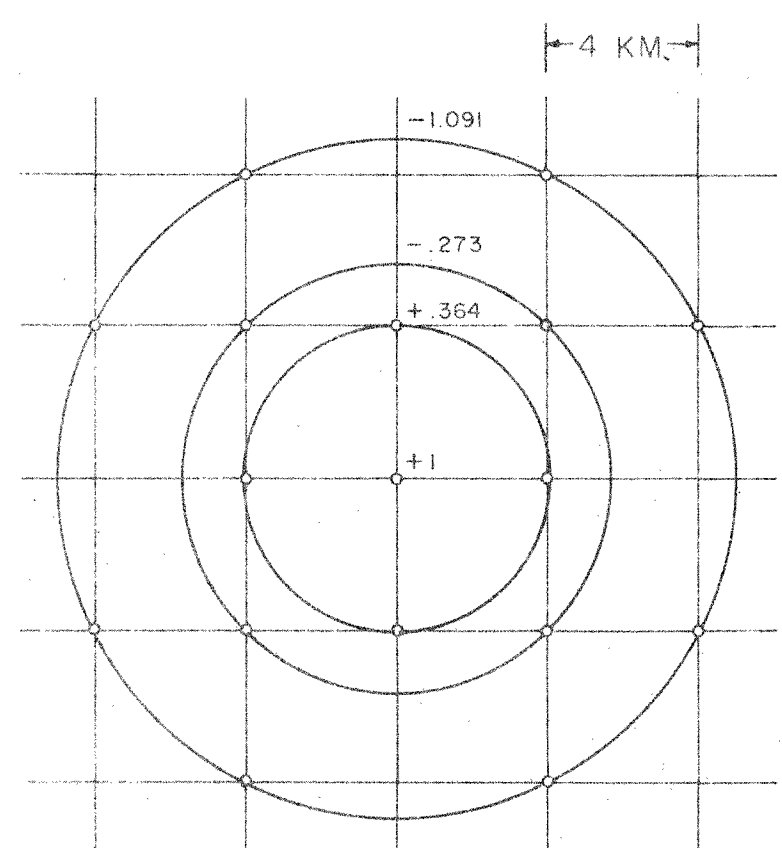


28°00'
133°15'

30'

45'

28°00'
134°00'



GRID RESIDUAL CALCULATION PATTERN
AND WEIGHTING COEFFICIENTS

MURUMBA OIL N.L.
EASTERN OFFICER BASIN
HELICOPTER GRAVITY SURVEY
P.E.L. 10 & 11, South Australia

GRID RESIDUAL NO.1

EG&G INTERNATIONAL
GEOPHYSICAL ASSOCIATES PTY LTD

FLYING BY: ROTOR-WORK HELICOPTERS PTY LIMITED SYDNEY
SUPERVISION BY: ANALYTICAL EXPLORATION (AUST) PTY LTD.

SCALE 1:100,000

2 0 2 4 6 8 10 Kilometres
2 0 2 4 6 8 10 Miles

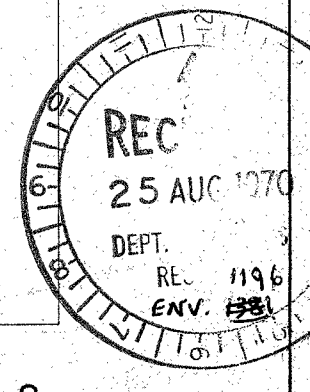
ELEVATION FACTOR: 0.06599 milligals/ft
DENSITY: 2.2 gms/cc

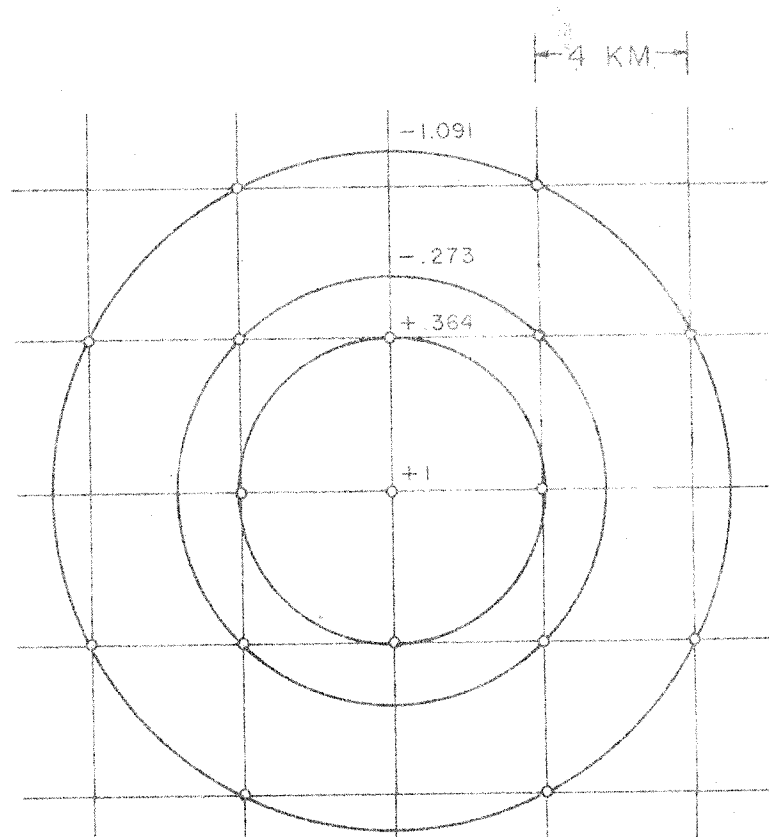
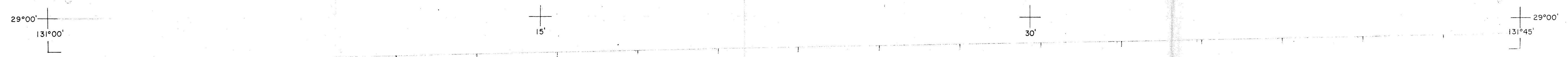
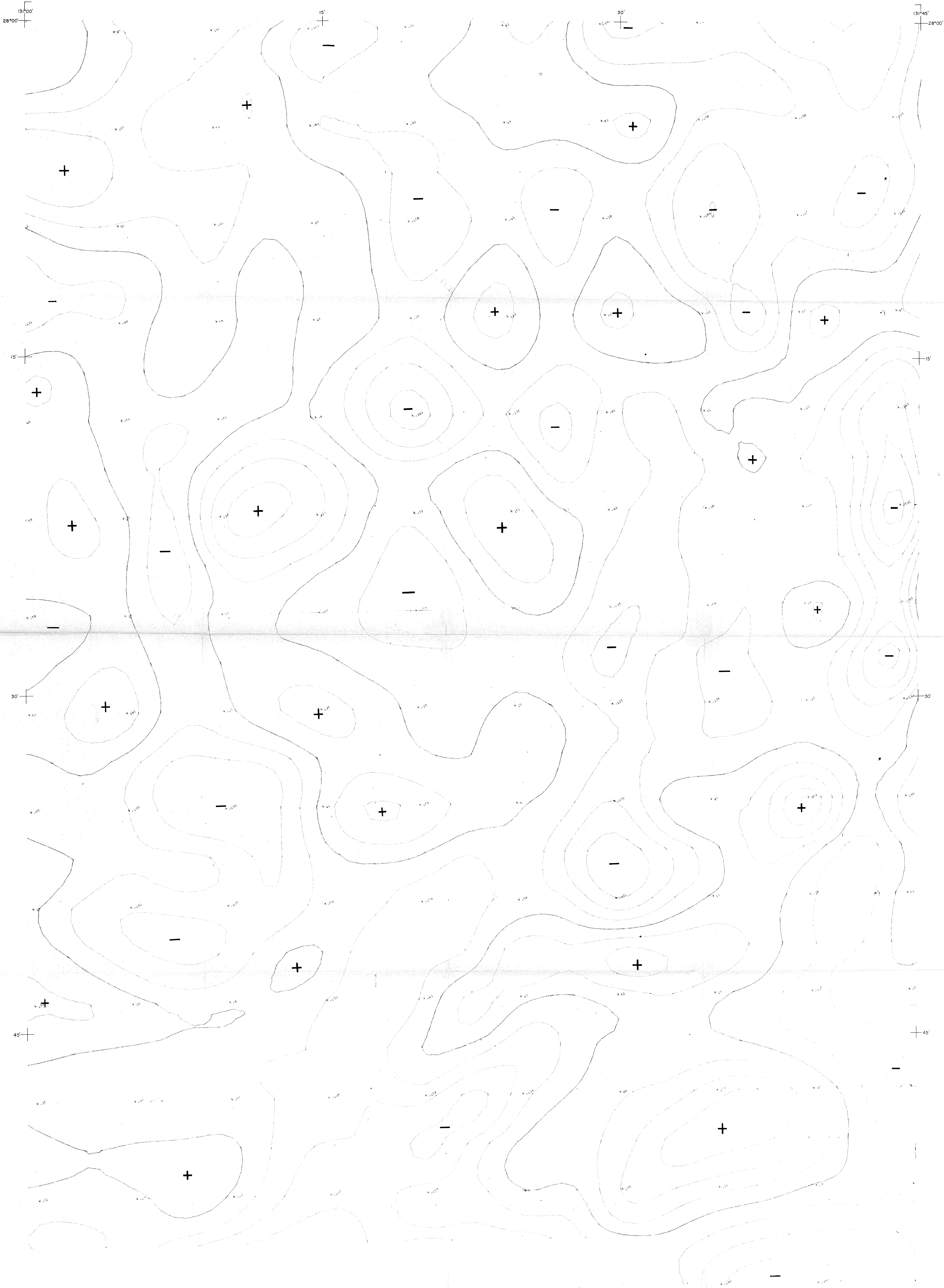
CONTOUR INTERVAL: 1.0 milligal
DATUM: M.S.L.

PLATE IV

ENV. 1196-21

SHEET 5 OF 8





GRID RESIDUAL CALCULATION PATTERN
AND WEIGHTING COEFFICIENTS

MURUMBA OIL N.L.
EASTERN OFFICER BASIN
HELICOPTER GRAVITY SURVEY
P.E.L. 10 & 11. South Australia

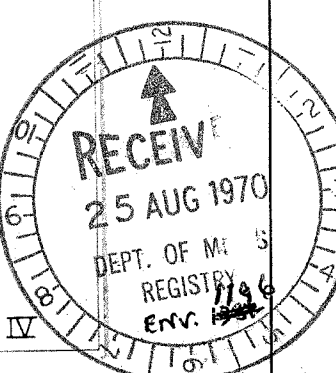
GRID RESIDUAL NO.1

EG&G INTERNATIONAL
GEOPHYSICAL ASSOCIATES PTY LTD

FLYING BY: ROTOR-WORK HELICOPTERS PTY LIMITED SYDNEY
SUPERVISION BY: ANALYTICAL EXPLORATION (AUST) PTY LTD.

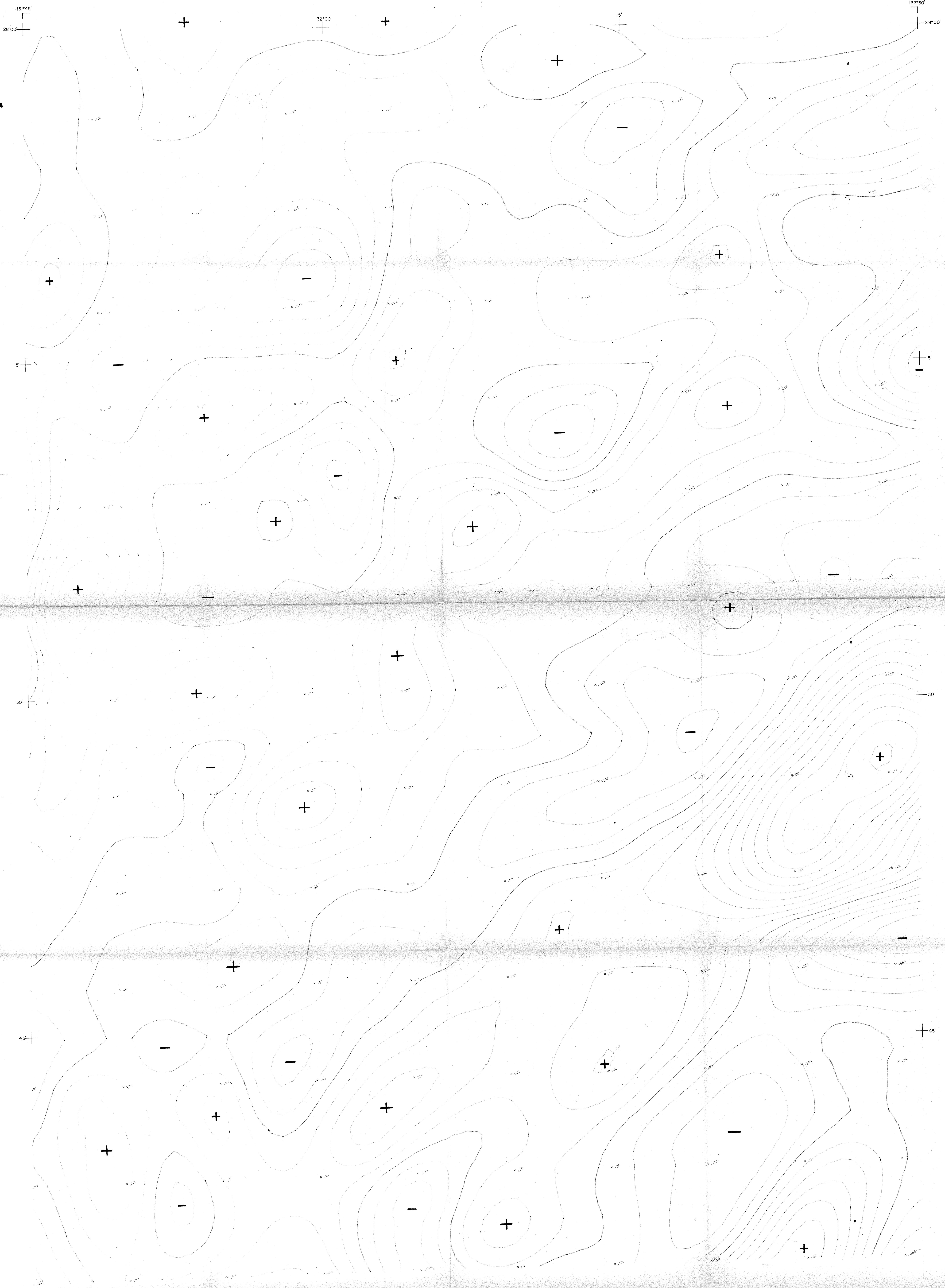
SCALE 1:100,000

ELEVATION FACTOR 0.06599 mgals/m
CONTOUR INTERVAL 10 mgals
DENSITY 2.2 gm/cc
DATUM M.S.L.

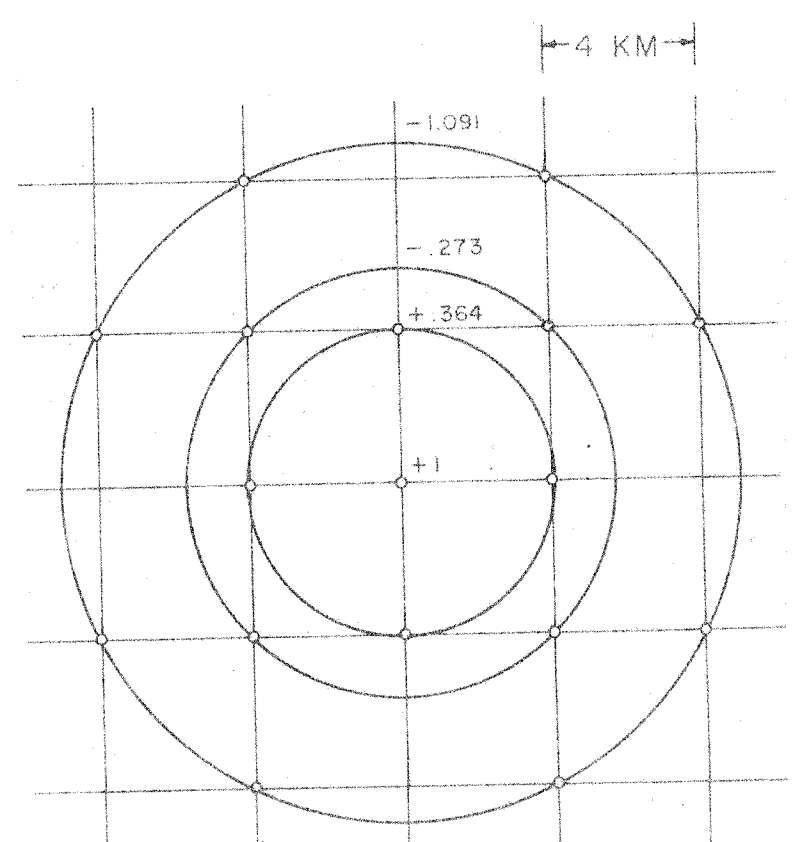


ENVU. 1196-22

SHEET 6 OF 8



29°00' 131°45' 132°00' 15' 29°00' 132°30'



GRID RESIDUAL CALCULATION PATTERN AND WEIGHTING COEFFICIENTS

MURUMBA OIL N.L.
EASTERN OFFICER BASIN
HELICOPTER GRAVITY SURVEY
P.E.L. 10 & 11. South Australia

GRID RESIDUAL NO.1

EG&G INTERNATIONAL AUGUST 1970
GEOPHYSICAL ASSOCIATES PTY LTD BRISBANE QLD

FLYING BY: ROTOR-WORK HELICOPTERS PTY LIMITED SYDNEY
SUPERVISION BY: ANALYTICAL EXPLORATION (AUST) PTY LTD.

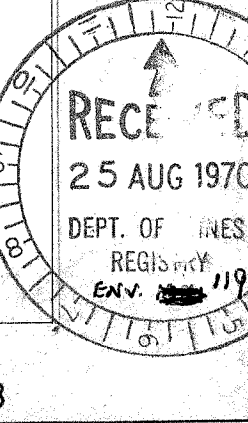
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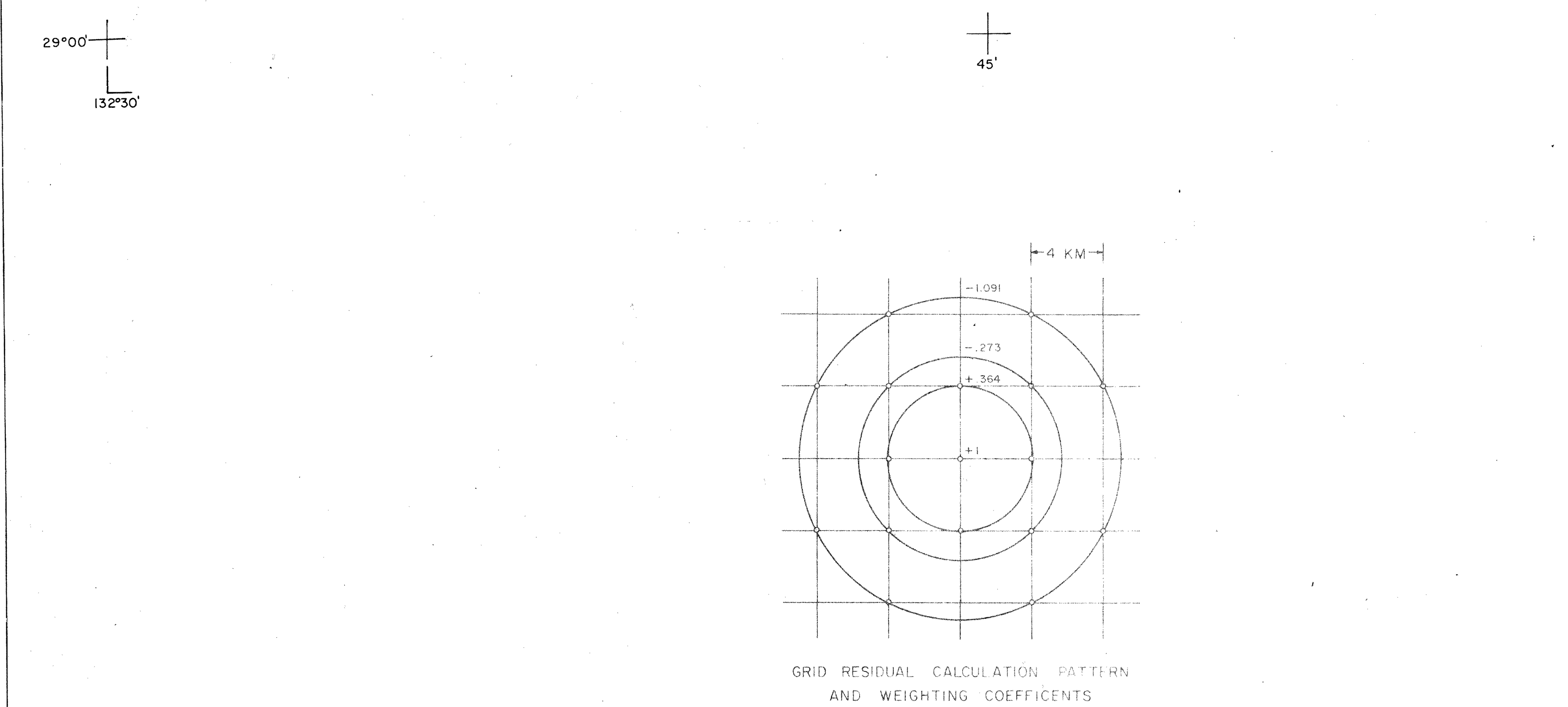
ELEVATION FACTOR: 0.06599 milligals/m
DENSITY: 2.2 gms/cc CONTOUR INTERVAL: 1.0 milligal
SATUM M.S.L.

PLATE IV

ENV. 1196-23

SHEET 7 OF 8





SHEET 8 OF 8

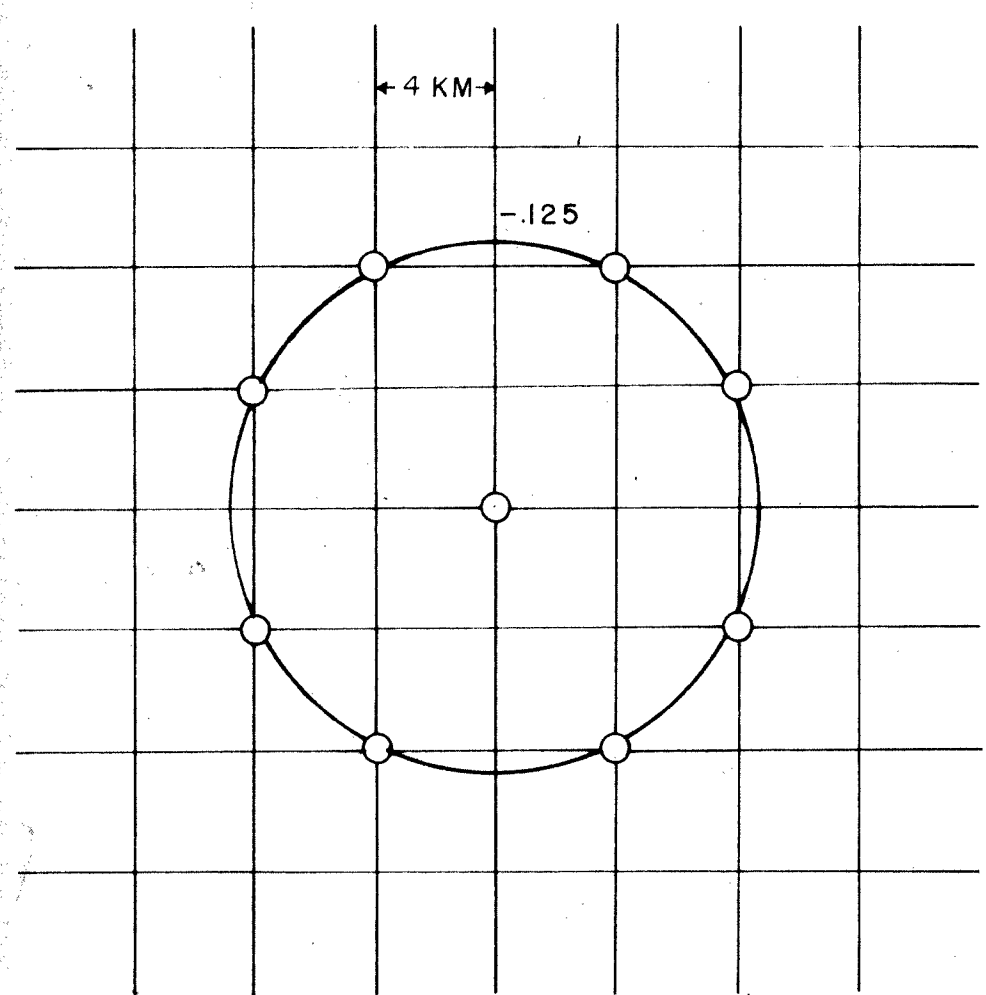
130°15' 27°00' 30' 45' 131°00' 27°00'

15' 15'

30' 30'

45' 45'

28°00' 130°15' 30' 45' 28°00' 131°00'



GRID RESIDUAL CALCULATION PATTERN
AND WEIGHTING COEFFICIENT

MURUMBA OIL N.L.
EASTERN OFFICER BASIN
HELICOPTER GRAVITY SURVEY
P.E.L. 10 & 11. South Australia

GRID RESIDUAL NO.3

EG&G INTERNATIONAL
GEOPHYSICAL ASSOCIATES PTY LTD

FLYING BY: ROTOR-WORK HELICOPTERS PTY LIMITED SYDNEY
SUPERVISION BY: ANALYTICAL EXPLORATION (AUST) PTY LTD

SCALE 1:100,000

ELEVATION FACTOR: 0.06599 milligals/ft
DENSITY: 2 gms/cc

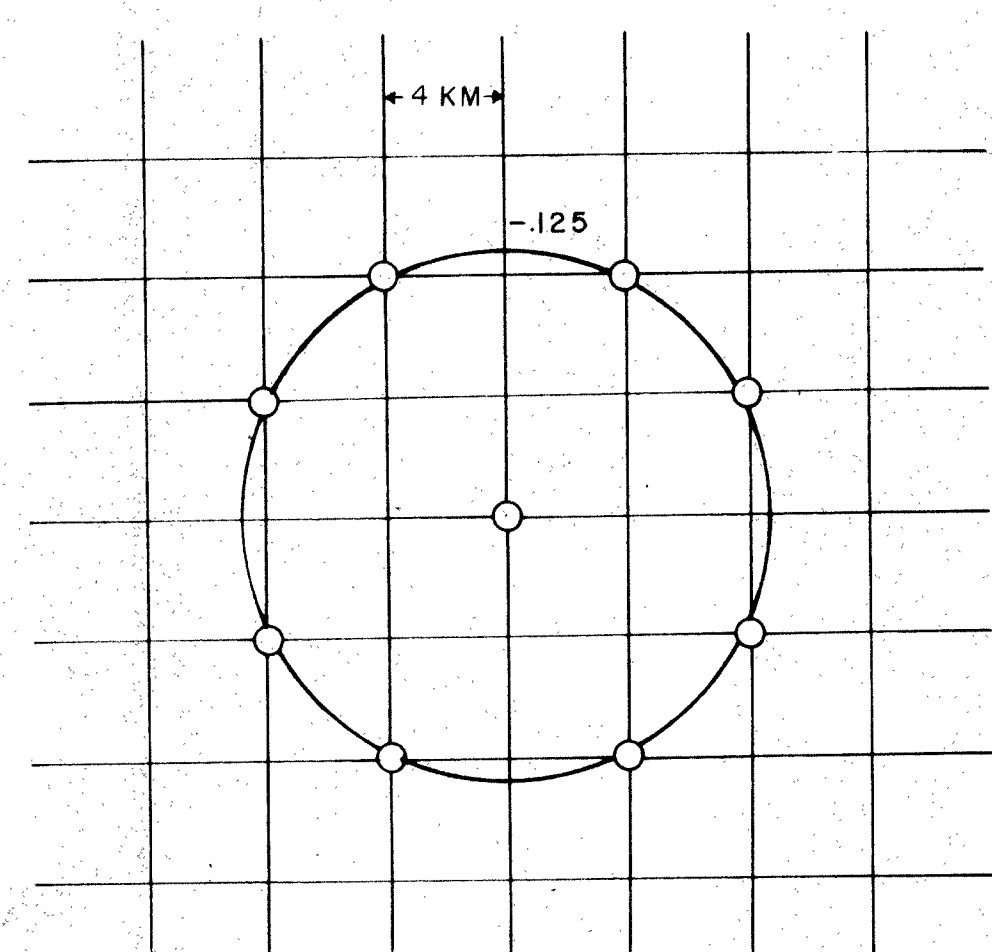
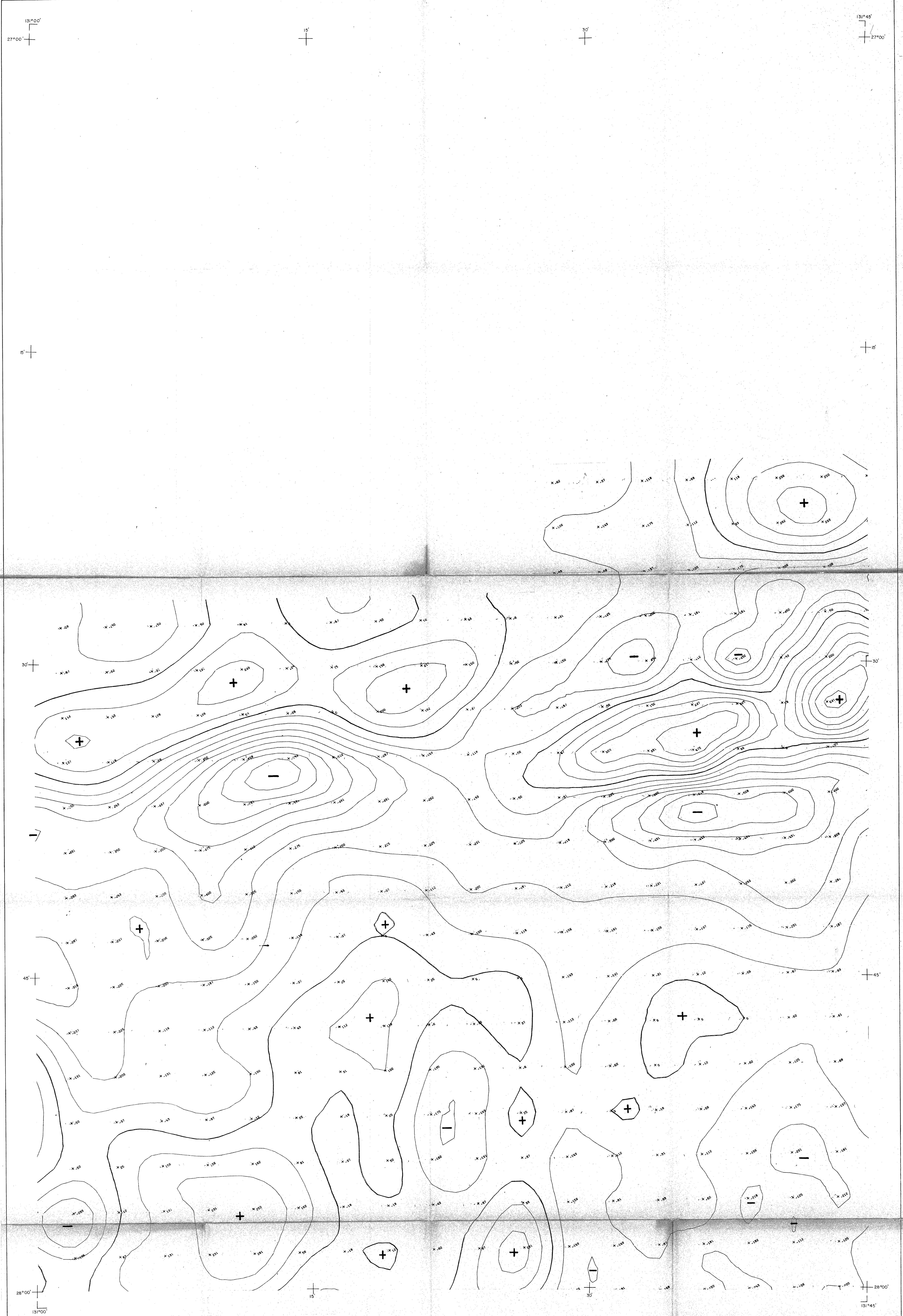
CONTOUR INTERVAL: 1.0 milligal
DATUM: M.S.L.

2 0 2 4 6 8 10 Kilometres
2 0 2 4 6 8 10 Miles

ENV. 1196-25

PLATE
25 AUG 1970
RECEIVED
DEPT. OF MINES
REGISTERED
ENV.

SHEET 1 OF 8



GRID RESIDUAL CALCULATION PATTERN
AND WEIGHTING COEFFICIENT

MURUMBA OIL N.L.
EASTERN OFFICER BASIN
HELICOPTER GRAVITY SURVEY
P.E.L. 10 & 11. South Australia

GRID RESIDUAL NO.3

EG&G INTERNATIONAL

AUGUST 1970
BRISBANE QLD

FLYING BY: ROTOR-WORK HELICOPTERS PTY. LIMITED SYDNEY
SUPERVISION BY: ANALYTICAL EXPLORATION (AUST) PTY. LTD.

SCALE 1:100,000

2 0 2 4 6 8 10 Kilometres

ELEVATION FACTOR: 0.06599 milligals/m
DENSITY: 2.2 gms/cc

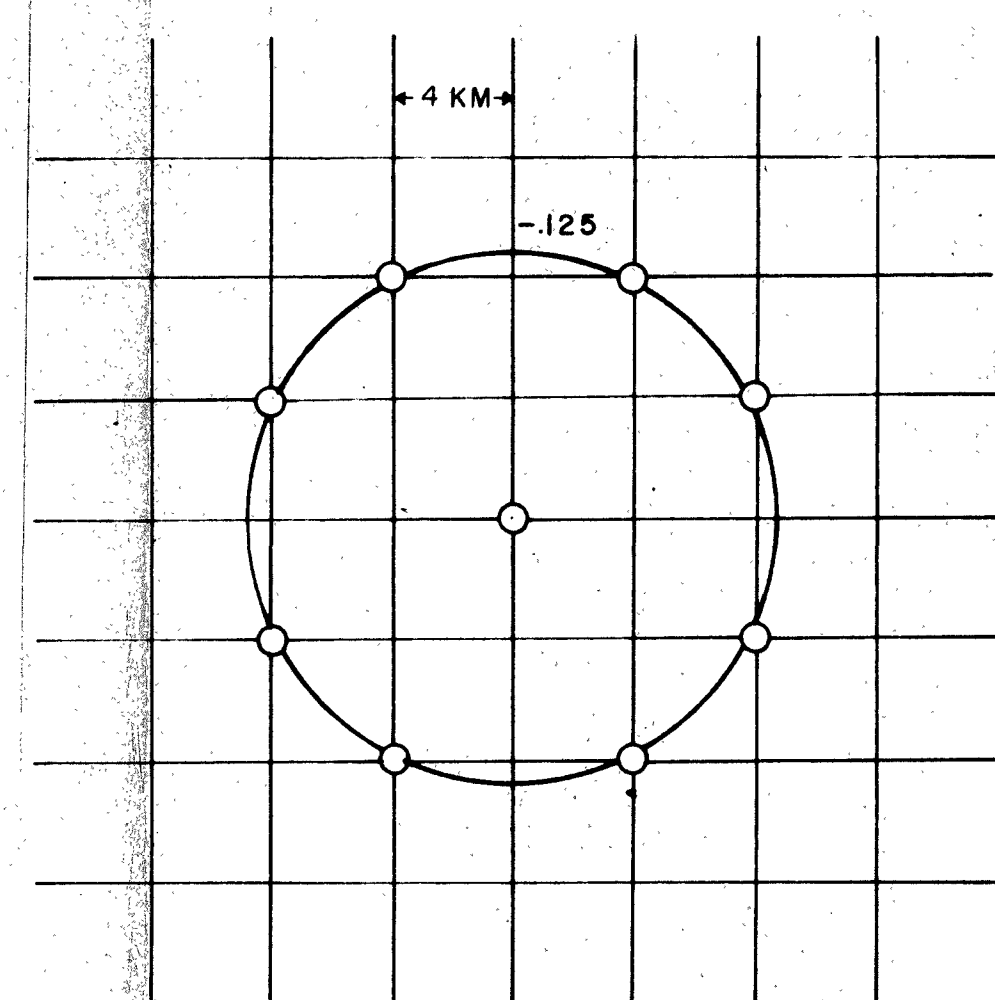
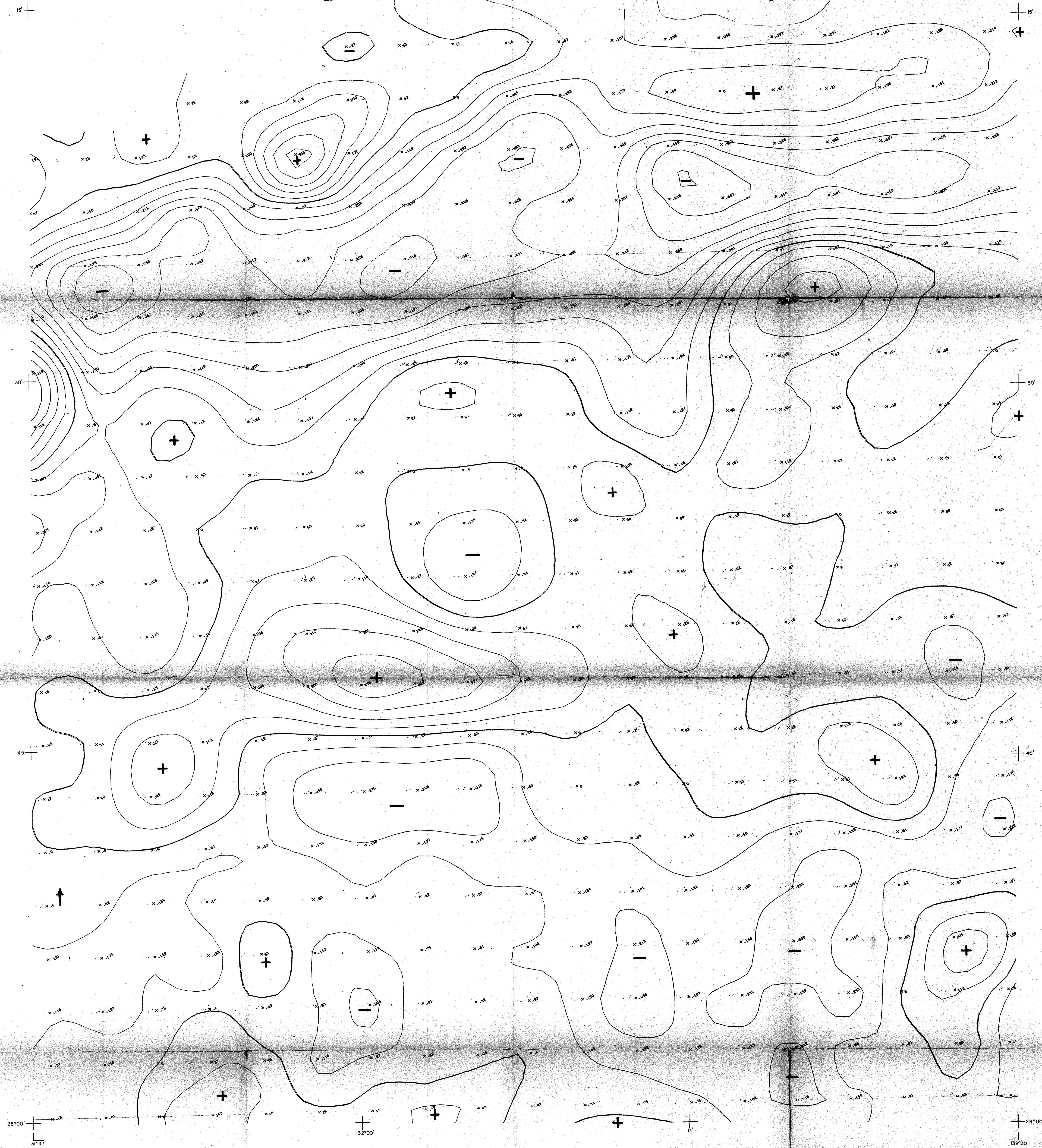
CONTOUR INTERVAL: 1.0 mgals
DATUM: M.S.L.

PLATE: 101 OF 100
RECEIVED
25 AUG 1970
GEO. DIV.
DEPT. OF MINES
SOUTH AUSTRALIA

ENW. 1196-26

SHEET 2 OF 8

131°45' 27°00' 132°00' 15' 132°30' 27°00'



GRID RESIDUAL CALCULATION PATTERN
AND WEIGHTING COEFFICIENT

MURUMBA OIL N.L.
EASTERN OFFICER BASIN
HELICOPTER GRAVITY SURVEY
P.E.L. 10 & 11. South Australia

GRID RESIDUAL NO.3

EG&G INTERNATIONAL
GEOPHYSICAL ASSOCIATES PTY LTD

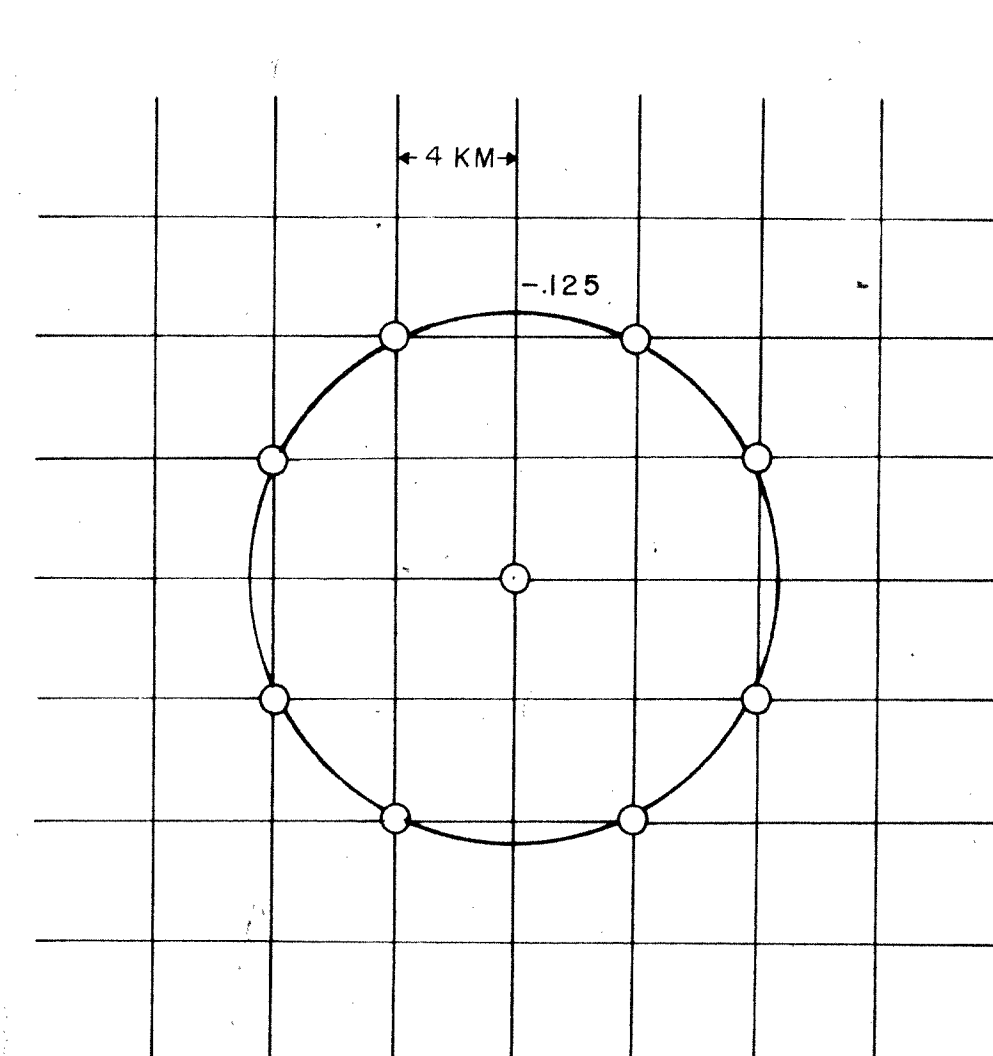
FLYING BY: ROTOR-WORK HELICOPTERS PTY. LIMITED SYDNEY
SUPERVISION BY: ANALYTICAL EXPLORATION (AUST.) PTY. LTD.
SCALE 1:100,000

ELEVATION FACTOR: 0.06599 milligals/ft.
DENSITY: 2.2 gms/cc
CONTOUR INTERVAL: 10
DATUM: M.S.L.

ENR 1196-27

SHEET 3 OF 8





GRID RESIDUAL CALCULATION PATTERN
AND WEIGHTING COEFFICIENT

MURUMBA OIL N.L.
EASTERN OFFICER BASIN
HELICOPTER GRAVITY SURVEY
P.E.L. 10 & 11, South Australia

GRID RESIDUAL NO.3

EG&G INTERNATIONAL
GEOPHYSICAL ASSOCIATES PTY LTD

FLYING BY: ROTOR-WORK HELICOPTERS PTY LIMITED SYDNEY
SUPERVISION BY: ANALYTICAL EXPLORATION (AUST) PTY LTD.
SCALE 1:100,000

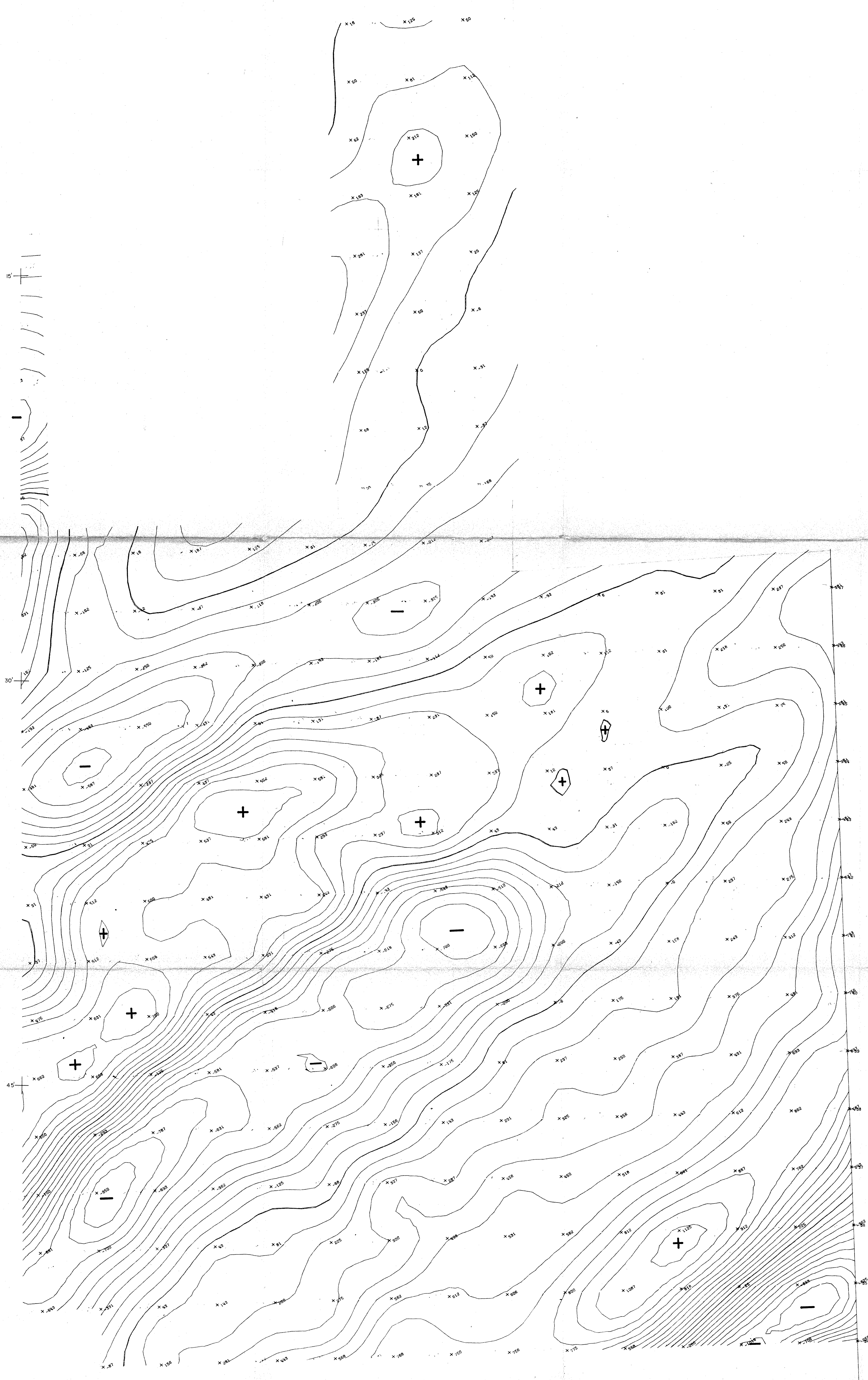
ELEVATION FACTOR: 0.06589 milligals/m
DENSITY: 2.2 gms/cc
CONTOUR INTERVAL: 10 m
DATUM: M.S.L.

ENV. 1196-28

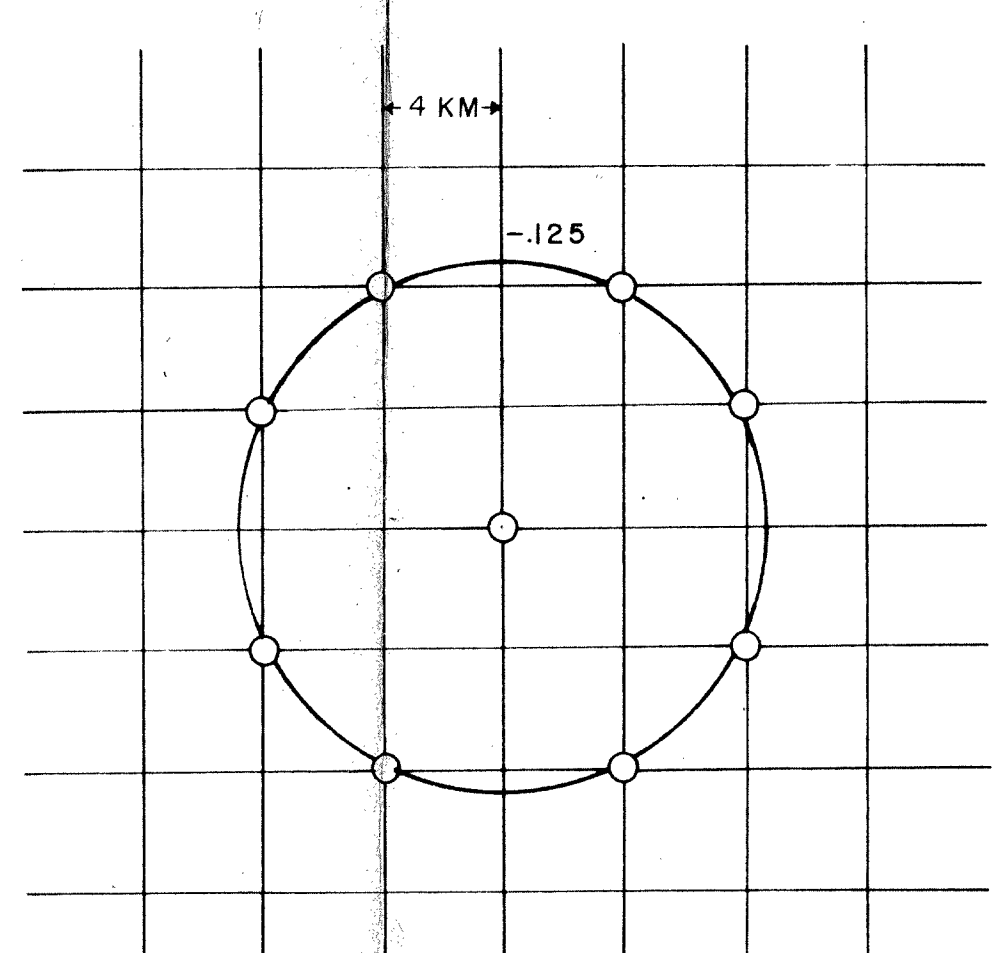
RECEIVED
25 AUG 1970
DEPT. OF N.
RESOURCES
CIVIL ENGINEERING

PLATE
SHEET 4 OF 8

133°15' 27°00' 30' 45' 134°00' 27°00'



28°00' 133°15' 30' 45' 28°00' 134°00'



GRID RESIDUAL CALCULATION PATTERN AND WEIGHTING COEFFICIENT

MURUMBA OIL N.L.
EASTERN OFFICER BASIN
HELICOPTER GRAVITY SURVEY
P.E.L. 10 & 11, South Australia

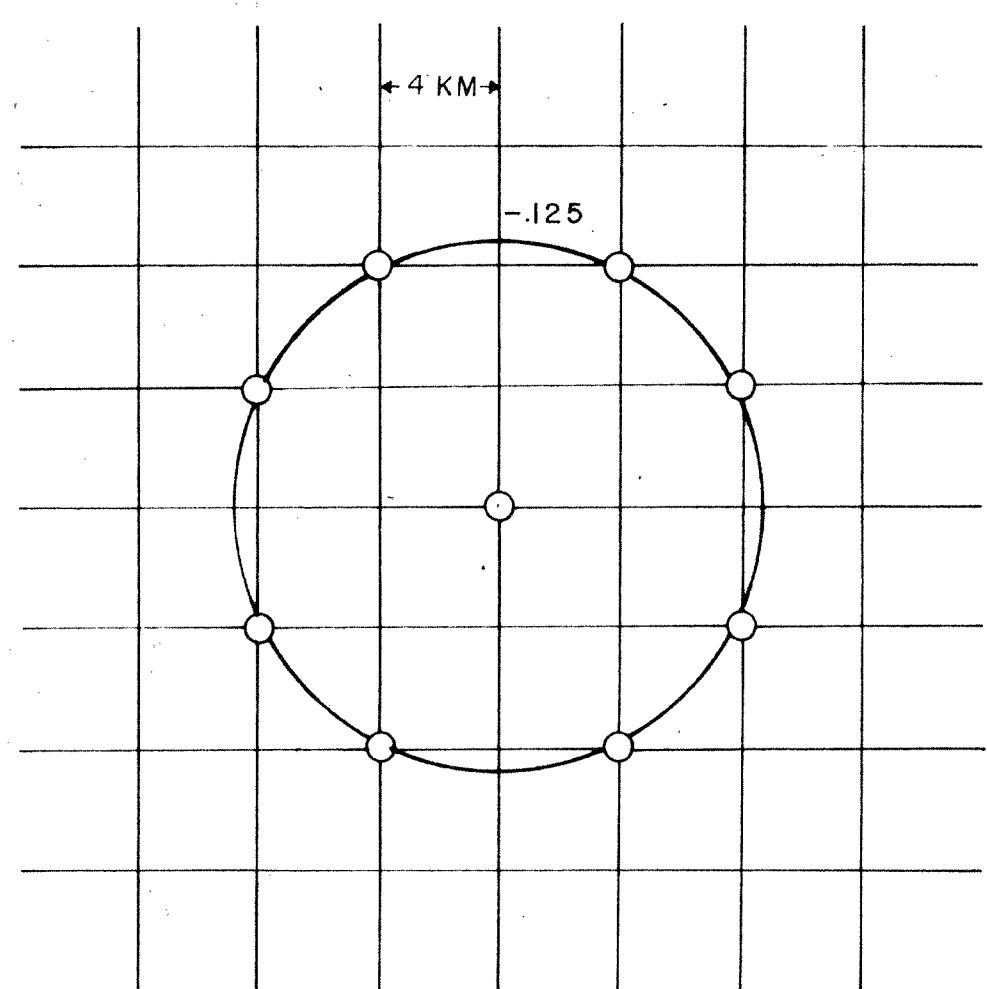
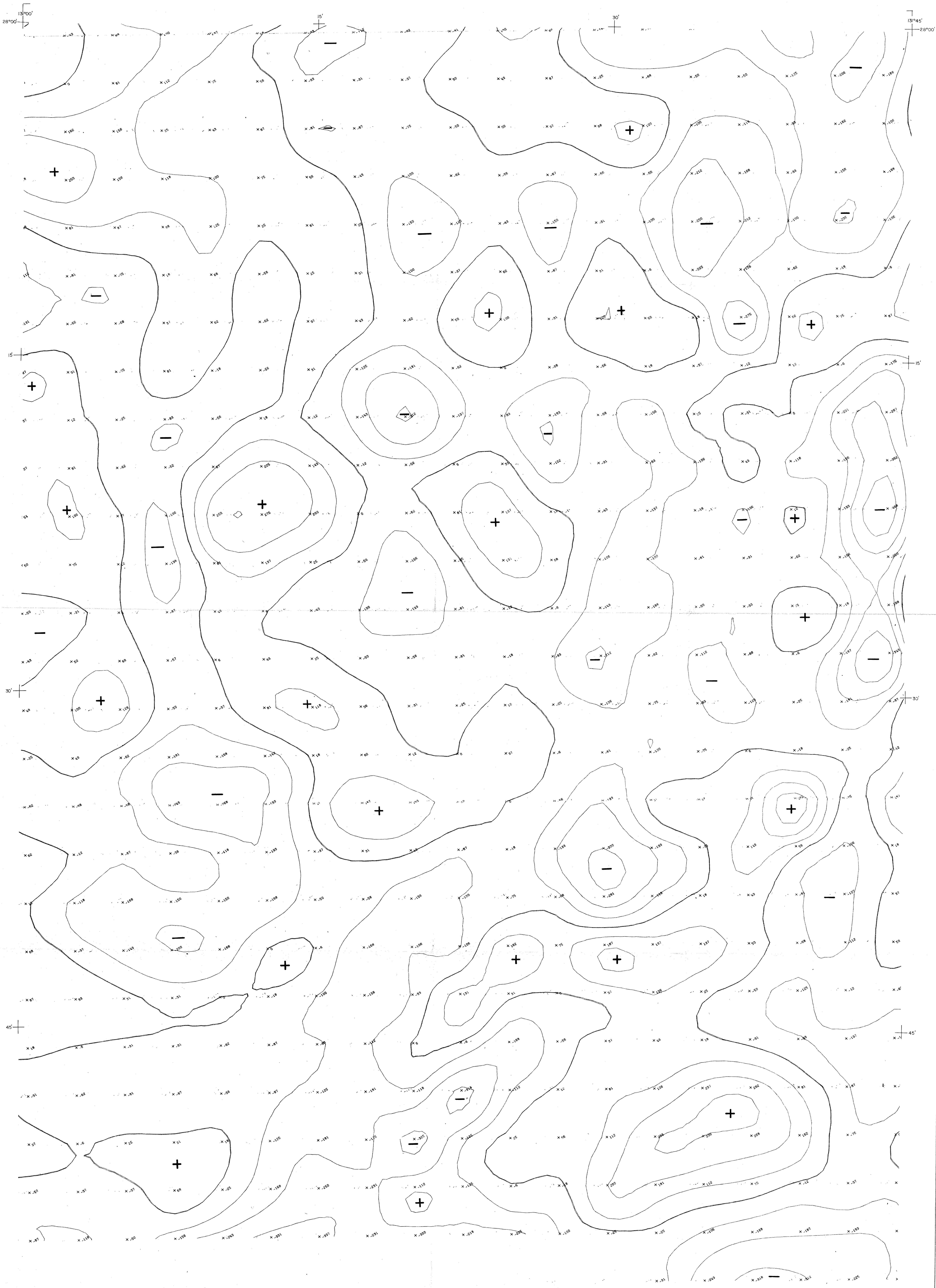
GRID RESIDUAL NO.3

E G & G INTERNATIONAL
GEOPHYSICAL ASSOCIATES PTY LTD

FLYING BY: ROTOR-WORK HELICOPTERS PTY LIMITED SYDNEY
SUPERVISION BY: ANALYTICAL EXPLORATION (AUST) PTY LTD.
SCALE 1:100,000

ELEVATION FACTOR: 0.06599 milligals/ft
DENSITY: 2.2 gms/cc
CONTOUR INTERVAL: 10 m
DATUM: M.S.L.

ENV. 1196-29



GRID RESIDUAL CALCULATION PATTERN
AND WEIGHTING COEFFICIENT

MURUMBA OIL N.L.
EASTERN OFFICER BASIN
HELICOPTER GRAVITY SURVEY
P.E.L. 10 & 11. South Australia

GRID RESIDUAL NO.3

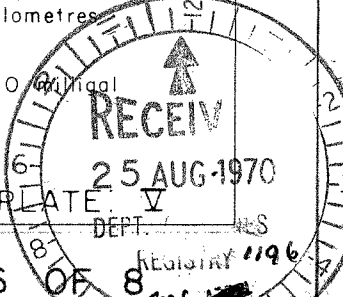
EG&G INTERNATIONAL
GEOPHYSICAL ASSOCIATES PTY LTD

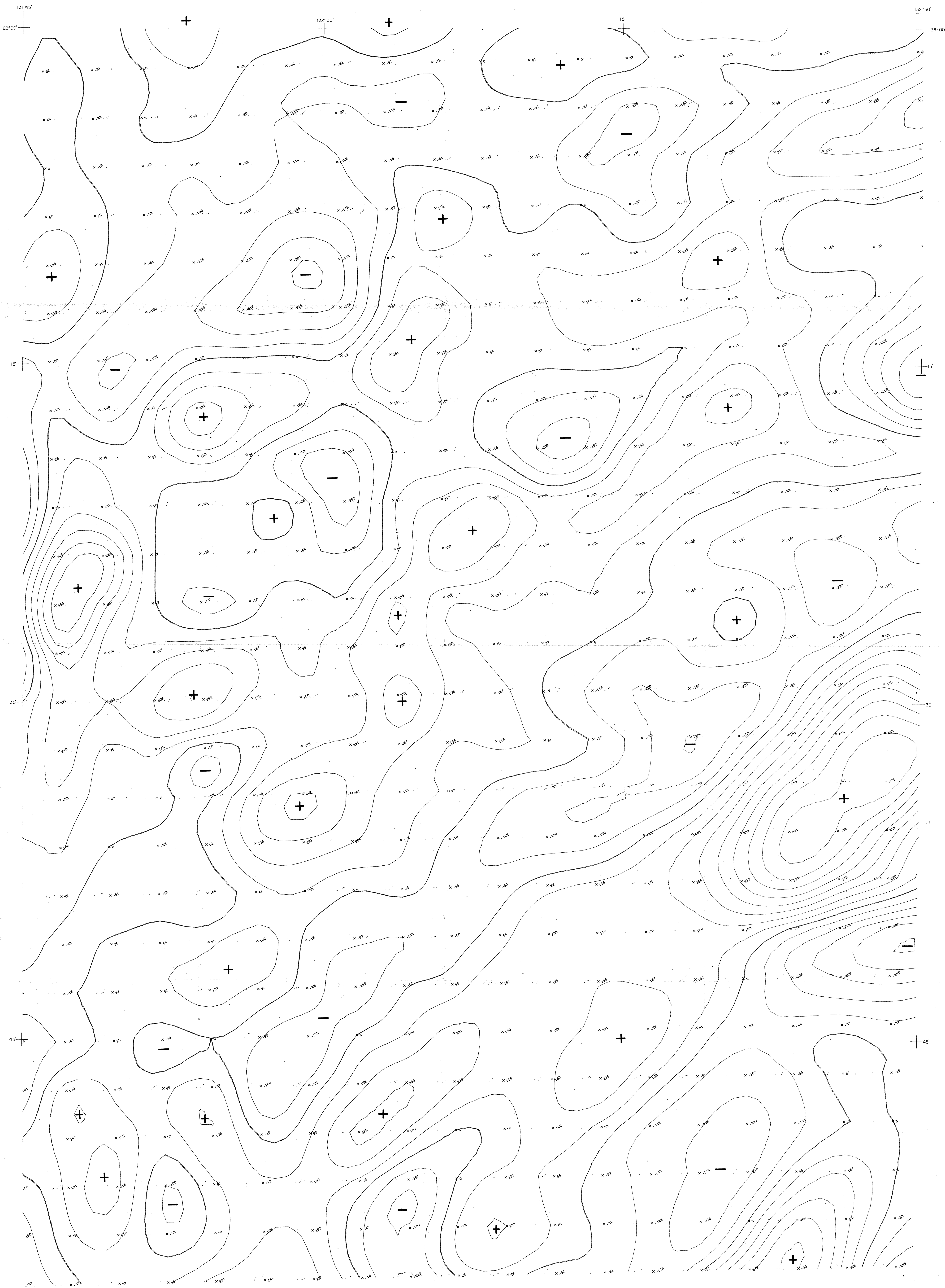
FLYING BY: ROTOR-WORK HELICOPTERS PTY LIMITED SYDNEY
SUPERVISION BY: ANALYTICAL EXPLORATION (AUST) PTY LTD.
SCALE 1:100,000

ELEVATION FACTOR: 0.06599 milligals/ft
DENSITY: 2.2 gms/cc
CONTOUR INTERVAL: 10 METERS
DATUM: M.S.L.

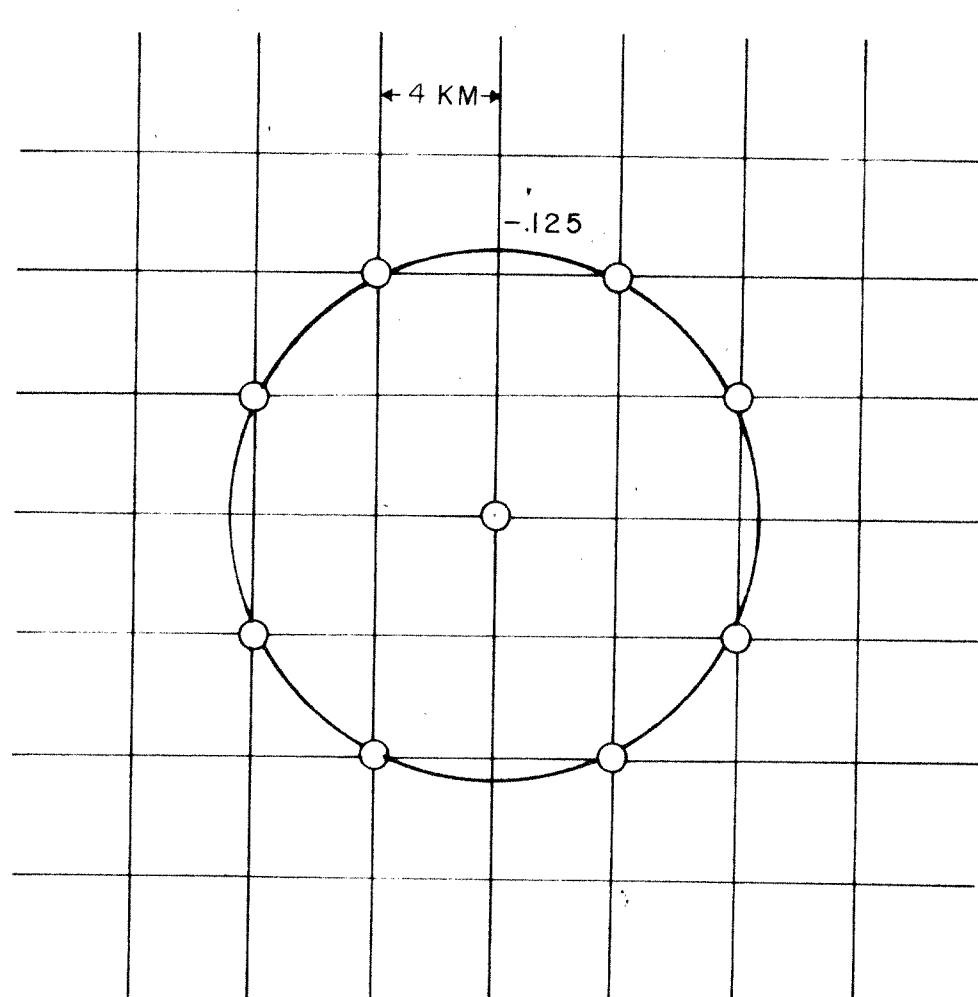
ENV. 1196-30.

SHEET 6





29°00' 131°45' 132°00' 15' 29°00' 132°30'



GRID RESIDUAL CALCULATION PATTERN
AND WEIGHTING COEFFICIENT

MURUMBA OIL N.L.
EASTERN OFFICER BASIN
HELICOPTER GRAVITY SURVEY
P.E.L. 10 & 11. South Australia

GRID RESIDUAL NO.3

EG&G INTERNATIONAL
GEOPHYSICAL ASSOCIATES PTY LTD

FLYING BY ROTOR-WORK HELICOPTERS PTY. LIMITED SYDNEY
SUPERVISION BY ANALYTICAL EXPLORATION (AUST) PTY. LTD.

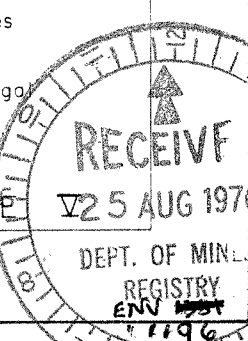
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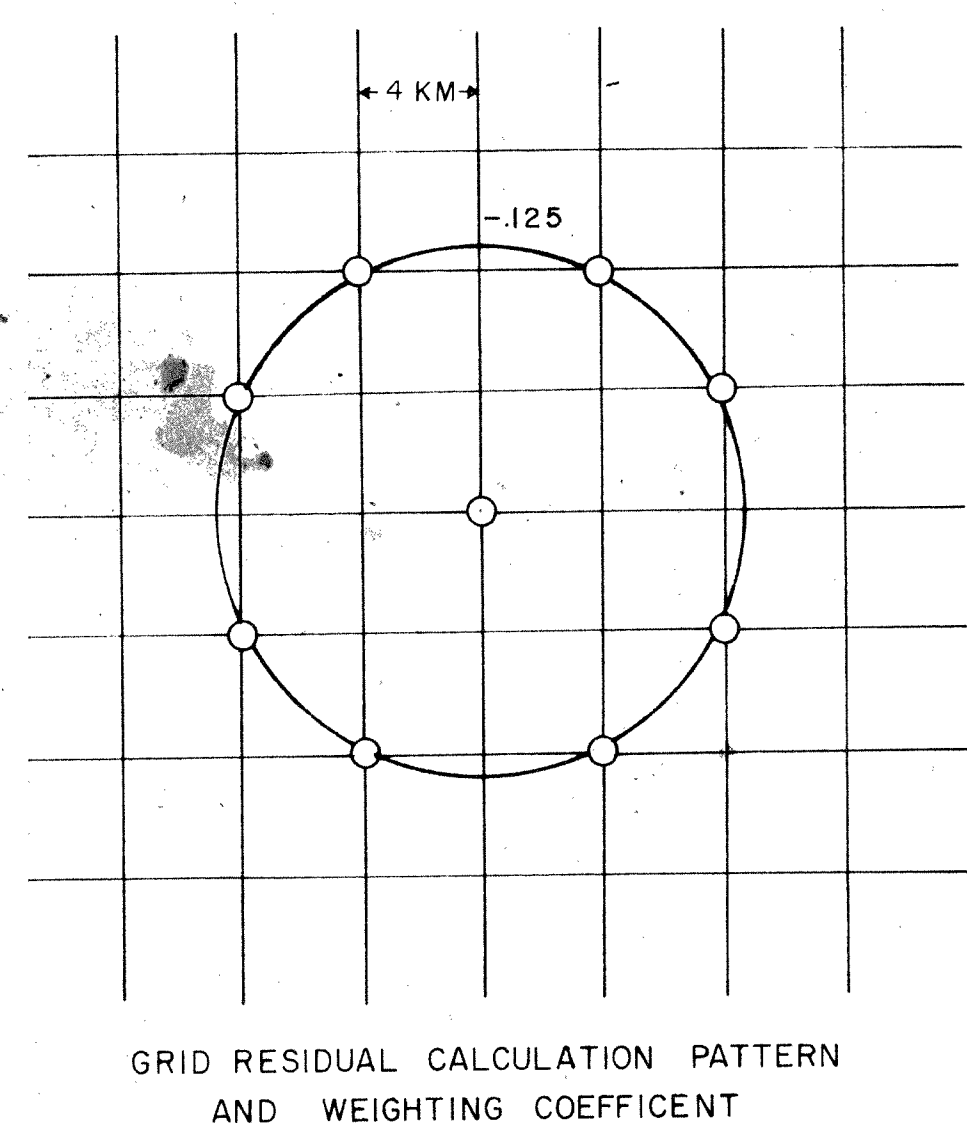
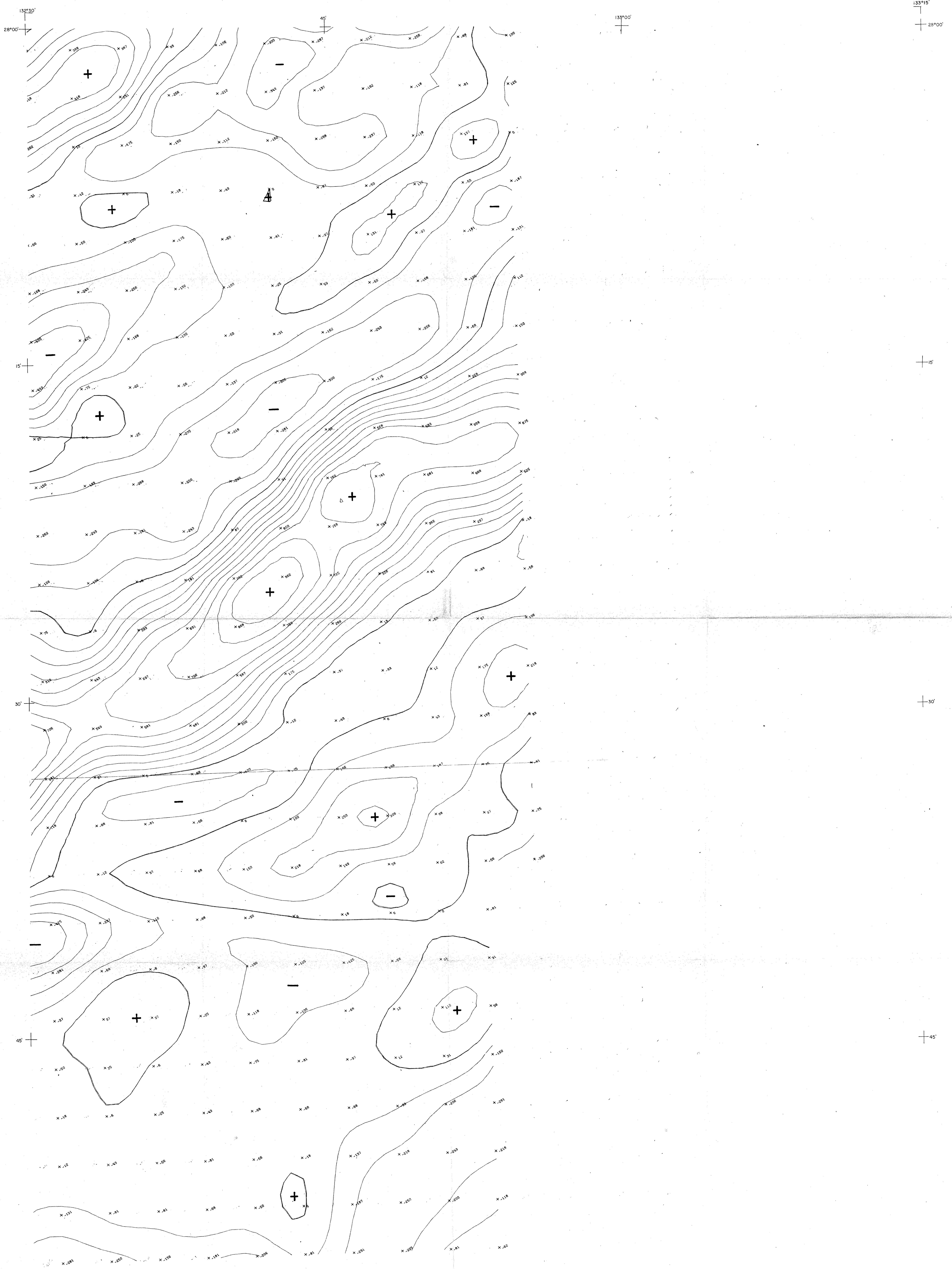
ELEVATION FACTOR 0.06599 milligals/m
DENSITY 2.67 gm/cc

CONTOUR INTERVAL 10 milligals
DATUM W.S.L.

ENV. 1196-31.

SHEET 7 OF 8





MURUMBA OIL N.L.
EASTERN OFFICER BASIN
HELICOPTER GRAVITY SURVEY
P.E.L. 10 & 11. South Australia

GRID RESIDUAL NO.3

EG&G INTERNATIONAL
GEOPHYSICAL ASSOCIATES PTY LTD

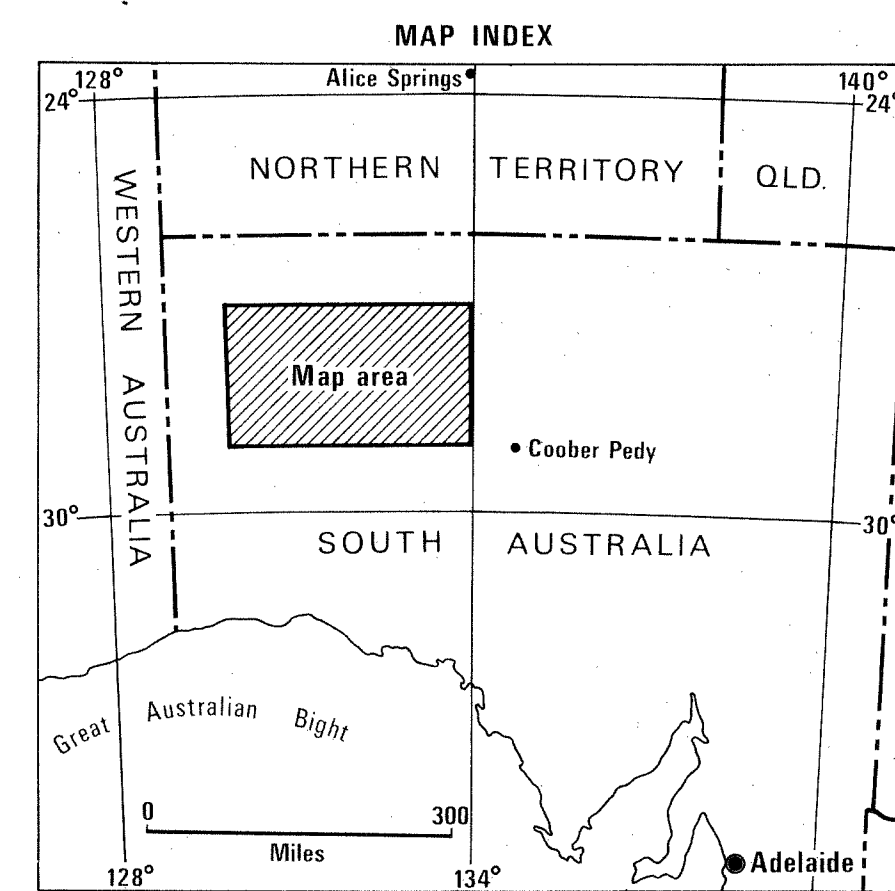
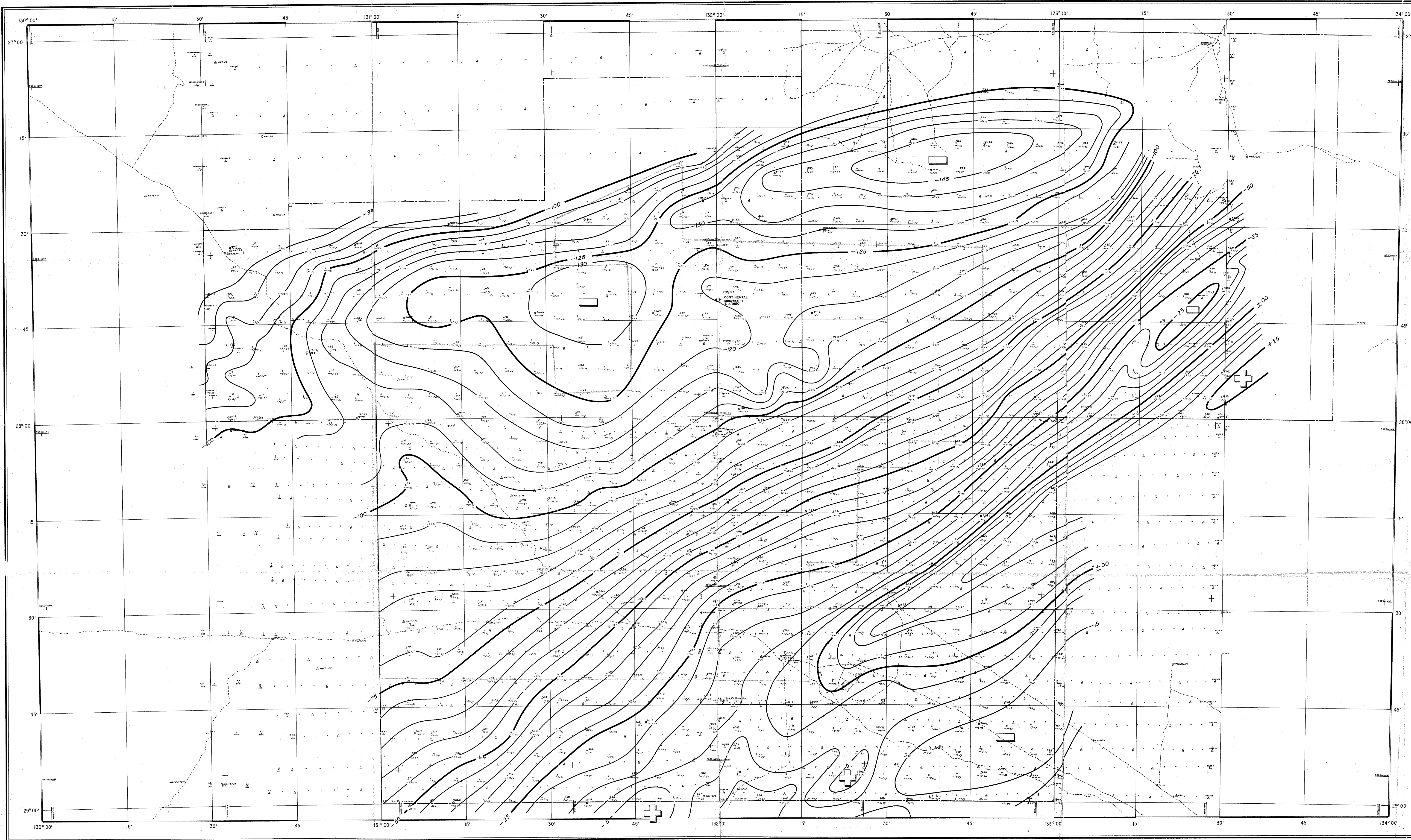
FLYING BY: ROTOR-WORK HELICOPTERS PTY LIMITED SYDNEY
SUPERVISION BY: ANALYTICAL EXPLORATION (AUST) PTY LTD.
SCALE 1:100,000

ELEVATION FACTOR 0.06599 m/gals/ft
DENSITY 2.65 gm/cc
CONTOUR INTERVAL 1.0
DATUM M.S.L.

ENV. 1196-32.

RECEIVED
25 AUG 1970
PLATE 10
G.P.E.
G.P.E.

SHEET 8 OF



- LEGEND**
- ✦ Dry and abandoned well
 - Δ Major control point
 - Minor control point
 - ⊕ Astronomical control point
 - Photo-centre, run number, photo number
 - Approximate position of existing roads and tracks (1:250,000 topographic maps)
 - Petroleum tenement boundary
 - Isogals
 - ⊕ High anomaly
 - Low anomaly

ANALYTICAL EXPLORATION (AUST) PTY. LTD.
OFFICER BASIN
SOUTH AUSTRALIA

PRELIMINARY BOUGER GRAVITY MAP

Contour interval: 5.0 milligals Datum: Sea level

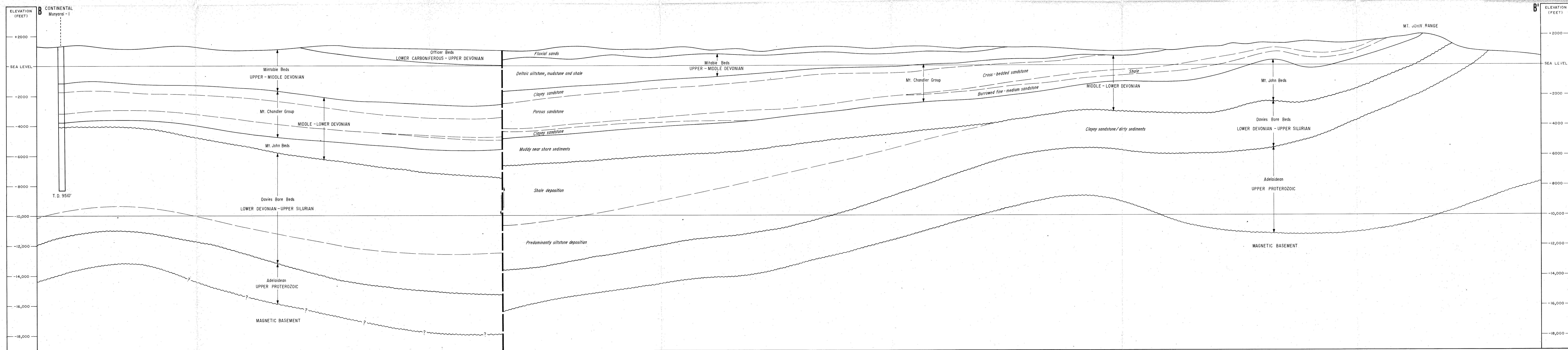
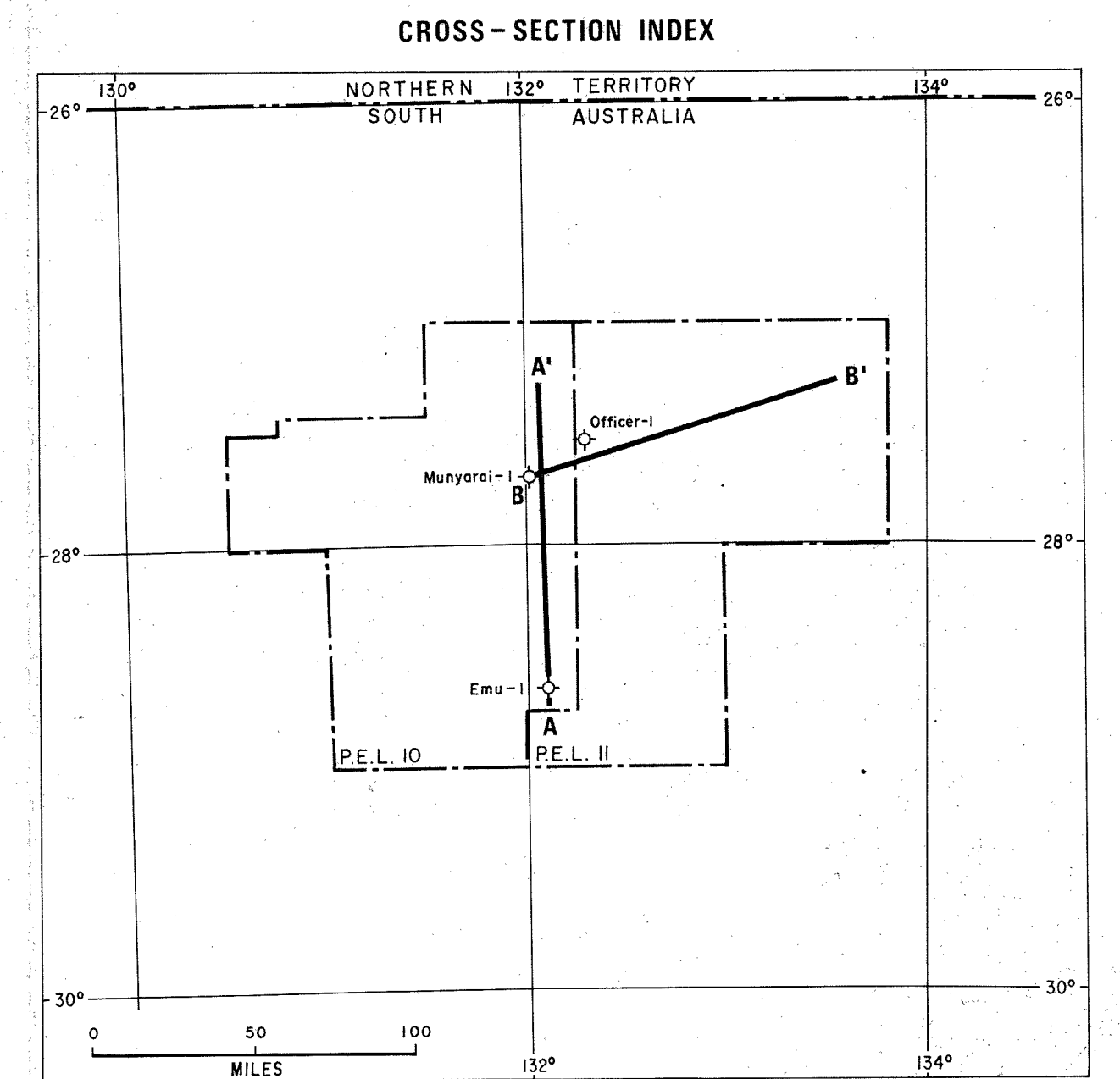
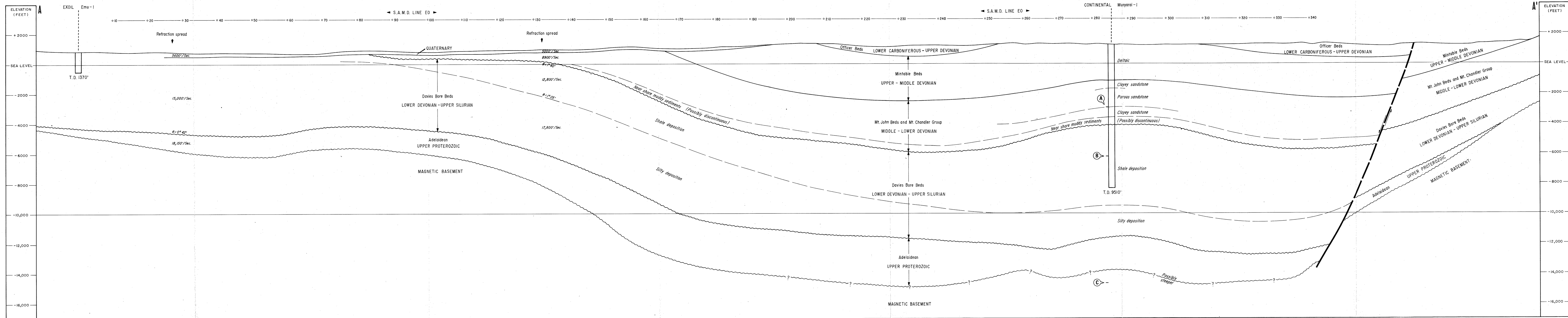
SCALE 1:500,000

5 0 5 10 15 20 Miles
5 0 5 10 15 20 25 30 Kilometres

Compiled and drafted by Geophysical Associates Pty. Ltd.

To accompany subsidy application for the Eastern Officer Basin
Helicopter Gravity Survey, 2 March, 1970.

ENV. 1196-33



ANALYTICAL EXPLORATION (AUST.) PTY. LTD.
OFFICER BASIN
 SOUTH AUSTRALIA

ENV 1196



GEOLOGICAL CROSS - SECTIONS
 A - A', B - B'

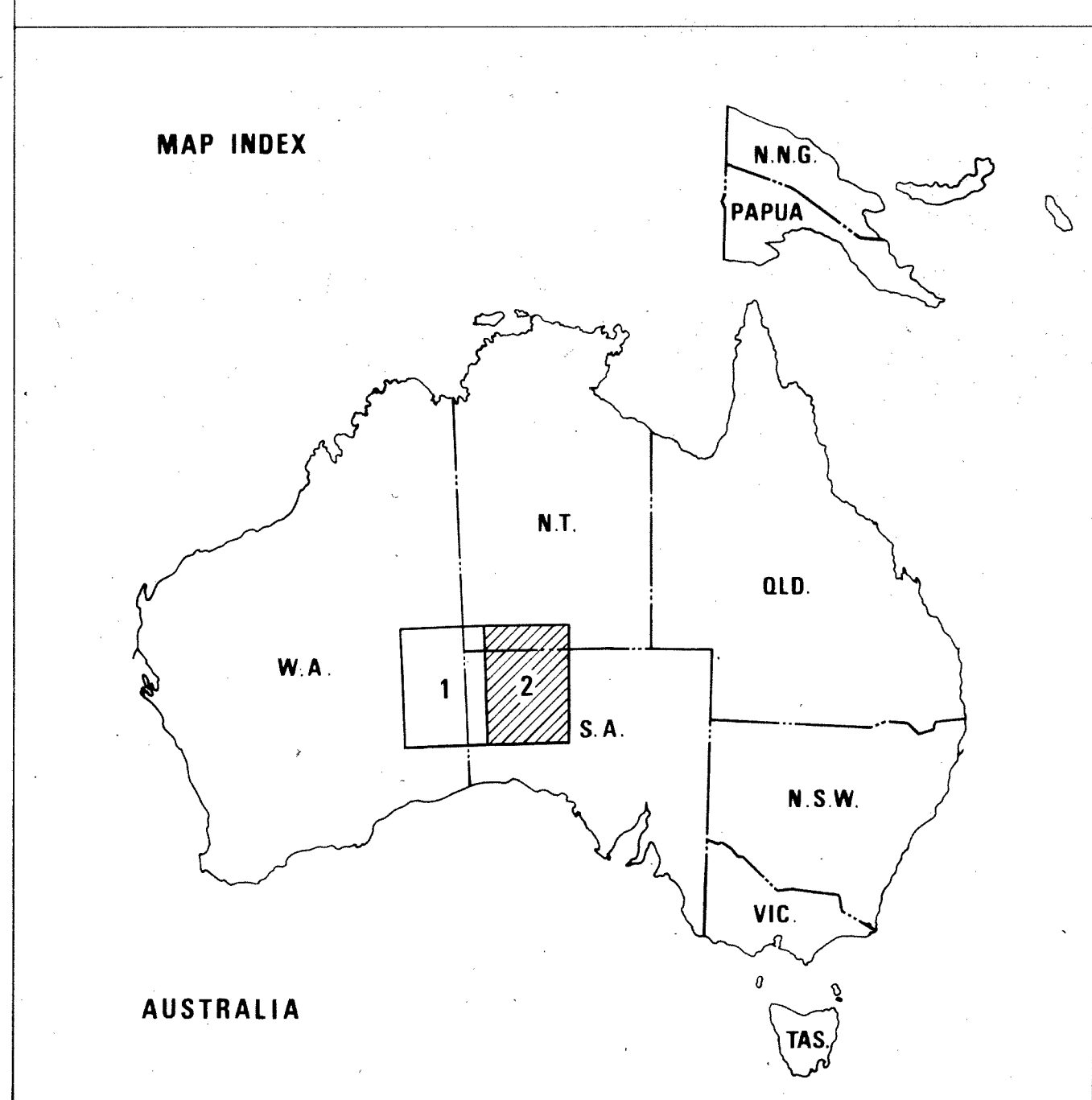
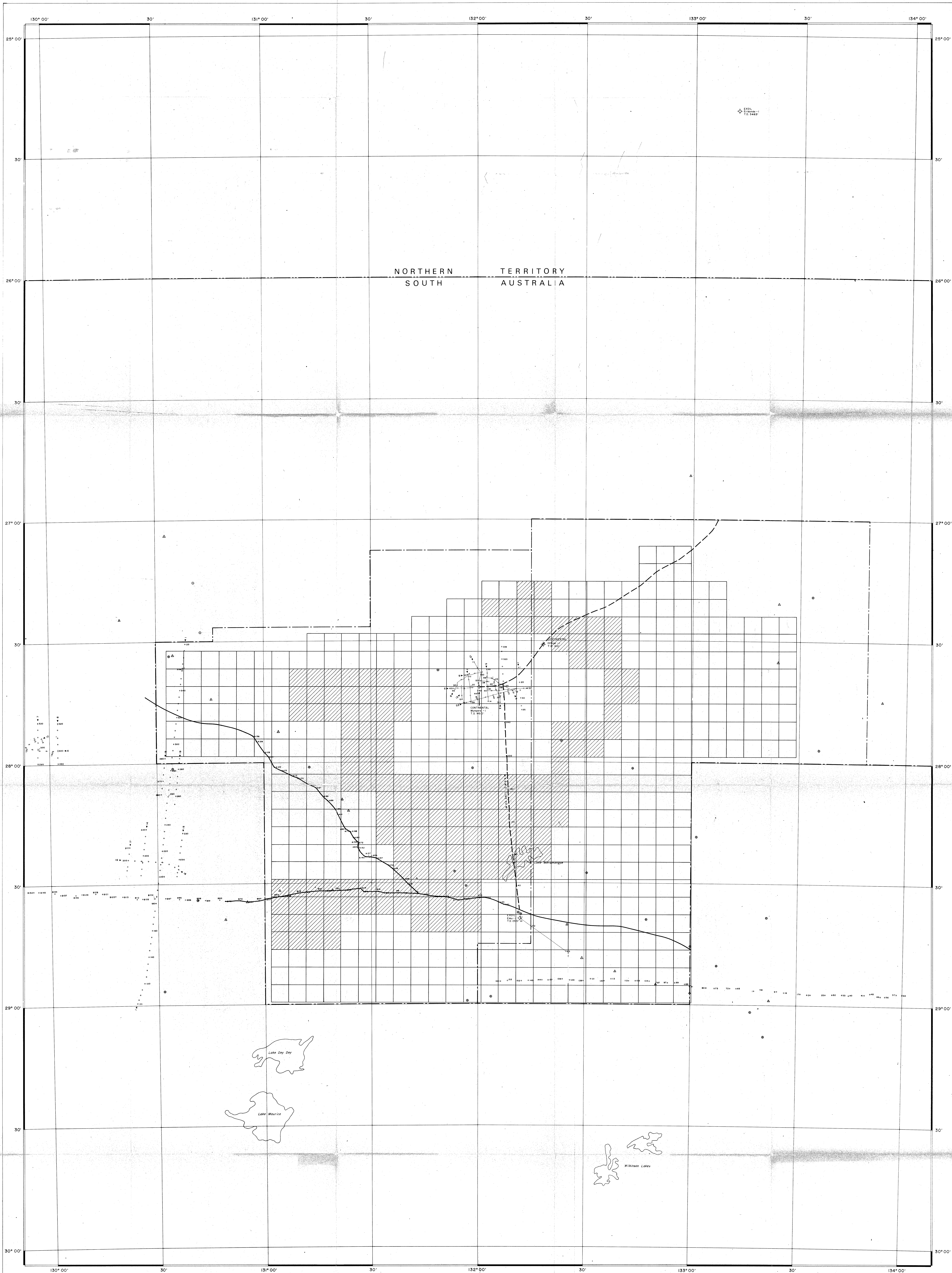
Horizontal scale: 1 inch = 2 miles
 Vertical scale: 1 inch = 2000 feet
 Miles

AUTHOR: R.B. MURDOCH
 TO ACCOMPANY: REPORT ANEXA - 24, NOVEMBER, 1969.
 DRAFTED BY: P.L. SPINNER

PLATE I

ENV. 1196-34

Dwg. 22/1



- LEGEND
- ◆ Dry and abandoned well
 - △ Major control point
 - Minor control point
 - Astronomical control point
 - Seismic shot point
 - Proposed regional gravity survey
 - ▨ Proposed area for detailed gravity survey
 - Existing B.M. R. land traverse
 - Proposed land traverse

TRANSVERSE MERCATOR PROJECTION (CLARK'S 1866 FIGURE)

ANALYTICAL EXPLORATION (AUST.) PTY. LTD. **ENV 1196**

OFFICER BASIN

NORTHERN TERRITORY - SOUTH AUSTRALIA

670A PROPOSED GRAVITY PROGRAMME
(P.E.L. S.A. 10 and 11)

SCALE 1:500,000

0 10 20
MILES

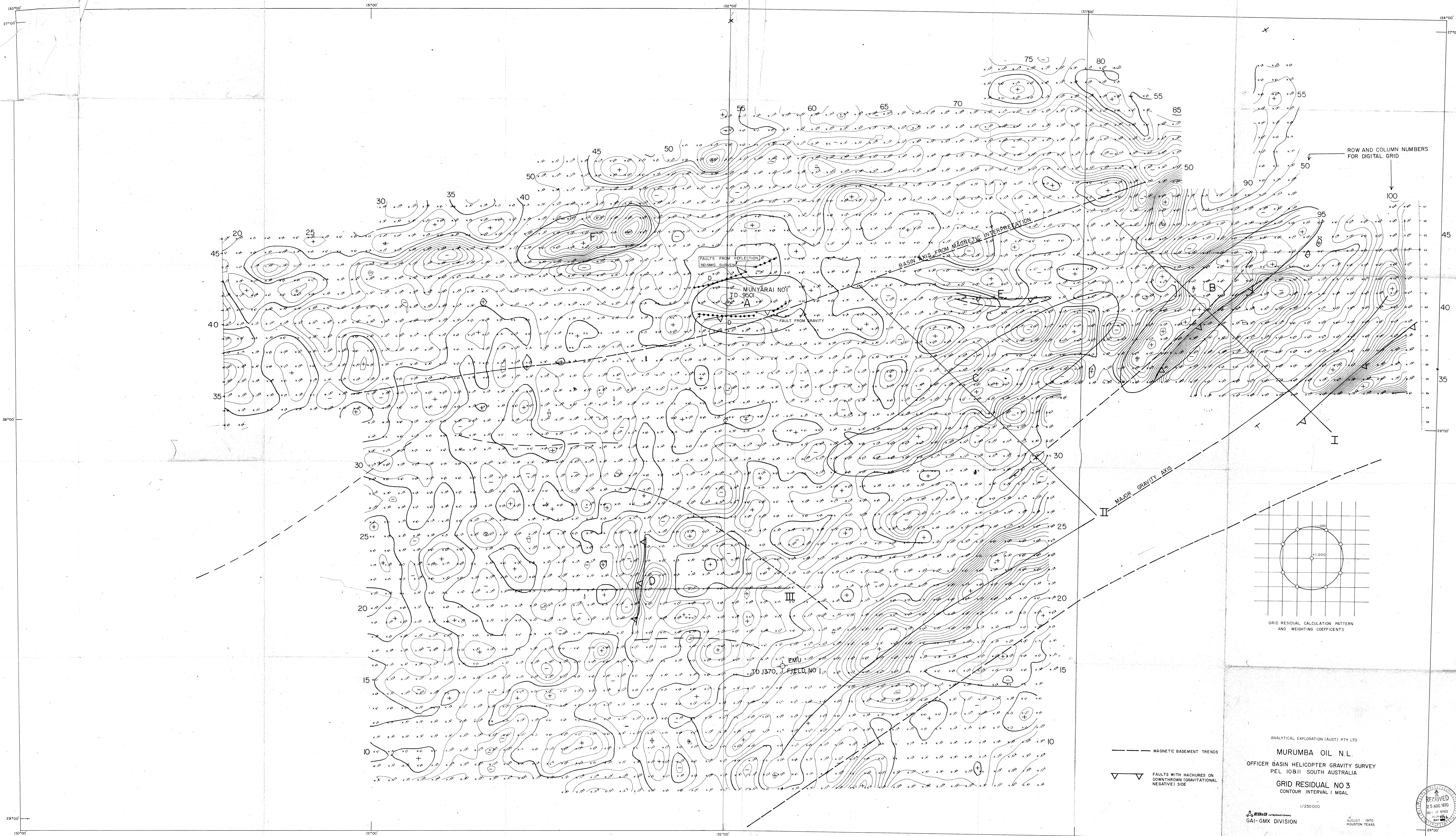
AUTHOR: R. B. MURDOCH DRAFTED BY: M. F. WETMAN
TO ACCOMPANY REPORT ANEXA - 24 NOVEMBER 1969 P.L. SPINNER

SHEET 2 PLATE II

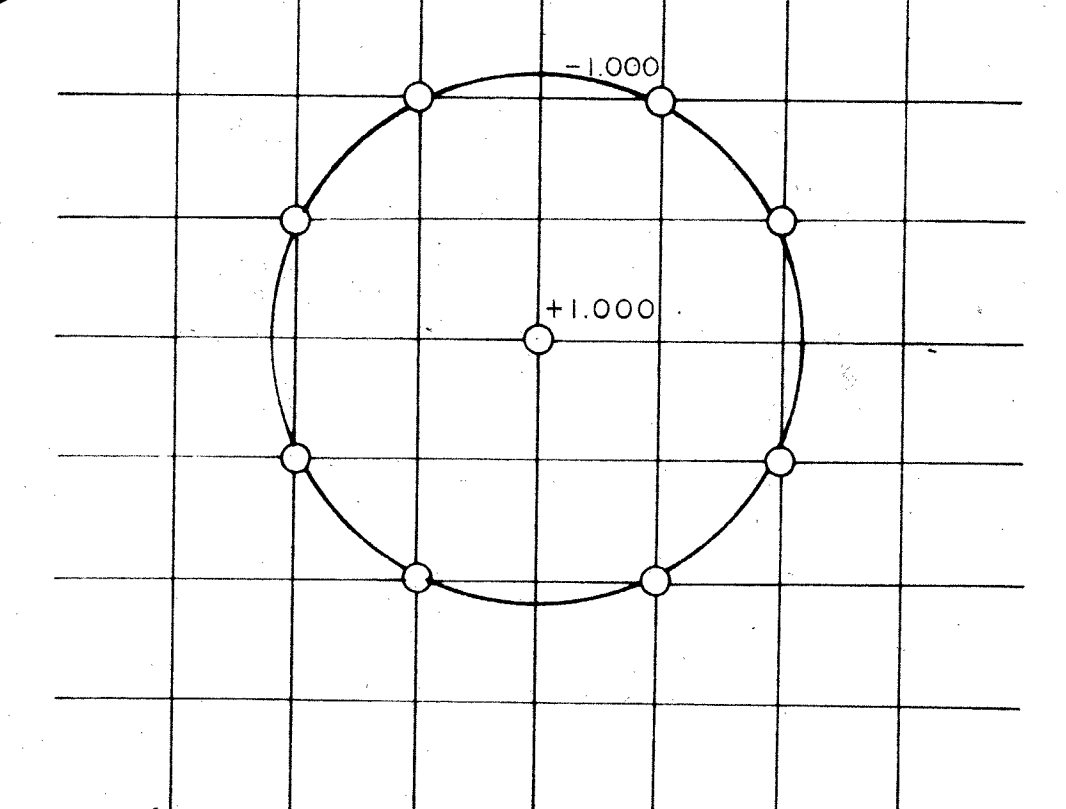
RECEIVED
23 JAN 1970
DEPT. OF MINES
SOUTH AUSTRALIA

ENV 1196-35

Dwg. 22/2



ROW AND COLUMN NUMBERS FOR DIGITAL GRID



GRID RESIDUAL CALCULATION PATTERN AND WEIGHTING COEFFICIENTS

--- MAGNETIC BASEMENT TRENDS

▽▽ FAULTS WITH HACHURES ON DOWNTHROWN (GRAVITATIONAL NEGATIVE) SIDE

ANALYTICAL EXPLORATION (AUST) PTY LTD

MURUMBA OIL N.L.

OFFICER BASIN HELICOPTER GRAVITY SURVEY

PEL 108/11 SOUTH AUSTRALIA

GRID RESIDUAL NO 3

CONTOUR INTERVAL 1 MGAL

EG&G INTERNATIONAL

GAI-GMX DIVISION

1/250 000

AUGUST 1970 HOUSTON TEXAS

PLATE II

ENV. 1196-36

