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OEL 20 AND OEL 21, PEL 5 AND PEL 6

REGIONAL GEOLOGICAL STUDIES

TECHNICAL REPORTS AND DATA

Submitted by

Delhi International Oil Corp., Delhi Petroleum Pty Ltd and Santos Ltd
1993

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ENVELOPE 8126

TENEMENT: OELs 20 and 21; PELs 5 and 6

TENEMENT HOLDER: Delhi International Oil Corp., Delhi Petroleum Pty Ltd and Santos Ltd (operators)

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SUMMARY REPORT
ON HYDROCARBON POTENTIAL OF
SOUTH AUSTRALIAN AND QUEENSLAND
LICENCE AREAS

October 14, 1976

Delhi International Oil Corp.

INTRODUCTION

This report is a confidential summary of the exploration potential within the licence areas P.E.L. 5 & 6 and A.T.P. 66/67P in South Australia and Queensland respectively. Within the licence areas there are six sedimentary basins (Fig. 1); only two of these basins have been assigned quantitative potential reserve numbers - these are the Cooper Basin (Table I and Fig. 2) and the Pedirka Basin (Table II). The other four basins are not highly rated for significant amounts of potential reserves and therefore no quantitative reserve numbers were assigned to these other basins. The reserves tabulated in this summary are recoverable and based on maximum processing.

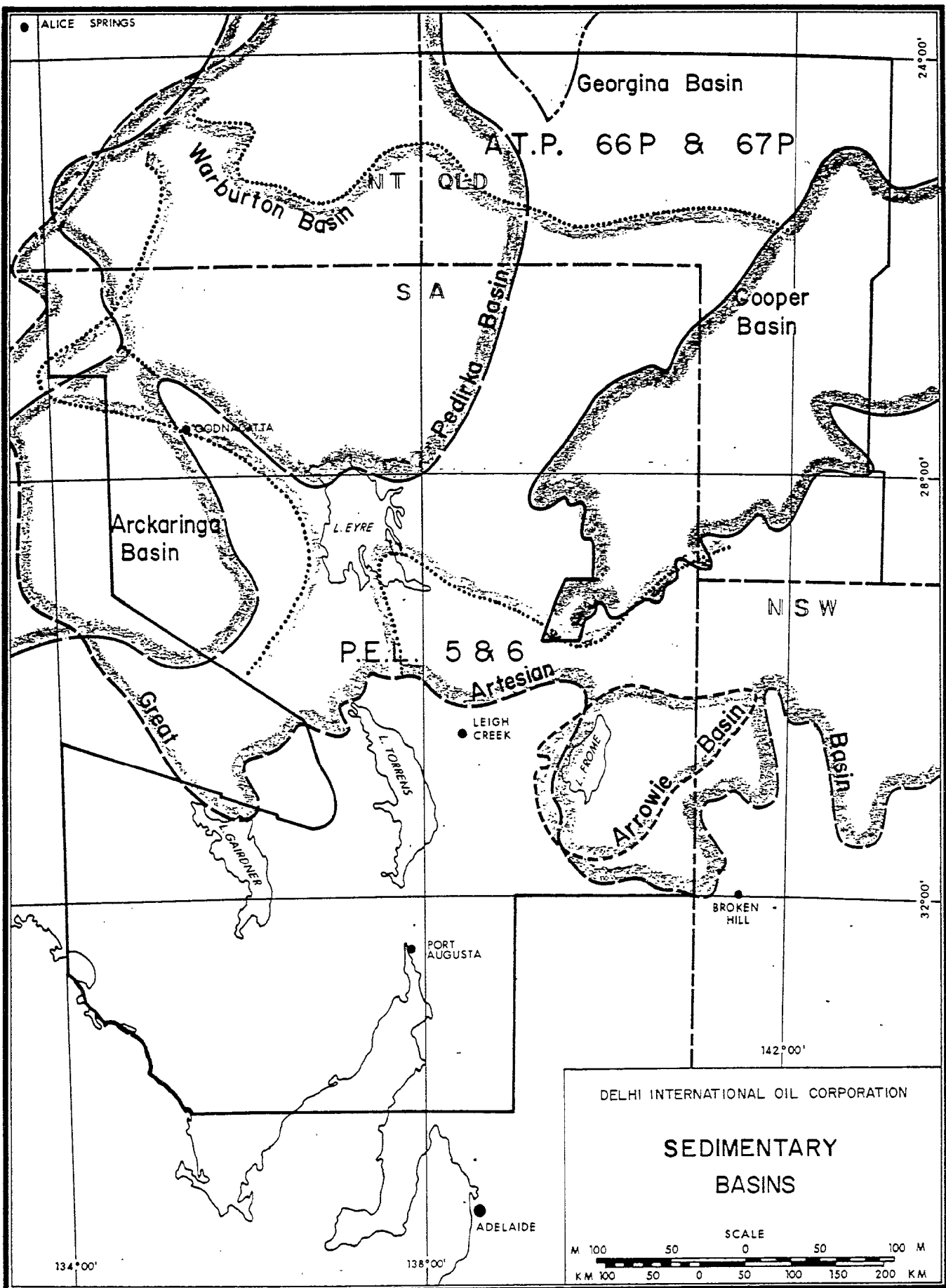


Fig. 1

TABLE I

ULTIMATE POTENTIAL OF COOPER BASIN -
SOUTH AUSTRALIA & QUEENSLAND

	Total Reserves BTU x 10 ¹²	Sales Gas Reserves BCF	Liquids Reserves (STB x 10 ⁶)					Total
			C 2	C 3	C 4	C 5-7	C 8+	
Proved & Probable Reserves Excl. Tirrawarra Secondary Recovery	4620.9	3531.0	131.3	59.3	29.2	35.6	39.0	294.4
Possible Reserves								
Total	3063.5	2218.0	92.9	40.4	20.8	28.9	39.1	222.1
Success Ratio - 70%	2144.5	1552.6	65.0	28.3	14.6	20.2	27.4	155.5
- 50%	1531.7	1109.0	46.5	20.2	10.4	14.5	19.6	111.2
Prospects								
Total	6189.7	4866.3	148.7	65.0	33.1	46.9	56.0	349.7
Success Ratio - 30%	1856.9	1459.9	44.6	19.5	9.9	14.1	16.8	104.9
- 20%	1237.9	973.3	29.7	13.0	6.6	9.4	11.2	69.9
Strong Leads								
Total	4561.7	3292.2	151.1	65.8	32.6	42.4	48.2	340.5
Success Ratio - 15%	684.3	493.8	22.7	9.9	4.9	6.4	7.2	51.1
- 10%	456.2	329.2	15.1	6.6	3.3	4.2	4.8	34.0
Ultimate Potential including Proved & Probable -								
Minimum	7846.7	5942.5	222.6	99.1	49.5	63.7	74.6	509.5
Maximum	9306.6	7073.3	263.6	117.0	58.6	76.3	90.4	605.9

1.) 100%
2.) 100% excluding PIP

13907
10376

TABLE II

ULTIMATE POTENTIAL OF PEDIRKA BASIN -
SOUTH AUSTRALIA - P.E.L. 5 & 6 ONLY

	Total Reserves BTU x 10 ¹²	Sales Gas Reserves BCF	Liquids Reserves (STB x 10 ⁶)					Total
			C 2	C 3	C 4	C 5-7	C 8+	
The total number represents the ultimate potential of the Basin and includes reserves assigned to defined prospects	* 4101.0	3133.7	116.5	52.6	25.9	31.6	34.6	261.3

Note: The component breakdown is based on the composition of the hydrocarbon reserves in the Proved and Probable category in the Cooper Basin and as such the assumed gas liquid fractions are considered a conservative estimate. Current information indicates that the Pedirka Basin may be rich in gas liquids or oil.

* Based on Sediment Volume Method

This section is a more detailed description of the existing and potential hydrocarbon reserves of the Cooper Basin. All the reserves are broken down into their various components and also equated to a gross BTU value. These reserves have been interpreted from the information obtained from the 139 wells drilled in the Cooper Basin and nearly 13,000 miles of seismic profiling and extensive magnetic and gravity surveys.

PROVED AND PROBABLE RESERVES

The Proved and Probable Reserves of the Cooper Basin presented in this report are located in 17 fields. These fields and the reserves within them have been evaluated by the Sydney Gas Market Technical Sub Committee and these are also the reserves that are reported to the Bureau of Mineral Resources in Canberra. The reserves amount to 3531 BCF of gas, 269 MMSTB of gas liquids and 42 MMSTB of oil including secondary recovery. Approximately 96% of the gas and gas liquids and all of the oil reserves are located in the South Australian portion of the Cooper Basin. These reserves are tabulated by field and components (Table III).

Definition of Proved and Probable Category

This category includes reserves whose presence can be reasonably confirmed by geological and engineering data and including those reserves which are reasonably certain to be productive. The reservoir limits are defined either by a gas water contact or based on net pay and the areal extent includes those portions not yet drilled that can be reasonably judged to be productive on the basis of structural and formation characteristics.

Notes

The reserves are based upon maximum processing, i.e. a volumetric shrinkage from the full well stream based upon a plant design to remove 75% of the Ethane, 95% of the Propane and 100% of the Butanes + components from

the gas leaving the CO₂ removal plant. They are tabulated under Gas which includes associated gas from the oil reservoirs, Gas Liquids and Oil. Among the fields listed are dry gas and wet gas and oil reservoirs. Both gas and liquid reserves have been calculated using a full well stream analysis for most reservoirs. However where a full well stream is not available an analysis of the gas stream has been used.

TABLE III
COOPER BASIN

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PROVED AND PROBABLE RESERVES DISCOVERED TO DATE

Field Reservoir	Total Reserves (BTU x 10 ¹²)	Original Sales Gas Reserves (BCF)	Original Liquids Reserves (STB x 1000)						Total
			C2	C3	i C4	n C4	C5-7	C8+	
BIG LAKE									
Toolachee) Daralingie Bed) Middle Sand Unit)	564.7	507.9	10903.0	2753.0	372.6	621.4	1220.0	1130.0	17000.0
Patchawarra	144.9	126.6	2375.0	1419.0	391.6	421.4	542.0	58.0	5207.0
BRIMBY									
Patchawarra	86.9	60.9	3712.0	1363.0	245.3	369.7	774.0	781.0	7245.0
BURKE									
Toolachee	71.5	59.1	2199.0	719.0	169.8	99.2	257.0	220.0	3664.0
Patchawarra	17.4	15.3	416.0	103.0	17.9	23.1	45.0	41.0	646.0
DARALINGIE									
Patchawarra	134.9	84.7	5644.0	3081.0	516.7	1000.3	1702.0	1544.0	13488.0
DELLA									
Toolachee	609.1	551.4	9334.0	3350.0	459.9	817.1	1459.0	1243.0	16663.0
DULLINGARI									
Toolachee	138.1	97.6	5275.0	2408.0	408.9	695.1	1094.0	1281.0	11162.0
Patchawarra	124.3	111.2	2878.0	607.0	91.5	109.5	203.0	182.0	4071.0
EPSILON									
Toolachee/Patchawarra	87.1	68.4	2764.0	1071.0	154.1	306.9	516.0	480.0	5292.0
Moomba	50.7	38.4	1640.0	693.0	126.5	216.5	310.0	408.0	3394.0
FLY LAKE/BROLGA									
Tool./Patch. Non Ass.	113.8	58.6	5286.0	2967.0	621.9	864.1	1993.0	2530.0	14262.0
Tirrawarra - Assoc.Gas	14.5	5.3	906.0	879.0	128.6	364.4	247.0	14.0	2539.0
- Crude	19.1		20.0	109.0	59.7	168.6	959.1	2461.5	3787.9
GIDGEALPA									
Toolachee/Patchawarra	270.0	231.6	6018.0	2063.0	271.0	552.0	751.0	1278.0	10933.0
MERRIMELIA									
Mapp./Tool.	42.2	31.6	1250.1	537.3	71.4	146.8	370.7	451.1	2827.4
Patchawarra	34.4	19.8	1329.5	1078.5	226.0	428.6	586.3	227.7	3876.6
MOOMBA									
North Dome	139.8	124.4	3319.0	779.8	121.1	159.7	273.0	136.3	4788.9
South Dome	876.6	777.0	20238.0	5097.0	769.7	1128.7	2017.8	1182.8	30434.0
MOORARI									
Tool./Patch. Non Ass.	14.9	8.6	725.0	373.0	58.2	123.8	204.0	202.0	1686.0
Tirrawarra - Assoc. Gas	33.2	12.1	2080.0	2016.0	361.9	770.1	567.0	32.0	5827.0
- Crude	19.1		21.6	117.8	64.5	182.1	1047.0	2659.5	4092.5
MUDRANGIE									
Patchawarra	26.6	14.9	1314.0	493.0	91.3	140.7	617.3	404.0	3060.3
ROSENEATH									
Patchawarra	10.0	7.5	323.0	182.0	33.6	57.4	97.0	16.0	769.0
STRZELECKI									
Toolachee	2.4	1.7	80.0	38.0	6.0	13.0	34.0	22.0	193.0
TIRRAWARRA									
Patchawarra Non Ass.	150.6	65.1	7290.0	4280.0	718.0	1543.0	3523.0	4237.0	21591.0
Tirrawarra - Assoc. Gas	157.6	58.0	9530.0	9701.0	1675.0	3601.0	2757.0	107.0	27371.0
- Crude									
(Primary)	84.9		85.9	526.5	313.5	914.6	5648.1	9508.4	16997.0
- Crude									
(Secondary)	85.6		89.7	486.5	267.4	757.2	4341.7	11026.5	16969.0
TOOLACHEE									
Patchawarra 1, 3, 7	368.0	236.6	15711.1	7399.8	1167.0	2335.6	4066.7	4752.5	35432.7
Patchawarra 4, 6	213.6	156.7	8602.2	3065.3	476.4	848.7	1668.0	1460.4	16121.0
TOTALS (Incl. Tirrawarra Secondary Recovery)									
	4706.5	3531.0	131359.1	59756.5	10457.0	19780.3	39900.7	50076.7	311330.3
TOTALS (Excl. Tirrawarra Secondary Recovery)									
	4620.9	3531.0	131269.4	59270.0	10189.6	19023.1	35559.0	39050.2	294361.3

POSSIBLE RESERVES - COOPER BASIN

Reserves of approximately 2200 BCF of gas, 185 MMSTB of gas liquids and 35 MMSTB of oil are mapped in the possible category in the Cooper Basin.

Approximately 80% of the gas and gas liquids and 45% of the oil is mapped within South Australia and the remainder within Queensland. The reserves are tabulated by field (Table IV).

Definition of Possible Category

This category includes areas where geological and engineering data indicate the possibility of reserves and geological control is reasonable. Normally the lowest closing contour on the structure horizon associated with the top of pay is taken as the limit of the field.

Notes

The possible gas, gas liquids and oil reserves listed in this report are taken from the S.G.M. Technical Sub Committee reports on the various fields except for Coonatie, Kanowana, Wolgolla, Durham Downs and Karmona which are based upon Delhi inhouse studies.

The reserves are based upon maximum processing, i.e. a volumetric shrinkage from the full well stream based upon a plant design to remove 75% of the Ethane, 95% of the Propane and 100% of the Butanes + components from

the gas leaving the CO₂ removal plant. They are tabulated under Gas which includes associated gas from the oil reservoirs, Gas Liquids and Oil. Among the fields listed are dry gas and wet gas and oil reservoirs. Both gas and liquid reserves have been calculated using a full well stream analysis for most reservoirs. However where a full well stream is not available an analysis of the gas stream has been used.

TABLE IV
COOPER BASIN

SUMMARY OF POSSIBLE RESERVES

FIELD	TOTAL RESERVES (BTU x 10 ¹²)	SALES GAS RESERVES (BCF)	LIQUIDS RESERVES (STB x 10 ⁶)					TOTAL
			C ₂	C ₃	C ₄	C ₅₋₇	C ₈₊	
<u>SOUTH AUSTRALIA</u>								
Big Lake	39.0	33.6	0.91	0.32	0.15	0.13	0.07	1.58
Brumby	67.1	47.9	2.75	1.01	0.46	0.57	0.57	5.36
Burke-Dullingari	805.1	697.0	19.87	5.53	2.19	2.22	2.27	32.08
Daralingie	115.4	74.4	4.61	2.51	1.24	1.39	1.26	11.01
Della	21.6	19.9	0.28	0.10	0.04	0.04	0.03	0.49
Fly Lake/Brolga - Non Ass. Gas	58.8	31.6	2.67	1.51	0.76	1.01	1.13	7.08
- Assoc. Gas	80.1	30.6	4.81	4.74	2.66	1.32	0.08	13.61
- Crude	77.9		0.08	0.44	0.93	3.95	10.05	15.45
Gidgealpa	76.6	58.3	2.39	1.34	0.70	0.60	0.13	5.16
Marrimelia	170.4	116.2	5.54	3.50	1.89	2.06	1.41	14.40
Moomba	424.2	363.2	12.84	3.15	1.09	1.10	0.65	18.83
Moorari - Non Ass. Gas	40.1	23.5	1.95	0.99	0.49	0.57	0.50	4.50
- Assoc. Gas	9.7	3.7	0.58	0.57	0.32	0.17	0.01	1.65
- Crude	5.9		0.01	0.03	0.07	0.30	0.76	1.17
Mudrangie	12.3	7.1	0.60	0.23	0.11	0.26	0.17	1.37
Packsaddle	138.0	117.6	3.46	1.22	0.57	0.49	0.26	6.00
Strzelecki	77.6	55.5	2.45	1.15	0.57	1.03	0.66	5.86
Tirrawarra		0.0	-	-	-	-	-	-
Toolachee	135.8	96.4	5.55	2.21	0.98	1.22	1.05	11.01
Coonatie*	33.2	21.4	1.32	0.82	0.43	0.37	0.27	3.21
Kanowana*	54.2	35.4	1.60	0.95	0.50	0.77	0.94	4.76
<u>SUB TOTALS</u>	2443.0	1833.3	74.27	32.32	16.15	19.57	22.27	164.58
<u>QUEENSLAND</u>								
Epsilon	21.5	18.9	0.50	0.17	0.06	0.04	0.03	0.80
Roseneath	3.0	2.3	0.08	0.05	0.03	0.03	0.01	0.20
Wolgolla*	46.8	35.0	1.33	0.72	0.36	0.40	0.36	3.17
Durham Downs	446.3	328.5	16.58	6.60	2.93	3.65	3.14	32.90
Karmona - Crude	102.9		0.10	0.58	1.23	5.22	13.27	20.40
<u>SUB TOTALS</u>	620.5	384.7	18.59	8.12	4.61	9.34	16.81	57.47
COOPER BASIN TOTALS	3063.5	2218.0	92.86	40.44	20.76	28.91	39.08	222.05

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* Reserves listed in these fields include a total of approximately 18 BCF of gas 2.5 x 10⁶ STB of gas liquids (approximately 27 x 10¹² BTU) which are carried in house in the Proved and Probable category.

PROSPECTS AND LEADS - COOPER BASIN

A total of 174 features have been delineated in the Cooper Basin. These have been categorized into 23 prospects, 67 strong leads and 84 weak leads. It is estimated that the 23 prospects mapped have the potential to contain reserves of the order of 4.8 TCF of gas, 300 MMSTB of gas liquids and 50 MMSTB of oil. Approximately two-thirds of the gas, a half of the gas liquids and all the oil is mapped within South Australia and the remainder within Queensland. The additional potential of the 67 strong leads recognized is estimated as of the order of 3.2 TCF of gas, 305 MMSTB of gas liquids and 35 MMSTB of oil. Approximately 45% of the gas and gas liquids and all the oil is mapped within South Australia and the remainder within Queensland.

Recognition of the features has been entirely from seismic and as a consequence they consist of structural anticlines, faulted anticlines and noses. No attempt has been made to pick entirely stratigraphic traps, although it is clearly recognized that a strong stratigraphic component will be critical in some of the abovementioned traps.

Reserve estimates have been made only for the prospects and strong leads (Table V). The bulk reservoir volume was determined by multiplying the area of closure by an average net effective pay (NEP) figure. A maximum NEP was estimated from the pay figures in the most comparable field with allowances for any variations that could be identified from the geological appraisal. For prospects and leads with a large area of closure which were classed as "broad" features, the average NEP was considered to be

equivalent to the maximum NEP. For "broad featured" prospects and leads with a smaller area of closure the average NEP was considered to be one half of the maximum NEP. For those prospects and leads which were considered to be sharp features, the average NEP was taken as one third of the maximum NEP. Hydrocarbon reserves were then determined by multiplying the bulk reservoir volume by the estimated recovery per acre ft. Once again as with the maximum net effective pay estimate the recovery per acre ft. used for a particular feature has been based on the figures of the nearest comparable field with allowances for any identified variations. All gas reserves (and associated gas liquids) are based on maximum processing and oil reserves represent recoverable figures. (The above techniques of determining the potential reserves in the prospects and leads was taken from the "Petroleum Production Handbook", Volume II by T.C. Frick, Chapter 37, Page 8).

A summary table of reserves for Prospects and for Strong Leads for both South Australia and Queensland is included.

Definitions

Prospect : A feature which presently satisfies all geophysical, geological and economic criteria necessary to justify drilling.

Strong Lead : A feature which needs limited detailed seismic definition and/or geological

evaluation to adequately define it or
further assessment of economic factors.

Weak Lead : A feature which needs considerable additional
seismic definition and geological evaluation
to define it.

TABLE V

SUMMARY OF POTENTIAL RESERVES
FOR PROSPECTS AND STRONG LEADS IN THE COOPER BASIN

	TOTAL RESERVES (BTU x 10 ¹²)	SALES GAS RESERVES (BCF)	LIQUIDS RESERVES (STB x 10 ⁶)					
			C ₂	C ₃	C ₄	C ₅₋₇	C ₈₊	TOTAL
<u>PROSPECTS</u>								
South Australia - Gas & Gas Liquids	3619.0	3127.0	66.6	29.8	14.0	14.2	12.4	137.0
- Oil	249.7		0.3	1.5	3.6	16.7	27.9	50.0
Queensland	2320.5	1739.3	81.8	33.7	15.5	16.0	15.7	162.7
TOTAL PROSPECTS	6189.7	4866.3	148.7	65.0	33.1	46.9	56.0	349.7
<u>STRONG LEADS</u>								
South Australia - Gas & Gas Liquids	2095.0	1591.0	68.3	30.5	14.4	14.6	12.6	140.4
- Oil	175.0		0.1	1.1	2.5	11.6	19.7	35.0
Queensland	2291.7	1702.2	83.1	34.2	15.7	16.2	15.9	165.1
TOTAL STRONG LEADS	4561.7	3293.2	151.5	65.8	32.6	42.4	48.2	340.5

NOTE: COMPONENT BREAKDOWN OF LIQUIDS IS BASED ON THE AVERAGE COMPOSITION OF FIELDS DISCOVERED TO DATE.

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September 16, 1976.

STATISTICAL APPRAISAL OF POTENTIAL RESERVES1. Arps, Mortada and Smith

A relationship between exploratory effort and exploratory results is described by Arps, Mortada and Smith (JPT, June 1971).

They have stated that, for a geological basin or area, the above relationship is best described using cumulative proved reserves discovered and cumulative total exploratory footage (as the independent variable). These variables are plotted for the Cooper Basin on the attached figure. The writers indicate that the curve will asymptote towards the ultimate resource potential of the area and that an economic limit will be reached as drilling no longer produces economically justifiable increments in reserves.

As the Cooper Basin curve (Fig. 3) does not show any noticeable flattening, the area is considered to be in a relatively early stage of exploration. Furthermore, the estimate of 9306.6×10^{12} BTU as the ultimate reserve potential of the Cooper Basin, appears reasonable in that 49% of this figure has been discovered without any significant deviation from a straight line relationship.

2. Sediment Volume Method

The May 1976 API report on reserves (Vol. 30) and the January 26, 1976 Oil and Gas Journal present

the following statistics for the U.S. :

(a) Oil and Condensate

Cumulative production to 1/1/76	115.7 Billion barrels
Remaining Reserves as of 1/1/76	38.9 Billion barrels
Oil to be found	45.4 Billion barrels

(b) Gas

Cumulative production to 1/1/76	495.2 TCF
Remaining Reserves as of 1/1/76	228.2 TCF
Gas to be found	276.6 TCF

Using a calorific value for oil of 6×10^6 BTU per barrel and for gas of 1050 BTU per cubic foot the total ultimate resource potential of the U.S. is estimated at 2,250,000 TBTU. L.G. Weeks estimates there are 2,000,000 cubic miles of effective sediments in the U.S. (AAPG, Vol. 34, P. 1947).

Thus a factor of 1,125,000 MMBTU per cubic mile is calculated. Utilising only proved reserves and cumulative production at 1/1/76 results in a factor of 843,500 MMBTU per cubic mile.

In specific areas of the U.S., reserves and cumulative production at 1/1/76 gives the following factors :

Kansas	887,000 MMBTU per cubic mile
North Texas	674,000 MMBTU per cubic mile

A Cooper Basin factor, for the Licence area only, is calculated as follows -

(i)	Southern Cooper Basin Area	17,430 square miles
(ii)	Northern Cooper Basin Area	<u>22,570 square miles</u>
	Total Cooper Basin Area	<u>40,000 square miles</u>

Average thickness of prospective sediments in :

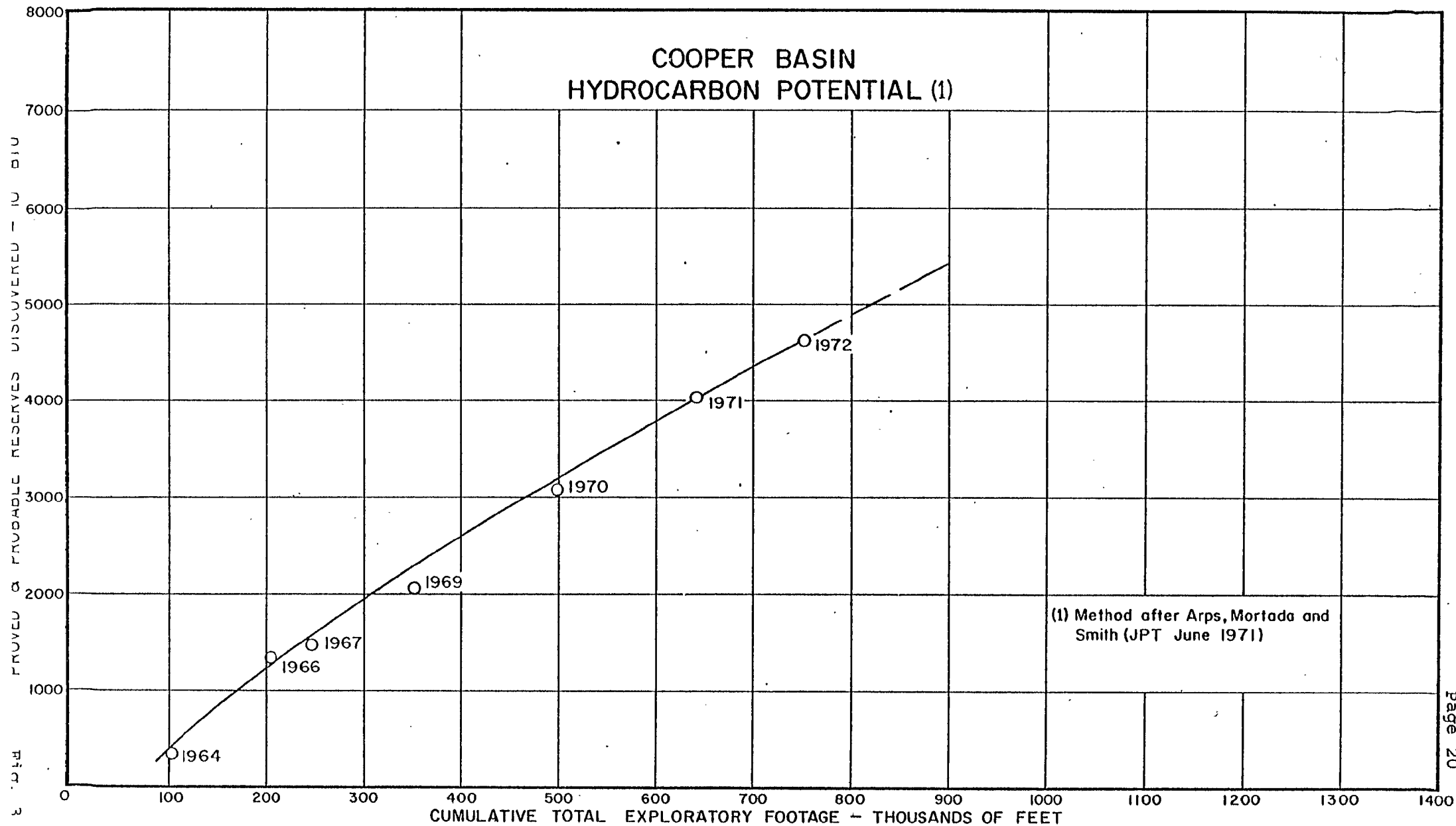
(i)	Southern Cooper Basin	3,000 feet
(ii)	Northern Cooper Basin	700 feet

Total Volume of Cooper Basin prospective sediments -
12,896 cubic miles.

Total reserve potential of Cooper Basin -
 9306.6×10^{12} BTU.

Therefore factor is 721,666 MMBTU per cubic mile.

Thus ultimate reserves potential of the Cooper Basin of 9306.6×10^{12} BTU is considered conservative when compared with the U.S. average presented.



PROSPECTS AND LEADS - PEDIRKA BASIN

Prospects have been delineated on two large structural trends and leads of varying potential have been identified in the South Australian portion of the Pedirka Basin.

Reserve estimates of gas or oil have been made for the two structural trends and the associated prospects only and are tabulated below :

	<u>Gas</u>	or	<u>Oil</u>
Prospect I			
	500 BCF		160 MMSTB
Prospect II			
A	400 BCF		125 MMSTB
B	200 BCF		60 MMSTB
C	200 BCF		60 MMSTB
TOTAL	1300 BCF		405 MMSTB

In the interpretation of potential reserves on the two prospects an average of 50 feet of pay has been assumed within the area of mapped closure, and recovery factors of 550 MCF/acre ft. for gas and 175 bbls/acre ft. for oil have been used.

In any evaluation of Prospects and Leads in the Pedirka Basin the relatively limited amount of exploration that has been carried out should be kept in mind. Only seven wells have been drilled in the 72,000 square miles of the basin. Of these, five are within the licence area. Good

quality seismic in this area dates from 1974. Vast areas of the southern and eastern parts of the basin lack any good quality seismic control. The Pillan Hill seismic survey which is currently in progress is examining some of the documented prospects and leads and extending the area of good quality seismic control. Preliminary evaluation of this survey suggests that the potential size of Prospect II may be greater than indicated in this report.

Appraisal of Potential Reserves - Pedirka Basin

Sediment Volume Method

The resource potential of the Cooper Basin was expressed as 721,666 MMBTU/cubic mile of effective sediments.

In the Pedirka Basin a total of 5,682 cubic miles of prospective sediments is calculated as follows :

Area of licence area in Pedirka Basin	=	30,000 square miles
Average thickness of sediments	=	1,000 feet
∴ Volume of prospective sediments	=	5,682 cubic miles

By applying the same factor as the Cooper Basin the resource potential of the Pedirka Basin is estimated as 4101×10^{12} BTU. This means that within the licence area a potential for reserves exists that is nearly equal to present proved and probable reserves of the Cooper Basin.