

APPENDIXES

APPENDIX 1 A brief chronology of petroleum exploration and development in the Cooper and Eromanga Basins, South Australia

Year	Event
1900	
	<ul style="list-style-type: none"> • First discovery of natural gas in the Eromanga Basin during water drilling at Roma (Qld).
1914	
	<ul style="list-style-type: none"> • Patchawarra Bore on Innamincka Station, drilled in search of water, provided first useful information on oil in the Eromanga Basin.
1924	
	<ul style="list-style-type: none"> • Dr R. Lockhart Jack, while mapping northeast SA for water supplies, noted a fold structure and the presence of gentle folds in the Cordillo Downs area.
1940	
	<ul style="list-style-type: none"> • Zinc Corporation commissioned a geological review of the oil prospects of northeast SA and the adjoining States by J.P. De Verteuil but the prospects were not rated positively.
1941	
July	<ul style="list-style-type: none"> • SA's <i>Mining (Petroleum) Act 1940</i> came into effect.
1945	
	<ul style="list-style-type: none"> • Quinyambie New Homestead Bore, completed for water supplies at the southern edge of the Great Artesian Basin (GAB) near the SA–NSW border, revealed flammable gas.
April	<ul style="list-style-type: none"> • The first Oil Exploration Licence under the <i>Mining (Petroleum) Act</i>, OEL 1, was granted to A.J. Keast on behalf of the Zinc Corp. Ltd. It covered 10 360 km² between Lake Frome and the NSW border, within the southern margin of the Cooper Basin.
1947	
January	<ul style="list-style-type: none"> • M. Mawby, on behalf of the Australian Mining and Smelting Co. Ltd (an associate of Zinc Corp.), was granted OEL 3 for two years over 126 910 km² of the northeast of SA, covering the area of the now known Cooper and Eromanga Basins' petroleum discoveries.
December	<ul style="list-style-type: none"> • OELs 2 and 3 were transferred to the Frome–Broken Hill Co. Pty Ltd which had been formed so that Zinc Corp. could introduce international expertise and assistance to the petroleum search.
1948	
June	<ul style="list-style-type: none"> • OEL 3 was reissued to Frome–Broken Hill.
1954	
January	<ul style="list-style-type: none"> • Australian Mining and Smelting Co. Ltd took up OEL 6 for two years over the Lake Frome and GAB areas, including the area covered by the earlier OELs 2 and 3.
September	<ul style="list-style-type: none"> • OEL 7, granted to R. Bristowe in March 1954, was transferred to Santos. The licence initially adjoined OEL 6 but when the Australian Mining and Smelting surrendered OEL 6 Santos applied successfully to have the area included in OEL 7. The area then totalled 507 397 km². The Santos holdings in SA and Qld then totalled 860 000 km².
1956	
June and July	<ul style="list-style-type: none"> • Reconnaissance gravity and magnetic surveys undertaken by Geosurveys for Santos between Birdsville and Marree. Jack's 1924 observations were recalled when Geosurveys' geologist Dr Heli Wopfner mapped large structures near Oodnadatta west of the GAB.
1957	
February	<ul style="list-style-type: none"> • Observations by Dr A.I. Levorsen (from Tulsa, Oklahoma) were critical to extending the search in the northeast.
March	<ul style="list-style-type: none"> • During a ground and air reconnaissance survey in the northeast Wopfner mapped fold deformations similar to Jack's observations.
12 December	<ul style="list-style-type: none"> • Federal Government's <i>Petroleum Search Subsidy Act</i> providing financial incentives to company exploration passed.
1957–58	
October–January	<ul style="list-style-type: none"> • Geosurveys drilled five structural/stratigraphic bores for Santos across the east limb of the Nappamilkie anticline and the Haddon syncline in the Cordillo Downs area to confirm structures in depth.

This appendix was compiled by B.J. O'Neil as a preliminary working document with the intention of building up a comprehensive chronology of events relating to the Cooper and Eromanga Basins, South Australia. Contributions, corrections and comments are invited and should be sent to the Director, Petroleum Group, PIRSA.

Year	Event
1958	
6 May	<ul style="list-style-type: none"> • Checkerboarding Agreement between Santos and Delhi. Santos had attracted overseas interest in its efforts and Delhi-Taylor Oil Corporation joined Santos as its partner in the search. Delhi was the explorer until 1987.
1959	
1 March	<ul style="list-style-type: none"> • Upon expiry of OEL 7, OELs 20 and 21 were issued.
28 March	<ul style="list-style-type: none"> • Spudding of Innamincka 1, the first oil and gas well in the GAB.
4 November	<ul style="list-style-type: none"> • The <i>Petroleum Search Subsidy Act</i> was extended under a new <i>Petroleum Search Subsidy Act</i>.
November	<ul style="list-style-type: none"> • Drilling of Innamincka completed: Permian sediments discovered beneath the Mesozoic.
1962	
	<ul style="list-style-type: none"> • Seismic work and drilling Dullingari 1 in the Strzelecki Desert 65 km south of Innamincka.
1963	
March–July	<ul style="list-style-type: none"> • Pandieburra 1 (~100 km south of Birdsville) and Putamurdie 1 (~57 km southeast of Birdsville) were drilled.
31 December	<ul style="list-style-type: none"> • Discovery of potentially economic gas accumulation at Gidgealpa 2 confirmed the prospectivity and extent of Permian strata assigned to Coopers Creek Basin.
1966	
March	<ul style="list-style-type: none"> • The name Cooper's Creek Basin informally becomes the Cooper Basin through usage. • Discoveries by Delhi-Santos of natural gas at Moomba 1 followed by Moomba 2 indicated a large reserve of natural gas. Moomba was 30 km south of Gidgealpa. Further drilling to prove up reserves included Moomba 6 in November 1967.
November	<ul style="list-style-type: none"> • Delhi-Santos gas sales contract with Sagasco.
1967	
November	<ul style="list-style-type: none"> • Natural Gas Pipelines Authority of SA (PASA) established by State Government legislation. • Discovery of first condensate-rich gas in Daralingie 1, and Daralingie 2 also produced positive results.
1968	
	<ul style="list-style-type: none"> • Amendments to the <i>Mining (Petroleum) Act</i> were passed. • Construction of gas processing facility at Moomba begins.
1969	
30 January	<ul style="list-style-type: none"> • Contracts signed between Delhi-Santos, Electricity Trust of SA (ETSA), Sagasco and some industrial users of gas. Late in the year Sagasco began converting the metropolitan area to natural gas.
28 February	<ul style="list-style-type: none"> • First Petroleum Production Licences (PPLs 1–5) issued to Delhi-Santos and gas produced for sale. • OELs 20 and 21 were reissued as Petroleum Exploration Licences (PELs) 5 and 6. The licensees reduced their area by surrendering the offshore region of the western coast of Eyre Peninsula. PELs 5 and 6 were issued for a guaranteed 20 years without area relinquishments and with nominal exploration requirements and the right of renewal for a further 20 years. These rights were protected by a covenant to the amended <i>Mining (Petroleum) Act</i> passed in 1968.
March	<ul style="list-style-type: none"> • Delhi-Santos Toolachee 1 flowed natural gas from sands in the lower 'Gidgealpa' (=Patchawarra) Formation.
July	<ul style="list-style-type: none"> • 750 km Moomba-Adelaide pipeline (0.56 m outside diameter) completed. Officially opened in November.
10 November	<ul style="list-style-type: none"> • Gas sold to first customer, Sagasco.
1970	
July	<ul style="list-style-type: none"> • Discoveries of gas at Packsaddle, Tirrawarra, Della, Merrimelia, Mudrangie and Strzelecki. Some of these discoveries were made by farmin companies such as Crusader and Pursuit Oil NL. • Discovery of light crude oil by Bridge at Tirrawarra, the first to flow to the surface in SA, overturns view that Cooper Basin would be gas only. The associated gas discovery there also upgraded the natural gas reserves of the Cooper Basin and set the scene for more exploration.
1970–71	
c. November–October	<ul style="list-style-type: none"> • Flooding from Strzelecki and Cooper Creeks interrupted drilling.
1971	
26 May	<ul style="list-style-type: none"> • Santos appointed Operator of the gas production facilities and camp at Moomba. • Agreement signed between Alliance, Basin, Bridge, Delhi International, Pursuit, Reef, Santos, Total, Vamgas and AGL to supply gas to Sydney from 1976 to 2006.
1971–72	
	<ul style="list-style-type: none"> • Permian gas was discovered at Big Lake, Coonatie, Dullingari, Burke, Brumby and Kanowana and oil and gas at Fly Lake, Brolga and Moorari.
1972	
September	<ul style="list-style-type: none"> • AGL agreement became binding after sufficient gas reserves (56 x 10⁹ m³ (2 tcf)) had been established. SA wanted to reserve sufficient reserves for a petrochemical plant; Qld agreed to dedicate three small gas fields (all that had been discovered in SW Qld) to the AGL Agreement.

Year	Event
1973	<ul style="list-style-type: none"> AGL and the SA Government agreed to a request from the Producers to raise the gas price for which there would be an expanded gas exploration program. PASA took over the responsibility from the Producers for gas sales to SA consumers and purchased the gas from the Moomba plant. Development of the gas fields in the Cooper Basin was enhanced when an integrated supply system replaced the dedicated field approach which took into account the mechanics of production and depletion of gas fields, the economy of scale in production and to allow for an increase in gas production to support gas liquids development. This was ostensibly in the interests of the Producers and the consumers. Contracts were then rearranged. Gas pipeline to NSW under construction.
1973–74	<ul style="list-style-type: none"> Exploration and development drilling was all but abandoned and few seismic surveys were conducted.
1974	<ul style="list-style-type: none"> Flooding of Moomba and Lake Eyre, worst in recorded history with a recorded rainfall of 864 mm. Delhi International Oil Corporation offered to sell 50% of its production interests and 25% of its exploration interests. Purchased by Petroleum and Minerals Authority (PMA) for the Federal Government.
28 February	<ul style="list-style-type: none"> Renewal of PELs 5 and 6 between Minister of Development and Mines, Delhi International and Santos.
30 June	<ul style="list-style-type: none"> Federal Government's Petroleum Search Subsidy scheme terminated (but work-in-progress payments continued to 1976).
1975	<ul style="list-style-type: none"> SA Government became involved in working PELs 5 and 6 when it acquired the PMA's interests from the Federal Government.
1 January	<ul style="list-style-type: none"> Cooper Basin Unit Agreement between Alliance, Basin, Bridge, Delhi International, Pursuit, Reef, Santos and Vamgas.
16 October	<ul style="list-style-type: none"> Cooper Basin Indenture between the State of SA, Minister of Mines and Energy, Santos, Delhi International, Alliance, Basin, Bridge, Pursuit, Reef and Vamgas for PELs 5 and 6.
11 December	<ul style="list-style-type: none"> <i>Cooper Basin Ratification Act</i> (and Indenture) came into effect after passing the SA Parliament in November.
1976	<ul style="list-style-type: none"> Gas was discovered at Namur 1. This was the first evidence of gas migration from Permian to Cretaceous strata.
18 December	<ul style="list-style-type: none"> Supply of gas to AGL in NSW commenced.
21 December	<ul style="list-style-type: none"> Exploration Indenture for PELs 5 and 6; Producers Unitisation; Interim Gas Sales; and PASA Future Sales Requirement Agreements were signed. (The parties were Alliance, Basin, Bridge, Delhi International, Pursuit, Reef, Santos, Total, Vamgas, Commonwealth of Australia, PASA and Minister of Mines and Energy.)
1977	<ul style="list-style-type: none"> Oil was discovered at Poolowanna 1.
August–October	<ul style="list-style-type: none"> South Australian Oil and Gas Corporation (SAOG) was incorporated. Created in, and separated in August 1977 from, the Mines Department as the South Australian Petroleum Exploration Group, SAOG was to undertake an independent major exploration program in the Cooper Basin.
1978	<ul style="list-style-type: none"> Santos's shareholders receive first dividend payment, 2c per share.
23 June	<ul style="list-style-type: none"> A flow of 382 kL (2400 bbl) of oil per day from Strzelecki 3 established the Eromanga Basin's oil potential.
September–October	
1979	<ul style="list-style-type: none"> Santos became the sole operator for the development drilling, production, processing, maintenance and servicing of the gas and condensate fields while Delhi became the exploration operator. The exploration rights granted to Delhi–Santos were modified when the companies volunteered to halve PELs 5 and 6 to 284 086 km² and the area was divided into three sectors, the Cooper, Pedirka and Arrowie Sectors. The Cooper Sector is not subject to any relinquishment provisions until 1999 when the exploration rights to the whole Cooper Basin must be relinquished, without the right to renewal.
1 January	
28 February	<ul style="list-style-type: none"> Renewal of PELs 5 and 6 between Minister of Mines and Energy, Delhi and Santos.
August–October	<ul style="list-style-type: none"> Oil was discovered at Dullingari North 1.
1980	<ul style="list-style-type: none"> Oil was discovered at Cuttapiirrie 1.
March–May	
1981	<ul style="list-style-type: none"> <i>Stony Point (Liquids Project) Ratification Act</i> passed SA Parliament and Cooper Basin Liquids Project commenced. CSR Ltd purchased the Australian petroleum interests of Delhi. First 3D seismic survey over Cuttapiirrie oil and gas field by SAOG. Strzelecki 4, drilled in the same stratigraphic unit as Strzelecki 3, recorded the largest oil flow to 1983 from a single sand unit on continental Australia. McKinlay 1 discovered oil on the Murteree Ridge, the first of many fields on the structure. Jackson 1 oil discovery in the Qld sector of the Cooper and Eromanga Basins, the largest onshore oilfield in Australia.
January–February	
May–June	
November	
26 November	<ul style="list-style-type: none"> Stony Point Liquids Project Indenture between the State of SA, the Minister of Mines and Energy, Santos, Delhi, SAOG, Basin, Total, Reef, Vamgas, Alliance, Crusader, Bridge and Bridge Oil Developments.
1982	<ul style="list-style-type: none"> Moomba – Stony Point high pressure vapour liquids pipeline construction commenced. 659 km Moomba – Stony Point liquids pipeline completed. First crude oil production began, from Strzelecki Field.
15 January	
October	
December	

Year	Event
1982–83	
	<ul style="list-style-type: none"> SAOG's experimental massive hydraulic fracturing programs in the Tirrawarra sandstone reservoir of the Big Lake Field proved successful and paved the way for other fracture stimulation programs.
1983	
4–6 February	<ul style="list-style-type: none"> First export shipments of condensate through liquids pipeline from Cooper Basin from Stony Point.
11 March	<ul style="list-style-type: none"> First shipment of crude oil from Port Bonython.
June	<ul style="list-style-type: none"> Stony Point renamed Port Bonython.
16 December	<ul style="list-style-type: none"> Official opening of new camp at Moomba.
1983–85	
	<ul style="list-style-type: none"> An Accelerated Gas Program was conducted through the State Government as part of its agreement with the Producers over the 1982 gas price arbitration.
1984	
	<ul style="list-style-type: none"> First enhanced oil recovery (EOR) scheme initiated: water injected into Eromanga Basin sediments, Dullingari Field. Under the conditions of renewal, PELs 5 and 6 were reduced to 231 948 km² and Delhi-Santos were required to drill 18 wells and acquire 7100 line km of seismic in the Pedirka and Arrowie Sectors, and 54 wells and 4000 line km in the Cooper Sector.
28 February	<ul style="list-style-type: none"> Renewal of PELs 5 and 6 between Minister of Mines and Energy, Delhi and Santos. At five-yearly intervals, the Pedirka (west of Cooper Basin) and Arrowie (north of Lake Frome) sectors were now subject to 25% relinquishment.
June	<ul style="list-style-type: none"> First Code of Environmental Practice prepared for petroleum, seismic and drilling operations by Delhi, Santos and the Department of Mines and Energy.
21 June	<ul style="list-style-type: none"> LPG production began at Port Bonython.
July	<ul style="list-style-type: none"> First sale of LPG to the Australian market.
September	<ul style="list-style-type: none"> First export shipment (to Japan) of LPG produced at Port Bonython and official opening of the plant.
1985	
	<ul style="list-style-type: none"> Initiation of development of new environmental operating techniques (such as rolling of seismic lines in gibber plains). Eleven drilling rigs operated simultaneously in SA (over 100 wells drilled).
1986	
	<ul style="list-style-type: none"> Tirrawarra and Moorari Fields EOR scheme initiated: fracture stimulation and ethane injection. Multiple land use concept introduced for Innamincka Pastoral Lease. As the world oil price collapsed, from about A\$277 to \$101/kL (A\$44 to \$16/bbl), exploration in Australia was halved.
March	<ul style="list-style-type: none"> Joint Operations Management Group (JOMG, including Santos, Delhi and Department of Mines and Energy) formed to manage environmental and safety aspect of operations.
1987	
1 September	<ul style="list-style-type: none"> Santos becomes exploration and production operator for all of its involvement in SA.
1988	
	<ul style="list-style-type: none"> 1000th petroleum well drilled in SA. 20th anniversary of uninterrupted gas supply from the Cooper Basin. 1 000 000th barrel of liquids shipped from Port Bonython. Agreement signed by government Ministers and Producers over operational procedures in the Coongie Lakes Control Zone.
February	<ul style="list-style-type: none"> PELs 5 and 6 were reduced to 111 756 km².
May–July	<ul style="list-style-type: none"> Discovery of Taloola, Sturt, Sturt East and Tantanna oil fields in Lake Hope block of the Eromanga Basin near the southwestern edge of the Cooper Basin.
15 June	<ul style="list-style-type: none"> Second renewals of PELs 5 and 6 granted to Delhi and Santos.
17 June	<ul style="list-style-type: none"> SAOG changed its name to Sagasco Resources Ltd.
September	<ul style="list-style-type: none"> James 1 flowed oil from the upper Triassic sequence in the Patchawarra East block of PELs 5 and 6.
23 November	<ul style="list-style-type: none"> Santos and Delhi applied for the second renewal of PELs 5 and 6 and in so doing, surrendered 92 995.19 km² of the licence area, with the option of surrendering a further ~12 000 km² within the first six months of the renewed licences. The remaining area of the licences: <ul style="list-style-type: none"> Pedirka 38 479.61 km² Cooper 76 381.59 km² Arrowie nil Total 114 861.20 km²
22 December	<ul style="list-style-type: none"> The Simpson Desert and Innamincka Regional Reserves were proclaimed.
c.1989–90	
	<ul style="list-style-type: none"> PELs 5 and 6 again reduced, to 73 202 km².
1990	
	<ul style="list-style-type: none"> Permian-sourced oil (Sturt 6) and gas (Lycosa 1 and Moolalla 1) discovered in early Palaeozoic reservoirs of the Warburton Basin.

Year	Event
1991	
	<ul style="list-style-type: none"> Contract signed to sell SW Qld gas to SA. Competition resulting from interconnection of the SA, Victorian and NSW electricity transmission systems led to decrease in use of Cooper Basin gas by ETSA. Highest ever petroleum royalty in SA of \$61.5 million received from the Producers (due to higher crude oil prices as a result of the Gulf War and the renegotiated royalty system). Santos completes takeover of Vamgas. Sale of Sagasco Holdings Ltd, which includes Sagasco Resources, to Boral means SA Government sold its exploration and operating interest in the Cooper Basin. First modern 3D seismic survey program in the Cooper Basin undertaken over Gidgealpa Field. New Australian drilling bit record achieved — 1962 m at an average of 8.75 m/hour using a Longyear polycrystalline diamond compact drill bit.
1 January	<ul style="list-style-type: none"> In assuming operatorship for exploration in the Qld sector of the Cooper and Eromanga Basins, Santos becomes the operator for all exploration, development and production activities in the Qld and SA sectors of these basins.
April	<ul style="list-style-type: none"> Naphtha replaces condensate production from Port Bonython.
September	<ul style="list-style-type: none"> Environmental Management Groups supersede JOMG in environment, and includes a representative from Department of Environment and Planning.
1994	
February	<ul style="list-style-type: none"> Santos Environmental Management System initiated. Gas production commenced from SW Qld to SA via Moomba.
1995	
	<ul style="list-style-type: none"> PASA sold to Tenneco Gas (now Epic Energy); includes Moomba–Adelaide pipeline system. To facilitate active upstream industry competition, the SA Government confirmed no rights of renewal would apply to PELs 5 and 6 upon their expiry in 1999. Sagasco Resources changed its name to Boral Energy Resources Ltd.
September	<ul style="list-style-type: none"> Coongie Lakes Control Zone Management Group formed to administer operations in Coongie Lakes region.
1996	
	<ul style="list-style-type: none"> Santos announced a \$200 million exploration program in the SA sector of the Cooper and Eromanga Basins over a three-year period. Ethane production commenced from Moomba to ICI plant at Botany Bay via a new pipeline. Ethane, previously stored in depleted reservoirs at State Government request for a petrochemical plant, released for sale to NSW also.
May	<ul style="list-style-type: none"> A record 916.7 km of seismic recorded by Geco-Prakla (Australia) for Santos in the Cooper Basin.
5 December	<ul style="list-style-type: none"> Fixed Factor Settlement Agreement between Santos, Delhi, Santos Petroleum, Boral, Vamgas, Crusader, Bridge Oil Developments, Santos (BOL), Reef, Alliance and Basin.
1997	
3 November	<ul style="list-style-type: none"> Minister signs PPLs for Santos in the Nappamerri Trough.
1999	
28 February	<ul style="list-style-type: none"> PELs 5 and 6 expire.

APPENDIX 2 Oil geochemistry parameters of selected Cooper–Eromanga wells, South Australia and Queensland

Well	Top (m)	Base (m)	Test ^a	AGSO sample no. ^b	API ^c	<C ₁₅ ^c (%)	Pr/Ph ^d	Pr/C ₁₇ ^d	Ph/C ₁₈ ^d	OEP(1) ^e
Wyandra Sandstone										
Ipundu 1	798.6	829.7	DST 5	10142 *	50.9	27.1	5.59	0.77	0.15	1.05
Talgeberry 4	842.0	867.0	DST 3	10145	–	–	4.76	0.52	0.11	1.03
Cadna-owie Formation										
Cuddapan 1	1521.1	1533.1	DST 1	10140 *	–	26.6	6.85	0.74	0.09	1.03
Tickalara 10	1191.8	1202.1	DST 3	10097 *	44.6	12.6	4.26	0.33	0.07	1.09
Toby 1	1088.4	1125.0	DST 1	10149 *	–	–	4.49	0.23	0.05	1.07
McKinley Formation										
Morney 3	–	–	–	10221	48.6	23.6	3.76	0.45	0.13	1.04
Murta Formation										
Chookoo 1	1370.1	1377.7	DST 1	333 *	51.1	36.5	3.83	0.24	0.06	1.08
Dullingari 19	1483.8	1496.3	DST 1	200 *	52.3	29.9	5.51	0.39	0.08	1.08
Dullingari 22	1505.7	1514.9	DST 3	199 *	52.5	27.8	5.47	0.37	0.08	1.08
Dullingari 26	1482.9	1507.2	DST 2	10163	–	–	4.65	0.37	0.09	1.08
Ethel 1	–	–	–	10246	–	12.5	4.76	0.56	0.09	1.11
Ipundu North 1	886.0	908.5	DST 2	10143 *	–	–	5.44	0.72	0.14	1.04
Jackson 1	1104.9	1113.4	DST 1	2 *	48.4	21.7	6.46	0.42	0.08	1.11
Jackson 13	1106.4	1114.0	DST 1	10114	–	–	6.06	0.42	0.08	1.11
Kihee 2	968.7	978.0	DST 1	421 *	44.6	17.3	6.34	0.43	0.08	1.10
Limestone Creek 3	1206.7	1218.3	DST 2	342 *	41.2	7.7	3.94	0.32	0.07	1.07
Merrimelia 6	1559.1	1589.8	DST 3	1 *	50.0	28.2	4.99	0.36	0.08	1.07
Mooliampah 2	1231.4	1249.1	DST 1	10084	–	–	4.43	0.33	0.07	1.08
Naccolwah 2	1346.9	1351.5	DST 4	10088 *	44.4	11.0	6.16	0.45	0.08	1.14
Narcoonowie 3	1324.4	1348.7	DST 2	10176	–	–	5.86	0.58	0.11	1.11
Nockatunga 1	1005.2	1011.7	DST 1	307 *	47.5	21.4	6.98	0.44	0.08	1.13
Nockatunga 4	1006.0	1016.7	DST 1	308 *	47.5	20.6	6.37	0.44	0.08	1.11
Talgeberry 2	926.3	931.5	DST 2	10146	–	–	4.50	0.46	0.10	1.03
Taloola 1	1353.6	1384.1	DST 3	10157 *	45.7	6.6	6.92	1.09	0.16	1.09
Thungo 1	1004.3	1008.6	ST 1	305 *	45.7	1.6	5.51	0.45	0.08	1.08
Thungo 1	1003.5	1016.7	FT	309 *	46.6	18.0	5.35	0.45	0.09	1.08
Tickalara 7	1188.7	1207.9	DST 2	10093	–	–	3.69	0.30	0.07	1.10
Tickalara 10	1243.0	1252.7	DST 2	10096 *	44.2	13.2	4.02	0.31	0.07	1.08
Utopia 1	1010.0	1023.0	–	10201	46.8	18.7	4.84	0.54	0.11	1.04
Wilson 2	1139.6	1148.8	DST 1	10103	–	–	6.49	0.44	0.08	1.14
Winna 1	993.2	1017.4	FT	316 *	46.3	17.1	5.11	0.46	0.09	1.08
Yanda 4	1508.8	1522.5	DST 1	10106 *	42.5	10.4	4.63	0.36	0.08	1.12
Namur Sandstone Member										
Big Lake 55	1697.7	1716.0	DST 1	10162	–	–	4.48	0.42	0.09	1.05
Dullingari 22	1507.5	1516.7	DST 3	10164	–	–	4.64	0.37	0.09	1.09
Dullingari 29	1488.9	1507.8	DST 1	4 *	52.5	29.1	5.81	0.36	0.07	1.08
Inland 1	1246.6	1257.6	DST 2	10129 *	50.4	29.2	4.52	0.39	0.09	1.05
McKinlay 1	1232.0	1245.4	DST 1	6 *	41.6	1.9	3.45	0.28	0.07	1.08
Merrimelia 8	1597.2	1608.7	DST 2	7 *	50.4	18.9	5.26	0.37	0.08	1.08
Mooliampah 1	1322.2	1329.5	DST 3	10083	–	–	3.16	0.25	0.07	1.07
Mooliampah 2	1322.8	1329.2	DST 5	10085	–	–	3.31	0.26	0.07	1.07
Strzelecki 6	1413.1	1419.2	DST 1	5 *	49.3	36.6	4.40	0.30	0.06	1.07
Tickalara 7	1280.2	1291.4	DST 3	10094 *	45.3	15.3	3.54	0.26	0.06	1.11
Tickalara 10	1276.5	1284.1	DST 1	10095	–	–	3.49	0.25	0.07	1.11
Wilson 1	1210.7	1216.8	DST 6	337 *	54.9	31.5	9.00	0.53	0.10	1.10
Westbourne Formation										
Chookoo 7	1619.1	1629.5	DST 1	10075	–	–	3.44	0.24	0.06	1.07
Cooroo 5	1629.5	1666.0	DST 3	10077 *	50.9	28.5	5.30	0.44	0.09	1.08
Jackson 1	1331.4	1350.0	DST 5	195 *	40.8	5.4	3.46	0.27	0.07	1.09
Jackson 1	1314.3	1331.1	DST 4	196 *	40.8	4.7	3.62	0.27	0.06	1.08
Jackson 3	1315.2	1342.3	DST 2	10111	–	–	3.29	0.27	0.07	1.10
Jackson 3	1343.6	1358.5	DST 3	10112	–	–	3.15	0.26	0.07	1.09

Well	Top (m)	Base (m)	Test ^a	AGSO sample no. ^b	API ^c	<C ₁₅ ^c (%)	Pr/Ph ^d	Pr/C ₁₇ ^d	Ph/C ₁₈ ^d	OEP(1) ^e
Jackson 3	1315.2	1342.3	DST 3	8 *	38.6	42.7	3.51	0.26	0.06	1.10
Jackson 11	1316.7	1347.2	DST 2	10113	–	–	3.10	0.27	0.07	1.09
Jackson 20	1335.0	1352.7	DST 3	10116	–	–	3.51	0.29	0.07	1.08
Jackson 21	1342.6	1347.2	DST 2	10117	–	–	3.31	0.27	0.07	1.07
Jackson 22	1338.4	1359.7	DST 1	10118	–	–	3.23	0.26	0.07	1.09
Jackson 26	1342.3	1350.9	DST 1	10119	–	–	3.19	0.26	0.07	1.08
Jackson 28	1346.3	1357.0	DST 2	10120	–	–	3.24	0.27	0.07	1.08
Jackson 30	1429.5	1445.4	DST 1	10121	–	–	4.05	0.36	0.08	1.09
Jackson 30	1315.2	1339.6	DST 2	10122	–	–	3.31	0.27	0.07	1.08
Jackson 35	1316.7	1341.1	DST 1	10123	–	–	3.18	0.26	0.07	1.07
Jackson 38	1360.9	1371.0	DST 1	10124	–	–	3.20	0.26	0.07	1.08
Jackson 39	1311.2	1335.6	DST 1	10125	–	–	3.12	0.26	0.07	1.07
Jackson 42	1321.6	1342.6	DST 2	10127	–	–	3.22	0.26	0.07	1.08
Jackson South 1	1298.4	1311.5	DST 3	9 *	41.8	7.6	3.56	0.26	0.06	1.10
Wilson 1	1344.2	1360.9	DST 3	338 *	43.5	12.3	3.48	0.26	0.06	1.09
Wilson 7	1344.2	1360.9	DST 1	10104	–	–	3.20	0.26	0.07	1.08
Birkhead Formation										
Big Lake 37	1960.5	1970.2	DST 1	10161	–	–	5.43	0.54	0.11	1.04
Bookabourdie 5	2140.0	2146.0	DST 1	10154 *	44.4	13.6	7.07	1.33	0.19	1.11
Bookabourdie 8	2139.1	2158.9	DST 1	10155 *	47.9	24.0	7.16	1.33	0.19	1.11
Bowen 2	1703.2	1716.0	DST 2	10073 *	48.1	16.3	3.79	0.25	0.07	1.05
Cooroo 5	1744.7	1751.4	DST 4	10078	–	–	5.45	0.42	0.08	1.08
Echuburra 1	1706.9	1710.8	DST 3	10080	–	–	5.58	0.47	0.09	1.09
Endeavour 2	1302.0	1330.2	DST 1	10141	–	–	4.19	0.42	0.10	1.03
Gidgealpa 17	1803.5	1813.9	DST 3	10172 *	42.5	1.5	4.32	0.36	0.09	1.06
Jackson 18	1446.3	1452.4	DST 2	10115 *	40.0	3.2	3.13	0.28	0.08	1.08
Keleary 2	2084.8	2122.6	DST 5	10156	–	–	5.18	0.44	0.09	1.09
Merrimelia 9	1862.3	1885.5	DST 2	11 *	50.9	53.1	4.96	0.38	0.08	1.08
Moorari 4	2150.4	2162.6	DST 2	10 *	47.9	30.8	9.45	2.46	0.26	1.16
Strzelecki 5	1682.8	1692.3	DST 3	13 *	43.8	8.1	3.77	0.32	0.07	1.10
Talgeberry 1	1175.6	1186.3	DST 7	10147 *	44.2	13.0	4.73	0.51	0.11	1.04
Hutton Sandstone										
Big Lake 36	1971.5	1977.5	DST 2	10160	–	–	4.02	0.38	0.09	1.07
Bodalla South 2	1464.0	1460.0	?DST 4	10132 *	44.8	5.4	5.07	0.43	0.09	1.04
Chookoo 2	1720.3	1722.1	DST 1	10074	–	–	3.35	0.24	0.07	1.07
Cook 3A	1965.0	1977.5	DST 1	10076 *	48.8	29.1	4.91	0.43	0.09	1.07
Gidgealpa 17	1823.6	1829.4	DST 4	10173 *	42.9	3.3	4.25	0.34	0.08	1.06
Gidgee 2	1454.5	1464.3	DST 2	10081	–	–	5.43	0.43	0.09	0.92
Inland 1	1579.2	1597.5	DST 1	10130 *	50.0	27.6	4.71	0.39	0.09	1.04
Jackson 1	1428.6	1454.8	DST 7	191 *	40.7	0.8	3.72	0.28	0.06	1.09
Jackson 1	1428.9	1436.5	DST 6	197 *	40.2	1.0	3.25	0.27	0.07	1.09
Jackson 2	1438.4	1445.4	DST 1	10110	–	–	3.25	0.27	0.07	1.09
Jackson 2	1438.3	1445.4	DST 1	12 *	40.0	2.8	3.51	0.28	0.07	1.09
Jackson 2	1442.3	1450.8	PT	192 *	40.2	0.8	3.35	0.26	0.07	1.08
Jackson 39	1438.7	1451.5	DST 2	10126	–	–	3.25	0.27	0.07	1.08
Jackson 42	1442.6	1448.4	DST 3	10128	–	–	3.02	0.26	0.07	1.08
Jarrar 2	–	–	DST 1	10082	–	–	4.05	0.26	0.07	1.06
Kenmore 1	1514.2	1519.0	?DST 2	10131	–	–	4.41	0.37	0.09	1.04
Merrimelia 8	1859.3	1879.1	DST 3	193 *	50.2	27.3	5.02	0.35	0.08	1.09
Munro 2	1442.0	1449.9	DST 1	10087	–	–	4.47	0.33	0.07	1.11
Muteroo 2	1714.5	1722.1	PT	10175	–	–	4.62	0.37	0.08	1.08
Naccowlah South 1	1670.3	1682.3	DST 2	339 *	48.6	27.7	3.69	0.25	0.06	1.07
Naccowlah South 7	1694.4	1704.9	DST 1	10089	–	–	3.15	0.24	0.07	1.07
Naccowlah West 13	1688.0	1694.1	DST 2	10092	–	–	3.25	0.27	0.07	1.10
Tintaburra 3	1068.9	1084.2	DST 1	10148 *	–	–	3.52	0.33	0.09	1.01
Toobunyah 3	–	–	–	10151 *	44.8	8.6	3.52	0.34	0.09	1.02
Wandilo 2	1620.3	1628.2	DST 4	10100	–	–	4.54	0.36	0.08	1.06
Watson South 1	1605.4	1611.8	–	10101 *	46.4	5.6	6.54	0.91	0.15	1.05
Wilson 1	1478.3	1488.6	DST 5	10102	–	–	3.06	0.26	0.07	1.07

Well	Top (m)	Base (m)	Test ^a	AGSO sample no. ^b	API ^o	<C ₁₅ ^c (%)	Pr/Ph ^d	Pr/C ₁₇ ^d	Ph/C ₁₈ ^d	OEP(1) ^e
Wilson 1	1478.3	1488.6	DST 5	335 *	40.2	2.7	3.48	0.26	0.06	1.09
Wilson 7	1460.0	1476.2	DST 2	10105	–	–	3.09	0.27	0.07	1.08
Poolowanna Formation										
Bargie 1	1609.5	1615.1	?DST 2	10134 *	46.6	17.0	5.07	0.45	0.09	1.04
Black Stump 1	1621.3	1632.2	?DST 1	10135 *	45.0	6.2	5.40	0.49	0.09	1.08
Bodalla South 5	1603.0	1610.0	?DST 3	10133 *	46.6	21.1	4.61	0.39	0.08	1.03
Chookoo 6	1795.3	1801.4	DST 1	10138 *	36.7	0.6	3.10	0.26	0.07	1.06
Cooroo 5	1824.5	1830.9	DST 1	10139	–	–	3.83	0.32	0.09	1.05
Cuttapirrie 1	2443.3	2452.4	DST 12	15 *	45.9	21.3	6.65	0.68	0.11	1.07
Cuttapirrie 1	2439.0	2468.6	DST 3	420 *	44.6	19.2	6.09	0.69	0.11	1.08
Keleary 2	2325.0	2344.5	DST 2	10165	–	–	3.92	0.31	0.08	1.07
Sturt 7	1871.2	1875.7	DST 3	10167 *	49.5	24.5	6.40	1.07	0.17	1.04
Toby 1	1740.7	1746.8	DST 5	10150 *	42.1	32.3	4.52	0.21	0.04	1.09
Wandilo 2	1679.4	1685.5	DST 3	10099	–	–	3.86	0.28	0.08	1.03
Nappamerri Group										
Coonatie 1	2839.8	2850.2	DST 1	27 *	42.3	14.7	4.05	0.24	0.07	1.05
Della 4	1910.8	1951.0	–	169 *	–	0.0	2.91	0.24	0.08	1.06
Merrimelia 7	2146.4	2161.6	DST 5	16 *	36.6	0.3	4.17	0.34	0.07	1.08
Tinchoo Formation										
Keleary 2	2383.5	2405.5	DST 4	10166 *	47.5	30.3	3.24	0.28	0.08	1.05
Toolachee Formation										
Durham Downs 1	2534.0	2574.0	DST 2	114 *	51.1	39.5	4.74	0.44	0.11	1.04
Gidgealpa 2	2083.9	2085.4	PT	171 *	42.7	10.5	4.69	0.32	0.08	1.07
Gidgealpa 2	2083.9	2312.2	PT	394 *	48.8	46.0	4.53	0.32	0.08	1.06
Karmona 1	2273.8	2334.8	DST 1	133 *	–	5.4	3.27	0.28	0.08	1.06
Naccowlah South 10	1903.5	1912.6	DST 1	10090 *	39.4	1.0	3.25	0.26	0.07	1.05
Strzelecki 10	1936.7	1943.4	DST 3	17 *	37.3	1.4	3.41	0.25	0.06	1.07
Yanda 7	2245.8	2253.1	DST 1	10108 *	–	0.9	3.14	0.27	0.07	1.06
Patchawarra Formation										
Brolga 1	2816.1	2853.5	DST 4	25 *	48.6	35.7	6.66	0.36	0.06	1.05
Brolga 1	2769.1	2798.1	DST 3	59 *	49.0	30.0	5.72	0.44	0.09	1.05
Costa 1	–	–	DST 3	10079	–	–	4.50	0.30	0.08	1.02
Daralingie 1	2152.5	2185.4	DST 4	121 *	53.2	48.6	4.18	0.35	0.09	0.99
Daralingie 18	2267.9	2269.9	PT	10181 *	37.1	0.8	3.23	0.36	0.09	1.07
Fly Lake 1	2618.5	2795.0	PT	29 *	39.8	2.7	5.24	0.47	0.10	1.06
Gidgealpa 3	2229.0	2234.2	DST 5	26 *	–	1.3	1.98	0.14	0.09	0.84
Gidgealpa 17	2164.1	2264.1	DST 6	10174 *	37.9	1.5	3.57	0.34	0.09	1.07
Kanowana 1	2766.7	2768.5	PT 4	21 *	53.0	66.9	5.93	0.36	0.07	1.08
Kanowana 1	2817.9	2824.3	PT 3	22 *	35.9	0.8	3.75	0.38	0.10	1.04
Kanowana 1	2834.6	2850.2	PT 1	23 *	47.5	62.5	3.04	0.46	0.17	0.98
Munkah 4	2266.5	2276.9	DST 4	10086 *	53.2	50.5	3.69	0.25	0.07	1.04
Sturt 6	1883.7	1898.3	DST 3	10158 *	49.7	31.2	5.72	0.86	0.16	1.04
Toolachee 1	2088.5	2122.6	PT	31 *	44.0	4.1	5.29	0.34	0.07	1.07
Toolachee 6	2277.2	2322.3	PT	49 *	39.0	0.5	3.81	0.30	0.09	1.03
Toolachee 7	2229.6	2244.9	PT	30 *	44.0	2.1	6.48	0.36	0.07	1.08
Wancoocha 2	1730.7	1751.4	DST 3	10177 *	43.1	2.6	4.65	0.38	0.08	1.06
Tirrawarra Sandstone										
Fly Lake 2	2905.4	2914.5	PT	88 *	34.2	1.0	6.32	0.75	0.12	1.05
Fly Lake 8	2890.4	2907.8	PT	10182 *	48.1	30.2	5.73	0.69	0.12	1.06
Gidgealapa 41	2224.4	2233.3	PT	10183	–	–	4.17	0.36	0.08	1.04
Moorari 1	2895.6	2991.9	–	18 *	49.9	49.5	7.94	0.63	0.09	1.05
Moorari 1	2913.9	2970.3	PT	10185	–	–	6.07	0.61	0.11	1.03
Pepita 1	2218.3	2248.2	DST 2	10144 *	38.6	1.8	3.29	0.27	0.06	1.17
Tirrawarra 2	2978.2	3001.1	PT	10186	–	–	5.55	0.64	0.11	1.06
Tirrawarra 8	2915.4	2935.5	PT	10187	–	–	5.94	0.65	0.11	1.07
Woolkina 1	2999.2	3007.8	PT	10188	–	–	5.97	0.64	0.11	1.06
Yanpurra 1	2894.1	2896.8	DST 7	28 *	43.3	19.4	7.27	1.02	0.14	1.03

Well	Top (m)	Base (m)	Test ^a	AGSO sample no. ^b	API ^c	<C ₁₅ ^c (%)	Pr/Ph ^d	Pr/C ₁₇ ^d	Ph/C ₁₈ ^d	OEP(1) ^e
Merrimelia Formation										
Chandos 1	2303.1	2312.2	–	393 *	49.3	16.3	6.24	0.65	0.12	1.07
Malgoona 1A	2264.7	2268.9	PT	10184	–	–	5.49	0.80	0.16	1.07
Pre-Permian										
Sturt 6	1883.7	1919.0	DST 5	10159 *	52.3	35.5	5.93	0.89	0.16	1.04

a DST drillstem test, FT formation test, PT production test.

b Asterisk indicates oil analysed for saturated biomarkers and $\delta^{13}\text{C}$ of saturated and aromatic hydrocarbons (AGSO and GeoMark Research, in prep.).

c <C₁₅ = % weight loss of the whole oil by evaporation of volatile components over a 24-hour period at room temperature.

d Pr pristane, Ph phytane.

e $\text{OEP}(1) = \text{C}_{21} + 6\text{C}_{23} + \text{C}_{25} / (4\text{C}_{22} + 4\text{C}_{24})$.

3 ABBREVIATIONS, MEASUREMENTS AND WELL SYMBOLS

Company and organisation names

ACCC	Australian Competition and Consumer Commission
AGL	Australian Gas Light Co.
AGSO	Australian Geological Survey Organisation
API	American Petroleum Institute
BMR	Bureau of Mineral Resources (now AGSO)
ETSA	Electricity Trust of South Australia
EWS	Engineering and Water Supply Department
ICI	Imperial Chemical Industry
PASA	Natural Gas Pipelines Authority of South Australia
PIRSA	Primary Industries and Resources South Australia
PMA	Petroleum and Minerals Authority
SAOG	South Australian Oil and Gas Corporation
SAPEG	South Australian Petroleum Exploration Group

General

2D	two-dimensional
3D	three-dimensional
¹² C, ¹³ C	carbon isotopes
abs	absolute
AFTA	apatite fission track analysis
APRAS	Analytical Petroleum Resource Appraisal System
C horizon	near top of Cadna-owie Formation seismic horizon
CO ₂	carbon dioxide
C _{org}	carbon from organic sources
DBT	dibenzothiophene
DMP	dimethylphenanthrene
DST	drillstem test
DOM	dispersed organic matter
DT	sonic log
DW	deviated well
EOR	enhanced oil recovery
GAB	Great Artesian Basin
GIS	geographic information system
GMI Ridge	Gidgealpa–Merrimelia–Innamincka Ridge
GOR	gas–oil ratio
GR	gamma ray log
H	horizontal well
HI	hydrogen index
J horizon	top of the Nappamerri Group seismic horizon
JOMG	Joint Operations Management Group
KB	kelly bushing
LLD	deep laterolog resistivity
LLS	shallow laterolog resistivity
LPG	liquefied petroleum gas
Ma	million years
MAI	methyl adamantane index
MP	methylphenanthrene
MPI-1	methylphenanthrene index
MSFL	microspherically focused log resistivity
NGMA	National Geoscience Mapping Accord
NPV	Net Present Value
NSW	New South Wales
OEL	oil exploration licence
OGIP	original gas-in-place
OI	oxygen index
P	phenanthrene
P horizon	near top of Permian coal seismic horizon
PEL	petroleum exploration licence
PEPS	Petroleum Exploration and Production System (database)
PPL	petroleum production licence

Pr/Ph	pristine/phytane ratio
Qld	Queensland
R horizon	Daralingie unconformity seismic horizon
RTSTM	rate too small to measure
R _c	calculated vitrinite reflectance
R _o	measured vitrinite reflectance
R _w	(formation) water resistivity
SA	South Australia
SADME	South Australian Department of Mines and Energy
sd	standard deviation
<i>sensu stricto</i>	in the narrow sense
S ₁ , S ₂	potential yield (kg of hydrocarbon per tonne of rock)
SIS	seismic increment of strata
TD	total depth
TeMN	tetramethylnaphthalene
T _{max}	temperature of maximum generation of S ₂ hydrocarbons (°C)
TMN	trimethylnaphthalene
TOC	total organic carbon
U horizon	approximates the top of the Murteree Shale seismic horizon
V horizon	top of the Patchawarra Formation seismic horizon
V _c	Patchawarra coal seismic horizon
VR	vitrinite reflectance
W horizon	top Merrimelia Formation and/or Tirrawarra Sandstone seismic horizon
Z horizon	the base of the Cooper Basin or top of Warburton Basin seismic horizon

Measurement

Most units of measurement used in this volume are those of the International System of Units (SI) and are not included in this glossary. Units outside the SI which have been authorised for use within Australia's metric system, and units having general application are given.

‰	parts per mil (per thousand)
°C	degree Celsius (the Celsius temperature)
cP	centipoise (10 ⁻² P; viscosity; P = 10 ⁻⁴ Pa.s (pascal second))
GJ	gigajoule (10 ⁹ joule)
J	joule (energy; 1 kg.m ² /s ²)
kL	kilolitre (volume; = 1 m ³)
kPa	kilopascal (10 ³ Pa)
Ma	million years
mD	millidarcies (permeability)
MPa	megapascal (10 ⁶ Pa)
mW	milliwatt (10 ⁻³ watt)
Pa	pascal (pressure; Pa = 1 kg /m.s ²)
PJ	petajoule (10 ¹⁵ joule)
sm ³	standard cubic metre
t	tonne (mass; = 10 ³ kg)
W	watt (power; 1 kg.m ² /s ³)

Conversions

1 cubic metre (m ³)	= 1 kilolitre (kL)
1 cubic metre (m ³)	= 35.49373 cubic feet (standard conditions are assumed for conversions of gas: 15°C and 101.325 kPa)
1 square kilometre	= 247.1 acres
1 kilolitre (kL)	= 6.2898 barrels
1 kilopascal (kPa)	= 0.1450 pound-force per square inch (psi)

Imperial

bbl	barrel
bcf	billion cubic feet (10 ⁹)

bopd	barrels of oil per day
mmbbl	million barrels
mm(s)cf	million (standard) cubic feet
mmcf/d	million cubic feet per day
mmstb	million stock tank barrels
psi	pounds per square inch
psia	pounds per square inch absolute
psig	pounds per square inch gauge
scf	standard cubic feet
tcf	trillion cubic feet (10^{12})

Well symbols

Petroleum

⊖	dry
○	oil show
⊗	gas show
●	oil
⊛	gas
✱	oil and gas

Other

- mineral, stratigraphic, water

