Mineral and Energy Resources South Australia – Highlights

Department of State Development

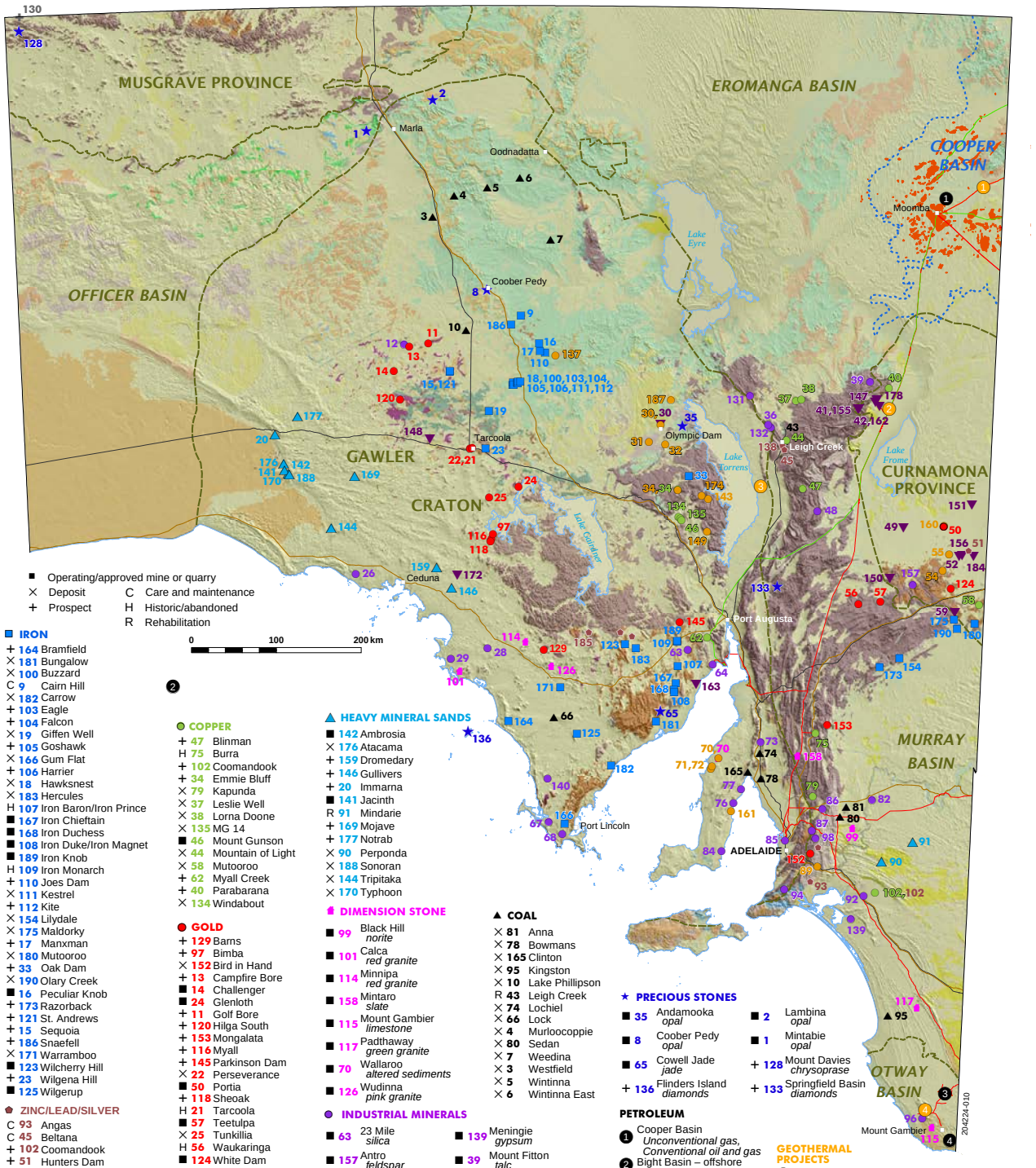
- Continued growth of the Roundtable for Oil and Gas Projects in South Australia (over 1800 members representing companies, government, peak representative bodies, academia and individuals) and ongoing progress on key recommendations of the roundtable through the eight working groups.
- Construction of the new South Australia Drill Core Reference Library on time and on budget. In addition to housing all of South Australia's key geoscience collections and other world-class sample reference collections, this state-of-the-art facility incorporates a core viewing hall, conference and education facilities, 3D theatre and drill core scanning systems.
- Launch of *PACE* Copper, a new $20 million initiative to encourage further exploration and investment in South Australia's copper belt in the next two years.
- South Australia rated best jurisdiction in the Oceania region in the 2015 Fraser Institute Global Petroleum Survey.
- Under the Mineral Systems Drilling Program six drillholes were completed and a seventh underway trialling new technologies to acquire and display geoscience drilling data in near-real-time. Associated geological studies of the southern Gawler Range Volcanics margin complement the program.
- Acquisition and release of the *PACE* Coompana Airborne Magnetic and Radiometric Survey and the AusLAMP magnetotellurics survey.
- Release of interpretations from the western Gawler Craton section of the Eucla–Gawler deep crustal seismic reflection and magnetotelluric profile.
- Joint leadership, with the Department of the Premier and Cabinet, of a cross-agency reference group developing a South Australian Multiple Land Use Framework for release in mid 2016.
- Release of a report on strategic mineral resource areas in South Australia to assist future planning for the state and help minimise conflicts from incompatible developments.
- Publication of the inaugural annual minerals regulation report on compliance activities.
- Release of 13 new and updated guidelines, determinations and policies for mineral exploration and mining.
- Online release of an application template for programs for environment protection and rehabilitation (PEPRs) for on-ground mineral exploration activities, and for mining proposals and associated PEPRs.
- Launch of the new Minerals and Petroleum websites with improved designs and features.

Industry

- Commencement of operations at Havilah Resources' Portia open-pit gold mine in eastern South Australia.
- Achievement of further approvals for Arrium Mining's iron ore operations across the Middleback Range.
- Completion of OZ Minerals' Hydromet research trials to improve copper concentrate quality. Results at Prominent Hill Mine show a process capable of increasing the copper-in-concentrate to more than 50% compared to the globally achieved average of 25–30%.
- Lodgement of a mining lease proposal for Iron Road's Central Eyre Iron Project.
- Lodgement of a mining lease proposal for Lincoln Minerals' Kookaburra Gully graphite project on the Eyre Peninsula.
- Lodgement of a mining lease proposal for WPG Resources' Tarcoola gold project.
- Achievement of mining lease approvals for Klein Point Limestone Quarry (Adelaide Brighton Cement), Mount Compass Sand Quarry and Tooperang Sand Quarry. ■

Government of South Australia
Department of State Development

SELECTED SOUTH AUSTRALIAN RESOURCES



■ Operating/approved mine or quarry
× Deposit
+ Prospect
C Care and maintenance
H Historic/abandoned
R Rehabilitation

IRON
+ 164 Bramfield
× 181 Bungalow
× 100 Buzzard
C 9 Cairn Hill
× 182 Carrow
+ 103 Eagle
+ 104 Falcon
× 19 Giffen Well
+ 105 Goshawk
× 166 Gum Flat
+ 106 Harrier
× 18 Hawksnest
× 183 Hercules
H 107 Iron Baron/Iron Prince
■ 167 Iron Chieftain
■ 168 Iron Duchess
■ 108 Iron Duke/Iron Magnet
■ 189 Iron Knob
H 109 Iron Monarch
+ 110 Joes Dam
× 111 Kestrel
+ 112 Kite
× 154 Lilydale
× 175 Maldorky
+ 17 Manxman
× 180 Mutooroo
+ 33 Oak Dam
× 190 Olary Creek
■ 16 Peculiar Knob
+ 173 Razorback
+ 121 St. Andrews
+ 15 Sequoia
+ 186 Snaefell
× 171 Warramboo
■ 123 Wilcherry Hill
+ 23 Wilgena Hill
■ 125 Wilgerup

ZINC/LEAD/SILVER
C 93 Angas
C 45 Beltana
+ 102 Coomandook
+ 51 Hunters Dam
× 60 Menninnie Dam
+ 88 Mount Torrens
× 185 Paris
× 138 Reliance
+ 61 Telephone Dam

URANIUM
■ 42 Beverley
■ 178 Beverley North
× 162 Beverley South
× 150 Crocker Well
+ 156 East Kalkaroo
■ 147 Four Mile
× 49 Goulds Dam
C 52 Honeymoon
× 184 Junction Dam
× 155 Mount Gee
+ 41 Mount Painter
+ 151 Oban
■ 30 Olympic Dam
H 59 Radium Hill
× 163 Samphire
× 148 Warrior
+ 172 Yarranna

COPPER
+ 47 Blinman
H 75 Burra
+ 102 Coomandook
+ 34 Emmie Bluff
× 79 Kapunda
× 37 Leslie Well
× 38 Lorna Doone
× 135 MG 14
■ 46 Mount Gunson
× 44 Mountain of Light
× 58 Mutooroo
+ 62 Myall Creek
+ 40 Parabarana
× 134 Windabout

GOLD
+ 129 Barns
+ 97 Bimba
× 152 Bird in Hand
+ 13 Campfire Bore
■ 14 Challenger
■ 24 Glenloth
+ 11 Golf Bore
+ 120 Hilga South
+ 153 Mongalata
+ 116 Myall
+ 145 Parkinson Dam
× 22 Perseverance
■ 50 Portia
+ 118 Sheoak
H 21 Tarcoola
■ 57 Teetulpa
× 25 Tunkillia
H 56 Waukaringa
■ 124 White Dam

COPPER–GOLD
+ 31 Acropolis
× 143 Carrapateena
H 54 Dome Rock
+ 34 Emmie Bluff
■ 161 Hillside
× 55 Kalkaroo
■ 89 Kanmantoo
× 174 Khamsin
H 72 Moonta
× 160 North Portia
■ 30 Olympic Dam
■ 137 Prominent Hill
+ 149 Punt Hill
× 187 Vulcan
H 70 Wallaroo
H 71 Wheal Hughes
+ 32 Wirrda Well

NICKEL
× 130 Claude Hills

HEAVY MINERAL SANDS
■ 142 Ambrosia
× 176 Atacama
+ 159 Dromedary
+ 146 Gullivers
+ 20 Immarna
■ 141 Jacinth
R 91 Mindarie
+ 169 Mojave
+ 177 Notrab
× 90 Perponda
× 188 Sonoran
× 144 Tripitaka
× 170 Typhoon

DIMENSION STONE
■ 99 Black Hill *norite*
■ 101 Calca *red granite*
■ 114 Minnipa *red granite*
■ 158 Mintaro *slate*
■ 115 Mount Gambier *limestone*
■ 117 Padthaway *green granite*
■ 70 Wallaroo *altered sediments*
■ 126 Wudinna *pink granite*

INDUSTRIAL MINERALS
■ 63 23 Mile *silica*
■ 157 Antro *feldspar*
■ 76 Ardrossan *dolomite*
■ 98 Birdwood *kaolin*
■ 82 Blanchetown *gypsum*
C 67 Coffin Bay *lime sand*
■ 92 Cooke Plains *gypsum*
R 85 Dry Creek *salt*
+ 12 Garford *palygorskite*
■ 94 Glenshera *sand*
■ 84 Klein Point *limestone*
■ 26 Lake MacDonnell *gypsum*
■ 140 Lake Malata *gypsum*
■ 73 Lochiel *salt*
■ 139 Meningie *gypsum*
■ 39 Mount Fitton *talc*
× 132 Mt Hutton *magnesite*
■ 36 Myrtle Springs *magnesite*
■ 48 Oraparinna *barite*
■ 86 Penrice *marble*
× 28 Poochera *kaolin*
■ 77 Price *salt*
× 29 Streaky Bay Lakes *gypsum*
■ 96 Tantanoola *dolomite*
C 68 Uley *graphite*
■ 64 Whyalla *salt*
H 87 Williamstown *kaolin-sillimanite-mica*
× 131 Witchelina *magnesite*

COAL
× 81 Anna
× 78 Bowmans
× 165 Clinton
× 95 Kingston
× 10 Lake Phillipson
R 43 Leigh Creek
× 74 Lochiel
× 66 Lock
× 4 Murloocoppie
× 80 Sedan
× 7 Weedina
× 3 Westfield
× 5 Wintinna
× 6 Wintinna East

PRECIOUS STONES
■ 35 Andamooka *opal*
■ 8 Coober Pedy *opal*
■ 65 Cowell Jade *jade*
+ 136 Flinders Island *diamonds*
■ 2 Lambina *opal*
■ 1 Mintabie *opal*
+ 128 Mount Davies *chrysoprase*
+ 133 Springfield Basin *diamonds*

PETROLEUM
1 Cooper Basin *Unconventional gas, Conventional oil and gas*
2 Bight Basin – offshore *Oil and gas*
3 Katnook area *Gas*
4 Caroline *Carbon dioxide*
Oil and gas field

GEOTHERMAL PROJECTS
1 Innamincka
2 Paralana
3 Parachilna
4 Limestone Coast

PIPELINES
Gas
Gas and liquids
Liquids

1:2 000 0000 SURFACE GEOLOGY (Age)
draped over DTM image
Pleistocene
Holocene
Tertiary-Pleistocene
Pliocene
Miocene-Pliocene
Eocene-Pleistocene
Eocene-Miocene
Paleocene-Eocene
Cretaceous
Jurassic
Triassic
Permian
Carboniferous
Devonian
Ordovician-Silurian
Cambrian
Palaeo-Mesoproterozoic
Neoproterozoic
Mesoproterozoic
Palaeoproterozoic
Archaean-Palaeoproterozoic

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Current May 2016

Note: This map is updated periodically and can be downloaded from the DSD Minerals website <www.minerals.statedevelopment.sa.gov.au>. Go to Knowledge centre, Resource maps. It is also available from Customer Services, phone +61 8 8463 3000, email <Resources.CustomerServices@sa.gov.au> at A3 , A1 or A0 size for $2, $15 and $20 respectively, plus postage and handling.

South Australian resource production

COMMODITY	2014–15		2013–14	
	Quantity (t)	Value ($)	Quantity (t)	Value ($)
Metallic minerals				
Copper	256 926	1 901 219 210	276 550	2 057 970 732
Gold (g)	10 062	483 876 141	10 089 297	463 810 603
Iron ore – hematite	12 749 683	882 925 012	12 699 775	1 542 769 779
Iron ore – magnetite	1 613 226	207 888 443	3 214 480	393 976 113
Lead	0	0	3 285	5 704 770
Silver (kg)	44 311	29 538 964	150 406	36 219 647
Zinc	0	0	10 159	9 166 155
Total metallic minerals		*3 505 447 770*		*4 509 617 799*
Energy minerals				
Coal	2 771 728	64 752 440	1 942 560	53 423 965
Uranium oxide	3 893	346 534 026	4 484	350 403 166
Total energy minerals		*411 286 466*		*403 827 131*
Construction materials				
Basalt	176 924	3 812 562	92 244	2 017 139
Calcrete	550 303	5 507 166	408 905	4 143 935
Clay	17 454	57 724	6 571	24 890
Clay – red plastic	39 241	190 779	48 089	235 357
Clay – white plastic	184 256	1 205 081	253 895	1 774 622
Dimension stone	24 799	5 749 778	24 163	3 844 333
Dolomite	2 113 425	36 715 564	2 250 015	33 818 303
Epidote	0	0	100	3 500
Feldspar	1 114	39 000	2 815	62 613
Fine tailings	12 807	115 897	9 439	76 978
Gneiss	158 155	2 933 167	161 745	3 020 296
Granite	28 489	705 857	18 828	433 578
Gravel (natural)	144 969	2 726 328	128 289	2 987 217
Ironstone	63 255	713 634	50 640	236 631
Limestone	4 232 893	47 419 069	4 124 329	44 260 765
Marble	475 871	7 162 950	623 248	7 943 767
Metasiltstone	411 916	6 342 930	453 882	7 790 616
Quartzite	1 293 613	19 512 685	1 329 160	18 666 057
Sand	2 517 739	25 505 830	2 565 541	24 574 210
Sandstone	404 439	7 831 130	568 496	8 290 863
Shale	155	3 100	70 353	563 384
Shale – coloured	54 760	177 076	50 398	168 209
Shale – white	56 070	328 569	39 275	206 653
Shell grit	7 779	127 836	6 770	110 766
Siltstone	48 073	707 929	43 823	790 678
Slate	356	70 382	0	0
Total construction materials		*175 662 021*		*166 045 358*
Industrial minerals				
Barite	10 864	1 449 773	14 411	1 556 290
Cement shale	124 864	749 187	54 727	331 646
Diatomite	368	7 295	530	3 126
Dolomite	111 828	3 396 703	329 857	5 970 663
Feldspar	0	0	0	0
Fire clay	15	120	30	240
Foundry sand	588	79 313	0	0
Graphite	20	3 759	0	0
Gypsum	2 126 694	14 609 066	1 809 220	8 752 161
Heavy mineral concentrate	480 174	215 612 916	543 550	237 316 958
Ilmenite*	128 270	12 217 028	144 779	12 005 603
Kaolin	2 577	15 462	4 718	35 382
Leucoxene*	3 369	np	5 273	np
Limesand	27 647	349 518	26 895	314 230
Limestone	1 980 336	13 271 727	1 786 840	12 479 899
Magnesite	3 105	314 103	6 152	543 911
Marble	364 648	6 887 539	2 296 322	29 954 756
Peat	851	38 295	1 406	63 270
Phosphate	1 762	261 877	1 424	181 747
Rutile*	28 104	15 174 750	30 921	16 291 921
Salt	442 887	27 098 243	451 643	14 957 149
Shell grit	23	9 783	73	14 549
Silica	43 257	920 402	35 182	1 242 138
Silica sand	248 934	8 368 670	327 323	11 104 071
Talc	1 504	350 574	4 673	284 507
Zircon*	210 837	169 097 923	233 935	175 549 470
Total industrial minerals		*293 794 323*		*325 106 693*
Gemstones (kg)				
Jade	0	0	0	0
Opal	na	13 300 000	na	13 190 000
Talc	0	0	0	0
Total gemstones		13 300 000		13 190 000
TOTAL MINERALS		***4 399 490 580***		*5 417 786 981*
Petroleum products				
Caroline 1 CO_2 well	6 355	1 701 902	7 311	1 816 290
Condensate (kL)	189 771	107 409 849	228 146	166 746 009
Crude oil (kL)	1 758 366	999 404 447	1 674 037	1 316 492 445
LPG	162 605	120 348 513	152 187	149 898 031
Natural gas (including ethane; Gm^3)	1.44	329 797 974	1.27	253 169 406
TOTAL PETROLEUM PRODUCTS		***1 558 662 685***		*1 888 122 181*
TOTAL RESOURCES VALUE		***5 958 153 265***		***7 305 909 162***

*Individual volumes for ilmenite, leucoxene, rutile and zircon are also included in the heavy mineral concentrate value.
na = not available; np = not available for publication.
Note: Quantities in tonnes unless otherwise specified. These 2014–15 figures may be subject to amendment.

Sources: DSD 6-monthly mineral resource production statistics reports which are available via SARIG (RB 2015/00020; RB 2016/00003).

Mineral Resources

Global benchmarking

Fraser Institute annual survey of mining companies

South Australia continues to perform well across key metrics assessed in the *Fraser Institute annual survey of mining companies*. The survey gauges the opinions of executives and exploration managers in mining companies operating worldwide and in 2015 evaluated data for 109 jurisdictions.

South Australia attained three top ten global rankings:

- Investment Attractiveness (10th), rising from 16th in 2014
- Geological Databases (9th) – in this category South Australia scored 1st for 'geological databases that encourage investment'; this strong performance is consistent with results of previous years
- Legal System (5th).

South Australia continued to perform well across other categories, placed in the top quartile in 8 of 13 categories assessed for positive perception (compared with 10 in 2014).

Despite improvements in Investment Attractiveness, South Australia has fallen in its national ranking to third best overall performer behind Western Australia and the much improved Northern Territory.

The report includes the following comments on South Australia from respondents:

> Best mineral potential in Australia with a government that wants to be a world producer in copper and encourages exploration more than any state in Australia.

> Government departments involved in the resources area have a 'can do' attitude to assisting companies wanting to invest.

RESOURCESTOCKS world risk mining survey

In 2015 South Australia was ranked 11th in the world for lowest risk resource investment destination in the *RESOURCESTOCKS* 2015 World Risk Mining Survey. After four consecutive years (2011–14) as the highest ranking Australian state, South Australia has fallen to second, just behind Western Australia who ranked 10th globally. Respondents were asked to rank their perception of risk according to financial, social and sovereign risk, land access, green and red tape, land claims, infrastructure, civil unrest, natural disasters and labour relations.

Minerals ScoreCard 2014–15

Full report available via SARIG, reference: RB 2015/00034 (.pdf, 2 MB)

The minerals value chain scorecard, initiated in 2001, provides information regarding the performance of South Australia's mineral industry across the exploration, investment, production, processing and export stages of wealth creation. In doing so, the scorecard measures give critical information on the minerals strategic development targets (South Australia's Strategic Plan (SASP), 2011), as well as assisting in the development of programs designed to aid expansion of the minerals industry.

The minerals industry in South Australia contracted from the record high levels of recent years but continues to be driven by:

- The South Australian Government's Plan for Accelerating Exploration (*PACE*) initiative which is credited with incentives for stimulating and maintaining exploration and providing a direct line of sight through the resources value chain.
- Exploration discoveries – evidence of advanced exploration (maiden resource figures and

resource/reserve upgrades released to the ASX) and new drilling discoveries during 2014–15 confirm the state's mineral endowment.

- South Australia's stable and progressive regulatory environment ensured a steady stream of projects progressing to development stage with new capital spending, despite no single large capital projects during this period.
- Global economics – ongoing subdued commodity prices in 2014–15 adversely affected investment in exploration; however, the global demand for South Australian mineral resources remained high and major international companies continued to invest in South Australian mineral projects.

Value chain summary

Key measures for the mineral industry value chain are summarised in Table 1.

Public targeted geo-information expenditure. Geo-information expenditure reached $4.845 million in 2014–15, increasing by $1.045 million (28%) from $3.8 million in 2013–14. This demonstrates the continued commitment of the South Australian Government to stimulate the value chain, particularly during the current downturn in investment.

Mineral exploration expenditure. Exploration expenditure reached $86.7 million in 2014–15, decreasing by $29.6 million (25%) from $116.3 million in 2013–14. Exploration expenditure reached $57.9 million in 2015 (Fig. 1).

South Australia was a national destination for copper exploration, attracting a quarter of Australia's copper exploration expenditure valued at $37.1 million (267%).

Mineral production. Production was $4.399 billion in 2014–15, decreasing by $1.019 billion (19%) from $5.418 billion in 2013–14 (Fig. 2).

Mineral exports. Exports reached $3.636 billion in 2014–15, decreasing by $1.154 billion (24%) from $4.790 billion in 2013–14. This was the result of decreased volumes and values of iron ore, refined copper and copper concentrates exported.

Table 1 *Minerals ScoreCard summary, 2000–01 to 2014–15*

Year	Mineral tenement rent expenditure ($m)	Public targeted geo-information expenditure ($m)	Private exploration expenditure ($m)	New capital expenditure ($m)	Net mine gate production value ($m)	Royalties payable ($m)*	Commodity import value ($m)	Net off-site refining value ($m)	Commodity export value ($m)	Net mineral industry value ($m)
Data source	DSD – TMS data	DSD	ABS Catalogue 8412	ABS Catalogue 5625	DSD	DSD	DSD	DSD estimate	ABS Catalogue 5368 and DSD	DSD
Status	—	—	Not achieved	—	On track	—	—	On track	—	—
SASP targets effective September 2011			Target 41, Minerals exploration expenditure to be >$200m to 2015		Target 42, Production sub-target of $8.5b by 2020			Target 42, Processing sub-target of $1.5b by 2020	Target 37, Total exports: contribute to $25b by 2020	Target 42, Production and processing $10b by 2020
2014–15	**9.8**	**4.8**	**86.7**	**306**	**4399**	**125.5**	**427**	**757**	**3636**	**5156**
2013–14	11.1	3.8	116.3	1052	5418	125.2	488	953	4790	6371
2012–13	10.9	3.0	230.4	927	4854	111.6	504	1077	4099	5932
2011–12	7.4	2.99	328.4	613	5079	119.9	577	1195	4216	6274
2010–11	7.2	2.45	254.7	530	4963	119.4	538	950	4225	5914
2009–10	6.4	3.14	167.9	457	3283	75.2	445	949	2825	4153
2008–09	6.4	3.84	220.7	746	2873	84.3	446	973	2744	3846
2007–08	5.0	3.1	355.2	855	2626	78.0	539	1181	2730	3806
2006–07	3.2	5.6	260.7	760	2497	81.2	365	1176	2354	3673
2005–06	2.3	5.75	146.5	424	2365	73.9	310	997	1972	3365
2004–05	3.0	5.6	66.8	201	1585	47.7	248	1118	1448	2702
2003–04	2.2	5.4	41.7	332	1014	28.4	188	1002	896	2017
2002–03	2.2	5.9	36.7	389	985	29.6	178	999	991	1984
2001–02	2.2	6.4	32.1	270	1023	33.6	202	966	1003	1989
2000–01	2.0	6.1	29.6	245	1262	41.0	216	820	1159	2081

* Not royalty receipts as reported to Treasury. This is the gross royalty figure payable relating to minerals produced during the period; includes funds for the Extractive Areas Rehabilitation Fund.
DSD = Department of State Development; SASP = South Australia's Strategic Plan; TMS = Tenement Management System (application); ABS = Australian Bureau of Statistics.
The 2014–15 figures may be subject to amendment.

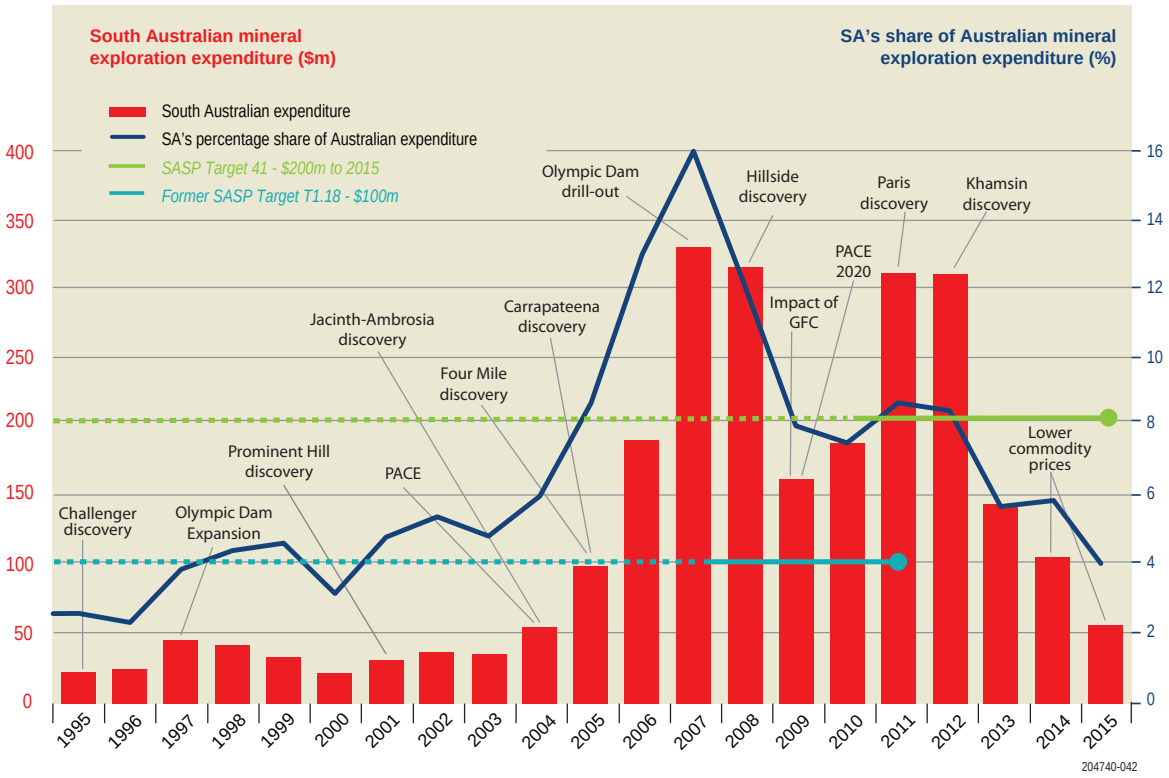


Figure 1 *Private mineral exploration expenditure in South Australia and its percentage of the Australian total, 1995–2015.*

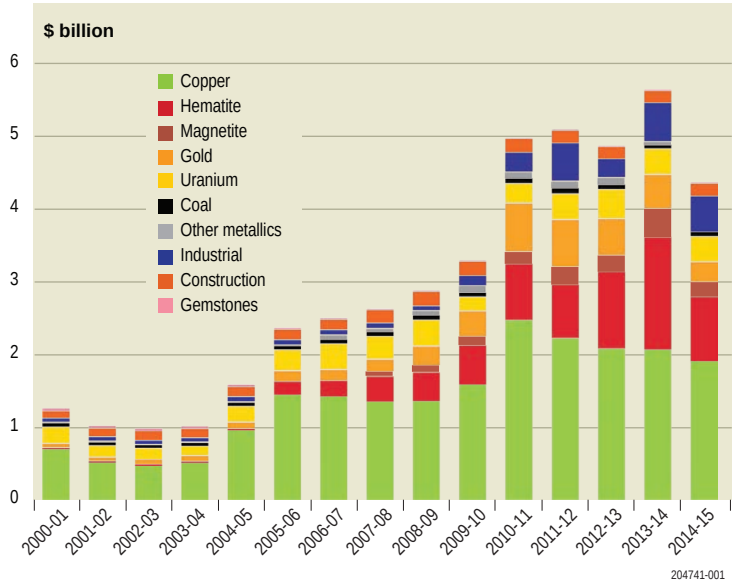


Figure 2 *Value of mineral production in South Australia, 2000–01 to 2014–15. (Based on DSD data)*

Minerals comprise the single largest export sector in South Australia, accounting for $3.6 billion (32%) of the state's total merchandise export value of $11.3 billion for 2014–15.

Net off-site refining. The estimated value was $757 million in 2014–15, decreasing by $196 million (21%) from $953 million in 2013–14. This was generally the result of decreased commodity prices for the major commodities refined in South Australia (iron ore, silver, lead and gold) and marginally lower volumes at Nyrstar's Port Pirie Smelter (except increased volume of lead).

Net mineral industry value (NMIV). The NMIV reached $5.156 billion in 2014–15 (Fig. 3), decreasing by $1.419 billion (22%) from $6.371 billion in 2013–14. NMIV is the combined commodity value of mineral production and estimated net off-site refining from the state's mines and mineral refineries (including the Port Pirie smelter and Whyalla steelworks).

South Australia's Strategic Plan targets

- *Target 41, Minerals exploration: exploration expenditure in South Australia to be maintained in excess of $200 million per annum until 2015*. Not achieved; $86.7 million in 2014–15.
- *Target 42, Minerals production and processing: increase the value of minerals production and processing to $10 billion by 2020.* This comprises sub-targets of $8.5 billion in minerals production and $1.5 billion in minerals processing by 2020. Challenging; reached $5.140 billion in 2014–15.

The minerals industry is the major contributor to:

- ***Target 37, Total exports: increase the value of South Australia's exports to $25 billion by 2020***. Minerals is the largest single sectoral contributor; mineral exports contributed $3.6 billion of South Australia's $11.3 billion exports total in 2014–15.

Australian resources sector value chain and outlook

Based on: Resources and Energy Quarterly, September Quarter, 2015, Department of Industry, Innovation and Science, Canberra (.pdf, 2.4 MB)

The combination of slowing demand growth (particularly in China) and relatively strong supply growth contributed to lower prices for most commodities in 2014–15 (Table 2).

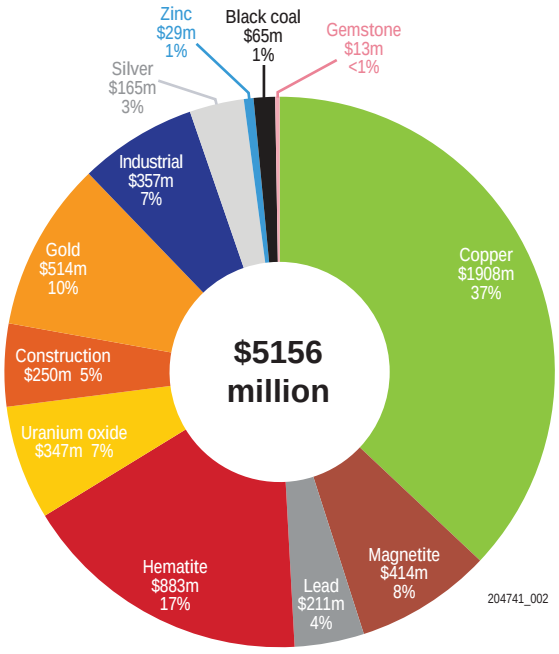


Figure 3 *Net mineral industry value by commodity in South Australia, 2014–15. Total value $5.156 billion (combined mineral production and net off-site refining value).*

The outlook for Australia's resources and energy sector will be characteristically different to the price and investment phases observed over the past decade. In the short term, the resources and energy sectors are transitioning from the investment phase to the production phase.

Australian minerals and petroleum value chain and outlook:

- Australia's mineral and petroleum exploration expenditure in 2014–15 was $5.4 billion, down by $400 million from $6.9 billion in 2013–14. Given generally lower prices forecast for commodities, a rebound in exploration expenditure appears unlikely in the short term.
- Australia's capital expenditure on mining in 2014–15 was $76.1 billion, down by $14.3 billion from $90.4 billion in 2014–15. With global consumption of most commodities slowing and prices falling, mining companies have been shifting their focus from capital expenditure on expanding production, to cutting costs and improving productivity.
- Despite growth in export volumes, export earnings from resource and energy commodities are estimated to have declined by $22 billion from $194.1 billion in 2013–14 to $172.1 billion in 2014–15. Export earnings are forecast to decrease to around $166 billion in 2015–16 as any increase in export volumes are more than offset by lower prices.
- Mining sector employment was 226 000 people in 2014–15, down by 40 000 from 266 000 people in 2013–14. To cut costs and maximise profit margins, many producers have sought to reduce the number of employees. Mining sector employment is not expected to rebound in the short term as a fall in construction labour, associated with declining capital expenditure, is anticipated to more than offset any increases associated with increasing production.

Table 2 *Annual world indicator prices of selected mineral commodities, 2010–11 to 2014–15*

Commodity (unit)	Price				
	2010–11	2011–12	2012–13	2013–14	2014–15
Copper (US$/t)	8 671	8 193	7 675	7 014	6 370
Gold[a] (US$/oz)	1 372	1 671	1 605	1 295	1 224
Silver (USc/troy oz)	2 880	3 309	2 894	2 056	1 734
Uranium[b] (US$/lb)	57.1	51.5	43.4	33.4	36
Iron ore[c] (USc/dmtu)	104.2	132.0	107.0	114.6	72.9
Lead (US$/t)	2 396	2 127	2 132	2 103	1 990
Zinc (US$/t)	2 241	2 020	1 926	1 964	2 206
Nickel (US$/t)	23 963	19 275	16 390	15 233	15 433

Based on: Department of Industry Innovation and Science, Resources and Energy Quarterly, December Quarter 2015.
a = London AM fix, London Bullion Market Association; b = Cameco; c = average export unit value for iron ore and pellets.

Mineral Exploration in South Australia

Commodity highlights and achievements

2015

SOUTH AUSTRALIA

Government of South Australia

Department of State Development

PDF

www.minerals.statedevelopment.sa.gov.au/exploration/mineral_exploration_in_south_australia

Over the medium term there are still factors to support growth in commodities demand, particularly in emerging economies that are investing in housing, infrastructure and manufacturing to support growing populations and industrial bases. The Australian sector is well placed to meet future commodity demand as production starts to increase following a long period of investment.

Mineral Resources Division achievements

Geological Survey of South Australia

The Geological Survey of South Australia (GSSA) has over 130 years of experience as the custodian of geological data and information for South Australia, particularly for use by the resources industry. As part of this, a major emphasis is placed on providing world-class precompetitive geological data to stimulate mineral exploration and discovery as well as attract mineral exploration investment to the state. It also provides advice and assistance across government and to the wider community on South Australia's geology, land use planning and mineral resources.

The South Australian Government's *PACE* initiative is closely linked to funding and activities for the GSSA. For 2015 this has included activities from the later part of the $4 million *PACE* Frontiers program and a new focus towards the commencement of the $20 million *PACE* Copper program. *PACE* continues to be a critical investment in maintaining exploration momentum within South Australia and provides crucial funding for maintaining the GSSA's collaborative work with industry, research and government partners.

A major influence on the GSSA's 2015 program and activities has been the development of the national UNCOVER initiative. A highlight for this in 2015 included the release of Stage 1 of AMIRA International's *Roadmap for exploration under cover*. This compiles industry-driven priorities and needs for focus to improve mineral exploration success in areas where mineral exploration targets have otherwise been concealed by cover, which is the situation for over 80% of South Australia. The National Mineral Exploration Strategy, of which the GSSA is a key member, is closely aligned to UNCOVER and the findings from the UNCOVER roadmap. The GSSA Director was a member of the UNCOVER Executive Committee and the Geoscience Committee in 2015. Further details and copies of the roadmap and strategy can be downloaded from the UNCOVER website <www.uncoverminerals.org.au>.

The top 10 highlights for the GSSA in 2015 include:

- Mineral Systems Drilling Program and associated geological studies of the southern Gawler Range Volcanics margin.
- Benchmark uranium resource publications and contributions to the Nuclear Fuel Cycle Royal Commission.
- Eastern Gawler Craton new iron oxide – copper–gold (IOCG) mineral system insights and solid geology map release.
- Western Gawler Craton margin and Coompana Province targeted geoscience.
- South Australian Magnetotellurics Program, including AusLAMP.
- New geological map releases (WINTINNA 1:250 000 scale, Mount Painter region 1:100 000 and FOWLER digital) and Curnamona Province mapping.
- International and national partnerships.
- State geoscience data compilations and databases.
- *PACE* Copper within the South Australian Copper Strategy.
- Construction of the new South Australia Drill Core Reference Library.

The administrative groups within the GSSA are:

- Regional Geology and Mapping team
- Mineral Systems team
- Geophysics and Prospectivity team
- Resource Evaluation and Planning team
- Geoscientific Information Management program.

Regional Geology and Mapping

The Regional Geology and Mapping team was heavily involved in leading three of the GSSA's major geoscience projects: Southern Gawler Ranges margin, Geology and mineral potential of the Curnamona Province, and Western craton margins (amalgamating the former Mapping the Musgrave Province and Eucla/Western Gawler Craton basement projects).

Work on the southern Gawler Ranges margin was closely integrated with the Mineral Systems Drilling Program, with field mapping focused in surrounding areas at Cariewerloo, Peltabinna and Mount Double. Team members also carried out core logging and sampling for the program. Compilation of mapping was accompanied by oxygen and lead isotope and geochronological investigations, targeted field visits to related outcrops, an industry workshop, and sponsorship of a University of Adelaide honours project. Epithermal-style mineral textures, brecciation, veining and alteration were described in a report book and *MESA Journal*

article, and a report book summarised a field trip run to support the Chief Government Geologists' meeting. Two report books detailed the refined stratigraphy of the lower Gawler Range Volcanics in the southeastern Gawler Ranges and included broader stratigraphic revisions. Work continued on a regional study of the metal sources and lithological and structural controls of Pb–Zn–Ag mineral systems on Eyre Peninsula and a regolith map of the southern Gawler Ranges margin.

Mapping and compilation also continued for the geology and mineral potential of the Curnamona Province. Surface geology and solid geology interpretations for KALABITY (1:100 000) map sheet have been completed, and generalisation of the surface geology for nominal 1:100 000 scale is proceeding, along with solid geology interpretation for MULYUNGARIE. Support was also provided for a project investigating the palynology and geochronology of Mesozoic sediments surrounding the Mount Painter and Mount Babbage Inliers. The enigmatic Sprigg Diamictite Member of the Mount Painter Inlier was defined in a *MESA Journal* article. In May GSSA joined with the Geological Survey of New South Wales to hold the Resources Investment Conference and Uncover Curnamona Technical Forum in Broken Hill. Several presentations and posters were delivered, and four products were released: *South Australian uranium occurrences map* (7th edn), *Uranium and uranium mineral systems of South Australia* report book (3rd edn), *Mount Painter region* 1:100 000 geology map and *Geological field excursion guide: from Arkaroola to Paralana Hot Springs*. The preliminary KALABITY map sheet was also displayed.

The Western craton margins project was focused on the interpretation and delivery of the data from the western Gawler Craton section of the 13GA-EG1 deep crustal reflection seismic profile, a collaboration with Geoscience Australia, Geological Survey of Western Australia and AuScope Earth Imaging. This culminated in an industry workshop and release of an extended abstracts volume in December. Work now continues on interpreting the Coompana Province section of the line and the newly acquired Coompana airborne survey. Team members also carried out fieldwork and sampling of the few drillholes available and held discussions with exploration companies working in this poorly known area. Work in the Musgrave Province continued on the compilation of ALCURRA explanatory notes alongside generalisation of surface geology and compilation of solid geology for ALCURRA and AGNES CREEK (part of), and geochemical data interpretation. Geological advice and field assistance was provided to the Department of Environment, Water and Natural Resources (DEWNR) towards securing water resources for the Anangu Pitjantjatjara Yankunytjatjara (APY) Lands, including reports and maps of areas around key APY communities. Planning commenced for an aerial electromagnetic survey over the central and eastern Musgrave Province in collaboration with Geoscience Australia, CSIRO and DEWNR, to be flown in 2016.

Planning began for the Australian Earth Sciences Convention to be held in Adelaide in June 2016. The GSSA is a major sponsor and contributor to this event and two team members are on the organising committee. Several team members will be involved in running field trips and workshops, as well as convening sessions at the conference.

Team members have presented results of their work and represented GSSA at a number of other conferences and events, notably at Minerals Exploration RoundUp (Vancouver, Canada; January), UNCOVER workshop 3 (Perth; February), Science in the Surveys seminar (Adelaide; March), South Australian Resources & Energy Investment Conference (SAREIC) and Technical Forum (Adelaide; April), AusIMM International Uranium Conference (Adelaide; June), Diggers & Dealers Conference (Kalgoorlie, WA; August), Eucla Basement Stratigraphic Drilling Results Release Workshop (Perth; September), the Volcanic Processes, Products, Successions and Resources short course (Merimbula, NSW; November), and South Australian Exploration and Mining Conference (Adelaide; December). A South Australian uranium mineral system core display was organised for the International Uranium Conference. An invited talk was given at the 4th Asia Pacific Luminescence and Electron Spin Resonance Dating Conference in Adelaide.

Other products released include the WINTINNA geological map and explanatory notes, *The Adelaide Geosyncline* bulletin (published in 1987) as a text-searchable pdf on CD, and report books documenting the presentations and drillcore selected for the core shack display at SAREIC. The WINTINNA map was displayed at the 2015 International Cartographic Exhibition in Brazil in August through the Mapping Sciences Institute Australia. Five peer-reviewed articles were published in international journals including *Applied Earth Science, Precambrian Research* and the *Australian Journal of Earth Sciences*.

Several team members have contributed to supervision or guidance of vacation students, and honours and PhD students. One team member accompanied the University of Adelaide study trip to New Zealand in February, and provided valuable insights into the application of geology in his role as a mapper in the GSSA, and what the GSSA does in regard to data collection, compilation and publication. A field trip to Hallett Cove and an optical mineralogy session were run for DSD's annual Geosciences Summer School.

Two regolith science workshops were held to spread the knowledge across the mapping team. A half-day regolith mapping module of the Minerals Tertiary Education Council regolith course was delivered at the Australian National University in Canberra. Photographic metadata capture and sample preparation for permanent storage for a regolith sample atlas is nearing completion.

Geological advice and review were provided on numerous occasions, including for a 1:2 500 000 bedrock geology map of Australia (Geoscience Australia), National ICT Australia machine learning modelling project, UNCOVER roadmap, draft management plans for the Arkaroola Protection Area, Breakaways and Flinders Ranges National Park, and for several company and international visitors.

Work continued on streamlining and refining the capture of digital field data using field tablet devices in cooperation with the Geoscientific Information Management team, including production of a glossary of validated lithology modifier terms and landforms. Closer collaboration with Spatial Information Services (part of Primary Industries and Regions South Australia) aims to streamline and enhance the processes involved in preparing, storing and presenting digital map data.

A substantial groundwater hydrochemistry dataset for the southwestern part of South Australia was uploaded to SA Geodata and is available through the DEWNR WaterConnect website; a draft co-branded report with CSIRO has been produced incorporating this new data and existing groundwater hydrochemistry data throughout the state.

Team member Rian Dutch received the Walter Howchin Medal from the Geological Society of Australia (SA division), which is awarded to a researcher (35 years and younger) in the early stage of their career and distinguished by their significant published work within South Australia, or from a South Australian base.

Mineral Systems

The focus of the Mineral Systems team in 2015 was on mineralisation developed along the southern margin of the Gawler Range Volcanics. This included techniques to explore through the base of the volcanic rocks in close vicinity to major structures that were possible fluid conduits for mineralising solutions during the c. 1590 Ma thermal event. The Mineral Systems Drilling Program was commenced in July 2015 in collaboration with the Deep Exploration Technologies Cooperative Research Centre (DET CRC) and mineral exploration companies Kingston Resources Limited and Minotaur Exploration Limited. Prior to commencement of drilling, geophysical targets were evaluated and drillsites were prioritised in consultation with exploration teams from each company. Work programs were prepared and site clearances were conducted with traditional owner representatives for the Barngarla people and the Gawler Ranges Aboriginal Corporation with respect to Aboriginal heritage, and also with staff from DEWNR for sites within the Gawler Ranges National Park. Two contract geologists with extensive drillsite experience were employed to manage the day-to-day field operations and to coordinate safety aspects for the department.

During 2015 six fully cored diamond drillholes were completed and a seventh hole was underway for a total of 4291 m. Four holes were with Kingston Resources on their Six Mile project, northwest of Port Augusta; three holes were with Minotaur Exploration on their Peltabinna project in the Gawler Ranges. Drilling contractor, Boart Longyear, worked closely with researchers from DET CRC to facilitate field testing of various instruments deployed to provide real-time sensing of factors affecting drilling performance and for downhole measurement of rock properties. Drill cuttings were recovered from circulating drill fluids using a solids

The Mineral Systems Drilling Program 2015 is a new and innovative program designed to improve our understanding of the geology of northern Eyre Peninsula. It incorporates a world-first trial of new technologies set to advance the success of mineral exploration. (Photo 414780)

recovery unit. Dried sub-samples, representative of 1 m intervals, were analysed on-site using portable X-ray fluorescence for chemical analyses and X-ray diffraction for sample mineralogy, as deployed on Reflex's mobile Lab-at-Rig®. Water chemistry was also continuously monitored using element-selective electrodes. Core samples were progressively transported to Adelaide for further analyses, including HyLogger™ spectral scanning for spectral mineral analysis. The Mineral Systems Drilling Program has a critical role in field testing new technologies, adopted or under development at DET CRC, with the objective of fast tracking their evaluation for commercialisation.

In conjunction with the drilling, detailed mapping of the surface geology in the area around the drillsites is underway and data on mineralisation in the district is being compiled and evaluated with the aim of revising current mineral system models – preliminary results were presented in April 2015 at the SAREIC Technical Forum (abstracts in Report Book 2015/00006). The present investigations complement new ideas on primary controls on fluid sources for IOCG mineralisation in the eastern Gawler Craton by Reid and Fabris, which were published during 2015 in international journal *Economic Geology* (110:2147–2157).

HyLogger spectral scanning of drill core held at the Glenside Core Storage facility continued during the first half of the year, but was suspended in the second half year to accommodate preparations for the relocation of the drill sample collection to new premises at Tonsley. In May a spectral analysis workshop for industry was held at Glenside using drill core from the Wirrda Well IOCG deposit, courtesy of BHP Billiton. Background information on the deposit was presented at the workshop by Kathy Ehrig, principal geometallurgist with BHP Billiton. Spectral projects completed in support of DET CRC studies included comparison of quantitative mineralogy using automated spectral and X-ray diffraction methods, and a review of spectral analyses of data from the Hillside Cu–Au deposit.

Geochronology projects completed during the year included a summary of zircon U–Pb dating of selected igneous rocks on the Gawler Craton (Report Book 2015/00025) and publication of results of a sponsored project at the University of Adelaide (Kathleen Lane) on zircon age constraint on the timing of iron ore mineralisation at the Warramboo magnetite deposit, central northern Eyre Peninsula (*Australian Journal of Earth Sciences* 62:55–75). Collaborations continued with the University of Tasmania's Centre of Excellence in Ore Deposits on determining metamorphic conditions across the western Gawler Craton, and with Boise State University, Idaho (US), on the timing and duration of igneous and volcanic activity represented by the Hiltaba Suite granites and Gawler Range Volcanics.

A comprehensive summary of the state's uranium deposits and uranium mineral systems was revised and updated (Report Book 2015/00011). The potential for unconformity-style uranium mineralisation in the Cariewerloo Basin was reassessed based on patterns of mineral alteration in the Pandurra Formation derived from analysis of short-wave infrared spectral data of drill core. Results were presented at the SAREIC Technical Forum. Uranium mobilisation and redispersion in the Callabonna Sub-basin were re-examined based on interpretation of regional airborne electromagnetic data acquired earlier by Geoscience Australia, together with spectral mineralogy from HyLogger scans of selected stratigraphic drillholes from the district.

In collaboration with Murray Zircon Pty Ltd, the provenance of zircon in heavy mineral sand deposits in the western Murray Basin was determined from the distribution of zircon ages obtained by U–Pb isotope analyses (Report Book 2015/00031). Results of this work and earlier studies are being incorporated in a review of heavy mineral distribution in sedimentary basins in South Australia.

Geophysics and Prospectivity

Geophysical surveys. The Coompana Airborne Magnetic and Radiometric Survey, recorded between February and November 2015, is the largest single airborne survey flown in South Australia. The 255 800 line-km survey, extending over ~86 000 km^2, collected magnetic and radiometric data at 80 m flight height and 400 m line spacing. Infill data was recorded at 200 m line spacing over the Coompana magnetic anomaly in the southwest to capture features at even higher accuracy. Previous interpretations of the Coompana survey area and its margins suggest parallels with geological systems hosting Cu–Ni sulfides, such as the Nova prospect in Western Australia, immediately to the west.

A gravity survey was conducted over the Uno Fault in the southern Gawler Ranges to better determine the position of the fault. This work is of relevance to mineral deposits in the region, which are believed to be related to the Uno Fault.

Geophysical images. As part of an initiative to provide the highest quality and most current reprocessed, merged gravity and total magnetic intensity data, regional grids covering the combined northern Gawler Craton, eastern Gawler Craton and southern Gawler Ranges were released. The image series include derivative images of gravity and total magnetic intensity and can be downloaded via SARIG. Examples are displayed in Figure 4.

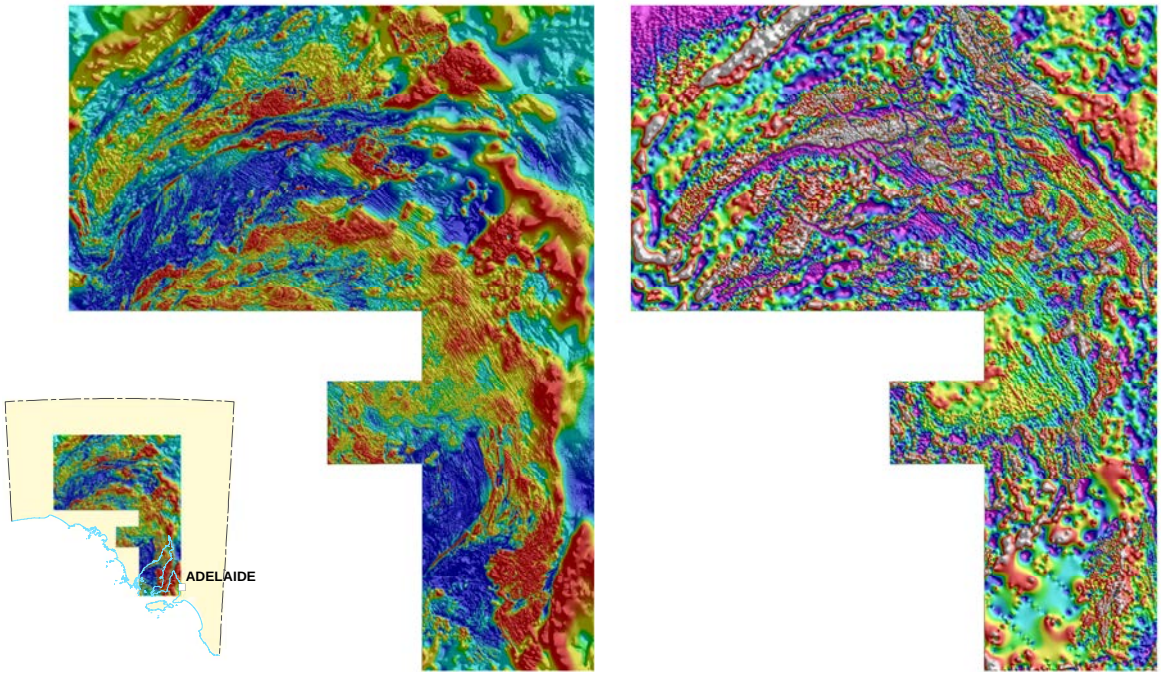


Figure 4 *Reduced-to-pole total magnetic intensity (left) and residual gravity (right) are among the derived images available via SARIG for the northern and eastern Gawler Province and southern Gawler Ranges.*

Gawler Province. The eastern–central Gawler Craton solid geology was re-interpreted and released as a new map and geoscientific data package (00034). Up-to-date drillhole stratigraphy and reprocessed and merged magnetic intensity and gravity grids were used. Solid geology interpretation is now expanding into the western Gawler Craton; a report, *What lies beneath the western Gawler Craton?* (Report Book 2015/00029), was released for the 13GA-EG1E Seismic and Magnetotelluric Workshop 2015.

Depth to crystalline basement. The depth to crystalline basement geoscientific data package (00003) was updated and is available via SARIG. It includes newly acquired drillhole depth information as well as a 3D triangular irregular network surface, crystalline basement elevation, depth of cover grids and a data reliability map that highlights areas of sparse and abundant data. Figure 5 shows application of this data in the UNCOVER initiative, illustrating relationships between mineral deposits and depth of cover in South Australia. The data package has great utility in geological modelling and interpretation.

3D models. Two new 3D models have been added to the 3D model library. The eastern Gawler IOCG/Woomera Prohibited Area model integrates 100 years of data into a seamless model. It forms part of a collaborative project between DSD, University of Adelaide and DET CRC, and includes publicly available datasets as a background to visualise and interpret new data generated within the project and, specifically, within the regional Mineral System Drilling Program. It will be used to assess IOCG mineral prospectivity in the eastern Gawler Craton and gaps analysis.

The Fleurieu Peninsula earthquake hypocentres 3D model displays 100 high quality earthquake measurements from 2007 to mid 2015 from an area with the densest seismograph coverage.

Magnetotellurics (MT) – AusLAMP. The AusLAMP MT survey, carried out through 2015, acquired data at a regular half-degree grid to complete a coverage south of 28.5° latitude. It is a joint GSSA, University of Adelaide and Geoscience Australia project. Geoscience Australia co-invested $260 000 to complete the Maralinga Tjarutja Aboriginal Lands area in late 2015. Modelling of the central Gawler Craton was presented at the 26th International Union of Geodesy and Geophysics conference in Prague, 2nd Lithosphere workshop (Perth), Broken Hill Symposium, and SAREIC Technical Forum. AusLAMP modelling of Curnamona and Flinders Ranges is almost complete and an article is in preparation for a peer-reviewed journal.

Other MT-related work included the western Gawler – Eucla MT survey; modelling and presentation at the Eucla workshop (WA) in December; audio MT and broadband MT 2D and 3D modelling of two profiles across Peltabinna (Minotaur) as in-kind support to the Mineral Systems Drilling Program;

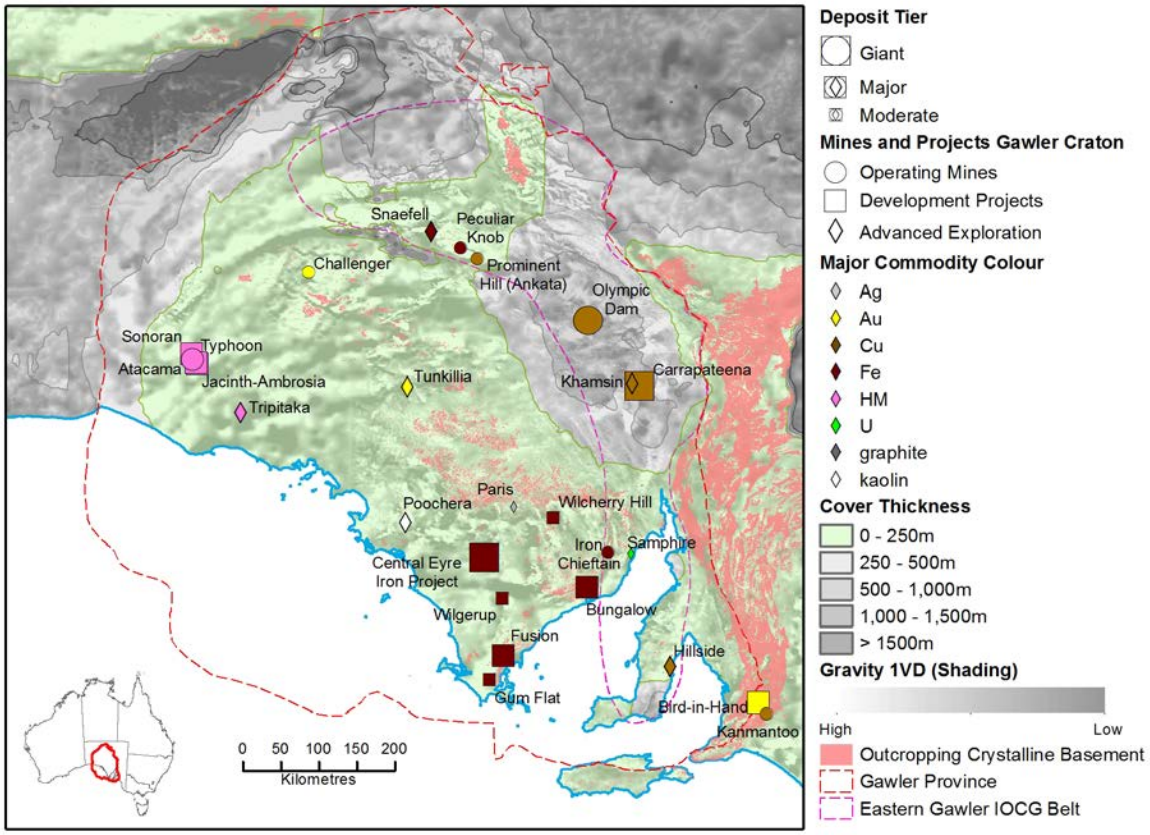


Figure 5 *The depth to crystalline basement dataset has been used to produce a cover thickness map that illustrates relationships between cover thickness, commodities and deposit locations.*

and conductivity structure used for targeting with alteration detection success.

Conferences. Several team members attended the 24th International Geophysical Conference and Exhibition in Perth in February, contributing four posters and one presentation. See 'Publications' for a list and hyperlink options. A presentation on applying spatial statistics to gravity anomalies to define the extent of IOCG systems in the eastern Gawler IOCG Province was given at the OZRI Conference in Melbourne, Australia's premier GIS event.

Resource Evaluation and Planning

Advice on mineral resource aspects of mineral tenement applications (20) and land use planning matters (33) was provided to government along with the assessment of applications for four exploration release areas. Information on the state's mineral resources, including metallic minerals, industrial minerals, dimension stones and construction materials, was provided to government and other stakeholders.

Two new 1:50 000 mineral resource potential maps were completed, *Cape Jervis* and *Meningie*. Resource potential mapping has provided the basis for a report on identification of strategic mineral resource areas in South Australia (Report Book 2015/00017) to assist land use planning. This was complemented by a new interactive layer developed in SARIG summarising mineral resources of the Greater Adelaide Region.

New records (306) were added to the mineral deposits database (MINDEP) which now contains a total of 8087 records. MINDEP underpins the SARIG Mines and Mineral Deposits layer as well as DSD's commodity resource appraisals. A MINDEP poster presentation was displayed at SAREIC.

As part of ongoing assistance to the opal industry reports were published on the Andamooka opal exploration program and geochronology of alunite and opal formation at Coober Pedy (Report Books 2015/00005 and 7). Reports were also published on the Eurelia kimberlite province and historical Woodside Goldfield (Report Books 2015/00008 and 22).

Geoscientific Information Management

Mineral exploration drilling and sample analysis data from statutory reporting continued to be added to the corporate database. A total of 2087 drillholes (2059 open file, 28 confidential) and 41 198 drillhole and surface samples were added with their associated 772 397 individual analyte results.

Indexing of reports added to SAMREF continued as an essential part of making company and other technical information discoverable, primarily via SARIG.

The field digital data capture system continues to be enhanced according to user and system requirements.

Monitoring and interpretation of seismic events through the state seismic network is an ongoing task for the seismology unit. Seismology staff maintain close links with the state's emergency services sector and with Geoscience Australia staff involved with the national-scale seismic network.

The technical support unit provided logistical support for staff of GSSA and other business units.

Drill Core Reference Library. The Core Library continued to provide world-class facilities and service to clients, operating sites at Glenside, Thebarton, Moonta and Whyalla. In 2015 there were 997 visitors, with 134 inspections of 106 564 m of drill core.

Normal operations were suspended from 1 August 2015 to allow preparation and movement of existing Core Library contents at Glenside, Whyalla, Moonta and Thebarton to the new South Australia Drill Core Reference Library at Tonsley. At end 2015 the Tonsley facility had been constructed to the stage of initial occupation and use of the main storage space. Relocation of Glenside and satellite library contents to the new facility continues. Normal operations, including core inspections, are expected to resume at Tonsley by July 2016.

A total of 160 pallets of core/samples were received prior to the temporary suspension of operations.

Fifty pallets of core were remediated from outdoor storage at Moonta Core Library, making a total of 300 pallets since the retraying program began.

The HyLogger core scanner was moved to Thebarton for several months prior to being installed at Tonsley.

The Data Metallogenica collection was prepared for rehousing at Tonsley where it will be available for subscriber inspection by appointment.

PACE – major programs

***PACE* Discovery Drilling 2015.** In December 2014 the South Australian Government announced an eighth round of collaborative drilling – *PACE* Discovery Drilling 2015. The call for proposals was made at the South Australian Exploration and Mining Conference, 5 December 2014, and the final submission date was 30 January 2015. Thirty-five proposals were received, of which 27 were selected (Table 3; Fig. 6). These programs are currently underway with the round scheduled for completion by 30 June 2016.

A total of $13.05 million has been directed towards 217 successful exploration drilling projects through *PACE* Collaborative Drilling (Rounds 1 to 7 inclusive), with these projects spread across all regions of the state and targeting a wide range of deposit styles and commodities.

The Geoscientist Assistance Program (GAP). The program was relaunched in April 2015 with the South Australian Government, through the *PACE* Initiative, committing $425 000 over two years ($225 000, 2015–16; $200 000, 2016–17) to re-establish the program. This announcement

Table 3 *Summary of PACE Discovery Drilling 2015 proposals*

PACE Discovery Drilling 2015	
Number of proposals	35
Number of funded proposals	27
Total funding	$2 000 000
Estimated additional company expenditure	$4 938 325
Total estimated expenditure	$6 938 325

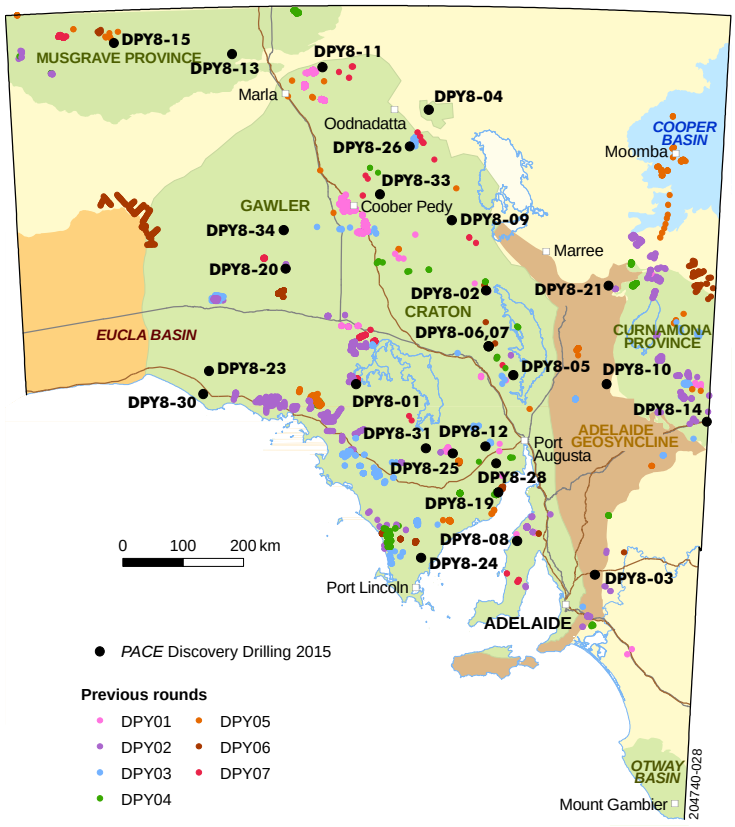


Figure 6 *Locality map showing the locations of PACE Discovery Drilling 2015 projects (DPY8) as well as previous collaborative drillholes.*

was met with overwhelming support and generated significant interest from companies wishing to submit project proposals and employ exploration staff. In light of this interest, the 2016–17 financial commitment payment was brought forward to ensure:

- program funding is available when it is most critically needed
- company exploration programs and recruitment are not inhibited by a lack of funding
- funds are available to support the 2015 mid-year and end-of-year geoscience graduates.

GAP is a collaborative effort between DSD and the South Australian Chamber of Mines and Energy, with further strong linkages to local universities and the mineral and energy resources sector. Its reintroduction was one of 12 recommendations put forward in the evaluation of the *PACE* initiative report published in May 2014 (Report Book 2014/00014).

The new program is a critical step for the state in addressing current job losses, ensuring companies have every opportunity to maintain their current exploration momentum. From its launch to the end of 2015, the new GAP program placed 11 graduate and experienced geoscientists within nine different companies and saw six companies extend their involvement with the program from three to six months.

***PACE* Copper.** For more than a decade the South Australian Government has actively invested in the state's minerals and energy sector to capture new exploration investment, promote discovery, stimulate job growth within the sector and position South Australia as an exploration and mining friendly jurisdiction. The flagship under which this critical industry development work has been delivered is the highly successful and internationally renowned *PACE* initiative.

The government's newest precompetitive geoscience initiative – *PACE* Copper ($20 million; 2015–16 to 2016–17) was announced by the Minister for Mineral Resources and Energy on 30 November 2015. *PACE* Copper is designed to transform mineral exploration opportunity and activity, bringing forward new discoveries and setting the vital foundations for the next generation of resources industry growth and job creation in the services, supplies and manufacturing sectors. The investment is strongly outward looking with a focus on the provision of the most contemporary and accessible precompetitive geoscientific data and information, a program of direct government–industry collaborations and open access to a range of innovative research programs and their results.

The *PACE* Copper work program is a critical component of the state's Copper Strategy in driving discovery of the new high quality copper resources required to meet the copper production goal of 1 Mtpa by 2030. This program is also a direct response to the recommendations put forward by the evaluation of the *PACE* initiative report.

The program directly addresses key exploration challenges highlighted during the recent Copper Strategy workshop including:

- a focus on expanding the copper search space on the discovery-proven Gawler Craton
- delivery of new, coherent and detailed geophysical, geochemical and depth to basement data to support successful exploration undercover
- application of new techniques and new technologies to the investigation of known deposits and to fully understand our copper mineral systems.

PACE Copper is comprised of a number of innovative programs including:

- high-resolution airborne geophysics and ground geochemistry survey(s) of the Gawler Craton designed to bring forward:
  - new discoveries of copper, gold, uranium, mineral sands and groundwater resources
  - high-resolution terrain and surface mapping to facilitate regional engagement with traditional owners/claimants on access to land for exploration.
- Targeted drilling, geochemistry and geophysics in the Far West of South Australia ahead of release of the area for competitive exploration application.
- A further 2016–17 round of industry collaborative drilling across the state with significant increase in grant ceiling to $250 000 and an expansion in claimable expenditure, including assay costs and site clearance expenses.

Mineral Tenements and Exploration

The Mineral Tenements and Exploration Branch is responsible for the administration and grant of secure mineral exploration and mining titles pursuant to South Australian legislation. The branch is also responsible for the assessment, approval and compliance monitoring of mineral exploration activities throughout South Australia. Key achievements for the branch in 2015 are summarised below.

Mineral tenements

In 2015, 246 applications for exploration licences were received, an increase from 238 in 2014. A total of 154 exploration licences covering 64 428 km^2 were granted, a decrease from 182 covering 71 122 km^2 in 2014. At 31 December 2015 there were 725 active exploration licences covering 333 928 km^2 held by 178 licensees registered in the Mining Register, a decrease from 812 licences held by 185 licensees in 2014 (Table 4; Fig. 7).

In 2015, 23 mineral claims were received, an increase from 13 in 2014. Eleven production temements were granted (2 mineral leases and 9 extractive minerals leases), a decrease from 21 in 2014 (8 mineral leases, 7 extractive minerals leases and 6 miscellaneous purposes licences).

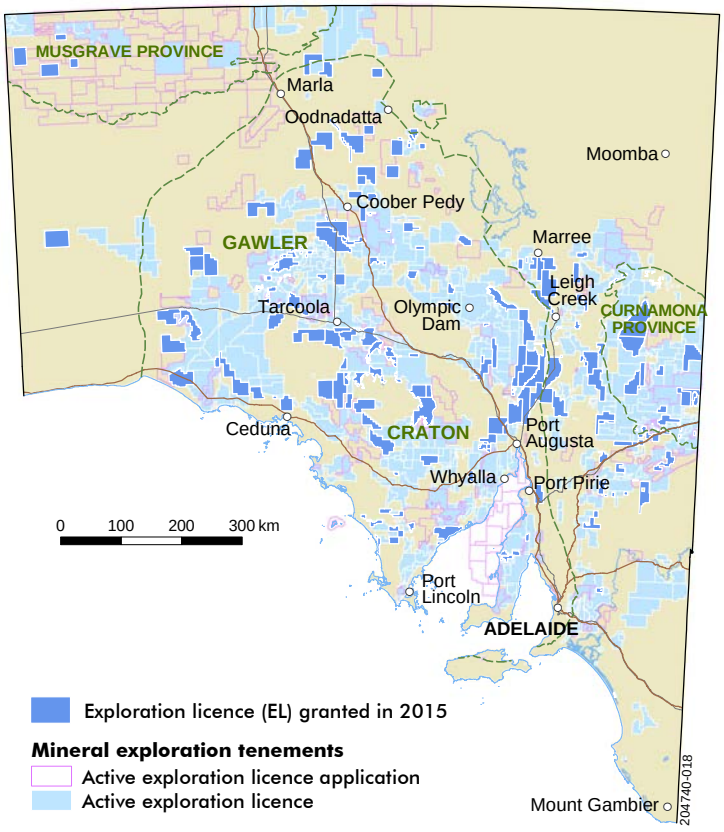


Figure 7 *Mineral exploration licences granted in South Australia in 2015.*

The Mining Registrar, Deputy Mining Registrar and Project and Court Officer attended several community forums during the year, including focused community consultation and general field days. These forums provide opportunities for communities to better understand the *Mining Act 1971* and land access issues and for team members to understand the issues being faced by the communities impacted by exploration and mining. Staff continued to develop specialised skills through formal studies, attending conferences and workshops and undertaking site visits, where possible.

The Central Eyre Iron Project was a significant focus, with the branch responsible for the distribution of the mining lease application to a large number of stakeholders. Pre-planning and a collaborative approach across the Mineral Resources Division saw this task completed efficiently and effectively. Logistics and promotional material for public meetings were organised. Meetings were held over three days in different locations on the Eyre Peninsula enabling effective, professional engagement with the local community regarding this project. The Deputy Mining Registrar was in attendance.

Implementation of updated documents for all mining lease, miscellaneous purposes licences and retention leases granted since 2011 was completed. Changes to the Mining Regulations 2011 were also communicated to industry and implemented during the year. The most significant change ensures applicants are provided an opportunity to make a submission on proposed terms and conditions of a mining tenement prior to determination of the application.

Participation in continuous improvement processes across the Mineral Resources Division has included input into the development of various system improvements and updating of multiple process maps and procedure manuals. Significant progress has been made towards a shift to digital management of mining tenement correspondence and files.

South Australia's mineral tenements are administered and managed using the Tenement Management System (TMS) application. TMS currently records information on 12 070 tenements, both active and inactive. System improvements have been made to allow for the online payment of monthly royalties, streamlining of receipting and

Table 4 *Tenement activity in South Australia, 2011 to 2015*

	2011	2012	2013	2014	2015
Number of exploration licences	870	967	937	812	725
Area of exploration licences (km^2)	401 005	449 928	398 927	338 697	333 928
Number of licensees	187	198	198	185	178

processing of client payments, and an increase in the amount of information provided through SARIG. Other enhancements include a module for strategic mineral resource areas and improved record keeping on exploration licence expenditure and drilling programs. Twenty-five new reports were deployed to TMS in 2015, allowing DSD staff to better track and report on their business areas.

Exploration assessment

During 2015, 685 exploration licence (EL) technical/regulatory assessments were completed. This included the assessment of 213 EL applications, 201 EL renewals, 42 amalgamated expenditure arrangements (AEAs), and 28 dealings (EL transfers/agreements). The provision of technical/regulatory advice to government and industry in relation to EL regulation and related issues also took place. This included a large number of meetings with EL holders, including the conduct of 33 AEA review meetings.

During 2015, 178 ERAs covering 71 153 km^2 were released. Forty-five applications for ERAs were lodged by interested parties with five ERAs receiving applications from two or more parties. Additional exploration investment committed for ERAs awarded during 2015 (above the minimum standard commitment) totalled $6.1 million. One special declared area was released: ERA 683 covering ~72 km^2 within the central Middleback Range, east of Iron Baron. This included value-adding by releasing via open file all data from the ERA so that it was available to industry prior to calling for applications over the area, and providing additional information on geology, mineral potential and available geoscientific datasets.

Strategic policy and project work pursuant to best practice regulation included: provision of advice and input into the Productivity Commission's Inquiry report into non-financial barriers to mineral and energy resource exploration implementation status; provision of advice and input into the review of the *Aboriginal Heritage Act 1988* and proposal for statutory agreement-making process; input into the Part 9B of the Mining Act post-forum report to industry; inter-agency collaborative work in relation to the new *Aboriginal Lands Trust Act 2013* and its interaction with mineral tenements within these lands including the Yalata Aboriginal Reserve; input into conservation and national park proposals from the Department of Environment, Water and Natural Resources; and review and development of operational policy and procedures to impose an administrative penalty for EL reporting noncompliance. Streamlining and improvement of the SARIG application portal and a number of internal processes and procedures were also undertaken.

Exploration regulation

A total of 149 exploration work applications (programs for environment protection and rehabilitation, PEPRs) were approved in 2015, a decrease from 197 in 2014 (Table 5; Fig. 8). Drilling metres approved in 2015 (477 140 m) also decreased compared to 2014 (514 969 m; Table 5). These figures continue to show a consolidation of exploration drilling around existing projects and brownfield areas. The downward trend in exploration applications and approved metreage is expected to continue in 2016.

Applications within environmentally sensitive areas (including regional reserves, conservation parks, national parks, vegetation heritage agreement areas and Flinders Ranges planning areas) made up ~26% of all approvals, compared with 17% in 2014.

Twenty-five compliance inspections were undertaken during 2015 to ensure adherence to standards specified in guidelines, exploration licence conditions and approved PEPRs.

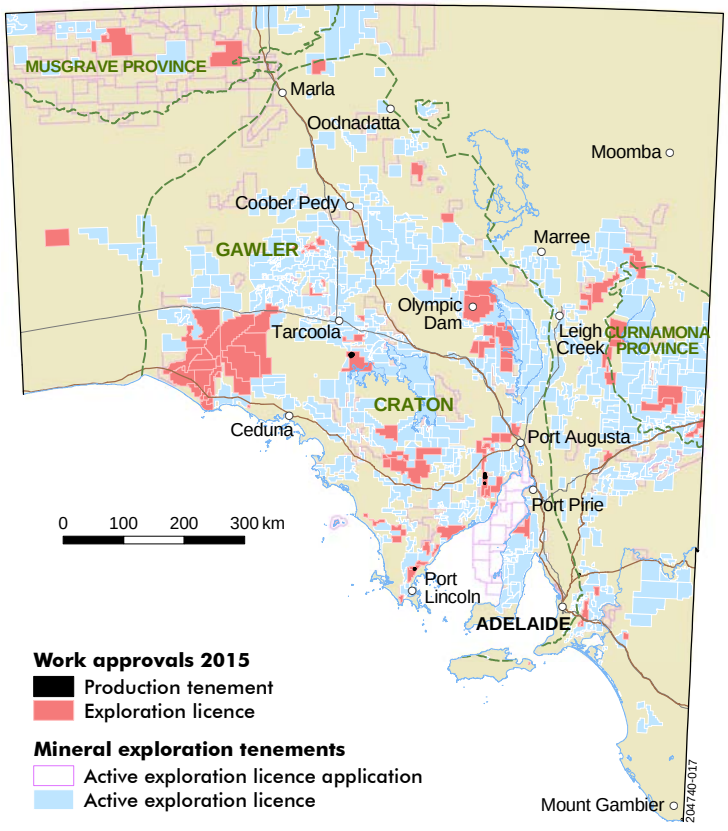


Figure 8 *Mineral exploration activities approved in South Australia in 2015 (shown by tenement).*

Table 5 *Mineral exploration work approvals in South Australia, 2011 to 2015*

Statistics	2011	2012	2013	2014	2015
Number of work approvals	396	272	213	197	149
Drilling metreage approved	1 408 855	1 429 553	828 012	514 969	477 140

Other key achievements. New requirements for the submission of PEPRs and exploration compliance reports, including the development of new ministerial determinations, submission templates and guidance materials, were released during the year.

The new comprehensive Minerals Regulatory Guideline MG22, *Guidelines for conducting mineral exploration in South Australia*, provides guidance to explorers when conducting mineral exploration within South Australia and in the preparation of a PEPR for submission and approval under the Mining Act and Regulations.

Ministerial Determination 013 specifies the form and minimum information required within a PEPR for mineral exploration activities that fall outside of the scope of the generic PEPR for low impact exploration activities.

Ministerial Determination 012 specifies the reporting periods, the manner and form of the report, and the minimum information required to be provided in an exploration compliance report.

In addition to the above, DSD developed a secure online PEPR application template and lodgement process for use when applying to conduct on-ground mineral exploration activities within South Australia. The online application process has been designed to:

- Allow explorers to submit exploration PEPR applications to DSD online.
- Assist explorers to develop applications that meet the requirements of the Mining Act, Mining Regulations and Ministerial Determination 013.
- Provide certainty to explorers on the information required in an exploration PEPR and provide useful links to reference information.
- Allow applicants to use previously submitted PEPRs to create new applications (only applications previously submitted online).
- View all previously submitted applications (only applications submitted online).
- Allow explorers to track the progress of online applications.

Exploration data management

Company-submitted exploration licence technical and geoscientific reports are analysed and registered for compliance under the Mining Act to meet regulatory and quality control requirements and ensure future accessibility. Reports and datasets are analysed for accuracy and documented in the TMS. Datasets relating to exploration activities are reviewed and documented in SA Geodata (drilling, sampling and geophysical surveys).

A total of 366 confidential company exploration annual reports were analysed and captured in confidential servers during the year. Subject to due process, confidential mineral exploration reports are made publicly available as their status changes to open file. This normally occurs on tenement surrender, company authorisation to release, or data that has been held by DSD for a period of at least five years.

Eighty-three surrender and partial surrender datasets, comprising 128 ELs, were completed and uploaded to SARIG.

A total of 909 six-monthly summary and expenditure reports were analysed and captured in confidential servers.

Over 90% of reports and associated data for upcoming ERAs were uploaded to SARIG prior to the application week of the ERA release, compared with 50% in 2014.

Four public releases of annual technical reports and associated data held by DSD for at least five years and released under the Mining Act, section 77D, and Mining Regulations, regulation 88, occurred and were published in the *MESA Journal* as part of the Sunset Data Release Program. This comprised 127 envelopes and data packages covering 277 exploration licences.

Scanning and digital assembly of current and historical annual technical reports continued with ~124 530 pages completed during 2015. Reports were indexed in SAMREF (DSD's geoscience reference database) as part of the process and can be retrieved through SARIG. At the end of 2015 all mineral exploration reports which were classified open file at that time had been imaged and made publicly available in digital form.

Resources and Energy Group Field Safety Program

The branch coordinates the Resources and Energy Group Field Safety Program, maintaining accurate field itineraries and ensuring constant accessible emergency contact 24/7. Knowledge and specialist capabilities of field safety and response procedures are conveyed to field staff through advice and training.

Prior to commencement of the 2015 Mineral Systems Drilling Program (MSDP) on the Eyre Peninsula, all MSDP staff were inducted in field safety procedures relating to this project. Three presentations on field safety processes and procedures were also provided to DSD staff from Corporate Services, Traineeship and Apprenticeship Services, and Information and Communication Technology.

Defence-controlled areas

Woomera Prohibited Area coexistence regime. DSD plays an integral part as a state representative in the implementation of an innovative coexistence regime in the Woomera Prohibited Area (WPA) for non-Defence access and use, balancing national security and economic interests. This is managed as a joint South Australia – Commonwealth initiative.

In August 2014 the WPA legislation and WPA Rule 2014 came into operation, formally establishing an access permit system for non-Defence users and providing greater certainty to future infrastructure and economic development of the world-class Gawler Craton mineral province. The statutory permit system is administered and managed by the Canberra-based WPA Coordination Office (WPACO), while the branch sits as a remote member. WPACO also supports the high-level WPA Advisory Board which oversees the implementation of the coexistence policy framework in WPA.

During 2015 the branch worked closely with WPACO in the assessment of access permit applications received from exploration and production tenement holders in the WPA. At the end of 2015 more than 30 resource and energy companies were issued seven-year WPA resource exploration access permits and one mining company was issued a nine-year WPA resource production access permit to recommence mining operations of an iron ore mine in early 2016.

Updates on resource industry activities in the WPA were provided at a WPA Advisory Board meeting in Adelaide. Four quarterly reports were submitted as well as contributions for the WPA 2014–15 annual report. A new spatial layer called the Woomera Restricted Airspace (WRX) became live on SARIG following collaboration between DSD, Primary Industries and Regions South Australia Legal Boundaries Unit and the Woomera Test Range Aerospace Operational Support Group. The WRX layer will assist companies planning airborne surveys and other airspace-related activities over the WPA.

Multi-agency collaborative work included: sourcing the relevant spatial datasets to show all Defence-controlled land in the government's LocationSA map viewer <http://www.location.sa.gov.au/viewer/>; review of the *Pastoral Land Management and Conservation Act 1989* and *Land and Business (Sale and Conveyancing) Act 1994* to enable notification to Defence of any sale, transfer or surrender of pastoral leases in the WPA; and input into the Foreign Investment Review Board inquiry into the sale of S Kidman and Company Ltd which included a pastoral lease in the WPA.

Cultana Training Area. The branch continued collaborative work with Defence in finalising standard mineral lease and exploration licence conditions for mineral tenements granted in the Defence-controlled Cultana Training Area. Industry guidance material was also developed to provide general information on how to access the Cultana Training Area for exploration and mining in light of the Miscellaneous Lease for Defence Purposes over the training expansion area and will be published in early 2016.

Resource Royalties – minerals and petroleum

The Resource Royalties team is responsible for the management of all mineral and petroleum royalty in South Australia including the collection, verification and administration of royalty receipts. To ensure producers are able to meet their royalty obligations, the team undertakes a variety of educational and regulatory programs including a comprehensive audit strategy and a proactive education and engagement program with industry.

Mineral royalty receipts as reported to Treasury totalled $133.1 million in 2014–15 (Table 6).

The team has an ongoing commitment to providing simpler royalty collection systems for all tenement holders, and 2015 saw significant improvements rolled out in the minerals Tenement Return e-lodgement system (Trel). Implemented just prior to the December 2015 return, the enhancements now provide a summary of the monthly royalty instalments received in the reporting period. In addition, once the returns have been entered, any outstanding royalty balance (or credit) is displayed for easy reconciliation of payments made throughout the period. Improvements are also currently under review for e-lodgement of petroleum returns.

Since its inception, Trel clients have found that the application makes it easier to meet the required deadlines, correctly calculate royalty and submit returns, as well as check tenements for which they are responsible. Trel users currently account for over half of all mineral return submissions each six-month period.

Table 6 *South Australian mineral royalty receipts received 2010–11 to 2014–15*

Commodity	Royalty receipt ($'000)				
	2010–11	2011–12	2012–13	2013–14	2014–15
Base metals (copper, zinc, lead) and iron ore	69 298	72 608	73 137	85 197	88 068
Precious metals (gold, silver)	16 560	17 683	14 122	13 530	19 113
Energy minerals (uranium, coal)	11 178	17 869	18 937	17 452	14 482
Industrial minerals	3 584	7 871	1 937	5 107	8 433
Construction materials	1 494	4 046	3 977	3 937	2 977
Total	102 114	120 077	112 110	125 226	133 073

Note: The 2014–15 figure is for actual royalty receipts as reported to Treasury. Prior years were sourced from the DSD Tenement Management System which included the Extractive Areas Rehabilitation Fund royalty component in the construction materials category.

Over the next year the team will be strongly encouraging tenement holders to create accounts and submit returns electronically; the goal is to have all producers preparing and submitting returns electronically. Account application forms can be found on the DSD website <http://www.minerals.statedevelopment.sa.gov.au/mining/mineral_royalties#elodgement>.

A total of 66 royalty audits covering 98% of the state's annual royalty revenue were undertaken in 2014–15. Producers demonstrated high-level compliance with the legislative requirements and willingness to engage with DSD to gain a greater understanding of their regulatory obligations. Regional area visits included Mount Gambier, Naracoorte, Kangaroo Island, Port Pirie and the Riverland. Although the majority of audits involved site visits, the team also undertook desktop reconciliations and audit by correspondence.

In June 2015 the government announced changes in the State Budget that see the introduction of royalties being paid by local councils for any recovery of extractive material from borrow pits. The changes also included an exemption to pay royalty if their total revenue was less than $5 million per annum. In recognition of the valuable contribution to rural road maintenance undertaken by regional councils, the state government included in the amendments provision for 75% of royalty collected to be dispersed to the Local Government Research and Development Scheme to continue this important work.

Resource Land Access Strategy

Land access policy initiatives

The Resource Land Access Strategy (RLAS) Branch, which has responsibilities crossing both the Mineral Resources and Energy Resources divisions, continues to take the lead role in delivering state and national land access policy programs and initiatives. Key achievements for the branch in 2015 are summarised below.

COAG Multiple Land Use Framework. RLAS took the lead in managing South Australia's representation in the delivery of the Multiple Land Use Framework, which is endorsed by the COAG Energy Council. This innovative framework establishes the vision, guiding principles, tools and methods for more effective integration of land use policy, planning and development, and will lead to better outcomes for communities through more transparent and consistent land use decision-making.

South Australian Multiple Land Use Framework. RLAS is working with a statewide reference group to deliver a state-based multiple land use framework which sets out an approach to manage land use that achieves South Australia's long-term economic, environmental and social goals. Engagement on a South Australian Multiple Land Use Framework occurred between November and December 2015. The reference group is currently preparing a 'What we heard' report based on the 58 submissions received and this report is likely to be published on the yourSAy website in early to mid 2016.

COAG Energy Council Land Access for Resources Working Group (LARWG). RLAS continued its successful management of the co-chairing of LARWG on behalf of the Deputy Chief Executive, Resources and Energy, DSD. The work of the LARWG focuses on addressing issues impacting on investment in resources exploration and development, particularly land access. Key actions for the 2015 plan included promoting community confidence and engagement through: promotion of leading practice engagement approaches; transparency of regulatory processes; and improving public communications, including the Adelaide-hosted LARWG National Transparency Workshop in May.

Premier's Community Excellence Awards in Mining and Energy. RLAS delivered the 2015 Premier's Community Excellence Awards in Mining and Energy. These are South Australian flagship awards presented by the Premier to celebrate the

positive impact the minerals and energy sectors and associated service providers have on the communities in South Australia.

The awards recognise mineral and energy resource companies that demonstrate commitment, leadership and a best practice approach to improving the social wellbeing of communities in a practical way through programs and practices. Heathgate Resources received the Award for Excellence in Social Inclusion for working in partnership with the Indigenous community; Kalari Transport and Iluka Resources received the Award for Excellence in Supporting Communities for their contribution to the Ceduna community; and OZ Minerals received the Award for Excellence in Leadership – Women in Resources for demonstrating a model of continued excellence with an ongoing planned approach that has been successfully implemented and continually monitored and reviewed. Highly commended certificates were presented to Terramin Australia and Iron Road for Environmental Excellence.

Eyre Peninsula Land Use Support (EPLUS). EPLUS is a DSD-driven and sponsored innovative program that aims to assist Eyre Peninsula landholders (agribusinesses) in realising the benefits of statewide growth in the mineral and energy resource sectors, which in turn will ensure long-term sustainable growth of the region.

The program has been designed to assist landholders to move through a change process, providing information and targeted support to enable them to identify and capitalise on the opportunities provided by exploration and mining and to realise the benefits for their own businesses and communities.

The primary EPLUS program concluded on 30 June 2015, with a modified form of the program continuing.

The program of work over the last two and half years included free EPLUS workshops provided for the community comprising: 'Future Farm Landscapes', 'Understanding Mineral Exploration', information about minerals exploration and mining relating to the entire value chain, and understanding the assessment and approvals processes under the mining and development legislation. Workshops have been held at Port Lincoln, Tumby Bay, Cleve, Lock, Wudinna and Warramboo targeting landowners and community, service providers, industry and local government.

The EPLUS website can be accessed at <www.pir.sa.gov.au/eplus>.

Resource Area Management and Planning (RAMP). RAMP is a joint initiative between DSD and the Department of Planning, Transport and Infrastructure (DPTI) which seeks to mitigate potential interface issues where urban encroachment (sensitive uses) and quarries or mines are situated within close proximity. RLAS released a RAMP information sheet in May 2015 outlining five areas for action by the government and has been working with DPTI to implement these actions.

Identification of strategic mineral resource areas in South Australia report. Developed by RLAS in conjunction with the Geological Survey of South Australia, this report was released by the Minister for Mineral Resources and Energy at the annual construction industry dinner in July 2015. The report addresses a central recommendation of the RAMP report – to achieve interaction between the *Development Act 1993* and the Mining Act at the strategic level by conducting a strategic planning exercise to consider the need for protection of mineral resources. RLAS has been working to raise awareness of the listed quarries and mines with relevant councils across South Australia.

Environment Protection and Biodiversity Conservation Act accreditation. RLAS is the Mineral Resources Division representative on the inter-government steering committee seeking accreditation under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act; Cth) for the assessment and approval of projects under the Mining Act, Development Act and *Petroleum and Geothermal Energy Act 2000*.

Negotiation and endorsement of a state–Commonwealth memorandum of understanding (Stage 1) and negotiation and endorsement of a state–Commonwealth assessment bilateral agreement (Stage 2) have been completed. A draft approval bilateral agreement which proposes to accredit a range of actions under the Mining Act and Petroleum and Geothermal Energy Act was released for public consultation and the comments considered. RLAS is currently working with Energy Resources Division, the Commonwealth and other state agencies to finalise an approval bilateral agreement following necessary amendments to the EPBC Act to allow accreditation to occur.

Proposed 'privately protected areas' provisions under the National Parks and Wildlife Act. RLAS is leading DSD's involvement in proposed amendments to the *National Parks and Wildlife Act 1972* to introduce a new category of reserve that would allow for private land to be proclaimed as a protected area.

Gluepot, Calperum and Taylorville pastoral leases. RLAS is leading a project to develop appropriate land access arrangements for the Gluepot, Calperum and Taylorville pastoral leases. The aim is to determine what access provisions may or may not be appropriate under state mineral resources and energy legislation in consideration of the conservation values and resource potential of these areas. A geoscientific investigation has been commenced by the Geological Survey pursuant to section 15 of the Mining Act over these areas; no applications for mining tenements will be received over them during this time.

Regulatory reform and policy initiatives

The branch provided strategic land access policy advice and took the lead role in coordinating responses for the following.

Foreign Investment Review Board. The board examines proposals by foreign persons to invest in Australia. RLAS coordinates the DSD responses to these proposals and provides comments to the Department of the Premier and Cabinet for inclusion in South Australia's response to the Commonwealth Government.

Productivity Commission. The commission is a national independent research and advisory body that conducts inquiries on a range of economic, social and environmental issues. RLAS provides substantial expert advice to these inquiries including public infrastructure, major project development assessment, mineral and energy resources exploration, and environmental and resource management issues.

Planning Reform. RLAS has contributed to the planning reform process, led by DPTI, through an inter-agency working group. RLAS has provided expert advice on the impacts of reform on the mineral resources sector, particularly through the development of the whole-of-government response to the Expert Panel on Planning Reform's final report and the Planning, Development and Infrastructure Bill 2015.

Landholders' Right to Refuse (Gas and Coal) Bill 2015. This is a private member's Bill by federal Senator Larissa Waters. It proposes to make gas or coal mining activities undertaken without prior written authorisation from landholders unlawful and would ban constitutional corporations from engaging in hydraulic fracturing operations (fracking) for coal seam gas, shale gas and tight gas. RLAS coordinated the Mineral Resources Division's input into a submission to the Senate Environment and Communications Legislation Committee.

Local Nuisance and Litter Control Bill 2015. RLAS, in conjunction with the Mining Regulation Branch, provided advice to the Environment Protection Authority South Australia on technical and legal matters relating to quarries, leading to appropriate exemptions being included in the Bill.

Biodiversity Inquiry. RLAS coordinated and prepared the DSD component of a whole of South Australian Government submission to Environment, Resources and Development Committee's Biodiversity Inquiry.

Planning referrals

RLAS provides advice and coordinates the DSD responses on planning referrals and policy matters relating to land access issues for the mineral and energy resources sectors. In 2015 key input included the planning interface issues with wind farm development and mineral exploration and resource development. Responses were provided for:

- *Greater Adelaide Planning Strategy*. RLAS provided input to DPTI's review and update of 'The 30-year plan for Greater Adelaide'. The plan outlines how the South Australian Government proposes to respond to population growth, demographic change (such as an ageing population and more single person and couple households without children) and an evolving economy.
- *Four statements of intent (SOI)*. SOIs detail the scope, considerations, investigations and consultation process to be carried out for a development plan amendment (DPA).
- *Ten development plan amendments*. DPAs set out new planning policies that have been identified in the SOI process as the main document for planning controls in local government areas.
- *One environment report*. These are an assessment of the environmental factors relating to a specific development project.
- *Seven development assessments*. Advice on any resource-related development issues, including advice to DPTI regarding the sale of surplus government land.

Environmental policy initiatives and referrals

In 2015 RLAS provided advice and coordinated DSD's comments on one environment protection and biodiversity conservation assessment, as well as five policies or plans prepared under the EPBC Act.

The branch coordinates and provides strategic advice on reserve proclamations under the National Parks and Wildlife Act. In 2015 formal responses on the following proposals were submitted to the

Department of Environment, Water and Natural Resources:

- Proclamation of seven new reserves (the proposed Adelaide International Bird Sanctuary, and Menzelli, Monarto Woodlands, Browns, Kinchina, Lauwari and Thidna conservation parks) covering an area of 6945 ha.
- Addition to seven existing reserves (Gawler Ranges National Park, and Cape Blanche, Ediacara, Kaiserstuhl, Lake St Clair, Little Dip and Searcy Bay conservation parks) covering an area of 29 376 ha.
- Four draft management plans for protected areas, namely Breakaways Conservation Park, Flinders Ranges National Park, Innamincka Regional Reserve and Arkaroola Protection Area (under the *Arkaroola Protection Act 2012*).
- Matters referred under the *Natural Resources Management Act 2004*, including regional natural resources management strategic and business plans, water allocation plans and proposed regulation amendments.
- 'Managing the water resource impacts of mineral and energy development' document which outlines the framework to manage mineral and energy industries' access to water resources and their availability for other users, to increase industry and community confidence.
- Significant environmental benefit (SEB) Metric and Third Party and SEB Credits Introduction; Native Vegetation (Credit for Environmental Benefits) Regulations 2015; and review of Native Vegetation Regulations 2003 (*Native Vegetation Act 1991*). Significant changes have been undertaken to the environmental benefit metrics, third party rehabilitation provisions and regulations to improve the management and ongoing rehabilitation of native vegetation in South Australia.

Aboriginal heritage and native title initiatives

RLAS continued to work closely with the Aboriginal Affairs and Reconciliation Division (AARD) in DSD on various strategic matters, including the ongoing management of Aboriginal heritage and exploration activities. Opportunities to improve the existing administrative and policy framework under the Aboriginal Heritage Act are also being investigated.

RLAS continued to work with regulatory branches of DSD to assist industry and native title groups in relation to compliance with Part 9B of the Mining Act, and to facilitate access to native title land. In particular, RLAS worked with the Aboriginal Lands Trust, AARD and exploration companies to clarify processes under the Aboriginal Lands Trust Act and the Mining Act.

Work with stakeholders to ensure that South Australia maintains a leading practice regulatory framework that provides clear and fair processes for access to native title land continued. Following forums with native title and industry representatives in 2014, RLAS is progressing measures to provide additional certainty and clarity to stakeholders in relation to the native title land access scheme in Part 9B of the Mining Act and to facilitate engagement between government, the minerals industry and Aboriginal people. RLAS intends to re-engage with forum participants to explore access to native title land more generally, with a view to developing a shared understanding about how we can better meet our collective objectives moving forward. RLAS is currently seeking feedback from native title representatives and industry on these proposed next steps which will inform the development of project and consultation plans.

State government insurance policy for Aboriginal heritage surveys

To assist all parties in managing survey costs, RLAS renewed an insurance policy for Aboriginal consultants conducting cultural or heritage surveys for mineral and energy resources projects. The policy applies from 31 May 2015 to 31 May 2016 to projects that are undertaken pursuant to a registered native title mining agreement or a right to negotiate agreement.

The policy applies to hazards that arise out of or during the course of fieldwork authorised in writing by DSD, including necessary direct travel to and from such fieldwork. RLAS will review the continuation of the policy beyond 31 May 2016 and give stakeholders sufficient notice of changes to the policy if any are required.

Community engagement program

RLAS managed the delivery of DSD community workshops on the Eyre Peninsula for the purpose of informing landowners and the community about their rights and the resources industry and the strict regulatory controls and environmental processes that DSD regulates. The branch also coordinated an information booth at the Yorke Peninsula Field Days in September–October 2015.

A presentation on 'Minerals and Energy Resources directions for community engagement' was given in June 2015 at the DSD-hosted South Australian Chamber of Mines and Energy community engagement forum for the resources industry.

A presentation on 'Exploration and mining in South Australia – legislative requirements' was delivered to TAFE Diploma of Geoscience students for the module on Acts and Regulations. The branch also hosted a session at the DSD Geosciences Summer

School in December 2015, 'To mine or not to mine? That is the question!', a role play addressing the varying stakeholder complexities that must be considered by a mining company when progressing a mining project.

Mining Projects

The Mining Projects Branch works with the proponents of major mining projects to facilitate streamlined pathways through the regulatory and community processes that underpin successful mining projects.

At any given time there are around 30 diverse major mineral projects in various stages of resource definition, feasibility or approvals in South Australia. During 2015, despite difficult economic conditions, the companies taking forward South Australia's major mining projects continued to invest significantly in their pathway toward approvals. Highlights included:

- Commencement of operations at Havilah Resources' Portia gold mine in eastern South Australia.
- Lodgement of a mining lease proposal for Lincoln Minerals' Kookaburra Gully graphite project.
- Lodgement of a mining lease proposal for Iron Road's Central Eyre Iron Project.
- Achievement of further approvals for Arrium Mining's iron ore operations across the Middleback Range, including the expansion of mining and processing at Iron Baron.
- Lodgement of a mining lease proposal for WPG Resources' Tarcoola gold project.

In addition, the branch had the opportunity to work closely with companies including OZ Minerals (Carrapateena, copper–gold); Heathgate Resources – Quasar (Beverley and Four Mile, uranium); Cu-River (Cairn Hill, iron ore and copper–gold); Archer Exploration (Campoona, graphite); Havilah (Kalkaroo, copper–gold–molybdenum; Maldorky, iron ore).

In 2016 the branch will continue to focus on a 'minimum risk – minimum time' approach to identifying solutions to the challenges posed by the state's major mining projects.

Mining Regulation

The Mining Regulation Branch is responsible for the assessment of mining lease proposals and programs for environment protection and rehabilitation (PEPRs), the setting of tenement conditions, and for monitoring and enforcing compliance of approved mining operations. It is also responsible for administering the *Opal Mining Act 1995*, Extractive Areas Rehabilitation Fund, setting rehabilitation bonds, managing mine remediation projects and the risk management of potential liabilities of former mines.

Mining assessment

In 2015, 45 mining assessments were completed for metallic, industrial and extractive minerals:

- 19 mineral tenement applications (mineral leases and miscellaneous purposes licences) were assessed and recommendations made regarding grant of a mining tenement
- 26 PEPRs and mine operation plans (MOPs) were assessed and approved.

DSD regularly reviews PEPRs and MOPs for ongoing operations, and provides formal advice on development issues that are adjacent to existing mining operations.

Significant mining assessments that were completed or under assessment are described below.

Extractive and industrial mines:

- ***Klein Point Limestone Quarry (Adelaide Brighton Cement)***. A mining lease proposal was approved in November 2015 which provides additional reserves to the long-term mine plan for this quarry of state significance.

Left: *Removing overburden, Portia Mine.*
(Courtesy of Havilah Resources; photo 414850)
Right: *Drilling, Central Eyre Iron Project.*
(Courtesy of Iron Road Limited; photo 414855)

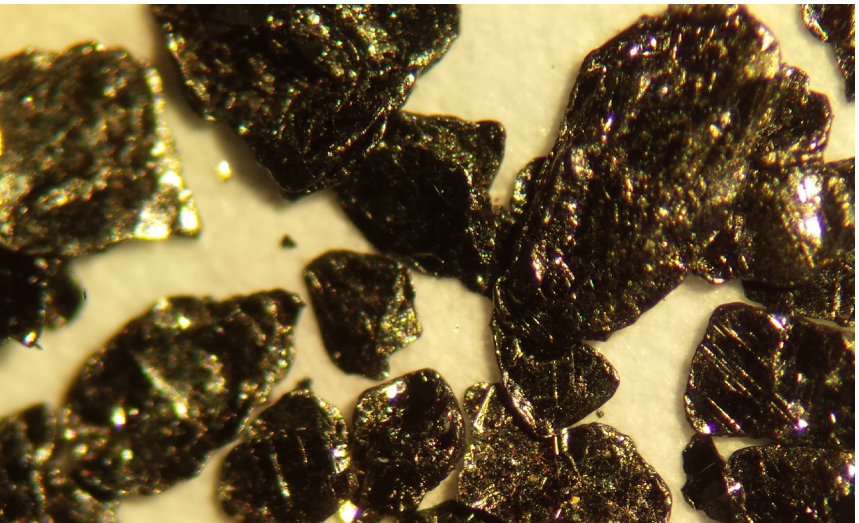
- *Montacute Quarry (Holcim Australia)*. A MOP was approved in May 2015 which provides more detailed mine closure strategies for this metropolitan quarry.
- *Mount Compass Sand Quarry*. A mining lease proposal was approved in May 2015 resulting in the grant of two mineral leases.
- *Tooperang Sand Quarry*. A mining lease proposal was approved in February 2015 which provides additional reserves to the existing operation.

Metallic mineral mines:

- *Angas zinc mine (Terramin)*. The mine has been in care and maintenance during 2014 and 2015. DSD has been engaging with the mine operator to update the current approved PEPR with more detailed mine closure strategies.
- *Beverley North uranium mine (Heathgate Resources)*. A revised PEPR was approved in December 2015.
- *Campoona graphite project (Archer Resources)*. Pre-lodgement guidance was provided in 2015 for the development of their mining lease proposal; formal application is expected during 2016.
- *Central Eyre Iron Project (Iron Road)*. A mining lease proposal was submitted in November 2015 and processing and assessment of this application has begun.
- *Challenger gold mine (Challenger Gold Operations)*. Assessment of a new mining lease proposal for an extension to the underground mine was completed during 2015. In addition, pre-lodgement guidance was provided on a review to the current PEPR for the mine.
- *Cowell jade deposits (Olliver Geological Services)*. A revised PEPR was approved in December 2015, which in conjunction with a separate Mining Act authorisation, enabled the removal of extractive minerals from the site for use in the construction of the Lucky Bay Ferry Terminal.
- *Dry Creek Salt Fields (Ridley)*. The holding pattern MOP/PEPR for the Dry Creek Salt Fields was approved in December 2014 with a subsequent MOP/PEPR approved in October 2015. Approval of these PEPRs represents key milestones in the process for the closure of the site and surrender of all mining tenements.
- *Honeymoon uranium mine (Boss Resources)*. A revised PEPR was approved in April 2015.
- *Iron Baron mining area (Arrium Mining)*. A PEPR was approved in May 2015 which enables mining of scree ore in the Middleback Range.
- *Jacinth-Ambrosia mineral sands mine (Iluka)*. A revised PEPR was approved in December 2015 which included substantial updates to the rehabilitation and closure strategies for the mine.
- *Kalkaroo copper project (Havilah Resources)*. Assessment of the mining lease proposal continued during 2015.
- *Kookaburra Gully graphite (Australian Graphite)*. A mining lease proposal was submitted in February 2015 and is currently under assessment.
- *Leigh Creek coal mine (Alinta)*. Announcement of the closure of the mine during 2015 resulted in the development of an updated closure plan for the site. DSD has been providing guidance to Alinta throughout the development of the closure plan which is forecast to be submitted in early 2016.
- *Prominent Hill copper–gold mine (OZ Minerals)*. A revised PEPR was submitted in late 2015 and is currently under assessment.
- *Tarcoola gold project (WPG Resources)*. Assessment of the mining lease proposal was completed during 2015.
- *White Dam (Exco-Polymetals)*. Mining of ore ended in 2012; however, extraction of gold from the heap leach pads has continued. DSD has been engaging with the mine operator to revise the current approved PEPR with updated rehabilitation and mine closure strategies to ensure a detailed closure plan is in place. Recommencement of open pit mining is forecast for early 2016.

During 2015 an internal review of the mining application and assessments process identified areas for continuous improvement to increase efficiencies, reduce timelines and any duplication in the process. Actions to realise these have been completed in the areas of new assessment report templates, assessment officer training, a project management framework and updates to regulatory guidelines.

Extra-large flake (+300 µm) graphite concentrate from Wilclo South. (Courtesy of Archer Exploration; photo 414853)



Policy work undertaken in the mining assessment function during 2015 included:

- ***Determinations and guidelines for mining lease proposals and PEPRs for metallic and industrial minerals.*** These determinations and guidelines were completed and released for industry use in November 2015.
- ***Mining lease proposals and PEPR template and guidelines for extractive minerals.*** A template application form for mining lease proposals and PEPRs to be used for extractive minerals has been released for industry to use and is complemented by a guideline.

Mining compliance and regulation

A total of 2664 tenement and mining operations were regulated by DSD as at December 2015 (Table 7).

Compliance activities in 2015 primarily focused on managing high-risk operations, addressing incidents and complaints, reviewing compliance reports from mining companies, providing specialist mining advice to the assessments function, and representation at community consultative groups and meetings.

In 2015, 64 public complaints and 37 reportable incidents were addressed. A total of 576 compliance inspections were also completed across extractive, metallic and uranium operations (Fig. 9) and 10 formal instructions (including environmental/compliance directions and formal letters) were issued regarding mining operations. Regular advice was provided to operators to ensure they comply with the current standards and lease conditions whilst ensuring transparency with the local communities. Key risk areas included blasting, water management, noise and dust emissions.

The inaugural public annual mining regulation report was published in 2015. This report, available on the DSD website, covers all compliance activities related to South Australia's metallic, uranium, industrial, extractive and opal mining operations for the 2014 calendar year. DSD recognises that this report satisfies key features of its regulatory framework by providing transparency of its regulatory services to the South Australian mining industry, community and other stakeholders. DSD expects that these annual reports will contribute to providing community confidence and trust in the regulator, the industry's overall performance and a demonstrated commitment by mining companies to best practice management.

The 2015 year also saw a continued emphasis on mine closure and rehabilitation, with many operations moving into care and maintenance or towards closure in coming years.

Opal fields

During 2015, 1029 inspections were conducted across the four precious stones fields (Coober Pedy, Andamooka, Stuart Creek and Mintabie), of which 159 tenements were improperly pegged, or required labour conditions were not adhered to as required by the Opal Mining Act.

Seventy-two illegally pegged tenements were removed from the fields and 13 tenement holders plainted for forfeiture in the Warden's Court for noncompliance with the Act in 2015. A total of 39 Warden's Court matters were heard, which included applications for suspension of working conditions and amalgamations of tenements.

Mining activity has ceased at Lambina and Welbourn Hill diggings following the expiry of the Native Title Mining Agreement (NTMA) on 14 December 2014. Two registered tenements and one tenement pending rehabilitation remain at Seven Waterholes (Lambina). The South Australian Opal Miners Association initiated negotiations for a replacement NTMA during 2015.

Table 7 *Current tenement and mining operation data regulated by DSD, December 2015*

Tenement type	Number registered
Mining lease	820
Extractive minerals lease	624
Private mine	235
Retention lease	36
Mineral claim	90
Mining operation	529
Producing operation	330

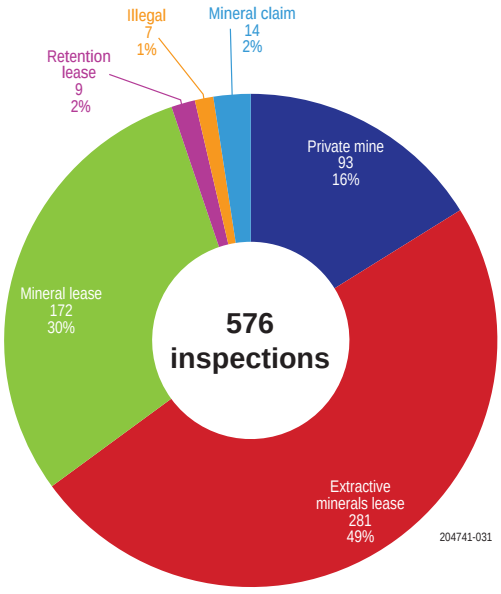


Figure 9 *Mining compliance site inspections in 2015 by tenement type.*

In 2015 the opal field offices at Coober Pedy, Marla and Andamooka issued 417 precious stones prospecting permits, and processed 298 registration renewals and 132 cancellations of unwanted claims.

The Indigenous land use agreement (ILUA) for opal mining on the Coober Pedy Proclaimed Precious Stones Field was registered in February 2015; at the end of 2015, 466 Coober Pedy opal miners had signed the acceptance deed.

Negotiations have commenced for an ILUA for opal mining on the Andamooka Precious Stones Field and are expected to continue during 2016.

Extractive Areas Rehabilitation Fund

The Extractive Areas Rehabilitation Fund (EARF) provides funding to:

- rehabilitate land disturbed by extractive mining operations
- implement measures designed to prevent or limit damage or impairment of the environment
- research measures to reduce environmental damage or impairment resulting from mining operations for extractive minerals.

Activity for 2015 is summarised in Table 8.

The Project Assessment Panel was suspended in 2015 following the government review of boards and committees. EARF project approvals are now made by the Minister (or delegate).

Seven projects totalling $353 083 were approved in 2015 which mainly related to sites where mining ceased many years ago (Table 9).

Table 8 *Extractive Areas Rehabilitation Fund statistics, 2015*

Extractive Areas Rehabilitation Fund	Number	Value ($)
Applications	7	353 083
Approvals	7	353 083
Unsuccessful applications	0	0
Awaiting assessment	0	0
Payments finalised	10	258 559
Payment timelines met	30 days from the end of the month lodged	95%
Balance of EARF at 31/12/15	11 projects	885 186
Committed funds at 31/12/15	8 projects	650 100
Balance of uncommitted funds at 31/12/15	—	20 173 281

Table 9 *Extractive Areas Rehabilitation Fund projects approved in 2015*

Extractive minerals lease/ private mine	Amount approved ($)	Reason
EML 4850, Mount Gambier	37 171	Final rehabilitation
EML 5942, Haydons	52 982	Final rehabilitation
EML 5602, Clare Quarries	29 418	Final rehabilitation
EML 6393, Stoney Pinch	23 245	Final rehabilitation
EMLs 3203, 3245, Windinna Farmers	139 150	Final rehabilitation
EML 5831, Scheins	54 896	Old workings rehabilitated
EML 4786, PJ Whillias	16 221	Final rehabilitation
Total	**353 083**	

Brukunga Remediation Program

Phase 3 - Detailed investigation and design for the remediation of Days Creek. Design and planning for the rehabilitation of Days Creek concluded in 2015 with the publication of a technical report by the Brukunga Technical Advisory Group and completion of various investigation, modelling and engineering projects.

The design incorporates a co-disposed waste storage facility with an engineered cover system and a creek diversion. The aim is to reduce acid and metalliferous drainage (AMD) by co-disposing waste rock and tailings with limestone to neutralise any acidic minerals, saturating the mixture with water and storing it in an impoundment to prevent future AMD generation.

All design and investigation activities related to the Brukunga remediation program continue to be audited by an environmental consultant on behalf of the Environment Protection Authority South Australia (EPA SA). The audit, to be published in 2016, will be the first produced under the EPA SA's new restricted scope policy and will enable the auditor to focus on the key contamination issue at Brukunga, namely AMD.

Implementation of the design, subject to funding, will result in a large section of the open-cut mine area being rehabilitated and reduction of the volumes of AMD produced from the legacy mine wastes and the associated costs of treatment.

A final report for the Brukunga remediation program was prepared in 2015 which provides options and recommendations on next steps following the completion of Phase 3.

Brukunga Asset Management Plan. The plan aims to provide readily available and reliable infrastructure for the continuous operation of the Brukunga neutralisation plant for the next 30 years including the overhaul/upgrade of the plant and implementation of a structured maintenance program.

The main focus of the plant is the intervention and treatment of the acid water in the creek while the remediation program progresses towards implementation. Improved efficiencies in the plant since the automation in 2014 have resulted in reduced operational cost. By changing the properties of the waste product (gypsum sludge) the AMD can be treated at greater volumes and with reduced reagent (lime) cost. Further steps in 2016 include the replacement and upgrade of the ageing infrastructure.

Water quality strategy in Dawesley Creek. The strategy aims to return water in Dawesley Creek downstream of the Brukunga mine to a beneficial use. There has been a progressive improvement of water quality downstream of the mine site as a result of continuous refinement of the treatment plant and collection systems since 2004. An assessment of 17 years of water quality data in Dawesley Creek shows a quality trending towards suitability for irrigation and livestock use.

The remaining source of contamination downstream of the mine is during high-flow flood events (typically in winter) that cause untreated acid pulses to overflow from the southern end of the mine. In 2015 DSD partnered with CSIRO to evaluate the toxicity of these acid pulses on macro-invertebrates. This trial involved both field and laboratory tests of a range of ecologically sensitive species to determine how sensitive each species is to infrequent exposure to acid pulses.

To increase the pumping and holding capacity in Dawesley Creek, a new acid water retention pond has been designed and will be constructed in 2016 to contain and buffer large flood events causing these acid overflows. In addition, a real-time water quality monitoring system downstream of the mine will be scoped and implemented in 2016.

Third parties. The Brukunga mine site continues to provide beneficial use for other organisations, such as the South Australian Country Fire Service, DET CRC research site, and mining training provider Australian Training Alliance. The site has been used for mining-related research and trade skills over the last five years.

In 2015 two new long-term access agreements were signed: with Boart Longyear to establish a research and development drill rig site, and TAFE SA to conduct practical training at the mine.

DSD and CSIRO ecotoxicological trials at the Brukunga mine to evaluate the toxicity of acid pulses on sensitive aquatic species. (Photo 414897)

Resource Information

The Resource Information Branch is focused on the delivery of high quality geoscientific information and data that showcases South Australia's minerals and energy resources prospectivity and competitive advantages, both nationally and internationally.

Key achievements in 2015 included the launch of the new-look Minerals and Petroleum websites, publication of *Mineral exploration in South Australia 2014* and *Minerals ScoreCard 2013–14*, coordination of Mineral Resources Division's contribution to *The Facts about uranium mining in South Australia* booklet, 2015 Geoscience Summer School, the successful transition of the Resources Industries Development Board into the Minerals and Energy Advisory Council and preparation of more than 30 premier/ministerial speeches.

In 2015 DSD hosted the first Unearthed Adelaide, a 54-hour innovation hackathon focused on the resources sector where software developers, data scientists, designers and industry insiders come together to develop prototype solutions to resources sector problems. Initiated by Resource Information staff, the event attracted 21 teams to work on BHP Billiton, OZ Minerals and the South Australian Government resource-related challenges facing South Australia.

Priority events

The Mineral Resources Division's Minerals Targeted Investment Strategy (MTIS) has been established to provide a proactive framework that presents a clear approach to investment attraction. An important component of the strategy is the priority events schedule.

In 2015 Resource Information coordinated several key international events, including the Minerals Exploration Roundup (Vancouver, Canada), Prospectors and Developers Association of Canada conference (PDAC – Toronto, Canada), China Mining (Tianjin, China), Mines and Money London (London, United Kingdom) and Australia Minerals exploration and investment seminars in Beijing (China), Seoul (South Korea) and Tokyo (Japan).

The branch also participated in a number of MTIS national and local resource industry events, including the South Australia Copper Summit (Adelaide), Diggers & Dealers (Kalgoorlie, WA), South Australian Resources & Energy Investment Conference (SAREIC) and Technical Forum (Adelaide), Australian Copper Conference (Brisbane), Broken Hill Resources Investment Symposium & Technical Day (Broken Hill, NSW), AusIMM Uranium Conference (Adelaide), SEG-CODES 2015 Conference (Hobart), Mining 2015

(Brisbane), Yorke Peninsula Field Days (Paskeville), South Australia Copper Strategy workshop (Adelaide) and the South Australian Exploration and Mining Conference (Adelaide).

South Australian resource presentations

Resource Information staff were responsible for the production of more than 30 executive and staff presentations in 2015. As in previous years, presentations highlighted the achievements of the South Australian resources sector, the government's *PACE* Frontiers initiative, collaborations and future priorities.

A number of international delegations visited the Mineral Resources and Energy Resources divisions during the year, including those from China, Canada, India and Sweden. Presentations delivered included information on mineral prospectivity, tenement approval process, regulation, land access and royalties.

Publications

The Mineral Resources and Energy Resources divisions continue to expand and update their publications list. Publications in 2015 included Minerals Regulatory Guidelines MG2a, *Preparation of a mining proposal and/or management plan for metallic and industrial minerals*, and MG2b, *Preparation of a program for environment protection and rehabilitation (PEPR) for metallic and industrial minerals; Mining regulation report 2014;* SAREIC Core Shack catalogue and Technical Forum abstracts and posters volume; and Seismic and Magnetotelluric Workshop extended abstract volume. See 'Publications' for a full list and hyperlink options.

Resource Information, in collaboration with Customer Services and Mineral Tenements and Exploration Branch, oversee the Minerals and Energy Resources historical documents project. In 2015 scanning of the bore general file records (1 million pages) and petroleum historical drillhole files (~2000 files) was completed and the datasets made available via SARIG. Scanning of other datasets is continuing, including departmental envelopes (~60% complete).

SARIG

The South Australian Resources Information Geoserver (SARIG) is a world-class, secure 24/7 public web application providing a spatial map based portal to over 130 years of non-confidential government-managed geoscientific information relating to mineral, petroleum and geothermal industries. With over 480 layers of information, including the outcomes of the internationally recognised *PACE* initiative, SARIG appeals to a broad global customer base covering the resources industry, investors, landowners, legal agencies, other government agencies, researchers, educators, students and the general public.

Partnerships with other government agencies and organisations allow SARIG to value-add to minerals and energy information and provide users unprecedented access to the information. Users can view, query and download spatial and database information, apply for mineral exploration licences and print their own maps at user selected paper size and scale.

In 2015 a new Basemap Gallery was released on the SARIG portal that allows customised base map selection; ESRI topography and world imagery basemaps have been introduced to the gallery.

SARIG data releases in 2015 included:

- Extractive minerals (MLP) eEvaluation tool, an online tool to streamline the eligibility criteria process for the new extractive minerals lease (EML) template.
- Remote sensing catalogs with links to downloads. Catalogs include hyperspectral (HyMap) and multispectral (Landsat 5).
- Coompana survey, the largest airborne magnetic and radiometric survey conducted in South Australia.
- Eucla–Gawler seismic survey; line 13GA-EGIE is available to download in SEG-Y format.
- Strategic resource areas spatial map layer which locates all strategic resource areas for the economic future and development of South Australia.
- Mineral resource potential – Greater Adelaide Region spatial map layer which translates geological mapping, current mineral production tenement locations and a range of other resource information into a three level categorisation of resource potential and suggested planning responses.
- Depth to crystalline basement state image update (V 4).
- New water well spatial layer indicating wells with full analyses and a direct link to the Department of Environment, Water and Natural Resources WaterConnect online application.
- Continuous updates to the Geoscience Library where geoscientific books, journals, CDs, DVDs and audiovisual materials can be requested online.

In 2015 precompetitive data (map layers and databases) in SARIG was released under the Australian Government's Open Access and Licensing Framework Creative Commons Attribution 3.0 Australian Licence (CC-BY). This is the most accommodating of open data licences allowing

others to distribute, remix, tweak and build upon their own work, even commercially, as long as they credit the original creation. Industry and their service providers can freely develop new, innovated data technologies, mobile applications and products designed to increase resource exploration and discovery in South Australia.

Geoscience Library

During 2015 the Geoscience Library continued to provide specialist library services to the mineral and petroleum industry, academic institutions, other libraries, government agencies and the general public, both online and through the Resource Information Centre. The centre, located on Level 7, 101 Grenfell Street, Adelaide, provides a one-stop shop to the agency's wide range of geoscientific products and services.

The library continues to focus on providing access to digital resources. Users can easily access digital publications via the library catalogue which now features an 'Online Resource' field and also via the library webpages which have been updated on the DSD Minerals website. New enhancements to GeoScienceWorld and GeoRef literature search platforms have provided users with improved access to the latest published geoscientific information.

In late October the Geoscience Librarian gave a joint presentation at the national Australian Geoscience Information Association's Geoscience Information Seminar. The presentation on 'Geoscience legacy data and collection management in South Australia' provided three different perspectives on how industry, university and government manage and add value to geoscientific legacy data to encourage investment and exploration in South Australia.

Minerals website

April 2015 saw the launch of the new DSD Minerals website with improved designs and features to enhance user experience. New features include a modern, responsive design with improved access for mobile devices; improved search facility; improved site structure and features to aid navigation throughout the site; and more uniform presentation of content.

The DSD Minerals website communicates to a broad global audience covering exploration and mining industries, investors, landowners, other government agencies, academia and the general public. The website is a means to:

- Raise awareness of initiatives which showcase South Australia as a premier investment destination.
- Provide the exploration and mining industry with information and tools to assist in meeting licensing and regulatory requirements.
- Provide information to and an engagement forum for stakeholders to help ensure the responsible development of South Australia's mineral resources within a sustainable framework.
- Deliver precompetitive geoscientific data to ensure the continuing discovery of mineral deposits in our state.

The new structure is broadly based on the minerals industry value chain, giving our many and varied stakeholders a clearly defined pathway along which to navigate to the information they require. Further navigation tools are included on the home page providing easy access to regularly used areas of the site.

New and updated content includes:

- Dedicated webpages for the recently developed South Australia's Copper Strategy, keeping industry and investors up to date with actions designed to accelerate exploration, discovery and information; develop innovative infrastructure, services and research; and build industry and community capacity.
- A section to inform potential investors and communities of the many significant opportunities within the minerals industry in South Australia.
- New pages outlining the work of the Geological Survey of South Australia and the work programs in place to ensure that the mineral exploration industry has access to the latest geoscience and precompetitive data.
- The latest programs within the *PACE* initiative including *PACE* Copper which is leading the transformation of the South Australian mineral exploration industry over the next two years.
- Information for mineral exploration and mining companies, and landowners and communities, to understand the regulatory framework regarding access to land, including Defence land, conservation areas, native title and Aboriginal land.
- Restructured content in the exploration and mining sections makes it easier for industry to find all the regulatory information needed to complete licence applications and regulatory documentation. Exploration companies can now complete and submit an online EPEPR, with tools available to guide them through the online process.
- The Online tools section provides easy access to free data delivery and publications downloads; online databases and products; E-regulation (applications and lodgements); and interactive

tools and apps (rapid earthquake data, 3D geological models, South Australia Mining app).
- The Knowledge centre showcases the wealth of South Australia's geoscientific data and information, including priority events program, *MESA Journal*, Resource Information Centre, community education service, departmental presentations, Geoscience Library, regulatory guidelines, information sheets and resource maps.

A web presence was also established for the proposed Central Eyre Iron Project to provide easy access for the public to view the mining lease application and environmental impact statement for infrastructure components related to the project. Public submissions could be made using the online forms provided on the website. Submissions and company responses will be made available on these webpages in 2016.

***PACE* twitter.** The Mineral Resources Division *PACE* twitter account <@PACE_sagov> complements the website in providing industry and other stakeholders with technical information and developments of relevance to the mineral exploration and mining industry in South Australia.

This social media platform has been used to build an engaged and industry-appropriate online community, with tweets being utilised to advise stakeholders about:

- *PACE* initiatives including calls for submissions from industry for collaborative drilling proposals
- successful drilling programs from *PACE* co-funded initiatives
- forthcoming application weeks for exploration release areas (ERAs)
- new publications and data releases
- events where members of the Mineral Resources Division will be in attendance
- registration for forthcoming technical workshops and outcomes from these workshops
- updates to regulatory information
- new online processes to assist industry in managing their tenements.

Community information and education

The community education service delivered 99 presentations to South Australian students, teachers and community groups in 2015. Topics ranged from career advice in geosciences to the importance of the resources industry to the state's economy and our standard of living. Most scientific and technical presentations were aligned with school curriculum guidelines.

Promotion of the Science Technology Engineering and Mathematics (STEM) initiative was an integral part of many presentations across a range of age groups. Information booths were hosted at major events such as School Career nights, Careers and Employment Expo, Yorke Peninsula Field Days, South Australian Certificate of Education (SACE) Research Projects Expo and National Science Week.

DSD is now a supporter of the Bright Sparks Science Club which replaces the Double Helix Science Club. Hands on workshops were given in the geoscience context to this group.

Regular meetings were held with Pitjantjatjara law and culture elders to support community capacity building and assist with knowledge acquisition on mineral exploration and mining in the context of the Mining Act.

On the TAFE and university scene, information booths were provided to assist students with career planning during the current downturn in employment opportunities in the resources industry. TAFE Geoscience Diploma students were also mentored during their field project studies.

Input was given at a SACE syllabus steering committee level on the new curriculum offering of Earth and Environmental Science which will be launched in 2016 for Years 11 and 12.

Geosciences Summer School capped off the year with a group of 17 keen junior geoscientists who gave up a week of their vacation to participate in an intensive course. This gave high school students who do not have access to the geosciences at their school the opportunity to gain insight into the myriad of sub-disciplines covered by this field. Guest presenters from universities, industry and DSD were able to share their academic and professional experiences and bridge the gap into the future for these young and keen minds. Fieldwork, including mapping and visiting an operating copper–gold mine, were major highlights. ■

Geosciences Summer School 2015. (Photo 414898)

Energy resources

Petroleum exploration and development

Summary

In calendar year 2015, 78 wells were drilled in onshore licences under the *Petroleum and Geothermal Energy Act 2000*. All drilling was located in the Cooper and Eromanga basins and comprised 15 conventional petroleum exploration wells, 3 dedicated gas resource play exploration and appraisal wells, 16 appraisal wells and 44 development wells.

The Australian Bureau of Statistics reported that combined minerals and petroleum exploration spending in South Australia totalled $453.2 million in the 12 months to September 2015. Spending on petroleum exploration alone during the same period totalled $380.8 million. Cooper Basin work programs in 2015 included ongoing oil and deep gas exploration and development drilling, hydraulic fracture stimulation programs in gas wells, and both 2D and 3D seismic acquisition.

Petroleum royalties and production

Petroleum royalty payments to the state in financial year 2014–15 were $104.4 million, with estimated total product sales of $1559 million (Fig. 1). This brings the cumulative royalty paid since 1970 to $2.826 billion (2014–15 dollars) and cumulative sales to an estimated $47 260 billion (2014–15 dollars); Cooper Basin production is shown in Table 1. Since 1991 the average royalty paid equals 6.69% of the sales value.

In 2014–15 petroleum producers were faced with oil price volatility; at January 2015 Brent crude fell 57% compared to January 2014. Industry responded to the changing environment by instigating strategic reviews focused on minimising operational risks, including the review of operating expenditure, postponement of capital programs and downsizing workforces.

Annual sales of key South Australian petroleum commodities are shown in Figures 2–6.

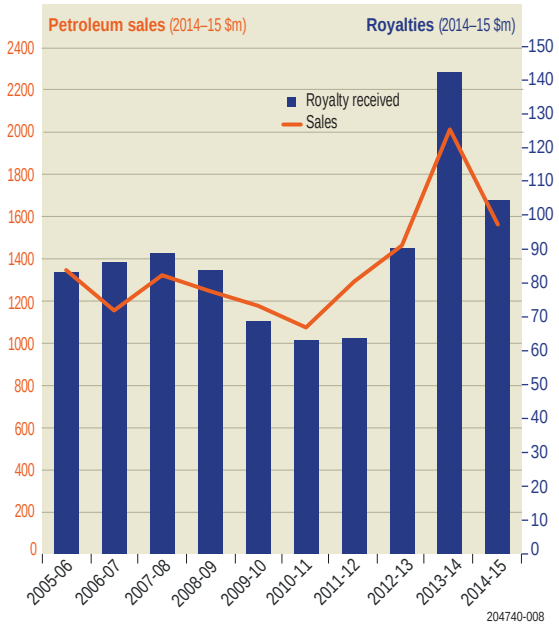


Figure 1 *Petroleum sales and royalty payments, South Australia, 2005–06 to 2014–15.*

Table 1 *Cooper Basin production statistics, June 2015*

	Sales gas (bcf)	**Oil** (mmbbl)	**LPG** (mmboe)	**Condensate** (mmboe)
Cumulative production	(since 1970) 5310	(from 1983) 186.1	(from 1984) 82.0	(from 1983) 79.9
Annual production (2014–15)	57.92	11.06	1.38	1.12

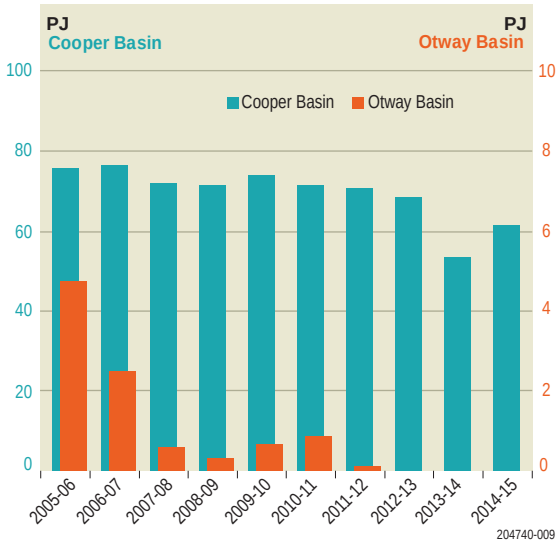


Figure 2 South Australian gas sales, 2005–06 to 2014–15.

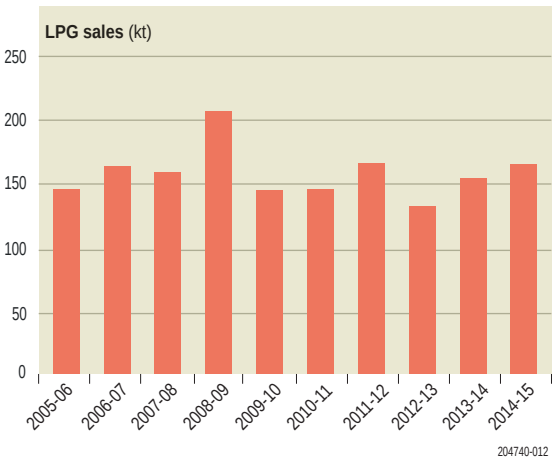


Figure 5 South Australian LPG sales, 2005–06 to 2014–15.

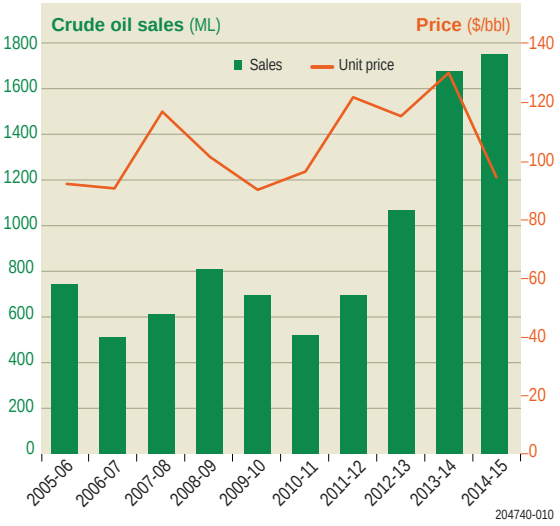


Figure 3 South Australian crude oil sales, 2005–06 to 2014–15.

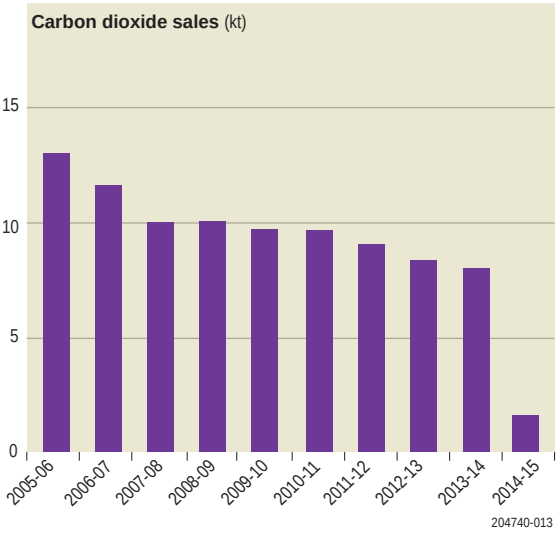


Figure 6 Carbon dioxide sales, Caroline 1, 2005–06 to 2014–15.

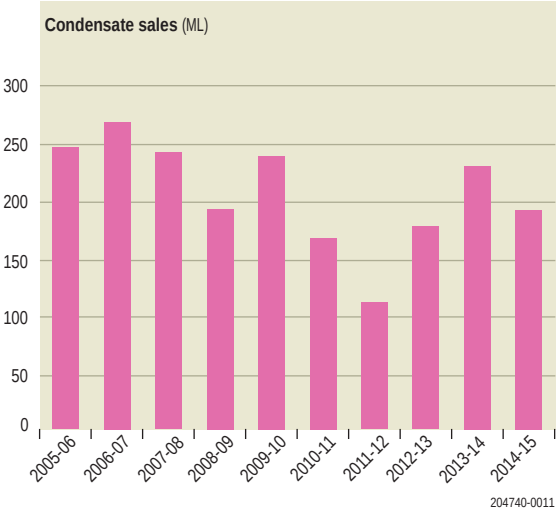


Figure 4 South Australian condensate sales, 2005–06 to 2014–15.

Petroleum licences

Onshore production licences

Onshore, at end 2015, there were 221 petroleum production licences (PPLs) in place in the Cooper and Otway basins.

Onshore exploration licences

At the end of 2015, 52 petroleum exploration licences (PELs) covering 211 120 km^2 (Fig. 7) were current, located in the productive Otway and Cooper and Eromanga basins, the frontier Officer, Arrowie, Stansbury and Arckaringa basins, and over the Cenozoic basins with coal seam gas and underground (in situ) coal gasification potential (i.e. Walloway, St Vincent, Murray, Springfield, Boolcunda and Willochra basins).

The right to negotiate (RTN), Indigenous land use agreement (ILUA) and legislation-specific processes consistent with the federal *Native Title Act 1993* have been effective in South Australia. In the case of RTN and ILUA processes to the end of 2015, the relevant registered native title claimants, petroleum explorers and the state government have concluded 53 RTN agreements, and 910 companies have signed up to 10 ILUAs with the Yandruwandha Yawarrawarrka and the Wangkangurru Yarluyandi peoples, enabling the subsequent grant of PELs. A successful conclusion to the current negotiations with the Dieri people will see conjunctive petroleum ILUAs covering the whole of the South Australian Cooper Basin.

All South Australian land access agreements cover the full cycle of petroleum activities including exploration, development and production. Legislation-specific, RTN and ILUA processes are being instigated in other parts of the state on a priority basis, with the highest priority being given to PEL applications over play trends with the perceived highest prospectivity for material petroleum discoveries.

Work programs and licence documents for granted licences, including the terms prescribed in native title access agreements, are available on the DSD Petroleum website (go to Licence Register under Licensing & Land Access).

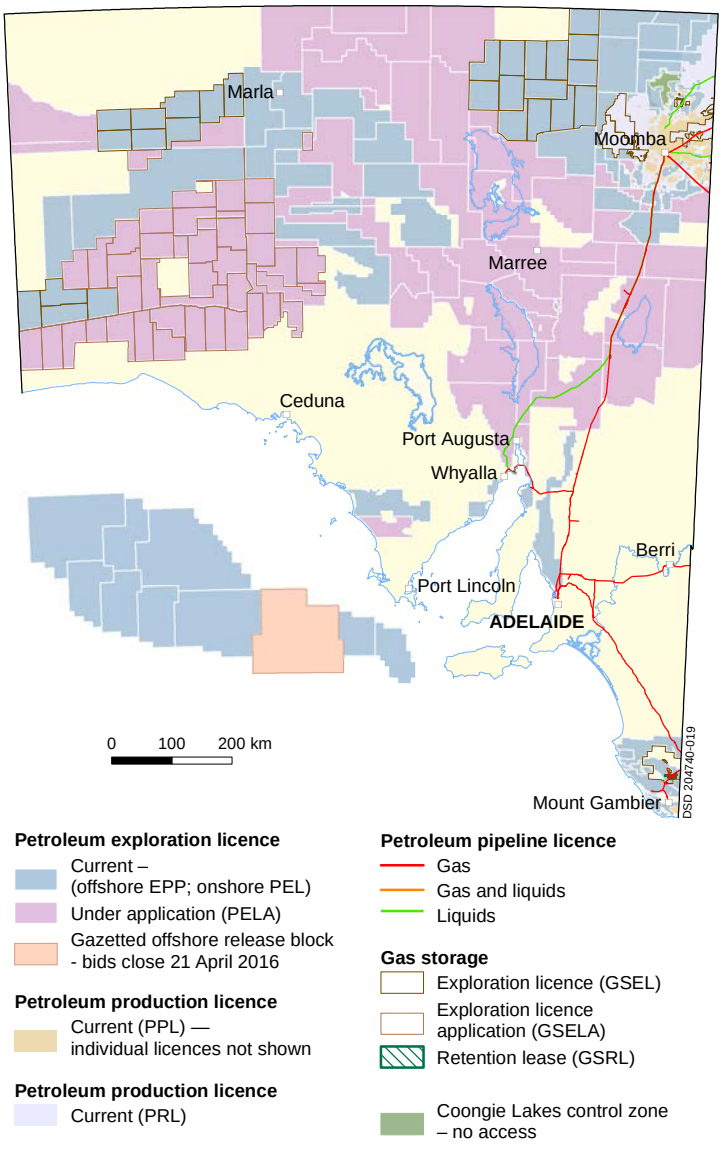


Figure 7 *Petroleum tenements in South Australia, December 2015.*

Retention licences

Four petroleum retention licences (PRLs) were current in the Otway Basin and 184 in the Cooper Basin at the end of 2015.

Operators of PELs within Cooper Basin proven play trends may apply for PRLs to get more time to reduce economic and/or subsurface uncertainties to progress to production. PRLs offer five-year terms including an exploration and appraisal work program and no acreage drop on renewal.

Associated activities licences

A total of 41 associated activities licences (AALs) were current at the end of 2015. AALs allow licensees to establish facilities or undertake surface surveys (e.g. seismic) in proximity to exploration, retention and production licences. Most AALs were granted to enable either the recording of full-fold seismic to a licence boundary by recording tails of seismic lines outside of the exploration licence, or to construct flowlines or production facilities adjacent to existing production or retention licences.

Gas storage licences

The new Petroleum and Geothermal Energy Act opened the state for 'over-the-counter' gas storage exploration licences (GSELs), while preserving storage entitlements in pre-existing petroleum licences. No royalties are levied for gas stored as an incentive for carbon dioxide geosequestration projects. There are currently nine GSELs current in the Cooper Basin, 12 GSELs and 38 GSELAs in the Officer Basin, 14 GSELs in the Simpson Basin and one GSEL and one gas storage retention licence (GSRL) in the Otway Basin.

Offshore exploration permits

Offshore there are currently nine exploration petroleum permits (EPPs) in the Bight Basin: four operated by BP Developments Australia Pty Ltd (BP), two by Bight Petroleum Ltd, two by Chevron Australia New Ventures Pty Ltd and one by the Murphy Australia Oil Pty Ltd – Santos Offshore Pty Ltd joint venture (Fig. 8).

BP was granted EPPs 37–40 inclusive on 17 January 2011. BP has guaranteed to undertake exploration worth about $605 million with the acquisition of 12 418 km^2 of 3D seismic (completed in May 2012) followed by four exploration wells in the third operational year. BP plans to drill the first two wells in 2016–17 then analyse the drilling results. The combined secondary exploration program includes an additional six deepwater wells and 5000 km^2 of 3D seismic for a total expenditure of $832 million, bringing total investment to $1.44 billion over six years. In 2013 Statoil agreed to acquire a 30% equity share in EPPs 37–40, with BP remaining as the operator of the joint venture.

EPPs 41 and 42 were awarded to Bight Petroleum on 7 July 2011. Bight Petroleum has guaranteed to undertake 935 km^2 of 3D seismic acquisition and one exploration well for a total expenditure of $67.6 million. The combined secondary term work program commitments for the two permits include an additional three wells, 1969 km^2 of 3D seismic and 405 km of 2D seismic totalling $206 million. Total exploration expenditure for the two permits is about $274 million over six years.

EPP 43 was awarded to the Murphy–Santos joint venture in October 2013. The companies have guaranteed to undertake 7367 km^2 of 3D seismic acquisition. The secondary work program includes one exploration well and post well studies totalling $58 million.

EPPs 44 and 45 were awarded to Chevron in October 2013. Chevron has guaranteed to undertake 9000 km^2 of 3D seismic acquisition and two exploration wells for a total expenditure of $237 million in EPP 44; the secondary work program includes 1000 km^2 of 3D seismic totalling $5 million. In EPP 45 the company has guaranteed to undertake 12 000 km^2 of 3D seismic acquisition and two exploration wells for a total expenditure of $249 million; the secondary work program includes geological and geophysical studies and 1000 km^2 of 3D seismic totalling $5 million.

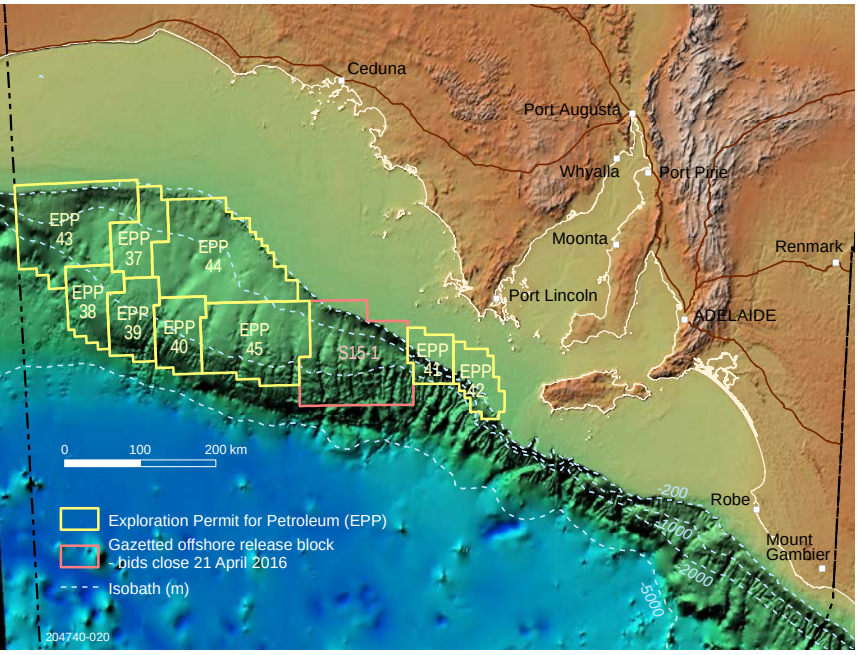


Figure 8 *Offshore petroleum tenements in South Australia superimposed on a digital terrain model, December 2015.*

Petroleum exploration activity 2015

Onshore

Low global oil prices since the end of 2014 have reduced on and offshore petroleum exploration in Australia. In South Australia, drilling activity reached records levels in 2013–14 but has reduced in 2015.

Exploration, development and appraisal drilling statistics are shown in Figure 9, and seismic in Figure 10.

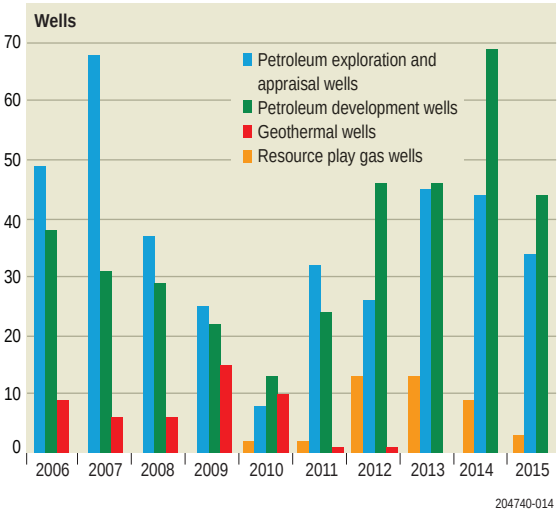


Figure 9 *Exploration, development and appraisal drilling statistics, South Australia, 2006 to 2015.*

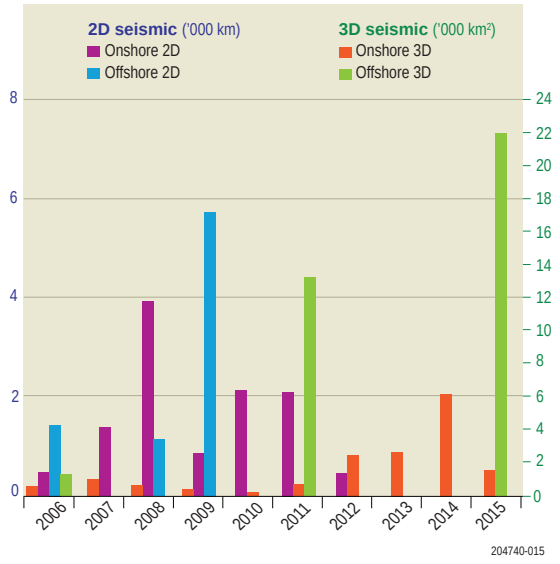


Figure 10 *Seismic survey statistics, South Australia, 2006 to 2015.*

Cooper and Eromanga basins. In 2015, 78 petroleum drillholes were drilled in the Cooper and Eromanga basins, down from 119 in 2014. There were 15 conventional petroleum exploration wells, 3 dedicated gas resource play exploration and appraisal wells, 16 appraisal wells and 44 development wells. Cooper Basin tenements, infrastructure and wells, superimposed on the C seismic horizon depth image, are shown in Figure 11.

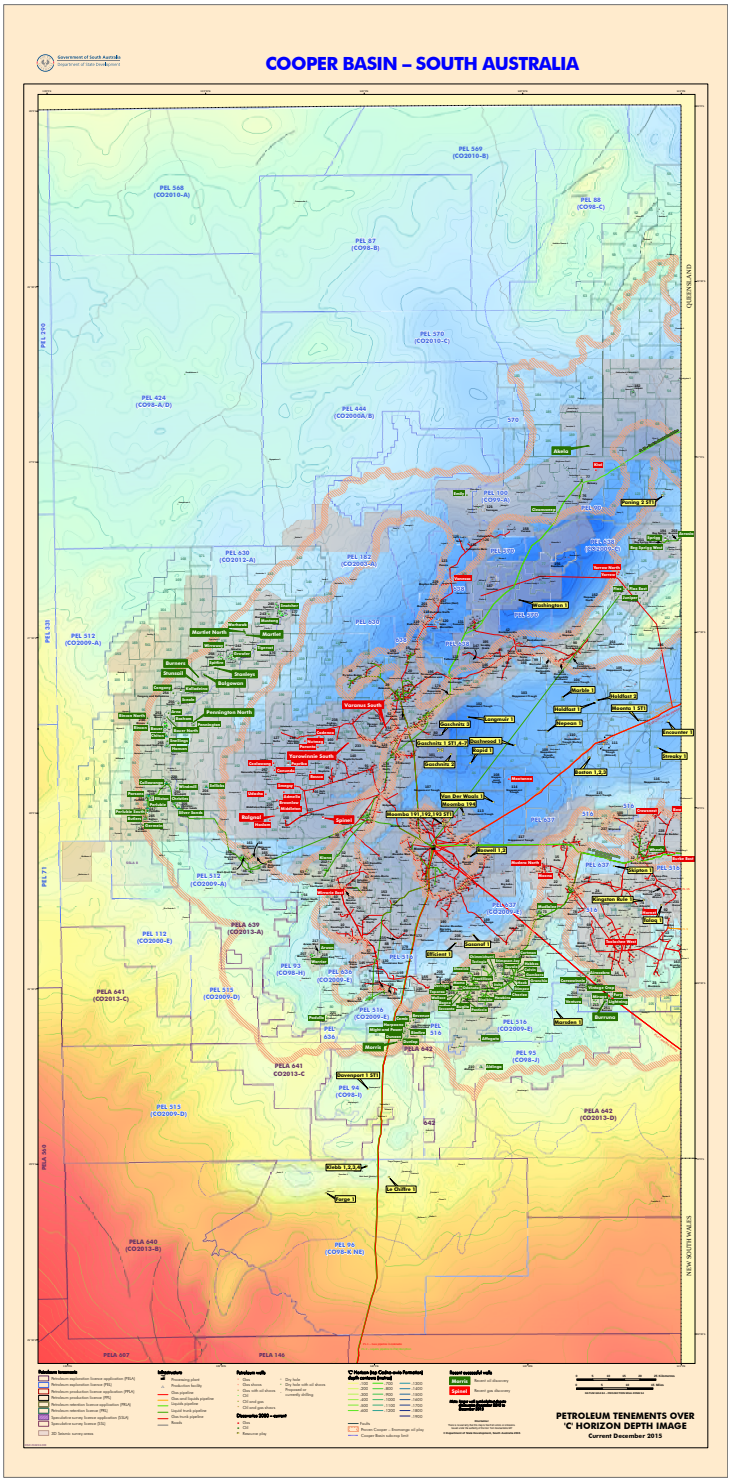


Figure 11 *Cooper Basin tenements, infrastructure and wells, superimposed on C seismic horizon depth image, December 2015.*

Cooper Basin success rates since January 2002 are shown in Table 2. Figure 12 shows oil exploration success rates for the South Australian Cooper and Eromanga basins since exploration commenced. The increased success rates since 2000 reflect improved target delineation with higher resolution 2D and 3D seismic, higher oil prices reducing the minimum size for economic targets, and the skill and experience of explorers.

Eight onshore 3D seismic surveys were completed in the Cooper Basin area in 2015 for a total surface coverage of 1585 km^2.

One seismic VSP survey was conducted in association with Santos's Kyanite well.

Offshore

BP has contracted Diamond Offshore for the drilling of at least four wells beginning in 2016–17. The rig is under construction by the world's biggest shipbuilder, Hyundai Heavy Industries, based in South Korea.

BP has committed to supporting a novel $20 million Research Science Program to improve understanding of the environmental, economic and social value of the Great Australian Bight, in collaboration with CSIRO and Marine Innovation Southern Australia. The program aims to obtain information about the unique marine environment and potential marine resources within the Great Australian Bight, and will provide information to decision-makers to support sustainable development in the region and monitor possible future impacts.

PGS completed a multi-client 3D seismic survey over much of EPP 43 in April 2015, with 8867 km^2 recorded in the permit. The EPP 43 joint venture parties, Murphy and Santos, are key underwriters for this non-exclusive survey.

TGS's Nerites 3D (Season 2) seismic survey in Chevron's EPPs 44 and 45 was completed in May 2015. This non-exclusive survey was substantially underwritten by the permitter. It covered 13 137 km^2 safely without any significant environmental incident.

In December 2015 the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) and the National Offshore Petroleum Titles Administrator (NOPTA) convened a series of offshore oil and gas open days in Adelaide, Port Lincoln, Kingscote and Ceduna. Representatives from NOPSEMA, NOPTA, Department of Industry, Innovation and Science (Cth), Australian Marine Safety Authority (Cth), DSD and Department of Planning, Transport and Infrastructure (SA) attended to answer questions. The initiative was aimed at providing an opportunity to the community to learn more about how the oil and gas industry in Australia was administered and regulated.

Table 2 *Cooper Basin conventional oil and gas success rates, January 2002 to December 2015*

	New entrants	Santos joint venture
Exploration wells drilled	255	43
Commercial success rate (%)	41	49
Technical success rate (%)	49	49.4
Appraisal and development wells drilled	146	500
Commercial success rate (%)	90	98

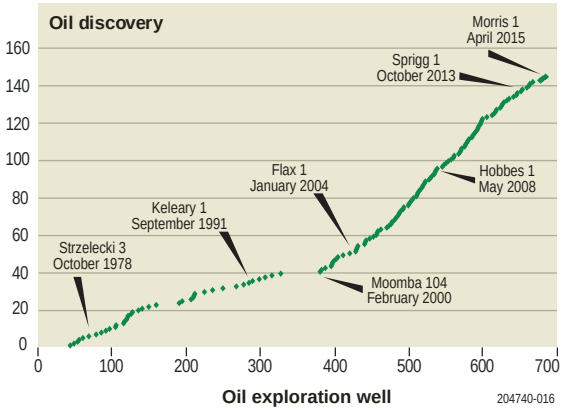


Figure 12 *Oil exploration success rates for the Cooper region, 1962 to 2015.*

Resource play exploration

The South Australian Cooper Basin has significant potential for economic gas resources from unconventional reservoirs, referred to as resource plays, which could extend production for decades. These resource gas plays include shale gas, basin-centred gas (pervasive tight gas) and deep gas from coal source rocks. Contingent gas resources totalling more than 5 tcf have been identified in resource plays in the South Australian Cooper Basin by the Cooper Basin Joint Venture (operated by Santos), Beach Energy and Senex Energy, approaching the total sales gas production from the basin to date.

The United States Energy Information Administration (EIA) has estimated that the entire Cooper Basin (South Australia and Queensland) has a risked recoverable shale gas resource of 85 tcf. The US EIA report *World shale gas resources: an initial assessment of 14 regions outside the United States* can be downloaded at <www.eia.gov/analysis/studies/worldshalegas/pdf/fullreport.pdf>.

Modern exploration and appraisal of Cooper Basin gas resource plays commenced in 2010 and reached high levels in 2012–13 (Fig. 9). Ten vertical wells tested resource plays in 2012 and 15 in 2013; there were 3 in 2015 (Fig. 13; Table 3). In December 2012 Beach Energy spudded Holdfast 2, the first dedicated horizontal well to test shale gas deliverability in the state. It is still early days in the evaluation of these potentially large gas resources, with only 34 wells drilled in a range of Cooper Basin play types.

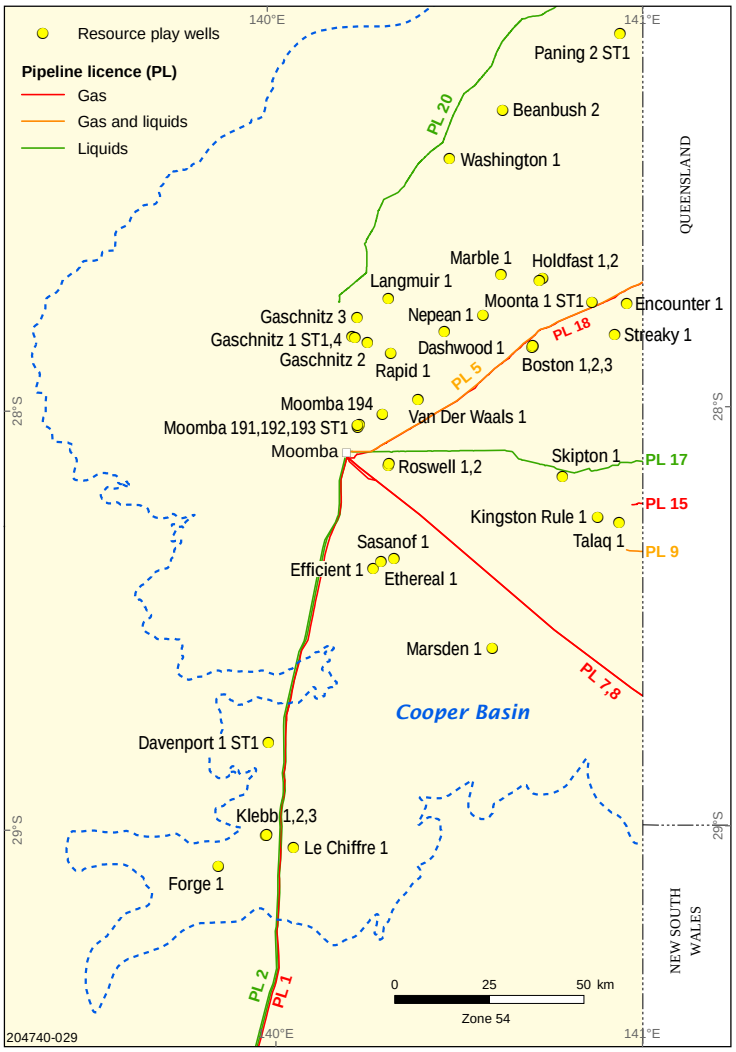


Figure 13 *Resource play gas wells in the Cooper Basin, 2010 to 2015.*

Table 3 *South Australian resource play wells drilled, 2010 to 2015*

Well	Operator	Spudded	Rig released
Forge 1	Strike Oil NL	28/06/10	25/07/10
Encounter 1	Beach Petroleum Ltd	03/10/10	23/12/10
Holdfast 1	Beach Energy Ltd	21/01/11	08/04/11
Moomba 191	Santos Ltd	01/12/11	26/12/11
Sasanof 1	Senex Energy Ltd	03/01/12	03/04/12
Marsden 1	Beach Energy Ltd	22/02/12	18/04/12
Moonta 1 ST1	Beach Energy Ltd	18/03/12	01/05/12
Talaq 1	Senex Energy Ltd	10/04/12	17/06/12
Davenport 1 ST1	Beach Energy Ltd	09/05/12	22/05/12
Streaky 1	Beach Energy Ltd	13/05/12	19/07/12
Skipton 1	Senex Energy Ltd	15/08/12	11/10/12
Marble 1	Beach Energy Ltd	30/09/12	02/12/12
Kingston Rule 1	Senex Energy Ltd	21/10/12	29/11/12
Boston 1	Beach Energy Ltd	02/11/12	29/12/12
Gaschnitz 1 ST1	Santos Ltd	18/11/12	14/02/13
Holdfast 2	Beach Energy Ltd	10/12/12	21/03/13
Roswell 1	Santos Ltd	11/12/12	20/01/13
Nepean 1	Beach Energy Ltd	10/01/13	25/02/13
Paning 2 ST1	Senex Energy Ltd	25/01/13	12/02/13

Well	Operator	Spudded	Rig released
Dashwood 1	Beach Energy Ltd	16/03/13	11/05/13
Van Der Waals 1	Santos Ltd	07/04/13	05/07/13
Moomba 192	Santos Ltd	08/04/13	01/05/13
Boston 2	Beach Energy Ltd	08/04/13	19/05/13
Langmuir 1	Santos Ltd	22/07/13	29/09/13
Rapid 1	Beach Energy Ltd	03/08/13	03/10/13
Moomba 194	Santos Ltd	25/08/13	07/10/13
Boston 3	Beach Energy Ltd	07/09/13	03/12/13
Roswell 2	Santos Ltd	12/10/13	06/12/13
Le Chiffre 1	Strike Energy	31/10/13	11/12/13
Klebb 1	Strike Energy	16/12/13	03/01/14
Moomba 193 ST1	Santos Ltd	28/01/14	27/02/14
Gaschnitz 4	Santos Ltd	28/05/14	30/07/14
Gaschnitz 3	Santos Ltd	07/09/14	25/11/14
Klebb 2	Strike Energy Ltd	26/10/14	13/11/14
Klebb 3	Strike Energy Ltd	16/11/14	14/12/14
Gaschnitz 2	Santos Ltd	03/12/14	09/02/15
Washington 1	Santos Ltd	24/08/15	01/10/15
Efficient 1	Senex Energy Ltd	16/10/15	07/11/15
Ethereal 1	Senex Energy Ltd	19/12/15	08/01/16

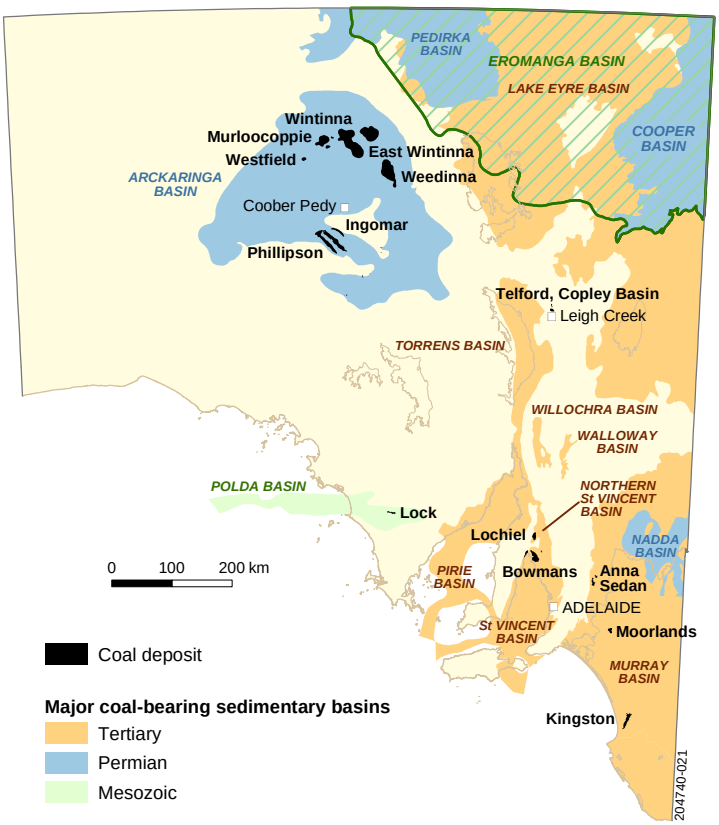


Figure 14 *Basins with coal measures and coal deposits in South Australia, December 2015.*

Coal seam gas and underground coal gasification exploration

Coal measures in South Australia are primarily of Permian, Triassic, Jurassic and Tertiary age (Fig 14). Interest has been shown by a number of companies to explore for coal seam gas and some explorers are also focused on underground (in-situ) coal gasification.

Petroleum exploration outlook 2016

Onshore

Cooper Basin. Work programs in 2016 include ongoing oil and deep gas exploration and development drilling, hydraulic fracture stimulation programs in gas wells and seismic acquisition.

The record levels of 3D acquisition in 2013 and 2014 will generate prospects for drilling in the future when the oil price recovers. In the meantime, DSD is providing flexibility to explorers managing PEL and PRL work programs through this current period of low commodity prices.

Offshore

BP is well advanced in its planning for its drilling program, which includes substantial stakeholder consultation in addition to technical, logistical and environmental planning. The proposed drilling area has water depths of 1000–2500 m and at the closest point is ~400 km west of Port Lincoln and 300 km southwest of Ceduna.

BP submitted its 1200-page environment plan for undertaking exploration drilling in the Great Australian Bight in October 2015. In November NOPSEMA determined that the plan does not yet meet the criteria for acceptance under the environment regulations and provided BP with an opportunity to modify and resubmit the plan. This does not mean the BP plan had been rejected; NOPSEMA is required by law to provide BP with a reasonable opportunity to modify the environment plan. It is usual for NOPSEMA to provide initial feedback that titleholders need to address before resubmitting. BP is currently revising its plan.

Many companies across various industry sectors in South Australia have registered an interest in participating in BP's drilling program project, through the Industry Capability Network.

Chevron's four-well drilling commitment is due in 2017–18 and planning is underway for stakeholder consultation which forms an important part of the environmental approval process.

Geothermal exploration and proof-of-concept projects

The number of geothermal exploration licences (GELs) and GEL applications in South Australia totalled 22 at the end of 2015, covering 27 400 km^2. A further 15 geothermal retention licences (GRLs) are held by Geodynamics Limited extending over 1482 km^2 in the Cooper Basin (Figs 15, 16).

The only three geothermal energy projects in Australia to have progressed to deep drilling and flow testing are located in South Australia (Geodynamics in the Cooper Basin, Petratherm in the northern Flinders Ranges and Raya Group, formerly Panax Geothermal, in the Otway Basin). A total of 71 geothermal wells have been drilled in South Australia. Of these wells, only nine are considered to have been drilled to the target objective (Habanero 1, 2, 3 and 4; Jolokia 1; Savina 1; Salamander 1; Paralana 2; and Celsius 1). No drilling or data acquisition was undertaken in 2015.

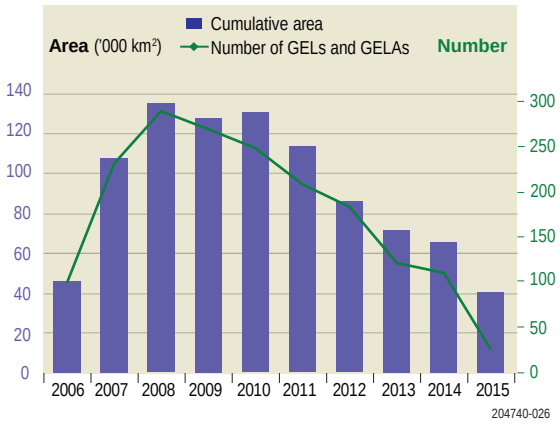


Figure 15 *Number and area of geothermal licences and applications in South Australia, 2006 to 2015.*

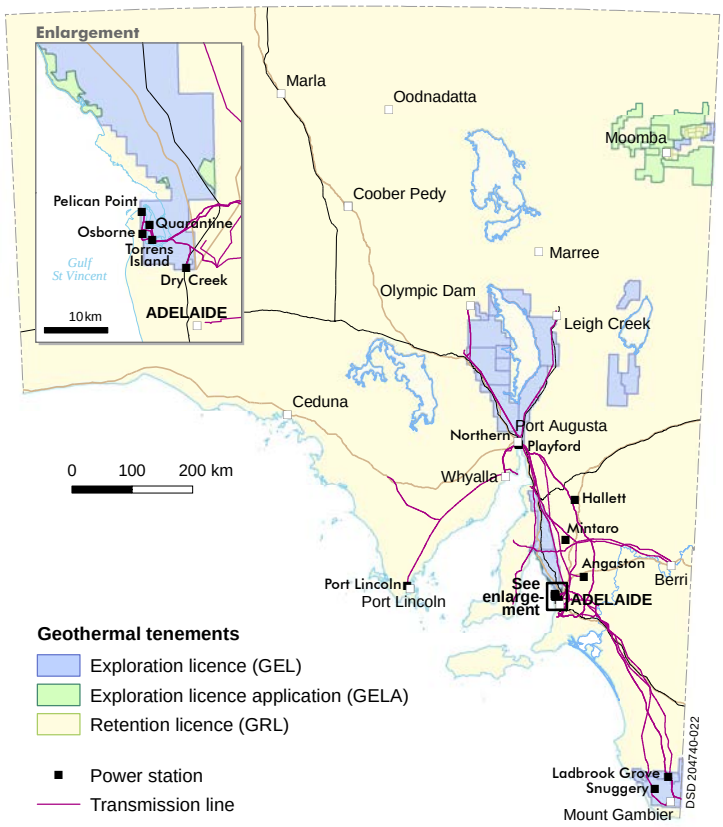


Figure 16 *Geothermal tenements in South Australia, December 2015.*

Energy Resources Division achievements

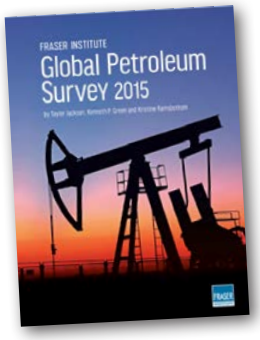
Roundtable for Oil and Gas Projects in South Australia

South Australia is the first Australian state to deliver a comprehensive approach to developing its vast gas resource plays. The *Roadmap for unconventional gas projects in South Australia,* released in December 2012, lays out the priorities for attention that once addressed will lead to more gas being extracted from South Australia. The work to implement the roadmap continues through the Roundtable for Oil and Gas Projects in South Australia. Eight working groups are addressing the roadmap's most critical recommendations:

1. Training
2. Supply hubs, roads, rail and airstrips for the Cooper and Eromanga basins
3. Water use in the Cooper and Eromanga basins
4. Minimise red tape for interstate 'wharf to well' corridors to/from the Cooper and Eromanga basins
5. Cost-effective, trustworthy greenhouse gas detection
6. Suppliers' forum
7. Use gas for transport and heavy equipment
8. Sharing information and 'fact checking'.

The roadmap is available from the DSD website <www.statedevelopment.sa.gov.au/resources/unconventional-gas-projects>. To join the roundtable or one of the working groups, phone +61 8 8463 3204 or email <DSD.ERDAdmin@sa.gov.au>.

DSD officers inspecting recent works on pipeline infrastructure in the northern Cooper Basin. (Photo 414829)



Fraser Institute global survey of petroleum companies

The ninth Fraser Institute global petroleum survey was released on 1 December 2015. South Australia ranked 12th in the world according to the Policy Perception Index values, up from 18th in 2014 and was the third non-North American jurisdiction behind Netherlands–Offshore and Norway–North Sea. South Australia was ranked first in the Oceania region; the next ranked Australian jurisdictions were Western Australia at 33 and Northern Territory at 34 (Fig. 17).

Since 2010 South Australia has consistently ranked in the top two for the Oceania region, vying with New Zealand for the top spot. The Oceania region is composed of 15 jurisdictions: six Australian states, Northern Territory, offshore Australia, Timor Gap Joint Petroleum Development Area (JPDA), New Zealand, Brunei, Malaysia, Philippines, Papua New Guinea and Indonesia.

South Australia was ranked best in the world for its fiscal regime, evidence that the sector appreciates the state's willingness to look at royalty relief through deferral arrangements, and initiatives to look at company exploration and development expenditure requirements during times of commodity pricing stress.

The report includes the following comment on South Australia made by a respondent:

> Strong political leadership on the fracking debate and support for free market on gas supply versus calls for domestic gas reservation policy. Also strong bipartisan support for the oil and gas exploration industry generally – progressive tenure management legislation and flexibility through low oil price.

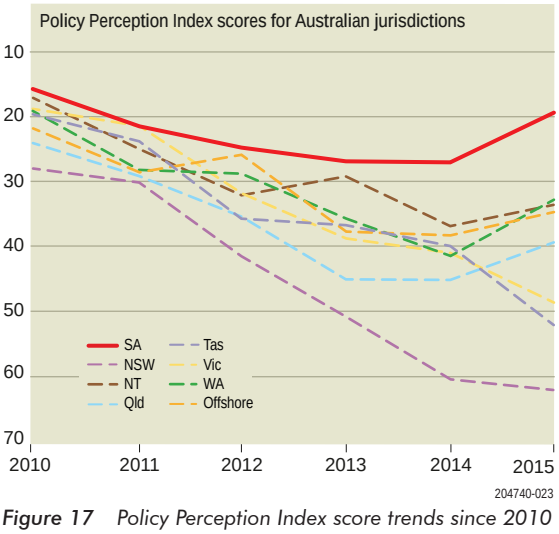


Figure 17 Policy Perception Index score trends since 2010 for Australian jurisdictions.

Growing the mining and petroleum service and supply sector in South Australia

The Oil and Gas Suppliers' Forum (Working Group 6 under the Roundtable) was established in October 2014 and is led by the Mining Industry Participation Office (MIPO) in DSD. MIPO works with industry to understand the gaps and opportunities in the mineral and energy resources supply chain and assists local businesses to position themselves to add value to the resource sector.

Mining and Petroleum Services Centre of Excellence

The South Australian Government continues to drive research and build the skilled workforce the state needs to support the on and offshore upstream petroleum industry through the Mining and Petroleum Services Centre of Excellence. The centre provides a pathway for mining and energy companies, research institutions and South Australian businesses to work together to find solutions that will make our state's resources globally competitive. It supports the development of local supply chains to enable South Australian based companies to compete nationally and globally, providing high value added products and services to the resources sector.

The centre has been funded by the state government with $10 million over five years from 2013–14 to 2017–18 for innovation seed funding toward the development of strategically important capabilities in areas such as:

- deep resource exploration and deep mining
- next generation minerals processing
- leading practice in mine rehabilitation and environmental protection
- mine to mill optimisation, ore selection and pre-concentration, mine logistics
- automating the resource sector through innovative ICT applications across the entire mining lifecycle
- leading practice in multiple land use policy and community engagement
- deep gas well operations and training.

Funding applications are open now; forms and guidelines are available on the DSD website <www.statedevelopment.sa.gov.au/resources/mining-and-petroleum-services-centre-of-excellence>.

Petroleum prospectivity research

The Energy Resources Division has developed many collaborative research projects with the University of Adelaide School of Earth and Environmental

Sciences, Australian School of Petroleum (ASP) and South Australian Centre for Geothermal Energy Research (SACGER) to address the critical uncertainties which have dissuaded petroleum and geothermal exploration investment in South Australia.

PACE Energy

Three programs underpin the *PACE* Energy initiative:

- Unconventional Gas Resources
- SACGER
- Cooperative Research Centre for Greenhouse Gas Technologies (CO2CRC).

The Unconventional Gas Resources program comprises three projects:

- Cooper Basin atlas: understanding Australia's premier onshore hydrocarbon province
- GeoFrac
- Australian Research Council (ARC) project.

Cooper Basin Petroleum Prospectivity Review. The Cooper Basin is the state's premier energy resource and remains the country's largest oil and gas producing onshore basin. It is critical that DSD fully understands the basin's gas resource potential, particularly now that new resource plays are being explored and evaluated. This project focuses on continuous gas accumulations (basin-centred gas, shale gas, coal and coaly shale source rock, plays and deep coal seam gas) in the Permian Cooper Basin succession. Many existing Cooper Basin datasets have not been significantly updated since their development under the SAEI and TEISA government initiatives in the 1990s to early 2000s. Additionally, new datasets are necessary to properly identify and assess the various continuous gas plays.

This project sees a return to gathering and value-adding data for DSD, academic and industry researchers that will be accessed via SARIG. It also provides DSD with the necessary knowledge to develop appropriate policy and energy planning advice to government and enable effective investment attraction. Project deliverables are aligned with key recommendations from the *Roadmap for unconventional gas projects in South Australia as* determined by industry, government, academia and other stakeholders.

The project involves close collaboration with Geoscience Australia and the Geological Survey of Queensland (GSQ). The consolidated datasets form the foundation for an independent assessment of Cooper Basin resource plays that is currently being conducted by the United States Geological Survey in collaboration with Geoscience Australia, DSD and GSQ and is due for completion in the first quarter of 2016. This independent assessment will form a part of Australia's yearly hydrocarbon resource assessment.

GeoFrac. The University of Adelaide's Institute for Mineral and Energy Resources, Centre for Tectonics, Resources and Exploration, and the ASP supported development of GeoFrac, an industry consortium to improve the understanding of different geomechanical and geochemical contributions to variations in wellbore productivity from unconventional reservoirs. DSD joined GeoFrac in 2012; the project was completed in 2015.

Australian Research Council (ARC) project. In 2012 Professor Martin Kennedy (chief investigator) was part of a successful ARC grant of $750 000 over four years with DSD and industry partners Santos, JRS Petroleum Research, Central Petroleum Ltd and Petrofrontier (Australia) Pty Ltd. The project, 'From organo-mineral nanocomposite to Australian basins: an integrated approach to unconventional gas exploration and development' is due for completion in 2016 and is currently being run out of Macquarie University.

Support for universities

DSD provides funding for the State Chair of Petroleum Geology at the ASP, which is the largest university centre for petroleum geosciences and petroleum engineering in the southern hemisphere. That the ASP is located in Adelaide is in significant part due to DSD's long-term support of the petroleum geosciences at the University of Adelaide.

Professor Peter McCabe was appointed in March 2014 as the new State Chair and has been busy establishing research projects on the Cooper Basin and expanding links with industry.

DSD professionals provide strategic advice to South Australian university programs through membership on the ASP Board of Management and the SACGER Board. Further support is provided through voluntary unpaid lecturing and workshops to the ASP and the University of South Australia on regulation and environmental impact assessment and risk assessment.

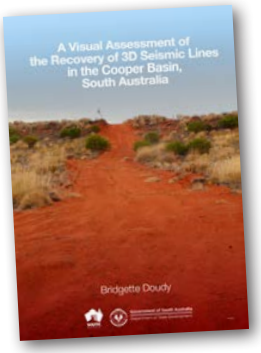
Pipeline research and committee work

DSD participates in a number of working groups and committees responsible for the revision and promotion of Australian Standard (AS) 2885 for high-pressure pipelines.

Environmental initiatives

The Energy Resources Division provides input on proposed changes to land use or management in the state, particularly for park and reserve acquisitions and management plans, marine planning proposals and regulatory changes that may have an influence on resource industry access to land. It provides DSD representation on a number of committees and boards, providing strategic advice on issues relating to petroleum and geothermal activities. These include the South Australian Arid Lands Regional Natural Resource Management Board, South Australian Outback Consultative Committee, Great Australian Bight Marine Park Consultative Committee and Marine Planning/Marine Parks Steering Committee.

In South Australia the Arckaringa and Pedirka basins have coal deposits with potential for future coal seam gas and/or large coal mining development. As the processes and mechanisms that drive groundwater recharge are poorly understood in these basins (in general), projects are underway to provide an information basis that will inform water asset vulnerability. DSD contributes to these projects through its participation in the Arckaringa Basin and Pedirka Basin Groundwater Assessment Technical Advisory Group as well as in-kind support for the seismic mapping of aquifers.



A project to analyse the visible impact of 3D seismic lines in the South Australian portion of the Cooper Basin between 1992 and 2015 was undertaken (Report Book 2015/00027). Results showed that visible impact is minimal in dune and floodplain land systems, but a long-term issue in gibber plain land systems. This was presented to the Environmental Institute of Australia and New Zealand Conference in Perth in October 2015, and a poster of this project work has been accepted for the 2016 APPEA Conference.

Vibroseis truck with environmentally sensitive balloon tyres recording seismic data in the Cooper Basin. (Courtesy of Geokinetics; photo 414828)

Carbon dioxide capture and storage (geosequestration)

DSD is the South Australian representative for upstream energy issues addressed through the International Energy Agency, Carbon Storage Taskforce, the Global Carbon Capture and Storage Institute and Ministerial Council on Mineral and Petroleum Resources subcommittees and working groups that deal with the regulation of, and investment attraction for, greenhouse gas storage projects.

DSD provides funding and in-kind support towards the CO2CRC's Research Centre at the University of Adelaide.

Support for geothermal research

South Australian Government

International Energy Agency's Geothermal Implementing Agreement (IEA GIA). DSD Energy Resources Division provides Australia's executive committee representatives to IEA GIA and a vice-chair of the IEA's GIA executive committee. This role entails the preparation of Australia's annual reports on geothermal energy to the IEA. Historical annual reports up to 2013 are available for download from the DSD Geothermal website (go to AGEG, Information, IEA GIA).

Australian Geothermal Energy Group (AGEG). AGEG is Australia's peak, whole-of-sector body for companies, research organisations and government agencies with an interest in the development of Australia's vast geothermal resources. AGEG is Australia's affiliate to the International Geothermal Association. DSD provides the chair (Energy Resources Executive Director) and secretariat services for AGEG.

South Australian Centre for Geothermal Energy Research. SACGER at the University of Adelaide brings together cross-disciplinary research and expertise from the ASP; Chemical Engineering; Civil, Environmental and Mining Engineering; Earth and Environmental Sciences; Mathematical Sciences; Computer Science; and the South Australian Museum to facilitate research into geothermal resources and power systems for viable delivery of geothermal energy. Initially founded on South Australian Government grants of $3.6 million in 2009–11, SACGER has since been successful in attracting additional grants for geothermal research and development projects from external sources.

DSD and SACGER maintain a close working relationship through joint research projects and the co-supervision of PhD and Honours students working on geothermal-themed research. In particular, DSD and SACGER are co-researchers in an Australian Geophysical Observing System funded project to gather wireline logging and petrophysical data across the state for use as precompetitive data for industry. This data will also be used to investigate in situ stress changes across the state as well as understanding the distribution of heat flow and temperature at depth.

Other support

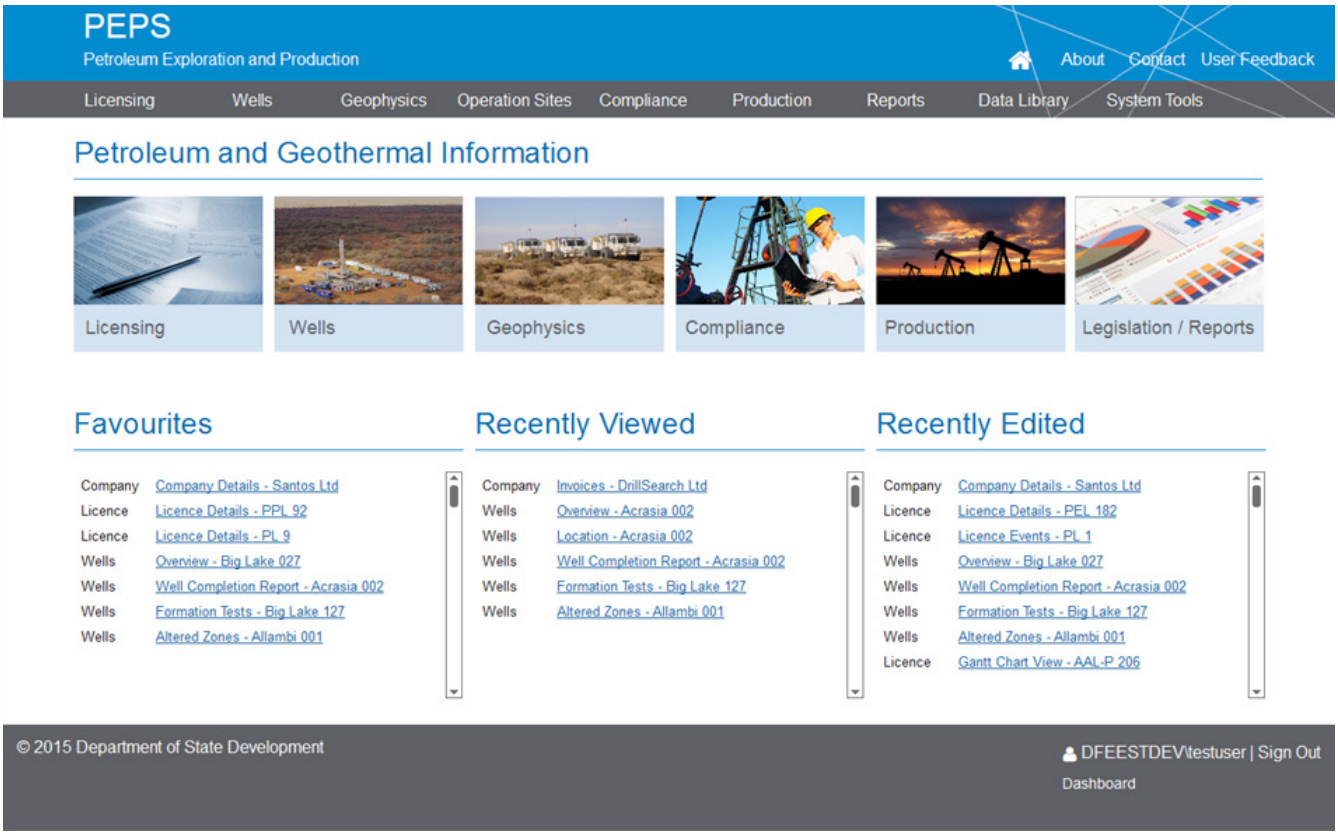
The Australian Government has implemented a number of initiatives to underpin national energy security and the development of renewable energy resources in Australia. Of particular importance is the creation of the Australian Renewable Energy Agency (ARENA) which now administers all Australian Government funding for renewable energy technologies, including a $495 000 grant to SACGER for a project to better understand and predict the structural permeability of sedimentary basins.

PEPS database translation project

A major 18-month project is underway to migrate DSD's Petroleum Exploration and Production System – South Australia (PEPS-SA or PEPS) database onto a web-enabled platform (PEPS 2) with ongoing linkages to SARIG. The PEPS project will provide a foundation for improvements to the public-facing PEPS application, which is unique amongst Australian jurisdictions in offering well, seismic, tenement and engineering data as well as highly detailed production data via a free ~70 MB download of open file data. Industry feedback has been sought via an information session and a survey.

The project will deliver a web-enabled solution that will provide stakeholders with the ability to access data anywhere and on a range of devices. Completion is scheduled for 30 June 2016.

PEPS can be downloaded from the DSD Petroleum website <http://petroleum.statedevelopment.sa.gov.au/data_and_publications/peps-sa>.



New web-enabled public PEPS interface currently in development and scheduled for completion mid 2016.

Regulatory compliance

The Petroleum and Geothermal Energy Act is designed as an effective, efficient and flexible regulatory system for all exploration and production activities for petroleum, gas storage and geothermal resources onshore in South Australia, as well as the construction, operation and technical regulation of high-pressure transmission pipelines.

Key objects of the Act include:

- protecting the public and the environment from risks inherent in activities regulated under the Act
- establishing appropriate consultative processes, both with people directly affected by activities regulated under the Act, and the general public
- ensuring appropriate levels of security of natural gas supply are provided for.

The DSD Energy Resources Division's compliance and enforcement activities are driven by the above objectives and the six key principles of certainty, openness, transparency, flexibility, practicality and efficiency. DSD prepares an annual compliance report to report on the administration of the Act and the regulatory performance of the industries covered by the Act. A summary of the report for 2015 is provided below and the full report will be available via SARIG and the DSD Petroleum website.

Due to community interest in natural gas and fracture stimulation, DSD has published an information brochure to show how fracture stimulation is being effectively regulated and managed in South Australia. It is available from the DSD Petroleum website.

Activity notifications

A total of 250 activity notifications covering various geophysical, drilling and production operations were submitted to and reviewed by DSD in 2015, including 29 for high surveillance operators which required assessment and approval by the Minister for Mineral Resources and Energy (Fig. 18). Due to the current industry climate both for the domestic and international petroleum industry the overall level of industry activity is significantly lower than in previous years as reflected by the number of activity notifications received.

Included in these activities, 78 petroleum wells were spudded in South Australia. Figure 19 shows the number of petroleum wells drilled per year since 2006.

Further to wells drilled, 51 petroleum wells were fracture stimulated in the Cooper Basin in South Australia. Figure 20 shows the number of petroleum wells fracture stimulated per year since 2006. A total of 837 petroleum wells have been fracture stimulated up to the end of 2015 in South Australia.

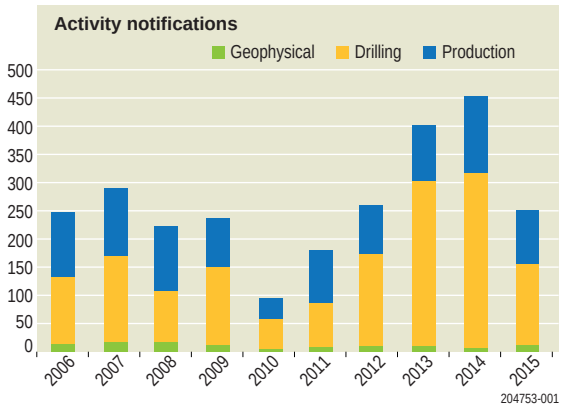


Figure 18 *Activity notifications submitted to DSD, 2006 to 2015.*

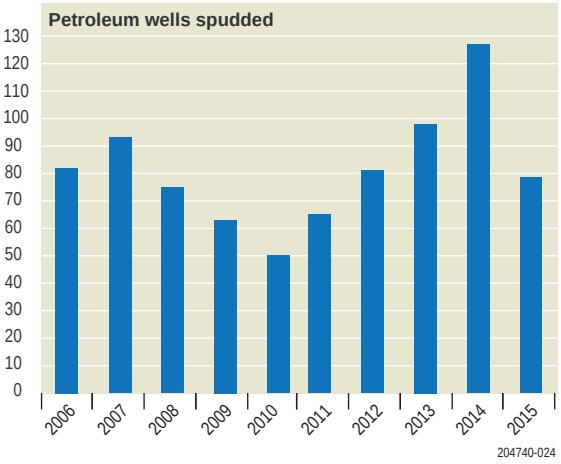


Figure 19 *South Australian petroleum wells spudded per year, 2006 to 2015.*

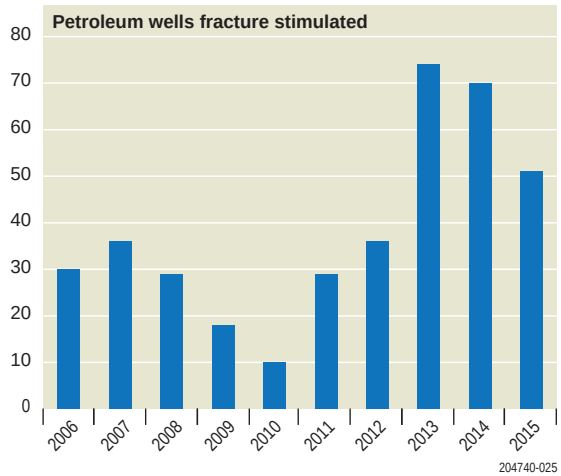


Figure 20 *South Australian petroleum wells fracture stimulated per year, 2006 to 2015.*

Statements of environmental objectives

One new statement of environmental objectives (SEO) was gazetted in 2015, and three SEOs were revised and gazetted. The review process for a further eight SEOs is ongoing.

Surveillance activities

During 2015, 17 field trips were conducted covering areas of the Cooper–Eromanga, Eromanga, Officer, Otway, Warburton, Arckaringa and Arrowie basins, resulting in 135 individual inspections of wellsites, pipelines and associated facilities and infrastructure. Ninety inspections of geophysical seismic surveys were also undertaken in 2015. A number of issues relating to waste and wastewater management, uncontained fuels, oils and chemicals, soil contamination, site fencing and weed issues were identified during these inspections. Figures 21–23 show goal attainment scores for wellsite and access track, water disposal facility and geophysical seismic line assessments carried out in 2015. DSD did not assess borrow pits against goal attainment scaling (GAS) criteria in 2015 but will recommence in 2016 as the GAS criteria for borrow pits has been revised and is expected to be incorporated into a number of production SEOs under review in 2016.

As a result of field surveillance activities in 2015, 35 individual potential environmental improvements were observed at separate sites and 11 environmental improvement notices were issued regarding breaches and potential breaches of relevant SEOs. Following on from this, one issue required escalation resulting in a formal notice of noncompliance letter being issued detailing Step 2 persuasive measures undertaken by DSD.

Health, safety and environmental management systems self-assessment

To assist licensee understanding of regulator expectations and to aid continuous improvement of their health, safety and environment management systems (HSEMSs), licensees and contractors are required to demonstrate capabilities against the regulation 16 operator assessment factors by undertaking self-assessments of their HSEMSs and reporting this to DSD biennially, using the recommended self-assessment tool available on the DSD Petroleum website.

To become comfortable that the self-assessment scores provide a true reflection of licensees' performance, DSD conducts validation initiatives with all licensees, with the exception of companies undertaking limited low-risk activities. Validation initiatives include but are not limited to field

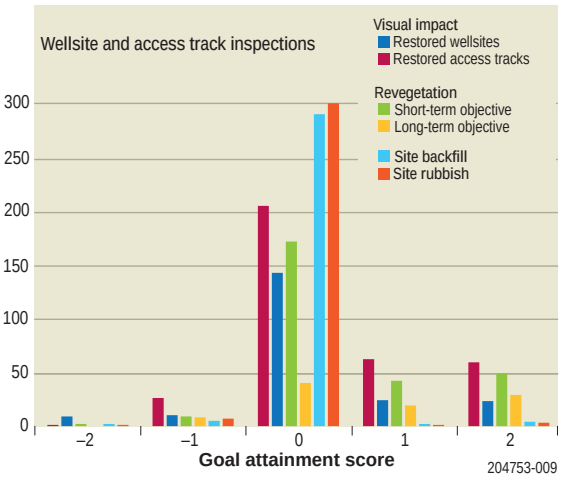


Figure 21 *Compliance of wellsite and access track restoration in 2015.*

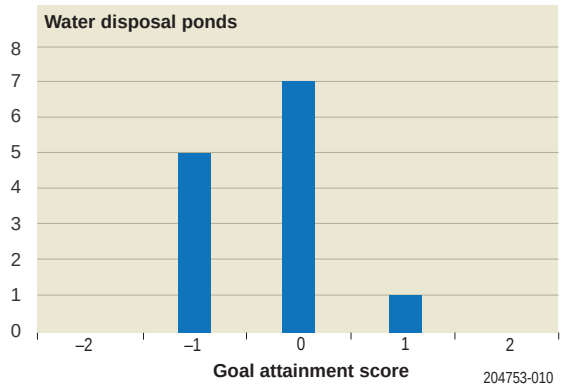


Figure 22 *Compliance of water disposal facility ponds in the Cooper and Eromanga basins for 2015.*

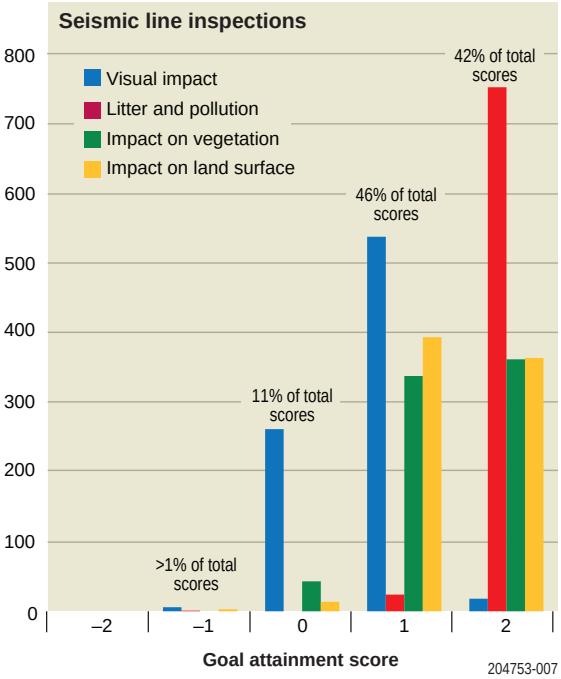


Figure 23 *Compliance of seismic line preparation activities with the relevant SEO in 2015.*

inspections, audits, observation of risk assessment workshops and review and interrogation of reports. Validation activities relating to licensee self-assessments received in 2014 continued in 2015. The next round of licensee health, safety and environmental management system self-assessments are to be completed and submitted to DSD in 2016.

Compliance incidents

During 2015, 11 serious incidents were reported under the Act. These included six spill events, four gas releases and one event relating to security of gas supply. The spill events were classified as serious incidents at the time of occurrence due to the potential for contaminants to either enter a water body, including shallow groundwater, or affect the health of native flora and fauna. The gas release events were classified as serious incidents because they resulted in the activation of emergency response and/or evacuation procedures. The security of supply event was classified as a serious incident due to prejudice of natural gas supply.

Industry compliance statistics for 2015 – such as oil spills, pipeline encroachment, work health and safety related incidents, physical integrity and gas release incidents – together with an analysis of their root causes, are summarised in Figures 24–27. Oil spills for 2015 totalled 453.8 m^3, which was approximately 0.03 % of total oil produced for the year (Fig. 28) and largely due to a major pipeline leak of ~300 m^3, an incident which despite its volume was responded to in an adequate timeframe with the site remediated in line with the requirements of the relevant SEOs to minimise potential impacts to the environment. Note that further submissions or clarifications of data were made in 2015 relating to prior years resulting in changes to the oil spilt volumes displayed in Figure 28 compared with previous years.

Co-produced water

On 16 February 2009 the Minister for Environment and Conservation adopted a water allocation plan for the Far North Prescribed Wells Area (FNPWA) pursuant to section 80(3)(a) of the *Natural Resources Management Act 2004*.

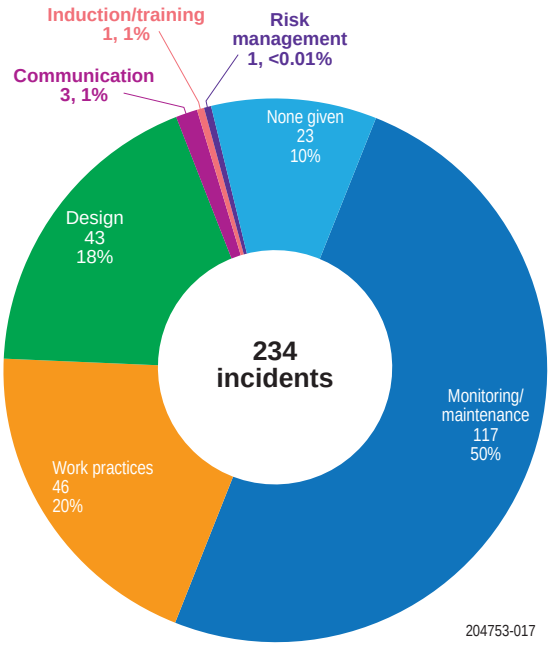


Figure 25 *Summary of root causes of incidents (number and %) in 2015.*

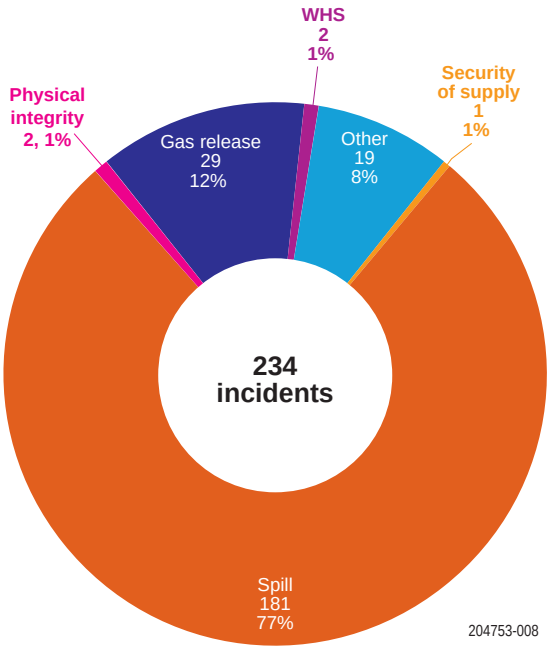


Figure 24 *Categories of incidents in 2015.*

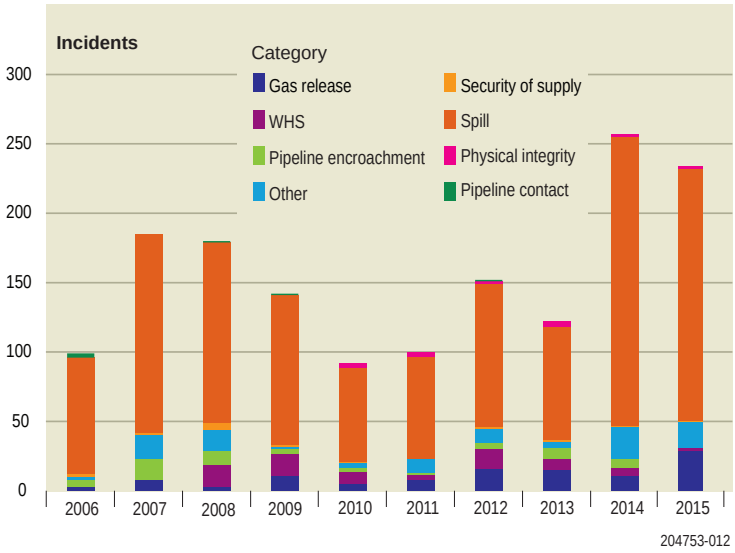


Figure 26 *Comparison of categories of incidents, 2006 to 2015.*

The Minister for Mineral Resources and Energy has been assigned a water allocation of 60 ML/d (or 21 900 MLpa) under the water allocation plan for the FNPWA pursuant to section 80(3)(a) of the Natural Resources Management Act for petroleum co-produced water within the FNPWA. As part of this assignment, the Minister is obliged to collect, monitor and publish all co-produced water to ensure that the 60 ML/d allocation is not exceeded and that petroleum licensees are managing this water production in accordance with the relevant SEO requirements. Figure 29 illustrates the level of water co-produced within the Cooper and Eromanga basins since 1983. Note that additional historical data has been provided during 2015 which has resulted in updates to the database and increases to the co-produced water volumes displayed in this figure when compared with previous years. ■

Water disposal facility ponds, Moomba South, Cooper Basin. (Photo 414830)

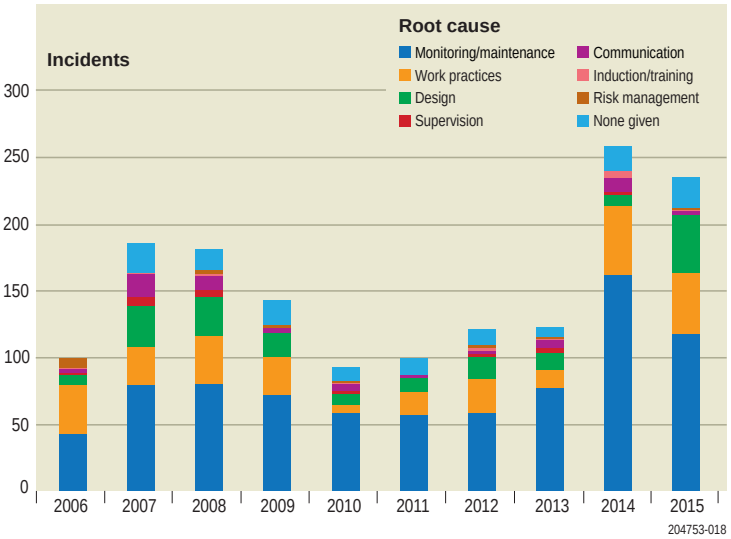


Figure 27 Comparison of root causes of incidents, 2006 to 2015.

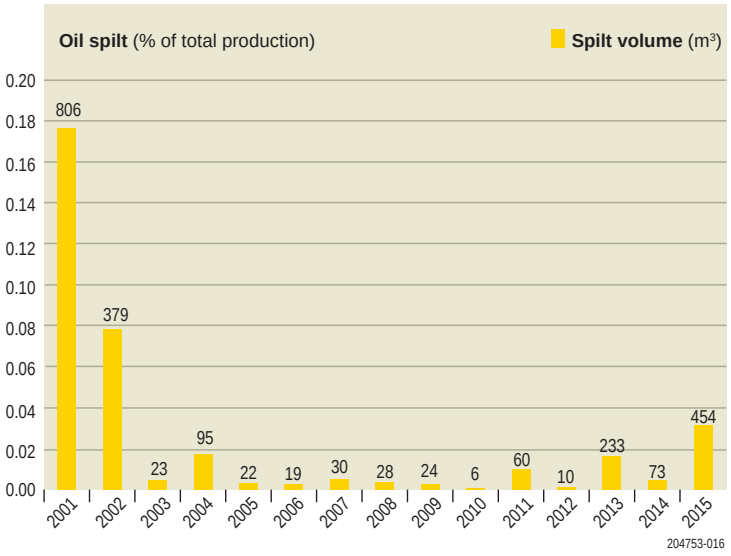


Figure 28 Percentage of volume of oil spilt to total oil produced, 2001 to 2015.

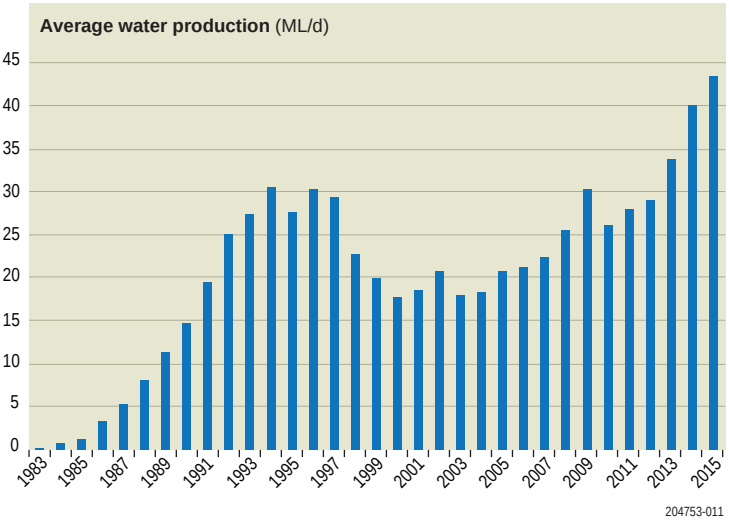


Figure 29 Co-produced water in the Cooper and Eromanga basins, 1983 to 2015.

Publications

Mineral and Energy Resources publications for 2015 are listed below and hyperlinked where possible. Department of State Development publications link via SARIG to the PDFs; externally published articles link to the publisher. Articles are available through the Department of State Development Geoscience Library.

Published articles (peer reviewed)

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SARIG reference: RB 2015/00005 (8 MB).

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Foss C, **Reed G, Keeping T** and **Heath P** – Geoscientific investigation of a remanent anomaly? Teetulpa, South Australia.

Heath P – New gravity in the Musgrave Ranges, South Australia.

Thiel S, Heinson G and **Hill S** – Imaging the electrical lithosphere of South Australia – 2D profiles and preliminary results of AusLAMP SA.

Wise T and **Katona L** – Gravity anomalies as trap sites in prospectivity modelling of the eastern Gawler copper-gold belt.

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Water Management for Shale and Tight Gas Resources, June 8-9 2015, Perth, Western Australia, Seminar Program

Brochure. Co-convened by International Association of Hydrogeologists Australia, Society of Petroleum Engineers and Australian Society of Exploration Geophysicists, WA Chapters.

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Minerals

SARIG reference: MRG MG0 (where '0' is the number)

MG1 *Guidelines for miners: mining approval processes in South Australia,* V 2.0. (1.3 MB)

MG2a *Preparation of a mining proposal and/or management plan for metallic and industrial minerals (excluding coal and uranium) in South Australia.* (4.2 MB)

MG2b *Preparation of a program for environment protection and rehabilitation (PEPR) for metallic and industrial minerals (excluding coal and uranium) in South Australia.* (5.9 MB)

MG8 *Preparation of a program for environment protection and rehabilitation (PEPR) for low impact mineral exploration in South Australia,* V 2. (0.5 MB)

MG13 *Mineral exploration reporting guidelines for South Australia,* V 1.4. (0.7 MB)

MG18 *Guidelines for submission of samples for mineral exploration drillholes,* V 2. (5.4 MB)

MG22 *Guidelines for conducting mineral exploration in South Australia,* V 1. (0.9 MB)

MG23 *Preparation of a mining proposal and program for environment protection and rehabilitation for quarries in South Australia with defined impacts.* (2.8 MB)

Ministerial determinations

SARIG reference: MD 000 (where '000' is the number)

005 *Minimum information required to be provided in a program for environment protection and rehabilitation (PEPR) for a mineral lease (ML) and any associated miscellaneous purposes licence (MPL) for metallic and industrial minerals (excluding coal and uranium).* (0.2 MB)

006 *Minimum information required to be provided in a mining proposal and/or management plan for a mineral lease (ML) and any associated miscellaneous purposes licence (MPL) applications for metallic and industrial minerals (excluding coal and uranium).* (0.2 MB)

012 *Reporting periods and minimum information required to be provided in a compliance report for exploration operations conducted on an exploration licence (EL), mineral claim (MC) or retention lease (RL).* (0.2 MB)

013 *Format of and minimum information required to be provided in a program for environment protection and rehabilitation (PEPR) for exploration operations on an exploration licence (EL), retention lease (RL) and mineral claim (MC) not within the scope of the Generic program for environment protection and rehabilitation—low impact mineral exploration in South Australia (Ministerial Determination 001).* (0.2 MB)

Information sheets

Minerals

* Indicates Chinese version available.

SARIG reference: IS M00 where '00' is the number (or IS M00 Chinese version).

M01 *Mineral exploration licence applications in South Australia.* Updated daily.

M02 *Mineral exploration licences in South Australia.* Updated daily.

M03 *Current mineral exploration licences in South Australia - alphabetical index.* Updated daily.

M04 *Mineral exploration licence holders in South Australia.* Updated daily.

***M05** *Mineral exploration licences – general conditions, procedures and information.* (1.4 MB)

M06 *Prospecting and mining for minerals.* (1.3 MB)

M53 *Mineral exploration release areas in South Australia.* Updated daily.

Petroleum

P01 *Holders of petroleum and geothermal tenements in South Australia.* Updated quarterly.
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Education Sheet 30 *Tsunamis, waves and water depth – experiments and activities.* (1.5 MB)

Education Sheet 31 *How do waves shape coastlines? – experiment.* (0.5 MB)

Education Sheet Brukunga *Brukunga Mine Site – field excursion assignment.* (0.1 MB)

Brochures

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Regulating mineral exploration and mining in South Australia. Setting the framework for best practice regulation. (0.6 MB)

South Australia's Resource Area Management Plan: valuing the future of our extractives sector. (0.5 MB)

Mineral Systems Drilling Program 2015. (3.2 MB)

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Developing South Australia's copper strategy. (2 MB)

PACE Copper fact sheet. (1 MB)

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