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DEPARTMENT OF
MINERALS AND ENERGY

BUREAU OF MINERAL RESOURCES,
GEOLOGY AND GEOPHYSICS

AN APPRAISAL OF PETROLEUM EXPLORATION TITLE AREA

WA-1-P

OFFSHORE NORTHERN CARNARVON BASIN,

AUGUST 1974

055279

by

W.J. McAvoy & P.R. Temple



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SUMMARY

This Record is the result of a brief examination of all available data including confidential company reports. No original interpretation has been made.

Summaries are given of the regional geology, hydrocarbon potential, geophysical activity, and drilling results. An assessment has been made of the prospectivity of WA-1-P and recommendations are made for further exploration.

The title area has been covered by a reconnaissance seismic grid, with detailed coverage over the Angel gas field and other structural leads. Sixteen wells have been drilled within WA-1-P, a gas field has been discovered at the Angel location, and oil has been recovered on the Legendre-Rosemary trend at Legendre-1 well.

A number of leads have been located, mainly in deeper water along the seaward extremities of the title area. With advances in technology these leads will become increasingly important.

INTRODUCTION

This Record is the result of a brief examination of data; four weeks were allotted to the work.

All available data received in the Petroleum Exploration Branch under the Petroleum Search Subsidy Act and the Petroleum (Submerged Lands) Act were studied, together with confidential company reports and files. No time was allowed for interpretative work: the interpretations presented are those of the contractors and title holders.

This Record is classified as 'In Confidence' because it contains information derived from confidential company reports and files.

REGIONAL SETTING

Petroleum Exploration Title Area WA-1-P is located in the northern Carnarvon Basin on the Northwest Shelf of Australia, (Fig. 1) offshore from Dampier and Port Hedland on the coast of Western Australia.

It lies entirely offshore and is bounded by Petroleum Exploration Title area WA-28-P, to the north and west by WA-29-P to the east, and by WA-23-P to the south.

Water depths within the title area range from less than 60 m along the southern boundary to nearly 600 m along the northern boundary. The northern 25 percent of the title area lies in water deeper than 200 m.

The title area extends over parts of three major subdivisions of the Carnarvon Basin - the Dampier Sub-basin, the Beagle Sub-basin, and the Pilbara Shelf.

GEOPHYSICS

Aeromagnetic and gravity work has been carried out over the offshore Carnarvon Basin, and there is extensive marine seismic coverage. Aeromagnetic surveys carried out for WAPET in 1967 and 1969 provided regional information on structural configuration, basement depths, and fault patterns. Shallow basement was indicated along the southeastern margin of WA-1-P over the Pilbara Shelf, and up to 7600 m of sediments in the basin proper.

Earliest offshore gravity coverage was completed in the 1968 BMR Marine Geophysical Survey of the Northwest Continental Shelf. The most prominent feature on the Bouguer contour map was a 70-milligal northeast-trending positive anomaly which was interpreted as an uplifted platform of

older rocks. Subsequent exploration has confirmed this anomaly to be an expression of the Rankin Platform which forms the western margin of the Dampier Sub-basin.

Since 1964, an extensive program of marine seismic work, carried out for BOC of Australia Ltd has provided reconnaissance and detailed coverage of the Northwest Shelf. Individual surveys are listed in Appendix 1 and the coverage is indicated in Plates 2 and 3. The initial survey in 1964 confirmed aeromagnetic indications of sedimentary thickness and provided a number of structural leads. The 1965 Montebello-Mermaid Shoal survey was a semi-reconnaissance survey designed to locate anomalies suitable for drilling. In the wide-ranging Rankin-Troubadour survey in 1966 further detailing of structural leads took place, and additional control was provided by refraction depth probes and expanded-spread velocity profiles.

In 1968, a non-dynamite energy source was introduced in the Offshore Canning-Seringapatam survey which used the Aquapulse source and high-multiplicity (1200%) digital recording techniques. Recovery of hydrocarbons in Legendre-1 in 1968 stimulated further detailing of Dampier Sub-basin leads in 1969 and 1970. An improvement in penetration resulted from the introduction of the Maxipulse energy source in 1971 when detailing was extended to the Beagle Trough. Detailing of anomalies in the Dampier Sub-basin and Beagle Trough was continued in 1972 in the Montebello-Turtle project and also in the Malus-Hedland survey in which the Malus and Sable well-sites were matured. In 1973, the De Grey Nose survey was programmed to investigate stratigraphic entrapment possibilities along the southeastern margins of the Dampier and Beagle Sub-basins; stratigraphic control was obtained with the drilling of Haüy-1, De Grey-1, and Cossigny-1.

Geophysical exploration has shown that WA-1-P can be subdivided into three major regions - Dampier Sub-basin, Pilbara Shelf, and Beagle Sub-basin (Plate 1). The Dampier Sub-basin is a major sedimentary downwarp containing more than 6000 m of post-Triassic sediments. The sub-basin can be divided into seven main structural elements: Rankin Platform, Kendrew Trough, Madeleine-Dampier Trend, Lewis Trough, Legendre-Rosemary Trend, Enderby Trend, and De Grey Nose. The Pilbara Shelf forms the southeastern margin of the Dampier and Beagle sub-basins, being an area of shallow basement lying immediately offshore from the Pilbara Block. The Beagle Sub-basin is an irregular depression separated from the Dampier Sub-basin by the De Grey Nose, a seaward extension of the Pilbara Shelf. B.O.C. regional seismic mapping divides the Beagle Sub-basin into the following tectonic elements - an outer platform related to the Rankin Platform, the Picard Trend, the Beagle Trough,

the North Turtle Arch, and the inner Beagle Sub-basin.

Record quality of the more recent surveys has shown considerable improvement although there remains some deterioration of the shallow horizons over the high blocks of the Rankin Platform. The quality of deeper events is adversely affected by faulting and by lack of penetration. Basement is recognized only along the margins of the Pilbara Shelf and drops steeply off to the north and northwest in the direction of regional dip. Structural closures are associated with fault blocks which are high relative to bordering basinal depressions.

REGIONAL GEOLOGY, DRILLING RESULTS, AND HYDROCARBON POTENTIAL

The Carnarvon Basin is a complex Phanerozoic basin lying to the west and southwest of the Precambrian Pilbara Block. Offshore, it is separated from the Bedout Sub-basin of the Canning Basin by the North Turtle Arch. The basin extends offshore at least as far as the margin of the continental shelf; the onshore eastern margin is either a sedimentary onlap onto, or a faulted contact with, rocks of the Precambrian shield.

DAMPIER SUB-BASIN

Geophysical data and the drilling of numerous wells have established the existence of a complex Phanerozoic basin extending along the continental shelf offshore from the Pilbara Block of Western Australia. This offshore basin, referred to as the Dampier Sub-basin, is regarded as a northward extension of the Carnarvon Basin. To date the existence of Permian, Triassic, Jurassic, Cretaceous, and Tertiary rock sequences have been established in the Dampier Sub-basin. These units have gross lithologic similarities to sequences of the same ages in the main parts of the Carnarvon Basin. WA-1-P covers the southeastern part of the Sub-basin.

Rankin Platform

The Rankin Platform is a relatively high structural platform of Lower Jurassic-Triassic rocks. Interpretation of a recent seismic shooting and the results of drilling on the Rankin Platform have confirmed the presence of Lower Jurassic-Triassic sediments and indicate that these sediments are unconformably draped by Cretaceous and Tertiary sediments. The Rankin Platform has been formed by movements on a series of large southwest-trending en echelon faults which downthrow to the southeast. A series of smaller north-south faults, which appear to post-date the main faults and which downthrow to the west, have given rise to the horst blocks which constitute the main hydrocarbon prospects.

Although the trend of the Platform cannot be definitely traced northeast of Eaglehawk-1 and Egret-1 wells, an elevated horst block is mapped farther northeast in the vicinity of Sable-1 where Upper Cretaceous sediments are unconformable upon the Lower Jurassic sequences. Much of this northeast extension is in water deeper than 200 m.

Kendrew Trough

The Kendrew Trough is adjacent to the Rankin Platform and is separated from it by major faults which trend northeast along the southeastern margin of the Platform. It is a very narrow and low trend extending southwest into Title area WA-25-P (McAvoy & Temple, BMR Record 1976/80). The southeastern flank is much less steep and merges with the Madeleine-Dampier Trend.

No wells have been drilled in the Kendrew Trough within WA-1-P.

Madeleine - Dampier Trend

The Madeleine-Dampier Trend forms the southeastern limit of the Kendrew Trough. The trend represents faulting in pre-Upper Jurassic rocks over which faulted anticlinal closures have been formed in younger sediments. The trend rises to the northeast towards the De Grey Nose and is expressed in complex faulting and folding at the Angel gas field. Angel-1, 2 and 3 wells have been drilled within WA-1-P on this trend.

Lewis Trough

This elongate, almost symmetrical northeast-trending trough is the deepest depression in the Dampier Sub-basin probably containing of the order of 6000 m of post-Triassic sediments. From seismic reflection data the trough appears as a relatively simple downwarp. No wells have been drilled within it.

Legendre-Rosemary Trend

The Legendre-Rosemary Trend is located at the southeastern margin of the Lewis Trough. The structural framework of the trend is extremely complicated owing to severe cross-faulting. It is considered that two independently initiated Jurassic fault zones gave rise to the trend, the first down-to-the-southeast and the second down-to-the-northwest. The Legendre-Rosemary trend rises to the northeast towards the De Grey Nose. Four wells, Legendre-1 and 2, Rosemary-1, and Nelson Rocks-1 have been drilled on this trend within WA-1-P.

Enderby Trend

The Enderby Trend is a complex fault trend running along the margins of the Pilbara Block. It is characterized by a set of normal faults forming several horsts, grabens, and half grabens. Most faulting is syndepositional.

One well, Enderby-1, has been drilled on the Enderby Trend within WA-1-P.

De Grey Nose

The De Grey Nose is a prominent feature trending northwest. It is the northeastern limit of the Dampier Sub-basin, and separates it from the Beagle Sub-basin. Shallow basement is indicated by the presence, in Hany-1, of metamorphosed basic igneous rocks. The Mesozoic and Tertiary sequences are thin over the De Grey Nose but thicken seaward off the nose. The seaward extent of the Nose is not well defined, although the limit does seem to be indicated south of a fault zone near Cossigny-1 well.

Hydrocarbon potential

The hydrocarbon potential of the Dampier Sub-basin is well known; a number of wells have had good hydrocarbon shows and a number of gas-condensate fields have been proved. Drilling on three of the anticlinal trends, the Rankin Platform, Madeleine-Dampier Trend, and the Legendre-Rosemary Trend, have demonstrated that reservoirs, and potential reservoirs, are present.

The productive reservoir sections found on the Rankin Platform to date range in age from Middle-Upper Triassic to Upper Jurassic; all belong to one essentially continuous depositional sequence which was terminated by northwest regional tilting and major faulting (at some period) late in the Jurassic. The tilting and subsequent erosion have given rise to a situation in which progressively younger section is preserved towards the northwest in individual fields.

The proved fields and discoveries on the Rankin Platform are all within WA-28-P. Gas/condensate fields are located at Rankin, Goodwyn, and North Rankin, and oil discoveries have been made at Rankin-1, Dockrell-1, Goodwyn-3, Eaglehawk-1, Egret-1, and Lambert-1.

The Angel gas/condensate field has been proved on the Madeleine-Dampier Trend within WA-1-P. Angel-1 well proved 85 m of gross hydrocarbon pay section in an Upper Jurassic sand interval equivalent to the Barrow Group. Although gas shows have been detected at Madeleine-1 and Dampier-1, the flows from the Angel wells are the first from the Madeleine-Dampier Trend.

Four wells, Rosemary-1, Legendre-1 and 2, and Nelson Rocks-1 have been drilled on the Legendre-Rosemary Trend. Although good reservoir rocks were encountered in all these wells the only significant shows were from Legendre-1 which flowed oil on test from Neocomian sandstone.

To date the Dampier Sub-basin appears to have the best prospects on the Northwest Shelf. Primary objectives in the basin are sandstones within the Jurassic/Triassic sequence, and secondary objectives are sandstones within the basal Cretaceous and the Upper Cretaceous Toolonga Calcilutite (which had shows in North Rankin-1 well).

BEAGLE SUB-BASIN

The Beagle Sub-basin is the most northerly sub-basin of the offshore Carnarvon Basin. It is bounded to the southwest by the De Grey Nose, and to the northeast it is separated from the offshore Canning Basin by the North Turtle Arch.

Originally the northward extension of the Lewis Trough, the Beagle Trough, was regarded as part of the Dampier Sub-basin, but regional seismic mapping has indicated that the Beagle Trough area should be regarded as a sub-basin in its own right. Results of recent exploratory drilling on the Ronsard, Sable, Cossigny, and Picard structures within WA-1-P have served to confirm this. The sections penetrated in the Beagle Sub-basin are broadly similar to those in the Dampier Sub-basin.

Tectonically the sub-basin can be divided into a number of major elements; a poorly defined outer platform area, Picard Trend, Beagle Trough, North Turtle Arch, and inner Beagle Sub-basin.

The major feature of the outer part of the Dampier Sub-basin to the south is the Rankin Platform, a pronounced positive gravity area comprising a series of large, regionally high, Triassic/Lower Jurassic fault blocks overlain by thin Cretaceous sediments and a thick Tertiary section. The platform appears to extend in a northeasterly direction into the Beagle Sub-basin. Two wells (Sable-1 and Ronsard-1) were drilled on this structural trend and both encountered Lower Jurassic sediments below the regional basal Cretaceous unconformity (see Table 2).

The dominant tectonic element in the Beagle Sub-basin is the Beagle Trough, a Mesozoic depositional downwarp. The Beagle Trough trends northeastwards on an apparent continuation of the Dampier Sub-basin/Lewis Trough axis, to which it bears a marked resemblance. The two troughs are separated by the old, structurally positive De Grey Nose feature, but a general continuity of structural trend exists across the Nose.

The northeastern limit of the Beagle Trough downwarp is the structurally positive, block faulted, North Turtle Arch. The latter also effectively marks the eastern margin of the Beagle Sub-basin as a whole. To the south, marginal to the Precambrian Pilbara Block, the sub-basin is bounded by the Pilbara Shelf

which is characterized by a thin Mesozoic and Tertiary section containing multiple unconformities. Cossigny-1 well was drilled to test an extensive area of fault closure developed on the basinward side of a large down-to-basin fault situated towards the De Grey Nose area and has provided valuable data on the Tertiary and Mesozoic facies near the basin margin.

Immediately to the north of the Beagle Trough downwarp is the structurally positive Picard Trend on which Picard-1, the first exploratory well in the sub-basin, was drilled. This trend is believed to be a northeasterly continuation of the Madeleine-Dampier Trend of the Dampier Sub-basin.

Hydrocarbon potential

As previously stated, results of drilling within the Beagle Sub-basin indicate a considerable number of broad similarities with the sedimentation patterns in the Dampier Sub-basin. To date, wells drilled have not discovered significant hydrocarbons, although a number of potential reservoir sections have been demonstrated.

Primary objectives in the Beagle Sub-basin are sands within the Jurassic-Triassic section; secondary objectives are sands within the basal Cretaceous and the Upper Cretaceous Toolonga Calcilutite.

PILBARA SHELF

The Pilbara Shelf forms the southeastern margin of the Dampier and Beagle Sub-basins, and lies immediately offshore from the Pilbara Block. In the Dampier Sub-basin the shelf area is limited seawards by the Enderby Trend, a northeast-trending fault complex downthrown to the northwest. The southwestern and western limits of the shelf are delineated by the down-to-the-Barrow Sub-basin Sholl Island Fault System.

The stratigraphy of the Pilbara Shelf was investigated in Haug-1 which drilled Tertiary (?), Cretaceous, and Triassic sediments to 805 m, where metamorphosed basic igneous rock was encountered. Although no hydrocarbons were encountered, the stratigraphic section penetrated was favourable for the accumulation of hydrocarbons. Below 592 m an interbedded sequence of claystones siltstones, and sandstones with extremely good reservoir characteristics was penetrated.

Hydrocarbon potential

Numerous unconformities are present.

Stratigraphic trapping is a distinct possibility where units have thinned considerably and rapid changes in lithology may have occurred.

PROSPECTIVITY (Plate 1)

A number of significant hydrocarbon shows have been reported from wells drilled in the title area.

Angel-1, 2, and 3 produced gas/condensate from the 'Barrow Group' (uppermost Jurassic to Lower Cretaceous). Legendre-1 recovered oil on D.S.T. from the 'Barrow Group' and gas shows were encountered in Hampton-1 well.

DAMPIER SUB-BASIN

The Dampier Sub-basin within WA-1-P is generally indicated as having fair to good prospectivity; some areas within it have poor prospectivity. Lowest prospectivity would be given to the southern margins of the sub-basin where only thin sediments overlie shallow basement. Prospects generally improve with increasing sedimentary thickness to the north towards the Rankin Platform.

Good prospects exist for stratigraphic entrapment along the Pilbara Shelf margins, and wells drilled so far have proved stratigraphic sections which have excellent reservoir characteristics.

Structural development is restricted to the anticlinal trends and is of particular importance in the Angel Field and Legendre-1 well.

To date the largest and most promising prospects have been drilled.

Recommendation

A number of structural leads in the vicinity of the Angel Field have been revealed by seismic reconnaissance and these could mature into well locations after further seismic detailing.

BEAGLE SUB-BASIN

This sub-basin can be conveniently subdivided into a northern area where water depths are in excess of 200 m, and a southern area where they are less than 200 m.

Northern area (water depths greater than 200 m)

This area has been covered by only limited reconnaissance seismic work. No wells have been drilled. Several fairly large structural leads have been delineated which appear to be on trend with the Rankin Platform.

Recommendation

At this stage no further work is recommended, but when technology advances sufficiently to drill and produce in deep waters, one of these structures should be considered as a prospect after further seismic detailing.

Southern area (water depths less than 200 m)

The sub-basin has been covered by a medium-density seismic grid and a number of structural leads have been revealed. Although results in the Beagle Sub-basin have not been encouraging, further evaluation and investigation of these leads is justified. Stratigraphic trapping possibilities along the margins of the Pilbara Shelf should be further evaluated.

Recommendation

Seismic detailing of existing leads to mature drill sites, followed by test drilling.

Pilbara Shelf

This is an area of thin sedimentary section overlying shallow basement. As much of this area is covered by less than 600 m of sediments its prospectivity has been downgraded (brown shading, Plate 1). The drilling of Hauy-1 well has demonstrated that part of the area has sufficient potential to warrant further investigation.

Recommendation

Any further assessment of this area would be dependent upon successful drilling in the more prospective basinal areas.

Survey	Dates	Company	Contractor	Tenements	Seismic Source	Cable	Recorder	Coverage	Line Kilometres	Refraction	Quality	Remarks
SUBSIDIZED												
Marine Seismic												
NW Shelf N.S. 64/4529	12/7/84 - 17/10/84	B.O.C.	Western	PE 213H (N.A.) OP 90 & OP 92 (N.T.)	Explosive	1200 m	Western FA-32S	200%	290	Yes	P = F	Confirmed aeromag. results
Montebello - Herald Shoal 65/11015	6/8/85 - 23/11/85	B.O.C.	Western	PE 213H N.A. OP90, OP92, OP132 NT	Explosive	2400 m	Western FA-40A	300%	370	Yes	P = F	Recommendation for 6-fold CDP
Rankin - Troubadour 66/11104	3/7/86 - 2/9/86	B.O.C.	Western	PE 213H, OPe 105, 141, 92, 90, 108 N.T.	Explosive	2400 m	Western FA-40A	300%	475	Yes	F	Some digital processing
Scott - Cartier 67/11173	3/8/87 - 29/9/87	B.O.C.	Western	OP 160, 161 PE 213H	Explosive	2400 m	SDS 1010	300%	596	Yes	P = F	Deep data poor
Offshore Canning-Seringapatam 68/3027	20/6/88 - 27/9/88	B.O.C.	Western	OP 160, 161 PE 213H	Aquapulse	7520 ft	SDS 1010	1200%	- 71	Yes	P = F	Introduction of non-dynamite source, routine decon., & improved velocity analysis
Legende - Marie 69/3005	23/2/89 - 12/6/89	B.O.C.	Western	PE's 213H, 232H, 238H OP's 108, 158, 159 N.T.	Aquapulse	7520 ft	SDS 1010	3600% 4800%	1111		F = G	Reconnaissance and detailed coverage
Adole-Scott 69/3038	13/6/89 - 14/8/89	B.O.C.	Western	WA-29-P, WA-30-P WA-31-P, WA-1-P	Aquapulse	7520 ft	SDS 1010	1200%	718		F = G	Detailed structures
Tryal-Evans 70/245	7/3/70 - 18/7/70	B.O.C.	Western	WA-1, 28, 29, 30, 31, 32, 33, 35, 36, 37 NT/P6, 11, 12	Aquapulse	7520 ft	SDS 1010	3600% 4800% 7200%	1690		P = G	Reconnaissance of NW Shelf
Triscuille-Dillon 70/976	20/12/70 - 2/5/71	B.O.C.	Western	WA-1-P, 28, 29, 30, 31 32, 33, 34, 35, 36, 37P BT/P5, P8, P10, P15	Aquapulse	7773 ft	SDS 1010	2400%	1301		P = G	Detailed E. Rankin, Rankin, de Grey, Angel, Goodwyn
Rankin Trend 71/538	5/9/71 - 15/9/71	B.O.C.	Western	WA-1-P, WA-28-P, WA-29-P	Maxipulse	7590 ft	SDS 1010 DFR 300	2400%	293		F = G	Detailed structures in Dampier Sub-basin and Beagle Trough
Montebello - Turtle 72/509	10/2/72 - 15/3/72	B.O.C.	Western	WA-1-P, WA-28-P, WA-29-P	Maxipulse	3200 m	DDS 777	2400%	741		F = G	Detailed structures
Halus-Hedland 72/2701	30/6/72 - 15/7/72	B.O.C.	Western	WA-1-P, WA-28-P	Maxipulse	3200 m	DDS 777	2400%	459		F = G	Halus structure confirmed as drill target
Steamboat - Spit 72/3253	23/11/72 - 4/1/73	B.O.C.	Western	WA-1-P, WA-28-P WA-29-P, WA-30-P	Maxipulse	3200 m	DDS 777	2400%	650		F = G	Detailing of Kendrew Trough leads recommended
De Grey Nose 73/213	14/3/73 - 21/3/73	B.O.C.	G.S.I.	WA-1-P, WA-23-P	Air-gun	1200 m	DFS 111	2400%	607		F = G	Shallow section
Aeromagnetic:												
Rosley Shoals, Scott Reef, Sabul Bank 63/1709	23/8/63 - 28/10/63	Woodside M.L.	Aero Service Ltd									
UN-SUBSIDIZED												
Marine Seismic:												
Kendrew Trough 73/12	25/7/73 - 31/7/73	B.O.C.	Western	WA-1-P, WA-28-P	Magnapulse	3200 m	DDS 777	2400%	335			Improved penetration
Kendrew - Costanundra 74/31	Dec 73 - Sept 74	B.O.C.	G.S.I.	WA-1-P, WA-28P, WA-29P, WA-30P, WA-23P	Air-gun Magnapulse	3200 m	DFS 111	2400%	9196			Provided extensive coverage of BT/P6, BT/P12
B.M.R.												
Marine Geophysical Survey of N.W. Shelf	Sept - Dec '68	"	Ray		Sparker (21kV)	Single channel	Analogue		24150		F	Reconnaissance. Also gravity and magnetic
Other												
Robertson Research Gulfex												Review Report Scientific Survey

APPENDIX 2

TITLE DATA

Title holder: Woodside Oil N.L.
Shell Development (Aust.) Pty Ltd
B.O.C. of Australia Ltd

Number of blocks in title area: 364

Note: Nine blocks have been declared as a Petroleum Location for the Angel field (West Australian Gazette 4 January 1974, Declaration of Location No. 1SL).

Expiry date: 15.11.74

Notes: B.O.C. of Australia Ltd, Woodside Oil N.L., and Mid-Eastern Oil N.L. now operate as Woodside-Burmah Oil N.L. The title has still to be reissued in the name of the new company.

B.O.C. of Australia Ltd, a wholly-owned subsidiary of Woodside-Burmah Oil N.L., is 'Operator' on behalf of the Group.

Expenditure commitments

<u>Year</u>	<u>\$A</u>	<u>\$A/block/year</u>
1 (1968/69)	3,032,700	8331.59/block
2 (1969/70)	10,000	27.47/block
3 (1970/71)	100,000	274.72/block
4 (1971/72)	3,000,000	8241.75/block
5 (1972/73)		
6 (1973/74)		
	<hr/> 6,142,700	<hr/> 16,875.53
	(average \$2812.59/block/year)	

Table 1. Details of offshore wells drilled in
WA-1-P (depths in feet below K.B.)

IN CONFIDENCE

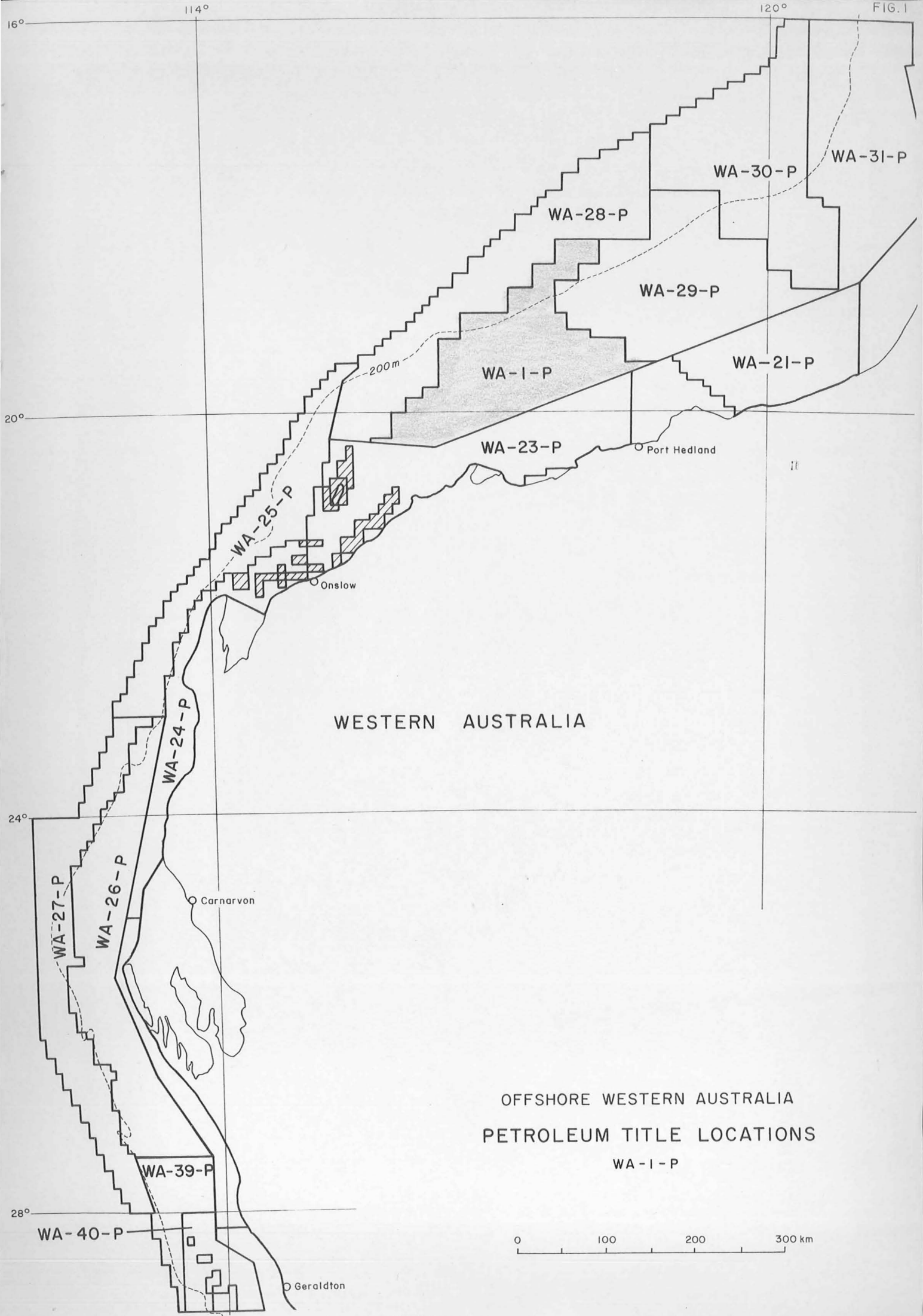
Table 1.

Wells	Total Cost Aust. \$ Mil.	File No.	Rig Released	T.D.	WD	RT	Rig	Deepest Horizon	Base Cretaceous (Subsea)	Type of trap	Sub-basin	Status	Remarks
Subsidized:													
Legendre - 1	4.67	68/2016	17.11.68	11393	170	30	Gloamr Tasman	M. Jurassic	approx. 6453	Anticline	Damper	oil well	(6211' - 6227') 'Barrow Beds' DST 3 Rec 1014 BOFD (44-70 API), 24/64" choke, GOR 1320
Legendre - 2	1.75	70/769	23.12.70	11871	158	30	Gloamr Tasman	L. Jurassic	6812	Anticline	Damper	dry	No shows
Enderby - 1	0.81	70/737	15.10.70	7051	177	31	Gloamr Tasman	Permian ?	2262	Anticline	Damper	dry	First well - Damper Sub-basin to encounter Triassic. No significant shows. Basement rhyolite @ 6828'
De Gray - 1	0.90	71/616	18.10.71	6850	310	99	Ocean Digger	Triassic ?	4131	Fault-controlled	Damper	dry	Lost circulation @ 6598'. Triassic @ 6828'(t)
Angel - 1	2.56	71/617	22.1.72	11190	293	31	Gloamr Tasman	L. Jurassic	approx. 8419	Anticline	Damper	gas well	'Barrow Group' gas/condensate. 280 ft gross pay. DST Gas @ 13.20 MMcf/D, with 52 bbls condensate/MMcf
Angel - 2	2.49	72/857	2.6.72	14425	284	31	Gloamr Tasman	L. Jurassic	8735	Anticline	Damper	gas well	Confirmed Angel -1
Rosemary - 1	3.79	72/3172	25.4.73	12825	213	31	Gloamr Tasman	L. Jurassic	6995	Anticline	Damper	dry	Minor MC in Jurassic. No signif. shows in 5 F.I.T.'s
Hawy - 1	0.57	72/3186	14.12.72	2708	215	99	Ocean Digger	(basic igneous) Indeterminate?	1916	Stratigraphic	Damper	dry	Economic basement @ 2642' No shows. Neocomian/M. Trias. Good potential reservoir beds.
Ronsard - 1	not available	72/3330	12.11.73	9344	525	31	Gloamr Tasman	Lower Jurassic	6969	Anticline	Beagle	dry	No significant shows. Neocomian u/c on L. Jurassic
Picard - 1	1.96	72/2710	3.10.72	13832	462	31	Gloamr Tasman	L. Jurassic	7136	Anticline	Beagle	dry	Minor MC shows. Neocomian u/c on M. Jurassic
Cossigny - 1	0.81	72/3063	8.11.72	10510	370	41	Big John	M. Triassic	5483	Anticline	Beagle	dry	No significant shows. First time M. Triassic Beagle S-Basin
Sable - 1	1.54	72/2770	14.10.72	13030	495	41	Big John	U. Triassic	7712	Anticline	Beagle	dry	No shows. Cenomanian u/c on L. Jurassic
Unsubsidized:													
Angel - 3	2.02	?	28.6.73	12401	226	31	Gloamr Tasman	Jurassic	7453	Anticline	Damper	gas well	Appraisal of Angel 1 + 2. Proved 42 ft gas/condensate pay in interval, 8984'-9034'
Hampton -1	1.11	74/112	24.4.74	8478	174	99	Ocean Digger	Not known	2129	Horst block	Damper	well with show of gas	
Nelson Rocks -1	1.15	73/1005	1.8.73	7185	246	31	Gloamr Tasman	U. Jurassic	6503	Anticline	Damper	dry	No shows
Polessemler -1	1.25	73/1010	25.1.74	6437	272	99	Ocean Digger	Triassic or older	2871	Fault-controlled	Beagle	dry	Crystalline basement @ 1947 ft

Well RT(ft)		Legendre-1 30	Enderby-1 31	Legendre-2 30	De Grey-1 99	Angel-1 31	Angel-2 31	Angel-3 31	Navy-1 99	Rosemary-1 31	Nelson Rocks-1 31	Polsonale-1 99	Hampton-1 99	Picard-1 31	Sable-1 41	Cossigny-1 41	Rensard-1 31
Sea bed		200	208	188	408	324	315	257	314	244	277	371	273	483	538	411	558
Quaternary/Plio.				895													1624
Tertiary					1450						1328			1420	1530		
Cret.	Upper	Maa.	3315	3650	3625	6228		5803		1545	3685	2213		8205	7595	4385	6427
		Comp.		857	3830	6980		6257		3357	3927			8510	7874	5173	6693
		Sant.			3976	7158		6700		Abs	4249	2543		6627			7202
		Con.			Abs			7002		Abs	4790	2772		6660			7267
		Tur.		1355	Abs			7260		Abs	5128	2704		6688	8195	Abs	Abs
		Canoe.			Abs			7390		3602	5282	Abs	1345	6727		Abs	Abs
	Lower	Alb.		6051	4154				1815	4213	5742	Abs	1478		Abs	Abs	7300
		Apt.		1820	Abs	7842		7710	1822	4874	6014	2963	1618	6815	Abs	Abs	7402
		Neoc.			4256				2030	5996	6142	3074		7170	Abs	Abs	
	Upper	Tith.	6780	2470	6800	Abs	8712	9050	8980	Abs	7239	3242			Abs	Abs	Abs
		Klms.				Abs	11100	Abs	11038	Abs	7885				Abs	Abs	Abs
		Oxf.				Abs		Abs	11342	Abs	8567	3324			Abs	Abs	
		Call.				Abs		10300	11431	Abs	8853	Abs	2402		Abs	Abs	
	Middle	Bath.			Abs			10750		Abs	10309	Abs	2749	7628	Abs	5894	
		Baj.		3395	4540					Abs		Abs			Abs		
	Lower	Tear.			Abs			13550		Abs	11050	3386	3206	9840	8248	8838	7527
		Plien.			Abs			14080		Abs		Abs			10044		
		Sine			Abs					Abs		Abs					
		Hett.			Abs					Abs		Abs			11700		
Triassic	Upper		5150		6828(?)				Abs			3088	5181		12148	7527	
	Mid.		5700						2230				6883			8990	
Pre-Triassic	Lower																
													78127				
Permian																	
Pre-Permian																	
TD (ft)		11393	7051	11871	8850	11190	14425	12401	2708	12825	7185	6437	8478	13832	13038	10510	9344

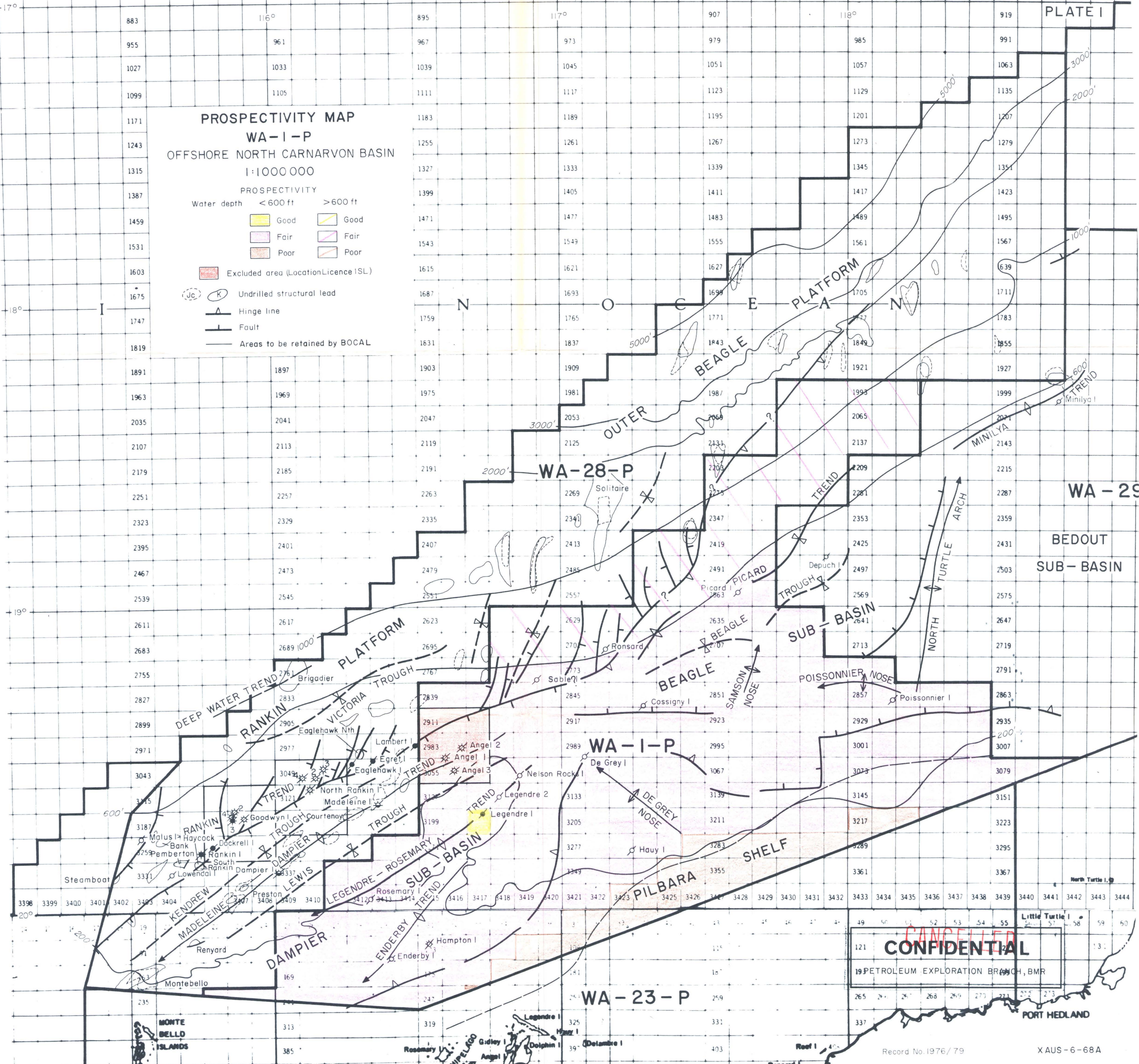
JURASSIC

Age
Unknown
2642



DAMPIER SUB-BASIN—TABLE OF FORMATIONS (after BOCAL)

SYSTEM	SERIES	STAGE	AGE M/Y	SEISMIC HORIZON	STRATIGRAPHIC NOMENCLATURE	REMARKS
QUATERNARY						
TERTIARY	PLIOCENE		1.5-2		UNNAMED	
	MIOCENE	UPPER	7			
		MIDDLE	12			
		LOWER	18-19	'T ₂ ' 'E'	TREALLA	Unconformity
			26		CAPE RANGE	Unconformity
	OLIGOCENE	UPPER				
		MIDDLE	31-32			
		LOWER	37-38		GIRALIA	
	EOCENE	UPPER	45			
		MIDDLE	49	'T ₄ '		Unconformity
		LOWER	53-54			
	PALAEOCENE	UPPER	58-5		CARDABIA	
		MIDDLE				
CRETACEOUS	UPPER	LOWER (DANIAN)	65	'X'		Unconformity
		MAESTRICHTIAN	70		MIRIA	
		CAMPANIAN	76			
		SANTONIAN	82	'D'	TOOLONGA	Unconformity
		CONIACIAN	88			
		TURONIAN	94			
		CENOMANIAN	100		GEARLE SILTSTONE	
		ALBIAN	106	'F'	WINDALIA RADIOLARITE SAND	Unconformity
	LOWER	APTIAN			MUDERONG SHALE	
			112		MUDERONG GREENSAND	
					BIRDONG SAND	
		NEOCOMIAN		'Y'		Unconformity
JURASSIC	UPPER	TITHONIAN	136	'H'	BARROW GROUP	Unconformity
		KIMMERIDGIAN	146			
		OXFORDIAN	151	'Jc'	DAMPIER FORMATION DUPUY SAND MEMBER	Major Unconformity
		CALLOVIAN	157			
			162			
	MIDDLE	BATHONIAN	167		LEGENDRE FORMATION	
		BAJOCIAN				
	LOWER		172	'J'	?	Possible Unconformity
					ENDERBY FORMATION	
		LIASSIC				
TRIASSIC	UPPER		190-195	'T'	?	Possible Unconformity
					MUNGAROO BEDS	
	MIDDLE		205	Intra 'R'		
	LOWER		215		LOCKER SHALE	
PERMIAN	UPPER		225	'S'	?	Possible Unconformity
					UNNAMED	
	LOWER	KUNGURIAN	240		KENNEDY GROUP	
		ARTINSKIAN			BYRO GROUP	
		SAKMARIAN	280			

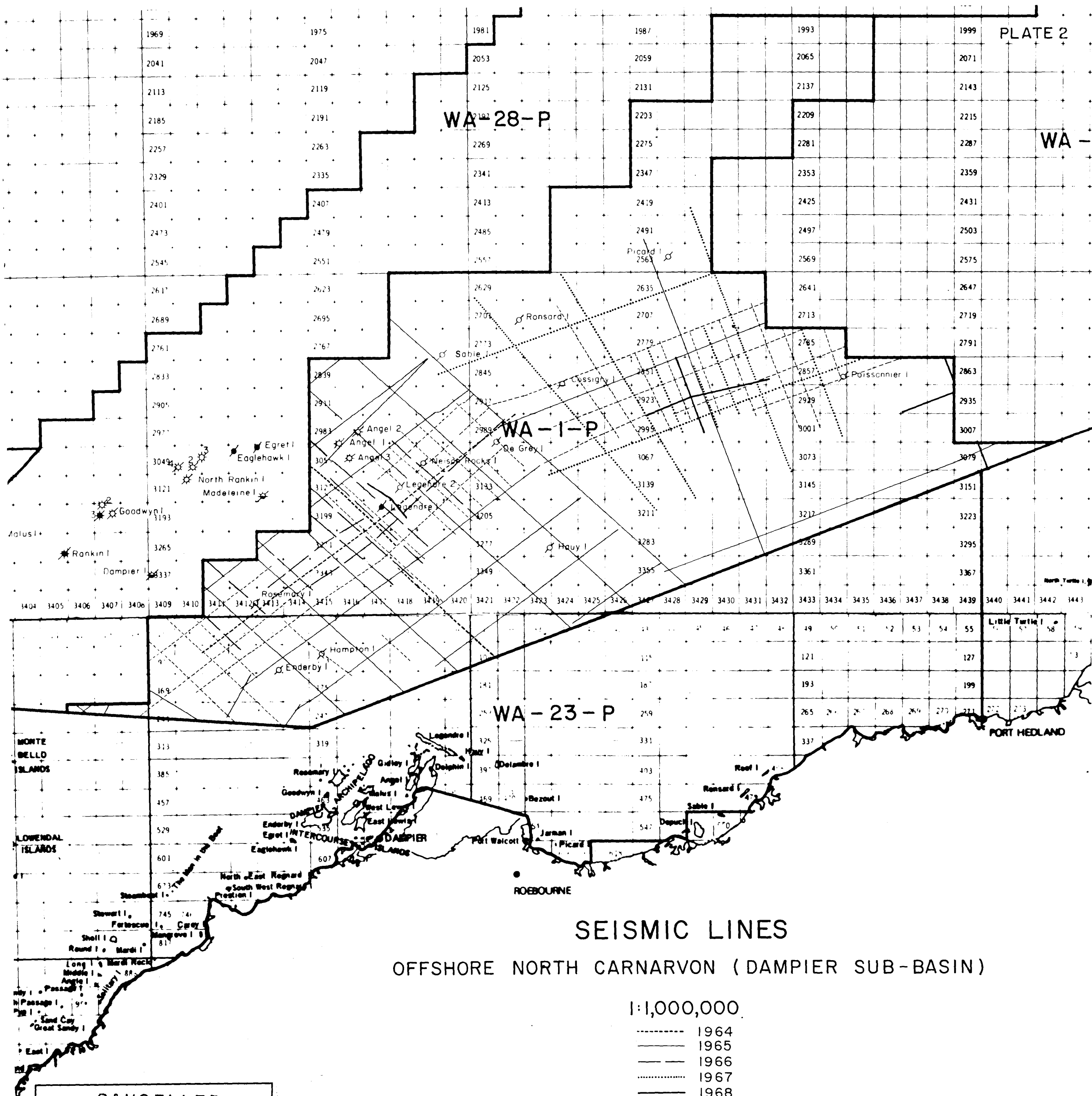


PROSPECTIVITY MAP
WA-1-P
OFFSHORE NORTH CARNARVON BASIN
1:1000 000

PROSPECTIVITY
Water depth < 600 ft > 600 ft
Good Fair Poor Good Fair Poor

Excluded area (Location Licence ISL)
Undrilled structural lead
Hinge line
Fault
Areas to be retained by BOCAL

CANCELLED
19 PETROLEUM EXPLORATION BRANCH, BMR
PORT HEDLAND



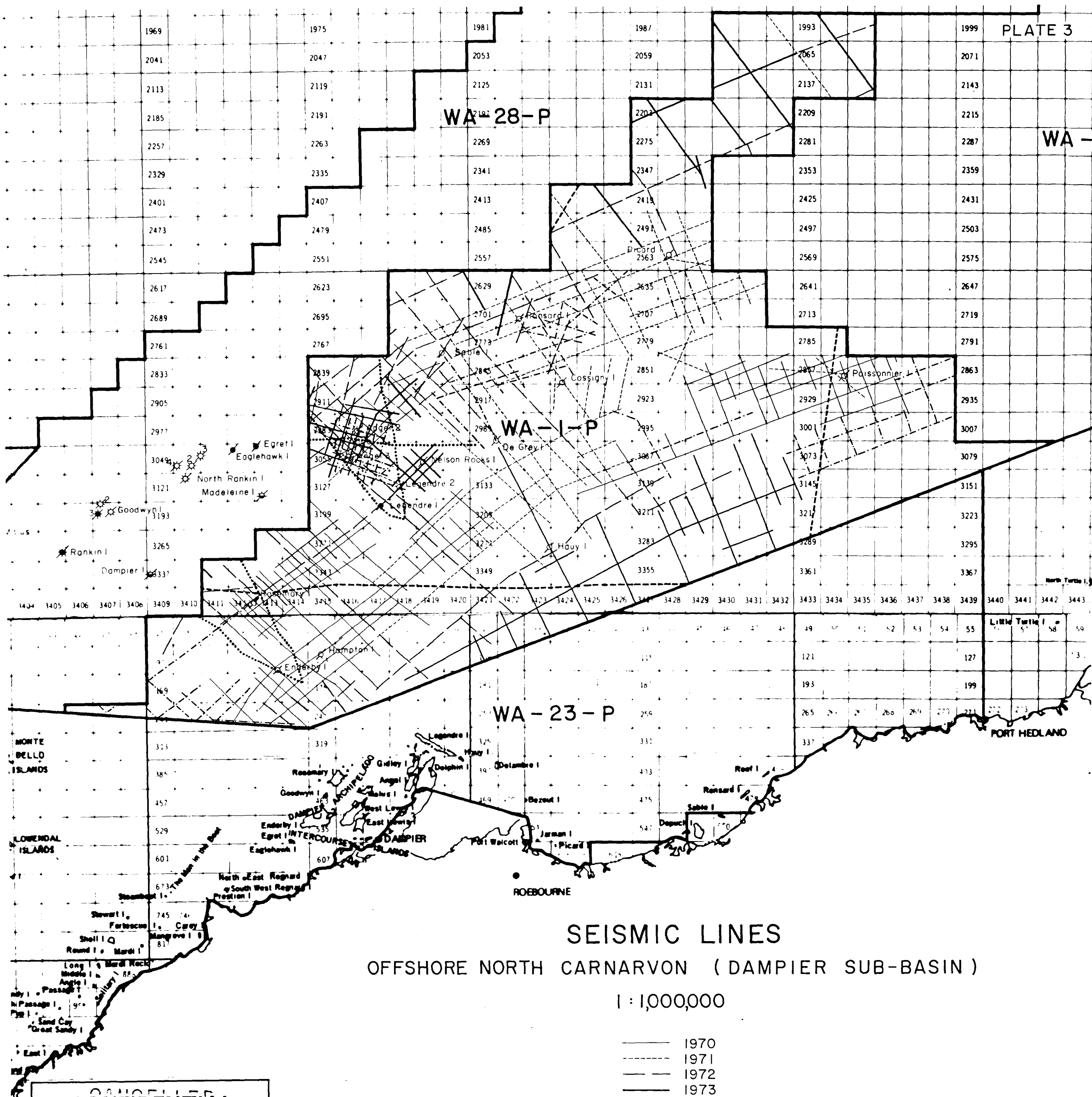
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PETROLEUM EXPLORATION BRANCH, BMR

Record No. 1976/79

XAUS-6-59A

XAUS-6-59B



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PETROLEUM EXPLORATION BRANCH, BMR

Record No. 1976/79

- 1970
- 1971
- 1972
- 1973
- Gulfex
- B.M.R.
- 1973/74 Proposed traverses

XAUS-6-59B