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# THE RESERVOIR GEOLOGY OF GAS RESERVE ESTIMATES, COOPER BASIN

I.J. TOWNSEND

&

B.C. YOUNGS

Department of Mines
South Australia —

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by

I.J. TOWNSEND and B.C. YOUNGS
GEOLOGISTS
PETROLEUM GEOLOGY SECTION

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## LIST OF ENVELOPE NUMBERS

The following list gives the numbers of envelopes containing the working sections and maps used in this study:-

| | |
|---|---|
| ENV.NO. 2051 | Big Lake Gas Field |
| 2052 | Burke Gas Field |
| 2053 | Daralingie Gas Field |
| 2054 | Della Gas Field |
| 2055 | Fly Lake & Brolga Fields |
| 2056 | Moorari Oil & Gas Field |
| 2057 | Mudrangie Gas Field |
| 2058 | Strzelecki Gas Field |
| 2059 | Tirrawarra Oil & Gas Field |
| 2060 | Toolachee Gas Field |

DEPARTMENT OF MINES
SOUTH AUSTRALIA

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# THE RESERVOIR GEOLOGY OF GAS RESERVE ESTIMATES, COOPER BASIN

## INTRODUCTION

A reservoir geology study was undertaken for all gas and oil fields in the South Australian Cooper Basin except Moomba, Gidgealpa and Packsaddle. The fields studied are those which will supply the Sydney gas market. Moomba and Gidgealpa supply Adelaide. Packsaddle is considered to have reserves too small to be economic.

The aim of this project is to outline the geology of the gas bearing Permian Formations and to obtain estimates of the volume of proven probable gas contained within the individual structures. From individual isopach maps of producing formations the Petroleum Engineering Branch calculated the hydrocarbon pore volume and deliverable gas and oil for each of the fourteen fields.

The formations of interest are all contained within the Gidgealpa Group which includes from oldest to youngest the Tirrawarra Sandstone, the Patchawarra Formation, the Murteree Shale, the Epsilon Formation, the Roseneath Shale, and the Toolachee Formation (Table 1). Figure 1 shows the gamma ray and sonic logs of Big Lake No.1 well for the Permian Gidgealpa Group. This well was chosen as an example because all formations mentioned above are present. Although it is not the thickest section available, the Big Lake No 1 log does give a good picture of the Gidgealpa Group.

The South Australian portion of the Cooper Basin is contained entirely within Petroleum Exploration Licences 5 and 6 held by Delhi International Oil Corp., Santos Limited and Vamgas N.L. Farmout areas as shown in figure 2 show the interests earned by each of the Farmoutees and the locations of all fields incorporated in the project.

Three main criteria were used to determine the field limits. If a gas-water interface was recognised in one or more of the wells, it was used to define the pay sand boundaries. In all such cases, with the exception of the Toolachee Field, a horizontal or dipping planar interface was assumed. In the case of no gas-water interface being present within a field, a horizontal plane was drawn through the base of the lowest producing sand and used as an assumed gas-water interface. In many cases this would have given a conservative reserve estimate. In the absence of any recoveries of water during testing, it was assumed that permeability barriers were affecting production and these were placed halfway between producing and dry wells wherever possible. A special study of permeabilities and their relation to structure and formation thicknesses was made for use only in the Tirrawarra Field.

A summary of all calculations for the fourteen fields is contained in Table 2.

The pages are numbered in sequence throughout this report but figure and table numbers are not. The figure and table numbers commence at number one for each field.

# THE GIDGEALPA GROUP — COOPER BASIN

| AGE | PALYNOLOGY PATEN (1969)* | REVISED TERMINOLOGY | FORMER TERMINOLOGY KAPEL (1972) | FORMER TERMINOLOGY MARTIN (1967) |
|---|---|---|---|---|
| TRIASSIC | | NAPPAMERRI FM. | NAPPAMERRI FORMATION | NAPPAMERRI FORMATION |
| TARTARIAN | UPPER STAGE 5 | GIDGEALPA GROUP: TOOLACHEE FORMATION | GIDGEALPA GROUP: TOOLACHEE FORMATION | GIDGEALPA FORMATION: UPPER MEMBER |
| KUNGURIAN — KAZANIAN | | | | |
| | Disconformity | | | |
| ARTINSKIAN | UPPER L. ST. 5 | DARALINGIE BEDS | | |
| | LOWER STAGE 5 | ROSENEATH SHALE | | MIDDLE MEMBER: UPPER MIDDLE MBR. |
| | UPPER UPPER ST. 4 | EPSILON FORMATION | GIDGEALPA GROUP: MOOMBA FORMATION | MIDDLE MEMBER: MIDDLE MIDDLE MBR. |
| | UPPER STAGE 4 | MURTEREE SHALE | | MIDDLE MEMBER: LOWER MIDDLE MBR. |
| | LOWER STAGE 4 | PATCHAWARRA FORMATION | GIDGEALPA GROUP: PATCHAWARRA FORMATION | GIDGEALPA FORMATION: LOWER MEMBER |
| SAKMARIAN — ARTINSKIAN | STAGE 3 | MOORARI BEDS | MOORARI BEDS | |
| | | TIRRAWARRA SANDSTONE | GIDGEALPA GROUP: TIRRAWARRA FORMATION | |
| SAKMARIAN | STAGE 2 | MERRIMELIA FORMATION | GIDGEALPA GROUP: MERRIMELIA FORMATION | Unconformity ? GIDGEALPA FORMATION: MERRIMELIA FORMATION |
| POSSIBLY PRE-PERM. | | | | |

* modified by P. Price (personal comm.)

TABLE 1

FIGURE

00008

# RESERVOIR DATA – TABLE 2

| FIELD | AREA | PAY VOL | Shyd. | Ø | H.P.V | Temp and Av. Res. Press. | Z | RF1 | RF2 | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| BIG LAKE T. | 15868·9 | 1154267·7 | 72·3 | 13·1 | 109157·2 | 280° 3427 | ·96 | 171·2 | 24·5 | |
| P. | 7575 | 60606 | 58·4 | 11·3 | 4014 | 338° 4470 | 1·005 | 197·8 | 22·5 | Av. Pay of 8' |
| BROLGA | 2100·6 | 54146·5 | 76·2 | 13·5 | 5549 | 230° 4012 | ·836 | 246·87 | 25·72 | |
| BRUMBY | 4379·0 | 67923·4 | 74·0 | 12·2 | 6127 | 278° 3183 | ·919 | 166·6 | 24·79 | |
| BURKE T. | 3317·3 | 155911·2 | 79·8 | 14·9 | 18551 | 270° 3137 | ·936 | 162·96 | 24·91 | |
| P. | 4884·1 | 207449·1 | 75·1 | 12·0 | 18742 | 270° 3457 | ·949 | 177·12 | 24·86 | |
| COONATIE | 642 | 28248 | 71·7 | 10·8 | 2181 | 255° 4227 | ·902 | 232·64 | 25·96 | Assumed 642 acres |
| DARALINGIE A. | 13309·2 | 328328·7 | 82·9 | 16·4 | 44728 | 252° 3262 | ·903 | 180·09 | 25·91 | Well Nos 1&2. |
| B. | 15323·7 | 278397·1 | 75·0 | 11·7 | 24429 | 252° 3207 | ·902 | 177·05 | 25·91 | Well No 3. |
| DELLA | 15593·4 | 9274036 | 77·0 | 15·7 | 111971 | 258° 2911 | ·943 | 152·61 | 25·43 | |
| G. | 4476·6 | 252462·2 | 61·8 | 11·4 | 17734 | 250°/3958 | ·877 | 225·62 | 26·17 | |
| FLYLAKE O. | 3764·9 | 126492 | 61·9 | 11·2 | 8738 | | | | | |
| MERRIMELIA | 1371·7 | 64468 | 76·0 | 16·0 | 7839 | 276° 3215 | ·915 | 169·45 | 24·86 | Assumed 47' of pay. |
| MOORARI G. | 1704·5 | 46073·8 | 53·7 | 10·9 | 2689 | 260° 3952 | ·826 | 235·87 | 26·17 | |
| O. | 2203·9 | 126264·2 | 59·2 | 11·9 | 8860 | | | | | |
| MUDRANGIE T. | 2221 | 124376 | 78·0 | 10·4 | 4456 | 250° 3660 | ·878 | 208·4 | 25·98 | |
| P | 2221 | 24431 | 76·0 | 21·0 | 10089 | 250° 4160 | ·901 | 230·82 | 25·98 | |
| STRZELECKI | 12649·2 | 373180·1 | 36·0 | 12·4 | 16631 | 280° 2798 | ·935 | 143·54 | 23·98 | |
| TIRRAWARRA G. | 7145·3 | 205821·9 | 64·0 | 10·6 | 14002·5 | 253·5° 3980 | ·860 | 230·23 | 26·13 | |
| O. | 11817·0 | 829144·9 | 67·4 | 12·2 | 73590 | | | | | |
| TOOLACHEE | 21768·0 | 1139596 | | | | | | | | |

6000000

## SECTION 1: BIG LAKE GAS FIELD (I.J.T.)

### General

The Big Lake Gas Field was discovered by Delhi International Oil Corporation on the 3rd of December 1971 when Big Lake No.1 Well produced economic quantities of gas from drill stem test No.4.

The Big Lake Gas Field contains 4 wells on the fault bounded, elongated domal structure (Fig.1) and each produced commercial quantities of gas. The Big Lake Field was drilled first to test the structural trap for the presence of hydrocarbons and subsequently to delineate the extent of the field.

### Reservoir Data

The maximum pay thickness for the Toolachee Formation obtained from the section (Fig.2) was 130 feet and the producing sands cover an area of 15 869 acres. The calculated volume was 1 154 268 acre feet and the average porosity for the producing sands was 13.1%. The total pay thickness for the Patchawarra Formation was 8 feet as determined from wells No.1 and No.3. The producing sand has an average porosity of 11.3% and covered an approximate area of 7575 acres. This gives a volume of 60606 acre feet for the Patchawarra reservoir which was treated separately from the Toolachee reservoir.

### Geometry of the Field

The field was drilled on a fault bounded elongated dome trending northeast-southwest and the field lies to the southeast of the Moomba Gas Field, Moomba No.4 being the closest well approximately 2 miles to the northwest. Moomba 4 was a dry well and therefore Moomba 2 is the closest producing well some 5 miles to the northeast.

The Della Gas Field lies approximately 20 miles to the northeast of the Big Lake Gas Field. Big Lake No.1 well was drilled off the culmination of the domal structure as shown by Fig.1.

The tops and bases of each producing sand found in the four Big Lake wells are listed in Table 1 which also gives the total pay thickness of each formation intersected. It should be noted that Big Lake No. 2 well did not intersect the Patchawarra Formation but was still included in the areal extent of Patchawarra producing sand. Big Lake Nos. 1 and 3 both intersected 8 feet of pay sand in the base of the Patchawarra and No.2 well was considered to be in a similar stratigraphic position to these, and hence should intersect this interval if it were possible to drill through the formation.

All formations of the Permian are represented in the Big Lake wells making correlations between wells very good. Moomba and Della Gas Fields do not correlate as well with Big Lake formations as they are incomplete sections, although correlation is still reasonable.

The Big Lake Field is bounded by faults which were active during the Permian and this downfaulting of the Big Lake structure relative to Moomba and Della allowed a complete section to be deposited.

(a) Toolachee Formation.

A section through all four wells was drawn for this formation for the reservoir estimates (D.M. envelope no.2051). As the schematic section (Fig.2) and P horizon (Fig.1) show, fault boundaries limit most of the field. The southwestern boundary

was defined by an almost horizontal gas water interface chosen from dual laterologs. The easternmost wedge shape of the structure was likewise discounted by the gas water interface projected horizontally through Well Nos.3 & 1.

(b) Patchawarra Formation

As only 2 wells intersected the 8 feet section of sand and no basal Gidgealpa seismic was available the boundary of the Patchawarra sands could only be trended around the P horizon contours just outside No.3 well (see Fig.1). This approximate area was assumed to have a constant 8 feet pay thickness for the calculation of volume for the Patchawarra Formation.

TABLE 1

000013

| WELL NAME AND NUMBER | K.B. (FEET) | FORMATION | SAND | SAND TOP (FEET) (SUBSEA) | SAND BASE (FEET) (SUBSEA) | THICK-NESS (FEET) |
|---|---|---|---|---|---|---|
| BIG LAKE 1 | 140 | TOOLACHEE | $B_1$ | 7640 | 7646 | 6 |
| | | | $B_2$ | 7624 | 7630 | 6 |
| | | | $C_1$ | 7598 | 7606 | 7 |
| | | | $C_2$ | 7589 | 7595 | 6 |
| | | | $C_3$ | 7541 | 7586 | 45 |
| | | | $D_1$ | 7523 | 7531 | 8 |
| | | | $D_2$ | 7518 | 7521 | 3 |
| | | | $D_3$ | 7509 | 7517 | 8 |
| | | | F | 7416 | 7423 | 7 |
| | | | | | TOTAL | 96 |
| | | PATCHAWARRA | | 9357 | 9365 | 8 |
| BIG LAKE 2. | 122 | TOOLACHEE | A | 7553 | 7561 | 8 |
| | | | $B_{1+2}$ | 7499 | 7519 | 20 |
| | | | $C_1$ | 7479 | 7487 | 8 |
| | | | $C_2$ | 7430 | 7474 | 44 |
| | | | $C_3$ | 7415 | 7425 | 10 |
| | | | D | 7339 | 7365 | 26 |
| | | | | | TOTAL | 116 |
| BIG LAKE 3 | 136 | TOOLACHEE | $C_1$ | 7668 | 7683 | 15 |
| | | | $C_2$ | 7654 | 7666 | 12 |
| | | | $C_3$ | 7636 | 7648 | 12 |
| | | | $C_4$ | 7614 | 7625 | 11 |
| | | | $D_1$ | 7559 | 7578 | 19 |
| | | | $D_2$ | 7549 | 7555 | 6 |
| | | | | | | 75 |
| | | PATCHAWARRA | | 9714 | 9722 | 8 |
| BIG LAKE 4. | 111 | TOOLACHEE | $B_1$ | 7609 | 7645 | 36' |
| | | | $B_2$ | 7592 | 7606 | 14 |
| | | | $C_1$ | 7570 | 7585 | 15 |
| | | | $C_2$ | 7531<br>7540 | 7538<br>7548 | 15 |
| | | | $C_3$ | 7519 | 7522 | 3 |
| | | | D | 7457 | 7462 | 5 |
| | | | ?E | 7429<br>7435 | 7433<br>7437 | 6' |
| | | | | | | 94 |

## SECTION 2: BROLGA GAS FIELD (B.C.Y.)

### General

The Brolga No.1 well was drilled during April and May, 1972, with Delhi as operators for the Delhi-Santos-Vamgas-Bridge-Basin-Reef group. The first gas flow was reported on 16th May, 1972, and further tests in the Patchawarra Formation also produced gas. No other wells have been drilled in the field. The well was drilled to test a structurally elevated area along the already proven Fly Lake-Moorari trend. No oil was found in the Brolga Field, unlike in the neighbouring ones.

### Reservoir Data

There is a total of 77 feet of pay in Brolga 1; it occurs entirely in the Patchawarra Formation. The field covers an area of 2 101 acres and contains 54 147 acre feet of pay sand, having an average porosity of 13.5%.

### Geometry of the Field

The Brolga well was drilled slightly away from the top of a roughly circular dome which lies approximately 4 miles northeast of Fly Lake 2.This small dome lies on a saddle dipping, generally northeasterly, away from the Fly Lake towards the Moorari Field.

Ten sands, of thicknesses varying between 2 and 26 feet, produced from the Patchawarra Formation. Details are given in Table 1. No correlation of these ten sands with those in adjacent fields has been attempted.

The field limit was drawn around the 9150 feet b.s.l. contour on the Lower Member Coal seismic map. This level was chosen as it represents the lowest level of the coal seismic horizon between the Brolga and Fly Lake Fields, and also because

it approximates to the base of the lowest pay sand in the well (Fig.1). No gas-water interface was detected in Brolga 1.

The isopachs (Fig.1) were drawn using the Lower Member Coal seismic contour map as a guide for the zero isopach and a working section, (see D.M. Env.2055). A diagramatic representation of the section is given in Fig.1.

TABLE 1

000016

FIELD: BROLGA

| Well KB | Sand | Top s.s. | Base s.s. | Thickness | Well KB | Sand | Top s.s. | Base s.s. | Thickness |
|---|---|---|---|---|---|---|---|---|---|
| 1 | A | 8953 | 8968 | 15 | | | | | |
| 130' | B | 8982 | 8984 | 2 | | | | | |
| | C | 9102 | 9104 | 2 | | | | | |
| | D | 9137 | 9163 | 26 | | | | | |
| | E | 9179 | 9182 | 3 | | | | | |
| | F | 9188 | 9191 | 3 | | | | | |
| | G | 9200 | 9203 | 3 | | | | | |
| | H | 9213 | 9221 | 8 | | | | | |
| | I | 9223 | 9228 | 5 | | | | | |
| | J | 9232 | 9237 | 5 | | | | | |

## SECTION 3: BRUMBY GAS FIELD (B.C.Y.)

### General

The Brumby No.1 well was drilled by the Delhi-Santos-Vamgas group with Delhi as operators. Only the one well has so far been drilled in the field and it tested gas from the Patchawarra Formation on 1st April, 1972. The well was drilled in South Australia, close to the border with Queensland, on an anticlinal structure which is present in both states.

### Reservoir Data

The total pay in Brumby 1 in 37 feet. It occurs entirely in the Patchawarra Formation and is composed of four interconnected sands. The field covers an area of 4 379 acres and the pay volume is 67 923 acre feet of sand with an average porosity of 12.2%.

### Geometry of Field

The Brumby well was drilled at the southeastern end of a north-westerly trending anticline (Fig.1). It is approximately 10 miles due east of Toolachee 6, which lies in the Toolachee Gas Field.

Four pay sands have been identified in Brumby 1; the thickest is 20 feet (Table 1).

The limit of the pay sands was taken as the lowest closing contour on the top of Patchawarra seismic contours (Fig.1); this was considered to be probably a little lower than 7 000 feet b.s.l. A drill stem test immediately below the one that produced gas recovered a full string of water. Calculations, which are shown in Fig.2, show that on this basis the reservoir limit may be placed at 7 029 feet b.s.l. on the top of Patchawarra Seismic

Contour map (Fig.1). These two criteria therefore give approximately the same limit, as shown by the zero isopach on Fig.1. The isopachs were drawn with the thickest pay of 37 feet occurring at the well.

TABLE 1



FIELD: BRUMBY

| Well KB | Sand | Top s.s. | Base s.s. | Thick-ness | Well KB | Sand | Top s.s. | Base s.s. | Thick-ness |
|---|---|---|---|---|---|---|---|---|---|
| 1 | A | 7082 | 7090 | 8 | | | | | |
| 274' | B | 7092 | 7099 | 7 | | | | | |
| | C | 7105 | 7107 | 2 | | | | | |
| | D | 7112 | 7132 | 20 | | | | | |

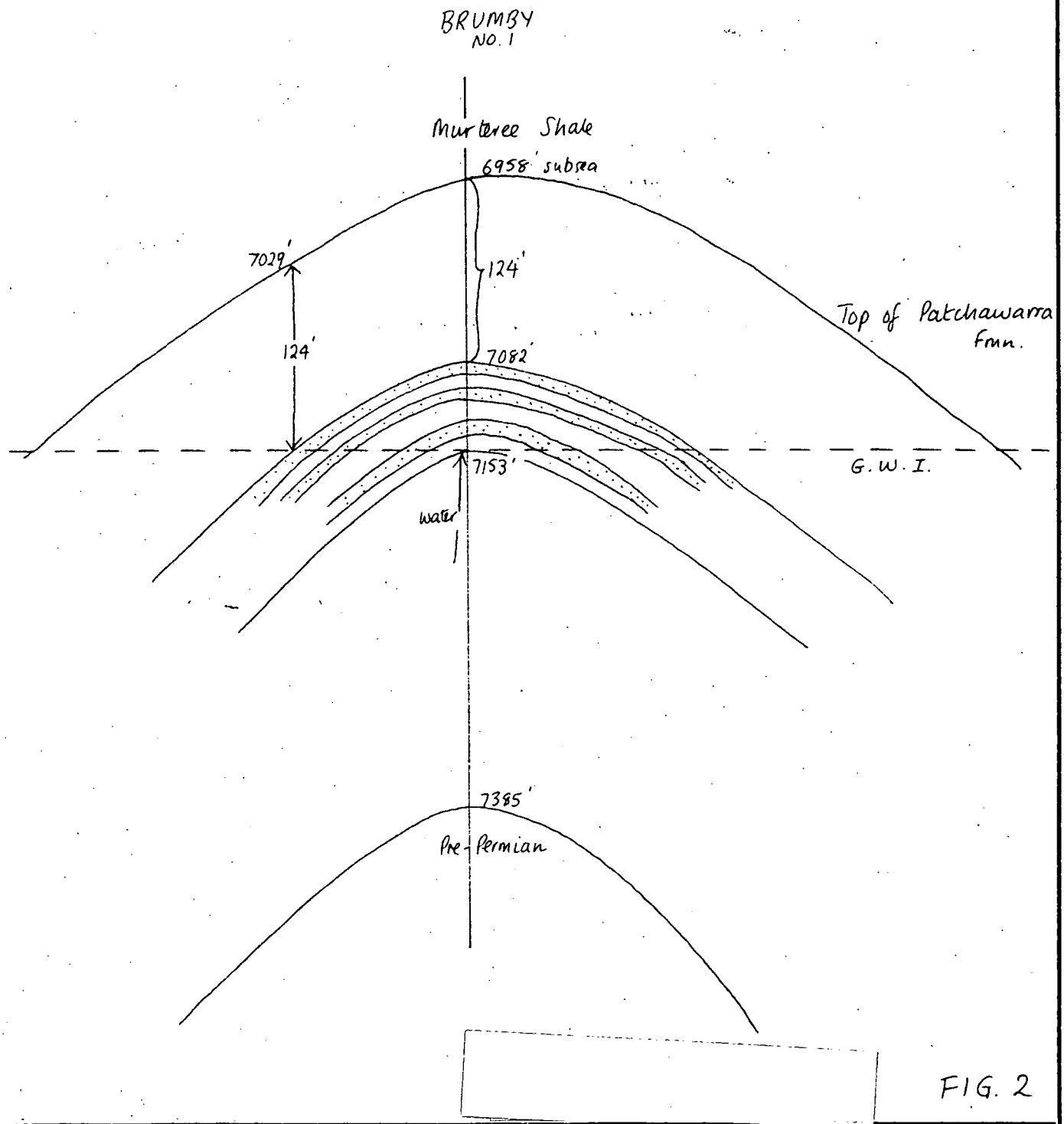


FIG. 2

| | DEPARTMENT OF MINES – SOUTH AUSTRALIA | Scale: diag. |
|---|---|---|
| Compiled: BCY | BRUMBY GAS FIELD | Date: 8 : 9 : 72 |
| Drn. \| Ckd. | Diagrammatic Section, showing G-W-I. | Drg. No. Gw 2060 |

## SECTION 4: BURKE GAS FIELD (I.J.T.)

### General

The Burke Field is one well gas field discovered by Delhi International Oil Corporation during the first drill stem test of Burke No.1 well, on the 31st of July 1972.

The Burke structure is a simple dome shape adjacent and to the east of the large Dullingari structure. Burke No.1 well was drilled because no adequate tests were conducted in Dullingari No.1 well. The Toolachee Formation was not tested at all. The production from Burke No.1 strongly upgrades the potential of the Toolachee Formation in the Dullingari structure.

### Reservoir Data

The total pay thickness for Burke No.1 well was 47 feet in the Toolachee and 96 feet in the Patchawarra Formations.

The areal extent of producing sands, pay thicknesses and volumes are listed below.

a. Toolachee Formation: 47 feet of pay; 3317 acres; 155911 acre feet, and an average porosity of 14.9%.

b. Patchawarra Formation: 96 feet of pay; 4884 acres; 207449 acre feet, and an average porosity of 12.0%.

### Geometry of Field

The Burke No.1 well was drilled on a simple domal trap (see Fig.1). The nearest other well is Dullingari No.1 well about 5 miles to the west. Dullingari No.1 well as mentioned above was certainly not tested and so cannot be discounted as a producer at this stage.

The formations, producing sands, their depths and thicknesses are listed in Table 1.

Good correlations of the Gidgealpa Group exist between Dullingari No.1 well and Burke No.1 well.

a. Toolachee Formation

The sand limits were chosen at the lowest point in the saddle between Dullingari No. 1 well and Burke No.1 well. From this point the structure contours of the P horizon were trended around the Burke structure.

A probable gas water interface was chosen on laterlogs for Burke No.1 and placed horizontally on the Toolachee Formation section (see Fig.2). This shows it is quite likely that the Dullingari structure contains gas in the Toolachee Formation. The Toolachee Formation was not tested in Dullingari No.1 well. The gas water interface in the Burke No.1 well does not limit the reservoir to the Burke structure (Fig.2). However for a "proven probable" figure calculation only the Burke structure could be considered. As relief at this level is low a constant thickness of 47 feet was used for the area plotted on the P horizon (Fig.1).

b. Patchawarra Formation

As dips are much greater than in the Toolachee Formation a constant thickness could not be used for the whole area. A single section was drawn (Dept. of Mines envelope No.2052), and an isopach map drawn-up, using the Base of Gidgealpa contour map as a guide. A horizontal gas water interface was assumed. The level was chosen from laterologs at 7738 feet. The laterologs show at this depth the ideal characteristics of a gas water interface which provided a cut off all around the Burke structure. Consequently no half way barrier had to be assumed. The isopach map drawn for the Patchawarra Formation is included in figure 3 which also shows the Base of Gidgealpa contours.

TABLE 1

000023

| WELL NAME AND NUMBER | K.B. (FEET) | FORMATION | SAND | SAND TOP (FEET) (SUBSEA) | SAND BASE (FEET) (SUBSEA) | THICK-NESS (FEET) |
|---|---|---|---|---|---|---|
| BURKE No.1. | 286 | TOOLACHEE | | 6884 | 6912 | 28 |
| | | | | 6855 | 6867 | 12 |
| | | | | 6827 | 6834 | 7 |
| | | | | | | 47 |
| | | PATCHAWARRA | 1. | 7703 | 7738 | 35 |
| | | | 2. | 7679 | 7698 | 19 |
| | | | 3. | 7653 | 7669 | 16 |
| | | | 4. | 7625 | 7632 | 7 |
| | | | 5. | 7596 | 7607 | 11 |
| | | | 6. | 7563 | 7571 | 8 |
| | | | | | | 96 |

## SECTION 5: COONATIE GAS FIELD(I.J.T.)

### General

The Coonatie Field is a gas field containing only a single well Coonatie No.1 well, drilled by Flinders Petroleum in their Patchawarra East Farmout. The field was discovered during the 1st drill stem test on the 6th of October, 1971. It was drilled to test the Lower Triassic and Permian sections on a seismically defined anticlinal closure.

### Reservoir Data

The total amount of pay is 44 feet in two sands, one of 25 feet, the other 19 feet, both being in the Toolachee Formation. No recent seismic P horizon map was available at this time so a standard area of 642 acres was chosen. The 642 acres with a constant thickness of 44 feet assumed for this area, resulted in a volume of 28248 acre feet. The average porosity for this volume is 10.8%. The closest gas field to this location is Mudrangie approximately 12 miles to the south-southwest.

## SECTION 6: DARALINGIE GAS FIELD (B.C.Y.)

### General

The Daralingie Gas Field is owned by the Delhi-Santos-Vamgas group and is covered by PPL 5 (Fig.1). Daralingie No.1 tested gas from the Patchawarra Formation on 27th November, 1967, and since that date two more gas wells have been drilled. All three wells were drilled to test a large structure which is composed of two parallel, northeast trending anticlines (Fig.1). A distinctive feature of the field is that one anticline produces gas from sands different from those in the parallel structure.

### Reservoir Data

The maximum pay of 58 feet occurs north of No.1 which is also the well with the thickest pay section (47 feet). All production is from the Patchawarra Formation but the two sand intervals have been considered separately for drawing the isopachs. The areal extent of the field around well Nos.1 and 2 (sands A, B and C) is 13 309 acres and the pay volume is 328 383 acre feet of sand with an average porosity of 16.4%. The other area, which includes only sand Y, covers 15 323 acres but contains only 278 397 acre feet of 11.7% porosity sand.

### Geometry of the Field

The Daralingie Field is contained within a large composite anticlinal structure (Fig.1) which comprises two parallel northeast trending anticlines each with a smaller northeastern lobe. The first well was drilled over 150 ft down-structure from the top of the largest (southeastern) dome. The Daralingie Field lies 8 miles northeast of the three dry Pando wells and is 20 miles southwest of the Moomba Gas Field.

There is a total of four pay sands in the Daralingie Field. Sand Y produces in the western anticline, i.e. from well No.3, and sands, A, B and C in well No.1 Only sand A produces gas in Daralingie 2. The maximum thickness of 21 feet is attained by sand A in well No. 2 (Table 1). All the sands of the Patchawarra Formation were found to correlate well between the wells and the two parallel features contain similar sections.

The boundaries of both reservoirs were not easily determined and have been drawn using several criteria. No water was recovered during drill stem tests and the limits of pay sands are therefore presumed to be related to permeability trends within the sands. To minimize the errors in trying to predict permeability barriers, a "half-way" cut-off was used whenever a sand produced gas in one well but not in another. No gas-water interface was recognized so a horizontal plane through the base of the lowest producing sand was used to limit the reservoirs away from the area between the wells (Fig.2). The working sections (see D.M. Env.2053) and resulting isopachs for both sets of sands were drawn using the above mentioned criteria and the base of Gidgealpa Seismic Contour Plan (Fig.1) as a guide for positioning the horizontal cut-off plane.

TABLE 1

000027

FIELD: DARALINGIE

| Well KB | Sand | Top s.s. | Base s.s. | Thick-ness | Well KB | Sand | Top s.s. | Base s.s. | Thick-ness |
|---|---|---|---|---|---|---|---|---|---|
| 1 | A | 6967 | 6956 | 19 | | | | | |
| 95' | B | 6997 | 7016 | 19 | | | | | |
| | C | 7023 | 7032 | 9 | | | | | |
| 2 | A | 7282 | 7303 | 21 | | | | | |
| 90' | | | | | | | | | |
| 3 | Y | 7063 | 7078 | 15 | | | | | |
| 95' | | | | | | | | | |

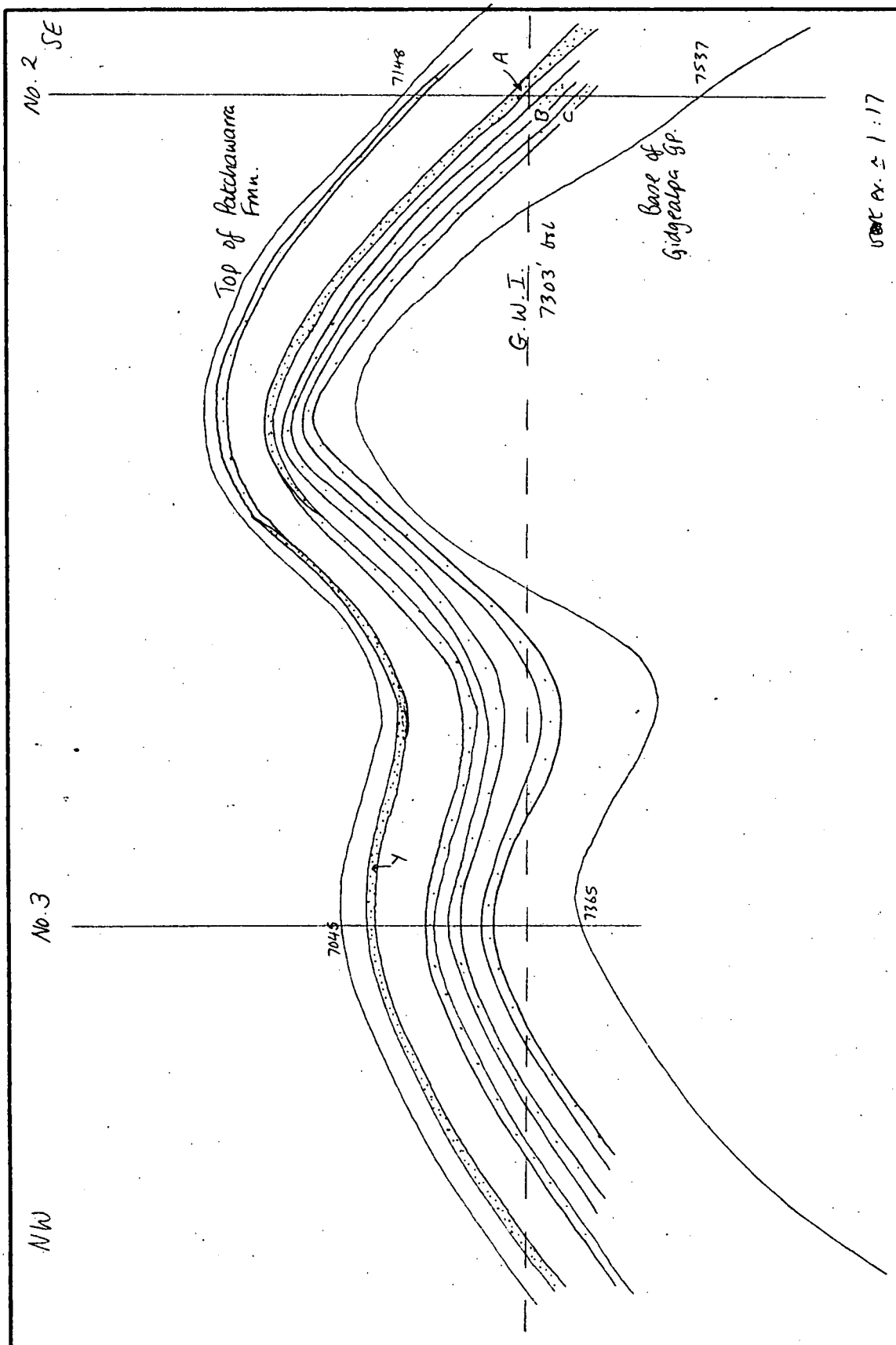


FIG 2

| | | |
|---|---|---|
| | **DEPARTMENT OF MINES – SOUTH AUSTRALIA** | Scale: diag. |
| Compiled: BCY | DARALINGIE GAS FIELD | Date: 8:9:72 |
| Drn. \| Ckd. | Section thro' wells 3 & 2 | Drg. No. |
| | (Diagrammatic only) | Env 2053 |

1M—2.70 A1810

## SECTION 7: DELLA GAS FIELD (I.J.T.)

### General

Della Field is a gas field discovered by Pursuit Oil N.L. by the drilling of Della No.1 Well in August, 1970. To date there are six wells in the Della Gas Field of which 5 are producing wells and one, Della No.3, well, was uneconomic. Della Nos.1 and 2 were drilled by Pursuit Oil and the other four were drilled by Delhi International. The Della structure is an elongated simple dome and was drilled to test this domal trap for the presence of hydrocarbons.

### Reservoir Data

The thickest producing sand total was 120 feet just east of Della 5a. All production in the Della Field comes from the Toolachee Formation. The field covers an area of 15593 acres and its volume is 927404 acre feet. The average porosity for these sands is 15.7%.

### Geometry of the Field

The Della Field was drilled on a broad elongated domal structure and the first well was drilled down the flank (see Fig. 1). The other 5 wells were positioned to give maximum information about the limits of the field. The Della Field is about 25 miles east of the Moomba Field and 5 miles north of Strzelecki No. 1 well. Strzelecki No. 1 well correlates with Della No. 6 well with respect to the Toolachee Formation.

The sands in the Della Field have been placed into 4 groups of sands, A, B, C, and D the producing members of which are listed with depths to top and base and their thicknesses in

Table 1. Della No. 1 well intersected 95 feet of pay sand. This is the thickest pay section in the field.

The limit of the sands was chosen from a horizontal gas water interface at 6458 feet (B.M.S.L.) selected from Della No.2, Della No. 3 and Della No. 6 wells, from log interpretation, drill stem tests and the dual laterologs. This horizontal surface was plotted on working sections (D.M. Envelope No.2054) and an isopach map drawn from the sections (Fig.3) following the trend of the P horizon. Figure 2 is a schematic representation of the working sections.

It should be noted that the horizontal gas water interface does not extend at the same level under the Nappacoongee structure. Water was intersected in the uppermost Toolachee test along with some gas. This means the gas water interface is either steeply dipping from Nappacoongee down to Della 3 or it is a perched gas water interface in the Nappacoongee structure. In either case the volume of gas in the Nappacoongee structure would be small, and of the order of the possible producing structure shown by dashed lines in Fig.3 between Della 3 and Nappacoongee wells.

TABLE 1

000031

| WELL NAME AND NUMBER | K.B. (FEET) | FORMATION | SAND | SAND TOP (FEET) (SUBSEA) | SAND BASE (FEET) (SUBSEA) | THICK-NESS (FEET) |
|---|---|---|---|---|---|---|
| DELLA No. 1 | 208 | TOOLACHEE | A | 6397 | 6436 | 39 |
| | | | B | 6372 | 6388 | 16 |
| | | | $C_1$ | 6353 | 6360 | 7 |
| | | | $C_2$ | 6337 | 6349 | 12 |
| | | | $C_3$ | 6322 | 6328 | 6 |
| | | | D | 6268 | 6283 | 15 |
| | | | | | | 95 |
| DELLA No. 2. | 149 | TOOLACHEE | D | 6386 | 6426 | 40 |
| DELLA No. 3. | 222 | TOOLACHEE | D | 6446 | 6458 | 10 |
| DELLA No. 4. | 213 | TOOLACHEE | A | 6347 | 6392 | 45 |
| | | | B | 6322 | 6336 | 14 |
| | | | $C_1$ | 6305 | 6313 | 8 |
| | | | $C_2$ | 6292 | 6296 | 4 |
| | | | | | | 73 |
| DELLA No. 5a. | | TOOLACHEE | A | 6192 | 6234 | 42 |
| | | | B | 6175 | 6181 | 6 |
| | | | C | 6135 | 6165 | 30 |
| | | | D | 6096 | 6107 | 11 |
| | | | | | | 89 |
| DELLA No. 6. | | TOOLACHEE | B | 6454 | 6458 | 4 |
| | | | $C_1$ | 6435 | 6442 | 7 |
| | | | $C_2$ | 6419 | 6424 | 5 |
| | | | D | 6368 | 6407 | 39 |
| | | | | | | 55 |
| | | | | | | |

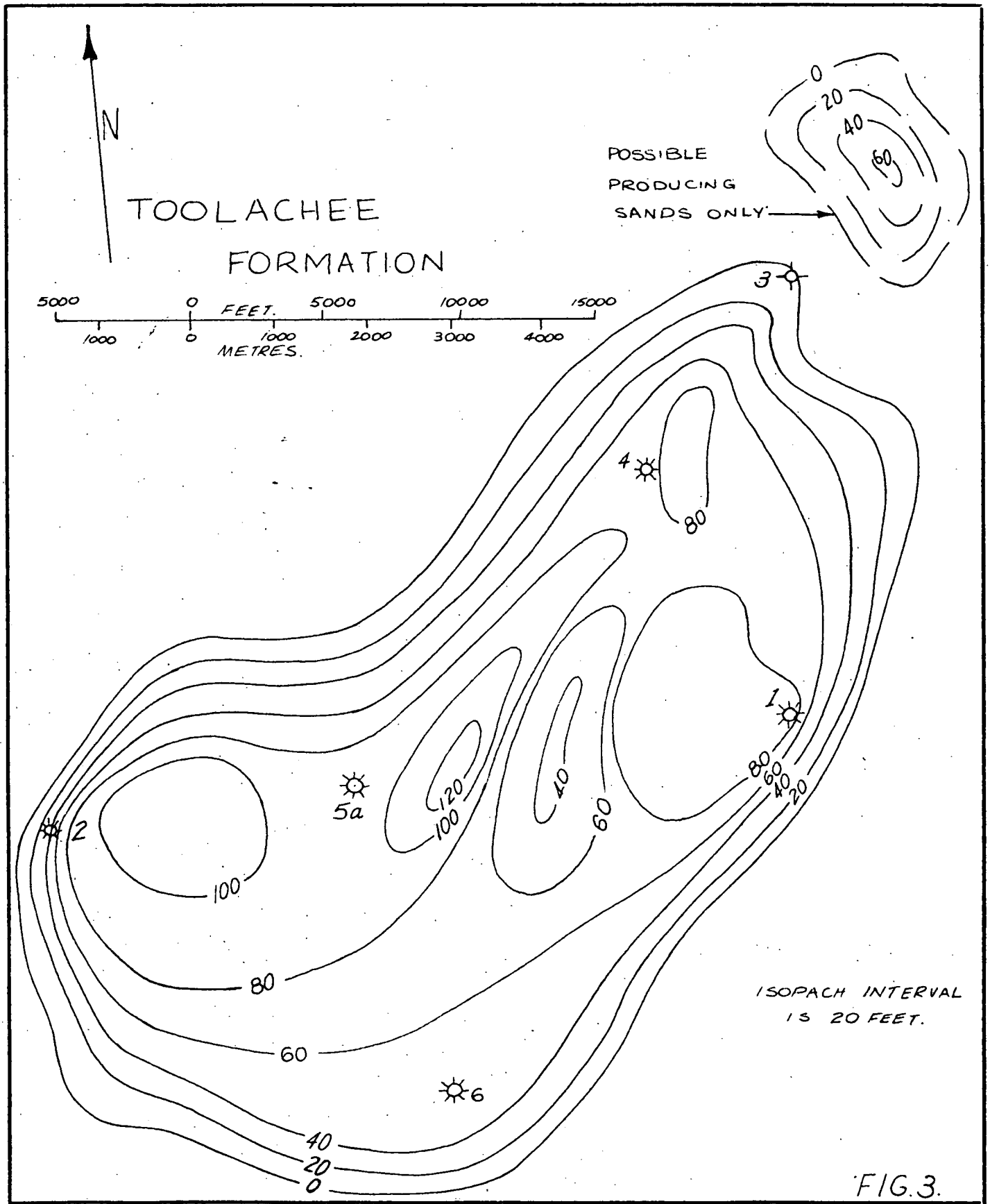


FIG.3.

| | DEPARTMENT OF MINES – SOUTH AUSTRALIA | Scale: 1:60,000 |
|---|---|---|
| Compiled: I.J.T. | DELLA GAS FIELD | Date: 11-9-72 |
| Drn. I.J.T. \| Ckd. | ISOPACHS OF | Drg. No. |
| | PRODUCING SANDS | Env 2054 |

## SECTION 8: FLY LAKE OIL AND GAS FIELD (B.C.Y.)

### General

The Fly Lake Oil and Gas field is owned by the Delhi-Santos-Vamgas-Basin-Bridge-Reef group of companies. Three wells have been drilled in the field, two of them produced oil and gas, the third was dry. Fly Lake 1 tested gas from the Patchawarra Formation on 26th September, 1971, and oil from the Tirrawarra Sandstone two weeks later. The field is sub-divided into two structures which are aligned along the northeasterly trending Fly Lake-Brolga-Moorari Trend (fig. 1). The wells were drilled on these structures with the hope of finding oil and gas as at Tirrawarra to the east.

### Reservoir Data (Patchawarra Formation)

The maximum pay thickness in the gas sands is 163 feet at Fly Lake 1. The gas reservoir covers an area of 4 477 acres and contains 252 462 acre feet of sands with an average porosity of 11.4%.

### Reservoir Data (Tirrawarra Sandstone)

The Tirrawarra Sandstone attains a maximum thickness of 60 feet (fig. 2) to the northeast of No. 2. The field covers an area of 3 765 acres and contains 126 492 acre feet of sands with an average porosity of 11.2%.

### Geometry of the field

The field was drilled on an anticlinal trend consisting of two sub-structures (fig. 1). The first well was drilled at the top of the larger, southwestern one, No. 3 was drilled lower down the same feature and No. 2 on the smaller, northeastern anticline (fig. 1).

The Fly Lake field lies approximately 10 miles west of the Tirrawarra Oil and Gas Field.

Fly Lake 1 contains 15 gas pay sands and 4 oil sands; No. 2 contains only 7 and 2 respectively. The maximum gas sand thickness of 27 feet is attained in No. 2, and there are 3 sands of 20 feet and greater in No. 1. (see Table 1). An oil sand in No. 2 is 39 feet thick. The sands in both the producing wells and the dry one, No. 3, all correlate well with each other.

No gas-water interface was identified within the Fly Lake Field, although No. 3 produced considerable amounts of water from the Patchawarra Formation, and a half-way permeability cut-off was chosen between producing and dry wells. This half-way cut-off was used to minimise the errors involved in predicting a permeability barrier. The field limit to the northeast of No. 2 was placed on the top of a small anticline between the Fly Lake and Brolga Fields because of the absence of any definite indication of a permeability barrier's position (fig. 1). Away from the wells, the two reservoir limits were drawn using the seismic maps as a rough guide - the Lower Member Coal for the Patchawarra Gas Sands and the Base of Gidgealpa for the Tirrawarra Oil Sands. Isopach plans were compiled with the help of a working section (D.M. Env. 2055) drawn from the southwest to the northeast of the field. Figure 2 shows a diagramatic representation of the working section.

Table 1

000035

FIELD: FLY LAKE

| Well KB | Sand | Top s.s. | Base s.s. | Thickness |
|---|---|---|---|---|
| 1 | A | 8476 | 8491 | 15 |
| 114' | B | 8499 | 8501 | 2 |
| | C | 8543 | 8550 | 7 |
| | D | 8563 | 8578 | 15 |
| | E | 8638 | 8640 | 2 |
| | F | 8656 | 8676 | 20 |
| | G | 8681 | 8684 | 3 |
| | H | 8704 | 8714 | 10 |
| | I | 8747 | 8772 | 25 |
| | J | 8779 | 8799 | 20 |
| | O | 9031 | 9046 | 15 |
| | P | 9048 | 9051 | 3 |
| | Q | 9053 | 9056 | 3 |
| | R | 9120 | 9126 | 6 |
| | S | 9182 | 9199 | 17 |
| | T1a | 9220 | 9227 | 7 |
| | T1b | 9230 | 9243 | 13 |
| | T1c | 9246 | 9250 | 4 |
| | T1d | 9254 | 9272 | 18 |

| Well KB | Sand | Top s.s. | Base s.s. | Thickness |
|---|---|---|---|---|
| 2 | K | 9054 | 9065 | 11 |
| 133' | L | 9079 | 9106 | 27 |
| | M | 9146 | 9151 | 5 |
| | N | 9175 | 9178 | 3 |
| | O | 9193 | 9207 | 14 |
| | Q | 9238 | 9241 | 3 |
| | R | 9270 | 9273 | 3 |
| | T1 | 9397 | 9436 | 39 |
| | T2 | 9448 | 9466 | ~~13~~ 18 |

000036

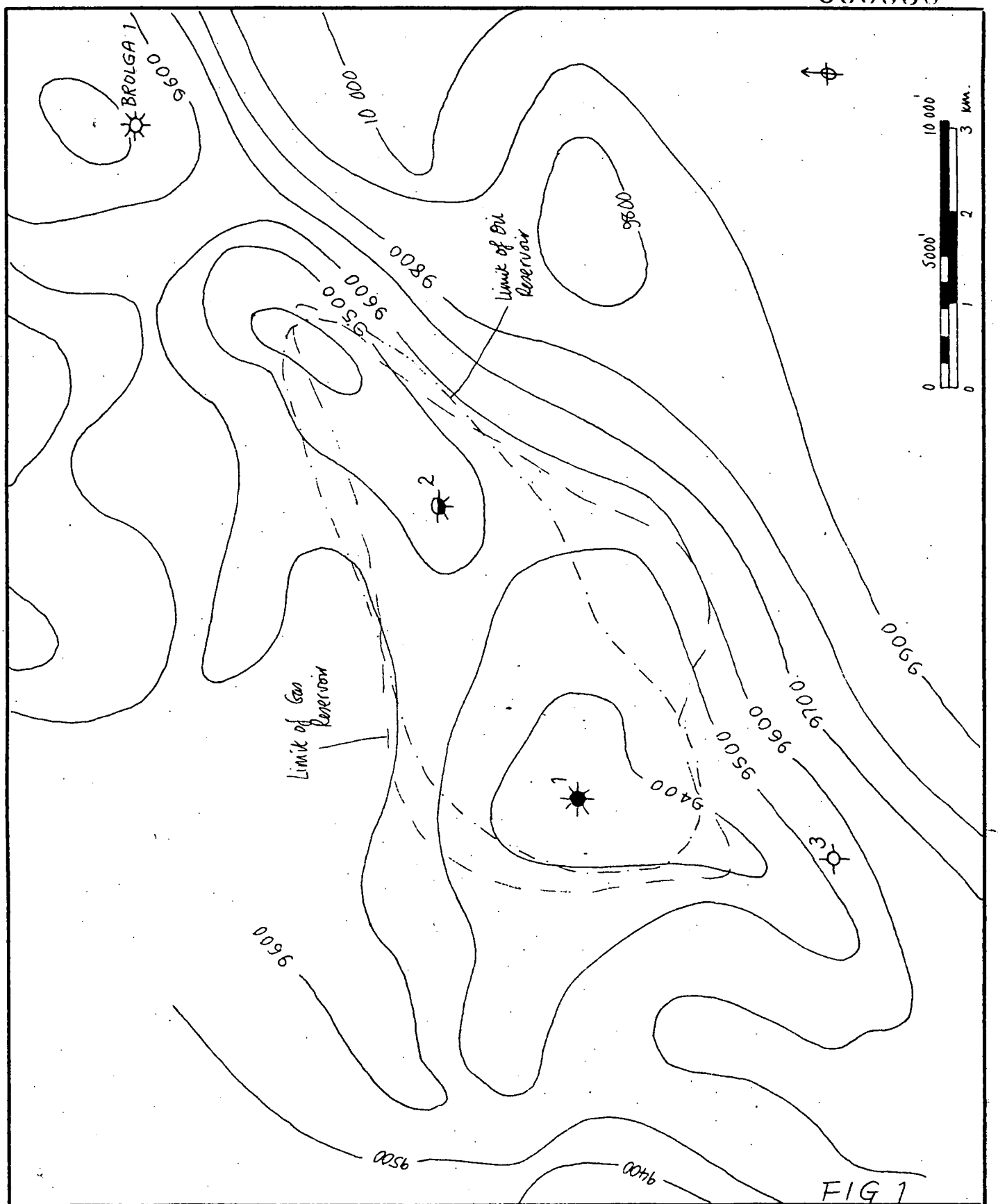


FIG 1

| | DEPARTMENT OF MINES – SOUTH AUSTRALIA | Scale: 1 : 60 000 |
|---|---|---|
| Compiled: BCY | FLY LAKE OIL & GAS FIELD | Date: 11 : 9 : 72 |
| Drn. \| Ckd. | Base of Gidgealpa Seismic Contours | Drg. No. EW 2055 |

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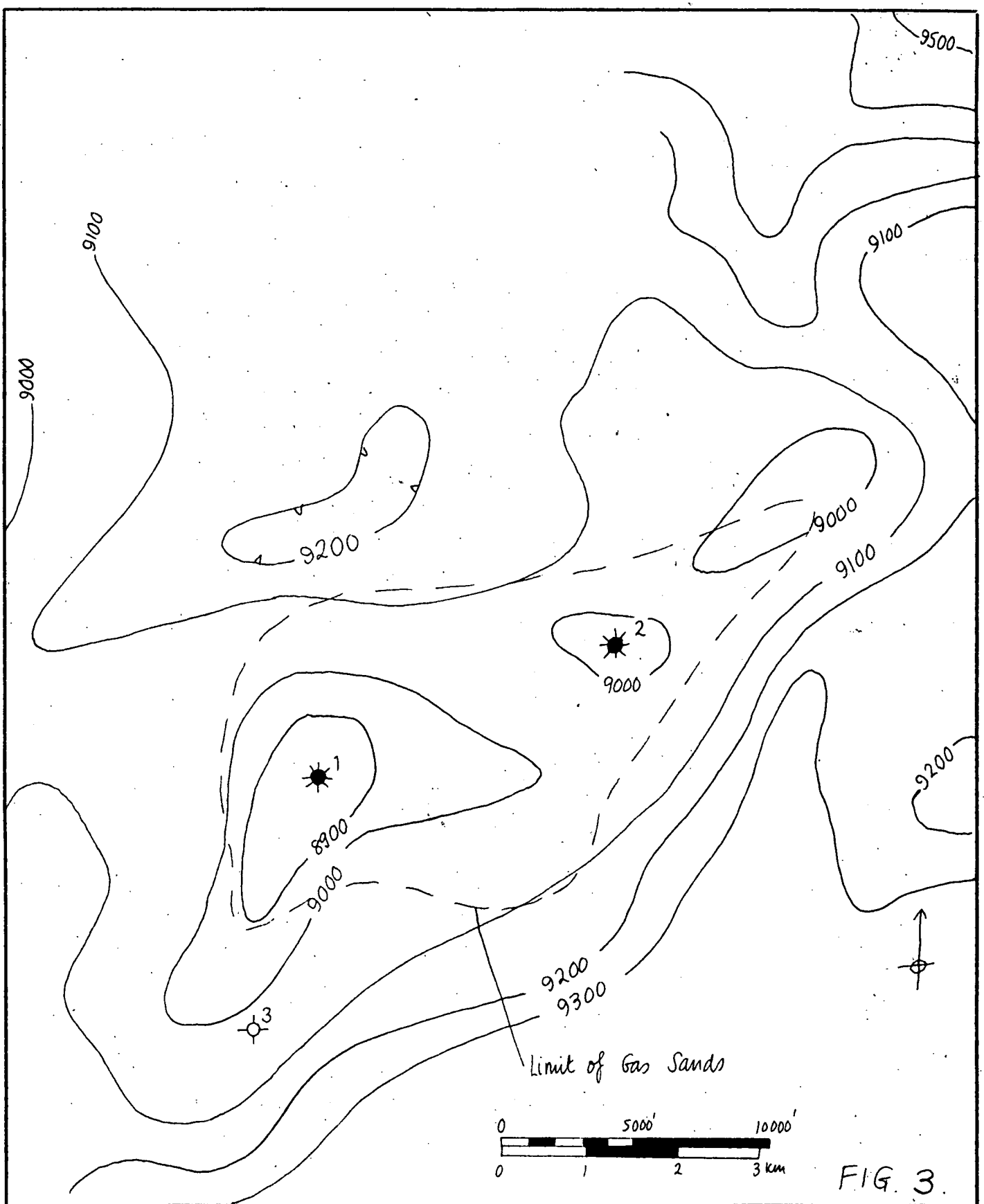


FIG. 3.

| | DEPARTMENT OF MINES – SOUTH AUSTRALIA | Scale: 1 : 60 000 |
|---|---|---|
| Compiled: BCY | FLY LAKE OIL & GAS FIELD | Date: 14 : 9 : 72 |
| Drn. \| Ckd. | Lower Member Coal Seismic Contours, Field Limit | Drg. No. Env 2055 |

## SECTION 9: MERRIMELIA GAS FIELD (B.C.Y.)

### General

The Merrimelia Field was explored by Alliance Oil Development; only the fifth and final well found gas. All previous ones were dry. The five Merrimelia wells are scattered over a distance of more than 20 miles within the Merrimelia-Innamincka farmout area - Nos. 2 and 3 are well to the north of Nos. 1, 4 and 5. All were drilled on separate anticlinal features along the eastern, up-thrown side of the main Gidgealpa Fault and No. 2 was drilled on a structure devoid of any Permian strata.

### Reservoir Data

Merrimelia 5 produced gas from 47 feet of sands at the top of the Toolachee Formation (formerly believed to be Triassic). The reservoir covers an area of 1 372 acres around No. 5 and contains 64 468 acre feet of sand with an average porosity of 16%.

### Geometry of the Field

The well was drilled near to the top of a small dome which is part of a larger, northeast trending structure (fig. 1). It lies a little over 1 mile northeast of No. 4 and approximately 8 miles south of the producing Tirrawarra Field.

Five pay sands are present in the well, the maximum thickness being 19 feet (Table 1).

The reservoir limit was drawn at approximately the 7350 feet b.s.l. contour on the P seismic horizon plan (fig. 1), which corresponds with the position of well No. 5 on that plan. A uniform thickness of 47 feet throughout the area was assumed. The corresponding sands in No. 4 were tight and failed to produce hydrocarbons or water.

Table 1

000040

FIELD: MERRIMELIA

| Well KB | Sand | Top s.s. | Base s.s. | Thick-ness | Well KB | Sand | Top s.s. | Base s.s. | Thick-ness |
|---|---|---|---|---|---|---|---|---|---|
| 5 | A | 7128 | 7132 | 4 | | | | | |
| 201' | B | 7184 | 7186. | 2 | | | | | |
| | C | 7219 | 7223. | 4 | | | | | |
| | D | 7233 | 7251 | 18 | | | | | |
| | E | 7254 | 7373 | 19 | | | | | |

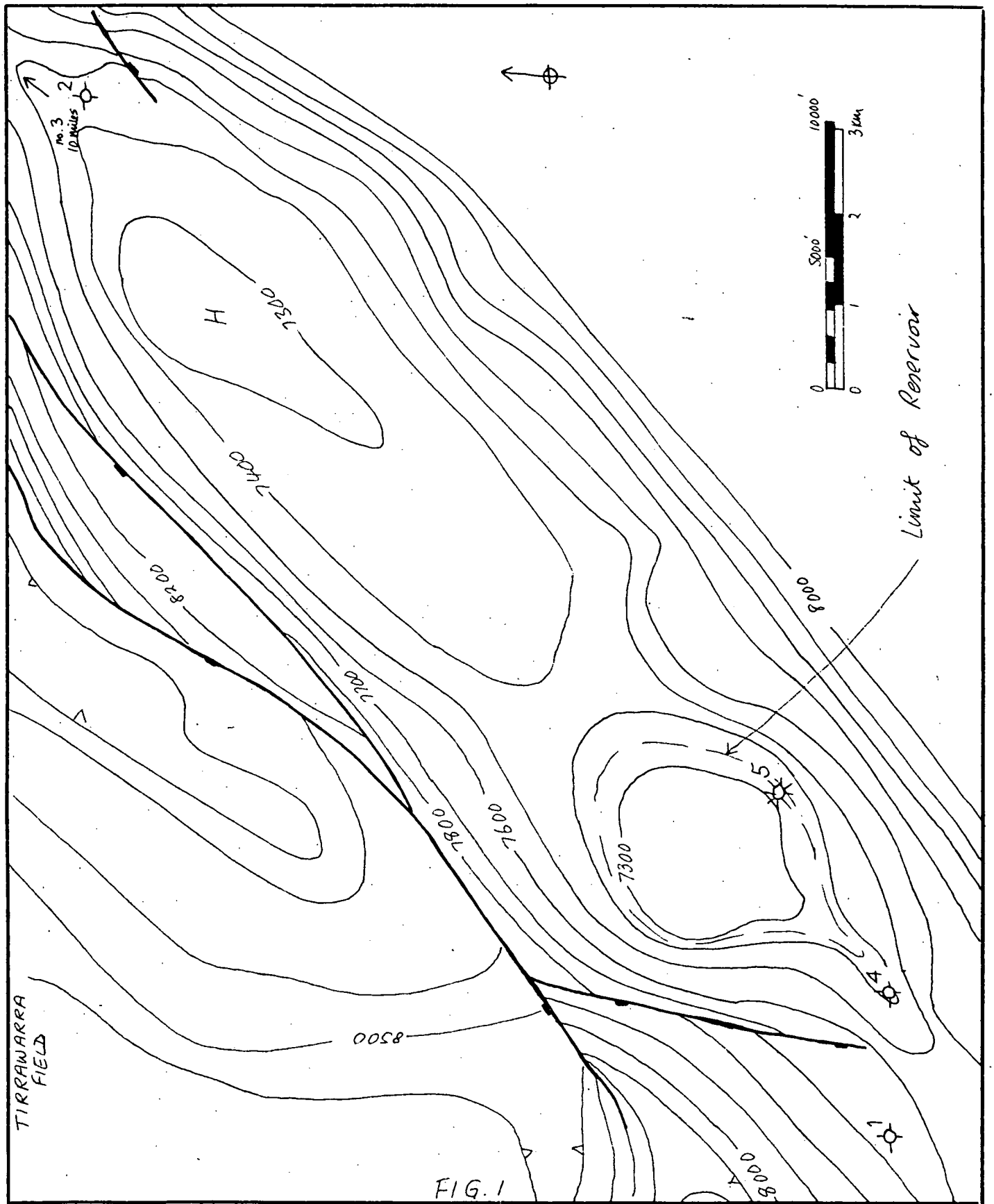


FIG. 1

| | DEPARTMENT OF MINES – SOUTH AUSTRALIA | Scale: 1 : 60 000 |
|---|---|---|
| Compiled: BCY | MERRIMELIA GAS FIELD | Date: 11-9-72 |
| Drn. \| Ckd. | "P" Horizon Contours | Drg. No. Env 2057 |

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## SECTION 10: MOORARI OIL AND GAS FIELD (B.C.Y.)

### General

The Moorari Field is owned by the Delhi-Santos-Vamgas-Bridge-Reef-Basin group. Moorari 1 tested gas from the Toolachee Formation on 8th February, 1971, and oil from the Tirrawarra Sandstone 13 days later. The second, and last, well was dry throughout the section. The field was drilled to test a structural trap which is well defined at the top and base of the Gidgealpa (fig. 1). This small anticline is part of the northeast trending Fly Lake-Brolga-Moorari structural feature.

### Reservoir Data (Toolachee and Patchawarra Formations)

The Toolachee pay consists of four sands totalling 20 feet; the thickest is 6 feet. The three Patchawarra gas sands are 22 feet thick in total and the maximum is 9 feet.

In this study, the gas pay sands from both formations were combined for compilation of the isopach plan; their areal extent equals 1 705 acres, the volume is 46 074 acre feet of sand with an average porosity of 10.9%.

### Reservoir Data (Tirrawarra Sandstone)

The Tirrawarra Sandstone contains four separate sands which total 129 feet. The lowermost sand, 52 feet, is the thickest in the section. The oil reservoir covers an area of 2 204 acres and contains 126 242 acre feet of sand with an average porosity of 11.9%.

Geometry of the Field

The field was drilled on a dome elongated in a north-northeasterly direction which is part of the Fly Lake-Brolga-Moorari trend. The first well was drilled about 200 feet down structure on the southwestern side of the anticline and the second well further down on the northern side (fig. 1). The Moorari field is 4 miles due north of Tirrawarra 3 and a little further northeast of Brolga 1 - both are gas producing wells.

Table 1 shows the tops and bottoms of the pay sands encountered in Moorari 1; the first four are in the Toolachee Formation, the next three the Patchawarra Formation and the rest are Tirrawarra Sandstone (Fig. 2). The sands all correlate reasonably well with the non-productive ones in Moorari 2 and the relationships are shown on the working section (see D.M. Env. 2056).

No water was recovered during testing of Moorari 2 and the sands were assumed to be tight. The limit of each set of pay sands was defined by placing a horizontal cut-off plane (assumed interfaces on fig. 2) at the base of each productive interval. Away from the wells, boundaries were drawn using the P horizon and Base of Gidgealpa Seismic Contours for the gas and oil sands respectively (Fig. 1).

# TABLE 1

000044

FIELD: MOORARI

| Well KB | Sand | Top s.s. | Base s.s. | Thick-ness | Well KB | Sand | Top s.s. | Base s.s. | Thick-ness |
|---|---|---|---|---|---|---|---|---|---|
| 1 | A | 8708 | 8714 | 6 | | | | | |
| 154' | B | 8717 | 8722 | 5 | | | | | |
| | C | 8759 | 8762 | 3 | | | | | |
| | D | 8772 | 8778 | 6 | | | | | |
| | E | 8867 | 8873 | 6 | | | | | |
| | F | 8921 | 8930 | 9 | | | | | |
| | G | 8977 | 8954 | 7 | | | | | |
| | T1 | 9405 | 9454 | 49 | | | | | |
| | T2 | 9472 | 9486 | 14 | | | | | |
| | T3 | 9523 | 9537 | 14 | | | | | |
| | T4 | 9540 | 9592 | 52 | | | | | |

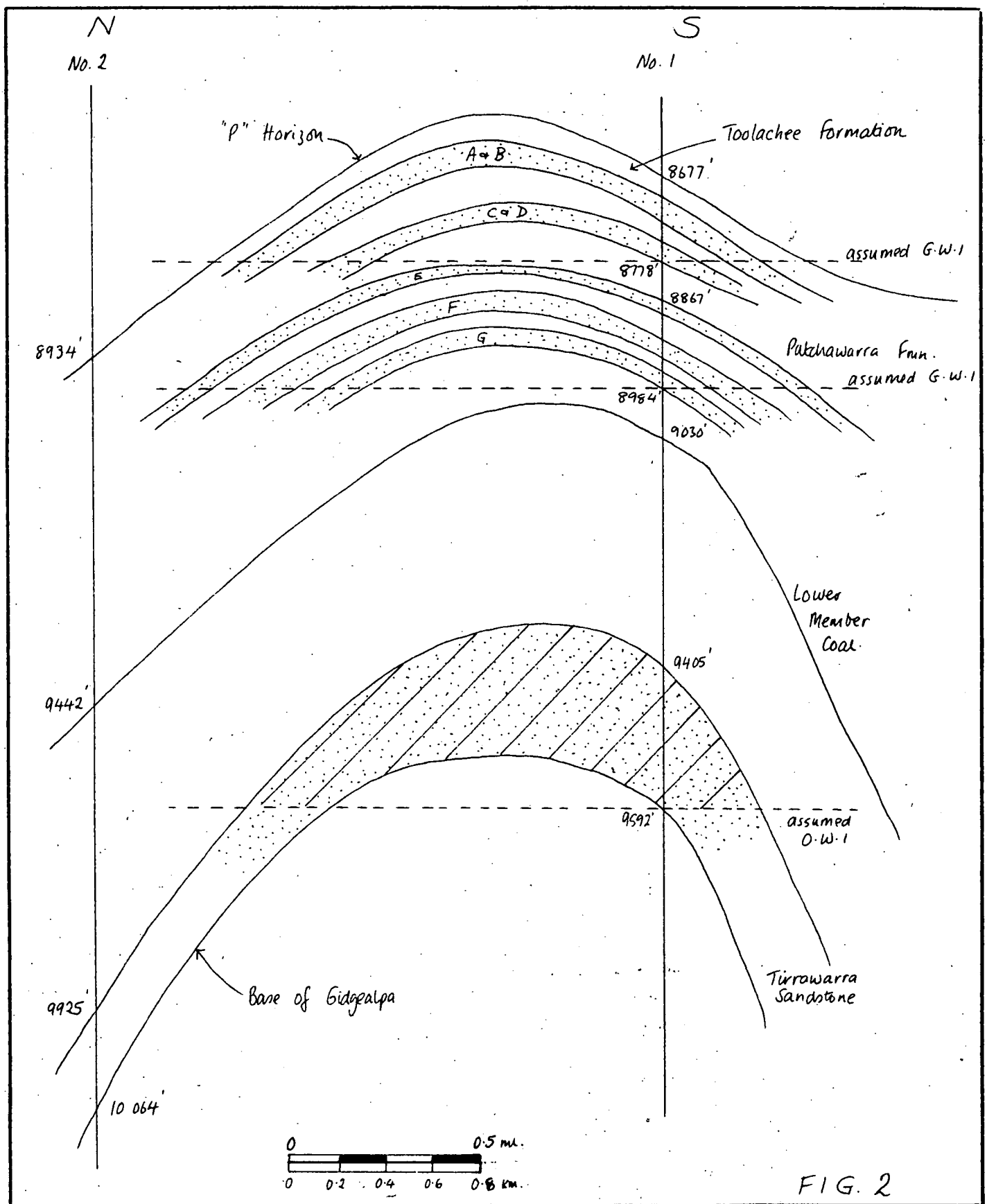


FIG. 2

| | | |
|---|---|---|
| Compiled: BCY | DEPARTMENT OF MINES — SOUTH AUSTRALIA | Scale: diag |
| Drn. / Ckd. | MOORARI OIL & GAS FIELD<br>Diagrammatic Section<br>(depths below S.L.) | Date: 11:9:72 |
| | | Drg. No. Env 2056 |

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## SECTION 11: MUDRANGIE GAS FIELD (I.J.T.)

### General

The Mudrangie Field is a gas field discovered by Alliance Petroleum Australia N.L. during the drilling of Mudrangie No.1 well on the 2nd of November, 1970. Two wells have been drilled on the field (fig.1) one by Pursuit Oil and the 2nd by Delhi International Oil Corp. Mudrangie No.2 did not produce economic quantities of gas owing to tight sands.

The field is probably unique to date as it is the only fault trap producing field in the Cooper Basin (see fig.2). Mudrangie No.1 well was a wildcat well to test this fault trap for the presence of hydrocarbons.

### Reservoir Data

The total pay thicknesses were 11 feet in the Toolachee Formation and 56 feet in the Patchawarra Formation, each consisting of one sand only. The aereal extent of the field is 2 221 acres for both the Patchawarra and Toolachee Formations but volumes were 124,376 acre feet and 24,431 acre feet respectively. The average porosities were 10.4% for the Patchawarra and 24.0% for the Toolachee Formations.

### Geometrey of Field

The Mudrangie Gas Field was drilled on a fault trap, with bedding down and away from the fault, towards the northwest (Figs.1 and 2). The first well was positioned reasonably close to the fault (see fig.1) as no knowledge of the gas water interface was then available.

The closest well to Mudrangie No. 1 is Merrimelia No.3, 6 miles to the east which is a dry well and very close to a bald headed Permian structure. The Tirrawarra Oil and Gas Field is only 8-10 miles west of Mudrangie No. 1 and correlations with this field are far better than the reduced, to non existant, Permian sections in the Merrimelia Field. Only the Roseneath Shale is not represented in the Mudrangie Field.

Only one sand from each formation produced in Mudrangie No. 1 and these are 11 feet for the Toolachee and 56 feet for the Patchawarra Formations. A simple working section was drawn up (Dept. of Mines Env.2057) but was not necessary as constant thicknesses were assumed.

As the P horizon was the only seismic available and no gas water interface was determined, the base of the producing sand in each formation was taken as the boundary. The trend then followed the P horizon contours to the fault in the east and to a permeability barrier in the west. (See Fig.1).

The permeability barrier was chosen from the complications in faulting and change of trend of contours near Mudrangie No.2, because this approximated a half way cut off (See Fig.1). Volumes of each formation were then calculated using the same area and assuming constant pay thickness for each formation.

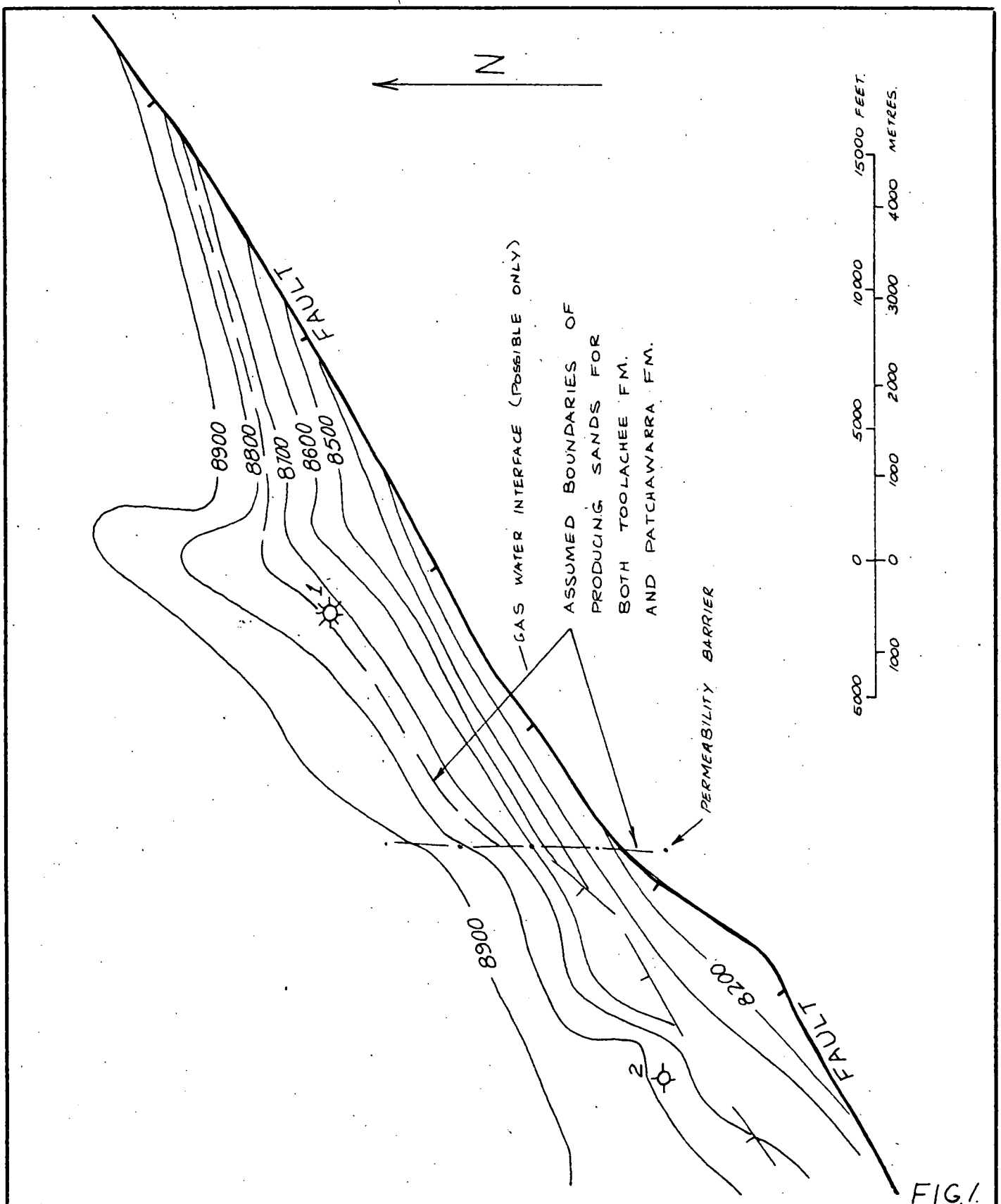


FIG. 1.

| | DEPARTMENT OF MINES — SOUTH AUSTRALIA | Scale: 1: 60,000 |
|---|---|---|
| Compiled: | MUDRANGIE GAS FIELD | Date: 6 - 9 - 72 |
| Drn. \| Ckd. | P - HORIZON | Drg. No. Env 2057 |
| | STRUCTURE CONTOUR PLAN | |

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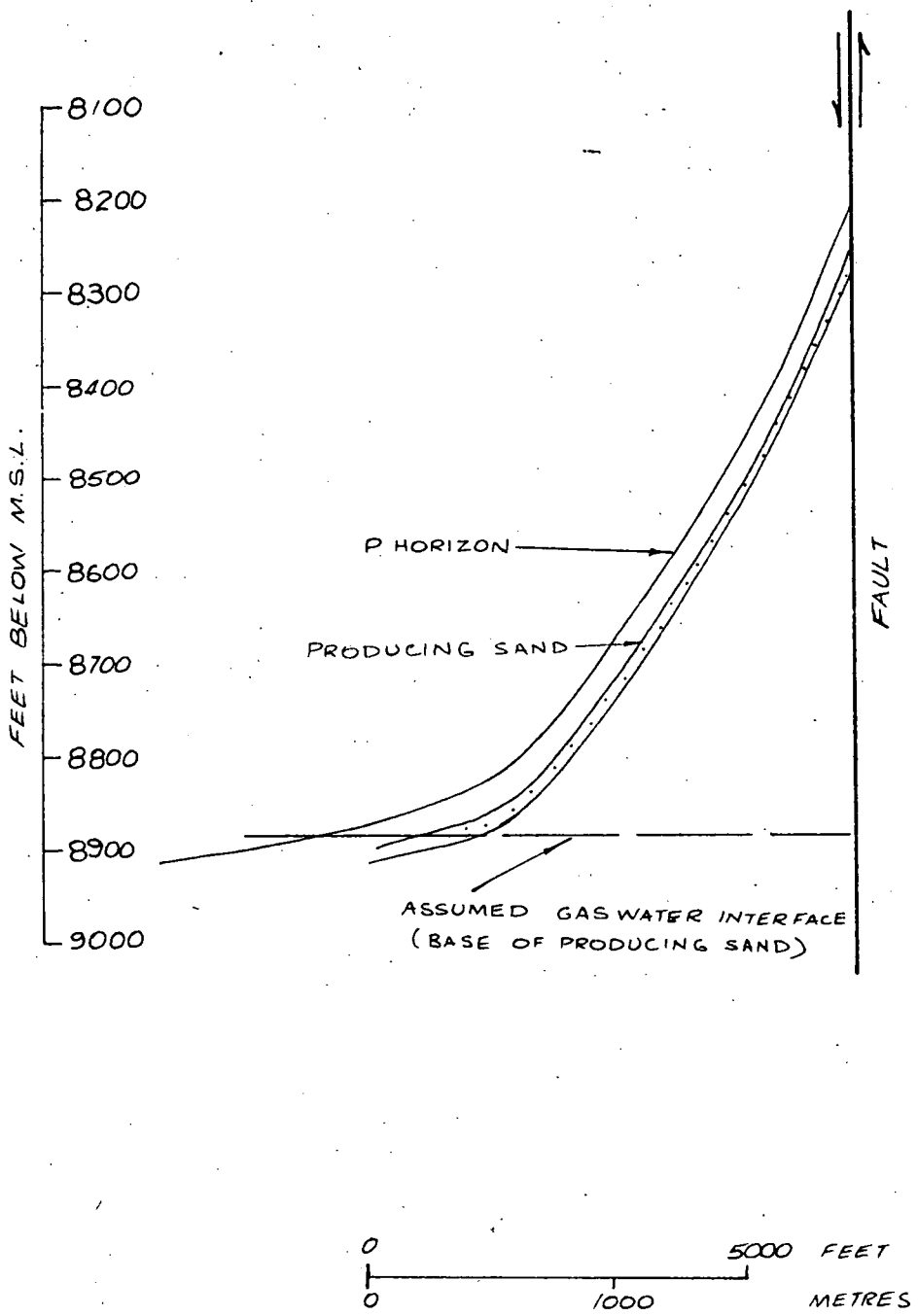


FIG. 2.

| | DEPARTMENT OF MINES – SOUTH AUSTRALIA | Scale: 1: 30 000 |
|---|---|---|
| Compiled: I.J.T. | MUDRANGIE GAS FIELD | Date: 6 - 9 -72 |
| Drn. I.J.T. \| Ckd. | SECTION | Drg. No. |
| | TOOLACHEE FORMATION | Env 2057- |

## SECTION 12: STRZELECKI GAS FIELD (I.J.T.)

### General

The Strzelecki Field is a gas field discovered by Pursuit Oil N.L. during the testing of their Strzelecki No. 1 well in the first drill stem test conducted. Two wells have been drilled on the Strzelecki structure. Strzelecki No.2 well produced only water. It is a broad domal structure complicated by a saddle closer to Strzelecki No. 2 well and separated by another saddle from the Mudlalee structure which also produced only water (Fig.1). Note that North is to the top right hand side of the page in Fig.1. The field was drilled to test this large structure south of the Della Gas Field and to investigate the porous and permeable sands of the Permian Gidgealpa Group.

### Reservoir Data

The maximum pay thickness obtained from the section is 80 feet (see Fig.3) and pay sands are confined to the Toolachee Formation. The field area covers 12,649 acres resulting in a volume of 373,180 acre feet of 12.4% average porosity sands.

### Geometry of the Field

The first well was drilled on a broad domal structure 6 miles to the south of the Della Gas Field. It was situated north of the culmination of the dome on its flank (Fig.1). Eight sands produced from Strezelcki No.1 well as can be seen in Table 1 where tops, bases and producing thicknesses are listed. The total pay thickness is 43 feet for Strzelecki No.1.

Strzelecki No.1 well and Della No.6 well show a good correlation; in fact, better than Della No.6 well correlates with the other Della wells.

The pay sand limits were complicated by the dipping gas water interface from Strzelecki No.2 to Strzelecki No. 1 well. Dips on the gas water interface were calculated by a simple plotting method for;

(a) Mudlalee No. 1 to Strzelecki No.1 wells. The top water producing sand was taken as the gas-water interface (G.W.I.) for Mudlalee. Strzelecki No. 1 well has a well defined G.W.I.

(b) Strzelecki No. 2 to Strzelecki No. 1 wells. Strzelecki No. 1 G.W.I. was fixed (see above) and a slope was chosen (See Fig. 2) so that Strzelecki No. 2 Toolachee Formation was below the G.W.I. and the saddle between the two wells dipped below the G.W.I.

The slopes of the above two G.W.I.'s were corrected to a single direction and compared most favourably (N 1/1000). The calculated slope was adjusted in direction again, and found to trend favourably to the Della G.W.I. level. A dipping gas water interface with the calculated slope was then plotted on the P horizon contour plan (See Fig.1) and the isopach map drawn with the aid of the cross section (Fig.2 sketch). The working sections are all included in Envelope 2058 of the Department of Mines Security Register.

TABLE 1

000052

| WELL NAME AND NUMBER | K.B. (FEET) | FORMATION | SAND | SAND TOP (FEET) (SUBSEA) | SAND BASE (FEET) (SUBSEA) | THICK-NESS (FEET) |
|---|---|---|---|---|---|---|
| STRZELECKI No. 1. | 219 | TOOLACHEE | $B_2$ | 6146 | 6155 | 9 |
| | | | $C_1$ | 6125 | 6127 | 6 |
| | | | | 6129 | 6133 | |
| | | | $C_2$ | 6113 | 6121 | 8 |
| | | | D | 6289 | 6292 | 3 |
| | | | E | 6047 | 6055 | 8 |
| | | | $F_1$ | 6032 | 6037 | 5 |
| | | | $F_2$ | 6018 | 6022 | 4 |
| | | | | | | 43 |

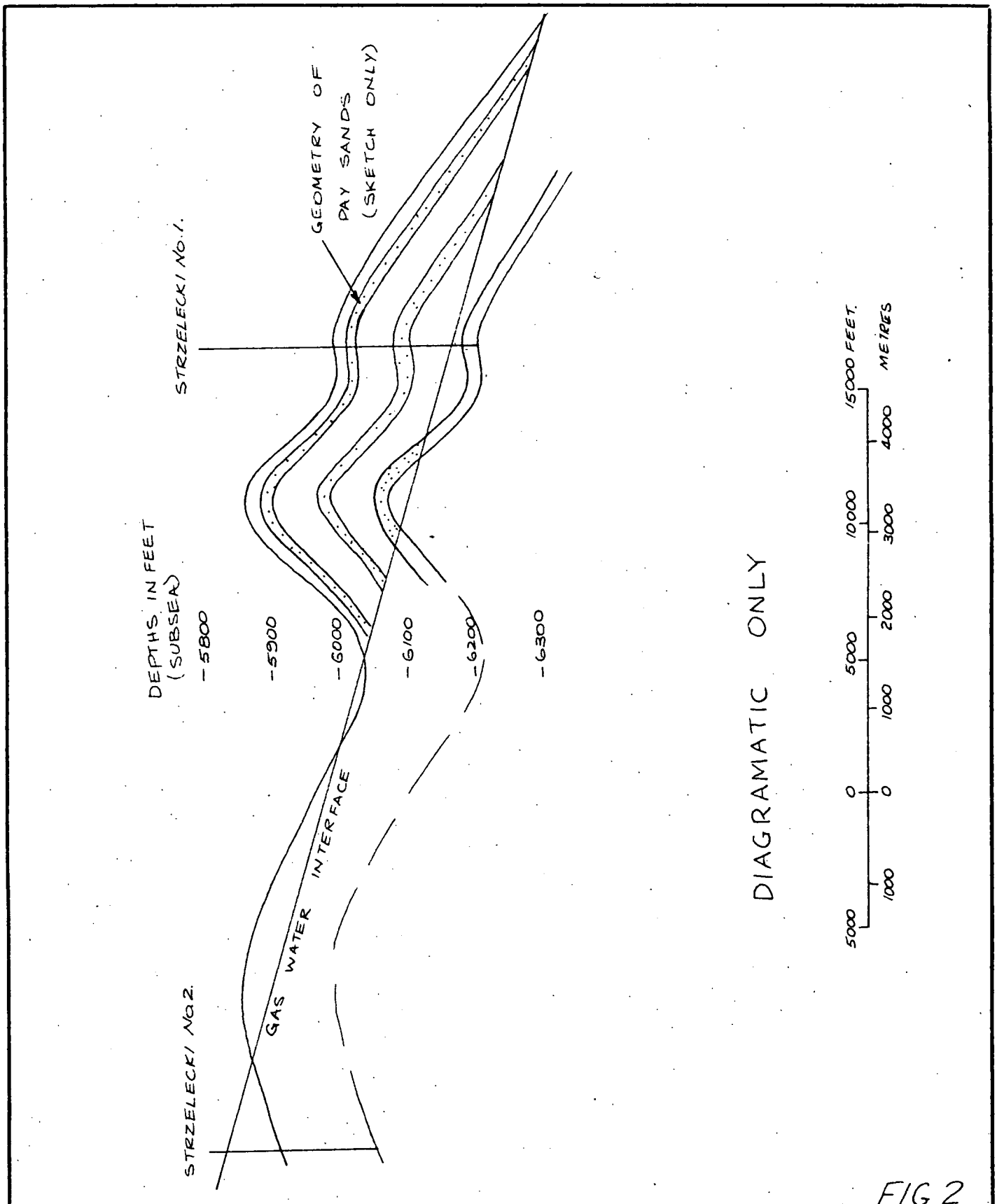


FIG 2

| | DEPARTMENT OF MINES – SOUTH AUSTRALIA | Scale: 1:60,000 (horiz) |
|---|---|---|
| Compiled: I.J.T | STRZELECKI GAS FIELD | Date: 7-9-72 |
| Drn. I.J.T. \| Ckd. | CROSS SECTION | Drg. No. |
| | TOOLACHEE FORMATION | Env 2058 |

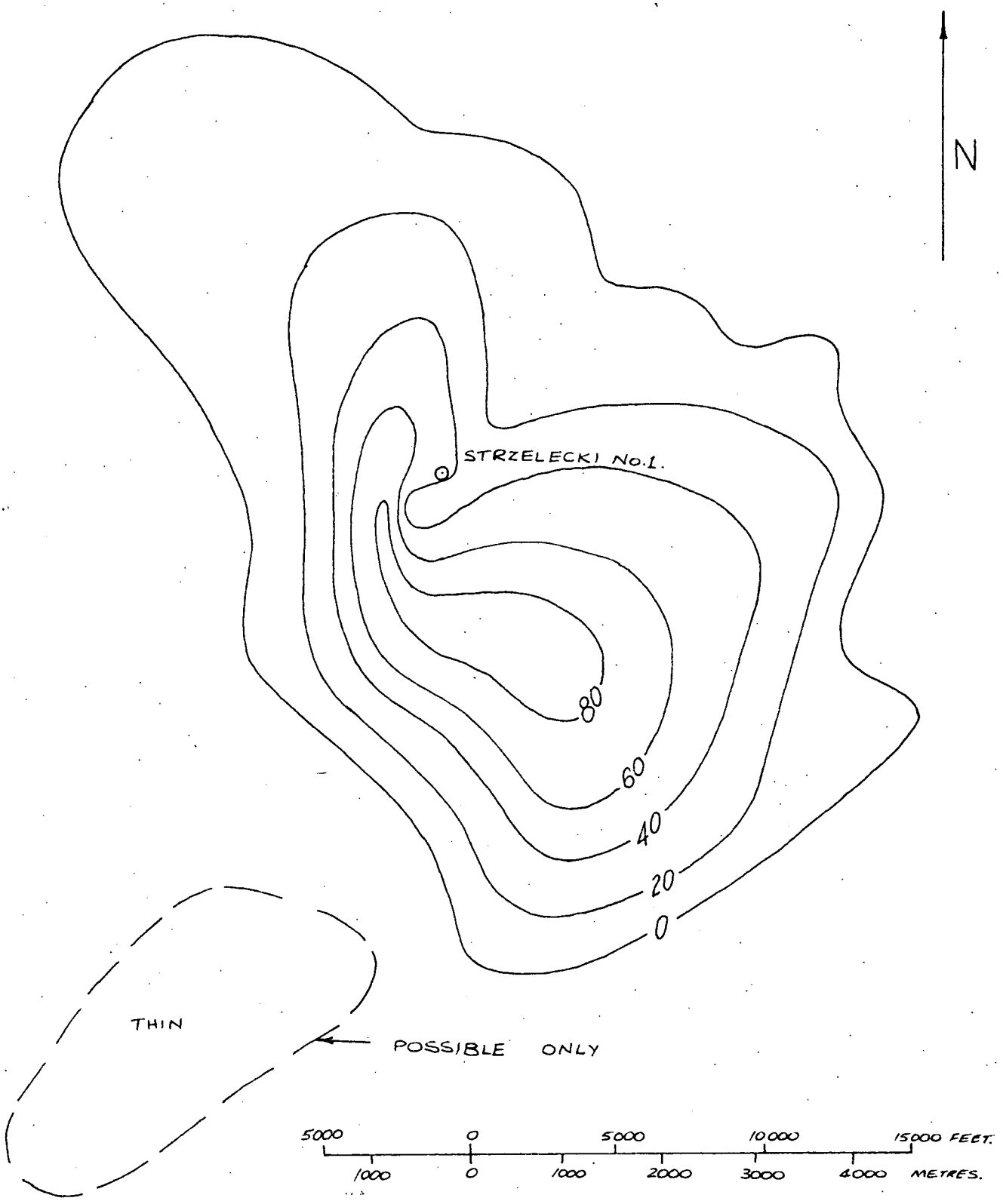


FIG.3.

| | DEPARTMENT OF MINES – SOUTH AUSTRALIA | Scale: 1:60,000 |
|---|---|---|
| Compiled: I.J.T | STRZELECKI GAS FIELD | Date: 7-9-72 |
| Drn. I.J.T. Ckd. | ISOPACHS OF | Drg. No. |
| | PRODUCING SANDS | Env 2058 |

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## SECTION 13: TIRRAWARRA OIL & GAS FIELD (B.C.Y.)

### General

The Tirrawarra Field is owned by the Delhi-Santos-Vamgas-Bridge-Basin-Reef group and is situated in the Patchawarra Central farmout area. The first well tested gas on 20th May, 1970, and oil on 29th May, 1970. Eight more wells were drilled after that and Tirrawarra 10 was drilling at the time of writing. Of the nine drilled so far, five have found oil (Nos. 1, 2, 4, 8 and 9) and five gas (Nos. 1, 2, 3, 8 and 9). Nos. 5, 6 and 7 were all dry. Data concerning No. 9 were received too late to be included in this study. The field was drilled on a large anticline to test what was anticipated as being a structural trap. Since the commencement of exploration it has been realised that the reservoir limits in the Tirrawarra Field are dependent mainly upon permeability barriers rather than structural criteria.

### Reservoir Data

(a) Patchawarra Gas Sands

The gas is produced entirely from the Patchwarra Formation and maximum pay thickness occurs near well No. 8 (Fig. 1). The gas reservoir covers an area of 7 145 acres and contains 205 822 acre feet of sands with an average porosity of 10.6%.

(b) Tirrawarra Oil Sands

The Tirrawarra Sandstone attains much greater thicknesses than the gas pay sands (Fig. 2) and covers a larger area. The oil reservoir extends over 11 817 acres and contains 829 145 acre feet of sands with 12.2% porosity.

Geometry of the Field

The field is situated on a simple anticlinal structure which is aligned roughly parallel to the northeast trending Fly Lake-Brolga-Moorari trend. The first well was drilled slightly away from the centre of the structure and the rest of the wells have been placed at varying distances down the structure (Figs. 1 and 2). The Tirrawarra Field lies 4 miles south of the Moorari Field and the Brolga and Fly Lake Fields lie a little farther to the west.

(a) Patchawarra Gas Sands

Five producing sands (F, G, H, I, & J) have been identified in the Patchawarra Formation (see Table 1 and Fig. 3). Not all of the five produce gas in a given well and the maximum number in most wells is 3 sands. The basal sand, J, is generally the thickest and reaches a maximum of 33 feet in well No. 1. The Patchawarra Formation sands are generally easily correlatable between wells and this is helped by the presence of the Lower Member Coal and other thinner seams which are present throughout the field.

(b) Tirrawarra Oil Sands

The Tirrawarra Sandstone in many places is composed of one sandstone which ranges to more than 100 feet in thickness (Table 1 and working sections, D.M. Env. 2059). In some wells one or more thinner sands and silty layers occur above the main sand. The Tirrawarra Sandstone is easily identifiable underneath the Patchwarra Formation and can be correlated in wells throughout this field and in the surrounding area.

Reservoir Boundaries

(a) Patchawarra Gas Sands

The gas reservoir limits were derived using a combination of half-way permeability cut-offs and the Lower Member Coal structure contours. No gas-water interface was identified in any of the wells. The isopach plan (Fig. 1) was drawn using the working sections (D.M. Env. 2059) and the Lower Member Coal contours.

(b) Tirrawarra Sandstone

Only small amounts of water have been recovered from tests in the Tirrawarra Field and the production is therefore assumed to be controlled mainly by permeability barriers within the sands. Following a study of the average permeability for cores from the Tirrawarra Sandstone in all of the wells, it was felt that the previously referred to half-way cut-off between producing and dry wells would be innappropriate here where the well density was greater.

An empirical relationship between the average permeability of the Tirrawarra Sandstone and the amount of folding and Gidgealpa Group overburden was applied in an effort to define the oil reservoir limits. The degree of folding which the Tirrawarra Sandstone has undergone was equated with the tangent of the angle ($\theta$) between the tangents of points at half a mile either side of the point for which the folding was being measured (Fig. 4). The profile for measuring the angle was drawn along the line of greatest slope on the Base of Gidgealpa plan (Fig. 2).

The following formula was used:

$$K = F \left( \frac{G. \tan \theta}{T} \right)$$

Where K = permeability (average) in millidarcys

G = thickness of Gidgealpa Group in feet

$\theta$ = angle of folding (see Fig. 4)

T = thickness of Tirrawarra Sandstone in feet.

In an attempt to determine the relationship between the LHS and RHS of the above formula permeability data from well cores were used. Values for $\left( \frac{G. \tan \theta}{T} \right)$ were determined at each well site. These calculated values were then plotted against average permeability values (Fig. 5). No simple relationship is evident. All wells fall within a zone which is asymptotic to both axes. No cores were taken from well No. 4 so that a permeability value cannot be assigned to it. Whatever its value, it will fall within the general zone outlined on Figure 5. This zone was outlined by eye.

In choosing a line to represent the function relating the two parameters plotted, the most conservative view was taken. That is to say, the lower boundary of the zone of plots was taken as the function rather than a line of best fit.

Values of $\frac{(G. \text{ Tan } \theta)}{T}$ were calculated at 14 points around the Tirrawarra Field (Fig. 4). These points were chosen close to seismic lines where the structural control would be best. Using the function on the graph (Fig. 5) permeability values were determined at these points. These points were then used as controls for a line defining the 2.5 md limit of permeability in the field (solid line, figure 4).

In order to make the estimate even more conservative, structural control on the limits of the field was also assumed. The 9850 feet contour was chosen because it allows the possibility of some water in the sandstones in Well No. 7 (D.S.T. No. 3).

The final limits of the field were determined by using the 9 850 feet structure contour and the 2.5 md permeability line in combination. The final limit was taken at either of these two boundaries, whichever defined the most conservative area (shaded area, figure 4).

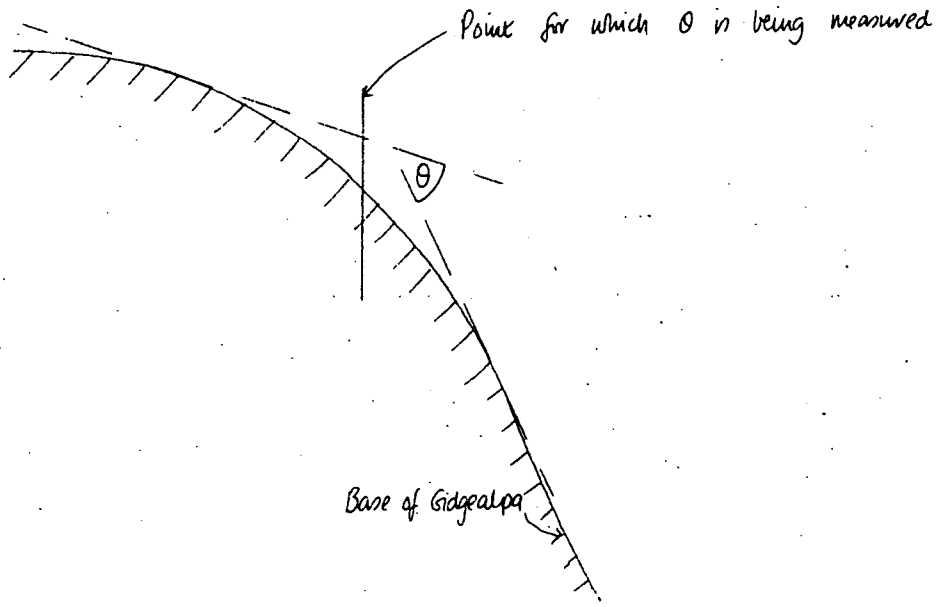
The isopach plan (Fig. 2) was drawn using working sections (DM. envelope 2059) and the Base of the Gidgealpa contours.

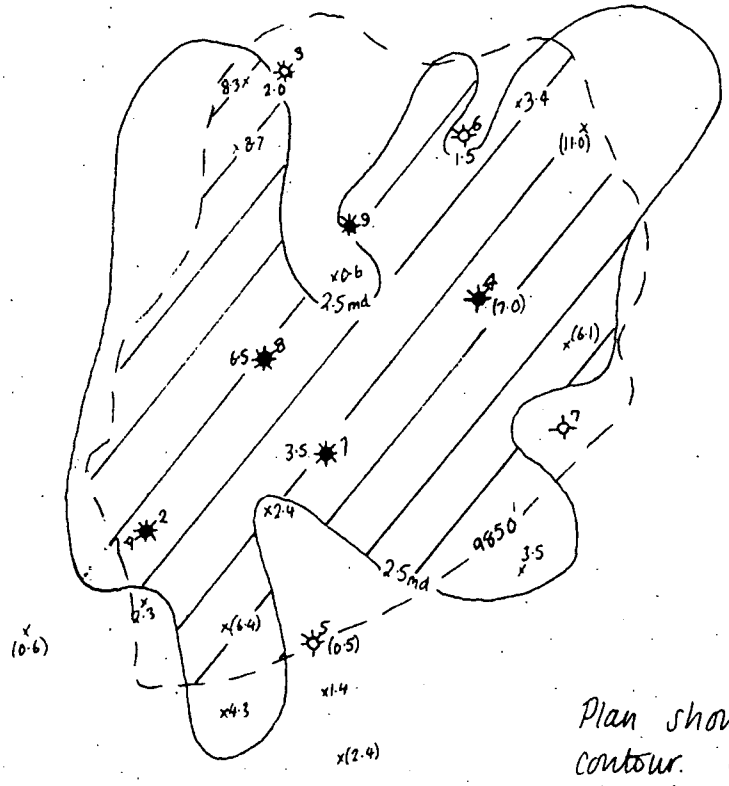
Table 1

000060

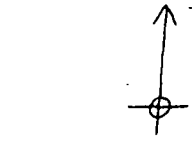
FIELD: TIRRAWARRA

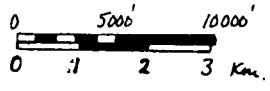
| Well KB | Sand | Top s.s. | Base s.s. | Thickness | Well KB | Sand | Top s.s. | Base s.s. | Thickness |
|---|---|---|---|---|---|---|---|---|---|
| 1 | G | 8691 | 8704 | 13 | | | | | |
| 129' | I | 8860 | 8866 | 6 | | | | | |
| | J | 8874 | 8907 | 33 | | | | | |
| | T | 9429 | 9566 | 137 | | | | | |
| 2 | I | 8939 | 8948 | 9 | | | | | |
| 123' | J | 8972 | 8989 | 17 | | | | | |
| | T1 | 9618 | 9628 | 10 | | | | | |
| | T2 | 9639 | 9729 | 90 | | | | | |
| 3 | F | 8859 | 8863 | 4 | | | | | |
| 127' | G | 8873 | 8883 | 10 | | | | | |
| | H | 9008 | 9023 | 15 | | | | | |
| 4 | T | 9537 | 9637 | 100 | | | | | |
| 129' | | | | | | | | | |
| 8 | H | 8801 | 8823 | 22 | | | | | |
| 129' | I | 8853 | 8870 | 17 | | | | | |
| | J | 8878 | 8904 | 26 | | | | | |
| | T1 | 9418 | 9424 | 6 | | | | | |
| | T2 | 9431 | 9503 | 72 | | | | | |




Oil Reservoir Boundary






Plan showing the 2·5 md line and 9850' b.s.l. contour. Shaded area is reservoir area used in calculations.

FIG 4.

| | DEPARTMENT OF MINES – SOUTH AUSTRALIA | Scale: — |
|---|---|---|
| Compiled: BCY | TIRRAWARRA OIL & GAS FIELD | Date: |
| Drn. \| Ckd. | Calculations and Plan for Reservoir limit | Drg. No. Env 2059 |

LM—2.70 A1810

000062

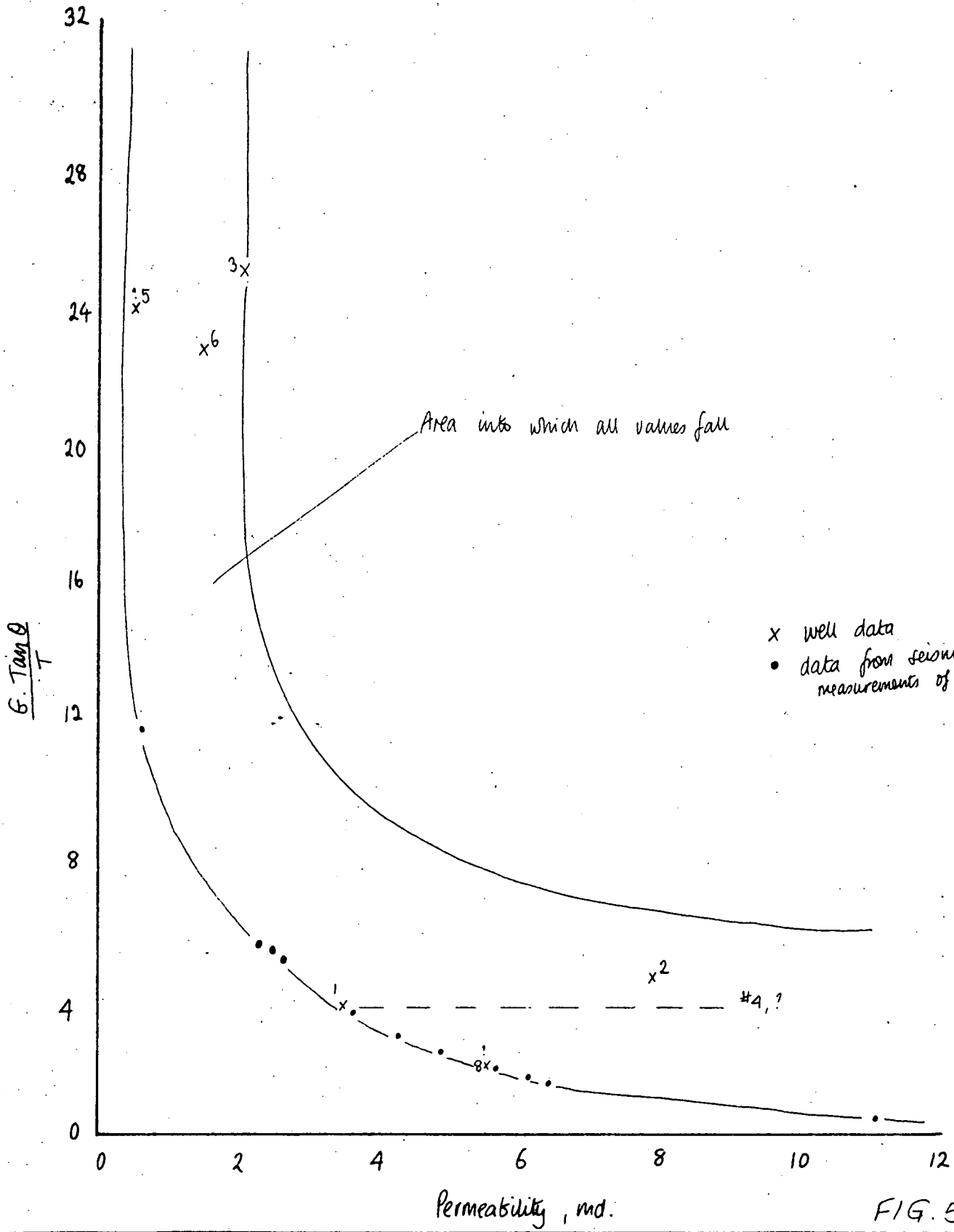



FIG. 5

| | DEPARTMENT OF MINES – SOUTH AUSTRALIA | Scale: |
|---|---|---|
| Compiled: BCY | TIRRAWARRA OIL & GAS FIELD | Date: 14 : 9 : 72 |
| Drn. \| Ckd. | Graph for Permeability Calculations, Oil Sands | Drg. No. Emo 2059 |

1M—2.70 A1810

## SECTION 14: TOOLACHEE GAS FIELD (B.C.Y.)

### General

The Toolachee Field is owned by the Delhi-Santos-Vamgas group and was discovered on 16th March, 1969. Nine wells have been drilled to date, the ninth (Toolachee East-1) was drilled after this reservoir study and is not included in this report. Six of the wells have tested gas and only two (Nos. 2 and 8) were dry. The field is divided into three distinct producing areas mainly as a result of a sloping gas-water interface (Fig. 2) which cuts off the reservoirs around wells Nos. 4 and 5 (Fig. 3). The three reservoirs were all discovered as a result of drilling to test structural traps.

### Reservoir Data

The thickest pay occurs in the centre of the largest reservoir area (wells 1, 3, 6 and 7 on Fig. 3) and is over 180 feet. All gas production comes from the Patchawarra Formation. The three reservoirs at Toolachee cover a total area of 21 768 acres and contain 1 139 596 acre feet of sands with an average porosity varying between 12.4 and 15.4%.

### Geometry of the Field

The field was drilled on four separate anticlines, three of which were productive. The first well was placed nearly to the top of the largest anticline (Fig. 1). Brumby No. 1 lies 10 miles to the east of Toolachee and is the nearest field to it.

Six pay sands have been delineated within the Patchawarra Formation but they do not all produce within any one well (Table 1). The maximum pay thickness of 160 feet occurs in the centre of the largest reservoir (i.e. around well Nos. 1, 3, 6 & 7) (Fig. 3). The sands correlate well between all wells in the field and between the separate structures.

A gas-water interface was identified in all of the wells except No. 1 and was shown to be dipping towards No. 6 (Fig. 2). The intersection of the undulating gas-water interface with the top of the Patchawarra Formation (derived from Patchawarra Isopachs (Fig. 5) and Base of Gidgealpa Seismic contours (Fig. 1)) outlined three distinct reservoirs. Isopachs were drawn using the working sections (DM. Env. 2060), the structural contour and Patchawarra Isopach plans (Fig. 3). The eastern limit of the No. 4 reservoir and the western and eastern limits of the main reservoir are bounded by large faults (Fig. 1).

TABLE 1

000065

| WELL NAME AND NUMBER | K.B. (FEET) | FORMATION | SAND | SAND TOP (FEET) (SUBSEA) | SAND BASE (FEET) (SUBSEA) | THICK-NESS (FEET) |
|---|---|---|---|---|---|---|
| TOOLACHEE 1 | 185 | Patchawarra | A | 6657 | 6679 | 22 |
| | | | B | 6689 | 6730 | 41 |
| | | | C | | | |
| | | | E | 6771 | 6777 | 6 |
| " 3 | 221 | " | A | 6983 | 6997 | 14 |
| | | | B | 7051 | 7077 | 26 |
| | | | B2 | 7087 | 7100 | 13 |
| | | | C | 7116 | 7131 | 15 |
| " 4 | 205 | " | X | 6956 | 6965 | 9 |
| | | | A | 7019 | 7029 | 10 |
| | | | C | 7063 | 7085 | 22 |
| " 5 | 221 | " | A | 7122 | 7134 | 12 |
| | | | B | 7140 | 7155 | 15 |
| | | | C | 7170 | 7188 | 18 |
| " 6 | 238 | " | A | 7238 | 7251 | 13 |
| | | | B | 7320 | 7335 | 15 |
| | | | C | 7353 | 7410 | 57 |
| " 7 | 221 | " | X | 7090 | 7110 | 20 |
| | | | Y | 7130 | 7150 | 20 |

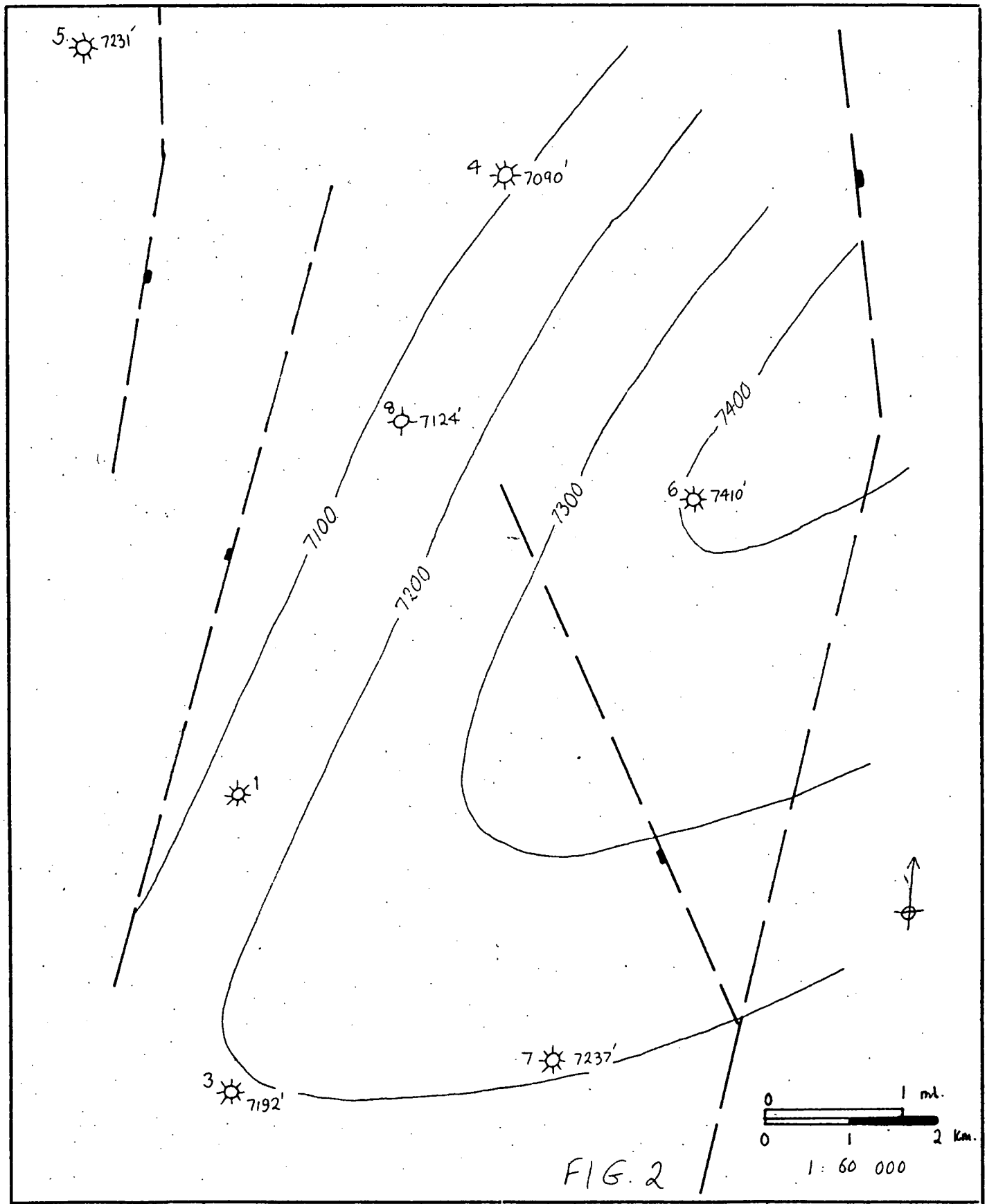
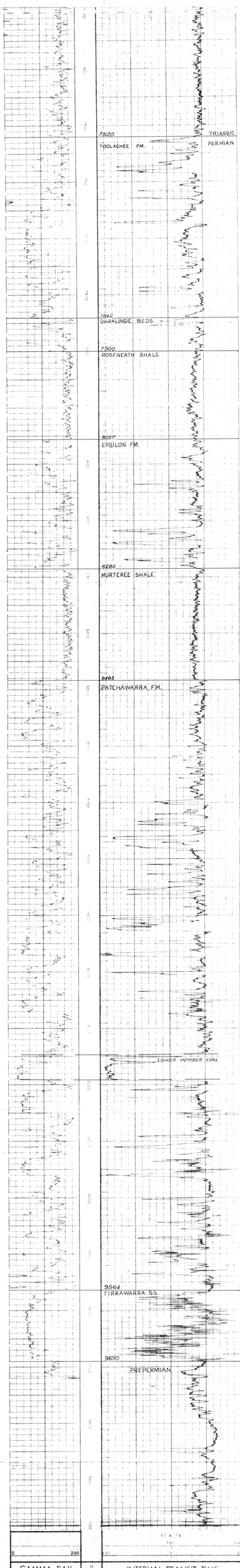



FIG. 2

| | DEPARTMENT OF MINES – SOUTH AUSTRALIA | Scale: 1 : 60 000 |
|---|---|---|
| Compiled: BCY | TOOLACHEE GAS FIELD | Date: 14 : 9 : 72 |
| Drn. \| Ckd. | Depth to Gas-Water Interface, feet B.S.L. | Drg. No. Eng 2060 |

1M—2,70 A1810




0 200

GAMMA RAY
API UNITS

INTERVAL TRANSIT TIME
MICROSECONDS PER FOOT

COMPANY DELHI PETROLEUM

WELL BIG LAKE # 1

FIELD WILDCAT

COUNTY MURRAY STATE S.A.

SCHL. TD 10047
SCHL. TD 10046
DRLR. TD 10046
Elev.:
KB 130
DF 133
GL 123

RB 772-1

FIG. 2.

RB 772-2

139°00'
140°00'
141°00'
142°00'
142°45'
26°30'
27°00'
28°00'
29°00'

PATCHAWARRA EAST
(FLINDERS)

FLINDERS 37·5
SANTOS 25
DELHI 20
VAMGAS 5
ABROLHOS 12·5

5-D 1966
(TOTAL)

TOTAL 25
SANTOS 37·5
DELHI 30
VAMGAS 7·5

BRIDGE 25
SANTOS 25
DELHI 20
VAMGAS 5
REEF 12·5
BASIN 12·5

INNAMINCKA
(FLINDERS)

FLINDERS 10
SANTOS 45
DELHI 36
VAMGAS 9

PATCHAWARRA CENTRAL
(BRIDGE)

ALLIANCE 50
SANTOS 25
DELHI 20
VAMGAS 5

MERRIMELIA
INNAMINCKA
(ALLIANCE)

VAMGAS 30
PEXA 15
SANTOS 25
DELHI 20
ENDEAVOUR 10

PATCHAWARRA SOUTHWEST
(PEXA - VAMGAS)

SANTOS 50
DELHI 40
VAMGAS 10

PPL 1
PPL 2
PPL 3
PPL 4
PPL 5

LAKE HOPE

SANTOS 50
DELHI 40
VAMGAS 10

NAPPACOONGIE
MURTEREE
(PURSUIT)

PURSUIT 30
SANTOS 35
DELHI 25
VAMGAS 7

MURTA
(PEXA - VAMGAS)

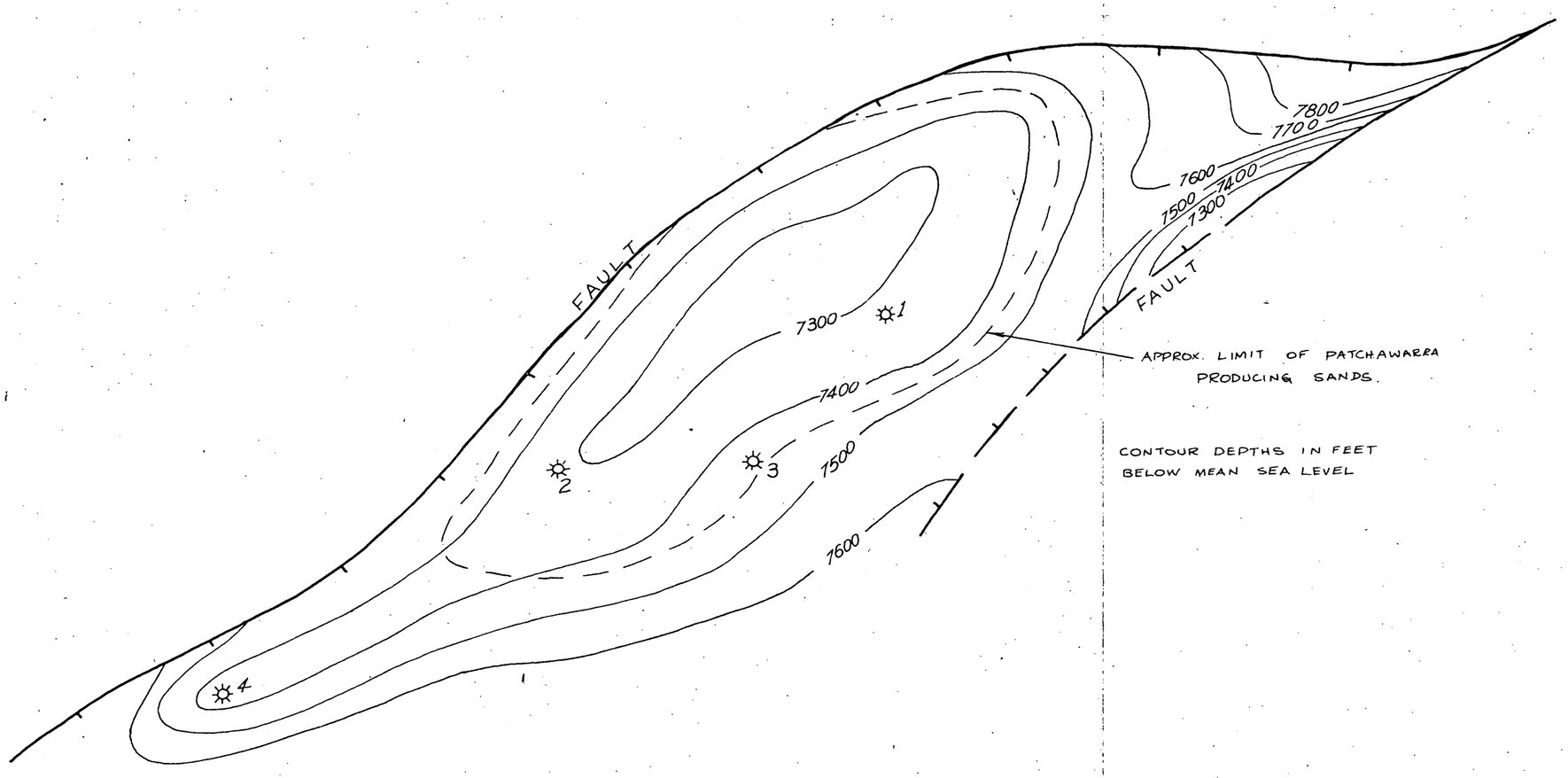
VAMGAS 14
PEXA 5
SANTOS 45
DELHI 36

SANTOS 50
DELHI 40
VAMGAS 10

INDEX MAP
OF
COOPER BASIN

FIELDS AND FARMOUT AREAS
AT JUNE 1972

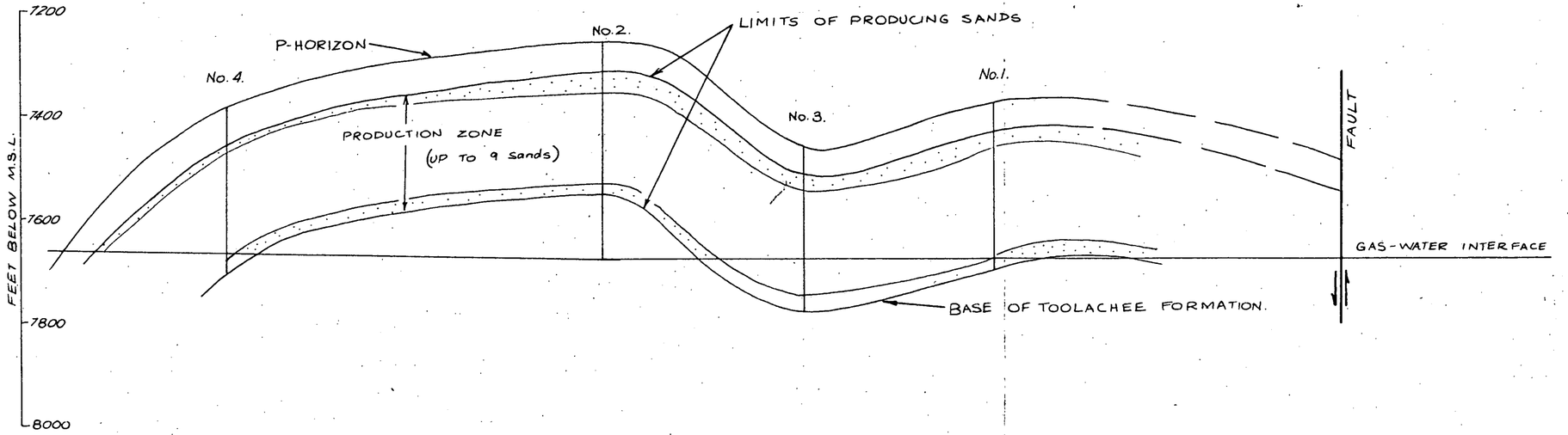
0 10 20 30
Miles




RB 772-3 FIG. 1.

| | DEPARTMENT OF MINES — SOUTH AUSTRALIA | Scale: 1:60,000 |
|---|---|---|
| Compiled: I.J.T. | BIG LAKE GAS FIELD | Date: 30-8-72 |
| Drn. I.J.T. Ckd. | P - HORIZON | Drg. No. Env 2051 |
| | STRUCTURE CONTOUR PLAN | |

1M—2.70 A1611



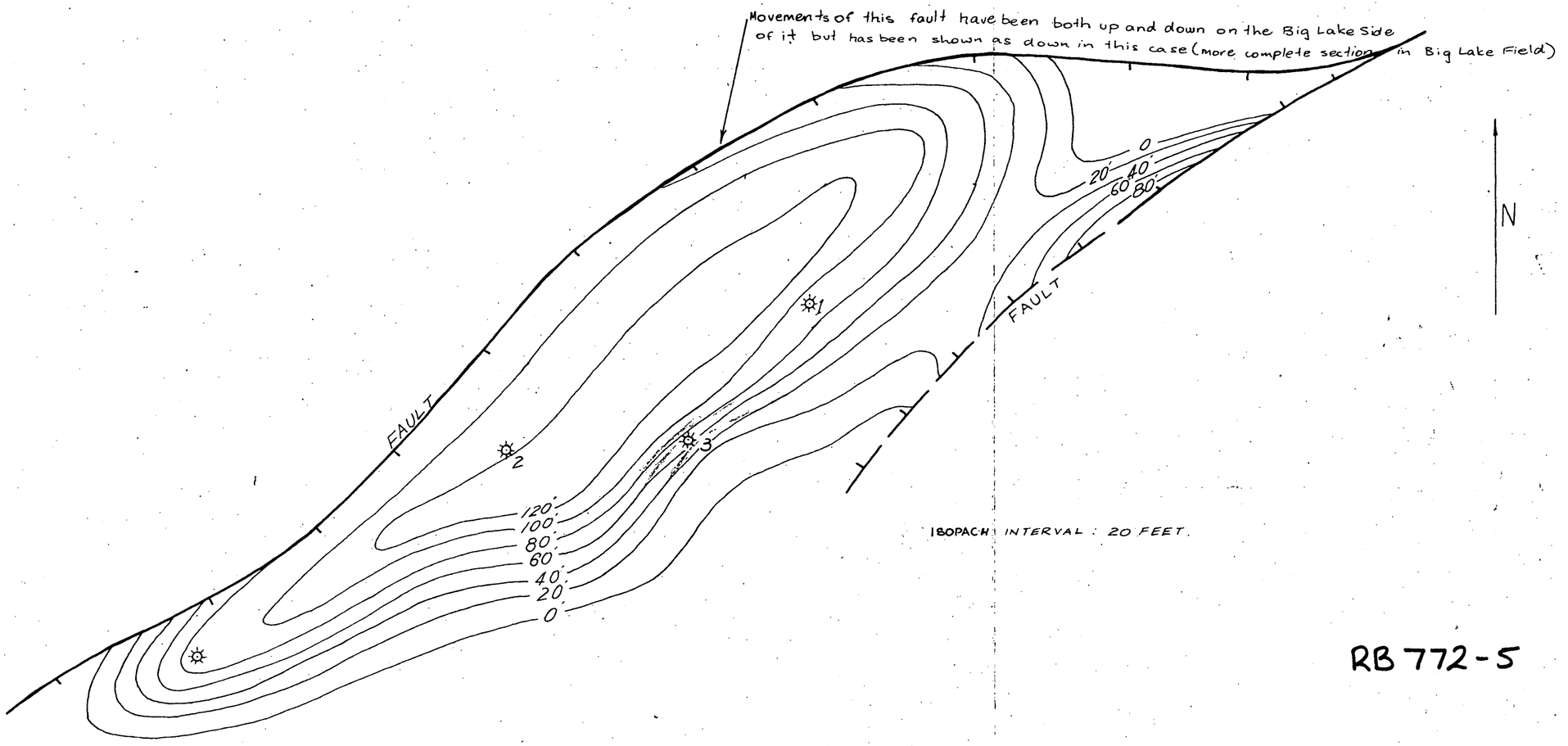

DIAGRAMATIC ONLY

5000 0 5000 10000 15000 FEET.
1000 0 1000 2000 3000 4000 METRES

RB 772-4 FIG. 2.

| | | |
|---|---|---|
| | DEPARTMENT OF MINES — SOUTH AUSTRALIA | Scale: 1:60,000 (horiz.) |
| Compiled: | BIG LAKE GAS FIELD | Date: 30-8-72 |
| Drn. \| Ckd. | CROSS SECTION | Drg. No. |
| | TOOLACHEE FORMATION | Gw 2057 |

1M—2,70 A1811




ISOPACH INTERVAL : 20 FEET.

RB 772-5

5000 0 5000 10000 15000 FEET.
1000 0 1000 2000 3000 4000 METRES.

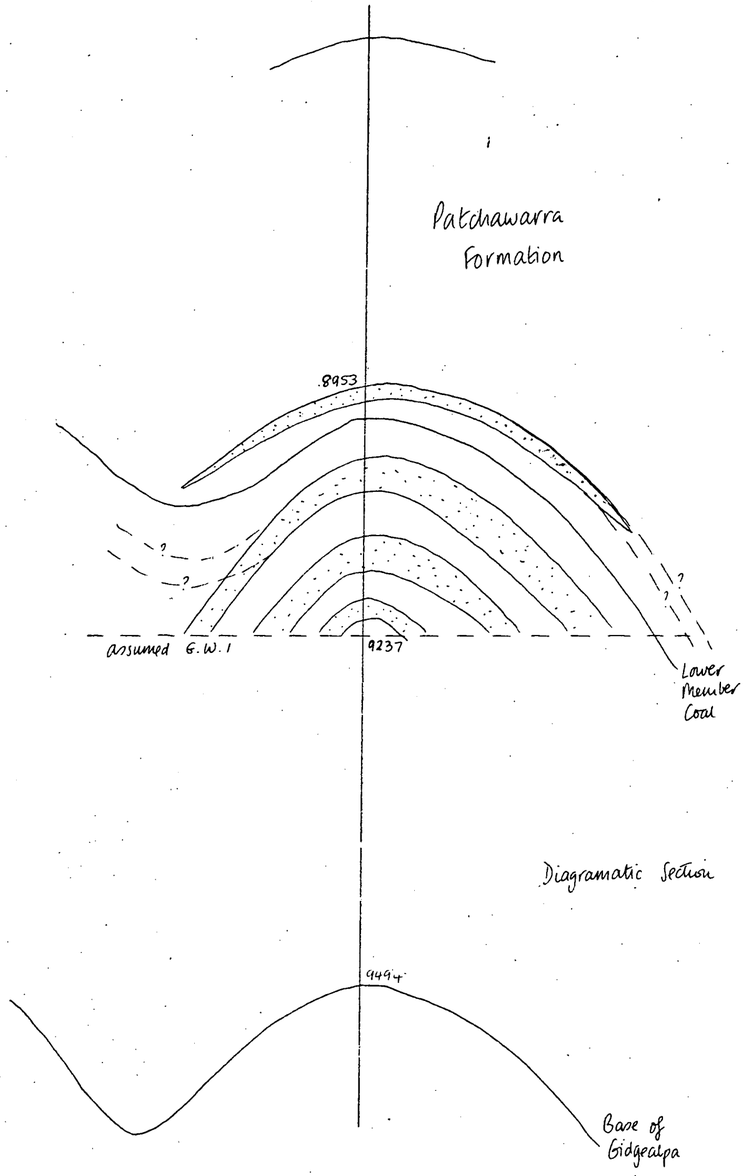
TOOLACHEE FORMATION

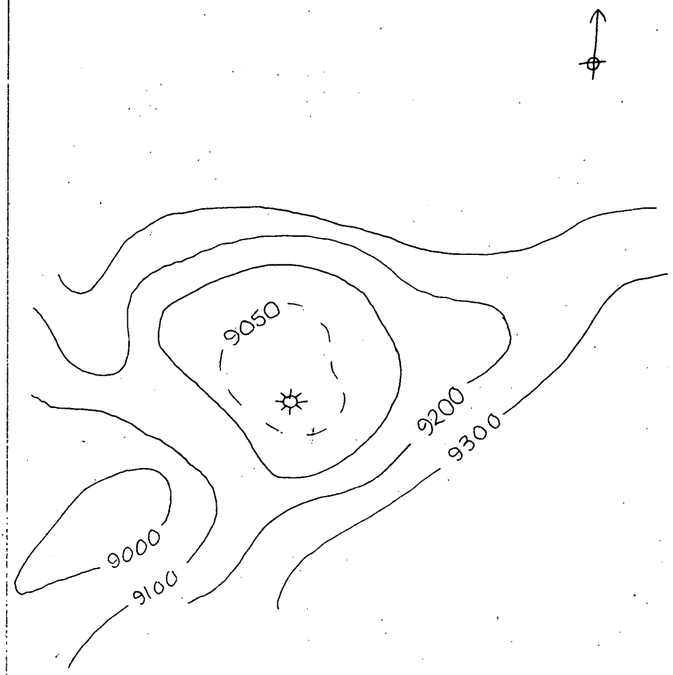
FIG. 3.

| | DEPARTMENT OF MINES – SOUTH AUSTRALIA | Scale: 1:60,000 |
|---|---|---|
| Compiled: I.J.T. | BIG LAKE GAS FIELD ISOPACHS OF PRODUCING SANDS | Date: 30-8-72 |
| Drn. I.J.T. Ckd. | | Drg. No. Gw 2051 |

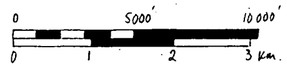
IM–2.70 A1811

BROLGA 1

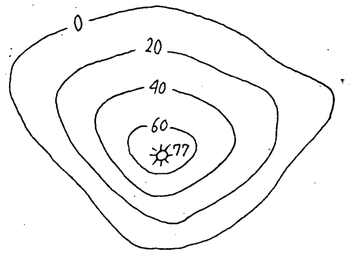



Contours on Lower Member Coal
. feet b.s.l.
1:60 000




Fly Lake 2



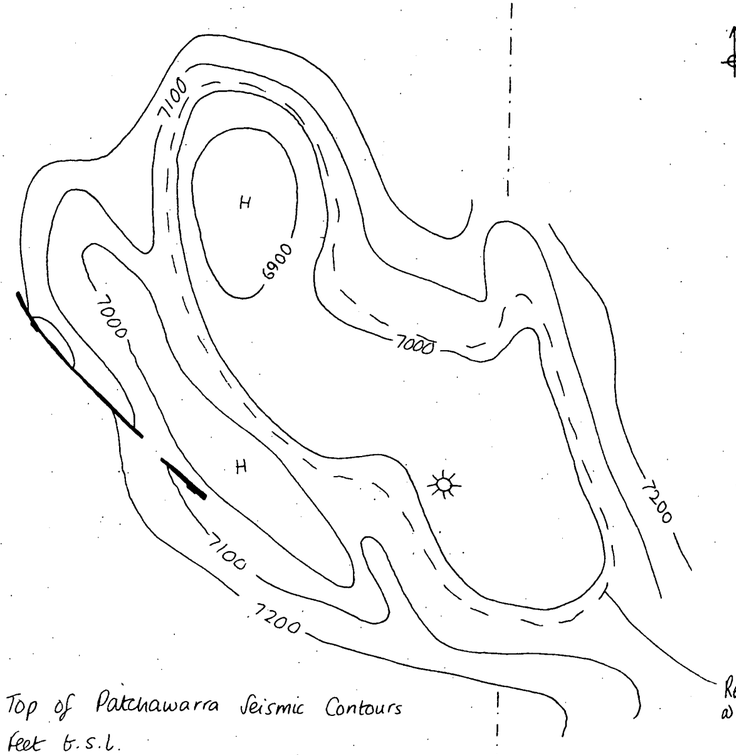

Isopachs
Feet
1:60 000

RB 772-6

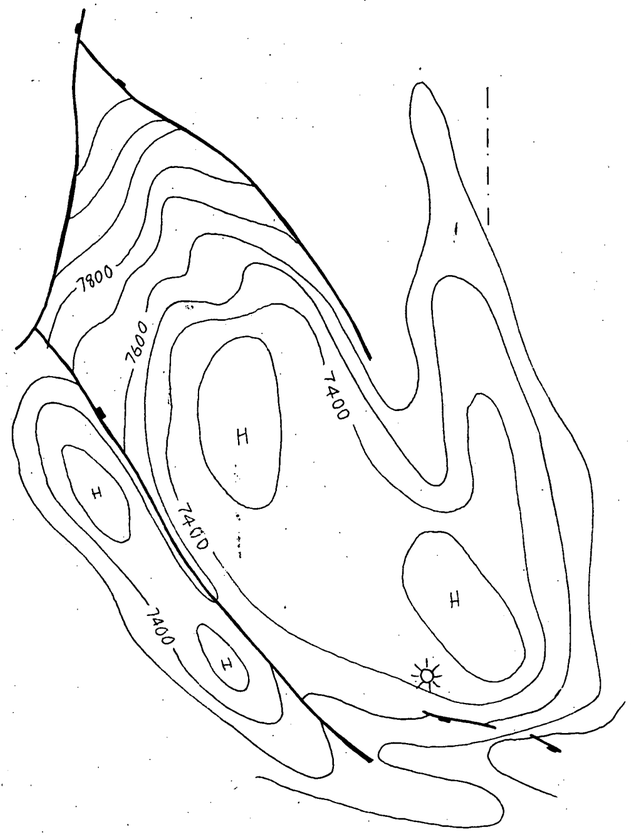
FIG. 1

| | DEPARTMENT OF MINES – SOUTH AUSTRALIA | Scale: |
|---|---|---|
| Compiled: BCY | BROLGA GAS FIELD | Date: 6:9:72 |
| Drn. / Ckd. | Section, Seismic Contours, Isopachs | Drg. No. Env 2055 |

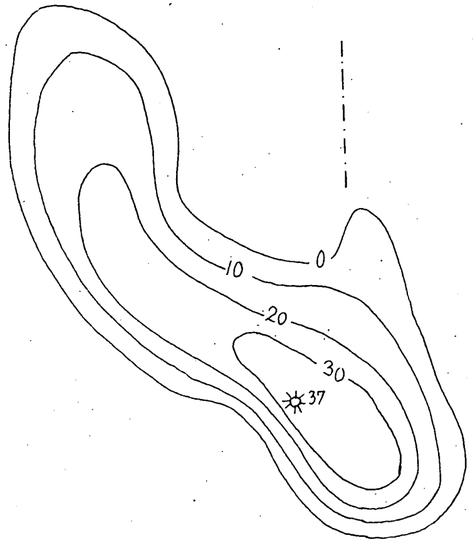
1M—2.70 A1811




Top of Patchawarra Seismic Contours
Feet b.s.l.
1:60 000




Base of Gidgealpa Seismic Contours
Feet b.s.l.
1:60 000




Isopachs, in feet
1:60 000

Reservoir Limit
@ 7029' b.s.l.

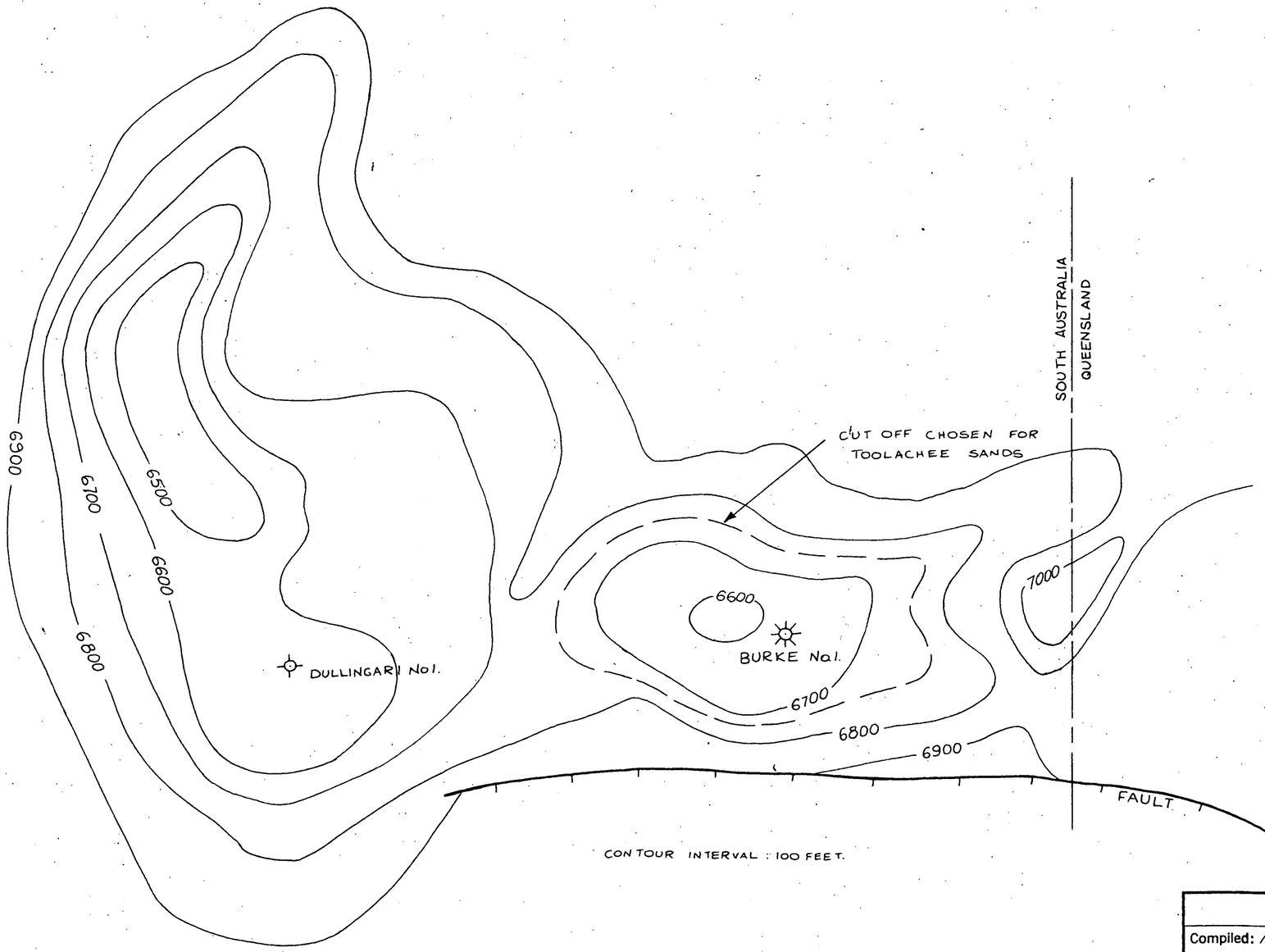
S.A. | QLD

0 5000' 10 000'
0 1 2 3 km

RB 772-7 FIG. 1.

| | DEPARTMENT OF MINES – SOUTH AUSTRALIA | Scale: 1:60 000 |
|---|---|---|
| Compiled: BCY | BRUMBY GAS FIELD | Date: 7:9:72 |
| Drn. / Ckd. | Seismic Contours and Isopachs | Drg. No. GW 2060 |

1M-2.70 A1811





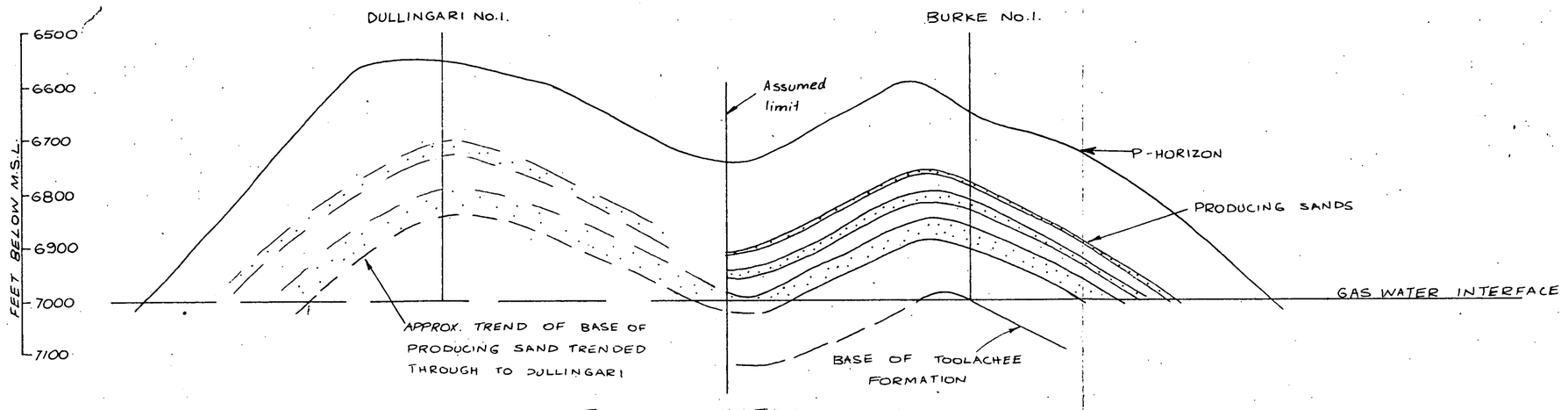
RB 772-8

5000 0 5000 10000 15000 FEET.
1000 0 1000 2000 3000 4000 METRES.

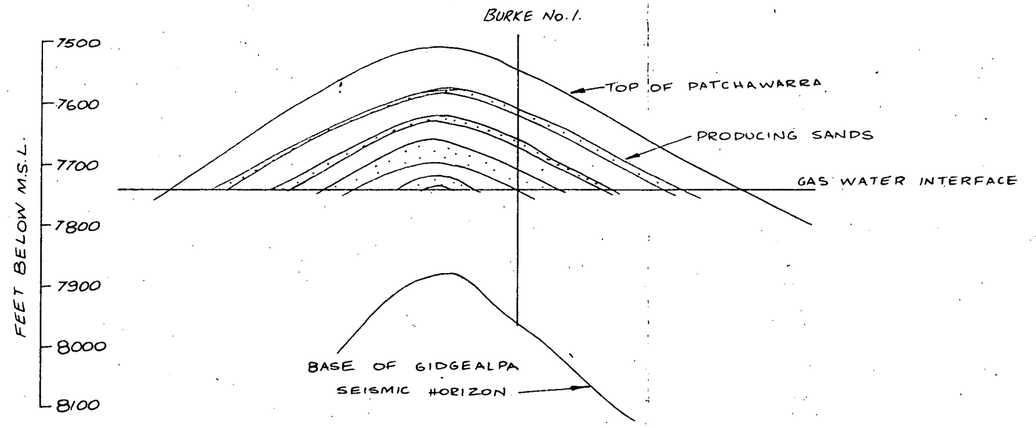
FIG. 1.

| | DEPARTMENT OF MINES – SOUTH AUSTRALIA | Scale: 1:60,000 |
|---|---|---|
| Compiled: I.J.T | BURKE GAS FIELD | Date: 8-9-72 |
| Drn. I.J.T \| Ckd. | P - HORIZON | Drg. No. Gw 2052 |
| | STRUCTURE CONTOUR PLAN | |

1M—2.70 A1811




TOOLACHEE FORMATION




PATCHAWARRA FORMATION

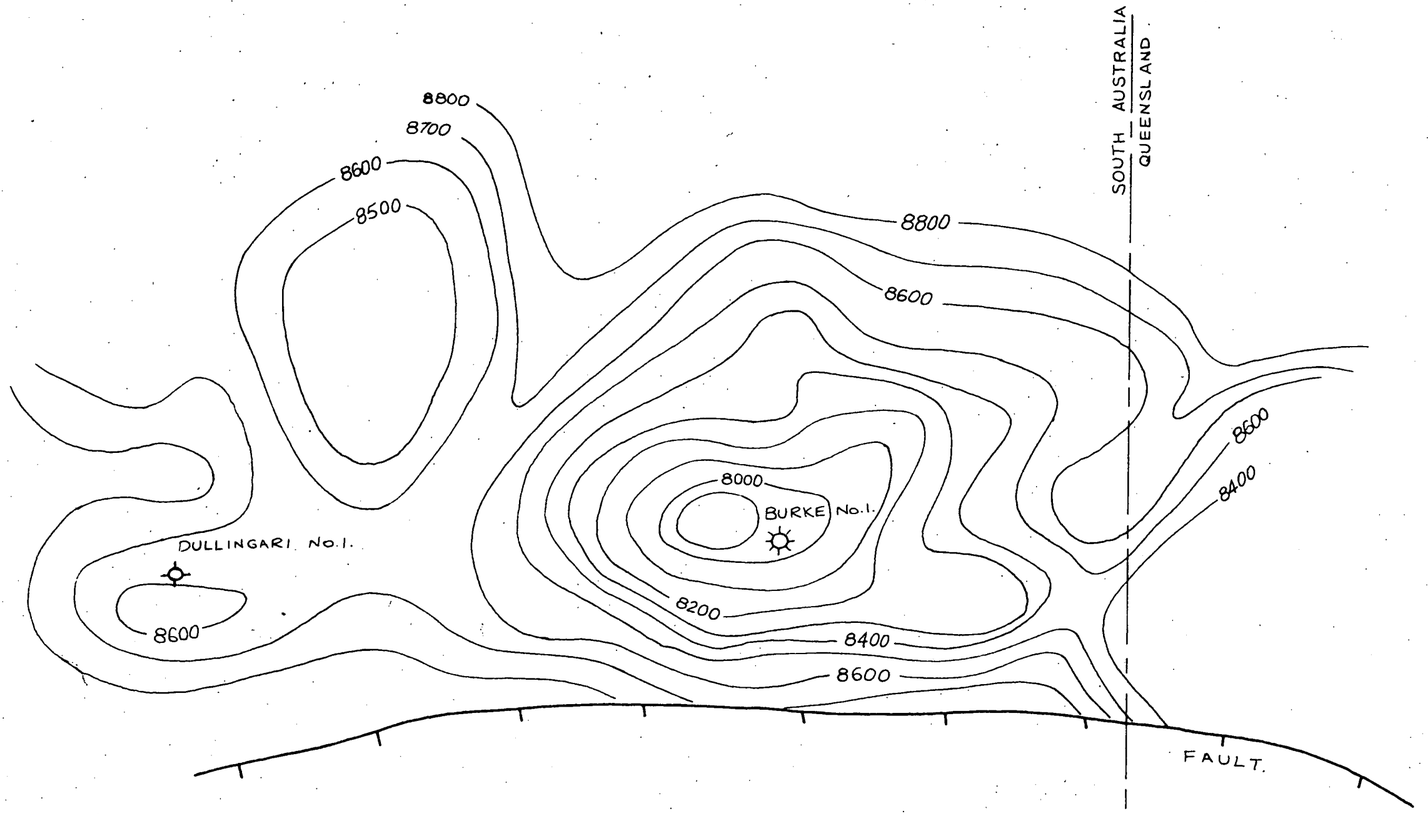
RB 772-9

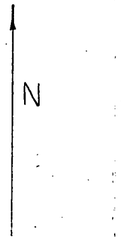
FIG. 2.

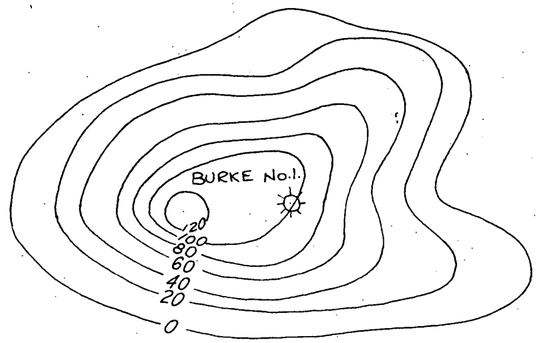
5000 0 5000 10000 15000 FEET.
1000 0 1000 2000 3000 4000 METRES.

DIAGRAMATIC ONLY

| | DEPARTMENT OF MINES — SOUTH AUSTRALIA | Scale: 1:60,000 |
|---|---|---|
| Compiled: I.J.T | BURKE GAS FIELD | Date: 8-9-72 |
| Drn. I.J.T. \| Ckd. | SECTIONS THROUGH TOOLACHEE AND PATCHAWARRA FMS. | Drg. No. Env 2052 |




ISOPACH OF PRODUCING SANDS OF THE PATCHAWARRA FORMATION

ISOPACH INTERVAL : 20 FEET.

RB 772-10

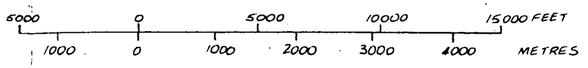
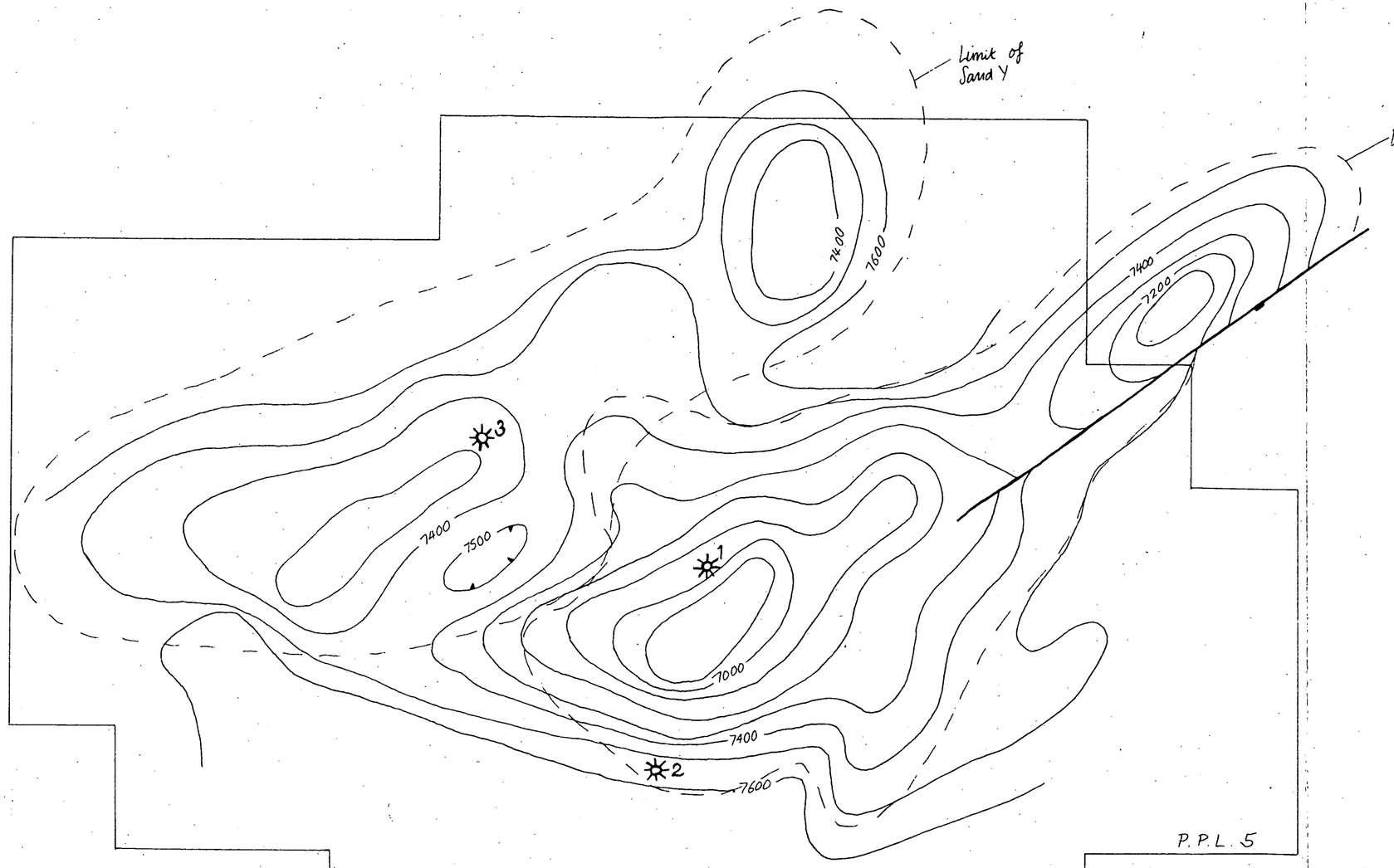



FIG.3.

| | DEPARTMENT OF MINES — SOUTH AUSTRALIA | Scale: 1:60,000 |
|---|---|---|
| Compiled: I.J.T. | BURKE GAS FIELD | Date: 8-9-72 |
| Drn. I.J.T. \| Ckd. | BASE OF GIDGEALPA AND ISOPACHS OF PRODUCING SANDS | Drg. No. GW 2052 |

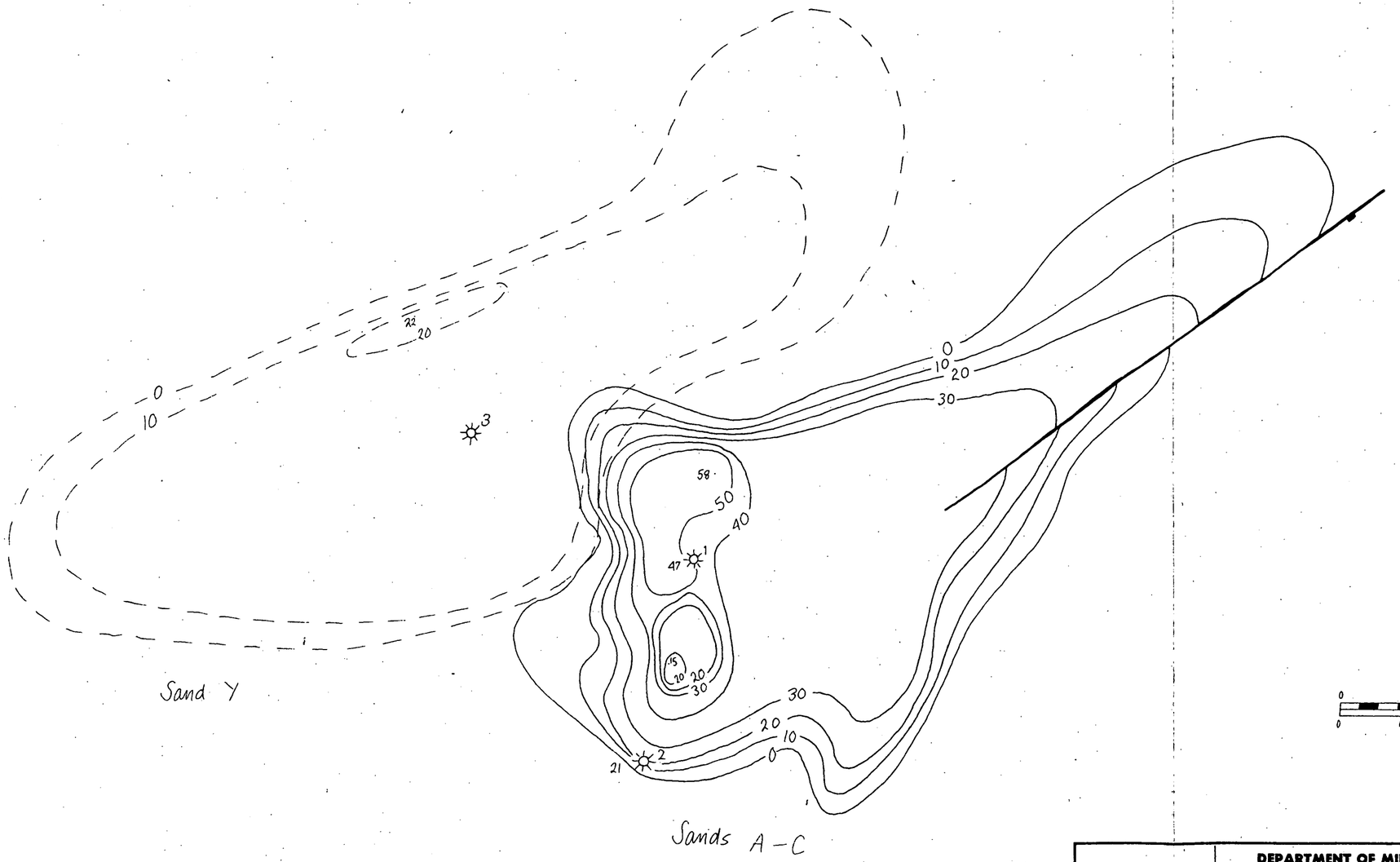
1M—2.70 A1811




RB 772-11

FIG. 1

| | | | |
|---|---|---|---|
| | DEPARTMENT OF MINES – SOUTH AUSTRALIA | | Scale: 1 : 60 000 |
| Compiled: B'CY | DARALINGIE GAS FIELD | | Date: 7 : 9 : 72 |
| Drn. / Ckd. | Base of Gidgealpa Seismic Contours (feet b. s. l.) | | Drg. No. Env 2053 |

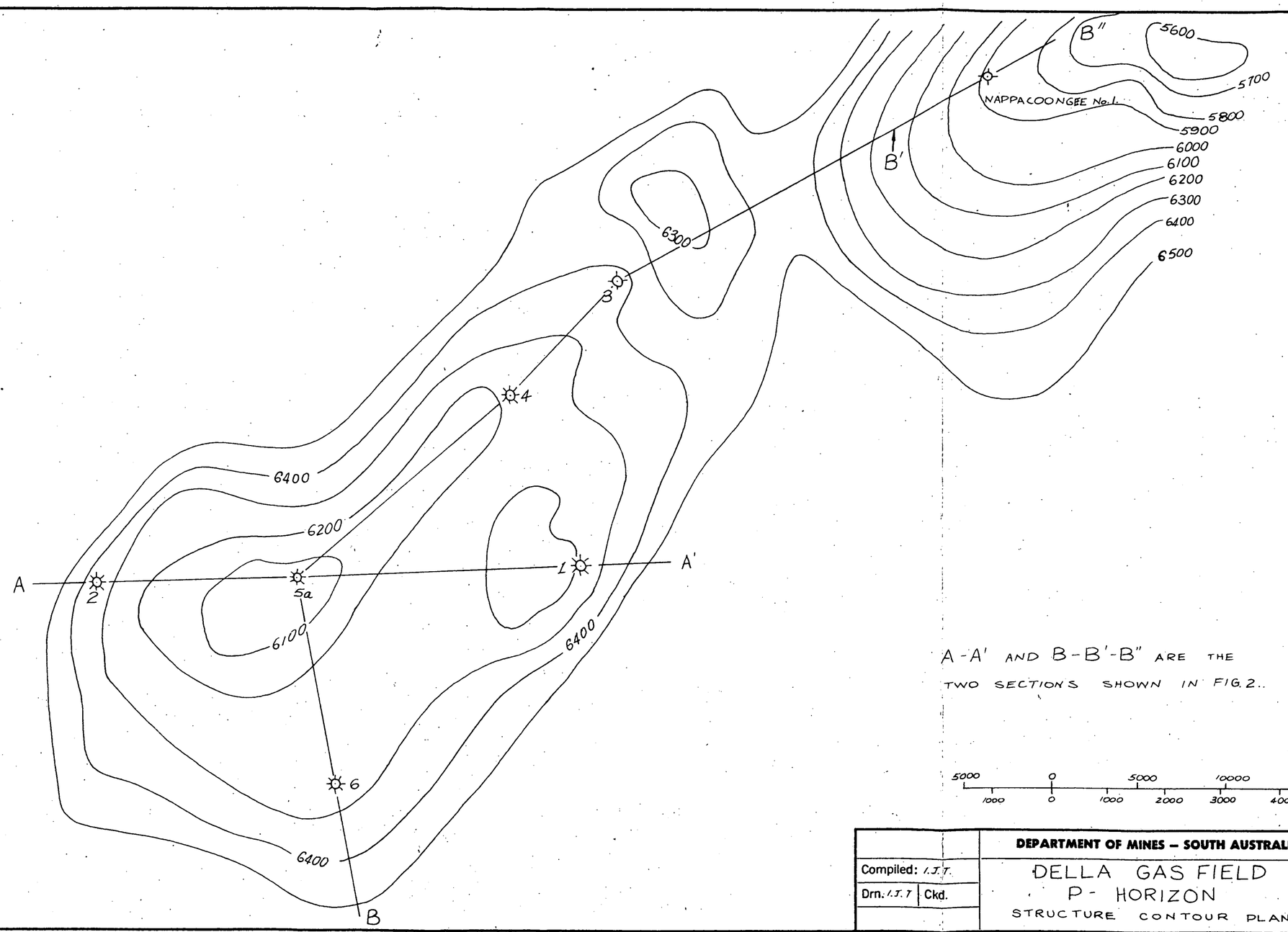



RB 772-12

FIG. 3

| | DEPARTMENT OF MINES – SOUTH AUSTRALIA | Scale: 1 : 60 000 |
|---|---|---|
| Compiled: BCY | DARALINGIE GAS FIELD | Date: 7:9:72 |
| Drn. / Ckd. | Pay Sand Isopachs (in feet) | Drg. No. Env 2053 |

1M—2.70 A1811




A-A' AND B-B'-B" ARE THE TWO SECTIONS SHOWN IN FIG. 2..

RB 772-13

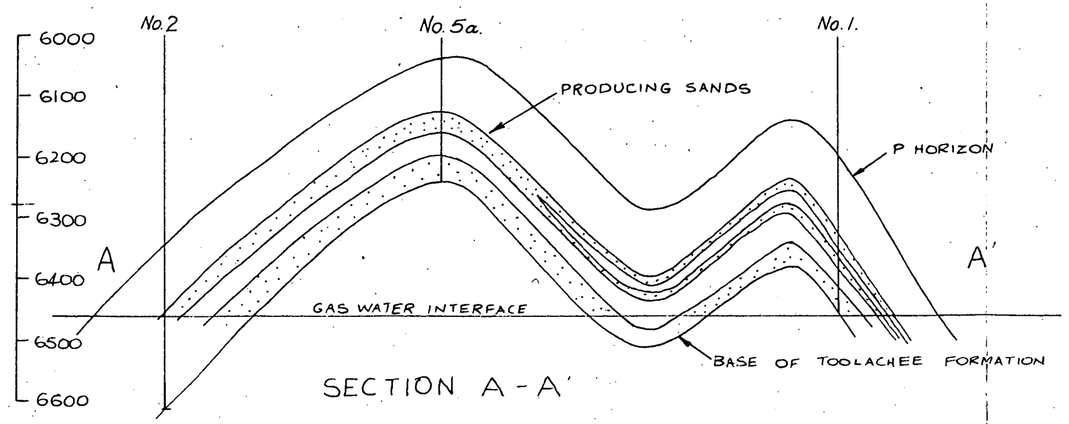
5000 0 5000 10000 15000 FEET.

1000 0 1000 2000 3000 4000

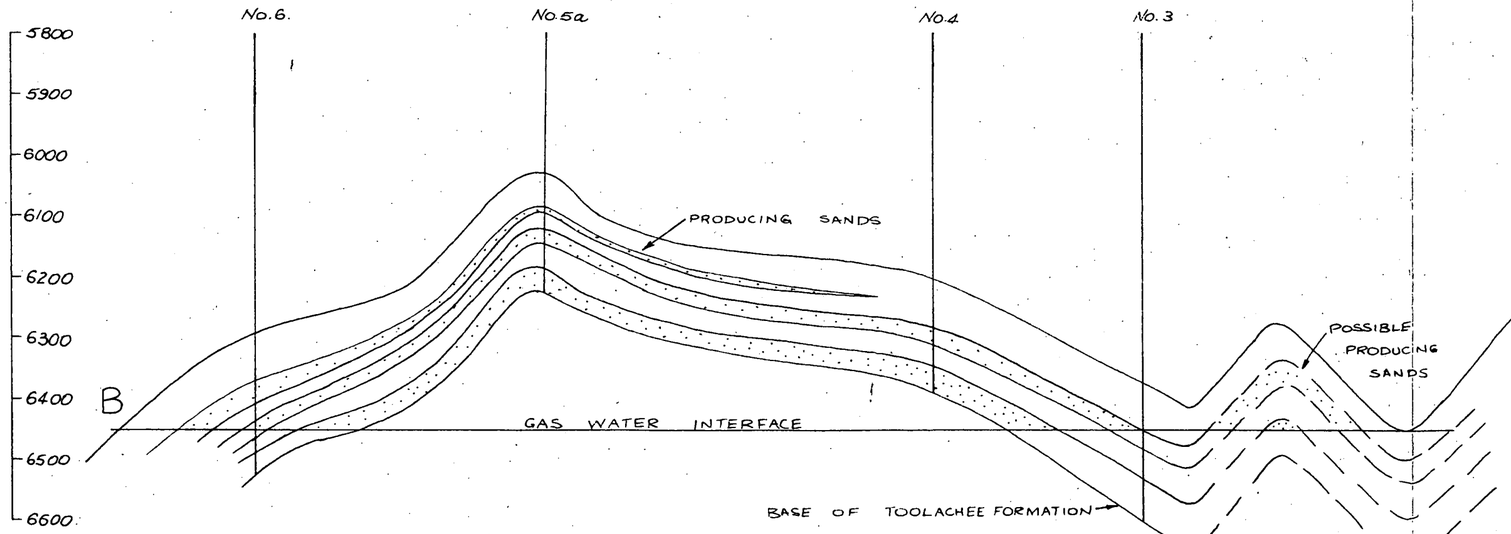
FIG. 1.

| | DEPARTMENT OF MINES – SOUTH AUSTRALIA | Scale: 1:60,000 |
|---|---|---|
| Compiled: I.J.T. | DELLA GAS FIELD | Date: 11-9-72 |
| Drn: I.J.T. \| Ckd. | P- HORIZON | Drg. No. Env 2054 |
| | STRUCTURE CONTOUR PLAN | |

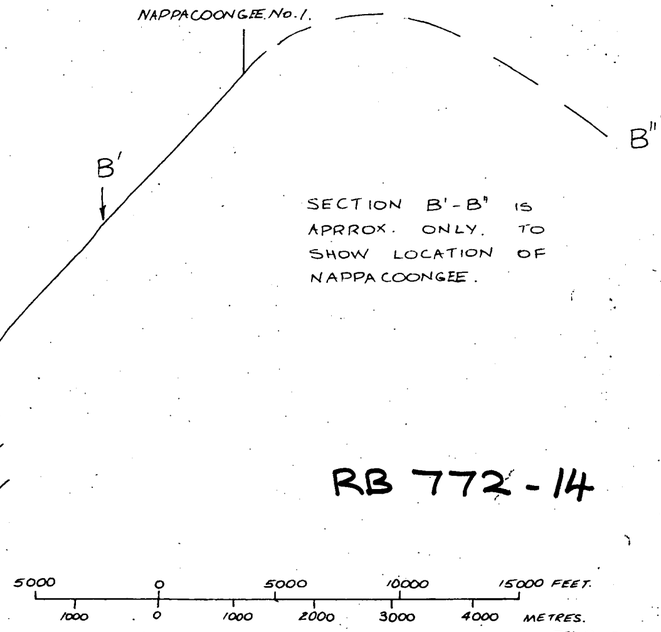
1M—2.70 A1811




SECTION A-A'




SECTION B-B'




SECTION B'-B" IS APRROX. ONLY. TO SHOW LOCATION OF NAPPACOONGEE.

RB 772-14

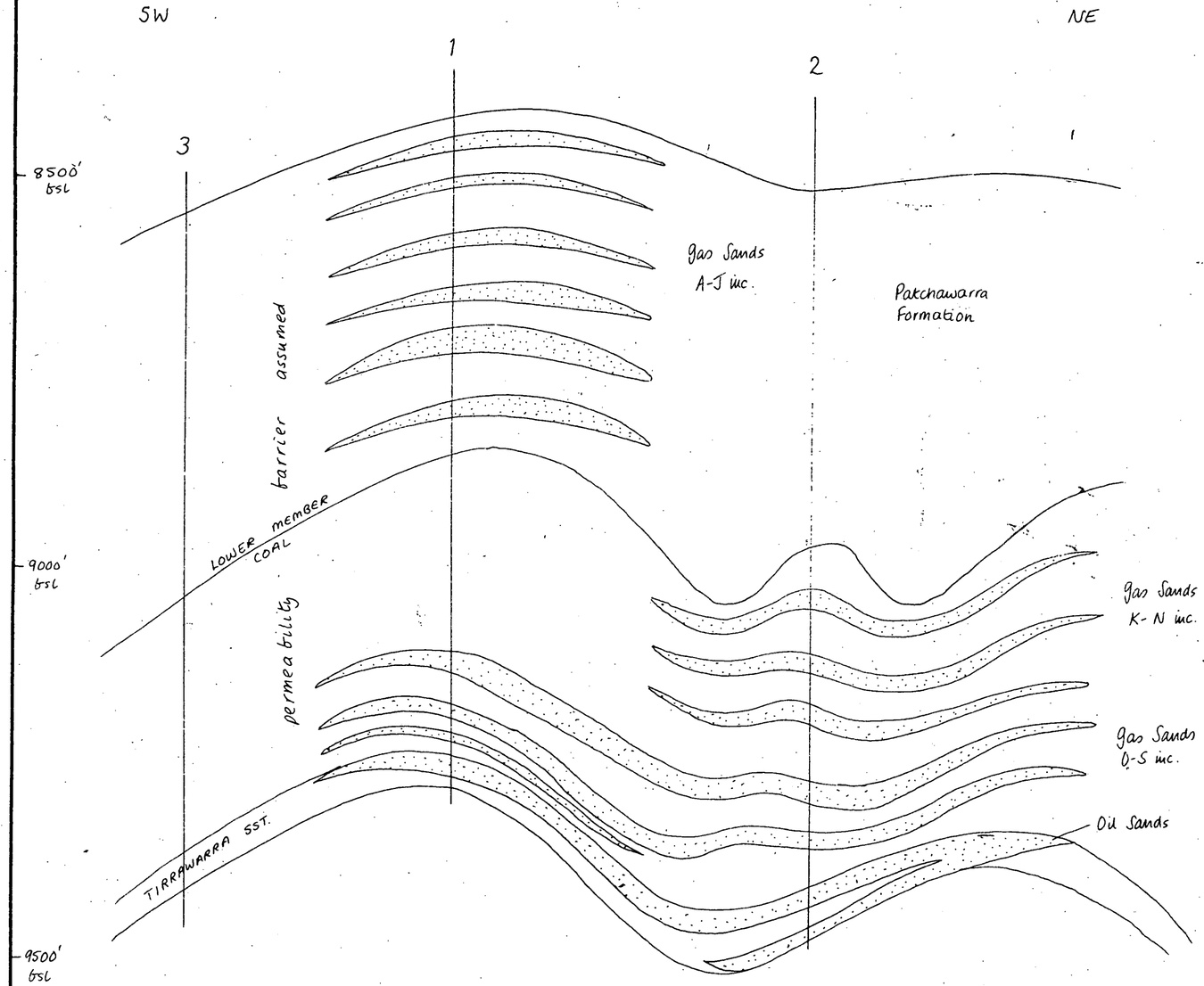
5000 0 5000 10000 15000 FEET.
1000 0 1000 2000 3000 4000 METRES.

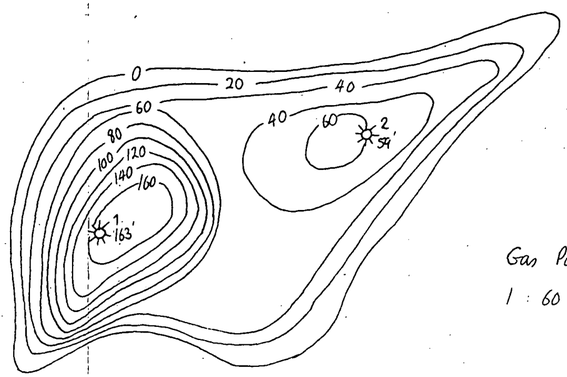
FIG 2.

DIAGRAMATIC ONLY

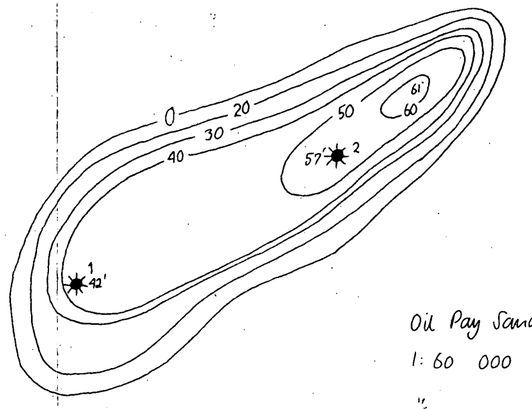
| | DEPARTMENT OF MINES – SOUTH AUSTRALIA | Scale: 1:60,000 (horiz.) |
|---|---|---|
| Compiled: I.J.T. | DELLA GAS FIELD | Date: 11-9-72 |
| Drn. I.J.T. Ckd. | CROSS SECTIONS TOOLACHEE FORMATION | Drg. No. Env 2054 |

1M—2.70 A1811




Gas Pay Sands, in feet
1 : 60 000




Oil Pay Sands, in feet
1: 60 000

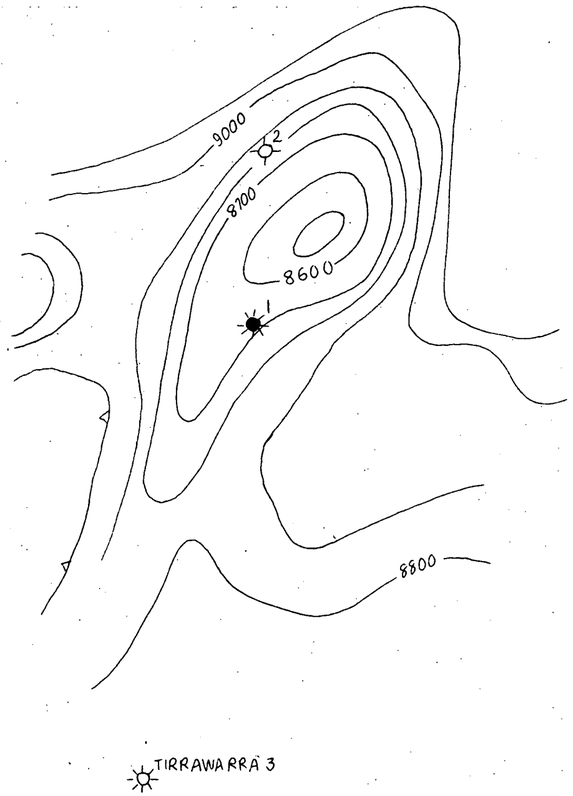
"

3

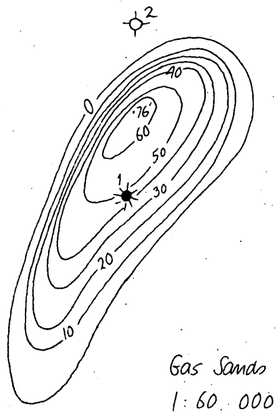
RB 772-15 FIG. 2

| | DEPARTMENT OF MINES – SOUTH AUSTRALIA | Scale: — |
|---|---|---|
| Compiled: BCY | FLY LAKE OIL & GAS FIELD | Date: 11:9:72 |
| Drn. / Ckd. | Diagrammatic Section and Isopach Plans | Drg. No. Env 2055 |

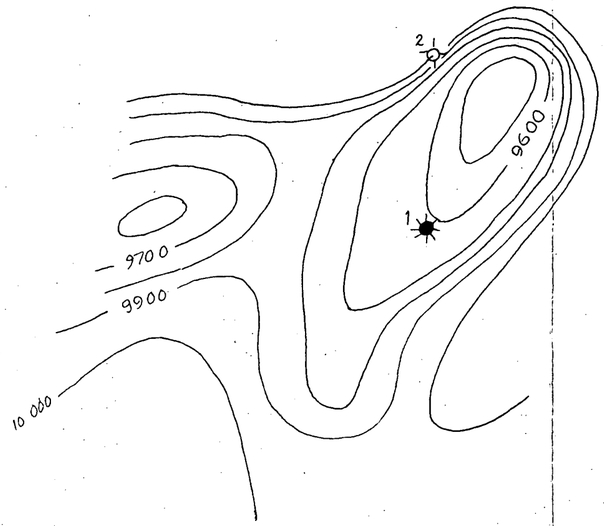
1M—2.70 A1811



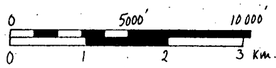

"P" Seismic Horizon Contours, in feet b.s.l.
1 : 60 000

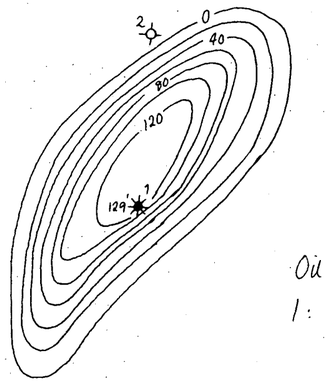



Gas Sands Isopachs, in feet
1 : 60 000




Base of Gidgealpa Seismic Horizon Contours
feet b.s.l.
1 : 60 000




Oil Sands Isopachs, in feet
1 : 60 000

RB 772-16 FIG 1

| | | |
|---|---|---|
| | DEPARTMENT OF MINES – SOUTH AUSTRALIA | Scale: 1 : 60 000 |
| Compiled: BCY | MOORARI OIL & GAS FIELD | Date: 11 : 9 : 72 |
| Drn. / Ckd. | Seismic Contours & Isopach Plans | Drg. No. Gw 2056 |

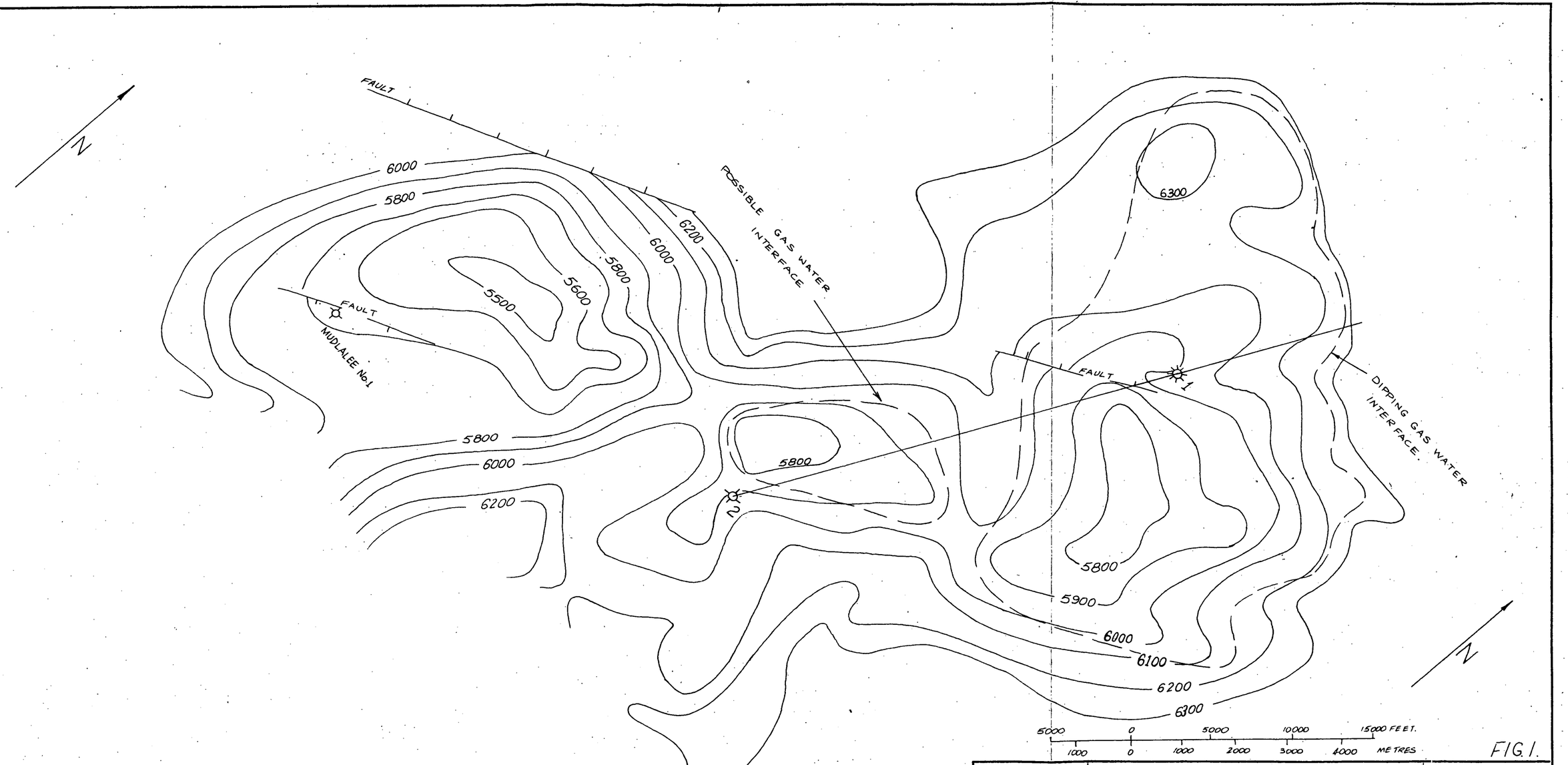
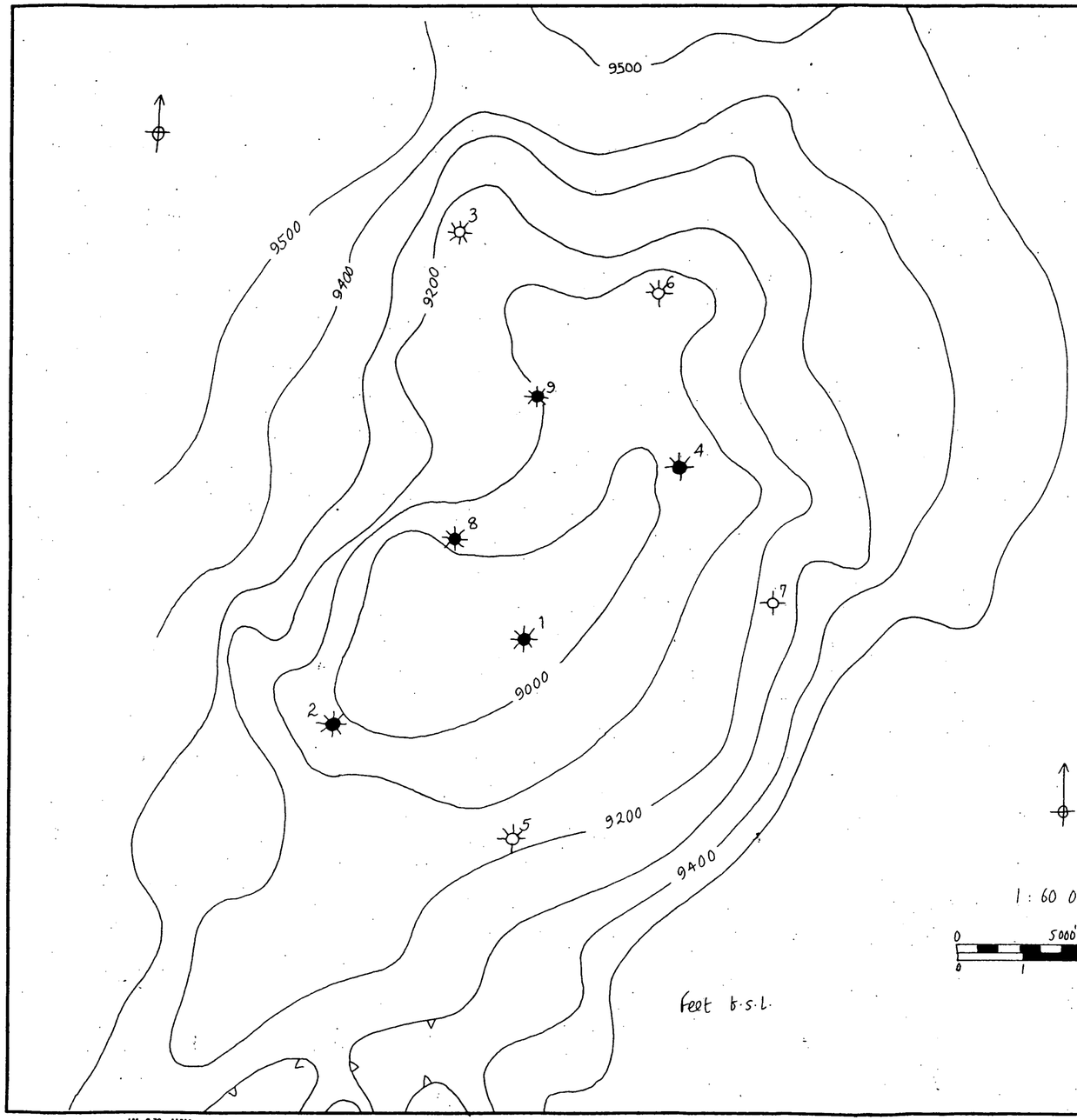



FIG. 1.

| | DEPARTMENT OF MINES — SOUTH AUSTRALIA | Scale: 1:60,000 |
|---|---|---|
| Compiled: I.J.T. | STRZELECKI GAS FIELD | Date: 7-9-72 |
| Drn. I.J.T. \| Ckd. | P HORIZON | Drg. No. Env 2058 |
| | STRUCTURE CONTOUR PLAN | |

1M—2.70 A1811

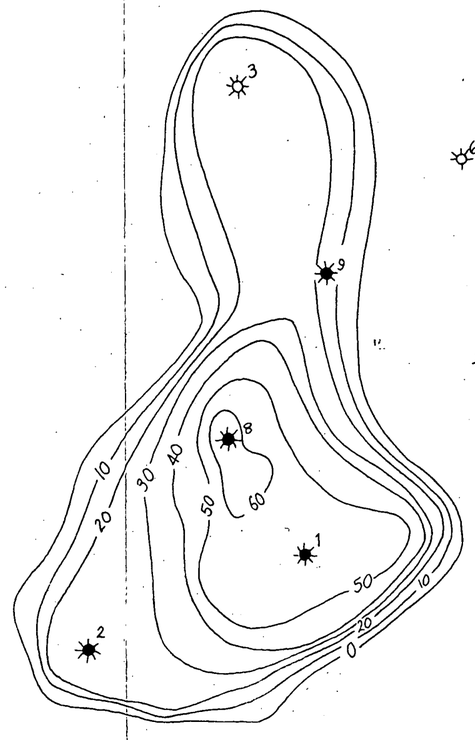
RB 772-17




1 : 60 000

0 5000' 10 000'

0 1 2 3 km.

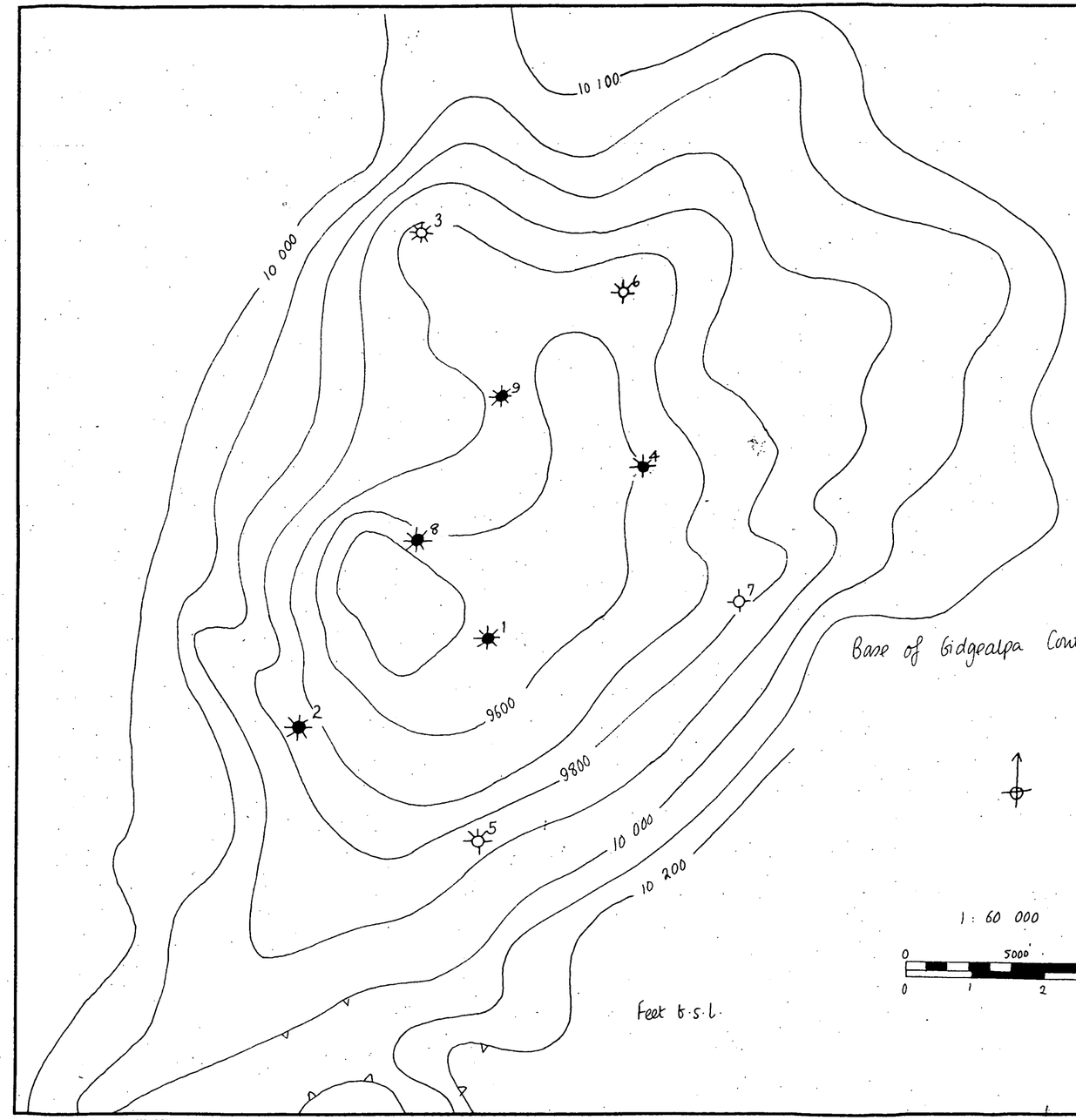



Patchawarra Gas Sands
Isopachs, in feet.

RB 772-18 FIG. 1

| | DEPARTMENT OF MINES — SOUTH AUSTRALIA | Scale: 1 : 60 000 |
|---|---|---|
| Compiled: BCY | TIRRAWARRA OIL & GAS FIELD | Date: 13 : 9 : 72 |
| Drn. / Ckd. | Lower Member Coal & Gas Sands Isopachs | Drg. No. Env 2059 |

1M—2.70 A1811



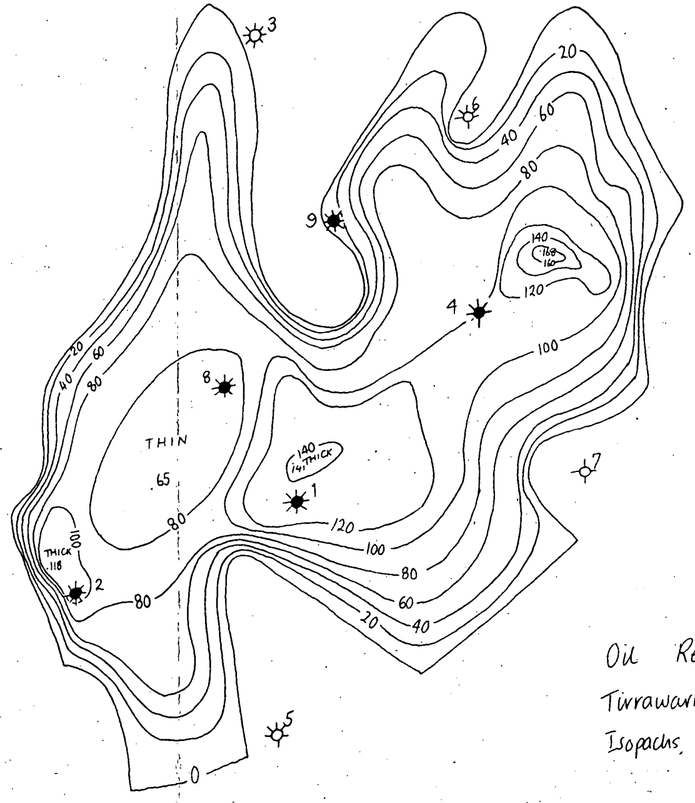

Base of Gidgealpa Contours

Feet b.s.l.

1 : 60 000

0 5000' 10000'

0 1 2 3 Km

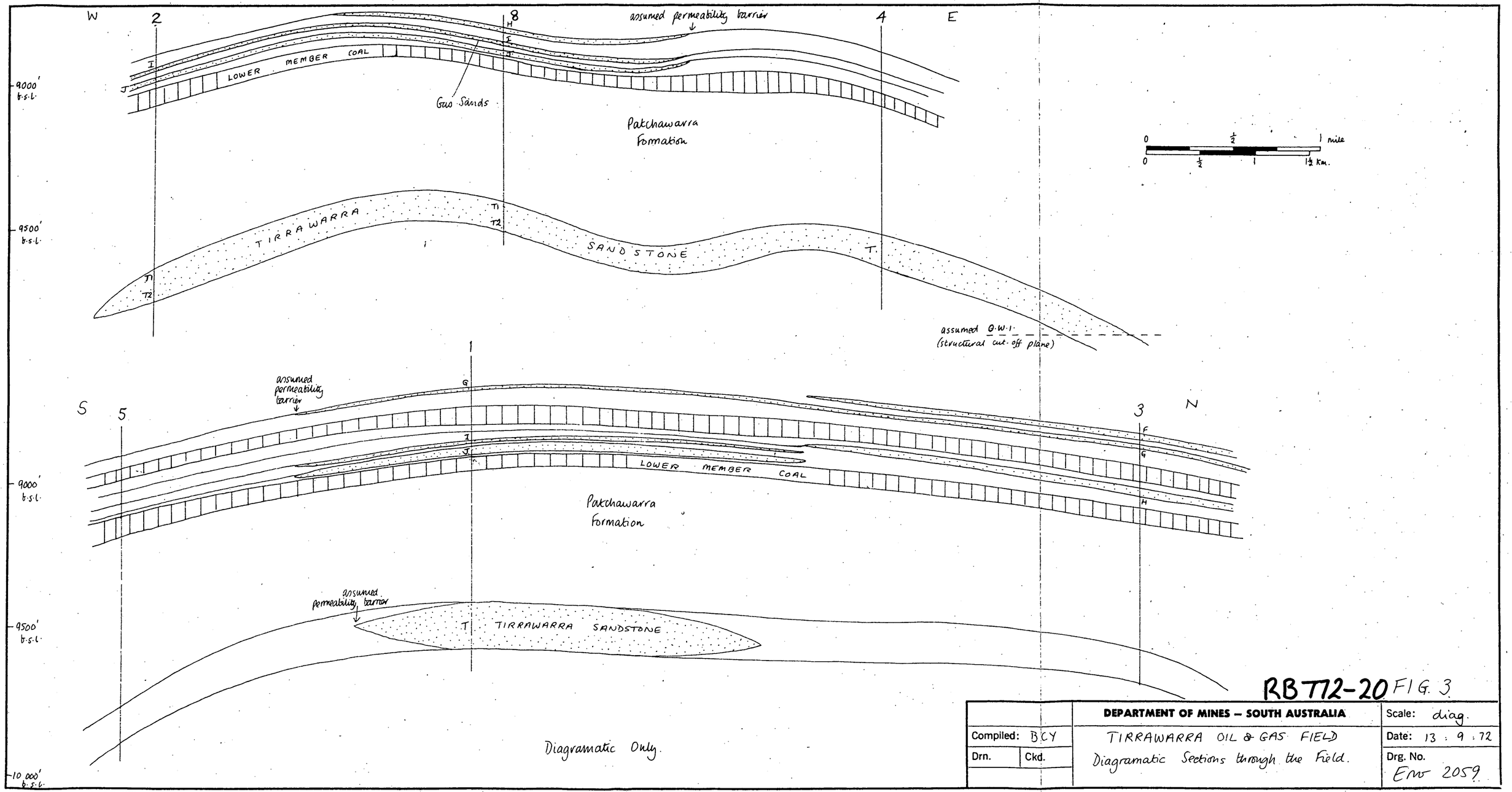



Oil Reservoir —
Tirrawarra Sandstone
Isopachs, in feet

RB 772-19 FIG. 2

| | DEPARTMENT OF MINES – SOUTH AUSTRALIA | Scale: 1 : 60 000 |
|---|---|---|
| Compiled: BCY | TIRRAWARRA OIL & GAS FIELD | Date: 13 : 9 : 72 |
| Drn. / Ckd. | Base of Gidgealpa & Oil Sands Isopachs | Drg. No. Env 2059 |

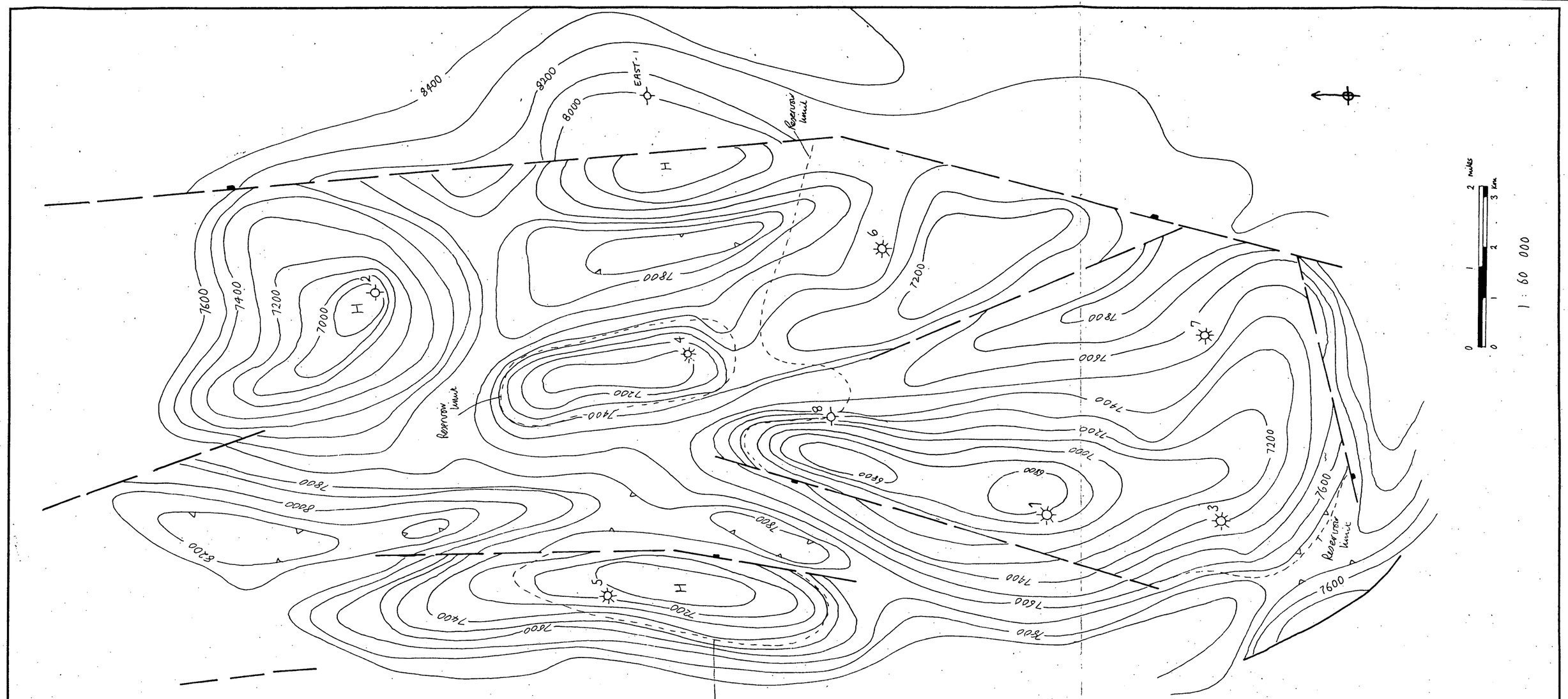
1M—2.70 A1811




RBT12-20 FIG. 3

| | | DEPARTMENT OF MINES — SOUTH AUSTRALIA | Scale: diag. |
|---|---|---|---|
| Compiled: BCY | | TIRRAWARRA OIL & GAS FIELD | Date: 13 : 9 : 72 |
| Drn. | Ckd. | Diagramatic Sections through the Field. | Drg. No. Env 2059 |

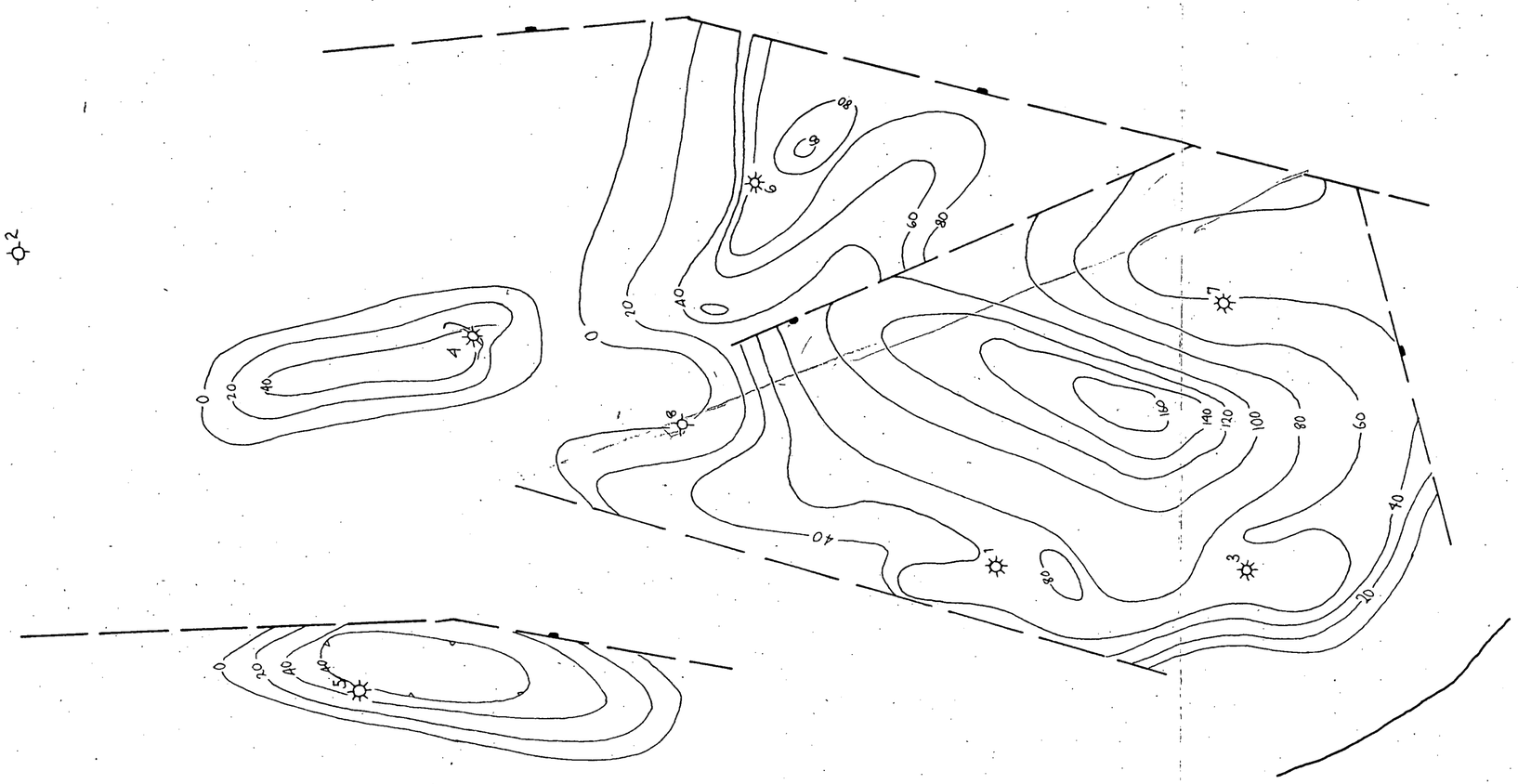
1M—2.70 A1811




RB 772-21 FIG. 1

| | | DEPARTMENT OF MINES – SOUTH AUSTRALIA | Scale: 1 : 60 000 |
|---|---|---|---|
| Compiled: BCY | | TOOLACHEE GAS FIELD | Date: 13 : 9 : 72 |
| Drn. | Ckd. | Base of Gidgealpa Seismic Contours (feet b.s.l.) | Drg. No. Env 2060 |

1M—2.70 A1811




1 : 60 000

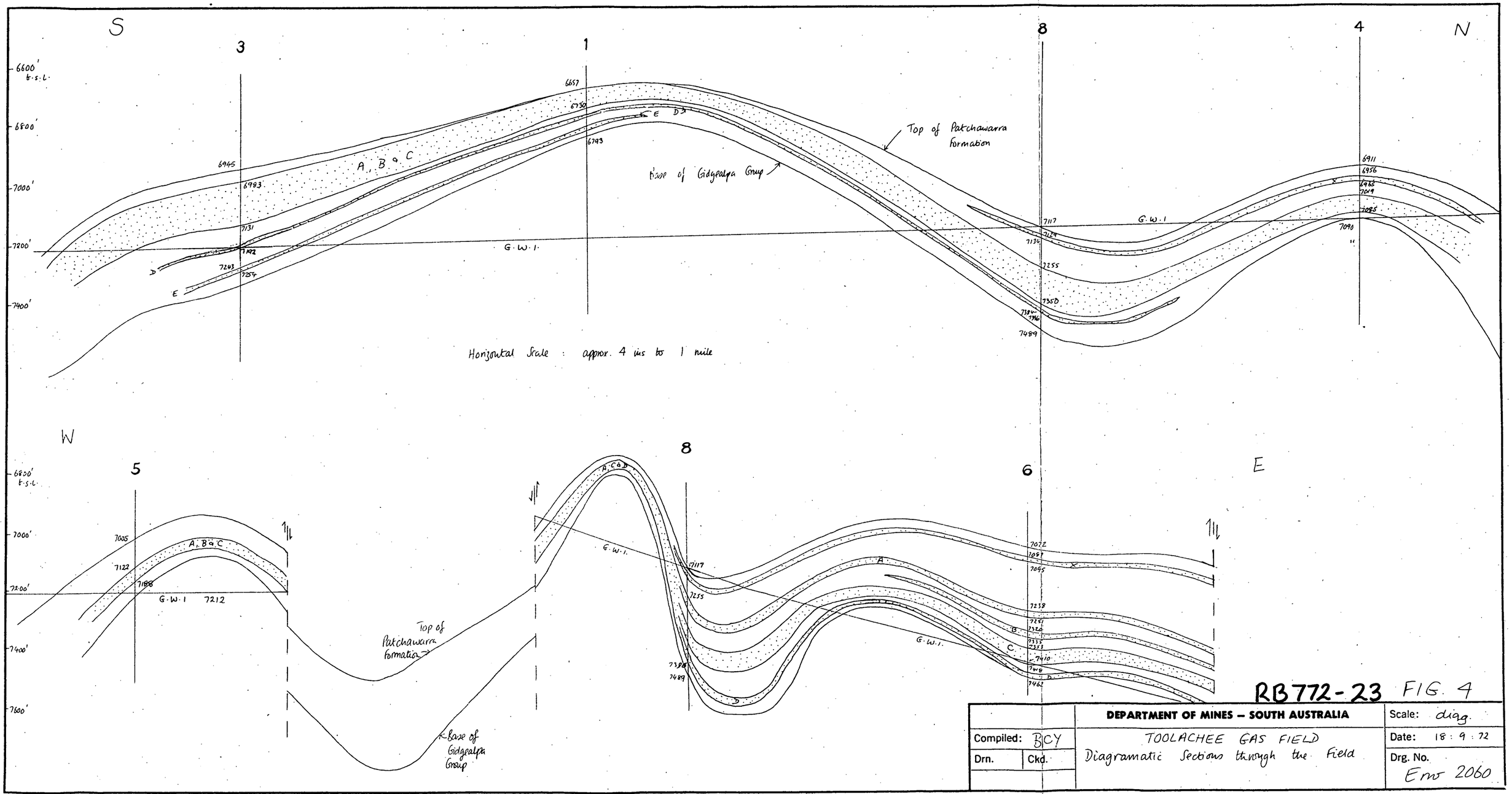
2 miles
3 km

RB 772-22

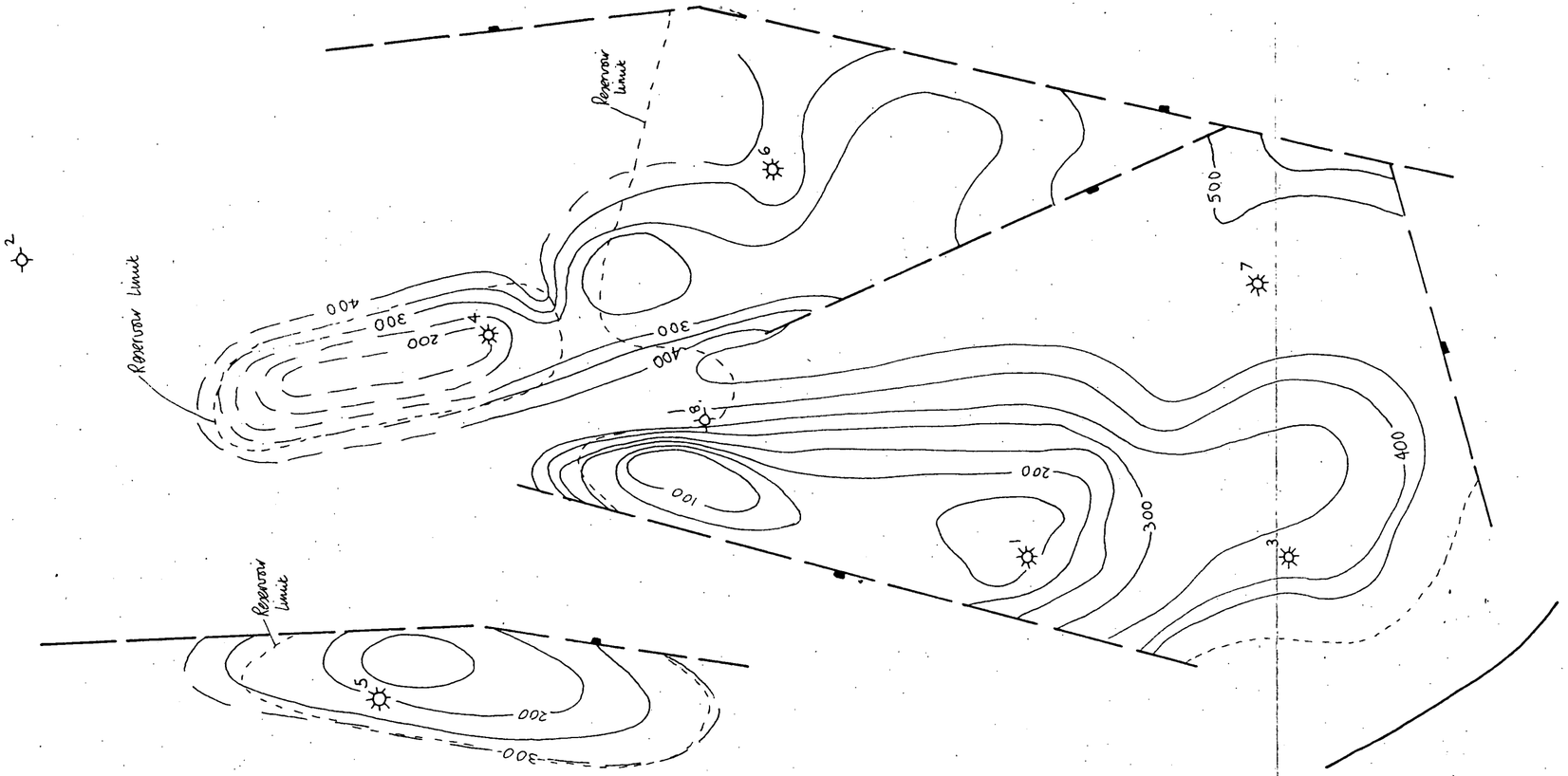
FIG. 3

| | | DEPARTMENT OF MINES – SOUTH AUSTRALIA | Scale: 1 : 60 000 |
|---|---|---|---|
| Compiled: BCY | | TOOLACHEE GAS FIELD<br>Gas Sands Isopachs<br>in Feet | Date: 14 : 9 : 72 |
| Drn. | Ckd. | | Drg. No. Env 2060 |

1M—2.70 A1811


S
N
3
1
8
4
6600' b.s.l.
6800'
7000'
7200'
7400'
6657
6730
6793
6945
6983
7131
7142
7243
7254
A, B & C
D
E
Top of Patchawarra formation
Base of Gidgealpa Group
G.W.1
7117
7174
7236
7255
7350
7384
7396
7489
6911
6956
6988
7049
7085
7098
Horizontal Scale : approx. 4 ins to 1 mile
W
E
5
8
6
6800' b.s.l.
7000'
7200'
7400'
7600'
7005
7122
7188
7212
7072
7097
7095
7238
7251
7320
7333
7351
7410
7448
7462
7398
7489
Top of Patchawarra formation
Base of Gidgealpa Group
RB772-23 FIG. 4
DEPARTMENT OF MINES – SOUTH AUSTRALIA
Compiled: BCY
Drn.
Ckd.
TOOLACHEE GAS FIELD
Diagramatic Sections through the Field
Scale: diag.
Date: 18:9:72
Drg. No. Env 2060

1M—2.70 A1811




RB 772-24 FIG. 5

| | DEPARTMENT OF MINES — SOUTH AUSTRALIA | Scale: 1 : 60 000 |
|---|---|---|
| Compiled: BCY | TOOLACHEE GAS FIELD | Date: 19 : 9 : 72 |
| Drn. / Ckd. | Isopachs of Patchawarra Formation (in feet) | Drg. No. Env 2060 |