VICTOR PETROLEUM & RESOURCES LTD.

on behalf of

NORTH WEST BAY COMPANY PTY. LTD.

RENEWAL & PROGRESS REPORT

for

EXPLORATION LICENCE 31/80

for

PERIOD NOVEMBER 21, 1981 - MAY 21, 1982

T. G. SUMMONS
19 May, 1982.

EL 31/80

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PROPOSED EXPLORATION PROGRAMME FOR PERIOD MAY 21, 1981 - NOVEMBER, 21, 1982

The results of Victor Petroleum's exploration activities since the granting of the Exploration Licence 31/80 has identified the Woodbury - Bells Lagoon area of the Central Midlands as a high priority target area for Triassic coal.

The application for coal leases covering the Woodbury Coal Deposit has resulted in the lodging of objections by the private land holders effected by the lease applications.

Until the objections by private landholders are resolved by a Ministerial and/or Warden's Court Hearing, Victor is of the opinion that exploration on private land is at risk, and thus have requested a nominal reduced expenditure be accepted until the matters are resolved.

Victor Petroleum intends however to continue with its regional and general appraisal of both the potential for Triassic coal and Permian coal within the licence area.

As indicated in the body of the report, results of the hydrocarbon exploration programme, warrants a further and more comprehensive study of the literature to establish the basis of an ongoing exploration programme.

The proposed activities to establish the characteristics of potential source, reservoir and seal rocks, the nature of hydrocarbon generation and migration, and structural aspects of the marine sequence of the Parmeener Super Group of the onshore Tasmania basin include:

- Geological data generated by the Department of Mines mapping.
- Data generated by University and other institutions research including petography, palynology, paleontology.
- Further study of the nature of the hydrocarbons within the Woody Island Siltstone, and its correlates.
- Assessment of data compiled on the Sprayberry Formation of Texas, which is comparable with the Woody Island siltstone as a source rock.
- Definition of a geophysical exploration programme to identify the subsurface characteristics of the Parmeener Super Group.
- Definition of a surface sampling programme for organic geochemical analyses, maturation indices and other organic parameters.

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It is estimated that the above proposed activities will take approximately twelve months.

The proposed expenditure for the six month period for EL 31/80 and 16/81 combined is a total of $50,000.

SUMMARY

Exploration activity within EL 31/80 for the six month period to May 21, 1982 consisted of mapping, relogging of previous drill holes, reappraisal of previous wireline logging, interpretation of gravity survey results (Woodbury), reappraisal of all coal and related data for the Woodbury area, and completion of three coal reserve estimates for the Woodbury Coal Deposit.

The overall Bells Lagoon - Woodbury area is viewed as being part of the same gross structural zone, commencing on the eastern margin of the Great Western Tiers and swinging to the S.E. through Woodbury. This area therefore assumes a high exploration priority, with coal discoveries in both of the areas drilled to date.

The coal reserves amenable to open cut extraction at Woodbury are as follows:

High Grade Reserve (total measured and first class indicated for 10:1 overburden to coal ratio):

15.3×10^6 tonnes containing 35.6% ash

Low Grade Reserve (total measured and first class indicated for a 10:1 overburden to coal ratio):

24.8×10^6 tonnes containing 40.7% ash

Low Grade Reserve (total measured and first class indicated for a 7:1 overburden to coal ratio):

15.1×10^6 tonnes containing 41.6% ash

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Geological mapping of the Marine Sequence of the Parmeener Super Group, has further confirmed the nature and extent of the hydrocarbon source rock potential of the sequence. Results to date warrant further investigation to establish the source, reservoir, and seal rock characteristics, the nature of hydrocarbon generation and migration and structural features of the onshore Tasmania Basin.

1.0 WOODBURY COAL DEPOSIT

1.1 INTRODUCTION

The Woodbury area is subdivided into the Woodbury Coal Project (covering 16 sq. km.), and the North and South Woodbury areas. The Woodbury Coal Project relates to the nine coal leases (1070 P/m - 1078 P/m) generally encompassing the Woodbury Coal Deposit as currently defined by drilling; these coal leases cover an area of 16 sq. km., and are still under application pending the result of the hearing of objections from the land owners.

The North Woodbury area is that part of the gross structural feature termed the Woodbury Basin, which lies to the north of the Woodbury Coal Deposit, (itself contained within the Woodbury Basin).

The South Woodbury area is the area of Triassic Coal Measured Sequence rocks occurring beneath the eastern end of the Bellevue Hill - Black Tier Horst.

Follow up drilling in the North and South Woodbury areas is expected to result in an increase in the size of the presently defined Woodbury Coal Deposit.

1.2 GEOLOGY

Reappraisal of the regional stratigraphic and tectonic setting of the Woodbury area was completed during the period; structural details are discussed elsewhere in this report, and in Appendices 1 and 3.

Parmeener Super Group Upper Fresh Water Sequence rocks in the Woodbury area consist of three main groups, which in approximate order down section are the Coal Measures, Tuff-Siltstone and Ross Sandstone sequences:

Coal Measures Sequence

This consists of lithic arenite, grey, brown and carbonaceous mudstone/siltstone, coal and rare tuffs; a minimum of 5 coal seams (A,B,C, D & E) occur in the eastern portion and 5 coal seams (L, M, N, O & P) in the western portion. Total thickness of the sequence is > 150m, and it dips flatly to the south and west.

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The Coal Measures Sequence was probably formed in a high sinuosity - single channel drainage environment, although there is evidence for alternative modes of coal genesis.

Tuff - Siltstone Sequence

This underlies the Coal Measures Sequence, and consists of lithic to sub lithic arenite, cream, grey, green and red mudstone and siltstone, with numerous tuffs.

Total thickness is probably ≪ 50m, and the entire sequence is variably zeolitized; it is probably a floodplain facies of the Ross Sandstone.

Ross Sandstone Sequence

This consists mainly of quartz (± feldspar) arenite with minor mudstone/ siltstone; it underlies the Coal Measures Sequence, but is probably a channel facies equivalent to the Tuff - Siltstone Sequence.

The Ross Sandstone was probably formed in a low sinuosity - multi channel drainage environment, and is ≪ 200m. thick.

1.3 OPEN CUT COAL RESERVES

Following the interpretation of the gravity survey results at Woodbury by D. E. Leaman (Appendix 3), certain photo-interpreted structures were confirmed.

Consequently it became necessary to incorporate this data with the pre-existing analytical, lithologic, and stratigraphic data relating to the coal seams and the host Coal Measures Sequence.

Full details of the reinterpretation of the structural setting of the Woodbury Coal Deposit, and the subsequent recalculation of coal reserves are provided in Appendix 1.

Three reserve calculations were made, namely a high grade, and two low grade, with overburden : coal ratios ranging from 7:1 to 10:1.

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The results of these reserve calculations are shown in the following table.

TABLE 1

WOODBURY COAL DEPOSIT - SUMMARY MAY 1982

COAL RESERVE TYPE	COAL RESERVE CATEGORY	O/B : COAL RATIO	TONNES x 10^6	ASH (%)	V.M. (%)	S.E. (MJ/kg.)	S (%)
LOW GRADE	MEASURED	10:1	10.021	40.6	20.1	24.3	0.36
LOW GRADE	INDICATED	10:1	14.788	40.8	-	-	-
		TOTAL	24.809	40.7	-	-	-
LOW GRADE	MEASURED	7:1	5.506	42.4	22.5	24.4	0.37
LOW GRADE	INDICATED	7:1	9.637	41.2	-	-	-
		TOTAL	15.143	41.6			
HIGH GRADE	MEASURED	10:1	6.100	35.6	-	-	-
HIGH GRADE	INDICATED	10:1	9.165	35.6	-	-	-
		TOTAL	15.265	35.6			

VM : Volatile matter - estimated for 20% ash
SE : Specific energy - estimated for 20% ash
S : Sulphur

1.4 INSITU COAL RESERVES

NORTH WOODBURY AREA

The area of Woodbury Basin outside the presently defined Woodbury Coal Deposit is 8 sq. km., coal seams A, B and C are inferred to extend under this area, and considering only Seams B and C (combined thicknes of 3 m.) the inferred coal reserve is 36 million tonnes.

SOUTH WOODBURY AREA

The gravity survey indicated certain sections of the Bellevue Hill - Black Tier Horst to have been intruded by dolerite feeder pipes, with the result that the coal potential in those sections is unprospective.

However, north and east of the region of thickened dolerite (Figure 9 in Appendix 3), and extending from 535 500E to 542 000 E south of the Woodbury Coal Project, dolerite covered Coal Measured Sequence rocks are inferred over a minimum area of 11 sq. km.

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Coal Seams C and D (combined thickness of 4 m.), are inferred to extend into this area, so that the inferred coal reserve is 66 million tonnes.

The total inferred coal reserves for the combined North and South Woodbury areas is 102 million tonnes.

2.0 MAPPING AND REINTERPRETATION OF DATA

2.1 BELLS LAGOON AREA

2.1.1. INTRODUCTION

Photo mapping at a scale of 1:42000 was completed over an area of approximately 100 sq. km., bounded by Gavins Tier, Tunbridge Tier Road, Verwood Road and Auburn Road as depicted on geological Plan No. 1.

All 11 rotary/percussion holes drilled in the area were relogged and the wireline logs were reinterpreted to enable the NNW - SSE cross section (Figure 1) to be compiled. Drill hole logs are contained in Appendix C.

From a consideration of regional Triassic stratigraphy, and the mapping and drilling results, the Bells Lagoon area can be subdivided into four inferred fault blocks, as shown on the geological plan No. 1 and as discussed subsequently.

2.1.2. BELLS LAGOON NO. 3 BLOCK

A. Geology

The main rocks cropping out in this block are Cainozoic (Tertiary in part) age sediments, in part ferruginized and lateritized.

Drill hole BL 3 intersected approximately 60 m. of lithic arenite, hosting 6 black coal seams ranging in thickness from 0.5 - 1.3m, and containing approximately 30 - 40% ash.

This lithic arenite is similar to that seen elsewhere in the state where it also contains coal, and together with grey, brown, green and carbonaceous mudstone and siltstone, comprises the Triassic Coal Measures Sequence (part of P.S.Gp. UFW Sequence).

The dip of this sequence is inferred to be toward the north at 2^{o}.

B. COAL POTENTIAL

The BL 3 Block covers approximately 12 sq. km., and assuming a total coal thickness of 4m, and an RD of 1.5, the inferred black coal reserve is 72 million tonnes.

2.1.3. BELLS LAGOON NO. 6 - ANNANDALE NO. 1 BLOCK

A. GEOLOGY

This block may actually consist of two blocks, divided by a NE trending inferred fault, as shown on geological sketch map No. 1.

Cainozoic (Tertiary) age sedimentary rocks cover the southern block (A - 1 block), while Jurassic age dolerite has intruded a substantial portion of the northern block (BL - 4, 5 & 6 block). The two blocks are described together, as the sequences intersected in drill holes A - 1 and BL - 6 appear similar.

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Drill hole BL - 6 penetrated a dolerite intruded fresh-water, Triassic Age sequence of grey, brown and green mudstone and siltstone, with subordinate lithic and quartz arenites, and two black coal seams (part of P.S.Gp. UFW Sequence).

This sequence may lie stratigraphically below that in hole BL - 3, and may be transitional to the underlying quartz arenite (Ross Sandstone, also part of the P.S.Gp. UFW Sequence).

The coal seams average 0.75 m. in thickness, and contain approximately 30 - 40% ash.

Drill hole A - 1 intersected 62 m. of Cainozoic age clays, silts, sands and conglomerate; the basal section included 5 lignite (?brown coal) seams totalling 3.3 m. over a 7m. interval. Below the Tertiary section, grey, brown and green mudstone and siltstones hosting a single 2 m. thick black coal seam/carbonaceous mudstone were penetrated; this sequence is interpreted as being similar to that in hole BL - 6, with a tentative correlation of the coal seam with the lower coal seam in BL - 6.

<u>B. Coal Potential</u>
The BL-6 A-1 block covers ≈7 sq km, + assuming a single 1m thick coalseam, (RD of 1.5), the inferred black coal reserve is ≈ 10x10⁶ tonnes

The dip of the sequence in the BL - 6 - A - 1 Block is inferred to be northward at 2^{0}.

B.

2.1.4. <u>BELLS LAGOON NO. 2 - VERWOOD NO. 1 BLOCK</u>

A. <u>GEOLOGY</u>

Cainozoic (Tertiary in part) age sedimentary rocks crop out in this block, and were intersected to a maximum depth of 50 m. in drill holes BL - 2 and V - 1.

Similarly to drill hole A - 1, the basal sections (approx. 10 m. thick) in both holes consisted of lignite (? brown coal) bearing siltstone/mudstone; however, no details on the number or thickness of these seams is available, and those shown on the section are schematic.

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Beneath the Tertiary sequence, a freshwater sequence of quartz ($\pm$ feldspar) arenite and grey, brown, green and red mudstone/siltstone was encountered.

This sequence is interpreted as being either transitional from the lithic arenite (Coal Measures) sequence to the quartz ($\pm$ feldspar) arenite (Ross Sandstone) sequence, or a lutite rich (? floodplain) facies of the Ross Sandstone, (all part of the P.S.Gp. UFW Sequence).

A carbonaceous mudstone/black coal unit occurs in both BL - 2 and V - 1, and a southerly dip of 3^0 is inferred for the sequence.

B. COAL POTENTIAL

This block, in the immediate vicinity of BL - 2 and V - 1 is not as prospective as the BL - 3 block for Woodbury-Fingal type coal (i.e. Triassic lithic arenite sequence); however, given the potential for NW trending faults, the western half of the block is worthy of further work.

Approximately 5 sq. km. of ground occurs in this western half, and assuming a single 1 m. thick coal seam, and an RD of 1.5, the hypothetical coal resource is 8 million tonnes.

2.1.5. ISIS RIVER - JOES CREEK PLAIN

A. GEOLOGY

This area is depicted on the Lake Sorell 1: 100 000 topographic, and Oatlands 1: 250 000 geological sheets.

Drill holes BL 1A and 1B intersected quartz ($\pm$ feldspar) arenite (Ross Sandstone) on the eastern side of the plain, and from a consideration of the regional stratigraphy and structure, the potential exists under the Isis River - Joes Creek Plain for the occurrence of P.S.Gp. UFW sequence rocks, (i.e. both Permian Cygnet Coal Measures correlates, and Triassic lithic arenite/Coal Measures sequence).

B. COAL POTENTIAL

The area covered by this plain is approximately 15 sq. km., and assuming a single 1 m. thick coal seam, and RD of 1.5, the hypothetical coal resource is 22.5 million tonnes.

2.1.6. CONCLUSIONS

Several important points arise from the reappraisal of the Bells Lagoon area, namely:

1. Black coal occurs in five of the drill holes (A-1, BL-2, 3, 6, V-1,), the quality of this coal is not known in detail, and the ash contents of 30 - 40% were estimated from the wireline radiometric logs.

2. The Upper Freshwater Sequence of the Parmeena Super Group is represented by:
   (a) The lithic sandstone (Coal Measures Sequence) of Triassic age (A-1, BL-3, BL-6).

   (b) The quartz sandstone (Ross Sandstone) of Triassic age (BL-2, V-1); this unit is apparently uncharacteristicall rich in lutite content, and observation complemented by the presence of black coal in holes BL-2 and V-1.

3. Faulting of the area in Tertiary time resulted in the formation of several variably oriented grabens contained within a larger NW trending graben (Bells Lagoon Basin).

4. Lignite/brown coal of probable Tertiary age is present in two of the grabens/blocks, namely those centered on drill holes A-1, and BL-2, V-1.

5. Black and brown coal inferred reserves and resources are as follows:

Inferred Black Coal Reserves

BL-3 Block	:	72 million tonnes
BL-6 - A-1 Block	:	10 million tonnes
TOTAL	:	82 million tonnes

Hypothetical Black Coal Resources

BL-2 - V-1 Block	:	8 million tonnes
Isis River Plain	:	22.5 million tonnes
TOTAL	≈	30 million tonnes

Inferred Lignite (? Brown Coal) Reserves

A-1 Block	:	$3.5 \times 3 \times 1 \times 10^6$	= 10.5 million tonnes
BL-2 - V-1 Block	:	$5 \times 3 \times 1 \times 10^6$	= 15 million tonnes
		TOTAL	25.5 million tonnes

N.B.

1. Inferred coal reserves refer to the areas for which there is a poor cover of information; further information will either raise these reserves to a higher category, or show that part or all of them does not exist.

2. Hypothetical coal resources refer to the areas for which the level of information is less than that requirec to state inferred coal reserves; similarly to the latter category, further investigation will either upgrade or down grade part or all of the areas concerned.

2.2 ROSS - MACQUARIE RIVER AREA

2.2.1. INTRODUCTION

Investigations by Victor Exploration have consisted of reconnaissance mapping at a scale of 1:42 000 and 1:100 000. The potential of this area lies in the presence of Tertiary age basalt which, although covering the P.S.Gp. UFW Sequence rocks, would preserve the same from erosion, in a broadly similar, but less disruptive style to the Jurassic age dolerite in the state.

2.2.2. GEOLOGY

The Ross area (refer Plan 2) consists of both UM and UFW rocks of the P.S.Gp., subsequently intruded by Jurassic age dolerite, and covered by Tertiary age basalt.

The outcropping freshwater rocks are predominantly quartz ($\pm$ feldspar) arenites (Ross Sandstone), with one exposure of lithic arenite (Coal Measures) sequence in Tacky Creek, approximately 3 km. east of Ross.

The structure of the area is not fully understood at the present, with variable dip azimuths; Tertiary faulting peripheral to the major lineament known as the Tamar Fracture System can be inferred, with consequent down faulting of P.S.Gp. rocks. Alternatively, up faulting with consequent erosion of the Ross Sandstone, would place the Cygnet Coal Measures correlate beneath the Tertiary basalt.

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The attached cross section (Figure 2) was constructed on the basis that the outcrop of lithic arenite in Tacky Creek is the northern end of a gently south dipping (1^{o}) block.

The Tertiary basalt appears to average 20 m. in thickness, and the inferred Coal Measures Sequence appears to be > 100m. in thickness. (Northern Area).

2.2.3. COAL POTENTIAL

The area is considered in two basalt covered portions; a northern portion north of 5,339,000N, and a southern portion south of this boundary to 5,333,000N.

A. NORTHERN AREA

This is shown on the section, and in part on the plan and is bounded to the west by the Macquarie River and on the east by grid 545,000E, covers an area of 20 sq. km. (Refer Figure 3). Assuming a single 1m thick coal seam and an RD of 1.5, the hypothetical coal resource is 30 million tonnes

B. SOUTHERN AREA

This area, bisected by the Macquarie River, and bounded on the west by Artillery Ridge, and on the east by grid 548,000E, covers an area of 25 sq. km. (Refer Figure 3).

Thus assuming a single 1 m. thick coal seam, and an RD of 1.5, the hypothetical resource of coal is 37 million tonnes.

C. TOTAL HYPOTHETICAL COAL RESOURCE

The total for the two area is approximately 67 million tonnes.

2.3 BELLS LAGOON - WOODBURY AREA

2.3.1. INTRODUCTION

One of the significant results arising from the mapping, drilling and gravity work in the Woodbury and Bells Lagoon areas, was the realization that a thin dolerite cover may occur in graben structures, such as the Woodbury Trough, Kuranda Graben, and capping horst structures such as the Bells Lagoon Horst. (refer Plan No. 3).

5 cm

ROSS - MACQUARIE RIVER AREA. Figure 3.

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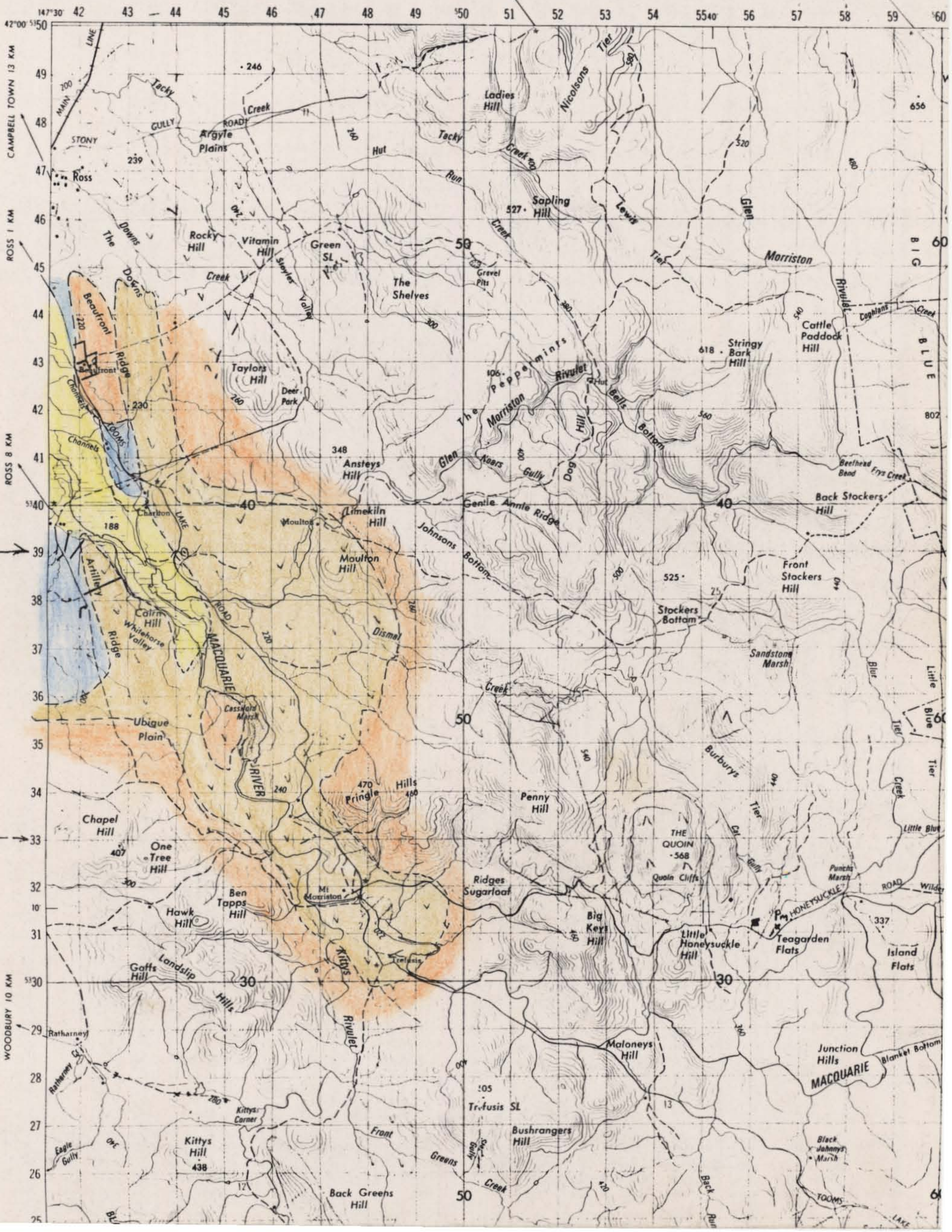
TASMANIA 1:100 000
TOPOGRAPHIC SURVEY

Quaternary Alluvium
Tertiary Basalt
Jurassic Dolerite
Parmeener Super Group — UFW Seq.

Geology: KC Morrison.



Consequently, areas prospective for shallow depth coal may have surface outcrop of dolerite, either in the form of talus (Woodbury Trough), or as thin remmant sheets (Kuranda Graben, Bells Lagoon Horst).

The main factors instrumental in the preservation of Triassic age lithic sandstone / Coal Measures Sequence are as follows:-

1. Emplacement of Jurassic dolerite sills above the Coal Measures Sequence (e.g. Fingal Tier);

2. Extrusion of Tertiary basalt flows over the Coal Measures Sequence (e.g. Macquarie River);

3. Block faulting of either Jurassic or Tertiary age, to produce grabens, which may also be infilled with Tertiary basalt and/or sediments.

The latter two modes of preservation are envisaged as the most likely to result in black or brown coal deposits potentially amenable to open pit extraction. Conversely, block faulting could also result in Permian age black coal being placed at shallow depth within horst structures.

In the following discussion, only the graben structures, suitable for the preservation of the Triassic Coal Measures Sequence, are considered. The significance of the coal in the Ross Sandstone in the Bells Lagoon area has not been fully evaluated, and in this report the Ross Sandstone is assumed to be devoid of coal.

Reconnaissance mapping, photo interpretation, gravity and drilling results in the Bells Lagoon - Woodbury area were combined to produce a structural overview, as shown on Plan No. 3.

2.3.2. GELOOGY

Triassic age lithic sandstone hosting up to five black coal seams occurs in both the Bells Lagoon and Woodbury areas; Ross Sandstone also occurs in both area, and in the Bells Lagoon drilling it was revealed to be unusually lutite rich, and to contain coal. Lack of deep drilling of the Ross

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Sandstone in the Woodbury area precludes further comment on the significance of this apparent variation in sand:shale ratio.

The confirmation of photo linears representing major fault structures in the Woodbury area (by gravity data) permits a reasonable degree of reliability to the interpretation of photo linears as faults in the region west of Woodbury.

The plan of the area indicates the photo linears occur in two main groups, a NE (045^{o} - 070^{o}) trending, and a SE (130^{o}-155^{o}) trending group. Gravity confirmed fault structures in the Woodbury area strike at 110^{o} - 140^{o} (Woodbury Trough), and approximately 060^{o} (Kuranda Graben), these orientations are regarded as belonging to the SE and NE groups respectively.

Outcrop other than dolerite, in the region south east of Bells Lagoon, and west of the Midland Highway is poor, and a comprehensive interpretation of this region will require drill investigation. However, it is apparent that the 140^{o} trending linear forming the north east margin of the Annandale Graben is similarly aligned to the She Oak Ridge ?Horst, the northern boundary of the Woodbury Trough, and the lithic - guartz sandstone boundary between Red Ridge and Glen Morey Saltpan; this latter boundary is the northern margin of the Woodbury Basin.

Consequently, three grabens have been interpreted in the region, namely the Melrose, Tunbridge West, and Woodbury West Grabens; the inferred Woodbury West and Annandale - Melrose Grabens may originally have been the same structure, now disrupted by dextral movement across the NE trending linear/fault which transects She Oak Ridge. Alternatively, the inferred Woodbury West Graben diverges around the inferred She Oak Ridge Horst.

Similarly, the Annandale - Melrose Graben appears to have been offset from the Bells Lagoon Graben by dextral movement across the NE trending fault at the southern end of Bells Lagoon.

NE trending structures include the inferred Mill Brook Graben and Horst, the Bells Lagoon Horst (BL-6 Block) and the Bells Lagoon Graben.

The relative ages of the NE and SE trenching structural groups is not known, and as shown on the NNW-SSE section through the Bells Lagoon area (Figure 1), fault movements of Jurassic and Tertiary age may have been compensatory.

It is likely that both structural groups were originally Jurassic in derivation (?or other), but with major reactivation of the SE trending group in Tertiary time.

2.3.3. COAL POTENTIAL

As mentioned previously under the section on Bells Lagoon, the Bells Lagoon Graben (B1-3 Block), and the Annandale Graben (A-1-BL-6 Block), contain inferred reserves of black coal. Similarly the Woodbury Basin (North Woodbury) and Bellevue Hill - Black Tier Horst (South Woodbury) contain inferred coal reserves, and these areas are included in the following table for completion.

The totals for the Isis River - Joes Creek Plain - Bells Lagoon - Woodbury structural zone (outside the Woodbury Coal Deposit) are as follows:-

Inferred Coal Reserve = 184 million tonnes

Hypothetical Coal ~~Reserve~~ Resource = 73 million tonnes

TABLE 2

BELLS LAGOON - WOODBURY STRUCTURAL ZONE

REGION		STRUCTURE	AREA (km^2)	NO. OF SEAMS (ASSUMED)	AVE. SEAM THICKNESS (ASSUMED) (m)	TOTAL SEAM THICKNESS (m)	ASSUMED R.D. (T/M^3)	INFERRED COAL RESERVE ($T \times 10^6$)	HYPOTHETICAL COAL RESOURCE ($T \times 10^6$)
BELLS LAGOON	(	ISIS R. - JOES CK. PLAIN (?Graben)	15	(1)	(1)	(1)	1.5	-	22
	(	BL - 2 - V - 1 Graben	5	(1)	(1)	(1)	1.5	-	8
	(	BELLS LAGOON GRABEN	12	4	1	4	1.5	72	-
ANNANDALE	(	ANNANDALE GRABEN	7	1	1	1	1.5	10	0
	(	MILL BROOK ? Graben	4	(2)	(1)	(2))	1.5	-	12
MELROSE		MELROSE ? Graben	5	(2)	(1)	(2)) θ	1.5	-	15
TUNBRIDGE		TUNBRIDGE WEST ?Graben	1.5	(2)	(1)	(2))	1.5	-	4
WOODBURY	(	WOODBURY WEST ?Graben	4	(1)	(1)	(2))	1.5	-	12
	(	WOODBURY NORTH *	8	2	1.5	3	1.5	36	-
	(	WOODBURY SOUTH **	11	2	2	4	1.5	66	-
							TOTALS	184	73

* Woodbury Basin, north of the Woodbury Coal Deposit as presently defined.

** Eastern portion of the Bellevue Hill - Black Tier Horst

θ The average total thickness of coal in the Bells Lagoon and Woodbury areas is 3 m. and 5 m. respectively; the inferred grabens between these two areas were assumed to contain approximately 2 m. of coal (total thickness).

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2.4 ISIS RIVER - GREAT WESTERN TIERS AREA

2.4.1. INTRODUCTION

Photo mapping at a scale of 1:42 000 was completed over an area of approximately 25 sq. km., bounded by the Great Western Tiers, the Isis River, 522 000m. E, and the northern boundary of the licence, as shown in Figure 4.

In addition, it was found necessary to undertake field examinations of the Parmeener Super Group (P.S.Gp.) rocks exposed in the Millers Bluff - Isis River area, located immediately to the north of the area mapped.

2.4.2. GEOLOGY

Outcropping P.S.Gp. rocks in the area mapped consist of the Lower Freshwater Sequence (LFW), and the Upper Marine Sequence (UM).

A. STRATIGRAPHY

(1) LOWER FRESHWATER SEQUENCE

This is represented by a well sorted, medium-coarse grained quartz arenite, with subordinate micaceous quartz arenite, and carbonaceous shale, bedding ranges from massive to cross bedded, and the sequence is characterized by worm cast upper and lower sections. Thickness is estimated at 30-50 m.

(2) UPPER MARINE SEQUENCE

This is lithologically similar to the Lower Marine Sequence in the area east of Millers Bluff, and the entire marine sequence of the P.S.Gp. in the Millers Bluff - Great Western Tiers area may be broadly considered as a cyclic sequence of siltstone and mudstone, with occasional sandstone interbeds.

Subdivision of the UM Sequence followed convention, and relied mainly on the location of sandstone horizons, with some auxiliary palaeontological input.

(i) Poatina Group

This consists of medium-dark grey interbedded mudstones and siltstones containing dropstones;

RECONNAISSANCE MAP OF THE ISIS RIVER / GREAT WESTERN TIERS

SCALE 1:42 000

T.G. SUMMONS
K.C. MORRISON.

JAN 1982.

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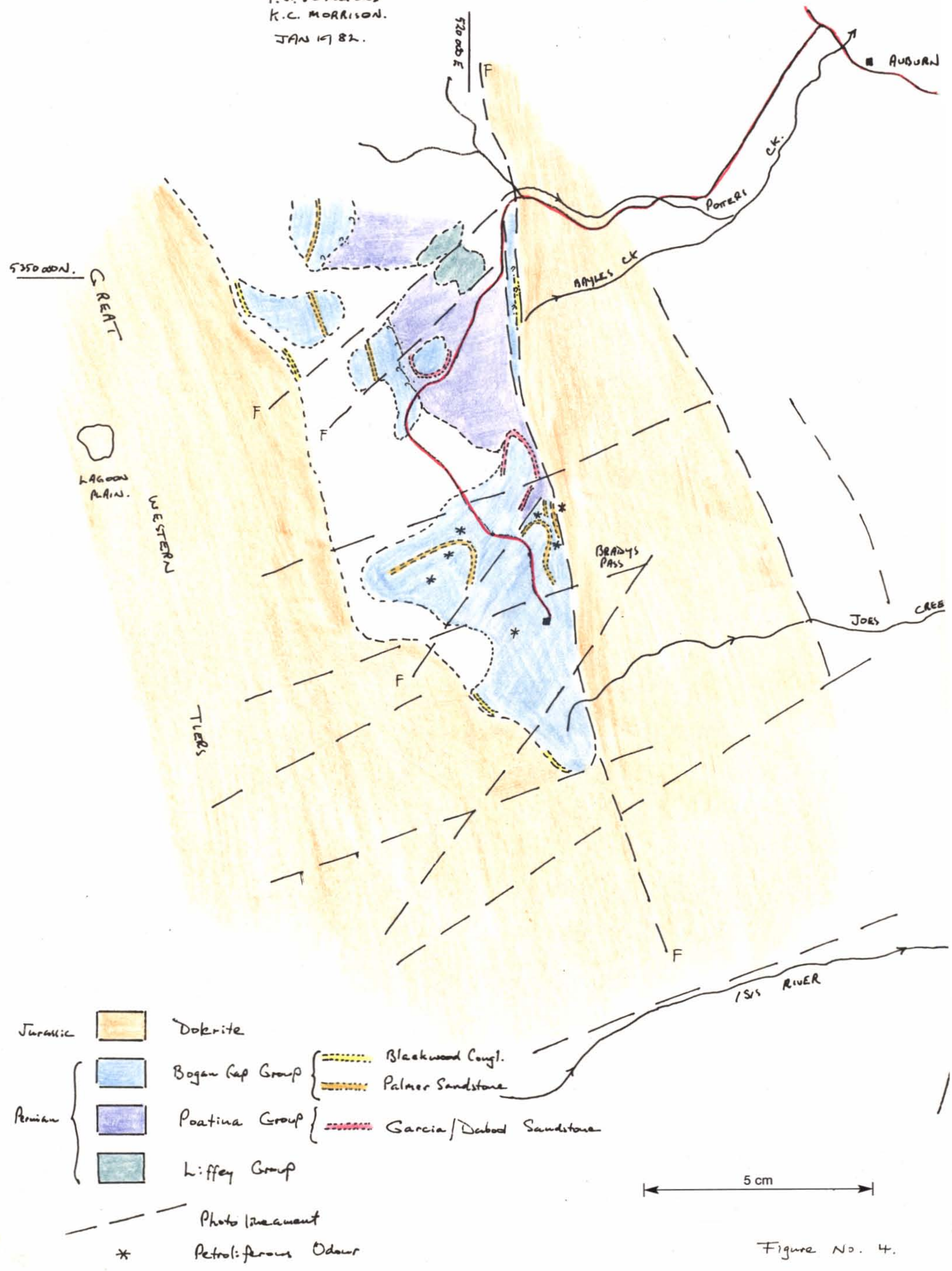

Figure No. 4.

it is poorly fossiliferous, and occurs immediately above the LFW Sequence (Liffey Group). The top of the sequence is represented by a pebbly feldspathic wacke sandstone, interpreted as the Garcia or Dabool Sandstone, which is immediately overlying a shale rich in bryozoa.

(ii) BOGAN GAP CROUP

This consists of medium/dark grey interbedded siltstones and mudstones containing dropstones, and which are generally poorly fossiliferous. A persistent pebbly feldspathic wacke (interpreted as the Palmer Sandstone), was located in several places; near the head waters of Bayle's Creek, a second sandstone similar to the one described above appears although fault repetition of the unit cannot be precluded as an optional interpretation.

The top of this group was not located, but the presence of a pebbly granule conglomerate (Blackwood conglomerate), along the inferred eastern margin of the dolerite forming the Great Western Tiers, suggests that virtually the complete sequence is exposed.
The total thickness of the UM sequence is estimated to be 250-300 m.

B. STRUCTURE

The dominant structural element in the area appears to be a N-S trending fault, east of which occurs an elongate (?dyke) body of dolerite. Although this fault probably has several subsidiary splinter faults, the general sense of movement is believed to be east block down. Evidence for this interpretation comes from a probable occurence of Blackwood conglomerate east of the Liffey Group outcrop, and from regional evidence pertaining to the area north of EL 31/80.

Other faults in the area are oriented NE to ENE, and although complicating the stratigraphic interpretation, the throws on these faults are considered to be much less than that across the N-S trending fault.

Dip measurements on the sandstone units indicated a general flat lying to flat south dipping sequence.

2.4.3. HYDROCARBON POTENTIAL

As the geological map (Figure 4) depicts, the P.S.Gp., L.M. Sequence does not outcrop in EL 31/80, and because this sequence is known to emit a petroliferous odour when broken in other areas of the state (e.g. Styx River, Poatina, head of the Mersey River), the Millers Bluff - Great Western Tiers - Isis River area was briefly examined. Petroliferous odours were noted in the Quamby Mudstone (516 800mE, 5 358 500m N, 515 500m E, 5 360 100m N), in the Golden Valley Group (516 500 mE, 5 358 400m N), and in the UM Sequence (Poatina Group: 518 400m E, 5 351 200m N; 517 500m E, 5 352 500m N.).

Within the area mapped, petroliferous odours were discovered at several localities in the Upper Marine Sequence (Bogan Gap Group) as shown on Figure 4.

The petroliferous smell observed in both marine sequences was most readily detected in samples from recent excavations (road cuttings, quarries); detection of a petroliferous odour in surface outcrops is generally only possible in dense mudstone/ siltstone, and these rock types are frequently coated with a yellow salt (?sulphates) on the joint surfaces.

Lower Marine Sequence rocks with a petroliferous odour are typically brittle with ellipsoidal ("weathering) fragments, and do not exhibit positive outcrop expression. The ellipsoidal (pseudo spheroidal) ?weathering characteristic has been observed throughout the P.S.Gp. marine sequences, and is not confined to the basal section of the LM Sequence.

These discoveries of petroliferous smelling rocks have expanded the previously known thickness of source rocks from approximately 90m. to approximately 450m. in the Millers Bluff - Great Western Tiers - Isis River area.

Previous analyses of petroliferous smelling LM Sequence rocks (Quamby Mudstone, Woodby Island Siltstone etc.) revealed the following characteristics:

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Mersey River: 0.85% TOC, 91 mg/gTOC of EOM, 58% sapropelic kerogen.

Poatina : 0.62% TOC,122 mg/gTOC of EOM, 70% sapropelic kerogen.

Styx River : 1.19% TOC,192 mg/gTOC of EOM, 80% sapropelic kerogen.

However, despite these encouraging hydrocarbon source rock parameters, some doubts existed as to the authenticity and significance of the petroliferous odour.

Analysis of a sample of Quamby Mudstone collected from the tail race portal at Poatina was completed by the Chemistry Department in the University of Tasmania. The technique employed to identify the hydrocarbons in the rock was a modified version of the normal headspace gas chromatography.

Although the separating column was operated isothermally at 50^{o}C, (normal practise is to gradually heat the sample to $>$150^{o}C, so that progressively lower volatile, heavier hydrocarbons are vaporised), the resultant gas chromatograph revealed the presence of a homologous paraffin series of hydrocarbons, ranging from C3 (propane - liquified petroleum gas) to C_{10} (decane).

The method used did <u>not</u> allow the detection of hydrocarbons heavier than decane, and further analytical work on petroliferous sediments will require the conventional technique to be adopted.

Further analysis of the petroliferous smelling mudstone from the Styx River was performed by C.R.A. (M.C. Forster, pers. comm.), also with most encouraging results. Analysis of the sample revealed it to contain approximately 2% TOC, while the gas chromatogram indicated the following:

(a) The sample has significant hydrocarbon generating potential,

(b) The sample has already generated 30% of its hydrocarbons,

(c) The sample would generate recoverable hydrocarbons with further heating.

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In reference to point (b) above, the TAI production index implies that 30% of the potential hydrocarbon generating capacity has been used; significantly, this figure appears to confirm the interpreted geothermal gradient of 39°C/km. across the dolerite and P.S.Gp. (to the top of the Wynyard Tillite) reported previously; (Preliminary Report on Petroleum Potential - Onshore Tasmania by T. G. Summons, dated August 1981, and submitted as Appendix 3 in the Victor Petroleum and Resources Ltd., Renewal and Progress Report to November 21, 1981, EL 31/80).

The significant conclusion arising from these analyses is that the P.S.Gp. LM Sequence has been shown to contain authentic saturated hydrocarbons, and that consequently the UM Sequence of the P.S.Gp. may be considered as potential oil/gas source rocks.

3.0 GEOPHYSICS

3.1 GRAVITY SURVEY

The gravity survey over an area of approximately 53 sq. km. at Woodbury was completed during the period ended November 21, 1981. Interpretation of the results was completed by Dr. D. E. Leaman (consulting geophysicist) during the current period. Full details of this work are contained in Appendix 3. The main conclusions arising from the interpretation of the gravity survey results are as follows:

1. The lithic sandstone/Coal Measures Sequence at Woodbury is "sandwiched" between two dolerite sheets.

2. The major faults are oriented NE and ESE, and have throws of 40-150m.

3. At least two dolerite feeder pipes occur to the south and south east of Kuranda homestead; these pipes, in conjunction with the west dipping upper dolerite sheet effectively preclude the occurrences of coal in the area west of 540 000E.

4. The major portion of the Woodbury Coal Deposit is contained within the ESE trending Woodbury Trough and NE trending Kuranda Graben.

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5. The major faults appear to down throw to the north, and appear to have dissipated some of the Tertiary age upward movement of the Great Western Tiers.

3.2 WIRELINE LOGGING

Consulting geophysicist, Dr. D. E. Leaman, conducted a review of the usefulness and significance of the results obtained from wire line logging of drill holes by Victor in central Tasmania. The main conclusion arising from this work is that previous drill hole logging rates (15m/min.for electric, and 6m/min for radiometric logs), were too rapid, with a consequent loss of some resolution in the results.

Details are contained in Appendix 4.

APPENDIX 1

BELLS LAGOON DRILL LOGS

APPENDIX 1

BELLS LAGOON AREA

ROTARY/PERCUSSION DRILL HOLE LOGS

ANNANDALE - 1

Collar Co-Ordinates: 529 270 m E
5 336 820 m N

0 - 6 m	:	Gravel, Limonitic and pisolitic (? ferruginous zone of Tertiary laterite)
6 - 10 m	:	Gravel/sand, guartzose
10 - 20 m	:	Clay, white and grey (? pallid zone of Tertiary laterite)
20 - 52 m	:	?Talus/gravel/boulder bed, composed of dolerite
52 - 62 m	:	Silt and siltstone, grey/brown, interbedded with lignite; the 5 lignite beds total approximately 3.3 m. thickness.
62 - 68 m	:	Siltstone, white
68 - 76 m	:	Siltstone, grey/brown
76 - 84 m	:	Siltstone, white
84 - 88 m	:	Siltstone, grey
88 - 90 m	:	Coal and carbonaceous mudstone, minor grey siltstone
90 - 116 m	:	Siltstone, clayey, grey, interbedded with mudstone.

EOH - 116 m.

BELLS LAGOON - 1A

Collar Co-Ordinates: 527 130 m E
5 349 300 m N

0 - 32 m	:	Sandstone, quartz ± feldspar, white/yellow
32 - 44 m	:	Dolerite

EOH - 44 m.

BELLS LAGOON - 1B

Collar Co-Ordinates: 527 530 m E
5 348 780 m N

0 - 25 m	:	Sandstone, quartz ± feldspar, white yellow
25 - 37 m	:	sandstone, quartz ± feldspar, dense - cemented
37 - 40 m	:	Sandstone, quartz ± feldspar - thermal alteration
40 - 67 m	:	Dolerite

EOH - 67 m.

BELLS LAGOON 2

COLLAR CO-ORDINATES: 528 515 m E
5 344 600 m N

0 - 12 m	:	Clay, grey/yellow
12 - 16 m	:	Clay, sandy, with guartz sand.
16 - 28 m	:	Sand, white, fine grained, red mottling; minor silt/clay.
28 - 41 m	:	Sand/sandstone, green, fine grained, minor silt/clay.
41 - 46 m	:	Mudstone/siltstone, grey to carbonaceous; several lignite beds; minor green quartz sandstone.
46 - 50 m	:	Mudstone/siltstone, grey to black with plant debris.
50 - 60 m	:	Sandstone, quartz; interbedded with siltstone
60 - 132 m	:	Sandstone, quartz; minor sub lithic sandstone, minor grey/red shales
132 - 137 m	:	Mudstone, red, grey and carbonaceous; minor coal
137 - 153 m	:	Sandstone, guartz
153 - 166 m	:	Sandstone, guartz, interbedded with mudstone/siltstone
166 - 194 m	:	Mudstone, green/grey (?Permian Jackey Shale)

EOH - 194 m.

BELLS LAGOON 3

COLLAR CO-ORDINATES: 529 290 m E
5 341 030 m N

0.0 - 6.0m	:	Sand, quartz
6.0 - 11.5m	:	Sandstone, lithic
11.5 - 12.5m	:	Coal
12.5 - 15.0m	:	Sandstone, lithic
15.0 - 16.5m	:	Mudstone, carbonaceous
16.5 - 20.0m	:	Sandstone, lithic
20.0 - 21.0m	:	Mudstone, carbonaceous
21.0 - 21.8m	:	Coal
21.8 - 26.0m	:	Sandstone, lithic
26.0 - 26.6m	:	Mudstone, carbonaceous
26.6 - 27.1m	:	Coal
27.1 - 35.2m	:	Sandstone, lithic
35.2 - 36.2m	:	Coal, minor carbonaceous mudstone
36.2 - 42.5m	:	Sandstone, lithic
42.5 - 43.0m	:	Mudstone, carbonaceous
43.0 - 43.6m	:	Coal
43.6 - 55.0m	:	Sandstone, lithic
55.0 - 55.8m	:	Mudstone, carbonaceous
55.8 - 56.6m	:	Coal
56.6 - 64.0m	:	Sandstone, lithic

EOH - 64 m.

BELLS LAGOON - 4

COLLAR CO-ORDINATES: 530 280 m E
5 337 690 m N

0 - 12 m	:	Dolerite, weathered; clay, limonite, pisolites
12 - 58 m	:	Dolerite - fresh

EOH - 58 m.

BELLS LAGOON - 5

COLLAR CO-ORDINATES: 529 560 m E
5 338 920 m N

0 - 12 m	:	Dolerite, weathered and clayey.
12 - 28 m	:	Dolerite, weathered and ?chloritic
28 - 32 m	:	Dolerite - fresh

EOH - 32 m.

BELLS LAGOON - 6

COLLAR CO-ORDINATES: 529 570 m E
5 339 260 m N

0 - 10 m	:	Dolerite, weathered and clayey
10 - 26 m	:	Dolerite, fresh
26 - 39 m	:	Siltstone/mudstone, grey
39 - 42 m	:	Mudstone, carbonaceous
42 - 52 m	:	Siltstone/mudstone, grey
52 - 58 m	:	Mudstone, grey
58 - 62 m	:	Dolerite
62 - 77 m	:	Sandstone, lithic
77 - 77.5m	:	Coal
77.5- 80 m	:	Sandstone, lithic
80 - 97 m	:	Mudstone, grey
97 - 103 m	:	Sandstone, quartz and sub lithic
103 - 110 m	:	Mudstone, grey
110 - 117 m	:	Siltstone, grey/brown
117 - 126.2 m	:	Mudstone, grey
126.2 - 127 m	:	Coal and carbonaceous mudstone
127 - 131 m	:	Mudstone, grey
131 - 148 m	:	Dolerite

EOH - 148 m.

VERWOOD - 1 — COLLAR CO-ORDINATES: 526 815 m E, 5 345 500 m N

0 - 4 m	:	Gravel, Limonitic and pisolitic (? ferruginous zone of Tertiary laterite)
4 - 16 m	:	Sand/sandstone, quartz and lithic (reworked Triassic)
16 - 21 m	:	Sand/sandstone, minor granule gravel; all quartzose with minor lithic fragments (reworked Triassic).
21 - 30 m	:	Sand/sandstone, quartz to sub lithic; minor clay
30 - 36 m	:	Siltstone, grey, carbonaceous, with several lignite beds
36 - 60 m	:	Mudstone/siltstone, grey black; minor lithic sandstone
60 - 62 m	:	Mudstone, carbonaceous and minor coal
62 - 70 m	:	As for 36 - 60 m.
70 - 83 m	:	Sandstone, quartz to sub lithic, interbedded mudstone
83 - 89 m	:	Mudstone/siltstone, grey
89 - 92 m	:	Sandstone, guartz to sub lithic
92 - 110 m	:	Mudstone, green/grey
110 - 117 m	:	Siltstone and silty sandstone, grey/green
117 - 142 m	:	Sandstone, guartz

EOH - 142 m.

KITCHENER RIDGE - 1 — COLLAR CO-ORDINATES: 535 855 m E, 5 345 080 m N

0 - 60 m	:	Silstone, dark grey, indurated; minor dense shale, rare dropstones (Bogan Gap Group)

EOH - 60 m.

KITCHENER RIDGE - 2 — COLLAR CO-ORDINATES: 535 780 m E, 5 344 180 m N

0 - 4 m	:	Sandstone, white/yellow, quartzose and micaceous
4 - 14 m	:	Siltstone/shale, grey, brown and black; minor quartz sandstone.
14 - 34 m	:	Sandstone, white, quartzose and micaceous, minor feldspar; subordinate brown shale.
34 - 78 m	:	Siltstone, grey, black, indurated, occasional dropstones.

EOH - 78 m.

INTERPRETATION:

0 - 4 m	:	? Basal Triassic quartz sandstone
4 - 14 m	:	Permian Jackey Shale/Cygnet Coal Measures correlate
14 - 34 m	:	Permian Cygnet Coal Measures sandstone correlate
34 - 78 m	:	Parmeener Super Group - Upper Marine Sequence - Bogan Gap Group

APPENDIX 2

WOODBURY COAL DEPOSIT - DEFINITION OF COAL RESERVES

(Revised)

APPENDIX 2

WOODBURY COAL DEPOSIT

EL 31/80 - TASMANIA

DEFINITION OF THE COAL RESERVES

T. G. SUMMONS

1.0 INTRODUCTION

The Woodbury Coal Deposit is located 80 km. north of Hobart and 85 km. S.S.E. of Launceston and extends from 1 km. to 10 km. east of the connecting Midland Highway. The area consists of undulating pastoral lands, interspersed with low ranges which are capped by dolerite.

Investigations by Victor Petroleum and Resources Ltd., commenced in January, 1981, and to date, consist of both open drill holes (1732m) and cored drill holes (1388m), totalling 3120m. of drilling.

2.0 GEOLOGY

2.1 LITHOLOGY & STRATIGRAPHY

The middle to late Triassic stratigraphy of the Woodbury area consists of a coal measures sequence overlying a tuff and siltstone sequence. The coal measures sequence consists of lithic sandstone, mudstone (grey, brown and carbonaceous), coal, minor siltstone and rare tuffs. The tuff-siltstone sequence consists of lithic and sub-lithic sandstone, siltstone and mudstone (cream, grey, green) with numerous tuff (and volcanic) bands, and is apparently devoid of coal.

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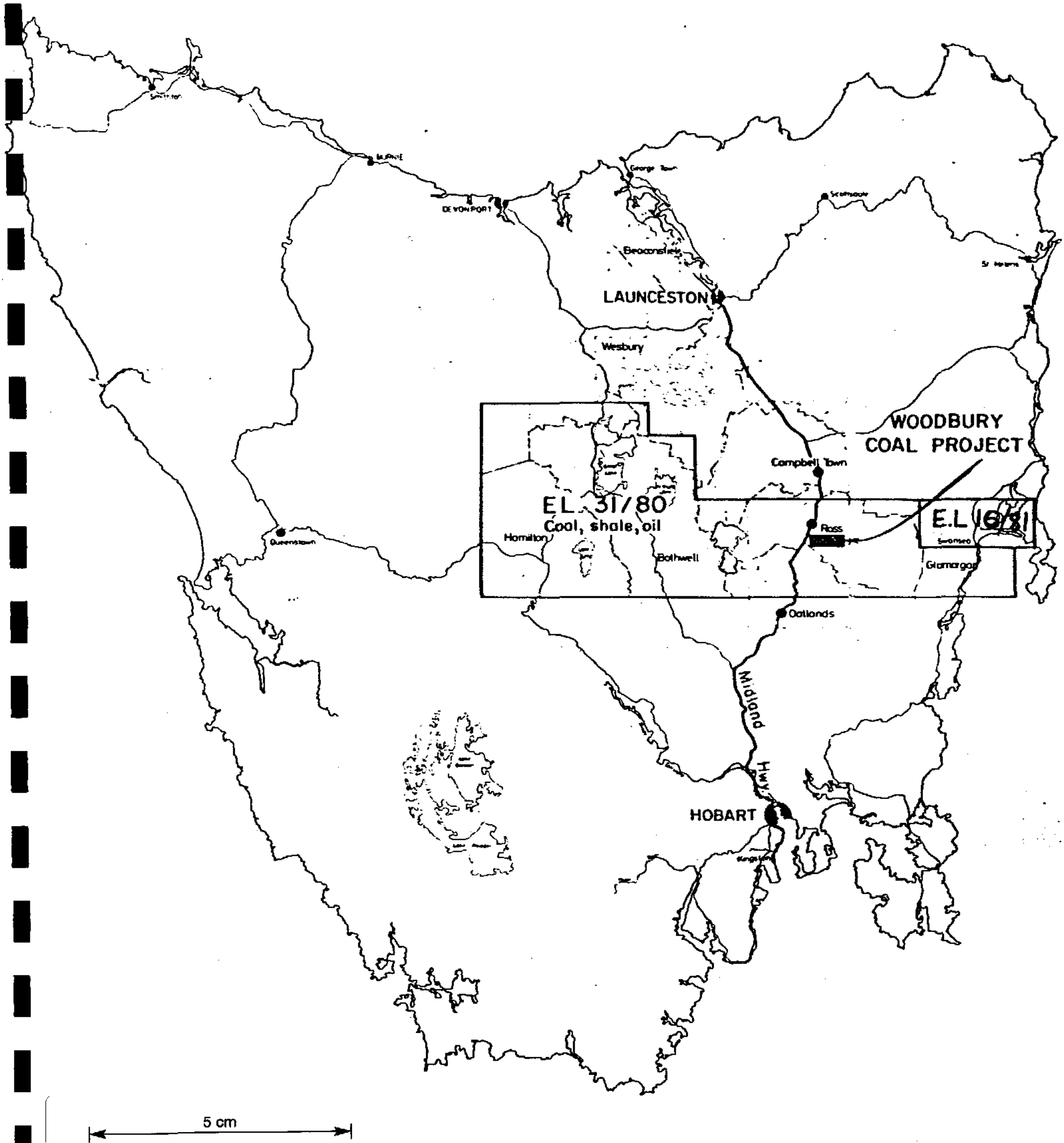

VICTOR PETROLEUM & RESOURCES LTD.

LOCALITY PLAN OF E.L. 31/80 & E.L. 6/81

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MARCH 1981

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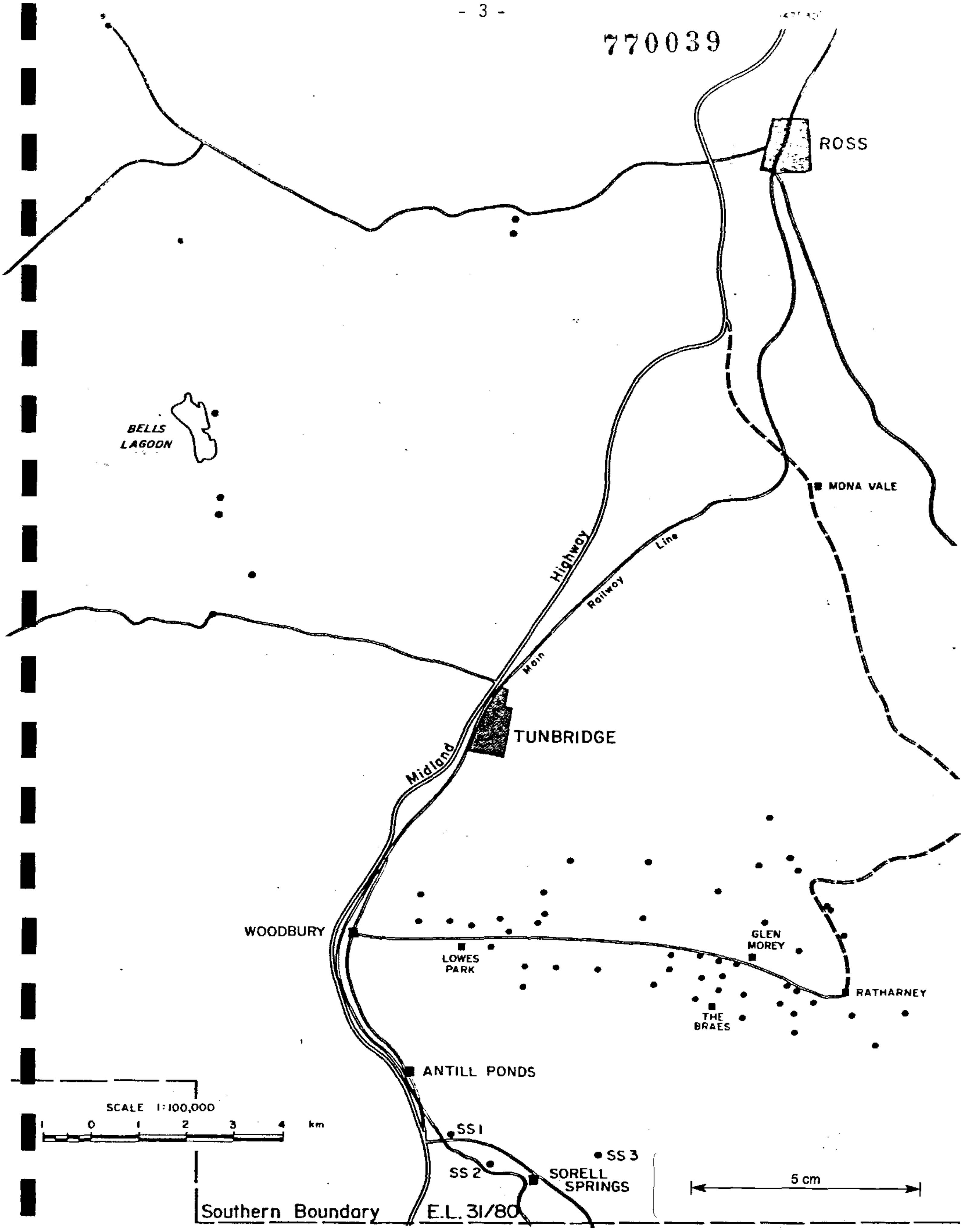

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TASMANIA E.L. 31/80

WOODBURY COAL PROJECT & DRILL HOLE LOCATION P...

Consideration of coal seam and general stratigraphic correlations indicates two components to the Woodbury Coal Deposit, namely the Western Area and the Eastern Area. The boundary between the areas is located approximately 5 km. east of the Midland Highway. The Western Area contains five coal seams named, L, M, N, O and P, while the Eastern Area contains five coal seams, defined as A, B, C, D and E.

Stratigraphic evidence suggests the Western Area is younger than the Eastern Area, with Seam E being the apparent correlate of seam L.

2.2 STRUCTURE

The orientation of the lithic arenite (Coal Measures) sequence is variable according to the effects of both primary depositional features, and subsequent modification by dolerite intrusions during the Jurassic, and faulting in mid to late Mesozoic and the Tertiary.

The combination of a gravity survey (Leaman 1981) and photo linear studies, reveals several graben and horst structures in the Woodbury area. The most significant of these structures are the NE (062^{o}) trending Kuranda Graben, the ESE (112^{o}) trending Woodbury Trough, and the ESE trending Black Tier - Bellevue Hill and Glen Morey Horsts. The Kuranda Graben is approximately 4 km. long and 0.7 km. wide, while the Woodbury Trough is at least 9 km. in length, and approximately 1 km. wide.

Major faults in the area are the Woodbury Faults South and North defining the Woodbury Trough, the Kuranda Faults 1 and 2 defining the Kuranda Graben, the Woodbury Fault North and the Ratharney Fault (112^{o}) defining the Glen Morey Horst and the Glen Morey Fault (145^{o}).

Displacement across these faults ranges from approximately 15 m. (Kuranda Fault 1), to 25m. (Kuranda Fault 2), to 35-100m. (Woodbury Fault South); throws across the Woodbury Fault North decrease toward the east, from 45m. (536 000E - 538 000E), to 30m. (539 000E), to 25m. (540 000E) to 15m. (541 000E).

The Kuranda Graben is thought to predate the Woodbury Trough because the latter is not offset across the former, but the Woodbury Trough margins are diffracted from approximately 112^{o} to approximately 102^{o} in strike within the Kuranda Graben. Likely ages for these structures are Jurassic and Tertiary respectively.

The Coal Measures Sequence ranges in attitude from 3^{o} NW (310^{o}) from 535 000E - 539 000E, (north of the Kuranda Graben and the Woodbury Trough), to flat within the Kuranda Graben; dips within the Woodbury Trough in the western Section are approximately 1^{o} NW (310^{o}) from 534 000E - 537 500E, and in the eastern section consist of variable 2^{o}N to 2^{o}S dips superimposed on a general 1^{o} WNW attitude from 537 500E - 541 000E. The Glen Morey Horst apparently dips at approximately 1^{o} to the south.

The nett effect of the faulting has been to produce both parallel sided and polygonal shaped blocks, containing different coal seams placed in juxtaposition.

As a consequence, coal amenable to open cut mining consists of coal seams M, N, O, P, B, C and D, as shown in Tables 2, 3 and 4, and on the eight N-S and the W-E cross sections.

2.3 COAL SEAM CHARACTERISTICS

Detailed coal seam characteristics are shown in Table (1). The coal seams of the Woodbury Deposit have been correlated using lithological, analytical, general stratigraphic and geophysical parameters.

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COAL SEAM CHARACTERISTICS

Hole	Seam	Sub Seam	Thickness (m)	No. of Stone Bands	Type of Stone Bands	Roof	Floor	m (%)	a(%)	VM(%)	Fixed C (%)	SE MJ/kg	S (%)	Cl (%)
W38	D	-	1.05	-	-	ms/gry	ms/brn	5.6	26.0	20.0	48.3	22.8	.45	.01
W39	D	-	2.86	2	ms,c	ss	ms/c/brn	4.1	27.8	19.8	48.3	22.1	.46	.04
W46	D	-	2.40	3	ms,c(2) ms/brn(1)	ss	ms,gry	-	44.4	-	-	-	-	-
		Ave.	2.10	2				4.8	32.7	19.9	48.3	22.4	0.45	0.03
W25	C	C4	0.20	-	-	ss	ms/gry	-	-	-	-	-	-	-
		C3	0.33	2	ms/c/gry	ms/gry	ms/gry	-	-	-	-	-	-	-
		C2	0.57	1	ms/brn	ms/gry	ms/gry	5.1	39.5	18.1	37.3	17.6	.43	.03
		C1	0.51	-	-	ms/c	ms/gry	4.3	27.9	21.2	46.6	22.4	.47	.04
W32	C	C3	0.97	2	ms/brn	ms/gry	ms/gry	6.1	29.1	18.9	45.9	21.5	.43	<.01
		C2	1.00	1	silt/gry	ms/gry	ms/c	5.8	31.5	16.6	46.1	21.1	.47	.01
W38	C	C3	1.06	2	ms/c	ss	ms/c	3.7	29.7	16.1	50.5	22.1	.37	.02
		C2	1.10	2	ms/brn	ms/gry	ms/gry	4.5	28.4	16.7	50.4	22.5	.43	.01
W39	C	C3	0.49	1	ms/brn	"	"	4.3	36.0	15.2	44.5	20.4	.43	<0.01
		C2	0.91	2	ms/brn	"	"	5.4	29.3	16.5	48.8	22.1	.45	.01
		C1	0.67	-	-	"	"	4.3	28.6	15.3	51.8	22.7	.47	.02
W46	C	C3	0.50	1	ms/brn			-	-	-	-	-	-	-
		C1,2	1.58	2	ms/c/brn	"	ms/c	-	31.8	-	-	-	-	-
W47	C	C1,2	1.28	1	ms/brn	ms/c	ms/c	2.3	34.6	7.9	55.2	20.3	.38	.03
W48	C	C3	0.89	?	-	ss	ms/brn	-	-	-	-	-	-	-
		C1,2	1.02	1	ms/gry	ms/gry	silt/gry	-	28.6	-	-	-	-	-
		Ave.	1.87	2				4.3	31.3	15.5	48.4	21.1	0.43	0.02
W32	B	B4	1.00	-	-	ms/gry	ms/c	3.8	33.7	13.1	49.4	21.1	.36	0.01
W39	B	B4	0.51	-	-	"	"	4.2	45.9	4.8	45.1	16.6	.49	.03
W40	B	B4	0.65	-	-	ss	ms/gry	2.6	29.9	15.6	51.9	23.0	.44	.04
W41	B	B4	0.75	-	-	ms/gry	ms/c	2.7	32.1	8.0	57.2	21.6	.36	.03
		B2,3	1.49	-	-	ss		2.2	40.7	6.1	51.0	18.2	.25	.04
		B1	0.55	-	-	ms/c		2.2	34.5	8.3	55.0	19.9	.66	.05

...Contd.

Hole	Seam	Sub Seam	Thickness (m)	No. of Stone Bands	Type of Stone Bands	Roof	Floor	m(%)	a(%)	VM(%)	Fixed C (%)	SE MJ/kg	S (%)	Cl (%)
W46	B	B4	0.60	-	-	ss	ms/c	1.8	46.0	7.6	44.6	17.4	.24	.04
W47	B	B4	0.59	-	-	ms/gry	"	2.7	43.1	6.6	47.6	16.2	.55	.03
W48	B	B4	0.75	1	ms/c	"	ms/gry	-	35.8	-	-	-	-	-
W61	B	B4	0.83	-	-	"	"	3.2	28.0	15.7	53.1	23.2	.51	.01
		B2,3	1.66	2	ms/carb	"	"	3.8	34.8	10.8	50.6	20.1	.25	.03
W63	B	B	1.20	3	"	"	silt/gry	6.0	44.7	16.9	32.4	14.4	.25	.05
		Ave.	0.83	-	-	-		3.4	38.5	10.7	47.1	18.8	0.39	0.03
W40	A	A2	0.26	-	-	ms/carb	ms/carb	{3.8	39.2	4.7	52.3	17.0	0.46	0.03
		A1	0.41	-	-	"	"							
W41	A	A2	0.45	-	-	"	"	5.1	52.5	-	-	-	-	-
		A1	0.40	-	-	"	"	4.2	56.4	-	-	-	-	-
W61	A	A2	0.45	-	-	"	"	{8.1	41.4	5.3	45.2	15.3	0.79	0.04
		A1	0.32	-	-	"	"							
W36A	A	A1,2	0.78	-	-	ss	"	1.9	39.2	13.0	45.9	18.7	0.25	0.03
		Ave.	0.48	-	-			4.6	43.5	7.7	47.8	17.0	0.50	0.03

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EASTERN AREA

Seam A: (Lowest Seam) Consists of two sub-seams, and has an average thickness of 0.48m, and an average of 4.6% moisture, 43.5% ash, 7.7% volatile matter and 17MJ/kg specific energy.

Seam B: Consists of a maximum of four sub-seams and has an average thickness of 0.83m, and an average of 3.4% moisture, 38.5% ash, 10.7% volatile matter and 18.8 MJ/kg specific energy.

Seam C: Consists of a maximum of four sub-seams (usually three), and has an average thickness of 1.87m, and an average of 4.3% moisture, 31.3% ash, 15.5% volatile matter and 21.1 MJ/kg specific energy.

Seam D: Consists of a single seam, with an average thickness of 2.10m, and an average of 4.8% moisture, 32.7% ash, 19.9% volatile matter and 22.4 MJ/kg specific energy.

Seam E: (Highest Seam) Consists of three sub-seams, and has an average thickness of approximately 2.0m. Further details about this seam are not available, as it has only been intersected in rotary drill holes.

The analytical data quoted above is on an air dried basis. The lower four seams show a trend from Seam A to Seam D of decreasing ash, associated with increasing volatile matter and specific energy characteristics of the coal.

WESTERN AREA

The characteristics of coal seams L, M, N, O and P within the Western Area of the Woodbury Coal Deposit are not as clearly defined, and further core drilling is required to enable reliable comments to be made in this regard.

3.0 PARAMETERS & METHOD USED IN CALCULATION OF OPEN CUT COAL RESERVES

3.1 INTRODUCTION

The terminology employed in the determination of the coal reserves at Woodbury is based on the procedures defined by the Geological Survey of Queensland and the Standing Committee on Coal Field Geology of New South Wales (Code for Calculating and Reporting Coal Reserves - Third Edition ratified since 1977 - as shown in SAA DR 81033, January, 1981).

The calculation of the open cut reserves at Woodbury was based on all relevant factors as discussed below. All drill holes were logged according to lithology, geophysical properties (with some exceptions) and observable coal seam characteristics. Proximate analysis, ash analysis, ash fusion temperatures and sink float testing were conducted by S.G.S. Australia Pty. Ltd. in Sydney, on the total coal seam obtained from HQ drilling.

Open cut coal reserve calculations were divided into low and high grade categories, with varying analytical and physical parameters as discussed subsequently.

3.2 LOW GRADE RESERVE CALCULATION

3.2.1. ANALYTICAL FACTORS

(a) ASH

(i) Solitary coal seams with an ash content greater than 50% were excluded from consideration for coal reser

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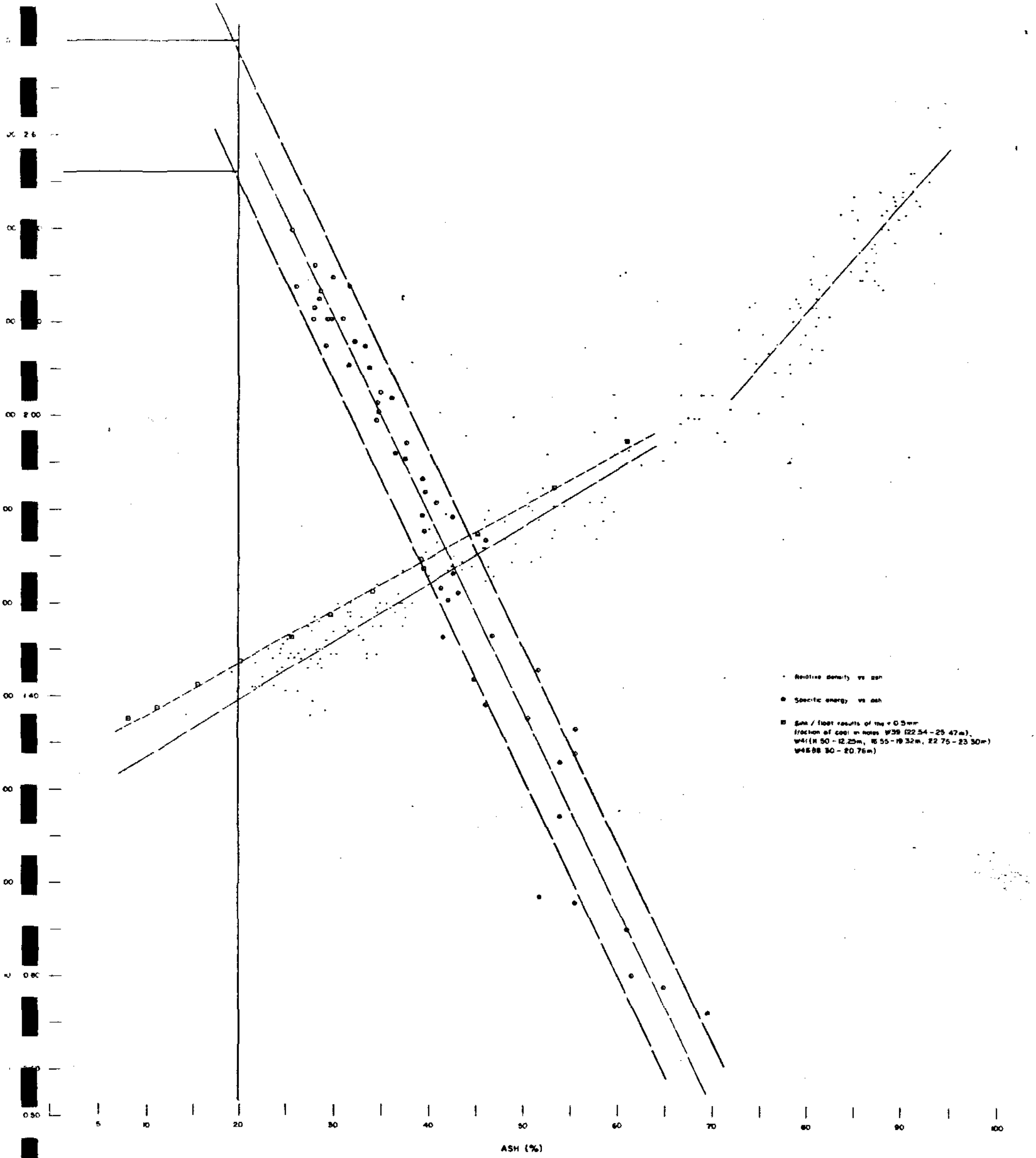

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SPECIFIC ENERGY / RELATIVE DENSITY

(ii) Coal seams with an ash content greater than 50% where accompanied by other lower ash coal seams, such that the average (composite analysis or graphically determined) ash content was less than 50%, were included.

(iii) Figure (3) depicts specific energy and relative density versus ash, and the line of best fit for the relative density - ash data was used to determine the ash contents of those blocks for which no direct ash data existed.

(b) VOLATILE MATTER

The volatile matter (VM) as shown in Tables 2 and 3 was estimated using a slight modification to the formula quoted in AS 1038, Part 16, 1975,

ie. $VM\ (d.a.f.) = VM \left(\frac{100}{100 - m - a}\right)$

where the volatile matter (VM), the moisture (m) and ash (a) are air dried values. The formula quoted in AS 1038, Part 16, 1975, used VM (d.m.m.f.) i.e., dry mineral matter free as distinct from dry ash free.

This VM (d.a.f.) value was then used in the following expression to obtain the estimated volatile matter in the coal after washing to 20% ash.

$VM\ (20\%\ ash) = VM\ (d.a.f.) \left(\frac{100 - m - a}{100}\right)$

$= 0.76 \times VM\ (d.a.f.)$ for 4% moisture.

(c) SPECIFIC ENERGY

The specific energy (SE) as shown in Tables 2 and 3 was calculated for a 20% ash washed product by using the formula quoted in AS 1038, Part 16, 1975. Alternatively, extrapolation of the line of best fit as shown in Figure (3) indicated that specific energy for a 20% ash washed product is in the range of 25.2 - 28.0 MJ/kg.

Both volatile matter and specific energy values for individual coal seams were weighted by their respective thicknesses to obtain the values for the blocks shown in Tables 2 and 3.

(d) SULPHUR

Sulphur values were also calculated by weighting individual coal seam values by their respective widths and all are less than 0.5%.

3.2.2. PHYSICAL FACTORS

(a) COAL AND STONE BAND THICKNESS

(i) The minimum coal seam thickness used was 0.2m.

(ii) Stone bands greater than 0.3m. thick, and clearly distinguishable from coal, were excluded from calculations of cumulative coal thickness.

(iii) Carbonaceous mudstone floors to coal seams were included in the cumulative coal thickness when the former were less than 0.3m. thick.

(b) TONNEAGE FACTORS

(i) Within a coal seam, individual ply relative density values were weighted by their respective widths to obtain a weighted average relative density (i.e. tonneage factor) for the seam.

(ii) Where more than one coal seam occurred in a given block, the procedure outlined above was adopted and then the weighted average relative density value for each seam was further weighted by the respective seam thicknesses to obtain a composite weighted relative density (i.e. composite tonneage factor) for the block.

(c) STRIPPING RATIO

(i) Maximum stripping ratios (cubic metres of overburden to tonnes of insitu coal), of 10:1 and 7:1 were then applied to the tonneage factors as follows:-

For unit area, overburden thickness
To = X x TF x W, where TF is the tonneage factor for all seams in a block, W is the composite width of all seams in a block, and X is the factor 7 or 10.

(ii) The convention used was to add the cumulative coal seam thickness to the overburden thickness (i.e. To+W), to calculate the maximum depth of open cut mining in a given block. The locus of this vertical line of length To+W was taken at the base of the lowest coal seam in a given block.

The limits of open cut mining were depicted on the geological cross section as To+W (down dip), and the base of oxidation (up dip). Where direct information on the base of oxidation was missing, it was assumed to be 10m.

(d) OPEN CUT RESERVE BLOCK DEFINITION

The limits to open cut mining as discussed above were transposed onto the plans of the Woodbury Coal Deposit; open cut block areas were then defined by assuming the coal seams were continuous to:-

(i) The mid point between drill holes, or

(ii) Gravity indicated and photo lineaments interpreted as being actual faults, or

(iii) In the absence of other drill holes in close proximity, the coal seams were assumed to be continuous for either 0.5 km. (for measured reserves) or 1.0 km. (for first class indicated reserves).

The mass of coal in a given block was then calculated by multiplying the block area by the cumulative coal seam thickness, and this product by the tonneage factor.

Parameters used in the calculations are recorded in Appendix 1.

3.3 HIGH GRADE RESERVE CALCULATION

3.3.1. ANALYTICAL FACTORS

(a) ASH (i) Solitary coal seams with an ash content greater than 40.5% were excluded from consideration for coal reserves

(ii) Coal seams with an ash content greater than 40.5% where accompanied by other lower ash coal seams, such that the average (graphically determined) ash content was less than 40.5%, were included.

(iii) Ash contents of the reserve blocks were determined from the graph of relative density versus ash (Figure 3.).

(b) VOLATILE MATTER, SPECIFIC ENERGY AND SULPHUR

These qualities were calculated in the same manner as was done in the low grade reserve calculation.

3.3.2. PHYSICAL FACTORS

(a) COAL AND STONE BAND THICKNESS

(i) The minimum coal seam thickness used was 0.2m.

(ii) Stone bands greater than 0.15m. in thickness, irrespective of their colour, were excluded from calculations of cumulative coal thickness.

(iii) Carbonaceous mudstone floors to coal seams were excluded from the cumulative coal thickness.

(b) TONNEAGE FACTORS

These were calculated in identical style to those used in the low grade reserve calculations.

(c) STRIPPING RATIO

A maximum stripping ratio of 10:1 was used, and the methods of determining To+W values are indentical with those used in the low grade reserve calculations.

(d) OPEN CUT RESERVE BLOCK DEFINITION

Open cut reserve blocks were defined in the same way as the blocks in the low grade reserve.

Parameters used in the calculations are recorded in Appendix 1.

4.0 OPEN CUT COAL RESERVES

4.1 LOW GRADE

(a) The total low grade measured and first class indicated coal reserve, using a 10:1 overburden : coal stripping ratio is:

24.8×10^6 tonnes containing 40.7% Ash

(refer Tables 2 and 3 for details)

(b) The total low grade measured and first class indicated coal reserve, using a 7:1 overburden : coal stripping ratio is:

15.1×10^6 tonnes containing 41.6% Ash

(refer Tables 2 and 3 for details)

4.2 HIGH GRADE

The total high grade measured and first class indicated coal reserve, using a 10:1 overburden : coal stripping ratio is:

15.3×10^6 tonnes containg 35.6% Ash

Block	Hole(s)	Intersection (m)	Seam	B.O. (m)	To+W (m)	W (m)	T. F. (T/m^3)	A_2 (Km^2)	Tonnes x10^6 10:1 7:1	Ash (%)	VM (%)	SE (MJ/kg)	S (%)
1.	W30	10.55 - 10.90 20.20 - 21.00 34.88 - 36.10	O N M	10.0	40.3 (28.9)	2.37	1.60	0.19 (NA)	0.720 (NA)	36.5	12.3	25.6	0.29
2.	W30	20.20 - 21.00 34.88 - 36.10	N M	10.0	33.5 (24.1)	2.02	1.56	0.35 (NA)	1.103 (NA)	33.2	11.9	25.8	0.30
3.	W32	16.65 - 17.62 18.80 - 19.80	C3 C2	7.3	37.2 (26.6)	1.97	1.79	0.40 (0.40)	1.410 (1.410)	44.0	24.0	27.2	0.40
4.	W25	19.00 - 19.20 21.38 - 21.71 25.37 - 25.94 27.68 - 28.19	C4 C3 C2 C1	11.2	28.7 (20.5)	1.61	1.68	0.29 (NA)	0.784 (NA)	43.0	25.0	22.1	0.37
5.	W1 (W39)	58.02 - 58.55 59.14 - 60.05 61.60 - 62.27	C3 C2 C1	11.2	37.1 (26.6)	2.11	1.66	0.10 (0.06)	0.350 (0.210)	41.2	18.7	23.6	0.37
6.	W39	22.54 - 25.47	D	10.0	51.3 (36.8)	2.93	1.65	0.38 (0.31)	1.837 (1.499)	40.5	26.6	22.9	0.37
7.	W46	18.36 - 20.76	D	10.0	44.4 (31.8)	2.40	1.75	0.43 (0.31)	1.806 (1.302)	48.5	26.6	22.9	0.37
8.	W61	25.30 - 26.13 29.65 - 30.17 30.71 - 31.85	B4 B3 B2	8.0	42.6 (30.5)	2.49	1.61	0.20 (0.09)	0.802 (0.361)	37.2	14.7	25.2	0.34
9.	W41	11.50 - 12.25 16.55 - 17.15 18.43 - 19.32 22.75 - 23.30	B4 B3 B2 B1	9.80	46.9 (33.6)	2.79	1.58	0.23 (0.12)	1.014 (0.529)	34.7	8.8	24.4	0.36
10.	W41	16.55 - 17.15 18.43 - 19.32 22.75 - 23.30	B3 B2 B1	9.80	34.5 (24.7)	2.04	1.59	0.06 (0.06)	0.195 (0.195)	35.7	8.6	24.1	0.36
TOTAL USING OVERBURDEN : COAL RATIO OF 10:1									10.021	40.6	20.1	24.3	0.36
TOTAL USING OVERBURDEN : COAL RATIO OF 7:1									5.506	42.4	22.5	24.4	0.37

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Block	Hole(s)	Intersection (m)	Seam	B.O. (m)	To+W (m)	W (m)	T. F. (T/m^3)	A_2 (Km^2)	Tonnes $x10^6$ 10:1 7:1	Ash (%)	VM (%)	SE (MJ/kg)	S (%)
1.	W9	21.50 - 22.50 39.00 - 40.00 51.00 - 52.00	P O N	≃ 10.0	52.5 (37.6)	3.00	1.65	0.20 (NA)	0.990 ~~(NA)~~	40.5	-	-	-
2.	W30/23	10.55 - 10.90 20.20 - 21.00 34.88 - 36.10	O (N (M (	< 10.0	40.3 (28.9)	2.37	1.60	0.29 (NA)	1.100 (NA)	36.5	12.3	25.6	0.29
3.	W30/23	20.20 - 21.00 34.88 - 36.10	N (M (	< 10.0	33.5 (24.1)	2.02	1.56	0.22 (NA)	0.693 (NA)	33.2	11.9	25.8	0.30
4.	W10/7	RANGES FROM 4.00 - 15.00	C2+C3 (	≥ 10.0	37.2 (24.6)	1.90	1.71	0.96 (0.96)	3.119 (3.119)	42.7	-	-	-
5.	W32	16.65 - 17.62 18.80 - 19.80	C3 (C2 (	7.3	37.2 (26.6)	1.97	1.79	0.49 (0.34)	1.728 (1.200)	44.0	24.0	27.2	0.40
6.	W25	19.00 - 19.20 21.38 - 21.71 25.37 - 25.94 27.68 - 28.19	C4 (C3 (C2 (C1 (	11.2	28.7 (20.5)	1.61	1.68	0.16 (NA)	0.433 (NA)	43.0	25.0	22.1	0.37
7.	W39	22.54 - 25.47	D	≥ 10.0	51.3 (36.8)	2.93	1.65	0.06 (0.06)	0.290 (0.290)	40.5	26.6	22.9	0.37
8.	W47	43.62 - 44.90	C1,2	10.2	22.3 (16.0)	1.28	1.64	0.09 (0.07)	0.189 (0.147)	37.6	11.4	24.6	0.39
9.	W41	11.50 - 12.25 16.55 - 17.15 18.43 - 19.32 22.75 - 23.30	B4 (B3 (B2 (B1 (	9.8	46.9 (33.6)	2.79	1.58	0.11 (0.06)	0.485 (0.264)	34.7	8.8	24.4	0.36

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Block	Hole(s)	Intersection (m)	Seam	B.O. (m)	To+W (m)	W (m)	T. F. (T/m^3)	A (Km^2)	Tonnes x10^6 10:1 7:1	Ash (%)	VM (%)	SE (MJ/kg)	S (%)
10.	W41	16.55 - 17.15 18.43 - 19.32 22.75 - 23.30	B3 (B2 (B1 (	9.8	34.5 (24.7)	2.04	1.59	0.01 (0.01)	0.032 (0.032)	35.7	8.6	24.1	0.36
11.	W49	29.55 - 33.25	B	12.4	62.2 (44.6)	3.70	1.58	0.45 (0.45)	2.631 (2.631)	34.7	-	-	-
12.	W63	15.00 - 16.20	C1,2	13.2	23.9 (17.1)	1.20	1.89	0.16 (0.06)	0.363 (0.136)	46.0	28.1	21.9	0.25
13.	W4/48	37.58 - 38.47 44.03 - 45.05	C3 (C1,2(	8.2	33.6 (24.1)	1.91	1.66	0.24 (0.10)	0.761 (0.306)	41.2	-	-	-
14.	W13/15/ 46	18.36 - 20.76	D	10.0	44.4 (31.8)	2.40	1.75	0.47 (0.36)	1.974 (1.512)	48.5	-	-	-
TOTAL USING OVERBURDEN : COAL RATIO OF 10:1									14.788	40.8			
TOTAL USING OVERBURDEN : COAL RATIO OF 7:1									9.637	41.2			

GRAND TOTAL (MEASURED & FIRST CLASS INDICATED) FOR 10:1 RATIO = 24.8 X 10^6 TONNES CONTAINING 40.7% ASH.

GRAND TOTAL (MEASURED & FIRST CLASS INDICATED) FOR 7:1 RATIO = 15.1 X 10^6 TONNES CONTAINING 41.6% ASH.

<u>LEGEND</u> (TABLES 2, 3, 4, & 5.)

B.O. - BASE OF OXIDATION
To - OVERBURDEN THICKNESS FOR 10:1 or (7:1) *stripping ratios*
W - CUMMULATIVE THICKNESS OF COAL SEAMS
T.F. - TONNEAGE FACTOR
A - AREA OF BLOCK
VM - VOLATILE MATTER - ESTIMATED FOR 20% ASH
SE - SPECIFIC ENERGY - ESTIMATED FOR 20% ASH
S - SULPHUR

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Block	Hole(s)	Intersection (m)	Seam	B.O. (m)	To+W (m)	W (m)	T. F. (T/m³)	A (Km²)	Tonnes x10⁶	Ash (%)	VM (%)	SE (MJ/kg)	S (%)
1.	W30	10.55 - 10.90 20.20 - 21.00 34.88 - 36.10	O N M	< 10.0	40.3	2.37	1.60	0.19	0.720	36.5	12.3	25.6	0.29
2.	W30	20.20 - 21.00 34.88 - 36.10	N M	< 10.0	33.5	2.02	1.56	0.35	1.103	33.2	11.9	25.8	0.30
3.	W32	16.98 - 17.62 18.80 - 19.00 19.28 - 19.80	C3 C2	7.3	23.5	1.36	1.63	0.28	0.621	38.7	> 24.0	> 27.2	< 0.40
4.	W39	22.66 - 23.18 23.42 - 23.95 24.33 - 25.40	D	≥ 10.0	34.8	2.12	1.54	0.29	0.947	31.7	> 26.6	> 22.9	< 0.37
5.	W46	19.10 - 19.47 19.62 - 20.76	D	≥ 10.0	26.4	1.51	1.65	0.28	0.698	40.5	> 26.6	> 22.9	0.37
6.	W61	25.30 - 26.13 29.65 - 30.17 30.71 - 31.85	B4 B3 B2	8.0	42.6	2.49	1.61	0.20	0.802	37.2	14.7	25.2	0.34
7.	W41	11.50 - 12.25 16.55 - 17.15 18.43 - 19.32 22.75 - 23.30	B4 B3 B2 B1	9.8	46.9	2.79	1.58	0.23	1.014	34.7	8.8	24.4	0.36
8.	W41	16.55 - 17.15 18.43 - 19.32 22.75 - 23.30	B3 B2 B1	9.8	34.5	2.04	1.59	0.06	0.195	35.7	8.6	24.1	0.36
							TOTAL:		6.100	35.61			

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(N.B. Legend as for Tables 2 and 3)

[redacted] WOODBURY CO[redacted]DEPO[redacted] - [redacted] GR[redacted] FI[redacted]CLA[redacted]INDI[redacted]ED [redacted]RVE[redacted] [redacted]AGE[redacted]

Block	Hole(s)	Intersection (m)	Seam	B.O. (m)	To+W (m)	W (m)	T. F. (T/m^3)	A (Km^2)	Tonnes $x10^6$	Ash (%)	VM (%)	SE (MJ/kg)	S (%)
1.	W9	21.50 - 22.50 39.00 - 40.00 51.00 - 52.00	P O N	≥10.0	52.5	3.00	1.65	0.20	0.990	40.5	-	-	-
2.	W30/23	10.55 - 10.90 20.20 - 21.00 34.88 - 36.10	O N M	<10.0	40.3	2.37	1.60	0.29	1.100	36.5	12.3	25.6	0.29
3.	W30/23	20.20 - 21.00 34.88 - 36.10	N M	<10.0	33.5	2.02	1.56	0.22	0.693	33.2	11.9	25.8	0.30
4.	W10/7	RANGES 4.00 - 15.00	C3 C2	≥10.0	22.7	1.36	1.57	0.88	1.879	34.0	-	-	-
5.	W39	22.66 - 23.18 23.42 - 23.95 24.33 - 25.40	D	≥10.0	34.8	2.12	1.54	0.06	0.196	31.7	>26.6	>22.9	<0.37
6.	W47	43.92 - 44.90	C1/2	10.2	15.9	0.98	1.52	0.07	0.104	30.0	>11.4	>24.6	<0.39
7.	W41	11.50 - 12.25 16.55 - 17.15 18.43 - 19.32 22.75 - 23.30	B4 B3 B2 B1	9.8	46.9	2.79	1.58	0.11	0.485	34.7	8.8	24.4	0.36
8.	W41	16.55 - 17.15 18.43 - 19.32 22.75 - 23.30	B3 B2 B1	9.8	34.5	2.04	1.59	0.01	0.032	35.7	8.6	24.1	0.36
9.	W49	29.55 - 33.25	B	12.4	62.2	3.7	1.58	0.45	2.631	34.7	-	-	-
10.	W4/48	37.58 - 38.47 44.44 - 45.05	C3 C1/2	8.2	25.0	1.50	1.57	0.12	0.283	34.0	-	-	-
11.	W13/15/46	19.10 - 19.47 19.62 - 20.76	D	≥10.0	26.4	1.51	1.65	0.31	0.772	40.5	-	-	-
							TOTAL:		9.165	35.64			
GRAND TOTAL	-	MEASURED AND FIRST CLASS INDICATED							15.265	35.63			

(N.B. Legend as for Tables 2 and 3)

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APPENDIX 1

COMMENTS ON THE CALCULATIONS OF THE OPEN CUT COAL RESERVES

A. LOW GRADE RESERVE

1. MEASURED CATEGORY

BLOCK 1 : Seam O was assumed to have the same volatile matter and specific energy values as Seam N in hole W30.

BLOCK 3 : Due to sampling problems with the C2 seam in hole W32, the resultant analysis was not considered to be a reliable representation of the coal. The ash value of this block was therefore calculated by averaging the ash values (graphically determined) for the C2 seams in drill holes W25, 38, 39, 46, 47 and 48.

BLOCK 4 : Seams C3 and C4 were not subjected to a complete proximate analysis; Seam C3 was assumed to be the same as seam C3 in hole W32. The weighted average volatile matter and specific energy values for this block are based on the values for seams C1,C2 and C3.

BLOCK 5 : Seams C1, C2 and C3 in drill hole W1 were assumed to be identical with those in hole W39.

BLOCK 7 : A proximate analysis of D seam in W46 was not done; the volatile matter, specific energy, and sulphur values shown were assumed to be the same as those for Seam D in W39.

BLOCK 8 : Selective mining was assumed to allow removal of the grey mudstone (30.17 - 30.71m.), in W61, between seams B2 and B3; the analytical data presented is approximate, as the original SGS data was based on a sample which excluded two narrow (total 0.08m. thick) stone bands.

With the exception of Block 3, all blocks had ash values assigned from the graph of relative density versus ash.

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2. FIRST CLASS INDICATED CATEGORY

BLOCK 1 : The thickness of seams N, O and P in holes W9 were determined from the gamma-gamma density log of W9, and the average weighted relative density value (i.e. tonneage factor) for the block was calculated by averaging the weighted relative density values for seams M and N in hole W67 with seams M, N and O in hole W30.

BLOCK 2 : Seam O was assumed to have the same volatile matter and specific energy values as seam N in hole W30.

BLOCK 4 : Seams C2 and C3 were interpreted in hole W10 partly on the basis of more rigorous gravity indicated controls on the structural setting of the area, and partly on the basis that the wireline logging was done at a rate which did not produce satisfactory resolution factors for the gamma-gamma density logging.

The cumulative thickness (W), the tonneage factor (T.F.), and the ash values for this block were taken as the arithmetic average of the adjoining blocks, namely Block 3 (W32), Block 4 (W25), and Block 5 (W1/39).

BLOCK 5 : The same comments apply to this block as for measured Block 3.

BLOCK 8 : This block is based on the intersection of Seam C1/2 (undifferentiated) in drill holes W13 and W47. The ash value for this block was determined by composite analysis of the coal plies.

BLOCK 11 : Selective mining was assumed to allow removal of the 0.5m. thick roof of brown shale with minor coal from 29.05 - 29.55m. in W49. Although part of this seam (B) was sink - float tested, the core recovery of 70% precludes definitive estimates of the overall ash content of this seam. Accordingly the interval from 30.05 - 33.25m. in W49 was assumed to have a relative density of 1.60.

BLOCK 12 : The ash value for this block was determined by composite analysis of the coal plies.

BLOCK 13 : Seams C1/2 (undifferentiated) and C3 in hole W4 were assumed to be the same as seams C1/2 (undifferentiated) and C3 in hole W48. The C3 seam in W48 (37.58 - 38.47m) was not fully recovered during core drilling and this seam was assigned a relative density of 1.60.

BLOCK 14 : Seam D in open holes W13 and W15 was detected from geophysical logs; the nearest cored section of Seam D occurs in hole W46, and accordingly, this block was assigned thickness, relative density, and ash values identical to Seam D in W46.

With the exception of Blocks 4,5, 8, and 12, the remaining blocks had ash values assigned from the graph of relative density versus ash. Blocks 4, 5, 8 and 12 had ash values determined as described above.

B. HIGH GRADE RESERVE

1. MEASURED CATEGORY

BLOCK 1 : The same comments apply to this block as for low grade measured Block 1.

BLOCK 5 : The same comments apply to this block as for low grade measured Block 7.

BLOCK 6 : The same comments apply to this block as for low grade measured Block 8.

2. FIRST CLASS INDICATED CATEGORY

BLOCK 1 : The same comments apply to this block as for low grade indicated Block 1.

BLOCK 2 : The same comments apply to this block as for low grade indicated Block 2.

BLOCK 4 : Similar comments apply to this block as for low grade indicated Block 4, except that the cumulative thickness and tonneage factor were determined from the average of the high grade values for the C2 and C3 seams in W32, the C1, C2, C3 and C4 seams in W25, and the C1, C2 and C3 seams in W39.

BLOCK 9 : The same comments apply to this block as for low grade indicated Block 11.

BLOCK 10 : The same comments apply to this block as for low grade indicated Block 13.

BLOCK 11 : The same comments apply to this block as for low grade indicated Block 14.

APPENDIX 2

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COAL ASH VALUES

Table 6 depicts a comparison of coal ash values as discussed subsequently;

TABLE 6

HOLE	SEAM	RD (T/M^3)	W (m)	ASH VALUE (%)		
				1	2	3
W30	N	1.59	0.80	36.40	35.61	35.70
W32	C3	1.70	0.97	46.70	45.83	44.50
W25	C2	1.75	0.57	51.80	52.98	48.50
	C1	1.51	0.51	27.90	28.43	29.20
W39	C3	1.94	0.53	55.60	60.39	63.70
	C2	1.64	0.91	39.20	41.34	39.70
	D	1.65	2.93	42.10	44.01	40.50
W41	B4	1.54	0.75	32.10	31.08	31.70
W47	C1/2	1.64	1.28	37.60	47.89	39.70
W63	C1/2	1.89	1.20	46.00	48.04	59.70

LEGEND:

RD - Weighted relative density of coal seam
W - Cumulative width of coal seam
ASH VALUE 1 - Composite analysis
2 - Ash weighted by RD x W
3 - Graph of ash versus RD

A sample of ten coal seams was taken as follows:

W 30 (N), W32 (C3), W25 (C1,C2), W39 (C2, C3), W39 (D), W41 (B4), W 47 (C1/2), W63 (C1/2).

HOLES W47 and W63 ILLUSTRATE THE PROBLEM:

W47 (1.28m) contains 37.6% Ash (1 above), or 47.9% Ash (2 above) or 39.7% Ash (3 above).

W63 (1.20m) contains 46.0% Ash (1 above), or 48.0% Ash (2 above) or 59.7% Ash (3 above).

Three methods were used to interpret the data:

(i) Weight averaging the three types of ash values by widths
(ii) Arithmetic averaging the three types of ash values
(iii) Calculating the % change on an individual sample basis

...../2.

770063

Results are as follows:

METHOD (i)- Ash type 1. is 3.4% lower than Ash type 3., and 5.6% lower than Type 2.

" (ii)- Ash type 1. is 4.2% lower than Ash type 3, and 4.9% lower than Type 2.

" (iii)- Ash type 1. is 7.7% lower than Ash type 3, and 5.4% lower than Type 2.

Since the majority of reserve blocks in both the measured and indicated categories have graph (Type 3), determined Ash values, the quoted Ash values are probably on average 4-8% higher than actual, but with individual blocks ranging up to 20% higher than actual Ash values.

Consequently, the overall average exaggeration of the total reserve Ash value, (allowing for vastly different block tonnages), is difficult to estimate at present.

References:

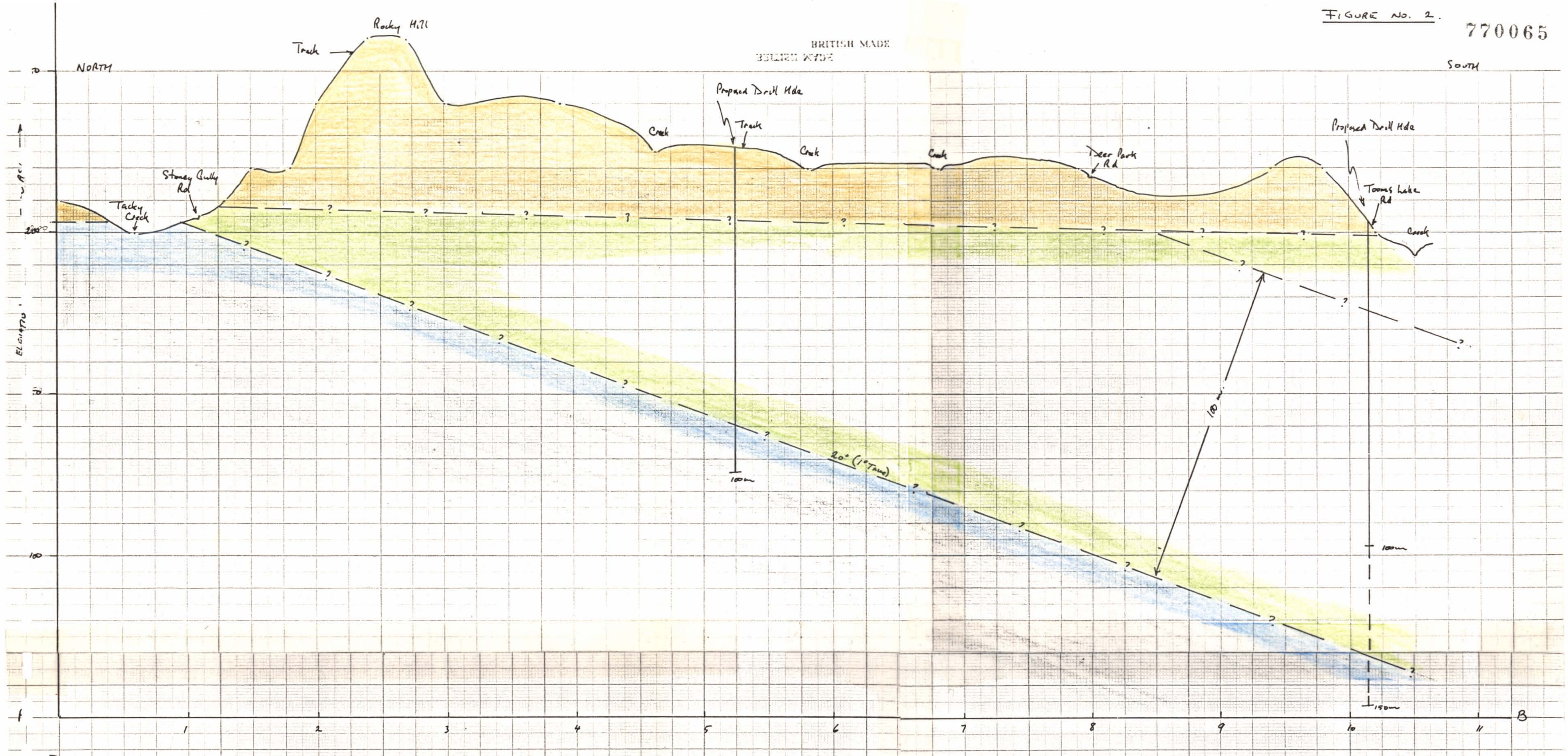
Leaman, D. E. 1981 Gravity Survey of the Woodbury Region; Unpublished, Rep. Leaman Geophysics.

FIGURE NO. 1.

770064

FIGURE NO. 2.

770065



ROSS AREA.

NORTH - SOUTH CROSS SECTION

ON

≈ 544 000 E

VS 1: 1000

HS 1: 25 000

Exaggeration = 25:1

5 cm

Tertiary Basalt

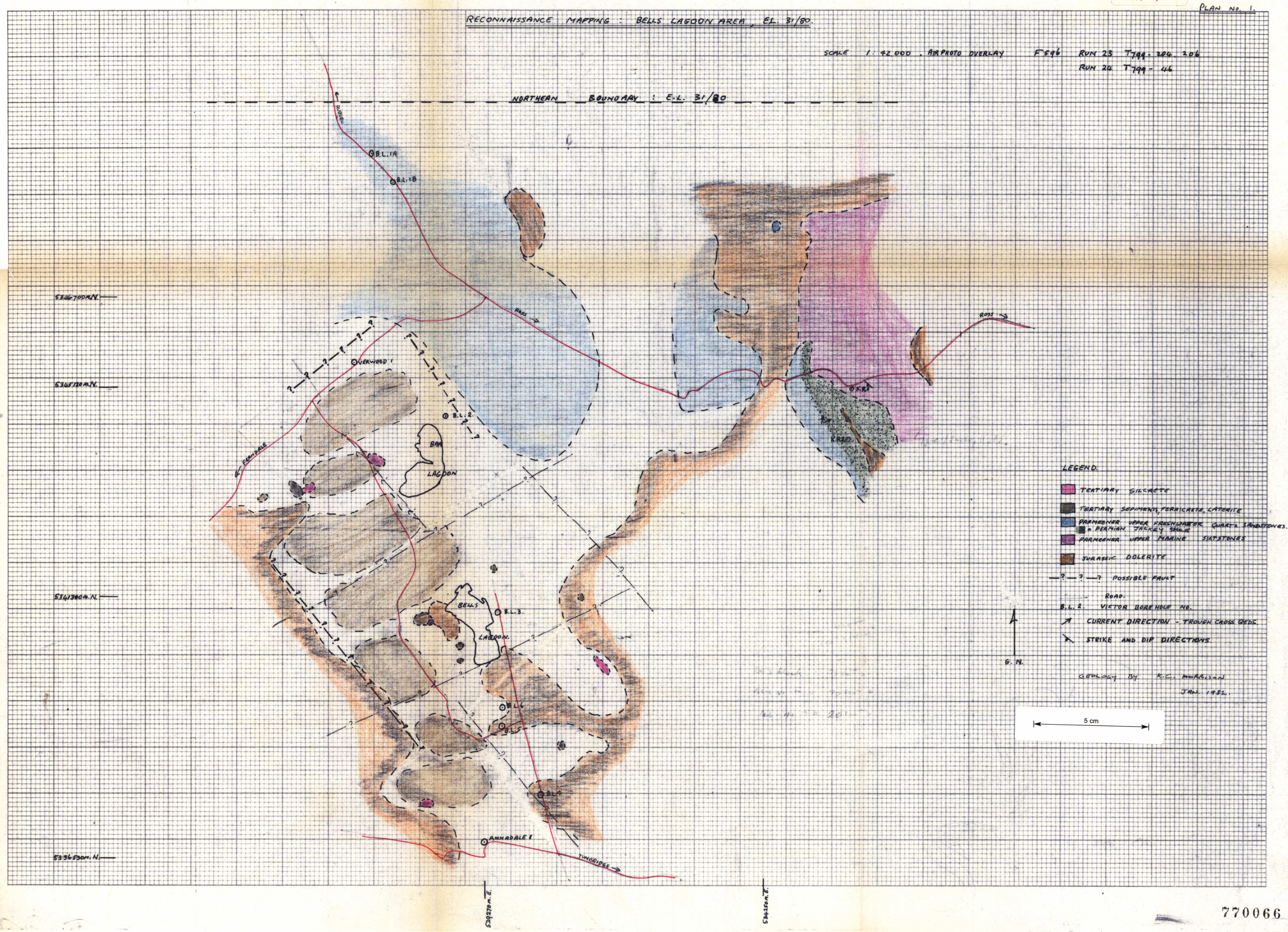
Upper Freshwater Sequence Parmeener Super Group.

Lithic Sandstone (arenite) - Brady or Coal Measures Sandstone

Quartz Sandstone (arenite) - Ross Sandstone

K.C. Morrison + T.G. Summons

PLAN- 1



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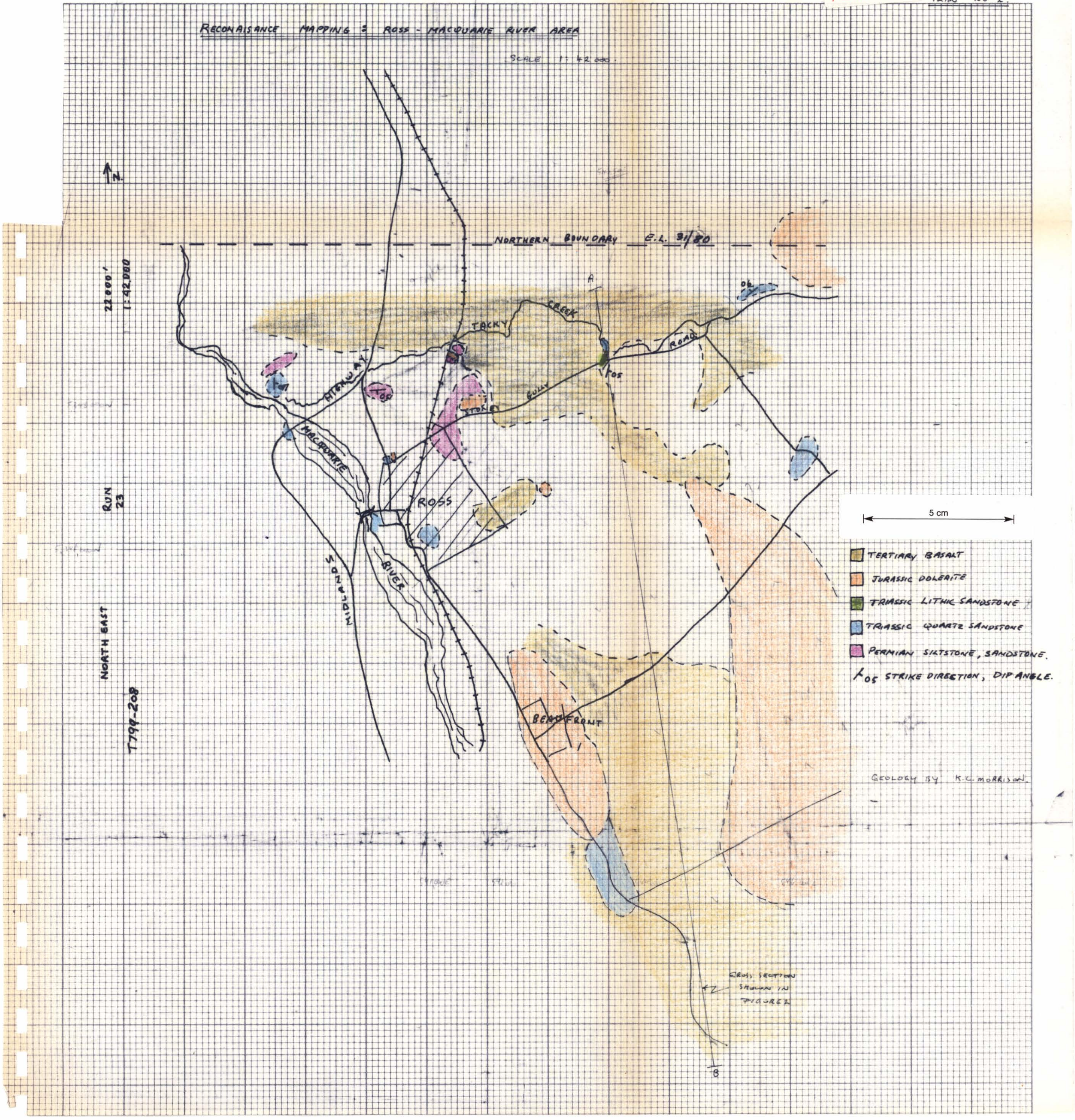
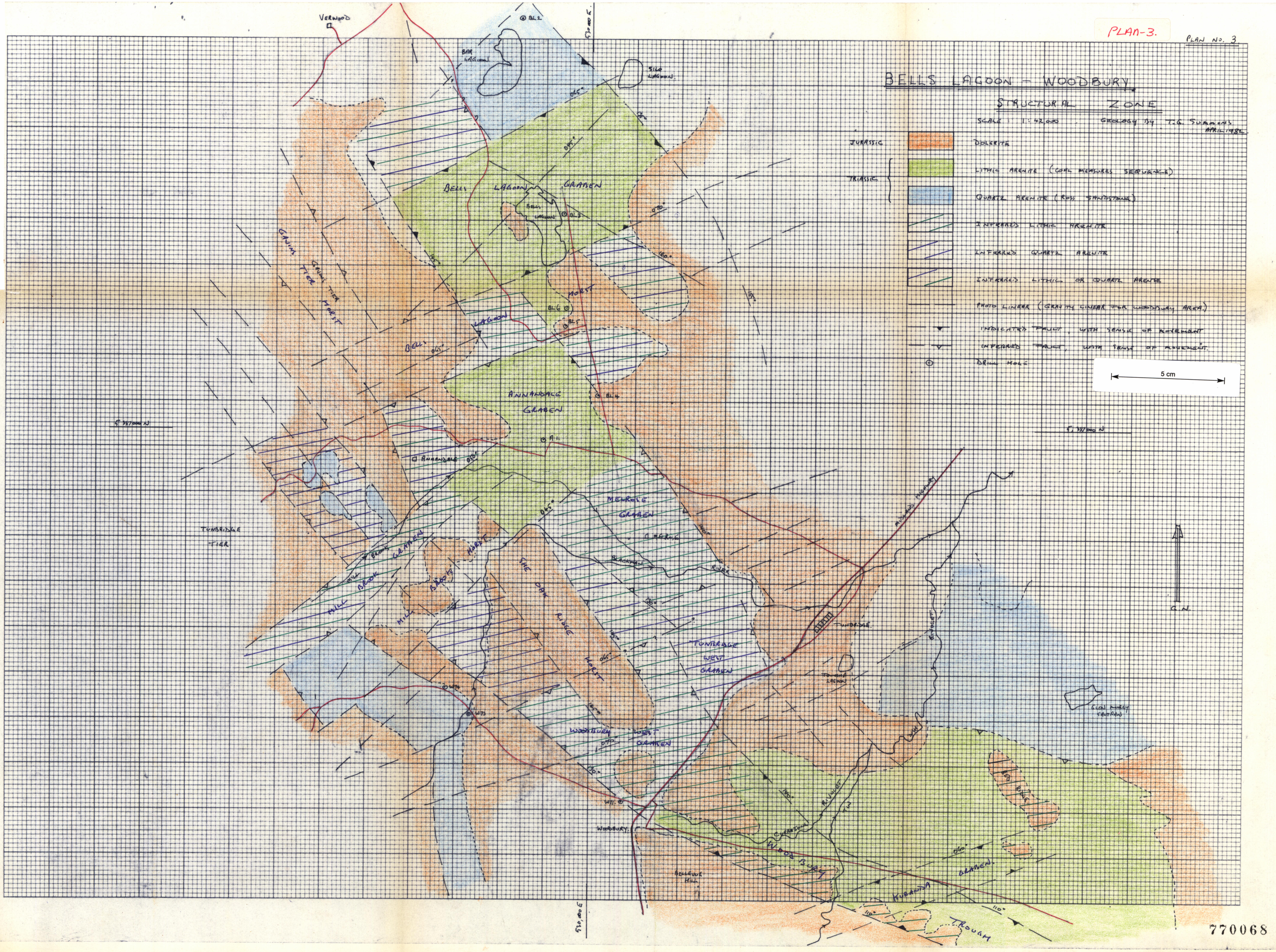
PLAN- 2

PLAN NO 2.




PLAN-3.
PLAN No. 3
BELLS LAGOON - WOODBURY
STRUCTURAL ZONE
SCALE : 1:42,000
GEOLOGY BY T.G. SUMMONS
APRIL 1982.
JURASSIC
DOLERITE
TRIASSIC
LITHIC ARENITE (COAL MEASURES SEQUENCE)
QUARTZ ARENITE (ROSS SANDSTONE)
INFERRED LITHIC ARENITE
INFERRED QUARTZ ARENITE
INFERRED LITHIC OR QUARTZ ARENITE
PHOTO LINEAR (GRAVITY LINEAR FOR WOODBURY AREA)
INDICATED FAULT, WITH SENSE OF MOVEMENT
INFERRED FAULT, WITH SENSE OF MOVEMENT.
DRILL HOLE
5 cm
G.N.
BELLS LAGOON GRABEN
ANNANDALE GRABEN
MELROSE GRABEN
TUNBRIDGE WEST GRABEN
THE OAK RIDGE HORST
MILL BROOK GRABEN
GRIM TIER HORST
TUNBRIDGE TIER
TUNBRIDGE
WOODBURY
770068

APPENDIX 3

GRAVITY SURVEY OF THE WOODBURY REGION

by D. E. LEAMAN

770070

GRAVITY SURVEY OF THE WOODBURY REGION

by

D.E. LEAMAN,
LEAMAN GEOPHYSICS

for

VICTOR PETROLEUM & RESOURCES LTD.

December, 1981.

Leaman Geophysics - G.P.O. Box 320D, Hobart 7001 - 002)442239

CONTENTS:

770072

SUMMARY:

The Triassic rocks of the Woodbury region in Central Tasmania are extensively faulted and intruded by two major dolerite bodies. Most of the exposed coal-bearing units lie immediately below the upper sheet. Most faults are oriented WNW - ESE and NE - SW and have throws of the order of 40 - 150 m. Some fault blocks contain substantial thicknesses of Upper Triassic rocks.

The upper dolerite is exposed from Black Tier to Woodbury where it is contained in a west dipping fault block. The exposure conceals a thick root and at least two feeding pipes 500 - 800 m. in diameter. The fault on the northern escarpment of Black Tier was probably active during intrusion and the upper sheet displays a range of stratigraphic relationships.

The principal structure on the Woodbury plain is a narrow graben and most of the coal-bearing sequence is contained within it. The structure is forked toward Nessie Rise at 'Kuranda'. The most complete sequences occur in downfaulted blocks along an axis from 'The Braes' to west 'Kuranda', east 'Kuranda' to Nessie Rise and very locally near 'Glen Morey'.

Most of the large faults appear to distribute movements related to the uplift of the Great Western Tiers across the Central Midlands.

INTRODUCTION:

The Woodbury Region is located about 15 km. north of Oatlands in the midlands of Tasmania. It forms part of exploration licence area EL 31/80 and is being actively explored for its coal potential by Victor Petroleum and Resources Ltd.

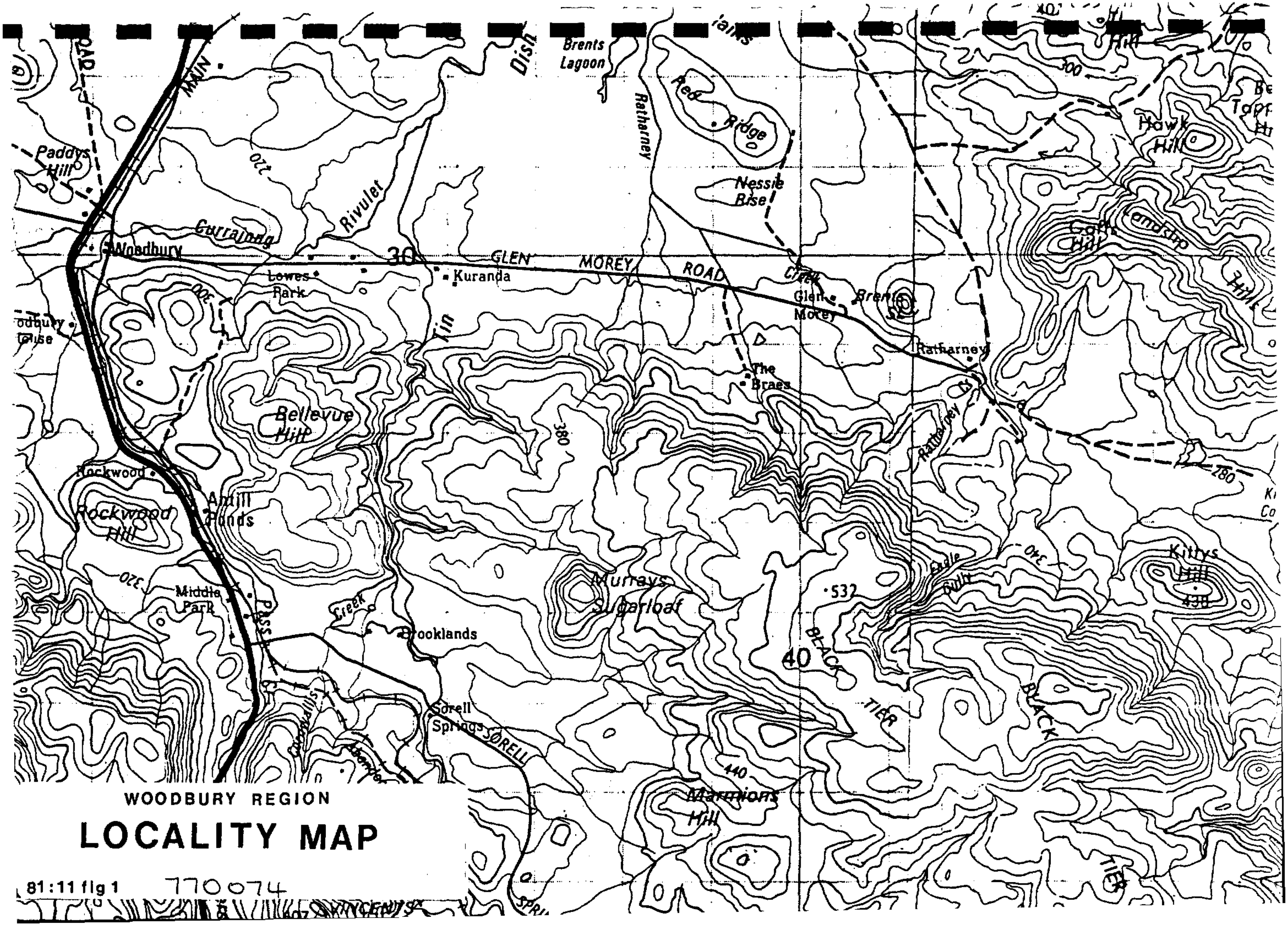
A substantial amount of coal has already been found in the Upper Triassic rocks exposed in the low lands between Woodbury and Ratharney. The coal is at shallow depth. It is possible that the coal bearing rocks extend southward beneath the dolerite intrusion which dominates the region. Dolerite is exposed in all elevated country east of Woodbury to Black Tier (locations - Figure 1).

The proposition that the dolerite is present in a generally concordant form and that the Triassic rocks continue beneath could be tested by drilling. Inspection of Figure 1, however, will show that, depending on hole site, between 100 and 300 metres of dolerite must be drilled. The expense of such drilling is tolerable only if the proposition is likely to be correct. Unfortunately, Tasmanian dolerite intrusions are notoriously unpredictable from surface geological information. The apparent concordance of an intrusion at one point is not proof of general concordance. Ample evidence has been accumulated to show that rapid, major structural variations are general. Drilling in such an environment is a risky gamble unless sites can be purposefully, rather than randomly, selected.

Leaman (1981) recommended a relatively detailed gravity survey of the region as the simplest and cheapest means of identifying significant variations in the dolerite mass and at the same time suggesting the general form of the body and the continuity of the sedimentary section. Drilling can be programmed, if the interpretation is optimistic, for those sites most likely to reveal coal measures with minimal risk of information loss due to unexpected dolerite structure variations.

This report describes the survey resulting from acceptance of the recommendations of Leaman (1981).

Prior to the survey only one reconnaissance gravity station had been observed in the Woodbury region (Zadoroznyj, 1975). The recorded value appeared anomalous in the preliminary data release after the survey and was modified or deleted for final presentation. The reason is unknown. A substantial local positive anomaly was implied; adjacent stations were some seven kilometres distant. It is clearly important to any assessment of the region that the presence or absence of such an anomaly, and any relationship with the dolerite, be established.



WOODBURY REGION
LOCALITY MAP

81:11 fig 1 770074

GRAVITY DATA:

The survey was undertaken by staff employed by Victor Petroleum and Resources Ltd. after initial supervision and tuition by the author. The meter used was Worden 913 (scale factor 0.094 mgal/division) hired from the Tasmanian Department of Mines.

Stations were located at intervals along various survey lines and at various randomly chosen points between them in order to obtain a general coverage not biassed by line placement. The station spacing is variable but generally 200 to 400 metres. Most stations have been levelled to an accuracy of better than 5 cm and all stations have been terrain corrected to a radius of about 21 km. Calculated terrain corrections range from about 0.1 to 2 mgal - a significant range since the expected anomaly from a sheet model is less than 1 to 1.5 mgal. The overall precision of the survey after allowing for drift, loop, position, elevation and correction errors is estimated at 0.1 to 0.2 mgal. A few stations located at spot heights have a precision of 0.2 to 0.3 mgal. In the former case most errors are related to direct meter corrections (drift, loop) while in the latter case the errors are related to the precision of elevation measurements (about 1 metre). Station positions are shown in Figure 2.

The observations have been reduced using a density of 2.67 t/m^3 and the results are given in the appendix. No attempt was made to incorporate density control data within the reduction since this removes the normalising character of the reduction process, and complicates subsequent interpretation. All density variations are considered as part of the interpretation process.

The Bouguer anomalies are presented in Figure 3. Bouguer values are based on gravity ties to the Bureau of Mineral Resources (BMR) Isogal network at Hobart and St. Helens airports per links to Department of Mines tie stations at Melton Mowbray (9.8035288 m/s^2) and Ross (9.8031158 m/s^2). The local base station (observed value 9.8031017 m/s^2) was located at the intersection of the Midland Highway and Woodbury side roads. The occupied position was at the base of HEC light standard pole (HEC 1,P/L 76 opposite the rail crossing) on the southeast side of the pole.

DENSITY DATA:

Seventy five density determinations have been undertaken on core samples from the Woodbury area (refer Summons, 1981 for details of samples and methodology). Summons (op. cit.) quotes the following results.

sandstone:	dry	2.25 t/m^3 av. ;	2.07 - 2.37 t/m^3
	wet	2.51 ;	2.25 - 2.72
mudstone:	dry	2.36 ;	2.21 - 2.44
	wet	2.65 ;	2.48 - 2.83
dolerite:	dry	2.80 ;	2.72 - 2.95
	wet	2.90 ;	2.79 - 3.10

Wet values have been derived from analysis of dry density, broken dry density and broken wet density calculations. The values given probably reflect total saturation values (density maxima) which may not reliably reflect actual field conditions.

Previous bulk wet determinations of Upper Triassic rocks by the author (using whole sample soaking rather than broken sample techniques) have yielded

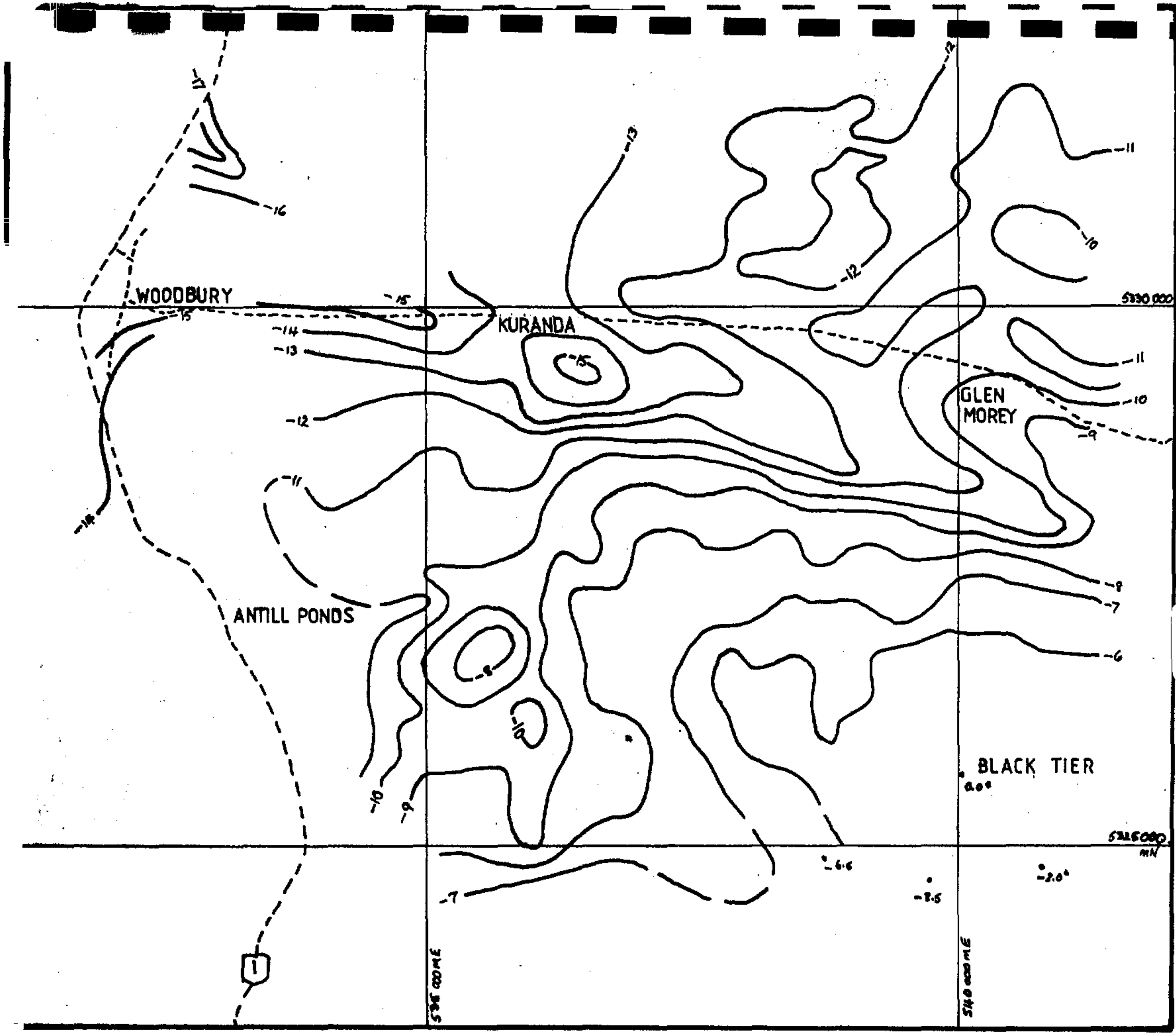
sandstone:	2.43 t/m^3 av.	; 2.36 t/m^3 , max 2.51 t/m^3
mudstone:	2.51	; 2.35 , 2.54
dolerite:	2.90	; 2.83 , 2.93
	Hobart area Leaman(1972)	; Fingal area Leaman and Richardson(1981)

In each case both the averages and maximum values are significantly less than the Woodbury measurements for the sedimentary rocks. This clearly reflects the problems of porosity, absorption and choice of laboratory technique. Summons (1981) concluded, and the author concurs, that the wet values determined by broken sample methods are probably not representative of actual in-situ field conditions of absorbed water in view of the retention noted in some residues. Only in the case of the dolerite are the average values comparable.

A distinct compositional variation is apparent between the rocks of the Fingal and Hobart areas while the Woodbury and Hobart materials are probably comparable. Realistic values for the three rock types at Woodbury probably lie in the following ranges.

sandstone:	2.43 - 2.51 t/m^3,	(2.45 t/m^3)
mudstone:	2.51 - 2.65 ,	(2.55)
dolerite:	2.85 - 2.90 ,	(2.90)

A reasonable average value is suggested in brackets. The greatest adjustment has been made in the case of the mudstones since the broken wet values for this material are most likely to be in error. Thus a typical bulk density for the Triassic coal-bearing rocks, excluding the effect of coal, carbonaceous units etc., might be about 2.50 t/m^3. It is unlikely to exceed this value since sandstones are normally dominant. The minimum contrast is thus 0.40 t/m^3 and unlikely to exceed 0.45 t/m^3. This range may be compared with 0.43 - Hobart and 0.48 t/m^3 - Fingal.



WOODBURY REGION

BOUGUER ANOMALY
(in mgal)

ρ = 2.67 t/m³

5 cm

0 1km

82:1 Fig 3

770078

INTERPRETATION:

Geology.

Geological knowledge for the region is summarised in Figure 4. Several, apparently basal, concordant dolerite margins have been identified - south of Kuranda, Red Ridge, Nessie Rise and Brents S.L. - and a number of minor bodies (sills?) have been recorded in drillholes (e.g. W41). The form of the principal dolerite intrusion is unknown but the overall topographic character of Black Tier - Bellevue Hill and the concordant (?) margin on the northern escarpent does imply a sheet reflecting regional dips. Unfortunately, the detailed landforms around the escarpment suggest the presence of a major fault and, or, dolerite talus deposits. The possibility of faulting or talus deposits, and the implications for the geological interpretation cannot be resolved by surface mapping. Faulting or intrusive transgression is suggested by the 106m of dolerite in W50 since the dolerite base is more than 70m lower than the apparent concordant contact on the escarpment.

Figure 4 is based on Figure 4 of the geological and drilling summary produced by T.G. Summons for Victor Petroleum & Resources Ltd. in September, 1981. A number of photolinears were shown and correlated with various displacements of the coal seams.

Dolerite intrudes an Upper Triassic coal-bearing sequence which contains a variable sandstone; mudstone ratio. Lithic sandstone dominates the section; sandstone is typically more than 75% of any 100m section and never less than 50%.

Interpretation objectives.

The survey and consequent interpretation have been directed at key economic and structural questions:

a) the nature of the dolerite intrusion between Black Tier and Bellevue Hill and the likely type and accessibility of sedimentary rocks beneath.

b) the presence and approximate position of major faults. (Survey precision is sufficient to resolve displacements of less than 25-50m providing station coverage is locally adequate).

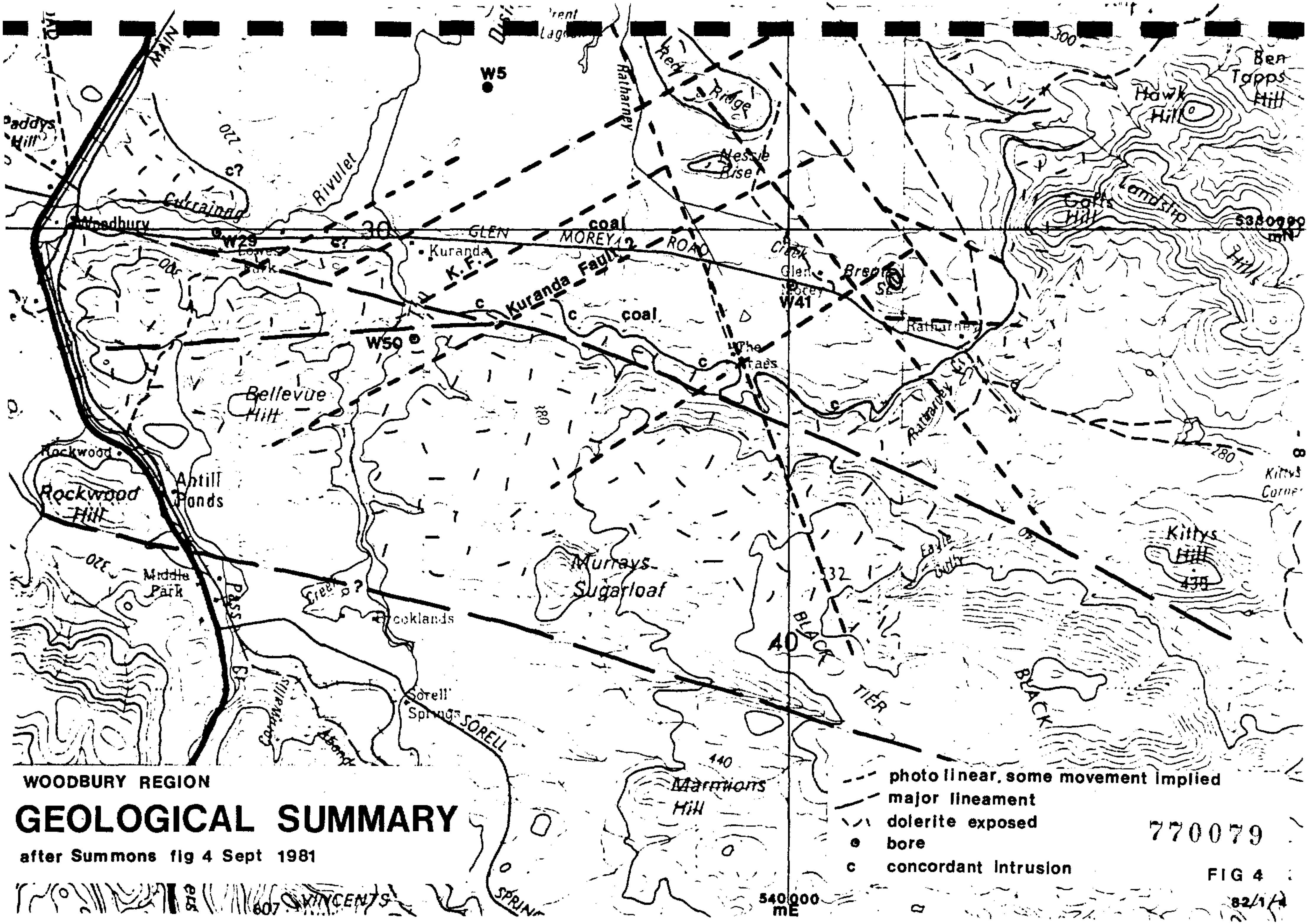
c) general resolution of structural relationships in the Woodbury region to enable improved conceptual and economic assessments.

Analysis.

The gravity data, as Bouguer anomalies at 2.67 t/m^3, were presented in Figure 3. The gravity field has five main features:

1) a general positive trend from NW to SE. The 'regional' gradient appears to be about 0.7 to 0.9 mgal per km.

2) the field is positive over the Woodbury-Black Tier dolerite mass; the relief is up to 5 mgal depending on reference levels.



WOODBURY REGION

GEOLOGICAL SUMMARY

after Summons fig 4 Sept 1981

FIG 4

3) a -2 to -3 mgal east trending trough anomaly across the face of the Tier escarpment.

4) a +3 mgal pimple in Tin Creek north of Brooklands, and

5) a gently undulating character (relief 2 to 3 mgal) on the plain.

The strong regional trend prevents simple correlation of anomalies and while features 1, 2 and 5 could have been expected, 3 is surprising since it cuts most implied linears (Figure 4). The field has been filtered to yield residual anomalies. Grid filters with apertures of 1, 2, 4 km and nominal source-depth separations of 300, 600, 1200m ($\pm$ 15%) were applied. The four kilometre filter was used for all interpretation since the anomalies appear to be sourced at depths up to one kilometre and the high frequency filters confirmed this suggestion. The filter used allows interpretation of dolerite-Triassic structures but excludes dolerite-Permian structures. The residual field for the 4 km filter is presented in Figure 5.

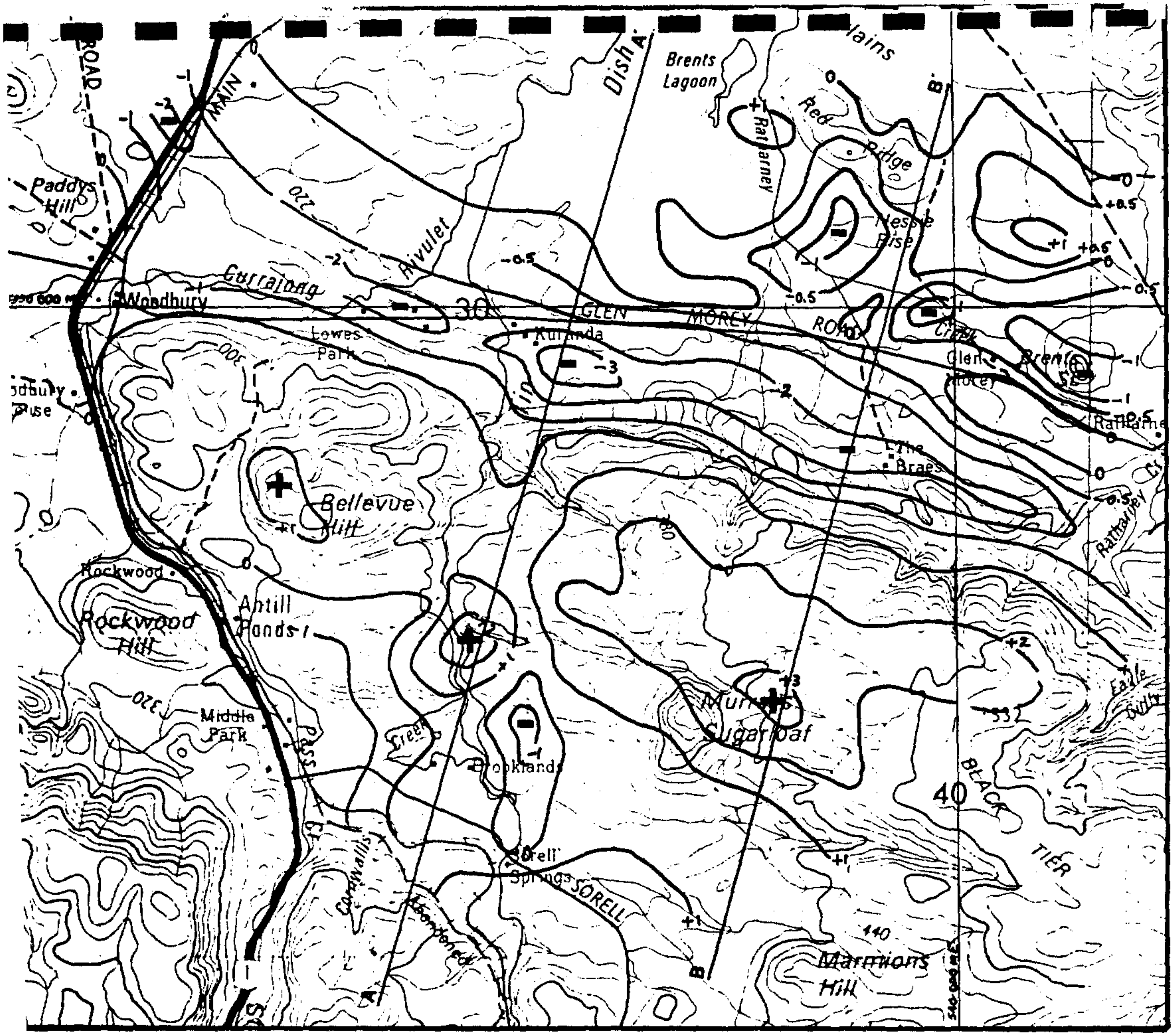
The oscillating character of the field on the plain north of the Ratharney Road, the east-west trough anomaly and the positive character of the Black Tier region is accentuated.

Since the area covered by the survey is quite small, and the coverage is patchy away from the survey core, the gravity anomalies - and especially the filters and residuals - are not well defined south of Woodbury nor south of a line from Antill Ponds-Brooklands and South Black Tier. No great weight should be attached to peripheral data pending availability of further regional data (Mines Dept. surveys).

Bouguer maps make allowance for terrain, elevation and position effects but do not normally include corrections for density variations in the terrain. These are commonly unknown and understanding the distribution of such variations is often the reason for a survey. Unfortunately a typical land surface does not provide a usable reference surface for quantitative modelling and models must allow for near surface variations. It is obvious that density substitutions, versus the reduction density which for convenience is usually taken as 2.67 t/m^3, are really part of the interpretation process, not the reduction process. In this case the surveyed area is quite small, the topography relatively simple and of low to moderate relief. Reasonable assumptions can be made about the geology above the level of the plain (~210m) and tested for their effect on the Bouguer anomalies. This process can reveal 'topography' anomalies (not to be confused with terrain corrections). The Bouguer anomalies (Figure 3) are referenced to the geoid (sea level), not 210m.

The residual Bouguer anomalies were topography corrected using Victor's available data and the measured densities to yield the stripped anomalies of Figure 6. The procedure has little effect on the undulating anomalies on the plain and low hills, although the effect of these is removed - BB', but completely alters the anomalies on the dolerite massif. In the dolerite hills (e.g. Red Ridge) and range (Bellevue Hill-Black Tier) it was assumed that

WOODBURY REGION



RESIDUAL BOUGUER ANOMALY

(in mgal)

ρ : 2.67 t/m³
4 km grid filter

0 — 1km

5 cm

82: I Fig 5

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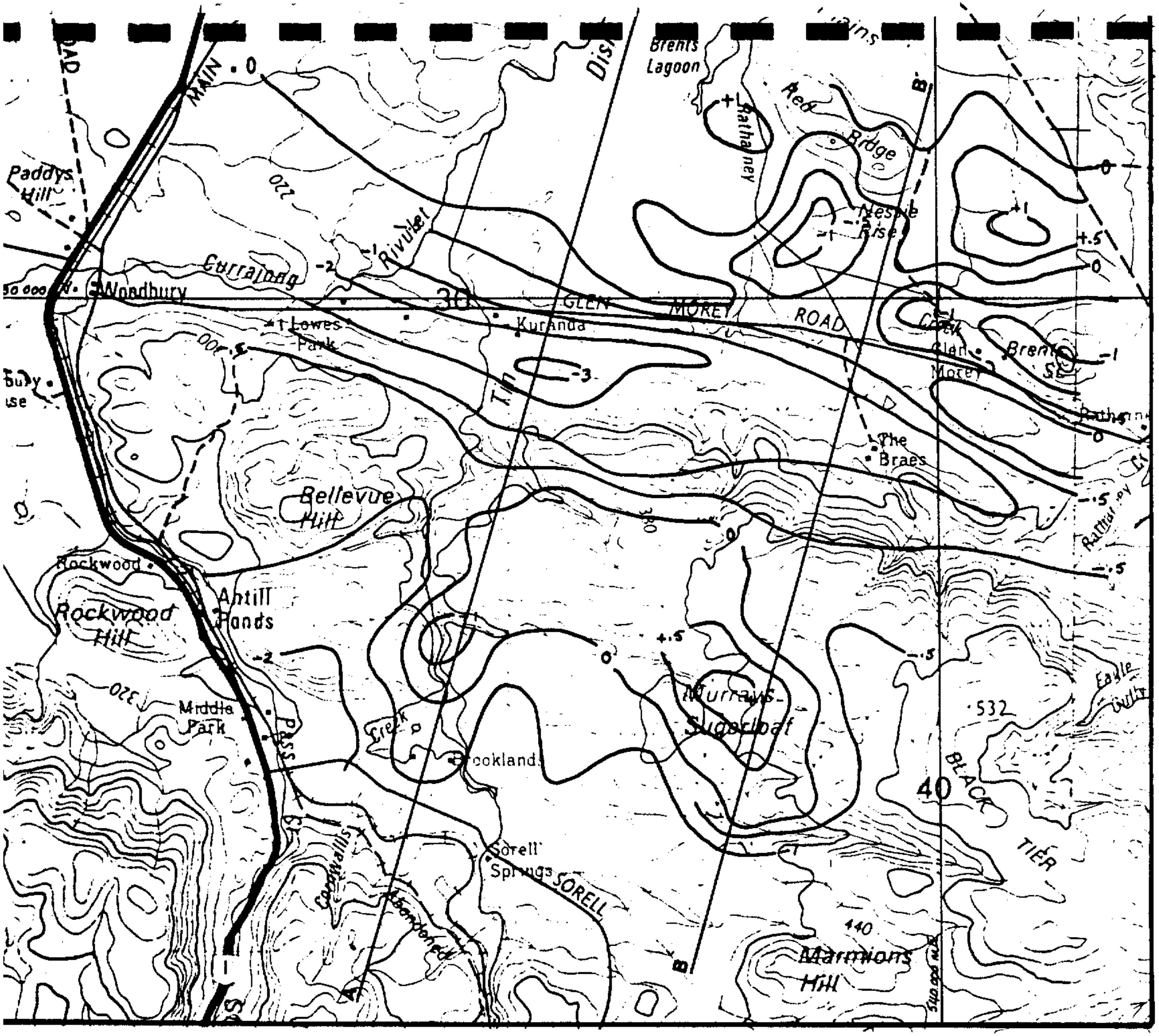


WOODBURY REGION

RESIDUAL ANOMALIES AT 210 AFTER GEOLOGICAL STRIPPING (in mgal)

0 1km

5 cm

82:1 Fig 6

770082

dolerite extended to the reference level (210m). Since each 100m of dolerite is equivalent to about 1 mgal, correction erases the positive anomalies. In some areas the correction was clearly excessive since the anomaly has changed sign showing that the dolerite may not be as thick as presumed. Elsewhere the correction is quite inadequate indicating much thicker dolerite. Normal residual and 210m residual profiles are shown in Figures 7, 8 and can be compared with geology. The procedure provides a modelling surface (210m) which can be anomaly adjusted during modelling, for features above 210m, should changes be necessary. The stripped anomalies can be used as a first interpretive guide to mass distributions across the area since most geologic noise factors have now been removed, albeit imperfectly. The sedimentary stripping density used was 2.48t/m^3 allowing a mudstone content of 25% in the Upper Triassic rocks.

Two sections AA', BB' have been examined in detail, using two and three dimensional methods, to control possible inferences based on Figure 6. Although interpretation has been extended to the Permo-Triassic interface some assumptions have been made in the absence of deep control. The density assumed for Upper Permian rocks is 2.57 t/m^3 and for Lower Triassic rocks - a maximum of 2.45 t/m^3 (mudstone included). In each case basic input is:

Block A: Exposures and shallow drilling near Sorell Springs suggest a thin cover (14-76m) of mid Triassic rocks over dolerite.

Block B: The key, unknown block clearly contains Triassic rocks, deduced from the moderate positive values and Figure 6, but no independent estimate is possible.

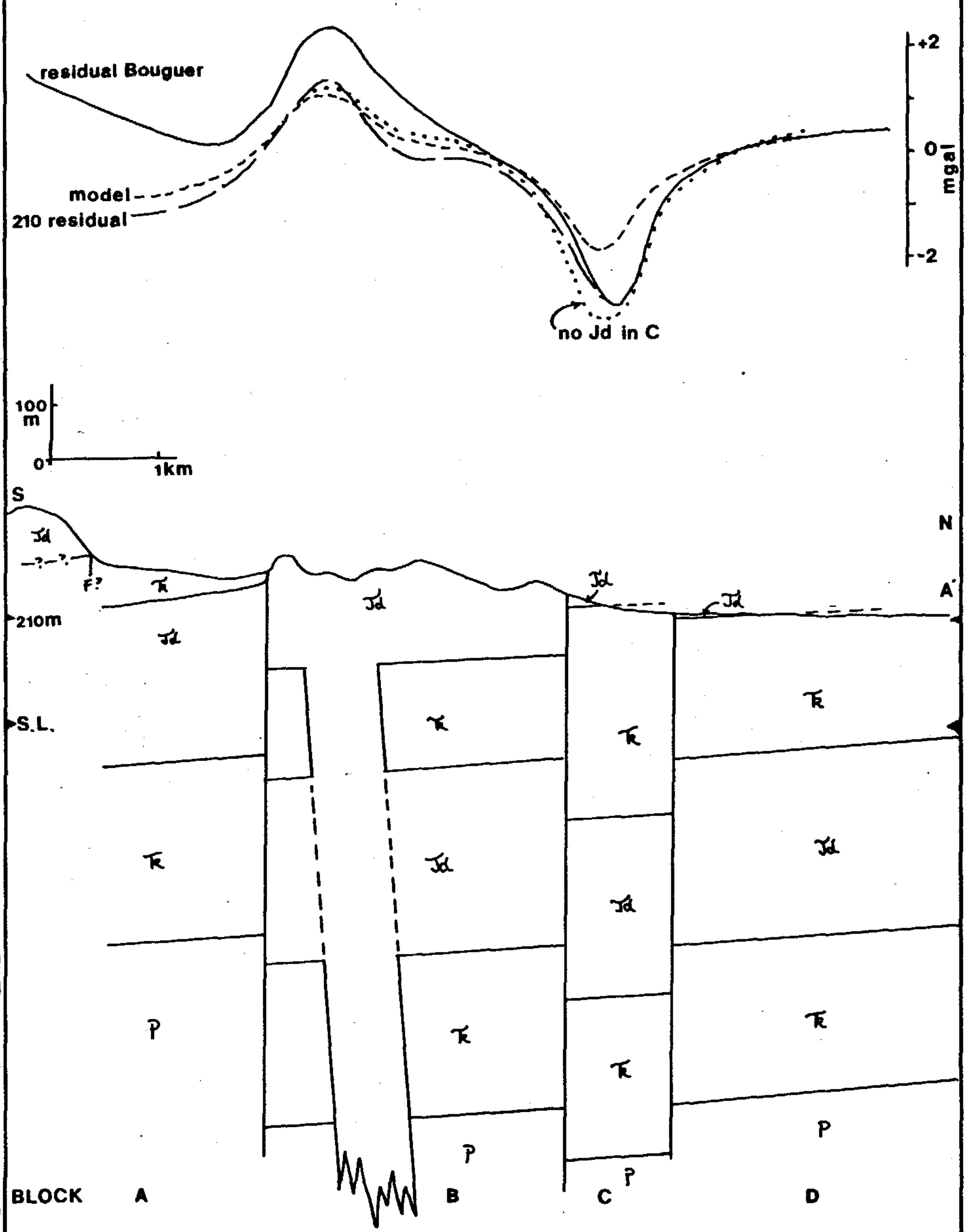
Block C: Covers the anomaly trough and contains more than 100-150m of Upper Triassic rocks (with coal) beneath a possible dolerite sheet, now a remnant. Some minor intrusive bodies are included.

Block D: Coal measures are exposed beneath remnants of dolerite intrusions (scale unknown). Although the Triassic rocks are generally thicker than 80m, dolerite is present (e.g. W5 at 40m). Bores in the Tunbridge region suggest that a dolerite sheet is general.

Blocks A and D are crucial to the gravity interpretation since the presence of a major dolerite sheet in either block means that a similar sheet <u>must</u> be present in the other. Deviations in residual anomaly between blocks A and D are consistent with stratigraphic situation only. If dolerite is present in either A or D then it must also be present in block B. This will be quite evident from inspection of Figures 7 or 8. A relatively three dimensional dolerite slab, such as in block B, contributes about +2.5 mgal to the total anomaly and could not be omitted, irrespectiv of the form of the exposed dolerite.

Block C poses some special problems (below) and before considering these the following factors should be noted:

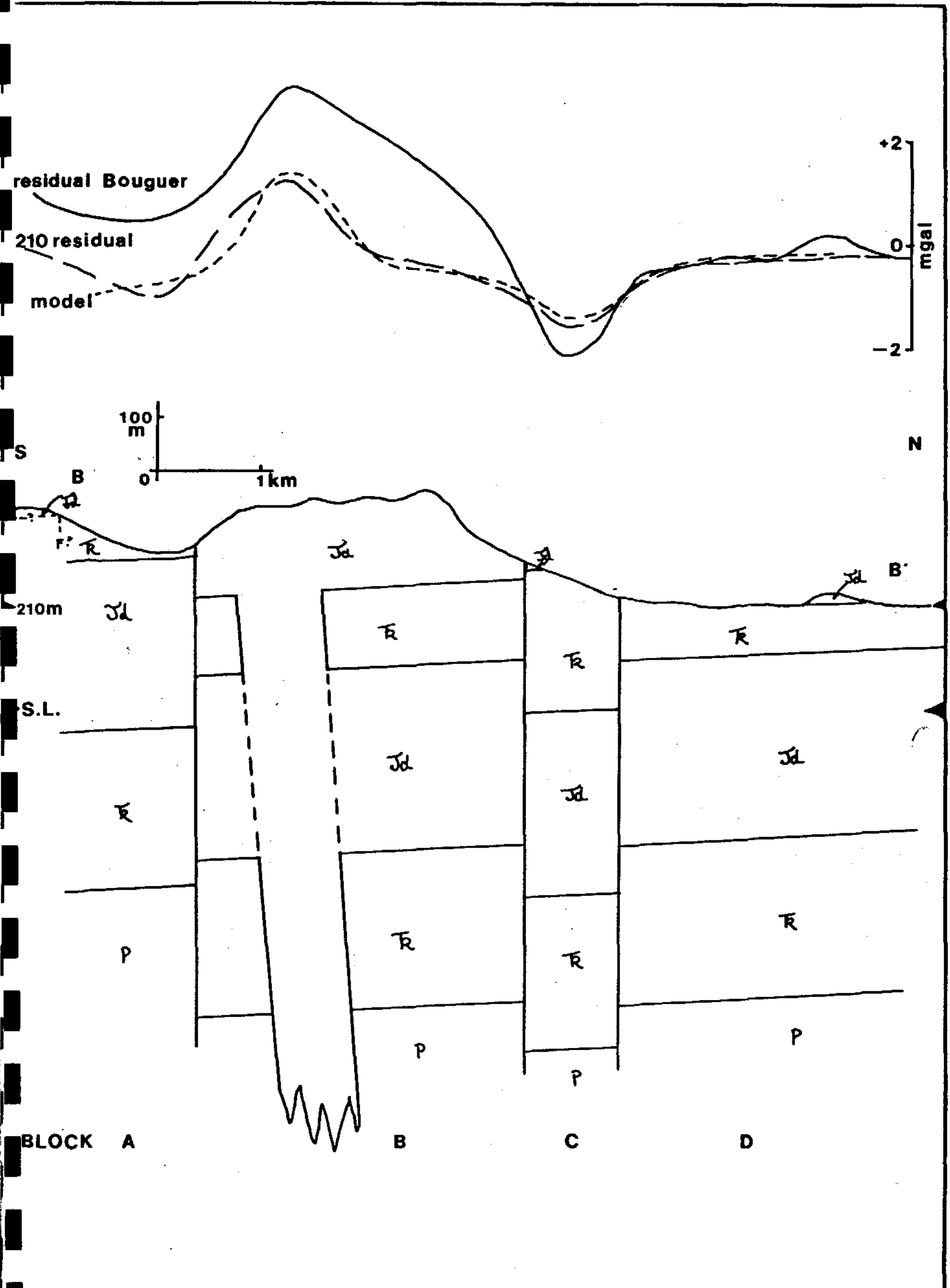
a) There is no control on the thickness of the mid section sheet but 300-350m could be considered typical for a sheet at this stratigraphic level.



PROFILE A-A'

FIG 7

82/1/7



PROFILE B-B′

FIG 8
82/1/8

b) There is no control on the thickness of the lower part of the Triassic section but about 300m has been assumed. This is not especially critical and is based on the presumptions that the rocks exposed in block A lie near the base of the lithic succession while those in block D are 150-200m higher and the anomaly/contrast link to dolerite thickness is valid.

c) Although neither sheet nor lower section thicknesses are absolutely controlled the relative contrasts of +0.23 and about -0.22 t/m^3 mean that any variations in one must be coupled with commensurate changes in the other. Thickness proportions are about 1:1 (see also a, b above).

d) Typical bulk densities for the Lower Triassic section are probably 2.40-2.45 t/m^3 and for the Upper section 2.45 - 2.50 t/m^3, allowing for some mudstone content.

e) If other unsuspected major dolerite sheets are present within the Lower Triassic or Permian sections they must be more than 800m below the surface and probably universal. Deeper features cannot be resolved with the filter employed.

f) Dip effects are not significant in the direction of the profiles.

Block C is related to a -2 to -3 mgal anomaly. This could be produced in only two ways - absence of dolerite in the block or more sedimentary section. Very light surface rocks, deep weathering or recent channel deposits can be excluded since the coal measures sequence is exposed and has been sampled.

Models have been attempted in which dolerite has been omitted from all blocks. It is possible to balance blocks A, B, D but not generate the sharp gradients related to C since the source of anomaly is then the graben depression into a Permian 'gravity' basement which is deep and of low contrast. Dolerite must be present within 150-200m of the surface in B and D and hence A. Profile BB' is quite definitive also. Irrespective of the near surface residual corrections or the contrast employed (-0.15 to -0.22 t/m^3) a section thickened by about 100m but intruded by dolerite is implied. Profile AA' is exceptional (see Figures 4,5) in that the minimum anomaly is sampled and is difficult to model. A wider, lighter section above dolerite or a section lacking dolerite could yield the effect (Figure 7). Consistency suggests the former.

Figures 7, 8 suggest the general form of the structure but several factors are ill-defined in detail.

i) The upper dolerite in block B, exposed on the Tier, is locally thickened by 100 to 150m between the profiles; the exact amount could only be estimated by a complete three dimensional analysis. Dolerite feeders are certainly present and an estimate of pipe diameter is shown. At least two pipes are indicated. Pipe position is approximate.

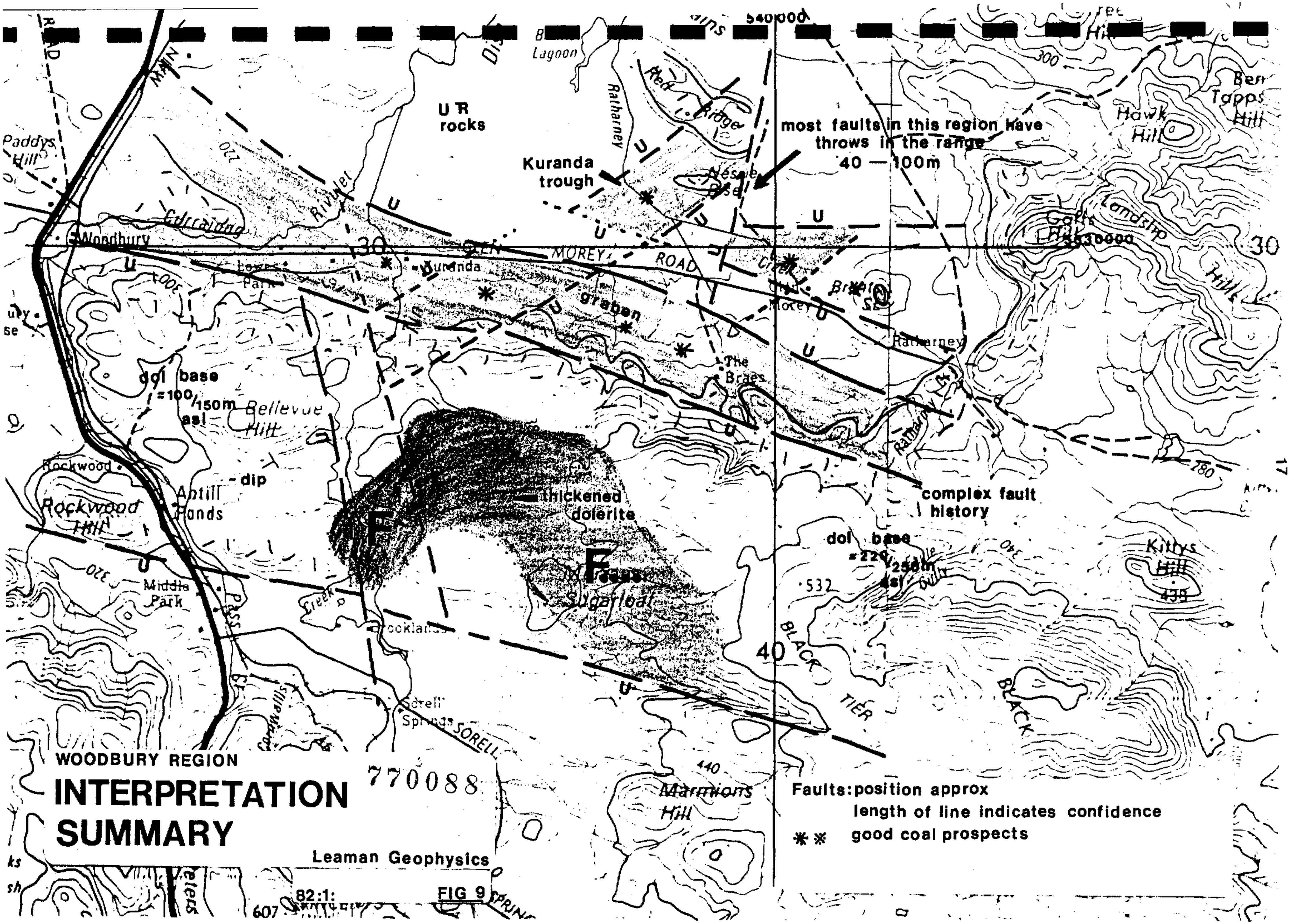
ii) The slab of Upper Triassic rocks between the major sheets cannot be accurately described. Small errors in density estimates are inevitable and it is probable that some movement on the faults was pre or syn-intrusion lending unpredictability to already uncontrolled estimates. Coal content is unlikely to affect significantly the contrast estimates at the scale of this survey. The upper unit has a maximum thickness in D of about 250m but the estimate for block B could be varied by ±50m. Errors in density contrasts employed probably generate errors of less than 25m in the estimates for fault displacements.

Dip effects in the profile direction are displayed by the asymmetry of the feeder anomalies and are of the order of 5° maximum. Faults are shown vertical, and while the angle cannot be resolved it must exceed 70-75°. The models establish the existence of a major fault between blocks A and B since block B must contain the lower sheet and a more substantial Triassic section. There is no evidence for significant sheet discordance other than beneath the heart of the Tier. The undulating anomalies on the plains area reflect faulting and sheet displacement similar to that of block C but on a smaller scale. Some of the displacements may affect only the lower sheet or if pre-dating the first intrusion, both. Offset displacements are certainly implied in Block C - note the apparent up-throw of the upper sheet. These yield a simple, consistent, if slightly unpredictable, structure. Within the available constraints the gravity data impose realistic limits.

The principal structure of the plain and slopes is the E-W graben (block C) with sympathetic faults. Two possible trend sets can be detected in the anomalies but the station density is not adequate to fully define the more subtle features. However, possible trends are shown in the interpretation summary (Figure 9) and the dominant features are basically WNW-ESE, not NE-SW as suggested in Figure 4. Few photo linear trends are reflected in the gravity data indicating that most represent simple fractures or faults having small displacements (less than 25m). Several dolerite cappings are related to blocks with negative anomalies implying downthrown blocks (compare block C). Cross faulting is indicated in the region of Kuranda. This interpretation of faulting implies that the stratigraphic level (and coal sequence) is not comparable between blocks C and D, except within the downthrown Kuranda block, but is comparable between blocks B and D.

The important dolerite intrusion exposed in block B shelves westward, is fault-terminated to north and south and was fed from the region of Brooklands. Only east of 539mE is the concealed coal-bearing sequence likely to be near surface and accessible to relatively low cost mining and shallow drilling.

Although the major faults may have been active from Jurassic times and to have experienced movement before or during dolerite intrusion the predominant movements appear to be post Jurassic and the general down-throw pattern from SW to NE suggests that these structures are distributing the Tertiary movements related to the Great Western Tiers faulting. The general E-W trend of the Woodbury structures probably accounts for the absence of major N-S movements on several faults mapped to the south which are extensions of the Western Tier structures.



WOODBURY REGION
INTERPRETATION SUMMARY
770088
Leaman Geophysics
82:1:
FIG 9
Faults:position approx
length of line indicates confidence
✱✱ good coal prospects
most faults in this region have throws in the range 40 — 100m
U Ʀ rocks
Kuranda trough
graben
dol base =100/150m asl
dip
thickened dolerite
complex fault history
dol base =220/250m asl
F
F
U
Woodbury
Kuranda
Lower Park
Paddys Hill
Bellevue Hill
Rockwood
Rockwood Hill
Antill Ponds
Middle Park
Brooklands
Sorell Springs
Sugarloaf
Marmions Hill
Kittys Hill
Hawk Hill
Ben Tapps Hill
Red Ridge
Ratharney
The Braes
BLACK TIER
BLACK
MAIN
ROAD
MOREY ROAD
Calcraidag
Lagoon
540000
5330000
30
40
300
320
280
340
440
532
439
607

CONCLUSIONS:

The moderately detailed gravity survey of the Woodbury region has led to the resolution of many structural problems and revealed several previously unknown aspects.

1. The Triassic rocks exposed near Woodbury are probably around 450-500m above the base of the succession, except in some downthrown blocks where the thickness is about 600m.
2. The Triassic succession is multiply intruded by Jurassic dolerite. There are two main sheets and possibly several minor sills. The main sheets are about 300m thick but the minor bodies cannot be resolved although their total thickness probably does not exceed 50m. Other sheets may be present in the Lower Triassic or Permian rocks but these cannot be resolved in this small area with the processing applied.
3. The dolerite mass of the Black Tier - Bellevue Hill range is essentially a fault-bounded, westward dipping sheet. It is the largest exposure of the upper main sheet and the fault block contains sources for the sheet. Two feeder pipes up to 800m in diameter and a thickened (by 100-150m) sheet root are present. A large part of the mid-upper Triassic succession will have been displaced as a result.
4. The northern edge of the dolerite escarpment is faulted. Although most of the movement may be post-dolerite some earlier movements are suggested since the upper sheet has intruded various stratigraphic levels in the adjacent fault blocks. Some talus may be present on the escarpment but the structural picture revealed by the gravity field is more consistent with a dislocated sheet base and a typical, if complex, fault history.
5. The escarpment fault forms one side of a narrow graben which was in existence prior to intrusion of the upper sheet, at least. The succession is about 100m thicker in an arc around the escarpment as a result. Much of the shallow coal reserve is in this zone.
6. Several cross faulted blocks are also present on the Woodbury plain but only a few correlate with photo linears. Some of this faulting probably predates some of the intrusions (compare escarpment-graben faults). It could be expected, therefore, that more complete coal-bearing sections occur in these down thrown blocks.
7. Near surface coal bearing sections, as shown in Victor's summary of September, 1981, correlate with anomalously negative-downthrown-blocks suggesting that comparable, and higher, stratigraphic levels are exposed in patches of the area.
8. Coal-bearing rocks within the Black Tier fault block are likely to be restricted by lower stratigraphic level and dolerite intrusion. Any exploratory drilling should be sited east of 539mE and at the lowest possible altitudes,

e.g. in Eagle Gully, in order to minimise drilling of dolerite. No coal-bearing units can be expected beneath the centre of the Tier and any present beneath the Bellevue Hill region will probably be at uneconomic mining depths.

9. Fault throws in the plain area range from 25-100m; the typical throw is about 50m. The gravity data suggest that the lower sheet is disrupted and most of the movements may be Tertiary in age. The major faults appear to down-throw consistently to the north (strike WNW-ESE) and probably distribute some of the Great Western Tiers uplift reducing the movements on N-S trending structures as observed further south near Oatlands.

10. It is recommended that the drilling results be reviewed as a result of the inferences on the general placement and orientation of fault blocks. In the writer's view the available data are consistent with this interpretation but are structurally and stratigraphically ambiguous. The gravity survey has positively identified some major structures but further surveys, and/or reconsideration of drilling data, aimed at definition of fault position and orientation will be an essential part of any ultimate mining assessment given the variance between the extant geological view (Figure 4) and this interpretation (Figure 9). Gravity, magnetic, reflection or resistivity methods could be applied to the problem of precise fault block location.

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APPENDIX:

GRAVITY REDUCTIONS

Bouguer density: 2.67 t/m^3

Reduction uses 1930 Ellipsoid

Units: mgal

NUMBER	EASTING	NORTHING	HEIGHT m	TERR CORR	G THEO	G OBS	BOUG ANOM
Base	147.3884	42.1772	250.00	0.30	980375.03	980310.17	-15.38
9000	.4030	.2023	317.00	0.31	377.28	303.51	-11.11
9001	.4083	.1982	398.00	0.89	376.91	287.45	-10.28
9002	.4178	.2068	376.00	0.57	377.69	292.42	-10.74
9003	.4162	.2124	396.00	0.76	378.19	287.97	-11.57
9004	.4106	.2098	395.00	0.85	377.96	288.00	-11.42
9005	.4272	.2167	296.00	0.25	378.58	310.50	-9.60
9006	.4262	.2200	309.00	0.24	378.87	308.78	-9.07
9007	.4305	.2212	318.00	0.23	378.98	307.67	-8.53
9008	.4306	.2277	348.00	0.25	379.57	302.87	-8.00
9009	.4267	.2288	357.00	0.31	379.66	301.42	-7.71
9010	.4356	.2295	336.00	0.25	379.73	306.55	-6.84
9011	.4427	.2267	335.00	0.25	379.48	306.13	-7.20
9012	.4623	.2300	367.00	0.31	379.77	300.09	-7.18
9013	.4683	.2277	418.00	0.55	379.57	280.90	-6.50
9014	.4806	.2305	505.00	0.65	379.82	271.34	-8.50
9015	.4942	.2278	514.00	0.29	379.57	275.87	-2.31 *
9016	.4850	.2208	528.00	0.43	378.94	274.94	0.28 *
9017	.4171	.2177	303.00	0.23	378.66	307.59	-11.25
9018	.4047	.2135	293.00	0.33	378.29	304.86	-15.47

* Position or elevation suspect.

NUMBER	EASTING	NORTHING	HEIGHT m	TERR CORR	G THEO	G OBS	BOUG ANOM
1	147.4964	42.1660	227.06	0.13	980,374.02	980,317.96	-11.27
2	3964	1705	225.84	0.16	374.43	319.50	-10.34
3	4964	1741	232.84	0.15	374.75	318.77	-10.03
4	4965	1777	232.88	0.15	375.07	319.31	-9.81
5	4965	1813	232.79	0.17	375.40	319.18	-10.26
6	4965	1849	263.55	0.21	375.72	312.86	-10,81
7	4965	1867	265.80	0.31	375.88	312.13	-11.15
8	4965	1885	242.31	0.29	376.04	317.45	-10.65
9	4966	1921	242.42	0.27	376.37	319.89	-8.52
10	4966	1957	263.51	0.39	376.69	316.20	-8.27
11	4966	1993	290.57	0.83	377.01	309.84	-9.19
12	4967	2029	338.09	0.73	377.34	301.62	-8.49
13	4967	2065	388.31	1.48	377.66	293.06	-6.74
14	4967	2101	445.81	1.94	377.98	282.68	-5.68
15	4967	2137	542.95	1.09	378.31	264.71	-5.71
16	4968	2155	529.52	1.03	378.47	268.01	-5.27
17	4937	2151	536.36	0.52	378.44	267.01	-5.40
18	4887	2155	533.50	0.35	378.47	267.97	-5.20
19	4879	2119	514.85	0.44	378.14	271.20	-5.23
20	4930	2100	546.20	2.20	377.97	261.53	-6.80
21	4926	2066	432.93	1.12	377.67	285.08	-6.31
22	4882	2070	477.84	0.97	377.71	275.98	-6.76
23	4885	2034	406.27	0.96	377.38	289.46	-7.05
24	4933	2936	362.92	0.99	377.40	297.41	-7.61
25	4932	1997	336.83	0.76	377.05	298.82	-11.21
26	4874	1996*	356.10	0.81	377.04*	297.40	-8.78*
27	4947	1981	301.05	0.60	376.90	307.33	-9.76
28	4920	1968	262.60	0.44	376.79	314.10	-10.60
29	4861	1953	253.75	0.49	376.65	315.89	-10.36
30	4908	1919	237.18	0.29	376.35	320.33	-9.07

NUMBER	EASTING	NORTHING	HEIGHT m	TERR CORR	G THEO	G OBS	BOUG ANOM
31	147.4941	42.1924	249.43	0.27	980,376.39	980,318.40	-8.66
32	4887	1893	231.49	0.24	376.12	321.02	-9.33
33	4879	1859	228.02	0.20	375.81	320.31	-10.45
34	4922	1848	234.08	0.20	375.71	318.45	-11.02
35	4880	1818	225.03	0.17	375.44	320.06	-10.95
36	4875	1784	223.75	0.16	375.14	320.30	-10.67
38	4886	1752	223.35	0.15	374.85	320.93	-9.83
39	4922	1694	223.38	0.13	374.33	319.39	-10.87
40	4924	1681	223.11	0.13	374.21	319.69	-10.50
41	4875	1698	218.23	0.13	374.29	320.28	-10.96
42	4842	1633	214.30	0.12	373.78	319.74	-11.77
43	4843	1669	215.30	0.14	374.11	320.19	-11.43
44	4843	1705	218.00	0.14	374.43	320.48	-10.93
45	4843	1723	218.89	0.13	374.59	320.22	-11.19
46	4844	1777	218.40	0.13	375.08	321.21	-10.78
47	4844	1813	220.67	0.16	375.40	320.57	-11.27
48	4844	1849	224.26	0.19	375.72	320.87	-10.55
49	4844	1885	238.23	0.25	376.05	319.02	-9.91
50	4845	1921	244.99	0.29	376.37	318.04	-9.85
51	4845	1957	267.52	0.65	376.69	312.39	-11.03
52	4845	1975	315.56	0.85	376.86	302.27	-11.66
53	4845	1993	326.69	0.72	377.02	302.42	-9.61
54	4845	2029	346.28	0.93	377.34	300.75	-7.55
55	4846	2075	446.09	1.17	377.75	282.59	-6.24
56	4846	2102	496.73	0.65	377.99	273.73	-5.91
57	4846	2138	516.24	0.33	378.31	271.07	-5.37
58	4847	2174	524.80	0.32	378.64	269.98	-5.11
59	4805	2141	507.80	0.29	378.35	272.52	-5.65
60	4751	2154	493.22	0.31	378.46	275.34	-5.79

*37 No elevation observed

NUMBER	EASTING	NORTHING	HEIGHT m	TERR CORR	G THEO	G OBS	BOUG ANOM
61	147.4758	42.2106	495.08	0.32	980,378.03	980,274.26	-6.06
62	4818	2103	501.67	0.36	378.01	273.24	-5.73
63	4826	2079	487.82	0.56	377.79	274.77	-6.50
64	4776	2074	482.47	0.52	377.74	275.20	-7.12
65	4808	2026	377.07	1.15	377.31	293.80	-8.20
66	4782	2005	344.04	0.91	377.12	299.75	-8.79
67	4809	1967	318.01	0.77	376.78	301.88	-11.57
68	No elevation observed						
69	4788	1938	267.75	0.35	376.52	312.02	-11.48
70	4806	1908	249.05	0.28	376.25	316.41	-10.57
71	4761	1904	250.87	0.29	376.21	315.34	-11.24
72	4821	1882	229.76	0.25	376.02	320.38	-10.19
73	4769	1864	233.79	0.23	375.86	318.36	-11.28
74	4770	1842	217.68	0.19	375.65	321.46	-11.19
75	4763	1797	215.32	0.15	375.25	321.09	-11.65
76	4791	1778	218.61	0.15	375.08	321.06	-10.87
77	4747	1756	243.69	0.16	374.89	314.41	-12.38
78	4774	1747	222.51	0.15	374.80	318.93	-11.96
79	4773	1700	261.03	0.51	374.38	311.28	-11.25
80	4804	1688	238.24	0.40	374.28	315.62	-11.39
81	4811	1646	213.26	0.12	373.90	319.85	-11.98
82	4763	1656	224.43	0.21	373.99	316.93	-12.71
83	4781	1621	214.33	0.11	373.67	319.02	-12.39
84	4721	1589	208.07	0.15	373.38	319.14	-13.17
85	4721	1598	208.53	0.15	373.46	319.11	-13.19
86	4721	1607	210.25	0.16	373.54	319.19	-12.83
87	4721	1616	213.45	0.16	373.63	318.64	-12.84
88	4721	1625	218.59	0.19	373.71	317.91	-12.61
89	4721	1634	232.43	0.23	373.79	315.69	-12.15
90	4721	1643	243.15	0.19	373.87	314.25	-11.60

NUMBER	EASTING	NORTHING	HEIGHT m	TERR CORR	G THEO	G OBS	BOUG ANOM
91	147.4722	42.1652	241.69	0.17	980,373.95	980,314.65	-11.59
92	4722	1661	239.90	0.19	374.03	315.02	-11.63
93	4722	1670	247.54	0.20	374.11	313.19	-12.03
94	4722	1679	255.29	0.28	374.19	312.13	-11.56
95	4722	1688	258.34	0.40	374.27	310.41	-12.64
96	4722	1697	227.91	0.25	374.35	317.04	-12.23
97	4722	1706	217.25	0.19	374.43	319.49	-12.03
98	4722	1715	213.26	0.15	374.51	320.25	-12.17
99	4722	1724	211.57	0.13	374.60	320.49	-12.36
100	4722	1733	211.62	0.15	374.68	320.70	-12.20
101	4722	1742	217.17	0.16	374.76	319.61	-12.27
102	4722	1751	229.61	0.20	374.84	316.88	-12.59
103	4722	1760	227.50	0.19	374.92	317.63	-12.35
104	4722	1769	213.24	0.17	375.00	320.72	-12.17
105	4722	1778	213.18	0.16	375.08	320.33	-12.66
106	4723	1787	213.23	0.16	375.16	320.88	-12.18
107	4723	1796	213.19	0.15	375.24	321.54	-11.62
108	4723	1805	213.90	0.16	375.32	321.63	-11.46
109	4723	1814	214.99	0.16	375.41	321.67	-11.29
110	4810	1859	229.30	0.20	375.81	320.06	-10.45
111	4723	1850	221.77	0.20	375.73	321.06	-10.85
112	4723	1886	235.14	0.28	376.05	318.37	-11.15
113	4724	1922	249.27	0.37	376.38	315.08	-11.90
114	4724	1958	282.27	0.51	376.70	308.64	-12.03
115	4724	1994	338.53	1.05	377.02	300.67	-8.72
116	4724	2030	457.35	0.89	377.35	278.61	-7.88
117	4725	2066	473.52	0.32	377.67	277.35	-6.85
118	4725	2102	463.25	0.35	377.99	280.20	-6.32
119	4725	2138	487.45	0.35	378.32	275.84	-6.24
120	4725	2174	467.24	0.41	378.64	280.64	-5.68

NUMBER	EASTING	NORTHING	HEIGHT m	TERR CORR	G THEO	G OBS	BOUG ANOM
121	147.4694	42.2169	452.14	0.36	980,378.59	980,283.24	-6.06
122	4650	2171	414.01	0.40	378.61	291.01	-5.76
123	4686	2145	465.36	0.35	378.38	280.10	-6.39
124	4640	2130	426.10	0.35	378.25	288.47	-5.68
125	4679	2106	455.38	0.36	378.03	281.63	-6.46
126	4643	2091	428.85	0.32	377.90	286.49	-6.73
127	4687	2072	464.25	0.35	377.72	279.29	-6.76
128	4691	2037	459.07	0.43	377.41	278.55	-8.13
129	4634	2043	431.77	0.33	377.46	284.99	-7.22
130	4648	2006	418.07	0.52	377.13	286.90	-7.48
131	4644	1995	408.40	0.72	377.03	287.41	-8.57
132	4682	2000	349.90	0.89	377.08	298.68	-8.68
133	4688	1974	308.09	0.71	376.85	305.66	-9.88
134	4684	1948	270.74	0.59	376.61	309.75	-13.02
135	4647	1940	316.42	0.57	376.54	301.74	-11.99
136	4679	1907	238.07	0.41	376.24	316.60	-12.40
137	4635	1908	254.62	0.44	376.25	312.72	-13.01
138	4691	1870	229.16	0.25	375.91	319.23	-11.35
139	4639	1853	226.24	0.21	375.76	319.36	-11.68
140	No elevation observed						
141	4690	1791	211.47	0.15	375.20	321.33	-12.12
142	4678	1770	210.34	0.16	375.01	321.47	-12.01
143	4699	1740	210.49	0.15	374.74	321.19	-12.00
144	4648	1713	209.49	0.12	374.50	321.42	-11.75
145	4657	1692	208.20	0.14	374.31	321.55	-11.66
146	No elevation observed						
147	4707	1636	240.15	0.23	373.81	314.14	-12.21
148	4703	1618	233.04	0.19	373.64	313.80	-13.82
149	4601	1670	208.21	0.09	374.12	321.17	-11.90
150	4601	1706	209.16	0.09	374.44	321.04	-12.17

NUMBER	EASTING	NORTHING	HEIGHT m	TERR CORR	G THEO	G OBS	BOUG ANOM
151	147.4601	42.1742	209.39	0.12	980,374.76	980,321.79	-11.67
152	4601	1778	211.05	0.15	375.09	321.41	-12.01
153	4602	1814	214.34	0.19	375.41	321.67	-11.39
154	4602	1850	221.73	0.21	375.73	319.89	-12.02
155	4602	1886	239.10	0.44	376.06	315.98	-12.61
156	4602	1922	286.72	0.43	376.38	307.10	-12.46
157	4603	1958	333.48	0.45	376.70	300.91	-9.75
158	4603	1994	377.54	0.49	377.03	293.73	-8.55
159	4603	2030	413.14	0.53	377.35	287.86	-7.69
160	4603	2067	413.86	0.43	377.67	288.70	-7.14
161	4604	2103	408.39	0.40	378.00	290.60	-6.67
162	4604	2139	396.83	0.33	378.32	294.31	-5.62
163	4604	2175	382.45	0.32	378.64	297.24	-5.86
164	4545	2158	474.97	2.05	378.49	276.69	-6.33
165	4571	2117	386.82	0.41	378.12	295.74	-5.89
166	4532	2117	361.78	0.48	378.13	299.49	-6.99
167	4519	2080	367.56	0.32	377.80	297.91	-7.27
168	4571	2075	409.36	0.37	377.75	289.39	-7.47
169	4575	2041	403.35	0.36	377.45	290.08	-7.67
170	4531	2055	387.58	0.36	377.57	293.85	-7.12
171	4533	2020	385.92	0.37	377.25	293.14	-7.83
172	4572	2009	397.06	0.43	377.16	290.11	-8.52
173	4540	1993	390.57	0.45	377.01	290.92	-8.82
174	4576	1977	377.15	0.57	376.87	293.74	-8.38
175	4566	1943	304.37	0.57	376.57	305.73	-10.39
176	4521	1953	363.27	0.59	376.66	295.02	-9.60
177	4525	1898	297.21	0.57	376.16	304.67	-12.46
178	4569	1889	244.91	0.48	376.08	314.26	-13.16
179	4532	1873	235.15	0.40	375.94	315.45	-13.83
180	4565	1859	228.68	0.33	375.82	317.78	-12.72

NUMBER	EASTING	NORTHING	HEIGHT m	TERR CORR	G THEO	G OBS	BOUG ANOM
181	No elevation observed						
182	147.4526	42.1802	213.93	0.17	980,375.29	980,321.42	-11.62
183	4580	1783	211.41	0.16	375.13	321.39	-11.99
184	4515	1776	214.14	0.15	375.07	320.25	-12.55
185	4519	1746	210.98	0.12	374.80	321.05	-12.13
187	4559	1696	210.00	0.09	374.35	320.71	-12.25
186	No elevation observed						
188	4494	1714	208.96	0.09	374.51	320.56	-12.76
189	4598	1689	211.21	0.09	374.29	321.31	-11.34
190	4480	1707	214.33	0.09	374.44	319.21	-12.98
191	4480	1743	211.89	0.11	374.77	320.71	-12.27
192	4480	1779	216.15	0.13	375.09	320.16	-12.28
193	4481	1815	216.19	0.19	375.41	320.89	-11.81
194	4481	1851	221.10	0.26	375.74	319.06	-12.92
195	4481	1887	238.02	0.37	376.06	315.05	-13.82
196	4481	1923	280.68	0.75	376.38	308.99	-11.44
197	4482	1959	354.74	0.52	376.71	297.35	-9.06
198	4482	1995	349.03	0.42	377.03	299.78	-8.17
199	4482	2031	358.47	0.39	377.36	298.88	-7.57
200	4482	2067	392.31	0.40	377.68	292.39	-7.72
201	4483	2103	345.41	0.43	378.00	301.68	-7.95
202	4483	2139	344.24	0.41	378.33	302.83	-7.38
203	4483	2175	331.09	0.55	378.65	304.63	-8.34
204	4445	2168	341.92	0.43	378.59	302.69	-8.21
205	No elevation observed						
206	4433	2137	363.61	0.49	378.31	298.96	-7.34
207	No elevation observed						
208	No elevation observed						
209	4447	2099	355.59	0.39	377.97	299.78	-7.85
210	4448	2061	381.58	0.43	377.62	294.55	-7.59

NUMBER	EASTING	NORTHING	HEIGHT m	TERR CORR	G THEO	G OBS	BOUG ANOM
211	147.4398	42.2054	382.45	0.60	980,377.56	980,293.71	-8.82
212	4388	2031	362.18	0.41	377.36	297.52	-8.19
213	4435	2035	368.74	0.41	377.39	295.29	-9.16
214	4453	1997	322.70	0.43	377.05	304.43	-8.72
215	4376	1987	333.37	0.44	376.96	301.45	-9.50
216	4445	1948	340.50	0.55	376.61	299.23	-9.85
217	4379	1952	300.39	0.57	376.64	306.34	-10.64
218	4383	1928	307.50	0.65	376.43	304.69	-10.61
219	4438	1901	281.74	0.64	376.19	305.56	-14.57
220	No elevation observed						
221	4427	1867	250.87	0.33	375.89	311.15	-15.06
222	No elevation observed						
223	4430	1827	220.00	0.20	375.52	319.29	-12.76
224	4377	1800	225.35	0.19	375.28	317.55	-13.21
225	4411	1773	216.46	0.15	375.04	319.46	-12.85
226	4440	1745	214.50	0.10	374.78	319.77	-12.72
227	4359	1761	222.08	0.15	374.93	317.25	-13.85
228	4359	1779	223.20	0.17	375.09	317.74	-13.28
229	4359	1815	223.06	0.24	375.42	317.83	-13.47
230	4360	1833	223.08	0.28	375.58	318.18	-13.24
231	4360	1851	224.88	0.31	375.74	316.83	-14.37
232	4360	1869	228.38	0.32	375.90	316.03	-14.64
233	4360	1887	230.60	0.36	376.07	315.47	-14.87
234	4360	1905	245.07	0.49	376.23	313.63	-13.90
235	4360	1923	281.95	0.55	376.39	308.82	-11.56
236	4360	1941	276.19	0.51	376.55	310.11	-11.60
237	4360	1959	268.92	0.49	376.71	312.20	-11.13
238	4361	1977	307.93	0.43	376.87	305.35	-10.53
239	4361	1995	326.15	0.49	377.04	302.26	-10.14
240	4361	2013	331.75	0.44	377.20	301.34	-10.16

NUMBER	EASTING	NORTHING	HEIGHT m	TERR CORR	G THEO	G OBS	BOUG ANOM
241	147.4361	42.2031	352.91	0.40	980,377.36	980,298.02	-9.53
242	4361	2049	364.54	0.47	377.52	295.34	-10.01
243	4361	2067	339.57	0.49	377.68	301.35	-9.05
244	4361	2085	314.81	0.59	377.84	306.22	-9.11
245	4361	2103	320.06	0.26	378.01	305.17	-9.62
246	4362	2121	332.12	0.32	378.17	303.49	-9.03
247	4362	2140	345.01	0.32	378.33	300.48	-9.67
248	4362	2158	314.45	0.32	378.49	305.87	-10.45
249	4362	2176	308.70	0.24	378.65	307.59	-10.11
250	4362	2194	306.01	0.21	378.81	308.70	-9.71
251	4362	2212	299.02	0.21	378.98	310.80	-9.15
252	4362	2230	305.56	0.23	379.14	309.76	-9.06
253	4362	2248	310.97	0.23	379.30	308.68	-9.23
254	4363	2266	304.55	0.21	379.46	310.23	-9.12
255	4324	2159	308.04	0.25	378.51	307.77	-9.89
256	4288	2126	336.11	0.47	378.21	304.10	-7.53
257	4331	2105	337.34	0.31	378.02	303.78	-7.58
258	4334	2071	315.41	0.33	377.71	305.80	-9.54
259	No elevation observed						
260	4334	2037	334.64	0.40	377.41	301.32	-9.86
261	4284	2003	283.71	0.45	377.10	310.09	-10.76
262	4323	1985	279.67	0.44	376.94	310.97	-10.52
263	4322	1957	262.63	0.40	376.69	313.19	-11.44
264	4320	1922	261.33	0.45	376.38	312.74	-11.79
265	4286	1888	246.20	0.33	376.07	314.74	-12.57
266	4344	1882	232.25	0.33	376.02	317.59	-12.42
267	4263	1855	249.37	0.31	375.77	312.32	-14.09
268	4311	1847	248.65	0.29	375.71	312.92	-13.58
269	4300	1824	223.20	0.27	375.50	317.26	-14.07
270	4270	1799	217.97	0.24	375.27	318.24	-13.91

NUMBER	EASTING	NORTHING	HEIGHT m	TERR CORR	G THEO	G OBS	BOUG ANOM
271	147.4238	42.1816	221.50	0.25	980,375.42	980,316.75	-14.85
272	4238	1834	228.33	0.29	375.58	315.04	-15.34
273	4239	1852	257.16	0.40	375.75	309.93	-14.84
274	4239	1870	257.45	0.45	375.91	311.98	-12.83
275	4239	1888	277.60	0.47	376.07	309.09	-11.91
276	4239	1906	285.59	0.55	376.23	307.98	-11.53
277	4239	1924	271.45	0.51	376.39	311.26	-11.23
278	4239	1942	304.30	0.52	376.55	305.61	-10.57
279	4239	1960	300.33	0.40	376.72	306.73	-10.43
280	4239	1978	320.44	0.51	376.88	303.20	-10.13
281	4240	1996	311.73	0.41	377.04	304.88	-10.43
282	4240	2014	299.63	0.61	377.20	307.51	-10.14
283	4240	2032	314.10	0.47	377.36	305.02	-10.09
284	4240	2050	308.29	0.44	377.53	306.80	-9.64
285	4240	2068	294.69	0.44	377.69	308.15	-11.13
286	4240	2086	341.07	0.41	377.85	300.50	-9.86
287	4240	2122	358.14	0.51	378.17	298.44	-8.78
288	4241	2158	300.65	0.37	378.50	308.70	-10.29
289	4241	2176	296.31	0.25	378.66	311.35	-8.77
290	No elevation observed						
291	4118	1978	399.89	0.73	376.88	286.44	-11.05
292	4118	1960	359.95	0.72	376.72	293.87	-11.33
293	4118	1942	357.26	0.73	376.56	294.06	-11.50
294	4118	1924	347.23	0.68	376.40	295.42	-11.99
295	4118	1906	359.58	0.89	376.24	292.59	-12.02
296	4118	1888	327.15	0.76	376.07	298.66	-12.30
297	4118	1870	300.67	0.73	375.91	303.41	-12.63
298	4117	1852	268.79	0.68	375.75	309.08	-13.08
299	4117	1834	234.64	0.53	375.59	314.06	-14.84
300	3996	1799	235.35	0.28	375.27	312.86	-15.84

NUMBER	EASTING	NORTHING	HEIGHT m	TERR CORR	G THEO	G OBS	BOUG ANOM
301	147.3996	42.1781	253.83	0.24	980,375.11	980,309.60	-15.34
302	3996	1763	251.16	0.24	374.94	309.60	-15.70
303	3996	1745	244.12	0.23	374.78	310.99	-15.55
304	3996	1727	249.89	0.23	374.62	309.62	-15.62
305	3995	1708	238.98	0.23	374.46	310.99	-16.23
306	3995	1690	230.46	0.21	374.30	310.69	-18.07
307	3995	1672	230.08	0.19	374.14	311.42	-17.27
308	3995	1654	228.69	0.17	373.97	312.06	-16.76
309	3995	1639	228.77	0.17	373.84	311.60	-17.07
310	3875	1835	248.64	0.28	375.60	311.35	-15.05
311	3875	1853	255.04	0.35	375.76	310.17	-15.07
312	3875	1871	256.56	0.39	375.92	310.92	-14.14
313	3876	1889	257.85	0.45	376.08	311.36	-13.55
314	3876	1907	258.00	0.44	376.24	311.37	-13.68
315	3876	1925	264.76	0.43	376.40	310.14	-13.75
316	3876	1943	265.20	0.41	376.57	310.30	-13.69
317	3876	1961	265.53	0.39	376.73	310.31	-13.80
318	3876	1979	267.85	0.36	376.89	309.68	-14.16
319	3876	1997	276.20	0.37	377.05	309.27	-13.08
320	4452	1785	217.15	0.15	375.15	319.97	-12.31
321	4643	1634	209.70	0.20	373.79	320.03	-12.31
322	4810	2165	503.84	0.31	378.56	273.77	-5.37

APPENDIX 4

NOTES ON LOGGING TECHNIQUES

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NOTES ON LOGGING TECHNIQUE

Victor Petroleum and Resources Ltd. owns an SIE 450 portable logging system comprising chart recorder and single point resistivity-self potential, natural gamma and density (gamma-gamma)/caliper sondes. The absence of a digital tape recorder means that the paper records produced in the field must display the best possible results since there may be no second chances to log the hole nor vary any processing parameters. It is wise practice to produce some apparent redundancy of information and to ensure that every record is clearly and fully annotated. Where several passes are made in a hole it is good practice to write all relevant data or decisions on the chart before each run (or during it if scale changes are made).

Notation should include:

- well name and number
- date
- sonde
- reference depth
- note on sensor start position (counter depth or surface/collar to sensor distance) and correction. For example, there is a separation of about 1 m between caliper arm and gamma sensor positions which will yield a false offset for features noted with the density/caliper tool.
- scale setting (range across paper)
- any base measurements or calibrations
- intended rate of logging

For a gamma log these notes might be
W36A; 12/1/82; gamma; 0.6m (tool at surface, sensor at 0.6m from hole collar); TC = 2; 100 cps; start calibration 150 cps; 5 m/min.

If the scale is changed during a run the record should be fully marked - counter depth, new scale and base settings. No need will arise for radiometric tools if the hole is in good condition. The gamma tool can be logged down and an excellent settings guide obtained. The paper should be run on the downward run; the use of an ink range bar on the paper as a guide to settings is a very poor alternative. If the down-going record is good, the up-run can be used for detailed sampling of sections of the hole or for a different speed or time constant.

Reading down is not possible with the density/caliper tool and the first up-run will require guessed parameters. 100 or 250 cps is suggested with the start value centrally located on the chart paper. Any major anomalies can be re-run once located.

Electric logs can be obtained on the run down the hole and must be. There are two reasons. Establishment of optimum scale settings is often difficult and the number of electrical logging runs must be minimised in order to avoid excessive mixing of fluids in the hole. The run down should be completely annotated if any changes are made.

Where the condition of the hole is unknown or uncertain the number of passes must be the minimum necessary - once each way for each tool. The down run is then crucial.

Logging order is a corollary of the above discussion. In order to obtain the optimum data from a hole the order should be

a) SP-R, to minimise hole disturbance effects. Run paper on way down, mark fully. If it is possible to select a sensitive single scale for the run up, do so.
b) gamma. Since this can be logged down any risk associated with the hole or tool allows some data recovery even if a panic withdrawal is necessary.
c) density/caliper. Use presumes a sound hole since several runs are usually necessary. If the hole was at risk it will have been fully tested by the cheaper tools and which, at the same time, will have provided basic logs.

Note that electric logs can not be obtained in cased holes and that radiometric logs can be repeated without loss of reliability such as might occur with SP in many cases.

If the hole is in poor condition but must be logged then a decision must be made about which tool to risk. In my opinion the tool should be SP-R since the resistivity log is generally the most useful single record. The tool is also the cheapest. In a coal programme a valid decision might be to use the density log but this decision should not be left to the field operator. Any decision should be made quickly since hole deterioration may be rapid.

The hole should be logged while drilling plant is standing by or in the general locality in case recovery problems arise.

Selection of scale is rarely easy and will require some experience of the region and its rock types. Such experience is usually adequate for definition of radiometric parameters but SP-R settings are likely to be quite erratic and must be settled at the time of logging. No suggestions are given here.

However, the settings chosen must be the most sensitive possible although a fair choice may sometimes force a scale change during logging - or reset of the chart pen. This is better than loss of resolution. The importance of a proper setting is shown in Figure 2. The original R record (at 15 m/min) is featureless. A new run at the same scale but 5 m/min rate suggests useful character but is still too conservative (see record at far right at highest sensitivity using the whole width of paper). The original record is useless. This problem is common with SP records.

Permian rocks exhibit a wider range of electrical properties than Triassic rocks. This reflects lower porosity, fracturing and differing weathering properties. The difference is clearly seen in KR 2 (Figure 2).

While resistivity logs are usually reproducible, SP logs sometimes are not. This reflects the origin of the self potential and is dependent on the properties of the hole fluids and the wall rock junctions. Any mixing of fluids will affect junction e.m.fs. The first run is therefore the truest.

Electric logs may also display minor oscillatory noise or interference. This was observed on some of the test runs and is due to electrolytic action on the cable. It may be ignored. The battery effect is more serious and will be noted after any halt in logging. Practice at scale setting changes will reduce the period of any halt and lessen the effect. The battery effect or deficiencies in the ground electrode (placement or earth connection) will produce scale offsets.

Problems were experienced with the 'mud pit' ground electrode while test logging. This electrode should be placed in damp earth and a deep hole may be necessary. At W36A the earth was very dry. If the pit is newly dug it should be filled with water (preferably saline) and allowed a little time to soak in. The electrode must remain covered in the pit. Interference problems can be reduced by shifting the ground electrode further from the hole or by taping the first 3 - 5 m of cable.

Reproducibility problems (SP) are apparent in Figure 2. Neither the original or coarse/detailed new logs are wholly compatible. A time spread of 15 minutes applies to the new logs.

Logging speed should be as slow as practicable. The SIE manual suggests a rate of 6 m/min and 2 second time constant for radiometric sondes and 15-25 m/min for electric logs. While the latter is not especially critical any rate over 5-6 m/min will degrade the results. This is apparent in the test overlay from 12-30 m (KR2) and in the high frequency content of the new log for W36A which may be compared with the older log for W36.

In the case of radiometric logs the speed is directly related to resolution and record quality. If quantitative interpretations are to be undertaken then the logging speed and the time constant must be carefully considered. In any event recognition of lithology may depend on proper sampling of the rock units. Consider the ten metre section of W36A shown in Figure 3.

First, background or rock response level. Only at relatively low speeds can a reasonably accurate value be estimated; one that allows other small anomalies to be resolved or which describes the level for a given unit. All radiometric measurements are to some extent random and must be given some statistical basis. Thus the gross waviness near 31 m (s=5m/min, TC=2) is shown to be an artifact of speed and reduced sampling. Figure 4 shows another run across this interval at the same speed. False anomalies, apparently related to features in other logs, could be produced in this way. Increasing the time constant merely reduces the statistical significance of the data and is not as important as speed changes.

Second, anomaly definition. The profiles in Figure 3 show that the peak value and bed width are better estimated by the lower time and speed rates. This is to be expected since the approximate resolution in metres is speed (m/min) x TC (secs)/60.

Thus at 1.5 m/min, TC = 2 secs, the nominal resolution is 5 cm. Twenty measurements are made in each metre and the results are less influenced by sporadic variations or by too rapid passage of the unit since the odd deviation is easily recognised. The actual resolution is about 7 cm. since only about 70% of the counts recorded arrive from any particular 5 cm. due to the movement of the sonde.

In contrast the resolution at 5 m/min, TC = 2 is 16 cm. in theory and about 25 cm. in practice. This may mean a span of nearly half a metre for any peaking with resultant rounding and loss of definition. The same applies to the low contrast background observations. Ideally, correlations should be made only with features which can be reproduced on a repeat run, preferably at lower resolution factors, or which are clearly double the noise envelope for the record.

For the profiles in Figure 3, the definition of the main seam is

rate m/min	TC secs	Counts cps	width m
5	2	155	1.3
1.5	2	165	0.9
1.5	5	155	1.3
1.5	1	180	<0.9

where counts refers to peak level above background and width (a maximum for the unit) is interpolated from the maximum gradients to background level. Given the inflexions on the flanks of the anomaly the likely thickness of the unit may be as little as 0.7 m. This neglects the effect of scanning and the spacer separation. The seam is probably 0.8 - 0.9 m. thick and fairly uniform in properties. These judgments could not be made unless the feature is adequately sampled and this requires both low speed and low time constant.

The problem of reproducibility of radiometric logs was mentioned above. It is not generally serious and the problem is minor when compared with electric logs. Figure 4 shows the changed character of 'background' from two passes. Increased sampling (Figure 3) alone can determine whether any feature is 'real'.

In order to obtain a good sample of the rock mass it is recommended that a wide spacer separation be employed (use both spacers). Although this dimension was not varied for these tests it is likely that a smaller spacing will yield results strongly modified by wall conditions.

SUMMARY

1. Clearly annotate all records before logging.
2. Note carefully all offset corrections whether the result of pen movements or sensor positions or offsets.
3. Aim to produce a fair log on the run down the hole and a much better one on the way up.
4. Log SP-R first, then gamma and density.
5. Use the most sensitive scale settings compatible with the observed contrasts.

6. 5 to 6 m/min should be considered a maximum logging speed for all tools. Good radiometric results may require speeds as low as 1 m/min.
7. Properly earth the ground electrode.
8. Expect some variations in SP logs.
9. Time constants of 1, 2 seconds are recommended.
10. Spend adequate un-rushed time on site to guarantee sound observations.

GEOPHYSICAL LOGGING OF A HOLE, ESPECIALLY WHERE NO CORE IS RECOVERED, WILL OFFER THE ONLY RELIABLE MEANS OF PREPARING A LITHOLOGIC LOG (IN ASSOCIATION WITH CHIPPINGS). IN SUCH CASES IT IS IMPERATIVE THAT ENOUGH TIME IS SPENT ON THE HOLE TO ENSURE THAT DATA RECOVERY IS OF THE HIGHEST POSSIBLE RESOLUTION AND CHARACTER.

Although the author was commissioned to advise on the techniques required for logging rocks in Central Tasmania some comments are offered on the holes used. The comments are not, and should not be considered, complete interpretations.

<u>W36/36A</u>

It was intended that W36 be used but an adjacent diamond hole (150 m distant) W36A was logged by mistake. The original logs for W36 are compared with the new logs for W36A in Figure 1. Six gross features are labelled for correlation. These features are not offset by a constant amount suggesting changes in the rock sequence across the 150 m. The two seams are about 3.5 m. apart in each log but while the quality of the smaller lower seam is probably comparable -presuming that the better resistivity response in W36A relates to slower logging speed - there is a significant deterioration in the main seam; the count level is a third in W36A.

The radiometric logs show broad trends and some substantial features but the sampling is rarely adequate for proper definition of radiation levels. However, the sequence appears to be sandier above the coal than below it and this is reflected in both gamma and resistivity logs. The density log for W36A is relatively uniform but materials denser than the normal sandstone/mudstone occur at 24.5, 44, 54.5, 66 m. Both radiometric logs would be improved by a reduction of logging speed and the definition of the denser zones greatly enhanced. Since the density tool is best suited to low density work any use on subtly varying consolidated materials will require careful definition of background and peak levels. It is feasible but difficult.

<u>KR2</u>

Only SP-R logs were repeated in this test due to equipment failure. These show the general inconsistencies of SP records with multiple passage in the hole although anomaly features can, with care and correction, be recovered. Run numbers should be assigned to multiple passes of this tool. The importance of sensitive scale settings is obvious. The Permian siltstone in the lower part of the hole is fractured and water-bearing. Comparable oscillations in resistivity and gamma logs imply some weathering.

The acquisition of good SP-R logs enables resolution of the junction between freshwater (Triassic?) and marine (Permian) rocks in the hole. This occurs at 16-18 m. In the original logs this is suggested by the caliper responses (less stable Triassic), lower density (could also be weathering) and higher gamma responses (also possibly weathering) - all somewhat circumstantial and ambiguous. The new logs demonstrate the nature of the change at 16-18 m. It is clearly lithological and not consistent with a simple weathering effects. The upper rocks are quite conductive with low contrasts while the lower rocks are basically resistive. The SP response mirrors these properties and the conclusion from the whole group of logs is concordant.

Report submitted on behalf of
Leaman Geophysics
by

D. Leaman

Jan 15 1982

Dr. D. E. Leaman B.Sc. Ph.D
M.Aus.I.M.M
M.M.I.C.A

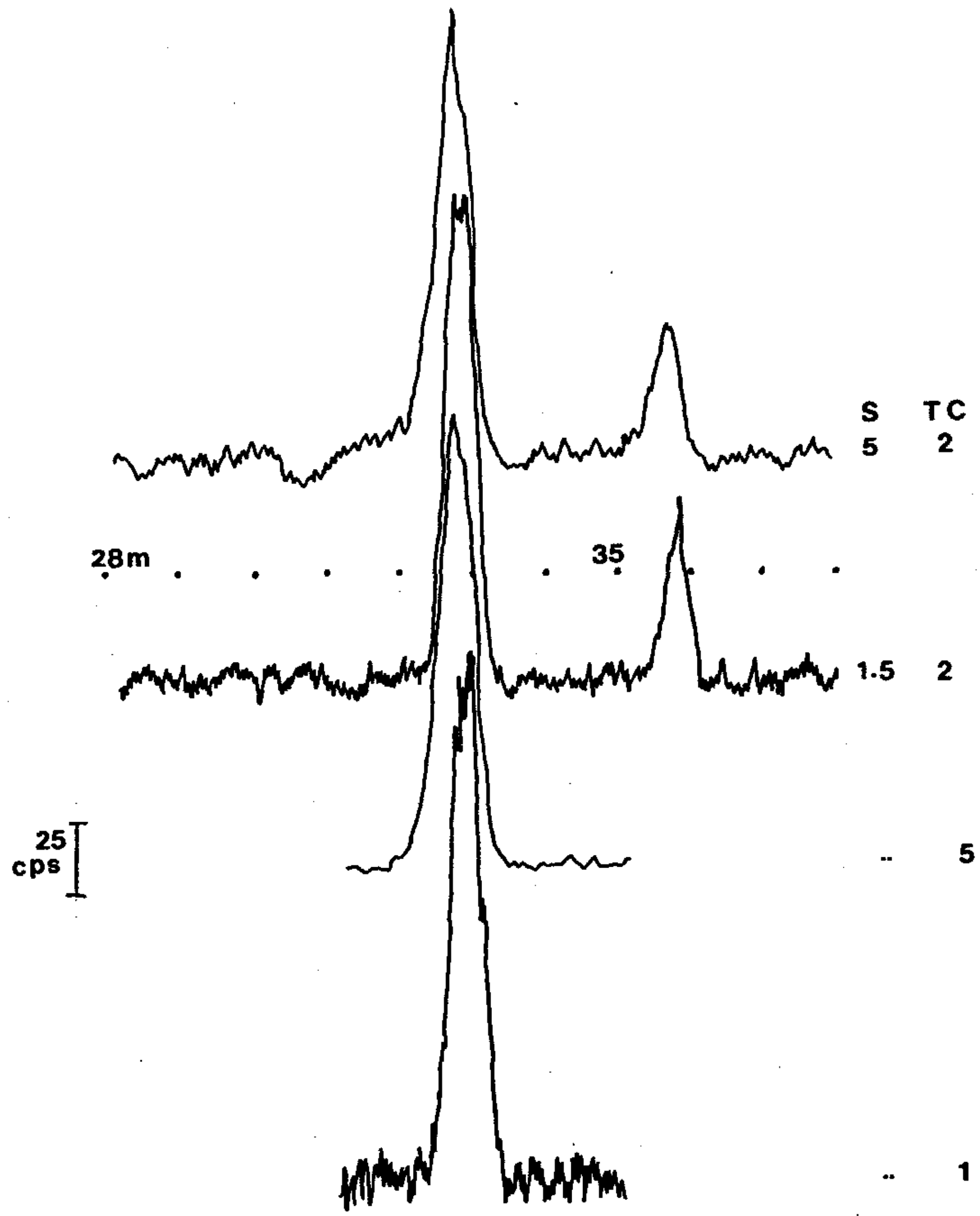

W36
W36A
SELF POTENTIAL SP
RESISTIVITY R
GAMMA G
DENSITY D
scale both holes
10 mV
10 Ω
5cps
50cps
10cps
surface
20m
40m
60m
R
SP
D
G
1
2
3
4
5
6
15m/min
6m/min
5m/min
VICTOR PETROLEUM
WOODBURY 36
770112
LEAMAN GEOPHYSICS

82/2
FIG 1

LEAMAN GEOPHYSICS

82/2

FIG 2



EFFECT OF SPEED AND TIME CONSTANT

W36A

FIG 3

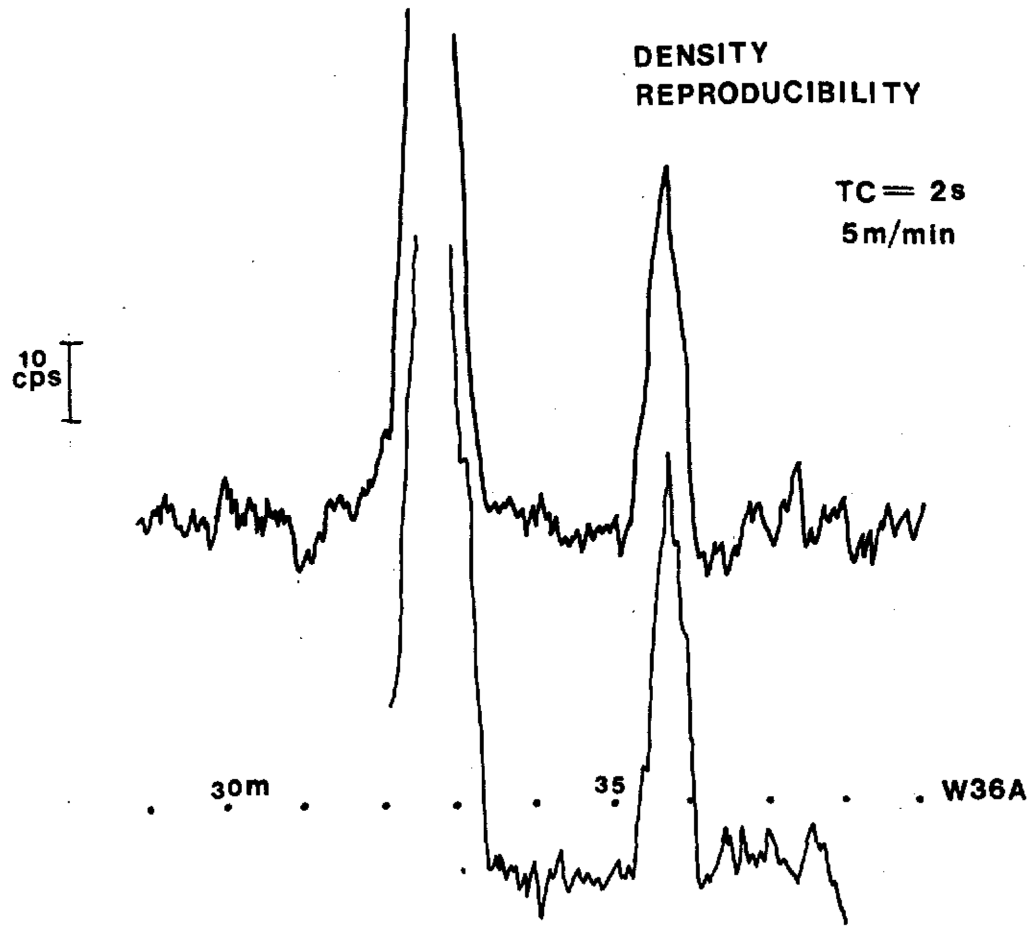


FIG 4